User Manual

D·MicroIR
Vision beyond Invisible

MD16U

Human Body Temperature Measurement Module

Rev. 1.0

Zhejiang DALI Technology Co.,Ltd.

Outline

1. Product Introduction

The MD16U human body temperature measurement thermal imaging module is developed by DALI manufactured uncooled microbolometer detectors. MD16U outputs data with a resolution of 120×322 in UVC mode. The pseudo-color image and the temperature image are spliced up and down and output at the same time. The upper 120×160 is the pseudo-color image, the lower 120×160 is the temperature data, and the last 2 lines of information output other information.

The module supplies power through the USB interface, communicates control and data output in UVC mode, and is easy to integrate with other application systems.

MD16U module can be connected to a computer for independent application, and is also suitable for integration with other human body temperature measurement and screening equipment: temperature measurement flat panel, temperature measurement gate, temperature measurement security gate, temperature measurement attendance machine, temperature measurement access control intercom and other equipment.

Picture .1: MD16T Module appearance

MD16U Features and Advantages:

- Integrated mini black body, high temperature measurement accuracy, stable performance, and small influence of working environment temperature.
- Full-frame human body temperature measurement: Each frame of image provides

160×120 temperature point data, suitable for various applications.

- UVC output to realize drive-free development
- Small size, convenient installation, universal single USB cable input and output
- Flexible application: users can perform personalized algorithm processing such as back-end image stretching and pseudo-color rendering.

Precautions for module use:：

- Use in strict accordance with the specified use conditions of the product, and the module needs to be used in an indoor no wind scene.
- When the system is used in integration, it is necessary to strengthen heat dissipation and ensure uniform and stable temperature around the module, and to be isolated from other cold/heat sources to avoid severe fluctuations in ambient temperature.
- Take care to protect the surface of the lens to avoid scratches and oil stains from hard objects.
- The module should not look directly at high temperature targets such as the sun to prevent high temperature burns to the detector.

2. Technical Specifications

The detailed technical parameters of MD16U is described as below：

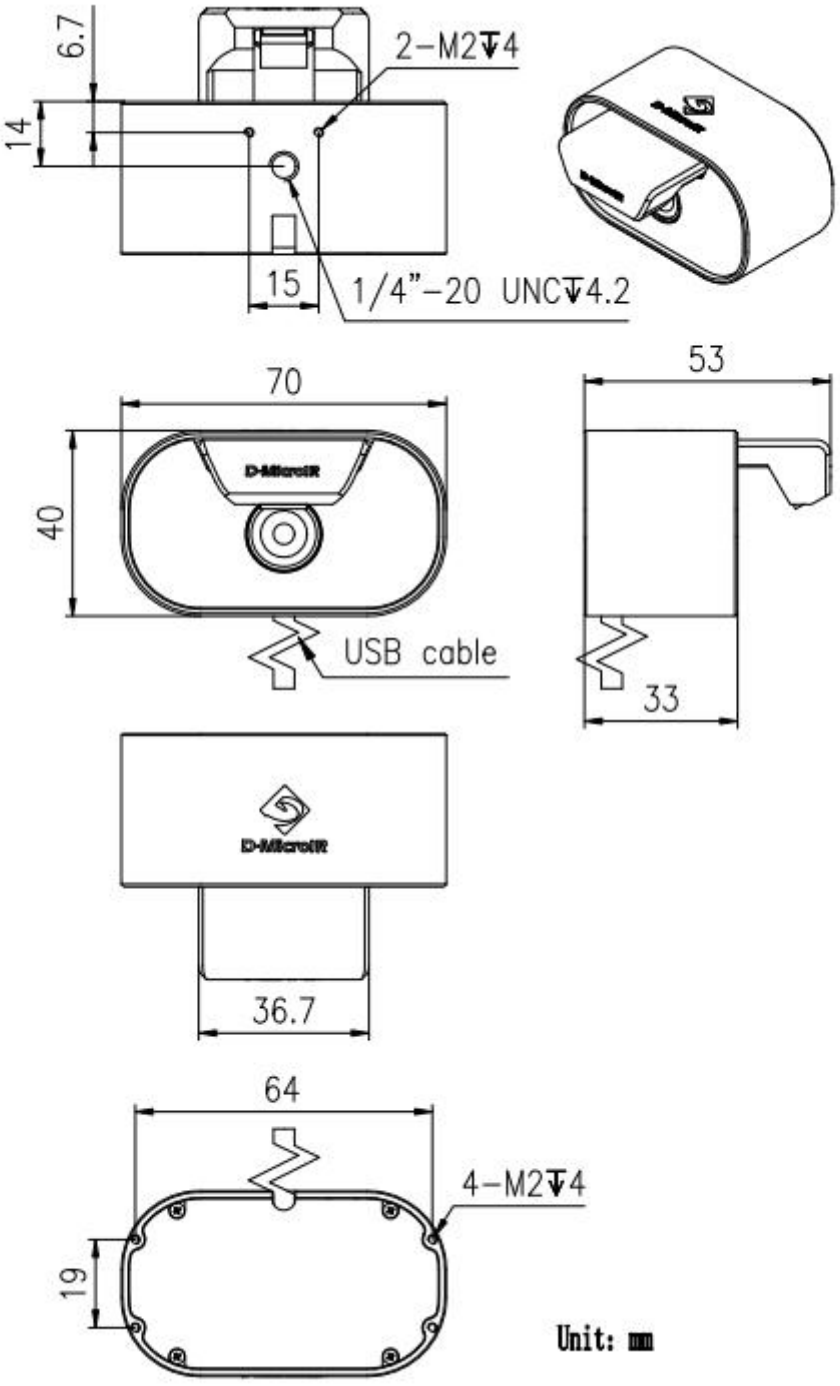
Table 1：Technical Parameters

Detector Type	Uncooled microbolometer array sensor
Resolution	160×120
Pixel Pitch	17um
Pixel Pitch	17um
NETD	≤60mK (F/1,300K,60Hz)
Frame Rate	≤12Hz（image and temp output at the same time） ≤14Hz（single image or temperature）
Image Calibration	Single point, two point, dead point replacement, etc., dynamic dead point correction, automatic gain and false color (can be turned off) are completed before leaving the factory
Output Interface	UVC
Control Interface	UVC
Temperature Range	30℃～40℃
Temperaure Accuracy	Inbuilt black body, ± 0.3°C (ambient temperature 20°C~30°C)/±0.5°C (ambient temperature 10°C~40°C)
Temperature Measurement Range	0.5m
Distance Calibration	Support
Human Body Temperature Calibration	Support surface temperature / human body internal temperature
Temperature Data Output	120×322（Image and temperature stitching up and down） 120×162(Gray value or temperature data)
Working voltage	DC 4.4V～5.5V
Power consumption	0.8W(room temperature steady state), peak 2.5W
Working Temp	10℃～40℃
Storage Temp	-40℃～60℃
Dimension	70mm×40mm×53mm
Install port	2 M2 threaded holes on the bottom, 1 1/4'-20UNC threaded hole, 4 M2 threaded holes on the back
Lens	Athermalized fixed focus infrared lens
Focus	f3.85mm/F1.0
FOV	29.7°×38.9°
PC Software	Provide Windows version PC software, can view images, temperature measurement, etc.

SDK	Provide SDK, including data receiving, sending, parsing, output mode switching, filtering algorithm switch, automatic gain switch, pseudo-color calling and distance correction interface

3. Mechanical Parameters

The dimensions of the module is shown in Picture 2(unit：mm)



Picture 2: Module dimension

4. Electrical Parameters

The module output interface is a USB Type-A male data cable, which works in USB2.0 mode.

Power requirements input range 4.4V ~ 5.5V, current greater than 500mA, more than 1A is recommended

5. Software protocol

The module is a UVC slave device with a VC interface and a VS interface inside. The VC interface is used for module control, and the VS interface is used for image and temperature data output.

Use the "contrast" adjustment command in the VC interface to issue control commands, upload module response information, and control the basic composition and format of transmission data packets as shown in Table 3.

Table 3: Packet format

No.	Definition	Bytes	Format
1	start byte	1	Fixed number: 0x6e
2	status code	1	0x00
3	reserved bit	1	0x00
4	script	1	As shown in Table 4
5	Data length (high order)	1	Indicates the length of number 9 data, see Table 4 "Data Length" column
6	Data length (low order)	1	
7	CRC1 (high order)	1	check code
8	CRC1 (low order)	1	
9	data	changeable	Actual data, sent in little-endian mode, with variable length
10	CRC2 (high order)	1	check code
11	CRC2 (low order)	1	

CRC1 check: CCITT-16 checksum is used, CRC-CCITT（0xFFFF）, that is CRC-16/CCITT-FALSE

a) The check operation is performed on the four parts of “No. 1”-“No. 6”.

b) The check is formed at the backend and is checked at the module side. If

the check fails, it needs to be retransmitted.

CRC2 check: CCITT-16 checksum is used, CRC-CCITT（0xFFFF）, that is CRC-16/CCITT-FALSE。

a) The check operation is performed on the six parts of “No. 1” - “No. 9”.

b) The check is formed at the backend and is checked at the module side. If the check fails, it needs to be retransmitted.

The table used for CRC1 and CRC2 check is shown in Appendix 1.

Table 4: Command

Code	Direction	Data	Length	Description
0x04	Serial down	0x00:Turn on single-point calibration (manual calibration) Example: 6e 00 00 04 00 01 1d 4a 00 00 00	1	Manual single point calibration
0x2a	Serial down	Auto Gain and Pseudo Color On Example: 6e 00 00 2a 00 02 b0 ee 02 00 66 62 Auto Gain and Pseudo Color Off Example: 6e 00 00 2a 00 02 b0 ee 02 01 76 43	2	Automatic gain and pseudo-color switch
	Serial down	The module temperature measurement data enables the human body compensation mode Example: 6e 00 00 2a 00 02 b0 ee 0c 00 45 6d The module temperature measurement data closes the human body compensation mode Example: 6e 00 00 2a 00 02 b0 ee 0c 01 55 4C	2	On/off state, it will take effect after the next shutter release, and it will be automatically saved in the module
0x84	Serial down	Parameter 1～2: The number of data packets of the upgrade file Example: 6e 00 00 84 00 02 16 73 05 00 ff f5	2	Notify the module to upgrade, and inform the number of data packages, Note 2

	Serial up	Parameter 1～2: Request the packet number of the next data packet, the packet number starts from 0 Example: 6e 00 00 84 00 02 16 73 00 00 00 00	2	The module responds with 0x00
	Serial down	Parameters 1 to 4: file length (sent in little endian mode) Parameters 5 to 6: CRC of the entire file (sent in little endian mode) Parameter 7～18: The modification time of the file (year, month, day, hour, minute) Parameters 19~30: The version number of the file (included in the file name) Parameter 31~50: reserved parameter, default 00. Example: 6e 00 00 84 00 32 20 20 04 e7 00 00 dc 35 32 30 32 31 30 38 32 34 31 32 31 39 5a 32 30 30 30 38 32 34 31 32 31 39 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 40 1f	50	Firmware file length, verification, file modification time, version number and other information.
	Serial up	Parameter 1~2: Request the packet number of the next data packet, the packet number starts from 1 Example: 6e 00 00 84 00 02 16 73 01 00 33 31	2	The module responds to the packet number 0x01; the next step starts to send the data packet of the file.
	Serial down	Parameter 1~2: the package number of the current package, starting from 1 Parameter 3~4: effective data length Parameter 5～: Valid data	≤12800	data pack
0x88	Serial down	switch to grayscale image Example: 6e 00 00 88 00 01 53 71 00 00 00 00 switch to temperagture image Example: 6e 00 00 88 00 01 53 71 01 10 21 00	1	switch to grayscale image and temperature image
0x8a	Serial down	0x00:Module reset restart Example: 6e 00 00 8a 00 01 3d 11 00 00 00	1	Module restart
0xa4	Serial down	Parameter 1: 02 Parameter:2～5: distance,Unit is centimeter, float type Example: 6e 00 00 a4 00 05 e0 52 02 00 00 a0 41 01 18	5	The example is 20.0cm, the float value is 41 a0 00 00, sent in little

				endian mode

Note 1 : The command packet is transmitted by using the "contrast" adjustment command of UVC. Only 2 bytes must be transmitted at a time. Therefore, when the length of the command packet (number of bytes) is not an even number, it needs to be filled with zeros at the end. Special attention should be paid to the high and low bits of the sending command. For example, the length (number of bytes) of the first 6e 00 00 04 00 01 1d 4a 00 00 00 is odd, and 0 should be added to 6e 00 00 04 00 01 1d 4a 00 00 00 00 , the module needs to receive the information in this order. If it is sent from a computer, the computer transmits the problem of size end, and the content that needs to be sent on the computer is as follows

0x6e 0x00;

0x00 0x04;

0x00 0x01;

0x1d 0x4a;

0x00 0x00;

0x00 0x00;

```
23.0   OUT    6e 00                                    n.                  1.2.0
23.0   CTL    21 01 00 03  00 03 02 00                 SET CUR             2.1.0
23.0   OUT    00 04                                    ..                  2.2.0
23.0   CTL    21 01 00 03  00 03 02 00                 SET CUR             3.1.0
23.0   OUT    00 01                                    ..                  3.2.0
23.0   CTL    21 01 00 03  00 03 02 00                 SET CUR             4.1.0
23.0   OUT    1d 4a                                    .J                  4.2.0
23.0   CTL    21 01 00 03  00 03 02 00                 SET CUR             5.1.0(2)
23.0   OUT    00 00                                    ..                  5.2.0
```

Note 2; Firmware Upgrade Instructions

The firmware data is sent to upgrade through UVC instruction, and 0x84 is used. The process is:

A. Send the 0x84 downlink command for the first time, notify the module to enter the firmware upgrade state, and inform the firmware of the number of data packets (Byte), the module responds to the 0x84 command and returns 0x00, indicating that it is ready;

B. Send the 0x84 downlink command for the second time to notify the module of the total length, check code, modification time and version number of the firmware file to be upgraded. The module responds with 0x01, indicating that the packet

number of the first data packet is requested, starting from 1;

C. Next, divide the firmware size into multiple packages by 12796Byte each time, each package is accompanied by the package number and length of the current package, and send all firmware data in turn through the 0x84 command. Note that CRC2 needs to be calculated correctly, and the modulo Each time the group receives a 0x84 firmware data packet, it will return a 0x84 response command to notify the upper computer that the reception is completed and request the packet number of the next data packet. If there is no 0x84 response, the current packet needs to be resent. The last data packet may be less than 12800Byte in length, and it is sent according to the actual data length.

6. UVC Output

The module is a UVC slave device, and the VS interface is used for data transmission. When outputting data, the format is YUYV, and the size of each pixel is 2Byte.

The default state of the module is to output pseudo-color image and temperature image at the same time, and the output resolution is 120×322. Lines 1 to 160 are pseudo-color images, lines 161 to 320 are temperature data, and the last two lines are status information.

The module can also be switched to output only pseudo-color image data, or only output temperature data, the output resolution is 120×162, the first row to the 160th row is pseudo-color image data, or temperature data, and the last two rows are status information.

When acquiring data, the data is first read in the YUYV method, the pseudo-color image data is directly converted to RGB output, and the temperature data is converted to grayscale. The conversion relationship between the temperature measurement value Tc (°C) of the detection target and the grayscale value Vc (grayscale) of the temperature data is:

Tc= Vc/10–273;

In the output data, the last two lines are used to display the status information, and the information of each part is shown in Table 5. The information of the two lines of status bits, the starting position is at the position of 0 point of the last two lines, after outputting the data of the previous array, the next 12Byte is the detector type. That is, Table 5 is output in order from the 0-point position of the last two lines.

Table 5: Information Format

Name		No(Byte)	Remark
Module Info	Detector type	12	Example: DM1716A 1st byte ~ 12th byte on line 321
	Detector number	12	Example: P2235A 12th byte~24th byte
	Firmware version number	12	Example: C20210081556 25th byte~36th byte
	bootloader version	12	37th byte~48th byte
	Module model	12	Example: MD16U 49th byte~60th byte
	reserved	12	61th byte~72th byte
Shutter grayscale		2	91th byte~92th byte
TOUT gray value		2	93th byte~94th byte
Center point information		12	Row coordinate (UINT16) starts at byte 105 column coordinates (UINT16) temperature (float) Grayscale (UINT32)
Highest point information		12	Row coordinate (UINT16) starts at byte 117 column coordinates (UINT16)

		temperature (float) Grayscale (UINT32)
Lowest point information	12	Row coordinate (UINT16) starts at byte 129 column coordinates (UINT16) temperature (float) Grayscale (UINT32)
any point information	12	Row coordinate (UINT16) starts at byte 141 column coordinates (UINT16) temperature (float) Grayscale (UINT32)

Note 1: TOUT gray value, shutter gray value, center point information, highest point information and lowest point information are all in little-endian mode.

Note 2: The conversion relationship between the internal temperature of the detector Ts (°C) and the module TOUT gray value Vs (gray) is:

$Ts = 190.64 - 0.02164 \times Vs$

(The following page is Appendix 1)

Appendix 1:

CRC checklist

Item	CRC value	Item	CRC value	Item	CRC value	Item	CRC value
0x00	0x0000	0x40	0x48c4	0x80	0x9188	0xc0	0xd94c
0x01	0x1021	0x41	0x58e5	0x81	0x81a9	0xc1	0xc96d
0x02	0x2042	0x42	0x6886	0x82	0xb1ca	0xc2	0xf90e
0x03	0x3063	0x43	0x78a7	0x83	0xa1eb	0xc3	0xe92f
0x04	0x4084	0x44	0x0840	0x84	0xd10c	0xc4	0x99c8
0x05	0x50a5	0x45	0x1861	0x85	0xc12d	0xc5	0x89e9
0x06	0x60c6	0x46	0x2802	0x86	0xf14e	0xc6	0xb98a
0x07	0x70e7	0x47	0x3823	0x87	0xe16f	0xc7	0xa9ab
0x08	0x8108	0x48	0xc9cc	0x88	0x1080	0xc8	0x5844
0x09	0x9129	0x49	0xd9ed	0x89	0x00a1	0xc9	0x4865
0x0a	0xa14a	0x4a	0xe98e	0x8a	0x30c2	0xca	0x7806
0x0b	0xb16b	0x4b	0xf9af	0x8b	0x20e3	0xcb	0x6827
0x0c	0xc18c	0x4c	0x8948	0x8c	0x5004	0xcc	0x18c0
0x0d	0xd1ad	0x4d	0x9969	0x8d	0x4025	0xcd	0x08e1
0x0e	0xe1ce	0x4e	0xa90a	0x8e	0x7046	0xce	0x3882
0x0f	0xf1ef	0x4f	0xb92b	0x8f	0x6067	0xcf	0x28a3
0x10	0x1231	0x50	0x5af5	0x90	0x83b9	0xd0	0xcb7d
0x11	0x0210	0x51	0x4ad4	0x91	0x9398	0xd1	0xdb5c
0x12	0x3273	0x52	0x7ab7	0x92	0xa3fb	0xd2	0xeb3f
0x13	0x2252	0x53	0x6a96	0x93	0xb3da	0xd3	0xfb1e
0x14	0x52b5	0x54	0x1a71	0x94	0xc33d	0xd4	0x8bf9
0x15	0x4294	0x55	0x0a50	0x95	0xd31c	0xd5	0x9bd8
0x16	0x72f7	0x56	0x3a33	0x96	0xe37f	0xd6	0xabbb
0x17	0x62d6	0x57	0x2a12	0x97	0xf35e	0xd7	0xbb9a
0x18	0x9339	0x58	0xdbfd	0x98	0x02b1	0xd8	0x4a75
0x19	0x8318	0x59	0xcbdc	0x99	0x1290	0xd9	0x5a54
0x1a	0xb37b	0x5a	0xfbbf	0x9a	0x22f3	0xda	0x6a37
0x1b	0xa35a	0x5b	0xeb9e	0x9b	0x32d2	0xdb	0x7a16
0x1c	0xd3bd	0x5c	0x9b79	0x9c	0x4235	0xdc	0x0af1
0x1d	0xc39c	0x5d	0x8b58	0x9d	0x5214	0xdd	0x1ad0
0x1e	0xf3ff	0x5e	0xbb3b	0x9e	0x6277	0xde	0x2ab3
0x1f	0xe3de	0x5f	0xab1a	0x9f	0x7256	0xdf	0x3a92
0x20	0x2462	0x60	0x6ca6	0xa0	0xb5ea	0xe0	0xfd2e
0x21	0x3443	0x61	0x7c87	0xa1	0xa5cb	0xe1	0xed0f
0x22	0x0420	0x62	0x4ce4	0xa2	0x95a8	0xe2	0xdd6c
0x23	0x1401	0x63	0x5cc5	0xa3	0x8589	0xe3	0xcd4d

0x24	0x64e6	0x64	0x2c22	0xa4	0xf56e	0xe4	0xbdaa
0x25	0x74c7	0x65	0x3c03	0xa5	0xe54f	0xe5	0xad8b
0x26	0x44a4	0x66	0x0c60	0xa6	0xd52c	0xe6	0x9de8
0x27	0x5485	0x67	0x1c41	0xa7	0xc50d	0xe7	0x8dc9
0x28	0xa56a	0x68	0xedae	0xa8	0x34e2	0xe8	0x7c26
0x29	0xb54b	0x69	0xfd8f	0xa9	0x24c3	0xe9	0x6c07
0x2a	0x8528	0x6a	0xcdec	0xaa	0x14a0	0xea	0x5c64
0x2b	0x9509	0x6b	0xddcd	0xab	0x0481	0xeb	0x4c45
0x2c	0xe5ee	0x6c	0xad2a	0xac	0x7466	0xec	0x3ca2
0x2d	0xf5cf	0x6d	0xbd0b	0xad	0x6447	0xed	0x2c83
0x2e	0xc5ac	0x6e	0x8d68	0xae	0x5424	0xee	0x1ce0
0x2f	0xd58d	0x6f	0x9d49	0xaf	0x4405	0xef	0x0cc1
0x30	0x3653	0x70	0x7e97	0xb0	0xa7db	0xf0	0xef1f
0x31	0x2672	0x71	0x6eb6	0xb1	0xb7fa	0xf1	0xff3e
0x32	0x1611	0x72	0x5ed5	0xb2	0x8799	0xf2	0xcf5d
0x33	0x0630	0x73	0x4ef4	0xb3	0x97b8	0xf3	0xdf7c
0x34	0x76d7	0x74	0x3e13	0xb4	0xe75f	0xf4	0xaf9b
0x35	0x66f6	0x75	0x2e32	0xb5	0xf77e	0xf5	0xbfba
0x36	0x5695	0x76	0x1e51	0xb6	0xc71d	0xf6	0x8fd9
0x37	0x46b4	0x77	0x0e70	0xb7	0xd73c	0xf7	0x9ff8
0x38	0xb75b	0x78	0xff9f	0xb8	0x26d3	0xf8	0x6e17
0x39	0xa77a	0x79	0xefbe	0xb9	0x36f2	0xf9	0x7e36
0x3a	0x9719	0x7a	0xdfdd	0xba	0x0691	0xfa	0x4e55
0x3b	0x8738	0x7b	0xcffc	0xbb	0x16b0	0xfb	0x5e74
0x3c	0xf7df	0x7c	0xbf1b	0xbc	0x6657	0xfc	0x2e93
0x3d	0xe7fe	0x7d	0xaf3a	0xbd	0x7676	0xfd	0x3eb2
0x3e	0xd79d	0x7e	0x9f59	0xbe	0x4615	0xfe	0x0ed1
0x3f	0xc7bc	0x7f	0x8f78	0xbf	0x5634	0xff	0x1ef0

The initial value of CRC is 0xFFFF.

Note: CRC does not directly check the table in Appendix 1, but is calculated according to the algorithm. The table in Appendix 1 is the table called during the calculation process. This table is used in the CRC algorithm source code.。

The CRC check algorithm of the module is CRC-CCITT (0xFFFF), namely CRC-16/CCITT-FALSE