

### **Optris Easy Comm via Ethernet**

#### Introduction

Optris Easy Comm is a small and simple software solution for developers who wants to have direct access to temperature data out of Optris infrared cameras<sup>1</sup>. The complex temperature calculation is fully processed in the device and the user of Easy Comm gets temperature information of all pixels.

This document gives a short overview of the interface and protocol, how to setup the camera and describes the format for the temperature data stream.

#### **Interface and Protocol**

Besides the established USB interface for Optris infrared cameras, some cameras also have an Ethernet interface as a second communication path especially for a longer distance between instrument and processing PC. For real-time data streaming Optris use the User Datagram Protocol (UDP). This connectionless communication model provides only checksums for data integrity, source and destination port numbers and the packet length. With this minimal set UDP is preferred for fast data streaming, but has a few drawbacks. UDP has no handshake-mechanism, there is no guarantee of delivery, ordering, or duplication protection. If some error protection is needed, the user must handle this in their application.

Optris infrared cameras with Ethernet interface act as UDP client for video streaming (temperature or raw data) and sends packets to a user selectable port. Easy Comm Ethernet software examples act as UDP server who listen to this port.

The default configuration is the following:

Camera IP address:	192.168.0.101
Computer IP address:	192.168.0.100
Subnet mask:	255.255.255.0
Port number:	50101

The transfer from camera to computer does not need to be initiated and it cannot be stopped, but the camera must be configured for it.

<sup>&</sup>lt;sup>1</sup> only for Xi 80 and Xi 410

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### Setup the camera

After installing the latest Optris PIX Connect and connecting an Optris infrared camera with Ethernet interface to your computer (for setup see Xi or PIX Connect manual), you can configure the camera for the specific measurement environment.

It depends on the type of camera what you can configure.

#### Important: Easy Comm must use Flag automatic enabled!

Function	Xi 80	Xi 410			
Tab - Measure areas					
max. measurement areas *)	9	3			
Shape	al	l			
Mode	Minimum, Maximum, Mea	an value, Distribution [%]			
Measure area depending on emissivity	Yes	No			
max. calculated objects	9				
Operation	Difference, Absolute differenc	Average, Peak Hold, Valley y Hold			
Tab - Device					
Flag automatic	Ye	s			
min. / max. Interval	Ye	es			
Emissivity	Yes				
Transmissivity	Yes				
Ambient temperature	Yes				
Temperature range	Ye	S			
Video formats	Ye	S			
Tab - Alarms					
Low / high Alarms	Ye	S			
Alarms to PIF (AO/DO)	Ye	S			
Tab – Device (PIF)					
Analog Inputs	Emissivity, Ambient temperature, Flag Control, Reset Peak- /Valley-Hold				
Analog Outputs	Measure area, Internal temperature, Flag Status, Alarm, Frame sync, Fail-safe, Autonomous status				
Digital Outputs	Flag Status, Alarm, Frame sync,	Fail-safe, Autonomous status			
Fail-safe	No	Yes			

All these configurations are handled by the camera. Some configurations are applied immediately, some configurations must be enabled by checking "*using autonomously by device*".

\*) Via a super area several measuring areas can be bundled into one measuring area.

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After finishing the configuration, it must be stored in the camera. This is handled differently by device.

Xi 80:

• wait for at least 5 seconds after closing Configuration with "OK"

Xi 410:

click on "Set configuration to device" <sup>2</sup> in menu bar Devices

Dev	ices	Tools	Help					
	Refr	esh flag		F5				
~	Enable Ethernet							
格	Ethe	rnet setti	ngs (TCP/IP)					
<b>)</b>	Set o	configura	tion to device					

Configuration done! Now activate the "*Direct temperature mode*" to work with Easy Comm. This is done in the Configuration menu under *External Communication*.

Configuration					×
Snapshots / Copy t General Measure IR Image arranging	o clipboard Trig. Record areas Temp. profiles Alams Event grabbe	ding / Snapshots Capture Sc Temp/Time diagram Device r External Communication E	reen Histogran Device (PIF) Extended Layout	n Extended measurin Referencing Record	g Measuring colors ling Playing
Mode Off	Connect SDK (IPC)	○ COM-Port ○ V	Veb Server	Direct temperate	ure mode

Once the "*Direct temperature mode*" is enabled, PIX Connect shows "*temperature mode*" in the corners of the live IR image.



Before you close PIX Connect to work with Easy Comm check the focus settings!

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### Easy Comm – Ethernet Examples

Easy Comm Ethernet examples (C#) are located in the installation path of PIX Connect or can be easily found in the PIX Connect software menu under *Help* and *Easy Comm*. These ready to use software examples show, how to:

- setup a UDP server listening on the default port 50101
- collect the temperature data from the data stream
- create a bitmap to show this in the user interface

Once the application has a complete temperature array, the user can build their own post processing algorithm.

To understand the structures behind the code, more information about the temperature streaming format is needed.

### Streaming Data Format

Due to the different resolution of Xi 80 and Xi 410 the data format is slightly different. But both cameras send packets with a specific length. The length of a packet depends on how many rows are in one packet. For Xi 80 there are three rows and for Xi 410 there is only one row per packet. Each row contains all pixels for this row with two bytes per pixels plus two header bytes. The first byte of the header is a row counter and the second byte is an image counter. Additionally, there are two more rows for metadata.

Data details	Xi 80	Xi 410			
Image resolution with metadata	80 x 84	384 x 242			
Image resolution	80 x 80	384 x 240			
Rows per packets	3	1			
Bytes per pixel		2			
Header length in bytes	2				
Packet length bytes	length bytes 482 770				

### Table 1: Summary of data details

The packet length is now calculated by following formula:

Packet length = Header length + (Rows per packet \* Row length \* 2 Bytes per pixel)

**Xi 80:** Packet length = 2 Bytes + (3 \* 80 \* 2 Bytes) = 482 Bytes

**Xi 410:** Packet length = 2 Bytes + (1 \* 384 \* 2 Bytes) = 770 Bytes

Packet details will be explained with protocol screen shots from "Wireshark", a free Ethernet protocol tool. It is highly recommended for the developer to verify all data transfers on the camera Ethernet bus with "Wireshark".

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### Packet details - Xi 80

In the screen shot below it can be seen that with this packet the image starts with row number 0x00 (0 decimal) of an image, numbered with 0x1d (29 decimal) and the length of 482 bytes. Followed by the next UDP packets.

	*Etherne	t 3							- 0	×
Dat	ei Bear	beiten Ansicht	Navigation Aufzeich	nnen Analyse	Statistiken Tel	phonie Wireless	Tools Hilfe			
	<b></b>		• • • • • •	ал <b>—</b> —	- 	-				
<u> </u>					~~~					
<b>.</b>	Anzeigefilt	er anwenden <ctrl-< td=""><td>-/&gt;</td><td></td><td></td><td></td><td></td><td></td><td><u> </u></td><td><b>▼</b> +</td></ctrl-<>	-/>						<u> </u>	<b>▼</b> +
No.		Time	Source	Destination	Protocol Le	ngth bmRequestType	Data	Text Info		^
	2828	2.014704	192.168.0.101	192.168.0.100	UDP	524	4b1ce204e404e404e604e704e704e504e	K\034�\00… 49154 → 50101 Len=482		
	2829	2.014704	192.168.0.101	192.168.0.100	UDP	524	4e1ce004df04e204e304e504e304e104e404e	N\034�\00… 49154 → 50101 Len=482		
	2830	2.014919	192.168.0.101	192.168.0.100	UDP	524	511c00000000000000000000000000000000000	Q\034 49154 → 50101 Len=482		
	2831	2.033089	192.168.0.101	192.168.0.100	UDP	524	001de504e604ed04f104f304f704f804fc04f	49154 → 50101 Len=482		
	2832	2.033089	192.168.0.101	192.168.0.100	UDP	524	031de804ec04f004f604f504f804f904fa04f	\003\035� 49154 → 50101 Len=482		
	2833	2.033089	192.168.0.101	192.168.0.100	UDP	524	061dee04ef04f204f504f604f904fc04fc04f	\006\035� 49154 → 50101 Len=482		<b>×</b>
>	Frame 2	831: 524 bytes	on wire (4192 bit	s), 524 bytes	captured (41	92 bits) on inte	rface \Device\NPF {63630049-5074-40F7-BF63-	4E77391EFB91}, id 0		^
>	Etherne	t II, Src: Optr	is 0a:33 (9c:43:1	le:70:0a:33), D	st: CeLink 0	d:26:6c (a0:ce:c	3:0d:26:6c)			
>	Interne	t Protocol Vers	ion 4, Src: 192.1	.68.0.101, Dst:	192.168.0.1	ao `	· ·			
>	User Da	tagram Protocol	, Src Port: 49154	, Dst Port: 50	101					
>	Data (4	82 bytes)								~
000	00 a0 (	e c8 0d 26 6c 9	9c 43 1e 70 0a 3	3 08 00 45 00	····&1·C ·	0-3E-				^
00:	LO 01 1	fe ad 2c 00 00 f	ff 11 8a a8 <u>c0 a</u>	<u>8 00 65</u> c0 a8	,	····e··				
003	20 <b>00 (</b>	54 c0 02 c3 b5 0	01 ea 60 73 <mark>00</mark> 1	d e5 04 e6 04	-d `					
003	30 <mark>ed (</mark>	04 f1 04 f3 04 f	f7 04 f8 04 fc 0	4 fd 04 ff 04	••••••					
004	10 03 0	05 08 05 07 05 0	08 05 0a 05 0b 0	5 0d 05 10 05						
00	00 0T 0	05 08 05 08 05 0 5 12 05 14 05 1	0e 05 10 05 0e 0 10 05 0d 05 0c 0	5 15 05 14 05 5 05 05 00 05						
000	70 07 0	05 15 05 14 05 1 05 05 05 04 05 0	10 05 00 05 0C 0 01 05 01 05 02 0	5 02 05 09 05						
008	30 f6 0	04 f2 04 f1 04 f	f7 04 00 05 01 0	5 ff 04 04 05						
009	90 06 0	95 08 05 05 05 0	06 05 07 05 08 0	5 09 05 09 05	· · · · · · · · · ·					
00;	a0 <mark>0a (</mark>	05 09 05 0c 05 0	0f 05 10 05 0e 0	5 10 05 12 05	•••••					
001	00 <mark>11 (</mark>	95 12 05 11 05 1	13 05 15 05 12 0	5 16 05 12 05	····· ·					
000	:0 16 (	05 18 05 19 05 1	1a 05 1c 05 1a 0	5 e2 04 e9 04						×
$\circ$	🖉 By	tes 42-523: Text (data	a.text)					Pakete: 3123 · Angezeigt: 3123 (100.0%) · Verworfen: 0 (0.	0%) Profil:	Default 🔡

The next 2 bytes contain the temperature of the first pixel in this row, the most left pixel (0,0) in the row of the image, the next two bytes contain the temperature of the next pixel (1,0) to the right and so on. The temperature values are 16 bit numbers, stored with the LSB first. So, value for the top left pixel is 0x04e5 (1253). The value is in a special format, which is defined as:

Temperature in  $^{\circ}C = (value - 1000) / 10$ 

For this example: 25.3 °C.

Generally, the packets have this format with row number n.

Header		Data					
row counter	image counter	LSB <sub>Px0, n</sub>	MSB <sub>Px0, n</sub>	LSB <sub>Px1, n</sub>	MSB <sub>Px1, n</sub>	 LSB <sub>Px79, n</sub>	MSB <sub>Px79, n</sub>
		Data					
		LSB <sub>Px0, n+1</sub>	MSB <sub>Px0, n+1</sub>	LSB <sub>Px1, n+1</sub>	MSB <sub>Px1, n+1</sub>	 LSB <sub>Px79, n+1</sub>	MSB <sub>Px79, n+1</sub>
		Data					
		LSB <sub>Px0, n+2</sub>	MSB <sub>Px0, n+2</sub>	LSB <sub>Px1, n+2</sub>	MSB <sub>Px1, n+2</sub>	 LSB <sub>Px79, n+2</sub>	MSB <sub>Px79, n+2</sub>

The next UDP packet is followed by row number n+3.

Header		Data					
row counter+3	image counter	LSB <sub>Px0, n+3</sub>	MSB <sub>Px0, n+3</sub>	LSB <sub>Px1, n+3</sub>	MSB <sub>Px1, n+3</sub>	 LSB <sub>Px79, n+3</sub>	MSB <sub>Px79, n+3</sub>
		Data					
		LSB <sub>Px0, n+4</sub>	MSB <sub>Px0, n+4</sub>	LSB <sub>Px1, n+4</sub>	MSB <sub>Px1, n+4</sub>	 LSB <sub>Px79, n+4</sub>	MSB <sub>Px79, n+4</sub>
		Data					
		LSB <sub>Px0, n+5</sub>	MSB <sub>Px0, n+5</sub>	LSB <sub>Px1, n+5</sub>	MSB <sub>Px1, n+5</sub>	 LSB <sub>Px79, n+5</sub>	MSB <sub>Px79, n+5</sub>

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The last UDP packet with real image data has the row number 0x4e (78). This packet includes 2 rows (row 78 and 79) and the start of the metadata. The next packet with row number 0x51 (81) includes the second part of metadata and two rows with dummy data. Because each UDP frame contains 3 rows of image data the complete UDP image has a format of 80x84 to have a multiple of 3 rows.

The last UDP packet of a complete image has the row number 0x51 (81). Then the row number rolls over to 0x00 and the image number is incremented by one.

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### Packet details – Xi 410

In the screen shot below it can be seen that with this packet the image starts with row number 0x00 (0 decimal) of an image, numbered with 0x75 (117 decimal) and the length of 770 bytes. Followed by the next UDP packets.

4	2 *Eth	ernet 3								-		×
D	atei	Bearbeiten Ansicht	Navigation Aufzeic	hnen Analyse	Statistiken Telephor	ie Wireless T	ools Hilfe					
		- - - -					-					
4				Y ⊻ 🖃 🔳	લ લ લ 🏛							
	Anzei	gefilter anwenden <ct< td=""><td>rl-/&gt;</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>r +</td></ct<>	rl-/>									r +
No		Time	Source	Destination	Protocol Length	bmRequestType	Data	Text	Info			^
	548	1.409471	192.168.0.101	192.168.0.100	UDP 812		ef74f004ef04e804e304e204e104e004de04d	�t�\004	49153 → 50101 Len=770			
	549	1.409730	192.168.0.101	192.168.0.100	UDP 812		f0740f88052a0fe8020f88000000000000e60	@t\017@\.	. 49153 → 50101 Len=770			
	550	1,409730	192.168.0.101	192.168.0.100	UDP 812		f1740f88052a0fe8020f88000000000000e60	\$+\017\$\	49153 → 50101 Len=770			
	551	1,451208	192.168.0.101	192.168.0.100	UDP 812		00750b050c050e05060507050e050b0509050		49153 → 50101 Len=770		-	
	552	1 451208	192 168 0 101	192 168 0 100	UDP 812	<b>y</b>	a1750b0506050b050005000500050b050d050	\0010\0\0	49153 → 59191 Lep=779			
	552	1.451200	192.100.0.101	192.100.0.100	007 012		61756565665656565656565656565665666566	(0010 (0 (0	49199 4 90101 220-770			~
>	Fram	e 551: 812 bytes	on wire (6496 bit	s), 812 bytes o	aptured (6496 bi	ts) on interf	ace \Device\NPF_{63630049-5074-40F7-BF63-	4E77391EFB9	1}, id 0			^
>	Ethe	rnet II, Src: Opt	ris_09:1d (9c:43:	1e:70:09:1d), D	st: CeLink_0d:26	:6c (a0:ce:c8	:0d:26:6c)					
>	Inte	rnet Protocol Ver	sion 4, Src: 192.	168.0.101, Dst:	192.168.0.100							
>	User	Datagram Protoco	l, Src Port: 4915	3, Dst Port: 50	101							
>	Data	(770 bytes)										~
0	900	a0 ce c8 0d 26 6c	9c 43 1e 70 09 1	1d 08 00 45 00	····&l·C ·p···	E						^
0	010	03 1e 1a 20 00 00	ff 11 1c 95 c0 a	a8 00 65 c0 a8								
0	320	00 64 c0 01 c3 b5	03 0a 65 fb 00	75 00 05 0c 05	·d···· e·							
0	a40	0e 05 00 05 07 05 0b 05 0c 05 0a 05	0a 05 0f 05 05 0	05 00 05 01 05 05 0d 05 07 05								
0	250	0b 05 0e 05 09 05	0b 05 09 05 0b 0	05 0d 05 10 05								
0	960	09 05 0b 05 0b 05	0b 05 0f 05 0a 0	05 0d 05 0f 05	•••••	•••						
0	ð70	09 05 0d 05 0d 05	0b 05 0a 05 0b 0	05 0d 05 11 05	•••••	•••						
0	980	0e 05 0d 05 0c 05	0c 05 0c 05 0b 0	05 09 05 0c 05	•••••							
0	890 2-0	0d 05 0d 05 13 05	0a 05 0e 05 0d 0	05 0b 05 0t 05								
6	abo	of 05 01 05 11 05 of 05 11 05 od 05	0a 05 0f 05 0f 0	05 10 05 00 05 05 10 05 0c 05								
0	0c0	0c 05 10 05 11 05	0d 05 11 05 13 0	05 0e 05 11 05								~
(	2	wireshark_Ethernet 3E	4W220.pcapng					Pakete	: 869 · Angezeigt: 869 (100.0%)· Ve	erworfen: 0 (0.0%)	Profil: Def	ault

The next 2 bytes contain the temperature of the first pixel in this row, the most left pixel (0,0) in the row of the image, the next two bytes contain the temperature of the next pixel (1,0) to the right and so on. The temperature values are 16 bit numbers, stored with the LSB first. So, value for the top left pixel is 0x050b (1291). The value is in a special format, which is defined as:

Temperature in  $^{\circ}C = (value - 1000) / 10$ 

For this example: 29.1 °C.

Generally, the packets have this format with row number n.

Header		Data					
row counter	image counter	LSB <sub>Px0, n</sub>	MSB <sub>Px0, n</sub>	LSB <sub>Px1, n</sub>	MSB <sub>Px1, n</sub>	 LSB <sub>Px383, n</sub>	MSB <sub>Px383, n</sub>

The next UDP packet is followed by row number n+1.

Header		Data					
row counter+1	image counter	LSB <sub>Px0, n+1</sub>	MSB <sub>Px0, n+1</sub>	LSB <sub>Px1, n+1</sub>	MSB <sub>Px1, n+1</sub>	 LSB <sub>Px383, n+1</sub>	MSB <sub>Px383, n+1</sub>

The last UDP packet with real image data has the row number 0xef (239). The next two packets with row number 0xf0 (240) and 0xf1 (241) are metadata rows, both contain the same data.

The last UDP packet of a complete image has the row number 0xf1 (241). Then the row number rolls over to 0x00 and the image number is incremented by one.

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### Metadata details

The Easy Comm – Ethernet examples are built in a way that the receiving buffer size is the multiplication of WIDTH and HEIGHT of the image with metadata (**Table 1**: Summary of data details).

**Xi 80:** 80x84 with 16-bit numbers or 80x84x2 bytes = 13.440 bytes

**Xi 410:** 384x242 with 16-bit number or 384x242x2 bytes = 185.856 bytes

If an UDP packet arrives at the programmed port (DEFAULT\_PORT) and has the specific packet length (UDP\_PACKAGE\_LENGTH), then the first byte is a pointer to the Y-coordinate of the buffer, where to store the receiving bytes. For

Xi 80: 480 bytes or 240 16-bit numbers, or

Xi 410: 768 bytes or 384 16-bit numbers

when the first 2 header bytes of that UDP packet have been removed.

When a UDP packet arrives with the row counter is equal META\_DATA\_INDEX these data are copied to another byte array (metaData).

Two indices are important here:

FLAG\_INDEX\_IN\_METADATA and IS\_TEMPERATURE\_MODE\_IN\_METADATA.

The FLAG\_INDEX\_IN\_METADATA-index is the 11th byte in the metadata contains information of the flag. The cameras need to rebuild from time to time the internal reference. This is done by bringing a flag with a known temperature into the optical path. During this time, the sensor does not "see" the target and the image is not displayed. To inform the user about that situation two states are defined.

### Flag states:

0x00: open 0x01: close

The IS\_TEMPERATURE\_MODE\_IN\_METADATA-index is the 33<sup>rd</sup> byte in the metadata which contains the information if the camera is set to "*Direct temperature mode*". The 3<sup>rd</sup> bit checks the state.

### Direct temperature mode states:

- 0: Direct temperature mode OFF
- 1: Direct temperature mode ON

When the last row of the UDP packet has arrived (LAST\_EMPTY\_ROW\_INDEX), then a full image has arrived and can be processed or displayed. With the row and image numbers it is easy to check whether all rows of an image have been received or some rows (UDP packets) are missing. The UDP protocol does not guarantee delivery of each frame in exchange for simplicity and speed.

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