

RLC-MS3F Smart Lock Face Recognition Module Product Specification

File No. :

RLC-MS3F-001

The right to:

Kneron

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1 Product overview

RLC-MS3F is a structured light smart lock face recognition module (hereinafter referred to as "the face recognition module or module") with liveness detection and facial recognition functions. It can output IR image, liveness detection results, face recognition results, etc. The module can be used in the night, normal indoor lighting, outdoor sunlight and various lighting conditions. The structured light face recognition solution can not only capture facial information dynamically, identify accurately and quickly, but also have strong anti-counterfeiting performance. Kneron proprietary liveness detection algorithm has passed the Bank Card Test Center (BCTC) enhanced level certification, which can eliminate all kinds of printing photos, electronic photos or videos, 3D head mold, 3D mask and other attacks. Comparing to traditional 2D single camera or dual-camera face recognition, it is more secure and accurate.

1.1 Product Structure

The basic structured of Kneron face module is shown in Figure 1. It is composed of PCBA, 3D structured light module and 3D liveness face recognition algorithm based on KL520 SoC. Fig. 1 Block diagram of RLC-MS3F 3D FR module 1 Power supply and communication can be realized through a 4PIN terminal and lock control connection.

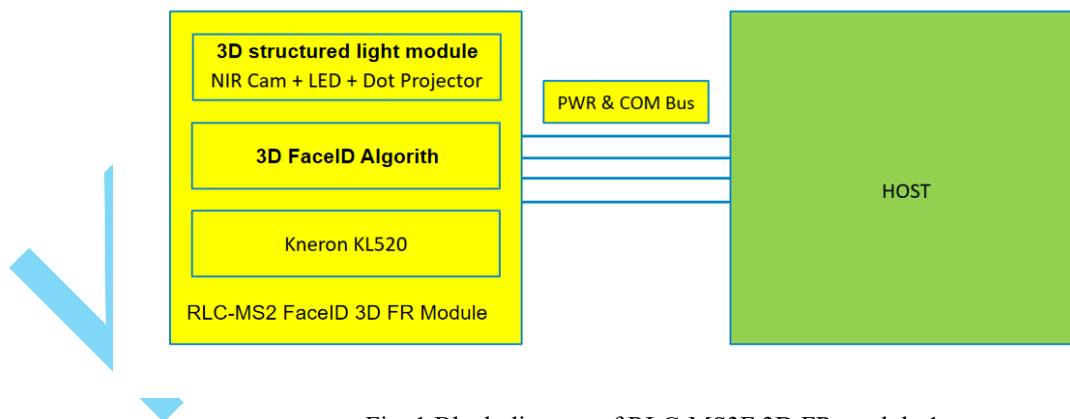


Fig. 1 Block diagram of RLC-MS3F 3D FR module 1

1.2 SoC

Kneron KL520 (figure 2) contains proprietary NPU and Cortex-M4 CPU, using UMC 40nm process node, has the features such as high performance, low power consumption. The re-configurable NPU is able to process audio, 2D and 3D images, support TensorFlow, Pytorch machine learning framework and ResNet, MobileNet

CNN models. It has been widely used in smart door locks, smart doorbell, smart home equipments. Figure 2 Block diagram of KL520 SoC 2

The liveness detection algorithm and face recognition algorithm have been done in-depth optimization and iteration on this SoC platform, and can achieve ultra-high unlocking performance and precision under the premise of low power consumption.

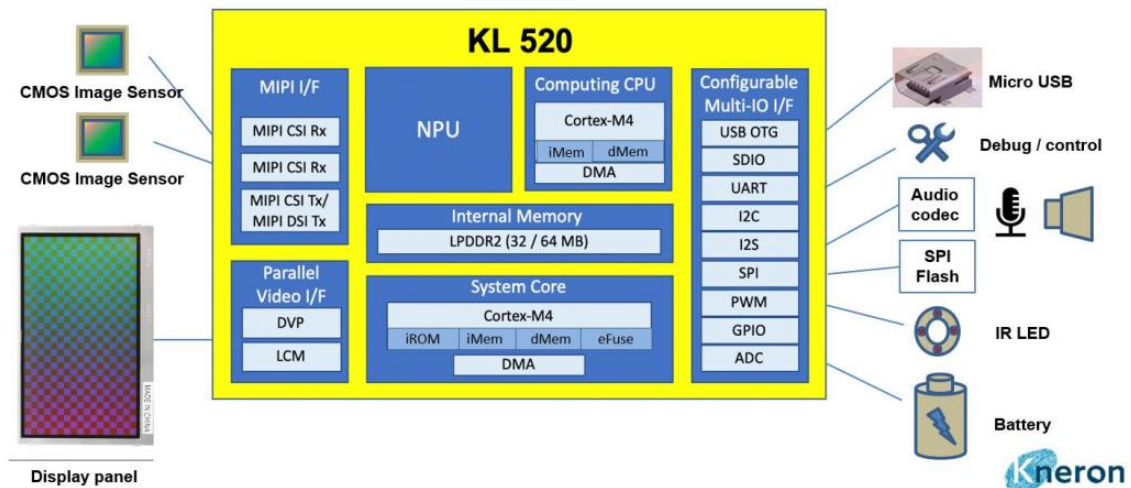


Figure 2 Block diagram of KL520 SoC 2

1.3 Product features

1. Security

RLC-MS3F face recognition module with 3D liveness algorithm and face recognition algorithm, can effectively guarantee the security of user information and product. The liveness detection algorithm has passed the Bank Card Test Center (BCTC) facial recognition and liveness detection enhanced level certification, which can effectively prevent all kinds of printed photos, electronic photos or video, 3D head mold, such as 3D mask attacks. Its security level is much superior to traditional fingerprint identification solution, single camera or 2D face recognition solution.

2. Ease of use

- 1) RLC - MS2 smart door lock is able to provide user with contactless, non-inductive unlock door experience without pressing fingerprints or enter the passwords, and can be used by elderly or children who has blur fingerprints. Moreover it eliminate the risk of residual fingerprints on smart lock being copied.
- 2) The 3D liveness detection algorithm and face recognition algorithm are deeply optimized based on the KL520 platform.
- 3) The vertical angle of view of 71° enables the lock to support a height range from 1.2m to 2.0m, covering both children and tall people.

4) Horizontally, it supports a field of view angle of 58° and a unlock distance of 0.3-1.0 meter. When approaching the door, the user does not need to face the camera, but only needs to face the door lock in the field of view angle to unlock the door. Even if the door lock is close to the wall, it can unlock smoothly.

3. Adapt to complex lighting environment

It can adapt to night, indoor daylight, outdoor daylight (can unlock within 100000 Lux), corridor light and a wide range of lighting environment. No matter when, and no matter the environment, it can open the door normally.

4. Ultra-low power consumption

Typical power consumption 5V / 600mA (non-average power consumption);

A single unlock typically consumes 5V / 0.035mAh, which equates to 0.18mWh.

It supports both lithium battery and AA battery.

5. Super fast speed

From wake-up to unlock, the typical time is 1.0S.

6. The stability

Mature and stable chip hardware solutions and strict product quality inspection.

7. The interface is simple and easy to integrate

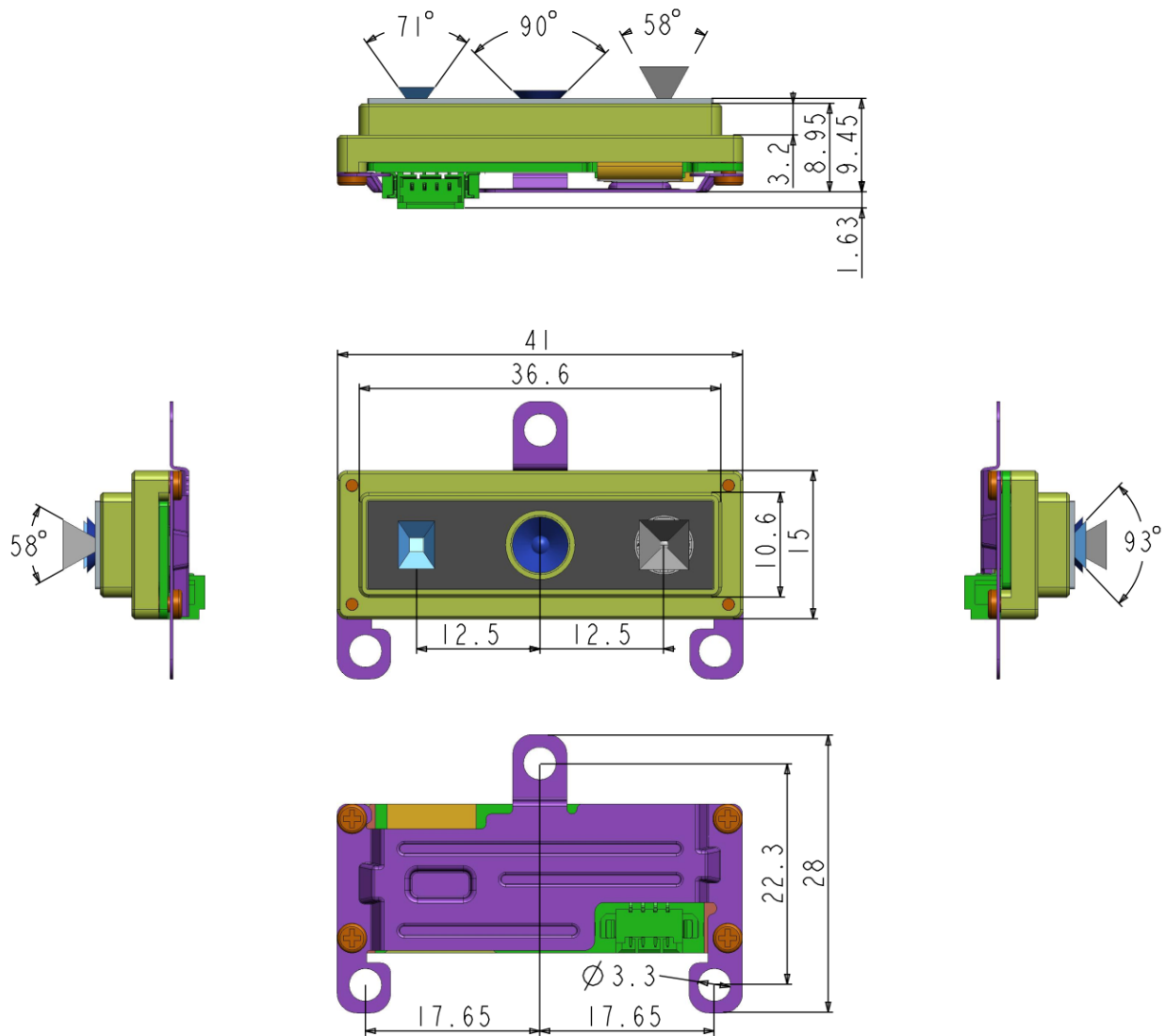
Kneron face module only needs a 4PIN interface to connect with the main control board, and support power supply and serial communication at the same time. Compact structure design, simple and complete software functions, coupled with comprehensive communication protocols, make lock OEMs possible to quickly upgrade to the most secure face unlock function.

1.4 Applications

1. Face recognition
2. 3D liveness detection
3. 3D FR smart lock
4. Access control etc.

2 Hardware description

2.1 Face module structure diagram



2.2 Interfaces and PIN definitions

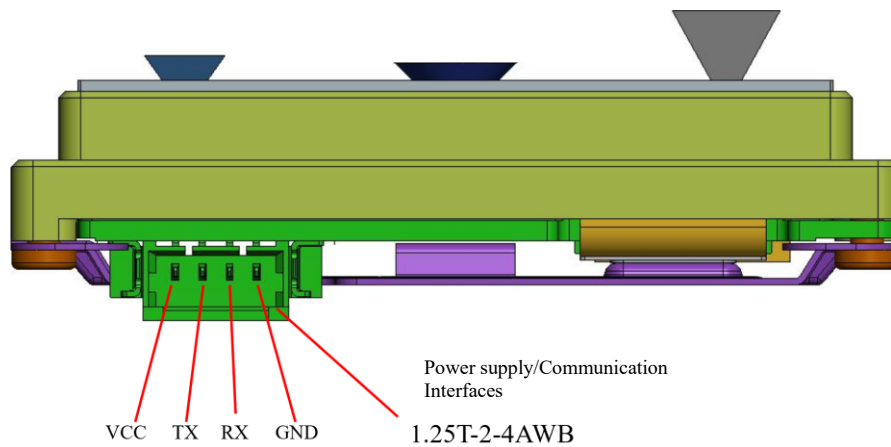


Fig. 4 Interfaces of face module 4

The interface between the module and the main control is defined in Figure 4, which is plug-plug mode. Two of the four lines are power supply lines, and the lock control is responsible for the power supply. The power supply voltage range is 4.5-10 v, the peak power supply current is 600mA @ 5V, and the sleep mode power consumption is 12 uA@5-10V..

The other two are UART communication lines, which are connected to the module's UART communication interface. Interface schematic diagram is shown in Fig. 5. PIN definition of 4PIN interface. Fig. 5 PIN definition of 4PIN interface

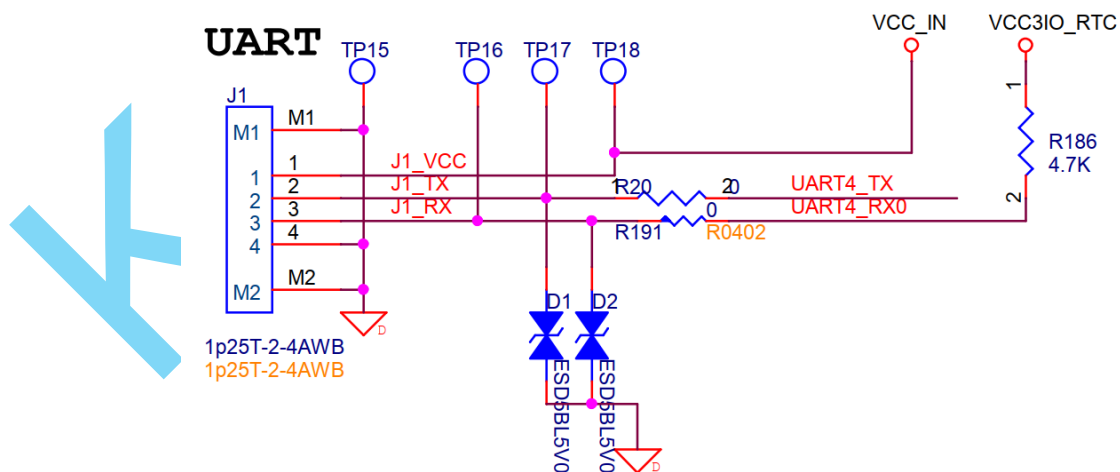


Fig. 5 PIN definition of 4PIN interface 5

2.2.1 Error handling

The UART of the module can send out heartbeat commands once every one second. If the module does not work for unknown reasons (interference, ESD, etc.), the user can simply let the module's input power VCC, PIN pin 1, power down for a period of time and then power up again, it should be noted that this means that the VCC provided by the user can be controlled.

2.2.2 PIR sensor (optional)

If the user's project has more stringent power consumption requirements, the PIR sensor can be connected to the user's main control (mcu or others), which is a "proximity sensing" sensor that will send a trigger signal to the main control when it detects a person approaching. Then main control will power on the face module to do face recognition or registration. After the face module is finished, the face module will be powered down again. This can reduce the standby power consumption of the face module.

2.3FOV: Installation elevation angle and height range

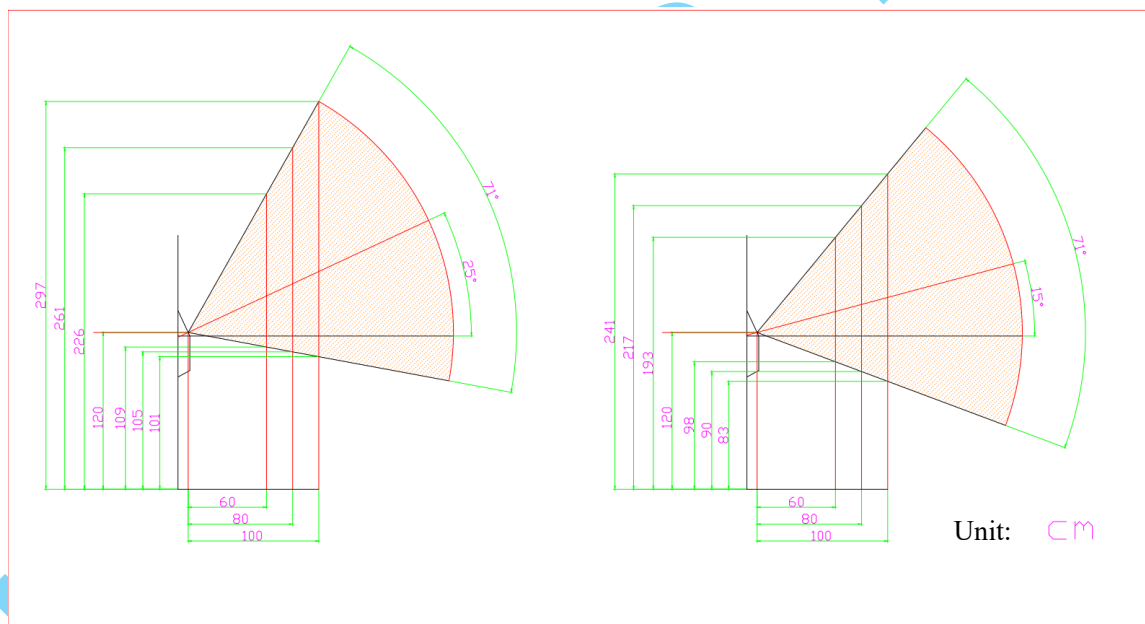


Fig. 6 diagram of height range applicable to different elevation angles

The longitudinal FOV of the camera is about 71°. The figure above shows the height range that can be covered by the longitudinal field of view of the camera when the installation height of the camera is 120cm and the installation elevation Angle is 25° and 15° respectively, and the distance between the head and the camera is 60/80/100 cm.

Table 1 The height range of people covered by different installation angles (head height of 20cm)

Angle between main optical axis and horizontal plane	Installation height_ 120cm, camera _vertical FOV~71°		
	height coverage / cm		
	Distance 60cm	Distance 80cm	Distance 100cm
15°	118-193	110-217	103-241

25°	129-226	125-261	121-297
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3 Product specifications and parameters

Table 2 Product specification parameter table 1

Category	Item	Description
Hardware	Product model	RLC-MS3F
	Baseline	25 mm
	Working voltage	4.5-10 V,
	Communication interface	Serial port, serial port level 3.3V, default baud rate 115200
	Sleep mode power consumption	12 uA @ 5-10V
	Working power consumption	Peak 600mA@5V, Average 130mA @ 5V (single unlock time 1.0s)
	Power consumption per unlock	0.035mAh @ 5V (0.18mWh)
	Unlock latency	around 1.0 s
	Dimension	L41.0mm * W15.0 mm * H9.45 mm
	Camera FOV	H 57.8° * V 71.7°
	Optical security	The structured light laser meets the Class 1 standard
Facial recognition	Optimal FR distance range	0.4-1.0 m
	Extended FR distance range	0.3-1.2 m
	Number of images can be stored	≤ 100
	Liveness FAR/FRR	FRR < 1% @ FAR < 0.1%
	FR FAR/FRR	FRR < 1% @ FAR < 0.1%
	Certification	BCTC Enhanced security level R_TFCR203Q51TP
Application	OTA	Support
	Hijacking alarm	Support
	Occulasion detection	Support
	Self-learning	Support
	Decorative tolerance	Glass, hat, earphone, beard, makeup

Working environment	Working temperature (°C)	Recommended -10°C ~ +55°C Limits -25°C ~ +70°C
	Working humidity	≤ 95 RH
	ESD	Air 15kV, Touch 8kV
	Salt mist	96H

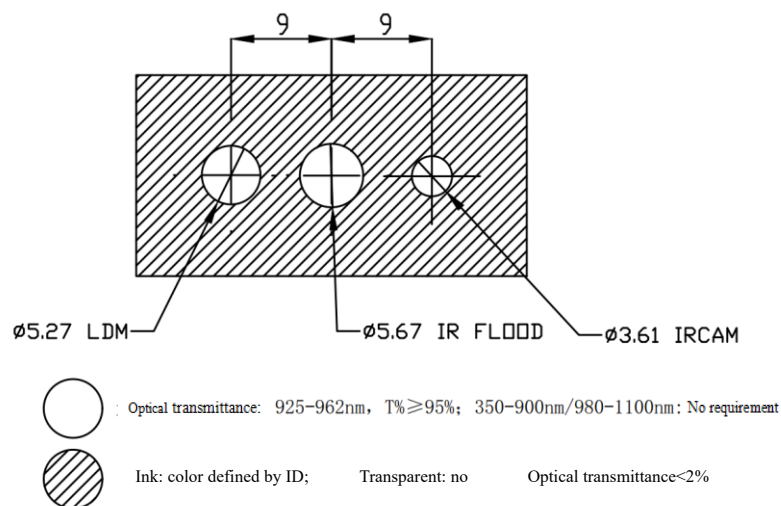
4 Regulations and implementation standards

Comply with Class 1 laser product certification.

5 Installation and heat dissipation

1. Cover glass: need to update the transmission or reflection requirements

Front shell opening and cover glass or screen printing inside TP should avoid blocking the FOV of all cameras. To ensure performance of the module, the transparent hole of the cover glass should meet the requirements of the transmission band and transmittance.



2. Seal

The optical devices on the camera module are all sealed with sealed foam (own) for dustproof seal.

3. Heat dissipation

Not required

4. Fixed installation

- (1). It is recommended to use three-in-one screws to fix (or screws with anti-falling glue), which can effectively prevent loosening;
- (2). The torque of the screwdriver shall not be greater than 1.0kgf. Cm.

5. Grounding

The metal bracket of optical module should be well grounded to avoid bad ESD.

6. To prevent deformation

The optical module and calculation board shall not be subjected to any external force except the fixed screws on both sides.