



Xcore Micro III Lite Series
Uncooled Thermal Imaging Module
Command Protocols
V1.0.2

IRay Technology Co., Ltd.

www.infiray.com

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Version History

Version	Date	Description
V1.0.0	2022-04	Initial version
V1.0.1	2022-06	Update brightness and contrast setting commands
V1.0.2	2023-01	Add digital video/image set and read protocols

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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
0xF1	Command sending timeout
0xFB	No CW
0xFD	The DRC check bit error
0xFF	Packet header 0xFF error

2.3 The Receiving Command and Status Information

Table5 Settings menu

Settings						
CW0	CW1	Meaning	OW	PRM Byte	PRM	RV Bytes Count
0x01	0x11	NUC	0x02	1	0x00: background correction 0x01: shutter correction	1
0x01	0x01	Auto NUC	0x01	1	0x00: off 0x01: on	1
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 °C (0.1°C/cnt)	1
0x01	0xC3	Read FPA temp.	0x00	0	none	2
0x01	0x7C	Read core	0x00	0	none	2

		temp.				
0x01	0x76	Read NIOS version	0x00	0	none	20
0x01	0x75	Read logic version	0x00	0	none	64
0x01	0x7F	Save settings	0x02	0	none	1
0x01	0x82	Recovery default settings	0x02	0	none	1

Table6 Video Menu

Gain Control						
CW 0	CW 1	Meaning	OW	PRM Byte Count	PRM	RV Byte Count
0x01	0x19	Set image enhancement class	0x01	1	0x00: manual; 0x01-0x0A: class0 – class9	1
0x01	0x19	Read image enhancement class	0x00	21	byte[4]: image enhancement (0-10) byte[6]: spatial filtering (0-255) byte[7]: DDE (0-128) byte[9-10]: contrast (0-255) byte[13]: brightness (0-255)	21
0x01	0x1E	DDE settings	0x02	1	range: 0-128	1
0x01	0x1D	Spatial filtering settings	0x02	1	range: 0-255	1
0x01	0x24	Contrast settings	0x01	2	Range: 0-255	1
0x01	0x26	Brightness settings	0x01	1	Range: 0-255	1
0x01	0x05	Set temporal filtering	0x01	1	Range: 0-255	1

0x01	0x05	Read temporal filtering	0x00	0	None	0
0x01	0x21	Set dynamic range	0x01	1	Range: 0-255	1
0x01	0x21	Read dynamic range	0x00	0	None	0
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 warning color threshold	0x01	2	PRM1: threshold value PRM2: 0x00 warning red 0x01 warning green 0x02 warning blue	1

Table7 Advance settings

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

Table 8 Functional Menu of Temperature Measurement Parameters

Micro III Lite 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	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
0x07	0x0f	Read reflected temperature	0x00	1	0x00	4

Micro III Lite Temperature Measurement Parameters						
		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 of temperature scale	0x01	4	Threshold=PRM/10000 low bit in front	1
		Write high temperature threshold of temperature scale	0x00	1	0x00	4

Table 10 Digital Video Function Menu

Digital Video						
CW0	CW1	Meaning	OW	PRM Byte Count	PRM	RV Byte Count
0x01	0x5D	Type of digital video output	0x02	2	00 00: off 02 00: LVCOMS 03 00: LVDS 04 00: BT.656 05 00: BT1120 05 80: CDS_2 05 40: CDS_3 0A 00: MIPI	1

0x01	0x5D	Read the type of digital video output	0x00	0	none	2
0x01	0x5C	Select digital video source	0x01	1	0x00: ORG 0x01: NUC 0x02: DRC 0x04: TEMP 0x05: DNS	1
0x01	0x5C	Read digital video source	0x00	0	None	1
0x01	0x4C	Image flip	0x01	1	0x01: no flip 0x02: left-right flip 0x04: up-down flip 0x08: diagonal flip	1
0x01	0x3E	Video freeze	0x02	1	0x00: off 0x01: on	1

Table 11 Menu of Calibration Function

Full Frame Temperature Measurement						
CW0	CW1	Meaning	OW	PRM Bytes	PRM	Returned Value
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	For imaging type: AA 05 01 11 02 00 C3 EB AA (background correction) AA 05 01 11 02 01 C4 EB AA (shutter correction) For temperature measurement type: AA 05 01 11 02 80 43 EB AA (background correction) AA 05 01 11 02 81 44 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°C, the returned value is 47.55×100°C, that is 4755 in decimal, low byte returns first. If the temp. is below 0°C, 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°C, the returned value is
	Return	55 05 7C 33 75 12 90 EB AA	

			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.
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	<p>For example:</p> <p>The interval time is 10 minutes (accurate to 1minute) of PRM is 0x0A.</p> <p>When auto NUC is enabled, the shutter correction interval can be set. For example, if the time interval is 10 min., then the sent parameter is 0x0A(the set accuracy is 1 minute).</p>
	Return	55 04 03 33 01 90 EB AA	
Auto NUC interval temp.	Receive	AA 05 01 04 01 0F C4 EB AA	<p>When the Auto NUC is enabled, temperature interval of shutter correction can be set.</p> <p>For example:</p>
	Return	55 04 04 33 01 91 EB AA	

			0x0F means the interval temp is 25/10 = 1.5°C
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 AA (Gray-red) AA 05 01 42 02 08 FC EB AA (Purple orange) AA 05 01 42 02 09 FD ED AA 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 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	
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
	Return	55 04 5C 33 02 EA EB AA	01: NUC 02: DRC 04: TEMP 05: DNS
Set digital video interface	Receive	(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 (CDS_3) AA 06 01 5D 02 05 40 55 EB AA (MIPI) AA 06 01 5D 02 0A 00 1A EB AA (disable) AA 06 01 5D 02 00 00 10 EB AA	BT656, BT1120, CDS-2 and CDS-3 only supports DRC data source.
	Return	55 04 5D 33 01 EA EB AA	
Read digital video interface	Receive	AA 04 01 5D 00 0C EB AA	02 00: LVCMOS
	Return	55 05 5D 33 02 00 EC EB AA 55 05 5D 33 04 00 EE EB AA 55 05 5D 33 05 00 EF EB AA 55 05 5D 33 05 40 2F EB AA 55 05 5D 33 05 80 6F EB AA 55 05 5D 33 0A 00 F4 EB AA	04 00: BT.656 05 00: BT.1120 05 40: CDS_3 05 80: CDS_2 0A 00: MIPI
Image flip	Receive	(off) AA 05 01 4C 02 01 FF EB AA (left-right) AA 05 01 4C 02 02 00 EB AA (up-down) AA 05 01 4C 02 04 02 EB AA (mirror flip) AA 05 01 4C 02 08 06 EB AA	
	Return	55 04 4C 33 01 D9 EB AA	

PN Query	Receive	AA 04 01 70 00 1F EB AA	
	Return	55 17 70 33 4D 33 36 34 30 54 30 31 31 59 30 31 33 31 32 58 45 4E 4E 58 F0 EB AA (M3640T011Y01312XENNX)	The returned PN code is ASCII code, which will return 00 if the returned bit is not enough.
SN Query	Receive	AA 04 01 71 00 20 EB AA	
	Return	55 43 71 33 42 32 32 34 31 30 30 32 00 D9 EB AA (B2241002)	The returned SN is ASCII code, which will returned 00 if the bit is not enough.
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	
Set image enhancement class	Receive	AA 05 01 19 01 01 CB EB AA	0x00: manual; 0x01~0x0A : Class0 – Class9
	Return	55 04 19 33 01 A6 EB AA	
Read image enhancement class and parameters	Receive	AA 04 01 19 00 C8 EB AA	byte[4]: image enhancement(0-10) byte[6]: spatial filtering (0-255) byte[7]: DDE (0-128) byte[9-10]: contrast (0-255) byte[13]: brightness (0-255)
	Return	55 18 19 33 03 06 64 32 50 19 00 01 00 7D 1E 01 02 00 64 00 03 1E 00 FA 00 DF EB AA	
Set DDE	Receive	AA 05 01 1E 02 32 02 EB AA	Parameter range: 0~128; E.G.: DDE is 50 (in decimal, then the sending parameter is 0x32.
	Return	55 04 1E 33 01 AB EB AA	
Set spatial filtering	Receive	AA 05 01 1D 02 64 33 EB AA	Parameter range: 0~255;
	Return	55 04 1D 33 01 AA EB AA	

Contrast setting	Receive	AA 06 01 24 01 19 00 EF EB AA	Parameter range: 0~255;
	Return	55 04 24 33 01 B1 EB AA	
Brightness setting	Receive	AA 05 01 26 01 7D 54 EB AA	Parameter range: 0~255;
	Return	55 04 26 33 01 B3 EB AA	
Set temporal filtering	Receive	AA 05 01 05 01 B4 6A EB AA	Parameter range: 0~255;
	Return	55 04 05 33 01 92 EB AA	
Read temporal filtering	Receive	AA 04 01 05 00 B4 EB AA	Parameter range: 0~255;
	Return	55 04 05 33 B4 45 EB AA	
Set dynamic range	Receive	AA 05 01 21 01 F0 C2 EB AA	Parameter range: 0~255;
	Return	55 04 21 33 01 AE EB AA	
Read dynamic range	Receive	AA 04 01 21 00 D0 EB AA	Parameter range: 0~255;
	Return	55 04 21 33 F0 9D EB AA	
Baud rate setting	Receive	(9600bps) AA 06 01 77 02 02 00 2C EB AA (19200bps) AA 06 01 77 02 04 00 2E EB AA (38400bps) AA 06 01 77 02 08 00 32 EB AA (57600bps) AA 06 01 77 02 40 00 6A EB AA (115200bps) AA 06 01 77 02 10 00 3A EB AA	
	Return	55 04 77 33 01 04 EB AA	
The cursor 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	
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	
Image non-uniformity calibration	Receive	Clear: AA 05 01 A1 01 02 54 EB AA Acquire: 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	

Appendix2 Temp. Measuring Command Protocols

Command	The Incoming Message		Remark
Read the threshold of low-high gain	Receive	AA 05 07 05 00 00 BB 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 05 07 06 00 00 BC 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
	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)	Hight 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.
	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°C)	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°C)	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 07 07 6D 02 0A 00 01 32 EB AA (10℃)	PRM1, two bytes, stands for the input blackbody temp, 0A 00 , low bit in front, 10℃
	Return	55 05 07 6F 33 01 04 EB AA	PRM 2: 01(blackbody 1), 02(blackbody 2)
Secondary calibration (enable and save)	Receive	AA 04 07 6A 02 21 EB AA	Enable the parameters of 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	