Optris CTratio 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 CTratio 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 CTratio 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.

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Table of contents

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1 Basic Functions

DECIMAL	HEX	Command	Data	Answer	Result	Unit
1	0x01	READ Temp. - Process	none	byte1 byte2	= (byte1*256 + byte2 - 1000) / 10	°C
2	0x02	READ Temp. - Det	none	byte1 byte2	= (byte1*256 + byte2 - 1000) / 10	°C
3	0x03	READ Temp. - Box	none	byte1 byte2	= (byte1*256 + byte2 - 1000) / 10	°C
10	0x0A	READ Temp. - Ratio	none	byte1 byte2	= (byte1*256 + byte2 - 1000) / 10	°C
11	0x0B	READ Temp. – T2	none	byte1 byte2	= (byte1*256 + byte2 - 1000) / 10	°C
12	0x0C	READ Temp. – T1	none	byte1 byte2	= (byte1*256 + byte2 - 1000) / 10	°C
13	0x0D	READ Temp. - Attenuation	none	byte1 byte2	= (byte1*256 + byte2 - 1000) / 10	%

1.1 IR- Settings

DECIMAL	HEX	Command	Data	Answer	Result
4	0x04	READ Epsilon SET Epsilon (0x00 for Emissivity 0x01 for Slope)	byte1 byte2 byte 3	byte1 byte2	=(byte1*256 + byte2) / 1000
144	0x90	READ Epsilon T1		byte1 byte2	=(byte1*256 + byte2) / 1000
145	0x91	READ Epsilon T2		byte1 byte2	=(byte1*256 + byte2) / 1000
146	0x92	READ Slope		byte1 byte2	=(byte1*256 + byte2) / 1000

1.1.1 Example of READ and SET the emissivity value

READ emissivity value (FFFF for READ): 0400FFFF04

byte1	byte2	byte3	byte4	byte5
04	**00**	**FF**	**FF**	**04**
Command	Index	Value	Value	Check sum

SET emissivity value to 0.8: 0400032027

byte1	byte2	byte3	byte4	byte5
04	**00**	**03**	**20**	**27**
Command	Index	Value	Value	Check sum

Explanation:
Bring value to HEX: $0{,}8_{Float} \rightarrow 800_{Decimal} \rightarrow 0320_{HEX}$
Check sum: 04 XOR 00 XOR 03 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

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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, 3 - Adv. Peak, 4 - 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)

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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 F1, F2, F3 mV value	byte1	byte1 byte2	= (byte1*256 + byte2) / 100	V
17	0x11	READ / SET Output Value (mA)	byte1 bye2 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
0002 = Alarm Output

10 - Analog Source

0000 = TempProcess
0001 = TempRatio
0002 = TempT1
0003 = TempT2
0004 = Attenuation
0005 = TempDet
0006 = TempBox

11 - Analog mA below

uu uu = µA Value

12 - Analog mA above

uu uu = µA Value

13 - Analog Range below

uu uu = Temp. or Attenuation Value

14 - Analog Range above

uu uu = Temp. or Attenuation Value

18 - Analog Failsafe mA below

uu uu = µA Value

19 - Analog Failsafe mA above

uu uu = µA Value

1A - Analog Failsafe Range below

uu uu = Temp. or Attenuation Value

1D - Analog Failsafe active above

0000 = inactive
0001 = active

20 - Alarm Source

0000 = TempProcess
0001 = TempRatio
0002 = TempT1
0003 = TempT2
0004 = Attenuation
0005 = TempDet
0006 = TempBox

21 - Alarm Threshold

uu uu = Temp. or Attenuation Value

22 - Alarm Hysteresis

uu uu = Hysteresis

23 - Alarm mA - NO Alarm

uu uu = µA Value

24 - Alarm mA - Alarm

uu uu = µA Value

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

0000 = normally open
0001 = normally close

26 - Alarm Difference Mode

0000 = inactive
0001 = active

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1B - Analog Failsafe Range above

uu uu = Temp. or Attenuation Value

1C - Analog Failsafe Active below

0000 = inactive
0001 = active

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	0x0A:	Uncommitted value
0x01:	Alarm	0x0B:	Laser on low
0x02:	valid low	0x0C:	Laser on high
0x03:	valid high		
0x04:	Hold LoHi		
0x05:	Hold HiLo		
0x06:	Hold Reset low		
0x07:	Hold Reset high		
0x08:	analog Slope		
0x09:	analog Epsilon		

Alarm Values:

0x10: Source

Possible values for yy: 0x00
Possible values for zz zz:

0x00:	Threshold TProcess
0x01:	Threshold TempRatio
0x02:	Threshold TempT1
0x03:	Threshold TempT2
0x04:	Threshold Attenuation
0x05:	Threshold TempDet
0x05:	Threshold TempBox

0x11: Threshold

Possible values for yy:	0x00…0x0F (Source)	up to 16 entries (Source)
Possible values for zz zz:	0x0000...0xFFFE, 0xFFFF for READ	Temperature * 10 +1000

0x12: Hysteresis

Possible values for yy:	0x00…0x0F (Source)	up to 16 entries (Source)
Possible values for zz zz:	0x0000...0xFFFE, 0xFFFF for READ	Hysteresis*10

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

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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

Hold Reset high value:

0x70: Threshold

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

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0x71: Hysteresis

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

Analog Slope value:

0x80: mV bottom

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

0x81: mV top

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

0x82: Slope bottom

Possible values for yy:	0x00	
Possible values for zz zz:	0…10000, 0xFFFF for READ	Slope * 1000

0x83: Slope top

Possible values for yy:	0x00	
Possible values for zz zz:	0…10000, 0xFFFF for READ	Slope * 1000

Analog Emissivity T1:

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

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4 Visual Alarm Settings and Display

The optris CTratio 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 uu vv vv ww

Possible values for xx (Source):
- 00: TempProcess
- 01: TempRatio
- 02: TempT1
- 03: TempT2
- 04: Attenuation
- 05: TempDet
- 06: TempBox

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-TempProcess, 1-TempRatio, 2-TempT1, 3-TempT2, 4-Attenuation, 5-TempBox
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

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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	=byte1*2^{24} + byte2*2^{16} + byte3*2^{8} + byte4
15	0x0F	READ FW Rev.	none	byte1 byte2	=byte1*256 + 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 xx FF FF, SET: 18 xx yy yy

Possible values for xx:
- 0x00: Temp. Ratio
- 0x01: Temp. T1
- 0x02: Temp. T2

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 xx FF F, SET: 19 xx yy yy

Possible value for xx:
- 0x00: Temp. Ratio
- 0x01: Temp. T1
- 0x02: Temp. T2

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 - Detector temperature
- 01 Block 1 yy yy = Temp.*10+1000

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

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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 Ratio min
Byte12 Byte13	Temp Ratio max
Byte14 Byte15	Detector temp min
Byte16 Byte17	Detector temp max
Byte18 Byte19	Temp Bot min
Byte20 Byte21	Temp Top min
Byte22…Byte29	0

Block 1:

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

5.2 Advanced IR-Settings

DECIMAL	HEX	Command	Data	Answer	Result
18	0x12	READ / SET Max Attenuation	byte1 byte2 byte3	byte1 byte2	See Max Attenuation Values
19	0x13	READ / SET Amb. Temp.	byte1 byte2 byte3	byte1 byte2	See Ambient Values
20	0x14	READ Amb. Temp. Fix Value	none	byte1 byte2	= (byte1*256 + byte2 - 1000) / 10

5.2.1 Description Max Attenuation Value READ / SET (all bytes in HEX)

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

Possible values for xx:

00	max. Attenuation	1000 - 1999
01	Mode	0 - TRatio = fixed value; 1 - TRatio = last valid value
02	fixed TRatio Value	Tmin…Tmax

5.2.2 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	yy yy = 0 - Fix, 1 – Detector temp, 2 - mV Input
01	Ambient Temp	yy yy = Temp.*10+1000
02	Ambient Temp @ 0V ext. voltage	yy yy = Temp.*10+1000
03	Ambient Temp @ 10V ext. voltage	yy yy = Temp.*10+1000
	Answer: yy yy	Source = yy yy = 0 - Fix, 1 - Detector temp. Temp. = (yy yy → Decimal) /10 - 100

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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 byte20	byte1 to byte20	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 yy yy yy yy

Possible values for yy: (20x)

- 00: Burst end
- 01: TProcess
- 02: TRatio Avg
- 03: T1 Avg
- 04: T2 Avg
- 05: TRatio Act
- 06: T1 Act
- 07 T2 Act
- 08 Attenuation Avg
- 09 TDetector
- 0A TBox
- 0B Epsilon T1
- 0C Epsilon T2
- 0D TProcess Avg
- 0E TProcess Act
- 0F mA I/O 1
- 10 mA I/O 2
- 11 mA I/O 3
- 12 Attenuation Act
- 13 Slope
- FF for READ

Examples:

Set Burst string to TProcess (01), TRatio (02), T1 (03), T2 (04) and Attenuation (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

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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 (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
Reset to normal mode: FF FF

5.5 Further Advanced Settings

DECIMAL	HEX	Command	Data	Answer	Result
169	0xA9	SET DEFAULT	byte1 to byte 11 *	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)

* Data for factory default: 46 41 43 54 44 45 46 41 55 4C 54

6 Contact information

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

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