

## Optris CS/ CSmicro communication interface

### Serial interface parameters

<b>Baud rate:</b>	<b>9600 / 115200, set by user (factory default: 9600)</b>
<b>Data bits:</b>	<b>8</b>
<b>Parity:</b>	<b>none</b>
<b>Stop bits:</b>	<b>1</b>
<b>Flow control:</b>	<b>off</b>

### Protocol

The protocol of the optris CS/CSmicro 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<sub>hex</sub> byte and the CS/CSmicro 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. The checksum byte is built 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 ...

### Set CS/ CSmicro in communication mode

If for example the device is configured in mV output or alarm mode, the following command is necessary in order to set the device in communication mode:

**39 57 41 49 54 32** (all in hex incl. checksum, name: "9WAIT2")

#### Procedure:

1. Set DTR signal to 0 → Switch off CS/CSM voltage
2. Wait at least 1 s
3. Set DTR signal to 1 → Switch on CS/CSM voltage
4. Wait about 250 ms until the firmware is running
5. Send command → Reply: 57 41 49 54 49 4E 47 ("WAITING"), if necessary, send several times until the answer is received. (time between sending and receiving max. 50 ms, Baud rate is 9600 Baud)
6. CS/CSM does not switch into the configured mode of the IN and OUT pin

**Note: The setting only works in the first second after switching on the power!**

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## 1 Basic Functions

LT mA	LT mV	xM mA	xM mV	DEZ	HEX	Commands	Data	Answer	Result	Unit
✓	✓	✓	✓	1	0x01	READ Temp - Process	none	byte1 byte2	$= (\text{byte1} * 256 + \text{byte2} - 1000) / 10$	°C
✓	✓	✓	✓	2	0x02	READ Temp - Head	none	byte1 byte2	$= (\text{byte1} * 256 + \text{byte2} - 1000) / 10$	°C
✓	✓	✓	✓	3	0x03	READ Temp - Actual (non averaged Process)	none	byte1 byte2	$= (\text{byte1} * 256 + \text{byte2} - 1000) / 10$	°C
✓	✓	✓	✓	9	0x09	READ Temp - Box	none	byte1 byte2	$= (\text{byte1} * 256 + \text{byte2} - 1000) / 10$	°C
✓	✓	✓	✓	131	0x83	READ Temp - Averaged		byte1 byte2	$= (\text{byte1} * 256 + \text{byte2} - 1000) / 10$	

### 1.1 IR- Settings

LT mA	LT mV	xM mA	xM mV	DEZ	HEX	Commands	Data	Answer	Result	Unit
✓	✓	✓	✓	4	0x04	READ Epsilon	none	byte1 byte2	$= (\text{byte1} * 256 + \text{byte2}) / 1000$	
✓	✓	✓	✓	132	0x84	SET Epsilon	byte1 byte2	byte1 byte2	$= (\text{byte1} * 256 + \text{byte2}) / 1000$	
✓	✓	✓	✓	5	0x05	READ Transmission	none	byte1 byte2	$= (\text{byte1} * 256 + \text{byte2}) / 1000$	
✓	✓	✓	✓	133	0x85	SET Transmission	byte1 byte2	byte1 byte2	$= (\text{byte1} * 256 + \text{byte2}) / 1000$	

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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.

LT mA	LT mV	xM mA	xM mV	DEZ	HEX	Commands	Data	Answer	Result	Unit
✓	✓	✓	✓	6	0x06	READ AVG Time	none	byte1 byte2	$= (\text{byte1} * 256 + \text{byte2}) / 10$	sec
✓	✓	✓	✓	134	0x86	SET AVG Time	byte1 byte2	byte1 byte2	$= (\text{byte1} * 256 + \text{byte2}) / 10$	sec
✓	✓	✓	✓	28	0x1C	READ AVG Mode (adaptive)	none	byte1	1 = adaptive mode, 0 = normal	
✓	✓	✓	✓	156	0x9C	SET AVG Mode	byte1	byte1	1 = adaptive mode, 0 = normal	
✓	✓	✓	✓	16	0x10	READ Smart Avg. Threshold	none	byte1 byte2	$= \text{byte1} * 256 + \text{byte2}$	°C
✓	✓	✓	✓	144	0x90	SET Smart Avg. Threshold	byte1 byte2	byte1 byte2	$= (\text{byte1} * 256 + \text{byte2}) / 10$	°C

### 2.2 Hold Functions

LT mA	LT mV	xM mA	xM mV	DEZ	HEX	Commands	Data	Answer	Result	Unit
✓	✓	✓	✓	7	0x07	READ Hold Time	none	byte1 byte2	$= (\text{byte1} * 256 + \text{byte2}) / 10$	sec
✓	✓	✓	✓	135	0x87	SET Hold Time	byte1 byte2	byte1 byte2	$= (\text{byte1} * 256 + \text{byte2}) / 10$	sec
✓	✓	✓	✓	29	0x1D	READ Hold Mode	none	byte1	0 = off, 1 = Peak, 2 = Valley, 3 = adv. Peak, 4 = adv. Valley	
✓	✓	✓	✓	157	0x9D	SET Hold Mode	byte1	byte1	0 = off, 1 = Peak, 2 = Valley, 3 = adv. Peak, 4 = adv. Valley	
✓	✓	✓	✓	30	0x1E	READ Advanced Hold Threshold	none	byte1 byte2	$= (\text{byte1} * 256 + \text{byte2} - 1000) / 10$	°C
✓	✓	✓	✓	158	0x9E	SET Advanced Hold Threshold	byte1 byte2	byte1 byte2	$= (\text{byte1} * 256 + \text{byte2} - 1000) / 10$	°C
✓	✓	✓	✓	34	0x22	READ Adv. Hold Hysteresis	none	byte1 byte2	$= (\text{byte1} * 256 + \text{byte2}) / 10$	°C
✓	✓	✓	✓	162	0xA2	SET Adv. Hold Hysteresis	byte1 byte2	byte1 byte2	$= (\text{byte1} * 256 + \text{byte2}) / 10$	°C

# Communication interface

## 3 Outputs, Inputs, LED

### 3.1 Outputs

LT mA	LT mV	xM mA	xM mV	DEZ	HEX	Commands	Data	Answer	Result	Unit
✓	✓	✓	✓	17	0x11	READ Scale_Out_Min	none	byte1 byte2	= byte1*256 + byte2	µA
✓	✓	✓	✓	145	0x91	SET Scale_Out_Min	byte1 byte2	byte1 byte2	mV or µA	
✓	✓	✓	✓	18	0x12	READ Scale_Out_Max	none	byte1 byte2	= byte1*256 + byte2	µA
✓	✓	✓	✓	146	0x92	SET Scale_Out_Max	byte1 byte2	byte1 byte2	mV or µA	
✓	✓	✓	✓	24	0x18	READ Low End for outputs	none	byte1 byte2	= (byte1*256 + byte2 - 1000) / 10	°C
✓	✓	✓	✓	152	0x98	SET Low End for outputs	byte1 byte2	byte1 byte2	= (byte1*256 + byte2 - 1000) / 10	°C
✓	✓	✓	✓	25	0x19	READ High End for Outputs	none	byte1 byte2	= (byte1*256 + byte2 - 1000) / 10	°C
✓	✓	✓	✓	153	0x99	SET High End for outputs	byte1 byte2	byte1 byte2	= (byte1*256 + byte2 - 1000) / 10	°C
	✓		✓	36	0x24	READ Tmin Output 0-1V	none	byte1 byte2	= (byte1*256 + byte2 - 1000) / 10	
				164	0xA4	SET Tmin Output0-1V	byte1 byte2	byte1 byte2	= (byte1*256 + byte2 - 1000) / 10	
	✓		✓	37	0x25	READ Tmax Output 0-1V	none	byte1 byte2	= (byte1*256 + byte2 - 1000) / 10	
				165	0xA5	SET Tmax Output0-1V	byte1 byte2	byte1 byte2	= (byte1*256 + byte2 - 1000) / 10	
✓		✓		48	0x30	READ mA Mode	none	byte1	0 - mA, 1 - Alarm	
✓		✓		176	0xB0	SET mA-Pin Mode	byte1	byte1	0 - mA, 1 - Alarm	
✓	✓	✓	✓	51	0x33	READ Out-Pin Mode	none	byte1	0 - TXD, 1 - Burst, 2 - Alarm, 3 - 0..10V, 4 - 0..1V, 5 - TCK	
✓	✓	✓	✓	179	0xB3	SET Out-Pin Mode	byte1	byte1	0 - TXD, 1 - Burst, 2 - Alarm	
✓	✓	✓	✓	13	0x0D	READ Percentage Value (LED and MV)	byte1	byte1 byte2	<a href="#">see Percentage output Value</a>	°C
✓	✓	✓	✓	141	0x8D	SET Percentage Value (LED and MV)	byte1 byte2 byte3	byte1 byte2	<a href="#">see Percentage output value</a>	

#### 3.1.1 Description Percentage Output Value read / write (all bytes in HEX)

Send for read: 0D xx, write: 0D xx yy yy

Possible value for xx:

00: LED - Temp. Range min    yy yy = Temp.\*10+1000  
 01: LED - Temp. Range max    yy yy = Temp.\*10+1000  
 10: MV - Temp. Range min    yy yy = Temp.\*10+1000  
 11: MV - Temp. Range max    yy yy = Temp.\*10+1000

Answer: yy yy

Temp. = (yy yy → Dez) / 10 - 100

# Communication interface

## 3.2 Inputs

LT mA	LT mV	xM mA	xM mV	DEZ	HEX	Commands	Data	Answer	Result	Unit
✓	✓	✓	✓	50	0x32	READ In-Pin Mode	none	byte1	0 - off, 1 - RXD, 2 - Alarm, 3 - Alarm with Temp output, 4 - ValidHi, 5 - ValidLo, 6 - HoldLoHi, 7 - Hold HiLo, 8 - Percentage output, 9 - HoldResetLo, 10 - HoldresetHi, 11 - ext. Emiss., 12 - ext. Ambient, 13 - AutoEmissCorrection	
✓	✓	✓	✓	55	0x37	SET In-Pin Mode temporary	byte1	byte1	0 - off, 1 - RXD, 2 - Alarm, 3 - Alarm with Temp output, 4 - ValidHi, 5 - ValidLo, 6 - HoldLoHi, 7 - Hold HiLo, 8 - Percentage output, 9 - HoldResetLo, 10 - HoldresetHi	

## 3.3 LED

LT mA	LT mV	xM mA	xM mV	DEZ	HEX	Commands	Data	Answer	Result	Unit
✓	✓	✓	✓	49	0x31	READ LED Mode	none	byte1	0 - off, 1 - Alarm, 2 - Aiming min, 3 - Aiming max, 4 - Self diagnostic, 5 - Percentage output	
✓	✓	✓	✓	177	0xB1	SET LED Mode	byte1	byte1	0 - off, 1 - Alarm, 2 - Aiming min, 3 - Aiming max, 4 - Self diagnostic, 5 - Percentage output	
✓	✓	✓	✓	178	0xB2	SET In-Pin Mode	byte1	byte1	0 - off, 1 - RXD, 2 - Alarm, 3 - Alarm with Temp output, 4 - ValidHi, 5 - ValidLo, 6 - HoldLoHi, 7 - Hold HiLo, 8 - Percentage output, 9 - HoldResetLo, 10 - HoldresetHi, 11 - ext. Emiss., 12 - ext. Ambient, 13 - AutoEmissCorrection	

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## 4 Alarm Settings

The optris CS/CSmicro has 3 alarms: AL1 = LED, AL2 = Input PIN (Transistor), AL3 = mV/mA output

LT mA	LT mV	xM mA	xM mV	DEZ	HEX	Commands	Data	Answer	Result	Unit
✓	✓	✓	✓	10	0x0A	READ AL1 value	byte1	byte1 byte2	<a href="#">see Alarm Value</a>	°C
✓	✓	✓	✓	138	0x8A	SET AL1 Value	byte1 byte2 byte3	byte1 byte2	<a href="#">see Alarm Value</a>	°C
✓	✓	✓	✓	11	0x0B	READ AL2 value	byte1	byte1 byte2	<a href="#">see Alarm Value</a>	°C
✓	✓	✓	✓	139	0x8B	SET AL2 Value	byte1 byte2 byte3	byte1 byte2	<a href="#">see Alarm Value</a>	°C
✓	✓	✓	✓	12	0x0C	READ AL3 value	byte1	byte1 byte2	<a href="#">see Alarm Value</a>	°C
✓	✓	✓	✓	140	0x8C	SET AL3 Value	byte1 byte2 byte3	byte1 byte2	<a href="#">see Alarm Value</a>	°C

### 4.1 Description Alarm Value read / write (all bytes in HEX)

Send for read LED: 0A xx, write: 8A xx yy yy  
 Send for read In-Pin: 0B xx, write: 8B xx yy yy  
 Send for read Out-Pin: 0C xx, write: 8C xx yy yy

Possible values for xx:

00: Threshold TProcess	yy yy = Temp.*10+1000	
01: Threshold TActual	yy yy = Temp.*10+1000	
02: Threshold THead	yy yy = Temp.*10+1000	
03: Threshold TElectronic	yy yy = Temp.*10+1000	
06: Alarm mX min	yy yy = mV / mA*10	only AL3
07: Alarm mX max	yy yy = mV / mA*10	only AL3
08: Hysteresis	yy yy = Hysteresis*10	
09: Source	yy yy = 0 ... 3	
0A: Flags	yy yy = Bits	

Answer: yy yy  
 xx 00...03: yy yy = Temperature  
 xx 08: yy yy = Temperature  
 xx 09: yy yy = 0 - TProcess, 1 - THead, 2 - TElectronic, 3 - TActual  
 xx 0A: yy yy = BIT0 - active, BIT1 - NormClose, BIT2 - Diff.Mode



# Communication interface

## 5 Advanced Settings

### 5.1 Sensor Information/ Calibration

LT mA	LT mV	xM mA	xM mV	DEZ	HEX	Commands	Data	Answer	Result	Unit
✓	✓	✓	✓	14	0x0E	READ Serial Number	none	byte1 byte2 byte3 byte4	= byte1*2 <sup>24</sup> + byte2*2 <sup>16</sup> + byte3*2 <sup>8</sup> + byte4	
✓	✓	✓	✓	15	0x0F	READ FW Rev.	none	byte1 byte2	= byte1*256 + byte2	
✓	✓	✓	✓	69	0x45	READ Sensor Information	byte1	byte1 - byte6	<a href="#">see Model Information description</a>	
✓	✓	✓	✓	71	0x47	READ Description String	byte1	byte1 ... Byte16	0 : 16 sign	
✓	✓	✓	✓	38	0x26	READ Tweak Offset	none	byte1 byte2	= (byte1*256 + byte2 - 1000) / 10	°C
✓	✓	✓	✓	166	0xA6	SET Tweak Offset	byte1 byte2	byte1 byte2	=(byte1*256 + byte2 - 1000) / 10	°C
✓	✓	✓	✓	39	0x27	READ Tweak Gain	none	byte1 byte2	= (1/2 <sup>15</sup> ) * (byte1*256 + byte2)	
✓	✓	✓	✓	167	0xA7	SET Tweak Gain	byte1 byte2	byte1 byte2	= (1/2 <sup>15</sup> ) * (byte1*256 + byte2)	
✓	✓	✓	✓	183	0xB7	SET Description String	byte1 ... Byte17	byte1 .. byte16	0 + 16 sign	

With the tweak function the sensor can be linear recalibrated.

#### 5.1.1 Description Model Information Value read (all bytes in HEX)

Send for read: 45 xx

Possible values for xx:

00: Block 0

01: Block 1

yy yy = 0 - Fix, 1 - Head temp

yy yy = Temp.\*10+1000

Answer: xx = 0: 30 Byte, XX = 1: 24

Source = yy yy = 0 - Fix, 1 - Head temp

Temp. = (yy yy → Dez) / 10 - 100

Block 0:

Byte0 Byte1

Byte2 Byte3

Byte4 Byte5

Byte6 Byte7

Byte8 Byte9

Byte10 Byte11

Byte12 Byte13

Byte14 Byte15

Byte16 Byte17

Byte18 ... Byte30

Modelword

ModelFlags1

ModelFlags2

ModelFlags3

ModelFlags4

Temp min

Temp max

Head temp min

Head temp max

0

Block 1:

Byte0 ... Byte7

Byte8 ... Byte15

Byte16 ... Byte23

Model String 1

Model String 2

Model String 3

# Communication interface

## 5.2 Advanced IR-Settings

LT mA	LT mV	xM mA	xM mV	DEZ	HEX	Commands	Data	Answer	Result	Unit
	✓		✓	21	0x15	READ Emiss Value	byte1	byte1 byte2	<a href="#">see mVin-Emiss Value</a>	
✓	✓	✓	✓	40	0x28	READ Ambient Value	byte1	byte1 byte2	<a href="#">see Ambient Value</a>	
✓	✓	✓	✓	50	0x32	READ In-Pin Mode	none	byte1	0 - off, 1 - RXD, 2 - Alarm, 3 - Alarm with Temp output, 4 - ValidHi, 5 - ValidLo, 6 - HoldLoHi, 7 - Hold HiLo, 8 - Percentage output, 9 - HoldResetLo, 10 - HoldresetHi, 11 - ext. Emiss., 12 - ext. Ambient, 13 - AutoEmissCorrection	
✓	✓	✓	✓	178	0xB2	SET In-Pin Mode	byte1	byte1	<b>0 - off,</b> 1 - RXD 2 - Alarm, 3 - Alarm with Temp output, 4 - ValidHi, 5 - ValidLo, 6 - HoldLoHi, 7 - Hold HiLo, 8 - Percentage output, 9 - HoldResetLo, 10 - HoldresetHi, <b>11 - ext. Emiss.,</b> <b>12 - ext. Ambient,</b> 13 - AutoEmissCorrection	
	✓		✓	149	0x95	SET Emissivity Value	byte1 byte 2 byte3		<a href="#">see mVin-Emiss-Value</a>	
✓	✓	✓	✓	168	0xA8	SET Ambient Value	byte1 byte2 byte3	byte1 byte2	<a href="#">see Ambient Value</a>	

### 5.2.1 Description Emissivity value read / write (all bytes in HEX)

Send for read 15 xx, write: 95 xx yy yy

Possible values for xx:

00: Emiss. Source	yy yy = 0 - Fix, 1 - mV Input
01: Fix Emiss.	yy yy = Emiss.*1000
02: Emiss. @ 0V ext. power	yy yy = Emiss.*1000
03: Emiss. @ 10V ext. power	yy yy = Emiss.*1000

Answer: yy yy                      Source = yy yy = 0 - Fix, 1 - mV Input  
    Emiss. = (yy yy → Dez) /1000

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## 5.2.2 Description Ambient value read / write (all bytes in HEX)

Send for read: 28 xx, write: A8 xx yy yy

Possible values for xx:

00: Ambient Source                      yy yy = 0 - Fix, 1 – Head temp, 2 - mV Input  
 01: Ambient Temp                      yy yy = Temp.\*10+1000  
 02: Ambient Temp @ 0V ext. power   yy yy = Temp.\*10+1000  
 03: Ambient Temp @ 10V ext. power   yy yy = Temp.\*10+1000

Answer: yy yy                              Source = yy yy = 0 - Fix, 1 - Head temp  
     Temp. = (yy yy → Dez) /10 – 100

## 5.3 Advances Digital Communication Settings

LT mA	LT mV	xM mA	xM mV	DEZ	HEX	Commands	Data	Answer	Result	Unit
✓	✓	✓	✓	45	0x2D	READ if Checksum expect	none	byte1	0 - without Checksum, 1 - with Checksum	
✓	✓	✓	✓	173	0xAD	SET Checksum expected	byte1	byte1	0 - no Checksum expected, 1 - Checksum expected	
✓	✓	✓	✓	80	0x50	READ out Burst String	none	byte1 ... byte8	<a href="#">see Burstmode description</a>	
✓	✓	✓	✓	81	0x51	SET Burst String	byte1 ... byte8	byte1 ... byte8	<a href="#">see Burstmode description</a>	
✓	✓	✓	✓	82	0x52	SET Burst mode	byte1	byte1	1 = start , 0 = stop	
✓	✓	✓	✓	128	0x80	SET Baud rate	byte1	byte1	0 - temp. 9600, 1 - temp. 115200, 2 - 9600, 3 - 115200, 255 - reading	

**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 ...

# Communication interface

## 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.

LT mA	LT mV	xM mA	xM mV	DEZ	HEX	Commands	Data	Answer	Result	Unit
✓	✓	✓	✓	26	0x1A	SET DAC mA/mV	byte1	byte1	= byte1 / 10	mA/ V *
✓	✓	✓	✓	154	0x9A	SET DAC Percentage	byte1	byte1	0..100	
✓	✓	✓	✓	27	0x1B	SET DAC Temp	byte1 byte2	byte1 byte2	= (byte1*256 + byte2 - 1000) / 10	°C
✓	✓	✓	✓	129	0x81	SET DAC mA/mV	byte1	byte1		°C
✓	✓	✓	✓	130	0x82	SET DAC to normal				
	✓		✓	31	0x1F	READ Online Maintenance	byte 1	byte1 byte2	<a href="#">see Online Maintenance-Value</a>	
	✓		✓	159	0x9F	SET Online Maintenance	byte1 byte2 byte3	byte1 byte2	<a href="#">see Online Maintenance-Value</a>	

\* Step size 0,1 V or 0,1 mA

### 5.4.1 Description Online Maintenance value read / write (all bytes in HEX)

Send for read: 1F xx, write: 9F xx yy yy

Possible values for xx:

00: Pre Alarm difference	yy yy = temperature difference (1/10°C steps)
01: TriState0	yy yy = No alarm mV value
02: TriState1	yy yy = Pre alarm mV value
03: TriState2	yy yy = Alarm mV value
04: Config	yy yy = BIT0 - Mode on
05: Voltage for Service	yy yy = Voltage for service (0.1V steps)
06: Alarm mV min	yy yy = Voltage for alarm (0.1V steps)
07: Alarm mV max	yy yy = Voltage for alarm (0.1V steps)

## 5.5 Emissivity Determination

LT mA	LT mV	xM mA	xM mV	DEZ	HEX	Commands	Data	Answer	Result	Unit
✓	✓	✓	✓	161	0xA1	Calculating Emissivity	byte1 ... byte4	byte1 byte2	= (byte1*256 + byte2) / 1000 <a href="#">see Emissivity description</a>	

### 5.5.1 Description Emissivity calculation (all bytes in HEX)

Send: A1 xx xx yy yy

xx xx = Current temperature of the device

yy yy = Set Temperature

Receives e.g. 03 2A

Emissivity = 0x032A = 810/1000 = 0.810

# Communication interface

## 5.6 Failsafe Mode

LT mA	LT mV	xM mA	xM mV	DEZ	HEX	Commands	Data	Answer	Result	Unit
✓	✓	✓	✓	22	0x16	READ Failsafe Value	byte1	byte1 byte2	<a href="#">see Failsafe Value</a>	
✓	✓	✓	✓	150	0x96	SET Failsafe Value	byte1 byte2 byte3	byte1 byte2	<a href="#">see Failsafe Value</a>	

### 5.6.1 Description Failsafe value read / write (all bytes in HEX)

Send for read: 16 xx, write: 96 xx yy yy

Possible values xx:

00: TProcess min	yy yy = Temp.*10+1000
01: TProcess max	yy yy = Temp.*10+1000
02: µA min	yy yy = µA
03: µA max	yy yy = µA
04: TProcess active	yy yy = 0 - off, 1 - on
10: TActual min	yy yy = Temp.*10+1000
11: TActual max	yy yy = Temp.*10+1000
12: µA min	yy yy = µA
13: µA max	yy yy = µA
14: TActual active	yy yy = 0 - off, 1 - on
20: THead min	yy yy = Temp.*10+1000
21: THead max	yy yy = Temp.*10+1000
22: µA min	yy yy = µA
23: µA max	yy yy = µA
24: THead active	yy yy = 0 - off, 1 - on
30: TElectronic min	yy yy = Temp.*10+1000
31: TElectronic max	yy yy = Temp.*10+1000
32: µA min	yy yy = µA
33: µA max	yy yy = µA
34: TElectronic active	yy yy = 0 - off, 1 - on

Answer: yy yy      Temp. = (yy yy → Dez) /10 - 100  
 µA = (yy yy → Dez)  
 active = (yy yy = 1)

## 5.7 Material table

LT mA	LT mV	xM mA	xM mV	DEZ	HEX	Commands	Data	Answer	Result	Unit
✓		✓		35	0x23	READ Material table	byte1 byte2	byte1 byte2	<a href="#">see Material Table</a>	
✓		✓		163	0xA3	SET Material Table	byte1 ... byte4	byte1 byte2	<a href="#">see Material Table</a>	
✓		✓		20	0x14	READ mV Vcc	none	byte1 byte2	= byte1*256 + byte2	mV

# Communication interface

## 5.7.1 Description Material Table read / write (all bytes in HEX)

Send for read: 23 xx yy, write A3 xx yy zz zz    Answer: zz zz

Possible values for xx and yy:

xx = 0x00 ... 0x09: Position in Material table	
yy = 0x00: Read Emissivity	zz zz = Emissivity * 1000
yy = 0x01: Read Alarm	zz zz = Temp * 10+1000
yy = 0x02: Read Difference Mode	zz zz = 0 - off, 1 - on
yy = 0x03: Read Normally closed	zz zz = 0 - n.o., 1 - n.c.
xx = 0x10: Read Option	
yy = 0x00: Read Material Table on	zz zz = 0 - off, 1 - on
yy = 0x01: 6 - 15V or 11 - 20V ?	zz zz = 0 - 6-15V, 1 - 11-20V

## 5.8 Burst mode

LT mA	LT mV	xM mA	xM mV	DEZ	HEX	Commands	Data	Answer	Result	Unit
✓	✓	✓	✓	23	0x17	READ Burst delay	none	byte1	byte1 * 100	ms
✓	✓	✓	✓	151	0x97	SET Burst delay	byte1	byte1	= byte1 * 100	ms
✓	✓	✓	✓	80	0x50	Burst String read out	none	byte1 ... byte8	<a href="#">see Burst mode description</a>	
✓	✓	✓	✓	81	0x51	Set Burst String	byte1 ... byte8	byte1 ... byte8	<a href="#">see Burst mode description</a>	
✓	✓	✓	✓	82	0x52	Set Burst mode	byte1	byte1	1 = start , 0 = stop	

### 5.8.1 Description Burst commands (all bytes in HEX)

Send: 50            Commands to read the Burst strings

Receives e.g.: 12 34 56 78 00 00 00 00            Burst string

The Burst string consists of 16 "half bytes"!

Possible value per half byte:

- 1 - Process temperature
- 2 - Head temperature
- 3 - Electronic temperature
- 4 - Actual process temperature
- 5 - Emissivity
- 6 - Transmissivity
- 7 - Non averaged temperature
- 8 - mV Input Pin (mV device only)
- 9 - Vcc (mV Pin only)
- 10 - Actual ambient temperature
- 11 - 15 not used
- 0 - Burst string end

Send: 51 12 00 00 00 00 00 00            Commands to set the Burst string, sets Burst string to Process Temperature and Head Temperature

# Communication interface

Receives: 12 00 00 00 00 00 00 00

Send: 52 01

Commands to start the Burst mode

Receives: AA AA xx xx xx xx xx xx ...

AA AA is meant for synchronization, is sent before each new burst

Send: 52 00

Commands to end Burst mode

**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 ...

## 5.9 Aiming

LT mA	LT mV	xM mA	xM mV	DEZ	HEX	Commands	Data	Answer	Result	Unit
✓	✓	✓	✓	19	0x13	READ Aiming Value	byte1	byte1	<a href="#">see Aiming Value</a>	
✓	✓	✓	✓	147	0x93	SET Aiming Value	byte1 byte2 byte3	byte1 byte2	<a href="#">see Aiming Value</a>	

### 5.9.1 Description Aiming Value read / write (all bytes in HEX)

Send for read: 13 xx, write: 93 xx yy yy

Possible values for xx:

00: Hysteresis

01: Reset time

yy yy = Temp.\*10

yy yy = Seconds\*10

Answer: yy yy

Temp. = (yy yy → Dez) /10 - 100

Time = (yy yy → Dez) /10 [s]

## 5.10 Further Advanced Settings

LT mA	LT mV	xM mA	xM mV	DEZ	HEX	Commands	Data	Answer	Result	Unit
✓	✓	✓	✓	169	0xA9	SET DEFAULT	byte1 ... byte11	byte1	"FACTDEFAULT" → Answer 0: wrong pass, 1 : ok	
✓	✓	✓	✓	112	0x70	SET Settings to change saving	byte1	byte1	1 - Data is no longer written to flash, 0 - Data is written in the flash	
✓	✓	✓	✓	113	0x71	READ Settings to change saving	none	byte1	1 - Data is no longer written to flash, 0 - Data is written in the flash	

# Communication interface

## 6 Examples

READ COMMANDS	SEND	RECEIVE	
Reading a process temperature	01	04 D3	$(04D3_{\text{hex}} - 1000) / 10 = (1235 - 1000) / 10 = 23.5^{\circ}\text{C}$
Reading emissivity	04	03 B6	$03B6_{\text{hex}} / 1000 = 950 / 1000 = 0.950$
Reading serial number	0E	3D CC 5D	$3DCC5D_{\text{hex}} = 4050013$
Query whether the device uses checksums	2D	01	01 = Device uses checksums

SET COMMANDS	SEND *)	RECEIVE	
Setting the alarm 1 value	8A 04 D3 [5D]	04 D3	$(04D3_{\text{hex}} - 1000) / 10 = (1235 - 1000) / 10 = 23.5^{\circ}\text{C}$
Setting the emissivity to 0.95	84 03 B6 [31]	03 B6	$03B6_{\text{hex}} / 1000 = 950 / 1000 = 0.950$
Switch the checksums off, if the device uses checksums	AD 00 [AD]	00	
Switch the checksums on, if the device does not use checksums	AD 01	01	

\*) Checksum in square brackets

### 6.1 Burst mode

The burst string consists of 16 "half bytes".

HALF BYTE	VALUE
1	Target temperature
2	Head temperature
3	Box temperature
4	Current target temperature
5	Emissivity
6	Transmissivity
7	Non averaged temperature
8	mV Input Pin (mV device only)
9	Vcc (mV Pin only)
10	Actual ambient temperature
11-15	not used
0	End of burst string

READ/SET BURST EXAMPLES	SEND	RECEIVE	
Command for read out of burst string	50	12 34 56 78	reads the burst string
Set burst string	51 12 00 00 00	12 00 00 00	sets burst string to target and head temperature
Start burst mode	52 01	AA AA xx xx xx xx xx xx	starts the burst mode; AA AA is for synchronization, will be send in front of each new burst
Stop burst mode	52 00		stops the burst mode



## 7 Contact information

If you plan your own software to query and control the optris CS/CSmicro sensor and you have further questions please contact:

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