

# ThermoView™ Pi20

## Fixed Thermal Imager



## Operating Instructions



Rev. B 09/2011  
55301

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## WARRANTY

The manufacturer warrants this product to be free from defects in material and workmanship under normal use and service for the period of one year from date of purchase, except as hereinafter provided. This warranty extends only to the original purchaser (a purchase from Raytek or a licensed distributor of Raytek is an original purchase). This warranty shall not apply to fuses, batteries, or any product which has been subject to misuse, neglect, accident, or abnormal conditions of operation.

In the event of failure of a product covered by this warranty, the manufacturer will repair the instrument when it is returned by the purchaser, freight prepaid, to an authorized Service Facility within the applicable warranty period, provided manufacturer's examination discloses to its satisfaction that the product was defective. The manufacturer may, at its option, replace the product in lieu of repair. With regard to any covered product returned within the applicable warranty period, repairs or replacement will be made without charge and with return freight paid by the manufacturer, unless the failure was caused by misuse, neglect, accident, or abnormal conditions of operation or storage, in which case repairs will be billed at a reasonable cost. In such a case, an estimate will be submitted before work is started, if requested.

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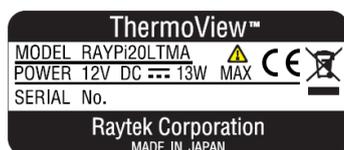
## SOFTWARE WARRANTY

The manufacturer does not warrant that the software described herein will function properly in every hardware and software environment. This software may not work in combination with modified or emulated versions of Windows operating environments, memory-resident software, or on computers with inadequate memory. The manufacturer warrants that the program disk is free from defects in material and workmanship, assuming normal use, for a period of one year. Except for this warranty, the manufacturer makes no warranty or representation, either expressed or implied, with respect to this software or documentation, including its quality, performance, merchantability, or fitness for a particular purpose. As a result, this software and documentation are licensed "as is," and the licensee (i.e., the User) assumes the entire risk as to its quality and performance. The liability of the manufacturer under this warranty shall be limited to the amount paid by the User. In no event shall the manufacturer be liable for any costs including but not limited to those incurred as a result of lost profits or revenue, loss of use of the computer software, loss of data, the cost of substitute software, claims by third parties, or for other similar costs. The manufacturer's software and documentation are copyrighted with all rights reserved. It is illegal to make copies for another person.

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**Specifications subject to change without notice.**

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The device complies with the requirements of the European Directives.

EC – Directive 2004/108/EC (EMC)

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## 1 Safety Instructions

This document contains important information, which should be kept at all times with the instrument during its operational life. Other users of this instrument should be given these instructions with the instrument. Updates to this information must be added to the original document. The instrument can only be operated by trained personnel in accordance with these instructions and local safety regulations.

### Acceptable Operation

This instrument is intended only for temperature measurement and is appropriate for continuous use. The instrument operates reliably in demanding conditions, such as in high environmental temperatures, as long as the documented specifications are adhered to. Compliance with the operating instructions is necessary to ensure the expected results.

### Unacceptable Operation

The instrument should not be used for medical diagnosis.

### Replacement Parts and Accessories

Use only original parts and accessories approved by the manufacturer. The use of other products can compromise the operational safety and functionality of the instrument.

### Instrument Disposal



Disposal of old instruments should be handled according to professional and environmental regulations as electronic waste.

### Operating Instructions

The following symbols are used to highlight essential safety information in the operation instructions:



Helpful information regarding the optimal use of the instrument.



Warnings concerning operation to avoid instrument damage or personal injury.



Incorrect use of 110 / 230 V electrical systems can result in electrical hazards and personal injury. All instrument parts supplied with electricity must be covered to prevent physical contact and other hazards at all times.

# Description

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## 2 Description

The ThermoView™ Pi20 is a rugged thermal imaging camera designed for industrial process control applications. The camera is designed with an IP54 rating to withstand demanding industrial environments.

The ThermoView Pi20 provides easy networking over long distances using the standard Ethernet interface. This interface allows for the PC operating the DTPi software to be located far away. The Ethernet interface transmits up to 30 frames per second of imaging data and also allows for camera control. For long Ethernet cable runs beyond 90 m (295 ft), additional fiber optic Ethernet accessories are available.

The ThermoView Pi20 process imager is a noncontact and highly sensitive infrared thermal camera. The infrared radiation emitted from measured objects is detected and converted to an electrical signal by a two-dimensional uncooled focal plane array detector. After this, the amplified analog temperature signal is converted to a digital signal, which is displayed as a thermal image in color or black-and-white on a PC running TSA or DataTemp® (DTPi) software.

Part number	Temperature Range	Lens Type	Focus
RAYPi20LTMA	-40 to 500°C (-40 to 932°F)	21.7° x 16°	manual
RAYPi20LTMB	-40 to 500°C (-40 to 932°F)	30° x 22°	manual
RAYPi20HTMA	200 to 2000°C (392 to 3632°F)	21.7° x 16°	manual
RAYPi20HTMB	200 to 2000°C (392 to 3632°F)	30° x 22°	manual
RAYPi20LTRC	-40 to 500°C (-40 to 932°F)	45.2° x 33.7°	remote
RAYPi20HTRC	200 to 2000°C (392 to 3632°F)	45.2° x 33.7°	remote

Table 1: Available Models



Figure 1: ThermoView Pi20 Process Imager





Figure 2: Rear View

## 2.1 System Architecture

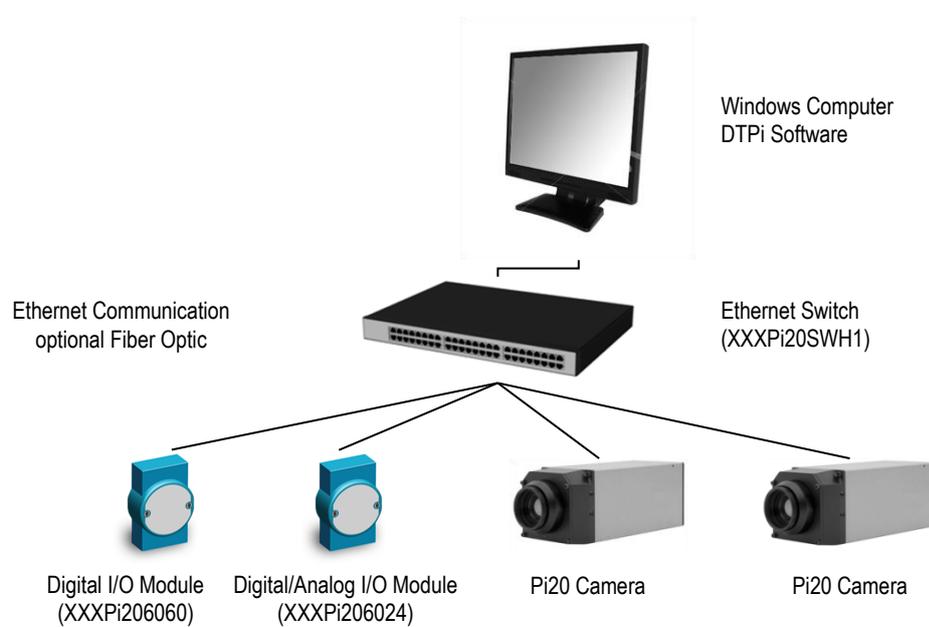


Figure 3: Typical System Architecture for Multi-Camera Usage

# Technical Data

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## 3 Technical Data

### 3.1 Measurement Specifications

#### Measuring Temperature

Pi20LT, range 1	-40 to 120°C (-40 to 248°F)
Pi20LT, range 2	0 to 500°C (32 to 932°F)
Pi20HT	200 to 2000°C (392 to 3632°F)

#### Minimum Detectable Temperature Difference (NETD)<sup>1</sup>

Pi20LT, range 1	0.08°C at 30°C measuring temperature
Pi20LT, range 2	0.3°C at 30°C measuring temperature
Pi20HT	2°C at 200°C measuring temperature

**System Accuracy<sup>2</sup>** ± 2% of reading or ± 2°C (4°F), whichever is greater

**Spectral Response** 8 to 14 µm

**Detector** uncooled focal plane array (micro bolometer)

**Number of Pixels<sup>3</sup>** 320 x 240 (horizontal x vertical)

**Thermal Time Constant** 16 ms

**Repeatability** within the accuracy specifications

**Ethernet Frame Rate** 30 frames / sec

**A/D resolution** 14 bits

**Emissivity Correction** 0.10 to 1.00

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<sup>1</sup> at 30 frames/sec

<sup>2</sup> throughout the operating temperature range

<sup>3</sup> 3 edge lines of screen are out of the specification



## 3.2 Optical Specifications

The following optical specification is based on the theoretical calculated spot size derived on the pitch of the camera detector array and the lens focal length. Typically, for accurate temperature measurements, the target area needs to be 2 to 3 times larger than that determined by the calculated theoretical spot sizes, which corresponds to 7 x 7 pixels.

### 21.7° Lens (MA)

Field of View (FOV)	21.7° x 16.4° (horizontal x vertical)
Instant. Field of View (IFOV)	1.2 mrad
Distance to Spot Size Ratio (D:S)	830:1
Focus Range	30 cm to ∞ (12 in to ∞)

Measuring distance	Thermal image (H x V)	Minimum detectable spot size (H x V)
0.3 m (1 ft)	0.11 x 0.09 m (0.36 x 0.29 ft)	0.36 x 0.36 mm (0.014 x 0.014 in)
0.5 m (1.6 ft)	0.19 x 0.14 m (0.62 x 0.46 ft)	0.6 x 0.6 mm (0.023 x 0.023 in)
1.0 m (3.3 ft)	0.38 x 0.29 m (1.25 x 0.95 ft)	1.2 x 1.2 mm (0.047 x 0.047 in)
5.0 m (16 ft)	1.9 x 1.4 m (6.2 x 4.6 ft)	6.0 x 6.0 mm (0.24 x 0.24 in)
10 m (33 ft)	3.8 x 2.9 m (12.5 x 9.5 ft)	12 x 12 mm (0.47 x 0.47 in)

### 30° Lens (MB)

Field of View (FOV)	30.0° x 22.7° (horizontal x vertical)
Instant. Field of View (IFOV)	1.7 mrad
Distance to Spot Size Ratio (D:S)	596:1
Focus Range	30 cm to ∞ (12 in to ∞)

Measuring distance	Thermal image (H x V)	Minimum detectable spot size (H x V)
0.3 m (1 ft)	0.16 x 0.12 m (0.53 x 0.39 ft)	0.5 x 0.5 mm (0.02 x 0.02 in)
0.5 m (1.6 ft)	0.27 x 0.2 m (0.89 x 0.66 ft)	0.84 x 0.84 mm (0.033 x 0.033 in)
1.0 m (3.3 ft)	0.54 x 0.4 m (1.77 x 1.31 ft)	1.68 x 1.68 mm (0.066 x 0.066 in)
5.0 m (16 ft)	2.7 x 2.0 m (8.8 x 6.5 ft)	8.4 x 8.4 mm (0.33 x 0.33 in)
10 m (33 ft)	5.4 x 4.0 m (17.7 x 13.1 ft)	17 x 17 mm (0.67 x 0.67 in)



# Technical Data

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## 45° Lens (RC)

Field of View (FOV) 45.2° x 33.7° (horizontal x vertical)

Instant. Field of View (IFOV) 2.46 mrad

Distance to Spot Size Ratio (D:S) 406:1

Focus Range 30 cm to ∞ (12 in to ∞)

Measuring distance		Thermal image (H x V)		Minimum detectable spot size (H x V)	
0.3 m	(1 ft)	0.25 x 0.19 m	(0.82 x 0.62 ft)	0.79 x 0.79 mm	(0.03 x 0.03 in)
0.5 m	(1.6 ft)	0.38 x 0.29 m	(1.25 x 0.95 ft)	1.2 x 1.2 mm	(0.05 x 0.05 in)
1.0 m	(3.3 ft)	0.77 x 0.58 m	(2.52 x 1.90 ft)	2.4 x 2.4 mm	(0.09 x 0.09 in)
5.0 m	(16 ft)	3.8 x 2.9 m	(12.5 x 9.5 ft)	12 x 12 mm	(0.47 x 0.47 in)
10 m	(33 ft)	7.7 x 5.8 m	(25.2 x 19.0 ft)	24 x 24 mm	(0.94 x 0.94 in)

Please note that the lenses are not interchangeable in the field.



## 3.3 Electrical Specifications

<b>Primary Interface</b>	Ethernet (default IP address: 192.168.200.254)
<b>Optional Interface</b>	RS232 <sup>4</sup> (special accessory cable is required)
<b>Video Output</b>	NTSC, composite video (BNC connector)
<b>LED (green)</b>	lights at power supply ON.
<b>Power Supply</b>	+ 11 to 13 VDC (12 VDC nominal)
<b>Power Consumption</b>	8 W (typ), 13 W (max)

## 3.4 General Specifications

<b>Environment Rating</b>	IP54 (IEC60529)
<b>Operating Ambient Temperature</b>	-15 to 50°C (5 to 122°F)
<b>Operating Internal Temperature</b>	-10 to 65°C (14 to 149°F)
<b>Storage Temperature</b>	-40 to 70°C (-40 to 158°F)
<b>Warm-up Time</b>	30 min.
<b>Relative Humidity</b>	less 90%, non-condensing, for operating and non-operating ambient temperature range
<b>Vibration Resistance</b>	29.4 m/sec <sup>2</sup> (3 G) (IEC60068-2-6)
<b>Shock Resistance</b>	294 m/sec <sup>2</sup> (30 G) (IEC60068-2-27)
<b>Dimensions (W x H x D)</b>	65 x 65 x 208 mm (2.5 x 2.5 x 8.1 in)
<b>Weight</b>	approx. 1 kg (2.2 lb)

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<sup>4</sup> RS232 is specifically for camera setup in the event the user changes the camera to a different address and then forgets it.



# Technical Data

## 3.5 Dimensions

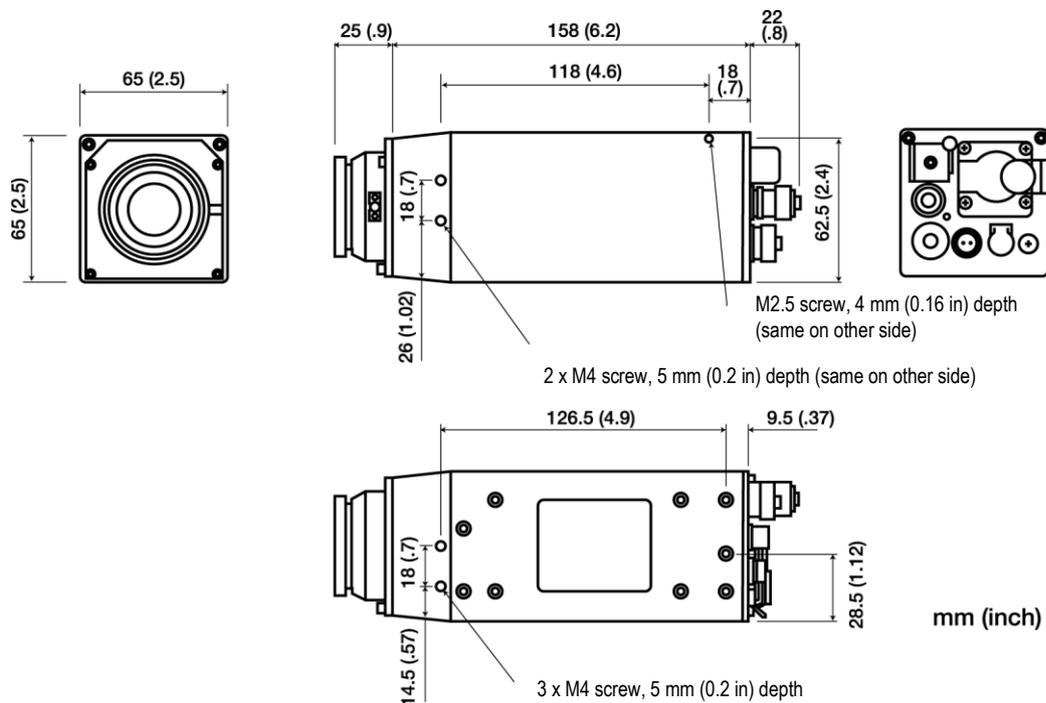


Figure 4: Camera with Manual Focus (...MA, ...MB)

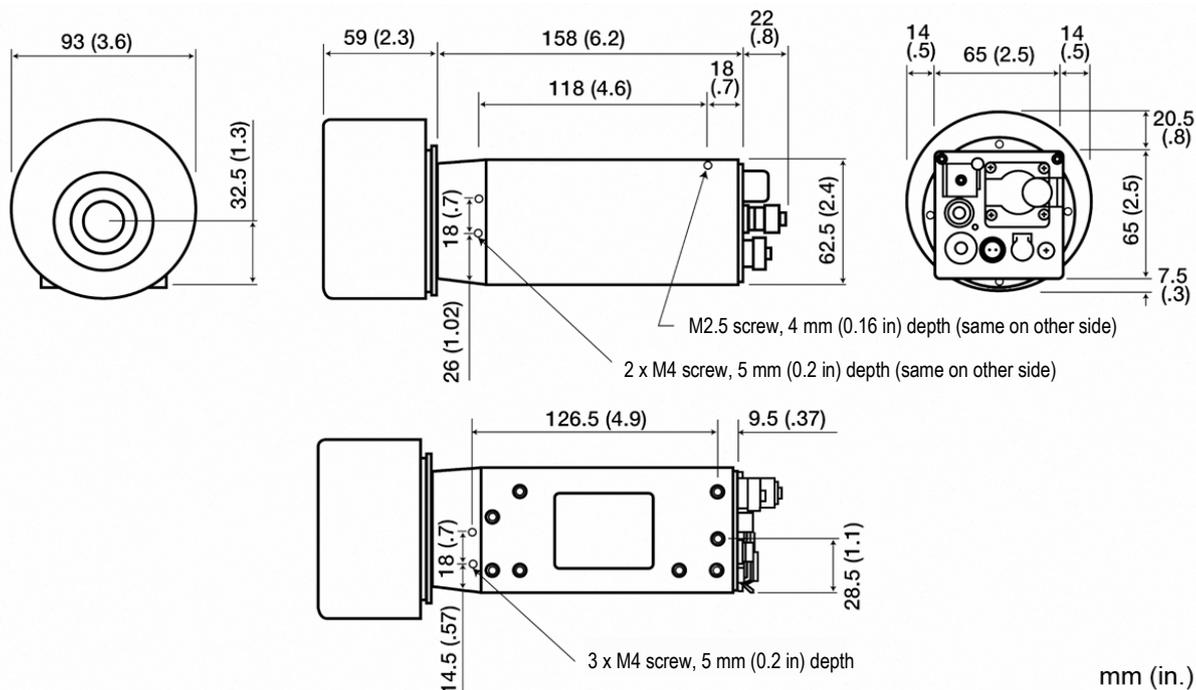


Figure 5: Camera with Remote Focus (...RC)

## 3.6 Scope of Delivery

The delivery package includes the following:

- Pi20 ThermoView process imager
- Straight Ethernet cable, 7.5 m (25 ft) long
- Power supply cable, 7.5 m (25 ft) long
- Ethernet Crossover Adapter for direct connection to older PC's
- Industrial DIN rail mounted power supply (XXXPi20PS1)
- ThermoView Start-up Software Application (TSA)
- Operations manual on CD
- Quick Start instructions (hardcopy included in the box)



## 4 Basics

### 4.1 Measurement of Infrared Temperatures

Every object emits an amount of infrared radiation (IR) according to its surface temperature. The intensity of the infrared radiation changes with the temperature of the object. Depending on the material and surface properties, the emitted radiation lies in a wavelength spectrum of approximately 1 to 20  $\mu\text{m}$ . The intensity of the infrared radiation ("heat radiation") is dependent on the material. For many substances, this material-dependent constant is known. It is referred to as "emissivity value". See appendix 9.2 [Typical Emissivity Values](#) on page 50.

Infrared thermometers are optical-electronic sensors. These sensors are able to detect "radiation of heat". Infrared thermometers consist of a lens, spectral filter, sensor, and an electronic signal processing unit. The task of the spectral filter is to select the wavelength spectrum of interest. The sensor converts the infrared radiation into an electrical signal. The connected electronics process this signal for further analysis. The intensity of the emitted infrared radiation is thereby used to determine the temperature of the target. Since the intensity of the infrared radiation is dependent on the material, the appropriate emissivity can be selected on the sensor.

The biggest advantage of the infrared thermometer is its ability to measure temperature without the need to be in contact with the target. Consequently, surface temperatures of moving or hard to reach objects can be easily measured.

### 4.2 Emissivity of Target Object

For accurate temperature readings, the sensor must be set to the appropriate emissivity value for the target material. Determine the emissivity of the target object, as described in appendix 9.1 [Determination of Emissivity](#) on page 50.

When measuring materials with low emissivity, the results could be effected by interfering infrared radiation from background objects (such as heating systems, flames, fireclay bricks, etc. near to or behind the target object). This type of problem can occur when measuring reflective surfaces and very thin materials, such as plastic films and glass. This error can be reduced to a minimum if particular care is taken during installation, and the camera is shielded from reflected infrared radiation.



## 5 Installation

### 5.1 Ambient Temperatures

Without water cooling, the camera is designed for ambient operating temperatures between -15 to 50°C (5 to 122°F). With water cooling equipment, it can be used in environments at higher temperatures. For more details, see section 7.4 [Cooling Enclosure](#), page 30.

### 5.2 Environment

This unit complies with the international protection standard IP54. "Splash-proof" here refers to "effective against splashing by water from every direction."

Note that effectiveness against splashing is possible only with terminal caps in place and the power connector connected. To maintain IP54 compliance, we recommend periodic inspection/replacement of gaskets. Gaskets should be replaced every two years.

### 5.3 Electrical Interference

To minimize electrical or electromagnetic interference, follow these precautions:

- Mount the unit as far away as possible from possible sources of interference such as motorized equipment producing large step load changes!
- Ensure a fully insulated installation of the unit (avoid ground loops!).
- Make sure the shield wire in the unit cable is earth grounded at one location!
- To avoid potential differences, use a single power circuit to power both the camera and the PC running the software!



# Installation

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## 5.4 Geometry

The camera provides different lens models (factory installed) to accommodate a wide range of applications. Each individual lens provides different thermal images (Field of View) and minimum detectable spot sizes (Instantaneous Field of View). The optical diagram below shows the principal graphical representation for measuring distance over the field of view.

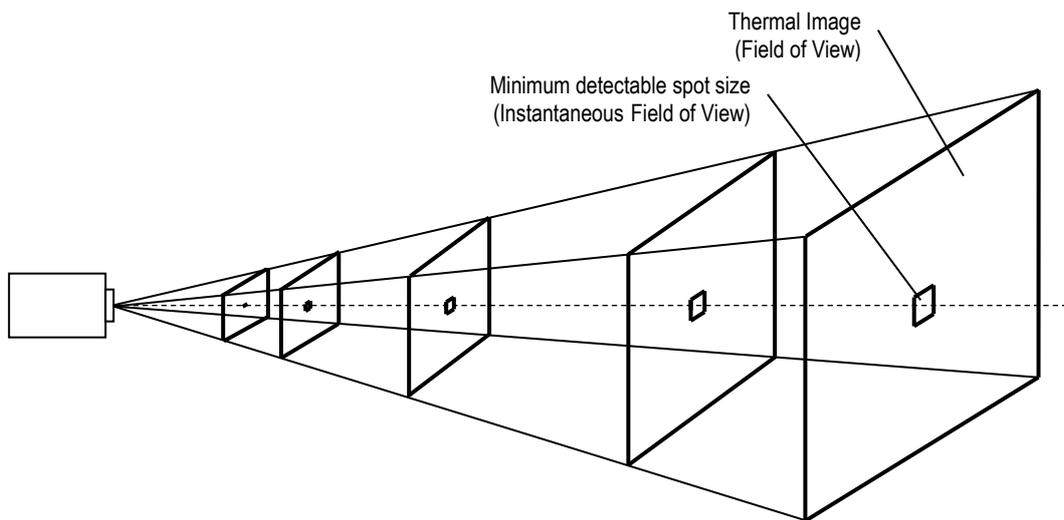


Figure 6: Field of View for the Camera

It is important that the camera is mounted at a distance from the target sufficient to be able to “see” the entire area of interest. For this reason, the manufacturer provides a software tool (on the support CD or downloadable from the website) calculating the Field of View for a given lens based on a specific camera mounting distance.



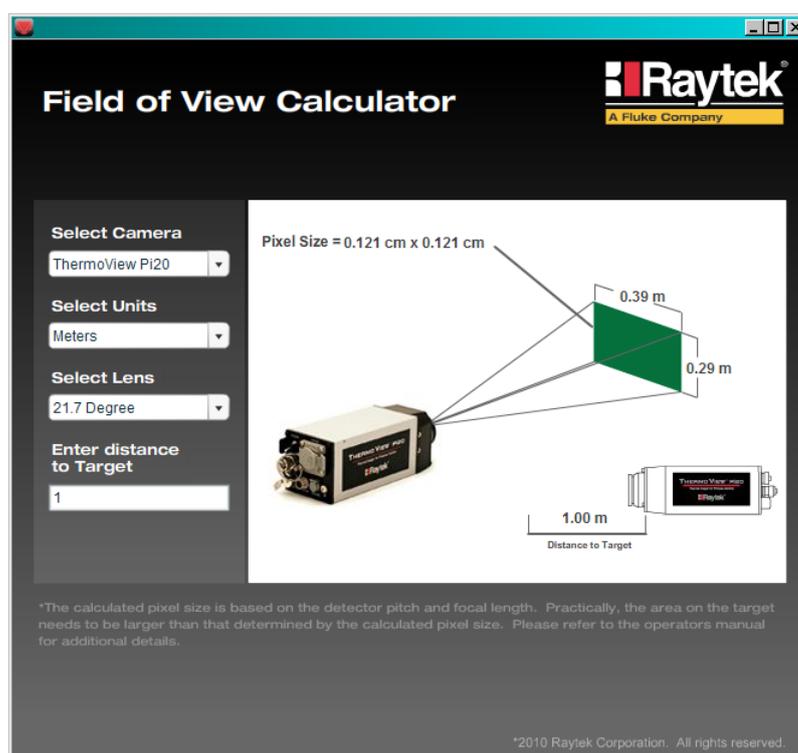


Figure 7: Field of View Calculator

## 5.5 Focusing

After the camera has been mounted, it is important to make sure that the optimum focus has been established for the given mounting distance. It is important to focus the camera correctly to obtain the sharpest image of the target you wish to view.

The camera with remote focus (...RC) can be set via the TSA software.

The camera with manual focus (...MA, ...MB) can only be focused manually on the front of the camera.



Figure 8: Focusing the Camera with Manual Focus (...MA, ...MB)

It should be noted that if the focus changes or the camera is moved from its installed location, the user must make sure that a new focus setting has been achieved.

# Installation

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## 5.6 Mounting

The camera installation requires the most planning effort. The camera needs to be accurately mounted in relationship to the product (target). Adjustments to align the camera with the target may have to be designed into the camera mounting to provide the required alignment accuracy. Avoiding or removing physical mounting limitations and obstructions in the camera's optical path, may also be required.

For dedicated mounting equipment, see section 7.3 [Mounting Bracket](#), page 29.



## 5.7 Cable Connections



Before connecting and disconnecting any connector, make sure that the power switch is off!



To maintain EMI compliance to CE standards the attached Ferrite cores need to be placed on the Ethernet and power supply cables! You have to assemble the Ferrite cores after cables have been pulled through pipes, holes, etc. Please note, the Ferrite cores withstand temperatures up to 105°C (221°F).

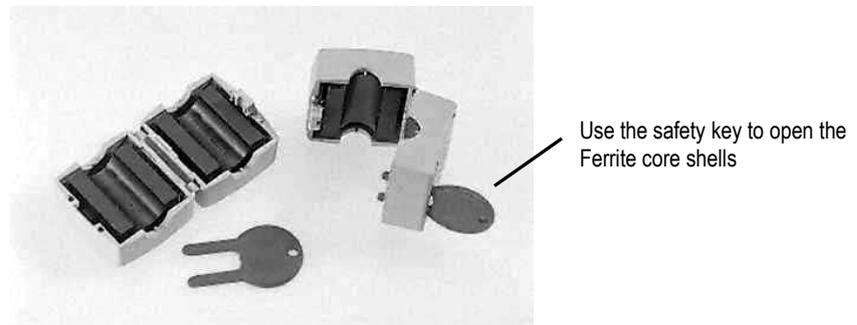


Figure 9: Ferrite Core Shells and Safety Key

### 5.7.1 Connecting the Ethernet Cable

The straight Ethernet cable comes with an IP67 connector assembled to one end of the camera, and an IP20 connector at the other end. The standard cable is about 5 mm (0.2 in) in outer diameter and 7.5 m (25 ft) long. Other cable lengths are available as an accessory. The cable withstands ambient temperatures up to 180°C (356°F).

To connect the Ethernet cable follows the steps below:

1. Remove the cap.
2. Connect the Ethernet cable plug straight into the Ethernet terminal on the body by closing the connector latches!

### 5.7.2 Connecting the Power

The power supply cable comes with a connector assembled to one end of the camera, and a pig tail on the other end. The standard cable is about 5 mm (0.2 in) in outer diameter and is 7.5 m (25 ft) long. The cable withstands ambient temperatures up to 180°C (356°F).

To connect the power, follow the steps below:

1. Connect the power connector to the camera.
2. Tighten the nut on the connector.

# Installation

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Pin	Description	Color
A	+12 VDC	Red
B	Ground	Black

Figure 10: Power Connector



Be very careful in wiring the pig tailed end of the power cable – making sure that the conductor colors on the cable match the correct terminals on the power supply!



The cable shield must be connected to earth ground!



The power supply is factory set to 12 VDC - do not adjust the power supply voltage in the field!

The provided power supply supports a single camera, as well as analog and digital I/O modules (accessories). For further details, see section 5.9 [Industrial Power Supply](#), page 26.



For accurate temperature readings, we recommend a 20 minute warm-up period after power on. During this time, the internal calibration sources will be stabilized. Digital communication can be started 60 seconds after power on.

## 5.7.3 Connecting the RS232 Cable

To connect the cable (available as accessory):

1. Remove the cap and connect the RS232 connector.
2. Push it in firmly until it locks in place.

The RS232 cable is required when the user has lost the IP address of his camera and needs to determine the IP Address. This cable is only used with the TSA software and does not get used at all with the DTPi software.

## 5.7.4 Connecting the Video Cable

To connect the video cable (not supplied):

1. Remove the BNC cap.
2. Connect the video cable plug straight into the VIDEO output terminal on the body and lock the video cable in place.



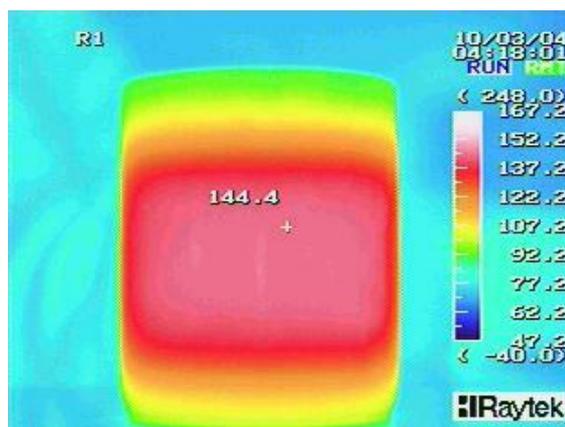


Figure 11: NTSC Video Output Example

The video output is not used with TSA and DTPi software.

## 5.8 Ethernet Communication

For connecting the camera to the PC, a dedicated Ethernet connection is required.

### Camera IP Address

The factory default IP address for the camera is **192.168.200.254**.

The camera's address is not free of choice: It has to be unique in the network, meaning that no other device in the network (including the PC network adapter) may run at the same IP address.



**Ask your IT administrator for a free IP address to be used!**

### Advanced Ethernet Settings

Subnet Mask:

The Subnet Mask defines the interpretation of the IP address. The factory default setting is **255.255.255.0**.

Gateway:

A gateway connects two subnets (which have a different subnet address). The factory default setting is **192.168.200.1**.



**To establish the Ethernet communication, the subnet addresses for both the camera and the PC need to match! Appropriate changes can be applied either on the camera side or on the PC network adapter!**

### 5.8.1 Changing the Ethernet Settings for the PC

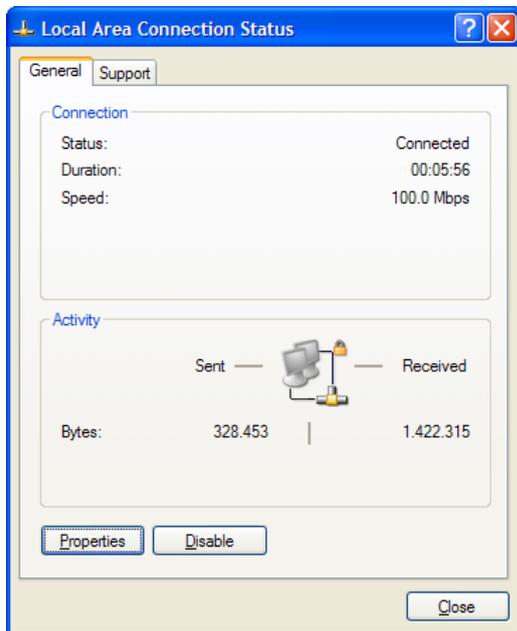
The network adapter on the PC side can be configured as follows:  
(example below is for Windows XP systems)

1. Go to <Start> <Settings> <Network Connections> <Local Area Connection>

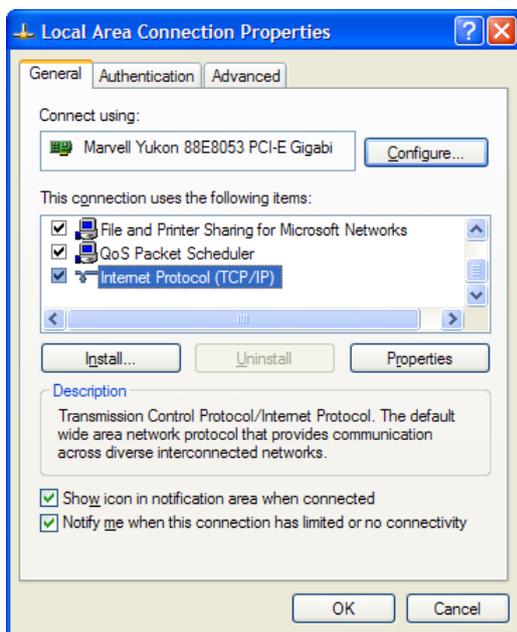
# Installation

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2. Click on <Properties>:

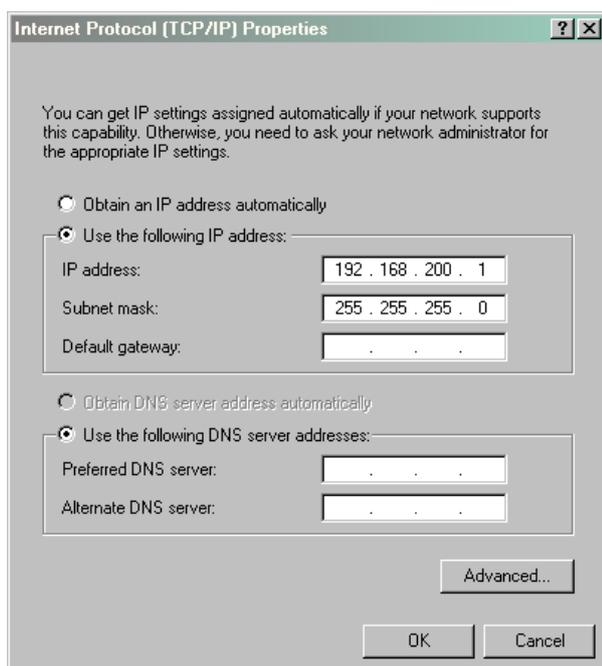


3. Under <This connection uses the following items>, select <Internet Protocol (TCP/IP)> and click on <Properties>:



4. Activate the radio button <Use the following IP address> and make the following settings:  
IP address: 192.168.200.x  
where x is an address between 1 and 255 (except 254, which is already used by the camera by factory default)  
Subnet mask: 255.255.255.0  
Default gateway: {empty}





5. Close all dialog boxes by clicking <OK>.

## 5.8.2 Changing the Ethernet Settings for the Camera

To change the IP address of the camera, you can use the TSA or the DTPi software.

# Installation

## 5.9 Industrial Power Supply

The DIN-rail mount industrial power supply delivers isolated dc power and provides short circuit and overload protection.

The power supply is able to power a single camera, as well as Analog and Digital I/O Modules, and a media converter (if used).



**To prevent electrical shocks, the power supply must be used in protected environments (cabinets)!**

### Technical data:

Protection class	class II as per IEC/EN 61140
Environmental protection	IP20
Operating temperature range	-25°C to 70°C (-13°F to 158°F)
AC Input	100 – 240 VAC 50/60 Hz [L/N]
wire size	0.5 to 2 mm <sup>2</sup> (AWG 24 to 12)
DC Output	12 VDC / 2.5 A [+/-]
wire size	0.5 to 2 mm <sup>2</sup> (AWG 24 to 12)

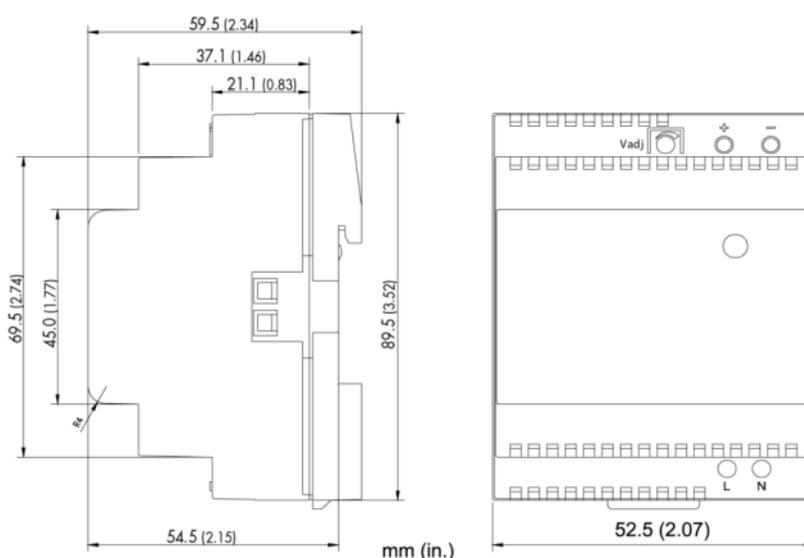


Figure 12: Dimensions of Industrial Power Supply

## 6 ThermoView Start-up Application

The ThermoView Start-up Application software<sup>5</sup> (TSA) is a simple and easy to use software program that interfaces to the Pi20 camera (all variations). The software is provided free-of-charge on CD, along with the operations manual. The intention of the software is to provide a basic imaging display of the camera to allow the user to validate that all camera functions are operating properly. This program is not intended to be sold or to provide significant functionality to make it useful in a process control environment.

The functions of the software include the following:

- Basic 320 x 240 image of the target in grayscale palette
- Cursor movement on the image providing position and temperature
- Temperature measurement in °F or °C
- Emissivity adjustment of the entire image
- Camera control
- Calibration refresh performing a single point calibration on the camera
- Capability to change temperature ranges of the Pi20LT camera
- Read back of the following camera information:
  - a) internal temperature
  - b) detector stabilization error
  - c) internal data error
- Selection of different cameras on the network (only one camera can be shown, however)
- The user can change the IP address for the designated camera.
- Temperature range selection for image display

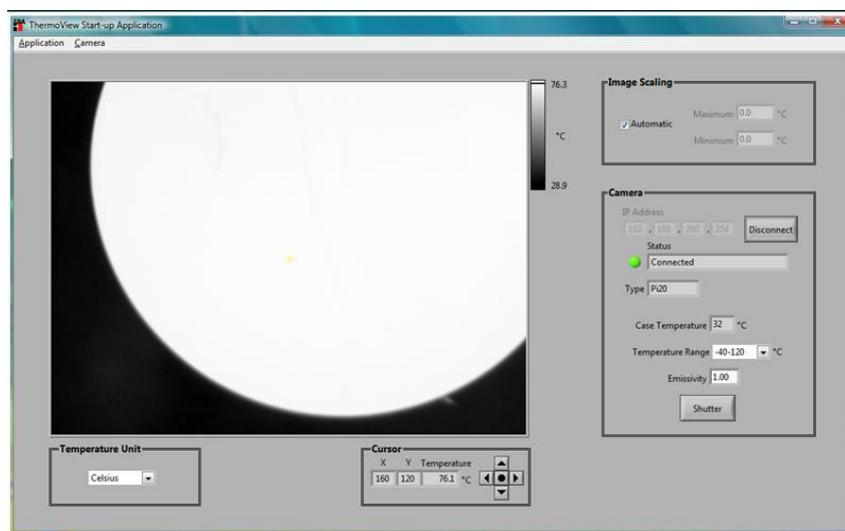


Figure 13: TSA Screenshot

<sup>5</sup> Copyright © Fluke Corporation. All rights reserved. Portions of this software copyrights © National Instruments Corporation.

# Accessories

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## 7 Accessories

### 7.1 Overview

A full range of accessories for various applications and industrial environments are available. Accessories include items that may be ordered at any time and added on-site. These include the following:

- [Mounting Bracket](#) (XXXPi20MB)
- [Cooling Enclosure](#) with air purge (XXXPi20ENCAP)
- [Outdoor Enclosure](#) (XXXPi20OENC)
- [Digital Input / Relay Output Module](#) (XXXPi206060)
- [Digital I/O and Analog Output Module](#) (XXXPi206024)
- [Ethernet Switch](#) (XXXPi20SWH1)
- [Fiber Optic / RJ45 Ethernet Converter](#), requires two for a set (XXXPi20MC)
- [Fiber Optic Cable](#), 150 m/500 ft (XXXPi20FO1), 300 m/1000 ft (XXXPi20FO2) multi-mode fiber, 50/125  $\mu\text{m}$ , equipped with SC connectors
- Carrying case contains camera, cables, power supply, and CD (XXXPi20CC)
- Ethernet crossover adapter for direct connect to camera (XXXPi20ECC)
- Straight Ethernet Cable with office grade connector on both ends, 25 m (82 ft) (XXXPi20EC3)
- [Junction Box](#) to contain power supply, I/O modules, and Switch (XXXPi20CAB)
- Short Ethernet Cable to allow the I/O modules to easily be connected to switch inside Junction Box (XXXPi20ECS)
- Serial RS232 cable to re-configure IP address (XXXPi20SC)
- Raytek SDK (XXXPi20SDK) – software development kit for users who build up their own application for the camera
- [DataTemp Pi Software](#) (XXXPi20DTPi)

### 7.2 Spares

- [Industrial Power Supply](#) (XXXPi20PS1)
- [Power Supply Cable](#) 7.5 m (25 ft) with connector assembled to camera end (XXXPi20PSC)
- [Straight Ethernet Cable](#) 7.5 m (25 ft) with IP67 connector assembled to camera end and IP20 connector connected to the other end (XXXPi20EC1)



## 7.3 Mounting Bracket

The mounting bracket provides a 1/4" - 20 holes for tripod mounting.

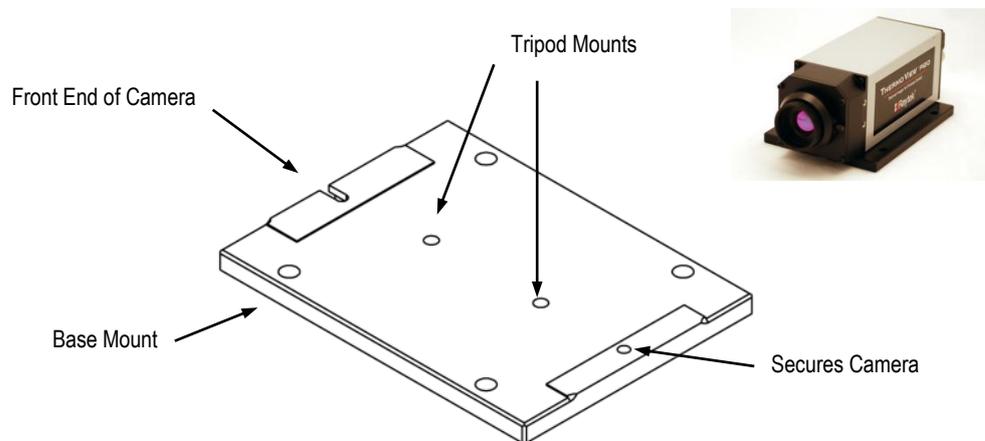
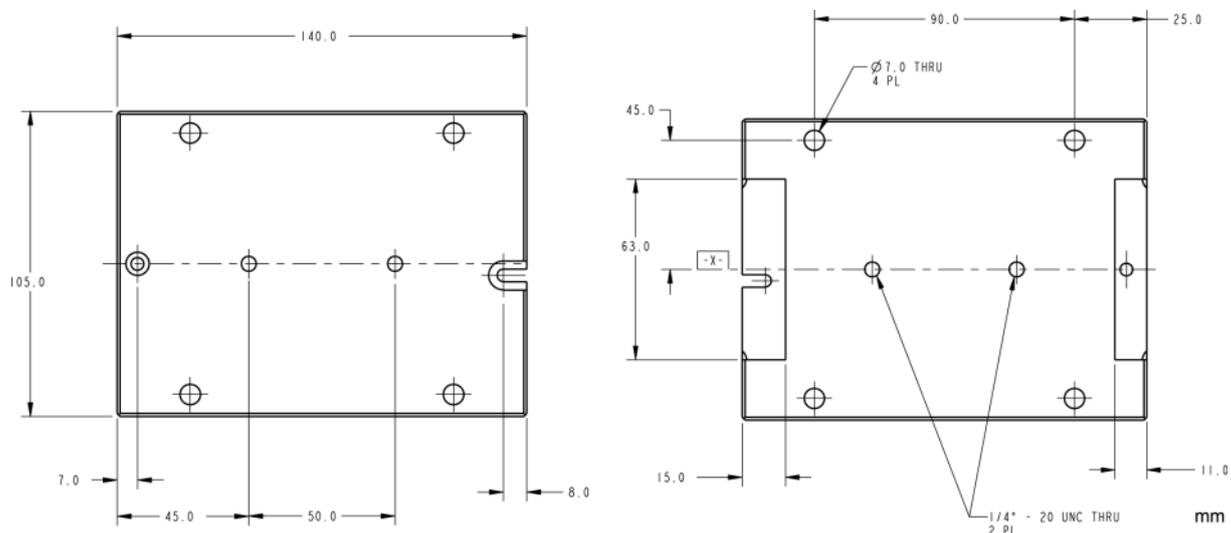


Figure 14: Dimensions for the Mounting Bracket

# Accessories

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## 7.4 Cooling Enclosure

When the camera is installed in dirty and hot environments, the enclosure provides water cooling and air purge for protection.

### 7.4.1 Technical Data

#### Scope of delivery

- Enclosure with cooling jacket and Zinc Selenide window
- Air barrier flange
- 2x cable glands

#### Environment

Rating	IP67
Ambient temperature	200°C (392°F) with 6 l/min (1.5 gal/min) of water at 20°C (68°F) inlet temperature and 6 bar (87 PSI) for front air barrier
Air pressure	recommended: 4 to 6 bar (58 to 87 PSI)

#### Mechanical

Construction	stainless steel, AISI 316L, polished
Weight	13 kg (29 lb), without camera
Cable gland	M12x1.5, threaded holes on the rear flange



The Zinc Selenide window has a transmission factor of 0.96 meaning it transmits 96% of the radiation before it gets to the camera. For correct temperature readings, that transmission factor needs to be considered via setting the global emissivity value as a composite correction factor in the camera's software. For example, if the target emissivity is 0.93, but the camera must look through the Zinc Selenide window with the transmission factor of 0.96, then the global emissivity setting should be set to 0.89 to compensate for both ( $0.93 \times 0.96 = 0.89$ ).



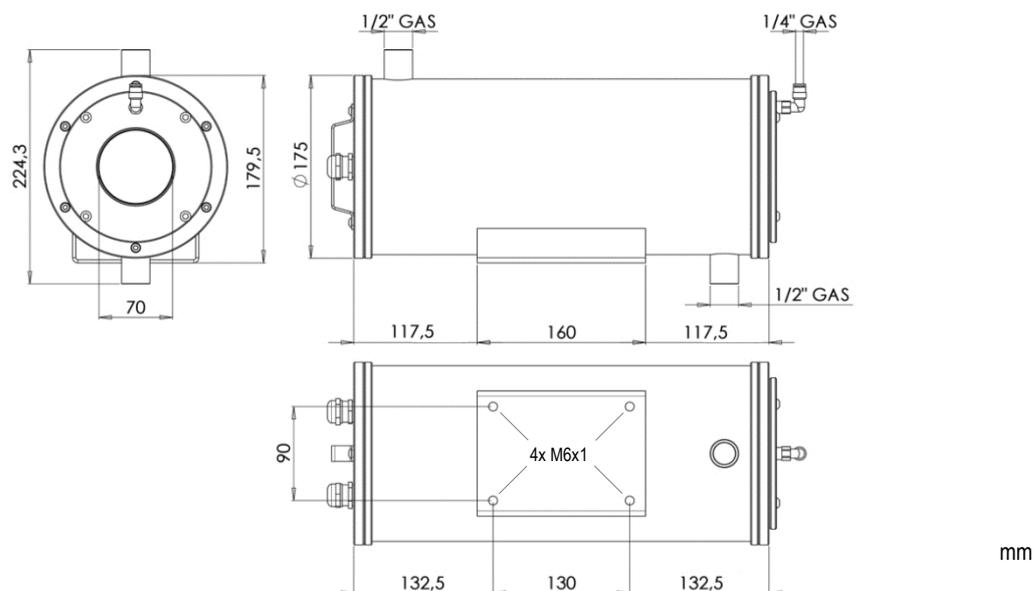


Figure 15: Dimensions

## 7.4.2 Cooling

By forcing water circulation, it is possible to maintain cooled internal housing temperatures. It helps to verify the flow capacity needed and cooling water temperature before proceeding with the installation. Before installation, it is also necessary to verify the environmental temperature and install the housing at the correct distance from the heating source.

## 7.4.3 Air Barrier

The flange for window cleaning uses ventilation to create an air barrier on the front of the housing in order to prevent any deposits of dust on the outer surface of the window. For proper use, it is always advisable to filter the compressed air with a dedicated filter that is equipped with a gauge pressure regulator. For proper installation, it is necessary to check the environmental temperature and place the air filter group at the correct distance from the heat source.



For optimal performance of air barrier, it is recommended positioning the enclosure in a horizontal position or decline angle. Positioning the enclosure with the air barrier vertically may affect its performance!



Noise level emissions produced by air barrier may exceed recommend safe exposure levels!

# Accessories

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## 7.4.4 Installation

Locate 2x M4 screws on camera.



Place conduction plate onto camera as shown, making sure to line up holes on camera with hole and slot on conduction plate.



Install 2x M4 screws and secure conduction plate onto camera.

Place the housing internal rail onto conduction plate as shown on first slot, making sure to place rail with correct orientation by having rail securing hole at rear.



Secure rail to conduction plate by installing 2x screws (truss), 4x curved washers (2x per screw), and 2x flat washers. Insert the screws until each screw makes contact with curved washer; curved washers will be compressed once camera is installed in enclosure.



**Note:** For cameras with remote focus place rail as shown with one screw in each slot.



Secure ground cable to camera as shown (color of cable/ring terminals used for display only).



Disassemble Ethernet cable connector by loosening nut as shown.

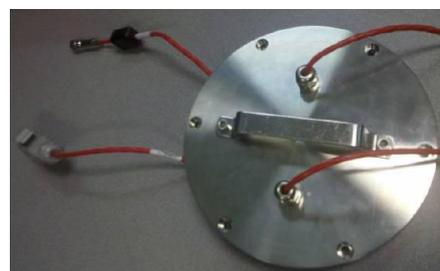


Remove cable from RJ45 jack by lifting tab, note wiring for reassembly.



Pass Ethernet cable through cable gland on rear enclosure flange then reassemble connector.

Pass power cable end with isolated cable ends through cable gland on rear enclosure flange.



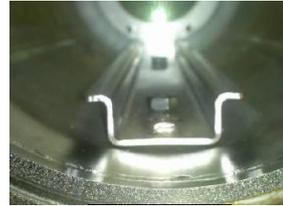
Using Ethernet and power cables that have been passed through cable glands on rear flange, install cables onto camera as shown (turn camera on if needed).



# Accessories

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Place conduction plate onto inside surface of enclosure and slide rail onto internal rail of enclosure then slide camera forward.



Internal Rail



Cables removed for clarity

Secure ground to enclosure using 1x tooth washer, 1x flat washer, and rail screw from enclosure as shown.



Install rear flange onto enclosure by installing 6x screws, then tighten cable glands to create seal around cables.



## 7.5 Outdoor Enclosure

When the camera is mounted in outdoor environments, the enclosure ensures weatherproofed installations by providing a high protection rate, a sunshield, and thermostat control heater in cooler climates.

### 7.5.1 Technical Data

#### Scope of delivery

- Enclosure with sunshield and Germanium window
- Double thermostat control heater
- Cable glands

#### Environment

Rating	IP66/IP67 EN60529 with cable glands
Max. Temperature	-30 to 50°C (-22 to 122°F)

#### Electrical

Double heater	115/230 VAC, 80 W
---------------	-------------------

#### Mechanical

Construction	Aluminum
Weight	4.1 kg (9 lb), without camera
Cable entry	M16x1.5



The Germanium window has a transmission factor of 0.87 meaning it transmits 86% of the radiation before it gets to the camera. For correct temperature readings, that transmission factor needs to be considered via setting the global emissivity value as a composite correction factor in the camera's software. For example, if the target emissivity is 0.93, but the camera must look through the Germanium window with the transmission factor of 0.87, then the global emissivity setting should be set to 0.81 to compensate for both ( $0.93 \times 0.87 = 0.81$ ).



Figure 16: Outdoor Enclosure<sup>6</sup>

<sup>6</sup> Photo © 2009, Videotec S.p.A.

# Accessories

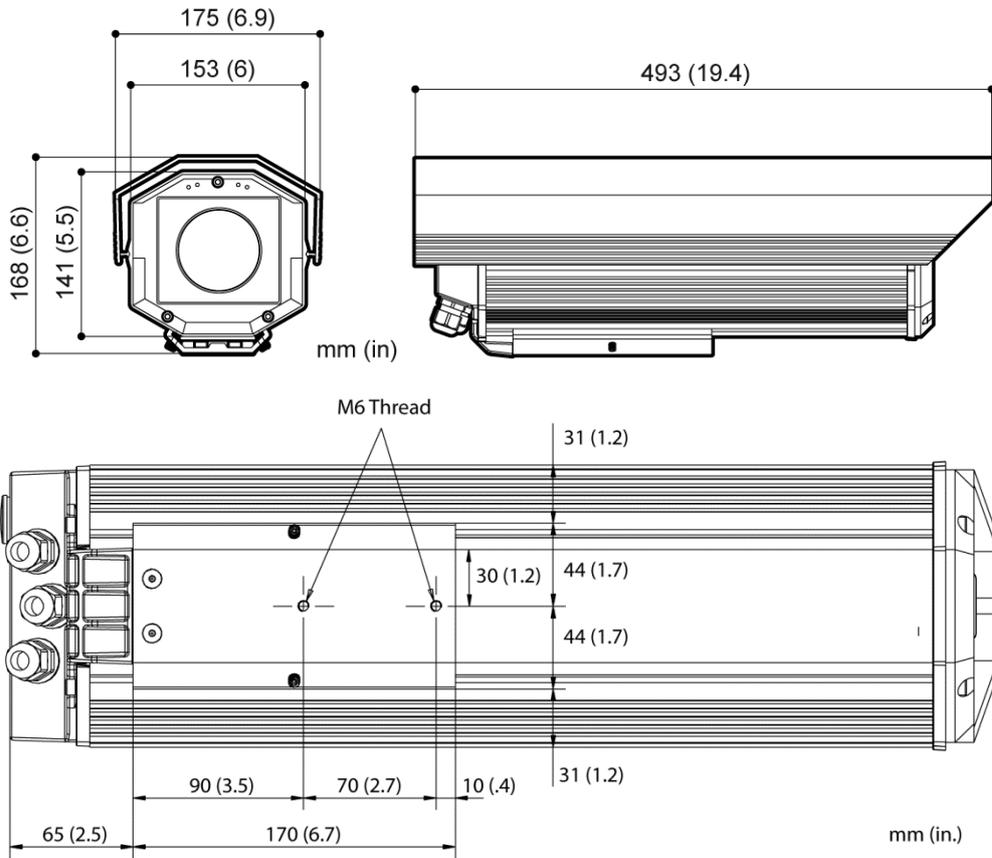


Figure 17: Dimensions and Footprint

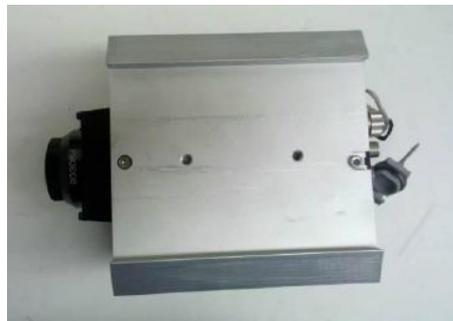
## 7.5.2 Installation

Locate 2x M4 screws on camera.



Place conduction plate onto camera as shown, making sure to line up holes on camera with hole and slot on the conduction plate.

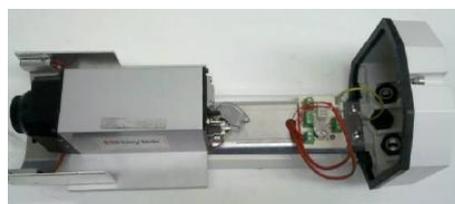
Install 2x M4 screws and secure conduction plate onto camera.



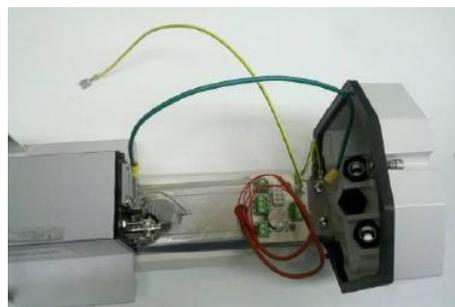
Place housing internal rail onto conduction plate as shown.



Secure conduction plate to rail by installing 2x Screws (truss), 4x curved washers (2x per screw), and 2x flat washers. Insert each screw half a turn past after making contact with curved washer and slide camera forward.



Secure ground cable to camera as shown (color of cable/ring terminals used for display only), from camera to internal rail screw with tooth washer. Then install supplied ground cable onto heater board for connection to enclosure.



Disassemble Ethernet cable connector by loosening nut as shown.



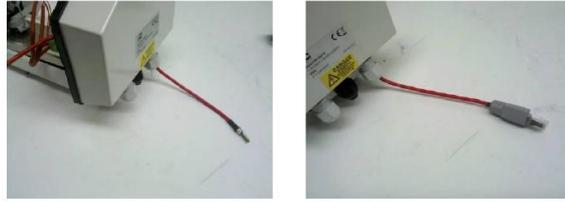
Remove cable from RJ45 jack by lifting tab, note wiring for reassembly.



# Accessories

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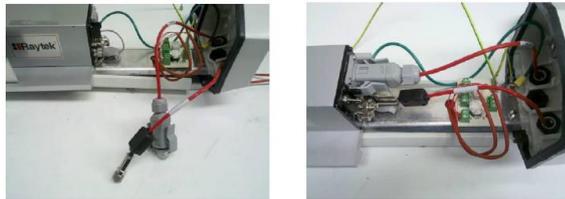
Pass Ethernet cable through enclosure cable gland as shown and reassemble connector.



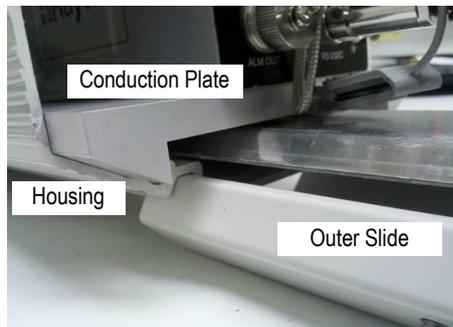
Inset power cable with isolated cable ends through cable gland on enclosure.



Using power and Ethernet cables that have been passed through cable glands on rear of enclosure, install cables onto camera (turn on camera if needed).



Place camera conduction plate on inside surface of enclosure and slide the outer slide onto the housing as shown.



Connect ground cable onto housing as shown before closing housing.



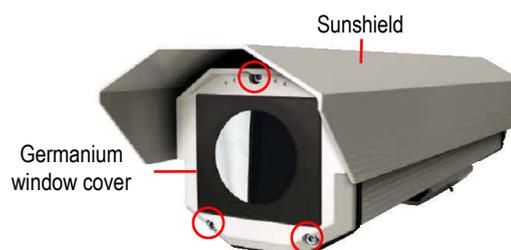
Tighten rear cover 3x screws, then tighten 2x setscrews on outer slide as shown.



Slide camera forward if needed and ensure that camera conduction plate makes contact with inside surface of enclosure in order to ensure adequate thermal conductivity.



Install front Germanium window cover by tightening 3x screws then install sunshield as shown.



Tighten rear cable glands to create seal around cables.



# Accessories

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## 7.6 Digital Input / Relay Output Module

The module interfaces to DTPi software only.



**Type** 6060

**Digital Input**

Channels 6

Dry contact low level: close to GND  
high level: open

**Relay Output**

Channels 6

Contact rating (resistive) 120 V @ 0.5 A (AC)  
30 V @ 1 A (DC)

Type form A (normally open) 

Maximum switching rate 20 operations / minute

**Ethernet Communications**

LAN 10/100 Base-T (X)

LAN cable length max. 100 m (328 ft)

Factory default IP address 192.168.200.241

Factory default gateway 255.255.255.0

For changing the network settings, see section 9.3 [Configuring of I/O Modules](#), page 54.

**General**

Power 10 to 30 V<sub>DC</sub>

Power consumption 2 W @ 24 V<sub>DC</sub>

Connectors 1 x RJ-45 (LAN)  
Plug-in screw terminal block (I/O and power)

Isolation voltage 2 kV<sub>DC</sub>

Operating temperature -10 to 70°C (14 to 158°F)

Storage temperature -20 to 80°C (-4 to 176°F)

Operating humidity 20 to 95% RH, non-condensing

Storage humidity 0 to 95% RH, non-condensing

Dimension 70 x 120 x 30 mm (2.8 x 4.7 x 1.2 in)

Mounting wall or DIN rail mounting



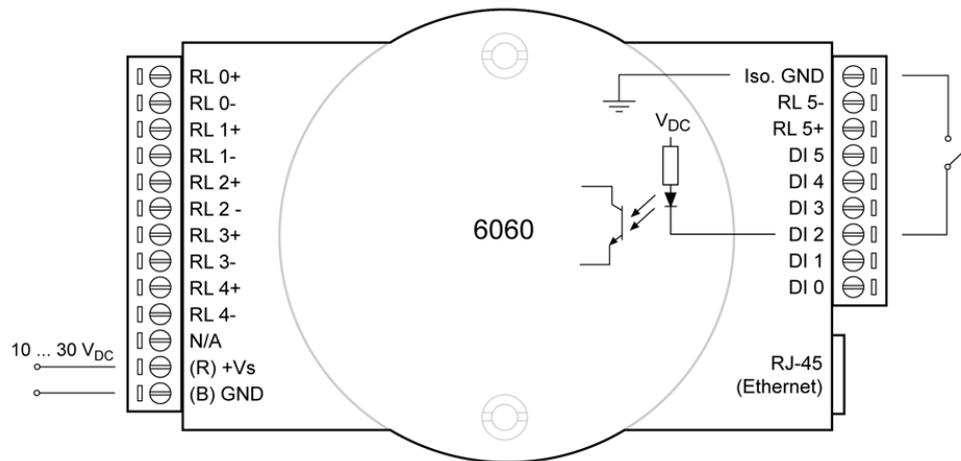


Figure 18: Digital Input Wiring

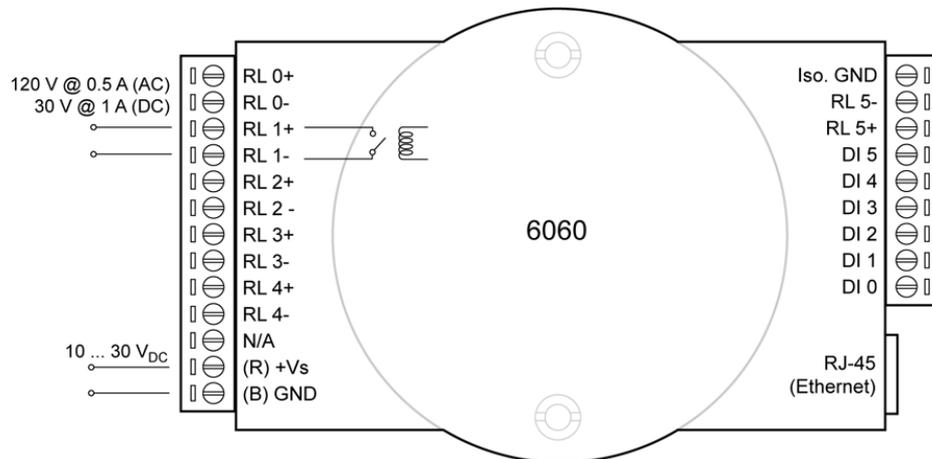


Figure 19: Relay Output Wiring

# Accessories

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## 7.7 Digital I/O and Analog Output Module

The module interfaces to DTPi software only.



<b>Type</b>	6024
<b>Analog Output</b>	
Channels	2
Output type	0/4 to 20 mA (for switching to a voltage signal, see section 7.7.1 <a href="#">Changing the Output Type</a> , page 44.)
<b>Digital Output</b>	
Channels	2
Output type	open collector to 30 V, 100 mA max. load
<b>Digital Input</b>	
Channels	2
Dry contact	low level: close to GND high level: open
<b>Ethernet Communications</b>	
LAN	10/100 Base-T (X)
LAN cable length	max. 100 m (328 ft)
Factory default IP address	192.168.200.240
Factory default gateway	255.255.255.0
For changing the network settings, see section 9.3 <a href="#">Configuring of I/O Modules</a> , page 54.	
<b>General</b>	
Power	10 to 30 V <sub>DC</sub>
Power consumption	4 W @ 24 V <sub>DC</sub>
Connectors	1 x RJ-45 (LAN) Plug-in screw terminal block (I/O and power)
Isolation voltage	2 kV <sub>DC</sub>
Operating temperature	-10 to 50°C (14 to 122°F)
Storage temperature	-20 to 80°C (-4 to 176°F)
Operating humidity	20 to 95% RH, non-condensing
Storage humidity	0 to 95% RH, non-condensing
Dimension	70 x 120 x 30 mm (2.8 x 4.7 x 1.2 in)
Mounting	DIN rail, wall



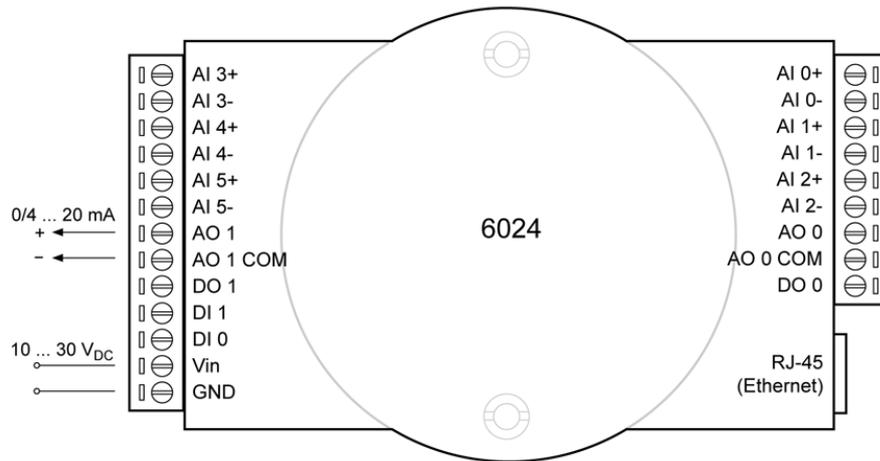


Figure 20: Analog Output Wiring

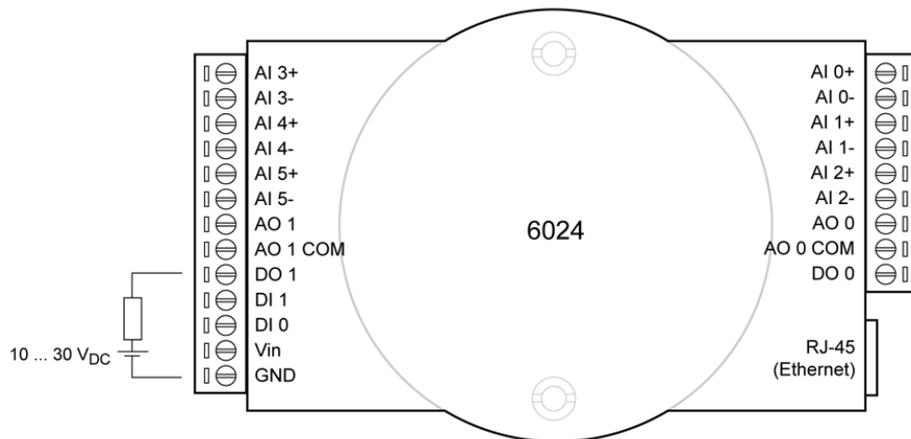


Figure 21: Digital Output Wiring

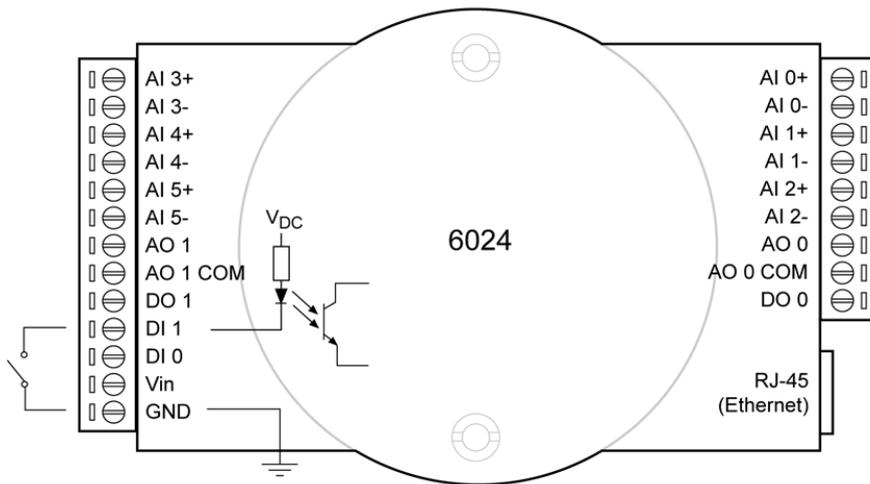


Figure 22: Digital Input Wiring

## 7.7.1 Changing the Output Type

The output type of the module 6024 is determined by the setting of internal jumpers on the analog board. The default jumper setting is <Current Signal>. To change the analog output to <Voltage Signal>, you have to open the module and set the jumpers J7-J8 for the analog output AO0 and J9-J10 for the analog output AO1, as illustrated in the figure below:

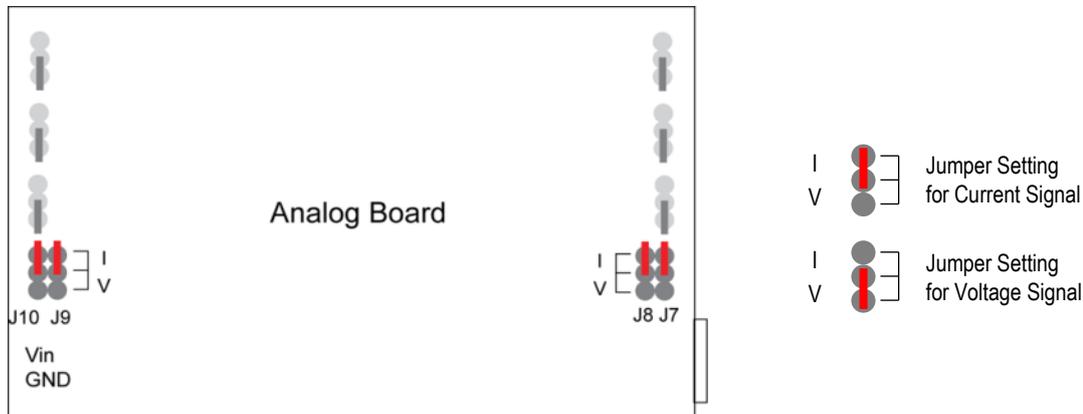


Figure 23: Jumper Settings

## 7.8 Ethernet Switch

The Industrial 5 Port Gigabit Ethernet Switch allows input/output modules, camera and PC to be connected on a single network.

<b>Type</b>	EKI-2725
<b>Communications</b>	
Ports	5 x
LAN	100Base-TX, 10/1000Base-T
Transmission speed	10/100/1000 MBit/s (Auto Negotiation)
Transmission distance	100 m (328 ft) 4-wire Cat.5e, Cat.6 RJ-45 cable
<b>General</b>	
Rating	IP30
Power	12 to 48 V <sub>DC</sub>
Power consumption	4.6 W
Connectors	5x RJ-45 (LAN) 6-pin removable screw terminal (power & relay)
Operating temperature	-10 to 60°C (14 to 140°F)
Storage temperature	-40 to 85°C (-40 to 185°F)
Operating humidity	5 to 95% RH, non-condensing
Storage humidity	0 to 95% RH, non-condensing
Dimension	37 x 140 x 95 mm (1.5 x 5.5 x 3.7 in) (W x H x D)
Mounting	DIN rail, wall



## 7.9 Fiber Optic / RJ45 Ethernet Converter

The Fiber Optic / RJ45 Ethernet Converter (type Advantech EKI-2526M) assures high reliability and stability in harsh environments, making it a robust bridge between enterprise fiberoptic backbones and Ethernet devices, like the Pi20 camera. Using fiber optics, you prevent electrical interference from corrupting the camera system. The Fiber Optic / RJ45 Ethernet Converter supports fast speed and high distance transmissions. Copper-based Ethernet communication is very limited in length without using a repeater.

The Fiber Optic / RJ45 Ethernet Converter converts up to 4 Ethernet channels to support a single camera and multiple Analog or Digital I/O Modules. A second Fiber Optic / RJ45 Ethernet Converter is required to reconvert the fiber optic signals back to TCP/IP Ethernet again.



### Ethernet Communications

Ports	4x
Port connector	RJ45
Distance	max. 90 m (295 ft)

### Fiber Optic Communications

Ports	1x
Port connector	SC type
Fiber	multi-mode, 62.5/125 $\mu\text{m}$ or 50/125 $\mu\text{m}$
Distance	max. 2 km (1.24 mi)

### Mechanics

Dimensions (W x H x D)	37 x 140 x 95 mm (1.45 x 5.5 x 3.7 in)
Mounting	DIN-rail, wall

### Power

Power input	12 to 48 VDC, redundant dual inputs
Power connector	removable screw terminal
Power consumption	5 W

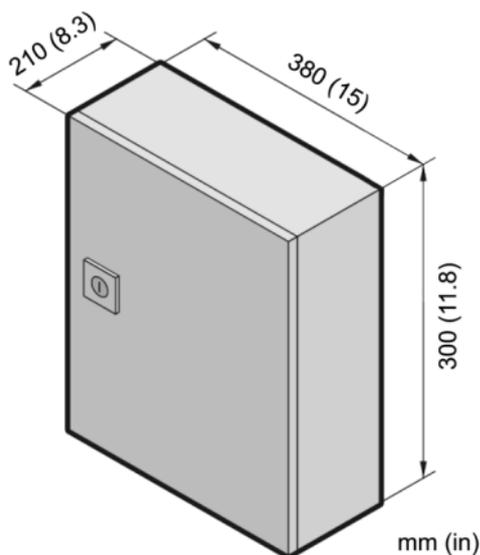
### Environment

Operating temperature	-10 to 60°C (14 to 140°F)
Storage temperature	-40 to 85°C (-40 to 185°F)
Operating humidity	5 to 95% RH
Protection	4 kV <sub>DC</sub> ESD (Ethernet), 3 kV <sub>DC</sub> Surge (EFT for power)



### 7.10 Junction Box

The junction box provides the space to the mount the industrial power supply, I/O modules, Fiber Optic / RJ45 Ethernet Converter, and/or the Ethernet switch.

**Technical Data:**

Box	sheet steel, powder-coated
Dimensions (W x H x D)	380 x 300 x 210 mm (15 x 11.8 x 8.3 in)
Net Weight	9.8 kg (22 lb)
Protection Rate:	IP66 (NEMA 4)
Internal wiring	cable diameter max. 2.5 mm <sup>2</sup> (AWG 14)
Box, fused	6 A

**Delivery:**

Connection box  
Cable entry system

# Accessories

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## 7.11 DataTemp Pi Software

The ThermoView camera is easily interfaced to the DataTemp Pi software<sup>7</sup> (DTPi). This software is fully featured to allow for real time viewing, saving and playback of images from the ThermoView camera. The software is intuitive, easy-to-use and is designed to be set up and operational for your application within minutes. With this PC based software, you can view and analyze live or archived images. In addition, the software interfaces to remote I/O modules to be used as triggering inputs, process alarm and analog outputs.

The DTPi software is intended to be run on a dedicated PC.

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<sup>7</sup> Copyright © Fluke Corporation. All rights reserved. Portions of this software copyrights © National Instruments Corporation.



## 8 Maintenance

It is recommended to carry out periodic temperature calibrations at least once a year to maintain product quality and ensure the reliability of temperature indications.

There are no user-serviceable parts in the camera. Periodically inspect and insure that all camera mounting screws remain tightly fastened.

If you need application assistance, calibration, repair, and solutions to specific problems, our customer service representatives are always at your disposal. In many cases, problems can be solved over the telephone. If you need to return equipment to us, please contact our Service Department before doing so. You will find their contact information on the Contact page of this manual.

### 8.1 Troubleshooting

Symptom	Probable cause	Remedy
Power does not turn on.	Power switch is not on.	Turn on the Power Switch.
	AC adapter is not connected.	Connect AC adapter.
Measuring temperature is in error. (out of the specifications)	Wrong emissivity is set	Set correct emissivity.
	Ambient reflection calibration is not made	Execute ambient reflection calibration
	Focus is not met	Adjust focus correctly.
Noise problem	High voltage source is nearby.	Take a distance from the high voltage source.
	Connectors or cable touches to any noise source.	Turn off the power and take a distance from the noise source.

### 8.2 Cleaning the Lens

The camera's lens must be kept as clean as possible. Any foreign matter on the lens will affect the accuracy of the measurements. Take care when cleaning the lens, as it can easily be scratched. Please observe the following guidelines for cleaning the lens:

- Lightly blow off loose particles!
- Wipe off the dust lightly, using a chamois cloth!
- For removing oil film, moisten a soft cotton swab (or boiled and dried gauze) with a little non-aqueous alcohol (ethanol) and wipe it lightly!



**Absolutely avoid using organic solvents such as thinner, benzene or chemicals for cleaning. These will cause discoloration!**

**Directly wiping the lens with a coarse cloth may leave scratches!**

# Appendix

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## 9 Appendix

### 9.1 Determination of Emissivity

Emissivity is a measure of an object's ability to absorb and emit infrared energy. It can have a value between 0 and 1.0. For example a mirror has an emissivity less of 0.1, while the so-called "Blackbody" reaches an emissivity value of 1.0. If a higher than actual emissivity value is set, the output will read low, provided the target temperature is above its ambient temperature. For example, if you have set 0.95 and the actual emissivity is 0.9, the temperature reading will be lower than the true temperature. An object's emissivity can be determined by one of the following methods:

1. Determine the actual temperature of the material using an RTD (PT100), a thermocouple, or any other suitable method. Next, measure the object's temperature and adjust emissivity setting until the correct temperature value is reached. This is the correct emissivity for the measured material.
2. For relatively low temperatures (up to 260°C, 500°F) place a plastic sticker on the object to be measured. This sticker should be large enough to cover the target spot. Next, measure the sticker's temperature using an emissivity setting of 0.95. Finally, measure the temperature of an adjacent area on the object and adjust the emissivity setting until the same temperature is reached. This is the correct emissivity for the measured material.
3. If possible, apply flat black paint to a portion of the surface of the object. The emissivity of the paint must be above 0.95. Next, measure the temperature of the painted area using an emissivity setting of 0.95. Finally, measure the temperature of an adjacent area on the object and adjust the emissivity until the same temperature is reached. This is the correct emissivity for the measured material.

### 9.2 Typical Emissivity Values

The following table provides a brief reference guide for determining emissivity and can be used when one of the above methods is not practical. Emissivity values shown in the table are only approximate, since several parameters may affect the emissivity of a material. These include the following:

1. Temperature
2. Angle of measurement
3. Geometry (plane, concave, convex)
4. Thickness
5. Surface quality (polished, rough, oxidized, sandblasted)
6. Spectral range of measurement
7. Transmissivity (e.g. thin films plastics)



Material	METALS	
	Emissivity	
	8 – 14 $\mu\text{m}$	
Aluminum		
Unoxidized		0.02-0.1
Oxidized		0.2-0.4
Alloy A3003, Oxidized		0.3
Roughened		0.1-0.3
Polished		0.02-0.1
Brass		
Polished		0.01-0.05
Burnished		0.3
Oxidized		0.5
Chromium		0.02-0.2
Copper		
Polished		0.03
Roughened		0.05-0.1
Oxidized		0.4-0.8
Gold		0.01-0.1
Haynes		
Alloy		0.3-0.8
Inconel		
Oxidized		0.7-0.95
Sandblasted		0.3-0.6
Electropolished		0.15
Iron		
Oxidized		0.5-0.9
Unoxidized		0.05-0.2
Rusted		0.5-0.7
Molten		
Iron, Cast		
Oxidized		0.6-0.95
Unoxidized		0.2
Molten		0.2-0.3
Iron, Wrought		
Dull		0.9
Lead		
Polished		0.05-0.1
Rough		0.4
Oxidized		0.2-0.6
Magnesium		0.02-0.1
Mercury		0.05-0.15
Molybdenum		
Oxidized		0.2-0.6
Unoxidized		0.1
Monel (Ni-Cu)		0.1-0.14
Nickel		



# Appendix

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<b>Material</b>	<b>METALS</b>
	<b>Emissivity</b>
	<b>8 – 14 μm</b>
Oxidized	0.2-0.5
Electrolytic	0.05-0.15
Platinum	
Black	0.9
Silver	0.02
Steel	
Cold-Rolled	0.7-0.9
Ground Sheet	0.4-0.6
Polished Sheet	0.1
Molten	
Oxidized	0.7-0.9
Stainless	0.1-0.8
Tin (Unoxidized)	0.05
Titanium	
Polished	0.05-0.2
Oxidized	0.5-0.6
Tungsten	0.03
Polished	0.03-0.1
Zinc	
Oxidized	0.1
Polished	0.02



Material	NON-METALS
	Emissivity
	8 – 14 $\mu\text{m}$
Asbestos	0.95
Asphalt	0.95
Basalt	0.7
Carbon	
Unoxidized	0.8-0.9
Graphite	0.7-0.8
Carborundum	0.9
Ceramic	0.95
Clay	0.95
Concrete	0.95
Cloth	0.95
Glass	
Plate	0.85
“Gob”	
Gravel	0.95
Gypsum	0.8-0.95
Ice	0.98
Limestone	0.98
Paint (non-al.)	0.9-0.95
Paper (any color)	0.95
Plastic, opaque at 500 $\mu\text{m}$ thickness (20 mils)	0.95
Rubber	0.95
Sand	0.9
Snow	0.9
Soil	0.9-0.98
Water	0.93
Wood, Natural	0.9-0.95

**Table 2: Typical Emissivity Values**

To optimize surface temperature measurements, consider the following guidelines:

- Determine the object emissivity using the instrument which is also to be used for the measurements.
- Avoid reflections by shielding the object from surrounding temperature sources.
- For higher temperature objects use instruments with the shortest wavelength possible.
- For translucent materials such as plastic foils or glass, assure that the background is uniform and lower in temperature than the object.
- Mount the sensor perpendicular to surface whenever emissivity is less than 0.9. In all cases, do not exceed angles more than 30 degrees from incidence.



# Appendix

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## 9.3 Configuring of I/O Modules

### 9.3.1 Overview

It is recommended to use an Ethernet switch to connect the Ethernet port of the I/O Module to the computer, as shown in the [Figure 3](#) on page 9.

### 9.3.2 Installing the Configuration Software

For the module IP address setting, you will need to use the ADAM.NET Utility software<sup>8</sup> found on the ADAM support CD.



Figure 24: Installing the ADAM.NET Utility Software



Before installing ADAM.NET Utility, you need to install .NET Framework 1.1 or later!

### 9.3.3 IP Address Setting

After you have confirmed the hardware wiring between host PC and your ADAM-6000 module, you can find that module in ADAM.NET Utility software by following the steps below:

1. Launch ADAM.NET Utility software.
2. Select the <ADAM5000TCP\_6000> item ① on the module tree display area.
3. Right click the <ADAM5000TCP\_6000> item and activate <Search>. ADAM.NET Utility will then search all ADAM-6000 modules on the Ethernet network. You will find it showing on the <Others> item ② and under the status display area ③.

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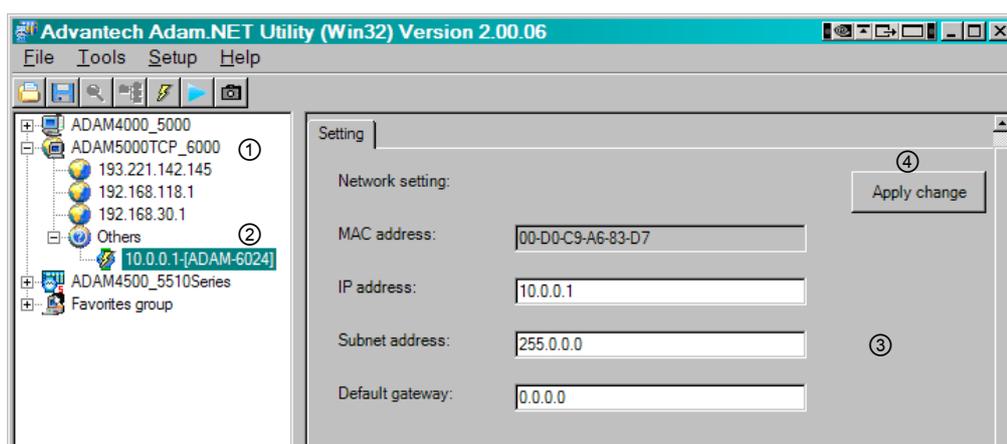


Figure 25: ADAM-6000 Module under the ADAM.NET Utility Software



If network Firewall is enabled on your computer, you may not be able to connect with your ADAM-6000 module. You need to add ADAM.NET Utility into the list of exceptions. See section 9.4 [Defining of Firewall Exceptions](#), page 56!

4. You need to change the IP address of the ADAM-6000 modules the same subnet with the host PC. Type the correct <IP address>, <Subnet address>, and <Default gateway> on the status display area ③.  
For more information on setting the host PC see section 5.8.1 [Changing the Ethernet Settings for the PC](#), page 23.
5. When completed, click the <Apply Change> button ④. A dialog box appears, asking you to type the password. The default password of ADAM-6000 module is **00000000**.

# Appendix

## 9.4 Defining of Firewall Exceptions

With the Windows Firewall turned on, an exception must be added to allow the imaging software (TSA or DTPi) to receive and send data. To add the firewall exceptions, follow instructions given below.

1. Choose <Control Panel> under the <Windows Start> <Settings> menu.
2. Open the <Windows Firewall> utility.
3. Determine the status of the Windows Firewall. If the Windows Firewall is off, it is not blocking connections from your host system. Regardless of the status, we recommend adding the program exception for the imaging software (TSA or DTPi), as the Windows Firewall may be turned on at any time.
4. XP/Vista: Open the <Exceptions> tab and click the <Add Program>.  
Win 7: Click on <Change Settings> tab and click the <Allow another Program> button.
5. In the following dialog, click <Browse> and locate the imaging software (TSA or DTPi) which you wish to allow. Typically, the program is located at "C:\Program Files\Raytek\DTPi".
6. Verify that the imaging software (TSA or DTPi) is shown in the exception list and press the <OK> button to accept the changes and dismiss the dialog. The new firewall exceptions will take effect immediately.

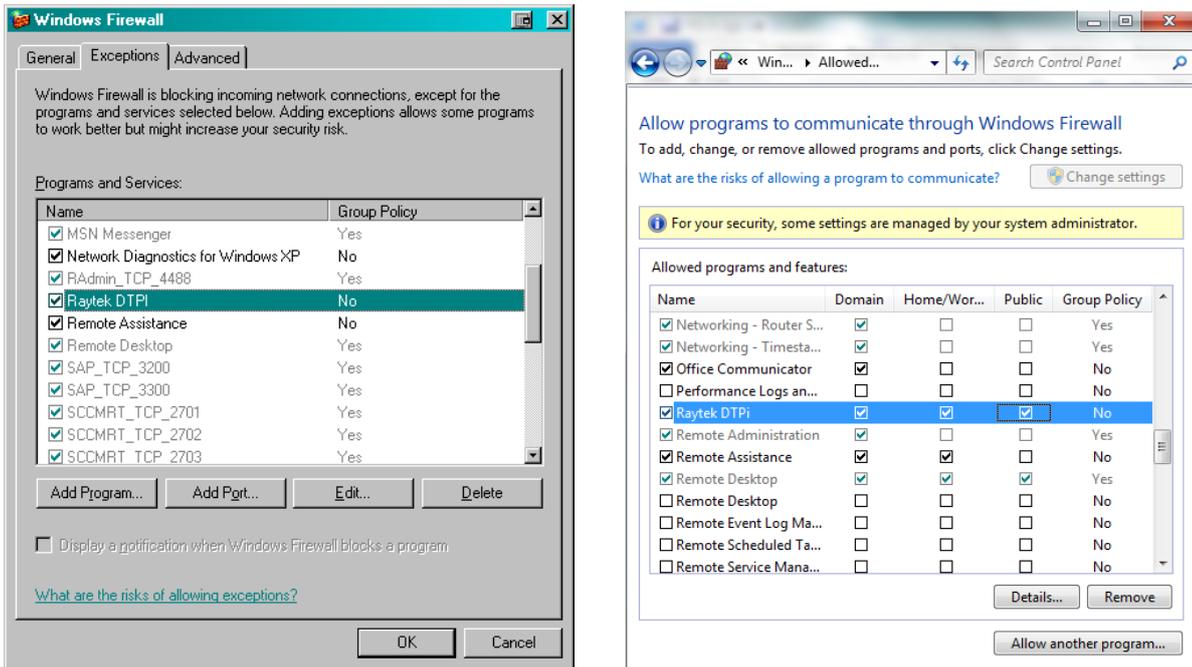


Figure 26: Firewall Exceptions under Windows XP (left) and Windows 7 (right)