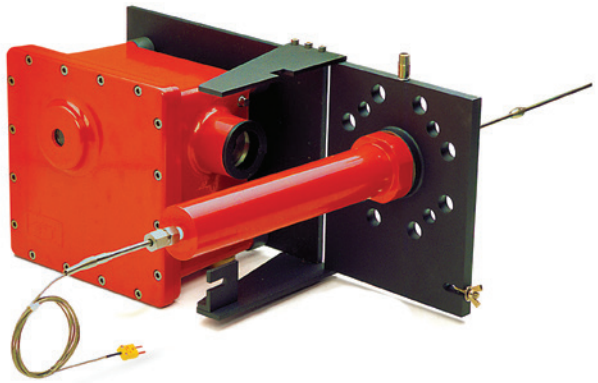
LUMASENSE® TECHNOLOGIES

Infrared Thermometry for Sulfur Reactors and Other High Temperature Furnaces

E²T PULSAR 4 / PULSAR 4 Advanced

- Single Channel Standard Model programmable for Gas or Refractory Measurement
- Two Channel Advanced Model with simultaneous Measurement of Refractory and Gas Temperatures
  - Separate channel anolog outputs and alarm relay set points
  - Instant or Average Readings
- Smart FMA™ Flame Measurement Algorithm (PULSAR 4 Advanced Only)
- Explosion-Proof Certification II 2G EX d IIB +H2 T4, IECEx, ATEX, FM (US and CDN) plus additional regional certifications
- Integrated power supply, capable of operating with 24 V DC/120/230 V AC
- RS485 Interface, HART protocol (PULSAR 4 Advanced Only)



LumaSense Technologies' new generation E²T PULSAR 4 combines continuous measurement of gas and refractory temperatures, reporting both readings simultaneously in one instrument.

Complex Processes

Optimal operation of Sulfur Recovery Unit (SRU), Sulphur Burner, and Thermal Oxidizer furnaces require accurate process Gas (Flame) measurement and accurate Refractory measurement for operational safety (high temperature alarms).

Of particular importance is control of the furnace process temperatures to prevent damage to the furnace refractory and assurance that reaction or destruction temperatures are reached and maintained.

The Problem

Thermocouple measurement of acid processes either fail prematurely or are protected by multiple thermo wells and sweep air systems that make thermal transmission to the actual thermocouple inaccurate or slow and only provides a refractory measurement not useful for process control.

Typical Single Channel Infrared pyrometers do not compensate for changing flame transparencies and only provide one wavelength measurement. Clients must settle for either a Gas (Flame) or Refractory measurement or make multiple installations requiring multiple ports and hardware installations.

Changing flame transparency is a common issue that affects typical infrared pyrometer measurements. Combustion changes in the processes changes the Gas (Flame) transparency and affects the Gas and Refractory IR measurements. A clean burning flame becomes transparent to the IR Gas measurements. The transparency of the gases will cause the Gas IR Measurement to see the cooler refractory and include this into the gas measurement, which results in a lower than actual temperature measurement. The opposite happens for a dirty burning flame that will limit the refractory measurement from seeing through the dirty flame and adding this flame influence to the refractory measurement.

Since Flame Transparency varies with the process feeds to the furnaces, the transparency effect on the IR measurements is a variable factor used to correct measurements in these applications.

The LumaSense Solution

A single system installation with two independent IR filtered detectors that provides both Gas (Flame) and Refractory measurements simultaneously. The innovative LumaSense Smart FMA™ Flame Measurement Algorithm allows for accurate real-time flame transparency compensation and correction. Applying the flame transparency calculation with FMA removes the flame transparency errors due to the Gas (Flame) temperature, providing the highest accuracy in process temperatures.

Both Gas and Refractory measurements are critical to the furnace operations. The Gas (Flame) measurement is used by the operator to detect thermal events before IR energy is absorbed by the refractory, creating a refractory thermal event. This method of early warning by use of the Gas (Flame) temperatures, allows added time for operators to make process changes and reduce potential Refractory thermal events before they can become critical by triggering a high level alarm system based on the Refractory temperature measurements set point.

Temperature Systems

LumaSense's E²T PULSAR 4 Advanced is designed to measure two wavelengths for continuous and instantaneous measurement of Refractory Temperature (RT), Gas Temperature (GT) and Integrated Temperature (FF).

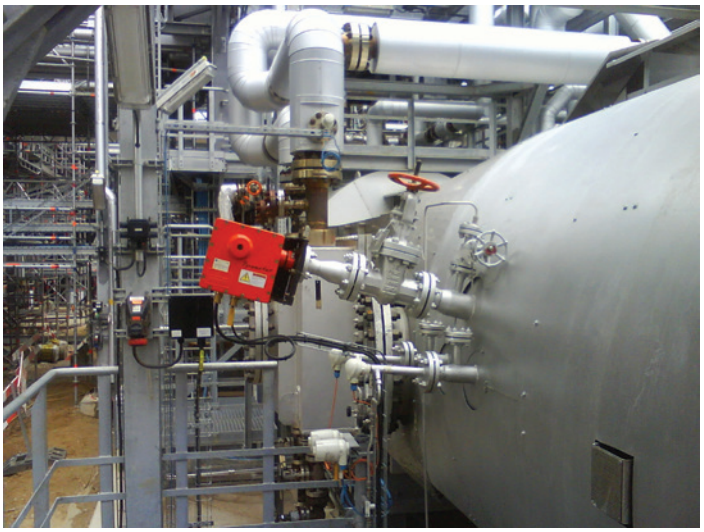
The PULSAR 4 is a single channel option for direct replacement of our older PULSAR II products. The 2nd channel can be added with a firmware key after purchasing the PULSAR 4.

Over 550 refineries, gas plants and petrochemical companies with over 1,700 installations worldwide have looked to us for accurate infrared temperature data. When you install E²T PULSAR 4 infrared thermometers, you are investing in proven experience, superior performance and ultimate cost savings.

Installation Principles

Location on Furnace

Utilization of the different temperature measurement systems depends upon the feed gases and burner design of the reactor. If you burn simple acid gas with combustion air, the PULSAR 4 should be installed two-thirds of the way downstream from the burner to the waste heat boiler. If there is a checker wall or choke ring, installation at Locations 2 and 3 (shown in the diagram below) is recommended.

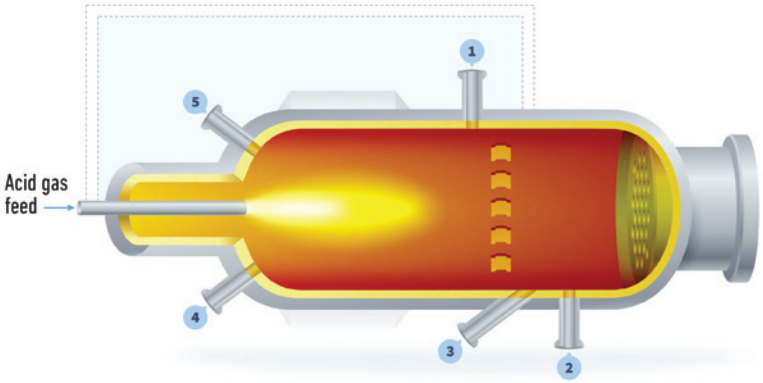


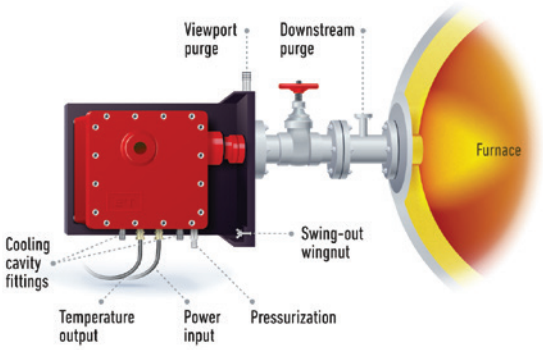
With oxygen-enrichment, refractory integrity is critically important. Burner design and location become paramount in determining the placement of the IR thermometer. The RT Refractory Temperature should be installed aimed at the area where the designers anticipate the highest refractory temperatures. For example, Location 1 is recommended for checker wall protection and Location 4 for tube sheet monitoring. Temperatures at the tube sheet are especially critical since the ferrules and ceramic tube-to-metal junctions may face potential excessive temperature excursions as a result of oxygen-enrichment operations.

Mounting to Furnace

The E^2T PULSAR 4 should be mounted on the horizontal diameter (no greater than ±15°) perpendicular to the vessel sighting on refractory, or adjacent to the burner sighting on the checker wall or tube sheet.

The SOF-8 Swing-out Fixture mounts to a 3-inch 150 or 300 pound ball valve connected to the furnace via a customer-supplied downstream purge connection. Minimum purge rates for downstream and viewport is 17 m3/h (@ standard conditions) SCFM. The PULSAR 4 housing includes a cavity for water or vortex air cooling when ambient temperatures exceed 140 °F (60 °C). Client-supplied sealed flex lines should be used for power input and signal output in accordance with local codes for hazardous environments.





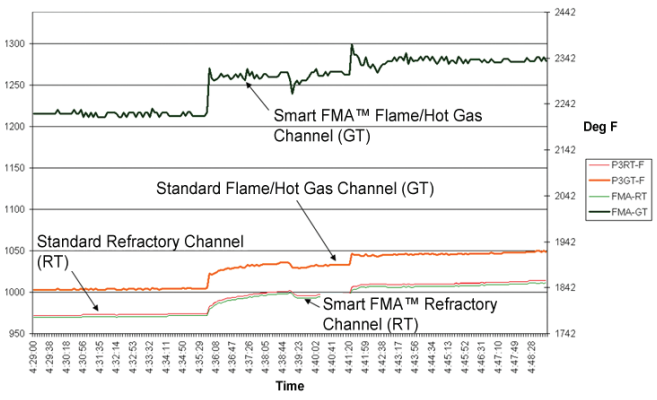
Smart FMA™ (PULSAR 4 Advanced Only)

LumaSense Technologies has developed a unique method called LumaSense Smart Flame Measurement Algorithm (Smart FMA™) to compensate for varying gas transparency and their effects on gas and refractory IR temperature measurements. In a normal situation, a dirty flame can increase 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 decrease the flame temperature. The FMA algorithm virtually removes these unwanted 'crosstalk' artifacts and solves for more meaningful refractory and flame/hot gas temperatures in real time.

The chart illustrates the difference between Standard operating mode and Smart FMA™ operating mode (field switchable). Note that 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. 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.

Actual SRU Data Showing Standard Mode vs. Smart FMA™ Mode in the PULSAR 4 Advanced



Field-Configurable to Multiple Temperature Combinations

PULSAR 4

The PULSAR 4 has the capability to measure one selected temperature measurement. For example, the single channel can measure refractory wall temperature or measure hot combustion gas temperature. The dual channel measurements capability is not activated for the PULSAR 4. An optional product firmware upgrade can be purchased to activate the PULSAR 4 Advanced capabilities. The PULSAR 4 is intended as a direct single channel replacement for clients with PULSAR II equipment.

Each PULSAR 4 provides two identical analog outputs, but No FMA capability.

Field Selectable measurements:

- RT — Refractory Temperature
- GT — Gas Temperature
- FF — Average Integrated Temperature

PULSAR 4 Advanced

The PULSAR 4 Advanced has been uniquely designed to have the ability to continuously measure two simultaneous temperatures. For example, one channel can measure refractory wall temperature while the second channel can measure hot combustion gas temperature. The dual channel measurements share the same optical path (viewport, isolation valve, etc.).

Each PULSAR 4 Advanced provides two analog outputs, FMA capability and when turned on, effect all outputs.

Field Selectable measurements:

- RT — Refractory Temperature
- GT — Gas Temperature
- FF — Average Integrated Temperature
- FMA — Flame Measurement Algorithm

Technical Data

	PULSAR 4	PULSAR 4 Advanced
Temperature Range:	350 … 2000 °C (662 … 3632 °F)	
Measurement uncertainty: **(E = 1, t_{90} = 1 s, $T_{amb.}$ = 25 °C)**	+0.3% of Reading or 3°C +1 Digit, whichever is greater	
Repeatability: **(E = 1, t_{90} = 1 s, $T_{amb.}$ = 25 °C)**	0.1% of full scale span	
Response Time t_{90}:	Programmable from 0.05 to 120 sec.	Programmable from 0.05 to 120 sec. When FMA mode is on 0.5 to 120 sec.
Analog outputs	2 identical analog outputs 4 ... 20 mA, linear, Select one of RT, GT or FF Corresponding to NAMUR NE43	2 analog outputs 4 ... 20 mA, linear, Outputs can be assigned to RT, GT or FF Corresponding to NAMUR NE43
Digital Interfaces	RS485 addressable (half-duplex) Baud rate: 1.2 … 115.2 kBd	RS485 addressable (half-duplex) Baud rate: 1.2 … 115.2 kBd HART Rev. 7 interface
Load	0 … 600 Ω (mA output)	0 … 600 Ω (mA output) 230 … 600 Ω (mA output with HART)
Relay Alarm	30 VDC / 1A max.; Resistive; Configuration of alarm: no alarm; alarm, if temperature > setpoint; alarm, if temperature < setpoint	
Emissivity Adjustment	0.100 to 1.000 digital on both channels when in Standard mode	
Transmittance Adjustment	0.100 to 1.000 digital on both channels when in Standard mode	
Alpha Adjustment	N/A	0.050 to 1.000 aLP when in FMA mode on GT channel (when in FMA mode)
Focusing Range	500 mm to infinity	
Target Size	160:1 Standard Resolution, (distance / target size)	
Power supply	24 V (18 … 30 VDC), 0.2 A maximum; 3.5 A with heater . 115 VAC ±10%, 47…63 Hz; 230 VAC ±10%, 47…63 Hz	
Power consumption	Max. 90 W (with heater)	
Fusing	(F1) 1.6A, 'T' Time-Lag 5x20mm; (F2) 1.25A, 'T' Time-Lag 5x20mm; (F3) 1A,'T' Time-Lag 5x20mm	
Ambient Temperature Limits	-40 ... +60°C with no cooling and using internal heater (ambient temperature <4°C) 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	CE 1725 Ex II 2G, EX d IIB +H2 T4 Gb FM14ATEX0004X IECEx FME 14.0001X Class I, Div. 1, Groups B, C & D, T4 Ta = -40 °C to 60 °C IP66 NEMA "Type 4X" classification FM C US APPROVED	
Torque Spec, Lid Bolts	5.5 Nm	
Air	View port purge: 1.4 bar min., 1.7 m^3/h (@ standard conditions) Combustion purge: 1.4 bar min., 17 m^3/h (@ standard conditions)	

Reference Numbers

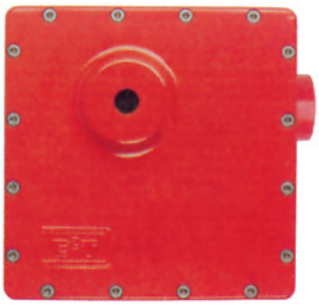
3 909 010	PULSAR 4 Advanced
3 909 020	PULSAR 4
3 909 030	PULSAR 4 Advanced Backup
3 909 040	PULSAR 4 Backup

Accessories

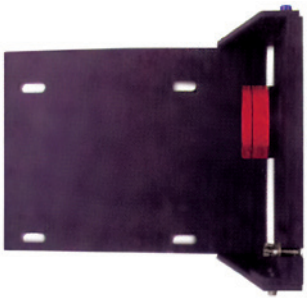
0 006 581	O ring EXP LID PULSAR 4
3 909 114	Front window gasket for PULSAR 4
3 909 800	Fuse Set for PULSAR 4 (F1) 1.6A, (F2) 1.25A and (F3) 1A
6 882 010	BUP-10; Backup TC probe and adaptor
6 882 020	COP-10; 1 ea Model CRA Clean-Out-Ram Assy and Model PAPG Probe Adaptor w/Packing Gland
6 882 030	BUP-10/COP-10; Backup thermocouple probe clean-out probe and single adapter for PULSAR 4
6 882 040	CRA Cleanout Ram; Includes: 1" & 1.5"; Heads (2.54 & 3.81 cm) and SS Rod for PULSAR 4
6 884 060	VP-10P SST Viewport Assembly with Pyrex window, Stainless Steel
6 884 050	SOF-1, 2" 150lb Swing out Fixture, Stainless Steel, incl. VP-10P SST and mounting hardware kit
6 884 040	SOF-8-SS, 3" 150/300lb swing out fixture, Stainless Steel, 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

PULSAR 4 Explosion-Proof Infrared Thermometer

CE 1725 Ex II 2G, EX d IIB +H2 T4 Gb
FM14ATEX0004X IECEx FME 14.0001X
Class I, Div. 1, Groups B, C & D, T4
Ta = -40 °C to 60 °C IP66
NEMA "Type 4X" classification



Model COP-10 Clean Out Rod for Clearing Sight-Port



Model SOF-8 SS Swing-Out Fixture for Sight-Port Access

Model BUP-10 Thermocouple and Adapter for Start-Up and Verification

LumaSense Technologies — Awakening Your 6th Sense

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