



# **Xcore LT Series**

## **Measuring Thermal Imaging Module**

### **Command Protocols**

#### **V1.0.9**

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## Version History

Version	Date	Description
V1.0.0	2018-09	Initial version
V1.0.1	2018-12	Add image flip, ROI and Gain settings.
V1.0.2	2019-04	Add magnification in any area , temperature width tensile and other functions
V1.0.3	2019-08	Add command for secondary calibration
V1.0.4	2019-12	Add read command for secondary calibration status
V1.0.5	2020-01	Modify sample command for digital zoom
V1.0.6	2020-02	Modify sample command for ambient transmissivity
V1.0.7	2020-02	Add sample commands for reading the highest, lowest, and center temperature/coordinates of full frame
V1.0.8	2020-03	Add instructions for temperature imaging and black body correction (For LTxxxH series).
V1.0.9	2020-04	Add instructions for skin temperature measurement (For LTxxxH series) and glare protection. Modify command for palette setting.

# 1. Serial Port Settings

**Table1 Serial Port Setting**

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 Format

### 2.1 Format of Receiving Commands

**Table2 Format of Receiving Commands**

Process Start	Byte Count	CW0	CW1	OW	PRM0	PRM1	...	PRM N	SC	Process End	
		This part is the command body									
0xAA	0x05	0x00	0x03	0x00	0x00	none	none	none	0xB1	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 SC byte Mod 256;
- (3) The command and parameter information is described from Table5 to Form9;
- (4) The process body byte count is the number of valid bytes from CW0 to SC;
- (5) Process start is fixed to 0xAA, process end is fixed to 0xEB and 0xAA;
- (6) BC of 0x00 is the command of Core settings, and BC of 0x07 is the command of temperature measuring.

### 2.2 Format of Status Information

**Table3 Format of Status Information**

Process  Start	Byte  Count	CW0	CW1	OW	RV	RV	...	RV	SC	Process End	
		This part is the command body									
0x55	0x06	0x00	0x03	0x33	0x00	0x02	none	none	0x93	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 512 is the hexadecimal number of 0x200, so the RV is 0x00 by 0x02.
- (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.
- (7) BC of 0x00 is the command of Core settings, and BC of 0x07 is the command of temperature measuring.

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 overtime
0xFB	None of CW
0xFD	DRC SC error
0xFF	Process start 0xAA error

## 2.3 The Receiving Command and Status Information

**Table5 Status Menu**

Status						
CW0	CW1	Meaning	OW	PRM Byte Count	PRM	RV Bytes Count
0x00	0x00	Read SN	0x00	0	none	10
0x00	0x01	Read PN	0x00	0	none	20
0x00	0x02	Read FPA Width	0x00	0	none	2
0x00	0x03	Read FPA Length	0x00	0	none	2
0x00	0x04	Read FPA Temp.	0x00	0	none	2

**Table6 Setup Menu**

Setup						
CW	CW1	Meaning	OW	PRM Bytes Count	PRM	RV Bytes Count
0x00	0x05	Read camera temperature	0x00	0	None	2
0x00	0x11	Save settings	0x01	0	None	1
0x00	0x12	Restore factory settings	0x02	0	None	1
0x00	0x13	Camera reboot	0x02	0	None	1
0x00	0x15	NUC	0x01	1	0x00:Manual 0x01:Auto(default)	1
		Read status of Auto NUC	0x00	0	none	1
0x00	0x16	Set manual NUC	0x01	1	0x00:external shutter correction 0x02: Background correction	1
0x00	0x17	Set interval time of NUC	0x01	1	Interval time: 0-255	1
		Automatically Set interval time of NUC	0x00	0	none	1
0x00	0x18	Set interval temperature of NUC	0x01	1	Interval temp.: 0-255(integer)	1
		Automatically set interval temperature of NUC	0x00	0	none	1

**Table7 Video Menu**

Video						
CW0	CW1	Meaning	OW	PRM Bytes Count	PRM	RV Bytes Count

Video						
CW0	CW1	Meaning	OW	PRM Bytes Count	PRM	RV Bytes Count
0x00	0x2A	Digital zoom	0x01	1	Refer to appendix 1	1
		Read Digital zoom Status	0x00	0	None	2
0x01	0x40	Magnification in any area	0x02	8	Parameter 0: low byte of left-up X coordinate; Parameter 1: high byte of left-up X coordinate; Parameter 2: low byte of left-up Y coordinate; Parameter 3: high byte of left-up Y coordinate; Parameter 0: low byte of right-bottom X coordinate; Parameter 1: high byte of right-bottom X coordinate; Parameter 2: low byte of right-bottom Y coordinate; Parameter 3: high byte of right-bottom Y coordinate; Refer to appendix 1	1
0x00	0x30	Image flip	0x01	1	bit0=1 no-operation bit1=1 Horizontal bit2=1 Vertical bit3=1 Diagonal	1
		Read flip status	0x00	0	None	1

Video						
CW0	CW1	Meaning	OW	PRM Bytes Count	PRM	RV Bytes Count
0x00	0x2D	Palette Settings (savable)	0x01	1	0x00: White Hot (Default) 0x01: Black Hot 0x02: Blue Red yellow 0x03: Purple red yellow 0x04: blue green red 0x05: Rainbow 1 0x06: Rainbow 2 0x07: Black red 0x08: blackish green Red 0x09: BGR -pink 0x0A: mixed 0x0B: Red high-temperature	1
		Read	0x00	0	None	1
0x01	0x4B	Threshold setting for warning red/green/blue	0x01	2	Parameter 0: Threshold, 0~255 Parameter 1 : 0x00- warning red 0x00- warning green 0x00- warning blue	
0x00	0x32	Image freeze	0x02	1	0x00: Analog video active 0x01: Analog video freeze 0x02: digital video active 0x03: digital video freeze	1
0x00	0x33	Analog video switch	0x02	1	0x00: Analog video off 0x01: Analog video on	1
0x00	0x42	ROI	0x01	8	PRM 0: left-up X- low byte PRM 1: left-up X- high byte PRM 2: left-up Y -low byte PRM 3: left-up Y -high byte PRM 4: right-down X- low byte PRM 5: right-down X- high byte PRM 6: right-down Y -low byte PRM 7: right-down Y -high byte	1



**Table8 AGC Menu**

AGC						
CW0	CW1	Meaning	OW	PRM Bytes Count	PRM	RV Bytes Count
0x00	0x3A	AGC mode (savable)	0x01	1	0x00: Manual 0x01: Auto 0 (default) 0x02: Auto 1	1
		Read current AGC mode	0x00	0	none	1
0x00	0x3B	Contrast Setting (Manual mode, savable)	0x01	1	Contrast(0-255)	1
		Read current Contrast value	0x00	0	None	
0x00	0x40	Set contrast by steps (Manual mode, savable)	0x01	2	PRM0: 0x00 reduce contrast 0x01 increase contrast PRM1: Step (0-255)	1
0x00	0x3C	Set brightness (Manual mode, savable)	0x01	2	Brightness(0-511) PRM0: low byte of brightness PRM1: high byte of brightness	1
		Read brightness value	0x00	0	None	2
0x00	0x41	Set brightness by step (Manual mode, savable)	0x01	2	PRM1:0x00 reduce brightness 0x01 increase brightness PRM2: Step 0-255	1
0x00	0x31	Filter on/off	0x01	1	0x00: off 0x01: on	1
		Read image filter status	0x00	0	None	1
0x00	0x3E	DDE switch (savable)	0x01	1	0: DDE on 1: DDE off	1
		Read DDE status	0x00	0	None	1
0x00	0x3F	DDE level (savable)	0x01	1	Limit :0-7(integer)	1
		Read DDE level	0x00	0	None	1

**Table9 Advance Menu**

Advance						
CW0	CW1	Meaning	OW	PRM Bytes Count	PRM	RV Bytes Count
0x00	0x1	Set baud rate	0x02	2	PRM0: 0x00 Reserve PRM1: 0x02: 9600 0x04: 19200 0x08: 38400 0x10: 115200 (default) 0x40: 57600	1

**Table10 Glare Protection**

Glare Protection						
CW0	CW1	Meaning	OW	PRM Bytes Count	PRM	RV Bytes Count
0x01	0x08	Read glare protection status	0x00	1	0x00	1
		Set glare protection	0x01	4	Parameter1 : 00 : glare protection is off 01 : glare protection is on Parameter 2 、 3 : threshold (low byte first) Parameter4 : glare protection time.	1

**Table11 LT Temperature Measuring Functions Menu**

LT Temperature Measuring Parameters						
CW0	CW1	Meaning	OW	PRM Bytes Count	PRM	RV Bytes Count
0x07	0x00	Measuring OSD on/off	0x01	1	0x00: off 0x01: on	1
0x07	0x01	Temp measuring range	0x01	1	0x00: High Gain 0x01: Low Gain 0x03: Auto	1
0x07	0x02	Temp unit	0x01	1	0x00: Celsius 0x01: Kelvin	1

LT Temperature Measuring Parameters						
CW0	CW1	Meaning	OW	PRM Bytes Count	PRM	RV Bytes Count
					0x02: Fahrenheit	
0x07	0x05	Read low-high gain threshold value	0x00	1	0x00	2
		Set low-high gain threshold value	0x01	2	Threshold value = parameter/10, low byte is in the front	1
0x07	0x06	Read the percent of low-high gain	0x00	1	0x00	2
		Set the percent of low-high gain	0x01	2	Percent=parameter/100	1
0x07	0x07	Read high-low gain threshold value	0x00	1	0x00	2
		Set high-low gain threshold value	0x01	2	Threshold value = parameter/10, low byte is in the front	1
0x07	0x08	Read the percent of high-low gain	0x00	1	0x00	2
		Set the percent of high-low gain	0x01	2	Percent=parameter/100	1
0x07	0x0f	Read Reflect temp	0x00	1	0x00	4
		Set reflect temp	0x01	4	Temp = parameter/10000, low byte is in the front	1
0x07	0x10	Read ambient temp	0x00	1	0x00	4
		Set ambient temp	0x01	4	Temp = parameter/10000, low byte is in the front	1
0x07	0x11	Read ambient transmissivity	0x00	1	0x00	4
		Set ambient transmissivity	0x01	4	Transmissivity= parameter/10000, low byte is in the front	1
0x07	0x12	Read emissivity	0x00	1	0x00	4
		Set emissivity	0x01	4	Emissivity= parameter/10000, low byte is in the front	1
0x07	0x13	Read distance	0x00	1	0x00	4
		Set distance	0x01	4	Distance= parameter/10000, low byte is in the front	1
0x07	0x18	Environment variables take effect	0x01	1	0x00	1

**Table 12 Spot temperature Measuring Tool Function Menu**

Spot Temperature Measuring Tool						
CW0	CW1	Meaning	OW	PRM Bytes Count	PRM	RV Bytes Count
0x07	0x80	Spot on/off (support 10 spots)	0x01	2	PRM0: 0x00~0x09 stands for spot 1-10 PRM1: 0x00 off 0x01 on	1
0x07	0x82	Read the spot coordinates	0x00	1	PRM0: 0x00~0x09 stands for spot 1-10	5
		Set the spot coordinates	0x01	5	PRM0: 0x00~0x09 stands for spot 1-10 PRM 1: Axis x-low 8 byte PRM 2: Axis x-high 8 byte PRM 3: Axis y-low 8 byte PRM 4: Axis y-high 8 byte	1
0x07	0x83	Read spot temperature value	0x00	1	PRM0: 0x00~0x09 stands for spot 1-10	5

**Table 13 Area/line Temperature Measuring Tools Function Menu**

Area/line Temperature Measuring Tools						
CW0	CW1	Meaning	OW	PRM Bytes Count	PRM	RV Bytes Count
0x07	0x40	Area/line tools on/off (support 12 areas or lines)	0x01	2	PRM0: 0x00~0x0b stands for area/line 1-12 PRM1: 0x00 off, 0x01 on	1
0x07	0x41	Type of Area/Line tools	0x01	2	PRM0: 0x00~0x0b stands for area/line 1-12 PRM1: 0x00 Area, 0x01 Line	1
0x07	0x42	Read coordinates of area/line	0x00	1	0x00	9

Area/line Temperature Measuring Tools						
CW0	CW1	Meaning	OW	PRM Bytes Count	PRM	RV Bytes Count
		Set coordinates of area/line	0x01	9	PRM0: 0x00~0x0b stands for area/line 1-12 PRM 1: Start axis X – low 8-byte PRM 2: Start axis X – high 8-byte PRM 3: Start axis Y – low 8-byte PRM 4: Start axis Y – high 8-byte PRM 5: End axis X – low 8-byte PRM 6: End axis X – high 8-byte PRM 7: End axis Y – low 8-byte PRM 8: End axis Y – high 8-byte	1
0x07	0x45	Read the spot temp value and coordinates of highest temp of area/line	0x00	1	PRM0: 0x00~0x0b stands for spot of area/line 1-12	9
0x07	0x48	Read the spot temp value and coordinates of lowest temp of area/line	0x00	1	PRM0: 0x00~0x0b stands for spot of area/line 1-12	9
0x07	0x4B	Read the central spot temp value and coordinates of area/line	0x00	1	PRM0: 0x00~0x0b stands for spot of area/line 1-12	9
0x07	0x4C	Read the average temp value of area/line	0x00	1	PRM0: 0x00~0x0b stands for spot of area/line 1-12	5

**Table 14 Temperature Measuring of Full Frame Functions Menu**

Temperature Measuring in Full Frame						
CW0	CW1	Meaning	OW	PRM Bytes Count	PRM	RV Bytes Count
0x07	0x20	Isotherm on/off	0x01	1	0x00: off 0x01: on	1
0x07	0x24	Temp Measuring tools of whole image on/off	0x01	1	0x00: off 0x01: on	1
0x07	0x26	Highest temp spot display on/off	0x01	1	0x00: off 0x01: on	1
0x07	0x28	lowest temp spot display on/off	0x01	1	0x00: off 0x01: on	1

Temperature Measuring in Full Frame						
CW0	CW1	Meaning	OW	PRM Bytes Count	PRM	RV Bytes Count
0x07	0x2b	Central spot display on/off	0x01	1	0x00: off 0x01: on	1
0x07	0x2a	Read Average temp of whole image	0x00	1	0x00	4
0x07	0x2d	Measuring Alarm type	0x01	1	0x00: off 0x01: lowest temp alarm 0x02: highest temp alarm 0x03: lowest & highest temp alarm	1
0x07	0x2e	Read threshold of lowest temp alarm	0x00	1	0x00	4
		Set threshold of lowest temp alarm	0x01	4	Temp=parameter/10, low byte is in the front	1
0x07	0x2f	Read threshold of highest temp alarm	0x00	1	0x00	4
		Set threshold of highest temp alarm	0x01	4	Temp=parameter/10, low byte is in the front	1
0x07	0x27	Read coordinates of highest temp spot	0x00	1	0x00	8
0x07	0x29	Read coordinates of lowest temp spot	0x00	1	0x00	8
0x07	0x2c	Read temp & coordinates of central spot	0x00	1	0x00	8
0x07	0xf0	Temperature width tensile ON/OFF	0x01	1	0x00: OFF 0x01: ON	1
0x07	0x1d	Write the threshold of low temperature width tensile	0x01	4	Threshold=Parameter/10000, low byte is in the front	1
		Read the threshold of low temperature width tensile	0x00	1	0x00	4
0x07	0x1e	Write the threshold of high temperature width tensile	0x01	4	Threshold=Parameter/10000, low byte is in the front	1
		Read the threshold of high temperature width tensile	0x00	1	0x00	4

**Table15 Digital Video Functions Menu**

Digital video						
CW0	CW1	Meaning	OW	PRM Bytes Count	PRM	RV Bytes Count
0x00	0x2F	Digital video output format type	0x02	2	PRM0: Select the digital video output format, supporting parallel data and serial data output together. 0x00: digital video output off 0x02: parallel LVC MOS video 0x03: serial LVDS video 0x04: parallel BT.656 video 0x05: parallel BT.1120 video 0x06 : LVDS and LVC MOS video output together 0x07: LVDS and BT.656 video output together 0x08 : LVDS and BT.1120 video output together When serial LVDS video outputting, the Bit1 & Bit4 of PRM1 definition is video type and palette type. -Bit4 is serial LVDS video type, Bit4=0 stands for LVDS_H video Bit4=1 stands for LVDS_F video -Bit1 is serial LVDS palette type only in the video source of DRC Bit1=0 stands for palette video Bit1=1 stands for gray scale video	1
0x00	0x2E	Digital video source	0x01	1	Only for LVC MOS and LVDS video source. Low 4-byte for LVC MOS video source: 0xX2: DRC 0xX4: TEMP 0xX5: RAW High 4-byte for LVDS video source: 0x2X: DRC 0x4X: TEMP 0x5X: RAW	1

**Table 16 Calibration Manu**

Temperature Measurement in Full Frame						
CW0	CW1	Meaning	OW	PRM Bytes Count	PRM	RV Bytes Count
0x07	0x6E	Secondary calibration (single point correction)	0x02	2	Temperature=Parameter	1
0x07	0x6F	Secondary calibration (two points correction)	0x02	2	Temperature=Parameter	1
0x07	0x6A	Save secondary calibration	0x02	1	0x00	1
		Read secondary calibration status	0x00	1	0x00	1
0x07	0x6B	Clear secondary calibration	0x02	1	0x00	1

**Table 17 Black Body Calibration (For LTxxxH)**

Black Body Calibration						
CW0	CW1	Meaning	OW	PRM Bytes Count	PRM	RV Bytes Count
0x07	7c	Read black body calibration status	0x00	1	0x00	1
		Set black body calibration status	0x01	1	0x00 off, 0x01on	1
0x07	7d	Rear black body temperature	0x00	1	0x00	1
		Set black body temperature	0x01	4	Temp=parameter/10000, low byte is in the front	1
0x07	7e	Read black body coordinate	0x00	1	0x00	8
		Set black body coordinate	0x01	8	PRM0: start axis X – low 8-byte PRM1 : start axis X – high 8-byte PRM2 : start axis Y – low 8-byte	1



Black Body Calibration						
CW0	CW1	Meaning	OW	PRM Bytes Count	PRM	RV Bytes Count
					PRM3 : start axis Y – high 8-byte PRM4 : end axis X – low 8-byte PRM5 : end axis X – high 8-byte PRM6 : end axis Y – low 8-byte PRM7 : end axis Y – high 8-byte	

**Table 18 Skin Temperature Measurement**

Skin Temperature Measurement						
CW0	CW1	Meaning	OW	PRM Bytes Count	PRM	RV Bytes Count
0x07	0x72	Read skin temperature measurement status	0x00	1	0x00	1
		Set skin temperature measurement	0x01	1	0x00 off, 0x01on	1

### 3. Company Information

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## Appendix1 Core Command Protocol

Command Description		Received Commands	Remark
Read SN	Receive	AA 04 00 00 00 AE EB AA	For example: The returned SN is the ASCII of 010001. If the data length is not enough, the rest data position return '0x00'.
	Return	55 0D 00 00 33 30 30 31 30 30 30 31 00 00 00 00 B7 EB AA	
Read PN	Receive	AA 04 00 01 00 AF EB AA	For example: The returned SN is the ASCII of LT serial cores. If the data length is not enough, the rest data position return '0x00'.
	Return	55 18 00 01 33 4C 41 33 32 33 30 00 00 00 00 00 00 00 00 00 0000 F6 EB AA	
Read FPA Width	Receive	AA 04 00 02 00 B0 EB AA	Return 2-byte, low-byte is in the front, for example, 0x80,0x01 stand for FPA width is 0x180 = 384
	Return	55 06 00 02 33 80 01 11 EB AA	
Read FPA Height	Receive	AA 04 00 03 00 B1 EB AA	Return 2-byte, low-byte is in the front, for example, 0x20,0x01 stand for FPA width is 0x120 = 288
	Return	55 06 00 03 33 20 01 B2 EB AA	
Read FPA Temp.	Receive	AA 04 00 04 00 B2 EB AA	For example: If the readout temp. is 30.7°C, the returned value is 3070 (30.7x100°C, decimal), and low byte returns first. If the temp. is below 0°C, the returned value is the complement code of current temp.
	Return	55 06 00 04 33 FE 0B 9B EB AA	
Read core Temp.	Receive	AA 04 00 05 00 B3 EB AA	For example: If the readout temp. is 10.7°C, the returned value is 1070 (10.7x100°C, decimal), and low byte returns first. If the temp. is below 0°C, the returned value is the complement code of current temp.
	Return	55 06 00 05 33 37 04 CE EB AA	
Save Setting	Receive	AA 04 00 11 01 C0 EB AA	
	Return	55 05 00 11 33 01 9F EB AA	
Restore factory setting	Receive	AA 04 00 12 02 C2 EB AA	
	Return	55 05 00 12 33 01 A0 EB AA	
NUC setting	Receive	(Manual) AA 05 00 15 01 00 C5 EB AA (Auto) AA 05 00 15 01 01 C6 EB AA	The default setting is Auto calibrating.
	Return	55 05 00 15 33 01 A3 EB AA	

Command Description		Received Commands	Remark
Read NUC Setting	Receive	AA 04 00 15 00 C3 EB AA	Core feedback value of 1-byte. 0x01 means Auto mode 0x00 means Manual mode
	Return	(Auto) 55 05 00 15 33 01 A3 EB AA (Manual) 55 05 00 15 33 00 A2 EB AA	
Manually NUC setting	Receive	(Shutter calibration) AA 05 00 16 01 00 C6 EB AA (Background calibration) AA 05 00 16 01 02 C8 EB AA	In any calibrations, send anyone of the commands to run the NUC calibrated.
	Return	55 05 00 16 33 01 A4 EB AA	
Interval time of Auto NUC setting	Receive	AA 05 00 17 01 0A D1 EB AA	In Auto NUC, the interval time can be set. For example: The interval time is 10 minute, then send the 0x0A (accurate to 1minute,0x01).
	Return	55 05 00 17 33 01 A5 EB AA	
Read Interval time of Auto NUC	Receive	AA 04 00 17 00 C5 EB AA	0x01 means the interval time is 1 minute.
	Return	55 05 00 17 33 01 A5 EB AA	
Interval temp. Auto NUC setting	Receive	AA 05 00 18 01 14 DC EB AA	In Auto NUC, the interval temp. can be set. For example: 0x14 means the interval temp is 20/10 =2°C.
	Return	55 05 00 18 33 01 A6 EB AA	
Read Interval Temp of Auto NUC	Receive	AA 04 00 18 00 C6 EB AA	Core feedback value of 1-byte. For example: 0x14 means the interval temp is 20/10 =2°C.
	Return	55 05 00 18 33 14 B9 EB AA	
Digital zoom	Receive	1x AA 0D 00 2A 01 00 00 00 00 00 7F 02 FF 01 63 EB AA 1.1x AA 0D 00 2A 01 00 1D 00 17 00 61 02 E7 01 61 EB AA 1.2x AA 0D 00 2A 01 00 35 00 2B 00 49 02 D4 01 62 EB AA 1.3x AA 0D 00 2A 01 00 4A 00 3B 00 35 02 C3 01 62 EB AA 1.4x AA 0D 00 2A 01 00 5B 00 49 00 23 02 B5 01 61 EB AA 1.5x AA 0D 00 2A 01 00 6B 00 55 00 14 02 A9 01 62 EB AA 1.6x AA 0D 00 2A 01 00 78 00 60 00 06 02 9E 01 61 EB AA 1.7x AA 0D 00 2A 01 00 84 00 69 00 FB 01 95 01 61 EB AA 1.8x AA 0D 00 2A 01 00 8E 00 72 00 F0 01 8D 01 61 EB AA 1.9x AA 0D 00 2A 01 00 98 00 79 00 E7 01 85 01 61 EB AA 2.0x AA 0D 00 2A 01 00 A0 00 80 00 DF 01 7F 01 62 EB AA 2.1x AA 0D 00 2A 01 00 A8 00 86 00 D7 01 78 01 61 EB AA 2.2x AA 0D 00 2A 01 00 AF 00 8C 00 D0 01 73 01 62 EB AA 2.3x AA 0D 00 2A 01 00 B5 00 91 00 CA 01 6E 01 62 EB AA	Let the detector array be W in width, H in height and m in magnification, that (accurate to 1 decimal) $X = \frac{W}{2} - \frac{W}{2 \cdot m}$ Left-up $Y = \frac{H}{2} - \frac{H}{2 \cdot m}$ Left-up Right-down $X = \frac{W}{2} + \frac{W}{2 \cdot m} - 1$ Right-down $Y = \frac{H}{2} + \frac{H}{2 \cdot m} - 1$ The commands on the left are as 640x512 as example.

Command Description	Received Commands	Remark
	<p>2.4x AA 0D 00 2A 01 00 BB 00 95 00 C4 01 69 01 61 EB AA</p> <p>2.5x AA 0D 00 2A 01 00 C0 00 9A 00 BF 01 65 01 62 EB AA</p> <p>2.6x AA 0D 00 2A 01 00 C5 00 9E 00 BA 01 61 01 62 EB AA</p> <p>2.7x AA 0D 00 2A 01 00 C9 00 A1 00 B5 01 5D 01 61 EB AA</p> <p>2.8x AA 0D 00 2A 01 00 CE 00 A5 00 B1 01 5A 01 62 EB AA</p> <p>2.9x AA 0D 00 2A 01 00 D2 00 A8 00 AD 01 57 01 63 EB AA</p> <p>3.0x AA 0D 00 2A 01 00 D5 00 AB 00 A9 01 54 01 62 EB AA</p> <p>3.1x AA 0D 00 2A 01 00 D9 00 AD 00 A6 01 51 01 62 EB AA</p> <p>3.2x AA 0D 00 2A 01 00 DC 00 B0 00 A2 01 4E 01 61 EB AA</p> <p>3.3x AA 0D 00 2A 01 00 DF 00 B2 00 9F 01 4C 01 61 EB AA</p> <p>3.4x AA 0D 00 2A 01 00 E2 00 B5 00 9D 01 4A 01 63 EB AA</p> <p>3.5x AA 0D 00 2A 01 00 E5 00 B7 00 9A 01 48 01 63 EB AA</p> <p>3.6x AA 0D 00 2A 01 00 E7 00 B9 00 97 01 46 01 62 EB AA</p> <p>3.7x AA 0D 00 2A 01 00 EA 00 BB 00 95 01 44 01 63 EB AA</p> <p>3.8x AA 0D 00 2A 01 00 EC 00 BD 00 93 01 42 01 63 EB AA</p> <p>3.9x AA 0D 00 2A 01 00 EE 00 BE 00 91 01 40 01 62 EB AA</p> <p>4.0x AA 0D 00 2A 01 00 F0 00 C0 00 8F 01 3F 01 63 EB AA</p> <p>4.1x AA 0D 00 2A 01 13 F2 00 C2 00 8D 01 3D 01 75 EB AA</p> <p>4.2x AA 0D 00 2A 01 13 F4 00 C3 00 8B 01 3B 01 74 EB AA</p> <p>4.3x AA 0D 00 2A 01 13 F6 00 C4 00 89 01 3A 01 74 EB AA</p> <p>4.4x AA 0D 00 2A 01 13 F7 00 C6 00 87 01 39 01 74 EB AA</p> <p>4.5x AA 0D 00 2A 01 13 F9 00 C7 00 86 01 37 01 74 EB AA</p> <p>4.6x AA 0D 00 2A 01 13 FA 00 C8 00 84 01 36 01 73 EB AA</p> <p>4.7x AA 0D 00 2A 01 13 FC 00 CA 00 83 01 35 01 75 EB AA</p> <p>4.8x AA 0D 00 2A 01 13 FD 00 CB 00 81 01 34 01 74 EB AA</p> <p>4.9x AA 0D 00 2A 01 13 FF 00 CC 00 80 01 33 01 75 EB AA</p> <p>5.0x AA 0D 00 2A 01 13 00 01 CD 00 7F 01 32 01 76 EB AA</p> <p>5.1x AA 0D 00 2A 01 13 01 01 CE 00 7D 01 31 01 75 EB AA</p> <p>5.2x</p>	

Command Description	Received Commands	Remark
	AA 0D 00 2A 01 13 02 01 CF 00 7C 01 30 01 75 EB AA 5.3x AA 0D 00 2A 01 13 04 01 D0 00 7B 01 2F 01 76 EB AA 5.4x AA 0D 00 2A 01 13 05 01 D1 00 7A 01 2E 01 76 EB AA 5.5x AA 0D 00 2A 01 13 06 01 D1 00 79 01 2D 01 75 EB AA 5.6x AA 0D 00 2A 01 13 07 01 D2 00 78 01 2C 01 75 EB AA 5.7x AA 0D 00 2A 01 13 08 01 D3 00 77 01 2B 01 75 EB AA 5.8x AA 0D 00 2A 01 13 09 01 D4 00 76 01 2B 01 76 EB AA 5.9x AA 0D 00 2A 01 13 0A 01 D5 00 75 01 2A 01 76 EB AA 6.0x AA 0D 00 2A 01 13 0B 01 D5 00 74 01 29 01 75 EB AA 6.1x AA 0D 00 2A 01 13 0C 01 D6 00 73 01 28 01 75 EB AA 6.2x AA 0D 00 2A 01 13 0C 01 D7 00 72 01 28 01 75 EB AA 6.3x AA 0D 00 2A 01 13 0D 01 D7 00 71 01 27 01 74 EB AA 6.4x AA 0D 00 2A 01 13 0E 01 D8 00 71 01 27 01 76 EB AA 6.5x AA 0D 00 2A 01 13 0F 01 D9 00 70 01 26 01 76 EB AA 6.6x AA 0D 00 2A 01 13 10 01 D9 00 6F 01 25 01 75 EB AA 6.7x AA 0D 00 2A 01 13 10 01 DA 00 6E 01 25 01 75 EB AA 6.8x AA 0D 00 2A 01 13 11 01 DA 00 6E 01 24 01 75 EB AA 6.9x AA 0D 00 2A 01 13 12 01 DB 00 6D 01 24 01 76 EB AA 7.0x AA 0D 00 2A 01 13 12 01 DB 00 6C 01 23 01 74 EB AA 7.1x AA 0D 00 2A 01 13 13 01 DC 00 6C 01 23 01 76 EB AA 7.2x AA 0D 00 2A 01 13 14 01 DC 00 6B 01 22 01 75 EB AA 7.3x AA 0D 00 2A 01 13 14 01 DD 00 6A 01 22 01 75 EB AA 7.4x AA 0D 00 2A 01 13 15 01 DD 00 6A 01 21 01 75 EB AA 7.5x AA 0D 00 2A 01 14 15 01 DE 00 69 01 21 01 76 EB AA 7.6x AA 0D 00 2A 01 14 16 01 DE 00 69 01 20 01 76 EB AA 7.7x AA 0D 00 2A 01 14 16 01 DF 00 68 01 20 01 76 EB AA 7.8x AA 0D 00 2A 01 14 17 01 DF 00 68 01 1F 01 76 EB AA 7.9x AA 0D 00 2A 01 14 17 01 E0 00 67 01 1F 01 76 EB AA 8.0x AA 0D 00 2A 01 14 18 01 E0 00 67 01 1F 01 77 EB AA	

Command Description		Received Commands	Remark
	Return	55 05 00 2A 33 01 B8 EB AA	
Magnification in any area	Receive	AA 0C 01 40 02 64 00 64 00 C8 00 C8 00 51 EB AA	Left-up dot coordinate (100,100), right-bottom coordinate (200,200), area size should be larger than (Whole array)*1/8
	Return	55 04 40 33 01 CD EB AA	
Read digital zoom value	Receive	AA 04 00 2A 00 D8 EB AA	Return 2 bite, example: return 0x64, 0x00, means zoom time 100/100=1X
	Return	55 06 00 2A 33 64 00 1C EB AA	
Palette settings	Receive	(white hot) AA 05 00 2D 01 00 DD EB AA (black hot) AA 05 00 2D 01 01 DE EB AA (BRY) AA 05 00 2D 01 02 DF EB AA (PRY) AA 05 00 2D 01 03 E0 EB AA (BGR) AA 05 00 2D 01 04 E1 EB AA (rainbow1) AA 05 00 2D 01 05 E2 EB AA (rainbow2) AA 05 00 2D 01 06 E3 EB AA (black-red) AA 05 00 2D 01 07 E4 EB AA (blackish green-red) AA 05 00 2D 01 08 E5 EB AA (BGR-pink) AA 05 00 2D 01 09 E6 EB AA (mixed) AA 05 00 2D 01 0A E7 EB AA (red hot) AA 05 00 2D 01 0B E8 EB AA Icy red AA 05 00 2D 01 0C E9 EB AA Black-red (green-red) AA 05 00 2D 01 0D EA EB AA blue-red (special 2) AA 05 00 2D 01 0E EB EB AA Gradual red AA 05 00 2D 01 0F EC EB AA Gradual green AA 05 00 2D 01 10 ED EB AA Gradual yellow (blue) AA 05 00 2D 01 11 EE EB AA Warning green AA 05 00 2D 01 12 EF EB AA Warning blue AA 05 00 2D 01 13 F0 EB AA	
	Return	55 05 00 2D 33 01 BB EB AA	
Read the palette value	Receive	AA 04 00 2D 00 DB EB AA	0x00: white hot (default) 0x01: black hot 0x02: BRY 0x03: PRY 0x04: BGR
	Return	55 05 00 2D 33 00 BA EB AA	0x05: 1 rainbow 1 0x06: 2 rainbow 2 0x07: B-R

Command Description		Received Commands	Remark
			0x08: blackish green Red 0x09: BGR-pink 0x0A: mixed 0x0B: Red hot 0x0C: Icy red 0x0D: black-red(green-red) 0x0E: blue-red (special 2) 0x0F: Gradual red 0x10: Gradual green 0x11: Gradual yellow (blue) 0x12: Warning green 0x13: Warning blue
Set threshold of warning red/green/blue	Receive	Threshold of warning red 200: AA 06 01 4B 01 C8 00 C5 EB AA Threshold of warning green 200: AA 06 01 4B 01 C8 01 C6 EB AA Threshold of warning blue 80: AA 06 01 4B 01 50 02 4F EB AA	
	Return	55 04 4B 33 01 D8 EB AA	
AGC setting	Receive	(manual) AA 05 00 3A 01 00 EA EB AA (auto0) AA 05 00 3A 01 01 EB EB AA (auto1) AA 05 00 3A 01 02 EC EB AA	
	Return	55 05 00 3A 33 01 C8 EB AA	
Read AGC Value	Receive	AA 04 00 3A 00 E8 EB AA	
	Return	(manual) 55 05 00 3A 33 00 C7 EB AA (auto0) 55 05 00 3A 33 01 C8 EB AA (auto1) 55 05 00 3A 33 02 C9 EB AA	
Contrast setting	Receive	AA 05 00 3B 01 82 6D EB AA	For example: Set the contrast to 130 (decimal), then send PRM 0x82.
	Return	55 05 00 3B 33 01 C9 EB AA	
Read contrast value	Receive	AA 04 00 3B 00 E9 EB AA	Return 1 Byte ,0x82 means the current manual AGC value is 130
	Return	55 05 00 3B 33 82 4A EB AA	
Set contrast by steps	Receive	AA 06 00 40 01 01 05 F7 EB AA	PRM0: 0x00 decrease, 0x01 increase; PRM1: step.

Command Description		Received Commands	Remark
	Return	55 05 00 40 33 01 CE EB AA	Example shows contrast increasing 5 in manual AGC.
Brightness setting	Receive	AA 06 00 3C 01 2C 01 1A EB AA	For example : Set the brightness to 300(decimal), send PRM 0x2C, 0x01.
	Return	55 05 00 3C 33 01 CA EB AA	
Set brightness by steps	Receive	AA 06 00 41 01 01 05 F8 EB AA	PRM0: 0x00 decrease, 0x01 increase; PRM1: step. Example shows brightness increasing 5 in manual AGC.
	Return	55 05 00 41 33 01 CF EB AA	
Read brightness value	Receive	AA 04 00 3C 00 EA EB AA	Return 2 Bytes, example 0xF4,0x00 means brightness is 244.
	Return	55 06 00 3C 33 F4 00 BE EB AA	
Set DDE on/off	Receive	(DDE on) AA 05 00 3E 01 01 EF EB AA (DDE off) AA 05 00 3E 01 00 EE EB AA	
	Return	55 05 00 3E 33 01 CC EB AA	
Read DDE value	Receive	AA 04 00 3E 00 EC EB AA	
	Return	(DDE on) 55 05 00 3E 33 01 CC EB AA (DDE off) 55 05 00 3E 33 00 CB EB AA	
DDE range setting	Receive	AA 05 00 3F 01 03 F2 EB AA	Example shows DDE value set as 3.
	Return	55 05 00 3F 33 01 CD EB AA	
Read DDE range	Receive	AA 04 00 3F 00 ED EB AA	return 1 Byte, 0x02 means DDE level 2.
	Return	55 05 00 3F 33 02 CE EB AA	
Image flip	Receive	AA 05 00 30 01 01 E1 EB AA (no flip) AA 05 00 30 01 02 E2 EB AA (left-right flip) AA 05 00 30 01 04 E4 EB AA (up-down flip) AA 05 00 30 01 08 E8 EB AA (left up – right down flip)	
	Return	55 05 00 30 33 01 BE EB AA	
Analog video freeze	Receive	(frozen) AA 05 00 32 02 00 E3 EB AA (active) AA 05 00 32 02 01 E4 EB AA	
	Return	55 05 00 32 33 01 C0 EB AA	
Digital video freeze	Receive	(frozen) AA 05 00 32 02 02 E5 EB AA (active) AA 05 00 32 02 03 E6 EB AA	
	Return	55 05 00 32 33 01 C0 EB AA	



Command Description		Received Commands	Remark
Analog video on/off	Receive	(on) AA 05 00 33 02 01 E5 EB AA (off) AA 05 00 33 02 00 E4 EB AA	
	Return	55 05 00 33 33 01 C1 EB AA	
ROI	Receive	AA 0C 00 42 01 64 00 64 00 F4 01 F4 01 AB EB AA	For example : Left-Up (100,100), Right-Down (500,500)
	Return	55 04 2B 33 01 B8 EB AA	
Image filtering setting	Receive	AA 05 00 31 01 00 E1 EB AA (off) AA 05 00 31 01 01 E2 EB AA (on)	
	Return	55 05 00 31 33 01 BF EB AA	
Read the image filtering value	Receive	AA 04 00 31 00 DF EB AA	
	Return	(off) 55 05 00 31 33 00 BE EB AA (on) 55 05 00 31 33 01 BF EB AA	
Digital video output settings	Receive	AA 06 00 2F 02 00 00 E1 EB AA (all off) AA 06 00 2F 02 02 00 E3 EB AA (LVCMOS) AA 06 00 2F 02 03 00 E4 EB AA (LVDS) AA 06 00 2F 02 04 00 E5 EB AA (BT.656) AA 06 00 2F 02 05 00 E6 EB AA (BT.1120) AA 06 00 2F 02 06 00 E7 EB AA (LVDS & LVCMOS) AA 06 00 2F 02 07 00 E8 EB AA (LVDS & BT.656) AA 06 00 2F 02 08 00 E9 EB AA (LVDS & BT.1120)  AA 06 00 2F 02 03 02 E6 EB AA (only LVDS_H video select palette) AA 06 00 2F 02 03 00 E4 EB AA (only LVDS_H video select gray scale) AA 06 00 2F 02 03 12 F6 EB AA (only LVDS_F video select palette) AA 06 00 2F 02 03 10 F4 EB AA (only LVDS_F video select gray scale)	PRM0 : Select the digital video output format, supporting parallel data and serial data output together. 0x00: digital video output off 0x02 : parallel LVCMOS video 0x03: serial LVDS video 0x04 : parallel BT.656 video 0x05 : parallel BT.1120 video 0x06 : LVDS and LVCMOS video output together 0x07: LVDS and BT.656 video output together 0x08 : LVDS and BT.1120 video output together When serial LVDS video outputting, the Bit1 & Bit4 of PRM1 definition is video type and palette type. -Bit4 is serial LVDS video

Command Description		Received Commands	Remark
			type, Bit4=0 stands for LVDS_H video Bit4=1 stands for LVDS_F video -Bit1 is serial LVDS palette type only in the video source of DRC Bit1=0 stands for palette video Bit1=1 stands for gray scale video
	Return	55 05 00 2F 33 01 BD EB AA	
Digital video source	Receive	AA 05 00 2E 01 20 FE EB AA (LVDS-DRC) AA 05 00 2E 01 40 1E EB AA (LVDS-TEMP) AA 05 00 2E 01 50 2E EB AA (LVDS-RAW)  Only LVC MOS video output, the video source is: AA 05 00 2E 01 02 E0 EB AA (LVC MOS-DRC) AA 05 00 2E 01 04 E2 EB AA (LVC MOS -TEMP) AA 05 00 2E 01 05 E3 EB AA (LVC MOS -RAW)  LVDS DCR & LVC MOS DRC output together: AA 05 00 2E 01 22 00 EB AA	Only LVC MOS or LVDS video source selected. Low 4-byte shows the LVC MOS video source: 0xX2: DRC 0xX4: TEMP 0xX5: RAW High 4-byte shows the LVDS video source: 0x2X: DRC 0x4X: TEMP 0x5X: RAW
	Return	55 05 00 2E 33 01 BC EB AA	
Baud rate setting	Receive	(115200bps) AA 06 00 14 02 00 10 D6 EB AA (9600bps) AA 06 00 14 02 00 02 C8 EB AA (19200bps) AA 06 00 14 02 00 04 CA EB AA (38400bps) AA 06 00 14 02 00 08 CE EB AA (57600bps) AA 06 00 14 02 00 40 06 EB AA	
	Return	55 05 00 14 33 01 A2 EB AA	
Read glare protection status	Receive	AA 05 01 08 00 00 B8 EB AA	
	Return	55 07 08 33 00 80 3E 07 5C EB AA	Return 4bytes
Set glare protection	Receive	AA 08 01 08 01 00 80 3E 07 81 EB AA	00: Off 80 3E: 0x3E80, threshold16000 07: protection time 7s
	Return	55 04 08 33 01 95 EB AA	Return 1byte

## Appendix2 Temp. Measuring Command Protocol

Command Description		Received Commands	Remark
Measuring OSD on/off	Receive	AA 05 07 00 01 00 B7 EB AA (on) AA 05 07 00 01 01 B8 EB AA (off)	
	Return	55 05 07 00 33 01 95 EB AA	
Temp. 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 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 05 07 06 33 5F F9 EB AA (percent is 95%)	Return 1 Byte. Percent = returned value/100.
Set the percent of low-high gain	Receive	AA 05 07 06 01 5F 1C EB AA (percent is 95%)	PRM 1 Byte. Percent = returned value/100.
	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	07 07 33 78 05 19 EB AA (threshold is 140.0)	PRM 2Bytes, low Byte is in the front. Temp.=PRM/10.
	Return	55 05 07 07 33 01 9C EB AA	
Read the percent of high-	Receive	AA 05 07 08 00 00 BE EB AA	

Command Description		Received Commands	Remark
low gain	Return	55 05 07 08 33 0F AB EB AA (percent is 15%)	Return 1 Byte. Percent = returned value/100.
Set the percent of high-low gain	Receive	AA 05 07 08 01 0F CE EB AA (set percent is 15%)	PRM 1 Byte. Percent = returned value/100.
	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 core will auto 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 05 07 11 00 00 C7 EB AA	
	Return	55 08 07 11 33 D0 DD 06 00 5B 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 D0 DD 06 00 7E EB AA (transmissivity is 0.45)	PRM 4 Bytes, low Byte is in the front. Transmissivity = returned value/10000.

Command Description		Received Commands	Remark
	Return	55 05 07 11 33 01 A6 EB AA	
Read the emissivity	Receive	AA 05 07 12 00 00 C8 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 05 07 13 00 00 C9 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	
Environment variables take effect	Receive	AA 05 07 18 01 00 CF EB AA	
	Return	55 05 07 18 33 01 AD EB AA	
Spot measuring tools on/off	Receive	AA 06 07 80 01 00 01 39 EB AA (on) AA 06 07 80 01 00 00 38 EB AA (off)	PRM0: 0x00~0x09 stands for spot 1-10 PRM1: 0x01 ON 0x00 OFF
	Return	55 05 07 80 33 01 15 EB AA	
Read the spot coordinates	Receive	AA 05 07 82 00 00 38 EB AA	PRM0: 0x00~0x09 stands for spot 1-10
	Return	55 09 07 82 33 00 41 00 64 00 BF EB AA (coordinates: (65,100) )	Return0: number of spot Return 1: low 8-bits of start x axis Return 2: high 8-bits of start x axis Return 3: low 8-bits of start y axis Return 4: high 8-bits of start y axis

Command Description		Received Commands	Remark
Set the spot coordinates	Receive	AA 09 07 82 01 00 41 00 64 00 E2 EB AA	PRM0: 0x00~0x09 stands for spot1-10 PRM1: 8-bits of start x axis PRM 2: high 8-bits of start x axis PRM 3: low 8-bits of start y axis PRM 4: high 8-bits of start y axis
	Return	55 05 07 82 33 01 17 EB AA	
Read spot temp.	Receive	AA 05 07 83 00 00 39 EB AA	
	Return	55 09 07 83 33 00 65 01 00 00 81 EB AA (spot1, 35.7°C)	Return0: 0x00~0x09 stands for spot1-10 Return1-4: temp./10, low Bytes in the front.
Area/line measuring tools On/off	Receive	AA 06 07 40 01 00 01 F9 EB AA (on) AA 06 07 40 01 00 00 F8 EB AA (off)	PRM0: 0x00~0x0b stands for area/line 1-12. PRM1: 0x00 off 0x01 on
	Return	55 05 07 40 33 01 D5 EB AA	
Choose area or line	Receive	AA 06 07 41 01 00 00 F9 EB AA (Area) AA 06 07 41 01 00 01 FA EB AA (Line)	PRM0: 0x00~0x0b stands for area/line 1-12. PRM1: 0x00 Area, 0x01 Line
	Return	55 05 07 41 33 01 D6 EB AA	
Read the coordinates of area/line	Receive	AA 05 07 42 00 00 F8 EB AA	PRM0: 0x00~0x0b stands for area/line 1-12.

Command Description		Received Commands	Remark
	Return	55 0D 07 42 33 00 64 00 64 00 C8 00 C8 00 36 EB AA	Return0 : stands for number of area/line Return 1 : low 8-bits of start x axis Return 2 : high 8-bits of start x axis Return 3 : low 8-bits of start y axis Return 4 : high 8-bits of start y axis Return 5 : low 8-bits of end x axis Return 6 : high 8-bits of end x axis Return 7 : low 8-bits of end y axis Return 8 : high 8-bits of end y axis
Set the coordinates of area/line	Receive	AA 0D 07 42 01 00 64 00 64 00 C8 00 C8 00 59 EB AA	PRM0 : stands for number of area/line PRM 1 : low 8-bits of start x axis PRM 2 : high 8-bits of start x axis PRM 3 : low 8-bits of start y axis PRM 4 : high 8-bits of start y axis PRM 5 : low 8-bits of end x axis PRM 6 : high 8-bits of end x axis PRM 7 : low 8-bits of end y axis PRM 8 : high 8-bits of end y axis
	Return	55 05 07 42 33 01 D7 EB AA	
Read the highest temp. and	Receive	AA 05 07 45 00 00 FB EB AA	PRM0: 0x00~0x0b stands for area/line 1-12.

Command Description		Received Commands	Remark
coordinates of area/line	Return	55 0D 07 45 33 00 4E 01 00 00 10 00 0A 00 4A EB AA (The highest temp. of Area/line1 is 33.4°C, and the coordinate is (16,10) )	Return 9 bits; Return 0: number of Area/line Return 1-4: temp.*10, low Byte is in the font Return 5-6: coordinate x, low Byte is in the font Return 7-8: coordinate y, low Byte is in the font
Read the lowest temp. and coordinates of area/line	Receive	AA 05 07 48 00 00 FE EB AA	PRM0: 0x00~0x0b stands for area/line 1-12.
	Return	55 0D 07 48 33 00 42 01 00 00 2B 00 15 00 67 EB AA (The highest temp. of Area/line1 is 32.2°C, and the coordinate is (43,21) )	Return 9 Bytes; Return 0: number of Area/line Return 1-4: temp.*10, low Byte is in the font Return 5-6: coordinate x, low Byte is in the font Return 7-8: coordinate y, low Byte is in the font
Read Temp. and coordinate of central spot	Receive	AA 05 07 4B 00 00 01 EB AA	PRM0: 0x00~0x0b stands for area/line 1-12.



Command Description		Received Commands	Remark
of area/line	Return	55 0D 07 4B 33 00 33 01 00 00 96 00 96 00 47 EB AA (The highest temp. of Area/line1 is 30.7°C, and the coordinate is (150,150) )	Return 9 Bytes; Return 0: number of Area/line Return 1-4: temp.*10, low Byte is in the font Return 5-6: coordinate x, low Byte is in the font Return 7-8: coordinate y, low Byte is in the font
Read average temp. of area/line	Receive	AA 05 07 4C 00 00 02 EB AA	PRM0: 0x00~0x0b stands for area/line 1-12.
	Return	55 09 07 4C 33 00 33 01 00 00 18 EB AA (The average temp. of Area/line1 is 30.7°C)	Return 5 Bytes; Return 0: number of Area/line Return 1-4: temp.*10, low Byte is in the font
Isotherm on/off	Receive	AA 05 07 20 01 01 D8 EB AA (on) AA 05 07 20 01 00 D7 EB AA (off)	
	Return	55 05 07 20 33 01 B5 EB AA	
Temp. measuring of full frame on/off	Receive	AA 05 07 24 01 01 DC EB AA (on) AA 05 07 24 01 00 DB EB AA (off)	
	Return	55 05 07 24 33 01 B9 EB AA	
The highest temp. display on/off	Receive	AA 05 07 26 01 01 DE EB AA (on) AA 05 07 26 01 00 DD EB AA (off)	
	Return	55 05 07 26 33 01 BB EB AA	
The lowest temp. display on/off	Receive	AA 05 07 28 01 01 E0 EB AA (on) AA 05 07 28 01 00 DF EB AA (off)	
	Return	55 05 07 28 33 01 BD EB AA	
The central temp. display on/off	Receive	AA 05 07 2B 01 01 E3 EB AA (on) AA 05 07 2B 01 00 E2 EB AA (off)	
	Return	55 05 07 2B 33 01 C0 EB AA	

Command Description		Received Commands	Remark
Temp. Alarm type	Receive	AA 05 07 2D 01 00 E4 EB AA (off) AA 05 07 2D 01 01 E5 EB AA (alarm of low temp.) AA 05 07 2D 01 02 E6 EB AA (alarm of high temp.) AA 05 07 2D 01 03 E7 EB AA (alarm of low-high temp.)	
	Return	55 05 07 2D 33 01 C2 EB AA	
Read Temp. alarm value	Receive	AA 05 07 2E 00 00 E4 EB AA	
	Return	55 08 07 2E 33 C8 00 00 00 8D EB AA (20.0°C)	Return 4 Bytes. Temp.=Returned value/10, low Byte is in the front.
Set temp. alarm value	Receive	AA 08 07 2E 01 C8 00 00 00 B0 EB AA (20.0°C)	PRM 4 Bytes. Temp.=Returned value/10, low Byte is in the front.
	Return	55 05 07 2E 33 01 C3 EB AA	
Read temp. alarm of high-value	Receive	AA 05 07 2F 00 00 E5 EB AA	
	Return	55 08 07 2F 33 90 01 00 00 57 EB AA (40.0°C)	Return 4 Bytes. Temp.=Returned value/10, low Byte is in the front.
Set temp. alarm of high-value	Receive	AA 08 07 2F 01 90 01 00 00 7A EB AA (40.0°C)	PRM 4 Bytes. Temp.=Returned value/10, low Byte is in the front.
	Return	55 05 07 2F 33 01 C4 EB AA	
Read the highest temperature/coordinate in full frame	Receive	AA 05 07 27 00 00 DD EB AA	
	Return	55 0C 07 27 33 4E 01 00 00 5C 01 2D 00 9B EB AA (temperature 32.3°C; coordinate (348,45) )	Return 8bytes; Return 0-3: Temp. *10, low bytes is in the front Return 4-5: coordinate x, low bytes is in the front Return 6-7: coordinate y, low bytes is in the front
Read the lowest	Receive	AA 05 07 29 00 00 DF EB AA	

Command Description		Received Commands	Remark
temperature/coordinate in full frame	Return	55 0C 07 29 33 CD 00 00 00 62 02 17 00 0C EB AA (temp. 20.5°C; coordinate (610,23) )	Return 8bytes; Return 0-3: Temp. *10,low bytes is in the front Return 4-5: coordinate x, low bytes is in the front Return 6-7: coordinate y, low bytes is in the front
Read the central temperature/coordinate in full frame	Receive	AA 05 07 2C 00 00 E2 EB AA	
	Return	55 0C 07 2C 33 F2 00 00 00 40 01 00 01 FB EB AA (temp. 24.2°C; coordinate (320,256) )	Return 8bytes; Return 0-3: Temp. *10,low bytes is in the front Return 4-5: coordinate x, low bytes is in the front Return 6-7: coordinate y, low bytes is in the front
Read the average temperature/coordinate in full frame	Receive	AA 05 07 2A 00 00 E0 EB AA	
	Return	55 08 07 2A 33 43 01 00 00 05 EB AA (32.3°C)	Return 4 Bytes. Temp.=Returned value/10, low Byte is in the front.
Temperature width tensile 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 width tensile	Receive	AA 08 07 1D 01 40 0D 03 00 27 EB AA	Receive data = Actual data ×10000, low byte is ahead.
	Return	55 05 07 1D 33 01 B2 EB AA	
Read low temperature threshold of temperature width tensile	Receive	AA 05 07 1D 00 00 D3 EB AA	
	Return	55 08 07 1D 33 40 0D 03 00 04 EB AA	Actual data = Return data(low byte is ahead)/10000

Command Description		Received Commands	Remark
Write high temperature threshold of temperature width tensile	Receive	AA 08 07 1E 01 80 1A 06 00 78 EB AA	Receive data = actual data × 10000, low byte is ahead
	Return	55 05 07 1E 33 01 B3 EB AA	
Write high temperature threshold of temperature width tensile	Receive	AA 05 07 1E 00 00 D4 EB AA	
	Return	55 08 07 1E 33 80 1A 06 00 55 EB AA	Actual data = Return data(low byte is ahead)/10000
Read temperature imaging status	Receive	AA 05 07 71 00 00 27 EB AA	
	Return	55 05 07 71 33 XX sum EB AA	Return 1byte: temperature imaging 0x00: off ; 0x01: on
Set temperature imaging	Receive	AA 05 07 71 01 01 29 EB AA	Parameter 1byte 0x00: off ; 0x01: on
	Return	55 05 07 71 33 01 sum EB AA	
Secondary Calibration (single point calibration)	Receive	AA 06 07 6E 02 19 00 40 EB AA (25°C)	Parameter:2bytes
	Return	55 05 07 6E 33 01 03 EB AA	
Secondary Calibration (two points calibration)	Receive	AA 06 07 6F 02 19 00 41 EB AA (25°C)	Parameter:2bytes
	Return	55 05 07 6F 33 01 04 EB AA	
Save secondary calibration	Receive	AA 05 07 6A 02 00 22 EB AA	The parameters for the second calibration are enabled, and it will be still used for power-off and restart.
	Return	55 05 07 6A 33 01 FF EB AA	
Read secondary calibration status	Receive	AA 05 07 6A 00 00 20 EB AA	
	Return	55 05 07 6A 33 XX sum EB AA	Return 1byte 0x00: non-calibrated 0x01: calibrated

Command Description		Received Commands	Remark
Clear secondary calibration	Receive	AA 05 07 6B 02 00 23 EB AA	The parameters for the second calibration are enabled, and it will be still used for power-off and restart.
	Return	55 05 07 6B 33 01 00 EB AA	
Read black body calibration status	Receive	AA 05 07 7C 00 00 32 EB AA	
	Return	55 05 07 7C 33 01 11 EB AA	Return 1byte; 0x01 on, 0x00 off
Set black body calibration	Receive	AA 05 07 7C 01 00 33 EB AA	0x01 on, 0x00 off
	Return	55 05 07 7C 33 01 11 EB AA	Return 1byte
Read black body temperature	Receive	AA 05 07 7D 00 00 33 EB AA	
	Return	55 08 07 7D 33 80 1A 06 00 B4 EB AA 40°C	Return 4bytes
Set black body temperature	Receive	AA 08 07 7D 01 80 1A 06 00 D7 EB AA	Temp.=parameter/10000, low byte is in the front.
	Return	55 05 07 7D 33 01 12 EB AA	Return 1byte
Read black body coordinate	Receive	AA 05 07 7E 00 00 34 EB AA	
	Return	55 0C 07 7E 33 BE 00 8C 00 C8 00 96 00 C1 EB AA    Upper left corner (190, 140,) bottom right corner (200, 150)	Return 8byte
Set black body coordinate	Receive	AA 0C 07 7E 01 BE 00 8C 00 C8 00 96 00 E4 EB AA	Black body coordinate: The resulting frame is a square with sides not exceeding 30.
	Return	55 05 07 7E 33 01 13 EB AA	Return 1byte
Read skin temperature measurement status	Receive	AA 05 07 72 00 00 28 EB AA	
	Return	55 05 07 72 33 00 06 EB AA	Return 1byte; 0x01 on, 0x00 off

Command Description		Received Commands	Remark
Set skin temperature measurement	Receive	AA 05 07 72 01 01 2A EB AA	0x01 on, 0x00 off
	Return	55 05 07 72 33 01 07 EB AA	Return 1byte