

# DPS Wellhead Logger Product Manual

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# 1 INTRODUCTION

## PRODUCT DESCRIPTION

The DPS Wellhead Logger is a compact and robust interrogator for static measurement of Fibre Bragg Grating, (FBG) sensors. This Wavelength Division Multiplexing (WDM) instrument is based on an agile, tuneable laser source that enables high-resolution interrogation.

The DPS Wellhead Logger is available with 2 optical channels; multiple sensors can be multiplexed on each fibre without reducing acquisition speed or performance.

The DPS Wellhead Logger connects to a host PC using standard Ethernet and/or a Modbus client using Modbus/TCP.

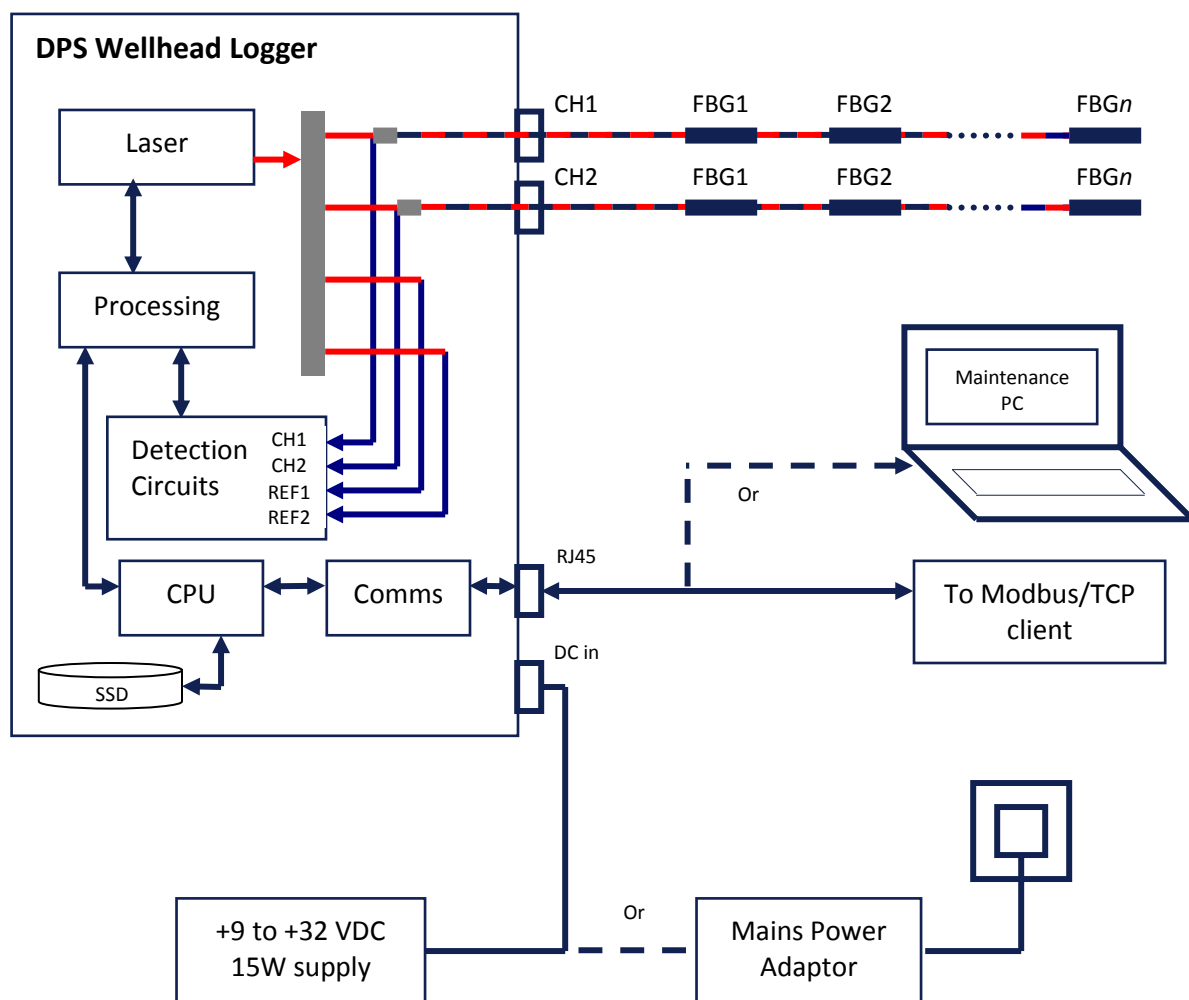


Figure 1. DPS Wellhead Logger System Diagram

## PACKING LIST

The DPS Wellhead Logger package should contain the following items as standard:



- DPS Wellhead Logger
- Rugged carry case
- Interface Installation Media
- Ethernet Cross-over cable
- Mains power adaptor and regional mains cable or DC power cable
- Cletop-S Fibre Optic Connector Cleaner

***If any items are missing please contact Smart Fibres or your local representative immediately.***

## 2 SAFETY INFORMATION

### SAFETY SYMBOLS

The following symbols may be present on the unit:

Symbol	Description
	Laser Safety. Refer to user manual for safety instructions for use.
	Refer to user manual for safety instructions for use and handling.

### LASER SAFETY

Applicable Standard:	EN60825-1 (Safety of Laser Products)
Laser Type:	cw
Laser Class:	1M
Max power:	2.5 mW
Wavelength:	1528-1568 nm

***Refer servicing only to qualified and authorised personnel.***

### CE COMPLIANCE

Applicable Standards:  
 EMC Directive 2004/108/EC  
 BS EN61326-1 *Electrical equipment for measurement, control and laboratory use. EMC requirements. 2006 edition*

### 3 SPECIFICATIONS

#### Specifications

Measurement and Processing	
Wavelength Range	46 nm (Approx. 1526 – 1572 nm)
Number of Optical Channels	2
Maximum Number of Sensors / Channel	16
Scan Frequency (all sensors simultaneously)	1 Hz
Wavelength Resolution <sup>1</sup>	0.05 pm @ 1 Hz
Wavelength Accuracy <sup>2</sup>	1 pm
Wavelength Stability over Operating Temperature Range <sup>3</sup>	1 pm
Polarisation Extinction Ratio <sup>4</sup>	< 1dB
Dynamic Range <sup>5</sup>	38 dB
Gain Control	9 levels, per channel or per sensor, automatic or user controlled
FBG Full Width at Half Maximum (FWHM)	> 0.2 nm, 0.5 nm recommended
Mechanical, Environmental and Electrical	
Dimensions (W x H x D)	310 x 175 x 55 mm / 12.2 x 6.9 x 2.16"
Weight	2 kg / 4.4 lb.
Operating Temperature <sup>6</sup>	-15 to +60 °C / 5 to 140 °F
Storage temperature	-40 to +85 °C / -40 to 185 °F
Comms Interface	Ethernet/TCP-IP Modbus/TCP
Data Connector	RJ45
Power Connection	via mains adapter or DC cable supplied
Optical Connector	FC/APC
Input Voltage	+9 to +32 VDC
Power Consumption	typ 8.5 W, max. 10 W
EMC Certification	Per BS EN 61326-1 edition 2006
Hazardous Area Certification (optional)	Per ATEX for hazardous zones 0, 1 or 2 with gas groups IIA, IIB or IIC <a href="#">Link to certification</a>

<sup>1</sup> Measurement distributions (1σ) when measuring a controlled artefact having recommended FWHM, during 16 hours. Maintained for up to 15 dB optical gain.

<sup>2</sup> Per NIST Technical note 1297, maximum wavelength difference when compared to NIST SRM 2519. Measurement with instrument at 25 °C

<sup>3</sup> Per NIST Technical note 1297, ed 1994, D1.1.3 Maximum wavelength variations over full temperature range. The measurand is NIST SRM 2519.

<sup>4</sup> Light is not polarised out of the instrument, therefore polarisation rotation cannot increase the measurement uncertainty

<sup>5</sup> Laser launch power minus detector noise floor.

<sup>6</sup> +60° as standard, +70° in development.

## 4 INSTALLATION

### MOUNTING DETAILS

The DPS Wellhead Logger can be used on a bench-top or may be wall or panel mounted using the 4 supplied mounting brackets with suitable screws on a 185 mm / 7.28" wide pitch. The bracket positions can be adjusted along the length of the enclosure allowing a pitch length of between 40 and 260 mm / 1.6 and 10". For wall or panel mounting it is recommended to avoid orienting the instrument with the connectors facing upwards in order to prevent the ingress of dirt and dust.

The slots in the brackets are suited for M5 or 3/16" size threads.

### OPTICAL CONNECTIONS

The DPS Wellhead Logger has 2 FC/APC connectors for connecting Single Mode Fibres. These are numbered from the left as CH1 and CH2. Observe the recommended connector cleaning practice described in the Appendices. Connectors should only be fastened finger tight, take care to correctly align the key-way when mating the connectors.



### ELECTRICAL CONNECTIONS

- A = RJ45 Ethernet Connector
- B = DC power Input
- C = Power light
- D = On/Off Switch

### SWITCHING ON THE DEVICE

Once the equipment has been connected as shown in Figure 1 the device is ready to be switched on using the power switch on the front panel. Move the power switch to the down position and observe the LED illuminates.

### SWITCHING OFF THE DEVICE

The device may be switched off by moving the power switch to the up position.

## 5 SOFTWARE INTERFACE UTILITIES

Included with the Installation media that ships with the DPS Wellhead Logger is a suite of interface applications. The DPS Wellhead Logger has a number of interfaces that can be used for reading measurement data, configuration and diagnostic purposes. A brief description of each is given below with more detailed descriptions presented in subsequent sections.

### INTERFACE OVERVIEW

#### Modbus/TCP

This is the primary interface for reading measurement data. Data is written to Input Registers starting at address 30001. All the data in Input Registers is in swapped floating point format in accordance with IEEE 754, or swapped long integer format, so each measurement value uses a pair of registers. The data that is written to each register is configurable, a map file is used to allocate registers to measurement data, the map file is stored on the interrogator's internal file system. In general the measurement data originates from the optical sensors connected to the instrument but some internally generated data such as on-board temperatures for system health monitoring are also available.

On-board averaging can be applied to the Modbus data, the number of samples to average is configurable.

#### TCP/IP

This interface is used to obtain a spectrum from a selectable source channel. This can be used for set-up, commissioning and diagnostic purposes. The TCP/IP interface also provides an alternative for reading measurement data.

#### HTTP

This interface is used to display status information and allows some basic configuration via a web browser.

#### SCP

This interface allows browsing of the instrument's internal file system and download and upload of configuration and data files. The more complex configuration tasks are achieved using configuration files which can be downloaded, edited and then uploaded again. The SCP interface can also be used for upgrading the instrument's on-board software.

### INTERFACE TOOLS OVERVIEW

#### Modbus/TCP client

A client application is not supplied with the interrogator but any off-the-shelf Modbus/TCP client application can be used. Smart Fibres have experience of using Modscan32 from WinTech. The connection should be configured with the IP address of the interrogator and TCP Port 502.

#### DPS Diagnostic Tool

Smart Fibres provides a Diagnostic tool which uses a combination of TCP/IP and Modbus/TCP interfaces, the diagnostic tool is a software application that can run on PC with a Windows operating system. The PC must be connected to the interrogator via the LAN connection. Its primary function is to display a graph of the optical spectrum of the interrogator which is invaluable in monitoring the condition of the gauges and interconnecting fibre optic cable.

As a secondary function Sensor values are displayed on a graph and in a table. The sensor values can also be saved to a file on the host PC.



### **Web Browser**

The user may make a connection to the interrogator using the web browser on a PC. The PC must be connected to the interrogator via the LAN connection. Some general status information can be viewed and some basic user level configuration parameters can be accessed.

### **WinSCP**

Smart Fibres provides this 3<sup>rd</sup> party software tool to make use of the SCP interface. WinSCP allows maintenance personnel to browse the interrogator's internal file system. The primary function would be to retrieve data and spectra files from the interrogator, these are recorded at regular intervals. The spectra files provide a history of the condition of the gauges and the data files could be useful in the event of any loss of the primary communications with the customer's infrastructure.

## **6 DPS DIAGNOSTIC TOOL – DETAILED INSTRUCTIONS**

### **INSTALLATION**

The host PC must run a suitable Operating System, this manual covers installation on a PC running Windows XP, Vista or 7.

To install the software on the host PC navigate to "setup.exe" on the CD and follow the instructions that appear during the install process. The installer will also install National Instruments' LabVIEW™ Run Time Engine (RTE). It will then place a short cut in the Windows Start Menu (under the Smart Fibres program group) and on the Desktop.

### **PREPARING FOR USE**

After installing the DPS Diagnostic Tool, connect the supplied Ethernet cross-over cable between the host PC and Interrogator. The PC's network connection must be configured to a suitable subnet; by default the IP address is 10.0.0.150 and its Net mask is 255.255.255.0. Although if the customer has supplied a static IP address and subnet mask the interrogator will have been pre-configured with these. (see appendix 7.1 for further details or contact your network administrator for assistance).

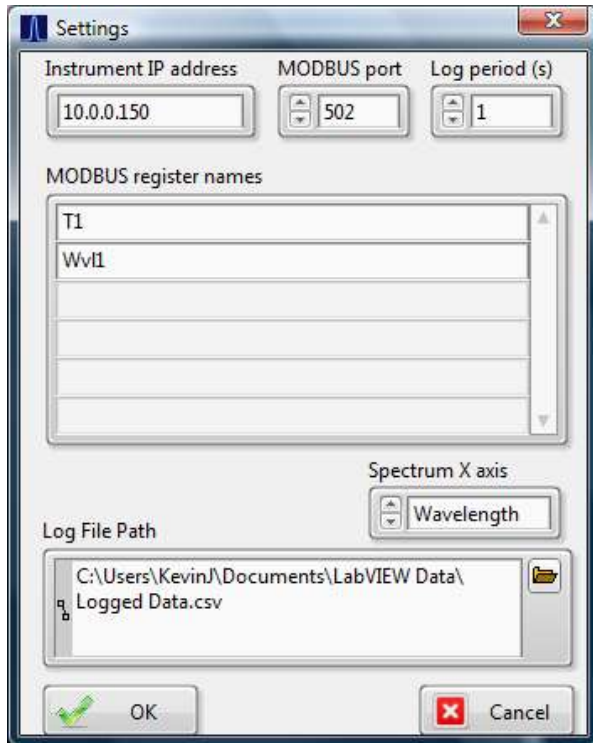
If the interrogator is not already powered it should be powered now. The interrogator can be powered directly from a DC supply, in which case the DC supply must be in the range +9 to +36V and capable of supplying 15W of power. It may also be powered from the optionally supplied Mains adaptor.

When the supply is switched on observe that the Power LED illuminates, to indicate the presence of supply voltage allow a few seconds for the unit to be ready for a host PC connection. FBG sensors can be connected to the Interrogator at any time.

## STARTING THE DPS DIAGNOSTIC TOOL

On the host PC Navigate to the Smart Fibres > SmartSoft short-cut on the Windows Start Menu and start the DPS Diagnostic Tool program.

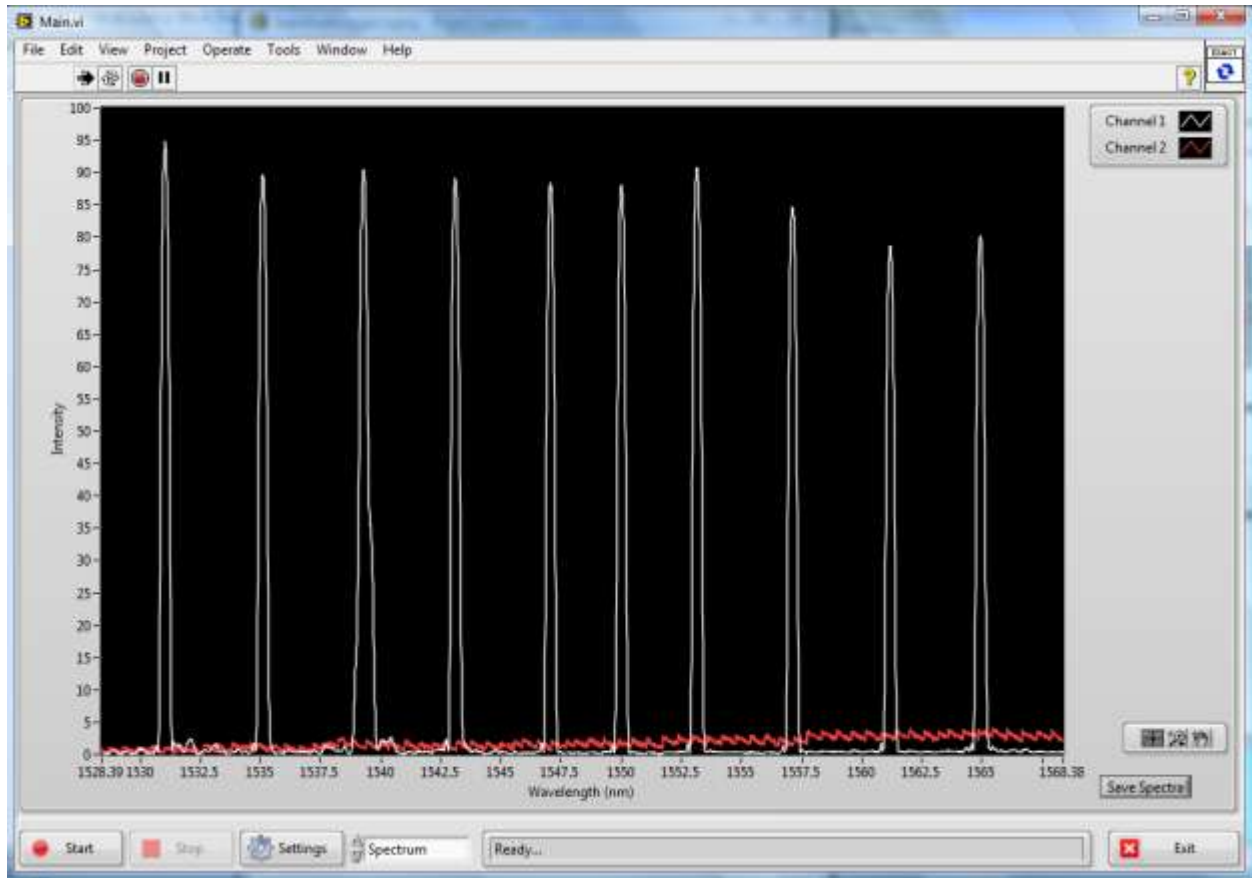
On starting the programme a settings dialogue panel will be displayed, similar to the following image.



The Settings panel gives the user the opportunity to set the IP address of the interrogator to communicate with. If this does not need to be changed just press cancel, the other settings can be changed later if desired. Otherwise edit the IP address as required but note that the host PC's IP address must be within the compatible address range (see Appendices for guidance on Host PC IP address settings and if necessary contact your local network administrator for assistance).

If the program successfully connects to the interrogator then the spectrum data from the interrogator will be displayed, similar to the following image.

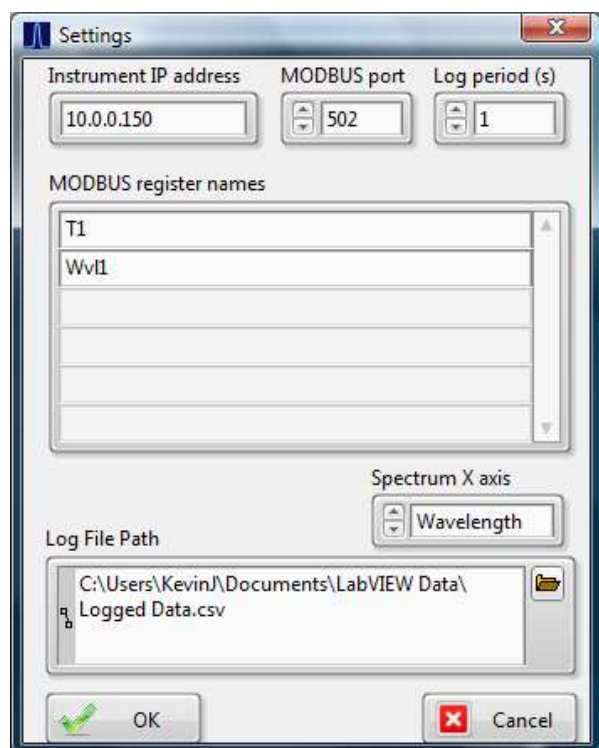
## CONTROLS AND INDICATIONS



Any FBGs connected to Channel 1 will appear as peaks on the white trace and any FBGs on Channel 2 will appear as peaks on the red trace.

### Settings

Click on the settings button to open the Settings dialogue panel, shown below.



The interrogator's default **IP address** appears at the top.  
The **Modbus port** should not be changed from 502.

The **Log period** sets the interval for recording sensor values to a file on the host PC. It is actually the interval between sending Modbus requests to the interrogator. 1 second is the default value but a large number of registers are being read it might take longer than this to retrieve all the data.

The **Log File path** control allows the user to select the file location when saving sensor values to the host PC.

The **Modbus register names** is a list of the values reported in modbus registers, starting at address 30005. The number of names listed should not exceed the quantity of Modbus data written to the interrogator's Modbus registers otherwise a Modbus exception will be generated when the diagnostic tool attempts to read the registers. An additional timestamp **TIMESTAMP\_SEC** is written to address 30001 and **TIMESTAMP\_NSEC** is written to 30003, these parameters do not need to be included in the list of Modbus Register names but are used to provide Time values for the x-axis of the data graph. The Modbus map file that is stored on the interrogator must contain entries for **INTERNAL\_TIMESTAMP\_SEC** and **INTERNAL\_TIMESTAMP\_NSEC** in the first two entries for use with the DPS Diagnostic tool, otherwise the time x-axis will not display correctly.

The **Spectrum X axis** control allows the user to select which units are used on the x-axis of the spectrum graph. The laser in the interrogator is tuned to 4000 discrete output frequencies, the user may select whether to view spectral output as Frequencies in (MHz), Wavelengths in nm, or Tuning step numbers. Tuning Step should be selected when viewing or adjusting Gain Slots in the Web Browser interface (described later). Note when switching to Wavelengths the data order is reversed on the x-axis compared to Frequency and Tuning Step.

Click **OK** to apply any changes, or press **cancel** to discard them.

Settings made in the dialogue panel are saved to file on the host PC.

### **Spectrum / Data** selection

The user may select to display spectral information on the graph or the sensor values. When Spectra data is displayed a snapshot of the data may be saved by pressing the Save Spectra button in the bottom right corner. This opens a dialogue panel where the user may choose a folder path for saving a spectra file.

When Data is selected the sensor data is displayed over time. By default the amplitude scale on the Y-axis is auto scaled, to zoom in on a particular sensor value first right click near the Y-axis and deselect AutoScale, then edit the max and min axis values as required. To zoom out again right click again near the Y axis and select AutoScale.

The Sensor data may be recorded to file by pressing the **Start** button, recording is ceased by pressing the **Stop** button. The file will be recorded to the file path that was selected in the Settings panel.

When Sensor data is displayed on the graph the sensor values are also displayed in the Modbus values table on the right hand side. If there are more than 10 values use the scroll bar to view them.

To exit the DPS Diagnostic tool press the **Exit** button.

## 7 WEB BROWSER TOOL – DETAILED INSTRUCTIONS

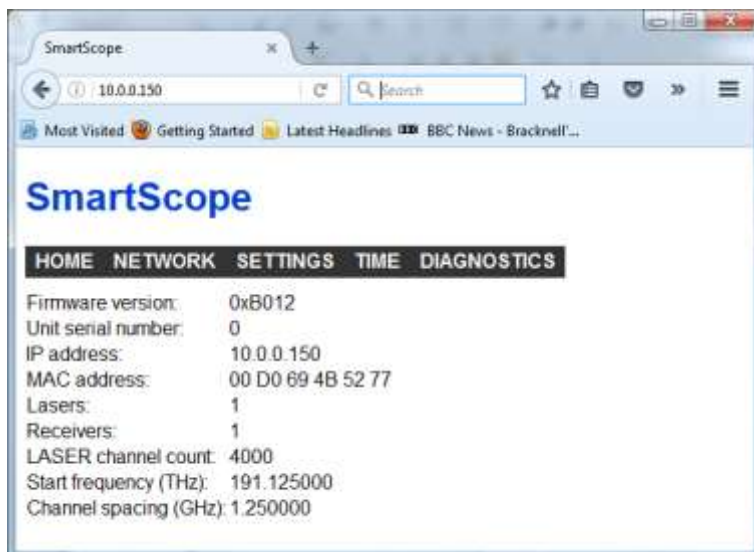
The existing interface is implemented as pages on a webserver that is hosted on the interrogator as part of the Linux operating system. Pages are coded using html. The user just needs a PC with a web browser to access the pages.

The interrogator must be connected via LAN to the host PC, details of this can be found in the SmartSoft user guide.

Once the interrogator is connected via LAN simply open a web browser and enter the interrogator's IP address as the URL.

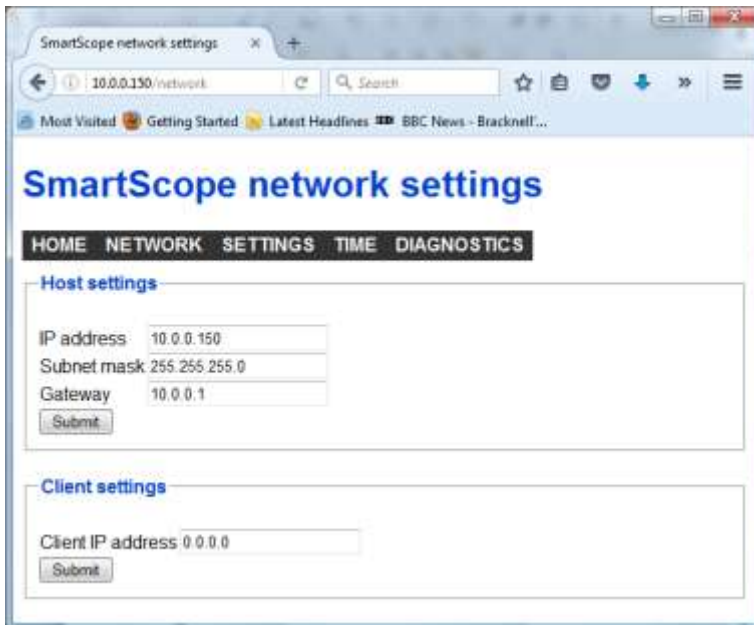
On all pages with user configurable parameters changes are made by overwriting the existing settings and then pressing a submit button.

### Home Page



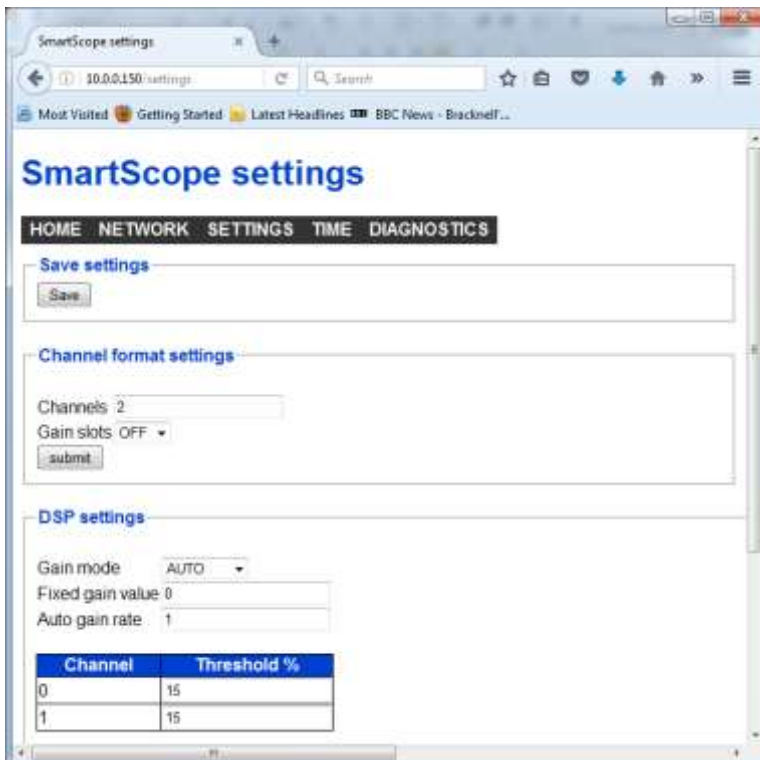
Some basic identity information is displayed here, there are no user configurable fields.

## Network Page



The user may view and change the IP settings on this page. Care should be taken to avoid losing track of the IP settings of the interrogator which might result in not being able to communicate with the instrument. There are further details of IP address settings in section 6.2 “Preparing for Use” and in the Appendices. The Host settings in this case are for the interrogator. The client settings are not usually used. If the IP address of the interrogator is changed, the IP address in the Modbus01.map file also needs to be changed, this is described in the Configuration Files section of this manual.

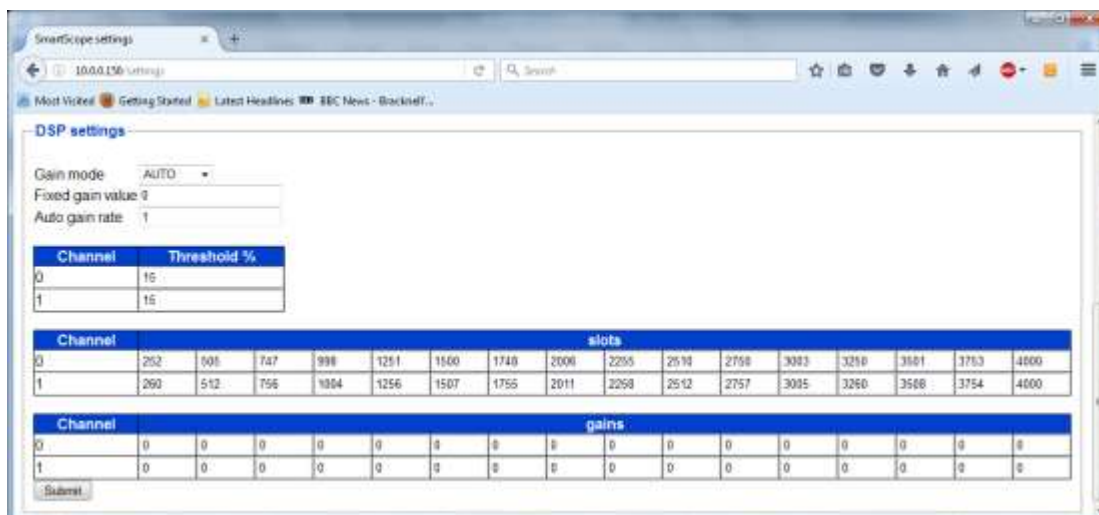
## Settings Page



Channel	Threshold %
0	15
1	15

The settings page contains all of the controls needed to configure the Gain on each channel of the instrument. Gain can be applied on a per channel basis, whereby one gain level is applied to signals from all the FBGs present on a channel or on a per FBG basis, whereby an individual gain level is applied to each FBG. In order to apply per FBG gain the user must first configure a portion of the spectrum in which the FBG is to operate, the gain will be applied to all light received in that portion of the spectrum (regardless of whether an FBG is present or not). To apply per channel Gain set Gain Slots to OFF, to apply per FBG gain set Gain Slots to ON. Press Submit to apply the change.

All FBG peaks that breach the Threshold setting will be recognised as a valid FBG peak, the default threshold value is 15 %, but this can be adjusted if necessary to allow smaller amplitude signals to be measured or to ignore unwanted signals being counted as valid FBGs.



The screenshot shows the 'SmartScope settings' window. Under 'DSP settings', 'Gain mode' is set to 'AUTO'. Below it are fields for 'Fixed gain value: 0' and 'Auto gain rate: 1'. There are three tables:

Channel	Threshold %
0	15
1	15

Channel	slots															
0	252	505	747	998	1251	1500	1748	2006	2255	2510	2758	3003	3250	3501	3753	4000
1	260	512	756	1004	1256	1507	1755	2011	2259	2512	2757	3005	3260	3508	3754	4000

Channel	gains															
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

A 'Submit' button is located at the bottom left of the settings area.

On the lower part of the settings page is a table for dividing up the spectrum into slots and another table to set what gain level is applied to each slot.

The Gain Mode can be set to Auto, Manual or Fixed. In Auto mode the gain will be set automatically such that the largest amplitude signal will be maintained between 50 and 95 % (See details of the Spectral graph in the Diagnostic Tool Section x). If using per channel Gain (Gain Slots OFF), then the gain will be set such that the largest signal amplitude on the whole channel is maintained between 50 and 95%. Note if there are large variations in the amplitudes between FBGs on the same channel it may not be possible to read all FBGs using one Gain level, in which case Gain Slots should be used.

If using per FBG Gain (Gain Slots ON) then the gain for each slot will be set so that the largest amplitude signal within the slot is maintained at an amplitude of between 50 and 95%.

Should the optical signal amplitude change over time for any reason the Gain will automatically be increased or decreased accordingly.

The Gain mode can also be set to Manual. In manual Gain the user sets the Gain level to a value between 0 and 8, the gain will not change if the FBG amplitude changes over time. In most cases Auto Gain is recommended.

### Setting Gain Slots

The DPS Diagnostic Tool should be used in parallel with the Web Browser interface. The Spectrum x-axis should be set to Tuning Steps (see Spectrum x-axis in section 6.3). When viewing the spectrum the user should aim to set the Gain slot boundary midway between adjacent FBG peaks. For each mid-point observe the approximate step value on the x-axis, then enter these in the slots table in the web browser. The left



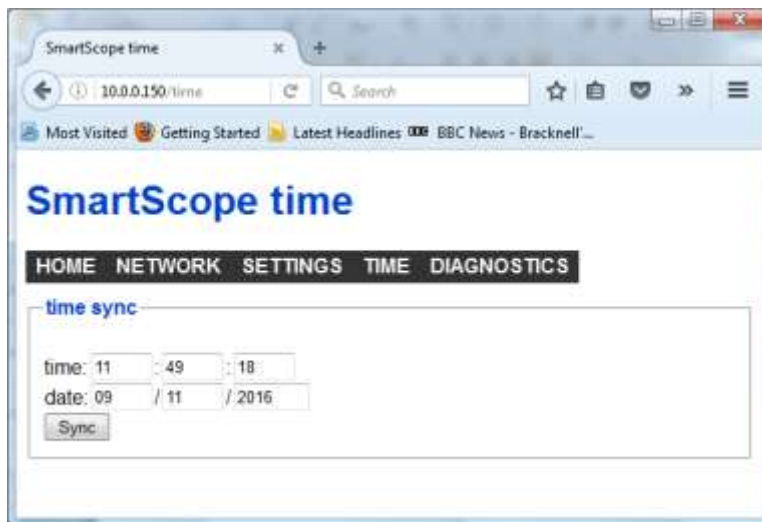
most entry in the table should not be 0 or to the left of the first FBG peak. The last slot boundary value should be 3999, up to 16 slots can be set up per channel, if fewer than 16 are needed then set all remaining slot boundaries to 4000.

If using Manual Gain now set the gain level for each slot in the Gain table, in Auto Gain mode these values are ignored. If using Manual Gain on a per channel basis the gain is set in the left most entry in the Gains table. The value can be set between 0 and 8.

### Saving Changes

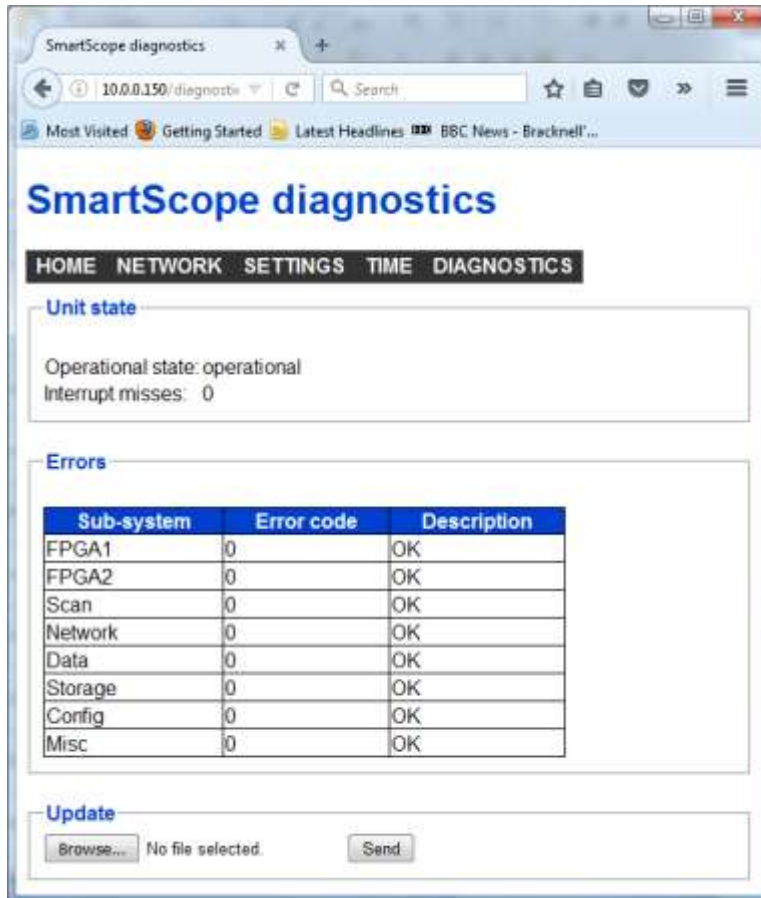
If any values on the settings page are changed press the Save Settings button at the top of the page, this ensures the new settings are stored when the interrogator is switched off.

### Time Page



The time page shows the interrogator's current date and time, although the page will need to be refreshed to update the display. The time and date fields can be edited and then pressing the Sync button will update the interrogator's time accordingly.

## Diagnostics Page



The Diagnostics page gives some information about the status and health of the interrogator. Any Error codes here can be reported to Smart Fibres support team in the event of a system malfunction.

There is also a facility to perform an update to the interrogator's firmware, if an update is required Smart Fibres support team will provide the update file and further instructions.

## 8 WINSCP – DETAILED INSTRUCTIONS

WinSCP is a utility for browsing the interrogator's internal file system and transferring files between interrogator and host PC. WinSCP is a third party application and is available as a free download from <https://sourceforge.net/projects/winscp/files/latest/download> but may also be included on the installation media supplied with the interrogator.

Some instructions on using this particular application are detailed in the remainder of this chapter.

### INSTALL THE WINSCP PROGRAM

Follow the on-screen installation instructions.

When requested select "Typical" Installation and choose the "Commander" style.

### RUN WINSCP

Select New Site and use the settings shown below,

File Protocol = SCP

Host name = the IP address of the interrogator, the default IP address is shown below

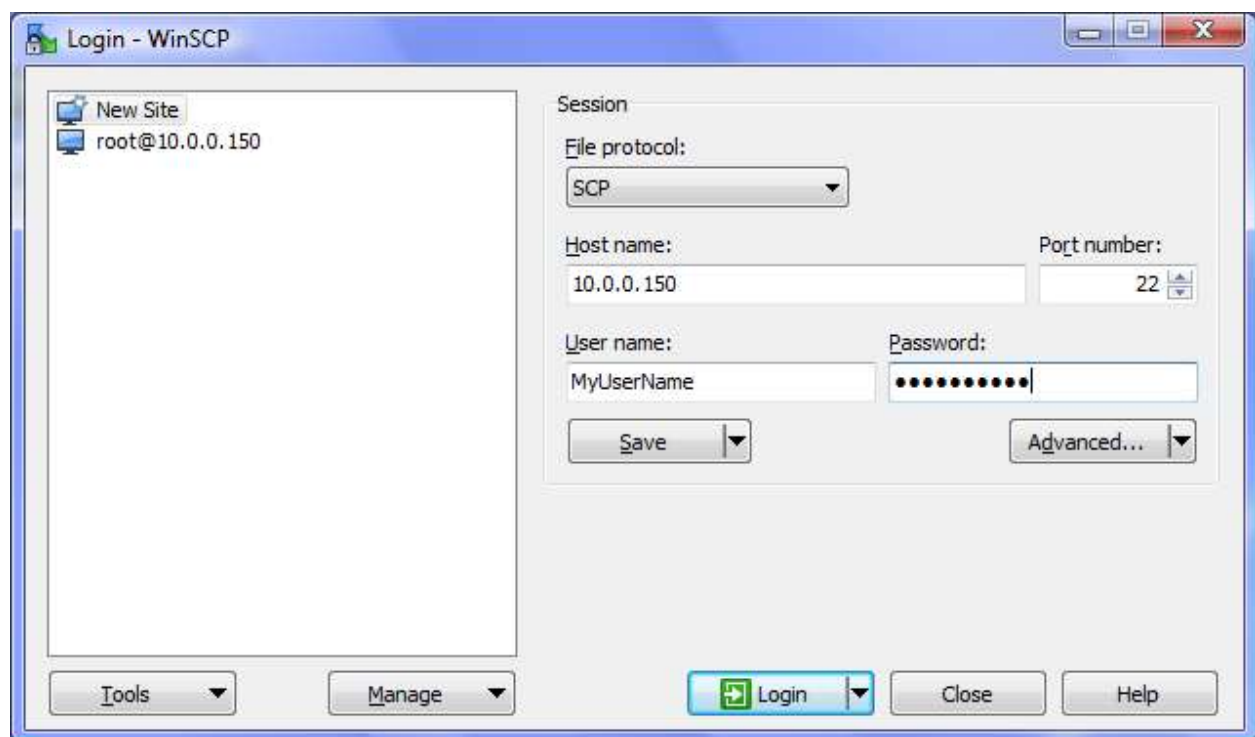
Port number = 22

User name = *[Enter the user name supplied by Smart Fibres]*

Password = *[Enter the password supplied by Smart Fibres]*

You can optionally save these settings for later use by pressing the Save button,

To open the connection press "Login"



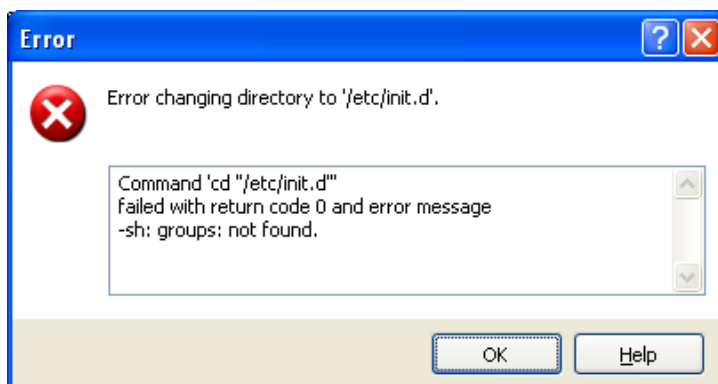
You may see a warning message like:



You can either Update the key or Skip.

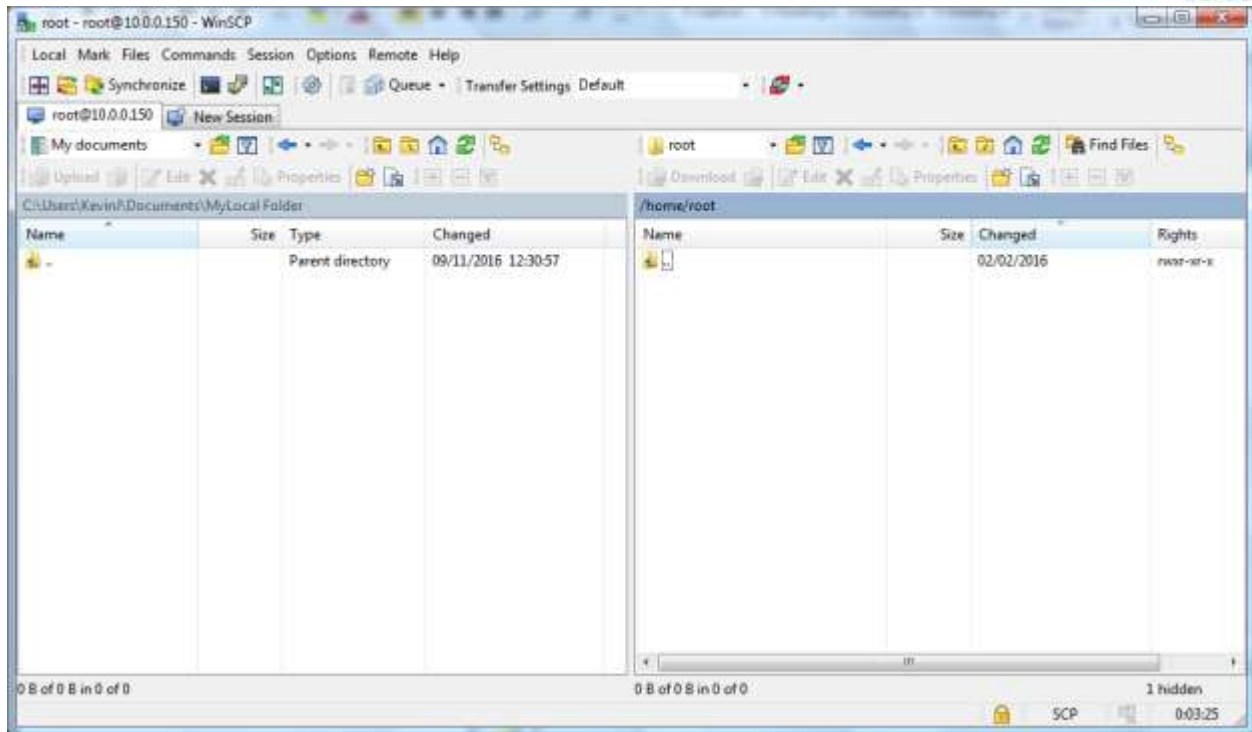
If a password is requested, enter it again.

You may see an error like:



Just click "OK". You can prevent this in future by disabling "lookup user groups" in the advanced site settings and saving the site details.

WinSCP should now open as shown below.



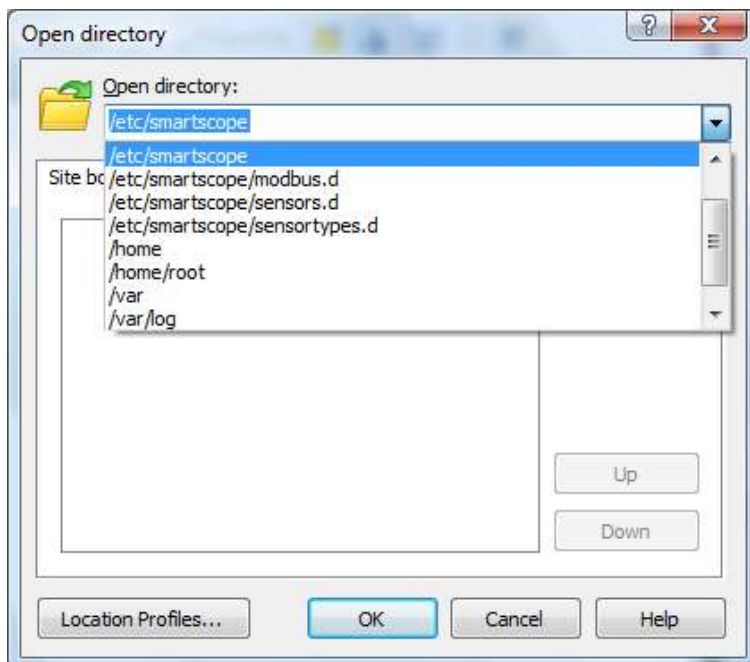
The file browser on the left side will be a folder on the host PC, the file browser on the right side will be the home folder of the User account on the interrogator.

On the host PC navigate to a suitable folder where files can be transferred to.

The folders of interest on the interrogator's file system are:

**/etc/smartscope** and **/var/log/smartscope**

It can be useful to use the Open Directory button on the interrogator side as previously opened folders can be selected from a dropdown list.



The interrogator's configuration files are stored in `/etc/smartscope`, these can be viewed, downloaded to the host PC, edited or replaced.

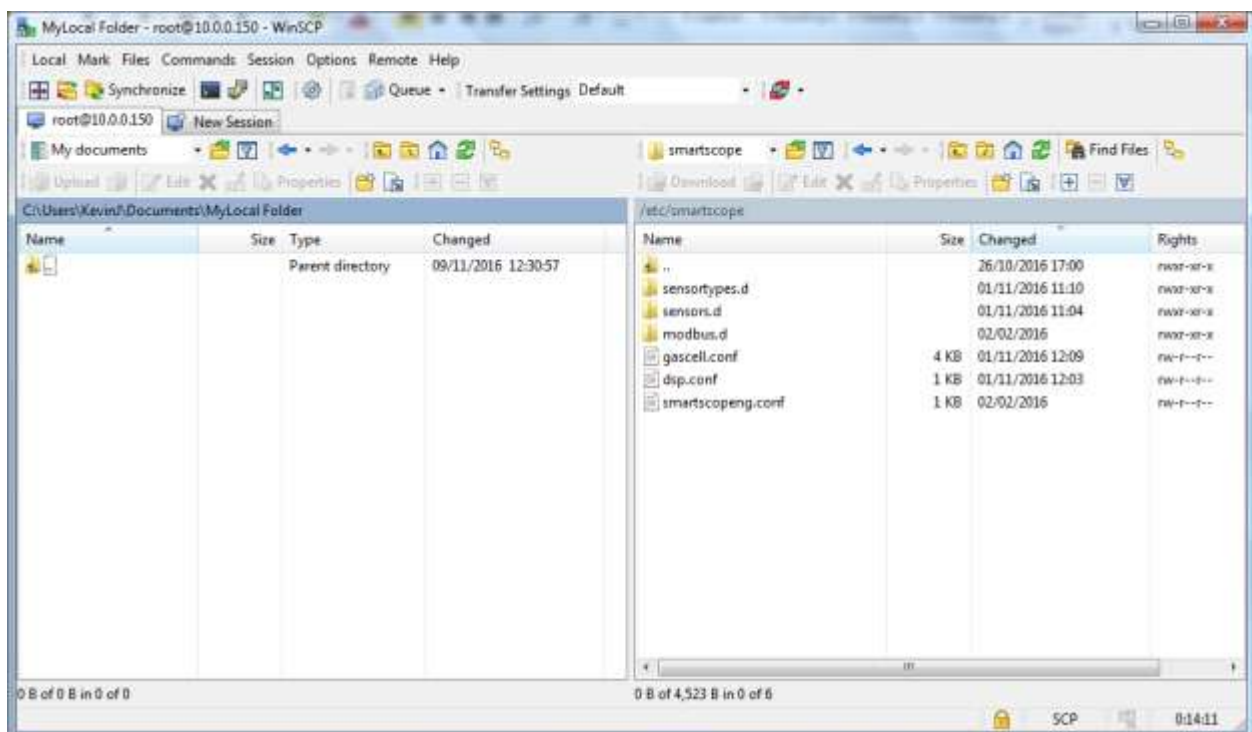
Best practice is as follows:

Download a copy of the file to the host PC, right click the file on the interrogator and select Download.

On the host PC back up the current version by making a copy and changing its file name to e.g. `CurrentFilename_YY-MM-DD.ext`

Edit the downloaded file as desired and save it. The file should be edited using WinSCP's editor which opens by default when any text file within its file browser windows is double clicked. Other editors may be used but they must recognise Unix style line endings, one such editor is Notepad++. Using other editors may corrupt the file.

Right click the file on the host PC and select upload be sure that the original filename is not altered.



## CONFIGURATION FILES

The subfolders beneath `/etc/smartscope` are used as follows:

`Sensortypes.d` is used to store sensor type definition files. The interrogator has the most common sensor types built-in but Smart Fibres or the user may create custom sensors types to perform different functions or adapt the algorithm used for an existing type of sensor. The naming convention for Sensor Type definition files is `measurand.lua`, e.g. `linear_displacement.lua`, each file defines a single sensor type and there can be multiple sensor type files.

`Sensors.d` is used to store a sensor configuration file, the file must be named `sensors.conf`.

All sensors that are to be connected to the interrogator must be defined in this one file.

The names of FBGs, coefficients and sensors used within the file will depend on the sensor type being defined and are determined by the sensor type definition file.

Modbus.d is used to store Modbus map files, that is a file which allocates sensors to Modbus registers. All outputs are 32 bit big-endian floats or long integers and so take up 2 Modbus registers with the high word in the low register. The first entry in the list will be allocated to Modbus address 30001 & 2 and subsequent entries will take pairs of registers in numerical order. Sensors are referenced by their names as declared in the sensors.conf file. The file may also contain some “internal” sensors for monitoring values such as internal board temperatures. At the top of the file is an entry for the IP address, this must be set to match the IP address of the interrogator.

It is best if there is only one Modbus map file and the naming convention is modbus\_01.map. It is possible to create multiple Modbus map files but each will need a unique port number, the usual port number for Modbus is 502.

## LOG FILES

In the /var/log/smartscope folder there may be various log files depending on how the logging has been configured.

Pdo.log records all the sensor values every 3 hours.

Spectra.log is the most recent spectra on all channels, it is logged once every 24 hrs, previous spectra files are zipped and named with an incrementing number.

Modbus\_01.log is a log of modbus register values, the data is formatted as Hexadecimal, the logging interval is configured in the Modbus map file, a value of 0 disables modbus logging.

It is also possible to log sensor data by setting the log period in the sensors.conf file to a value other than 0. If logging is enabled the log file will appear in the /var/log/smartscope folder and be named sensors.log.

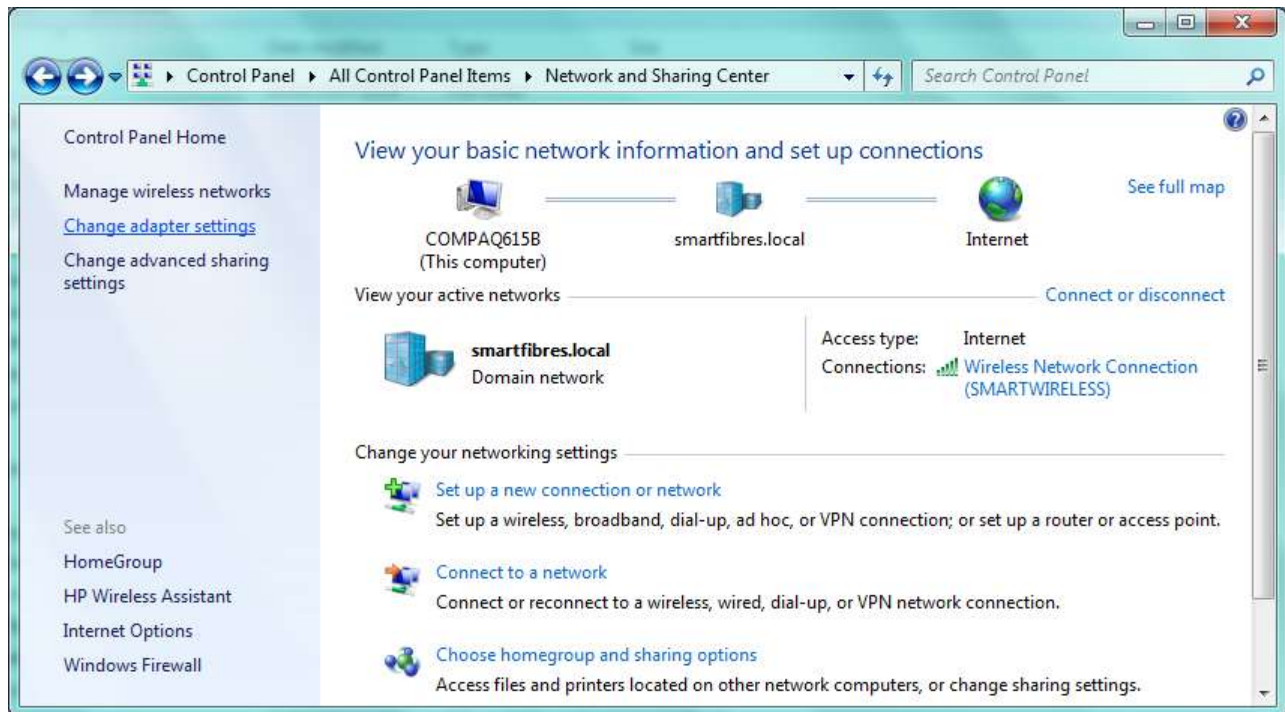


## 9 APPENDICES

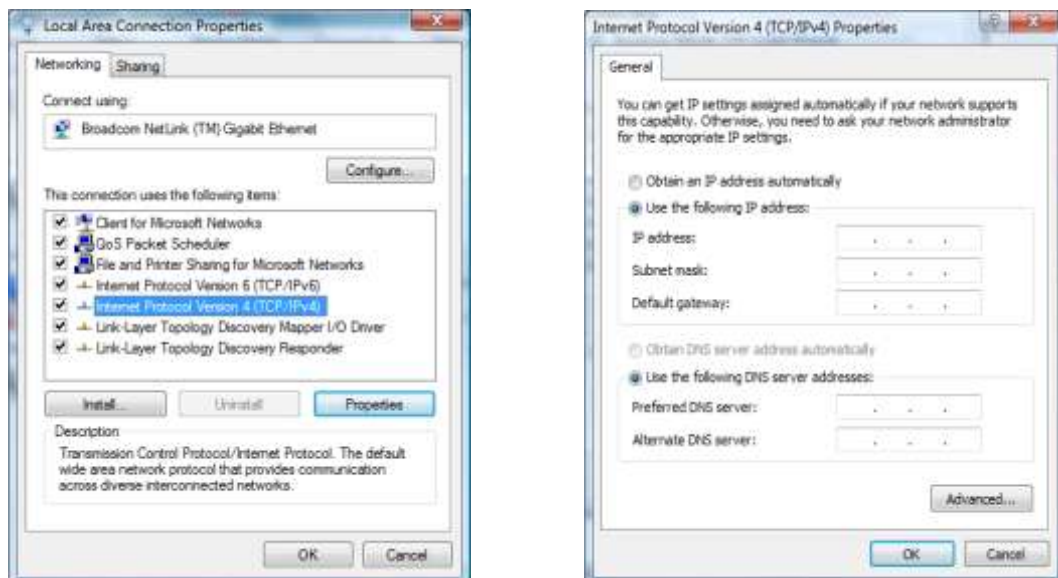
### IP ADDRESS SETTINGS OF HOST PC

#### 9.1.1 Windows 7

Click on the Start Bar and select Control Panel, select “Network and Sharing Centre”.



Select “Change adapter settings”, Right Click on the Local Area Connection and select “Properties”



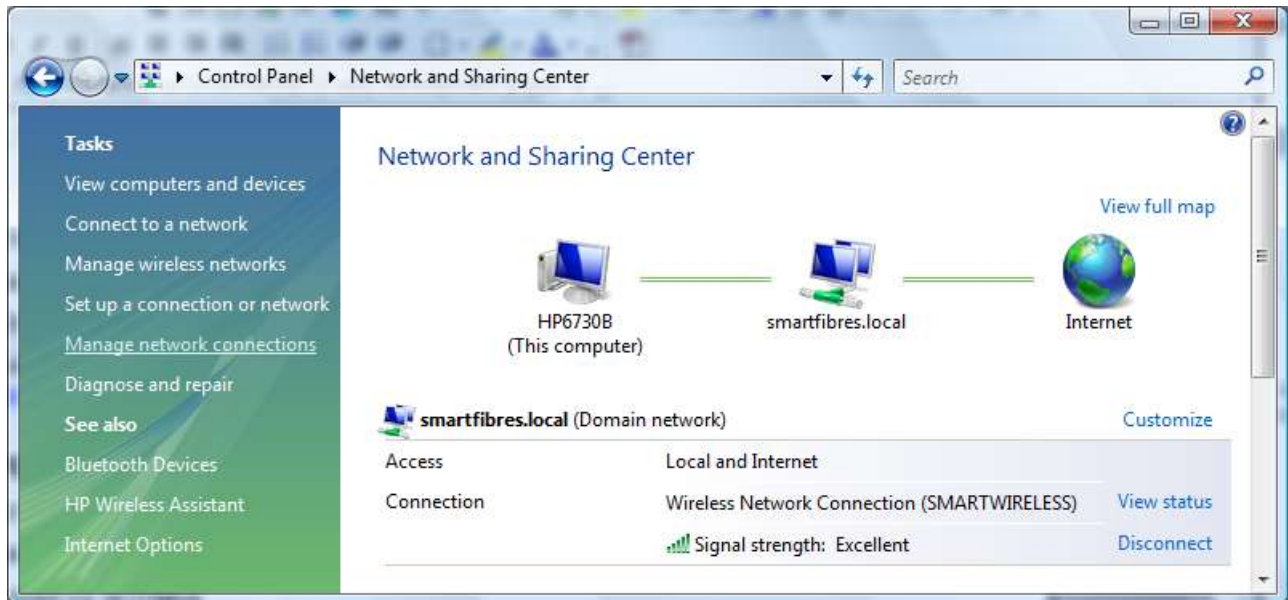
Select “Internet Protocol Version 4” and click the “Properties” button. Select “Use the following IP address” and enter the desired IP address and Subnet Mask to suit SmartScan. Click OK to save settings.

After using SmartScan, to reconnect to a Local Area Network select “Obtain an IP address automatically”.

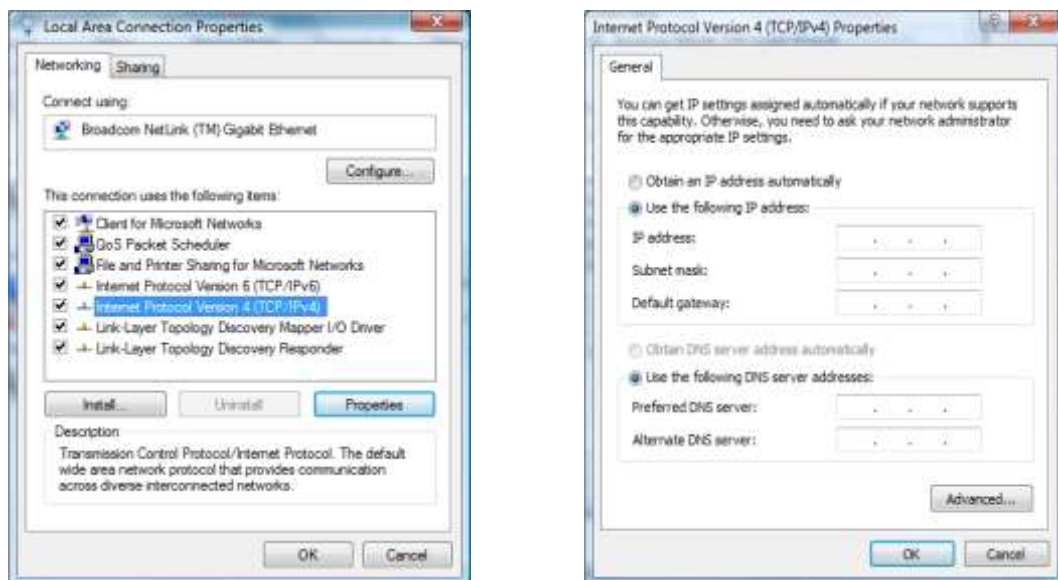


### 9.1.2 Windows Vista

Click on the Start Bar and select Control Panel, select “Network and Sharing Centre”.



Select “Manage Network connections”, Right Click on the Local Area Connection and select “Properties”

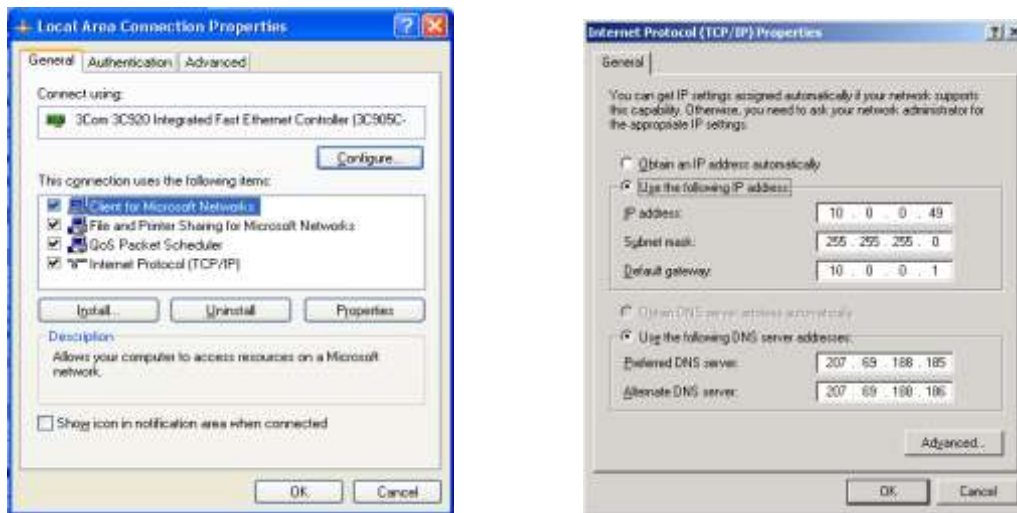


Select “Internet Protocol Version 4” and click the “Properties” button. Select “Use the following IP address” and enter the desired IP address and Subnet Mask to suit SmartScan. Click OK to save settings.

After using SmartScan, to reconnect to a Local Area Network select “Obtain an IP address automatically”.

### 9.1.3 Windows XP

On a Windows XP machine, click on the Start Bar and select “Control Panel.” Click on the icon entitled “Network Connections” to open. When open, highlight the “Local Area Network” selection, right click, and choose “Properties”.



Highlight the “Internet Protocol (TCP/IP)” entry and click “Properties”. You will then have access to change the IP address and Subnet mask to suit SmartScan. Click “OK” to save settings.

After using SmartScan, to reconnect to a Local Area Network select “Obtain an IP address automatically”.

## MAINTENANCE

### 9.1.4 Optical Connector Cleaning

The use of optical fibre connectors requires some care if good results are to be obtained. The core of the fibre is very small, typically 8 to 9 micrometres in diameter and even the smallest dust particles, lint fibres or smears of oil can obscure it and cause optical losses. Scratches and chips in the highly-polished end face of the fibre also result in poor quality, unreliable connections. Therefore, it is important to develop good habits for handling and cleaning connectors. Ideally, both sides of a connection should be inspected and cleaned before mating.

Connector tips can easily be damaged by hitting a hard surface. This can be avoided by always keeping the plastic cover in place when not using or cleaning the connector.

A brief guide to good practise is given here. The interested reader will find further information from Industry bodies. There are also some useful proprietary standards in the public domain, for example:

- AT&T: document ID ATT-TP-76461
- Cisco: document ID 51834
- JDSU: document ID IBYC – Fiber Inspection, Cleaning & Test

Note: These documents are identified for information only. No connection between any of the named companies and Smart Fibres Ltd is intended or should be implied.

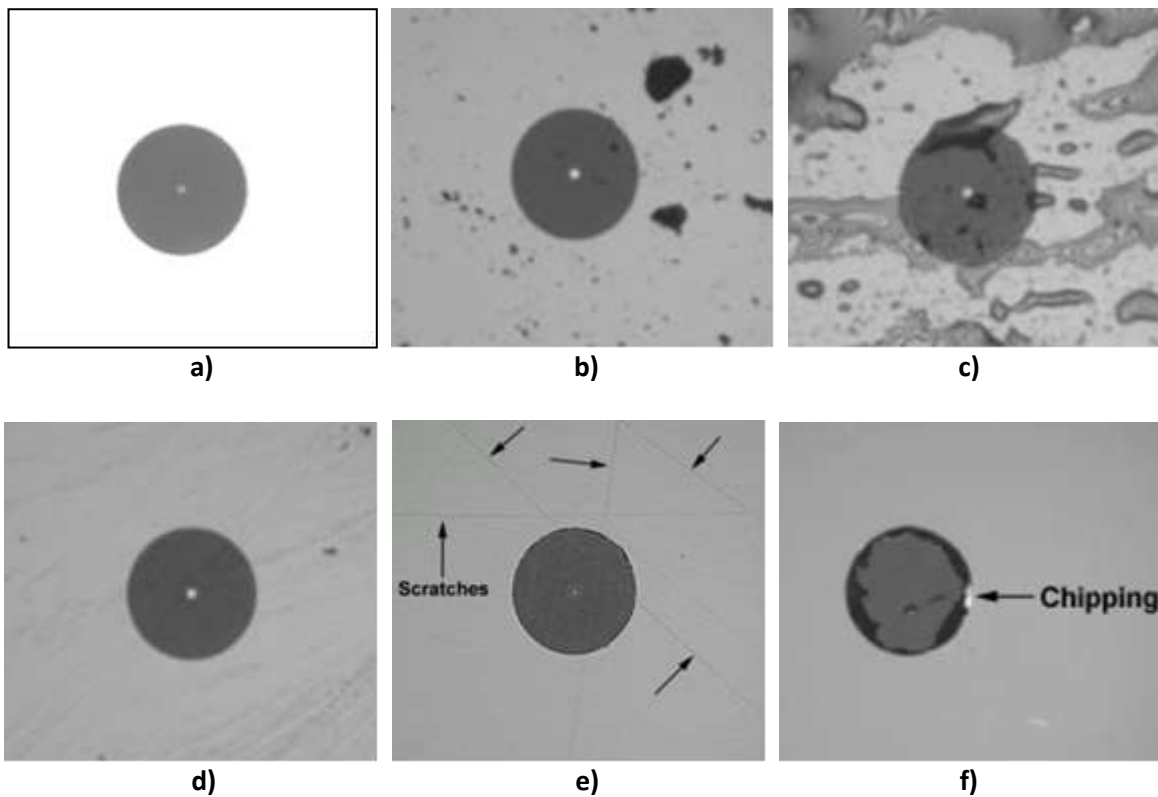
We understand that the first time user of a Smart Fibres product may not have all the correct equipment to hand but cleaning and inspection tools are relatively inexpensive and help to ensure continued correct operation of the interrogator. The regular user should make an effort to acquire them and learn how to use them effectively. The Interrogator is shipped with a Cletop-S Fibre optic connector cleaner, which facilitates dry cleaning (see sections 5.1.2 and 5.1.5).

Some or all of the operations described below may be required to ensure that the fibre-optic connection is free from contaminants. The order of operations is given in Section 9.1.8, 'Cleaning Flowchart'.

### 9.1.5 Inspection

It is highly desirable to inspect the end-face of connector ferrules (the white ceramic part) before mating them, to ensure that they are clean and undamaged. If no inspection means is available, you may skip this stage and proceed to a dry cleaning step, but be aware of the risk of making lossy connections by mating ferrules that may be contaminated or scratched.

Remove the protective cap from the connector ferrule. Insert the connector into the fibre inspection microscope and examine the end face. If the connector is of an angle-polished type, it may be necessary to rotate it in order to see the end of the fibre clearly. Bulkhead connectors, such as those in the front face of a Smart Fibres interrogator, can only be inspected using a fibre video microscope with a suitable adapter. Typical views of a ferrule end-face are shown below:



- a) Clean fibre end-face, ready for mating.
- b) Dust particles on connector. Cleaning needed.
- c) Liquid on connector. Cleaning needed.
- d) Oily streaks on connector. Cleaning needed.
- e) Connector is clean but has scratches. This is acceptable as there are no scratches on the fibre core. Ready for mating.
- f) Fibre cladding is chipped. A small amount of chipping is acceptable but this connector should be replaced.

#### 9.1.6 Dry cleaning

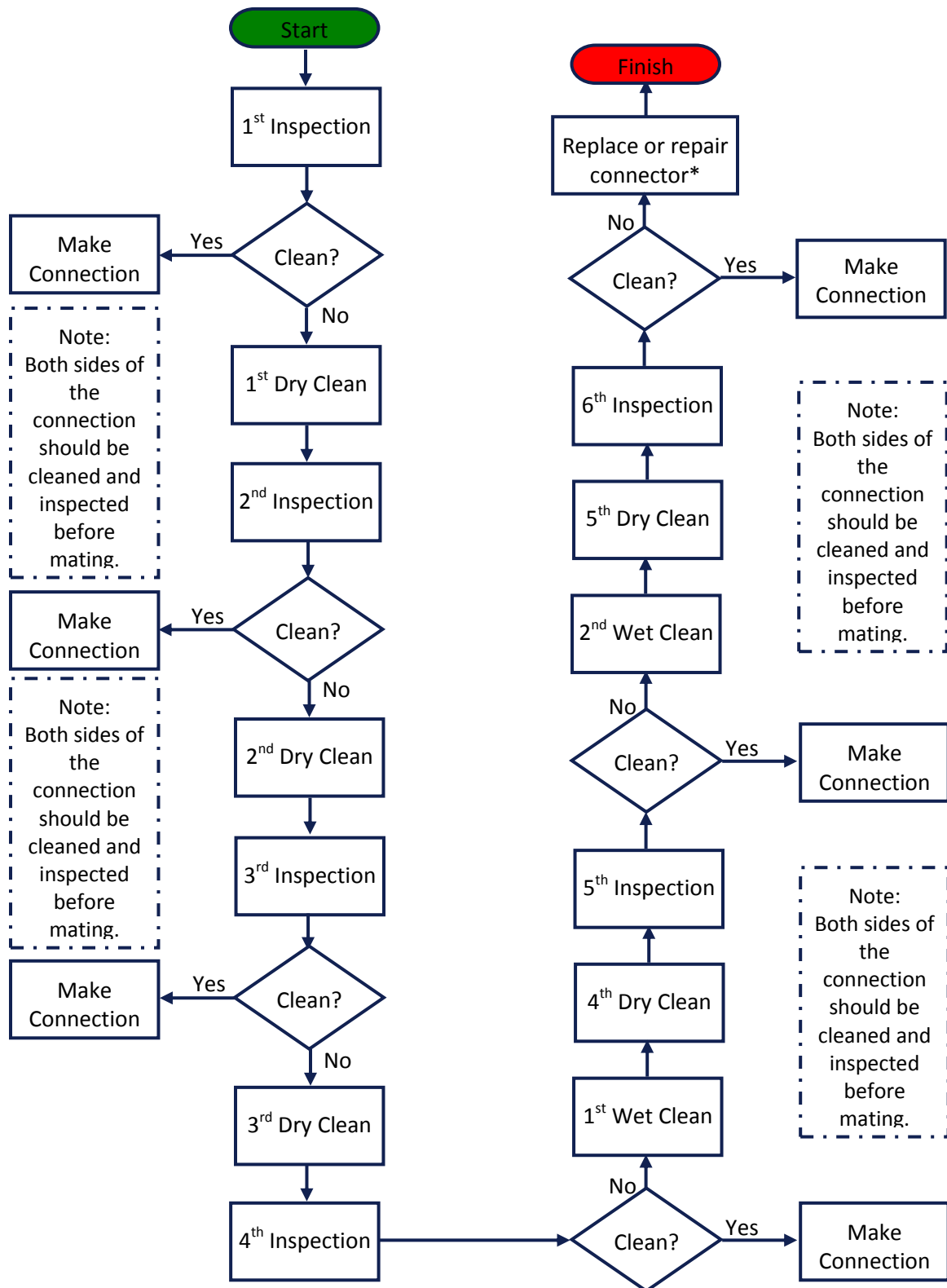
Dry cleaning involves wiping contaminants from the connector end-face using a clean, lint-free cloth. It is important to use fresh cleaning material for each wipe. Gentle but firm pressure is required, enough to depress slightly the spring-loaded ferrule. We recommend you use a 'CLETOP-S' type cleaner for free connectors and a 'One-Click' type cleaner for bulkhead or other recessed connectors.

#### 9.1.7 Wet cleaning

If a contaminant resists removal by dry cleaning methods then wet cleaning may be needed. The process is similar but the cleaning material is either supplied pre-impregnated with solvent (as in some optical wipes) or a solvent is added just before use. The solvent must be of a high purity to avoid leaving a residue and a dry cleaning operation must follow immediately so that it does not have time to dry on the connector ferrule. Isopropyl alcohol is often used but there are also some good proprietary solvents.

### 9.1.8 Cleaning Flowchart

The flowchart below covers the process of cleaning and inspecting connectors before mating. It also shows the escalation of the cleaning method from dry cleaning to wet cleaning with solvents.



## 9.1.9 Cleaning tools

### Fibre Inspection Microscope



Battery-powered microscope with 200x magnification. Requires different adapters for different connector types. Must never be used to examine 'live' fibres.

### CLETOP-S Cassette cleaner



Highly effective method of cleaning a free connector ferrule. Contains a cassette of anti-static cleaning cloth. Pressing the blue lever exposes a fresh length of material. The end face of the connector is then gently wiped across the exposed cloth in the direction indicated on the tool. Not suitable for wet cleaning.

### 'One-click' Ferrule cleaner



Required for cleaning recessed ferrules but can also be used on free connectors. Automatically wipes the ferrule end-face when it is pushed into the connector receptacle. Can be impregnated with solvent for wet cleaning.

## INTERROGATOR

The interrogator contains no user serviceable parts and should be returned to Smart Fibres UK or their local representative for maintenance or repairs.