L384

Uncooled Thermal Imaging Module

Operating Commands User Manual

V1.0.1

Version History

Version	Date	Description
V1.0.0	2024-08	Initial release
V1.0.1	2024-09	modify some information

Contents

1. Serial Port Settings

Table1 Serial Port Settings

Baud Rate	Trans-format			Parity Check
	Data bits	Start Bits	Stop Bits	
115200bps	8	1	1	none

***Note**: Start transmission from the Least Significant Bit (LSB) of each byte.*

2. Command and Message Format of the Thermal Imaging Core

2.1 Receive Command Format of the Thermal Imaging Core

Table2 Receive Command Format of the Thermal Imaging Core (Take Read FPA temperature as an example)

Command Head	Byte Count	CW0	CW1	OW	PRM1	PRM2	…	PRM N	Check Bit	Command Tail	
		Command Body									
0xAA	0x04	0x01	0xC3	0x00	none	none	none	none	0x72	0xEB	0xAA

Note：

(1) All the format values described in Table2 are hexadecimal bytes;

(2) SC value is the sum of all the bytes before the Check Bit byte divided by 256;

(3) The command and parameter information are described from Table5 to Table8;

(4) The command body byte count is the number of valid bytes from CW0 to Check Bit;

(5) The command head is fixed to 0xAA, and the command tail is fixed to 0xEB and 0xAA;

2.2 Status Information Format of the Thermal Imaging Core

Table3 Status Information Format of the Thermal Imaging Core (Take *Read FPA temperature* as an example)

Command head	Byte count	CW1	OW	RV	RV	…	RV	Check Bit	Command tail	
		Command body								
0x55	0x05	0xC3	0x33	0xCB	0x11	none	none	0x2C	0xEB	0xAA

Note:

(1) Status information reflects command execution result;

(2) CW and RV are described from Table5 to Table9. For the RV, the lower bit is in the front, as Decimal 4725 is the hexadecimal number of 0x11CB, so the RV is 0xCB by 0x11;

(3) Byte count is the number of process body bytes;

(4) The OW (operation word) is fixed to 0x33;

(5) The process start is fixed to 0x55;

(6) The process end is fixed to 0xEB and 0xAA.

If two bytes of command words are 0xFF and the only one RV (returned value) is one of the values shown in Table 4, the command is error. Users can search for the cause of error by consulting Table 4.

Table4 Error list of RV

Returned value	Cause of Error
0xFB	No CW
0xFD	The DRC check bit error

2.3 The Receiving Command and Status Information

Table5 Settings Menu

Settings						
CW0	**CW1**	**Meaning**	**OW**	**PRM Byte**	**PRM**	**RV Bytes Count**
0x01	0x00	Shutter Enabled/Disabled	0x01	1	00:Enabled 80:Disabled	1
0x01	0x01	Auto NUC	0x01	1	0x00: off 0x01: on	1
0x01	0x02	NUC	0x02	2	Parameter 1: The lower four bits represent the correction type: 0: Background correction 1: Bistable 4: Monostable The upper four bits : 0: Perform both NUC and offset correction 4: Perform only offset correction 8: Perform only NUC correction C: Do neither NUC nor offset correction Parameter 2: 01: Shutter correction while	1

Settings						
					maintaining shutter state 02: Background correction while maintaining shutter state	
0x01	0x03	Set time interval of auto NUC	0x01	1	0~255 minutes	1
0x01	0x04	Set temp interval of auto NUC	0x01	1	0.0~25.5 ℃ (0.1℃/cnt)	1
0x01	0xC3	Read FPA temp.	0x00	0	The return value is in little-endian mode. The actual temperature value is the return value divided by 100. If the value is negative, the temperature is returned in two's complement form.	2
0x01	0x7C	Read core temp.	0x00	0	The return value is in little-endian mode. The actual temperature value is the return value divided by 100. If the value is negative, the temperature is returned in two's complement form.	2
0x01	0x7F	Save settings	0x02	0	none	1
0x01	0x82	Recovery default settings	0x02	0	00: Restore public only 01: Restore all	1

Table6 Video Menu

Video						
CW0	**CW1**	**Meaning**	**OW**	**PRM Byte**	**PRM**	**RV Bytes Count**
0x01	0x44	Move reticle position	0x02	1	Bit 7 = 0: Small step size Bit 7 = 1: Large step size 0x06 / 0x86: Move up 0x07 / 0x87: Move down 0x08 / 0x88: Move left 0x09 / 0x89: Move right	1
				5	Parameter 1: 0x05 indicates directly setting the reticle coordinates Parameter 2: Lower byte of X-axis coordinate	1

Video						
					Parameter 3: Upper byte of X-axis coordinate Parameter 4: Lower byte of Y-axis coordinate Parameter 5: Upper byte of Y-axis coordinate	
		Read reticle position	0x00	0	None	4
0x01	0x43	Set reticle display	0x02	1	C1: Defective pixel reticle on 40: Defective pixel reticle off 00: User reticle off 80: Style 1 81: Style 2 and so on	1
0x01	0x5D	Select digital video	0x02	2	0x00 0x00: off 0x02 0x00: LVCOMS 0x03 0x00: LVDS 0x04 0x00: BT656 0x05 0x00: BT1120 0x05 0x80: CDS_2	1
0x01	0x5C	Select digital video source	0x01	1	0x00: ORG 0x01: NUC 0x02: DRC 0x04: TEMP 0x05: DNS	1
0x01	0x4C	Image Flip	0x01	1	0x01: no flip 0x02: Horizontal 0x04: Vertical 0x08: Horizontal &Vertical	1
0x01	0x40	Digital Zoom	0x02	8	Parameter 1: Lower byte of top-left X coordinate Parameter 2: Upper byte of top-left X coordinate Parameter 3: Lower byte of top-left Y coordinate Parameter 4: Upper byte of top-left Y coordinate Parameter 5: Lower byte of bottom-right X coordinate Parameter 6: Upper byte of bottom-right X coordinate Parameter 7: Lower byte of bottom-right Y coordinate Parameter 8: Upper byte of	1

Video						
					bottom-right Y coordinate For detailed calculation methods, refer to the appendix.	
0x01	0x3D	CVBS video on/off	0x02	1	0x00: off 0x01: on	1
0x01	0x3E	Video freeze	0x02	1	0x00: off 0x01: on	1
0x01	0x42	Color Palettes	0x02	1	0x00:WhiteHot (by default) 0x01: BlackHot 0x02: Rainbow 0x03: Rainbow HC 0x04: Iron 0x05: lava 0x06: sky 0x07: mid-gray 0x08: red gray 0x09: purple orange 0x0A: special 1 0x0B: warning red 0x0c: ice fire 0x0d: blue red 0x0E: special 2 0x0F: gradient red 0x10: gradient green 0x11: gradient yellow 0x12: warning green 0x13: warning blue	1
0x01	0x4B	Set threshold of warning color	01	2	PRM1: Threshold value PRM2: 0x00 warning red; 0x01warning green; 0x02 warning blue	1
0x01	0x19	Set DDE class	01	1	0x00: manual 0x01: Class0 0x02: Class1 0x03: Class2 0x04: Class3 0x05: Class4 0x06: Class5 0x07: Class6 0x08: Class7 0x09: Class8 0x0A: Class9	1

Table7 Advance settings

Advance settings						
CW0	**CW1**	**Meaning**	**OW**	**PRM Bytes**	**PRM**	**RV Byte Count**
0x01	0x77	Baud rate	0x02	1	0x01:Auto 0x02: 9600 0x04:19200 0x08: 38400 0x10:115200 0x20:921600 0x40:57600	1

Table 8 Functional Menu of Temperature Measurement Parameters

Temperature Measurement Parameters						
CW0	**CW1**	**Meaning**	**OW**	**PRM Byte Count**	**PRM**	**RV Byte Count**
0x07	0x01	Select Temperature Measurement Range	0x01	1	0x00: high gain 0x01: low gain 0x03: auto	1
0x07	0x02	Temperature unit	0x01	1	0x00: Celsius 0x01: Kelvin 0x02: Fahrenheit	1
0x07	0x05	Read low-high gain threshold	0x00	1	0x00	2
		Set low-high gain threshold	0x01	2	Threshold=parameter/10, low bit in front	1
0x07	0x06	Read low-high gain percentage	0x00	1	0x00	3
		Set low-high gain percentage	0x01	1	Percentage=parameter/100	1
0x07	0x07	Read high-low gain threshold	0x00	1	0x00	2
		Set high-low gain threshold	0x01	2	Threshold=parameter/10, low bit in front	1
0x07	0x08	Read high-low gain percentage	0x00	1	0x00	3
		Set high-low gain percentage	0x01	1	Percentage=parameter/100	1

Temperature Measurement Parameters						
0x07	0x0f	Read reflected temperature	0x00	1	0x00	4
		Set reflected temperature	0x01	4	Temperature=parameter/10000 low bit in front	1
0x07	0x10	Read atmospheric temperature	0x00	1	0x00	4
		Set atmospheric temperature	0x01	4	Temperature=parameter/10000, low bit in front	1
0x07	0x11	Read atmospheric transmissivity	0x00	1	0x00	4
		Set atmospheric transmissivity	0x01	4	Transmissivity=parameter/10000, low bit in front	1
0x07	0x12	Read emissivity	0x00	1	0x00	4
		Set emissivity	0x01	4	Emissivity=parameter/10000, low bit in front	1
0x07	0x13	Read distance	0x00	1	0x00	4
		Set distance	0x01	4	Distance=parameter/10000, low bit in front	1
0x07	0x18	Environmental variable enable	0x01	1	0x00	1

Table 9 Menu of Full Frame Temperature Measurement

Full Frame Temperature Measurement						
CW0	**CW1**	**Meaning**	**OW**	**PRM Byte Count**	**PRM**	**Returned Byte Count**
0x07	0xf0	Temperature scale on/off	0x01	1	0x00: off 0x01: on	1
0x07	0x1d	Write low temperature threshold of temperature scale	0x01	4	Threshold=PRM/10000 low bit in front	1
		Read low temperature threshold of temperature scale	0x00	1	0x00	4
0x07	0x1e	Write high temperature threshold	0x01	4	Threshold=PRM/10000 low bit in front	1

Full Frame Temperature Measurement						
		of temperature scale				
		Read high temperature threshold of temperature scale	0x00	1	0x00	4

Table 10 Menu of Calibration Function

Calibration						
CW0	**CW1**	**Meaning**	**OW**	**PRM Bytes**	**PRM**	**RV Byte Count**
0x07	0x6E	Secondary Calibration (single point)	0x02	2	Temp=RPM	1
0x07	0x6F	Secondary Calibration (two points)	0x02	2	Temp=RPM	1
0x07	0x6A	Secondary Calibration enable and save	0x02	1	0x00	1
0x07	0x6B	Secondary Calibration Clear	0x02	1	0x00	1

Appendix 1 Commands List

Commands		The incoming message	Remark
NUC	Receive	AA 05 01 11 02 **00** C3 EB AA (background correction) AA 05 01 11 02 **01** C4 EB AA (shutter correction)	No matter Auto NUC on or off, send background correction or shutter correction command to perform manual NUC.
	Return	55 04 11 33 01 9E EB AA	
Auto NUC	Receive	AA 05 01 01 01 **01** B3 EB AA (on) AA 05 01 01 01 **00** B2 EB AA (off)	
	Return	55 04 01 33 01 8E EB AA	
Read FPA Temp.	Receive	AA 04 01 C3 00 72 EB AA	For example: If the readout temp. is 47.55℃, the returned value is 47.55×100℃, that is 4755 in decimal, low byte returns first. If the temp. is below 0℃, the value will be returned as the complement code of current temp.
	Return	55 05 C3 33 **CB 11** 2C EB AA	
Read core temp.	Receive	AA 04 01 7C 00 2B EB AA	For example: If the readout temp. is 47.55℃, the returned value is 47.55×100℃, that is 4755 in decimal, low byte returns first. If the temp. is below 0℃, the value will be returned as the complement code of current temp.
	Return	55 05 7C 33 **75 12** 90 EB AA	
Save settings	Receive	AA 04 01 7F 02 30 EB AA	
	Return	55 04 7F 33 01 0C EB AA	
Restore to default settings	Receive	AA 05 01 82 02 00 34 EB AA	
	Return	55 04 82 33 01 0F EB AA	
Auto NUC interval time	Receive	AA 05 01 03 01 **0A** BE EB AA	For example: The interval time is 10 minutes (accurate to 1minute) of PRM is 0x0A. When auto NUC is enabled, the shutter correction interval can be set. For example, if the
	Return	55 04 03 33 01 90 EB AA	

Commands		The incoming message	Remark
			time interval is 10 min., then the sent parameter is 0x0A(the set accuracy is 1 minute).
Auto NUC interval temp.	Receive	AA 05 01 04 01 **0F** C4 EB AA	When the Auto NUC is enabled, temperature interval of shutter correction can be set. For example: 0x0F means the interval temp is 25/10 =1.5℃
	Return	55 04 04 33 01 91 EB AA	
Color Palettes	Receive	(WH) AA 05 01 42 02 **00** F4 EB AA (BH) AA 05 01 42 02 **01** F5 EB AA (Rainbow) AA 05 01 42 02 02 F6 EB AA (Rainbow HC) AA 05 01 42 02 **03** F7 EB AA (Iron) AA 05 01 42 02 **04** F8 EB AA (Lava) AA 05 01 42 02 **05** F9 EB AA (Sky) AA 05 01 42 02 **06** FA EB AA (Medium Gray) AA 05 01 42 02 **07** FB EB AA (Gray-red) AA 05 01 42 02 **08** FC EB AA (Purple orange) AA 05 01 42 02 **09** FD ED AA (Special 1) AA 05 01 42 02 **0A** FE EB AA (warning red) AA 05 01 42 02 **0B** FF EB AA (Ice fire) AA 05 01 42 02 **0C** 00 EB AA (cyan-red) AA 05 01 42 02 **0D** 01 EB AA (Special 2) AA 05 01 42 02 **0E** 02 EB AA (Gradient red) AA 05 01 42 02 **0F** 03 EB AA (Gradient green) AA 05 01 42 02 **10** 04 EB AA (Gradient blue) AA 05 01 42 02 **11** 05 EB AA (alarm green) AA 05 01 42 02 **12** 06 EB AA (alarm blue) AA 05 01 42 02 **13** 07 EB AA	
	Return	55 04 42 33 01 CF EB AA	

Commands		The incoming message	Remark
Set the threshold of warning color	Receive	(warning red, 0xF0 = 240) AA 06 01 4B 01 **F0 00** ED EB AA (warning green, 0xF0 = 240) AA 06 01 4B 01 **F0 01** EE EB AA (warning blue, 0x14 = 20) AA 06 01 4B 01 **14 02** 13 EB AA	0x00: warning red 0x01: warning green 0x02: warning blue
	Return	55 04 4B 33 01 D8 EB AA	
Select digital video source	Receive	(ORG) AA 05 01 5C 01 **00** 0D EB AA (NUC) AA 05 01 5C 01 **01** 0E EB AA (DRC) AA 05 01 5C 01 **02** 0F EB AA (TEMP) AA 05 01 5C 01 **04** 11 EB AA (DNS) AA 05 01 5C 01 **05** 12 EB AA	
	Return	55 04 5C 33 01 E9 EB AA	
Read digital video source	Receive	AA 04 01 5C 00 0B EB AA	00: ORG 01: NUC 02: DRC 04: TEMP 05: DNS
	Return	55 04 5C 33 **02** EA EB AA	
Set digital video interface	Receive	(LVDS) AA 06 01 5D 02 **03 00** 13 EB AA (LVCOMS) AA 06 01 5D 02 **02 00** 12 EB AA (BT.656) AA 06 01 5D 02 **04 00** 14 EB AA (BT.1120) AA 06 01 5D 02 **05 00** 15 EB AA (CDS_2) AA 06 01 5D 02 **05 80** 95 EB AA (Off) AA 06 01 5D 02 **00 00** 10 EB AA	BT656, BT1120 and CDS-2 only supports DRC data source.
	Return	55 04 5D 33 01 EA EB AA	
Digital Zoom	Receive	1.0 × AA 0C 01 40 02 **00 00 00 00 7F 01 1F 01** 99 EB AA 2.0 × AA 0C 01 40 02 **60 00 48 00 1F 01 D700** 98 EB AA 3.0 × AA 0C 01 40 02 **80 00 60 00 FF 00 BF00** 97 EB AA 4.0 × AA 0C 01 40 02 **90 00 6C 00 EF 00 B3 00** 97 EB AA 5.0 × AA 0C 01 40 02 **9A 00 74 00 DF 00 AC 00** 92 EB AA 6.0 × AA 0C 01 40 02 **A0 00 78 00 DF 00 A7 00** 97 EB AA 7.0 × AA 0C 01 40 02 **A5 00 7C 00 D B 00 A4 00** 99 EB AA	If the width of the detector array is W and the height is H, with a preset magnification factor of m (accurate to one decimal place), then the top-left corner coordinates $X = \frac{W}{2} - \frac{W}{2 \cdot m}$ $Y = \frac{H}{2} - \frac{H}{2 \cdot m}$

Commands		The incoming message	Remark
		8.0 × AA 0C 01 40 02 **A8 00 7E 00 D7 00 A1 00** 97 EB AA	Bottom-right corner coordinates $X = \frac{W}{2} + \frac{W-1}{2 \cdot m}$ $Y = \frac{H}{2} + \frac{H-1}{2 \cdot m}$ The left-side command uses 384x288 as an example. Similarly, fractional commands can be derived.
	Return	55 04 40 33 01 CD EB AA	
Image flip	Receive	(No flip)AA 05 01 4C 01 **01** FE EB AA (Horizontal)AA 05 01 4C 01 **02** FF EB AA (Vertical)AA 05 01 4C 01 **04** 01 EB AA (Mirror)AA 05 01 4C 01 **08** 05 EB AA	
	Return	55 04 4C 33 01 D9 EB AA	
SN Query	Receive	AA 04 01 71 00 20 EB AA	
	Return	55 17 71 33 42 30 33 35 30 30 33 33 00 00 00 00 00 00 00 00 00 00 00 00 B0 EB AA (B0350033)	The returned SN is ASCII code, which will return 00 if the bit is not enough.
CVBS video on/off	Receive	(On) AA 05 01 3D 02 **01** F0 EB AA (Off)AA 05 01 3D 02 **00** EF EB AA	
	Return	55 04 3D 33 01 CA EB AA	
Video Freeze	Receive	(on) AA 05 01 3E 02 **01** F1 EB AA (off) AA 05 01 3E 02 **00** F0 EB AA	
	Return	55 04 3E 33 01 CB EB AA	
Logo display settings	Receive	(On) AA 05 01 49 02 80 7B EB AA (Off) AA 05 01 49 02 00 FB EB AA	
	Return	55 04 49 33 01 D6 EB AA	
Set image enhancement class	Receive	AA 05 01 19 01 03 CD EB AA	0 represents the manual mode, while the other DDE levels range from 1 to 9. When setting a level, the parameter sent should be the desired level plus 1. For example, if you want to set the DDE level to 2, you need to send 2 + 1 = 0x03.
	Return	55 04 19 33 01 A6 EB AA	

Commands		The incoming message	Remark
Set contrast	Receive	AA 06 01 22 01 12 00 E6 EB AA	The parameter range is 0 to 1023, represented by a two-byte parameter with the lower byte first. For example, 0x0012= 18.
	Return	55 04 22 33 01 AF EB AA	
Set brightness	Receive	AA 05 01 23 01 7D 51 EB AA	The parameter range is 0 to 255. For example, 0x7D = 125.
	Return	55 04 23 33 01 B0 EB AA	
Set DDE	Receive	AA 05 01 1E 02 47 17 EB AA	The parameter range is 0 to 255. For example, 0x**47**=71.
	Return	55 04 1E 33 01 AB EB AA	
Set spatial noise reduction	Receive	AA 05 01 1D 02 9E 6D EB AA	The parameter range is 0 to 255. For example, 0x**9E** =158.
	Return	55 04 1D 33 01 AA EB AA	
Set temporal noise reduction	Receive	AA 05 01 05 01 82 38 EB AA	The parameter range is 0 to 255. For example, 0x**82**=130.
	Return	55 04 05 33 01 92 EB AA	
Baud rate setting	Receive	(115200bps) AA 06 01 77 02 **10 00** 3A EB AA	
	Return	55 04 77 33 01 04 EB AA	
The reticle of the defective pixels	Receive	Show: AA 05 01 43 02 **C1** B6 EB AA Hide: AA 05 01 43 02 **40** 35 EB AA	
	Return	55 04 43 33 01 D0 EB AA	
Move the defective pixel cursor	Receive	Up 1: AA 05 01 44 02 **01** F7 EB AA Down 1: AA 05 01 44 02 **02** F8 EB AA Left 1: AA 05 01 44 02 **03** F9 EB AA Right 1: AA 05 01 44 02 **04** FA EB AA Up 20: AA 05 01 44 02 **81** 77 EB AA Down 20: AA 05 01 44 02 **82** 78 EB AA Left 20: AA 05 01 44 02 **83** 79 EB AA Right 20: AA 05 01 44 02 **84** 7A EB AA	
	Return	55 04 44 33 01 D1 EB AA	
Scan defective pixels	Receive	AA 04 01 93 02 44 EB AA	
	Return	55 04 93 33 01 20 EB AA	

Commands		The incoming message	Remark
Defective pixels add/cancel	Receive	Add: AA 05 01 90 01 **01** 42 EB AA Cancel: AA 05 01 90 01 **02** 43 EB AA	
	Return	55 04 90 33 01 1D EB AA	
Save the defective pixel list	Receive	AA 05 01 90 01 **05** 46 EB AA	
	Return	55 04 90 33 01 1D EB AA	
Recover the defective pixel list	Receive	AA 05 01 90 01 **06** 47 EB AA	
	Return	55 04 90 33 01 1D EB AA	
Calibrate the K value of lens	Receive	Acquire low temperature data: AA 05 01 A0 01 **0A** 5B EB AA Acquire high temperature data: AA 05 01 A0 01 **0B** 5C EB AA Calculate: AA 05 01 A0 01 **0C** 5D EB AA Save: AA 05 01 A0 01 **0D** 5E EB AA Clear: AA 05 01 A0 01 **0E** 5F EB AA	
	Return	55 04 A0 33 01 2D EB AA	
Halo calibration	Receive	Clear: AA 05 01 A1 01 **02** 54 EB AA Get: AA 05 01 A1 01 **00** 52 EB AA Save: AA 05 01 A1 01 **01** 53 EB AA	
	Return	55 04 A1 33 01 2E EB AA	
Set sync mode and frequency	Receive	AA 06 01 A3 01 **00 32** 87 EB AA	Mode: 00: Self-sync 01: Internal sync 02: External sync 03: Adaptive Frequency: (0x32 = 50Hz)
	Return	55 04 A3 33 01 30 EB AA	
Read sync mode and frequency	Receive	AA 04 01 A3 00 52 EB AA	Mode: 00: Self-sync 01: Internal sync 02: External sync 03: Adaptive Frequency: (0x32 = 50Hz)
	Return	55 05 A3 33 **00 32** 62 EB AA	

Appendix2 Temp. Measuring Command Protocols

Command	The Incoming Message		Remark
Select Temperature Unit	Receive	AA 05 07 02 01 **00** B9 EB AA (Celsius) AA 05 07 02 01 **01** BA EB AA (Kelvin) AA 05 07 02 01 **02** BB EB AA (Fahrenheit)	
	Return	55 05 07 02 33 01 97 EB AA	
Read the threshold of low-high gain	Receive	AA 04 07 05 **00** BA EB AA	
	Return	55 06 07 05 33 **B0 04** 4E EB AA (threshold is 120)	Return 2Bytes, low Byte is in the front. Temp.=return value/10, for example, 120.0 degrees: B0 04.
Set the threshold of low-high gain	Receive	AA 06 07 05 01 **B0 04** 71 EB AA (threshold is 120)	PRM 2Bytes, low Byte is in the front. Temp.=PRM/10.
	Return	55 05 07 05 33 01 9A EB AA	
Read the percent of low-high gain	Receive	AA 04 07 06 00 BB EB AA	
	Return	55 07 07 06 33 **5F 00 00** FB EB AA (95%)	Return 3 Bytes. Percentage = returned 0/100+returned 1-2(low byte in front)/100000.
Set the percentage of low-high gain	Receive	AA 07 07 06 01 **5F 00 00** 1E EB AA (95%)	PRM 3 Bytes. Percentage = PRM0/100+PRM 1-2(low bit in front)/100000
	Return	55 05 07 06 33 01 98 EB AA	
Read the threshold of high-low gain	Receive	AA 05 07 07 00 **00** BD EB AA	
	Return	55 06 07 07 33 **78 05** 19 EB AA (threshold is 140.0)	Return 2Bytes, low Byte is in the front. Temp.=return value/10.
Set the threshold of high-low gain	Receive	AA 06 07 07 01 **2C 01** EC EB AA (threshold is 30.0)	PRM 2Bytes, low Byte is in the front. Temp.=PRM/10.
	Return	55 05 07 07 33 01 9C EB AA	
Read the percentage of high-low gain	Receive	AA 05 07 08 00 **00** BE EB AA	
	Return	55 07 07 08 33 **0F 00 00** AD EB AA (15%)	Return 3 Bytes. Percentage = returned 0/100+returned 1-2(low bit in front)/100000
Set the percentage of high-low gain	Receive	AA 07 07 08 01 **0F 00 00** D0 EB AA (set as 15%)	Return 3 Bytes. Percentage = returned 0/100+returned 1-2(low bit in front)/100000

Command	The Incoming Message		Remark
	Return	55 05 07 08 33 01 9D EB AA	
Measuring temp. range	Receive	AA 05 07 01 01 **00** B8 EB AA (high gain) AA 05 07 01 01 **01** B9 EB AA (low gain) AA 05 07 01 01 **03** BB EB AA (Auto)	High gain temp. measuring range -20~+150°C. Low gain temp. measuring range 0~+550°C. In Auto mode, the module will automatically select the temp. measuring range.
	Return	55 05 07 01 33 01 96 EB AA	
Read the reflect temp.	Receive	AA 05 07 0F 00 **00** C5 EB AA	
	Return	55 08 07 0F 33 **90 D0 03 00** 09 EB AA (reflect temp. is 25°C)	Return 4 Bytes, low Byte is in the front. Temp.=returned value/10000.
Set the reflect temp.	Receive	AA 08 07 0F 01 **E0 93 04 00** 40 EB AA (reflect temp. is 30°C)	PRM 4 Bytes, low Byte is in the front. Temp.=returned value/10000.
	Return	55 05 07 0F 33 01 A4 EB AA	
Read the ambient temp.	Receive	AA 05 07 10 00 **00** C6 EB AA	
	Return	55 08 07 10 33 **90 D0 03 00** 0A EB AA (ambient temp. is 25°C)	Return 4 Bytes, low Byte is in the front. Temp.=returned value/10000.
Set the ambient temp.	Receive	AA 08 07 10 01 **90 D0 03 00** 2D EB AA (ambient temp. is 25°C)	PRM 4 Bytes, low Byte is in the front. Temp.=returned value/10000.
	Return	55 05 07 10 33 01 A5 EB AA	
Read the ambient transmissivity	Receive	AA 04 07 11 00 C6 EB AA	
	Return	55 08 07 11 33 **94 11 00 00** 4D EB AA (transmissivity is 0.45)	Return 4 Bytes, low Byte is in the front. Transmissivity = returned value/10000.
Set the ambient transmissivity	Receive	AA 08 07 11 01 **94 11 00 00** 70 EB AA (transmissivity is 0.45)	PRM 4 Bytes, low Byte is in the front. Transmissivity = returned value/10000.
	Return	55 05 07 11 33 01 A6 EB AA	
Read the emissivity	Receive	AA 04 07 12 00 C7 EB AA	
	Return	55 08 07 12 33 **48 26 00 00** 17 EB AA (Emissivity: 0.98)	Return 4 Bytes, low Byte is in the front. Emissivity = returned value/10000.
Set the emissivity	Receive	AA 08 07 12 01 **48 26 00 00** 3A EB AA	PRM 4 Bytes, low Byte is in the front. Emissivity = returned value/10000.

Command	The Incoming Message		Remark
	Return	55 05 07 12 33 01 A7 EB AA	
Read the distance	Receive	AA 04 07 13 00 C8 EB AA	
	Return	55 08 07 13 33 **60 EA 00 00** F4 EB AA (distance: 6.0)	Return 4 Bytes, low Byte is in the front. Distance = returned value/10000.
Set the distance	Receive	AA 08 07 13 01 **60 EA 00 00** 17 EB AA	PRM 4 Bytes, low Byte is in the front. Distance = returned value/10000.
	Return	55 05 07 13 33 01 A8 EB AA	
Environmental Variables Enable	Receive	AA 05 07 18 01 **00** CF EB AA	
	Return	55 05 07 18 33 01 AD EB AA	
Temperature scale ON/OFF	Receive	ON: AA 05 07 F0 01 **01** A8 EB AA OFF: AA 05 07 F0 01 **00** A7 EB AA	
	Return	55 05 07 F0 33 **01** 85 EB AA	Return 1 byte 0x01: Success 0x00: Fail
Write Low temperature threshold of temperature scale	Receive	AA 08 07 1D 01 **40 0D 03 00** 27 EB AA (20.00℃)	Sending data = Actual data ×10000, low bit in front.
	Return	55 05 07 1D 33 01 B2 EB AA	
Read low temperature threshold of temperature scale	Receive	AA 04 07 1D 00 D2 EB AA	
	Return	55 08 07 1D 33 **40 0D 03 00** 04 EB AA (20.00℃)	Actual data = Return data (low bit in front)/10000
Write high temperature threshold of temperature scale	Receive	AA 08 07 1E 01 **80 1A 06 00** 78 EB AA (40.00℃)	Receive data = actual data × 10000, low bit in front
	Return	55 05 07 1E 33 01 B3 EB AA	
Read high temperature threshold of temperature scale	Receive	AA 04 07 1E 00 D3 EB AA	
	Return	55 08 07 1E 33 **80 1A 06 00** 55 EB AA (40.00℃)	Actual data = Return data (low bit in front)/10000
Secondary calibration (two points correction)	Receive	AA 06 07 6F 02 19 00 41 EB AA (25℃)	2-byte parameter, representing the temperature of the target blackbody input by the upper computer software. Calibration is done first for the low-temperature target, and then for the high-temperature target.
	Return	55 05 07 6F 33 01 04 EB AA	
Secondary	Receive	AA 04 07 6A 02 **21** EB AA	Enable the parameters of

Command	The Incoming Message		Remark
calibration (enable and save)			secondary calibration, parameters of secondary calibration will be saved after power off
	Return	55 05 07 6A 33 01 FF EB AA	
Secondary calibration (Eliminate)	Receive	AA 04 07 6B 02 22 EB AA	Enable the original calibration parameter, the original calibration parameters will be saved after power off
	Return	55 05 07 6B 33 01 00 EB AA	