Digital pyrometer for non-contact temperature measurement of Sapphire and Sapphire Wafers between 0 and 1500 °C.

IN 5/9 plus

- Specifically designed for measurement on Sapphire and Sapphire Wafers

- Pyrometer with analog output 0 or 4 to 20 mA, digital interface RS232 and laser targeting light

- High accuracy due to digital linearisation of the output

- Adjustable exposure time

- Compact housing

The IN 5/9 plus is specially designed for non-contact temperature measurements on Sapphire and Sapphire Wafers.

It is a digital instrument that is equipped with an analog output and a digital interface enabling temperature indication and storage on a PC.

A temperature sub range can also be configured and the instrument parameters can be adjusted remotely.

For optimal match of the instrument to the application (size of the measuring object, distance) different optics are available.

For a precise alignment of the pyrometer to the measuring object, the instrument is equipped with a laser targeting light.

Typical Applications:
- Sapphire
- Sapphire Wafers

Technical Data

Measurement Specifications

Temperature Range:	0 … 1500 °C
Subrange:	any range adjustable within the temperature range, minimum span 51 °C
Spectral Range:	8 … 9.7 µm
Optics:	Zinc-Sulfide (ZnS)
Resolution:	0.1°C on interface < 0.1% of temperature range at the analog output
Measurement uncertainty: ($\varepsilon = 1$, $t_{90} = 1$ s, $T_{amb.}$ = const.)	0.6% of reading in °C or 3 °C (T_{amb} = 15...30 °C) 1 % of reading in °C or 5 °C (T_{amb} = 0…15 or 30…63 °C) Whichever value is greater. The instrument must be at a constant ambient temperature for a minimum of 60 minutes and has to be connected to the power supply.
Repeatability: (at $\varepsilon = 1$, $T_{90} = 1$ s, $T_{amb.}$ = const.)	**0.3 % of reading in °C or 0.6 °C** The instrument must be at a constant ambient temperature for a minimum of 30 minutes

Noise Equivalent Temperature Difference (NETD): (at $\sigma = 1$, $\varepsilon = 1$, $T_{amb.}$ = 23 °C)	Temperature	NETD at t_{90} = 180 ms / °C	NETD at t_{90} = 1 s / °C
	350 °C	0.5	0.2
	950 °C	0.4	0.1

Emissivity ε:	0.2 ... 1.2 switchable in the instrument (offline mode - adjustable from 0.2 ... 1.0) or with the software InfraWin (online mode) in steps of 0.01
Exposure Time t_{90}:	0.18 s; adjustable in the pyrometer: 0.5 s; 1 s; 2 s; 5 s, adjustable via interface: 0.5 s; 1 s; 2 s; 5 s; 10 s; 30 s
Sighting:	Laser targeting light 650 nm Laser power level < 1 mW Laser class 2 per IEC60825-1-3-4

CAUTION
LASER RADIATION
DO NOT STARE INTO BEAM
WAVELENGTH: 630-680nm
< 1 mW MAXIMUM
CLASS II LASER PRODUCT

Maximum Value Storage:	Built-in single and double store. Clearing with clear time t_{CL} (0.1 s; 0.25 s; 0.5 s; 1 s; 5 s; 25 s), external contact or via interface or also automatically with each new item to be measured

Note: The calibration / adjustment of this pyrometer is carried out in accordance with VDI/VDE 3511, Part 4.4. See http://info.lumasenseinc.com/calibration for more information.

Communication / Interface

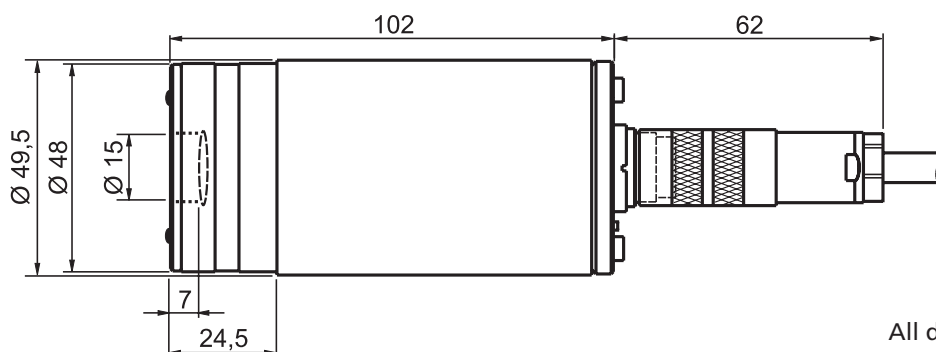|	
Analog Ouput:	adjustable 0 ... 20 mA or 4 ... 20 mA (linear)
Load:	max. 500 Ohm at 24 V (max. 200 Ohm at 18 V)
Digital Interface:	RS232 (RS485 on request)

Parameters:	Adjustable on the pyrometer (in offline mode):
	    Emissivity, exposure time, 0/4 ... 20 mA analog output range, online- / offline switch
	Readable and adjustable via interface / PC (in online mode):
	    Emissivity, exposure time, 0/4... 20 mA analog output range, sub temperature range, automatic clearing of the max./min value storage, external clearing of the max./min value storage, clear times of the max/min value storage, address, baud rate, internal temperature °C / °F, max. / min. selection, activation of ambient temperature correction

Electrical

Power Supply:	24 V DC (18 ... 30V DC) nominal, ripple must be less than 0.5 V
Power Consumption:	Max. 70 mA
Isolation:	Power supply, analog outputs and digital interfaces are electrically isolated from each other

Environmental

Ambient Temperature:	0 ... 63 °C
Storage Temp.:	-20 ... 70 °C
Rel. Humidity:	Non condensing conditions
Protection Class:	IP65 (DIN 40050)
Operating Position:	Any
Housing:	Stainless steel
Weight:	410 g
Connection:	12 pin connector
CE-Label:	according to EU directives about electromagnetic immunity

# Dimensions

All dimensions in mm

Optics

The pyrometers are equipped ex works with one of the specified optics. Each optic is focussed at a certain distance (main measuring distance). At these distances each lens achieves its smallest spot size. Normally the spot size will increase at any other distance (shorter or longer).

The IN 5/9 plus is supplied with one fixed optics shown in the table. Select one optics corresponding to the required measuring distance of the application.

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	Measuring distance a [mm]	Spot diameter M [mm]
Optics 1 a = 95 mm	95	1.7
	150	11.3
	250	28.6
Optics 2 a = 112 mm	112	1.9
	200	15
	300	29.9
Optics 3 a = 160	160	2.8
	250	12.7
	350	23.7
Optics 4 a = 280	280	4.5
	500	19.7
	750	36.9
Optics 5 a = 400	400	6.4
	750	25
	1000	38.2
Optics 6 a = 620	620	10
	1000	25.2
	1500	45.2

For each optic, some example values for measuring distance (measured from the front of the lens) and spot size are listed. Keep this in mind when considering the mounting position of the pyrometer as well as the size of the measuring object (the measuring object must be at least as big as the spot size).
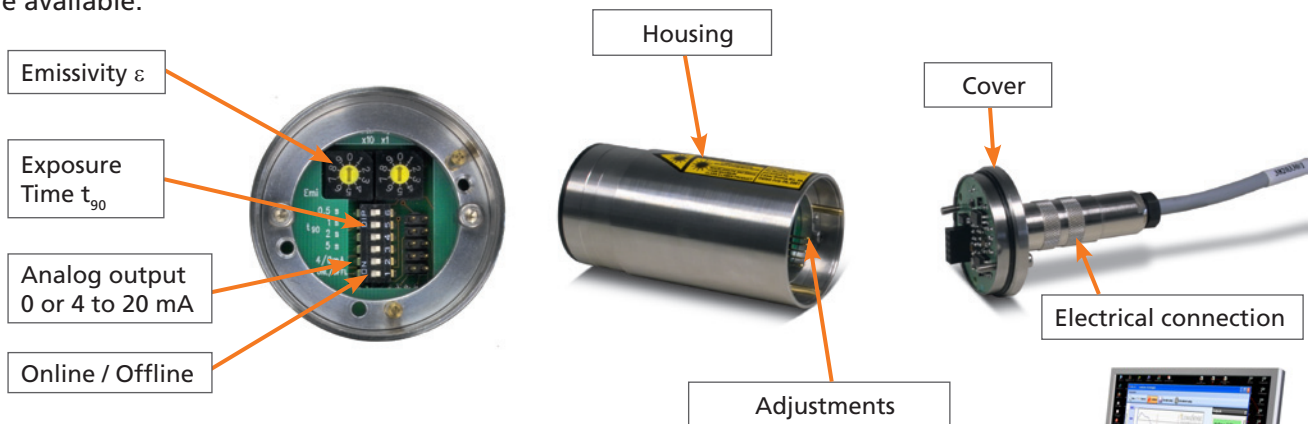
Spot sizes differing from the stated values can be calculated with the equations shown below.

$$M_2 = \frac{a_2}{a_1} (M_1 + D) - D \qquad M_3 = \frac{a_3}{a_1} (M_1 - D) + D$$
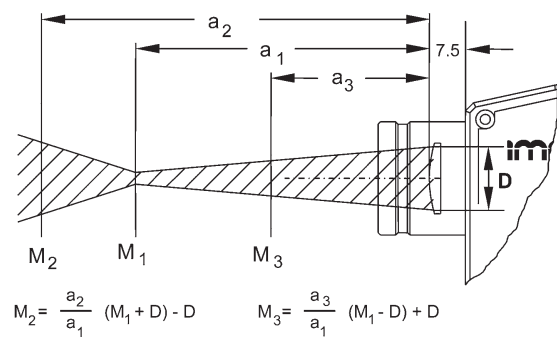
Effective aperture D for all optics is 14.8 mm.

Instrument Settings

The most important parameters such as emissivity, exposure time and analog output can be set directly in the instrument. After removing the cover on the back side of the pyrometer, the corresponding adjustments are available.

Emissivity ε

Exposure Time t_{90}

Analog output 0 or 4 to 20 mA

Online / Offline

Housing

Cover

Electrical connection

Adjustments

Alternatively, the IN 5/9 plus can be switched to online mode to enable the communication via serial interface and software InfraWin (in scope of delivery) on a PC. This allows additional setting options as well as the graphical temperature display combined with subsequent analysis of the measurement values.

Reference numbers

IN 5/9 plus

Instrument with optics a = 95 mm	3 871 800	Instrument with optics a = 270 mm	3 871 830
Instrument with optics a = 112 mm	3 871 810	Instrument with optics a = 400 mm	3 871 840
Instrument with optics a = 160 mm	3 871 820	Instrument with optics a = 620 mm	3 871 860

Scope of delivery: Instrument with selected optics, works certificate, PC measurement and evaluation software InfraWin

Ordering note: A connection cable is not included in scope of delivery.

Accessories

3 820 330	Connection cable, 5 m, straight connector
3 820 500	Connection cable, 10 m, straight connector
3 820 510	Connection cable, 15 m, straight connector
3 820 810	Connection cable, 20 m, straight connector
3 820 820	Connection cable, 25 m, straight connector
3 820 520	Connection cable, 30 m, straight connector
3 820 320	Connection cable, 5 m (angled connector, additional laser targeting light push button)
3 820 740	Connection cable, 5 m, (straight connector, temperature resistant up to 200 °C)
3 852 290	Power supply NG DC (100...240 V AC ⇒ 24 V DC, 1 A)
3 890 640	DA 4000-N: LED digital display, 230 V AC
3 891 210	DA 4000-N: LED digital display, 115 V AC
3 890 650	DA 4000: as DA 4000-N, additionally with 2 limit switches, 230 V AC
3 891 220	DA 4000: as DA 4000-N, additionally with 2 limit switches, 115 V AC
3 890 560	DA 6000-N: LED digital display with digital input RS232 and possibility for pyrometer parameter settings
3 826 500	HT 6000: portable battery driven indicator and instrument for pyrometer parameter settings; RS232 and RS485 interface
3 826 510	PI 6000: programmable PID controller
3 852 430	Converter I-7520; RS485 ⇔ RS232 (half duplex)

3 852 440	Protocol converter RS485/RS232 (switchable) ⇔ Profibus-DP for 1 instrument
3 834 210	Adjustable mounting support
3 835 160	Air purge unit
3 835 440	Air purge unit, stainless steel
3 837 230	Water cooling jacket (heavy design) with integrated air purge unit
3 837 350	Heavy water cooling jacket with protection window
3 837 370	Water cooling jacket (lightweight design) with integrated air purge unit
3 837 400	Lightweight water cooling jacket with protection window
3 846 100	Mounting tube
3 846 120	Flange tube
3 846 630	Vacuum flange KF16 with protection window
3 846 660	Spare protection window, Ø 25 x 3 with Viton-O-ring

Flange system: the flange system is a modular mounting system to fix the pyrometer on furnaces, vacuum chambers, etc. It can consist of e.g. mounting support, tube support with air purge and flange and an open or closed ceramic sighting tube. The mounting support can be equipped with a quartz window for vacuum applications

Water cooling jackets (heavy and lightweight design)

Mounting support

Air purge units

Example flange system

Programmable PID controller PI 6000

Power Supply NG DC