User's Manual

DTSXL Distributed Temperature Sensor Long Range System Guide

IM 39J06B40-01EN

YOKOGAWA
Yokogawa Electric Corporation

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Introduction

■ About this Manual

This user's manual (IM 39J06B40-01EN) describes the overview, operation, and maintenance of the DTSXL Distributed Temperature Sensor Long Range System (DTSXL System). This manual is written for all those who will be using the DTSXL System.

Before using the DTSXL System, read this document and "Read Me First" (IM 39J06A40-01EN).

■ Organization of this Manual

This manual consists of the following chapters:

● PART-A Hardware

This chapter describes the hardware of the DTSXL System, including the names, specifications, locations, and connections for each component unit.

● PART-B Software

This chapter describes the function overview of the DTSX3000 Distributed Temperature Sensor of the DTSXL System, as well as the tools used to perform various configurations.

● PART-C Operation and Maintenance

This chapter describes the operation and maintenance of the DTSM System.

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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 instruction manual. We assume no liability for safety if users fail to observe these instructions when operating the product.
- If this instrument is used in a manner not specified in this manual, the protection provided by this instrument 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 symbols are used in the product and instruction manual to indicate that there are precautions for safety:



Indicates that warning is required for operation. This symbol is placed on the product to refer the user to the instruction manual in order to protect the operator and the equipment. In the instruction manuals you will find precautions to avoid physical injury or death of the operator, including electrical shocks.



Indicates a caution of high temperature surface.



Indicates a caution of Laser radiation.



Identifies a functional grounding terminal. Before using the product, ground the terminal.

Indicates a DC supply.

■ Notes on Handling Manuals

- Please hand over the user's manuals to your end users so that they can keep the manuals on hand for convenient reference.
- Please read the information thoroughly before using the product.
- The purpose of these 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 manuals may be transferred or reproduced without prior written consent from YOKOGAWA.
- YOKOGAWA reserves the right to make improvements in the manuals and product at any time, without notice or obligation.
- If you have any questions, or you find mistakes or omissions in the manuals, please contact our sales representative or your local distributor.

■ 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 cannot predict in advance.

■ Notes on Hardware

● Appearance and Accessories

Check the following when you receive the product:

- Appearance
- Standard accessories

Contact our sales representative or your local distributor if the product's coating has come off, it has been damaged, or there is shortage of required accessories.

● 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.

■ Symbol Marks

Throughout this manual, you will find several different types of symbols being used to identify different sections of text. This section describes these icons.



WARNING

- Identifies instructions that must be observed in order to avoid physical injury and electric shock or death of the operator.

CAUTION

- Identifies instructions that must be observed in order to prevent the software or hardware from being damaged or the system from becoming faulty.

IMPORTANT

Identifies important information required to understand operations or functions.

TIP

- Identifies additional information.

SEE ALSO

- Identifies a source to be referred to.

■ Safety Precautions for Using the Device

● Standard

SEE ALSO

Different standards are applied according to the types of equipment. For details, refer to the hardware general specifications (GS) for individual equipment.

Table Compliant Standards

Item		Specifications (✔:Compliant)	Suffix Code (*14) 5: Non explosion-proof	E: Explosion proof
Safety Standards (*1) (*2)		CAN/CSA C22.2 No.61010-1-12	✔	✔
		CAN/CSA C22.2 No.61010-2-030	✓	✓
		CAN/CSA IEC 61010-2-201	✓	✓
		EN 61010-1	✔	✔
		EN 61010-2-030 (*3)	✔	✔
		EN IEC 61010-2-201 (*3)	✔	✔
		CU TR 004 (*13)	✔	
EMC Standards (*1)	CE Marking	EN 55011 Class A Group 1 EN 61000-6-2 (*4) (*5) EN 61000-3-2 (*6) EN 61000-3-3 (*6) (*7)	✔	✔
	RCM	EN 55011 Class A Group 1	✔	✔
	KC Marking	Korea Electromagnetic Conformity Standard	✔	✔
	EAC Marking	CU TR 020 (*13)	✔	
Laser safety (*1) (*8)	Class	IEC 60825-1:2007 Class1M, EN 60825-1:2014+A11:2021 Class1	✔	✔
	FDA(CDRH)	21CFR 1040.10	✔	✔
Standards for Hazardous Location Equipment (*1) (*9) (*10)	FM Nonincendive (*2)	Class I, Division 2, Groups A, B, C, D T4 FM 3600-2018 FM 3611-2018 FM 3810-2018		✔
	ATEX Type ”n” (*11)	II 3 G Ex nA ic [op is Gc] IIC T4 Gc X (*12) EN IEC 60079-0:2018 EN 60079-11:2012 EN 60079-15:2010 EN 60079-28:2015		✔
	CSA Non-Incendive (*2)	Class I, Division 2, Groups A, B, C, D T4 C22.2 No. 213-17		✔
Restriction of Hazardous Substances	RoHS Directive(*15)	EN IEC 63000:2018	✔	✔

Note: Under EU legislation, the manufacturer and the authorized representative in EEA (European Economic Area) are indicated below:
Manufacturer: YOKOGAWA Electric Corporation (2-9-32 Nakacho, Musashino-shi, Tokyo 180-8750, Japan).
Authorized representative in EEA: Yokogawa Europe B.V. (Euroweg 2, 3825 HD Amersfoort, The Netherlands).

*1: Not applicable to DTRK10. Refer to GS 39J06Z40-01EN “DTSXL Distributed Temperature Sensor Long Range System (for SMF)” in the case of specification of DTSXL for single mode fiber.
*2: To be compliant with these standards, the DTSXL System hardware needs to be installed in a lockable metal cabinet.
*3: Applicable when CPU module NFCP050 is used.
*4: For lightning surge immunity, a device such as a lightning arrester needs to be installed externally to Power cable and Network cable.
*5: To be compliant with EMC Standards, Mount three ferrite cores “A1190MN” or “A1193MN” to FG cable, Power cable, Network cable and RS-232-C Communication cables.
*6: Applicable when power supply module NFPW442 is used.
*7: The specified magnitude of the voltage drop determined by the cable wiring length needs be met.
*8: Applicable to DTSX3000.
*9: Refer to IM 39J06B40-01EN “DTSXL Distributed Temperature Long Range System Guide” for the products meeting NI.
*10: For modules conforming to explosion-proof standards, refer to the section Explosion Protection of “COMBINING SYSTEM COMPONENTS” of this document.
*11: When DTSXL System is used under the ATEX Type ”n” environment, the Instruction Manual, IM 39J06B40-10EN “Explosion Protection of DTSXL Distributed Temperature Sensor Long Range System under the ATEX Directive” is required for safer installation and wiring.

*12: "X" indicates specific condition of use, in a hazardous area of Zone 2, install DTSXL System in a lockable metal cabinet which meets the IP54 or higher protection rating provided in IEC 60529.

*13: The EAC mark is as follows.

*14: Refer to each suffix code for DTSX3000, DTOS2L, DTOS4L and DTOS16L.

*15: Including the confirmation of 10 restricted substances defined in the Commission Delegated Directive (EU) 2015/863 amending Annex II to Directive 2011/65/EU.

Note: Waste Electrical and Electronic Equipment (WEEE) Directive
This is a directive governed by the EU's environmental regulations. The DTSXL System is designed to comply with the requirements for large industrial equipment among the equipment categories controlled by the WEEE Directive.

SEE ALSO

- For details on the power supply modules (NFPW426, NFPW441, NFPW442, and NFPW444) and CPU module (NFCP050), see General Specifications of the STRADOM FCN/FCJ (GS 34P02Q13-01E) and the STARDOM FCN/FCJ Installation Guide (TI 34P02Q91-01E).
- For safety precautions on use of power equipment, see Chapter A3, "Power Supply Equipment."
- For details on selection and wiring of power cables, see Section A5.1, "Power Supply Wiring.

● Installation conditions

When installing the device, the installation requirements of the device must be satisfied. Install the device under the following conditions:

Item		Specifications
Power Supply	Power supply Module	Rating
	NFPW426	12 V DC（3.4 A） 24 V DC（1.7 A）
	NFPW441	100～120 V AC（1.4 A）、50/60 Hz
	NFPW442	220～240 V AC（0.7 A）、50/60 Hz
	NFPW444	24 V DC（3.3 A）
Ambient Temperature (Operation)		-40～65 °C (*1)
Ambient humidity (Operation)		20 to 80% RH (no condensation)
Installation height		Altitude up to 3000 m (*2)
Installation category based on IEC 61010 *3		Ⅰ, Ⅱ
Pollution degree based on IEC 61010 *4		2
Installation		Indoor use only

*1: 0 to 55 ℃ when power supply module NFPW441, NFPW442, or NFPW444 is used.

*2: Altitude up to 2000 m when power supply module NFPW441, NFPW442 or NFPW444 is used.

*3: Installation category is the specification of the impulse withstanding voltage which is termed overvoltage category. Category I applies to specially protected electrical devices on the secondary side (when NFPW444 / NFPW426 is used.) Category II applies to electrical devices (when NFPW441 / NFPW442 is used)

*4: Pollution degree represents the level of foreign matter adhesion, solid, liquid, and gaseous, which may decrease the withstanding voltage.
Pollution degree 2 is applicable to general indoor atmosphere.

● Installation method

Follow the guidance below on how to use this device to guarantee satisfactory safety and performance.

- Keep the cabinet door of the device closed.
- Confirm that all the empty slots in the cabinet are covered by dummy covers.
- Confirm that all cables are firmly secured with the screws.
- Install rack type devices in the cabinet and lock the cabinet doors for safety.

- Prepare a dedicated circuit breaker in the same room of the device so that it can be used to cut off the power supply when abnormality occurs. Use this breaker to shutdown power supply to equipment devices when a device abnormality occurs. Use a breaker that meets STARDOM power supply specification requirements.

● Installation



WARNING

Be careful not to drop and damage the equipment during installation to avoid equipment damage or injury.

● Wiring Power Cable



WARNING

Connect the power cables according to the procedure given in this document.

The power cables must conform to the safety standards of the country where the device is installed.

SEE ALSO

For more information about power cables, refer to A5.1 “Power Supply Wiring”.

● Earth Wiring



WARNING

Ground the device following the procedure in this document to prevent electric shock and to minimize noise.

SEE ALSO

For more information about earth wiring, refer to A5.2 “Wiring the Ground.”

● Battery



WARNING

- Yokogawa designated batteries must be used.
- Mount and change batteries following the procedure given in this document.

SEE ALSO

For more information about batteries, refer to C4.3.1 “Batteries for DTSX3000”.

● I/O Devices



WARNING

To ensure this system compliance with the CSA safety standards, all devices connected to this system shall be CSA certified devices.

● Maintenance



WARNING

- When the device becomes dusty, use a vacuum cleaner or a soft cloth to clean it.
- During maintenance, wear a wrist strap, and adopt other ESD (Electrostatic Discharge) measures.

● Cables and Connectors



WARNING

When power is ON, Do not install or remove the cables, connectors not listed in this manual.

● Laser Beam

Safety Precautions for Laser Products

This instrument uses a laser light source. This instrument is a Class 1M laser product as defined by IEC 60825-1:2007 Safety of Laser Products - Part1: Equipment classification and requirements, and a Class1 laser product as defined by IEC 60825-1:2014 Safety of Laser Products - Part1: Equipment classification and requirements. In addition, this instrument complies with 21 CFR 1040.10 except for conformance with IEC 60825-1 Ed. 3., as described in Laser Notice No. 56, dated May 8, 2019.

The table below shows the parameters of the laser light used in this instrument.

Table Parameters of Laser Light

Laser Class	Class 1M(2007)/ Class1 1(2014)
Structure	DFB-LD and EDFA
Wavelength	1552 nm
Output power (min. and max.)	3.8 W
Pulse train	Periodic pulse train
Pulse time	Max 10 ns
Pulse repetition cycle	Min 80 µs

The Laser Class label is printed on the front panel of the instrument.

WARNING



Invisible laser light is output from the OPTICAL OUTPUT terminal located on the front face of this instrument. When Optical switch module connects to DTSX3000 with the optical fiber, the laser beam is output from optical terminals of Optical switch module.

Do not look directly or indirectly into the laser beam or at a specular reflection of the beam without protective equipment.

Do not aim the laser beam at the eye. The laser beam may cause blindness or damage to your eyes. Attach the cover to the optical connector when it is not in use.

Using an optical instrument, such as a loupe, magnifying glass, or microscope, to observe the laser beam from a distance of less than 100 mm may cause eye injury.

This instrument uses invisible laser light, which may cause eye injury or vision damage if it enters the human eye. To prevent accidents, always observe the following precautions:

- Do not turn on laser output when no optical fiber is connected to the optical connector.
- Always stop laser output before disconnecting the optical fiber from the optical connector.
- Never look into the end of an optical fiber connected to the optical connector during laser output.
- Never direct the laser beam into an area where a telescope optical instruments (for example, telescopes and binoculars) are likely to be used.

High-power laser light may be emitted during disassembly and modification of this instrument. For this reason, customers must not disassemble or modify this instrument under any circumstance.

Operating this instrument not in accordance with procedures described in this manual may result in exposure to hazardous laser emissions.

■ IEC60825-1:2007

LASER RADIATION
DO NOT VIEW DIRECTLY WITH OPTICAL INSTRUMENTS
CLASS 1M LASER PRODUCT

RAYONNEMENT LASER
NE PAS OBSERVER DIRECTEMENT À L'AIDE D'INSTRUMENTS D'OPTIQUE
APPAREIL À LASER DE CLASSE 1M

不可见激光辐射
勿通过光学仪器直接观看光束
1M 类激光产品

■ IEC60825-1:2014

CLASS 1 LASER PRODUCT

APPAREIL À LASER DE CLASSE 1

1 类激光产品

● High Temperature Safety Caution



Figure High Temperature Caution Mark

WARNING

Avoid skin contact. Burn hazard.

When installed in high ambient temperature environments, the instrument surface may become hot. Wear thermal protective gloves when touching metallic parts. Avoid direct skin contact. Beware especially in high temperature installation environments.

■ Measurement

Before performing distributed temperature measurement:

- Ensure that the environment complies with the DTSXL System specifications, and
- Perform temperature calibration of the sensor optical fiber with DTSXL System.

■ Drawing Conventions

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

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

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DTSXL Distributed Temperature Sensor Long Range System PART – A Hardware

IM 39J06B40-01EN

This chapter describes the hardware overview of the DTSXL Distributed Temperature Sensor Long Range System (DTSXL System).

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A1. DTSXL System

This section describes the hardware of the DTSXL System

A1.1. Structure and Names of Each Component Unit

The DTSXL System is comprised of the following modules:

- Base module (This is the module to which other modules such as the power supply module, CPU module, DTSX3000 Distributed Temperature Sensor, and Optical Switch modules are installed)
- DTSX3000 Distributed Temperature Sensor (Main module of the DTSXL Distributed Temperature Sensor Long Range System with built-in communication functions)
- Optical Switch module (module with built-in optical switch required for channel switching in multi-channel measurement)
- Rack Mount kit (required for reducing the load on the optical fiber connector)
- Optical Fiber for DTSX (used for checking the operation of the DTSX3000 Distributed Temperature Sensor.)
- Power Supply module (STARDOM module supplying power to each module)
- CPU module (STARDOM module with CPU functions)

SEE ALSO

For details on the power supply modules (NFPW426, NFPW441, NFPW442 and NFPW444) and CPU module (NFCP050), see General Specifications of the STRADOM FCN/FCJ (GS 34P02Q13-01E) and the STARDOM FCN/FCJ Guide (IM 34P02Q01-01E).

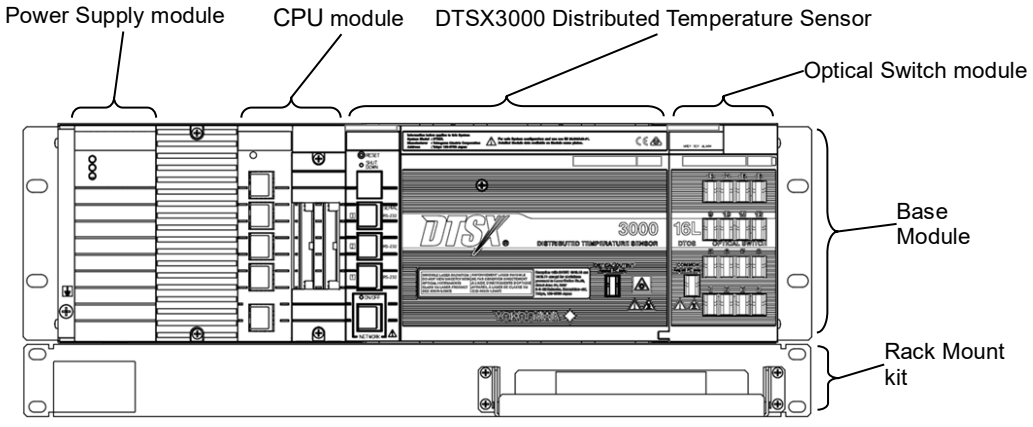
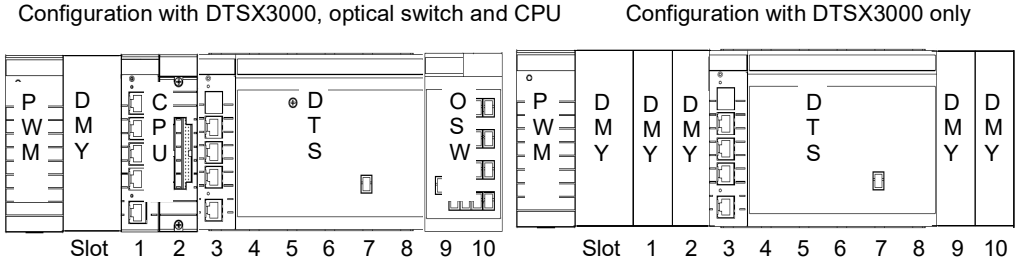


Figure Names of DTSXL System

■ Configuration Examples



Code	Module
DTS	DTSX3000 Distributed Temperature Sensor
OSW	Optical Switch module
PWM	Power Supply module
CPU	CPU module
DMY	Dummy cover

Figure Configuration Examples for DTSXL System

■ Appearance

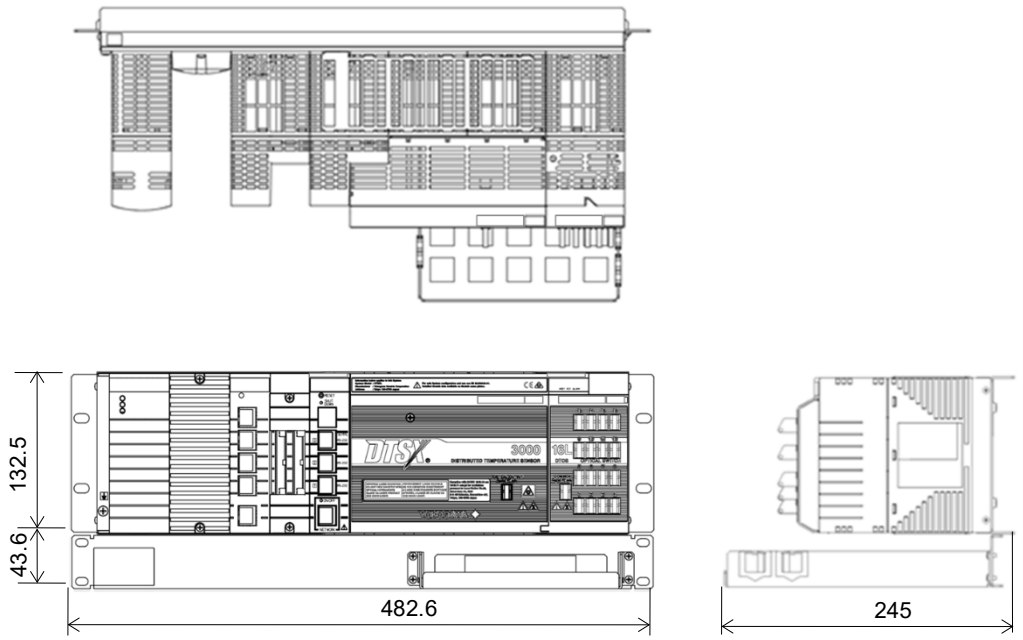


Figure Appearance of DTSXL System Modules Mounted on 19-inch Rack

A1.2. DTSX3000 Distributed Temperature Sensor

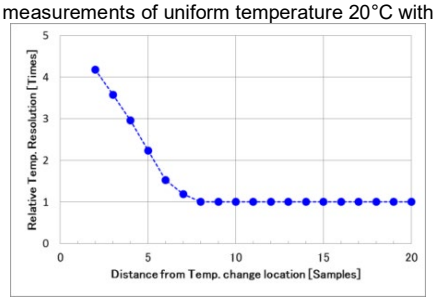
The DTSX3000 measures temperature distribution using optical fiber (not included in this specification) as the sensing element.

■ Specifications

Table Specifications of DTSX3000 Distributed Temperature Sensor (*12)

Item				Specifications			
Distance range suffix code				-S	-N	-M	-L
Distributed temperature measurement (*1)	Distance (*2)	Measurement distance range		6 km, 10 km,	6 km, 10 km, 16 km	6 km, 10 km, 16 km, 20 km, 30 km	6 km, 10 km, 16 km, 20 km, 30 km, 50 km
		Sampling resolution (*3)		0.5 m, 1 m, 2 m			
		Spatial resolution (*4)		1 m or less			
	Temperature	Measurement temperature range		-200 ～ +800 °C (*5)			
		Temperature resolution (*6) (10-minute measurement, 1 σ, without optical switch)		Distance range			
				10 km	16 km	30 km	50 km
			Max. Value	0.03 °C	0.06 °C	0.2 °C	2.6 °C
			Typical Value(*7)	0.02 °C	0.03 °C	0.1 °C	1.6 °C
Sensor optical fiber			Optical fiber (*8)	50/125μm GI, closed end, non-reflection required			
			Optical connector	E2000/APC			
Interface				3 ports, non-isolated, RJ45 modular jacks Full duplex, asynchronous			
	Serial (RS-232C)		SERIAL 1	Function: Communication (Modbus) Baud rate: 1.2, 2.4, 4.8, 9.6, 19.2, 38.4 57.6, 115.2 kbps			
			SERIAL 2	Function: Communication (Modbus) Baud Rate: 1.2, 2.4, 4.8, 9.6, 19.2, 38.4 kbps			
			SERIAL 3 (*9)	Function: Maintenance (Private)			
	Network interface	LAN		1 port, 10BASE-T (*10) or 100BASE-TX, RJ45 modular jacks, automatic negotiation, automatic MDI, with power switch (ON/OFF)			
	Display			LEDs : HRDY, RDY, LASER ON			
Power supply	Consumption	Operating mode		16 W			
		Power save mode		2.1 W			
Dimensions (W×H×D)				197.8×132.0×162.2 mm (6 slots width) (*11)			
Weight				2.5 kg			

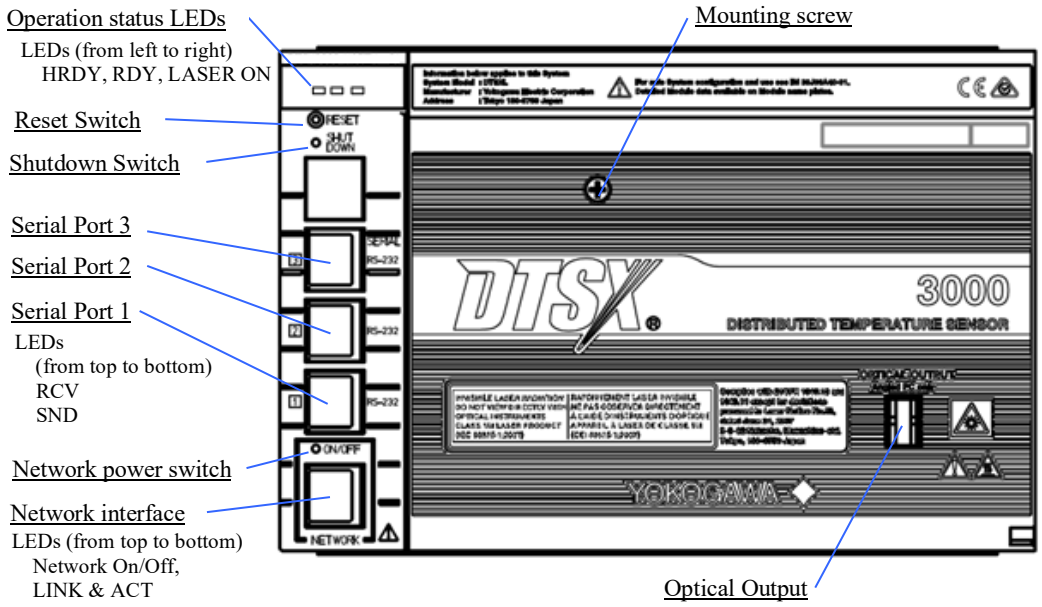
*1: Temperature calibration of the Sensor Optical Fiber for DTSX3000 is required before temperature distribution measurement.
*2: Indicated nominal values vary with the refractive index of the optical fiber.
*3: Sampling range is 2 m for 50 km range; selectable from 1 m and 2 m for 20 km and 30 km range; and selectable from 0.5 m, 1 m and 2 m for other distance ranges.
*4: The spatial resolution (sometimes known as the response distance) is the distance between the 10 % and 90 % points on the DTS response to a step temperature change in the near end part of the optical fiber under 16 km distance range or less and 0.5 m sampling.
*5: This range depends on the temperature range of the sensor optical fiber.
*6: The given values indicate one standard deviation over distance for measurements of uniform temperature 20°C with no coupling loss and fiber attenuation of 0.25 dB/km for stokes light and 0.25dB/km for anti-stokes light. Time values indicate hardware measurement time in fast measurement mode at sampling resolution of 1 m (2 m for 50 km range) A 100 meter section each at the near end and the far end of the optical fiber is excluded. The temperature resolution changes near a temperature change location or a fiber connection point. (The diagram on the right shows the graph for 1 m sampling as a reference case); how the temperature resolution changes depends on the fiber length, measurement time and excess loss.



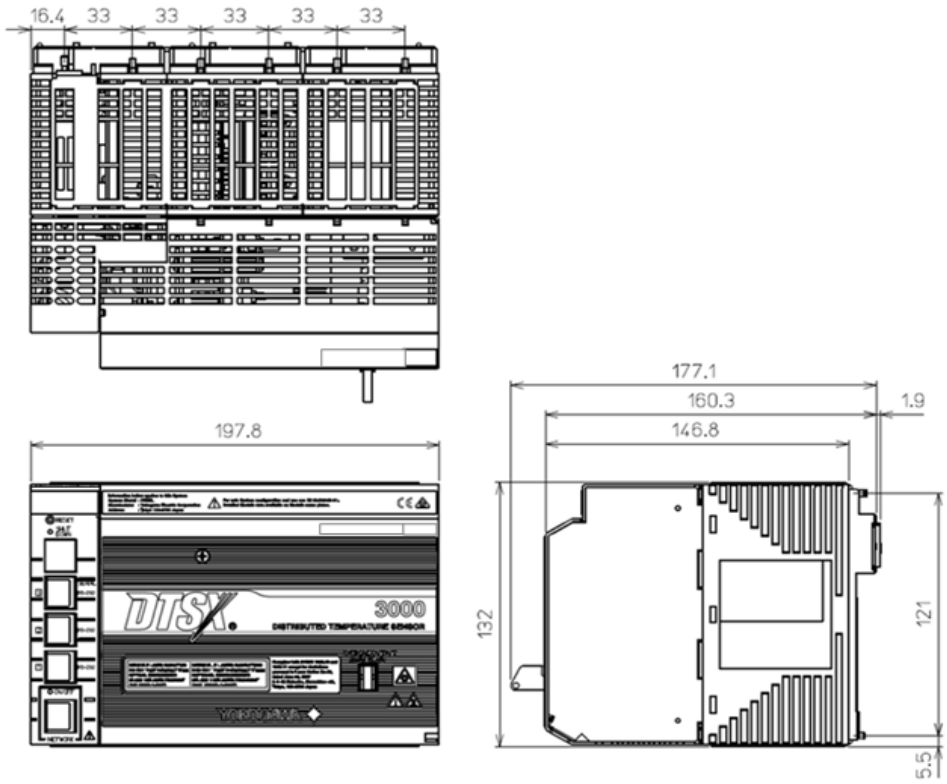
*7: These values indicate typical performance at 23 °C ambient temperature but are not performance specification values.
*8: Sensor optical fiber splicing must be by fusing splicing. Sensor optical fiber connection loss must be 0.3 dB max. and no more than 0.15 dB on average
*9: SERIAL 3 of RS-232C is dedicated for maintenance use.
*10 A repeater hub cannot connect.
*11: Dimensions exclude protective cap of optical connector.
*12: Refer to GS 39J06Z40-01EN in the case of specification of DTSXL for single mode fiber.

■ Appearance

● Front View



● External Dimensions



Unit: mm

■ Pin Assignment, LEDs, and Switches

● Pin Assignment

Table Pin Assignment of Serial Port (RS-232)

RJ45 Pin No.	RS-232 Signal Name	Conversion to D-sub Connector	
		D-sub 9pin Male (Straight Cable)	D-sub 9pin Female (Crossover Cable)
1	DCD (Data Carrier Detect)	1	1
2	DSR (Data Set Ready)	6	4
3	RXD (Received Data)	2	3
4	RTS (Request To Send)	7	8
5	TXD (Transmitted Data)	3	2
6	CTS (Clear To Send)	8	7
7	DTR (Data Terminal Ready)	4	6
8	GND (Common Ground)	5	5

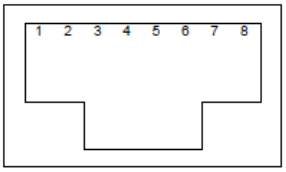


Figure Front View of RJ45 Connector (RS-232)

Table Pin Assignment of Network Interface (RJ45 modular jack)

RJ45 Pin No.	Signal name	Function
1	Transmission data (+)	-
2	Transmission data (-)	-
3	Receiving data (+)	-
4	Not used	-
5	Not used	-
6	Receiving data (-)	-
7	Not used	-
8	Not used	-

● LEDs

Table Operation Status LED Indicators

LED Indicator	Color	Description
HRDY	Green	Lit when the hardware is operating normally.
RDY	Green	Lit when the system is operating normally.
Laser ON	Green	Lit when the laser is on.

Table Serial Transmission Status LED Indicators (RJ45 connector)

LED Indicator	Color	Description
RCV (Receive)	Green	Lit when receiving
SND (Send)	Green	Lit when transmitting

Table Network Status LED Indicators (RJ45 connector)

LED Indicator	Color	Description
NETWORK ON / OFF	Green	Lit in normal communication state. Unlit in power down state.
LINK & ACT	Green	Lit when a LINK is established. Blinks when transmitting or receiving.

● Switches

Table Various Switches

Name	Purpose
Reset Switch	Press this switch to reboot the DTSX3000.
Shutdown Switch	Press this switch to terminate the DTSX3000 safely.
Network power switch	Press this switch when not using network functions.

A1.3. OPTICAL SWITCH MODULE

Installing an optical switch module (2, 4 or 16-channel model) allows monitoring of multiple optical fibers using a single DTSX3000 system.

An optical switch module can also be used in double-ended measurement using DTSX3000.

■ Specifications

Table Specifications of Optical Switch Module (*4)

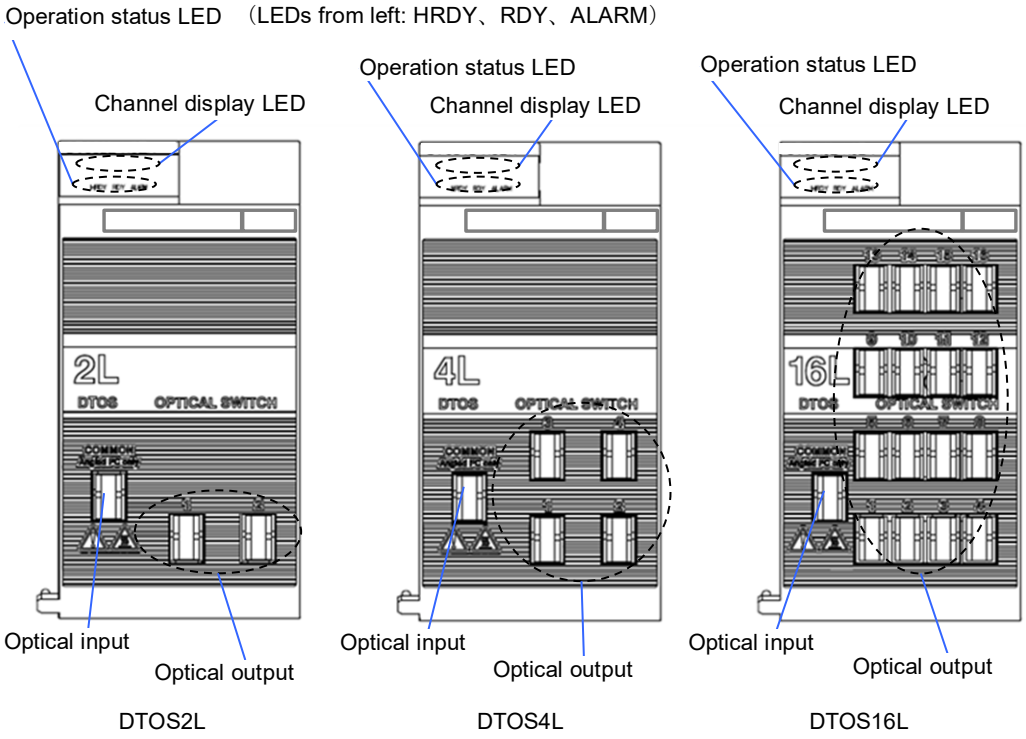
Item		Specifications		
Model		DTOS2L	DTOS4L	DTOS16L
Insertion loss (*1)		0.8 dB (Typical) (*2) 1.4 dB (Max.)		
Distributed temperature measurement	Measurement type	Single end, Double end		
Sensor optical fiber	Optical fiber	50/125 µm GI, closed end, non-reflection required		
	Optical connector	E2000/APC		
	Optical channels	2 channels	4 channels	16 channels
Interface	Control	Controlled by DTSX3000		
	Display	LEDs: HRDY, RDY, Alarm, Active channel		
Power supply	Consumption	Operating 4 W Power save 1 W		
Dimensions (W x H x D) (*3)		71.65 x 130.0 x 160.3 mm (2 slots width)		
Weight		0.63 kg	0.65 kg	0.75 kg

*1: One-way loss
*2: These values indicate typical performance at 23 °C ambient temperature but are not performance specification values.
*3: Dimensions exclude protective cap of optical connector.
*4: Refer to GS 39J06Z40-01EN in the case of specification of DTSXL for single mode fiber.

Note: As a guideline, the module should be replaced periodically every 4.7. 6 and 9.5 years for continuous operation of 15-second, 20-second and 30-second measurements, respectively.

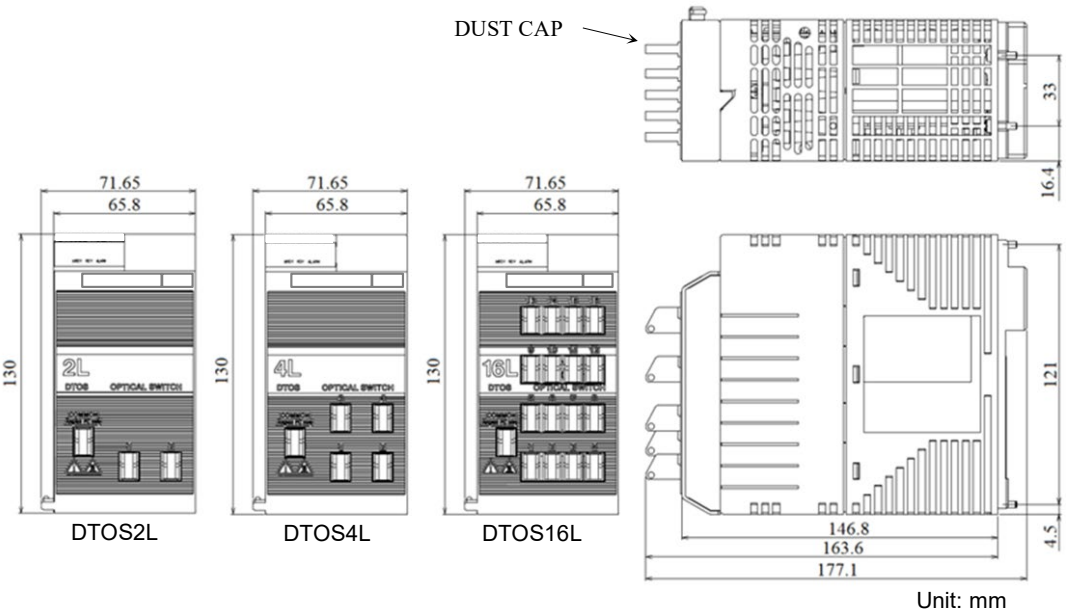
■ Appearance

● Front View



DTOS2L DTOS4L DTOS16L

● External Dimensions



DTOS2L DTOS4L DTOS16L

Unit: mm

● LED

Table Status Indicators

LED Indicator	Color	Description
HRDY	Green	Lit when the hardware is operating normally.
RDY	Green	Lit when the system is operating normally.
ALARM	Green	Flashes when an alarm condition is present.
Active Channel	Green	Indicates an active channel.

TIP

The optical switch module cannot be installed on a base module of STARDOM (NFBU200-S0, NFBU200-S1 and NFBU050-S1).

A1.4. BASE MODULE

The DTSX3000 base module, which is also compatible with the DTSXL200, is used for mounting various function modules including the DTSX3000 Distributed Temperature Sensor, power supply modules, optical switch modules and CPU module.

IMPORTANT

- Dummy covers must be installed on all empty slots of the base module.
- Only power supply modules (NFPW426, NFPW441, NFPW442 and NFPW444) and CPU module (NFCP050) but no other STARDOM module can be mounted on the base module (DTSBM10).
- Dual-redundant configuration is not allowed for CPU module and power supply modules.
- DIN rail mounting is not allowed.

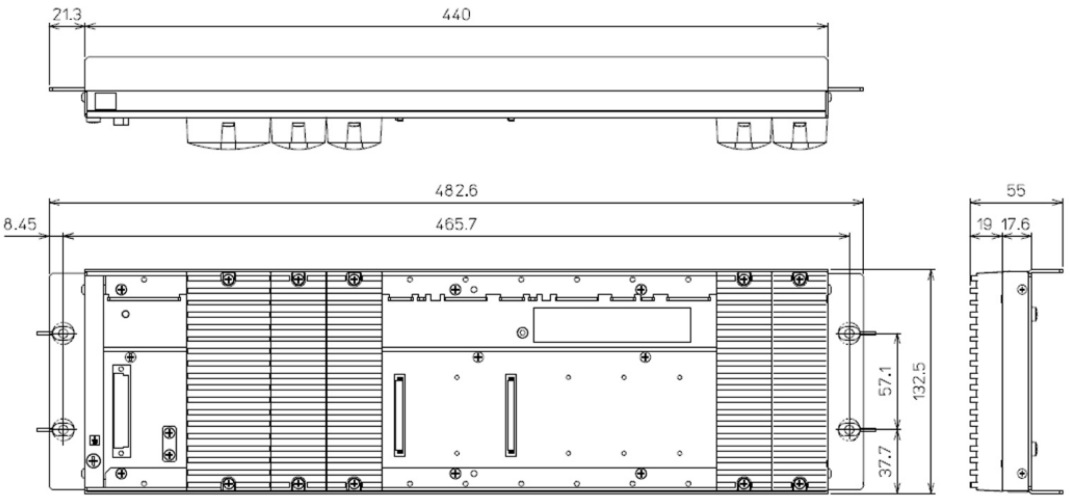
■ Specification

Table Specifications of Base Module (DTSBM10)

Item		Specifications
Power supply	Consumption	0.3 W
	Input Rating	5 V DC : Max 8 A, 24 V DC : Max 8 A
Dimensions (W x H x D)		482.6 x 132.5 x 55.0 mm
Weight		2.3 kg
Mounting Type		19-inch rack mount
Isolation		Functional isolation between 19-inch rack and base module (*1)

*1: Insulating bushing must be used for isolation when installing the base module on the 19-inch rack.

■ Appearance



Unit: mm

Figure Base Module DTSBM10

A1.5. RACK MOUNT KIT

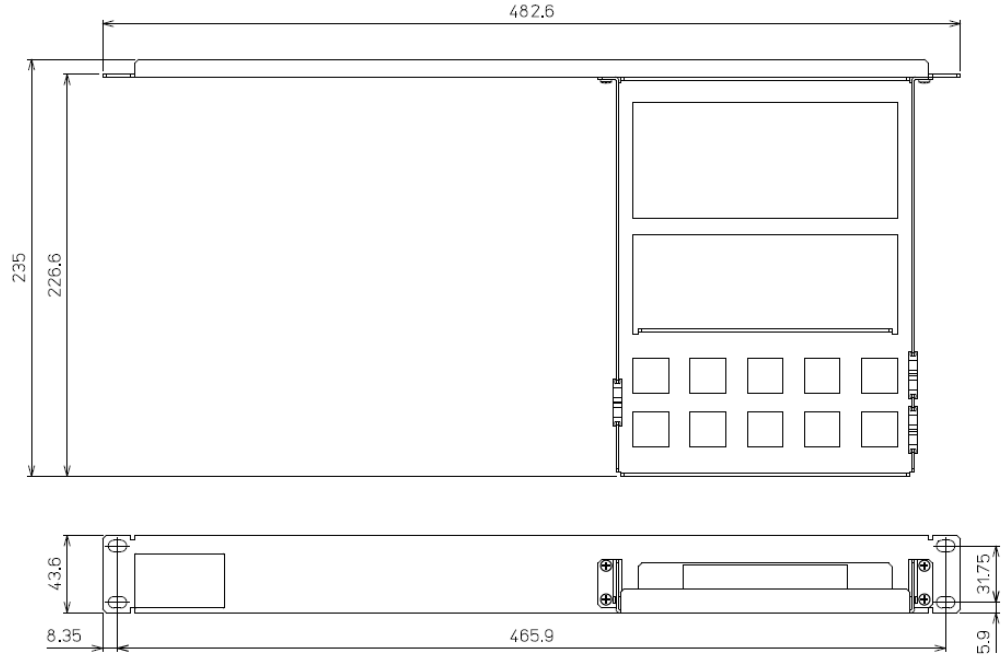
The rack mount kit can be used for laying optical fibers in a cabinet.

■ Specification

Table Specifications of Rack Mount Kit (DTRK10)

Item	Specifications
Dimensions (W x H x D)	482.6×235×43.6 mm
Weight	0.87 kg

■ Appearance



Unit: mm

Figure Rack Mount Kit

A1.6. POWER SUPPLY MODULE

One of the following power supply modules must be selected when configuring a DTSXL system.

Dual-redundant configuration is not allowed for the power supply module.

Table Power Supply Modules Compatible with DTSXL System

Model	Reference (Input voltage range)
NFPW426	10 to 30 V DC
NFPW441	100 to 120 V AC, 47 to 66 Hz
NFPW442	220 to 240 V AC, 47 to 66 Hz
NFPW444	21.6 to 31.2 V DC

SEE ALSO

For the specifications of the power supply modules, see GS 34P02Q13-01E “FCN-RTU Low Power Autonomous Controller Hardware” .

A1.7. CPU MODULE

This is the CPU module for the autonomous controller.

One CPU module of the following model may be optionally installed onto the DTSBM10 base module.

Table CPU Module Compatible with DTSXL System

Model	NFCP050

Dual-redundant configuration is not allowed for the CPU module.

STARDOM modules including I/O modules, bus repeater modules and serial communication modules cannot be mounted on the DTSBM10 base module.

SEE ALSO

For details on the specifications of the CPU module, see GS34P02Q13-01E “FCN-RTU Low Power Autonomous Controller Hardware”.

A2. Installation Environment

■ Installation Specifications and Precautions

The conditions of the installation location must be appropriate for stable operation of the system.

The table below shows the conditions required for the installation location (and some conditions for transportation and storage) of DTSXL System.

Table Installation Environment Specification of DTSXL System (*1)

Item		Specifications
Ambient temperature	Operation	-40 to +65 °C (*2)
	Transportation/storage	-40 to +70 °C
Ambient humidity	Operation	20 to 80 % RH (no condensation)
	Transportation/storage	5 to 85 % RH (no condensation)
Rate of change in temperature	Operation	Within ±10 °C/h
	Transportation/storage	Within ±20 °C/h
Dust		0.3 mg/m^3 or less
Protection class		IP20
Resistance to corrosive gases		ANSI/ISA S71.04 Class G2 (Standard) (ANSI/ISA S71.04 Class G3, option)
Resistance to vibration		0.15 mm P-P (5 to 58 Hz), 1 G (58 to 150 Hz)
Resistance to shock		15 G, 11 ms (during power-off, for sine half-waves in XYZ-directions)
Altitude		3000 m or less (*3)
Noise	Electric field	10 V/m or less (26 MHz to 1 GHz)
	Magnetic field	30 A/m (AC) or less, 400 A/m (DC) or less
	Electrostatic discharge	4 kV or less contact discharge, 8 kV or less aerial discharge
Grounding		100 Ω or less (*4)
Cooling		Natural air cooling

*1: Refer to GS 39J06Z40-01EN “DTSXL Distributed Temperature Sensor Long Range System (for SMF)” in the case of specification of DTSXL for single mode fiber.
*2: 0 to +55 °C when power supply module NFPW441, NFPW442, or NFPW444 is used.
*3: 2000 m or less when power supply module NFPW441, NFPW442, or NFPW444 is used.
*4: Applicable to DTSBM10.

CAUTION

- The unit must be placed in a lockable metal cabinet to comply with standards.
- The temperature specification during operation indicates the criterion of the temperature at the air intake of the bottom portion of modules. Do not block ventilation holes, as it may hinder the air-cooling capabilities of the unit. When installing DTSX3000 in a cabinet, note that the temperature specification is not with respect to the ambient temperature of the cabinet. Provide cooling fans in the cabinet if needed.
- Avoid exposing DTSX3000 to direct sunlight.
- Prevent condensation under any circumstance.
- The dust level of the room should not exceed 0.3 mg/m^3. Under any circumstance, avoid iron flakes, carbon particles, or any other type of dust that are conductive.
- Avoid existence of corrosive gases such as hydrogen sulfide, sulfurous acid gas, chlorine, and ammonia.
- This instrument is designed for indoor use.
- For outdoor installation within a cabinet (such as RTU), use a rainproof cabinet of IP54 class or higher protection rating.

SEE ALSO

- For vibration at the installation location, see also “DTSXL System Vibration Criteria” within this Chapter.
- For radio device noise to DTSXL System, see “Radio Device Noise to DTSXL System” within this Chapter.

■ Vibration Criteria of DTSXL System

Ensure that if the frequency of vibration at the installation location is 58 Hz or less, the total amplitude is kept below 0.15 mm. If the vibration frequency is greater than 58 Hz, find a location that will meet the following condition:

Acceleration (m/s^2) = $2\pi^2 \times A \times F^2 \times 10^{-3} < 9.8$ (=1G)

where

A: Total amplitude (mm)

F: Frequency (Hz)

The allowable range for total amplitude is shown below.

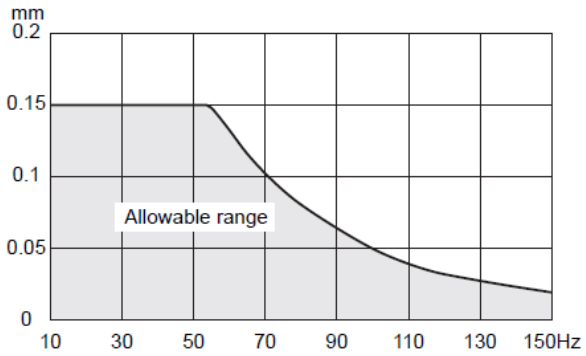


Figure Allowable Vibration Range

■ Radio Device Interference to DTSXL System

The following shows general requirements when using radio devices such as transceivers. As a general rule, close the cabinet door when a radio device is used:

- Transceivers that have 3 W of output power or less should be at least 1 m away. Transceivers that have 10 W of output power or less should be at least 2 m away.
- Radio devices that have 1 W of output power or less including cellular phones and cordless phones should be at least 1 m away.

IMPORTANT

To comply with EMC standards, mount three ferrite cores (A1190MN or A1193MN) on each of the FG, power, network and RS-232C cables.

A3. Power Supply Equipment

The DTSXL System uses the same power supply modules as the FCN/FCN-RTU. This manual describes the use of the power supply module in a DTSXL System.

Proper power equipment must be used for stable system operation. This section describes the following topics:

- **Power supply system**
- **Grounding**

SEE ALSO

For details on the power supply specifications, read the STARDOM FCN/FCJ Guide (IM 34P02Q01-01E).

A3.1. Power Supply System

This section describes the power supply system for DTSXL System.

- System Separation
  The power supply system for the DTSXL System must be separated from other systems.
- Installation of Breakers, Switches, etc.
  The power supply module for the DTSXL System has no switch. An external breaker or an external switch should be installed for maintenance and safety purposes.

IMPORTANT

To conform the power supply system for the DTSXL System to safety standards, use a breaker or a switch that conforms to the safety standards.

A3.2. Supplied Power Source

The following items must be considered to ensure stable DTSXL System operation.

■ Supplied Power Source Voltage Distortion (AC power)

Power failure may be detected even if the effective value is the same when the peak of the input voltage waveform is decreased due to a deformed crest of the waveform.

This may be caused by the output impedance of the supply source or a voltage drop due to the impedance of wiring. If the supplied input voltage meets the following condition, the rated instantaneous power failure sense delay time may not be maintained, which may cause instantaneous power failure. Therefore, a solution so that stable power can be supplied must be applied at the power source.

Peak value of the input voltage $<$ Lower limit of Input voltage $\times\sqrt{2} \times 0.99$

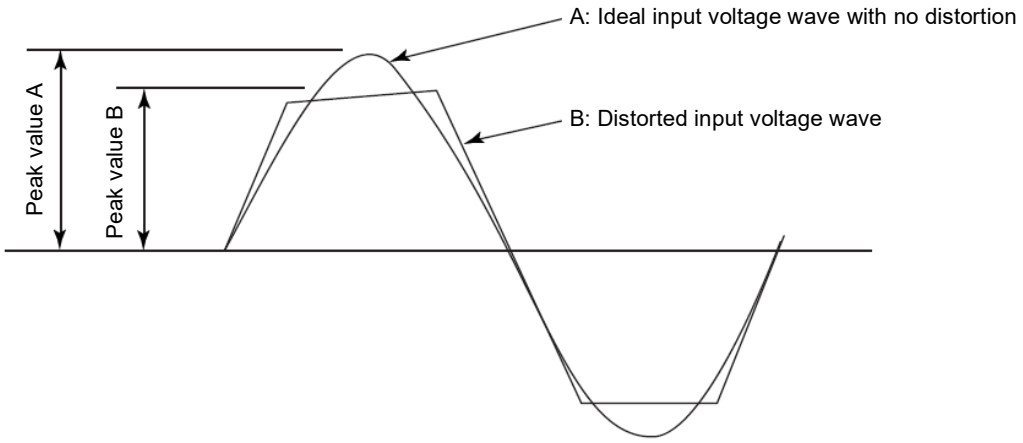


Figure Distortion of Input Voltage Waveform

■ Inrush Current

An input current much larger than normal will flow when the power supply is turned on. Refer to the specification of the power supply module for inrush currents to each power supply module.
Make sure that the supplied power and protection devices can withstand this inrush current.

TIP

The peak values and waveforms of the current are affected by the impedance of the input system. These change depending on the system structure (when comprised of multiple devices) and the power supply line condition.
Generally, the inrush current when the system is comprised of multiple devices will be less than the total sum of the inrush current of each device.

■ Output Capacity

The output capacity of the power supply device is determined by calculating the maximum electric power demand of the system, but the peak value of the current will be 2 to 5 times the effective value. The effects of inrush current, as well as allowance for future device expansion must be carefully considered.

■ Power Consumption Calculation

Refer to the power supply module specification for the maximum power consumption. Take into consideration future expansion and device changes. In general, the maximum value should be used.

TIP

The power consumption varies with the installed modules.

- The maximum power consumption of a unit is given by the following equation:
  Power consumption of unit = power consumption of base module
  + power consumption of DTSX3000
  + power consumption of additional modules
- The power consumption can then be calculated using the following equation:
  Power consumption (VA) = power consumption of unit
  / (efficiency of power supply module x power factor of power supply module)
- The efficiency and power factor of the power supply module varies with usage conditions. Use the following guidelines to determine their values:
  Efficiency of power supply module
  = 0.75 (except for NFPW426)
  = 0.8 (for NFPW426)
  Power factor of power supply module
  = 0.5 (when no power factor improvement device is used)
  = 1.0 (when NFPW444 or NFPW426 is used.)

CAUTION

- Power failure during writing of files to the system memory of the DTSX3000, say during program update, may damage the file system. (Power failure during DTSX3000 operation will not damage the system memory.)
  Power failure during measurement may also damage measurement data.
- To prevent such risks, install an uninterrupted power supply (UPS) device.

A3.3. Grounding for DTSXL System

When DTSXL System is installed in a cabinet (with a 19-inch rack), instrument panel, or the like, it is functionally insulated by the insulation bushings (accessories of DTSBM10). To maintain this insulation, the following instructions must be followed.

- Ground the DTSXL System separately from the grounding of other devices, motor control circuits, and electric control circuits.
- Grounding resistance on the FG terminal of the base module must be 100 Ω or less.
- Grounding resistance on the GND terminal of the power supply module (line filter grounding) must be 100 Ω or less.
- Perform the grounding of the base module and the power supply module at one point.

SEE ALSO

For the specification of the grounding wire, see A5.2, “Wiring the Ground.”

A4. Installation and Attachment

This section describes the installation procedures, attachment procedures, and precautions for each module when attaching the DTSXL System to cabinets (19-inch racks), control panels, etc.
The following basic procedures are described:

1. **Installing the base module**
2. **Installing other modules**
3. **Ground wiring and power wiring**

A4.1. Installing the Base Module

The DTSXL System is designed to be attached to 19-inch racks. Observe the following precautions when installing a DTSXL System to cabinets, control panels, etc.

■ Installation Direction

The DTSXL System is designed to be cooled by natural air. Install a DTSXL System so that the ventilation air flows upward from its bottom to its top as shown below.

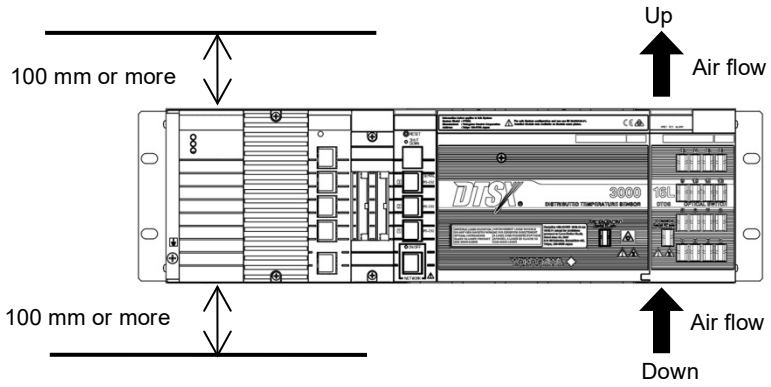


Figure Installing the Base module

CAUTION

- Be sure to turn off the power before installing or removing the base module.
- Do not install the unit in a manner that blocks the ventilation holes on the top and bottom.
- To prevent the cooling air current from being blocked, be sure to place the unit at least 100 mm away from other devices.
- Do not expose the unit to direct sunlight
- All access to the DTSXL System is from the front. Reserve a space of 100 and 150 mm from the front panel of the unit to the cabinet door to provide enough space for the cables. (The minimum bending radius varies with cable material. Check the wire specification.)

■ Installing to a 1 9-Inch Rack

When installing the base module to a 19-inch rack or general-purpose control panel, install the supplied insulation bushings to insulate the base module from the rack as shown in the diagram. Attach the base module to the 19-inch rack (cabinet) using the screws supplied.

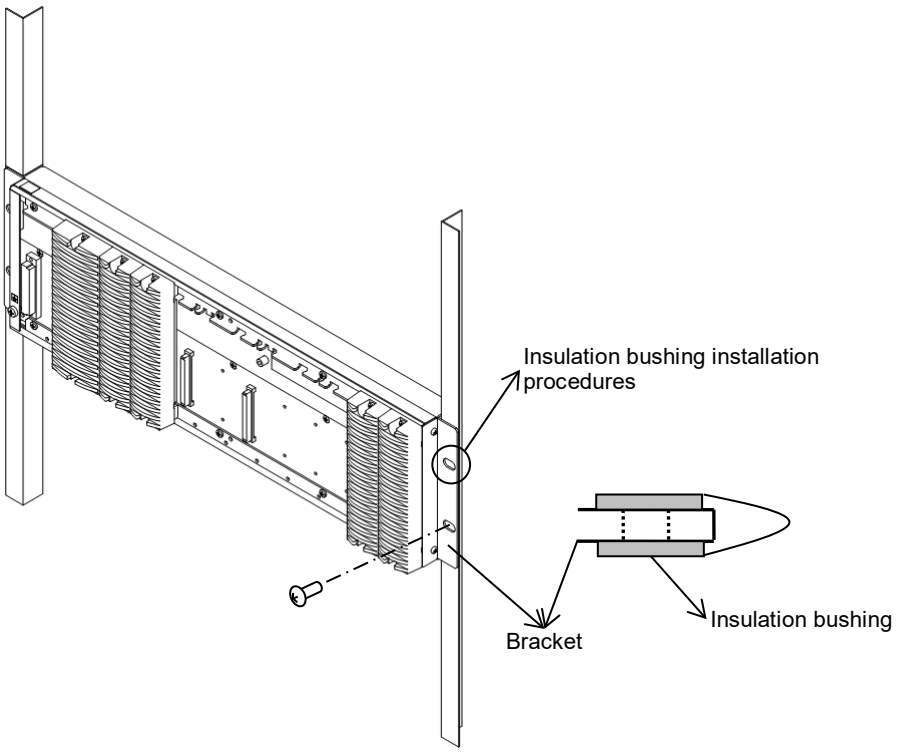


Figure Installing the Base module to a 19-inch Rack

A4.2. Installing Other Modules onto the Base Module

This section describes the procedure for installing a power supply module, a DTSX3000 Distributed Temperature Sensor module, an Optical Switch module and a CPU module onto a base module.

■ Installation Position of Each Module

This section describes the positioning of the modules for installation to the base module.

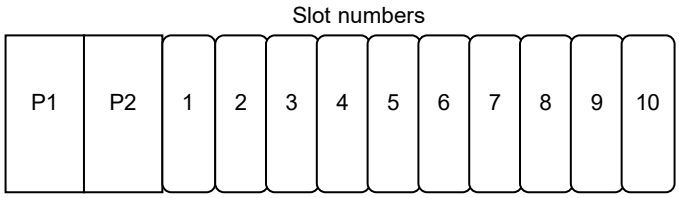


Figure Installation Positions of DTSXL System Modules

Table Installation Positions of DTSXL System Modules

Module	Installation Position	Remarks
Power supply module	P1	Module is to be installed in slot P1.
CPU module (*1)	Slots 1 to 2	Each module occupies 2 slots.
DTSX3000	Slots 3 to 8	Each module occupies 6 slots.
Optical switch module	Slots 9 to 10	Each module occupies 2 slots

■ Installation Restrictions and Precautions

● Power supply module installation restrictions

Redundant configuration is not allowed for the power supply module. Does not use slot P2.

● CPU module installation restrictions

Redundant configuration is not allowed for the CPU module.

● STARDOM module installation restrictions and precautions

STARDOM modules other than the power supply modules (NFPW426, NFPW441, NFPW442 or NFPW444) and CPU module (NFCP050) cannot be installed to the base module for DTSX3000.
Do not install other STARDOM modules.

● Optical switch module installation precautions

When installing the optical switch module, to prevent it from contacting with the front panel of the distributed temperature sensor, always install the sensor first. Similarly, on removal, always remove the optical switch module first. When installing the optical switch module, ensure that the gasket of the front panel is not loosened.

■ Installing Modules

The procedures for installing a module to and removing a module from the base module are described below.

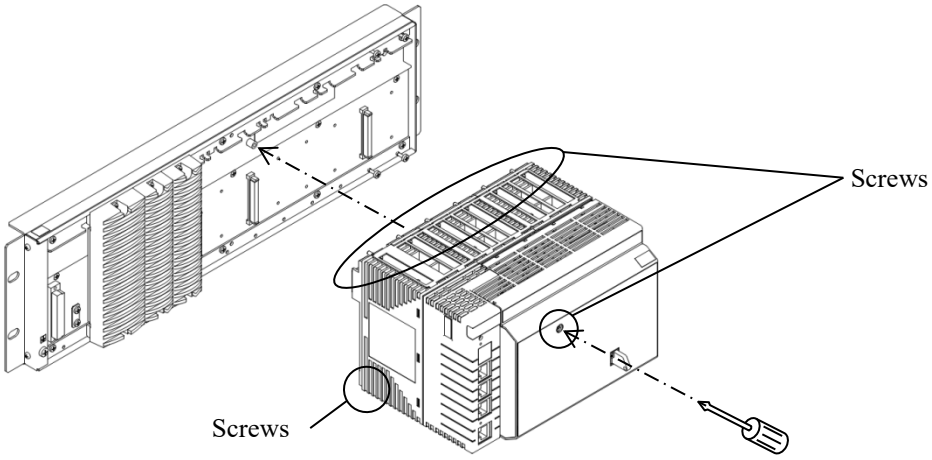


Figure Example for Attaching a DTSX3000 to the Base Module

● Installation Procedures

1. Attach the module to the base module using screws.
   When attaching a DTSX3000, tighten the securing-screws of the DTSX3000 panel first.
   Attach the DTSX3000 first before attaching an optical switch module.
2. Use a torque of approximately 0.5 N·m for the tightening torque of the screws.
3. Attach the optical fiber.

● Removal Procedures

1. Remove the optical fiber.
2. Remove the screws that hold the module.
   Detach an optical switch module before detaching the DTSX3000.
3. Pull the module forward away from the Base unit.

IMPORTANT

- The base module is preinstalled with dummy I/O module covers in the empty slots for the CPU and optical switch modules. Do not remove these covers except when installing CPU and optical switch modules.
- Do not remove the dummy power supply module cover from the empty slot for the power supply module.
- When attaching the DTSX3000 to the base module, wedge the gasket between the DTSX3000 and the base module.
- Before attaching the DTSX3000 to the base module, ensure that the SD card is locked in place at the back of the DTSX3000.

A4.3. Considerations on Environment inside Cabinet or Panel

■ Arrangement

When determining the internal arrangement of the cabinet or panel in which the DTSXL System is to be installed, ensure that operability and maintainability will not be compromised and take the following environmental concerns into consideration. Shown below is an example of recommended arrangements.

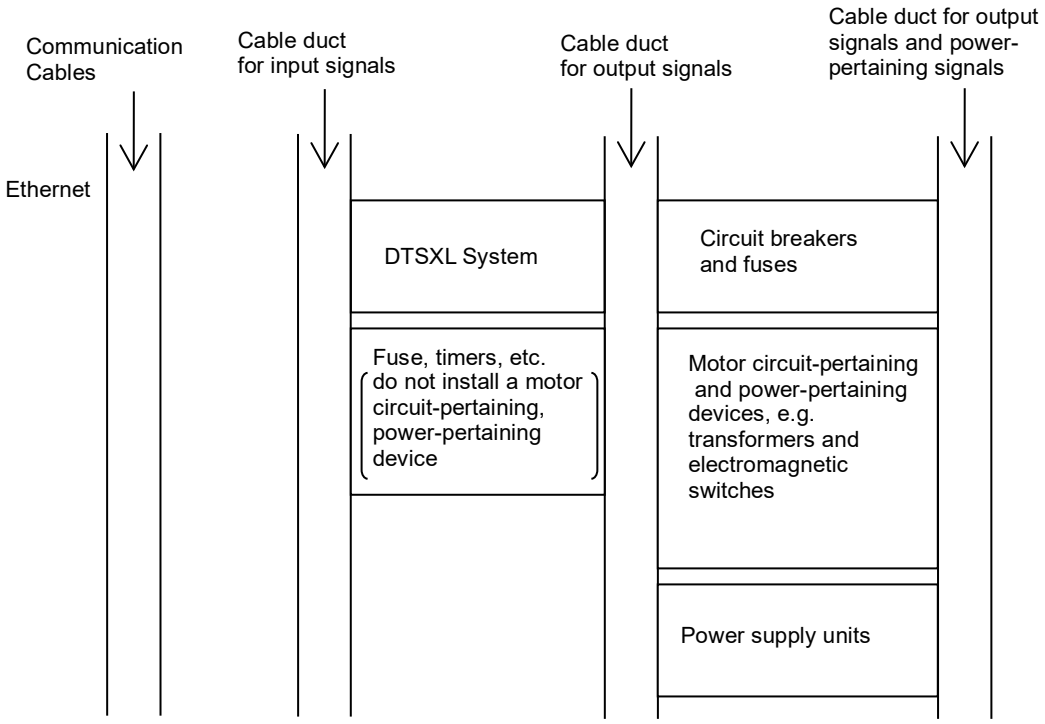
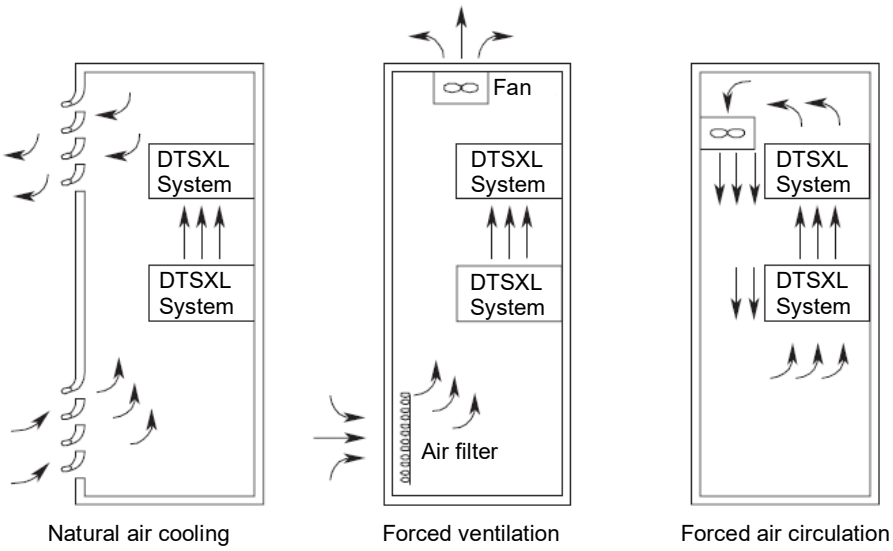


Figure Recommended Cabinet or Panel Arrangement

■ Temperature Considerations

- Provide adequate ventilation to release heat to the outside.
- Avoid installing a high heat-producing device right below DTSXL System.
- Cool down the DTSXL System with forced ventilation or a cooler when the temperature beneath the module is above 65 °C (55°C when NFPW441, NFPW442, or NFPW 444 is used). Implement cooling by, for example, installing forced ventilation or circulation fans or a cooler. As a failed fan or cooler will affect the system, consider implementing a backup system such as a temperature sensor in the cabinet/panel that will report an alarm in the event of a fan or cooler failure. Conversely, if the ambient temperature is lower than -40 °C (0 °C when NFPW441, NFPW442, or NFPW444 is used) at system startup such as in a cold climate, install a low-power space heater or lamp to provide preheating before system startup.

Examples of cooling methods are shown below.



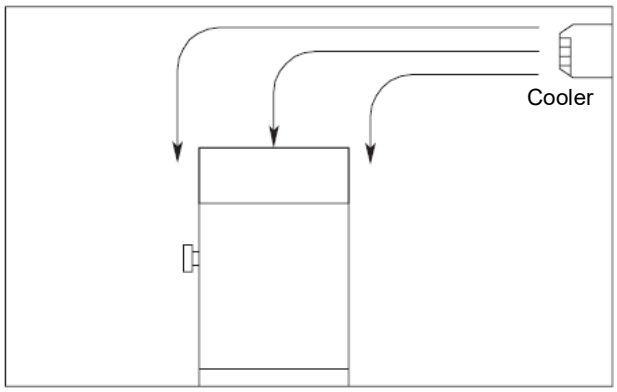


Figure Panel Cooling Methods

■ Humidity Considerations

Condensation may be caused by a rapid change in temperature after heating or cooling is started or stopped. Condensation on a circuit board may cause a short circuit, resulting in malfunction. If condensation may occur, leave the power on at all times or continuously preheat the cabinet or panel interior with a space heater or the like.

■ Vibration and Shock Considerations

- Keep external vibration and shock to the DTSXL System within specified limits by insulating the cabinet or panel from vibration and shock generating sources or fixing the cabinet or panel with rubber isolators.
- For shocks and vibrations generated by devices such as electromagnetic switches operating inside the cabinet or panel, keep vibration and shock to the DTSXL System within specified limits by adopting measures such as fixing those devices with rubber isolators.

■ Atmospheric Considerations

Where a large amount of dust is suspended in the atmosphere, prevent the entry of suspended dust by, for example, using an airtight cabinet or panel, or pumping clean air into the cabinet or panel to keep the internal pressure slightly higher than the atmosphere.

A4.4. Noise Considerations

■ Isolation from Power and Motor-circuit Cables

Lay any power or motor-circuit cable at least 20 cm away from the DTSXL system and all signal cables connected to the DTSXL system. Should this be impossible, run the power or motor-circuit cables all the way through a metal conduit that is grounding (100 Ω or less).

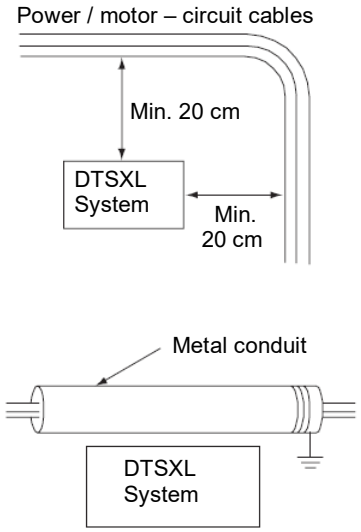


Figure Separation from Motor-circuit Cables

■ Antinoise Measures for Power Supply Module and Circuit

- Twist the power supply wires and minimize the wiring length.
- The power supply modules of the DTSXL System incorporate a noise filter and hence have ample immunity to the level of noise likely to occur in generic applications. However, for use in an environment of high noise levels, it is recommended to interpose a noise filter or noise-cut transformer in the power supply wiring.

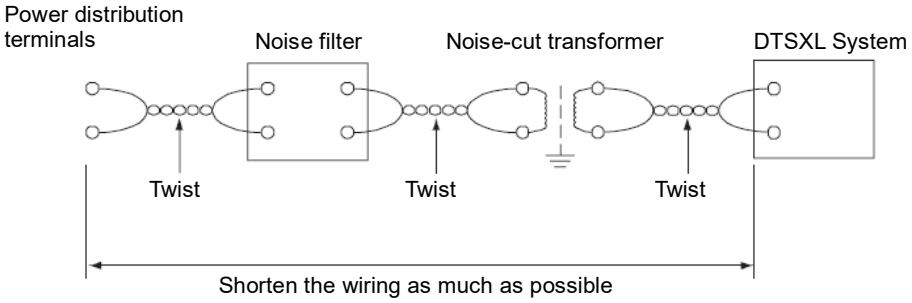


Figure An Example of Anti-noise Measure for Power Circuit

■ Communication Signals

Communication signal wires carry high-speed signals. Lay these wires in a separate duct at least 10 cm away from other input/output wires.

IMPORTANT

Be sure to use specified cables and take extra special care with grounding and cable/wire runs.

SEE ALSO

For details on cabling, see Chapter A5, “Wiring.”

A4.5. Corrosive-gas Environment Compatibility

The DTSXL System employs modules which meet the ANSI/ISA G3 optional environment requirements and are compatible with the corrosive gas-susceptible environment.

SEE ALSO

Refer to the general specifications (GS 39J06B40-01EN) of each module to check whether each module meets the G3 environment requirements.

■ Outline of G3 Environment Compatibility

The classification of the environment in which the process control equipment is installed is determined by the ANSI/ISA S71.04 “Environmental Conditions for Process Control Systems” standard. The environment having an atmosphere which contains steams and mists (liquids, coded L), dusts (solids, coded S), or corrosive gases (gases, coded G) is classified into four categories according to the levels of these substances determined.

The four categories of the corrosive gas environment are defined as follows:

- G1 (Mild) :
  A well-controlled environment in which corrosive gas is not the major cause adversely affecting the reliability of plant equipment. The corrosion level on the copper test piece is below 0.03 µm (see note below).
- G2 (Moderate) :
  An environment in which corrosive gas can be detected and it could be determined that the gas is the major cause adversely affecting the reliability of plant equipment. The corrosion level on the copper test piece is below 0.1 µm (see note below).
- G3 (Harsh) :
  An environment in which corrosive gas is frequently generated to cause corrosion and that it is necessary to provide special measures or employ specially designed or packaged plant equipment. The corrosion level on the copper test piece is below 0.2 µm (see note below).
- GX (Severe) :
  An environment that demands special protective chassis for plant equipment, specifications of which should be determined by a user and the manufacturer through consultation. The corrosion level on the copper test piece is below 0.3 µm (see note below).

TIP

Copper test pieces are used to determine the level of corrosion for the classification of the plant environment.
The test piece is an oxygen-free copper sheet, which is 15 cm^2 in area, 0.635 mm in thickness, 1/2 to 3/4H in hardness. The test piece is placed in the plant site for one month and checked for any change before and after the test to determine the degree of corrosion (see table below). If the test period is shorter than one month, the result is calculated to obtain equivalent data using an expression defined by the standard.

Table Corrosive-gas Environment Classification

Severity Level		G1 Mild	G2 Moderate	G3 Harsh	GX Severe	
Copper corrosion level		＜300 (＜0.03)	＜1000 (＜0.1)	＜2000 (＜0.2)	≥2000 (≥0.2)	[Å] ([μm])
Group A	H_2S	＜3	＜10	＜50	≥50	[mm^3/m^3]
	SO_2, SO_3	＜10	＜100	＜300	≥300	
	Cl_2	＜1	＜2	＜10	≥10	
	NOx	＜50	＜125	＜1250	≥1250	
Group B	HF	＜1	＜2	＜10	≥10	
	NH_3	＜500	＜10000	＜25000	≥25000	
	O_3	＜2	＜25	＜100	≥100	

TIP

- The gas density data indicated in the table are for reference only, with the relative humidity of 50 % RH or less. The category goes up one rank higher every time the humidity increases 10 % exceeding the 50 % RH or over 6 % per hour.
- The Group-A gases shown in the table may coexist and cause inter-reaction.
- Inter-reaction factors are not known for the Group-B gases.

A4.6. FM Nonincendive

A4.6.1. Precaution for Nonincendive

The DTSXL System have been approved that the products meet the Nonincendive (NI) (*1) requirements of the FM Standards.

By this approval, these devices can be installed in Class I Division 2 (*2) hazardous locations, but for compliance with the standard, the devices must be installed in a cabinet approved by local explosion-proof testing organization.

*1: Nonincendive (NI):
NI is one of the explosion-proof systems of electrical products used in hazardous locations, particularly, in North America. NI devices can be used in Class I Division 2 locations.

*2: Class I Division 2:
This is an location where gaseous / vaporous explosive atmospheres are not generated under normal conditions; if generated, they exist for a short period of time only.

CAUTION

- Control equipment connected to the DTSXL System must not use or generate more than 250Vrms or Vdc.
- Installation should be in accordance with the National Electrical Code (ANSI/NFPA 70).
- Associated Apparatus manufacture’s installation drawing must be followed when installing this equipment.
- No revision to drawing without prior FM’s approval.
- WARNING - EXPLOSION HAZARD. DO NOT OPEN ENCLOSURE OR REPLACE BATTERY WHEN A FLAMMABLE OR COMBUSTIBLE ATMOSPHERE IS PRESENT.

■ Compliance

Class I, Division 2, Groups A, B, C, D T4

- Class 3600:2018
- Class 3611:2018
- Class 3810:2018

IMPORTANT

The DTSXL System is indoor use. For compliance with these standards, devices must be installed in a lockable metal cabinet with a key. Use a cabinet approved by local explosion-proof testing organization.

■ NI Products and Their Configuration

The figure below shows the example, how to configure NI products for DTSXL System installed in Class I Division 2 Hazardous Locations.

SEE ALSO

For NI products for DTSXL System, see the table below.

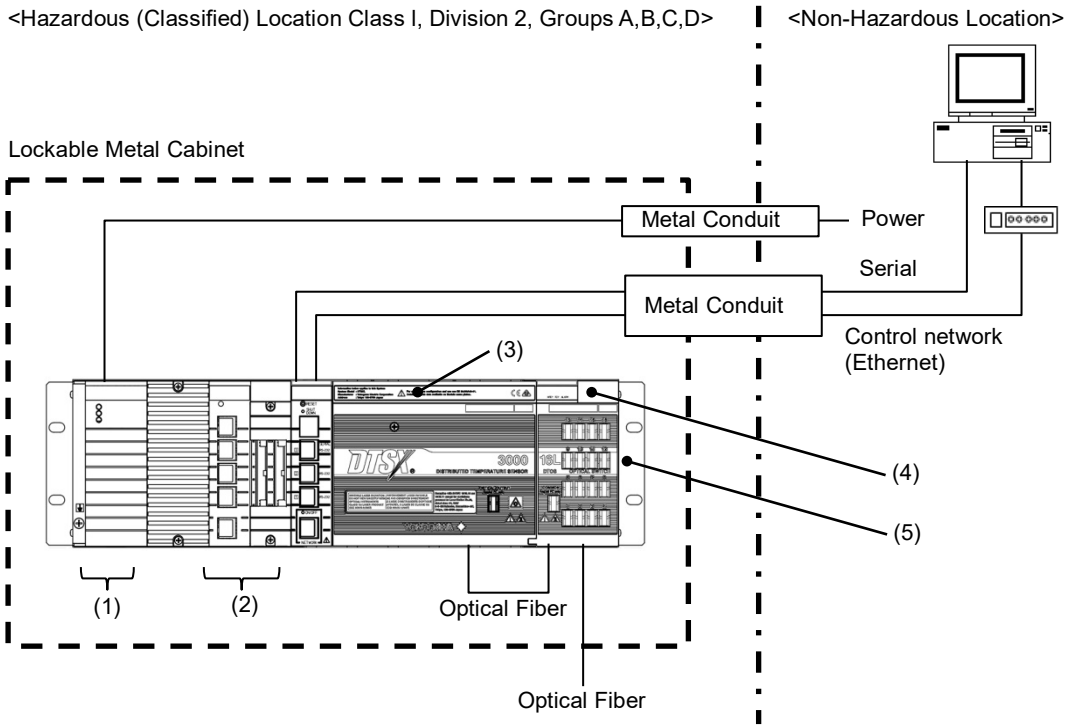


Figure NI Products and Their Configuration

Table NI products

	Type	Model	description
(1)	Power Supply Module	NFPW426	Power supply module for FCN-RTU (12 V DC, 4 A input, 24 V DC, 4 A input)
		NFPW441	Power Supply (100 to 120V AC, 1.4 A input)
		NFPW444	Power Supply (24Vdc, 3.3 A input)
(2)	CPU Module	NFCP050	CPU module
(3)	DTSX3000	DTSX3000-a0bEcd (*1)	Distributed Temperature Sensor
(4)	OSW Module	DTOS2L-NbEcd (*1)	2ch Optical Switch
		DTOS4L-NbEcd (*1)	4ch Optical Switch
		DTOS16L-NbEcd (*1)	16ch Optical Switch
(5)	Base Module	DTSBM10-N0cd(*1)	Base Module

*1 a = S (10 km Range) or N (16 km Range) or M (30km Range) or L (50 km Range)
b = E (Explosion protection)
c = N (Basic Type) or G(With ISA Standards G3 option)
d = /Z(special order not relevant to safety) or blank

SEE ALSO

For details on the power supply modules (NFPW426, NFPW441, and NFPW444) and CPU module (NFCP050), see the STARDOM FCN/FCJ Installation Guide (TI 34P02Q91-01E).

■ Power Cable

The power cables of DTSXL System must be passed through a metal conduit, and wired from a nonhazardous location without applying stress to the end of the cables. In addition, connect cables according to the National Electrical Code (NEC) or local electrical codes.

■ Ethernet Cable

The Ethernet cable of DTSXL System must be passed through a metal conduit, without applying stress to the end of the cables. In addition, connect cables according to the National Electrical Code (NEC) or local electrical codes.

■ Serial Port of DTSXL System

The cable for serial ports of DTSXL System must be passed through a metal conduit, without applying stress to the end of the cables. In addition, connect cables according to the National Electrical Code (NEC) or local electrical codes.

■ Other Cables

Connect cables according to the National Electrical Code (NEC) or local electrical codes.

SEE ALSO

For details on the power supply modules (NFPW426, NFPW441, and NFPW444) and CPU module (NFCP050), see the STARDOM FCN/FCJ Installation Guide (TI 34P02Q91-01E).

CAUTION

- During Operation
  While the system is on, never connect or disconnect cables, in explosive atmospheres.
- During Maintenance
  When doing maintenance on a system in operation, never connect or disconnect products in explosive atmospheres.
- WARNING - EXPLOSION HAZARD. DO NOT DISCONNECT WHILE CIRCUIT IS LIVE UNLESS AREA IS KNOWN TO BE NON-HAZARDOUS.

■ Cabinet for DTSXL System

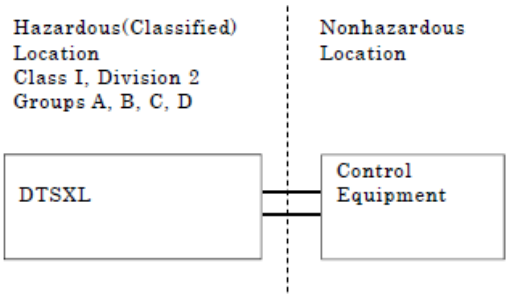
DTSXL System must be installed in a lockable metal cabinet with a key. Use a cabinet approved by the authority having jurisdiction.

Use the DTSXL System accommodated in the cabinet on condition that the ambient temperature of the DTSXL System meets its specifications, considering temperature rise in the cabinet.

A4.6.2. **NFM031-A11**

The contents of NFM031-A11 are shown below.

9.0 **Instruction Document**



Model and Item:	Model DTSXL is suitable for use in Class I, Division 2, Groups A, B, C and D, Hazardous (Classified) Locations.
Temperature Code:	T4
Cabinet:	DTSXL shall be installed in lockable metal cabinets. The suitability of the installation shall be verified by the authority having jurisdiction (AHJ).
Location:	Indoor use
Power Supply:	100 to 120 V a.c., 1.4 A, 50/60 Hz (when NFPW441 is used); 24 V d.c., 3.3 A (when NFPW444 is used); 12 V d.c., 4 A / 24 V d.c., 4 A (when NFPW426 is used)

Notes:

1. Installation should be in accordance with the National Electrical Code (ANSI/NFPA 70).
2. Installation of the Power Supply Modules and the CPU Modules should be in accordance with NFM009-A13.
3. No revision to drawing without prior FM's approval.
4. WARNING - EXPLOSION HAZARD. DO NOT OPEN ENCLOSURE OR REPLACE BATTERY WHEN A FLAMMABLE OR COMBUSTIBLE ATMOSPHERE IS PRESENT.

Doc. No.: NFM031-A11

Yokogawa Electric Corporation

A4.7. ATEX Type “n”

ATEX Type “n” is a construction that enhances safety not to cause a spark, an arc or high surface temperatures in a normal operation in CENELEC standard and IEC standard and also to avoid causing a spark, an arc or high surface temperatures under defined conditions such as an overload.

■ Compliance

ATEX Type “n” standards complied by DTSXL System are the following.

[Explosion-proof specifications]

II 3 G Ex nA ic [op is Gc] IIC T4 Gc X

[Complied standards]

EN 60079-0:2018

EN 60079-11:2012

EN 60079-15:2010

EN 60079-28:2015

- Explosive atmospheres-Part15: Equipment protection by type of protection “n”

The DTSXL System is indoor use. It can be installed in a hazardous location of Zone 2 after accommodating them in a keyed cabinet (*1) of protection rating IP54 or higher. It is possible to directly connect a node unit installed in a non-hazardous location and a Type “n” approved field device installed in a hazardous location of Zone 2.

*1: Use the DTSXL System accommodated in the cabinet on condition that the ambient temperature of the DTSXL System meets its specifications, considering temperature rise in the cabinet.

SEE ALSO

Refer to IM 39J06B40-10EN for the installation and the precaution for Type “n” compliant devices.

CAUTION

Modification or parts replacement of this product is prohibited. If it is carried out by other than authorized engineer of Yokogawa Electric Corporation, it becomes an invalid type of protection.

■ Type “n” Approved Products

The figure below is an example of the configuration of Type “n” approved products that can be installed in hazardous locations.

SEE ALSO

For Type “n” approved DTSXL System, see the table below.

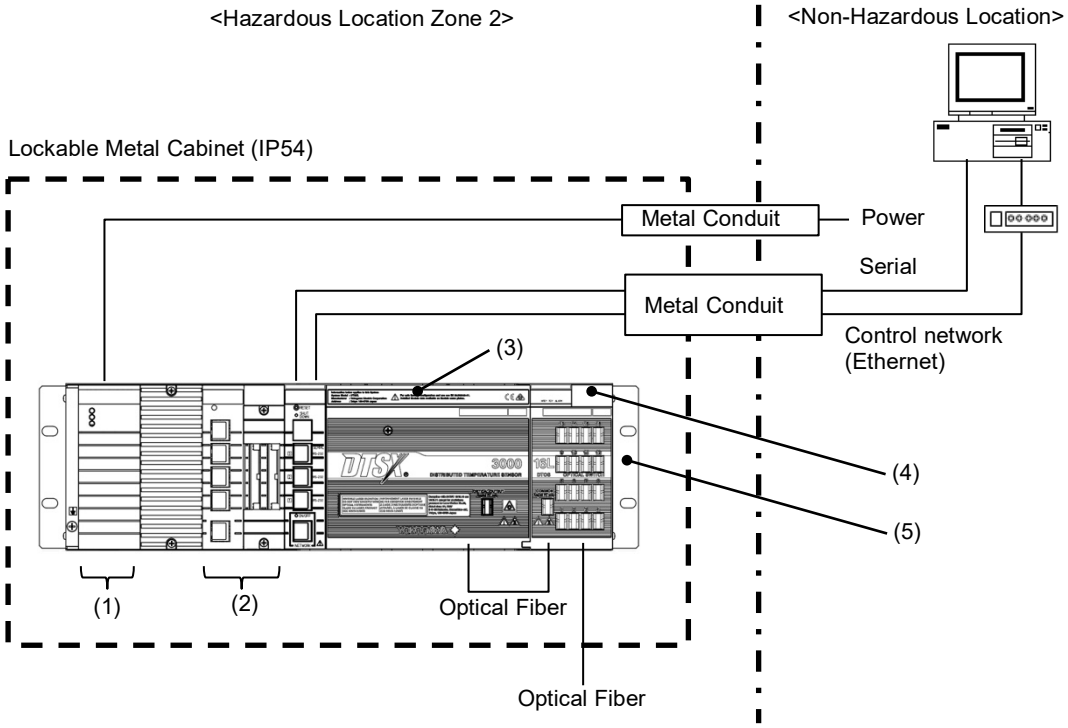


Figure Type ”n” Products and Their Configuration

Table Type of Protection “n” Products

	Type	Model	description
(1)	Power Supply Module	NFPW426	Power supply module for FCN-RTU (12 V DC, 3.4 A input, 24 V DC, 1.7 A input)
		NFPW444	Power Supply (24 V DC, 3.3 A input)
(2)	CPU Module	NFCP050	CPU module
(3)	DTSX3000	DTSX3000-a0bEcd (*1)	Distributed Temperature Sensor
(4)	OSW Module	DTOS2L-NbEcd (*1)	2ch Optical Switch
		DTOS4L-NbEcd (*1)	4ch Optical Switch
		DTOS16L-NbEcd (*1)	16ch Optical Switch
(5)	Base Module	DTSBM10-N0cd(*1)	Base Module

*1 a = S (10 km Range) or N (16 km Range) or M (30 km Range) or L (50 km Range)
b = E (Explosion protection)
c = N (Basic Type) or G(With ISA Standards G3 option)
d = /Z(special order not relevant to safety) or blank

SEE ALSO

For details on the power supply modules (NFPW426 and NFPW444) and CPU module (NFCP050), see the STARDOM FCN/FCJ Installation Guide (TI 34P02Q91-01E).

IMPORTANT

- For specific condition of use, when DTSXL System is located in hazardous areas, it shall be installed in metal cabinets with locks and keys which provides a degree of protection not less than IP54 in accordance with IEC 60529.
- DTSXL System shall be accordingly located in areas of not more than pollution degree 2 (defined in IEC 60664-1) to prevent adverse environmental conditions caused by foreign solid particles, dust and water etc.
- When connecting DTSXL System in a non-hazardous location with field devices in a hazardous location, install DTSXL System in a metal cabinet which meets the requirements of the EN61010.

■ Power Cable

The power cables of DTSXL System must be passed through a metal conduit, and wired from a nonhazardous location without applying stress to the end of the cables. In addition, connect cables according to local electrical codes for explosion-proof.

■ Ethernet Cable

The Ethernet cable of DTSXL System must be passed through a metal conduit, without applying stress to the end of the cables. In addition, connect cables according to local electrical codes for explosion-proof.

Connect cables according to local electrical codes for explosion-proof.

■ Serial Port of DTSXL System

The cable for serial ports of DTSXL System must be passed through a metal conduit, without applying stress to the end of the cables. In addition, connect cables according to local electrical codes for explosion-proof.

■ Other Cables

Connect cables according to local electrical codes for explosion-proof.

SEE ALSO

For details on the power supply modules (NFPW426 and NFPW444) and CPU module (NFCP050), see the STARDOM FCN/FCJ Installation Guide (TI 34P02Q91-01E).

CAUTION

- During Operation
  While the system is on, never connect or disconnect cables, in explosive atmospheres.
- During Maintenance
  When doing maintenance on a system in operation, never connect or disconnect products in explosive atmospheres.
- <English>
  Warning – Explosion Hazard
  DO NOT DISCONNECT WHILE CIRCUIT IS LIVE UNLESS AREA IS KNOWN TO BE NON-HAZARDOUS.
- <French>
  AVERTISSEMENT-RISQUE D'EXPLOSION.
  NEPAS DÉBRANCHER TANT QUE LE CIRCUIT EST SOUS TENSION, À MOINS QU'IL NE S'AGISSE D'UN EMPLACEMENT NON DANGEREUX.

■ Cabinet for DTSXL System

DTSXL System must be installed in a lockable metal cabinet with a key. Use a cabinet approved by local explosion-proof testing organization.

Use the DTSXL System accommodated in the cabinet on condition that the ambient temperature of the DTSXL System meets its specifications, considering temperature rise in the cabinet.

■ Wiring of Type "n" Devices

Wiring should be installed to conform to EN 60079-14 or the standards in countries or regions where wiring will be installed. Confirm the installation according to the checklist in EN 60079-17.

· The lead-in of the cabinet wiring installed in Zone 2 should be handled not to diminish a protection rating IP54 of the cabinet.

A4.8. CSA Non-incendive

DTSXL System have been approved that the products meet the Non-incendive requirements of the CSA Standards.

A4.8.1. CSA Non-incendive

DTSXL System have been approved that the products meet the Non-incendive (NI) (*1) requirements of the CSA Standards.

By this approval, these devices can be installed in Class I Division 2 (*2) hazardous locations, but for compliance with the standard, the devices must be installed in a cabinet approved by local explosion-proof testing organization.

*1: Non-incendive (NI):
NI is one of the explosion-proof systems of electrical products used in hazardous locations, particularly, in North America. NI devices can be used in Class I Division 2 locations.

*2: Class I Division 2:
This is an location where gaseous/ vaporous explosive atmospheres are not generated under normal conditions; if generated, they exist for a short period of time only.

IMPORTANT

- Installation should be in accordance with the Canadian Electrical Code (C22.1-06).
- Modification or parts replacement of this product is prohibited. If it is carried out by other than authorized engineer of Yokogawa Electric Corporation, CSA certification becomes void.

■ Compliance

Class I, Division 2, Groups A, B, C, D T4

- C22.2 No. 213-17

IMPORTANT

The DTSXL System is indoor use. For compliance with these standards, devices must be installed in a lockable metal cabinet with a key. Use a cabinet approved by local explosion-proof testing organization.

■ NI Products and Their Configuration

The figure below shows the example, how to configure NI products for DTSXL System installed in Class I Division 2 Hazardous Locations.

SEE ALSO

For NI products for DTSXL System, see the table below.

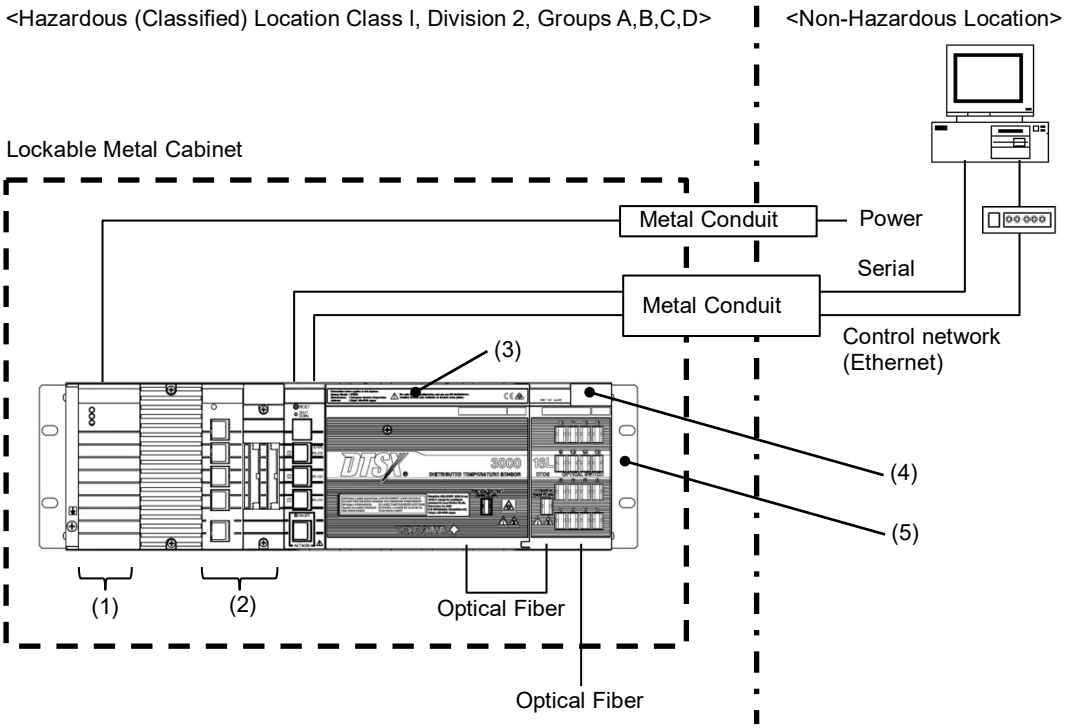


Figure NI Products and Their Configuration

Table NI products

	Type	Model	description
(1)	Power Supply Module	NFPW426	Power supply module for FCN-RTU (12 V DC, 3.4 A input, 24 V DC, 1.7 A input)
		NFPW441	Power Supply (100 to 120V AC, 1.4 A input)
		NFPW444	Power Supply (24 V DC, 3.3 A input)
(2)	CPU Module	NFCP050	CPU module
(3)	DTSX3000	DTSX3000-a0bEcd (*1)	Distributed Temperature Sensor
(4)	OSW Module	DTOS2L-NbEcd (*1)	2ch Optical Switch
		DTOS4L-NbEcd (*1)	4ch Optical Switch
		DTOS16L-NbEcd (*1)	16ch Optical Switch
(5)	Base Module	DTSBM10-N0cd(*1)	Base Module

*1 a = S (10 km Range) or N (16 km Range) or M (30 km Range) or L (50 km Range)
b = E (Explosion protection)
c = N (Basic Type) or G(With ISA Standards G3 option)
d = /Z(special order not relevant to safety) or blank

SEE ALSO

For details on the power supply modules (NFPW426, NFPW441, and NFPW444) and CPU module (NFCP050), see the STARDOM FCN/FCJ Installation Guide (TI 34P02Q91-01E).

■ Power Cable

The power cables of DTSXL System must be passed through a metal conduit, and wired from a nonhazardous location without applying stress to the end of the cables. In addition, connect cables according to the Canadian Electrical Code (CEC) or local electrical codes.

■ Ethernet Cable

The Ethernet cable of DTSXL System must be passed through a metal conduit, without applying stress to the end of the cables. In addition, connect cables according to the Canadian Electrical Code (CEC) or local electrical codes.

■ Serial Port of DTSXL System

The cable for serial ports of DTSXL System must be passed through a metal conduit, without applying stress to the end of the cables. In addition, connect cables according to the Canadian Electrical Code (CEC) or local electrical codes.

■ Other Cables

Connect cables according to the Canadian Electrical Code (CEC) or local electrical codes.

SEE ALSO

For details on the power supply modules (NFPW426, NFPW441, and NFPW444) and CPU module (NFCP050), see the STARDOM FCN/FCJ Installation Guide (TI 34P02Q91-01E).

CAUTION

- During Operation
  While the system is on, never connect or disconnect cables, in explosive atmospheres.
- During Maintenance
  When doing maintenance on a system in operation, never connect or disconnect products in explosive atmospheres.
- <English>
  Warning – Explosion Hazard
  DO NOT DISCONNECT WHILE CIRCUIT IS LIVE UNLESS AREA IS KNOWN TO BE NON-HAZARDOUS.
- <French>
  AVERTISSEMENT-RISQUE D'EXPLOSION.
  NEPAS DÉBRANCHER TANT QUE LE CIRCUIT EST SOUS TENSION, À MOINS QU'IL NE S'AGISSE D'UN EMPLACEMENT NON DANGEREUX.

■ Cabinet for DTSXL System

DTSXL System must be installed in a lockable metal cabinet with a key. Use a cabinet approved by the authority having jurisdiction.

Use the DTSXL System accommodated in the cabinet on condition that the ambient temperature of the DTSXL System meets its specifications, considering temperature rise in the cabinet.

A5. Wiring

IMPORTANT

- Do not bend or press the power cable or the signal cable if the ambient temperature is minus 20 degrees Celsius or below.
- Cables with the temperature rating of an ambient temperature plus 10 °C or more must be used.

A5.1. Power Supply Wiring

The following describes the power supply wiring for a power supply module that has been installed.

SEE ALSO

For details on wiring of power supply modules, see the STARDOM FCN/FCJ Guide (IM 34P02Q01-01E).

■ Wiring Specification and Terminal Preparation

For the wire terminals, use crimp-on terminal lugs with insulation sleeve. Be sure to use ring tongue terminal and crimping tools of the same brand.

● Applicable Cables

Insulated cables for industrial equipment such as;

- 600 V polyvinyl chloride insulated wires (IV); JIS C3307
- Polyvinyl chloride insulated wires for electrical apparatus (KIV); JIS C3316
- 600 V grade heat-resistant polyvinyl chloride insulated wires (HIV); JIS C3317
- Heatproof vinyl insulated wires VW-1 (UL1015/UL1007)

● Recommend Sizes

0.5 mm^2 to 2 mm^2 (AWG 20 to 14)

● Terminal Preparation

Use ring tongue terminal for M4 terminals, with the outer diameter of the lug tip (outer terminal diameter) not exceeding 8.5 mm, and with an insulation sleeve.

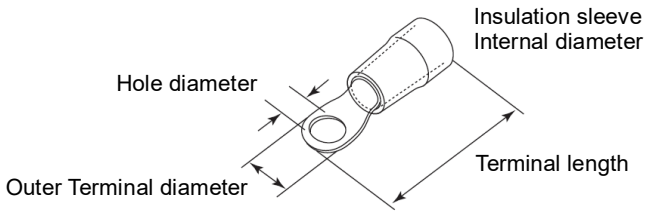


Figure Ring Tongue Terminal

Table Example of Ring Tongue Terminal Specification

Conductor nominal cross-sectional area (mm^2)	Screw used (mm)	Hole diameter (mm)	Outer terminal diameter (mm)	Terminal length (mm)	Insulation sleeve internal diameter (mm)
0.5 to 1.65 (AWG 20 to 16)	4	4.3 or more	8.0 or less	Approx. 20.0	3.6 or larger
1.04 to 2.63 (AWG 16 to 14)	4	4.3 or more	8.5 or less	Approx. 21.0	4.3 or larger

■ Connecting Power Supply

Follow the procedures below to connect the power supply cable.

1. Detach the protective cover for the terminals on the power supply module as follows:
   - Push the locking tab (circled area in figure) up to unlock it.
   - Pull gently to remove the cover.
2. Connect the power cable to the terminals. Power supply modules use different terminals so the power cable should be connected in accordance with the manual of the power supply module.
   Tighten the terminal screws (Phillips head M4) at a torque of 1.2 N·m.
3. Connect the grounding cable to the terminal labeled 3 (earth mark).
4. Replace the protective cover on the power supply connection terminal after wiring is complete.

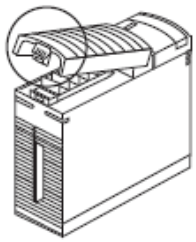
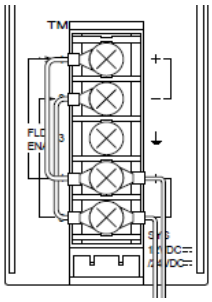


Figure Locking Tab of Protective Terminal Cover

CAUTION

When using power supply module NFPW426, you must also connect the power supply to the analog field power supply terminal as shown in the figure below. (Beware that this part of the connection differs from the description given in the manual of the power supply module.)

If this connection is not done, the power capacity of the NFPW426 may be exceeded and the power supply cut off.



Do not connect to the analog field power supply terminal when using power supply module NFPW441, NFPW442, or NFPW444.

IMPORTANT

- It is recommended to install a switch or circuit breaker on the power wiring so that the power can be turned on and off individually during maintenance.
- It is also recommended to install a noise filter to improve power supply quality.

A5.2. Wiring the Ground

Grounding resistance must be 100 Ω or less.

CAUTION

Ground only the specified, dedicated grounding terminal.
DTSXL System needs to be grounded to prevent electric shocks and effects of foreign noise. grounding resistance must be 100 Ω or less.

■ Applicable Cables

Insulated cables for industrial equipment such as;

- 600 V polyvinyl chloride insulated wires (IV); JIS C3307
- Polyvinyl chloride insulated wires for electrical apparatus (KIV); JIS C3316
- 600 V grade heat-resistant polyvinyl chloride insulated wires (HIV); JIS C3317
- Heatproof vinyl insulated wires VW-1 (UL1015/UL1007)

■ Recommend Sizes

2 mm^2 to 2.6 mm^2 (AWG 14 to 13)

■ Terminal Preparation

Round crimping terminal M4: External dimensions must be within 8.5 mm with insulation covers.

■ Cable Connection

Connect the ground cable to the FG terminal (M4 screws) on the bottom left of the base module.

Secure the M4 screws at a tightening torque of 1.2 N·m.

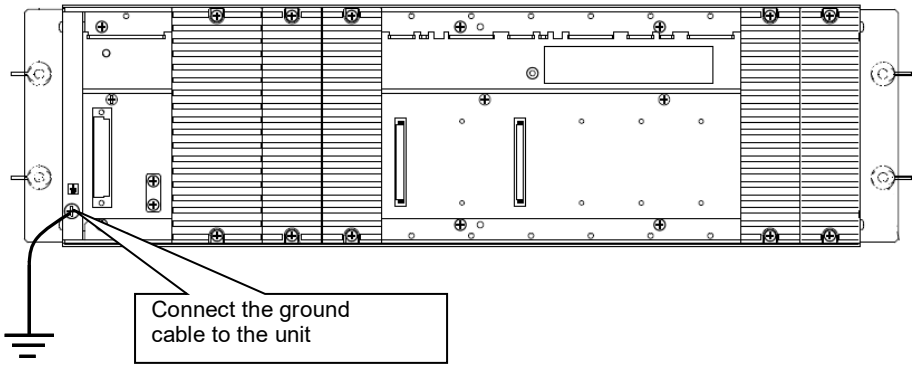


Figure Grounding DTSBM10 Base Module

A5.3. Connecting the Signal Cable

Communication Cables

The signal cable can be connected in the following ways:

■ Network

Connect the network cable to the connector in the front of the DTSX3000.

Use cables that comply with the 100BASE-TX standard.

CAUTION

This precaution relates to control network cable connection.

LAN communication may fail after a control network cable (LAN cable) is disconnected with the DTSX3000 powered on. If this happens, reboot the DTSX3000 or power it on again.

■ RS-232C Communication Cable of DTSX3000

● Cable Connection

If the RS-232 communication ports of the DTSX3000 are used, prepare the RJ45 connector cables.

RS-232C communication cables for DTSX3000 should be prepared by the user.

Table Pin Assignment of SERIAL Port (RS-232)

RJ45 Pin No.	RS-232 Signal Name	Conversion to D-sub Connector	
		D-sub 9pin Male (Straight Cable)	D-sub 9pin Female (Crossover Cable)
1	DCD (Data Carrier Detect)	1	1
2	DSR (Data Set Ready)	6	4
3	RXD (Received Data)	2	3
4	RTS (Request To Send)	7	8
5	TXD (Transmitted Data)	3	2
6	CTS (Clear To Send)	8	7
7	DTR (Data Terminal Ready)	4	6
8	GND (Common Ground)	5	5

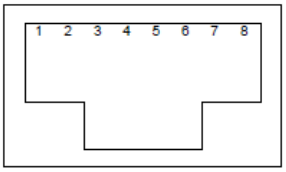


Figure Front View of RJ45 Connector (RS-232)

IMPORTANT

When not using the network interface, leave the connector cover for dust protection on to prevent any damage to the connector.

SEE ALSO

When using and performing wiring for the CPU module NFCP050, you should also refer to the STARDOM FCN/FCJ Guide (IM 34P02Q01-01E), installation guide (TI 34P02Q91-01E).

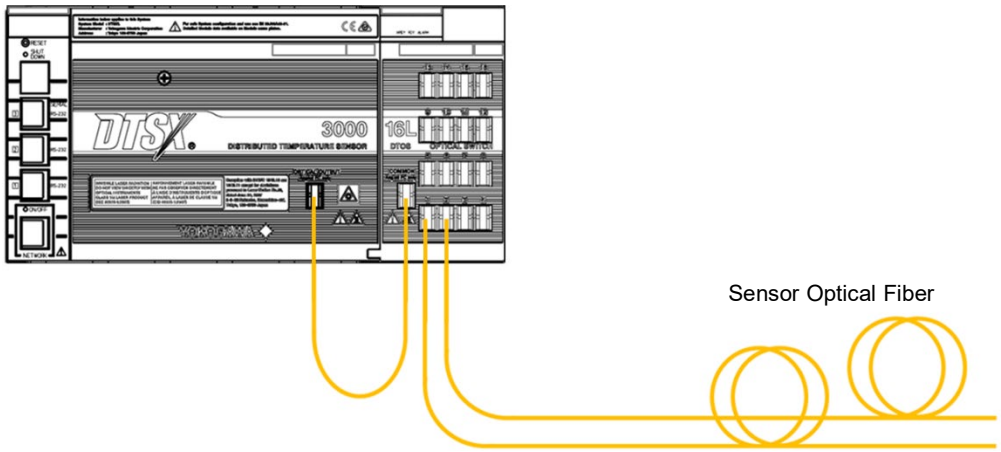
A5.4. Routing and Connecting a Sensor Optical Fiber

A5.4.1. Measurement

You can configure the DTSX3000 to perform single-ended measurement or double-ended measurement. In double-ended measurement, the sensor optical fiber needs to be looped back, which halves its effective measurement distance. However, it is an effective measure against unknown sensor optical fiber loss or sensor optical fiber darkening.

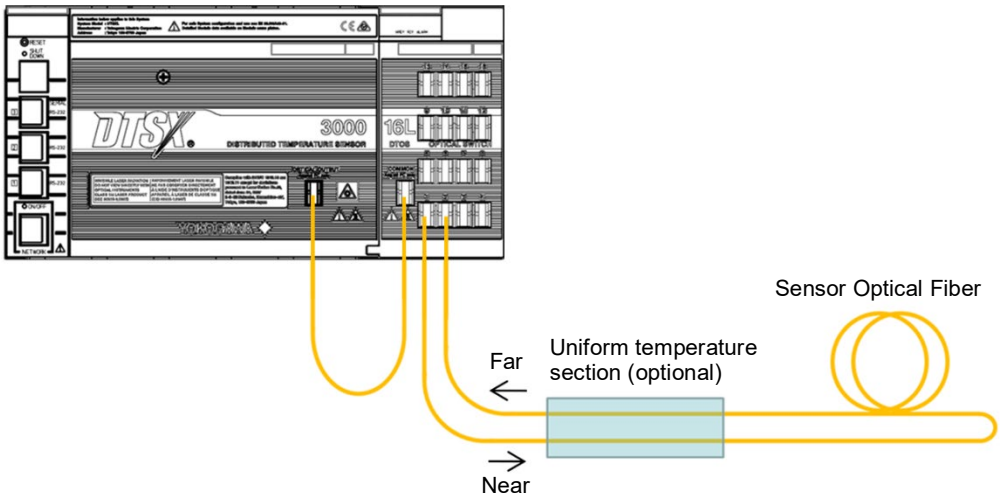
■ Single-ended Measurement

The figure below shows an example of a connection for single-ended measurement. In this example, two channels are measured. If only one channel is to be measured, an optical switch (DTOS) is not required. In multi-channel measurement, an optical switch (DTOS) can be purchased as an option and installed to enable auto-switching between channels during measurement according to a user-defined measurement sequence.



■ Double-ended Measurement

The figure below shows an example of a connection for double-ended measurement. In double-ended measurement, the sensor optical fiber is looped back to an optical switch (DTOS) to form a loop configuration. Signals from the DTSX3000 use 2 channels of the DTOS to measure one system. The two DTOS channel ports must be defined as the near end and far end respectively. Measurement data is processed using the channel name of the channel configured as the near end. Uniform temperature sections (10 m or longer) can be optionally configured on the near-end and far-end of the looped sensor optical fiber such that the sections are subjected to the same temperature for calibration purposes. If this option is used, the DTSX3000 performs sensor optical fiber loss calibration at each measurement so that the impact on temperature measurement of any sensor optical fiber darkening or any change in sensor optical fiber loss during temperature measurement is minimized.



A5.4.2. Routing Sensor optical fibers

Sensor optical fibers used must meet the DTSX3000 specifications and be routed in compliance with the cable specifications.

Observe the following general precautions when routing a sensor optical fiber:

- The sensor optical fiber must not be subjected to excessive stress or bending beyond cable specifications. Excessive stress or a tight bending radius may result in sensor optical fiber loss (bending loss). Bending loss is also affected by the ambient temperature and other conditions. Excessive sensor optical fiber loss may result not only in performance degradation but also unstable distributed temperature measurement with the DTSX3000.
- Beware that the minimum bending radius and maximum allowable stress vary with sensor optical fiber conditions.
- Do not contort or twist the sensor optical fiber. Excessive torsion or twist may result in sensor optical fiber loss (bending loss).
- The sensor optical fiber must be free of reflection. sensor optical fiber splicing must be by fusion splicing and the far end of the cable must be processed (e.g., cut at an angle) to prevent reflection.
  Sensor optical fiber connection loss must be 0.3 dB max. per splice point and no more than 0.15 dB on average.
- Provide an extra length of the sensor optical fiber near the DTSX3000 and reserve enough space to accommodate the extra length.
  It will be easier to connect a sensor optical fiber to the DTSX3000 if about one turn of extra cable length is provided near the DTSX3000.
- If the DTSXL System is to be installed in a cabinet, provide adequate space within the cabinet for routing the sensor optical fiber. More space is needed for routing additional sensor optical fibers if the optical switch module is used with the DTSXL System in the cabinet.
- Before connecting a sensor optical fiber to the DTSXL System, form the cable optimally so that it will not be subjected to stress when connected to the DTSXL System.

- As the DTSXL System is to be installed vertically on a wall, sensor optical fibers must be supported. The DTRK10 rack mount kit (option) is recommended for this purpose.
  The DTRK10 rack mount kit is designed to support sensor optical fibers and cords which are no more than 3 mm in diameter. If thicker cables or cords are used, a suitable shelf must be provided to support the cables.



Figure Example of Cable Routing using the DTRK10

CAUTION

If sensor optical fibers do not satisfy the relevant requirements or are wrongly routed or connected, the DTSX3000 may fail to perform to specifications.

Ensure that selected sensor optical fibers meet DTSX3000 specification requirements and are routed and connected in compliance with cable specifications.

A5.4.3. Connecting a Sensor optical fiber

Follow the procedure below to connect the optical connector of a sensor optical fiber to the optical connector of the DTSX3000.

Connection Procedure:

1. Firstly, ensure that the sensor optical fiber is routed properly.
   Ensure that the optical fiber is optimally formed so that its optical connector mates with the corresponding optical connector on the DTSX3000 with no stress.
2. Stop the operation of the DTSX3000.
   The power need not be switched off as long as the DTSX3000 is idle.
3. Ensure that the optical fiber and its optical connector meet the DTSX3000 specification requirements.
   In particular, even if two optical connectors to be mated are of the same type, ensure that their end face treatment and angles are also the same. For example, PC and APC (angled PC) types look the same but are not compatible with each other.

SEE ALSO

The following optical fiber and optical connector are recommended for use with the DTSX3000.

- Refer to GS39J06B40-01EN

4. Ensure that the end face of the optical connector is free of dirt or scratches.
   If visual inspection is inadequate, we recommended using an observation microscope to check the end face of the optical connector.
5. Clean the optical connector end face.
   Use a cleaner dedicated for cleaning optical fiber for this purpose.
   Although the E2000/APC optical connector is provided with a protective shutter to protect its end face, if it has been stored in a dusty place or for a prolonged period, it must be cleaned to remove any dust which might have entered through gaps on the shutter.
6. Remove the protective cap from the optical output connector on the DTSX3000.
   Do not discard the removed cap but store it in a plastic bag or otherwise to protect it against dust. It should be replaced when the sensor optical fiber is disconnected from the DTSX3000.
   Do not remove its protective cap if the optical output connector on the DTSX3000 is not used.
7. Connect the E2000/APC optical connector to the DTSX3000.
   The figures below show how to mate the optical connectors together at the DTSX3000.
   Hold the optical connector of the optical fiber with your two fingers (see Figure A) and ensure that it is correctly oriented (the lever side up) to the optical output connector on the DTSX3000 and mate them together (see Figure B).
   A clicking sound confirms that the optical connectors are properly interlocked properly (see Figure C).
   To confirm proper locking, hold the sides of the optical connector of the optical fiber with your two fingers and pull lightly to check that it is securely fastened.
   When attaching the optical connector of the optical fiber to or detaching it from the optical connector on the DTSX3000, always push or pull perpendicularly to the panel face of the DTSX3000. Do not apply force at an angle when and after the optical connectors are mated.



Figure A Being Mated

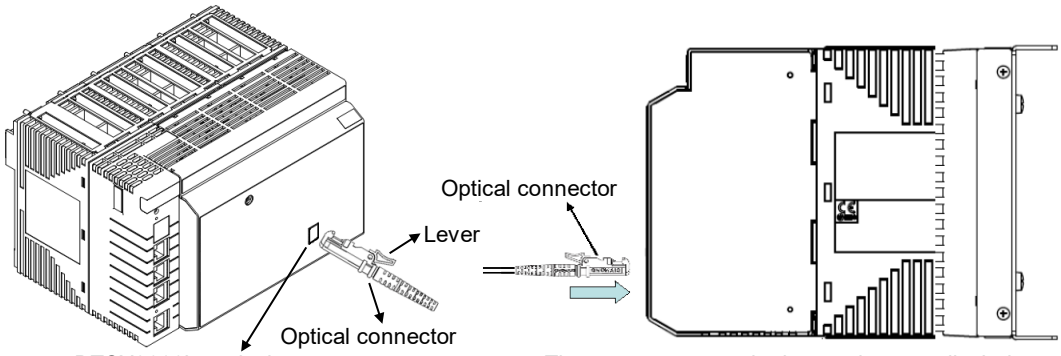


Figure B Mating the Connectors



Figure C Properly Mated

8. Check the connected optical fiber and ensure that neither its optical connector nor optical fiber is subjected to stress. Ensure also that the bending radius of the cable satisfies its minimum bending radius requirement.

TIP

The bending radius for a typical 3mm diameter optical fiber must not be less than 3cm.

9. If the DTSX3000 is installed in a cabinet, ensure that the cabinet door does not touch the optical fibers when it is closed.
10. With the sensor optical fiber connected to the DTSX3000, start measurement and check that distributed temperature measurement is normal. If not, redo the cable routing and connection.
    If the DTSX3000 still fails to measure temperature distribution normally, either the optical fiber or the DTSX3000 itself may be faulty. Repeat the measurement with another cable to isolate the fault.
11. Apply similarly to connection with the DTOS2L, DTOS4L or DTOS16L optical switch module.
    For easier connection with the DTOS4L or DTOS16L, which has many optical connectors, attach optical fibers to inner optical connectors before outer optical connectors, temporarily detaching existing optical fibers from outer optical connectors if necessary.

A5.4.4. Disconnecting a Sensor optical fiber

Follow the procedure below to disconnect the optical connector of a sensor optical fiber from the optical output connector of the DTSX3000

Disconnection Procedure:

1. Stop the operation of the DTSX3000.
   Always ensure that no measurement is in progress before disconnecting a sensor optical fiber.
2. Have on hand a protective cap for the optical output connector of the DTSX3000 to be disconnected.
   The protective cap that was previously removed and stored when the optical fiber was connected to the DTSX3000 may be reused.
   If the protective cap has been stored in a dusty place or stored for a prolonged period, it must be cleaned to remove any dust which might have collected in the cap.
3. In reverse order of the connection procedure, unlock the optical connector of optical fiber, and pull it away from the optical output connector on the DTSX3000 perpendicularly to the panel face of the DTSX3000.
   For the E2000/APC optical connector, press down on its lever to unlock it. Then, hold it with your two fingers and pull it lightly towards you (see the Figure below).
   If the optical connector is not unlocked properly, it will not come off easily. Do not disengage the connector forcibly in this state or it may be damaged. To unlock it properly, press down the lever completely.
   When pulling the optical connector towards you, do so perpendicularly to the panel face of the DTSX3000. Otherwise, it may not come off easily. Moreover, when disconnecting the optical fiber, hold its optical connector but never the optical fiber itself.
4. Put a protective cap on the optical output connector on the DTSX3000.
5. These instructions apply similarly to disconnection from the DTOS2L, DTOS4L, or DTOS16L optical switch.
   For easier disconnection from the DTOS4L or DTOS16L, which has many optical connectors, detach optical fibers from outer connectors before inner connectors, and if necessary, temporarily detach existing optical fibers from outer connectors and re-attach the optical fibers after detaching optical fibers from the inner connectors.

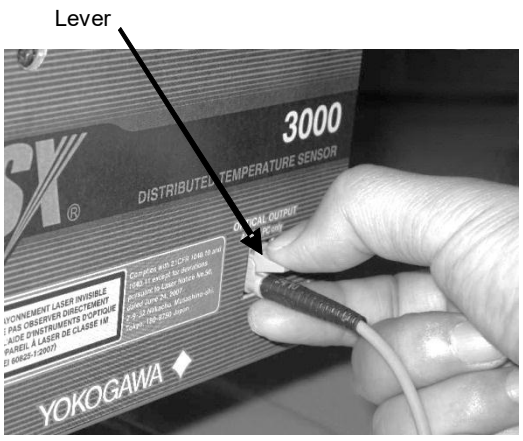


Figure Disconnecting a Sensor optical fiber

A5.4.5. Connecting an Optical Switch Module to the DTSX3000 with the optical fiber

When an optical switch module is used with the DTSX3000, the optical fiber provided with the optical switch module must be connected between them.

The optical fiber must be connected directly between the optical connector for optical output on the DTSX3000 and the optical connector for optical input on the optical switch module. The optical connectors for optical output on the optical switch module are intended for connection of sensor optical fibers. Optical fibers must be connected as described above under the heading “Connecting a Sensor optical fiber.”

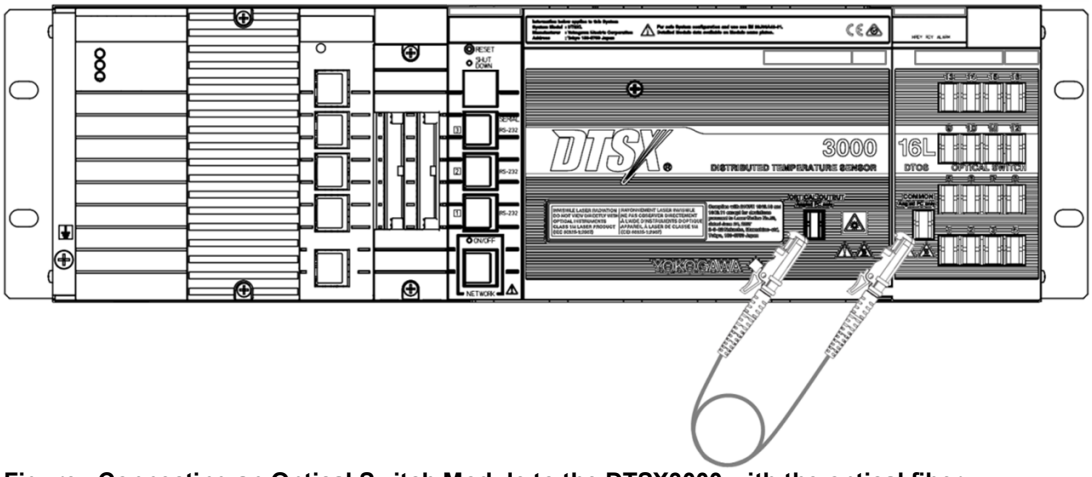


Figure Connecting an Optical Switch Module to the DTSX3000 with the optical fiber

CAUTION

Handling precautions for optical fibers:

- Use optical connectors and optical fibers that meet product specification requirements.
  Connecting the wrong type of optical connector to the DTSX3000 may damage not only the optical connector but also the optical connector of the DTSX3000 or the optical switch module.
- Do not apply excessive force on the lever of an optical connector.
  Pressing down too hard or too much on the lever may damage it.
- Before connecting an optical connector, clean its end face to remove dirt, dust, oil or other contaminants.
  Contaminants on optical connectors may lead to fiber loss and optical reflection and in turn failure to meet the DTSX3000 or the optical switch module performance specifications. Moreover, the laser pulse peak power of this instrument is about 30 W, which may cause contaminants to be fused to and thus damage the end face of the optical connector.
- Ensure that the end face of an optical connector is free of scratches.
  Using an optical connector with a scratched end face may damage the optical connector of the DTSX3000 or the optical switch module.
  Never connect an optical connector with a scratched end face.
- When connecting an optical connector, insert it gently and vertically into the optical connector of the DTSX3000 or the optical switch module.
  Improper connection, lateral movements and insertion by force may damage not only the optical connector but also the optical connector of the DTSX3000 or the optical switch module.
  Ensure that a connected optical connector is locked in place.
- Optical fibers must be routed according to routing instructions and not be subjected to excessive tension, lateral pressure, tight bending, or twisting.
- Disconnecting an optical connector improperly or forcibly may damage not only the optical connector but also the optical connector of the DTSX3000 or the optical switch module.
- Do not open the shutter, which protects the ferrule of an optical connector, in normal use.
  The shutter will open (not visible externally) automatically when the optical connector is connected.
  If you need to check or clean the end face of the optical connector, open the shutter of the optical connector in a clean, dust-free place.
- The optical connector of the DTSX3000 or the optical switch module comes with its protective cap.
  Leave the cap in place except when connecting an optical fiber cable.
- Using an optical connector or optical fiber that does not meet product specification requirements, using an optical connector with a scratched end face or improper handling of optical connectors may result in hardware failure. Hardware repair or parts replacement necessitated by improper use is chargeable even during the warranty period.

A6. Sensor Optical Fiber

A6.1. Choosing Sensor optical fiber

Sensor optical fibers to be used must satisfy the DTSXL System specifications.

Table Sensor Optical Fiber Specifications

Item	Specification Requirements
Optical connector	E2000/APC
Optical fiber material	50/125 µm GI quartz fiber or SM fiber (Select the optical fiber by specification code)
Wavelength characteristics	Minimal loss and flat wavelength loss characteristics at the 1550 nm band
Typical loss	GI: 0.25 dB/km (for the ST) or 0.25 dB/km (for the AS) SM: 0.20 dB/km (for the ST) or 0.20 dB/km (for the AS)
Splicing method	Fusion splicing
Connection loss	0.3 dB max., 0.15 dB max. on average
Reflection	No reflection (Anti-reflection termination required at the far end of the optical fiber.)

A6.2. Precautions When Choosing Sensor optical fiber

In addition to the specification requirements stated above, observe the following precautions when selecting sensor optical fiber.

■ Precautions on Environment Resistance

● Temperature

Selected optical fibers must cover the intended temperature distribution measurement range.
Typical optical fibers are resistant up to 80 °C. If higher temperatures are to be measured, heat-resistant optical fibers (e.g., polyimide-coated optical fibers). In addition to short-term deterioration, deterioration under prolonged exposure to high temperatures must also be considered when selecting sensor optical fibers.

● Humidity

Optical fibers deteriorate when in contact with water (or the OH radical). If sensor optical fibers must be used in water or at high humidity, select water resistant and heat-resistant optical fibers. Beware that optical fibers deteriorate even faster under high-temperature, high-humidity conditions.

● Corrosive gas

For installation in the presence of hydrogen sulfide or other corrosive gases, select a metal-tubing cable (e.g., made of incoloy) resistant to the specific corrosive gases.

● Length

Optical fiber splice points should be as few as possible, preferably none. The required optical fiber length must be determined taking into account the optical fiber laying method employed. The required length must include extra length for optical fiber sagging and installation, and thus would be longer than the length calculated from the drawing or map.

● Minimum bending radius

Optical fibers and optical fibers have stipulated minimum bending radius. Consider this property when selecting sensor optical fibers for an intended installation.

■ Precautions on Usage and Installation

In addition to the above general precautions, the following usage and installation precautions must be observed.

● No reflection

The sensor optical fiber must be reflection free. Thus fusion splicing must be used and the optical fiber far end must include anti-reflection termination, which may be achieved through an angled cleave or a fused connector. For single-ended measurement, a large optical loss on the far end of the sensor optical fiber is fine. (For instance, a terminator can be installed).
An optical fiber can also be checked for reflection from the optical loss distribution profile of the ST or AS wavelengths measured with the DTSX3000.

● Connection loss

If it is necessary to splice optical fibers together, minimize connection loss at the splice point and keep it within 0.3 dB. If the measured connection loss exceeds 0.3 dB, redo the splicing. Connection loss can be checked from the optical loss distribution profile of the ST or AS wavelengths measured with the DTSX3000.

● Bending loss

Optical fibers and optical fibers have their own minimum bending radius. Ensure that laid optical fibers satisfy these requirements. Pay special attention when optical fibers must be bent within a tight space. If the requirements are not satisfied, the optical fibers and optical fibers may exhibit larger loss, leading to unstable distributed temperature measurement.

● Stress

Optical fibers (and sensor optical fibers) used must satisfy the maximum stress requirement. Excessive stress will cause torsion and thus increase optical loss or even shorten the optical fiber service life.
Pay special attention to the bending radius and the stress of a sensor optical fiber at its exit from the optical connector which is connected to the DTSXL System. If the DTSXL System is installed in a cabinet, ensure that the cabinet door does not touch the optical fibers when the door is closed.

● Darkening

Optical fibers (and sensor optical fibers) have service life, which is affected by temperature and humidity. For example, a sensor optical fiber with a service life of 20 years under normal temperature-humidity conditions may suffer darkening and deteriorate much earlier under high-temperature, high-humidity conditions. The rate of deterioration depends on the optical fiber used and the usage environment. If optical fibers are used under unfavorable conditions, replace them regularly just like consumables. Optical fiber darkening leads to optical fiber loss increase, which varies with optical wavelengths and in turn adversely affects the temperature resolution and temperature measurement accuracy of the DTSX3000. While minor darkening may be compensated through temperature calibration with the DTSX3000, more severe darkening will necessitate optical fiber replacement.

● Temperature calibration

The DTSX3000 must be temperature-calibrated with the sensor optical fiber connected. Temperature calibration must be done when the DTSX3000 is first used or when optical fiber is replaced. Moreover, re-calibration is required if optical fiber characteristics change due to aging or other reasons.

SEE ALSO

For details on temperature calibration, see Section C2.2, “Temperature Calibration.”

DTSXL Distributed Temperature Sensor
Long Range System
PART – B Software

IM 39J06B40-01EN

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B1. Before Using the DTSXL System

B1.1. Functional Overview of the DTSX3000

The DTSX3000 of the DTSXL System measures the temperature distribution over the length of an optical fiber using the fiber itself as the sensing element. The module can be combined with appropriate power supply and optical switch modules to configure a required system. It can be accessed using the optional DTSX3000 Control Visualization Software (DTAP3000), using the DTSX3000 Data Conversion Software WITSML1.3.1.1 (DTAP3000D), or via the communications interface of a host computer.

- Temperature distribution measurement range of up to 16 km is supported using optical fibers as temperature sensing elements. Temperature distribution measurement of up to 50 km is available as an option.
- Multiple channel measurement with auto channel switching allows up to 16 sensing fibers when an optional optical switch module is used.
- Channel sequencing, sequence start time and sequence intervals are programmable as measurement sequences.
- Modbus communication support allows the DTSX3000 to be controlled from STARDOM or CENTUM.
- File transfer protocols (SFTP, SCP) are supported so measurement data can be retrieved from a host controller or data server.
  The HTTP client function enables data transfer to a HTTP server using PUT or POST.
- The DTSX3000 can be accessed from a Web browser running on a host PC for performing network-related configuration, backup, restore, system revision update and other maintenance operations.
- Up to 50 alarm sections, each configured with its own alarm conditions for alarm reporting, can be defined by distance for temperature measurement data.
- Up to 200 sections can be defined by distance for temperature measurement point data. Point data (average value, maximum value, etc.) can be calculated from temperature distribution data and output for each section.
- Measurement data can be saved in LAS (Log ASCII Standard) format or CSV (comma-separated values) format. Using the optional DTSX3000 Data Conversion Software WITSML 1.3.1.1 (DTAP3000D), measurement data can additionally be saved in WITSML (Wellsite information transfer standard markup language) data format.
- Power save mode ensures low power consumption.
- RAS functions (self-diagnosis, optical fiber failure detection, etc.) are provided.

B1.2. Functions

■ DISTRIBUTED TEMPERATURE SENSOR (DTSX3000)

● Software Functions

Item		Function
Measurement functions	Optical switch control (*1)	Controls channel switching by optical switch DTOS2L, DTOS4L or DTOS16L.
	Measurement control	Starts measurement and stops measurement
	(Global) measurement settings	Settings for channel combination, measurement sequence, measurement mode (single-ended or double-ended), measurement interval and measurement start time
	Channel settings	Measurement condition settings (repetition rate, measurement time (*2) or averaging times, distance range and sampling resolution)
		Sensor optical fiber settings (optical fiber length, wave number, group index, loss correction, temperature offset correction and winding coefficient (distance-depth conversion factor))
	WITSML data conversion configuration (*3)	WITSML data conversion configuration, destination server configuration for data transfer by HTTP client
	LAS data conversion configuration	LAS data conversion settings and destination server configuration for data transfer by HTTP client
	CSV data conversion configuration	CSV data conversion settings and destination server configuration for data transfer by HTTP client
Data processing functions	Temperature data calculation	Calculates temperature by applying various defined corrections.
	Generated data	Temperature distribution data, temperature alarm data and sectional temperature data
	Sectional temperature data generation (up to 200 sections can be defined)	Data generation sections can be defined with the temperature output data type (average, maximum, minimum, difference or slope) selected for each section
Detection functions	Temperature alarm settings (Up to 20 alarm sections can be defined)	Alarm detection sections can be defined with temperature high limit, low limit, rise limit, fall limit and difference limit, average temperature difference high limit, average temperature difference low limit values specified for each section.
	Optical fiber failure detection	An error and alarm is generated if optical fiber loss exceeds a specified threshold value.
	Increased loss detection	An increased loss alarm is generated if the CFL value near the fiber far end exceeds a threshold value.
Data management functions	Configuration data	Various settings
	LAS data	Data files in LAS (Log ASCII Standard) format. More than 100 files can be saved. With 2 m sampling over 6 km range, more than 1000 files can be saved.
	WITSML data (*3)	Data files in WITSML (Wellsite Information Transfer Standard Markup Language) format. More than 100 files can be saved. With 2 m sampling over 6 km range, more than 1000 files can be saved.
	CSV data	Data files in CSV (comma-separated values) format. More than 100 files can be saved. With 2 m sampling over 6 km range, more than 1000 files can be saved.
WITSML data conversion function (*3)		Conversion of configuration and temperature distribution data into WITSML format (WITSML version 1.3.1.1 compatible).
LAS data conversion function		Conversion of configuration and temperature distribution data into LAS format (LAS version 2.0 compatible).
CSV data conversion function		Conversion of configuration and temperature distribution data into CSV format
Data transfer functions		Transfers LAS data files or CSV data files or WITSML data files (*3) to HTTP server using PUT or POST.
RAS functions		Fault diagnosis, self-diagnosis, log data generation, error handling and watchdog timer

(Continued)

Item	Function
Maintenance functions	Firmware upgrade, power management, reset processing, time setting and maintenance functions
Authentication functions	SSH, SFTP, SCP and HTTPS; authentication using username and password
User registration functions	Up to 10 users can be registered for use with HTTPS server and SSH server.

*1: Available when DTSX3000 is used with optical switch DTOS2L, DTOS4L or DTOS16L.
*2: The measurement time setting refers to pure measurement time.
It does not include time for hardware ready, temperature calculation, alarm detection, sectional data generation, file creation, data conversion, data transfer and other auxiliary time.
*3: Available when DTSX3000 is used with the DTSX3000 Data Conversion Software (DTAP3000D).

● Network Function (Ethernet)

Ethernet is used for connecting the DTSX3000 to the DTSX3000 Control Visualization Software (DTAP3000), the DTSX3000 Data Conversion Software (DTAP3000D), autonomous controllers FCN/FCJ and various types of PLCs. It is also used for maintenance of the DTSX3000.

Communication Functions

	Destination	Maximum Number of Connections (*1)	Description
1	DTSX3000 Control Visualization Software (DTAP3000)	4	Enables measurement configuration, control and data display for the DTSX3000.
2	DTSX3000 Data Conversion Software (DTAP3000D)	4	Enables configuration of data conversion by DTSX3000.
3	DTSX3000 Calibration Software	4	Enables automatic calibration of the DTSX3000.
4	Modbus/TCP client	5	The DTSX3000 runs as a Modbus/TCP server.
5	SSH client	4	The DTSX3000 runs as an SSH server.
6	SFTP client	4	The DTSX3000 runs as an SSH server.
7	SCP client	4	The DTSX3000 runs as an SSH server.
8	Web browser	No restriction	Enables display of DTSX3000 system settings and status. Moreover, modification of system settings, as well as backup/restore and other maintenance operations are allowed when connected with administrator privileges.
9	HTTP server	1	The DTSX3000 runs as an HTTP client and transfers measurement data files in LAS format or converted to WITSML format (*2) to the HTTP server using PUT or POST.
10	SNTP server	3	The DTSX3000 runs as an SNTP client to synchronize its time with an SNTP server.

*1: Up to 4 connections of types 1 to 6 combined are allowed.
*2: Available only when the DTSX3000 is used with the DTSX3000 Data Conversion Software (DTAP3000D).

● Network Function (serial port)

The DTSX3000 can exchange data with other devices via the serial port.
Number of ports: Two (RS-232-C) communications ports
One port dedicated for maintenance

Destination	Description
Modbus master	The DTSX3000 runs as a Modbus serial slave.

● Modbus Connection Function

The DTSX3000 can connect with Modbus master devices and Modbus client devices supporting the Modbus communications protocol.

Item	Description
Destination device	Modbus compliant devices
Connection ports	Serial port Ethernet port
Available registers	Input registers (300001 to 365535) Holding registers (400001 to 465535)

The following communications functions are supported.

Communications Type	Communications Mode	Communications Functions
Serial communications	ASCII mode	Slave
	RTU mode	Slave
Ethernet communications	Modbus/TCP	Server

● Time Synchronization Function

The DTSX3000 supports time synchronization between SNTP (Simple Network Time Protocol) enabled devices. The DTSX3000 can run as an SNTP client.

Item	Client Functions
Communications protocol	SNTP (Simple Network Time Protocol) UDP port: 123
Unicast mode (*1)	Available
Number of connections	3 servers
Time accuracy	±1 s
Time correction method	Time retrieval from the server at hourly intervals (unicast mode) (*2)

*1: An SNTP client sends a time request to the SNTP server periodically.
*2: Smooth time transition is adopted to avoid sudden change in time. However, immediate time change (immediate change to specified time) is adopted at startup and exit.

■ CONFIGURATION TOOLS

● Operating Environment

The table below shows the system requirements for running configuration tools such as the Maintenance web page on a PC.

Item	Specification
OS	Windows 11
CPU	Dual-core 32-bit processor 2 GHz or better
RAM	2 GB or more
Storage free space	2 GB or more
Ethernet adaptor	100BASE-TX or 10BASE-T
Web browser	Microsoft Edge

B1.3. Connection

This section shows some examples of DTSX3000 connections.

IMPORTANT

The DTSX3000 is not designed to be directly connected to the Internet and is not guaranteed to work properly for such use.

Therefore, to connect the DTSX3000 and control devices over a network, ensure that they are connected on the same network, and the network is either not connected to the Internet, or isolated from the Internet by a router and firewall.

SEE ALSO

For risks arising from connecting the DTSX3000 with external networks such as the Internet or the like, please go to the URL below. However, the information on the following website does not cover all the possible risks.
https://partner.yokogawa.com/global/member/ofs/index.htm

B1.3.1. Connecting to Control Devices

The DTSX3000 can be connected to STARDOM, CENTUM and other control devices and be controlled via Modbus Communication (Modbus/TCP and Modbus Serial).

The DTSX3000 performs measurement according to instructions from control and monitoring devices and accumulates measurement data for calculating temperature distribution data. A control and monitoring device polls the DTSX3000 constantly and when measurement data is available, it retrieves the data from the DTSX3000.

Measurement data can also be transmitted to a specified HTTP server automatically whenever available.

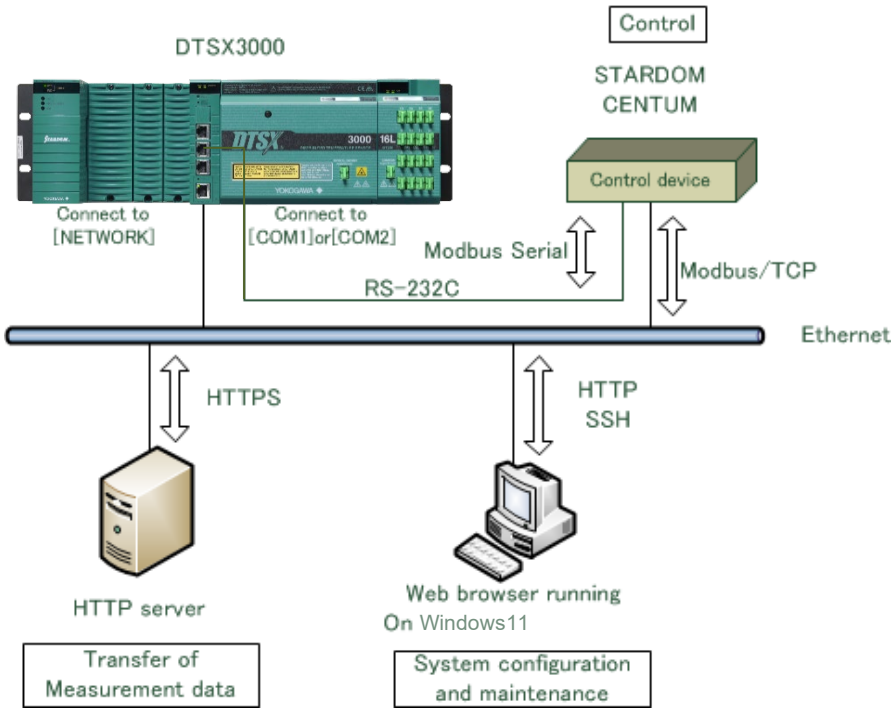


Figure Example of Connections to Control Devices

SEE ALSO

COM ports of the DTSX3000 use RJ45 connectors. Thus, when connecting the DTSX3000 to a control device using RS-232-C, use a dedicated cable with an RJ45 connector on one end and a connector compatible with the control device on the other end. See the Hardware part of this manual for wiring details.

B1.3.2. Connecting to Various Software for DTSX3000

Software for the DTSX3000, when purchased separately and used with the DTSX3000, enables measurement, data conversion and calibration to be done easily using a graphical user interface (GUI).

- IP Address Configurator software (available on the accompanying CD-R)
  Enables configuration of the IP address.
- DTSX3000 Control Visualization Software (DTAP3000 optional purchase)
  Enables configuration of measurement conditions, measurement execution and control, as well as retrieval and display of measurement data to be done easily using a graphical user interface (GUI).
- LAS 2.0 Data Conversion Software (included in the DTAP3000 optional purchase)
  Enables configuration and conversion of measurement data to LAS 2.0 format or CSV format to be done easily using a graphical user interface (GUI).
- Calibration Software (included in the DTAP3000 optional purchase)
- DTSX3000 Data Conversion Software WITSML1.3.1.1 (DTAP3000D optional purchase)
  Enables configuration and conversion of measurement data to WITSML 1.3.1.1 format to be done easily using a graphical user interface (GUI

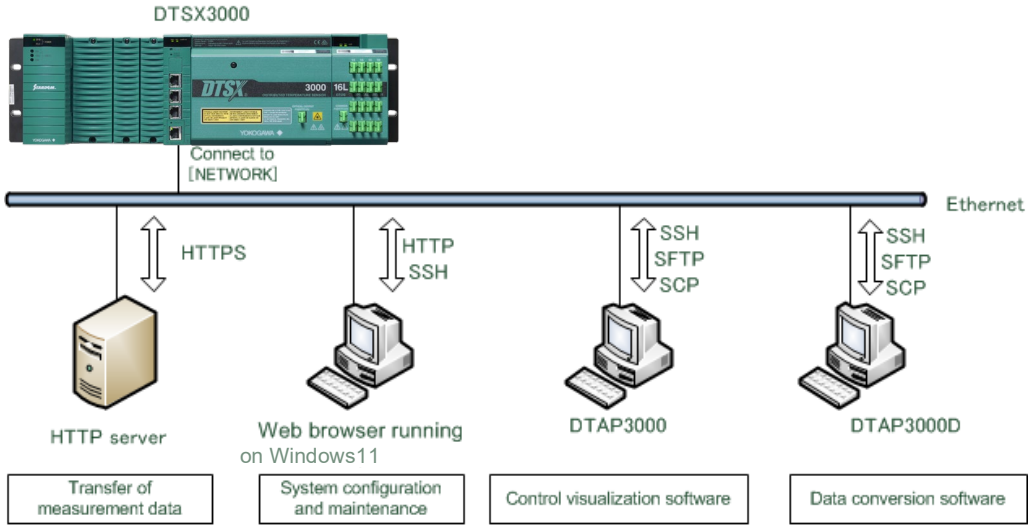


Figure Example of Connections when using DTSX3000 Control Visualization Software and Data Conversion Software

IMPORTANT

We recommend using the latest versions of software for DTSX3000. Beware that some DTSX3000 functions may be unavailable if an older version is used. About latest version of DTAP3000 DTSX3000 Control Visualization Software, contact your Yokogawa sales representative or local distributor.

SEE ALSO

For details on how to use the DTSX3000 Control Visualization Software (DTAP3000) and Data Conversion Software, read their respective user manuals.

- DTAP3000 DTSX3000 Control Visualization Software Guide (IM 39J02B40-01EN)
- DTAP3000D Data Conversion Software WITSML1.3.1.1 Guide (IM 39J02B40-03EN)

TIP

The Web browser and software for DTSX3000 can be installed and used on the same PC.

B1.4. IP Address Configuration

The first IP address of the DTSX3000 is set to 192.168.1.10 in the factory before the shipment. The IP address can be configured from a Web browser as needed.

This section explains how to perform setup for IP address configuration for the DTSX3000 when the previously configured address is unknown or forgotten.

You need to enter a MAC address, which is unique to each device, in IP address configuration. Write down the MAC address of the DTSX3000, which can be found on the product nameplate pasted on the side of the DTSX3000.

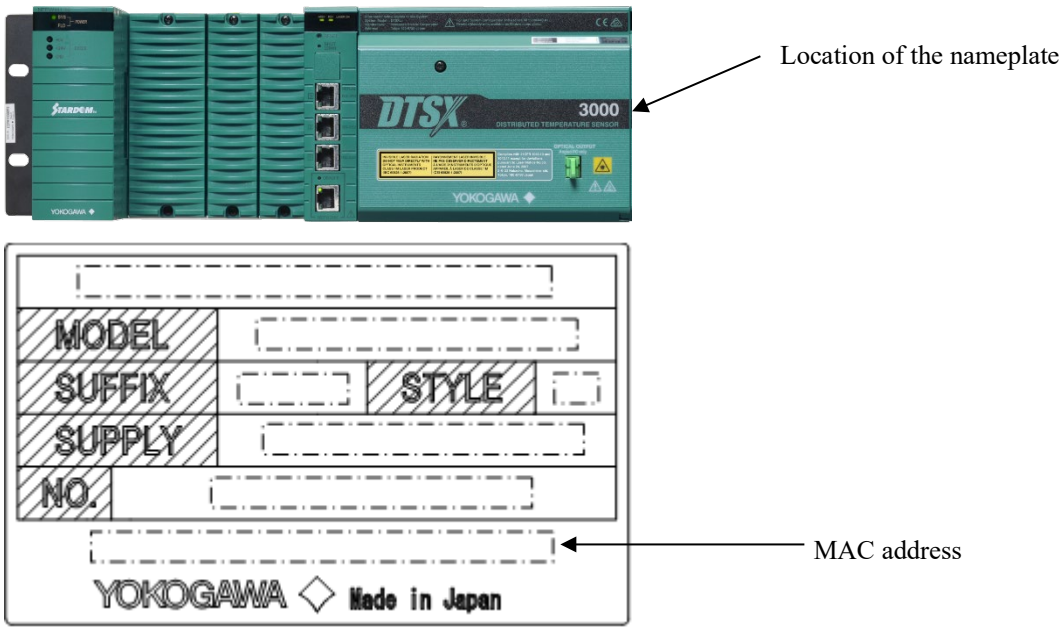


Figure Location of Nameplate and MAC Address

TIP

- An optical switch, when installed, will block the nameplate. Write down the MAC address before installing an optical switch.

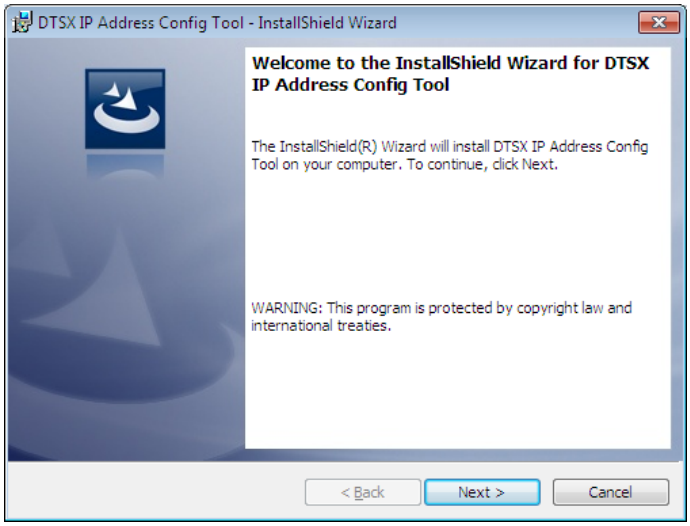
The procedure for IP address configuration is described below.

■ Install the IP Address Configuration Tool on a PC.

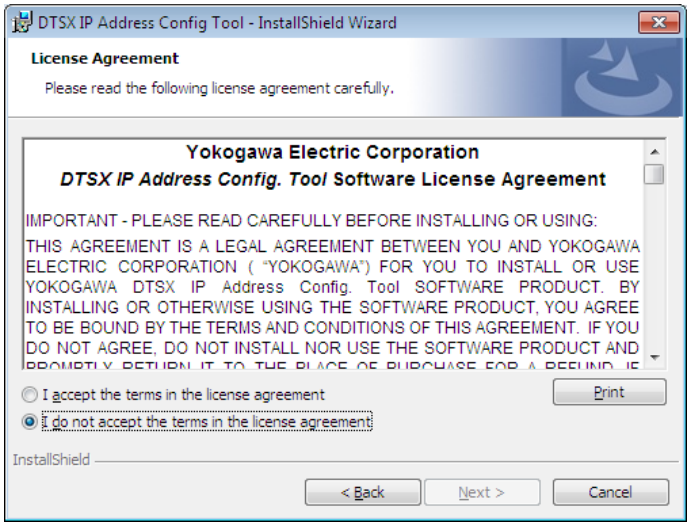
Install the IP Address Configuration Tool on a PC if it is not already installed using the following procedure.

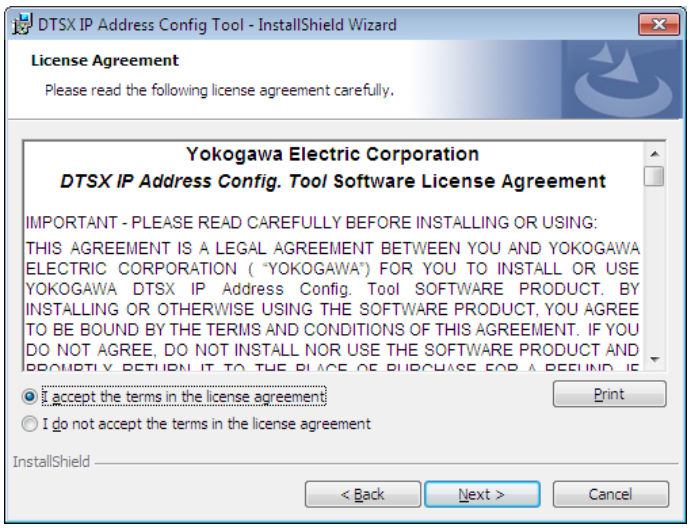
The IP Address Configuration Tool runs on Windows. It needs to be installed on the PC first by running the installer program provided on the accompanying CD-ROM following the procedure below:

1. Insert the accompanying CD-ROM into the CD-ROM drive of the PC to be installed with the IP Address Configuration Tool.
2. Double-click on the Setup.exe file in the “\Configurator\IP Address Config Tool\” folder of the CD-ROM. On the displayed Welcome window, click the [Next] button.

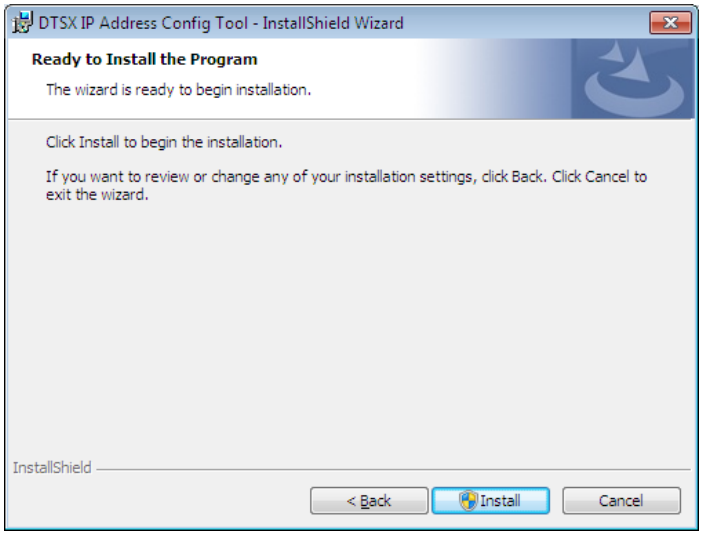


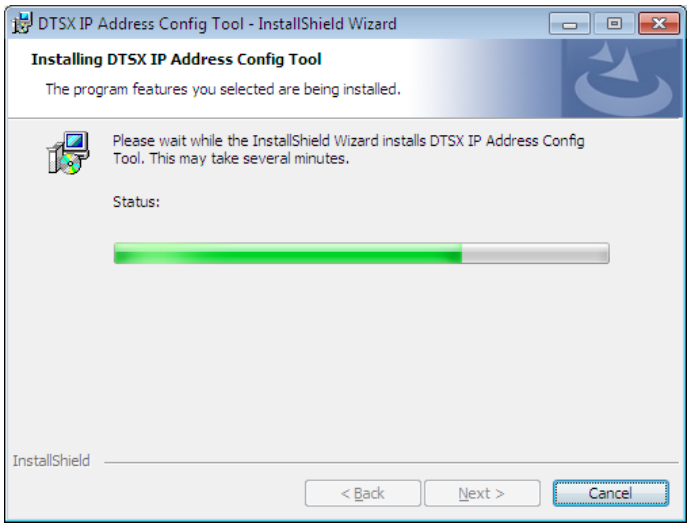
3. Accept the terms of the license agreement.
   Read the terms of the license displayed in the installation window carefully. If you agree with the terms of the license, select the “I accept the term in the license agreement” option and then click the [Next] button. If you do not agree with the terms of the license, click the [Cancel] button to abort installation.

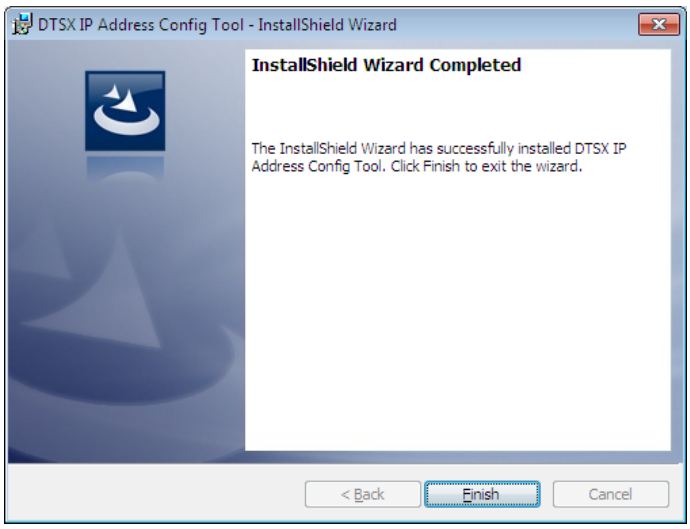




4. Confirm to begin installation.
   If you have accepted the terms of the license, the installation initiation window is displayed. Click the [Install] button to begin installation.
   Installation begins. When installation completes, the installation completion window is displayed.





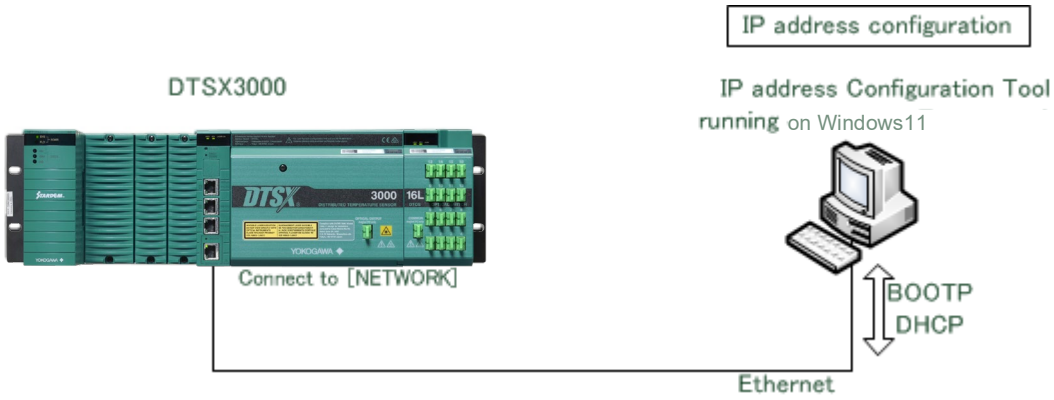


■ Connect the DTSX3000 and PC using an Ethernet cable.

Perform connection as described below.

The PC installed with the IP Address Configuration Tool runs as a DHCP server to assign IP addresses to DTSX3000 units.

To avoid problems arising from having two DHCP servers running on the same network, connect the PC and the DTSX3000 one-to-one.



■ Boot up the DTSX3000 in IP address setting state.

Boot up the DTSX3000 in IP address setting state.

- Should you forget a previously configured IP address, put the system in IP address setting selected state when it transits to boot mode selection state immediately after power up. If the system is left in this state for more than 5 seconds, it goes into IP address setting state.

The state of the DTSX can be determined from the state of its LED indicators.

Boot mode selection state : HRDY and RDY blink fast.

IP address setting selected state : HRDY blinks fast; RDY blinks.

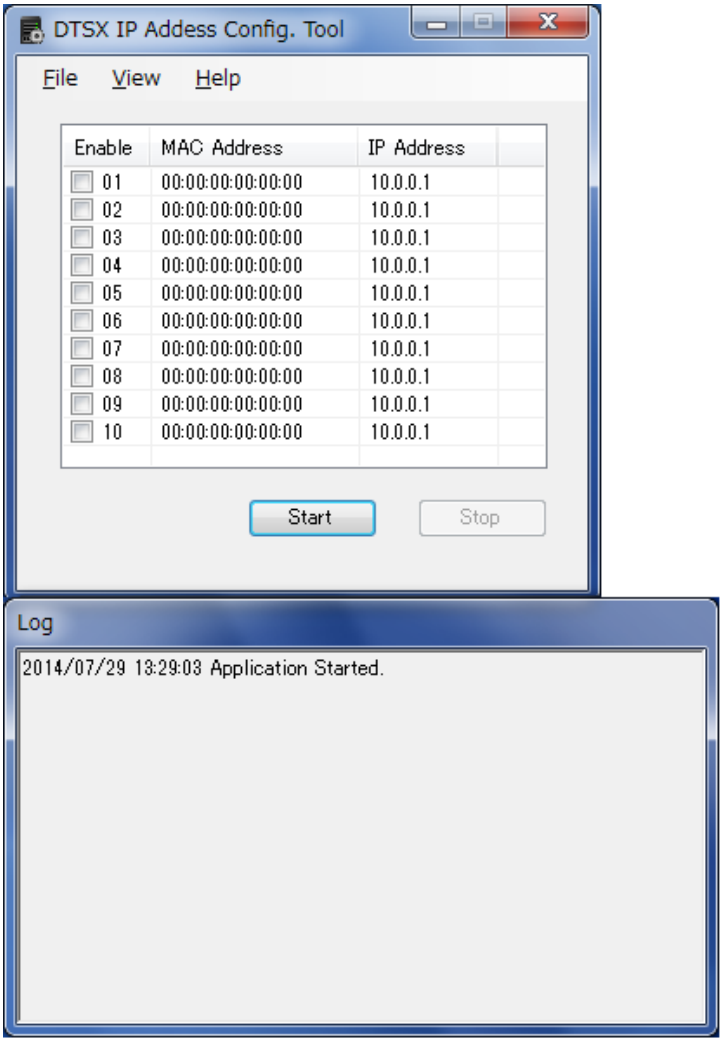
In IP address setting state, the system broadcasts its MAC address according to the Bootp protocol and waits to be assigned an IP address.

SEE ALSO

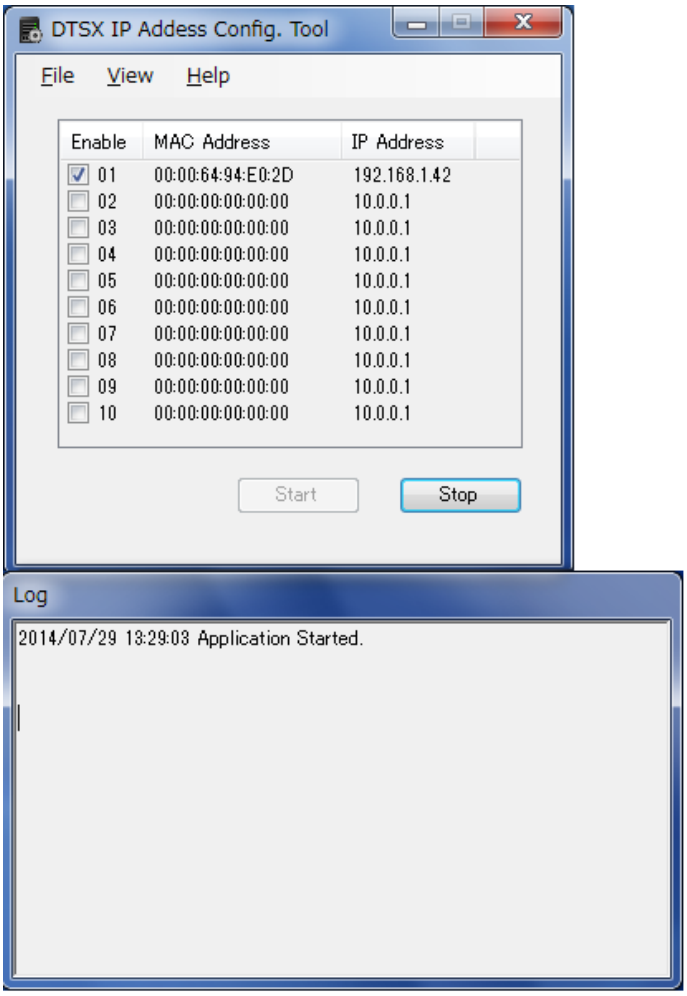
For details on the system operating states, see Subsection B4.1, “Operation Overview.”

■ Run the IP Address Configuration Tool.

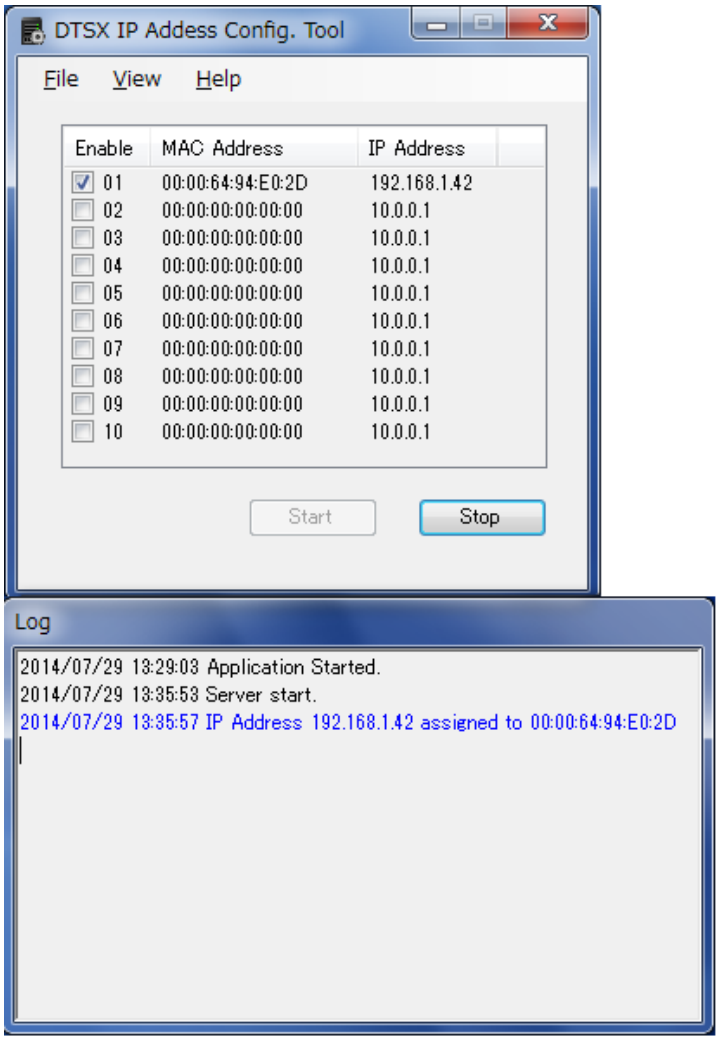
Double-click on the DTSX IP Address Config Tool icon on Windows desktop. The IP Address Configuration Tool runs. Configure IP addresses using the following procedure.



1. Define the MAC address and IP address mapping table.
   Map the MAC address of a DTSX3000 to the IP address to be assigned to the DTSX3000 by selecting the Enable checkbox at the beginning of the row.
   IP address settings for up to ten DTSX3000 units can be saved.



2. Start IP Address Assignment.
   Click the [Start] button. The tool receives the MAC address sent by the DTSX3000 requesting for IP address assignment, searches the MAC address and IP address mapping table for a row with a matching MAC address and assigns the corresponding IP address to the DTSX3000.
   A corresponding message is displayed in the Log window when the IP address is assigned.



3. Terminate the IP Address Configuration Tool.
   Click the [Stop] button to terminate the execution of the IP Address Configuration Tool.

■ Perform system configuration

After IP Address configuration is completed, the DTSX3000 boots up in maintenance mode. Perform system configuration according to Section B1.5, “System Configuration.”

B1.5. System Configuration

You can perform network and other system configurations from any Web browser running on a PC.

SEE ALSO

For details on network configuration, see Chapter B6, “System Configuration”.

1. Connect the DTSX3000 and a PC using an Ethernet cable.

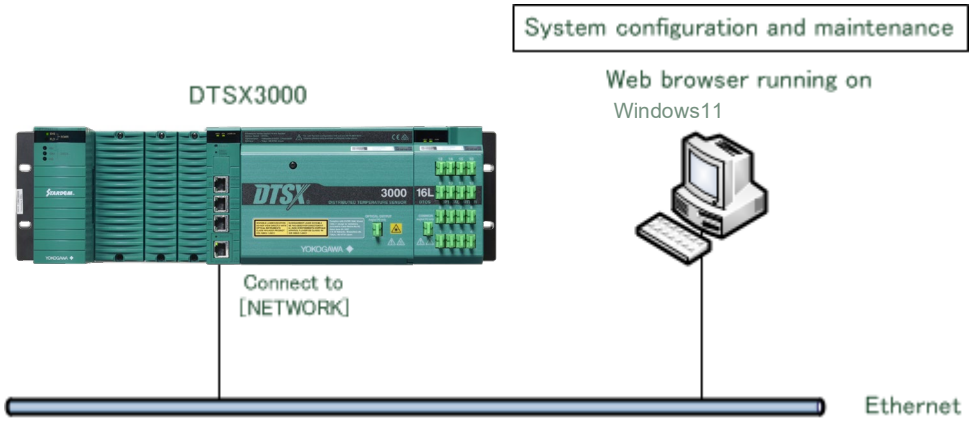


Figure Connection for System Configuration

Boot up the DTSX3000 in maintenance state.
To boot up the system in maintenance state, put the system in maintenance mode selected state when it transits to boot mode selection state immediately after power up. If the system is left in this state for more than 5 seconds, it goes into maintenance state.

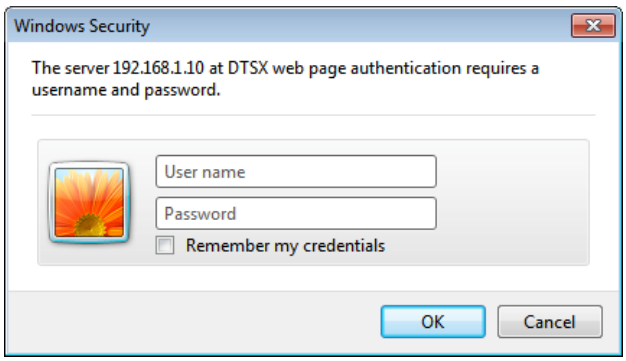
The state of the DTSX can be determined from the state of its LED indicators.

Boot mode selection state	: HRDY and RDY blink fast.
Maintenance mode selected state	: HRDY blinks fast; RDY is off.

SEE ALSO

For details on the system operating states, see Subsection B4.1, “Operation Overview.”

2. Run a Web browser on the PC and enter the following text in the URL:
   http://<hostname or IP address of DTSX3000>/mnt/
   On the displayed user authentication dialog, enter a valid user name and password.
   The following user is pre-registered in the factory.
   Username: dtsx
   Password: YOKOGAWA
   User authority: Administrator (admin)
   After user authentication succeeds, the top maintenance window is displayed.



3. Perform user registration, time, network and other required configuration according to Chapter B6, “System Configuration.”

TIP

- We recommend changing the default password of the pre-registered “dtsx” user right away.
- To connect to the DTSX3000 using the DTSX3000 Control Visualization Software (DTAP3000) or the DTSX3000 Data Conversion Software WITSML1.3.1.1(DTAP3000D), which are available as separate purchases, the user must have ReadWrite authority. Therefore, if you are using these software applications, you need to add a user with ReadWrite authority.

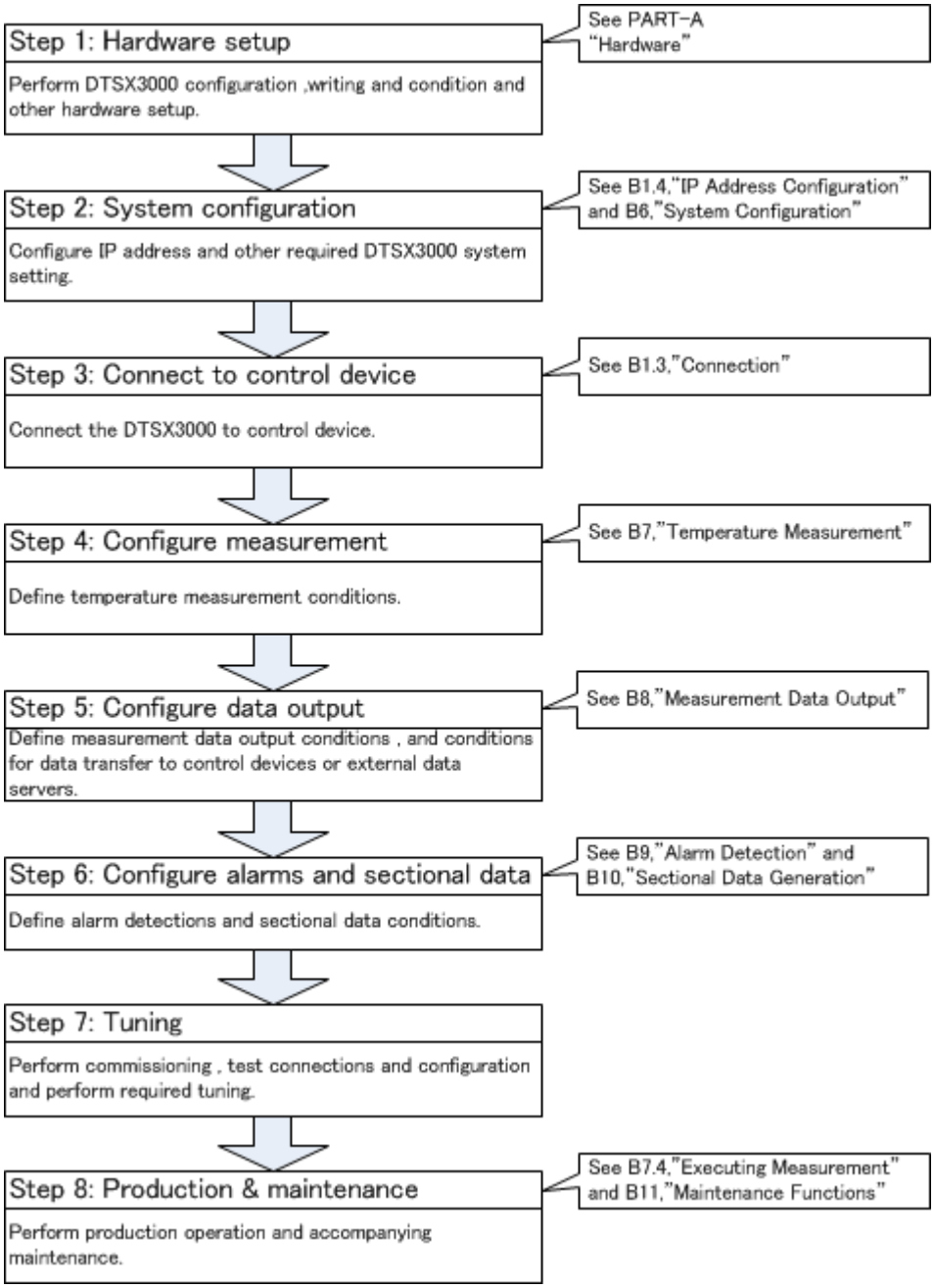
SEE ALSO

- For details on user authority, see Subsection B5.2.1, “Login Function.”
- Some configuration items are applied immediately during configuration while others are applied only on the next system reboot. For details, see Chapter B6, “System Configuration.”

B2. Using the DTSX3000

B2.1. Operation Flowchart

The operation flowchart below shows the overall operation flow when using the DTSX3000 for the first time. For details on individual items, see the respective chapters or sections indicated in the flowchart.



B3. Starting and Stopping the System

B3.1. Starting the System

Start the system by switching on its power supply. You can also start the system by pressing the [RESET] switch when it is in ready-for-power-down state (shutdown state).

B3.2. Stopping the System

To shutdown the system safely, press its [SHUTDOWN] switch. Alternatively, you can select Reboot>[Shutdown] from its Web configuration window.

TIP

If you cut off the power supply or reboot the system using the [RESET] switch without first pressing the [SHUTDOWN] switch, memory data backed up by the backup battery will not be saved.

CAUTION

The RDY LED blinks during [SHUTDOWN] processing. Do not switch off the power supply, unplug the power cord, or press the [RESET] switch until [SHUTDOWN] processing has completed (the RDY LED goes off).

B4. System Operation

B4.1. Operation Overview

The figure below shows transitions between the various DTSX3000 operation states. The current operation state of the DTSX3000 can be determined by checking the states of its LED indicators.

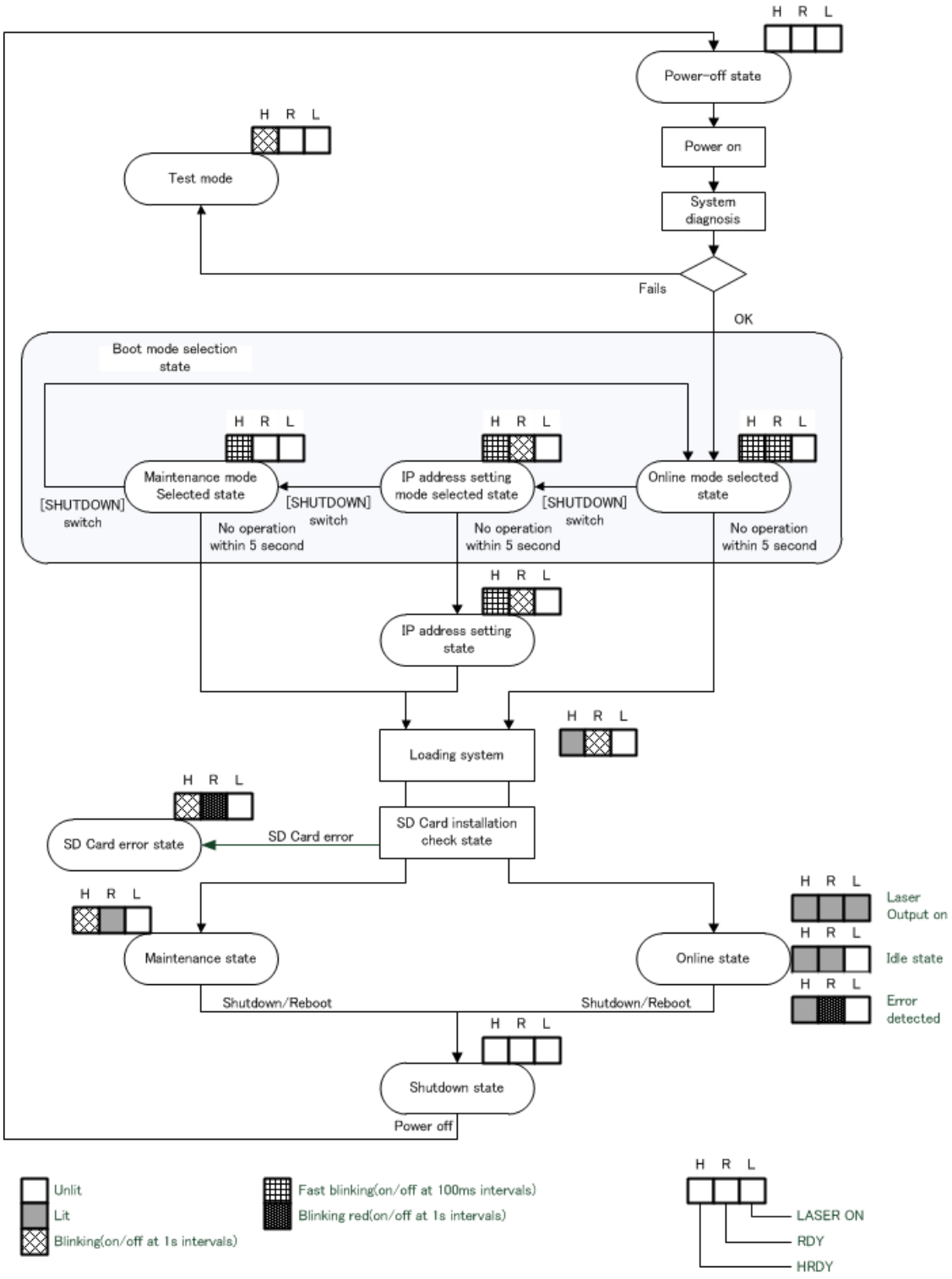


Figure DTSX3000 Operation States

B4.2. Boot Mode Selection State

The boot mode can be selected when the DTSX3000 is in Boot mode Selection state. The following three boot mode options are available. The boot mode currently selected is indicated by the states of the LED indicators.

- Online Mode Selected state (default)
- IP Address Setting Mode Selected state
- Maintenance Mode Selected state

When the system is in Boot Mode Selection state, the selected mode transits to the next selected mode sequentially each time the [SHUTDOWN] switch is pressed. If the [SHUTDOWN] switch is not pressed for five seconds, the system boots up in the selected mode.

However, the DTSX3000 always boots up in IP address setting state if it is not configured with an IP address.

B4.3. IP Address Setting State

The IP address of the DTSX3000 can be configured when it is in IP address setting state. When IP address configuration is completed, the DTSX3000 transits to Loading state and then to Maintenance state.

B4.4. Loading State

In Loading state, the DTSX3000 loads the operating system and the system software, and performs self-diagnosis at initialization.

B4.5. SD Card Installation Check State

The DTSX3000 checks whether an SD card is properly installed when it is in the SD Card Installation Check state.

B4.6. Online State

Temperature measurement can be performed when the DTSX3000 is in Online state.

- The LASER ON LED blinks when the laser light is on.
- The RDY LED blinks in red when an error is detected.

SEE ALSO

For details on how to recover from an error, see Section B11.2 Fault Diagnosis”.

B4.7. Maintenance State

System configuration and maintenance operations can be performed when the DTSX3000 is in Maintenance state. Maintenance operations include backing up and restoring system configuration data, updating the system revision, etc.

SEE ALSO

For details, see Chapter B6, “System Configuration” and Chapter B11, “Maintenance Functions”.

B4.8. Shutdown State

The DTSX3000 can be safely powered down when it is in Shutdown (ready-for-power-down) state.

The states of the LED indicators of the DTSX3000 module are the same in shutdown state and power-off state but the two states can be distinguished by checking the state of the LED of the power supply module.

- If the LED of the power supply module is lit, the DTSX3000 is in Shutdown state.
- If the LED of the power supply module is not lit, the DTSX3000 is in Power-off state.

B4.9. Test Mode

The Test mode is used for fault analysis and system recovery when the system fails to boot.

The DTSX3000 enters Test mode automatically if the system software is not installed or a fatal error is detected during system boot.

Contact your Yokogawa service representative if your DTSX3000 is in Test mode.

B4.10. SD Card Error State

The DTSX3000 enters SD Card Error state if it detects an error during SD card installation check. If this happens, turn off the power and ensure that a SD card is properly installed. If the DTSX3000 enters SD Card Error state even though an SD card is properly installed, try replacing the SD card as it may be faulty.

SEE ALSO

For details on how to install an SD card, see Subsection C4.3.3, “Replacing Other Parts.”

B5. Communication Functions

The DTSX3000 is equipped with Ethernet and serial communication ports, which can be used for external communications.

B5.1. Serial Communication

The DTSX3000 has three serial communication ports, namely COM1, COM2 and COM3, which can be used for Modbus communications, as well as maintenance communications.

B5.1.1. Modbus

The DTSX3000 runs as a Modbus slave device. You can define the slave address and communication mode for Modbus communications. A Modbus master device can connect to a DTSX3000 running as a Modbus slave device to read and write its internal registers.

The DTSX3000 provides internal registers for measurement control, measurement condition configuration, as well as storage of channel measurement data (in tag format) and alarm information data.

Any of the COM1 and COM2 communication ports can be used for Modbus communications.

SEE ALSO

- For details on Modbus communications, see the “DTSX3000 Communications Guide.” (IM 39J06B40-02EN)
- For details on Modbus communications related settings, see Subsection B6.5.3, “Modbus Serial Related Settings.”

B5.1.2. RS232 Connection

The RS232 connection is used for maintenance. The COM3 serial port is dedicated for maintenance use and cannot be used for general communications.

B5.2. Ethernet Communications

The DTSX3000 supports the SSH, SFTP, SCP, HTTP(S) and Modbus/TCP protocols.

B5.2.1. Login Function

Only pre-registered users are allowed access when communicating with the DTSX3000.

Up to ten users can be registered.

Three user authority levels are available.

User Type	User Authority Level	Displayed Text
Administrator	Configuration administrator	Admin
User	Data creator	User:ReadWrite
	Data reviewer	User:ReadOnly

The access authority of each of these user types are described below for different protocols.

SEE ALSO

For details on how to add a user, see Subsection B6.4.3, “User Management (User).”

B5.2.2. HTTP and HTTPS

■ Web Service

The web service enables system information and RAS information to be displayed, as well as the system operation mode and system configuration data of the DTSX3000 to be modified using any Web browser running on a PC.

To perform these operations, access the following URL:

http://<hostname or IP address of the DTSX3000>/mnt/

Example: http://192.168.1.10/mnt/

The following access restrictions apply depending on the user authority level of the log in user.

User Authority Level	Read System Configuration	Modify System Configuration
Admin	○	○
User:ReadWrite	○	×
User:ReadOnly	○	×

■ Client Functions

Measurement data files created by the DTSX3000 can be transmitted to an external HTTP or HTTPS server.

B5.2.3. SFTP/SCP

The DTSX3000 supports the SFTP/SCP server function. Transmission and deletion of generated measurement data files can be executed from a PC connected to the DTSX3000.

The following SFTP and SCP client access restrictions apply depending on the user authority level of the log in user.

User Authority Level	Directories Allowing Read Access	Directories Allowing Write Access
Admin	All directories	Data archive directories
User:ReadWrite	Data directories	
User:ReadOnly	Data archive directories	×

SEE ALSO

- For details on data archive directories and the procedure for retrieving generated measurement data files, See Chapter B8, “Measurement Data Output.”
- In addition, SFTP/SCP can be enabled or disabled in the system configuration using a Web browser running on a PC. For details on how to do so, see Subsection B6.4.7, “SSH & SFTP Configuration (SSH & SFTP)”

B5.2.4. SSH

The DTSX3000 supports the SSH server function, which is used for connection with DTSX3000 Control Visualization Software. Up to four users of the DTSX3000 Control Visualization Software can connect to the DTSX3000.

The SSH function is also used in maintenance (security risk check, etc.).

SEE ALSO

The SSH function can be enabled or disabled in the system configuration using a Web browser running on a PC. For details on how to do so, see Subsection B6.4.7, “SSH & SFTP Configuration (SSH & SFTP)”

TIP

The SSH server can be disabled by specifying “no” in the system configuration but beware that this will disallow connections from DTSX3000 Control Visualization Software.

B5.2.5. Modbus/TCP

The DTSX3000 supports the Modbus server function. You can define the port number and timeout duration for Modbus/TCP communications. A Modbus client device can connect to the DTSX3000 running as a Modbus server device to read and write its internal registers.

The DTSX3000 provides internal registers for measurement control, measurement condition configuration, as well as storage of channel measurement data (in tag format) and alarm information data.

Up to five client devices can be connected concurrently.

SEE ALSO

- For details on Modbus communications, see the “DTSX3000 Communications Guide.” (IM39J06B40-02EN)
- For details on Modbus/TCP communications related settings, see Subsection B6.5.2, “Modbus TCP Related Settings.”

B6. System Configuration

B6.1. Overview

To customize the operation of the DTSX3000, you need to correctly specify DTSX3000 system configuration data to match the application environment.

System configuration data of the DTSX3000 can be modified and displayed using any Web browser running on a Windows PC.

Using system configuration, you can perform time and network configuration, change the operation state of the DTSX3000, reboot the DTSX3000, as well as display current configuration data, RAS information and log messages.

SEE ALSO

See Section B6.2, “Item List” for details.

When accessing the DTSX3000 from a browser, you need to enter a valid user name and password. To modify certain configuration data, you also need to change the operation state or get operation authority beforehand.

B6.1.1. Access Procedure

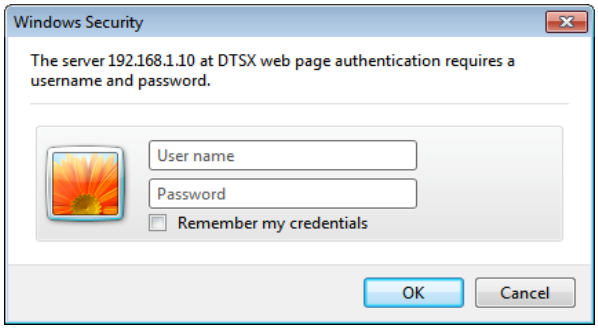
To access the DTSX3000, enter the following URL in the Web browser:

http://<hostname or IP address of DTSX3000>/mnt/

TIP

- If SSL is enabled for the Web Server function of the DTSX3000, you need to prefix the URL with “https://” (SSL is disabled by default.).
- Do not use the [Back] button in the Web browser.

A user authentication dialog is displayed. Enter a valid username and password.



TIP

To modify system configuration data, you need to access the DTSX web page using a user ID with Administrator authority.

If user authentication is successful, the Top page is displayed.

B6.1.2. Top Page

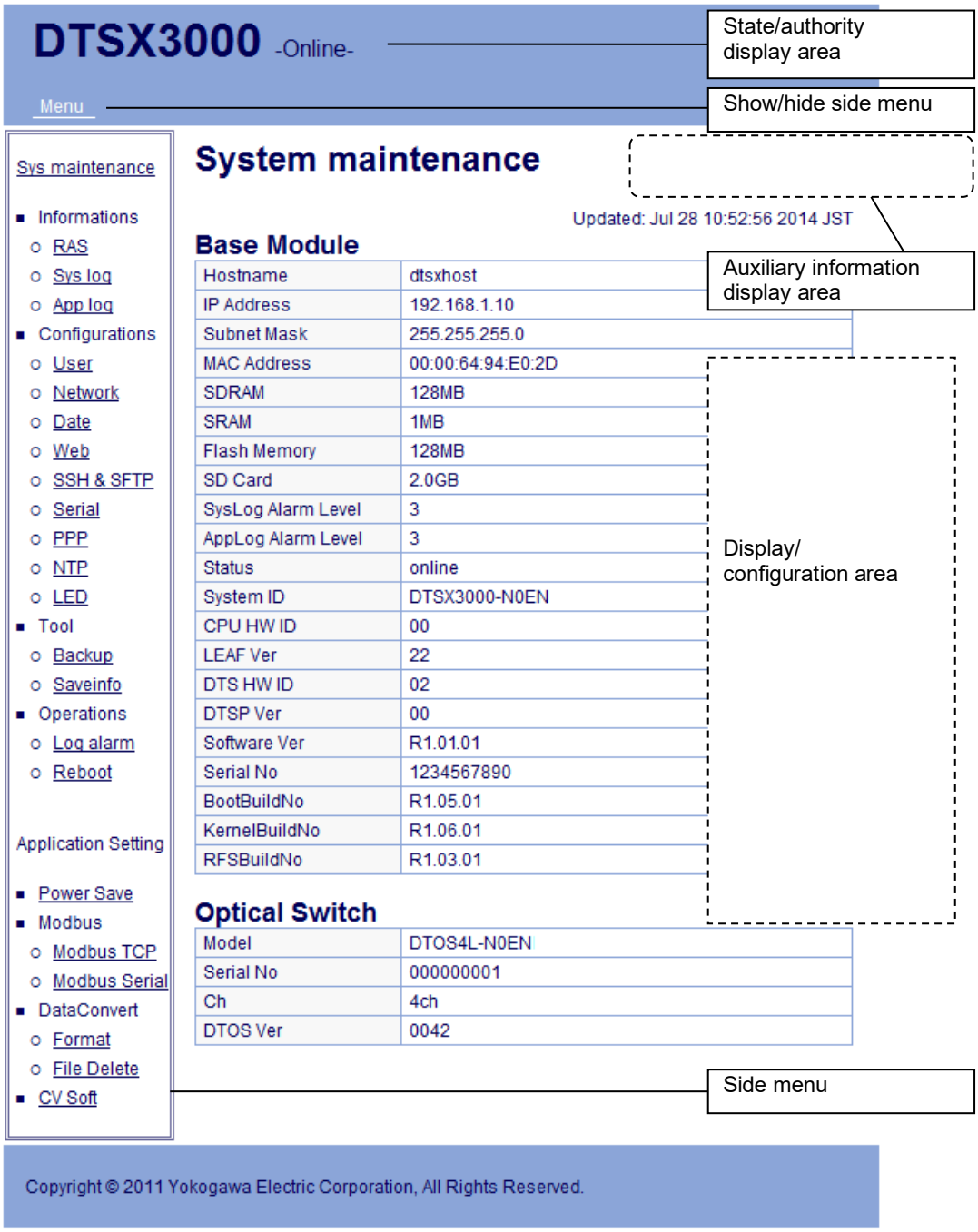
The figure below shows a sample top page.

The top page consists mainly of the state/authority display area, the side menu, the display/configuration area and the auxiliary information display area.

The state/authority display area displays the operation state of the DTSX3000 and the operation authority (privilege) of the user accessing the DTSX3000 from a Web browser.

The side menu displays a list of items. Clicking on an item in the list displays its associated content in the display/configuration area. The side menu can be shown or hidden by clicking on [Menu].

The auxiliary information display area displays various types of information during configuration, including error messages for invalid settings, instructions to reboot in order to apply modified settings and a button for getting operation authority.



B6.1.3. Operation States and Operation Authority

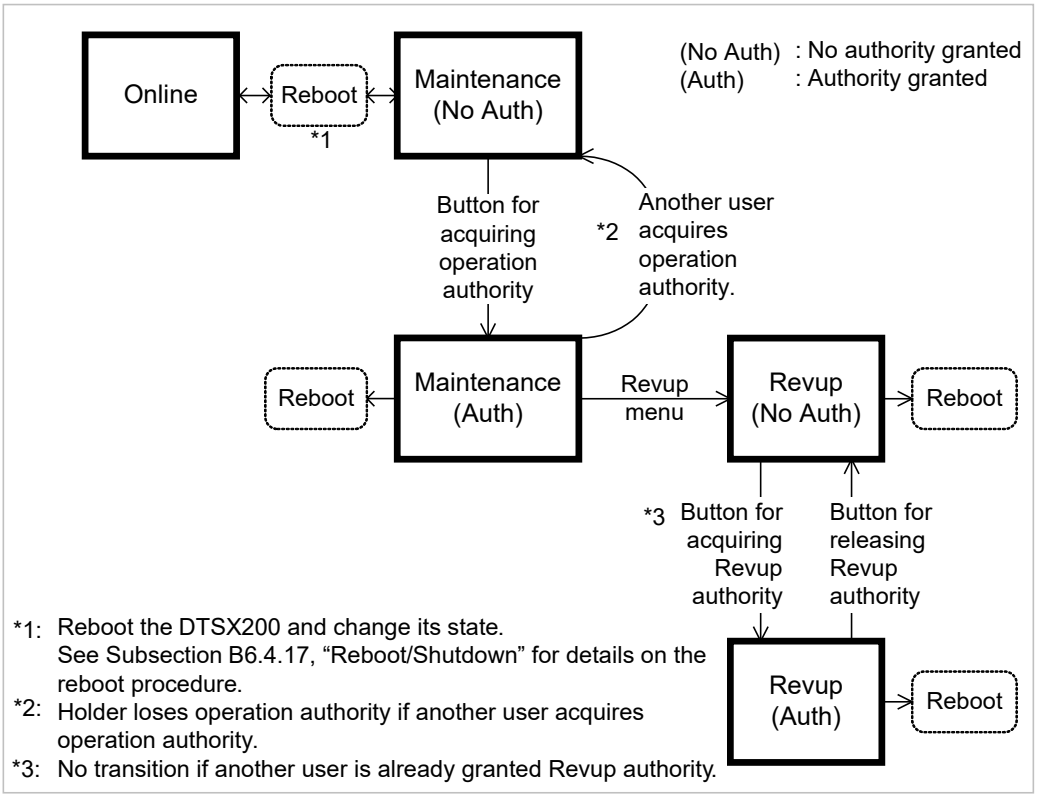
The DTSX3000 can run in two operation states, namely online state and maintenance state.

In online state, you can display and view almost all DTSX3000 configuration data from a Web browser even during measurement execution. Multiple users can access the DTSX3000 concurrently but configuration data cannot be modified in online state.

In maintenance state, DTSX3000 configuration data can be modified. Multiple users can access the DTSX3000 concurrently but configuration data can only be modified by one user who has been granted operation authority. Thus, to modify configuration data, you need to put the DTSX3000 into maintenance state and then acquire operation authority by pressing the [Acquire Auth] button in the browser window. Connection from DTSX3000 Control Visualization Software is not allowed in maintenance state.

To update or restore (Revup/Restore) DTSX3000 system software, you need to additionally acquire and be granted Revup authority after putting the DTSX3000 in maintenance state and acquiring operation authority.

The figure below shows the transitions between various DTSX3000 operation states.



TIP

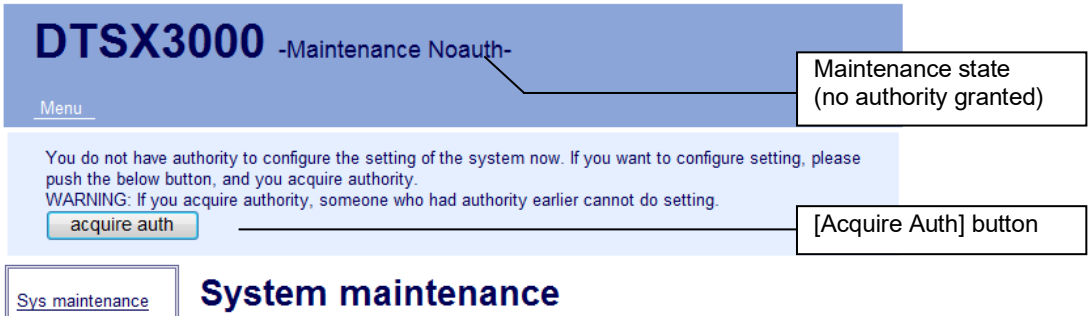
Do not reboot the DTSX3000 during temperature measurement. Correct measurement result is not guaranteed if reboot is executed during measurement.

The current operation state is displayed in the state/authority display area. Examples of the state/authority display in various states are shown in the figures below.

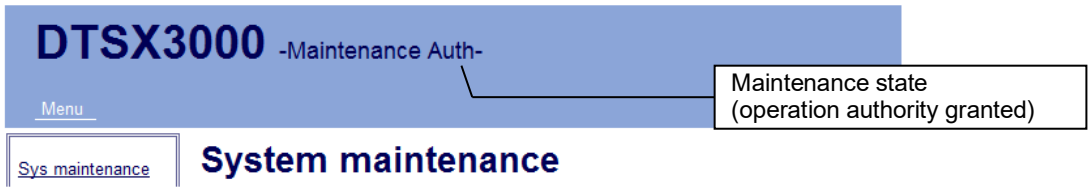
■ Online state



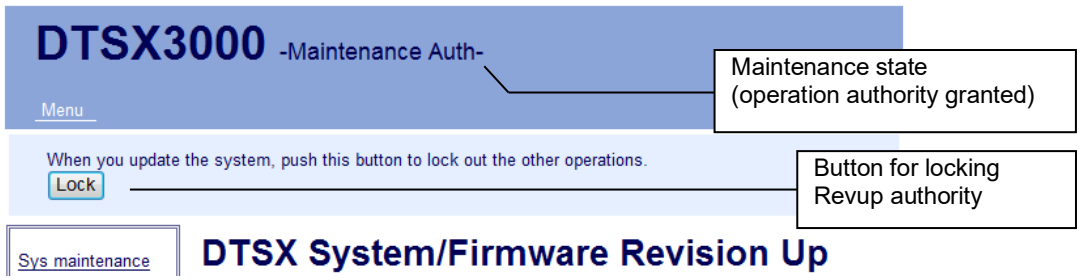
■ Maintenance state (No authority granted)



■ Maintenance state (operation authority granted)



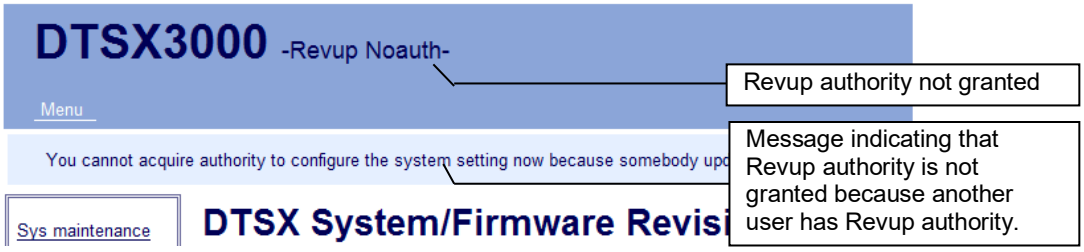
■ Maintenance state (operation authority granted and system update page displayed)



■ Revup authority granted



■ Revup authority not granted

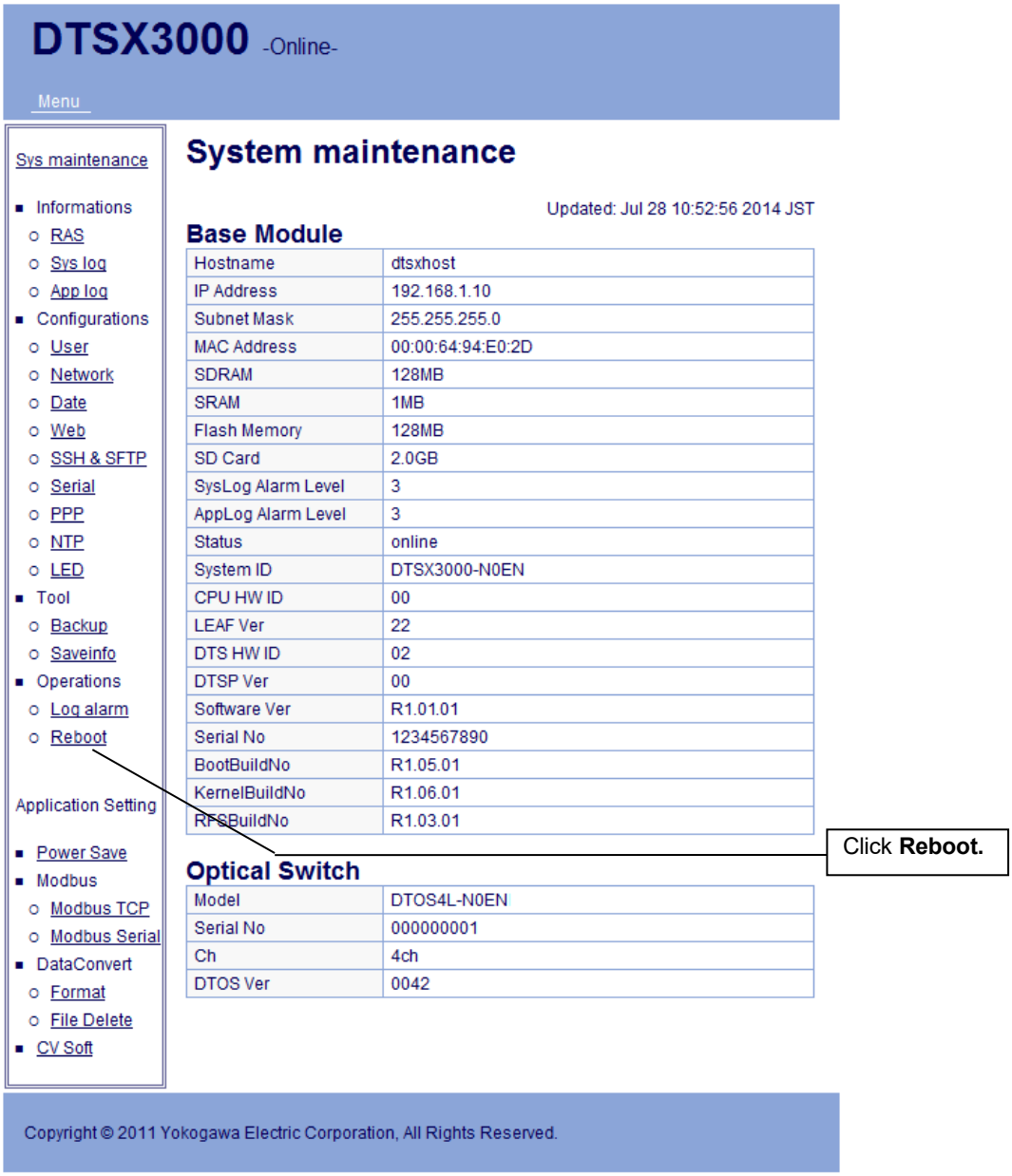


B6.1.4. How to Transit between Operation States

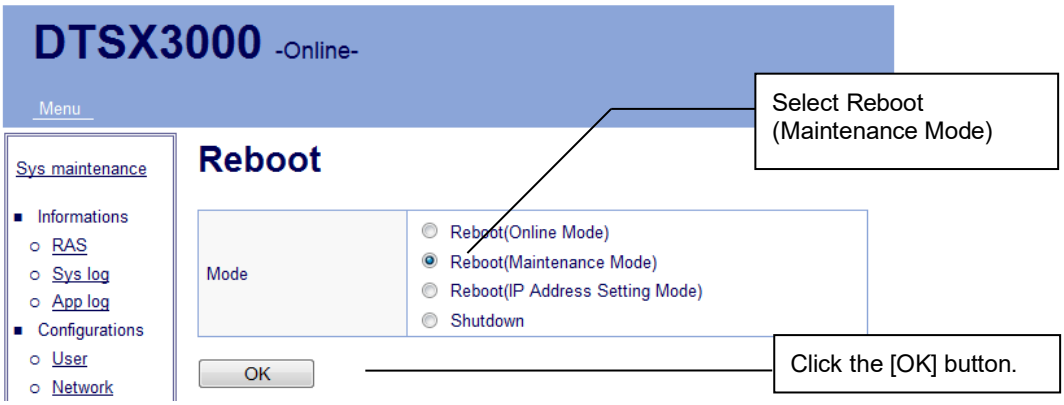
This subsection describes how to transit between operation states and how to acquire authority.

■ Procedure for transiting from online state to maintenance state

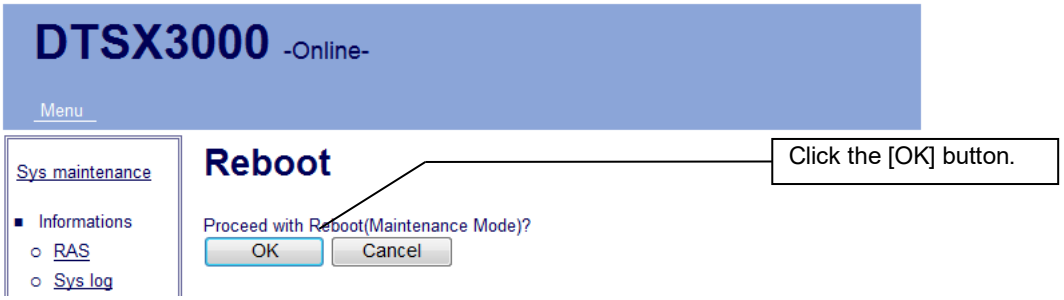
1. Click [Reboot] in the side menu.



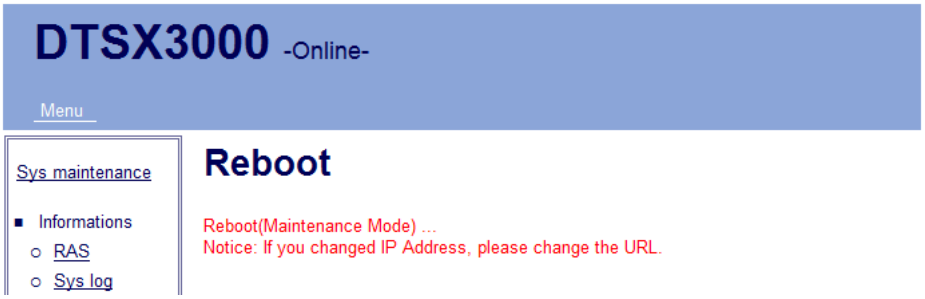
2. The Reboot page is displayed. Select the Reboot (Maintenance Mode) option and click the [OK] button.



3. When the confirmation window is displayed, click the [OK] button.

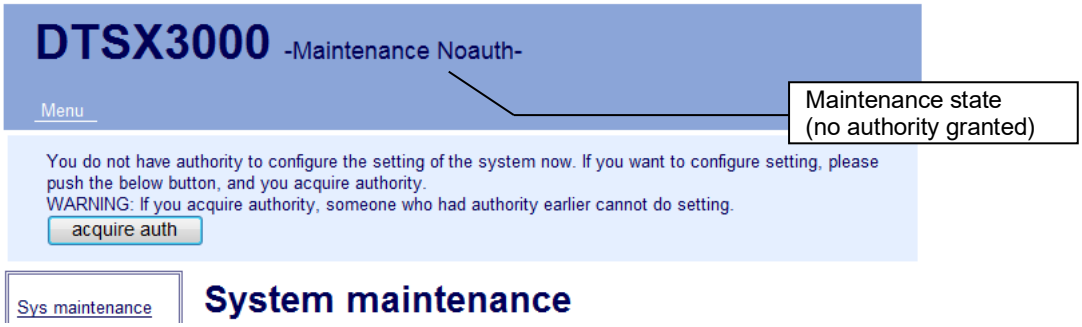


4. The DTSX3000 reboots.



5. After reboot

After reboot has completed, access the DTSX3000 from the Web browser and verify that the operation state has changed to maintenance state with no authority granted.



TIP

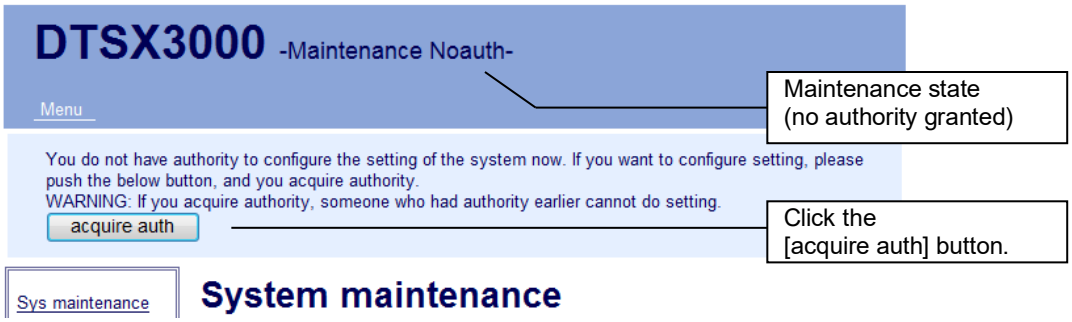
Do not reboot the DTSX3000 during temperature measurement. Correct measurement result is not guaranteed if reboot is executed during measurement.

■ Procedure for transiting from maintenance state to online stat

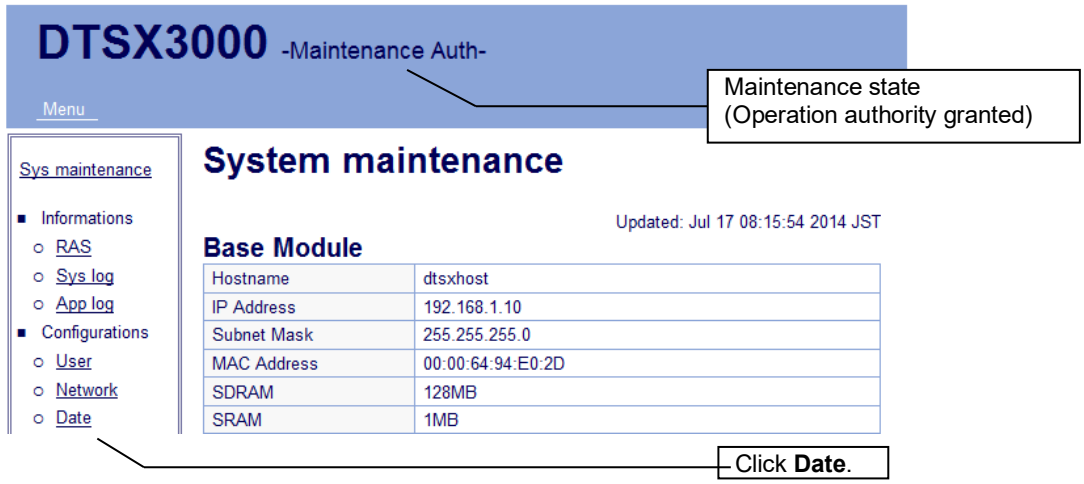
To transit from maintenance to online state, reboot the system as described in procedure above but select the Reboot (Online Mode) option instead on the Reboot page in step 2.

■ Procedure for acquiring operation authority in Maintenance (no authority granted) state

1. Click the [acquire auth] button.

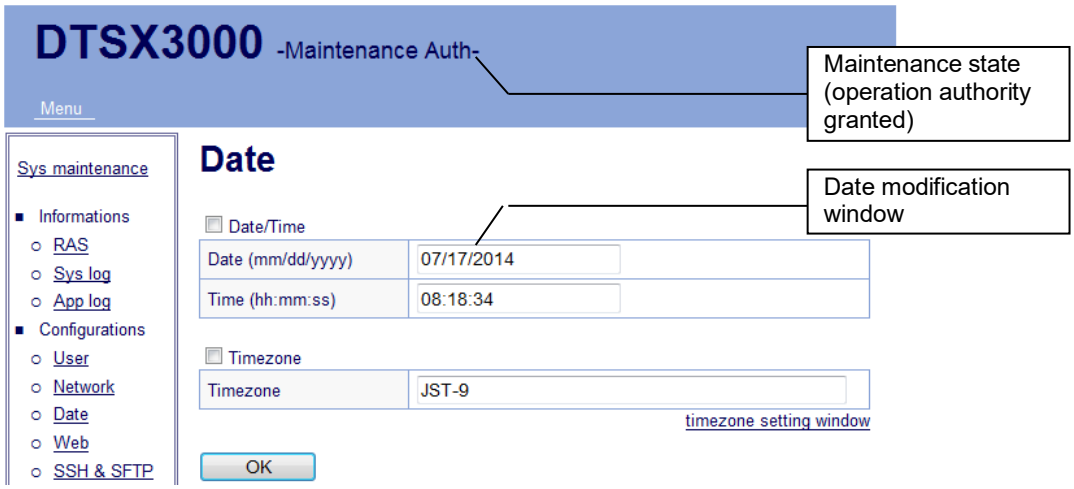


2. Confirm that operation authority has been granted.

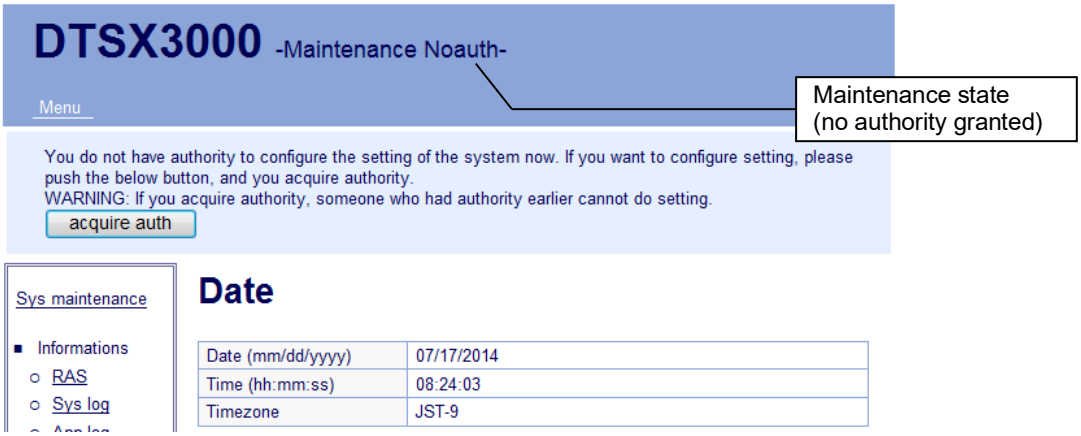


If no other user has been granted operation authority, the configuration modification window is displayed.

As an example, click Date after operation authority is granted

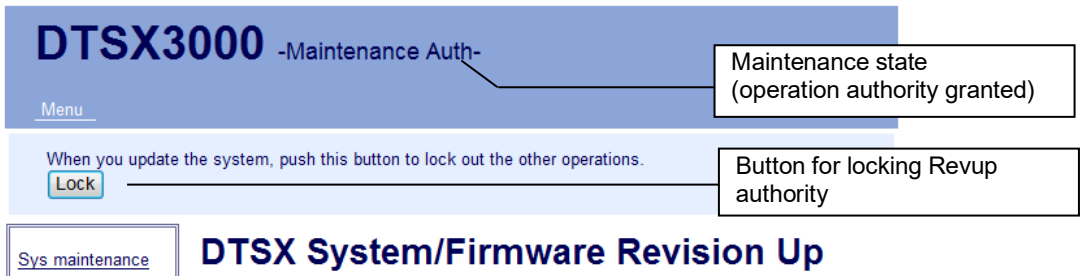


If another user has acquired authority, the DTSX3000 transits to Maintenance (no authority granted) state without displaying the configuration modification window.



■ Procedure for acquiring and releasing Revup authority in maintenance state

1. Click the [Lock] button to acquire Revup authority.

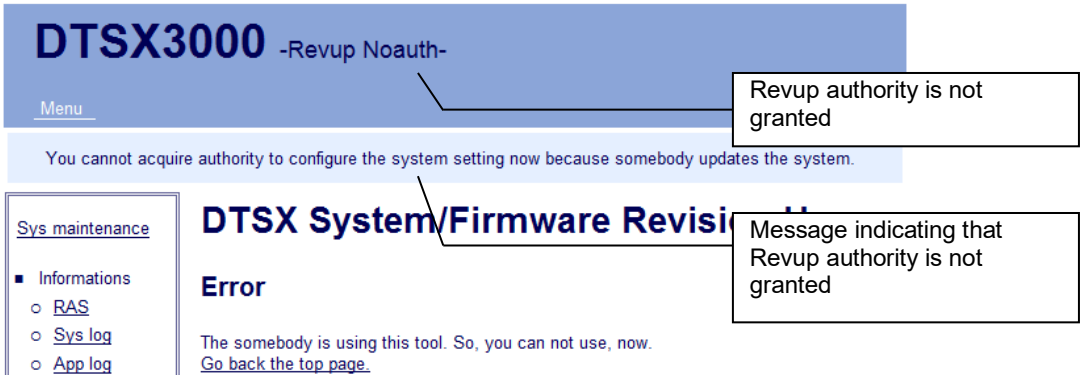


2. Confirm that Revup authority has been granted.

To release Revup authority, click the [Unlock] button.



3. Revup authority is not granted if another user is already granted Revup authority.

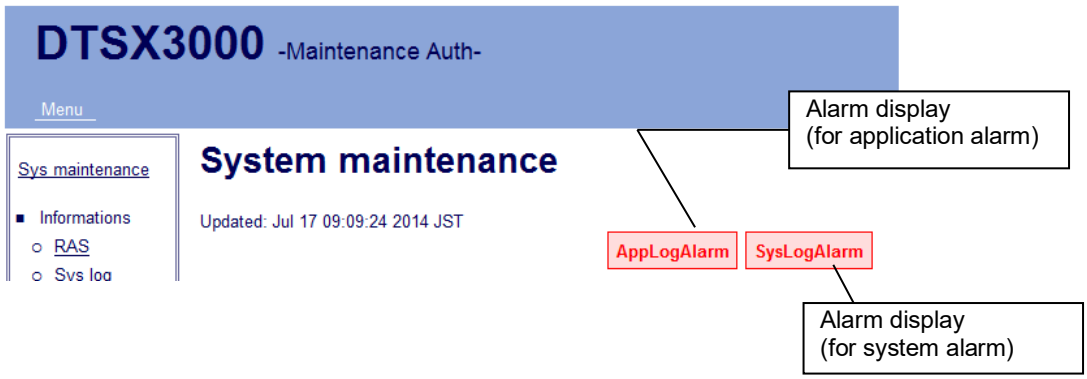


B6.1.5. Auxiliary Information Display

The figures below show some examples of auxiliary information displayed in the auxiliary information display area

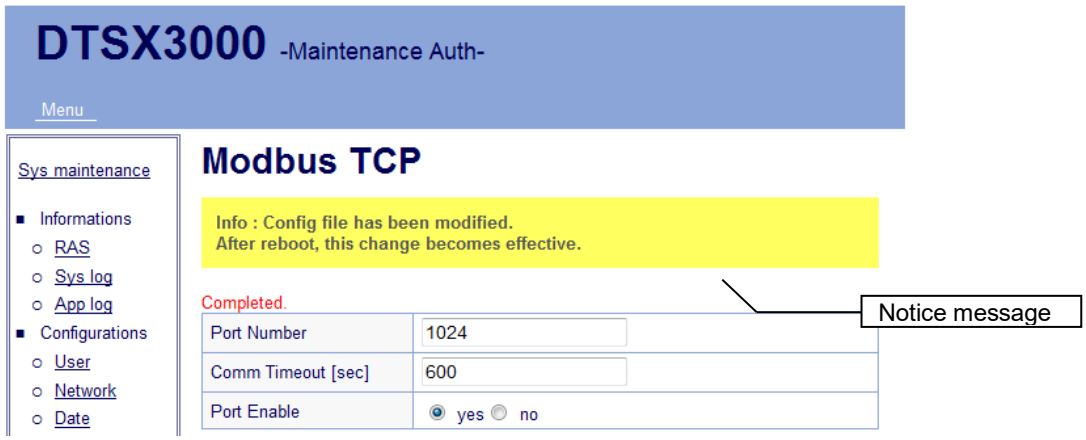
■ Alarm display

An alarm icon is displayed when any message at or above the configured log alarm level described in Subsection B6.4.16, “Log Alarm Level Configuration (Log Alarms)“ is logged.



■ Notice messages

Notice messages (such as a message informing about the need to Reboot to effect a configuration modification) are displayed.



■ Error messages

Error messages (such as a message informing that a specified value is out of the valid data range) are displayed.



B6.2. Item List

The table below lists the system configuration items.

Side Menu Item	Function	Description
Sys Maintenance	Maintenance information	Displays maintenance information.
Informations		
RAS	RAS Information display	Display RAS information.
Sys log	System log display	Display system log messages.
App log	Application log display	Display application log messages.
Configurations		
User	User management	Add, delete or change the password for a user.
Network	Network configuration	Configure IP addresses, DNS and domain names.
Date	Data and time configuration	Configure system date, time and time zone.
Web	Web server configuration	Configure Web server authentication and HTTPS.
SSH & SFTP	SSH & SFTP configuration	Enable or disable SSH, SFTP, TELNET and FTP.
Serial	Serial port configuration	Configure serial ports COM1 and COM2.
PPP	PPP server configuration	Configure the PPP server function.
NTP	NTP server configuration	Register external NTP servers.
LED	LED power save configuration	Configure LED power save mode of DTSX3000.
Tool		
Backup	System configuration backup	Back up system configuration data to a PC.
Restore	System configuration restoration	Restore system configuration backup data on a PC to DTSX3000.
Revup	System revision update	Perform revision update of the kernel, root file system, bit data for FPGA and DTSX3000 applications.
Saveinfo	Save log	Back up system log, application log and RAS information to a PC.
Operations		
Log Alarm	Log alarm level configuration	Specify log levels for reporting alarms for the system log and application log.
Reboot	Reboot/shutdown	Reboot or shutdown the DTSX3000.
App Setting		
Power Save	Power save settings	Enable or disable power saving when measurement system is idle.
Modbus		
Modbus TCP	Modbus TCP related settings	Specify port number to be used by the Modbus TCP function.
Modbus Serial	Modbus serial related settings	Specify the device number and protocol for the Modbus Serial function. Select whether to enable or disable the port used for Modbus serial communications.
Data Convert		
Format	Converted file format and storage format	Select the converted file format (LAS/WITSML/CSV) and storage format (compressed or uncompressed).
File Delete	Delete converted data	Remove generated converted data files.
CV Soft	CV software related settings	Select whether using or not using the DTSX3000 Control Visualization Software, as well as specify the port number to be used for connection with the DTSX3000 Control Visualization Software and the DTSX3000 Data Conversion Software

B6.3. Configurable Items in Each Operation State

The table below shows the configuration items available for display and configuration in various operation states.

Menu Item	Online State		Maintenance State							
			Normal Operation				Revup/Restore			
			Authority granted		No authority		Authority granted		No authority	
	Display	Config.	Display	Config.	Display	Config.	Display	Config.	Display	Config.
Sys maintenance	O	-	O	-	O	-	O	-	O	-
Informations										
RAS	O	-	O	-	O	-	O	-	O	-
Sys log	O	-	O	-	O	-	O	-	O	-
App log	O	-	O	-	O	-	O	-	O	-
Configurations										
User	O	X	O	O	O	X	O	X	O	X
Network	O	X	O	O	O	X	O	X	O	X
Date	O	X	O	O	O	X	O	X	O	X
Web	O	X	O	O	O	X	O	X	O	X
SSH & SFTP	O	X	O	O	O	X	O	X	O	X
Serial	O	X	O	O	O	X	O	X	O	X
PPP	O	X	O	O	O	X	O	X	O	X
NTP	O	X	O	O	O	X	O	X	O	X
LED	O	X	O	O	O	X	O	X	O	X
Tool										
Backup	O	-	O	O	X	X	X	X	X	X
Restore	X	X	O	O	X	X	O	O	X	X
Revup	X	X	O	O	X	X	O	O	X	X
Saveinfo	O	-	O	O	X	X	X	X	X	X
Operations										
Log Alarm	O	X	O	O	O	X	O	X	O	X
Reboot	O	O	O	O	X	X	O	O	X	X
App Setting										
Power Save	O	X	O	O	O	X	X	X	O	O
Modbus	O	X	O	O	O	X	X	X	O	O
Data Convert	O	X	O	O	O	X	X	X	O	O
CV Soft	O	X	O	O	O	X	X	X	O	O

O : Allowed

X : Not Allowed

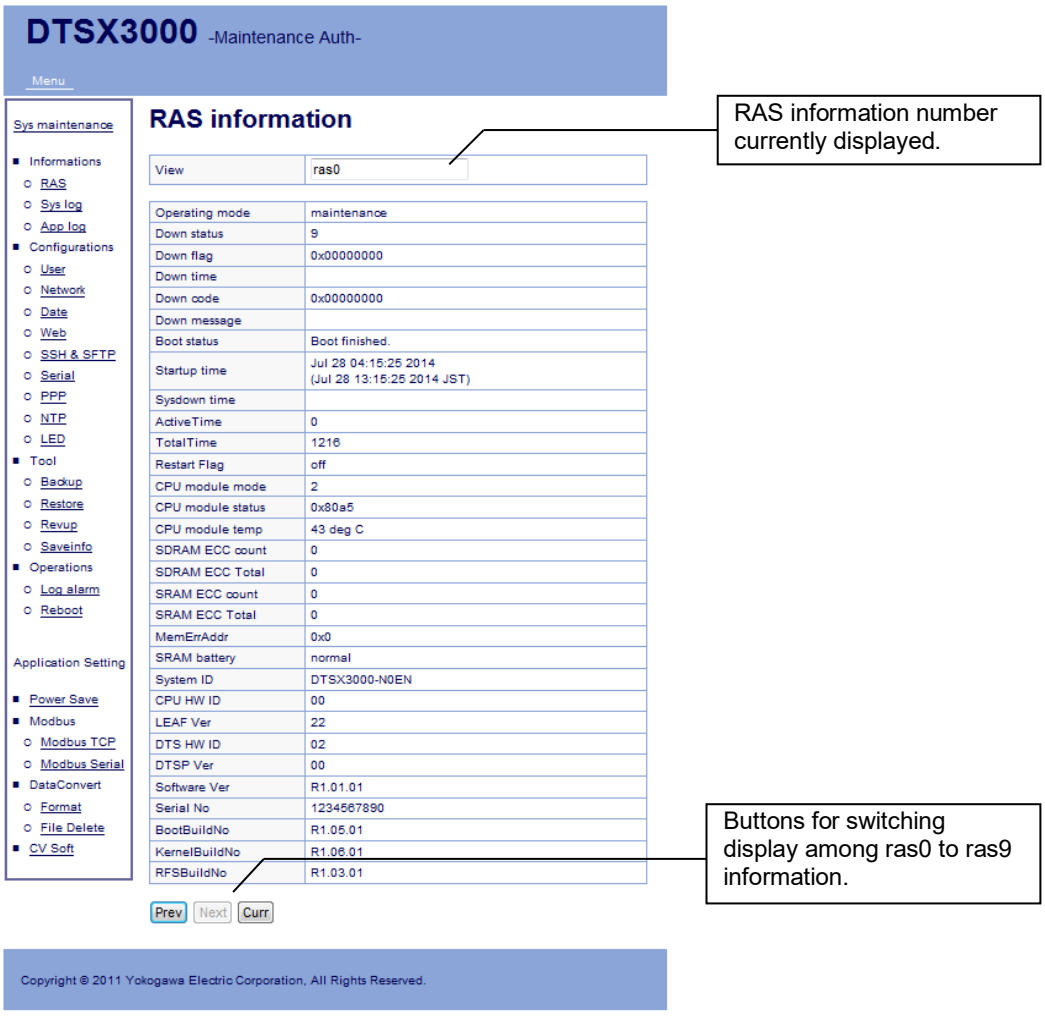
- : Not applicable

B6.4. System Configuration and Display Items

This section describes the displayed information and configuration procedure for each item selectable from the side menu. The side menu is hidden in the screen captures shown below.

B6.4.1. RAS Information Display (RAS)

You can display various DTSX3000 system and hardware information in RAS information Display by selecting RAS from the side menu. Ten historical RAS information records from ras0 to ras9 can be displayed, with ras0 representing the most recent information, and ras9 representing the oldest information. The oldest RAS information is deleted, and new RAS information is added each time the system is booted.



TIP

RAS information is used by Yokogawa for system analysis, and at times may need to be saved and sent to Yokogawa for fault diagnosis in the event of a system failure.

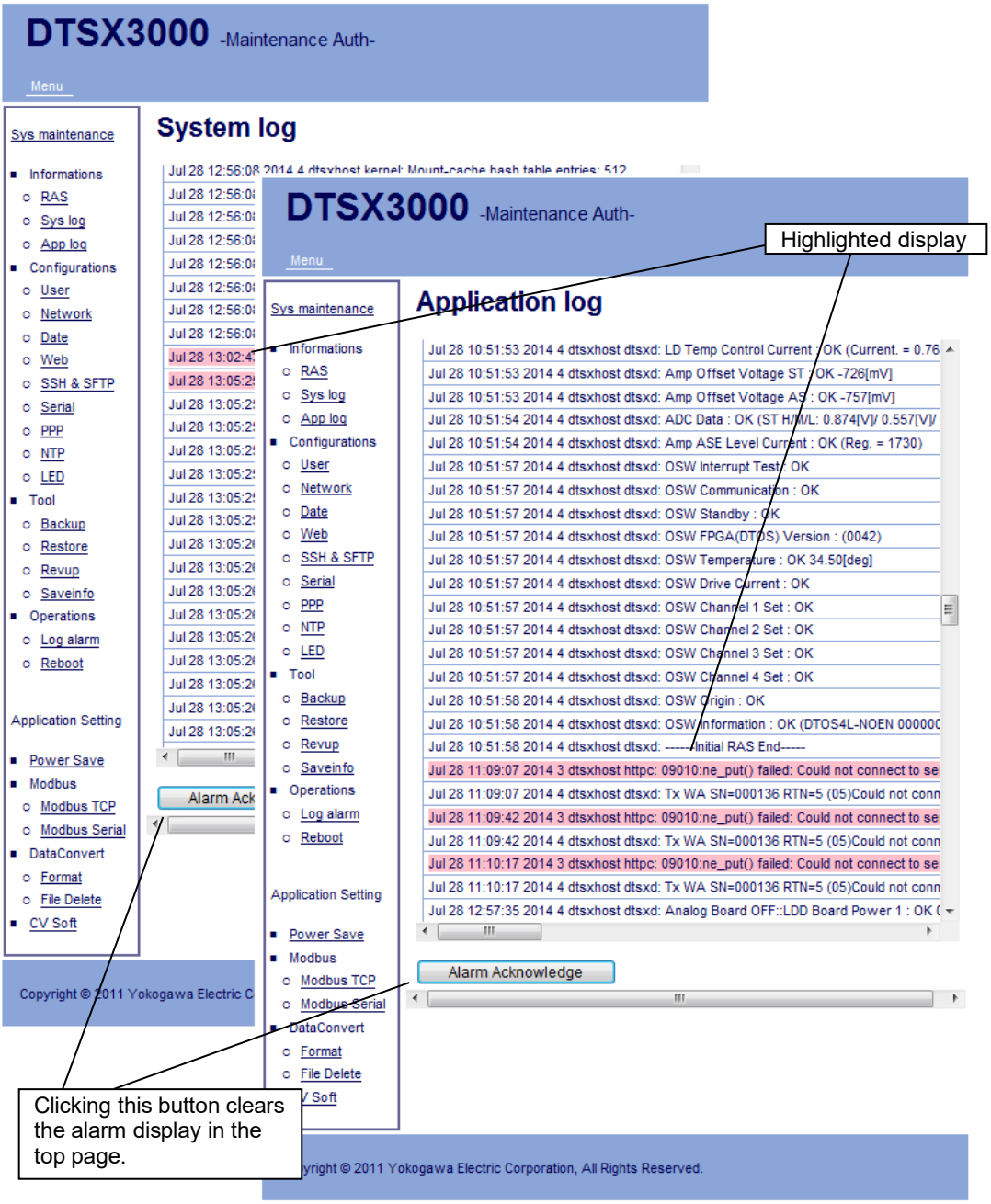
SEE ALSO

For details on saving RAS information, see Subsection B6.4.15, “Save Log (Saveinfo).”

B6.4.2. Log Display (Sys log and App log)

You can lists messages logged by the system (system log) and messages logged by applications (application log) in log display by selecting Sys log or App log from the side menu.

Log messages at or above the log alarm level described in Subsection B6.4.16, “Log Alarm Level Configuration (Log Alarms)” are highlighted in the display.

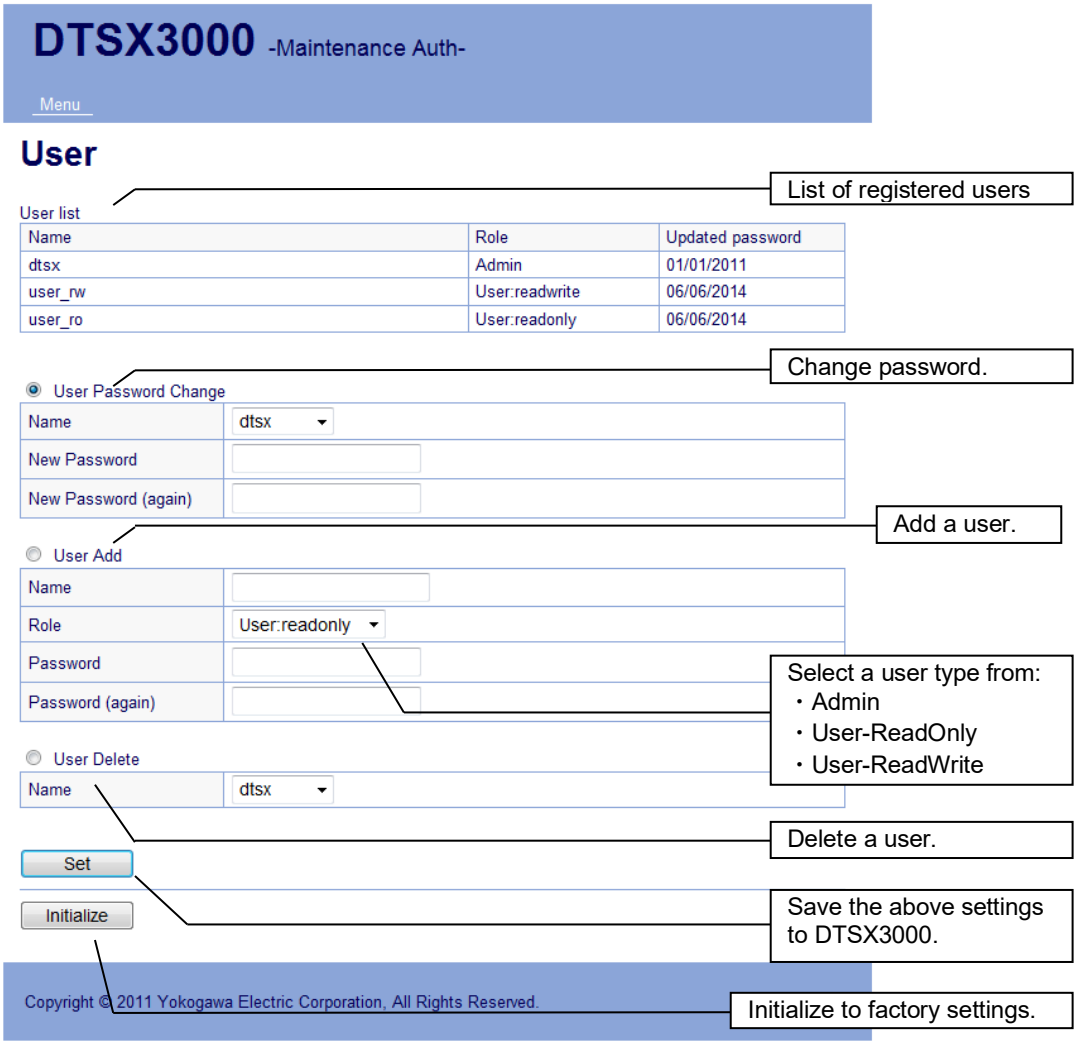


SEE ALSO

See Section B11.3, “Log Function” for details.

B6.4.3. User Management (User)

You can add, delete or change the password of a DTSX3000 user in user management.



■ Changing User Password

Select [User Password Change].

- Name
  Select the user whose password is to be changed from the displayed list.
- New Password
  Specify a new password.
  A password must begin with an alphanumeric character, and consist of alphanumeric characters and any of the "! # $ & + * @ ― = ~ _ ." characters, and be from 6 to 32 characters long.
- New Password(again)
  Re-enter the new password as confirmation.

After entering the password, click [Set]. The new password is applied after reboot.

■ Adding a User

Select [User Add].

- Name
  Enter a username.
  A username must begin with an alphanumeric character, and consist of alphanumeric characters and any of the " ― _ . " characters, and be up to 31 characters long.
  - Role
  Select the user type from among [Admin], [User:readwrite] and [User:readonly].
- Password
  Specify a password.
  A password must begin with an alphanumeric character, and consist of alphanumeric characters and any of the "! # $ & + * @ ― = ~ _ ." characters, and be from 6 to 32 characters long.
- Password(again)
  Re-enter the password as confirmation.

After completing all input, click [Set]. The changes are applied after reboot.

SEE ALSO

For details on user type, see Subsection B5.2.1, “Login Function.”

Tip

- Up to ten users can be added.
- A new user cannot have the same name as an existing user.
- You cannot modify the role (authority profile) of a user. To change the authority of a user, delete and add the user again with a new role.

■ Deleting a user

Select [User Delete].

- Name
  Select the user to be deleted from the displayed list.

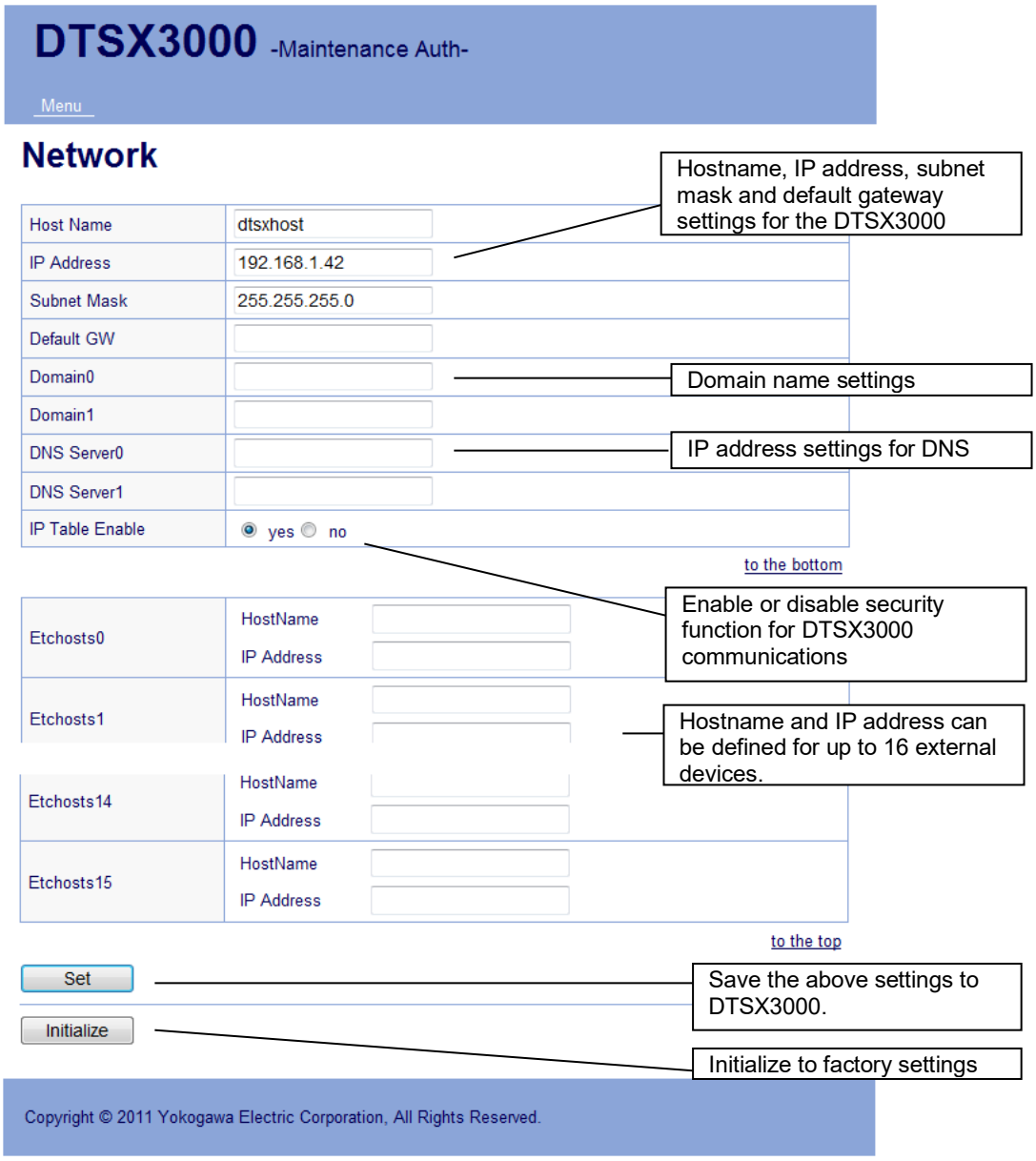
After selecting the username to be deleted, click [Set]. The changes are applied after Reboot.

Tip

- The “dtsx” user cannot be deleted.
- Deleting a user does not remove the user’s home directory.
- You cannot delete the “root” user.

B6.4.4. Network Configuration (Network)

You can specify the hostname, IP address and domain name of the DTSX3000, as well as other network-related settings in network configuration



- Host Name
  Optionally specify a hostname for the DTSX3000. A hostname must begin and end with an alphanumeric character, consist only of alphanumeric characters, the period (.) character and the hyphen (-) character, and be no longer than 32 characters.
- IP Address
  Specify an IP address, which must consist of only numeric characters and the period (.) character, and be no longer than 15 characters.
- Subnet Mask
  Specify a subnet mask, which must consist of only numeric characters and the period (.) character, and be no longer than 15 characters.
- Default GW
  Specify the IP address of the default gateway, which must consist of only numeric characters and the period (.) character, and be no longer than 15 characters.
- Domain0, Domain1
  Up to 2 domain names can be specified. A domain name must begin and end with an alphanumeric character, consist only of alphanumeric characters, the period (.) character and the hyphen (-) character, and be no longer than 32 characters.
- DNS Server0, DNS Server1
  Up to 2 DNS servers can be specified. Specify the IP address of the DNS server to be registered as required.
- IP Table Enable
  This setting is for maintenance use and should always be set to yes.
- Etchosts0 – Etchosts15
  Up to 15 pairs of IP address and hostname combinations can be registered.

After specifying the required settings, click [Set] to save it to the DTSX3000. The new settings will be applied on the next reboot.

Tip

-- Only Internet protocol IPv4 is supported. Protocol IPv6 is not supported.

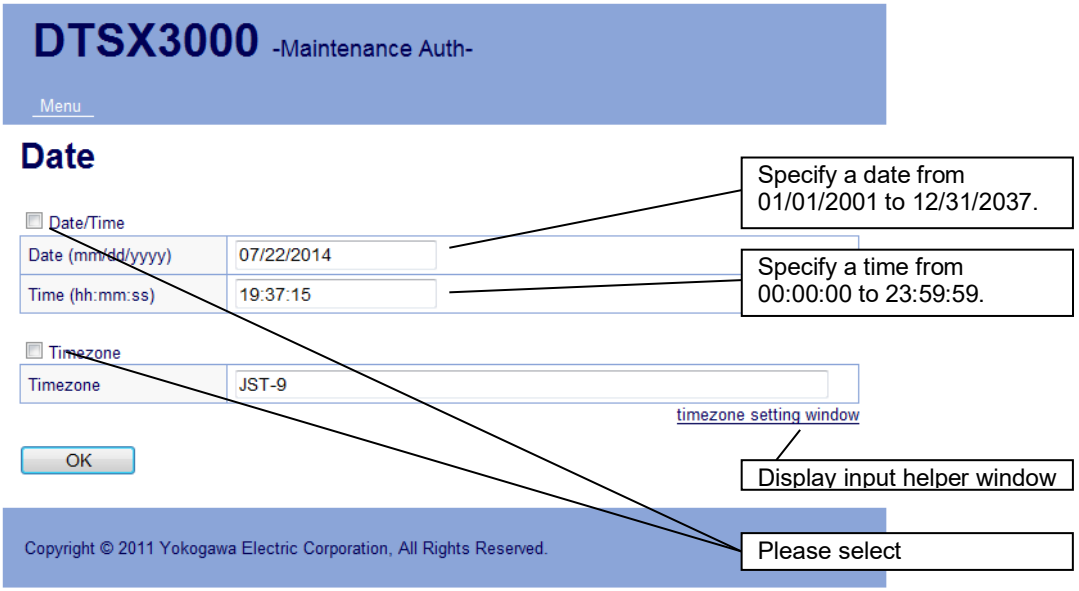
- The host name cannot be modified if HTTPS is enabled or if the HTTPS Enable described in Section B6.4.6, “Web Server Configuration” is set to yes.

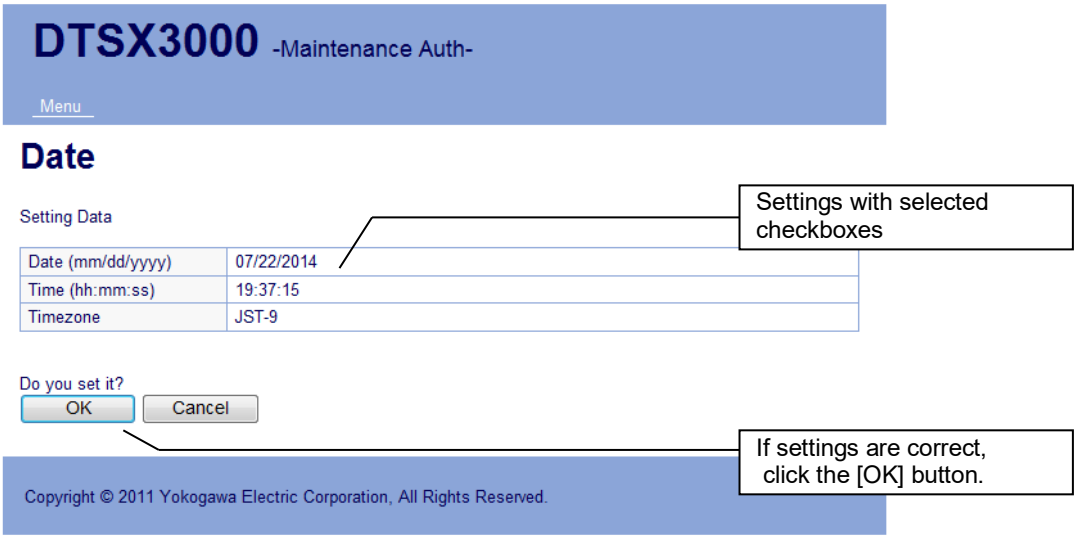
B6.4.5. Date and Time Configuration (Date)

You can specify the internal clock date, time and time zone for the DTSX3000 in date and time configuration by selecting Date from the side menu. Next, select the checkboxes for the settings to be configured and specify the required settings.

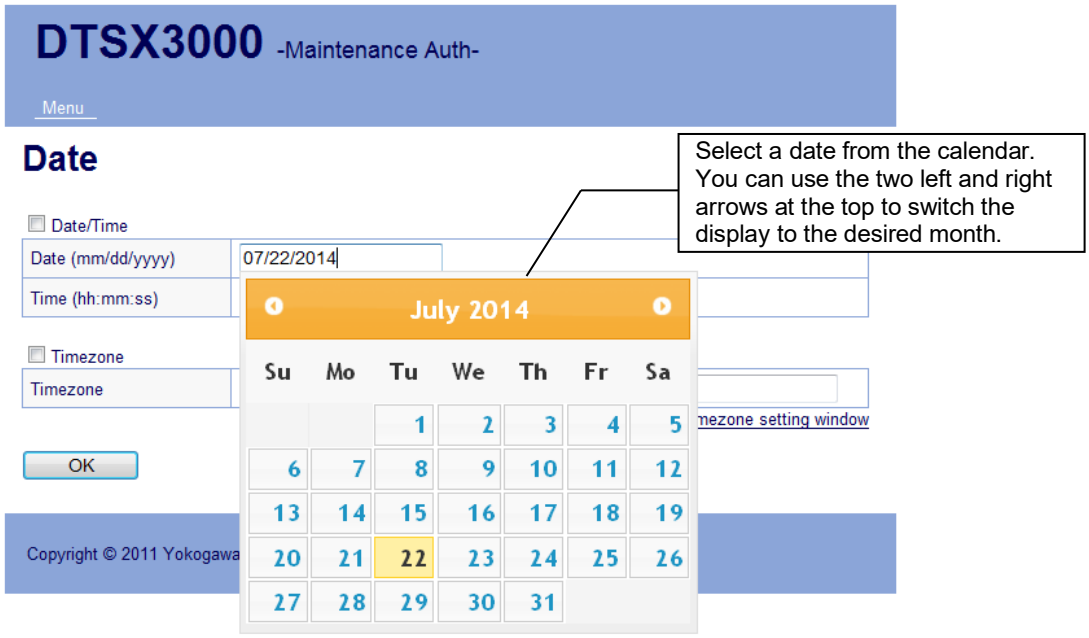
- Date can be specified by directly entering a date in mm/dd/yy format in the Date field or by selecting a date from the displayed calendar.
- Time can be specified directly by entering a time value in hh:mm:ss format.
- Time zone can be entered directly or specified using the timezone setting helper window.

After entering the required settings, click the [OK] button. A confirmation dialog is displayed. Click [OK] again to update the settings with selected checkboxes. Modified settings are applied only on the next Reboot.


DTSX3000 -Maintenance Auth-
Menu
Date
Date/Time
Date (mm/dd/yyyy)
07/22/2014
Time (hh:mm:ss)
19:37:15
Timezone
Timezone
JST-9
timezone setting window
OK
Copyright © 2011 Yokogawa Electric Corporation, All Rights Reserved.
Specify a date from 01/01/2001 to 12/31/2037.
Specify a time from 00:00:00 to 23:59:59.
Display input helper window
Please select


DTSX3000 -Maintenance Auth-
Menu
Date
Setting Data
Date (mm/dd/yyyy)
07/22/2014
Time (hh:mm:ss)
19:37:15
Timezone
JST-9
Do you set it?
OK
Cancel
Copyright © 2011 Yokogawa Electric Corporation, All Rights Reserved.
Settings with selected checkboxes
If settings are correct, click the [OK] button.

Time zone can be entered directly or specified using the timezone setting helper window. How to do so is described on the following pages.



TIP

Changing the clock time and time zone of the DTSX3000 will not affect existing date, time and time zone values in the system log and application log (see Subsection B6.4.2, “Log Display (Sys log and App log)”).

■ Entering a time zone value directly

Time zone can be specified using the following format. Keywords enclosed within square parentheses ({}) are optional.

std offset {dst {offset}{,start{/time}, end{/time}}}

● std and dst:

Time zone abbreviations (comprising 3 or more letters)

- std represents standard time.
- dst represents daylight saving time.

● Offset:

A time value to be added to local time to convert it to UTC time

- The format is ±hh{:mm{:ss}}

● start{/time}, end{/time}:

Defines the start date and time, and the end date and time for daylight saving.

Time can be specified in the following formats.

Jn:the number of days from 1st January, which is considered day 1.

- J is a prefix
- n is an integer from 1 to 365 (2/29 is not included in the calculation so 2/28 and 3/1 are to be specified as J59 and J60 respectively)

n:the number of days from 1st January, which is considered day 0.

- n is an integer from 0 to 365 (2/29, if present, is included in the calculation)

Mm.n.d: month, week and day

- M is a prefix
- m is an integer from 1 to 12 representing a month
- n is an integer from 1 to 5 representing the nth week of the month
- d is an integer from 0 to 6 representing a day of the week with 0, 1, 2, 3, 4, 5, 6 representing Sunday, Monday, Tuesday, Wednesday, Thursday, Friday and Saturday respectively

time: the start time and end time

- It has the same format as offset except that no '-' and '+' prefix is allowed
- If omitted, a default value of 02:00:00 is assumed

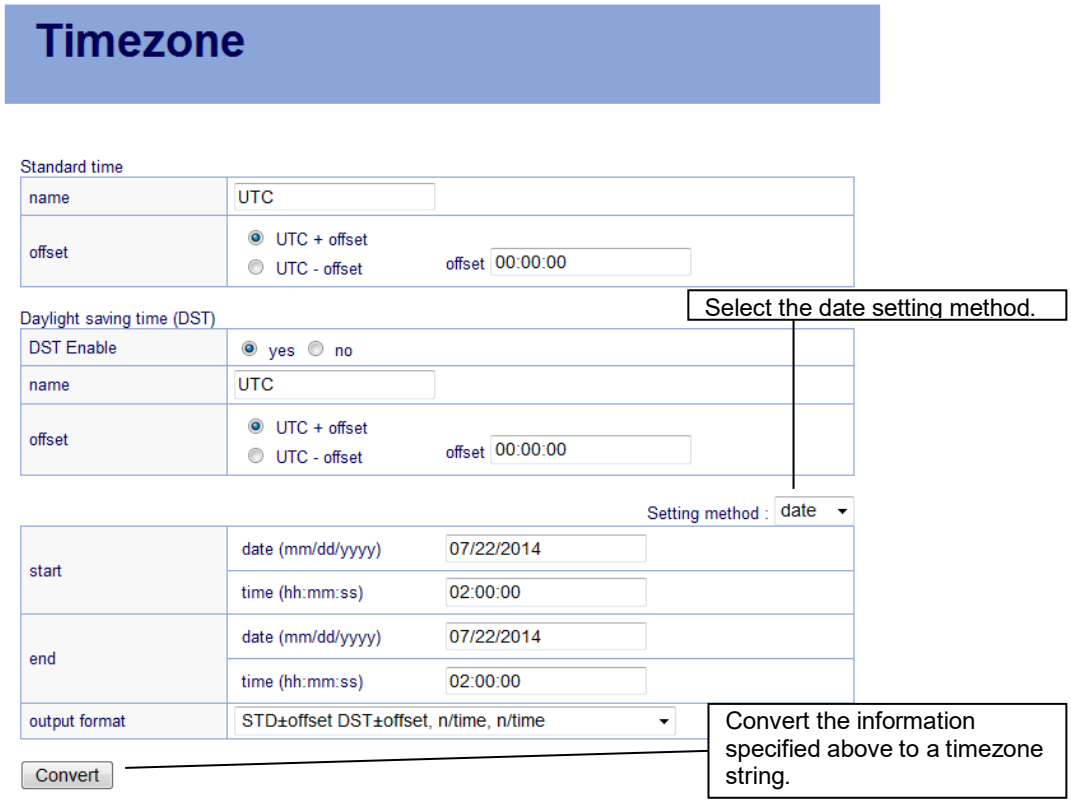
Examples of valid time zone values:

```
JST9:00:00JST+9:00:00
JST9JST9,J150/00:00:00,J300/00:00:00
AEST-10AEDT-11,150,300
UTC0UTC0,M4.1.0,M10.5.0
```

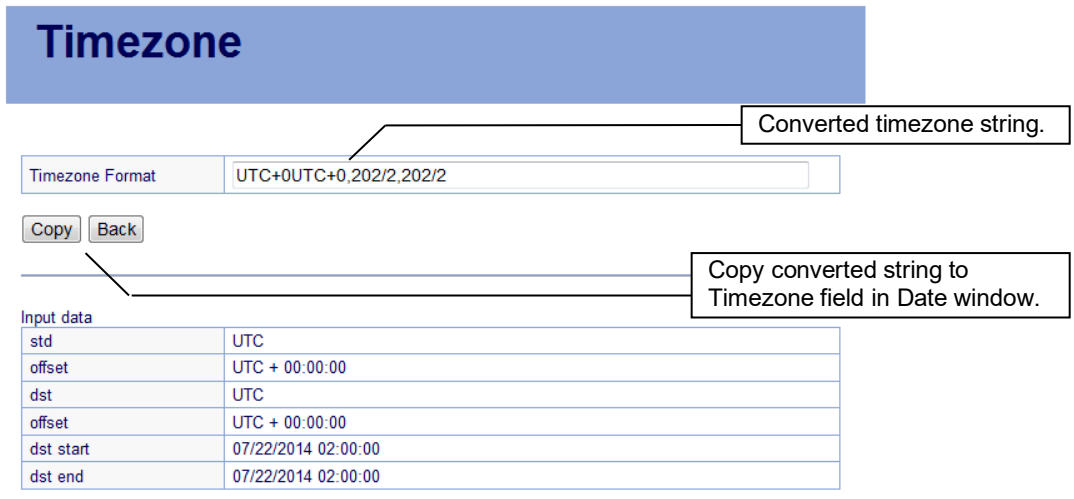
■ Specifying time zone with the time zone setting helper window (using Date setting method)

Select [date] for the [Setting method]. After specifying the required settings, press the [Convert] button.

A time zone string is converted automatically from the specified settings.

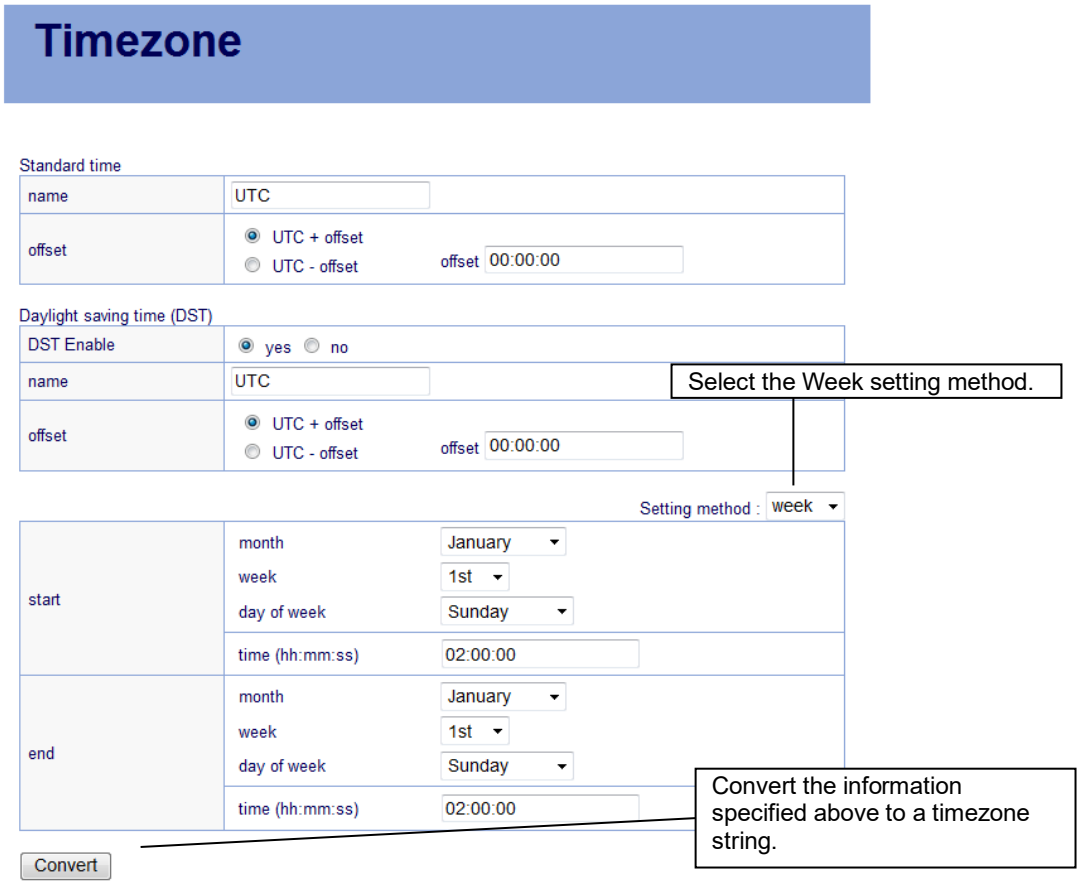


Click the [Copy] button to copy the automatically generated character string to the Timezone field on the Date window.

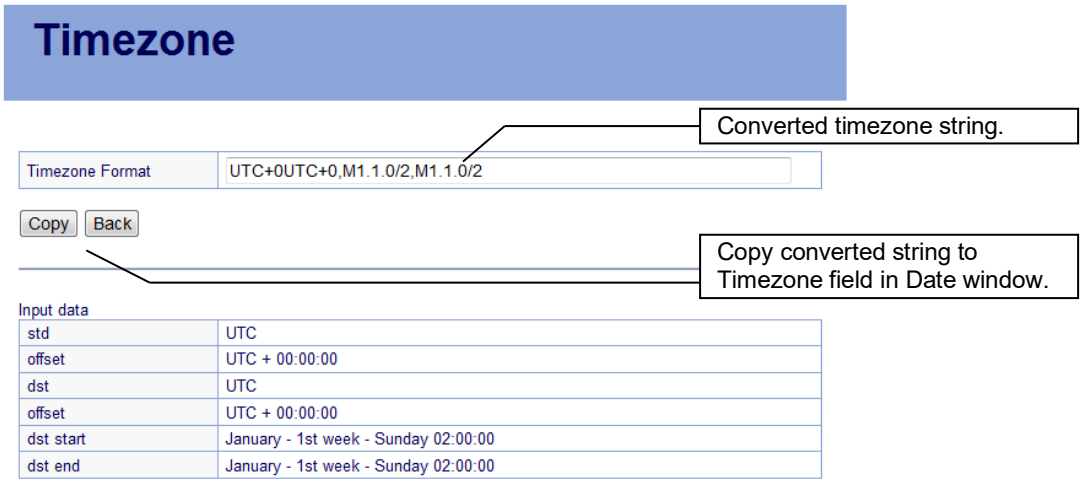


■ Specifying time zone with the time zone setting helper window (using the Week setting method)

Select [week] for the [Setting method]. After specifying the required settings, press the [Convert] button.

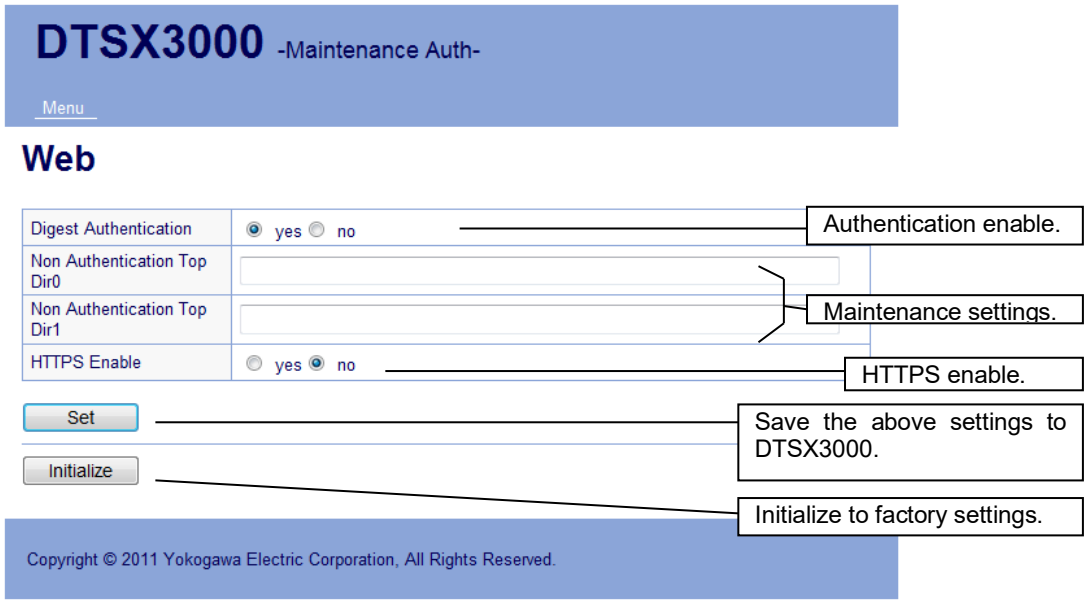


A time zone string is converted automatically from the specified settings.



B6.4.6. Web Server Configuration (Web)

You can specify DTSX3000 Web server authentication related items in Web server configuration.



- Digest Authentication
  Specify whether to enable or disable user authentication. Select yes to enable user authentication. When enabled, user authentication requires a valid username and password to be entered from a browser before allowing access to the DTSX3000. Select no to disable user authentication. When user authentication is disabled, no username and password is required so anyone can access the DTSX3000 system settings.
- Non Authentication Top Dir0, Non Authentication Top Dir1
  These settings are for maintenance purpose and are normally not used.
- HTTPS Enable
  Specify whether to enable or disable HTTPS communication.
  If you select yes, data exchange between a browser and the DTSX3000 is encrypted by HTTPS communication. To enable HTTPS, you need to obtain (purchase) or generate an SSL server certificate and store the certificate in the DTSX3000.
  How to enable HTTPS and how to update the SSL server certificate stored in the DTSX3000 is described below.

After entering the above settings, click [Set]. Any changes are applied on the next Reboot.

● Enabling HTTPS

1. Put the DTSX3000 into maintenance state.
2. Transfer the SSL server certificate file to the DTSX3000 using SFTP or some other means.
3. Log on to the DTSX3000 as a user with Admin authority.
4. Execute the following command to store the SSL server certificate file.

```
/usr/sbin/sslset  SSL server certificate file
```

5. Select yes for HTTPS Enable.
6. Reboot the DTSX3000.

● Updating the SSL server certificate

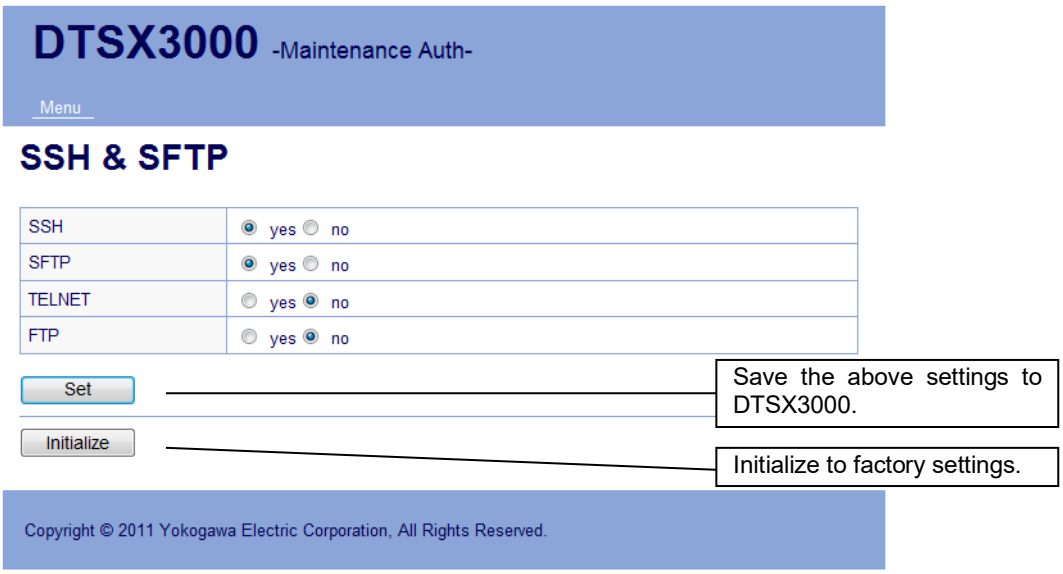
1. Put the DTSX3000 into maintenance state.
2. Select no for HTTPS Enable.
3. Reboot the DTSX3000 (in maintenance state).
4. Perform the steps described for “Enabling HTTPS” above.

Tip

- An SSL server certificate must be addressed to the hostname (domain name) of the DTSX3000. Example: dtsx3000.dtstest.com
- The host name and domain name in the network configuration (see Section B6.4.4, “Network Configuration (Network).”) cannot be modified when HTTPS is enabled. To change the host name or domain name, you need to disable HTTPS temporarily, modify the host name and domain name, and then re-enable HTTPS.
- If HTTPS is enabled, you need to prefix the URL with “https://” when accessing the DTSX3000 from a browser.

B6.4.7. SSH & SFTP Configuration (SSH & SFTP)

You can enable or disable the SSH, TELNET and FTP server functions in SSH & SFTP Configuration.



- SSH
  If using SSH, select yes; if not using SSH, select no.
  Be sure to select yes if connecting to the DTSX3000 using the DTSX3000 Control Visualization Software or the DTSX3000 Data Conversion Software.

Tip

The SSH2 protocol is used.

- SFTP
  If using SFTP, select yes; if not using SFTP, select no.
  To use SFTP, you need to enable SSH. Be sure to select yes if connecting to the DTSX3000 using the DTSX3000 Control Visualization Software or the DTSX3000 Data Conversion Software.
- TELNET
  If using TELNET, select yes; if not using TELNET, select no.
  TELNET communication is unencrypted, so we recommend disabling TELNET unless there is some special reason not to do so.
- FTP
  If using FTP, select yes; if not using FTP, select no. FTP communication is unencrypted, so we recommend disabling FTP unless there is some special reason not to do so.

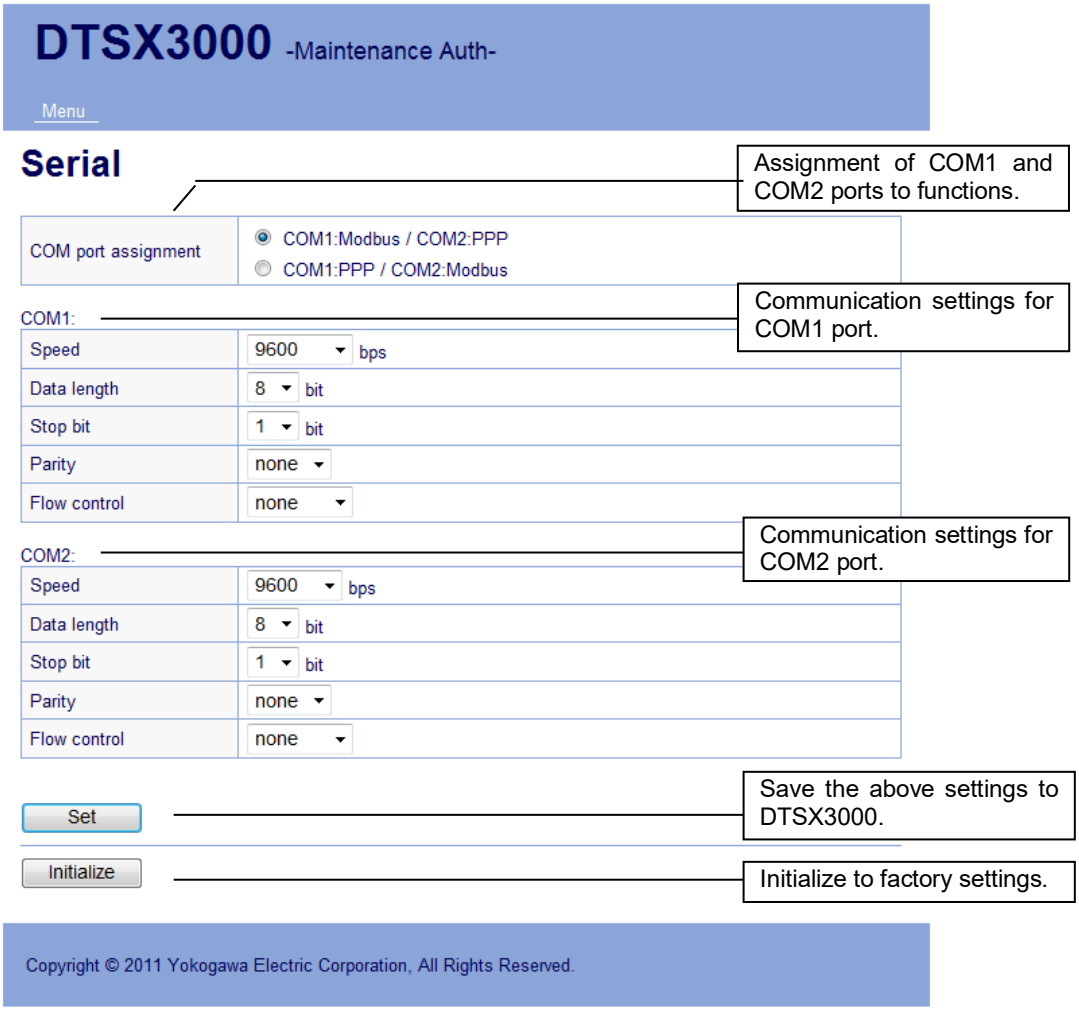
After selecting the above options, click the [Set] button. The changes are applied after reboot.

Tip

- Up to four SSH and TELNET connections are allowed.

B6.4.8. Serial Port Configuration (Serial)

You can select the serial port (COM1 and COM2) of the DTSX3000 to be assigned for the PPP function and Modbus serial function, as well as define communication settings in serial port configuration.
After selecting and entering the required settings, click the [Set] button. The DTSX3000 configuration is updated but the changes are applied only after reboot.



Item	Meaning	Data Range	
		COM1	COM2
Speed	Baud rate(bps)	*1	*2
Data length	Data length	7 or 8(*3)	7 or 8(*3)
Stop bit	Number of stop bits	1(*3) or 8	1(*3) or 2
Parity	Parity check	None(*3), even or odd	None(*3), eve or odd
Flow control	Flow control	None(*3), rst/cts or xon/xoff	None(*3), rts/cts or xon/xoff

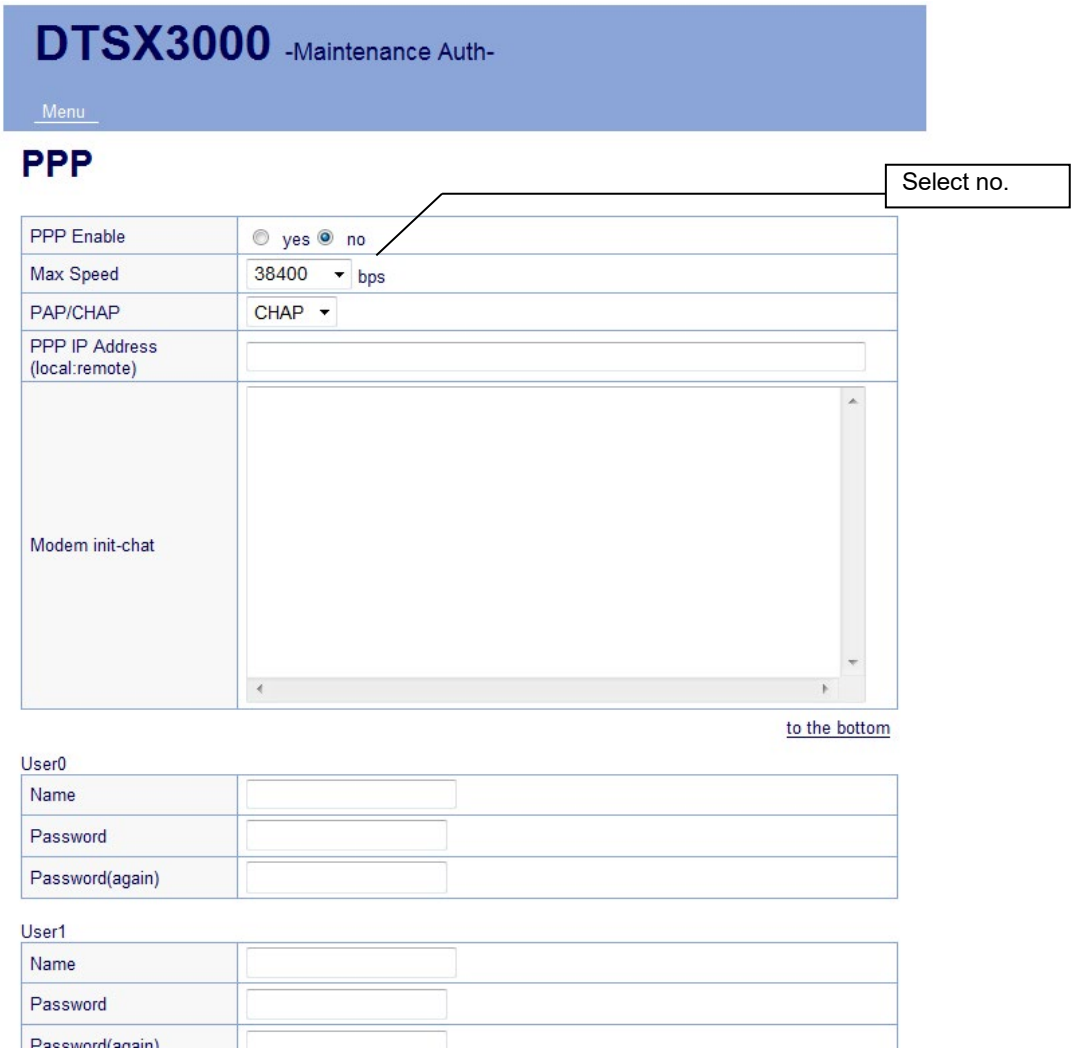
*1: 1200, 2400, 4800, 9600, 19200, 38400, 57600 or 115200. Default is "9600".
*2: 1200, 2400, 4800, 9600, 19200 or 38400. Default is "9600".
*3: default value

Tip

- Half-duplex communication is not supported
- The COM1 or COM2 port goes into power save mode when not used

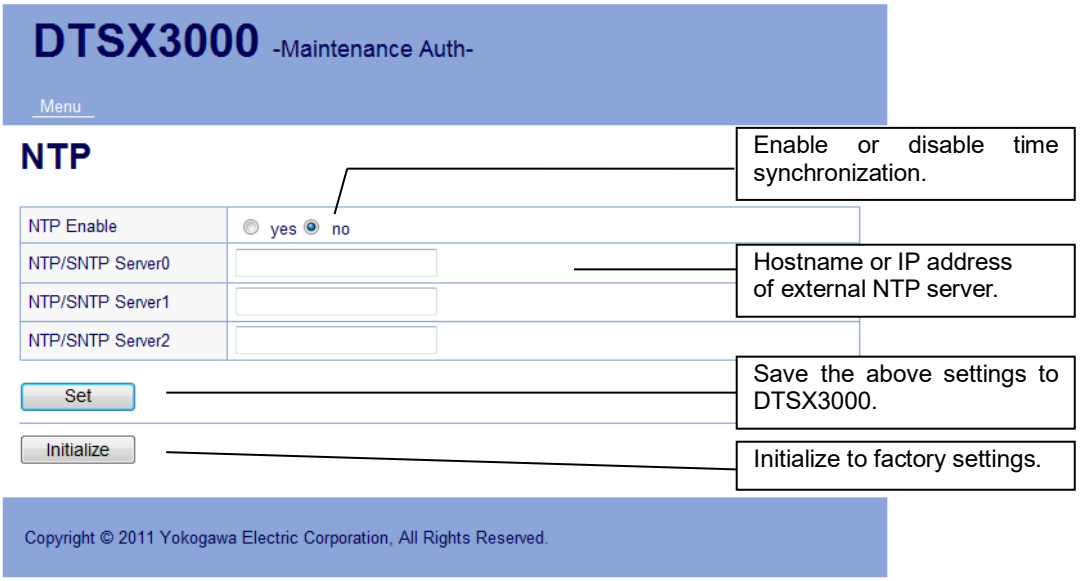
B6.4.9. PPP Server Configuration (PPP)

This configuration item is intended for maintenance use and is normally not used. Set PPP Enable to no.



B6.4.10. NTP Server Configuration (NTP)

You can specify whether to perform clock time synchronization with NTP servers on the network, as well as specify the hostnames or IP addresses of the NTP servers in NTP server configuration.



- NTP Enable
  Specify whether to synchronize the clock time of the DTSX3000 with NTP servers. Select yes if synchronizing clock time with NTP servers; select no if not synchronizing clock time with NTP servers.
- NTP/SNTP Server0 — NTP/SNTP Server2
  Up to 3 NTP servers can be registered if you are synchronizing the clock time with NTP servers. Specify the hostnames or IP addresses of the NTP servers. A hostname must begin and end with an alphanumeric character, consist only of alphanumeric characters, the period (.) character and the hyphen (-) character, and be no longer than 32 characters. An IP address must consist only of numeric characters and the period (.) character, and be no longer than 15 characters.

After specifying the required settings, click the [Set] button. The DTSX3000 configuration is updated but the changes are applied only after reboot.

Tip

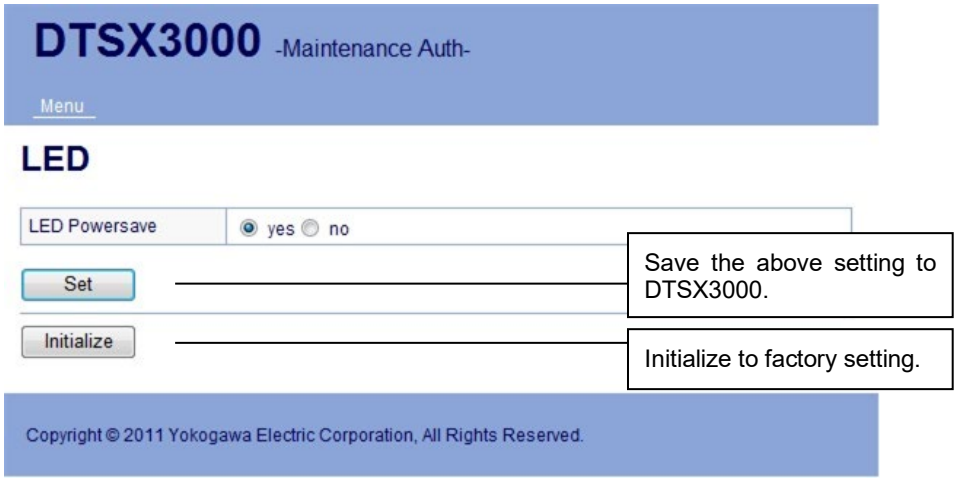
- Only the unicast mode, which sends time requests periodically to the NTP server, is supported.
- Time synchronization is done on hourly basis.
- The year 2036 timestamp rollover problem is not supported.
- To specify a hostname, you need to perform network configuration so that the DTSX3000 can resolve the IP address from a hostname.

SEE ALSO

For details on network configuration, see Subsection B6.4.4, “Network Configuration (Network).”

B6.4.11. LED Power Save Configuration (LED)

You can disable or enable the LED power save mode, which reduces the LED brightness to 33 %, in LED Power Save Configuration.

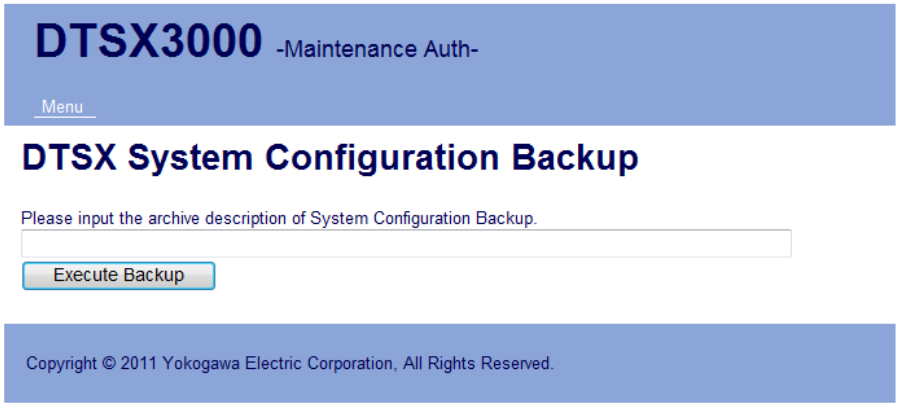


- LED Powersave
  Specify whether to enable or disable LED power save mode. Select yes to enable LED power save mode, and select no if otherwise. Then, click the [Set] button. The DTSX3000 configuration is updated but the changes are applied only after reboot.

B6.4.12. System Configuration Backup (Backup)

You can back up all system configuration data to a PC in system configuration backup by selecting Backup from the side menu.

Press the [Execute Backup] button. On the displayed file save dialog, specify the destination folder and output file name. A configuration archive file will be saved in the specified folder on the PC as a zip formatted file with the specified filename.



SEE ALSO

See Subsection B11.5.1, “Backup” for details.

B6.4.13. System Configuration Restoration (Restore)

By selecting Restore from the side menu, you can restore DTSX3000 system configuration data from a configuration archive file saved previously on a PC using system configuration backup.

Press the [Browse] button. On the displayed file selection dialog, select the configuration archive file on the PC to be loaded and then press the [Upload] button. Data restoration begins.

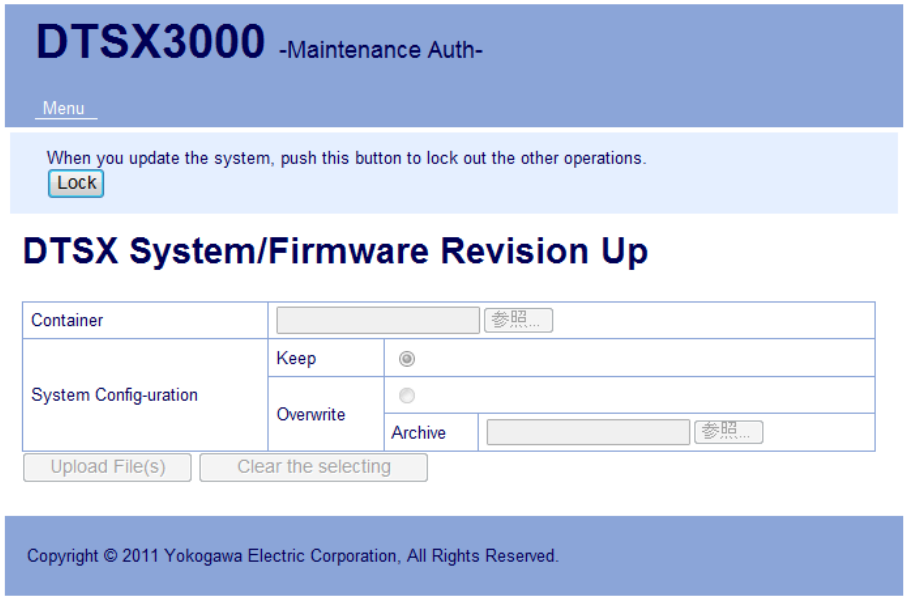


SEE ALSO

See Subsection B11.5.2, “Restore” for details.

B6.4.14. System Revision Update (Revup)

You can perform revision update of the DTSX3000 kernel, root file system and DTSX3000 applications in system revision update by selecting Revup from the side menu.

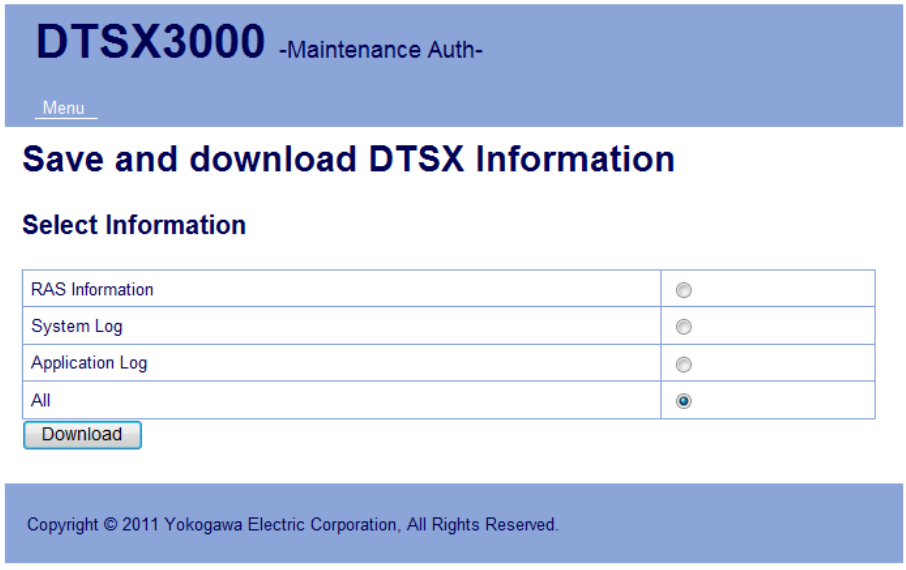


SEE ALSO

See Section B11.6, “System Revision Update” for details.

B6.4.15. Save Log (Saveinfo)

You can download RAS information, system log and application log to a PC using the Save Log function by selecting Saveinfo from the side menu.



SEE ALSO

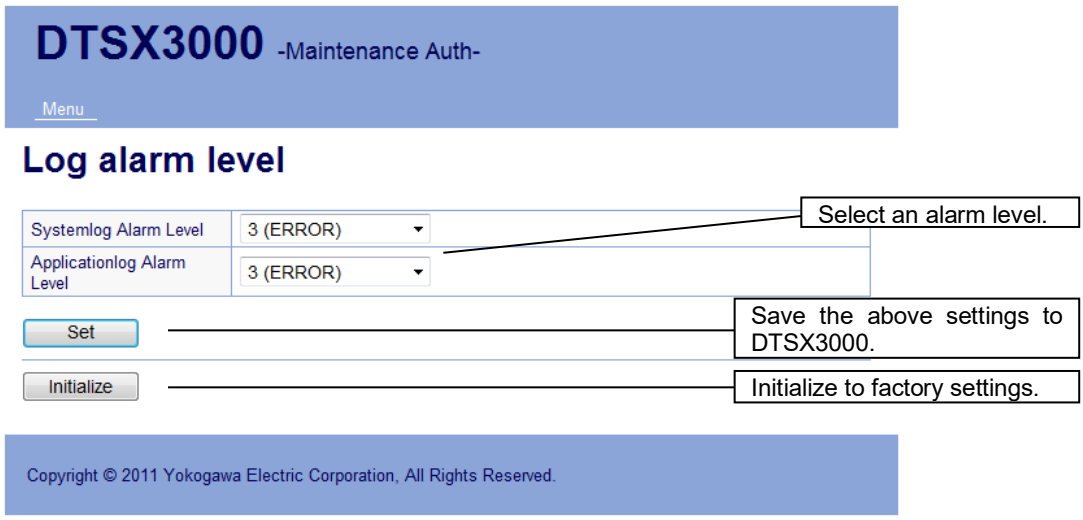
See Section B11.3, “Log Function” for details.

B6.4.16. Log Alarm Level Configuration (Log Alarms)

You can specify a log level for reporting alarms for the system log, as well as the application log, in log alarm level configuration by selecting Log Alarms from the side menu.

Whenever a message at or above the specified level is logged, an alarm is displayed as shown in Subsection B6.1.5, “Auxiliary Information Display” and the log message will be displayed as highlighted as shown in Subsection B6.4.2, “Log Display (Sys log and App log).”

Select and specify the required settings and then press the [Set] button. The DTSX3000 configuration is updated.

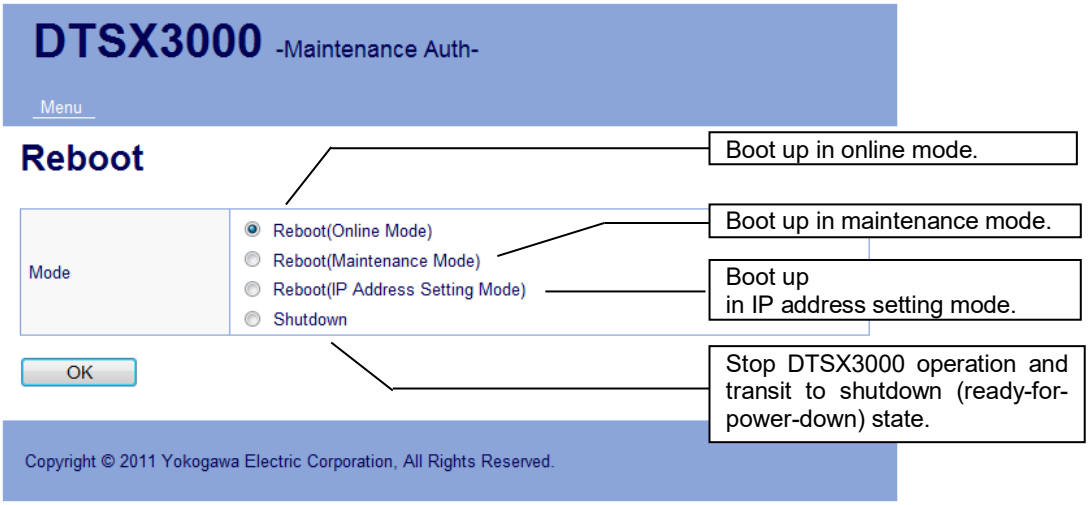


● Available log alarm level options

- 0 EMERGENCY
- 1 ALERT
- 2 CRITICAL
- 3 ERROR
- 4 WARNING
- 5 NOTICE
- 6 INFORMATION
- 7 DEBUG

B6.4.17. **Reboot/Shutdown (Reboot)**

You can reboot or shutdown the DTSX3000, as well as select the boot mode (operation state of the DTSX3000 after reboot) in reboot/shutdown by selecting Reboot from the side menu.



B6.5. Application Configuration Items

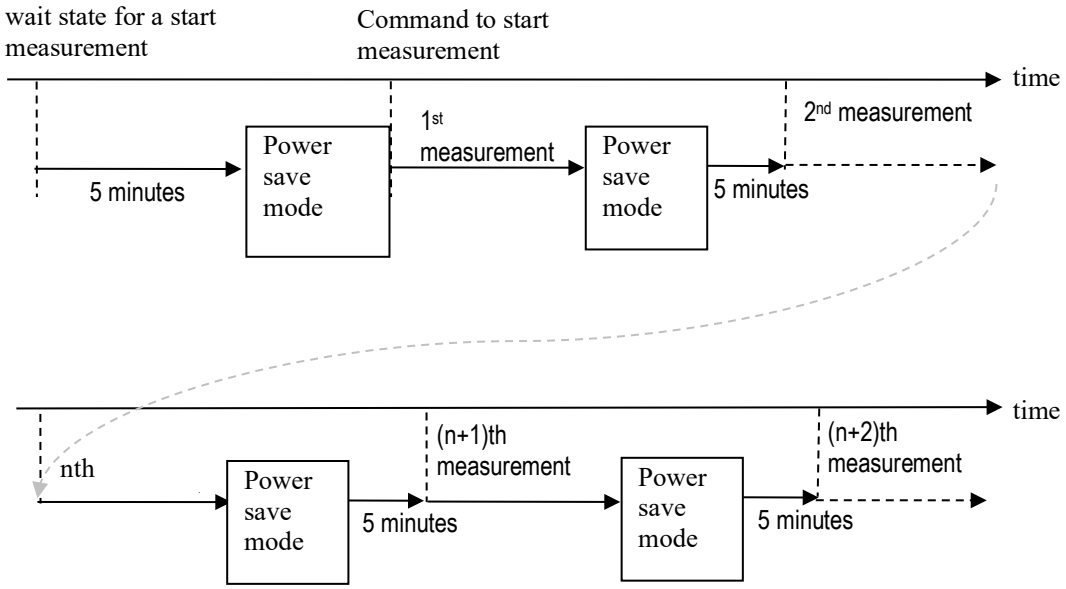
B6.5.1. Power Save Settings

Using power save settings, you can configure the power save function, which suspends power supply to measurement hardware when no measurement is being done. When power save is enabled, the system behaves as follows:

- After power on, the system goes into wait state for a start measurement instruction. If no start measurement instruction or start self-test instruction is received after 5 み minutes have elapsed, the system goes into power save mode.

The system exits from power save mode when it receives a start measurement instruction or start self-test instruction.

- The system goes into power save mode immediately after measurement ends. It exits from power save mode thereafter 5 minutes before the next measurement start time according to the sequence settings.



To configure power save, click on Power Save on the side menu to display the following screen. The settings are applied after reboot.



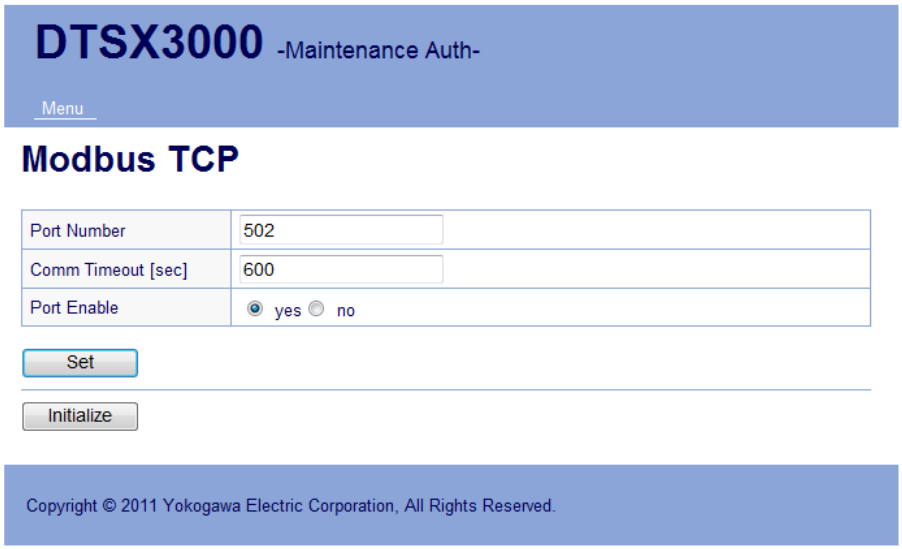
- Power Save
  Select whether to enable or disable power save.
  Select yes to enable power save and no to disable power save.
  The default value is no.

B6.5.2. Modbus Related Settings

Modbus related Settings include Modbus TCP related Settings and Modbus Serial related Settings.

■ Modbus TCP Related Settings

You can specify the port number and the communication timeout duration to be used by the Modbus TCP function of the DTSX3000 using Modbus TCP related settings. After specifying the required settings, press the [Set] button. The DTSX3000 configuration will be updated but the changes will be applied only after reboot.



- Port Number
  Specify the port number to be used by Modbus TCP. Available port numbers are 502 and from 1024 to 65535. Default value is 502.
- Port Number
  Specify the port number to be used by Modbus TCP. Available port numbers are 502 and from 1024 to 65535. Default value is 502.
- Comm Timeout[sec]
  Specify any communication timeout duration between 5 and 1800 (seconds). Default value is 600.
- Port
  You can use the Port Enable setting to disable the port used for Modbus/TCP communications when not using Modbus/TCP communications, and therefore strengthen security. Select "yes" if using Modbus/TCP communications; we recommend selecting “no” if not using Modbus/TCP communications.

■ Modbus Serial Related Settings

You can specify the slave address and protocol for the Modbus Serial function of the DTSX3000 using Modbus serial related settings. After specifying the required settings, press the [Set] button. The DTSX3000 configuration will be updated but the changes will be applied only after reboot.



- Slave Address
  Specify the address number to be used. Available port numbers are from 1 to 247. Default value is 1.
- Protocol
  Select either RTU or ASCII for the protocol to be used. Select “rtu” if using RTU and select “ascii” if using ASCII.

B6.5.3. Data Conversion Related Settings (Data Convert)

You can specify the data converted file format and storage format, as well as delete generated converted files using data conversion related settings.

■ Converted File Format and Storage Format

Select from among LAS conversion, WITSML conversion and CSV conversion for the converted file format. In addition, you can select either to save files in compressed format, or to save files without compression.

If you have selected to save files in compressed format, files will be stored in gzip compression format with file extension “.gz”.

To specify the converted file format and storage format, click on [Format] on the side menu to display the following screen.

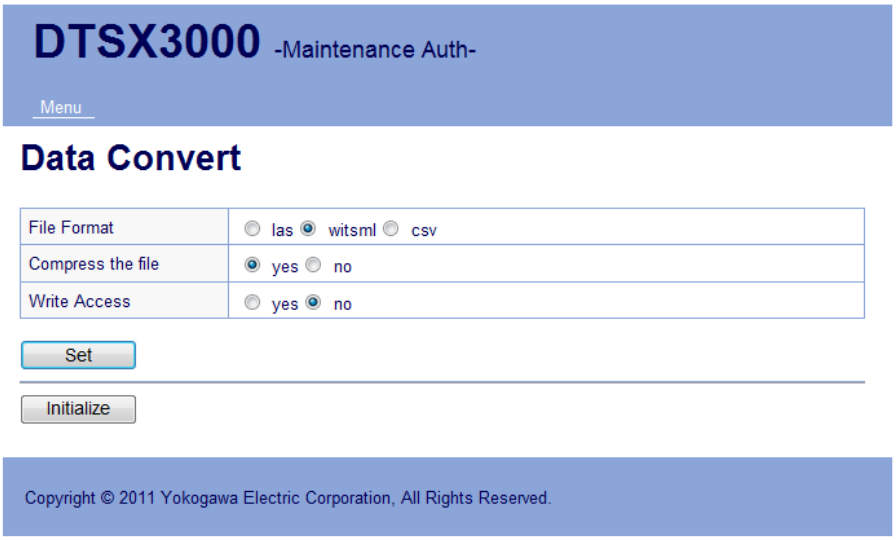
- File Format (selection of converted file format)
  Select from [LAS], [WITSML] and [CSV] for the converted file format.

Tip

A WITSML license is required for selecting converted file format [WITSML]. A WITSML license is included in the DTSX3000 Data Conversion Software WITSML1.3.1.

- Compress the file (storage format selection)
  Select [yes] to save files in compressed format; select [no] to save files without compression.
- Write Access
  Select the write access for the /mnt/data/LATEST folder.
  Select [yes] to grant write access, otherwise select [no].

After specifying the required settings, click the [Set] button. The settings will be applied after reboot.



IMPORTANT

If you change the converted file format, previously stored converted files will be deleted on the next reboot. Therefore, you should back up any required converted files using the procedure for retrieving measurement data.

SEE ALSO

For details on measurement data output, see Chapter B8, “Measurement Data Output.”

Tip

The /mnt/data/LATEST directory stores links for up to 1200 most recent converted files.

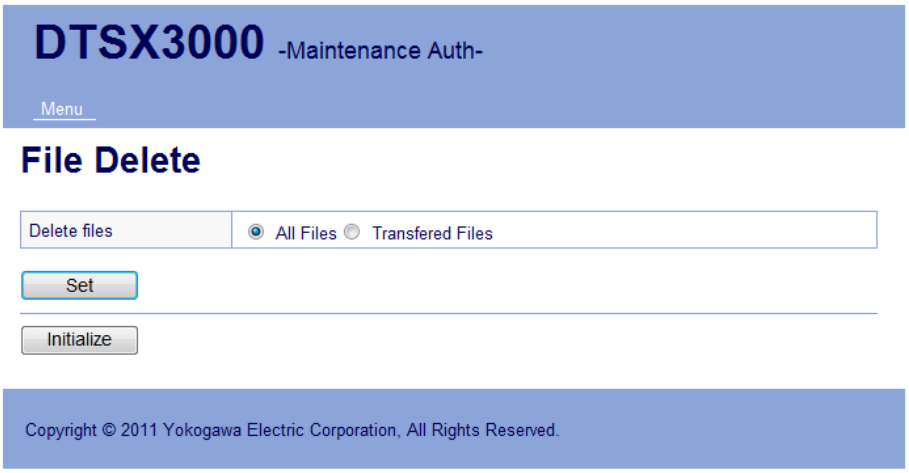
During DTSX3000 control, FAST/TOOLS needs to delete files in the /mnt/data/LATEST directory, so it is necessary to grant write access to the /mnt/data/LATEST directory.

If you are not using FAST/TOOLS, be sure to set [Write Access] to [no]. This is important as deletion of files in the /mnt/data/LATEST directory by other means may lead to unexpected problems and absolutely must not be done.

■ Deleting Generated Converted Files

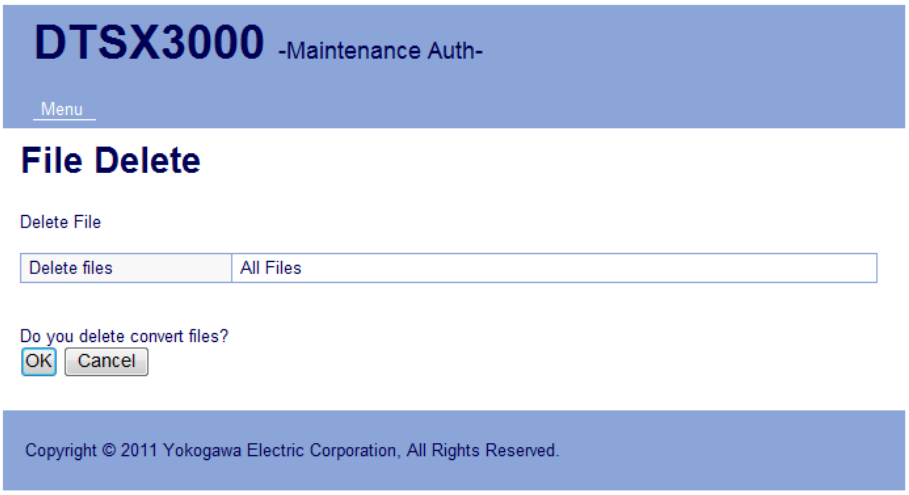
You can delete converted files stored on the DTSX3000. Deleting converted files frees up space in the converted file memory area on the DTSX3000, and might shorten processing time for saving new converted files.

To delete converted files, click [File Delete] in the side menu to display the following window.



- Delete files
  Select the files to be deleted. Select [All files] to delete all files; select [Transferred file] to delete transferred files.

Check the [Delete files] selection, and then click the [Set] button. The following confirmation window is displayed.



Check the settings, and if it is alright to delete the files, click [OK].

Tip

Deletion cannot be aborted after you click [OK] in the file deletion confirmation window.

SEE ALSO

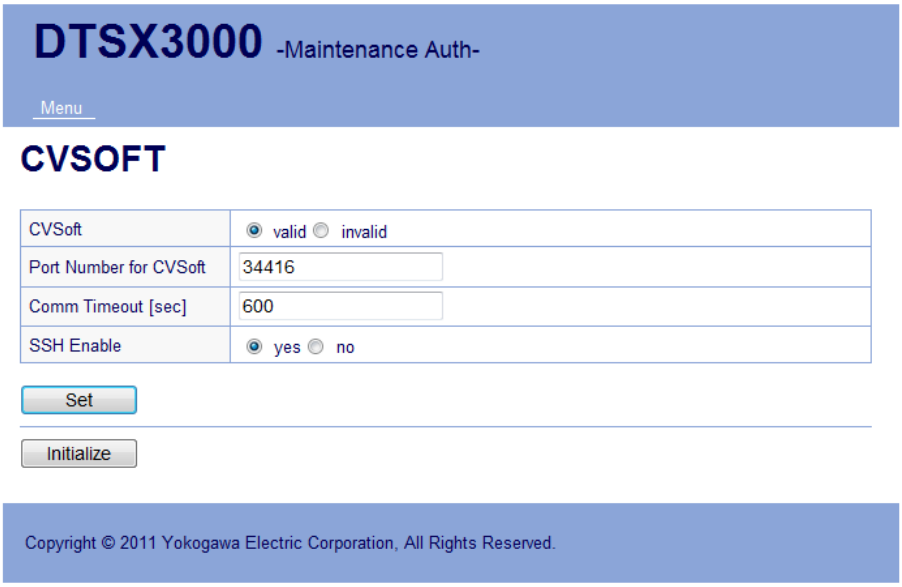
For details on the specifications of the memory area, see Chapter 5, “Measurement Data Output.”

B6.5.4. CV Software Related Settings

CV Software related settings can be used to configure communications between the DTSX3000 and the DTSX3000 Control Visualization Software as follows:

- Allow or disallow connection with the DTSX3000 Control Visualization Software
- Port number for DTSX3000
- Communication timeout duration
- Make port number public or non-public

After specifying the required settings, click the [Set] button. The DTSX3000 configuration will be updated but the changes will be applied only after reboot.



- CV Soft
  Select whether to allow connection with the DTSX3000 Control Visualization Software. Select [valid] if using the software, and select [invalid] if not using the software. Selecting [invalid] will shorten the measurement time by omitting the creation of data files used for communication between DTSX3000 and the software. The default value is [valid].

Tip

The measurement time saving achievable by disallowing connection with the DTSX3000 Control Visualization Software varies with the measurement conditions.

The DTSX3000 Data Conversion Software can always be used regardless of the value of this setting.

- Port Number for CVSoft
  Specify any port number from 1024 to 65535. The default value is 34416.
- Comm Timeout[sec]
  Specify any communication timeout duration between 5 and 1800 (seconds). The default value is 600.
- SSH Enable
  Selecting [yes] for SSH Enable makes the communications port dedicated for use by the DTSX3000 Control Visualization Software non-public (disallows connection externally of DTSX3000). To connect to the communications port, port forwarding by SSH is required. Selecting [yes] for SSH Enable makes the port public (allows connection externally of DTSX3000).

B6.6. List of Error Messages

The following tables lists and describes the messages displayed in the auxiliary information display area.

● Top Page

Message	Description
Error: can not read "Log alarm level".	Loading of system log or application log has failed.
Fatal: can not read "Ras information".	Loading of RAS information has failed.
Fatal: can not read "Network information".	Loading of Network information has failed.

● RAS information display window

Message	Description
Info: Nodata	No RAS information is available. * This message is displayed immediately after shipment when no RAS information has been created yet.

● User management window

Message	Description
Error. Passwords are less than six characters.	A specified password is too short. A password must be at least 6 characters long.
Error. Passwords don’t match	The entered password and confirmation password do not match.
Error: user exists. [username]	A specified username is already registered.
Error: user doesn’t exist. [username]	A specified username is not registered.
Error: can not register eleven or more users.	A new user could not be added because the maximum limit of ten users was exceeded.
Error: can not delete user dtsx.	Deleting the dtsx user is not allowed.
Error: can not regist user root.	Adding a root user is not allowed.
Error: can not set timezone. [***]	The format of the specified time zone is invalid.

● Network configuration window

Message	Description
Error: Etchosts isn’t a pair. [***,…]	Either the hostname or IP address is missing for a host. You need to enter both values for each host.
Notice: Please set "IP Address" and "Subnet Mask".	You need to specify the IP address and subnet mask. * This message is displayed after DTSX3000 system initialization. It is not displayed in normal operation.

● Date and time configuration window

Message	Description
Error: Not date format	The format of the specified date is invalid.
Error: Illegal date	The numeric value specified for year, month or date is invalid.
Error: Not time format	The format of the specified time is invalid.
Error: Illegal time	The numeric value specified for hour, minute or second is out of the valid range of 00:00:00 to 23:59:59.

● Web server configuration window

Message	Description
Error. "HTTPS Enable" can not be set to "yes". [a certificate is nothing.]	No SSL server certificate is installed in the DTSX3000. For details on how to install an SSL certificate, see Subsection B6.4.6, “Web Server Configuration (Web)."

● PPP server configuration window

Message	Description
Error. Local IP address and remote IP address is a duplicate value.	The specified local IP address and remote IP address are the same.
Error. Passwords are less than six characters.	The specified password is shorter than the minimum limit of 6 characters.
Error. Passwords don’t match.	The specified password and confirmation password are not the same.
Error: Duplicate username. [***,…]	The specified username is already registered.

● NTP server configuration window

Message	Description
Error: The server isn’t registered.	The NTP server fields are empty. If you have selected Yes for NTP Enable, you must specify at least one NTP server.

● Reboot/Shutdown window

Message	Description
Notice: If you changed IP Address, please change the URL.	As the IP address of the DTSX3000 has been changed, you should change the URL accordingly when accessing the DTSX3000 from a Web browser. * This message is displayed after reboot if the IP address has been changed before reboot.

● CV software related settings window

Message	Description
Error : Port number that can be used are from 1024 to 65535	The specified port number must be from 1024 to 65535.
Error : Timeout that can be used are 5 to 1800.	The specified timeout value must be from 5 to 1800.
Error : Port number for cvsoft conflicts with modbustcp	The specified port number conflicts with the port number used for modbustcp.

● Modbus TCP related settings window

Message	Description
Error : Port number that can be used are 502 or from 1024 to 65535	The specified port number must be 502 or from 1024 to 65535.
Error : Timeout that can be used are 5 to 1800.	The specified timeout value must be from 5 to 1800.
rror : Port number for modbustcp conflicts with cvsoft	The specified port number conflicts with the port number used for cvsoft.

● Modbus serial related settings window

Message	Description
Error : Slave address that can be used are from 1 to 247	The specified address must be from 1 to 247.

● Common messages

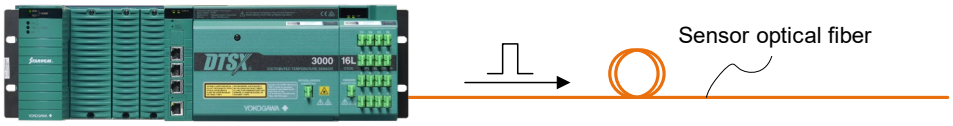
Message	Description
Error: Multi web accessed.	Configuration is performed from multiple Web browsers running on the same PC. Close the Web browser and access the Web page again.
Error: Empty	A required setting is empty. Enter the required data.
Error. Illegal character.	An entered character is illegal.
Error. Illegal format.	The format of an entered value for an IP address or some other setting is illegal.
Error: can not read.	Reading of an internal file has failed.
Fatal(***): Internal Error. [title]	An internal error has been detected.
Fatal: can not write. [filename]	Writing to an internal file has failed.
Fatal: can not initialize. [filename]	Initialization has failed.
Fatal(***): can not read default file. [filename]	Reading of an internal file has failed.

B7. Temperature Measurement

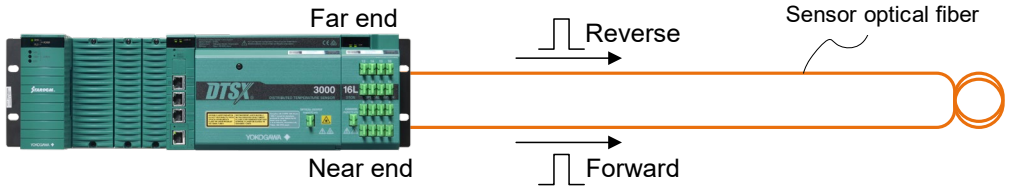
B7.1. Overview

The DTSX3000 supports both single-ended and double-ended distributed temperature measurement. In single-ended measurement, a light pulse is launched from one end of the sensor optical fiber and the returned Raman scatter is measured to determine temperature distribution. In double-ended temperature measurement, a light pulse is launched from each of the two ends of the sensor optical fiber and the returned Raman scatter is measured separately to determine temperature distribution.

<Single-ended measurement>



<Double-ended measurement>



B7.2. Measurement Sequence

You can define the execution order within one measurement sequence using a sequence table as described later in Subsection B7.2.1, “Sequence Table Settings” and then define the execution order between measurement sequences using sequence control as described in Subsection B7.2.2, “Sequence Control.”

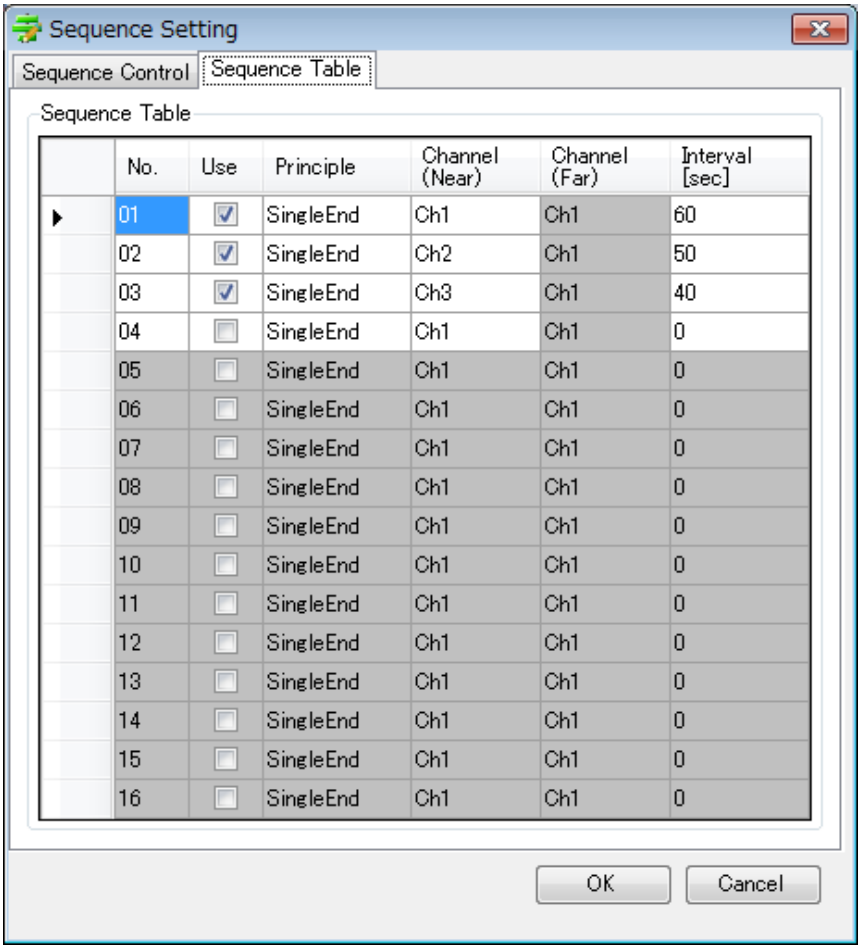
B7.2.1. Sequence Table Settings

Each setting can be written to its associated register in the DTSX3000 via Modbus.

For ease of understanding, we describe each setting using sample screen captures of the configuration windows of the DTSX3000 Control Visualization Software (DTAP3000), which is available as a separate purchase.

SEE ALSO

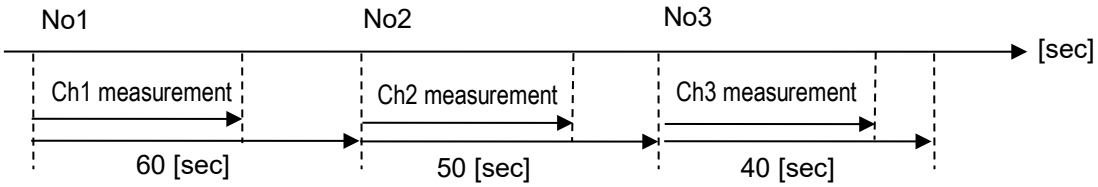
For information on the mapping between individual items in the configuration windows and the Modbus registers, see the DTSX3000 Communications Guide (IM39J06B40-02EN).



Up to 16 entries (the limit depends on whether an optical switch is installed and the number of installed channels) can be configured in the sequence table as described below.

- Use
  Select the checkbox of a table entry to enable it.
- Principle
  Select [Single End] for single-ended measurement or [Double End] for double-ended measurement.
- Channel Near
  Select a channel from Ch1 to Ch16 as the forward direction channel in double-ended measurement.
- Channel far
  Select a channel from Ch1 to Ch16 as the reverse direction channel in double-ended measurement. This item is enabled only when double-ended measurement (Double End) is selected. The selected channel must be different from the selected forward direction channel.

- Interval
  Specify a value from 0 [s] to 3600 [s] in units of 1 [s]. The preceding sample screen capture defines the following sequence:
  Ch1 measurement → wait until 60 seconds after beginning of Ch1 measurement → Ch2 measurement → wait until 50 seconds after beginning of Ch2 measurement → Ch3 measurement → wait until 40 seconds after beginning of Ch3 measurement.
  If the execution time for measurement is longer than the specified measurement interval, the next measurement begins immediately after the current measurement ends.



SEE ALSO

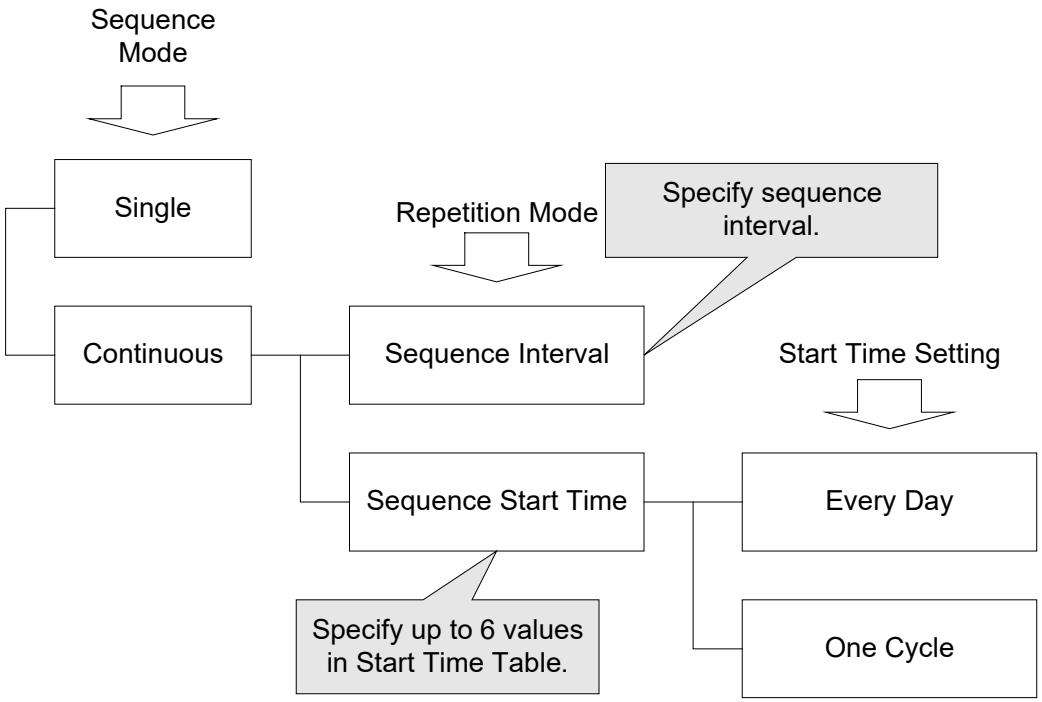
For details on double-ended measurement, see Subsection B1.1.2, “Double-ended Measurement Settings.”

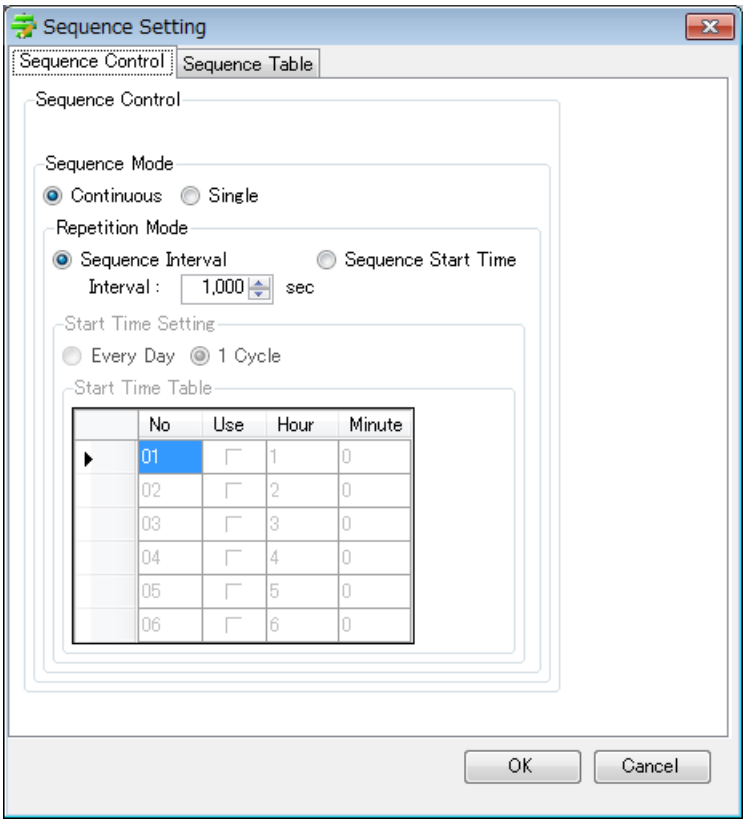
Tip

- To configure Ch2 to Ch16, you need to purchase additional optical fibers.
- The same channel cannot be selected more than once in the sequence table.

B7.2.2. Sequence Control

By specifying the sequence mode, repetition mode, sequence interval and sequence start time, you can define the sequence control conditions for the sequence table described in Subsection B7.2.1, “Sequence Table Settings.”


Sequence Mode
Single
Continuous
Repetition Mode
Specify sequence interval.
Sequence Interval
Start Time Setting
Sequence Start Time
Every Day
One Cycle
Specify up to 6 values in Start Time Table.

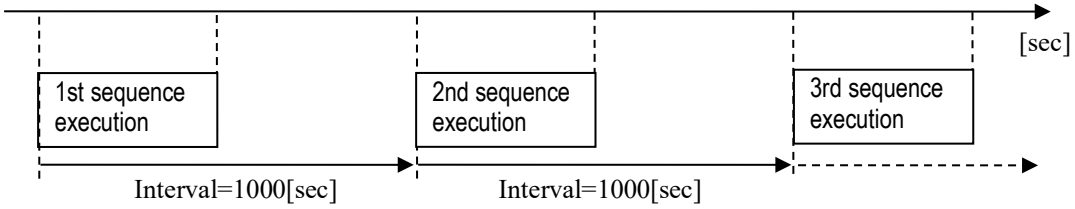

Sequence Setting
Sequence Control
Sequence Table
Sequence Control
Sequence Mode
Continuous
Single
Repetition Mode
Sequence Interval
Sequence Start Time
Interval :
1,000
sec
Start Time Setting
Every Day
1 Cycle
Start Time Table
No
Use
Hour
Minute
01
02
03
04
05
06
OK
Cancel

- Sequence Mode
  If [Single] is selected, the sequence defined in Subsection B7.2.1, “Sequence Table Settings” is executed once, after which measurement stops. If [Continuous] is selected, the sequence defined in sequence table settings is executed repeatedly until a stop measurement command is received.
  If [Continuous] is selected, the sequence is executed repeatedly according to the Repetition Mode settings.

- Repetition Mode
  Specify the repetition mode for repeating the execution of the sequence table when [Continuous] is selected for [Sequence Mode]. For repetition mode, select either [Sequence Interval] and specify the interval between two start times in the sequence table, or [Sequence Start Time] and specify the start times table.

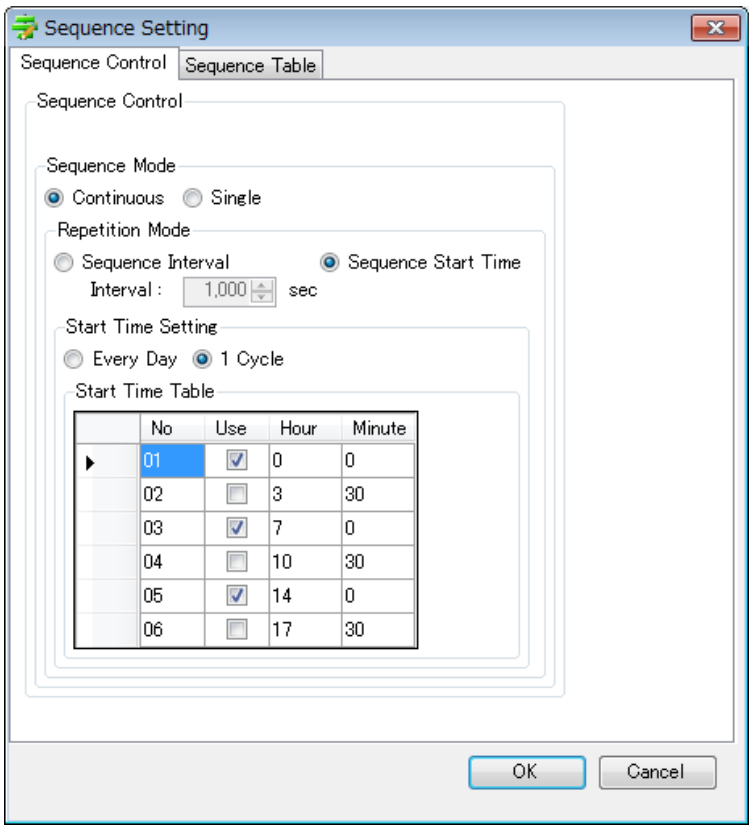
  If [Sequence Interval] is selected, specify [Interval] (the interval between two start times in the sequence table) as a value from 0 seconds to 86400 seconds in units of 1 second.

  The sample settings shown in the preceding screen capture defines the following sequence execution:

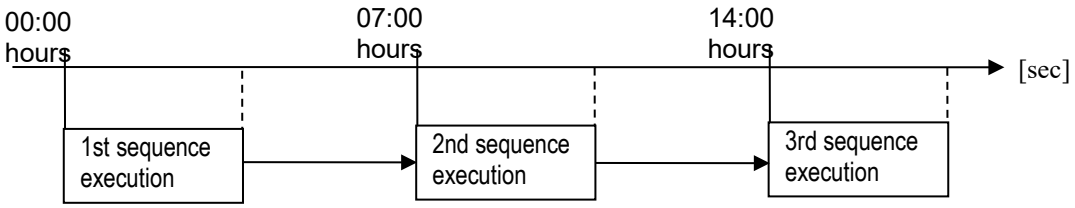


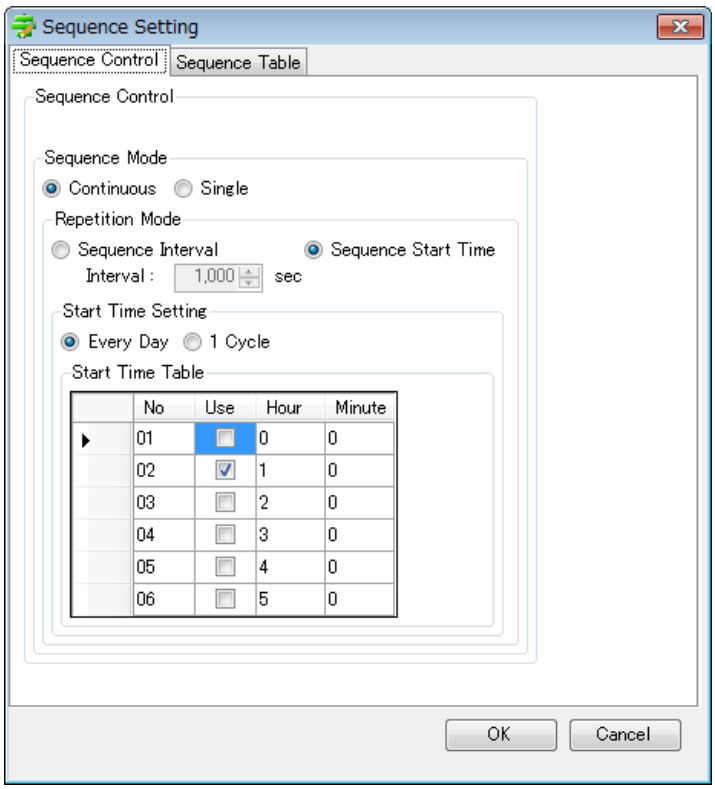
  If the execution time for measurement is longer than the specified measurement interval, the next measurement begins immediately after the current measurement ends.

  If [Sequence Start Time] is selected, measurement starts from the first line of the sequence table at the specified starting times. Up to 6 start times in hhmmss format (24-hour time representation) can be specified in the [Start Time Table].
  If [Start Time Setting] is specified as [Every Day], measurement starts from the first line of the sequence table at the times specified in the [Start Time Table] every day.
  If [Start Time Setting] is specified as [1 Cycle], measurement is executed at the start times specified in the [Start Time Table] once, after which measurement stops.

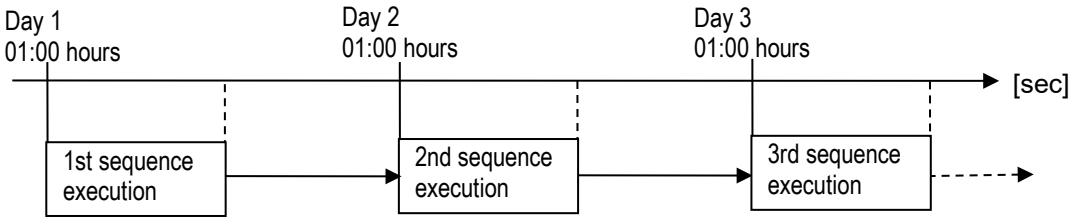


In the example shown above (where [Start Time Setting] is 1 Cycle), the measurement sequence is executed thrice at 00:00, 07:00 and 14:00 hours respectively, after which the system goes into idle mode.



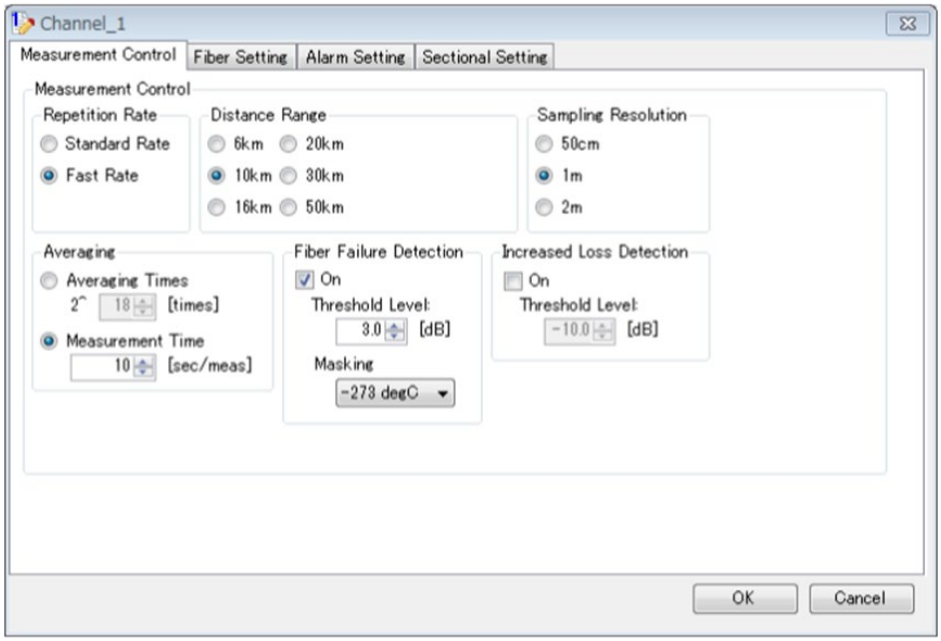


In the example shown above, the measurement sequence is executed every day at 01:00 hours.



B7.3. Channel Settings

You can configure parameters related to measurement time and measurement accuracy for each channel using channel settings.



Tip

Only settings for the channel specified as Channel (Near) as described in Subsection B7.2.1, “Sequence Table Settings” are valid.

- Reptation Rate
  Select either Standard Rate or Fast Rate. Selecting fast rate shortens the repetition cycle and accordingly the measurement time but will result in larger measurement error due to reflection if the optical fiber used does not have anti-reflection termination so standard rate should be selected unless there is some special reason not to do so.

- Distance Range
  Select from 6 km, 10 km, 16 km, 20 km, 30 km and 50 km, taking into consideration the sensor optical fiber length. The selected distance range must be longer than the length of the connected sensor optical fiber.

Tip

The available distance range options depend on the suffix code (the character following the hyphen character) as follows:

- N: [6km], [10km], [16km]
- S: [6km], [10km]
- M: [6km], [10km], [16km], [20km], [30km]
- L: [6km], [10km], [16km], [20km], [30km], [50km]

The suffix code is displayed in the System Configuration window as System ID.

SEE ALSO

For details on the System Configuration window, see Chapter B6, “System Configuration.”

- Sampling Resolution
  Select either 1 m or 2 m for the sampling resolution.
  The maximum allowable sampling size is 32000. Accordingly, the specified distance range divided by the specified sampling resolution must not exceed 32000.

	6 km	10 km	16 km	20 km	30 km	50 km
50 cm	✔	✔	✔	-	-	-
1 m	✔	✔	✔	✔	✔	-
2 m	✔	✔	✔	✔	✔	✔

- Averaging
  Select either Averaging Times to specify the number of measurements used for averaging or Measurement Time to specify the measurement time.
  If Averaging Times is selected, specify a value as a power of 2 from 12 to 28 (2^{12} to 2^{28}) in units of 1 (2^{1}).
  If Measurement Time is selected, specify a value from 1 [sec] to 86400 [sec] in units of 1 [sec]. The specified [Measurement Time] is used together with the [Reptation Rate], [Distance Range], [Sampling Resolution] and [Principle] settings to calculate the number of measurements to be used for averaging. If the calculated value exceeds 2^{28}, it is taken as 2^{28}.
  The measurement time excludes alarm detection time, sectional data generation time and measurement data file creation/transfer time.

Tip

- The [Averaging] parameter determines the number of measurements used for averaging. Averaging can be used to improve the signal-noise ratio when the Raman scatter signal level is very weak.

SEE ALSO

- For details on the [Principle] setting, see Subsection B7.2.1, “Sequence Table Settings.”
- For details on alarm decision, see Chapter B9, “Alarm Detection.”
- For details on sectional data generation, see Chapter B10, “Sectional Data Generation.”
- For details on measurement data file creation/transfer time, see Chapter B8, “Measurement Data Output”

- Fiber Failure Detection
  Specify the condition for sensor optical fiber failure detection. If ON is selected, a fiber failure is detected, and an alarm is generated if the ST value exceeds the specified [Threshold] (sensor optical fiber threshold value) during measurement.
  Specify a threshold level from 0.1 [dB] to 99.9 [dB] in units of 0.1 [dB].
  If ON is not selected, fiber failure detection is not done.

Tip

Fiber failure is detectable from 0 [m] to [Fiber End] - X [m], where X varies with [Fiber End] (length).

<Reference> 0～10 km : X=10[m], 10～20km : X=20[m], 20～30km : X=30[m], 30～40km : X=40[m], 40～50km : X=50[m]

- Masking
  When a fiber failure is detected, it masks temperature in the range where temperature cannot be measured due to fiber failure.
  OFF : does not mask.
  999 degC : masks temperature to +999 degC.
  -273 degC : masks temperature to -273 degC.

Tip

- Masking is effective when DTSX3000 firmware R1.06.01 or later and DTAP3000 R1.06.01 or later versions are combined.
- Masking is enabled when Fiber Failure Detection is selected as On.

- Increased Loss Detection
  Specify the condition for increased loss detection. If ON is selected, an increased loss alarm is generated if the CFL level near the far end of the sensor fiber falls below the specified [Threshold] (detection threshold value) during measurement. Specify a threshold level from -99.9 [dB] to 0.0 [dB] in units of 0.1 [dB].
  If ON is not selected, increased loss detection is not done.

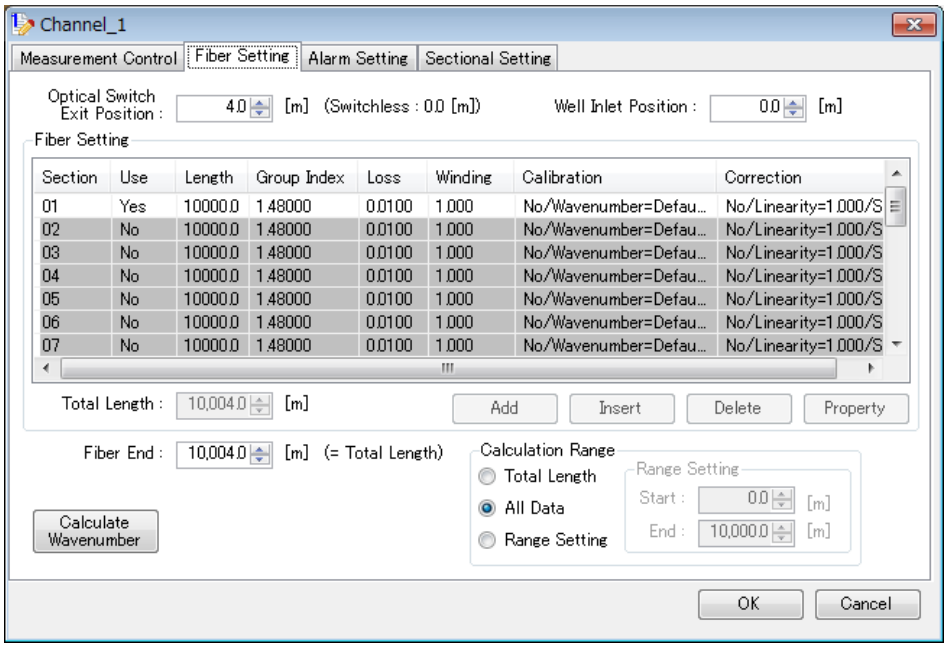
Tip

An increased loss alarm is generated if the CFL level near the far end (at position [Fiber End] - X [m]) of the sensor fiber falls below the specified Threshold Level, where X varies with [Fiber End] (length).

<Reference> 0～10 km : X=10 [m], 10～20 km : X=20 [m], 20～30 km : X=30 [m], 30～40 km : X=40 [m], 40～50 km : X=50 [m]

B7.3.1. Fiber Settings

These parameters are required for calculating temperature from the measurement result.



- Optical Switch Exit Position
  Define the exit position of the optical switch relative to the DTSX3000 exit position, which is taken as 0 m. Specify a value from 0.0 [m] to 50000.0 [m] in units of 0.1 [m].

Tip

Specify 0.0 [m] if no optical switch is installed.

- Well Inlet Position
  Specify the well inlet position relative to the DTSX3000 exit position as a value from 0.0 [m] to 50000.0 [m] in units of 0.1 [m].
  This parameter is used when distance values are converted to depth values for an axis. The well inlet position is taken as Depth=0.0.

- Fiber End
  Specify the sensor optical fiber end as a value from 0.0 [m] to 50000.0 [m] in units of 0.1 [m].

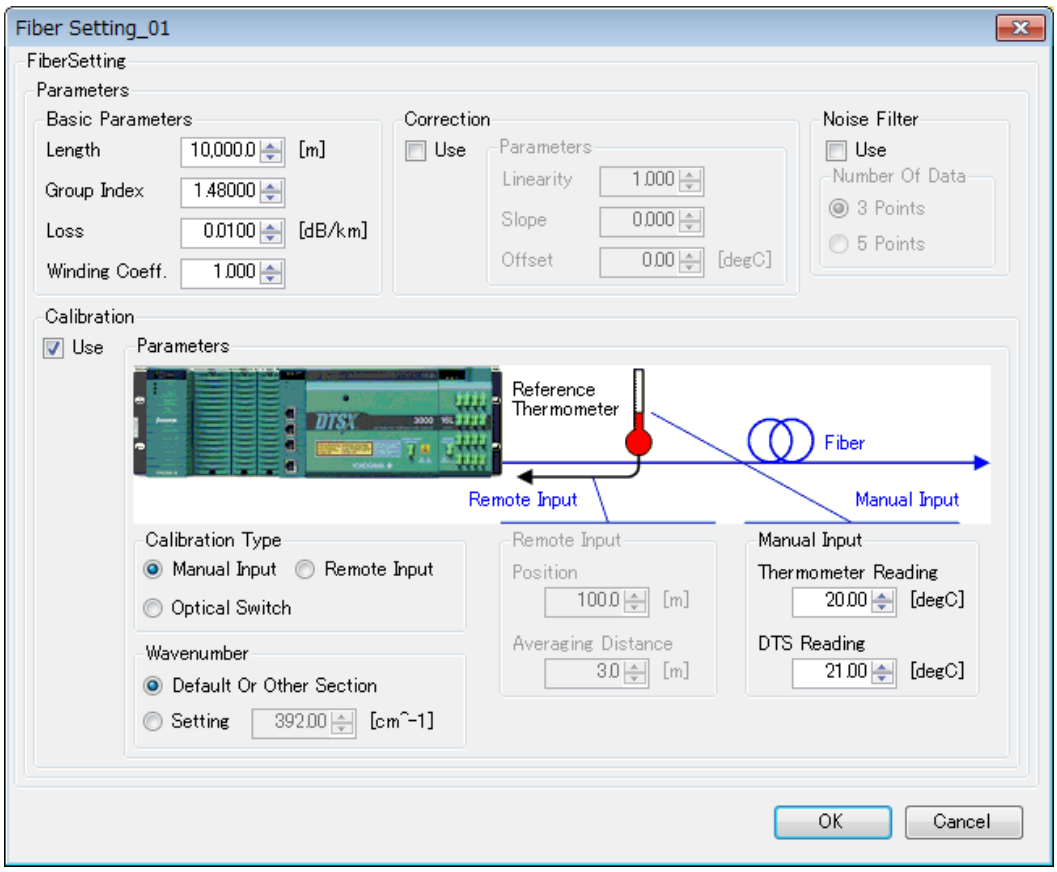
Tip

Sensor optical fiber failure is not detected beyond the sensor optical fiber end.

- Calculation Range
  Select the range to be used for calculation from among Total Length, All Data and Range Setting. The distance axis range specified here is used for temperature data output (Modbus or measurement data files), alarm detection and sectional data calculation.
  If Total Length is selected, the range up to the end of the fiber is used for calculation.
  If All Data is selected, the distance selected for distance range is used for calculation.
  If Range Setting is selected, the specified range from [Start] to [End] of Range Setting is used for calculation. Specify a value from 0.0 [m] to 50000.0 [m] in units of 0.1 [m] for [Start], as well as [End]. Specifying a value less than zero for [Start] or [End], or specifying a [Start] value larger than the [End] value is not allowed.

Tip

- If the specified calculation range exceeds the distance range, the distance range is used for calculation.



■ Basic Parameters

Up to 20 sensor optical fibers can be connected. Basic Parameters can be specified for each of the fibers to be connected.

- Length
  Specify the sensor optical fiber length of a fiber section as a value from 0.0 [m] to 50000.0 [m] in units of 0.1 [m].
- Group Index
  Specify the group refractive index of a fiber section as a value from 1.3 to 1.79999 in units of 0.00001. Distance is calculated using the specified group refractive index.
- Loss
  Specify the transmission loss of a fiber section as a value from -9.999 [dB/km] to 9.999 [dB/km] in units of 0.001 [dB/km].

Tip

- The Stokes and anti-Stokes signals of the Raman scatter suffer different fiber loss because of their different wavelengths. Specify the differential loss for a fiber section to correct for this type of temperature error.
- For double-ended measurement, the Loss setting need not be specified because the measurement results of the forward and reverse directions are combined. Even if specified, it will not affect the temperature calculation result. However, the Loss setting is required when a fiber failure is detected. If fiber failure happens, the measurement results up to the fiber failure position of the forward and reverse directions are combined.

- Winding Coeff
  Specify the winding coefficient of a fiber section as a value from 0.001 to 99.999 in units of 0.001.
  The winding coefficient is used when distance values are converted to depth values for an axis using the following formula:
  Depth = (Distance－Well Inlet Position)/ Winding Coeff.

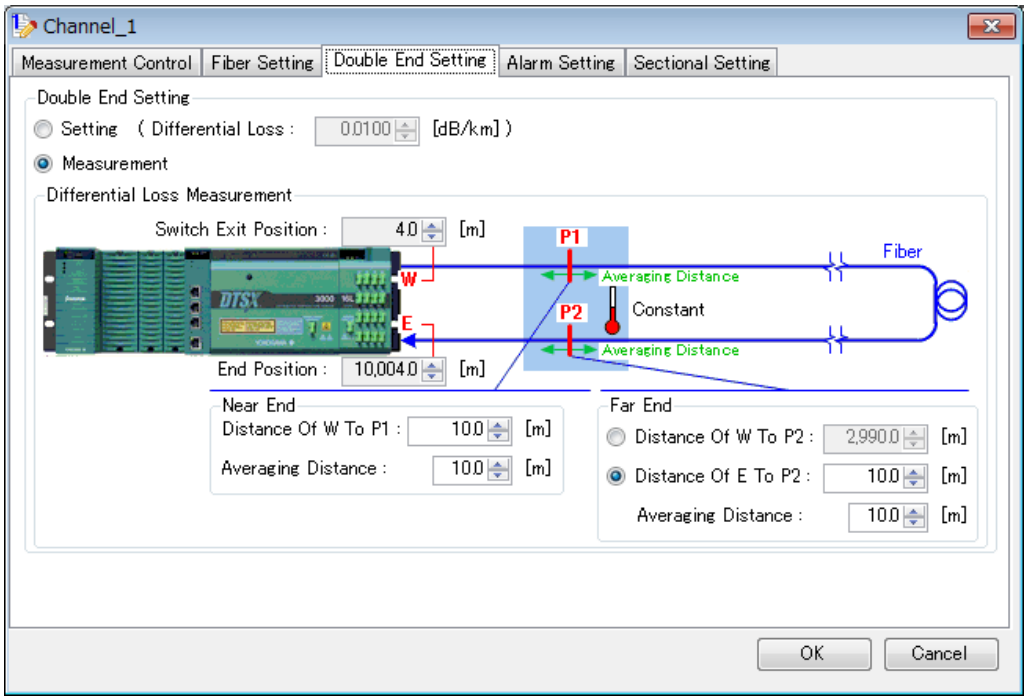
SEE ALSO

For information on the setting parameters for calibration, correction and noise filter, see Chapter B7.3.3, “Calibration”.

B7.3.2. Double-ended Measurement Settings

As measurement results of the forward and reverse directions are combined in double-ended measurement, loss correction is not required. However, absolute temperatures must still be corrected for the total differential loss between the Stokes and anti-Stokes light over the full fiber length.

Double-ended measurement settings are used for calculating the total differential loss between the Stokes and anti-Stokes light over the full fiber length.



You can select either to use a known differential loss value or use the execution result of differential loss measurement.

■ Using a known differential loss

Select [Setting] and enter the differential loss.

- Differential Loss
  Enter the total differential loss between the Stokes and anti-Stokes signals over the full fiber length as a value from -9.999 [dB/km] to 9.999 [dB/km] in units of 0.001 [dB/km].

Tip

- We recommend using the default value of 0.220 [dB/km] for Differential Loss.
- Specify 0.000 [dB/km] for Differential Loss to perform no correction.

■ Using the execution result of differential loss measurement

Select [Measurement] and specify the following parameters for differential loss measurement.

● Specifying the Near End

- Distance Of W To P1
  Specify the near end P1 (by its distance from the switch exit position W) as a value from 0.0 [m] to 50000.0 [m] in units of 0.1 [m].
- Averaging Distance
  Specify the near-end averaging distance (distance in meters centered at the near end to be used for correction) as a value from 5.0 [m] to 20.0 [m] in units of 0.1 [m].

● Specifying the Far End

Select whether to specify the far end P2 as a (forward) distance from the switch position W (Distance Of W to P2) or as a (reverse) distance from the sensor optical fiber end E (Distance Of E To P2).

- Distance Of W To P2
  To specify the far end P2 as a (forward) distance from the switch position W, select [Distance Of W To P2], and specify a value from 0.0 [m] to 50000.0 [m] in units of 0.1 [m].
- Distance Of E To P2
  To specify the far end P2 as a (reverse) distance from the sensor optical fiber end E, select [Distance Of E To P2], and specify a value from 0.0 [m] to 50000.0 [m] in units of 0.1 [m].
- Averaging Distance
  Specify the far-end averaging distance (distance in meters centered at the far end to be used for correction) as a value from 5.0 [m] to 20.0 [m] in units of 0.1 [m]

Tip

- The temperatures at the specified near-end and far-end positions must be the same.
- If continuous sequence mode is selected, differential loss is averaged over the repeated measurements. This improves the accuracy especially for the far-end where signal-to-raise ratio is poor.

B7.3.3. Calibration

Calibration must be done to achieve accurate temperature measurement by setting calibration parameters in the DTSX3000 beforehand.

■ Calibration

To perform temperature calibration, select [Use], and then specify the following parameters.

- Calibration Type
  Select the calibration type from Manual Input, Remote Input and Optical Switch.

  For the [Manual Input] calibration type, DTSX3000 temperature measurement (DTS Reading) offset is calibrated using the temperature reading of an external thermometer (Thermometer Reading). If [Manual Input] is selected, specify the temperature reading of an external thermometer, and the DTSX3000 measured temperature.
  - [Thermometer Reading]
    Specify the temperature reading of an external thermometer as a value from -273.15 [deg C] to 999.99 [deg C] in units of 0.01 [deg C].
  - [DTS Reading]
    Specify the DTSX3000 temperature measurement reading before calibration as a value from -273.15 [deg C] to 999.99 [deg C].

  For the [Remote Input] calibration type, DTSX3000 temperature measurement offset is calibrated using actual thermometer temperature reading at a specified position. If [Remote Input] is selected, specify the position for temperature calibration, and the temperature averaging distance of the DTSX3000.
  - Position
    Specify the position for temperature calibration as a value from 0.0 [m] to 50000.0 [m] in units of 0.1 [m]
  - Averaging Distance
    Specify the distance in meters centered at the specified position to be used for averaging in temperature calibration as a value from 1.0 [m] to 20.0 [m] in units of 0.1 [m].

  For the [Optical Switch] calibration type, DTSX3000 temperature measurement offset is calibrated using settings stored in the optical switch memory.

Tip

- The Optical Switch option can only be selected as the Calibration Type for the first fiber section.
- If no optical switch is installed, temperature calibration is not performed.

- Wavenumber
  Specify the wavenumber. This parameter determines the temperature scale factor. Select [Default Or Other Section] or [Setting] as the wavenumber setting mode.

  If [Default Or Other Section] is selected, the average of the wavenumber values specified for other fiber sections is used as the wavenumber. If no fiber section is specified with a wavenumber, the default wavenumber value is used.
  If [Setting] is selected, a specified wavenumber is used. Specify the wavenumber as a value from 0.01 cm^{-1} to 999.99 cm^{-1} in units of 0.01 $cm^{-1.}$

The wavenumber can also be calculated using pre-calibration DTSX3000 measured data and the temperature readings of a reference thermometer.

SEE ALSO

For details on how the wavenumber is calculated, see Chapter C2.

■ Correction

The correction function performs correction of DTSX3000 measured temperature using linear correction coefficients. We do not recommend using this correction function of the DTSX3000; it is provided for compatibility reasons. To perform temperature correction using linear correction coefficients, enable [Use] and specify the following parameters.

- Linearity
  Specify the linearity as a value from 0.001 to 9.999 in units of 0.001.
- Slope
  Specify the temperature slope (the temperature change [deg C] per 100 meters) as a value from -9.999 to 9.999 in units of 0.001.
- Offset
  Specify the temperature offset as a value from -273.15 [deg C] to 999.99 [degC] in units of 0.01 [deg C].

The corrected measured temperature is calculated using the following formula:

Corrected temperature (°C)

= Linearity x pre-correction temperature (°C) + Slope x (Depth (m) / 100) + Offset (°C)

■ Noise Filter

A noise filter can be installed at ±5 m of an optical fiber splice point to reduce spike noise.

A noise filter can be configured for each spliced fiber section; the setting will apply to the splice connecting the previous section. For instance, if a noise filter function is defined for section 2 of the sensor optical fiber, a noise filter is installed at ±5 m of the boundary between section 1 and section 2.

A median filter is used for noise filtering.

To use the noise filter function, enable [Use], and specify the following parameter.

- Number Of Data
  Select either 3 Points or 5 Points for the number of points for the median filter.

B7.4. Executing Measurement

B7.4.1. Executing Measurement and Checking Status

After specifying the above settings, you can start measurement.

You can also check created measurement data, reported errors and other statuses during measurement.

SEE ALSO

For details on remote commands for executing measurement and checking statuses, see the "DTSX3000 Communications Guide (IM39J06B40-02EN)".

B7.5. Optical Switch (optional)

When used with an optional optical switch, which is available as a separate purchase, the DTSX3000 allows up to 16 optical fibers to be connected for multi-channel measurement by auto channel switching. The optical switch is available in 3 models supporting 2 channels, 4 channels and 16 channels respectively to suit different applications. For details on how to connect the optical switch and the DTSX3000, as well as how to connect optical fibers, see the Hardware part of this manual.

TIP

The optical switch can be controlled by the DTSX3000 to perform channel switching or other operations according to user-defined sequence tables so remote control from a PC is not required.

SEE ALSO

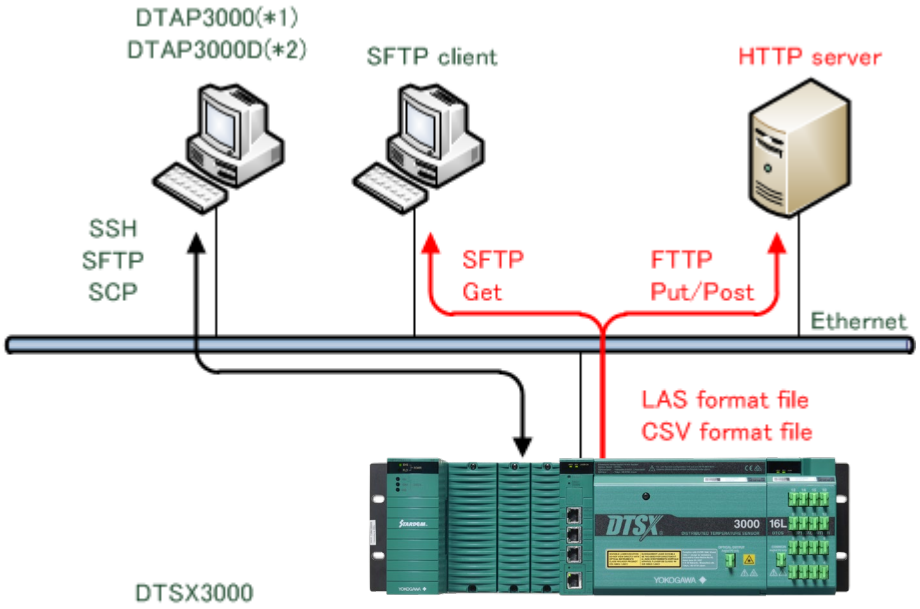
For details on how to connect the optical switch and the DTSX3000, as well as how to connect sensor optical fibers, see chapter A5.

B8. Measurement Data Output

B8.1. Overview of Data Output

The DTSX3000 converts measured data into LAS (Log ASCII Standard version 2.0) formatted or CSV formatted files and stores them in its non-volatile internal memory area. More than 100 converted data files can be stored in its memory area.

Converted data files stored in the DTSX3000 can be retrieved externally using SFTP client software or transferred to an external HTTP server using the HTTP transmission function of the DTSX3000.



(*1)DTAP3000 Control Visualization Software
(*2)DTAP3000D Data Conversion Software

■ Data Output Conditions

The DTSX3000 can generate LAS formatted and CSV formatted converted data files.

The data types, well information and other data to be output to the respective converted data files can be configured either via Modbus or using the DTSX3000 Data Conversion Software.

This section describes the settings related to the respective converted data files.

SEE ALSO

- For details on the data conversion software, see the “DTAP3000 LAS 2.0 Guide (IM39J02B40-02EN)”.
- For details on configuration via Modbus, see the “DTSX3000 Communications Guide (IM39J06B40-02EN)”.

B8.1.1. LAS Files

The mapping between configuration items and output items in LAS files is described in this subsection.

■ Configuration Items

Well information and data output conditions can be configured.

Well information specifies locality and other information about the well to be measured, as well as the output format of measurement start date and time in LAS files.

Data output conditions define the measurement data types to be output to LAS files, and their units.

The table below lists the configuration items.

No	Item	Data	Tip
1	COMPANY	Company name	-
2	WELL	Well name	-
3	FIELD	Field name	-
4	LOCATION	Location name	-
5	PROVINCE	Province name	Select between this item and item 6.
6	COUNTY	County name	Select between this item and item 5.
	STATE	State name	
	COUNTRY	Country name	
7	SERVICE Corp	Service company name	-
8	DATE	Measurement start date and time	Specify the output format for measurement start date and time and whether to use UTC or local time representation.
9	UNIQUE WELL ID	WELL ID	Select between this item and item 10.
10	API NUMBER	API number	Select between this item and item 9.
11	LICENSE No	License number	-
12	Date Type	Output data selection	Select whether to output each of the following data types: Length(actual distance) Depth(depth) Temp(temperature) ST(stokes intensity data) AS(anti-Stokes intensity data) CFL(Calculated fiber loss) Select either Length or Depth but not both for distance-related data.
13	Unit of Distance	Unit of distance	Select from: m(meter) feet yard mile
14	Unit of Temperature	Unit of temperature	Select from: K(kelvin) degC(Centigrade) degF(Fahrenheit)

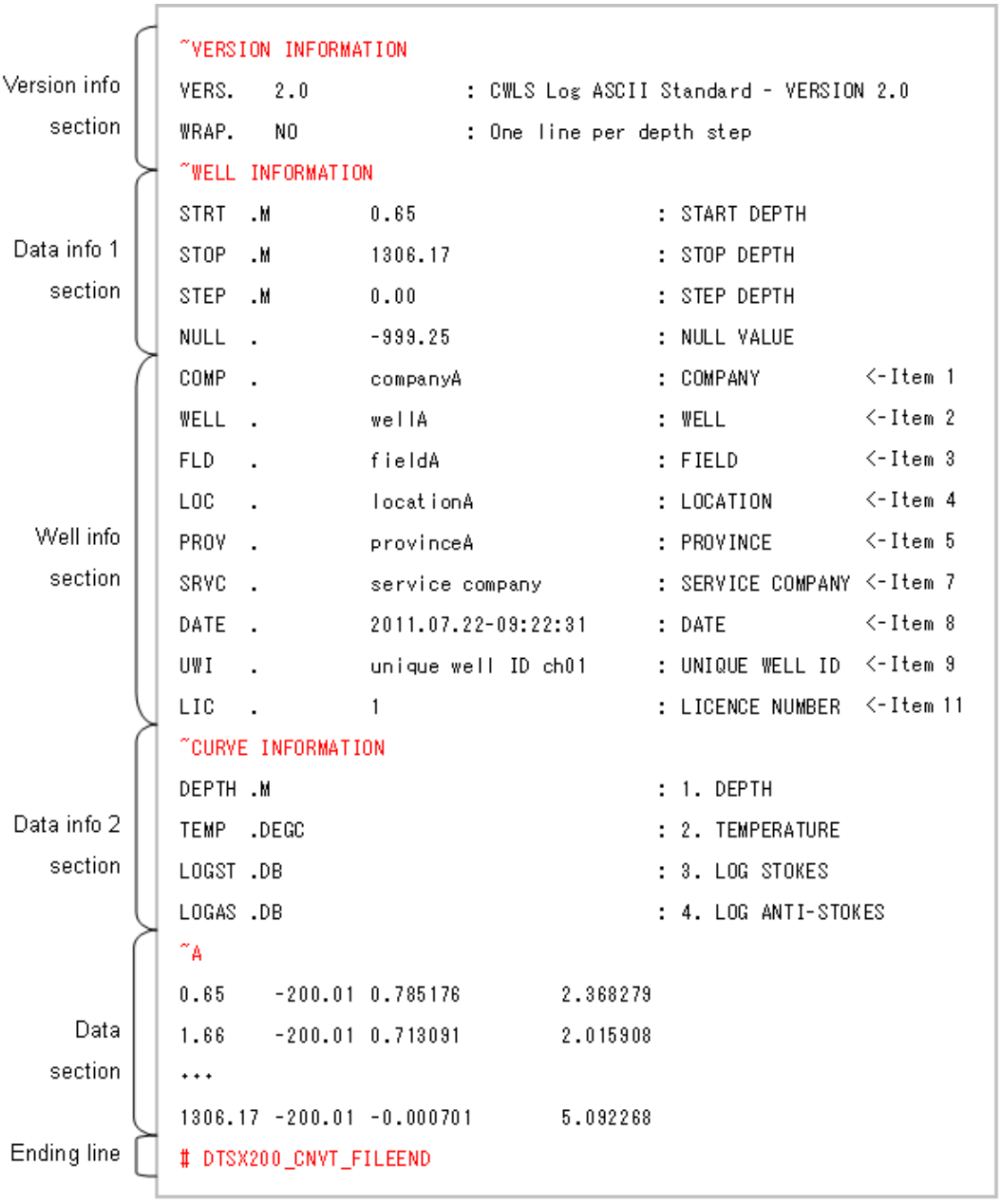
For Items No.1 to No.11 above, the specified data values are output to the LAS file.

SEE ALSO

For details on the measurement start time, see Subsection B8.2.3, "Format of Measurement Start Time."

■ LAS File Format

The figure below shows a sample LAS file. Any text following a pound (#) character or a colon (:) character on a line is comment text.



Message	Description
Version info section	Information about the LAS format version.
Data info 1 section	START, STOP and STEP indicating the start position, end position and interval between data in the depth direction. STEP indicates the depth interval between measured data if the interval is constant and indicates 0 if the interval is variable. A constant value is output for NULL.
Well info section	Specified and selected settings. DATE indicates the measurement start date and time.
Data info 2 section	Column headings and units of output data.
Data section	Depth, temperature, Stokes intensity, anti-Stokes intensity data and CFL (calculated fiber loss) of measured data.
Ending line	Comment text representing the ending line of the file.

TIP

The number of data values contained in the data section varies with the Calculation Range setting.

SEE ALSO

For details on the calculation range, see Subsection B7.3.1, "Fiber Settings."

B8.1.2. CSV Files

The mapping between configuration items and output items in CSV files is described in this subsection.

■ Configuration Items

Well information and data output conditions can be configured.

Well information specifies locality and other information about the well to be measured, as well as the output format of measurement start date and time in CSV files.

Data output conditions define the measurement data types to be output to CSV files, and their units.

The table below lists the configuration items.

No	Item	Data	Tip
1	COMPANY	Company name	—
2	WELL	Well name	—
3	FIELD	Field name	—
4	LOCATION	Location name	—
5	PROVINCE	Province name	—
6	COUNTY	County name	—
	STATE	State name	
	COUNTRY	Country name	
7	SERVICE Corp	Service company name	—
8	DATE	Measurement start date and time	Specify the output format for measurement start date and time and whether to use UTC time representation.
9	UNIQUE WELL ID	WELL ID	—
10	API NUMBER	API number	—
11	LICENSE No	License number	—
12	Date Type	Output data selection	Select whether to output each of the following data types: Length (actual distance) Depth (depth) Temp(temperature) ST(stokes intensity data) AS(anti-Stokes intensity data) CFL (Calculated fiber loss) Select either Length or Depth but not both for distance-related data.
13	Unit of Distance	Unit of distance	Select from: m(meter) feet yard mile
14	Unit of Temperature	Unit of temperature	Select from: K(kelvin) degC(Centigrade) degF(Fahrenheit)

For Items No.1 to No.11 above, the specified data values are output to the CSV file.

SEE ALSO

For details on the measurement start time, see Subsection B8.2.3, "Format of Measurement Start Time."

■ CSV File Format

The figure below shows a sample CSV file.

Well info section

```
Company,Company A                                    <- item 1
Well,Well A                                          <- item 2
Field,Field A                                        <- item 3
Location,Location A                                  <- item 4
Province,Province A                                  <- item 5
ServiceCompany,Service Company                       <- item 7
Date,2014/05/19 05:48:52                             <- item 8
UniqueWellId,Unique Well ID Ch1                      <- item 9
LicenceNumber,1                                      <- item11
```

Data section

```
Depth[m],Temperature[degC],LogST[dB],LogAS[dB],Cfl[dB]
0.54,-220.00,0.000000,11.180180,0.000000
1.55,-87.64,15.265209,15.009468,15.159114
2.56,-215.19,14.785413,0.000641,14.785844
...
10722.17,-220.00,0.000000,15.377779,2.680408
10723.18,-84.68,12.694783,12.495176,15.263751
```

Ending line

```
10724.19,-75.44,0.000000,0.108202,2.551930
# DTSX_CNVT_FILEEND
```

Item	Description
Well info section	Output of specified and selected settings Date indicates the measurement start date and time.
Data section	Output of data types and units: Length, depth, temperature, Stokes intensity data, anti-Stokes intensity data and CFL (calculated fiber loss) of measured data.
Ending line	Comment text representing the ending line of the file.

TIP

The number of data values contained in the data section varies with the Calculation Range setting.

SEE ALSO

For details on the calculation range, see Subsection B7.3.1, "Fiber Settings."

B8.1.3. Format of Measurement Start Time

The measurement start time can be formatted automatically using format specifiers. Either UTC or local time representation can be selected. In addition, arbitrary text can be specified within the date format string.

The following format specifiers, if specified in the date format string, are automatically converted by DTSX3000 into its associated data as shown in the table below. Characters in the format string other than the format specifiers are output without conversion.

■ Format Specifiers

Format specifier	Data	Example	Remarks
%Y	Year in Gregorian calendar	2011	Four-digit representation
%y		11	Two-digit representation
%m	Month	07	0 is displayed in the tens place for values 0 to 9.
%d	Date	19	
%H	Hour	01	
%M	Minute	23	
%S	Second	45	

● Restrictions

- The percent character (%), when not used as part of a format specifier, and the backslash character (\) are not allowed.
- Up to 64 characters can be specified with each format specifier counted as two characters.

■ Examples

Specified format string	Converted date/time string
%Y-%m-%dT%H:%M:%S	2011-07-19T01:23:45
%Y-%m-%dT%H:%M:%S-%%_%a	2011-07-19T01:23:45-_ (%% and %a are deleted automatically.)

B8.2. Executing Data Output

After defining the output conditions, you can start measurement. You can also check created measurement data, reported errors and other statuses during measurement.

SEE ALSO

For details on remote commands for executing measurement and checking statuses, see the "DTSX3000 Communications Guide (IM39J06B40-02EN)".

B8.3. Measurement Data Output

The DTSX3000 converts measurement data into converted data files and archives the files into its internal non-volatile memory. The DTSX3000 converts measurement data first into LAS format files and archives the files into its internal non-volatile memory. Files are archived continuously in its memory area according to limits on minimum free space and maximum number of files. When the memory area limit is exceeded, the oldest file is deleted, and the most recent file is archived. Thus, the memory area of the DTSX3000 always contains the most recent files.

TIP

You can select whether to have the DTSX3000 compress converted files before archival. For more details, see Subsection B6.5.4, "Data Conversion Related Settings."

The DTSX3000 assigns a user-specified string and an automatically generated control number as part of the name of each measurement data archive file. This control number is related to the archive directory name.

This section describes the specifications of the memory area for archiving measurement data, as well as the structure of an archive file name and its relationship to the archive directory name.

B8.3.1. Specifications of Memory Area

The table below shows the specifications of the memory area.

Item	Description	Remarks
Memory media	SD Card	
Available disk capacity	About 1.5 Gbyte (*1)	When the remaining free space falls below 20 Mbyte, the oldest file is deleted.
Maximum number of files	About 40,000 (*1)	When the number of files that can be created falls below 50, the oldest file is deleted.
Compression format	gzip compression	A “.gz” filename extension is assigned to archive files.

*1: Applicable when the capacity of the SD card is 2 Gbyte.

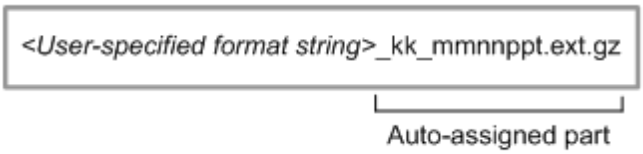
SEE ALSO

For details on the archive directory, see Subsection B8.4.3, "Archive Directory."

B8.3.2. File Name Structure

You can include file creation year, month and day, as well as measured channel number as part of generated file names using format specifiers.

The final file name consists of a user specified part and an auto-assigned part. The former is a result of format conversion according to specified format specifiers while the latter is assigned automatically by DTSX3000.



■ User-specified format string

The following format specifiers, if specified in the user-specified format string, are automatically converted by DTSX3000 into its associated data as shown in the table below. Characters in the specified format string other than the format specifiers are output without conversion.

● Format specifiers

Format specifier	Data	Example	Remarks
%Y	Year in Gregorian calendar	2011	Four-digit representation
%y		11	Two-digit representation
%m	Month	07	0 is displayed in the tens place for
%d	Date	19	values 0 to 9.
%H	Hour	01	
%M	Minute	23	
%S	Second	45	
%#	Channel number	01	

● Restrictions

- The '%' character can only be used to denote a format specifier within a format string.
- Only alphanumeric characters, the underscore (_) character and the hyphen (-) character are allowed in a format string.
- Up to 64 characters can be specified for the format string with each format specifier counted as two characters.

● Examples

Message	Description
DTSX_%Y-%m-%dT%H-%M-%S_%#	DTSX_2011-07-19T01-23-45_01_kk_mmnnpp.ext.gz
DTSX_%Y-%m-%dT%H-%M-%S_%#-%%-%a	DTSX_2011-07-19T01-23-45_01--_kk_mmnnpp.ext.gz (%% and %a are deleted automatically)

■ Auto-assigned part

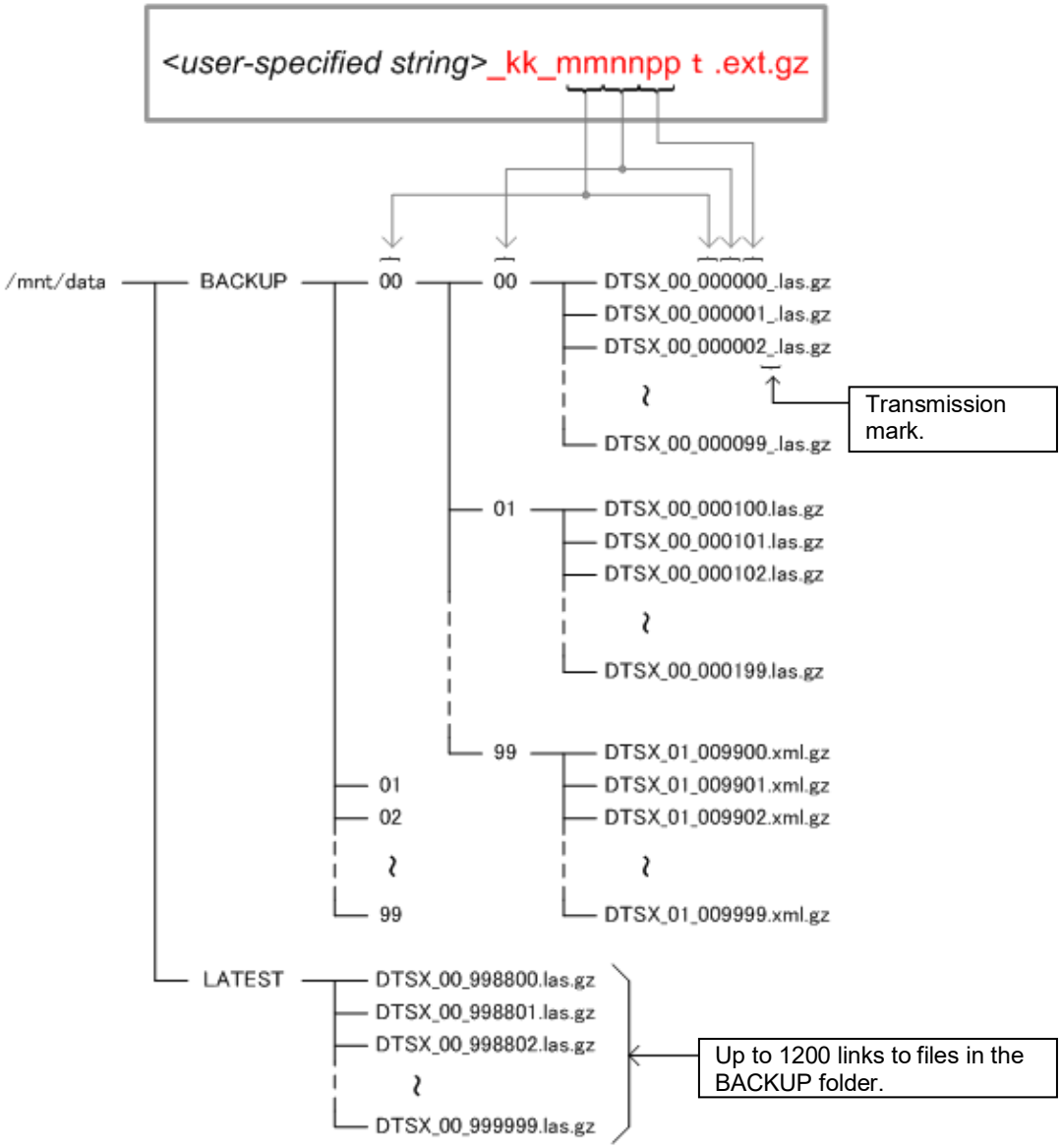
The auto-assigned part, which includes internal control information, is generated automatically by DTSX3000.

The following character strings are assigned in the auto-assigned part.

Item	Data	Description
_kk	File type	Represents the file format type. 00 = LAS format 01 = WITSML format 02 = CSV format 03 to 99: reserved for future use
_mmnnpp	Serial number	This is a running counter from 000000 to 999999 assigned to each created file. The counter returns to 000000 when it reaches 999999. mm: 00 to 99 nn: 00 to 99 pp: 00 to 99 * mm and nn together refers to a directory where the file is stored. For details, see Subsection B8.4.3, “Archive Directory.”
t	Transmission mark	Underscore character (_) An underscore (_) character is assigned for a file that has been transmitted externally using the HTTP client function of the DTSX3000 or other means.
.ext	Extension	A file extension is assigned according to the conversion format. .las = LAS format .xml = WITSML format .csv = CSV format
.gz	Extension	Indicates a file compressed in gzip format.

B8.3.3. Archive Directory

Converted files in LAS and other formats are archived in the /mnt/data/BACKUP directory. Two levels of subdirectories are created below the BACKUP directory, with files stored in subdirectories at the lowest level. The subdirectory names at the two levels match the mm and nn numbers included in the auto-assigned part of the file name of a file stored thereunder. The figure below shows an example of a LAS archive directory.



The /mnt/data/LATEST directory stores up to 1200 links to the most recent files archived in the BACKUP directory.

This allows the most recent files to be retrieved externally using SFTP client software or some other means by accessing the LATEST directory.

TIP

Do not delete and rename files below the BACKUP directory and LATEST directory. Do not create new files as well.

B8.4. Retrieving Measurement Data

This section describes how to get files using SFTP client software and how to transfer files to an external HTTP server using the HTTP Client function of the DTSX3000.

The described procedures are not guaranteed to work in all application environments.

B8.4.1. Retrieving Files Using SFTP Client

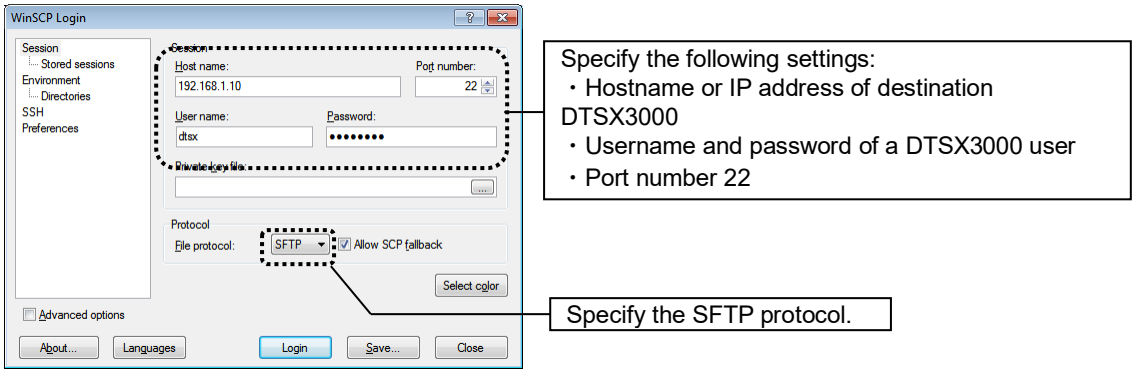
The procedures described in this subsection assume the use of SFTP client software WinSCP Ver4.3.3 .

■ Getting individual files from the /mnt/data/BACKUP directory.

1. Connect to DTSX3000.

Run WinSCP. Enter the following settings in the displayed Login dialog and then press the [Login] button.

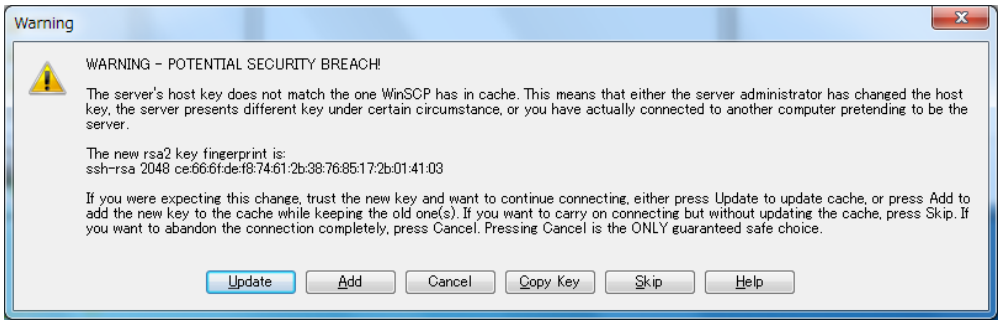
Host name	: Hostname or IP address of DTSX3000
Port Number	: 22
User name, Password	: Username and password of a DTSX3000 user
Protocol	: Select SFTP.



Tip

- If the number of existing connections to the DTSX3000 is already the maximum allowed, the DTSX3000 rejects the login request from the SSH/SFTP, the client receives the following message and connection fails.
  Received message too long 1416589088

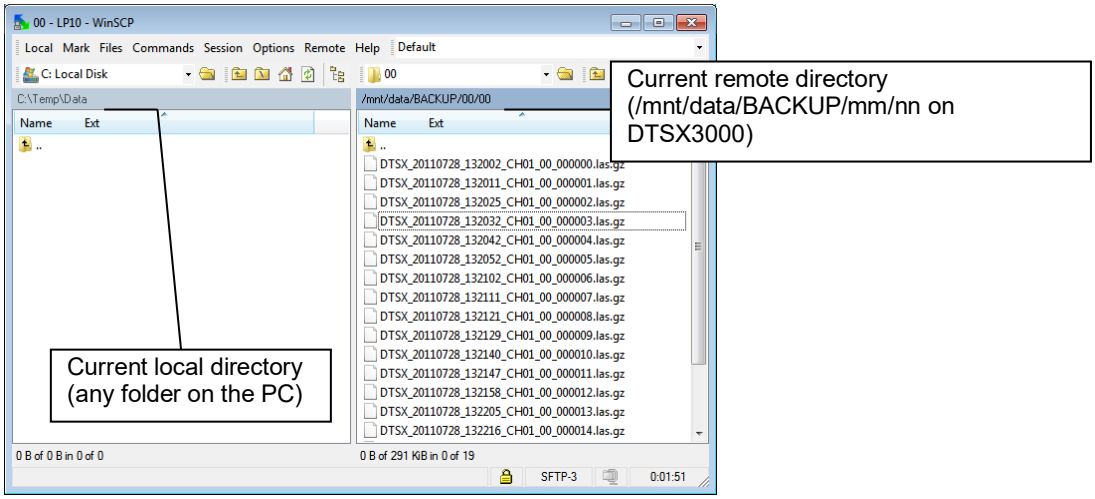
- If this message is displayed, check the number of existing connections, disconnect any existing connection no longer required and then try connecting to the DTSX3000 again.
- The SSH/SFTP client may display a “host key does not match” message as shown below.
  If this message is displayed, there is a possibility that you have connected to the computer of a malicious attacker pretending to be the DTSX3000. In this case, abort the connection using SSH/SFTP client, and check to ensure that neither the PC running the client software nor the DTSX3000 shows any sign of being attacked.



- However, this same message will also be displayed if the system has been updated and a new host key has been generated on the DTSX3000. Check with the DTSX3000 administrator whether a system update has been done, and if so, update the SSH/SFTP client with the new host key sent by the DTSX3000.

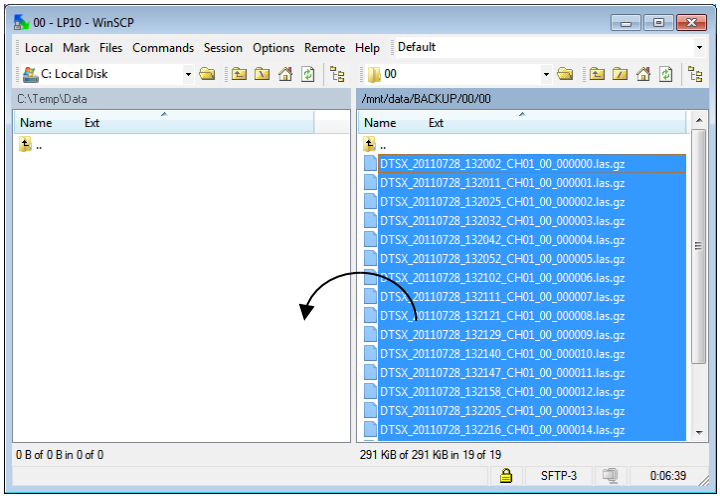
2. Move to the desired folder.

Change the current local directory and the current remote directory.

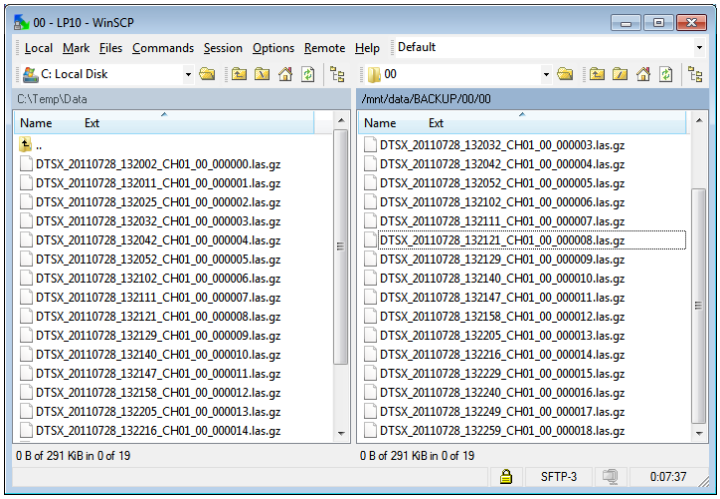


3. Get files.

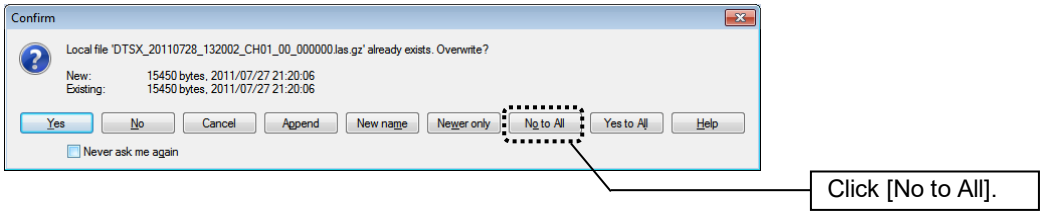
Select one or more files to be retrieved from the remote directory side, and then drag and drop it into the local directory side.



When retrieval is completed, the filenames are displayed in the local directory side.

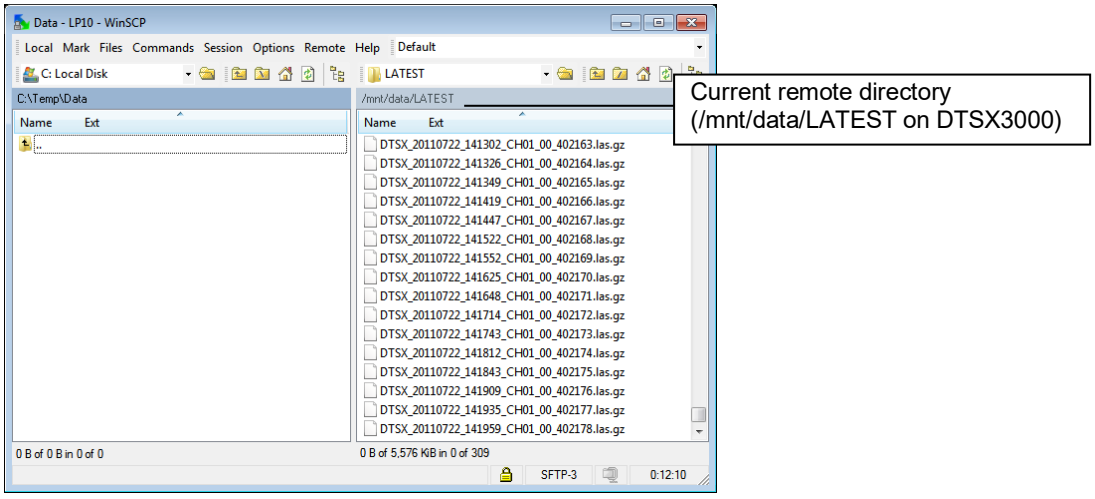


If a file having the same name already exists in the local directory side before transfer, a confirmation dialog is displayed. By clicking [No to All], you can shorten transfer time by retrieving only files that are not already present.

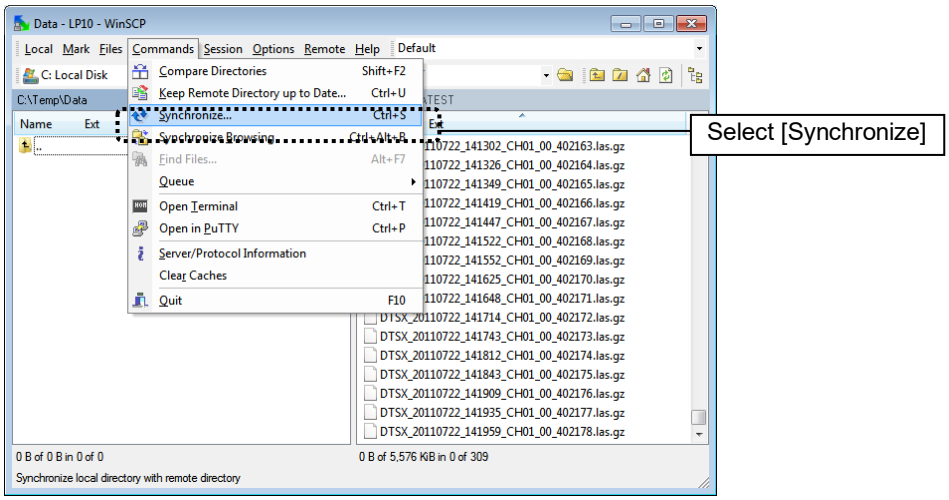


■ Synchronizing a local directory with the /mnt/data/LATEST directory.

1. Change the current directories.

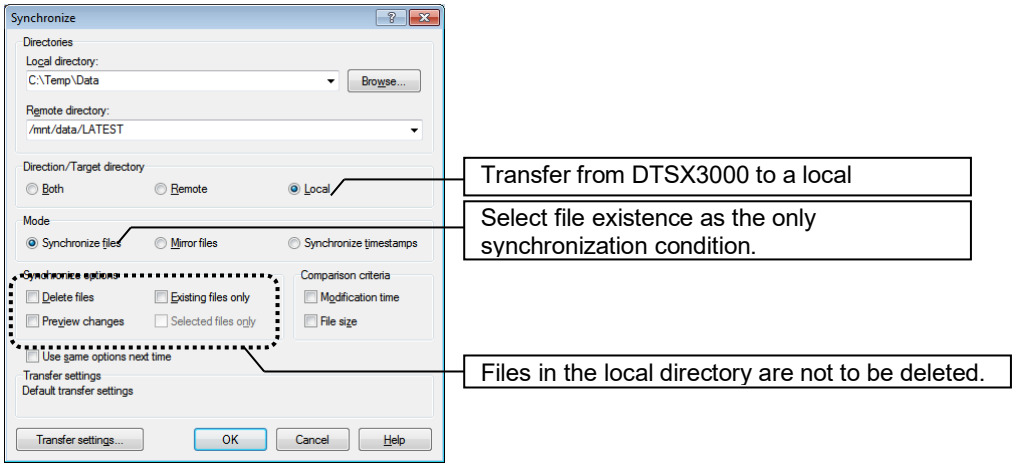


2. Select [Synchronize] from the menu bar.

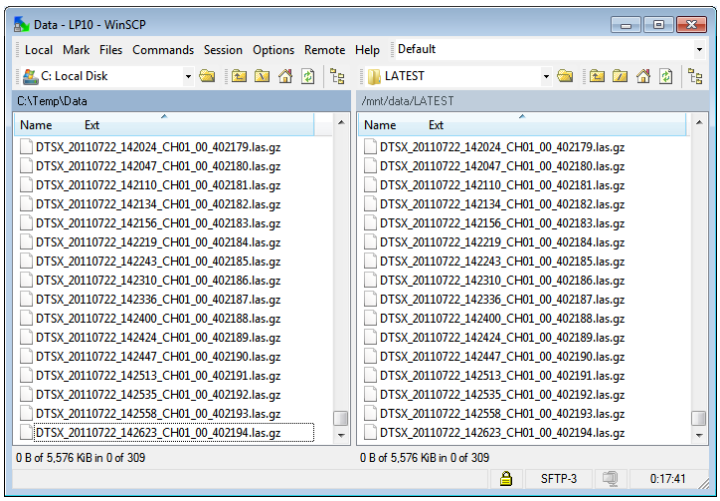


3. Get files.

Specify the Synchronization options as shown in the dialog below, and press the [OK] button.



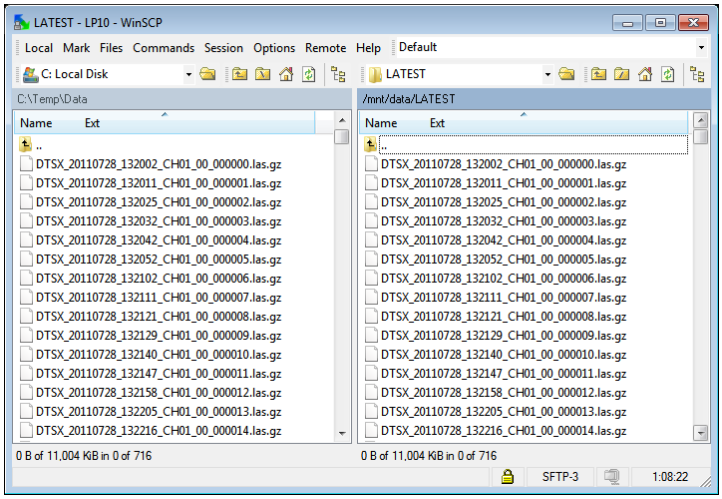
When retrieval is completed, all files not present in the local directory are retrieved.



4. Repeat steps 2 and 3 to perform resynchronization.

During DTSX3000 measurement, new files are added constantly to the /mnt/data/LATEST directory. Repeat steps (2) and (3) to perform resynchronization.

Only files newly added to the /mnt/data/LATEST directory will be retrieved to the local directory.



By performing synchronization regularly, you can retrieve the most recent files stored in DTSX3000 to a local directory.

B8.4.2. HTTP Client Function

Converted data files can be transmitted to an external HTTP server using the HTTP client function of DTSX3000.

■ Specifications

The table below describes the specifications of the HTTP client function of the DTSX3000.

Message	Specification	Remarks
Protocol	HTTP	DTSX3000 determines the protocol to be used according to
	HTTPS	the specified destination URI.
Method	PUT	Specify the method matching the setting at the server side.
	POST	If POST is selected, CGI is required at the server side.
User authentication	Basic	DTSX3000 determines the authentication scheme
scheme	Digest	automatically by communicating with the HTTP server, and
Via proxy	Supported	performs authentication using a user ID and a password.
File formats	Text	
	Compressed (Files are compressed to gzip format and appended with ".gz" file extension before transmission)	
Server authentication	No authentication is performed with respect to an SSL server certificate from a server. (*)	

* : Connect only to a HTTP server within the same local network with a visible network configuration.

■ Transmission related settings

The table below lists the transmission related settings.

Each setting can be specified via Modbus or DTSX3000 Data Conversion Software.

SEE ALSO

- For details, see the "DTAP3000 LAS2.0 Guide (IM39J02B40-02EN)".
- For details on configuration via Modbus, see the "DTSX3000 Communications Guide (IM39J06B40-02EN)".

No.	Item		Description
1	Server Configuration (Destination configuration)	Configure the destination server by specifying: (1) URI (HTTP server address and directory) (2) User ID and password The HTTP protocol or HTTPS protocol is used for communication if the specified URL begins with "http://" or "https://" respectively. The specified user ID and password is used for authentication according to the authentication scheme of the specified directory.	
2	Use Proxy	If the HTTP server is accessed via a proxy server in a network environment, specify the following settings: (1) Hostname or IP address of the proxy server (2) Port number	
3	HTTP method	Select PUT or POST. If you have selected POST, specify the form data name (The data name to be passed to the CGI on the HTTP server side.)	
4	Transmit Files (file transmission mode)	Select one of the following file transmission modes for determining the files to be transmitted.	
		New	Transmits newly created files as and when available. Files created in the past are not transmitted.
		Newer Than the Last Transmission	Transmits files created after the last transmitted file. Newly created files are also transmitted.
		Since Selection	Transmits files created after a selected file. Newly created files are also transmitted.

5	Deflate	Select whether to transmit compressed gzip files or uncompressed plain text files.

TIP

If one of the following occurs when Since Selection is set to Transmit Files, DTSX3000 can't start to convert measured data into LAS formatted files and can't start to transmit the files. Please reselect another transmission file at the restart.

- The file to be selected is not found.
- The remaining space of the file storage area is below 30M bytes and no more than 10 files are to be selected starting with the oldest file.

In this case, the following message is output to the application log:

"SN=xxxxxx file couldn't transmit. Please set another transmission file at the restart."

Where "xxxxxx" is the serial number of the file which failed to be transmitted.

If one of the following occurs except for the above condition, transmission will start with the file which is midway between the newest and the oldest file.

- The file to be transmitted is not found.
- The remaining space of the file storage area is below 30M bytes and no more than 10 files are to be transmitted starting with the oldest file.

In this case, the following message is output to the application log:

"SN=xxxxxx file transmits failed. Transmit files from SN=yyyyyy."

Where "xxxxxx" is the serial number of the file which failed to be transmitted, and "yyyyyy" is the serial number of the file with which transmission will start.

SEE ALSO

- For details on Transmit Files, see the above table "4.Transmit Files."
- For details on how to display the application log, see Subsection B11.3.2, "Application Log File."
- For details on serial numbers, see Subsection B8.4.2, "File Name Structure."

Next, we describe below the transmission settings for two examples, one using PUT method and the other using POST method, for the same sample configuration on the HTTP server side. This description assumes that the HTTP server uses Apache2.2.3 (CentOS). The described procedures are not guaranteed to work in all application environments.

■ Example using PUT method

● Configuration file on the HTTP server side

The configuration file (httpd.conf) below enables the WebDAV function, defines the destination directory for storing received files and specifies whether user authentication is required.

```
# Directories not requiring authentication
Alias /webdav "/var/www/html/webdav/"
<Location /webdav>
    DAV on
</Location>

# Directories requiring Basic authentication
Alias /webdav_basic "/var/www/html/webdav/basic/"
<Location /webdav_basic>
    DAV on
    AuthType Basic
    AuthName "Secret Zone"
    AuthUserFile /etc/httpd/.htpasswd
    Require user secret
</Location>

# Directories requiring Digest authentication
Alias /webdav_digest "/var/www/html/webdav/digest/"
<Location /webdav_digest>
    DAV on
    AuthType Digest
    AuthName "Secret Zone"
    AuthUserFile /etc/httpd/.htdigest
    Require user secret
</Location>

# Directory containing CGI file
ScriptAlias /cgi-bin/ "/var/www/cgi-bin/"
```

Defines the destination directory (/var/www/html/webdav/) if “/webdav” is specified in the URI.

Enables WebDAV function

Defines the destination directory (/var/www/html/webdav/basic/) if “/webdav_basic” is specified in the URI.

Basic authentication is used.

File storing user IDs and passwords for Basic authentication.

User ID for user authentication.

Defines the destination directory (/var/www/html/webdav/digest/) if “/webdav_digest” is specified in the URL.

Digest authentication is used.

File storing user IDs and passwords for Digest authentication.

User ID for user authentication.

Location of the required CGI file if POST transmission method is used.
* Not required if PUT is used.

● Transmission settings

Specify a URI, user ID and password appropriate for the desired destination directory.

Specify a URI	Destination directory on HTTP server side
https://<hostname or IP address>/webdav	/var/www/html/webdav
https://<hostname or IP address>/webdav_basic	/var/www/html/webdav/basic
https://<hostname or IP address>/webdav_digest	/var/www/html/webdav/digest

■ Example using POST method

In this example for transmitting files from DTSX3000 to a HTTP server using the POST method, we show a sample configuration on the HTTP server side, sample CGI programs for communicating with the HTTP client function of DTSX3000 and sample transmission settings on the DTSX3000.

● Configuration file on the HTTP server side

Same as using PUT method above.

● CGI settings on server side

To perform authentication using the POST transmission method, install the CGI program itself in a directory requiring authentication on the server side. You can require or skip authentication by specifying the corresponding CGI program in the transmission settings on the client side.

In this example, the following three directories are provided on the server side.

Directory	De
/var/www/cgi-bin/dtsx_cgi	not requiring user authentication
/var/www/cgi-bin/dtsx_cgi/basic	requiring Basic authentication
/var/www/cgi-bin/dtsx_cgi/digest	requiring Digest authentication

In each of these directories, install an access control file as shown below.

- /var/www/cgi-bin/dtsx_cgi/.htaccess

```
AddType application/x-httpd-cgi .cgi
order allow,deny
allow from all
```

- /var/www/cgi-bin/dtsx_cgi/basic/.htaccess

```
AuthType Basic
AuthName "Secret Zone"
AuthUserFile /etc/httpd/.htpasswd
Require user secret
```

- /var/www/cgi-bin/dtsx_cgi/digest/.htaccess

```
AuthType Digest
AuthName "Secret Zone"
AuthUserFile /etc/httpd/.htdigest
Require user secret
```

● CGI programs

- user authentication is not required

```
#!/usr/bin/perl
use CGI;

my($form) = new CGI;
my($filename) = $form->param('uploadfile');

@files = split(/¥//, $filename);
$basename = $files[-1];

$path = "/var/www/html/webdav/";

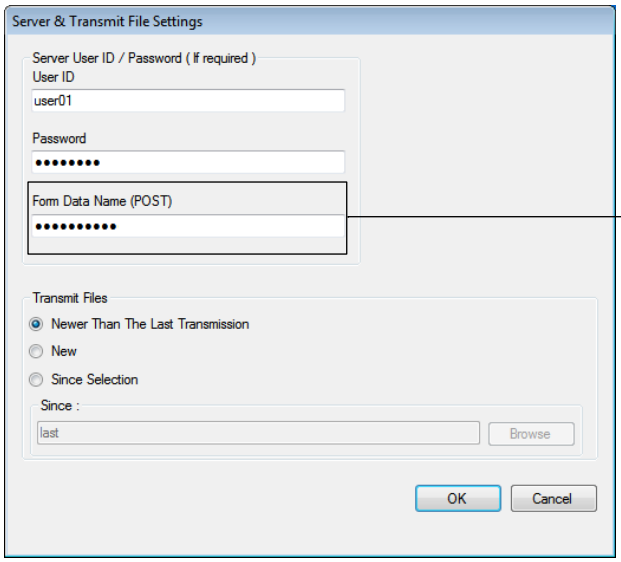
$newfile = "$path" . "$basename";
if( $path eq $newfile){
  &filename_error;
}
open (OUTFILE,">$newfile") or &fileopen_error;
while ($bytesread = read($filename,$buf,1024)) {
  print OUTFILE $buf;
}

print $form->header("text/html");
print "AUTH_TYPE=$ENV{'AUTH_TYPE'}<br>¥n";
print "O.K. File($filename) was uploaded as $newfile<br>¥n";

sub filename_error {
  print $form->header(-status => "400 Bad Request");
  die "Can't get filename¥n";
}
sub fileopen_error {
  print $form->header(-status => "400 Bad Request");
  die "Can't make serverside file!¥n";
}
```

Form data name
* Specify this in server & transmit file settings

Destination directory
for storing received files.



- for Basic authentication

The file content is the same as upload.cgi shown above except for the $path value shown below.

```
$path = "/var/www/html/webdav/basic/";
```

- for Digest authentication

The file content is the same as upload.cgi shown above except for the $path value shown below.

```
$path = "/var/www/html/webdav/digest/";
```

● Transmission settings

Specify a CGI file, form name (uploadfile in this example), user ID and password appropriate for the desired destination directory.

Specify a URI (CGI file)	Destination directory on HTTP server side
https://<hostname or IP address>/cgi-bin/dtsx_cgi/upload.cgi	/var/www/html/webdav
https://<hostname or IP address>/cgi-bin/dtsx_cgi/basic/basic_upload.cgi	/var/www/html/webdav/basic
https://<hostname or IP address>/cgi-bin/dtsx_cgi/digest/digest_upload.cgi	/var/www/html/webdav/digest

B8.5. Other Data Output Formats (Option)

Provided the DTSX3000 Data Conversion Software WITSML1.3.1.1 is purchased additionally, the DTSX3000 can be configured to convert measured data into WITSML (Wellsite Information Transfer Standard Markup Language) formatted files (hereinafter known as WITSML files in short) and store them in its internal memory area. WITSML format version 1.3.1.1 is supported.

WITSML files stored in the DTSX3000 can be retrieved externally using SFTP client software or transferred to an external HTTP server using the HTTP transmission function of the DTSX3000.

SEE ALSO

For details on the WITSML Data Conversion function, see the "DTAP3000D Guide (IM39J02B40-03EN)".

To use the WITSML data conversion function, however, you need to first install its license using the DTSX3000 Data Conversion Software WITSML1.3.1.1.

The procedures for installing and deleting a license are described below.

■ Procedure for Installing a License

1. Run the DTSX3000 Data Conversion Software WITSML1.3.1.1

Run the DTSX3000 Data Conversion Software WITSML1.3.1.1. Next, connect to the DTSX3000.

SEE ALSO

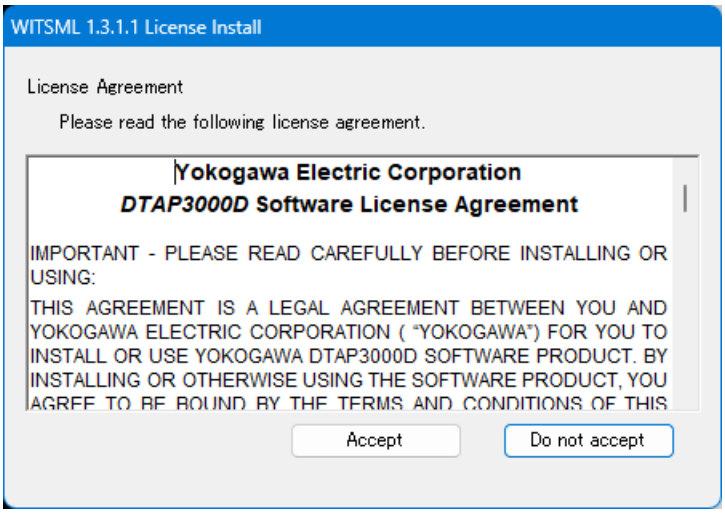
For details on connection configuration, see the "DTAP3000D Guide (IM39J02B40-03EN)".

2. License install dialog

If connection is successful and a license for the WITSML conversion function is not already installed in the DTSX3000, the following dialog is displayed.

When you are asked whether you accept the terms of the Software license agreement, read the terms carefully and click the [Accept] button if you accept the terms. If you do not accept the terms, software installation will be aborted.

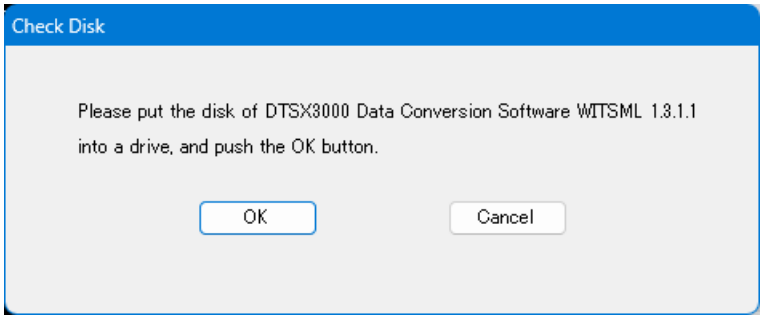
To install the license, press the [Accept] button.



3. Put the disk

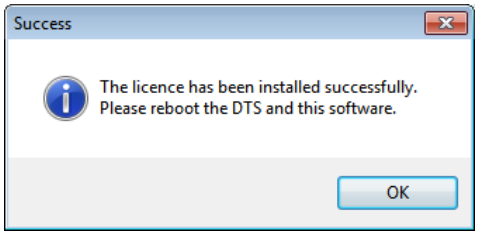
Put the disk "DTSX3000 Data Conversion Software WITSML 1.3.1.1" into the drive of PC.

Press the [OK] button.



4. Complete license installation

If license installation is successful, the following dialog is displayed. Press the [OK] button. Next, reboot the DTSX3000. This completes license installation.



5. Reboot DTSX3000

Terminate and restart the DTSX3000 Data Conversion Software WITSML1.3.1.1. Next, connect to the DTSX3000 and verify that the WITSML data conversion function can be executed in online state.

TIP

One license for the WITSML data conversion function is required per DTSX3000.

■ Procedure for Deleting an Installed License

1. Run DTSX3000 Data Conversion Software WITSML1.3.1.1

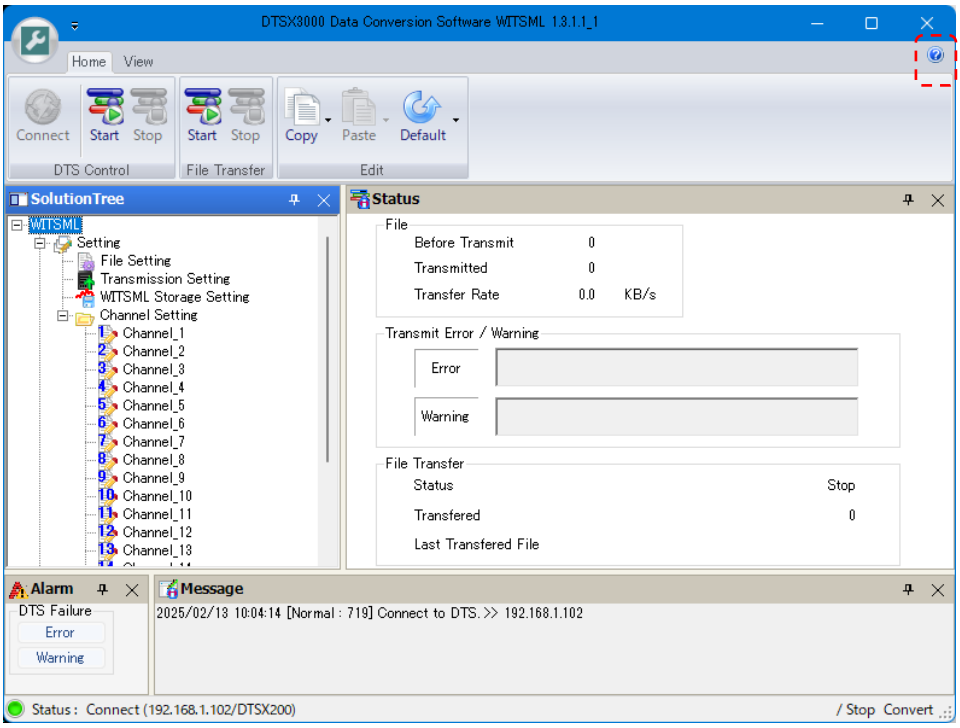
Run DTSX3000 Data Conversion Software WITSML1.3.1.1. Next, connect to the DTSX3000.

SEE ALSO

For details on connection configuration, see the "DTAP3000D Guide (IM39J02B40-03EN)".

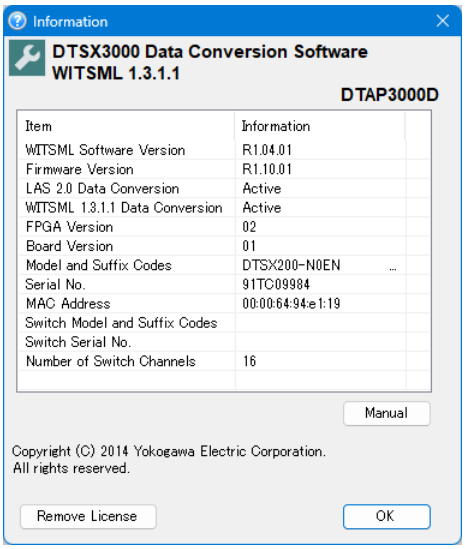
2. Open the help window

Press the [?] icon displayed at the top right of the configuration window of the DTSX3000 Data Conversion Software WITSML1.3.1.1. The Help window is displayed.

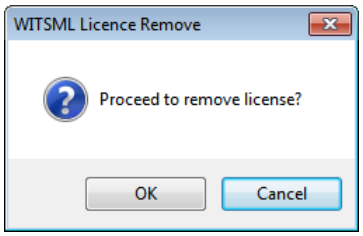


3. Remove license

Press the [Remove License] button displayed at the bottom left of the Help window.

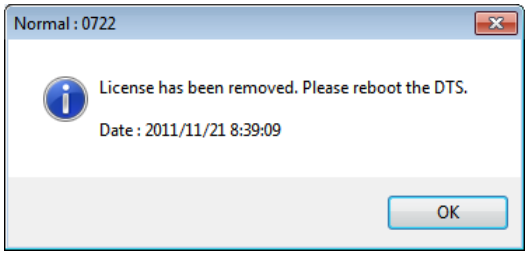


To delete the license, press the [OK] button.



4. Complete license deletion

If license deletion is successful, the following dialog is displayed. Press the [OK] button. Next, reboot the DTSX3000. This completes license deletion.



B9. Alarm Detection

B9.1. Overview

Alarm detection compares temperature measurement data against user-defined alarm conditions. In this chapter, configuration of conditions for alarm detection is described in Section B9.2, “Configuration of Alarm Conditions” and output of the result of alarm detection is described in Section B9.3, “Alarm Results.”

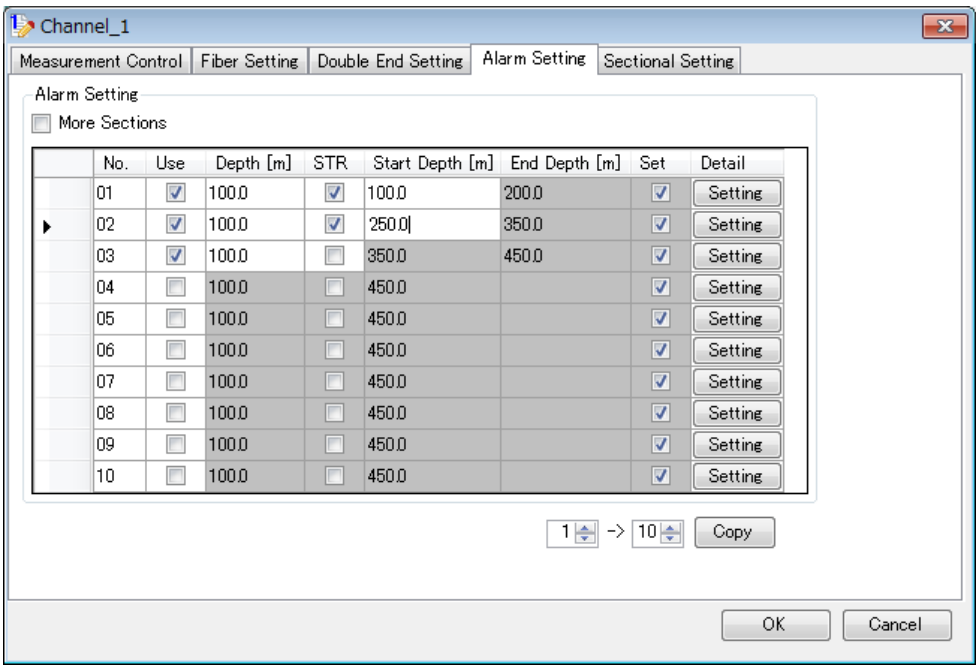
B9.2. Configuration of Alarm Conditions

Alarm conditions can be configured via Modbus.

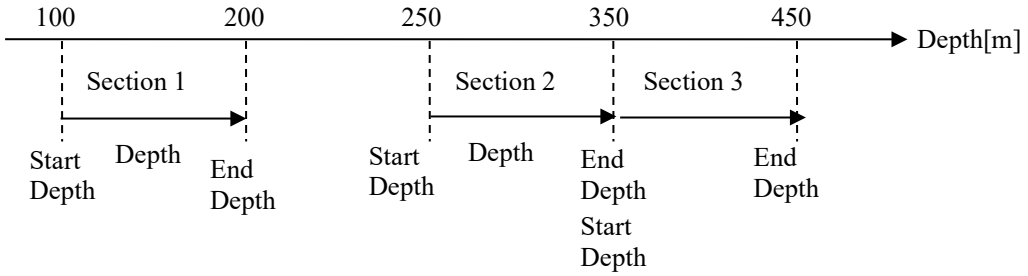
SEE ALSO

For details, see the DTSX3000 Communications Guide (IM39J06B40-02EN).

Alarm conditions can also be configured as described below using the DTSX3000 Control Visualization Software (DTAP3000), which is available as a separate purchase.



The settings in the above screen capture define three alarm detection sections, as shown in the figure below.



B9.2.1. Number of Alarm Sections

Select the number of alarm sections.

If [More Sections] is disabled, up to 10 alarm sections can be used.

If [More Sections] is enabled, up to 50 alarm sections can be used, but there will be some restrictions on alarm conditions.

B9.2.2. Alarm Section

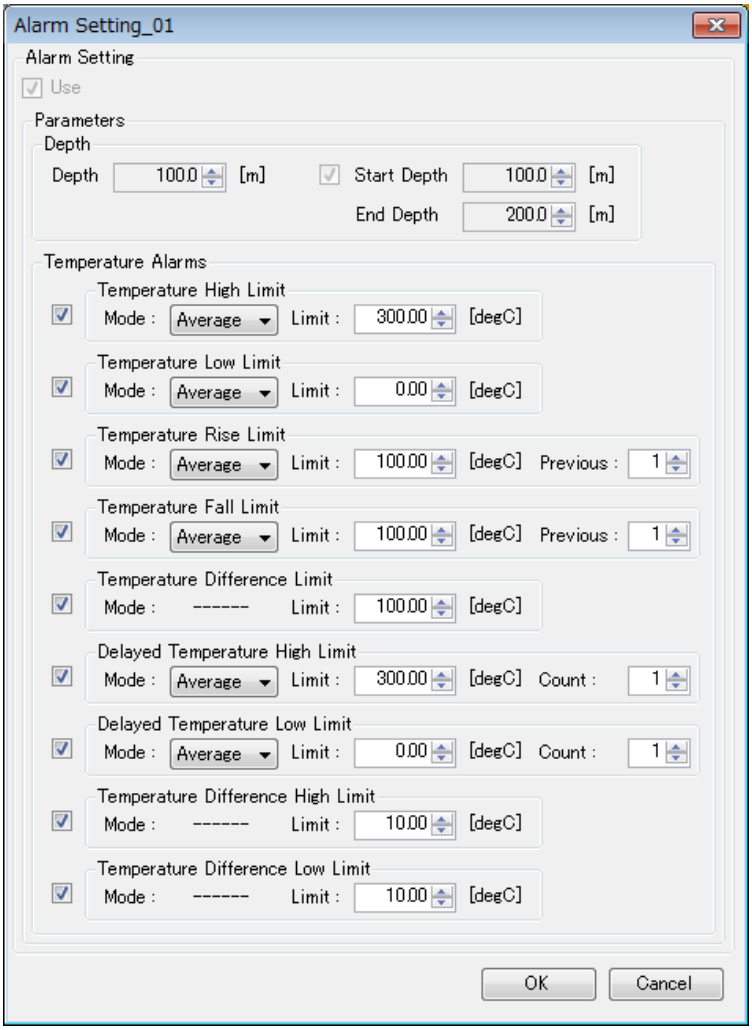
Select whether to use an individual alarm section using its Use flag.

- Specify the Start Depth and Depth (distance from the Start Depth) for each alarm section as a value between 0.1 m to 50000.0 m in units of 0.1 m.
- The End Depth is calculated automatically and thus need not be specified.
- When specifying contiguous alarm sections where the Start Depth of a section coincides with the End Depth of the preceding section, you can save typing by deselecting the STR checkbox.
- If an entered Start Depth is before the End Depth of the preceding section, an error is reported and the entered value is rejected.
-

B9.2.3. Alarm Conditions

Define the alarm detection condition for each alarm section.

Clicking the [Setting] button in an alarm section row on the Alarm Setting tab window displays the following pop-up dialog window for detailed configuration of the alarm section.



There are 9 available alarm types, which can be enabled or disabled individually for individual alarm sections. All alarm limit values can be specified with a resolution of 0.01 [deg C].

You can select either of the following alarm modes for some alarm types:

- Select Point to report an alarm when any measured value within the section satisfies the alarm condition.
- Select Average to report an alarm when the average measured value of a section satisfies the alarm condition.

● Temperature High Limit

Specify a temperature high limit value from -273.15 to 999.99.

An alarm is reported when the measured value exceeds the limit.

The alarm mode setting is enabled.

● Temperature Low Limit

Specify a temperature low limit value from -273.15 to 999.99.

An alarm is reported when the measured value is below the limit.

The alarm mode setting is enabled.

● Temperature Rise Limit

Specify a temperature rise limit value from 0.00 to 1273.14.

An alarm is reported when (measured value – previous measured value) exceeds the limit.

Specify a value n from 1 to 10 to use the nth preceding measured value as the previous measured value for comparison.

The alarm mode setting is enabled.

● Temperature Fall Limit

Specify a temperature fall limit value from 0.00 to 1273.14.

An alarm is reported when (previous measured value – measured value) exceeds the limit.

Specify a value n from 1 to 10 to use the nth preceding measured value as the previous measured value for comparison.

The alarm mode setting is enabled.

● Temperature Difference Limit

Specify a temperature difference limit from 0.00 to 1273.14.

An alarm is reported when the difference between the maximum and minimum measured values within a section exceeds the limit.

The alarm mode setting is disabled.

● Delay Temperature High Limit

Specify a delay temperature high limit value from -273.15 to 999.99.

An alarm is reported when the measured value exceeds the limit for a specified number of successive measurements.

The alarm mode setting is enabled.

Specify the number of successive measurements as a value from 1 to 10.

● Delay Temperature Low Limit

Specify a delay temperature low limit value from -273.15 to 999.99.

An alarm is reported when the measured value is below the limit for a specified number of successive measurements.

The alarm mode setting is enabled.

Specify the number of successive measurements as a value from 1 to 10.

● Temperature Difference High Limit

Specify a temperature difference high limit value from 0.00 to 1273.14.

An alarm is reported when the difference between the average value and each measured value within a section exceeds the limit.

The alarm mode setting is disabled.

● Temperature Difference Low Limit

Specify a temperature difference low limit value from 0.00 to 1273.14.

An alarm is reported when the difference between the average value and each measured value within a section is below the limit.

The alarm mode setting is disabled.

■ Restrictions

When 50 alarm sections are used, the settings for the preceding measured value to be compared against for detection of alarm types Temperature Rise Limit and Temperature Fall Limit are common to all sections.

TIP

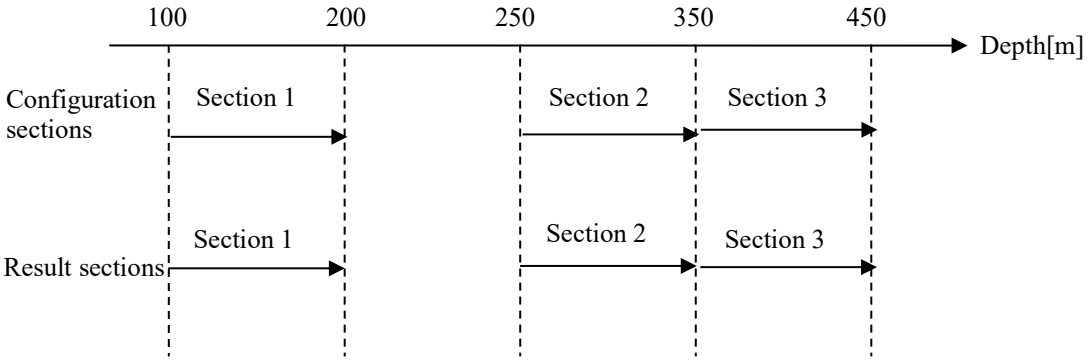
- The range used for alarm detection varies with the calculation range setting.
- Temperature-Rise-Limit and Temperature-Fall-Limit for alarms are ignored for single sequence measurement.

SEE ALSO

For details on the calculation range, see Subsection B7.3.1, "Fiber Settings."

B9.3. Alarm Results

As described in Section B9.2, “Configuration of Alarm Conditions,” alarm conditions can be configured for up to 50 alarm sections. Alarm detection results can be retrieved for the same number of sections.

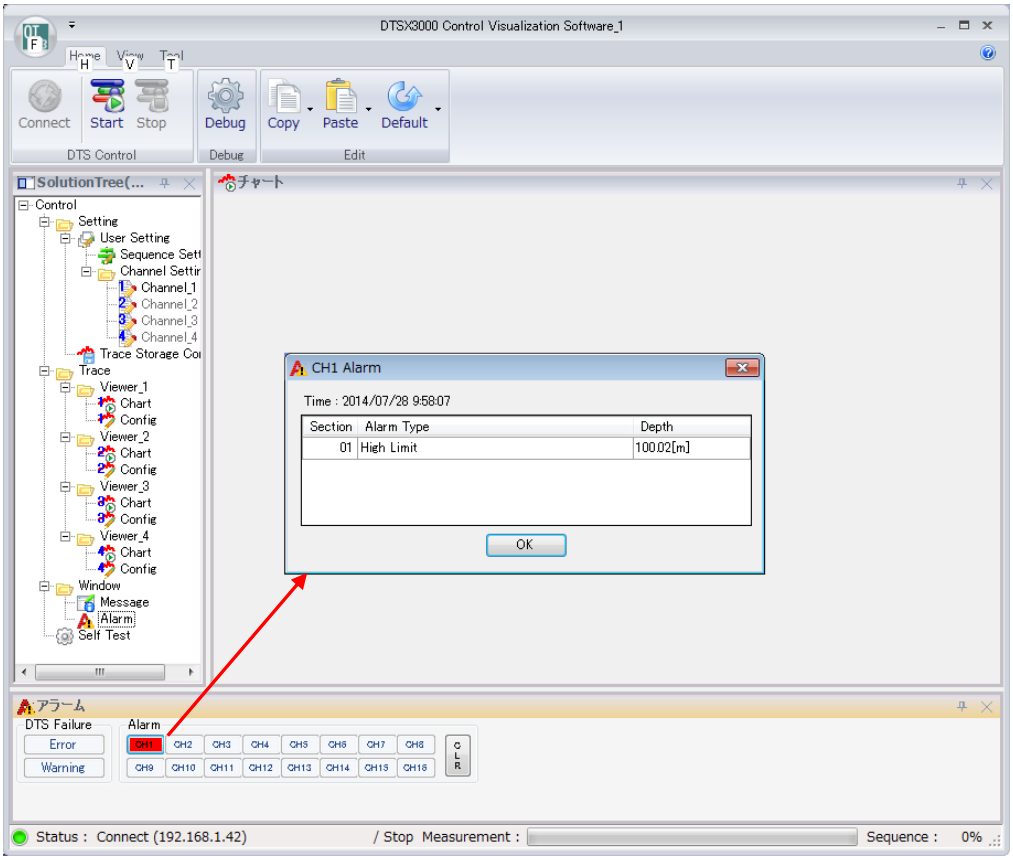


The alarm result of each alarm section can be retrieved via Modbus.

SEE ALSO

For details, see the DTSX3000 Communications Guide (IM 39J06B40-02EN).

The alarm result of each alarm section can also be retrieved using the DTSX3000 Control Visualization Software (DTAP3000), which is available as a separate purchase, as described below.



When any alarm condition is true, the corresponding alarm button for the channel in the Alarm window turns red. Clicking a red Alarm button opens a child window displaying information on the alarm section, alarm type and alarm position (Depth) for the detected alarm.

The table below describes what is displayed for the alarm position (Depth) when one or more alarms have been detected for a channel.

Alarm Type	Depth
Average-type alarm detected.	The Start Depth of the alarm section is displayed.
Both average-type and point-type alarm detected.	Point-type alarms have precedence over average-type alarms. The position nearest to the Start Depth of the alarm section is displayed.
Point-type alarm detected.	The position nearest to the Start Depth of the alarm section is displayed.

B10. Sectional Data Generation

B10.1. Overview

DTSX3000 can split temperature measurement data according to user-defined sections, perform calculation on temperature data within each section and output the calculation result as sectional data.

In this chapter, configuration of conditions for sectional data generation is described in Section B10.2, “Configuration of Sectional Data Conditions” and the output result of sectional data generation is described in Section B10.3, “Sectional Data Results.”

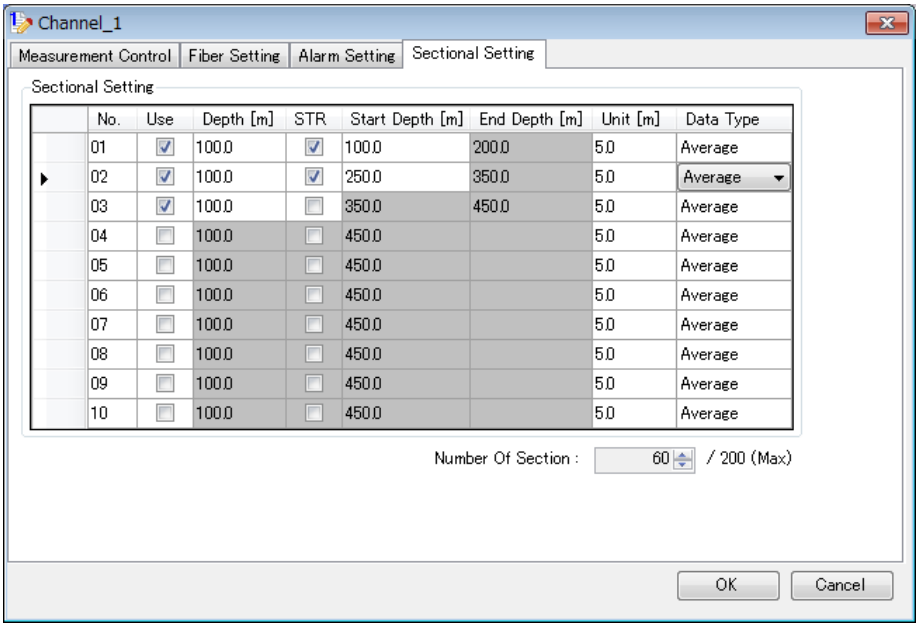
B10.2. Configuration of Sectional Data Conditions

Sectional data conditions can be configured via Modbus.

SEE ALSO

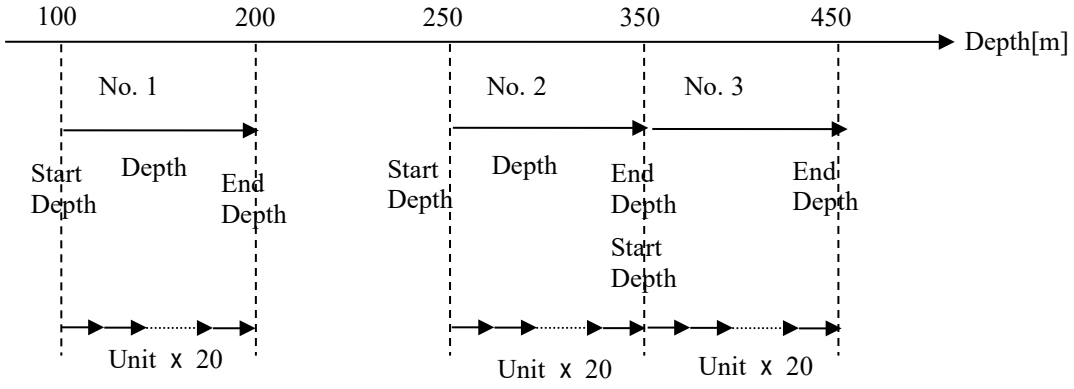
For details, see the DTSX3000 Communications Guide (IM 39J06B40-02EN).

Sectional data conditions can also be configured as described below using the DTSX3000 Control Visualization Software (DTAP3000), which is available as a separate purchase.



No.	Use	Depth [m]	STR	Start Depth [m]	End Depth [m]	Unit [m]	Data Type
01	☑	100.0	☑	100.0	200.0	5.0	Average
02	☑	100.0	☑	250.0	350.0	5.0	Average
03	☑	100.0	☐	350.0	450.0	5.0	Average
04	☐	100.0	☐	450.0		5.0	Average
05	☐	100.0	☐	450.0		5.0	Average
06	☐	100.0	☐	450.0		5.0	Average
07	☐	100.0	☐	450.0		5.0	Average
08	☐	100.0	☐	450.0		5.0	Average
09	☐	100.0	☐	450.0		5.0	Average
10	☐	100.0	☐	450.0		5.0	Average

The settings in the above screen capture define sections for sectional data generation as shown in the figure below.



You can define up to 10 sections for sectional data generation.

- Set the Use flag to select whether to generate sectional data for each section.
- Specify the Start Depth and Depth (distance from the Start Depth) as a value from 0.1 m to 50000.0 m in units of 0.1 m for each section.
- The End Depth is calculated automatically, and need not be specified.
- When specifying contiguous sections where the Start Depth of a section coincides with the End Depth of the preceding section, you can skip specifying the Start Depth by deselecting the STR (Start Depth use flag) checkbox.

Each section can be further split into smaller units by specifying a value for Unit, provided that the total number of units for all sections does not exceed 200.

- Configuration is on section basis so generation of sectional data for all units within the same section uses the same data type.
- Processing result is retrievable for each unit.
- If the Depth of a section is not divisible by the specified Unit, the last unit will be shorter than the specified value. (For example, if Depth=100 m and Unit=30 m, then the section will be split into 4 units of 30 m, 30 m, 30 m and 10 m.)

Any of the following five data types can be selected from the pull-down menu.

Sectional Data Type	Unit	Processing
Average	degC	The average value of all measured values within a section is determined.
Maximum	degC	The maximum value of all measured values within a section is determined.
Minimum	degC	The minimum value of all measured values within a section is determined.
Difference	degC	The difference between the maximum and minimum measured values within a section is determined.
Slope	degC	The slope is determined for a section using least square method.

TIP

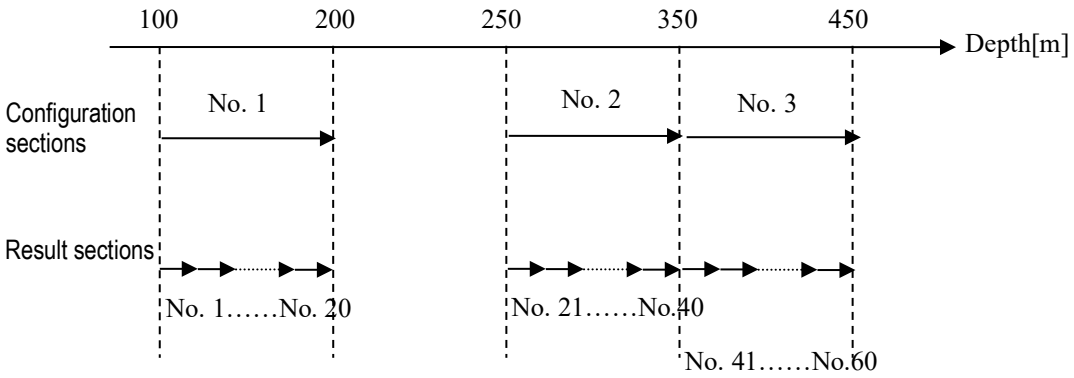
The range used for sectional data generation varies with the Calculation Range setting.

SEE ALSO

For details on the calculation range, see Subsection B7.3.1, “Fiber Settings.”

B10.3. Sectional Data Results

As described in Section B10.2, “Configuration of Sectional Data Conditions,” sectional data conditions can be configured for up to 10 sections but sectional data results can be generated for up to 200 sections. The figure below shows the relationship between configuration sections and result sections using the example given in Section B10.2, “Configuration of Sectional Data Conditions“.



The result of each result section can be retrieved via Modbus.

SEE ALSO

For details, see the DTSX3000 Communications Guide (IM 39J06B40-02EN).

B11. Maintenance Functions

B11.1. Displaying System Status Information

You can display system status information (system information and alarm status) of a DTSX3000 from a Web browser running on a Windows PC.

To access the DTSX3000 from a Web browser, you need to enter a pre-defined user name and password.

B11.1.1. Access Procedure

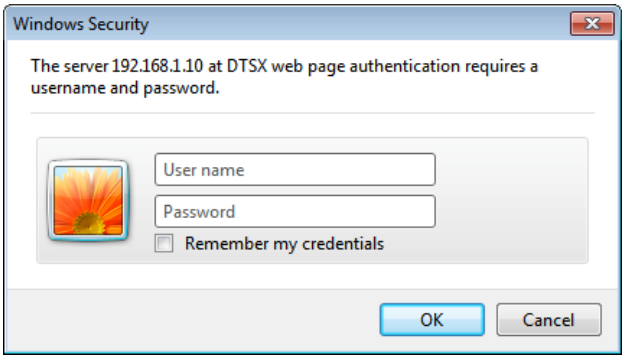
To access the DTSX3000, enter the following URL in the Web browser:

http://<hostname or IP address of the DTSX3000>/mnt/

Tip

If HTTPS communication is enabled, specify “https:”.

A user authentication dialog is displayed. Enter a valid username and password.



If user authentication is successful, the Top page is displayed. You can check the following information on the Top page:

- System information
  System configuration summary, hardware information and software version
- Alarm status information
  System alarm and application alarm status

Tip

If user authentication is disabled in the configuration, the user authentication dialog is not displayed.

SEE ALSO

For details on user authentication, as well as enabling and disabling of HTTPS communication, see Subsection B6.4.6, “Web Server Configuration (Web).”

DTSX3000 -Online-

Menu

Sys maintenance

- Informations
  - RAS
  - Sys log
  - App log
- Configurations
  - User
  - Network
  - Date
  - Web
  - SSH & SFTP
  - Serial
  - PPP
  - NTP
  - LED
- Tool
  - Backup
  - Saveinfo
- Operations
  - Log alarm
  - Reboot

Application Setting

- Power Save
- Modbus
  - Modbus TCP
  - Modbus Serial
- DataConvert
  - Format
  - File Delete
- CV Soft

System maintenance

Updated: Jul 28 10:52:56 2014 JST

Base Module

Hostname	dtsxhost
IP Address	192.168.1.10
Subnet Mask	255.255.255.0
MAC Address	00:00:64:94:E0:2D
SDRAM	128MB
SRAM	1MB
Flash Memory	128MB
SD Card	2.0GB
SysLog Alarm Level	3
AppLog Alarm Level	3
Status	online
System ID	DTSX3000-N0EN
CPU HW ID	00
LEAF Ver	22
DTS HW ID	02
DTSP Ver	00
Software Ver	R1.01.01
Serial No	1234567890
BootBuildNo	R1.05.01
KernelBuildNo	R1.06.01
RFSBuildNo	R1.03.01

Optical Switch

Model	DTOS4L-N0EN
Serial No	000000001
Ch	4ch
DTOS Ver	0042

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B11.1.2. RAS (Reliability Availability Serviceability) Information

RAS information displays various DTSX3000 system and hardware information. RAS information can be saved in text format on a Windows PC.

Ten historical RAS information records (ras0 to ras9) are maintained with one record containing information for one system session, from the time the system is started until the time the system is stopped.

The oldest RAS information is deleted and new RAS information is added each time the system is started. ras0 represents the most recent information while ras9 represents the oldest information.

- Switching RAS Information Display
  Clicking the [Prev] button displays the previous older RAS information record.
  Clicking the [Next] button displays the next newer RAS information record.
  Clicking the [Curr] button displays RAS information of the current system session.

TIP

RAS information is used by Yokogawa for system analysis, and at times may need to be saved and sent to Yokogawa for fault diagnosis in the event of a system failure.

DTSX3000 -Online-

Menu

Sys maintenance

- Informations
  - RAS
  - Sys log
  - App log
- Configurations
  - User
  - Network
  - Date
  - Web
  - SSH & SFTP
  - Serial
  - PPP
  - NTP
  - LED
- Tool
  - Backup
  - Saveinfo
- Operations
  - Log alarm
  - Reboot

Application Setting

- Power Save
- Modbus
  - Modbus TCP
  - Modbus Serial
- DataConvert
  - Format
  - File Delete
- CV Soft

RAS information

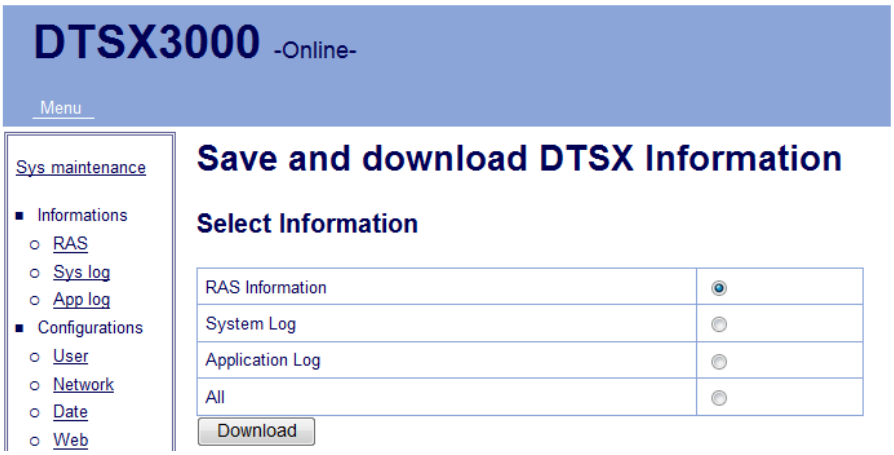
View	ras0

Operating mode	online
Down status	8
Down flag	0x00000000
Down time	
Down code	0x00000000
Down message	
Boot status	Boot finished.
Startup time	Jul 28 01:51:28 2014 (Jul 28 10:51:28 2014 JST)
Sysdown time	
ActiveTime	0
TotalTime	1215
Restart Flag	off
CPU module mode	2
CPU module status	0x80a5
CPU module temp	43 deg C
SDRAM ECC count	0
SDRAM ECC Total	0
SRAM ECC count	0
SRAM ECC Total	0
MemErrAddr	0x0
SRAM battery	normal
System ID	DTSX3000-N0EN
CPU HW ID	00
LEAF Ver	22
DTS HW ID	02
DTSP Ver	00
Software Ver	R1.01.01
Serial No	1234567890
BootBuildNo	R1.05.01
KernelBuildNo	R1.06.01
RFSBuildNo	R1.03.01

Prev Next Curr

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● Saving RAS Information File
Selecting Tool –[Saveinfo] from the side menu displays a window for selecting the type of log file to be saved.
Select the [RAS Information] option and click the [Download] button.
On the displayed window, click the [Save] button. After specifying an appropriate folder on the Windows PC and an output file name, click the [Save] button.
The RAS information file is saved in plain text format and thus can be viewed and edited using any general text editor.



B11.1.3. Checking Alarms

Alarm display indicates whether an alarm has been detected.

There are two types of message logs related to alarms, namely, system log and application log. The former is output by the boot loader or the operating system while the latter is output by the DTSX3000 measurement function.

There are eight message log levels as shown below. An alarm is displayed when any message at or above the configured log alarm level described in Subsection B6.4.16, “Log Alarm Level Configuration (Log Alarms)” is logged.

For instance, if the log alarm level is 4 (WARNING), an alarm will be displayed if any error of levels 0 (EMERGENCY) to 4 (WARNING) is detected.

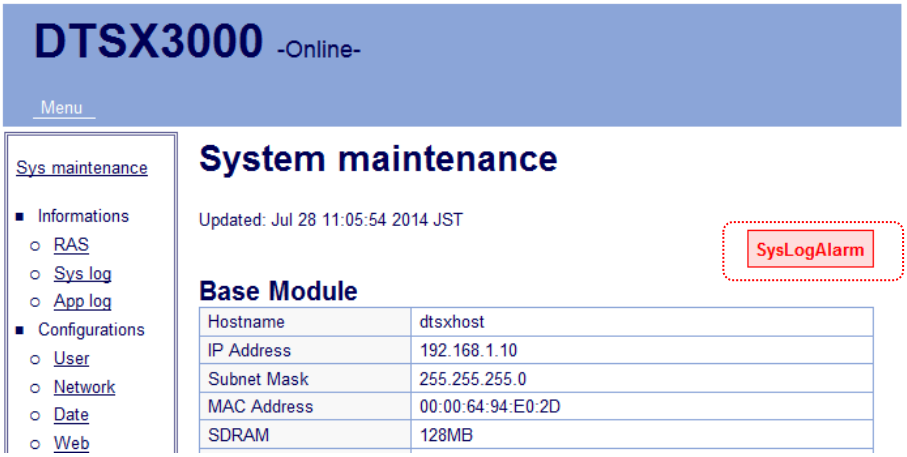
■Log levels

Higher	0	EMERGENCY
	1	ALERT
	2	CRITICAL
	3	ERROR
	4	WARNING
	5	NOTICE
	6	INFORMATION
Lower	7	DEBUG

- When a message at or above the log alarm level is output to the system log:
  A SysLogAlarm icon is displayed. You can check the details of the system log by selecting Informations – [Sys log] from the side menu.

SEE ALSO

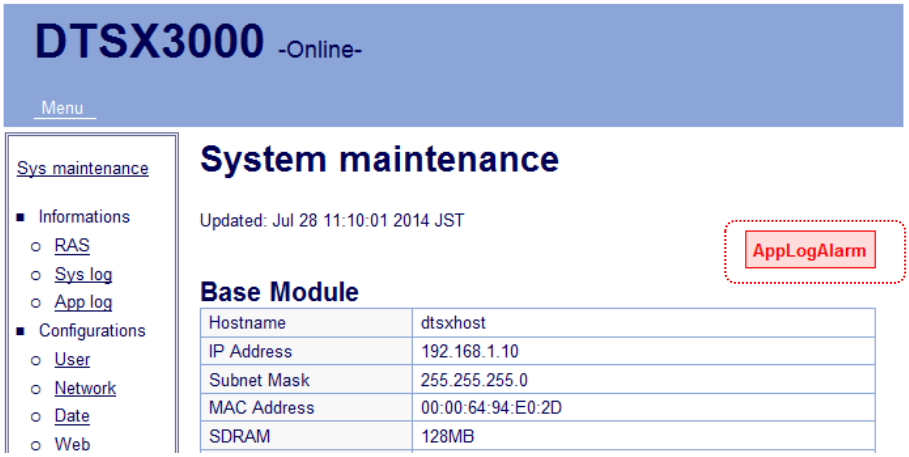
See Subsection System Log File B11.3.1, “System Log File” for details.



- When a message at or above the log alarm level is output to the application log:
  An AppLogAlarm icon is displayed. You can check the details of the application log by selecting Informations – [App log] from the side menu.

SEE ALSO

See Subsection B11.3.2, “Application Log File” for details.



Tip

- The system alarm and application alarm display is updated at one minute intervals.
- To remove the displayed alarm, click the [Alarm Acknowledge] button on the system log display window or application log display window accordingly.

B11.2. Fault Diagnosis

Fault diagnosis includes regular fault diagnosis performed by the DTSX3000 automatically and self-diagnosis performed by the DTSX3000 when it receives a transmitted self-diagnosis command.

SEE ALSO

For details on the tests performed in fault diagnosis and fault handling, see Part C, “Operation and Maintenance.”

B11.2.1. Self Diagnosis

The DTSX3000 performs self-diagnosis whenever it receives a communication command for self-diagnosis execution.

SEE ALSO

For details on the remote command for self-diagnosis execution, see the DTSX3000 Communications Guide (IM39J06B40-02EN).

Tip

Self-diagnosis cannot be executed during measurement. If a self-diagnosis execution command is received during measurement, an execution error is generated.

B11.2.2. Display of Fault Diagnosis Results

Fault diagnosis results are displayed in the application log according to the tests performed and the test results as listed in the Table below.

When “NG” is displayed in the application log as the results of fault diagnosis, there is a possibility of failure. If the same diagnosis result is frequently detected, please contact our sales representative with the application log information.

SEE ALSO

For details on how to display the application log, see Subsection B11.3.2,“Application Log File”.

Table: Display of Fault Diagnosis Results

Self-diagnostic Test	Application Log Display	
	When test result is good	When test result is bad
PLL status	Pll Lock : OK	Pll Lock : NG＋(data)
DTS clock status	DTS Clock Status : OK＋(data)	DTS Clock Status : NG+(data)
FPGA version	DTSX FPGA(DTSP) Version :＋(Ver)	(not detected)
ADF board version	ADF Board Version: (+Ver)	(not detected)
DTS interrupt line	DTS Interrupt Line : OK	DTS Interrupt Line : NG
ADC status	ADC Status : OK	ADC Status : NG＋(data)
ADC reference voltage	ADC Reference Volt : OK＋(data)	ADC Reference Volt : NG+(data)
Reference temperature status	Reference Temp Status : OK	Reference Temp Status : NG＋(data)
DAC Set voltage	DAC(B/C) Set : OK	DAC(B/C) Set (set)[V] : NG diff = (data)
Analog power voltage	Analog Board OFF::LDD Board Power (n) : OK+(data) Analog Board OFF::APD Board Power (n) : OK+(data) Analog Board ON::LDD Board Power (n) : OK+(data) Analog Board ON::APD Board Power (n) : OK+(data)	Analog Board OFF::LDD Board Power (n) : NG+(data) Analog Board OFF::APD Board Power (n) : NG+(data) Analog Board ON::LDD Board Power (n) : NG+(data) Analog Board ON::APD Board Power (n) : NG+(data)
LD temperature	LD Temperature : OK＋(data)	LD Temperature : NG＋(data)
LD temperature control current	LD Temp Control Current : OK＋(data)	LD Temp Control Current : NG＋(data)
LD drive current	LD Drive Current : OK＋(data)	LD Drive Current : NG+ (data)
Photoreceiver APD temperature	APD Temperature ST : OK＋(data) APD Temperature AS : OK＋(data)	APD Temperature ST : NG＋(data) APD Temperature AS : NG＋(data)
Photoreceiver APD bias voltage	APD Bias Voltage ST : OK＋(data) APD Bias Voltage ST : NG＋(data)	APD Bias Voltage ST : NG+ (data) APD Bias Voltage AS : NG+ (data)
Photoreceiver amplifier offset voltage	Amp Offset Voltage ST : OK＋(data) Amp Offset Voltage AS : OK＋(data)	Amp Offset Voltage ST : NG＋(data) Amp Offset Voltage AS : NG＋(data)
Photoreceiver ADC data	ADC Data : OK＋(data)	ADC Data ST [H] : NG diff =(data) ADC Data ST [M] : NG diff =(data) ADC Data ST [L] : NG diff =(data) ADC Data AS [H] : NG diff =(data) ADC Data AS [M] : NG diff =(data) ADC Data AS [L] : NG diff =(data)
Photoreceiver ADC overflow	ADC Overflow : OK	ADC Overflow : NG
Light Emission Error	(Not Display)	Light Emission Error
ST Light Receive Error	(Not Display)	Light Receive Error [ST]
AS Light Receive Error	(Not Display)	Light Receive Error [AS]
DTSX3000 Measurement start/stop	Measure Start: OK Measure Abort : OK	Measure Start: NG Status=(data) Measure Abort : NG Status=(data)
Excitation LD drive current	EXLD Drive Current : OK+ (data)	EXLD Drive Current : NG+ (data)
Optical amplifier ASE **level current**	Amp ASE Level Current : OK+ (data)	Amp ASE Level Current : NG+ (data)
Optical switch interrupt line	OSW Interrupt : OK	OSW Interrupt : NG
Optical switch communication	OSW Communication : OK	OSW Communication : NG
Optical switch standby	OSW Standby : OK	OSW Standby : NG
Optical switch FPGA version	OSW FPGA(DTOS) Version:+(Ver)	(not detected)
Optical switch internal temperature	OSW Temp. : OK	OSW Temp. : NG + (data)
Optical switch drive current	OSW Drive Current : OK	OSW Drive Current : NG
Optical switch channel setup	OSW CH(n) test : OK	OSW CH(n) test : NG
Optical switch origin	OSW Origin : OK	OSW Origin : NG
Optical switch information display	OSW Information : OK (OSW info)	OSW Information : NG (OSW Info)
OSW Communication Error Interrupt	(Not Display)	OSW Communication Error Interrupt
OSW Timeout Error	(Not Display)	OSW Timeout Error
OSW Response Error	(Not Display)	OSW Response Error

Total number of switch operations of the OSW	(Not Display)	The counter of OSW channel switching has been exceeded.

Tip

- If a message is displaying warning that the total number of switch operations of the optical switch has exceeded its limit, we recommend replacing the optical switch as it is nearing the end of its useful life.
- When the power save function is enabled, total number of switch operations of the optical switch may not be counted.

SEE ALSO

For details on the power save, see Subsection B6.5.1, “Power Save Settings.”

B11.3. Log Function

You can display DTSX3000 log information from a Web browser running on a Windows PC.

To access the DTSX3000 from a Web browser, you need to enter a pre-defined user name and password.

SEE ALSO

For details on the access procedure, see Subsection B11.1.1, “Access Procedure.”

If access is allowed, the Top page is displayed.

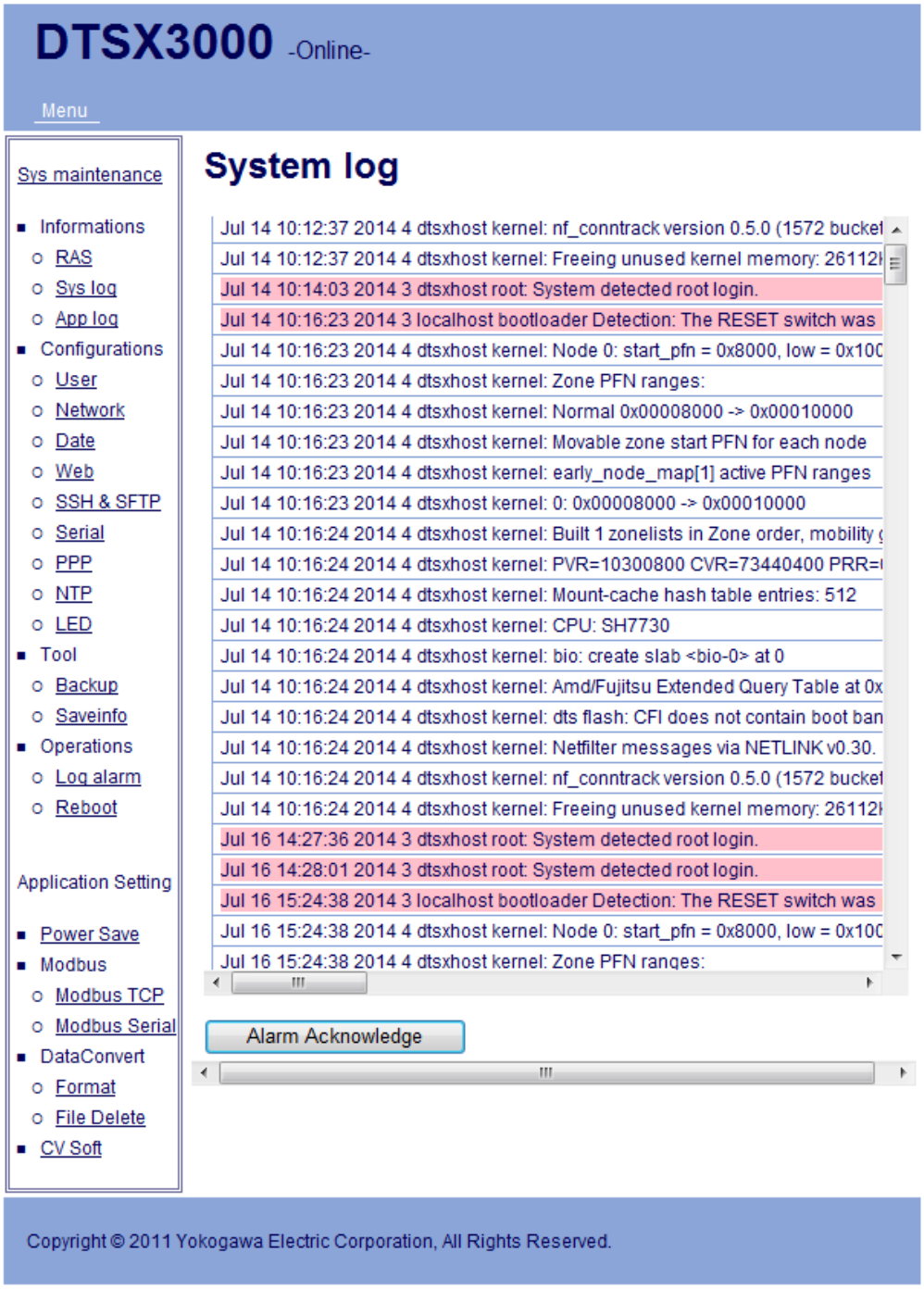
B11.3.1. System Log File

● Displaying System Log File

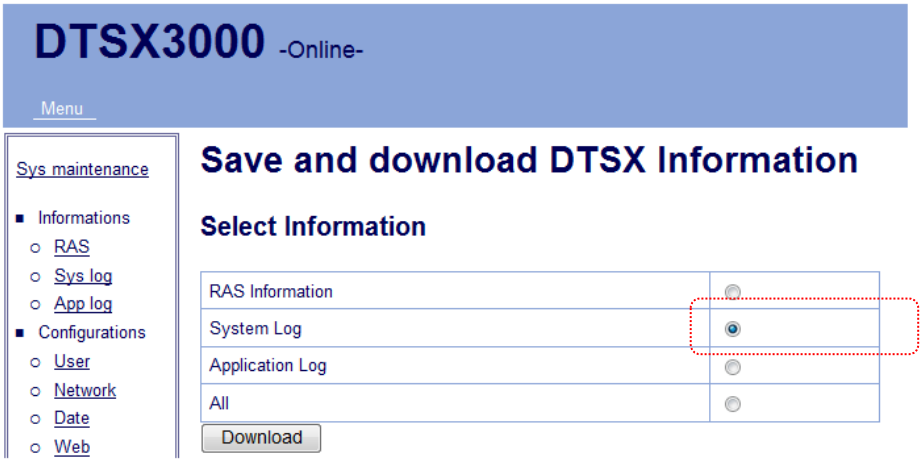
You can check system log data by selecting Information – [Sys log] from the side menu. Log messages at or above the specified Systemlog Alarm Level described in Subsection B6.4.16, “Log Alarm Level Configuration (Log Alarms)” are highlighted in red in the display.

If any log message at or above the configured Systemlog Alarm Level is present, a SysLogAlarm icon is displayed on the Top page to notify that an alarm has been reported in the system log.

You can display and check the most recent log records. To remove the SysLogAlarm icon displayed on the Top page, click the [Alarm Acknowledge] button at the bottom of the system log display window.



● Saving System Log File
Selecting Tool – [Saveinfo] from the side menu displays a window for selecting the type of log file to be saved.
Select the System Log option and click the [Download] button.
On the displayed window, click the [Save] button. After specifying an appropriate folder on the Windows PC and an output file name, click the [Save] button.
The log file is saved in plain text format and thus can be viewed and edited using any general text editor.


DTSX3000 -Online-
Menu
Sys maintenance
Informations
RAS
Sys log
App log
Configurations
User
Network
Date
Web
Save and download DTSX Information
Select Information
RAS Information
System Log
Application Log
All
Download

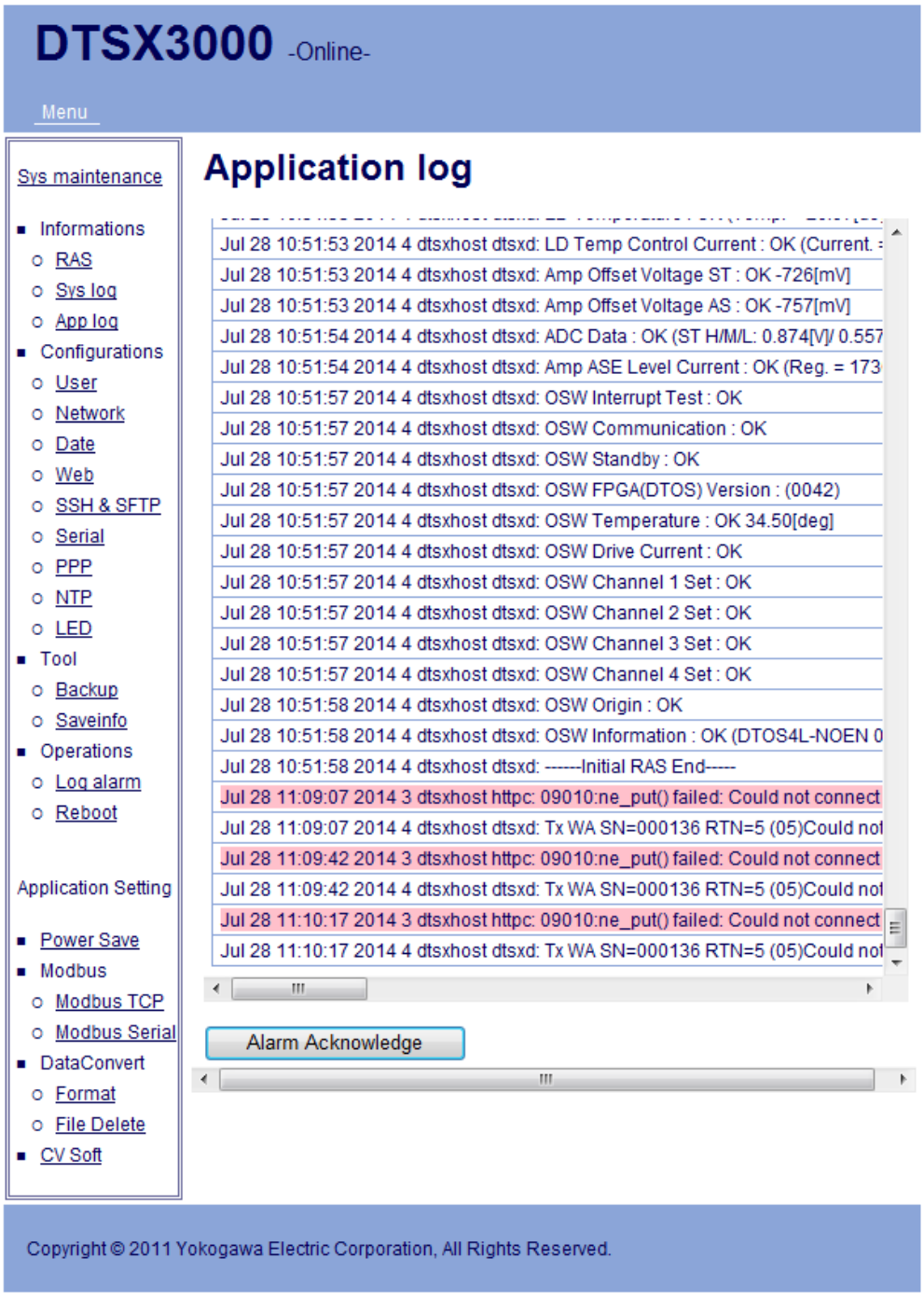
B11.3.2. **Application Log File**

- Displaying Application Log File

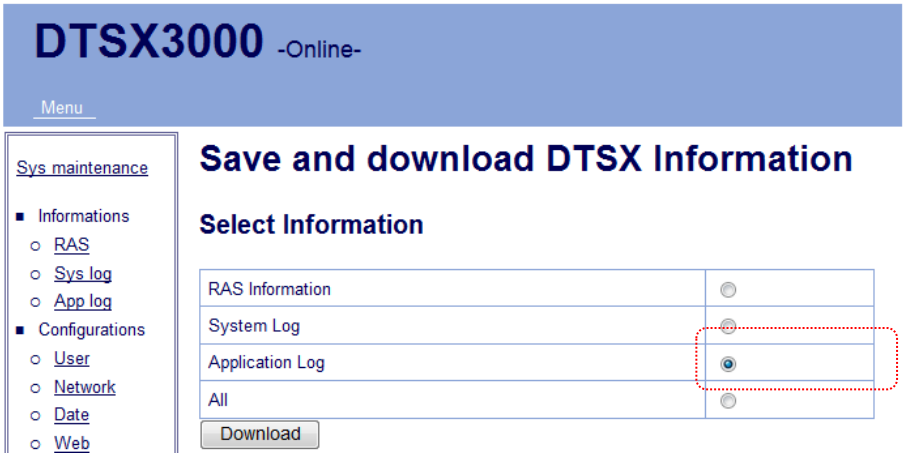
  You can check application log data by selecting Information – [App log] from the side menu. Log messages at or above the specified Applicationlog Alarm Level described in Subsection B6.4.16, “Log Alarm Level Configuration (Log Alarms)” are highlighted in red in the display.

  If any log message at or above the specified Applicationlog Alarm Level is present, an AppLogAlarm icon is displayed on the Top page to notify that an alarm has been reported in the application log.

  You can display and check the most recent log records. To remove the AppLogAlarm icon displayed on the Top page, click the [Alarm Acknowledge] button at the bottom of the Application log display window.



● Saving Application Log File
Selecting Tool – [Saveinfo] from the side menu displays a window for selecting the type of log file to be saved.
Select the Application Log option and click the [Download] button.
On the displayed window, click the [Save] button. After specifying an appropriate folder on the Windows PC and an output file name, click the [Save] button.
The log file is saved in plain text format and thus can be viewed and edited using any general text editor.



Tip

Selecting the All option in the log file selection window saves RAS information, system log data and application log data in one text file.

B11.4. Checking Security Risks

This section describes how to check for security risks using the functions provided by DTSX3000.

B11.4.1. Checking for System File Modifications

The DTSX3000 provides a system check function for checking whether system files have been modified. By using this function regularly, a DTSX3000 administrator can ensure that system files are not tampered with. To use this function, you need to log in remotely to the SSH server as a user with administrator authority (admin) and execute the procedure described below.

Before checking Security Risks, get the following checksum files that correspond to each version of kernel, Root File System and the App File System.

kernel	uImage-R *. **. **-checksum.txt
Root File System	exfs-R *. **. **-checksum.txt
App File System	app-R *. **. **-checksum.txt

“R*.**.**” denotes the version number.

These files are in the \Software folder on the accompanying CD-ROM.

If you performed revision update after purchase, please use the checksum file that is distributed with the archive container file.

SEE ALSO

For details on performing revision update, see Subsection B11.6, “System Revision Update.”

1. Check the check command file.
   Before performing the check, you must first verify that the check command file itself has not been tampered with.

   Execute the following command. Do not omit the pathname when entering the command

   $ /bin/ls -lL /usr/bin/md5sum: cat /usr/bin/md5sum /usr/bin/dtsxck | /usr/bin/md5sum

   The output result should look like this:
   -rwxr-x--- 1 root admin-users 523352 Jun 16 07:27 /usr/bin/md5sum
   bf01d4348bf31a48a5c61ea6d1f74308 -
   You should also check that the execution time until result output is reasonable (As a guide, it should be within 0.5 seconds).

   Compare the output result against the content of the “uImage-R*.**.**-checksum.txt” file. “R*.**.**” denotes the version number. For instance, if the version number is R1.02.01, the output result should be compared against the “uImage-R1.02.01-checksum.txt” file.

   The figure below shows the content of a sample “uImage-R*.**.**-checksum.txt” file. Check that the output result obtained above is identical to line 3 of the “uImage-R*.**.**-checksum.txt” file.

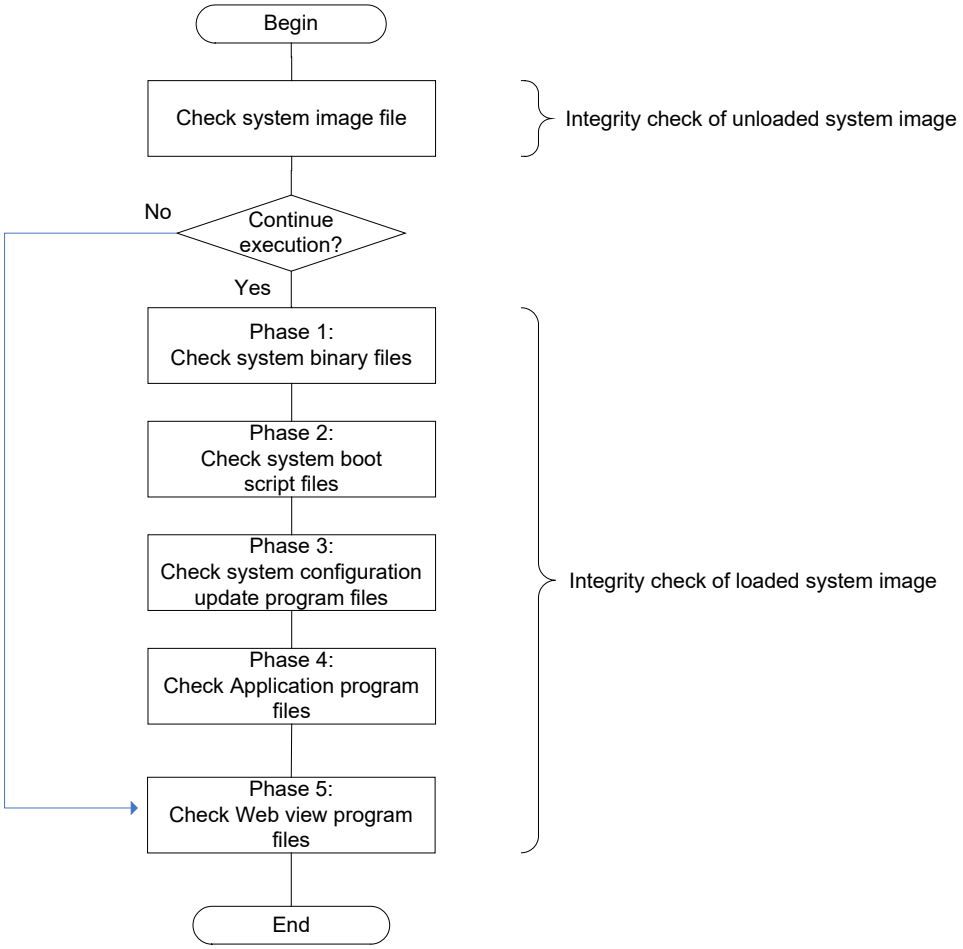
```
---- cut ----
-rwxr-x--- 1 root admin-users 523352 Jun 16 07:27 /usr/bin/md5sum
bf01d4348bf31a48a5c61ea6d1f74308  -
----
---- cut ----
# System Image Checksum.
# Please compare to the offline value, manually.
----
6af74eaa039df24e34d4b780cb6704ab  -
----
```

Tip

Check the output result visually. If you use a script to perform auto-checking, there is a risk that tampering of the reference value used for comparison may escape detection.

2. Execute the check command.
   Next, you need to perform tamper check for system files. The tamper check for system files checks the system image, as well as files that are required for system operation and are not to be converted.

   The following figure shows the sequence flowchart for tamper check of system files.



Execute the following test command. Do not omit the pathname when entering the command.
$ /usr/bin/dtsxck

The command runs and when it transits to tamper check for system files, the following message is displayed:

System Image Checksum.
Please compare to the offline value, manually.

6af74eaa039df24e34d4b780cb6704ab -

Do you want to continue checking for the loaded system files? (Y/N)
It may block your application processing, because it is very high load process.

Compare the output result against the content of the “uImage-R*.**.**-checksum.txt” file. “R*.**.**” denotes the version number. For instance, if the version number is R1.02.01, the output result should be compared against the “uImage-R1.02.01-checksum.txt” file.

The figure below shows the content of a sample “uImage-R*.**.**-checksum.txt” file. Check that the output result obtained above is identical to line 9 of the “uImage-R*.**.**-checksum.txt” file.

```
---- cut ----
-rwxr-x--- 1 root admin-users 523352 Jun 16 07:27 /usr/bin/md5sum
bf01d4348bf31a48a5c61ea6d1f74308  -
----
---- cut ----
# System Image Checksum.
# Please compare to the offline value, manually.
----
6af74eaa039df24e34d4b780cb6704ab  -
----
```

If the check performed thus far is adequate, enter 'N' and press the ENTER key to terminate the checking process.
If you enter 'Y' and press the ENTER key, the following message is displayed and the system transits to integrity check for loaded system files. However, this check is a high CPU load process, which may affect measurement execution, and thus should be performed only when no measurement is in progress or when the DTSX3000 is in maintenance state.

```
# Checking loaded system files.
## Phase 1: Checking base executable files.
###.....##.....#.....##.....###.....##.....##.....#.....##.....##...
.....##.....#.....#.....#.....#.....#.....#.....###.....###.....###..
.....#.....#.....##.....#.....##.....##.....#.....###.....#.....###.
.....#.....##.....###.....#.....###.....##.....###.....#.....##.....
..###.....###.....#.....###.....###.....##.....#.....#.....##.....#
##.....#.....##.....##.....#.....###.....##.....#.....##.....#.....
.###.....##.....###.....#.....#.....##.....###.....###.....##.....#
#.....###.....##.....###.....###.....#.....##.....###.....#.....##.
.....#.....##.....##.....###.....#.....#.....##.....##.....#.....#..
.....###.....##.....###.....#.....##.....###.....#.....###.....##.....
.....#.....##.....##.....
OK!

## Phase 2: Checking initialization script files on boot sequence.
###.....###.....##.....#.
OK!

## Phase 3: Checking DTSX base configuration program files.
##.....###.....##.....###....
OK!

## Phase 4: Checking application program files.
##.....#.....#.....###.....###.....###.....#.....#.....##.....#.....
...#.....###.....
# Application Image Checksum.
# Please compare to the offline value, manually.
----
e951a72ee393bde12019de30ed2dd88b -
----
OK!

## Phase 5: Checking Web view program files.
#.....#.....#.....###.....##.....###.....##.....###.....#.....#.....
...##.....#.....#.....###.....#.....##.....
```

```
# Web view program files Checksum
# Please compare to the offline value manually.
----
5930b0b8bdb997ae82a52a3b9d492dff -
----
OK!
```

At the end of each checking phase (the displayed phase number corresponds to the phase number in the above flowchart), an “OK!” message is displayed if file integrity can be verified. If a possibility of tampering is detected, however, a “FAILED” and a “Please contact the customer support.” message is displayed, and the checking process is aborted.

You need to check the output result of phase 4 and phase 5 visually as described below.

Compare the output result of phase 4 against the content of the “app-R*.**.**-checksum.txt” file. “R*.**.**” denotes the version number. For instance, if the version number is R1.02.01, the output result should be compared against the “app-R1.02.01-checksum.txt” file.

The figure below shows the content of a sample “app-R*.**.**-checksum.txt” file. Check that the output result obtained above is identical to line 4 of the “app-R*.**.**-checksum.txt” file.

```
# Application Image Checksum.
# Please compare to the offline value, manually.
----
e951a72ee393bde12019de30ed2dd88b  -
----
```

Compare the output result of phase 5 against the content of the “exfs-R*.**.**-checksum.txt” file. “R*.**.**” denotes the version number. For instance, if the version number is R1.02.01, the output result should be compared against the “exfs-R1.02.01-checksum.txt” file.

The figure below shows the content of a sample “exfs-R*.**.**-checksum.txt” file. Check that the output result obtained above is identical to line 4 of the “exfs-R*.**.**-checksum.txt” file.

```
# Web view program files Checksum.
# Please compare to the offline value manually.
----
5930b0b8bdb997ae82a52a3b9d492dff  -
----
```

B11.4.2. Getting Authentication Success and Failure Log

■ Log Files

The DTSX3000 creates and maintains internal access logs (records of authentication successes and failures) for SSH, SFTP and HTTP server accesses.
The following log files are maintained:

- /var/log/secure (SSH access log)
- /var/log/lighttpd/error.log (lighttpd error log)
- /var/log/lighttpd/access.log (lighttpd access log)

In addition, to limit the size of log records, DTSX3000 imposes the following connection limits for SSH and HTTP.

- For SSH, packets are dropped with no access log records created if 17 or more new connections are made within 4 seconds.
- For HTTP, packets are dropped with no access log records created if 5 or more new connections are made within 4 seconds.

The rotation specifications of individual log files are shown below. The rotation cycle is the period for performing rotation even if the size limit is not reached.

- /var/log/secure
  Checking cycle for rotation: hourly
  Number of historical log files: 20
  Size threshold for rotation: 6 MB
  Rotation cycle: weekly

- /var/log/lighttpd/error.log
- /var/log/lighrrpd/access.log
  Checking cycle for rotation: hourly
  Number of historical log files: 1
  Size threshold for rotation: 6 MB
  Rotation cycle: weekly

In the event of rotation failure due to file system full, only 10 lines of the most recent log records are extracted and the remaining records are discarded for the following log files:

- /var/log/secure
- /var/log/lighttpd/error.log
- /var/log/lighttpd/access.log

Tip

The DTSX3000 also supports the following log files:

- /var/log/iptables.log (packet drop log of iptables)
- /var/log/typescript.root (Shell operation log for the root user account)

These log files have the following rotation specifications:

Checking cycle for rotation: hourly

Number of historical log files: 1

Size threshold for rotation: 1 MB

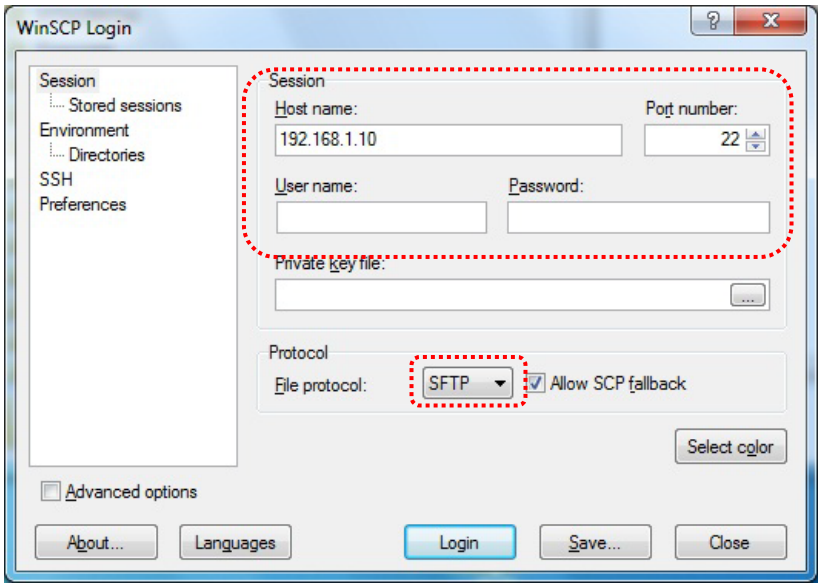
Rotation cycle: weekly

As the DTSX3000 may be subject to malicious attacks, we recommend checking these log files too.

■ Procedure for Getting Log File

An example for getting log files using SFTP client software (WinSCP Ver4.3.3) is described below.

1. Connect to the DTSX3000.
   Run WinSCP. After specifying the following settings on the displayed login dialog, press the [Login] button.
   - Host name : Hostname or IP address of DTSX3000
   - Port Number : 22
   - User name, Password : Username and password of DTSX3000 user
     Log in as a user with administrator authority (admin).
   - Protocol : Select SFTP

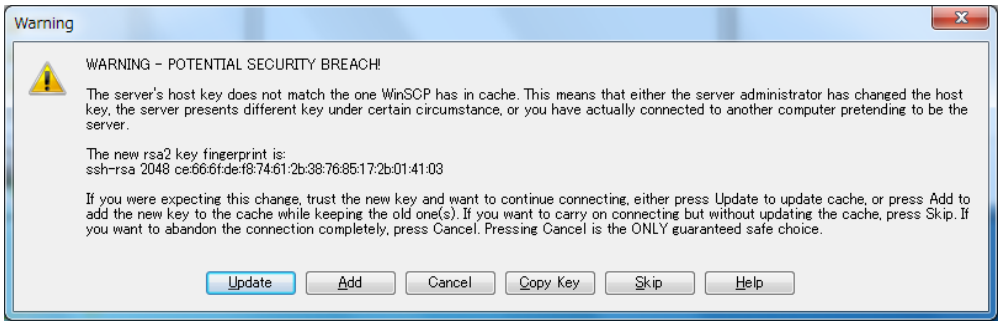


Tip

- If the number of existing connections to the DTSX3000 is already the maximum allowed, the DTSX3000 rejects the login request from the SSH/SFTP, the client receives the following message and connection fails.

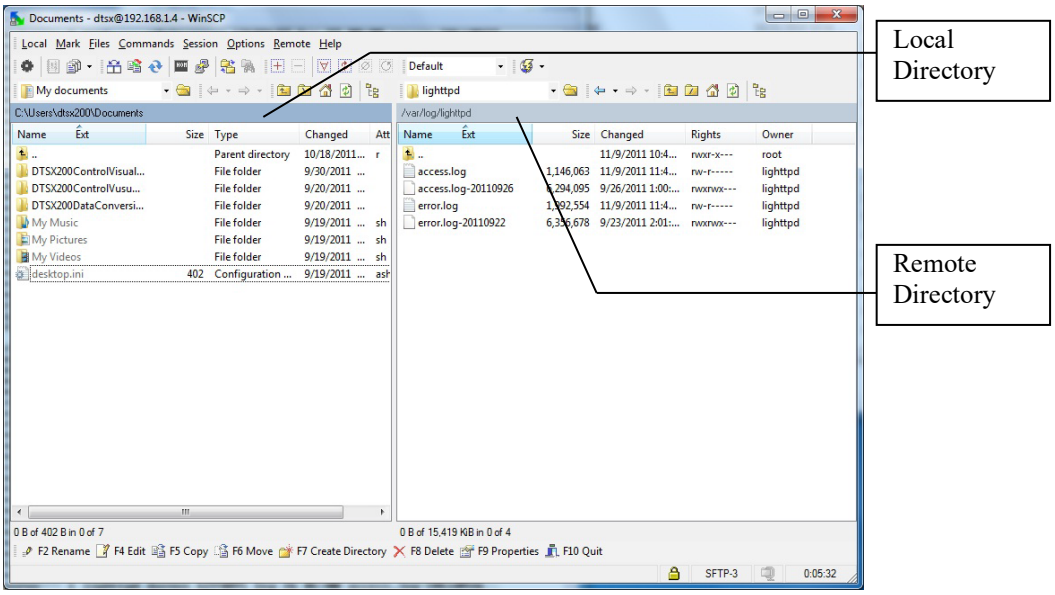
  Received message too long 1416589088

- If this message is displayed, check the number of existing connections, disconnect any existing connection no longer required and then try connecting to the DTSX3000 again.
- The SSH/SFTP client may display a “host key does not match” message as shown below.
  If this message is displayed, there is a possibility that you have connected to the computer of a malicious attacker pretending to be the DTSX3000. In this case, abort the connection using SSH/SFTP client, and check to ensure that neither the PC running the client software nor the DTSX3000 shows any sign of being attacked.

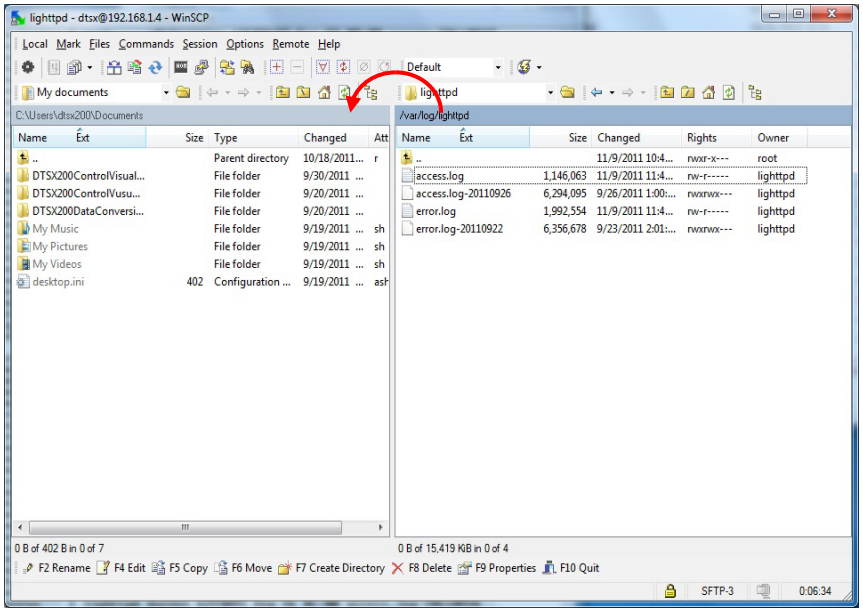


- However, this same message will also be displayed if the system has been updated and a new host key has been generated on the DTSX3000. Check with the DTSX3000 administrator whether a system update has been done, and if so, update the SSH/SFTP client with the new host key sent by the DTSX3000.

2. Move to the directory containing the log file.
   Change the current remote directory (source for copying) and the current local directory (destination for copying).
   In the figure below, /var/log/lighttpd is specified as the remote directory.



3. Get the file.
   Select a file in the remote directory side, and then drag and drop it into the local directory side.


lighttpd - dtsx@192.168.1.4 - WinSCP
Local Mark Files Commands Session Options Remote Help
Default
My documents
lighttpd
C:\Users\dtsx200\Documents
/var/log/lighttpd
Name Ext Size Type Changed Att
Parent directory 10/18/2011... r
DTSX200ControlVisual... File folder 9/30/2011 ...
DTSX200ControlVusu... File folder 9/20/2011 ...
DTSX200DataConversi... File folder 9/20/2011 ...
My Music File folder 9/19/2011 ... sh
My Pictures File folder 9/19/2011 ... sh
My Videos File folder 9/19/2011 ... sh
desktop.ini 402 Configuration ... 9/19/2011 ... ash
Name Ext Size Changed Rights Owner
11/9/2011 10:4... rwxr-x--- root
access.log 1,146,063 11/9/2011 11:4... rw-r----- lighttpd
access.log-20110926 6,294,095 9/26/2011 1:00:... rwxrwx--- lighttpd
error.log 1,992,554 11/9/2011 11:4... rw-r----- lighttpd
error.log-20110922 6,356,678 9/23/2011 2:01:... rwxrwx--- lighttpd
0 B of 402 B in 0 of 7
0 B of 15,419 KiB in 0 of 4
F2 Rename F4 Edit F5 Copy F6 Move F7 Create Directory F8 Delete F9 Properties F10 Quit
SFTP-3
0:06:34

B11.5. Backup and Restore

You can back up current system configuration data, as well as restore configuration data from the created configuration archive file later.

B11.5.1. Backup

To perform backup, follow the procedure below.

1. Boot up the DTSX3000 in online state or maintenance state.

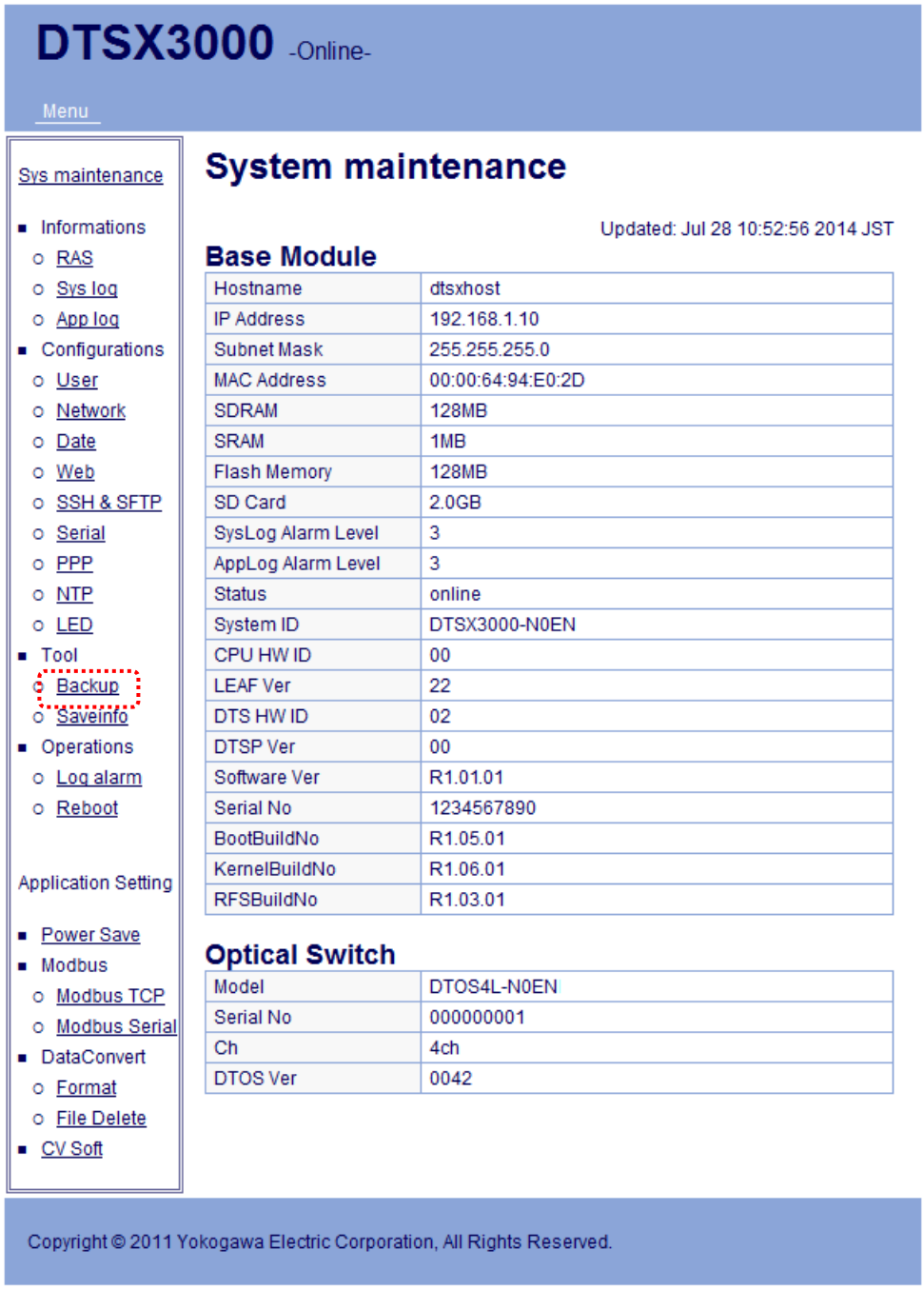
SEE ALSO

For details on the boot procedure, see Chapter B4, “System Operation.”

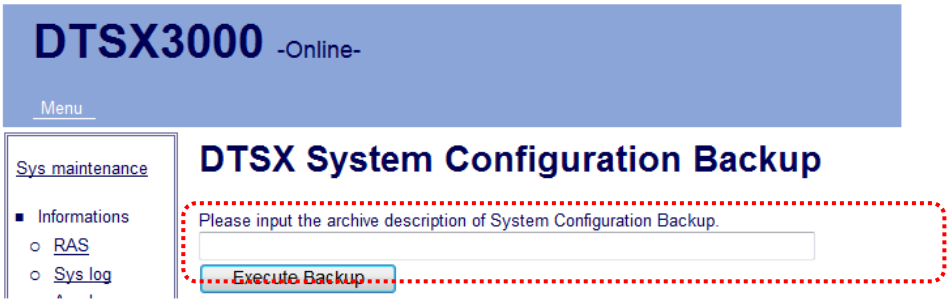
2. Access the DTSX3000 from a Web browser. The Top page is displayed.

SEE ALSO

For details on the access procedure, see Subsection B11.1.1, “Access Procedure.”



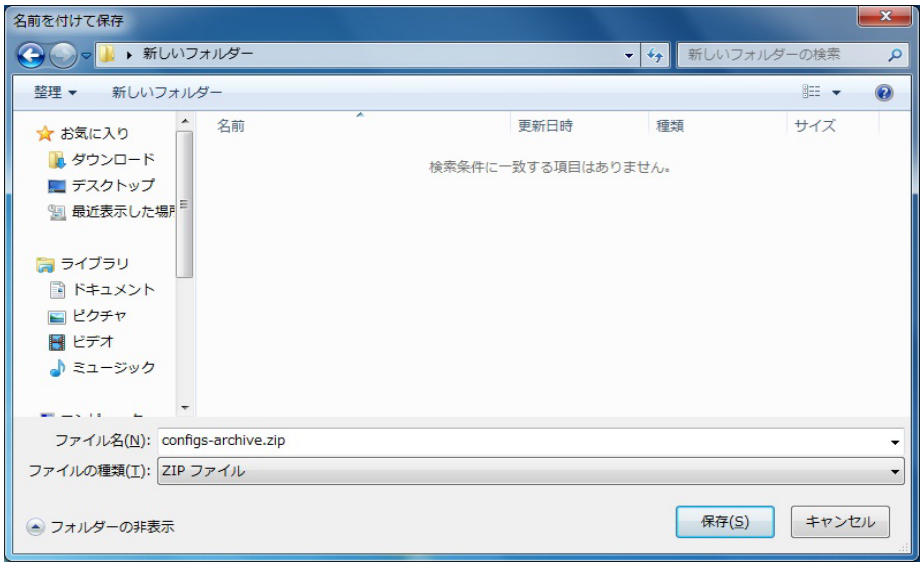
3. Display the backup window.
   If the system was started in online state, select Tool-[Backup] from the side menu.
   If the system was started in maintenance state, click the [acquire auth] button at the top of the Top page, and then select Tool-[Backup] from the side menu.



4. Enter any comment text for the configuration archive file.
   You can enter any comment text in the text box of the Backup window. The comment text will be displayed in the Restore window when you execute restoration.
   After entering the comment, click the [Execute Backup] button.

Tip

Comment is optional.



5. Specify the destination folder for saving the configuration archive file.
   When you click the [Save] button, a destination folder selection window is displayed. Specify a configuration archive output file name and a destination folder, and then click the [Save] button.
   The configuration file is created with the specified file name.

Tip

We recommend copying the configuration archive file to a removable media or some other safe location as backup.

B11.5.2. Restore

Follow the procedure below to restore configuration data from a configuration archive file. Prepare the configuration archive file to be restored beforehand.

Tip

A file created according to Subsection B11.5.1, “Backup” can be used as the configuration archive file for restoration. However, restoration is not guaranteed to work properly if the configuration archive file has been edited using a PC or some other means after backup.

1. Boot up the DTSX3000 in maintenance state.

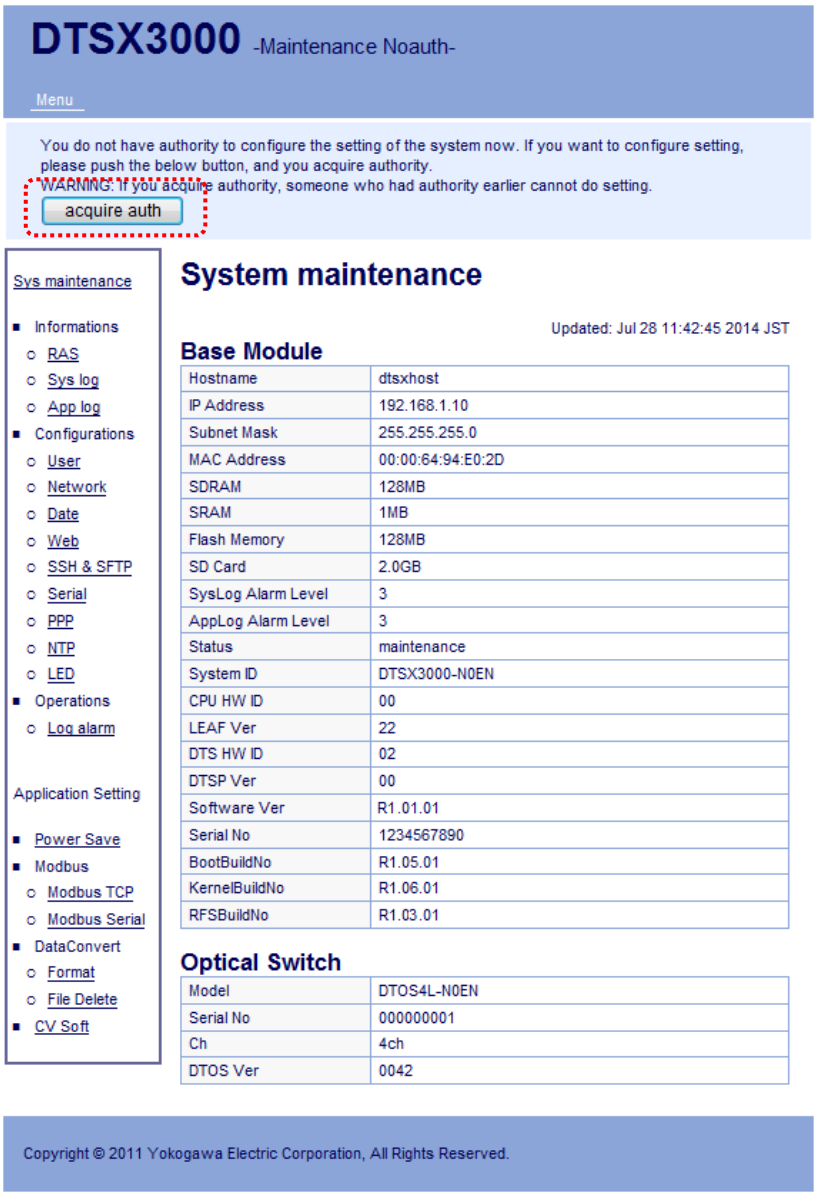
SEE ALSO

For details on how to boot up in maintenance state, see Chapter B4, “System Operation.”

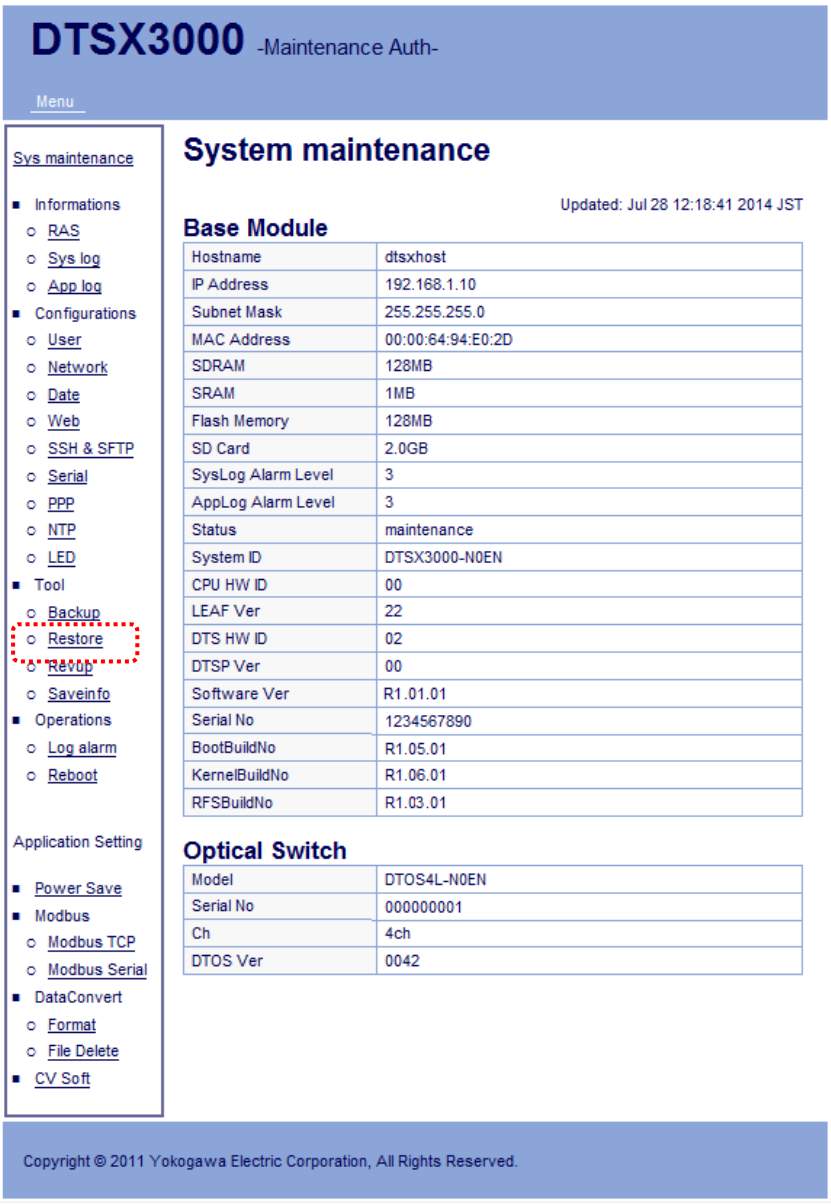
2. Access the DTSX3000 web page from a Web browser. The Top page is displayed.

SEE ALSO

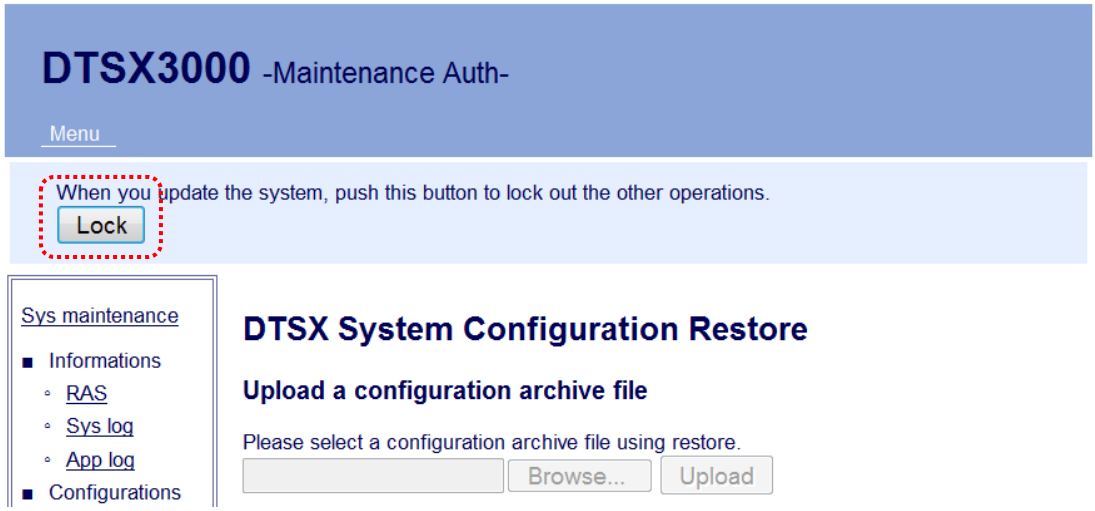
For details on the access procedure, see Subsection B11.1.1, “Access Procedure.”



3. Acquire authority.
   Click the [acquire auth] button at the top of the Top page. The Tool menu is displayed in the side menu.


DTSX3000 -Maintenance Auth-
Menu
Sys maintenance
Informations
RAS
Sys log
App log
Configurations
User
Network
Date
Web
SSH & SFTP
Serial
PPP
NTP
LED
Tool
Backup
Restore
Revup
Saveinfo
Operations
Log alarm
Reboot
Application Setting
Power Save
Modbus
Modbus TCP
Modbus Serial
DataConvert
Format
File Delete
CV Soft
System maintenance
Updated: Jul 28 12:18:41 2014 JST
Base Module
Hostname dtsxhost
IP Address 192.168.1.10
Subnet Mask 255.255.255.0
MAC Address 00:00:64:94:E0:2D
SDRAM 128MB
SRAM 1MB
Flash Memory 128MB
SD Card 2.0GB
SysLog Alarm Level 3
AppLog Alarm Level 3
Status maintenance
System ID DTSX3000-N0EN
CPU HW ID 00
LEAF Ver 22
DTS HW ID 02
DTSP Ver 00
Software Ver R1.01.01
Serial No 1234567890
BootBuildNo R1.05.01
KernelBuildNo R1.06.01
RFSBuildNo R1.03.01
Optical Switch
Model DTOS4L-N0EN
Serial No 000000001
Ch 4ch
DTOS Ver 0042
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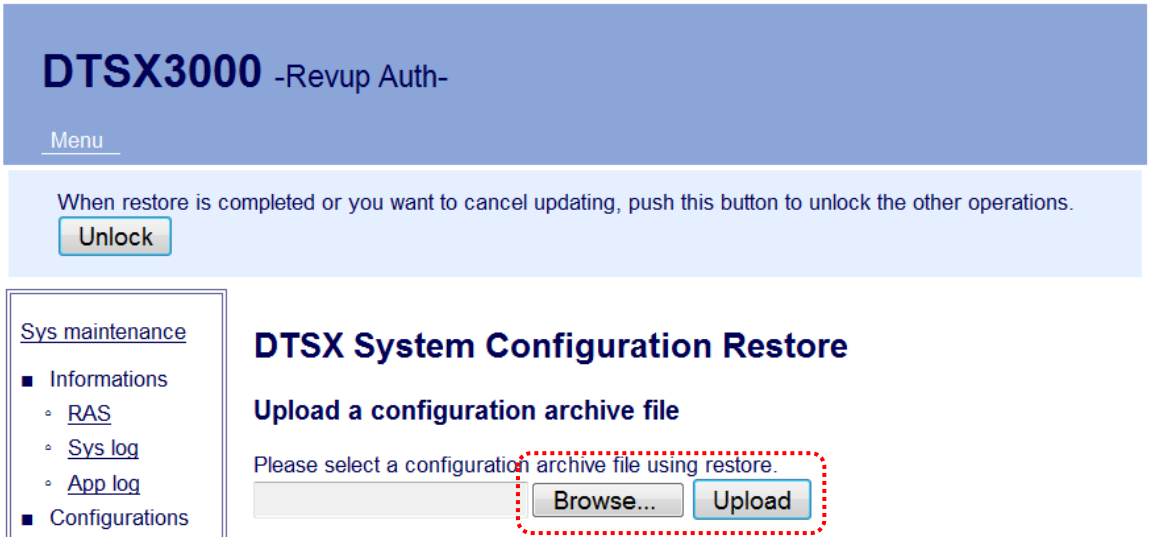
4. Transit to Restore mode and get Revup authority.
   Select Tool-Restore from the side menu. On the displayed Restore window, click the [Lock] button located at the top.



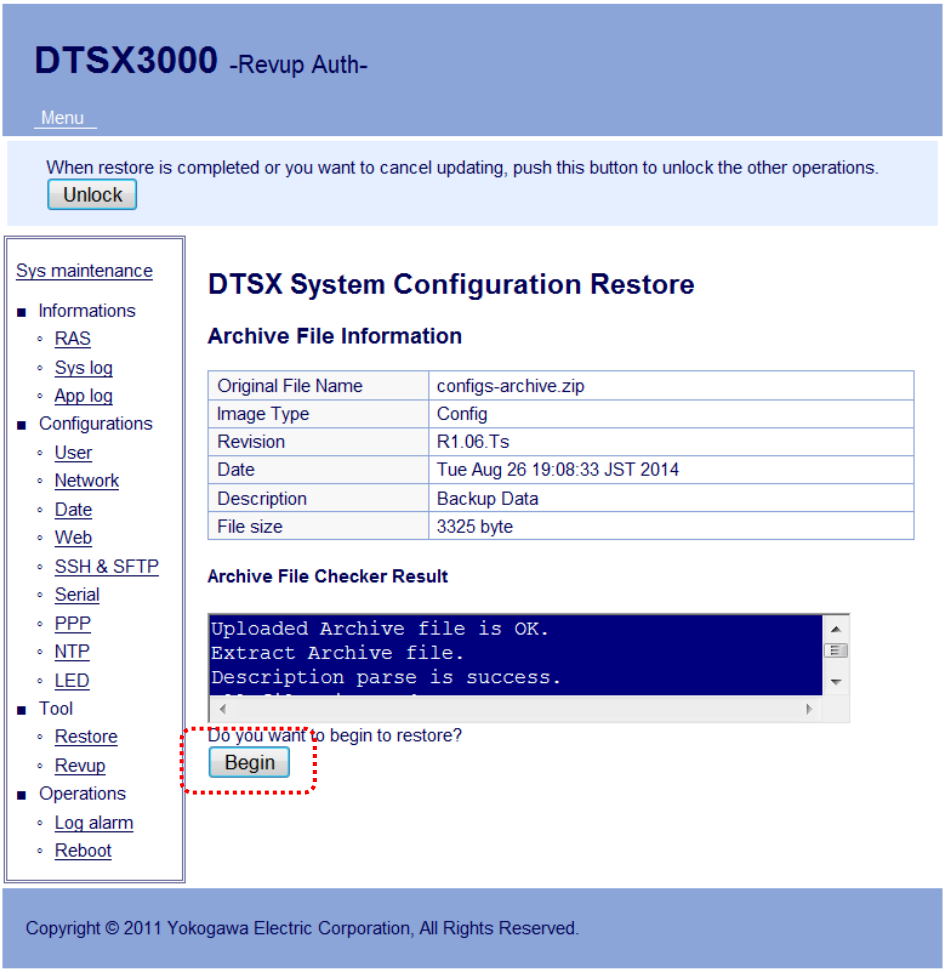
Tip

- When you want to cancel updating, push [Unlock] button to do the other operations.
- To unlock is only possible in the locked browser.
- If you close the browser in a locked status, lock status will continue for 10 minutes. During the period, you and the other users can not change the settings.

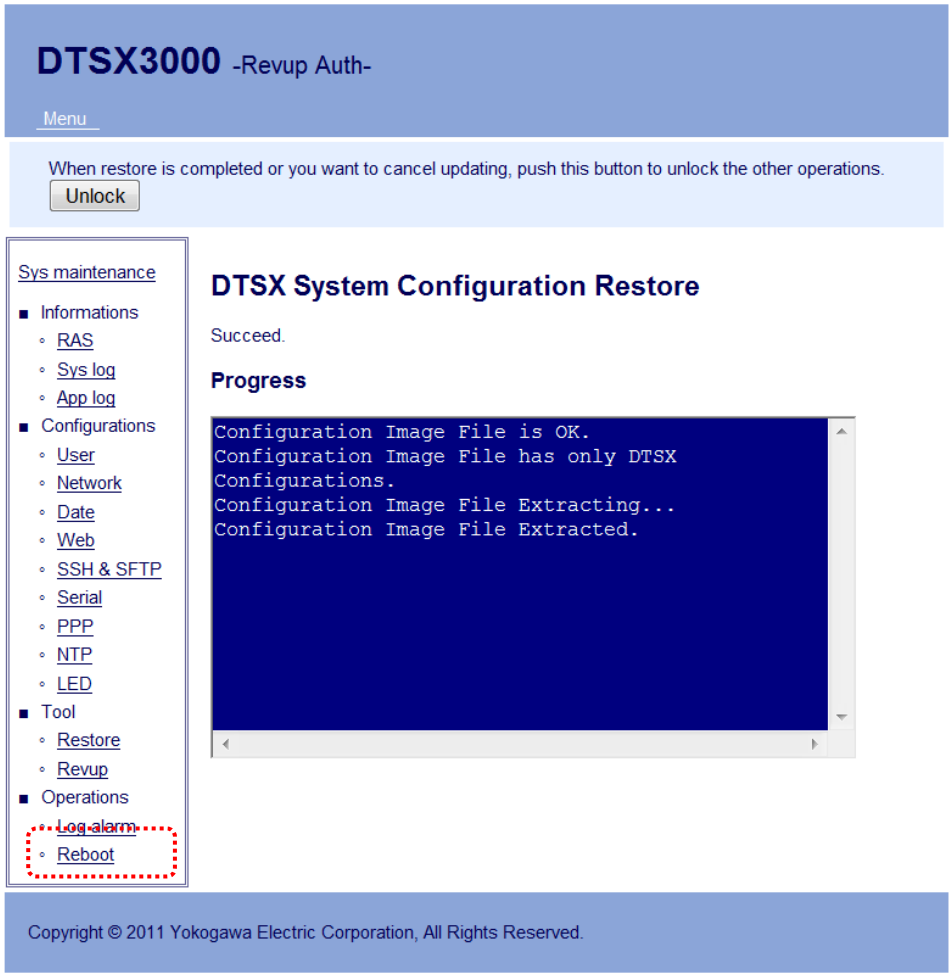
5. Upload configuration archive file.
   Click the [Browse] button in the Restore window. Select the configuration archive file to be restored and click the [Upload] button.



6. Initiate restoration.
   When uploading is completed, click the [Begin] button at the bottom of the displayed window.



If restoration is successful, the following window is displayed.



7. To unlock the other operations
   Push [Unlock] button to unlock the other operations.

B11.6. System Revision Update

You can perform revision update of the system from a Web browser running on a Windows PC.
Before performing revision update, get the archive container file(*1) and save it in an appropriate folder on a Windows PC or on a storage media (e.g. USB memory) accessible from a PC.

*1 Archive container file
The DTSX3000 comprises broadly of the Kernel, Root File System and App File System. An archive container file is a collection of their respective revision update images within one file. The latest archive container file can be downloaded from the members-only Yokogawa Plus of YOKOGAWA website

Follow the procedure below to update the system from an archive container file.

1. Connect the DTSX3000and a Windows PC using a LAN cable.
2. Boot up the DTSX3000 in maintenance state.

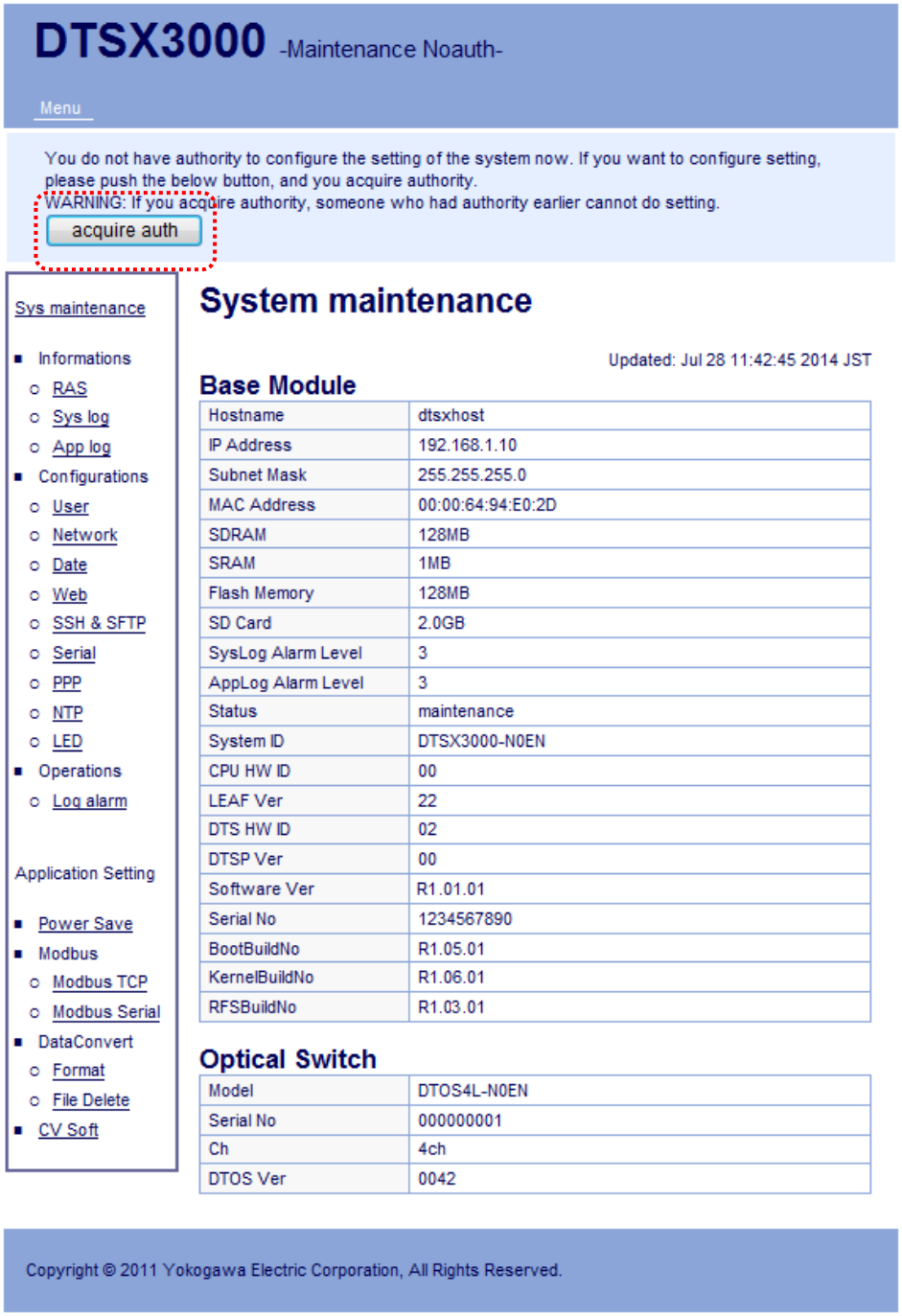
SEE ALSO

For details on how to boot up in maintenance state, see Chapter B4, “System Operation.”

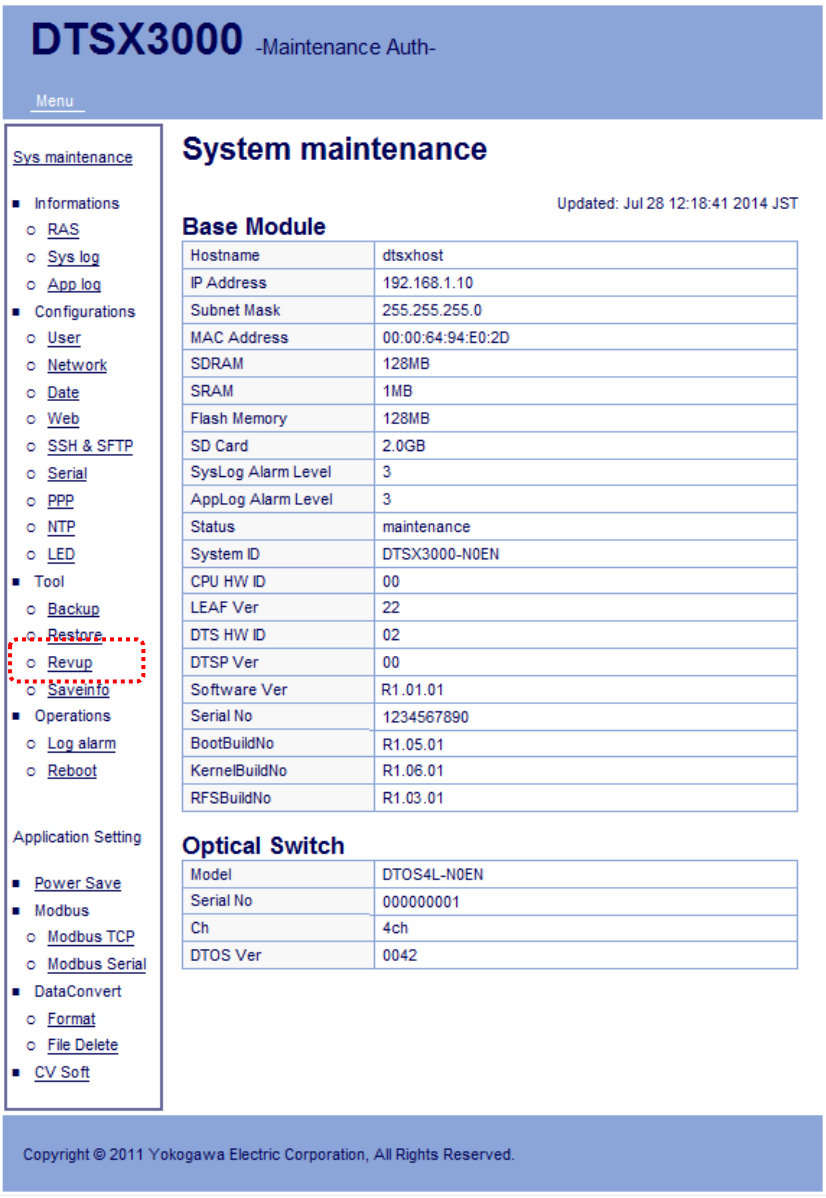
3. Access the DTSX3000 web page from a Web browser. The Top page is displayed.

SEE ALSO

For details on the access procedure, see Subsection ” B11.1.1, “Access Procedure.”



4. Acquire authority
   Click the [acquire auth] button at the top of the Top page. The Tool menu is displayed in the side menu.



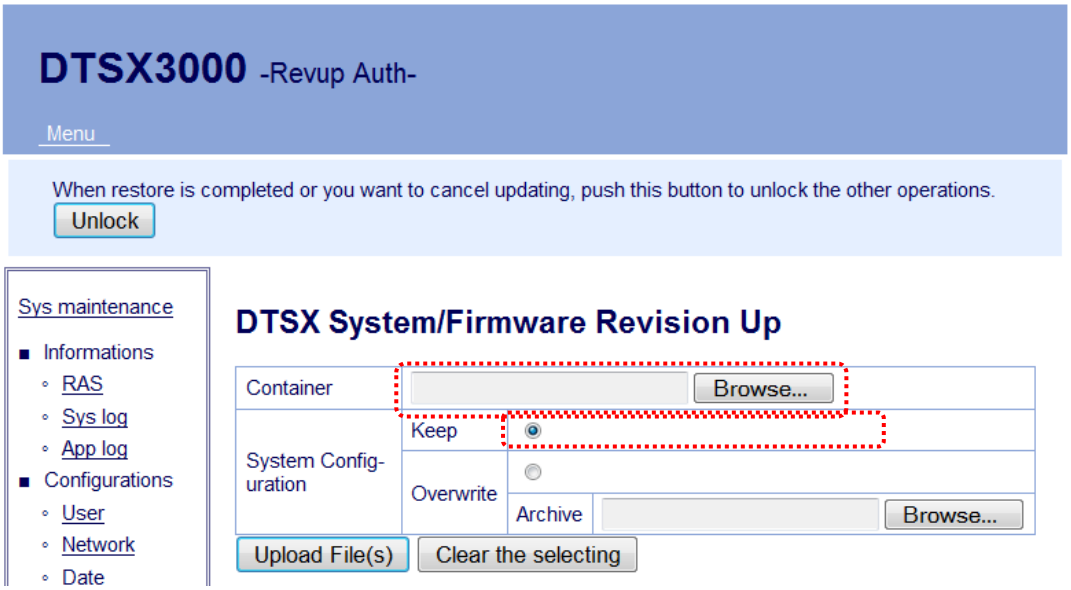
5. Transit to Revision Update mode and get Revision Update (Revup) authority
   Select Tool-Revup from the side menu. On the displayed Revision Update window, click the [Lock] button located at the top.



Tip

- When you want to cancel updating, push [Unlock] button to do the other operations.
- To unlock is only possible in the locked browser.
- If you close the browser in a locked status, lock status will continue for 10 minutes. During the period, you and the other users can not change the settings.

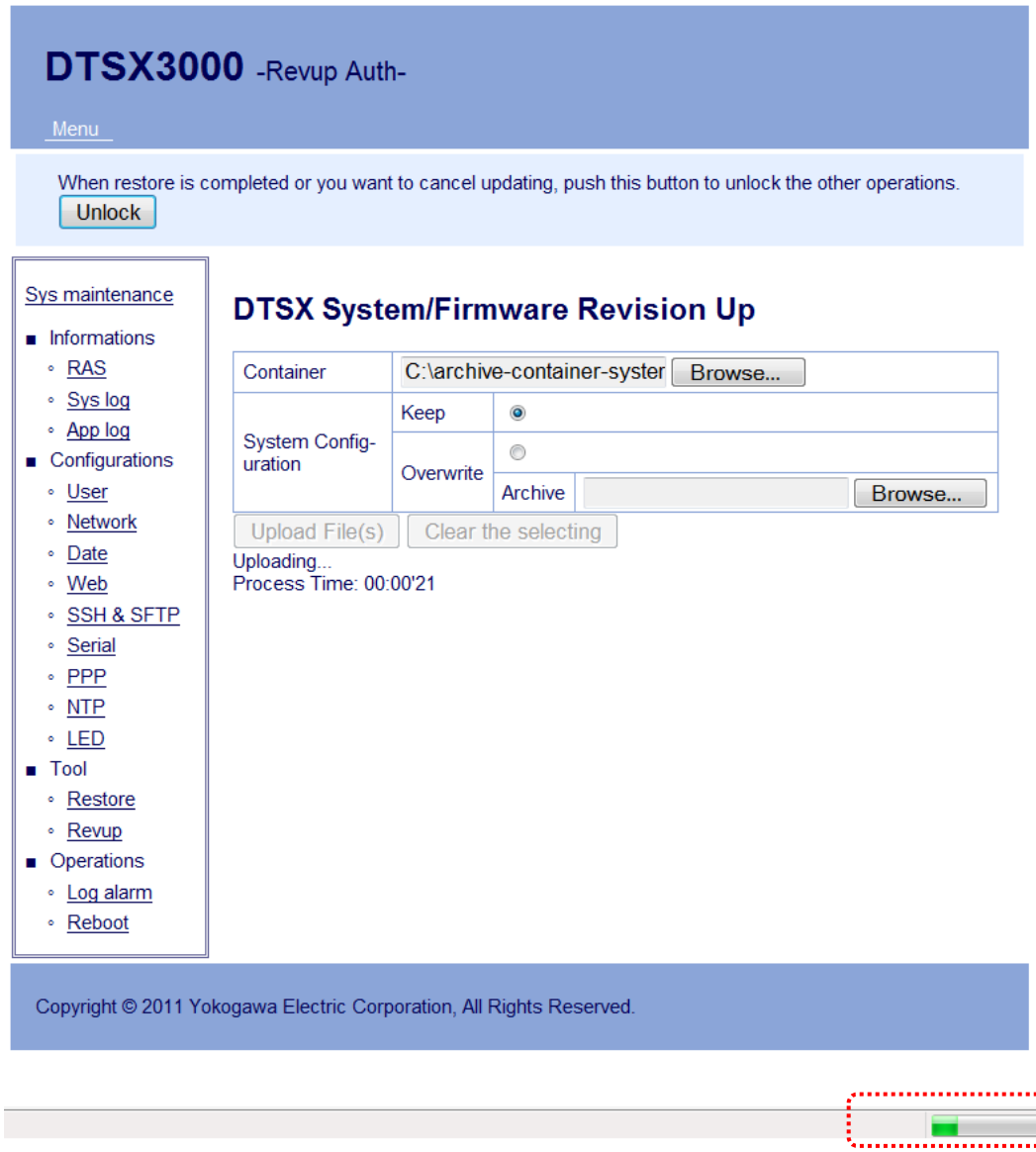
6. Configure uploading of archive container file and configuration archive file.
   Click the [Browse] button on the Container row and select the archive container file. On the System Configuration row, select [Keep] to keep the system configuration file or select [Overwrite] to overwrite it with an archive configuration file. If you have selected the [Overwrite] option, click the [Browse] button on the Archive row and select an archive configuration file created beforehand.



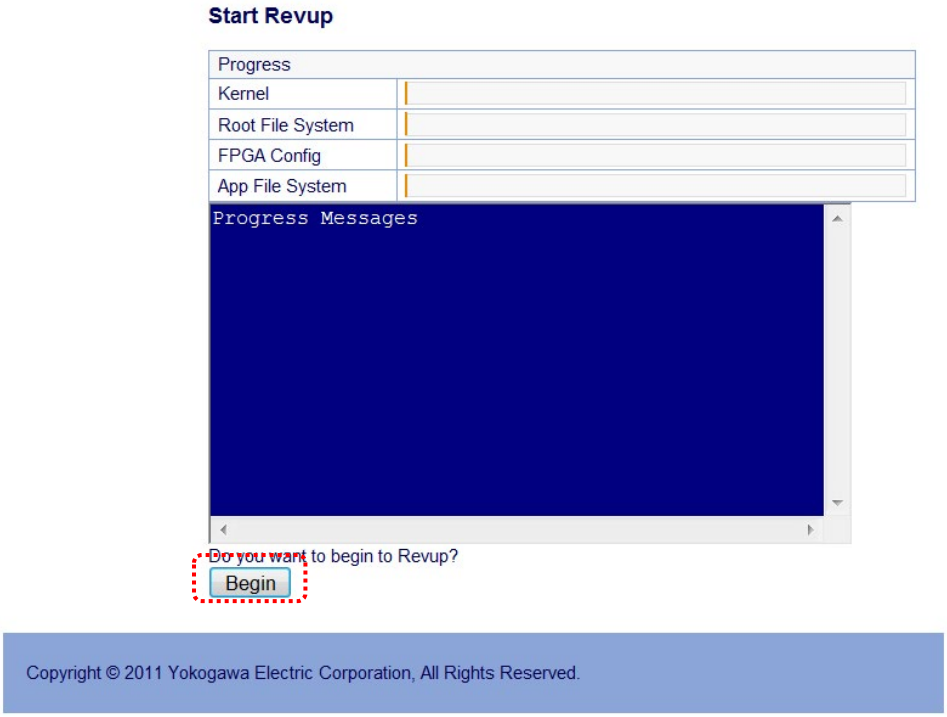
7. Upload archive files.
   Click the [Upload File(s)] button located at the center of the window. Uploading begins. You can monitor the upload progress from the progress bar of the Web browser.

Tip

The time required for uploading varies with each revision update.


DTSX3000 -Revup Auth-
Menu
When restore is completed or you want to cancel updating, push this button to unlock the other operations.
Unlock
Sys maintenance
Informations
RAS
Sys log
App log
Configurations
User
Network
Date
Web
SSH & SFTP
Serial
PPP
NTP
LED
Tool
Restore
Revup
Operations
Log alarm
Reboot
DTSX System/Firmware Revision Up
Container
C:\archive-container-syster
Browse...
System Config-uration
Keep
Overwrite
Archive
Browse...
Upload File(s)
Clear the selecting
Uploading...
Process Time: 00:00'21
Copyright © 2011 Yokogawa Electric Corporation, All Rights Reserved.

When uploading is completed, the following window is displayed.

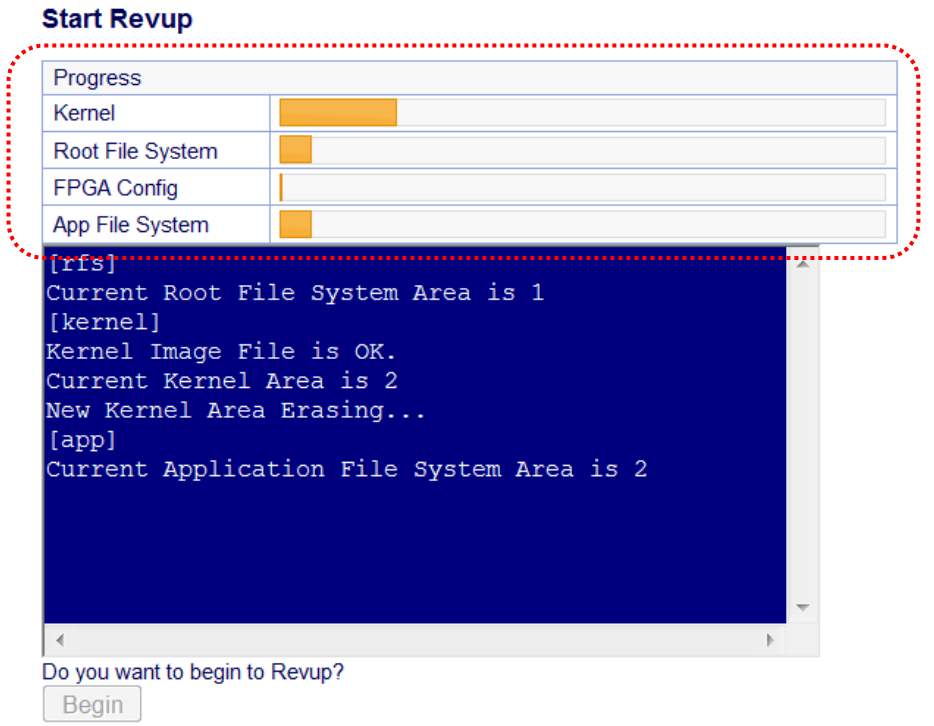


8. Initiate revision update .
   Click the [Begin] button at the bottom of the window displayed when uploading is completed.

Tip

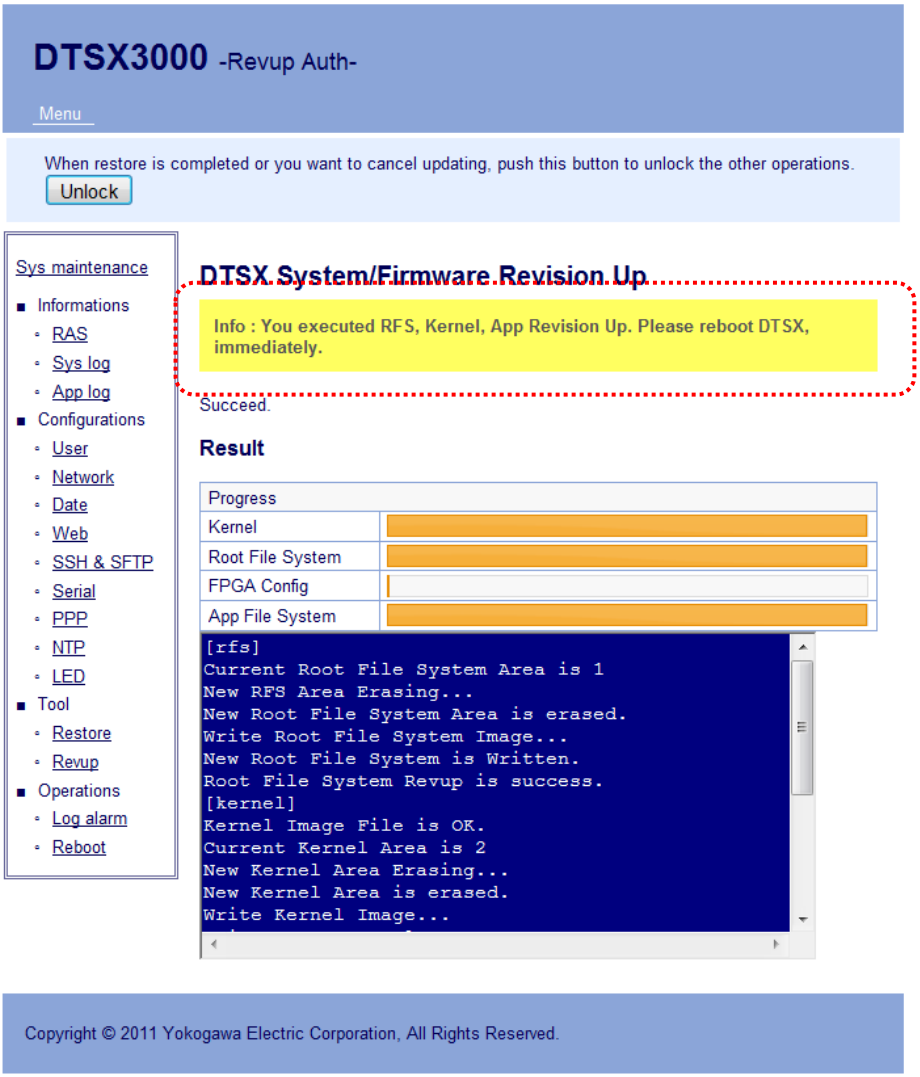
The FPGA Config is not included in the archive container file. Revision update of the FPGA Config is carried out under maintenance by Yokogawa.

You can monitor the revision update progress from the progress bars displayed at the center of the window.



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When revision update is completed, the following window is displayed.



9. Reboot the system

TIP

When a system update is performed, a new host key is generated on the DTSX3000. This may cause a “host name does not match” error message to be displayed on the first SSH/SFTP connection to the DTSX3000 after the system update.

If this happens, check with the DTSX3000 administrator whether a system update has been done, and if so, update the SSH/SFTP client with the new host key sent by the DTSX3000.

B12. Using FAST/TOOLS

B12.1. Overview

If you are purchasing "FTDTSX (-S11)" as an option for the server package (RVSVRN(-S**-**)/MSSVRN(-S**-**)) of our products FAST / TOOLS (SCADA software), DTS driver is installed. Accordingly, you can now use FAST/TOOLS to retrieve temperature data from DTSX3000, as well as monitor temperature distribution and temporal changes of the sensor fiber.

The next method is provided for retrieving temperature data from the DTSX3000 using FAST/TOOLS:

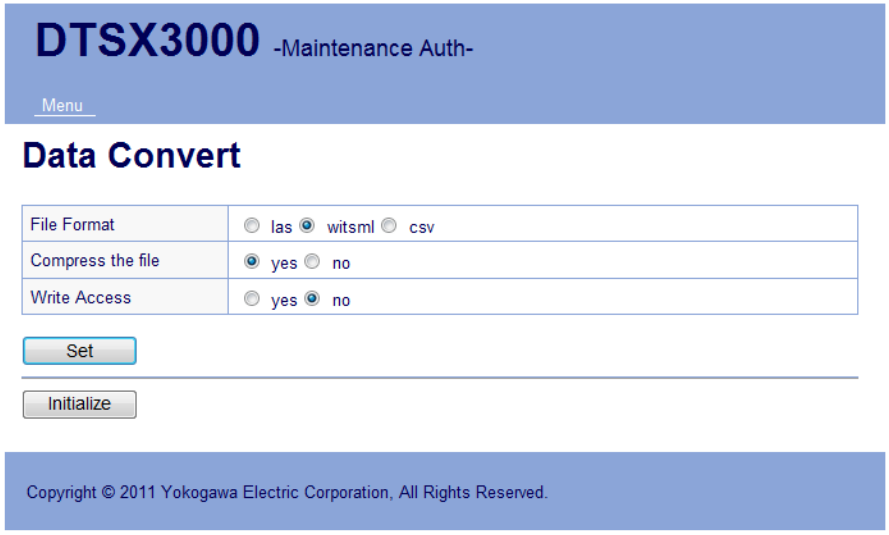
- Retrieving data (WITSML files) using FTP or SFTP

To enable this feature require some pre-setup, which is described in the subsequent subsections.

B12.2. Retrieving Data Using FTP/SFTP

To retrieve temperature data (WITSML files) from DTSX3000 using the FTP or SFTP client function of FAST/TOOLS, you will need additionally the DTAP3000D software (DTSX3000 Data Conversion Software).

Before running FAST/TOOLS, you will also need to grant write access to the /mnt/data/LATEST directory by setting [Write Access] to [yes] in the DTSX3000 system settings (see figure below for details).



SEE ALSO

For details on the system settings, see Subsection B6.5.4, “Data Conversion Related Settings.”

TIP

Beware that adding new files to or modifying existing files in the /mnt/data/LATEST directory by some means other than temperature data (WITSML files) retrieval using FAST/TOOLS may result in unexpected problems.

DTSXL Distributed Temperature Sensor Long Range System
PART – C Operation and Maintenance

IM 39J06B40-01EN

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C1. Operation

C1.1. Power on/off Procedures and Operation

This section describes the procedures for powering on, powering off and rebooting the DTSX3000 of the DTSXL System.

SEE ALSO

For details on CPU module, see the STARDOM FCN/FCJ Guide (IM 34P02Q01-01E).

C1.1.1. Power-on Procedure

The DTSX3000 boots up automatically when powered on, and operates in the state prevailing before power-off.

For instance, as in the case where power is restored after a power failure, if the DTSX3000 is powered off during measurement and then powered on, it automatically restarts measurement using the settings prevailing before power off even though no communication command to start measurement is received.

In normal operation, you should shutdown the DTSX3000 when it is in idle state (not performing measurement) before powering off the system. When the DTSX3000 is next powered on, it maintains its previous idle state.

C1.1.2. Power-off Procedure

To power-off the DTSX3000 safely, you need to put it into shutdown state (ready-for-power-down state) before turning off the power.

If a CPU module is installed, you need to put both the DTSX3000 and the CPU module into shutdown state before turning off the power.

Once a module is in shutdown state, you need to press its RESET switch or reapply power to put it back into operation.

● SHUTDOWN switch

When you press the SHUTDOWN switch of the DTSX3000, its LED lamps start blinking. When the LED lamps of the DTSX3000 go off thereafter, it is in shutdown state.

When you press the SHUTDOWN switch of the CPU module, its LED lamps start blinking. When the LED lamps of the CPU module go off thereafter, the CPU module is in shutdown state.

● Web browser

If you display the maintenance menu of the DTSX3000 in a Web browser and select Shutdown from its Reboot menu, the DTSX3000 transits to shutdown state.

The same procedure applies to the CPU module. However, as the DTSX3000 and CPU module are independent of each other, you need to shutdown the two modules individually from their respective maintenance web pages.

CAUTION

The RDY LED blinks during SHUTDOWN processing. Do not switch off the power supply, unplug the power cord, or press the RESET switch until SHUTDOWN processing has completed (the RDY LED goes off).

C1.2. Reboot

There are two ways to reboot the DTSX3000 of the DTSXL System.

● Using the RESET switch

To reboot the DTSX3000 when it is in shutdown state, press its RESET switch.

● Using the Web browser

Open the maintenance menu of the DTSX3000 from a Web browser and select Reboot from its Reboot menu.

The same procedure applies to the CPU module.

C1.3. System Operation upon Power Failure

If the power supply to the system is interrupted for a period exceeding the instantaneous power failure sense delay time stipulated in the specifications of the power supply module, the DTSX3000 detects a power failure and stops its operation.

● System behavior after power recovery

When the power is restored, the DTSX3000 restarts (with the system operation as that after a normal power on).

CAUTION

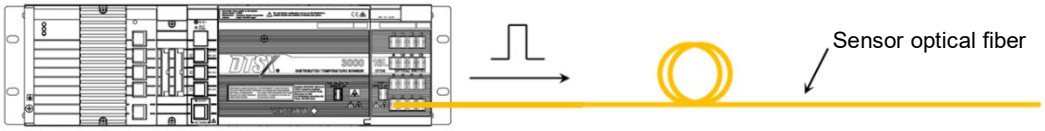
- Power failure during writing of files to the system memory may damage the file system.
- To prevent such risks, install an uninterrupted power supply (UPS) device.

C2. DTS-specific Operation and Precautions

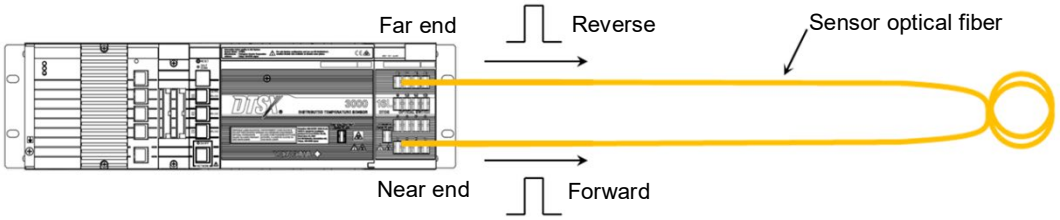
C2.1. Single-ended and Double-ended Measurement

The DTSX3000 of the DTSXL System supports both single-ended and double-ended distributed temperature measurement. In single-ended measurement, a light pulse is launched from one end of the sensor optical fiber and the returned Raman scatter is measured to determine temperature distribution. In double-ended temperature measurement, a light pulse is launched from each of the two ends of the sensor optical fiber and the returned Raman scatter is measured separately to determine temperature distribution. This section describes the respective characteristics and precautions relating to single-ended and double-ended measurements.

<Single-ended measurement>



<Double-ended measurement>



● Single-ended measurement

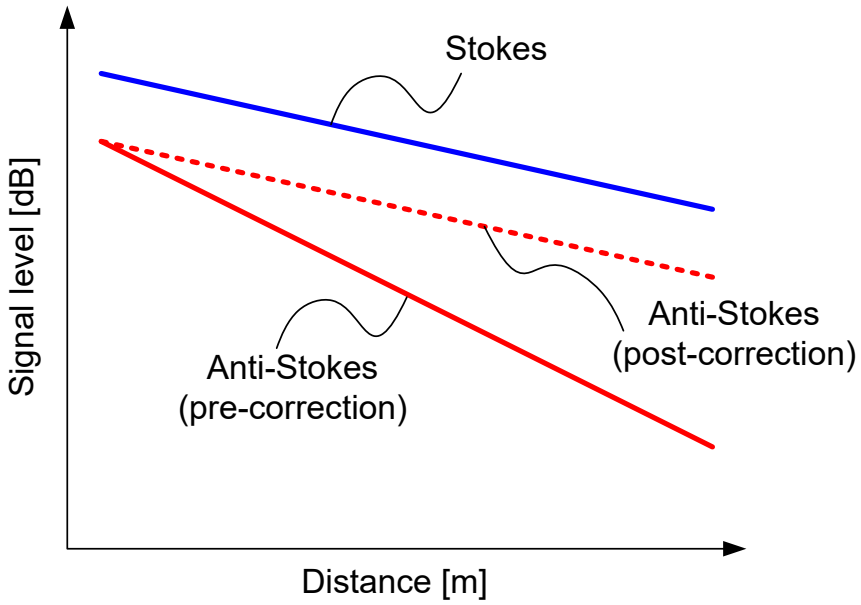
Single-ended measurement can be used in distributed temperature measurement applications where the sensor optical fiber cannot be looped back or no optical switch is used.

Single-ended measurement is simpler than double-ended measurement but requires correction for the differential sensor optical fiber loss between the Stokes light and anti-Stokes light of the Raman scatter. The DTSX3000 uses the signal intensities of the backscattered Stokes and anti-Stokes light in the sensor optical fiber for temperature calculation. However, the Stokes and anti-Stokes light suffer different sensor optical fiber loss due to their different wavelengths. The DTSX3000 corrects for this differential loss in temperature calculation in single-ended measurement. The differential loss varies between sensor optical fibers and thus needs be calculated beforehand and corrected for in single-ended measurement.

SEE ALSO

For details on the temperature correction configuration, see Section B7.3.1., “Fiber Settings.”

● Signal level distribution



● Temperature distribution

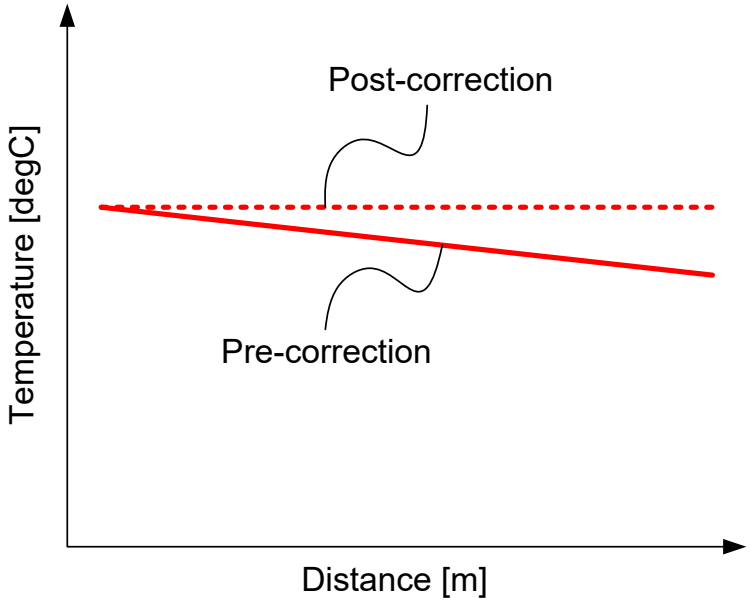


Figure Differential Loss Correction

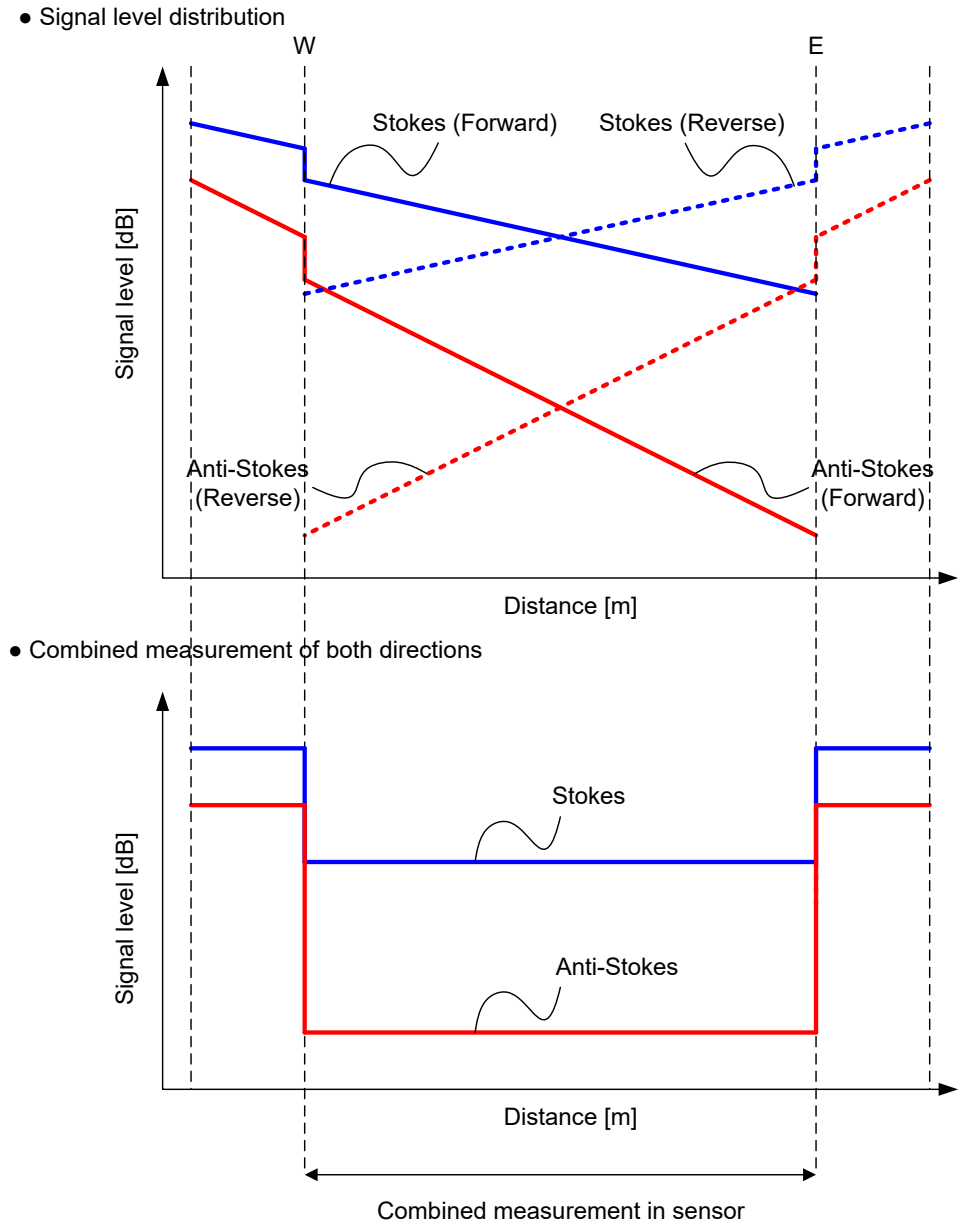
● Double-ended measurement

Double-ended measurement can be used in distributed temperature measurement applications where an optical switch is available, and the sensor optical fiber can be looped back.

Double-ended measurement is somewhat more complex than single-ended measurement but does not require correction for the differential sensor optical fiber loss between the Stokes light and anti-Stokes light of the Raman scatter because the measurement results in the forward direction and reverse direction from the switch exit position to the sensor optical fiber end are combined. However, a value for the total differential loss between the Stokes light and anti-Stokes light over the full sensor optical fiber length is still required to correct for absolute-temperature error in double-ended measurement. Two options are provided for calculating this differential loss value. The first option is a straight-forward calculation of a fixed default differential loss value from a user-defined per kilometer differential loss value. The second option is automatic calculation by the DTSX3000 using the measurement data for two sensor optical fiber sections (one each on the far end and near end) subjected to the same temperature. In the second option, the DTSX3000 performs sensor optical fiber loss calibration at each measurement so the impact on temperature measurement of any sensor optical fiber darkening or any change in sensor optical fiber loss during temperature measurement is minimized.

SEE ALSO

For details on temperature correction configuration, see Section B7.3.2, “Double-ended Measurement Settings.”

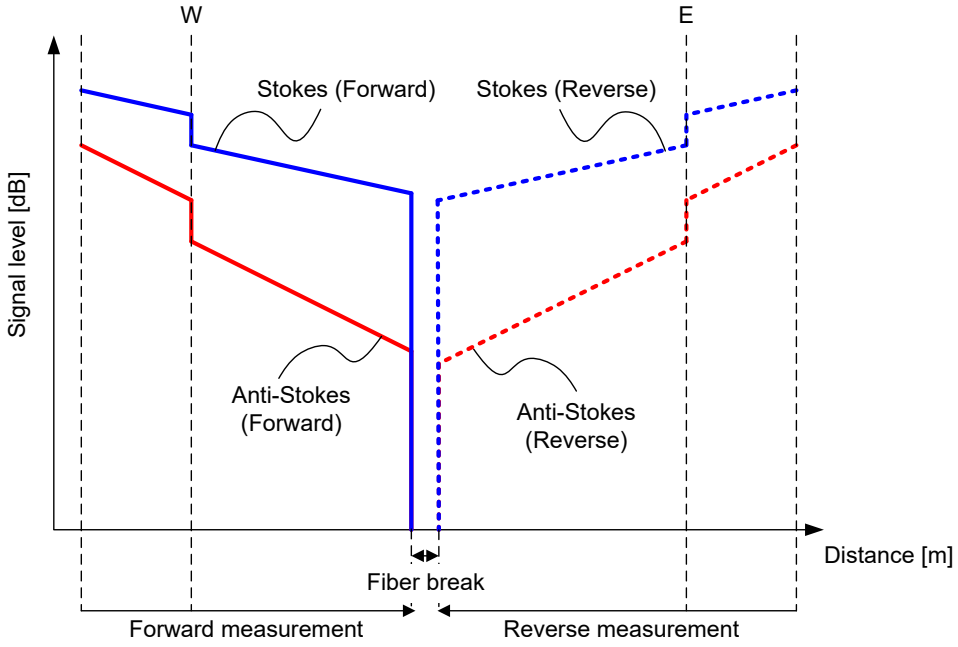


* W denotes the optical switch exit position; E denotes the sensor optical fiber end position

Figure Double-ended Measurement Illustration Diagram

If sensor optical fiber failure is detected at any position on the sensor optical fiber, measurement results of the forward and reverse directions up to the sensor optical fiber failure position are combined.

● Signal level distribution (when there is a fiber break)



* W denotes the optical switch exit position; E denotes the sensor optical fiber end position

Figure Sensor optical fiber Failure Illustration Diagram

In single-ended measurement, temperature measurement resolution depends on sensor optical fiber loss and is thus comparatively better near the DTSX3000 and worse at the far end. On the contrary, in double-ended measurement, temperature measurement resolution degrades at both the far and near ends.

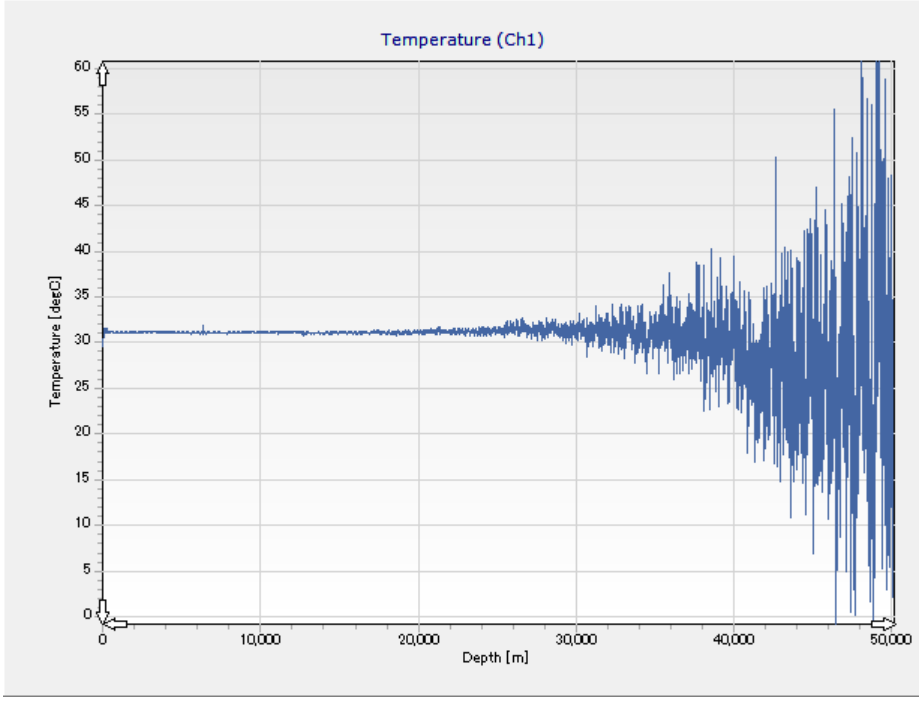


Figure Single-ended Measurement Example

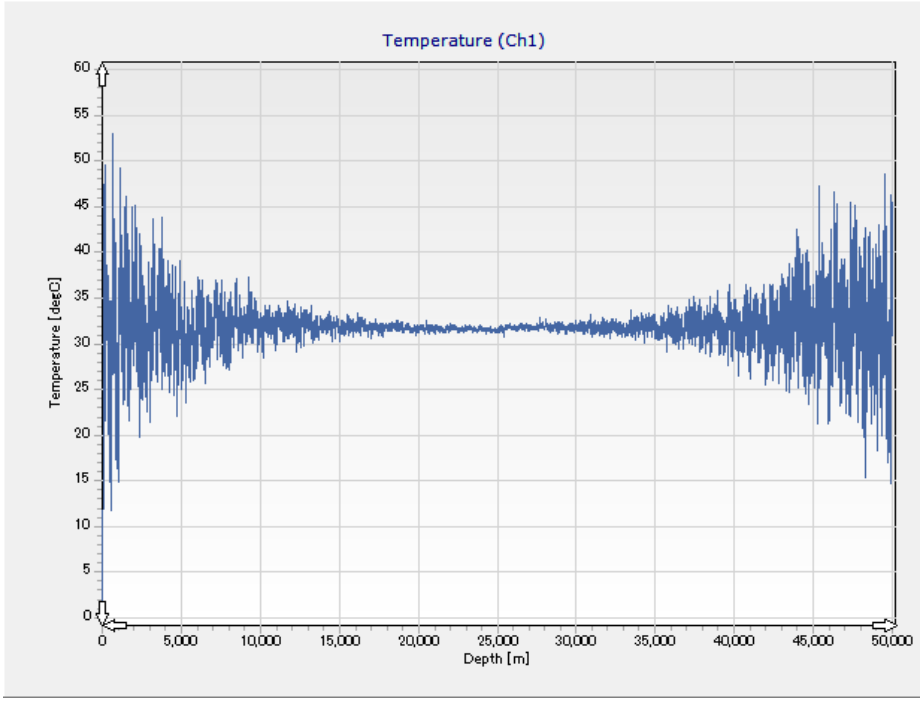


Figure Double-ended Measurement Example

C2.2. Temperature Calibration

The DTSX3000 uses intensity data of the Raman backscatter in its temperature calculation. As the Raman scatter intensity varies with the sensor optical fiber used, splice loss and other factors, these configuration conditions need to be used to calibrate the DTSX3000. This section describes the procedure and precautions for temperature calibration.

The DTSX3000 introduces a temperature calibration approach, which uses a new temperature compensation formula based on the Raman scatter principle. Compared to the general correction approach using linear correction coefficients, this temperature calibration approach reduces temperature correction errors even at temperatures faraway from the temperature that was used for calibration. It not only simplifies the temperature calibration workflow tremendously but also greatly reduces errors due to temperature correction calculations. For compatibility reasons, temperature correction using linear correction coefficients is also provided as an option, but we recommend selecting temperature calibration using the new compensation formula for the DTSX3000.

SEE ALSO

For details on parameters related to temperature calibration, see Section B7.3.3, “Calibration.”

C2.2.1. Temperature Calibration Procedure

To perform temperature calibration, follow the steps described below.

1. Determine sensor optical fiber sections
   Temperature calibration is required for each spliced section of the sensor optical fiber, so the first step is to split the sensor optical fiber into sections at sensor optical fiber connection points.
2. Determine differential loss values
   Differential loss configuration is required for single-ended measurement but not for double-ended measurement. A differential loss value must be specified for each sensor optical fiber section. This value is obtained by first ensuring that the temperature distribution over a section is uniform, and then adjusting the loss value so that the measured temperature is constant over the section. In applications where it is difficult o achieve a uniform temperature distribution over a section and/or the temperature difference within a section is relatively small, the loss value can also be obtained by measuring the temperatures at two or more positions within the section, and then adjusting the loss value so that the temperature difference measured by the DTSX3000 is the same as the actual temperature difference.
   In general, this differential loss value varies with the optical fiber manufacturer and the optical fiber lot. For sensor optical fibers from the same lot from the same manufacturer, the same value measured for any one section can be used for other sections.

3. Determine the wavenumber
The wavenumber is the Raman shift wavenumber (per cm) of the sensor optical fiber and is related to how Raman scatter intensity changes with sensor optical fiber temperature. The DTSX3000 can calculate the wavenumber using two-point temperature calibration parameters (T1, T1', T2, T2'). Here T1 and T2 denote the thermometer readings at two points along a section of the sensor optical fiber in question, and T1' and T2' denote the temperatures measured with DTSX3000 before calibration (with Calibration OFF). Based on these parameters, the wavenumber is calculated using the wavenumber calculation tool of the DTSX3000 Control Visualization Software. In this case, the DTSX3000 Control Visualization Software uses the internal data of the DTSX3000 to perform wavenumber calculation so you must run the program on a PC connected to the DTSX3000 via a LAN. The error in the calculated wavenumber varies inversely with the temperature difference between T1 and T2 so you should maximize the temperature difference between T1 and T2 to cover the expected temperature measurement range as much as possible.
In high temperature measurement range applications, temperature calibration often cannot be carried out at such high temperatures. In such cases, relatively small errors can still be achieved even for temperatures 100°C to 200°C higher than the calibration temperature by using a wavenumber which is 1 to 1.5 % the wavenumber calculated using the above tool.
A wavenumber must be determined for each section. However, for optical fibers from the same lot from the same manufacturer, the same value determined for any one section can be used for other sections.

4. Calibration
Finally, you need to configure parameters (T1, T1') for single-point temperature calibration to correct for optical switch and splice loss. T1 denotes the temperature reading of a reference thermometer while T2 is the temperature measured by DTSX3000 before calibration (in Calibration OFF state). The T1 and T1' values acquired at the time of wavenumber determination can be used without modification. These values must be measured for each section and entered as temperature calibration parameters for that section.
The T1 and T1' values vary with the arrangement of the sensor optical fiber and splice loss. They also vary for single-ended measurement and double-ended measurement. Even in double-ended measurement, the T1 and T1' values vary depending on whether you have selected to determine the total differential loss between the Stokes and anti-Stokes light over the full sensor optical fiber length automatically using a uniform temperature section or simply using a fixed value. For these reasons, recalibration is required if there is any change in the measurement method, connection method, sensor optical fiber arrangement, etc. In particular, if a significant temperature measurement error is discovered for a sensor optical fiber segment of known temperature, splice loss change is suspected. In such a case, we recommend performing recalibration.

C2.2.2. Temperature Correction

Temperature correction refers to correction processing of DTSX3000 temperature measurement data using linear correction coefficients. We do not recommend using the correction function in DTSX3000, which is provided only for downward compatibility considerations.

SEE ALSO

For details on correction , see Section B7.3.3, "Calibration."

C3. Description of Measurement Data

C3.1. Temperature Distribution Waveform

The DTSX3000 uses the optical fiber itself as the sensing element so data can be acquired for sections along the full optical fiber length at fixed distance intervals specified by the sampling resolution. The distance resolution is normally set to 1 m but data can also be acquired at distance resolutions of 50 cm using multi-sampling technique. Compared to the measurement time required for 1 m sampling resolution, the measurement time required for sampling resolutions of 50 cm are 2 times respectively at the same temperature measurement accuracy.

C3.1.1. Effect of Spatial Resolution

The DTSX3000 has a spatial resolution of about 1 m. If a heated section is shorter than 1 m, the measured value by DTSX3000 indicates the average temperature over a 1 m section and thus may be incorrect. The DTSX3000 also has a spatial temperature response of about 1 m so in cases of drastic temperature variation over a distance shorter than 1 m, the displayed temperature response distance is about 1 m.

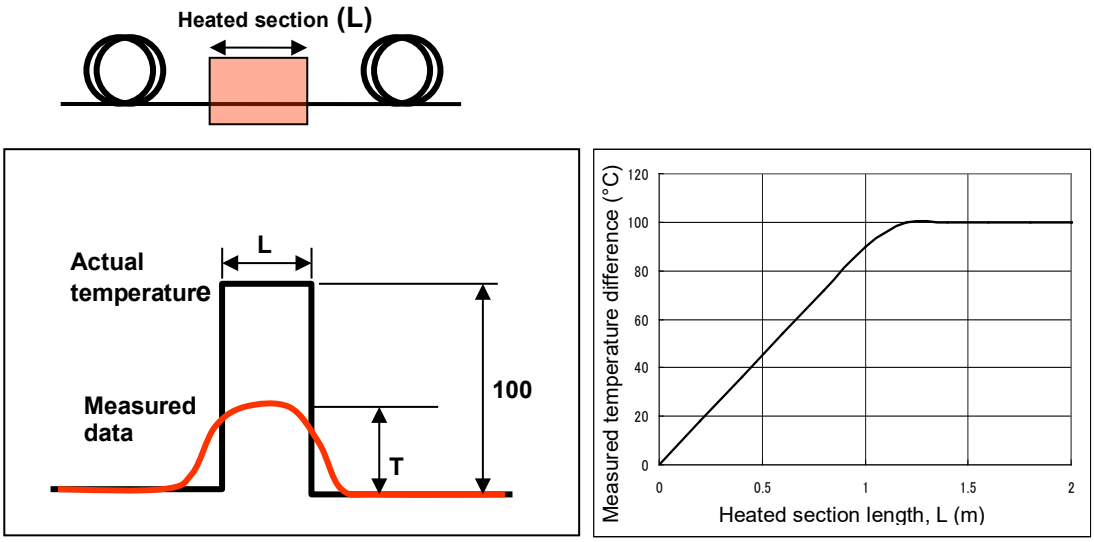


Figure Heated Section Length and Temperature Measurement

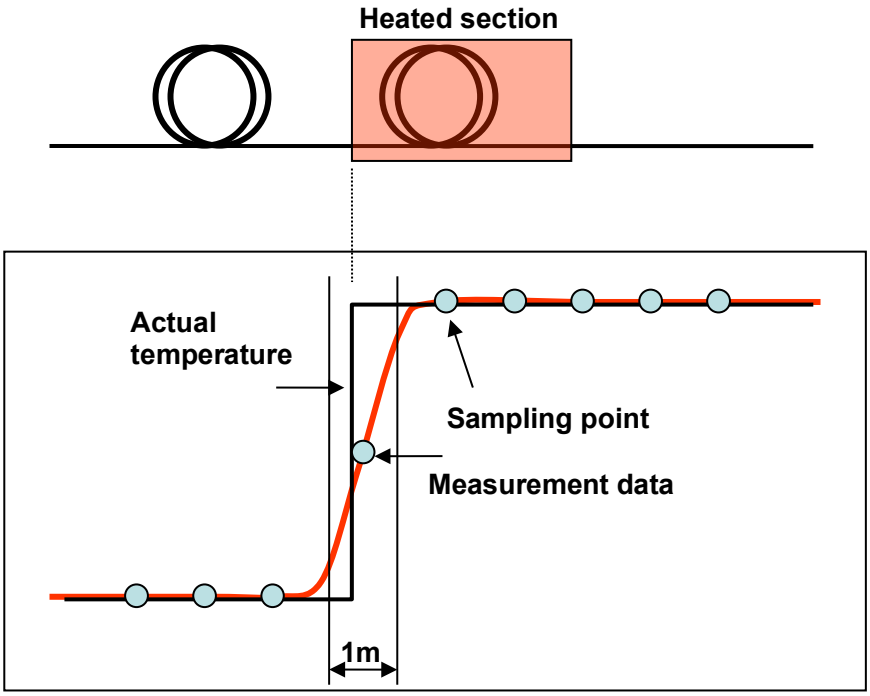


Figure Temperature Response Waveform Example

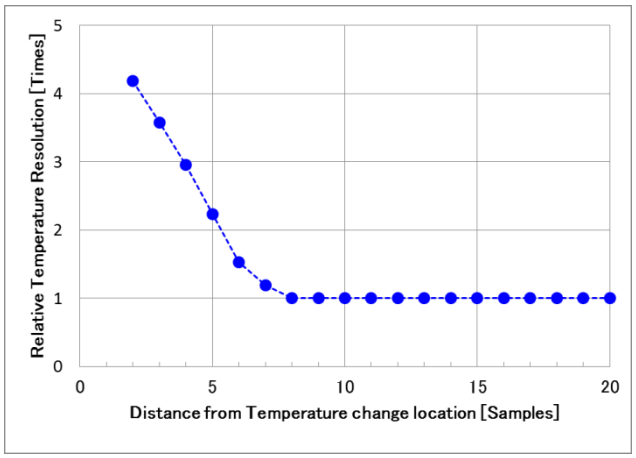
C3.1.2. Effect of Internal Reflection in Sensor Optical Fiber

DTSX3000 measures temperature by measuring Raman scatter signal levels. DTSX3000 measured temperatures near (within a range of tens of meters) high reflection points such as sensor optical fiber connection points and sensor optical fiber ends may be incorrect due to the effect of Rayleigh scattering.

C3.1.3. Effect of Signal Processing

The DTSXL uses digital signal processing, which improves the temperature resolution.

The temperature resolution improves with increasing distance from a temperature change point or a fiber connection point as shown in the figure below. Moreover, tiny temperature changes might be undetected. This effect can be alleviated by lengthening the measurement time or by using a sensor optical fiber having low fiber loss.



C3.2. Temperature Measurement Accuracy

The temperature resolution specification of the DTSX3000 is specified as 1 σ. When temperature is measured at a given position, the measured values vary within a range ±3σ of the median temperature. Quadrupling the measurement time halves the temperature resolution. The absolute temperature measurement accuracy depends on the temperature resolution, the temperature calibration, error and the temperature measurement repeatability of the DTSX3000. The temperature calibration error includes the absolute error of the reference thermometer used and temperature sensing error.

C4. Hardware Maintenance

This chapter describes maintenance (inspection, hardware replacement, etc.) for ensuring uninterrupted system operation.

C4.1. Periodic Inspection

The periodic inspection items consist of the minimum inspection items to check for operation malfunctions. Using the system under the optimal conditions will allow stable operation.

Table Daily Inspection Items

Inspection item	Inspection content	Assessment criteria
Power supply	Is the voltage deviation measured at the power supply terminal within specifications?	Depends on the specifications for each power supply module
Environment	Is the ambient temperature (temperature within panel) normal?	-40 to 65 °C (*1)
	Is the ambient humidity (humidity within panel) normal?	20 to 80 % RH (No condensation) (*1)
	Is the environment free of dust or debris?	No dust or debris.
Installation	Is each module installed properly?	No looseness.
	Are the connectors for cables inserted properly and securely attached?	No looseness.
	Are any of the external wiring screws loose?	No looseness.
	Are any external wiring cables severed?	No external anomaly.
Optical fiber	Are optical fiber connections secure?	No looseness.
	Are any optical fibers subjected to excessive bending and stress?	No excessive bending and stress.
LED Display	Does the LED for each module indicate proper operation status?	Depends on the specifications for each module.
RAS information	Does the RAS information indicate proper operation?	RAS indicates normal operation (*2)
	Has self-diagnosis detected any anomaly?	No anomaly has been detected.

*1: Depends on the specification of each module.
*2: Verify the content of RAS information.

SEE ALSO

For details on RAS information, see Subsection B11.1.2, “RAS (Reliability Availability Serviceability) Information.”

■ Tools Needed for Inspection

- Screwdriver, flathead screwdriver
- Tester or digital voltmeter
- Thermometer
- Humidity measurement device
- PC, Control Visualization Software (DTAP3000)

C4.2. Maintenance and Replacement Operations

This section describes precautions and replacement procedures for maintenance and replacement operations.

C4.2.1. Precautions for Operation

This section describes the precautions when performing DTSXL System maintenance and replacement operations.

■ Precautions regarding Static Electricity

- Always store or carry maintenance parts contained in static-free bags. (When DTSX3000 parts are shipped from the factory, they are contained in static-free bags with static electricity warning labels.)
- When performing maintenance, use a grounded wrist strap with a 1MΩ grounding resistance. Be sure to ground the wrist strap.
- When performing operations on a table, be sure to perform operation on an anti-static sheet that is properly grounded with 1MΩ of grounding resistance. Be sure to wear wrist straps when performing operations. Avoid placing plastic items that may conduct electricity on the anti-static sheet.
- Avoid touching maintenance parts without using conductive sheets or wrist straps.

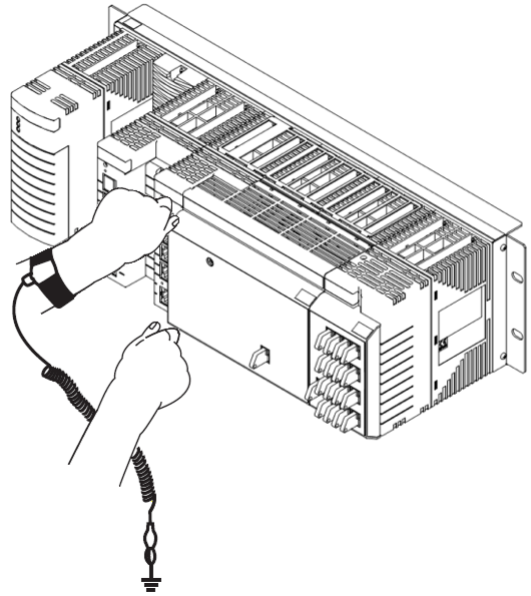


Figure Example when Handling Modules

■ Precautions regarding Electric Shock

- Always turn off the power supply of the equipment to be handled when replacing powered modules.

■ Precautions regarding Explosions

- Maintenance operations cannot be performed while power is supplied unless it is verified that there are no explosive gases in the environment.

C4.2.2. Replacing DTSXL System Modules

The following describes the procedure for replacing DTSXL System modules.

■ Replacing Power Supply Modules

Follow the procedure below to replace Power Supply modules.

1. Shut down the DTSX3000 and the CPU module in accordance with their respective replacement procedures.
2. Shut off the power supply to the power supply module to be replaced.
3. Remove the power supply cable and line filter grounding cable from the terminal block.
4. Remove the target Power Supply module from the Base module.
5. In reverse order of the above steps, install the Power Supply module, power supply cable, and line filter grounding cable.
6. Turn on the power supply.

■ Replacing DTSX3000

Follow the procedure below to replace a DTSX3000.

1. If the DTSX3000 is running, stop its operation.
   Shut down the DTSX3000 using its SHUTDOWN switch.
   If a CPU module is installed, shut down the CPU in accordance with its replacement procedure.
2. Turn off the power.
3. Remove the sensor optical fiber. Replace the dust protective cap of the optical output connector after removing the cable.
4. Remove the control network cable.
5. Remove the DTSX3000 from the Base module.
   To do so, loosen the securing screw located at the center of the panel first, followed by the eight top and bottom screws and remove the DTSX3000.
   Detach an optical switch module before detaching the DTSX3000.
6. Attach the new DTSX3000 to the Base module.
   Tighten the securing screw located at the center of the panel, followed by the eight top and bottom screws.
7. Connect the sensor optical fiber.
8. Connect the control network cable.
9. Turn on the power.
   If a CPU module is installed, reboot the CPU module in accordance with its replacement procedure.

IMPORTANT

- When attaching the DTSX3000 to the base module, wedge the gasket between the DTSX3000 and the base module.
- When attaching the DTSX3000 to the base module, ensure that the SD card is locked in place at the back of the DTSX3000.

■ Replacing Optical Switch Modules

Follow the procedure below to replace an Optical Switch module

1. If the Optical Switch module is running, stop its operation. Shut down the Optical Switch module using its SHUTDOWN switch.
   If a CPU module is installed, shut down the CPU module in accordance with its replacement procedure.
2. Turn off the power.
3. Remove the sensor optical fiber. Replace the dust protective cap of the optical output connector after removing the cable.
4. Remove the Optical Switch module from the Base module.
5. Attach the new Optical Switch module to the Base module.
   Attach the DTSX3000 first before attaching an optical switch module.
6. Connect the sensor optical fiber.
7. Turn on the power.
   If a CPU module is installed, reboot the CPU module in accordance with its replacement procedure.

■ Replacing CPU Module

Follow the procedure below to replace a CPU module.

1. Save retentive data to the on-board Flash Memory.
2. Backup system files using the backup command.
3. If the CPU is powered on, use the SHUTDOWN switch to turn it off.
   Shut down the DTSX3000.
4. Turn off the power.
5. Remove the control network cable.
6. Remove the MIL connector cable.
7. Remove the CPU module from the Base module.
8. Install the new CPU module in the Base module and connect the control network cable.
9. Re-connect the MIL connector cable that was removed.
10. Power on and boot up the CPU module in maintenance mode.
11. Restore backup files using the Restore command.
12. Reboot and start up the CPU module in online mode.

CAUTION

After a hardware failure, data stored on the on-board flash memory can not be retrieved. It is recommended to backup retentive data and system files. For the backup and restore procedure, refer to FCN-RTU manual.

SEE ALSO

For the backup and restore procedure, refer to FCN-RTU manual (IM 34P02Q01-01E).

C4.3. Parts with Limited Lifespan

This section describes parts that have limited life spans.
Parts with limited life spans degrade in performance and reliability over time, resulting in loss of function or ultimately breakdown. For DTSXL System, parts with limit life spans are defined as "parts that are expected to exhibit function loss and malfunction due to wear within 10 years when the average temperature of the air intake from the bottom of the module is 30°C."

C4.3.1. Batteries for DTSX3000

The DTSX3000 have lithium batteries installed to maintain data and the RTC (Real-time clock) when power is off.
The recommended replacement period varies depending on the operating environment and conditions (operation time and ambient temperature).

Table Limited Lifespan Component (Battery)

Product name	Part number
Battery	S9883FA

■ Recommended Replacement Period

The battery lifespan greatly depends on ambient temperature. The following table shows the ambient temperatures and recommended replacement periods for the battery.
A label for writing battery replacement dates is supplied with the unit. As a guide, write the year and month when the unit should be next replaced on the label and affix it to an easily visible location.

Table Ambient Temperatures and Recommended Replacement Periods of the Battery

Ambient temperature (*1)	Replacement period
-40 °C	10 years
25 °C	10 years
35 °C	8 years
45 °C	4.5 years
55 °C	3 years
65 °C	2 years

*1: The ambient temperature is the average temperature in which the unit is used.



Figure Battery Replacement Period Label

CAUTION

- Even when the average ambient temperature is below 25 °C, the battery should be replaced after 10 years.
- If the unit is used beyond its recommended replacement period, the battery may leak.
- If the battery leaks, a strong odor may be produced, and the metal parts may be corroded.

- Replace batteries that have leaked as soon as possible.
- Replacing the battery clears the data storage memory and clock setting. Before requesting for a battery replacement, back up the data (retained data, etc.) using a software tool. Set the clock in the Maintenance window after replacing the battery.

SEE ALSO

The CPU module also uses a battery, which needs to be replaced regularly. For details, see the STARDOM FCN/FCJ Guide (IM 34P02Q01-01E).

■ Replacing the Battery of DTSX3000

● Preparation

Have on hand a new battery, as well as the necessary equipment for connecting to the DTSX3000 from a PC.

● Replacement Procedure

Follow the procedure below to replace the battery of a DTSX3000.

1. Perform the following steps in accordance with the replacement procedure of the DTSX3000.
   - Shut down the DTSX3000 and the CPU module.
   - Turn off the power.
   - Remove the sensor optical fiber and control network cable from the DTSX3000.
   - Remove the DTSX3000 from the Base module.
2. Verify that the battery is connected by a cable at the back of the DTSX3000.

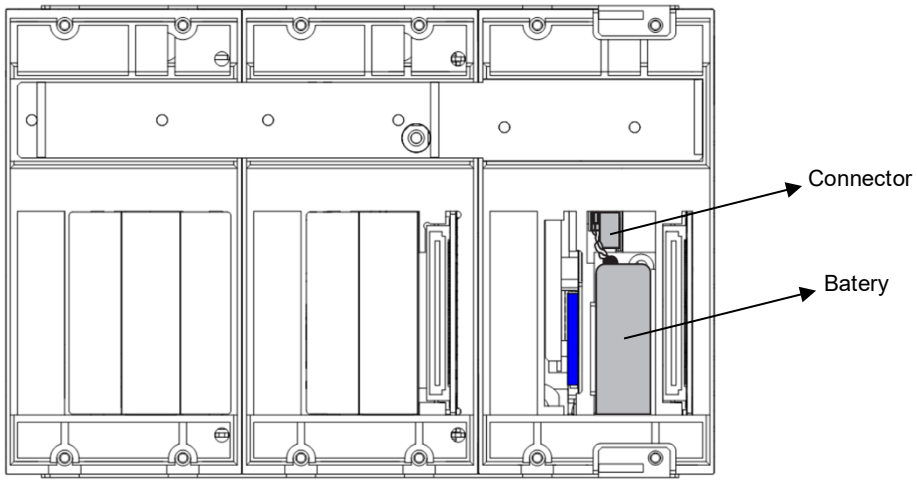
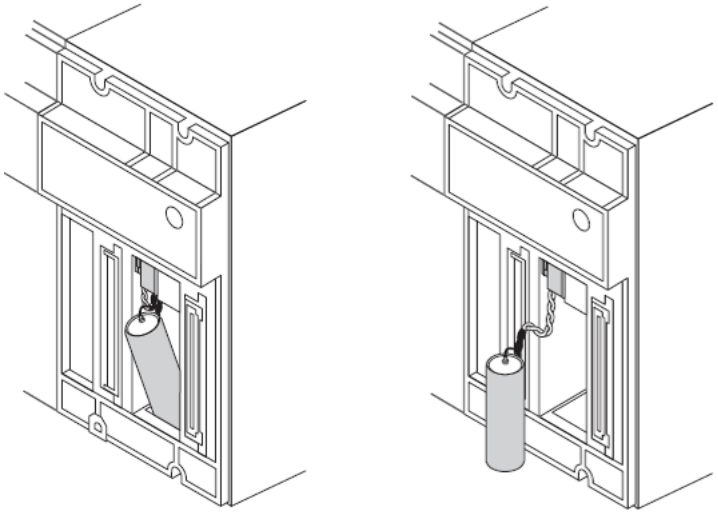


Figure Back view of DTSX3000

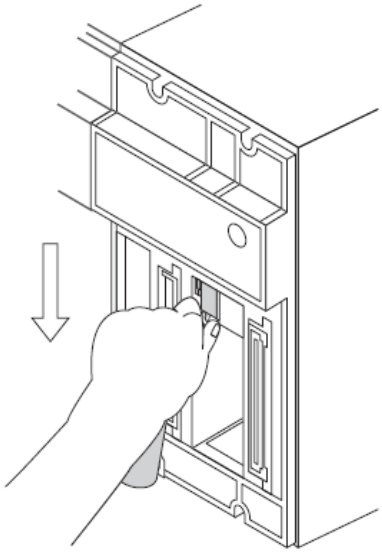
3. Pull out the upper part of the battery, followed by its lower part.



(1) Pull out the upper part of the battery (2) Remove the whole battery

Figure Removing the Battery

4. Pull the connector downwards to remove it.



5. In reverse order of the above steps, install the new battery.
   The figure below shows how the battery connector should be inserted.
   When inserting the connector, the connector lever should be facing left.

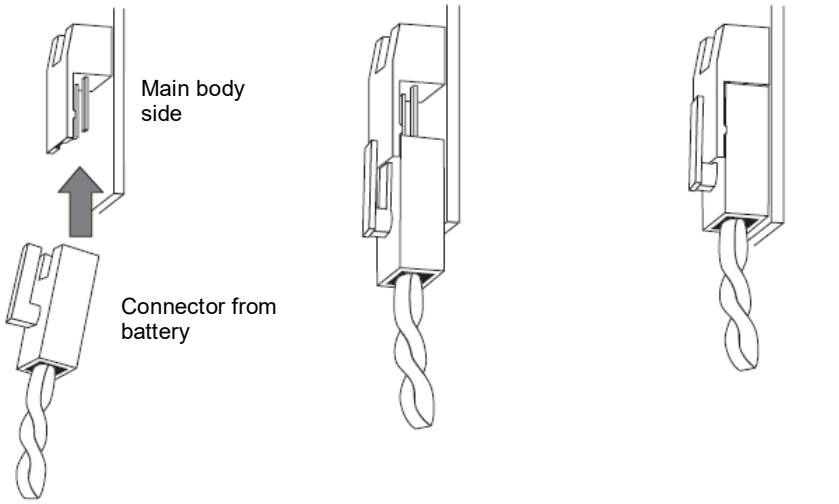


Figure Attaching the Connector

6. Perform the following steps in accordance with the replacement procedure of the DTSX3000.
- Install the DTSX3000 to the Base module.
- Connect the sensor optical fiber and the control network cable to the DTSX3000.
- Turn on the power.

7. When the HRDY LED indicator starts blinking after power on, press the RESET switch.
- When you press the RESET switch, the module boots up in Maintenance mode with blinking HRDY and RDY LED indicators.

8. Display the DTSX3000 maintenance menu from a Web browser running on a PC, and set the system date and time.
9. From the reboot menu in the Web browser, boot up the DTSX3000 in online state.

SEE ALSO

For details on date and time configuration, see Subsection B6.4.5, “Date and Time Configuration (Date).”

TIP

If the battery of the DTSX3000 is totally discharged, resulting in a power failure, the IP address, DTSX3000 total power-on time and other information will be lost and the DTSX3000 will restart in the state prevailing at the time of the last shutdown.

To avoid such risks, replace the battery regularly.

CAUTION

- Do not replace the battery of the DTSX3000 and the battery of the CPU module in explosive atmospheres.
- Do not short circuit the wire when replacing the battery.
  Short-circuiting the battery may result in generated heat , electrolyte leakage and battery damage.
- Follow the procedure described in the FCN/RTU manual when replacing the battery of the CPU module. You will need to save retentive data, set system date and time, transit to online mode and perform other operations from a Web browser.
- When attaching the DTSX3000 to the Base module, ensure that the gasket is properly in place at the back of the DTSX3000.
- Before attaching the DTSX3000 to the Base module, ensure that the SD card is locked in place at the back of the DTSX3000.

■ Handling Precautions Regarding the Battery

This device uses a lithium battery. The lithium battery is structurally sealed by glass seal and laser welding, and lithium and thionyl chloride are charged inside. Therefore, improper handling may cause the battery to leak electrolyte, generate heat, burst or ignite, resulting in injury or damage to the equipment. To prevent these problems, be sure to observe the following precautions.

CAUTION

- Never charge the battery.
  If the battery is charged, the electrolyte inside the battery may bubble or the internal pressure may rise due to generated gas. When this happens, the battery may leak electrolyte, generate heat, burst or ignite.
- Do not use this battery except for the specified purpose.
  The terminal structure or other aspect of the battery may be incompatible with the equipment, resulting in poor contact or nonconforming voltage. When this happens, the battery may leak electrolyte, generate heat, burst or ignite.
- Do not put the battery into fire, or heat, disassemble or modify the battery.
  The glass seal, vent (safety valve) or other parts of the battery may be damaged, causing the battery to leak electrolyte, generate heat, burst or ignite.
- Do not connect the positive and negative electrodes of the battery in reverse.
  Abnormal reaction may occur due to accidental charging or short-circuiting, causing the battery to leak electrolyte, generate heat, burst or ignite.
- Electrolyte is harmful to the human eyes. If electrolyte has gotten into the eye, do not rub but rinse the eye thoroughly under clean running water and then immediately seek medical attention.
- If electrolyte has been licked, immediately rinse the mouth and consult a doctor.
- Do not connect the positive and negative electrodes of the battery using a wire, etc., or transport or store the battery with a metal necklace, hairpin, etc.
  The battery will be shorted and excessive current may flow, causing the battery to leak electrolyte, generate heat, burst or ignite.

- If the battery is leaking electrolyte or releasing odor, immediately dispose of the battery. Failure to do so may result in corroded metal due to the leaked electrolyte.
- Do not solder the battery directly.
  The glass seal, vent (safety valve) or other parts of the battery may be damaged by heat, causing the battery to leak electrolyte, generate heat, burst or ignite.
- Do not remove or damage the exterior label of the battery (heat shrinkable tube).
  The battery may be shorted and leak electrolyte, generate heat, burst or ignite.
- Do not drop or throw the battery or otherwise apply strong impact.
  The battery may leak electrolyte, generate heat, burst or ignite.
- Do not deform the battery.
  The glass seal or vent (safety valve) of the battery may be damaged, causing the battery to leak electrolyte, generate heat, burst or ignite.
- Do not use or leave the battery in a high-temperature environment, such as a place exposed to direct sunlight or inside a car parked under the hot summer sun. Doing so may cause the battery to leak electrolyte, generate heat or burst.
- Do not wet the battery with liquid such as water. Doing so may cause the battery to generate heat.

IMPORTANT

- Use a lithium battery designed exclusively for use with DTSX3000.

■How to dispose the batteries included in this product

Dispose of the lithium battery in accordance with domestic law and regulation.

●How to dispose the batteries in the EU

This is an explanation about the EU Battery Directive.

This directive is only valid in the EU.

Batteries are included in this product.

When you remove batteries from this product and dispose them, discard them in accordance with domestic law concerning disposal.

Take a right action on waste batteries, because the collection system in the EU on waste batteries are regulated.

Battery type: Thionyl Chloride Lithium battery



Notice:

The symbol (see above),which is marked on the batteries, means they shall be sorted out and collected as ordained in the EU Battery Directive.

C4.3.2. Power Supply Module

The lifespan of the electric field condenser used in the power supply module is 8 years provided that the average temperature of the air intake from the bottom of the module is 45 °C. The power supply module needs to be replaced periodically.

C4.3.3. Replacing Other Parts

The parts described below are not considered parts with limited life spans but may require replacement depending on their usage and installation environment.

■ SD Cards

The SD card needs no replacement under normal use. If measurement is executed continuously over short durations at higher sampling resolutions, the limit on the number of write operations to the SD card may be exceeded. If the DTSX3000 is used under such conditions over an extended duration, regular replacement of the SD card is necessary.

Table Part Number of SD Card

Part	Part Number
SD card	A1016NL

Table Usage Conditions versus Replacement Period for SD Cards

Usage Conditions (*2)		Replacement Period for SD Card
Data Size (*1)	Measurement Repetition Period	
16000	1 minute	6 years
16000	10 minutes	No replacement required

*1: The data size is the distance range divided by the sampling resolution.
For example, assuming 16 km distance range and 1 m sampling resolution, the data size will be 16000.

*2: This table lists typical usage conditions (data size and measurement repetition period combinations). If the usage condition for your application is not listed above, calculate the ratio of data size to measurement repetition period and estimate the replacement period using the nearest usage condition listed above.

● Replacement Preparation

Have on hand a new SD card, as well as the necessary equipment for connecting to the DTSX3000 from a PC.

● Replacement Procedure

Follow the procedure below to replace the SD card.

1. After DTSX3000 measurement ends, back up the following data as required:

- LAS/ WITSML files
- measurement settings and
- system settings.

SEE ALSO

- For details on backup of LAS/WITSML files, see Section B8.4, “Retrieving Measurement Data.”
- For details on backup of measurement settings, see Section 4.2, “Loading and Saving Settings,” of the DTSX3000 Distributed Temperature Sensor Guide (IM39J02B40-01EN).
- For details on backup of system settings, see Section B11.5, “Backup and Restore.”

TIP

For the DTSX3000, even though measurement settings and system settings are preserved when the SD card is replaced, backup is recommended as a precautionary measure.

2. Perform the following steps in accordance with the replacement procedure of the DTSX3000.

- Shut down the DTSX3000 and the CPU module.
- Turn off the power.
- Remove the sensor optical fiber and control network cable from the DTSX3000.
- Remove the DTSX3000 from the Base module.

3. Replace the SD card at the back of the DTSX3000.

- Press the SD card. This unlocks and pops the SD card slightly out of its slot. Pull out the SD card gently using your fingers.
- Install the new SD card.
  Ensure that write-protection of the SD card is switched off (i.e. the SD card is writeable).
  Insert the SD card with correct orientation, and press it in gently with your finger to lock it in place.

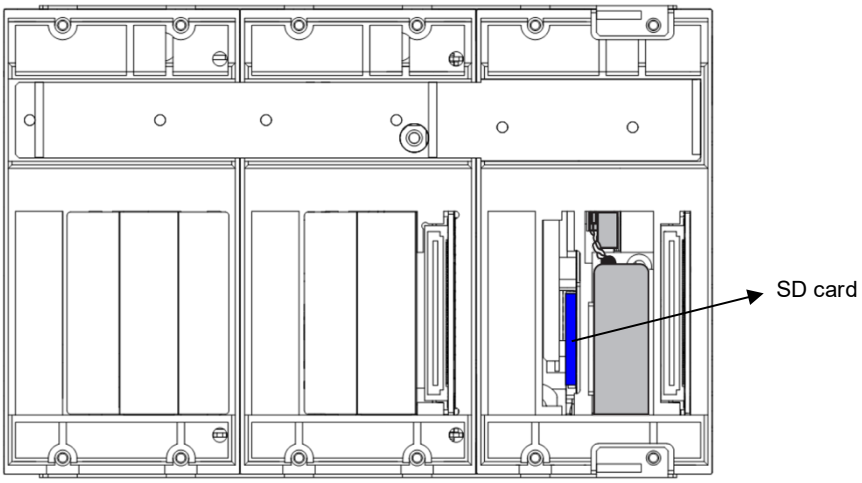


Figure Back View of DTSX3000

4. Perform the following steps in accordance with the replacement procedure of the DTSX3000.

- Install the DTSX3000 to the Base module. (Beware not to accidentally press on and thus unlock the SD card.)
- Connect the sensor optical fiber and the control network cable to the DTSX3000.
- Turn on the power. (The boot process will take longer than usual as the DTSX3000 needs t6 format and write files to the SD card.)

5. Display the DTSX3000 maintenance menu from a Web browser running on a PC, and set the system date and time.
6. Restore the following data as required:

- measurement settings and
- system settings.

SEE ALSO

- For details on restoration of measurement settings, see Section 4.2, “Loading and Saving Settings,” of the DTSX3000 Distributed Temperature Sensor Guide(IM39J02B40-01EN).
- For details on restoration of system settings, see Section B11.5, “Backup and Restore.”

IMPORTANT

- When attaching the DTSX3000 to the Base module, ensure that the gasket is properly in place at the back of the DTSX3000.
- When attaching the DTSX3000 to the Base module, ensure that the SD card is locked in place at the back of the DTSX3000.

■ Optical Switch Modules

Optical switch modules may require regular replacement depending on their usage and installation environment.

Table Recommended Replacement Period

Operating Condition		Replacement Period (*2)
Installation Temperature (*1)	40 °C and below	No replacement required
	45 °C	8 years
	50 °C	7 years
Continuous operation	15-second measurements	4.7 years
	20-second measurements	6 years
	30-second measurements	9.5 years

*1: The installation temperature is the average ambient temperature where the optical switch module is installed.
*2: The listed replacement periods represent average values.
Depending on the situation, performance may degrade earlier.
Replace an optical switch module in accordance with its replacement procedure described earlier.

C4.4. Sensor Optical Fiber

When a sensor optical fiber fails or degrades, measurement may fail completely or the rated performance is not achieved. A defective sensor optical fiber must be repaired or replaced.
After repairing or replacing a sensor optical fiber, sensor optical fiber parameter configuration and temperature calibration must be redone.

C4.5. Fault Isolation and Self Diagnosis

When distributed temperature measurement fails, it may be due to a DTSX3000 fault or a fault beyond the DTSX3000 so fault isolation to pinpoint the type of fault and its location is required.
Follow the procedure below to isolate a fault.

1. System Status
   Check the system status of the DTSX3000 from a Web browser running on a PC.

SEE ALSO

For details on how to check the system status, see Section B11.1, “Displaying System Status Information.”

2. Self-diagnosis
   Execute self-diagnosis of the DTSX3000 remotely to check for existence of failures.

SEE ALSO

For details on self-diagnosis execution, see Section B11.2.1, “Self Diagnosis.”

3. Installation Environment
   Power supply: Check for any anomaly in the power supplied to the power supply module of the DTSXL System.
   Check that the installation environment conditions (temperature, humidity, vibration, corrosive gases, ventilation, external noise, etc.) meet the installation specification of the DTSX3000.

SEE ALSO

For details on the installation specification, see Chapter A2, “Installation Environment.”

4. Sensor Optical Fiber
   Check that the sensor optical fiber is connected properly and free of defect.
   Perform these checks if distributed temperature measurement fails even if no DTSX3000 failure is reported by the self-diagnosis function of the DTSX3000. If no defect is observed by visual inspection, replace the sensor optical fiber with another one and check if distributed temperature measurement is successful. If distributed temperature measurement succeeds, it means that the DTSX3000 is normal and the fault lies with the sensor optical fiber.

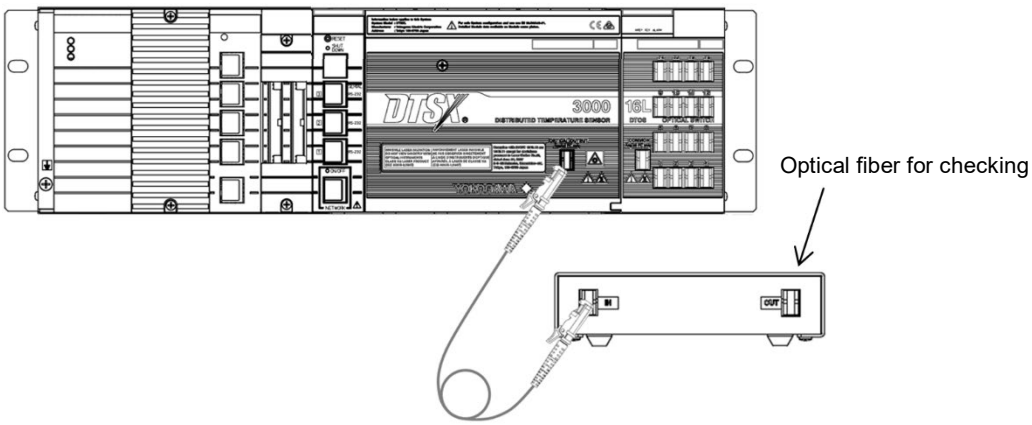


Figure Connecting the Optical Fiber for checking

If an optical switch is used with the DTSX3000, connect the optical fiber to the output of the optical switch and check if distributed temperature measurement is successful. If measurement succeeds, it means that the DTSX3000 and the optical switch are normal and the fault lies with the sensor optical fiber.

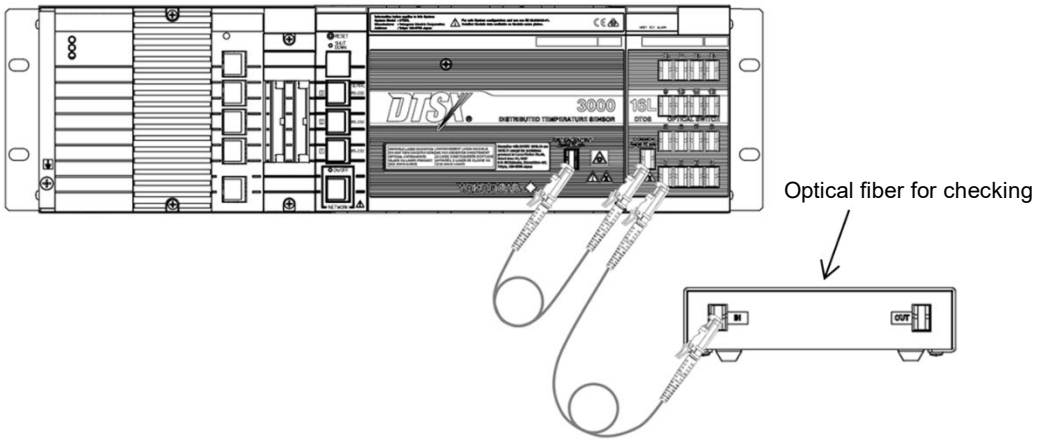


Figure Connecting the Optical Fiber for checking to the Optical Switch

C4.5.1. Self-diagnosis

The DTSX3000 provides a self-diagnosis function for detecting hardware problems. Some of the tests of self-diagnosis are automatically executed by the DTSX3000 at system startup, while waiting for measurement and at the beginning of measurement. To perform a full diagnosis of all test items, you need to execute the self-diagnosis function.

Not all problems can be detected and isolated by self-diagnosis. Moreover, installation environment conditions (temperature, external disturbance, external noise, etc.) may also result in false detection. If the same failure is frequently detected, contact your Yokogawa sales representative or local distributor.

SEE ALSO

For details on self-test execution, see Section B11.2.1, “Self Diagnosis.”

C4.5.2. Fault Isolation

If a problem occurs during operation, you can perform fault isolation as described in the table below. If the DTSX3000 can be booted up and self-diagnosis can be executed, execute self-diagnosis first and check for any reported hardware problem. If no hardware problem is detected, check the system as described in the table below. If a possible hardware problem is identified, or the problem cannot be identified, or the same problem recurs frequently, contact Yokogawa.

Problem Symptoms	Troubleshooting
- No power (None of the LED lamps of the DTSX3000 are lit.) - The DTSX3000 remains in boot state.	- Check if the power supply module and the DTSX3000 are installed properly. - Check that the SD card is properly inserted. If the SD card is dislodged, re-insert the SD card. - Check if the external power source used meets the input specification requirements of the power supply module. - If NFPW426 is used, check if the power supply is connected to the analog field power supply terminal. - If there is no problem with the installation, the connections and external power source but the LED lamp of the power supply module is unlit, the power supply module may be faulty. - If the LED of the power supply module is lit but the LED lamp of the DTSX3000 is unlit, either the DTSX3000 or the base module may be faulty.
The LED of the DTSX3000 blinks in red.	- Check message logs for problem description. Re-apply power and see if the same problem recurs. - If the same problem recurs frequently even after reapplying power, the DTSX3000 may be faulty.
Temperature measurement completely fails (when DTSX3000 is used alone without an optical switch).	- Check the connection of the optical fiber and if necessary, reconnect properly. - Check for any anomaly on the end face of the optical connector. - Replace the sensor optical fiber with another optical fiber or the Optical Fiber and check if measurement can be correctly executed. - If there is no problem with the optical fiber connection and temperature measurement completely fails even after replacing the optical fiber, the DTSX3000 may be faulty.
Noisy temperature waveform	- Check the ST light and AS light signal levels. It should be about 25 to 27 dB (depending on the temperature) if no optical switch is used. If the signal levels are normal, there is no hardware failure. Set a longer measurement time. - If the ST and AS light signal levels are abnormal, proceed to the previous row on Temperature measurement completely failed”.
Periodic waveform observed in temperature waveform.	- A periodical pattern could be observed in measured temperature distribution along an optical fiber if part of the optical fiber is wound around a drum or otherwise bundled together. There is no problem with the measuring system itself but with the way the optical fiber is installed. Ensure that no part of the optical fiber is bundled together and repeat temperature measurement
Temperature measurement is incorrect.	- Check if temperature calibration has been done properly. - If the difference between the calibration temperature and the measured temperature is large, actual temperature and measured temperature tend to differ. As far as possible, perform temperature calibration at a temperature near to measured temperatures.
Temperature waveform is tilted when measuring a constant temperature.	- Check if fiber loss correction has been done. - Perform loss correction with adequate measurement time and a clean waveform.
Channel switching by optical switch fails.	- Check if the HDY, RDY and Ch LED lamps of the optical switch are lit. - Check if the DTSX3000 and optical switch are installed properly. - Check for any problem at optic fiber connections. - Check for any anomaly on fiber connector end faces. - If the LED lamp of the optical switch is unlit, the optical switch or the base module may be faulty.

Temperature measurement completely fails (when DTSX3000 is used together with an optical switch).	- Check if measurement is normal with the DTSX3000 alone. - If measurement is normal with the DTSX3000 alone, proceed to previous row for “Channel switching by optical switch fails.”
The green LED on the optical switch module blinks.	- Check message logs for problem description. Re-apply power and check if the same problem recurs. - If the same problem recurs frequently even after reapplying power, the optical switch may be faulty.
LAN communication fails.	- Check if the LINK LED lamp is lit. - Check if the communication cable is connected properly. Try reapplying power to the DTSX3000 and communication devices. - Try reconnecting the communication cable properly. - Try replacing the communications cable with a new cable. - Check if firewall and other settings of communication devices are proper. - Check if IP addresses and subnet masks are configured correctly for the DTSX3000 and communication devices. - Try replacing communication devices. If communication fails even after replacing the communication devices, the DTSX3000 may be faulty.
RS-232C communications fails.	- Check if the communication cable is connected properly. Try reapplying power to the DTSX3000 and communication devices. - Check if the pin assignment of the communication cable is proper. - Try reconnecting the communication cable properly. - Try replacing the communications cable with a new cable. - Check if the baud rate, parity, protocol and other transmission settings of the DTSX3000 and the communication device are proper. - Try replacing communication devices. If communication fails even after replacing the communication devices, the DTSX3000 may be faulty.

◆Revision History

Title : DTSXL Distributed Temperature Sensor Long Range System Guide
Manual No. : IM 39J06B40-01EN

Nov. 2014/1st Edition/R1.01.01 or later*
- First published
May 2015/2nd Edition/R1.03.01 or later*
-Correspondence to explosion proof standard
Nov. 2015/3rd Edition/R1.03.01 or later*
-Information was added.
Dec. 2015/4th Edition/R1.03.01 or later*
-Correspondence to EAC mark
Feb. 2016/5th Edition/R1.03.01 or later*
- Update of compliant standards.
- Information added.
Sep. 2016/6th Edition/R1.03.01 or later*
- Add single mode fiber.
Feb. 2017/7th Edition/R1.03.01 or later*
- Correspondence RoHS Directive.
June, 2017/8th Edition/R1.03.01 or later*
- Update of compliant standards for single mode fiber.
May 2019/9th Edition/R1.03.01 or later*
- Update of compliant standards and changing of related description.
-Symbol mark and content correction.
- Added Windows 10 on ‘Operating Environment’.
May 2020/10th Edition/R1.03.01 or later*
- Update of compliant standards.
- Removed Windows 7 from support OS.
Mar. 2021/11th Edition/R1.06.01 or later*
- New functions added.
May 2021/12th Edition/R1.06.01 or later*
- Update of compliant standards.
July 2021/13th Edition/R1.06.01 or later*
- Update of compliant standards.
May 2022/14th Edition/R1.06.01 or later*
- Removed of corresponding year notation for safety standards and EMC standards.
July 2023/15th Edition/R1.06.01 or later*
- Update of compliant standards.
Apr. 2024/16th Edition/R1.06.01 or later*
- Update of compliant standards.
- Changed on ‘Operating Environment’.
June 2025/17th Edition/R1.06.01 or later*
- Update to the "Laser Beam" section in "Safety Precautions"
Mar. 2025/18th Edition/R1.07.01 or later*
- Added Windows 11 on ‘Operating Environment’
June 2026/19th Edition/R1.07.01 or later*
- Changed the design of DTSX3000 modules and optical switch modules

*: Denotes the release number of the software corresponding to the contents of this instruction manual. The revised contents are valid until the next edition is issued.

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