RT212
OEM Scan Engine

Integration Guide

Table of Contents

Chapter 1 Getting Started

Introduction

The RT212 is an area image engine for barcode reading. It includes a laser aiming system, an LED illumination system and a 12-pin FPC connector.

LED Compliance Statement

The RT212 complies with IEC 62471:2006 for LED safety.

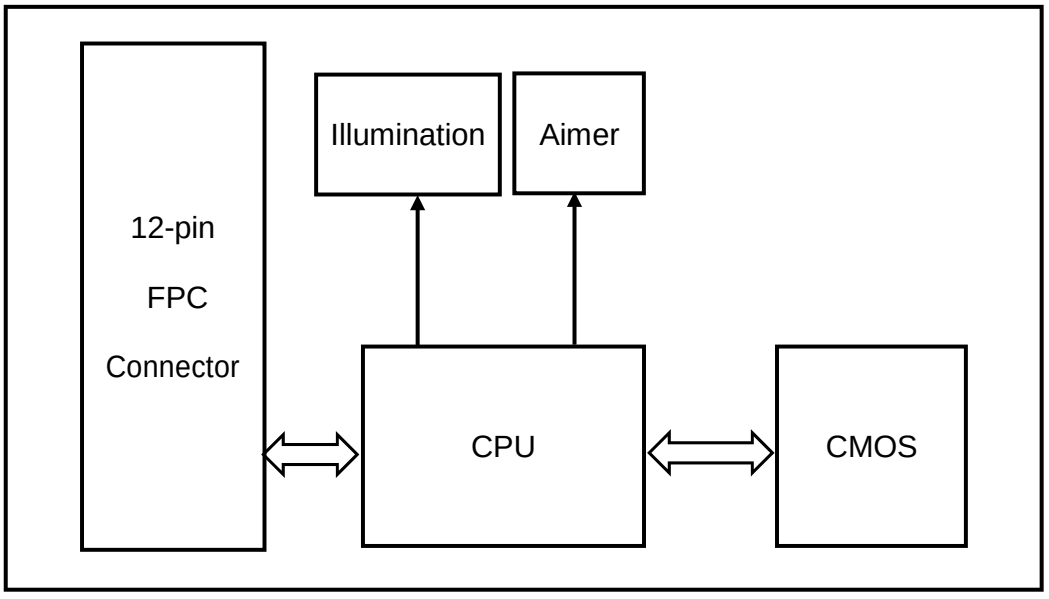
Laser Compliance Statement

The RT212 is certified to be in compliance with IEC 60825-1:2014 as a class 1 laser product.

The RT212 contains:

- a CPU decoder board
- a CMOS image sensor and its lens
- an LED illumination system
- a laser aiming system
- a 12-pin FPC connector

Figure 1-1 System Block Diagram



The 12-pin FPC connector on the engine can be connected to a host device with an FFC cable. For information about this cable, please see the “12-pin FFC Cable” section in Chapter 4.

Illumination

The RT212 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. Besides, external illumination LED for further improving lighting can be turned On by programming PIN 8 of the 12-pin FPC connector on the engine when needed.

Aimer

The RT212 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.

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Chapter 2 Installation

Introduction

This chapter explains how to install the RT212, 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 or diffractive optical element during handling. Improper handling may affect engine performance.

General Requirements

ESD

ESD protection has been taken into account when designing the RT212. 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.

Avoid Hot-plugging

The RT212 does not support hot-plugging. Be sure the power is cut off before connecting a cable to or disconnecting a cable from the engine. Hot-plugging could damage the engine.

Dust and Dirt

The RT212 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 RT212.

Operating Temperature	°C to 60°C
Storage Temperature	-40°C to 70°C
Humidity	5% ~95% (non-condensing)

Thermal Considerations

Electronic components in the RT212 will generate heat during the course of their operation. Operating the RT212 in continuous mode for an extended period may cause temperatures to rise on CPU, CIS, LEDs, DC/DC, etc. Overheating can degrade image quality and affect scanning performance. Given that, the following precautions should be taken into consideration when integrating the RT212.

- ✧ Avoid continuous use of the engine for prolonged periods.
- ✧ Reserve sufficient space for good air circulation in the design.
- ✧ Avoid wrapping the engine with thermal insulation materials such as rubber.
- ✧ Use thermally conductive but electrically insulating material to conduct heat to the housing of the engine.

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 RT212 after correct installation.

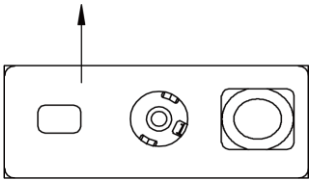


Figure 2-1

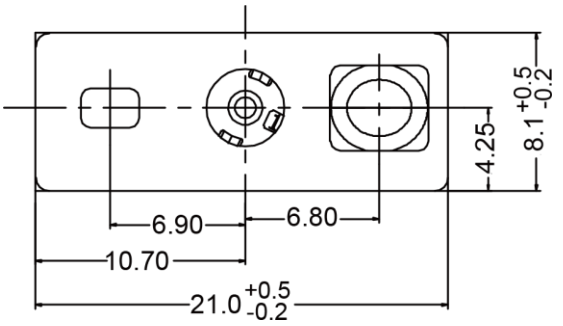
Mounting

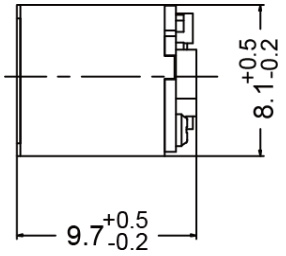
For the RT212, the user can mount the decoder board and the imager separately and connect them with an FFC cable.

The illustrations below show the mechanical mounting dimensions for the RT212. The structural design should leave some space between components and reserve sufficient room for the installation of the FFC cable.

Mechanical Mounting Dimensions for RT212 (Unit: mm)

Imager





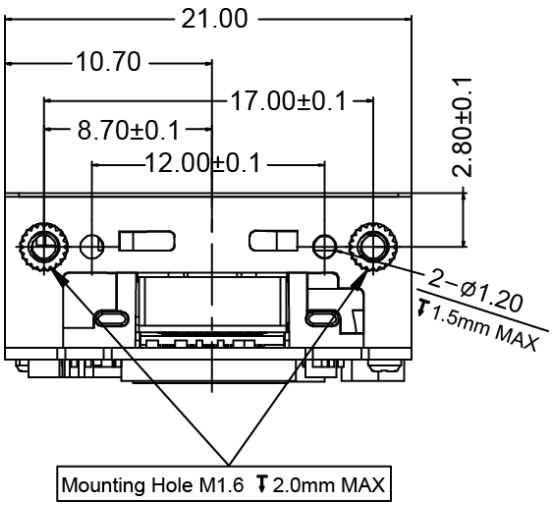

21.00
10.70
17.00±0.1
8.70±0.1
12.00±0.1
2.80±0.1
2−Ø1.20
↧1.5mm MAX
Mounting Hole M1.6 ↧2.0mm MAX

Figure 2-3

Decoder Board

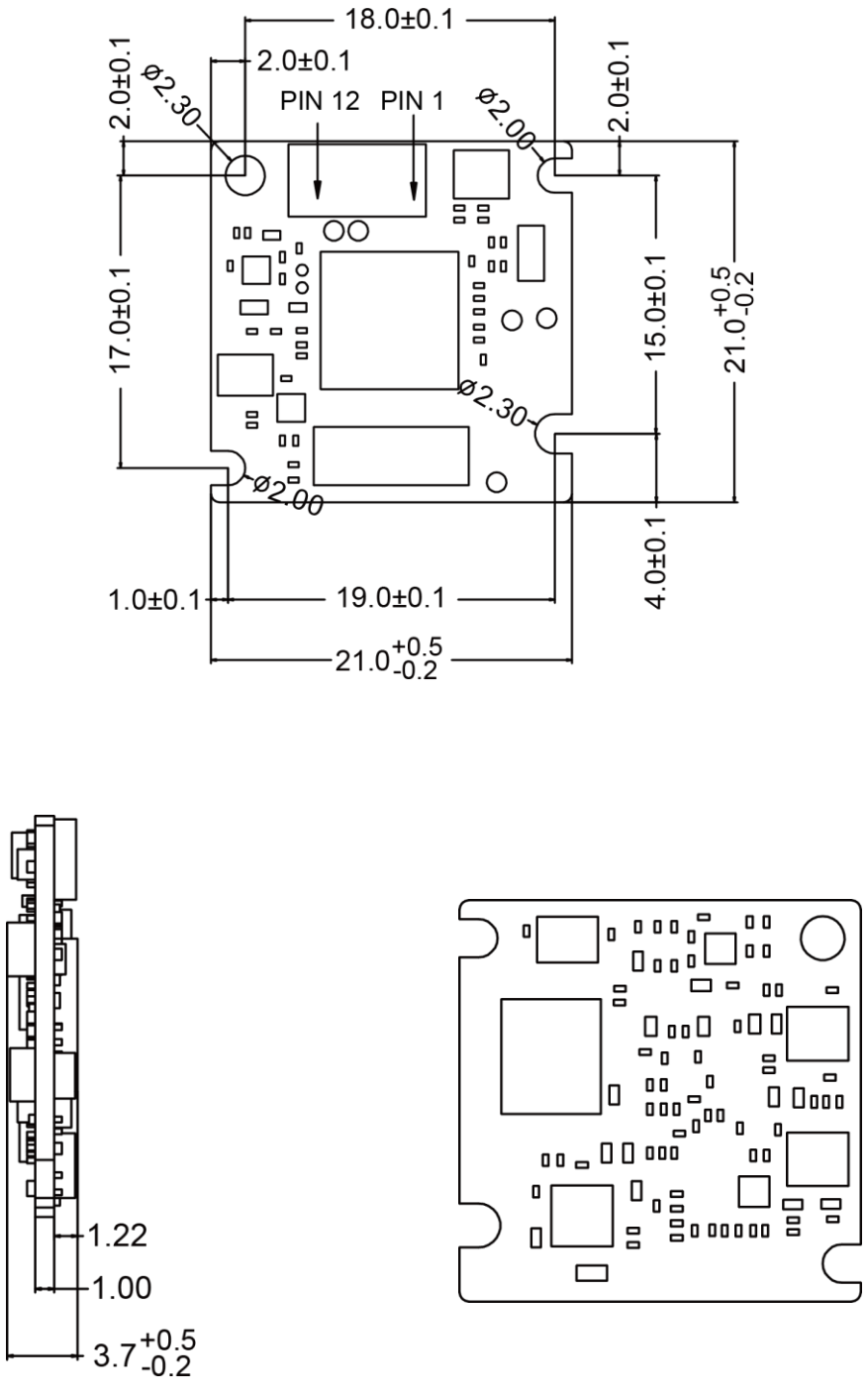


Figure 2-4

FPC Cable

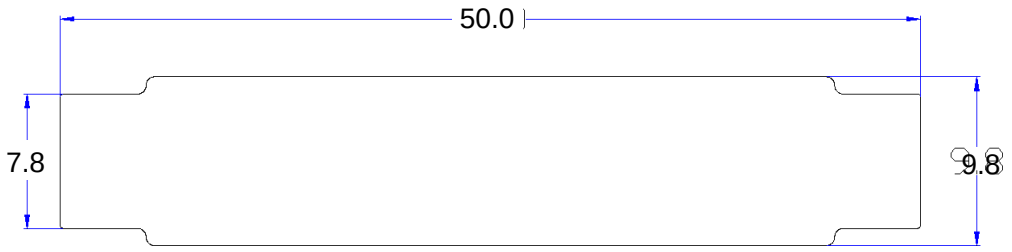


Figure 2-5

Installation of FPC Cable

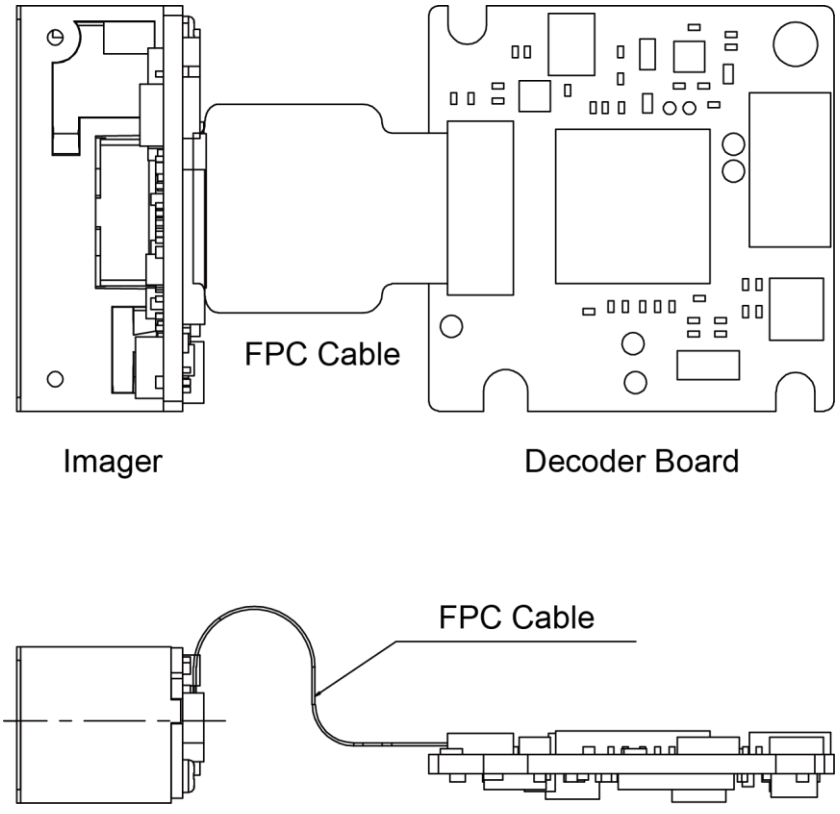


Figure 2-6

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 RT212 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 2-7**.
- **Tilted window** - This option is for laser/imager engines. For the tilted window distance requirements, please see **Table 2-3**.

Figure 2-7

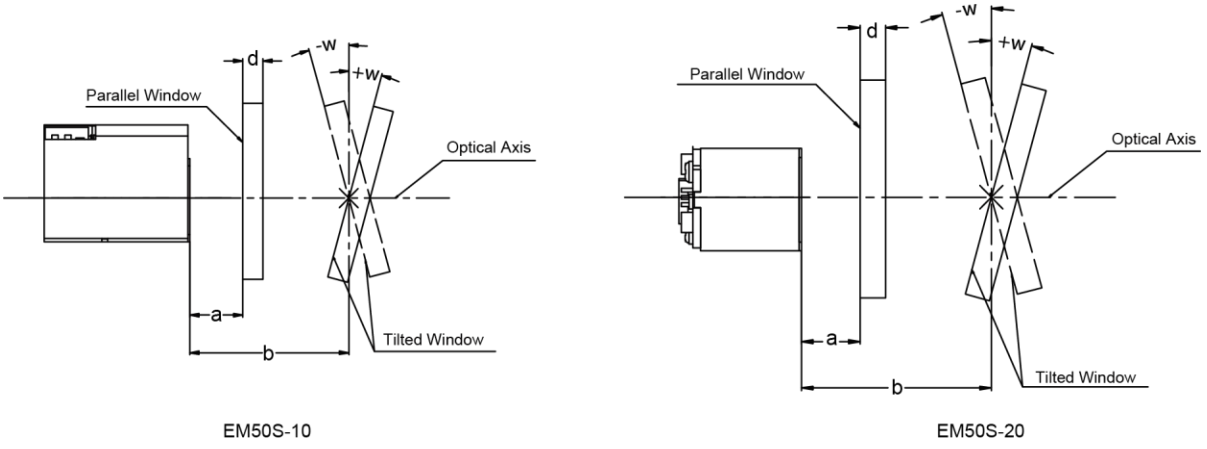


Table 2-3

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 **Table2-4**.

- **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 2-4

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 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 RT212. 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.

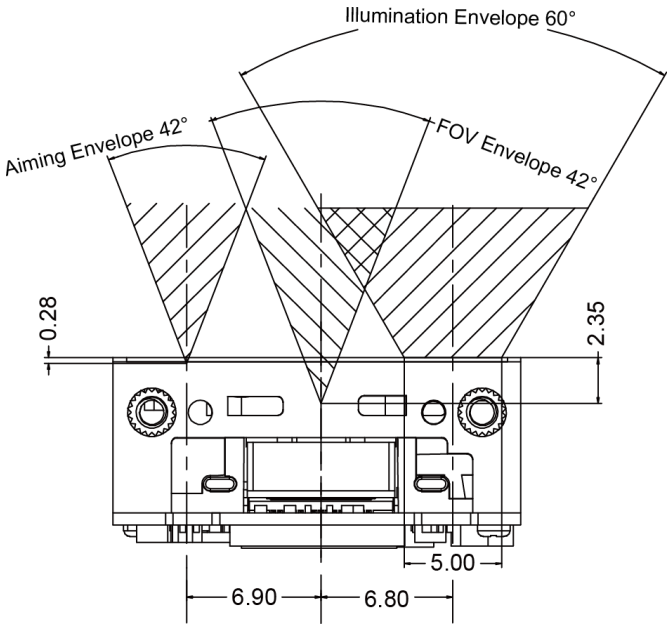
The AR coating specifications below should be met when using an AR coated window.
Single side AR coating: 92% minimum transmittance within spectrum range from 420 nm to 730 nm.
Double side AR coating: 97% minimum transmittance within spectrum range from 420 nm to 730 nm.

Window Size

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

RT212

Horizontal:



Vertical:

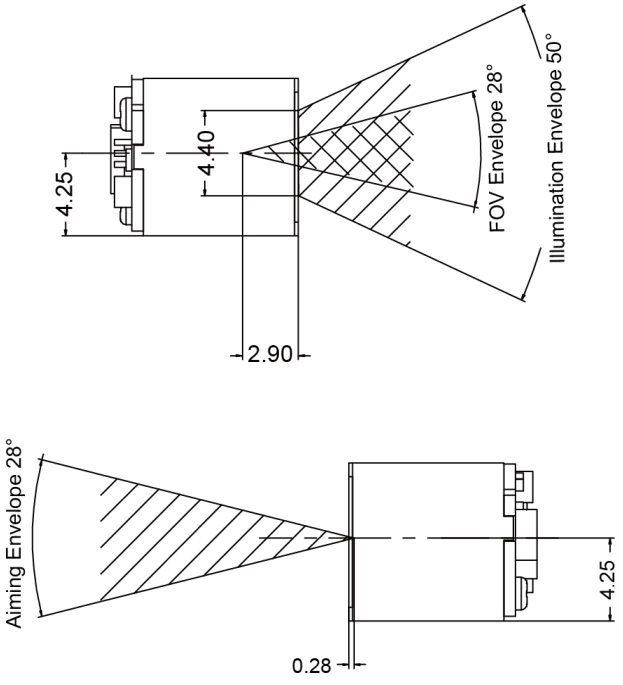


Figure 2-9

Ambient Light

The RT212 shows better performance with ambient light. However, high-frequency pulsed light can result in performance degradation.

Eye Safety

The RT212 uses LEDs to produce illumination beam. The LEDs are 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 RT212 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 RT212 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 (12-pin FPC Connector)	3.135	3.3	3.465	V
Current (@3.3V)	Operating Current	-	269 (RMS)	600 (PKPK)*	mA
	Idle Current	-	60	72	mA
	Sleep Current			1	mA

Note:

* 600mA (PKPK) is the peak current draw when the engine is scanning with the illumination set to Always On. To ensure the engine performance, it is imperative that the power supply can provide a minimum current of 600mA, but preferrably 1A.

The user may put the engine into Sleep mode by sending the command **7E 00 00 09 7E 53 54 41 4E 44 42 59 7E A1** to it through serial interface, USB HID Keyboard, USB CDC COM. To awake the engine from sleep mode, simply press the trigger.

I/O Voltage

Table 3-2

VDD=3.3 V, VSS=0 V, T=23°C

Parameter	Minimum	Maximum	Unit
VIL	VSS	0.8	V
VIH	2.0	VDD	V
VOL	VSS	0.4	V
VOH	2.4	VDD	V

Timing Sequence

Power Up and Power Down Timing Sequence

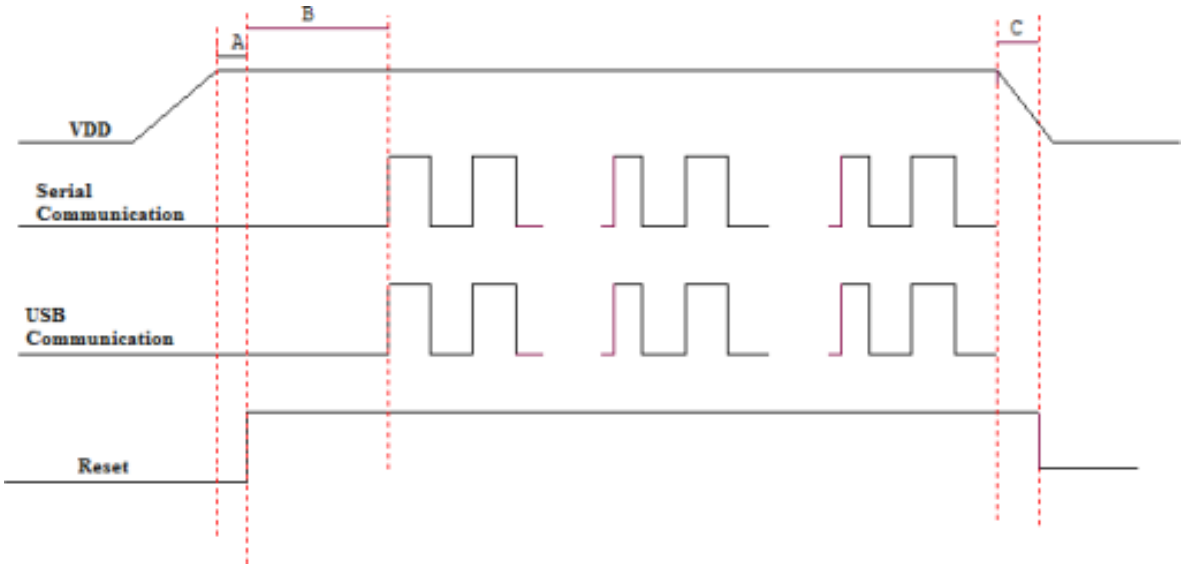


Figure 3-1

1. In the diagram above, it takes **A+B** (less than 1s) for the engine to power up: **A** is reset time (about 560ms), **B** is time needed to start the engine (including bootloader execution, kernel boot and decoding chip initialization). The engine is ready to receive commands via its serial/USB port after the power-up sequence completes.
2. **C** is the time it takes to power down the engine (during power-down, all voltages in the engine ramp down, with all communication stopped and all signals at a low level). To ensure that all voltages are fully down and signals on the interfaces at a low level, the minimum interval between removing and resupplying the power must exceed 2s.

Chapter 4 Interfaces

Interface Pinouts

The host interface connector of the RT212 is a 12-pin FPC connector, which can be used as TTL-232 interface or USB interface.

The figure below illustrates the position of 12-pin FPC connector on the RT212's decoder board, as well as the pin 1 location.

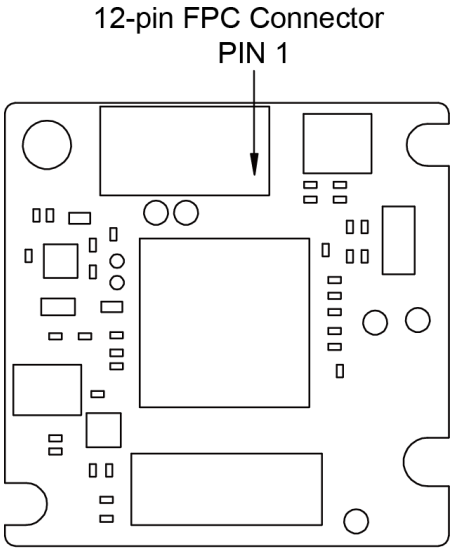


Figure 4-1

12-pin FPC Connector

The following table lists the pin functions of the 12-pin FPC connector.

Table 4-1

PIN#	Signal	I/O	Function	Remark
1	PIN1	-	No connection	
2	VIN	-	3.3V power supply input	
3	GND	-	Power-supply ground	
4	RXD	I	TTL level 232 receive data	
5	TXD	O	TTL level 232 transmit data	
6	USB_D-	I/O	USB D- differential data signal	
7	USB_D+	I/O	USB D+ differential data signal	
8	OUT_LIGHT_EN	-	External illumination control Default: disable (external illumination Off), input with ≥20K ohm pull up	See Note 1
9	BUZ	O	Beeper output	See Note 2
10	LED	O	Good Read LED output	See Note 3
11	nRESET	I	Reset signal input: active low	See Note 4
12	nTRIG	I	Trigger signal input: active low	See Note 5

※ I = Input; O = Output

※ 1 The OUT_LIGHT_EN signal (PIN 8) can be used to turn on external illumination LED when configured as an output. To program the external illumination On or Off, please see the RT212 user guide.

For the external illumination LED circuit design, please see the “External Illumination LED Circuit” section in this chapter. If the OUT_LIGHT_EN pin is not used, leave it unconnected.

※ 2 This output signal can be used by an external beeper circuit to generate audible feedback to the user to indicate power-on and good read statuses.

Power On beep: The BUZ pin (PIN 9) produces a PWM output (duration: 400ms; frequency: 4184Hz, both parameters are **NOT** user-programmable) 970ms after power-on. The beep can be programmed On or Off. To learn how to program the parameter, please see the RT212 user guide.

Good Read beep: The BUZ pin (PIN 9) produces a PWM output (default duration: 80ms; default frequency: 2730Hz, both parameters are user-programmable) when a good read occurs. The beep can be programmed On or Off. To learn how to program these parameters, please see the RT212 user guide.

For the external beeper circuit design, please see the “Beeper Circuit” section in this chapter. If the BUZ pin is not used, leave it unconnected.

※ 3 This output signal can be used by an external LED to indicate good read status.

The LED pin (PIN 10) produces a low output (default duration: 20ms, user-programmable) when a good read occurs. The Good Read LED can be programmed On or Off. To learn how to program these parameters, please see the RT212 user guide.

For the external LED circuit design, please see the “Good Read LED Circuit” section in this chapter. If the LED pin is not used, leave it unconnected.

※ 4 Giving a 200μs low pulse on the nRESET pin (PIN 11) will reset the engine. Normally this pin should be asserted high or in a high impedance state (there is a weak pull-up in the engine).

For the external reset circuit, please see the “Reset Circuit” section in this chapter. If the nRESET pin is not used, leave it unconnected.

※ 5 This external trigger signal can be either level trigger or pulse trigger.

Level trigger: A trigger pull (i.e. driving the nTRIG pin low for over 20ms) activates a decode session. The decode session continues until a barcode is decoded or the trigger is released.

Pulse trigger: When the trigger is pulled and released (pulse width : 50ms), scanning is activated until a barcode is decoded or the decode session timeout expires.

For the external trigger circuit, please see the “Trigger Circuit” section in this chapter. If the nTRIG pin is not used, leave it unconnected.

Connector/Cable Specifications (Unit: mm)

The RT212 is equipped with a 12-pin FPC connector.

12-pin FPC Connector

The 12-pin FPC connector on the RT212 is supplied by Hirose Electric Co., Ltd. Model No.: FH34SRJ-12S-0.5SH(50), dual contact.

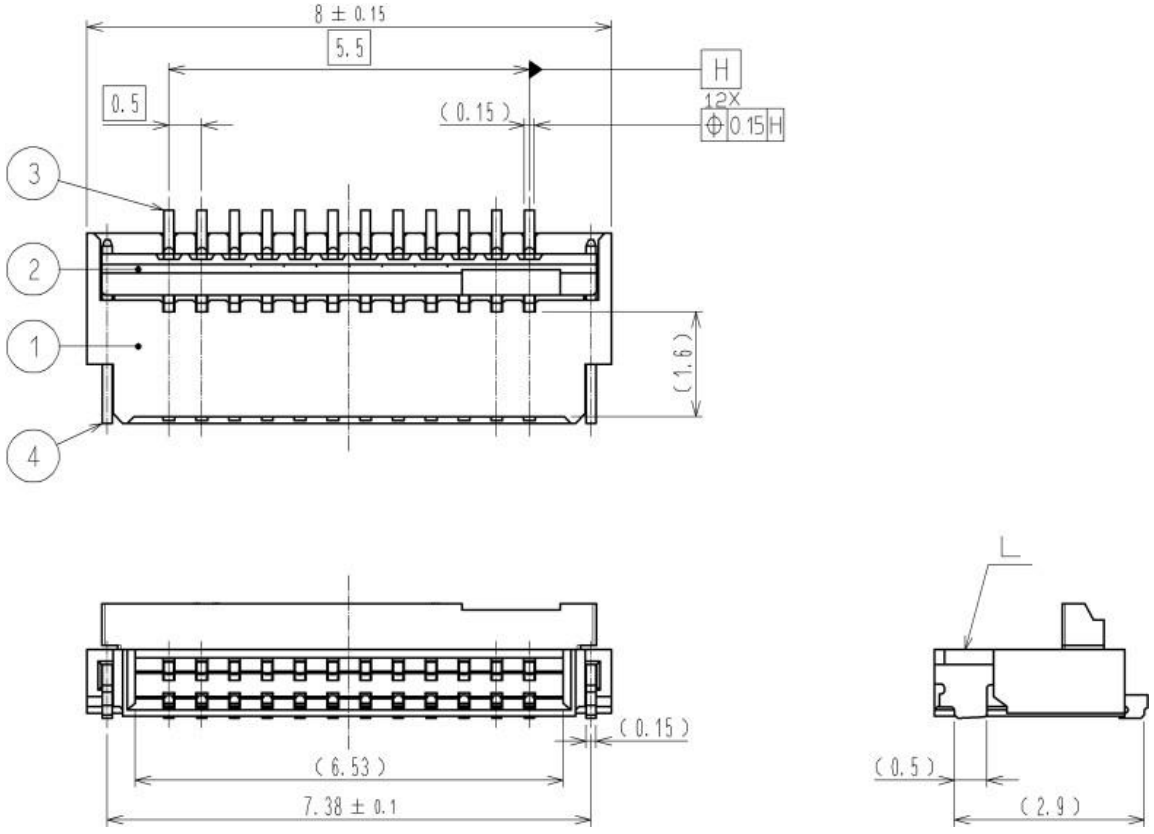
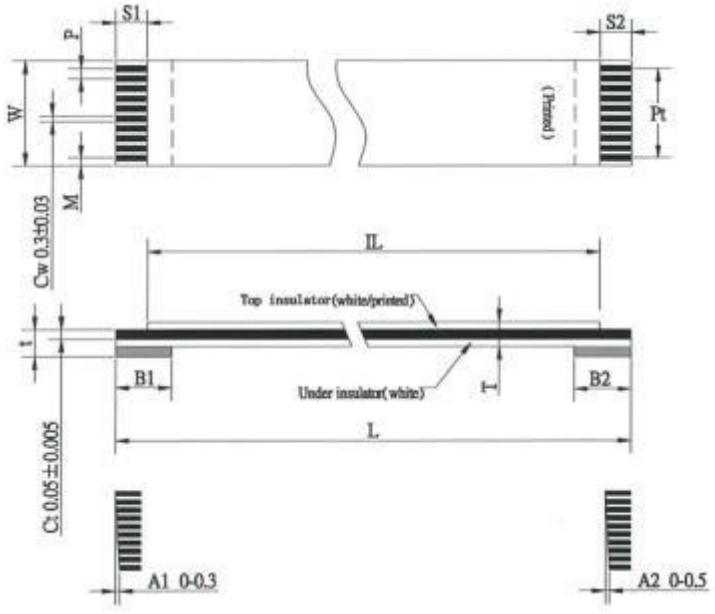


Figure 4-2

12-pin FFC Cable

A 12-pin cable can be used to connect the engine's 12-pin FPC connector to a host device.



Number of Conductors N.	12P
Pitch P.	0.50±0.05
Total Pitch Pt.	5.50±0.07
Total Length L.	75.00±2.00
Film Length IL.	67.00±2.00
Margin Width M.	0.50±0.07
Total Width W.	6.50±0.07
Strip Length S1.	3.00±1.00
Strip Length S2.	3.00±1.00
Stiffener B1.	4.00±1.00
Stiffener B2.	4.00±1.00
Slanting A1.	≤0.30
Slanting A2.	≤0.50
Terminal Thickness t.	0.303±0.03
Thickness T.	0.186±0.03

Figure 4-3

External Circuit Design

Good Read LED Circuit

The circuit below can be used to drive an external LED for indicating good read. The LED signal is from PIN 10 of the 12-pin FPC connector.

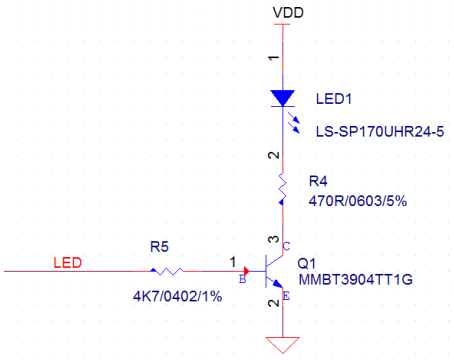


Figure 4-4

Beeper Circuit

The circuit below can be used to drive an external beeper. The BUZ signal is from PIN 9 of the 12-pin FPC connector.

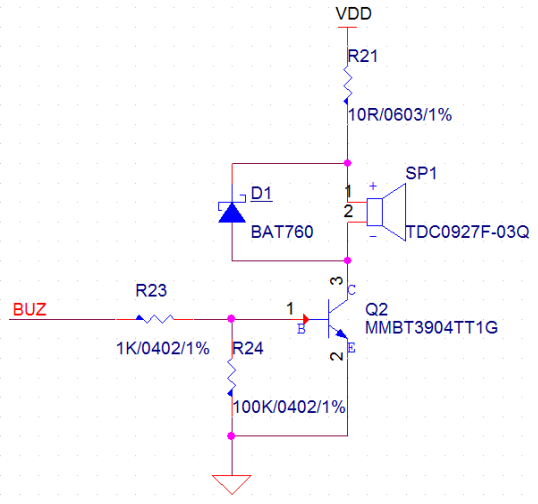


Figure 4-5

Trigger Circuit

The circuit below can be used to provide the engine with a signal to trigger a scan and decode session. The nTRIG signal is from PIN 12 of the 12-pin FPC connector.

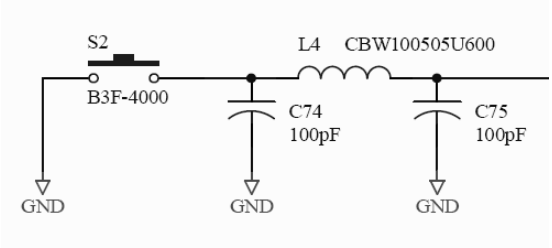


Figure 4-6

External Illumination LED Circuit

The circuit below can be used to control external illumination LED when the user wants to add external illumination to further improve lighting. It is recommended that the time it takes to power up the ciruit be shorter than 100µs. The OUT_LIGHT_EN signal is from PIN 8 of the 12-pin FPC connector.

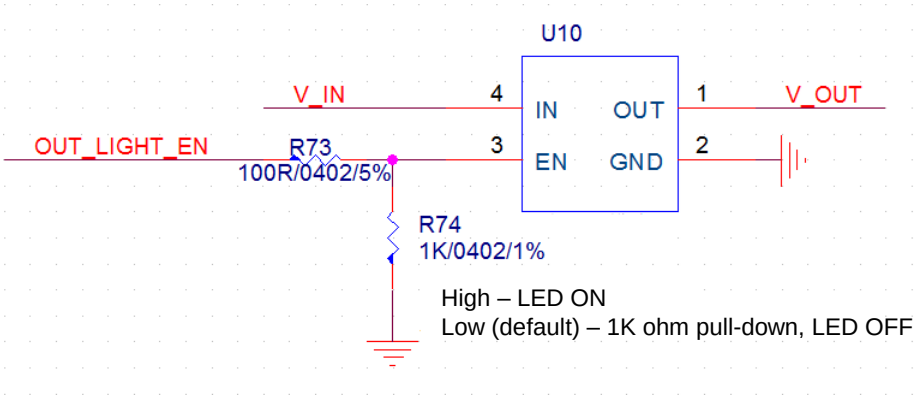


Figure 4-7

Reset Circuit

The circuit below can be used to reset the engine by giving a 200µs low pulse on the nRESET pin (PIN 11) on the host interface. The host device can send the RESET signal through GPIO.

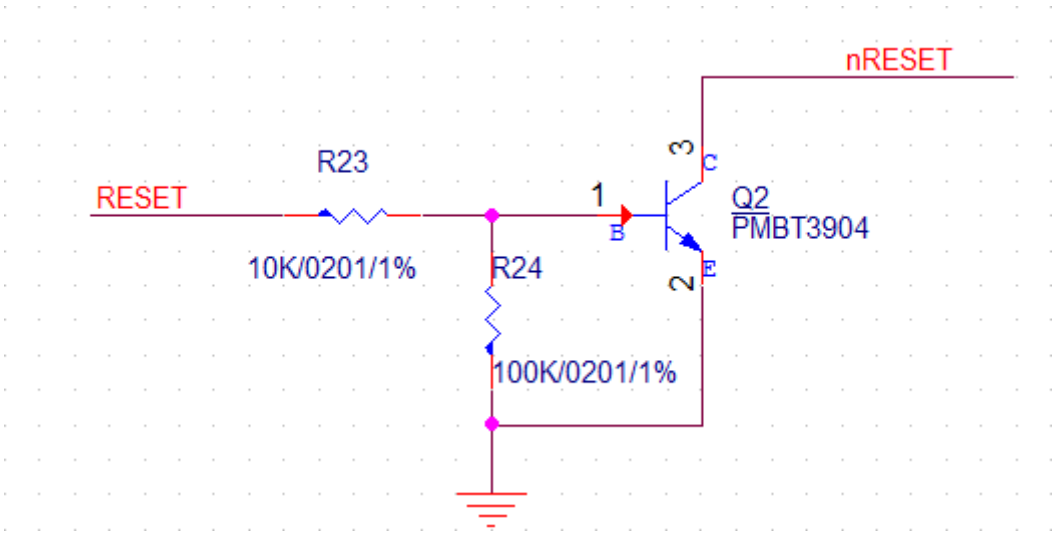


Figure 4-8

Chapter 5 Auxiliary Tools

The RT212 provides the following two tools to assist users in engine performance evaluation, application development and engine configuration.

EVK

The EVK is provided to help users to test and evaluate the RT212, which contains beeper & beeper driver circuit, LED & LED driver circuit, and trigger & reset buttons, TTL-232 to RS-232 converter & TTL-232 to USB converter, RS-232 & USB interfaces, etc. The RT212 can be connected to the EVK via a 12-pin FFC cable type 1 (contacts on the same side). Either USB connection or RS-232 connection can