Newland

NLS-CM60

OEM Scan Engine

Integration Guide

Disclaimer

Please read through the manual carefully before using the product and operate it according to the manual. It is advised that you should keep this manual for future reference.

Do not disassemble the device or remove the seal label from the device, doing so will void the product warranty provided by Fujian Newland Auto-ID Tech. Co., Ltd.

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Revision History

Version	Description	Date
V 1.0.0	Initial release.	March 29, 2019
V 2.0.0	Updated the typical and maximum value of the operating current (VIN3V3_LED_LASER) as 600mA and 800mA respectively in the table 3-1. Updated the figures from 2-1 to 2-9 and figure 4-1.	October 30, 2019
V 2.0.1	Updated Figure 2-1 to Figure 2-6 and Figure 4-1 and Table 3-1.	June 24, 2020
V 2.0.2	Updated Table 3-1.	July 07, 2020

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About This Guide

Introduction

The NLS-CM60 OEM scan engines (hereinafter referred to as “the CM60” or “the engine”) are armed with CMOS image capturer and the Newland patented UIMG®, a computerized image recognition system-on-chip, featuring fast scanning and accurate decoding on barcodes on virtually any medium-paper, magnetic card, mobile phones and LCD displays. The CM60 can be easily integrated into OEM equipment or systems, such as handheld, portable, or stationary barcode scanners. The CM60 offers fully open image acquisition interface, raw data interface and I/O interface, which enable users to easily develop their own applications with Newland’s SDK.

※ Note: This guide provides general instructions for the installation of the engine into a customer's device. Fujian Newland Auto-ID Tech. Co., Ltd. recommends an opto-mechanical engineer should conduct an opto-mechanical analysis before integration.

Chapter Description

Chapter 1, Getting Started	Gives a general description of the CM60.
Chapter 2, Installation	Describes how to install the engine, including installation information, housing design, optical, grounding, ESD, and environmental considerations.
Chapter 3, Electrical Specifications	Includes the electrical characteristics for the engine and timing sequences.
Chapter 4, Interfaces	Includes interface pinout and connector/cable specifications.
Chapter 5, I2C Commands	Describes how to control the CM60 with I2C commands.

Explanation of Symbols

- This symbol indicates lists of required steps.

※ This symbol indicates something important to the readers. Failure to read the notice will not lead to harm to the reader, device or data.

⚠ This symbol indicates caution that, if ignored, may cause data or device damage or even personal injury.

Related Documents

- 34-pin board-to-board connector specification, Molex Corporation, Model: 51338-3474, https://www.molex.com/

Chapter 1 Getting Started

Introduction

The CM60 is an area image engine for barcode reading. It includes a laser aiming system and an LED illumination system.

LED Compliance Statement

The CM60 complies with IEC 62471:2006 for LED safety.

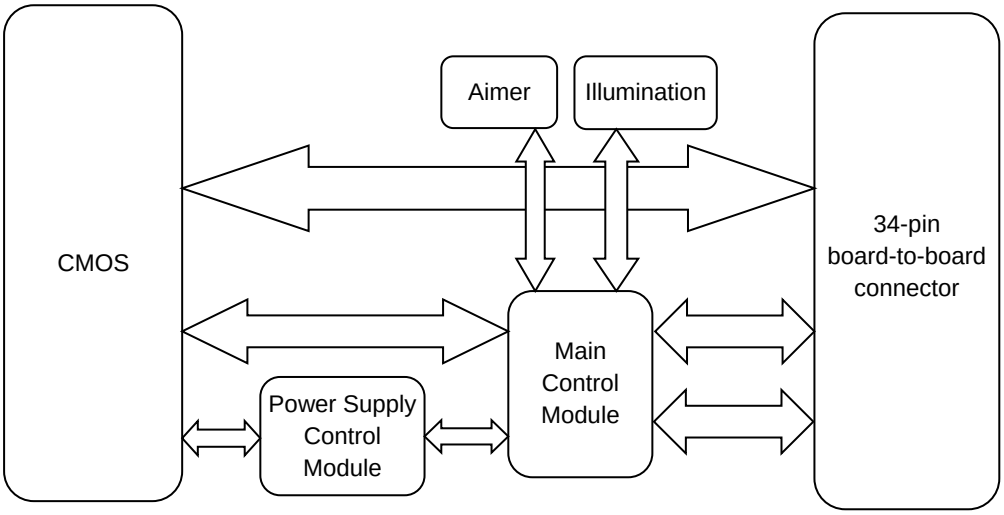
Laser Compliance Statement

The CM60 is certified to be in compliance with IEC 60825-1:2014 as a class 1 laser product.

The CM60 contains:

- a CMOS image sensor and its lens
- an LED based illumination system
- a laser aiming system

Figure 1-1 System Block Diagram



The CM60 can be connected to a host device via its 34-pin board-to-board connector. For more information about this connector, please see Chapter 4.

Illumination

The CM60 has a white LED for supplementary lighting, making it possible to scan barcodes even in complete darkness. The illumination can be turned On or Off.

Aimer

The CM60 contains a laser aimer that produces a crosshair aiming pattern to help the user to easily position the target barcode within the engine’s field of view to increase scan efficiency. The aiming pattern can be turned On or Off. It is advisable to turn it on when scanning barcodes.

Chapter 2 Installation

Introduction

This chapter explains how to install the CM60, including general requirements, housing design, and physical and optical information.

⚠ Caution: Do not touch the imaging lens when installing the engine. Be careful not to leave fingerprints on the lens.

⚠ Caution: Do not touch the illumination LED during handling. Improper handling may damage the LED.

General Requirements

ESD

ESD protection has been taken into account when designing the CM60. However, due to limited board space, additional ESD protection, such as TVS protection, is not provided on the engine's I/O interface. It is advised to take corresponding protection measures when integrating the engine.

The engine is shipped in ESD safe packaging. Always exercise care when handling the engine outside its package. Be sure grounding wrist straps and properly grounded work areas are used.

Dust and Dirt

The CM60 must be sufficiently enclosed to prevent dust particles from gathering on the lens and circuit board. Dust and other external contaminants will eventually degrade the engine's performance.

Ambient Environment

The following environmental requirements should be met to ensure good performance of the CM60.

Table 2-1

Operating Temperature	-20℃ to 55℃
Storage Temperature	-40℃ to 70℃
Humidity	5% to 95% (non-condensing)

Thermal Considerations

Electronic components in the CM60 will generate heat during the course of their operation. Operating the CM60 in continuous mode for an extended period may cause temperatures to rise on MCU, CIS, LEDs, DC/DC, etc and could result in a 40°C increase inside the engine. Overheating can degrade image quality and affect scanning performance. Given that, the following precautions should be taken into consideration when integrating the CM60.

- ✧ Avoid continuous use of the LED for prolonged periods.
- ✧ Reserve sufficient space for good air circulation in the design.
- ✧ Avoid wrapping the CM60 with thermal insulation materials such as rubber.

External Optical Elements

Do not subject external optical components on the engine to any external force. Do not hold the engine by an external optical component, which may cause the mechanical joints that secure the components to crack or break due to excessive stress.

Installation Orientation

The **Figure 2-1** illustrates a front view of the CM60 after correct installation.

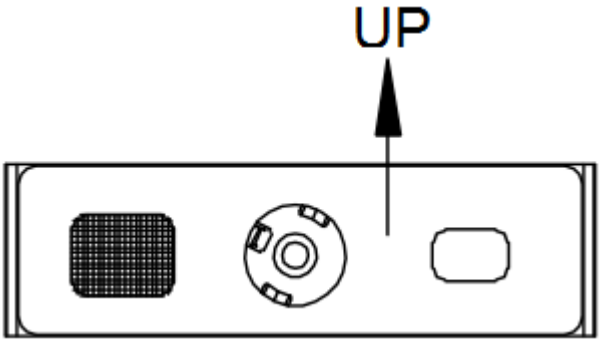


Figure 2-1

Mounting

It is recommended to use self-tapping screw that meets the following specifications: 1.4mm diameter; 0.45 mm pitch. When installing the screws, the depth of screw insertion should be 2.5-3.2mm and the recommended torque is 0.6-0.8 KGf.cm. The illustrations below show the mechanical mounting dimensions for the CM60.

Mechanical Mounting Dimensions (Unit: mm)

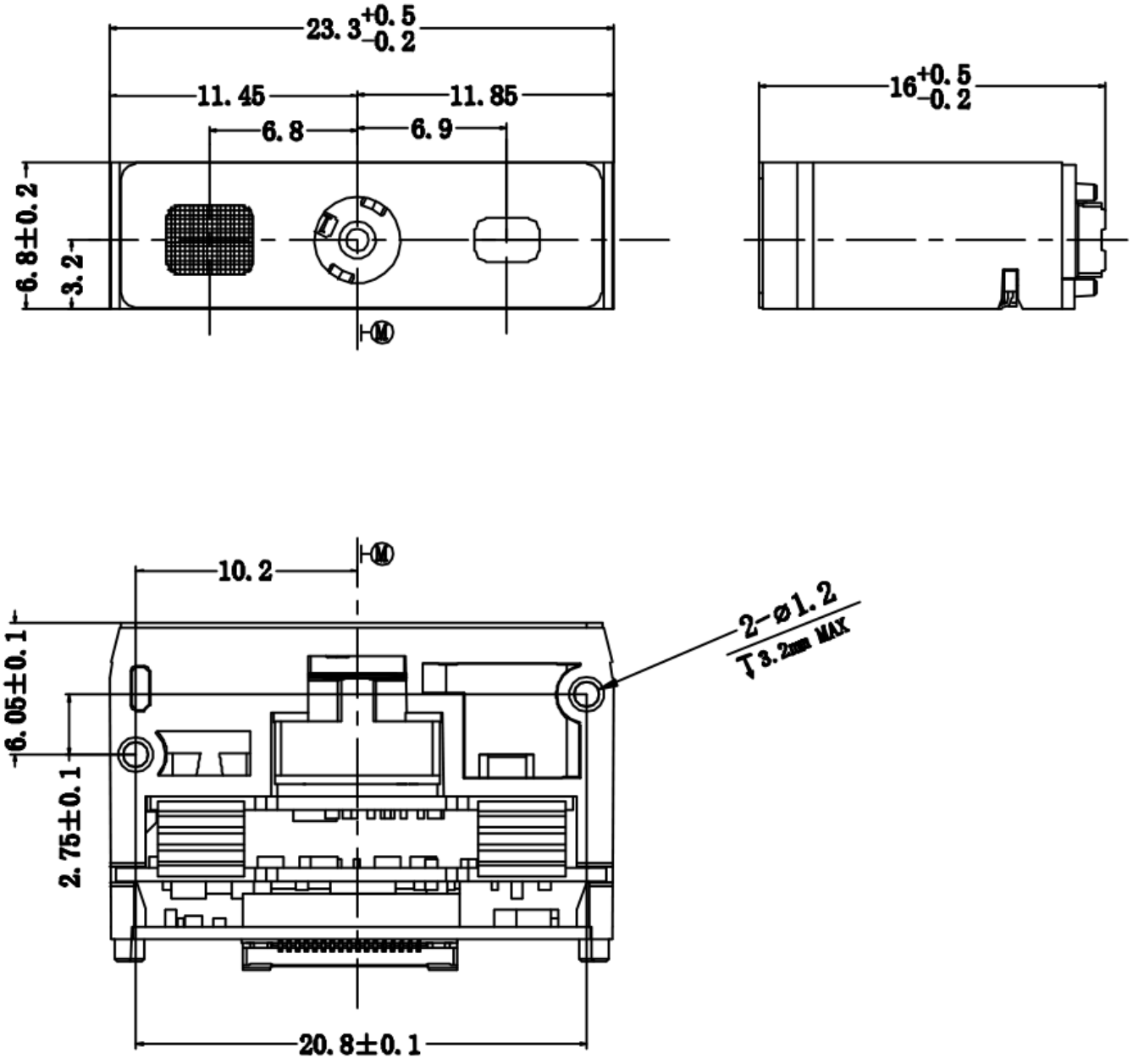


Figure 2-2

Housing Design

※ Note: Conduct an optical analysis for the housing design to ensure optimal scanning and imaging performance.

Housing design should make sure that internal reflections from the aiming and illumination system are not directed back to the engine. The reflections from the housing or window can cause problems. For particular window tilt angles, the unwanted reflections can bounce off the top or bottom and reach the engine. Avoid any highly reflective objects around the engine that can cause bright spots to appear in the captured image. It is recommended to use baffles or matte-finished dark internal housing colors.

Optics

The CM60 uses a sophisticated optical system. An improperly designed internal housing or improper selection of window material can degrade the engine's performance.

Window Placement

The window should be positioned properly to let the illumination and aiming beams pass through as much as possible and no reflections back into the engine (reflections can degrade the reading performance of the engine).

There are two window placement options.

• **Parallel window** – Primary option for imager engines. The following window distance requirements should be satisfied: The maximum distance is measured from the front of the engine housing to the furthest surface of the window. In order to reach better reading performance, the distance from the front of the engine housing to the nearest surface of the window should not exceed **a** (a=1mm) and the distance from the front of the engine housing to the furthest surface of the window should not exceed **a+d** (a=1mm, d=2mm), as shown in **Figure 2-3**.

• **Tilted window** - This option is for laser/imager engines. For the tilted window distance requirements, please see **Table 2-2**.

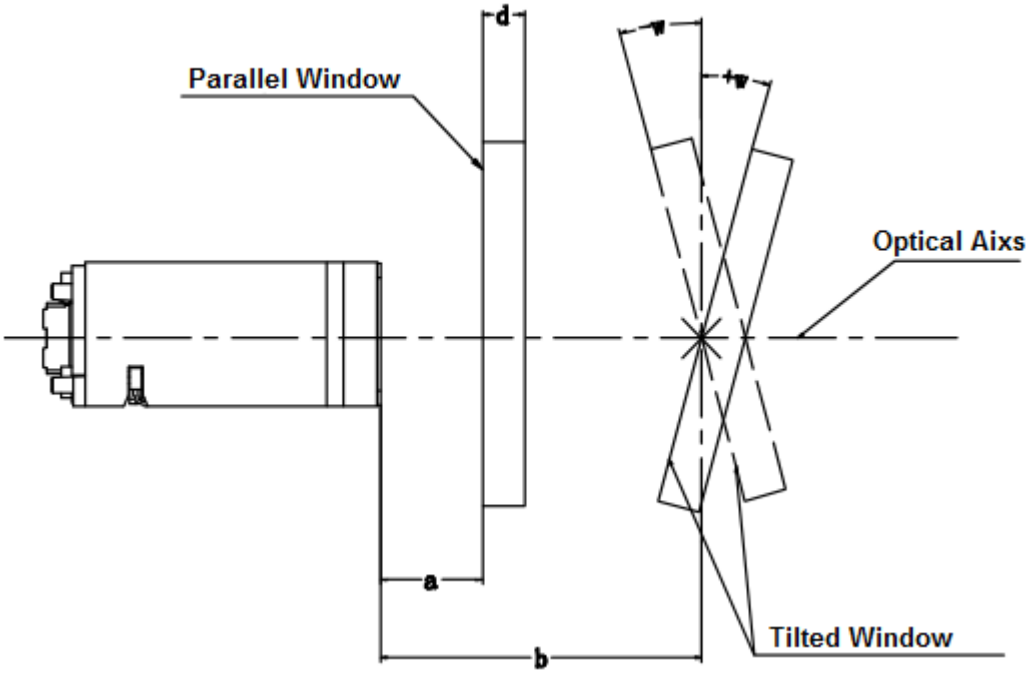


Figure 2-3

Table 2-2

Minimum Angle (Tilted Window)	Distance from the front of the engine housing (b)			
	5mm	10mm	15mm	20mm
Uncoated, minimum window positive tilt (+w)	22°	20°	18°	18°
Uncoated, minimum window negative tilt (-w)				
Anti-reflection coated, single side, minimum window positive tilt (+w)	20°	18°	16°	16°
Anti-reflection coated, single side, minimum window negative tilt (-w)				
Anti-reflection coated, double sides, minimum window positive tilt (+w)	16°	16°	16°	16°
Anti-reflection coated, double sides, minimum window negative tilt (-w)				

Window Material and Color

Window material must be clear. Use only cell-cast plastics or optical glass. PMMA, ADC and chemically tempered glass are recommended. Window material selected for the engine should meet or exceed the specifications specified in **Table 2-3**.

- **PMMA (Cell-cast acrylic):** When fabricated by cell-casting, has very good optical quality and low initial cost, but surface must be protected from the environment due to its susceptibility to attack by chemcials, mechanical stresses, and UV light. Reasonably good impact resistance. This material can be laser-cut into odd shapes and ultrasonically welded.
- **ADC (CR-39):** A thermal-setting plastic produced by the cell-casting process. Excellent chemical and environmental resistance. Quite good surface hardness, and therefore does not have to be hard-coated. Reasonably good impact resistance. This material cannot be ultrasonically welded.
- **Chemically tempered glass:** Glass is a hard material which provides excellent scratch and abrasion resistance. But unannealed glass is brittle. Increased flexibility strength with minimal optical distortion requires chemical tempering. Glass is hard to be cut into odd shapes and cannot be ultrasonically welded.

Table 2-3

Specification	Description
Spectral Transmittance	≥90%
Thickness	0.8-2.0mm
Wavefront Distortion	PV maximum: 0.2λ RMS maximum: 0.04λ
Clear Aperture	1.0mm to edges
Surface Quality	60-20 scratch/dig

Pay extra attention to the wavefront distortion when using plastic materials. Plastic materials are not recommended for tilted windows; colored windows are not recommended if the engine is used to scan barcodes on moving objects.

Coatings and Scratch Resistance

Scratch on the window can greatly reduce the performance of the CM60. It is suggested to use recessed window or apply abrasion resistant coatings to window surface.

The following introduces two commonly-used types of coatings:

- **Anti-reflection coatings:** Anti-reflection (AR) coatings can be applied to window surfaces to reduce reflected light from the window back into the engine. But they are expensive and have poor abrasion/scratch resistance.
- **Polysiloxane coatings:** Polysiloxane coatings can be applied to plastic surfaces to increase the surfaces' abrasion and scratch resistance.

Both tempered glass and plastic windows can be AR coated. However, it is easier and more cost-effective to put an AR

coating on the glass than on the plastic.

The AR coating specifications below should be met when using an AR coated window.
Single side AR coating: 92% minimum transmittance within spectrum range from 420 nm to 730 nm.
Double side AR coating: 97% minimum transmittance within spectrum range from 420 nm to 730 nm.

Window Size

The window must not block the field of view and should be sized to accommodate the aiming and illumination envelopes shown below.

Horizontal:

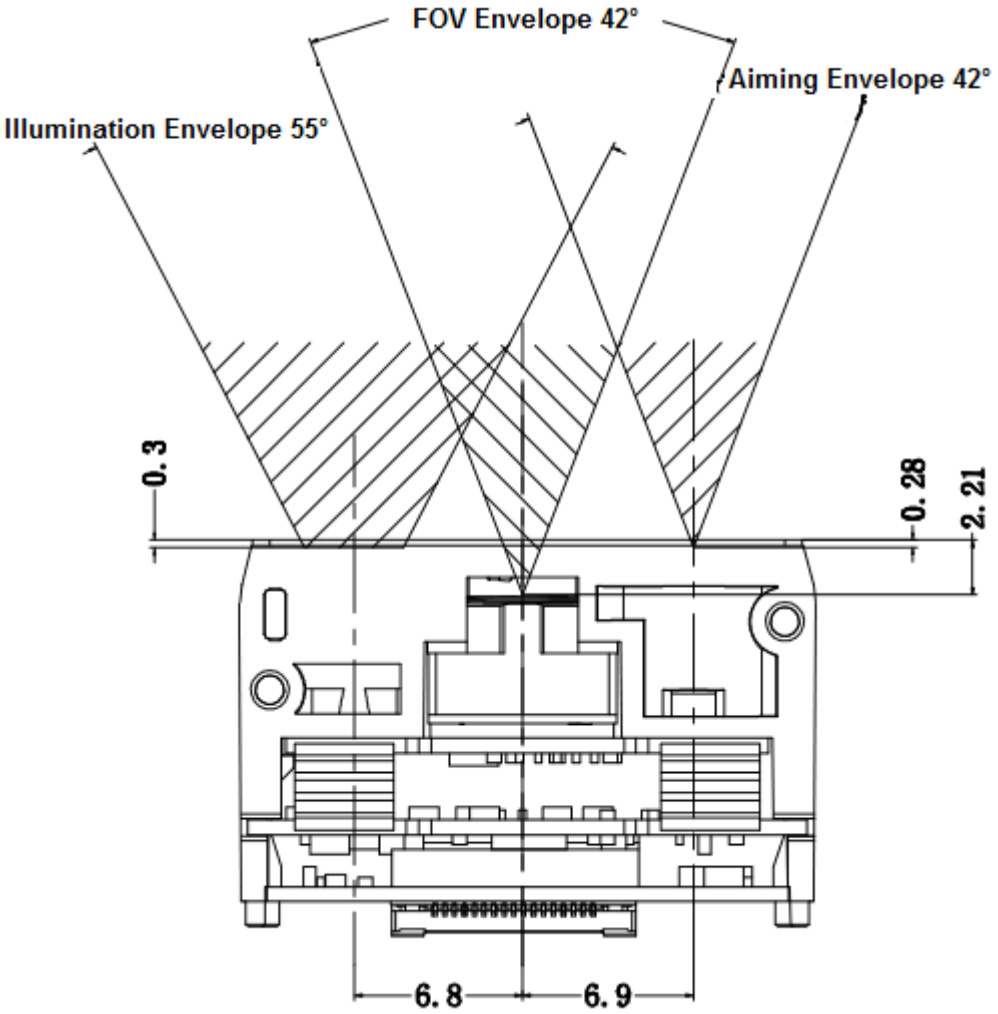


Figure 2-4

Vertical:

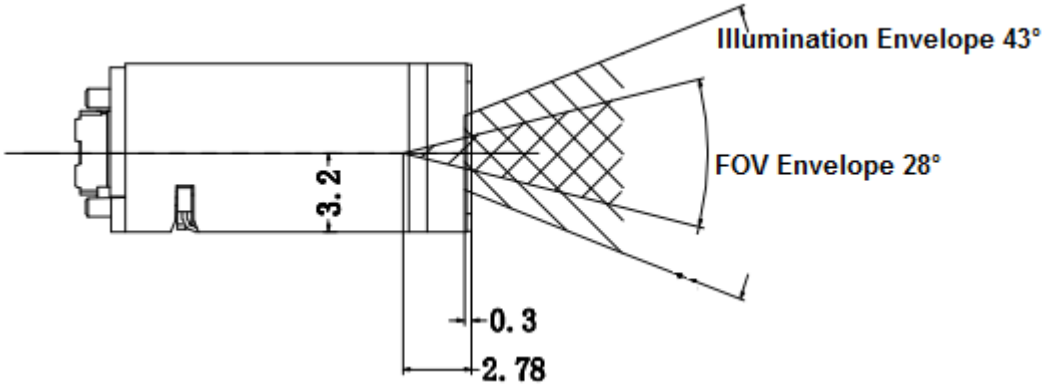


Figure 2-5

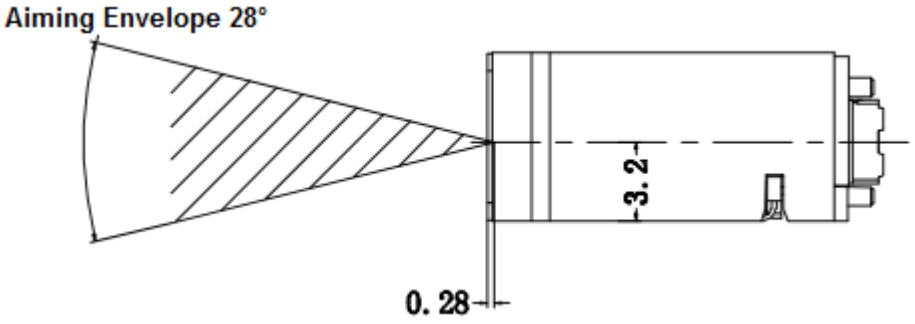


Figure 2-6

Roll, Skew and Pitch

Three different reading angles, roll, skew and pitch are illustrated in **Figure 2-9**. Roll refers to rotation around the Z axis, skew to rotation around the X axis and pitch to rotation around the Y axis. For the engine's technical specifications, please visit the Newland website or contact your dealer.

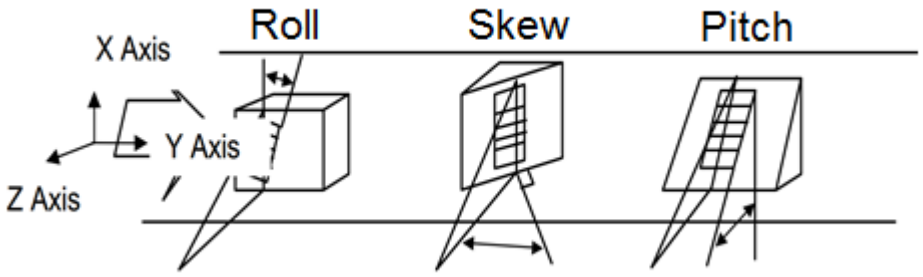


Figure 2-7

Ambient Light

The CM60 shows better performance with ambient light. However, high-frequency pulsed light can result in performance degradation.

Eye Safety

The CM60 uses an LED to produce illumination beam. The LED is bright, but testing has been done to demonstrate that the engine is safe for its intended application under normal usage conditions. However, the user should avoid looking into the beam.

The CM60 uses a laser diode to form a bright, intuitive aiming aid. This device has been tested and found to comply with the limits for a Class 1 laser product, pursuant to Safety of laser products - Part 1: Equipment classification and requirements of IEC 60825-1:2014. A class 1 laser is safe under all conditions of normal use.

Chapter 3 Electrical Specifications

Power Supply

Do not power up the CM60 until it is properly connected. Be sure the power is cut off before connecting a cable to or disconnecting a cable from the host interface connector. Hot-plugging could damage the engine.

Unstable power supply or sharp voltage drops or unreasonably short interval between power-ons may lead to unstable performance of the engine. Do not resupply the power immediately after cutting it off.

Ripple Noise

To ensure the image quality, a power supply with low ripple noise is needed.

Acceptable ripple range (peak-to-peak) : ≤80mV

DC Characteristics

Operating Voltage / Current

Table 3-1

T=23°C

Parameter	Description	Minimum	Typical	Maximum	Unit
Operating Voltage	VIN_3V3_IMGR	3.14	3.3	3.47	V
	VIN_3V3_LED_LASER	3.14	3.3	3.47	V
Current (VIN_3V3_IMGR)	Operating Current	-	83	192	mA
	Idle Current	-	27	73	mA
Current (VIN_3V3_LED_LASER)	Operating Current	-	225	590	mA
	Idle Current	-	0	-	mA

I/O Voltage

Table 3-2

VDD=3.3V, VSS=0V, T=23°C

Parameter	Minimum	Maximum	Unit
VIL	-0.3	0.8	V
VIH	2.0	3.6	V
VOL	VSS	0.4	V
VOH	VDD-0.4	VDD	V

Timing Sequence

Power Up Timing Sequence

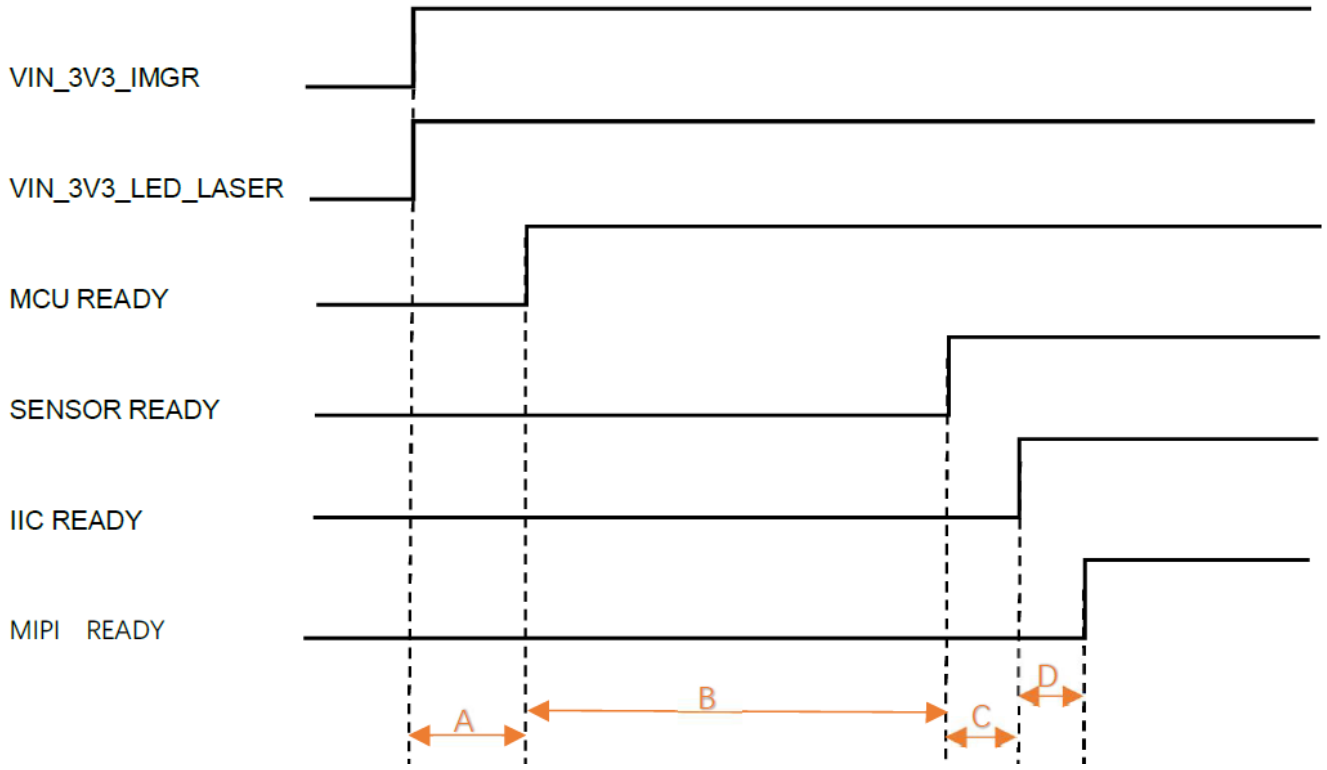


Figure 3-1

1. **A** is the time needed to reset MCU after power-up (A≥10ms).
2. **B** is the time needed to initialize Sensor (B≥20ms).
3. **C** is the time needed to initialize IIC (C≥5ms).
4. **D** is the time needed to initialize MIPI (D≥5ms).

Chapter 4 Interfaces

Interface Pinouts

The host interface connector of the CM60 is a 34-pin board-to-board connector, including MIPI, IIC, power supply, ground and other control interfaces.

The figure below illustrates the position of the connector on the CM60, as well as the pin 1 and pin 2 location.

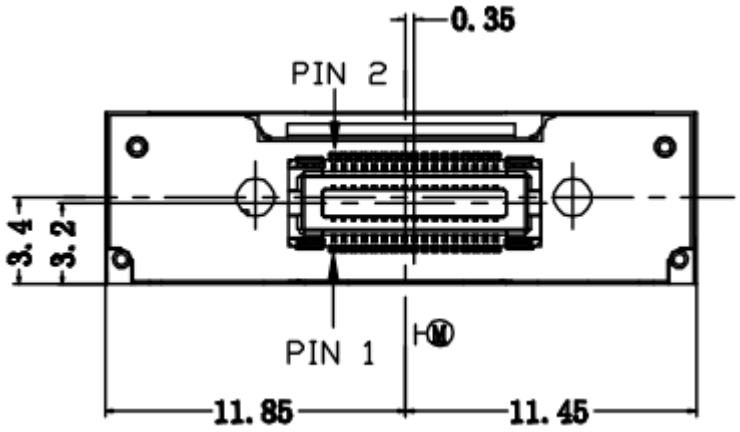


Figure 4-1

The following table lists the pin functions of the 34-pin board-to-board connector.

Table 4-1

PIN#	Signal	I/O	Function	Remark
1	GND	-	Power-supply ground	
2	GND	-	Power-supply ground	
3	VIN_3V3_LED_LASER	-	3.3VDC±5% power supply for illumination/aimer	
4	MD0n	O	MIPI data lane 0	
5	VIN_3V3_LED_LASER	-	3.3VDC±5% power supply for illumination/aimer	
6	MD0p	O	MIPI data lane 0	
7	NC	-	No connection	
8	GND	-	Power-supply ground	

9	I2C_SCL	I/O	I2C clock signal	
10	MD1n	O	MIPI data lane 1	
11	GND	-	Power-supply ground	
12	MD1p	O	MIPI data lane 1	
13	I2C_SDA	I/O	I2C data signal	
14	GND	-	Power-supply ground	
15	NC	-	No connection	
16	MCn	O	MIPI clock signal	
17	NC	-	No connection	
18	NC	-	No connection	
19	NC	-	No connection	
20	MCp	O	MIPI clock signal	
21	NC	-	No connection	
22	GND	-	Power-supply ground	
23	NC	-	No connection	
24	NC	-	No connection	
25	NC	-	No connection	
26	NC	-	No connection	
27	NC	-	No connection	
28	GND	-	Power-supply ground	
29	VIN_3V3_IMGR	-	3.3VDC±5% power supply for the engine	
30	NC	-	No connection	
31	VIN_3V3_IMGR	-	3.3VDC±5% power supply for the engine	
32	NC	-	No connection	
33	GND	-	Power-supply ground	
34	GND	-	Power-supply ground	

※ I = Input; O = Output.

Connector Specifications

The CM60 is equipped with a 34-pin board-to-board connector. The connector is supplied by Molex LLC, Model No.: 51338-3474. For more information about the connector, please visit https://www.molex.com.

Chapter 5 I2C Commands

Introduction

The CM60 uses standard I2C communication protocol and its I2C address is 0X12.

I2C Command Format

<I2C-Start Bit> <SLA-W/R> <Command Code> <[Data]> <I2C-Stop-Bit>

I2C Commands

Command Code	Parameter Settings
0x80	Set minimum exposure time (1-16,000μs, in 1μs increments; default: 50μs) **Data**: The desired value in hex (2 bytes), low byte followed by high byte. Minimum exposure time ≤ Maximum exposure time e.g. To set the time to 10,000 microseconds, the value of the **Data** field should be **10 27**.
0x82	Set maximum exposure time (1-16,000μs, in 1μs increments; default: 14,000μs) **Data**: The desired value in hex (2 bytes), low byte followed by high byte. Minimum exposure time ≤ Maximum exposure time e.g. To set the time to 10,000 microseconds, the value of the **Data** field should be **10 27**.
0x84	Set expected brightness (1-255, the bigger the value, the brighter the image; default: 80) **Data**: The desired value in hex (2 bytes), low byte followed by high byte. e.g. To set the brightness to 255, the value of the **Data** field should be **FF 00**.
0x90	Set minimum gain (0-64; default: 1) **Data**: The desired value in hex (1 byte) Minimum gain ≤ Maximum gain
0x92	Set maximum gain (0-64; default: 48) **Data**: The desired value in hex (1 byte) Minimum gain ≤ Maximum gain
0xE0	Set the maximum time the aimer stays on over the exposure interval (1-16.0ms, in 0.1ms increments; default: 10.0ms) **Data**: The desired value in hex (1 byte) Note: The “Aimer acts upon configuration” feature under Aimer setup must be enabled in order for this parameter to function. e.g. To set the time to 10.0ms, the value of the **Data** field should be **64**.
0xE1	Set the maximum time the illumination LED stays on during exposure (1-16.0ms, in 0.1ms

	increments; default: 2.4ms) **Data**: The desired value in hex (1 byte) Note: The “Illumination acts upon configuration” feature under Illumination setup must be enabled in order for this parameter to function. e.g. To set the time to 10.0ms, the value of the **Data** field should be **64**.
0xF3	Query firmware version Query result returned is in the format of V1.xx.xxx.
0xF4	Aimer setup Bit 1-0: **0** – Aimer off when scanning **1** – Aimer on when scanning (default) Bit 3: **0** – Auto control **1** – Aimer acts upon configuration (default) The default value of the remaining bits is 0.
0xF5	Illumination setup Bit 1-0: **0** – Illumination off when scanning **1** –Illumination on when scanning (default) Bit 2: **0** – Auto control **1** – Illumination acts upon configuration (default) The default value of the remaining bits is 0.
0xFD	Operating mode setup **Data**: **01** – Ready (CMOS does not output image) **02** – Idle (CMOS is turned off) **03** – Running (CMOS outputs image, and illumination and aimer act upon configuration) **03** – Lazy (CMOS outputs image, and illumination and aimer are both off)

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