IR*tec* Rayomatic 20/40

IR*tec* Rayomatic 60/100

Process Infrared thermometer

Instruction Manual MM850341 ed. 06f

INTRODUCTORY NOTE

ATTENTION: THIS MANUAL IS VALID FOR IRTEC RAYOMATIC 20/40/60/100.

*This publication contains operating instructions, as well as a description of the principles of operation, of **IRtec Rayomatic 20/40/60/100** IR thermometers.*
This information covers all models of the instrument, including the basic equipment and its options and accessories. This manual is a complete "USER GUIDE", providing step-by-step instructions to operate the instrument in each of its designed functions.

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***IRtec** IR thermometers uses sophisticated analogic and digital technologies. Any maintenance operation must be carried out by qualified personnel **ONLY**. We recommend to contact our technicians for any support requirements.*

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EUROPEAN Headquarters	USA Headquarters
Eurotron Instruments SpA	**E-Instruments Group LLC**
Viale F.lli Casiraghi 409/413	172 Middletown Blvd – Suite B201
20099 Sesto S. Giovanni (MI)	Langhorne, PA 19047
Tel. : +39-02 24 88 201	Tel.: 215 750 1212
FAX: +39-02 24 40 286	FAX: 215 750 1399
Mail: info@eurotron.com	Mail: info@einstrumentsgroup.com

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1 GENERAL DESCRIPTION

The temperature measurement of a liquid or gaseous compound has been successfully made with thermoelectric or expansion thermometers thanks to the good thermal exchange between the fluid and the sensor.
With solid bodies a good thermal exchange is difficult to be obtained and an additional measuring error should be considered.
Direct contact measurement is impractical when the object being measured is moving, or electrically hazardous, or for any other reasons cannot be touched with a thermocouple. A non-contact IR temperature measurement is the only solution to the above problems. Other applications benefit because non-contact thermometers do not add or remove heat or disturb the process in any way.

Eurotron has applied the most recent development in IR sensor technology and, based on an extensive application experience, has designed the new line of non-contact thermometers series **IRtec Rayomatic** applying a total modularity concept. Each **IRtec Rayomatic** thermometer consists of a cylindrical chassis able to contain: lens, optical filters, IR sensor and electronic. **IRtec Rayomatic 100** has a remote optical head that allow a good location of the instrument and the best accessibility of measuring head .

Eurotron IRtec infrared thermometers have been designed to be used on a wide range of industrial and research applications.
These thermometers include the emissivity adjusment and a 4/20 mA linear output in order to work using the **DigiMax** display units**.** DigiMax is a microprocessor unit and it is able to provide the necessary 24Vdc current loop power supply. You can order the indicator complete of one or two programmable alarm relè.
Any other acquisition unit with 4/20 mA two wires current loop input can be used with the thermometers.

IRtec Rayomatic 20

IRtec Rayomatic 40

IRtec Rayomatic 20
IRtec Rayomatic 20 thermometers are easy to use and reliable pyrometers that can be manually set acting on trimmers situated on the back side of the instrument.

IRtec Rayomatic 40
IRtec Rayomatic 40 are sophisticated thermometers that implement a digital communication protocol superimposed to the standard 4-20mA current loop. This allows the user to set the parameters by means of a PC, a Bell202/RS232 adapter and the dedicated software as well as continuously monitoring the measurements.

IRtec Rayomatic 60
Fibre optic IRtec Rayomatic 60 infrared thermometers are designed for non contact temperature measurements.
Two series are available with different spectral band: series 100 in 0.9 μm and series 160 in 1.6 μm.

IRtec Rayomatic 60

IRtec Rayomatic 100

IRtec Rayomatic 100 thermometers represent the new frontier in non-contact temperature measurement. **Eurotron** applied the most recent development in IR sensor technology and, based on an extensive application experience, has designed the new line of PC reconfigurable and programmable IR thermometers.
The 2-colors principle measurement is performed at the same time by two indipendent detectors with different but adjacent narrow band IR filters. By rationing the output of these 2 sensors, the temperature measurement becomes indipendent from a number of factors that can affect the desired accuracy.
An internal modem allows using the same two wires 4/20mA current loop for smart communication. A smart/RS232 adapter is available for PC bi-directional communication. You can read the temperature measurement, set all parameters (temperature range, averaging, peak-picking, alarms, emissivity, etc.).

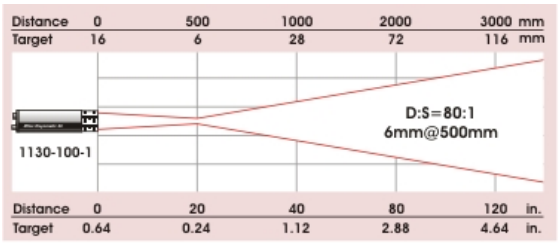
IRtec Rayomatic 100

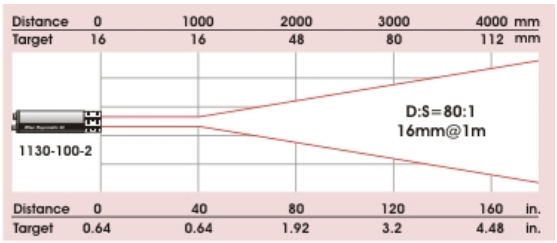
	Rayomatic 20	Rayomatic 40	Rayomatic 60	Rayomatic 100
2-wire 4/20 mA output	STD	STD	STD	STD
Serial comm. Bell202	NO	STD	STD	STD
ALARM	NO	STD	STD	NO
RESET	NO	STD	STD	NO
LASER	OPT	OPT	OPT	NO
Emissivity Adj.	Rotative switches	PC	Rotative switches + PC	PC
Configuration	Factory	PC	PC	PC

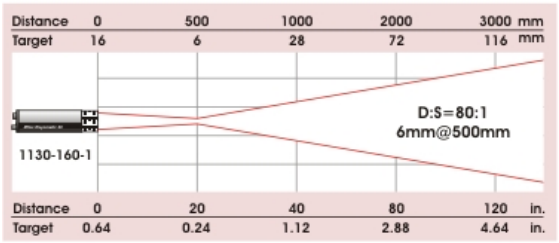
1.1 Specifications

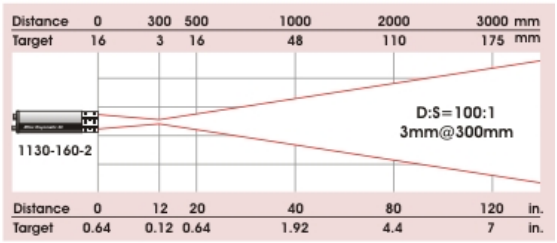
1.1.1 IRtec Rayomatic 20

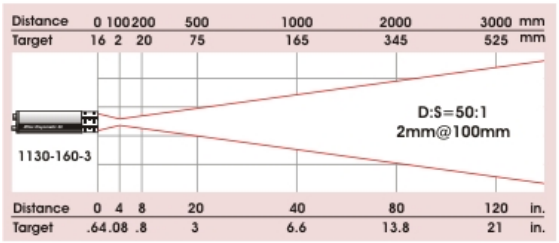
- **Measuring ranges:**
  see par 1.2.1 Table A
- **Accuracy:** @ 23°C ±5°C and ε=1.0
  IRtec Rayomatic 20-100 and 160: ±0.5% of rdg.
  IRtec Rayomatic 20-510: ±1% of rdg.
  IRtec Rayomatic 20-814 : ±1% of rdg. or ±1 °C whichever is greater
- **Repeatability:**
  IRtec Rayomatic 20-100 and 160: ± 0.25% of the reading
  IRtec Rayomatic 20-510 : ± 0.5% of the reading
  IRtec Rayomatic 20-814 : ± 0.5% of the reading
- **Response time:**
  IRtec Rayomatic 20-100 and 160: 28 ms (t95)
  IRtec Rayomatic 20-510 : 100 ms (t95)
  IRtec Rayomatic 20-814 : 100 ms (t95)
- **Type of detector:**
  IRtec Rayomatic 20-100: Si
  IRtec Rayomatic 20-160: InGaAs
  IRtec Rayomatic 20-510 : Thermopile
  IRtec Rayomatic 20-814 : Thermopile
- **Spectral band:**
  see par 1.2.1 Table A
- **Emissivity:**
  adjustable with 2 rotative switch from 0.30 to 1.00
- **Working temperature:**
  from -20 to +60 °C (without cooling)
  from 0 to +50 °C (for laser operation)
- **Storage temperature:**
  from -30 to +70 °C
  from -10 to +50 °C (for laser operation)
- **Output signal:**
  4/20 mA 2 wire current loop – max load 700 Ω
- **Temperature stability:**
  ±0.1 °C/°C for the band exceeding +18 to +28°C
- **Target pinpointing:**
  optional on-board laser pinpointing system with remote command
- **Environmental rating:**
  IP65 (NEMA-4)
- **Power supply:**
  4-20mA loop: from 12 to 32 Vdc
  Laser pinpointing: 12 to 32 Vdc max. 100mA
- **Dimension / Weight:**
  ø 45 mm x 200 mm - 0.5 Kg net weight

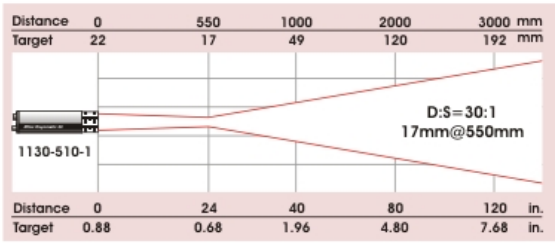


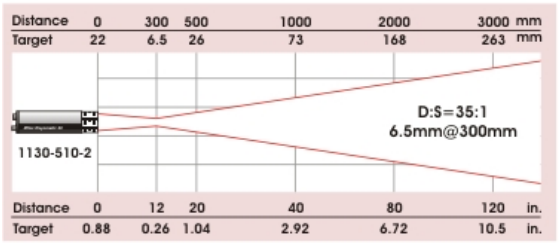


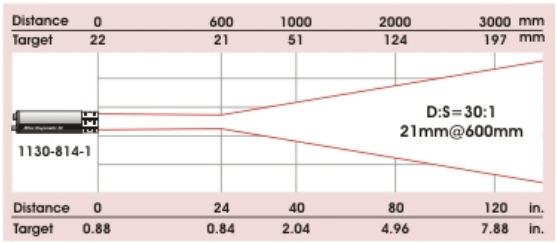


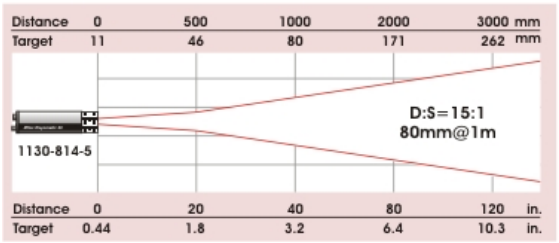


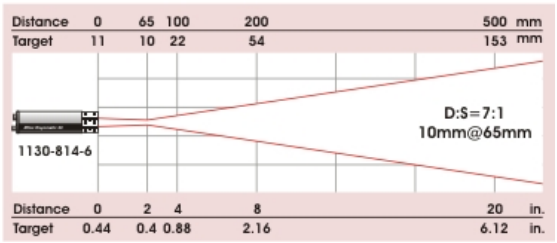












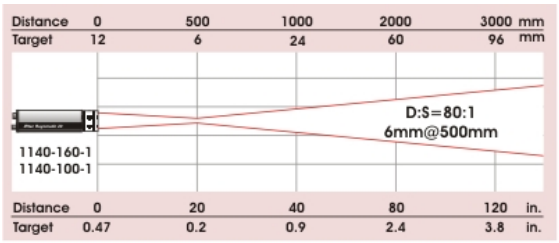
Note:

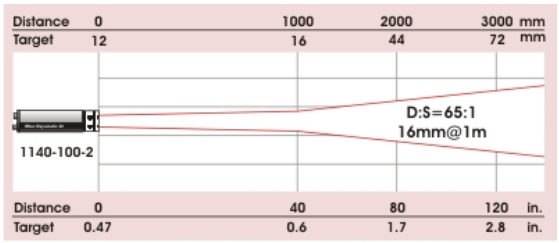
- *Nominal target @95% energy*

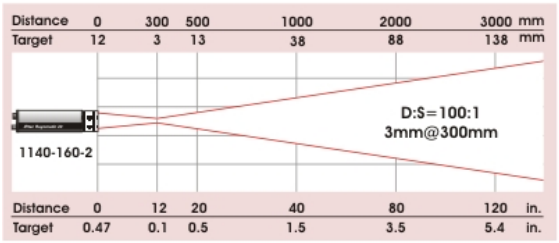
When the laser pinpointing system is installed, multiply the actual target diameter by 1.2

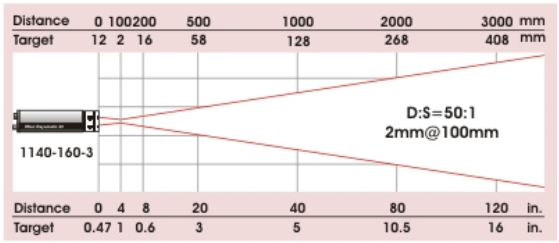
1.1.2 IRtec Rayomatic 40

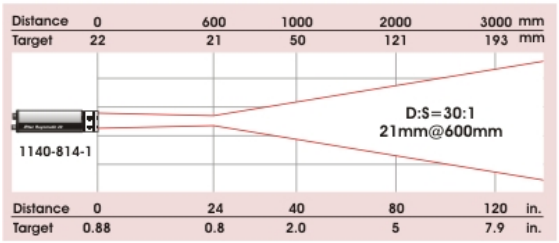
- **Accuracy:** @ 23°C ±5°C and ε=1.0
  IRtec Rayomatic 40-100: ±0.5% of rdg.
  IRtec Rayomatic 40-160: ±0.5% of rdg.
  IRtec Rayomatic 40-814: ±1% of rdg. or ±1°C whichever is greater
  IRtec Rayomatic 40-390: ±1% of rdg.
  IRtec Rayomatic 40-460: ±1% of rdg.
  IRtec Rayomatic 40-510: ±1% of rdg.
  IRtec Rayomatic 40-343: ±1% of rdg. or ±3°C whichever is greater
  IRtec Rayomatic 40-790: ±1% of rdg. or ±2°C whichever is greater
- **Repeatability:**
  IRtec Rayomatic 40-100: ±0.25% of rdg.
  IRtec Rayomatic 40-160: ±0.25% of rdg.
  IRtec Rayomatic 40-814: ±0.5% of rdg. or ±0.5°C whichever is greater
  IRtec Rayomatic 40-390: ±0.5% of rdg.
  IRtec Rayomatic 40-460: ±0.5% of rdg.
  IRtec Rayomatic 40-510: ±0.5% of rdg.
  IRtec Rayomatic 40-343: ±0.5% of rdg. or ±1.5°C whichever is greater
  IRtec Rayomatic 40-790: ±0.5% of rdg. or ±1.5°C whichever is greater
- **Response time:**
  IRtec Rayomatic 40-100: 28ms (t95)
  IRtec Rayomatic 40-160: 28ms (t95)
  IRtec Rayomatic 40-814: 100ms (t95)
  IRtec Rayomatic 40-390: 100ms (t95)
  IRtec Rayomatic 40-460: 100ms (t95)
  IRtec Rayomatic 40-510: 100ms (t95)
  IRtec Rayomatic 40-343: 1000ms (t95)
  IRtec Rayomatic 40-790: 1000ms (t95)
- **Type of detector:**
  IRtec Rayomatic 40-100: Si
  IRtec Rayomatic 40-160: InGaAs
  IRtec Rayomatic 40-814 : Thermopile
- **Emissivity:**
  adjustable by PC from 0.30 to 1.00
- **Temperature drift:**
  ±0.1 °C/°C for the band exceeding +18 to +28°C
- **Working temperature:**
  from -20 to +60 °C (without cooling)
  from 0 to +50 °C (for laser operation)
- **Storage temperature:**
  from -30 to +70 °C Si and InGaAs detectors
  from +10 to +60 °C Thermopile
- **Digital communication:**
  Bell 202 superimposed on 2-wire current loop (4/20 mA)
  RS232 with optional adapter
- **Output signal:**
  4/20 mA 2 wire current loop – max load 700 Ω
- **Target pinpointing:**
  optional on-board laser pinpointing system with remote command
- **Environmental rating:** IP65 (NEMA-4)
- **Power supply:**
  Current Loop: from 12 to 32 Vdc
  Laser: from 12 to 32 Vdc
- **Dimension / Weight:** ø 45 mm x 200 mm - 0.5 Kg

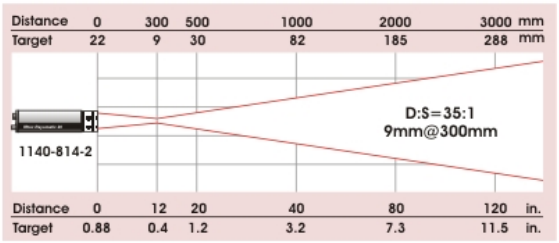


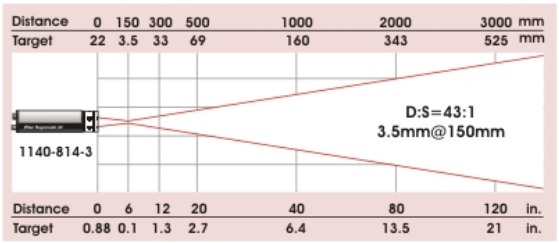


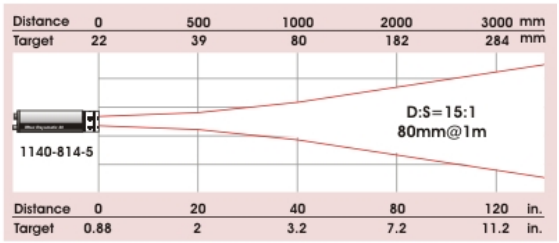


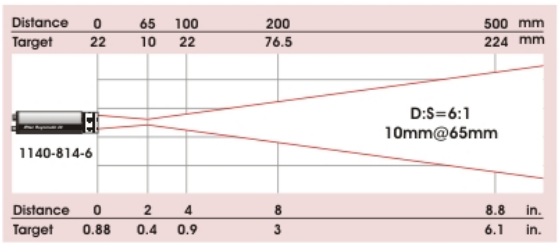


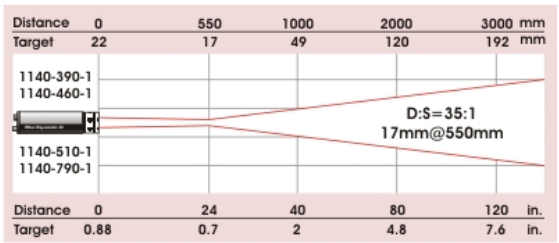


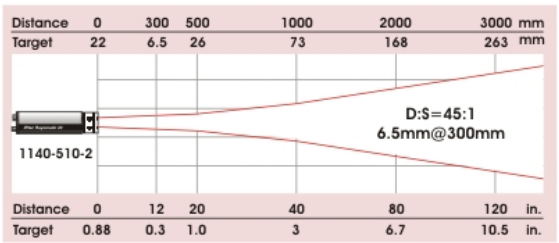










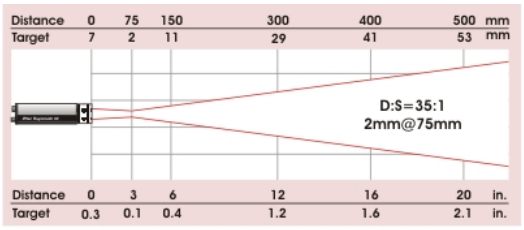


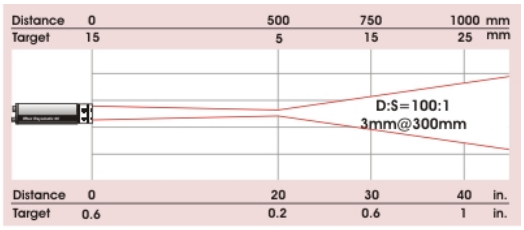
Note:

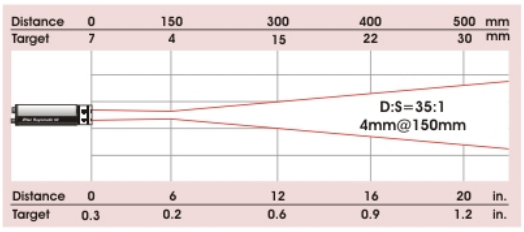
- *Nominal target @95% energy*
- *When the laser pinpointing system is installed, multipy the actual target diameter by 1.2*

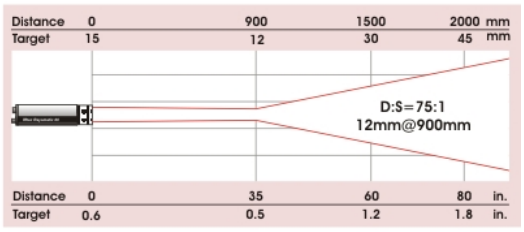
1.1.3 IRtec Rayomatic 60

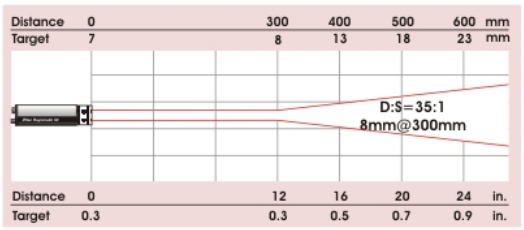
Accuracy: ±(0.5% of rdg. + 1°C)
Repeatability: ±0.25% of rdg.
Spectral Band:
Series 100: 0.9 mm (Silicon detector)
Series 160: 1.6 mm (InGaAs detector)
Response Time:
adjustable by PC from 50ms to 10s
Reference temperature:
from +15 to +35°C
Emissivity: adjustable from 0.30 to 1.00 in 0.01 steps with selector swithces or from PC
Digital communication:
Bell 202 superimposed on 2-wire current loop
RS232 with optional adapter
Output signal: 4/20 mA 2-wire current loop - max load 700 Ω
Environmental rating: IP65 (NEMA-4)
Power supply:
Current loop: from 12 to 32 Vdc
Laser (optional): from 12 to 32 Vdc
Green Laser (optional): 12Vdc±2Vdc
Temperature stability : <0.05% of rdg./°C for temperature exceeding the reference band
Working temperature:
Optical head: 200°C max
Optic fiber: 200°C max
Electronic module: from -20 to +60°C
Green Laser (optional): from +20°C to +30°C
Storage temperature: from -30 to +70°C
Dimensions / Weight :
Electronic module: ø 45x200 mm / 0.8 kg
Optical head: ø 16x52 mm - Fast Lock
ø 30x94 mm – Threaded M1









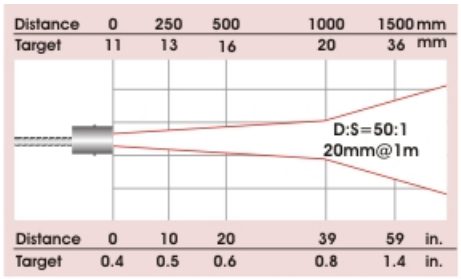


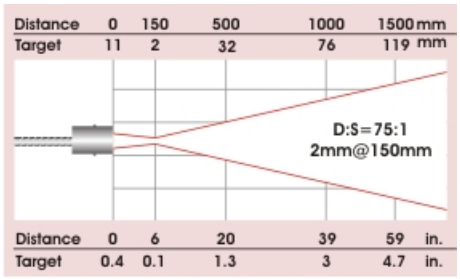
Note:

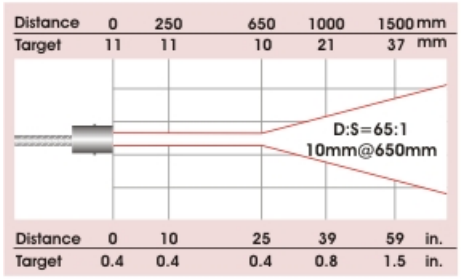
- *Nominal target @95% energy*

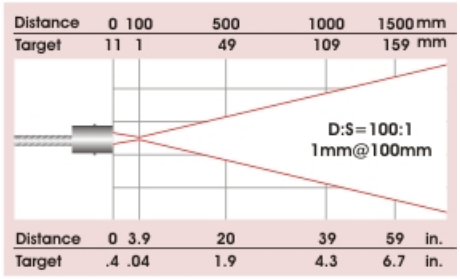
1.1.4 IRtec Rayomatic 100

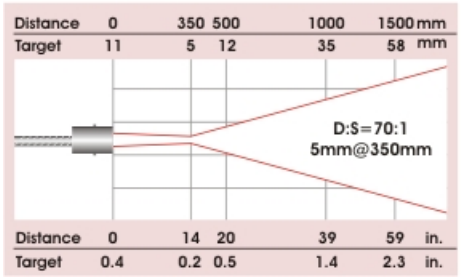
- **Accuracy:** @ 23°C ±5°C and ε=1.0
  2-color: ±0.75% FS (with 95% attenuation)
  monocromatic: ±0.5% FS
- **Repeatability:**
  2-color: ±0.25% FS
  monocromatic: ±0.25% FS
- **Response time:** 38ms (t95)
- **Emissivity:**
  adjustable by PC from 0.30 to 1.00 in 0.01 steps
  E-Slope adjustable by PC from 0.800 to 1.200 in 0.001 steps
- **Temperature drift:**
  <±0.05 % rdg./°C for the band exceeding +18 to +28°C
- **Working temperature:**
  from -20 to +60 °C (without cooling)
- **Storage temperature:**
  from -30 to +70 °C
- **Digital communication:**
  Bell 202 superimposed on 2-wire current loop
  RS232 with optional adapter
- **Output signal:**
  4/20 mA 2 wire current loop – max load 700 Ω
- **Environmental rating:** IP65 (NEMA-4)
- **Power supply:**
  Loop: from 12 to 32 Vdc
- **Operating temperature**:
  optical head: 200 °C max
  fiber optic: 200 °C max
  electronic module: from -20 to +60 °C
- **Dimension / Weight:**
  Elecronic module ø 45 mm x 200 mm - 0.5 Kg
  fiber optic ø 8 mm
  optic head ø 16 mm x 52 mm











Note:

- *Nominal target @95% energy*

1.2 Ordering code

1.2.1 IRtec Rayomatic 20

cat. 1130 - A - B - C – D – E - F

Table A	CWL	ϕ target/distance	Range	
100-1	0.9µm	6mm @ 500mm	600 to 1600°C	(1100 to 2900°F)
100-2	0.9µm	16mm @ 1000mm	600 to 1600°C	(1100 to 2900°F)
160-1	1.6µm	6mm @ 500mm	300 to 1300°C	(570 to 2350°F)
160-2	1.6µm	3mm @ 300mm	300 to 1300°C	(570 to 2350°F)
160-3	1.6µm	2mm @ 100mm	300 to 1300°C	(570 to 2350°F)
510-1	5.1µm	10.5mm @ 300mm	150 to 1300°C	(300 to 2350°F)
510-2	5.1µm	17mm @ 500mm	800 to 2000°C	(1470 to 3630°F)
814-1	8-14µm	21mm @ 600mm	-25 to 1000°C	(-15 to 1800°F)
814-5	8-14µm	80mm @ 1000mm	0 to 800°C	(32 to 1450°F)
814-6	8-14µm	10mm @ 65mm	0 to 400°C	(32 to 750°F)

Table B	Signal output
2	4÷20 mA 2-wire current loop

Table C	Pinpointing system
0	None
1	built-in pinpointing laser

Table D	Electrical connection cable
1	2m long - 2 wires shielded
2	8m long - 2 wires shielded
9	Length on request

Table E	Report of Calibration
0	None
1	Eurotron traceable SIT

1.2.2 IRtec Rayomatic 40

cat. 1140 - A - B - C – D – E – F

Table	A - B	CWL	ϕ target/distance	Range	
	100-1	0.9µm	6mm @ 500mm	600 to 1600°C	(1100 to 2900°F)
	100-2	0.9µm	16mm @ 1000mm	600 to 1600°C	(1100 to 2900°F)
	160-1	1.6µm	6mm @ 500mm	300 to 1300°C	(570 to 2350°F)
	160-2	1.6µm	3mm @ 300mm	300 to 1300°C	(570 to 2350°F)
	160-3	1.6µm	2mm @ 100mm	300 to 1300°C	(570 to 2350°F)
	814-1	8-14µm	21mm @ 600mm	-25 to 1000°C	(-15 to 1800°F)
	814-2	8-14µm	9mm @ 300mm	0 to 1000°C	(32 to 1800°F)
	814-3	8-14µm	3.5mm @ 140mm	0 to 1000°C	(32 to 1800°F)
	814-5	8-14µm	80mm @ 1000mm	0 to 800°C	(32 to 1450°F)
	814-6	8-14µm	10mm @ 65mm	0 to 400°C	(32 to 750°F)
	343-1	3.43µm	26mm @ 500mm	100 to 400°C	(210 to 750°F)
	390-1	3.9µm	17mm @ 550mm	600 to 1300°C	(1100 to 2350°F)
	460-1	4.6µm	17mm @ 550mm	400 to 1600°C	(750 to 2900°F)
	510-1	5.1µm	17mm @ 550mm	150 to 1300°C	(300 to 2350°F)
	510-2	5.1µm	8.5mm @ 300mm	800 to 2000°C	(1470 to 3630°F)
	790-1	7.9µm	17mm @ 550mm	40 to 600°C	(104 to 1100°F)

Table	C	Signal output
	2	4÷20 mA 2-wire current loop with superimposed serial communication

Table	D	Pinpointing system
	0	None
	1	built-in laser pinpointing

Table	E	Electrical connection cable
	1	2 m long - 6 wires shielded
	2	8 m long - 6 wires shielded
	9	Special length

Table	F	Report of Calibration
	0	None
	1	Eurotron NIST or EA traceable certificate with data

1.2.3 IRtec Rayomatic 60

cat. 1110 – A - B - C – D – E – F – G

Table	**A**	**Range**
	100-1	from +600 to +1600°C
	160-1	from +300 to +1300°C
Table	**B**	**Signal output**
	2	4÷20 mA linear
Table	**C**	**Optic fiber length**
	2	3.5 m
	3	6 m
	4	8 m
	9	Special lenght
Table	**D**	**Target / Distance**
	1	2mm OD @ 75mm – fast lock head
	2	4mm OD @ 150mm – fast lock head
	3	8mm OD @ 300mm – fast lock head
	4	5mm OD @ 500mm – threaded M1
	5	12mm OD @ 900mm – threaded M1
	9	special
Table	**E**	**Options**
	0	None
	1	Red laser pinpointing (650nm)
	2	Green laser pinpointing (532nm)
Table	**F**	**Electrical connection**
	1	2m long - shielded cable
	2	8m long - shielded cable
	4	2m long – high temperature (200°C) shielded cable
Table	**G**	**Calibration certificate**
	1	Eurotron NIST or EA traceable certificate with data

1.2.4 IRtec Rayomatic 100

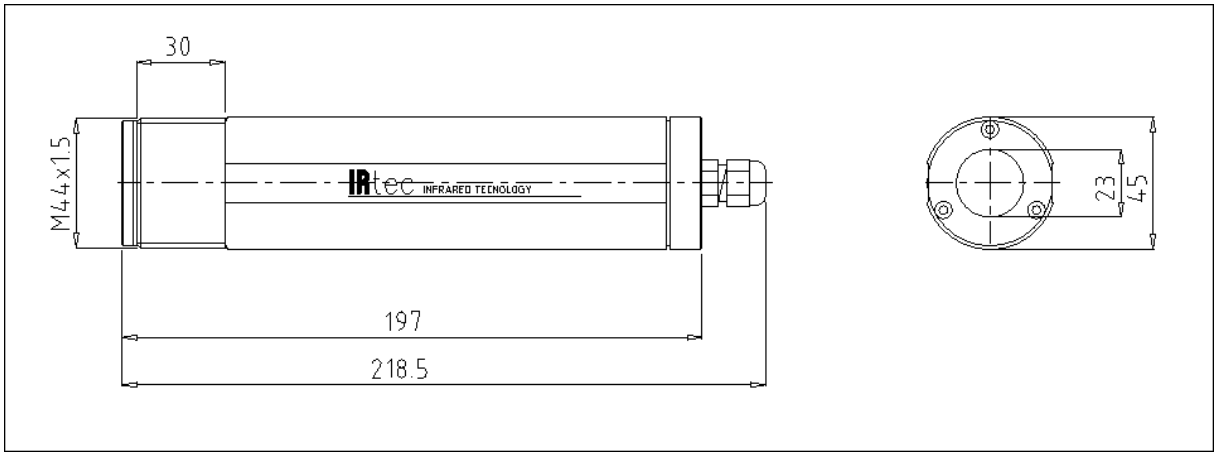
cat. 1148 – 100 - A - B - C – D – E - F

Table	**A**	**Range**
	1	600 to 1600°C (1100 to 2900°F)
	2	800 to 2200°C (1470 to 3630°F)
	3	1000 to 2200°C (1830 to 4000°F)
	4	1500 to 2700°C (2700 to 4900°F)
Table	**B**	**Signal output**
	2	4÷20 mA 2-wire current loop with superimposed serial communication
Table	**C**	**Optic fiber length**
	1	1 m
	2	3.5 m
	3	6 m
	4	8 m
	9	Special lenght
Table	**D**	**Target / Distance**
	1	20mm OD @ 1000mm (50:1)
	2	10mm OD @ 650mm (65:1)
	3	5mm OD @ 350mm (70:1)
	4	2mm OD @ 150mm (75:1)
	5	1mm OD @ 100mm (100:1)
Table	**E**	**Electrical connection**
	1	2m long - 6 wires standard shielded cable
	2	8m long - 6 wires standard shielded cable
	4	2m long - 6 wires high temperature (200°C) shielded cable
	9	Special length shielded cable
Table	**F**	**Calibration certificate**
	1	Eurotron NIST or EA traceable certificate with data

2 PHYSICAL DESCRIPTION

2.1 IRtec Rayomatic 20/40

IRtec Rayomatic 20/40 radiation thermometers are designed by using the most recent sensor technology. The external case is made of extruded aluminium with M44x1.5 threading compatible with a wide range of accessory. The case provides the room for the optic system, the pointing system, the optic filter, the sensor, the electronics for signal conditioning, and the laser pinpointing system. The instruments are IP65 protected and the electrical connections are very sturdy.
All thermometers could install an integrated laser pinpointing system.

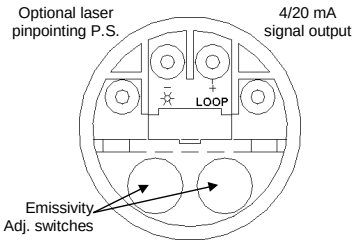


There are two different series of **IRtec Rayomatic** thermometers available in order to satisfy all applications and using conditions:

IRtec Rayomatic 20
Three different models are available:

MODEL	SENSOR	WAVELENGTH
IRtec Rayomatic 20 – 100	Silicon	0.9 μm
IRtec Rayomatic 20 – 160	InGaAs	1.6 μm
IRtec Rayomatic 20 – 814	Thermopile	8-14 μm

Removing the rear flange, the binding posts for 4/20 mA signal output and laser pinpointing system are accessible. Two rotative switches allows the operator to set the correct emissivity value.
Response time, range, and special mathematical output functions can be programmed by factory on request.



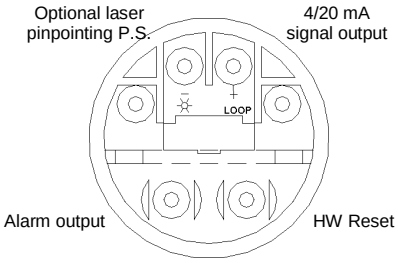
IRtec Rayomatic 40
IRtec Rayomatic 40 thermometers represent the new frontier in non-contact temperature measurement. **Eurotron** applied the most recent development in IR sensor technology and, based on an extensive application experience, has designed the new line of PC reconfigurable and programmable IR thermometers. An internal modem allows to

use the same two wire 4/20mA current loop for smart communication. A smart/RS232 adapter is available for PC bi-directional communication. You can read the temperature measurement, set all parameters (range, averaging, peak-picking, alarms, emissivity, etc.). The communication data is fixed; 1200baud, 8bit ,no parity, 1 stop bit.

Two auxiliary lines can be programmed and used for function and alarm reset and to drive alarm relè.

Four different models are available:

MODEL	WAVELENGTH
IRtec Rayomatic 40 – 100	0.9 μm
IRtec Rayomatic 40 – 160	1.6 μm
IRtec Rayomatic 40 – 814	8-14 μm



2.2 IRtec Rayomatic 60

Fibre optic IRtec Rayomatic 60 infrared thermometers are designed for non contact temperature measurements.
Two series are available with different spectral band: series 100 in 0.9 mm and series 160 in 1.6 mm.

Measuring System
Each IRtec 60 thermometer consists of three separate and interchangeable parts:

- Single lens optical adapter (head) to collect the IR radiation;
- Flexible fiber optic cable steel coated to transmit the IR radiation from the “head” to the electronic module;
- Microprocessor electronic module to convert the IR radiation in electric signal. The thermometer can be ordered for different measuring ranges as specified in ordering instruction table A.

The Optic fiber IR thermometers are the ideal solution when:

- The ambient temperature is very high (up to 200 °C);
- The target is not easily accessible.

Optical head
Five different interchangeable optical adapters are available for differents target/distance vision cones.

Flexible fiber optic
You can choose between different fiber optic cable lengths. The fiber is protected by a flexible steel band for environment applications up to 200°C.

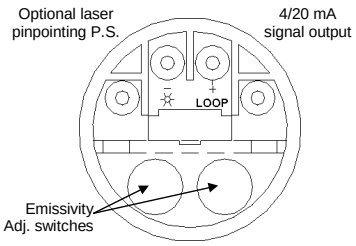
WARNING
DO NOT CURVE THE FIBER OPTIC WITH RADIUS SMALLER THAN 200 MM !
SMALLER RADIUS CAN CAUSE A BREAKING OF THE FIBER.

Fast lock connectors
The optic head can be connected and disconnected from the process using a special fast connection system. It allows the quick installing and maintenance of the measuring system.

Electronic module
The electronic module contains a detector, processing electronics, and Bell202 serial comunication interface. The Bell202 interface consist of a modem to modulate the digital communication over the 4-20 mA 2-wire current loop. The communication data is fixed; 1200baud, 8bit ,no parity, 1 stop bit.

This feature allows you to change the thermometer setting connecting a PC on the signal current loop using a simple RS232 converter. E-slope, response time, and range can be set from the PC with the optional Configuration Software. Also advanced function as Peak, Valley, Peak-Picker, Average, Track&Hold, etc. can be set on the IRtec Rayomatic 60.

Removing the rear flange, the binding posts for 4/20 mA signal output and laser pinpointing system are accessible. Two rotative switches allows the operator to set the correct emissivity value.
Response time, range, and special mathematical output functions can be programmed by PC.



Two different models are available:

MODEL	SENSOR	WAVELENGTH
IRtec Rayomatic 60 – 100	Silicon	0.9 μm
IRtec Rayomatic 60 – 160	InGaAs	1.6 μm

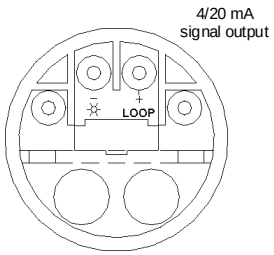
2.3 IRtec Rayomatic 100

IRtec Rayomatic 100 radiation thermometers are designed by using the most recent sensor technology. The external case is made of extruded aluminium with M44x1.5 threading compatible with a wide range of accessory. The case provides the room for the optic system, the optic filter, the sensor, the electronics for signal conditioning, and the laser pinpointing system. The optical head is fiber made of different length (1 mt., 3mt., 8 mt.) and grant an easy installation with fast lock attack. The instruments are IP65 protected and the electrical connections are very sturdy.

WARNING
DO NOT CURVE THE FIBER OPTIC WITH RADIUS SMALLER THAN 200 MM !
SMALLER RADIUS CAN CAUSE A BREAKING OF THE FIBER.

The infrared radiation emitted from the target is focalized from a beamsplitter on 2 sensors inside the instrument. The electronic module treats the termal signal and makes a report between the 2 different received signals, filtered on different bands. As a function of this report, the memory assigns a measuring temperature. This system grant a right temperature also if the target is obscured

Removing the rear flange, the binding posts interconnections are accessible.
On the instrument are situated 2 binding posts for 4/20 mA signal output system.



Software for IRtec Rayomatic 40/60/100
An optional RS232 PC adapter and a configuration software allow the changes of the most important instrument parameters: emissivity, response time, measuring span, average, peak-picker, decay, etc.
The LogMan data logger software is developed by Eurotron for displaying on a Personal Computer the trend of temperature or help you to calculate the correct programmable parameters.
The acquired data can also be stored in your hard-disk with Excel™ file format.

3 PRINCIPLE OF OPERATION

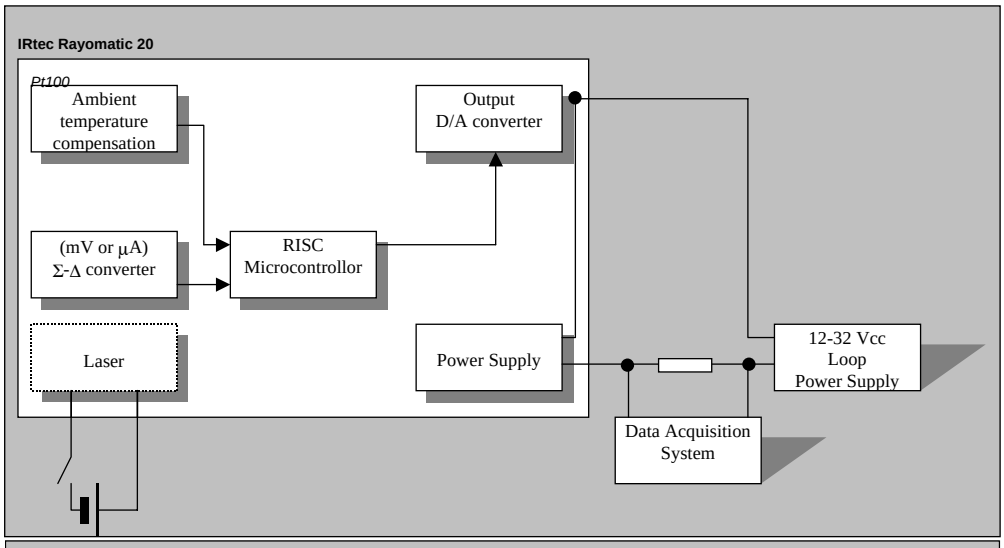
3.1 Modular systems

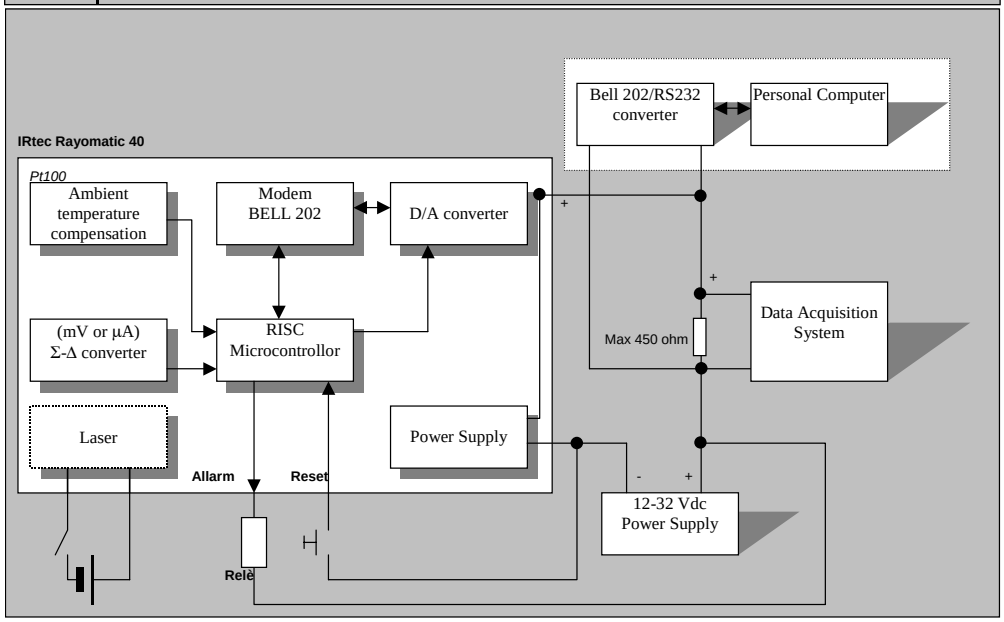
IRtec radiation thermometers uses a modular structure and component interchangeability to ensure an instrument to be exactly suited for each particular application. The modular construction allows an easy add and substitution of any option directly on the field. It also simplifies field troubleshooting, repair and calibration.
Different lenses, filters, IR sensors, electronic module, target sighting systems and accessories provide over 100 possible standard instruments to exactly fulfil your application requirement.

3.2 Basic elements

3.2.1 Monochromatic thermometers

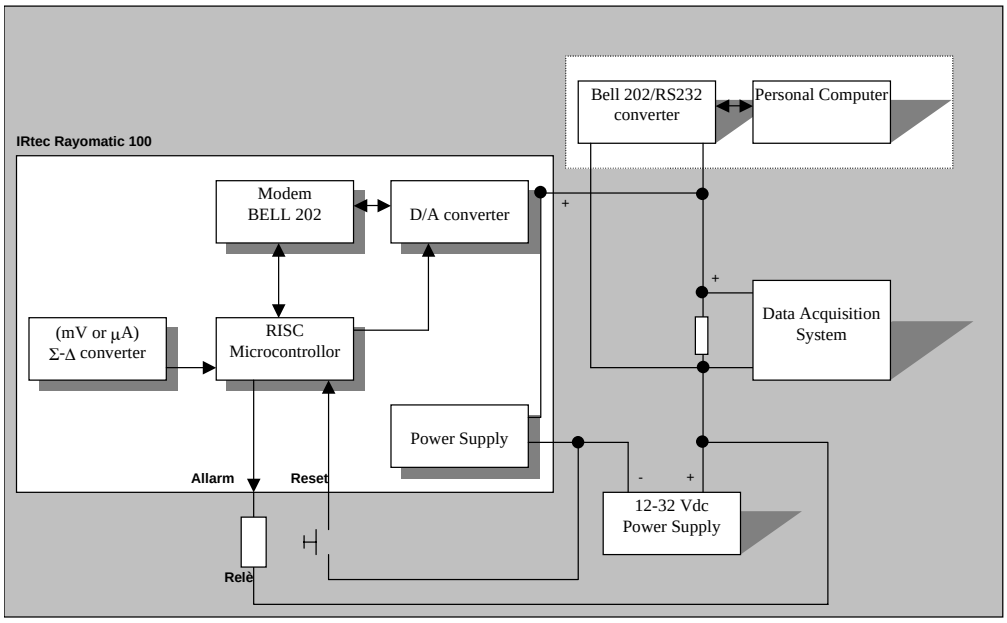
IRtec radiation thermometers contains the following basic elements: optical system, detector, and signal-processing electronic. The general features of these elements are first examined in the following sections.





3.2.2 Two-Color thermometers

The functioning system is the following.
The visual cone is determined by the optical head, using the achromatic lens and the fiber, that act as limiting range (f.i. 20mm@1000mm). The fiber collect the energy and carry it in an optical device that divide the signal with a proper mirror, filter it on 2 bands (0.88μm; 0.98μm) and focalize it on 2 sensors.
The infrared radiation received form the sensor is converted in electric signal that is not linear function of the temperature of the target. The electric signal is treated from an electronic circuit inside the microprocessor that generate an output signal in linear current 4-20mA.



3.2.3 Optical system

The detector is positioned at a focus distance of a high quality lens. The lens forms an image of the source in the plane of the detector. The size of the cone of radiation accepted from an axial point of the target and, the irradiance at the detector, is determined by the clear aperture of the lens, while the active area of the detector determines the field of view. The lens and detector then act as the aperture and field stop of the system respectively.

3.2.4 Detectors

Thermopile
A thermopile contain a large number of thermocouples in a very small area. The thermocouples are connected together and the output is the difference between the ambient temperature (cold junction) and the temperature collected by the optical system (hot junction).
Inspite of large number of thermocouples, the signal output is very small: few μV/°C. The response time of the detector is very long because the detector must be warming up (or cooled) by the collected energy.
The waveband is determined by an additional optical filter chose by Eurotron for the specific application. This solution permits to reduce disturbs due by atmosphere absorption and to maximise the output signal.

Photodiode
Both Silicium and InGaAs photodiode principle is completely different from thermopile: the collected energy is transformed in a electron flow. The result is a current proportional with the incident energy.
This transformation is very fast (only few μS). This time the response time of the measuring system is limited by electronics: high resolution and low energy consumption, make it a little bit slower.
The waveband is determined by the physical characteristic of the sensor.

Ratio detectors
Special IR applications could not be solved using the standard monochromatic thermometers. A ratio detector could be the solution.
Typical problems which will cause an incorrect reading include:

- small objects e.g. to small to fill the target area
- smoke, dust or steam which obscure the line of sight
- dirty windows in the process
- emissivity of the product changes (due to changes in alloy or surface condition).

A ratio detector is a single chip twin detector with different working wavelengths. The ratio of the two simultaneous measurements is independent from emissivity and the result is the correct target temperature.
Every ratio thermometer has a limit as to how much signal can be lost. This is referred as the reduction ratio that can vary up to 90% without effecting the measurement accuracy. To be also kept in consideration that the loss in signal can come from 3 sources:

- low emissivity of the target
- object too small to fill the cone of vision
- obstruction caused by steam, smoke, dirt and dirty windows

In all the above condition a ratio thermometer will operate with better accuracy than any monochromatic thermometer. The IRtec “Rayomatic” thermometers was designed to operate with spectral bands with limited temperature coefficient.

3.2.5 Input stage

Is the most important part of the thermometer. It should be able to interface the detector to the micro-controller. IRtec Rayomatic series uses different kind of detectors (thermopile, photodiode, and ratio detectors) with different operating specifications.

- Thermopile models needs electronics with high impedance input and very low drift.
- Photodiode models needs fast electronics.
- Ratio models needs electronics able to drive a double detector.

For the best modularity of the measuring system, Eurotron has developed special configurable electronics to meet all requirements.

3.2.6 Microcontroller

Microcontroller has to manage all thermometer functionality. It should be fast, with low absorption, with integrate memory, serial interface, etc.
Eurotron’s IRtec Rayomatic use a RISC processor with internal re-writable FLASH memory.

3.2.7 Serial communication

This module is included in **IRtec Rayomatic 40/60** only. This module consist of a special modem to implement serial communication on the thermometer.
The smart IRtec Rayomatic line uses a digital communication method superimposed on the 2 wire 4-20 mA loop to communicate with PC, lap-top and/or handheld communicators.
The communication capability also means that a PC can be used both for remote calibration and transmitter operative mode configuration.
The digital protocol operates using the frequency shift keying (FSK) principle, which is based on the Bell 202 communication standard where sine waves are superimposed on the dc analog signal to gives simultaneous analog and digital communication
Temperature unit, peak hold, emissivity, average can be programmed through the digital port using either a PC or a dedicated communicator.

3.2.8 Output stage

This module is based by a D/A converter to transform the temperature measurements from the microcontroller digital format to the current signal. The signal output from the thermometer is a 4/20 mA on 2-wire current loop linear with the temperature range.

3.2.9 Temperature compensation

All IR detector are ambient temperature sensible. Detectors measure the difference between detector and target energy. To obtain the correct value of target temperature, it is necessary to measure the detector temperature and add it to the detector measurement. A Pt100 is mounted on the detector and microcontroller reads the temperature and makes the computation.

3.2.10 Power supply

A power supply stage is built-in the thermometer for adapting the current loop supply (from 12 to 32 Vdc) to all digital and analogue circuits.

3.2.11 Laser pinpointing

IRtec Rayomatic 20/40/60 thermometers can be optionally equipped with a laser pinpointing system to simplify alignement operation.
When target has small and critical dimensions the laser aiming system can be activated by operator to check and adjust appropriate alignment of thermometer.
A separate (12-32 Vdc max. 100mA and 12Vdc±2Vdc for the green laser) power supply input allows operator to use it only when necessary.

NOTE: THE WORKING TEMPERATURE FOR THE GREEN LASER IS FROM +20°C TO +30°C

WARNING
USE A SEPARATE POWER SUPPLY OF 12VDC±2VDC 100MA ONLY WHEN USING THE GREEN LASER

4 SIGNAL PROCESSING

When a radiation thermometer is employed in an on-line system, its signal may be subjected to large fluctuations. Time function facilities are useful to retain the signal levels that are more likely to represent the true target temperature.
Eurotron IR thermometers can be factory pre-set with one of the signal processing facilities: averaging, Track & Hold, Peak, Valley, Peak-Picking, Valley-Picking, etc.

IRtec Rayomatic 40/60/100 functions can be programmed from user by using a Personal Computer, a Bell202/RS232 adapter and a configuration software.

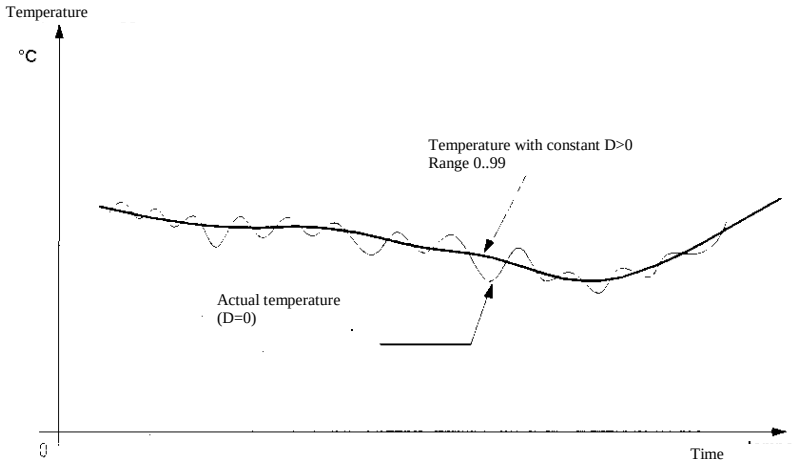
IRtec Rayomatic 20 can be programmed by factory only.

4.1 Average

Rapid temperature fluctuations about a true mean value can make the thermometer output unsuitable for recording and control. In these cases, the average function can be used to provide a smoothed signal. The output signal Avu is given by:

$Avu = Avp + (M - Avp) * 2 \Delta T / D$

where:
M = Actual temperature
Avu = Output average
Avp = Previous average
ΔT = sampling time = 20ms
D = Average time (sec) (programmable)



4.2 Peak

The Peak function holds a maximum temperature and retain its until a higher value appear or an external reset signal appear to decay the output to the current temperature measurement.

4.3 Valley

The Valley function holds the minimum temperature and retain its until a lower value appear or an external reset signal appear to increase the output to the current temperature measurement.

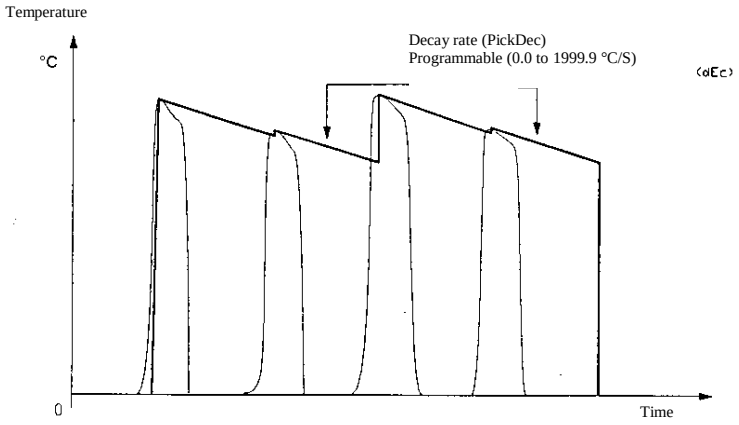
4.4 Peak-Picker

The peak-picker function holds a peak signal and allows it to decay slowly until the arrival of the next peak. It is used in such applications as rolling mills where the signal is occasionally lowered by steam, smoke, water droplets, metal scale, etc. When Peak-Picker function is programmed, the 4/20 mA output will follows the mathematical expression below:

U = Peak – (PickDec * 2 ΔT)

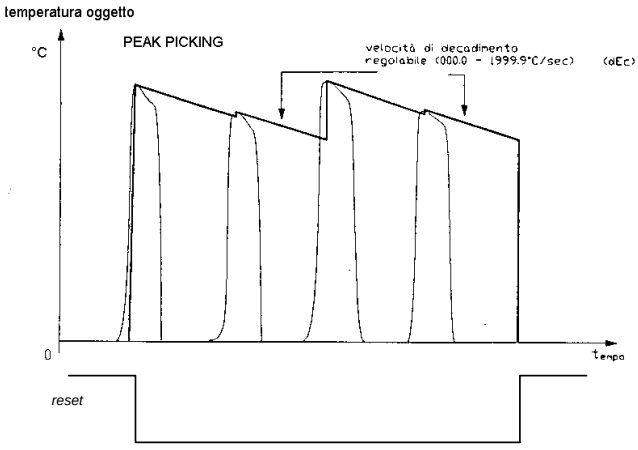
dove :

U	=	output signal
Peak	=	peak signal
PickDec	=	Decay rate °C/sec (programmable)
ΔT	=	sampling time



4.4.1 Peak-Picker with reset

When the Peak-Picker with reset function is selected, the external reset input is used to force the signal output to the current temperature measurement.

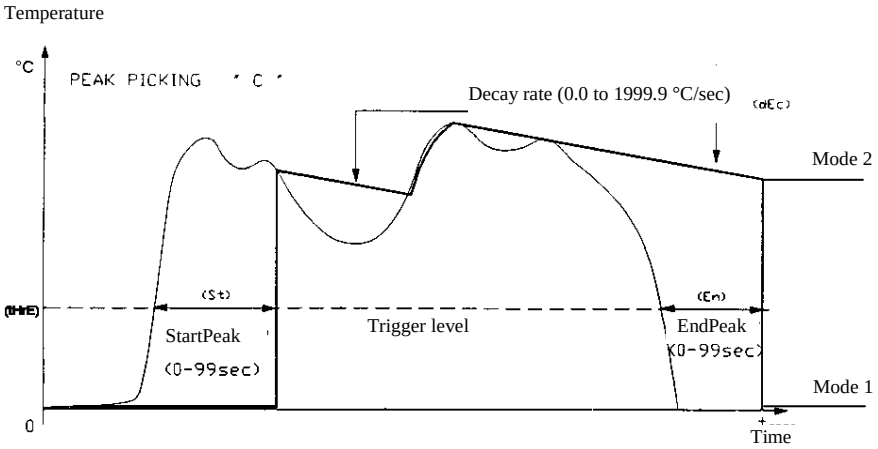


4.4.2 Peak-Picker delayed

When the Peak-Picker delayed function is selected, you have to set the following parameters:

PickDec	=	Decay rate
Threshold	=	Temperature threshold level
StartPeak	=	delay for starting peak-picking
EndPeak	=	delay for ending peak-picking
Delayed Mode 2	=	when selected, enable mode 2 output sustain

When the signal exceed the programmed trigger level (Threshold), the thermometer will wait the “StartPeak” delay before starting with the standard Peak-Picker function. When the input signal will decrease below the trigger level (Threshold), the thermometer will wait the “EndPeak” delay before reset the output signal.
The output signal will be reduced to low scale if Mode 1 is selected or to the last calculated value if Mode 2 is selected.



4.5 Valley-Picker

Reverse the Peak-picker function principle to describe the Valley Picker.

U = Valley + (PickDec * 2 ΔT)

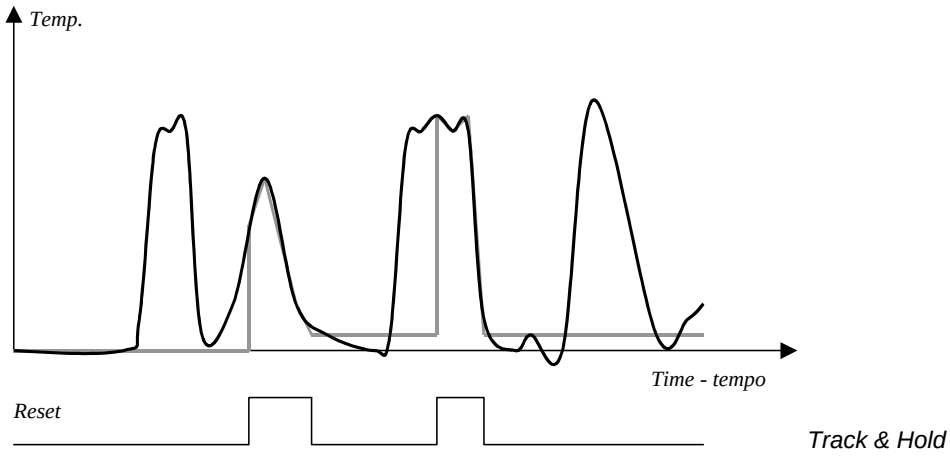
where :
U = output signal
Valley = Valley signal
PickDec = Increasing rate °C/sec (programmable)
ΔT = sampling time

4.5.1 Valley-Picker with reset

Reverse the Peak-Picker with reset function principle to describe the Valley-Picker with reset.

4.6 Track and Hold

The track (sample) and Hold function allows smoothed signals to be obtained from intermittent events. These may originate from objects on a conveyor belt or targets where the view is periodically obscured by rotating machinery. The output sampling is activated by a command signal received by an external switch that can be actuated by the belt or rotating machinery itself. The output is held when the switch is operated until the next command is received.


Temp.
Time - tempo
Reset
Track & Hold

5 UNPACKING

Remove the instrument from its packing case and remove any shipping ties, clamps or packing materials.
Carefully follow any instruction given by any attached tags.
Inspect the instrument from scratches, dents, damages to case corners etc. which may have occurred during shipment.
If any mechanical damage is noted, report the damage to the shipping carrier and then notify **Eurotron** directly or its nearest agent, and save the damaged packaging for inspection.
A label, on the instrument, shows the serial number and model of the unit. Refer to these numbers for any inquiry for service, spare parts supply or application and technical support requirements.

6 INSTALLATION

IRtec Rayomatic installing is very easy. The cylindrical aluminium chassis is externally threaded (M44x1.5) and allows quick connecting with all available accessories.

The following procedure could help you for installing your **IRtec Rayomatic 20/40/60 (monochromatic)** thermometer.

- Configure the thermometer. Set the emissivity on the **IRtec Rayomatic 20** moving the 2 rotative switches. Connect the **IRtec Rayomatic 40** to the PC and set the mathematical function, the emissivity and the temperature range by software. For **Rayomatic 60** you can adjust the emissivity either by PC or by the selector switches on the back panel.
- Connect, if necessary, all accessories (air purge, support, sighting tube, etc.). Fix the IRtec Rayomatic to the process.
- Connect the signal cable from your data acquisition system to the instrument terminals. Pay attention to the polarity.
- Aim accurately the thermometer to your target. Refers to Target vs. distance table on section 1. Be sure that your target is bigger than the measuring area. The optional laser pinpointing can help you for best installation.

The following procedure could help you for installing your **IRtec Rayomatic 100 (2-Colors)** thermometer.

- Install the thermometer on your plant.
- Supply the instrument and connect them to the PC. Use the Smart/RS232 converter.
- Run the configuring software.
- Select the right IRtec model
- Select the “Monocromatic” mode and start the PC temperature monitoring.
- Move the IRtec Rayomatic until the measured temperature correspond to maximum (the optical cone of thermometer is centered to the target).
- Select the two-color mode on software.
- Adjust the “E-Slope” (non-gray) function until the measured temperature correspond to the real target temperature.

6.1 Important notes

ATTENTION

ARE TO BE AVOID BACKSCATTERING, SUNLIGHT OR OTHER LIGHTING FONTS. TO CHECK THIS CONDITIONS: POINT THE INSTRUMENT, LOWER THE TEMPERATURE OF THE PROCESS UNDER 600°C: DISTURB RADIATIONS ARE PRESENT ONLY IF THE INSTRUMENT READ OVER 600°C. POINTING ON SUNLIGHT YOU CAN READ ALSO 400°C BUT THIS IS FOR THE SPECTRUM COMPONENTS OF PLANK EMISSION AT 600°C. A CLOSED MEASURING AREA WILL BE THE BEST SOLUTION.

IMPORTANT

DO NOT PULL OUT THE ELECTRONIC BOARD FROM THE CYLINDER. IT COULD BE DIFFICULT TO REASSEMBLE THE THERMOMETER.

WARNING

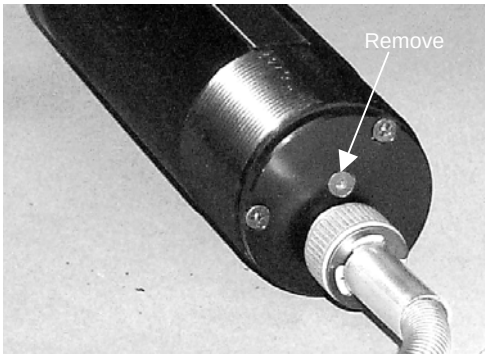
DO NOT INSTALLING THE THERMOMETER IN ROOM WITH TEMPERATURE HIGHER THAN +60°C WITHOUT AN ADEQUATE COOLING SYSTEM.

WARNING

DO NOT CURVE THE FIBER OPTIC WITH RADIUS SMALLER THAN 200 MM !
SMALLER RADIUS CAN CAUSE A BREAKING OF THE FIBER.

WARNING

IRTEC RAYOMATIC 100 OPTICAL FIBER ASSEMBLY
REMOVE THE CENTRAL SCREW (SEE FIGURE BELOW) BEFORE TO REMOVE THE FIBER OPTIC FROM THE ELECTRONIC MODULE.



IMPORTANT
IRTEC RAYOMATIC 60 OPTICAL FIBER ASSEMBLY
IN ORDER TO ACHIEVE THE BEST RESULTS, BEFORE SCREWING THE OPTICAL FIBER TO THE MAIN INSTRUMENT, SWITCH ON THE LASER PINPOINTING SYSTEM AND PROPERLY TURN THE FIBER WITH THE AIM OF OBTAINING THE MAXIMUM BEAM INTENSITY EXITING FROM THE OPTICAL HEAD.

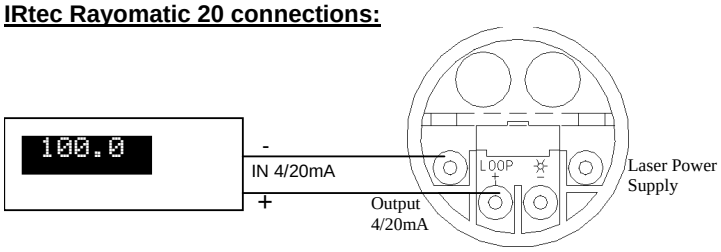
6.2 Electrical connection

IMPORTANT
TO SHEILD THE CONNECTION CABLES, EXTEND THE SHIELD WIRE UNTILL THE DESTINATION POINT (DISPLAY, CONTROLLER…) AND CONNECT IT TO GROUND.

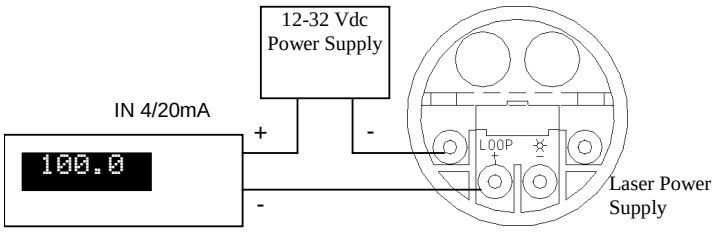
The temperature signal is converted, amplified and linearized by the internal electronics that makes available a 4/20 mA linear output. **Eurotron** supply a connector for 4/20 mA active current loop connection.
The unit is supplied complete with a shielded multi-wires electrical cable.

The following procedure could help you for electrical cable substitution on your IRtec Rayomatic thermometer:
1. Remove the 3 screw on the flange on the rear of the instrument.
2. Open the cable gland and insert the shielded signal cable (ϕ 3.9 – 6.5 mm) through the flange.
3. Unsheathe the cable and prepare the wire for connection.
4. Unscrew partially the cable clamp. Insert correctly the wires. Pay attention to the polarity. Screw the cable clamp.
5. Put near the flange to the cylinder and screw firmly.
6. Close the cable gland.
7. Insert the 3 screw to the flange holes and accompain them manually. Use an adequate screw driver. Look up (1 or 2 rotation) alternatively the 3 screw.

IRtec Rayomatic 20 connections:

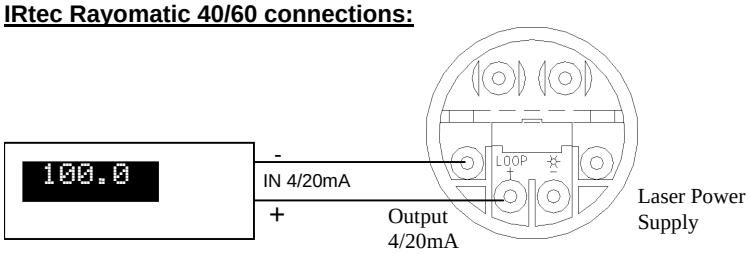


Indicator with 24Vdc internal power supply

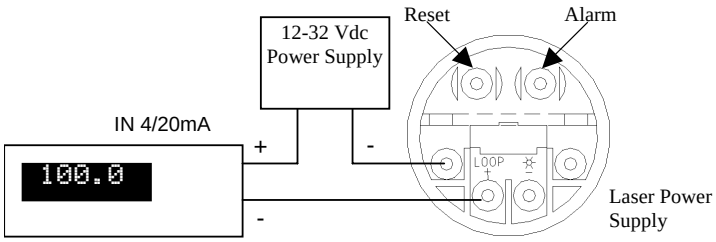


Indicator with 24Vdc external power supply

IRtec Rayomatic 40/60 connections:



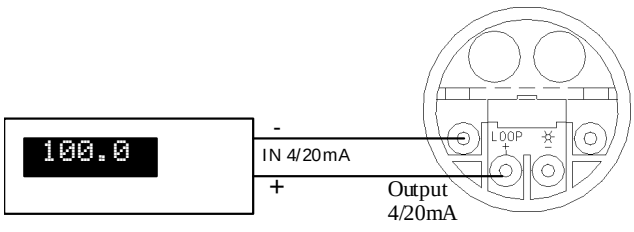
Indicator with internal power supply



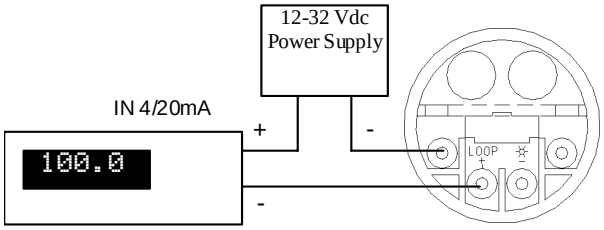
Indicator with external power supply

WARNING
DO NOT GO THROUGH THE SIGNAL CABLE NEAR ELECTROMAGNETIC SOURCE
(EG. ELECTRICAL MOTORS, HIGH POWER CABLE, WELDINGS, ETC). IF NECESSARY USE METAL CONDUIT.

IRtec Rayomatic 100 connections:



Indicator with internal power supply

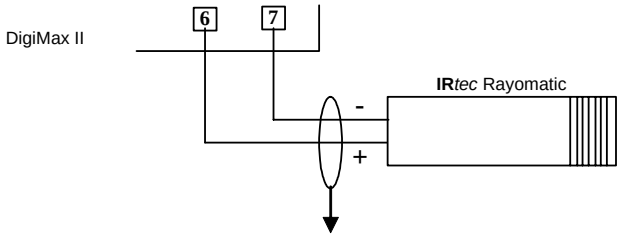


Indicator with external power supply

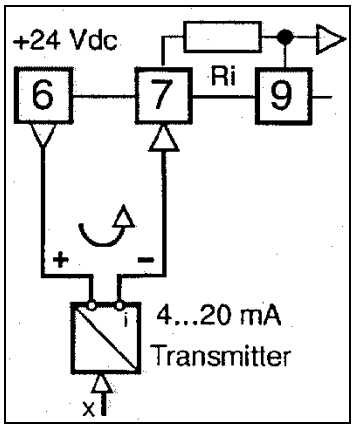
6.2.1 DigiMax II connections and programming

NOTE: REFER TO DIGIMAX II MANAUL FOR PROGRAMMING DETAILS.

The outoput of the pyrometer is a current signal. In any case you must power the termometer: for this aim, use the following configuration where the pyrometer is considered as a transmitter and is powered by the Digimax itself.



- Connect the loop+ and loop- wires to clamps 6 and 7.



DigiMax II
Connectors on the back side: use the Rayomatic as a transmitter.

In order to set the Digimax indicator, follow the procedure beginning from “Normal operation” and access to the subsequent pages to modify the parameters:

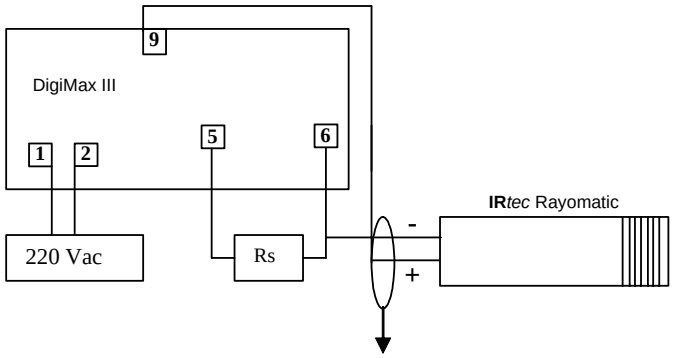
- Press ●▲ , the indicator shows “Par”
- Press ●▲ , the indicator shows “Conf”
- Press twice ●► to enter the configuration, the indicator shows “PASS”
- Insert the configuration password: “3333” and press ●►
- Insert the configuration code “9000”, it means a 4-20mA input and press ●►
- The indicator shows “Scdd”, set the number of decimal digits (0 to 3) and press ●►
- The indicator shows “ScLo”, set the beginning value of the scale (e.g. 0°C) and press ●►
- The indicator shows “Schi” , set the end of scale value (e.g. 600°C) and press ●►
- Set to “0” the “sqrt” parameter (square root) and press ●

6.2.2 DigiMax III connections and programming

NOTE: REFER TO DIGIMAX III MANAUL FOR PROGRAMMING DETAILS.

The outoput of the pyrometer is a current signal, hence you need to insert the proper connector (a 2.5ohm shunt resistor) to adapt the voltage input of the DigiMax. Anyway, you must power the termometer: for this aim, use the following configuration where the pyrometer is considered as a transmitter and is powered by the Digimax itself.

- Connect the loop+ and loop- wires to clamps 6 and 9.



DigiMax III
Connectors on the back side: notice the external shunt resistance between 5 and 6

NOTE: THE SHUNT RESISTOR IS SUPPLIED WITH THE DIGIMAX

EXAMPLE: how to read continuously a temperature by means of Digimax III in a range of 0-600°C and without any programming alarm. In order to set the Digimax indicator, follow the procedure beginning from "Operator mode" and access to the subsequent pages to modify the parameters:

- Press ⇄ a number of times enough to show the indication "PASS"
- Insert the password code "**33**" with ⬆⬇keys and press ↵
- Press ⇄, the indicator shows "conf" and press ↵
- The indicator shows "Conf"
- Insert the configuration code "8000" with ⬆⬇keys (it means a 10-50mV input) and press ↵
- Press ↵, the indicator shows "Unit"
- Select °C or °F with ⬆⬇keys
- Press ↵, the indicator shows "Scdd"
- set the number of decimal digits (0 to 3) with ⬆⬇keys and press ↵
- Press ↵, the indicator shows "Sc.Lo"
- set the beginning value of the scale (e.g. 0°C) with ⬆⬇keys and press ↵
- Press ↵, the indicator shows "Sc.Hi"
- set the end of scale value (e.g. 600°C) with ⬆⬇keys and press ↵
- press ⇄ to return to the actual reading

6.2.2 Laser Pinpointing systems

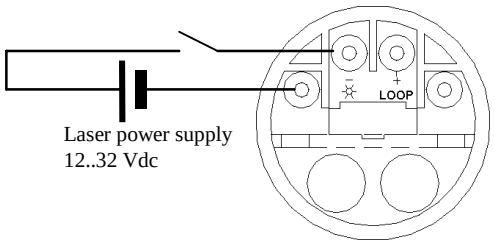
IRtec Rayomatic 20/40 thermometers can be optionally ordered complete of an integrated laser pinpointing system. The advantages of an integrate laser system with an independent power supply are:

- More accuracy in target aiming
- More stability with vibration
- Aiming system always available for maintenance
- Remote laser switching on/off

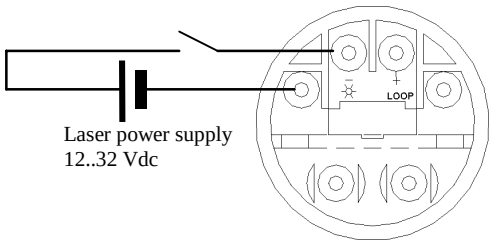
NOTE: Laser pinpointing is NOT available on Ratio thermometers

Remove the flange on the back of the instrument to access to the power supply terminals.
Connect the power supply (12…32 Vdc max. 100mA) to the instrument. Before switch the laser on verify the correct polarity.

WARNING
USE A SEPARATE POWER SUPPLY OF 12VDC±2VDC 100MA ONLY WHEN USING THE GREEN LASER



IRtec Rayomatic 20



IRtec Rayomatic 40/60

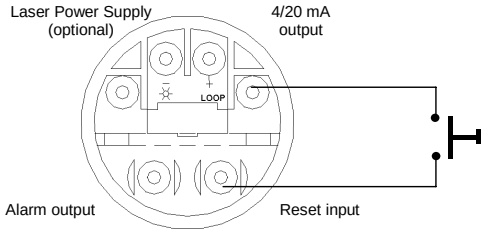
WARNING: LASER EMISSIONS

DO NOT STARE INTO BEAM OR VIEW DIRECTLY WITH OPTICAL INSTRUMENTS.
CLASS 2 LASER PRODUCT CONFORMS TO IEC825-1:1993 AND 21CFR CAP.1 PAR.J
MAX. OUTPUT: <1mW – WAVELENGTH: 630-670 nm

6.2.3 Reset input

IRtec Rayomatic 40 thermometers only, have an external input terminal that allows resetting of special functions (e.g. Alarms, Peak-Picker, Peak, etc.).

ATTENTION
IF THE HARDWARE RESET IS ENABLED FOR A MATHEMATICAL FUNCTION, IT IS USED FOR ALARM RESETTING TOO.



Reset connections

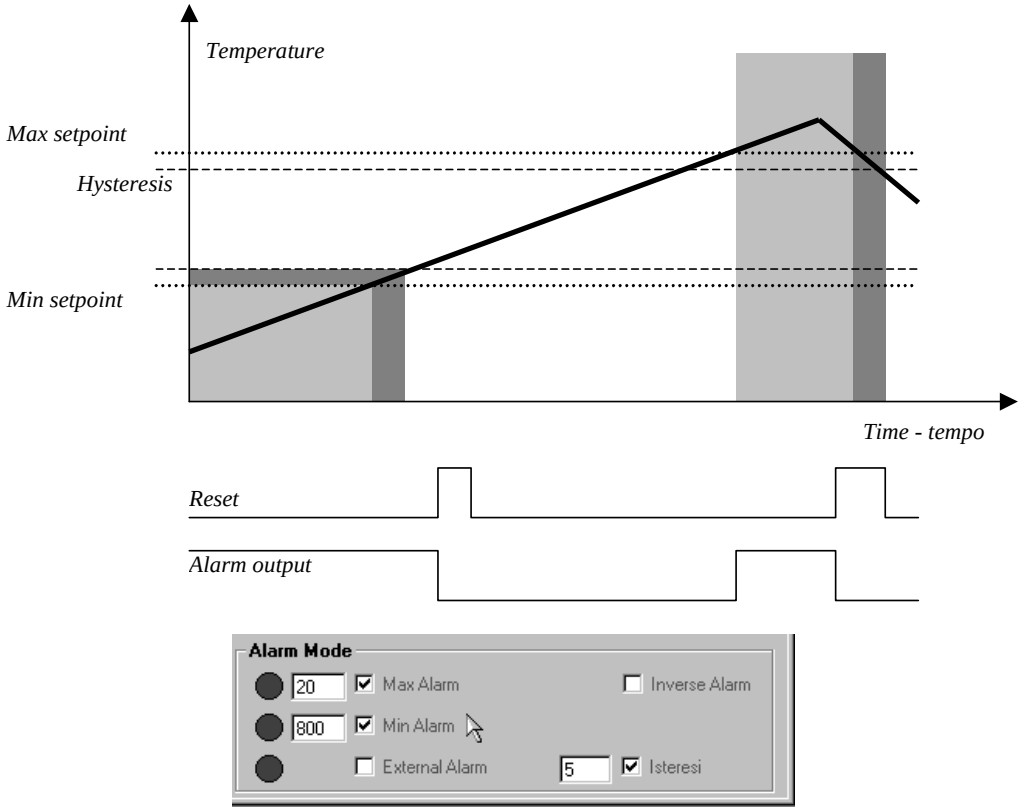
6.3 Alarms

IRtec Rayomatic 40 thermometers only, have two programmable alarms (Low and High) with hysteresis.

- **System alarm**: always enabled with output directed to the hardware alarm output. The thermometer activate the output when the detector temperature is out of the operative range (e.g. When the water cooling system is malfunctioning). It is factory set and you cannot disable it.
- **Low alarm**: you can set the minimum temperature of your process. When the temperature goes below the programmed value, the alarm output became active.

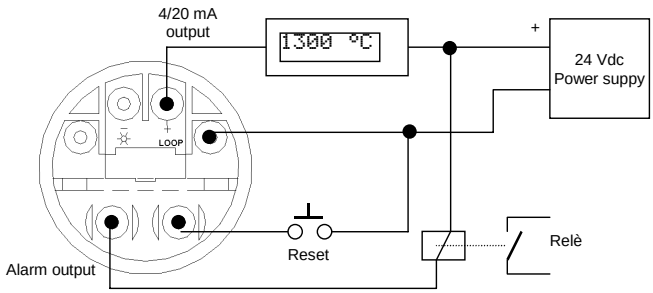
- **High alarm**: you can set the maximum temperature of your process. When the temperature goes above the programmed value, the alarm output became active.
- **Hysteresis**: you can program the hysteresis band for re-entry from the alarm status.
- **Alarm Output**: Two output modes are available. When alarms are programmed, the instrument uses the current loop output to signal the alarm status; the high alarm status change the current loop to 21 mA, the low alarm status change the output to 3.75 mA. You can also enable an hardware output line (20 mA sink current) to drive an external relais.
- **Alarm mode**: if the external alarm output is selected, you can choose between normally high or normally low output.
- **Alarm reset**: you can enable the reset input to reset (quit) the alarm status.

NOTE:
- All alarm set point are referred to the effective measured temperature.
- The alarm output and reset input terminals are available on model IRtec Rayomatic 40 only.
- Anyway, the alarm output is ever enabled to signal the system alarm event.



6.3.1 Alarm output

IRtec Rayomatic 40 thermometers only, have a programmable alarms output terminal to allows the connection with an external relais or a data acquisition system (max. 20mA). Anyway, this output is used by the thermometer to signal if the operative temperature of the electronic module is out of range.

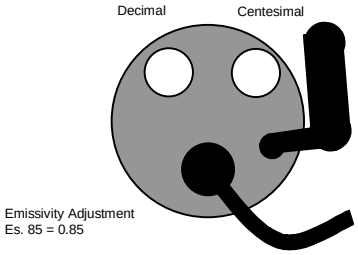


Alarm output and reset connections

6.4 Emissivity adjustment

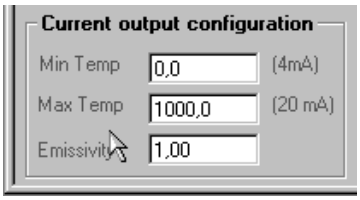
IRtec Rayomatic 20/60 has two rotative switches to set the emissivity of your target. You can change it in the range from 0.30 to 1.00.

- Remove the rubber plug on the rear of the instrument.
- Use a small, plastic screw driver to set the emissivity to the correct value. Thermometer uses the “00” value to set the emissivity to 1.00. Values lower than “30” are considered by the thermometer equal to 0.30.



IRtec Rayomatic 20

IRtec Rayomatic 40 emissivity can be changed only by using a PC connected to the current loop.



IRtec Rayomatic 100 E-Slope can be changed only by using a PC connected to the current loop.

6.5 Positioning

The thermometer has to be installed in an accessible place for any further maintenance operation, and it hasn't to be exposed to excessive heat, smoke and steam.
The optical path between the lens and the target, should be as much free as possible from smoke and steam.
The pointing axis should be placed with a 90° angle against the target surface; an angle smaller than 45° could be acceptable for most materials.

NOTE: A LARGE NUMBER OF MATERIALS HAVE THE EMISSIVITY COEFFICIENT DEPENDENT ON THE VIEWING ANGLE. LARGE ANGLES (MORE THAN 45°) CAN INDUCE A LARGE ERROR IN MEASUREMENT.

Before the installation, it iss useful to look at the tables supplied together with the instrument, in order to determine the correct distance and visual field.

NOTE: USING THE MONOCHROMATIC THERMOMETERS THE TARGET AREA HAVE TO BE LARGER THAN THE CALCULATED MEASURING AREA.

6.6 Mounting and Alignment

The Raryomatic IR beam profile is a cone described by the optical charts. The IR monochromatic thermometer must be installed so that the target is bigger than circle described by optics and the optical path is free from obstruction (steam, dust, etc.).
Install the mounting plate in a suitable place in the most favourable position from a thermal, and mechanical point of view. Mount on the plate, if it is necessary, the cooling device and/or the purge air ejector. If a cooling jacket has to be used, use the water outlet on the upper part of the support in order not to create air bubbles in the jacket.

WARNING

IT ADVISABLE TO USE A PROTECTIVE SCREEN DURING THE THERMOMETER ALIGNMENT OPERATIONS IF THE TARGET HAS A STRONG RADIATION.

In order to align the support with the target, look through the support hole (without the thermometer) and find the best position. It's important for the optic path to be free from any obstacle. In particular, when the surface is targeted through a hole, the hole diameter has to be big enough according to the distance from the instrument. If optional laser pinpointing system is installed, switch it on for spot centre viewing.

7 MAINTENANCE

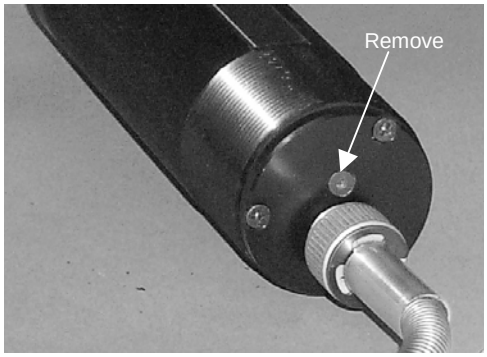
Each IRtec Rayomatic is factory calibrated and certified against Eurotron Standards and shipped with a Report of calibration stating the nominal and actual values and the deviation error. The instrument calibration has to be periodically verified. **IRtec** uses a sophisticated analog and digital technology. All the maintenance operations must be carried on by qualified personnel. **Eurotron** supplies instructions and operative modalities for any maintenance operation. Please contact **Eurotron** for any support.

For a correct working of the instrument, the optic system must be kept clean and it mustn't reach temperatures higher than the specified ones. The maintenance department should ensure these working conditions with a periodical check of the cooling system and cleaning the lens.

7.1 Rayomatic 100 fiber optic

IRtec Rayomatic 100 allow to change the fiber optic without the instrument calibration.

IMPORTANT
REMOVE THE CENTRAL SCREW (SEE FIGURE BELOW) BEFORE TO REMOVE THE FIBER OPTIC FROM THE ELECTRONIC MODULE.



WARNING
DO NOT CURVE THE FIBER OPTIC WITH RADIUS SMALLER THAN 200 MM !
SMALLER RADIUS CAN CAUSE A BREAKING OF THE FIBER.

7.2 Rayomatic 60 fiber optic

IRtec Rayomatic 60 allow to change the fiber optic without the instrument calibration.

IMPORTANT
IRTEC RAYOMATIC 60 OPTICAL FIBER ASSEMBLY
IN ORDER TO ACHIEVE THE BEST RESULTS, BEFORE SCREWING THE OPTICAL FIBER TO THE MAIN INSTRUMENT, SWITCH ON THE LASER PINPOINTING SYSTEM AND PROPERLY TURN THE FIBER WITH THE AIM OF OBTAINING THE MAXIMUM BEAM INTENSITY EXITING FROM THE OPTICAL HEAD.

WARNING
DO NOT CURVE THE FIBER OPTIC WITH RADIUS SMALLER THAN 200 MM !
SMALLER RADIUS CAN CAUSE A BREAKING OF THE FIBER.

7.3 Purge Air Supply

The air filters cleanliness must be checked at regular intervals.
Our suggestion is to check it every day, then, according to your experience, find a correct time interval.
If the optic system reaches temperatures higher than the working one, it has to be recalibrate in **Eurotron** laboratories.

The purge air device is to be accurately checked, as the diffuser may become obstructed by non-clean air. When this happens, the air flow from the diffuser is not uniform, and dust particles appear on the lens.
In this case, the diffuser should be drowned in a detergent solution and blown with compressed air, then dried. A good air filtering can solve this problems.

7.4 Water Supply

Verify the water flow according to your experience: daily first, and then when the system is running well, weekly.
Check the thermometer temperature: it has to be high enough to prevent any condense formation. Once the water continuity is defined, it's enough to verify the support temperature, that has to be slightly warm.
If the thermometer reaches too high temperatures, due to water absence or to a flow partial interruption, it has to be verified and calibrated by **Eurotron**.

7.5 Optic cleaning

Remove the connection wires from the terminal board.
Remove the thermometer from its support. Verify the cleanliness of the internal part of the cylinder removing any dirt particles or oil.
If necessary, clean the lens with a very soft cloth and then reinstall the thermometer.
Verify the alignment and reconnect everything.

Use an air purge system to keep the lens clean.

7.6 Mounting Device

Verify at regular intervals that these devices are in good conditions and that no damage has occurred.

7.7 Interconnection Cable

Verify at regular intervals that it is in good conditions and that no damage has occurred. Verify also the good connections with the indicator or the acquisition system.

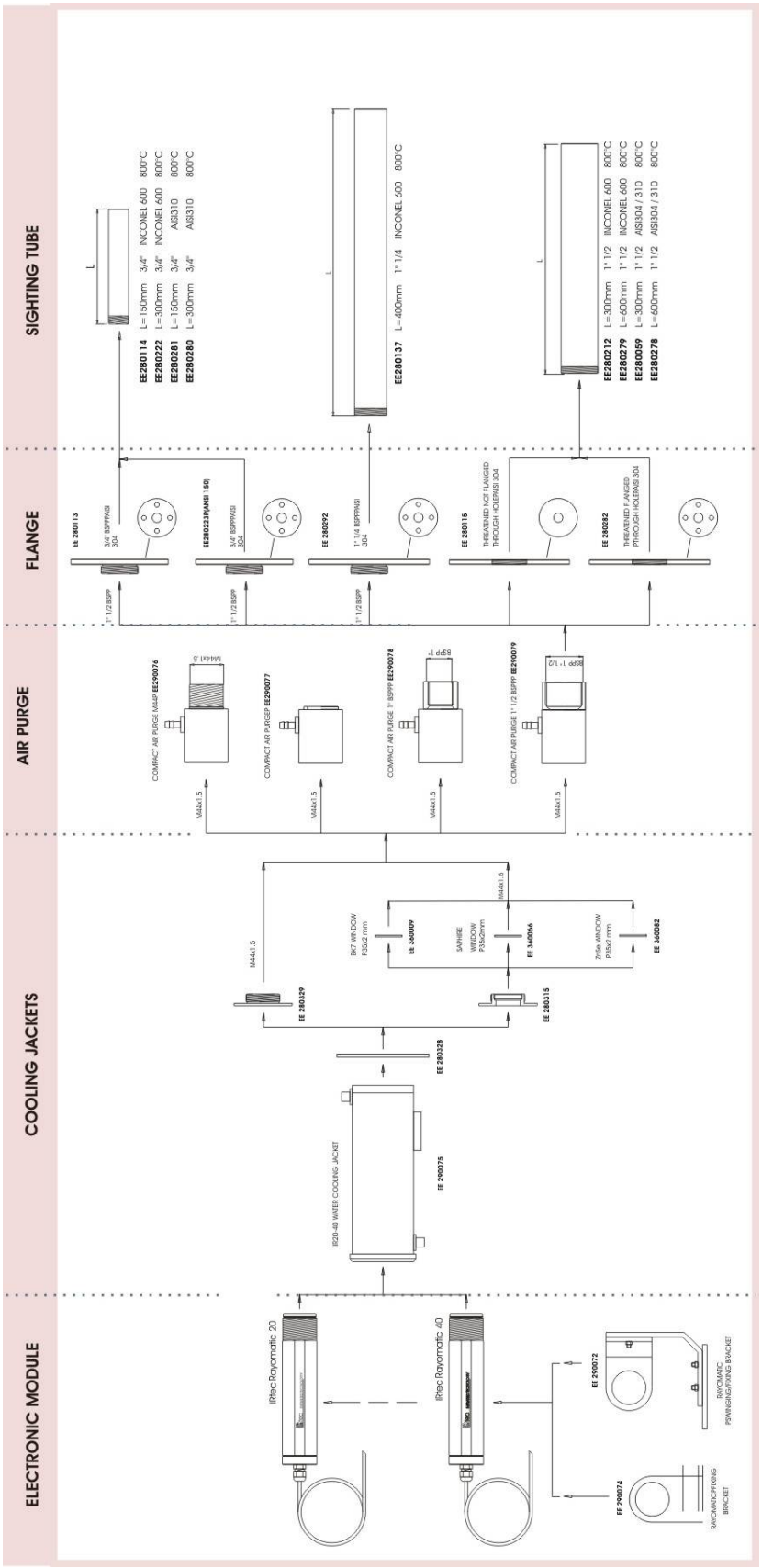
7.8 Storage

Store the instrument in the original package, at temperature from –30°C to +70°C (from +10 to +70°C for thermopile sensors) with non condensing R.H. less than 90%.

8 SUPPORT AND ACCESSORIES

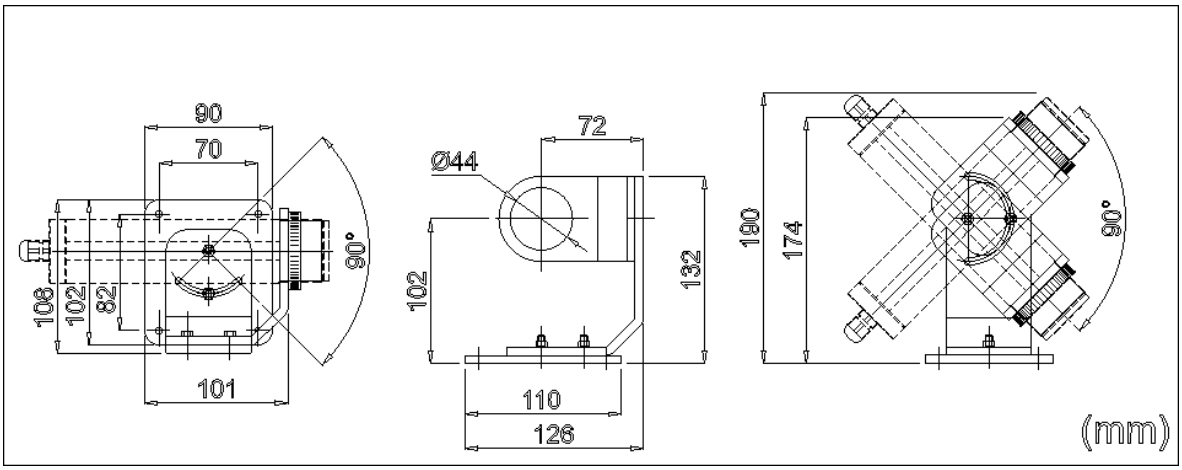
This chapter shows the full range of available accessories that can be supplied with the measuring systems. Special configurations or mounting systems can be realised by **Eurotron** to satisfy every application necessity. **Eurotron** R&D department will be happy to help you solving the problem with the best choice.

8.1 Rayomatic 20/40

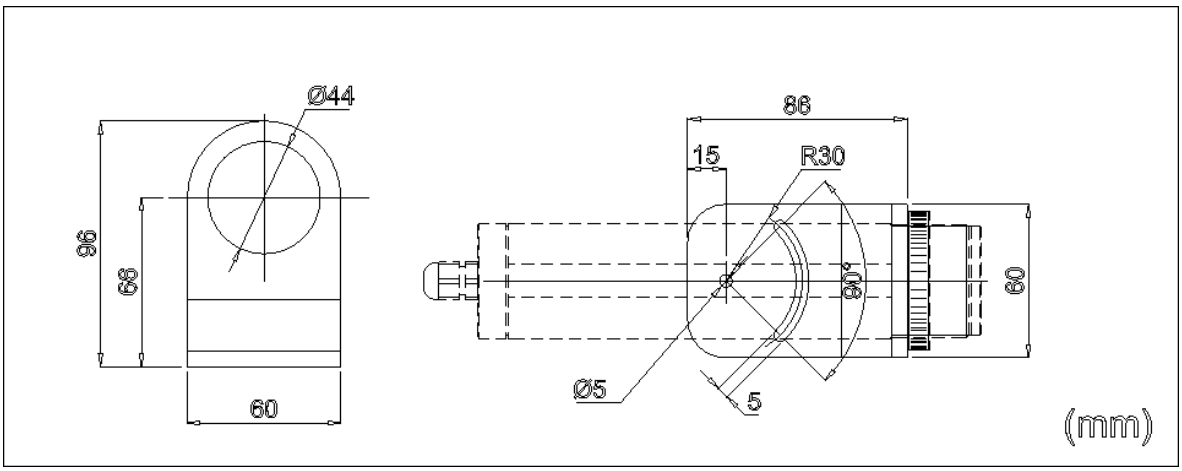


8.1.1 Positioning plates

When the thermometer is installed with standard environmental conditions you do not need to use any special cooling or lens cleaner systems. The thermometer could be installed directly on your process.
To make the positioning more easy use the Eurotron supports.



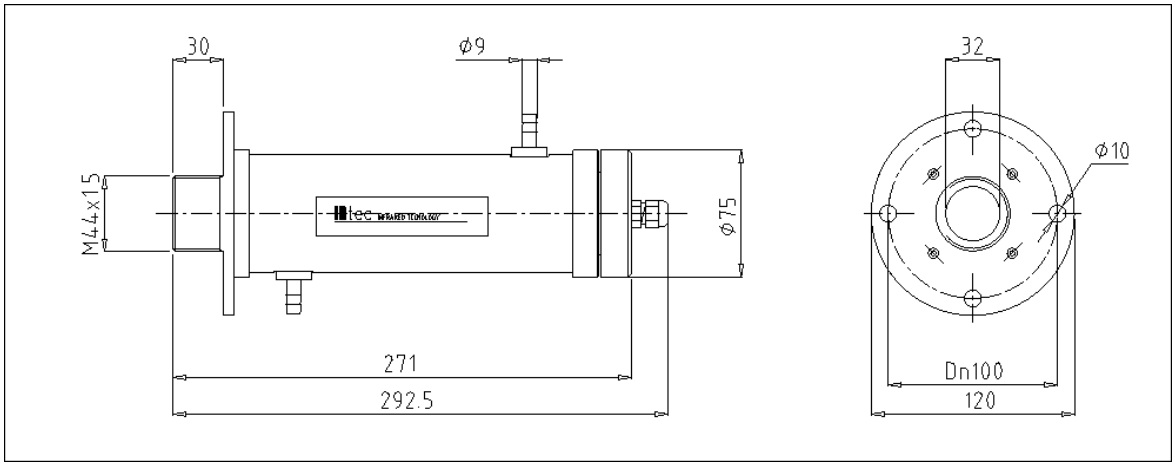
2-axis orientable plate cod. EE290072



1-axis orientable plate cod. EE290074

8.1.2 Water cooling jacket

When the thermometer is installed in a very hot environment it is useful to cool its electronics using a special cooling jacket. Use clean water in order to create no obstruction and cold enough to ease the thermometer working.



Water cooling jacket cod. EE290075

IMPORTANT

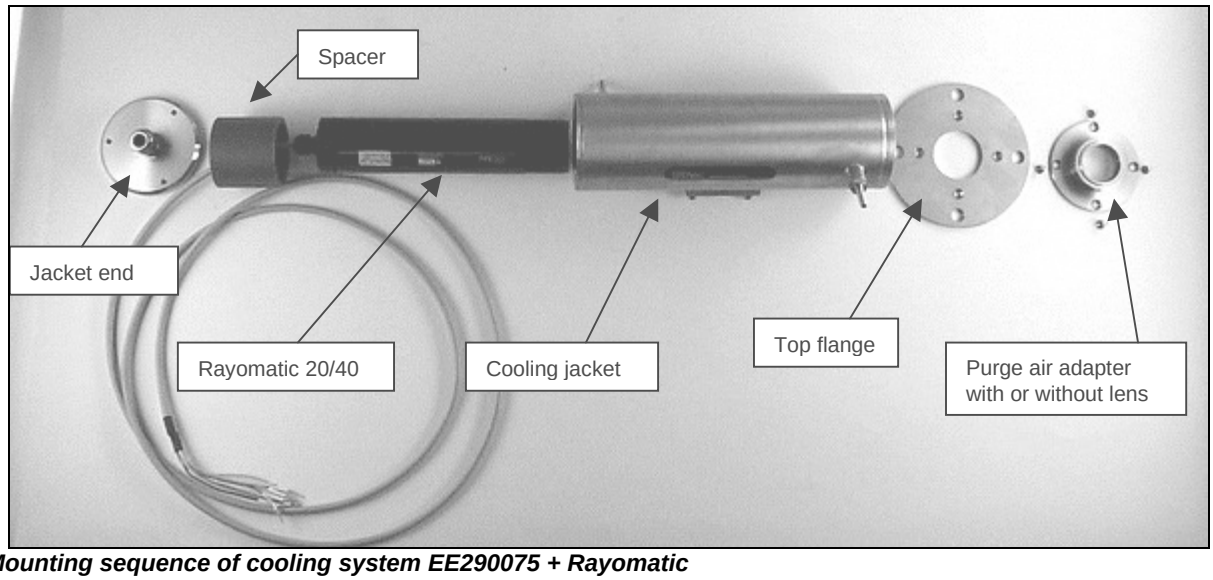
DO NOT USE TOO COOL WATER AS IT COULD CREATE CONDENSE ON THE SUPPORT OR ON THE LENS.
IT IS ADVISABLE TO HAVE A LOW WATER FLOW TO KEEP THE TEMPERATURE OF THE SUPPORT HIGHER THAN THE DEW-POINT OF A HOT AND HUMID DAY.
THE FLOW SHOULD NOT BE HIGHER THAN 0.7 BAR AND THE AMBIENT TEMPERATURE SHOULD BE LOWER THAN 200°C.

The cooling water line has to be made using the following precautions:
- The outlet of the cooling jacket must be kept free in order to control the flow and water temperature;
- It's useful to use a thermometer to control the water temperature.

NOTE: IN CLOSE CIRCUIT SYSTEMS, ALWAYS USE A FLOW WATER WITH A LOW LEVEL ALARM.

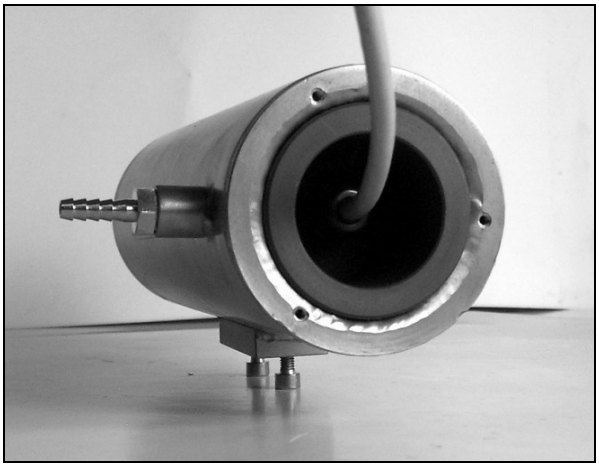
Before the installation, it is useful to look at the tables supplied together with the instrument, in order to determine the correct distance and visual field.

To properly install the water cooling jacket, follow this procedure:



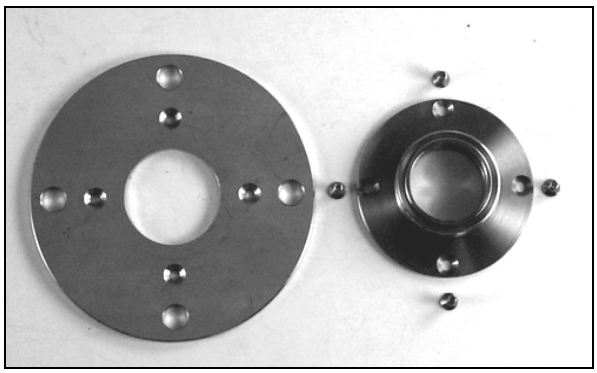
Mounting sequence of cooling system EE290075 + Rayomatic

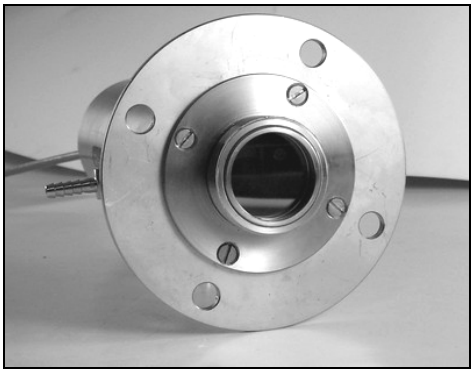
- Insert the Rayomatic inside the jacket and fix it.
- Insert the cable through the spacer and insert it inside the jacket in order to fasten the Rayomatic



Cooling jacket mounting: back side

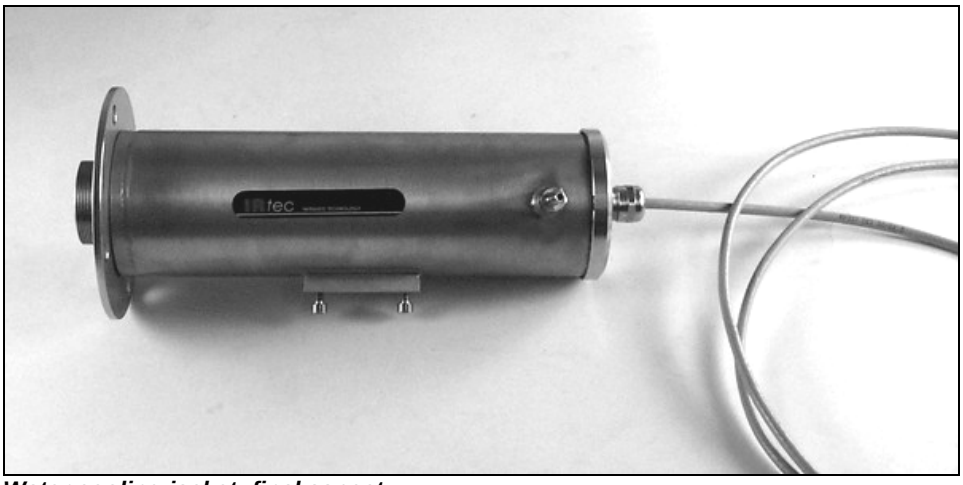
- Fix the flange and the purge air adapter (eventually with a proper lens) with 4 screws:





Water cooling jacket mounting: flange and purge air adapter M44x1.5 (EE280329 or EE280315)

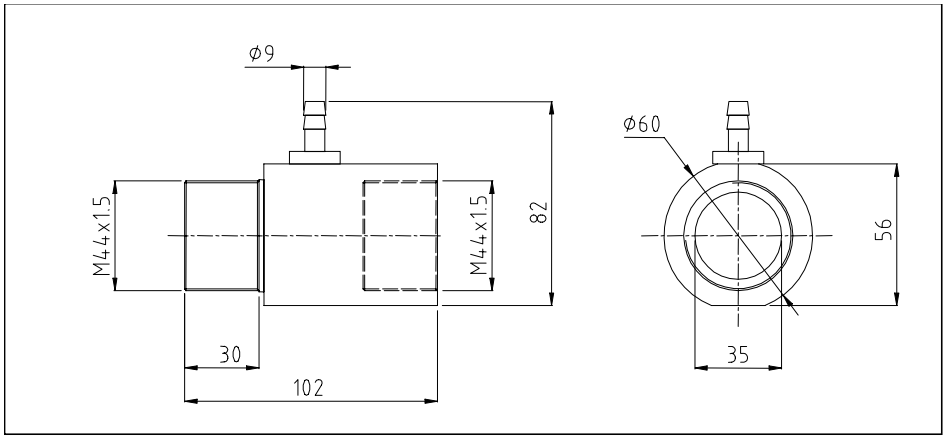
- Insert the cable through the jacket end and fix it at the end of the system



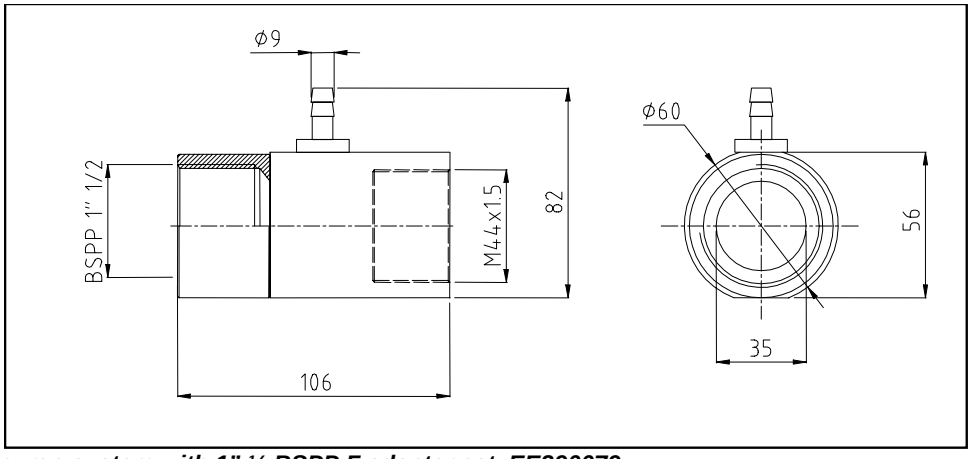
Water cooling jacket: final aspect

8.1.3 Air purge devices

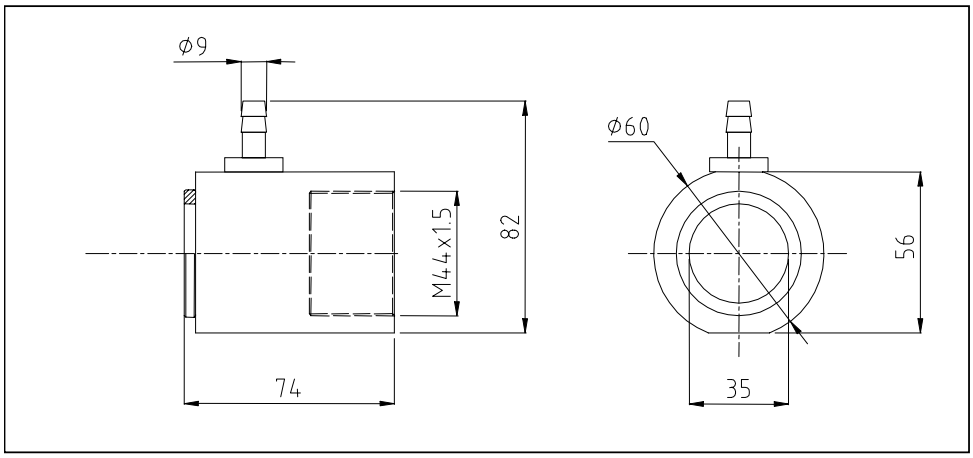
To eliminate fumes or vapours from the front of the optic head, and to keep the lens clean, an air flux is used. This air flux can also be used to cool, when necessary the thermometer.



Air purge system with M44x1.5 M adapter cat. EE290076



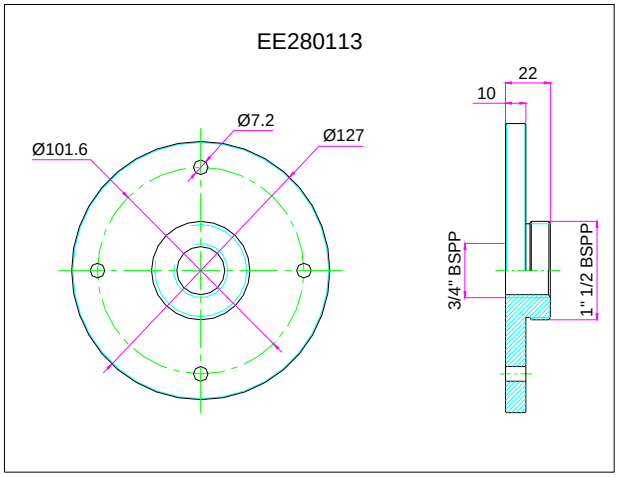
Air purge system with 1" ½ BSPP F adapter cat. EE290079

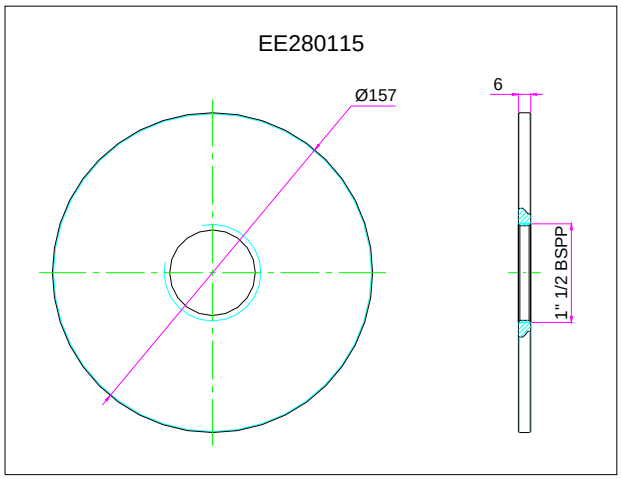


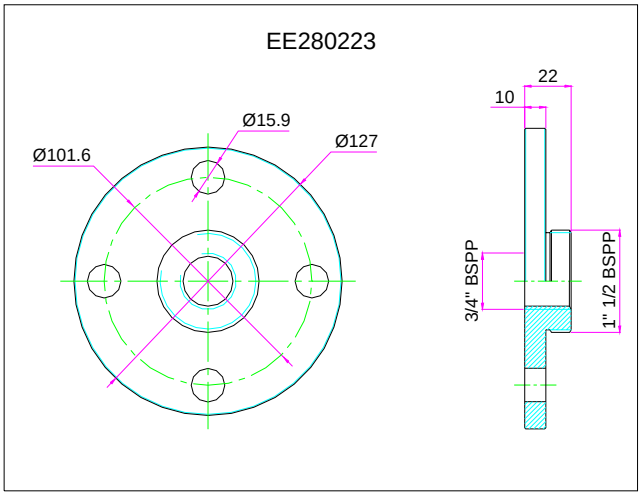
Air purge system cat. EE290077

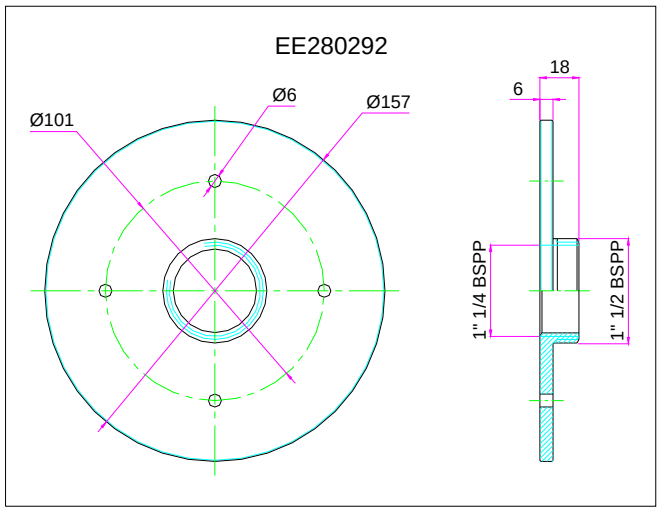
8.1.4 Flanges

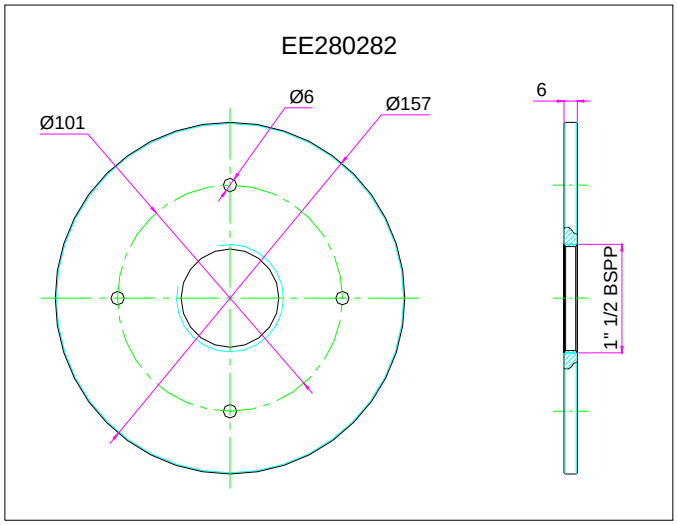
Code	From ∅	To ∅	Fori	Material
EE280113	1 ½ " BSPP male	¾ " BSPP female	4 x ∅7.2 mm	AISI 304
EE280223	1 ½ " BSPP male	¾ " BSPP female	4 x ∅15.9 mm	AISI 304
EE280292	1 ½ " BSPP male	¼ " BSPP female	4 x ∅6 mm	AISI 304
EE280115	Through hole 1 ½" BSPP			AISI 304
EE280282	Through hole 1 ½" BSPP		4 x ∅6 mm	AISI 304


EE280113
Ø7.2
Ø127
Ø101.6
22
10
3/4" BSPP
1" 1/2 BSPP


EE280115
Ø157
6
1" 1/2 BSPP


EE280223
Ø15.9
Ø127
Ø101.6
22
10
3/4" BSPP
1" 1/2 BSPP





8.1.5 Sighting tubes

The sighting tubes must be used when the target is covered by fumes or flames. They shold be used together with an air purge system and help you to have a clean viewing path from target to the thermometer.

Code	Material	Tube length	Instrument connection
EE280059	AISI 310	300 mm	1 ½ " BSPP Male (1)
EE280278	AISI 310	600 mm	1 ½ " BSPP Male (1)
EE280212	INCONEL 600	300 mm	1 ½ " BSPP Male (1)
EE280279	INCONEL 600	600 mm	1 ½ " BSPP Male (1)
EE280215	ALLUMINA	600 mm	1 ½ " BSPP Male (1)
EE280216	ALLUMINA	600 mm	1 ½ " BSPP Male (1)
EE280218	Silicon Carbide	450 mm	1 ½ " BSPP Male (1)
EE280286	Aluminium	1000 mm	M44 x 1.5 Female (2)
EE280293	Aluminium	200 mm	M44 x 1.5 Female (2)
EE280294	Aluminium	300 mm	M44 x 1.5 Female (2)
EE280114	INCONEL 600	150 mm	¾ " BSPP Male (1)
EE280222	INCONEL 600	300 mm	¾ " BSPP Male (1)
EE280281	AISI 310	150 mm	¾ " BSPP Male (1)

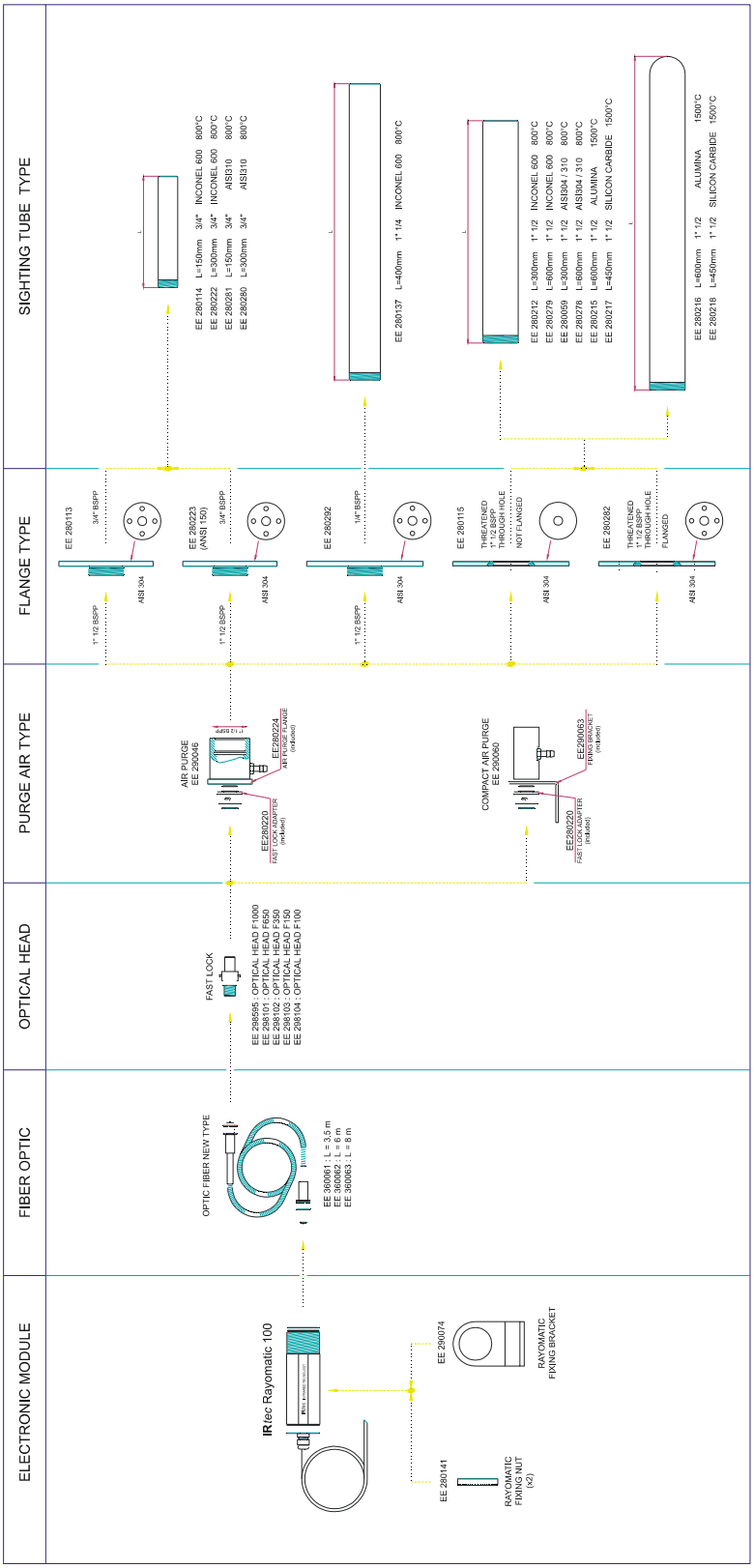
EE280280	AISI 310	300 mm	¾ “ BSPP Male (1)
EE280137	INCONEL 600	400 mm	1 ¼” BSPP Male (1)

(1) compatible with cat. EE290079 air purge system
(2) compatible with cat. EE290076 air purge system

8.1.6 Other accessories

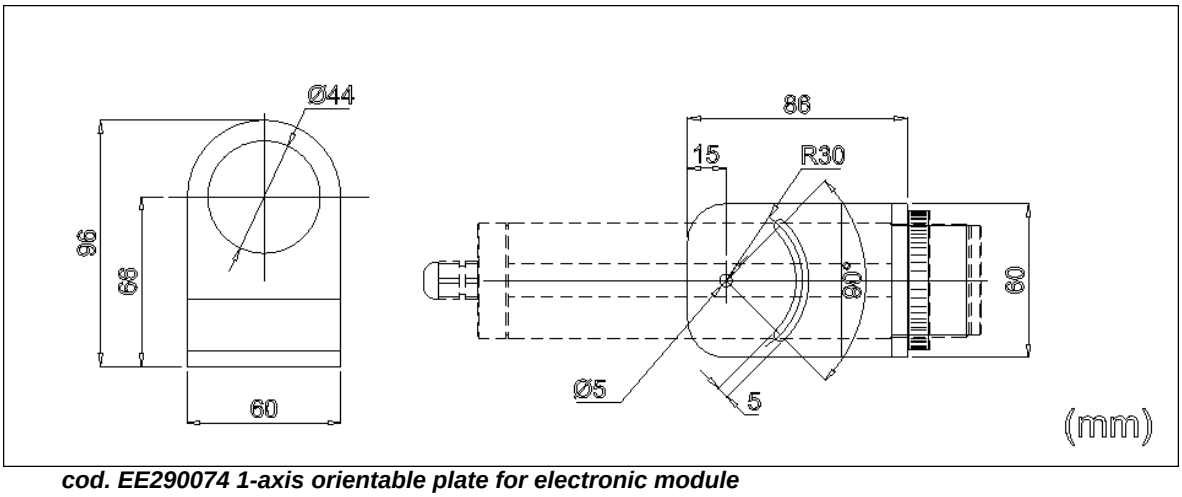
CODE	DESCRIPTION
BB530200	Bell202/RS232 adapter (IRtec Rayomatic 40/100)
BB530018	RS232 adapter (IRtec Rayomatic 20)
BB260195	Setup Software (IRtec Rayomatic 40/100)
BB260196	Setup & LogMan Graphic Software (IRtec Rayomatic 40/100 only)

8.2 Rayomatic 60/100



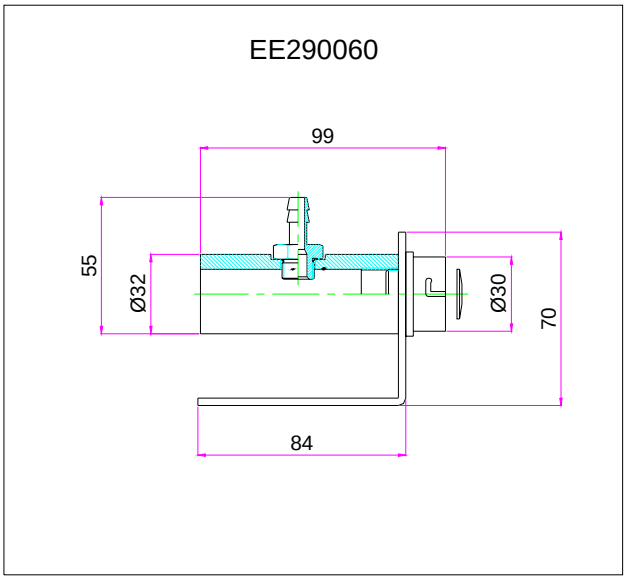
8.2.1 Positioning plates

When the thermometer is installed with standard environmental conditions you do not need to use any special cooling or lens cleaner systems. The thermometer could be installed directly on your process.
To make the positioning more easy use the Eurotron supports.

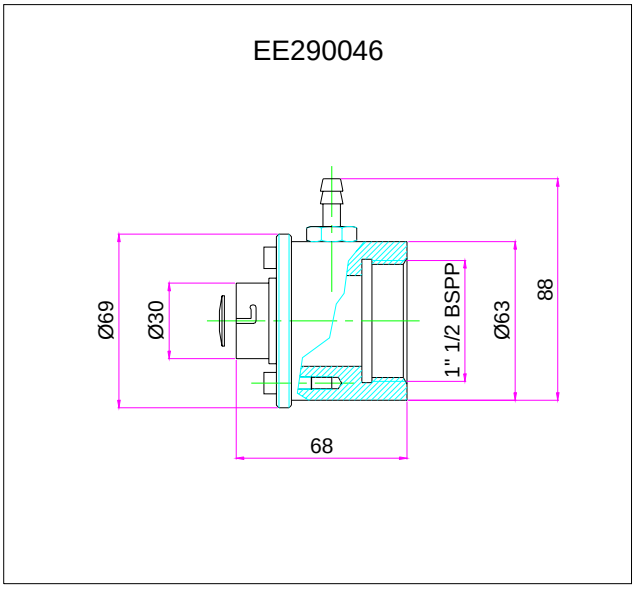


cod. EE290074 1-axis orientable plate for electronic module

8.2.2 Air purge devices



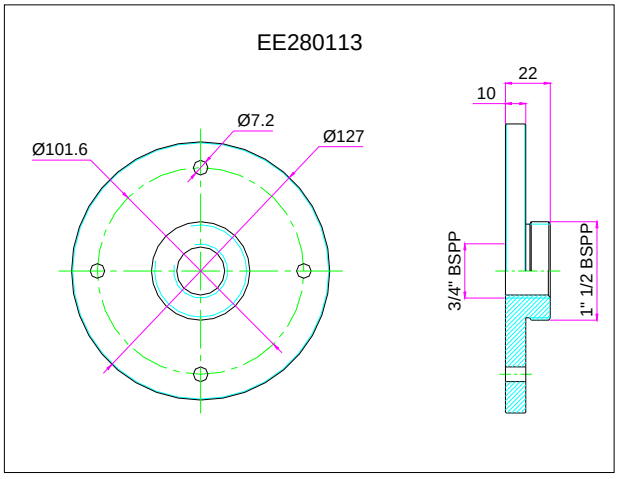
Compact Air purge code EE290060 complete of fast lock adapter and positioning plate (EE290063)

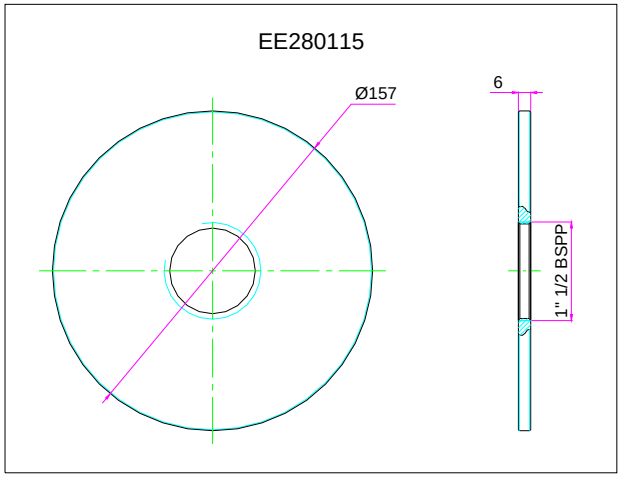


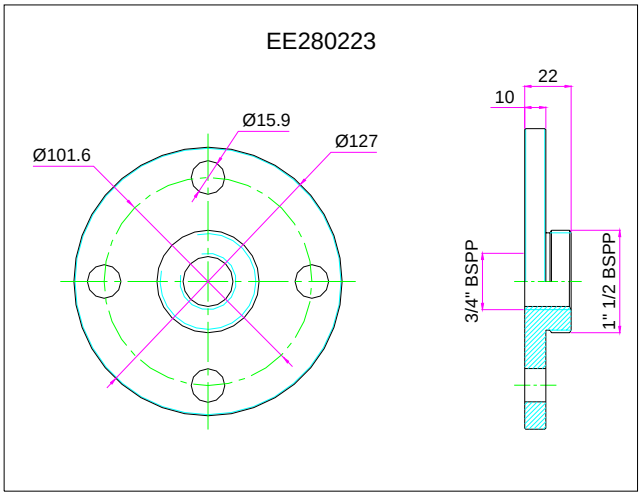
Air purge code EE290046 complete of fast lock adapter

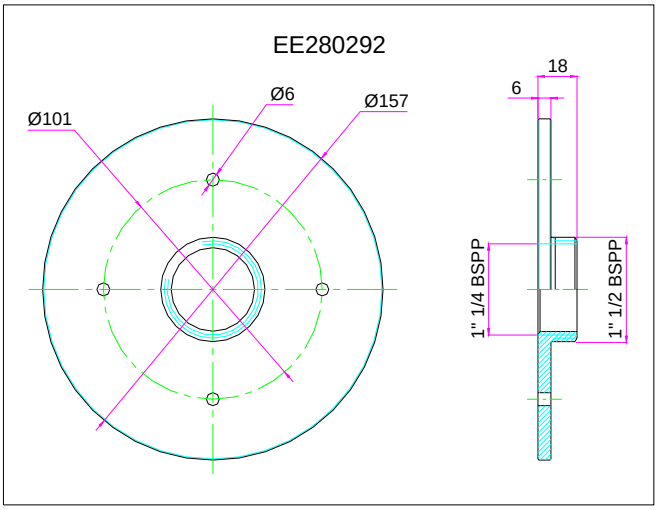
8.2.3 Flanges

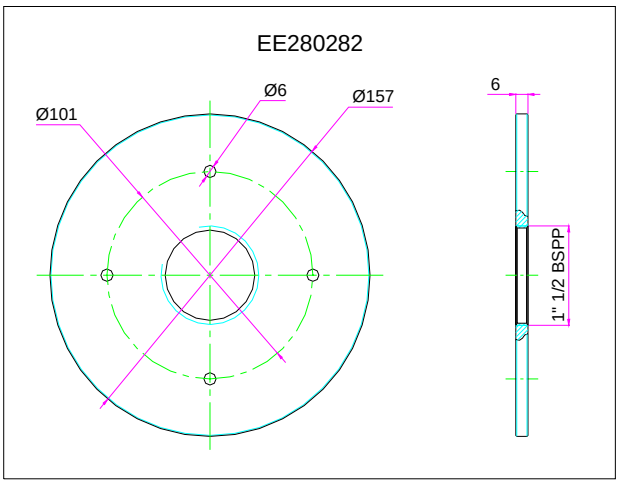
Code	From Ø	To Ø	Fori	Material
EE280113	1 ½ " BSPP	¾ " BSPP	4 x ∅7.2 mm	AISI 304
EE280223	1 ½ " BSPP	¾ " BSPP	4 x ∅15.9 mm	AISI 304
EE280292	1 ½ " BSPP	¼ " BSPP	4 x ∅6 mm	AISI 304
EE280115	Through hole 1 ½" BSPP			AISI 304
EE280282	Through hole 1 ½" BSPP		4 x ∅6 mm	AISI 304




EE280115
Ø157
6
1" 1/2 BSPP


EE280223
Ø15.9
Ø127
Ø101.6
22
10
3/4" BSPP
1" 1/2 BSPP


EE280292
Ø6
Ø157
Ø101
18
6
1" 1/4 BSPP
1" 1/2 BSPP



8.2.4 Sighting tubes

The sighting tubes must be used when the target is covered by fumes or flames. They shold be used together with an air purge system and help you to have a clean viewing path from target to the thermometer.

Code	Material	Tube length	Process connection
EE280059	AISI 310	300 mm	1 ½ " BSPP Male
EE280278	AISI 310	600 mm	1 ½ " BSPP Male
EE280212	INCONEL 600	300 mm	1 ½ " BSPP Male
EE280215	ALLUMINA	600 mm	1 ½ " BSPP Male
EE280278	AISI 314/310	600 mm	1 ½ " BSPP Male
EE280279	INCONEL 600	600 mm	1 ½ " BSPP Male
EE280216	ALLUMINA	600 mm	1 ½ " BSPP Male
EE280217	Silicon Carbide	450 mm	1 ½ " BSPP Male
EE280114	INCONEL 600	150 mm	¾ " BSPP Male
EE280222	INCONEL 600	300 mm	¾ " BSPP Male
EE280281	AISI 310	150 mm	¾ " BSPP Male
EE280280	AISI 310	300 mm	¾ " BSPP Male
EE280137	INCONEL 600	400 mm	1 ¼" BSPP Male

8.2.5 Other accessories

CODE	DESCRIPTION
BB530200	Bell202/RS232 adapter (IRtec Rayomatic 40/100)
BB530018	RS232 adapter (IRtec Rayomatic 20)
BB260195	Setup Software (IRtec Rayomatic 40/100)
BB260196	Setup & LogMan Graphic Software (IRtec Rayomatic 40/100 only)

8.3 Advice

It's important to use very clean air to prevent dirt from depositing on the main lens. Every particle in the air could obstruct part of the diffuser, and modify the aerodynamic characteristics in the air flux. So, the flux would be modified, and dirt air could reach the lens. The air system must be periodically checked. To add a filtering system is strongly recommended.

Eurotron can supply an air filtering system (cod. EE290015) to be used on the already present air network. This system needs dry and clean air at a pressure up to 10 bar. If a compressed air network isn't available, a fan generating system can be used.

According to the application, it could be necessary to cool the thermometer using an air flow. The maximum pressure for an air purge system is 0.7 bar. Just for a normal air purge, only the tenth part of this flow is required.

Remember that the air tube must have a diameter bigger enough not to have flow losses.

IMPORTANT NOTE:

WHEN A PURGE AIR IS USED, IT MUST BE CLEAN AND DRY. THE DIFFUSOR PRODUCES A LAMINAR FLOW THAT KEEPS THE LENS CLEAN. IF THE AIR ISN'T PERFECTLY CLEAN, TRACKS OF OIL AND DIRT MAY DEPOSIT ON THE LENS.

IMPORTANT NOTE:

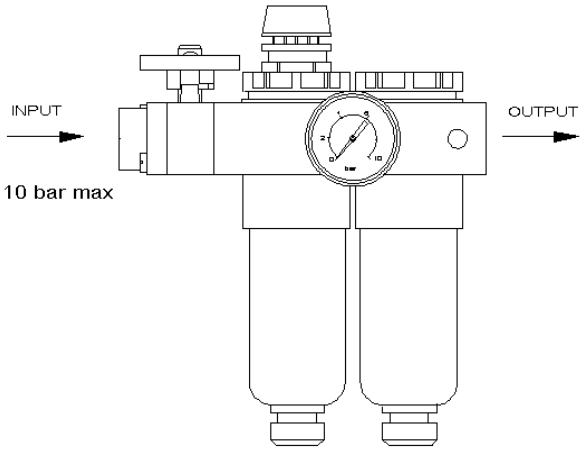
WHEN MEASURING TEMPERATURES INSIDE OVENS, DO NOT USE ANY AIR COMING FROM THE FAN OF THE OVEN. THE AIR FROM THE OVEN, IN FACT, MAY VARY, AND THE PRESSURE ON THE THERMOMETER MAY BE NOT SUFFICIENT TO GRANT ITS CLEANING AND COOLING.

8.4 Air treatment equipment

The reduction and air filtering group (code EE290015) is composed by a modular system including:
- An interception valve (1/8")
- A pressure reducer with a filtering element
- An anti-oil filter
- A pressure gauge (0 ÷ 10 bar)

Two different air flow controllers are available:
1) For low flows: when only the purge air is required.
2) For high flows: when an air cooling system is required instead of a water one.

We suggest to minimise the distance between the controller group and the thermometer:



9 SERIAL COMMUNICATION

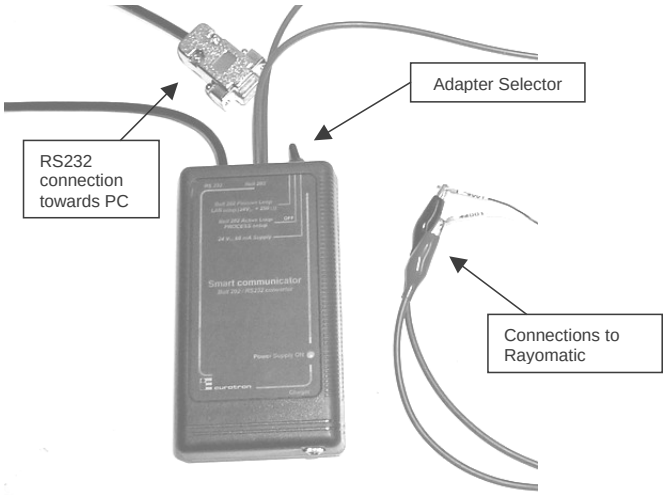
IRtec Rayomatic 40 is a programmable infrared thermometer using the same current loop wires to transmit and receive digital informations from a Personal Computer. To do this, Eurotron has included inside the unit, a modem with Bell202 communication protocol.

9.1 Smart/RS232 adapter

For connecting a PC to the **IRtec Rayomatic 40/100**, it is necessary to use the optional SMART/RS232 adapter (cat. **BB530200**). The SMART/RS232 adapter could be used for the following operations:

- Powering and Programming the unit (fig. 1). Switch to *LAB Setup* position.
- Programming the unit connected to an acquisition loop (fig. 2, 3 and 4). You can have different hardware configurations depending on the indicator internal resistance. Switch to *PROCESS Setup* position.
- Powering the laser pinpointing (fig.5). You have to switch to *24Vdc Supply* position.

Two Windows™ 98/2000/NT/XP compatible software packages are available to set the unit and for data acquisition.



SMART/RS232 adapter (BB530200)

9.1.1 Connections

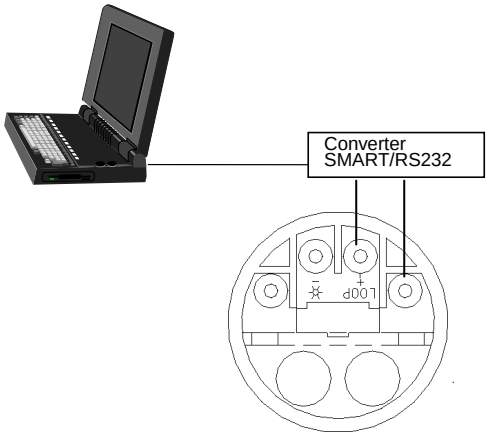


fig. 1 – Direct PC connection

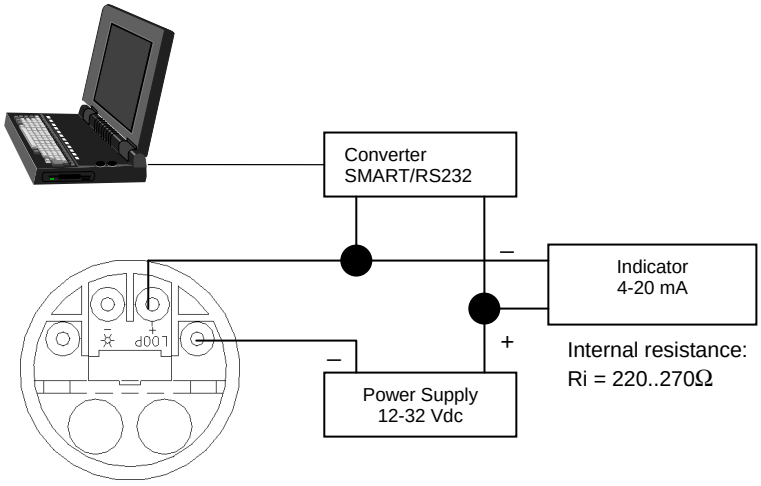


fig. 2 – Connection on a powered current loop

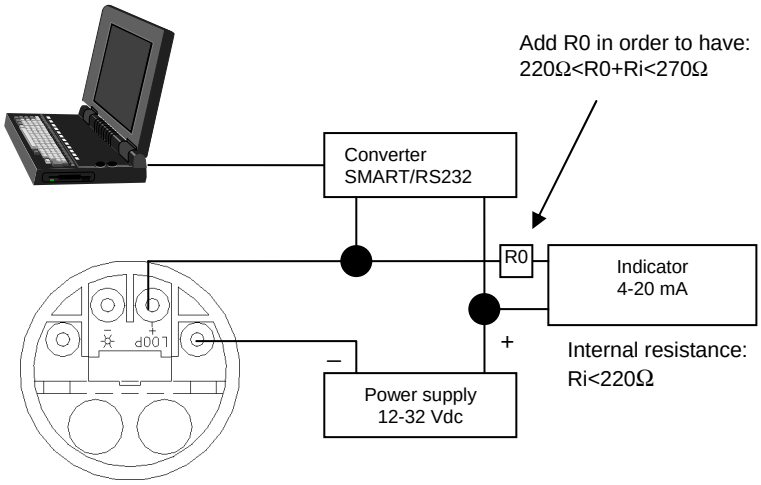


fig. 3 – Connection on a powered current loop

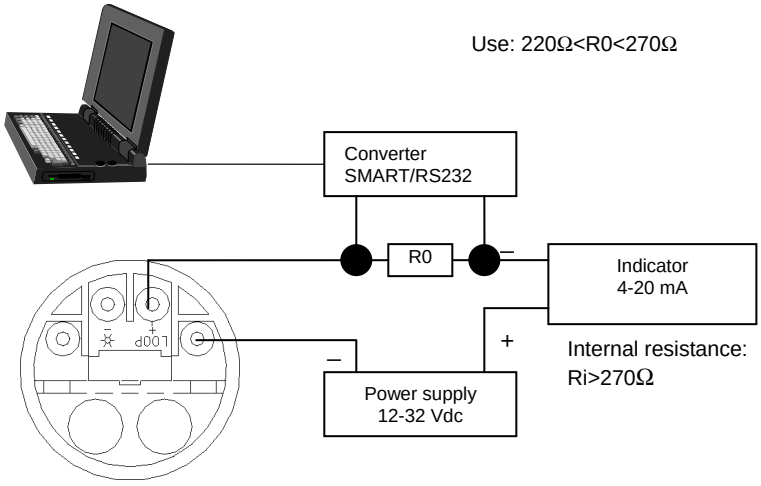


fig. 4 – Connection on a powered current loop

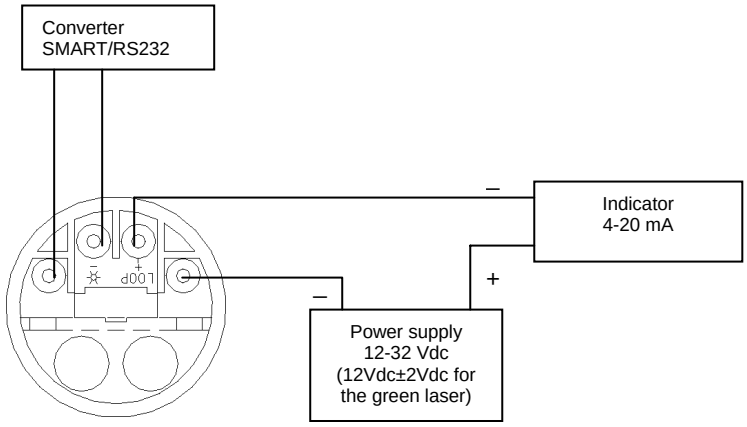


fig 5 – Laser pinpointing supply

WARNING

USE A SEPARATE POWER SUPPLY OF 12VDC±2VDC 100MA ONLY WHEN USING THE GREEN LASER

10 CERTIFICATES

10.1 Warranty Terms

Each instrument is shipped with a Warranty Certificate that indicates the validity conditions of the warranty itself. **Eurotron** warrants its products against defects in materials and workmanship.
If the unit should malfunction, it must be returned during the warranty period, transportation prepaid, to **Eurotron** for evaluation. Upon examination, if the unit is found to be defective it will be repaired or replaced at no charge.
Eurotron's WARRANTY does not apply to defects resulting from any action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorized modification. This WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of being damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of **Eurotron**'s control.
This warranty applies to the original purchaser only. Please include a copy of the original invoice or a small service charge may be applied.

Direct all warranty and repair requests/inquiries to the **Eurotron** Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO **EUROTRON**, PURCHASER MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM **EUROTRON**'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS).
The purchaser is responsible for shipping charges, freight, insurance and proper packaging to prevent breakage in transit.

10.2 Letter of Conformity

Each instrument is shipped with a Letter of Conformity, to grant that the characteristics of the instrument correspond to the required ones, and that the instrument calibration is traceable to the National and International Standards.

APPENDIX

A1 EMC Conformity

The instrument is designed to fulfil the prevision of the directive 89/336/CEE Electromagnetic Compatibility.
In the following page you will find the EMC declaration of conformity

Declaration of Conformity

We : Eurotron Instruments S.p.A.

(Supplier's name)

Viale F.lli Casiraghi, 409/413 20099 Sesto S. Giovanni (MI) - Italy

(Address)

declare under our sole responsibility that the product :

IR thermometers series **IR*tec*** Rayomatic 20 & 40

(Name and type)

Cat. 1130 & cat. 1140

(Model)

to which this declaration relates is in conformity with the following normative documents :

EN 50082-2 (3/95)
IEC 1000-4-2 / IEC 1000-4-4 / IEC 1000-4-11
ENV 50140 - ENV 50141 - ENV 50204

EN 55011

(Title, number and date of issue of normative documents)

following the prevision of directive :

89/336/CEE Electromagnetic Compatibility (EMC)

Sesto S. Giovanni, July 20th, 2000

(Place and date of issue) (Signature of authorised person)

eurotron

Declaration of Conformity

We : Eurotron Instruments S.p.A.

(Supplier's name)

Viale F.lli Casiraghi, 409/413 20099 Sesto S. Giovanni (MI) - Italy

(Address)

declare under our sole responsibility that the product :

IR thermometers series **IR*tec*** Rayomatic 100

(Name and type)

Cat. 1148

(Model)

to which this declaration relates is in conformity with the following normative documents :

EN 50082-2 (3/95)
IEC 1000-4-2 / IEC 1000-4-4 / IEC 1000-4-11
ENV 50140 - ENV 50141 - ENV 50204

EN 55011

(Title, number and date of issue of normative documents)

following the prevision of directive :

89/336/CEE Electromagnetic Compatibility (EMC)

Sesto S. Giovanni, July 20th, 2000

(Place and date of issue) (Signature of authorised person)

eurotron

A2 How to determine an object emissivity

Emissivity is the measure of an object ability to absorb, transmit, and emit infrared energy. It can have a value from 0 (shiny mirror) to 1.0 (blackbody). If a value of emissivity higher than the actual one is set, the output will read low, provided that the target temperature is above the ambient one. For example, if 0.95 is set in and the actual emissivity is 0.9, the reading will be lower than the true temperature when the target temperature is above the ambient one.

The emissivity can be determined by one of the following methods, in order of preference:

1. Determine the actual temperature of the material using a sensor such as a RTD, thermocouple or another suitable method. Next, measure the object temperature and adjust the emissivity setting until the correct value is reached. This is the correct emissivity for the measured material.

2. For relatively low temperature objects (up to 260°C or 500°F, place a piece of tape, such as a masking, on the object. Make sure the tape is large enough to cover the field of view. Next, measure the tape temperature using an emissivity setting of 0.95. Finally, measure 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 a portion of the surface of the object can be coated, use a flat black paint, which will have an emissivity of about 0.98. Next, measure the painted area using an emissivity setting of 0.98. Finally, measure 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.

A2.1 Typical Emissivity Values

The following table provides a brief reference guide to determine emissivity and can be used when one of the above methods is not practical. Emissivity values shown in the table below are only approximate, since several parameters may effect the emissivity of an object. These include the following ones:

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

A2.2 Metals - Typical Emissivity Values

	1.0 µm	1.6 µm	5.1 µm	8-14 µm
Aluminium				
Non-Oxidized	0.1-0.2	0.02-0.2	0.02-0.2	0.02-0.1
Oxidized	0.4	0.4	0.2-0.4	0.2-0.4
Alloy A 3003				
Oxidized	—	0.4	0.4	0.3
Roughened	0.2-0.8	0.2-0.6	0.1-0.4	0.1-0.3
Polished	0.1-0.2	0.02-0.1	0.02-0.1	0.02-0.1
Brass				
Polished	0.8-0.95	0.01-0.05	0.01-0.05	0.01-0.05
Burnished	—	—	0.3	0.3
Oxidized	0.6	0.6	0.5	0.5
Carbon				
Non-oxidized	0.8-0.95	0.8-0.9	0.8-0.9	0.8-0.9
Graphite	0.8-0.9	0.8-0.9	0.7-0.9	0.7-0.8
Chromium	0.4	0.4	0.03-0.3	0.02-0.2
Copper				
Polished	0.05	0.03	0.03	0-03
Roughened	0.05-0.2	0.05-0.2	0.05-0.15	0.05-0.1
Oxidized	0.2-0.8	0.2-0.9	0.5-0.8	0.4-0.8
Gold	0.3	0.01-0.1	0.01-0.1	0.01-0.1
Haynes Alloy	0.5-0.9	0.6-0.9	0.3-0.8	0.3-0.8
Inconel				
Oxidized	0.4-0.9	0.6-0.9	0.6-0.9	0.7-0.95
Sandblasted	0.3-0.4	0.3-0.6	0.3-0.6	0.3-0.6
Electropolished	0.2-0.5	0.25	0.15	0.15
Iron				
Oxidized	0.4-0.8	0.5-0.9	0.6-0.9	0.5-0.9
Non-oxidized	0.35	0.1-0.3	0.05-0.25	0.05-0.2
Rusted	—	0.6-0.9	0.5-0.8	0.5-0.7
Molten	0.35	0.4-0.6	—	—
Iron Cast				
Oxidized	0.7-0.9	0.7-0.9	0.65-0.95	0.6-0.95
Non-oxidized	0.35	0.3	0.25	0.2
Molten	0.35	0.3-0.4	0.2-0.3	0.2-0.3
Iron Wrought				
Dull	0.9	0.9	0.9	0.9
Lead				
Polished	0.35	0.05-0.2	0.05-0.2	0.05-0.1
Rough	0 65	0.6	0.4	0-4
Oxidized	—	0.3-0.7	0.2-0.6	0.2-0.6
Magnesium	0.3-0.8	0.05-0.3	0.03-0.15	0.02-0.1
Mercury	—	0.05-0.15	0.05-0.15	0.05-0.15
Molybdenum				
Oxidized	0.5-0.9	0.4-0.9	0.3-0.7	0.2-0.6
Non-oxidized	0.25-0.35	0.1-0.3	0.1-0.15	0.1

	1.0 µm	1.6 µm	5.1 µm	8-14 µm
Monel (Ni-Cu)	0.3	0.2-0.6	0.1-0.5	0.1-0.14
Nickel				
Oxidized	0.8-0.9	0.4-0.7	0.3-0.6	0.2-0.5
Electrolytic	0.2-0.4	0.1-0.3	0.1-0.15	0.05-0.15
Platinum				
Black	—	0.95	0.9	0.9
Silver	0.04	0.02	0.02	0.02
Steel				
Cold-Rolled	0.8-0.9	0.8-0.9	0.8-0.9	0.7-0.9
Ground Sheet	—	—	0.5-0.7	0.4-0.6
Polished Sheet	0.35	0.25	0.15	0.1
Molten	0.35	0.25-0.4	0.1-0.2	—
Oxidized	0.8-0.9	0.8-0.9	0.7-0.9	0.7-0.9
Stainless	0.35	0.2-0.9	0.15-0.8	0.1-0.8
Tin (Non-oxidized)	0.25	0.1-0.3	0.05	0.05
Titanium				
Polished	0.5-0.75	0.3-0.5	0.1-0.3	0.05-0.2
Oxidized	—	0.6-0.8	0.5-0.7	0.5-0.6
Tungsten		0.1-0.6	0.05-0.5	0.03
Polished	0.35-0.4	0.1-0.3	0.05-0.25	0.03-0.1
Zinc				
Oxidized	0.6	0.15	0.1	0.1
Polished	0.5	0.05	0.03	0.02

A2.3 Non-Metals - Typical Emissivity Values

	1.0 µm	2.2 µm	5.1 µm	8-14 µm
Asbestos	0.9	0.8	0.9	0.95
Asphalt	—	—	0.95	0.95
Basalt	—	—	0.7	0.7
Carborundum	—	0.95	0.9	0.9
Ceramic	0.4	0.8-0.95	0.85-0.95	0.95
Clay	—	0.8-0.95	0.85-0.95	0.95
Concrete	0.65	0.9	0.9	0.95
Cloth	—	—	0 95	0.95
Glass				
Plate	—	0.2	0.98	0.85
"Gob"	—	0.4-0.9	0.9	
Gravel	—	—	0.95	0.95
Gypsum	—	—	0.4-0.97	0.8-0.95
Ice	—	—	—	0.98
Limestone	—	—	0.4-0.98	0.98
Paint				0.9-0.95
Paper (any colour)	—	—	0.95	0.9S
Plastic (opaque, over 20 mils)	—	—	0.95	0.95
Rubber	—	—	0.9	0 95
Sand	—	—	0.9	0.9
Snow	—	—		0.9
Soil	—	—	—	0.9-0.98
Water	—	—	—	0.93
Wood, Natural	—	—	0.9-0.95	0.9-0.95

To optimize surface temperature measurements consider the following guidelines:

1. Determine the object emissivity using the instrument to be used for the measurement.
2. Avoid reflections by shielding the object from surrounding high temperature sources.
3. For Higher temperature objects use shorter wavelength instruments, whenever any overlap occurs.
4. For semi-transparent materials such as plastic films and glasses, assure that the background is uniform and lower in temperature than the object.
5. Mount the sensor perpendicular to the surface whenever the emissivity is less than 0.9. In any case, do not exceed angles more than 30 degrees from incidence.