

Optris CTi communication interface

Serial interface parameters

Baud rate:	115,2 / 921,6 kBaud (factory default: 115,2)
Data bits:	8
Parity:	none
Stop bits:	1
Flow control:	off

Protocol

The protocol of the optris CTi is a binary protocol. Checksum is needed for set commands but not for read commands. The protocol has no additional overhead with CR, LR or ACK bytes. This makes the communication fast.

To get the current object temperature the user must send a simple 01_{hex} byte and the CTi will respond with the two byte temperature. To get the temperature as a floating value subtract 1000 and divide by 10.

Checksum's

If the device is setup to use checksums any SET command must have a checksum suffix. The checksum can be switched off with command AD. After every "Power on" the device will expect the checksum again. The checksum byte is build by the arithmetical XOR of all command bytes except of the address prefix.

To switch off the checksums with the SET command AD you must send the checksum.

To switch on the checksums with the SET command AD you must not send the checksum.

Please note that all commands that are more than one byte long require a checksum!

The checksum is formed by an XOR combination of all bytes to be sent.

Checksum = byte1 XOR byte2 XOR byte3 ...

Addressing RS485

This is relevant for communication with the RS485 bus only. If you use the RS485 interface board you must use the multidrop addresses.

A multidrop address is a simple prefix byte to the command. The byte is build by adding the hexadecimal value B0 to the device address. B5 01 will read the temperature from the device with the address 5.

The address of any device can be set by the device user interface ("M__01") or by the communication interface with the command 90 (Hex).

A special case is address prefix B0 for set commands. Because there is no multidrop address 0 this addresses no certain device. But a SET command with prefix broadcast the command to all devices at the RS485 bus.

Note: The command is executed immediately on any of the devices even if they do not respond to the command. That is because all are slaves and can't talk at the same time.

Communication interface

Table of contents

1	BASIC FUNCTIONS	3
1.1	IR- SETTINGS	3
1.1.1	EXAMPLE OF READ AND SET THE EMISSIVITY VALUE	3
1.2	AIMING	3
2	SIGNAL PROCESSING	4
2.1	AVERAGING	4
2.1.1	DESCRIPTION AVG READ / SET (ALL BYTES IN HEX)	4
2.2	HOLD FUNCTIONS	4
2.2.1	DESCRIPTION HOLD READ / SET (ALL BYTES IN HEX)	4
3	OUTPUT, INPUTS SETTINGS	5
3.1.1	DESCRIPTION OUTPUT VALUE (MA/MV) READ / SET (ALL BYTES IN HEX)	5
3.1.2	DESCRIPTION I/O PIN VALUES READ / SET (ALL BYTES IN HEX)	6
4	VISUAL ALARM SETTINGS AND DISPLAY	10
4.1.1	DESCRIPTION VISUAL ALARM ENTRIES READ / SET (ALL BYTES IN HEX)	10
4.1.2	DESCRIPTION VISUAL ALARM VALUE READ / SET (ALL BYTES IN HEX)	10
5	ADVANCED SETTINGS	11
5.1	SENSOR INFORMATION/ CALIBRATION	11
5.1.1	DESCRIPTION USER OFFSET VALUE READ / SET (ALL BYTES IN HEX)	11
5.1.2	DESCRIPTION USER GAIN VALUE READ / SET (ALL BYTES IN HEX)	11
5.1.3	DESCRIPTION MODEL INFORMATION READ VALUE: (ALL BYTES IN HEX)	11
5.2	ADVANCED IR-SETTINGS	12
5.2.1	DESCRIPTION AMBIENT VALUES READ / SET (ALL BYTES IN HEX)	12
5.3	ADVANCED DIGITAL COMMUNICATION SETTINGS	12
5.3.1	DESCRIPTION BURST-VALUE READ / SET (ALL BYTES IN HEX)	12
5.4	LOOP MAINTENANCE	13
5.4.1	DESCRIPTION SET OUTPUT MA/MV (ALL BYTES IN HEX)	13
5.5	FURTHER ADVANCED SETTINGS	13
6	CONTACT INFORMATION	14

Communication interface

1 Basic Functions

DECIMAL	HEX	Command	Data	Answer	Result	Unit
1	0x01	READ Temp. - Process	none	byte1 byte2	$= (\text{byte1} * 256 + \text{byte2} - 1000) / 10$	°C
2	0x02	READ Temp. - Int	none	byte1 byte2	$= (\text{byte1} * 256 + \text{byte2} - 1000) / 10$	°C
3	0x03	READ Temp. - Box	none	byte1 byte2	$= (\text{byte1} * 256 + \text{byte2} - 1000) / 10$	°C
10	0x0A	READ Temp. - Avg	none	byte1 byte2	$= (\text{byte1} * 256 + \text{byte2} - 1000) / 10$	°C

1.1 IR- Settings

DECIMAL	HEX	Command	Data	Answer	Result
4	0x04	READ Epsilon SET Epsilon	byte1 byte2	byte1 byte2	$= (\text{byte1} * 256 + \text{byte2}) / 1000$
144	0x90	READ Epsilon Act		byte1 byte2	$= (\text{byte1} * 256 + \text{byte2}) / 1000$
145	0x91	READ Transmission Act		byte1 byte2	$= (\text{byte1} * 256 + \text{byte2}) / 1000$

1.1.1 Example of READ and SET the emissivity value

READ emissivity value (FFFF for READ): 0400FFFF04

byte1	byte2	byte3	byte4
04	FF	FF	04
Command	Value	Value	Check sum

SET emissivity value to 0.8: 0400032027

byte1	byte2	byte3	byte4
04	03	20	27
Command	Value	Value	Check sum

Explanation:

Bring value to HEX: $0,8_{\text{Float}} \rightarrow 800_{\text{Decimal}} \rightarrow 0320_{\text{HEX}}$

Check sum: $04 \text{ XOR } 00 \text{ XOR } 03 \text{ XOR } 20 = 27$

1.2 Aiming

DECIMAL	HEX	Command	Data	Answer	Result
37	0x25	READ Laser SET Laser	byte1	byte1	= ON if byte1 =1 , OFF if byte1=0 Read byte1 = 0xFF

Communication interface

2 Signal Processing

2.1 Averaging

Smart averaging stops averaging if big temperature changes are occurring. For more information see manual.

DECIMAL	HEX	Command	Data	Answer	Result
6	0x06	READ AVG Values SET AVG Values	byte1 byte 2 byte 3	byte1 byte2	See AVG Value

2.1.1 Description Avg READ / SET (all bytes in HEX)

06 xx yy yy

Possible values for xx:

00	Time	(yyyy - 1...65000 ms, FFFF for READ)
01	Smart Avg on	(0 - off, 1- on, FFFF for READ)
02	Smart threshold	(1, FFFF for READ)

2.2 Hold Functions

DECIMAL	HEX	Command	Data	Answer	Result
7	0x07	READ Hold Value SET Hold Value	byte 1byte2 byte3	byte1 byte2	See Hold Value

2.2.1 Description Hold READ / SET (all bytes in HEX)

07 xx yy yy

Possible values for xx:

00	Mode	(0 - off, 1 - Peak, 2 - Valley, Adv. Peak, Adv. Valley, FFFF for READ)
01	Time	(yyyy - 1...64999 (65000 for infinity), FFFF for READ)
02	Adv. threshold	(yyyy - Temperature range, FFFF for READ)
03	Adv. Hysteresis	(1, FFFF for READ)

Communication interface

3 Output, Inputs settings

For the analog output there are the output channels 1 and 2. Details are shown in the tables below. For further information see the examples.

DECIMAL	HEX	Command	Data	Answer	Result	Unit
8	0x08	READ I/O1, I/O2, IO/3 mA value	byte1	byte1 byte2	$= (\text{byte1} * 256 + \text{byte2} - 1000) / 10$	V
17	0x11	READ / SET Output Value (mA)	byte1 byte2 byte3 byte4	byte1 byte2	See Output Values	
21	0x15	READ / SET I/O Pin Values	byte1 byte2 byte3 ...byte6	byte1 byte2	See I/O Pin Values	

3.1.1 Description Output Value (mA/mV) READ / SET (all bytes in HEX)

11 xx yy uu uu

Possible values for xx (Output-No.): 00 or 01

Possible values for yy:

00 - Mode

0000 = Off (0 mA)
 0001 = Analog Output mA
 0002 = Analog Output mV
 0003 = Alarm mA
 0004 = Alarm mV
 0005 = TCK

10 - Analog Source

0000 = Temp Process
 0001 = Temp Int
 0002 = Temp Box

11 - Analog mA below

uu uu = μ A Value

12 - Analog mA above

uu uu = μ A Value

13 - Analog Range below

uu uu = Temp. Value

14 - Analog Range above

uu uu = Temp. Value

15 - Analog mV below

uu uu = Temp. Value

16 - Analog mV above

uu uu = Temp. Value

18 - Analog Failsafe mA below

uu uu = μ A Value

19 - Analog Failsafe mA above

uu uu = μ A Value

1A - Analog Failsafe Range below

uu uu = Temp. Value

1B - Analog Failsafe Range above

uu uu = Temp. Value

1C - Analog Failsafe Active below

0000 = inactive
 0001 = active

1D - Analog Failsafe active above

0000 = inactive
 0001 = active

20 - Alarm Source

0000 = Temp Process
 0001 = Temp Int
 0002 = Temp Box

21 - Alarm Threshold

uu uu = Temp. Value

22 - Alarm Hysteresis

uu uu = Hysteresis

Communication interface

23 - Alarm mA - NO Alarm

uu uu = μ A Value

24 - Alarm mA - Alarm

uu uu = μ A Value

25 - Alarm N.O. / N.C.

0000 = normally open
0001 = normally close

26 - Alarm Difference Mode

0000 = inactive
0001 = active

27 - Alarm mV - NO Alarm

uu uu = μ A Value

28 - Alarm mV - Alarm

uu uu = μ A Value

3.1.2 Description I/O Pin Values READ / SET (all bytes in HEX)

Send for READ I/O 1: 15 nn xx yy FF FF, SET: 15 nn xx yy zz zz

Possible values for nn: 0x00...0x02 (I/O1...I/O3)

Possible values for xx:

0x00: Function

Possible values for yy: 0x00

Possible values for zz zz:

0x00: not used
0x01: Alarm
0x02: valid low
0x03: valid high
0x04: Hold LoHi
0x05: Hold HiLo
0x05: Hold Reset low
0x06: Hold Reset high
0x07: analog Epsilon
0x08: analog Uncommitted Value
0x09: Laser on Low
0x0A: Laser on High
0x0B: analog Ambient
0x0C: analog Transmitted Radiation

Alarm Values:

0x10: Source

Possible values for yy: 0x00

Possible values for zz zz:

0x00: Threshold Temp Process
0x01: Threshold Temp Int
0x02: Threshold Temp Box

0x11: Threshold

Possible values for yy: 0x00...0x0F (Source)

Possible values for zz zz: 0x0000...0xFFFE, 0xFFFF for READ

up to 16 entries (Source)
Temperature * 10 + 1000

0x12: Hysteresis

Possible values for yy: 0x00...0x0F (Source)

Possible values for zz zz: 0x0000...0xFFFE, 0xFFFF for READ

up to 16 entries (Source)
Hysteresis*10

Communication interface

0x13: normally open / closed		
Possible values for yy:	0x00...0x0F (Source)	up to 16 entries (Source)
Possible values for zz zz:	0x0000...0x0001, 0xFFFF for READ	zz zz = 0x0000 - normal open, 0x0001 - normal closed
0x14: normally / differential		
Possible values for yy:	0x00...0x0F (Source)	up to 16 entries (Source)
Possible values for zz zz:	0x0000...0x0001, 0xFFFF for READ	zz zz = 0x0000 - normal, 0x0001 - differential
Valid low values:		
0x20: Threshold		
Possible values for yy:	0x00	
Possible values for zz zz:	0...10000, 0xFFFF for READ	mV
0x21: Hysteresis		
Possible values for yy:	0x00	
Possible values for zz zz:	0x0000...0xFFFE, 0xFFFF for READ	Hysteresis*10
Valid high value:		
0x30: Threshold		
Possible values for yy:	0x00	
Possible values for zz zz:	0...10000, 0xFFFF for READ	mV
0x31: Hysteresis		
Possible values for yy:	0x00	
Possible values for zz zz:	0x0000...0xFFFE, 0xFFFF for READ	Hysteresis*10
Hold LoHi value:		
0x40: Threshold		
Possible values for yy:	0x00	
Possible values for zz zz:	0...10000, 0xFFFF for READ	mV
0x41: Hysteresis		
Possible values for yy:	0x00	
Possible values for zz zz:	0x0000...0xFFFE, 0xFFFF for READ	Hysteresis*10
Hold HiLo value:		
0x50: Threshold		
Possible values for yy:	0x00	
Possible values for zz zz:	0...10000, 0xFFFF for READ	mV
0x51: Hysteresis		
Possible values for yy:	0x00	
Possible values for zz zz:	0x0000...0xFFFE, 0xFFFF for READ	Hysteresis*10
Hold Reset low value:		
0x60: Threshold		
Possible values for yy:	0x00	
Possible values for zz zz:	0...10000, 0xFFFF for READ	mV
0x61: Hysteresis		
Possible values for yy:	0x00	
Possible values for zz zz:	0x0000...0xFFFE, 0xFFFF for READ	Hysteresis*10

Communication interface

Hold Reset high value:

0x70: Threshold

Possible values for yy: 0x00
Possible values for zz zz: 0...10000, 0xFFFF for READ mV

0x71: Hysteresis

Possible values for yy: 0x00
Possible values for zz zz: 0x0000...0xFFFE, 0xFFFF for READ Hysteresis*10

Analog Emissivity:

0x90: mV bottom

Possible values for yy: 0x00
Possible values for zz zz: 0...10000, 0xFFFF for READ mV

0x91: mV top

Possible values for yy: 0x00
Possible values for zz zz: 0...10000, 0xFFFF for READ mV

0x92: Eps bottom

Possible values for yy: 0x00
Possible values for zz zz: 0...10000, 0xFFFF for READ Eps * 1000

0x93: Eps top

Possible values for yy: 0x00
Possible values for zz zz: 0...10000, 0xFFFF for READ Eps * 1000

Analog Ambient:

0x94: mV bottom

Possible values for yy: 0x00
Possible values for zz zz: 0...10000, 0xFFFF for READ mV

0x95: mV top

Possible values for yy: 0x00
Possible values for zz zz: 0...10000, 0xFFFF for READ mV

0x96: Ambient bottom

Possible values for yy: 0x00
Possible values for zz zz: 0...10000, 0xFFFF for READ Ambient * 1000

0x97: Ambient top

Possible values for yy: 0x00
Possible values for zz zz: 0...10000, 0xFFFF for READ Ambient * 1000

Analog Transmitted Radiation:

0x98: mV bottom

Possible values for yy: 0x00
Possible values for zz zz: 0...10000, 0xFFFF for READ mV

0x99: mV top

Possible values for yy: 0x00
Possible values for zz zz: 0...10000, 0xFFFF for READ mV

0x9A: Transmitted Radiation bottom

Possible values for yy: 0x00
Possible values for zz zz: 0...10000, 0xFFFF for READ Transmitted Radiation * 1000

Communication interface

0x9B: Transmitted Radiation top

Possible values for yy: 0x00

Possible values for zz zz: 0...10000, 0xFFFF for READ

Transmitted Radiation * 1000

Analog Uncommitted Value:

0xA0: mV bottom

Possible values for yy: 0x00

Possible values for zz zz: 0...10000, 0xFFFF for READ

mV

0xA1: mV top

Possible values for yy: 0x00

Possible values for zz zz: 0...10000, 0xFFFF for READ

mV

0xA2: Uncommitted Value bottom

Possible values for yy: 0x00

Possible values for zz zz: 0...10000, 0xFFFF for READ

Uncommitted Value * 1000

0xA3: Uncommitted Value top

Possible values for yy: 0x00

Possible values for zz zz: 0...10000, 0xFFFF for READ

Uncommitted Value * 1000

0xB0: Laser On Low Threshold

0xB1: Laser On Low Hysteresis

0xC0: Laser On High Threshold

0xC1: Laser On High Hysteresis

3.1.3 Description AL2 Values READ / SET (all bytes in HEX):

Send for READ: 12 xx FF FF, SET: 12 xx yy yy

Possible values for xx:

0x00 - Source

0000 - Temp Process

0001 - Temp Head

0002 - Temp Electronic

0x01 - Threshold

yy yy - Temperatur

0x02 - Hysteresis

yy yy - Temperature

0x03 - Alarm N.O. / N.C.

0000 = normally open

0001 = normally close

0x04 - Alarm Difference Mode

0000 = inactive

0001 = active

4 Visual Alarm Settings and Display

The optris CTi has up to 8 adjustable color ranges.

DECIMAL	HEX	Command	Data	Answer	Result
110	0x6E	READ / SET Visual Alarm Entry	byte1 to byte7	byte1 to byte7	See Visual Alarm Entries
111	0x6F	READ / SET Visual Alarm Value	byte1 byte2 byte3	byte1 byte2	See Visual Alarm Values

4.1.1 Description Visual Alarm Entries READ / SET (all bytes in HEX)

6E xx yy uu vv ww

Possible values for xx (Source):

- 00: Temp Process
- 01: Temp Int
- 02: Temp Box

Possible values for yy (Entry): 00 - 07

- uu uu below value (FF FF for READ)
- vv vv above value (FF FF for READ)
- ww LEDs (Combination of: 01 - Red, 02 - Green, 04 - Blue, FF for READ)

4.1.2 Description Visual Alarm Value READ / SET (all bytes in HEX)

6F xx yy yy

Possible values for xx (Value Index):

- | | | |
|----|----------------------------|--|
| 00 | Source | 0-Temp Process, 1-Temp Int, 2-Temp Box |
| 01 | Mode | 1-normal, 0-advanced |
| 02 | Low Alarm | |
| 03 | High Alarm | |
| 04 | Hysteresis | |
| 05 | Low Alarm normally closed | 0-off, 1-on |
| 06 | High Alarm normally closed | 0-off, 1-on |

Communication interface

5 Advanced Settings

5.1 Sensor Information/ Calibration

With the user offset function, the sensor can be linear recalibrated.

DECIMAL	HEX	Command	Data	Answer	Result
14	0x0E	READ Serial number	none	byte1 byte2 byte3, byte 4	$=\text{byte1} \cdot 2^{24} + \text{byte2} \cdot 2^{16} + \text{byte3} \cdot 2^8 + \text{byte4}$
15	0x0F	READ FW Rev.	none	byte1 byte2	$=\text{byte1} \cdot 256 + \text{byte2}$
24	0x18	READ / SET User Offset	byte1 byte2 byte 3	byte1 byte2	See User Offset Value
25	0x19	READ /SET User Gain	byte1 byte2 byte 3	byte1 byte2	See User Gain Value
69	0x45	READ Model Information	byte1	byte1...byteX	See Model Information

5.1.1 Description User Offset Value READ / SET (all bytes in HEX)

Send for READ: 18 FF FF, SET: 18 yy yy

Possible values for yyyy: 0...2000 0 = -100.0 °C; 1000 = 0 °C; 2000 = 100 °C

5.1.2 Description User Gain Value READ / SET (all bytes in HEX)

Send for READ: 19 FF F, SET: 19 yy yy

Possible values for yyyy: 0...65535 Factor = yyyy / 2^{15}

5.1.3 Description Model Information READ value: (all bytes in HEX)

Send for READ: 45 xx

Possible values for xx:

00: Block 0 yy yy = 0 - Fix, 1 - Internal temperature
01: Block 1 yy yy = Temp.*10+1000

Answer: XX = 0: 30 Byte, XX = 1: 24 Source = yy yy = 0 - Fix, 1 - Internal temperature
Temp. = (yy yy → Decimal) /10 - 100

Block 0:

Byte0 Byte1 Model word (Optris internal)
Byte2 Byte3 ModelFlags1 (Optris internal)
Byte4 Byte5 ModelFlags2 (Optris internal)
Byte6 Byte7 ModelFlags3 (Optris internal)
Byte8 Byte9 ModelFlags4 (Optris internal)
Byte10 Byte11 Temp Int min
Byte12 Byte13 Temp Int max
Byte18 Byte19 Temp Bot min
Byte20 Byte21 Temp Top min
Byte18...Byte29 0

Block 1:

Byte0...Byte7 Model String 1
Byte8...Byte15 Model String 2
Byte16...Byte23 Model String 3

Communication interface

5.2 Advanced IR-Settings

DECIMAL	HEX	Command	Data	Answer	Result
19	0x13	READ / SET Amb. Temp.	byte1 byte2 byte3	byte1 byte2	See Ambient Values
20	0x14	READ Amb. Temp. Fix Value	none	byte1 byte2	$= (\text{byte1} * 256 + \text{byte2} - 1000) / 10$

5.2.1 Description Ambient Values READ / SET (all bytes in HEX)

Send for READ: 13 xx FF FF, SET: 13 xx yy yy

Possible values for xx:

00 Ambient Source
01 Ambient Temp

yy yy = 0 - Fix, 1 - Internal temp, 2 - mV Input
yy yy = Temp.*10+1000

Answer: yy yy

Source = yy yy = 0 - Fix, 1 - Internal temp.
Temp. = (yy yy → Decimal) / 10 - 100

5.3 Advanced Digital Communication Settings

DECIMAL	HEX	Command	Data	Answer	Result
16	0x10	READ / SET Multidrop Address	byte1	byte1	= byte1 (1...79), 0xFF for READ, 0 = RS422
45	0x2D	READ / SET check sum	byte1	byte1	= ON if byte1 = 1, OFF if byte1 = 0, for READ byte1 = 0xFF
81	0x51	Read /Set Burst Value	byte1 to byte16	byte1 to byte16	See Burst Value
82	0x52	Set Burst Mode	byte1 byte2 byte3	byte1 byte2 byte3	Byte1 = Mode (1 = start, 0 = stop) Byte2*256 + byte3 = interval in ms
83	0x53	READ single Burst		byte1 to byteN	

5.3.1 Description Burst-Value READ / SET (all bytes in HEX)

51 yy yy yy yy yy yy yy yy yy yy yy yy yy yy yy yy

Possible values for yy: (16x)

00: Burst end	0B mV I/O3
01: Target Avg	0C Ambient
02: Target Act	0D Transmitted Radiation
03: Int	0E Uncommitted Value
04: Box	FF for READ
05: Epsilon	
06: Transmission	
07: Process Avg	
08: Process Act	
09: mV I/O1	
0A: mV I/O2	

Communication interface

Examples:

Set Burst string to Target Avg (01), Target Act (02), Int (03), Box (04) and Process Act (08), SEND:

Byte																
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
51	01	02	03	04	08	00	00	00	00	00	00	00	00	00	00	5D
CMD																Check sum

Start Burst mode in 100 ms (100 ms → 0064_{HEX}), SEND:

Byte1	Byte2	Byte3	Byte4	Byte5
52	01	00	64	37
Command	Index	Value	Value	Checksum

Stop Burst mode, SET:

Byte1	Byte2	Byte3	Byte4	Byte5
52	00	00	00	52
Command	Index	Value	Value	Checksum

5.4 Loop Maintenance

In order to simulate hot objects in the scene and double check the analog circuits the loop maintenance makes the analog output sending fixed values. Note: It is necessary to reset DAC percentage to get back to measure mode.

DECIMAL	HEX	Command	Data	Answer	Result
143	0x8F	SET DAC percentage output / mA	Byte1 byte2 byte3	Byte1 byte2	See Loop Maintenance

5.4.1 Description SET Output mA/mV (all bytes in HEX)

8F xx yy yy

Possible values for xx (Outgoing No.): 00, 01

Possible values for yy:
Value in 0.1 mA / 0,1 mV

5.5 Further Advanced Settings

DECIMAL	HEX	Command	Data	Answer	Result
169	0xA9	SET DEFAULT	FACTDEFAULT	byte1	0 – not set 1 - set
67	0x43	READ / SET Panel lock	byte1	byte1	= ON if byte1 = 1, OFF if byte1 = 0, for READ byte1 = 0xFF
9	0x09	READ / SET Temp. Unit	byte1	byte1	°C if byte1 = 1 °F if byte1 = 0 (for READ use FF)

6 Contact information

If you plan your own software to query and control the optris CTi sensor and you have further questions, please contact:

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