



## T-LGA4810 Series Laser Spectrometer

# Process Gas Analyzer

Ref: T\_LGA4810\_TFO\_DGA\_IntE  
Revision:2004-09-1  
Date: 2005-06-23

\_\_\_\_\_ *Both applicable to gas and liquid sample*

- Rugged industrial design, real time measurement
- Continuously in situ monitoring, None of special gas sampling process or extraction
- High selectivity by spectroscopy optimization, free from interference of other gases
- High accuracy, non online calibration needed
- Adjustable measuring range, dynamical range over  $10^{-4}$  to  $10^{-6}$
- Selectable output signals, both of standard analog or data communication
- Easy installation
- Built-in self calibration routines
- Dust on optical windows has less influence
- TAR type supports 1 to 4 gases analysis at one system.
- Series structure suit to varies device and arts
- Enhancement modules support the system from single beam photometer to spectroscopy analyzer. for higher chemical selection or multi-gases analysis exploration in your application.

- Unparalleled Speed and Repeatability
- Repeatability better than or equal to ASTM D-3612 or IEC 567 Analyzes oil or gas samples
- Measures the 7 fault gases simultaneously, in less than <180 seconds
- Integrated with data management and fault diagnostic (optional) software
- Works without oil sampling.
- Professional training and support

### Why doesn't the oil in an electrical transformer burn?

The oil may burn if the oil filled transformer fails and there is an electrical arc inside the power transformer and it is powerful enough and lasts long enough to rupture the transformer tank and cause the oil to spill and then burn. This does not happen very often.

### Why is oil used in an electrical transformer?

Oil is actually a great electrical insulator for the wire windings and iron core of a power transformer. It also is a coolant to carry the heat away from the electrical transformer windings and iron core to the cooling radiators on the side of the oil filled transformer. The heat is created by the flow of electrical current through the wire windings that are used to make a power transformer.

### Why need to detect the dissolved gases?

As the transformer running, the insulator materials might be aging, and emitting CO<sub>2</sub> and CO. the increase of CO is relative to the ponderance of corruption of the insulating materials.

Over current burden or leakage of magnetic might produce CH<sub>4</sub>, H<sub>2</sub>, C<sub>2</sub>H<sub>4</sub> and C<sub>2</sub>H<sub>6</sub> etc.

Partial discharge may induce H<sub>2</sub> and less of CH<sub>4</sub> and C<sub>2</sub>H<sub>2</sub>;

Arc might leads to H<sub>2</sub> and C<sub>2</sub>H<sub>2</sub>, usually with increase of C<sub>2</sub>H<sub>2</sub>

By detect of the dissolved gases, engineers can know the problem in the transformer.

## Description

The pGas2000TFO DGA is a new portable gas-in-oil analyzer which can measure transformer fault gas in laboratory, on-site, in less than 5 minutes, and also can be used as continually on-line analyzer. The analyzer mainly employs laser photometer sensor instead of IR sensor and electrochemical sensors, to measure gases in space upon oil or dissolved in oil or other dielectric fluids without interferences.

The instrument is designed as versatile usage, could be fixed in site, or carried up.

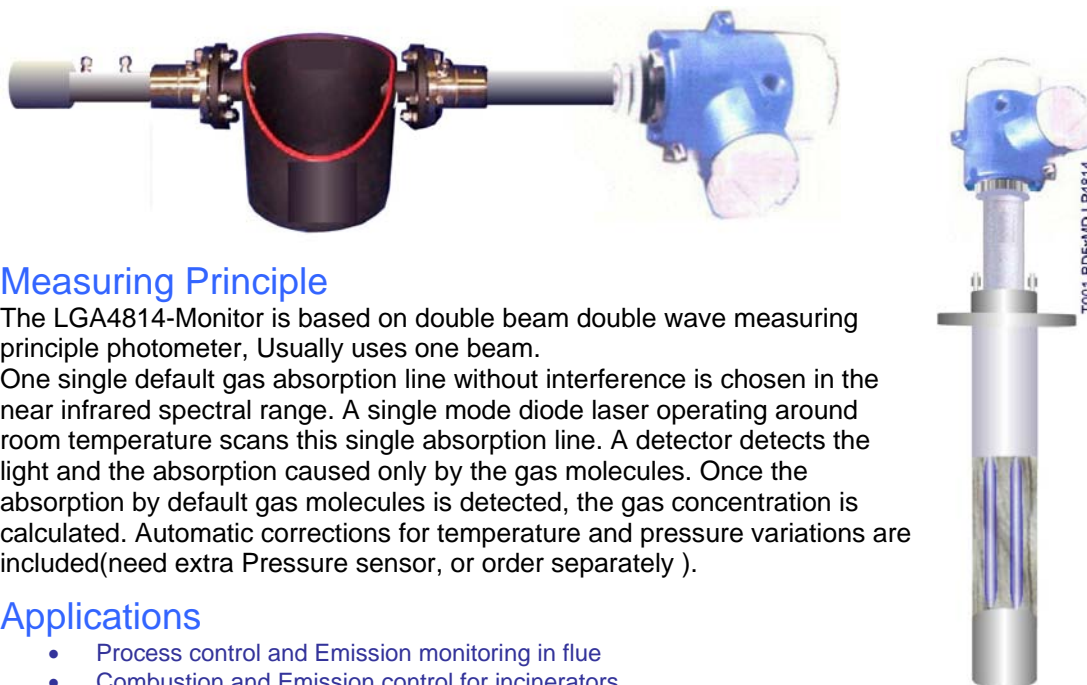
## Advantages

Laser photometer is new technology analyzer for gases, based on the latest development of technology of laser manufacture. The spectrum line width of laser photometer is usually  $<0.01\text{nm}$  in wide wave length, so it becomes possible now to absolutely distinguish single gas qualitatively and quantitatively from co-existing gases that having close energy absorption.

The life time of laser is longer than 10000 hours of working. the laser only decays with the running time, not drift with storage time.

Relatively the IR line width is from  $0.1$  to  $0.2\ \mu\text{m}$  usually. So there would be more interferences between gases to be analyzed, difficult to get higher resolution. Only few hard band-pass filters available for  $\text{CO}_2, \text{CO}, \text{NO}, \text{HC}$ , other gases usually employ soft film filters. It's life is limited in one year, no matter in use or not. So difficult to maintenance after sales.

Laser photometer also makes  $\text{H}_2$  and  $\text{O}_2$  analysis possible in TFO DGA. While IR system can not help. Although electronic sensors available, but the  $\text{H}_2$  sensor is heavily interfered by  $\text{CO}$  and all unsaturated hydrocarbons, such as acetylene and ethylene in TFO.  $\text{O}_2$  is affected by  $\text{CO}_2$  slightly.



## Measuring Principle

The LGA4814-Monitor is based on double beam double wave measuring principle photometer, Usually uses one beam.

One single default gas absorption line without interference is chosen in the near infrared spectral range. A single mode diode laser operating around room temperature scans this single absorption line. A detector detects the light and the absorption caused only by the gas molecules. Once the absorption by default gas molecules is detected, the gas concentration is calculated. Automatic corrections for temperature and pressure variations are included (need extra Pressure sensor, or order separately).

## Applications

- Process control and Emission monitoring in flue
- Combustion and Emission control for incinerators
- Industry chemical process
- Research and Process optimization
- Open space gas detect fro stack

## Limitations:

- Only applicable for clean gases, with suspended particles less than  $10\text{mg}/\text{M}^3$ ;
- Or could be purged with clean air or other gases available.

## Maintenance and Calibration

The rugged industrial design and the air purging make the Laser Gas Analyzer easy to maintain. There are no moving parts in the instrument and no consumables are needed during operation of the instrument. All critical parameters are monitored continuously and warning messages are given if maintenance is required beyond the recommended maintenance intervals. Calibration may be performed against certified calibration gas in the integrated internal cell, or on a separate calibration cell using certified calibration gas purged through the cell or contained in a sealed glass cell. The routine maintenance interval is three of months.

## Installation and Operation

The LGA4814 Monitor is easy to install and operate.

The transducer T model is one unit integrity; inserting the sensor part into gas container or

pipe where suitable, and fixing the instrument with attached flange.

The AR model consists of 3 basic units: Transmitter unit, receiver unit and electronics unit. The transmitter and receiver units are mounted directly to the process device by DN50/F165 flanges.

There are no moving parts in the instrument, thus preventative maintenance is limited to visual inspection and cleaning of optical windows.

Purging prevents dust from collecting on the optical windows. Experience shows that a three months preventative maintenance interval is sufficient for most applications.

## Calibration

The calibration procedure is easy. The monitor may be calibrated using the integrated flow through cell, or alternatively mounted to a separate calibration tube.

## Specifications

Optical path length (OPL): 0.5-6M, Max: <30 meter

Bandwidth: <10nm;

Start up time: <3 mins

Response time: Less than 2 seconds

Averaging time: Rolling average from 2 seconds to 24 hours (exp. decay)

Detection limit: Refer to Table 1

Min. measuring range: Refer to Table 1.

Max range: Refer to Table 1.

Dynamic range: 100 to 10000 :1

Instrument span drift: < 4% of measuring range between maintenance intervals

Instrument zero drift: Negligible (<2% of measuring range between maintenance intervals)

Maintenance interval: Recommended every 3 months (no consumables needed)

Calibration: Not needed in general running. In situ with flow through cell, or in separate calibration tube

## Input/ Output Signals

Analogue output: 0/4 - 20 mA current loop, 500 & max.

Digital output: RS 232 or RS485 by protocol of Modbus or STIMcom

Relay output: High gas relay (normally closed-circuit relays)

Warning relay (normally closed-circuit relays)

Fault relay (normally closed-circuit relays)

Analogue input: Optional 0/4 - 20 mA

## Operating Conditions

Ambient temperature: -20C to +55C

Maximum Sample Pressure: <1Mpa or 10 bars abs for general model. High pressure system under requirement;

Maximum Sample Temperature:

T type: Max <200°C;

TAR type: Max<500°C(direct set with cooling air). Extended to 1500°C possible with special installation.

Protection classification: Transmitter and Receiver units: IP65, optionally Ex-p adapted

Electronics unit: IP55, optionally IP65

Mains voltage: 24V DC

Power consumption: Less than 50 Watts (not include consumption of valve and air resource device)

## Mounting

Standard mounting: DN50/PN10, F165

Alignment tolerances: Flanges parallel within 1° with <1m light path(AR Model only).

Purging of air: Dry and oil-free pressured air or gas, or by fan. The pressure of purging air must be 0.1 kgf/cm<sup>2</sup> higher than that of samples in pipe.

Cooling air: adjust the flow to assure the temperature inside sensor is lower than 70 °C, this temperature could be read by instruments. In the case of high temperature application, cooling air must be guaranteed to supply continuously, once stop longer than seconds might damage the sensor. It was recommended to select AR model for high temperature application if possible.

Air connect: φ2- 6 pipe with M10 screw.

## Dimension and Weight

TR: Dia.150x (1000/possible sensor length+500/Electronics); 15Kg

Insertion Depth: <1300cm( varying from range)

Diameter of insertion part: φ50mm

TR/TAR:

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web: <http://www.fullsense.com.cn/> <http://www.bigdipper-technochem.com>

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Transmitter unit: Dia: 150x350 mm, 8 kg  
Receiver unit: Dia.150x350 mm] 8 kg  
Electronics unit: Dia. 120 x 400 mm, 5 kg

### Ordering Code:

TR/TAR-L[sample phase]A4814-[Product ID]-[gas]-R(range)-T[sample temperature]-P[sample pressure]-M[c-s-w]-S[serial port]P[communication portocol]-A[analog output standard]

### Coding information:

**Sample phase:** L for liquid sample, G for gases;

**Product ID:** Refer to Table 1.

**Connect code:** 0= none; 1=thread; 2=clamp; 3=Flange;

**Code Format of Contact Materials: xyz**

C: structure materials;

W: optical window;

S: seal ring

**Wet material code:** 01=PVC; 02=Nylon; 04=PTFE; 05=Acrylonitrile butadiene rubber;  
06=Fluorinated rubber; 10=Iron; 11=AM alloy; 12=SS316; 13= Hastelloy – C; 30=Optical glass; 31:Quartz

## Instrument Physical Information:

- pGas2000 is portable system; Also could be used for continuously analysis with periodically manual maintenance; pGas2000:600x350x250 mm; Transfer package size: approximately: 80x50 x40 cm. Weight<15kg;
- PGA is on-line system, specially designed for long time continuously analysis, with self maintenance function;  
Size:1200x460x460; Wight: ~45kg
- TA: Liquid position or head space gas phase across installation. the 2 parts of instrument should be fixed on 2 against wall of the transformer, the direct light path should be free of obstacles, such as wire etc.  
TA: Insertion Size:  $\Phi 65$   
Flange standard: DN50/PN10, Outline Dia. 165mm, Hole Position Dia.  $\Phi 125$ , Hole Num. 4, Hole size  $\Phi 18$   
Weight: 29kg
- TR: Reflect system, the instrument was fixed on the wall of transformer, the probe would be directly inserted in the oil. The insertion length is 600mm for most application.  
Type: TR  
Insertion Size:  $\Phi 65$   
Flange standard: DN50/PN10, Outline Dia. 165mm, Hole Position Dia.  $\Phi 125$ , Hole Num. 4, Hole size  $\Phi 18$   
Weight: 19 kg
- T-HS type should be installed on top of the transformer, and the probe connected to ventiduct. The vent pipe should be long enough to cooling the gas below 50 °C.

## Infra cture Model Introduction:

Applications system	Introduction
pGasxxx-TFO DGA-	Portable analyzer
PGA-xxx-TFO DGA-	Process continuous analyzer, support multi-channel extraction
TR-xxx-TFO DGA-	Process continuous analyzer, Liquid phase installation, or headspace gas phase installation
THS-xxx-TFO DGA	Process continuous analyzer, Head space gas phase installation system

## Technology of Method

- LGA4810 is high resolution laser spectrometer, with dynamical range of 10000:5. also support more gas detection by calibration of users; the advantage is economic for multi-gas detect.

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- LNIR4814 is single wave length NIR laser photometer, with dynamical range of 10000:1; the advantage is that easier to design each measurement to best suitable detect range for different application.

Tech Model	Introduction	Applications
LGA4810 WMS01-MP4	Listed gas could be identified, and be quantified	
LGA4810 WMS05-MP2	Listed gas could be identified, and be quantified	Important station
LGA4810 WMS05-MP1	Listed gas could be identified, and be quantified	General Station
LGA4814 PM30	Listed gas could be detected, but can not be identified.	Device safety detector

Refer to:

[http://www.fullsense.com/Products/BD4000/4800/T\\_LRGA4814\\_IntE.pdf](http://www.fullsense.com/Products/BD4000/4800/T_LRGA4814_IntE.pdf)

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### BigDipper Technochem Institute

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## Parameter Specifications

BitCode	Fault Gas	Gas Phase PPM	Oil Dissolved Gas	Accuracy	Repeatability	T90	Life/year	LGA4810 WMS01-MP4	LGA4810 WMS05-MP2	LGA4810 WMS05-MP1	LGA4814 PM30
1 1	Methane	0.1-50,000	0-2000mg/L	±2%	±1%	1s	LNIR10	⊙	⊙	⊙	⊙
1 2	Hydrocarbons	0-5%Vol	20-2000mg/L	±2%	±1%	1s	IR 10				
2 1	Ethane	0.1-50,000	0-2000mg/L	±2%	±1%	1s	LNIR10	⊙			⊙
3 1	Ethylene	0.1-100,000	0-4000mg/L	±2%	±1%	1s	LNIR10	⊙			⊙
4 1	Acetylene	0.1-100,000	0-4000mg/L	±2%	±1%	1s	LNIR10	⊙	⊙		⊙
5 1	Carbon Monoxide (CO)	0.1-50,000	0-5000mg/L	±2%	±1%	1s	LNIR10	⊙			⊙
6 1	Carbon Dioxide (CO <sub>2</sub> )	0.1-50,000	0-5000 mg/L	±2%	±1%	1s	LNIR10	⊙	⊙		⊙
7 1	Moisture(H <sub>2</sub> O)	0-100%	0-10000 mg/L	±2%	±1%	1s	LNIR10	⊙	⊙	⊙	⊙
8 1	Oxygen (O <sub>2</sub> )	0-25%	10-1250 mg/L	±10%	±5%	5s	EC 10				
8 2	Oxygen (O <sub>2</sub> )	0-25%	10-1250 mg/L	±2%	±1%	1s	LNIR10	⊙	⊙		⊙
9 1	Hydrogen (H <sub>2</sub> )	0-4%	10-2400 mg/L	±10%	±5%	30s	EC 2				
9 2	Hydrogen (H <sub>2</sub> )	0-4%	10-2400 mg/L	±10%	±5%	1s	LNIR10	⊙	⊙	⊙	⊙
101	Sulfur fluoride (SF <sub>6</sub> )	0-5000		±2%	±1%	1s	LNIR10				
111	<b>Total combustible Gas (TCG)</b>	<b>0-5%Vol(of CH<sub>4</sub>)</b>		<b>±2%</b>	<b>±1%</b>		<b>CAL</b>	④	④	④	④
	Moisture	0 to 100%RH	0-550mg/L	±2%	±1%	10s	Ms 10	✓	✓	✓	✓
	Temperature	-40 to 125 °C	-40 to 125 °C	±0.5%	±1%	30s	Ms 10	✓	✓	✓	✓
	Pressure	0.6-1.7 kgf/cm <sup>2</sup>	0.6-1.7 kgf/cm <sup>2</sup>	±0.5%	±1%	10s	ms 10	✓	✓	✓	✓

① System for headspace sampling only.

② Sorted as LGA4810-Laser spectrometer series.

③ Application limits: Only suitable for the system where oxygen existed in the transformer head space.

④ Calculated;

Note: Continuing research and improvements may result in specification or appearance changes at any time;

## Available Structure Types for Application

Type	Installation	Fixing Fitter	Application	
T	Insertion	DN50PN40 flange.	Flue, tank; Normal<60°C, <70°C (Air purge)	for 1 gases
TAR	Across reflect	DN50PN40 flange	Low temperature container, reactor etc., Sample temperature: <200°C ; Distance of transmitter and reflector: <3 m;	for 1 gases; the advantage is to increase OPL in limited space
TA	Across	DN50PN40 flange	Stove, oven, reactor, pipeline etc. original	Possible for 1 to 3 gases;

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TA-Bf	By flow		position analysis. Temperature <200 to 400°C; Wide space gas detect; Cell length: 0.1 to 6m usually Industry pipe line	
TARS	Across space	DN50 flange	Workshop, depot, Wide space toxic or hazardous gas detect; Max transmission distance:< 30m;	Possible for 2 or 3 gases;

\*the type have to be adjusted because of technical design for light path, or economic consideration.

\*Must be cooled with air, while the temperature of samples beyond 70°C.but suitable extended pipe(air cooling actually) with glass window could help usage below 120 °C without cooling.

## *Installation Information*

### *TA Type Application*

*TA-p# Installation at line under pressure < 1MPa, Temperature < 200°C*



Type: TA

Insertion Size:  $\Phi 65$

Flange standard: DN50/PN10, Outline Dia. 165mm, Hole Position Dia.  $\varnothing 125$ , Hole Num. 4, Hole size  $\varnothing 18$

Weight: 29kg