

**TDLS8000  
Tunable Diode Laser Spectrometer**

IM 11Y01D01-01EN

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# ◆ Introduction

Thank you for purchasing the TDLS™8000 Tunable Diode Laser Spectrometer.  
Please read the following respective documents before installing and using the TDLS8000.

The description of following products also be included in this manual.

YH8000	HMI Interface Unit
IF8000	Isolation Flange for TDLS8000
YC8000	Flow Cell for TDLS8000

The related documents are as follows.

General Specifications GS 11Y01D01-01EN  
User's Manual IM 11Y01D01-01EN (this manual)

\* the "EN" in the document number is the language code.

An exclusive User's Manual might be attached to the products whose suffix codes or option codes contain the code "Z" (made to customers' specifications). Please read it along with this manual.

## ■ Notes on Handling User's Manuals

- Please hand over the user's manuals to your end users so that they can keep the user's manuals on hand for convenient reference.
- Please read the information thoroughly before using the product.
- The purpose of these user's manuals is not to warrant that the product is well suited to any particular purpose but rather to describe the functional details of the product.
- No part of the user's manuals may be transferred or reproduced without prior written consent from YOKOGAWA.
- YOKOGAWA reserves the right to make improvements in the user's manuals and product at any time, without notice or obligation.
- If you have any questions, or you find mistakes or omissions in the user's manuals, please contact our sales representative or your local distributor.

## ■ Drawing Conventions

Some drawings may be partially emphasized, simplified, or omitted, for the convenience of description.

Some screen images depicted in the user's manual may have different display positions or character types (e.g., the upper / lower case). Also note that some of the images contained in this user's manual are display examples.

## ■ Notes on Hardware

### ● Appearance and Accessories

Check the following when you receive the product:

- Appearance
- Standard accessories

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- **Model and Suffix Codes**

The name plate on the product contains the model and suffix codes. Compare them with those in the general specification to make sure the product is the correct one. If you have any questions, contact our sales representative or your local distributor.

# ◆ Safety Precautions

## ■ Safety, Protection, and Modification of the Product

- In order to protect the system controlled by the product and the product itself and ensure safe operation, observe the safety precautions described in this user's manual. We assume no liability for safety if users fail to observe these instructions when operating the product.
- If TDLS8000 and YH8000 are used in a manner not specified in this user's manual, the protection provided by these instruments may be impaired.
- If any protection or safety circuit is required for the system controlled by the product or for the product itself, prepare it separately.
- Be sure to use the spare parts approved by Yokogawa Electric Corporation (hereafter simply referred to as YOKOGAWA) when replacing parts or consumables.
- Modification of the product is strictly prohibited.
- The following safety symbols are used on the product as well as in this manual.



### WARNING

This symbol indicates that an operator must follow the instructions laid out in this manual in order to avoid the risks, for the human body, of injury, electric shock, or fatalities. The manual describes what special care the operator must take to avoid such risks.



### CAUTION

This symbol indicates that the operator must refer to the instructions in this manual in order to prevent the instrument (hardware) or software from being damaged, or a system failure from occurring.

### CAUTION

This symbol gives information essential for understanding the operations and functions.

### NOTE

This symbol indicates information that complements the present topic.



This symbol indicates Protective Ground Terminal.



This symbol indicates Function Ground Terminal. Do not use this terminal as the protective ground terminal.

## ■ Warning and Disclaimer

The product is provided on an "as is" basis. YOKOGAWA shall have neither liability nor responsibility to any person or entity with respect to any direct or indirect loss or damage arising from using the product or any defect of the product that YOKOGAWA can not predict in advance.

## ■ Safety Precautions for Explosion Protected Type Instrument

Specified types of TDLS8000 and YH8000 are designed to protect against explosion.

When these type instruments are used in a hazardous area, please be sure to read Appendix 8.

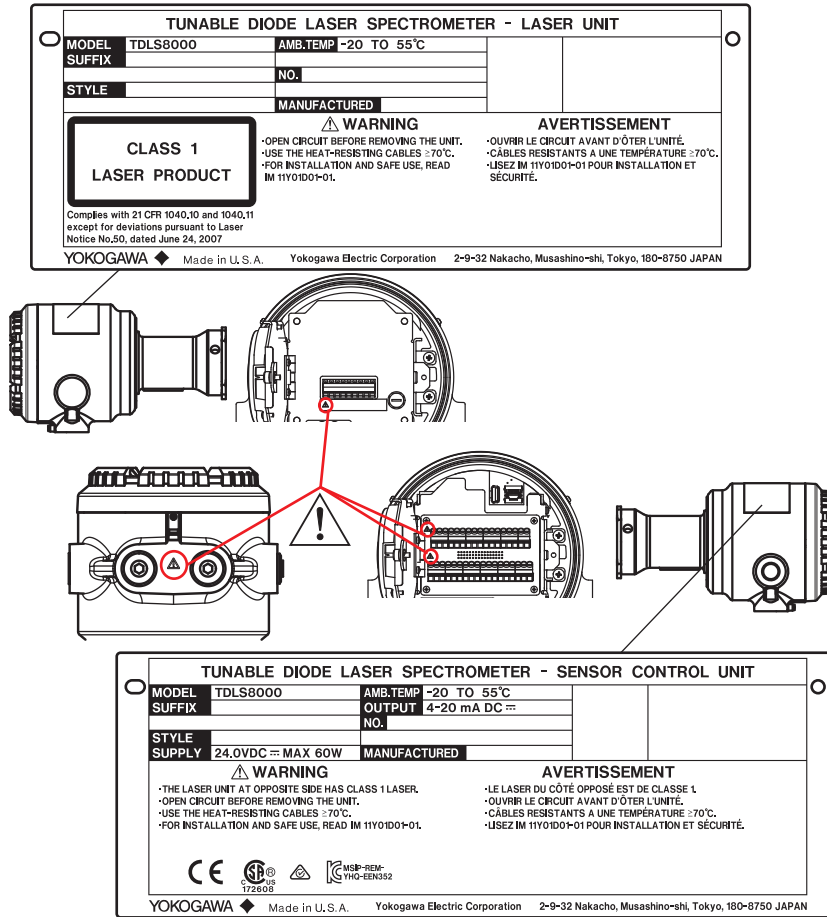
**! CAUTION**

Only trained persons use TDLS8000 and YH8000 in industrial locations.

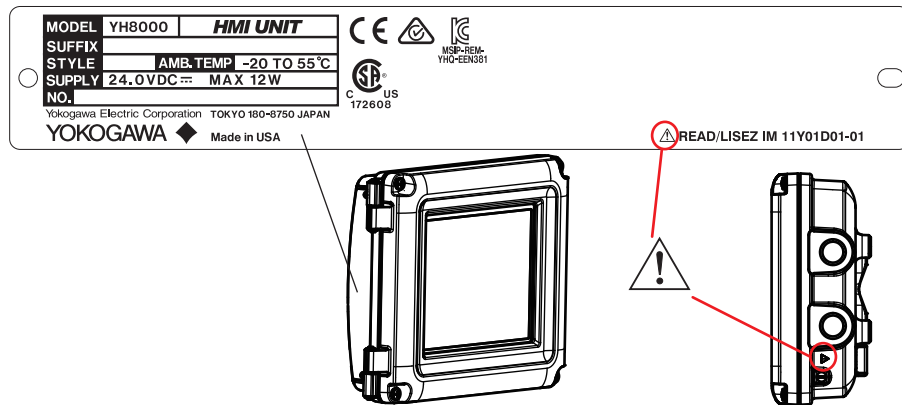
**TDLS8000 and YH8000**

There are safety symbols in the point of the figure to a product.

**TDLS8000**



**YH8000**



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 **CAUTION**

Be careful not to connect the power supply wires to the incorrect locations or reverse the polarity.

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 **CAUTION**

Use cables with a durable temperature of at least 70 °C.

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- Don't install "general purpose type" instruments in the hazardous area.
- The Instrument is packed carefully with shock absorbing materials, nevertheless, the instrument may be damaged or broken if subjected to strong shock, such as if the instrument is dropped. Handle with care.
- Components that can be damaged by static electricity are used in the TDLS8000 tunable diode laser spectrometer and YH8000 HMI interface unit. Take protective measures against static electricity when performing maintenance and inspection and use conductive packing material for shipping replacement components.
- Do not use an abrasive or organic solvent for cleaning the TDLS8000 tunable diode laser spectrometer and YH8000 HMI interface unit.
- The HART communication may be influenced by strong electromagnetic field.  
In this case another trial of the HART communication and/or operation with TDLS8000 touch screen can be carried out.

 **CAUTION**

TDLS8000 and YH80000 are EN61326-1 Class A products, and it is designed for use in the industrial environment. Please use these instruments in the industrial environment only.

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 **WARNING**

Depending on the specifications, toxic CO and NH<sub>3</sub> gas may be used for the offline calibration of this product. Take special care and ensure correct use when using such gas.

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 **WARNING**

Sufficiently ventilate the room to ensure the purge gas does not accumulate and there is no shortage of oxygen.

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 **CAUTION**

Do not subject the equipment to an impact. It may cause irreparable damage to the laser.

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## CAUTION

Sufficiently understand this user's manual and carry out the work carefully so as not to make a mistake with a pipe or wire.

## CAUTION

### Electrostatic discharge

The TDLS8000 and YH8000 contains devices that can be damaged by electrostatic discharge.

When servicing this equipment, please observe proper procedures to prevent such damage.

Replacement components should be shipped in conductive packaging. Repair work should be done at grounded workstations using grounded soldering irons and wrist straps to avoid electrostatic discharge.

## CAUTION

Do not use an abrasive or organic solvent in cleaning the instrument.



## CAUTION

Please turn off the power to the TDLS8000 before remove the analyzer from process flange.

## ■ Maintenance by qualified engineer

Work carried out by other than a qualified engineer may cause injury to the worker and/or severe damage to the equipment. Furthermore, if the warnings in this manual are not observed, the worker may be seriously injured and/or the equipment may be severely damaged.

Maintenance of the equipment must be performed by a qualified engineer. Qualified engineer refers to the following:

- Engineer who is familiar with how to safely handle process analyzers (or general automation technology) and has read this manual and understood its content.
- Engineer who has received training on how to start and configure equipment and has read this manual and understood its content.

## ■ Replacement of battery

The battery (CR2050 type) on the CPU board in TDLS8000 cannot be installed on site because it must be mounted at the factory. If it needs replacing, contact a Yokogawa service center.

## ■ Transportation of products containing lithium batteries

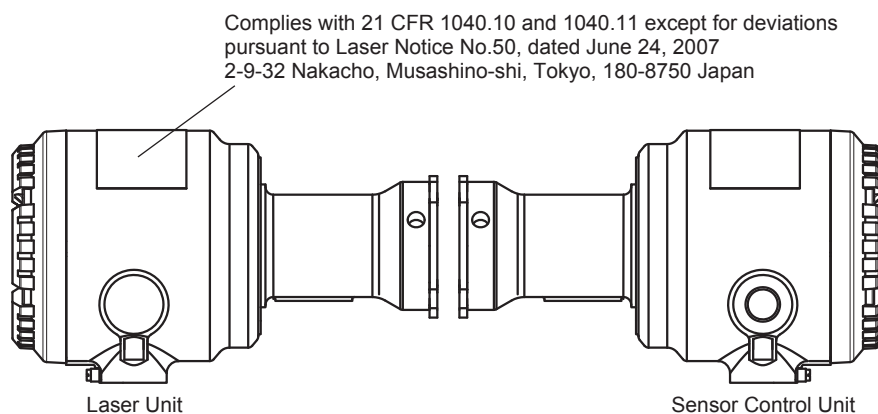
TDLS8000 contains lithium batteries. Primary lithium batteries are regulated in transportation by the U.S. Department of Transportation, and are also covered by the International Air Transport Association (IATA), the International Civil Aviation Organization (ICAO), and the European Ground Transportation of Dangerous Goods (ARD). It is the responsibility of the shipper to ensure compliance with these or any other local requirements. Please consult the current regulations and requirements regarding the transportation of lithium batteries before shipping.

## ■ Product Disposal

The instrument should be disposed of in accordance with local and national legislation/regulations.

## ■ Safety Precautions for Laser Products

TDLS8000 uses a laser light source. TDLS8000 is a Class 1 laser product as defined by IEC60825-1 Safety of Laser Products—Part1: Equipment Classification, Requirements and User's Guide. In addition, TDLS8000 complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50, dated June 24, 2007.



### CAUTION

This analyzer, a class 1 invisible laser product, is safe enough to avoid eye injury although, please do not see a light source. Laser light is emitted from the laser unit right after an analyzer is powered on. After attaching both the laser unit and sensor control unit to a process flange or flow cell, please power on an analyzer while laser light is not emitted outside measurement process.

## ■ Safety, EMC, and RoHS conformity standards

With regard to standards of Explosion Protect, please see Appendix 8.

### ● TDLS8000 Tunable Diode Laser Spectrometer

Safety conformity standards:

CE	EN61010-1, EN61010-2-030
UL	UL61010-1, UL 61010-2-030
CSA	CAN/CSA-C22.2 No.61010-1, CAN/CSA-C22.2 No.61010-2-030
GB	GB30439 Part 1

Installation altitude: 2000 m or less

Installation category: I (Anticipated transient overvoltage 330V)

Measuring category: O (Other)

Pollution degree: 2, Indoor/Outdoor use

Note: Installation category, called overvoltage category, specifies impulse withstand voltage. Pollution degree indicates the degree of existence of solid, liquid, gas or other inclusions which may reduce dielectric strength.



## EMC conformity standards:

CE	EN55011 Class A Group 1 EN61326-1 Class A Table 2 (For use in industrial location), EN61326-2-3
RCM	EN55011 Class A Group 1
KC	KN11 Class A Group 1, KN61000-6-2 (Korea Electromagnetic Conformity)

한국 전자파적합성 기준

A급 기기 (업무용 방송통신기자재)

이 기기는 업무용(A급) 전자파적합기기로서 판매자 또는 사용자는 이 점을 주의하시기 바라며, 가정외의 지역에서 사용하는 것을 목적으로 합니다.

## RoHS conformity standards:

EN50581

## Cable conditions:

- Power cable Use a shielded cable.
- I/O cable Use a shielded cable.
- Cable for connecting between units  
Use a separately sold dedicated cable (shielded cable). Attach the ferrite clamp supplied with TDLS8000 to the cable connecting between units on the inside of the equipment in the case of both an SCU and LU.
- Ethernet cable Use an STP cable (shielded) of category 5e or higher.

## Influence in immunity environment (criteria A):

Variation of gas concentration measurement value Within  $\pm 15\%$  of reading

## ● YH8000 HMI Unit

## Safety conformity standards:

CE	EN61010-1
UL	UL61010-1
CSA	CAN/CSA-C22.2 No.61010-1
GB	GB30439 Part 1

Installation Altitude: 2000 m or less

Installation category: I (Anticipated transient overvoltage 330 V)

Pollution degree: 2, Indoor/Outdoor use

## EMC conformity standards:

CE	EN55011 Class A Group 1 EN61326-1 Class A Table 2 (For use in industrial location)
RCM	EN55011 Class A Group 1
KC	KN11 Class A Group 1, KN61000-6-2 (Korea Electromagnetic Conformity)

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## RoHS conformity standards:

EN50581

## Cable conditions:

- Power cable Use a shielded cable.
- Local HMI connection cable  
Use a separately sold dedicated cable (shield cable).
- Ethernet cable Use an STP cable (shielded) of category 5e or higher.

Product conformity assessments of YH8000 for the relevant standards are performed in its own right.

## ■ Trademark Notices

- TDLS, FieldMate are trademarks of Yokogawa Electric Corporation.
- Ethernet is a registered trademark of XEROX Corporation.
- Modbus are registered trademarks of Schneider Electric SA.
- All other company and product names mentioned in this user's manual are trademarks or registered trademarks of their respective companies.
- We do not use TM or ® mark to indicate those trademarks or registered trademarks in this user's manual.

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# ◆ CE marking products

## ■ Authorized Representative in EEA

The Authorized Representative for this product in EEA is Yokogawa Europe B.V. (Euroweg 2, 3825 HD Amersfoort, The Netherlands).

## ■ Identification Tag

This manual and the identification tag attached on a packing box are essential parts of the product. Keep them together in a safe place for future reference.

## ■ Users

This product is designed to be used by a person with specialized knowledge.

## ■ How to dispose the batteries

This is an explanation about the new EU Battery Directive. This directive is only valid in the EU.

Batteries are included in this product. Batteries incorporated into this product cannot be removed by yourself. Dispose them together with this product.

When you dispose this product in the EU, contact your local Yokogawa Europe B.V.office.

Do not dispose them as domestic household waste.

Battery type: Manganese dioxide lithium battery



Notice:

The symbol (see above) means they shall be sorted out and collected as ordained in ANNEX II in DIRECTIVE 2006/66/EC.

## ■ Information of the WEEE Directive

This product is purposely designed to be used in a large scale fixed installations only and, therefore, is out of scope of the WEEE Directive. The WEEE Directive does not apply. This product should be disposed in accordance with local and national legislation/regulations.

The WEEE Directive is only valid in the EU.

# TDLS8000

## Tunable Diode Laser Spectrometer

IM 11Y01D01-01EN 5th Edition

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# 1. Overview

Yokogawa's new TDLS8000 houses all of the industry's leading features in one robust device. The platform design is for in situ measurements which negate the need for sample extraction and conditioning.

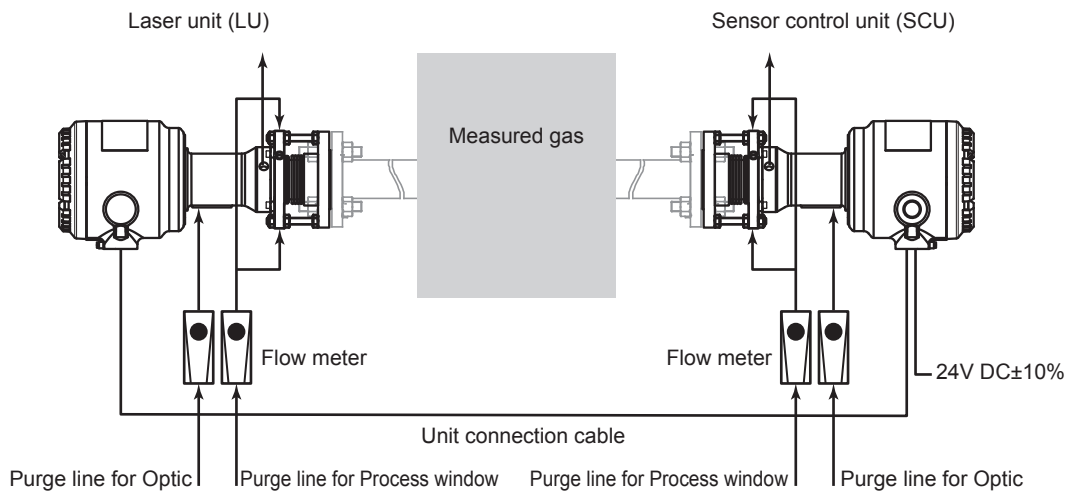
The non-contacting sensor allows for a variety of process types including corrosive, abrasive and condensing.

The first generation platform has been proven in many others for the measurements of O<sub>2</sub>, CO, CH<sub>4</sub>, NH<sub>3</sub>, H<sub>2</sub>O and many more NIR absorbing gases.

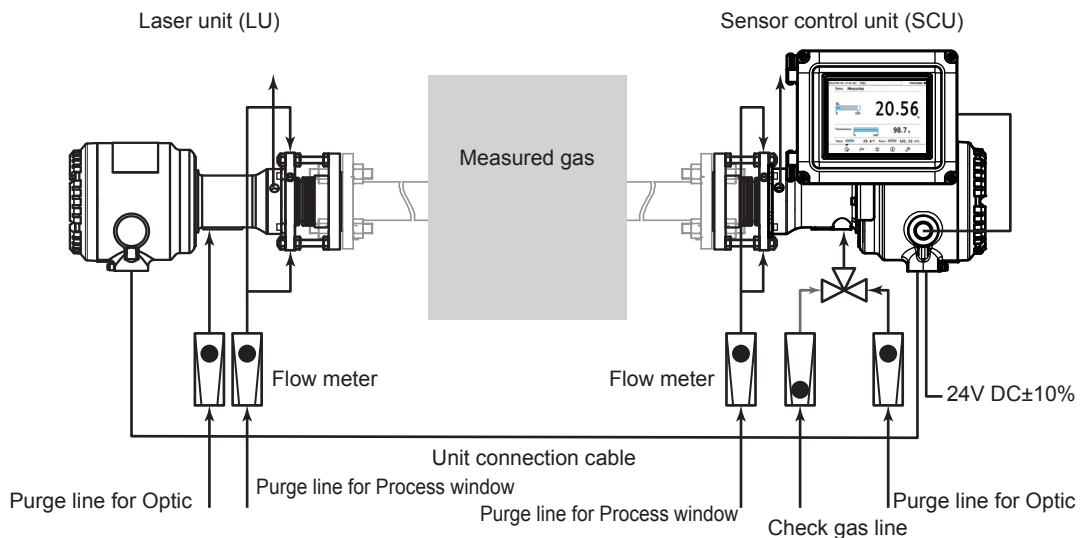
This second generation platform has improved reliability and ease of installation and maintenance while still meeting or exceeding designed application demands.

## 1.1 System configuration

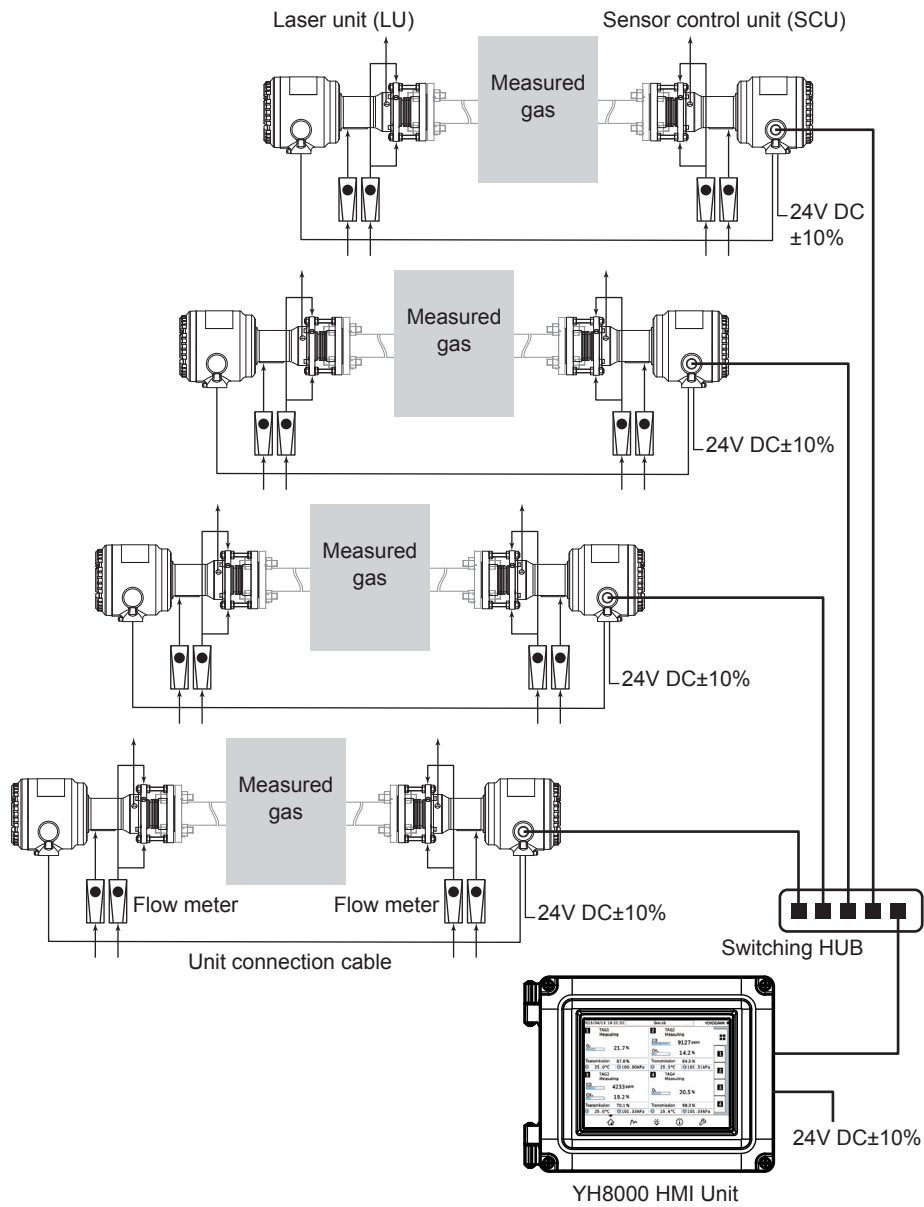
### Standard System Configuration



### System Configuration with YH8000 HMI Unit and Validation gas line



**Multi Analyzer Configuration with Remote HMI**

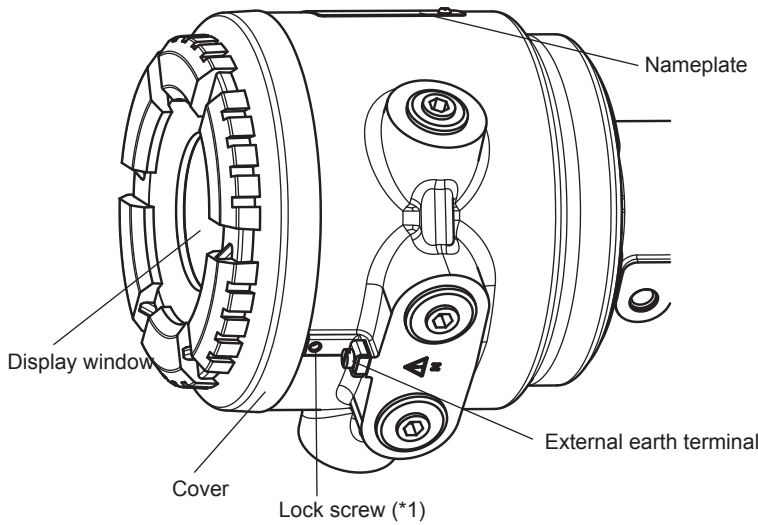


Note: If power supply is 100 to 240 V AC, purchase the Universal Power Supply M1276WW, separately.  
 If four multi analyzer configuration with remote HMI is made, five universal power supply including HMI are needed.

# 1.2 Name and Function of Each Part

TDLS8000 is composed Laser Unit and Sensor Control Unit.

## ■ TDLS8000 case

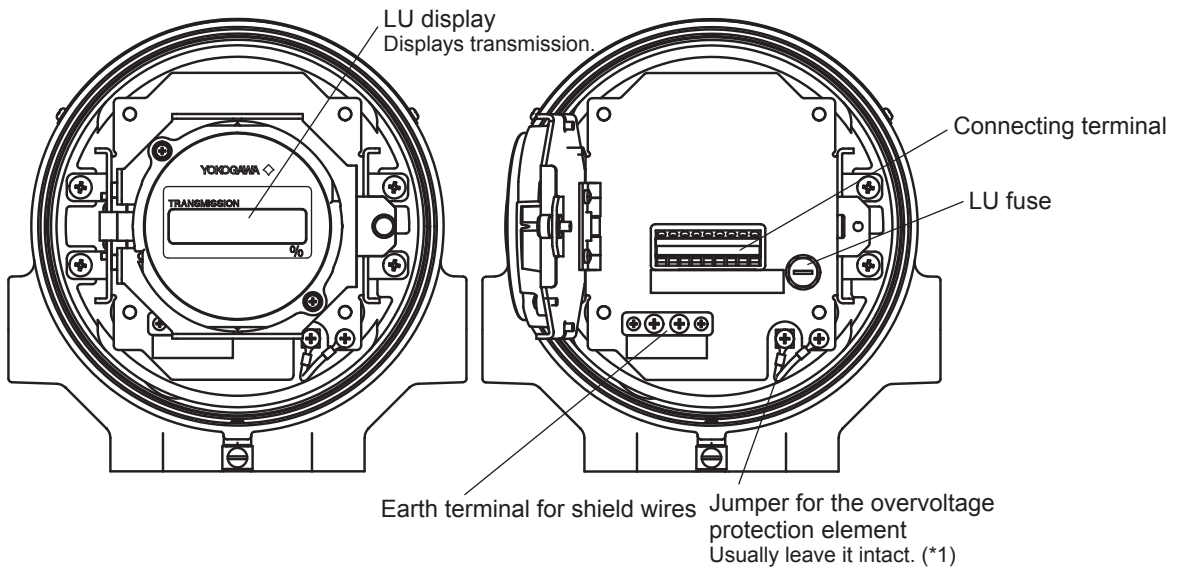


\*1: Close the cover securely and fix it with a lock screw. Loosen the lock screw before opening the cover.

### NOTE

Do not lose the lock screw when loosening it.

## ■ TDLS8000 laser unit



\*1: The TDLS8000 is equipped with an overvoltage protection element to prevent failure caused by surges and other overvoltages. This element may hinder the correct measurement of the insulation resistance of the power line during insulation tests. To disable this element, disconnect the jumper.

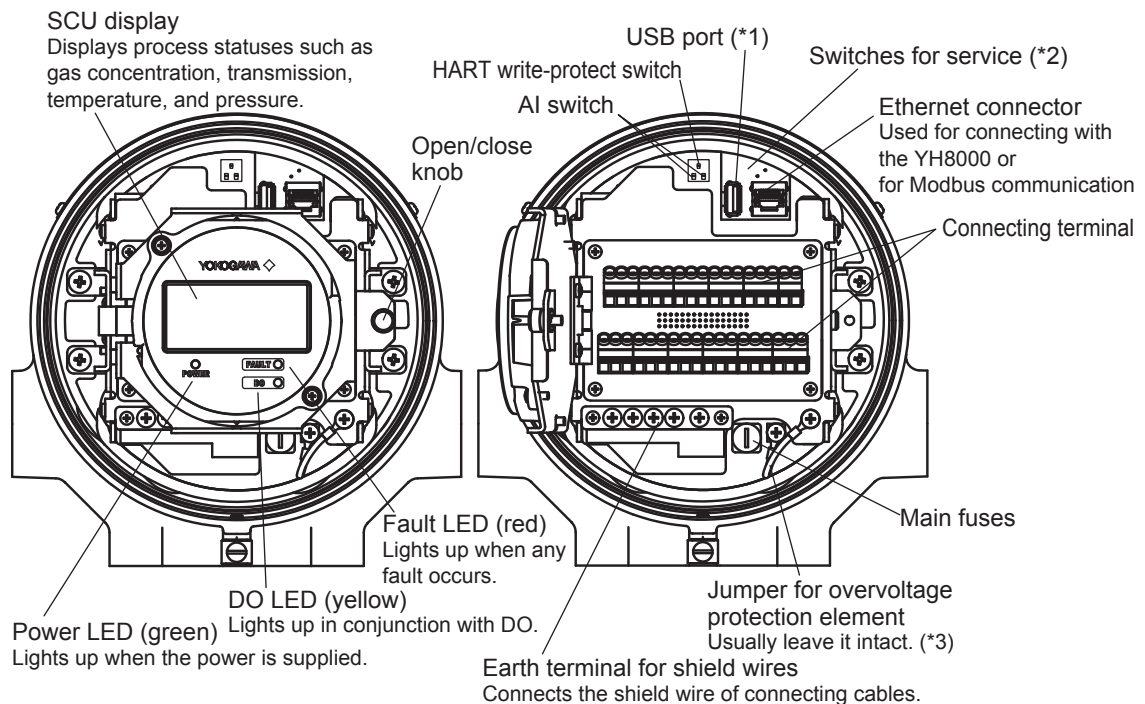
● **LU display**

The four-digit LED displays the transmission value. The sequence of display after power-on is as follows.

Timing	Description	Shown as
For approx. 5 seconds after power-on	No segment lights up.	
Until the first analysis result is updated	All segments light up.	
Whenever the analysis result is updated	The right-end dot blinks and transmission values are displayed. (Example: 92.0 [%])	

When the transmission is less than 1.0%, the value is displayed up to the second decimal place.

■ **TDLS8000 Sensor Control Unit**

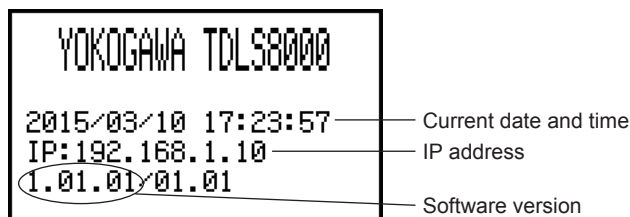


- \*1: On the USB port, do not plug anything except USB flash drive. For further information, see "9.13 Access to Stored Data in TDLS8000."
- \*2: Service staff use these switches for maintenance. Leave them all OFF.
- \*3: The TDLS8000 is equipped with an overvoltage protection element to prevent failure caused by surges and other overvoltages. This element may hinder the correct measurement of insulation resistance of the power line during insulation tests. To disable this element, disconnect the jumper.

● **SCU display**

**Starting screen**

The screen below is displayed for approx. 10 seconds after power-on.



LCD starting screen

**Normal screen**

After the starting screen, the following screen is displayed. The presentation of concentration values varies depending on the specifications of the TDLS8000.

O2	20.50 %	1st line
Trans	98.3 %	2nd line
Pres AI1	101.33 kPa	3rd line
Measuring	17:52	4th line
IP:192.168.1.10		5th line
		6th line

HART communication icon

**LCD normal screen (for single-gas measuring specifications)**

CO	2057.4 ppm	
CH4	35.12 %	
Trans	98.3 %	
Pres AI1	101.33 kPa	
Measuring	17:52	
IP:192.168.1.10		

HART communication icon

**LCD normal screen (for double-gas measuring specifications)**

**NOTE**

Measurements such as concentration and transmission are updated every analysis cycle. On the SCU display, the temperature and pressure values are displayed alternately in the 4th line every analysis cycle. This means that measurement is updated whenever the content of the 4th line changes.

The details of the information displayed in each line are as follows.

Line	Item	Display example												
1	Concentration of the 1st component gas (two lines are used for the single-gas measuring specifications) (*1)	O2 20.71%												
2	Concentration of the 2nd component gas (for double-gas measuring specifications) (*1)	CH4 1.82%												
3	Transmission	Trans 94.6%												
4	Temperature and pressure (displayed alternately for every analysis cycle)													
1	Process pressure: Displays "pressure input mode pressure value"	PresAI1 101.32kPa												
	<table border="1"> <thead> <tr> <th>Pressure input mode</th> <th>Display</th> </tr> </thead> <tbody> <tr> <td>Active Input: Input source is AI-1.</td> <td>Pres AI1</td> </tr> <tr> <td>Input source is Modbus communication.</td> <td>Pres COM</td> </tr> <tr> <td>Fixed</td> <td>Pres Fix</td> </tr> </tbody> </table>	Pressure input mode	Display	Active Input: Input source is AI-1.	Pres AI1	Input source is Modbus communication.	Pres COM	Fixed	Pres Fix					
Pressure input mode	Display													
Active Input: Input source is AI-1.	Pres AI1													
Input source is Modbus communication.	Pres COM													
Fixed	Pres Fix													
2	Process temperature: Displays "temperature input mode temperature value"	TempAI2 20.3°C												
	<table border="1"> <thead> <tr> <th>Temperature input mode</th> <th>Display</th> </tr> </thead> <tbody> <tr> <td>Active Input: Input source is AI-2.</td> <td>Temp AI2</td> </tr> <tr> <td>Input source is Modbus communication.</td> <td>Temp COM</td> </tr> <tr> <td>Fixed</td> <td>Temp Fix</td> </tr> <tr> <td>Active Ambient</td> <td>Temp ActA</td> </tr> <tr> <td>Active Peak (*2)</td> <td>Temp ActP</td> </tr> </tbody> </table>	Temperature input mode	Display	Active Input: Input source is AI-2.	Temp AI2	Input source is Modbus communication.	Temp COM	Fixed	Temp Fix	Active Ambient	Temp ActA	Active Peak (*2)	Temp ActP	
Temperature input mode	Display													
Active Input: Input source is AI-2.	Temp AI2													
Input source is Modbus communication.	Temp COM													
Fixed	Temp Fix													
Active Ambient	Temp ActA													
Active Peak (*2)	Temp ActP													

Line	Item	Display example														
5	Status or alarm information - Displays status information when there is no alarm. - Displays alarm information when there is an alarm. *: Displays the HART communication icon at the right end when HART commands are received.															
1	Status display: Displays the following equipment statuses. <table border="1"> <thead> <tr> <th>Equipment status</th> <th>Display example</th> </tr> </thead> <tbody> <tr> <td>During normal measurement</td> <td>Measuring hh:mm</td> </tr> <tr> <td>During warming-up</td> <td>Warm-up hh:mm</td> </tr> <tr> <td>During maintenance</td> <td>Maintenance hh:mm</td> </tr> <tr> <td>During calibration and validation</td> <td>Span Cal (for span calibration)</td> </tr> <tr> <td>During AO loop check or calibration</td> <td>AO1 Fixed=4.0mA (for AO-1 4 mA output)</td> </tr> <tr> <td>During AI calibration</td> <td>AI-1 (Pres) Cal (for AI-1 calibration)</td> </tr> </tbody> </table>	Equipment status	Display example	During normal measurement	Measuring hh:mm	During warming-up	Warm-up hh:mm	During maintenance	Maintenance hh:mm	During calibration and validation	Span Cal (for span calibration)	During AO loop check or calibration	AO1 Fixed=4.0mA (for AO-1 4 mA output)	During AI calibration	AI-1 (Pres) Cal (for AI-1 calibration)	Measuring 12:10
Equipment status	Display example															
During normal measurement	Measuring hh:mm															
During warming-up	Warm-up hh:mm															
During maintenance	Maintenance hh:mm															
During calibration and validation	Span Cal (for span calibration)															
During AO loop check or calibration	AO1 Fixed=4.0mA (for AO-1 4 mA output)															
During AI calibration	AI-1 (Pres) Cal (for AI-1 calibration)															
2	Alarm display: Displays “[W/F(alarm number)] alarm name” - Alternates displays every 5 seconds when multiple alarms are generated. - [W##] means warning, [F##] means fault. - Fault highlights characters.	[F53] Trans Lost														
6	Various setup information Alternately displays the following items every 5 seconds.															
1	IP address	IP: 192.168.1.10														
6	HART address	HART ADRS: 0														
3	LU temperature	LU: 34.5°C														
4	SCU temperature	SCU: 33.4°C														

\*1: Displays the invalid value “\*\*\*\*” while the following alarms are generated. Example: 02 \*\*\*%

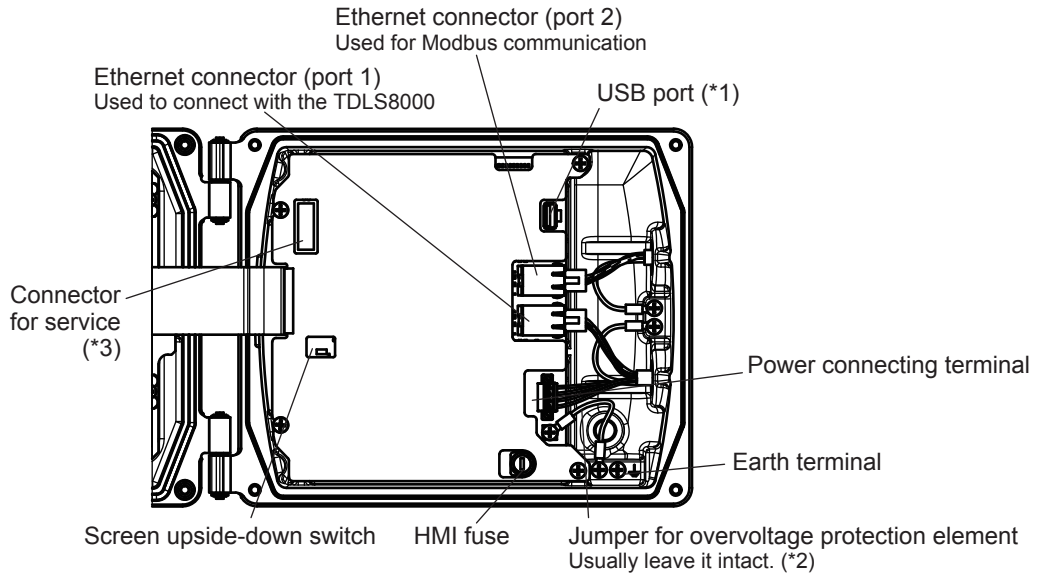
Number	Alarm
49	Detector signal high
50	Peak center out of range
52	Absorption too high
53	Transmission lost
56	Outlier Rejection Limit

\*2: Can be set only for certain measurement target gas (application).

### Spectrum screen

Absorption spectrum and receiving signals can be checked. Displaying the spectrum screen requires changes in the setting of the TDLS8000. See “6.9.4 Display.”

## ■ YH8000 HMI Unit



- \*1: On the USB port, do not plug anything except USB flash drive. For further information, see "9.13 Access to Stored Data in TDLS8000."
- \*2: The YH8000 is equipped with an overvoltage protection element to prevent failure caused by surges and other overvoltages. This element may hinder the correct measurement of insulation resistance of the power line during insulation tests. To disable this element, disconnect the jumper.
- \*3: Service staff use this connector for maintenance.





## 2. Specifications

### 2.1 TDLS8000 Tunable Diode Laser Spectrometer Specifications

Measurement object: O<sub>2</sub>, CO, CO or CH<sub>4</sub>, CO<sub>2</sub>, CO + CO<sub>2</sub>, H<sub>2</sub>O, NH<sub>3</sub>, NH<sub>3</sub> + H<sub>2</sub>O, H<sub>2</sub>S, HCl  
concentration in combustion exhaust gas and process gas

If other gas measurements are required, consult with Yokogawa.

Measurement system: Tunable diode laser spectroscopy

Light source; Near-infrared tunable diode laser

Measured components and ranges:

Measured component	Min. range	Max. range
O <sub>2</sub>	0-1%	0-25%
CO(ppm)	0-200 ppm	0-10000 ppm
CO or CH <sub>4</sub> (*3)	CO	0-200 ppm
	CH <sub>4</sub>	0-5%
NH <sub>3</sub>	0-30 ppm	0-5000 ppm
H <sub>2</sub> O(ppm) in non HC (*1)	0-30 ppm	0-30000 ppm
H <sub>2</sub> O(ppm) in HC (*2)	0-30 ppm	0-30000 ppm
CO (%)	0-20%	0-50%
CO (%) + CO <sub>2</sub> (%)	0-30%	0-100%
NH <sub>3</sub> + H <sub>2</sub> O	NH <sub>3</sub>	0-30 ppm
	H <sub>2</sub> O	0-5%
H <sub>2</sub> S	0-5%	0-100%
CO <sub>2</sub> (%) High Range	0-1%	0-5%
CO <sub>2</sub> (%) Extend. Range	0-30%	0-50%
H <sub>2</sub> O (%)	0-10%	0-100%
HCl	0-50 ppm	0-5,000 ppm

\*1: Non hydrocarbon background

\*2: Hydrocarbon background

\*3: Please consult with Yokogawa if CO or CH<sub>4</sub> ingredient coexists.

Please consult with Yokogawa if the measuring range for your sample gas is outside of the above ranges.

Optical path length: Optical distance between the laser unit and the sensor control unit

Standard; 0.5 to 6 m (Application dependent)

Max; 30 m (With optional Large Aperture Optics (LAO))

25 m (Zone 1/Div.1/Flameproof "d" with LAO)

Note: If your optical path length is under 0.5 m or over 30 m, please consult with Yokogawa.

Safety, EMC, and RoHS conformity standards:

Safety conformity standards:

CE EN61010-1, EN61010-2-030

UL UL61010-1, UL 61010-2-030

CSA CAN/CSA-C22.2 No.61010-1, CAN/CSA-C22.2 No.61010-2-030

GB GB30439 Part 1

Installation altitude: 2000 m or less

Installation category: I (Anticipated transient overvoltage 330V)

Measuring category: O (Other)

Pollution degree: 2, Indoor/Outdoor use

Note: Installation category, called overvoltage category, specifies impulse withstand voltage. Pollution degree indicates the degree of existence of solid, liquid, gas or other inclusions which may reduce dielectric strength.

EMC conformity standards:

CE EN55011 Class A Group 1

EN61326-1 Class A Table 2 (For use in industrial location), EN61326-2-3

RCM EN55011 Class A Group 1

KC KN11 Class A Group 1, KN61000-6-2 (Korea Electromagnetic Conformity)

RoHS conformity standards: EN50581

Laser classification; CSA E60825-1-03(R2012), CE EN60825-1:2007, GB7247.1-2012  
 FDA 21CFR part 1040.10  
 Class 1 laser product

SIL Certification; IEC 61508:Functional safety of Electrical/electronic/programmable electronic related systems; SIL 2 capability for single analyzer use, SIL 3 capability for dual analyzer use.

Display:  
 128 x 64 dots LCD; On Sensor Control Unit  
 Status LEDs; 3 on Sensor Control Unit (Green: Power, Orange: DO, Red: Fault)  
 4 digit 7-segment LEDs; On Laser Unit

Display items: LCD on Sensor Control Unit; Gas concentration, Transmission, Process gas temperature (AI), Process gas pressure (AI), System status, Alarm information, System information (Product serial no., Laser module serial no., Output signal, Setting parameter, IP address, HART address, Optical path length, Analyzer internal temperature)  
 7-segment LEDs on Laser Unit; Transmission

Analog output: 2 points, 4 to 20 mA DC (Isolated from the power supply and ground, Max. load resistance 550  $\Omega$ )  
 Output types; Gas concentration, Transmission, Process gas temperature, Process gas pressure  
 Output range; 3.0 to 21.6 mA DC

Digital communications:  
 HART; On analog output signal one (AO-1)  
 Load resistance; 250 to 550  $\Omega$  (Include cable resistance)  
 Ethernet; RJ-45 connector in Sensor Control Unit  
 Protocol; Modbus/TCP  
 Communication speed; 100 Mbps

Digital output: 2 points, contact rating 24V DC, 1A  
 DO;  
 Function: Activate during Warning / Calibration / Validation / Warm up / Maintenance conditions  
 Contact Specification: Relay contact output (Isolated from the power supply and ground), C-contact (NC/NO/COM)

Fault;  
 Function: Activate during normal conditions, not activate during Fault condition or when the system power is off  
 Contact Specification: Relay contact output (Isolated from the power supply and ground), A-contact (NC/COM)

Valve control output: 2 points  
 Function; Activate calibration or validation solenoid valves for zero, span or validation gas.  
 Output signal; 24V DC, 500 mA Max. per terminal

Alarm:  
 Warning; Gas concentration low, Gas concentration high, Transmission low, Process pressure low, Process pressure high, Process temperature low, Process temperature high, Validation required, Validation failure, Zero calibration error, Span calibration error, Non process alarm, External alarm, Detector signal high, Absorption too high  
 Fault; Laser module temperature low, Laser module temperature high, Laser temperature low, Laser temperature high, Peak center out of range, Reference peak height low, Transmission lost, Reference transmission low, Reference peak height high, Laser unit failure, Laser module error, File access error, E2PROM access error.

Digital input: 2 points  
 Function; External Alarm/Calibration start/Validation start/Stream switch (Valve control)  
 Contact specification; Zero voltage contact input (Isolated from the power supply and ground)  
 Input signal; Open signal: 100 k $\Omega$  or more, Close signal: 200  $\Omega$  or less

Analog input: 2 points  
 Signal type; 4 to 20 mA DC (Isolated from the power supply and Ground), with selectable powered/unpowered function  
 Input signal range; 2.4 to 21.6 mA DC  
 Input types; Process gas temperature, Process gas pressure

Transmitter power supply; 15 V DC or higher (at 20 mA DC)  
26 V DC or less (at 0 mA DC)

Note: This voltage is generated between the AI terminals of TDLS8000. When calculating the minimum operating voltage for transmitters, consider to allow margins for voltage drop in external wiring.

Self-diagnostics:

Laser Unit temperature, Sensor Control Unit temperature, Laser temperature, Detector signal level, Memory read/write function, Peak locking condition

Calibration:

Calibration method; Zero/Span calibration  
Calibration mode; Manual, Auto (Time initiate, Remote initiate (DI/Modbus), Semi-Auto (YH8000/HART))

Validation:

Validation method; Up to 2 points  
Validation mode; Manual, Auto (Time initiated, Remote initiate (DI/Modbus)), Semi-Auto (YH8000/HART)

Power supply: 24V DC +/-10%

If your power supply is 100 to 240 V AC, Universal Power Supply, M1276WW (sold separately), is required

Power consumption:

Max. 20W; TDLS8000 only  
Max. 60W; TDLS8000 with YH8000 and 2 solenoid valves

Protection degree: IP66, Type 4X

Material: Case; Aluminum alloy

Wetted materials: 316 SS, BK-7 glass, Teflon encapsulated FKM (O-ring for alignment flange), Silicone (O-ring for LAO)

Paint color: Mint green (RAL 190 30 15 or equivalent)

Weight:

Sensor Control Unit; 8 kg  
Laser Unit; 8 kg  
Large Aperture Optics; 14 kg  
ANSI Class 150-2-RF (Eq.) Alignment Flange; 5 kg/pc  
ANSI Class 150-3-RF (Eq.) Alignment Flange; 7 kg/pc  
ANSI Class 150-4-RF (Eq.) Alignment Flange; 9 kg/pc  
DIN PN16-DN50-D (Eq.) Alignment Flange; 5 kg/pc  
DIN PN16-DN80-D (Eq.) Alignment Flange; 6 kg/pc  
JIS 10K-50-FF (Eq.) Alignment Flange; 5 kg/pc  
JIS 10K-80-FF (Eq.) Alignment Flange; 6 kg/pc  
Flow Cell Alignment Flange; 5 kg/pc

Process gas condition:

Process gas temperature; Max. 1,500°C, Application dependent  
Process gas pressure; Max. 1 MPa abs., Min. 90 kPa abs., Application dependent  
Max. 15 kPa G with LAO unit

Note: When using TDLS8000 as CE marking compliance product, it has following limitation.

General purpose model (-G1, -G2): The upper limit of the measurement gas pressure is 50kPa in gauge pressure.  
ATEX model (-S1, -S2): The upper limit of the measurement gas pressure is 500kPa abs. The unstable gas defined by following cannot be measured.

An unstable gas in this context is a gas liable to transform itself spontaneously, producing a sudden pressure increase. Such transformation as an example can result from a relatively small variation of an operating parameter (e.g. pressure, temperature, presence of catalyzing material) in a confined volume.

This includes gases that are classified as chemically unstable gases according to CLP Regulation (EC) No 1272/2008 as amended.

Typical examples of unstable gases: acetylene (UN 1001), methyl acetylene (UN 1060), vinylfluoride (UN 1860), ozone and dinitrogen oxide (UN 1067).

For further examples, see Table 35.1 of the UN Manual of Tests and Criteria.

Dust in process gas; 20 g/m<sup>3</sup> or less  
(Dust loading levels are dependent upon the application, OPL and other installation factors)

Warm-up time: 5 min.

Installation condition:

Ambient operating temperature; -20 to 55°C  
 Storage temperature; -30 to 70°C  
 Humidity; 0 to 95%RH at 40°C (Non-condensing)  
 Mounting flange type; ASME B16.5, DIN, JIS

Cable entries;

Sensor Control Unit: 1/2NPT or M20x1.5mm, one hole  
 3/4NPT or M25x1.5mm, three holes

Laser Unit: 3/4 NPT or M25x1.5mm, one hole

Purge gas connections; 1/4NPT or Rc1/4

If other gas connections are required, please consult with Yokogawa.

Purge gas; Theoretically, instrument air could be used as a purge gas for all of the below applications except for oxygen or H<sub>2</sub>O measurement. Choosing between using nitrogen or instrument air or purge gas will ultimately depend upon further application details and the desired precision of the measurement. All gasses should be clean and dry.

Recommended purge gasses:

O<sub>2</sub> analyzer: N<sub>2</sub> (99.99% or greater, application dependent)

H<sub>2</sub>O ppm analyzer: N<sub>2</sub> (99.99% or greater with < 20 ppm H<sub>2</sub>O for feed to the optional dryer package)

CO, CO or CH<sub>4</sub>, CO<sub>2</sub>, CO + CO<sub>2</sub>, NH<sub>3</sub>, NH<sub>3</sub> + H<sub>2</sub>O, H<sub>2</sub>S, HCl analyzer:

N<sub>2</sub> (99.99% or greater, application dependent) or Instrument air

Purge gas flow rates;

Optic(Analyzer internal purge): 2 to 20L/min (Application dependent)

2 to 20 L/min for SCU/LU area and 50 to 70 mL/min for SCU/LU Ex area (Zone 1/Div.1/Flameproof "d", Refer to 3.4.3)

\*Not more than 10 kPa at the inlet for Zone 1/Div.1/Flameproof "d" and Zone 2/Div.2/Type of protection "n"

Process window purge: 5 to 30 L/min (Application dependent)

## ■ Characteristics

Repeatability / Linearity:

Measured gas	Repeatability	Linearity
O <sub>2</sub>	+/- 1% reading or +/- 0.01 %O <sub>2</sub> , whichever is greater	+/- 1% F.S.
CO (ppm)	+/- 2% reading or +/- 1 ppm CO, whichever is greater	+/- 1% F.S.
CO + CH <sub>4</sub>	CO +/- 2% reading or +/- 1 ppm CO, whichever is greater	+/- 2% F.S.
	CH <sub>4</sub> +/- 4% reading or +/- 0.02% CH <sub>4</sub> , whichever is greater	+/- 4% F.S.
NH <sub>3</sub>	+/- 2% reading or +/- 1 ppm NH <sub>3</sub> , whichever is greater	+/- 2% F.S.
H <sub>2</sub> O (ppm) in non HC	+/- 2% reading or +/- 0.1 ppm H <sub>2</sub> O, whichever is greater	+/- 1% F.S.
H <sub>2</sub> O (ppm) in HC	+/- 2% reading or +/- 0.1 ppm H <sub>2</sub> O, whichever is greater	+/- 1% F.S.
CO (%)	+/- 1% reading or +/- 0.01% CO, whichever is greater	+/- 1% F.S.
CO (%) + CO <sub>2</sub> (%)	CO +/- 1% reading or +/- 0.1% CO, whichever is greater	+/- 1% F.S.
	CO <sub>2</sub> +/- 1% reading or +/- 0.1% CO <sub>2</sub> , whichever is greater	+/- 1% F.S.
NH <sub>3</sub> + H <sub>2</sub> O	NH <sub>3</sub> +/- 2% reading or +/- 1 ppm NH <sub>3</sub> , whichever is greater	+/- 2% F.S.
	H <sub>2</sub> O +/- 4% reading or +/- 0.05% H <sub>2</sub> O, whichever is greater	+/- 2% F.S.
H <sub>2</sub> S	+/- 1% reading or +/- 0.005% H <sub>2</sub> S, whichever is greater	+/- 1% F.S.
CO <sub>2</sub> (%) High Range	+/- 1% reading or +/- 0.005% CO <sub>2</sub> , whichever is greater	+/- 1% F.S.
CO <sub>2</sub> (%) Extend. Range	+/- 1% reading or +/- 0.02% CO <sub>2</sub> , whichever is greater	+/- 1% F.S.
H <sub>2</sub> O (%)	+/- 1% reading or +/- 0.004% H <sub>2</sub> O, whichever is greater	+/- 1% F.S.
HCl	+/- 1% reading or +/- 2.5 ppm HCl, whichever is greater	+/- 2% F.S.

Measurement conditions: Gas temperature; 25°C, Gas pressure; 0.1 MPa, Optical path length; 1 m

Data Update Cycle:

Standard; Approx. 2 seconds (Response time may increase for non-standard applications)

If less than 2 seconds response is required, please consult with Yokogawa

Zero Drift: Typically <0.1% of the minimum range over 24 months  
Influences on the Measurement - Application dependent

- A. Temperature: The temperature of the measured gas should be taken into account by the analyzer so that the reading can be corrected on a real time basis. The effect is specific to each different measurement gas.
  - a. If the gas temperature is constant at the desired measurement condition, then a fixed gas temperature may be programmed into the analyzer. This fixed value can be used in real time by the analyzer to provide a temperature-compensated reading.
  - b. If the gas temperature is relatively equal to the ambient temperature, then an integral sensor value may be utilized by the analyzer. This active ambient value is used real time by the analyzer to provide a temperature compensated reading.
  - c. If the gas temperature is variable, then an external sensor value may be utilized by the analyzer. This active input value can be used in real time by the analyzer to provide a temperature compensated reading.
- B. Pressure: The pressure of the measured gas must be taken into account by the analyzer so that the reading can be corrected on a real time basis. The effect is specific to each different measurement gas.
  - a. If the gas pressure is constant at the desired measurement condition, then a fixed gas pressure may be programmed to the analyzer. This fixed value can be used in real time by the analyzer to provide a pressure compensated reading.
  - b. If the gas pressure is variable, then an external sensor value may be utilized by the analyzer. This active input value can be used in real time by the analyzer to provide a pressure compensated reading.

**■ Hazardous area classifications:**

Division 1, Zone 1: Explosionproof  
TDLS8000-D1 (FM Approval for US)

Division system:

Type of protection: Explosionproof for Class I, Division 1, Groups A, B, C, D, T5  
Dust-Ignitionproof for Class II/III, Division 1, Groups E, F, G, T5

Enclosure rating: Type4X

Applicable standards: FM Class 3600: 2011, FM Class 3615: 2006, FM Class 3616: 2011, FM Class 3810: 2005, NEMA 250: 2003

Zone system:

Type of protection: Class I, Zone 1, AEx db IIC T5 Zone 21, AEx tb IIIC T100°C

Enclosure rating: IP66

Applicable standards: ANSI/ISA 60079-0-2013  
ANSI/UL 60079-1:2015  
ANSI/ISA 60079-31-2015  
ANSI/IEC 60529-2004 (R2011)

TDLS8000-C1 (FM Approval for Canada)

Type of protection: Ex db IIC T5 Gb Class II/III, Division 1, Groups E, F, G, T5  
Ex tb IIIC T100 °c, Db

Enclosure rating: IP66, Type4X

Applicable standards: CAN/CSA-C22.2 NO. 0-10 (R2015)  
CAN/CSA-C22.2 NO. 0.4-04 (R2013)  
C22.2 NO. 0.5-1982 (R2012)  
C22.2 NO.25-1966 (R2014)  
C22.2 NO.94.2-07 (R2012)  
CAN/CSA-C22.2 NO. 60079-0:15  
CAN/CSA-C22.2 NO. 60079-1:16  
CAN/CSA-C22.2 NO. 60079-31:15  
CAN/CSA-C22.2 NO. 60529-05 (R2015)  
CAN/CSA-C22.2 NO. 61010-1-12  
CAN/CSA-C22.2 NO. 61010-2-030-12  
ANSI/ISA 12.27.01-2011

TDLS8000-S1 (ATEX)

Type of protection: II 2(1) G Ex db [op is T6 Ga] IIC T5 Gb  
II 2 D Ex tb IIIC T100 °C Db

Enclosure rating: Applicable standards:	IP66 (In Accordance with EN 60529) EN 60079-0:2012+A11:2013, EN 60079-1:2014, EN 60079-28:2015, EN 60079-31:2014,
TDLS8000-E1 (IECEX)	
Type of protection: Enclosure rating: Applicable standards:	Ex db [op is T6 Ga] IIC T5 Gb Ex tb IIIC T100°C Db IP66 (In Accordance with IEC 60529) IEC 60079-0:2011, IEC 60079-1:2014, IEC 60079-28:2015, IEC 60079-31:2013
TDLS8000-J1 (Japan Ex)	
Type of protection: Applicable standards:	Ex d IIC T5 Gb JNIOSH-TR-46-1:2015 JNIOSH-TR-46-2:2015
TDLS8000-Q1, -R1 (EAC)	
Type of protection: Enclosure rating: Applicable standards:	1Ex d [op is T6 Ga] IIC T5 Gb X Ex tb IIIC T100 °C Db X IP66 (In accordance with GOST 14254-96) GOST R IEC 60079-0-2011 GOST IEC 60079-1-2011 GOST 31610.28-2012 GOST IEC 60079-31-2013
<b>Division 2, Zone 2: Nonincendive/Type n</b>	
TDLS8000-D2 (FM Approval for US)	
Division system: Type of protection: Enclosure rating: Applicable standards:	Nonincendive for Class I, Division 2, Groups A, B, C, D, T5 Dust-Ignitionproof for Class II/III, Division 1, Groups E, F, G, T5 Type 4X FM Class 3600: 2011, FM Class 3611: 2004, FM Class 3616: 2011, FM Class 3810: 2005 NEMA 250: 2003
Zone system:	
Type of protection: Enclosure Rating: Applicable standards:	Class I, Zone 2, AEx nA nC IIC T5 Zone 21, AEx tb IIIC T100°C IP66 ANSI/ISA-60079-0-2013, ANSI/ISA-60079-15-2012, ANSI/ISA- 60079-31-2015, ANSI/IEC 60529-2004 (R2011)
TDLS8000-C2 (FM Approval for Canada)	
Type of protection: Enclosure rating: Applicable standards:	Ex nA nC IIC T5 Class II/III, Division 1, Groups E, F, G IP66, Type 4X CAN/CSA-C22.2 No.0-10 (R2015), CAN/CSA-C22.2 No.25- 1966 (R2014), C22.2 No.94.2-07 (R2012), CAN/CSA-C22.2 No.60079-0:15, CAN/CSA-C22.2 No.60079-15:16, CAN/ CSA-C22.2 No.61010-1-12, CAN/CSA-C22.2 No.61010-2-030- 12, CAN/CSA-C22.2 No.60529-05 (R2010) ANSI/ISA-12.27.01-2011
TDLS8000-S2 (ATEX)	
Type of protection: Enclosure rating: Applicable standards:	II 3(1) G Ex nA nC [op is T6 Ga] IIC T5 Gc II 2 D Ex tb IIIC T100 °C Db IP66 (In accordance with EN 60529) EN 60079-0: 2012+A11: 2013, EN 60079-15: 2010, EN 60079- 28: 2007, EN 60079-28: 2015, EN 60079-31: 2014
TDLS8000-E2 (IECEX)	
Type of protection: Enclosure rating: Applicable standards:	Ex nA nC [op is T6 Ga] IIC T5 Gc Ex tb IIIC T100°C Db IP66 (In accordance with IEC 60529) IEC 60079-0: 2011, IEC 60079-15: 2010, IEC 60079-28: 2015, IEC 60079-31: 2013

<b>TDLS8000-K2 (KOSHA)</b>	
Type of protection:	Ex nA nC IIC T5 Ex tD A21 T100 °C
Enclosure rating:	IP66 (In accordance with IEC 60529)
Applicable standards:	Notice of Ministry of Labor No. 2013-54 Harmonized with IEC 60079-0: 2011, IEC 60079-15: 2010, IEC 60079-28: 2015, IEC 60079-31: 2013
<b>TDLS8000-N2 (NEPSI)</b>	
Type of protection:	Ex nA nC [op is T6 Ga] IIC T5 Gc Ex tD A21 IP66 T100°C
Enclosure rating:	IP66 (In accordance with GB 4208)
Applicable standards:	GB 3836.1-2010, GB 3836.8-2014, GB 12476.1-2013, GB 12476.5-2013, IEC 60079-28:2015
<b>TDLS8000-Q2, -R2 (EAC)</b>	
Type of protection:	2Ex nA nC [op is T6 Ga] IIC T5 Gc X Ex tb IIIC T100 °C Db X
Enclosure rating:	IP66 (In accordance with GOST 14254-96)
Applicable standards:	GOST R IEC 60079-0-2011 GOST R IEC 60079-15-2010 GOST 31610.28-2012 GOST IEC 60079-31-2013
<b>TDLS8000-J2 (Japan Ex)</b>	
Type of protection:	Ex nA nC IIC T5 Gc Ex tb IIIC T100 °C Db
Enclosure rating:	IP66 (In accordance with IEC 60529)
Applicable standards:	JNIOOSH-TR-46-1:2015 JNIOOSH-TR-46-8:2015 JNIOOSH-TR-46-9:2015

## 2.2 Others

### 2.2.1 YH8000 HMI Unit

The YH8000 is an HMI designed specifically for the TDLS8000. The YH8000 features an easy-to-use touchscreen 7.5 inch color LCD which can be used to display maintenance information, display alarm statuses and records, and set all parameters of the TDLS8000.

The YH8000 can be installed directly on the TDLS8000 or installed remotely.

An Ethernet connection is used to connect the YH8000 to up to four TDLS8000s simultaneously via a hub.

#### ● General Specifications

Display: Touchscreen 7.5 inch TFT color LCD panel, 640 x 480 (VGA)

Communication: Ethernet; RJ-45 connector

Communication speed; 100 Mbps

Case: Aluminum alloy

Paint color: Mint green (RAL 190 30 15 or equivalent)

Protection degree of enclosure: IP65, Type 4X

Window: Polycarbonate

Weight: 4 kg

Mounting: Analyzer mount (Front, left-side, right-side) with tilt function, Pipe mount, or Panel mount (Stainless steel)

Cable Entries: 1/2NPT or M20x1.5 mm, two holes

Installation conditions:

Ambient operating temperature; -20 to 55°C

Storage temperature: -30 to 70°C

Humidity: 10 to 90%RH at 40°C (Non-condensing)



Power Supply: 24V DC +/-10%  
 Power consumption: Max.12 W

Safety, EMC, and RoHS conformity standards:

Safety conformity standards:

CE EN61010-1  
 UL UL61010-1  
 CSA CAN/CSA-C22.2 No.61010-1  
 GB GB30439 Part 1  
 Installation Altitude: 2000 m or less  
 Installation category: I (Anticipated transient overvoltage 330 V)  
 Pollution degree: 2, Indoor/Outdoor use

EMC conformity standards:

CE EN55011 Class A Group 1  
 EN61326-1 Class A Table 2 (For use in industrial location)  
 RCM EN55011 Class A Group 1  
 KC KN11 Class A Group 1, KN61000-6-2 (Korea Electromagnetic Conformity)

RoHS conformity standards: EN50581

## ● Hazardous area classifications

### Division 2, Zone2: Nonincendive/Type n

YH8000-D2 (FM Approval for US)

Division system

Type of protection: Nonincendive for Class I, Division 2, Groups A, B, C, D, T5  
 Enclosure rating: Type 4X  
 Applicable standards: FM Class 3600: 2011, FM Class 3611: 2004, FM Class 3810:  
 2005, NEMA 250: 2003

Zone system

Type of protection: Class I, Zone 2, AEx nA ic IIC T5  
 Enclosure rating: IP65  
 Applicable standards: ANSI/ISA-60079-0-2013, ANSI/ISA-60079-11-2014, ANSI/ISA-  
 60079-15-2012, ANSI/IEC 60529-2004 (R2011)

YH8000-C2 (FM Approval for Canada)

Type of protection: Ex nA nL IIC T5  
 Enclosure rating: IP65, Type 4X  
 Applicable standards: CAN/CSA-C22.2 No. 0-10 (R2015), CAN/CSA-C22.2 No. 94.1-07  
 (R2012), CAN/CSA-C22.2 No. 94.2-07 (R2012), CAN/CSA-C22.2  
 No.60079-0:11, CAN/CSA-C22.2 No.60079-15:12, CAN/CSA-C22.2  
 No.61010-1-12, CAN/CSA No.60529-05 (R2010)

YH8000-S2 (ATEX)

Type of protection: II 3 G Ex nA ic IIC T5 Gc  
 Enclosure rating: IP65 (In accordance with EN 60529)  
 Applicable standards: EN 60079-0: 2012+A11: 2013, EN 60079-11: 2012, EN 60079-15: 2010

YH8000-E2 (IECEX)

Type of protection: Ex nA ic IIC T5 Gc  
 Enclosure rating: IP65 (In accordance with IEC 60529)  
 Applicable standards: IEC 60079-0: 2011  
 IEC 60079-11: 2011  
 IEC 60079-15: 2010

YH8000-J2 (Japan Ex)

Type of protection: Ex nA ic IIC T5 Gc  
 Enclosure rating: IP54 (In accordance with IEC 60529)(\*)

(\*) IP 54, which is minimum requirement of Ex standards, is confirmed at the conformance assessment of Japan Ex.  
 YH8000 can be used in the environment required IP65.

Applicable standards: JNIOOSH-TR-46-1:2015  
 JNIOOSH-TR-46-6:2015  
 JNIOOSH-TR-46-8:2015

YH8000-K2 (KOSHA)

Type of protection: Ex nA nL IIC T5  
 Enclosure rating: IP65 (In accordance with IEC 60529)  
 Applicable standards: Notice of Ministry of Labor No. 2013-54  
 Harmonized with IEC60079-0: 2011, IEC 60079-11: 2011, IEC 60079-15:2010

YH8000-N2 (NEPSI)

Type of protection: Ex nA ic IIC T5 Gc  
 Enclosure rating: IP65 (In accordance with GB 4208)  
 Applicable standards: GB 3836.1-2010,  
 GB 3836.4-2010,  
 GB 3836.8-2014

YH8000-R2 (EAC)

Type of protection: 2Ex nA ic IIC T5 Gc X  
 Enclosure rating: IP65 (In accordance with GOST 14254-96)  
 Applicable standards: GOST R IEC 60079-0-2011  
 GOST R IEC 60079-15-2010

## 2.2.2 IF8000 Isolation Flanges

A process isolation flange protects the TDLS8000 from the process gas pressure and the heat, dust, and corrosive elements of the process gas. A process isolation flange must be installed in the following situations.

- When the process gas pressure exceeds 500 kPa
- When the process temperature is high and the temperature of the process window area exceeds 55°C even when process window purge is performed.
- When the process dust level is high and the adherence of dust or intrusion of corrosive elements cannot be prevented even when process window purge is performed.

The IF8000 isolation flanges can be used for additional protection in in-situ or bypass installations.

Note: Must use in conjunction with alignment flanges

### ● General Specifications

Process connections: (See next table)  
 Heatresistance temperature: 200°C max  
 Measured gas pressure: Max. 1 MPa abs.  
 Wetted materials: Sapphire, 316 SS, Monel 400, Kalrez (O-ring)  
 Weight;

Process connection	Analyzer connection	Approx. Weight	
		316SS	Monel 400
ANSI Class 150-2-RF Flange	ANSI Class 150-2-RF Flange	5 kg/pc	6 kg/pc
ANSI Class 300-2-RF Flange		7 kg/pc	7 kg/pc
ANSI Class 150-3-RF Flange		8 kg/pc	9 kg/pc
ANSI Class 300-3-RF Flange		11 kg/pc	12 kg/pc
ANSI Class 150-4-RF Flange		12 kg/pc	14 kg/pc
DIN PN16-DN50 Flange	DIN PN16-DN50 Flange	7 kg/pc	7 kg/pc
DIN PN16-DN80 Flange		10 kg/pc	11 kg/pc
JIS 10K-50-FF Flange		7 kg/pc	7 kg/pc
JIS 10K-80-FF Flange		9 kg/pc	10 kg/pc

Note: When using TDLS8000 as CE marking compliance product, the upper limit of the measurement gas pressure is 50kPa in gauge pressure.

## 2.2.3 YC8000 Flow Cell

Used for extracting sample streams at any location.

Note: Must use in conjunction with alignment flanges ("-FC")

● **General Specifications**

Gas temperature: 200°C max

Gas pressure: Max. 1 MPa abs.

Wetted materials: Sapphire, 316 SS, Monel 400, Kalrez (O-ring)

Weight;

<b>Material/Optical Path Length</b>	<b>1016 mm (40 inch)</b>	<b>1524 mm(60 inch)</b>
Monel 400	Approx. 15 kg	Approx. 18 kg
316SS	Approx. 14 kg	Approx. 17 kg

Note: When using TDLS8000 as CE marking compliance product, the upper limit of the measurement gas pressure in YC8000 is 50kPa in gauge pressure.

## 2.2.4 Calibration Cell

Used for off-line calibrations and validations. Appropriate process windows are included on calibration cell.

### ● General Specifications

Optical Path Length: 660 mm  
Material: 316SS

Part No.	Description	Weight
K9772XA	Calibration Cell with free-standing frame for O <sub>2</sub>	Approx. 14 kg
K9772XB	Calibration Cell with free-standing frame for O <sub>2</sub> LAO	
K9772XC	Calibration Cell with free-standing frame for ppm H <sub>2</sub> O in non-hydrocarbon background	
K9772XD	Calibration Cell with free-standing frame for NH <sub>3</sub>	
K9772XE	Calibration Cell with free-standing frame for ppm H <sub>2</sub> O in hydrocarbon background	
K9772XF	Calibration Cell with free-standing frame for ppm CO	
K9772XG	Calibration Cell with free-standing frame for ppm CO LAO	
K9772XH	Calibration Cell with free-standing frame for CO (%) + CO <sub>2</sub> (%), CO <sub>2</sub> (%) Extend. Range	
K9772XJ	Calibration Cell with free-standing frame for HCl	
K9772XL	Calibration Cell with free-standing frame for CO(%), CO <sub>2</sub> (%) High Range	
K9772XM	Calibration Cell with free-standing frame for H <sub>2</sub> S	

Note: When using TDLS8000 as CE marking compliance product, the upper limit of gas pressure in calibration cell is 50kPa in gauge pressure.

## 2.2.5 Unit Connection Cable

Use for interconnecting the Sensor Control Unit and the Laser Unit.

### ● General Specifications

Construction: Double-shielded (Overall shield and Individual shields) 4-pair cable

Part No.	Cable length
K9775XA	5 m
K9775XB	10 m
K9775XC	20 m
K9775XD	30 m
K9775XE	40 m
K9775XF	50 m
K9775XG	60 m

Note: When cable length is not more than 25m, Belden 1475A may be used as Unit Connection Cable.

### 2.3 Model and Codes

● **TDLS8000 Tunable Diode Laser Spectrometer**

Model	Suffix Code	Option Code	Description
<b>TDLS8000</b>	.....	.....	Tunable Diode Laser Spectrometer
Type	-G1 -G2 -GQ -GR -D2 -C2 -S2 -E2 -K2 -N2 -Q2 -R2 -D1 -C1 -S1 -E1 -J1 -J2 -Q1 -R1	..... .....	General Purpose, cable entry/piping:NPT General Purpose, cable entry:Metric thread, piping:Rc EAC with PA General Purpose, cable entry:Metric thread, piping:Rc EAC General Purpose, cable entry:Metric thread, piping:Rc FM (US) Class I Div 2, Zone2, cable entry/piping:NPT FM (Canada) Class I Zone2, cable entry/piping:NPT ATEX Type of protection "n", cable entry:Metric thread, piping:Rc IECEx Type of protection "n", cable entry:Metric thread, piping:Rc KOSHA Type of protection "n", cable entry:Metric thread, piping:Rc NEPSI Type of protection "n", cable entry:Metric thread, piping:Rc EAC with PA Type of protection "n", cable entry:Metric thread, piping:Rc EAC Type of protection "n", cable entry:Metric thread, piping:Rc FM (US) Class I Div 1, Zone1, cable entry/piping:NPT (*1) FM (Canada) Class I Zone1, cable entry/piping:NPT (*1) ATEX Flameproof "d", cable entry:Metric thread, piping:Rc (*1) IECEx Flameproof "d", cable entry:Metric thread, piping:Rc (*1) Japan Ex / Zone 1, cable entry:Metric thread, piping:Rc (*1) (*11) Japan Ex / Zone 2, cable entry:Metric thread, piping:Rc (*11) EAC with PA Flameproof "d", cable entry:Metric thread, piping:Rc (*1) EAC Flameproof "d", cable entry:Metric thread, piping:Rc (*1)
Gas Parameter	-X1 -X2 -C1 -C2 -C3 -C4 -C5 -A1 -S1 -D1 -D5 -H1 -H4 -L1	..... ..... ..... ..... ..... ..... ..... ..... ..... ..... ..... ..... ..... ..... ..... ..... ..... ..... ..... .....	O <sub>2</sub> < 600°C, 0-25% (*2) O <sub>2</sub> < 1500°C, 0-25% Combustion CO (%) 0-20%/0-50% < 500°C CO ppm 0-200ppm/0-10,000ppm < 500°C (*3) CO ppm < 1500°C Combustion (*3) CO ppm < 1500°C or CH <sub>4</sub> 0-5% Combustion (*3) CO (%) + CO <sub>2</sub> (%) 0-30%/0-100% < 150°C NH <sub>3</sub> up to 0-5,000ppm < 450°C DeNOX H <sub>2</sub> S 0-5%/0-100% < 100°C (*2) CO <sub>2</sub> High Range 0-1%/0-5% < 100°C CO <sub>2</sub> Extend. Range 0-30/0-50% < 150°C H <sub>2</sub> O ppm non-Hydrocarbon Background (*1) (*4) H <sub>2</sub> O 0-10%/0-100% < 500°C (*2) HCl 0-50ppm/0-5,000ppm < 500°C
Optics Accessory	-NN -LA -U2 -U3 -U4 -D5 -D8 -J5 -J8 -FC	..... ..... ..... ..... ..... ..... ..... ..... ..... ..... .....	Without Alignment Flanges (*4) Large Aperture Optics, ANSI CLASS150-4-RF (*5) (*6) ANSI CLASS150-2-RF(Eq.) Alignment Flange, pipng: NPT ANSI CLASS150-3-RF(Eq.) Alignment Flange, pipng: NPT ANSI CLASS150-4-RF(Eq.) Alignment Flange, pipng: NPT DIN PN16-DN50-D(Eq.) Alignment Flange, pipng: Rc DIN PN16-DN80-D(Eq.) Alignment Flange, pipng: Rc JIS 10K-50-FF(Eq.) Alignment Flange, pipng: Rc JIS 10K-80-FF(Eq.) Alignment Flange, pipng: Rc Flow Cell Alignment Flange (*6)
I/O Interface	-A1	.....	Analog with HART+Modbus Ethernet
SI Unit	-J -N	..... .....	Only SI Unit SI Unit or non SI Unit (*7)
—	-N	.....	Always -N
Option	/D /RX /RC /SCT /JA1 /JB3 /JB4 /JC1 /JD1 /JE3 /JE4	..... ..... ..... ..... ..... ..... ..... ..... ..... ..... ..... .....	Diverging Beam without LAO (*8) Reference Cell for O <sub>2</sub> (*9) Reference Cell for CO (*10) Stainless Steel Tag Plate Cable gland for Japan Ex "-J1" (Cable O.D. 8-12mm, G1/2) 1pc, for local HMI Cable gland for Japan Ex "-J1" (Cable O.D. 10-16mm, G3/4) 3 pcs Cable gland for Japan Ex "-J1" (Cable O.D. 10-16mm, G3/4) 4 pcs Cable gland for Japan Ex "-J2" (Cable O.D. 6-9.5mm, M20) 1pc, for local HMI Cable gland for Japan Ex "-J2" (Cable O.D. 8.5-13.4mm, M20) 1pc, for local HMI Cable gland for Japan Ex "-J2" (Cable O.D. 9.5-15.4mm, M25) 3 pcs Cable gland for Japan Ex "-J2" (Cable O.D. 9.5-15.4mm, M25) 4 pcs

\*1: Type "-D1", "-C1", "- S1", "-E1", "-J1", "-Q1", "-R1" cannot be selected with "-H1".  
\*2: When the process gas pressure is out of 90 to 130 kPa (abs.), please contact with YOKOGAWA.  
\*3: When CO or CH<sub>4</sub> ingredient coexist, please contact with YOKOGAWA.  
\*4: When "-NN" is selected, Zone2/Div2/Type of protection "n", FM (Canada) Zone1 is not available.

- \*5: For applications whose optical path length is 6 m or longer, select the "-LA". A condensing lens unit (LAO unit) is added to the SCU side.  
 "-LA" can be selected when Oxygen or CO (-C2, -C3, -C4) analyzer is selected.  
 "-LA" can be selected with Zone 1/Div.1/Flameproof "d" when Gas Parameter "-X2", "-C3", "-C4" is selected.
- \*6: When FM (US) or FM (Canada) is specified, the connecting port for window purge is 1/4NPT.  
 When ATEX, IECEx, KOSHA, NEPSI, EAC or Japan Ex is specified, the connecting port for window purge is Rc1/4.
- \*7: Available only to an end user located outside of Japan.
- \*8: The Option "/D" can be selected when Large Aperture Optics "-LA" of the Optic Accessory is not specified and Oxygen or CO (-C2, -C3, -C4) analyzer is selected.
- \*9: The Option "/RX" can be used when Oxygen analyzer is selected. When both "-X2" of the Gas Parameter and "-LA" of the Optics Accessory are selected, "/RX" must be specified.
- \*10: The Option "/RC" can be used when CO analyzer is selected. When both "-C3" or "-C4" of the Gas Parameter is selected, "/RC" must be specified.
- \*11: For Japan Ex model (TDLS8000-J1, TDLS8000-J2), specified cable glands shall be attached to each cable entry for wiring. Select one cable gland out of two types: (/JB3 or /JB4 for "-J1", /JE3 or /JE4 for "-J2"). If you need, specify (/JA1 for "-J1", /JC1 or /JD1 for "-J2") as well. For detailed information, refer to Japanese General Specifications.

● **YH8000 HMI Unit**

Model	Suffix Code	Option Code	Description
<b>YH8000</b>	.....	.....	HMI Unit
<b>Type</b>	<b>-G1</b>	.....	General Purpose, NPT thread for cable entry
	<b>-G2</b>	.....	General Purpose, Metric thread for cable entry
	<b>-GR</b>	.....	EAC General Purpose, Metric thread for cable entry
	<b>-D2</b>	.....	FM (US) Class I Div 2, Zone2, NPT thread for cable entry
	<b>-C2</b>	.....	FM (Canada) Class I Zone2, NPT thread for cable entry
	<b>-S2</b>	.....	ATEX Type of protection "n", Metric thread for cable entry
	<b>-E2</b>	.....	IECEx Type of protection "n", Metric thread for cable entry
	<b>-J2</b>	.....	Japan Ex / Zone 2, Metric thread for cable entry (*2)
	<b>-K2</b>	.....	KOSHA Type of protection "n", Metric thread for cable entry
	<b>-N2</b>	.....	NEPSI Type of protection "n", Metric thread for cable entry
<b>-R2</b>	.....	EAC Type of protection "n", Metric thread for cable entry	
<b>Language</b>	<b>-E</b>	.....	English and 9 other languages (*1)
<b>—</b>	<b>-N</b>	.....	Always -N
<b>Option</b>	<b>/M</b>		Mounting kit for TDLS8000 (*3)
	<b>/P</b>		Pipe mount
	<b>/W</b>		Wall mount
	<b>/S</b>		Sun Shield
	<b>/C</b>		Local HMI connection cable: 3m
	<b>/SCT</b>		Stainless Steel Tag Plate
	<b>/JA1</b>		Cable gland for Japan Ex (Cable O.D. 8-12mm, G1/2), 1 pc(*2)
<b>/JA2</b>		Cable gland for Japan Ex (Cable O.D. 8-12mm, G1/2), 2 pc(*2)	

- \*1: These languages are message languages on the display.  
 One analyzer has English and 9 languages.  
 All languages are as follows; English, German, French, Spanish, Portuguese, Russian, Hungarian, Korean, Chinese and Japanese.
- \*2: For Japan Ex model (TDLS8000-J1, TDLS8000-J2), specified cable glands shall be attached to each cable entry for wiring. Select one cable gland out of two types: (/JB3 or /JB4 for "-J1", /JE3 or /JE4 for "-J2"). If you need, specify (/JA1 for "-J1", /JC1 or /JD1 for "-J2") as well. For detailed information, refer to Japanese General Specifications.
- \*3: /M cannot be selected with TDLS8000 Type "-D1", "-C1", "-S1", "-E1", "-J1", "-Q1" "-R1".

● IF8000 Isolation Flanges

Model	Suffix Code	Option Code	Description
<b>IF8000</b>	.....	.....	Isolation Flange for TDLS8000 (2pcs/unit) (*1)
Process Connection (*2)	-21	.....	ANSI CLASS150-2-RF(Eq.)
	-23	.....	ANSI CLASS300-2-RF(Eq.)
	-31	.....	ANSI CLASS150-3-RF(Eq.)
	-33	.....	ANSI CLASS300-3-RF(Eq.)
	-41	.....	ANSI CLASS150-4-RF(Eq.)
	-50	.....	DIN PN16-DN50-D(Eq.)
	-80	.....	DIN PN16-DN80-D(Eq.)
	-J5	.....	JIS 10K-50-FF(Eq.)
-J8	.....	JIS 10K-80-FF(Eq.)	
Analyzer Connection (*3)	-21	.....	ANSI CLASS150-2-RF(Eq.)
	-50	.....	DIN PN16-DN50-D(Eq.)
Material	-MN	.....	Monel 400
	-SS	.....	316/316L SS
Sapphire Window Type	-12	.....	Coated for O <sub>2</sub> (-X1, -X2)
	-13	.....	Coated for ppmH <sub>2</sub> O non Hydrocarbon background (-H1)
	-14	.....	Coated for ppmNH <sub>3</sub> (-A1, -A2)
	-15	.....	Coated for ppmH <sub>2</sub> O Hydrocarbon background (-H3)
	-16	.....	Coated for ppmCO (-C2, -C3, -C4)
	-17	.....	Coated for %CO or %CO <sub>2</sub> (-C5, -D5)
	-18	.....	Coated for HCl (-L1)
	-20	.....	Coated for -C1, -D1, -H4, -S1
—	-N	.....	Always -N

\*1: IF8000 is delivered with two sets (for LU and SCU).

\*2: When ANSI flange of the Process Connection is selected, the "-21" of Analyzer Connection must be specified.

\*3: When DIN or JIS of the Process Connection is selected, the "-50" of Analyzer Connection must be specified.

\*3: The Analyzer Connection must be selected according to the flange size of TDLS8000.

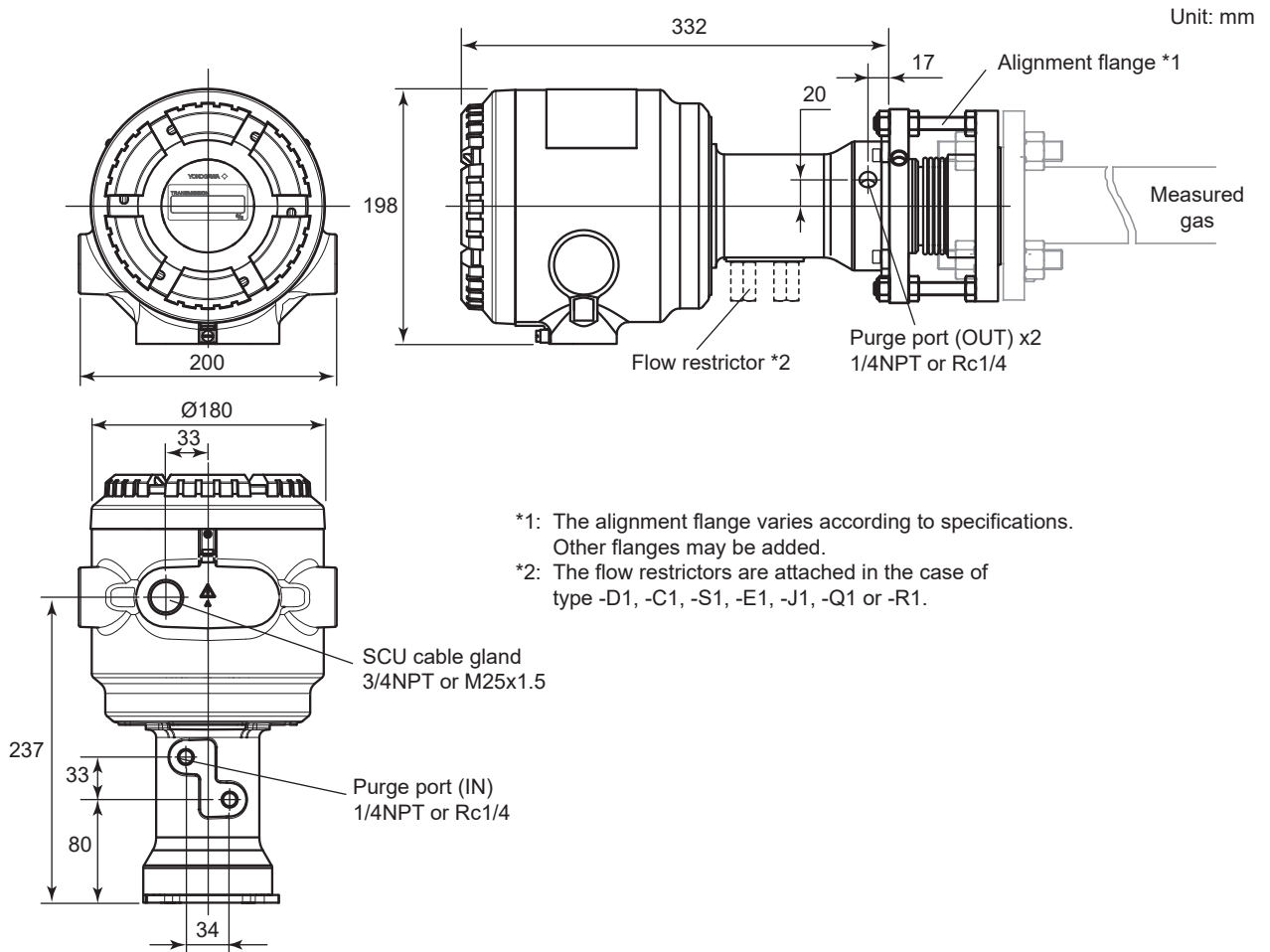
● YC8000 Flow Cell

Model	Suffix Code	Option Code	Description
<b>YC8000</b>	.....	.....	Flow Cell for TDLS8000
Flow Cell Type	-EN	.....	Enhanced
Optical Path Length	-40	.....	Forty Inches
	-60	.....	Sixty Inches
Material	-MN	.....	Monel 400
	-SS	.....	316/316L SS
Port Configuration	-3	.....	3 ports
Window Type	-XX	.....	Oxygen (-X1, -X2)
	-H3	.....	Moisture Hydrocarbon background (-H3)
	-HH	.....	Moisture non Hydrocarbon background (-H1)
	-NH	.....	NH <sub>3</sub> (-A1, -A2)
	-CC	.....	ppmCO (-C2, -C3, -C4)
	-C2	.....	CO%+CO <sub>2</sub> % (-C5, -D5)
	-HC	.....	HCl (-L1)
	-MC	.....	-C1, -D1, -H4, -S1
Inside Wall Treatment	-NN	.....	No treatment (cleaned)
	-EP	.....	Electro-polish
—	-N	.....	Always -N

## 2.4 External Dimensions

### ■ TDLS8000 with Alignment Flange

- LU

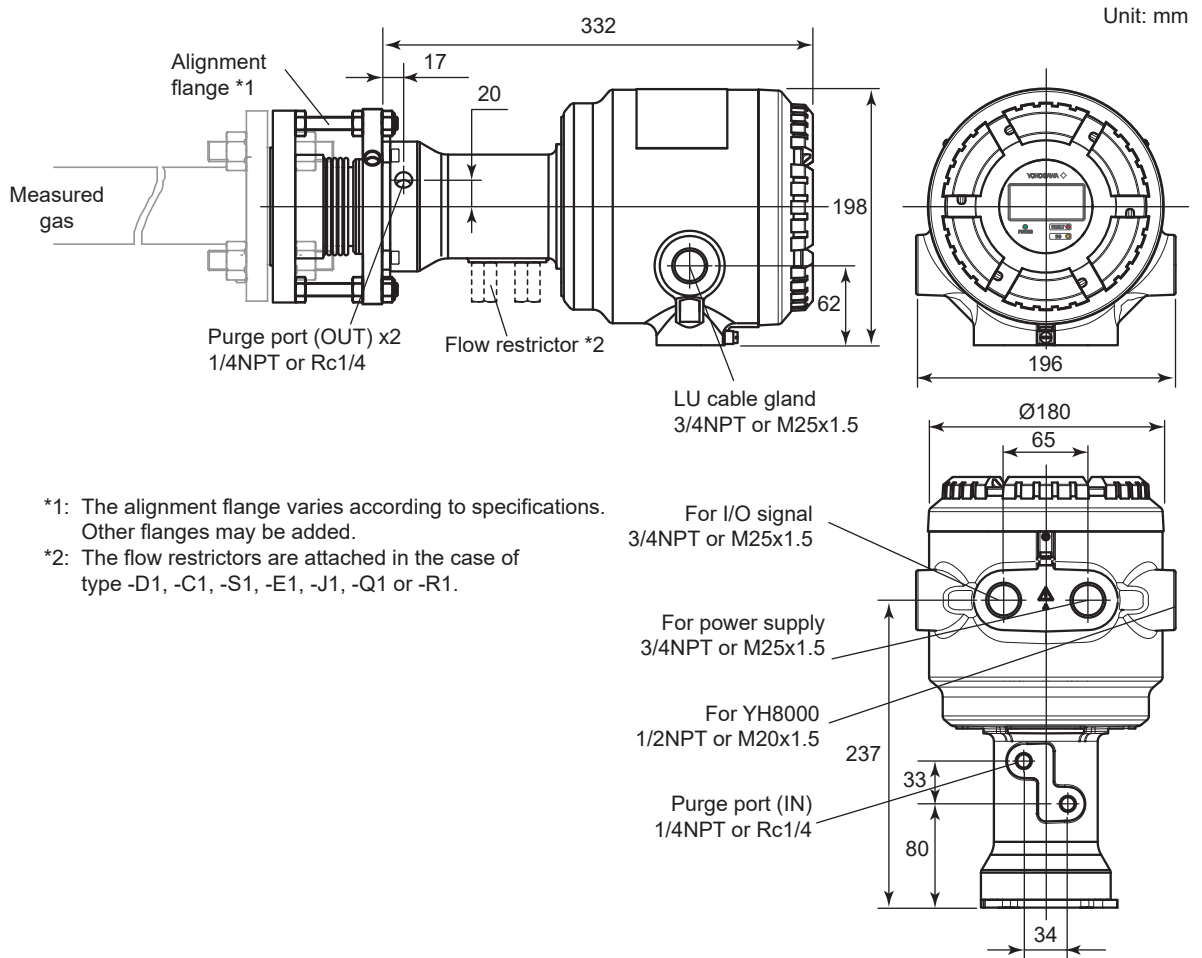


\*1: The alignment flange varies according to specifications. Other flanges may be added.

\*2: The flow restrictors are attached in the case of type -D1, -C1, -S1, -E1, -J1, -Q1 or -R1.



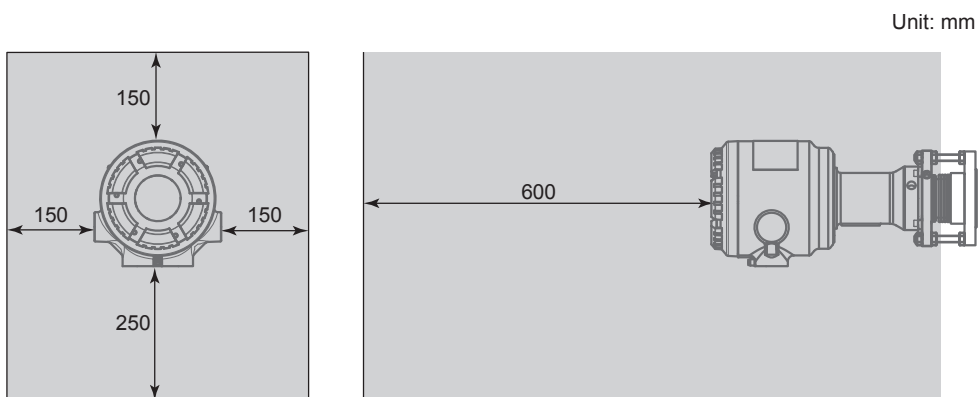
● SCU



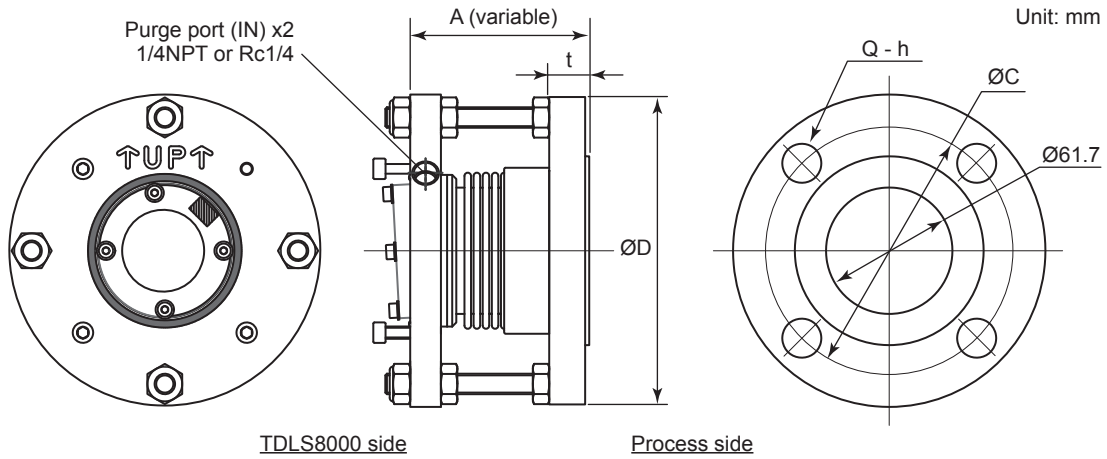
\*1: The alignment flange varies according to specifications. Other flanges may be added.

\*2: The flow restrictors are attached in the case of type -D1, -C1, -S1, -E1, -J1, -Q1 or -R1.

● Maintenance space



● Alignment Flange

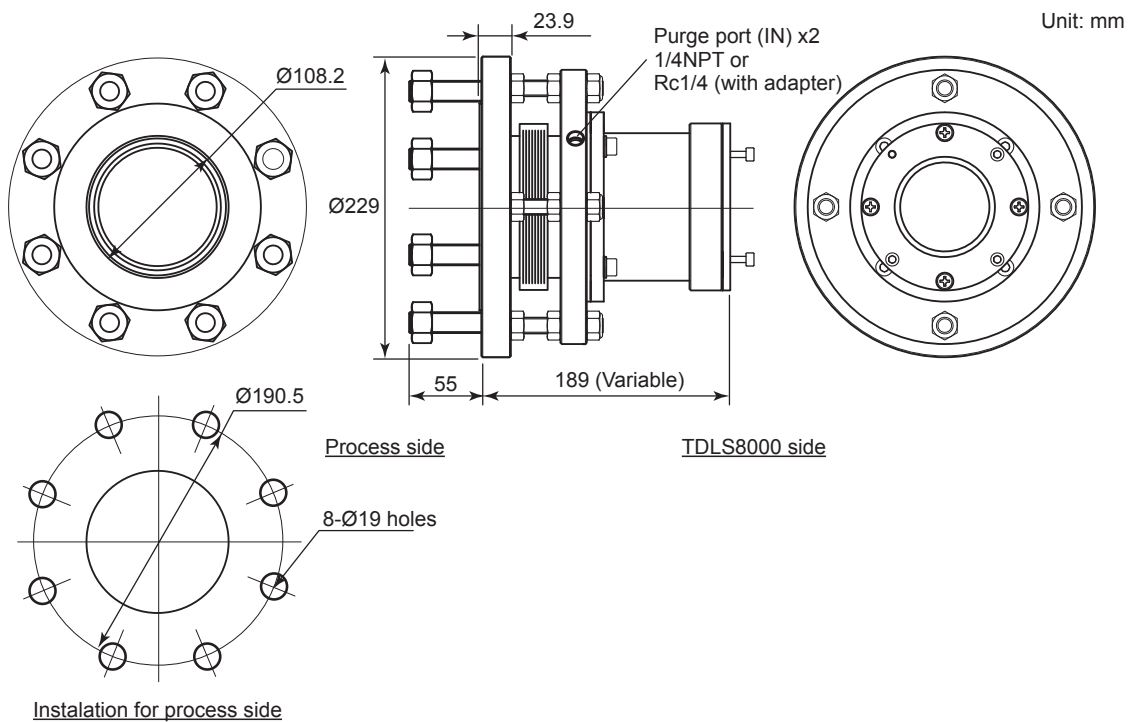


Optics Accessory code (flange)	Hole QTY Q	Hole h	Hole P.C.D C	Thickness t	Outside dia. D	Distance A	Purge port
-U2 ANSI CLASS150-2-RF(Eq.)	4	19	120.7	19.5	150	87	1/4NPT
-U3 ANSI CLASS150-3-RF(Eq.)	4	19	152.4	24.3	190	92	1/4NPT
-U4 ANSI CLASS150-4-RF(Eq.)	8	19	190.5	23.9	228.6	92	1/4NPT
-D5 DIN PN16-DN50-D(Eq.)	4	18	125	18	165	86	Rc1/4
-D8 DIN PN16-DN80-D(Eq.)	8	18	160	20	200	88	Rc1/4
-J5 JIS 10K-50-FF(Eq.)	4	19	120	16	155	84	Rc1/4
-J8 JIS 10K-80-FF(Eq.)	8	19	150	18	185	86	Rc1/4

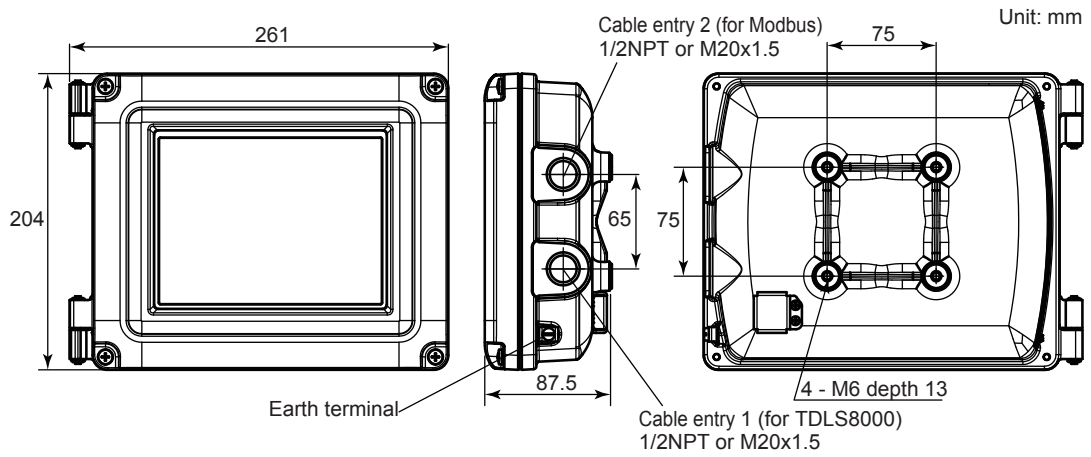
● LAO (Large Aperture Optics); Optics Accessory code “-LA”

This accessory is only for SCU side. For LU side, the Alignment flange ANSI CLASS150-4-RF (Eq.) will be mounted.

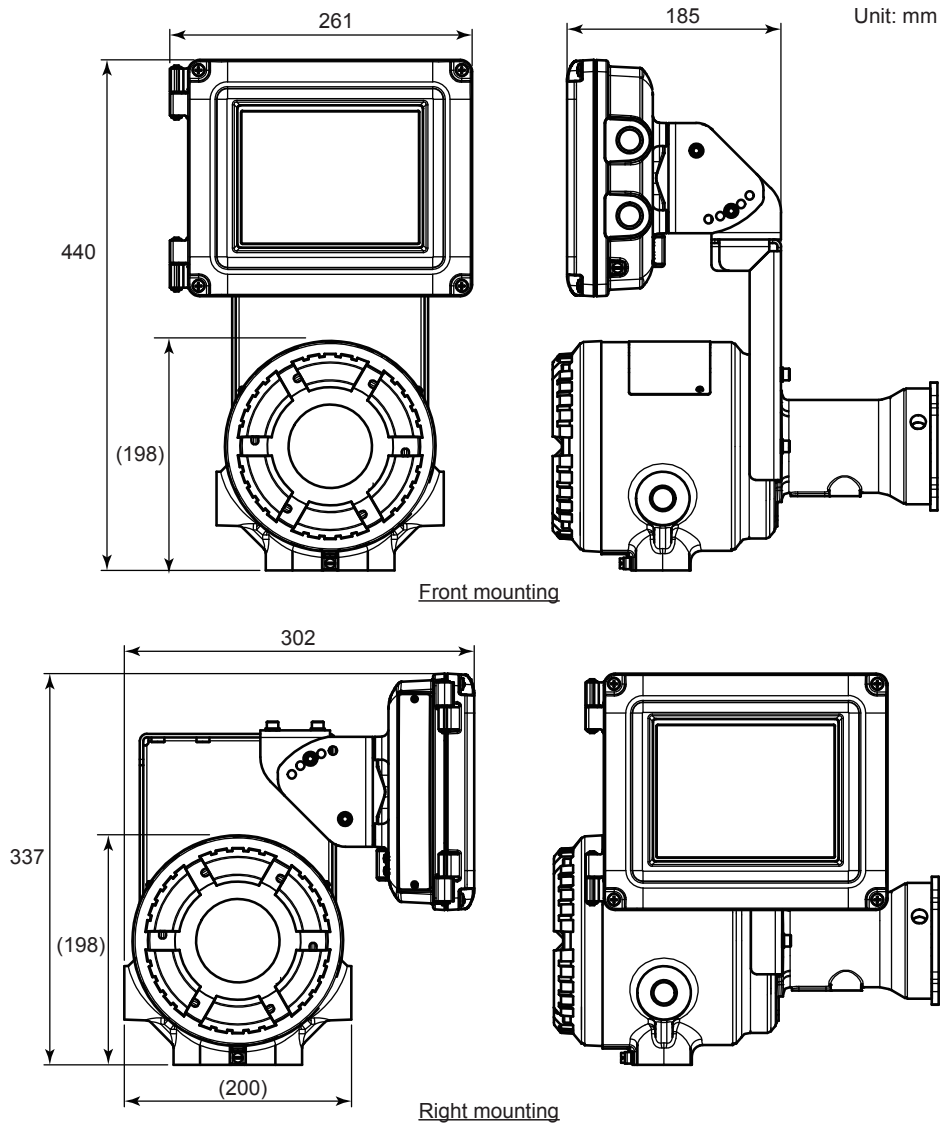
When piping is Rc1/4, a conversion adapter will be attached on the Alignment flange of the LU side.



■ YH8000 HMI Unit

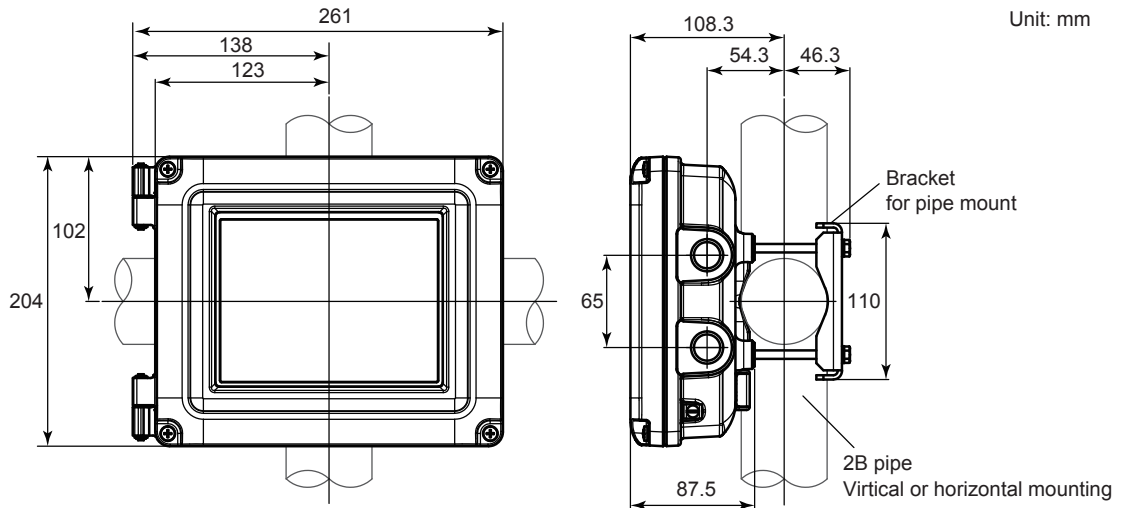


● Mounting kit for TDLS8000 (Option code: /M)

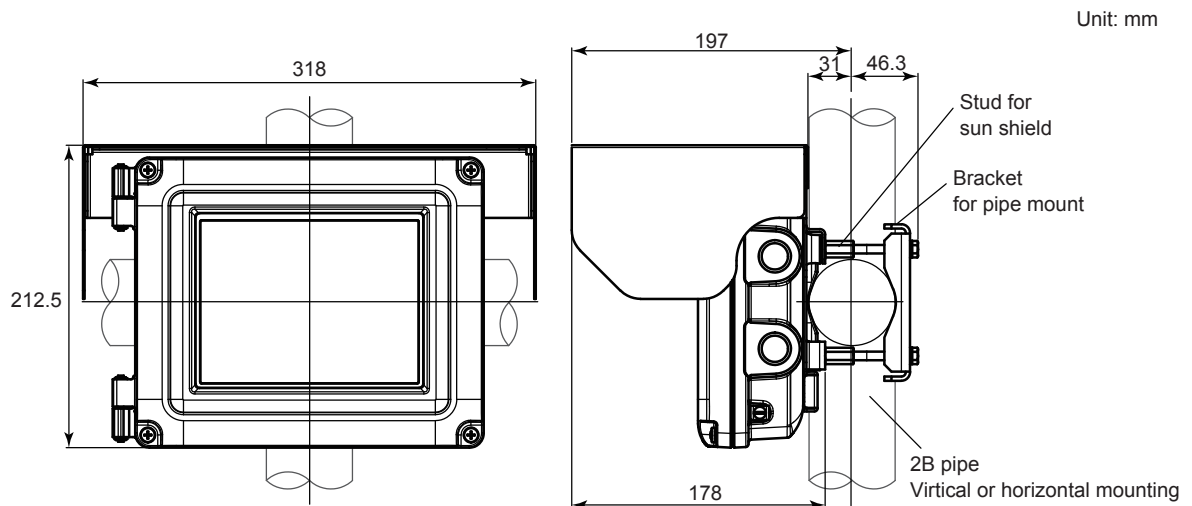


Available for left mounting

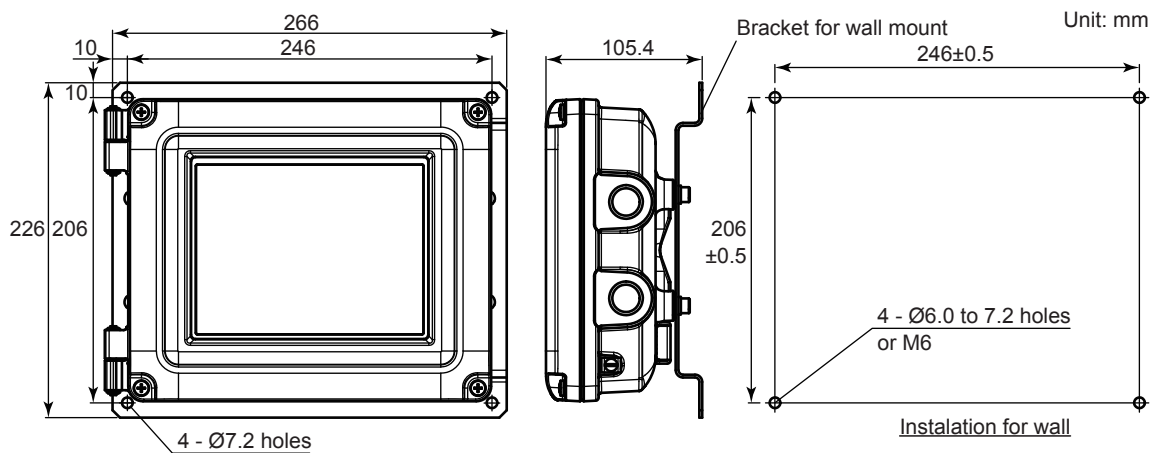
● Pipe mount (Option code: /P)



● Sun Shield (Option code: /S)

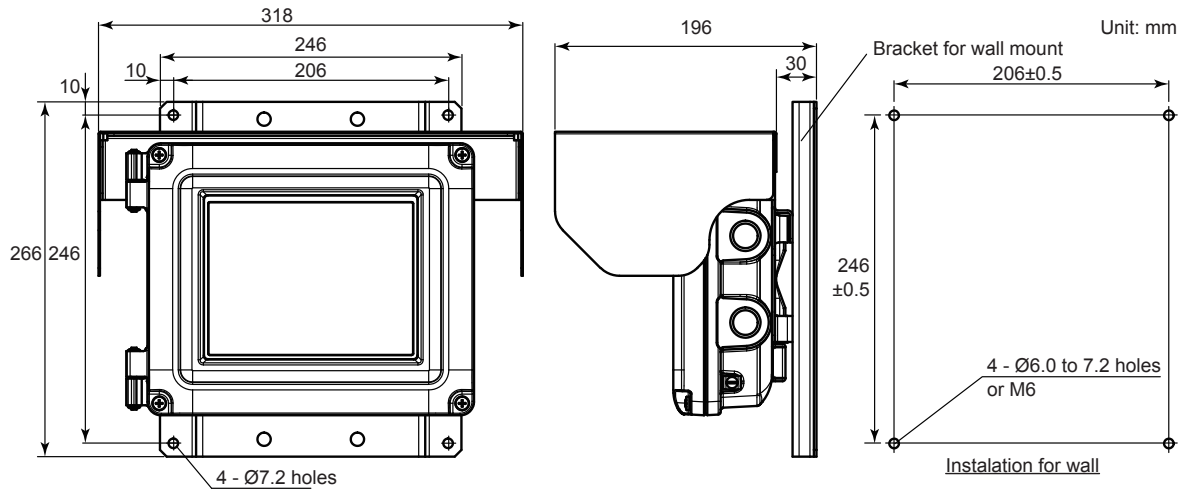


● Wall mount (Option code: /W)



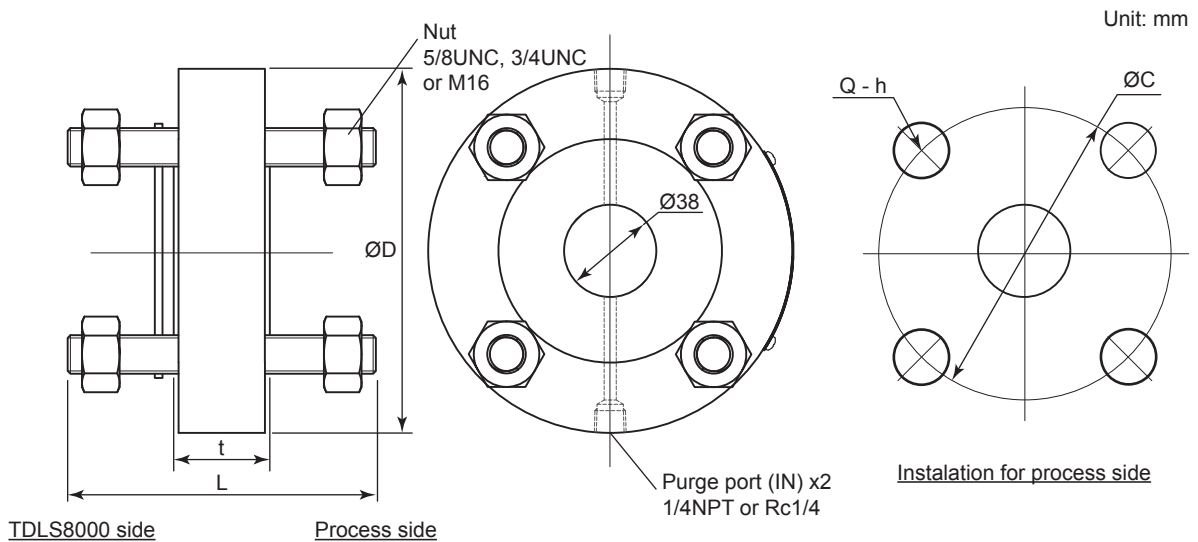
\*: The wall construction for mounting has to be designed for 4 times the weight of the YH8000. Bracket for wall mount can be placed in lengthwise

**Sun Shield (Option code: /S)**



When the sun shield is mounted, the bracket for wall have to be placed in widthwise.

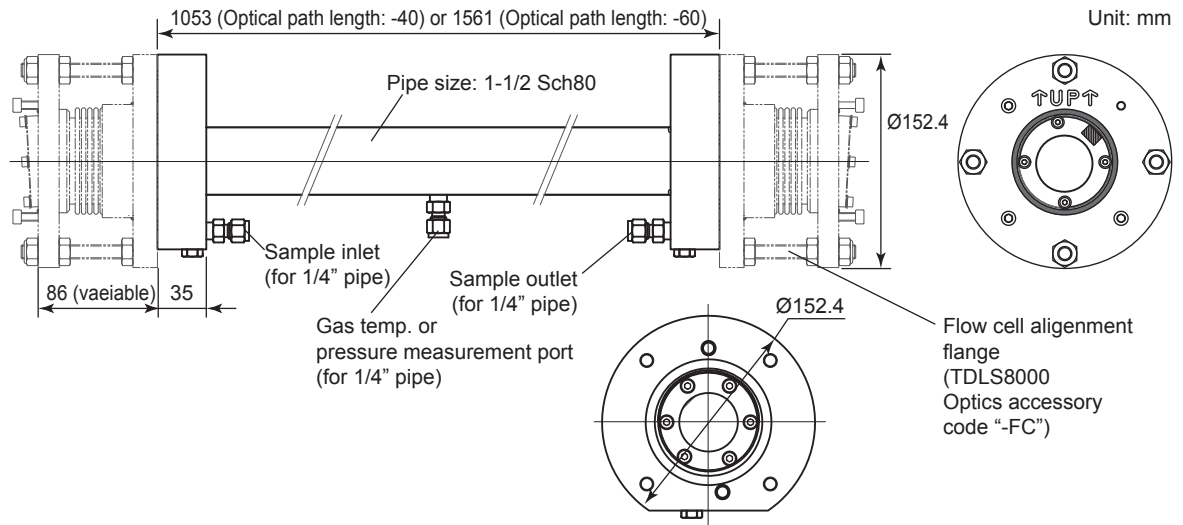
**IF8000 Isolation Flanges**



Process Connection code (flange)	Analyzer Connection code (flange)	Hole QTY Q	Hole h	Nut	Hole P.C.D C	Thickness t	Outside dia. D	Bolt length L	Purge port
-21 ANSI CLASS150-2-RF(Eq.)	-21 ANSI CLASS150-2-RF(Eq.)	4	19	5/8UNC	120.7	39.6	150	127	1/4NPT
-23 ANSI CLASS300-2-RF(Eq.)		8	19		127	39.6	165	137	
-31 ANSI CLASS150-3-RF(Eq.)		4	19	3/4UNC	152.4	39.6	190	137	
-33 ANSI CLASS300-3-RF(Eq.)		8	22		168.3	39.6	210	146	
-41 ANSI CLASS150-4-RF(Eq.)		8	19	5/8UNC	190.5	39.1	228.6	137	
-50 DIN PN16-DN50-D(Eq.)	-50 DIN PN16-DN50-D(Eq.)	4	18	M16	125	41.6	165	137	Rc1/4
-80 DIN PN16-DN80-D(Eq.)		8	18		160	41.6	200	137	
-J5 JIS 10K-50-FF(Eq.)		4	19		120	40.6	165	139	
-J8 JIS 10K-80-FF(Eq.)		8	19		150	40.6	185	139	

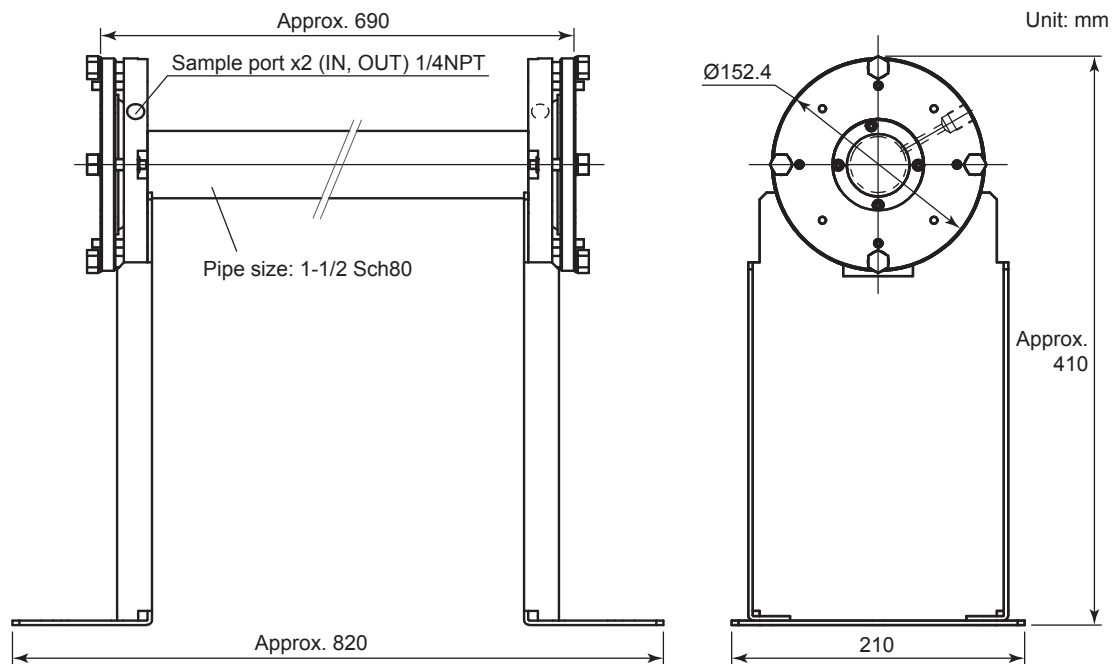
### ■ YC8000 Flow Cell

TDLS8000 have to be assigned the dedicated Alignment flange (Optic Accessory: -FC).  
When piping is Rc1/4, a conversion adopter will be attached on the Alignment flange.



### ■ Calibration Cell

Part number: K9772XA, K9772XB, K9772XC, K9772XD, K9772XE, K9772XE, K9772XF, K9772XG, K9772XH, K9772XJ, K9772XL, K9772XM





## 3. Installation, Wiring, Optical Axis Adjustment, and Piping

This chapter describes installation, wiring, optical axis adjustment, and purge gas piping in the order they need be performed.

If you are going to use the YH8000, install it after you complete the procedures in this chapter.

### 3.1 Installation

The TDLS8000 uses a laser beam. After installation, the optical axis needs to be adjusted. Install it in a location with sufficient working space.

#### CAUTION

During installation, be careful not to drop the product, damage the display, and so on.

Refer to 1.1 System configuration and 2.3 Model and Codesto install the product. Reserve space for maintenance so that you can adjust the optical axis.

#### NOTE

Use a process isolation valve with an opening whose diameter is at least 38 mm so that you can sufficiently adjust the optical axis of the laser beam after installation.

Flange alignment and installation are important. A proper flange installation ensures accurate optical axis adjustment of the laser beam.

In case of TDLS8000 Type “-D1”, “-C1”, “-S1”, “-E1”, “-J1”, “-Q1”, “-R1”, Local HMI Installation is not applicable.

#### ● Installation conditions

Install the product in a location that meets the conditions indicated in 2.1 TDLS8000 Tunable Diode Laser Spectrometer Specifications.

Note the following points.

- If an abnormal temperature occurs inside the case due to the influence of gas temperature, attach a reducer or the like to separate the laser unit (LU) and sensor control unit (SCU) from the flue.
- Process window purge protects the TDLS8000 from the heat, dust, and corrosive elements of the process gas. Be sure to run the process window purge gas during processing. The process window purge gas flow rate varies depending on the process gas conditions.
  - Temperature: Set the purge gas flow rate so that the temperature of the process window area and inside of the alignment flange does not exceed 55 °C.
  - Dust: Set the purge gas flow rate so that the transmission can be maintained. If the transmission decreases over time, the purge flow rate must be increased.
  - Corrosion: If the process includes corrosive elements, sufficient purge flow rate is necessary. If the sealant of the TDLS8000's process window corrodes, the inside of the TDLS8000 will also corrode, causing the TDLS8000 to malfunction. Set the purge gas flow rate appropriately to keep corrosive gas from entering the process window area or inside the alignment flange.



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**CAUTION**

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When the process gas is at high temperature, DO NOT STOP supplying purge gas into process window, alignment flange, and LAO unit even if the analyzer is not operating to prevent optical parts from being damaged.

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### 3.1.1 Measurement Point Selection

Take the following process conditions into consideration when selecting the measurement point.

- **Process gas flow rate conditions**

Set the measurement point to a location where the concentration distribution of the streamline flow is uniform.

In the case of a duct or flue with a circular cross section, a typical measurement point is where the distance from the end of a curved process area is at least three times the diameter (D) of the duct or flue and where there is nothing that would interfere with measurements.

In the case of a duct or flue with a rectangular cross section, the equivalent diameter (D) can be determined from the following equation.

$$\text{Diameter (D)} = 4 \times \text{duct cross sectional area} / \text{duct circumference}$$

If such point is not available or if setting a measurement point at such point is not possible, the measurement point is a location two-thirds of the length away from the duct inlet end or one-third from the outlet end.

Once the measurement point is determined, double-check that it is at the appropriate location.

- **Process gas temperature**

Install the TDLS8000 in a location with minimal process gas temperature fluctuations.

If the gas temperature fluctuation where the TDLS8000 is installed exceeds  $\pm 10$  °C, connect an external thermometer to the TDLS8000 temperature input terminal and enter the actual measured gas temperature to obtain correct measurements (for details, see 6.1.3 Process Temperature).

Check that a thermometer suitable for the maximum process gas temperature is being used.

In general, the lower the gas temperature, the better the measurement.

- **Process gas pressure**

Install the TDLS8000 in a location with minimal pressure fluctuations.

If the gas pressure fluctuation where the TDLS8000 is installed exceeds  $\pm 5$  kPa, enter the pressure signal from a separately applied process pressure meter to obtain correct measurements (for details, see 6.1.2 Process Pressure).

Check that a pressure meter suitable for the maximum process gas pressure is being used.

Check that the process window interfacing the process gas is suitable for the maximum preset gas pressure.

In general, the lower the gas pressure, the better the measurement.

● **Process dust/particulate concentration**

Install the TDLS8000 in a location with minimal dust concentration.

The transmission of the measurement laser beam will decrease due to dust or particles.

Measurement will not be affected as long as the transmission loss is within limits, but if it exceeds limits, an alarm will occur. The dust load also depends on the process optical path length. For details, contact your nearest Yokogawa representative.

In addition, install the TDLS8000 in the location such as not causing breakage of the process window and LAO unit lens by foreign object might damage the window and lens in process gas.

### 3.1.2 Constructing Process Flanges

Please prepare your own process flanges.

■ **Process Flange Reinforcing Plate**

If the duct or the wall of flue that the process flanges will be attached to is thin or may bend, weld large reinforcing plates around the area where the flanges will be attached. Figure 3.1 shows an example of welding reinforcing plates. Provide a secure platform to install the TDLS8000 on at your discretion.

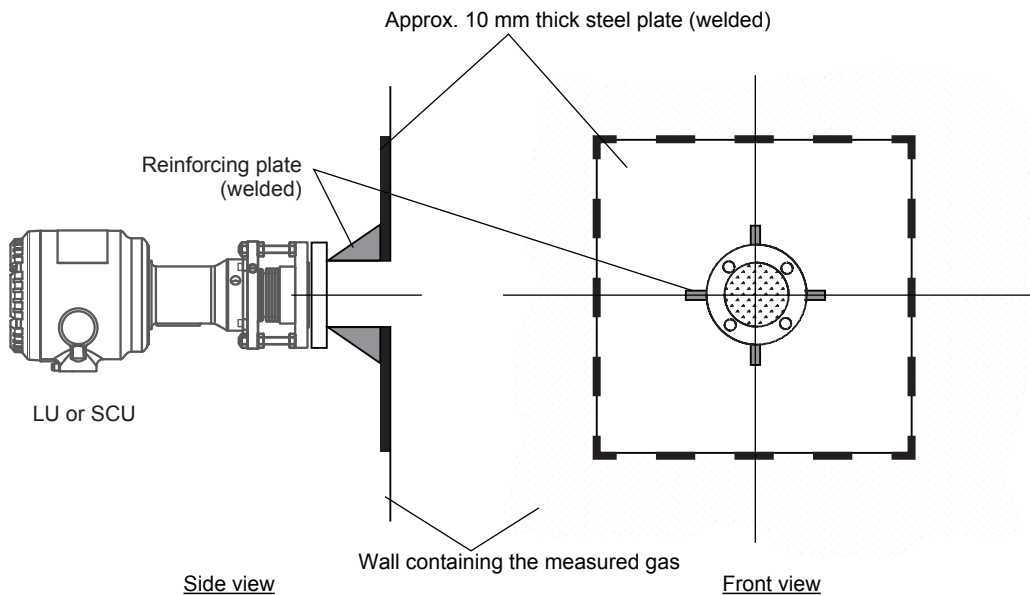


Figure 3.1 Reinforcing plate for LU and SCU process flanges

### CAUTION

Duct or flue with thin and easily bent walls must be reinforced to maintain laser beam alignment at all times. Reinforce the process flanges to maintain alignment.

● **Reinforcement of Process Flange on Heating Furnace (Example)**

The bending of the furnace wall is reduced by welding one side of the L angle as shown below to the process nozzle in the up, down, left and right directions, and welding the opposite side to the heater frame installed in the furnace.

To minimize the bending of the furnace wall, weld one side of the L-angle to the process nozzle in the four directions, up-down/left-right, and weld the opposite side to the heater frame installed on the furnace.(see the next two figures)

The tip of the process nozzle should be approximately 25 mm above the deepest point of furnace wall or where process gas flows. (see the next two figures)

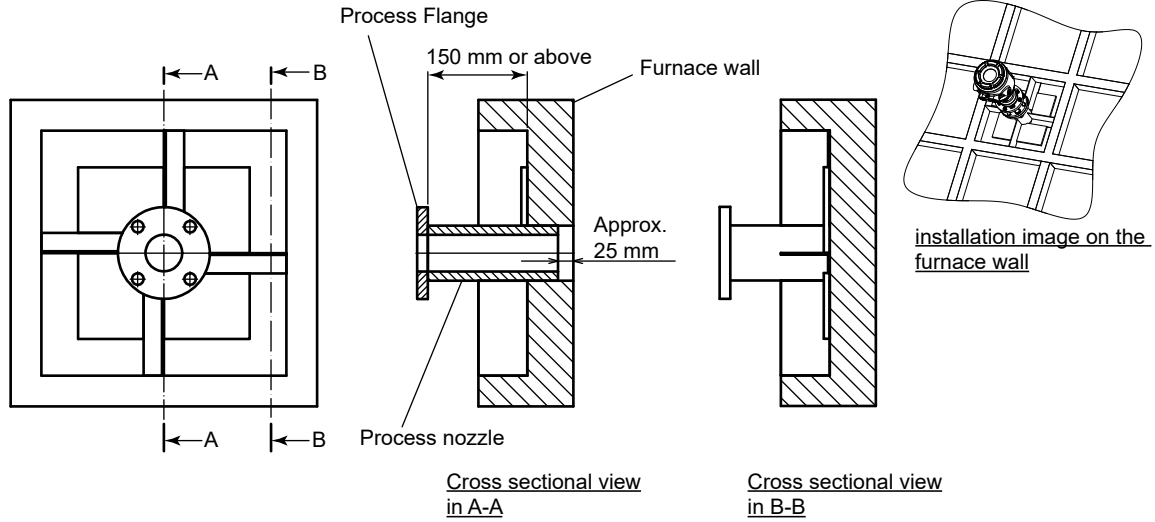


Figure 3.2 Reinforcement of Process Flange on Heating Furnace (example)

### ■ Alignment Angle Tolerance

The LU and SCU have alignment mechanisms that can be used to manually adjust the laser beam direction within vertical and horizontal planes. Make sure that the process flanges are within the tolerance angles indicated in Figure 3.2.

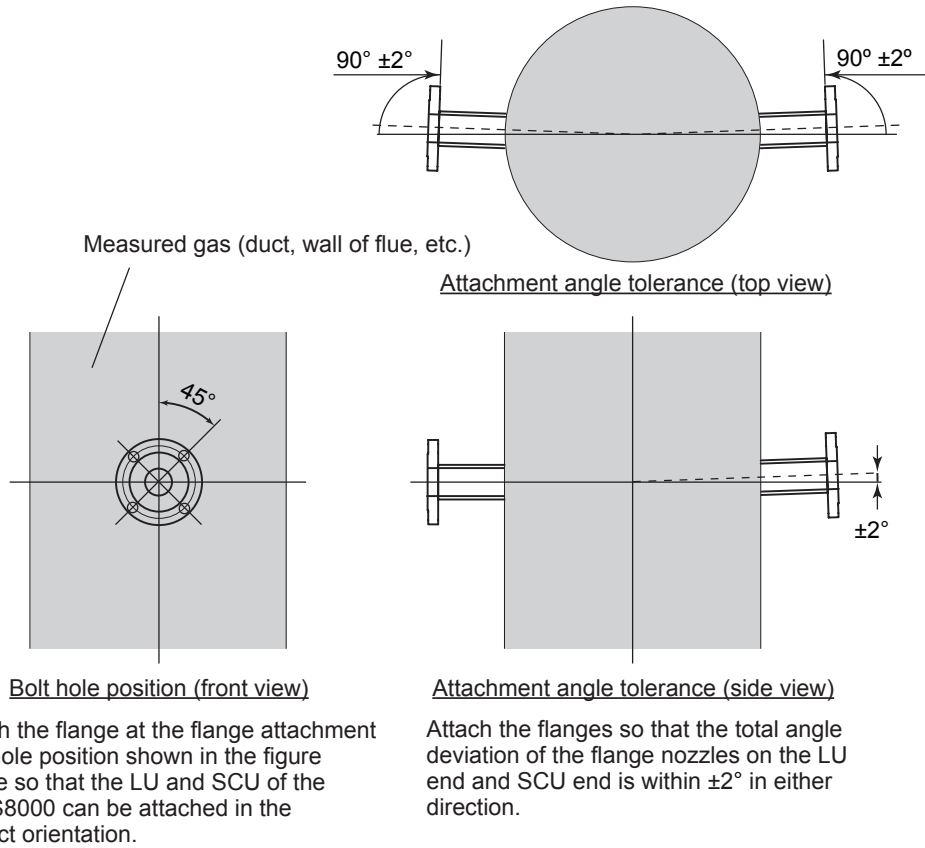


Figure 3.3 Alignment angle tolerance of LU and SCU flanges

### ■ Process Flange Opening

Attach LU and SCU flanges and insertion tubes (when used) so that the TDLS8000 can safely and easily be installed, operated, and removed.

#### NOTE

If the laser unit and sensor control unit are far apart, a larger opening may be required. For details, contact your nearest Yokogawa representative.

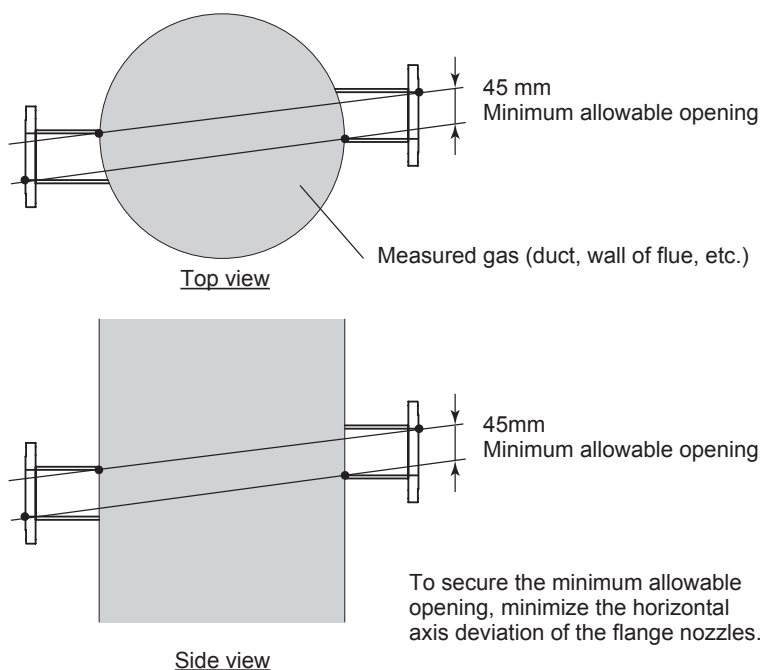


Figure 3.4 Openings for LU and SCU flanges

## ■ Selecting the Appropriate Process Flanges

### (1) Process flanges with optical path length less than 6 m

Use process flanges that conform to any of the flange standards listed in chapter 2.

### (2) Process flanges with optical path length greater than or equal to 6 m

The optical axis tends to deviate with longer process optical path lengths. As such, an LAO unit will be required as a process interface.

#### NOTE

When an LAO unit is used with a flange with process optical path length greater than or equal to 6 m, only a process flange conforming to ASME B16.5 4"-Class 150(RF) can be used.

### 3.1.3 Attaching the TDLS8000 to the Process Flange

The installation involves fixing an alignment flange or the like to a process flange first and then attaching the TDLS8000.

If the process conditions include high temperature, high pressure, or corrosive gas, insert a process isolation flange (IF8000) between the process flange and alignment flange.

If there is a lot of dust, use an insertion tube. The insertion tube is an interface for preventing dust from adhering to the TDLS8000 process window. The length is determined by the process flange length, the dust level in the process, the process gas flow velocity, and so on. If you require an insertion tube, please consult with Yokogawa.

For details of each component, see 1.1 System configuration and 2.4 External Dimensions.

## ■ Attaching Alignment Flanges

To attach an alignment flange to a process flange, follow the procedure below.

- (1) Insert a gasket between the process flange and alignment flange.
- (2) Pass the bolts through the alignment flange mounting holes, and fasten with nuts. Make sure that the nuts are securely fastened so that they do not fall off.

### CAUTION

- The alignment flange must be installed in the proper orientation. Install it so that the arrows of “↑UP↑” are facing up.
- The process window area is where the laser beam passes through. Be careful not to damage or stain the window during installation.

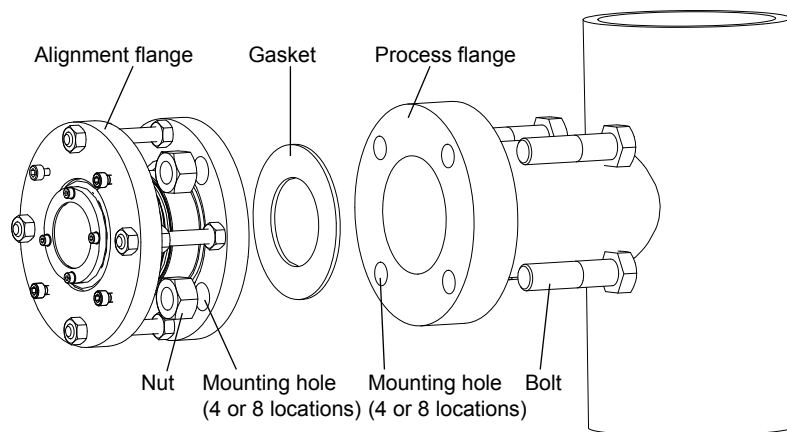


Figure 3.5 Installing an alignment flange

## ■ Attaching Process Isolation Flanges (IF8000)

To attach a process isolation flange (IF8000) and an alignment flange to a process flange, follow the procedure below.

- (1) Insert a gasket between the process flange and process isolation flange.
- (2) Secure the process isolation flange to the process flange with four or eight bolts. The process isolation flange must be installed in the proper orientation. Install it so that the arrows of “↑UP↑” are facing up.
- (3) Insert a gasket between the TDLS8000 side of the process isolation flange and alignment flange.
- (4) Pass the alignment flange through the bolts welded to the process isolation flange, and fasten with nuts. Make sure that the nuts are securely fastened.

### CAUTION

- The alignment flange must be installed in the proper orientation. Install it so that the arrows of “↑UP↑” are facing up.
- The process window area is where the laser beam passes through. Be careful not to damage or stain the window during installation.
- If there are welded bolts (process isolation flange), be careful not to crush or damage the threads during installation.

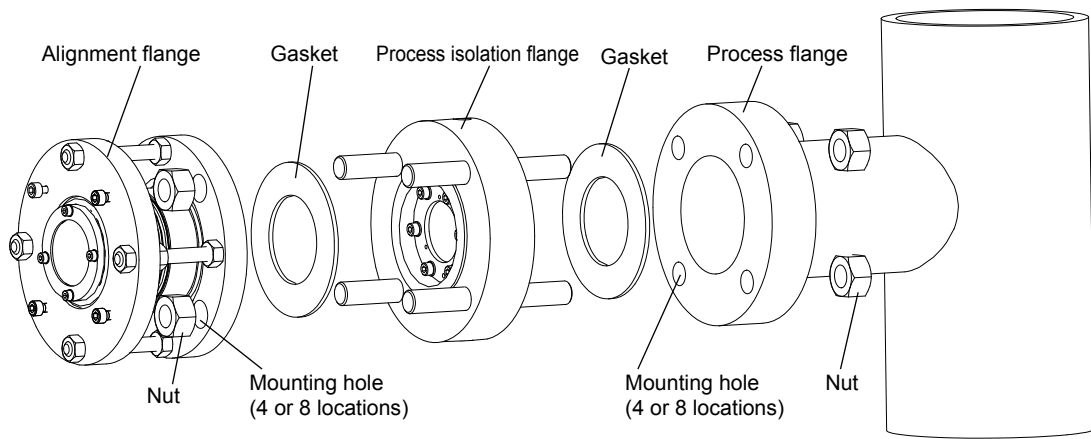


Figure 3.6 Installing a process isolation flange and alignment flange

## ■ Attaching Insertion Tubes

The shape of the insertion tube used when there is a lot of dust may vary from that in the figure depending on the measurement conditions.

### CAUTION

- The alignment flange must be installed in the proper orientation. Install it so that the arrows of “↑UP↑” are facing up.
- The process window area is where the laser beam passes through. If there is a process window area (alignment flange, process isolation flange), be careful not to damage or stain it during installation.
- If there are welded bolts (process isolation flange, insertion tube), be careful not to crush or damage the threads during installation.

### ● When only an alignment flange is to be used (IF8000 is not used)

- (1) Insert a gasket between the process flange and the process side of the insertion tube.
- (2) Secure the insertion tube to the process flange with four or eight bolts.
- (3) Insert a gasket between the TDLS8000 side of the insertion tube and alignment flange.
- (4) Pass the alignment flange through the bolts welded to the insertion tube, and fasten with nuts. Make sure that the nuts are securely fastened.

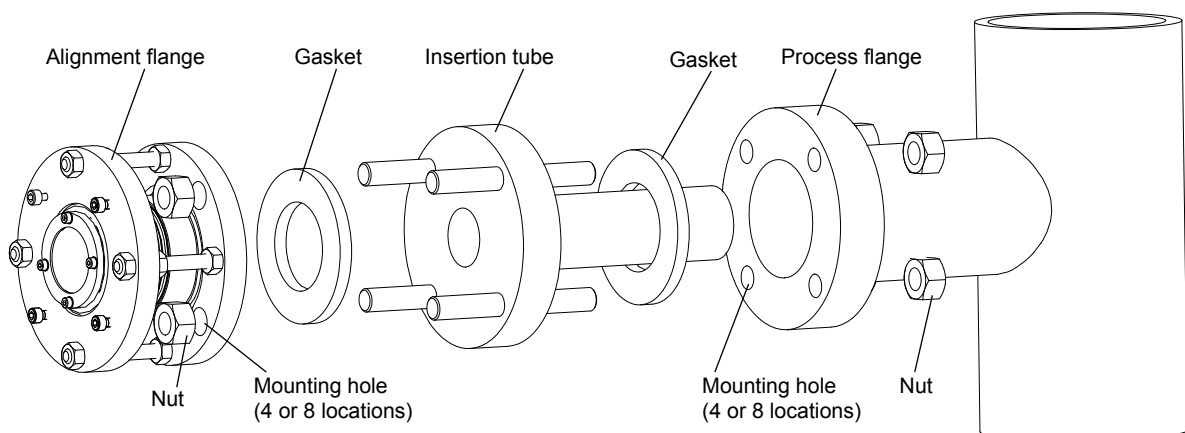
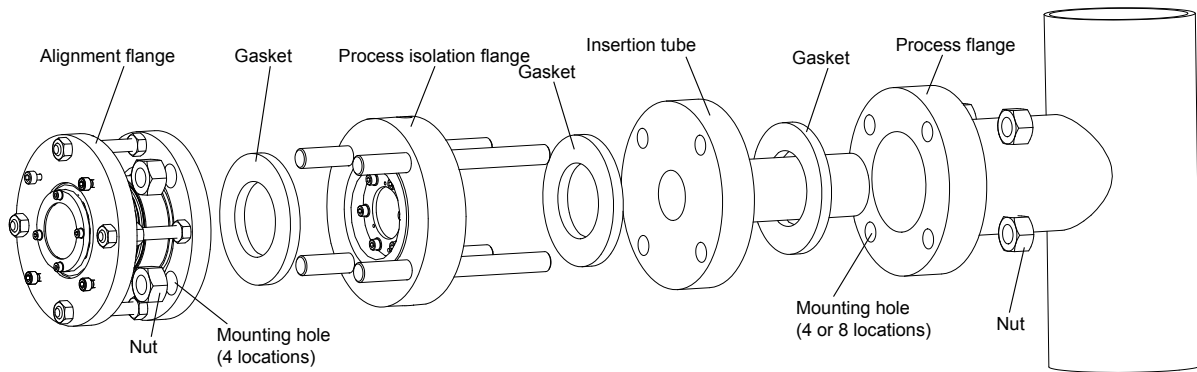


Figure 3.7 Installing an insertion tube and alignment flange

● **When a process isolation flange (IF8000) and alignment flange are to be installed**

- (1) Insert a gasket between the process flange and the process side of the insertion tube.
- (2) Insert a gasket between the insertion tube and process isolation flange.
- (3) Insert a gasket between the TDLS8000 side of the process isolation flange and alignment flange.
- (4) Pass the bolts welded to the process isolation flange through the alignment flange mounting holes and process flange mounting holes, and fasten with nuts. Make sure that the nuts are securely fastened so that they do not fall off.



**Figure 3.8** Installing an insertion tube, process isolation flange, and alignment flange



## ■ TDLS8000 Installation

### CAUTION

The process window is where the laser beam passes through. Be careful not to damage or stain the window during installation.

After mounting an alignment flange and the like to the process flange, install the TDLS8000 according to the following procedure.

- (1) First fasten three M6 screws in the TDLS8000 mounting screw holes on the flange surface of the alignment flange. Leave about 8 mm of gap from the flange surface. Do not fasten the screw in the upper right hole as viewed from the front. The upper right screw is attached on the TDLS8000 side.
- (2) Insert the alignment flange screws that you fastened in (1) in the holes on the mounting surface (quick connectors) of the laser unit (or sensor control unit), and then rotate the unit clockwise.
- (3) Temporarily fasten the upper right screw, and then tighten all screws evenly.

### CAUTION

Carefully mount the laser unit (or sensor control unit) to prevent the O-ring from being damaged or dropping out during assembly.

### CAUTION

Anti-seizing grease is applied to the screw areas. Be careful to keep dust or the like from adhering. If dust or the like adheres to the areas, remove the dust or the like, and then reapply the anti-seizing grease.

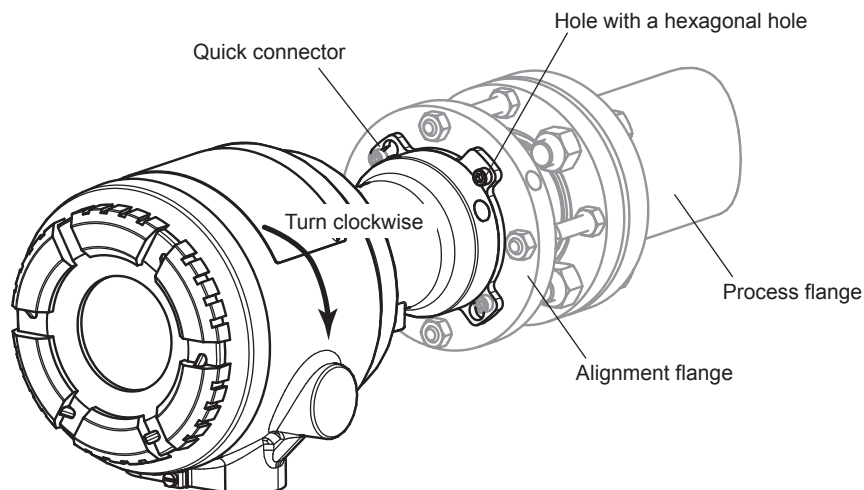


Figure 3.9 SCU or LU installation

## 3.2 Wiring

When the installation is complete, wire the TDLS8000 and external devices. YH8000 wiring is explained in chapter 4.

### ■ Wiring Precautions

To open the SCU and LU covers, turn the lock screw counterclockwise with the supplied hex wrench to loosen the screw.

After closing the SCU and LU covers, turn the lock screw clockwise to tighten.

### CAUTION

- Turning the cover without loosening the lock screw can damage the case or cover. Note that the lock screw is in a loosened state when the TDLS8000 is shipped from the factory.
- If sand or foreign substance adheres to the screw area of the cover or case, wipe it off to prevent it from damaging the screw threads and prevent it from entering the inside of the device.

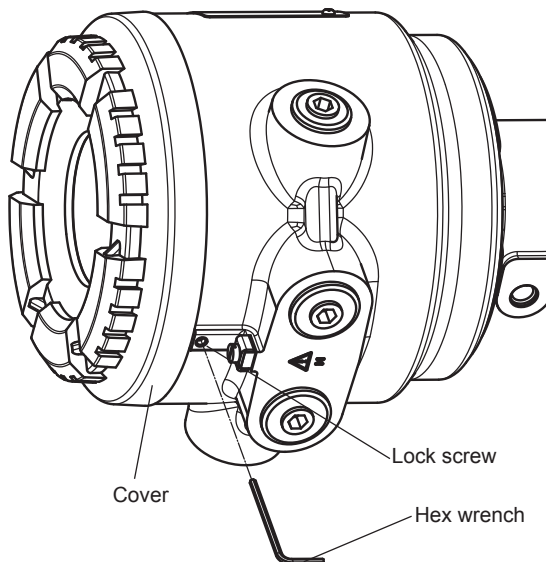


Figure 3.10

### CAUTION

Never turn on the power to the TDLS8000 or the devices connected to the TDLS8000 until all wiring is complete.

### ● Wiring procedure

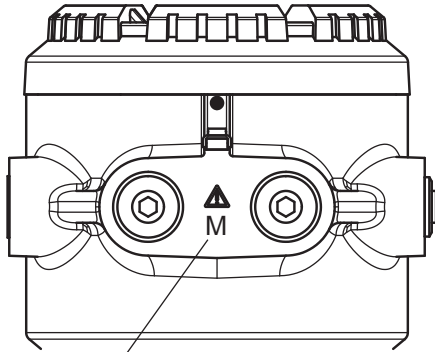
Construct signal cables and power supply cables according to the following conditions.

- (1) Be sure to connect the shield to the functional ground terminal for the shielded wire inside the TDLS8000.
- (2) Strip the necessary minimum length of outer most covering of signal cables and power supply cables.
- (3) When using conduit tubes, do not run power cables in the same conduit as signal cables. Doing so can cause noise interference on signals. Ground metal conduits.

- (4) Attach the supplied blind plugs to unused cable glands.
- (5) For the cables you need to use, see ■ Types of Wiring and Cabling
- (6) When you complete all wiring, close the terminal cover, and fasten with the lock screw.

## ■ Cable Entries

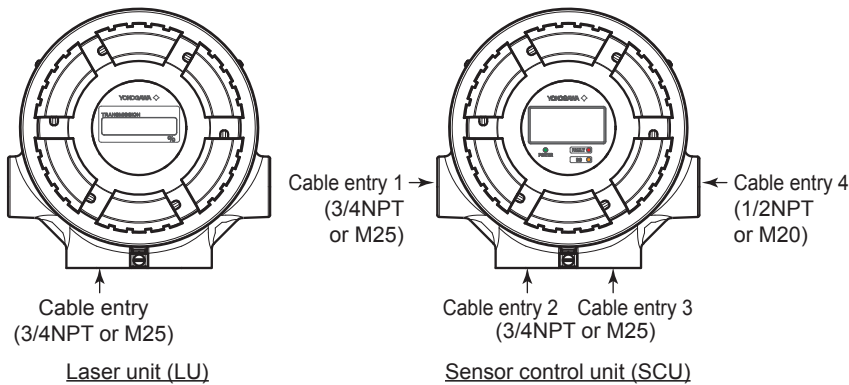
Symbols are inscribed near the cable entries for identifying the thread specifications.



For ANSI 1/2NPT, 3/4NPT(F): A  
 For ISO M20x1.5, M25x1.5: M

**Figure 3.11**

Attach conduits and cable glands with the appropriate thread size to the TDLS8000 cable entries.



**Figure 3.12** Cable entries

### Sensor control unit (SCU) cable entries

- Cable entry 1: Cable entry for inter-unit cables
- Cable entry 2: Cable entry for I/O signal cables
- Cable entry 3: Cable entry for power cables
- Cable entry 4: Cable entry for a cable connecting to the YH8000 or Ethernet cable

### Laser unit (LU) cable entry

- Cable entry: Cable entry for inter-unit cables

**TDLS8000 Wiring Terminals**



**CAUTION**

Be careful not to connect the power supply wires to the incorrect locations or reverse the polarity.

In particular, incorrectly connecting the power supply terminals (POWER, VO, VO[HMI]) or solenoid valve control output terminals (SV-1, 2) can damage the TDLS8000 or the devices connected to the TDLS8000.

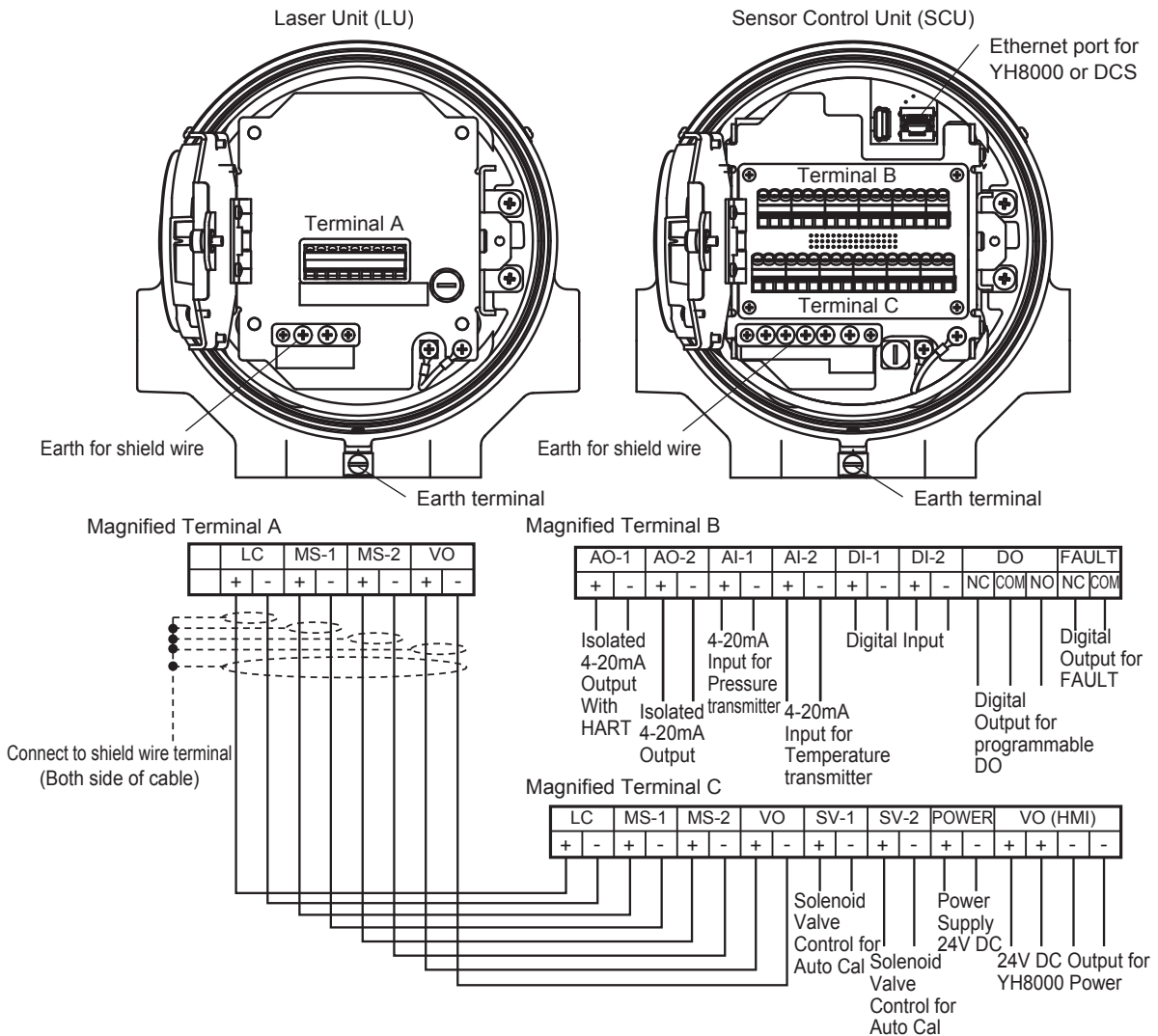


Figure 3.13 TDLS8000 wiring

**CAUTION**

The 4-pair cables between the laser unit and the sensor control unit are complexed cables consisting of one pair of AWG18 and 3 pairs of AWG22. Use black/white AWG18 for inter-VO terminal connections. Use other 3 pairs of AWG22 to connect among LC, MS-1, MS-2.

**Table 3.1** Terminals and functions (laser unit: LU)

Terminal block	Terminal name	Function
A	NC	Not used
	LC+	Inter-unit communication, control signal, power supply Connect these terminals to the terminals with the same names as on terminal block C in the SCU.
	LC-	
	MS-1+	Use a black/white AWG18 to connect to VO+ or VO-.
	MS-1-	
	MS-2+	
	MS-2-	
	VO+	
VO-		



**CAUTION**

Do not wire the NC terminal.

**Table 3.2** Terminals and functions (sensor control unit: SCU)

Terminal block	Terminal name	Function	
B	AO-1+	Analog output 1 (4-20 mA)/HART communication port	
	AO-1-		
	AO-2+	Analog output 2 (4-20 mA)	
	AO-2-		
	AI-1+	Analog pressure signal input (4-20 mA). Connect to a pressure transmitter.	
	AI-1-		
	AI-2+	Analog temperature signal input (4-20 mA). Connect to a temperature transmitter.	
	AI-2-		
	DI-1+	Digital input 1	Voltage-free digital input terminal. Open: 100 kΩ or more, Closed: 200 Ω or less (including wiring resistance)
	DI-1-		
	DI-2+	Digital input 2	Voltage-free digital input terminal. Open: 100 kΩ or more, Closed: 200 Ω or less (including wiring resistance)
	DI-2-		
	DO NC	Programmable digital output	
	DO COM	Between NC and COM: Closed when the specified operating condition is met	
DO NO	Between NO and COM: Open when the specified operating condition is met		
FAULT NC	FAULT signal digital output		
FAULT COM	Closed when the device is operating normally; open when a fault occurs or when the power is off		
C	LC+	Inter-unit communication, control signal, power supply Connect these terminals to the terminals with the same names as on terminal block A in the LU.	
	LC-		
	MS-1+	Use a black/white AWG18 to connect to VO+ or VO-.	
	MS-1-		
	MS-2+		
	MS-2-		
	VO+		
	VO-		
	SV-1+	Solenoid valve control output 1. Output rating: 24 V DC, 0.5 A max.	
	SV-1-		
	SV-2+	Solenoid valve control output 2. Output rating: 24 V DC, 0.5 A max.	
	SV-2-		
	POWER+	Power supply. 24 V DC ± 10%	
POWER-			
VO[HMI]+	Power supply terminal for the YH8000. 24 V DC		
VO[HMI]-			

■ **Types of Wiring and Cabling**



**CAUTION**

Use cables with a durable temperature of at least 70 °C.

## CAUTION

Use cables that are appropriate for the environment that the product is installed in. Use cables with an outer diameter that matches the cable gland that you are using.

Cable entry	Cable type	Nominal cross sectional area, conditions	Shield	Terminal	Withstand voltage, flame resistance	See
1, LU	Inter-unit cable	Cables of other selling for the TDLS8000 K9775XA to K9775XG (select according to cable length) 4 pairs (AWG18: 1 pair, AWG22: 3 pairs) Covering outer diameter approx. 13.5mm	Required (individual shields for each pair and overall shield)	Wire: Shield: M4 screw crimp-on terminal	500 V or more VW1	3.2.1
3	Power supply	AWG18 to AWG14 Two-core or three-core (when using the functional ground terminal inside the device)	Required	Wire: Shield: M4 screw crimp-on terminal	500 V or more VW-1 or more	3.2.2
2	I/O cable	Multi-core cable Up to 21 cores A terminal box or the like is required when branching the signals externally.	Required	Wire: Shield: M4 screw crimp-on terminal	500 V or more VW-1 or more	3.2.3 to 3.2.7
4	YH8000 connection cable	Special cable (YH8000 option) AWG24 4 pairs Covering outer diameter approx. 8.4 mm	Required	Wire: Shield: M4 screw crimp-on terminal	500 V or more FT-4	4
	Ethernet cable	CAT.5e AWG24 4 pairs 100 m max.	Required	Wire: Shield: M4 screw crimp-on terminal	VW-1 or more	3.2.8
Functional ground terminal (external)	Functional grounding	AWG16 or more	Not required	M5 screw crimp-on terminal		3.2.2

Use cables with outer diameters that match the conduits or cable glands that you are using.

### 3.2.1 Connecting between the Sensor Control Unit (SCU) and Laser Unit (LU)



## CAUTION

Be careful not to connect the power supply wires to the incorrect locations or reverse the polarity. Incorrectly wiring the power supply terminals (VO) and signal terminals may burn out the TDLS8000 circuitry.

The 4-pair cables between the laser unit and the sensor control unit are complexed ones consisting of one pair of AWG18 and 3 pairs of AWG22. Use black/white AWG18 for inter-VO terminal connections. Use other 3 pairs of AWG22 to connect among LC, MS-1, MS-2.

BELDEN 1475A, a designated cable for the previous model TDLS200, cannot be used.

To connect between the sensor control unit (SCU) and laser unit (LU), use the inter-unit cable of other selling (K9775XA to K9775XG, select according to the required cable length). Connect the inter-unit cable as shown in Figure 3.13.

For the terminating the inter-unit cable, see Appendix 1 Constructing Unit Connection Cables.

- (1) Connect pairs 1 to 4 of the inter-unit cable to terminal A of the laser unit. Use black/white AWG18 for inter-VO terminal connections.
- (2) Connect the shielded wire to the ground terminal inside the laser unit.
- (3) Attach the supplied ferrite clamp to the cable as shown in Figure 3.14.
- (4) Connect pairs 1 to 4 of the inter-unit cable to terminal C of the sensor control unit. Connect the positive terminal of the LU side to the positive terminal of the SCU side and the negative to the negative.
- (5) Like the laser unit, connect the shielded wire to the ground terminal inside the sensor control unit.
- (6) Within the SCU and LU, attach the supplied ferrite clamps to the cable as shown in Figure 3.14. Be sure to attach them on both sides (SCU and LU).

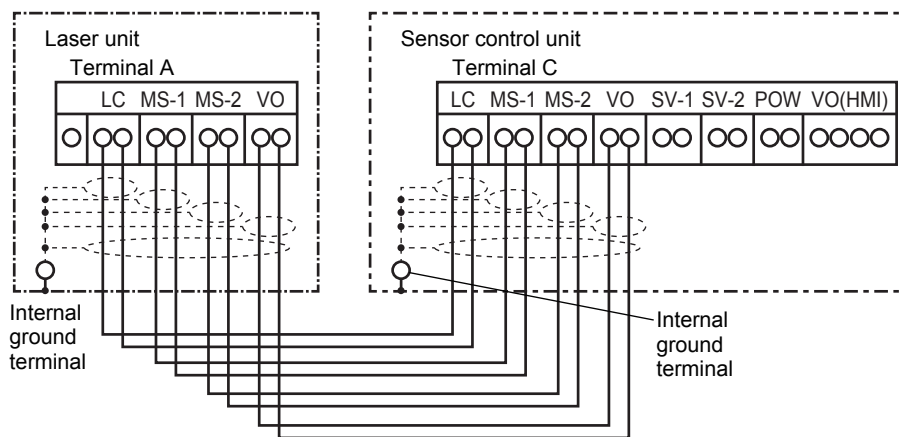


Figure 3.14 Connecting between the Sensor Control Unit (SCU) and Laser Unit (LU)

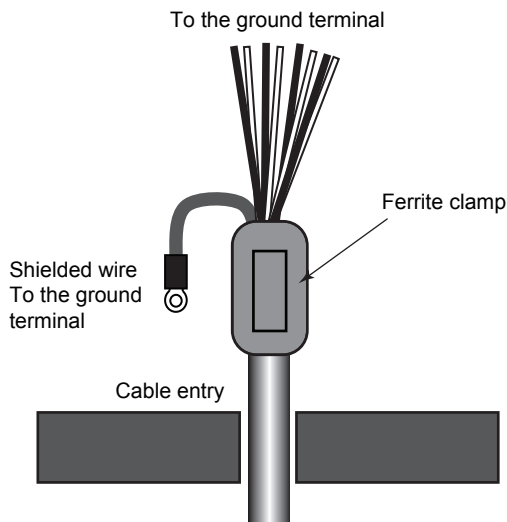


Figure 3.15

### 3.2.2 Connecting the Power Cable and Grounding

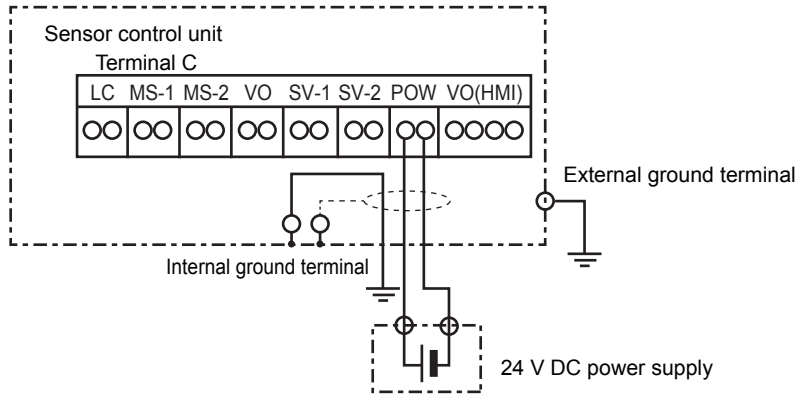


#### CAUTION

Be careful not to connect the power supply wires to the incorrect locations or reverse the polarity. Incorrectly connecting the power supply can cause the TDLS8000 to malfunction.

Use two-core or three-core shielded cable to wire the power supply.

For ground wiring, use the internal ground terminal or external ground terminal. If you want to use the internal ground terminal, use a three-core power cable.



### 3.2.3 Connecting to Temperature and Pressure Transmitters

This section explains the wiring for receiving current signals (4 to 20 mA DC) from a temperature and pressure transmitters. Connect AI-1 to a pressure transmitter and AI-2 to a temperature transmitter.

For analog input settings, see 6.3 Analog Input Settings

#### ■ Connection Preparation

To supply power to the transmitters from the TDLS8000, set the switch inside the sensor control unit to Active AI. To supply power externally, set to Passive AI. If you want to connect to a 4-wire system pressure meter or thermometer, set to Passive AI.

The factory default setting is Passive AI.

	Switch state		
	Applicable switch	External power supply	Power supply from the TDLS8000
AI-1 (pressure signal)	SW1	Passive AI	Active AI
AI-2 (temperature signal)	SW2	Passive AI	Active AI



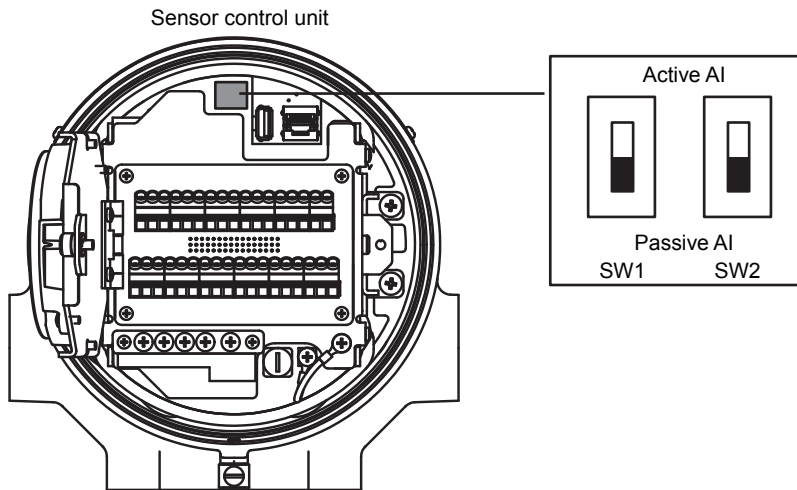


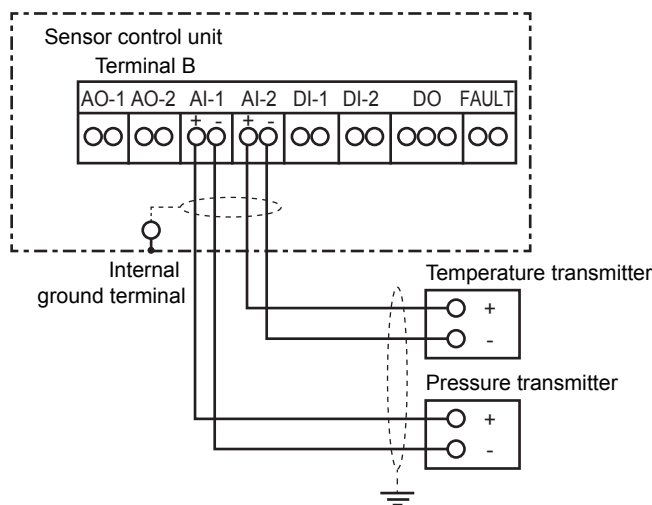
Figure 3.16 SW1 and SW2 settings

**CAUTION**

Check that the TDLS8000 is turned off before setting SW1 or SW2. Otherwise, the TDLS8000 may be damaged.

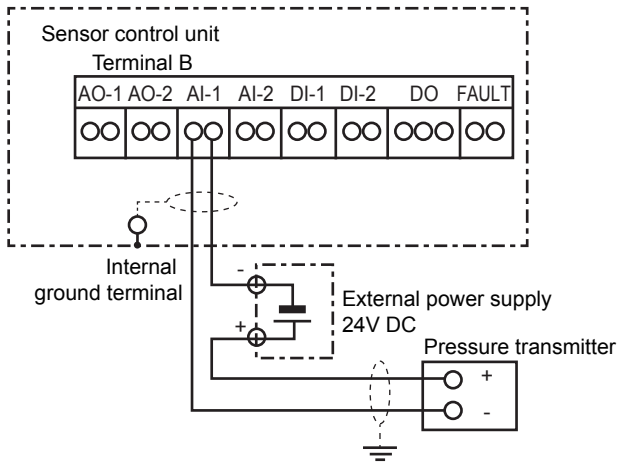
■ **Connecting a Pressure Meter and Thermometer**

Connect the analog output terminals of the transmitters as follows. The terminal polarity is the same for Passive AI and Active AI.



■ **When Connecting an External Power Supply Such as a Distributor**

If you need to connect an external power supply such as a distributor to a 2-wire system transmitter, connect it as follows. Set the switch to Passive AI.



● **Wiring procedure**

- For the cable type to use, see ■ Types of Wiring and Cabling
- Be sure to ground the cable shield on the TDLS8000 side and on the other side.
- When supplying power to the transmitters from the TDLS8000, take into account the drop in the transmitter supply voltage due to wiring resistance and the like.

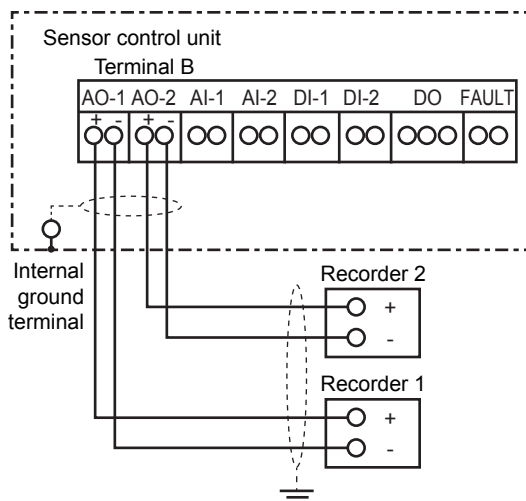
**CAUTION**

Do not apply current exceeding the allowable value to AI. Doing so can cause a malfunction.

**3.2.4 Wiring Analog Outputs (AO)**

This section explains the wiring for transmitting concentration, transmission, and other analog outputs to a recorder or other device. Only AO-1 supports HART communication.

For analog output settings, see 6.4 Analog Output Settings.



● **Wiring procedure**

- For the cable type to use, see ■ Types of Wiring and Cabling.
- Be sure to ground the cable shield on the TDLS8000 side and on the other side.
- For each output, keep the load resistance including the wiring resistance 550 Ω or less.

- During HART communication, keep the load resistance including the wiring resistance within the allowable load resistance range specified by the HART communication specifications, which is 250 to 550 Ω. (AO-1 only)



**CAUTION**

Be careful not to reverse the polarity when wiring. Doing so can cause a malfunction.

### 3.2.5 Wiring Digital Outputs

The following digital outputs are available. Both contacts are voltage-free dry outputs (mechanical relay digital outputs). The contact rating is 24 V DC 1 A for both contacts.

For digital output settings, see 6.5 Digital Output Settings

● **DO digital output (DO)**

A user-defined function can be assigned to this contact through configuration. It is a C-contact (transfer contact) consisting of three terminals: COM, NC, and NO. It is always de-energized and cannot be changed. The NC and NO markings on the terminals indicate the de-energized state.

<DO>

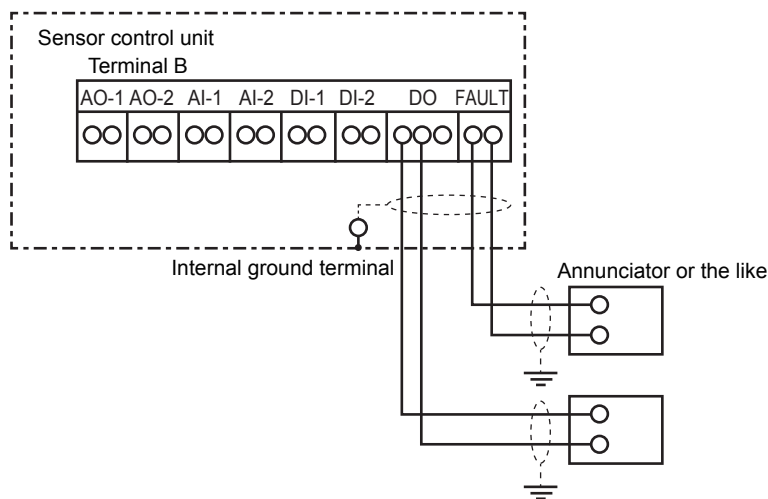
Contact state	State between the NO and COM terminals	State between the NC and COM terminals
Power off	Open	Closed
Output on	Closed	Open
Output off	Open	Closed

● **FAULT digital output (FAULT)**

This contact transmits a signal when a fault occurs. It is an A-contact (make contact) consisting of two terminals: COM and NC. It is always energized and cannot be changed. The NC marking on the terminal indicates the energized state.

<FAULT>

Contact state	State between the NC and COM terminals
Power off	Open
Output on	Open
Output off	Closed



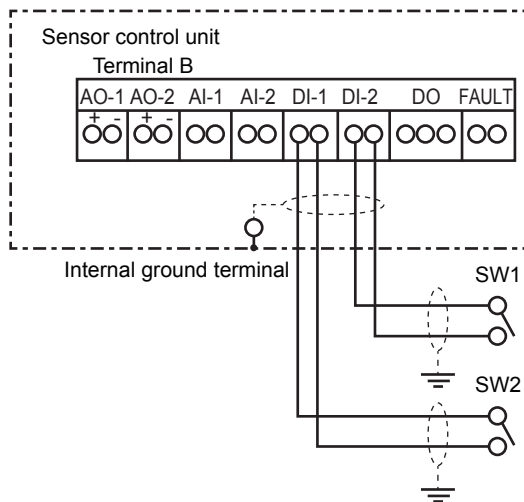
● **Wiring procedure**

- For the cable type to use, see ■ Types of Wiring and Cabling
- Be sure to ground the cable shield on the TDLS8000 side and on the other side.
- The contact rating is 24 V DC 1 A. Connect a load (e.g., indicator lamp, annunciator) that will not cause these values to be exceeded.
- For the DO digital output, select whether to wire NC or NO depending on your application.

### 3.2.6 Wiring Digital Inputs

The TDLS8000 executes specified functions when it receives contact signals. There are two inputs. Apply voltage-free contact signals. The digital input terminal outputs 5 V DC.

For digital input settings, see 6.7 Digital Input Settings.



● **Wiring procedure**

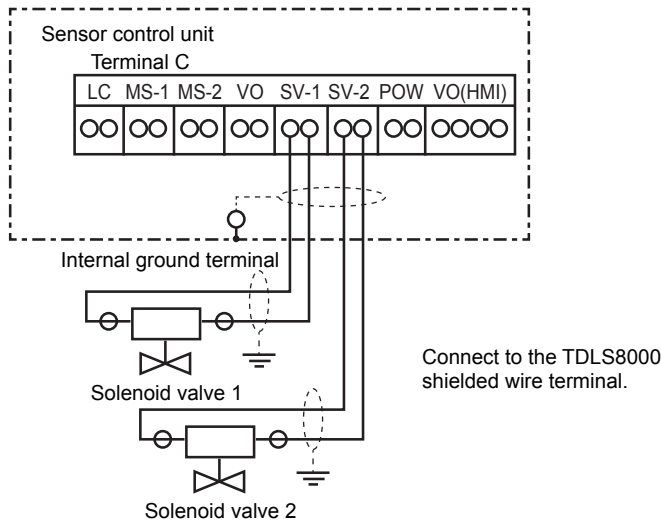
- For the cable type to use, see ■ Types of Wiring and Cabling
- Be sure to ground the cable shield on the TDLS8000 side and on the other side.
- The open and closed levels of the digital inputs are identified by the resistance seen from the TDLS8000 side. Wire the digital inputs to meet the following conditions. Note that wiring resistance is included.

If the DI terminals are shorted, about 2 mA of current will flow.

	Closed	Open
Resistance	200Ω or less	100 kΩ or more

### 3.2.7 Wiring Solenoid Valve Control Outputs

These outputs control the solenoid valves that are used during calibration and the like. There are two outputs. Each can supply 24 V DC 500 mA max.



● **Wiring procedure**

- For the cable type to use, see ■ Types of Wiring and Cabling
- Be sure to ground the cable shield on the TDLS8000 side and on the other side.
- The output rating is +24 V DC 500 mA max. Check that the solenoid valves that you want to use do not exceed these values before connecting them.

**CAUTION**

Do not short the SV terminals when the solenoid valve control output is on. Doing so will cause the internal protection fuse to melt, preventing output. If this happens, the component needs to be replaced.

### 3.2.8 Connecting an Ethernet Cable

**NOTE**

Reception of numerous invalid packets may affect the TDLS8000 functionality.

When connecting the TDLS8000 to a network, we recommended that you manage the network appropriately.

If you want to connect the TDLS8000 to an YH8000 (HMI unit) through an Ethernet hub or to an external device through Modbus/TCP communication, you will need to use an Ethernet cable.

The Ethernet cable connector must be crimped during the TDLS8000 installation.

**NOTE**

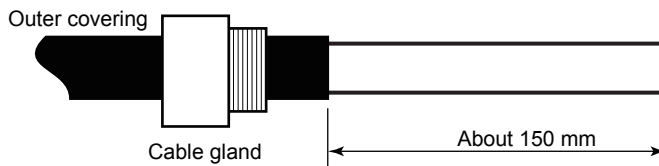
- Before crimping the Ethernet connector, pass the cable through cable gland. After crimping the Ethernet connector, the connector cannot be passed through the cable glands.
- Be careful of the cable gland orientation. The end with the screw section of the cable gland is the connector end.

- Use an eight-core CAT 5e shielded cable for the Ethernet cable.  
Use a braided wire type shield. If the shield is a metallic foil type, the shield may not be properly grounded.  
Use a cable with straight wiring.
- Use a cable gland with a cable diameter specification that matches the outer diameter of the Ethernet cable.
- The required components and tools are shown below.

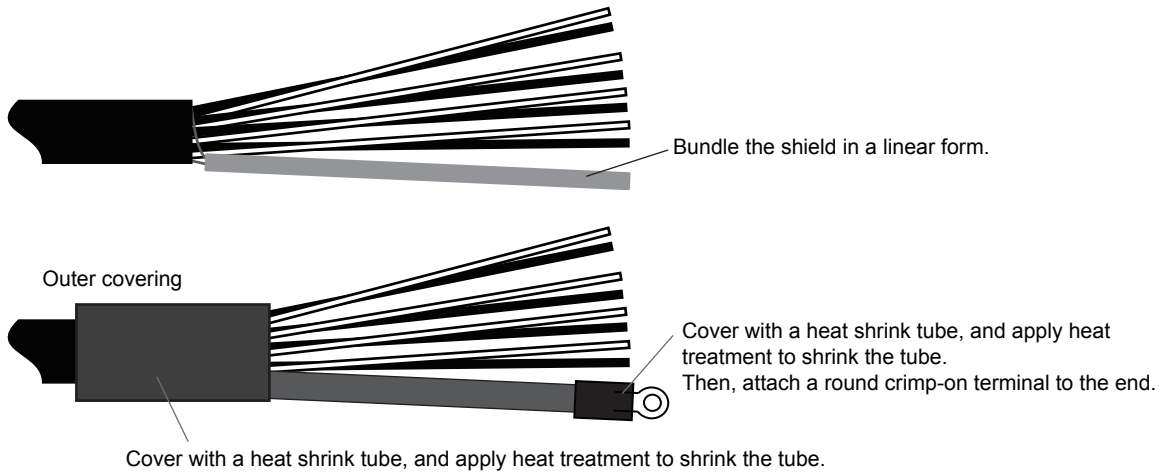
RJ45 modular plug	
RJ45 modular plug crimp tool	
LAN cable tester	
Wire cutter	
Wire stripper	
Round crimp-on terminal (for shielded wires)	For M4 screw Use the appropriate crimp-on terminals for the Ethernet cable that you are using. Crimp-on terminal example: For M4 screws, nominal cross sectional area of wire 2 mm <sup>2</sup> FV2-4 by J.S.T. Mfg. Co.,Ltd. or 170782-1 by TE Connectivity, or equivalent
Crimp tool for round crimp-on terminals	
Heat shrink tube	Used to cover the shielded parts of the Ethernet cable. Use the appropriate heat shrink tube for the Ethernet cable that you are using. Heat shrink tube example: For shielded wires: inner diameter 4 mm, length about 140 mm For external cable covering: inner diameter 10 mm, length about 30 mm
Heating gun	For shrinking heat shrink tubes

● **Processing an Ethernet cable**

- (1) Pass the Ethernet cable through the cable gland.
- (2) Remove about 150 mm of covering from the shielded Ethernet cable.  
Be careful not to cut off the shield.

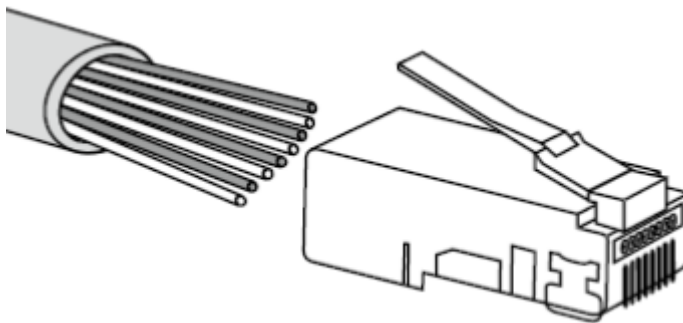


- (3) Bundle the shield in a linear form, cover it with a heat shrink tube, and apply heat treatment to shrink the tube.  
Then, attach a round crimp-on terminal to the end of the shield.  
Cover with a heat shrink tube the section of the cable where the covering was removed, and apply heat treatment to shrink the tube.



- (4) Crimp an RJ45 modular plug onto the end of the Ethernet cable.

Pin No.	Wire color
1	White-orange
2	Orange
3	White-green
4	Blue
5	White-blue
6	Green
7	White-brown
8	Brown



Insert the wires in the correct arrangement into the RJ45 modular plug, check that the wires are firmly inserted, and then crimp the plug with a RJ45 modular plug crimp tool.

Finally, check that the plug has been crimped on properly by testing the connection with a LAN cable tester.

- (5) Insert the RJ45 connector into the TDLS8000 Ethernet port and the round crimp-on terminal at the end of the shielded wire to the functional ground terminal (M4 screw) inside the SCU.

### 3.3 Optical Axis Adjustment

When wiring is complete, turn on the power, and adjust the optical axis.



#### CAUTION

The TDLS8000 is a Class 1 laser product. As such, the laser level of the product is safe to the eyes, but do not intentionally look at the laser light source. The TDLS8000 laser unit emits laser beam as soon as the power is turned on. Turn the power on after installing both the laser unit and sensor control unit to the process flange or flow cell (in a condition where the laser beam is not irradiated outside the process).

When the TDLS8000 is turned on, transmission is indicated on the display of the LU and that of the SCU. The LU displays the value with 4 digits, and the SCU as “Trans \*\*. \*%.” The alignment flange needs to be adjusted using the angle fine-adjustment nut so that this transmission is maximized. (See Figure 3.16.)

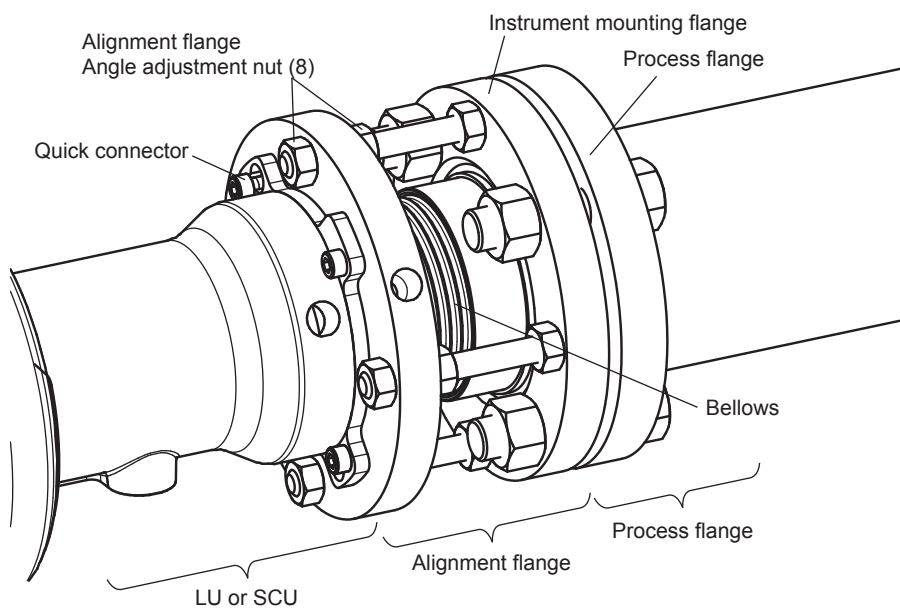
The transmission display is updated every analysis period. The standard analysis period is 2 to 5 seconds. For details on the analysis period, see Appendix 5 What Is an Analysis Period?

While adjusting the optical axis, check the updated display showing the most recent transmission. Note that it is possible to determine when the transmission is updated by the way each display changes its displayed content.

For details, see 1.2 Name and Function of Each Part

### 3.3.1 Optical Axis Adjustment When Not Using an LAO Unit (Optical path length 6 m or less)

As shown in Figure 3.16, alignment flanges are attached to the LU and SCU. The angle adjustment nuts of these flanges are used to adjust the optical axis.



**Figure 3.17** Optical axis adjustment when not using an LAO unit

Use the angle adjustment nuts of the alignment flange shown in Figure 3.16 to adjust the optical axis. For the optical axis adjustment on the LU and SCU, check the transmission each time you turn an angle adjustment nut quarter of a turn. Wait until the transmission shown on the display is updated at least twice. Repeat this process while regularly checking the transmission value.

Follow the procedure below to adjust the optical axis. Adjust one side at a time starting with the LU side. The proper optical axis adjustment may not be achieved when the optical axis on the LU and SCU is changed at the same time.

- (1) Checking the installation condition (LU and SCU)

Check the initial condition of the alignment flanges to see if the LU and SCU are facing each other. If it is apparent that they are not, adjust the alignment coarsely before continuing with the rest of the procedure.

- (2) Coarsely adjusting the laser unit (LU)

Loosen the angle adjustment nuts on the LU side.

While viewing the transmission value, move the LU with your hand to perform coarse adjustment. Repeat the adjustment in the vertical direction first and then the horizontal direction.



- Find the position that yields the maximum transmission value, and tighten the angle adjustment nuts with your fingers. From this position, begin the fine adjustment.
- If the transmission value does not increase when you coarsely adjust the LU, the mounting position of the SCU may not be correct. If this occurs, loosen the angle adjustment nuts on the SCU side, adjust it to a position that yields a higher transmission value, and then repeat step (2).
- If the transmission value does not change at all even when you make these adjustments, check that the positions of the process flange on the LU and SCU sides are correct.
- (3) Finely adjusting the laser unit (LU)
    - a. Vertical adjustment

Adjust the angle adjustment nuts while checking the transmission value to adjust the optical axis in the vertical direction. Adjust the nut to the position that yields the maximum transmission value.
    - b. Horizontal adjustment

Adjust the angle adjustment nuts while checking the transmission value to adjust the optical axis in the horizontal direction. Adjust the nut to the position that yields the maximum transmission value.
    - c. Fine adjustment

After adjusting the optical axis in the horizontal direction, make fine adjustments in the vertical direction again. After that, make fine adjustments in the horizontal direction. Repeat these final adjustments until the maximum transmission is obtained.
  - (4) Finely adjusting the sensor control unit (SCU) side
    - a. Vertical adjustment

Adjust the angle adjustment nuts while checking the transmission value to adjust the optical axis in the vertical direction. Adjust the nut to the position that yields the maximum transmission value.
    - b. Horizontal adjustment

Adjust the angle adjustment nuts while checking the transmission value to adjust the optical axis in the horizontal direction. Adjust the nut to the position that yields the maximum transmission value.
    - c. Fine adjustment

After adjusting the optical axis in the horizontal direction, make fine adjustments in the vertical direction again. After that, make fine adjustments in the horizontal direction. Repeat these final adjustments until the maximum transmission is obtained.

After the optical axis adjustment on the SCU side is complete, securely fasten the angle adjustment nuts.
  - (5) Finely adjusting the laser unit (LU) side

Again, finely adjust the laser unit (LU) side. Repeat step (3) above until the transmission value is finally at the maximum value. After the optical axis adjustment on the LU side is complete, securely fasten the angle adjustment nuts.
  - (6) Checking the angle adjustment nuts are fixed in place

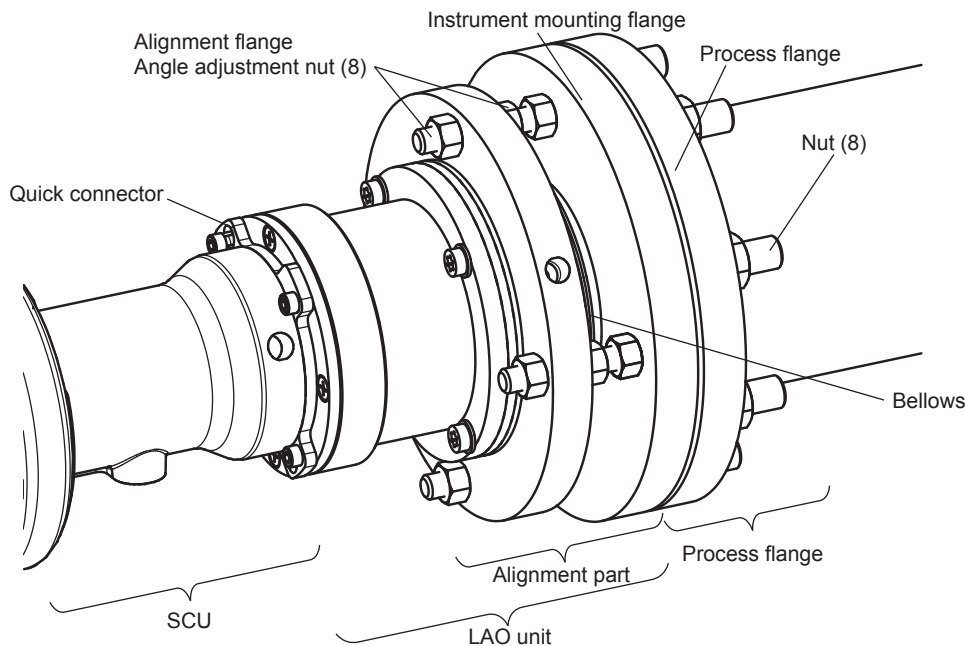
Check that the angle adjustment nuts on the LU side and SCU side are fixed securely in place.
  - (7) Transmission calibration

After the above adjustment is complete, perform transmission calibration by assuming the maximum transmission value that was obtained to be 100%. (See 9.1.1 Transmission Calibration.)

### 3.3.2 Optical Axis Adjustment When Using an LAO Unit (Optical path length 6 m or more)

For applications whose optical path length is 6 m or longer, select the “-LA” TDLS8000 optics accessory. The emitted laser beam is adjusted so that it spreads out slightly, and a condensing lens unit (LAO unit) is added to the SCU side. On the SCU side, the projected area of the laser beam spreads out making it easy to adjust the optical axis to obtain stable transmission.

An alignment flange as shown in Figure 3.16 is mounted on the LU, and an LAO unit as shown in Figure 3.17 is mounted on the SCU. In all cases, the angle adjustment nuts are used to adjust the optical axis. Although the LAO unit is used, the laser beam position will vary greatly even with a slight change in the optical axis because the process optical path length is long. As such, a more detailed adjustment will be necessary.



**Figure 3.18** Optical axis adjustment when using an LAO unit (SCU side)

Use the angle adjustment nuts shown in Figure 3.17 to adjust the optical axis. Check the transmission each time you turn an angle adjustment nut one-eighth of a turn. Wait until the transmission shown on the display is updated at least twice. Repeat this process while regularly checking the transmission value.

Follow the procedure below to adjust the optical axis when the LAO is used. Adjust one side at a time starting with the LU side. The proper optical axis adjustment may not be achieved when the optical axis on the LU and SCU is changed at the same time.

(1) Checking the installation condition (LU and SCU)

Check the initial condition of the alignment flange and the LAO unit to see if the LU and SCU are facing each other. If it is apparent that they are not, adjust the alignment coarsely before continuing with the rest of the procedure.

(2) Coarsely adjusting the laser unit (LU) side

Loosen the angle adjustment nuts on the LU side.

While viewing the transmission value, move the LU with your hand to perform coarse adjustment. Repeat the adjustment in the vertical direction first and then the horizontal direction.

Find the position that yields the maximum transmission value, and tighten the angle adjustment nuts with your fingers. From this position, begin the fine adjustment.

While making adjustments, keep in mind that the change in transmission may be extremely small depending on the laser incident angle to the SCU. Not paying attention to this fact may hinder the correct optical axis adjustment of the SCU.

If change in the transmission cannot be detected, adjust both the vertical and horizontal direction in more detail.

If the transmission value does not increase when you coarsely adjust the LU, the mounting position of the SCU may not be correct. If this occurs, loosen the angle adjustment nuts on the SCU side, adjust it to a position that yields a higher transmission value, and then repeat step (2). If the transmission value does not change at all even when you make these adjustments, double-check that the positions of the process flange on the LU and SCU sides are correct.

(3) Coarsely adjusting the sensor control unit (SCU) side

If change in the transmission is detected, coarsely adjust the SCU to maximize the transmission.

Loosen the angle adjustment nuts on the SCU side. To adjust the optical axis of the SCU, slowly tighten the angle adjustment nuts one-eighth of a turn at a time until the maximum transmission is obtained. Then fix the optical axis adjustment position.

(4) Finely adjusting the laser unit (LU)

a. Vertical adjustment

Adjust the angle adjustment nuts while checking the transmission value to adjust the optical axis in the vertical direction. Adjust the nut to the position that yields the maximum transmission value.

b. Horizontal adjustment

Adjust the angle adjustment nuts while checking the transmission value to adjust the optical axis in the horizontal direction. Adjust the nut to the position that yields the maximum transmission value.

c. Fine adjustment

After adjusting the optical axis in the horizontal direction, make fine adjustments in the vertical direction again. After that, make fine adjustments in the horizontal direction. Repeat these final adjustments until the maximum transmission is obtained.

(5) Adjusting the laser unit (LU) side one last time

Make a final adjustment so that the laser beam hits the center of the SCU with maximum transmission.

a. Final vertical adjustment

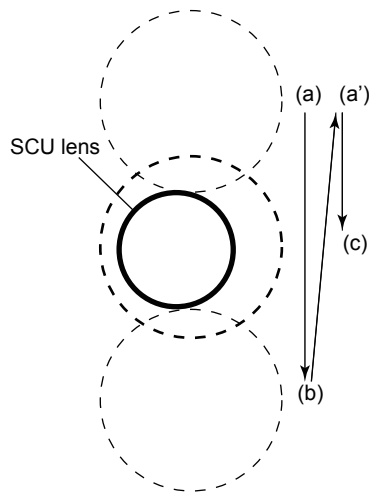
!!!Adjust only the top and bottom angle adjustment nuts!!!

i. Adjust the vertical angle adjustment nuts on the LU side so that the transmission is nearly zero (so that the laser beam barely misses the SCU lens) (Figure 3.18(a)).

ii. Adjust the vertical angle adjustment nuts on the LU side in the direction opposite to the direction of (a) until the transmission is nearly zero (until that the laser beam barely misses the SCU lens) (Figure 3.18(b)). During this process, turn the angle adjustment nuts one-eighth of a turn at a time and record how many one-eighth turns the nuts were turned.

iii. Adjust the vertical angle adjustment nuts on the LU side in the direction opposite to the direction of (b) until the transmission is nearly zero (until that the laser beam barely misses the SCU lens) (Figure 3.18(a')). During this process, turn the angle adjustment nuts one-eighth of a turn at a time and record how many one-eighth turns the nuts were turned.

iv. Check that the number of rotations of the angle adjustment nuts are nearly the same for ii and iii. Then, return the vertical angle adjustment nuts half the number of rotations, and securely fasten the nuts (Figure 3.18(c)).

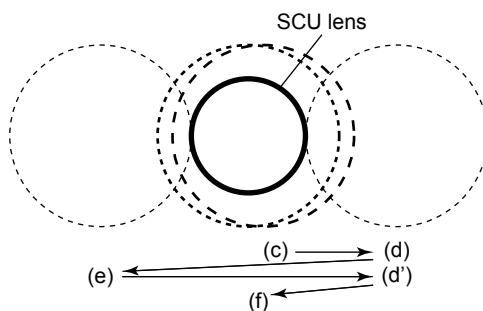


**Figure 3.19 Final vertical adjustment conceptual illustration**

**b. Final horizontal adjustment**

Adjust only the left and right angle adjustment nuts.

- i. Adjust the horizontal angle adjustment nuts on the LU side so that the transmission is nearly zero (so that the laser beam barely misses the SCU lens) (Figure 3.19(d)).
- ii. Adjust the horizontal angle adjustment nuts on the LU side in the direction opposite to the direction of i until the transmission is nearly zero (until that the laser beam barely misses the SCU lens) (Figure 3.19(e)). During this process, turn the angle adjustment nuts one-eighth of a turn at a time and record how many one-eighth turns the nuts were turned.
- iii. Again, adjust the horizontal angle adjustment nuts on the LU side in the direction opposite to the direction of ii until the transmission is nearly zero (until that the laser beam barely misses the SCU lens) (Figure 3.19(d')). During this process, turn the angle adjustment nuts one-eighth of a turn at a time and record how many one-eighth turns the nuts were turned.
- iv. Check that the number of rotations of the angle adjustment nuts are nearly the same for ii and iii. Then, return the horizontal angle adjustment nuts half the number of rotations, and securely fasten the nuts (Figure 3.19(f)).



**Figure 3.20 Final horizontal adjustment conceptual illustration**

**(6) Coarsely adjusting the sensor control unit (SCU) side one last time**

Make final vertical and horizontal adjustments to maximize the transmission. Repeat these final adjustments until the maximum transmission is obtained. After the final adjustment on the SCU side is complete, securely fasten the angle adjustment nuts.

**(7) Checking the angle adjustment nuts are fixed in place**

Check that the angle adjustment nuts on the LU side and SCU side are fixed securely in place.

(8) Transmission calibration

After the above adjustment is complete, perform transmission calibration by assuming the maximum transmission value that was obtained to be 100%. (See 9.1.1 Transmission Calibration).

## 3.4 Piping

After wiring and optical axis adjustment are complete, connect the pipes for the purge gas.

After piping is complete, to keep the TDLS8000 process window area clean, we recommend that you let the purge gas flow until the beginning of operation.

### CAUTION

To maintain the dust proof and waterproof performance of the TDLS8000, attach pipes or plugs to all ports.

For the piping thread specifications, check the inscriptions near the ports. See Figure 3.10 for an example.

### ■ Piping Parts

Refer to the following table, and check that all the necessary piping parts are available.

Device	Piping location	Piping parts	Remarks
TDLS8000	Purge port	Tube joint	Rc1/4 or 1/4NPT, off-the-shelf product
	Alignment flange purge port	Tube joint	Rc1/4 or 1/4NPT, off-the-shelf product
	LAO purge port	Tube joint	Rc1/4 or 1/4NPT, off-the-shelf product
YC8000	Piping port	Tube	1/4 inch stainless pipe, off-the-shelf product
IF8000	Purge port	Tube joint	Rc1/4 or 1/4NPT, off-the-shelf product
Calibration cell	Piping port	Tube joint	1/4NPT, off-the-shelf product

### ■ Purge Gas

Refer to the information provided in the specifications of chapter 2.

#### (1) Purge gas type

Normally, nitrogen (N<sub>2</sub>) is used for the purge gas, but depending on the application, instrumental air may suffice.

Use nitrogen gas or instrumental air that meets the following conditions.

- Is clean. Dust particle diameter is less than 0.5 μm.
- Does not contain oil.
- Nitrogen gas with 99.99% or higher purity when measuring O<sub>2</sub> or ppmH<sub>2</sub>O.
- Nitrogen gas with less than 20 ppm moisture content when measuring ppmH<sub>2</sub>O.

#### (2) Purge gas flow rates

Feed purge gases with the following purge flow rates.

- Analyzer internal purge, validation purge:  
2 to 20L/min (Application dependent)  
2 to 20L/min for SCU/LU area and 50 to 70mL/min for SCU/LU Ex area (Zone 1/Div.1/Flameproof “d”, Refer to 3.4.3)  
\*Not more than 10kPa at the inlet for Zone 1/Div.1/Flameproof “d” and Zone 2/Div.2/Type of protection “n”
- Process window purge:  
5 to 30L/min (Application dependent)

Insert a flowmeter with an adjustable needle valve between the supply line and purge inlet when feeding purge gas.

### (3) Exhausting purge gas

Purge gas exhaust is as follows.

- Analyzer internal purge, validation purge:
 

Connect pipes to outlet ports if necessary to exhaust the purge gas to an appropriate location. Construct them so that rainwater and the like do not enter the ports.

If you are using hazardous gas (e.g., CO gas) for check gas, exhaust it inside the process or in an appropriate manner.
- Process window purge:
 

The gas is exhausted inside the process.

## ■ Areas That Need to Be Purged

The TDLS8000 needs to be purged with nitrogen gas for the following two purposes.

First is the continuous nitrogen gas purging to prevent oxygen from open air and moisture from entering the measurement optical path during oxygen concentration, moisture concentration, and other process gas concentration measurements. This is called *analyzer internal purge*.

To perform validation, areas under analyzer internal purge is temporarily replaced with check gas. This is called *validation purge*.

Analyzer internal purge and validation purge are applied to the following five areas (see Figure 3.20).

- (1) Laser module area (inside the LU)
- (2) SCU module area (inside the SCU)
- (3) Validation area (inside the SCU)
- (4) LU alignment flange area (LU side: when a process isolation flange is used)
- (5) SCU alignment flange area (SCU side: when a process isolation flange is used)

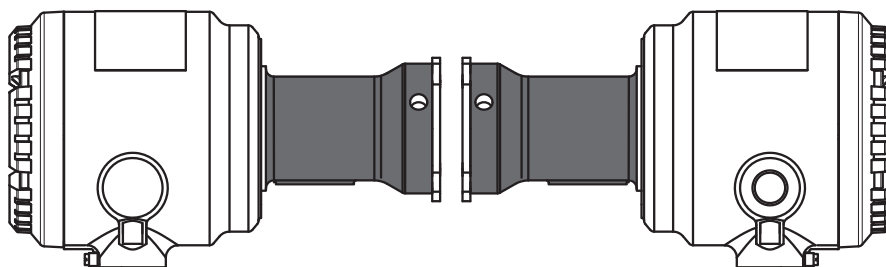


Figure 3.21 Areas to be purged

The second is the continuous purge on the process window (the interface to the process gas) to keep it clean (prevent the process from the adherence of dust). This is called *process window purge*. In process window purge, purge gas is fed inside the process from the purge port closest to the process side.

## NOTE

For Explosionproof/Flameproof type, refer to 3.4.3 Purge Gas Piping for Explosionproof/Flameproof type.

### 3.4.1 Purge Gas Piping for In-situ Installation

#### (1) When not using the validation function

If the installation into the process is in situ and the validation function is not used, connect the piping as shown in Figure 3.21. For analyzer internal purge, feed nitrogen gas through purge port A in Figure 3.21 for both the LU and SCU. For process window purge, feed nitrogen gas through the purge port of the alignment flange.

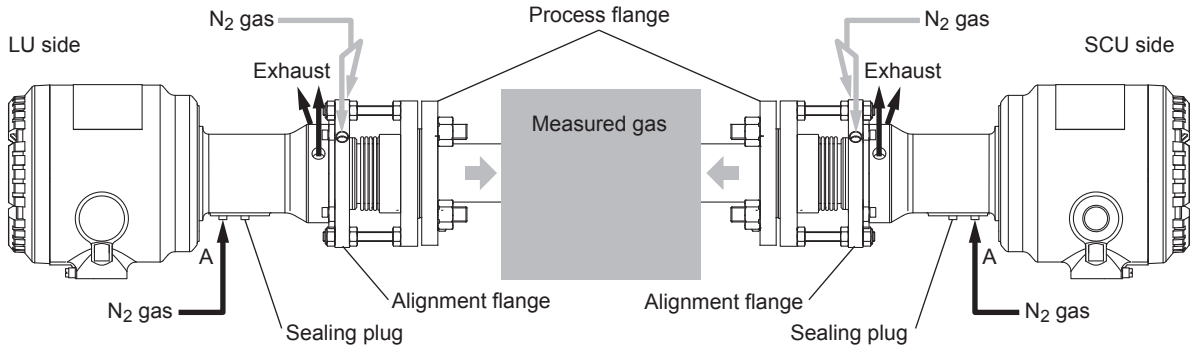


Figure 3.22 Piping for in-situ installation when not using the validation function

#### (2) When using the validation function

If the installation into the process is in situ and the validation function is used, connect the piping as shown in Figure 3.22. For analyzer internal purge, feed nitrogen gas through purge port A in Figure 3.22 for both the LU and SCU. For the SCU, since check gas needs to be fed during validation, connect the piping with a three-way valve so that the gas can be switched between nitrogen gas and check gas. For process window purge, feed nitrogen gas through the purge port of the alignment flange in the same manner as “(1) When using the validation function.”

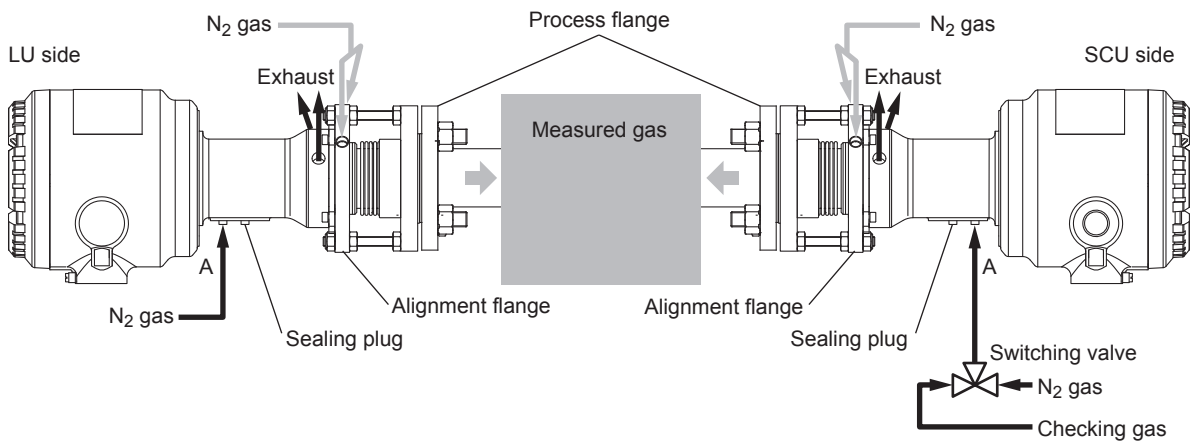


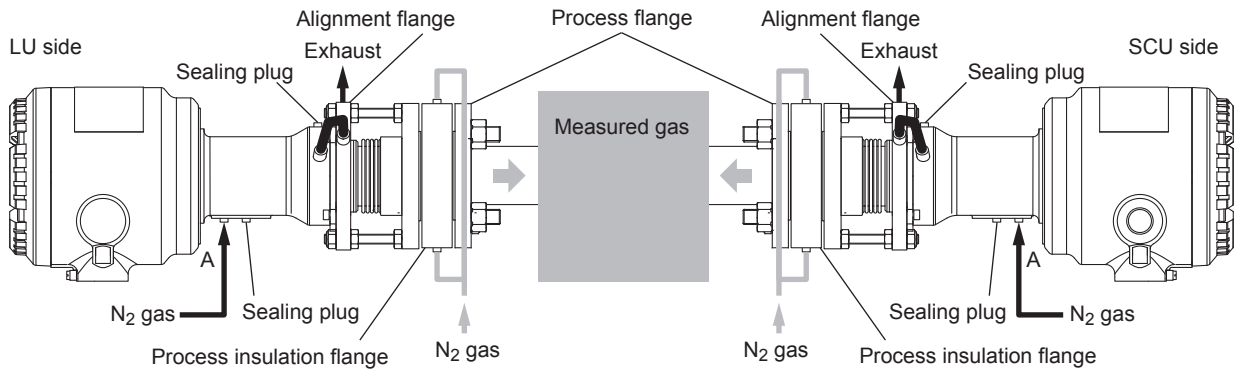
Figure 3.23 Piping for in-situ installation when using the validation function

#### (3) When using a process isolation flange but not the validation function

If the installation (in-situ or bypass) into the process uses a process isolation flange but validation will not be conducted, connect the piping as shown in Figure 3.23.

For analyzer internal purge, feed nitrogen gas through purge port A in Figure 3.23 for both the LU and SCU. Connect the piping so that the TDLS8000 purge gas also flows through the inside of the alignment flange.

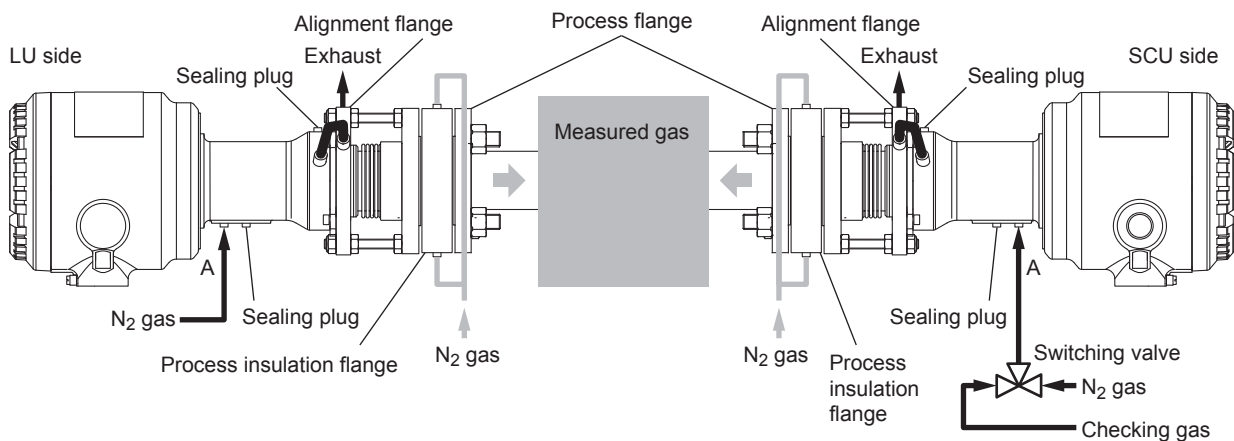
For process window purge, feed nitrogen gas through the purge port of the process isolation flange.



**Figure 3.24** Piping when using a process isolation flange (in-situ or bypass installation) but not the validation function

**(4) When using a process isolation flange and the validation function**

If the installation (in-situ or bypass) into the process uses a process isolation flange and validation will be conducted, connect the piping as shown in Figure 3.24. For analyzer internal purge, feed nitrogen gas through purge port A in Figure 3.24 for both the LU and SCU. For the SCU, since check gas needs to be fed during validation, connect the piping with a three-way valve so that the gas can be switched between nitrogen gas and check gas. For process window purge, feed nitrogen gas through the purge port of the process isolation flange in the same manner as “(3) When using a process isolation flange and the validation function.”



**Figure 3.25** Piping when using a process isolation flange (in-situ or bypass installation) and the validation function

### 3.4.2 Purge Gas Piping for Sampling System Using Flow Cells

**(1) When not using the validation function**

If the application uses a flow cell but not the validation function, connect the piping as shown in Figure 3.25.

The piping for analyzer internal purge is the same as “(3) When using a process isolation flange but not the validation function.” Feed nitrogen gas through purge port A in Figure 3.25 for both the LU and SCU. Connect the piping so that the TDLS8000 purge gas also flows through the inside of the alignment flange.

Process window purge is not used. The flow cell is purged directly with the process gas.



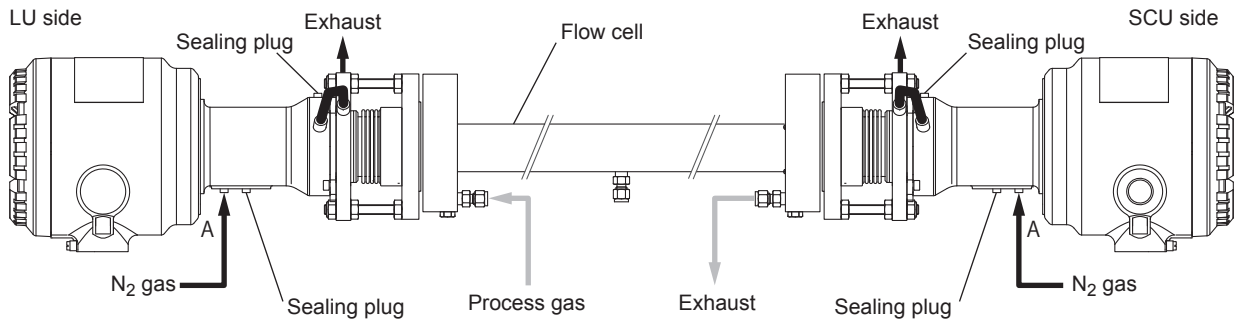


Figure 3.26 Piping when not using the validation function

**(2) When using the validation function**

If the application uses a flow cell and the validation function, connect the piping as shown in Figure 3.26.

The piping for analyzer internal purge is the same as “(4) When using a process isolation flange and the validation function.” Feed nitrogen gas through purge port A in Figure 3.26 for both the LU and SCU. For the SCU, since check gas needs to be fed during validation, connect the piping with a three-way valve so that the gas can be switched between nitrogen gas and check gas.

Process window purge is not used. The flow cell is purged directly with the process gas.

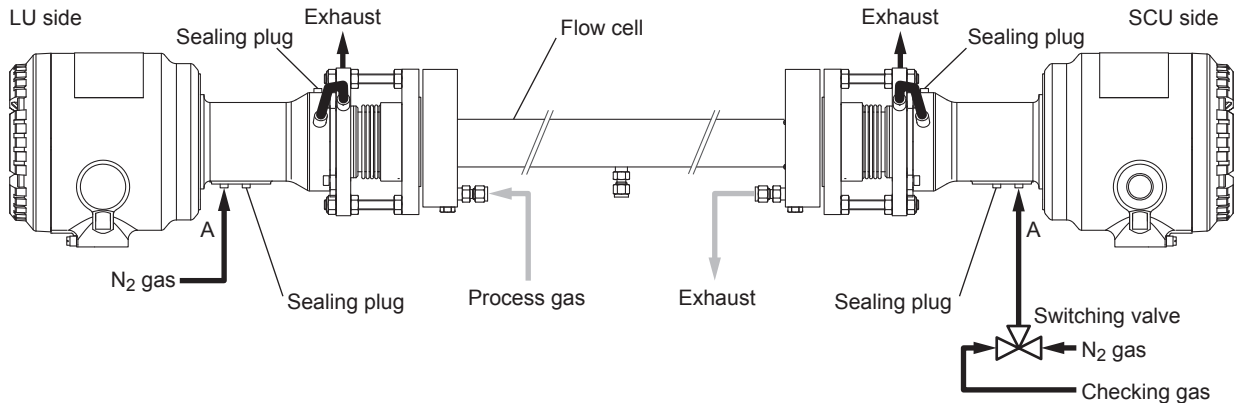


Figure 3.27 Piping when using the validation function

**3.4.3 Purge Gas Piping for Explosionproof/Flameproof type**

In Explosionproof/Flameproof type TDLS8000 (TDLS8000-C1,D1,E1,S1,J1, Q1, and R1), analyzer internal purge area, that is laser module area and detector module area, described in 3.4 are divided into two areas by explosion protection window as shown Figure 3.27. When using Explosion proof/Flame proof type, piping for purge gas should be connected to each area separately. For validation, SCU area and LU area are used.

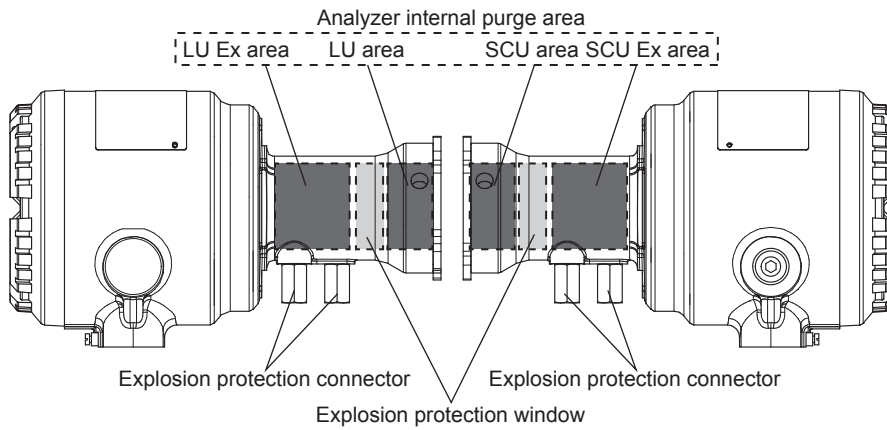


Figure 3.28 Areas to be purged in Explosion proof/Flame proof type

**(1) Explosionproof/Flameproof type without validation function**

If TDLS8000 Explosionproof/Flameproof type is installed in situ and the validation function is not used, connect piping as shown in Figure 3.28. For SCU Ex area and LU Ex area, feed nitrogen gas through purge port A at 50 to 70 mL/min and for SCU and LU area, feed nitrogen gas through purge port B in Figure 3.28. The piping for these two areas in a unit should be separated because required flow rate is different. For flow rate of SCU and LU are, refer to 3.4 (2). For process window purge, feed nitrogen gas through the purge ports of the alignment flange.

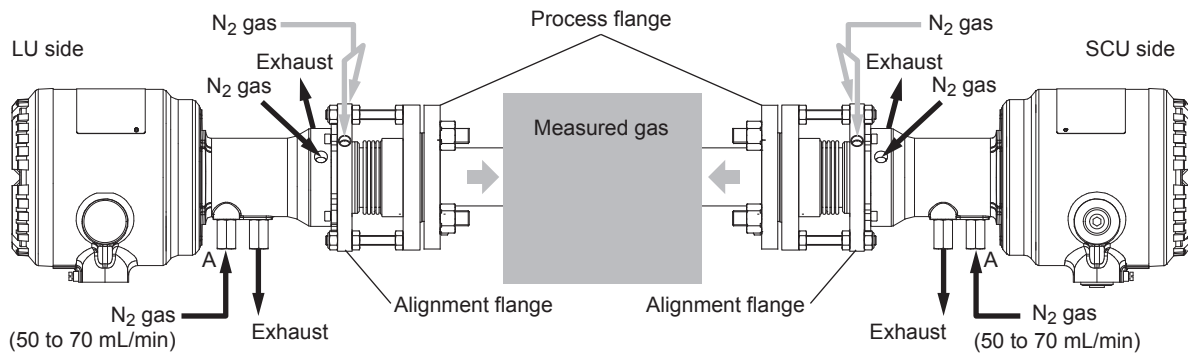


Figure 3.29 Piping for Explosion proof/Flame proof type without validation

**CAUTION**

Excess flow rate for SCU and LU Ex area may cause Detector or Laser module damage.



**WARNING**

Pressure at the inlet for SCU/LU area and SCU/LU Ex area shall not exceed 10kPa.

**(2) Explosionproof/Flameproof type with validation function**

If TDLS8000 is installed in the process is in situ and the validation function is used, connect the piping as shown in Figure 3.29. For SCU Ex area and LU Ex area, feed nitrogen gas through purge port A at 50 to 70 mL/min and for SCU area and SCU and LU area, feed nitrogen gas through purge port B in Figure 3.29. The piping for these two areas in a unit should be separated because flow rate is different. For flow rate of SCU and LU are, refer to 3.4 (2). For process window purge, feed nitrogen gas through the purge ports of the alignment flange. For validation, SCU area and LU area is used as validation cell and connect the piping with a three-way valve so that the gas can be switched between nitrogen gas and check gas. For process window purge, feed nitrogen gas through the purge port of the alignment flange.

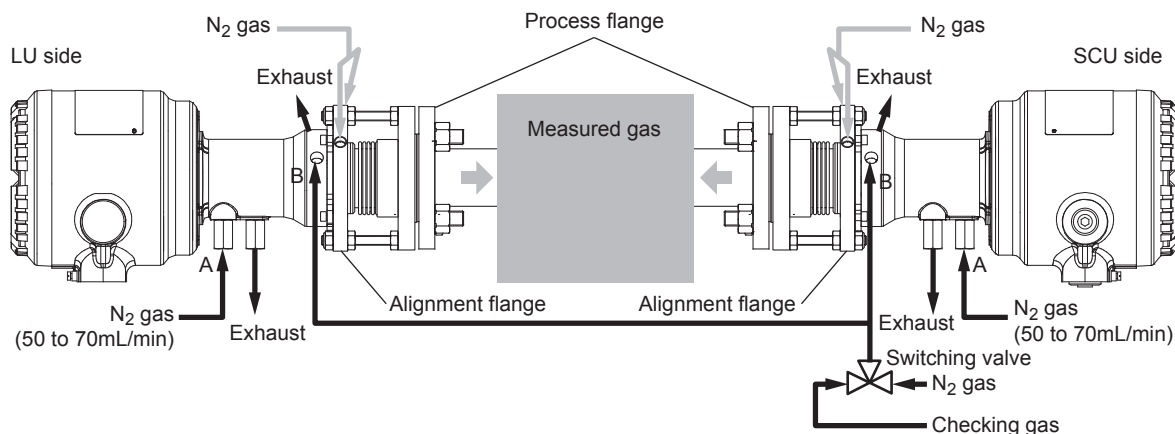


Figure 3.29 Piping for Explosion proof/Flame proof type with validation

**CAUTION**

- Excess flow rate for SCU and LU Ex area may cause Detector or Laser module damage.
- Validation gas line cannot be connected to SCU or LU Ex area.



**WARNING**

Pressure at the inlet for SCU/LU area and SCU/LU Ex area shall not exceed 10kPa.

**(3) Explosionproof/Flameproof type with Flow cell or Isolation flange**

If TDLS8000 is installed with an isolation flange or a flow cell, refer to this clause and 3.4.1 (3), (4) or 3.4.2. The piping for analyzer internal purge area is the same as 3.4.3 (1) or (2) except the outlets of SCU and LU area adjacent each alignment flange. Those outlets should be connected to the inlets of alignment flange. The piping for the flow cell or isolation flange is the same as the piping described in 3.4.1 (3), (4) or 3.4.2.

**CAUTION**

- Excess flow rate for SCU and LU Ex area may cause Detector or Laser module damage.
- Validation gas line cannot be connected to SCU or LU Ex area.



**WARNING**

Pressure at the inlet for SCU/LU area and SCU/LU Ex area shall not exceed 10 kPa.

## 4. YH8000 Installation

There are two methods of YH8000 HMI unit installation: local HMI installation in which the unit is mounted directly on the TDLS8000 and remote HMI installation in which the unit is mounted by itself on a wall or the like.

See 2.3 Model and Codes

### CAUTION

During installation, be careful not to drop the product, damage the display, and so on.

In case of TDLS8000 Type “-D1”, “-C1”, “-S1”, “-E1”, “-J1”, “-Q1”, “-R1”, Local HMI Installation is not applicable.

#### ● Installation location

The YH8000 is designed to work even in harsh environmental conditions, but note the following points in order to use it stably for a long time.

Select an installation location where the ambient temperature and humidity are within the specifications.

Be sure to block direct sunlight such as by attaching a sun shield or installing it in a cubicle.

If the YH8000 is subject to heat radiation such as from plant facilities, take heat insulation measures.

Also, select a location that meets the following conditions.

- Where there is hardly any mechanical vibration or shock
- Where it is not subject to direct sunlight or harsh weather conditions
- Where there is no corrosive atmosphere

## 4.1 Local HMI Installation

The YH8000 can be mounted on the TDLS8000 by using the mounting kit for TDLS8000 (option code: /M). The YH8000 can be mounted on the front, right, or left.

If you want the front cover to open in the opposite direction due to the installation location, the YH8000 can be mounted upside down.

The sun shield (option code: /S) for avoiding the effects of direct sunlight can also be mounted.

When attaching the mounting kit to the YH8000, fasten the supplied TDLS8000 bolt and YH8000 bolt with a torque of about 5 to 6 N·m.

### ● Procedure for attaching the bracket to the front

- (1) Fasten accessory brackets 1 and 2 in place with the YH8000 bolts (M6x14 mm).  
You can tilt the YH8000 in the range of  $-20^{\circ}$  to  $20^{\circ}$  by changing the angle adjustment hole used to fasten accessory bracket 1 in place.
- (2) Fasten accessory bracket 1 to the YH8000 with the YH8000 bolts.
- (3) Fasten accessory bracket 3 to the TDLS8000 with the TDLS8000 bolts (M6x10 mm).  
Note that the length of the TDLS8000 bolts and YH8000 bolts is different.
- (4) Fasten accessory bracket 2 to accessory bracket 3 with the YH8000 bolts.

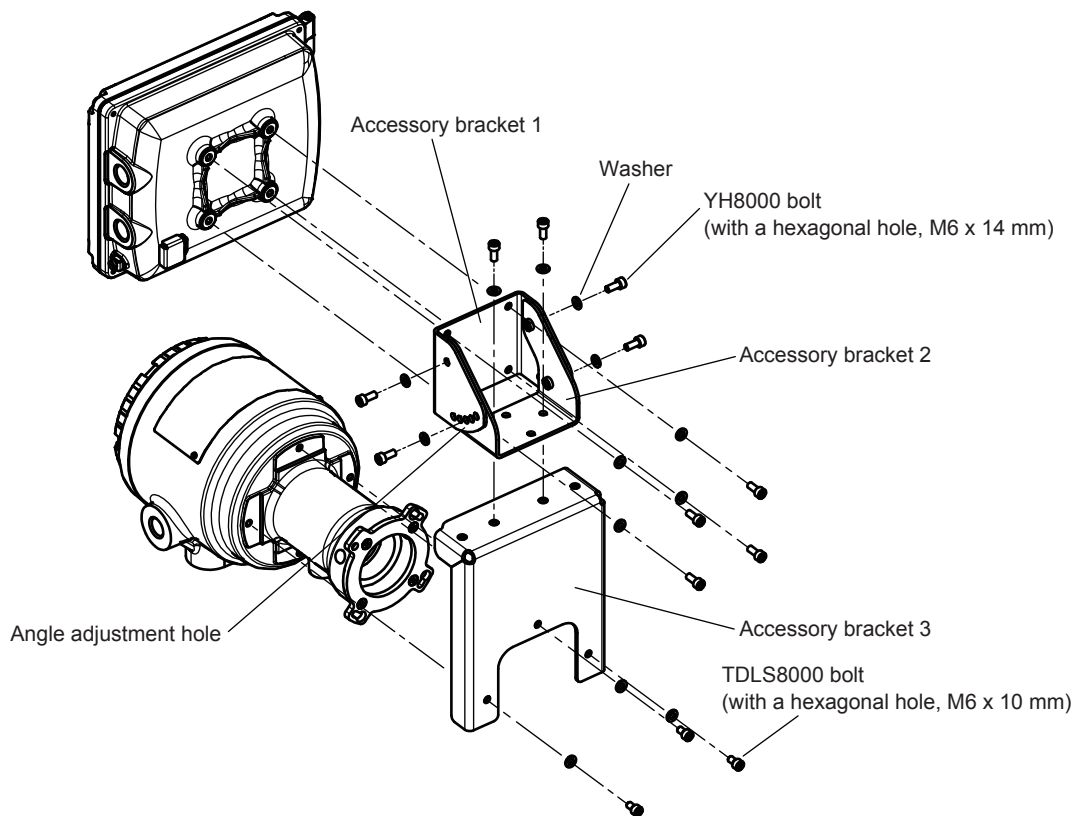


Figure 4.1 Mounting to the front

### ● Procedure for attaching the bracket to the side

- (1) Fasten accessory brackets 1 and 2 in place with the YH8000 bolts.  
You can tilt the YH8000 in the range of  $-20^{\circ}$  to  $20^{\circ}$  by changing the angle adjustment hole used to fasten accessory bracket 1 in place.
- (2) Fasten accessory bracket 1 to the YH8000 with the YH8000 bolts.

- (3) Fasten accessory bracket 3 to the TDLS8000 with the TDLS8000 bolts.
- (4) Fasten accessory bracket 2 to accessory bracket 3 with the YH8000 bolts. You can fasten it to the left or the right side.

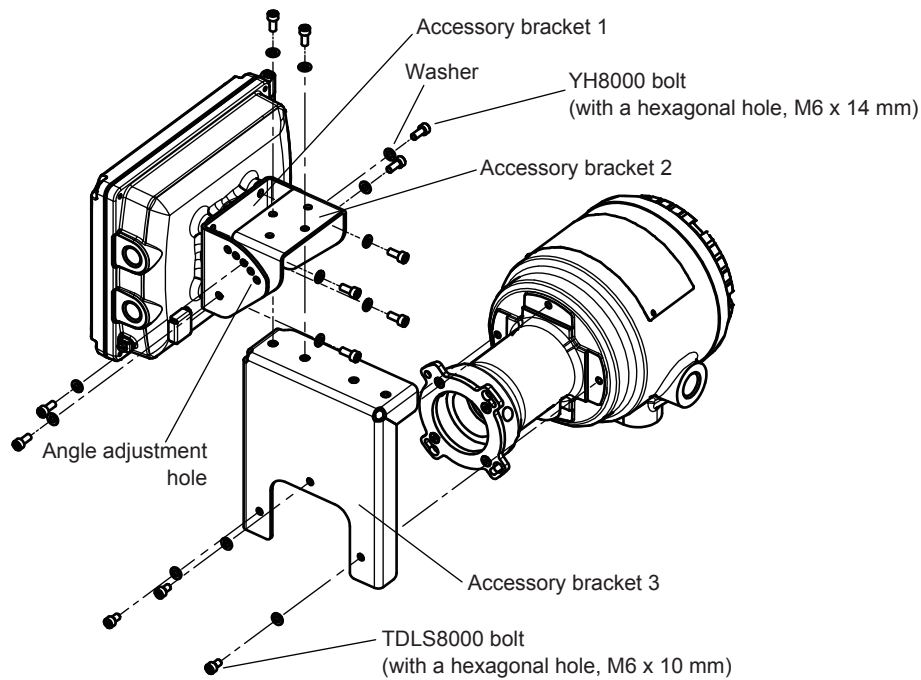


Figure 4.2 Mounting to the right

● **When attaching the sun shield**

Place the sun shield over the YH8000, and then fasten accessory bracket 1 in place with the YH8000 bolts. Fasten the bolts with a torque of about 5 to 6 N•m.

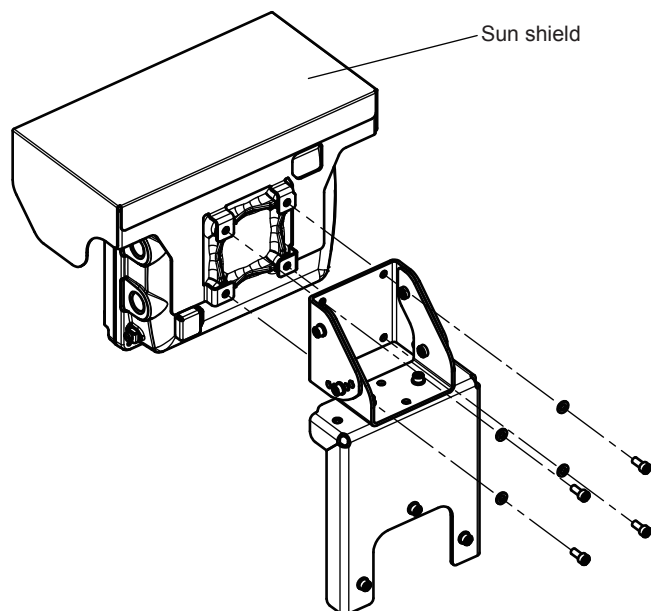


Figure 4.3 Attaching the sun shield

- **Inverted YH8000 installation**

The YH8000 can be mounted upside down so that the cables come out on the left side. When you mount the YH8000 upside down, you can invert the screen using the inversion switch. For details on how to use the inversion switch, see page 4-4 of ● Inverted YH8000 installation● Inverted YH8000 installation

This mounting method can be used when mounting the YH8000 on the mounting kit for TDLS8000, a wall, or a pipe. For details on the mounting bracket and the YH8000 tightening torque, see the details of each mounting method.

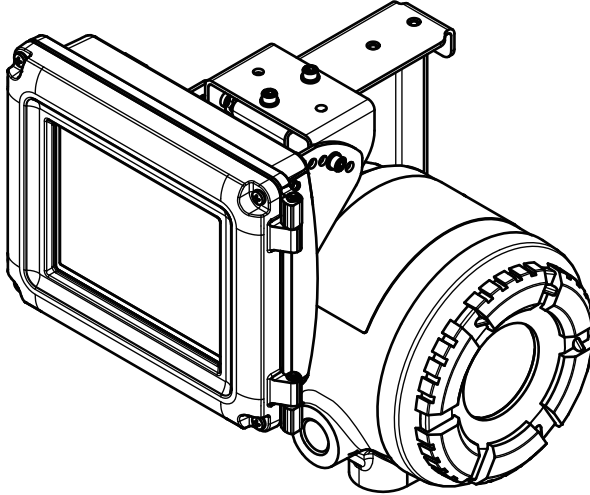


Figure 4.4      Upside down mounting

## 4.2      Wiring for Local HMI Installation

After mounting the YH8000 on the TDLS8000, wire it.

If the YH8000 is mounted upside down, reverse the YH8000 inversion switch.

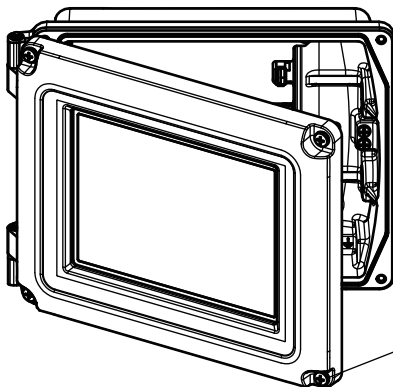


### **CAUTION**

Never turn on the power to the TDLS8000 or the devices connected to the TDLS8000 until all wiring is complete.

- **Opening the YH8000 front cover**

Open the front cover according to the following procedure.



Front cover fastening screw

**How to open the front cover**

- (1) Loosen the M5 screws holding the front cover. The screws are designed not to come off the front cover.
- (2) Open the front cover outward to the left.

**How to close the front cover**

- (1) Close the front cover. Be careful not to get your fingers or other body parts caught in the hinge area and between the front cover and the case.
- (2) Align the front cover to the screw holes of the case, and fasten the screws evenly. Do not tighten any screw all the way. When the gasket load starts to be applied to the four corner screws, tighten the screws evenly about one turn. Use a tightening torque of 1.8 to 2.0 N•m.

**CAUTION**

When opening or closing the front cover, be careful not to get your fingers or other body parts from being caught between the front cover and the case.

**CAUTION**

When opening the front cover, check that the screws are lifted completely off the screw holes, and open the cover slowly. This is to prevent damaging the threaded parts of the housing.

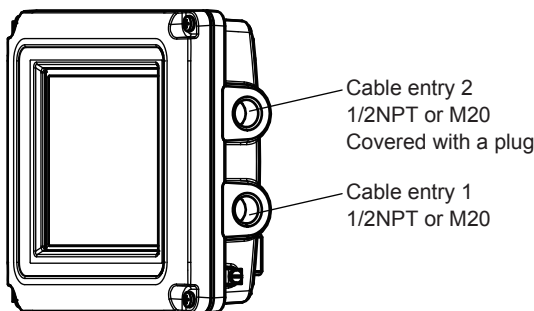
If the threaded parts are damaged and the screws cannot be tightened securely, waterproof capability will be lost.

● **Cable entries**

There are two cable entries on the YH8000. Attach conduits or cable glands with the appropriate thread size to the YH8000 cable entries.

Symbols are inscribed near the cable entries for identifying the thread specifications.

- For ANSI 1/2NPT:   A
- For ISO M20x1.5:   M



Cable entry 1   Cable entry for the cable that connects to the TDLS8000.

Cable entry 2   A plug with a hexagonal hole covers this entry. To use Port2 for Modbus communication, remove the plug and run the cable through this entry. This entry is also used when running an Ethernet cable for remote HMI installation.

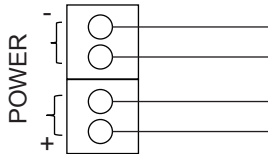
Be careful of the tightening torque when assembling cable glands.



● Wiring

 **CAUTION**

Be careful not to connect the power supply wires to the incorrect locations or reverse the polarity. Incorrectly connecting the power supply can cause a malfunction.



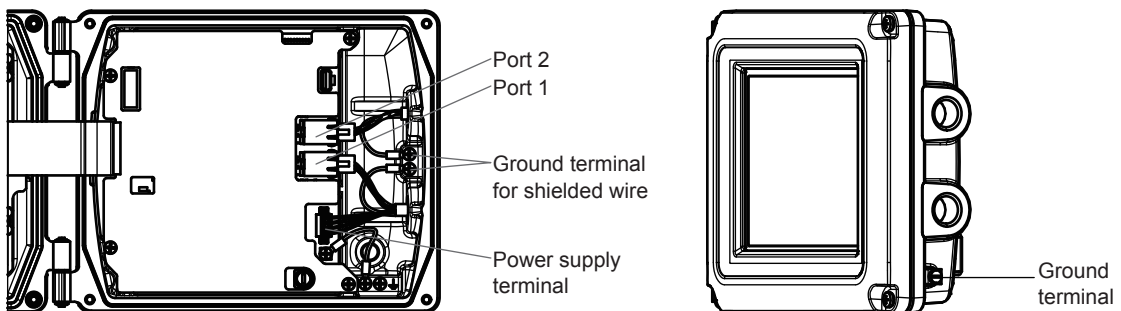
Terminal name	Function
POWER+	YH8000 power supply input. 24 V DC±10%
POWER-	In the case of a local connection, power is supplied from the SCU. In the case of special cables, connect two to the positive terminal and two to the negative.
PORT1	Connection to the SCU
PORT2	Modbus communication, Ethernet communication for remote connection

For the cables you need to use, see page 3-14 of ■ Types of Wiring and Cabling3-14 ■ Types of Wiring and Cabling

When the YH8000 is mounted on the TDLS8000 (local HMI installation), you need to use a local HMI connection cable (option code: /C), which is a special option cable. The wiring of the special cable is explained below.

This cable must be processed before it is connected. For details on how to process the cable, see Appendix 2 Constructing Local HMI Connection Cables

- (1) Connect the cable to the power supply terminal with the correct polarity. Use a tightening torque of 0.22 to 0.25 N•m for the power supply terminal.
- (2) Insert the RJ45 connector into Port1 until you hear a click.
- (3) Connect the shielded wire of the special cable to the ground terminal for the shielded wire.
- (4) Connect a grounding cable that complies with ■ Types of Wiring and Cabling



● **Setting the YH8000 inversion switch**

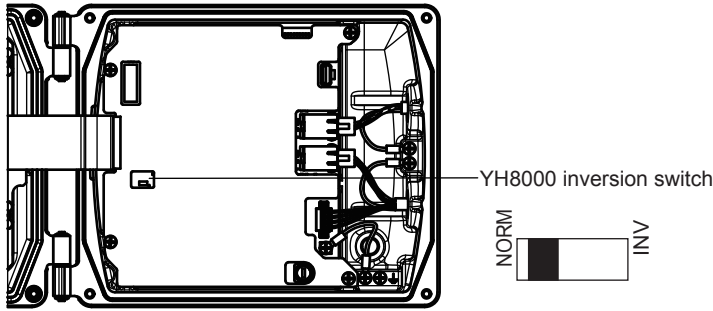
**NOTE**

Set the inversion switch with the YH8000 turned off. Turning it off applies the setting.

The YH8000 can be positioned so that the cables come out on the right side or the left side.

Depending on the direction, you need to reverse the YH8000 inversion switch, which is inside the case. The inversion switch is for inverting the screen upside down. Set the switch according to how the YH8000 is mounted as shown below.

The factory default setting is for the cables to come out from the right side.



YH8000 inversion switch

How the YH8000 is mounted	Inversion switch position
Cables coming out from the right side.	NORM
Cables coming out from the left side.	INV

### 4.3 Remote HMI Installation

This section explains how to mount the YH8000 using mounting brackets (pipe mount (option code: /P), wall mount (option code: /W)).

The sun shield (option code: /S) for avoiding the effects of direct sunlight can also be mounted.

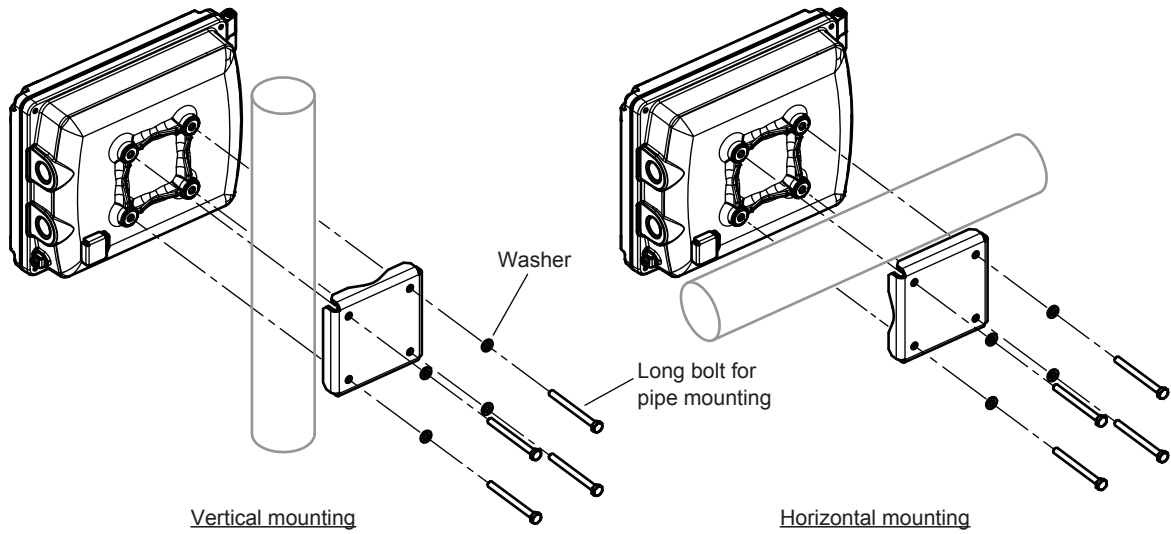
 **WARNING**

The TDLS8000 does not have a power switch. Provide a switch on the power supply line to separate the TDLS8000 from the main power supply. Use labels to indicate that this switch is for cutting off the power supply to the TDLS8000 and to indicate ON and OFF.

● **Pipe mounting**

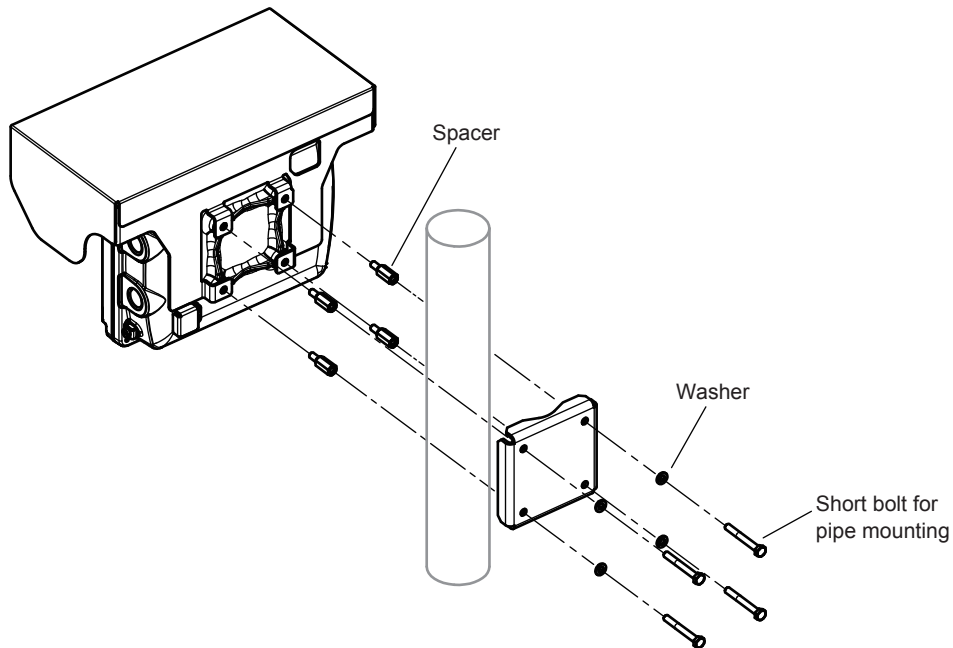
The YH8000 can be mounted on a 50A (2B) pipe. Fasten the YH8000 bolts with a torque of about 5 to 6 N•m. The YH8000 can be mounted horizontally or vertically.

The pipe mount option includes short bolts that are used when a sun shield is used and long bolts that are used when a sun shield is not used.



**Figure 4.5** Pipe mounting

When attaching a sun shield, spacers are used to fasten the sun shield to the YH8000 before mounting on the pipe.

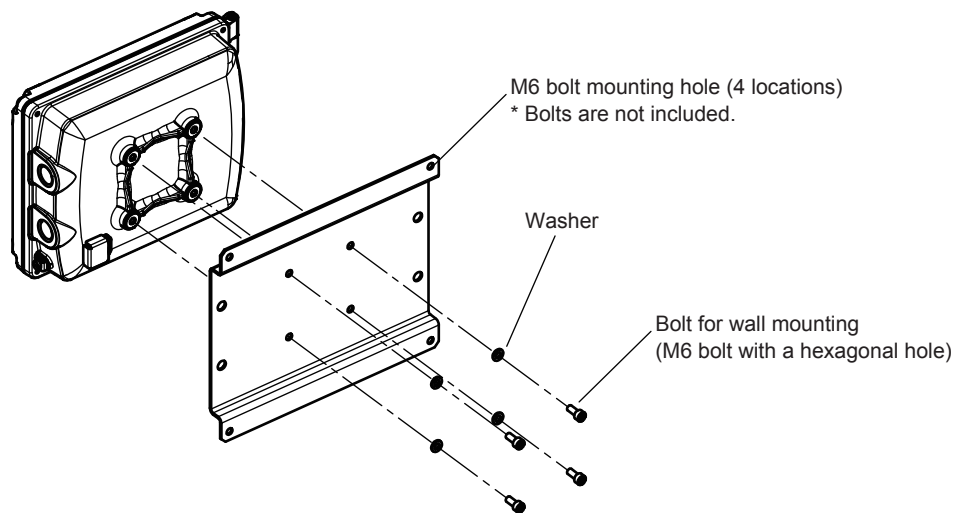


**Figure 4.6** Pipe mounting when a sun shield is used (vertical mount example)

● **Wall mounting**

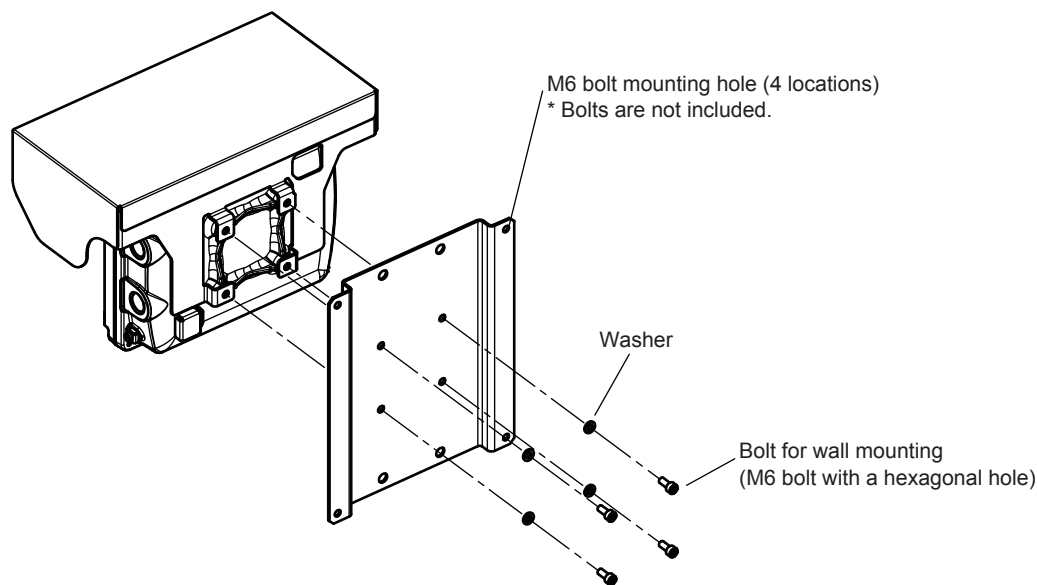
For the wall mount dimensions, see 2.3 Model and Codes

Fasten the wall mount bracket to the YH8000 with a tightening torque of about 5 to 6 N•m.



**Figure 4.7** Wall mounting

When attaching a sun shield, turn the wall mount bracket so that the longer side is vertical.



**Figure 4.8** Wall mounting when a sun shield is used

## 4.4 Wiring for Remote HMI Installation

Wire the cables after completing the remote HMI installation.



### CAUTION

Never turn on the power to the YH8000 or the devices connected to the YH8000 until all wiring is complete.

- **Opening the YH8000 front cover**

See 4.2 Wiring for Local HMI Installation

- **Cable entries**

Run the power cable through cable entry 1 shown in 4.2 Wiring for Local HMI Installation. Run the Ethernet cable through cable entry 2 after removing the plug with a hexagonal hole.

- **Wiring**

See 4.2 Wiring for Local HMI Installation



### CAUTION

Be careful not to connect the power supply wires to the incorrect locations or reverse the polarity.

Incorrectly connecting the power supply can cause a malfunction.

For the cables you need to use, see page 3-14 of ■ Types of Wiring and Cabling ■ Types of Wiring and Cabling

Use two-core or three-core shielded cable to wire the power supply.

If you want to connect the functional ground terminal inside the instrument, use a three-core power cable.

- **Connecting an Ethernet Cable**

If you want to connect the YH8000 to TDLS8000 through an Ethernet hub, you will need to use an Ethernet cable. The Ethernet cable connector must be crimped during the YH8000 installation.

The processing of the Ethernet cable is the same as for the TDLS8000. See 3.2.8 Connecting an Ethernet Cable

Power supply wiring, ground wiring, and Ethernet cable connection when using the YH8000 remotely are explained below. For the terminal positions, see the wiring diagram in 4.2 Wiring for Local HMI Installation

- (1) Connect the cable to the power supply terminal with the correct polarity. Use a tightening torque of 0.22 to 0.25 N•m for the power supply terminal.
- (2) Insert the RJ45 connector into Ethernet Port2 until you hear a click.
- (3) Connect the shielded wire of the special cable to the ground terminal for the shielded wire.
- (4) Connect a grounding cable that complies with page 3-14 of ■ Types of Wiring and Cabling

## 5. Startup

Refer to “3.2 Wiring” and “3.4 Piping”, and verify that the system has been constructed correctly. Perform the startup procedure with the optical axis adjustment completed.

Run analyzer internal purge gas and process window purge gas at the appropriate flow rates. Supply power to the TDLS8000.

The SCU display shows a screen indicated in “1.2 Name and Function of Each Part” The LU display shows the transmission value [%].

### NOTE

Even in an application that requires the system to be regularly run and suspended repeatedly, we recommend that you continuously supply power and process window purge gas to the TDLS8000. This is to prevent unnecessary temperature changes in and placing unnecessary load on the laser device and sensor.

## 5.1 Connecting the HART Configuration Tool

This section explains how to connect the HART configuration tool and provides a brief overview of the menu tree shown on the tool. For details on the menu tree and HART communication function, see “7. HART Communication” and “Appendix 3 General View of HART DD”.

### NOTE

Write protection based on password authentication is available for TDLS8000 HART communication. By factory default, the write protection is disabled. Therefore, you can change the settings simply by connecting the configuration tool. For details on how to enable write protection, see “7. HART Communication”.

### 5.1.1 Installing a DD File

Before using the HART configuration tool, the TDLS8000 DD (Device Description) must be installed in the configuration tool. If you use FieldMate for the configuration tool, obtain the latest Device Files, and install a DTM. For details, see the FieldMate instruction manual.

The following table shows the relation between DD and Device Files.

Software Revision	HART Device Revision	DD Revision	Device Files Revision
1.** **	01	01	3.06.11
		02	3.06.24
2.01.01 or above	02	01	3.08.13

If you want to connect your own configuration tool, download the DD file from the YOKOGAWA website and install it.

[https://partner.yokogawa.com/global/interoperability/dd-file-hart\\_an.htm](https://partner.yokogawa.com/global/interoperability/dd-file-hart_an.htm)

### 5.1.2 Connection Procedure

Connect the configuration tool in parallel with the load resistance connected to the analog output AO-1 terminal. There is no polarity. For details on connecting the load resistance, see "3.2 Wiring". Figure 5.1 shows a wiring example.

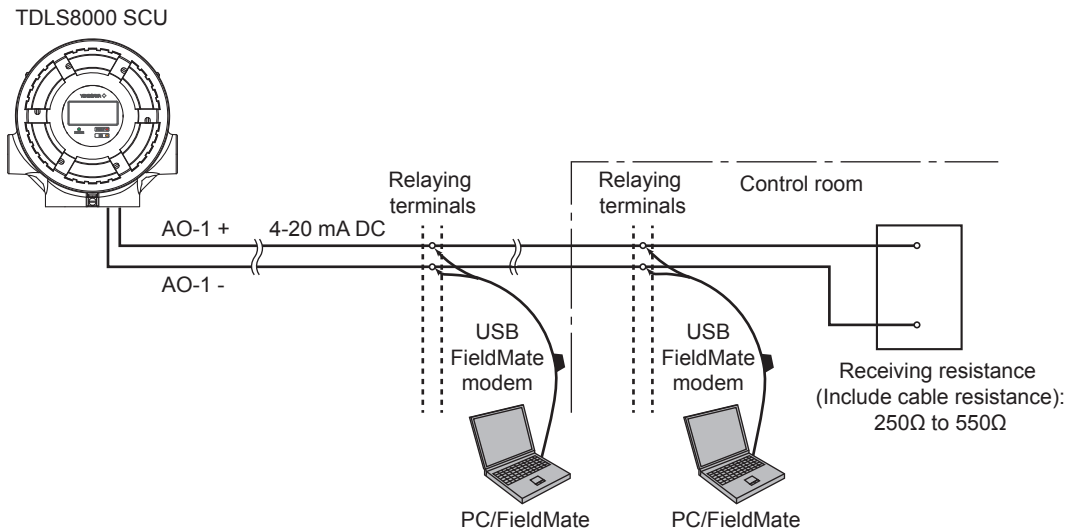


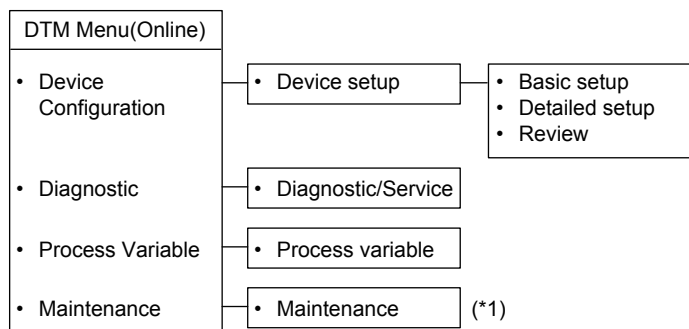
Figure 5.1 HART configuration tool wiring example

### 5.1.3 Basic Menu Configuration

The root menu of the menu tree displayed in the HART configuration tool is described below. For the entire menu structure, see "7.2 Menu Tree". For the entire menu including parameter names, see "Appendix 3 General View of HART DD".

Root menu	Description
Process variables	Displays the most recent PV-QV and measured values
Diagnosis/Service	Checks alarms and history and executes calibration, validation, and loop checks
Basic setup	Assigns PV-QV items and sets output ranges
Detailed setup	Sets TDLS8000-specific parameters
Review	Displays measured values, I/O values, and production information

On FieldMate, the top menu structure is different from the DD menu. The FieldMate root menu is "DTM Menu(Online)," and under it are the five DD root menus shown above. The lower level structure, however, is the same as DD.

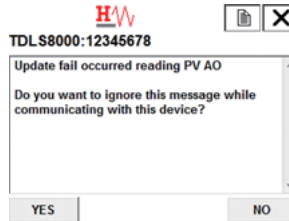


\*1: Of the commands in the "Diagnostic/Service" menu, the execution commands for calibration, validation, and loop check are included.

**DTM root menu**

**NOTE**

If you are using the Field Communicator 475 configuration tool, the following screen may appear depending on the factory default settings of the TDLS8000. This is a notification that the same measured value was read multiple times within the same analysis period. Since this is not a problem with the TDLS8000 operation, select “YES.” This screen will appear every time a connection is made. The analysis period is a fixed adjustment value assigned to each TDLS8000 and cannot be changed.



## 5.2 Connecting to the YH8000

This section describes how to connect the YH8000 HMI unit to the TDLS8000 and provides a basic description of the related screens. For a detailed explanation of the YH8000, see “8. YH8000 HMI Unit”.

### 5.2.1 Initialization and Connection Procedure

If you are connecting the TDLS8000 and YH8000 in a one-to-one configuration, the factory default settings can be used. The settings need to be changed when you are connecting the TDLS8000 to an existing LAN network or when you are connecting multiple TDLS8000s or YH8000s.

The initial IP address settings are shown in Figure 5.1.

**Table 5.1 Factory default IP address settings**

Model	IP address	Subnet mask	Default gateway
TDLS8000	192.168.1.10	255.255.255.0	192.168.1.254
YH8000	192.168.1.100	255.255.255.0	192.168.1.254

To change the TDLS8000 IP address and subnet mask from the YH8000, follow the procedure below.

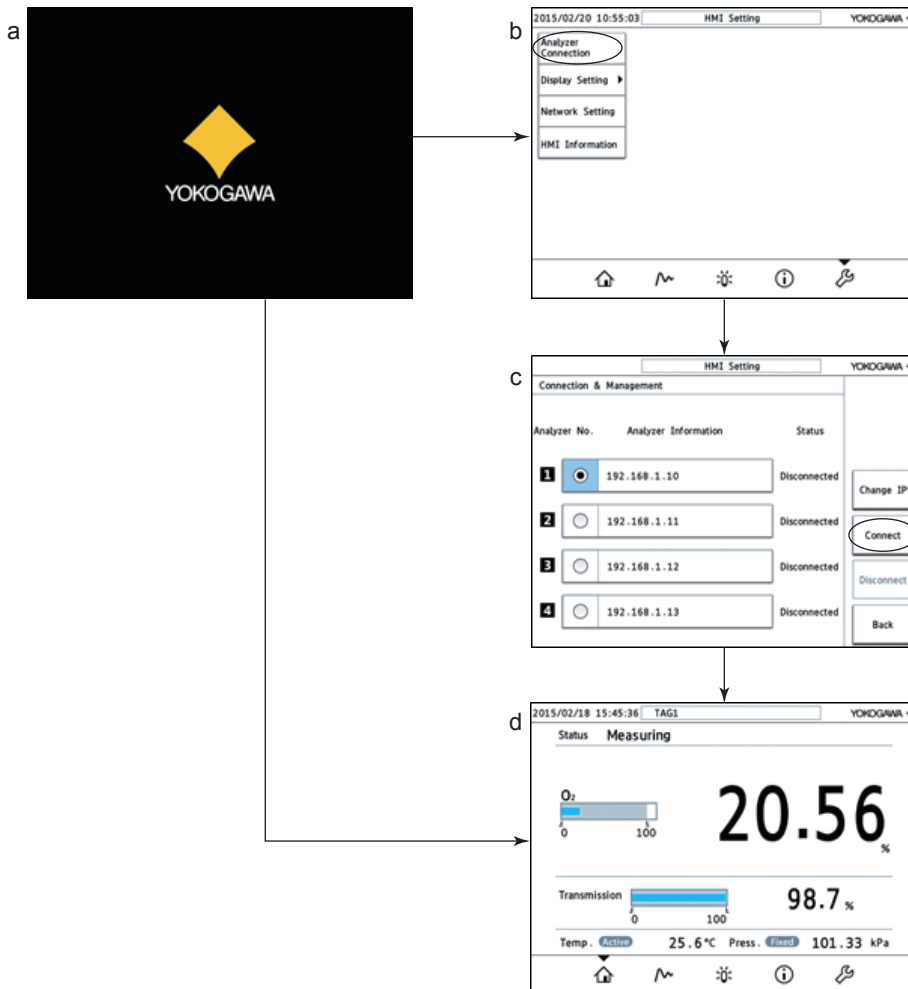
- (1) Connect the YH8000 using the factory default IP settings.
- (2) Change the TDLS8000 IP address and subnet mask (see section 5.2.2).
- (3) To change the IP address of multiple TDLS8000s, connect to the TDLS8000s one at a time and change the IP address and subnet mask.
- (4) If necessary, change the YH8000 IP address and subnet mask (see section 5.2.2).
- (5) Change the YH8000 destination IP address (see section 5.2.3).

The procedure from turning on the YH8000 to connecting it in step (1) above is provided below. The procedure assumes that the TDLS8000 has the factory default IP address settings. To connect to a TDLS8000 whose IP address has been changed or to connect to multiple TDLS8000s, see “5.2.3 Connecting to the TDLS8000”.

- (1) Complete the wiring of the TDLS8000 and YH8000 according to the instructions in “3.2.8 Connecting an Ethernet Cable”.




- (2) Turn on the TDLS8000 and YH8000.  
=> The opening screen (a) is displayed for about 10 seconds.  
=> If they do not connect automatically, the YH8000 configuration screen (b) will appear. => Step (3)  
=> If they connect automatically, the home screen (d) will appear.
- (3) Tap Analyzer Connection to switch to the TDLS8000 selection screen (c). => Step (4)
- (4) Tap Connect to start a connection.  
=> If a connection is established, the home screen (d) will appear.



## 5.2.2 Setting the IP Address

- **Setting the TDLS8000 IP address**

Configuration menu path:

“ >> Analyzer >> Configuration >> System >> Communication >> TCP/IP”

### NOTE

When you change the TDLS8000 IP address, the TDLS8000 automatically restarts with the new IP address. The connection to the YH8000 will be disconnected. Follow the procedure below to reconnect.

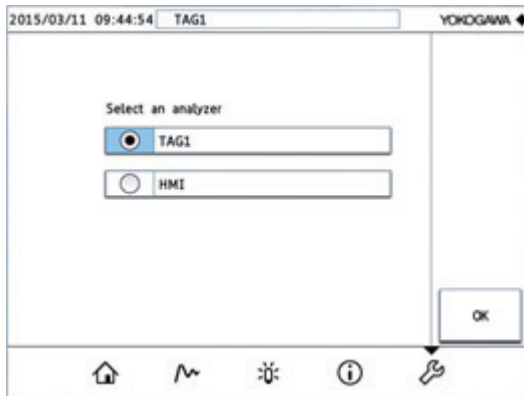
The procedure for changing the TDLS8000 IP address and reconnecting is as follows. If you change the TDLS8000 subnet mask, you will also need to change the YH8000 subnet mask as described in “Setting the YH8000 IP address” on the next page before reconnecting.

- (1) Tap  in the lower right of the screen.

The tag names (or the serial numbers if not assigned) of the connected TDLS8000s appear. Select the TDLS8000 that you want to change the IP address of.

In the example in the figure, the tag name is “TAG1.” Tag names are not assigned to TDLS8000s with factory default settings, so serial numbers are displayed instead.

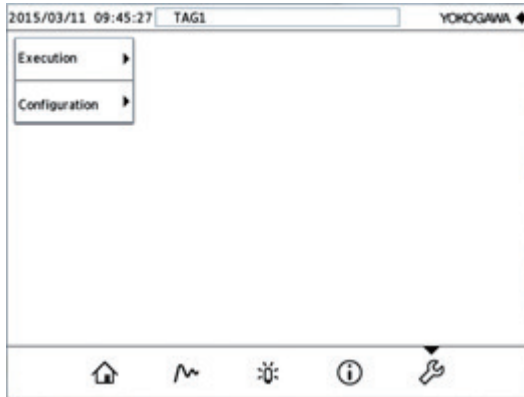
After selecting, tap OK. A password input screen will appear.



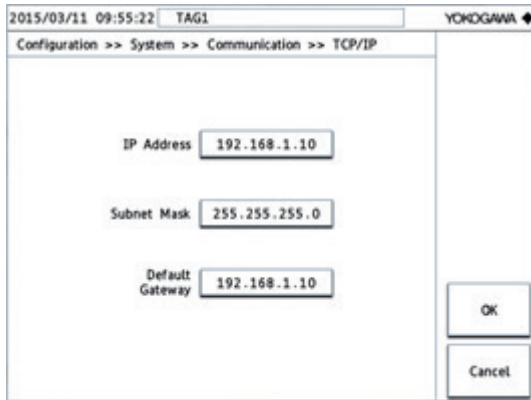
- (2) Enter the password and tap Enter. A configuration screen will appear. The factory default password is “1234.”

From the menu, select Configuration>>System>>Communication>>TCP/IP. A warning screen explaining that the instrument will restart if the IP address is changed appears.\*1 Tap OK.

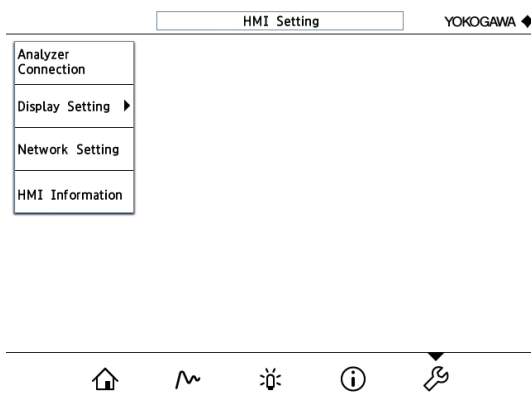
\*1: The analyzer will restart after changing IP settings”



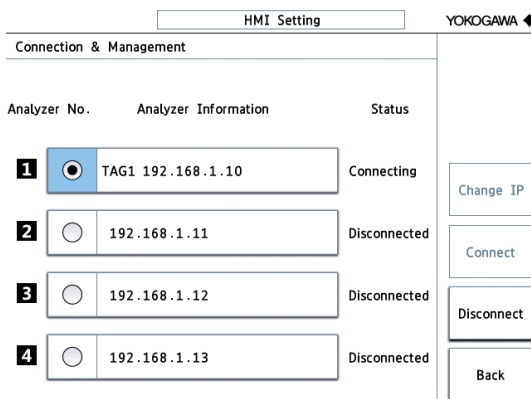
- (3) Select each item and change the value. The items that you change will show an asterisk in the upper left. Tapping OK will display a confirmation screen for restarting. Tap OK again.



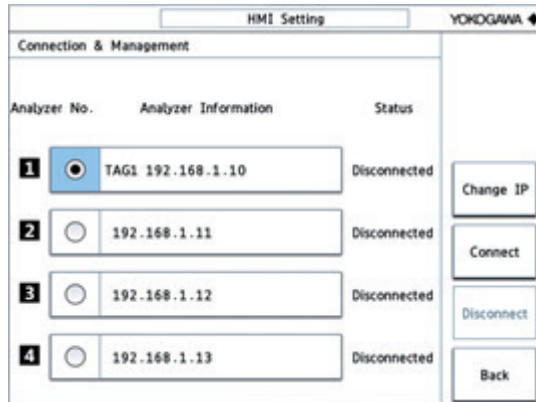
- (4) A disconnection error screen will appear. Tap OK.
- (5) The YH8000 (HMI) configuration screen will appear. Tap Analyzer Connection.



- (6) The TDLS8000 selection screen will appear. Tap Disconnect.



- (7) The Change IP button becomes available. Tap Change IP, and enter the new destination IP address.



- (8) Tap Connect to connect to the TDLS8000.

**NOTE**

The TDLS8000 IP address can also be changed via HART communication.

Configuration menu path:

“Detailed setup>>System>>Communication>>TCP/IP>>Set IP settings”

● **Setting the YH8000 IP address**

Configuration menu path: “>>HMI>>Network Setting”

**NOTE**

When you change the YH8000 IP address, the YH8000 automatically restarts with the new IP address, disconnecting the current connection with the TDLS8000.

**5.2.3 Connecting to the TDLS8000**

This section explains the TDLS8000 selection screen on the YH8000. From the YH8000 screen, you can connect in the following ways.

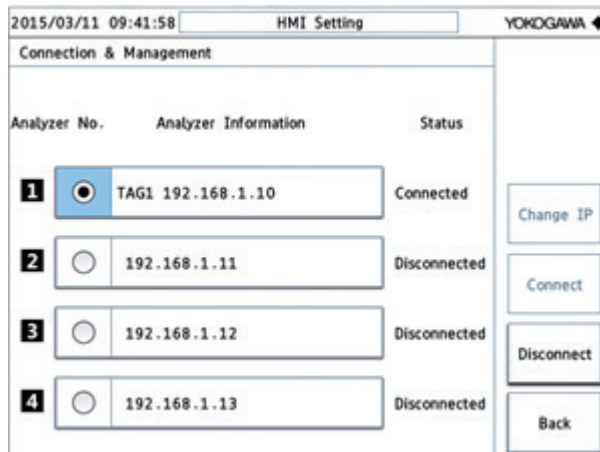
- Connect to a TDLS8000 with any IP address
- Connect up to four TDLS8000s from a single YH8000
- Connect to a TDLS8000 with an unknown IP address in the same network by searching

The YH8000 assigns an analyzer number from 1 to 4 to each connected TDLS8000. In the case of a one-to-one connection, analyzer number 1 is used. On the TDLS8000 selection screen, you can assign TDLS8000s to analyzer numbers by specifying the IP address.

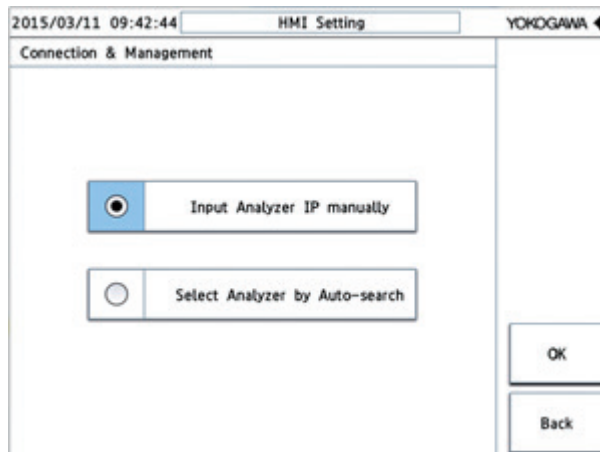
Path to the TDLS8000 selection screen “>>HMI>>Analyzer Connection”

The procedure to add a connection destination is shown below.

- (1) Open the TDLS8000 selection screen (the figure below), and select the analyzer number that you want to set under the Analyzer No. column.



- (2) Tap Change IP to open the IP address configuration screen (the figure below).  
If the selected analyzer number is already connected (Status is Connected), tap Disconnect to enable the Change IP button.



- (3) Specify the TDLS8000 IP address using either method below.
  - Input Analyzer IP manually  
Manually enter the IP address of the TDLS8000 you want to connect to.
  - Select Analyzer by Auto-search  
Select from the TDLS8000 IP addresses automatically found. Up to 32 TDLS8000s in the same subnet can be detected. Detection may not be possible depending on the network configuration or condition.  
Select either option, tap OK, and specify the IP address you want to connect to.
- (4) Tap Connect to connect to the TDLS8000.

---

- **Description of the TDLS8000 selection screen**

**Analyzer No. column**

Shows analyzer numbers 1 to 4. You can select a number and assign an IP address to connect to the corresponding TDLS8000.

**NOTE**

---

If there is only a single TDLS8000 that the YH8000 will connect to, connect it to analyzer number 1. Otherwise, you will need to reset the display items when displaying the trend waveform.

---

**Analyzer Information column**

Shows the TDLS8000 IP addresses and tag names. For TDLS8000s that have not been connected before, tag names do not appear. If a TDLS8000 is connected but a tag name is not assigned, its serial number will be displayed.

**Status column**

Shows the TDLS8000 connection status.

Connected

Connecting

Disconnected

**Change IP button**

Switches to the IP address configuration screen. This button is not available if the TDLS8000 is connected.

**Connect button**

Starts a connection with the TDLS8000. This button is available when the TDLS8000 is disconnected.

**Disconnect button**

Disconnects from the TDLS8000 that is connected or is in the process of establishing a connection.

**NOTE**

---

Once a connection is established between the YH8000 and TDLS8000, the connection information is saved. Therefore, the next time the power is turned on or after restarting, the connection will be established automatically.

---

**NOTE**

---

Up to two YH8000s can connect to a single TDLS8000.

---

### 5.2.4 Handling Connection Failures

If a connection to the TDLS8000 fails, check the following items.

- (1) Check that the Ethernet cable is connected properly.
  - Check that LED5 on the SCU circuit board is lit or blinking.

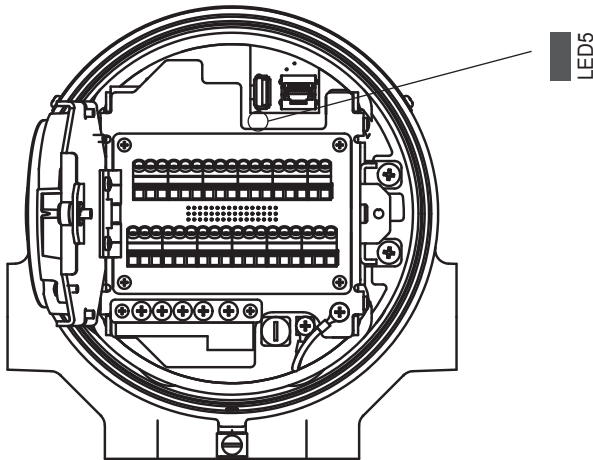


Figure 5.2 Front view of the inside of the SCU

- Check that the green LED of the YH8000 Ethernet port is lit or blinking.

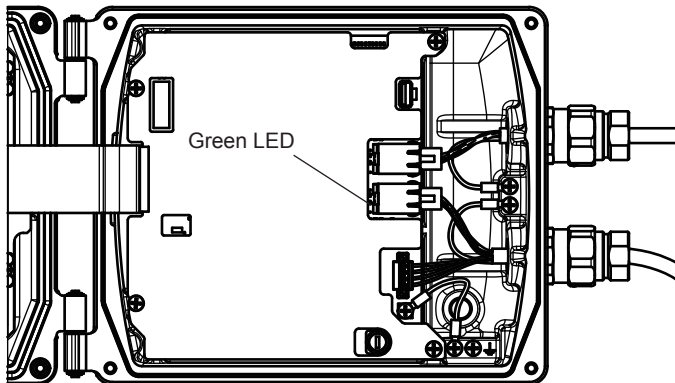


Figure 5.3 Top view of the inside of the YH8000

- (2) Check that the IP addresses are set properly.
  - Check that unique IP addresses are assigned to each YH8000 and TDLS8000.  
=> You can view the TDLS8000 IP addresses on the SCU display.  
For details, see “1.2 Name and Function of Each Part”.
  - Check that the subnet addresses and subnet masks are set properly.
  - If the instruments are connected via a router or the like, check that it is configured properly with your network administrator.

### 5.2.5 Basic Screen Configuration

This section provides an overview of the home screen that appears when a connection is established with a TDLS8000 and the buttons. For a detailed explanation, see “8.2 Home Screen”.

The screen shown in Figure 5.4 appears when a single TDLS8000 is connected to the YH8000. This screen is called the *home screen*.

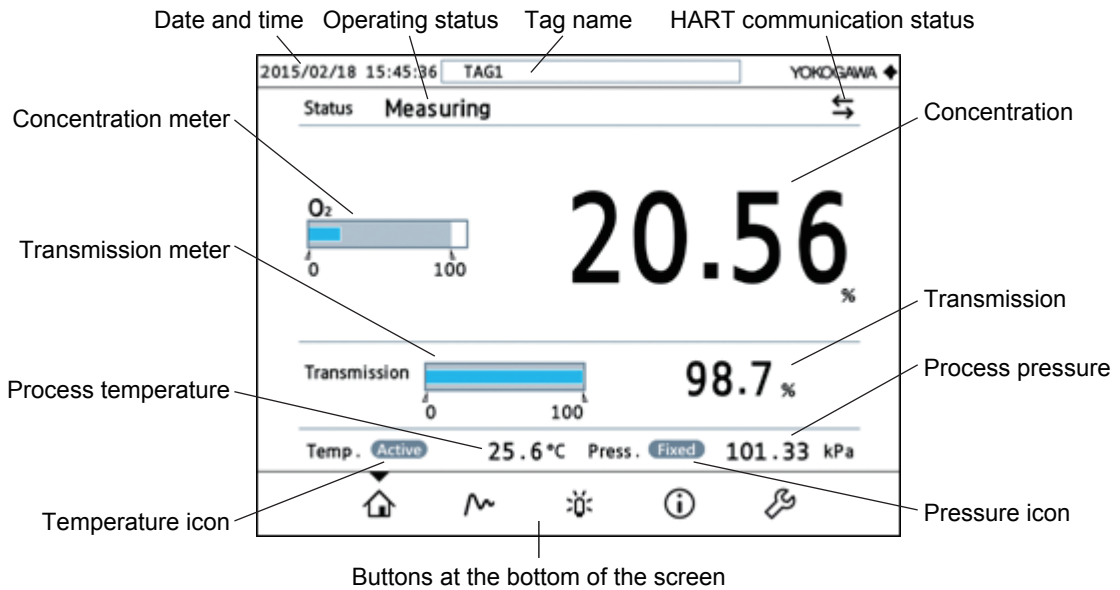


Figure 5.4 Home screen

If several TDLS8000s are connected to the YH8000, tabs for switching between the home screens of each TDLS8000 appears on the right. The tab numbers represent analyzer numbers. Selecting a tab shows the information of the TDLS8000 corresponding to the tab number. Further, the tab shows the information of all connected TDLS8000s. This screen is called the *overall screen*.

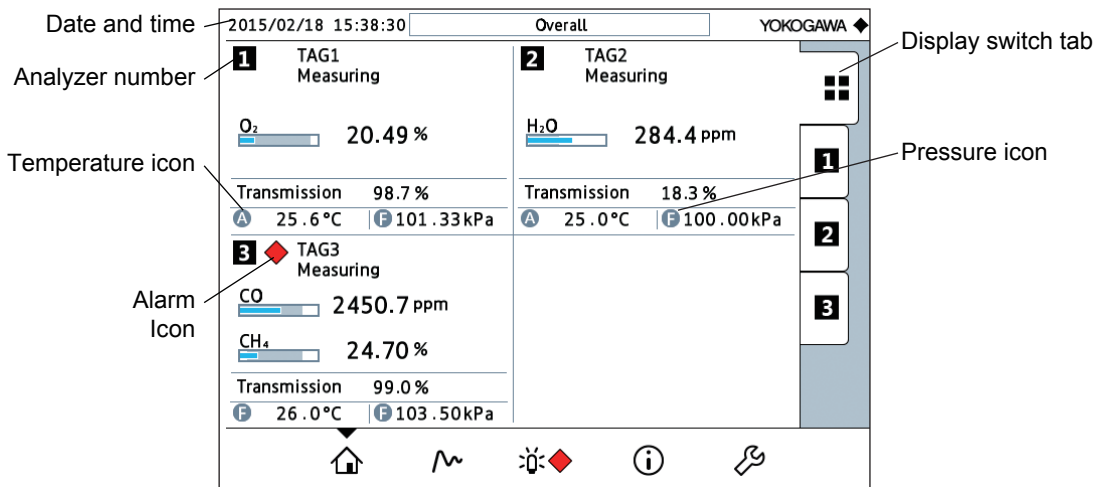







Figure 5.5 Overall screen




● **Functions of the buttons at the bottom of the screen**

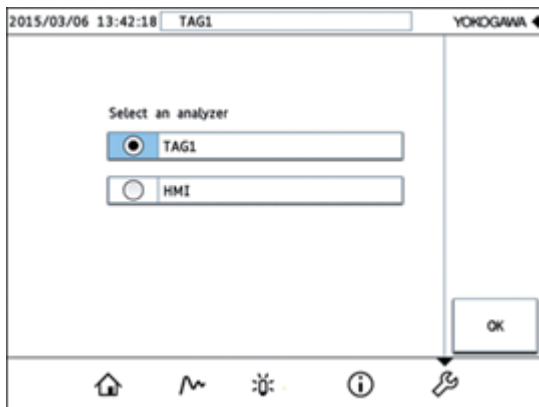
These buttons are used to show other screens.

Button	Button name	Description
	Home button	Displays the home screen.
	Trend display button	Displays the trend screen. You can view the measurement trends of multiple TDLS8000s on the same screen.
	Alarm information button	Displays the TDLS8000 alarm screen.
	Configuration display button	Displays the current TDLS8000 settings. The button can also be used to display I/O values, alarm history, and so on.
	Configuration button	Executes TDLS8000 configuration, calibration, and the like. It can also be used to change the YH8000 connection destination, IP settings, and so on.

● **How to open the TDLS8000 configuration screen**

- (1) Tap  to show a screen for selecting the TDLS8000 you want to configure. TDLS8000 tag names (serial numbers if tag names are not assigned) are displayed.

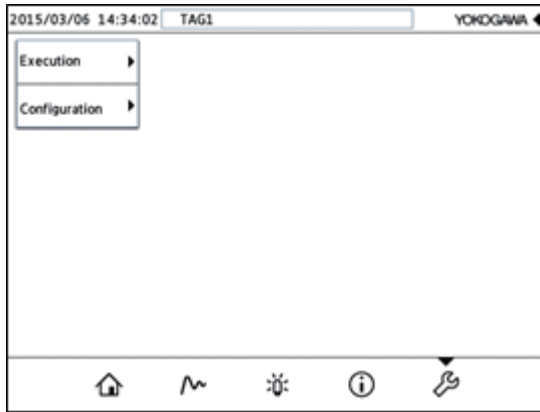
Select the target TDLS8000, and tap OK.



- (2) A user password input screen will appear. The factory default password is "1234."



(3) When password authentication is successful, a TDLS8000 configuration screen will appear.



**NOTE**

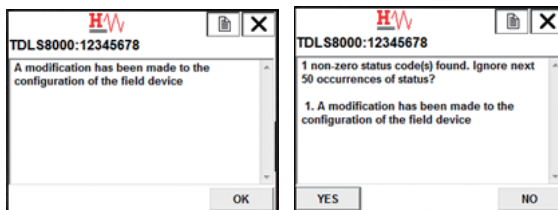
If you just want to view the settings, you can tap  to display the information screen. You don't need to enter a password to display this screen.

## 5.3 Setting Basic Parameters

This section explains how to set the basic parameters necessary to start measurements. Field Communicator 475 will be used as an example of a HART configuration tool to introduce the operation procedure. If you are using FieldMate or other tool, perform the equivalent procedure.

**NOTE**

When configuration changes are made with a Field Communicator 475, the following screen will appear. This warning screen is to indicate that the TDLS8000 settings have been changed. Since this is not a problem with the TDLS8000 operation, select OK and then YES.



### 5.3.1 Setting the Date and Time

Set the current date and time on the TDLS8000. The date and time will be retained through battery power even when the power is turned off.

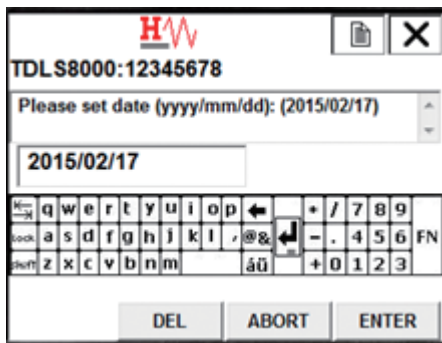
- **Setup procedure using HART**

- (1) Select “Detailed setup>>System>>Date/time>>Set date/time” and press the right arrow button to display the following screen.



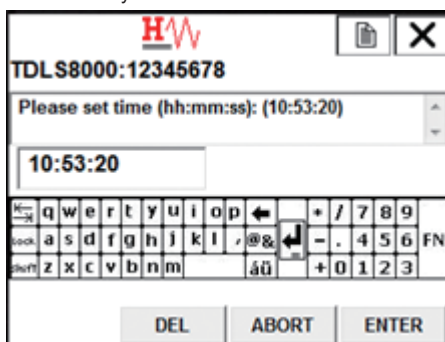
- (2) The current time will appear. If you want to change it, tap OK. The following screen will appear. If you do not need to change it, tap ABORT to abort the setup.

Enter the current date in yyyy/mm/dd format, and then tap ENTER.

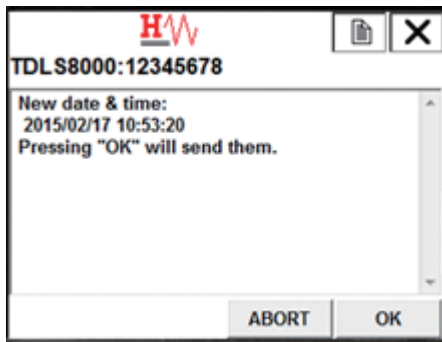


- (3) Enter the current time in hh:mm:ss format, and then tap ENTER. To enter a colon, tap the @& key.


Note: The time you enter here is reflected in the TDLS8000 when you tap OK in step (4).

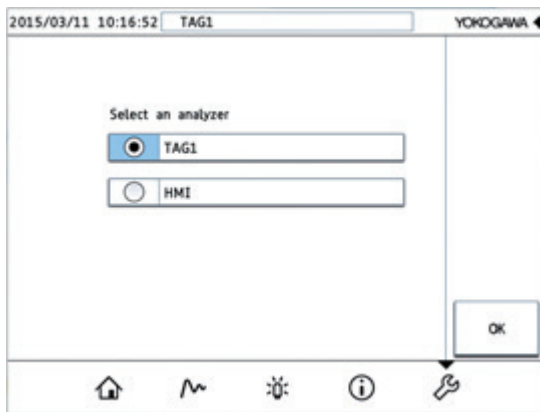


- (4) A screen appears for you to confirm the date and time that will be applied to the TDLS8000. To proceed, tap OK. The time will be reflected in the TDLS8000. To abort the setup, tap ABORT.



● Setup procedure using YH8000

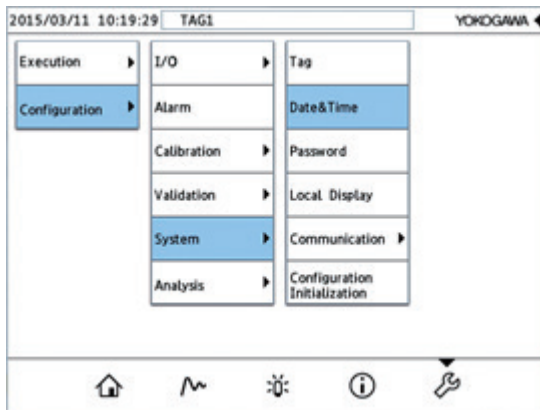
- (1) Tap  to switch to the TDLS8000 selection screen. Select the tag name of the TDLS8000 you want to connect to, and then tap OK.



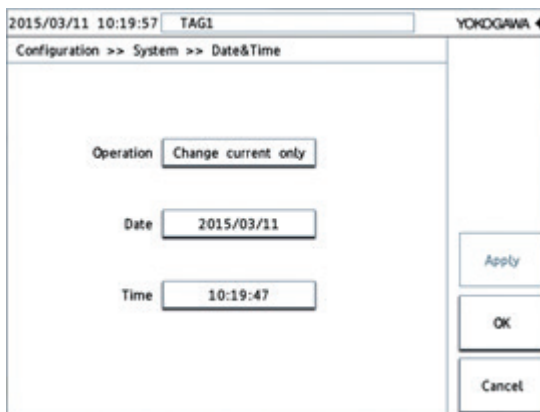
- (2) A password input screen will appear. Enter the password and tap Enter. A configuration screen will appear.



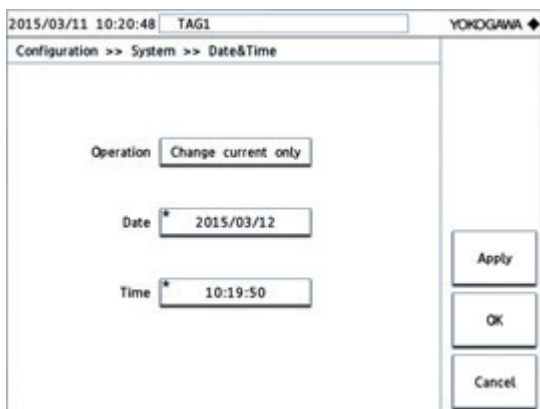
- (3) Select “Configuration>>System>>Date&Time” as shown in the following figure.



- (4) Select “Date” and “Time,” and enter the date and time you want to apply.



- (5) The items that you change will show an asterisk in the upper left as shown in the following figure. Tap OK to reflect the date and time in the TDLS8000.



### 5.3.2 Setting the Process Optical Path Length

Set the process optical path length. The process optical path length is the length that the laser beam travels through the gas to be measured. As shown in the following figure, enter the length (L) of the process that the LU and the SCU are connected to. It does not include the length of the flanges.

If insertion tubes are installed, the optical path length is the length between the closer ends of the insertion tubes.

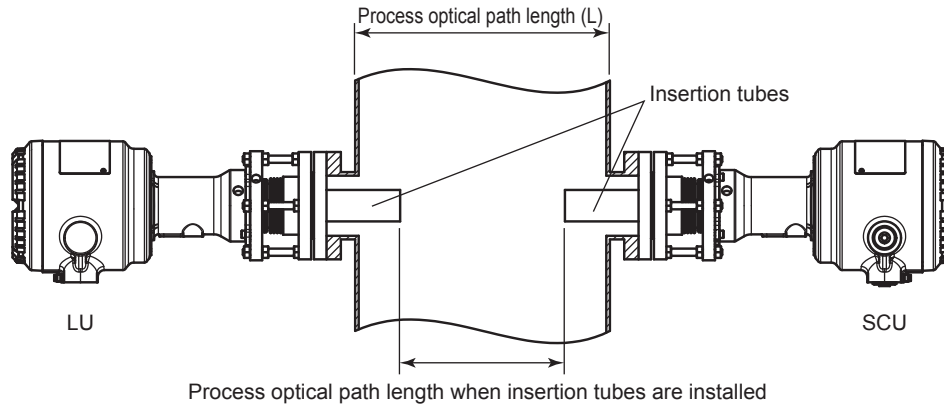
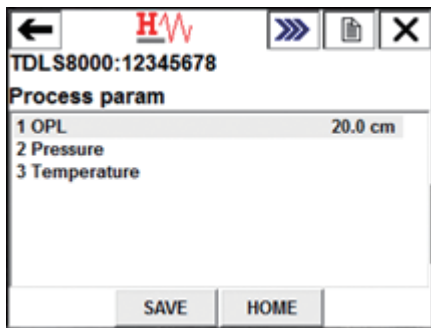


Figure 5.6 Process optical path length definition

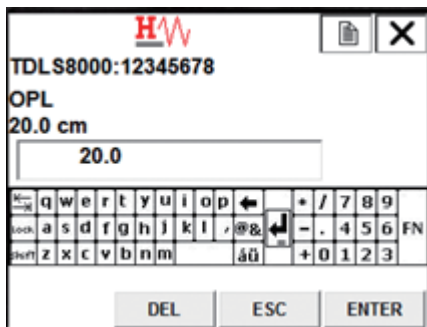
If the LU and SCU are mounted on a free cell, enter the length of the flow cell as the process optical path length.

#### ● Setup procedure using HART

- (1) From the menu, select “Detailed setup>>Analysis>>Process param.” The following screen will appear. Select “OPL” and press the right arrow button.



- (2) Enter the process optical path length, and tap ENTER to execute writing to the TDLS8000. To abort, tap ESC.



- **Setup procedure using YH8000**

Configuration menu path:

“ >> Configuration >> Analysis >> Process Parameters >> Path Length”

### NOTE


If you are not using nitrogen purge gas, you also need to enter the optical path length, pressure, and temperature of the non-measured process. For details, see “6.10 Non-process Parameter Settings”.

## 5.3.3 Setting the Process Pressure

This section explains the pressure value of the measurement process when the input mode is analog input (AI-1). When using other input modes, see “6.1.2 Process Pressure”.

Configuration menu path:

[HART] “Detailed setup >> Analysis >> Process param >> Pressure”

[YH8000] “ >> Configuration >> Analysis >> Process Parameters >> Pressure”

- (1) Set Mode (pressure input mode) to Active input.
- (2) Set Active type (pressure input source) to AI-1.
- (3) Select Backup mode (pressure value backup when the analog input is outside the range) from the following options.

If you select Disable, the analog input is converted as-is into a pressure value without backing up.


If you select Backup value, the pressure value is fixed to the value specified by Backup set value. Set Backup set value to a value of your choice.

If you select Hold, the pressure value is held at the previous value within the proper range.

- (4) Set the analog input range. Set the pressure values corresponding to 4 mA and 20 mA.

Configuration menu path:

[HART] “Detailed setup >> I/O condition >> Analog input >> AI-1(Pressure)”

[YH8000] “ >> Configuration >> I/O >> Analog Input >> AI-1(Pressure)”

## 5.3.4 Setting the Process Temperature

This section explains the temperature value of the measurement process when the input mode is analog input (AI-2). When using other input modes, see “6.1.3 Process Temperature”.

Configuration menu path:

[HART] “Detailed setup >> Analysis >> Process param >> Temperature”

[YH8000] “ >> Configuration >> Analysis >> Process Parameters >> Temperature”

- (1) Set Mode (temperature input mode) to Active input.
- (2) Set Active type (temperature input source) to AI-2.

- (3) Select Backup mode (temperature value backup when the analog input is outside the range) from the following options.

If you select Disable, the analog input is converted as-is into a temperature value without backing up.


If you select Backup value, the pressure value is fixed to the value specified by Backup set value. Set Backup set value to a value of your choice.

If you select Hold, the pressure value is held at the previous value within the proper range.

- (4) Set the analog input range. Set the temperature values corresponding to 4 mA and 20 mA.

Configuration menu path:

[HART] “Detailed setup>>I/O condition>>Analog input>>AI-2(Temperature)”

[YH8000] “ >>Configuration>>I/O>>Analog Input>>AI-2(Temperature)”

### 5.3.5 Setting the Output Range

This section explains how to assign an item to the 4 to 20 mA analog output. For details on the analog output hold function, see “6.4.2 Output Hold”.

Configuration menu path:

[HART] “Detailed setup>>I/O condition>>Analog output”

[YH8000] “ >>Configuration>>I/O>>Analog output”

- (1) Select the output item for each channel.

On HART, the AO-1 and AO-2 output items are displayed as “PV is” and “SV is,” respectively. On YH8000, it is displayed as “Item.” You can assign the following items to the analog output.

Output item	Name displayed on HART	Name displayed on YH8000
Component 1 gas concentration	Concentration 1	(*2)
Component 2 gas concentration (*1)	Concentration 2	(*2)
Transmission	Transmission	Transmission
Temperature	Temperature	Temperature
Pressure	Pressure	Pressure

\*1: Selectable only with two-gas measurement specifications

\*2: Displays the name of the gas component being measured.

Example: If the component being measured is oxygen: O<sub>2</sub> concentration

- (2) Set the measurement item values that correspond to the minimum point (4 mA) and maximum point (20 mA).

On HART, the minimum and maximum points are displayed as “PV LRV” and “PV URV,” respectively.



### 5.3.6 Setting Process Alarms

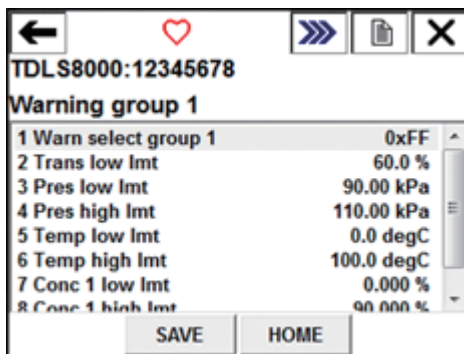
You can set threshold values of the high/low limit alarm (warning) for process measurement values. The following table shows the types of warnings that you can specify. For each type of warning, you can set the threshold values and select whether to enable the detection. For details on warnings, see “10.2 Warning Display and Handling” described later.

Alarm number	Warning name
1	Transmission Low
2	Process Pressure Low
3	Process Pressure High
4	Process Temperature Low
5	Process Temperature High
6	Concentration Gas1 Low
7	Concentration Gas1 High
8	Concentration Gas2 Low (only with two-gas measurement)
9	Concentration Gas2 High (only with two-gas measurement)

- **Setup procedure using HART**

- (1) From the menu, select “Detailed setup>>Alarm>>Warning>>Warning group 1.”

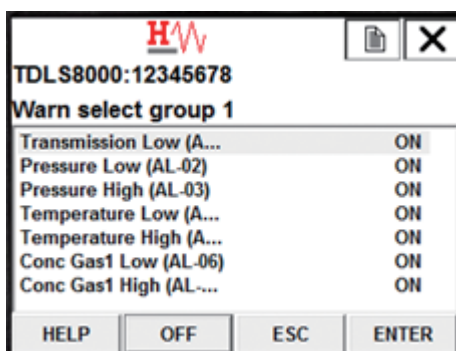
The following screen will appear.



- (2) “Warn select group 1” is used to enable or disable the warnings. By factor default, all warnings are enabled.

Select “Warn select group 1” and press the right arrow button to display the following screen. Here, you can enable or disable each warning.

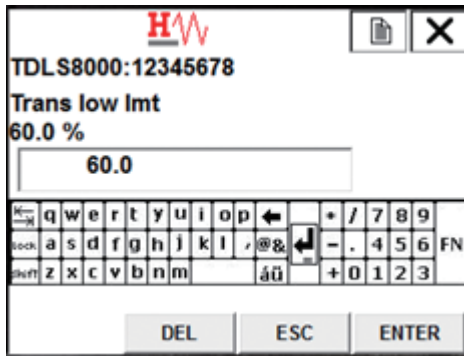
ON means enabled. To switch between ON and OFF, tap OFF (center-left at the bottom of the screen). When you are finished, tap ENTER.



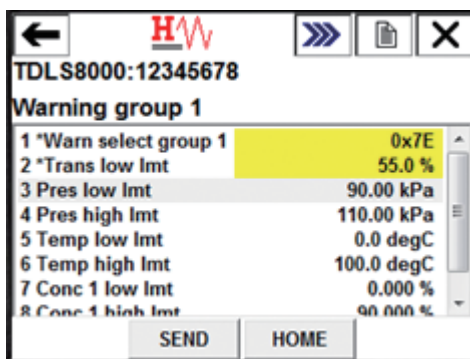
- (3) Set the high and low limit threshold values of each warning.

For example, to change the lower limit alarm threshold value for transmission, select “Trans low lmt,” and press the right arrow button. The following screen will appear.

Enter the value, and press ENTER.




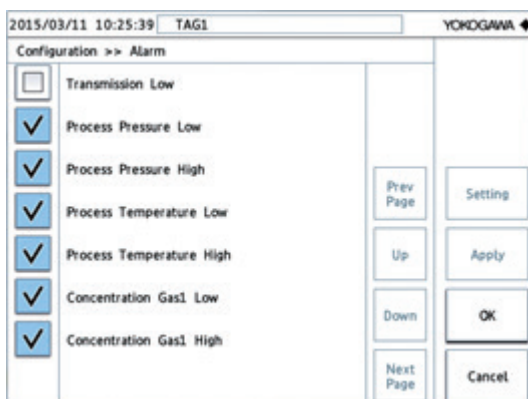
- (4) Tap SEND to execute writing to the TDLS8000.



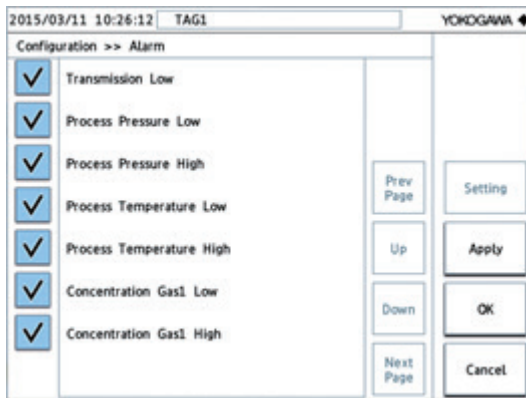
- (5) For two-gas measurement, select “Detailed setup>>Alarm>>Warning>>Warning group 1,” and set the gas concentration low limit alarm for component 2. Then select “Detailed setup>>Alarm>>Warning>>Warning group 2,” and set the gas concentration high limit alarm.

### ● Setup procedure using YH8000

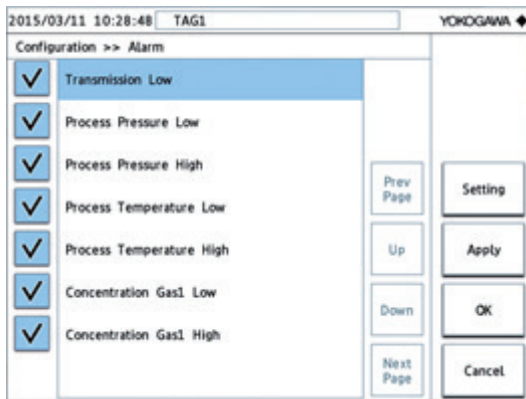
- (1) From the menu, select “>>Configuration>>Alarm” to display the following screen.



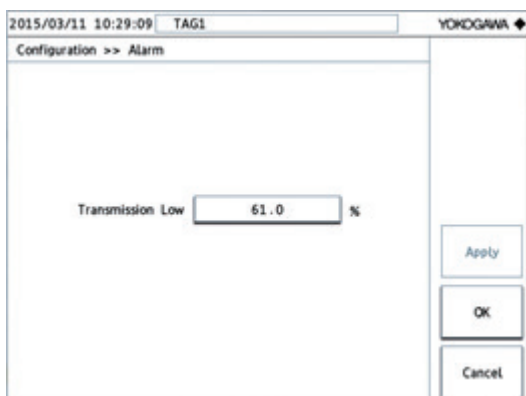
- (2) You can enable or disable each warning by tapping the check mark on the left side. In the following example, the “Transmission Low” check box is selected to enable the transmission low limit alarm. Touch Apply to apply the settings to the TDLS8000.



- (3) Change the threshold values of each warning. In the following example, to set the threshold value of the transmission low limit alarm, select “Transmission Low,” and tap Setting on the right side.



- (4) The following screen will appear. Select the value box, enter the threshold value, and touch OK to apply the value to the TDLS8000.



## 5.4 Loop Check (Simulation output)

You can force the analog output, digital output, and valve control output to a given state. This section explains how to do this. You can use this function to check the operation after wiring.

### 5.4.1 Executing a Loop Check

This section explains the loop check setup procedure for each output type separately. A loop check can be executed simultaneously on all terminals of all types.

Execution menu path:

[HART] "Diagnosis/Service>>Loop check"

[YH8000] " >>Execution>>Loop Check"

#### NOTE

---

If you turn off the TDLS8000 while performing a loop check, loop check will be cleared.

---

- **Analog output**

Open the Analog output menu, and set Loop check mode to Enable to output the specified simulated current ("check output").

#### NOTE

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If multi-drop mode is set on HART, loop checking of AO-1 via HART is not possible.

---

- **Digital output**

Open the Digital output menu, and set Loop check mode to Enable to output the specified simulated state ("check output").

- **Valve control output (SV)**

Open the Valve output menu, and set Loop check mode to Enable to output the specified simulated state ("check output").

### 5.4.2 Auto Release Function

The auto release function automatically clears loop checking on all terminals and restores normal output after the specified time elapses. The auto release counter starts when any of the loop check is enabled. The counter restarts whenever a loop check setting is changed. When the counter expires, all loop checking is disabled.


To set the auto release time, set Auto release time in the Loop check menu. If you select Disable, the auto release function is disabled, and the simulated output is maintained until you manually clear the loop check mode. The specified values are retained even after the power is turned off.



## 6. Configuration

This chapter provides details of all the setting items and shows the locations of the setting menus of the TDLS8000. However, the setting items related to calibration and validation are described in

9. Inspection and Maintenance

The setting menus of the YH8000 can be opened by performing the operation of " >> Select analyzer >> Configuration" but the location is shown as just being under "Configuration" in this chapter for simplicity.

### 6.1 Process Parameter Settings

Process parameters indicate the measurement conditions related to measurement process gas. Set the process optical path length, process pressure, and process temperature of the process gas correctly because they directly affect the measurement values.

#### NOTE

If nitrogen purge gas will not be used, you also need to configure the non-measurement process optical path length, pressure, and temperature in addition to the settings in this section. For details, see 6.10 Non-process Parameter Settings

#### 6.1.1 Process Optical Path Length

Set the process optical path length of the process to be measured. For a definition of the process optical path length, see 5.3.2 Setting the Process Optical Path Length Setup menu path:

[HART] "Detailed setup>>Analysis>>Process param>>OPL"

[YH8000] "Configuration>>Analysis>>Process Parameters>>Path Length"

#### 6.1.2 Process Pressure

Set the process pressure of the process to be measured. When you select the input source, set the action for error input as described in the procedure below.

Setup menu path:

[HART] "Detailed setup>>Analysis>>Process param>>Pressure"

[YH8000] "Configuration>>Analysis>>Process Parameters>>Pressure"

- (1) Select "Mode" (pressure input mode).

When "Fixed" is selected, set the pressure value as an arbitrary fixed value.

When "Active input" is selected, input the pressure value via a 4-20 mA analog input (AI-1) or Modbus. The TDLS8000 acquires a pressure value sent from the input source at every measurement value analysis cycle and uses it for the concentration calculation.

(2) Configure the settings below according to the pressure input mode.

**When “Fixed” is selected**

Enter a fixed pressure value for “Fixed mode value.” The other parameters do not need to be set.

**When “Active input” is selected**

Set each of the following parameters.

- Active type: Setting of pressure input source

“AI-1” is analog input (AI-1).

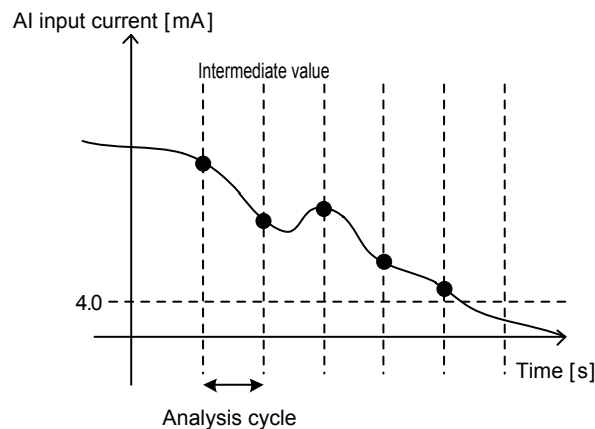
“Field Communication” is Modbus input. For details on the Modbus function, see 11. Modbus• Backup mode: When “Active input” is selected, set the pressure value to use for the concentration calculation when an input value from the sensor is out of range.

With “Disable,” backup is disabled and the input is used as is for the pressure value.

With “Backup value,” the value set in “Backup set value” is used for the pressure value.

With “Hold,” the intermediate value of the input values of five cycles that were within the range immediately before an input value from the sensor became out of range is used for the pressure value. The following figure shows the example of when the analog input falls below the lower limit of 4 mA.

A ● in the figure indicates the point of acquisition of an AI input value, and a value is acquired every analysis cycle. The second ● of the five cycles immediately before falling below the lower limit is the intermediate value of the current values so the pressure value of this time is held. If the analog input immediately after turning on the power of the TDLS8000 is out of range while “Hold” is selected, a pressure value corresponding to 4 mA is held.



In order to input via Modbus network, take notice how the Modbus network should correspond to the backup function as below.

When backup operation starts (the system starts restoring data)	When backup function stops
Modbus is off	First pressure value is input via Modbus network.

---

**NOTE**

Maintain Modbus network connected when the backup function is activated. If you want to shut down the Modbus network regularly, set the backup mode "Disable".

---

- If you select "Disable" in the backup mode, the last pressure value you enter remains valid i.e. in the same status as "Hold".
  - After the power of TDLS8000 turns on, the backup function keeps active until the first pressure value is received. During this period, when you select "Hold", or "Disable" in the backup mode, the pressure values will be on hold at the equivalent of the one obtained within the Analog input range mentioned below (3) with 4mA.
  - Backup set value: Backup pressure value when "Backup mode" is "Backup value"
- (3) Configure the analog input range setting only when "AI-1" is selected in "Active type."  
Enter the pressure value corresponding to each of 4 mA and 20 mA.

Setup menu path:

[HART] "Detailed setup>>I/O condition>>Analog input>>AI-1(Pressure)"

[YH8000] "Configuration>>I/O>>Analog Input>>AI-1 (Pressure)"



### 6.1.3 Process Temperature

Set the process temperature of the process to be measured. When you select the input source, set the action for error input as described in the procedure below.

Setup menu path:

[HART] "Detailed setup>>Analysis>>Process param>>Temperature"

[YH8000] "Configuration>>Analysis>>Process Parameters>>Temperature"

- (1) Select "Mode" (temperature input mode).

When "Fixed" is selected, set the temperature value as an arbitrary fixed value.

When "Active input" is selected, input the temperature value via a 4-20 mA analog input (AI-2) or Modbus. The TDLS8000 acquires a temperature value sent from the input source at every measurement value analysis cycle and uses it for the concentration calculation.

When "Active ambient" is selected, the value of the temperature sensor mounted in the vicinity of the laser device in the TDLS8000 is used as the process temperature.

- (2) Configure each of the settings below according to the temperature input mode.

#### **When "Fixed" is selected**

Enter a fixed temperature value for "Fixed mode value." The other parameters do not need to be set.

#### **When "Active input" is selected**

The setting items are the same as those in section 6.1.2. Read "pressure" as "temperature" and "AI-1" as "AI-2" when configuring the settings.

When "Active ambient" is selected

Set the temperature offset value in "Temp act amb ofst" ("Offset value" on the YH8000).

The temperature sensor value is the temperature in the vicinity of the laser device, and is not exactly equal to the process temperature so set a difference as an offset.

- (3) Configure the analog input range setting only when "AI-2" is selected in "Active type."

Enter the temperature value corresponding to each of 4 mA and 20 mA.

Setup menu path:

[HART] "Detailed setup>>I/O condition>>Analog input>>AI-2(Temperature)"

[YH8000] "Configuration>>I/O>>Analog Input>>AI-2 (Temperature)"

## 6.2 Unit Settings

Set the units for physical quantities related to concentration measurement. The physical quantities for which units can be set are “optical path length,” “pressure,” and “temperature,” and you can select from the following units for each of them.

When Only SI unit (-J) is assigned to TDLS8000, non SI Unit will not be displayed.

Item	SI	
Optical path length	m, cm	inch, feet
Pressure	kPa, atm, bar	psi, torr
Temperature	deg C, K	deg F

Setup menu path:

[HART] “Detailed setup>>Analysis>>Unit”

[YH8000] “Configuration>>Analysis>>Units”

## 6.3 Analog Input Settings

Analog input is used for the purpose of calculating a pressure value and temperature value from analog input within the 4-20 mA range. Set the pressure value and temperature value ranges here which will correspond to 4 mA and 20 mA.

Setup menu path to A1-1 (pressure input):

[HART] “Detailed setup>>I/O condition>>Analog input>>AI-1(Pressure)”

[YH8000] “Configuration>>I/O>>Analog Input>>AI-1(Pressure)”

Setup menu path to A1-2 (temperature input):

[HART] “Detailed setup>>I/O condition>>Analog input>>AI-2(Temperature)”

[YH8000] “Configuration>>I/O>>Analog Input>>AI-2(Temperature)”

### NOTE

For how to set the pressure values and temperature values for analog input, see and 6.1.2 Process Pressure and 6.1.3 Process Temperature

## 6.4 Analog Output Settings

This section describes how to set the process measurement values for analog output and the function to hold output in accordance with the status of the TDLS8000.

### 6.4.1 Normal Range Output

This section describes how to set 4-20 mA analog output and the detailed operation.

Setup menu path:

[HART] “Detailed setup>>I/O condition>>Analog output>>AO-1 or AO-2”

[YH8000] “Configuration>>I/O>>Analog Output>>AO-1 or AO-2>>Output”

● **Output items and range settings**

(1) Select the measurement item to assign to analog output.

Output Item	HART Display Name	YH8000 Display Name
1st component gas concentration	Concentration 1	(*2)
2nd component gas concentration (*1)	Concentration 2	(*2)
Transmission	Transmission	Transmission
Temperature	Temperature	Temperature
Pressure	Pressure	Pressure

\*1: Only selectable for two-gas measurement specification  
 \*2: Displays the gas name of the measurement component  
 (Example) When the measurement component is oxygen: O<sub>2</sub> Concentration

(2) Enter the values for the measurement items corresponding to the lower range value (4 mA) and upper range value (20 mA). In the case of HART, each of the lower range value (LVR) and upper range value (URV) is displayed.

● **Output value at startup**

The analog output value is fixed to 4.0 mA during the period from after turning on the power of the TDLS8000 until the first measurement result is updated. However, if output hold is set for the warming-up state, the value is in accordance with that setting.

● **Analog output range**

Measurement values within the range from 3.8 mA to 20.5 mA are output (NAMUR NE43 compliant).

## 6.4.2 Output Hold

Output hold is a function to fix (hold) analog output to a set value when the TDLS8000 is in the following specific states.

Setup menu path:

[HART] “Detailed setup>>I/O condition>>Analog output>>AO-1 or AO-2>>Hold menu for each specific state”

[YH8000] “Configuration>>I/O>>Analog Output>>AO-1 or AO-2>>Hold Mode”

● **Definitions of specific states**

Set output hold individually for each of the following states.

During fault occurrence	State when any fault is occurring
During warning occurrence	State when any warning is occurring
During calibration and validation	State when either the calibration or validation function is being executed
During maintenance	State in which the password for maintenance has been entered from the YH8000 and changing of the settings is enabled
During warm-up	State up until the temperature of the laser device stabilizes and measurement becomes possible after turning on the power of the TDLS8000.

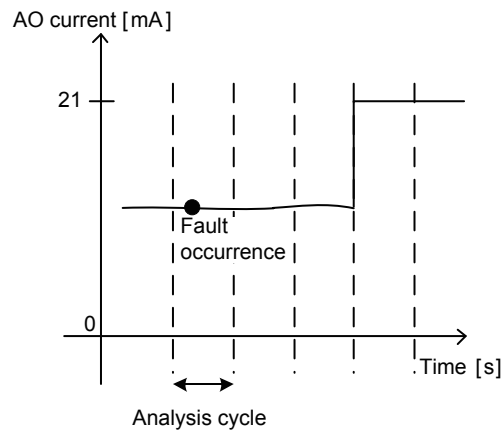
● **Output hold mode**

One of the following modes can be selected for output hold.

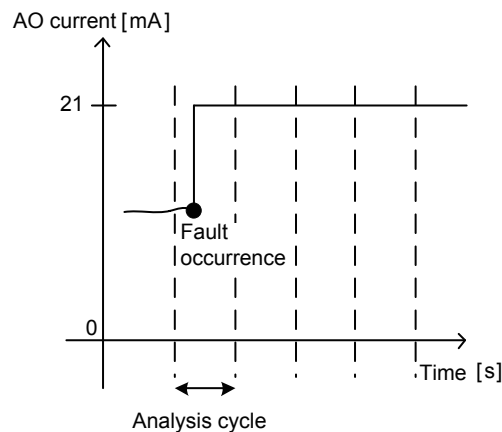
Setting Mode	Description
Preset hold	Holds output to any output value within 3.8 to 20.5 mA. * Any value within 3.0 to 21.6 mA can be set for during warning occurrence and during fault occurrence. Furthermore, the holding of output to any value can be delayed for a period of up to five analysis cycles (*1). Analog output during this delay is held to the value immediately before just as with the Hold mode.
Non-hold	Analog output is not held. Measurement values continue to be output.
Hold	Holds output to the normal output value immediately before.

\*1: The analysis cycle differs depending on the type of analyzer used. For details on the analysis cycle, see Appendix 5 What Is an Analysis Period?

(Example 1) Figure showing the analog output action when Preset hold is set to 21.0 mA and the number of delays is set to 2 for during fault occurrence

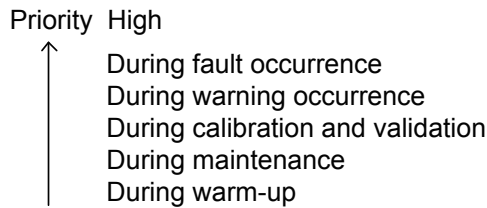


(Example 2) Figure showing the analog output action when Preset hold is set to 21.0 mA and the number of delays is set to 0 for during fault occurrence



● **Output hold priority**

When multiple specific states occur at the same time and multiple holds are enabled (when multiple Preset holds or Hold modes are enabled), the output hold is determined according to the following priority order.



(Example) When during warning occurrence = Non-hold, during maintenance = Preset hold, and during calibration and validation execution = Hold, and all three of the aforementioned states occurred at the same time, output hold becomes the Hold mode.

## 6.5 Digital Output Settings

This function is for turning on digital output when the TDLS8000 enters the following specific states.

### 6.5.1 DO Contact (DO-1)

Setup menu path:

[HART] “Detailed setup>>I/O condition>>Digital output>>DO-1(DO)”

[YH8000] “Configuration>>I/O>>Digital Output>>DO-1(DO)”

● **Definitions of specific states**

When any of the following specific states occurs, the contact turns on. Enabling or disabling of digital output can be set separately for each specific state. For an explanation of each state, see 6.4.2 Output Hold

- During warning occurrence
- Calibration and validation
- During maintenance
- During warm-up

● **Output delay**

A delay of up to 100 analysis cycles can be set for the period from when a specific state occurs until when the contact actually turns on. When the number of delays is set to zero, the contact turns on immediately after a state occurs.

The analysis cycle differs depending on the application and is set to the optimum value at the time of shipment. For details, see Appendix 5 What Is an Analysis Period?

## 6.5.2 Fault Contact (DO-2)

Setup menu path:

[HART] “Detailed setup>>I/O condition>>Digital output>>DO-2(Fault)”

[YH8000] “Configuration>>I/O>>Digital Output>>DO-2(Fault)”

- **Definitions of specific states**

When a fault occurs, the contact turns on. This contact is specifically for fault notification and cannot be disabled.

- **Output delay**

A delay of up to 100 analysis cycles can be set for the period from when a fault occurs until when the contact actually turns on. When the number of delays is set to zero, the contact turns on immediately after a fault occurs.

The analysis cycle differs depending on the application and is set to the optimum value at the time of shipment. For details, see Appendix 5 What Is an Analysis Period?

## 6.6 Process Alarm Settings

Of the alarms of the TDLS8000, the threshold value and enable and disable can be set arbitrarily only for the following warnings related to the measurement process status. For details on each alarm, see 10.2 Warning Display and Handling

Alarm No.	Alarm Name
1	Transmission low
2	Pressure low
3	Pressure high
4	Temperature low
5	Temperature high
6	Concentration gas1 low
7	Concentration gas1 high
8	Concentration gas2 low (analyzer 2 only)
9	Concentration gas2 high (analyzer 2 only)

Setup menu path:

[HART] “Detailed setup>>Alarm”

[YH8000] “Configuration>>Alarm”

For details on the setting procedure, see 5.3.6 Setting Process Alarms

## 6.7 Digital Input Settings

A specific function can be executed depending on the digital input (DI-1, DI-2). Also, the function to execute can be set for each channel. There are two types of digital input methods, edge input and status input, and the input method differs depending on the function.

- Edge input  
Execute a function when the digital input changes from “open” to “closed.”
- Status input  
Execute and continue executing a function while the digital input is closed.

Setup menu path:

[HART] “Detailed setup>>I/O condition>>Digital input>>DI-1 or DI-2”

[YH8000] “Configuration>>I/O>>Digital Input>>DI-1 or DI-2”

### ● Functions that can be executed

The following shows the functions that can be executed.

Function Name	Action	Input Method
External Alarm	Generates the “External Alarm” warning.	Status
Zero Calibration	Executes automatic zero calibration.	Edge
Span Calibration	Executes automatic span calibration.	Edge
Zero + Span Calibration	Continuously executes automatic zero calibration and automatic span calibration.	Edge
Offline Validation 1	Executes automatic offline validation 1.	Edge
Offline Validation 2	Executes automatic offline validation 2.	Edge
Offline Validation 1 + 2	Continuously executes automatic offline validation 1 and 2.	Edge
Online Validation 1	Executes automatic online validation 1.	Edge
Online Validation 2	Executes automatic online validation 2.	Edge
Stream 1	Switches the valve to stream 1.	Status
Stream 2	Switches the valve to stream 2.	Status
Stream 3	Switches the valve to stream 3.	Status

Note: The items of the above selection options that have been disabled by the “Valve usage setting” are not displayed. For details, see 6.8.2 Valve Usage Setting

### ● Filter time

A cutoff time can be set to prevent wrong operation due to chattering. A digital input change within the specified time will be ignored.

## 6.8 Valve Stream Settings

This section describes the procedure to automatically control multiple process gas streams according to the TDLS8000 valve control output (SV terminal). Up to three streams can be switched.

### 6.8.1 Definitions of Stream Numbers

Implement the valve operation of the TDLS8000 using stream numbers defined for the statuses of the two valves connected to the valve control outputs (SV-1 and SV-2). Do not perform valve operation independently but specify stream numbers (independent operation is possible only when performing a loop check).

The following shows the stream numbers to define for the TDLS8000 and the corresponding status of each valve.

Stream No.	Valve 1 (SV-1) Status	Valve 2 (SV-2) Status
Stream 1	OFF	OFF
Stream 2	ON	OFF
Stream 3	ON	ON

The process gases can be switched as shown in Figure 6.1 by switching the streams.

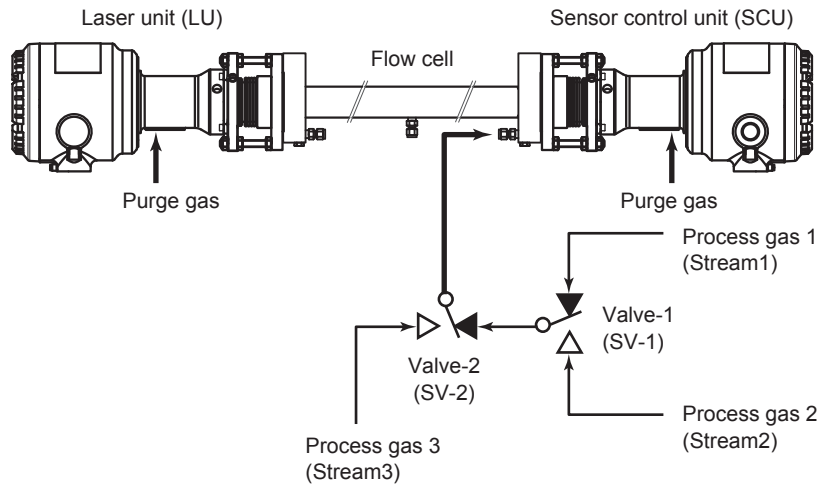


Figure 6.1 Piping diagram for switching streams

## 6.8.2 Valve Usage Setting

Set the valve usage purpose for automatically controlling the valves according to the SV terminal. “3 Streams Switching,” “2 Streams & Cal Val),” and “Cal/Val” can be selected.

If “3 Streams Switching” is selected, three process gases can be switched and measured in order. In the case of 2 stream switching, a calibration gas or check gas can be connected to the remaining stream (stream 3) so that it can be used for calibration or validation.

Setup menu path to Valve usage:

[HART] “Detailed setup>>I/O condition>>Valve control>>Set valve usage”

[YH8000] “Configuration>>I/O>>Valve Control>>Valve Usage”



**NOTE**

The stream switching and automatic calibration and validation items that can be executed according to the TDLS8000 valve control output (SV terminal) are limited depending on the “Valve usage” setting.

- Cal/Val Usage  
Stream switching cannot be used because all streams are used for automatic calibration and validation. When calibration and validation are not executed, the stream is fixed to stream 1.  
To switch the process gas, do it manually.
- 2 Streams & Cal/Val Usage  
Sets only stream 3 to be used for automatic calibration and validation. The following automatic calibration and validation cannot be executed because they would use stream 2. Calibration and validation can only be executed manually.
  - Zero calibration
  - Offline validation 1
  - Online validation 1
- 3 Streams Switching Usage  
All streams are set to be used for stream switching. None of the automatic calibration or validation can be executed. Calibration and validation can only be executed manually.

**NOTE**

If valve usage is changed, the following setting values are initialized.

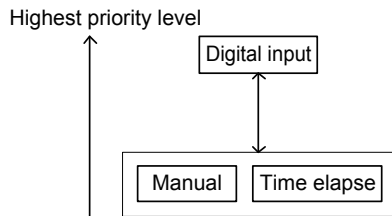
- The time execution setting (Time initiate) of all automatic calibration and validation is set to “Disable.”
- If remote execution of automatic calibration and validation is set for digital input, it is set to “Disable.”
- If stream switching is set for digital input, it is set to “Disable.”
- The “Current stream” setting is set to “Stream 1.”
- The “Initial stream” setting is set to “Stream 1.”

**6.8.3 Stream Settings**

There are the following three stream switching methods.

Manual	Specify a stream and then switch to it from an YH8000 or HART screen.
Time elapse	Switches to the next stream automatically when the specified time elapses after a stream has been switched. When switching is performed manually or when switching to the initial stream is performed after the power of the TDLS8000 is turned on, counting of the specified time begins. This function does not work for switching by digital input.
Digital input	Switches to the specified stream while the digital input is closed. The specified stream is switched to giving priority over the stream switched to with the manual or time elapse method. When the digital input returns to the open state, the stream returns to that switched to with the manual or time elapse method. The following figure shows the priority order.

The following figure shows the priority order. The manual and time elapse methods have the same priority level, and operation of the digital input is given higher priority.



● **Switching by manual operation**

Setup menu path:

[HART] “Detailed setup>>I/O condition>>Valve control>>Current stream”

[YH8000] “Configuration>>I/O>>Valve Control>>Current”

To switch the stream manually, select the stream you wish to switch to in “Current stream.”

● **Switching by time elapse**

If “3 Streams Switching” or “2 Streams & Cal Val” is selected for the “Valve usage” setting, the valve open duration and the stream to switch to can be set for each stream. Enter the duration to open the valve (duration for gas to flow to the target stream) in “Duration” and specify the stream you wish to switch to next in “Switch to.” Setting the next stream in “Switch to” in the same way for the stream that is switched to enables switching again to that stream after the specified time elapses.

Setup menu path:

[HART] “Detailed setup>>I/O condition>>Valve control>>Stream time switch”

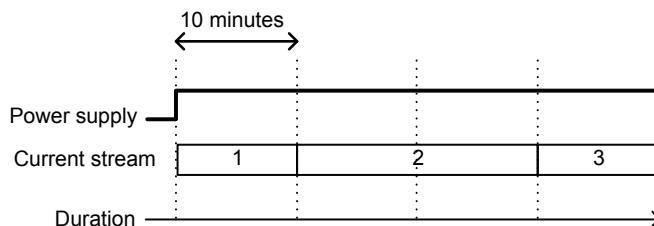
[YH8000] “Configuration>>I/O>>Valve Control”

**[Example of stream switching]**

When “Valve usage” = “3 Streams Switching” and the settings are as follows:

Stream	Current	Switch to	Duration	Initial
1	■	Stream 2	10	■
2	□	Stream 3	20	□
3	□	Disable	30	□

The transition to the current stream will be as shown in the figure below.



● **Switching by digital input**

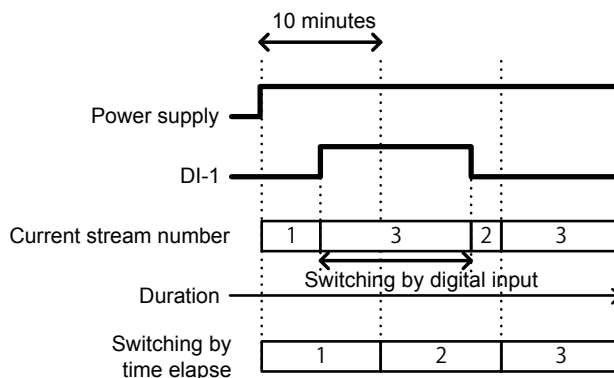
Set the function to switch the stream upon digital input. For the setting procedure, see 6.7 Digital Input Settings

**[Example of switching by digital input]**

When “Valve usage” = “3 Streams Switching,” “DI-1 Mode” = “Stream 3,” and the settings are as follows:

Stream	Current	Switch to	Duration	Initial
1	■	Stream 2	10	■
2	□	Stream 3	10	□
3	□	Disable	10	□

“Current stream number” in the following figure refers to the final stream. Priority is given to switching by digital input so the stream is switched to stream 3 while DI-1 is closed. However, since counting and stream switching by the time elapse method continues to be performed internally (bottommost line in the figure), the stream switches to stream 2 at the point when DI-1 returns to the closed state.



**6.8.4 Initial Stream (Stream at Startup)**

When the power of the TDLS8000 is turned on, the current stream is switched to the stream set as the initial stream. The settable range of the “Initial stream” setting is only a stream selected for stream switching usage in the “Valve usage” setting. The streams that can be set as the initial stream are indicated by ○ in the table below.

Valve usage	Stream 1	Stream 2	Stream 3
Cal/Val usage	○	×	×
2 Streams & Cal/Val usage	○	○	×
3 Streams Switching usage	○	○	○

Setup menu path:

[HART] “Detailed setup>>I/O condition>>Valve control>>Initial stream”

[YH8000] “Configuration>>I/O>>Valve Control>>Initial”

**NOTE**

If switching the stream by time elapse is set for the stream number of the initial stream, counting of the switching time begins from after the power is turned on.

## 6.9 Other Settings

This section describes various settings other than measurement process settings and the I/O and alarm settings.

### 6.9.1 Tag

This is a tag of up to 32 ASCII characters for identifying individual TDLS8000. It is displayed when you connect to the TDLS8000 from the YH8000. Furthermore, the long tag defined as standard in HART communication is the same as this tag. From YH8000, Latin-1 character cannot be inputted on tag.

Setup menu path:

[HART] "Detailed setup>>System>>Long tag"

[YH8000] "Configuration>>System>>Tag"

### 6.9.2 Date and Time

Set the current date and time. For a detailed description of the setting screen, see 5.3.1 Setting the Date and Time. Furthermore, it is possible to set the time simultaneously for multiple connected TDLS8000 only when setting it from the YH8000. For details, see 8.7.3 Setting the Date and Time on the TDLS8000

Setup menu path:

[HART] "Detailed setup>>System>>Date/time>>Set date/time"

[YH8000] "Configuration>>System>>Date&Time"

### 6.9.3 User Password Setting

Change the user password for when entering the setting screen from the YH8000. Enter the current password and then enter a new password twice for confirmation.

Setup menu path:

[YH8000] "Configuration>>System>>Password"

### 6.9.4 Display

Configure settings related to the LU display and SCU display.

- **Brightness adjustment of LU display**

Set the brightness to any of 11 levels.

Setup menu path:

[HART] "Detailed setup>>System>>Local display>>LU LED display"

[YH8000] "Configuration>>System>>Local Display>>LU"

- **Brightness adjustment of SCU display**

Adjust backlight brightness and contrast to any of 11 levels.

Setup menu path:

[HART] "Detailed setup>>System>>Local display>>SCU LCD display"

[YH8000] "Configuration>>System>>Local Display>>SCU"

● **Spectrum display of SCU display**

Set whether or not to display the spectrum screen.

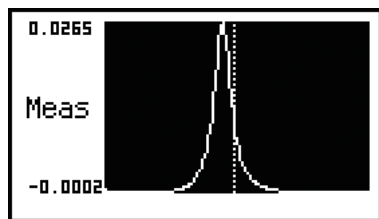
Setup menu path:

[HART] "Detailed setup>>System>>Local display>>SCU LCD display"

[YH8000] "CConfiguration>>System>>Local Display>>SCU"

Selection Option (HART Display Name)	Description																				
Hide	A spectrum is not displayed.																				
During alarm mode	<ul style="list-style-type: none"> <li>Measurement spectrum When any of the following alarms occur, the received optical signal and absorption spectrum of the measured gas are displayed alternately in a 3-second cycle.                             <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>No.</th> <th>Alarm</th> </tr> </thead> <tbody> <tr> <td>49</td> <td>warning: detector signal high</td> </tr> <tr> <td>50</td> <td>fault: peak center out of range</td> </tr> <tr> <td>52</td> <td>warning: absorption too high</td> </tr> <tr> <td>53</td> <td>fault: transmission lost</td> </tr> <tr> <td>57</td> <td>fault: laser unit failure</td> </tr> </tbody> </table> </li> <li>Reference cell spectrum When any of the following alarms occur, the received optical signal and absorption spectrum of the reference cell are displayed alternately in a 3-second cycle. (If the reference cell is disabled, the received optical signal and absorption spectrum of the measured gas are displayed.)                             <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>No.</th> <th>Alarm</th> </tr> </thead> <tbody> <tr> <td>51</td> <td>fault: reference peak height low</td> </tr> <tr> <td>54</td> <td>fault: reference transmission low</td> </tr> <tr> <td>55</td> <td>fault: reference peak height high</td> </tr> </tbody> </table> </li> </ul>	No.	Alarm	49	warning: detector signal high	50	fault: peak center out of range	52	warning: absorption too high	53	fault: transmission lost	57	fault: laser unit failure	No.	Alarm	51	fault: reference peak height low	54	fault: reference transmission low	55	fault: reference peak height high
No.	Alarm																				
49	warning: detector signal high																				
50	fault: peak center out of range																				
52	warning: absorption too high																				
53	fault: transmission lost																				
57	fault: laser unit failure																				
No.	Alarm																				
51	fault: reference peak height low																				
54	fault: reference transmission low																				
55	fault: reference peak height high																				
Periodic	After display of the 6th display item on the screen is complete, the measurement spectrum is displayed for 4 seconds.																				
Each measurement spectrum	The received optical signal and absorption spectrum of the measured gas are always displayed alternately in a 4-second cycle.																				
Each reference spectrum	The received optical signal and absorption spectrum of the reference cell are always displayed alternately in a 4-second cycle.																				

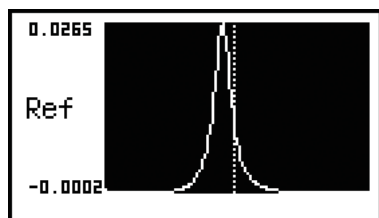
The following shows the display image of each spectrum screen.



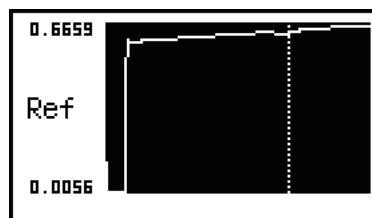
Measurement absorption spectrum



Measurement received optical signal



Reference cell absorption spectrum



Reference cell received optical signal

## 6.9.5 Communication Address Setting

Configure the address settings for TDLS8000 and HART communication.

- **IP address setting of TDLS8000**

Setup menu path:

[HART] “Detailed setup>>System>>Communication>>TCP/IP>>Set IP settings”

[YH8000] “Configuration>>System>>Communication>>TCP/IP”

---

### NOTE

When the IP address is changed, the TDLS8000 restarts automatically.

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### NOTE

When the IP address of the TDLS8000 is changed via the YH8000, the YH8000 connection settings need to be configured again. For details, see 5.2.3 Connecting to the TDLS8000.

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- **HART address setting**

Setup menu path:

[HART] “Detailed setup>>System>>Communication>>HART output”

[YH8000] “Configuration>>System>>Communication>>HART”

“Loop current mode” is a setting related to multi-drop mode. For details on multi-drop mode, see Appendix 5 What Is an Analysis Period?

## 6.9.6 Moving Average Count for Analysis Values

Configure the setting for how many analysis cycles of spectrum data to take the moving average. Increasing this value enables a more stable analysis result to be obtained but the response time will increase. For explanations on the analysis cycle and average count, see Appendix 5 What Is an Analysis Period?.

Setup menu path:

[HART] “Detailed setup>>Analysis>>Averaging”

[YH8000] “Configuration>>Analysis>>Average”

## 6.9.7 Concentration Offset

It is possible to display the value resulting from adding a fixed offset value to the calculated concentration value as the final reading. For the two-gas measurement specification, you can set an offset for each of the first component gas concentration and second component gas concentration.

Setup menu path:

[HART] “Detailed setup>>Analysis>>Zero offset”

[YH8000] “Configuration>>Analysis>>Zero Offset”

### 6.9.8 Safety Mode

Safety Mode secures TDLS8000 operation in the safety instrumented system. The following table shows how configuration of Safety Mode affects the operation.

See Appendix 7 Safety Instrumented System Installation

[HART] “Detailed setup>> System >> Safety mode”

[YH8000] “>> Configuration >> System >> Safety Mode

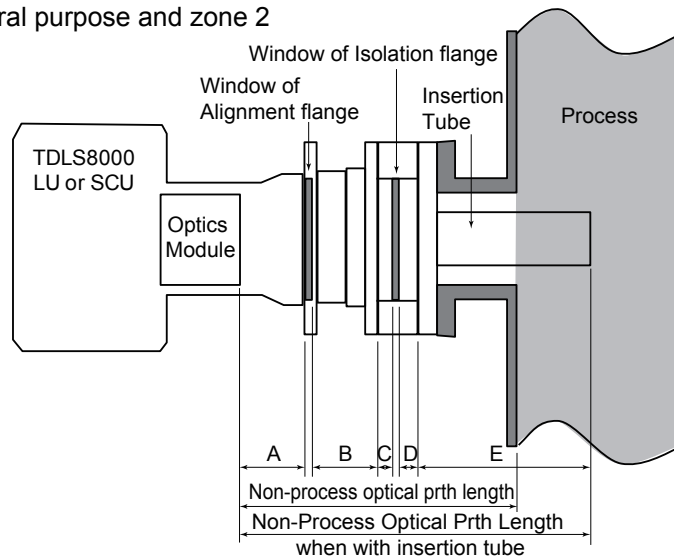
Effect on	Safety mode	Enable	Disable (default)
Condition of fault clearance		Fault stays until the system reboots.	Once the problem is solved, the fault is cleared.
Threshold of Fault: Transmission Lost		Detector sensitivity becomes high	Detector sensitivity becomes standard
Analog output on the following conditions: <ul style="list-style-type: none"> <li>● AI-1 &lt;= 3.6 mA, or AI-1 &gt;= 21.0 mA</li> <li>● Process pressure input mode is “Active Input” and “Input source is “A1-1”.</li> </ul>	Follow the Output Hold setting for Fault	Follow the Output Hold setting for Warning	
Analog output on the following conditions: <ul style="list-style-type: none"> <li>● AI-2 &lt;= 3.6 mA , or AI-2 &gt;= 21.0 mA</li> <li>● Process temperature input mode is “Active Input” and “Input source is “A1-2”.</li> </ul>			
Analog output after Fault reset		=0 mA	normal operation

## 6.10 Non-process Parameter Settings

Non-process parameters are for correcting the influence on measurement values resulting from the measurement target gas concentration contained in the purge gas when using gas containing a component to be measured as the purge gas. Non-process parameters are used, for example, with applications that use instrument air (approximately 20.9% oxygen) as the purge gas when measuring the oxygen concentration of the process. This is because the measurement values need to be corrected in consideration of the influence of laser absorption resulting from the oxygen in the purge gas. The oxygen in the instrument air exists in various sections of the optical path including the following.

- Laser module section in the laser unit (LU)
- Online validation cell in the sensor control unit (SCU)
- Alignment flanges (LU side and SCU side)
- Process insulation flanges (LU side and SCU side) (only when used)
- Insertion tubes (LU side and SCU side) (only when used)
- Valves (LU side and SCU side) (only when used)
- Process flanges (LU side and SCU side)

General purpose and zone 2



zone 1 model

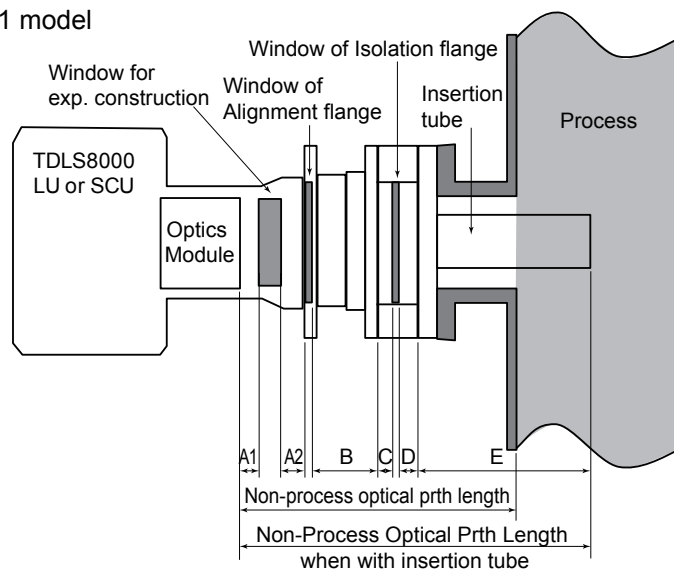


Figure 6.2 Definitions of non-process optical path length



## 6.10.1 Non-process Optical Path Length

Set the optical path length of the non-process area.

Setup menu path:

[HART] “Detailed setup>>Analysis>>Non process param>>No-prcs OPL”

[YH8000] “Configuration>>Analysis>>Non-Process Parameters>>Path Length”

The length of the non-process optical path is the total of the lengths of the laser unit (LU) side and sensor control unit (SCU) side. Calculate the length according to the corresponding procedure below because it differs depending on the installation conditions.

### ● Non-process optical path length

The total target area differs depending on the installation conditions as shown in Table 6.1. Furthermore, the length of each area of the total differs depending on the model name and code as shown in Table 6.2 to Table 6.5. Use the values in Table 6.2 to Table 6.6 to calculate the non-process optical path length using the corresponding calculation formula in Table 6.1.

**Table 6.1 Installation conditions**

Installation conditions	Calculation formula
LU section, SCU section and alignment flange only	$A + B + A' + B'$
When using insertion tube	$A + B + E + A' + B' + E'$
When using process insulation flange	$A + B + C + D + A' + B' + C' + D'$
When using process insulation flange and insertion tube	$A + B + C + D + E + A' + B' + C' + D' + E'$

Note: In case of Zone 1 model, value A is A1 + A2, value A' is A'1 + A'2.

**Table 6.2 A, and A' value by Gas parameter (General purpose and zone 2 model)**

Model name and code			Optics Accessory, Option Code	A (mm) LU side	A' (mm) SCU side	
Model	Type	Gas parameter				
TDLS8000		-X1	other than -LA, without /D	149.8	130.6	
			-LA	142.4	235.6	
			(other than -LA) /D	142.4	130.6	
		-X2	other than -LA, without /D	149.8	130.6	
			-LA	142.4	235.6	
			(other than -LA) /D	142.4	130.6	
		-G1 -G2 -GQ -GR	-C1	-	72.2	92.6
				other than -LA	72.2	92.6
		-D2 -C2	-C2	-LA	72.2	225.6
				other than -LA	72.2	92.6
		-S2 -C3	-C3	-LA	72.2	225.6
				other than -LA	72.2	92.6
		-E2 -C4	-C4	-LA	72.2	225.6
				other than -LA	72.2	92.6
		-K2 -C5	-C5	-	72.2	92.6
				-A1	-	72.2
		-N2 -Q2	-A2	-	72.2	92.6
				-D1	-	72.2
		-R2 -J2	-D5	-	72.2	92.6
				-H1	-	151.2
			-H3	-	152.2	132.6
				-H4	-	150.4
			-S1	-	72.2	92.6
	-L1	-	72.2	92.6		

**Table 6.3 A and A' value by Gas parameter (zone 1 model) A2= 61.0 mm**

Model name and code			Optics Accessory, Option Code	A1+A2 (mm) LU side	A1'+A2' (mm) SCU side
Model	Type	Gas parameter			
TDLS8000	-D1 -C1 -S1 -E1 -J1 -Q1 -R1	-X1	other than -LA, without /D	138.6	119.4
			-LA	131.2	224.4
			(other than -LA) /D	131.2	119.4
		-X2	other than -LA, without /D	138.6	119.4
			-LA	131.2	224.4
			(other than -LA) /D	131.2	119.4
		-C1	-	61.0	81.4
		-C2	other than -LA	61.0	81.4
			-LA	61.0	214.4
		-C3	other than -LA	61.0	81.4
			-LA	61.0	214.4
		-C4	other than -LA	61.0	81.4
			-LA	61.0	214.4
		-C5	-	61.0	81.4
		-A1	-	61.0	81.4
		-A2	-	61.0	81.4
		-D1	-	61.0	81.4
		-D5	-	61.0	81.4
		-H1	-	61.0	81.4
		-H3	-	61.0	81.4
-H4	-	139.2	119.4		
-S1	-	61.0	81.4		
-L1	-	61.0	81.4		

**Table 6.4 B and B' value by Optics accessory**

Model name and code		Optics Accessory	B (mm) LU side	B' (mm) SCU side
Model	Type			
TDLS8000	All	-NN	0	0
		-LA	89.7	174.6
		-U2	85.4	85.4
		-U3	90.2	90.2
		-U4	89.7	89.7
		-D5	83.9	83.9
		-D8	85.9	85.9
		-J5	81.9	81.9
		-J8	83.9	83.9
		-FC	83.4	83.4

**Table 6.5 C, C' and D, D' value**

Model name and code	C, C' (mm)	D, D' (mm)
IF8000	-21 -21	14 19.1
	-23 -21	14 19.1
	-31 -21	14 19.1
	-33 -21	14 19.1
	-41 -21	14 18.6
	-50 -50	15.1 20.1
	-80 -50	15.1 20.1
	-J5 -50	15.1 19.1
	-J8 -50	15.1 19.1

**Table 6.6 Insertion tube length**

Part name	E, E' (mm)
Insertion tube	Insertion tube length including flange part (Depends on measurement application)

● **Non-process optical path length of TDLS8000**

Convert the LU section length + SCU section length [mm] to the unit set for the optical path length and set the result as the non-process optical path length.

### 6.10.2 Non-process Pressure Setting

Set the pressure value of the non-process area.

Setup menu path:

[HART] “Detailed setup>>Analysis>>Non process param>>No-prcs pres”  
 [YH8000] “Configuration>>Analysis>>Non-Process Parameters>>Pressure”

### 6.10.3 Non-process Temperature Setting

Set the temperature input mode of the non-process area. Also, set the fixed temperature value when the mode is fixed and offset value when the mode is “Active ambient.”

Setup menu path:

[HART] “Detailed setup>>Analysis>>Non process param>>No-prcs temp”  
 [YH8000] “Configuration>>Analysis>>Non-Process Parameters>>Temperature”

### 6.10.4 Non-process Concentration Setting

Set the concentration of the gas to be measured that is included in the non-process area.

Setup menu path:

[HART] “Detailed setup>>Analysis>>Non process param>>No-prcs conc”  
 [YH8000] “Configuration>>Analysis>>Non-Process Parameters>>Concentration”

## 6.11 Initializing the Settings (Factory Default Settings)

This section describes the procedure to restore the settings to the state at the time of shipment and lists the initial values of the parameters at the time of shipment.

### 6.11.1 Initialization Procedure

Execution menu path:

[HART] "Detailed setup>>System>>Initialize config"

[YH8000]  >>Configuration>>System>>Configuration Initialization"

To execute initialization, open the above menu and then select from the following depending on the types of parameters you wish to initialize. Multiple items can be selected at the same time.

Item name (HART)	Initialization target
Setting data	All parameters settable from YH8000 and HART (All parameters in section 6.11.2 except for "User info.")
AI/AO cal data	Input/output calibration data of AI/AO
Calibration data	Zero/span calibration data
User info	TDLS8000 tag, IP settings, HMI (YH8000) user password, HART address, HART 8-character short tag, write protect password

#### NOTE

When initialization is executed, the TDLS8000 restarts automatically.

### 6.11.2 Parameter Initial Value List

The initial values of parameters at the time of shipment are as follows.

Parameters with ○ in the "User specification" column are initialized to the values specified by the customer at the time of ordering if the values were specified by the customer at that time.

#### ● Process parameters

Parameter	Initial value	User specification	Min. – Max.
OPL (Optical Path Length)	0.660[m]	○	0.01 – 100[m]
Pressure mode	Active input		Select in the screen
Pressure value for fixed mode	101.325[kPa]		0.1 – 10,000[kPa]
Pressure active input source	AI-1		Select in the screen
Pressure value at 4mA	40[kPa]		0 – 10,000[kPa]
Pressure value at 20mA	200[kPa]		0 – 10,000[kPa]
Pressure backup mode when AI-1 input is out of range or under AI calibration	Backup value		Select in the screen
Pressure backup set value	101.325[kPa]		0.1 – 10,000[kPa]
Temperature mode	Active input		Select in the screen
Temperature value for fixed mode	25[deg C]		-273 – 3,000[deg C]
Temperature active input source	AI-2		Select in the screen
Temperature value at 4mA input	0[deg C]		-273 – 3,000[deg C]
Temperature value at 20mA input	100[deg C]		-273 – 3,000[deg C]
Temperature backup mode when AI-2 input is out of range or under AI calibration	Backup value		Select in the screen
Temperature backup set value	25[deg C]		-273 – 3,000[deg C]
Temperature offset for active ambient method	-6[deg C]		-100 – 100[deg C]

- **Non-process parameters**

Parameter	Initial value	Min. – Max.
Non-process OPL	0[m]	0 – 10[m]
Non-process pressure	101.325[kPa]	0.1 – 10,000[kPa]
Non-process temperature mode	Fixed	Select in the screen
Non-process temperature	25[deg C]	-273 – 3,000[deg C]
Non-process temperature compensation coefficient for active ambient method	0.5	0 – 1
Non-process concentration for measurement gas 1	0[ppm]	0 – 1E6[ppm]
Non-process concentration for measurement gas 2	0[ppm]	0 – 1E6[ppm]

- **Units**

Parameter	Initial value	User specification	Min. – Max.
OPL unit	m	<input type="radio"/>	Select in the screen
Pressure unit	kPa	<input type="radio"/>	Select in the screen
Temperature unit	deg C	<input type="radio"/>	Select in the screen

- **Process alarms**

Parameter	Initial value	Min. – Max.
Warning selection	All selected	Select in the screen
Transmission low warning limit	20[%]	0 – 100[%]
Pressure low warning limit	90[kPa]	0.1 – 10,000[kPa]
Pressure high warning limit	110[kPa]	0.1 – 10,000[kPa]
Temperature low warning limit	0[deg C]	-273 – 3,000[deg C]
Temperature high warning limit	100[deg C]	-273 – 3,000[deg C]
Gas1 concentration low warning limit	10[ppm]	0 – 1E6[ppm]
Gas1 concentration high warning limit	900,000[ppm]	0 – 1E6[ppm]
Gas2 concentration low warning limit	10[ppm]	0 – 1E6[ppm]
Gas2 concentration high warning limit	900,000[ppm]	0 – 1E6[ppm]

● Analog output

Parameter		Initial value	User specification	Min. – Max.
AO output item		Concentration 1	○	Select in the screen
Measurement value at 4mA output	Concentration	0[ppm]	○	-1E7 – 1E7[ppm]
	Transmission	0[%]		-1E7 – 1E7[%]
	Temperature	0[deg C]		-1E7 – 1E7[deg C]
	Pressure	0[kPa]		-1E4 – 1E4[kPa]
Measurement value at 20mA output	Concentration	100[ppm]	○	-1E7 – 1E7[ppm]
	Transmission	100[%]		-1E7 – 1E7[%]
	Temperature	100[deg C]		-1E7 – 1E7[deg C]
	Pressure	0.1[kPa]		-1E4 – 1E4[kPa]
AO hold mode during warning		Non-Hold		Select in the screen
Preset hold value during warning		3.0[mA]		3.0 – 21.6[mA]
Preset hold delay during warning		0		0 – 5
AO hold mode during fault		Preset hold		Select in the screen
Preset hold value during fault		3.0[mA]		3.0 – 21.6[mA]
Preset hold delay during fault		0		0 – 5
AO hold mode during calibration/validation		Preset hold		Select in the screen
Preset hold value during calibration/validation		3.8[mA]		3.8 – 20.5[mA]
AO hold mode during maintenance		Preset hold		Select in the screen
Preset hold value during maintenance		3.8[mA]		3.8 – 20.5[mA]
AO hold mode during warm-up		Preset hold		Select in the screen
Preset hold value during warm-up		3.8[mA]		3.8 – 20.5[mA]

● Digital output

Parameter	Initial value	Min. – Max.
Number of output delays for warning and fault	0	0 – 100
DO output item selection	All selected	Select in the screen

● Digital input

Parameter	Initial value	Min. – Max.
Filter time	0.5[s]	Select in the screen
DI item selection	Disable	Select in the screen

● Valve

Parameter	Initial value	Min. – Max.
Valve usage	Cal/Val	Select in the screen
Initial stream	Stream 1	Select in the screen
Next stream of stream switching by time duration	Disable	Select in the screen
Time duration of next stream	60[min]	1 – 1,440[min]

● Loop check

Parameter	Initial value	Min. – Max.
Test auto release time	30[min]	Select in the screen

## ● System

Parameter	Initial value	User specification	Min. – Max.
User averaging number	1		1 – 32(*1)
Analyzer tag	Blank	○	ASCII 32 characters
Analyzer IP address	192.168.1.10		IPv4 address
Subnet mask	255.255.255.0		IPv4 address
Default gateway address	192.168.1.254		IPv4 address
HMI user password	1234		ASCII 8 characters
LCD spectrum display mode	Hide		Select in the screen
LCD backlight brightness	10		0 – 10
LCD contrast	5		0 – 10
Safety mode	Disable		Select in the screen

\*1: The maximum value varies depending on the measurement target gas (application). Normally, it is 16.

## ● HART parameters

Parameter	Initial value	Min. – Max.
Polling address	0	0 – 63
Loop current mode	Enable	Select in the screen
Write protect password	All space	ASCII 8 characters
Short tag	All space	8 characters (*1)
TV item	Temperature	Select in the screen
QV item	Transmission	Select in the screen
Response preamble number	5	5 – 20
Memo 1/ Memo 2/ Memo 3	All space	ASCII 32 characters
Message	All space	32 characters (*1)
Descriptor	All space	16 characters (*1)
Trim Who/Trim Desc/Trim Loc	All space	ASCII 16 characters
Date/Trim date	1900/01/01	1900/01/01 – 2155/12/31
Configuration locked status mask	Off	Select in the screen

\*1: Uppercase letters, numbers, and symbols can be entered.

## ● Zero calibration

Parameter	Initial value	Min. – Max.
Auto zero calibration time initiate	Disable	Select in the screen
Auto zero calibration time initiate cycle (day)	0 (=Disable)	0 – 999
Auto zero calibration time initiate cycle (hour)	0 (=Disable)	0 – 23
Auto zero calibration time initiate base clock	2010/01/01 00:00:00	2010/01/01 00:00:00 – 2068/12/31 23:59:59
Auto zero calibration gas purge time	600[s]	0 – 10,000[s]
Auto zero calibration process purge time	600[s]	0 – 10,000[s]
Auto valve control for manual zero calibration	Disable	Select in the screen

● **Span calibration**

Parameter	Initial value	Min. – Max.
Pressure mode for span calibration	Process parameter	Select in the screen
Temperature mode for span calibration	Process parameter	Select in the screen
OPL mode for span calibration	Process parameter	Select in the screen
Pressure fixed value for span calibration	101.325[kPa]	0.1 – 10,000[kPa]
Temperature fixed value for span calibration	25[deg C]	-273 – 3,000[deg C]
OPL fixed value for span calibration	0.66[m]	0.01 – 100[m]
Gas1 concentration value for span calibration	219,000[ppm]	0 – 1E6[ppm>(*1)
Gas2 concentration value for span calibration	219,000[ppm]	0 – 1E6[ppm>(*1)
Gas type for span calibration	Gas 1	Select in the screen
Auto span calibration time initiate	Disable	Select in the screen
Auto span calibration time initiate cycle (day)	0 (=Disable)	0 – 999
Auto span calibration time initiate cycle (hour)	0 (=Disable)	0 – 23
Auto span calibration time initiate base clock	2010/01/01 00:00:00	2010/01/01 00:00:00 – 2068/12/31 23:59:59
Auto span calibration gas purge time	600[s]	0 – 10,000[s]
Auto span calibration process purge time	600[s]	0 – 10,000[s]
Auto valve control for manual span calibration	Disable	Select in the screen

\*1: Zero is not allowed.

● **Zero + span calibration**

Parameter	Initial value	Min. – Max.
Auto zero + span calibration time initiate	Disable	Select in the screen
Auto zero + span calibration time initiate cycle (day)	0 (=Disable)	0 – 999
Auto zero + span calibration time initiate cycle (hour)	0 (=Disable)	0 – 23
Auto zero + span calibration time initiate base clock	2010/01/01 00:00:00	2010/01/01 00:00:00 – 2068/12/31 23:59:59



● **Offline validation (\*1)**

Parameter	Initial value	Min. – Max.
Pressure mode for offline validation 1	Process parameter	Select in the screen
Temperature mode for offline validation 1	Process parameter	Select in the screen
OPL mode for offline validation 1	Process parameter	Select in the screen
Pressure fixed value for offline validation 1	101.325[kPa]	0.1 – 10,000[kPa]
Temperature fixed value for offline validation 1	25[deg C]	-273 – 3,000[deg C]
OPL fixed value for offline validation 1	0.66[m]	0.01 – 100[m]
Gas1 concentration value for offline validation 1	200,000[ppm]	0 – 1E6[ppm](*2)
Gas2 concentration value for offline validation 1	200,000[ppm]	0 – 1E6[ppm](*2)
Gas type for offline validation 1	Gas 1	Select in the screen
Auto offline validation 1 time initiate	Disable	Select in the screen
Auto offline validation 1 time initiate cycle (day)	0 (=Disable)	0 – 999
Auto offline validation 1 time initiate cycle (hour)	0 (=Disable)	0 – 23
Auto offline validation 1 time initiate base clock	2010/01/01 00:00:00	2010/01/01 00:00:00 – 2068/12/31 23:59:59
Auto offline validation 1 gas purge time	600[s]	0 – 10,000[s]
Auto offline validation 1 process purge time	600[s]	0 – 10,000[s]
Auto valve control for manual offline validation 1	Disable	Select in the screen
Auto offline validation 1+2 time initiate	Disable	Select in the screen
Auto offline validation 1+2 time initiate cycle (day)	0 (=Disable)	0 – 999
Auto offline validation 1+2 time initiate cycle (hour)	0 (=Disable)	0 – 23
Auto offline validation 1+2 time initiate base clock	2010/01/01 00:00:00	2010/01/01 00:00:00 – 2068/12/31 23:59:59

\*1: The initial value for the parameters related to “offline validation 2” is the same as those for “offline validation 1.”

\*2: Zero is not allowed.

● **Online validation (\*1)**

Parameter	Initial value	Min. – Max.
Temperature mode for online validation 1	Active ambient	Select in the screen
Temperature ambient offset for online validation 1	-2.2[deg C]	-100 – 100[deg C]
Pressure value for online validation 1	101.325[kPa]	0.1 – 10,000[kPa]
Temperature fixed value for online validation 1	25[deg C]	-273 – 3,000[deg C]
OPL value for online validation 1	0.1306[m](*2)	0.01 – 10[m]
Gas1 concentration value for online validation 1	200,000[ppm]	-1E6 – 1E6[ppm]
Gas2 concentration value for online validation 1	200,000[ppm]	-1E6 – 1E6[ppm]
Gas type for online validation 1	Gas 1	Select in the screen
Auto online validation 1 time initiate	Disable	Select in the screen
Auto online validation 1 time initiate cycle (day)	0 (=Disable)	0 – 999
Auto online validation 1 time initiate cycle (hour)	0 (=Disable)	0 – 23
Auto online validation 1 time initiate base clock	2010/01/01 00:00:00	2010/01/01 00:00:00 – 2068/12/31 23:59:59
Auto online validation 1 validation gas purge time	600[s]	0 – 10,000[s]
Auto online validation 1 normal gas purge time	600[s]	0 – 10,000[s]
Auto valve control for manual online validation 1	Disable	Select in the screen
Reading mode for online validation 1	Process+Validation	Select in the screen
Concentration output factor during online validation 1	1.0	-9.9 – 9.9

\*1: The initial value for the parameters related to “online validation 2” is the same as those for “online validation.”

\*2: The parameter may be initialized to a value which is different from the one shown in the list above, because the initial value differs depending on the measurement target gas (application) of the TDLS8000.

● **Concentration offset**

Parameter	Initial value	Min. – Max.
Concentration offset for gas1	0[ppm]	-1E6 – 1E6[ppm]
Concentration offset for gas2	0[ppm]	-1E6 – 1E6[ppm]

# 7. HART Communication

The following functions can be performed via HART communication.

- Checking concentration, transmission, process pressure, and process temperature
- Checking alarm statuses
- Setting parameters
- Performing calibration and validation
- Performing loop check
- Checking alarms and calibration history

This chapter explains matters specific to HART communication.

## 7.1 Connection

For the method of connecting a HART setting tool to the TDLS8000, see 5.1 Connecting the HART Configuration Tool.

## 7.2 Menu Tree

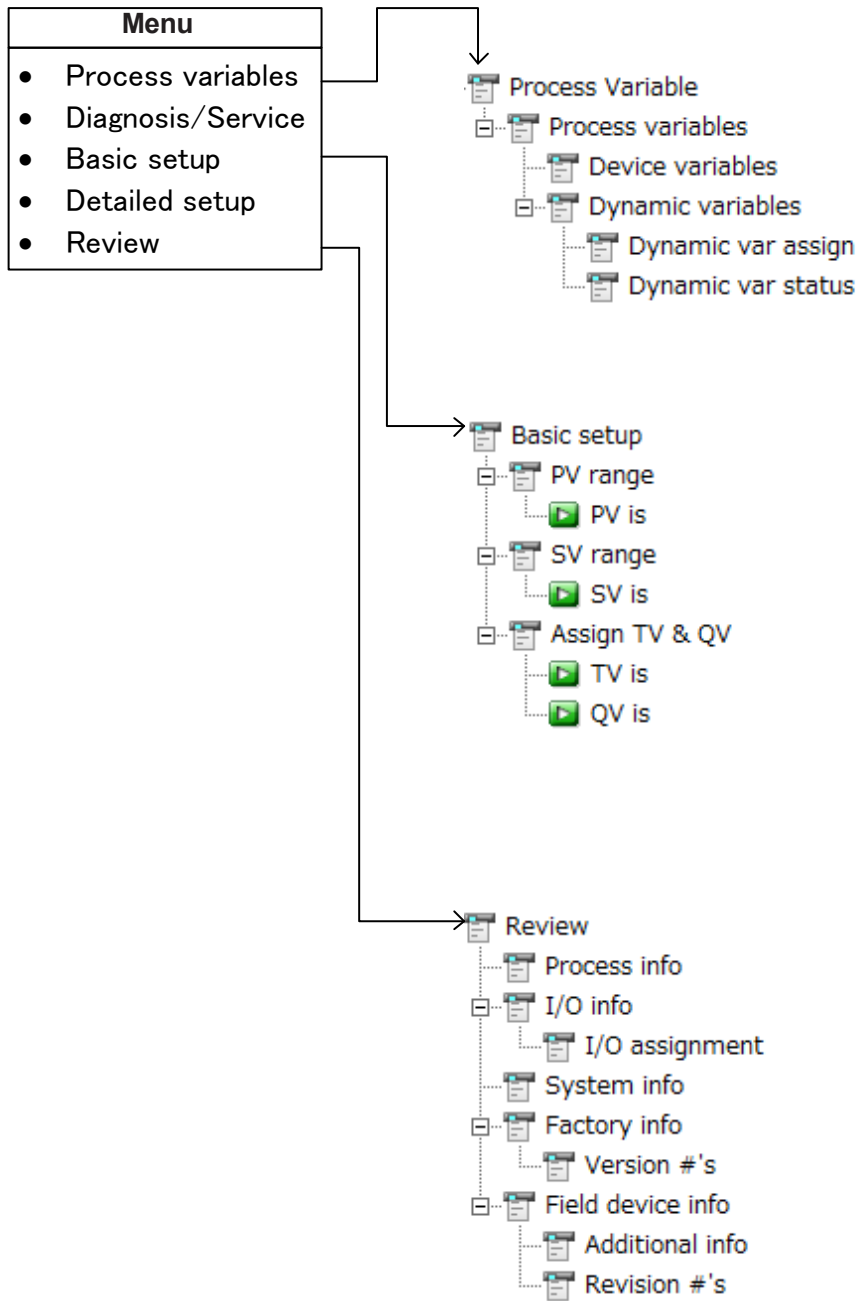
This section shows the hierarchal configuration of the DD menu. For the whole configuration containing all parameters, see Appendix 3 General View of HART DD.

### 7.2.1 DD Menu

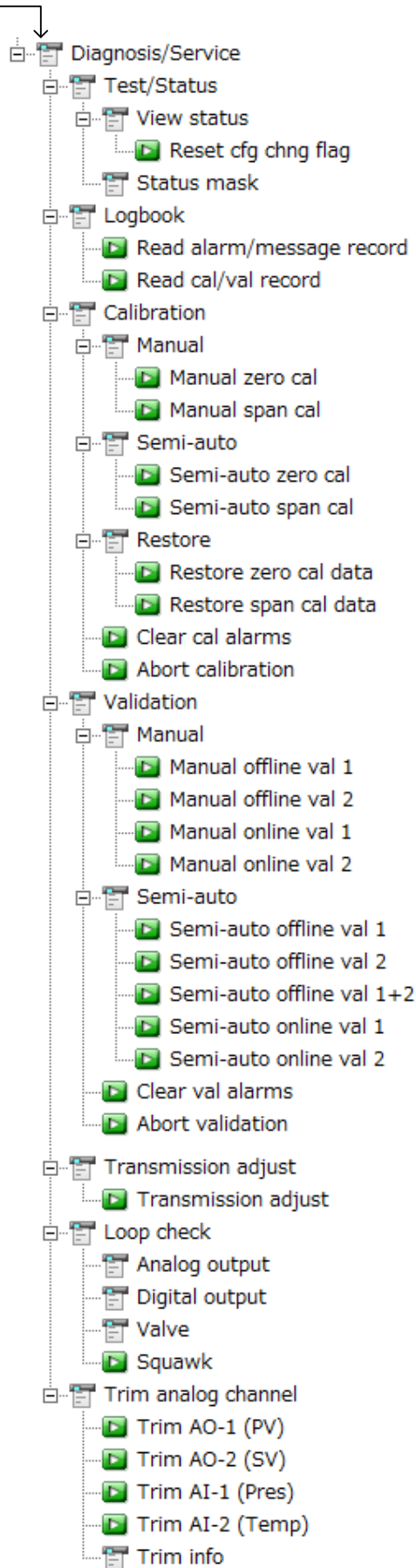
The root menu (top menu) is as follows.

Root menu	Description
Process variables	Displays the latest values of PV-QV and measurements.
Diagnosis/Service	Checks alarms and history; performs calibration, validation, and loop check
Basic setup	Assigns PV-QV items; sets output ranges
Detailed setup	Sets parameters specific to the TDLS8000
Review	Displays measurements, I/O values, and manufacturing information

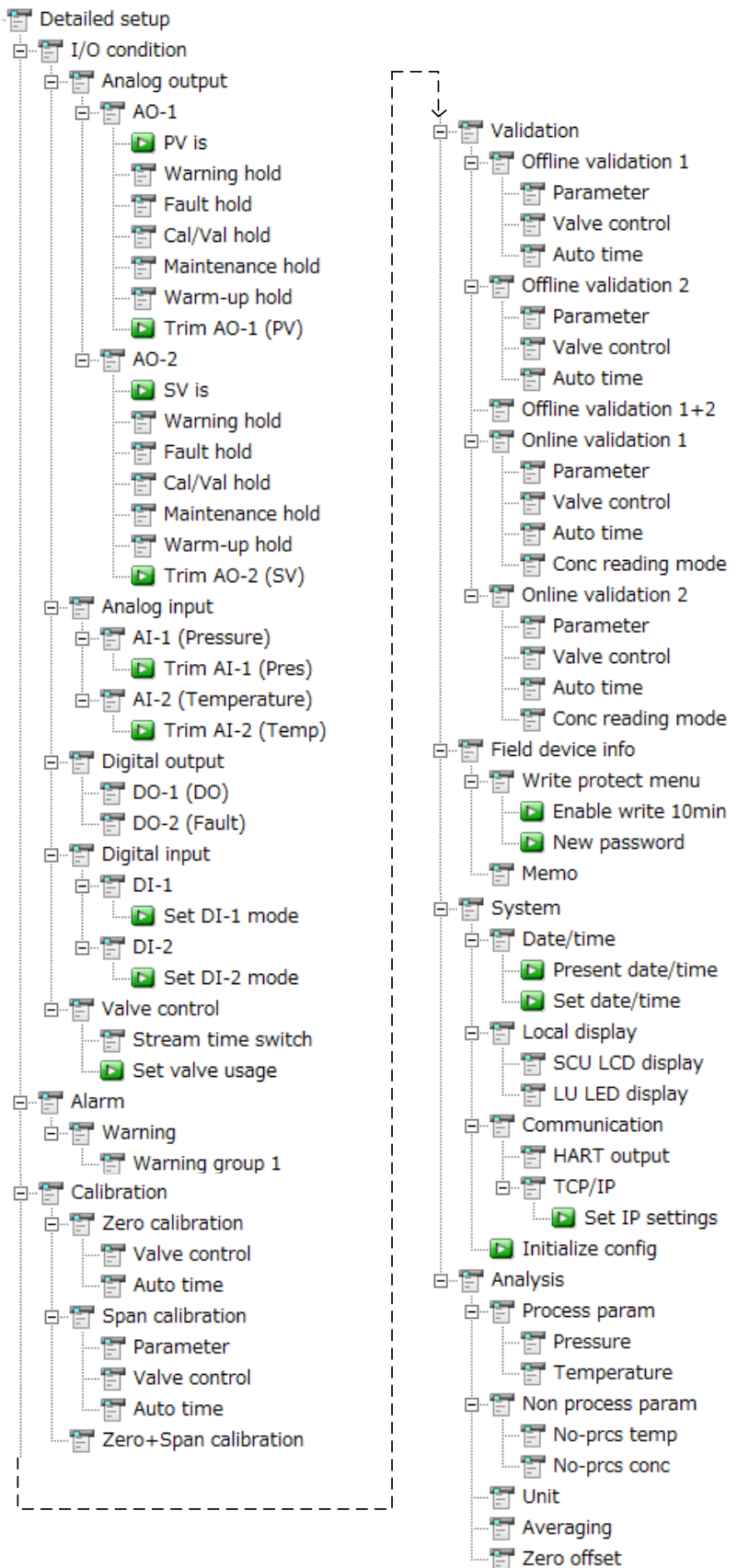
The menus in the second and lower layers are as follows.



Menu
• Process variables
• Diagnosis/Service
• Basic setup
• Detailed setup
• Review



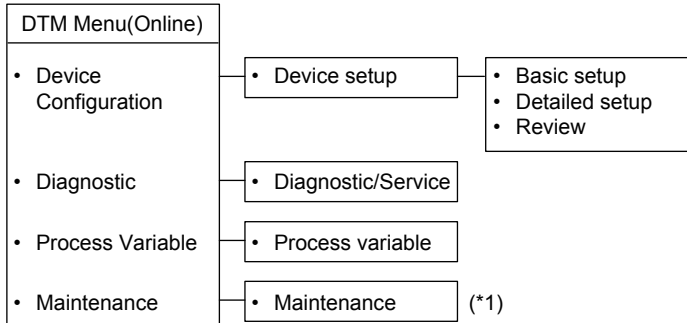
Menu
• Process variables
• Diagnosis/Service
• Basic setup
• Detailed setup
• Review



## 7.2.2 DTM Menu (FieldMate)

FieldMate is Yokogawa’s HART setting tool that runs on PCs. The menu displayed on FieldMate slightly differs from the DD menu.

As shown in the figure below, the root menu (top menu) of FieldMate is “DTM Menu (Online)”, under which the DD menu comes as five sub-menus (see 7.2.1). The configuration under the sub-menus is the same as that of the DD menu.



\*1: Of the commands in the “Diagnostic/Service” menu, the execution commands for calibration, validation, and loop check are included.

## 7.3 Write Protection

The write protection via HART communication is a double protection architecture: a hardware-switch protection and software-authenticated protection. When both protections are released, the data can be written to the TDLS8000.

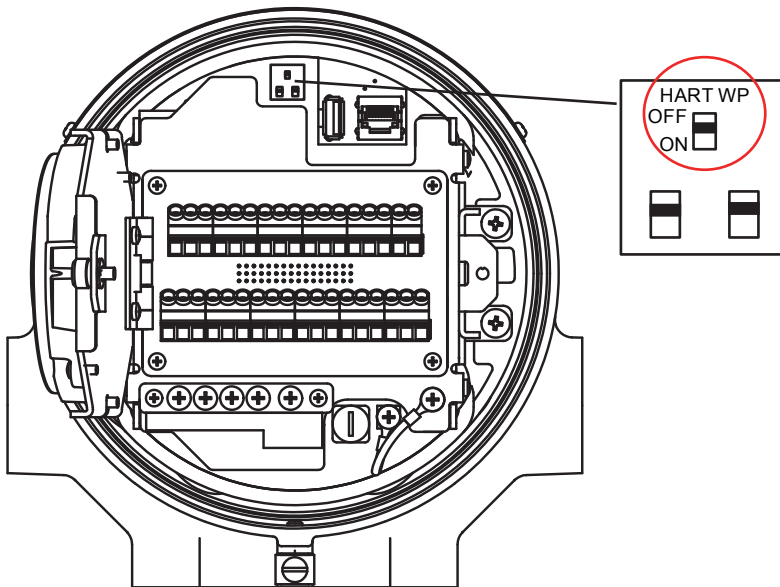
The current protection status can be confirmed from the value of “Yes” or “No” of the “Write protect” parameter, which is retrieved by either of the following menus.

- “Review>>Field device info”
- “Detailed setup>>Field device info>>Write protect menu”

### 7.3.1 Hardware Write Protection

By turning the switch ON on the SCU, write protection is enabled. The default setting is OFF.

Switch position	Write protection
OFF	Disabled
ON	Enabled



### 7.3.2 Software Write Protection

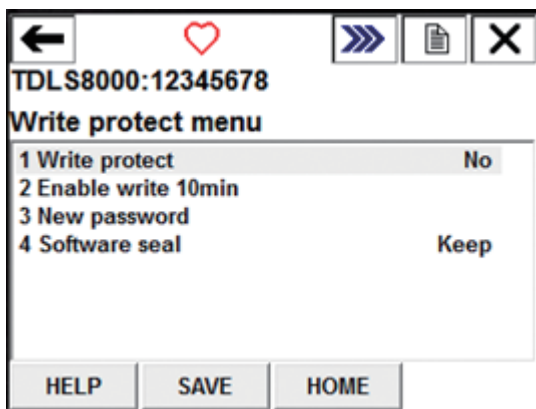
By setting a password (eight alphanumeric characters), write protection is enabled. The password can be set and changed on the “New password” screen. When a password has been set and it is entered in the “Enable write 10min” screen, the protection is disabled for 10 minutes. When any data is written to the TDLS8000, the disabled time will be extended for another 10 minutes. This means that the protection is enabled 10 minutes after the last writing.

To disable software write protection indefinitely, enter 8 character spaces in the “New password” screen. As the default, protection is disabled (8 character spaces have been entered).

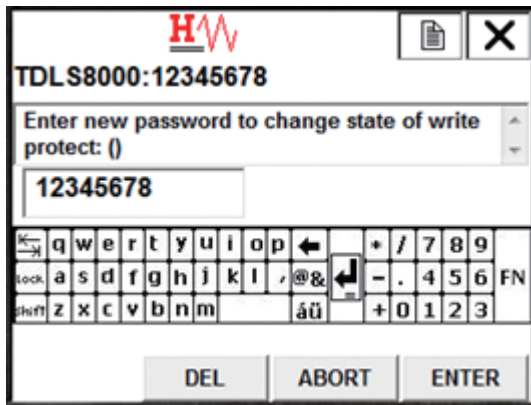
#### ● How to set a password

How to set a password will be explained using the character string “12345678” as an example.

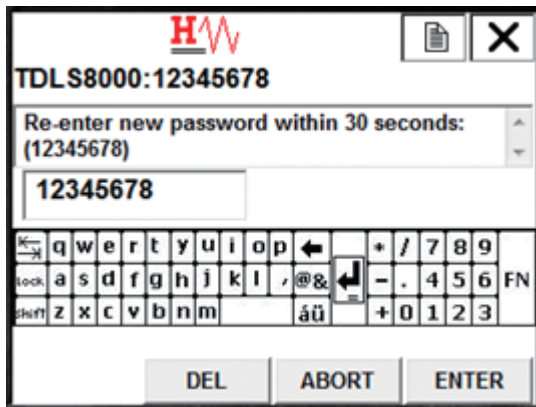
- (1) Go down the menu to Write protect menu: “Detailed setup>>Field device info>>Write protect menu”. The screen shown below will appear. Select the “New password” line.



- (2) Enter “12345678” and click “ENTER”.



(3) Confirm that “12345678” has been entered and click ENTER within 30 seconds.



(4) When the new password is set, the following screen will appear. Click “OK”.



## NOTE

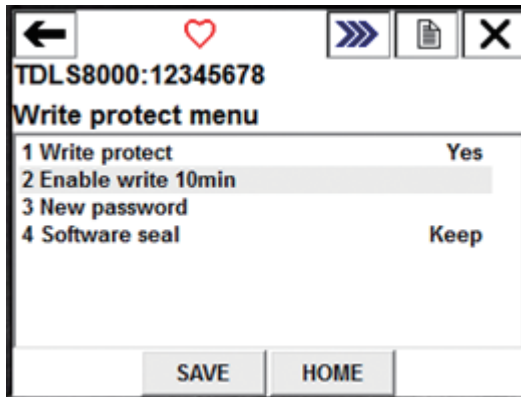
When the TDLS8000 is in either of the following statuses, writing via HART communication is not allowed even if write protection is disabled.

- A password for maintenance has been entered on the YH8000 and the setting change is enabled (during maintenance)
- Calibration and validation are being performed.

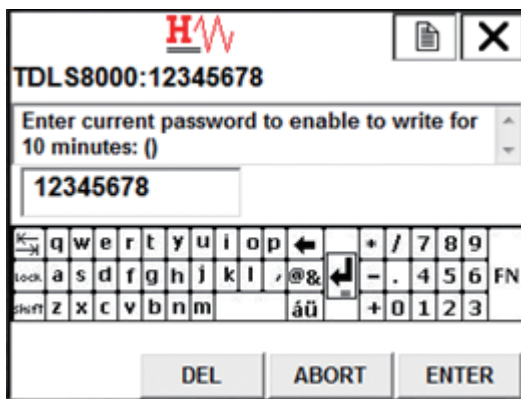


● **How to disable protection for 10 minutes**

- (1) Go down the menu to Write protect menu: “Detailed setup>>Field device info>>Write protect menu”. The following screen will appear. Select the “Enable write 10min” line.



- (2) Enter “12345678” and click “ENTER”.



- (3) After successful verification, the following screen will appear. Click “OK”. Click “OK” again on the next screen.



### 7.3.3 Device Configuration Locked

The TDL S8000 in the write protection status is recognized by some host systems as being in the “Device Configuration Locked” status, which is defined in HART communication, indicating that the TDL S8000 is in an abnormal condition. A window may pop up on a field communicator to prompt confirmation.

To avoid this, the TDL S8000 has a function to mask this status. By setting this mask to ON, the “Device Configuration Locked” status will not occur even in the write protection status. The default setting is OFF. The setting will be maintained even after the power is turned off.

Menu: “Diagnosis/Service>>Test/Status>>Status mask>>Dev cfg locked mask”

## 7.4 Alarm Definition (Status group)

This section explains the device-specific alarms on HART communication and their definition.

On a HART setting tool, device-specific alarms and their status information are bundled in groups consisting of up to eight items. These groups are defined as “Status group#” and alarms are expressed in the format of the character string of an alarm followed by (AL-alarm number). The details of each group are given below.

Display menu: “Diagnosis/Service>>Test/Status>>View status”

Group	Status	Attribute	Description
Group 1	Transmission Low (AL-01)	Warning	See10.2 Warning Display and Handling
	Pressure Low (AL-02)		
	Pressure High (AL-03)		
	Temperature Low (AL-04)		
	Temperature High (AL-05)		
	Conc Gas1 Low (AL-06)		
	Conc Gas1 High (AL-07)		
	Conc Gas2 Low (AL-08)		
Group 2	Conc Gas2 High (AL-09)		
	LU Temp Low (AL-10)		
	LU Temp High (AL-11)		
	SCU Temp Low (AL-12)		
	SCU Temp High (AL-13)		
	Validation Required (AL-14)		
	Validation Error (AL-15)		
Zero Cal Error (AL-16)			
Group 3	Span Cal Error (AL-17)		
	Non Process Alarm (AL-19)		
	AI-1 (Pres) Low (AL-20)		
	AI-1 (Pres) High (AL-21)		
	AI-2 (Temp) Low (AL-22)		
	AI-2 (Temp) High (AL-23)		
Group 4	External Alarm (AL-24)		
	Clock Adj Required (AL-25)		
	Setting File Error (AL-26)		
Group 6	Calib File Error (AL-27)		
	Laser Md Temp Low (AL-45)		
	Laser Md Temp High (AL-46)		
	Laser Temp Low (AL-47)		
Group 7	Laser Temp High (AL-48)	Warning	See 10.2 Warning Display and Handling.
	Detect Signal High (AL-49)		
	Peak Center OOR (AL-50)		
	Ref Peak Height Low (AL-51)		
	Absorption High (AL-52)		
	Transmission Lost (AL-53)		
	Ref Trans Low (AL-54)		
R Peak Height High (AL-55)			
Group 8	Outlier Reject Lmt (AL-56)	Warning	See 10.2 Warning Display and Handling.
	Laser Unit Fail (AL-57)		
	Inter Comm Fail (AL-58)		
	Laser Module Error (AL-59)		
	File Access Error (AL-60)		
	EEPROM Error (AL-61)		
	LU Connect Error (AL-62)		
	FPGA Failure (AL-63)		
Program Error (AL-64)			

Group	Status	Attribute	Description
Group 9	Warm-up	Status	Warming-up
	Maintenance mode		Maintenance
Group 10	Zero Cal		Zero calibration
	Span Cal		Span calibration
	Offline Val		Off-line validation
	Online Val		Online validation
	AI-1 (Pres) Cal		AI-1 (pressure input) calibration
	AI-2 (Temp) Cal		AI-2 (temperature input) calibration

## 7.5 Functions Specific to HART Communication

This section explains functions that can be performed only via HART communication. These functions include those specified by HART communication and those of the TDLS8000 only for HART communication.

### 7.5.1 Multidrop Mode

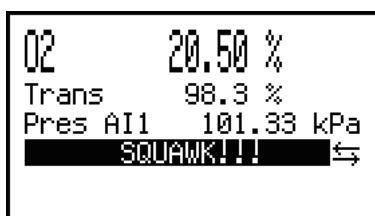
In the multidrop mode, multiple HART communication devices can be connected to a single HART communication line. Set “Poll addr” to a value of 0 to 63 so that each device has a different address.

Set “Loop current mode” to “Disabled”. In this setting, AO-1 output will be fixed to 4 mA, and burnout output will be disabled. However, in the multidrop connection with devices that receive analog outputs (including actuators), one unit in one loop can output analog signals. In this case, set “Loop current mode” to “Enabled”.

Configuration menu: “Detailed setup>>System>>Communication>>HART output”

### 7.5.2 Squawk

This function identifies any unit of the TDLS8000 that is connected via HART communication. “SQUAWK !!!” will appear on the SCU display of the TDLS8000 as shown below.



- **How to use the Squawk function**

- (1) Go down the menu to Squawk: “Diagnosis/Service>>Loop check>>Squawk”.
- (2) Choose an operation of Squawk among the following.

Option	Operation
Off	Disables Squawk..
On	Enables Squawk. Continues the display until “Off” is chosen or the TDLS8000 is turned off.
Squawk Once	Enables squawk for 10 seconds.

### 7.5.3 Aborting Calibration and Validation

Even if a setting tool is accidentally disconnected during calibration or validation via HART communication, these tasks do not suspend but continue on the TDLS8000. In this case, stop calibration and validation with the abort function, and then start these tasks afresh. Note that calibration and validation commanded from the YH8000 cannot be aborted with this function.

The abort function is available for calibration and validation.

For calibration: "Diagnosis/Service>>Calibration>>Abort calibration"

For validation: "Diagnosis/Service>>Validation>>Abort validation"

The following shows how to abort manual span calibration.

- (1) During the span calibration, go down the menu to Abort calibration:

"Diagnosis/Service>>Calibration>>Abort calibration"

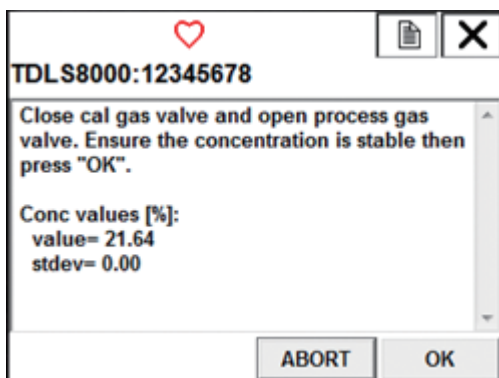
- (2) After clicking "OK" on the warning screen, the screen shown below will appear.

If calibration is not being performed, an error message will appear. Confirm that the abortion target is span calibration, and select "Yes".

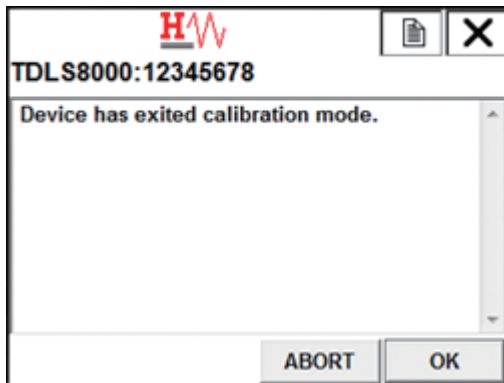


- (3) The process gas injection screen will appear.

When automatic valve control is disabled, manually open the valve and purge the calibration cell with process gas. After confirming that the process gas concentration has stabilized, click "OK".



- (4) The screen shown below appears and the abortion of span calibration will finish.  
Click "OK" to return to the menu.



# 8. YH8000 HMI Unit

The YH8000 HMI unit is an HMI (Human Machine Interface) option for the TDLS8000. This chapter explains how to use the YH8000.

## CAUTION

To prevent damaging the touch panel, do not use pointed objects (e.g., ballpoint pen, pencil), objects with narrow tips, hard objects, and the like when you use the touch panel.


Also, to prevent erroneous operation, touch the center of controls.

Avoid applying strong load on the screen to prevent damage or malfunction.

## 8.1 Connection

For details on how to connect the YH8000 HMI unit to the TDLS8000 Tunable Laser Spectrometer, see “5.2 Connecting to the YH8000”

## 8.2 Home Screen

The home screen shown in Figure 8.1 or Figure 8.2 is the YH8000 main screen. Tapping  at the bottom of the screen shows the home screen.

If a TDLS8000 is not connected to the YH8000, switching to the home screen is not possible.

If multiple TDLS8000s are connected, you can select to show the overall display. For details on the overall display, see “8.7.1 Overall Display”

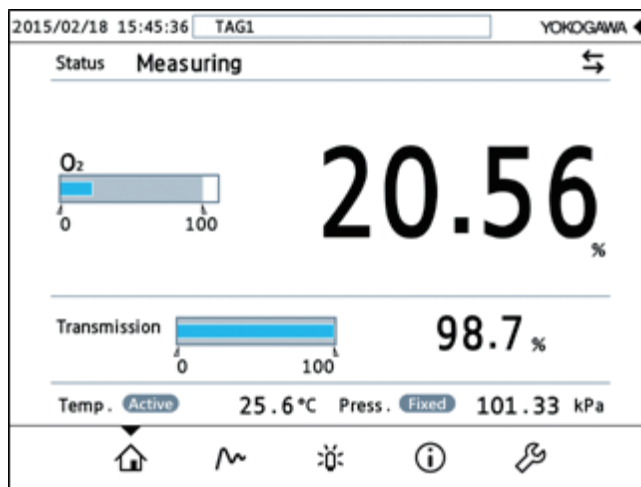


Figure 8.1 Home screen (when a single TDLS8000 is connected)

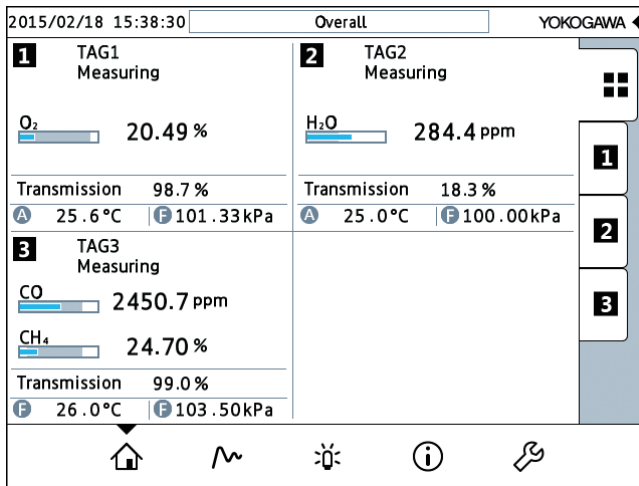


Figure 8.2 Home screen (overall display when three TDLS8000s are connected)

### 8.2.1 Home Screen Display Items

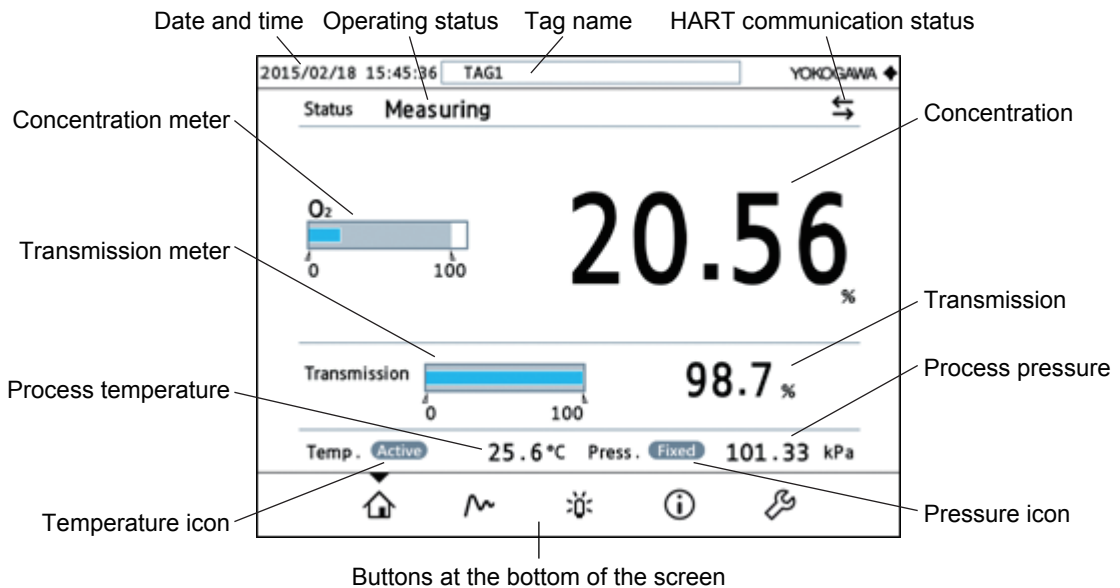


Figure 8.3 Home screen display items

**Date and time**

Shows the date and time set on the TDLS8000.

**Tag**

Shows the TDLS8000 tag name.

If the overall display is shown, “Overall” is displayed.

**Operating status**

Shows the TDLS8000 operating status.

Display	Meaning
Measuring	Measuring (normal operation)
Warm-up	Warming up
Maintenance	Maintenance in progress
Zero Calibration	Zero calibration in progress
Span Calibration	Span calibration in progress
Offline Validation	Offline validation in progress
Online Validation	Online validation in progress

**HART communication in progress**

An icon appears when a HART command is received.

**Concentration**

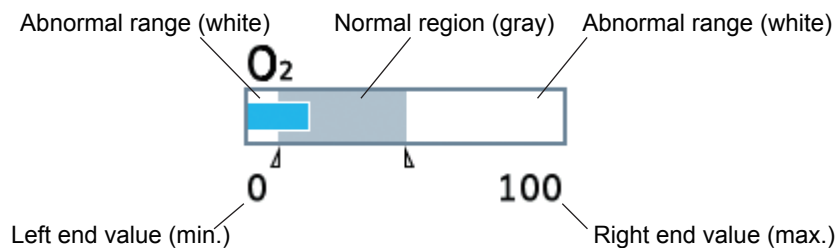
Shows the concentration.

If any of the following alarms are occurring, “\*\*\*\*” is displayed because the concentration cannot be calculated.

Alarm number	Alarm name
49	Detector Signal High
50	Peak Center Out of Range
52	Absorption too High
53	Transmission Lost
56	Outlier Rejection Limit

**Concentration meter**

Shows the concentration with a meter.



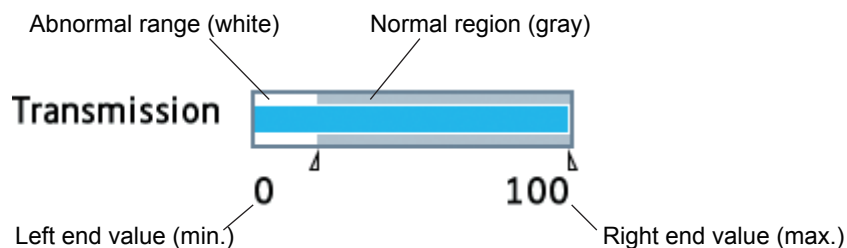
The white area indicates outside the concentration high/low limit alarm range. For details on high/low concentration limit alarm, see “6.6 Process Alarm Settings”. For details on how to set the meter display range, see “8.2.3 Setting the Meter Range”

**Transmission**

Shows the laser beam transmission.

**Transmission meter**

Shows the transmission with a meter.



The white area indicates outside the transmission low limit alarm range. For details on transmission low limit alarm, see “6.6 Process Alarm Settings”. The display range is fixed to 0 to 100% and cannot be changed.



**Process temperature and process pressure**

Shows the process temperature and process pressure.

**Temperature icon and pressure icon**






Shows the process temperature and process pressure input modes.

**Fixed** : Fixed value

**Active** : Non-fixed value

**Buttons at the bottom of the screen**

Selects different screens.

Button	Button name	Description
	Home button	Displays the home screen.
	Trend display button	Displays the trend screen. You can view the measurement trends of multiple TDLS8000s on the same screen.
	Alarm information button	Displays the TDLS8000 alarm screen.
	Configuration display button	Displays the current TDLS8000 settings. The button can also be used to display I/O values, alarm history, and so on.
	Configuration button	Executes TDLS8000 configuration, calibration, and the like. It can also be used to change the YH8000 connection destination, IP settings, and so on.

**8.2.2 Selecting the Style**

There are two home screen display styles: Bar meter and Arc meter. Select the style of your liking. The factory default setting is Bar meter.

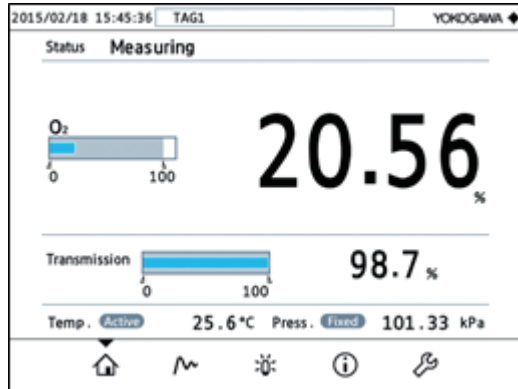
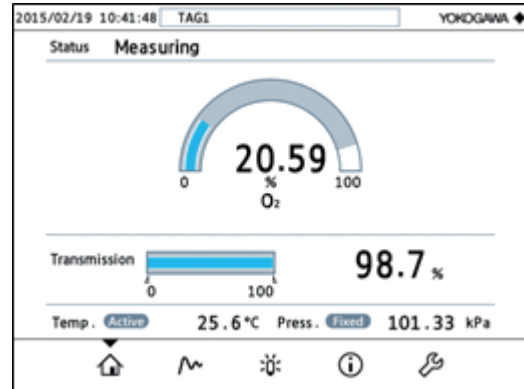



Figure 8.4 Bar meter style



Arc meter style

Configuration menu path:

“ >>HMI>>Display Setting>>Home Style”

**8.2.3 Setting the Meter Range**

You can set the concentration meter display range. The available range and default values are shown in the following table.

	Lower limit	Upper limit	Default value
Left end value (min.)	0% 0ppm	Right end value	0% 0ppm
Right end value (max.)	Left end value	100% 1000000ppm	100% 10000ppm


Configuration menu path:

“ >>HMI>>Display Setting>>Meter Range”

**NOTE**

Changing the meter display range will not change the analog output range of the TDLS8000.

**8.2.4 Alarm Indicator**

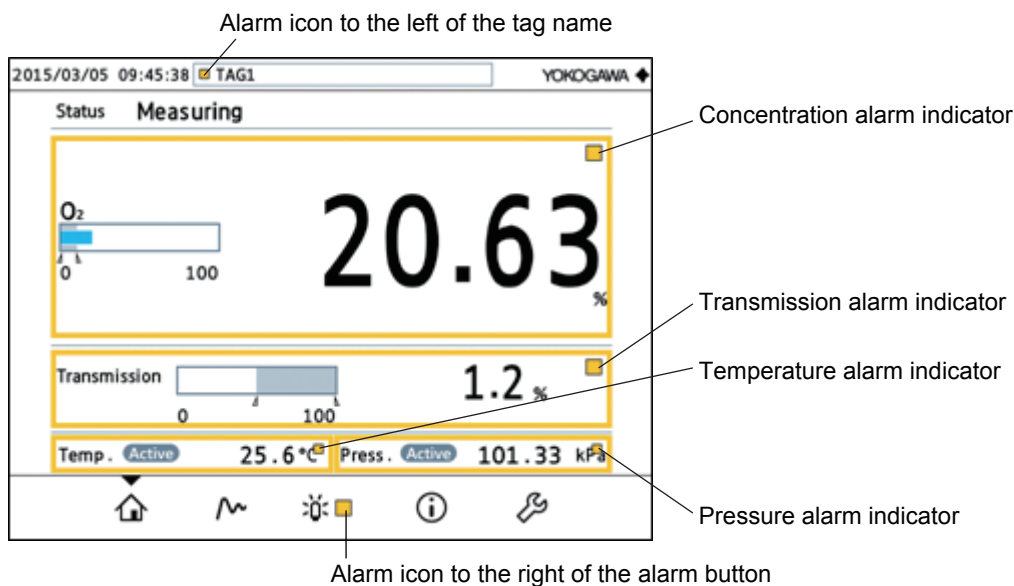
If an alarm is occurring on the TDLS8000, an icon is displayed to the left of the tag name at the top of the screen and to the right of  at the bottom of the screen. Also, the area related to the alarm is enclosed in a frame.

These alarm indicators remain blinking until you check the information on the alarm screen. The indicators also start blinking when a new alarm occurs. If the alarm ceases, the alarm icons disappear.

There are two types of alarm icons: a red icon indicating a fault (occurs when the various types of diagnostic information being monitored by the self-diagnostics function are clearly abnormal and correct concentration calculation is not possible) and a yellow icon indicating a warning (occurs when the various types of diagnostic information being monitored by the self-diagnostics function are outside the normal range).

**Alarm icon types**

Icon	Color	Meaning
	Red	Fault
	Yellow	Warning



**Figure 8.5 Alarm Indicator**

**Alarm icon to the left of the tag name**

Indicates that an alarm is occurring on the applicable TDLS8000.

**Alarm icon to the right of the alarm button**

Indicates that an alarm is occurring on the connected TDLS8000.

### Concentration alarm indicator

Indicates that one of the following alarms has occurred.

Alarm number	Alarm name
6	Concentration Gas1 Low
7	Concentration Gas1 High
8	Concentration Gas2 Low
9	Concentration Gas2 High

### Transmission alarm indicator

Indicates that one of the following alarms has occurred.

Alarm number	Alarm name
1	Transmission Low
53	Transmission Lost

### Temperature alarm indicator

Indicates that one of the following alarms has occurred.


Alarm number	Alarm name
4	Process Temperature Low
5	Process Temperature High

### Pressure alarm indicator

Indicates that one of the following alarms has occurred.

Alarm number	Alarm name
2	Process Pressure Low
3	Process Pressure High

## 8.3 Trend Screen

Tapping  at the bottom of the screen shows the trend screen. The trend screen displays the trend waveforms of four items. The items that can be displayed include concentration, transmission, process temperature, and process pressure.

If there is no connected TDLS8000, switching to the trend screen is not possible.

### 8.3.1 Trend Screen Display Items

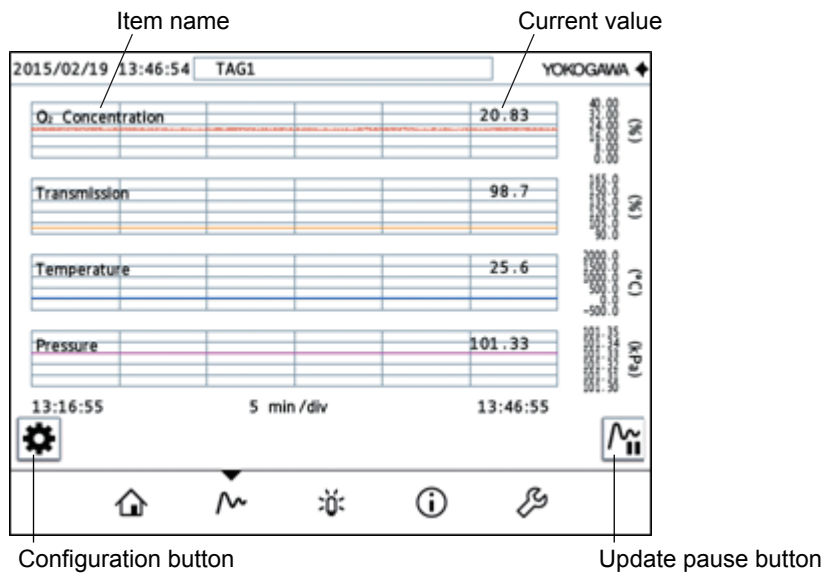


Figure 8.6 Trend Screen

#### Item name

Shows the item of the displayed trend waveform.


If multiple TDLS8000s are connected, analyzer numbers are added in front of item names as shown below.




#### Current value

Shows the current value of the displayed item.

#### Configuration button

Tapping  at the bottom of the screen shows the trend configuration screen.

#### Update pause button

Tapping  pauses the updating of the trend waveforms. Tapping it again resumes the updating.



### 8.3.2 Selecting the Items to Display

Press  on the trend screen to display the trend configuration screen.

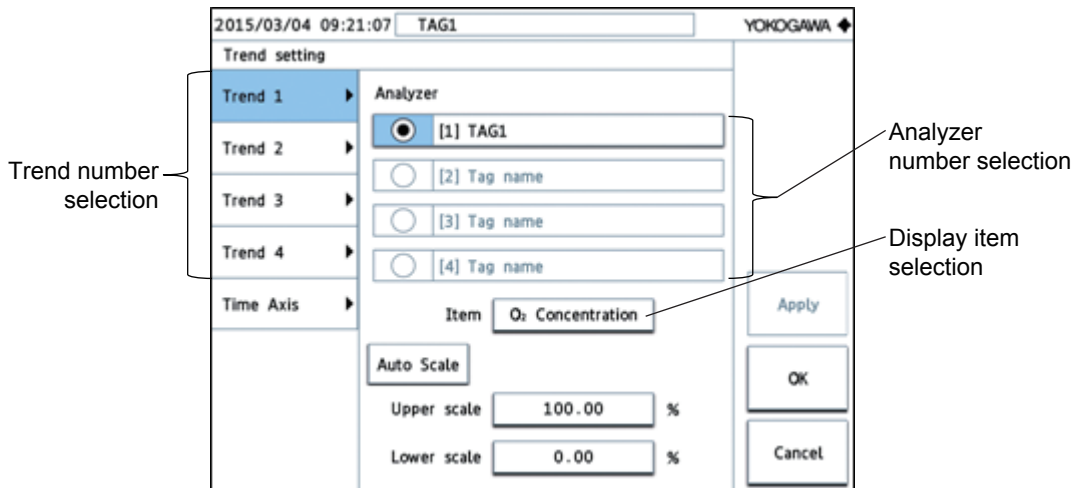


Figure 8.7 Trend configuration screen

- (1) Select the trend number you want to change.
- (2) Select a analyzer number. (When multiple TDLS8000s are connected)
- (3) Select the display item.

You can select from the following display items for the trend waveforms.

**Trend display items**

Available option	Description
Gas1 Concentration	Component 1 gas concentration
Gas1 STDEV	Standard deviation of component 1 gas concentration
Gas2 Concentration	Component 2 gas concentration (selectable only for two-gas measurement)
Gas2 STDEV	Standard deviation of component 2 gas concentration (selectable only for two-gas measurement)
Transmission	Transmission
Temperature	Process temperature
Pressure	Process pressure
None	Nothing

The factory default settings are shown in the following table.

**Factory default display items**

Trend number	Description
Trend 1	Gas1 Concentration
Trend 2	Transmission
Trend 3	Temperature
Trend 4	Pressure

### 8.3.3 Setting the Displayed Time

Press  on the trend screen to display the trend configuration screen.

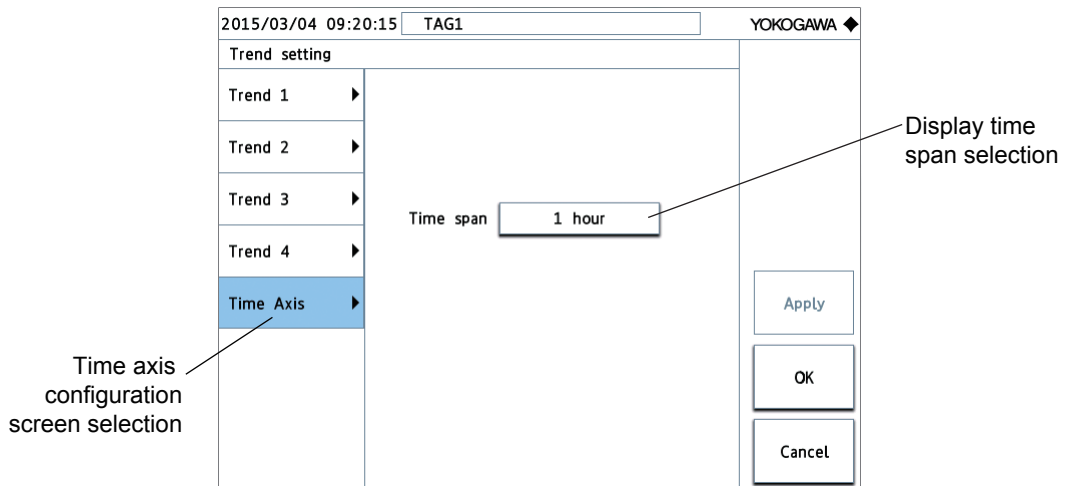


Figure 8.8 Trend time axis configuration screen

- (1) Switch to the time axis configuration screen.
- (2) Set the display time span.

You can select the display time span of the trend graph from the available options in the following table.

#### Trend display items

Available option	Description
1 min	1 minute
3 min	3 minutes
5 min	5 minutes
10 min	10 minutes
30 min	30 minutes
1 hour	1 hour
3 hour	3 hours
6 hour	6 hours
12 hour	12 hours

The factory default setting is 30 min.

### 8.3.4 Setting the Vertical Scale

Press  on the trend screen to display the trend configuration screen.

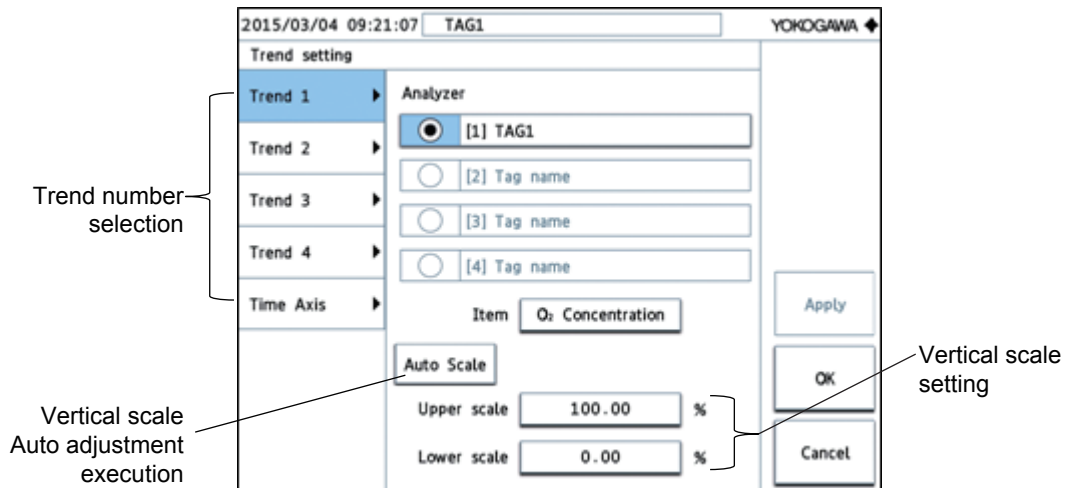




Figure 8.9 Trend configuration screen

- (1) Select the trend number you want to change.
- (2) Tapping Auto Scale automatically sets the most suitable value for that instant.
- (3) To specify the scale manually, set the upper scale and lower scale.

## 8.4 Alarm Screen

Tapping  at the bottom of the screen shows the alarm screen. The alarm screen displays a list of alarms that are currently occurring. For the meanings of alarms and correct actions, see “10. Troubleshooting”.

### NOTE

When multiple TDLS8000s are connected to the YH8000, tapping  displays a TDLS8000 selection screen first. Selecting the target TDLS8000 and touching OK will display the alarm screen of the selected TDLS8000.

For details, see “8.7.2 TDLS8000 Selection Screen”.

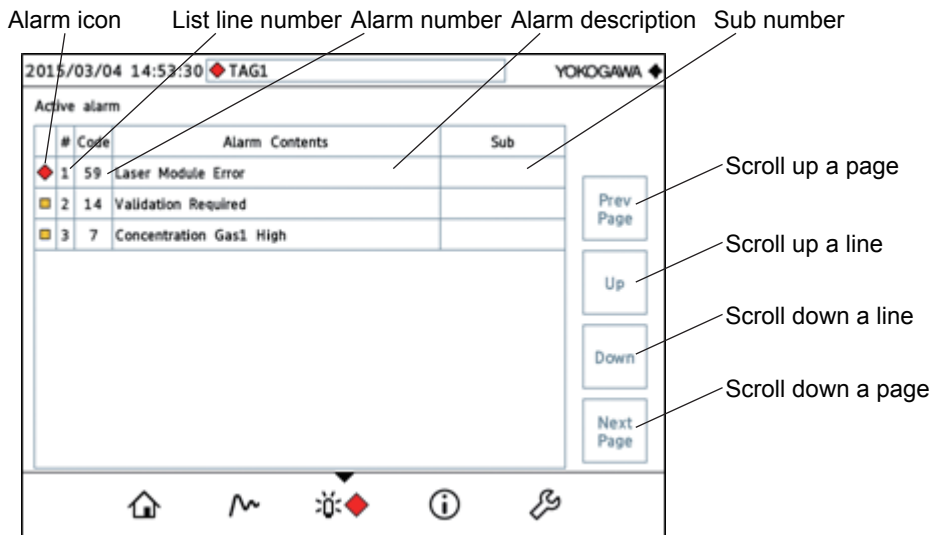



Figure 8.10 Alarm Screen

**NOTE**


The sub number is a number that indicates the details of the alarm. It is a number that Yokogawa service representatives use for troubleshooting.

## 8.5 Information Screen

You can view various types of TDLS8000 information on the information screen.

Tapping  at the bottom of the screen shows the information screen.

**NOTE**

When multiple TDLS8000s are connected to the YH8000, tapping  displays a TDLS8000 selection screen first. Selecting the target TDLS8000 and touching OK will display the information screen of the selected TDLS8000.

For details, see “8.7.2 TDLS8000 Selection Screen”.

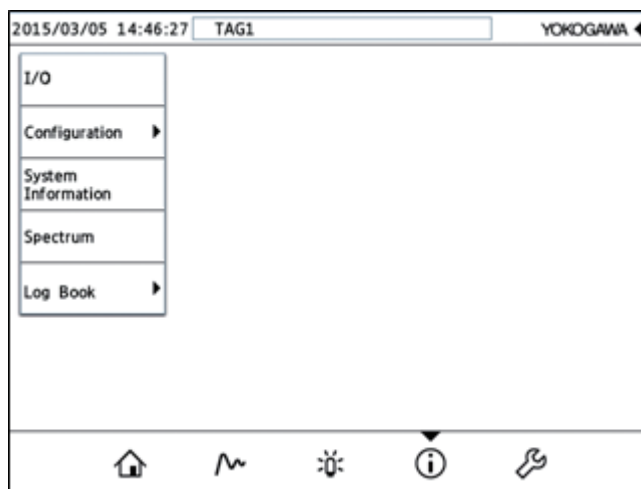



Figure 8.11 Information Screen




### 8.5.1 I/O List Screen

The I/O list screen displays the status of analog I/O, digital I/O, valve control power output, and SCU and LU temperatures. Tapping the I/O button on the  information screen displays the I/O list screen.

2015/03/05 14:53:51		TAG1		YOKOGAWA	
Measurement Result					
O <sub>2</sub> Conc.	20.63	%	Transmission	98.3	%
Analog Output			Digital Output		
AO-1(O <sub>2</sub> Conc.)	12.25	mA	DO-1(WN)	Off	
AO-2(O <sub>2</sub> Conc.)	20.50	mA	DO-2(Fault)	Off	
Analog Input			Digital Input		
AI-1(Pressure)	5.03	mA	DI-1(Disable)	Open	
AI-2(Temperature)	12.35	mA	DI-2(Disable)	Open	
Valve			Temperature		
SV-1	Off		SCU Temp.	32.8	°C
SV-2	Off		LU Temp.	30.1	°C

Figure 8.12 I/O list

### 8.5.2 Configuration View Screen

On the configuration view screen, you can view the TDLS8000 settings. Tapping the Configuration button on the  information screen displays the following menu. For details on the menu tree, see under Configuration in "Appendix 4 YH8000 Menu Tree"

2015/03/05 15:41:45		TAG1		YOKOGAWA	
I/O	I/O	Analog Output	AO-1		
Configuration	Alarm	Analog Input	AO-2		
System Information	Calibration	Digital Output			
Spectrum	Validation	Digital Input			
Log Book	System	Valve Control			
	Analysis				

Figure 8.13 Configuration View Screen

**NOTE**

You cannot change the settings on the configuration view screen. To change them, see "8.6 Configuration Screen".

### 8.5.3 System Information Screen

The system information screen displays the TDLS8000's tag name, serial number, IP address, MAC address, HART device ID, software version, and analysis period and the laser module's serial number. Tapping the System Information button on the ⓘ information screen displays the system information screen.

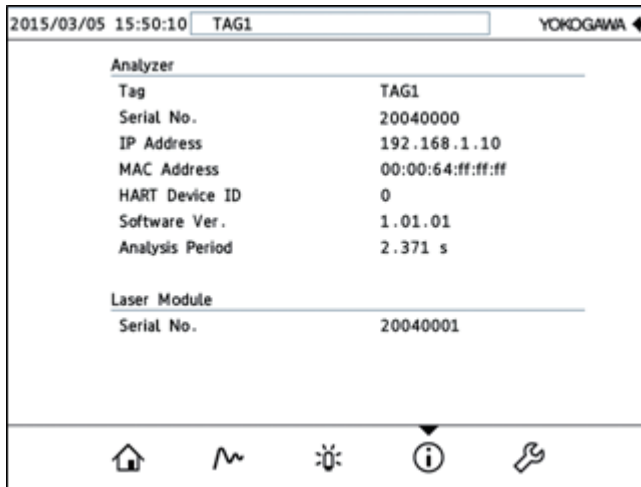


Figure 8.14 System Information Screen

### 8.5.4 Spectrum Screen

The spectrum screen displays the spectrum being measured. Tapping the Spectrum button on the ⓘ information screen displays the spectrum screen.

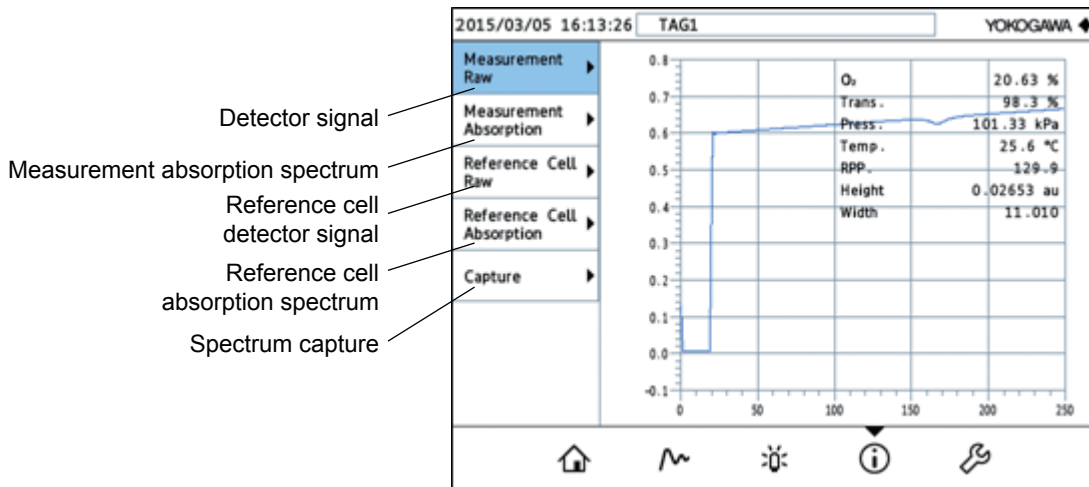


Figure 8.15 Spectrum Screen

#### Detector signal

Shows the detector signal on the measured gas side.

#### Measurement absorption spectrum

Shows the absorption spectrum of the measured gas.

#### Reference cell detector signal

Shows the detector signal of the reference cell. This can be shown only on a TDLS8000 with a valid reference cell.

**Reference cell absorption spectrum**

Shows the absorption spectrum of the reference cell. This can be shown only on a TDLS8000 with a valid reference cell.


**Spectrum capture**

Records spectrum waveform data to the TDLS8000 internal storage. Do not use this under normal circumstances. Use it only if you receive a request from your Yokogawa service representative.

**NOTE**

The spectrum screen is used by Yokogawa service representatives for troubleshooting purposes. You may be asked to check this screen depending on the situation. In such a case, please operate the screen according to their instructions.

**8.5.5 Alarm History Screen**

The alarm history screen can be used to check alarms and messages that occurred in the past. Tapping Log Book on the  information screen and then Alarm History displays the alarm history screen.

The maximum number of history events that you can view on the YH8000 is 99. For details on alarms, see “10. Troubleshooting”. For details on messages, see “9.12 Alarm History”.

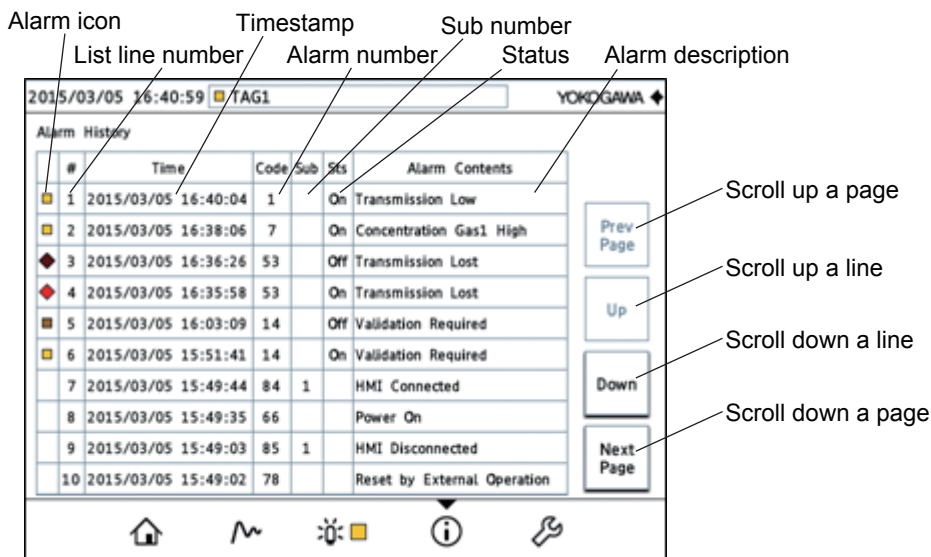


Figure 8.16 Alarm History Screen

**Alarm icon**

Nothing is displayed for messages. While the alarm is active, the icon appears bright. When the alarm is cleared, the icon changes to a dark indication.

**Status**

“On” is displayed when the alarm is active, and “Off” when it is cleared.

### 8.5.6 Cal/Val History Screen

The Cal/Val history screen can be used to view the results of calibrations and validations that have been executed in the past. Tapping Log Book on the ⓘ information screen and then Cal/Val History displays the Cal/Val history screen.

The maximum number of history events that you can view on the YH8000 is 99.

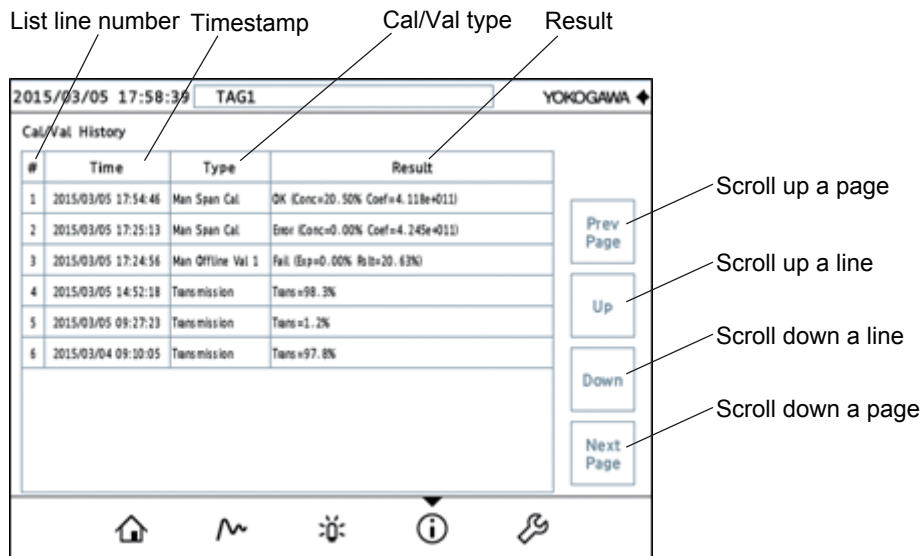


Figure 8.17 Cal/Val History Screen


The result column displays the following information depending on the Cal/Val type.

**Information displayed in Cal/Val history**

Cal/Val type	Result
Man Zero Cal Auto Zero Cal	Successful: OK Unsuccessful: (Max Absorption=<maximum absorption> Error
Man Span Cal Auto Span Cal	Successful: OK Unsuccessful: (Conc=<calibration gas concentration>Coef=<calibration coefficient after calibration> Error
Man Offline Val Auto Offline Val Man Online Val Auto Online Val	Pass Fail (Exp=<expected concentration>Rslt=<actual concentration>)
Transmission	Trans=<transmission after calibration>
Zero Cal Restored	Restored to factory default settings: By Factory data Restored to previous settings: By Previous data
Span Cal Restored	Restored to factory default settings: By Factory data Restored to previous settings: By Previous data

## 8.6 Configuration Screen

The configuration screen is used to configure the TDLS8000 and YH8000.

Tapping  at the bottom of the screen shows the setup target selection screen.

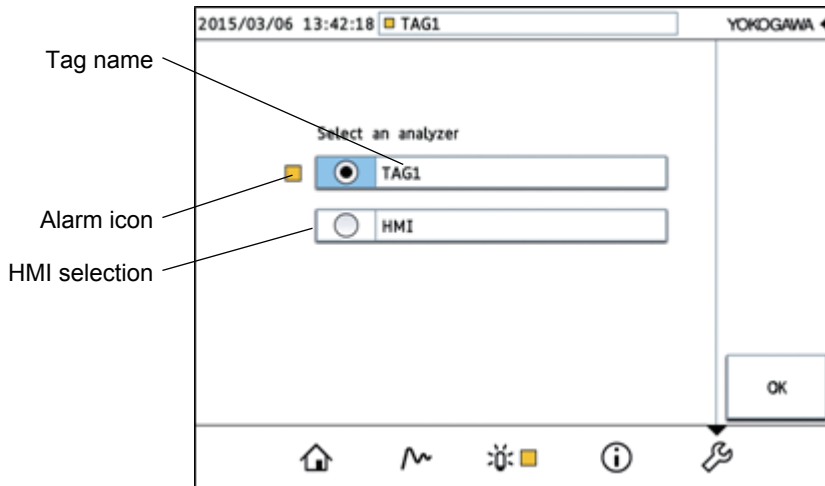





Figure 8.18 Setup target selection screen (when a single TDLS8000 is connected)

### Tag name

Shows the tag names assigned to each TDLS8000. Serial numbers are displayed if tag names are not assigned.

### Alarm icon

If an alarm is occurring on the TDLS8000, an alarm icon is displayed. If both a warning  and a fault  are occurring, the fault icon  is displayed.

### HMI selection

To switch to the YH8000 configuration screen, select the HMI option.

### 8.6.1 TDLS8000 configuration screen

After selecting a TDLS8000 on the setup target selection screen, tap OK. A password input screen will appear.

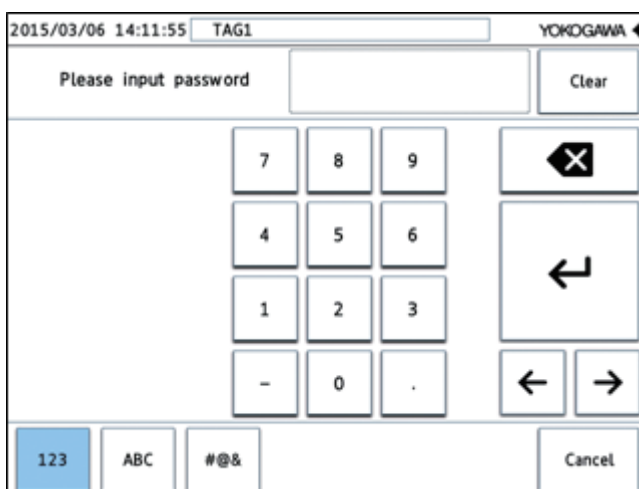


Figure 8.19 Password input screen


Enter the password on the password input screen, and tap  to display the TDLS8000 configuration screen.



Figure 8.20 TDLS8000 configuration screen

**Execution menu**

The execution operation screens for calibration, validation, loop check, and the like are under this menu.

**Configuration menu**

Various settings are under this menu.

The TDLS8000 configuration screen is arranged a menu tree structure.

- For the menu structure, see “Appendix 4 YH8000 Menu Tree”.
- For details on various settings, see “6. Configuration”.
- For details on calibration and validation, see “9. Inspection and Maintenance”
- For details on loop check, see “5.4 Loop Check (Simulation output)”.

**NOTE**

TDLS8000 status

When you switch to the TDLS8000 configuration screen, the TDLS8000 status is set to “in maintenance.” While in maintenance, the TDLS8000 cannot be configured from other YH8000s or HART. Tap any of the buttons at the bottom of the screen to exit from the TDLS8000 configuration screen. When you exit from the configuration screen, “in maintenance” is cleared. “In maintenance” is also cleared when the connection to the TDLS8000 is disconnected.

**NOTE**

Password

The factory default password for switching to the TDLS8000 configuration screen is “1234.” You can change the password on the following configuration screen.

 >>[Analyzer]>>Configuration>>System>>Password”

For the password, you can set a character string consisting of one to eight characters of your choice.

Keep the password in a safe place.

**NOTE**

If you forget the password

If you forget the password, contact your nearest Yokogawa representative.

If you can use a HART configuration tool, you can initialize the user information to reset the password to the factory default setting. However, other settings will also be initialized. For details, see “6.11.1 Initialization Procedure”.

**8.6.2 YH8000 Configuration Screen**

After selecting an HMI on the setup target selection screen, tap OK to display a YH8000 configuration screen. If there is no connected TDLS8000, only the YH8000 configuration screen will be displayed.

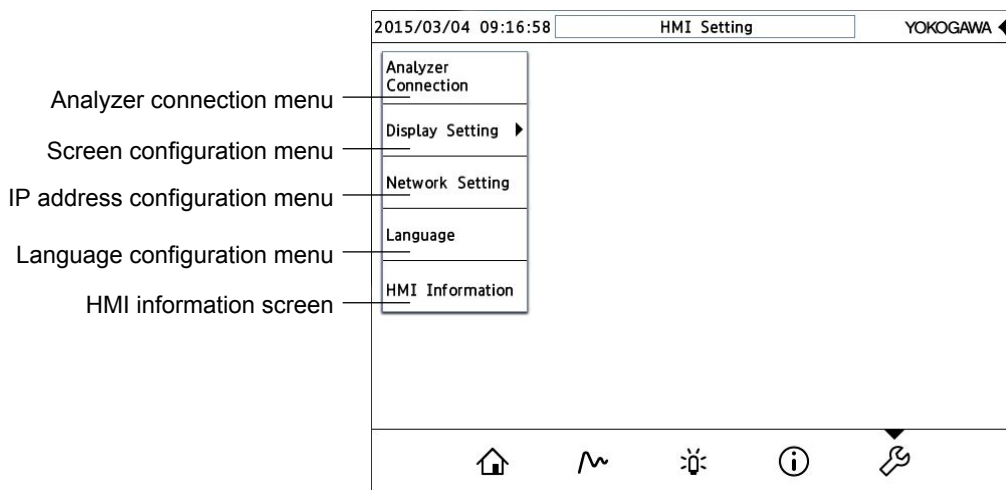


Figure 8.21 YH8000 (HMI) configuration screen

**Analyzer connection menu**

Switches to the TDLS8000 selection screen. For details, see “5.2.3 Connecting to the TDLS8000”

**Screen configuration menu**

Switches to the configuration screen for setting the home screen display style, meter range, and backlight. For the display styles, see “8.2.2 Selecting the Style”. For the meter range, see “8.2.3 Setting the Meter Range”. For backlight settings, see “8.6.3 Setting the YH8000 Backlight”.

**IP address configuration menu**

Switches to the YH8000 IP address configuration screen. For details, see “5.2.2 Setting the IP Address”.

**Language configuration menu**

Shows the language displayed on the YH8000.

**HMI information screen**

Shows the YH8000 IP address, MAC address, and software version.

### 8.6.3 Setting the YH8000 Backlight

This section explains how to set the brightness of the YH8000 backlight and the auto-off function.

Configuration menu path:

“ >>HMI>>Display Setting>>Backlight”

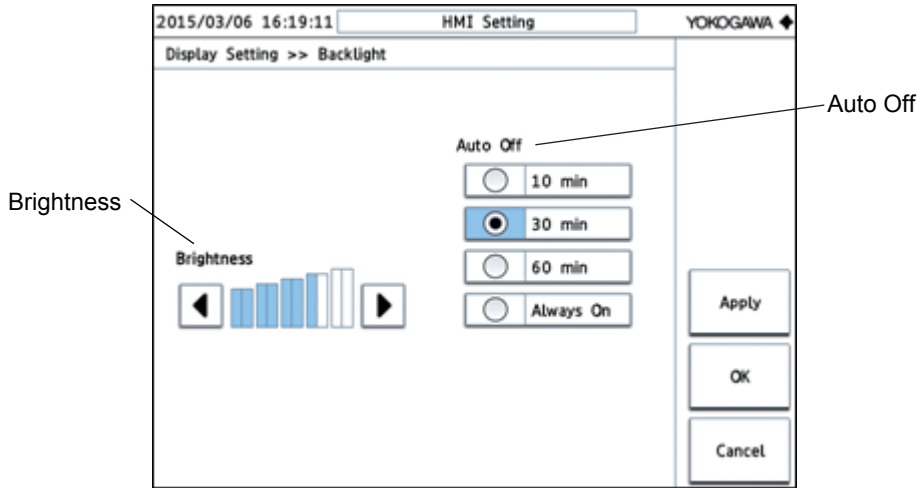


Figure 8.22 YH8000 backlight configuration screen

#### Brightness

You can set the backlight brightness using 11 levels. By factory default, the brightness is set to the highest level.

#### Auto Off

The backlight automatically turns off after a certain time of no YH8000 touch panel activity. You can set the auto-off time to any of the options in the following table.

#### Backlight auto-off time

Available option	Description
10 min	Turns off after 10 minutes of no activity
30 min	Turns off after 30 minutes of no activity
60 min	Turns off after 60 minutes of no activity
Always On	Disables the auto-off function (always on)



## 8.7 When Multiple TDLS8000s Are Connected

When multiple TDLS8000s are connected to the YH8000, a portion of the display and operation is different. This section explains the difference.

### 8.7.1 Overall Display

When multiple TDLS8000s are connected, the information of all the TDLS8000s can be collectively displayed on the home screen. This is called the *overall display*.

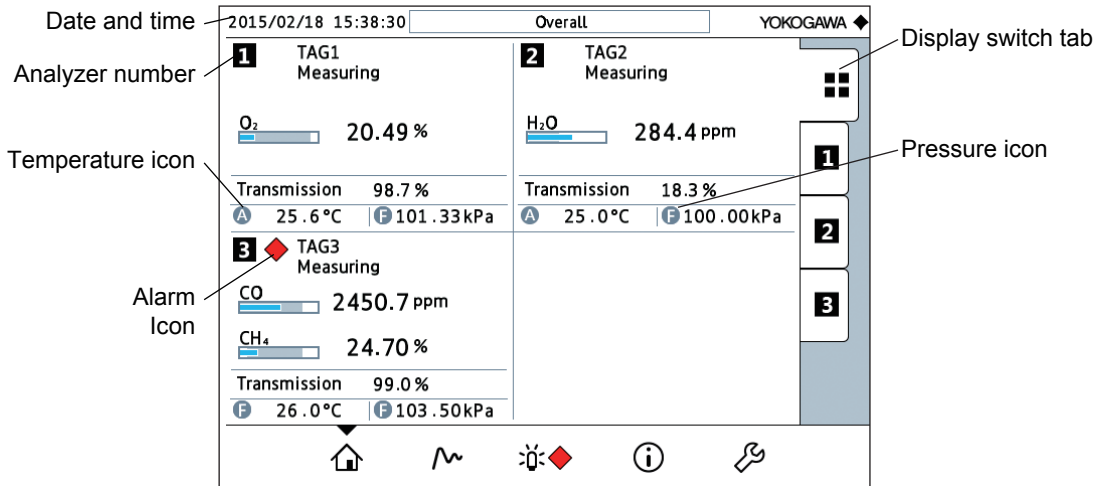


Figure 8.23 Overall display (when three TDLS8000s are connected)

#### Date and time




On the overall display, the time of the TDLS8000 with the smallest analyzer number is shown.

#### Analyzer number


Shows analyzer numbers 1 to 4.

Analyzer numbers are assigned using the YH8000 analyzer connection settings. For details, see “5.2 Connecting to the YH8000”.

#### Alarm icon

If an alarm is occurring on the TDLS8000, an alarm icon is displayed. If both a warning  and a fault  are occurring, the fault icon  is displayed.

#### Display switch tab

Selects the TDLS8000 to be displayed. Selecting  shows the overall display.

#### Temperature icon and pressure icon

Shows the process temperature and process pressure mode settings.

 : Fixed value

 : Non-fixed value

### 8.7.2 TDLS8000 Selection Screen

When multiple TDLS8000s are connected, a TDLS8000 selection screen appears when switching to the alarm screen or information screen. Selecting the target TDLS8000 and touching OK will display the alarm screen or information screen of the selected TDLS8000.

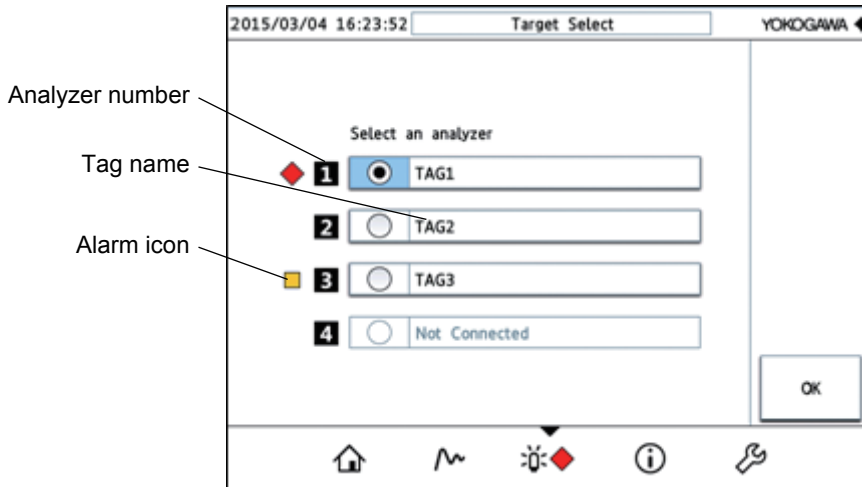


Figure 8.24 TDLS8000 selection screen (when three TDLS8000 are connected)




#### Analyzer number

Shows analyzer numbers 1 to 4.

#### Tag name

Shows the tag names assigned to each TDLS8000. Serial numbers are displayed if tag names are not assigned.

#### Alarm icon

If an alarm is occurring on the TDLS8000, an alarm icon is displayed. If both a warning  and a fault  are occurring, the fault icon  is displayed.

When multiple TDLS8000s are connected, the connected TDLS8000s are shown on the setup target selection screen when switching to the configuration screen. Selecting the target TDLS8000 and touching OK will display the password input screen of the selected TDLS8000.

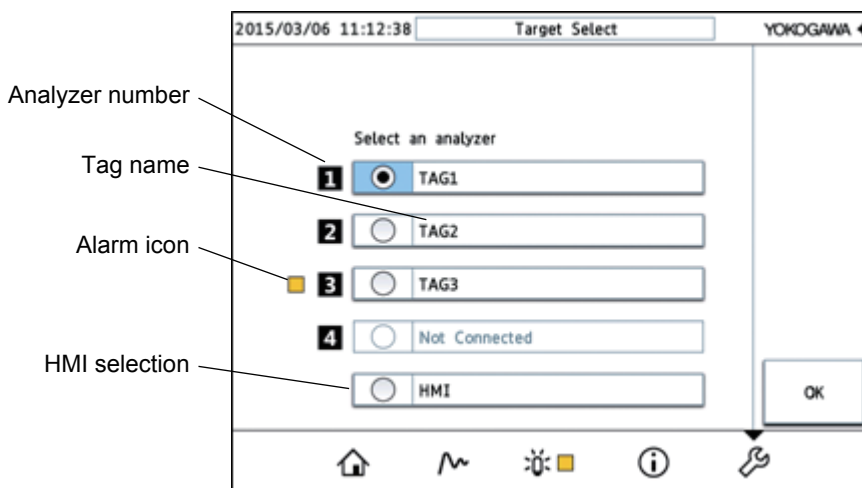


Figure 8.25 Setup target selection screen (when three TDLS8000 are connected)




#### Analyzer number

Shows analyzer numbers 1 to 4.

**Tag name**

Shows the tag names assigned to each TDLS8000. Serial numbers are displayed if tag names are not assigned.

**Alarm icon**

If an alarm is occurring on the TDLS8000, an alarm icon is displayed. If both a warning  and a fault  are occurring, the fault icon  is displayed.

**HMI selection**


To switch to the YH8000 configuration screen, select the HMI option.

### 8.7.3 Setting the Date and Time on the TDLS8000

If multiple TDLS8000s are connected, the following function can be used when setting the TDLS8000 clocks.

- Change all analyzer  
You can collectively set the clocks on all connected TDLS8000s.
- Time synchronization  
You can synchronize the clocks of other connected TDLS8000s with the clock of the TDLS8000 that you are currently configuring.

Configuration menu path:

 >> [Analyzer] >> Configuration >> System >> Date&Time >> Operation”

**NOTE**

The collective setting of the clocks and synchronization of the clocks do not completely synchronize the TDLS8000 clocks. Even when these functions are used, the clocks may be off by a few seconds. The clocks may drift even further as time passes.

## 8.8 Software version

The table below shows the valid combination between each version of softwares of YH8000 and TDLS8000. Check the validity of the combination and prepare appropriate version of softwares when you did not purchase YH8000 and TDLS8000 both together at a time.

		YH8000		
		1.01.xx	1.02.xx	2.01.xx
TDLS8000	1.01.xx	Can be used with the previous alarm specifications.	A portion of the alarms will not be displayed correctly.	A portion of the alarms will not be displayed correctly.
	1.02.xx	A portion of the alarms will not be displayed correctly.	Can be used correctly.	Can be used correctly.
	2.01.xx	Cannot be connected.	Cannot be connected.	Can be used correctly.

If the software version of either device is old, update the old version to the new version. For details on software updating, contact your nearest Yokogawa representative.



# 9. Inspection and Maintenance



## CAUTION

If you need to remove the TDLS8000 from the process flange for inspection or maintenance, be sure to turn off the power beforehand.

Work performed by an unqualified engineer can cause injury or severe damage to instruments. Not following the warnings in this manual can also cause injury or severe damage to instruments.

Make sure that maintenance is carried out by a qualified engineer. A qualified engineer is an engineer who:

- Is knowledgeable about the safe handling of process analysis instruments (or general automation technology) and has read and understood the content of this manual.
- Has received instructions on how to start and configure instruments and has read and understood the content of this manual.

This chapter explains inspection and maintenance to retain the measurement performance of the TDLS8000.

There are no operations that need to be performed regularly on the TDLS8000.

When the laser beam transmission decreases, clean the process window.

## 9.1 Maintaining the Laser Beam and Transmission

Transmission is a value determined by the magnitude of laser power that reaches the photo detector in the sensor control unit (SCU) after the laser beam emitted from the laser element of the LU passes through the gas to be measured. Transmission is used to verify aging after the optical axis is adjusted. As startup, adjust the optical axis correctly, perform transmission calibration, and set the transmission value to 100%.

By checking the variation in the transmission after startup, you can determine the state of the region that the laser beam travels through, the degree of optical axis misalignment between the LU and SCU, and the states of the laser beam emitting and receiving components. This information is important for maintenance and troubleshooting.

Generally, the transmission degrades due to the conditions shown below.

To maintain normal TDLS8000 operation, perform the required inspection and maintenance to prevent the transmission from degrading. To maximize the TDLS8000 performance, it is particularly important to optimally adjust the optical axis and keep the process window clean.

### ● Stained process window

If the process window is stained, the laser beam will be blocked causing the amount of laser beam reaching the photo detector to decrease. Perform process window purge continuously to prevent stains from adhering to the process window. See 3.4 Piping.

### ● Particles (dust and the like) in the process

Particles in the process gas block the laser beam causing the amount of laser beam reaching the photo detector to decrease. For measurement locations (applications) with high level of particles in the process, take measures such as installing insertion tubes as described in 3.1.3 Attaching the TDLS8000 to the Process Flange in addition to process window purging.

- **LU and SCU optical axis misalignment**

With a duct or flue with thin and easily bent walls, optical axis misalignment will occur between the LU and SCU after the TDLS8000 is installed, degrading transmission. Refer to 3.1.2 Constructing Process Flanges, and check the construction of the installation location. Also, in applications that measure the gas concentration in high temperature gas, bending caused by heat during processing may cause the optical axis to become misaligned. If this happens, refer to 3.3 Optical Axis Adjustment, and readjust the optical axis to the correct alignment.

- **Optical axis adjustment of the LU and SCU after removing alignment flanges**

If you remove alignment flanges to perform inspection and maintenance, be sure to perform optical axis adjustment according to 3. Installation, Wiring, Optical Axis Adjustment, and Piping and 3.3 Optical Axis Adjustment when you reinstall the LU and SCU in the measurement location.

## 9.1.1 Transmission Calibration


After reinstalling the TDLS8000 in the measurement location and performing optical axis adjustment according to 3.3 Optical Axis Adjustment, perform transmission calibration.

### NOTE

Optimum transmission may not be attainable if the optical axis is not adjusted correctly. Refer to 3.3 Optical Axis Adjustment, and perform optical axis adjustment correctly.

Execution menu path:

[HART] “Diagnosis/Service>>Transmission adjust>>Transmission adjust”

[YH8000]  >>Execution>>Transmission Adjustment>>Measurement>>Transmission Adjustment”

## 9.1.2 Process Window Cleaning

Under normal operation, if process window purge is performed correctly, the surface of the process window rarely become stained. However, the surface of the process window may become stained or clouded under the following conditions.

- If the gas to be measured including dust or stain makes contact with the process window due to insufficient process window purge flow rate or purge gas pressure.
- If the surface of the process window condenses when the process window is hot
- If gas that would cause quality deterioration in the process window (e.g., hydrogen fluoride on BK-7) makes contact with the window
- If particles, oil, and the like from the purge gas facility adheres to the surface of the process window

If the surface of the process window is stained, remove and clean the process window according to the following procedure.

### CAUTION

Before removing the process window, check that the process is completely stopped or that the process is isolated from open air and no process gas will be discharged.

### CAUTION

Be careful in handling the process window as it is made of optical glass that is easily damaged.

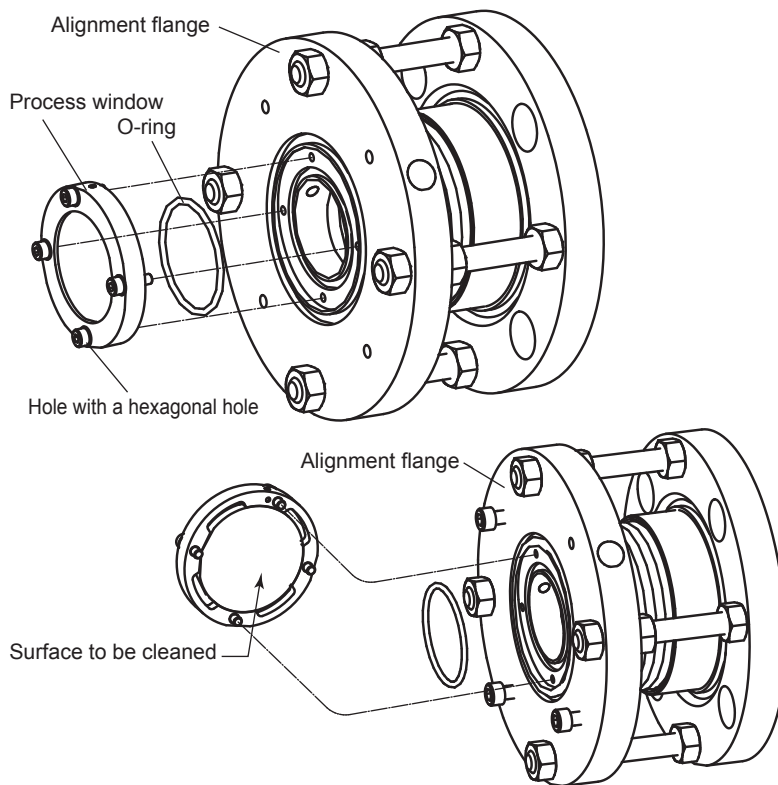
- (1) Turn off the TDLS8000.
- (2) Remove the TDLS8000 from the process.  
(If necessary, separate it completely from the process such as by using a process isolation valve.)
- (3) Check the stained area of the process window, and remove the relevant process window. Process windows are installed in alignment flanges, process isolation flanges, flow cells, and the like.
- (4) Loosen the four M4 screws with hexagonal holes on the process window holder installed in the alignment flange, and remove the process window.  
For details on how to install and remove the process window, see Figures 9.1 to 9.3.
- (5) Using clean and dry instrumental air or nitrogen gas, blow off the particles from the surface of the process window.
- (6) Using warm water and low irritative cleansing agent, gently wipe the surface of the process window with a soft cloth, being careful not to scratch it. Then, if necessary, clean with alcohol (e.g., isopropyl alcohol).
- (7) Blow clean and dry instrumental air or nitrogen gas again on the surface to dry it.
- (8) Thoroughly examine the surface of the process window from various angles, and check that the stain has been sufficiently removed and that the process window is ready for use.

## NOTE

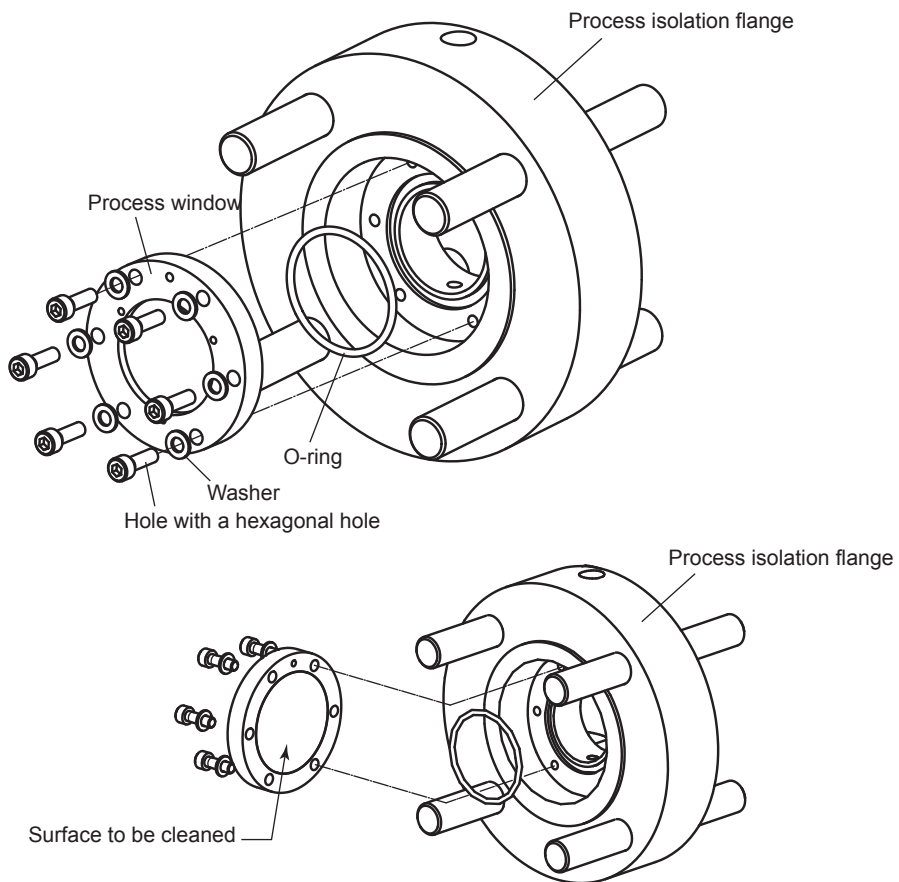
If you cannot remove the stain from the surface of the process window, replace with a new one. If the surface of the process window is corroded, it may have been contaminated with corrosive gas such as hydrogen fluoride. In such a case, replace the process window with a new one.

- (8) Install the cleaned process window (or a new one).  
Pay attention to the orientation of the process window. Install it in the same orientation as before.  
Tighten the screws evenly.
- (9) After installing the process window, install the TDLS8000 for use.  
If you removed an alignment flange from the process in order to clean the process window of a process isolation flange or if you removed an alignment flange from a flow cell to clean the process window of the flow cell, after installing the alignment flange, readjust the optical axis before use.

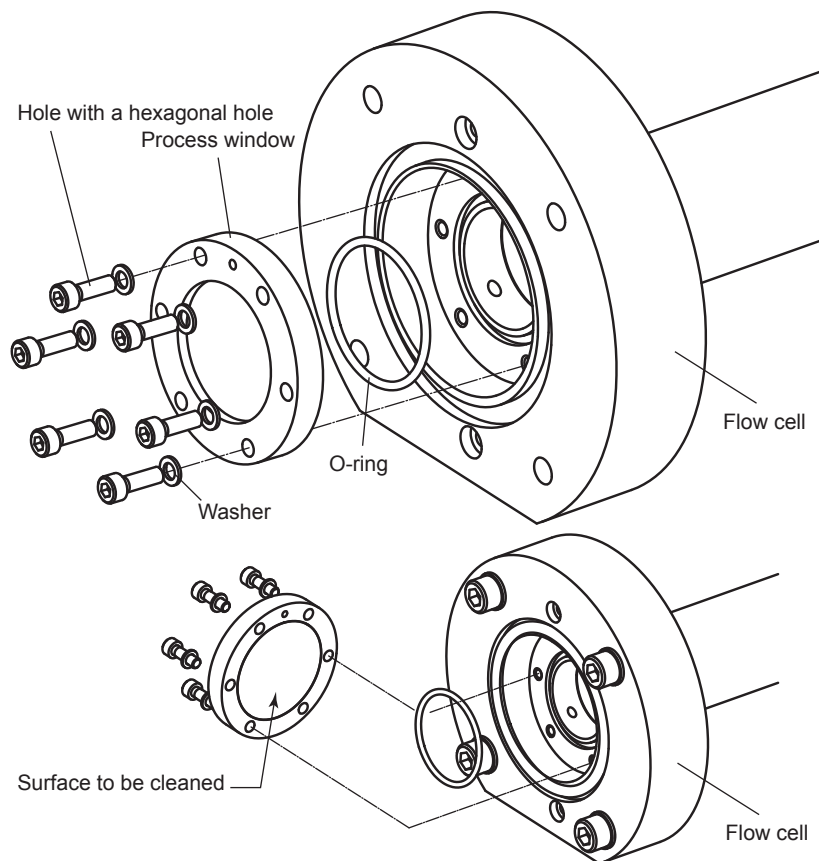




**Figure 9.1** Removing and installing the process window of an alignment flange



**Figure 9.2** Removing and installing the process window of a process isolation flange



**Figure 9.3** Removing and installing the process window of a flow cell

### 9.1.3 Insertion Tube Cleaning

Since insertion tubes are used in a process where there is a lot of dust, long-term use can cause dust or the like to accumulate inside the tubes at the tip. Regularly clean insertion tubes.

The cleaning procedure is as follows.

- (1) Turn off the TDLS8000.
- (2) Turn off the process window purge gas.
- (3) Remove the TDLS8000.
- (4) Remove the process interface (alignment flange or process isolation flange (if installed)).
- (5) Remove the insertion tube.
- (6) Remove the dust or the like that has accumulated inside the insertion tube at the tip. If necessary, clean with a cleansing agent or the like.
- (7) Install the insertion tube.
- (8) Install the process interface (alignment flange or process isolation flange (if installed)).
- (9) Install the TDLS8000, and turn on the power.
- (10) Adjust the optical axis.

## 9.2 Online Validation

Online validation is performed by purging a validation cell with check gas of known concentration while measuring the concentration of the measured gas under stable measured gas concentration conditions. The conditions that are controlled (or known) when purging with check gas are as follows.

- Pressure of the purge check gas
- Temperature of the purge check gas
- Length of the validation cell purged with check gas
- Concentration of the purge check gas

The basic procedure is shown below.

- Set known validation parameters.
- Purge the validation cell with check gas of known concentration.  
=> The result of "Process concentration" + "additional concentration from the check gas" is recorded in the TDLS8000.
- Purge the validation cell again with the original purge gas (typically nitrogen gas).  
=> "Process concentration" is recorded in the TDLS8000.  
=> The expected value for the "additional concentration from the check gas" is calculated from the known parameters.  
=> The expected value and the actual value are compared and validated (pass or fail).

### NOTE

Perform the online validation when the process is sufficiently stable. The longer the process optical path length or validation optical path length is, the more online validation is influenced by fluctuation of process gas concentration. Online validation may not be available in the following conditions. (Consult YOKOGAWA.)

- Process optical path is longer than 6 m in a model of Division 2, Zone 2: Nonincendive/Type n or general purpose.
- Process optical path is longer than 4 m in a model of Zone 1/Div 1/Flameproof "d".
- When "/D" Diverging Beam without LAO is specified as an option code.

### NOTE

Validation is a procedure to check whether the TDLS8000 is operating properly. If there is a reading error as a result of validation, check that there is no gas leak from the process. If no gas leak is confirmed, perform calibration.

### 9.2.1 Preparation

In online validation, a validation cell is purged with check gas. There are two check gas piping methods.

- When there is no process gas switching  
Up to two check gases are connected for online validation 1 and online validation 2 (Figure 9.4).
- When there is process gas switching  
A single check gas is connected for online validation 2. The remaining stream is used to switch between two process gases (Figure 9.5).

**NOTE**

If you want to switch the check gas stream through automatic valve control using the TDLS8000 SV terminal, you need to set the TDLS8000 valve usage according to the piping method as shown in the following table. For details on valve usage, see 6.8.2 Valve Usage Setting.

Piping	Valve usage setting
When there is no process gas switching	Cal/Val
When there is process gas switching	2 Streams & Cal/Val

Online validation piping diagram is shown below.

When using the type of Zone1/Div1/Flameproof “d” see 3.4.3 Purge Gas Piping for Explosionproof/Flameproof type

● **When there is no process gas switching**

Connect up to two types of online validation check gas. Execute online validation 1 or 2 to validate using the respective check gas. If you want to control valves automatically through the SV terminal, you need to set the valve usage to Cal/Val.

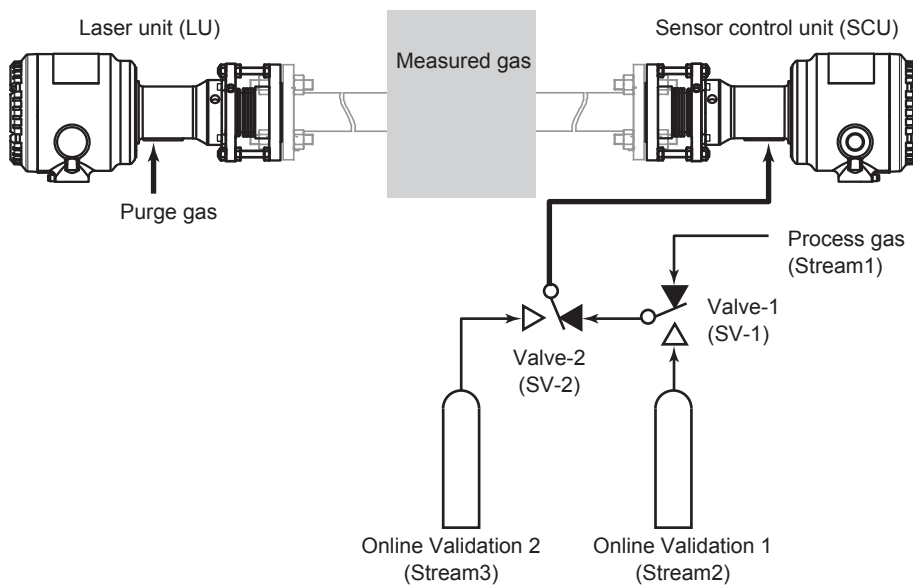


Figure 9.4 Online validation piping diagram for when there is no process gas switching

● **When there is process gas switching**

Connect two types of process gas and a single type of online validation gas. The process gas concentration affects the results of online validation. As such, switch to the process gas to be validated, and then start the validation.

If you want to control valves automatically through the SV terminal, you need to set the valve usage to 2 Streams & Cal/Val. Only online validation 2 can be executed.

**NOTE**

To automatically control valves in this arrangement, set the current stream to the same stream as the initial stream before starting validation. For example, if the initial stream is Stream1, switch to Stream1, and then start validation. Do not switch to Stream2 until the validation is finished.

The piping diagram for when the valve usage is 2 Streams & Cal/Val is shown in Figure 9.5.

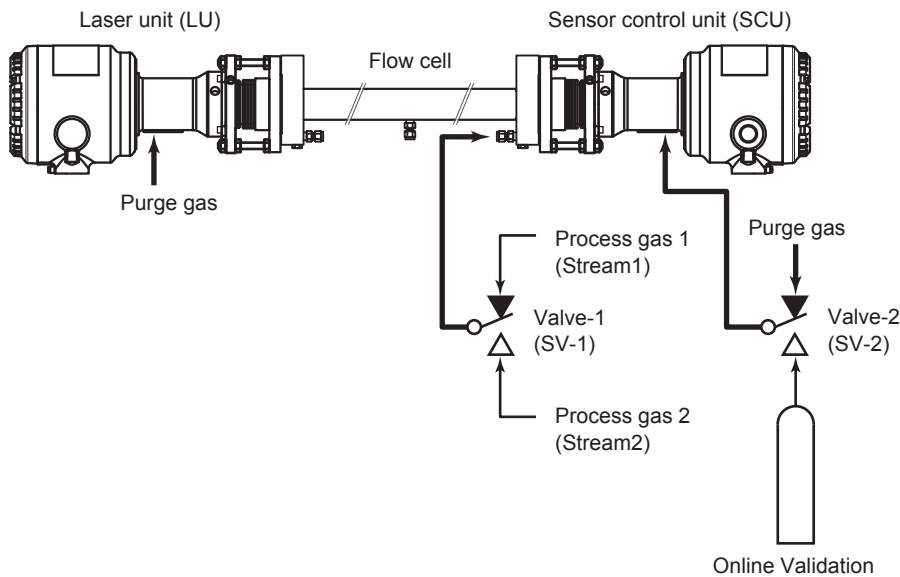


Figure 9.5 Online validation piping diagram for when there is process gas switching

## 9.2.2 Configuration8

Online validation configuration menu:

[HART] “Detailed setup>>Validation>>Online Validation #”

[YH8000] “ >>Configuration>>Validation>>Online Validation #”

The setup parameters required to manually execute online validation are indicated for each of the above submenus (tabs on the YH8000). Here, online validation 1 will be used as an example.

### ● Parameter

Parameter name (HART)	Parameter name (YH8000)	Description
Onval1 gas type	Gas type	Selects the type of validation 1 check gas (two-gas measurement only)
Onval1 gas conc	Concentration	Enters the concentration of the validation 1 check gas
Onval1 temp mode	Temperature	Selects the temperature mode for validation 1 execution
Onval1 temp fix val	Fixed Value	Enters the temperature for when Onval1 temp mode is set to Fixed
Onval1 act amb ofst	Offset Value	Enters the temperature offset for when Onval1 temp mode is set to Active ambient
Onval1 pres fix val	Pressure	Enters the pressure value for validation 1 execution
Onval1 OPL fix val	OPL	Enters the optical path length of the region purged with validation 1 check gas (*1)

\*1: The process optical path length of online validation is determined by the TDLS8000 model and code as shown below.

<Optical length at online validation>

See Figure 6.2, where A (on SCU side) shows the optical path length at validation, when using a model of Division 2, Zone 2: Nonincendive/Type n or general purpose. The optical path length is A+A' when using with validation area on LU side.

Model name and code			A (mm)	A' (mm)
Model	Type	Gas parameter	LU side	SCU side
TDLS8000	-G1	-X1	149.8	130.6
	-G2	-X2		
	-GQ	-C1		
	-GR	-C3	72.2	92.6
	-D2	-C4		
	-C2	-A1		
	-S2			
	-E2			
	-K2			
	-N2			
	-Q2			
	-R2			
	-J2			

In Figure 6.2, A2 (on SCU side) + A'2 (on LU side) shows the optical path length at validation, when using a type of Zone1/Div1/Flameproof "d". The area A1 or A'1 cannot be used as validation area because of the explosionproof construction. See also 3.4.3 Purge Gas Piping for Explosionproof/Flameproof type

Model name and code			A2+A'2(mm)
Model	Type	Gas parameter	
TDLS8000	-D1	-X1	75.8
	-C1	-X2	
	-S1	-C1	
	-E1	-C3	
	-J1	-C4	
	-Q1	-A1	
	-R1		

● Valve

Parameter name (HART)	Description
Onval1 auto vlv man	Selects whether to enable automatic valve control through the SV terminal during manual validation 1 execution.
Onval1 gas purg time	For automatic execution. Set these when performing automatic execution (see section 9.8.2).
Onval1 nml purg time	

● Auto time

For automatic execution. Set this when performing automatic execution (see 9.8.2 Configuration).

● Reading mode

For automatic execution.

Parameter name (HART)	Description
Onval1 read mode	Selects the concentration reading setting for automatic validation. If "Process+Validation" is selected, the reading shows the sum of the process and validation cell concentrations. If "Validation only" is selected, the reading shows only the validation cell concentration.
Onval1 output factor	Scaling coefficient for the concentration reading during automatic validation. If Reading mode is set to Validation only, the reading will be the product of the calculated concentration and the scaling coefficient.

### 9.2.3 Execution

Before starting online validation, check that the piping and online validation settings are correct. Here, online validation 1 for O<sub>2</sub> will be used as an example.

Execution menu path:

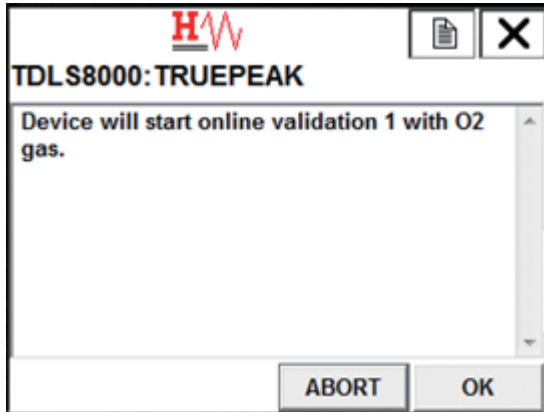
[HART] "Diagnosis/Service>>Validation>>Manual>>Manual online val 1"

[YH8000] "🔧">>Execution>>Validation>>Manual>>Online Validation 1"

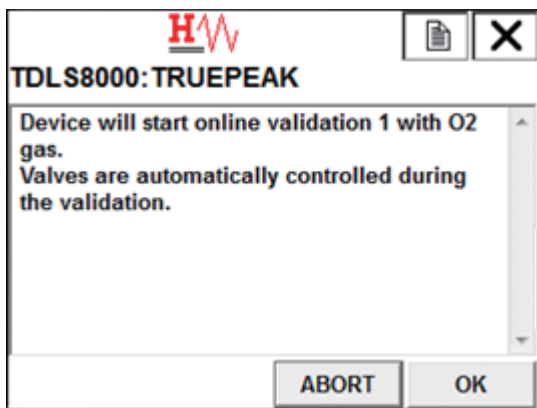
### ■ HART execution screen

- (1) Starting an online validation

If automatic valve control is disabled, the following screen will appear.

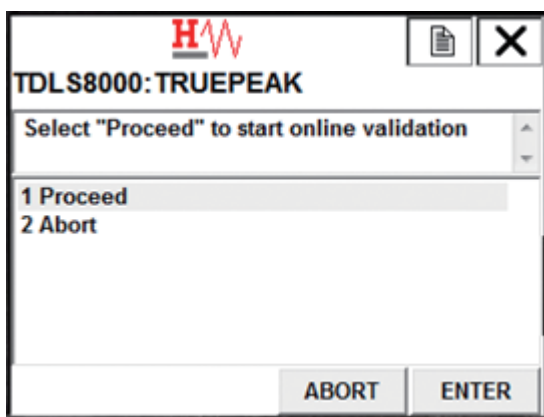


If automatic valve control is enabled, a message stating that the valves will be automatically controlled will appear as follows. In this case, you do not need to manually control the valves during validation.



In either screen, check the type of gas to use as check gas, and tap OK.

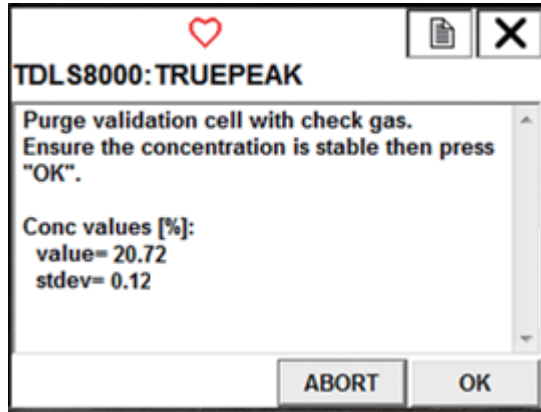
On the next screen, tap ENTER. If automatic valve control is enabled, the stream will be switched, and the validation cell will be purged with check gas.



- (2) Purging with the check gas

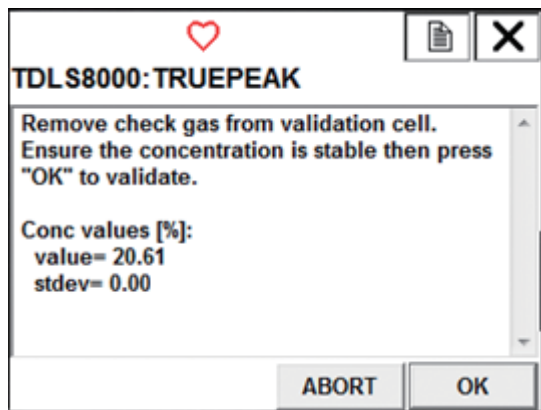
If automatic valve control is disabled, manually control the valves to purge the validation cell with the check gas. By referring to the “stdev” value, which indicates the standard deviation of concentration, check that the concentration is stable over a sufficient length of time (5 minutes as a guideline, at least 1 minute) with the validation cell filled with check gas. When stability is confirmed, tap OK.

If automatic valve control is enabled, the stream will be switched automatically, and check gas will be discharged from the validation cell.



(3) Discharging the check gas

If automatic valve control is disabled, manually control the valves to purge the validation cell with the analyzer internal purge gas (nitrogen gas) that is used normally during process measurement. By referring to the “stdev” value, which indicates the standard deviation of concentration, check that the concentration is stable, and then tap OK. The validation result will be displayed.



(4) Checking the online validation result

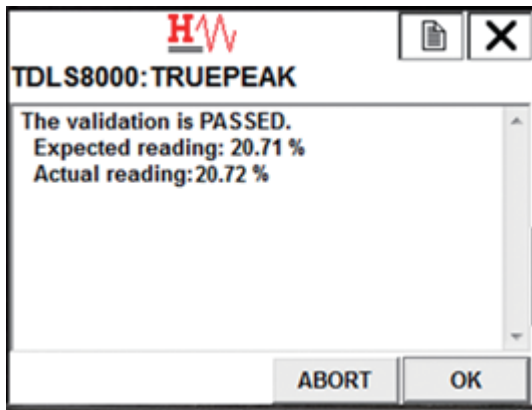
The online validation result is displayed, and online validation ends. If successful, “PASSED” appears. Otherwise, “FAILED” appears.

Expected reading: Gas concentration (expected value) obtained by adding the check gas

Actual reading: The actual value

Tap OK to return to the menu.





### NOTE

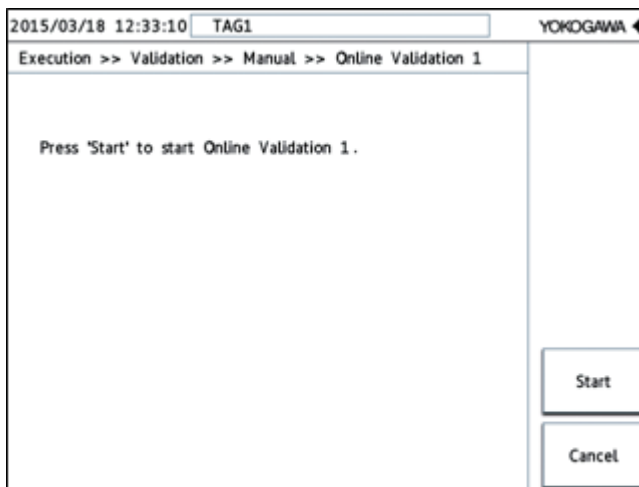
If the validation fails, the following warning will occur. For the corrective action, see 10.2 Warning Display and Handling.

Alarm number	Alarm name
15	Validation Error

## ■ YH8000 Execution Screen

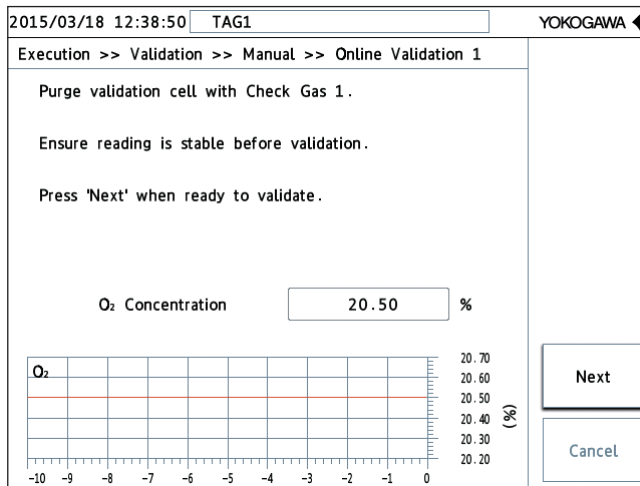
- (1) Starting an online validation

Touch Start to begin online validation. If automatic valve control is enabled, the stream will be switched, the validation cell will be purged with check gas.



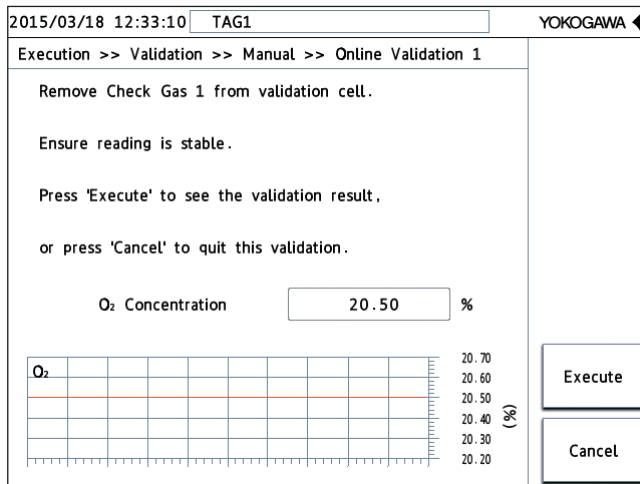
- (2) Purging with the check gas

If automatic valve control is disabled, manually control the valves to purge the validation cell with the check gas. Check that the concentration is stable over a sufficient length of time (5 minutes as a guideline, at least 1 minute) with the validation cell filled with the check gas. When stability is confirmed, tap Next. If automatic valve control is enabled, the stream will be switched automatically, and check gas will be discharged from the validation cell.



(3) Discharging the check gas

If automatic valve control is disabled, manually control the valves to purge the validation cell with the analyzer internal purge gas (nitrogen gas) that is used during process measurement. Check that the concentration is stable, and then touch Execute. The validation result will be displayed.



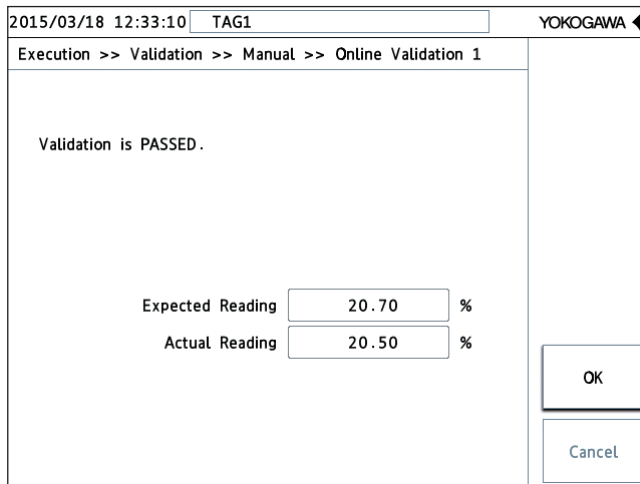
(4) Checking the online validation result

The online validation result is displayed, and online validation ends. If successful, "PASSED" appears. Otherwise, "FAILED" appears.

Expected Reading: Gas concentration (expected value) obtained by adding the check gas

Actual Reading: The actual value

Tap OK to return to the configuration menu.



**NOTE**

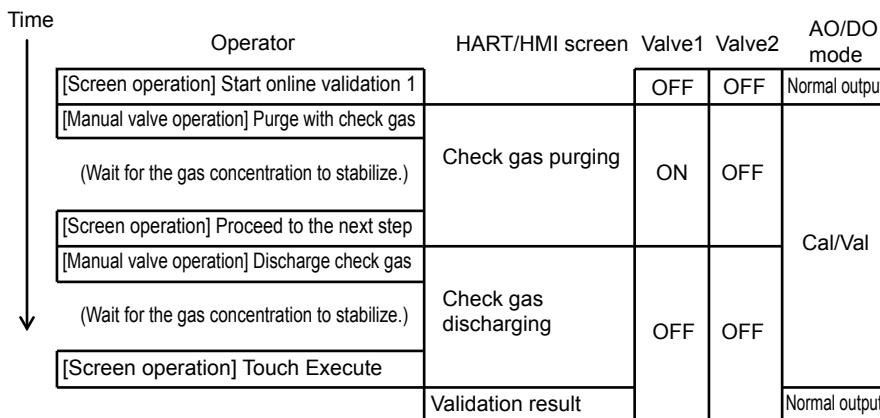
If the validation fails, the following warning will occur. For the corrective action, see 10.2 Warning Display and Handling.

Alarm number	Alarm name
15	Validation Error

**9.2.4 Time Chart**

The valve operation during manual online validation execution and the timing when the AO/DO output switches to Cal/Val mode are shown below. In Cal/Val mode, it is possible to hold the AO output or specify other settings. For the AO/DO output settings during Cal/Val mode, see 6.4.2 Output Hold and 6.5.1 DO Contact (DO-1).

In Figure 9.6, Valve1 and Valve2 are switched manually by following the instructions on the operation screen. If automatic valve control is enabled, there is no need for the operator to switch the valves manually.



**Figure 9.6 Valve and AO/DO output for manual online validation 1**

Time	Operator	HART/HMI screen	Valve1	Valve2	AO/DO mode
	[Screen operation] Start online validation 2		OFF	OFF	Normal output
	[Manual valve operation] Purge with check gas (Wait for the gas concentration to stabilize.)	Check gas purging	ON	ON	Cal/Val
	[Screen operation] Proceed to the next step [Manual valve operation] Discharge check gas (Wait for the gas concentration to stabilize.)	Check gas discharging	OFF	OFF	
	[Screen operation] Touch Execute	Validation result			Normal output

Figure 9.7 Valve and AO/DO output for manual online validation 2

If the initial stream is set to Stream1 in a piping arrangement with process gas switching, the valve state transition is different as shown below. For details, see section 9.2.1.

Operator	Valve1	Valve2
[Screen operation] Start online validation 2	OFF	OFF
[Manual valve operation] Purge with check gas	OFF	ON
[Manual valve operation] Discharge check gas	OFF	OFF

### 9.3 Mounting on a Calibration Cell

Before performing offline validation, zero calibration, or span calibration, you usually need to remove the LU and SCU from the process interface and mount them on a calibration cell. However, if the TDLS8000 is mounted on a flow cell, the gas flowing through the flow cell can be switched from the process gas making it possible to perform offline validation, zero calibration, and span calibration without removing the TDLS8000 from the flow cell.

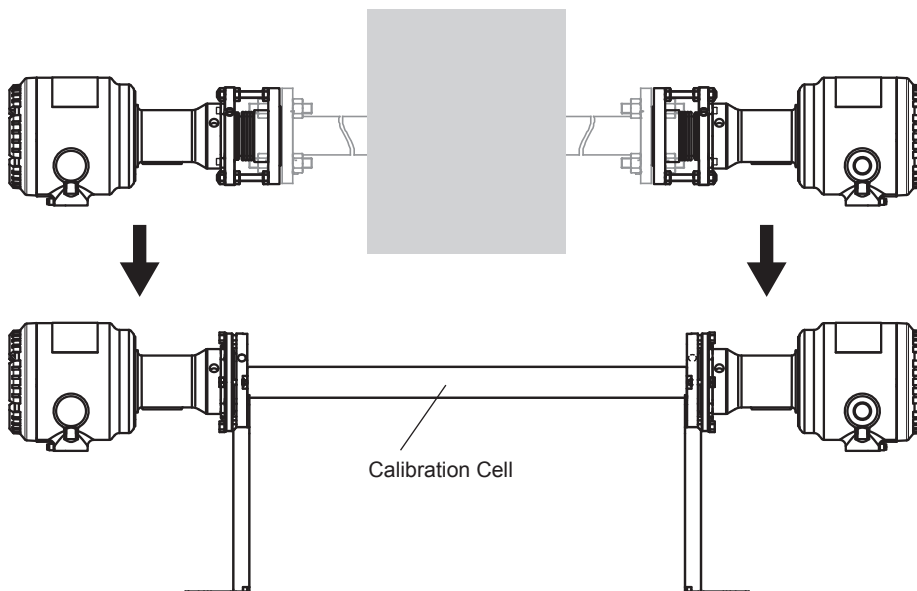


Figure 9.8 Connection example for offline work

#### 9.3.1 Preparation

If you want to perform calibration or offline validation, prepare the following tools, instruments, nitrogen gas, and gas for offline work (check gas, zero calibration gas (nitrogen gas), span calibration gas).

No.	Tool or instrument	Quantity	Remarks
1	Calibration cell	1	
2	YH8000 or HART configuration tool	1	For executing offline calibration and validation
3	Cable between the LU and SCU	1	
4	24 V DC power cable	1	
5	Valve drive cable	As required (1 or 2)	For controlling valves automatically through the SV terminal
6	YH8000 connection cable	1	When using the YH8000
7	24 V DC power supply	1	
8	1/4 inch piping	Several meters	
9	1/4 inch ferrule set	As required	
10	Pressure regulator	1	
11	1/4 inch pipe plug	2	
12	Three-way valve	As required	
13	Thermometer	1	
14	Pressure meter	1	
15	Coupling	As required	
16	Nitrogen gas	As required	For TDLS8000 purging For zero calibration
17	Span calibration gas	As required	For span calibration
18	Check gas	As required	For offline validation
19	Flowmeter	3	For TDLS8000 purging For zero calibration For span calibration and offline validation
20	Needle valve	3	For flow rate adjustment

### 9.3.2 Preparation Procedure

Perform the following procedure. Purge pipe connection is different for offline validation, zero calibration, and span calibration. For details, see sections 9.4, 9.5, and 9.6.

#### CAUTION

- Do not apply physical shock to the TDLS8000 when relocating the TDLS8000 to a calibration cell and when returning it to the process. Doing so can cause a malfunction.
- During calibration work, do not remove the LU or SCU while the power is on.
- If the process gas is positive pressure, shut off the TDLS8000 from the process, stop the process window purge, and prevent excessive pressure from being applied to the process window.

#### (1)Recording the settings

Before removing the TDLS8000, check the following settings and the process conditions.

These will be used when returning the TDLS8000 to the process.

- Process optical path length
- Process pressure (record only when the input mode is set to Fixed)
- Process temperature (record only when the input mode is set to Fixed)
- Transmission

#### (2)Turning the TDLS8000 off

Turn the TDLS8000 off.

---

### (3) Removing the TDLS8000 from the process

#### (a) Stopping the purge gas

Stop the nitrogen gas (or instrumental air) for process window purging and analyzer internal purging.

Prevent pressure from being applied between the inside of the TDLS8000 and the ball valve or between process windows (attached to alignment flanges or process isolation flanges) and the ball valve.

#### (b) Shutting off the TDLS8000 side from the process side (using a ball valve)

Check that there is no residual internal pressure, and then shut off the TDLS8000 from the process. (Close the process ball valve or the like.) If there is no component for shutting off the TDLS8000 side from the process side, check that the process is completely stopped before removing the TDLS8000. If there is no component for shutting off the TDLS8000 side from the process side and the process is running, do not remove the TDLS8000 as the process gas may blow out.

#### (c) Removing piping

Remove the pipes from the TDLS8000. (To make reinstallation easier after offline validation or calibration, we recommend that you mark the pipes.)

Apply vinyl tape or other protector to the TDLS8000 ports and pipe ferrule areas.

#### (d) Removing wiring

Remove wiring.

Be careful not to short the wires. Insulate and protect the removed wires with vinyl tape or the like, and bundle them together, making sure not to strain the cables. (For details on wiring, see 3.2 Wiring.)

### NOTE

---

To make reinstallation easier after the work is complete, we recommend that you mark the wires.

---

#### (e) Removing the TDLS8000 (LU and SCU)

Check that piping and wiring have been completely removed, and then remove the TDLS8000.

The method to remove the LU and SCU is the same. Remove them one at a time.

If a YH8000 is installed, remove the entire YH8000 with its mounting bracket before removing the SCU.

- (1) Using a hex wrench (5 mm), remove only the upper right screw of the quick connector (see Figure 9.9).
- (2) Loosen the other screws (upper left, lower left, and lower right).
- (3) Slowly turn the TDLS8000 counterclockwise to remove it from the alignment flange.

For details on how to remove the YH8000, see 4. YH8000 Installation.

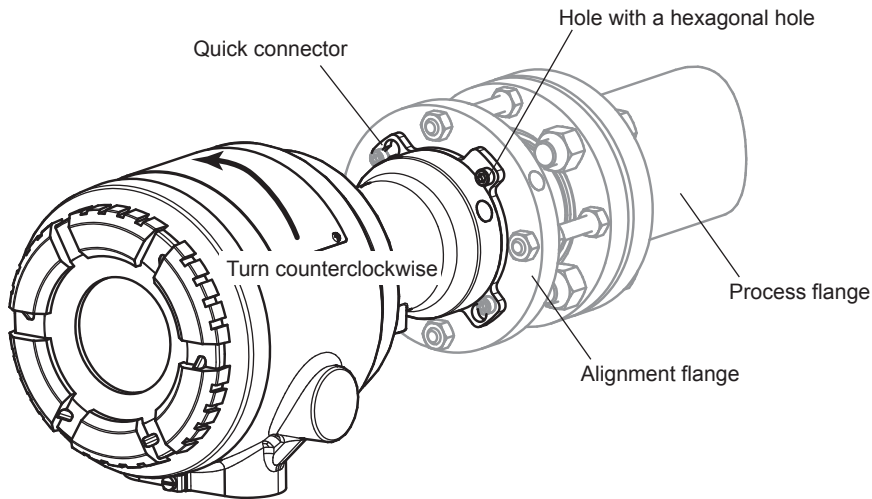


Figure 9.9 Removing from the process

#### (4) Mounting on a Calibration Cell

There are three screws with hexagonal holes at the upper left, lower left, and lower right on each of the calibration cell interface to the TDLS8000. Check that these screws are loosened enough (at least 8 mm) so that the LU or SCU can be mounted.

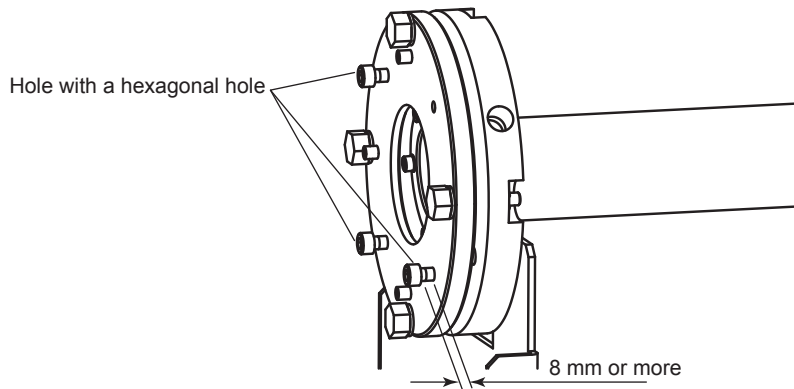


Figure 9.10 Gap in the TDLS8000 mounting screws with hexagonal holes

##### (a) Mounting the LU and SCU

Mount the LU or SCU to one end of the calibration cell. While making sure that the O-ring does not come loose or it is not damaged during the mounting process, insert the quick connector into the screw area, and rotate the LU or SCU clockwise.

While holding the LU or SCU perpendicular to the mounting surface, tighten the four screws, including the upper right screw, evenly.

Finally, mount the YH8000.

##### (b) Wiring

Connect the following cables.

- Inter-unit cable
- Power cable
- Valve drive cable (when necessary)

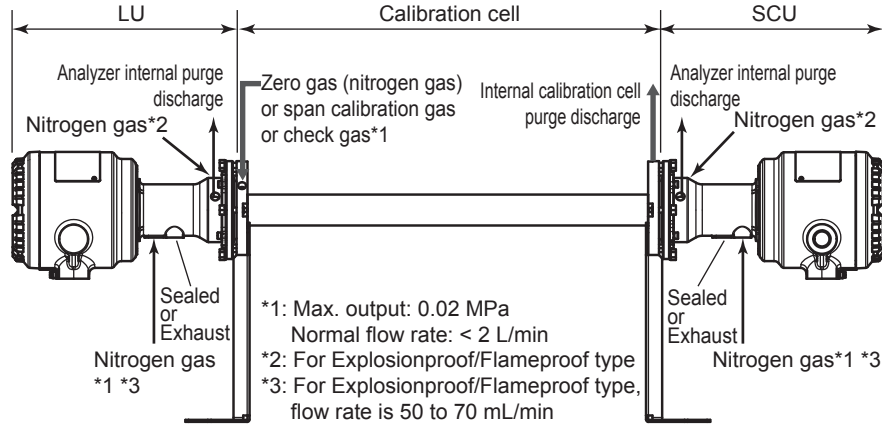
For details on wiring, see 3.2 Wiring.

**(c) Piping**

When the TDLS8000 is mounted on a calibration cell, the resulting unit is divided into three sections as shown in Figure 9.11. For Explosionproof/Flameproof Type, divided into five sections.

An appropriate gas must be fed into each section. Connect the pipes according to the offline work outlined in sections 9.3 to 9.5.

Stainless tubes or Teflon tubes are used for piping.



**Figure 9.11 Purge gas piping diagram**

When piping is complete, check for leaks such as by using Snoop. Use nitrogen gas for this purpose. For Explosionproof/Flameproof Type, at 50 to 70 mL/min, no more than 0.04 MPa.

**(5)Feeding purge gas**

When wiring and piping are complete, feed the gas.

Feed the appropriate gas for offline work at a flow rate no more than 2 L/min at a pressure no more than 0.02 MPa.

**(6)Turning the power on**

Turn the power on. Check that the TDLS8000 starts normally.

**9.3.3 Performing Calibration and Offline Validation**

Refer to sections 9.4, 9.5, and 9.6, and perform offline work.

For each kind of offline work, the settings may be different. Change the settings as necessary.

**9.3.4 Returning the TDLS8000 to the Process**

When offline work is complete, return the TDLS8000 to the process. Follow the procedure below.

**NOTE**

Check that the process is stopped before proceeding with this procedure.

- (1) Switching the span calibration gas or check gas

If hazardous gas is flowing (e.g., CO gas), switch it to nitrogen gas. Wait for the gas to be completely replaced before proceeding.

- (2) Stopping the gas

On the TDLS8000 display, check that the calibration gas concentration has dropped to zero, and then stop all purge gases.



- 
- (3) Removing piping  
Check that there is no residual internal pressure, and then remove the piping.
  - (4) Turning the TDLS8000 off  
Check the above items, and then turn the TDLS8000 off.
  - (5) Removing wiring  
Remove wiring according to the procedure of section 9.3.2 (3) (d).
  - (6) Removing the TDLS8000 from the calibration cell  
Remove the TDLS8000 according to the procedure of section 9.3.2 (3) (e).
  - (7) Installing the TDLS8000 in the process  
Install the TDLS8000 by reversing the procedure for removing it.
    - (a) Mounting the LU and SCU  
Attach the SCU or LU to the alignment flange. While making sure that the O-ring does not come loose or it is not damaged during the mounting process, insert the TDLS8000 quick connector into the alignment flange, and rotate the TDLS8000 clockwise.  
  
While holding the LU or SCU perpendicular to the mounting surface, tighten the four screws, including the upper right screw, evenly.
    - (b) Wiring  
Connect the following cables.
      - Cable between the LU and SCU
      - Power cable
      - Valve drive cable (when necessary)
      - AI/AO/DO/DI cable (when necessary)For details on wiring, see 3.2 Wiring.
    - (c) Piping  
Refer to 3.4 Piping, and connect the pipes to restore the TDLS8000 to its original condition before it was removed.
  - (8) Feeding purge gas  
When wiring and piping are complete, feed the purge gas.  
  
Since the internal pressure from the process window purge gas may become high when process isolation valve (ball valve) is used, open the valve immediately after starting to feed the process window purge gas.
  - (9) Turning the power on  
Turn the power on. Check that the TDLS8000 starts normally.
  - (10) Optical Axis Adjustment  
Refer to 3.3 Optical Axis Adjustment, and adjust the optical axis.
  - (11) Checking the settings  
Refer to the settings that you recorded before removing the TDLS8000, and reset them if necessary.
    - a) Process optical path length
    - b) Process pressure
    - c) Process temperature
    - d) Transmission
-

## 9.4 Offline Validation

Offline validation is a function used to verify the validity of gas concentration measurements. For the validation process, the TDLS8000 is separated from the measurement process, and a known check gas is fed through a calibration cell or flow cell.

Before performing a validation, you need to enter the following information in the TDLS8000.

- Pressure of the purge check gas
- Temperature of the purge check gas
- Length of the cell to be purged with check gas
- Concentration of the purge check gas

The basic procedure is shown below.

- Set known validation parameters.
- Purge the calibration cell or flow cell with check gas of known concentration.
  - => The check gas concentration reading will be recorded.
  - => The expected value for the “check gas” is calculated from the known parameters.
  - => The expected value and the actual value are compared and validated (pass or fail).

### NOTE

Validation is a procedure to check whether the TDLS8000 is operating properly. If there is an error in reading, calibrate.

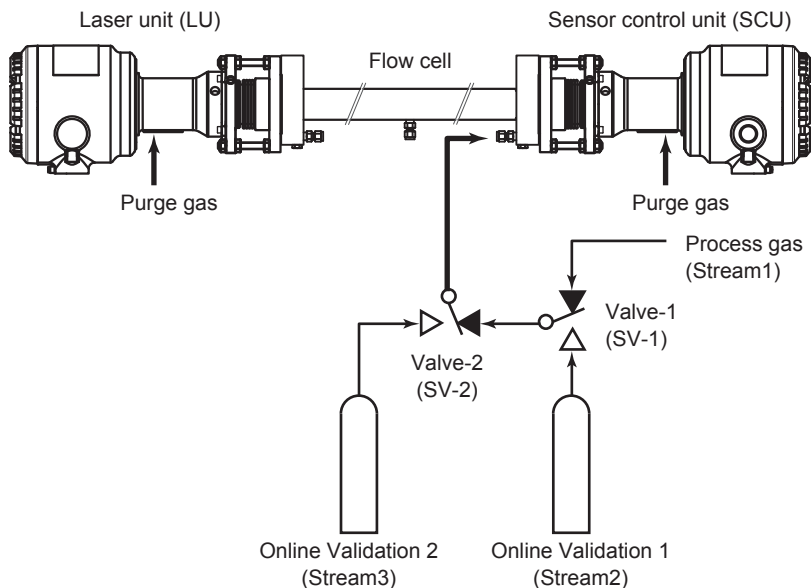
Normally in an in-situ installation, the LU and SCU are removed from the process and mounted to a calibration cell before performing offline validation. In a flow cell or bypass installation, offline validation can be performed without removing the LU and SCU by switching the stream from the process gas to check gas.

### 9.4.1 Preparation

Follow the instructions in 9.3 Mounting on a Calibration Cell. There are two piping methods for offline validation.

- **Offline validation exclusive**

Connect both offline validation 1 and 2 check gases. Validation 1 and 2 can be executed.

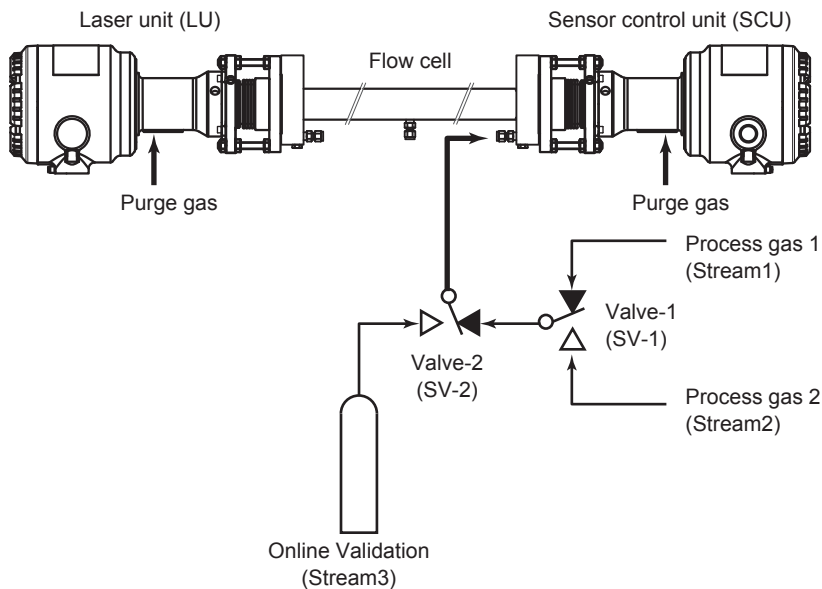


In this piping arrangement, automatic offline validation 1 and 2 can be executed consecutively. There are two methods to start a consecutive execution. One is by using HART, YH8000, Modbus, or digital input (semi-automatic execution), and the other is to start at a specified time (automatic execution). For details on automatic and semi-automatic execution, see 9.8 Automatic and Semi-automatic Execution of Validation and Calibration.

For details on consecutive execution, see 9.8.5 Consecutive Automatic Execution.

● **Offline validation check gas and two types of process gas**

Offline validation check gas is connected. The remaining stream is used to switch between two process gases.



If you want to switch the check gas stream through automatic valve control using the TDLS8000 SV terminal, you need to set the TDLS8000 valve usage according to the piping method as shown in the following table. Note that only online validation 2 can be executed. For details on valve usage, see 6.8.2 Valve Usage Setting.

Piping	Valve usage setting
Offline validation exclusive	Cal/Val
Offline validation 2 check gas and two types of process gas	2 Streams & Cal/Val

## 9.4.2 Configuration

Offline validation configuration menu:

[HART] “Detailed setup>>Validation>>Offline validation #”

[YH8000] “ >>Configuration>Validation>>Offline Validation #”

The setup parameters required to manually execute offline validation are indicated for each of the above submenus (tabs on the YH8000). Here, offline validation 1 will be used as an example.

### ● Parameter

Parameter name (HART)	Description
Offval1 gas type	Selects the type of validation 1 check gas (two-gas measurement only)
Offval1 gas conc	Enters the concentration of the validation 1 check gas
Offval1 pres mode	Selects the pressure mode for validation 1 execution (*1)
Offval1 pres fix val	Enters the pressure for when Offval1 pres mode is set to Fixed
Offval1 temp mode	Selects the temperature mode for validation 1 execution (*1)
Offval1 temp fix val	Enters the temperature for when Offval1 temp mode is set to Fixed
Offval1 OPL mode	Selects the optical path length mode for validation 1 execution (*1)
Offval1 OPL fix val	Enters the process optical path length for when Offval1 OPL mode is set to Fixed

\*1: Process parameter: Uses the process parameter value  
Fixed value: Set to a fixed value

### ● Valve

Parameter name (HART)	Description
Offval1 auto vlv man	Selects whether to enable automatic valve control through the SV terminal during manual validation 1 execution.
Offval1 gas purg time	For automatic execution. Set these when performing automatic execution (see section 9.8.2).
Offval1 prc purg time	

### ● Auto time

For automatic execution. Set this when performing automatic execution (see 9.8.2 Configuration).

## 9.4.3 Execution

Before starting offline validation, check that the piping and offline validation settings are correct. Here, offline validation 1 will be used as an example.

Execution menu path:

[HART] “Diagnosis/Service>>Validation>>Manual>>Manual offline val 1”

[YH8000] “ >>Execution>>Validation>>Manual>>Offline Validation 1”

#### (1) Starting an offline validation

On HART or YH8000, open the above menu, and start offline validation. If automatic valve control is enabled, a message stating that the valves will be automatically controlled will appear.\*1 In this case, you do not need to manually control the valves during offline validation.

#### (2) Purging with check gas

An instruction to purge the calibration cell with check gas will appear.\*2 If automatic valve control is disabled, manually control the valves to purge the calibration cell with the check gas. For safety verification, the standard deviation (stdev) of concentration is displayed on HART and the concentration trend on the YH8000. Check that the concentration is stable over a sufficient length of time (5 minutes as a guideline, at least 1 minute) with the validation cell filled with check gas. Then, execute validation.

(3) Checking the validation result

The validation result is displayed as “PASSED” or “FAILED.” After checking the result, proceed to the next screen to start purging with the process gas. Or select Retry to return to (2) and execute validation again.

(4) Discharging the check gas

An instruction to discharge the check gas from the calibration cell will appear.\*3 If automatic valve control is disabled, manually control the valves to purge the calibration cell with the process gas. For safety verification, the standard deviation (stdev) of concentration is displayed on HART and the concentration trend on the YH8000. Check that the concentration is stable, and proceed to the next screen.

(5) Ending validation

The TDLS8000 will exit from validation mode.

- \*1: [HART] Valves are automatically controlled during the validation.  
[YH8000] Valve for Check Gas 1 will be opened automatically.
- \*2: [HART] Purge validation cell with check gas.  
[YH8000] Purge flow cell with Check Gas 1.
- \*3: [HART] Ensure check gas is completely removed from validation cell and ...  
[YH8000] Remove Check Gas 1 from flow cell.

**NOTE**

If the validation fails, the following warning will occur. For the corrective action, see 10.2 Warning Display and Handling.

Alarm number	Alarm name
15	Validation Error

**9.4.4 Time Chart**

The valve operation during manual offline validation execution and the timing when the AO/DO output switches to Cal/Val mode are shown below. In Cal/Val mode, it is possible to hold the AO output or specify other settings. For the AO/DO output settings during Cal/Val mode, see 6.4.2 Output Hold and 6.5.1 DO Contact (DO-1).

In the following figure, Valve1 and Valve2 are switched manually by following the instructions on the operation screen. If automatic valve control is enabled, there is no need for the operator to switch the valves manually.

Time	Operator	HART/HMI screen	Valve1	Valve2	AO/DO mode
	[Screen operation] Start offline validation 1		OFF	OFF	Normal output
	[Manual valve operation] Purge with check gas (Wait for the gas concentration to stabilize.)	Check gas purging	ON	OFF	Cal/Val
	[Screen operation] Touch Execute (Check validation result.)				
	[Screen operation] Proceed to the next step (or retry)	Validation result			
	[Manual valve operation] Discharge check gas (Wait for the gas concentration to stabilize.)	Check gas discharging	OFF	OFF	
	[Screen operation] Proceed to the next step				
		Offline validation 1 end			Normal output

Figure 9.12 Valve and AO/DO output for manual offline validation 1

Time	Operator	HART/HMI screen	Valve1	Valve2	AO/DO mode
	[Screen operation] Start offline validation 2		OFF	OFF	Normal output
	[Manual valve operation] Purge with check gas (Wait for the gas concentration to stabilize.)	Check gas purging	ON	ON	Cal/Val
	[Screen operation] Touch Execute (Check validation result.)				
	[Screen operation] Proceed to the next step (or retry)	Validation result			
	[Manual valve operation] Discharge check gas (Wait for the gas concentration to stabilize.)	Check gas discharging	OFF	OFF	
	[Screen operation] Proceed to the next step				
		Offline validation 2 end			Normal output

Figure 9.13 Valve and AO/DO output for manual offline validation 2

## 9.5 Zero Calibration

Zero calibration is a function used to align the zero point in a condition where absolutely none of the measured components are absorbed by running gas (such as nitrogen) that does not include the measured components in the region where the laser beam passes through.

Typically zero calibration is performed in an ideal environment before product shipment. In principle, the TDLS8000 does not have any zero point drift. Therefore, customers normally do not have to perform zero calibration.

However, if the zero reading is clearly not normal or if you decide that zero calibration is necessary, perform a zero calibration by paying attention to the following items.

Not meeting the following conditions may adversely affect measurement gas readings.

If you are unclear about how to perform zero calibration, contact your nearest Yokogawa representative.

Note the following items to perform zero calibration correctly.

- Nitrogen gas concentration meeting the product specifications (99.99%N<sub>2</sub> or higher, depends on the application)

- Insufficient nitrogen gas concentration may affect the measurement gas concentration readings.
- The region where the laser beam passes through is adequately filled with nitrogen gas. If measured gas is mixed, measurement gas concentration readings will be affected.
  - There is no optical noise in the region where the laser beam passes through. Proper zero calibration cannot be performed in a condition where optical noise is present (for example, if the surface of the process window is clouded). This can affect measurement gas concentration readings.
  - There is no electrical noise in the environment where zero calibration is to be performed. Proper zero calibration cannot be performed in a condition where electrical noise is present. This can affect measurement gas concentration readings.

**NOTE**

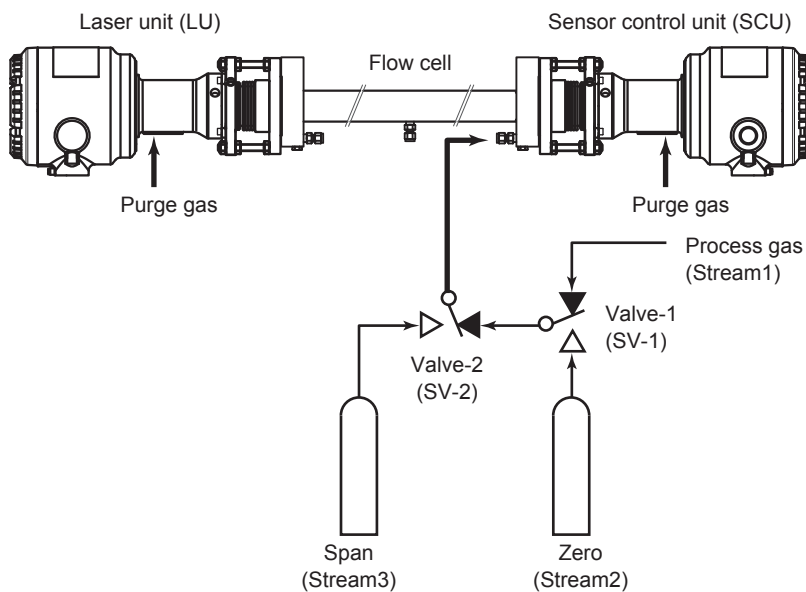
- If the purge piping leaks, correct results cannot be obtained.
- Wait at least 1 hour after turning on the power before performing calibration.

**9.5.1 Preparation**

Follow the instructions in 9.3 Mounting on a Calibration Cell. The piping method is describe below.

• **Zero+span calibration gas**

A piping arrangement that allows span calibration gas to be used in addition to zero calibration gas. Zero calibration and span calibration can be executed.



In this arrangement, automatic zero and span calibration can be executed consecutively. There are two methods to start a consecutive execution. One is by using YH8000, Modbus, or digital input (semi-automatic execution), and the other is to start at a specified time (automatic execution). Semi-automatic execution is not possible from HART. For details on automatic and semi-automatic execution, see 9.8 Automatic and Semi-automatic Execution of Validation and Calibration.


For details on consecutive execution, see 9.8.5 Consecutive Automatic Execution.

If you want to switch the zero calibration gas stream through automatic valve control using the TDLS8000 SV terminal, you need to set the TDLS8000 valve usage to Cal/Val. For details on valve usage, see 6.8.2 Valve Usage Setting.

### 9.5.2 Configuration

Zero calibration configuration menu:

[HART] “Detailed setup>>Calibration>>Zero calibration”

[YH8000] “ >>Configuration>Calibration>>Zero Calibration”

The setup parameters required to manually execute zero calibration are indicated for each of the above submenus (tabs on the YH8000).

● **Valve**

Parameter name (HART)	Description
Z-cal auto vlv man	Selects whether to enable automatic valve control through the SV terminal during manual zero calibration execution.
Z-cal gas purg time	For automatic execution. Set these when performing automatic execution (see section 9.8.2).
Z-cal prc purg time	

● **Auto time**


For automatic execution. Set this when performing automatic execution (see 9.8.2 Configuration).

### 9.5.3 Execution

Before starting zero calibration, check that the piping and zero calibration settings are correct.

Execution menu path:

[HART] “Diagnosis/Service>>Calibration>>Manual>>Manual zero cal”

[YH8000] “ >>Execution>>Calibration>>Manual>>Zero Calibration”

(1) Starting zero calibration

On HART or YH8000, open the above menu, and start zero calibration. First, a message asking you to execute zero calibration carefully will appear.\*1 Next, if automatic valve control is enabled, a message stating that the valves will be automatically controlled will appear.\*2 In this case, you do not need to manually control the valves during zero calibration.

(2) Purging with zero calibration gas

An instruction to purge the calibration cell with zero calibration gas will appear.\*3 If automatic valve control is disabled, manually control the valves to purge the calibration cell with the zero calibration gas. For safety verification, the standard deviation (stdev) of concentration is displayed on HART and the concentration trend on the YH8000. Check that the concentration is stable over a sufficient length of time (10 minutes as a guideline, at least 1 minute) with the validation cell filled with the zero calibration gas. Then, execute calibration.

(3) Checking the zero calibration result

The result of calibration is displayed as “successful” or “failed.” After checking the result, proceed to the next screen to start purging with the span calibration gas or process gas. Or select Retry to return to (2) and execute calibration again.

(4) Purging with process gas



An instruction to discharge the zero calibration gas from the calibration cell will appear.\*4 If automatic valve control is disabled, manually control the valves to purge the calibration cell with the process gas. For safety verification, the standard deviation (stdev) of concentration is displayed on HART and the concentration trend on the YH8000. Check that the concentration is stable, and proceed to the next screen.

(5) Ending zero calibration

The TDLS8000 will exit from calibration mode.

- \*1: [HART] WARN-Please be careful to execute zero calibration.  
[YH8000] Are you sure to start manual zero calibration?
- \*2: [HART] Valves are automatically controlled during the calibration.  
[YH8000] Valve for Zero Gas will be opened automatically.
- \*3: [HART] Purge calibration cell with zero gas then ...  
[YH8000] Purge calibration cell with Zero Gas.
- \*4: [HART] Ensure zero gas is completely removed from calibration cell and ...  
[YH8000] Remove Zero Gas from calibration cell.

**NOTE**

If the zero calibration fails, the following warning will occur. For the corrective action, see 10.2 Warning Display and Handling.

Alarm number	Alarm name
16	Zero Cal Error

### 9.5.4 Time Chart

The valve operation during manual zero calibration execution and the timing when the AO/DO output switches to Cal/Val mode are shown below. In Cal/Val mode, it is possible to hold the AO output or specify other settings. For the AO/DO output settings during Cal/Val mode, see 6.4.2 Output Hold and 6.5.1 DO Contact (DO-1).

In the following figure, Valve1 and Valve2 are switched manually by following the instructions on the operation screen. If automatic valve control is enabled, there is no need for the operator to switch the valves manually.

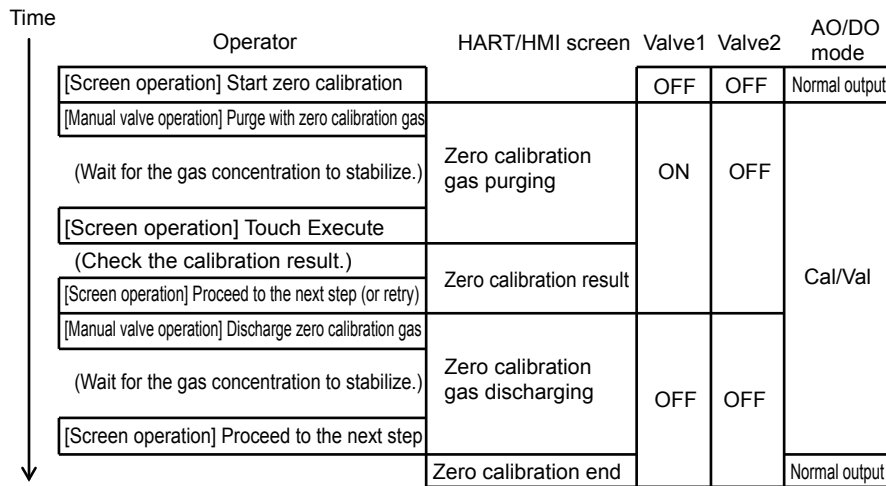


Figure 9.14 Valve and AO/DO output for zero calibration

## 9.6 Span Calibration

Zero calibration is a function used to align the concentration calculation result of the TDLS8000 to the concentration of the calibration gas by purging a calibration cell or flow cell with span calibration gas of known concentration.

Note the following items to perform span calibration correctly.

- Use gas with accurate concentration for the span calibration gas.
- Perform span calibration with the target region adequately filled with span calibration gas (purge with calibration gas and check that the reading is adequately stable).
- There is no optical noise in the region where the laser beam passes through.

Proper span calibration cannot be performed in a condition where optical noise is present (particularly if the surface condition of the process window changes). This can affect measurement gas concentration readings.

- There is no electrical noise in the environment where span calibration is to be performed.

Proper span calibration cannot be performed in a condition where electrical noise is present. This can affect measurement gas concentration readings.

**NOTE**

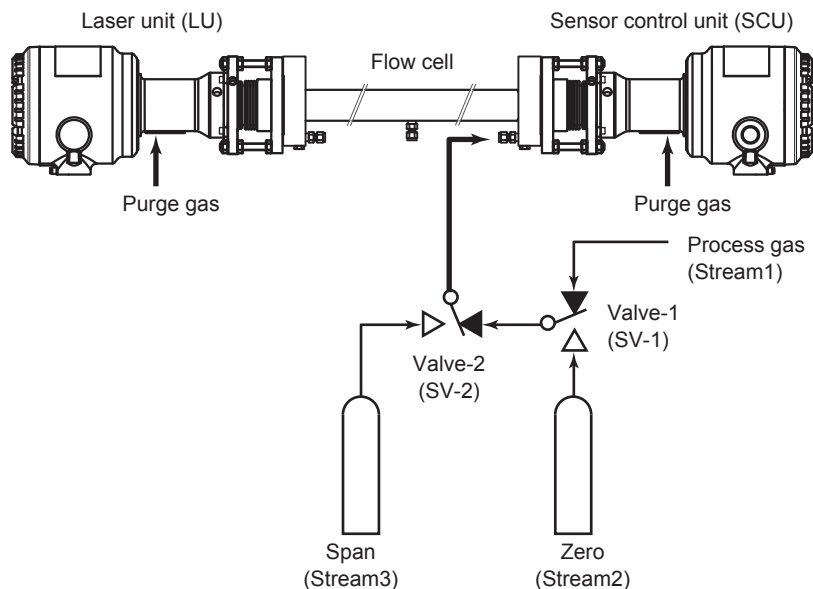
- If the purge piping leaks, correct results cannot be obtained.
- Wait at least 1 hour after turning on the power before performing calibration.
- Correct measurements may not be obtained if span calibration is performed when the reading is not stable.

**9.6.1 Preparation**

Follow the instructions in 9.3 Mounting on a Calibration Cell. There are two piping methods.

● **Zero+span calibration gas**

A piping arrangement that allows zero calibration gas to be used in addition to span calibration gas. Zero calibration and span calibration can be executed.

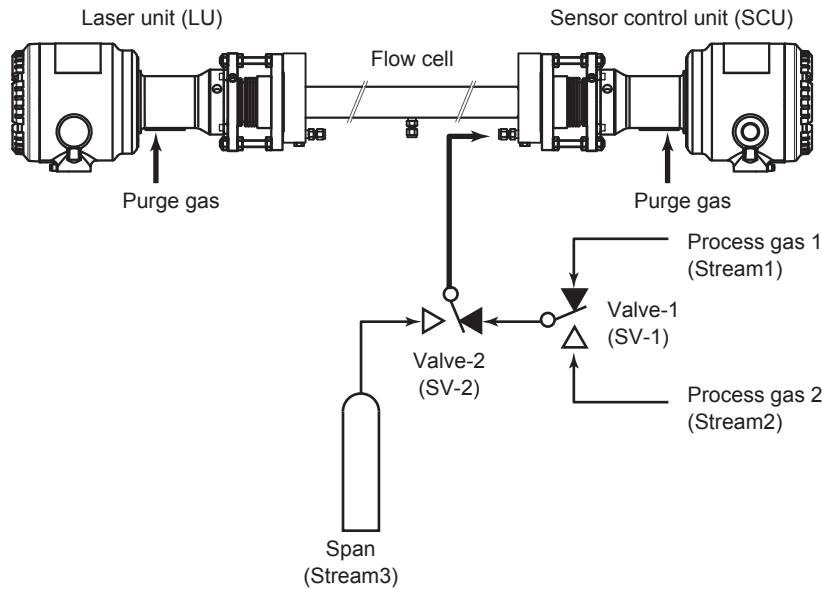


In this arrangement, automatic zero and span calibration can be executed consecutively. There are two methods to start a consecutive execution. One is by using YH8000, Modbus, or digital input (semi-automatic execution), and the other is to start at a specified time (automatic execution). Semi-automatic execution is not possible from HART. For details on automatic and semi-automatic execution, see 9.8 Automatic and Semi-automatic Execution of Validation and Calibration.

For details on consecutive execution, see 9.8.5 Consecutive Automatic Execution.

● **Span calibration gas and two types of process gas**

Span calibration gas is connected. The remaining stream is used to switch between two process gases.




If you want to switch the span calibration gas stream through automatic valve control using the TDLS8000 SV terminal, you need to set the TDLS8000 valve usage according to the piping method as shown in the following table. For details on valve usage, see 6.8.2 Valve Usage Setting.

Piping	Valve usage setting
Zero+span calibration gas	Cal/Val
Span calibration gas and two types of process gas	2 Streams & Cal/Val

## 9.6.2 Configuration

Span calibration configuration menu:

[HART] “Detailed setup>>Calibration>>Span calibration”

[YH8000] “ >>Configuration>Calibration>>Span Calibration”

The setup parameters required to manually execute span calibration are indicated for each of the above submenus (tabs on the YH8000).

● **Parameter**

Parameter name (HART)	Description
S-cal gas type	Selects the type of span calibration gas (two-gas measurement only)
S-cal gas conc	Enters the span calibration gas concentration
S-cal pres mode	Selects the pressure mode for span calibration execution (*1)
S-cal pres fix val	Enters the pressure for when S-cal pres mode is set to Fixed
S-cal temp mode	Selects the temperature mode for span calibration execution (*1)
S-cal temp fix val	Enters the temperature for when S-cal temp mode is set to Fixed
S-cal OPL mode	Selects the optical path length mode for span calibration execution (*1)
S-cal OPL fix val	Enters the process optical path length for when S-cal OPL mode is set to Fixed

\*1: Process parameter: Uses the process parameter value  
Fixed value: Set to a fixed value

**NOTE**

For two-gas measurement, you cannot set span calibration simultaneously on two types of gas. The setting is valid only for the gas type specified by “S-cal gas type,” and span calibration can be executed on this gas type. To switch the gas to be calibrated, you need to change “S-cal gas type.” Further, only one type of span calibration gas can be subject to automatic execution.

● **Valve**

Parameter name (HART)	Description
S-cal auto vlv man	Selects whether to enable automatic valve control through the SV terminal during manual span calibration execution.
S-cal gas purg time	For automatic execution. Set these when performing automatic execution (see section 9.8.2).
S-cal prc purg time	

● **Auto time**

For automatic execution. Set these when performing automatic execution (see section 9.8.2).

**9.6.3 Execution**

Before starting span calibration, check that the piping and span calibration settings are correct.

Execution menu path:

[HART] “Diagnosis/Service>>Calibration>>Manual>>Manual span cal”

[YH8000] “>>Execution>>Calibration>>Manual>>Span Calibration”

(1) Starting span calibration

On HART or YH8000, open the above menu, and start span calibration. If automatic valve control is enabled, a message stating that the valves will be automatically controlled will appear.\*1 In this case, you do not need to manually control the valves during span calibration.

(2) Purging with span calibration gas

An instruction to purge the calibration cell with span calibration gas will appear.\*2 If automatic valve control is disabled, manually control the valves to purge the calibration cell with the span calibration gas. For safety verification, the standard deviation (stdev) of concentration is displayed on HART and the concentration trend on the YH8000. Check that the concentration is stable over a sufficient length of time (10 minutes as a guideline, at least 1 minute) with the validation cell filled with the span calibration gas. Then, execute calibration.

(3) Checking the span calibration result

The result of calibration is displayed as “successful” or “failed.” After checking the result, proceed to the next screen to purge with the process gas. Or select Retry to return to (2) and execute calibration again.

(4) Purging with process gas

An instruction to discharge the span calibration gas from the calibration cell will appear.\*3 If automatic valve control is disabled, manually control the valves to purge the calibration cell with the process gas. For safety verification, the standard deviation (stdev) of concentration is displayed on HART and the concentration trend on the YH8000. Check that the concentration is stable, and proceed to the next screen.

(5) Ending span calibration

The TDLS8000 will exit from calibration mode.

- \*1: [HART] Valves are automatically controlled during the validation.  
[YH8000] Valve for Check Gas 1 will be opened automatically.
- \*2: [HART] Purge calibration cell with span gas then ...  
[YH8000] Purge calibration cell with Span Gas.
- \*3: [HART] Ensure span gas is completely removed from calibration cell and ...  
[YH8000] Remove Span Gas from calibration cell.

**NOTE**

If the span calibration fails, the following warning will occur. For the corrective action, see 10.2 Warning Display and Handling.

Alarm number	Alarm name
17	Span Cal Error

**9.6.4 Time Chart**

The valve operation during manual span calibration execution and the timing when the AO/DO output switches to Cal/Val mode are shown below. In Cal/Val mode, it is possible to hold the AO output or specify other settings. For the AO/DO output settings during Cal/Val mode, see 6.4.2 Output Hold and 6.5.1 DO Contact (DO-1).

In the following figure, Valve1 and Valve2 are switched manually by following the instructions on the operation screen. If automatic valve control is enabled, there is no need for the operator to switch the valves manually.

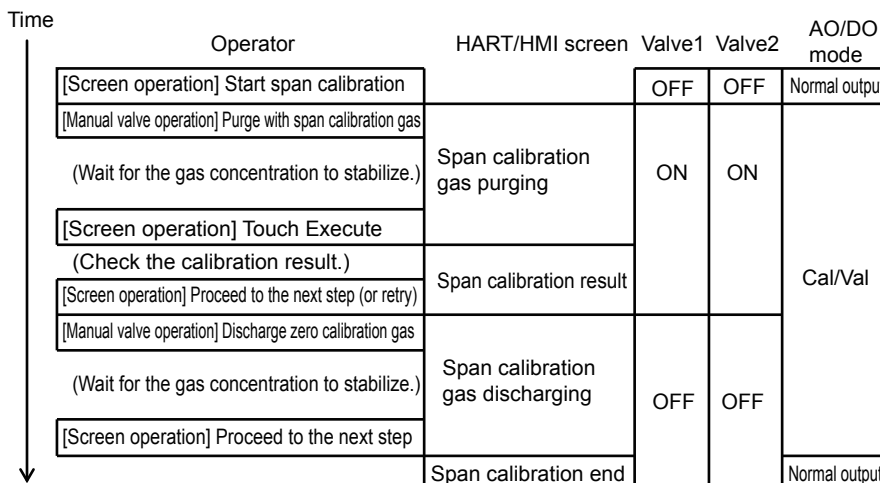


Figure 9.15

**9.7 Calibration Data Record and Restoring**

This section explains the function used to view the history of calibration and validation results and restoring the zero and span calibration data to its original condition.

● **Calibration and validation history**

You can view up to 10 events using HART and 99 events using the YH8000. For the displayed history content, see 8.5.6 Cal/Val History Screen. You can view using the following menu.

[HART] "Diagnosis/Service>>Logbook>>Read cal/val record"

[YH8000] " ⓘ >>Log Book>>Cal/Val History"

● **Restoring calibration data**

For zero and span calibration, you can restore past calibration results. You can restore separately for zero and span. You can select the original data for restoring from the following two types.

- Previous  
The calibration data executed previously is restored. When executed, the current calibration data is saved as past data. Therefore, restoring twice will cause the current calibration data to return.
- Factory  
The factory default calibration data is restored. When executed, the current calibration data is saved as past data. Therefore, if you restore using “Factory” and then using “Previous,” the original current data will return.

Execution menu path:

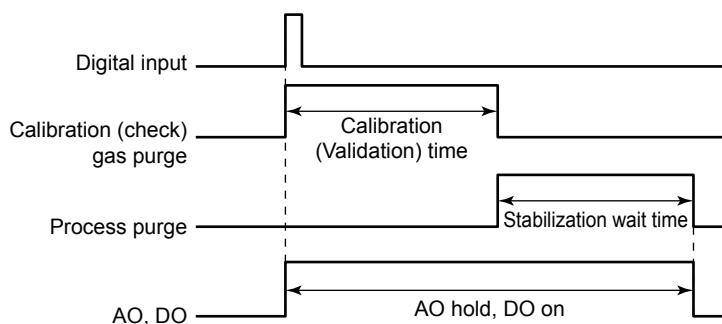
[HART] “Diagnosis/Service>>Calibration>>Restore”

[YH8000] “ >>Execution>>Calibration>>Restore”

## 9.8 Automatic and Semi-automatic Execution of Validation and Calibration

There are several methods to perform calibration and validation. One method is manual calibration and validation, which you execute from the screen. Another method is automatic calibration and validation, which are executed at a preset time or at preset time intervals. Yet another method is semi-automatic calibration and validation, which are executed in response to a start instruction from the YH8000, HART, digital input, or Modbus.

Since valves are controlled automatically in automatic and semi-automatic execution, you need to set time for preparatory check gas or calibration gas purging. As shown in the following figure, the time period during which calibration gas (or check gas) purging takes place is called *calibration (validation) time*. The subsequent time period during which process gas purging takes place is called *stabilization wait time*. The stabilization wait time is the wait time until the measurements stably return to normal process values. The TDLS8000 is in a Cal/Val state until the stabilization wait time is completed and holds the AO output. The following figure shows a remote execution example. Digital input is used to start calibration (validation).



**NOTE**

It is possible to disable the AO hold operation and DO ON operation that take place while calibration or validation is being executed. For details, see 6.4.2 Output Hold and 6.5.1 DO Contact (DO-1).

## 9.8.1 Preparation

Before automatic execution or semi-automatic execution, connect the piping properly according to the calibration or validation you want to perform. For the piping diagram, see the calibration and validation sections.

## 9.8.2 Configuration

To perform automatic or semi-automatic execution, you need to set certain parameters, which are shared with manual execution, as well as settings for automatic operation. The settings that are shared with manual execution are described in the “Configuration” section for validation and calibration. There are two types of settings for automatic operation. The menu path for accessing them is the same as that described in the “Configuration” section for validation and calibration. For online validation, the menu path is as follows.

[HART] “Detailed setup>>Validation>>Online validation #”

[YH8000] “ >>Configuration>>Validation>>Online Validation #”

- **Calibration gas or check gas and process gas purge time**

The purge time must be set regardless of automatic execution or semi-automatic execution. As an example, the parameters for online validation 1 are shown below.

Parameter name (HART)	Parameter name (YH8000)	Description
Onval1 gas purg time	Validation gas Purge time	Enters the purge time of online validation 1 check gas. This corresponds to the validation time.
Onval1 nml purg time	Normal gas Purge time	Enters the normal purge gas purge time for process measurement. This corresponds to the stabilization wait time.

- **Automatic execution settings**

To perform automatic execution, you need to set the execution method you want to use. This is not necessary for semi-automatic execution.

- Parameters for time initiate

As an example, the parameters for online validation 1 are shown below.

Parameter name (HART)	Parameter name (YH8000)	Description
Onval1 time initiate	Tlme Initiate	Enables time initiate of online validation 1
Onval1 init date	Initial time	Enters the initial execution date
Onval1 init time		Enters the initial execution time
Onval1 day cycle	Cycle (day)	Enters the cycle in days for time initiate
Onval1 hour cycle	Cycle (hour)	Enters the cycle in hours for time initiate

For example, if the initial execution time is 12:00:00 on January 1, 2015, the day cycle is 10, and the hour cycle is 0, the execution will take place at 12:00:00 on January 11, 2015, 12:00:00 on January 21, 2015, and so on.

### NOTE

If both the day and hour cycles for time initiate are set to zero, automatic execution takes place once at the initial execution time.

- If you want to use digital input, see 6.7 [Digital Input Settings](#)
- If you are using Modbus instructions, you do not need to set the parameters. For the instruction address, see 11.2 [Coil](#).

### 9.8.3 Execution



Before execution, check that the preparations and settings are correct.

#### NOTE

If a start request for another calibration or validation overlaps with a calibration or validation currently in progress, the request will be discarded. For example, if the start time of a time-based automatic calibration coincides with a manual calibration in progress, the time initiate request is discarded. Such incidents are recorded in the alarm history.

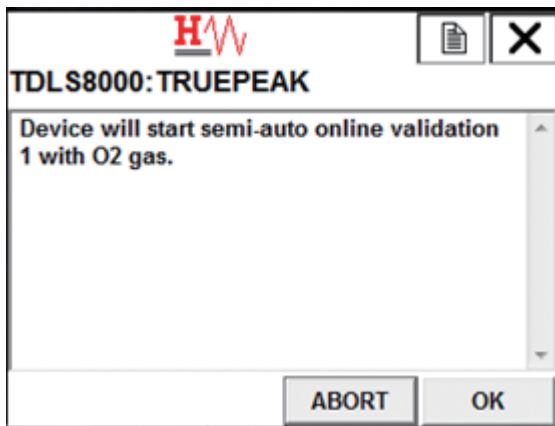
Since automatic calibration and validation are executed at the specified time cycle, there is no manual operation to start it. Here, a semi-automatic execution procedure will be explained using online validation 1 as an example.

Semi-automatic execution menu path:

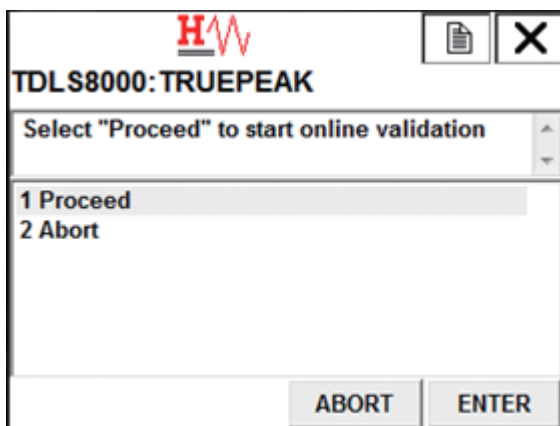
- [HART] “Diagnosis/Service>>Calibration>>Semi-auto”
- “Diagnosis/Service>>Validation>>Semi-auto”
- [YH8000] “>>Execution>>Calibration>>Semi-Auto”
- “>>Execution>>Validation>>Semi-Auto”

- **HART execution screen**

- (1) Starting a semi-automatic online validation  
Execute “Semi-auto online val 1.” Tap OK.



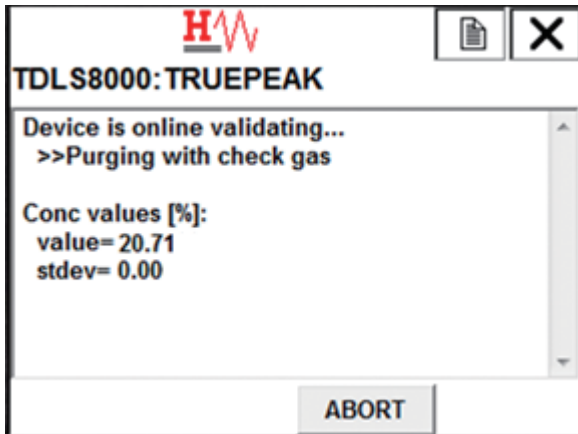
On the next screen, tap ENTER.





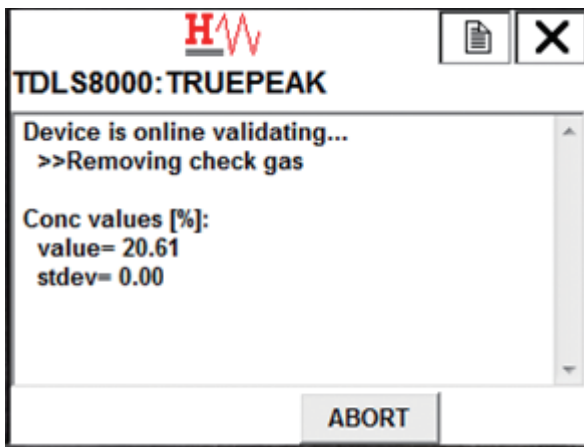
(2) Purging with check gas

When validation starts, the stream is automatically switched, and the validation cell is purged with check gas. The purge time is the time specified by “Onval1 gas purg time.” Tapping ABORT cancels validation.



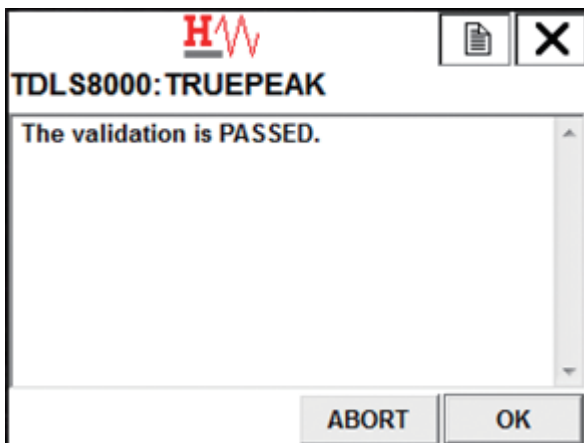
(3) Discharging the check gas (process purge)

The stream is automatically switched, and the validation cell is purged with normal process purge gas to discharge the check gas. The purge time is the time specified by “Onval1 nml purg time.” Tapping ABORT cancels validation.



(4) Checking the validation result

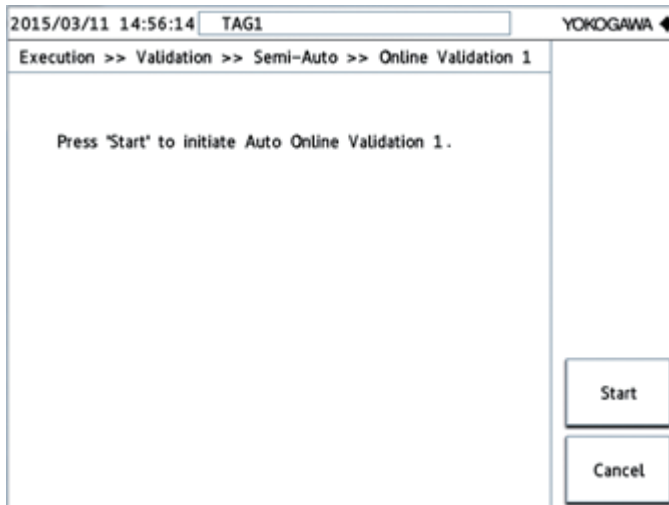
The validation result is displayed as “PASSED” or “FAILED,” and validation ends. If validation is unsuccessful, a warning will occur (see section 9.2.3). Tap OK to return to the menu.



● YH8000 Execution Screen

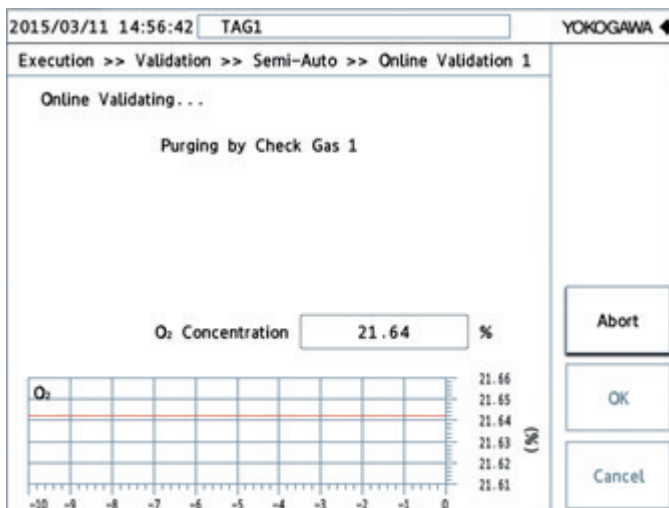
(1) Starting validation

Execute “Semi-Auto Online Validation 1.” Tap Start to begin.



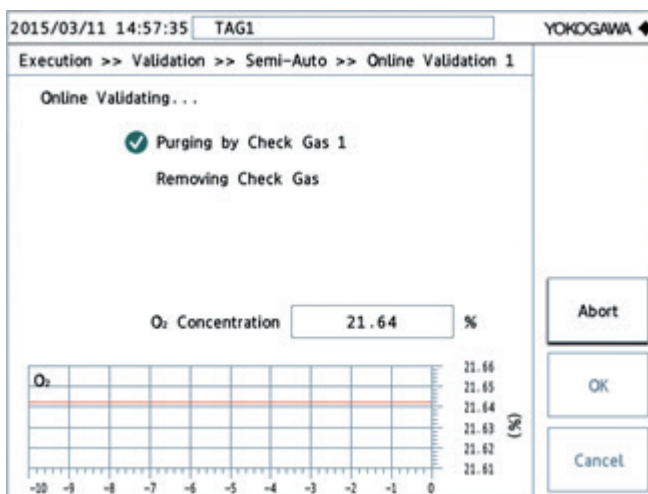
(2) Purging with the check gas

When validation starts, the stream is automatically switched, and the validation cell is purged with check gas. The purge time is the time specified by “Validation gas Purge time.” Tapping Abort cancels validation.



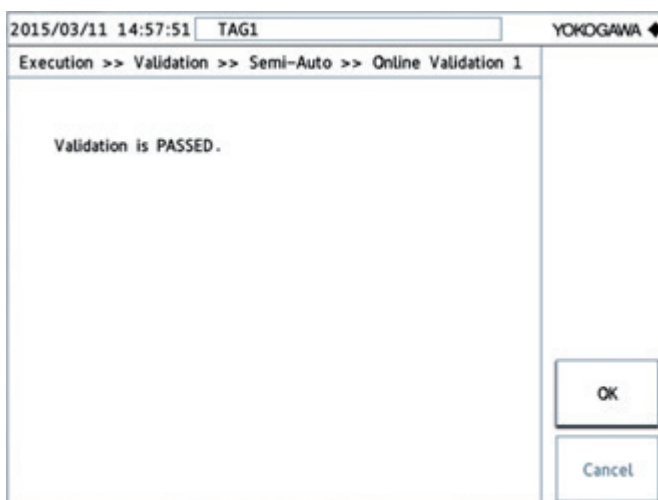
(3) Discharging the check gas (process purge)

The stream is automatically switched, and the validation cell is purged with normal process purge gas to discharge the check gas. The purge time is the time specified by “Normal gas Purge time.” Tapping Abort cancels validation.



(4) Checking the validation result

The validation result is displayed as “PASSED” or “FAILED,” and validation ends. If validation is unsuccessful, a warning will occur (see section 9.2.3). Tap OK to return to the configuration menu.



### 9.8.4 Aborting the Stabilization Wait Time for Automatic or Semi-automatic Execution

The stabilization wait time during which process purging takes place in an automatic or semi-automatic execution of calibration or validation is a wait time until the measurements are stably restored. It does not affect the calibration or validation results. Therefore, when you decide that the process measurements have been stably restored, you can abort the stabilization wait time to end calibration or validation. This avoids having to wait longer than needed for measurements to stabilize. For details on the stabilization wait time, see 9.8 Automatic and Semi-automatic Execution of Validation and Calibration.

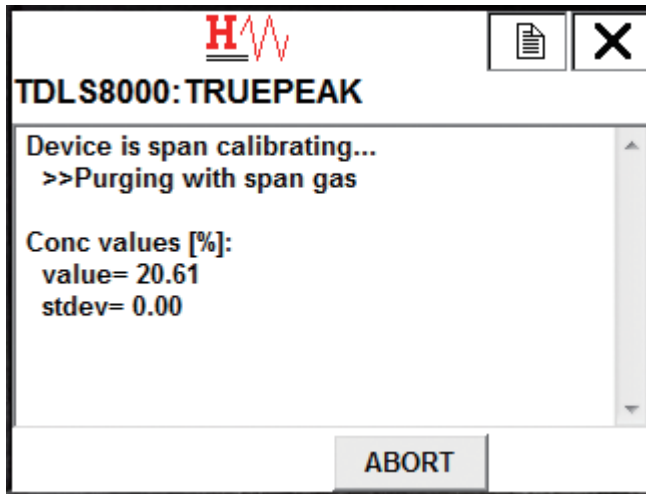
**NOTE**

For online validation only, the stabilization wait time cannot be aborted because the measurements in the normal process condition are used in the validation result. If you abort, validation itself will be aborted, and the results will not be displayed.

As an example, the procedure to abort process purging for semi-automatic span calibration is explained below.

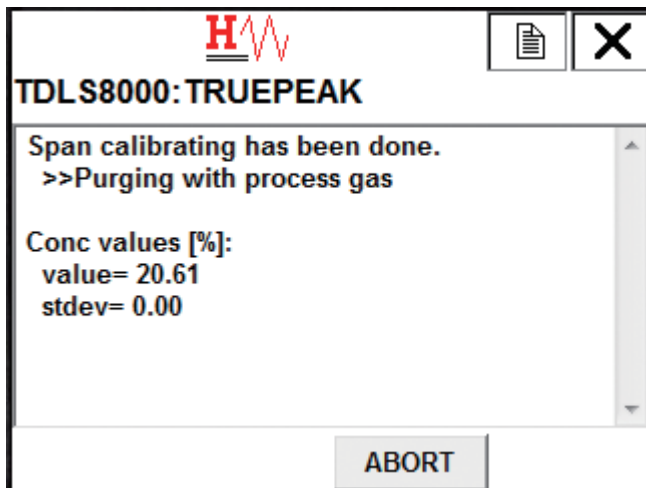
- (1) Purging with span calibration gas

When you execute semi-automatic span calibration, span calibration gas purging begins. Note that touching ABORT at this point will abort the span calibration.



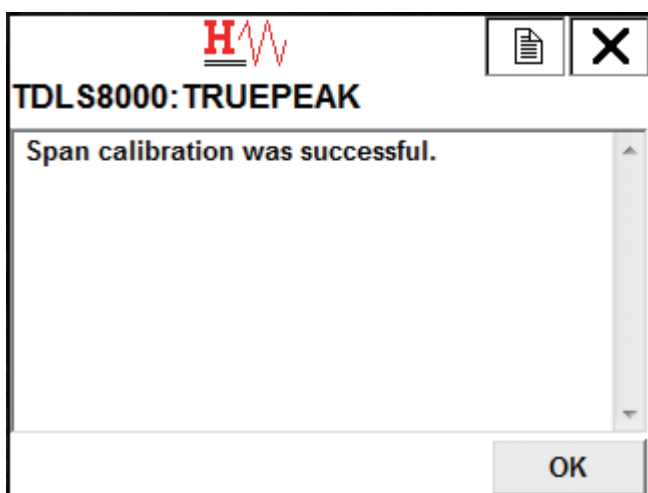
- (2) Purging with process gas

Immediately after the span calibration gas purge time elapses, the TDLS8000 calculates the span calibration result. Then, process gas purging takes place. Since span calibration is already completed at this point, you can view the span calibration result even if you abort the stabilization wait time. Check that the concentration has stabilized, and then touch ABORT.



(3) Checking the calibration result

The span calibration result is displayed. Tap OK to return to the menu.



### 9.8.5 Consecutive Automatic Execution

It is possible to execute zero calibration and span calibration consecutively in automatic execution or semi-automatic execution. It is also possible to execute offline validation consecutively using check gas 1 and then check gas 2.

The combinations that can be executed consecutively are shown below.

- Zero calibration and span calibration (zero+span calibration)
- Offline validation 1 and offline validation 2 (offline validation 1+2)

To perform consecutive automatic execution, you need to make the following preparations.

- Piping: Connect the piping so that both automatic calibration and validation can be executed.
- Configuration: Configure the automatic calibration and validation settings.
- Automatic execution configuration: Refer to 9.8.2 Configuration, and configure the automatic execution settings.

The settings and detailed operation of each consecutive automatic execution are explained below.

#### ● Zero+span calibration

Piping: Connect the piping for zero+span calibration provided in 9.5.1 Preparation.

Configuration: Configure the zero calibration (see section 9.5.2) and span calibration (see section 9.6.2).

Automatic execution configuration: Configure from the following menu as necessary.

[HART] "Detailed setup>>Calibration>>Zero+Span calibration"

[YH8000] "🔧>>Configuration>>Calibration>>Zero + Span Calibration"

Semi-automatic execution menu path:

[HART] (Cannot be executed from HART)

[YH8000] "🔧>>Execution>>Calibration>>Semi-Auto>>Zero + Span Calibration"

Time chart: The valve operation during zero+span calibration execution and the timing when the AO/DO output switches to Cal/Val mode are shown below. The following figure shows an example for semi-automatic execution.

Time	Operator	YH8000 screen	Valve1	Valve2	AO/DO mode
	[Screen operation] Start semi-automatic zero+span calibration		OFF	OFF	Normal output
	[Automatic valve operation] Purge with zero calibration gas	Zero calibration gas purging	ON	OFF	Cal/Val
	(Zero calibration time elapses.)				
	[Automatic valve operation] Purge with span calibration gas	Span calibration gas purging	ON	ON	
	(Span calibration time elapses.)				
	[Automatic valve operation] Discharge zero calibration gas	Span calibration gas discharging	OFF	OFF	
	(Span calibration stabilization wait time elapses.)				
		Span calibration end			Normal output

● **Offline validation 1+2**

Piping: Connect the piping as described in “Offline validation exclusive” in section 9.4.1.

Configuration: Configure the offline validation (see section 9.4.2) for validation 1 and 2.


Automatic execution configuration: Configure from the following menu as necessary.

[HART] “Detailed setup>>Validation>>Offline validation 1+2”

[YH8000] “>>Configuration>>Validation>>Offline Validation 1 + 2”

Semi-automatic execution menu path:

[HART] “Diagnosis/Service>>Validation>>Semi-auto>>Semi-auto offline val 1+2”

[YH8000] “>>Execution>>Validation>>Semi-Auto>>Offline Validation 1 + 2”



Time chart: The valve operation during offline validation 1+2 execution and the timing when the AO/DO output switches to Cal/Val mode are shown below. The following figure shows an example for semi-automatic execution.

Time	Operator	HART/YH8000 screen	Valve1	Valve2	AO/DO mode
	[Screen operation] Start semi-automatic offline validation 1+2		OFF	OFF	Normal output
	[Automatic valve operation] Check gas 1 purge	Check gas 1 purging	ON	OFF	Cal/Val
	(Offline validation 1 validation time elapses.)				
	[Automatic valve operation] Check gas 2 purge	Check gas 2 purging	ON	ON	
	(Offline validation 2 validation time elapses.)				
	[Automatic valve operation] Check gas 2 discharge	Check gas 2 discharging	OFF	OFF	
	(Offline validation 2 stabilization wait time elapses.)				
		Offline validation 1+2 Result display			Normal output

## 9.9 Analog Input Calibration

This section explains analog-digital conversion calibration of the analog input terminal (AI). Since the TDLS8000 is calibrated before shipment, you normally do not need to calibrate.

Execution menu path:

```
[HART] "Diagnosis/Service>>Trim analog channel>>Trim AI-1 (Pres)"
        "Diagnosis/Service>>Trim analog channel>>Trim AI-2 (Temp)"
[YH8000] ">>Configuration>>I/O>>Analog Input>>AI-1(Pressure)>>Calibration"
        ">>Configuration>>I/O>>Analog Input>>AI-2(Temperature)>>Calibration"
```

The calibration procedure is as follows.

- (1) From HART or YH8000, start AI calibration.
- (2) Connect a current source to the AI terminal, and apply 4 mA as instructed on the screen.
- (3) Check that the analog input is stable, and proceed to the next screen.
- (4) Apply 20 mA as instructed on the screen.
- (5) Check that the analog input is stable, and proceed to the next screen. Calibration is complete.



### NOTE

If analog input calibration is executed when the analog input is set to process pressure or temperature, the pressure or temperature during calibration is calculated based on the backup function. For example, if the pressure's Backup mode is set to Back value and Backup set value is set to 101.0 kPa, the pressure at AI-1 during calibration is fixed to 101.0 kPa. For details on the backup function, see 5.3.3 [Setting the Process Pressure](#).

## 9.10 Analog Output Calibration

This section explains digital analog conversion calibration of the analog output terminal (AO). Since the TDLS8000 is calibrated before shipment, you normally do not need to calibrate.

Execution menu path:

```
[HART] "Diagnosis/Service>>Trim analog channel>>Trim AO-1 (PV)"
        "Diagnosis/Service>>Trim analog channel>>Trim AO-2 (SV)"
[YH8000] ">>Configuration>>I/O>>Analog Output>>AO-1>>Calibration"
        ">>Configuration>>I/O>>Analog Output>>AO-2>>Calibration"
```

The calibration procedure is as follows.

- (1) Connect ammeter to the AO terminal.
- (2) From HART or YH8000, start AO calibration.
- (3) A current corresponding to 4 mA will flow. When the measuring instrument reading becomes stable, enter the measured value.
- (4) A current corresponding to 20 mA will flow. When the measuring instrument reading becomes stable, enter the measured value.

(5) Calibration is complete.

## NOTE

When analog output calibration is complete, the 20 mA fixed output is released, and normal analog output returns. At this point, the AO loop check simulation output is also released. For example, if analog output calibration is executed while AO-1 loop check is in progress, when the calibration is complete, AO-1 returns to normal output.

## 9.11 Loop Check


See 5.4 Loop Check (Simulation output).

## 9.12 Alarm History

You can view the history of alarms (faults and warnings) that occurred in the past. In addition, if a non-alarm event shown in Table 9.1 occurs, it is recorded as a message.

Menu path:

[HART] “Diagnosis/Service>>Logbook>>Read alarm/message record”

[YH8000] “>>Log Book>>Alarm History”

The information displayed in the alarm history is as follows.

- Times when faults and warnings occur and clear
- Times when messages occur
- Sub numbers of alarm messages (only for certain alarms and messages)

These numbers are used by Yokogawa service representatives for troubleshooting purposes. The numbers are displayed in HART and the YH8000.

You can view up to 30 events using HART and 99 events using the YH8000. For an explanation of the YH8000 alarm history screen, see 8.5.5 Alarm History Screen.

For details on faults and warnings, see 10. Troubleshooting.

Items recorded as messages are shown in the following table.



Table 9.1

No.	Message	Description
66	Power On	The power was turned on.
67	Restarted by WDT	Restarted due to a watchdog timeout.
68	Restarted by Power Failure	Restarted by a power supply monitoring IC.
69	Laser Module Replaced	Laser module was replaced.
70	Bootloader Updated	Boot loader was updated.
71	Firmware Updated	Firmware was updated.
72	FPGA Updated	CIO-FPGA was updated.
73	Config File Updated	The configuration file was updated.
74	Backup Config Loaded	Backup configuration was loaded.
75	Default Config Loaded	Default configuration was loaded.
76	Default Firmware Loaded	Default firmware was loaded.
77	Default HART config loaded	Default ROM values for HART parameters were loaded.
78	Reset by External Operation	Restarted by an external instruction.
79	RTC was Adjusted	The real-time clock was synchronized.
80	Auto Zero Cal was Skipped	Automatic zero calibration start instruction was skipped.
81	Auto Span Cal was Skipped	Automatic span calibration start instruction was skipped.
83	Auto Validation was Skipped	Automatic validation start instruction was skipped.
84	HMI Connected	YH8000 was connected.
85	HMI Disconnected	YH8000 was disconnected.
86	HMI Disconnected(recv)	YH8000 was disconnected while receiving.
87	HMI Disconnected(send)	YH8000 was disconnected while sending.
88	History File was Corrupted	The history file was corrupted.

## 9.13 Access to stored data in TDLS8000

Plugging a USB flash drive into USB port on TDLS8000 SCU or YH8000 enables downloading data stored in TDLS8000 memory.

The following files listed in the next table can be confirmed as in plain text or spreadsheet by converting file format to CSV file format or “.csv”.

Folder name	File name	description
DATA	YYMMDD.rst	Concentration, Transmission, Process temperature, Pressure, temperature inside the equipment, Trend data of AI1, AI2, AO1, AO2
	YYMMDD.spc	Automatically saved spectrum data
	YYMMDD.spr	Automatically saved spectrum data of reference cell automatically stored
CAPTURE	xxxxxx.spc	Manually saved spectrum data
	xxxxxx.spr	Manually saved spectrum data of reference cell,
LOG	current.alm	Alarm history
	backup.alm	Alarm history (back up)
	current.cal	history of calibration/validation
	backup.cal	history of calibration/validation ( back up)
	current.spc	Spectrum data at validation
	backup.spc	Spectrum data at validation (back up)

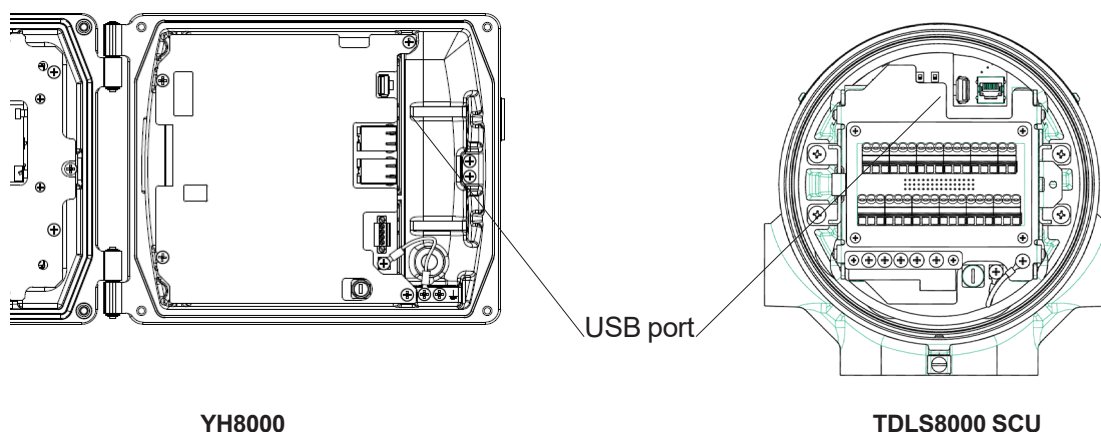
For file converter software, download the files from the following website. (member login required)

<https://partner.yokogawa.com/global/an/>

How to download data

- 1: Plug an empty USB flash drive\* into USB port on TDLS8000 SCU or YH8000.
- 2: Plugging a flash drive into USB port on TDLS8000 starts downloading files automatically. Plugging into YH8000 starts downloading by following the instruction on the panel.
- 3: After “Download complete” is displayed on TDLS8000 SCU panel, remove the USB flash drive.  
Remove the flash drive from YH8000 by following the direction displayed on the panel.

\*: Use a USB flash drive with the capacity of 1 GB or greater. Note that all USB flash drives are not guaranteed to be compatible.



YH8000

TDLS8000 SCU

# 10. Troubleshooting

This chapter explains the faults and warnings that the TDLS8000 may detect. It also explains how to inspect and restore the TDLS8000 when other problems occurs.

TDLS8000 is composed Laser Unit and Sensor control Unit. And these units are adjusted and checked in combined. Off-site repair is necessary as a result of troubleshooting, the both units are sent to factory.

## 10.1 Fault Display and Handling

A fault occurs when the various types of diagnostic information being monitored by the self-diagnostics function are clearly abnormal and correct concentration calculation is not possible. It may signify a malfunction. If a fault occurs, the TDLS8000 output and display will respond in the following manner.

- The analog output is set to the specified state.
- The fault contact is opened.
- The fault LED (red) lights.
- The alarm indicator blinks on the YH8000 display.
- Alarm information is indicated over HART communication (see section 7.4).
- Alarm information is shown on the SCU display.

The following table shows the fault types and their corrective actions. Alarm numbers are defined for fault type identification. These numbers are shared among the YH8000, HART, and SCU displays, even though the abbreviations of the displayed fault names may differ. Depending on the alarm, a sub number may also be displayed. This number is used by Yokogawa service representatives for troubleshooting purposes.

### NOTE

When Safety mode is enabled, a fault that occurs is not cleared automatically even when the cause of the fault is eliminated. Except for a portion of the faults, executing Clear Latched Alarms clears them, but if the cause of the fault is still present, the fault will occur again. If this happens, the device may have malfunctioned, so contact your Yokogawa service representative.

Execution menu path:

[HART] "Diagnosis/Service>>>System>>Clear latched alarms"

[YH8000] ">>Execution>>System>>Clear Latched Alarms"

No.	Displayed name (HART)	Description	Corrective action
45	Laser Md Temp Low	The laser module temperature is too low.	Check the laser unit's ambient temperature. Contact your Yokogawa service representative.
46	Laser Md Temp High	The laser module temperature is too high.	Check the laser unit's ambient temperature. Contact your Yokogawa service representative.
47	Laser Temp Low	The laser temperature is too low.	Contact your Yokogawa service representative.
48	Laser Temp High	The laser temperature is too high.	Contact your Yokogawa service representative.
50	Peak Center OOR	The absorption peak position is outside the range.	Contact your Yokogawa service representative.
51	Ref Peak Height Low	The reference peak height is too low.	Contact your Yokogawa service representative.

No.	Displayed name (HART)	Description	Corrective action
53	Transmission Lost	The transmission is too low to continue measurements.	Check that the alignment is correct. Check whether the laser beam is being blocked. Check whether the process window is stained. For details, see “9.1 Maintaining the Laser Beam and Transmission”.
54	Ref Trans Low	The reference cell transmission is too low.	Contact your Yokogawa service representative.
55	R Peak Height High	The reference cell peak height is too high.	Contact your Yokogawa service representative.
57	Laser Unit Fail	The laser unit failed.	Contact your Yokogawa service representative.
58	Inter Comm Fail	Internal communication error occurred.	Contact your Yokogawa service representative.
59	Laser Module Error	The laser module failed.	Contact your Yokogawa service representative. (*1)
60	File Access Error	File access error.	Contact your Yokogawa service representative. (*1)
61	EEPROM Error	EEPROM error.	Contact your Yokogawa service representative. (*1)
62	LU Connect Error	An error occurred in the laser unit connection.	Check that the laser unit connection cable is not loose. Contact your Yokogawa service representative.
63	FPGA Failure	FPGA failure.	Contact your Yokogawa service representative. (*1)
64	Program Error	Internal error occurred.	Contact your Yokogawa service representative. (*1)

\*1: Cannot be cleared using Clear Latched Alarms. If the fault occurs again even if you restart the TDLS8000, contact your Yokogawa service representative.

## 10.2 Warning Display and Handling

A warning occurs when the various types of diagnostic information being monitored by the TDLS8000 self-diagnostics function are outside the normal range. If a warning occurs, the TDLS8000 output and display will respond in the following manner.

- The analog output is set to the specified state (the factory default hold setting is off).
- DO digital output is generated (for the digital output wiring, see “3.2.5 Wiring Digital Outputs”).
- The DO LED (yellow) lights.
- The alarm indicator blinks on the YH8000 display.
- Alarm information is indicated over HART communication (see section 7.4).
- Alarm information is shown on the SCU display.

The following table shows the warning types and their corrective actions. Alarm numbers are defined for warning type identification. These numbers are shared among the YH8000, HART, and SCU displays, even though the abbreviations of the displayed warning names may differ. Depending on the alarm, a sub number may also be displayed. This number is used by Yokogawa service representatives for troubleshooting purposes.

No.	Displayed name (HART)	Description	Corrective action
1	Transmission Low	The transmission is less than the low limit.	Check that the alignment is correct. Check whether the laser beam is being blocked. Check whether the process window is stained. Check the low limit alarm threshold value. For details, see "9.1 Maintaining the Laser Beam and Transmission".
2	Pressure Low	The process pressure is less than the low limit.	Check the process gas pressure. Check whether the gas pressure meter signal is correct. Check whether the AI range setting is correct. Check the low limit alarm threshold value. For details, see "5.3.6 Setting Process Alarms".
3	Pressure High	The process pressure is greater than the high limit.	Check the process gas pressure. Check whether the gas pressure meter signal is correct. Check whether the AI range setting is correct. Check the high limit alarm threshold value. For details, see "5.3.6 Setting Process Alarms".
4	Temperature Low	The process temperature is less than the low limit.	Check the process gas temperature. Check whether the gas thermometer signal is correct. Check whether the AI range setting is correct. Check the low limit alarm threshold value. For details, see "5.3.6 Setting Process Alarms".
5	Temperature High	The process temperature is greater than the high limit.	Check the process gas temperature. Check whether the gas thermometer signal is correct. Check whether the AI range setting is correct. Check the high limit alarm threshold value. For details, see "5.3.6 Setting Process Alarms".
6	Conc Gas1 Low	The component 1 gas concentration is less than the low limit.	Check the component 1 gas concentration. Check the low limit alarm threshold value. For details, see "5.3.6 Setting Process Alarms".
7	Conc Gas1 High	The component 1 gas concentration is greater than the high limit.	Check the component 1 gas concentration. Check the high limit alarm threshold value. For details, see "5.3.6 Setting Process Alarms".
8	Conc Gas2 Low	The component 2 gas concentration is less than the low limit.	Check the component 2 gas concentration. Check the low limit alarm threshold value. For details, see "5.3.6 Setting Process Alarms".
9	Conc Gas2 High	The component 2 gas concentration is greater than the high limit.	Check the component 2 gas concentration. Check the high limit alarm threshold value. For details, see "5.3.6 Setting Process Alarms".
10	LU Temp Low	The laser unit temperature is too low.	Check the laser unit's ambient temperature. Contact your Yokogawa service representative.
11	LU Temp High	The laser unit temperature is too high.	Check the laser unit's ambient temperature. Contact your Yokogawa service representative.
12	SCU Temp Low	The sensor control unit temperature is too low.	Check the sensor control unit's ambient temperature. Contact your Yokogawa service representative.
13	SCU Temp High	The sensor control unit temperature is too high.	Check the sensor control unit's ambient temperature. Contact your Yokogawa service representative.
14	Validation Required	Validation is required for verifying the measurement accuracy.	Execute validation. Or, if you confirm that validation is not required, clear the alarm. (*1)
15	Validation Error	Validation failed.	Verify the check gas. Check whether the validation settings are correct. For details, see "9.2 Online Validation" and "9.4 Offline Validation". (*1)
16	Zero Cal Error	Zero calibration failed.	Check the zero calibration gas. Check whether the zero calibration settings are correct. For details, see "9.5 Zero Calibration". (*2)
17	Span Cal Error	Span calibration failed.	Check the span calibration gas. Check whether the span calibration settings are correct. For details, see "9.6 Span Calibration". (*2)
19	Non Process Alarm	The non-process reference peak height is too low.	Check whether the purge gas is running. Check the purge gas concentration. Contact your Yokogawa service representative.
20	AI-1 (Pres) Low	The AI-1 (pressure) input current is less than 4 mA.	Check the process gas pressure. Check whether the gas pressure meter signal is correct. Check whether the AI range setting is correct. For details, see "6.3 Analog Input Settings".
21	AI-1 (Pres) High	The AI-1 (pressure) input current is more than 20 mA.	Check the process gas pressure. Check whether the gas pressure meter signal is correct. Check whether the AI range setting is correct. For details, see "6.3 Analog Input Settings".

No.	Displayed name (HART)	Description	Corrective action
22	AI-2 (Temp) Low	The AI-2 (temperature) input current is less than 4 mA.	Check the process gas temperature. Check whether the gas thermometer signal is correct. Check whether the AI range setting is correct. For details, see "6.3 Analog Input Settings".
23	AI-2 (Temp) High	The AI-2 (temperature) input current is more than 20 mA.	Check the process gas temperature. Check whether the gas thermometer signal is correct. Check whether the AI range setting is correct. For details, see "6.3 Analog Input Settings".
24	External Alarm	An alarm triggered by digital input occurred.	Check the external alarm status.
25	Clock Adj Required	The real-time clock is not synchronized.	Set the current time.
26	Setting File Error	Restored from backup due to a setup file corruption.	Configure the settings again, and restart.
27	Calib File Error	Restored from backup due to a calibration file corruption.	Calibrate again, and restart.
49	Detect Signal High	The detector signal level is too high.	Contact your Yokogawa service representative.
52	Absorption High	The absorption signal level is too high.	Contact your Yokogawa service representative.
56	Outlier Reject Lmt	The detector signal level is abnormal.	Contact your Yokogawa service representative.

\*1: For validation alarms, you can manually clear the alarm without re-executing validation.

Menu path:

[HART] "Diagnosis/Service>>Validation>>Clear val alarms"

[YH8000] ">>Execution>>Validation>>Clear Validation Alarm"

\*2: For calibration alarms, you can manually clear the alarm without re-executing calibration.

Menu path:

[HART] "Diagnosis/Service>>Calibration>>Clear cal alarms"

[YH8000] ">>Execution>>Calibration>>Clear Calibration Alarm"

## 10.3 Handling Degraded Laser Transmission

For the TDLS8000 to operate normally, the optimal level of laser beam needs to reach the sensor control unit (SCU).

The following phenomena can cause the laser beam level to degrade. These factors may occur separately or together.

- Optical axis error: Degradation of received light level due to optical axis misalignment
  - The laser beam is not directed at the detector window.
  - The SCU has not be aligned with the laser incident beam.
  - Misaligned flange or nozzle is blocking the laser beam.
- Clogging: The opening where the laser beam travels through is blocked or is unclean.
  - Dust has accumulated inside nozzles or pipes, blocking the laser beam.
  - Stain or foreign substances adhering to the process window are attenuating the laser beam level.
- Particles: Dust in the process gas is attenuating the laser beam level.
  - Smoke concentration, opacity, or particle concentration is extremely high, and not enough laser beam is reaching the SCU.
- Laser degradation: The output power of the laser element itself has degraded.
  - The laser light source has degraded or malfunctioned, and not enough laser beam is being emitted.

## Improving transmission

This section provides corrective actions for when the transmission is lost or reduced after installing the TDLS8000.

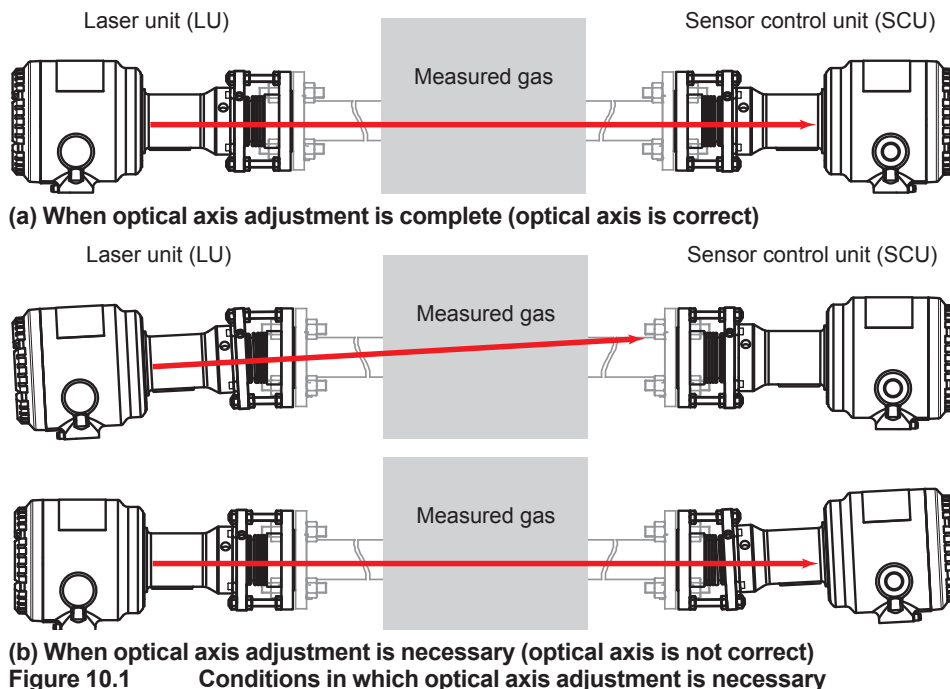
### (1) Checking for mechanical blockage

If process isolation valves or the like are used to shut off the process gas for periodic maintenance, check that the valve for the LU or SCU is not closed. Since the laser beam will be blocked if the valve is closed, open it. If the transmission does not improve even when the valve is opened, other factors may be causing the problem.

### (2) Adjusting the optical axis

If the laser beam is not shut off but the transmission is low, double check that the optical axis is adjusted correctly. As described in “9.1 Maintaining the Laser Beam and Transmission”, normally optical axis adjustment and transmission calibration are performed after the TDLS8000 is installed. But if the process gas temperature is high, the optical axis may diverge from the initial adjustment due to a deformation in the duct or the like causing the process flange or nozzle to be misaligned.

If optical axis readjustment is necessary, do so by referring to “3.3 Optical Axis Adjustment”.

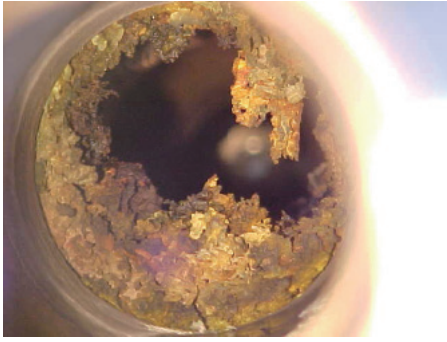


If the transmission does not improve even when the optical axis adjustment described in section 3.3 is executed, other factors may be causing the problem.

### (3) Checking and correcting the opening to the process

If no improvement is seen even when the measures described in (1) and (2) above are taken, the condition of the opening to the process may be causing the problem. For example, if dust or the like in the process gas accumulates inside a process flange or insertion tube, it may block the laser beam.

Remove the TDLS8000 from the alignment flange, and check that deposits have not accumulated inside the process flanges and insertion tubes. If deposits are found, remove it according to the following procedure.



**Figure 10.2** Example of deposits in the opening

- (a) Turn the power off.
- (b) Stop the LU and SCU analyzer purging.
- (c) Remove the LU and SCU from the alignment flange.
- (d) Check the condition of the process opening through the process window.

If accumulation is found, take the following corrective action.

- (e) Remove the process interface (alignment flange or process isolation flange).
- (f) If insertion tubes are used, remove them from the process. Then, remove the deposits. If deposits are found in the process flanges, remove them.
- (g) Attach the process interface to the process again.
- (h) Install the TDLS8000, supply purge gas and power, and turn on the power.

If you removed the alignment flange, readjust the optical axis according to “3.3 Optical Axis Adjustment”.

If the transmission does not improve even when deposits are removed, other factors may be causing the problem.

#### **(4) Checking and correcting laser output degradation or loss**

If the transmission is low or at zero even when the corrective measures described in (1), (2), and (3) are taken, the laser output may be degraded or the laser itself may be malfunctioning.

To check the laser output power, follow the procedure below.

- (a) Turn off the TDLS8000.
- (b) Remove the LU and SCU from the process.



### **CAUTION**

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Be sure to turn off the TDLS8000 before removing it from the process.

Removing the TDLS8000 without turning off the power constitutes a risk of laser beam entering your eye.

---

- (c) Connect the LU and SCU directly as shown in Figure 10.3.  
Connect it so that the laser beam is not blocked.



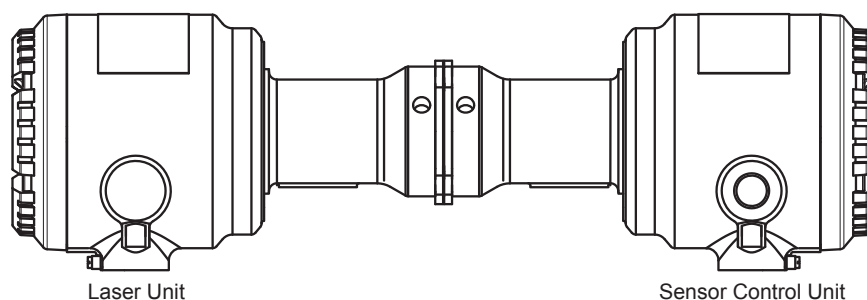


Figure 10.3 Direct connection of the LU and SCU

(d) Turn the power on, and check the transmission.

If the transmission improved as a result of connecting the LU and SCU directly, slightly adjust the angle to check whether the signal intensifies. If the transmission is zero even if you adjust the angle between the LU and SCU, the device is broken. Please consult with Yokogawa.

## 10.4 Process Window Replacement

If the stain on the surface of a process window does not come off even if you clean it according to section 9.1.2 or if the surface has corroded due to corrosive gas such as hydrogen fluoride, you need to replace the process window. Replace it according to the procedures in sections 10.3.2 and 10.3.3. When you replace a process window, be sure to also replace the O-ring.

### 10.4.1 Replacement Parts (Process window)

If you need to replace a process window, prepare the relevant parts in Table 10.1.

Table 10.1 Replacement parts

No.	Parts no.	Parts name	Purpose *	Quantity
1	K9772RA	Process window unit	For alignment flanges (for -X1, -X2)	1 or 2
2	K9772RB	Process window unit	For alignment flanges (for -H1)	
3	K9772RC	Process window unit	For alignment flanges (for -A1)	
4	K9772RD	Process window unit	For alignment flanges (for -H3)	
5	K9772RE	Process window unit	For alignment flanges (for -C3, -C4)	
6	K9772TH	O-ring	For process window attached to alignment flange	
7	K9775EA	Sapphire window unit	For process isolation flanges or flow cells (for -X1, -X2)	
8	K9775EB	Sapphire window unit	For process isolation flanges or flow cells (for -H1)	
9	K9775EC	Sapphire window unit	For process isolation flanges or flow cells (for -A1)	
10	K9775ED	Sapphire window unit	For process isolation flanges or flow cells (for -H3)	
11	K9775EE	Sapphire window unit	For process isolation flanges or flow cells (for -C3, -C4)	
12	K9775GE	O-ring	For process window attached to process isolation flange or attached to flow cell For process window attached to flow cell	

\*:

## 10.4.2 Process Window Replacement Procedure (Alignment flange)

The procedure for replacing the process window mounted on an alignment flange is provided below.

### NOTE

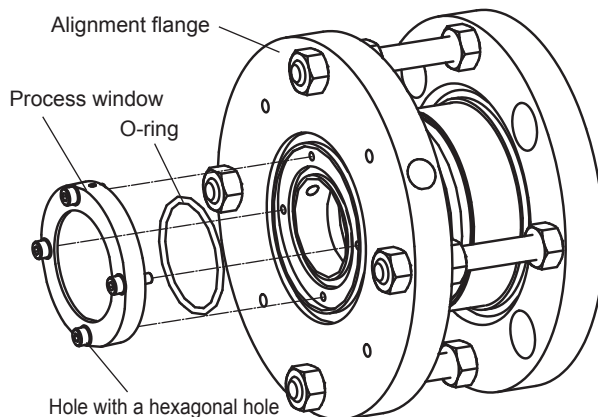
Before removing the process window, check that the process is completely stopped or that the TDLS8000 is isolated from the process and no process gas will be discharged. Never remove a process window while the process is running as it is extremely dangerous.

### CAUTION

Be careful in handling the process window as it is made of optical glass.

- (1) Turn the power off.
- (2) Stop the purge gas.
- (3) Remove the purge piping.
- (4) Remove the TDLS8000 from the process.  
(If necessary, separate it completely from the process such as by using a process isolation valve.)
- (5) Check the stained area of the process window, and remove the relevant process window.
- (6) Loosen the four M4 screws with hexagonal holes on the process window holder installed in the alignment flange, and remove the process window.
- (7) Install a new process window. Replace the O-ring also.

The position of the O-ring is indicated in Figure 10.4. Firmly mount the O-ring in the O-ring groove.



**Figure 10.4** Replacing the process window and O-ring of an alignment flange

- (8) Pay attention to the orientation of the process window. Install it in the same orientation as before.  
Tighten the screws evenly.
- (9) After installing the process window, install the TDLS8000 for use.

### 10.4.3 Process Window Replacement Procedure (Process isolation flange)

The procedure for replacing the process window mounted on a process isolation flange is provided below.

#### NOTE

Before removing the process window, check that the process is completely stopped or that the TDLS8000 is isolated from the process and no process gas will be discharged. Never remove a process window while the process is running as it is extremely dangerous.

#### CAUTION

Be careful in handling the process window as it is made of optical glass.

- (1) Turn the power off.
- (2) Stop the purge gas.
- (3) Remove the purge piping.
- (4) Remove the TDLS8000 from the process.  
(If necessary, separate it completely from the process such as by using a process isolation valve.)
- (5) Remove the alignment flange.
- (6) Check the stained area of the process window of the process isolation flange, and remove the process window.
- (7) Loosen the six M5 screws with hexagonal holes on the process window holder installed in the process isolation flange, and remove the process window.

Make sure not to drop the process window. There is no mechanism from preventing the screws with hexagonal holes or the washers from falling. Make sure not to drop or lose them.

- (8) Install a new process window. Replace the O-ring also.

The position of the O-ring is indicated in Figure 10.5. Firmly mount the O-ring in the O-ring groove.

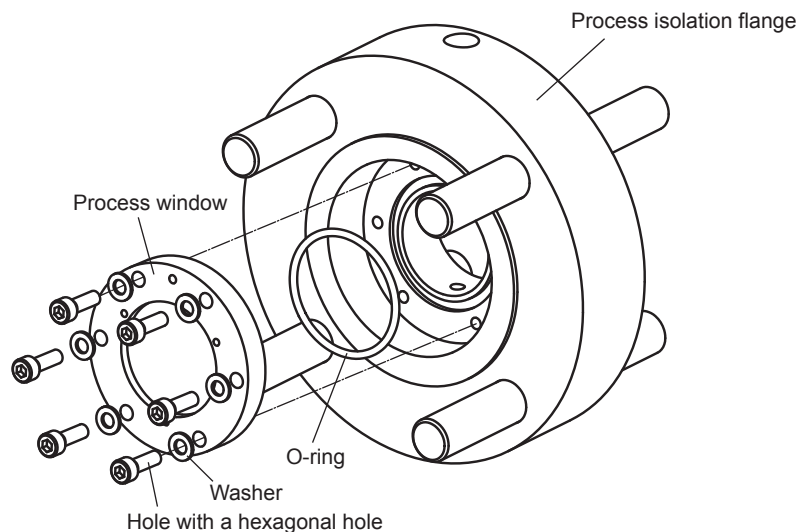


Figure 10.5 Replacing the process window and O-ring of a process isolation flange

- (9) Pay attention to the orientation of the process window. Install it in the same orientation as before.  
Tighten the screws evenly.
- (10) After mounting the process window, install the alignment flange and then the TDLS8000.  
Since you removed the alignment flange from the process, readjust the optical axis.

#### 10.4.4 Process Window Replacement Procedure (Flow cell)

The procedure for replacing the process window mounted on a flow cell is provided below.

There are two types of process windows used in a flow cell: a process window mounted on the alignment flange for the flow cell and a process window mounted on the flow cell itself. The process window mounted on the flow cell itself can only be replaced by removing the alignment flange for the flow cell.

#### NOTE

Before removing the process window, check that the process is completely stopped or that the TDLS8000 is isolated from the process and no process gas will be discharged. Never remove a process window while the process is running as it is extremely dangerous.

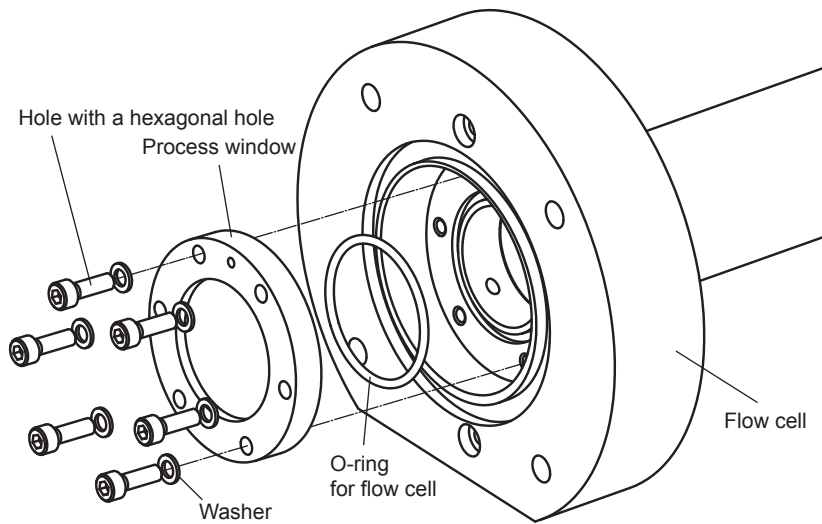
#### CAUTION

Be careful in handling the process window as it is made of optical glass.

- (1) Turn the power off.
- (2) Stop the purge gas.
- (3) Remove the purge piping.
- (4) Remove the TDLS8000 from the flow cell.  
(Be sure to separate the flow cell completely from the process in advance such as by using a process isolation valve.)
- (5) The procedure to replace the process window mounted on the alignment flange is similar to that explained in 10.4.2.
- (6) To remove the process window mounted on the flow cell, remove the alignment flange mounted on the flow cell.
- (7) Check the stained area of the process window of the flow cell, and remove the process window.
- (8) Loosen the six M5 screws with hexagonal holes on the process window holder installed in the flow cell, and remove the process window.

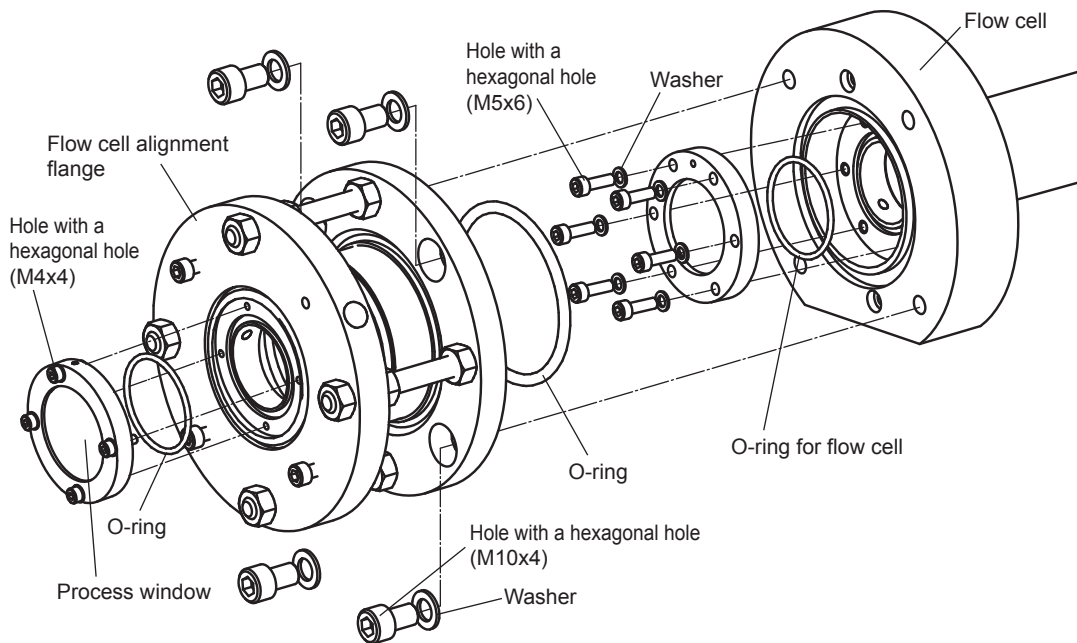
Make sure not to drop the process window. There is no mechanism from preventing the screws with hexagonal holes or the washers from falling. Make sure not to drop or lose them.

For details on how to install and remove the process window, see Figure 10.6.



**Figure 10.6** Removing and installing the process window of a flow cell

- (9) Install a new process window. Replace the O-ring for flow cell also. The position of the O-ring is indicated in Figure 10.7.



**Figure 10.7** Replacing the process window and O-ring of a flow cell

- (10) Pay attention to the orientation of the process window. Install it in the same orientation as before. Tighten the screws evenly.
- (11) After mounting the process window, install the alignment flange for the flow cell and then the TDLS8000. Since you removed the alignment flange for the flow cell from the process, readjust the optical axis.

## 10.5 Fuse Replacement

- (1) To safely replace the fuse, shut off the external circuit breaker to stop the power supply to the TDLS8000.
- (2) Remove the fuse from the fuse holder. Using a flat-blade screwdriver that matches the holder cap, turn the cap 90 degrees counterclockwise.  
Then you will be able to remove the fuse with the cap.
- (3) Check that the rating of the new fuse is correct, place it in the fuse cap, and insert the cap in the holder. Using a flat-blade screwdriver, turn the cap 90 degrees clockwise while pressing down.
- (4) If the new fuse blows immediately, there may be a problem with the circuitry. Contact your Yokogawa representative.

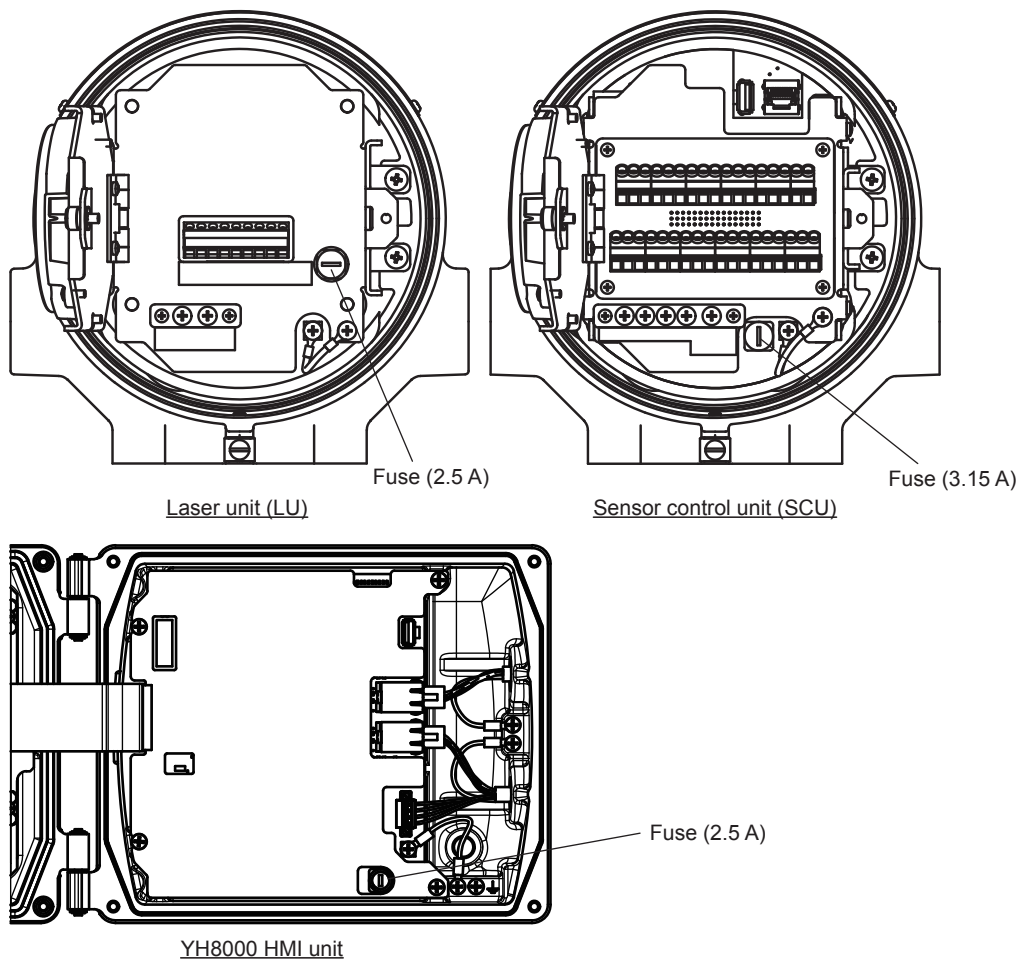


Figure 10.8 Fuse replacement

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## 10.6 Communication Interruption during Manual Calibration and Validation

If the communication between HART or YH8000 and the TDLS8000 is disconnected while performing manual calibration or validation from HART or YH8000, take the following corrective action.

- **HART**

See “7.5.3 Aborting Calibration and Validation”.

- **YH8000**

- (1) Reconnect.
- (2) Tap  to enter the TDLS8000 configuration screen. The screen for the calibration or validation in progress automatically recovers. You can continue the calibration or validation.





# 11. Modbus

Modbus protocol can be used for TDLS8000 DCS communication. This section explains the Modbus communication specifications that apply to the TDLS8000.

The main uses of Modbus communication on the TDLS8000 are shown below. Only a portion of the TDLS8000 configuration function is supported.

- Checking measured values, I/O, and alarms
- Executing calibration, validation, and clock setting
- A portion of configuration functions (setting the current stream, inputting the temperature and pressure)

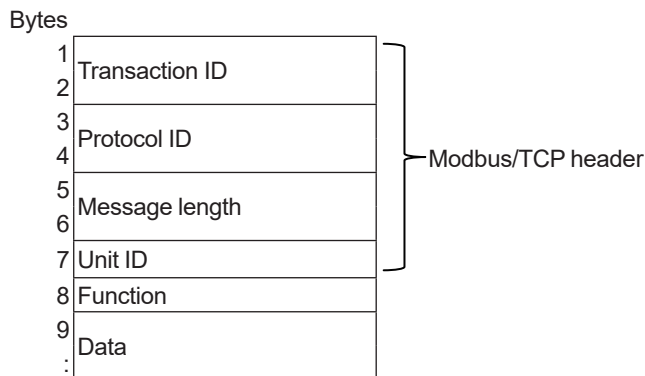
## 11.1 Communication Specifications

The TDLS8000 can be used as a Modbus slave device. Modbus communication is possible by connecting to a master device via Ethernet cable.

Communication standard	Ethernet
Number of sessions (max.)	2
Protocol	Modbus/TCP
Port number	502

### 11.1.1 Message Structure

The communication message structure is shown below. The first seven bytes are the Modbus/TCP header.



- **Transaction ID**

Data assigned by the master device to manage transactions. Slave devices simply return the received value.

- **Protocol ID**

Fixed at zero.

- **Message length**

Data byte length after the unit ID.

● **Unit ID**

Don't care for Modbus/TCP. Slave devices simply return the received value.

● **Function**

The supported function numbers are listed in the following table.

Function no.	Function	Type	Max. number of data points per transaction
1	Read coils	Bit	2000 points
2	Read the input relays	Bit	2000 points
3	Read hold registers	Word	125 points
4	Read the input registers	Word	125 points
5	Write to a single coil	Bit	1 point
6	Write to a single hold register	Word	1 point
16	Write to hold registers	Word	123 points
43	Read device information	ASCII string	(*1)

\*1: The following parameters, which are basic device ID parameters (in the basic category) are read by function 43.

ID	Object name	Meaning	Value
0x00	VenderName	Vendor name	"YOKOGAWA"
0x01	ProductCode	Product code	"TDLS8000"
0x02	MajorMinorRevision	Revision number	"[Device Revision]-[Software Revision]" Example: "01-1.01.01"

● **Data**

There are two types of data: "coil/relay" in unit of bits and "register" in unit of 16 bits. Data attributes and data addresses are shown in the following table.

Type	Attribute	Modbus name	Address (*1)	Application
Bit	W	Coil	0XXXX	Instruction
	R	Input relay	1XXXX	Status
Register	R	Input register	3XXXX	Measured value
	W	Hold register	4XXXX	Valve control, temperature/pressure input

\*1: XXXX: 0001 to 9999

## 11.1.2 Slave Response

Function and subsequent content of response messages vary depending on whether there are errors in instruction messages.

● **Normal response**

In the case of writing to a single coil or single hold register, the slave device returns the same message as the instruction message. In the case of a read function, the read data is added to the function in the response message. If an address in which no data is assigned is read, zero, not an error, is returned as the read data.

● **Error response**

If there is an error in the instruction message, the slave device returns an error response without executing the instruction. In an error response, the slave device returns the value obtained by adding 128 to the instruction function as the error function. Therefore, the master device can check the function in the response message to determine whether an instruction has been accepted normally. If the master device determines an error has occurred, it can find out the details by checking the error code.

The message structure from the function and beyond in an error response is as follows.

Error function (instruction function + 128)
Error code

The error code details are provided below.

Error code	Description
01	Function code error (nonexistent function)
02	Coil, input relay, or register address error (out of range)
03	Coil, input relay, or register data number error (out of range)
06	During instruction message execution, an error which is the slave device cannot execute occurs. Example: Writing not possible because maintenance is in progress
07	Command error Example: Write-data is out of range.

## 11.2 Coil

Coil name	Address	Action performed when "1" is set
Automatic zero calibration execution	00001	Remotely execute an automatic zero calibration
Automatic span calibration execution	00002	Remotely execute an automatic span calibration
Automatic offline validation 1 execution	00004	Remotely execute automatic offline validation 1
Automatic offline validation 2 execution	00005	Remotely execute automatic offline validation 2
Automatic online validation 1 execution	00006	Remotely execute automatic online validation 1
Automatic online validation 2 execution	00007	Remotely execute automatic online validation 2
Time set instruction	00008	Set the hold register time value (40201 to 40206)
Automatic zero+span calibration execution	00009	Remotely execute an automatic zero+span calibration
Automatic offline validation 1+2 execution	00010	Remotely execute automatic offline validation 1+2

## 11.3 Input relay

Input relay name	Address	Description
Analyzer error	10001	Alarm occurring when set to 1 (refer to address 10101 and beyond for the alarm details)
Maintenance in progress	10002	Maintenance in progress when set to 1
AO-1, 2 fixed output	10003	Both AO-1 and 2 fixed output when set to 1
AO-1 fixed output	10004	AO-1 fixed output in progress when set to 1
AO-2 fixed output	10005	AO-2 fixed output in progress when set to 1
Zero calibration in progress	10006	Zero calibration in progress when set to 1
Span calibration in progress	10007	Span calibration in progress when set to 1
Offline validation in progress	10009	Offline validation in progress when set to 1
Online validation in progress	10010	Online validation in progress when set to 1
Warming up	10013	Warming up when set to 1
Normal measurement in progress	10014	Normal measurement in progress when set to 1
Measurement update notification	10015	Set to 1 after measurement is updated. Reading this address resets the value to 0. (*1)
Alarm update	10016	Set to 1 when a new alarm occurs or when an alarm is cleared. Reading this address resets the value to 0. (*1)
Instruction failure update	10017	Set to 1 when an instruction by a coil fails. Reading this address or a successful next instruction resets the value to 0. (*1)
Manual Zero Calibration	10031	Calibration (validation) in progress when set to 1
Manual Span Calibration	10032	
Automatic Zero Calibration	10034	
Automatic Span Calibration	10035	
Manual Offline Validation 1	10037	
Manual Offline Validation 2	10038	
Manual Online Validation 1	10039	
Manual Online Validation 2	10040	
Automatic Offline Validation 1	10041	
Automatic Offline Validation 2	10042	
Automatic Online Validation 1	10043	
Automatic Online Validation 2	10044	
Digital input state	10051	DI-1 contact state (0: Open, 1: Closed)
	10052	DI-2 contact state (0: Open, 1: Closed)
Digital output state	10061	DO contact (DO-1) state (0: Off, 1: On)
	10062	Fault contact (DO-2) state (0: Off, 1: On)

Input relay name	Address	Description
Warning: Transmission low (AL-1)	10101	Alarm occurring when set to 1 * (AL-##) in the name column denotes the alarm number.
Warning: Process pressure low (AL-2)	10102	
Warning: Process pressure high (AL-3)	10103	
Warning: Process temperature low (AL-4)	10104	
Warning: Process temperature high (AL-5)	10105	
Warning: Concentration gas1 low (AL-6)	10106	
Warning: Concentration gas1 high (AL-7)	10107	
Warning: Concentration gas2 low (AL-8)	10108	
Warning: Concentration gas2 high (AL-9)	10109	
Warning: Laser unit temperature low (AL-10)	10110	
Warning: Laser unit temperature high (AL-11)	10111	
Warning: Sensor control unit temperature low (AL-12)	10112	
Warning: Sensor control unit temperature high (AL-13)	10113	
Warning: Validation required (AL-14)	10114	
Warning: Validation failure(AL-15)	10115	
Warning: Zero calibration error (AL-16)	10116	
Warning: Span calibration error (AL-17)	10117	
Warning: Non process alarm (AL-19)	10119	
Warning: AI Ch1 (pressure) low (AL-20)	10120	
Warning: AI Ch1 (pressure) high (AL-21)	10121	
Warning: AI Ch2 (temperature) low (AL-22)	10122	
Warning: AI Ch2 (temperature) high (AL-23)	10123	
Warning: External alarm (AL-24)	10124	
Warning: Clock adjustment required (AL-25)	10125	
Warning: Setting file corrupted (AL-26)	10126	
Warning: Calibration file corrupted (AL-27)	10127	
Fault: Laser module temperature low (AL-45)	10145	
Fault: Laser module temperature high (AL-46)	10146	
Fault: Laser temperature low (AL-47)	10147	
Fault: Laser temperature high (AL-48)	10148	
Warning: Detector signal high (AL-49)	10149	
Fault: Peak center out of range (AL-50)	10150	
Fault: Reference peak height low (AL-51)	10151	
Warning: Absorption too high (AL-52)	10152	
Fault: Transmission lost (AL-53)	10153	
Fault: Reference transmission low (AL-54)	10154	
Fault: Reference peak height high (AL-55)	10155	
Warning: Outlier rejection limit (AL-56)	10156	
Fault: Laser unit failure (AL-57)	10157	
Fault: Internal communication failure (AL-58)	10158	
Fault: Laser module error (AL-59)	10159	
Fault: File access error (AL-60)	10160	
Fault: EEPROM error (AL-61)	10161	
Fault: Laser Unit Connection Error (AL-62)	10162	
Fault: FPGA Failure (AL-63)	10163	
Fault: Program error (AL-64)	10164	

\*1: If this address is read from two sessions, the first access has priority.

## 11.4 Hold register

Name	Address	Setting details
Valve stream setting	40001	Sets the current stream 0: Stream 1 1: Stream 2 2: Stream 3 *: Note that via Modbus, exclusion check on the writing of the current stream according to the valve usage setting is not performed. For details on exclusion, see "6.8.2 Valve Usage Setting". *: Writing is not possible when maintenance is in progress.
Temperature input value	40101, 40102	Temperature input value via Modbus, IEEE754 float format (*1) The unit follows to the temperature unit setting. *: Writing is possible even when maintenance is in progress.
Pressure input value	40103, 40104	Pressure input value via Modbus, IEEE754 float format (*1) The unit follows to the pressure unit setting. *: Writing is possible even when maintenance is in progress.
Time setting (year)	40201	RTC setting date/time (year) based on 2000 (2015 is expressed as 15) (*2) (*3)
Time setting (month)	40202	RTC setting date/time (month) 1 to 12 (*2) (*3)
Time setting (day)	40203	RTC setting date/time (day) 1 to 31 (*2) (*3)
Time setting (hour)	40204	RTC setting time (hour) 0 to 23 (*2)
Time setting (minute)	40205	RTC setting time (minute) 0 to 59 (*2)
Time setting (second)	40206	RTC setting time (second) 0 to 59 (*2)

\*1: IEEE754 float format (in 2 registers, In the order upper 16 bits and then lower 16 bits)  
Write the both upper and lower bits together.

\*2: Apply the settings using the coil "time setting instruction".

\*3: Write the year, month, and day in order from the highest address.

### NOTE

When inputting the temperature value or pressure value via Modbus, set the input unit the same as the TDLS8000 unit. If input using a different unit, the concentration reading will not be output correctly.

As a default setting, when Modbus connection is shut down, the backup operation starts to restore data of temperature and pressure value. If you want to change or disable this backup function, see the description on the backup mode in the section 6.1.2.

# 11.5 Input register

Input register name	Address	Description												
Concentration value	30001, 30002	Component 1 gas concentration value, IEEE754 float format (*1) The unit follows to the component 1 gas setting.												
	30003, 30004	Component 2 gas concentration value, IEEE754 float format (*1) The unit follows to the component 2 gas setting.												
Transmission value	30007, 30008	Transmission [%], IEEE754 float format (*1)												
Temperature value	30011, 30012	Temperature value, IEEE754 float format (*1) The unit follows to the temperature unit setting.												
Pressure value	30015, 30016	Pressure value, IEEE754 float format (*1) The unit follows to the pressure unit setting.												
AI value	30019, 30020	AI-1 current value [mA], IEEE754 float format (*1)												
	30021, 30022	AI-2 current value [mA], IEEE754 float format (*1)												
AO value	30025, 30026	AO-1 current value [mA], IEEE754 float format (*1)												
	30027, 30028	AO-2 current value [mA], IEEE754 float format (*1)												
Calibration/validation execution state	30031	A value indicating the calibration/validation execution state <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Value</th> <th>Calibration state</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Not in progress</td> </tr> <tr> <td>1</td> <td>Zero calibration</td> </tr> <tr> <td>2</td> <td>Span calibration</td> </tr> <tr> <td>5</td> <td>Offline validation</td> </tr> <tr> <td>6</td> <td>Online validation</td> </tr> </tbody> </table>	Value	Calibration state	0	Not in progress	1	Zero calibration	2	Span calibration	5	Offline validation	6	Online validation
Value	Calibration state													
0	Not in progress													
1	Zero calibration													
2	Span calibration													
5	Offline validation													
6	Online validation													
Active alarm state value	30035 to 30038	Indicates active alarm states. A value in unsigned long format (Big-endian arrangement in four registers). Bit numbers corresponding to alarm numbers in which warning or fault is occurring are set to 1. When multiple alarms are occurring, they are expressed as a sum of the bits. Example: The read value when transmission low (alarm number 1) and transmission lost (alarm number 53) are occurring is 0x10000000000001: 30035: 0x0010\$3 30036: 0x0000\$3 30037: 0x0000\$3 30038: 0x0001\$3												
SCU temperature	30051 to 30052	[degC] temperature of Sensor Control Unit (SCU) , IEEE754 float(*1)												
LU temperature	30053 to 30054	[degC] temperature of Laser Unit (LU), IEEE754 float(*1)												
Current time (year)	30201	RTC Current time (year) based on 2000												
Current time (month)	30202	RTC Current time (month) 1 to 12												
Current time (day)	30203	RTC Current time (day) 1 to 31												
Current time (hour)	30204	RTC Current time (hour) 0 to 23												
Current time (minute)	30205	RTC Current time (minute) 0 to 59												
Current time (second)	30206	RTC Current time (second) 0 to 59												

\*1: IEEE754 float format (in 2 registers, In the order upper 16 bits and then lower 16 bits)  
Read the both upper and lower bits together.





# Appendix 1 Constructing Unit Connection Cables

Use the separately-sold exclusive cable to connect between the sensor control unit (SCU) and the laser unit (LU). This section explains how to terminate this cable.

## NOTE

To maintain the TDLS8000 performance and functionality, be sure to use exclusive type of cables sold separately.

### ● Required components and tools

- Wire cutter
- Wire stripper
- Round crimp-on terminals (for M4 screws, nominal cross sectional area of wire 2 mm<sup>2</sup>), 2 pcs.  
FV2-4 by J.S.T. Mfg. Co.,Ltd. or 170782-1 by TE Connectivity, or equivalent
- Crimp tool for round crimp-on terminals
- Heat shrink tubes  
Inner diameter 6 mm, length approx. 110 mm, 2 pcs.  
Inner diameter 16 mm, length approx. 50 mm, 2 pcs.
- Heating gun (for shrinking heat shrink tubes)

### ● Cable specifications

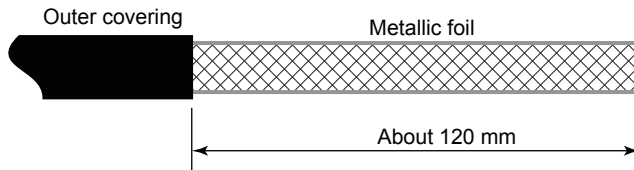
- |                               |  |
|-------------------------------|--|
| • Number of pairs             | 4 pairs<br>(1 pair for laser unit power supply, 3 pairs for inter-unit communication)  |
| • Category                    | CAT5E  |
| • Shield                      | Shield for each pair and shield for the whole cable  |
| • Wire diameter               | AWG18 (black/white) for laser unit power supply,<br>AWG22 (blue/white, orange/white, green/white) for inter-unit communication |
| • Cable outer diameter        | Approx. ø13.5 mm   |
| • Flame resistance            | VW-1   |
| • Operating temperature range | -25°C to +90°C   |
| • Usage environment           | Indoor/outdoor   |

Select cables with the appropriate length from 2.2.5 Unit Connection Cable according to the TDLS8000 installation conditions and adjust the length if necessary.

● **How to terminate the cables**

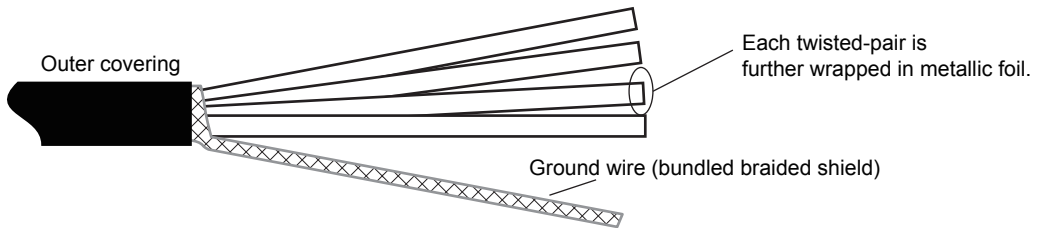
Terminate both ends of the cables in the same manner.

- (1) Remove about 120 mm of the outer cover from the ends of the cables.  
Be careful not to damage the wires, shields, and the like in the cables.



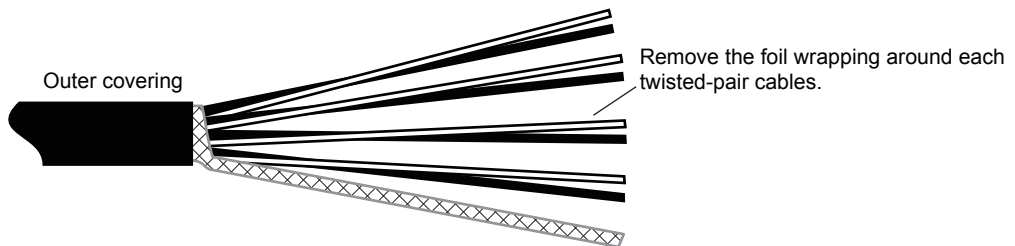
**Remove the outer cover.**

- (2) Loosen and undo the braid of the shield to see the entire 4 pairs of foil-wrapped cables inside. Bundle and twist the unbraided shield into a ground wire.



**Unbraid the external metallic shield and pull out the cables.**

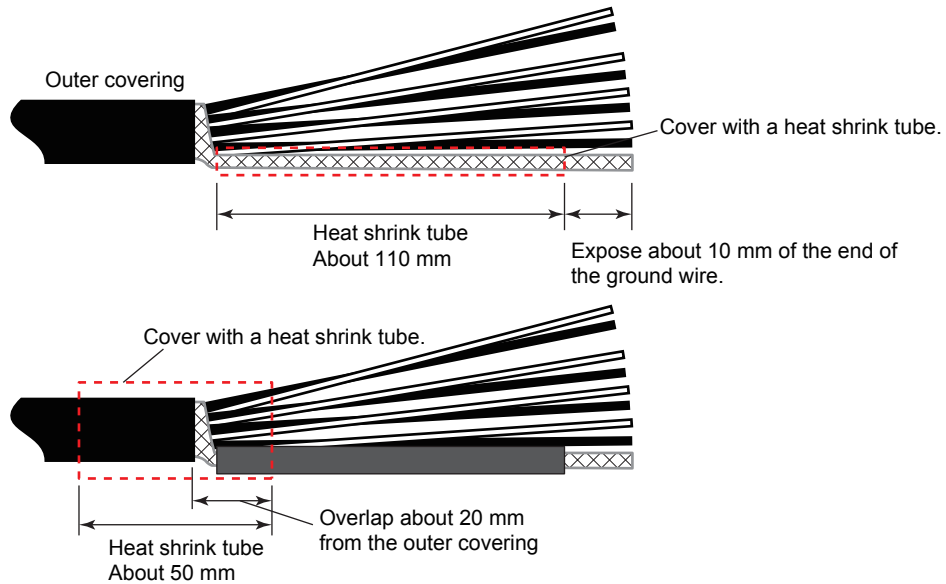
- (3) Remove the metallic foils from each twisted-pair (four pairs) cables.



**Remove the foil from each twisted-pair cables.**

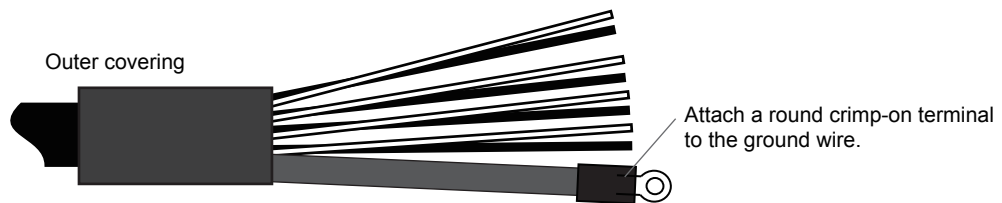
- (4) Wrap a heat-shrink tube (6 mm inner diameter, about 110 mm in length) around the bundled braided shield (ground wire) and apply a heat treatment. Keep about 10 mm of the ends of the ground wire uncovered with the heat shrink tube.

Then wrap the whole bundled cables with another heat shrink tube (16 mm inner diameter, 50 mm in length). Be sure to let the tube overwrapping on the outer layer (jackets) of twisted pair cables and the heat-sealed tube around the ground wire.( see below.) Apply the heat treatment on the heat-shrink tube.



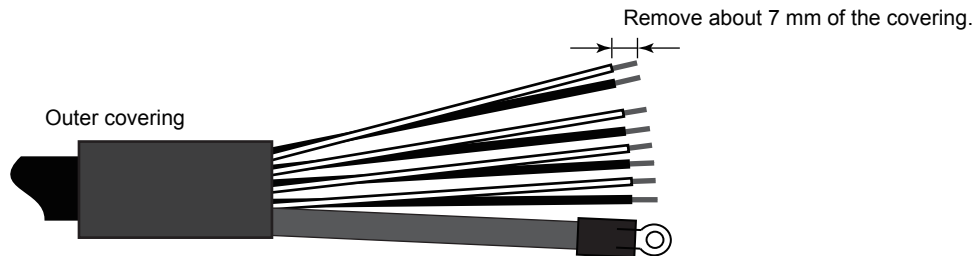
**Cover with a heat shrink tube.**

- (5) Attach a round crimp-on terminal (for M4 screws, nominal cross sectional area of wire 2 mm<sup>2</sup>) to the end of the bundled ground wire.



**Attach a round crimp-on terminal to the end of the ground wire**

- (6) Strip about 7 mm of covering (jacket) from the ends of each twisted-pair.



**Remove the covering (jacket) from the ends of each twisted-pair**

This completes the cable termination procedure.

The ends of the twisted-pair cables can be screwed on to the terminal block with the covering (jackets) stripped. To crimp a pin terminal to the ends of twisted-pairs, use the following recommended product or equivalent.

Connection wire size and recommended product:

AWG18 ,for black/white cable: Weidmüller H 0.75/12

AWG22, for other color pairs; Weidmüller H 0.34/10

## ■ When using BELDEN 1475A

BELDEN 1475A can be used as unit connection cables if the cable length is less than 25 m. This section describes how to construct unit connection cables when using BELDEN 1475A.

### ● Required components and tools

- Wire cutter
- Wire stripper
- Round crimp-on terminals (for M4 screws, nominal cross sectional area of wire  $5.5 \text{ mm}^2$ ), 2 pcs. FV5.5-S4 by J.S.T. Mfg. Co.,Ltd. or 324915 by TE Connectivity, or equivalent
- Crimp tool for round crimp-on terminals
- Heat shrink tubes  
Inner diameter 6 mm, length approx. 110 mm, 2 pcs.  
Inner diameter 16 mm, length approx. 50 mm, 2 pcs.
- Heating gun (for shrinking heat shrink tubes)

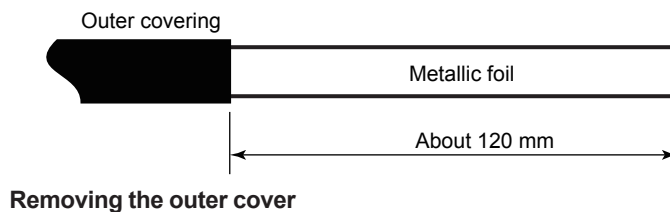
### ● Cable specifications

Manufacturer and model BELDEN 1475A.  
For detailed cable specifications, visit Belden website.  
Make the cable length less than 25 m.

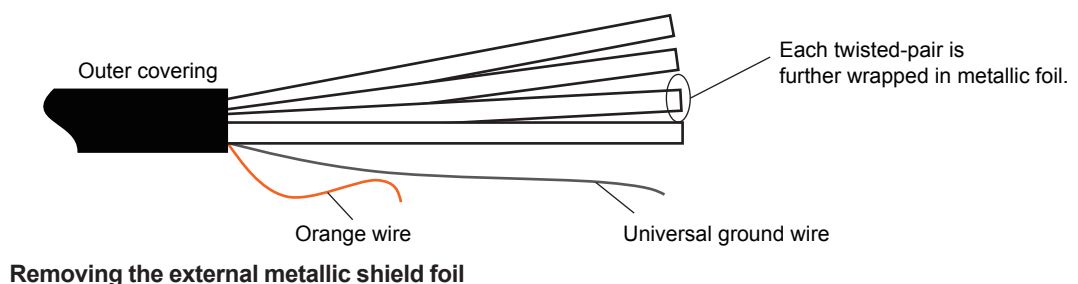
### ● How to terminate the cables

Terminate both ends of the cables in the same manner.

- (1) Remove about 120 mm of the outer cover from the ends of the cables.  
Be careful not to damage the wires, shields, and the like in the cables.



- (2) Remove the metallic shield foil from the outside of the cable.



- (3) Remove the metallic shield foil from each twisted-pair (four pairs) and the orange wire.



**Removing the metallic shield foil from each twisted-pair and the orange wire**

- (4) Bundle the ground wire of each twisted-pair (four pairs) and the universal ground wire together.

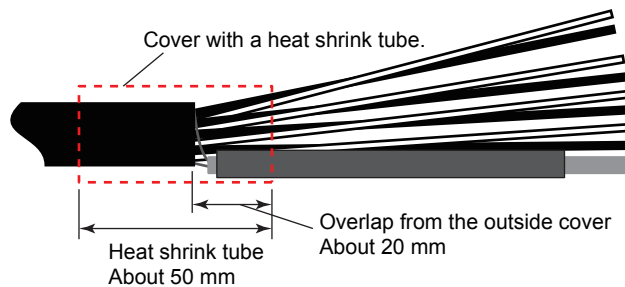
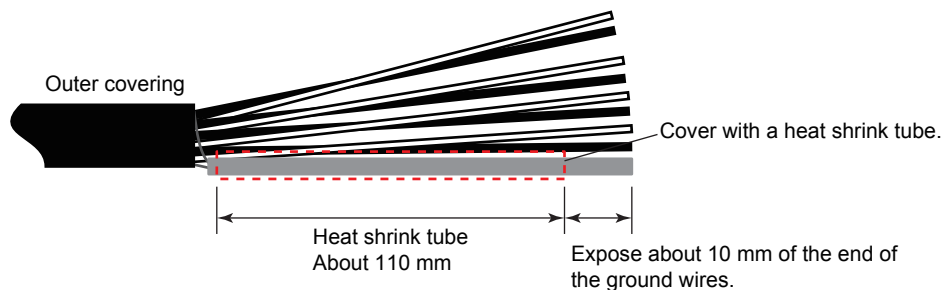
Each twisted-pair consists of a black wire and a white wire. On the cover of each wire, the pair number (ONE, TWO, THREE, FOUR) is marked. If necessary, apply additional markings for twisted-pair identification.



**Bundling ground wires**

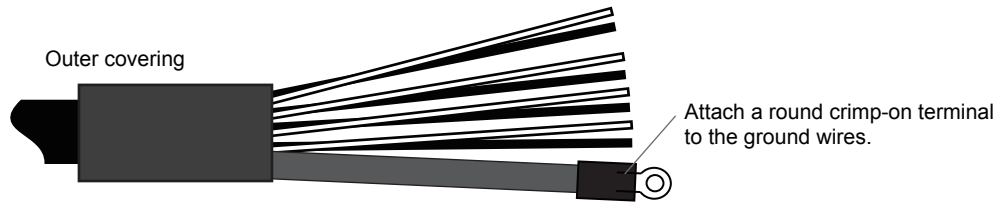
- (5) Cover the bundled ground wires with a heat shrink tube (6 mm inner diameter, about 110 mm in length), and apply heat treatment. Keep about 10 mm of the ends of the ground wires exposed from the heat shrink tube.

Then, as shown in the figure, cover the entire cable with a heat shrink tube (16 mm inner diameter, about 50 mm in length), and apply heat treatment.



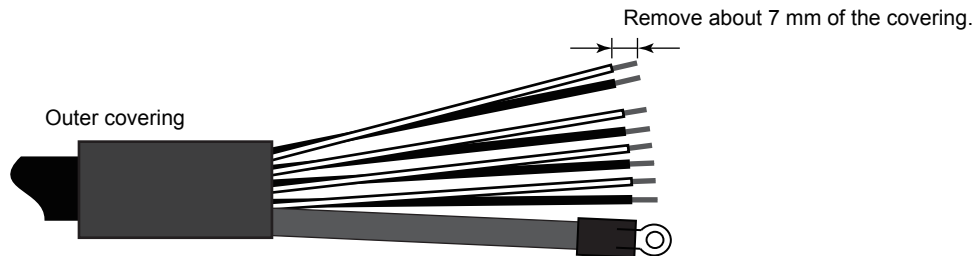
**Covering with heat shrink tubes**

- (6) Attach a round crimp-on terminal (for M4 screws, nominal cross sectional area of wire 5.5 mm<sup>2</sup>) to the end of the bundled ground wires.



**Attach a round crimp-on terminal to the end of the ground wires**

(7) Strip about 7 mm of covering from the ends of each twisted-pair.



**Removing the covering from the ends of each twisted-pair**

The ends of the twisted-pair cables can be screwed on to the terminal block without the covering. To crimp a pin terminal to the ends of twisted-pairs, use the following recommended product or equivalent.

Connection wire size:	0.75 mm <sup>2</sup> (AWG18)
Recommended product:	Weidmüller H 0.75/12

This completes the cable termination procedure.

# Appendix 2 Constructing Local HMI Connection Cables

To connect a YH8000 HMI unit as a local HMI to the TDLS8000 sensor control unit (SCU), use the special YH8000 option cable (option code: /C).

This section explains how to terminate this cable.

## NOTE

- Before performing cable termination, pass the cable through cable glands. After crimping the communication connector, the connector cannot be passed through the cable glands.
- Be careful of the cable gland orientation. The end with the screw section of the cable gland is the connector end.
- To maintain the TDLS8000 performance and functionality, be sure to use the optional dedicated cable.

### ● Required components and tools

- Wire cutter
- Pliers

### ● Pretreatment

Before terminating the special cable, pass the cable through cable glands (for 1/2NPT or M20). Apply the cable glands from the unterminated end of the special cable.

After crimping the communication connector (RJ45 modular plug), the cable cannot be passed through the cable glands.

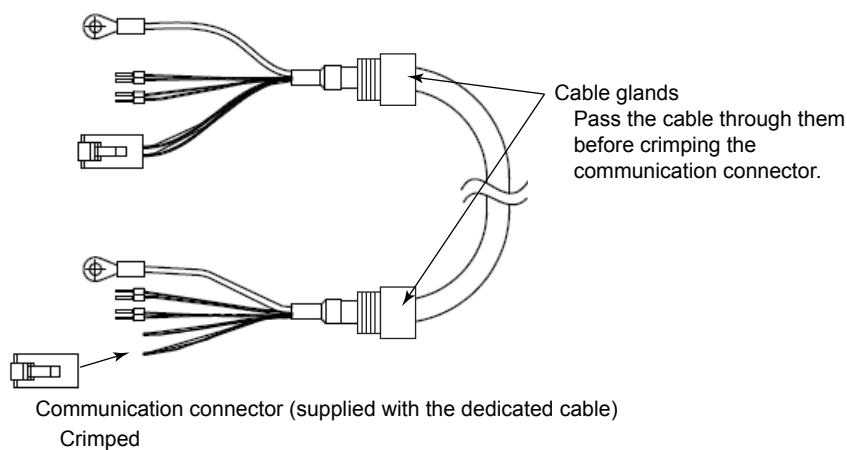
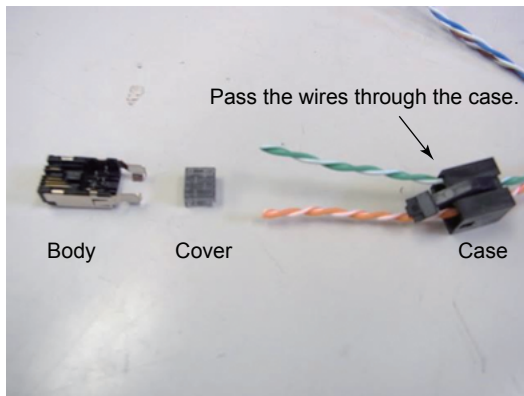


Figure 1 Local HMI connection cable

● **Attaching the communication connector**

Crimp a communication connector (RJ45 modular plug) to one end of the dedicated cable (the end without the communication connector). Use the communication connector supplied with the dedicated cable.

- (1) Pass the wires (two pairs: orange-white and green-white) through the communication connector case.

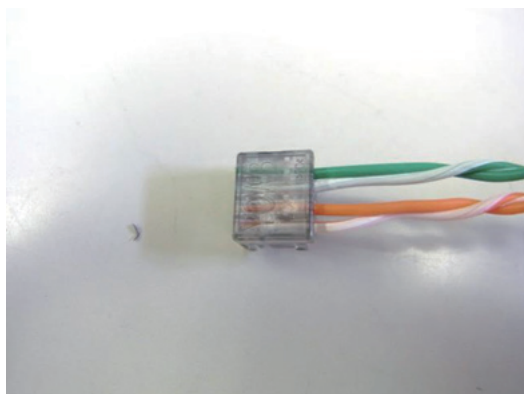


**Passing the wires through the communication connector case**

- (2) Insert the wires (two pairs: orange-white and green-white) into the communication connector case. Separate the ends of the twisted-pairs with a nipper or similar tool, and insert each wire in the connector case according to Table 1.

**Table 1 Where to insert the wires**

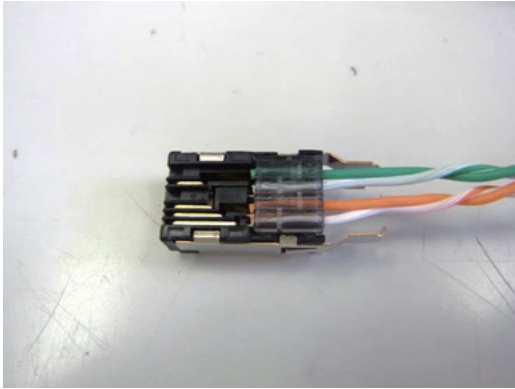
Cover marking	Wire color
B	Green
W	White-green stripe
O	Orange
Y	White-orange stripe



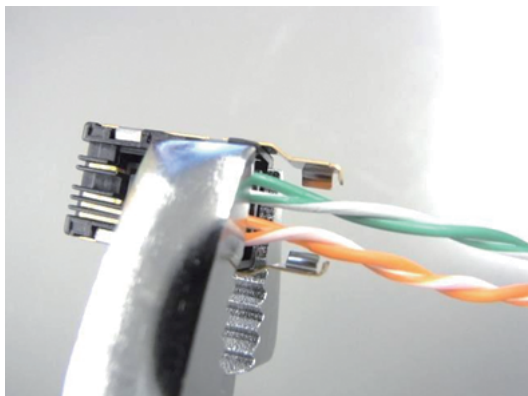
**Inserting the cable wires into the connector cover**



- (3) Insert the cover with the wires into the connector body until you hear it click.

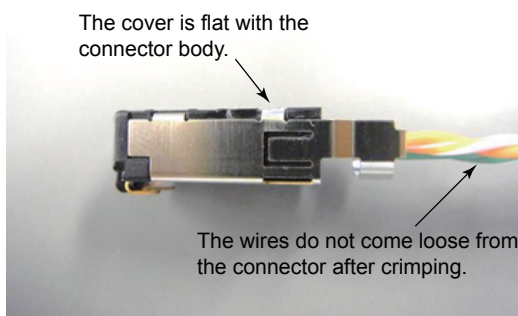


- (4) Crimp the cover to the connector body using a pair of pliers or a similar tool. Be sure not to crush the protruding parts of the connector.



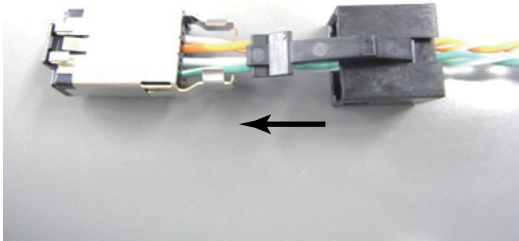
**Crimping the cover to the connector body**

- (5) After the cover has been crimped completely into the connector body, view the connector from the side. Check that the cover is flat and that wires do not come loose from the connector.

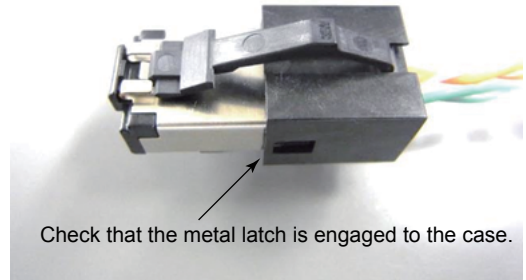


**Checking the crimping**

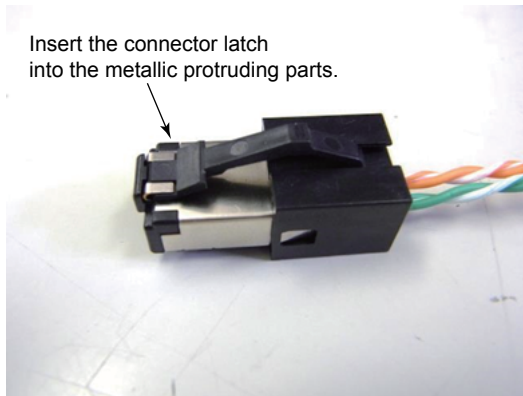
- (6) Place the case over the connector body. Check that the metallic latch on the side of the connector engages.



Placing the case over the connector body



- (7) Insert the connector latch into the metal protruding parts of the connector body. Make sure the metallic protruding parts at the end of the connector is not crushed.



This completes the communication connector attachment procedure.

# Appendix 3 General View of HART DD

The entire structure of the DD menu including parameter arrangement is listed below. The menu for a TDLS8000 with two-gas measurement specification is indicated here. Therefore, the list includes menus and parameters that do not appear in a TDLS8000 with one-gas measurement specification.

Note that the top menu structure is different on FieldMate. For details, see □7.2.2 DTM Menu (FieldMate)□. Further, the labeling of some parameters is different as follows.

- Dynamic variable label names such as “PV” and “SV” are replaced with assigned item names (e.g., “Concentration 1”).
- “PV Loop current” is displayed as “PV AO” (SV is also similar).
- “PDQ” and “LS” are displayed as “Data Quality” and “Limit Status,” respectively.

1st	2nd	3rd	4th	5th	Item		
Process variables	Device variables				Concentration 1		
					Conc 1 gas type		
					Concentration 2		
					Conc 2 gas type		
					Transmission		
					Temperature		
					Pressure		
	Dynamic variables					PV	
						PV Loop current	
						SV	
						SV Loop current	
						TV	
						QV	
			Dynamic var assign				PV is
						SV is	
						TV is	
			Dynamic var status				QV is
							PV PDQ
							PV LS
							SV PDQ
					SV LS		
					TV PDQ		
					TV LS		
					QV PDQ		
					QV LS		

1st	2nd	3rd	4th	5th	Item		
Diagnosis/ Service	Test/Status	View status			Status group 1		
					Status group 2		
					Status group 3		
					Status group 4		
					Status group 6		
					Status group 7		
					Status group 8		
					Status group 9		
					Status group 10		
					Device status		
					Ext dev status		
					Device Diagnostic Status 0		
					AO saturated		
					AO fixed		
					Cfg chng count		
			Reset cfg chng flag				
			Status mask				
				Dev cfg locked mask			
		Logbook				Read alarm/message record	
						Read cal/val record	
		Calibration	Manual			Manual zero cal	
							Manual span cal
			Semi-auto				Semi-auto zero cal
							Semi-auto span cal
			Restore				Restore zero cal data
							Restore span cal data
						Clear cal alarms	
						Abort calibration	
		Validation	Manual			Manual offline val 1	
							Manual offline val 2
							Manual online val 1
							Manual online val 2
			Semi-auto				Semi-auto offline val 1
							Semi-auto offline val 2
							Semi-auto offline val 1+2
							Semi-auto online val 1
							Semi-auto online val 2
							Clear val alarm
						Abort validation	
		Transmission adjust				Transmission	
							Transmission adjust
		Loop check	Analog output			Tst auto release time	
							AO-1 loop chk mode
							AO-1 chk output
							AO-2 loop chk mode
							AO-2 chk output
			Digital output				DO-1 loop chk mode
							DO-1 chk output
							DO-2 (Flt) loop chk mode
						DO-2 (Flt) chk output	
	Valve					Vlv-1 loop chk mode	
						Vlv-1 chk output	
					Vlv-2 loop chk mode		
					Vlv-2 chk output		
	Trim analog channel				Squawk		
					Trim AO-1 (PV)		
					Trim AO-2 (SV)		
					Trim AI-1 (Pres)		
					Trim AI-2 (Temp)		
		Trim info				Trim Who	
						Trim Date	
					Trim Loc		
					Trim Desc		
	System				Clear latched alarms		

1st	2nd	3rd	4th	5th	Item	
Basic setup					Tag	
					Long tag	
		PV range				PV is
						PV LRV
						PV URV
						PV unit
		SV range				SV is
						SV LRV
						SV URV
						SV unit
		Assign TV & QV				TV is
						QV is

1st	2nd	3rd	4th	5th	Item	
Detailed setup	I/O condition	Analog output	AO-1		PV is	
					PV LRV	
					PV URV	
				Warning hold	AO1 warn hld mode	
					AO1 warn hld level	
					AO1 warn hld delay	
				Fault hold	AO1 fault hld mode	
					AO1 fault hld level	
					AO1 fault hld delay	
				Cal/Val hold	AO1 calval hld mode	
					AO1 calval hld level	
				Maintenance hold	AO1 maint hld mode	
					AO1 maint hld level	
				Warm-up hold	AO1 w-up hld mode	
			AO1 w-up hld level			
				Trim AO-1 (PV)		
				AO-2		SV is
					SV LRV	
					SV URV	
			Warning hold		AO2 warn hld mode	
					AO2 warn hld level	
					AO2 warn hld delay	
			Fault hold		AO2 fault hld mode	
					AO2 fault hld level	
					AO2 fault hld delay	
			Cal/Val hold		AO2 calval hld mode	
					AO2 calval hld level	
			Maintenance hold		AO2 maint hld mode	
		AO2 maint hld level				
		Warm-up hold	AO2 w-up hld mode			
			AO2 w-up hld level			
			Trim AO-2 (SV)			
			Analog input	AI-1 (Pressure)	Pres val at 4mA	
					Pres val at 20mA	
				Trim AI-1 (Pres)		
				AI-2 (Temperature)	Temp val at 4mA	
			Temp val at 20mA			
			Digital output	DO-1 (DO)	DO-1 output item	
					DO-1 output delay	
				DO-2 (Fault)	DO-2 output item	
					DO-2 output delay	
			Digital input	DI-1	DI-1 mode	
					Set DI-1 mode	
				DI-1 filter time		
				DI-2	DI-2 mode	
			Set DI-2 mode			
			Valve control		Current stream	
					Initial stream	
					Stream 1 vlv pattern	
					Stream 2 vlv pattern	
	Stream 3 vlv pattern					
	Stream time switch	Switch stream1 to				
		Stream1 duration				
		Switch stream2 to				
		Stream2 duration				
		Switch stream3 to				
	Stream3 duration					
	Valve usage					
	Set valve usage					
Alarm	Warning	Warning group 1	Warn select group 1			
			Trans low lmt			
			Pres low lmt			
			Pres high lmt			
			Temp low lmt			
			Temp high lmt			
			Conc 1 low lmt			
			Conc 1 high lmt			
			Conc 2 low lmt			
			Warn select group 2			
			Conc 2 high lmt			
				Warning group 2	Warn select group 2	
			Conc 2 high lmt			

1st	2nd	3rd	4th	5th	Item			
(Detailed setup)	Calibration	Zero calibration	Valve control		Z-cal gas purg time Z-cal proc purg time Z-cal auto vlv man			
			Auto time		Z-cal time initiate Z-cal init date Z-cal init time Z-cal day cycle Z-cal hour cycle			
			Span calibration	Parameter		S-cal gas type Set s-cal gas type S-cal gas conc S-cal pres mode S-cal pres fix val S-cal temp mode S-cal temp fix val S-cal OPL mode S-cal OPL fix val		
					Valve control		S-cal gas purg time S-cal proc purg time S-cal auto vlv man	
					Auto time		S-cal time initiate S-cal init date S-cal init time S-cal day cycle S-cal hour cycle	
					Zero+Span calibration			Z+S cal time initiate Z+S cal init date Z+S cal init time Z+S cal day cycle Z+S cal hour cycle
					Validation	Offline validation 1	Parameter	
		Valve control						
		Auto time		Offval1 time initiate Offval1 init date Offval1 init time Offval1 day cycle Offval1 hour cycle				
		Offline validation 2	Parameter			Offval2 gas type Set offval2 gas type Offval2 gas conc Offval2 pres mode Offval2 pres fix val Offval2 temp mode Offval2 temp fix val Offval2 OPL mode Offval2 OPL fix val		
				Valve control			Offval2 gas purg time Offval2 prc purg time Offval2 auto vlv man	
				Auto time			Offval2 time initiate Offval2 init date Offval2 init time Offval2 day cycle Offval2 hour cycle	
		Offline validation 1+2				Offval1+2 time init Offval1+2 init date Offval1+2 init time Offval1+2 day cycle Offval1+2 hour cycle		

1st	2nd	3rd	4th	5th	Item						
(Detailed setup)	(Validation)	Online validation 1	Parameter		Onval1 gas type						
					Set onval1 gas type						
					Onval1 gas conc						
					Onval1 temp mode						
					Onval1 temp fix val						
					Onval1 act amb ofst						
					Onval1 pres fix val						
					Onval1 OPL fix val						
			Valve control		Onval1 gas purg time						
					Onval1 nml purg time						
					Onval1 auto vlv man						
			Auto time		Onval1 time initiate						
					Onval1 init date						
					Onval1 init time						
					Onval1 day cycle						
			Conc reading mode		Onval1 hour cycle						
					Onval1 read mode						
			Online validation 2	Parameter		Onval2 gas type					
						Set onval2 gas type					
						Onval2 gas conc					
						Onval2 temp mode					
						Onval2 temp fix val					
						Onval2 act amb ofst					
						Onval2 pres fix val					
		Onval2 OPL fix val									
		Valve control			Onval2 gas purg time						
					Onval2 nml purg time						
					Onval2 auto vlv man						
		Auto time			Onval2 time initiate						
					Onval2 init date						
					Onval2 init time						
					Onval2 day cycle						
		Conc reading mode			Onval2 hour cycle						
					Onval2 read mode						
		Field device info				Descriptor					
						Message					
						Date					
						Final asmbly num					
						Write protect menu		Write protect			
								Enable write 10min			
								New password			
			Software seal								
			Memo				Memo 1				
							Memo 2				
							Memo 3				
			System					Long tag			
								Date/time		Present date/time	
										Set date/time	
Local display	SCU LCD display								LCD spect disp mode		
									LCD backlight bright		
									LCD contrast		
Communication	LU LED display								LED brightness		
									HART output		Poll addr
											Loop current mode
Num req preams											
TCP/IP									Num resp preams		
									IP address		
									Subnet mask		
				Default gateway							
				Set IP settings							
			Initialize config								
			Safety mode								



1st	2nd	3rd	4th	5th	Item	
(Detailed setup)	Analysis	Process param	Pressure		OPL	
					Pres mode	
					Pres fix mode val	
					Pres active type	
					Pres backup mode	
					Pres backup set val	
				Temperature		Temp mode
					Temp fix mode val	
					Temp active type	
					Temp backup mode	
					Temp backup set val	
					Temp act amb ofst	
			Non process param		No-prcs OPL	
					No-prcs pres	
				No-prcs temp		No-prcs temp mode
						No-prcs temp fix val
						No-prcs act amb coef
				No-prcs conc		No-prcs conc 1
					No-prcs conc 2	
			Unit		OPL unit	
					Pres unit	
					Temp unit	
			Averaging		Averaging number	
		Averaging time				
	Zero offset		Zero offset 1			
			Zero offset 2			


1st	2nd	3rd	4th	5th	Item	
Review	Process info				Concentration 1	
					Conc 1 STDEV	
					Concentration 2	
					Conc 2 STDEV	
					Transmission	
					Temperature	
					Pressure	
					Conc 1 gas type	
					Conc 2 gas type	
					Temp mode	
					Pres mode	
			Advanced info			SCU temp
						LU temp
			I/O info			AI-1 (pres)
					AI-2 (temp)	
					PV Loop current	
					SV Loop current	
					DI-1	
					DI-2	
					DO-1	
					DO-2 (Fault)	
					Valve-1	
					Valve-2	
				I/O assignment		PV is
						SV is
						DI-1 mode
					DI-2 mode	
		System info			DO-1 output item	
					Long tag	
					IP address	
					Subnet mask	
		Factory info			Default gateway	
					Model name	
					Analyzer SN	
					Laser module SN	
					SI unit control	
					Analysis period	
			Version #'s		Software ver	
		Field device info			Write protect	
					Poll addr	
				Loop current mode		
				Num req preams		
				Num resp preams		
				Dev id		
				Tag		
				Long Tag		
				Descriptor		
				Message		
				Date		
			Additional info		Distributor	
					Final asmbly num	
					Max dev vars	
					Device Profile	
			Revision #'s		Universal rev	
				Fld dev rev		
				Software rev		

# Appendix 4 YH8000 Menu Tree

This section provides the tree structure of the setup and execution menus of the YH8000 HMI unit.

## (1) TDLS8000 Tunable Diode Laser Spectrometer operation panel

The TDLS8000 setup and execution menu tree is shown below. The menu for a TDLS8000 with two-gas measurement specification is indicated here. Therefore, some items will not appear in a TDLS8000 with one-gas measurement specification.

 => Select analyzer => Input password =>

1st	2nd	3rd	4th	Tab	Item				
Execution	Calibration	Manual	Zero Calibration		Zero Calibration				
			Span Calibration		Span Calibration				
		Semi-Auto	Zero Calibration		Zero Calibration				
			Span Calibration		Span Calibration				
			Zero + Span Calibration		Zero + Span Calibration				
		Restore	Zero Calibration		Restore Zero Calibration data				
			Span Calibration	Gas1	Restore Span Calibration data (Gas1)				
				Gas2	Restore Span Calibration data (Gas2)				
			Clear Calibration Alarm				Clear Calibration Alarm		
		Validation	Manual	Offline Validation 1		Offline Validation 1			
				Offline Validation 2		Offline Validation 2			
				Online Validation 1		Online Validation 1			
				Online Validation 2		Online Validation 2			
	Semi-Auto		Offline Validation 1		Offline Validation 1				
			Offline Validation 2		Offline Validation 2				
			Offline Validation 1+2		Offline Validation 1+2				
			Online Validation 1		Online Validation 1				
	Online Validation 2		Online Validation 2						
	Clear Validation Alarm				Clear Validation Alarm				
	Transmission Adjustment				Transmission Adjustment				
	Loop Check	Analog Output			AO-1 Loop check mode				
					AO-1 Check output				
					AO-2 Loop check mode				
					AO-2 Check output				
					Digital Output			DO Loop check mode	
								DO Check output	
								Fault Loop check mode	
								Fault Check output	
		Valve			SV-1 Loop check mode				
					SV-1 Check output				
					SV-2 Loop check mode				
					SV-2 Check output				
	Auto Release			Auto release time					
System	Clear Latched Alarms			Clear Latched Alarms					

1st	2nd	3rd	4th	Tab	Item
Configuration	I/O	Analog Output	AO-1	Output	Item
					4 mA
					20 mA
				Hold mode	Warning
					Delay
					Fault
					Delay
			Cal/Val		
			Maintenance		
			Warm-up		
			Calibration	Execute AO-1 Calibration	
			AO-2	Output	Item
					4 mA
					20 mA
		Hold mode		Warning	
				Delay	
				Fault	
				Delay	
		Cal/Val			
		Maintenance			
		Warm-up			
		Calibration	Execute AO-2 Calibration		
		Analog Input	AI-1 (Pressure)	Scaling	4mA value
					20mA value
				Calibration	Execute A1-1 Calibration
			AI-2 (Temperature)	Scaling	4mA value
					20mA value
				Calibration	Execute A1-2 Calibration
		Digital Output	DO-1 (DO)	Output item	
				Output delay	
			DO-2 (Fault)	Output delay	
		Digital Input	DI-1	Mode	
				Filter time	
			DI-2	Mode	
				Filter time	
		Valve Control	Valve Usage		
			Current		
			Stream 1 Switch to		
			Stream 1 Duration		
			Stream 2 Switch to		
			Stream 2 Duration		
			Stream 3 Switch to		
			Stream 3 Duration		
			Initial		
			Transmission Low		
		Alarm	Process Pressure Low		
			Process Pressure High		
Process Temperature Low					
Process Temperature High					
Concentration Gas1 Low					
Concentration Gas1 High					
Concentration Gas2 Low					
Concentration Gas2 High					
Calibration	Zero Calibration		Valve	Calibration gas Purge time	
				Process gas Purge time	
		Auto Valve for Manual Cal.			
	Auto Time	Time Initiate			
		Initial time			
		Cycle(day)			
		Cycle(hour)			

1st	2nd	3rd	4th	Tab	Item	
(Configuration)	(Calibration)	Span Calibration		Parameters	Gas type	
					Concentration	
					Pressure	
					Fixed value	
					Temperature	
					Fixed value	
					OPL	
				Fixed value		
				Valve	Calibration gas Purge time	
					Process gas Purge time	
					Auto Valve for Manual Cal.	
				Auto Time	Time Initiate	
	Initial time					
	Cycle(day)					
	Cycle(hour)					
	Zero + Span Calibration	Auto Time	Time Initiate			
			Initial time			
			Cycle(day)			
			Cycle(hour)			
	Validation	Offline Validation 1			Parameters	Gas type
						Concentration
						Pressure
						Fixed value
						Temperature
						Fixed value
						OPL
					Fixed value	
Valve					Validation gas Purge time	
					Process gas Purge time	
					Auto Valve for Manual Val.	
Auto Time					Time Initiate	
		Initial time				
		Cycle(day)				
		Cycle(hour)				
Offline Validation 2					Parameters	Gas type
						Concentration
						Pressure
						Fixed value
						Temperature
						Fixed value
						OPL
					Fixed value	
					Valve	Validation gas Purge time
						Process gas Purge time
						Auto Valve for Manual Val.
					Auto Time	Time Initiate
Initial time						
Cycle(day)						
Cycle(hour)						
Offline Validation 1+2	Auto Time	Time Initiate				
		Initial time				
		Cycle(day)				
		Cycle(hour)				
Online Validation 1				Parameters	Gas type	
					Concentration	
					Pressure	
					Temperature	
					Offset Value	
					Fixed Value	
					OPL	
				Valve	Validation gas Purge time	
					Normal gas Purge time	
					Auto Valve for Manual Val.	
				Auto Time	Time Initiate	
					Initial time	
Cycle(day)						
Cycle(hour)						
Reading mode	Mode					
	Output Factor					

1st	2nd	3rd	4th	Tab	Item				
(Configuration)	(Validation)	Online Validation 2		Parameters	Gas type				
					Concentration				
					Pressure				
					Temperature				
					Offset Value				
					Fixed Value				
					OPL				
				Valve	Validation gas Purge time				
					Normal gas Purge time				
					Auto Valve for Manual Val.				
				Auto Time	Time Initiate				
					Initial time				
					Cycle(day)				
				Reading mode	Cycle(hour)				
					Mode				
	System				Tag	Output Factor			
						Tag			
						Date & Time			
					Password	Current Password			
						New Password			
						Confirm New Password			
					Local Display	SCU	Operation		
							Date		
							Time		
					Communication	TCP/IP	LU	Spectrum	
								Brightness	
								Contrast	
HART	HART	LU	Brightness						
			IP Address						
			Subnet Mask						
Configuration Initialization			Default Gateway						
			HART Address						
			Loop Current Mode						
Analysis				Safety Mode	Setting data				
					Calibration data for AO and AI				
					Zero/Span Calibration data				
					Tag, Network setting, Password				
					Process Parameters	Path Length	Pressure	Safety Mode	
								Path Length	
								Mode	
								Active Type	
								Fixed Mode Value	
								Backup Mode	
						Temperature	Temperature	Concentration	Backup Set Value
									Mode
									Active Type
									Fixed Mode Value
									Backup Mode
									Backup Set Value
					Non-Process Parameter	Path Length	Temperature	Offset value	
								Path Length	
Pressure									
Concentration	Concentration	Concentration	Mode						
			Fixed Value						
			Ambient Coefficient						
Units			Gas1						
			Gas2						
			Path Length						
Average			Pressure						
			Temperature						
			Average number						
Zero Offset			Average time						
			Zero offset for Gas1						
			Zero offset for Gas2						

## (2)YH8000 HMI unit operation panel

The YH8000 HMI unit setup and execution menu tree is shown below.



1st	2nd	3rd	4th	Tab	Item	
Analyzer Connection					Change IP	
					Input Analyzer IP manually	
					Select Analyzer by Auto-search	
					Connect	
					Disconnect	
Display Setting	Home Style				Meter Type	
	Meter range				Analyzer 1	Gas1 Min
						Gas1 Max
						Gas2 Min
						Gas2 Max
					Analyzer 2	Gas1 Min
						Gas1 Max
						Gas2 Min
						Gas2 Max
					Analyzer 3	Gas1 Min
						Gas1 Max
						Gas2 Min
						Gas2 Max
					Analyzer 4	Gas1 Min
				Gas1 Max		
				Gas2 Min		
				Gas2 Max		
Backlight					Brightness	
					Auto Off	
Network Setting					IP Address	
					Subnet Mask	
					Default Gateway	
HMI Information						





# Appendix 5 What Is an Analysis Period?

The TDLS8000 calculates process gas concentration from a value obtain by integrating the spectrum data over a given period. This integration period is the *analysis period*.

Measured values and analog output are updated every analysis period. The analysis period is set to an optimal value depending on the application and cannot be changed.

On the TDLS8000, you can specify how many analysis periods of spectrum data to calculate the moving average over. The number of times moving average is taken in a single concentration calculation is called the *average number*, and the corresponding time is called *average time*. The average number is variable. The average time can be increased by increasing the average number in order to reduce the influence of disturbance existent in the measurement process. Even if the average number is increased, measured values and analog output are updated according to the analysis period, but the analysis responsiveness declines.

The analysis period and average number are set to optimal values according to the process to be measured before factory shipment. The average number set before factory shipment is called the *basic average number*. The final average time is determined as follows.

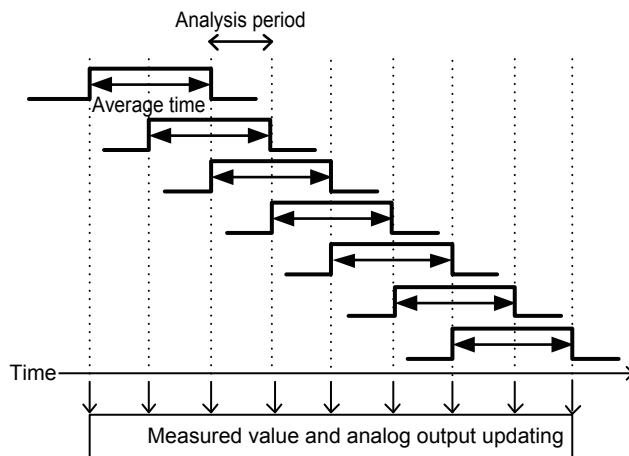
$$\text{Average time} = (\text{analysis period} \times \text{basic average number}) \times \text{average number}$$

Given a basic average number of 2, the following figures illustrate the moving average ranges when the average number is changed.

┌───┐ indicates an interval during which a spectrum is acquired and the concentration is calculated.

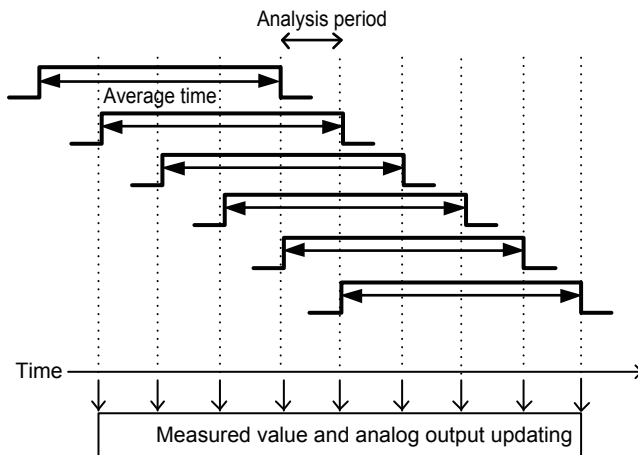
- **When the average number is 1**

(Average time = analysis period × basic average number × average number = analysis period × 2)




● **When the average number is 2**

(Average time = analysis period × 2 × 2 = analysis period × 4)



You can view the analysis period from the following menu.

[HART] “Review>>Factory info>>Analysis period”

[YH8000] “>>System Information>>Analysis Period”

For instructions on how to set the average number and how to view the average time, see □6.9.6 Moving Average Count for Analysis Values□

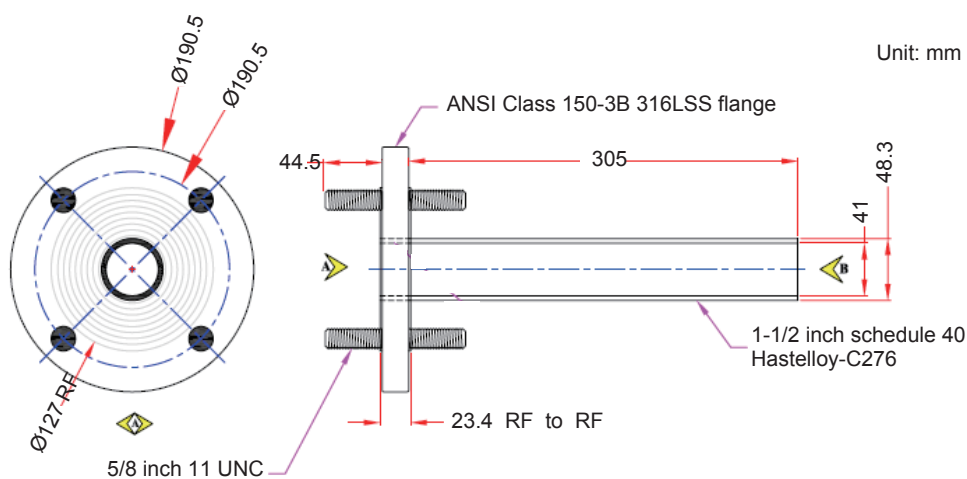
# Appendix 6 Maintaining Good Transmission

## ● High dust application

Depending on the measurement location, the process may include large amounts of contamination, dust, and particles. In such conditions, the amount of laser beam that reaches the SCU decreases.

Normally, such information should be conveyed to Yokogawa through the process information questionnaire of the Application Data Sheet and assessed in the TDLS8000 design, engineering, and specification determination stages before TDLS8000 installation. However, depending on the process, the contamination, dust, and particle conditions may change (e.g., waste disposal sites, thermal oxidation).

To improve transmission in a high particulate concentration process, you must reduce the process optical path length and perform process window purge correctly and thoroughly.



**Figure 1 Example of Insertion tubes**

For high dust concentration applications, please consult with Yokogawa. If it is deemed that reducing the process optical path length can significantly improve the transmission level (or at least to within the tolerance of the TDLS8000 capacity), we will discuss with you the special insertion tube specification requirements. In many cases, insertion tubes are made of materials compatible with the process medium. In applications that include acidic or corrosive gas, Hastelloy C276 or Monel 400 is used.

## ● Handling process nozzle clogging problems

If dust accumulates repeatedly in process flanges or insertion tubes, try the following measures.

- Increase the flow velocity and pressure of the process window purge gas
- Use a process nozzle or insertion purge tube with small opening.
- Keep the process nozzle warm to prevent condensation or solidification
- Combine the above methods
- In the worst case, move the TDLS8000 to a cleaner measurement location (e.g., downstream side of ESP, knockout drum, filter scrubber).

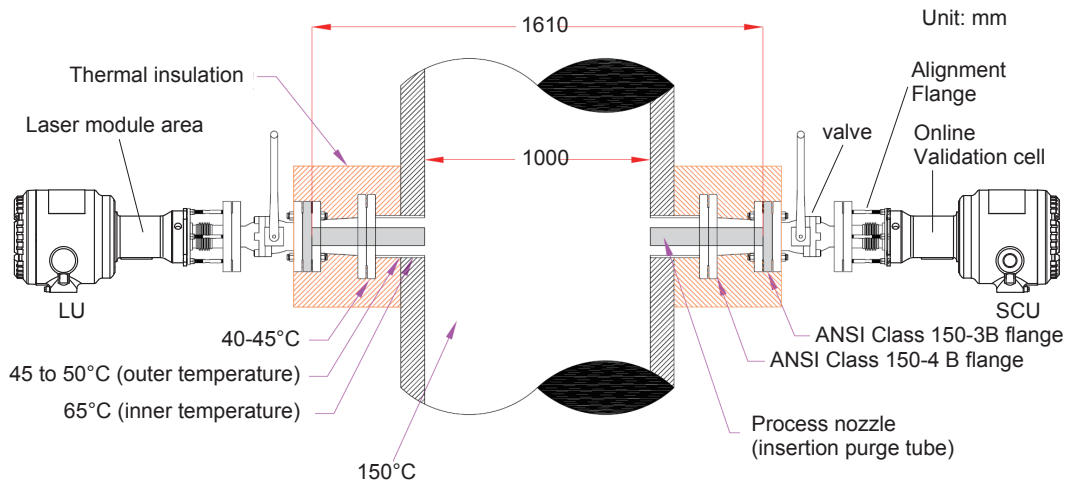


Figure 2 Installation example of insertion tubes with thermal insulation

# Appendix 7 Safety Instrumented System Installation



## WARNING

When using the TDLS8000 as a Safety Instrumented Systems (SIS), in order to maintain the necessary level of safety, strictly observe the instructions and procedures provided in this Appendix.

### ■ Scope and Purpose

This section describes the handling precautions to be taken when installing and operating the TDLS8000 in order to maintain the level of safety designed for using the TDLS8000 in a Safety Instrumented System application. It also provides an overview of the operation. The topics discussed in this section are the TDLS8000's proof test, repairs, and replacement; safety data; service life; environmental and application limitations; and parameter settings.

### ■ Using the TDLS8000 in a Safety Instrumented System Application

#### ● Safety accuracy

The following table shows the TDLS8000 safety accuracy. When an error caused by an internal component failure exceeds the safety accuracy, the TDLS8000 is considered to have malfunctioned.

Measured gas	Safety accuracy
O <sub>2</sub>	+/-0.2% O <sub>2</sub> or 15% of reading, whichever is greater
CO(ppm)	+/-50 ppm CO or 15% of reading, whichever is greater
CO+CH <sub>4</sub>	CO +/-50 ppm CO or 15% of reading, whichever is greater
	CH <sub>4</sub> +/-0.1% CH <sub>4</sub> or 15% of reading, whichever is greater
NH <sub>3</sub>	+/-0.1 ppm NH <sub>3</sub> or 15% of reading, whichever is greater
H <sub>2</sub> O(ppm) in nonHC	+/-3 ppm H <sub>2</sub> O or 15% of reading, whichever is greater
H <sub>2</sub> O(ppm) in HC	+/-3 ppm H <sub>2</sub> O or 15% of reading, whichever is greater
%CO	+/-0.3% CO or 15% of reading, whichever is greater
CO+CO <sub>2</sub>	CO +/-0.4% CO or 15% of reading, whichever is greater
	CO <sub>2</sub> +/-0.4% CO <sub>2</sub> or 15% of reading, whichever is greater
NH <sub>3</sub> +H <sub>2</sub> O	NH <sub>3</sub> +/-10 ppm NH <sub>3</sub> or 15% of reading, whichever is greater
	H <sub>2</sub> O +/-1% H <sub>2</sub> O or 15% of reading, whichever is greater
%CO <sub>2</sub> _ High Range.	+/-0.03% CO <sub>2</sub> or 15% of reading, whichever is greater
%CO <sub>2</sub> _ Extend. Range.	+/-0.4% CO <sub>2</sub> or 15% of reading, whichever is greater
H <sub>2</sub> O(%)	+/-0.3% H <sub>2</sub> O or 15% of reading, whichever is greater
HCl(ppm)	+/-3 ppm HCl or 15% of reading, whichever is greater
H <sub>2</sub> S(%)	+/-0.6% H <sub>2</sub> S or 15% of reading, whichever is greater
HF(ppm)	+/-3 ppm HF or 15% of reading, whichever is greater

#### ● Diagnostic response time

The TDLS8000 can indicate an internal malfunction within 30 seconds.

● **I/O restriction**

Only analog output AO-1, AO-2 and analog inputs AI-1 and AI-2 comply with Safety Instrumented System. Do not use other inputs or outputs as part of a Safety Instrumented System.

● **Opening and closing the TDLS8000**

When online, do not open or close the cover. If you need to open and close the TDLS8000 cover for maintenance, obtain permission from you safety administrator.

● **Configuration**

Use the HART Configuration tool or a YH8000 HMI unit to set the range and unit. Connect the HART Configuration tool or the YH8000 according to the instructions in this manual.

After installing the TDLS8000, check that the range and unit are set correctly. Calibrate the TDLS8000 after setting the parameters.

● **Connecting External Transmitters**

If you want to connect external transmitters for temperature or pressure input, use products that, when used by themselves, comply with Safety Integrity Level (SIL) 2 based on a PFDavg calculation of the entire safety instrumented function or in a redundant configuration, Safety Integrity Level (SIL) 3 based on a PFDavg calculation of the entire safety instrumented function. For details on installation and operation of the external transmitters in safety applications, see the relevant safety manuals.

Temperature and pressure transmitters that we recommend are shown below.

Temperature transmitter	YOGOGAWA YTA series
Pressure transmitter	YOKOGAWA EJX and EJA series

● **Setting required parameters**

To maintain the appropriate level of safety, set the following parameters.

Parameter	Description
Warm-up current setting	Using the HART configuration tool or the YH8000 HMI unit, set the output of AO-1 during warm-up to Preset hold and the output value to 3.8 mA Preset hold.
Warning-in-effect current setting	Using the HART configuration tool or the YH8000 HMI unit, set the output of AO-1 for when a warning is in effect to Non-hold or Hold. If you need to specify Preset hold, set a value different from the fault-in-effect current value (burnout current) to distinguish this value from the output for when a fault occurs.
Fault-in-effect current setting	Using the HART configuration tool or the YH8000 HMI unit, set the output of AO-1 for when an internal fault is detected to Preset hold and the output value to 21.0 mA or higher or to a burnout current of 3.6 mA or less.
Safety Mode setting	Using the HART configuration tool or the YH8000 HMI unit, set the Safety Mode to Enable.
Hardware write protection switch	Disable the HART write function.

● **Using the YH8000 HMI unit**

When using the YH8000 in a system, use password protection to prevent parameter settings from being changed in modes other than offline. The safety administrator should manage the password properly by referring to section "6.9.3 User Password Setting".

● **Proof test**

You must perform a proof test in order to detect faults that are not detected through self-diagnostics but still hinder the execution of the intended safety functions of the TDLS8000.

The proof test interval is determined by the safety calculation that is performed for each safety instrumented function, including the TDLS8000. To maintain the safety level of the safety instrumentation, proof tests must be performed at a frequency determined by the safety calculation or a higher frequency.

The following tests must be performed in a proof test. The result of proof tests must be documented, and the documents should be handled as part of the plant’s safety management. If a fault is detected, please consult with Yokogawa.

The operator that performs proof tests on the TDLS8000 must have a thorough knowledge of the operation of Safety Instrumented Systems, including the bypass procedure, TDLS8000 maintenance, and change procedures.

Test method	Required tools	Estimated result
<ol style="list-style-type: none"> <li>1. Bypass the safety functions, and perform appropriate measures to prevent malfunction.</li> <li>2. Use the HART Configuration tool or YH8000 to properly execute all diagnostics and collect the results.</li> <li>3. Use the loop function of the HART Configuration tool or YH8000 to output a burn-up current, and verify that the current is at this level.</li> <li>4. Use the loop function of the HART Configuration tool or YH8000 to output a burn-down current, and verify that the current is at this level.</li> <li>5. Thoroughly check for leakages and visible damages and stains.</li> <li>6. Perform two-point validation over the entire operating range.</li> <li>7. Release the bypass, and restore normal operation.</li> </ol>	HART Configuration tool or YH8000	Proof test coverage: 92%

● **Repair and replacement**

To repair the TDLS8000 while the process is online, bypass the TDLS8000. You must perform the bypass procedure correctly. If a fault is detected, please consult with Yokogawa. TDLS8000 replacement must be performed by a trained engineer.

● **Startup time**

The TDLS8000 sends valid signals within 5 minutes after power-on.

● **Firmware updating**

For firmware updating, please consult with Yokogawa.

● **Reliability data**

The FMEDA (Failure Mode, Effects and Diagnostic Analysis) report that Yokogawa provides contains failure rates and failure modes.

When used by itself, the TDLS8000 is certified for compliance with up to Safety Integrity Level (SIL) 2 based on a PFDavg calculation of the entire safety instrumented function. The development process of the TDLS8000 is certified for compliance with up to SIL3. When used in a redundant configuration, it can be used at Safety Integrity Level (SIL) 3 based on a PFDavg calculation of the entire safety instrumented function.

When used in a redundant configuration, we recommend that the common cause factors (β-factor) for the PFD calculation of the entire safety instrumented function be set at 5%. If the plant operator provides “common cause failure” training and a clear, detailed maintenance procedure for preventing common cause failures, the common cause factors (β-factor) can be set to 2%.

- **Lifetime limitation**

The expected lifetime of the TDLS8000 is 10 years. The reliability data in the FMEDA report is valid to 10 years. It is assumed that the failure rates of the TDLS8000 would increase when it is used over 10 years. Therefore, the safety integrity level based on the reliability data given in the FMEDA report may not be attainable.

- **Environmental limitation**

The environmental limitation of the TDLS8000 is defined in this manual.

- **Application limitation**

If the TDLS8000 is used in an application outside the limits defined in this manual, the reliability data is void.

## ■ Terminology and Acronyms

- **Terms**

### **Safety**

Freedom from unacceptable risk of harm

### **Functional Safety**

The ability of a system to carry out the actions necessary to achieve or to maintain a defined safe state for the equipment, machinery, plant, and apparatus under control of the system.

### **Basic Safety**

The equipment must be designed and manufactured such that it protects against risk of damage to persons by electrical shock and other hazards and against resulting fire and explosion. The protection must be effective under all conditions of the nominal operation and under single fault condition.

### **Verification**

- Compliance and confirmation

The demonstration for each phase of the life-cycle that the (output) deliverables of the phase meet the objectives and requirements specified by the inputs to the phase. The verification is usually executed by analysis, testing, or both.

- Validation

The demonstration that the safety-related system(s) or the combination of safety-related system(s) and external risk reduction facilities meet, in all respects, the Safety Requirements Specification. The validation is usually executed by testing.

- Safety Assessment

The investigation to arrive at a judgment—based on evidence—of the safety achieved by safety-related systems.

Further definitions of terms used for safety techniques and measures and the description of safety related systems are given in IEC 61508-4.

- **Acronyms**

FMEDA: Failure Mode, Effects and Diagnostic Analysis

SIF: Safety Instrumented Function

SIL: Safety Integrity Level

SIS: Safety Instrumented System

SLC: Safety Lifecycle



# Appendix 8 Explosion Protected Type Instrument

In this chapter, further requirements and differences for explosion proof type instrument are described. For explosion protected type, the description in this chapter is prior to other description in this User's Manual.



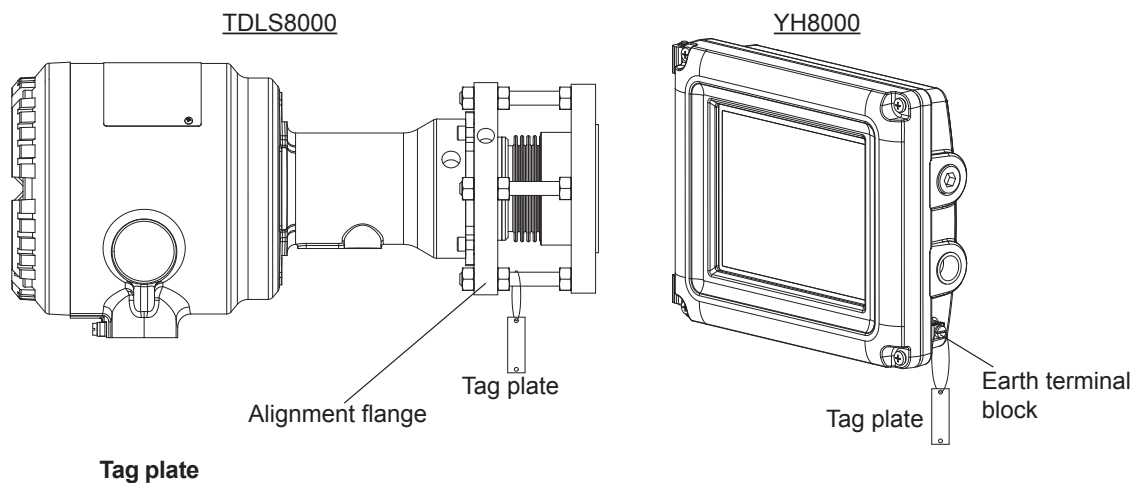
## CAUTION

TDLS8000 and YH8000 has been tested and certified as being explosion proof. Please note that severe restrictions apply to these instruments's construction, installation, external wiring, maintenance and repair. A failure to abide by these restrictions could make the instrument a hazard to operate.



## WARNING

Tag plate which is provided as an option of TDLS8000 or YH8000 shall be hung by a wire and the wire shall be tightly bound to the alignment flange or LAO of TDLS8000, or earth terminal block of the enclosure of YH8000, not to insulate electrically and to avoid electrostatic charging.



## ■ TDLS8000

### ● TDLS8000-D2 (FM Approval for US)

#### (1) Technical data

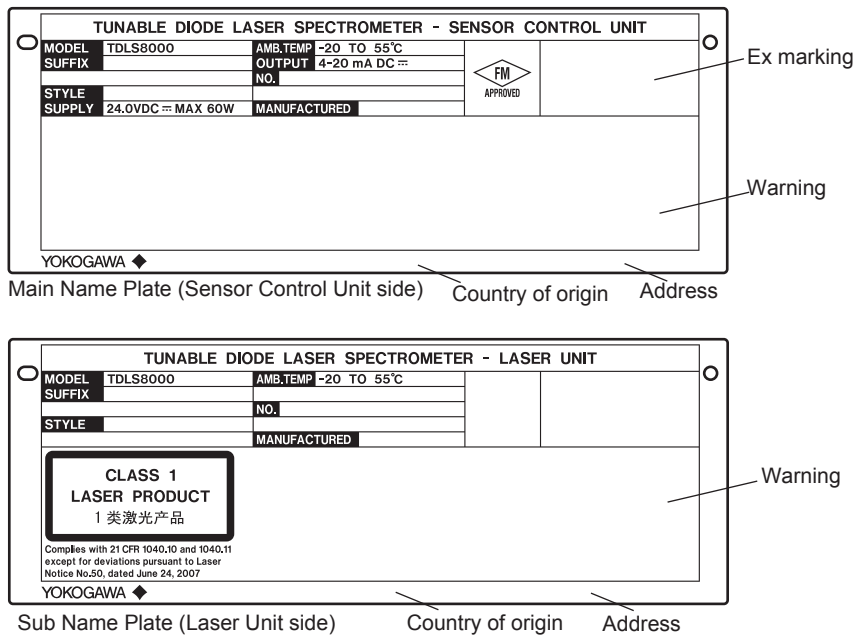
- Applicable standards
  - FM Class 3600: 2011
  - FM Class 3611: 2004
  - FM Class 3616: 2011
  - FM Class 3810: 2005
  - NEMA 250-2003
  - ANSI/ISA-60079-0-2013
  - ANSI/ISA-60079-15-2012
  - ANSI/ISA-60079-31-2013
  - ANSI/IEC 60529-2004 (R2011)
- Certificate No.
  - FM16US0237X
- Ratings
  - Nonincendive for
    - Class I; Division 2; Groups A, B, C, D; T5
    - Dust-Ignitionproof for Class II/III; Division 1; Groups E, F, G; T5
    - Class I, Zone 2, AEx nA nC IIC T5
    - Zone 21, AEx tb IIIC T100 °C
- Enclosure
  - Type 4X, IP66
- Specific condition of use
  - Precautions shall be taken to minimize the risk from electrostatic discharge or propagating brush discharge of painted parts of the enclosure.

#### (2) Name Plate

MODEL: Specified model code  
 AMB.TEMP: Specified ambient temperature range  
 SUFFIX: Specified suffix code  
 OUTPUT: Specified analog output range  
 NO.: Serial number  
 STYLE: Specified style code  
 SUPPLY: Specified supply voltage and wattage  
 MANUFACTURED: Month and year of production  
 Ex marking: CL I, DIV 2, GP ABCD, T5  
               CL II/III, DIV 1, GP EFG, T5  
               CL I, ZN 2, AEx nA nC IIC T5  
               ZN 21, AEx tb IIIC T100°C  
               TYPE 4X, IP66

Warning: USE THE HEAT-RESISTING CABLES  $\geq 70$  °C  
 DO NOT OPEN WHEN AN EXPLOSIVE ATMOSPHERE MAY BE PRESENT.  
 POTENTIAL ELECTROSTATIC CHARGING HAZARD.  
 FOR INSTALLATION AND SAFE USE, READ mmmm  
 INSTALL IN ACCORDANCE WITH NFM029-A91

Note: "mmm" means document number of user's manual.



**(3) Installation**

- The installation of the equipment should be carried out by the engineers or other professional personnel of the related expertise. The installation should not be carried out by operators or other unprofessional personnel.
- The installation should be in accordance with NEC (the National Electric Code: ANSI/NFPA-70) or local electric code.
- The equipment must only be used in an area of not more than pollution degree 2, as defined in IEC 60664-1.
- Mounting orientation of TDLS8000 is within 30 degrees relative to the horizontal direction.
- When the cable glands and/or adapters are used, they must be Ex “d”, Ex “e”, or Ex “n” type, and must also meet the ingress protection requirement of IP54 or more. If TDLS8000 is installed in where more than IP54 is required as ingress protection, the cable gland and/or adapters should be meet the requirement.
- The thread type of the cable entries shall be confirmed according to the user’s manual.
- Screws of the field wiring terminals must be tightened with specified torque values as follows:
  - Sensor Control Unit: 0.5 to 0.6 Nm,
  - Laser Unit: 0.4 to 0.5 Nm
- Field wiring for ethernet communication must be in accordance with IEEE 802.3 so as to avoid overvoltage of > 119 V.

**! WARNING**

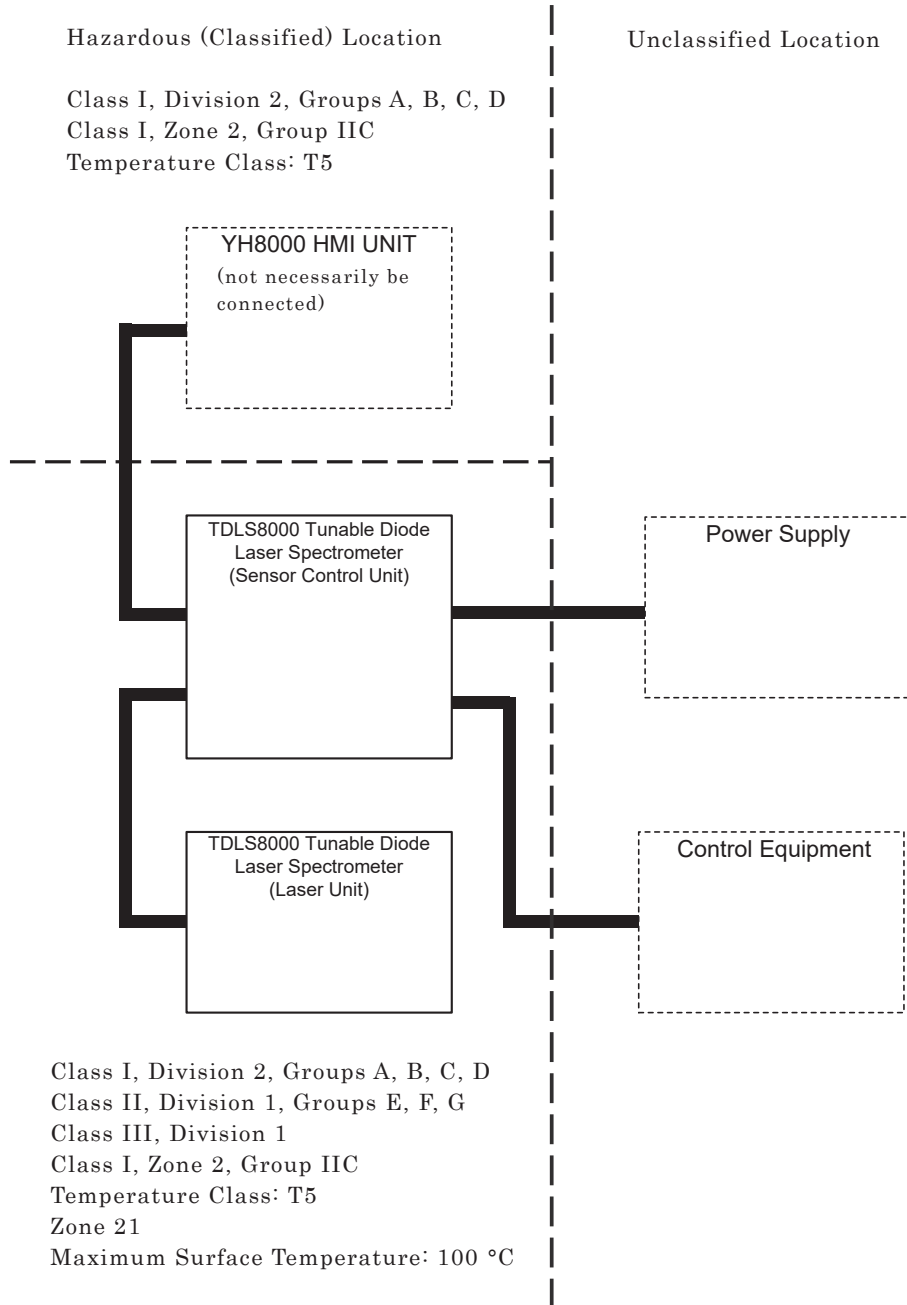
- DO NOT OPEN WHEN AN EXPLOSIVE ATMOSPHERE MAY BE PRESENT
- USE THE HEAT-RESISTING CABLES ≥ 70°C
- POTENTIAL ELECTROSTATIC CHARGING HAZARD
- FOR INSTALLATION AND SAFE USE, READ IM11Y01D01-01
- INSTALL IN ACCORDANCE WITH NFM029-A91

(4) Control Drawing

Model: TDLS8000

Date: January 16, 2015

Control Drawing (US)



Rev.

Doc. No.: NFM029-A91 P.1

Yokogawa Electric Corporation

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Model: TDLS8000

Date: January 16, 2015

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Specific Condition of Use:

Precautions shall be taken to minimize the risk from electrostatic discharge or propagating brush discharge of painted parts of the enclosure.

Notes:

1. No revision to this drawing without prior approval of FM.
2. Installation must be in accordance with the National Electric Code (NFPA 70) and relevant local codes.
3. The thread type of the cable entries must be confirmed according to the user's manual.
4. Screws of the field wiring terminals must be tightened with specified torque values as follows:
  - Sensor Control Unit: 0.5 to 0.6 Nm,
  - Laser Unit: 0.4 to 0.5 Nm
5. Field wiring for ethernet communication must be in accordance with IEEE 802.3 so as to avoid overvoltage of > 119 V.
6. WARNING – POTENTIAL ELECTROSTATIC CHARGING HAZARD – SEE USER'S MANUAL
7. WARNING – DO NOT OPEN WHEN AN EXPLOSIVE ATMOSPHERE MAY BE PRESENT
8. WARNING – USE HEAT-RESISTING CABLES  $\geq 70$  °C
9. WARNING – EXPOSURE TO SOME CHEMICALS MAY DEGRADE THE SEALING PROPERTIES OF MATERIALS USED IN THE FOLLOWING RELAY INCORPORATED IN THE SENSOR CONTROL UNIT:  
  
ATX206SA (Manufacturer: Panasonic Corporation)
10. WARNING – SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR DIVISION 2

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Rev.

Doc. No.: NFM029-A91 P.2

Yokogawa Electric Corporation

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**(5) Operation****WARNING**

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- Electrostatic charge may cause an explosion hazard. Avoid any actions that cause the generation of electrostatic charge, such as rubbing with a dry cloth on coating face of product.
  - Take care not to generate mechanical sparking when access to the instrument and peripheral devices in hazardous locations.
- 

**(6) Maintenance and Repair****WARNING**

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The instrument modification or parts replacement by other than authorized Representative of Yokogawa Electric Corporation is prohibited and will void the certification.

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When opening the cover, the enclosure should be dry and clean to prevent from ingress water or dust.

● TDLS8000-C2 (FM Approval for Canada)

Model: TDLS8000

Date: January 16, 2015

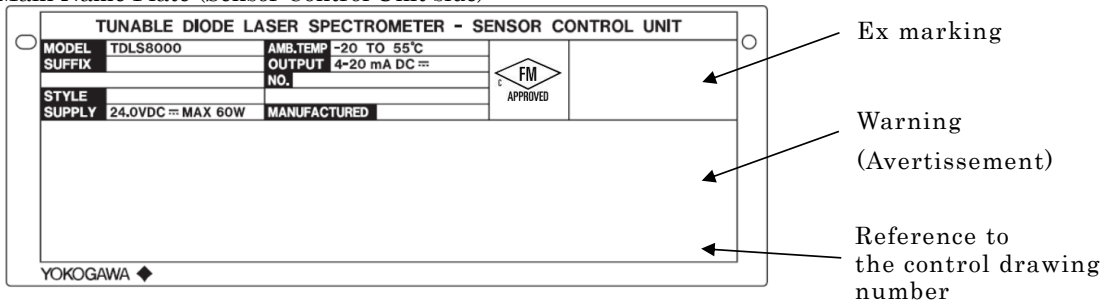
Instructions (Canada)

1) Technical data

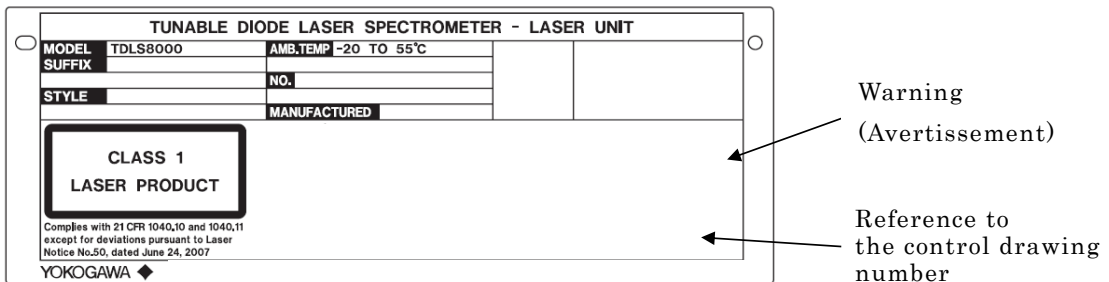
- Applicable standards
  - CAN/CSA-C22.2 No. 0-10 (R2015)
  - CAN/CSA-C22.2 No. 25-1966 (R2014)
  - CAN/CSA-C22.2 No. 94.2-07 (R2012)
  - CAN/CSA-C22.2 No. 60079-0:15
  - CAN/CSA-C22.2 No. 60079-15:16
  - CAN/CSA C22.2 No. 60529-05 (R2010)
  - CAN/CSA-C22.2 No. 61010-1-12
  - CAN/CSA-C22.2 No. 61010-2-030-12
  - ANSI/ISA-12.27.01-2011
- Ratings
  - Ex nA nC IIC T5
  - Class II/III; Division 1; Groups E, F, G
- Enclosure
  - Type 4X, IP66
- Specific condition of use
  - Precautions shall be taken to minimize the risk from electrostatic discharge or propagating brush discharge of painted parts of the enclosure.

2) Name Plate

Main Name Plate (Sensor Control Unit side)



Sub Name Plate (Laser Unit side)



- MODEL: Specified model code
- AMB.TEMP: Specified ambient temperature range
- SUFFIX: Specified suffix code
- OUTPUT: Specified analog output range
- NO.: Serial number
- STYLE: Specified style code
- SUPPLY: Specified supply voltage and wattage
- MANUFACTURED: Month and year of production

Rev.1: December 3, 2015

Doc. No.: NFM029-A92 P.1

Rev.2: May 23, 2018

Model: TDLS8000

Date: January 16, 2015

Ex marking: Ex nA nC IIC T5  
CL II/III, DIV 1, GP EFG  
TYPE 4X, IP66  
DUAL SEAL

Warning: USE THE HEAT-RESISTING CABLES  $\geq 70\text{ }^{\circ}\text{C}$   
DO NOT OPEN WHEN AN EXPLOSIVE ATMOSPHERE MAY BE  
PRESENT.  
POTENTIAL ELECTROSTATIC CHARGING HAZARD.  
FOR INSTALLATION AND SAFE USE, READ IM mmmm  
PROCESS TEMP. AT PROCESS WINDOW AREA SHALL BE WITHIN  
-20 TO 55 $^{\circ}\text{C}$ .

Avertissement: CÂBLES RESISTANTS A UNE TEMPÉRATURE  $\geq 70\text{ }^{\circ}\text{C}$   
NE PAS OUVRIR EN ATMOSPHERE EXPLOSIVE.  
DANGER : ELECTRICITÉ STATIQUE.  
LISEZ IM mmmm POUR INSTALLATION ET SÉCURITÉ.  
TEMPÉRATURE DE PROCESSUS A ZONE DE FENÊTRE  
DE PROCESSUS DOIT ÊTRE DE -20 A 55 $^{\circ}\text{C}$ .

Note: "mmm" means document number of user's manual.

### 3) Installation

- The installation of the equipment should be carried out by the engineers or other professional personnel of the related expertise. The installation should not be carried out by operators or other unprofessional personnel.
- The installation must be in accordance with Canadian Electrical Code Part I (C22.1) and relevant local codes.
- The equipment must only be used in an area of not more than pollution degree 2, as defined in IEC 60664-1.
- Mounting orientation of TDLS8000 is within 30 degrees relative to the horizontal direction.
- When the cable glands and/or adapters are used, they must be Ex "d", Ex "e", or Ex "n" type, and must also meet the ingress protection requirement of IP54 or more.
- The thread type of the cable entries shall be confirmed according to the user's manual.
- Screws of the field wiring terminals must be tightened with specified torque values as follows:
  - Sensor Control Unit: 0.5 to 0.6 Nm,
  - Laser Unit: 0.4 to 0.5 Nm
- Field wiring for ethernet communication must be in accordance with IEEE 802.3 so as to avoid overvoltage of > 119 V.

### WARNING

- USE THE HEAT-RESISTING CABLES  $\geq 70\text{ }^{\circ}\text{C}$   
- DO NOT OPEN WHEN AN EXPLOSIVE ATMOSPHERE MAY BE PRESENT.  
- POTENTIAL ELECTROSTATIC CHARGING HAZARD.  
- FOR INSTALLATION AND SAFE USE, READ IM mmmm  
- CÂBLES RESISTANTS A UNE TEMPÉRATURE  $\geq 70\text{ }^{\circ}\text{C}$   
- NE PAS OUVRIR EN ATMOSPHERE EXPLOSIVE.  
- DANGER : ELECTRICITÉ STATIQUE.  
- LISEZ IM mmmm POUR INSTALLATION ET SÉCURITÉ.

Note: "mmm" = document number of user's manual.

Rev.1: May 23, 2018

Doc. No.: NFM029-A92 P.2

Yokogawa Electric Corporation



Model: TDLS8000

Date: January 16, 2015

4) Operation

WARNING

- Electrostatic charge may cause an explosion hazard. Avoid any actions that cause the generation of electrostatic charge, such as rubbing with a dry cloth on coating face of product.
- Take care not to generate mechanical sparking when access to the instrument and peripheral devices in hazardous locations.

5) Maintenance and Repair

WARNING

- The instrument modification or parts replacement by other than authorized Representative of Yokogawa Electric Corporation is prohibited and will void the certification.
- When opening the cover, the enclosure should be dry and clean to prevent from ingress water or dust.

6) Dual seal

TDLS8000 is Dual seal equipment with annunciation according to ANSI/ISA 12.27.01-2011.

Primary seal is the alignment flange (AF) or LAO.

Wetted materials:

Alignment flange; Stainless steel, Borosilicate glass, Teflon encapsulated viton (O-ring)

LAO; Stainless steel, Borosilicate glass, Silicone (O-ring)

Process gas pressure (working pressure) shall not exceed 500kPa (alignment flange) or 15kPa (LAO).

Process temperature at process window area shall be within -20 to 55°C.

The validation is used as annunciation of the primary seal failure. Failure of the primary seal is detected by the validation failure.

Rev.1: May 23, 2018

Doc. No.: NFM029-A92 P.3

Yokogawa Electric Corporation

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- **TDLS8000-S2 (ATEX Certification)**

- (1) Technical Data**

- Applicable standards

EN 60079-0: 2012+A11:2013

EN 60079-15: 2010

EN 60079-28: 2007


EN 60079-28: 2015

EN 60079-31: 2014

- Certificate No.

FM15ATEX0027X

- Ratings

 II 3(1) G Ex nA nC [op is T6 Ga] IIC T5 Gc  
II 2 D Ex tb IIC T100 °C Db

- Enclosure

IP66 (In accordance with EN 60529)

- Specific condition of use

Precautions shall be taken to minimize the risk from electrostatic discharge or propagating brush discharge of painted parts of the enclosure.

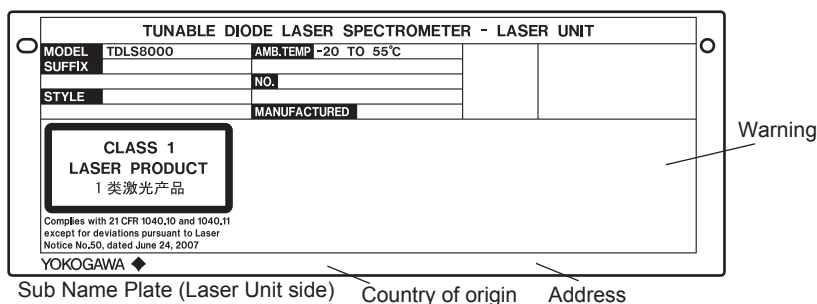
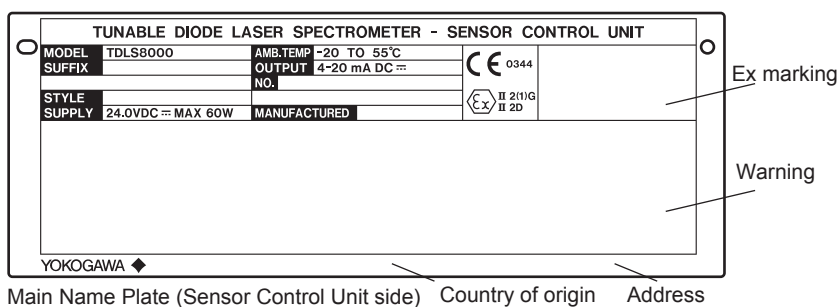
In case of the enclosure of TDLS8000 with paint layers, if it is mounted in an area where the use of category 2D equipment is required, it shall be installed in such a way that the risk from electrostatic discharges and propagating brush discharges caused by rapid flow of dust is avoided.

(2) Name Plate

MODEL: Specified model code  
 AMB.TEMP: Specified ambient temperature range  
 SUFFIX: Specified suffix code  
 OUTPUT: Specified analog output range  
 NO.: Serial number  
 STYLE: Specified style code  
 SUPPLY: Specified supply voltage and wattage  
 MANUFACTURED: Month and year of production  
 Ex marking: Ex nA nC [op is T6 Ga] IIC T5 Gc  
 Ex tb IIIC T100°C Db  
 IP66  
 No.FM15ATEX0027X

Warning: USE THE HEAT-RESISTING CABLES  $\geq 70\text{ }^{\circ}\text{C}$   
 DO NOT OPEN WHEN AN EXPLOSIVE ATMOSPHERE MAY BE PRESENT.  
 POTENTIAL ELECTROSTATIC CHARGING HAZARD.  
 FOR INSTALLATION AND SAFE USE, READ mmmm

Note: "mmm" means document number of user's manual.



### (3) Installation

- The installation of the equipment should be carried out by the engineers or other professional personnel of the related expertise. The installation should not be carried out by operators or other unprofessional personnel.
- The installation must be in accordance with EN 60079-14 and relevant local codes.
- The equipment must only be used in an area of not more than pollution degree 2, as defined in IEC 60664-1.
- Mounting orientation of TDLS8000 is within 30 degrees relative to the horizontal direction.
- When the cable glands and/or adapters are used, they must be Ex “d”, Ex “e”, or Ex “n” type, and must also meet the ingress protection requirement of IP54 or more. If TDLS8000 is installed in where more than IP54 is required as ingress protection, the cable gland and/or adapters should be meet the requirement.
- The thread type of the cable entries shall be confirmed according to the user’s manual.
- Screws of the field wiring terminals must be tightened with specified torque values as follows:
  - Sensor Control Unit: 0.5 to 0.6 Nm,
  - Laser Unit: 0.4 to 0.5 Nm
- Field wiring for ethernet communication must be in accordance with IEEE 802.3 so as to avoid overvoltage of > 119 V.



### WARNING

- USE THE HEAT-RESISTING CABLES  $\geq 70^{\circ}\text{C}$
- DO NOT OPEN WHEN AN EXPLOSIVE ATMOSPHERE MAY BE PRESENT
- POTENTIAL ELECTROSTATIC CHARGING HAZARD
- FOR INSTALLATION AND SAFE USE, READ IM11Y01D01-01

### (4) Operation



### WARNING

- Electrostatic charge may cause an explosion hazard. Avoid any actions that cause the generation of electrostatic charge, such as rubbing with a dry cloth on coating face of product.
- Take care not to generate mechanical sparking when access to the instrument and peripheral devices in hazardous locations.

### (5) Maintenance and Repair



### WARNING

The instrument modification or parts replacement by other than authorized Representative of Yokogawa Electric Corporation is prohibited and will void the certification.

When opening the cover, the enclosure should be dry and clean to prevent from ingress water or dust.

## ● TDLS8000-E2 (IECEX Certification)

### (1) Technical Data

- Applicable standards
  - IEC 60079-0: 2011
  - IEC 60079-15: 2010
  - IEC 60079-28: 2015
  - IEC 60079-31: 2013
- Certificate No.
  - IECEX FMG 15.0015X
- Ratings
  - Ex nA nC [op is T6 Ga] IIC T5 Gc
  - Ex tb IIIC T100 °C Db
- Enclosure
  - IP66 (In accordance with IEC 60529)
- Specific condition of use
 

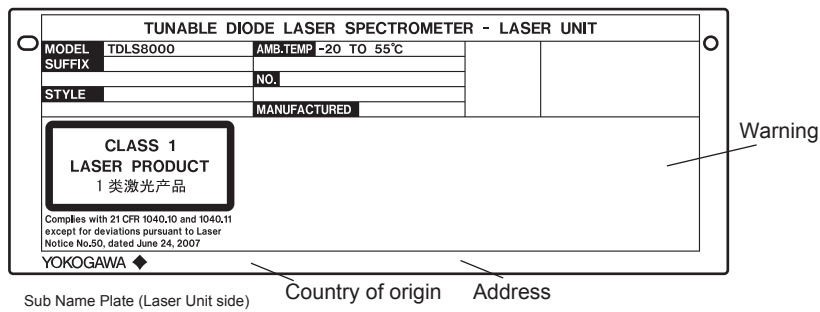
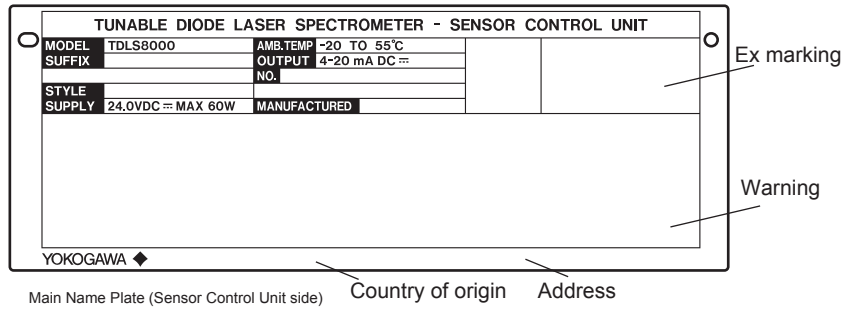
Precautions shall be taken to minimize the risk from electrostatic discharge of painted parts of the enclosure.

In case of the enclosure of TDLS8000 with paint layers, if it is mounted in an area where the use of EPL Db equipment is required, it shall be installed in such a way that the risk from electrostatic discharges and propagating brush discharges caused by rapid flow of dust is avoided.

### (2) Name Plate

MODEL:	Specified model code
AMB.TEMP:	Specified ambient temperature range
SUFFIX:	Specified suffix code
OUTPUT:	Specified analog output range
NO.:	Serial number
STYLE:	Specified style code
SUPPLY:	Specified supply voltage and wattage
MANUFACTURED:	Month and year of production
Ex marking:	Ex nA nC [op is T6 Ga] IIC T5 Gc Ex tb IIIC T100°C Db IP66 No. IECEX FMG 15.0015X
Warning:	USE THE HEAT-RESISTING CABLES $\geq 70$ °C DO NOT OPEN WHEN AN EXPLOSIVE ATMOSPHERE MAY BE PRESENT. POTENTIAL ELECTROSTATIC CHARGING HAZARD. FOR INSTALLATION AND SAFE USE, READ mmmm

Note: "mmmm" means document number of user's manual.



**(3) Installation**

- The installation of the equipment should be carried out by the engineers or other professional personnel of the related expertise. The installation should not be carried out by operators or other unprofessional personnel.
- The installation must be in accordance with IEC 60079-14 and relevant local codes.
- The equipment must only be used in an area of not more than pollution degree 2, as defined in IEC 60664-1.
- Mounting orientation of TDLS8000 is within 30 degrees relative to the horizontal direction.
- When the cable glands and/or adapters are used, they must be Ex “d”, Ex “e”, or Ex “n” type, and must also meet the ingress protection requirement of IP54 or more. If TDLS8000 is installed in where more than IP54 is required as ingress protection, the cable gland and/or adapters should be meet the requirement.
- The thread type of the cable entries shall be confirmed according to the user’s manual.
- Screws of the field wiring terminals must be tightened with specified torque values as follows:
  - Sensor Control Unit: 0.5 to 0.6 Nm,
  - Laser Unit: 0.4 to 0.5 Nm
- Field wiring for ethernet communication must be in accordance with IEEE 802.3 so as to avoid overvoltage of > 119 V.

 **WARNING**

- USE THE HEAT-RESISTING CABLES  $\geq 70^{\circ}\text{C}$
- DO NOT OPEN WHEN AN EXPLOSIVE ATMOSPHERE MAY BE PRESENT
- POTENTIAL ELECTROSTATIC CHARGING HAZARD
- FOR INSTALLATION AND SAFE USE, READ IM11Y01D01-01

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#### (4) Operation



### WARNING

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- Electrostatic charge may cause an explosion hazard. Avoid any actions that cause the generation of electrostatic charge, such as rubbing with a dry cloth on coating face of product.
  - Take care not to generate mechanical sparking when access to the instrument and peripheral devices in hazardous locations.
- 

#### (5) Maintenance and Repair



### WARNING

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The instrument modification or parts replacement by other than authorized Representative of Yokogawa Electric Corporation is prohibited and will void the certification.

---

When opening the cover, the enclosure should be dry and clean to prevent from ingress water or dust.

## ● TDLS8000-N2 (NEPSI Certification)

### (1) Technical Data

- Applicable standards
  - GB 3836.1-2010
  - GB 3836.8-2014
  - GB 12476.1-2013
  - GB 12476.5-2013
  - IEC 60079-28: 2015
- Certificate No.  
GYJ16.1282X
- Ratings
  - Ex nA nC [op is T6 Ga] IIC T5 Gc
  - Ex tD A21 IP66 T100°C
- Enclosure  
IP66 (In accordance with GB 4208)
- Specific condition of use
 

Precautions shall be taken to minimize the risk from electrostatic discharge of painted parts and non-metallic parts of the enclosure.

In case of the enclosure of TDLS8000 with paint layers, if it is mounted combustible dust atmosphere Zone 21, it shall be installed in such a way that the risk from electrostatic discharges and propagating brush discharges caused by rapid flow of dust is avoided.

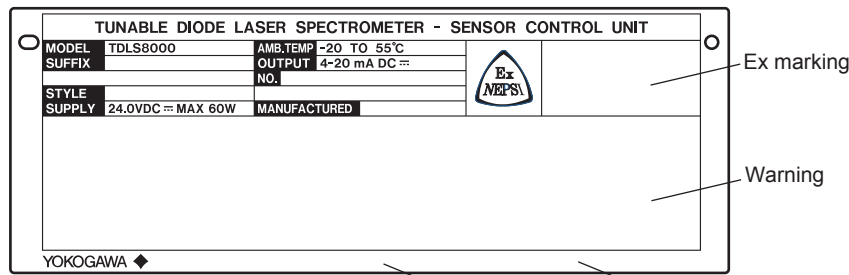
### (2) Name Plate

MODEL:	Specified model code
AMB.TEMP:	Specified ambient temperature range
SUFFIX:	Specified suffix code
OUTPUT:	Specified analog output range
NO.:	Serial number
STYLE:	Specified style code
SUPPLY:	Specified supply voltage and wattage
MANUFACTURED:	Month and year of production
Ex marking:	Ex nA nC [op is T6 Ga] IIC T5 Gc Ex tD A21 IP66 T100°C No. GYJ16.1282X

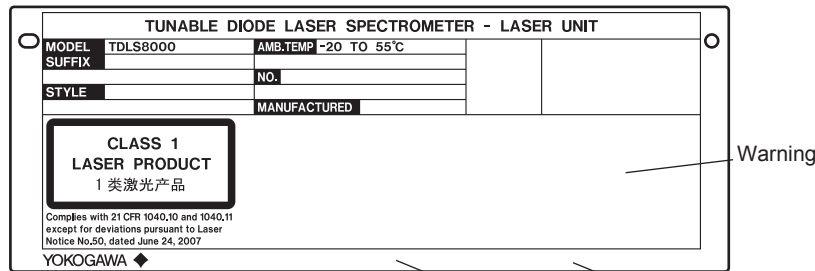
Warning: USE THE HEAT-RESISTING CABLES  $\geq 70^{\circ}\text{C}$   
DO NOT OPEN WHEN AN EXPLOSIVE ATMOSPHERE MAY BE PRESENT.  
POTENTIAL ELECTROSTATIC CHARGING HAZARD.  
FOR INSTALLATION AND SAFE USE, READ mmmm

Note: "mmmm" means document number of user's manual.





Main Name Plate (Sensor Control Unit side) Country of origin Address



Sub Name Plate (Laser Control Unit side) Country of origin Address

**(3) Installation**

- The installation of the equipment should be carried out by the engineers or other professional personnel of the related expertise. The installation should not be carried out by operators or other unprofessional personnel.
- Installation, use and maintenance of the product should comply with the manual and following standards.

GB 3836.13-2013 “Explosive atmospheres Part 13: Equipment repair, overhaul and reclamation”

GB 3836.15-2000 “Electrical apparatus for explosive gas atmosphere Part 15: Electrical installations in hazardous area (other than mines)”

GB 3836.16-2006 “Electrical apparatus for explosive gas atmosphere Part 16: Inspection and maintenance of electrical installation (other than mines)”

GB 50257-2014 “Code for construction and acceptance of electric equipment on fire and explosion hazard electrical equipment installation engineering”

GB 15577-2007 “Safety regulations for dust explosion prevention and protection”

GB 12476.2-2010 “Electrical apparatus for use in the presence of combustible dust Part 2: Selection and installation”

- The equipment must only be used in an area of not more than pollution degree 2, as defined in GB/T 16935.1.
- Mounting orientation of TDLS8000 is within 30 degrees relative to the horizontal direction.
- When the cable glands and/or adapters are used, they must be Ex “d”, Ex “e”, or Ex “n” type, and must also meet the ingress protection requirement of IP54 or more. If TDLS8000 is installed in where more than IP54 is required as ingress protection, the cable gland and/or adapters should be meet the requirement.
- The thread type of the cable entries shall be confirmed according to the user’s manual.
- Screws of the field wiring terminals must be tightened with specified torque values as follows:
  - Sensor Control Unit: 0.5 to 0.6 Nm,
  - Laser Unit: 0.4 to 0.5 Nm
- Field wiring for ethernet communication must be in accordance with IEEE 802.3 so as to avoid overvoltage of > 119 V.

**WARNING**

- USE THE HEAT-RESISTING CABLES  $\geq 70^{\circ}\text{C}$
- DO NOT OPEN WHEN AN EXPLOSIVE ATMOSPHERE MAY BE PRESENT
- POTENTIAL ELECTROSTATIC CHARGING HAZARD
- FOR INSTALLATION AND SAFE USE, READ IM11Y01D01-01

**(4) Operation****WARNING**

- Electrostatic charge may cause an explosion hazard. Avoid any actions that cause the generation of electrostatic charge, such as rubbing with a dry cloth on coating face of product.
- Take care not to generate mechanical sparking when access to the instrument and peripheral devices in hazardous locations.

**(5) Maintenance and Repair****WARNING**

The instrument modification or parts replacement by other than authorized Representative of Yokogawa Electric Corporation is prohibited and will void the certification.

When opening the cover, the enclosure should be dry and clean to prevent from ingress water or dust.

## ● TDLS8000-D1 (FM Approval for US)

### (1) Technical data

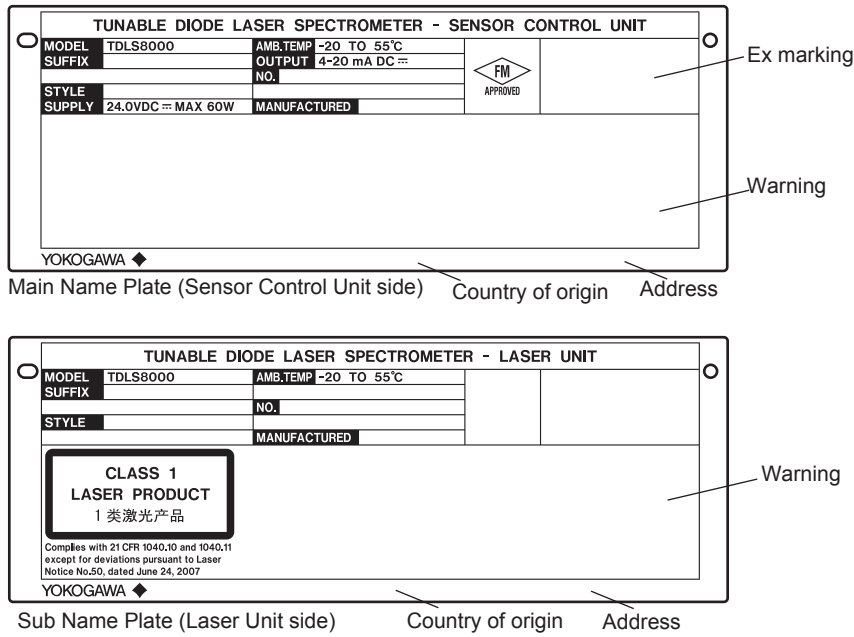
- Applicable standards
  - Class 3600: 2011
  - Class 3615: 2006
  - Class 3616: 2011
  - Class 3810: 2005
  - NEMA 250-2003
  - ANSI/ISA-60079-0-2013
  - ANSI/UL 60079-1:2015
  - ANSI/ISA-60079-31-2015
  - ANSI/IEC 60529-2004 (R2011)
- Certificate No.
  - FM16US0189X
- Ratings:
  - Explosionproof for
    - Class I; Division 1; Groups A, B, C, D; T5
  - Dust-Ignitionproof for Class II/III; Division 1; Groups E, F, G; T5
  - Class I, Zone 1, AEx db IIC T5
  - Zone 21, AEx tb IIIC T100 °C
- Enclosure: Type 4X, IP66
- Ambient temperature: -20 to +55°C
- Process temperature (Process window area): -20 to +55°C
- Specific condition of use:
  - Flameproof joints are not intended to be repaired. Contact Yokogawa representative or Yokogawa office.
  - Precautions shall be taken to minimize the risk from electrostatic discharge or propagating brush discharge of painted parts of the enclosure.

### (2) Name Plate

MODEL:	Specified model code
AMB.TEMP:	Specified ambient temperature range
SUFFIX:	Specified suffix code
OUTPUT:	Specified analog output range
NO.:	Serial number
STYLE:	Specified style code
SUPPLY:	Specified supply voltage and wattage
MANUFACTURED:	Month and year of production
Ex marking:	CL I, DIV 1, GP ABCD, T5 CL II/III, DIV 1, GP EFG, T5 CL I, ZN 1, AEx db IIC T5 ZN 21, AEx tb IIIC T100 °C TYPE 4X, IP66

Warning: USE THE HEAT-RESISTING CABLES  $\geq 70$  °C  
DO NOT OPEN WHEN AN EXPLOSIVE ATMOSPHERE MAY BE PRESENT.  
POTENTIAL ELECTROSTATIC CHARGING HAZARD.  
FOR INSTALLATION AND SAFE USE, READ mmmm  
SEAL ALL CONDUITS WITHIN 18 INCHES WHEN IN INSTALLED IN CL I DIV 1.

Note: "mmmm" means document number of user's manual.

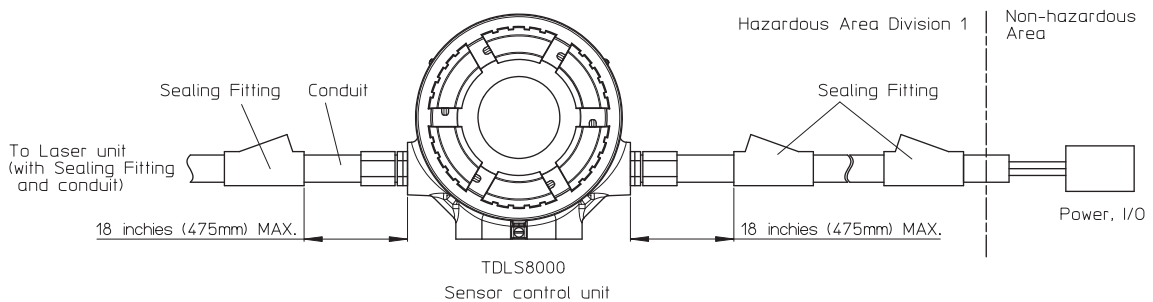


**(3) Installation**

- The installation of the equipment should be carried out by the engineers or other professional personnel of the related expertise. The installation should not be carried out by operators or other unprofessional personnel.
- The installation should be in accordance with NEC (the National Electric Code: ANSI/NFPA-70) or local electric code.
- In hazardous location, wiring shall be in conduit.

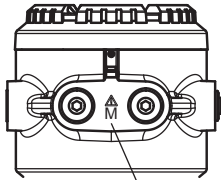
**! WARNING**

SEAL ALL CONDUITS WITHIN 18 INCHES. WHEN INSTALLED IN CL I, DIV 1 .



Note: Laser unit shall have conduit and sealing fitting in the same manner as Sensor control unit.

- Unused apertures shall be closed with suitable flameproof certified blanking elements. The plugs that are installed in the instrument are certified as a part of the instrument.
- Mounting orientation of TDLS8000 is within 30 degrees relative to the horizontal direction.
- If the TDLS8000 is mounted in an area where the use of Class II and III equipment is required, it shall be installed in such a way that the risk from electrostatic discharges and propagating burst discharges caused by rapid flow of dust is avoided.
- Process window area shall not exceed 55°C.
- A mark indicating the electrical connection type is stamped near the electrical connection port. These marks are as follows:



Location of the marking

Screw size	Marking
ISO M20x1.5 female M25x1.5 female	M
ANSI 1/2 NPT Female 3/4 NPT female	N

Note: This type is only NPT thread available.

**(4) Operation**

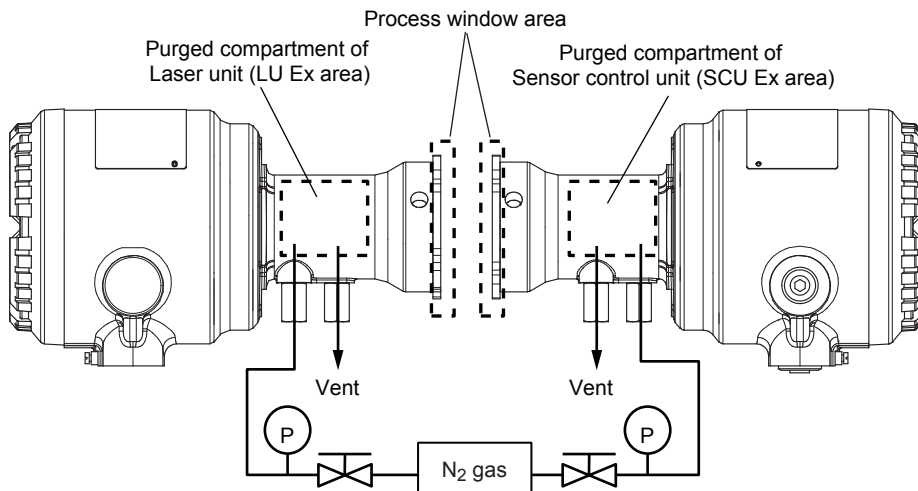
- Note a warning label worded as follows:



**WARNING**

- USE THE HEAT-RESISTING CABLES  $\geq 70^{\circ}$
- DO NOT OPEN WHEN AN EXPLOSIVE ATMOSPHERE MAY BE PRESENT.
- POTENTIAL ELECTROSTATIC CHARGING HAZARD.
- FOR INSTALLATION AND SAFE USE, READ IM 11Y01D01-01.
- SEAL ALL CONDUITS WITHIN 18 INCHES. WHEN INSTALLED IN CL I, DIV 1 .

- Take care not to generate mechanical spark when access to the instrument and peripheral devices in hazardous locations.
- Electrostatic charge may cause an explosion hazard. Avoid any actions that cause the generation of electrostatic charge, such as rubbing with dry cloth on coating face of product.
- Pressure at the inlet for purged compartment shall not exceed 10 kPa.



**(5) Maintenance**

- The equipment shall not be modified or repaired by personnel who is not authorized by Yokogawa Electric Corporation.
- Flameproof joints are not intended to be repaired. Contact Yokogawa representative or Yokogawa office.

## ● TDLS8000-C1 (FM Approval for Canada)

### (1) Technical data

- Applicable standards
  - CAN/CSA-C22.2 NO. 0-10 (R2015)
  - CAN/CSA-C22.2 NO. 0.4-04 (R2013)
  - C22.2 NO. 0.5-1982 (R2012)
  - C22.2 NO.25-1966 (R2014)
  - C22.2 NO.94.2-07 (R2012)
  - CAN/CSA-C22.2 NO. 60079-0:15
  - CAN/CSA-C22.2 NO. 60079-1:16
  - CAN/CSA-C22.2 NO. 60079-31:15
  - CAN/CSA-C22.2 NO. 60529-05 (R2015)
  - CAN/CSA-C22.2 NO. 61010-1-12
  - CAN/CSA-C22.2 NO. 61010-2-030-12
  - ANSI/ISA 12.27.01-2011
- Certificate No.  
FM16CA0076X
- Ratings:
  - Ex db IIC T5 Gb
  - Class II/III, Division 1, Groups E, F, G, T5
  - Ex tb IIIC T100 °C Db
- Enclosure: Type 4X, IP66
- Ambient temperature: -20 to +55 °C
- Process temperature (Process window area): -20 to +55°C
- Specific condition of use:
  - Flameproof joints are not intended to be repaired. Contact Yokogawa representative or Yokogawa office.
  - Precautions shall be taken to minimize the risk from electrostatic discharge or propagating brush discharge of painted parts of the enclosure.

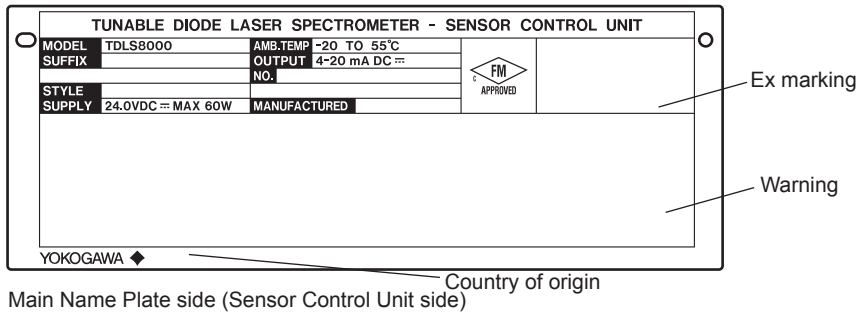
### (2) Name Plate

MODEL:	Specified model code
AMB.TEMP:	Specified ambient temperature range
SUFFIX:	Specified suffix code
OUTPUT:	Specified analog output range
NO.:	Serial number
STYLE:	Specified style code
SUPPLY:	Specified supply voltage and wattage
MANUFACTURED:	Month and year of production
Ex marking:	Ex db IIC T5 Gb CL II/III, DIV 1, GPS EFG T5 Ex tb IIIC T100°C Db TYPE 4X, IP66 DUAL SEAL No. FM16CA0076X

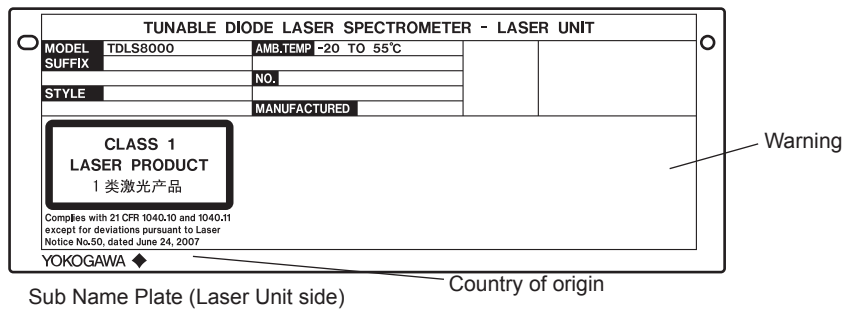
Warning: USE THE HEAT-RESISTING CABLES  $\geq 70^{\circ}\text{C}$   
 DO NOT OPEN WHEN AN EXPLOSIVE ATMOSPHERE MAY BE PRESENT.  
 POTENTIAL ELECTROSTATIC CHARGING HAZARD.  
 FOR INSTALLATION AND SAFE USE, READ mmmm  
 SEAL ALL CONDUITS WITHIN 18 INCHES WHEN INSTALLED IN CL I DIV 1.

AVERTISSEMENT: Câbles résistants à une température  $\geq 70^{\circ}\text{C}$ .  
 Ne pas ouvrir en atmosphère explosive.  
 DANGER : ÉLECTRICITÉ STATIQUE.  
 Lisez mmmm pour installation et sécurité.  
 Placer un matériau étanche à 50mm autour du boîtier.

Note: "mmm" means document number of user's manual



Main Name Plate side (Sensor Control Unit side)



Sub Name Plate (Laser Unit side)

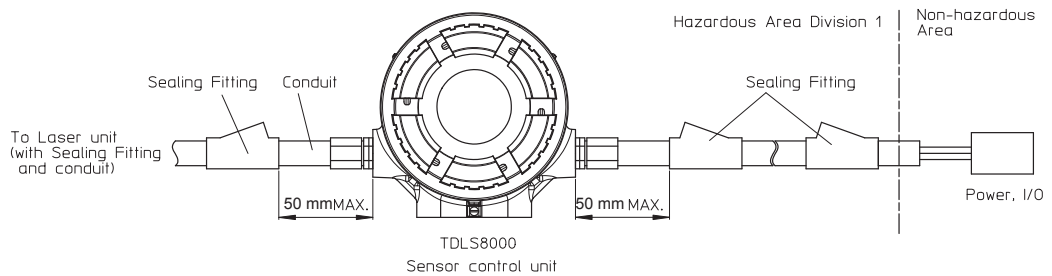
**(3) Installation**

- The installation of the equipment should be carried out by the engineers or other professional personnel of the related expertise. The installation should not be carried out by operators or other unprofessional personnel.
- All wiring shall comply with Canadian Electrical Code Part I and Local Electrical Codes.
- In hazardous location, wiring shall be in conduit.



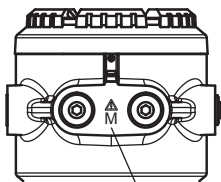
**WARNING AVERTISSEMENT**

A SEAL SHALL BE INSTALLED WITHIN 50 mm OF THE ENCLOSURE.  
 PLACER UN MATÉRIAU ÉTANCHE A 50 mm AUTOUR DU BOÎTIER.



Note: Laser unit shall have conduit and sealing fitting in the same manner as Sensor control unit.

- Unused apertures shall be closed with suitable flameproof certified blanking elements. The plugs that are installed in the instrument are certified as a part of the instrument.
- In case of ANSI 1/2NPT and 3/4NPT plugs, ANSI hexagonal wrench should be applied to screw in.
- Mounting orientation of TDLS8000 is within 30 degrees relative to the horizontal direction.
- If the TDLS8000 is mounted in an area where the use of Class II and III equipment is required, it shall be installed in such a way that the risk from electrostatic discharges and propagating burst discharges caused by rapid flow of dust is avoided.
- Process window area shall not exceed 55°C
- A mark indicating the electrical connection type is stamped near the electrical connection port. These marks are as follows:



Location of the marking

Screw size	Marking
ISO M20x1.5 female M25x1.5 female	M
ANSI 1/2 NPT Female 3/4 NPT female	N

Note: This type is only NPT thread available.

**(4) Operation**

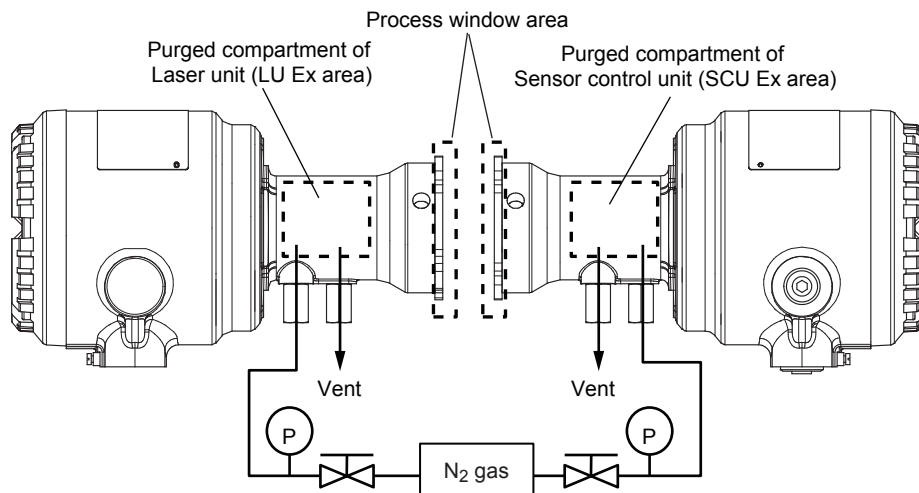
- Note a warning label worded as follows.





## WARNING AVERTISSEMENT

- USE THE HEAT-RESISTING CABLES  $\geq 70^{\circ}\text{C}$
  - DO NOT OPEN WHEN AN EXPLOSIVE ATMOSPHERE MAY BE PRESENT.
  - POTENTIAL ELECTROSTATIC CHARGING HAZARD.
  - FOR INSTALLATION AND SAFE USE, READ IM 11Y01D01-01.
  - A SEAL SHALL BE INSTALLED WITHIN 50 mm OF THE ENCLOSURE.
  - CÂBLES RESISTANTS A UNE TEMPÉRATURE  $\geq 70^{\circ}\text{C}$ .
  - NE PAS OUVRIR NE ATMOSHERE EXPLOSIVE.
  - DANGER : ELECTRICITÉ STATIQUE
  - LISEZ IM 11Y01D01-01 POUR INSTALLATION ET SÉCURITÉ.
  - PLACER UN MATÉRIAU ÉTANCHE A 50 mm AUTOUR DU BOÎTIER.
- Take care not to generate mechanical spark when access to the instrument and peripheral devices in hazardous locations.
  - Electrostatic charge may cause an explosion hazard. Avoid any actions that cause the generation of electrostatic charge, such as rubbing with dry cloth on coating face of product.
  - Pressure at the inlet for purged compartment shall not exceed 10 kPa.



### (5) Maintenance

- The equipment shall not to be modified or repaired by personel who is not authorized by Yokogawa Electric Corporation.
- Flameproof joints are not intended to be repaired. Contact Yokogawa representative or Yokogawa office.

**(6) Dual seal**

TDLS8000 is Dual seal equipment with annunciation according to ANSI/ISA 12.27.01-2011.

Primary seal is the alignment flange (AF) or LAO.

Wetted materials:

Alignment flange; Stainless steel, Borosilicate glass (BK-7), Teflon encapsulated viton (FKM) (O-ring)

LAO; Stainless steel, Borosilicate glass (BK-7), Silicone (O-ring)

Process gas pressure (working pressure) shall not exceed 500kPa(AF) or 15kPa(LAO).

Process temperature at process window area shall be within -20 to 55°C.

The validation is used as annunciation of the primary seal failure. Failure of the primary seal is detected by the validation failure.

For details on validation, see "9. Inspection and Maintenance".

**NOTE**

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The validation is a procedure to check whether the TDLS8000 is operating properly. Therefore, the validation may fail because of the reasons other than primary seal failure.

For details on validation, see "9. Inspection and Maintenance".

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● **TDLS8000-S1 (ATEX certification)**

**(1) Technical Data**

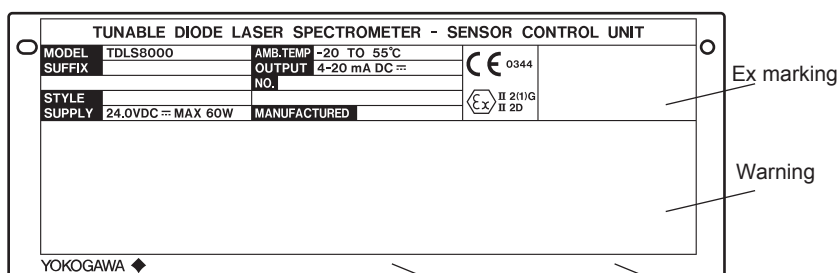
- Applicable standards
  - EN 60079-0: 2012+A11 2013
  - EN 60079-1: 2014
  - EN 60079-28: 2015
  - EN 60079-31: 2014
- Certificate No.  
FM15ATEX0042X
- Ratings
  -  II 2(1) G Ex db [op is T6 Ga] IIC T5 Gb  
II 2 D Ex tb IIIC T100 °C Db
- Enclosure: IP66
- Ambient temperature: -20 to +55 °C
- Process temperature (Process window area): -20 to +55°C
- Specific condition of use
  - Flameproof joints are not intended to be repaired. Contact Yokogawa representative or Yokogawa office.
  - Precautions shall be taken to minimize the risk from electrostatic discharge or propagating brush discharge of painted parts of the enclosure.
  - In case of the enclosure of TDLS8000 with paint layers, if it is mounted in an area where the use of category 2D equipment is required, it shall be installed in such a way that the risk from electrostatic discharges and propagating brush discharges caused by rapid flow of dust is avoided.

**(2) Name Plate**

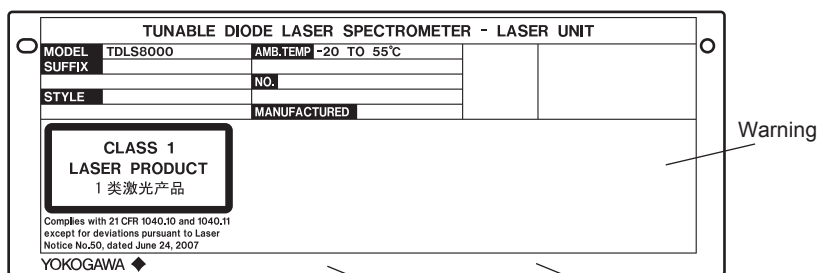
MODEL: Specified model code  
AMB.TEMP: Specified ambient temperature range  
SUFFIX: Specified suffix code  
OUTPUT: Specified analog output range  
NO.: Serial number  
STYLE: Specified style code  
SUPPLY: Specified supply voltage and wattage  
MANUFACTURED: Month and year of production  
Ex marking: Ex db [op is T6 Ga] IIC T5 Gb  
Ex tb IIIC T100°C Db  
IP66  
FM15ATEX0042X

Warning: USE THE HEAT-RESISTING CABLES ≥ 70 °C  
DO NOT OPEN WHEN AN EXPLOSIVE ATMOSPHERE MAY BE PRESENT.  
POTENTIAL ELECTROSTATIC CHARGING HAZARD.  
FOR INSTALLATION AND SAFE USE, READ mmmm

Note: "mmmm" means document number of user's manual



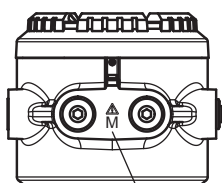
Main Name Plate (Sensor Control Unit side) Country of origin Address



Sub Name Plate (Laser Unit side) Country of origin Address

**(3) Installation**

- The installation of the equipment should be carried out by the engineers or other professional personnel of the related expertise. The installation should not be carried out by operators or other unprofessional personnel.
- All wiring shall comply with local installation requirement.
- Cable glands, adapters and/or blanking element with a suitable IP rating shall be of Ex d IIC/ Ex tb IIIC certified by ATEX and shall be installed so as to maintain the specific degree of protection of the equipment.
- Unused apertures shall be closed with suitable flameproof certified blanking elements. The plugs that are installed in the instrument are certified as a part of the instrument.
- In case of ANSI 1/2NPT and 3/4NPT plugs, ANSI hexagonal wrench should be applied to screw in.
- Mounting orientation of TDLS8000 is within 30 degrees relative to the horizontal direction.
- If the TDLS8000 is mounted in an area where the use of EPL Db equipment is required, it shall be installed in such a way that the risk from electrostatic discharges and propagating burst discharges caused by rapid flow of dust is avoided.
- Process window area shall not exceed 55°C.
- A mark indicating the electrical connection type is stamped near the electrical connection port. These marks are as follows:



Location of the marking

Screw size	Marking
ISO M20x1.5 female M25x1.5 female	M
ANSI 1/2 NPT Female 3/4 NPT female	N

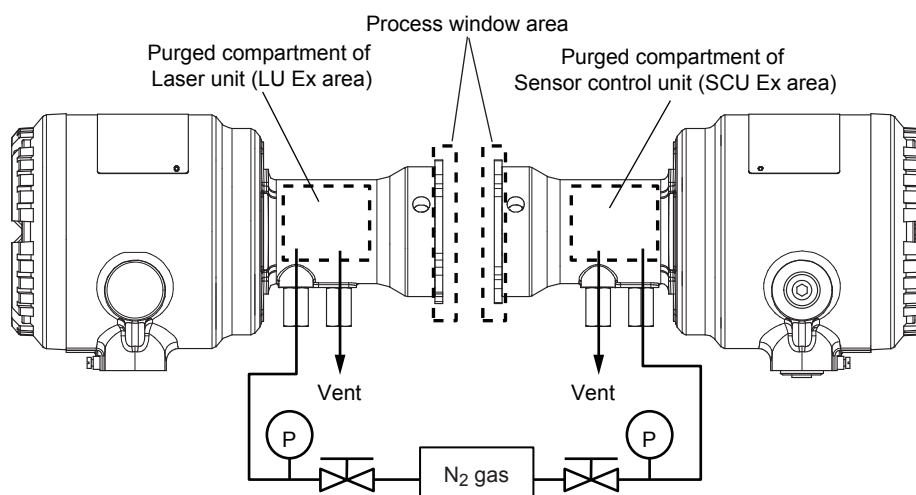
**(4) Operation**

- Note a warning label worded as follows.

**WARNING**

- USE THE HEAT-RESISTING CABLES  $\geq 70^{\circ}\text{C}$
- DO NOT OPEN WHEN AN EXPLOSIVE ATMOSPHERE MAY BE PRESENT.
- POTENTIAL ELECTROSTATIC CHARGING HAZARD.
- FOR INSTALLATION AND SAFE USE, READ IM 11Y01D01-01.

- Take care not to generate mechanical spark when access to the instrument and peripheral devices in hazardous locations.
- Electrostatic charge may cause an explosion hazard. Avoid any actions that cause the generation of electrostatic charge, such as rubbing with dry cloth on coating face of product.
- Pressure at the inlet for purged compartment shall not exceed 10kPa.

**(5) Maintenance**

- The equipment shall not be modified or repaired by personnel who is not authorized by Yokogawa Electric Corporation
- Flameproof joints are not intended to be repaired. Contact Yokogawa representative or Yokogawa office.

## ● TDLS8000-E1 (IECEX Certification)

### (1) Technical Data

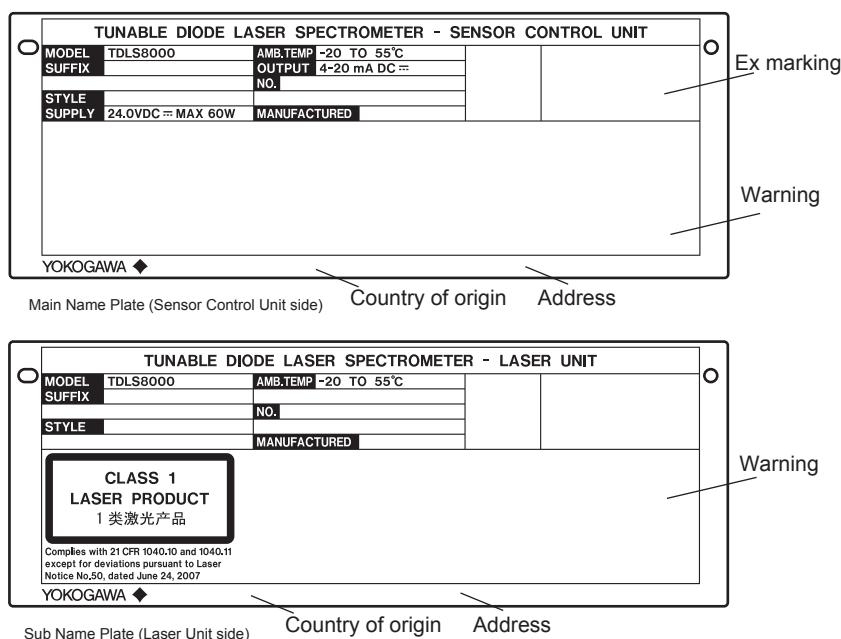
- Applicable standards
  - IEC 60079-0: 2011
  - IEC 60079-1: 2014
  - IEC 60079-28: 2015
  - IEC 60079-31: 2013
- Certificate No.
  - IECEX FMG 15.0024X
- Ratings
  - Ex db [op is T6 Ga] IIC T5 Gb
  - Ex tb IIIC T100 °C Db
- Enclosure: IP66
- Process temperature (Process window area): -20 to +55°C
- Ambient temperature: -20 to +55 °C
- Specific condition of use
  - Flameproof joints are not intended to be repaired. Contact Yokogawa representative or Yokogawa office.
  - Precautions shall be taken to minimize the risk from electrostatic discharge of painted parts of the enclosure.
  - In case of the enclosure of TDLS8000 with paint layers, if it is mounted in an area where the use of EPL Db equipment is required, it shall be installed in such a way that the risk from electrostatic discharges and propagating brush discharges caused by rapid flow of dust is avoided.

### (2) Name Plate

MODEL:	Specified model code
AMB.TEMP:	Specified ambient temperature range
SUFFIX:	Specified suffix code
OUTPUT:	Specified analog output range
NO.:	Serial number
STYLE:	Specified style code
SUPPLY:	Specified supply voltage and wattage
MANUFACTURED:	Month and year of production
Ex marking:	Ex db [op is T6 Ga] IIC T5 Gb Ex tb IIIC T100°C Db IP66 IECEX FMG 15.0024X

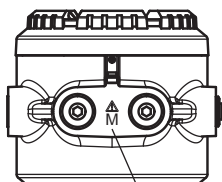
Warning: USE THE HEAT-RESISTING CABLES  $\geq 70$  °C  
DO NOT OPEN WHEN AN EXPLOSIVE ATMOSPHERE MAY BE PRESENT.  
POTENTIAL ELECTROSTATIC CHARGING HAZARD.  
FOR INSTALLATION AND SAFE USE, READ IM mmmm

Note: "mmmm" means document number of user's manual.



**(3) Installation**

- The installation of the equipment should be carried out by the engineers or other professional personnel of the related expertise. The installation should not be carried out by operators or other unprofessional personnel.
- All wiring shall comply with local installation requirement.
- Cable glands, adapters and/or blanking element with a suitable IP rating shall be of Ex d IIC/ Ex tb IIIC certified by IECEx and shall be installed so as to maintain the specific degree of protection of the equipment.
- Unused apertures shall be closed with suitable flameproof certified blanking elements. The plugs that are installed in the instrument are certified as a part of the instrument.
- In case of ANSI 1/2NPT and 3/4NPT plugs, ANSI hexagonal wrench should be applied to screw in.
- Mounting orientation of TDLS8000 is within 30 degrees relative to the horizontal direction.
- If the TDLS8000 is mounted in an area where the use of EPL Db equipment is required, it shall be installed in such a way that the risk from electrostatic discharges and propagating burst discharges caused by rapid flow of dust is avoided.
- Process window area shall not exceed 55°C
- A mark indicating the electrical connection type is stamped near the electrical connection port. These marks are as follows:



Location of the marking

Screw size	Marking
ISO M20x1.5 female M25x1.5 female	M
ANSI 1/2 NPT Female 3/4 NPT female	N

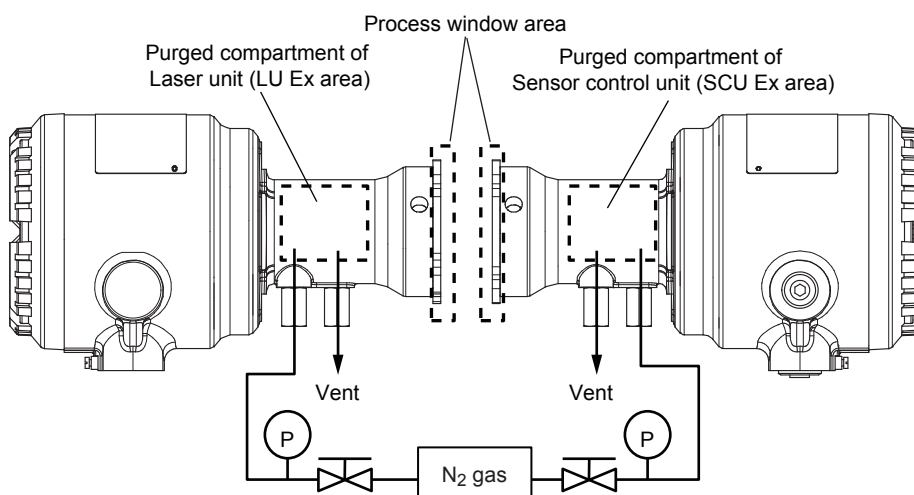
#### (4) Operation

- Note a warning label worded as follows.



### WARNING

- USE THE HEAT-RESISTING CABLES  $\geq 70^{\circ}\text{C}$
  - DO NOT OPEN WHEN AN EXPLOSIVE ATMOSPHERE MAY BE PRESENT.
  - POTENTIAL ELECTROSTATIC CHARGING HAZARD.
  - FOR INSTALLATION AND SAFE USE, READ IM 11Y01D01-01.
- 
- Take care not to generate mechanical spark when access to the instrument and peripheral devices in hazardous locations.
  - Electrostatic charge may cause an explosion hazard. Avoid any actions that cause the generation of electrostatic charge, such as rubbing with dry cloth on coating face of product.
  - Pressure at the inlet for purged compartment shall not exceed 10kPa.



#### (5) Maintenance

- The equipment shall not be modified or repaired by personnel who is not authorized by Yokogawa Electric Corporation.
- Flameproof joints are not intended to be repaired. Contact Yokogawa representative or Yokogawa office



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## ■ YH8000

### ● YH8000-D2 (FM Approval for US)

#### (1) Technical Data

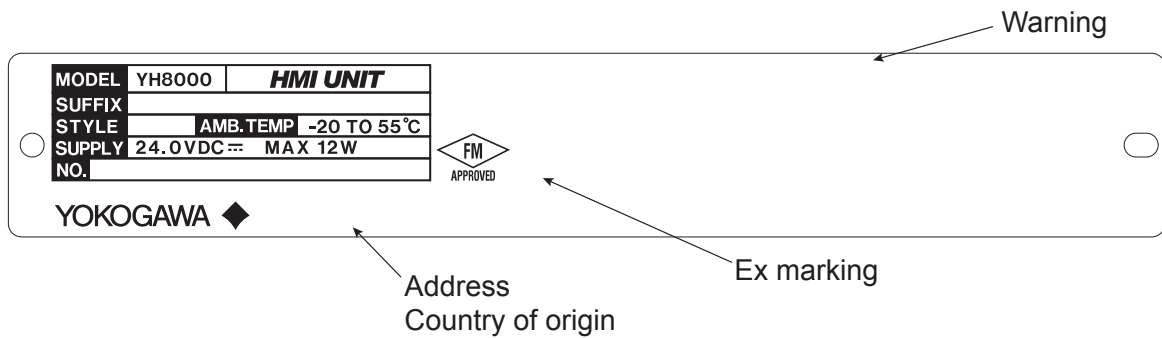
- Applicable standards
  - FM Class 3600: 2011
  - FM Class 3611: 2004
  - FM Class 3810: 2005
  - NEMA 250-2003
  - ANSI/ISA-60079-0-2013
  - ANSI/ISA-60079-11-2014
  - ANSI/ISA-60079-15-2012
  - ANSI/IEC 60529-2004 (R2011)
- Original Project ID  
3054584
- Ratings
  - Nonincendive for
  - Class I; Division 2; Groups A, B, C, D; T5
  - Class I, Zone 2, AEx nA ic IIC T5
- Enclosure
  - Type 4X, IP65
- Specific condition of use
  - Precautions shall be taken to minimize the risk from electrostatic discharge of painted parts and non-metallic parts of the enclosure.

(2) Name Plate

- MODEL: Specified model code
- SUFFIX: Specified suffix code
- STYLE: Specified style code
- AMB.TEMP: Specified ambient temperature range
- SUPPLY: Specified supply voltage and wattage
- NO.: Serial number
- Ex marking: CL I, DIV 2, GP ABCD, T5  
CL I, ZN 2, AEx nA ic IIC T5  
TYPE 4X, IP65

Warning: DO NOT OPEN WHEN AN EXPLOSIVE ATMOSPHERE MAY BE PRESENT.  
POTENTIAL ELECTROSTATIC CHARGING HAZARD.  
INSTALL IN ACCORDANCE WITH NFM030-A71  
FOR INSTALLATION AND SAFE USE, READ IM mmmm

Note: "mmmm" means document number of user's manual.



(3) Installation

- The installation of the equipment should be carried out by the engineers or other professional personnel of the related expertise. The installation should not be carried out by operators or other unprofessional personnel.
- The installation must be in accordance the National Electric Code (NFPA 70) and relevant local codes.
- The equipment must only be used in an area of not more than pollution degree 2, as defined in IEC 60664-1.
- When the cable glands and/or adapters are used, they must be Ex "d", Ex "e", or Ex "n" type, and must also meet the ingress protection requirement of IP54 or more. If YH8000 is installed in where more than IP54 is required as ingress protection, the cable gland and/or adapters should be meet the requirement.
- The thread type of the cable entries shall be confirmed according to the user's manual.
- Screws of the field wiring terminals must be tightened with the specified torque value: 0.22 to 0.25 Nm.
- Field wiring for ethernet communication must be in accordance with IEEE 802.3 so as to avoid overvoltage of > 119 V.



**WARNING**

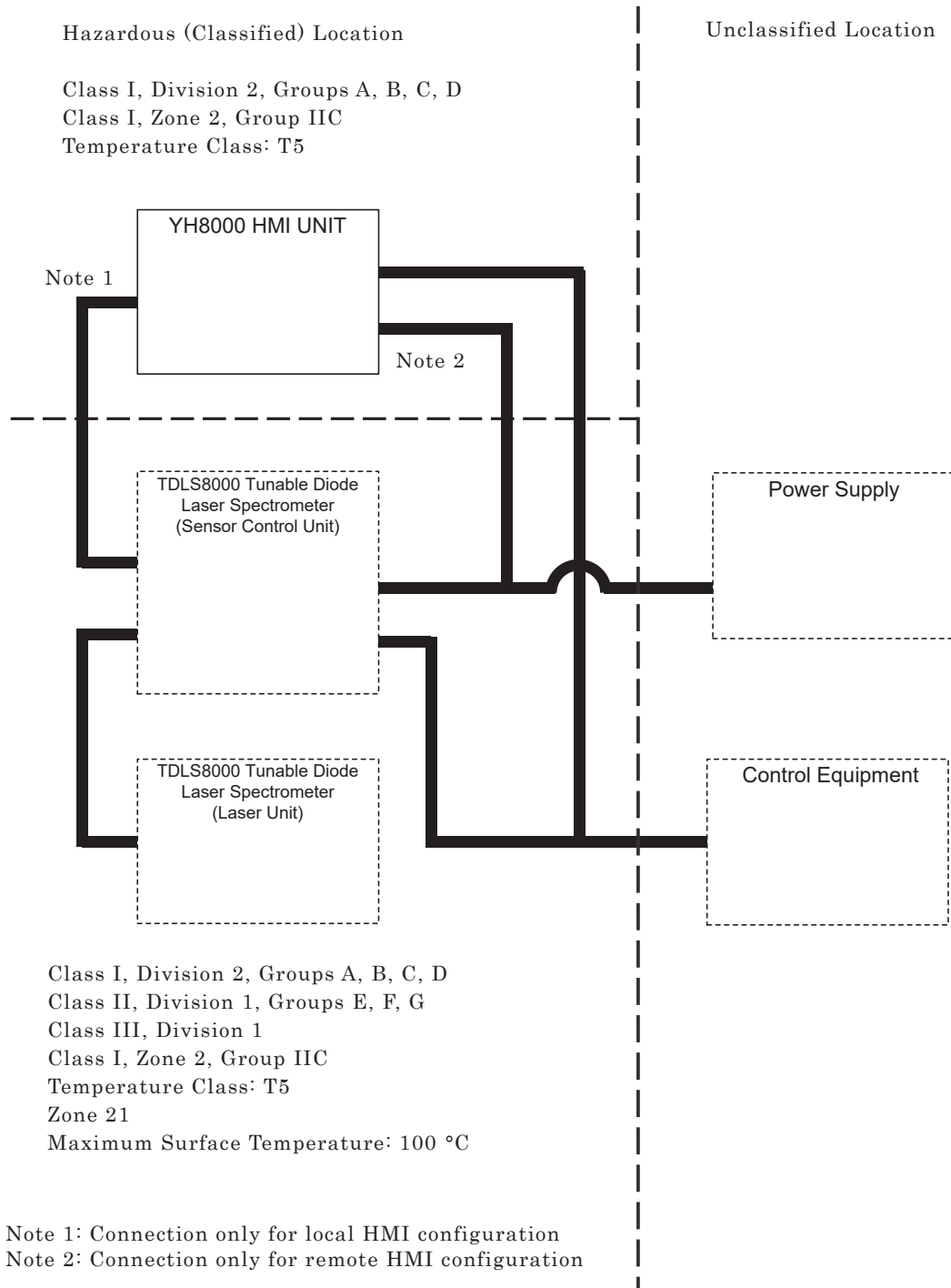
- DO NOT OPEN WHEN AN EXPLOSIVE ATMOSPHERE MAY BE PRESENT
- POTENTIAL ELECTROSTATIC CHARGING HAZARD
- INSTALL IN ACCORDANCE WITH NFM030-A71

(4) Control Drawing

Model: YH8000

Date: January 23, 2015

Control Drawing (US)



Rev.

Doc. No.: NFM030-A71 P.1

Yokogawa Electric Corporation

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Model: YH8000

Date: January 23, 2015

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Specific Condition of Use:

-Precautions shall be taken to minimize the risk from electrostatic discharge of painted parts and non-metallic parts of the enclosure.

Notes:

1. No revision to this drawing without prior approval of FM.
2. Installation must be in accordance with the National Electric Code (NFPA 70) and relevant local codes.
3. The thread type of the cable entries must be confirmed according to the user's manual.
4. Screws of the field wiring terminals must be tightened with the specified torque value: 0.22 to 0.25 Nm.
5. Field wiring for ethernet communication must be in accordance with IEEE 802.3 so as to avoid overvoltage of > 119 V.
6. WARNING – POTENTIAL ELECTROSTATIC CHARGING HAZARD – SEE USER'S MANUAL
7. WARNING – DO NOT OPEN WHEN AN EXPLOSIVE ATMOSPHERE MAY BE PRESENT
8. WARNING – SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR DIVISION 2

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Rev.1: December 24, 2015

Doc. No.: NFM030-A71 P.2

Yokogawa Electric Corporation

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**(5) Operation****WARNING**

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- Electrostatic charge may cause an explosion hazard. Avoid any actions that cause the generation of electrostatic charge, such as rubbing with a dry cloth on coating face of product.
  - Take care not to generate mechanical sparking when access to the instrument and peripheral devices in hazardous locations.
- 

**(6) Maintenance and Repair****WARNING**

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The instrument modification or parts replacement by other than authorized Representative of Yokogawa Electric Corporation is prohibited and will void the certification.

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When opening the cover, the enclosure should be dry and clean to prevent from ingress water or dust.

● YH8000-C2 (FM Approval for Canada)

Model: YH8000

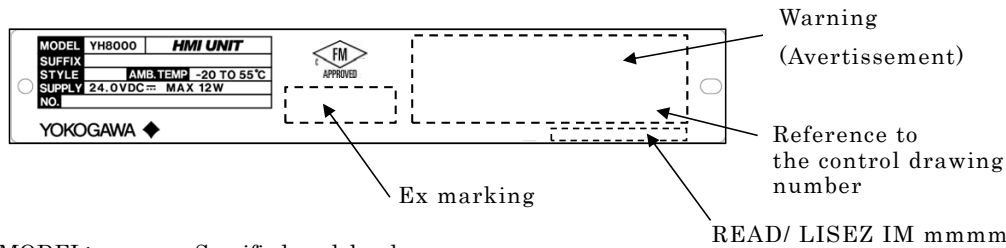
Date: January 23, 2015

Instructions (Canada)

1) Technical Data

- Applicable standards
  - CAN/CSA-C22.2 No. 0-10 (R2015)
  - CAN/CSA-C22.2 No. 94.1-07 (R2012)
  - CAN/CSA-C22.2 No. 94.2-07 (R2012)
  - CAN/CSA-C22.2 No.60079-0:11
  - CAN/CSA-C22.2 No.60079-15:12
  - CAN/CSA-C22.2 No.61010-1-12
  - CAN/CSA C22.2 No. 60529-05 (R2010)
- Ratings
  - Ex nA nL IIC T5
- Enclosure
  - Type4X, IP65
- Specific condition of use
  - Precautions shall be taken to minimize the risk from electrostatic discharge of painted parts and non-metallic parts of the enclosure.

2) Name Plate



- MODEL: Specified model code
- SUFFIX: Specified suffix code
- STYLE: Specified style code
- AMB.TEMP: Specified ambient temperature range
- SUPPLY: Specified supply voltage and wattage
- NO.: Serial number
- Ex marking: Ex nA nL IIC T5  
TYPE 4X, IP65
- Warning: DO NOT OPEN WHEN AN EXPLOSIVE ATMOSPHERE MAY BE PRESENT  
POTENTIAL ELECTROSTATIC CHARGING HAZARD
- Avertissement: NE PAS OUVRIR EN ATMOSPHERE EXPLOSIVE  
DANGER : ELECTRICITE STATIQUE

Note: “mmmm” means document number of user’s manual.

Rev.1: December 24, 2015

Doc. No.: NFM030-A72 P.1

Yokogawa Electric Corporation

Model: YH8000

Date: January 23, 2015

3) Installation

- The installation of the equipment should be carried out by the engineers or other professional personnel of the related expertise. The installation should not be carried out by operators or other unprofessional personnel.
- The installation must be in accordance with Canadian Electrical Code Part I (C22.1) and relevant local codes.
- The equipment must only be used in an area of not more than pollution degree 2, as defined in IEC 60664-1.
- When the cable glands and/or adapters are used, they must be Ex “d”, Ex “e”, or Ex “n” type, and must also meet the ingress protection requirement of IP54 or more.
- The thread type of the cable entries shall be confirmed according to the user’s manual.
- Screws of the field wiring terminals must be tightened with the specified torque value: 0.22 to 0.25 Nm.
- Field wiring for ethernet communication must be in accordance with IEEE 802.3 so as to avoid overvoltage of > 119 V.

WARNING / AVERTISSEMENT

- DO NOT OPEN WHEN AN EXPLOSIVE ATMOSPHERE MAY BE PRESENT
- POTENTIAL ELECTROSTATIC CHARGING HAZARD - READ IM mmmm
- NE PAS OUVRIR EN ATMOSPHERE EXPLOSIVE
- DANGER : ELECTRICITÉ STATIQUE - LISEZ IM mmmm

Note: “mmmm” means document number of user’s manual.

4) Operation

WARNING

- Electrostatic charge may cause an explosion hazard. Avoid any actions that cause the generation of electrostatic charge, such as rubbing with a dry cloth on coating face of product.
- Take care not to generate mechanical sparking when access to the instrument and peripheral devices in hazardous locations.

5) Maintenance and Repair

WARNING

- The instrument modification or parts replacement by other than authorized Representative of Yokogawa Electric Corporation is prohibited and will void the certification.
- When opening the cover, the enclosure should be dry and clean to prevent from ingress water or dust.

Rev.1: December 24, 2015


Doc. No.: NFM030-A72 P.2

Yokogawa Electric Corporation

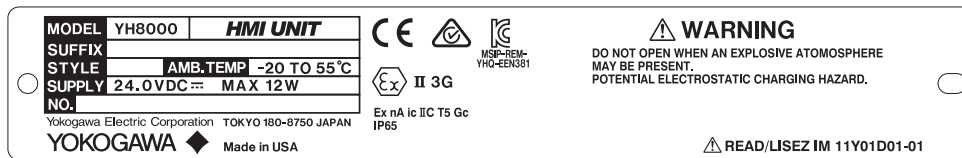
Note: If YH8000 is installed in where more than IP54 is required as ingress protection, the cable gland and/or adapters should be meet the requirement.

● **YH8000-S2 (ATEX Declaration)**

**(1) Technical Data**

- Applicable standards  
 EN 60079-0: 2012+A11:2013  
 EN 60079-11: 2012  
 EN 60079-15: 2010
- Ratings  
 II 3 G Ex nA ic IIC T5 Gc
- Enclosure  
 IP65 (In accordance with EN 60529)
- Specific condition of use  
 Precautions shall be taken to minimize the risk from electrostatic discharge of painted parts and non-metallic parts of the enclosure.

**(2) Name Plate**



**(3) Installation**

- The installation of the equipment should be carried out by the engineers or other professional personnel of the related expertise. The installation should not be carried out by operators or other unprofessional personnel.
- The installation must be in accordance with EN 60079-14 and relevant local codes.
- The equipment must only be used in an area of not more than pollution degree 2, as defined in IEC 60664-1.
- When the cable glands and/or adapters are used, they must be Ex “d”, Ex “e”, or Ex “n” type, and must also meet the ingress protection requirement of IP54 or more. If YH8000 is installed in where more than IP54 is required as ingress protection, the cable gland and/or adapters should be meet the requirement.
- The thread type of the cable entries shall be confirmed according to the user’s manual.
- Screws of the field wiring terminals must be tightened with the specified torque value: 0.22 to 0.25 Nm.
- Field wiring for ethernet communication must be in accordance with IEEE 802.3 so as to avoid overvoltage of > 119 V.

 **WARNING**

- DO NOT OPEN WHEN AN EXPLOSIVE ATMOSPHERE MAY BE PRESENT
- POTENTIAL ELECTROSTATIC CHARGING HAZARD
- FOR INSTALLATION AND SAFE USE, READ IM11Y01D01-01



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#### (4) Operation



### **WARNING**

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- Electrostatic charge may cause an explosion hazard. Avoid any actions that cause the generation of electrostatic charge, such as rubbing with a dry cloth on coating face of product.
  - Take care not to generate mechanical sparking when access to the instrument and peripheral devices in hazardous locations.
- 

#### (5) Maintenance and Repair



### **WARNING**

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The instrument modification or parts replacement by other than authorized Representative of Yokogawa Electric Corporation is prohibited and will void the certification.

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When opening the cover, the enclosure should be dry and clean to prevent from ingress water or dust.

● **YH8000-E2 (IECEX Certification)**

**(1) Technical Data**

- Applicable standards  
IEC 60079-0: 2011  
IEC 60079-11: 2011  
IEC 60079-15: 2010
- Certificate No.  
IECEX FMG 15.0016X
- Ratings  
Ex nA ic IIC T5 Gc
- Enclosure  
IP65 (In accordance with IEC 60529)
- Specific condition of use

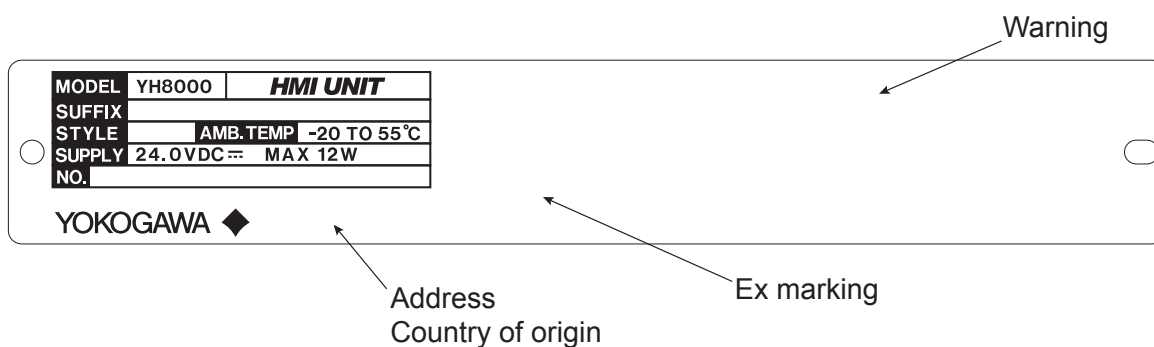
Precautions shall be taken to minimize the risk from electrostatic discharge of painted parts and non-metallic parts of the enclosure.

**(2) Name Plate**

MODEL: Specified model code  
 SUFFIX: Specified suffix code  
 STYLE: Specified style code  
 AMB.TEMP: Specified ambient temperature range  
 SUPPLY: Specified supply voltage and wattage  
 NO.: Serial number  
 Ex marking: Ex nA ic IIC T5 Gc  
 IP65  
 No. IECEX FMG 15.0016X

Warning: DO NOT OPEN WHEN AN EXPLOSIVE ATMOSPHERE MAY BE PRESENT.  
 POTENTIAL ELECTROSTATIC CHARGING HAZARD.  
 FOR INSTALLATION AND SAFE USE, READ IM mmmm

Note: "mmmm" means document number of user's manual.



**(3) Installation**

- The installation of the equipment should be carried out by the engineers or other professional personnel of the related expertise. The installation should not be carried out by operators or other unprofessional personnel.
- The installation must be in accordance with IEC 60079-14 and relevant local codes.
- The equipment must only be used in an area of not more than pollution degree 2, as defined in IEC 60664-1.
- When the cable glands and/or adapters are used, they must be Ex “d”, Ex “e”, or Ex “n” type, and must also meet the ingress protection requirement of IP54 or more. If YH8000 is installed in where more than IP54 is required as ingress protection, the cable gland and/or adapters should be meet the requirement.
- The thread type of the cable entries shall be confirmed according to the user’s manual.
- Screws of the field wiring terminals must be tightened with the specified torque value: 0.22 to 0.25 Nm.
- Field wiring for ethernet communication must be in accordance with IEEE 802.3 so as to avoid overvoltage of > 119 V.

**WARNING**

- DO NOT OPEN WHEN AN EXPLOSIVE ATMOSPHERE MAY BE PRESENT
- POTENTIAL ELECTROSTATIC CHARGING HAZARD
- FOR INSTALLATION AND SAFE USE, READ IM11Y01D01-01

**(4) Operation****WARNING**

- Electrostatic charge may cause an explosion hazard. Avoid any actions that cause the generation of electrostatic charge, such as rubbing with a dry cloth on coating face of product.
- Take care not to generate mechanical sparking when access to the instrument and peripheral devices in hazardous locations.

**(5) Maintenance and Repair****WARNING**

The instrument modification or parts replacement by other than authorized Representative of Yokogawa Electric Corporation is prohibited and will void the certification.

When opening the cover, the enclosure should be dry and clean to prevent from ingress water or dust.

● **YH8000-N2 (NEPSI Certification)**

1) **Technical Data**

- Applicable standards  
GB3836.1-2010  
GB3836.4-2010  
GB3836.8-2014
- Certificate No.  
GYJ16.1281X
- Ratings  
Ex nA ic IIC T5 Gc
- Enclosure  
IP65 (In accordance with GB 4208)
- Specific condition of use

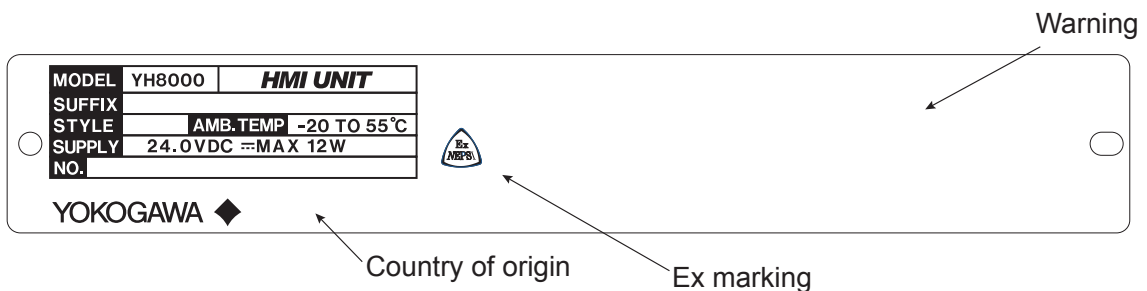
Precautions shall be taken to minimize the risk from electrostatic discharge of painted parts and non-metallic parts of the enclosure

(2) **Name Plate**

- MODEL: Specified model code
- SUFFIX: Specified suffix code
- STYLE: Specified style code
- AMB.TEMP: Specified ambient temperature range
- SUPPLY: Specified supply voltage and wattage
- NO.: Serial number
- Ex marking: Ex nA ic IIC T5 Gc  
IP65  
No. GYJ16.1281X

Warning: DO NOT OPEN WHEN AN EXPLOSIVE ATMOSPHERE MAY BE PRESENT.  
POTENTIAL ELECTROSTATIC CHARGING HAZARD.  
FOR INSTALLATION AND SAFE USE, READ IM mmmm

Note: "mmmm" means document number of user's manual.



**(3) Installation**

- The installation of the equipment should be carried out by the engineers or other professional personnel of the related expertise. The installation should not be carried out by operators or other unprofessional personnel.

- Installation, use and maintenance of the product should comply with the manual and following standards.

GB 3836.13-2013 “Explosive atmospheres Part 13: Equipment repair, overhaul and reclamation”

GB 3836.15-2000 “Electrical apparatus for explosive gas atmosphere Part 15: Electrical installations in hazardous area (other than mines)”

GB 3836.16-2006 “Electrical apparatus for explosive gas atmosphere Part 16: Inspection and maintenance of electrical installation (other than mines)”

GB 50257-2014 “Code for construction and acceptance of electric equipment on fire and explosion hazard electrical equipment installation engineering”

- The equipment must only be used in an area of not more than pollution degree 2, as defined in GB/T 16935.1.
- When the cable glands and/or adapters are used, they must be Ex “d”, Ex “e”, or Ex “n” type, and must also meet the ingress protection requirement of IP54 or more. If YH8000 is installed in where more than IP54 is required as ingress protection, the cable gland and/or adapters should be meet the requirement.
- The thread type of the cable entries shall be confirmed according to the user’s manual.
- Screws of the field wiring terminals must be tightened with the specified torque value: 0.22 to 0.25 Nm.
- Field wiring for ethernet communication must be in accordance with IEEE 802.3 so as to avoid overvoltage of > 119 V.

**WARNING**

- DO NOT OPEN WHEN AN EXPLOSIVE ATMOSPHERE MAY BE PRESENT
- POTENTIAL ELECTROSTATIC CHARGING HAZARD
- FOR INSTALLATION AND SAFE USE, READ IM11Y01D01-01

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**(4) Operation****WARNING**

- 
- Electrostatic charge may cause an explosion hazard. Avoid any actions that cause the generation of electrostatic charge, such as rubbing with a dry cloth on coating face of product.
  - Take care not to generate mechanical sparking when access to the instrument and peripheral devices in hazardous locations.
- 

**(5) Maintenance and Repair****WARNING**

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The instrument modification or parts replacement by other than authorized Representative of Yokogawa Electric Corporation is prohibited and will void the certification.

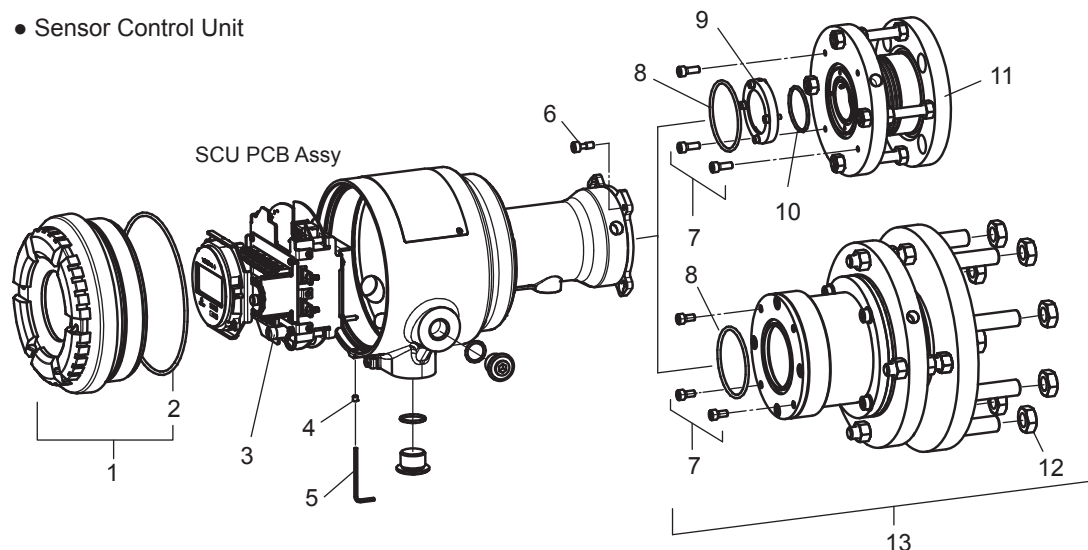
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When opening the cover, the enclosure should be dry and clean to prevent from ingress water or dust.

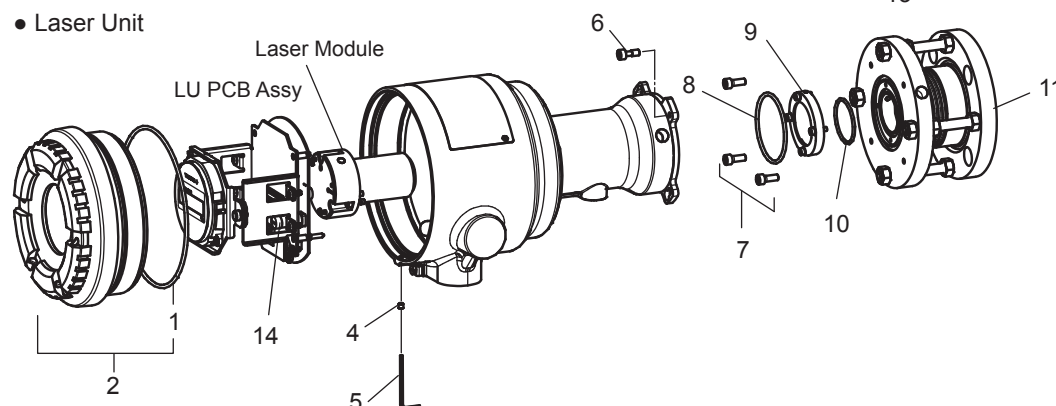
# Customer Maintenance Parts List

## TDLS8000 Tunable Diode Laser Spectrometer

### • Sensor Control Unit



### • Laser Unit



Item	Part No.	Qty	Description	Item	Part No.	Qty	Description
1	K9771CB	1	Cover Assy (with O-ring)	10	K9772TH	1	O-ring
2	K9771JN	1	O-ring	11 *	K9772NA	1	Alignment Flange Assy (for -U2)
3	A1624EF	1	Fuse (for SCU)		K9772NB	1	Alignment Flange Assy (for -U3)
4	B1093BS	1	Set Screw		K9772NC	1	Alignment Flange Assy (for -U4, -LA)
5	K9771KV	1	Hex. L-Key		K9772ND	1	Alignment Flange Assy (for -D5)
6	K9771JR	1	Captive Screw		K9772NE	1	Alignment Flange Assy (for -D8)
7	K9771JS	1	Screw 3pcs Set		K9772NF	1	Alignment Flange Assy (for -J5)
8	K9772TJ	1	O-ring		K9772NG	1	Alignment Flange Assy (for -J8)
9	K9772RA	1	Process Window Assy (for -X1, -X2)		K9775DA	1	FC Almt. Flange Assy (for -FC)
	K9772RB	1	Process Window Assy (for -H1)	12	K9775SB	8	Nut
	K9772RC	1	Process Window Assy (for -A1, -A2)	13	K9771NA	1	LAO Assy (for -LA)
	K9772RD	1	Process Window Assy (for -H3)	14	A1633EF	1	Fuse (for LU)
	K9772RE	1	Process Window Assy (for -C3, -C4)				
	K9772RG	1	Process Window Assy (for -C5, -D5)				
	K9772RJ	1	Process Window Assy (for -L1)				
	K9772RK	1	Process Window Assy (for -C1, -S1, -D1, -H4)				

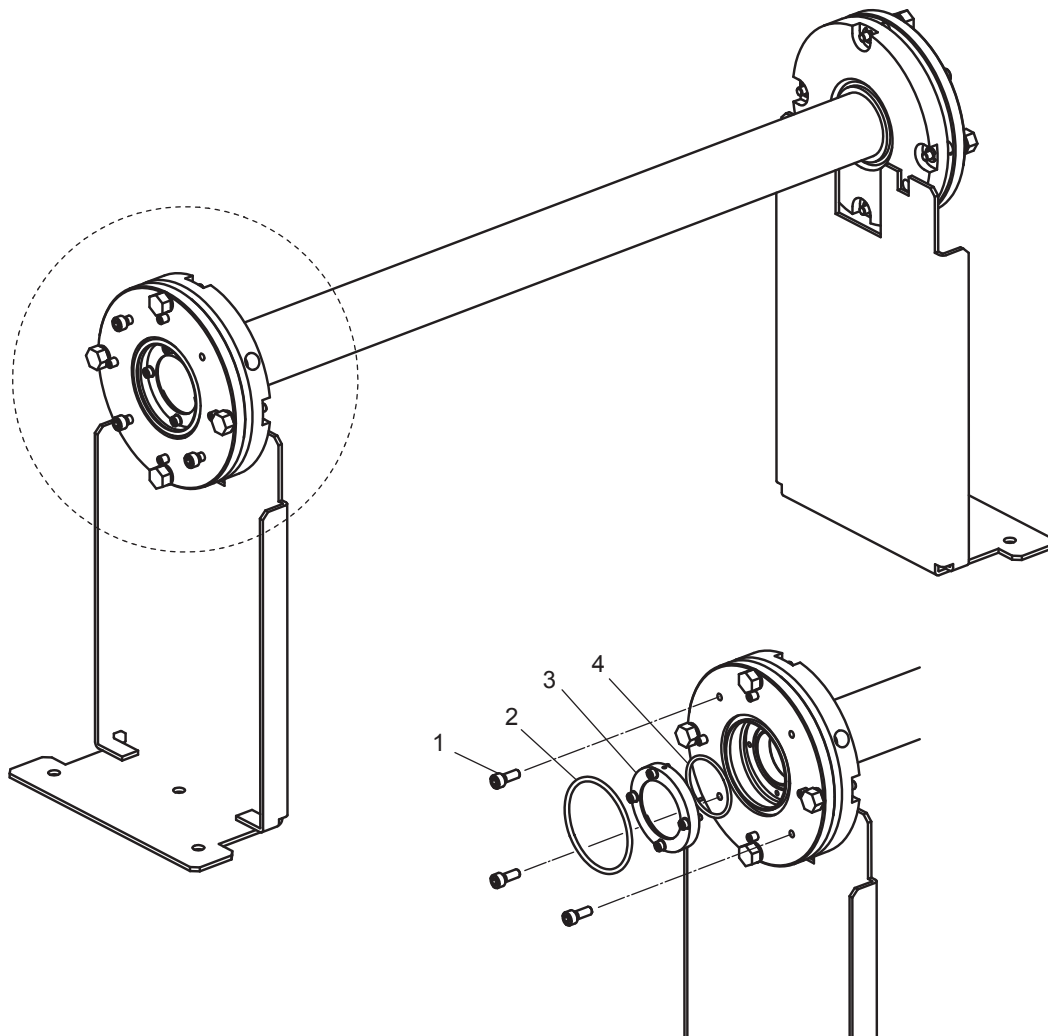
\*: Process window assy is not included.





# Customer Maintenance Parts List

K9772XA, K9772XB, K9772XC, K9772XD,  
K9772XE, K9772XF, K9772XG, K9772XH,  
K9772XJ, K9772XL, K9772XM  
Calibration Cell for TDLS8000



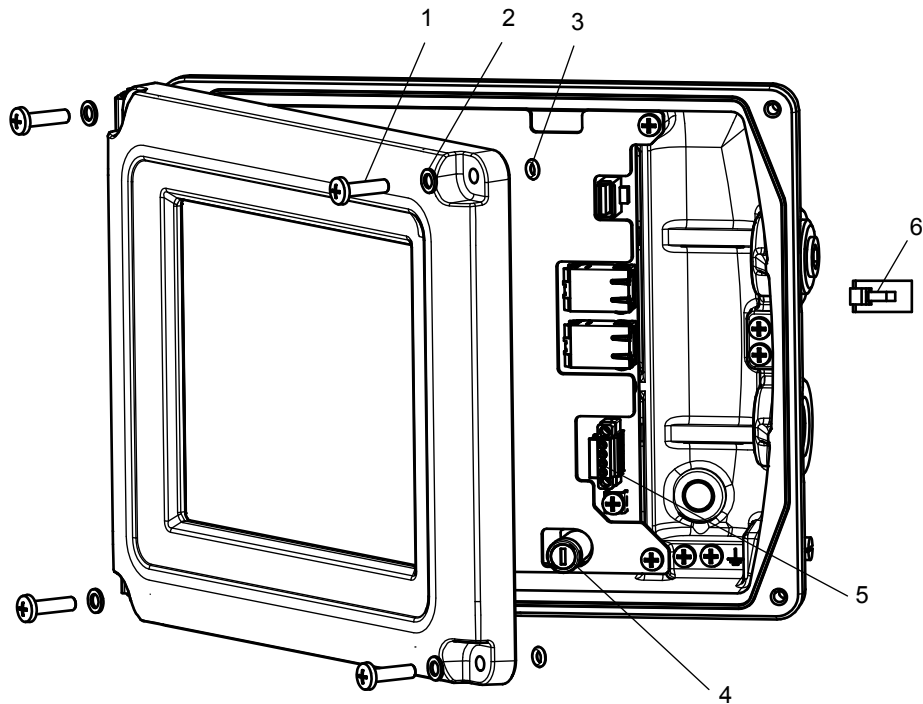
Item	Part No.	Qty	Description
1	K9771JS	1	Screw 3pcs Set
2	K9772TJ	1	O-ring
3	K9772RA	1	Process Window Assy (for K9772XA, K9772XB)
	K9772RB	1	Process Window Assy (for K9772XC)
	K9772RC	1	Process Window Assy (for K9772XD)
	K9772RD	1	Process Window Assy (for K9772XE)
	K9772RE	1	Process Window Assy (for K9772XF, K9772XG)
	K9772RG	1	Process Window Assy (for K9772XH)
	K9772RJ	1	Process Window Assy (for K9772XJ)
	K9772RK	1	Process Window Assy (for K9772XL, K9772XM)
4	K9772TH	1	O-ring

Note: Qty shows necessary number for one side.



# Customer Maintenance Parts List

YH8000  
HMI Interface Unit for TDLS8000

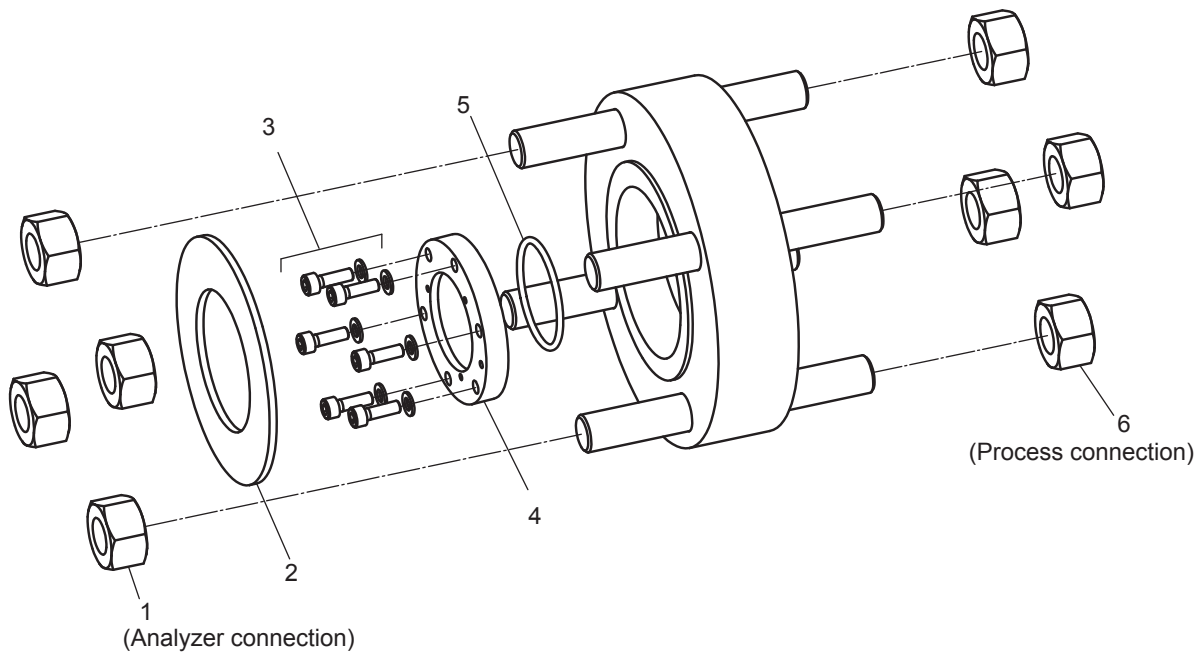


Item	Part No.	Qty	Description
1	K9774CR	4	Screw
2	Y9500WU	4	Washer
3	Y9102XA	4	O-ring for screw
4	A1633EF	1	Fuse
5	A3433JQ	1	Power connector
6	A1633JZ	1	RJ45 connector



# Customer Maintenance Parts List

IF8000  
Isolation Flange for TDLS8000



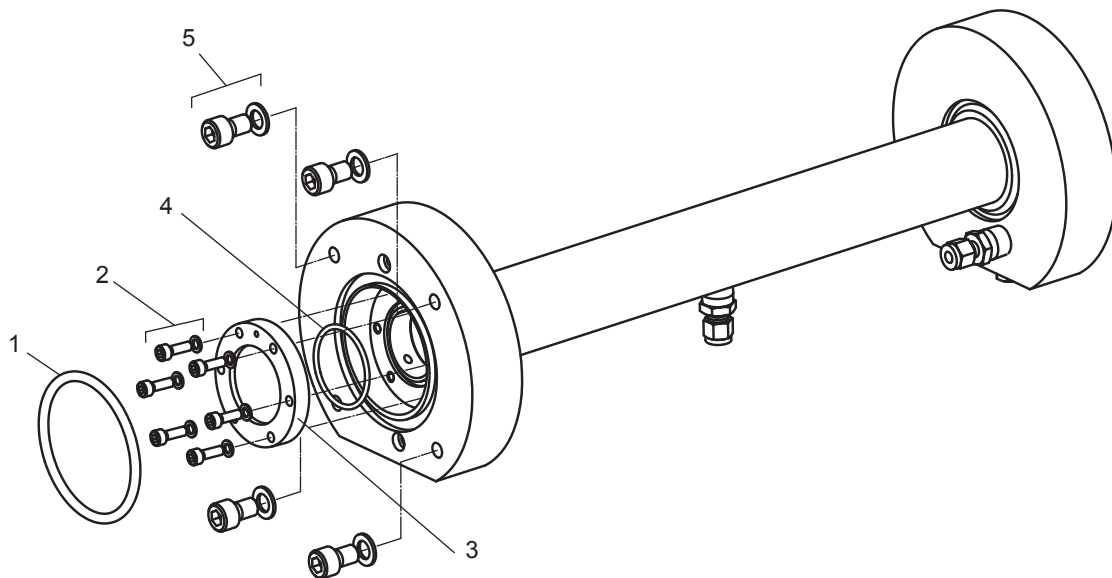
Item	Part No.	Qty	Description
1	K9775TC	1	Nut 4pcs Set (for Analyzer connection "-21")
	K9775TE	1	Nut 4pcs Set (for Analyzer connection "-50")
2	K9775SC	1	Gasket (for Analyzer connection "-21")
	K9775SF	1	Gasket (for Analyzer connection "-50")
3	K9775TA	1	Screw 6pcs Set
4	K9775EA	1	Sapphire Window Assy (for Sapphire window type "-12")
	K9775EB	1	Sapphire Window Assy (for Sapphire window type "-13")
	K9775EC	1	Sapphire Window Assy (for Sapphire window type "-14")
	K9775ED	1	Sapphire Window Assy (for Sapphire window type "-15")
	K9775EE	1	Sapphire Window Assy (for Sapphire window type "-16")
	K9775EG	1	Sapphire Window Assy (for Sapphire window type "-17")
5	K9775EH	1	Sapphire Window Assy (for Sapphire window type "-18")
	K9775EJ	1	Sapphire Window Assy (for Sapphire window type "-20")
	K9775GE	1	O-ring
6	K9775TC	1 or 2	Nut 4pcs Set (for Process connection "-21", "-23", "-31", "-41")
	K9775TD	2	Nut 4pcs Set (for Process connection "-33")
	K9775TE	1 or 2	Nut 4pcs Set (for -Process connection "50", "-80", "-J5", "-J8")

Note: Qty shows necessary number for one side.



# Customer Maintenance Parts List

YC8000  
Flow Cell for TDLS8000



Item	Part No.	Qty	Description
1	K9775GK	1	O-ring
2	K9775TA	1	Screw 6pcs Set
3	K9775EA	1	Sapphire Window Assy (for -XX)
	K9775EB	1	Sapphire Window Assy (for -HH)
	K9775EC	1	Sapphire Window Assy (for -NH)
	K9775ED	1	Sapphire Window Assy (for -H3)
	K9775EE	1	Sapphire Window Assy (for -CC)
	K9775EG	1	Sapphire Window Assy (for -C2)
	K9775EH	1	Sapphire Window Assy (for -HC)
	K9775EJ	1	Sapphire Window Assy (for -MC)
4	K9775GE	1	O-ring
5	K9775TB	1	Bolt 4pcs Set

Note: Qty shows necessary number for one side.





# Revision Information

- Manual Title : TDLS8000 Tunable Diode Laser Spectrometer
- Manual No. : IM 11Y01D01-01EN

## Jan. 2019/5th Edition

- TDLS8000 software change (Ver. 2.01.01)
  - Added Safety Mode, SCU/LU temp. on Modbus (pages 6-18, 6-21, 11-7, App. 3-6, App. 4-4, App. 7-2,)
- YH8000 software change (Ver. 2.01.01)
  - Added Safety Mode (6-18, App. 7-2)
  - Added description of Software version (8-23)
- HART device revision (Rev.2)
  - Added safety mode, SCU/LU temp. (6-15, App. 7-2)
- Revised specification and others
  - Modified optical path length (pages 6-20, 6-21)
  - Added TDLS8000-J2, other compliant regulation (pages 2-7, 2-12, 2-13, 9-9, 9-45)
  - Added notes on Dual seal (pages App.8-10, 8-25)
  - Added AO-2 on Safety Instrumented System (App.7-2)
  - Others (page 1-4, 1-7, 2-1, 9-13)

## Oct. 2017/4th Edition

- Upgraded software (Ver. 1.02.02) adding Modbus function. (pages 6-2, 11-6)
- Regulations : added RoHS directive (vii, viii, xii, 2-1, 2-7)
- Revised specification and others
  - Added TDLS8000-GQ, -GR, -Q2, -R2, -Q1, -K2, -N2.
  - Added YH8000-GR, -K2, -N2, -R2 (pages 2-5, 2-6, 2-7, 2-11, 2-12)
  - Added Zone1/Div.1/Flameproof “d” (pages 3-33 to 3-35, 9-19)
  - Changed unit connection cables.(pages 2-10, 3-12 to 3-14, App.1-1 to 1-4)
  - Changed name plates (whole pages in Appendix.8)
  - Changed optical path length and purge gas flow rate (pages 2-1, 2-4, 3-29)
  - Others: (pages i Vi Vii, Viii 2-3, 2-10, 2-11, 9-8, 9-9)

## Jun. 2016/3rd Edition

- TDLS8000, YH8000 software change (Ver. 1.02.01)
  - Alarm specifications change, “Clear latched alarms” addition, etc. (pages 2-2, 10-1, 10-2, 10-4, 7-9, App.4-1)
- YH8000 software change (Ver. 1.02.01)
  - Multilingual correspondence (pages 6-11, 8-18, 9-44, 11-5, App.4-3, App.4-4)
- HART DD revision change (Rev.2)
  - “Clear latched alarms” addition, etc. (pages 5-1, 5-2, 7-5, 9-9, 9-34, 9-36, 9-43, 11-4, App.3-2, App.3-5, App.3-6)
- Correction, specifications change, etc. (pages 2-1 to 2-12, 2-17, 2-18, 3-29, 3-34, 9-18, 9-19, Appendix 8, CMPL 11Y01D01-01EN, CMPL 11Y01D01-21EN, CMPL 11Y01D11-01EN, CMPL 11Y01D12-01EN)

## Dec. 2015/2nd Edition

- Addition of Type -D2, -C2, -S2, and -E2 of TDLS8000 and YH8000.
- Addition of functions due to TDLS8000 software change (Ver. 1.01.05) (Pages 6-12, 6-22, 11-2, 11-3, 11-6 and 11-7)
- Correction (CMPL 11Y01D10-01EN)

## Jul. 2015/1st Edition

Newly published

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