E²T PULSAR 4 / PULSAR 4 Advanced

Smart FMA™
Higher Area Class IIB+H2
High Ambient
No Cooling
Flexible Power
24VDC/120/230VAC
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1 General

1.1 Information about the user manual

This manual provides important information that can be used as a work of reference for installing, operating, maintaining, aligning, and/or troubleshooting your LumaSense Instrument. It is important that you carefully read the information contained in this manual and follow all safety procedures before you install or operate the system. If you are already familiar with this equipment you may choose to go directly to Section 2.6 Quick Installation Procedure. To avoid handling errors, keep this manual in a location where it will be readily accessible.

This document will be updated with changes as necessary. You are encouraged to recommend and submit changes, additions, and/or corrections to make this document more useful.

1.1.1 Legend

Note: Indicates tips and useful information in this manual. All notes should be read to effectively operate the instrument.

Caution: Denotes information critical to avoiding instrument damage or a severe impact to processing. When this symbol is found on the instrument it indicates a potential hazard. Consult the documentation before proceeding with any actions.

Warning: Denotes information critical to avoiding personal injury, such as when an electrical hazard is present. When this symbol is found on the instrument it indicates a potential hazard. Consult the documentation before proceeding with any actions).

Protective Earth Ground connection.

Caution Must be Followed: reference supplied documents.

Electric Shock Hazard: disconnect service before opening.

Voltage Alternating current (VAC).

Voltage Direct Current (VDC).

1.1.2 Definitions and Abbreviations

Many terms in this manual may be unfamiliar to you. This section is included to help you identify the terms used to describe the products.

Terminology VDI/VDE directives 3511 Part 4.4

Adapter The fixture through which a Thermocouple (T/C) may be inserted into the reactor while under full operating conditions.

Backup Probe Assembly A sub-system consisting of an Adapter and a Thermo-Couple
(Model BUP-10) (including a T/C stop).

Bulkhead Plate That portion of the SOF, which bolts to the client's Ball Valve.

Clean-Out Probe Assembly (Model COP-10) A sub-system consisting of an Adapter (the same one used in the BUP-10) and a stainless steel rod onto which different size rams may be screwed. The function of the COP-10 is to clear clogged sight paths into the reactor during operations.

Cooling Cavity A cavity cast into the bottom of the Explosion-Proof Enclosure through which either water or air can be pumped through for cooling. It is separate from the electronics cavity.

Explosion-Proof Enclosure The enclosure is designed to hold an explosion and release the hot gases slowly enough to allow them to cool sufficiently as to not ignite the explosive gases outside the enclosure.

IR Abbreviation for Infrared Radiation.

K Type Denotes a thermocouple (T/C) in a 1/4" diameter stainless steel sheath capable of measuring temperatures through the BUP Adapter in the reactor. Maximum temperature is approximately 1370 °C.

PULSAR 4 The complete Sulfur Recovery Reactor (furnace) Temperature Measuring System may consist of:

1. PULSAR 4 with Explosion-Proof Enclosure.
   • PULSAR 4 measures refractory temperature (RT mode), gas /flame temperature (GT mode) or average temperature (FF mode)
   • PULSAR 4 Advanced has an additional flame measurement algorithm (FMA mode)
2. Swing-Out Fixture Model SOF-1 or SOF-8.
3. Viewport Model VP-10 (incorporated in the SOF).

Reactor Reaction Furnace, Sulfur Reactor or Furnace.

SOF-1/SOF-8 A fixture which allows the operator to swing the PULSAR 4 away from the viewport for access.

SRU Sulfur Recovery Unit.

T/C Abbreviation for Thermo-Couple.

V-208-15-H A Vortex Air-Cooling device used when water cooling is not available or convenient.

VP-10P A Viewport Assembly consisting of a Pyrex window mounted in a housing which screws into the SOF-8 Bulkhead Plate.

1.2 Safety

This manual provides important information on safely installing and operating your LumaSense Instrument. Several sections of this manual provide safety warnings to avert danger. These safety warnings are specified with a warning symbol. You must read and understand the
contents of this manual before operating the instrument even if you have used similar instruments or have already been trained by the manufacturer.

It is also important to continually pay attention to all labels and markings on the instrument and to keep the labels and markings in a permanent readable condition.

See Chapter 9, Safety Assurances and Precautions for more information.

1.2.1 Explosion Proof Housing

The housing is designed to meet the explosion-proof requirements of the National Fire Protection Association (NFPA) Article 500 for hazardous locations. This Instrument holds the following approvals:

- FM for US and CDN
- European ATEX certification
- International IECEx certification

To ensure safe operating conditions, it is recommended that you review the certification and area classifications that pertain to this system:

Reference

- Appendix B, Area Classification/Protection Concepts
- Appendix C, Declaration of Conformity/Certificate

Warning: Hazardous Location Safety Minder – Service personnel shall be qualified to install and service electrical equipment designed for areas classified as hazardous. At no time should the cover be removed unless power is switched off first. When it is necessary to service the instrument with the power applied, ensure that proper safe environmental conditions exist and that such maintenance is authorized and pursuant to safe conditions. See Chapter 9, Safety Assurances and Precautions, for more information.

1.3 Limit of Liability and Warranty

All general information and notes for handling, maintaining, and cleaning this instrument are offered according to the best of our knowledge and experience.

LumaSense Technologies is not liable for any damages that arise from the use of any examples or processes mentioned in this manual or in case the content of this document should be incomplete or incorrect. LumaSense Technologies reserves the right to revise this document and to make changes from time to time in the content hereof without obligation to notify any person or persons of such revisions or changes.

All instruments from LumaSense Technologies have a regionally effective warranty period. Please check our website at http://info.lumasenseinc.com/warranty for up-to-date warranty information. This warranty covers manufacturing defects and faults which arise during operation, only if they are the result of defects caused by LumaSense Technologies.
1.4 Unpacking and Inspection

Before unpacking the instrument, locate the packing invoice on the outside of the carton. The invoice lists every item that was included in your shipment. Each LumaSense E'T PULSAR 4 instrument is configured to the default settings (Refer to Appendix A, Section 10.4 for a complete list). After you have installed the instrument and reviewed the contents of this manual, you will need to configure the instrument to match your application.

When unpacking and inspecting your system, you need to do the following:

- Check all materials in the container against the enclosed packing list.
- LumaSense Technologies cannot be responsible for shortages against the packing list unless a claim is immediately filed with the carrier. Final claim and negotiations with the carrier must be completed by the customer.
- Carefully unpack and inspect all components for visible damage.
- Save all packing materials, including the carrier’s identification codes, until you have inspected all components and find that there is no obvious or hidden damage.
- Before shipment, each instrument is assembled, calibrated, and tested at the LumaSense Factory. If you note any damage or suspect damage, immediately contact the carrier and LumaSense Technologies, Inc.

Once you have determined the unit you received is the unit you ordered and it is in acceptable condition, the unit is ready for installation. Be sure to reference Chapter 9, Safety Assurances and Precautions, before you begin installation.

1.5 Service Request, Repair, or Support

Contact LumaSense Technologies Technical Support in case of a malfunction or service request. Provide clearly stated details of the problem as well as the instrument model number and serial number. Upon receipt of this information, Technical Support will attempt to locate the fault and, if possible, solve the problem over the telephone.

If Technical Support concludes that the instrument must be returned to LumaSense Technologies for repair, they will issue a Return Material Authorization (RMA) number.

Return the instrument upon receipt of the RMA number, transportation prepaid. Clearly indicate the assigned RMA number on the shipping package exterior. Refer to Section 1.6, Shipments to LumaSense for Repair, for shipping instructions.

Technical Support can be contacted by telephone or email:

**Santa Clara, California (U.S., Mexico, and Canada)**
- Telephone (408) 727-1600 or 1-800-631-0176
- Email support@lumasenseinc.com

**Frankfurt, Germany**
- Telephone: +49 (0) 69 97373 0
- Email: eusupport@lumasenseinc.com

For customers requiring language assistance, please contact your local office or representative to facilitate support and repair.
1.6 Shipments to LumaSense for Repair

All RMA shipments of LumaSense Technologies instruments are to be prepaid and insured by way of United Parcel Service (UPS) or preferred choice. For overseas customers, ship units air-freight, priority one.

There is no need to return the EXP housing if the problem is with the electronics. Remove the electronics assembly from the EXP housing, then package the instrument in a sturdy container that is appropriate for the method of shipment. Secure it with plenty of packing material. LumaSense Technologies is not responsible for freight damage to instruments that are improperly packed.

Please enclose a packing slip with a list of everything you are returning, the reason for the return, and the name and phone number of the person we should contact (preferably the user) if we need any more information.

Contact us to obtain an RMA number (if one has not already been assigned by Technical Support). Clearly indicate the assigned RMA number on the shipping package exterior.

Send RMA Shipments to your nearest technical service center:

Customers in **North America** should send RMA Shipments to:

**Santa Clara, California**

LumaSense Technologies, Inc.
3301 Leonard Court
Santa Clara, CA 95054 USA
Telephone: +1 408 727 1600
+1 800 631 0176

Email: support@lumasenseinc.com

All other customers should send RMA Shipments to:

**Magdeburg, Germany**

LumaSense Sensor GmbH
Lübecker Straße 53-63
39124 Magdeburg
Germany
Ph: +49 (0) 391 5441746

Email: eusupport@lumasenseinc.com

1.7 Disposal / Decommissioning

Inoperable PULSAR 4 instruments must be disposed of in compliance with local regulations for electro or electronic material.
2 Introduction

2.1 System Overview

The PULSAR 4 is a unique temperature measurement system designed specifically for continuous-duty monitoring of high temperature furnaces of all kinds. The heart of the system is the PULSAR 4 wide-range, non-contact thermometer. A common limitation of the typical infrared thermometer is its narrow single scale limits. The PULSAR 4 has been designed to replace narrow scale pyrometers and contact probes where thermocouples (T/C) and resistance temperature device performance is marginal, unreliable, or impractical. Through computer calibration and advanced electronics, LumaSense has produced a non-contact thermometer exceeding T/C temperature ranges in a single, linear and continuous scale of 350 to 2000 °C.

The PULSAR 4 Advanced contains two channels that provide the measurements of the GT (Gas Temperature) and RT (Refractory Temperature) simultaneously using the same optics. The PULSAR 4 Advanced has an additional flame measurement algorithm (FMA mode).

The PULSAR 4 Advanced is a compact, single unit, electro-optical instrument with two independent 4-20 mA linear outputs (one for each channel). Even after dedicating a viewport on a reactor to the installation of the PULSAR 4 Model, you can still look into the reactor via the "sight-through" aiming optics. (Refer to Appendices A and B for details about the components of the PULSAR 4 System).

2.2 System Features

Features of the PULSAR 4 and PULSAR 4 Advanced Systems include:

- Hazardous Classification: IECEx, ATEX, FM (US and CDN).
- PULSAR family acceptance by the EPA as an accurate and reliable temperature measurement tool.
- Wide temperature range - Ambient (with BUP-10) to 2000 °C.
- Two 4-20 mA sourcing and isolated linear outputs. (Corresponding to NAMUR NE 43 recommendations)
- One RS485 Interface
- An emissivity adjustment from 0.100 to 1.000 in standard mode (0.050-1.000 aLP in FMA mode (PULSAR 4 Advanced only).
- Two programmable alarm setpoints with form “C” mechanical relays.
- A choice of three measurement modes to provide average, gas, or refractory temperatures. The PULSAR 4 Advanced has additional flame measurement algorithm (FMA mode)
- An electro-optical package that is easily removed from the explosion-proof housing, minimizing downtime and increasing reliability (See Figure 1).
- An internal heater and water/air cooling cavity for internal instrument temperature stability.
- High quality sight-through optics.
2.3 Principle of Operation

All objects above absolute zero temperature emit infrared energy. The amount of energy emitted is proportional to the body temperature. The PULSAR 4 collects this energy by means of a focusing optical system concentrating the energy from a body onto two sensitive infrared detectors. Specialized amplification circuitry converts the signals generated by the detectors into linear output signals corresponding to 4-20 mA.

The efficiency of energy emission from different objects varies significantly. A perfect energy emitter is known as a blackbody radiator and is assigned an emissivity value of one. Any object that emits with less than perfect efficiency is assigned an emissivity value between zero and one, with a perfect reflector assigned an emissivity value of zero.

The PULSAR 4 is calibrated against nearly perfect blackbody radiators in the laboratory. However, the emissivity of objects and processes which you are measuring will typically fall
somewhere between zero and one. This results in the need for an adjustment of the PULSAR 4’s emissivity setting to obtain a match against a known reference temperature. Once the emissivity setting has been adjusted for a particular installation, the PULSAR 4 will accurately track temperatures as they rise and fall. A reference temperature can be easily obtained through the use of LumaSense’s BUP-10 Backup Probe.

2.4 Expected Performance

The outputs of the PULSAR 4 are accurate to within 0.3% of the reading or 3 °C, whichever is greater. At 400 °C, the output would be within 3 °C, and at 1000 °C the output would be within 3 °C, and so on.

As with any precision instrument, the PULSAR 4 requires periodic calibration. However, since there are no moving parts and ultra-stable sensors are used, much longer recalibration intervals may be incorporated.

2.5 Smart FMA Mode (PULSAR 4 Advanced only)

LumaSense has developed a unique method to compensate for inter-channel effects when measuring hot gasses and refractory temperatures called Flame Measurement Algorithm (FMA). In a normal situation, a flame can add to the signal emitted from the refractory depending on the quality, quantity, and absorption of the flame. In a similar manner, some transparency of the flame or hot gas can cause refractory radiance to reduce the flame temperature. This algorithm virtually removes these unwanted “crosstalk” artifacts and solves for more meaningful refractory and flame/hot gas temperatures. This is based on the following physics (simplified):

![Figure 2: Flame Measurement Algorithm (FMA) Simplified](image)
The above chart illustrates the difference between “Standard” operating mode and “Smart FMA” operating mode (field switchable). Notice as the flame intensity undergoes step changes, refractory (RT) and standard flame/hot gas (GT) waveforms have dampened responses. This is expected on the refractory due to the thermal mass of the refractory, but not on the flame response, which is influenced by the refractory radiance. With Smart FMA activated, the hot gas channel (GT) displays a step change similar to the actual combustion air and gas flows into the SRU. In this mode, the response time is limited to 10 seconds, but the results will provide a new and valuable monitoring system.

**Note:** The situation depicted is a very clean burning flame resulting in a large transparency. The FMA mode compensates and corrects the GT measurement.
2.6 Quick Installation Procedure

This quick installation procedure may be used as a checklist if you are already familiar with the equipment. For complete instruction and safety precautions, refer to the appropriate sections of this manual:

- Appendix C: Engineering Drawings
- Chapter 3, Mechanical Installation
- Chapter 4, Electrical Installation
- Chapter 9, Safety Assurances and Precautions

**Warning: Hazardous Location Safety Minder** – Explosion Proof performance integrity must not be compromised during or after servicing. At any time when the Explosion Proof enclosure is exposed, i.e. purge plug removed, power shall be switched off to ensure safe operation. See Chapter 9, Safety Assurances and Precautions, for more information.

### 2.6.1 Mounting the Instrument

The PULSAR 4 is designed to be mounted directly to a 2-inch 150 lb. RF ball valve for SOF-1 (3-inch 150 or 300 lb. RF ball valve for SOF-8). A gasket is required between the valve and bulkhead plate of the swing-away fixture.

1. Verify that the location is within the instrument’s design capabilities. Refer to Chapter 3, Mechanical Installation.
2. Confirm that the instrument’s input power and signal output configuration is as expected.

#### 2.6.1.1 Conditions of Use:

1. Contact manufacturer for flamepath joint design information.
2. The cable glands, cable sealing device or blanking plugs for the unused entries (as applicable) shall be suitably certified with a minimum Ex gas rating of Ex d IIB+H2 Ta = - 40 °C to 60 °C Gb.
3. In order to maintain an IP65 rating for the equipment, the cable glands shall be suitably certified with a minimum rating of IP65.
4. To reduce the risk due to electrostatic discharge, the user shall regularly clean the enclosures with a damp cloth to limit dust layers on the enclosure sides.
5. The socket head screws used on the enclosure shall be stainless steel screws grade A4-70; M8 Socket Head Cap / Allen Screws with minimum yield strength 800 MPa.

### 2.6.2 Mechanical

Refer to Appendix C, Engineering Drawings, for more information.

#### 2.6.2.1 Connect Air Requirements

1. Viewport Purge

   1.7 m³/h (@ standard conditions) flow from 1.4 bar air is required for the viewport air purge fitting just downstream from the viewport Model VP-10.

   Instrument air is recommended.
2. Combustion Purge

17 m³/h (@ standard conditions) or greater combustion air purge is recommended between the valve and the reactor to keep the sight path clear. A 1/2” line from the combustion air supply is adequate.

3. Optional Housing Purge (Nitrogen, if needed)

Housing purge is not required for Explosion Proof ratings and is not recommended.

Caution – Make sure to use enough tubing to compensate for the Swing Out possibilities. Also with new installs, make sure to consider any pipes that may be in the way of the Swing Out space.

2.6.3 Electrical

Refer to Appendix C, Engineering Drawings, and Section 9.2, Electrical Service Protection, for more information.

Warning: Hazardous Location Safety Minder – At no time should the cover be removed unless power is switched off first. When it is necessary to service the instrument with the power applied, ensure proper safe environmental conditions exist and that such maintenance is authorized and pursuant to safe conditions. See Chapter 9, Safety Assurances and Precautions, for more information.

1. Connect the instrument power.

24 VDC POWER IN is marked on Terminals

or,

115 VAC POWER IN is marked on separate Terminals

or,

230 VAC POWER is marked on separate Terminals

Note: Secure power input lines together after connection to the terminal block to prevent an accidental hazardous live condition in the unlikely event that a terminal screw becomes loose. Sleeve or tie wrapping is acceptable.

2. Separate supply wires from signal wires by routing through separate ¾” NPT conduit ports.

3. Connect the instrument loops and alarm outputs:

a. Connect the lines as needed for Normal Open (N.O.) or Normal Closed (N.C.) relay to the corresponding locations.

Note: The relays are rated for 30 VDC, 1 A maximum.

b. Connect one or both 4-20 mA output lines to corresponding mA(-) and mA(+) terminals. Cable shield is to be connected only at one end of the cable.

4. Aim the instrument at the target.

5. Focus the instrument (adjust the lens).
2.6.4 Configure the Instrument

Prior to start-up, review your measurement needs and configure the PULSAR 4 to match those requirements. The PULSAR 4 is like having two pyrometers in one box, it offers you a variety of measurement options. In order to get the most out of this instrument, it is important to become familiar with all of its functions and configuration parameters prior to commissioning. Thoroughly review Section 5.7 and the Parameter Configuration tables in Appendix A.

If the configuration options are too overwhelming in the beginning, use the factory default settings to get started and monitor the results, then turn on FMA mode (PULSAR 4 Advanced only) and monitor the results. Proceed in more detail as time permits.

1. Eyepiece Lens with Reticle
2. Focus Adjust and Lens Locking Screw
3. Digital Display
4. Output 1: 4-20 mA
5. Output 2: 4-20 mA
6. 24 VDC Supply Connector to Electronics
7. 115/230 VAC Supply Connector to Electronics
8. LEDs for indication of displayed value
9. Fuses for power supply
10. Relay Alarm contacts

Figure 3: Configuration Options
To ensure consistent document formatting, this page was intentionally left blank.
3 Mechanical Installation

3.1 Getting Started

Each LumaSense PULSAR 4 instrument is configured to the default settings (Refer to Appendix A, Section 10.4 for a complete list).

Once you have determined the unit you received is the unit you ordered and it is in acceptable condition, the unit is ready for installation. Be sure to reference Section 9, Safety Assurances and Precautions, before installation.

After installation and reviewing this manual, configure the instrument to match the application.

3.2 Furnace Location

3.2.1 Choice of Temperature Measurements

- The PULSAR 4 measures refractory, checker work or tube sheet temperature (RT mode), gas/flame temperature (GT mode) or average calculated temperature (FF mode).
- The PULSAR 4 Advanced has an additional flame measurement algorithm (FMA mode).

3.2.2 Choice of Locations (Typical)

![Figure 4: Choice of Locations](image)

3.3 Mounting Options

The PULSAR 4 system requires a Swing Away Fixture incorporating features which facilitate mounting and alignment. See Appendix C, Engineering Drawings, for more information.

Caution – Make sure to use enough tubing to compensate for the Swing Out possibilities. Also with new installs, make sure to consider anything that may obstruct the Swing Out space.
3.3.1 Valve Flange Mounting
The Swing-Away Fixture mounts directly to a 2-inch 150 lb (SOF-1) or a 3-inch 150 or 300 lb. (SOF-8) RF (Raised Face) flange of ball valve using bolts with a gasket between the bulkhead plate flange and the valve. Mount the PULSAR 4 assembly in such a way to allow easy access to the instrument controls and allow the instrument to be swung away at least 55°. It should also be possible to conveniently sight through the eyepiece to periodically check the alignment and viewport cleanliness.

3.3.2 Viewport
The Swing-Away Fixture incorporates a heavy duty Viewport window, which may be easily removed by unscrewing the viewport assembly from the bulkhead plate when the ball valve is closed and the entrapped pressure vented off.

⚠️ Caution: Be careful not to damage or lose the silicon O-ring.

3.3.2.1 Focusing on the Target
The objective lens locking and focusing screw and eyepiece are both located on the top of the infrared electro-optical package inside the explosion-proof enclosure (Reference Figure 5).

1. Eyepiece Lens with Reticle
2. Focus Adjust and Lens Locking Screw
3. Objective Lens
4. Display
5. Output 1: 4-20 mA
6. Output 2: 4-20 mA
7. 24 VDC Supply Connector to Electronics
8. 115/230 VAC Supply Connector to Electronics

![Figure 5: Electro-Optical Package](image)

To focus, first rotate the eyepiece lens (Figure 5, item 1) in or out until the reticule is clear and sharp. Next, slowly loosen the lens locking and focusing screw (Figure 5, item 2). Move the objective lens in or out with the focusing screw until the target is clear and sharp. Tighten the screw; the focus is now set.
3.3.2.2 Aiming (Sighting) Adjustments

One advantage of the PULSAR 4 System is that if the target is in a closed chamber, such as a kiln or furnace, the PULSAR 4 can be aimed through a viewport at the target. The viewport can still be used by simply looking through the eyepiece of the instrument. This makes it possible to look at the object being measured and measure its temperature at the same time. Aiming adjustments for accurately sighting the PULSAR 4 down the port into the reactor are provided on the Swing-Out Fixture and on the Electro-Optical Package.

A clear unobstructed sight-path is critical.

When sighting through the PULSAR 4's optics, the circular targeting Reticle should be centered down the middle of the port. Three adjustments are available to achieve proper alignment:

1. A right sighting adjustment made with the washer in between bulkhead plate and wing nut plate as shown in Figure 7, Item 1.
2. A left sighting adjustment made with the washers between the legs of the Explosion-Proof Housing and back plate as shown in Figure 7, Item 2.
3. An up/down sighting adjustment made by loosening the four screws holding the Infrared Electro-Optical Package in the explosion-proof enclosure. Move the entire Infrared Electro-Optical Package. There should be enough play to center the Reticle down the port. Tighten the screws, repeating the first step if necessary.
If required, loosen the four M6 socket cap bolts holding the Explosion-Proof Enclosure to the Swing-Out Fixture, reposition the Enclosure on the Fixture and re-tighten the bolts.

3.4 Ambient Temperature Limits

The internal operating temperature limits of the PULSAR 4 are -40 °C to 60 °C. When the internal temperature drops below 4 °C an internal electric heater activates and keeps the internal temperature at or above +4 °C. If the internal temperature is expected to be above 60 °C, use of the built-in cooling base is required.

3.5 Cooling Requirements (Optional)

If ambient temperatures in excess of 60 °C are anticipated in the operation of the PULSAR 4, cooling will be required by one of two methods.

3.5.1 Water Cooling

Provides cooling water at 15 °C maximum from a filtered source with a flow rate capable of sustaining at least 38 liter per hour (l/h) to the water-cooling cavity built into the underside of the Explosion-Proof Enclosure. This method allows ambient temperatures of up to 93 °C. If the available cooling water is above 15 °C, then same trial-and-error testing will have to be performed to ensure that the electronics inside the Explosion-Proof Enclosure do not rise above 60 °C.

Note: The cooling cavity is isolated from internal surface of the explosion-proof enclosure. See Appendix C Engineering Drawing 3 909 072, Service Connections.
3.5.2 Vortex Air Cooling

Install a Model V208-15-H Vortex Air Cooler (available from LumaSense) into the cooling cavity of the Explosion-Proof Enclosure. Provide filtered dry compressed air from a minimum 7 bar source with a sustained flow rate capability of at least 17 m3/h (@ standard conditions) to the vortex air cooler. This will result in a temperature reduction of up to 15 °C lower than the supply air. Control the enclosure temperature by adjusting the upstream air pressure to the Vortex Cooler. It is not necessary to over-cool the instrument. If over-cooling occurs, the system’s built in heater will activate, resulting in an unnecessary use of power.

**Note:** The cooling cavity is isolated from internal surface of explosion-proof enclosure. See Appendix C Engineering Drawing 3 909 072, Service Connections.

3.6 Air Requirements

1. **Viewport Purge** - A source of sustained dry instrument air or nitrogen with a flow rate through a regulator or needle valve capable of sustaining 1.7 m3/h (@ standard conditions) flow rate from a 1.4 bar or greater supply.

2. **Combustion Purge** - LumaSense recommends the air purge between the valve and the combustion chamber be supplied through a 1/2" valve line at approximately 17 m3/h (@ standard conditions).

3. **Instrument Housing Purge** - (Not Required)

4. **Vortex Cooler (If required)** - Vortex Cooler air supply refer to Section 3.5.2.

**Caution:** An instrument housing purge with nitrogen is only recommended when the PULSAR 4 will be used in high humidity tropical environments. Exposure of the electronic components to high humidity can significantly reduce component life.

**Warning: Hazardous Location Safety Minder** – Explosion Proof performance integrity must not be compromised during or after servicing.

At any time when the Explosion Proof enclosure is exposed, i.e. purge plug removed, power shall be switched off to ensure safe operation.

If a purge is installed, ensure that proper conduit usage and minimum thread depth is maintained.
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When connecting instruments with mains voltage, general safety regulations for connecting to the 115/230 VAC power supply must be observed. Contact with mains voltage may have lethal consequences. Improper installation may cause extremely severe injuries, health problems or material damage. Only qualified personnel are permitted to connect power supply units of this type.

4.1 Electrical Installation Guidelines

Be sure to reference Appendix C Engineering Drawing 3 909 072, Service Connections during this procedure.

4.1.1 Conditions of Use

1. Contact manufacturer for flamepath joint design information.
2. The cable glands, cable sealing device or blanking plugs for the unused entries (as applicable) shall be suitably certified with a minimum Ex gas rating of Ex d IIB+H2 Ta = -40 °C to 60 °C Gb.
3. In order to maintain an IP65 rating for the equipment, the cable glands shall be suitably certified with a minimum rating of IP65.
4. To reduce the risk due to electrostatic discharge, the user shall regularly clean the enclosures with a damp cloth to limit dust layers on the enclosure sides.
5. The socket head screws used on the enclosure shall be stainless steel screws grade A4-70; M8 Socket Head Cap / Allen Screws with minimum yield strength 800 MPa.

4.1.2 Conduit/Connections

Power and signal wires are fed through the 3/4 inch NPT conduit holes in the side of the environmental housing. All wires exiting the enclosure must run through properly installed explosion-proof seal fittings to maintain explosion-proof rating. Only qualified service personnel should perform operations on this instrument.

LumaSense does not provide the sealing fittings required for installations since the brand or type of sealing fittings required by the client will vary due to the standards of different states and countries.

Flexible conduit of sufficient length must be used from the housing sealing fittings to the hard conduit or junction box to enable movement of the unit on the mounting fixture.

All power and signal connections are made on the Terminal Output board mounted on the infrared electro-optical package inside the explosion-proof enclosure.

See Section 9, Safety Assurances and Precautions, for more information.

4.1.3 Over-Current Protection/Service Switch

It is necessary to incorporate an external over-current protection device appropriate to the instrument’s service and to include a disconnect switch located near the instrument. The service disconnect should be clearly marked as pertaining to this instrument.
4.2 Power Connections

Connect the input power as described in this chapter. Confirm service type and check that the instrument service markings correspond to expectations. When wiring, follow local code regulations. Secure power input conductors together after connection to the terminal block to prevent an accidental hazardous live condition in the event a terminal screw becomes loose. Sleeve or tie wrapping is acceptable. Check to ensure power is not accidentally connected to signal outputs or digital communication lines.

4.2.1 Service Markings

Input Power service (24 VDC, 115/230 VAC) and Fusing types are factory set.

4.2.2 Protective Ground Connection

Connect the protective Earth conductor to the terminal lug located inside the housing as indicated by the symbol.

4.2.3 Cover Attachment

![Figure 8: Front Cover](image)
Warning: Hazardous Location Safety Minder — At no time should the cover be removed unless power is switched off first. When it is necessary to service the instrument with the power applied, ensure proper safe environmental conditions exist and that such maintenance is authorized and pursuant to safe conditions. See Chapter 9, Safety Assurances and Precautions, for more information.

4.3 Powering Requirements

The PULSAR 4 can be powered by a mains voltage of 115 VAC, 230 VAC, or alternatively with a voltage of 24 VDC. Only one of the three power supply possibilities may be connected!

Caution: The mains supply connection must meet the requirements of DIN/VDE regulation 57 411.

Note: Voltage/fusing are factory set. Use a wire gauge appropriate to service installation. See Appendix A for Power and Fuse Requirements and Appendix C, Service Connections, for more information.

4.3.1 Powering with 24 VDC

If powering with 24 VDC:

1. Connect 24 VDC to the terminal labeled +24 VDC as shown in Figure 9.
2. Connect 24V Return to the terminal labeled COM as shown in Figure 9.
3. Connect Ground to the Safety Ground stud.

4.3.2 Powering with 115 or 230 VAC

If powering with 115 or 230 VAC:

1. Connect phase to terminal labeled L1 as shown in Figure 9.
2. Connect neutral to terminal labeled N as shown in Figure 9.
3. Connect earth to terminal labeled as shown in Figure 9.
Note: The instrument electronics automatically recognizes whether 115 or 230 VAC is connected.

4.4 Fusing

4.4.1 Mains
Three fuses, F1, F2, and F3, each are mounted within fuse holders.
- F3 is for 24 VDC input power configurations rated at 1 AT.
- F2 is for the 115/230 VAC input rated at 1.25 AT.
- F1 is for the 5 VAC output of the transformer, rated at 1.6 AT.

4.5 Connections for Reading a Temperature

4.5.1 Connection for mA Output
Each PULSAR 4 provides two analog outputs that can be configured to RT, GT or FF as shown in the Channel Assignment table found in Section 5.7.6.
- RT — Refractory Surface Temperature
- GT — Gas Temperature
- FF — Average Integrated Total Temperature.

If FMA is turned on (PULSAR 4 Advanced only), its effect will apply to all outputs.

Each 4-20 mA current output is an isolated, self-powered linear output for recorders or controllers requiring current loop feedback. The PULSAR 4 supplies its own 4-20 mA current to the load. The 4-20mA is isolated. Loads up to 600 ohms maximum may be connected in series. A signal of 4 mA corresponds to the bottom-end temperature and 20 mA corresponds to the top-end temperature, with points in between falling on a linear scale.

Caution: Refer to Chapter 9, Safety Assurances and Precautions before connecting the 4-20mA loop to the terminal.

Connect the 4-20 mA loop to the terminal as shown in Figure 10.
- Positive mA to mA(+)
- Negative mA to mA(-)

The analog outputs correspond to the NAMUR recommendations (NE 43). For adjustment purposes or for a reliable detection of any range overshoot, the current range made available for the measurement signal will be extended beyond the standardized signal of 4 to 20 mA to the following limits:
- 3.8 mA to 20.5 mA
4.6 Connecting the Alarms

Each PULSAR 4 provides two relay contacts that can be configured to RT, GT or FF as shown in the alarm Assignment table found in Section 5.7.2.7.

- RT — Refractory Surface Temperature
- GT — Gas Temperature
- FF — Average Integrated Total Temperature.

Connect the relay contacts to the terminal as shown in Figure 10.

Each channel has a programmable alarm relay (form C) providing a dry contact with a normally open or normally closed output for a high or low temperature alarm. The contact relay is rated 1 A resistive at 30 VDC maximum. The minimum value is limited to Subrange “LO” and maximum value is “HI”. The relay changes state when temperature rises above the switch point (or falls below the switch point, if low alarm is activated).

⚠️ Attention: Do not attempt to switch 115 VAC or 230 VAC with these relays!
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5 Operating the PULSAR 4

This section covers the start-up procedures for operating the infrared thermometer after the unit has been installed in accordance with Chapters 3 and 4. This chapter includes the installation/start-up checklist and instructions for setpoint adjustment, backup, and clean out probe.

1. Eyepiece Lens with Reticle
2. LED for temperature unit
3. Focus Adjust and Lens Locking Screw
4. Objective Lens
5. Alarm relays
6. 115/230 VAC Supply Connector to Electronics
7. 24 VDC Supply Connector to Electronics
8. Output 2: 4-20 mA
9. Output 1: 4-20 mA
10. RS 485 Interface
11. Push buttons for parameter adjustment
12. LED for display mode
13. Display

Figure 11: PULSAR 4 Interface
5.1 Installation/Start-Up Checklist

Prior to start-up, review your measurement needs and configure the PULSAR 4 Advanced to match your requirements. The PULSAR 4 functions as three pyrometers in one box, offering a variety of measurement options. In order to get the most out of this instrument, you should become familiar with all of its functions and configuration parameters prior to commissioning. Please read through Section 5.7 and the parameter configuration tables in Appendix A.

If the configuration options are too overwhelming in the beginning, use the factory default settings to get started and monitor the results, then turn on FMA mode (PULSAR 4 Advanced only) and monitor the results. Proceed in more detail as time permits.

---

**Warning:** At no time should the cover be removed unless the power is switched off first. When it is necessary to service the instrument with the power applied, ensure that proper safe environmental conditions exist and that such maintenance is authorized and pursuant to safe conditions.

5.1.1 Getting Started

1. Ensure that the sight-path is clear.
2. Check that the optics is properly focused (See Section 3.3.2.1).
3. Connect the power as described in Section 4, Electrical Installation. Allow at least 10 minutes warm-up before proceeding.
4. Aim the PULSAR 4 at the object or process to be measured. Observe the output of the PULSAR 4 on the temperature display or with an amp meter connected in series with the 4-20 mA terminals.

If the output does not appear to match the actual temperature, then an emissivity adjustment is necessary. Use the BUP-10 (See Section 5.5) to obtain the proper emissivity calibration temperature. Adjust the emissivity over the push buttons or via the digital communication interface (software InfraWin 5 until the PULSAR 4 reads the correct temperature (see Section 5.3, Emissivity Adjustment for more information).

5. Check for positive air flow and pressure to air connections if installed.
6. Verify the temperature of PULSAR 4 housing is not above 60 °C.

5.2 Two Spectral Ranges

The PULSAR 4 Advanced continuously measures two of three selections of spectral ranges.

1. The GT measures the hot gas temperature in its field of view.
2. The RT measures the refractory, checker wall or tube sheet temperatures in its field of view.
3. FF is an average temperature extracted from the GT and RT channels.

Each channel output must be assigned to a temperature measurement function. This is done by selecting one of the output assignment configuration modes. See Section 5.7.1.7 for details.
5.3 Emissivity Adjustment and FMA mode

The PULSAR 4 may require an emissivity adjustment (field calibration) to the furnace’s full operating conditions. This is especially important with the introduction of $O_2$ enrichment and varying gas stocks to the process. The digital emissivity adjustment is accessible using the digital communications.

Field calibration is possible by measuring the furnace temperature under normal operating conditions using LumaSense’s BUP-10. However, the preferred method is to activate FMA mode using default aLP setting of 0.15 before attempting to adjust GT channel emissivity to match a thermocouple (PULSAR 4 Advanced only). Be aware that a sheathed thermocouple inserted into a gas stream will usually read lower than the actual gas/flame temperature due to thermal conduction down the t/c sheath. The K-type thermocouple has a 1370 °C temperature limit. The FMA mode will provide better performance than an emissivity calibration of the GT channel with FMA turned off. Try activating FMA mode and monitor results using default settings prior to attempting an emissivity calibration using external t/c probes. The GT is typically left at the factory setting of 1.000 emissivity.

The BUP-10 consists of a sacrificial K-type thermocouple inserted through the Backup Probe (BUP) adapter mounted in place of the viewport (VP-10) in the Swing-Out Fixture (SOF-8). The recommended procedure for this measurement can be found in Section 5.5. The combustion temperature of the infrared instrument and the thermocouple (T/C) are then compared. In some cases the PULSAR 4 may read differently from the T/C. To compensate for this temperature difference, the emissivity value can be changed to make the two temperatures agree in Standard mode. If in FMA mode, both the aLP and emr parameters may be changed. (See Section 5.7.2). Once the emissivity (or aLP) is set, the PULSAR 4 will accurately track temperatures in the furnace. Introduction or removal of major furnace gas constituents may require a readjustment of the emissivity (or aLP).

The RT spectral range can only be field calibrated with a dedicated refractory thermocouple installed in close proximity to where the PULSAR 4 is viewing the opposite refractory wall. Alter the RT channel emissivity to match the thermocouple. Otherwise it is recommended that the factory setting of the RT remain at 1.000 emissivity.

The FF spectral range requires the thermocouple calibration to the process.

For more information on the Smart FMA Mode, refer to Section 2.5.

5.4 Setpoint Adjustment (Alarms)

Setpoint temperatures can be configured using the digital communication. Refer to Section 5.7, Parameter Descriptions and Instrument Settings.

The factory default setpoint for each alarm output is 2000 °C. The contacts are rated 30 VDC at 1 A maximum.

Do not attempt to switch 115 VAC or 230 VAC with these relays!

The LED indicates that the relay is in alarm condition. These are non-latching alarms and will reset when the process temperature falls below the setpoint minus hysteresis (High-alarm) / setpoint plus hysteresis (Lo-alarm). (See Section 5.7.1.9 Alarm Contacts).
5.5 Operation of Backup Probe (BUP-10) Assembly (For FF Measurement Only)

Caution: Always wear gloves when performing the following operation; the equipment may be very hot. Perform this operation under a fresh air supply and comply with all local safety requirements.

Refer to Figure 14 when performing the following steps:

1. Prepare the Backup Probe Assembly for your installation by doing the following:
   a. Compute the length of (T/C) to be inserted through the BUP. Measure the distance from the packing gland (C) to the outside surface of the reactor shell. Add to it the shell thickness (usually a half to one inch) plus the thickness of the refractory (usually 20 to 30 cm); then add 15 cm (k) for the distance the T/C should project beyond the inner surface of the refractory.
   b. Lay out this total distance on the thermocouple, beginning at the measuring tip and make a mark on the T/C sheath (near the connecting wire end).
   c. The probe stop must be installed. Insert the T/C into the assembly and install the probe stop. Set the probe stop to 6 inches from the measuring tip end of the T/C. The stopper is used to prevent accidental withdrawal of the T/C from the packing gland (C) prior to closing the main valve (G). Failure to install this stop could result in hazardous gas leakage if the T/C is accidentally pulled all the way out of the packing gland!
2. Loosen the wing nuts on the SOF-8 and swing the infrared thermometer out of the line of path.

3. Close the valve (G).

4. Turn off the instrument air purge (F). Ensure there is no “T” connection between combustion air in (H) and instrument air in (F). A line connecting (F) and (H) would bypass the valve and allow combustion gases to vent out when the viewport is removed.

5. Disconnect the instrument airline to ensure that there is no pressure between the valve (G) and the viewport (E).

6. Check for leakage of combustion gases. Ensure that the gases cannot leak past the valve seat and out through the instrument air in port (F).

7. If no flow is detected through port (F), remove the viewport Model VP-10 and unscrew the entire assembly with a large pipe wrench if necessary. Be careful not to lose or damage the O-ring.

8. Screw the Backup Probe Assembly Model BUP-10 into the seat where the Viewport Assembly was removed. Check the condition of the O-ring before installing the BUP. The same O-ring is required with the BUP.

9. Push the T/C that was previously installed in the BUP-10 Assembly until the T/C stops against the closed valve. Back away from the valve about an inch and tighten the packing gland by hand until it is snug.

10. Reconnect the air purge line (F) and open the instrument air valve. Ensure that the pressure in the air purge line is greater than in the reactor. Purge air should be felt discharging around the sheath of the T/C at the packing gland.

11. Open the main valve (G) slowly while ensuring that combustion gases are not discharging around the sheath at the packing gland. If combustion gas is detected, close the main valve (G) immediately.

12. Insert the T/C into the reactor until the previously measured mark just disappears into the packing gland.

13. Observe the T/C output until the reading plateaus and changes less than 5° in 15 seconds. This is considered a steady state and will be a representative temperature of the combustion process.

14. After successful measurement, loosen the packing gland nut sufficiently to withdraw the T/C. Withdraw the T/C until the main valve (G) can be closed.

15. Close the main valve (G).

16. Turn off the instrument air (F) to the Swing-Away Fixture (SOF) and remove the instrument air fitting to ensure ambient pressure in the adapter cavity.

17. Unscrew the BUP Assembly and T/C and remove from the SOF.

18. Replace the cleaned Viewport Assembly, ensuring that the O-ring is in good condition.

19. Reconnect the instrument airline (F) and apply instrument air pressure.

20. Open the main valve (G) and check the system for any leaks.

21. Swing the infrared thermometer back into alignment and observe the temperature reading of the IR thermometer. The IR reading and the T/C reading should agree to within the accumulated accuracy of the two instruments. If not, adjust the emissivity on
GT channel, if in Standard operating mode, or adjust the alp, if in FMA mode, as described in Section 5.3.

5.6 Operation of the Clean-Out Probe (COP-10) Assembly

**Caution:** Always wear gloves when performing the following operation; the equipment may be very hot. Perform this operation under a fresh air supply and comply with all local safety requirements.

**Figure 13: Clean Out Probe Assembly**

Refer to Figure 16 when performing the following steps:

1. Prepare the COP-10 for use:
   a. Remove the small probe end (B) from the ram rod and put it through the Probe Adapter Assembly (D).
   b. Reinstall the probe end onto the rod.
   c. Tighten the Packing Gland until it is snug and the COP-10 will slide into the packing gland.

2. Swing the infrared thermometer out of the line of path.
3. Close the valve (G).
4. Turn off the instrument air purge (F). Ensure that there is no “T” connection between combustion air in (H) and instrument air in (F). A line connecting (F) and (H) would bypass the valve and allow combustion gases to vent out when the viewport is removed.
5. Disconnect the instrument airline to ensure that there is no pressure between the valve (G) and the viewport.

6. Check for leakage of combustion gases. Ensure that the gases are not leaking past the valve seat and out through the instrument air in the port (F).

7. If no flow is detected through the port (F), remove the viewport Model VP-10 and unscrew the entire assembly with a large pipe wrench if necessary. **Be careful not to lose or damage the O-ring.**

8. Screw the Clean-Out Probe Assembly Model COP-10 into the seat where the Viewport Assembly was removed. Check the condition of the O-ring before installing the COP-10. The same O-ring is required with the COP-10.

9. Reconnect the air purge line (F) and open the instrument air valve. Ensure the pressure in the air purge line is greater than in the reactor. Purge air should be felt discharging around the sheath of the COP-10 at the packing gland.

10. Open the main valve (G) slowly while ensuring that combustion gases are not discharging around the sheath at the packing gland. If combustion gas is detected, close the main valve (G) **immediately.**

11. Insert the COP-10 into the reactor pushing any debris out of the way.

12. Withdraw the COP-10 until the main valve (G) can be closed.

13. Close the main valve (G).

14. Turn off the instrument air (F) to the Swing-Away Fixture (SOF) and remove the instrument air fitting to ensure ambient pressure in the adapter cavity.

15. Unscrew the BUP Assembly and COP-10 and remove from the SOF.

16. Reinstall the larger Probe end (B) and repeat steps 3-15.

17. Replace the cleaned Viewport Assembly, ensuring that the O-ring is in good condition.

18. Reconnect the instrument airline (F) and apply instrument air pressure.

19. Open the main valve (G) and check for any leaks.

20. Swing the infrared thermometer back into alignment and look through the PULSAR 4 sighting optics to ensure that there is a clear sight path for measuring reactor temperatures. There should be no obstructions within the target reticule. If there are, repeat the entire clean-out process until the sight path is clear.

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**IMPORTANT:** As with all optical temperature sensors, the sight path is part of the primary measurement loop. It is important that this path remain clear. This includes the condition of the viewport. An obstruction in the sight path or a dirty viewport will influence the operation of the PULSAR 4 and cause erroneous measurements.

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### 5.7 Parameter Descriptions and Instrument Settings

All parameters are adjustable via the serial interface/software. The parameters for display mode, emissivity, transmittance, output assignment, FMA mode (PULSAR 4 Advanced only), Alpha (PULSAR 4 Advanced only) are also adjustable via integrated push buttons on the front panel.

The digital interface allows you to exchange data either by using the supplied software InfraWin 5 or by using the Universal Pyrometer Protocol (UPP) commands with your own communication program (see section 6.1.1 for the UPP Data Format commands).
After connecting the pyrometer to the power supply, the display shows one of the measuring temperatures (RT, GT, or FF, factory setting: Refractory temperature). For PULSAR 4 Advanced, this setting is independent from the setting of the analog outputs.

5.7.1 Global Parameters
Global parameters affect the PULSAR 4 as a whole, not mode dependent.

5.7.1.1 Temperature Display
This selects the mode that is shown on the display. The three-color LED shows the selected (displayed) mode.

Settings:
- RT (red): Refractory temperature measurement
- GT (blue): Gas temperature measurement
- FF (green): Average temperature measurement
- Alternating all 3 temperatures every 5 sec (PULSAR 4 Advanced Only)

PULSAR 4: Display shows temperature assigned to corresponding output mode.
Default: RT (red): Refractory temperature measurement.

5.7.1.2 Temperature Units
The temperature can be displayed in °C or °F.
The two-color LED shows the current setting.

Settings:
- °C (red) / °F (blue)

Default: °C (red).

5.7.1.3 Transmittance
Transmittance is a parameter that can compensate for signal loss due to external windows etc. For example, if the emissivity of the material is 0.6 and the transmittance of an additional window is 0.9, then the product would be 0.54 which is well inside the allowed range.
The product of transmittance and emissivity must not be less than 10%.

Settings:
- 10% to 100%

Default:
- 100%

5.7.1.4 Flame Measurement Algorithm FMA (PULSAR 4 Advanced only)
This turns the FMA mode on or off. When in off mode, the PULSAR 4 Advanced operates in its Standard mode. When in on mode, it is operating in FMA mode, which uses a unique and proprietary algorithm to infer flame or hot gas temperatures with more accuracy and less cross-talk between channels. (See Section 2.5, Smart FMA Mode.) This mode was developed for enhanced performance in SRU applications and it is highly recommended that it be used.

When in FMA mode, t90 will always force RT and GT to equal the highest t90 value that is set on either channel (t90 values cannot be different when in FMA mode).

Settings:
- ON, OFF

Default:
- OFF
5.7.1.5 Address

If you are connecting several pyrometers with RS485 to one serial interface, it is necessary to give each instrument an individual address for communication. If multiple PULSAR 4’s are connected, each PULSAR 4 is treated as a separate instrument. After all instruments are assigned different addresses, they can be connected to the bus structure.

Parameters can be simultaneously changed on all pyrometers, by using the Global Address 98. Using Global Address 98 allows you to program all pyrometers at the same time, regardless of the addresses that has already been assigned to each device. Commands with address 98 get no answer.

If the address of a pyrometer is unknown, it is possible to communicate with it using the Global Address 99. However, make sure you only have one pyrometer connected to the interface in this case.

Settings: 00 to 97
Default: 00

5.7.1.6 Baud Rate

The transmission rate of the serial interface in Baud (Bd) depends on the length of the cable. A standard cable length for 19200 baud with RS485 is 2 km. The baud rate should be reduced to 50% if the transmission distance is doubled.

Settings: 1.20, 2.40, 4.80, 9.60, 19.2, 38.4, 57.6, 115.2 kBd
Default: 19.2 kBd

5.7.1.7 Wait Time

When using the pyrometer with a serial interface, it is possible that the interface may not be fast enough to receive the pyrometer’s answer after an instruction from the master. In this case, a wait time can be set to slow down the data transfer (e.g.: tw = 02 at a baud rate 9600 means a wait time of 2/9600 s). Each type of interface (See Section 4.8.2.14, Serial Interface) may be assigned its own wait time value. This parameter can only be changed by a direct UPP command (”Test” button in InfraWin’s parameter window, then use “tw” command (see chapter 6.1.2).

Settings: 0 to 99
Default: 10

5.7.1.8 Analog Output Function Assignment

Each output must be assigned to a temperature measurement (RT, GT, FF) function. This is done by selecting the desired output assignment configuration.

Function assignment is possible via the push buttons (see 5.8 Parameter „Adjustment and Output Assignment with Push Buttons“) or with the InfraWin 5 software (see 5.10 „Parameter settings using InfraWin 5 Software“).

For PULSAR 4 both analog outputs are identical.

The configuration of the analog output is possible with the software INFRAWIN 5. The device allows you to determine if a failure signal generates a low signal (3.5 mA) or a high signal (21.5 mA).

The following errors generate a failure signal:

- Device temperature out of range (0...60°C) or error when reading or writing data to the EEPROM.
For the PULSAR 4, the output assignment also affects the display and alarm assignments.

### 5.7.1.9 Alarm Contacts

The instrument has two programmable switch-over type alarm relays (form C) providing dry contacts for a high or low temperature alarm. The contact relays are rated 1 A resistive at 30 VDC maximum.

Attention: Do not attempt to switch 115 VAC or 230 VAC with these relays!

**Settings:** 350 to 2000 °C  
**Default:** 2000 °C  

#### Configuration of the alarms

With the InfraWin 5 software, the alarm contacts can be configured separately.

**Settings:** Deactivated  
**Alarm if temperature** > switch point (Hi-alarm)  
**Alarm if temperature** < switch point (Lo-alarm)  

**Default:** Lo-alarm

The relay contacts are shown for temperature above switch point  
(Mode: Hi-alarm, LED is on), or with no power supply.

### Assigning the alarms to the measured temperature for PULSAR 4 Advanced

Each alarm contact can be assigned to a measured temperature (RT, GT, FF) via the push buttons, the InfraWin 5 software.

For PULSAR 4 both alarm 1 and alarm 2 are always effective to the selected (analog output assignment) mode (RT, GT or FF).

### 5.7.1.10 Hysteresis (HYS)

Hysteresis is used to avoid contact noise from the relay at the switch-point. The relay will change state when:

**Mode: Lo-Alarm:**

- for falling temperatures relay changes state under switch-point (alarm and LED on)
- for rising temperature relay changes state above switch-point plus Hysteresis value (alarm off)
- for example: switch point 500 °C, Hysteresis 20 °C
- for rising temperatures the relay changes state at 520 °C (LED turn off)
for falling temperatures the relay changes state at 500 °C (LED turn on)

Mode: Hi-Alarm

for falling temperatures relay changes state under switch-point minus hysteresis (alarm off)
for rising temperature relay changes state above switch-point (alarm and LED on)
for example: switch point 500 °C, Hysteresis 20 °C
for rising temperatures the relay changes state at 500 °C (LED turn on)
for falling temperatures the relay changes state at 480 °C (LED turn off)

Settings: 0 to 1650 °C
Default: 20 °C

5.7.1.11 Analog Output Test

This parameter can only be activated by a direct UPP command (“Test” button in InfraWin’s parameter window, then use “at1” command (see chapter 6.1.2). This diagnostic command generates a 12 mA current on both analog outputs, which is used to check if a connected external indicator shows the correct temperature value. The display will flash, showing the corresponding temperature. For example, if a measuring range of 650 °C to 1800 °C is selected, the temperature shown in the display will be 1225 °C. This temperature must be identical to an external indicator (within 1° typically) which is supplied by the respective current. If this is not the case, the selected analog input current span of the indicator is not equivalent to the chosen current output span of the pyrometer and one of the current spans or temperature ranges has to be modified. After the check of the external display, you have to de-activate the test current mode. (Press the “Test” button in InfraWin’s parameter window, then use the “at0” command)

5.7.1.12 Internal Temperature

The internal temperature of the PULSAR 4 can be read through the PC interface using the InfraWin 5 software (select Internal temperature for the parameter “Graph2”) or by using the UPP Data format commands (see chapter 6.1.2). It is a few degrees higher than the ambient temperature due to the heat generated by the electronics.

5.7.2 Individual Parameters for RT, GT and FF

5.7.2.1 Emissivity Setting

For a correct measurement it is necessary to adjust the emissivity. Emissivity (emission coefficient) is the relationship between the emission of a real object and the emission of a black body radiation source (an object which absorbs all incoming rays and has an emissivity of 100%) at the same temperature. Different materials have different emissivity, ranging between nearly 0% and 100% (settings at the pyrometer between 10 and 100%). Materials with reflective surfaces or transparent materials have a lower emissivity, and the emissivity setting of the pyrometer needs to be adjusted accordingly. In most furnace SRU applications, the emissivity should be set at 1.000 (100%).
The product of transmittance and emissivity must not be less than 10%.

Settings: 10% to 100%
Default: 100%
5.7.2.2 Alpha (Pulsar 4 Advanced only)

In FMA Mode the emissivity for GT is replaced by Alpha. This parameter represents the quality of the flame in %, which is the product of absorption, length and pressure. Lower values represent more transparency. Raising this value will decrease the GT channel output when in FMA mode, and decreasing the value will raise the output.

Settings: “Alpha” (must be in FMA mode, active only on GT-channel)

Settings: 5 to 100%
Default: 15%

5.7.2.3 Response Time

The response time is the time (in seconds) when the reading after a step change on the measured temperature reaches 90% of the final value. Also known as “input filter” on process instruments. In the “Min” position, the device operates using the time constant defined in the specification.

Settings: Min, 0.5 s, 1.00 s, 2.00 s, 5.00 s, 10.0 s, 30.0 s, 60.0 s, 90.0 s, 120 s.
Default: “Min” is in Standard mode 0.05 s, in FMA mode 0.5 s.

When in FMA mode, t90 will always force RT and GT to equal the highest t90 value that is set on either channel (t90 cannot be different when in FMA mode).

5.7.2.4 Subrange (LO)

You may alter the PULSAR 4 temperature range within the basic measuring range of the pyrometer. This subrange sets the temperatures for the analog output beginning and end. The beginning temperature of the subrange corresponds to 4 mA. Subranges do not have to match for each mode. They may be set differently.

Settings: 350 to 1949 °C
Default: 350 °C
Limitations: minimum span 51 °C

5.7.2.5 Subrange (HI)

You may alter the PULSAR 4 temperature range within the basic measuring range of the pyrometer. This subrange sets the temperatures for the analog output beginning and end. The end temperature of the subrange corresponds to 20 mA.

Settings: 401 to 2000 °C
Default: 2000 °C
Limitations: minimum span 51 °C
5.8 PULSAR 4 (not PULSAR 4 Advanced)

Parameter Adjustment and Output Assignment with Push Buttons

- Changing a parameter is only possible if keyboard is not locked.
- If the keyboard is locked, “LOCK” appears on the display if a button is pressed.
- Unlock via Lock/Unlock button in InfraWin “parameter” window.
5.8.1 Change Measuring Mode

Both analog outputs correspond to the displayed measuring temperature RT, GT or FF.
1. Press the **Out** button and hold down. 

   **On/RT mode**

   LEDs Out 1 and Out 2 are “on”
   - In this example, the mode is set to RT with a temperature of 456 °C
   - The mode LED is “red” to indicate RT mode
   - Output 1 and Output 2, correspond to the RT temperature.

2. Press the **Mode / Save** button (while holding the **Out** button down) to switch the display mode between RT, GT, and FF.

   **On/GT mode**

   LEDs Out 1 and Out 2 are “on”
   - In this example, the mode changes to GT with a temperature of 567 °C
   - The mode LED is “blue” to indicate GT mode
   - Output 1 and Output 2, changes to corresponding GT temperature and will be stored.

   **On/FF mode**

   LEDs Out 1 and Out 2 are “on”
   - In this example, the mode changes to FF with a temperature of 511 °C
   - The mode LED is “green” to indicate FF mode
   - Output 1 and Output 2, changes to corresponding FF temperature and will be stored.

3. Press the **Mode / Save** button again and you will return to the RT mode.

4. Release the **Out** button to exit this mode and turn both LEDs off.
5.8.2 Adjustment of emissivity or transmission

The following example shows how to adjust the emissivity value for the selected mode.

**RT mode**

Display: RT – temperature: 456 °C
LED for unit °C/°F is “red”
1. Press \( \text{↑} \) or \( \text{↓} \) and release to show the current emissivity for the selected mode temperature (e.g. “RT”) (without change).

**Example:**
Display: **Emissivity 0.985 for RT** – temperature
LED for unit “C/°F is “off”
Mode LED is flashing “red”

2. Press \( \text{↑} \) or \( \text{↓} \) again to increase or decrease the emissivity value for the selected mode temperature.

**Note:** The value changes more quickly the longer the button is held. If the parameter was changed, the display will be pulsating. After pressing the **Mode / Save** button, the value is accepted (stored) and the display changes to the temperature for the selected measuring mode.

If the new value is not stored with the **Mode / Save** button 30 seconds after the last pressing of a button, the display changes to the temperature without storing the emissivity changes.

**To set values for other modes:**
For GT, use the **Mode / Save** button to adjust the emissivity as in Steps 1 and 2 above.

It is also possible to change the Emi of a non-selected measuring mode or transmission value:

Press \( \text{↑} \) or \( \text{↓} \) and release to show the current Emi value (without change).

**To change between Emi RT, Emi GT and Transmission:**

Press \( \text{↑} \) and \( \text{↓} \) at the same time.

For Emi RT:   “Mode” Led flashing red
For Emi GT:   “Mode” Led flashing blue
For Transmission:  “Mode” Led flashing white

**Note:** The FMA button has no function in the PULSAR 4 (without the Advanced option). Also, in the PULSAR 4 version (without the Advanced option) the **Mode / Save** button works only in its **Save** function.
5.9 PULSAR 4 Advanced

Parameter adjustment and output assignment with push buttons

- Changing a parameter is only possible if keyboard is not locked.
- If the keyboard is locked, “LOCK” appears on the display if a button is pressed.
- Unlock via Lock/Unlock button in InfraWin “parameter” window.
5.9.1 Adjust Display Mode
(outputs remain unaffected)

Press the **Mode** button to switch the display mode between RT, GT, and FF.

Display: **RT** (default) – temperature: 456 °C
Mode LED “red”
Press **Mode / Save** button to change display mode to GT

![GT Mode](image)

Display changes to GT – temperature: 567 °C
Mode LED “blue”

Press **Mode / Save** button to change display mode to FF

![FF Mode](image)

Display changes to FF – temperature: 511 °C
Mode LED “green”

**Note:** When you press the **Mode / Save** button, the display changes to the alternating Mode. The Mode LED flashes red, blue, green. Then every 5 seconds, the display changes between RT, GT, and FF.

**5.9.2 Show Output Assignment**

The following example shows the default ex-works settings.

Press the **Out** button to see the output to which the mode is assigned. When pressed, the **Out** button will toggle the output LED between **Out1** and **Out2**.

**LED Out 1 is “on”**
- In this example, the Display is set to RT with a temperature of 456 °C
- Out 1 corresponds to the RT temperature.

Press the **Out** button again to switch to **Out 2**.

**LED Out 2 is “on”**
- In this example, the Display is changed to GT with a temperature of 567 °C
- Out 2 corresponds to the GT temperature.
Press the **Out** button again or wait 30 seconds for the “Out2” LED to turn off.

### 5.9.3 Change Output Assignment (Modify Out)

The following example shows how to modify the corresponding temperature output assignment for each mode.

#### 5.9.3.1 Out 1 Adjustments

1. Press and hold down the **Out** button.

   **LED Out 1 “on”**
   - In this example, the Display is set to RT with a temperature of 456 °C
   - The mode LED is “red” to indicate it is in RT mode
   - Out 1 corresponds to the RT temperature.
2. Press the **Out** button and hold down while pressing the **Mode** button to switch the display and Out1 mode between RT, GT, and FF.

**LED Out 1 “on”**
- In this example, the Display changes to GT with a temperature of 567 °C
- The mode LED is “blue” to indicate it is in GT mode
- Out 1 assignment changes to correspond with the GT temperature and will be stored.

**LED Out 1 “on”**
- In this example, the Display changes to FF with a temperature of 511 °C
- The mode LED is “green” to indicate it is in FF mode
- Out 1 assignment changes to correspond with the FF temperature and will be stored.

3. Release the **Out** button to exit the assignment mode of Out 1.

### 5.9.3.2 Out 2 Adjustments

1. Press and hold down the **Out** button.

**LED Out 2 “on”**
- In this example, the Display is set to GT with a temperature of 567 °C
- The mode LED is “blue” to indicate it is in GT mode
- Out 2 corresponds to the GT temperature.

2. Additionally, press **Mode / Save** button and change the output assignment of Out 2 in the same way as described in section 5.10.3.1 for output 1.

3. Press the **Out** button or wait 30 seconds after the last change, for both LEDs to turn off and the adjusted display mode to become active.
5.9.4 Adjustment of emissivity or transmission

The following example shows how to adjust the emissivity value for the selected mode.

The following example shows how to adjust the emissivity value for the selected mode.
2. Press \( \text{\textdagger}\) or \( \text{\textdaggerdbl}\) and release to show the current emissivity for the selected mode temperature (e.g. “RT”) (without change).

Example: Display: Emissivity 0.985 for RT – temperature
LED for unit °C/°F is “off”
Mode LED is flashing “red”

3. Press \( \text{\textdagger}\) or \( \text{\textdaggerdbl}\) again to increase or decrease the emissivity value for the selected mode temperature.

Note: The value changes more quickly the longer the button is held. If the parameter was changed, the display will be pulsating. After pressing the Mode / Save button, the value is accepted (stored) and the display changes to the temperature for the selected measuring mode.

If the new value is not stored with the Mode / Save button 30 seconds after the last pressing of a button, the display changes to the temperature without storing the emissivity changes.

To set values for other modes:
For GT, use the Mode / Save button to adjust the emissivity as in Steps 1 and 2 above.

It is also possible to change the Emi of a non-selected measuring mode or transmission value:

In normal operating mode, press \( \text{\textdagger}\) or \( \text{\textdaggerdbl}\) and release to show the current Emi value (without change).

To change between Emi RT, Emi GT and Transmission:
Press \( \text{\textdagger}\) and \( \text{\textdaggerdbl}\) at the same time.

For Emi RT: “Mode” Led flashing red
For Emi GT: “Mode” Led flashing blue
For Transmission: “Mode” Led flashing white

Emi RT ↔ Emi GT ↔ Transmission
5.9.5 Setting the FMA Mode

The following example shows how to switch on the FMA Mode.

To switch FMA mode on or off:
Press the FMA Button to enable FMA mode

Or,
Press the FMA button again to disable FMA mode.

Note: The FMA mode affects all three displays and output temperatures.

Note: Pressing the Mode / Save button changes the display between RT/FMA, GT/FMA, and FF/FMA.

Note: The default output setting in FMA mode is Out 1: RT / FMA mode; Out 2: GT / FMA mode
5.9.6 Adjustment of emissivity / Alpha in “FMA” mode:

**Note:** Adjusting the emissivity for RT and FF mode are the same as in standard mode. Factory setting: Alpha = 0150; Emissivity = 1000

The following example shows how to adjust the Alpha value for the GT temperature.

1. Press ▲ or ▼ and release to show the current Alpha value for the GT / FMA temperature (without change)

- **Example:**
  - Mode LED “blue”
  - LED FMA “on”
  - LED for unit °C/°F is “red”
  - Display: **GT / FMA** – temperature: 945 °C

2. Press ▲ or ▼ again to increase or decrease the Alpha value.

- **Example:**
  - Mode LED flashing “blue”
  - Display: Alpha value for GT / FMA – temperature: 0150
  - LED Alpha “on”
  - LED for unit °C/°F is “off”

**Note:** After pressing the Mode / Save button, the value is accepted (stored) and the display changes to the GT / FMA temperature.

If the value is not stored within 30 seconds after the last change (or is not saved by pressing the Mode / Save button) then the display will change to the GT temperature without storing the Alpha changes.

**Note:** It is also possible to change Emi RT / FMA, Alpha GT / FMA, and Transmission in the same display mode.
To change between Emi RT, Alpha GT and Transmission:

Press Ṫ and Ṫ at the same time.

For Emi RT: “Mode” Led flashing red
For Emi GT: “Mode” Led flashing blue
For Transmission: “Mode” Led flashing white

5.10 Parameter settings using InfraWin 5 Software

The InfraWin 5 operating and analyzing software is included in the delivery package of your PULSAR 4. With this software, the PC can be used for all pyrometer functions. The latest version is available for free as download from the homepage http://www.lumasenseinc.com/EN/products/infrared-thermometers-and-switches/pyrometer-accessories/software/infrawin.html

This section provides an overview of the InfraWin software functions for program version 5. Additional information can also be found in the program’s help menu.

To access the online help functions:

- Press the F1 button after InfraWin has been loaded
  Or
- Select the “?” in the menu bar.

5.10.1 Installing InfraWin

To install the InfraWin Software Program:

1. Select the setup program “setup.exe” from the InfraWin Software CD or by using the downloaded and unpacked zip file from the internet.

2. Follow the on-screen installation instructions.

Once the program has been installed, you will be prompted to select a language option. The InfraWin software is available in German, English, French, Italian, and Spanish.

After you have selected your preferred language, the software will open with the following menus.
All preset values can be displayed and modified if necessary through the “Devices/Parameters” menu. The pyrometer parameters screen contains all parameter settings as described in section 5.7 of this manual.

Choose the correct settings for your application from the displayed options.

### 5.10.2 Measuring Mode

#### 5.10.2.1 PULSAR 4 Advanced

With the RT (background color red), GT (background color blue) or FF (background color green) tab, you can select the measuring mode for adjusting the corresponding parameters, separately for each mode:
5.10.2.2 PULSAR 4

Alarm 1 and Alarm 2, out 1 and out 2 and display are assigned to the measuring mode.

5.10.3 FMA Mode (PULSAR 4 Advanced only):

If the FMA-mode is on, the emissivity for GT changes into the adjustment of the Alpha value.

The $t_{90}$ will always force RT and GT to equal the highest $t_{90}$ value that is set on either channel ($t_{90}$ cannot be different when in FMA mode)
5.10.4 Alarm Configuration for Alarm1 and Alarm2  
(PULSAR 4 Advanced and PULSAR 4)

Each Alarm can be configured independently from each other as “High alarm”, “Low alarm” or “Off”.

5.10.5 Alarm Assignment

5.10.5.1 PULSAR 4 Advanced

Assigning the alarm contacts to a measuring temperature RT, GT or FF:
5.10.5.2 PULSAR 4

For PULSAR 4, Alarm 1 and Alarm 2 are always assigned to the same measuring temperature:

5.10.6 Adjustment of Switch Point and Hysteresis for Alarm1 and Alarm2:
5.10.7 Output Assignment

5.10.7.1 PULSAR 4 Advanced

Assigning the outputs to a measuring temperature RT, GT or FF.

5.10.7.2 PULSAR 4

For PULSAR 4, both outputs are always identical.
5.10.8 Display Assignment

5.10.8.1 PULSAR 4 Advanced

Display assignment to a measuring temperature RT, GT, FF or alternating mode:

5.10.8.2 PULSAR 4

For PULSAR 4, no display assignment is possible.

5.10.9 Graph Assignment

5.10.9.1 PULSAR 4 Advanced

Assigning the Graph1 for the online measuring to a measuring temperature RT, GT or FF and Graph2 to RT, GT, FF, the internal temperature of the PULSAR 4, or None:
5.10.9.2 PULSAR 4

For PULSAR 4, only the internal temperature can be selected for Graph 2:

5.10.10 Inhibit Keyboard
5.10.11 Analog Output Assignment

Analog output assignment to 4…20 mA, 4…20 mA (NAMUR Lo) or 4…20 mA (NAMUR Hi)
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6 Digital Communications

6.1 RS485

The PULSAR 4 has an array of remote commands available via RS485 communication port. This instrument is compatible with LumaSense InfraWin 5 communication software (included with your PULSAR 4). A description of the protocol is shown below for those who wish to do their own programming.

6.1.1 Data Format Universal Pyrometer Protocol (UPP)

The data exchange occurs in ASCII format.

The interface settings of the instrument are defined to be 8 data bit, one stop bit, even parity (8,1,e).

Each command sequence is composed of a 2-character address, followed by 2 or 3-character command ID (two letters, three letters or one letter and one digit), zero or more parameters, and a trailing carriage return (no line feed).

The device responds to the entry of a command with: output (e.g. the measuring value) + CR (Carriage Return, ASCII 13), and to pure entry commands with "ok" + CR.

Example: Entry: “00emr”+ <CR>

The emissivity setting (c) of the refractory temperature of the device with the address 00 is returned:

Answer: “0970”+ <CR> (meaning Emissivity = 0.97 or 97.0%)

6.1.2 Commands Supported by the PULSAR 4:

<table>
<thead>
<tr>
<th>Command</th>
<th>Format</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ananlog output</td>
<td>AAas</td>
<td><strong>Read</strong></td>
</tr>
<tr>
<td></td>
<td>AAasX</td>
<td><strong>Set</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>X = 1 4...20 mA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X = 8 4...20 mA NAMUR Lo</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X = 9 4...20 mA NAMUR Hi</td>
</tr>
<tr>
<td>Analog output Test</td>
<td>AAat</td>
<td><strong>Read</strong></td>
</tr>
<tr>
<td>(for refractory, gas and FF)</td>
<td>AAatx</td>
<td><strong>Set</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>X = 0...1</td>
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<tr>
<td></td>
<td></td>
<td>0 = off</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 = on (12 mA)</td>
</tr>
<tr>
<td>Product number</td>
<td>AAbn</td>
<td><strong>Read</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>X XXXXXX (hex 6-digit)</td>
</tr>
<tr>
<td>Parameter</td>
<td>AAbr</td>
<td>AAbRX</td>
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<td>--------------------------------</td>
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</tr>
<tr>
<td>AAemr</td>
<td>AAemg</td>
<td>AAmrXXXX</td>
</tr>
<tr>
<td>Emissivity r=refractory</td>
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<td>g=gas</td>
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<tr>
<td>Transmittance</td>
<td>AAet</td>
<td>AAetXXXX</td>
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<td>°C / °F</td>
<td>AAfh</td>
<td>AAfhX</td>
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<tr>
<td>Alpha divisor (PULSAR 4 Advanced Only)</td>
<td>AAalp</td>
<td>AAalpXXXX</td>
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<tr>
<td></td>
<td>AAald</td>
<td>AAaldXXXX</td>
</tr>
<tr>
<td>Response time t&lt;sub&gt;r&lt;/sub&gt;</td>
<td>AAezr</td>
<td>AAezrX</td>
</tr>
<tr>
<td>r=refractory</td>
<td>AAezg</td>
<td>AAezgX</td>
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<td></td>
<td>AAezf</td>
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<td>f=gas</td>
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<tr>
<td>Error status</td>
<td>AAfs</td>
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<tr>
<td>Device address</td>
<td>AAga</td>
<td>AAgaXX</td>
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<tr>
<td>Feature Description</td>
<td>Command</td>
<td>Description</td>
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<tr>
<td>-----------------------------------------------------------------------------------</td>
<td>-----------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Internal temperature</td>
<td>AAgT</td>
<td>XXX (dec)</td>
</tr>
<tr>
<td>Set temperature sub-range</td>
<td>AAm1r</td>
<td>XXXXYYYYYYY (hex, 8-char) XXXX = beginning of temp. range YYYYY = end of temp. range</td>
</tr>
<tr>
<td>r=refractory</td>
<td>YYYY</td>
<td></td>
</tr>
<tr>
<td>g=gas</td>
<td>AAm1g</td>
<td></td>
</tr>
<tr>
<td>f=FF</td>
<td>YYYY</td>
<td></td>
</tr>
<tr>
<td>f=FF</td>
<td>AAm1f</td>
<td></td>
</tr>
<tr>
<td>Read temperature sub-range</td>
<td>AAm1r</td>
<td>XXXXYYYYYYY (hex, 8-char) XXXX = beginning of temp. range YYYYY = end of temp. range</td>
</tr>
<tr>
<td>r=refractory</td>
<td>YYYY</td>
<td></td>
</tr>
<tr>
<td>g=gas</td>
<td>AAm1g</td>
<td></td>
</tr>
<tr>
<td>f=FF</td>
<td>YYYY</td>
<td></td>
</tr>
<tr>
<td>Read full instrument temperature range</td>
<td>AAm1f</td>
<td>XXXXYYYYYYY (hex, 8-char) XXXX = beginning of temp. range YYYYY = end of temp. range</td>
</tr>
<tr>
<td>Read temperature value (PULSAR 4 Only)</td>
<td>AAms</td>
<td>XXXXX (dec, in 0.1° resolution)</td>
</tr>
<tr>
<td>Read temperature value (PULSAR 4 Advanced Only)</td>
<td>AAmsr</td>
<td>XXXXX (dec, in 0.1° (resolution)</td>
</tr>
<tr>
<td>r=refractory</td>
<td>YYYY</td>
<td></td>
</tr>
<tr>
<td>g=gas</td>
<td>AAmeg</td>
<td></td>
</tr>
<tr>
<td>f=FF</td>
<td>YYYY</td>
<td></td>
</tr>
<tr>
<td>Read temperature value (PULSAR 4 Advanced Only)</td>
<td>AAmsf</td>
<td>XXXXX (dec, in 0.1° (resolution)</td>
</tr>
<tr>
<td>a=all</td>
<td>YYYY</td>
<td></td>
</tr>
<tr>
<td>FMA mode OFF/ON (PULSAR 4 Advanced Only)</td>
<td>AAru</td>
<td>XXX = 000 = OFF XXX = 001 = ON</td>
</tr>
<tr>
<td>Alarm Setpoint - Temperature at which alarm relay 1 will change state.</td>
<td>AAs1</td>
<td>XXXX (hex, 4-char) Must be within sub-range and matching temperature units.</td>
</tr>
<tr>
<td>Alarm Setpoint - Temperature at which alarm relay 2 will change state.</td>
<td>AAs2</td>
<td>XXXX (hex, 4-char) Must be within sub-range and matching temperature units.</td>
</tr>
<tr>
<td>Alarm Hysteresis for alarm 1</td>
<td>AAh1</td>
<td>XXXX (hex, 4-char) 0...0672, corresponding to 0...1650 °C</td>
</tr>
<tr>
<td>Alarm Hysteresis for alarm 2</td>
<td>AAh2</td>
<td>XXXX (hex, 4-char) 0...0672, corresponding to 0...1650 °C</td>
</tr>
<tr>
<td>Configuration Alarm 1</td>
<td>AAt1</td>
<td>X=0...2 0 = no alarm 1 = alarm if temp &gt; setp.1 (Hi-alarm) 2 = alarm if temp &lt; setp.1 (LO-alarm)</td>
</tr>
<tr>
<td>Configuration Alarm 2</td>
<td>AAt2</td>
<td>X=0...2 0 = no alarm</td>
</tr>
<tr>
<td>Feature</td>
<td>Code 1</td>
<td>Code 2</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>--------</td>
<td>---------</td>
</tr>
<tr>
<td><strong>Alarm assignment</strong></td>
<td>AAaa</td>
<td>AAAaXXXX</td>
</tr>
<tr>
<td>(PULSAR 4 Advanced Only)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 = alarm if temp &gt; setp.2 (Hi-alarm)</td>
<td>XXXX</td>
<td>0011 RT RT</td>
</tr>
<tr>
<td>2 = alarm if temp &lt; setp.2 (LO-alarm)</td>
<td>XXXX</td>
<td>0021 GT RT (Advanced Only)</td>
</tr>
<tr>
<td></td>
<td>XXXX</td>
<td>0031 FF RT (Advanced Only)</td>
</tr>
<tr>
<td></td>
<td>XXXX</td>
<td>0012 RT GT (Advanced Only)</td>
</tr>
<tr>
<td></td>
<td>XXXX</td>
<td>0022 GT GT</td>
</tr>
<tr>
<td></td>
<td>XXXX</td>
<td>0032 FF GT (Advanced Only)</td>
</tr>
<tr>
<td></td>
<td>XXXX</td>
<td>0013 RT FF (Advanced Only)</td>
</tr>
<tr>
<td></td>
<td>XXXX</td>
<td>0023 GT FF (Advanced Only)</td>
</tr>
<tr>
<td></td>
<td>XXXX</td>
<td>0033 FF FF</td>
</tr>
<tr>
<td><strong>Channel assignment</strong></td>
<td>AAca</td>
<td>AAcaXXXX</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 = refractory temperature (RT)</td>
<td>XXXX</td>
<td>0011 RT RT</td>
</tr>
<tr>
<td>2 = gas temperature (GT)</td>
<td>XXXX</td>
<td>0021 GT RT (Advanced Only)</td>
</tr>
<tr>
<td>3 = FF temperature (FF)</td>
<td>XXXX</td>
<td>0031 FF RT (Advanced Only)</td>
</tr>
<tr>
<td></td>
<td>XXXX</td>
<td>0012 RT GT (Advanced Only)</td>
</tr>
<tr>
<td></td>
<td>XXXX</td>
<td>0022 GT GT</td>
</tr>
<tr>
<td></td>
<td>XXXX</td>
<td>0032 FF GT (Advanced Only)</td>
</tr>
<tr>
<td></td>
<td>XXXX</td>
<td>0013 RT FF (Advanced Only)</td>
</tr>
<tr>
<td></td>
<td>XXXX</td>
<td>0023 GT FF (Advanced Only)</td>
</tr>
<tr>
<td></td>
<td>XXXX</td>
<td>0033 FF FF</td>
</tr>
<tr>
<td><strong>Display assignment</strong></td>
<td>AAa</td>
<td>AAdaX</td>
</tr>
<tr>
<td>(PULSAR 4 Advanced Only)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>X = 0...3</td>
<td>XX</td>
<td>00 to 99</td>
</tr>
<tr>
<td>0 = alternating all 3 temperatures every 5 sec. (PULSAR 4 Advanced only)</td>
<td>XX</td>
<td>00 to 99</td>
</tr>
<tr>
<td>1 = refractory temperature (RT)</td>
<td>XX</td>
<td>00 to 99</td>
</tr>
<tr>
<td>2 = gas temperature (GT)</td>
<td>XX</td>
<td>00 to 99</td>
</tr>
<tr>
<td>3 = FF temperature (FF)</td>
<td>XX</td>
<td>00 to 99</td>
</tr>
<tr>
<td><strong>Serial number</strong></td>
<td>AAa</td>
<td>XXXXX (dec, 5-digits)</td>
</tr>
<tr>
<td><strong>Max. internal temperature</strong></td>
<td>AAa</td>
<td>XXX (dec, 3-digits)</td>
</tr>
<tr>
<td><strong>Wait time</strong></td>
<td>AAa</td>
<td>XXXXXXX (dec, 6-digits)</td>
</tr>
<tr>
<td>(see Note 1)</td>
<td>AAa</td>
<td>XX = 00 to 99</td>
</tr>
<tr>
<td>(dec, 2-digits)</td>
<td>AAa</td>
<td>XX = 00 to 99</td>
</tr>
<tr>
<td><strong>Operating hours</strong></td>
<td>AAa</td>
<td>XXXXXXX (dec, 6-digits)</td>
</tr>
<tr>
<td><strong>Device type</strong></td>
<td>AAa</td>
<td>Output: “PULSAR 4 Adv.” (16 ASCII characters) or “PULSAR 4” (16 ASCII characters)</td>
</tr>
<tr>
<td><strong>Reset</strong></td>
<td>AAa</td>
<td></td>
</tr>
<tr>
<td><strong>Device type / software version</strong></td>
<td>AAa</td>
<td>XXYZZZ (dec, 6-digits)</td>
</tr>
<tr>
<td></td>
<td>AAa</td>
<td>XX = 84 (PULSAR 4 Advanced)</td>
</tr>
<tr>
<td></td>
<td>AAa</td>
<td>xx = 88 (PULSAR 4)</td>
</tr>
</tbody>
</table>
|                           |       |       | \( YY = \text{Firmware month} \\
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th>( ZZ = \text{Firmware year} )</th>
</tr>
</thead>
</table>
| Lock keyboard             | AAlk  | AAlkx | \( X = 0 \ldots 3 \)  \\
|                           |       |       | \( 0 = \text{removal of lock lk1} \)  \\
|                           |       |       | \( 1 = \text{lock lk1, removal with command lk0 or power off-on} \)  \\
|                           |       |       | \( 2 = \text{removal of lock lk3} \)  \\
|                           |       |       | \( 3 = \text{continuous lock lk3, removal only with command lk2} \) |
| Communication Module/     | AAvc  |       | \( \text{tt.mm.yy XX.YY} \)  \\
| software version in      |       |       | \( \text{tt} = \text{day; mm = month; yy = year} \)  \\
| detail                   |       |       | \( XX.YY = \text{software version} \) |
| Measurement Module/      | AAvs  |       | \( \text{tt.mm.yy XX.YY(14 ASCII characters)} \)  \\
| Software version in      |       |       | \( \text{tt} = \text{day; mm = month} \)  \\
| detail                   |       |       | \( yy = \text{year} \)  \\
|                           |       |       | \( XX.YY = \text{software version} \) |

**Additional Instructions for the RS485 Interface:**

**Requirements of the master system during half-duplex operation:**

1. Wait-time from the reception of a valid command to the beginning of the answer. This time is specified in bit-times of the selected baud rate and is a minimum. The actual time needed may be longer depending on the processing time for the answer string.

2. If there is no response, there is a parity or syntax error and the inquiry has to be repeated.
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7 Troubleshooting

7.1 Problem Isolation Checkout Procedure
This section outlines what to do if the PULSAR 4 is not working after the initial installation. The following procedures should be performed before calling the factory.

7.1.1 Optical Alignment and Focus
The PULSAR 4 measures the temperature of the area inside the round reticule seen through the eyepiece. Check that the reticule is actually centered on the desired target. To check the focus, move your eye back and forth across the eyepiece and verify that the target and the reticule in the eyepiece do not move relative to each other. Move the lens in or out to correct the focus.

7.1.2 Clear Sight Path and Clean Optics
Ensure that the PULSAR 4 is aligned properly by looking into the eye-piece. The round reticule in the center of the field of view should be sighting at the target. Look for any blockage in the sight path that would reduce the energy received by the PULSAR 4.

Without a clear optical path, the radiation from the target cannot reach the detector. If the viewport assembly, front window assembly, or lens becomes smeared, smudged or otherwise dirty, attenuation of the signal will occur, resulting in abnormally low readings. Check the viewport, front window, or lens by removing it and looking through it towards a light source.

Rarely will cleaning the internal optics be necessary. The lens should be cleaned whenever it becomes dirty. The frequency of this operation will depend on the environment.

Note: Important! As with all optical temperature sensors, the sight path is part of the primary measurement loop. It is important that this path remain clear. This includes the condition of the viewport. An obstruction in the sight path or a dirty viewport will influence the operation of the PULSAR 4 and cause erroneous measurements.

Warning: Refer to Drawing 3 909 073 found in Appendix C, for the proper assembly method. Look for dirt or heavy smudges.

7.1.3 Power Fuse
Check that fuse for 24 VDC power supply (1 AT) is not open. Remove the fuse from its holder and test with an ohmmeter.

Check that fuse for 5 VAC transformer output (1.6 AT) is not open. Remove the fuse from its holder and test with an ohmmeter.

Check fuse for 115/230 VAC power supply (1.25 AT) is not open. Remove the fuse from its holder and test with an ohmmeter.
7.1.4 Low-End Temperature Reading

Swing the PULSAR 4 away, so that it is no longer looking into the reactor. Check the low-end temperature reading on the display. This is the bottom-end temperature of the unit minus one degree. A flashlight (non-LED type) may be used to functionally test the PULSAR 4. Aim the flashlight into the PULSAR 4 optics. The display should show some temperature above the beginning of the range.

7.1.5 Check Instrument Loops

Check the temperature display or recorder when in “Test Mode” to ensure that the signal is being transmitted and makes it to the control room display.

7.1.6 Broken Wire Harness

If the instrument appears to be working correctly, but the recording or control attachments are not receiving the proper signals, the problem may be due to a broken wire in the interconnecting cables. Use a field mA calibrator or ohm meter to check for continuity of all wiring.

7.1.7 Component Failure

Inspection and quality control procedures assure the highest standards of component reliability. However, electronic components do fail randomly and may cause your instrument to function improperly.

Changing components in the field may require your unit to be recalibrated by the factory. Replacement of PC board components other than fuses is strongly discouraged and may compound the problem.

Although it is not recommended, you can perform a recalibration procedure using the following laboratory equipment:

a. A standard instrument repair shop with the usual electronic diagnostic tools, such as scopes, voltmeters, power supplies and frequency generators.

b. A blackbody standard radiator source traceable to DIN/VDE 3511 Part 4.4, covering the temperature range from 350 °C to 2000 °C.

c. An optical alignment bench with variable aperture and a constant temperature infrared source.

d. A computer capable of communicating with the instrument using the LumaSense software.

The factory will assist with detailed calibration procedures and procurement of necessary equipment should the client wish to establish infrared thermometer calibration capability.
8 Maintenance

8.1 General Maintenance

- Refer to Section 9, Safety Assurances and Precautions, before beginning any maintenance.
- The PULSAR 4 is designed so that the instrument does not have to be returned to the factory for periodic recalibration if traceability according VDI/VDE 3511 Part 4.4 is not required.
- Repairs that can be performed without affecting instrument performance include replacement of MOV components, heater assemblies, switches, interconnecting cables, connectors, eyepiece, and lens and Front Window Assembly.
- Components in the “calibration” system may not be replaced.
- Any damage to the instrument affecting the optical alignment or critical electronic components usually requires the instrument to be returned to the factory for repair. The turnaround time including shipping from an international client is 4 to 6 weeks.
- It is recommended that a spare or backup unit be procured during the acquisition of your original equipment if the PULSAR 4 is to be used in a critical control installation.
- Only the Electro-Optical Package is required as a spare unit.

Warning: Hazardous Location Safety Minder. At no time should the cover be removed unless power is switched off first. When it is necessary to service instrument with the power applied, ensure that proper safe environmental conditions exist and that such maintenance is authorized and pursuant to safe conditions.

8.2 Cleaning the Optics

The optics of the PULSAR 4 consists of a lens, an eyepiece, and a specially coated front surface mirror mounted on a special bracket. These components are located within the Electro-Optical Package and will remain clean under normal conditions, provided that the enclosure remains sealed at all times with O-rings in place. LumaSense does not recommend cleaning the optics other than the objective lens. A complete cleaning requires disassembly of the optical train and will destroy the alignment and calibration.

To clean the objective lens, remove the Electro-Optical Package from the Explosion-Proof Enclosure. Use facial tissue dipped in rubbing alcohol (Isopropyl 70%). If it is especially dirty, use a lens cleaning solution and lens cleaning wipes available at camera stores. Press softly or the lens may become loose or dislodged. Blow off lint, and then replace the Electro-Optical Package in the Explosion-Proof Enclosure.
8.3 Cleaning or Changing the Viewport Window (VP 10)

1. Close ball valve.
2. Loosen the swing-out wing nut lock on the SOF-8 and rotate it out of the slot.
3. Swing the sensor assembly sufficiently to have clear access to the viewport. Turn off the air purge and disconnect the line to bleed pressure (See Appendix C).
4. Check for combustion gas leak.
5. Unscrew the viewport assembly counterclockwise. Three-inch flats have been provided for a wrench. Do not damage or lose the O ring.
6. Remove the viewport and clean with a soft cloth. Alcohol, water or solvents may be used if applied carefully. Do not soak: damage to the O rings may result. If the window is scratched or cracked, re-place it. Toothpaste may be used to clean stubborn dirt on windows. Thoroughly wash with water afterwards.
7. Replace O-rings in their seat; substitute a new O-ring if the old one is damaged.
8. Screw the viewport back in place clockwise. Tighten with a wrench to 6 ft. lbs.
9. Swing the sensor assembly back to locked position.
10. Rotate the wing nut into the slot and tighten finger tight.
11. Reconnect the purge line.
12. Turn on the air purge.
13. Open the ball valve.
14. Verify that the air purge flow is at least 10.7 Nm3/h.
15. Check for leaks. If a leak is detected, close the ball valve immediately.

---

**Warning: Hazardous Location Safety Minder.** At no time should the cover be removed unless power is switched off first. When it is necessary to service instrument with the power applied ensure that proper safe environmental conditions exist and that such maintenance is authorized and pursuant to safe conditions.
8.4 Replacing a Window in the Viewport Assembly VP-10

1. Remove the viewport assembly from the Swing-Out fixture according to steps 1 to 5 in Section 7.3.
2. Remove 4 Allen Head 3/16" screws from the retaining cover.
3. Separate the retaining cover from the rest of the assembly.
4. Remove the window. (Pyrex for FF and RT units.)
5. Replace any damaged O-rings.
6. Install the new window.
7. Replace the retaining cover.
8. Install the 4 Allen Head 3/16" screws. Tighten to 6 ft. lbs.
9. Replace the VP-10 in swing-out fixture according to steps 7 to 15 in Section 8.3.

8.5 Calibration: Traceability to VDI/VDE 3511 Part 4.4

All LumaSense infrared thermometers are calibrated to blackbody radiation standards traceable to the VDI/VDE 3511 Part 4.4. Our calibration standards are recalibrated each year to ensure we maintain our equipment traceable to the Institute. Although our pyrometers are of the finest quality, they are subject to electrical and mechanical wear which may cause performance variation over time. LumaSense recommends yearly recalibration.
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9 Safety Assurances and Precautions

9.1 Hazardous Environment Safety

The PULSAR 4 enclosure is designed to hold an explosion inside the housing and release the hot gases slowly enough to allow them to cool to the point where they will not ignite the explosive gases outside the housing. It is important to take care of the mating surfaces between the housing and its lid. It is also important to torque the lid bolts to specification.

Factory inspection, assembly, and test procedures are strictly followed to ensure the highest quality, integrity and functionality of the Explosion Proof housing. Use care when reassembling to maintain gasket and surface integrity. Deep scratches or gouges could allow gases to be released at excessively high temperatures during an explosion.

- When servicing the instrument, ensure that power is disconnected or switched off. Allow the instrument 20 minutes to cool down prior to opening.
- When connecting electrical wiring to the circuit board, ensure wires are properly secured to prevent accidental shorting or a hazardous live condition in the event that screws loosen.
- Check and secure the Safety Ground connections just prior to lid closure.
- When attaching the utility conduit, ensure that at least five threads are engaged and that appropriate seal fittings and practices are followed in accordance to local and manufacturer’s Explosion Proof practices.
- When replacing the top cover, the sixteen M8 x 1.25 socket head screws must be torqued to specification (5.5Nm).
- When air is used, verify positive air flow and pressure to air connections. See Appendix A for ratings.
- Ensure that the surface temperature of the Explosion Proof housing does not exceed 60 °C. If this condition occurs, cooling may be required.
- Take note of all hazardous classifications. See Appendix B, Area Classifications and Protection Concepts, for more information.

9.1.1.1 Conditions of Use:
1. Contact manufacturer for flamepath joint design information.
2. The cable glands, cable sealing device or blanking plugs for the unused entries (as applicable) shall be suitably certified with a minimum Ex gas rating of Ex d IIB+H2 Ta = -40 °C to 60 °C Gb.
3. In order to maintain an IP65 rating for the equipment, the cable glands shall be suitably certified with a minimum rating of IP65.
4. To reduce the risk due to electrostatic discharge, the user shall regularly clean the enclosures with a damp cloth to limit dust layers on the enclosure sides.
5. The socket head screws used on the enclosure shall be stainless steel screws grade A4-70; M8 Socket Head Cap / Allen Screws with minimum yield strength 800 MPa.
Note: N2 purging of the housing is not required to maintain the Explosion Proof rating.

9.2 Electrical Service Protection

9.2.1 Over-Current Protection / Service Switch
It may be necessary to incorporate an external over-current protection device appropriate to the instrument's service and to include a disconnect switch located near the instrument. The service disconnect should be clearly marked as pertaining to this instrument.

9.2.2 Over-Voltage Protection
Maximum applied voltage must not exceed the following limits:
- 253 VAC for Terminal Block "POWER IN 115/230VAC"
- 30 VDC for Terminal Block "POWER IN 24VDC"

9.2.3 Transient Protection
Transients must not exceed 2.5 kV between any terminal or any terminal and GND. The electronics provide some protection against transient as per EN61326-1 EMC Immunity. However, if higher transients are expected, it is recommended that transient protection devices be included as part of service installation.

9.2.4 Wiring
Confirm service type and check that Service markings correspond to expectations. When wiring, follow local code regulations. Secure power input lines together after connection to the terminal block to prevent an accidental hazardous live condition in the event a terminal screw becomes loose. Sleeve or tie wrapping is acceptable. Check to ensure that power is not accidentally connected to the low voltage I/O terminal block.

See Section 4, Electrical Installation, for power service installation details.

9.2.5 Protective Ground Connection
Connect the protective Earth conductor as instructed in Section 4, Electrical Installation. The Earth Ground connection is located on the inside surface of housing denoted by the symbol shown left.
### 9.3 Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>PULSAR 4</th>
<th>PULSAR 4 Advanced</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature Range:</td>
<td>350 ... 2000 °C (662 ... 3632°F)</td>
<td></td>
</tr>
<tr>
<td>Measurement uncertainty:</td>
<td>+0.3% of Reading or 3 °C +1 Digit, whichever is greater</td>
<td></td>
</tr>
<tr>
<td>Repeatability:</td>
<td>(ε = 1, t90 = 1 s, Tamb. = 25°C)</td>
<td>0.1% of full scale span</td>
</tr>
<tr>
<td>Response Time t90:</td>
<td>Programmable from 0.05 to 120 sec.</td>
<td>Programmable from 0.05 to 120 sec. When FMA mode is on 0.5 to 120 sec.</td>
</tr>
<tr>
<td>Analog Outputs:</td>
<td>2 identical analog outputs 4 ... 20 mA, linear,</td>
<td>2 analog outputs 4 ... 20 mA, linear, Outputs can be assigned to RT, GT or FF</td>
</tr>
<tr>
<td></td>
<td>Select one of RT, GT or FF Corresponding to NAMUR NE43</td>
<td>Corresponding to NAMUR NE43</td>
</tr>
<tr>
<td>Digital Interfaces:</td>
<td>RS485 addressable (half-duplex)</td>
<td></td>
</tr>
<tr>
<td>Load</td>
<td>0 ... 600 Ω (mA output)</td>
<td></td>
</tr>
<tr>
<td>Relay Alarm:</td>
<td>30 VDC / 1A max.; Resistive; Configuration of alarm:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>no alarm</td>
<td></td>
</tr>
<tr>
<td></td>
<td>alarm, if temperature &gt; setpoint</td>
<td></td>
</tr>
<tr>
<td>Emissivity Adjustment</td>
<td>0.100 ... 1.000 digital on both channels when in Standard mode</td>
<td></td>
</tr>
<tr>
<td>Transmittance Adjustment</td>
<td>0.100 ... 1.000 digital on both channels when in Standard mode</td>
<td></td>
</tr>
<tr>
<td>Alpha Adjustment:</td>
<td>N/A</td>
<td>0.050 to 1.000 on GT channel (when in FMA mode)</td>
</tr>
<tr>
<td>Focusing Range:</td>
<td>500 mm to infinity</td>
<td></td>
</tr>
<tr>
<td>Target Size:</td>
<td>160:1 Standard Resolution (distance / target size)</td>
<td></td>
</tr>
<tr>
<td>Power Supply:</td>
<td>24 VDC (18 ... 30 VDC), 0.2 A maximum; 3.5 A with heater</td>
<td>115 VAC ± 10%; 47 ... 63 Hz; 230 VAC ± 10%; 47 ... 63 Hz</td>
</tr>
<tr>
<td>Power Consumption:</td>
<td>Max. 90 W (with heater)</td>
<td></td>
</tr>
<tr>
<td>Fusing:</td>
<td>(F1) 1.6 AT Littelfuse 215 Series, 5×20 mm, Time-Lag (Slo-Blo®) Fuse</td>
<td>(F2) 1.25 AT Littelfuse 215 Series, 5×20 mm, Time-Lag (Slo-Blo®) Fuse</td>
</tr>
<tr>
<td></td>
<td>(F3) 1.0 AT Littelfuse 215 Series, 5×20 mm, Time-Lag (Slo-Blo®) Fuse</td>
<td></td>
</tr>
</tbody>
</table>
### Ambient Temperature Limits:

-40 ... +60 °C with no cooling and using internal heater to +80 °C with vortex air cooler (optional) with 7 bar source to +93 °C with cooling base and 38 l/h water flow at 15 °C (the water cooling method can accommodate higher ambient temperature by increasing flow rate; consult factory)

### Hazardous Classification:

#### Conditions of Use:
1. Contact manufacturer for flamepath joint design information.
2. The cable glands, cable sealing device or blanking plugs for the unused entries (as applicable) shall be suitably certified with a minimum Ex gas rating of Ex d IIB+H2 Ta = -40 °C to 60 °C Gb.
3. In order to maintain an IP65 rating for the equipment, the cable glands shall be suitably certified with a minimum rating of IP65.
4. To reduce the risk due to electrostatic discharge, the user shall regularly clean the enclosures with a damp cloth to limit dust layers on the enclosure sides.
5. The socket head screws used on the enclosure shall be stainless steel screws grade A4-70; M8 Socket Head Cap / Allen Screws with minimum yield strength 800 MPa.

### Torque Spec, Lid Bolts:

<table>
<thead>
<tr>
<th>Torque Spec, Lid Bolts:</th>
<th>5.5 Nm</th>
</tr>
</thead>
</table>

### Air

- View port purge: 1.4 bar min., 1.7 m³/h (@ standard conditions)
- Combustion purge: 1.4 bar min., 17 m³/h (@ standard conditions)

### Cooling

- WATER: 38 l/h at 15 °C
- AIR: Vortex, V208-15-H, 17 m³/h (@ standard conditions)
- Reference manufacturer data for pressure specs.

### Weight

22 Kg with Explosion Proof housing

### Dimensions

306 x 276 x 210 mm (l x w x h)
(with Explosion Proof housing)
<table>
<thead>
<tr>
<th>Channels</th>
<th>PULSAR 4</th>
<th>PULSAR 4 Advanced</th>
<th>Manual Settings</th>
<th>Software adjustable features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel function</td>
<td>Field Selectable</td>
<td>Field Selectable</td>
<td>Yes</td>
<td>Channels selection set thru Software</td>
</tr>
<tr>
<td>FF Temperature Range</td>
<td>350 to 2000 °C</td>
<td>350 to 2000 °C</td>
<td>No</td>
<td>Subrange set thru software</td>
</tr>
<tr>
<td>RT Temperature Range</td>
<td>350 to 2000 °C</td>
<td>350 to 2000 °C</td>
<td>No</td>
<td>Subrange set thru software</td>
</tr>
<tr>
<td>GT Temperature Range</td>
<td>350 to 2000 °C</td>
<td>350 to 2000 °C</td>
<td>No</td>
<td>Subrange set thru software</td>
</tr>
<tr>
<td>Emisivity</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Set thru software</td>
</tr>
<tr>
<td>Alpha (in FMA mode for GT channel) (PULSAR 4 Advanced Only)</td>
<td>N/A</td>
<td>Yes</td>
<td>Yes</td>
<td>Set thru software</td>
</tr>
</tbody>
</table>

**Analog Output**

| Channel Assignment | Field Selectable | Field Selectable | Yes | Set thru software |
| mA output | Two | Two | Set Output | Set thru software |

**Setpoint Relays**

<p>| Number of Relays | Two | Two | N/A | Assigned thru software |
| Relay 1 | Yes | Yes | No | Set thru software |
| Relay 2 | Yes | Yes | No | Set thru software |</p>
<table>
<thead>
<tr>
<th>Digital Communications</th>
<th>PULSAR 4</th>
<th>PULSAR 4 Advanced</th>
<th>Manual Settings</th>
<th>Software adjustable features</th>
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<tbody>
<tr>
<td>RS485</td>
<td>Yes</td>
<td>Yes</td>
<td>N/A</td>
<td>N/A</td>
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<tr>
<td>InfraWin Software</td>
<td>Yes</td>
<td>Yes</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>FMA Algorithm (PULSAR 4 Advanced Only)</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Set thru software</td>
</tr>
<tr>
<td>Wavelengths</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GT Gas (Flame)</td>
<td>One field setable</td>
<td>Two field setable</td>
<td>Yes</td>
<td>Set thru software</td>
</tr>
<tr>
<td>RT Refractory FF Average Integrated</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power Requirements</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24VDC</td>
<td>Yes</td>
<td>Yes</td>
<td>N/A</td>
<td>N/A</td>
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<td>115VAC</td>
<td>Yes</td>
<td>Yes</td>
<td>N/A</td>
<td>N/A</td>
</tr>
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<td>230VAC</td>
<td>Yes</td>
<td>Yes</td>
<td>N/A</td>
<td>N/A</td>
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9.4 Reference numbers pyrometer

3 909 010  PULSAR 4 Advanced
3 909 020  PULSAR 4
3 909 030  PULSAR 4 Advanced Backup
3 909 040  PULSAR 4 Backup

9.5 Reference numbers accessories

0 006 581  O ring EXP LID PULSAR 4
3 909 114  Front window gasket for PULSAR 4
3 909 800  Fuse Set for PULSAR 4 (F1) 1.6 AT, (F2) 1.25 AT and (F3) 1 AT
6 882 010  BUP-10; Backup TC probe and adaptor
6 882 020  COP-10; 1 ea Model CRA Clean-Out-Ram Assy and Model PAPG Probe Adaptor w/Packing Gland
6 882 030  BUP-10/COP-10; Backup thermocouple probe clean-out probe and single adapter for PULSAR 4
6 882 040  CRA Cleanout Ram
6 882 180  VP10P; Viewport set VP10 with pyrex window
6 882 210  SOF-1; 2" 150lb RF swing away fixture, incl. VP-10P and mounting hardware kit
6 882 220  SOF-8; 3" 150/300lb RF swing away fixture, incl. VP-10P and mounting hardware kit
6 882 350  TC-72; Thermocouple K, 6'(182.88 cm); with stop clamp, 1/4" dia.; stainless sheath
6 882 370  SST; stainless steel tag
6 882 400  Vortec air cooler for EXP housing
6 882 450  O-Ring large for VP-10
6 882 460  O-Ring small for VP-10
6 882 730  Mounting Kit EXP to SOF-8
6 882 740  Mounting Kit EXP to SOF-1
### 9.6 Configuration of Parameters

#### 9.6.1 PULSAR 4 Configuration Table

<table>
<thead>
<tr>
<th>Unit Firmware =</th>
<th>Comm-modul: Meas-modul:</th>
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<tr>
<td>Unit Serial No. =</td>
<td></td>
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<tr>
<td>Date =</td>
<td></td>
</tr>
<tr>
<td>Tech =</td>
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### Factory Defaults

<table>
<thead>
<tr>
<th>Parameter</th>
<th>CH1</th>
<th>CH2</th>
<th>CH2</th>
<th>FMA=ON (PULSAR 4 Advanced Only)</th>
<th>FMA=OFF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Custom</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Emi**: 1.000
- **Trans**: 1.000
- **aLP**: ---
- **Display**: CH1 (Refractory temperature)
- **t₉₀**: 0.50
- **FMA**: OFF

### Custom Configuration for This Unit if Not Default

<table>
<thead>
<tr>
<th>Parameter</th>
<th>CH1</th>
<th>CH2</th>
<th>CH2</th>
<th>Custom</th>
<th>FMA=ON (PULSAR 4 Advanced Only)</th>
<th>FMA=OFF</th>
</tr>
</thead>
<tbody>
<tr>
<td>FMA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **mA Output**: RT (PULSAR 4 Advanced Only)
- **PULSAR 4: RT PULSAR 4 Advanced: GT

- **mA**: 4-20
- **LO**: 350 °C
- **HI**: 2000 °C
- **°C/°F**: °C
- **Alarm**: 2000 °C
- **HYS**: 20 °C
- **Alarm config.**: Lo-alarm
- **Adr**: 00
- **kBd**: 19200
- **tw**: 10

- **Boxes spanning 2 columns indicate that the value is the same whether FMA is on or off.**
- **Boxes spanning all 3 columns indicate global settings.**
- **When in FMA mode, **t₉₀** will always force Out1 and Out2 to equal the highest **t₉₀** value that is set on either channel. (**t₉₀** cannot be different when in FMA mode)**
### 9.6.2 PULSAR 4 Quick Configuration Reference

<table>
<thead>
<tr>
<th>Default Parameter Settings</th>
<th>Parameter Choices</th>
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</thead>
<tbody>
<tr>
<td><strong>Default</strong></td>
<td><strong>FMA=OFF</strong></td>
</tr>
<tr>
<td><strong>Parameter</strong></td>
<td>CH1</td>
</tr>
<tr>
<td>Emi</td>
<td>1.000</td>
</tr>
<tr>
<td>Trans</td>
<td>1.000</td>
</tr>
<tr>
<td>aLP</td>
<td>---</td>
</tr>
<tr>
<td>Display</td>
<td>CH1 (Refractory temperature)</td>
</tr>
<tr>
<td>t90</td>
<td>0.50</td>
</tr>
<tr>
<td>FMA</td>
<td>OFF</td>
</tr>
<tr>
<td>mA Output</td>
<td>RT (PULSAR 4 Advanced Only)</td>
</tr>
<tr>
<td>mA</td>
<td>4-20</td>
</tr>
<tr>
<td>LO</td>
<td>350 °C</td>
</tr>
<tr>
<td>HI</td>
<td>2000 °C</td>
</tr>
<tr>
<td>°C/°F</td>
<td>°C</td>
</tr>
<tr>
<td>Alarm</td>
<td>2000 °C</td>
</tr>
<tr>
<td>HYS</td>
<td>20 °C</td>
</tr>
<tr>
<td>Alarm config</td>
<td>Lo-alarm</td>
</tr>
<tr>
<td>Adr</td>
<td>00</td>
</tr>
<tr>
<td>kBd</td>
<td>19200</td>
</tr>
<tr>
<td>tw</td>
<td>10</td>
</tr>
</tbody>
</table>

- Boxes spanning 2 columns indicate that the value is the same whether FMA is on or off.
- Boxes spanning all 3 columns indicate global settings.
- When in FMA mode, t90 will always force Out1 and Out2 to equal the highest t90 value that is set on either channel. (t90 cannot be different when in FMA mode)
Appendix B: Area Classification/Protection Concepts

According to IEC/EN 60079-14.
To ensure consistent document formatting, this page was intentionally left blank.
## Appendix C: Engineering Drawings

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<th>Dwg.#</th>
<th>Description</th>
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<td>3 909 073</td>
<td>Mechanical Installation Diagram</td>
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<td>97</td>
<td>3 909 072</td>
<td>Service Connections</td>
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# Appendix D: Declaration of Conformity/ Certificates

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<tr>
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<tr>
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<td>IECEx Certificate of Conformity</td>
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<tr>
<td>103</td>
<td>FM14A TEX0004X EC-Type Examination Certificate</td>
</tr>
<tr>
<td>106</td>
<td>Certificate of Compliance – Hazardous (Classified) Location Electrical Equipment</td>
</tr>
<tr>
<td>108</td>
<td>Certificate of Compliance – Hazardous Location Electrical Equipment per Canadian Requirements</td>
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</table>
IECEx Certificate of Conformity

INTERNATIONAL ELECTROTECHNICAL COMMISSION
IEC Certification Scheme for Explosive Atmospheres
for rules and details of the IECEx Scheme visit www.iecex.com

Certificate No.: IECEx FME 14.0001X
Issue No.: 0
Certification history:
Issue No.: 0 (2014-06-25)

Status: Current
Page 1 of 3

Date of issue: 2014-06-25

Applicant: LumaSense Technologies GmbH
Kleyerstrasse 90, Frankfurt D-60326
Germany

Electrical Apparatus: Infrared Pyrometer PULSAR 4 & PULSAR 4 Advanced

Optional accessory:

Type of Protection: Flameproof 'd'

Marking: Ex d II B T6Ta -40°C to +60°C (Process Temperature Range 350°C to 2000°C) Gb IP65

Approved for issue on behalf of the IECEx Certification Body: Mick Gover

Position: Certification Manager

Signature: (for printed version)

Date:

1. This certificate and schedule may only be reproduced in full.
2. This certificate is not transferable and remains the property of the issuing body.
3. The Status and authenticity of this certificate may be verified by visiting the Official IECEx Website.

Certificate issued by:

FM Approvals Ltd
1 Windsor Dials
SL4 1RS Windsor
United Kingdom

FM Approvals®
Member of the FM Global Group.
IECEx Certificate of Conformity

Certificate No: IECEx FME 14.0001X

Date of Issue: 2014-06-25

Manufacturer: Lumasense Technologies GmbH
Kleyerstrasse 90, Frankfurt D-60326
Germany

Additional Manufacturing location(s):

This certificate is issued as verification that a sample(s), representative of production, was assessed and tested and found to comply with the IEC Standard list below and that the manufacturer's quality system, relating to the Ex products covered by this certificate, was assessed and found to comply with the IECEx Quality system requirements. This certificate is granted subject to the conditions as set out in IECEx Scheme Rules, IECEx 02 and Operational Documents as amended.

STANDARDS:
The electrical apparatus and any acceptable variations to it specified in the schedule of this certificate and the identified documents, was found to comply with the following standards:

IEC 60079-0 : 2011 Explosive atmospheres - Part 0: General requirements
Edition 6.0

Edition 6

This Certificate does not indicate compliance with electrical safety and performance requirements other than those expressly included in the Standards listed above.

TEST & ASSESSMENT REPORTS:
A sample(s) of the equipment listed has successfully met the examination and test requirements as recorded in

Test Report:
GB/FME/ExTR14.0001/00

Quality Assessment Report:
GB/FME/QAR14.0004/00
IECEx Certificate of Conformity

Certificate No: IECEx FME 14.0001X

Date of Issue: 2014-06-25

Schedule

EQUIPMENT:
Equipment and systems covered by this certificate are as follows:

3909010, Pulsar 4 Advanced Intra-Red Pyrometer
3909020, Pulsar 4 Intra-Red Pyrometer

CONDITIONS OF CERTIFICATION: YES as shown below:

1. Contact manufacturer for flamepath joint design information.
2. The cable glands, cable sealing device or blanking plugs for the unused entries (as applicable) shall be suitably certified with a minimum Ex rating of Ex d IIB+H2 T6 = -40 °C to 60 °C Gb.
3. In order to maintain an IP65 rating for the equipment, the cable glands shall be suitably certified with a minimum rating of IP65.
4. To reduce the risk due to electrostatic discharge, the user shall regularly clean the enclosures with a damp cloth to limit dust layers on the enclosure sides.
5. The socket head screws used on the enclosure shall be stainless steel screws grade A2 Stainless M8 Socket Head Cap / Allen Screws with minimum yield strength 800 MPa.
1. **EC-TYPE EXAMINATION CERTIFICATE**


3. EC-Type Examination Certificate No: FM14ATEX0004X

4. Equipment or protective system: 3909010, E’T Pulsar 4 Advanced Infra-Red Pyrometer
   (Type Reference and Name) 3909020, E’T Pulsar 4 Infra-Red Pyrometer

5. Name of Applicant: LumaSense Technologies GmbH

6. Address of Applicant: Kleyerstrasse 90, Frankfurt, D-60326, Germany

7. This equipment or protective system and any acceptable variation thereto is specified in the schedule to this certificate and documents therein referred to.

8. FM Approvals Ltd, notified body number 1725 in accordance with Article 9 of Directive 94/9/EC of 23 March 1994, certifies that this equipment has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of equipment intended for use in potentially explosive atmospheres given in Annex II to the Directive.

   The examination and test results are recorded in confidential report number: 3049884 dated 24th June 2014

9. Compliance with the Essential Health and Safety Requirements, with the exception of those identified in item 15 of the schedule to this certificate, has been assessed by compliance with the following documents:


10. If the sign 'X' is placed after the certificate number, it indicates that the equipment is subject to special conditions for safe use specified in the schedule to this certificate.

11. This EC-Type Examination certificate relates only to the design, examination and tests of the specified equipment or protective system in accordance to the directive 94/9/EC. Further requirements of the Directive apply to the manufacturing process and supply of this equipment or protective system. These are not covered by this certificate.

12. The marking of the equipment or protective system shall include:

    II 2 G Ex d II B+H2 T4 Gb Ta= -40°C to +60°C (Process Temperature Range 350°C to 2000°C) IP65

Mick Gower
Certification Manager, FM Approvals Ltd.

Issue date: 25th June 2014

THIS CERTIFICATE MAY ONLY BE REPRODUCED IN ITS ENTIRETY AND WITHOUT CHANGE

FM Approvals Ltd | Windsor Dials, Windsor, Berkshire, UK, SL4 1RS
T: +44 (0) 1753 750 000  F: +44 (0) 1753 868 700  E mail: info@fmapprovals.com,  www.fmapprovals.com
F ATEX 020 (May/12)
SCHEDULE

to EC-Type Examination Certificate No. FM14ATEX0004X

13 Description of Equipment or Protective System:
The Lumasense ET Pulsar 4 series of detection systems are designed for continuous and instantaneous measurement of Refractory Temperature (RT), Gas Temperature (GT) or Integrated Temperature (IT) in the vessel away from the heat, vibration and corrosive gases. Each system allows visual inspection of combustion processes, refractory cure out and preventative maintenance while the vessel is pressurized and fully operational. The Advanced model is used for monitoring complex processes, such as O₂ enrichment, which normally involve higher temperatures and demand close monitoring.

Operation Temperature Ranges:
The ambient operating temperature range of the Pulsar 4 range is -40°C to 60°C. Process temperature range is 350°C to 2000°C.

Electrical data:
The Pulsar 4 models can be configured as 24V dc, 115V ac or 230V ac, 90W.

14 Specific Conditions of Use:
1. Contact manufacturer for flamepath design information.
2. The cable glands, cable sealing device or blanking plugs for the unused entries (as applicable) shall be suitably certified with a minimum Ex gas rating of Exd IIIB+H2 Ta = -40°C to 60°C G2b.
3. In order to maintain an IP66 rating for the equipment, the cable glands shall be suitably certified with a minimum rating of IP65.
4. To reduce the risk due to electrostatic discharge, the user shall regularly clean the enclosures with a damp cloth to limit dust layers on the enclosure sides.
5. The socket head screws used on the enclosure shall be stainless steel screws grade A4-70; M8 Socket Head Cap / Allen Screws with minimum yield strength 800Mpa.

15 Essential Health and Safety Requirements:
The relevant EHSRs that have not been addressed by the standards listed in this certificate have been identified and assessed in the confidential report identified in item 8.

16 Test and Assessment Procedure and Conditions:
This EC-Type Examination Certificate is the result of testing of a sample of the product submitted, in accordance with the provisions of the relevant specific standard(s), and assessment of supporting documentation. It does not imply an assessment of the whole production.

Whilst this certificate may be used in support of a manufacturer’s claim for CE Marking, FM Approvals Ltd accepts no responsibility for the compliance of the equipment against all applicable Directives in all applications.

This Certificate has been issued in accordance with FM Approvals Ltd’s ATEX Certification Scheme.

17 Schedule Drawings
A list of the significant parts of the technical documentation is annexed to this certificate and a copy has been kept by the Notified Body.

18 Certificate History
Details of the supplements to this certificate are described below:

<table>
<thead>
<tr>
<th>Date</th>
<th>Description</th>
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<tr>
<td>28th June 2014</td>
<td>Original Issue.</td>
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THIS CERTIFICATE MAY ONLY BE REPRODUCED IN ITS ENTIRETY AND WITHOUT CHANGE
## Blueprint Report

**Lumasense Technologies GmbH (145373)**

**Class No** 3615  
**Original Project I.D.** 3649884  
**Certificate I.D.** FM14ATEX0004X

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<th>Last Report</th>
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<td>Pulsar 4 User Manual</td>
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25/06/2014
CERTIFICATE OF COMPLIANCE

HAZARDOUS (CLASSIFIED) LOCATION ELECTRICAL EQUIPMENT

This certificate is issued for the following equipment:

3909010, E²T Pulsar 4 Advanced Infra-Red Pyrometer
3909020, E²T Pulsar 4 Infra-Red Pyrometer
XP/I/1/BCD/T4  Ta = -40°C to 60°C; IP65

Equipment Ratings:

Explosionproof for Class I, Division 1, Groups B, C, and D hazardous (classified) locations, Temperature Code T4 for ambient temperature range Ta = -40°C to 60°C and ingress protection IP65.

FM Approved for:

LumaSense Technologies GmbH
Frankfurt, Germany

To verify the availability of the Approved product, please refer to www.approvalguide.com

FM Approvals HLC 513
3040884
Page 1 of 2
This certifies that the equipment described has been found to comply with the following Approval Standards and other documents:

- Class 3600 2011
- Class 3615 2006
- Class 3810 2005
- ANSI/IEEE 60529 2004

Original Project ID: 3049884  Approval Granted: June 24, 2014

Subsequent Revision Reports / Date Approval Amended

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<th>Date</th>
<th>Report Number</th>
<th>Date</th>
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FM Approvals LLC

J.E. Marquedant
Manager, Electrical Systems

24 June 2014
Date

To verify the availability of the Approved product, please refer to www.approvalguide.com
CERTIFICATE OF COMPLIANCE

HAZARDOUS LOCATION ELECTRICAL EQUIPMENT
PER CANADIAN REQUIREMENTS

This certificate is issued for the following equipment:

3909010, E²T Pulsar 4 Advanced Infra-Red Pyrometer
3909020, E²T Pulsar 4 Infra-Red Pyrometer
XP/I/1/BCD/T4  Ta = -40°C to 60°C; IP65

Equipment Ratings:

Explosionproof for Class I, Division 1, Groups B, C, and D hazardous locations, Temperature Code T4 for ambient temperature range Ta = -40°C to 60°C and ingress protection IP65.

FM Approved for:

LumaSense Technologies GmbH
Frankfurt, Germany

To verify the availability of the Approved product, please refer to www.approvalguide.com

FM Approvals H/LC 5/13
Page 1 of 2

To verify the availability of the Approved product, please refer to www.approvalguide.com

FM Approvals H/LC 5/13
This certifies that the equipment described has been found to comply with the following Approval Standards and other documents:

CSA C22.2 No. 0.4                  R2009  
CSA C22.2 No. 0.5                  R2008  
CSA C22.2 No. 30                   R2007  
CSA C22.2 No. 142                  R2009  
CAN/CSA C22.2 No. 60529            R2010  

Original Project ID: 3049884C  Approval Granted: June 24, 2014

Subsequent Revision Reports / Date Approval Amended

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FM Approvals LLC

[Signature]

Manager, Electrical Systems

24 June 2014  
Date

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