Mini 384×288/640×512 Uncooled Thermal Camera Product Manual V1.4

InfiSense Technology Co., Ltd.

Contents

This manual is intended to be used as a guide. Pictures, figures, diagrams, illustrations, etc. provided in this manual are for explanation and illustration purposes only and may be different from the particular product. Please refer to the physical product. While the Company does its utmost to ensure the accuracy of content in this manual, it makes no explicit or implicit claims or guarantees on this manual.

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Historical Versions

Version	Date	Description
V0.1	2020-07-30	Initial version;
V0.2	2020-10-30	Updated power consumption parameters; added an SPI interface; updated pictures of interface boards;
V0.3	2020-12-22	Added adaptive lens parameters; updated temperature measurement accuracy and power consumption parameters;
V0.4	2021-06-01	Updated physical photos, product features, product selection, adaptive lens specifications, power consumption parameters, communication interface, temperature measurement range, and temperature measurement accuracy; added connector model; updated module assembly drawings;
V1.0	2021-08-31	Updated information about serial communication interface, and product performance parameters & notes; added pin definitions of interface boards, and data output & control; deleted digital video information; added power-on, power-off, and forced updating sequence diagrams;
V1.1	2021-10-14	Updated lens specifications, thermal camera power consumption, product legends of user interface components & legends of pin definitions, and pin definitions of user interface components; added pin definitions and illustrations of supporting cables; updated DVP sequence and notes;
V1.2	2021-12-09	Added the notes on product performance temperature measurement parameters；updated DVP sequence ；updated output information format；
V1.3	2021-12-30	Added the definition of analog video in DF40C-50DP-0.4V (51); added the description of I2C control in MINI00-V101F001C;
V1.4	2022-04-06	Replaned product selection; Updated temperature parameter range; Optimized and streamlined user instructions;

1. Product Description

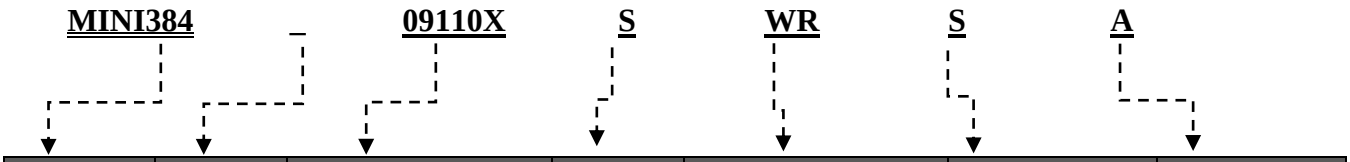
Mini 384/640 Series Uncooled Thermal Camera has a dedicated LY infrared image processing chip independently developed by InfiSense compared with the traditional FPGA solution, as well as a new self-developed 12μm WLP infrared detector. It comes with a parallel digital interface, which is easy to integrate and develop, and can be flexibly connected to various intelligent processing platforms. Featured by high performance, compact size, lightweight, low power consumption, and low cost, it meets SWaP^3 (Size, Weight and Power, Performance, Price) application requirements.

2. Product Features

- Lightweight and compact
- Ultra-low power consumption
- High-quality image
- 2 levels for temperature measurement

3. Models

Table 1 MINI Series Models



MINI384	_	09110X	S	WR	S	A
Product name	**Fixed symbols**	Lens (focal length, number of lens F)	**Gain Mode**	Movement mode	Lens focus type	Lens serial number
MINI384 MINI640	–	09110:9.1mm F1.0 13510:13.5mm F1.0 18011:18mm F1.1	S:High and low gain are switchable	NR:Single imaging WR:Temperature measurement	S:Fixed	A:The first lens of this focal length, f-number, focus mode B:The second lens

4. Lens Specifications

Table 2 Adaptive Lens Specifications

Array Size	Lens Type	Focusing Mode	FOV(H×V)	IFOV	Weight
384×288	9.1mm F1.0	Fixed, athermalized	29.2°×21.7°	1.3mrad	8.3g±5%
640×512			48.7°×38.6°		
384×288	13.5mm F1.0	Fixed, athermalized	19.6°×14.7°	0.9mrad	13.0g±5%
640×512			31.9°×25.7°		
384×288	18mm F1.1	Fixed, athermalized	14.7°×11.0°	0.7mrad	16.0g±5%
640×512			24.2°×19.5°		

5. Parameters

Table 3 Main Parameters

Component	MINI 640	MINI 384
Sensor Technology	Uncooled VOx microbolometer	
Resolution	640×512	384×288
Effective Frame Rate (1)	50Hz/25Hz	
Pixel Pitch	12μm	
Spectral Band	8~14μm	
NETD	≤50mK@25°C, F#1.0 (≤40mK, optional)	
Thermal Imaging		
Brightness Adjustment	0~255, optional	
Contrast Adjustment	0~255, optional	
Polarity	White-hot/Black-hot	
Palette	Supported	
Digital Zoom	0.25~2.0× continuous zoom	
Mirroring	Vertical/Horizontal/Diagonal	
Reticle	Show/Hide/Move	
Image Processing	TEC-less algorithm	
	Non-uniformity correction	
	Digital filtering noise reduction	
	Digital detail enhancement	
Thermal Camera Power Supply		
Input Supply Voltage	1.8V, 3.3V, 5V (2)	
Typical Power Consumption @25°C	<0.55W	<0.50W
Thermal Camera Interface		
Video Output format	DVP	
Command and Control Interface	I^2C	
Physical Characteristics of Module (Lens and Flange not included)		
Weight	<8 g	

Package Dimension	21mm×21mm
Temperature Measurement [3]	
Measurement Range	High gain: -20°C ~ +150°C; low gain: 0°C ~ +550°C
Measurement Accuracy (Typical values)	Target temperature of -20°C ~ +150°C: accuracy of ±2°C or ±2% of the reading (The greater shall prevail @ ambient temperature of -20°C ~ 60°C) Target temperature of 0°C ~ +550°C: accuracy of ±5°C or ±3% of the reading (The greater shall prevail @ ambient temperature of -20°C ~ 60°C)
Measurement Method	Point, line, and area
Environment Adaptability	
Operating Temperature	-40℃～+80℃
Storage Temperature	-50℃～+85℃
Humidity	5%–95%, non-condensing
Vibration	6.06g, random vibration, all axes
Shock	80g@4ms, final peak sawtooth wave, three axes and six directions

Notes:

(1) 25Hz temperature measuring thermal camera and 50Hz imaging camera are optional;

(2) The voltage value as shown refers to the voltage to the thermal camera connector;

(3) The data in this directory are all measured in laboratory environment.

6. Description of User Interface of Thermal Camera Component

6.1 Description of Thermal Camera Interface Components

50PIN connector model: DF40C-50DP-0.4V (51)

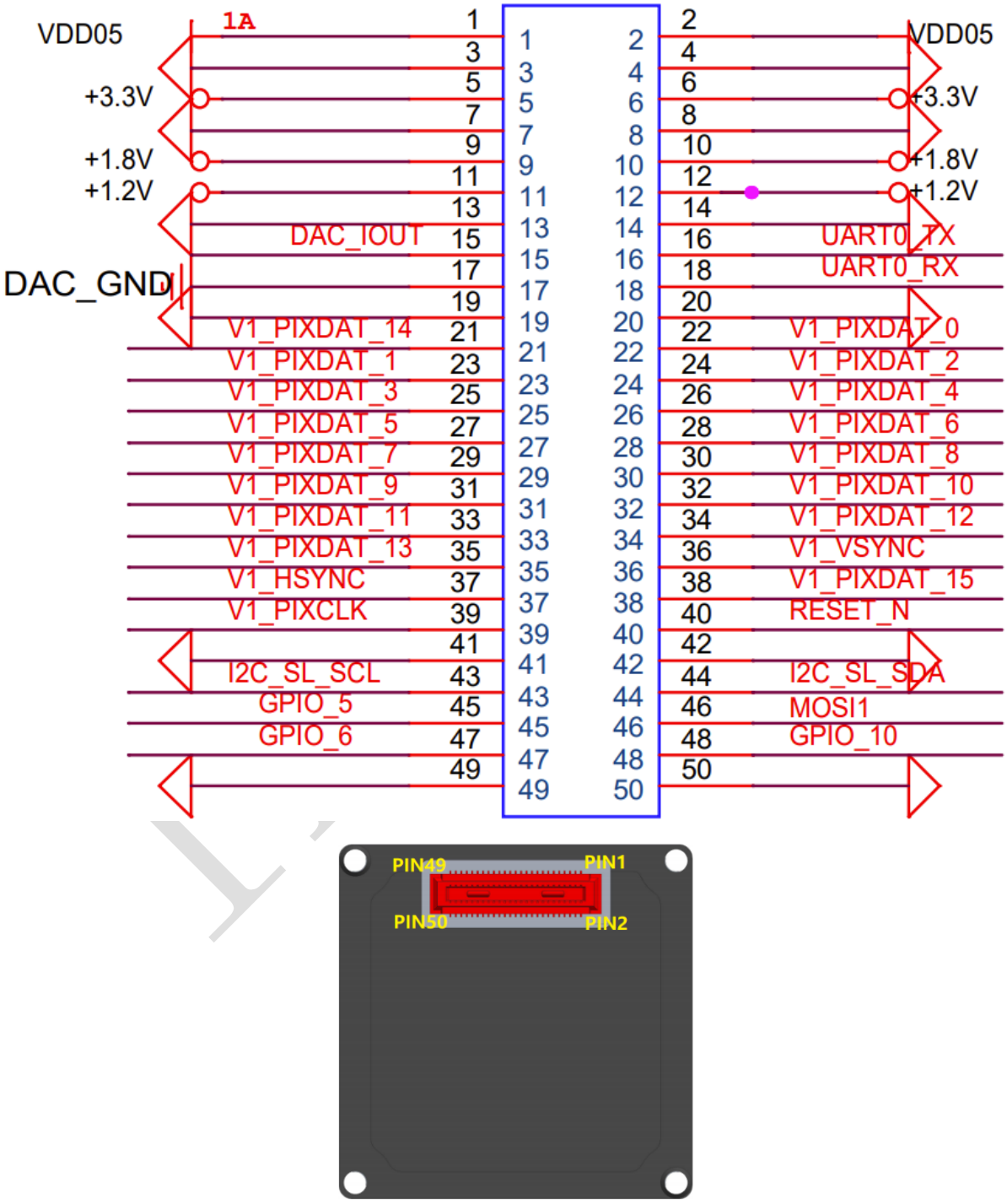


Figure 1 User Interface of Thermal Camera Hirose50

Table 4 Definitions of User Interface of Hirose50-core Connector

Pin No.	Pin Name	Type	Description	
1, 2	VDD5.0	Power (input)	External power input 5V (1)	
5, 6	VDD3.3	Power (input)	External power input 3.3V (2)	
9, 10	VDD1.8	Power (input)	External power input 1.8V (3)	
15	DAC_IOUT	Output	Analog video	
17	DAC_GND	Output	Analog video GND	
21	DATA14	Output	16Bit/8Bit parallel data	Data signal
22	DATA0			Data signal LSB(16bit)
23	DATA1			Data signal
24	DATA2			Data signal
25	DATA3			Data signal
26	DATA4			Data signal
27	DATA5			Data signal
28	DATA6			Data signal
29	DATA7			Data signal LSB (8bit)
30	DATA8			Data signal
31	DATA9			Data signal
32	DATA10			Data signal
33	DATA11			Data signal
34	DATA12			Data signal
35	DATA13			Data signal
36	VSYNC			Field synchronization signal
37	HSYNC			Line synchronization signal
38	DATA15			Data signal MSB
39	CLK			Clock signal
40	RESET	Input	Reset	
11, 12, 16, 18, 45~48	NA	NA	Not available	
43	SCL	Output	I^2C block line	
44	SDA	Input/Output	I^2C data line	
3, 4, 7, 8, 13, 14, 19, 20, 41, 42, 49, 50	GND	Power supply	Power supply GND	

Remarks:

(1) The typical power input voltage is 5 VDC, where the voltage value refers to the voltage to the module connector. The power rising time (10%~90%) is <4 mS; the peak current <1.0 A; and the ripple and noise <40 mVp-p;

(2) The typical power input voltage is 3.3 VDC, where the voltage value refers to the voltage to the module

connector. The power rising time (10%~90%) is <4 mS; the peak current <0.6 A; and the ripple and noise <40 mVp-p;

(3) The typical power input voltage is 1.8 VDC (1.75V<X<1.85V), where the voltage value refers to the voltage to the module connector;

(4) Do not hot plug, otherwise, component abnormalities may occur.

6.2 Data Output and Control

6.2.1 Information Format

There are three output modes available for users: image, temperature, and image & temperature. For image output, images may be gray or color ones. The data which have not been processed by the NUC and AGC is also available.

Table 5 Data Format Descriptions

Mode	Output	Data
Image	Gray image	Y14, Y10
	Color image	YUV422
Temperature	Temperature image	Y14
Temperature & image （The current version does not support）	Temperature & image	All

These three output modes are described as follows:

1. Image output

a) Gray image:

Y14: The default output is filtered data, set at [15:2], padded with zeros at two low bits.

Y10: AGC processed data, set at [15:6], padded with zeros at six low bits.

b) Color image:

The output format is YUV422 (16-bit/pixel), set as YU YV by default. Y is set at [7:0] and UV at bits[15:8].

2. Temperature output

Y14 output, set at [15:2], with the conversion equation:

$$\text{Temperature (°C)} = Y14/16 - 273.15$$

3. Temperature & image output（Take mini640 as an example）

Height1 = height2 = 512

Width=640

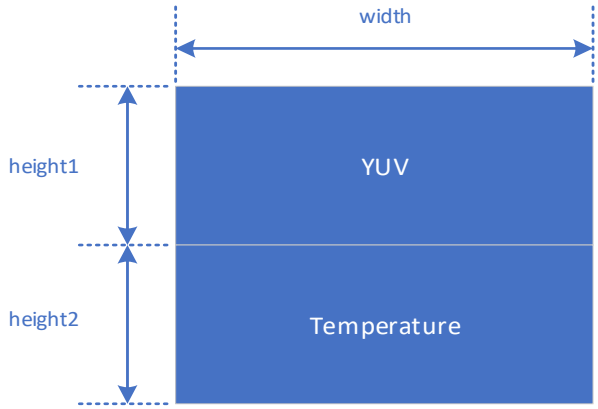


Figure 2 YUV and Temperature Output

6.2.2 Interface Definition

There are three interfaces: command interface, video interface, and other.

6.2.2.1CCI Command Interface

The CCI command interface has a standard I^2C and 400KHz clock, subject to the CCI protocol in the MIPI CSI-2.

6.2.2.2Video interface: DVP

DVP interface sequence transmission format of DVP interface (single channel/dual channel):

- Dual-channel (16Bit) transmission mode:

1) DATA0 is LSB, and DATA15 is MSB (if fewer than 16 bits, the data is set at high bits, padded with zero(s) at low bits)

2) Sequence Diagram

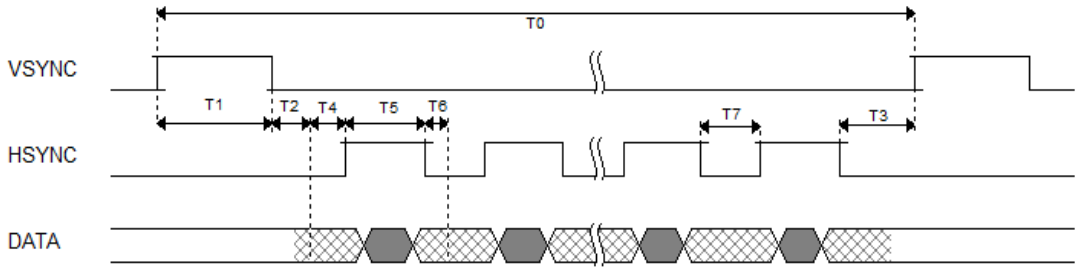


Figure 3

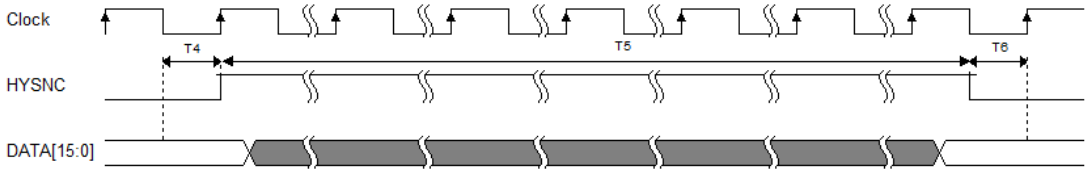


Figure 4

Table 6

Mode	Max frame rate	Timing
640*512	25fps	Clock: 18MHz T0: 719808 T1: 5216 T2: 20864 T3: 26744 T4: 65 T5: 640 T6: 599 T7: 664
384*288	25fps	Clock: 18MHz T0: 719632 T1: 8776 T2: 35104 T3: 45690 T4: 65 T5: 384 T6: 1745 T7: 1810

Table 7

Mode	Frame rate	Timing
640*512	50fps	Clock: 24MHz T0: 479136 T1: 3472 T2: 13888 T3: 17588 T4: 65 T5: 640 T6: 163 T7: 228
384*288	50fps	Clock: 18MHz

	T0: 599584 T1: 7312 T2: 29248 T3: 38004 T4: 65 T5: 384 T6: 1379 T7: 1444

Table 8

Mode	Frame rate	Timing
640*512	30fps	Clock: 18MHz T0: 599472 T1: 4344 T2: 17376 T3: 22166 T4: 65 T5: 640 T6: 381 T7: 446

- Single-channel (8Bit) transmission mode (using high 8bit pins of dual channels, i.e., DATA8~DATA15)

1) DATA8 is LSB, and DATA15 is MSB. Each pixel (16bit) needs to be transmitted in two clocks, the high 8 bits first, and then the low 8 bits. For example, the data received by 0x1234 is transmitted as [0x34] and [0x12].

2) Sequence diagram

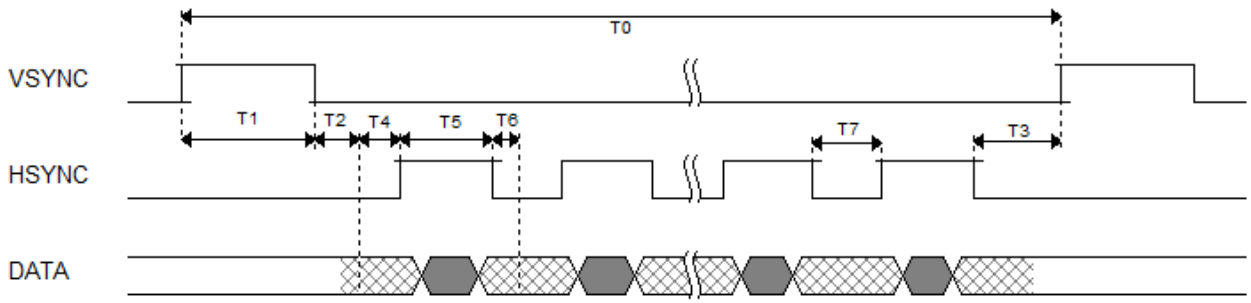


Figure 5

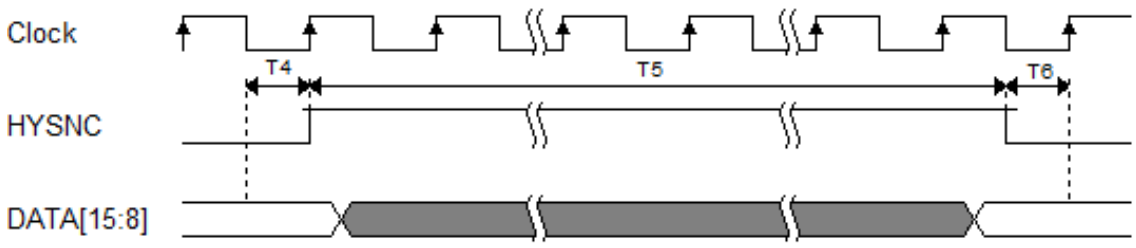


Figure 6

Table 9

Mode	Max frame rate	Timing
640*512	25fps	Clock: 24MHz T0: 959376 T1: 6952 T2: 27808 T3: 35218 T4: 129 T5: 1280 T6: 329 T7: 458
384*288	25fps	Clock: 18MHz T0: 719632 T1: 8776 T2: 35104 T3: 45306 T4: 129 T5: 768 T6: 1297 T7: 1426

Table 10

Mode	Frame rate	Timing
640*512	50fps	Clock: 45MHz T0: 899760 T1: 6520 T2: 26080 T3: 32950 T4: 129 T5: 1280 T6: 221 T7: 350
384*288	50fps	Clock: 18MHz

		T0: 599584 T1: 7312 T2: 29248 T3: 37491 T4: 129 T5: 768 T6: 931 T7: 1060

Table 11

Mode	Frame rate	Timing
640*512	30fps	Clock: 27MHz T0: 899760 T1: 6520 T2: 26080 T3: 32950 T4: 129 T5: 1280 T6: 221 T7: 350

Table 12

Mode	Frame rate	Timing
640*1024	30fps	Clock: 27MHz T0: 898016 T1: 3376 T2: 13504 T3: 20540 T4: 129 T5: 1280 T6: 3531 T7: 3660
384*288	30fps	Clock: 18MHz T0: 599584 T1: 7312 T2: 36689 T3: 37491 T4: 129 T5: 768 T6: 931 T7: 1030

Notes:

Due to the clock accuracy, there is a certain error between the total number of clocks calculated and the selected clock, and the error is a few ten thousandths, which is within a reasonable range.

(1) At the host side, the PixClk polarity is valid on the falling edge, i.e., the data sampling starts on the falling edge. However, for the thermal camera, it is valid on the rising edge, i.e., the data is transmitted on the rising edge.

(2) At the host side, the line synchronization signal is at a low level (the level signal at the end of one line), and the HSYNC signal is at a high level during data sampling.

(3) At the host side, the frame synchronization signal is at a high level (the level signal at the end of one frame) and the VSYNC signal is at a low level during data sampling.

DVP **Image Format**

- Gray image output

1) 14bit NUC data, subject to 16bit transmission, set at high 14 bits, padded with 2 zeros at low bits

2) 10bit DRC data, subject to 16bit transmission, set at high 10 bits, padded with 6 zeros at low bits

- Color image output (YUV422)

1) 16bitYUV data: YU YV by default, to be set as YV YU or UY VY or VY UY optionally.

6.2.3 Special Sequence Diagram

This section applies to the situations where the thermal camera power-on, power off, and forced updating need to be directly controlled by hardware on the client.

1. Power-on sequence

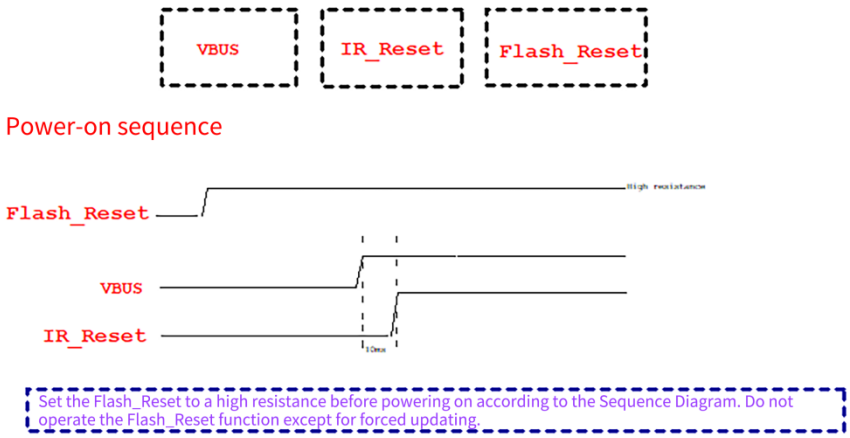


Figure 7 Power-on Sequence

2. Power-off sequence

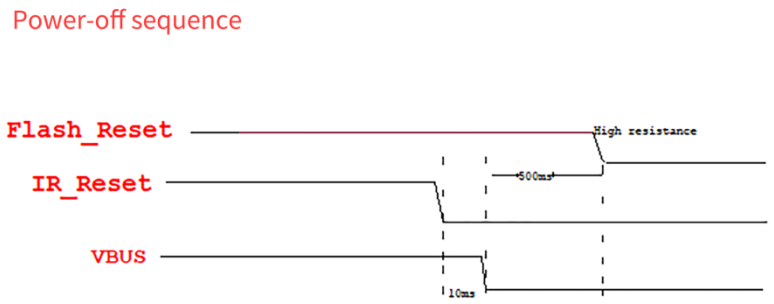


Figure 8 Power-off Sequence

3. Forced updating sequence

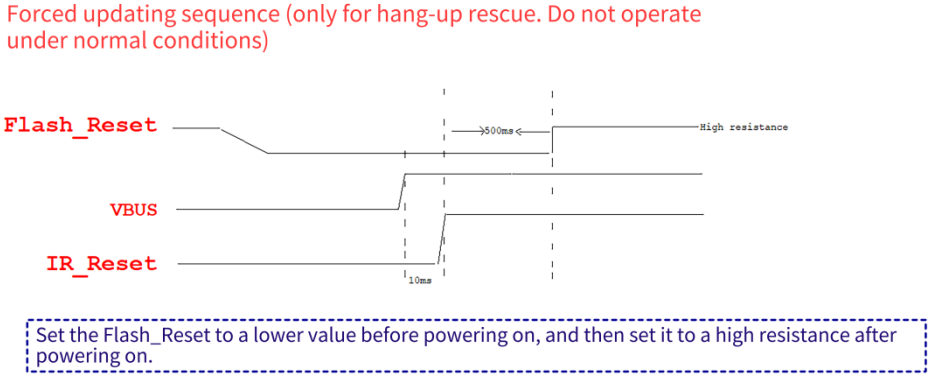


Figure 9 Forced Updating Sequence

6.2.4 Software Development

The SDKs and demonstration software as well as supporting drives are available.

1. SDK

SDKs provide imaging and control interfaces and infrared temperature algorithms, with Windows and Linux (including embedded systems) versions. There are libiruvc, libirtemp, libirparse, and libirprocess, as well as libirsample called from the aforesaid four libraries. For detailed descriptions, please refer to SDK User Manual.

Their functions are described as follows:

a. Libiruvc: For searching, connecting, and imaging of UVC camera, as well as sending proper image control commands.

b. Libirtemp: Parsing, processing, secondary correction, and other computing operations of temperature data.

c. Libirparse: Raw data slicing (temperature and image), and data format conversion, for example, between RGB and YUV.

d. Libirprocess: Additional processing algorithms, such as palette, mirror image flip, etc.

e. Libirsample: Example project. The main functions of the above four libraries are called to enable imaging, command sending, temperature measurement, etc.

Note:

Please provide compilation tools if specific embedded systems are to be supported.

2. Demonstration software

Falcon Application is a kind of upper computer software used to demonstrate the module effect, developed based on SDK library and QT, with Windows version only. It is connected via a USB cable, enabling the functions such as image display, image parameter adjustment, temperature measurement, palette mode switches, etc.

7. Module Assembly Drawing (9.1 mm lens, subject to the specific drawing provided by the salesperson)

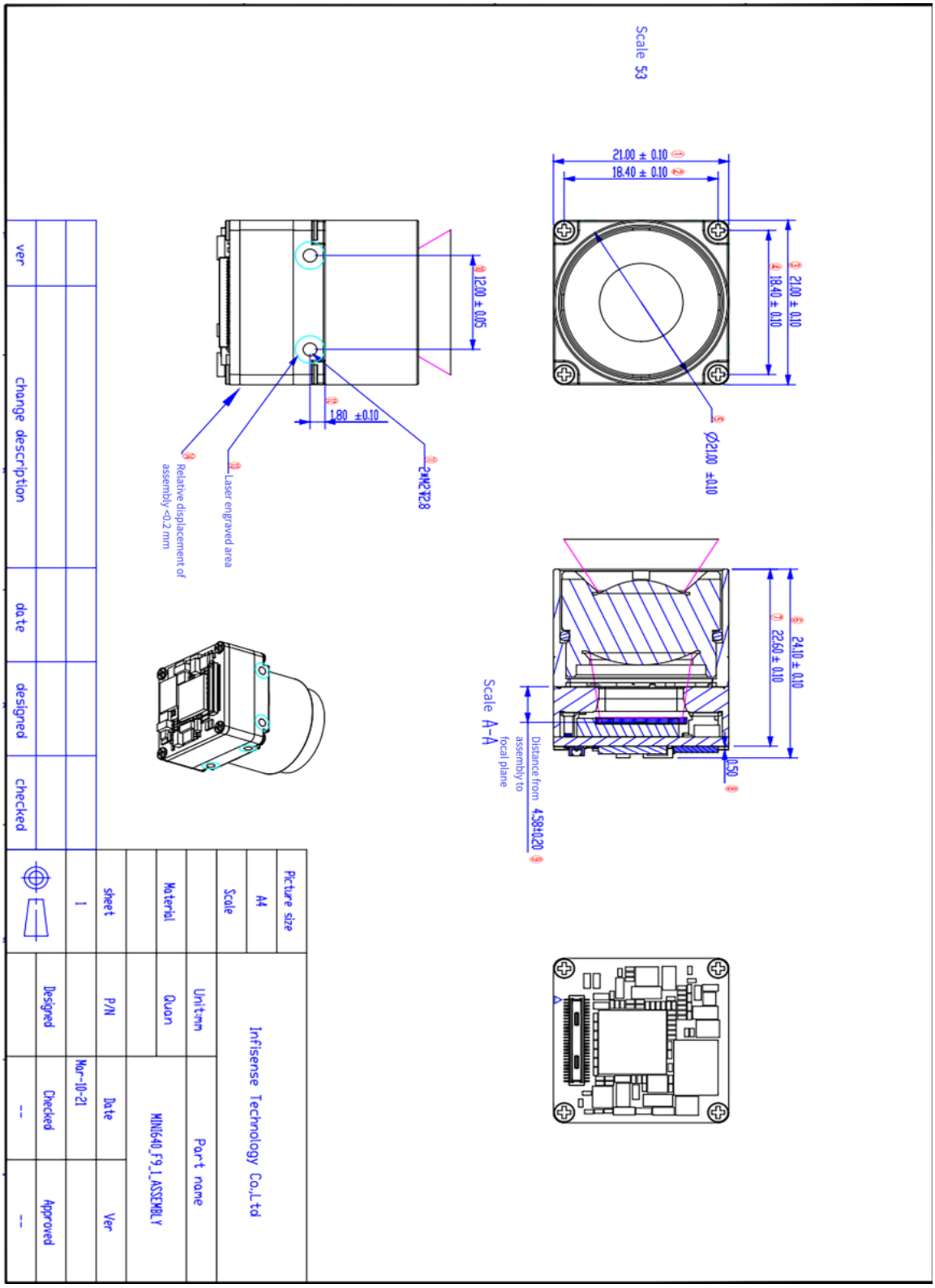


Figure 10 Standard Product

8. Precautions

To protect you and others from injury or to protect your device from damage, please read all the following information before using this device:

1. Do not expose the component to high-intensity sources such as the sun;
2. The ideal service ambient temperature is -40°C~80°C;
3. Do not touch the device or cables with wet hands;
4. Do not bend or damage the cables;
5. Do not scrub your device with diluent;
6. Do not unplug other cables before cutting off the power supply;
7. Do not connect the attached cables in the wrong way to avoid damaging the device;
8. Take measures to prevent static electricity;
9. Do not dismantle the device. If there is any fault, please contact us to have it repaired by professionals.

9. Supports and Services

9.1 Technical Support

1. User expansion components can be tailored to users' different application requirements.

9.2 After-sales Services

InfiSense provides excellent after-sales services such as device maintenance and repair for its self-developed **MINI** series uncooled thermal camera components. The warranty service lasts for one year. Please contact InfiSense if you have any requests.

10. Company Information

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