Bandweaver

OPERATION, INSTALLATION AND MAINTENANCE MANUAL

DISTRIBUTED TEMPERATURE SENSING

Bandweaver Product Family: **FireLaser**

Revision 1.3, April 2020

Bandweaver Technology Ltd., Clasford Farm Business Park, Aldershot Road, Guildford GU3 3HQ, UK
info@bandweaver.com

Revision History

Rev	Date	Reason for issue	Author	Reviewer	Reviewer
1	08-Mar-2019	First issue (translated from Chinese)	E. Fernandes	C. Li	J. Liu
1.1	20-May-2019	Minor update to Section 8.2.2 DTS-CM-02-MAN-001 ref. added	E. Fernandes		
1.2	29-May-2019	Default IP addresses corrected in 8.2.2	E. Fernandes		
1.3	07-Apr-2020	Update to Section 6, section 7, Section 9.2	R. Da Costa		J. Liu

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1 Introduction

The FireLaser series linear temperature sensor, developed by Bandweaver, is a modularized distributed temperature sensor which employs an optical fibre as the sensor. It provides high-performance near real-time temperature sensing and alarm functionality with standard communication interfaces.

This latest generation hardware now includes an integrated 5.7 inch, 640 × 480 pixels 262K colour touch screen. As with previous generations, it's a rack mounted device of up to 4 channels, which incorporates standard communication interfaces to provide clients with real time temperature monitoring and alarming.

The FireLaser system is based on temperature-sensitive Raman scattering and optical time-domain reflection technology for distributed positioning. It can probe the temperature at every 1m interval along the whole optical fibre up to 10km per circuit (range of up to 2Km, 5Km or 10Km, depending on the model). It also provides a series of alarm conditions such as a temperature maximum threshold, temperature rate of rise threshold and temperature deviation. Also, as an essential fail-safe scheme, it can detect a fibre break condition.

This product is particularly well suited to application of fire detection and it offers many distinct advantages over historical solutions to the Line Type Heat Detector solution. An important advantage of a distributed fibre optic sensor is that, the roles of the sensing elements and the transmission medium are combined utilising a single fibre, while retaining excellent temperature and position accuracy. High-speed optical signal detection and processing technology also provides for a quick system response time, which is critical in fire detection and power cable monitoring.

The interrogation of the sensing fibre uses light and the nature of the fibre means that it does not need any electric power nor does it generate any electrical signals. Therefore, the fibre is immune to electromagnetic interference and is an ideal sensor for electric field sensitive applications e.g. electrified railway tunnel applications, urban metros.

The fibre contains is a totally passive sensor and has a very long life. Over its lifetime, it will require little or no maintenance and is therefore suitable for applications where access for maintenance is a cost consideration.

Additionally, the optical fibre sensor has other advantages:

- Measurements are provided for the entire length of the sensing cable;
- Simple and low-cost installation, with minimal planning required for the position of the cable compared to point sensors;
- No electronics or moving parts;
- 30-year lifetime for the optical fibre;
- Low maintenance costs;
- Immune to shock/vibration and electromagnetic interference;
- Intrinsically safe for use in hazardous zones – the sensing cable cannot cause an ignition.

1.1 Glossary and abbreviations

DTS *Distributed Temperature Sensor*

DTSCM *Distributed Temperature Sensor Configuration Management*

FACP *Fire Alarm Control Panel*

FAS *Fire Alarm System*

FC/APC *A type of fiber optic connector*

ISCS *Integrated Supervisory Control Systems*

Differential temperature alarm *An alarm generated by the temperature rise rate of the fiber exceeding a set threshold. The red background colour is displayed when the alarm is in the main interface of the software, and the alarm type is **fire alarm**.*

Fiber Break *Indicates that the fiber is not connected or the fiber has a break. A yellow background is displayed when the alarm is in the main interface of the software, and the alarm type is **fault**.*

High temperature alarm *An alarm generated when the fiber temperature exceeds the set temperature threshold. A red background is displayed when the alarm is in the main interface of the software, and the alarm type is fire alarm.*

Zone *A configured section of fiber with start and end positions*

1.2 Related Documentation

Read this manual in conjunction with the following documents:

DTS-CM-02-MAN-001 DTSCM2 DTS Configuration Manager Software User Manual

Modbus COIL&REGISTER Definition – Manual that provides more detail for using MODBUS

2 Safety

2.1 Safety Warning Information and Symbols

General Warning Symbol

DO NOT ATTEMPT TO OPEN THE UNIT.
The product does not contain any user serviceable parts.

If smoke or any burning smell is emitted from the product, or in the event of any other emergency, immediately cut the power supply to the product and inform Bandweaver or its authorised agents.

This symbol is used throughout the user manual whenever there is a mandatory requirement or a risk of personal injury or probability of damaging the product.

Laser Radiation Warning Symbol

DO NOT EXAMINE OR LOOK DIRECTLY INTO THE EXPOSED FIBRE OR CONNECTOR DURING MEASUREMENT.
DO NOT UNDERTAKE FUSION SPLICING OR SIMILAR FIBRE JOINING WHEN THE PRODUCT IS IN OPERATION AND CONNECTED TO THE FIBER.

This product incorporates a pulsed laser device whose invisible output radiation is potentially hazardous if viewed directly by eye.

Always turn off the product, and if possible, disconnect the fibre/connector, before any examination of the fibre.

High Voltage warning Symbol

DO NOT ATTEMPT TO OPEN THE UNIT.
This product has High Voltage (HV) components inside and voltages within the equipment are high enough to endanger life.
Only manufacturer trained and approved service personnel are authorised to remove the covers.

DO NOT GET THE PRODUCT WET, OR EXPOSE TO EXCESSIVE MOISTURE.
In the event of water (or other liquid) ingress, disconnect the power and inform Bandweaver or its authorised agents. Do not touch the case during a lightning storm.

2.2 Laser Safety

The system incorporates a pulsed laser device whose invisible output radiation is potentially hazardous if viewed directly by eye. The laser radiation emission from the laser within the system is permanently coupled into a 62.5/125µm multimode optical fibre whose end is terminated with an E2000 angled optical fibre connector.

The FireLaser system should be interfaced to the test fibre, using a patch cord or pigtail assembly. It is recommended that the FireLaser system is connected to a test fibre or use the E2000 connector cap to prevent the light emitting to free space, and the far end of the test fibre should be optically cut off.

It is recommended that the unit is located where only authorised personnel have access to the front and rear connectors. Similarly, all personnel with such access must be made aware of the risks of working with such equipment. For unused output fiber optic connectors at the rear of the instrument, the protective caps must be utilised.

The laser radiation from the FireLaser system has been classified in accordance with international standard IEC 60825-1 Edition 1.2 E2001-03, with the following classification outcome:

FireLaser Laser System Classification: Class 1M

In accordance with the international standard document for Class 1M laser radiation:

Class 1M lasers are safe under reasonably foreseeable conditions of operation, but may be hazardous if the user employs optics within the beam.

2.2.1 Additional Warnings

Avoid exposing the device to direct sunlight or other heat sources to protect sensitive components.

3 FireLaser Product Specifications

Operating Environment	
BS EN 54-22:2015 – Environmental Classification	Environmental Group I for Sensor Control Units, response class A1N and BN
Operating temperature	-10°C to +50°C
Operating Humidity	0 to 95% RH NC
Storage temperature	-10°C to +85°C
EMC Immunity	EN 61000-6-1:2007
EMC Emissions	EN 61000-6-3:2007+A1:2011
Laser Classification	IEC60825-1:2014 Class1M Laser
Ingress Protection	IP40 Note: By installing the FireLaser inside an appropriate cabinet, the IP rating may be significantly increased.
Physical Characteristics	
Dimensions	131 mm (Height) x 431 mm (Width) x 334 mm (Depth)
Weight	10 Kg
Material	Painted Steel
Colour/Finish	Black/Matt
Electrical Characteristics	
Supply Voltage	Nominal 24VDC (18 to 36 VDC) For EN54 part22 use: 18 to 30 VDC
Max. Operating current	2A
Power Consumption	~ 20W
Relays	2 fault relays, 4 fibre break relays (1 per channel) 44 programmable fire zone relays
Electrical Interfaces	RJ45-1(for advanced configuration via a PC/Laptop running DTSCM2 configuration software) RJ45-2,3 – for Modbus TCP protocol communication RS485 1,2 – Modbus RTU protocol communication
FireDetection Criteria	
Maximum circuit length	Model dependent – 2Km, 5Km, 10Km
Spatial resolution	<2m
Channels	Model dependent – 1ch, 2ch, 4ch

3.1 Product Standard Packing List

No	Item description	Qty
1	FireLaser distributed temperature sensing unit	1
2	Packing list	1
3	CD (with Software and User Manuals)	1
4	Test report	1
5	Security Keys	2
6	SCSI Relay cable	2
7	SCSI 50P relay convertor	2
8	Network cable	2
9	RS485 cable	1
10	DB9 cable (double connector)	1
11	Power Adaptor (for configuration use only – not VdS approved)	1
12	Power cable	1
13	Chassis bracket Screws	8
14	Chassis mounting brackets	1 set
15	Fiber optic pigtail	1 per channel

Table 3-1 Packing List

4 Product Start-Up and Operation

4.1 Typical Configuration

The FireLaser system comprises a central control unit coupled to up to 10km of 62.5µm/125µm graded-index multimode temperature sensing fibre, FireFiber. The range of the control unit depends on the FireLaser model. The fiber is installed in the area to be detected and communicates with Bandweaver's DTSCM2 software. The system can accurately monitor temperature changes in real time.

The fibre may be connected in a spur configuration and the length of sensor cable attached may be configured into multiple detection zones. Each zone may have its own individual alarm level. The alarm levels are typically in compliance with the sensitivity definition as per prEN54 part 22.

Each detection zone is configured in terms of:

- Its position along the length of connected fibre optic sensor cable
- Its sensitivity in relation to the relevant grade of detection
- Its alarm output as each zone is allocated a separate relay output

The Fire Laser system has the capability to interface directly to a Fire Alarm Control Panel (FACP) circuit, typically via the use of the volt free relay interface. There are up to 50 relay outputs available on the FireLaser Relay interface.

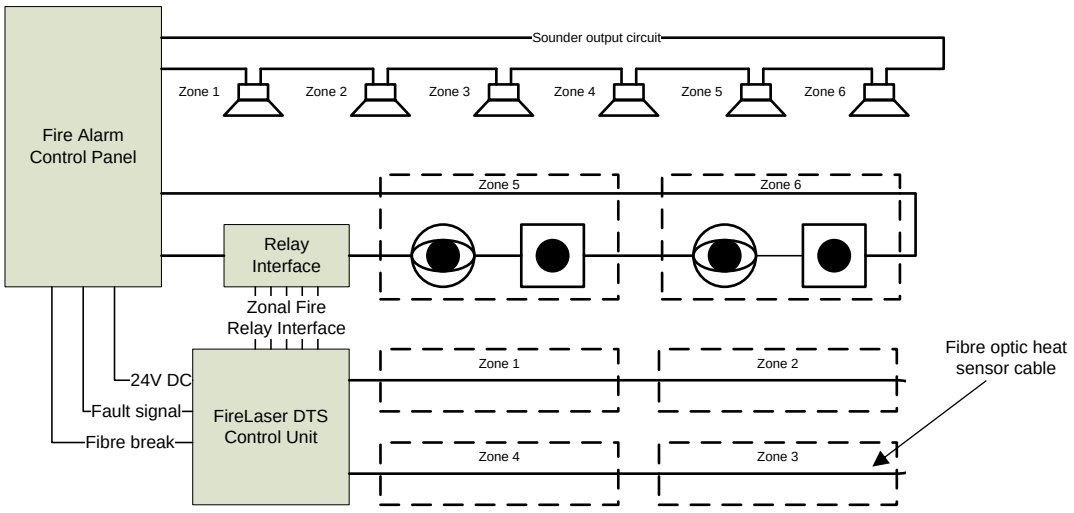

Figure 4-1 FireLaser connection with Fire Alarm Control Panel

Figure 4-1 shows an example configuration where the FireLaser unit is powered by, and interfaces directly to, the Fire Alarm Control Panel (FACP). The FireLaser signals to the FACP fire and fault conditions, which are in turn logged and signalled in the appropriate manner by the FACP.

FireLaser must be installed, connected and configured before measurements can be taken. The following sections will explain how to connect the FireLaser system to an optical fibre.

4.2 Front Panel View

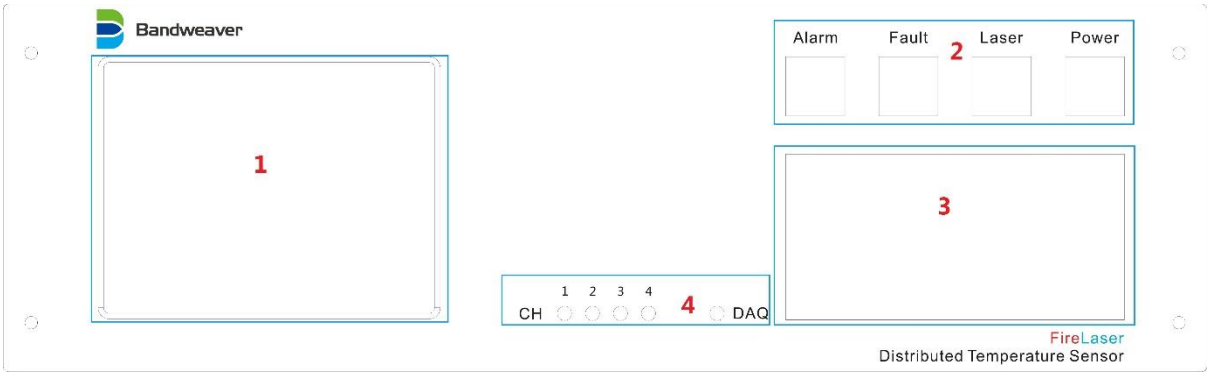

Figure 4-2 - Front Panel View

The front panel of the FireLaser is shown in Figure 4-2 above and the numbered items are described below:

1. Touch screen
2. LED indicators of the system status
   - Power When illuminated, this indicates that the power is on.
   - Laser When illuminated, this indicates the laser is operational and is emitting light
   - Fault When illuminated, this indicates a system fault
   - Alarm When illuminated, this indicates a temperature alarm (fire alarm event)
3. Lockable door to security controls
4. Channel indication showing the operating state of the system
   - Channel indication Green when a channel is in operation
     Yellow when there is a fiber break
     Red when there is a fiber alarm
   - DAQ Status Fast flashing: automatic data acquisition mode
     Slow flashing: manual mode / idle

Security controls:

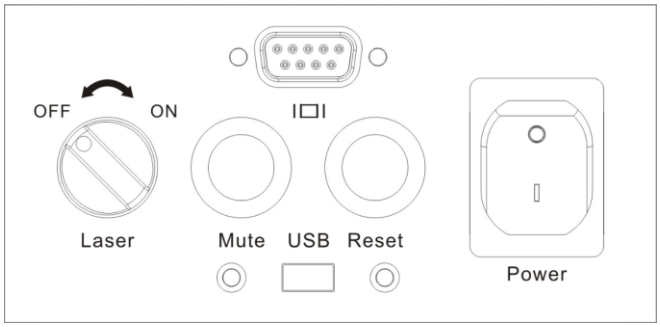

Figure 4-3 Security Controls view

Power: *Switch to **I** to turn the power, and **O** to turn the power off*

Laser: *Use to switch the laser on and off*

Reset: *Clears all current alarm information*

Mute: *Silences the audible alarm*

USB: *USB OTG (USB On-The-Go) interface. A OTG to USB Host cable is required to access the USB flash drive. The system maintenance function can be used when using OTG to USB Slave cable (data line)*

I□I: *DB9 terminal: System console interface for debugging and diagnostic operations. Not for general use.*

4.3 Rear Panel View

The FireLaser DTS is equipped with up to 4 channels of fiber output, 3 RJ45 network ports, 2 RS485 ports and 50 relay outputs.

The interfaces are located on the backplane of the host, as shown below:

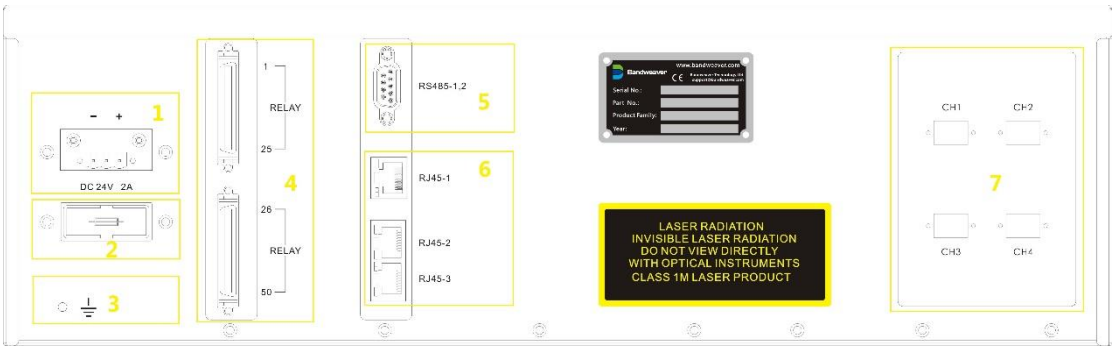

Figure 4-4-4 - Rear Panel View

4.3.1 Rear Panel Components

1. **24VDC in:** *DC power supply terminals, maximum current is 2A*
2. **Fuse box:** *Contains two 2A fuses. One is a backup fuse*
3. **Ground terminal:** *For grounding the chassis*
4. **Relays**: *50 relays for alarm outputs*
5. **RS485-1~2:** *Two RS-485 bus connectors that support Modbus RTU*
6. **RJ-45-1~3:** *Three 10/100Mbps Adaptive Ethernet Ports*
7. **CH1~4**: *Four E2000 type optic connectors for sensing fiber connections*

4.3.2 Power supply

The FireLaser requires nominal 24V DC power supply. The red and black terminals on the rear panel correspond to the positive and negative poles of the 24V DC power supply respectively.

In order to ensure system safety is maintained in an abnormal situation, a 2A fuse is mounted in the FireLaser rear panel.

Connect the DC 24V power input to the terminal block as shown in Figure 4-1 below, paying attention to the positive and negative poles.

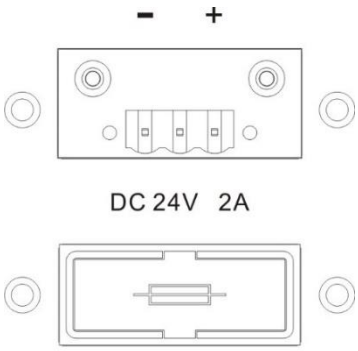

Figure 4-5 Power supply input and fuse

5 Quick Start Guide

5.1.1 Installation environment and initial checks

- Ensure that the operating environment of the FireLaser system is within specification.

  The environmental groups for the FireLaser is classified as Group I and the sensing element (FireFiber) is classified as Group III.
  The environmental groups are not be confused with the temperature response classifications (i.e. A1N, BN etc.).
  Group I covers equipment likely to be installed indoors in commercial/industrial premises but for which the avoidance of extreme environmental conditions can be taken into account in the selection of the mounting site.
  Environmental Group II covers equipment likely to be installed indoors in commercial/industrial premises in all general areas.
  Group III covers equipment which is intended to be installed outdoors.

- Ensure the instrument is positioned in clean, dry and a well-ventilated area, with free air flow around the unit. Do not obstruct the air intakes or vents. If several hosts are installed in the same cabinet, ensure that there is sufficient space around the hosts to promote adequate airflow. If the cabinet size does not allow for this, the cabinet should be fitted with fans or other cooling technologies, to maintain the operating conditions within specifications.

- After unpacking the unit, visually check the FireLaser for any signs of damage and ensure that all the accessories are included in the box. Refer to the packing list which is packed with the box. A copy can also be found in section 0 of this manual.
  Note: we recommend that the shipping box for the FireLaser is not discarded. This packaging provides the best protection for shipping or transporting the FireLaser when required.

- Before operating FireLaser, ensure all users have read and fully understood the safety sections of this user manual.

5.2 Configuring the FireLaser

The FireLaser can be configured in 2 ways:

1. **Via Bandweaver's DTSCM2 configuration software**
   Allows for advanced configuration but requires a computer running the DTSCM2 software. Please refer to the DTS-CM-02-MAN-001 - DTSCM2 User Manual.

2. **Via the integrated LCD**
   The FireLaser DTS integrates a 5.7-inch, 640 x 480-pixel 262K colour touch screen with a stylus, and it runs a GUI on the Linux kernel for main configurations and operations. This manual details the configuration and use of the FireLaser using only the integrated LCD display.

Required Equipment:

- FireLaser Distributed Temperature Sensor
  FireLaser is a Group I device and should be installed indoors in commercial/industrial premises.
- Suitable Power Supply
  FireLaser requires 24V DC power supply. The red and black terminals on the rear panel correspond to the positive and negative poles of the 24V DC power supply. In order to ensure system safety in an abnormal situation, a 2A fuse is mounted in the FireLaser rear panel.
- Fiber Optic Sensor Cable:
  Standard 62.5µm/125µm graded index multimode optical fibre terminated with an E2000 connector

5.2.1 Connect the power

Refer to Section 4.3.2 to ensure the power supply is connected correctly.

5.2.2 Connect the fiber

If the user is unfamiliar with good practices in the use of fiber and this type of system, refer to Section 9 before continuing.

As a safety precaution **ensure the laser is OFF** before inserting the connector into the optical connectors on the back of the FireLaser.

5.3 Switch on the FireLaser

Switch the power and the laser ON. The power and laser indicators on the front panel will light up and the device will run. FireLaser will load the configured parameters and start to measure automatically if there is no intervention within 30 seconds after power on.

The system integrates a 5.7-inch, 640×480-pixel 262K colour touch screen with a stylus; the user can use this touch screen to control and configure the system.

After the DTS is started, the system performs self-test and initialization. After the initialization is completed, the main interface will be displayed as shown in Figure 5-1.

This interface will also display the most recent alarm information, if any.

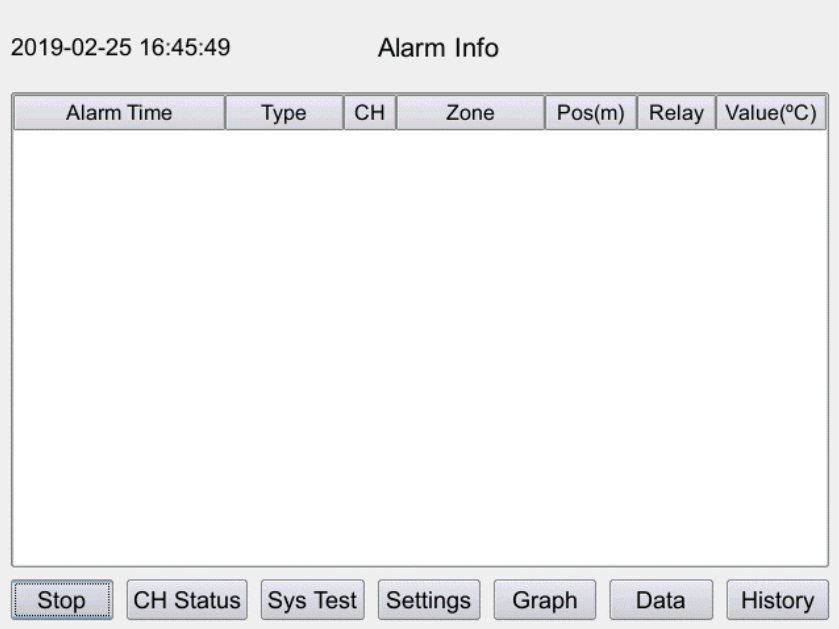

Figure 5-1 GUI Main interface (monitoring status)

5.3.1 Set the parameters

The DTS system is set to automatically load the internal storage configuration for automatic measurement if there is no intervention within 30 seconds after power on.

Use the Settings menu to configure the FireLaser for use – refer to Section 6.5.

Work through each of the sub-sections from 6.5.1 to 6.5.7 to complete the configuration.

6 LCD interface

6.1 Main interface

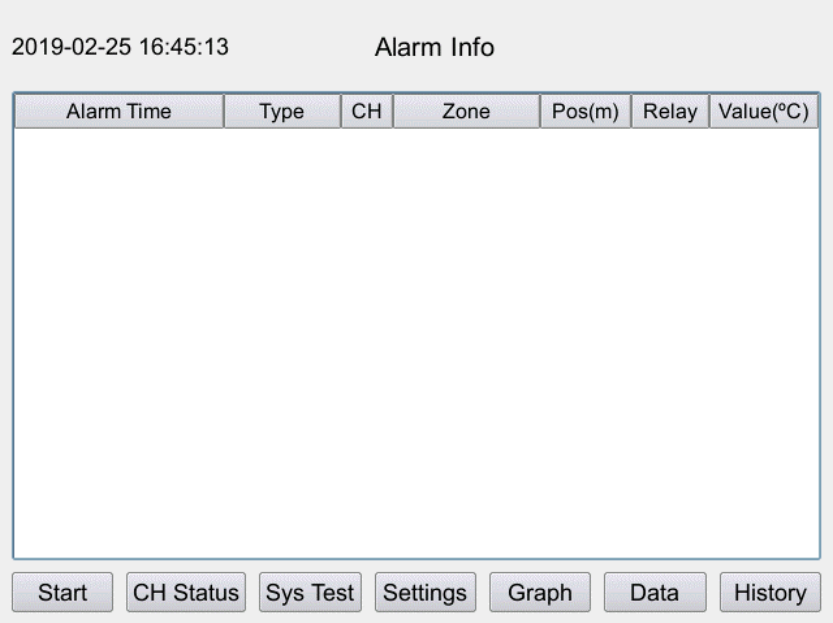

Figure 6-1 LCD Main monitoring interface

In the main interface, the most recent alarm information is displayed.

The fire alarms are recorded in the main interface and follow the fire alarm priority principle. The fire alarms are arranged in chronological order. Similarly, the faults are recorded, and these records are also arranged chronologically.

The menu buttons are arranged below the alarm view and the following configuration options are available:

Start / Stop *Start / Stop Measurement (depending on the current measurement status)*

CH Status *Channel Status, Laser Status*

Sys Test *Manual tests for alarm indicators or channel indicators*

Settings *Measurements time and zone related parameters*

Graph *Display the temperature data curve*

Data *Historical temperature data of the sensing fiber*

History *Historical alarms and fault events*

The functions of each item are described below.

6.2 Start / Stop

This button toggles between **Start** and **Stop** depending on the current measurement status. Click the **Start** button on the main interface to instruct the FireLaser to start measuring the temperature. While temperature measurement is in progress, this button changes to **Stop**, as shown below:

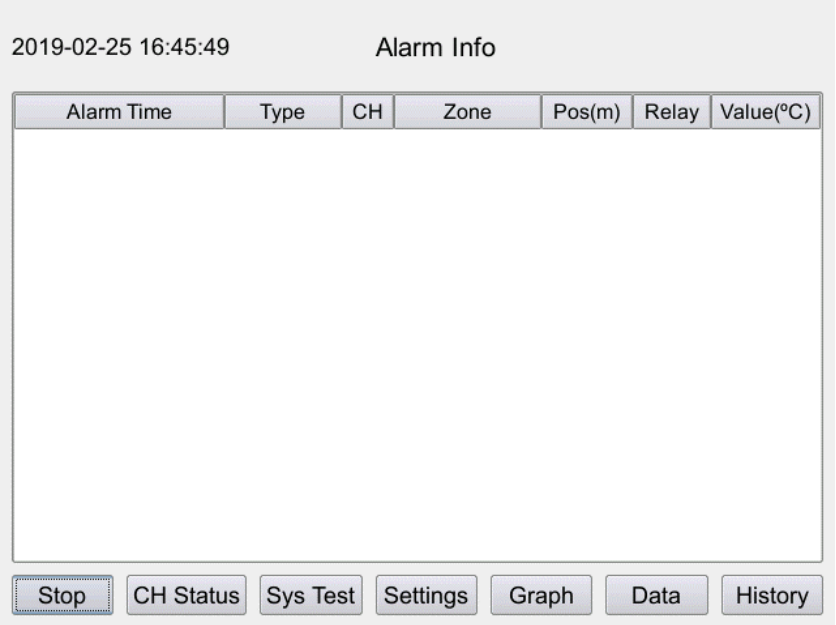

Figure 6-2 Stop measurement

Once measurement has begun, a password is required to stop the monitoring. To start measuring again, click the **Start** button.
Ensure that the DTS is in a non-measurement state when configuring and modifying parameters.

Pressing the **Stop** button therefore requires the input of a password:

Password: 11111111

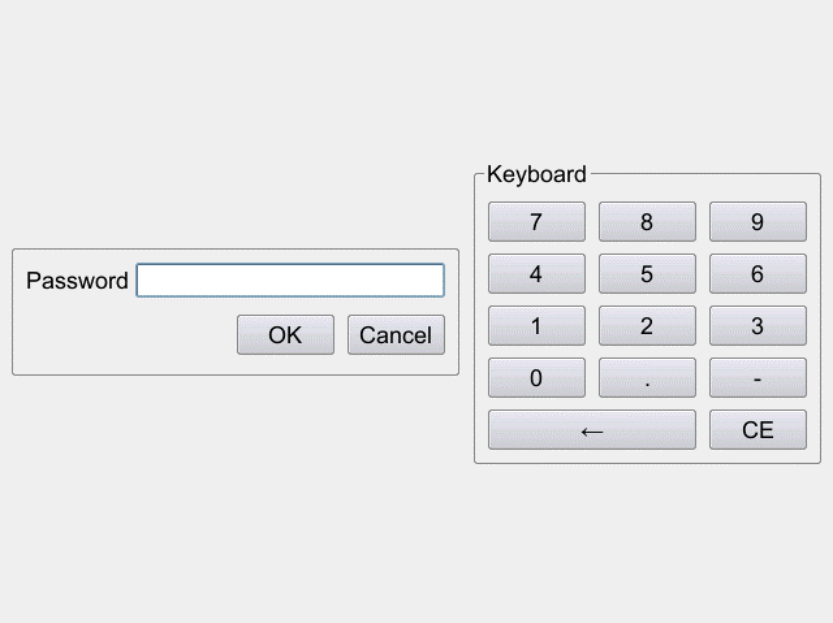

Figure 6-3 Password interface

6.3 Channel status

This button can be used to view the channel status and laser status of the DTS system.

The channel status page is as follows:

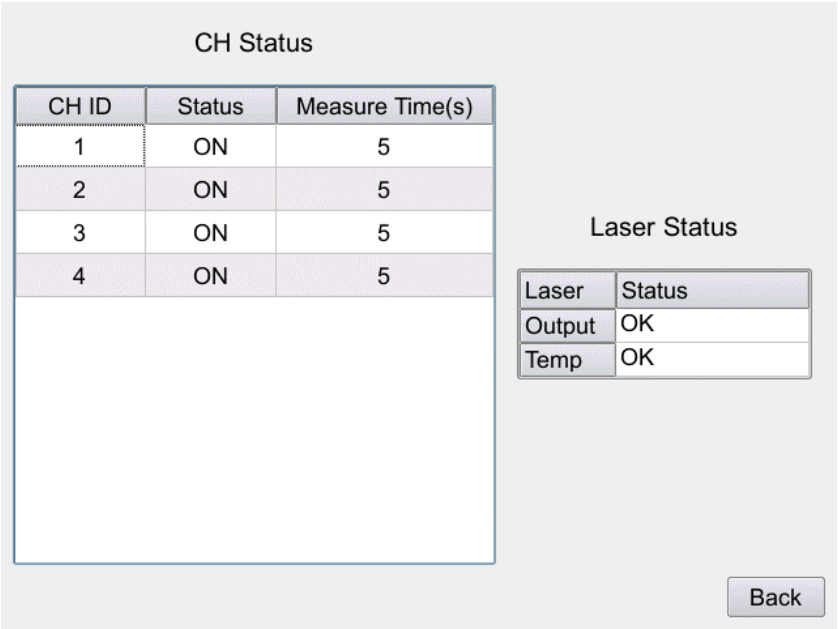

Figure 6-4 Channel Status

6.4 System Test

Use this button to access the system test menu, shown in the figure below:

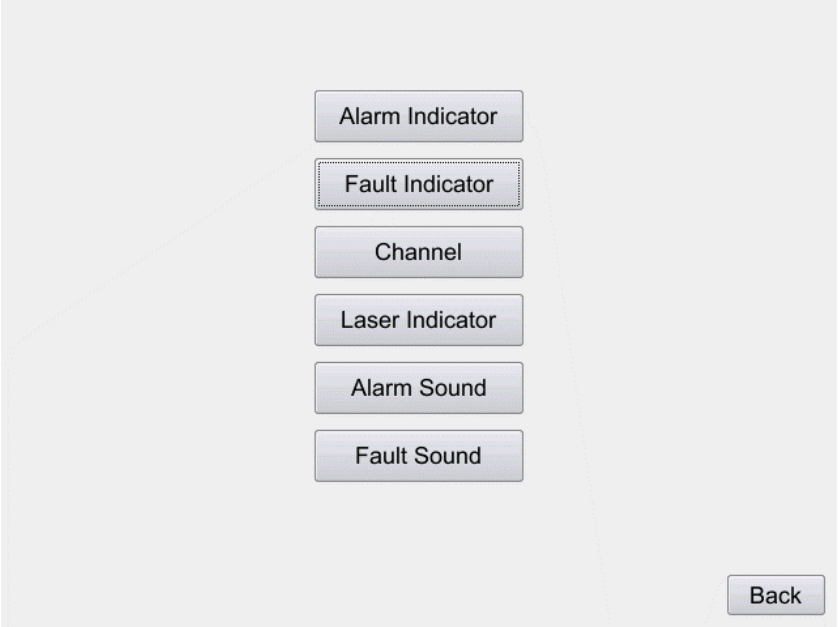

Figure 6-5 System test functions

Each button can be clicked to perform the corresponding test on the FireLaser DTS.

There is a total of 6 buttons, as follows:

Alarm Indicator *Use this button to test the Alarm indicator LED. The indicator will flash.*

Fault Indicator *Use this button to test the Fault indicator LED. The indicator will flash.*

Channel *Use this button to test the channel LEDs. The channel lights on the DTS panel will flash in sequence, and there will be an audible sound*

Laser Indicator *Use this button to test the Laser indicator LED. The indicator will flash.*

Alarm Sound *Use this button to test the Alarm audible alarm. The speaker will sound the fire alarm alert.*

Fault Sound *Use this button to test the Fault audible alarm. The speaker will sound the device fault alert.*

6.5 Settings

Accessed from: Main Interface < Settings

The password is required again to access or change the system configuration.

Click the **Settings** button on the main interface, enter the following password to successfully access the settings shown in Figure 6-6:

Password: 11111111

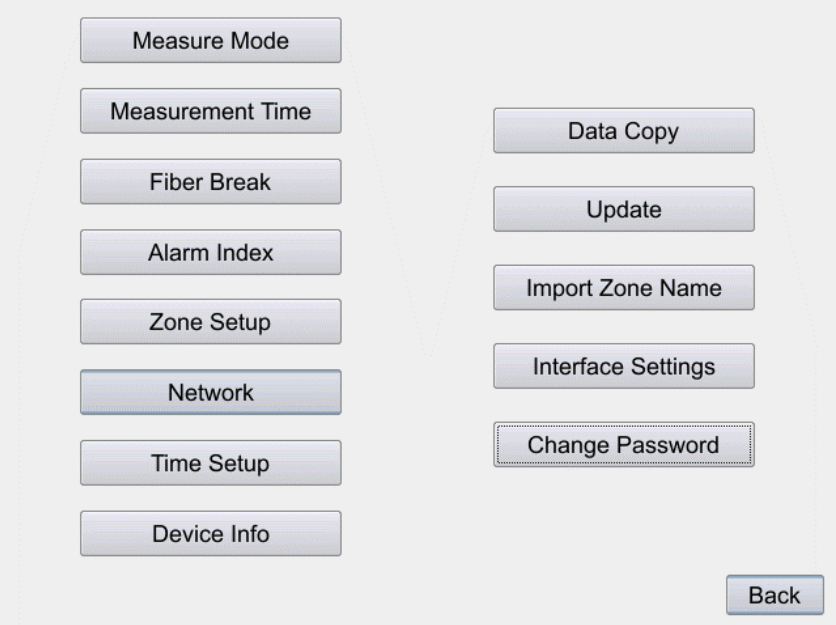

Figure 6-6 Settings

The description of each of the 7 buttons is as follows:

Measurement Mode: *To set the measurement mode for DTS*

Measurement time: *To set the measurement time and total period*

Fiber Break: *To set the effective fiber length and configure the fiber break alarm*

Alarm index: *To set the alarm index related parameters*

Zone Setup: *To configure the zones*

Network: *To configure the network*

Time Setup: *To set the time of the DTS*

Device Info: *To display the device information of the connected DTS*

Data Copy: *To copy files from the DTS to an external USB disk*

Update: *To update the GUI or firmware of the DTS*

Import Zone Name: *To rename the zones*

Interface Settings: *To choose the menu button in the main interface*

Change Password: *To modify the password for different user level*

Each of these is described in detail in the following sub-sections.

6.5.1 Measurement Mode

Accessed from: Main Interface < Settings < Measurement Mode

The **Measurement Mode** button in the **Settings** menu opens the following measurement mode interface:

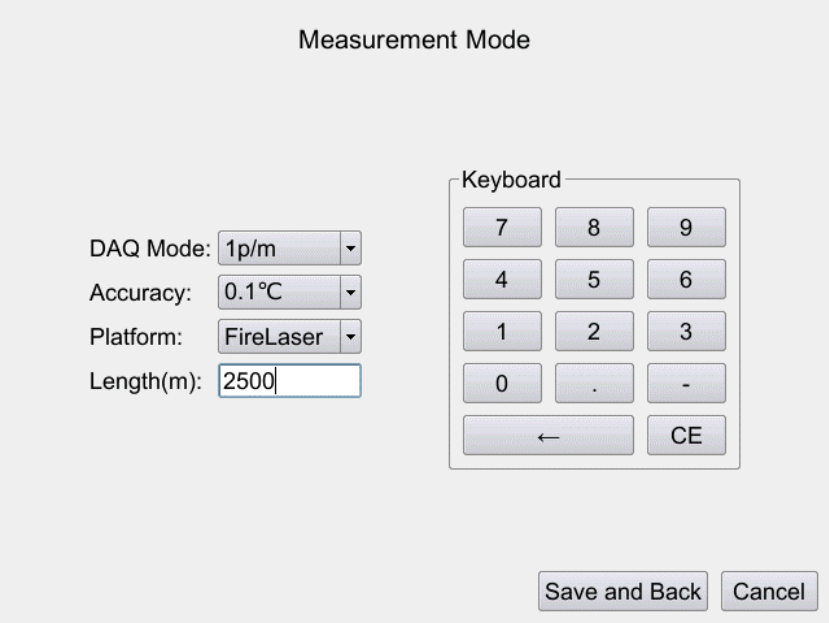

Figure 6-7 Measurement mode

The description of each parameter is as follows:

DAQ Mode: *Sample length resolution options:*

1p/m *one point per meter, sample length is 1 meter*

2p/m *two points per meter, sample length is 0.5 meter*

Accuracy: *Accuracy rating of displayed temperature*

0.1 °C *accurate to 0.1 °C*

0.01 °C *accurate to 0.01°C*

Platform: *To match the algorithm with the hardware platform*

Automatic *Select the algorithm automatically*

FireLaser *FireLaser algorithm*

T-Laser *T-Laser algorithm*

Length: *To set the maximum length of fiber using the numerical keypad displayed on the screen. Use the buttons as follows:*

0-9 *to enter numerical values*

CE *to clear the entered values*

← *Backspace*

6.5.2 Measurement Time

Accessed from: Main Interface < Settings < Measurement Time

The **Measurement Time** button in the **Settings** menu opens the following measurement time interface:

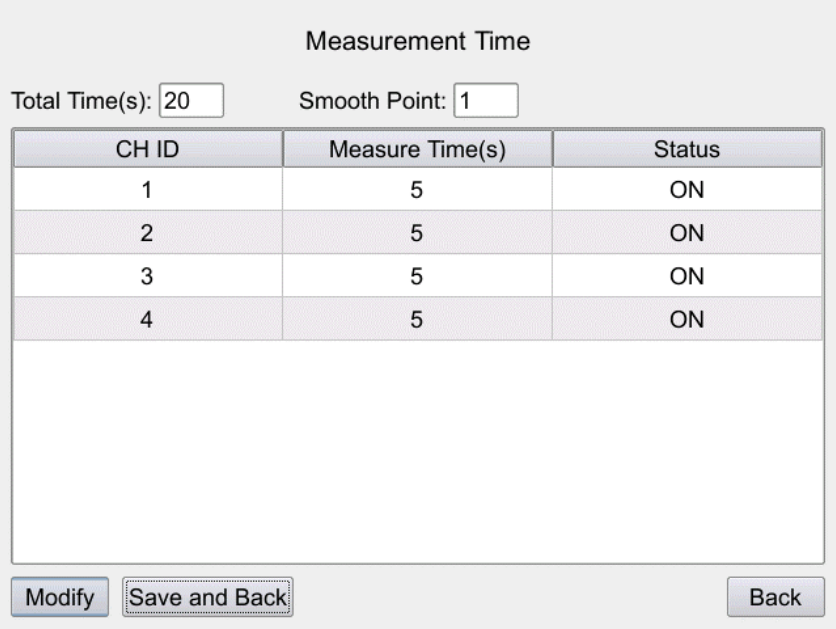

Figure 6-8 Measurement time

Click the **Modify** button in the lower left corner to access the page to modify any of the measurement times. This opens the Measure Time Setup interface shown below:

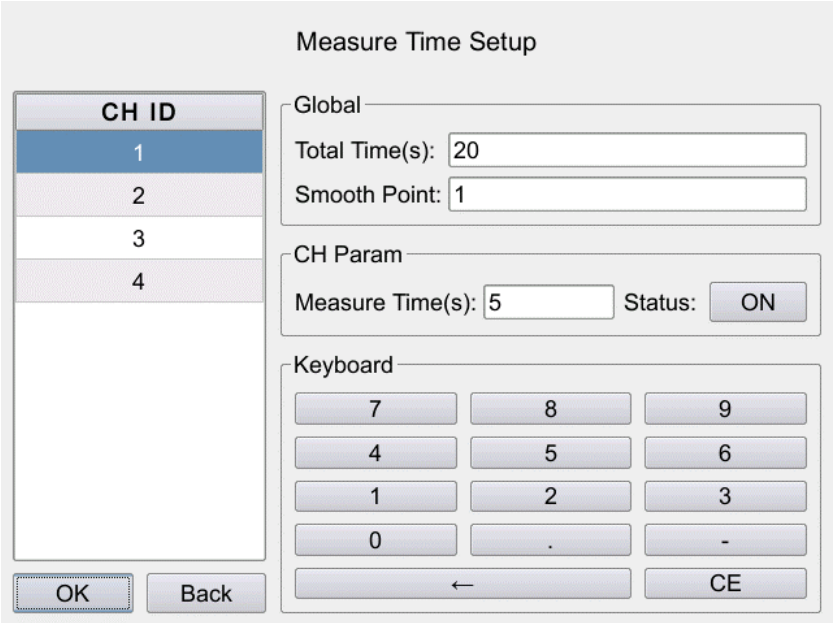

Figure 6-9 Measurement time setup

Select a channel on the left panel to make the corresponding changes to the measurement time and status settings on the right.

The description of each parameter is as follows:

Measure time(s): *Input the required measurement time in seconds using the numerical keypad displayed on the screen. Use the buttons as follows:*

0-9 *to enter numerical values*

CE *to clear the entered values*

← *Backspace*

Status: ***ON*** *means the channel is active,* ***OFF*** *means the channel is deactivated;*

Total Time: *The total measurement period needs to be greater than or equal to the sum of the measure time of each channel.*

Smooth Point: *The number of points averaging in distance*

Note: Be sure to press the **OK** button after the input is complete so that the entered parameters are successfully recorded.

After all channel parameters have been modified, the User can return to the previous interface to view the summary of these settings for all channels. If the User is satisfied with the changes, the

Save and Back button must be used to save the parameters and return to the Main Menu. The **Back** button returns to the previous menu without saving any changes.

6.5.3 Fiber Break alarm

Accessed from: Main Interface < Settings < Fiber Break

The **Fiber Break** button in the **Settings** menu opens the following fiber break interface:

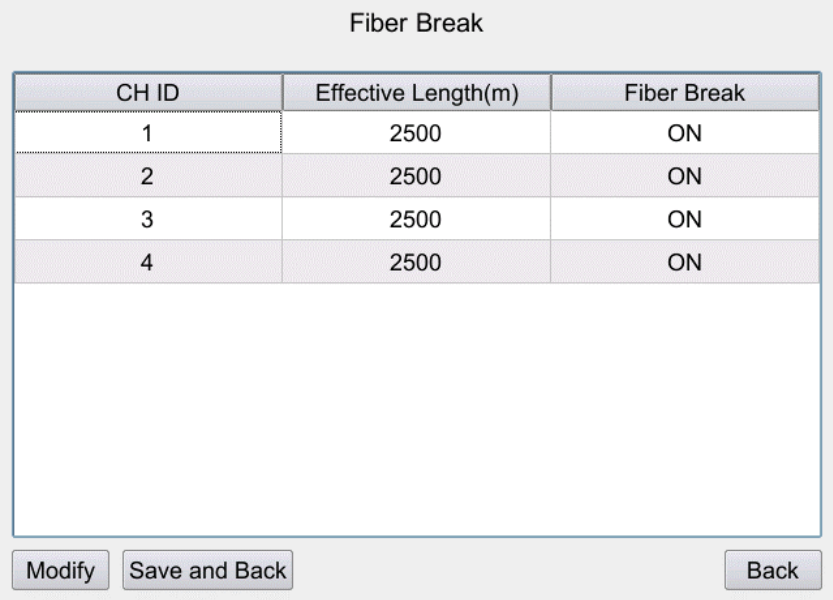

Figure 6-10 Fiber break interface

Click the **Modify** button in the lower left corner to enter the parameter modification interface for the fiber break alarm, as shown in Figure 6-11.

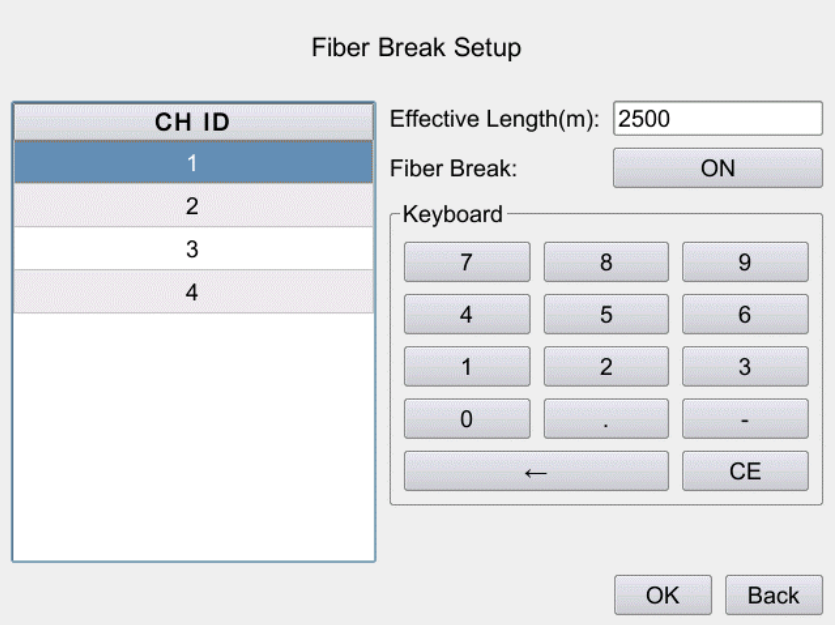

Figure 6-11 FIber break setup

The description of each parameter is as follows:

Fiber break: ***ON*** *indicates that the fiber break alarm is activated, and Fiber Break:* ***OFF*** *indicates that the fiber break alarm is deactivated.*

Effective Length: *Sets the required length of the monitored fiber. The system will only generate an alarm if the measured fiber length is shorter than this value.*

Note: Be sure to press the **OK** button after the input is complete so that the entered parameters are successfully recorded.

After all channel parameters have been modified, the User can return to the previous interface to view the summary of these settings for all channels. If the User is satisfied with the changes, the **Save and Back** button must be used to save the parameters and return to the Main Menu.

The **Back** button returns to the previous menu without saving any changes.

6.5.4 Alarm Index

Accessed from: Main Interface < Settings < Alarm Index

The **Alarm Index** button in the **Settings** menu opens the following alarm settings interface:

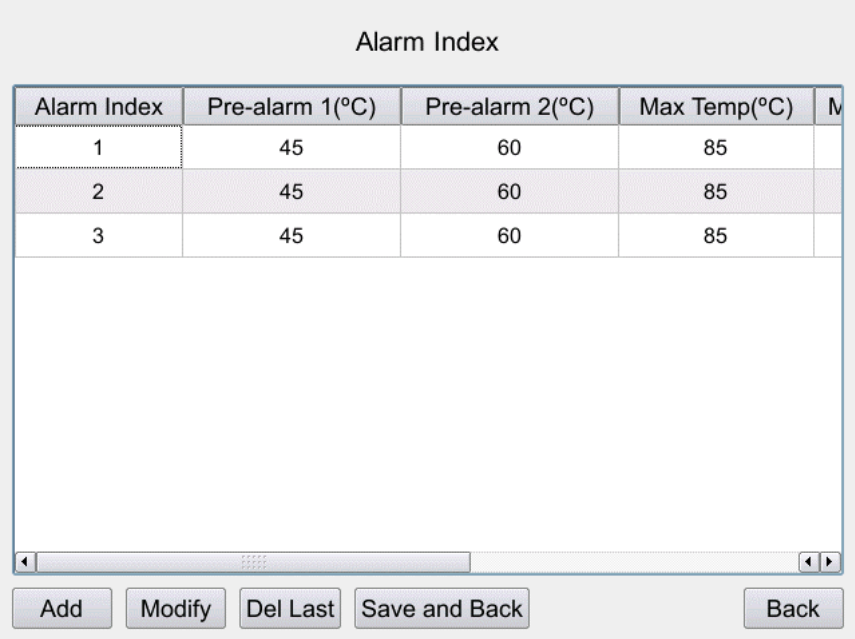

Figure 6-12 Alarm Index interface (1)

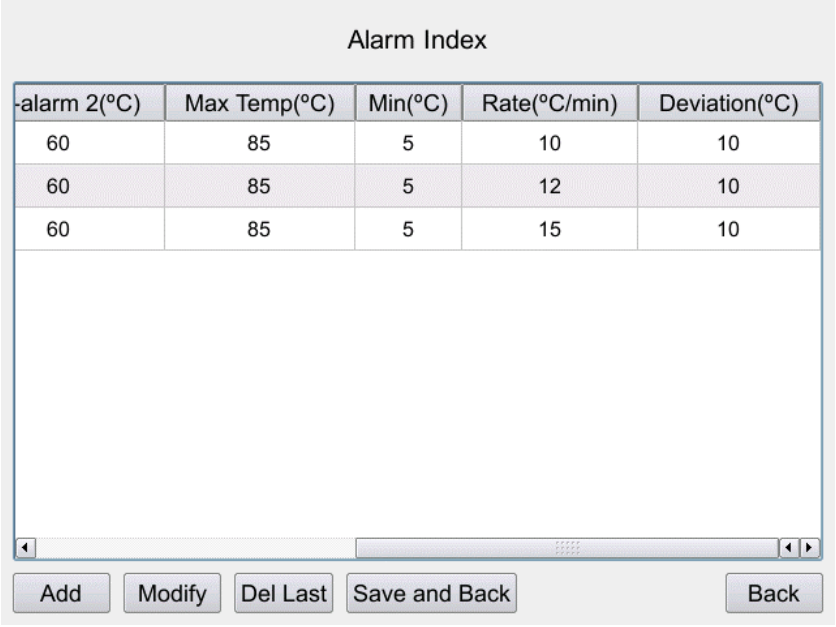

Figure 6-13 Alarm Index interface (2)

Click the **Add** button to add a new index, or select an existing alarm index to **Modify** the alarm index parameters. The interface for modifying parameters is shown below:

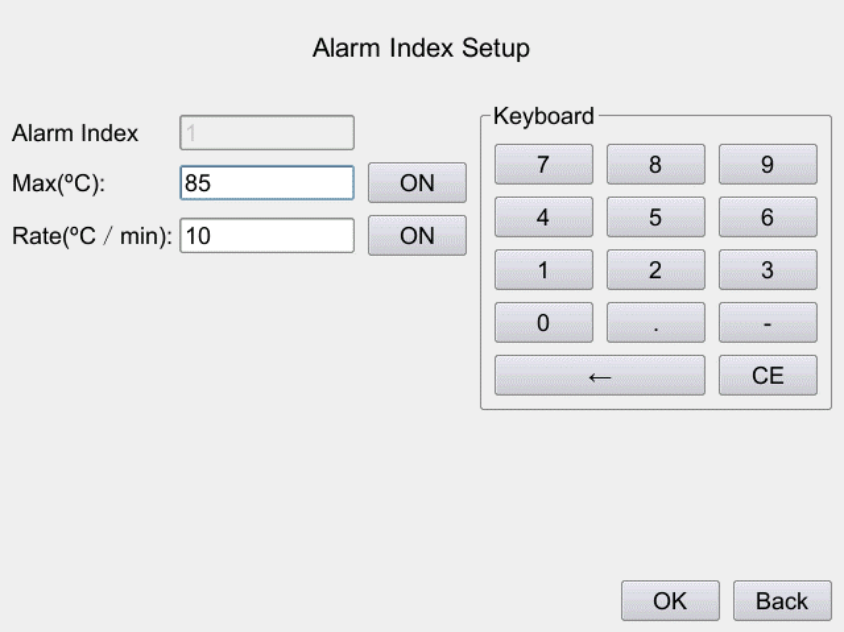

Figure 6-14 Alarm Index setup

The description of each parameter is as follows:

Max(°C): *This temperature is the upper threshold of the FireLaser alarm temperature. When the temperature measured by the fiber is higher than this value, the FireLaser DTS will generate an alarm.*

Rate(°C/min): *Rate of rise alarm. When the temperature of a zone rises faster than this value, the FireLaser DTS will generate an alarm.*

To the right of each of the two above items, there is an **ON/OFF** status button which indicates if the corresponding alarm is armed or disarmed. Clicking the corresponding button also allows the user arm or disarm the corresponding alarm.

Note: Be sure to press the **OK** button after the input is complete so that the entered parameters are successfully recorded.

After all channel parameters have been modified, the User can return to the previous interface to view the summary of these settings for all channels. If the User is satisfied with the changes, the **Save and Back** button must be used to save the parameters and return to the Main Menu.

The **Back** button returns to the previous menu without saving any changes.

6.5.5 Zone Setup

Accessed from: Main Interface < Settings < Zone Setup

The **Zone Setup** button in the **Settings** menu opens the following interface:

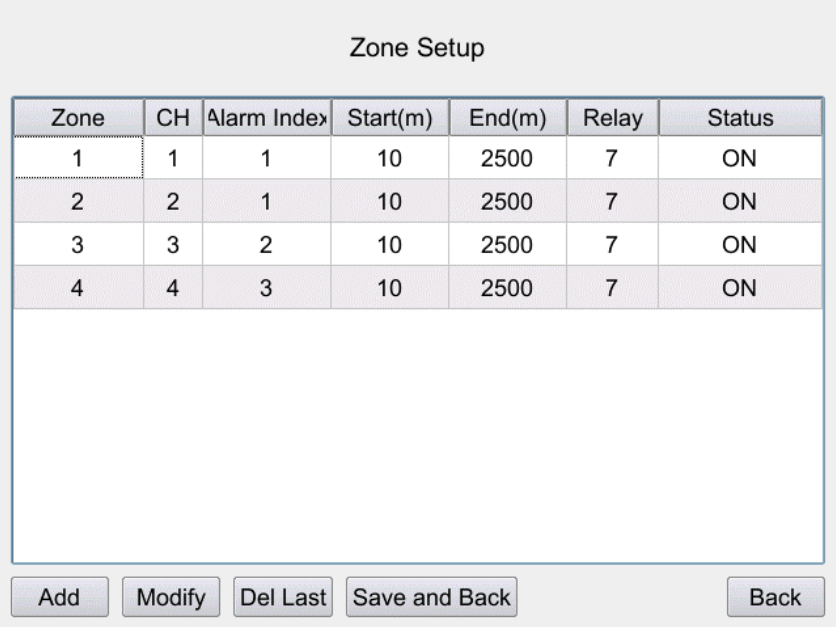

Figure 6-15 Zone Setup interface

Click the **Add** or **Modify** button to set and modify the parameters. The interface for modifying parameters is shown below:

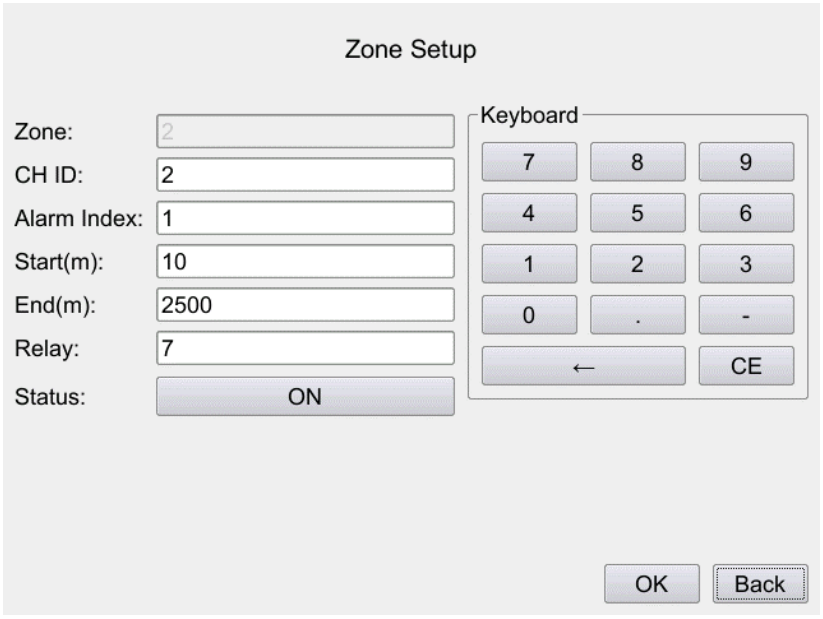

Figure 6-16 Zone setup

The description of each parameter is as follows:

Zone: *The selected zone number*

CH ID: *The channel to which the zone belongs*

Alarm index: *The alarm index in use in this zone*

Start (m): *The start position of the zone*

End (m): *The end position of the zone*

Relay: *The relay to be activated when an event is generated*

Status: *ON indicates that the zone is activated, OFF means the zone is not activated.*

Note:
Be sure to press the **OK** button after the input is complete so that the entered parameters are successfully recorded.

After all channel parameters have been modified, the User can return to the previous interface to view the summary of these settings for all channels.

If the User is satisfied with the changes, the **Save and Back** button must be used to save the parameters and return to the Main Menu.

The **Back** button returns to the previous menu without saving any changes.

6.5.6 Network

Accessed from: Main Interface < Settings < Network

The **Network** button in the **Settings** menu opens the following network interface:

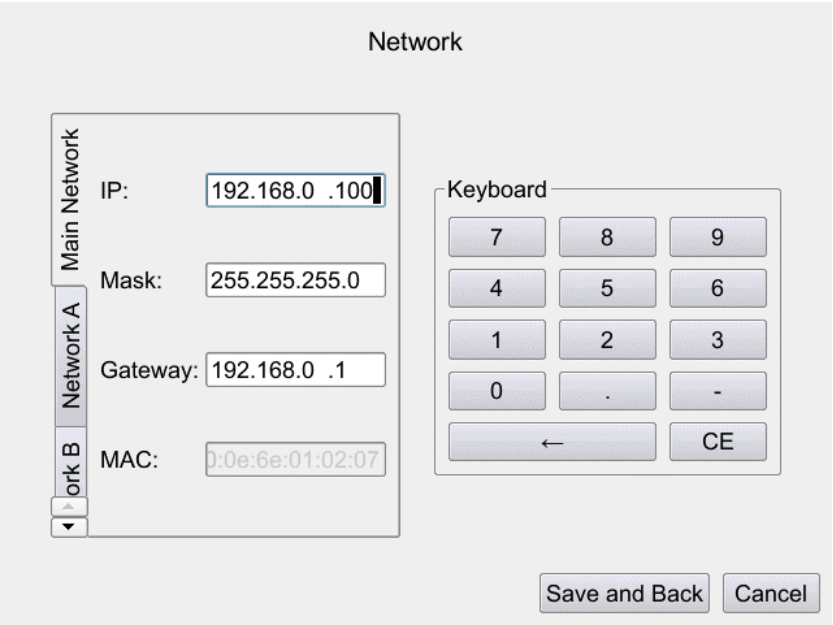

Figure 6-17 Network setup interface

There are four networks in this interface: Main Network, Network A, Network B and, Network C.

Click the name of the network to select the network to be modified and, modify it using the numerical keypad displayed on the screen.

Main Network Only for UDP connection with DTSCM2

Network A, Network B *Redundant ports for Modbus. Can also be used for TCP & UDP connections with DTSCM2*

Network C *Reserved for LCD connection. Do not change.*

6.5.7 Time Setup

Accessed from: Main Interface < Time Setup

The **Time Setup** button in the **Settings** menu opens the following interface:

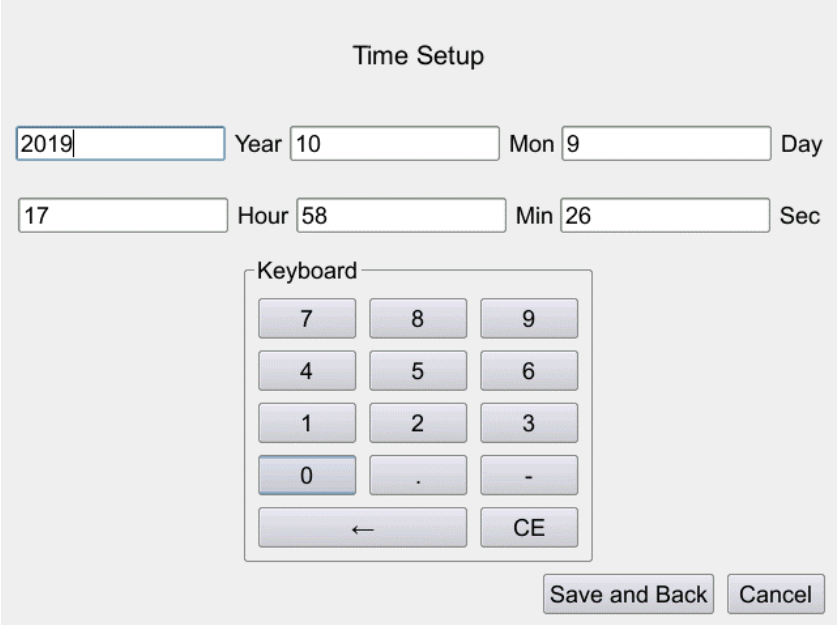

Figure 6-18 Time setup interface

Click the input box to select the field to be modified and, modify it using the numerical keypad displayed on the screen.

6.5.8 Device Info

Accessed from: Main Interface < Settings < Device Info

The **Device Info** button in the **Settings** menu displays the main information of the DTS host on the LCD interface. The interface is as shown below.

Figure 6-19 Device information

The description of each parameter is as follows:

Device ID: *Serial number of the FireLaser DTS*

Laser Freq: *Frequency of the laser pulse*

Oven Temp: *Temperature of internal oven*

Device IP: *IP address of the FireLaser's Ethernet card on the network*

Device No.: *Serial number of FireLaser DTS*

ARM Version: *Firmware version number of FireLaser DTS*

DSP Version: *Algorithm version number of FireLaser DTS*

S/W Version: *Software version number of FireLaser DTS*

Note: The above information is read-only and cannot be modified.

6.5.9 Device Copy

Accessed from: Main Interface < Settings < Data Copy

The **Data Copy** button in the **Settings** menu opens the following interface:

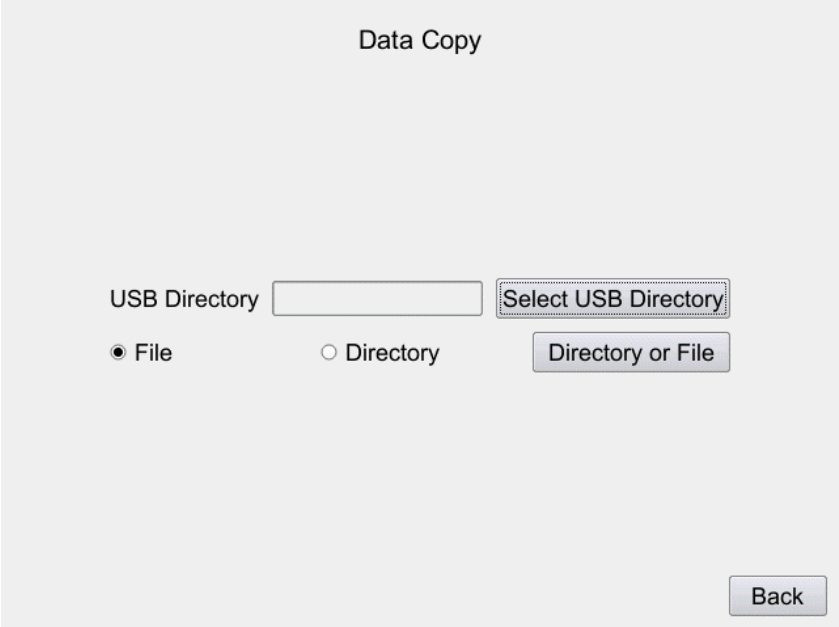

Figure 6-20 Data copy interface (1)

It requires to select the USB disk path before selecting the path of data. Option for data copying is as below:

File: *Copy the single file*

Directory: *Copy all the files in the specified directory*

Click the **Select USB Directory** button to select the USB disk path for data destination. Click the **Directory or File** button to select the path of data source.

The interface by clicking the path selection button is shown as below:

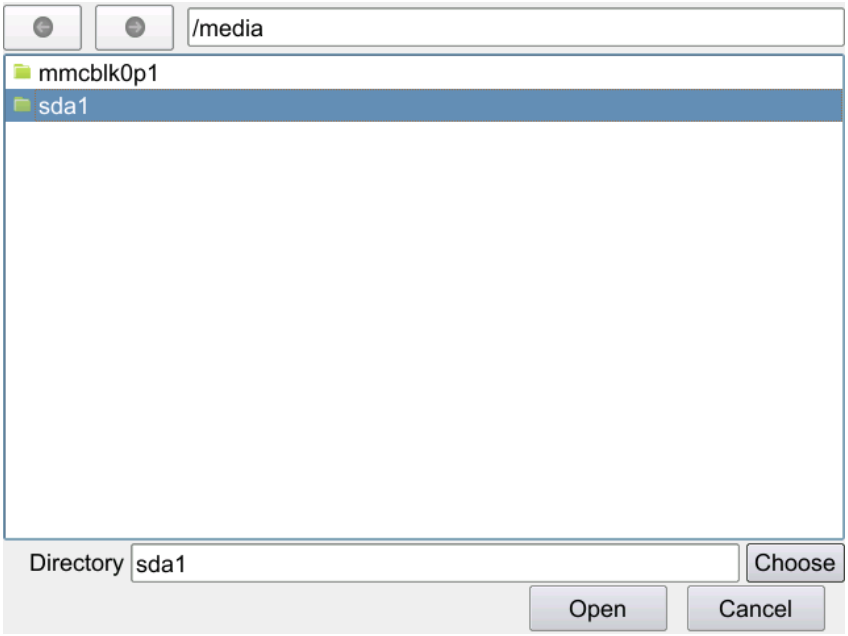

Figure 6-21 Data copy interface (2)

Note:

The USB disks always begin with a prefix of 'sda' or 'sdb', e.g. sda1 is a USB disk listed in the path dialog.

'**mmcblk0p1**' is the name of internal storage. The data source should be in this folder.

Click **Open** button to get into the directory. Click **Choose** button to select the directory

6.5.10 Update

Accessed from: Main Interface < Settings < Update

The **Update** button in the **Settings** menu opens the following interface:

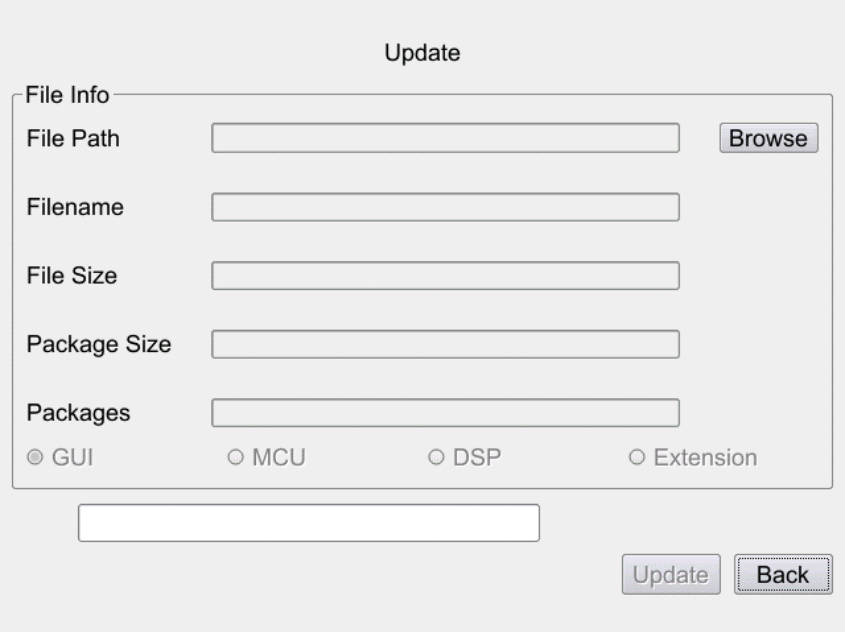

Figure 6-22 Update interface

This allows to update the GUI and firmware from USB disk. Click **Browse** button to select the file to be updated. Some of details of target file are list in the read only boxes. It will recognize the target type (GUI, MCU, DSP or Extension) automatically. After the file is selected, **Update** button becomes operable, click it to execute the update.

6.5.11 Import Zone Name

Accessed from: Main Interface < Settings < Import Zone Name

The **Import Zone Name** button in the **Settings** menu opens the following interface:

Figure 6-23 Import zone name

This allows to replace the zone id number with user definitions. Edit the field of name in the zone.xml file, and then import the file via USB disk. The example of zone.xml file is shown as below:

```
<?xml version="1.0" encoding="UTF-8"?>
<zoneconfig>
        <zone id="1" name="User definitions"/>
        <zone id="2" name="User definitions"/>
        <zone id="3" name="User definitions"/>
</zoneconfig>
```

Figure 6-24 Format of zone name replacement

The field of name is editable, and it supports up to 20 characters. Use other definitions instead of User definitions.

6.5.12 Interface Settings

Accessed from: Main Interface < Settings < Interface Settings

The **Interface Settings** button in the **Settings** menu opens the following interface:

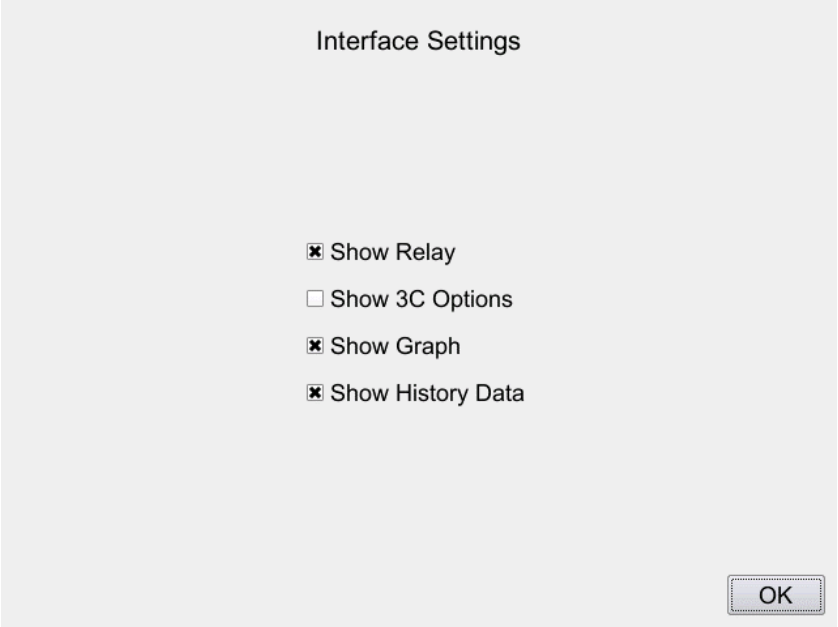

Figure 6-25 Interface settings

Clicking the check box can enable or disable the following display or menu in the main interface.

Show Relay *Display the relay id for the recent alarm information.*

Show 3C Options *Special for CCC certification in China. Be disabled normally.*

Show Graph *Display the **Graph** menu in the main interface.*

Show History Data *Display the **Data** menu in the main interface.*

6.5.13 Change Password

Accessed from: Main Interface < Settings < Change Password

The **Change Password** button in the **Settings** menu opens the following interface:

Figure 6-26 Password interface

Test Password *Password for engineering operations.*

User Password *Password for end users.*

Click the input box to select the field to be modified, and modify it using the numerical keypad displayed on the screen.

6.6 Graph

The **Graph** button on the main monitoring interface displays the temperature curve on the integrated display similar to the one shown in Figure 6-2 Stop measurementFigure 6-27 below:

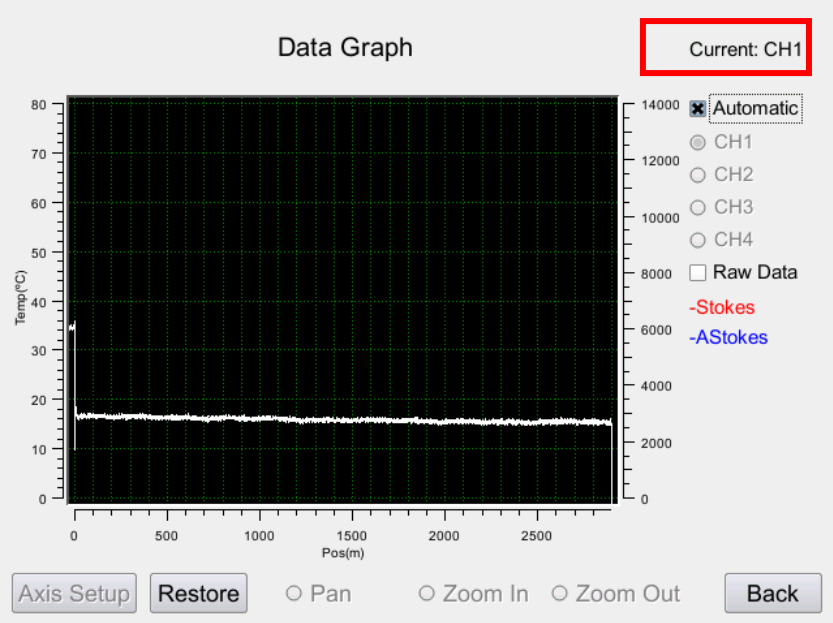

Figure 6-27 Graph interface (1)

When the DTS is measuring the temperature of the sensing fiber, the channel number being monitored is displayed on the top right corner as shown in figure above.

Otherwise, the **Current:** channel will be displayed as **N/A**.

By default, the graph will display the temperature curve without the raw data curve. To visualise the raw data, select the **Raw Data** checkbox. This will overlay the raw data curve on the same graph.

The **Axis Setup**, **Zoom In** and **Zoom Out** buttons are currently disabled.

If the Automatic checkbox is disabled, as shown in the Figure 6-28, the **Axis Setup** button can then be used to setup the display range for temperature, distance and raw data. Curve manipulations such as **Pan**, **Zoom In** and **Zoom Out** are also now enabled.

The **Restore** button can be used to revert to the default display range for curves.

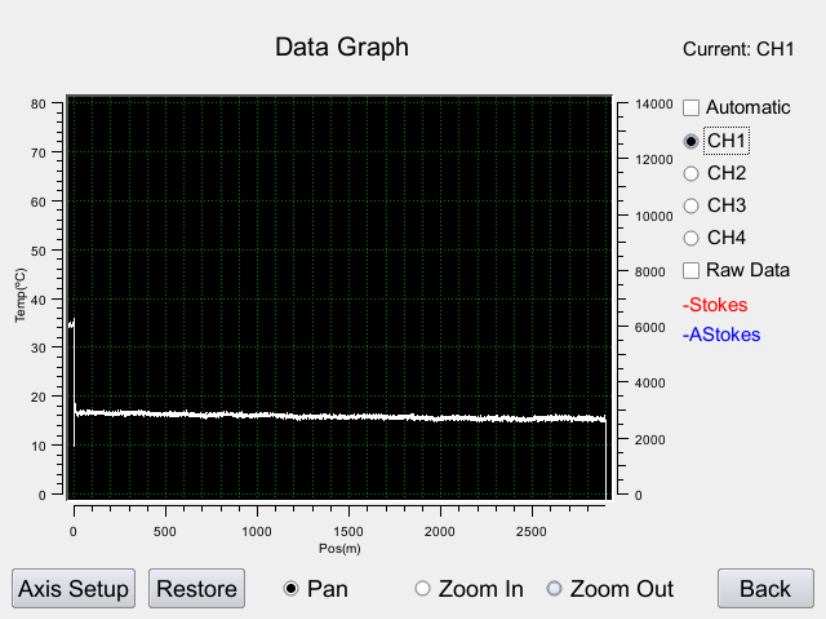

Figure 6-28 Graph interface (2)

Use the **Axis Setup** button to adjust the axis settings. See Figure 6-29 below.

Axes settings for distance, temperature and raw data can be set to specified values. Click the **Default Axis** button to restore the system default values.

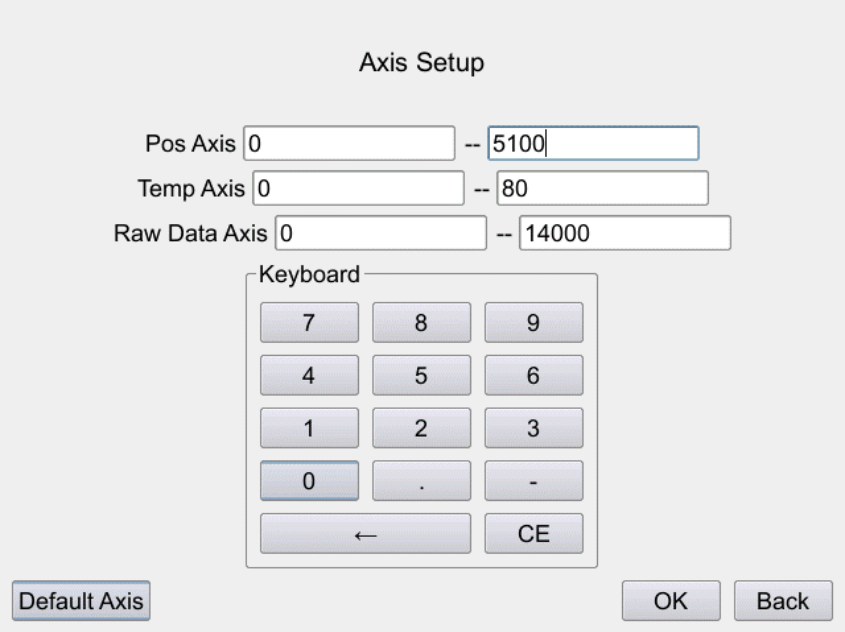

Figure 6-29 Axis setup

6.6.1 Data

Use the **Data** button to view historical temperature data. A password is required to access this feature. Use the following password:

Password: 11111111

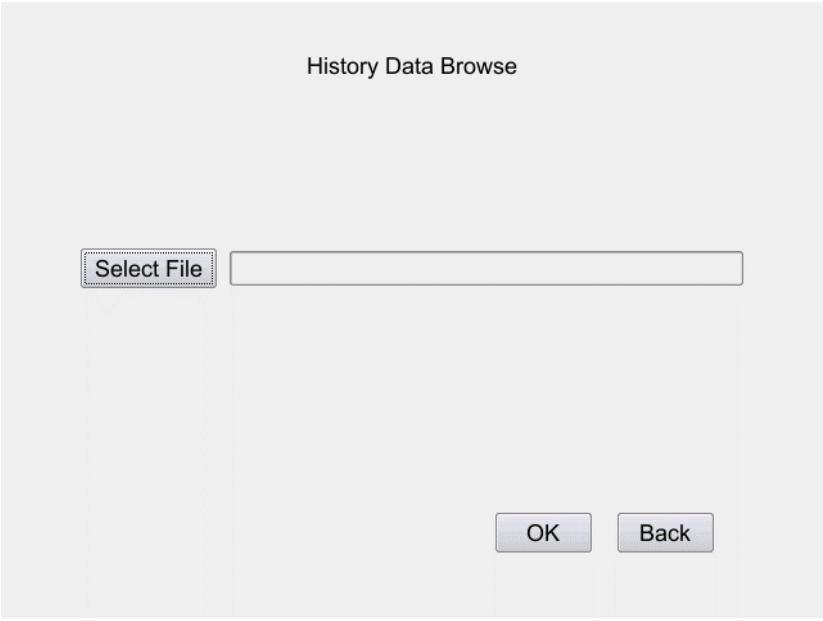

Figure 6-30 Historical Data - select file

The historical temperature data is stored in the **DTSdata** folder on the internal hard disk named **mmcblk0p1**.

This folder contains **Chan1~4** folders for storing historical temperature data and a **Data_Exception** folder for storing alarm temperature data. The structure of folders is shown in Figure 6-31 below:

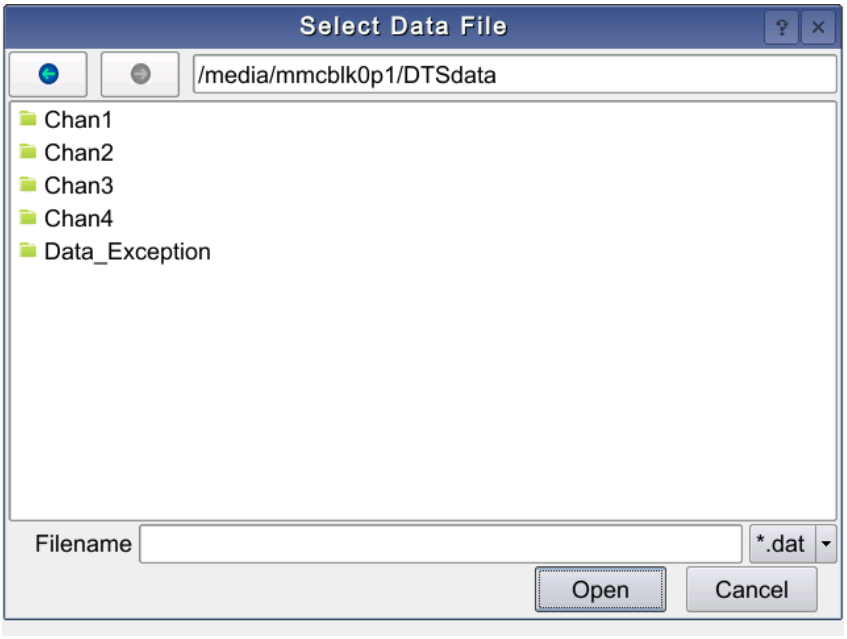

Figure 6-31 Historical Data - folder structure

The DTS automatically generates folders named by date in the format **YYYYMMDD** – for example 20190119 – to save temperature data under the different channel folders. Data is saved to a binary file in the format **HHMMSS.dat** – e.g. 000150.dat – for each measurement.

The historical data path and file list are shown in Figure 6-32.

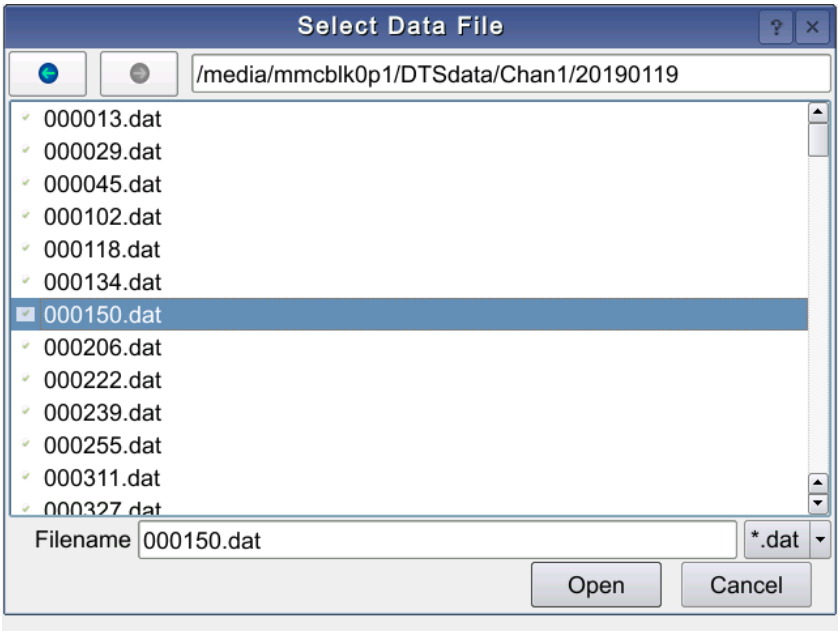

Figure 6-32 Historical Data - data path and file list

Choose the file and click **Open** to get the path of files. Then click **OK** to display the historical temperature curve shown in Figure 6-33.

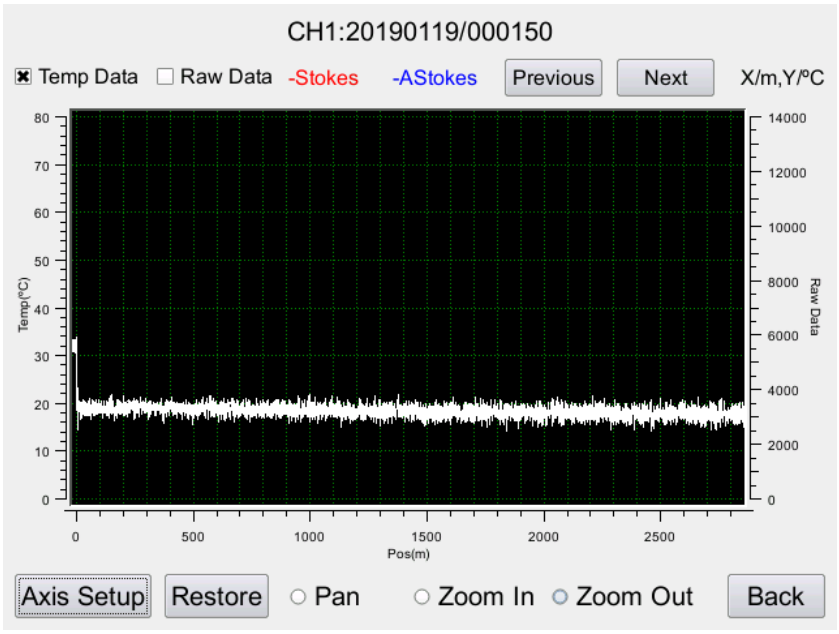

Figure 6-33 Historical temperature curve

Basic information is displayed at the top of the interface. The checkboxes **Temp Data** and Raw Data can be selected to display corresponding temperature and raw data curves.

Click **Next** or **Previous**, to replay the previous or next historical temperature.

Axis Setup can be used to set the display range and **Restore** to reset to the default range. As with the normal **Graph** interface, **Pan**, **Zoom In** and **Zoom Out** can be used to operate the curve. Click the **Back** button to return to the main interface.

6.6.2 History

The DTS records all the alarm and fault information on the internal disk. This data can be accessed by the **History** button on the main interface.

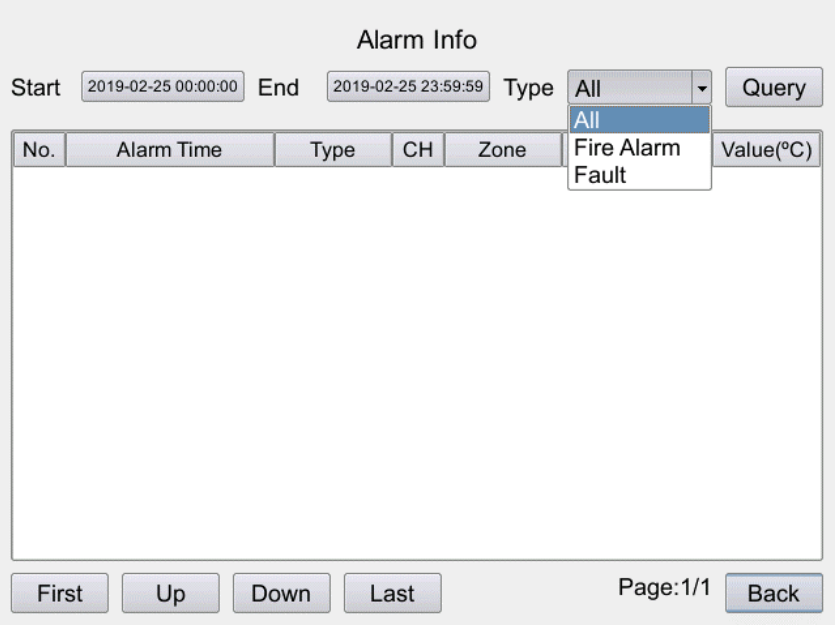

Figure 6-34 Historical Records interface

Use the **Start** and **End** buttons to select the time period of interest – the corresponding interface is shown in Figure 6-35 below.

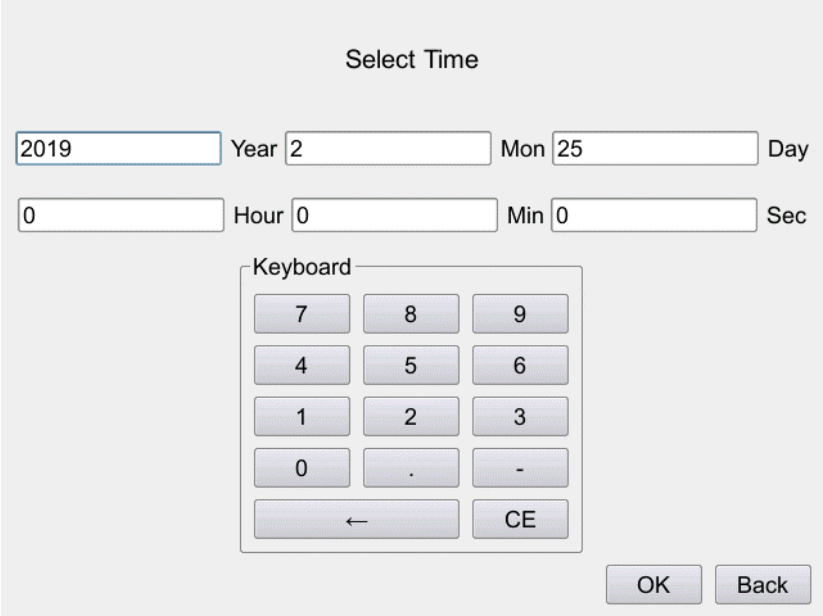

Figure 6-35 Select the period of interest

The record types are divided into **Fire Alarm**, **Fault** and **All**. The User can select which type is of interest or view all by type. Click **Query** to display the chosen records.

10 records are displayed per page. Use the **First**, **Up**, **Down** and **Last** buttons to scroll through the records. Click **Back** to return to main interface.

7 FireLaser use in accordance with EN54 part 22

The FireLaser's core operating principle is considered within EN54 part 22 Line Type Heat Detectors, the technology can be deemed to meet the general requirement of the pan-wide European Fire Standard EN54. When the FireLaser is used in accordance with **EN54 part 22**, the only connections to the FireLaser during normal operation should be:

1. Optical fiber in channel 1;
2. RJ45 network cable to PC (to view temperature profile / alarm status information)
3. SCSI Relay cable for Relay connectors
4. 24VDC EN54 part 4 approved power supply for fire applications and with a ground connection

The other connections are only for configuration and diagnosis.

Note:
That the power supply included with the FireLaser is not fire approved. It is included as an accessory for quick and easy configuration of the FireLaser. It can also be used on standard temperature monitoring applications where EN54 part 22 approval is not required.

7.1 CE Marking Information

CE
1674

Bandweaver Technologies Co., Ltd, Room 103, Building 1, 299 Zhongchen Road, Songjiang District, Shanghai 201613, China

18

7723081018

EN54-22

FireLaser

Fire detection and fire alarm systems – resettable line-type heat detector

Intended for use in and around buildings and civil engineering works

Nominal activation conditions/sensitivity

- Individual alarm Indication: Red LED
- Signalling: Alarm and fault status signalled
- Repeatability: t(3)max : t(3)min ≤ 1.3; t(20)max : t(20)min ≤ 1.6
- Reproducibility: t(3)max : t(3)min ≤ 1.3; t(20)max : t(20)min ≤ 1.6 (Class A1N)
- Reproducibility: t(3)max : t(3)min ≤ 1.3; t(20)max : t(20)min ≤ 1.6 (Class BN)

Operational Reliability

- Connection of ancillary devices: No functional effect
- Manufacturer's adjustments: Special means required

- Requirements for software controlled detectors: Documentation available/ modular structure/ invalid data not permitted/ program deadlock avoided/ site specific data in non-volatile memory with two-week retention

- Sensing element fault: Fault signal ≤ 300 sec, no alarm

- On-site adjustment of response behaviour: Special means required; settings clearly marked

- Maximum ambient temperature test - Sensing element (class A1N: 50°C): No alarm fault during conditioning. Afterward alarm given

- Maximum ambient temperature test - Sensing element (class BN: 65°C): No alarm fault during conditioning. Afterward alarm given

Tolerance to supply voltage

- Variation in supply parameters: t(3)max : t(3)min ≤ 1.3

- Low voltage fault (sensor control unit with external power supply): Fault signal ≤ 100 sec

Performance parameters under fire condition

- Fire sensitivity for room protection application: Alarm at assigned response class (A1N and A2N: TF6S, TF6, TF6F)

- Static response temperature test: Alarm at assigned response class (A1N)

- Static response temperature test: Alarm at assigned response class (BN)

Durability of Nominal activation conditions/sensitivity

Temperature resistance:

- Dry heat (operational) for sensor control unit: t(3)max : t(3)min ≤ 1.3; no false operation during 16 h at 40°C (Group I)

- Dry heat (endurance) for sensing element: t(3)max : t(3)min ≤ 1.3; no false operation after 21 d at high temperature (Group III: A1N, BN 70; Testing with the highest class BN)

- Cold (operational) for sensing element: t(3)max : t(3)min ≤ 1.3; no false operation during 16 h at -25°C (Group III)

- Cold (operational) for sensor control unit: t(3)max : t(3)min ≤ 1.3; no false operation during 16 h at -5°C (Group I)

Humidity resistance:

- Damp heat, steady state (endurance) for sensor control unit and sensing element: t(3)max : t(3)min ≤ 1.3; no false operation after 21 d at 40°C and 93% RH

- Damp heat, cyclic (operational) for sensing element: t(3)max : t(3)min ≤ 1.3; no false operation during 2 cycles at 55°C and 93% RH (Group III)

- Damp heat, steady state (operational) for sensor control unit: t(3)max : t(3)min ≤ 1.3; no false operation during 4 d at 40°C and 93% RH (Group I)

- Damp heat, cyclic (endurance) for sensor control unit and sensing element: t(3)max : t(3)min ≤ 1.3; no false operation after 6 cycles at 55°C and 93% RH (Group III)

Shock and Vibration resistance:

- Impact (operational) for sensor control unit: t(3)max : t(3)min ≤ 1.3; no false operation after 3 0.5 ± 0.04 J impacts (Group I)

- Impact (operational) for sensing element: t(3)max : t(3)min ≤ 1.3; no false operation after 3 0.5 ± 0.04 J impacts; Fall weight: 200 ± 10, Hammer weight: 500 ± 10 (Group III)

- Vibration, sinusoidal (operational) for sensor control unit: t(3)max : t(3)min ≤ 1.3; no false operation during vibration for a sweep between 10 and 150 Hz at 1 m s^{-2} (Group I)

- Vibration, sinusoidal (operational) for sensing element: t(3)max : t(3)min ≤ 1.3; no false operation for sweep between 10 and 150 Hz at 5 m s^{-2} (Group III)

- Vibration, sinusoidal (endurance) for sensor control unit: t(3)max : t(3)min ≤ 1.3; no false operation after vibration for 20 sweeps between 10 and 150 Hz at 5 m s^{-2} (Group I)

- Vibration, sinusoidal (endurance) for sensing element: t(3)max : t(3)min ≤ 1.3; no false operation after vibration for 20 sweeps between 10 and 150 Hz at 10 m s^{-2} (Group III)

Corrosion resistance - Sulphur dioxide (SO_2) corrosion (endurance) for sensing element: t(3)max : t(3)min ≤ 1.3; no false operation after 21 d at 25°C, 93% RH and 25 µl/l SO_2 content (Group III) **Electrical stability** - Electromagnetic compatibility (EMC), immunity tests (operational): t(3)max : t(3)min ≤ 1.3; no false operation when applying electrostatic discharge, radiated electromagnetic fields, conducted disturbances induced by electromagnetic fields, fast transient burst and slow high energy voltage surges

Table 7-1 CE marking information

Note:
That this section is pending the issue of the new Vds Approval for the FireLaser, complying with EN54 part 22: 2015.

7.2 FireFiber AT Sensor Cable

The sensing cable is the temperature sensor for the FireLaser system. Bandweaver's FireFiber AT cable comprises one or more 62.5/125 optical fibres within a particular cable construction.

The product specification of the FireFiber AT cable is as shown below:

FireFiber AT Specification	
BS EN 54-22:2015 – Environmental Classification	Environmental Group III for Sensing Elements
Optical fiber type	62.5 µm Multimode Graded Index acrylate coated
Attenuation	<2.4dB/km @ 850nm, <0.6dB/km @ 1550nm
Bandwidth	>600MHz.km
Outer diameter/ wall thickness	3.2mm/ 0.4mm
Operating temperature	-20°C to +80°C continuous
Minimum bend radius	100mm
Weight	25kg/km
Stainless steel tube diameter	~2.0mm
Outer diameter	3.3mm (customized)
Material	Low-smoke, non-halogen, thermoplastic
Permissible pressure	Long term 600N Short term 1000N

Permissible side pressure	Long term 300N/10cm Short term 1000N/10cm
Tensile strength	500N
Linear compaction	30kg/cm cause ~0.3mm deformity
Attack 5 point, 3x every point (N,M)	5
Permitted bending radius	Long term 10x cable outer diameter Short term 8x cable outer diameter
Temperature range	Long term -40°C to +90°C Short term -50°C to +120°C
Coefficient of heat expansion@ 20°C	17.2x10-6(1/°C)
Coefficient of heat conduction@ 20°C	0.0036(1/°C)
Specific temperature	0.502(j/g*°C)
Life span	>30 years
Defend degree	IP67
Standard	IEC 60332-3C

7.3 Sensor Cable Fixings

There are certain factors that should be considered when installing the FireFiber cable such that any of the physical limitations of the cable are not exceeded during the installation process.

7.3.1 Z-Shaped Brackets

The Z-shaped bracket is made of stainless steel i.e. SS 304. The bracket is fixed to the ceiling using a M6 x 60mm shielded anchor bolt. The installation procedure is as shown below:

- Mark the location on the ceiling using a punch mark where the anchor bolts are to be fitted.
- The distance between two markings should be no more than 1.5m apart.
- Using an impact drilling tool, drill a hole on the punch mark to match the collar on the M6 x 60mm shielded anchor bolt.
- Insert the bolt in the hole that is drilled and tap to ensure that the collar on the bolt is securely fitted.
- Fasten the Z-Shaped bracket on the bolt and fit the FireFiber sensor cable using cable ties.

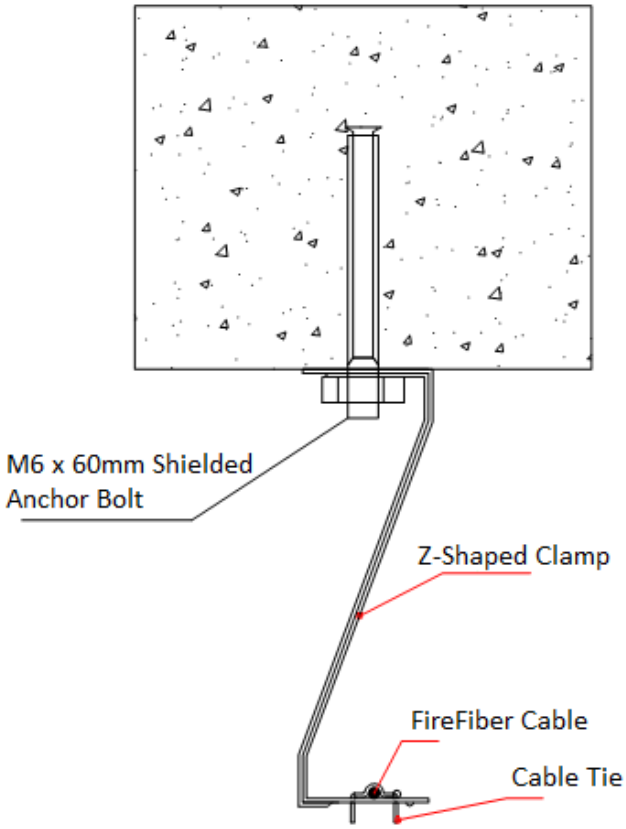

Figure 7-1 Z-Shaped Bracket

7.4 System Design

Resettable Line Type Heat Detectors (RLTHDs) have been used for many years and have been successfully integrated into fire system design. These detectors are typically used in areas where point type heat detectors are presented with challenging environmental characteristics and also, where access to the detectors, may significantly influence the fire alarm system design.

The EN54 part 22 standard defines the minimum system functionality for RLTHD products. RLTHD are based upon many unique operating principles. It is the intention of this standard to define common operating characteristics for each type of RLTHD in conjunction with existing EN 54 detector standards, so that resettable line type heat detectors have a response behaviour comparable to that of point type heat detectors.

Due to the various applications for RLTHD, it is necessary to devise separate environmental classification tests for the sensing element and the sensor control units of these systems. It is not the purpose of this standard to define applications or how RLTHD should be used in applications.

However, the standard indicates two general fields of application, room protection and secondly local protection. The standard defines separate response test classifications for these two fields.

Generally, there are two functional principles employed by RLTHD: non-integrating and integrating systems. Therefore, separated subclasses have been created for non-integrating systems and for integrating systems.

The Bandweaver FireLaser system operates as a multizone fire detector and is designed to interface directly to a Fire Alarm Control Panel (FACP). FireLaser is designed to be integrated into a fire detection system as an EN54 part 22 compliant line type heat detection system.

The FireLaser system shall be designed as A1N sensitivity detector for room protection applications and as a BN sensitivity for local protection applications. Fiber optic linear heat detection technology is defined as a non-integrating type sensing element. The definition of Room and Local protection applications within the EN54 part22 standard is indicated in section 7.4.1.

7.4.1 Room Protection Application

Room protection application in which the sensing element is installed at a distance from the potential fire hazard close to the ceiling or roof of the area to be protected.

Example

Car parks (open or closed), road/rail/metro tunnels, floor/ceiling voids, elevator shafts, cold stores, warehouses, heritage buildings, aircrafts hangars, spray shops, chemical storehouses, ammunition depots, refineries, silos.

7.4.2 Local Protection Application

Local protection application in which the sensing element is installed in a relatively close proximity to the potential fire risk.

Example

Pipelines, conveyor belts, combustion engines/turbines, rolling stock, transformers, process dryers, cable trays, escalators, chemical process equipment, electrical equipment cabinets, ventilation systems (dust collector, hood extractor, etc.), switch gear.

The FireLaser system provides up to 42 zonal fire relays which are interfaced directly to the FACP, normally via addressable relay input modules. The FACP operation shall therefore log all fire and fault events.

The FireLaser system is designed to be installed in a 19-inch cabinet, normally provided by other suppliers. Generally, the cabinet shall be installed to enable access to cables and also in a location

which is appropriate to the FireLaser system specifications. The system designer should ensure that visual and audible alarms from the FireLaser system are clearly available to the system operator.

FireLaser must not be subject to an operating environment below 0°C or above 55°C. The humidity level shall not be in excess of 95% Relative Humidity (non-condensing).

7.4.3 Fiber Optic Joint Boxes

Throughout the installation it may be necessary to join the fiber. Fiber optic cable is available in reels of predetermined length. As such the system design may require a length longer than the standard available lengths or difficulties with individual site installations may necessitate the use of remote fiber optic joint boxes. These boxes house and secure the fiber optic splices. The fiber optic joint box is also used in application areas where it is inconvenient to pull the fiber optic heat sensing cable from one risk area to another and so a separate fiber optic cable section may be required.

The fiber optic joint box is a plastic enclosure. The box should be located to provide easy access to the fiber optic fusion splice, should the need arise. For example, if a fiber optic heat sensing cable is applied to the roof of a tunnel, any associated fiber optic joint box should be located where it is easy to access in the event of maintenance. The joint box is fixed to the mounting surface by using suitable fixing screws.

7.4.4 Optical Budget

Fusion splices may be incorporated at any position along the length of installed fiber. The system designer should ensure that each splice is accounted for, because each splice introduces an additional optical loss within the fiber circuit. The more splices, the more optical loss. Since the FireLaser Sensor Control Unit is designed to operate up to an upper design threshold of 10 dB (one-way loss) at 975 nm, one needs to ensure that the cumulative loss of the fiber plus the splices does not exceed 10 dB per circuit. For design purposes, one should assume the loss of the fiber is 0.2 dB per optical splice and 2dB per km of sensing element (fiber optic sensing cable). The optical budget of 10dB applies from the (free) end of the first pigtail located at the FireLaser Sensor Control Unit. The system designer should ensure that the total optical loss of the circuit design does not exceed 10dB. Optical loss levels are further checked and recorded as part of the system commissioning procedure.

7.4.5 Sensor Cable Positioning

The design of the linear heat detection system should only be undertaken by a responsible fire alarm company with specialist knowledge in the product application. The location and spacing recommendations for this type of linear heat detection system are based on the need to ensure that the associated fire extinguishing products reach the sensor cable in adequate concentration, and to provide the required speed of response to a particular fire risk.

As mentioned previously, the sensor cable can be applied in two ways as defined with EN54 part 22.

1. Room Protection Applications. This method is to install the sensor cable at ceiling level to provide 'space' detection within buildings or structures. The sensitivity of the system shall be to A1N.
2. Local Protection Applications. This method of installation ensures that the sensor cable is sited in close proximity to the hazard in order to provide rapid response. The sensitivity of the system shall be to BN.

7.4.6 Minimum Setup Requirements

NOTE: FireLaser is a Group I device and should be installed indoors in a commercial/industrial premises.

At a minimum FireLaser requires a 24V DC power supply and an optical fibre to operate. In this basic form a preconfigured FireLaser will output audible alarms.

For configuration, viewing historical data, and alarm information an IPC can be connected to the RJ45 connector using DTSCM software.

If alarm information is required then alarm triggers can be accessed via the alarm relay output. Additional system information (power, fibre break, trouble etc) can also be accessed via the first six relays.

7.4.7 Environmental Groups

Different environmental groups are necessary to reflect the different service environments of the components of a line type heat detector. The environmental groups for the sensor control unit (FireLaser) is classified as Group I and the sensing element (FireFiber) is classified as Group III. The environmental groups should not be confused with the temperature response classifications (i.e. A1N, BN etc).

Group I cover equipment likely to be installed indoors in a commercial/industrial premises but for which the avoidance of extreme environmental conditions can be taken into account in the selection of the mounting site. Environmental Group II covers equipment likely to be installed indoors in commercial/industrial premises in all general areas. Group III covers equipment which is intended to be installed outdoors.

7.4.8 Heat Response Classes

As mentioned earlier, in section 7.4.5 Sensor Cable Positioning, when using the sensing element for room protection application, the heat response class is A1N.

The table below shows the temperature range for heat response class A1N:

Heat response class	Typical application temperature (°C)	Maximum application temperature (°C)	Minimum static response temperature (°C)	Maximum static response temperature (°C)
A1N	*25*	*50*	*54*	*65*

Table 7-2 Temperature range for A1N

The response time criteria for A1N is as shown in the table below:

TF6S		TF6		TF6F	
Response time		Response time		Response time	
Lower value (s)	Upper value (s)	Lower value (s)	Upper value (s)	Lower value (s)	Upper value (s)
50	*400*	*30*	*210*	*20*	*130*

Table 7-3 Response time criteria A1N

Where, TF6S, TF6 and, TF6F represent the slow, medium and fast test fires as per EN 54 part 22: 2015/ prA1:2017. The details are given in the table below:

Test fire	Dimensions of steel tray (mm)	Fuel (by volume)	Amount of fuel (kg)
TF6F	*500 x 500 x 50*	*Methylated spirit [90% Ethanol – C_2H_5OH to which has been added 10% denaturant impurity (Methanol)]*	*2*
TF6	*435 x 435 x 50*	*Methylated spirit [90% Ethanol – C_2H_5OH to which has been added 10% denaturant impurity (Methanol)]*	*2*
TF6S	*390 x 390 x 50*	*Methylated spirit [90% Ethanol – C_2H_5OH to which has been added 10% denaturant impurity (Methanol)]*	*2*

Table 7-4 Test fires

For the BN class i.e. for local protection described in section 7.4.2, the temperature range is as shown in the table below:

Heat response class	Typical application temperature (°C)	Maximum application temperature (°C)	Minimum static response temperature (°C)	Maximum static response temperature (°C)
BN	*40*	*65*	*69*	*85*

Table 7-5 Temperature range for BN

Note:
That this section is pending the issue of the new Vds Approval for the FireLaser, complying with EN54 part 22: 2015.

8 Alarms

In the event of the following conditions:

Alarm condition such as:

- The temperature exceeds an alarm parameter in a zone

Fault condition such as:

- Fibre break
- Laser fault

The following will occur:

- if the alarm is set to trigger a relay the relay will close contact (refer to Section 8.1).
  - Laser fault: Relay #2
  - Fiber break: Corresponding relay #3 ~ #6
- The corresponding LED indicator will light up
- if an IPC running the DTSCM2 software is connected, an alarm event window will pop up

In this situation, the user has two options to reset the alarm. The alarm may be reset from the **RESET** switch on the front panel or via the software.

After an alarm has been reset using the **RESET** button, the relays will open.

However, if the alarm condition has not been resolved the relay will close again after the next measurement is complete.

8.1 Relays

The FireLaser DTS integrates two SCSI connectors on the rear panel for output of relays. Each SCSI connector is 50 pins as dual-row for 25 relays. Together, the two connectors provide up to 50 relay outputs.

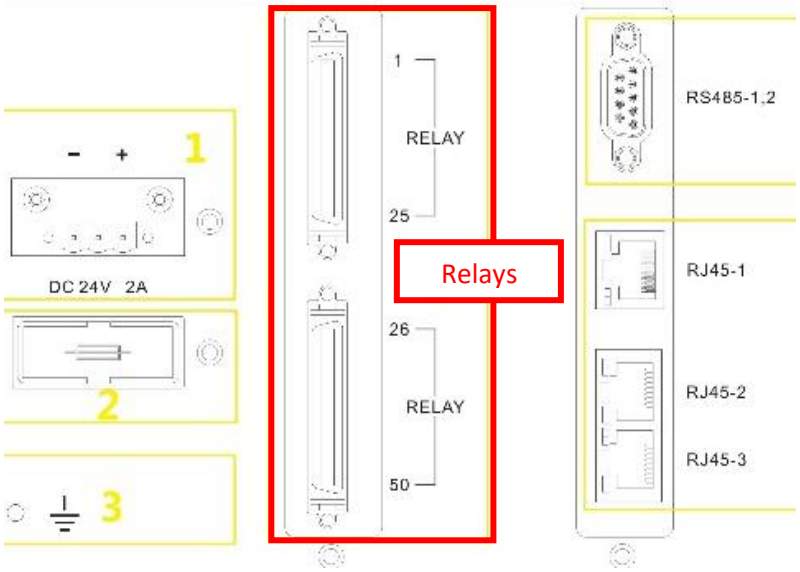

Figure 8-1 Relay connectors on rear panel

Connector 1: Relays 1 to 25 **Connector 2: Relays 26 to 50**

The two pins in the same row constitute the output of one relay. Two SCSI to PLC terminal convertors are supplied with FireLaser. The relays can be connected directly from the terminals of the convertor. The view of connector and convertor are shown in Figure 8-2 below:

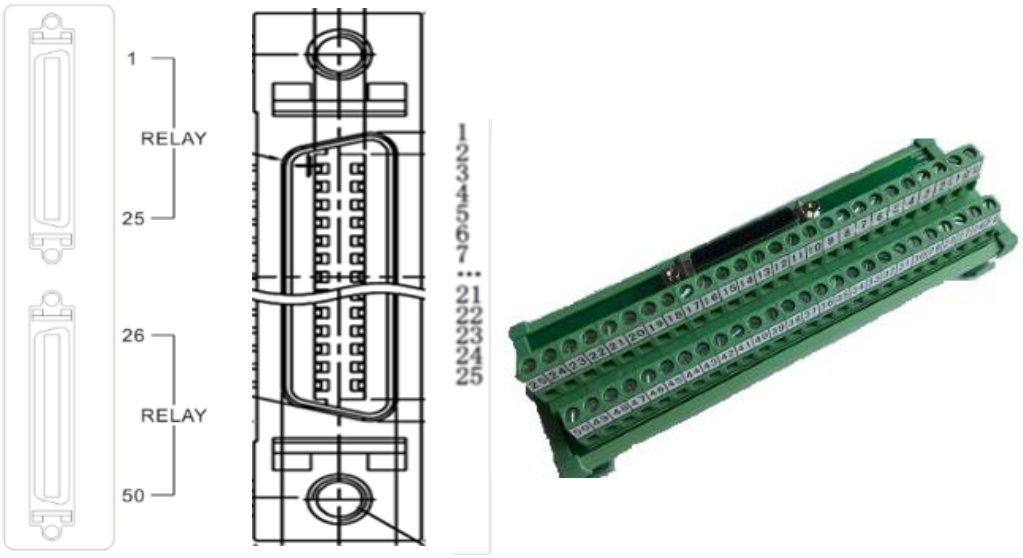

Figure 8-2 Output relays

Relay definitions:

Relay 1 *Power indicator*

Relay 2 *System status indicator*

Relay 3~6 *Broken fiber indicators for channel 1 to channel 4 respectively*

Relay 7~50 *User addressable alarm indicators for zones. Refer to Section 6.5.5 for details*

The first 6 relays are reserved for system faults. The first use addressable relay starts at relay 7.

The relay mapping is as follows:

Pin	Port 1 – Relays 1 to 25	Port 2 – Relays 26 to 50
1/26	Power Fault COM / NC	COM / NO
2/27	System Laser Fault COM / NO	COM / NO
3/28	Fibre break CH1 COM / NO	COM / NO
4/29	Fibre break CH2 COM / NO	COM / NO
5/30	Fibre break CH3 COM / NO	COM / NO
6/31	Fibre break CH4 COM / NO	COM / NO
7/32	COM / NO	COM / NO
8/33	COM / NO	COM / NO
9/34	COM / NO	COM / NO
10/35	COM / NO	COM / NO
11/36	COM / NO	COM / NO
12/37	COM / NO	COM / NO
13/38	COM / NO	COM / NO

14/39	COM / NO	COM / NO
15/40	COM / NO	COM / NO
16/41	COM / NO	COM / NO
17/42	COM / NO	COM / NO
18/43	COM / NO	COM / NO
19/44	COM / NO	COM / NO
20/45	COM / NO	COM / NO
21/46	COM / NO	COM / NO
22/47	COM / NO	COM / NO
23/48	COM / NO	COM / NO
24/49	COM / NO	COM / NO
25/50	COM / NO	COM / NO

Table 8-1 Relay connector pinout

8.2 Modbus

Please refer to the Modbus COIL&REGISTER Definition for Modbus communication details not included in this section.

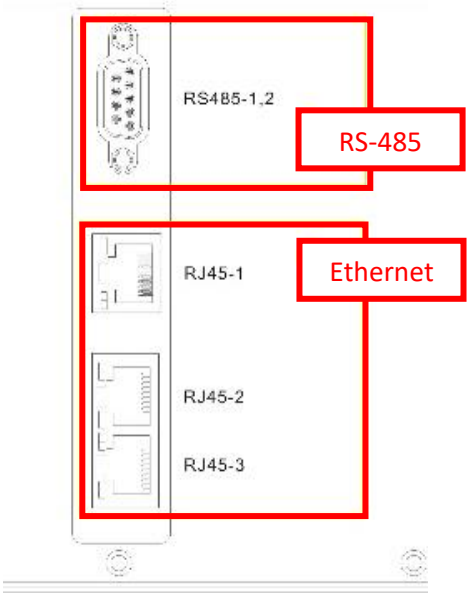

Figure 8-3 RS-485 and Ethernet ports

8.2.1 RS-485 Interfaces

The FireLaser DTS integrates two RS-485 bus into a DB-9 connector. They are configured as slave mode, and only used for Modbus RTU communication.

Please only use the RS-485 cable packing with the DTS.

The default settings are as below:

ID	1
Baud rate	19200
Stop bit	1
Parity	EVEN

8.2.2 Ethernet connection: RJ-45

The FireLaser DTS integrates three 10/100Mbps adaptive Ethernet network ports – labelled RJ45-1, RJ45-2 and RJ45-3 on the rear panel of the FireLaser.

Only RJ45-2 and RJ45-3 support Modbus TCP in server mode.

	RJ45-1	RJ45-2	RJ45-3
Default IP address	*192.168.0.100*	*192.168.0.11*	*192.168.0.12*
Type	▪ *10/100M adaptive* ▪ *MDI/MDI-X adaptive*	▪ *10/100M adaptive*	▪ *10/100M adaptive*
Use	▪ *UDP (Port: 1025) for DTSCM2*	▪ *TCP(Port: 1026) & UDP(Port: 1025) for DTSCM2,* ▪ *Modbus TCP server (Port: 502)*	▪ *TCP (Port: 1026) & UDP (Port: 1025) for DTSCM2,* ▪ *Modbus TCP server (Port: 502)*
		▪ *Crossover cable required for DTS<->PC connection*	▪ *Crossover cable required for DTS<->PC connection*

Table 8-2 Summary of RJ45 ports

Each Modbus TCP server can support a maximum of four sockets.

When connecting a PC directly to the FireLaser, if the card does not support MDI/MDI-X automatic adaptation, a crossover cable is required; i.e. a crossover cable is required to connect a FireLaser DTS to a PC via ports RJ45-2 or RJ45-3.

While all cards – RJ45-1, RJ45-2 and RJ45-3 – can be used with UDP protocol to connect DTSCM2, for long unattended connections the use of TCP is recommended instead of UDP. In this case, RJ45-2 or RJ45-3 must be used as RJ45-1 does not support TCP protocol.

Note:
The three network cards have different MAC addresses. However, if there is more than one FireLaser on the same local area network, their MAC address must be changed to be distinct. Please refer to DTS-CM-02-MAN-001 - DTSCM2 User manual on how to do this.

9 Good Practice

9.1 Use of fibre optic connectors ⚠

When the optical fibre is ready, the E2000 connector can be connected to the FireLaser system for temperature measurement.

Insert the E2000 connector into the back of the FireLaser. The connector must be firmly pushed into the receptor and an audible click will confirm a good connection.

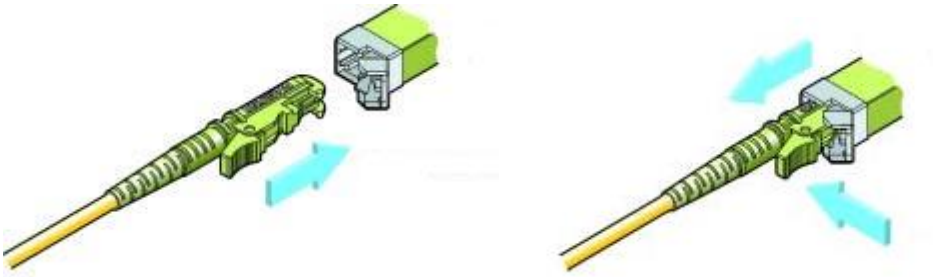

Figure 9-1 - E2000 Connector

NOTE:

- Always turn off the laser when inserting or removing a connector
- Do not look directly at the connector when the laser is on.
- The standard E2000 can only be inserted in one direction.
- The E2000 must be firmly pushed into the connector, an audible click will confirm a good connection.
- The connector has a built-in release catch that must be depressed before it can be removed
- Do not over bend or wind the patch cord too tightly as this can increase the attenuation in transmission
- Do not continue to use a connector if it has been damaged, and have it replaced as soon as possible.
- After use, ensure the connectors are well protected against dusts or grease contamination with a suitable cap.

WARNING:

As a safety precaution, before inserting the connector into the optical connectors on the back of the FireLaser, please turn off the laser or turn off the machine.

9.2 Terminating the far end of the sensing fiber

To prevent end reflections and inadvertent viewing of the laser light, at the far end of the fibre, the fibre must be appropriately terminated. These end reflections can damage the optical receiver if left unchecked.

There are several possible methods:

1. Splice an angled connector to the end of the optical fibre and cover it with a protector.
2. Roughly break the end of the optical fibre and cover the end.
3. Tie a knot of approximately 5mm in diameter at the end of the optical fibre.
4. Immerse the end of the optic fibre in matched refractive index liquid and cover the end.

10 Troubleshooting

Problem	Common causes	Recommended solution
No lights are on	- Power switch is off	- Turn the power switch to "I"
Failure reported as soon as the unit starts	- The laser switch is not turned on - There is no fiber connected - The connector is dirty	- Switch the laser ON - Clean connectors - Ensure the fiber is plugged in correctly
Temperature trace too noisy	- Not a perfect connection - Dirty connectors - Large splice losses - Sharp bends or breaks in the fibre	- Clean connectors - Check raw data and find the fibre sharp bends / breaks - Re-splice fibre joints if necessary ***Note:*** *Typical connector loss is about 0.3dB and splice loss is 0.1dB or less.*
Temperature trace has different slopes	- Differing fibre types are joined together	- Check fibres used
Temperature trace exhibits step changes at fibre joints	- Dirty connectors - Large splice losses - Different types fibres	- Clean connectors - Re-splice fibre joints
DAQ timeout error	- Laser outside the operating temperature range	- Reboot system ***Note:*** *Contact Bandweaver if the problem persists.*
Fatal error	- Communication error	Reboot system ***Note:*** *Contact Bandweaver if the problem persists.*
No data being received from the FireLaser	- Communications warning indicated on the front page	- Try to Ping the system Start → run → cmd Ping 192.168.0.100 - Make sure network connection is enabled
Raw data is almost zero	- Laser is off	- Ensure that the laser switch is in the ON position

If any problem persists or if the user is unable to resolve it, please contact Bandweaver or an authorized distributor.

Please include the following information when requesting support:

1. Serial number of the product. This is located on nameplate on the rear panel of the product;
2. Full description of the problem and any troubleshooting measures already attempted;
3. Configuration of the product when the issue is experienced;

4. Data files while the issue is experienced. The data files can be found in the **data** subdirectory located in the **DTSCM2.exe** folder. The default path is **D:\DTSCM 2\Data.**

11 Installation, Care and Maintenance

The FireLaser system is designed to provide a low-cost monitoring solution for many years.

There are measures that the user can take to extend the life of the product and ensure trouble free operation of the DTS.

11.1 Connector Care and Maintenance

- Ensure all optical connectors are clean before mating and are tightened firmly.

  The E2000 optical connectors and couplings should be cleaned and/or inspected before attaching to the FireLaser system. Failure to ensure connectors and couplings are clean and free of foreign matter can severely compromise the performance of the system and may possibly damage the integral system connector.

  There are two methods for cleaning connectors and couplings which are approved by Bandweaver. The technique used is dependent on the type of contamination.

  Ensure the laser is off before cleaning any fibres. ⚠
  Do not use a connector with a broken or damaged flange cap. ⚠

  1. *If the connector has been exposed to slight dust contamination, the preferred method is using a 'cassette style' cleaning tape. When cleaning the connector, please wipe gently several times following the same direction.*

  2. *If the connector has been exposed to grease, lint free tissues wetted with alcohol or pre-soaked wet wipes should be used. When using pre-soaked wet wipes, excess residue should be removed using dry lint free tissues. When cleaning the connector, please wipe gently several times following the same direction.*

11.2 Fiber Optic Sensor Cable

- It is good practice to take a baseline reading of the fiber loss after installation. Periodic examination of the fibre loss can then be taken and compared to a baseline. This will help track any aging of the optical fibre.

11.3 Data Storage

- If data is being collected frequently, periodic examination of the hard disk will be needed to ensure sufficient free space. Excess data should be cleared before the hard disk reaches 95% capacity.

11.4 Annual Service

- Bandweaver recommends an annual service by a qualified Bandweaver engineer or authorized distributor.

  Please contact an authorised Bandweaver representative for further information.

  This manual only provides maintenance advice on the FireLaser system and sensor cable. It is not intended to be used for maintenance on other systems to which the FireLaser system is connected. Inspection, testing and maintenance shall only be carried out by experienced and qualified personnel.

12 Routine System Testing

Inspection, testing and maintenance shall only be carried out by experienced and qualified personnel.

It is important that false alarms are prevented during routine system testing. Ensure that automatic dialling facilities are inhibited for the duration of the fire alarm system test. The occupants of the premises should be notified of any test of the system that may result in the sounders being operated. Suppression systems should be inhibited from activation for the duration of the test.

All system devices and releasing components must be returned to their normal condition after completion of the system testing.

12.1 Quarterly Inspection and Test

The purpose of the visual inspection is to ensure that there have been no significant changes to the installation site, regarding its structure or from its environment or any other factor that may affect the system performance. The cables and control unit should be visually inspected for mechanical damage, or other conditions, likely to interfere with correct operation. Visual inspections are carried out upon initial system installation and handover.

Many of the applications for Bandweaver's FireLaser are such that the systems are installed in critical areas, which are difficult to access. In such cases, it is important that the equipment servicing is carried out during periods of approved shutdown.

12.1.1 Power Supply Check

The FireLaser has a nominal 24VDC input. The health of the power supply should be routinely checked. A voltmeter may be used to verify that the voltage is between 9 and 36 V dc. If a Mains Changeover unit it fitted, its operation should be checked. If a UPS unit is fitted, its operation should be checked. If there are any faults present, maintenance should be carried out in accordance with the OEM instructions.

12.1.2 Functional Test

One should consider the system design carefully prior to deciding the test regime. It is possible to have staged alarms from a single length of detection cable or in many other cases staged alarms are programmed between corresponding detection zones on different sections of cable.

Bandweaver recommend that at least one detection zone should be tested per quarterly visit.

The functional test is to be done using a heat gun on a low temperature setting (not exceeding 80°C). The alarm event should be verified on the main Fire Alarm Control Panel (FACP). The FACP operation should be verified by the designated equipment maintainer.

12.1.3 Optical Loss Test

Ideally every quarter some baseline raw Stokes and Anti-stokes data should be recorded for reference. The optical loss of all connectors and splices should be measured and compared with the previous quarter to see if there is any degradation of the connections.

12.1.4 Optical Power Test

The output signal power of the laser should also be tested by the measuring the lowest signal level of the Stokes data and the power level in the reference oven (between -30m to -5m).

12.2 Annual Inspection

Visual Inspection: same as per quarterly inspection.

12.2.1 Functional Test

As per quarterly inspection. In addition, a fixed temperature reference oven with test coils of fibre 30m to 50m in length should be measured with the FireLaser. The temperature of the test coils should be compared with the FireLaser temperature reading. The system is adjusted as necessary.

All FireLaser relay outputs and the audible sounder should be checked. This functional test is normally achieved by instructing FireLaser to output each relay sequentially. This test can be performed using the DTSCM2 software, please refer to DTS-CM-02-MAN-001 - DTSCM2 manual.

12.2.2 System Interrogation

The system shall be interrogated by a Bandweaver engineer using a proprietary software package that will allow history data to be uploaded from the control unit. This data contains information to be used by the manufacturer to examine the internal condition of the FireLaser system and therefore acts as an integral part of Bandweaver's preventative maintenance package.

13 Contacts

Please refer to the contact page of the following webpages for details to contact Bandweaver:

English: www.bandweaver.com

Chinese: www.bandweaver.cn

Or email us on support@bandweaver.com