OEM Software Decoding Scan Engine

NLS-CM60E

User 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.	Jan. 24, 2025
V1.1.0	Modify incorrect images	Apr. 22, 2025
V1.2.0	Modify incorrect images The current parameters in Table 4-2 have been updated	Apr. 24, 2025

Table of Contents

Preface

Introduction

This manual provides installation, optics, electrical specifications as well as detailed instructions for setting up and using the NLS-CM60E OEM scan engines (hereinafter referred to as “the CM60E” or “the engine”).

Chapter Description

Chapter 1, Getting Started	Gives a general description of the CM60E.
Chapter 2, Installation	Describes how to install the engine, including installation information, housing design, optical, grounding, ESD, and environmental considerations.
Chapter 3, Optics	Provides parameters for optics and illumination
Chapter 4, Electrical Specifications	Includes the electrical characteristics for the engine and timing sequences.
Chapter 5, I2C Commands	Describes how to control the CM60E with I2C commands.
Chapter 6, Hardware Integration	Provide recommendations for hardware integration.

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.

Explanation of Icons

	This icon indicates auxiliary tools that help users to refer to the manual at ease.
	This icon indicates this information requires extra attention from the reader.

	This icon indicates handy tips that can help you use or configure the scanner with ease.
	This icon indicates practical examples that can help you to acquaint yourself with operations.

Chapter 1 Getting Started

Introduction

The NLS-CM60E OEM scan engines (hereinafter referred to as “the CM60E” 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 CM60E can be easily integrated into OEM equipment or systems, such as handheld, portable, or stationary barcode scanners. The CM60E 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. Fujian Newland Auto-ID Tech. Co., Ltd. recommends an opto-mechanical engineer should conduct an opto-mechanical analysis before design.

Symbologies

The NLS-CM60E can easily read printed barcodes and on-screen barcodes, including:

1D	EAN-13, EAN-8, UPC-A, UPC-E, Code 128, Code 39, Codabar, UCC/EAN-128, RSS, ITF, ITF14, ITF6, ISSN, ISBN, Standard 25, Matrix 25,Industrial 25, Plessey, MSI Plessey, Code 11, Code 93, GS1 Composite, etc.
2D	PDF417, Micro PDF417, QR Code, Micro QR, Data Matrix, Aztec, Chinese Sensible Code, Maxicode, etc.

NLS-CM60E OEM Scan Engine

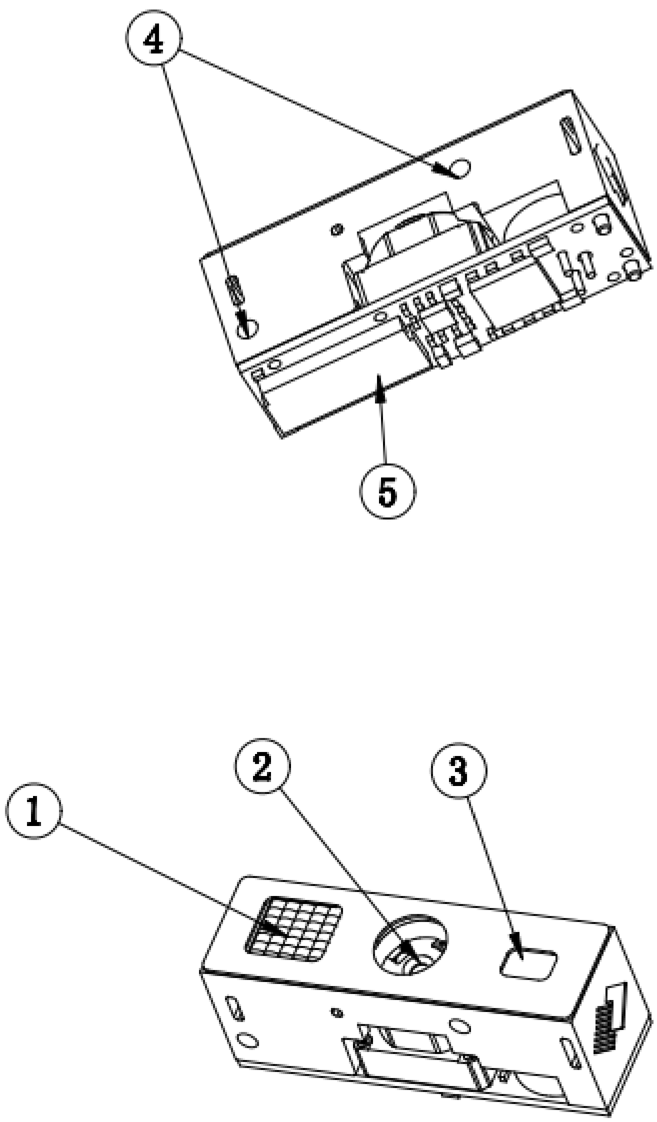


Figure 1-1

Chapter 2 Installation

Introduction

This chapter explains how to install the CM60E, including general requirements, housing design, and physical and optical information.

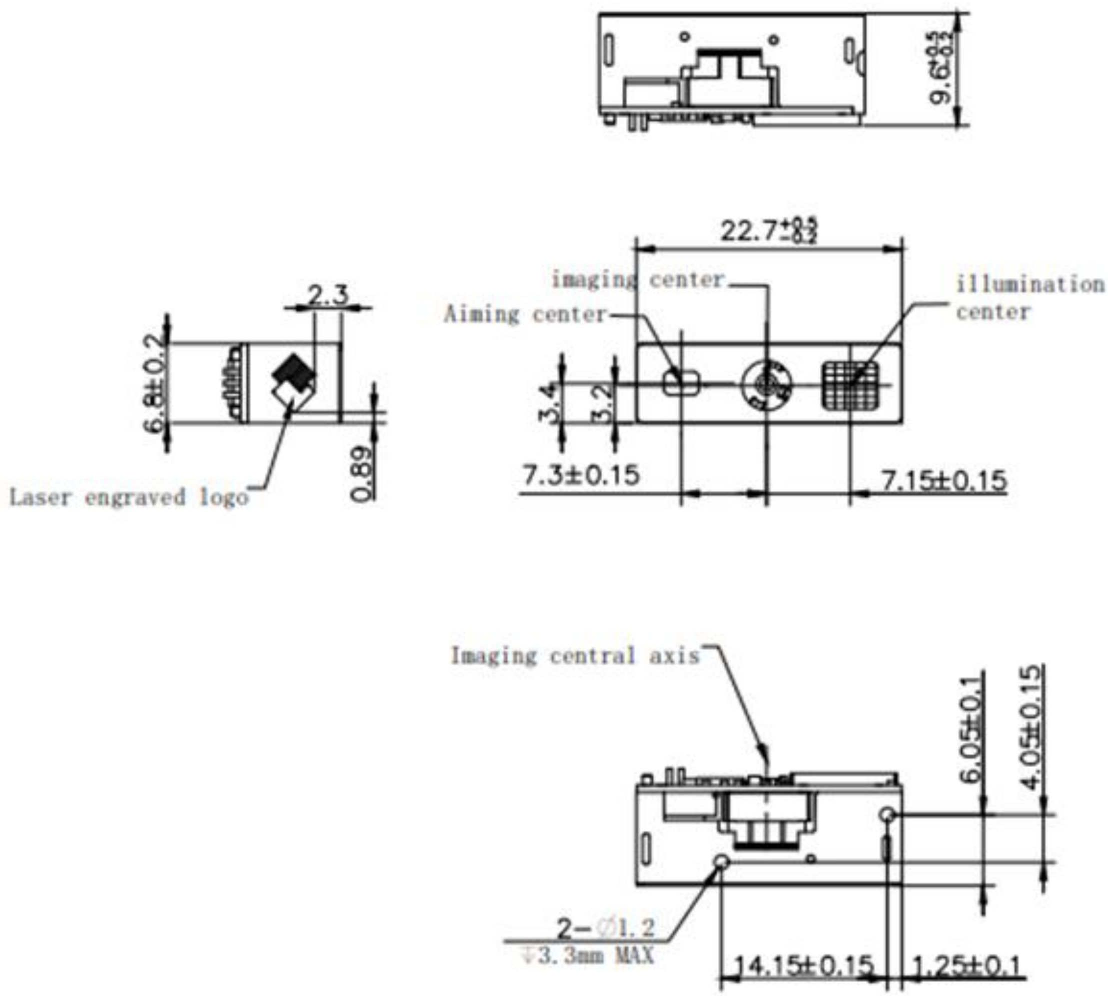
⚠ Caution: Do not touch the imaging lens when installing the engine. Be careful not to leave fingerprints on the lens.

⚠ Caution: Do not disassemble or modify the product yourself. Unauthorized disassembly or modification may damage the product

Dimensions (unit: mm)

23.2(W)×10.1(D)×7.0(H) (max.)

Mechanical Dimensions (Unit: mm)



25-pin Board-to-Board Connector

The host interface connector of the CM60E is a 25-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 CM60E.

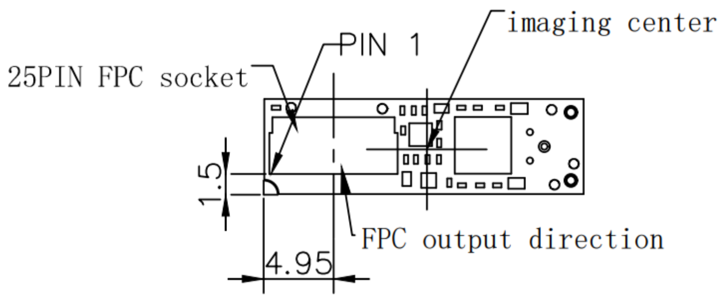
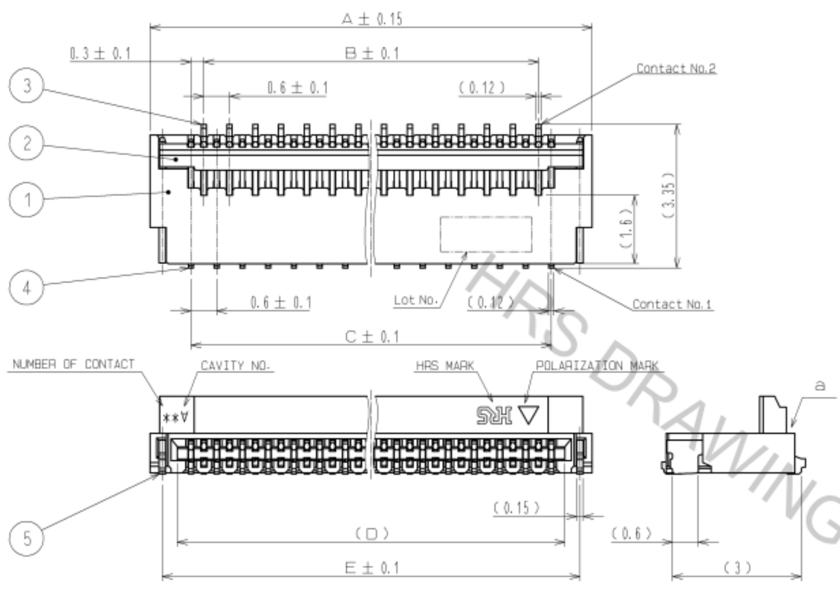


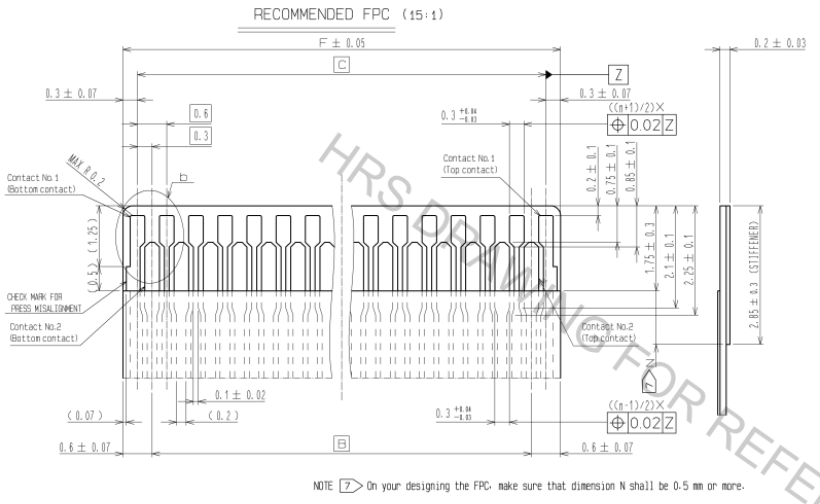
Figure 2-2

Connector Specifications

The CM60E is equipped with a 25-pin FPC Connector (model: FH35C-25S-0.3SHW). FPC mount supports double-sided contact.



Dimensions of FPC Gold Fingers



General Requirements

ESD

ESD protection has been taken into account when designing the CM60E. 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 CM60E 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 CM60E.

Table 2-1

Operating Temperature	-20℃ to 55℃(-4°F to 131°F)

Storage Temperature	-40℃ to 70℃(-40°F to 158°F)
Humidity	5% to 95% (non-condensing)

Thermal Considerations

Electronic components in the CM60E will generate heat during the course of their operation. Operating the CM60E 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 CM60E.

- ✧ Avoid continuous use of the LED for prolonged periods.
- ✧ Reserve sufficient space for good air circulation in the design.
- ✧ Avoid wrapping the CM60E with thermal insulation materials such as rubber.

Chapter 3 Optics

Introduction

The CM60E contains:

- a CMOS image sensor and its lens
- a white LED based illumination system
- a laser aimer and a red crosshair aiming pattern

Sensor

Pixel: 1280×800 CMOS

Frame rate: 60fps

Illumination

The CM60E has a white LED for supplementary lighting, making it possible to scan barcodes even in complete darkness. The illumination can be programmed On or Off. Customers can add the external illumination system if needed. The spectral range should be within the visible light.

Aimer

The CM60E contains a laser aimer that produces a red 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.

Note: when the scanner comes closer to the barcodes, aiming center and imaging center may deviate.

Red crosshair aiming pattern

Figure 3-1

Optics

The CM60E 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 imagers. The following window distance requirements should be satisfied: The maximum distance is measured from the front of the housing to the furthest surface of the window. In order to reach better reading performance, the distance from the front of the housing to the furthest surface of the window should not exceed a+b (a+b⩽3mm;), as shown in **Figure 3-2**..

• **Tilted window** - This option is for laser/imager engines. For the tilted window distance requirements, please see **Table 3-1**.

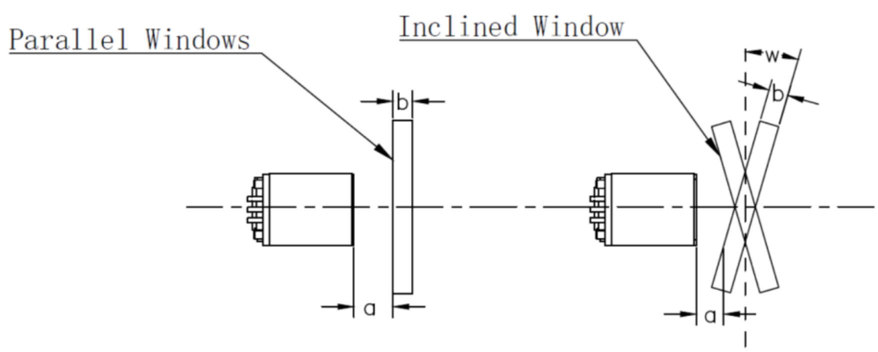


Figure 3-2

Table 3-1

Distance from the front of the engine housing (a)		The thickness of the window (b)		
		b=1mm	b=2mm	b=3mm
Window Tilt (W)	w=0°	a≤1.5mm	a≤0.5mm	a=0mm
	w=±10°	a≤0.5mm	a=0mm	ng
	w=±20°	a≤0.5mm	a=0mm	ng
	w=±25°	a≤1.5mm	a≤0.5mm	a=0mm
	w⩾±30°	a≤20mm	a≤20mm	a≤20mm

Window Material and Color

Window material must be clear. PMMA and optical glass are recommended. Window material selected for the scanner should meet or exceed the specifications specified in **Table 3-2**. When using a clear plastic window, it is recommended to apply anti-reflection (AR) coating on it.

Table 3-2

Specification	Description
Spectral Transmittance	≥92%
Light Wavelength	400-780nm

Coatings and Scratch Resistance

Scratch on the window can greatly reduce the performance of the CM60E. It is suggested to use abrasion resistant window material or coating.

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 scanner. Multi-layer AR coatings on windows help to achieve less than 0.5% reflectance and covered wavelength is 400-780nm.

- **Scratch resistance coatings:** Scratch resistance coatings require a degree of greater than 5H in its hardness. Coatings can be applied to plastic surfaces to increase the surfaces' abrasion and scratch resistance.

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:

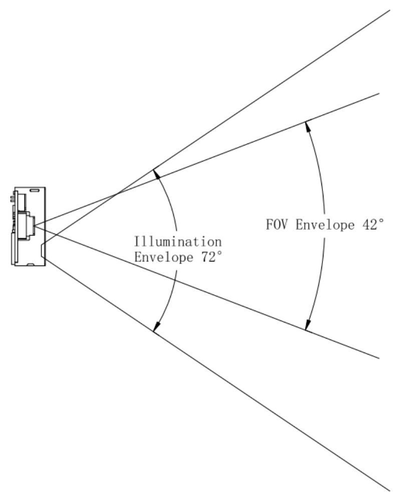


Figure 3-3

Vertical:

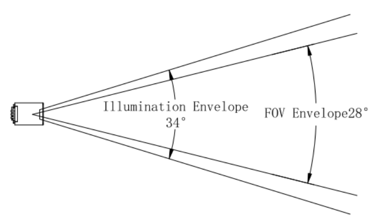


Figure 3-4

Ambient Light

The CM60E shows better performance with ambient light. However, high-frequency pulsed light can result in performance degradation.

Eye Safety

The CM60E uses a LED to produce illumination beam. The a LED are bright, but testing has been done to demonstrate that the scanner is safe for its intended application under normal usage conditions. The CM60E complies with IEC

62471:2006 for a LED safety. However, the user should avoid looking into the beam.

The CM60E 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.

Depth of Field

Table 3-3

Ambient light: 300LUX natural light

Symbologies	Near depth of field	Far depth of field
EAN-13 (13mil)	55mm	610mm
PDF417 (6.7mil)	110mm	230mm
Code 39 (5mil)	80mm	300mm
Data Matrix (10mil)	90mm	280mm
QR Code (15mil)	55mm	400mm

Chapter 4 Electrical Specifications

Power Supply

Do not power up the CM60E 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.

1 When designing, the user should ensure that the input power of CM60E is fully decoupled. It is recommended to place a 22uF and a 100nF X5R or X7R ceramic capacitor beside the power input pin on the connector which is soldered on the board.

2 Ensure that the input power drops below 0.5V before powering the CM60E on again, otherwise it will lead to abnormal function.

Ripple Noise

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

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

Interface Pinouts

The following table lists the pin functions of the 25-pin FPC connector.

Table 4-1

PIN#	Signal	I/O	Function
1	VIMG	-	3.3VDC±5% power supply for the engine
2	VIMG	-	3.3VDC±5% power supply for the engine
3	VIMG	-	3.3VDC±5% power supply for the engine
4	VLED	-	3.3VDC±5% power supply for illumination
5	VLED	-	3.3VDC±5% power supply for illumination
6	VLED	-	3.3VDC±5% power supply for illumination
7	EXT_IO	I/O	Reserved
8	GND	-	Power supply ground

9	EXT_IO	I/O	Reserved
10	NC	-	
11	GND	-	Power supply ground
12	EXT_SDA	I/O	I2C data signal
13	EXT_SCL	I/O	I2C clock signal
14	GND	-	Power supply ground
15	GND	-	Power supply ground
16	GND	-	Power supply ground
17	MIPI_MCN	O	MIPI clock signal
18	MIPI_MCP	O	MIPI clock signal
19	GND	-	Power supply ground
20	MIPI_MD1N	O	MIPI data signal
21	MIPI_MD1P	O	MIPI data signal
22	GND	-	Power supply ground
23	MIPI_MD0N	O	MIPI data signal
24	MIPI_MD0P	O	MIPI data signal
25	GND	-	Power supply ground

DC Characteristics

Operating Voltage/Current

Table 4-2

T=25°C

Parameter	Description	Minimum	Typical	Maximum	Unit
VCC	VIMG	3.14	3.3	3.47	V
	VLED	3.14	3.3	3.47	V

Parameter	Description	Minimum	Typical	Maximum(Peak)	Unit
Current (VIMG)	Operating Current	-	78(RMS)	145	mA
	Idle Current	-	2	-	mA
Current (VLED)	Operating Current	-	213(RMS)	561	mA
	Idle Current	-	0.2	-	mA
Current (TOTAL)	Operating Current	-	292(RMS)	706	mA
	Idle Current	-	2.5	-	mA

I/O Voltage

Table 4-3

VDD=3.3V, VSS=0V, T=25°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

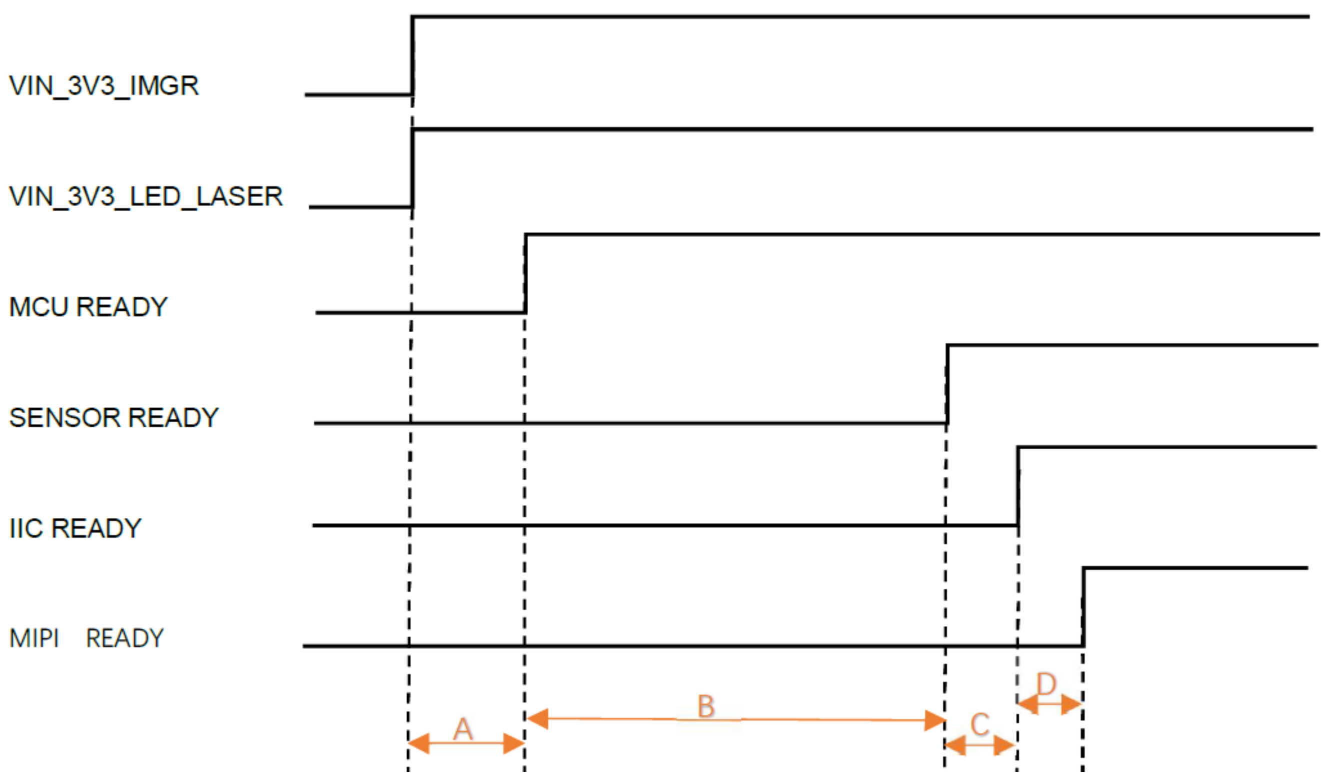


Figure 4-1

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 5 I2C Commands

Introduction

The CM60E 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 (0- 65535μs, 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 (0- 65535μs, in 1μs increments) **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 (0- 65535, 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 0: **0** – Aimer off when scanning **1** – Aimer on when scanning (default) Bit 2: **0** – Auto control **1** – Aimer acts upon configuration (default)
0xF5	Illumination setup Bit 0 : **0** – Illumination off when scanning **1** –Illumination on when scanning (default) Bit 2: **0** – Auto control **1** – Illumination acts upon configuration (default)
0xFD	Operating mode setup **Data**: **0x01** – Ready (CMOS does not output image) **0x02** – Idle (CMOS is turned off) **0x03** – Running (CMOS outputs image, and illumination and aimer act upon configuration) **0x11** – Lazy (CMOS outputs image, and illumination and aimer are both off)

Chapter 6 Hardware Debugging

Antenna Interference Debugging

1. Given that the 5G and GPS has a the broad frequency bands, it is inevitable that the module's MIPI may overlap with certain frequency bands of the antenna. To mitigate potential interference, it is strongly recommended to consider electromagnetic compatibility (EMC) during the design process and position the antenna as far as possible from the module.
2. During the module integration process, it is advisable to add shielding and ensure proper grounding of the shield. This will help minimize the module’s radiation and reduce the potential interference during image transmission.
3. Based on current testing results, it is recommended to utilize a 1lane configuration for image transmission when an antenna is present. This configuration helps reduce the interference caused by MIPI radiation.

The following table lists the Transmission Rate and Clock Frequency for each MIPI Configuration.

MIPI Configuration	Transmission Rate	Clock Frequency
1lan 8bit	592MHz	296MHz
2lan 8bit	296MHz	148MHz
1lane 10bit	744MHz	372MHz
2lane 10bit	368MHz	184MHz
1lan 8bit	592MHz	296MHz
2lan 8bit	296MHz	148MHz

I2C Debugging

Due to the potential need for I2C level shifting during module integration, it is strongly recommended to perform I2C communication tests after integration. This will help prevent communication issues that may arise from protocol mismatches. The I2C protocol should conform to the standard protocol requirements mentioned below. Furthermore, it is essential to verify that the I2C high and low voltage levels are compatible with the module's I/O voltage requirements.

Symbol	Parameter	Conditions	Standard-mode		Fast-mode		Fast-mode Plus		Unit
			Min	Max	Min	Max	Min	Max	
f_{SCL}	SCL clock frequency		0	100	0	400	0	1000	kHz
$t_{HD;STA}$	hold time (repeated) START condition	After this period, the first clock pulse is generated.	4.0	-	0.6	-	0.26	-	μs
t_{LOW}	LOW period of the SCL clock		4.7	-	1.3	-	0.5	-	μs
t_{HIGH}	HIGH period of the SCL clock		4.0	-	0.6	-	0.26	-	μs
$t_{SU;STA}$	set-up time for a repeated START condition		4.7	-	0.6	-	0.26	-	μs
$t_{HD;DAT}$	data hold time [1]	CBUS compatible controllers (see Remark in Section 4.1)	5.0	-	-	-	-	-	μs
		I^2C-bus devices	0 [2]	- [3]	0 [2]	- [3]	0	-	μs
$t_{SU;DAT}$	data set-up time		250	-	100 [4]	-	50	-	ns
t_r	rise time of both SDA and SCL signals		-	1000	20	300	-	120	ns
t_f	fall time of both SDA and SCL signals [2] [5] [6] [7]		-	300	$20 \times (V_{DD} / 5.5\ V)$	300	$20 \times (V_{DD} / 5.5\ V)$ [8]	120 [7]	ns
$t_{SU;STO}$	set-up time for STOP condition		4.0	-	0.6	-	0.26	-	μs
t_{BUF}	bus free time between a STOP and START condition		4.7	-	1.3	-	0.5	-	μs
C_b	capacitive load for each bus line [9]		-	400	-	400	-	550	pF
$t_{VD;DAT}$	data valid time [10]		-	3.45 [3]	-	0.9 [3]	-	0.45 [3]	μs
$t_{VD;ACK}$	data valid acknowledge time [11]		-	3.45 [3]	-	0.9 [3]	-	0.45 [3]	μs
V_{nL}	noise margin at the LOW level	for each connected device (including hysteresis)	$0.1V_{DD}$	-	$0.1V_{DD}$	-	$0.1V_{DD}$	-	V
V_{nH}	noise margin at the HIGH level	for each connected device (including hysteresis)	$0.2V_{DD}$	-	$0.2V_{DD}$	-	$0.2V_{DD}$	-	V

MIPI Trace

1. The differential signal trace impedance for MIPI must be maintained at 100Ω, with a tolerance not exceeding ±10%. To minimize signal reflections and prevent degradation of high-speed transmission performance, traces should avoid right-angle bends.
2. A continuous reference layer, typically a ground plane, must be positioned directly beneath the MIPI signal traces. This reference layer must remain uninterrupted and free of gaps. If a continuous reference layer cannot be implemented,

the width of the reference layer should be at least four times the width of the MIPI signal traces on each side.

3. To ensure signal synchronization and consistency, the differential pairs (DP/DN) of MIPI signals must be routed with equal length and consistent spacing. The length mismatch between different differential pairs should be controlled within 200 mils, while the length mismatch between the DP and DN within a single pair should be less than 50 mils. The priority is to maintain equal trace lengths over equal spacing, with a minimum distance of 2W between pairs.

The following table lists the length of the MIPI trace.

MCP	MCN	MD0P	MD0N	MD1P	MD1N
346.099mil	349.864mil	288.504mil	293.903mil	406.068mil	410.052mil

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