FCO540
Calibrator

User Guide

Please read carefully before using.

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Safety Notes And Recommendations

PLEASE READ CAREFULLY

1) Do not use the instrument in wet conditions.
2) There are no user-serviceable parts inside the case. Servicing should only be carried out by a qualified engineer.
3) The maximum static pressure is 4 bar gauge (5 bar absolute) with the automatic pressure generation disconnected.
4) When operating at high pneumatic pressures use suitable pipe work (6mm OD 4mm ID) and fittings rated for the pressure and correctly fitted.
5) Do not use the soft tubing supplied at pressures greater than ± 0.5 bar gauge (0.5 to 1.5 bar absolute).
6) Do not over-tighten the pneumatic connections. The manufacturers recommended method is to screw on the knurled nut until finger tight. The hexagon is to aid release.
7) The maximum differential overload is 10 times the instrument range.
8) When running from an external 12V DC supply ensure the supply is adequate for the purpose: 10.8V to 14V DC, minimum 2A.
9) The maximum recommended recalibration interval is 12 months.

Introduction

General Description

The FCO540 is a multi-function low differential pressure instrument that fulfils the calibration requirements for low differential pressure transmitters, transducers, and pressure switches.

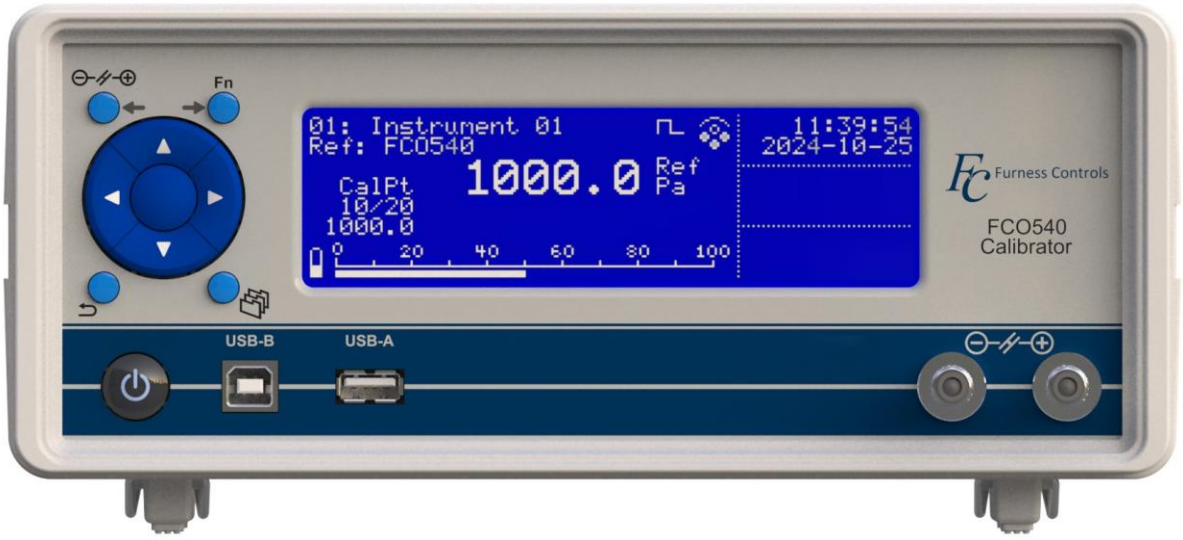
When used for site calibrations, the FCO540 may be preconfigured with information for up to 99 different instruments to be calibrated. For bench use, these configurations are useful rapidly changing between commonly used setups.



Features:

- Calibration of differential pressure
- Automatic differential pressure generator with automatic calibration profiles
- Graphical display and simple to use front panel controls
- Programmable display fields provide a choice of ancillary information
- Built-in data-logger
- Portable unit suitable for laboratory or on-site calibration
- Rechargeable battery for portable calibration
- USB-A memory stick support
- Communications via RS232 or USB-B

Front Panel

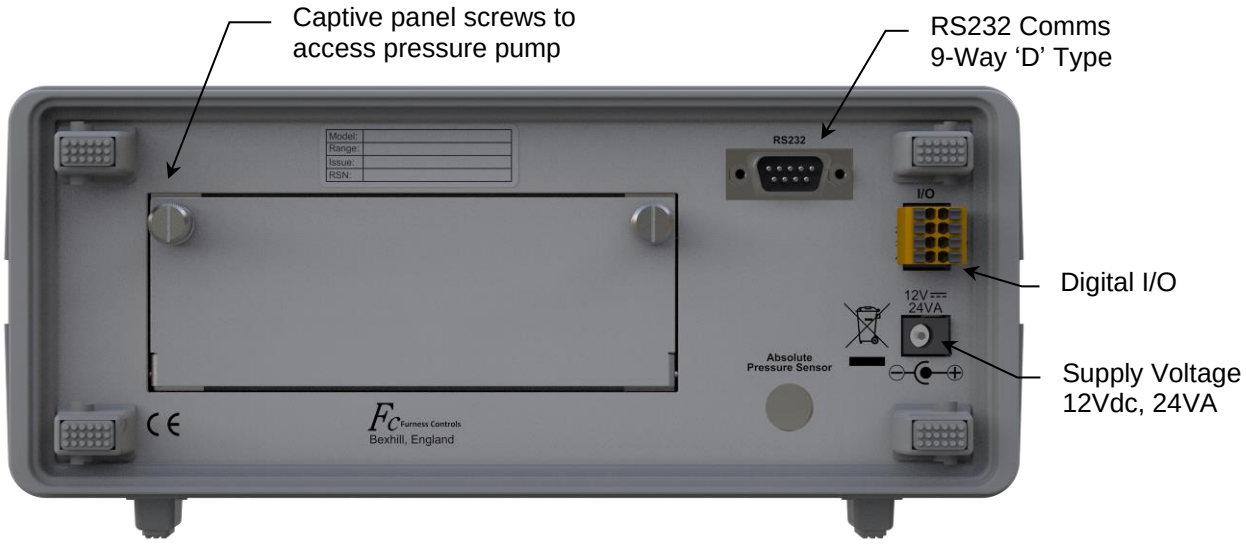


- Liquid Crystal Display with LED backlight.
- Menu navigation and four function buttons.
- Power switch.
- USB-B for PC communications. Note that a driver for the USB port may need to be installed on the PC. This is available from http://www.furness.com/info.
- USB-A for memory stick.
- Pneumatic pressure ports with M5 Female thread suitable for Ø4mmOD or Ø6mmOD push on fittings.

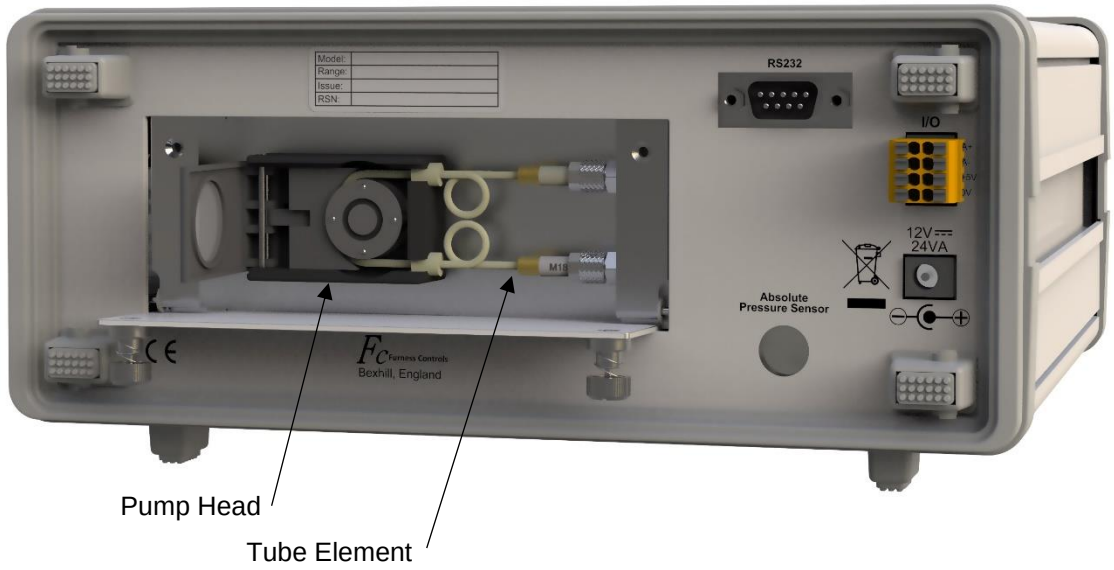
Push Buttons

⊖-//-⊕	Differential pressure (d.p.) Equalise/Read. The d.p. reference will display O=O when equalised and the ports will be connected together.
Fn	Functions Menu. This is context sensitive - the functions offered vary according to the instrument's other settings.
⮌	Backup/escape from menus or functions
	Store menu data or trigger the data logger
▲▼	Change the calibration point and navigation within menus
◀ ▶	Change the main display content and navigation within menus
ENTER	The centre button is used to enter the menu system and enter data

Rear Panel



Pressure Generation



The FCO540 differential pressure generation system utilises a miniature peristaltic pump to move air from one front panel pressure port to the other to create the pressure difference. The direction of the pump is changed to increase or decrease the pressure difference.

The internal diameter of the tube element sets the amount of air that is moved for each rotation of the pump. The time taken to reach a particular pressure depends upon the tube size and the volume of the equipment that is connected to the test ports. The FCO540 is supplied with a tube that is suitable for larger test volumes to reduce the time to reach the target pressure. If better control on small test volumes is required, a smaller tube can be fitted.

Each tube is colour coded for easy identification. Tubes are a push-fit onto a pneumatic fitting. Remove by gripping the large coupling tube at the pressure fitting and gently pull. **Do not pull on the smaller part of the tube as this may damage the tube and cause it to leak.**

Note: the pump is rated for ±30kPa maximum, if the calibrator is used with pressures exceeding ±30kPa the pipe must be removed and blanking caps fitted to the pneumatic ports

The tubes are consumable items and spares can be ordered using the M number codes shown below.

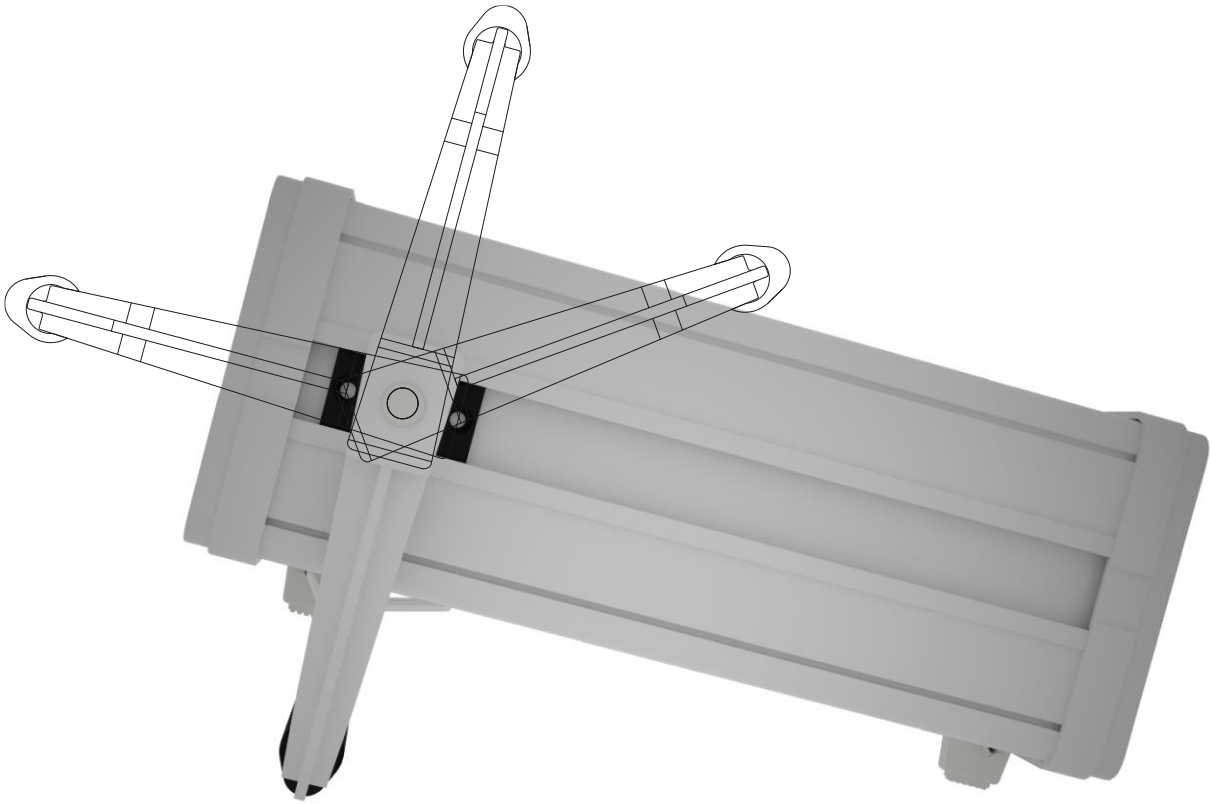
M1841	Ø0.51mm ID	Optional small volume tube for 2 kPa instrument
M1842	Ø0.76mm ID	Standard tube for 2 kPa instrument
M1843	Ø1.14mm ID	Optional small volume tube for 20 kPa instrument
M1844	Ø1.42mm ID	Standard tube for 20 kPa instrument

Enclosure

Aluminium enclosure with tilting front feet and optional carry handle.
A soft carry case is available as an accessory.

Carry Handle

The supplied handle locks in two positions 0º and 180º. The 90º position is for carrying and does not fully lock. The handle can also be folded back over the top when not in use.



Battery Operation

When the optional rechargeable battery pack is fitted it provides a running time of >8 hours of normal operation from a full charge. An icon on the display shows the battery charge level.

Charging

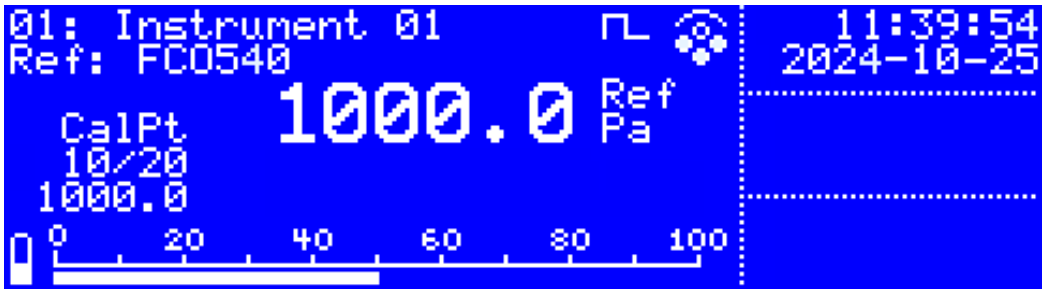
The battery charges when a 12V power supply is connected; this may be the universal mains adaptor that is supplied with the instrument, or an in-car adaptor.

Charging has two stages: The first stage is a fast-charge that takes approximately two hours from fully discharged or less time if the battery is partially charged. The second stage charges at a slower rate for three hours to achieve maximum capacity. While charging, an icon on the display indicates the charge stage. Once it is fully charged the battery will be given a small maintenance charge to ensure that it remains ready for battery operation. The mains adaptor may be left connected for bench use.

Basic Operation

Main Display

The main display is primarily the Differential Pressure. It also shows a variety of useful information and has a data logger.



- The content of the top two lines at the left of the display is user-selectable. This example shows the description/title of the instrument being calibrated and the FCO540 differential pressure reference.
- The symbol to the right of the description shows the measurement response as ⊓ step (damping off, fast) or ⌒ filtered (damping on, smoothed).
- The next symbol is only shown for instruments with automatic pressure generation. The symbol shows if pressure control is enabled or disabled
  Use the Fn menu to turn generation on/off.
- The large display value is the measured differential pressure. This will indicate 0=0 when the d.p. ports are equalised (linked) by an internal valve. A variety of engineering units are available by menu selection.
- The right side of the screen has three windows, the contents of which are user-selectable.
- The space below the large value is user selectable in the same way as the three windows.
- The left side shows the calibration point being taken and how many points are needed for this calibration. The up/down buttons select the calibration point. The target value for this point is shown beneath.
  - The Fn menu's **Enter CalPt** option allows the target value to be manually overridden up to ±120% of the configured maximum; when pressure generation is used, this can be a convenient way of varying the pressure, for example to check features of the connected device such as alarm or relay operation.
- The bottom left corner shows the battery status, if a battery is fitted.
- The bottom of the display has a bar graph showing the differential pressure as a percentage of full scale for the current instrument definition. The bar can be displayed as centre zero or left-hand zero.

Function Button

The **Fn** button can be used from the main operating screens to give quick access to the Functions Menu. The menu is context sensitive - the functions offered vary according to the instrument's other settings.

- Select Instrument — choose which instrument definition to use
- Auto Calibration — initiate automatic DP calibration – see calibration Profiles
- DP Control on/off — for pressure generation
- Damping on/off — see Filter in Global Settings
- Autozero DP — manually initiate an automatic zero of differential pressure
- Enter CalPt — manually override the calibration point set by a calibration profile
- Reset Peak/Valley — when a window is set for peak or valley
- DP Units — for the pressure generator utility
- Display Point

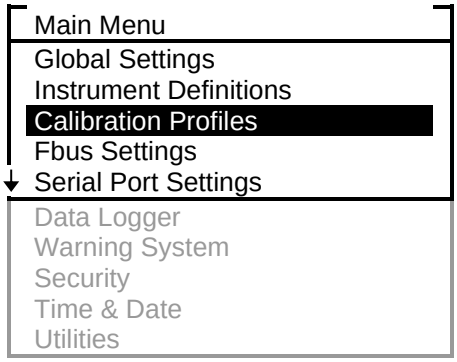
Menu System

The FCO540's settings may be viewed or set using the front panel buttons via a menu system. The main menu consists of:

◆ **GLOBAL SETTINGS**	General instrument operation settings.
◆ **INSTRUMENT DEFINITIONS**	Up to 99 instrument configurations can be defined. For each instrument to be calibrated, configure its serial number, identification, signal range etc.
◆ **CALIBRATION PROFILES**	Up to 20 different calibration profiles may be defined. Each profile may have up to 21 calibration points.
◆ **FBUS SETTINGS**	Fbus Communications may be used to load/save the instrument's settings, extract logged data, and monitor by a PC.
◆ **SERIAL PORT SETTINGS**	Configure the instrument's serial port settings. The serial port may be used by the data logger, to send data to a PC, or to print data.
◆ **DATA LOGGER**	Configure the data logger.
◆ **WARNING SYSTEM**	Used to advise when recalibration of the instrument is due and to monitor the data logger capacity.
◆ **SECURITY**	Instrument settings may be protected against accidental or unauthorised changes.
◆ **TIME & DATE**	Set the real-time clock.
◆ **UTILITIES**	Copy Data, Print Data, D.P. Generation, etc.

Menu Navigation

Press the **ENTER** button from the normal operator display to show the main menu:



The **UP** and **DOWN** buttons scroll the highlight bar through the list. Press **ENTER** to select the highlighted menu option. Press ⮌ to exit back to the main operator display. Some of the items shown here may not be visible depending on system settings.

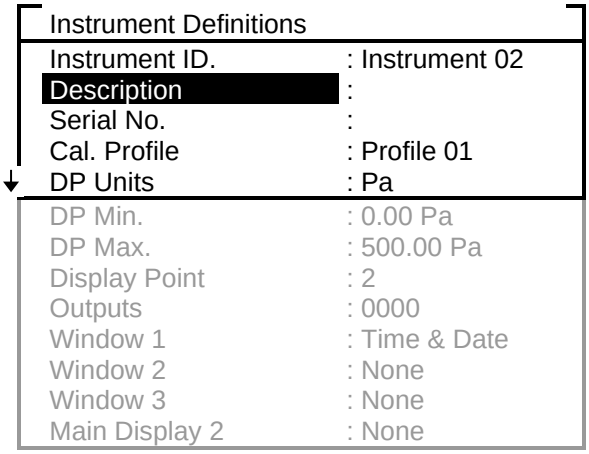
The menu list is longer than the display. When the highlight bar reaches the bottom of the display the list moves up. If there are more items off the top or bottom of the display, arrows are shown in the left side of the list.

The **RIGHT** button turns page mode on/off. When page mode is enabled the '>>' symbol is displayed at the top-right of the box and the **UP** and **DOWN** buttons move a page at a time. Page mode is cancelled automatically after two seconds.

Settings may be protected by a security code. When security is enabled it is possible to view the settings but you will be prompted to enter the security code if you try to alter settings.

If you select a menu with multiple configurations, such as Instrument Definitions or Calibration Profiles, you must first choose which to use. Use the **UP** or **DOWN** buttons to select from the list and press **ENTER**.

When you press **ENTER** a list of parameters is displayed with their settings, e.g.



Press **UP/DOWN** to scroll through the parameter list for this menu.

Press **ENTER** to alter the value of the current selection or press ⮌ to exit back to the menu list.

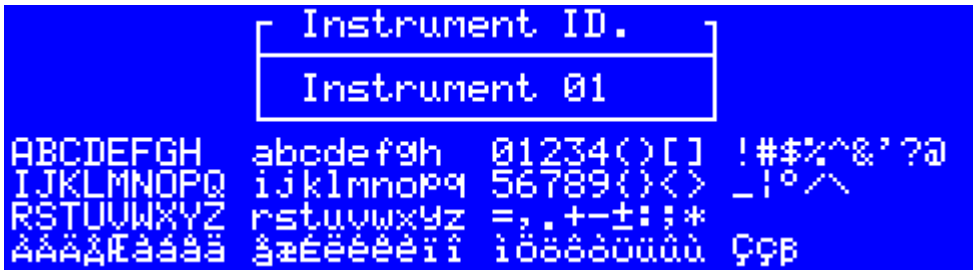
When you press **ENTER** a pop-up window lets you edit the data. If security is enabled you will be prompted for a pass code first.

When editing data, **UP** and **DOWN** change the selection. For text and numeric data the **LEFT** and **RIGHT** buttons are used to select a different digit/character.

Press **ENTER** to save the changes or ⮌ to exit without saving changes.

Text Entry

The FCO540 has a number of menus that have text to enter, e.g. Instrument ID, Serial No. etc. When editing text you will see a display like this:



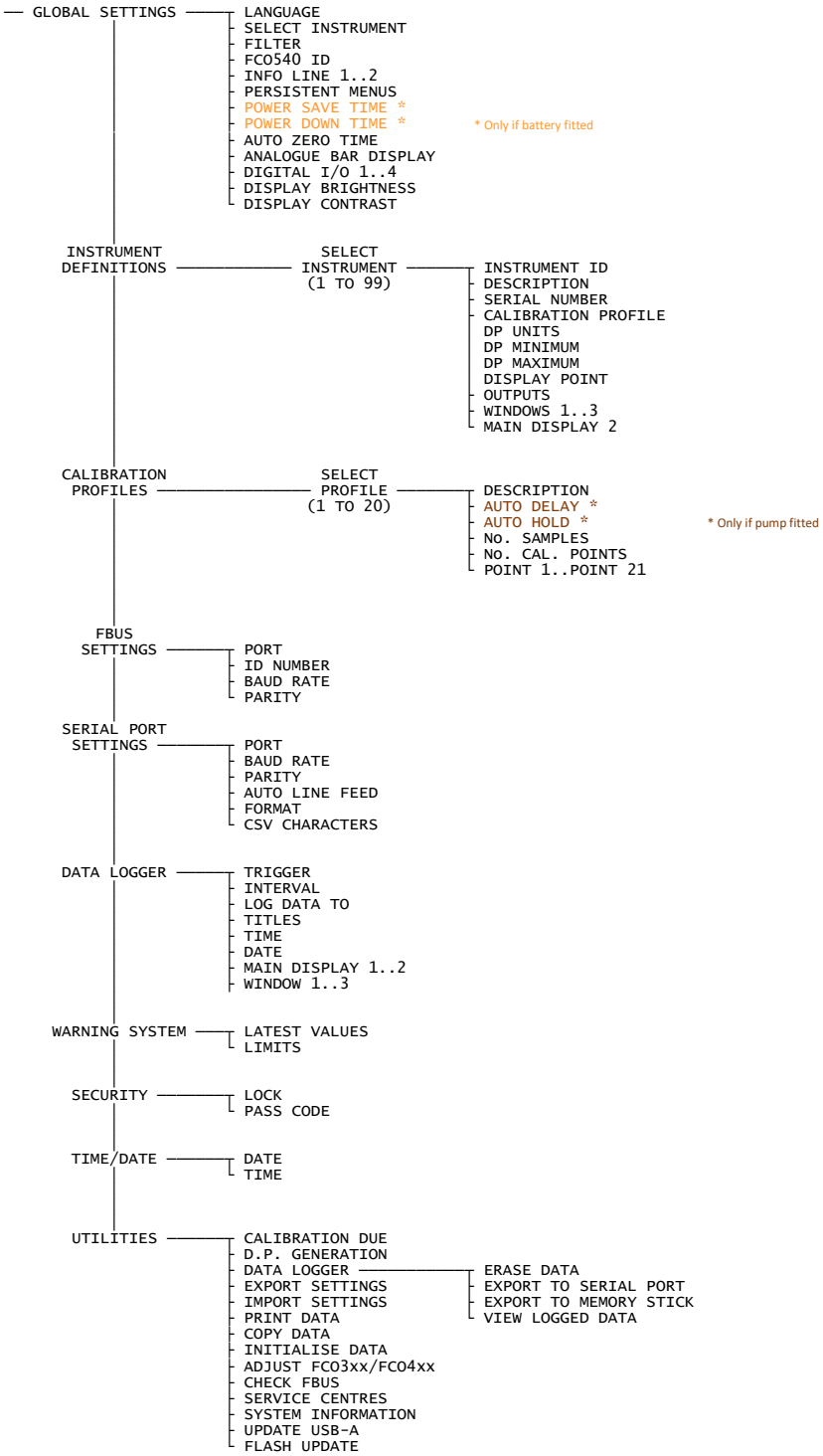
The text to edit is within the box with its title shown above.

Initially the first character in the edit box blinks to show that it is selected. The up, down, left, and right buttons move a blinking cursor around the characters shown at the bottom of the display. Press the **ENTER** button to replace the edit box character with the new selection from below. The edit box selection automatically advances to the next character. Any of the blanks in the selection characters may be used as a space.

Note that the ⊖–⚡–⊕ and **Fn** buttons have secondary ← and → usage for text editing. These are used to move the selection point in the edit box without changing the text. Unwanted text can be removed by entering blank spaces.

Press to store and exit, or ⮌ to escape without saving changes.

Menu Navigation Diagram



Global Settings Menu

Language

- Set the language for display and print-out messages.
  - English, French, German, Italian, Spanish, Polish, Czech, Russian.

Select Instrument

- Choose which instrument definition to use. This is typically done using the Fn menu because that is not security protected. This menu entry tracks instrument definition selection by any method, e.g. Fbus or legacy communications or BCD inputs.

Filter

- Any values derived from the FCO540 differential pressure measurement may be digitally filtered to provide a damped response.
  - Adjustable up to a maximum filter time constant of 60.0 seconds.
  - Damping can be simply switched on/off using the Fn button menu.

FCO540 ID.

- Assign an identifying description to this FCO540.
  - This is used when exporting calibration data and when differential pressure is the reference and one of the Info Lines below is set to “Reference”. It defaults to “FCO540” followed by its serial number but can be changed according to the user’s preference.
  - Note that this value does not get sent or received by Fbus Communications as part of global settings. It can only be set via this menu.

Info Line 1, 2

- Choose from a list of items to be displayed at the top left of the main display screen.
  - **None:** the display is left blank.
  - **Instrument definition ID.**
  - **Instrument definition description.**
  - **Instrument definition serial number.**
  - **Reference description / ID.**
  - **Date/time.**

Persistent Menus

- Enable or disable the persistent menu feature.
  - **No:** Each time the menu is entered the first menu entry is displayed.
  - **Yes:** Upon entering the menu, the display starts at the position last used.

Power Save Time

- When operating from batteries the instrument will automatically take power saving actions if it is left unattended for a period of time. The display will be dimmed, the pressure generation turned off, and the differential pressure ports will be equalised.
  - Set to zero to disable the power save feature or enter a value up to 60 minutes.
  - The display will blink for 30 seconds before entering power save as a notification.

Power Down Time

- When operating from batteries the instrument will automatically turn off to conserve battery power if the power down timer is enabled. The power down timer starts after the power save time expires.
  - Set to zero to disable the power down feature, or enter a value of up to 60 minutes.

Automatic Zero Time

- Measurement mode only.
- If the FCO540 is to be left in READ mode it is recommended that the instrument is zeroed regularly to maintain the best accuracy. The automatic zero can be set to operate on a regular timed basis with this setting. The FO540 can also be commanded to autozero from an external signal, a communications command, or the Fn button.
  - Set to zero to disable timed automatic zero, or set a value of up to 60 minutes.

Analogue Bar Display

- Select the format of the analogue display bar.
  - **LHZ:** Left Hand Zero. Only positive values are displayed.
  - **CZ:** Centre Zero. Negative and positive values are displayed.
- Note that the scaling of the bar is set by the instrument definition. D.P. Min/Max set the scaling of the analogue bar. 100% is considered to be the value with the larger magnitude.

Digital I/O 1...4

- Each of the four Digital I/O connector pins may be assigned a function that determines whether the signal is used as an input or an output.
  - **Monitor Input:** the signal has no function but may be monitored in a display window, e.g. to check a relay or switch operation.
  - **Store Input:** trigger the data logger in calibrate or measure mode. The measure mode data logger trigger must be configured for external input.
  - **Store + Eq. input:** trigger the data logger and then equalise the differential pressure. This is typically used with the peak-hold function for testing pressure switches.
  - **A.Z. Input:** triggers an auto-zero cycle.
  - **BCD Input:** may be used to select the instrument definition to use.
    Inputs 1…4 are weighted 1, 2, ,4, 8 respectively. You may use as few signals as required.
  - **Read/Equalised Input:** toggles the instrument state.
  - **Switch Input:** Used for pressure switch testing.
  - **Warning Output:** active when any warning system level exceeds its limit.
  - **A.Z. Output:** active during an auto-zero cycle.
  - **Read/Equalised Output:** active when the DP measuring system is reading.
  - **User Output:** as set in the instrument definition menu. Outputs 1...4 match the instrument definition setting from left to right. You may use as few signals as required.

Display Brightness

- Adjust the display for different viewing conditions. High brightness will slightly reduce the operating time when operating from the battery.
  - Enter a value from 1 (dim) to 16 (bright).

Display Contrast

- Adjust the display for different viewing conditions.
  - Enter a number from 1 to 16.

Instrument Definitions Menu

Instrument ID.

- For example instrument manufacturer/type or location tag (up to 16 characters). This is the text that is displayed when selecting which instrument definition to use via the Fn button.

Description

- May be used for additional text relating to the instrument. Up to 16 characters.

Serial number

- The serial number of the instrument to be calibrated. Up to 16 characters.

Calibration Profile

- Choose a named calibration profile. The calibration profile defines the number of calibration points that are required and at what %FS each point is required.

D.P. Units

- Select the differential pressure units of the EUT.
  - Pa: Pascals
  - kPa: kiloPascals
  - ubar: microbar
  - mbar: millibar
  - mmWC: millimetres Water Column (4°C)
  - Thou: thousands of an inch Water Column (4°C)
  - inWC: inches Water Column (4°C)
  - mmHg: millimetres mercury (0°C)
  - inHg: inches mercury (0°C)
  - NM^{-2}: Newtons per square metre (Pa)
  - PSI: Pounds per square inch
  - PSF: Pounds per square foot

D.P. Minimum

- Enter the differential pressure that corresponds with the minimum value for the input. This is required even if the input source is Communications or Manual so that an appropriate display resolution can be set and so that calibration errors can be expressed as %FS.
- This value may also set the scaling of the analogue bar display. See the Global Settings menu.

D.P. Maximum

- Enter the differential pressure that corresponds with the maximum value for the input. This is required even if the input source is Communications or Manual so that an appropriate display resolution can be set and so that calibration errors can be expressed as %FS.
- This value may also set the scaling of the analogue bar display. See the Global Settings menu.

Display Point

- Set the decimal point position of the differential pressure display. This is typically used to reduce the display resolution to suit the device being calibrated; note that the instrument will not show more resolution than it can measure, i.e. the maximum display resolution will be limited to that shown for D.P. Minimum and D.P. Maximum above.
  - Point 0 for values such as 1234
  - Point 1 for values such as 123.4
  - and so on up to point 5.

Outputs

- Digital outputs may be set for each instrument definition, e.g. for external valve selection.
- Each of the four outputs may be selected on (1) or off (0), e.g. to turn outputs 1 and 3 on you would set “1010”. Note that the digital inputs/outputs must be configured in the global setting menu.

Window 1, 2, 3

- Choose what to display in each window of the main display screen.
  - **None:** the display is left blank.
  - **DP:** Differential Pressure measured / generated by the FCO540.
  - **Time & Date**.
  - **Peak:** the maximum value that the main display reached. Reset via the Fn menu.
  - **Valley:** the minimum value that the main display reached. Reset via the Fn menu.
  - **Digital I/O:** monitor the states of the four digital inputs/outputs.
  - **Switch+:** for pressure switch testing, the pressure at which the switch operated for increasing pressure.
  - **Switch−:** for pressure switch testing, the pressure at which the switch operated for decreasing pressure.
  - **Hysteresis:** for pressure switch testing, the difference between Switch+ and Switch-.

Main Display 2

- Choose what to display on the lower main display position. The choices are the same as the window options above.

Calibration Profiles Menu

Up to 20 different calibration profiles may be defined. The use of calibration profiles allows for very flexible calibration methods. The profile allows you to choose how many calibration points are required and at what points to calibrate at.

Description

- 16 characters. This is used to identify the profile when it is selected for use within the instrument definition menu.

Auto Delay & Auto Hold

- Only shown if the automatic pressure generator is fitted.
- Differential pressure calibration may be made automatically, initiated from the Fn button menu. Once started no action is taken until the Auto Delay time expires. The target pressure for each calibration point is set automatically. When the target pressure is reached it is held for the Auto Hold time to allow the system to stabilise. If the data logger trigger is set to Front Panel, then it is triggered at this point. The instrument will then advance to the next profile point. When all points have been taken the instrument will equalise the Differential Pressure ports.
- Set both times to zero to remove this feature in the Fn menu.

No. Calibration Points

- Enter the number of calibration points that are required. This can be between 1 and 21.
  - E.g. calibration at 0%, 20%, 40%, 60%, 80%, and 100% is a 6 point calibration.

Point 1 … Point 21

- Enter a percentage of Full Scale for each calibration point to be used.
  - Positive and negative values can be entered up to 150% of the EUT's full scale. Note that values over 100% only apply when the EUT's full scale is less than the FCO540's full scale.
  - The calibration screen displays a target value based on this percentage but you are not obliged to calibrate at the suggested target. The Fn menu may be used to override the suggested value.

Fbus Settings Menu

A computer can communicate with the FCO540 using the Fbus protocol. Application software is available from Furness Controls such as the FCS432 Fbus Utility and the FCS487 data logger. The Fbus communications protocol is documented separately from this user guide.

Select the Fbus communication port and configure it to match the computer that the FCO540 is connected to.

* Note that the front-panel USB-B port has its own independent Fbus Communications channel, meaning that it can be used at the same time as another port configured in the menu. It can always be used for Fbus Communications regardless of the port setting here or elsewhere. When the port is set to USB in this menu the ID number from this menu is used, otherwise the ID is fixed as 01.

Port

- Select a communication port to use.
  - **Disabled:** Fbus communications is not available on this channel *.
  - **RS232:** Uses the 9 way D rear panel connector.
  - **USB:** Uses the front panel USB-B (square) connector *.

I/D number

- Assign a unique identification number to this instrument for Fbus communications in the range 01 to 99.

Baud

- The baud rate is the speed that data is sent via the serial ports. The baud rate must be the same on the FCO540 and device being connected. This is not used for USB.
  - 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200.

Parity

- Select the number of data bits and type of parity error checking to use when sending data via the RS232 port. Parity is not used for the USB port. The parity setting must be the same on the FCO540 and the computer being used.
  - **8,NONE:** 8 data bits and no parity.
  - **7,ODD:** 7 data bits plus odd parity.
  - **7,EVEN:** 7 data bit plus even parity.
  - **8,ODD:** 8 data bits plus odd parity.
  - **8,EVEN:** 8 data bits plus even parity.

  - Note that extended symbols/characters require 8 data bits. European characters are a subset of code page 1252. Cyrillic characters are a subset of code page 1251.
  - Generally, 8 data bits with no parity is preferred. Only use 7 data bits when compatibility with older equipment is necessary and parity is required and you do not use extended characters.

Serial Port Settings Menu

Select which port to use and configure it to match the device that the FCO540 is to be connected to. The serial port may be used with the data logger or to send instrument settings to a PC or serial printer.

Port

- Select a serial port to use.
  - **Disabled:** the serial port is not available.
  - **RS232:** Uses the 9 way D rear panel connector.
  - **USB:** Uses the front panel USB-B (square) connector. Note that this will ***not*** drive a USB printer because the FCO540 is a USB *peripheral* device, however it may be useful to print-out to a PC.

Baud

- The baud rate is the speed that data is sent via the serial ports. The baud rate must be the same on the FCO540 and device being connected. This is not used for USB.
  - 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200.

Parity

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- Generally, 8 data bits with no parity is preferred. Only use 7 data bits when compatibility with older equipment is necessary and parity is required and you do not use extended characters.

Auto Line Feed

- Set for compatibility with printers that add spacing between lines of print, or for printing to a PC.
  - **NO**: The FCO540 does not send a line-feed at the end of a line. If the printer does not add a line feed then all lined of print are printed on top of each other.
  - **YES**: At the end of every print line the FCO540 sends a line-feed. If the printer also has auto line-feed turned on it will print double-spaced. This is the usual setting for connection to a PC.

Data Format

- Set the output format for the measurement mode logger when logging to the serial port.
  - **Table:** Each item is output on a new line.
  - **CSV:** Each record is output on a new line. Each item is separated by the list separator character.

CSV Characters

- The decimal character and list separator may be chosen to suit your location. These are only used for output sent to the serial port.
  - **. ,** decimal point and comma list separator
  - **, ;** decimal comma and semicolon list separator

Data Logger Menu

The data logger can store data to internal memory and/or a serial port. Data can be logged on demand from the front panel store button, from the serial port, at timed intervals, or from an external switch or logic signal.

Data logged to the serial port can be in table format or CSV format.

Data logged to the internal memory can be exported in CSV format to the serial port, or extracted to a CSV file using Fbus Communications and the Fbus Utility. Data may be viewed via the utilities menu, or the right or left navigation button from the main display.

Data logged to the internal memory is stored in a compressed form. The maximum number of log records is dependent upon the data types and the number of items logged for each record. For example, if just the main reading is logged without a title then >350000 records may be stored; if all possible options are logged with titles this may be reduced to around 25000 records. When the internal memory fills the logger will overwrite the oldest data. The warning system can be used to get notice in advance of this happening if desired.

Trigger

- Data is stored when a trigger event occurs. Select the source of the trigger.
  - **Front Panel:** press the Store button for a single trigger.
  - **Serial Port:** trigger command from serial port.
  - **Timed:** built-in timer. The Store button is used to start and stop the timer. When the timer is running the display will show “Logging”
  - **External Input:** programmable digital / switch input. The input is sampled every 100ms. The signal must be active (low) for more than 100ms to ensure detection and must be released (high) for more than 100ms before a new trigger is allowed.

Interval

- Set the data logging interval when the trigger source is set to Timed.
  - From 0.1s to 3600.0s

Log Data To

- Choose where the data gets logged to.
  - Memory
  - Serial Port
  - Memory+Serial

The following menu entries have Yes/No options to enable/disable whether the value is logged or not.

Titles

- Logging the titles of each value is clearly helpful when looking at the stored data; however, since they are stored with every logged record they may consume significant resources. It may be useful to disable the logging of titles, particularly if it is necessary to log a large number of records to internal memory.

Time

- Enable or disable logging of the time.

Date

- Enable or disable logging of the date.

Main Display 1

- Enable or disable logging of the top main display value.

Main Display 2

- Enable or disable logging of the bottom main display value.

Window 1

- Enable or disable logging of the top display window.

Window 2

- Enable or disable logging of the middle display window.

Window 3

- Enable or disable logging of the bottom display window.

Warning System Menu

The warning system may be used to aid planned maintenance.

Latest Values

Any warnings that are currently active will flash.

- **Logged Data:** This may be used to warn that the data logger memory is nearly full so that the data may be off-loaded.
- **Calibration Due:** It is recommended that the calibration of this instrument is checked annually, or as often as your quality system demands. This value is a display of the number of days left before calibration is due. If the value is negative then calibration is over-due.
- **DP Zero:** If an overload situation occurs the instrument will attempt to protect the transducer by equalising the ports. However, the DP transducer is sensitive and its zero point may shift if it is badly overloaded. The instrument is able to tolerate this to a large degree, but eventually may stop with a fault.

Limits

- **Logged Data:** set as a percentage of the memory capacity.
- **Calibration Due:** how many days' notice is required in advance of the calibration due date. The calibration due date is set in the utilities menu.
- **DP Zero:** set as a percentage of the fault level.

Security Menu

The instrument may be configured to stop unauthorised changes to important parameters. If you select this menu when the instrument is locked then you will be asked to enter the security code before continuing.

Lock

- Lock or unlock data entry. When locked you will be asked for a security code before changing data.
  - **No:** unlocked.
  - **Supervisor:** all settings are locked.
  - **Operator:** all settings are locked except those that an operator requires.

Security Code

- Allows the user to set a 4 digit personal security code.

Time & Date Menu

Date

- The date is set in the format yyyy-mm-dd.

Time

- The time is set in 24 hour format as hh:mm:ss

Utilities Menu

Calibration Due Date

- Set the date that the next calibration check is due for this FCO540. This should be set each time the FCO540 is calibrated so that advanced warning of when the next calibration is due can be given.

D.P. Generation

- Only displayed if the pressure generation option is fitted.
- This allows direct manual control of the pressure generation.
- The Fn button gives a menu for the following functions:
  - Switch pressure control on/off.
  - Switch damping on/off.
  - Auto-zero the differential pressure transducer to maintain accuracy over time.
  - Select the engineering units for differential pressure.
  - Change the display resolution (Display Point).
- The target pressure is displayed in a window. The value is changed in the same way as numbers are changed within the menus.
- If the instrument is powered down in this mode it will return to this mode when power is restored.

Data Logger

Erase Data

- You will be prompted for confirmation before all logged data is erased.

Export to Serial Port

- All logged data is sent to the serial port in CSV format.

Export to Memory Stick

- All logged data is exported in CSV format to a memory stick plugged into the front-panel USB-A socket. The memory stick must be formatted as FAT32. The FCO540 does not support NTFS or exFAT etc.
- File names are automatic. Calibration mode starts with C001.CSV and measurement starts with M001.CSV. Each new export uses the next available number.

View Logged Data

- Each logged record is displayed on a single line showing the record number followed by the data, shown with titled fields in columns. Note that if the type of data that has been logged changes within the displayed records, the titles are for the record at the top of the display.
- The up/down/left/right buttons are used to navigate through the data.
- The Fn button allows you to go to the first record, last record, or a specific record.

Export Settings *(to memory stick)*

- You will be prompted for a filename which will default to the FCO540 ID as set in the Global Settings menu. Either accept the default or change as required. If the file already exists on the memory stick you will be prompted before overwriting it.
- Settings are stored in a folder named **FCO540** as a .FUR file that is compatible with the Fbus Utility.

Import Settings *(from memory stick)*

- Select the file that you wish to import from a list of files in the **FCO540** folder on the memory stick.
- You may only import settings that have the same differential pressure range and major firmware version.

Print Data

- This allows menu data to be sent to the serial port. Choose what to output.

Copy Data

- This allows instrument definition data to be copied from one entry to another to minimise the amount of setting up.

Initialise Data

- Restore all settings back to factory defaults. You will be prompted for confirmation before any action is taken.

Adjust FCO3xx / FCO4xx

- This utility may be used to adjust the gain and output calibration of a Furness Controls FCO400 series transmitter, or an FCO300 series transmitter using an FCO301 adaptor cable.
- The FCO301 cable is available with either USB or RS232 connection. The USB version will plug directly into the USB-A port of the FCO540. The RS232 version will need a USB to RS232 adaptor.

Service Centres

- Lists contact details for key service centres.

System Information

- Lists system details for this instrument, including firmware version, range, options etc.

Update USB-A

- The USB-A port has its own firmware that may be updated from a memory stick. This is rarely required and should only be done under instruction from a Furness Controls agent.
- The firmware update file should be put on a freshly formatted memory stick.

Flash Update

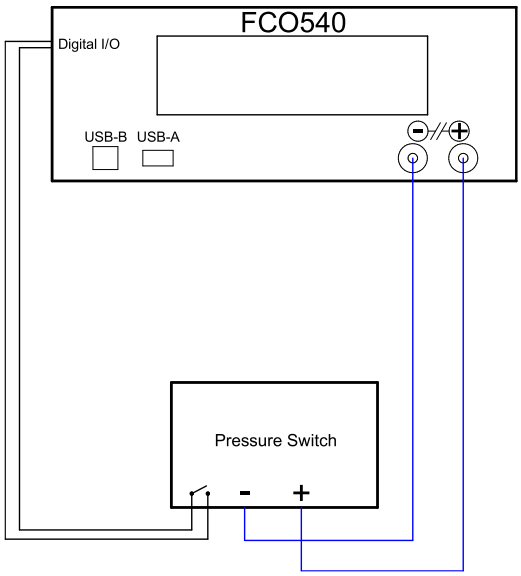
- Initiate a product firmware upgrade. You will be prompted for confirmation before any action is taken.
- It is recommended that all instrument settings are saved using the Fbus Utility before updating firmware. Major firmware updates normally initialise all settings to factory defaults.
- Once the procedure is started the upgrade process is commanded from the PC using either the RS232 or USB-B port, using the Fbus Utility program from Furness Controls. To cancel flash update mode, press ⮌ or command it from the Fbus Utility.
- Note that flash update is disabled if the data logger has stored data. You should export the logged data and then erase it before updating the instrument firmware.

Pressure Switch Calibration

The FCO540 may be used to check the operating point of a pressure switch. It allows both the switch make and break pressures to be logged, giving the switch hysteresis. A calibration profile may be used to check repeatability.

Typical configuration showing connections for pressure switch testing.

Connect the switch from 0V to an FCO540 digital input.



Significant menus required for Pressure Switch calibration:

Global Settings

Digital I/O
Switch Input

Instrument

Calibration profile → Calibration Profile (1 – 20)

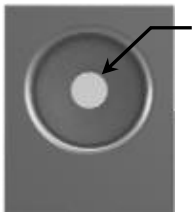
DP Min/Max
To suit pressure switch.

Window
As required: Switch+, Switch-, Hysteresis, Digital I/O

Input/Output Connectors

Rear Panel Connectors

Power Supply



The FCO540 is supplied with a modular 12Vdc universal power supply with a suitable mains lead.

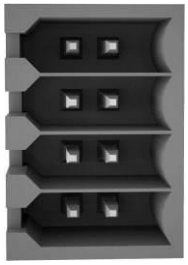
Battery Charging

The 12Vdc supply is normally used to charge the internal batteries.
An optional in-car charging lead is also available (plug into cigarette lighter socket).



Input/Output

Pin	Function
1	Input/Output 1
2	Input/Output 2
3	Input/Output 3
4	Input/Output 4

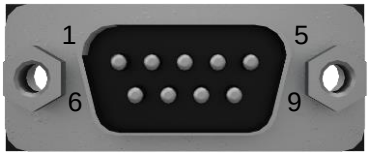


Function	Pin
N/C	5
N/C	6
+5V	7
0V	8

- Pins 1-4 are digital input or outputs depending on their assignment in Global Settings.
  - As outputs they are active high 5V logic levels with approximately 1KΩ in series.
  - As inputs they have an internal weak pull-up to +5V allowing them to be used with a simple volt-free contact to 0V. Alternatively, a 5V logic level may be used with the active state being low.
- Pin 7 is connected to +5V via a 100Ω resistor.
- Pin 8 is 0V that may be used with volt-free contacts for inputs.

Note: the digital i/o is 5V only. Application of more than 12V may damage your instrument.

RS232



9-way 'D' plug

Pin	Function
1	No Connection
2	Rx Receive (input)
3	Tx Transmit (output)
4	DTR Data Terminal Ready (output)
5	Ground
6	No Connection
7	RTS Request To Send (output)
8	CTS Clear To Send (input)
9	+5V

The RS232 drivers employ a power-saving shutdown feature such that the output signals are only active when a valid RS232 input signal is detected.

Note: RS232 connection to the instrument must be made using screened cable with the screen connected to a metallic shell of the 'D' connector at the instrument end.

Legacy Serial Commands

The preferred method of remote controlling the FCO540 is via Fbus Communications, however these legacy commands are provided for level of backwards compatibility with older instruments. Legacy commands apply to the selected serial port.

Command	Action	Response
A...P	Select instrument definition 1..16	Echo character<ACK>
Q	Set to equalised	Q<ACK> when complete
R	Set to read	R<ACK> when complete
?	Query equalise/read state	Q<ACK> or R<ACK>

S	Trigger the data logger	No response when equalised or data logger full.
		If log to RS232 is set then
		data<CR>S<ACK>.
		If only log to memory is set then
		S<ACK>.

T	Trigger the data logger	data<CR>
Z	Perform autozero	Z<ACK> when complete

Notes

- The data logger trigger must be set to 'Serial Port' to use the S and T commands.
- Normal (table) and CSV formats are supported.
- Use the Data Logger menu to select what data to log.
- The maximum trigger rate is every 100ms.

Trouble Shooting

PROBLEM: **Differential Pressure display resolution is not as expected.**
Cause: The Display Point is not set correctly in the instrument definition menu.
Action: Set the display point for the required resolution; note however that the instrument will not display at a higher resolution than it can measure.

PROBLEM: **Pressure generation not working**
Cause: The pressure pump has been turned off, indicated by the icon: 
Action: Press the Fn button and select “DP Control on/off”.
When pressure control is enabled and ready for use the icon will change to: 

PROBLEM: **The FCO540 turns the pressure generation off**
Cause: The FCO540 will protect the pump from unnecessary wear by turning it off if the pressure control system determines that it cannot reach the target pressure, for example if the pressure ports are left open or the pump tube is disconnected or damaged.
Action: Check that the pressure ports are not both open.
Check the integrity of the tube in the pressure pump.

PROBLEM: **The Fn menu does not show “Auto Calibration”**
Cause: The Auto Calibration feature is disabled if the “Auto Hold” time is set to zero.
Action: Set the Auto Hold time to a non-zero value in the current calibration profile.

PROBLEM: **The FCO540 displays “Unsupported USB Device”**
Cause: A USB to RS232 adaptor with an unsupported chip-set is plugged in.
Action: Only use adaptors with an FTDI chip-set as supplied by Furness Controls.

Cause: A memory stick is plugged in that is formatted to an unsupported file system.
Action: Only use memory sticks formatted for FAT or FAT32 file systems.

PROBLEM: **The FCO540 does not turn on when an external supply is connected**
Cause: The internal battery has been allowed to discharge too far. This may be seen if the instrument has not been charged for a long time.
Action: Leave the external supply connected to allow the battery to charge, then try again after a few hours. Let the battery fully charge.

Error Messages

A number of error messages can be displayed in the event of a system or hardware failure.

Data Corrupt + menu type
The data for the displayed menu has been corrupted. Re-enter the data for the menu. Data corruption may indicate severe electrical interference.

Not Configured
Not Calibrated + calibration type
Configuration or calibration data has been corrupted. Contact your supplier.

Dataflash Fault
EEPROM Fault + EEPROM type
One of the memory devices used to store data is not functioning properly. Contact your supplier.

ADC FAULT + ADC type
This indicates a fault in the analogue to digital conversion. Contact your supplier.

Keyboard Fault
One or more input buttons is not working properly. Contact your supplier.

RTC FAULT
The on-board real time clock is not functioning properly. Contact your supplier.

Pr. Zero Fault
The differential pressure transducer is not working properly. Contact your supplier.

Battery Low
This may be seen as the instrument is turned on or when exiting the menus. The battery is discharged further than normal and requires fully charging. Contact your supplier if the problem persists.

Specification

Differential Pressure Measurement

Instrument	Model 2	Model 3		
Range	2000 Pa	20000 Pa		
Accuracy @ 20°C (including linearity and hysteresis)	< 0.1% R + 0.03 Pa	< 0.1% R + 0.3 Pa		
Control Stability (if internal pump fitted)	<0.003% FS (with both ports sealed)			
Resolution	1:200000 (auto-range 5-digit display)			
Temperature Coefficients	Zero: < 0.02 % fsd per °C (eliminated by Automatic zero function) Span: < 0.01 % per °C			

Electrical

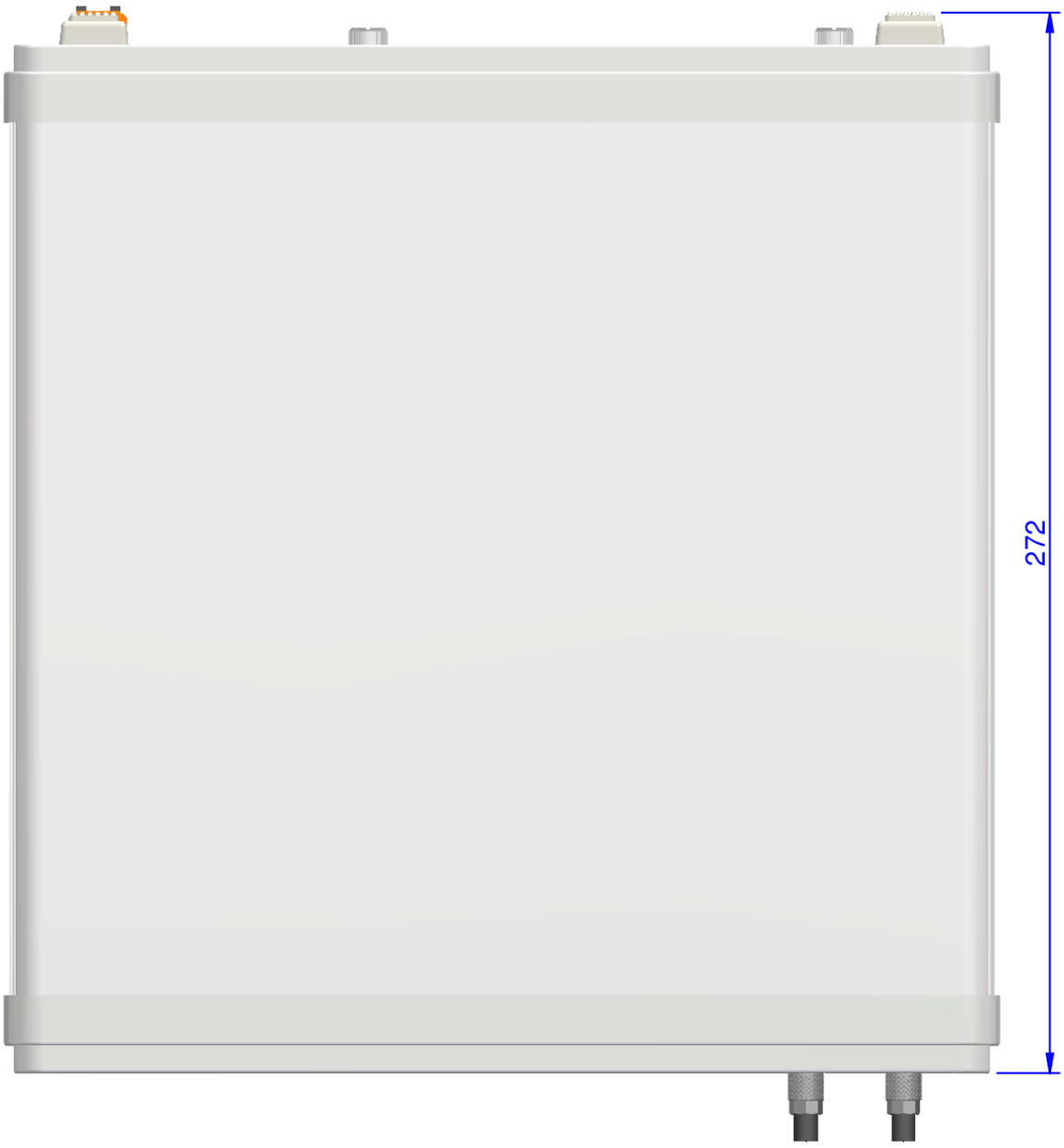
Supply Voltage	12 VDC ± 10% 2A (Universal mains power supply included) 2.1mm power socket
Communication Interfaces	RS232: 9-pin D plug USB: Type A connector for connection to a memory stick USB: Type B connector for connection to PC
Interface	Digital I/O: 4 inputs/outputs (5V logic)

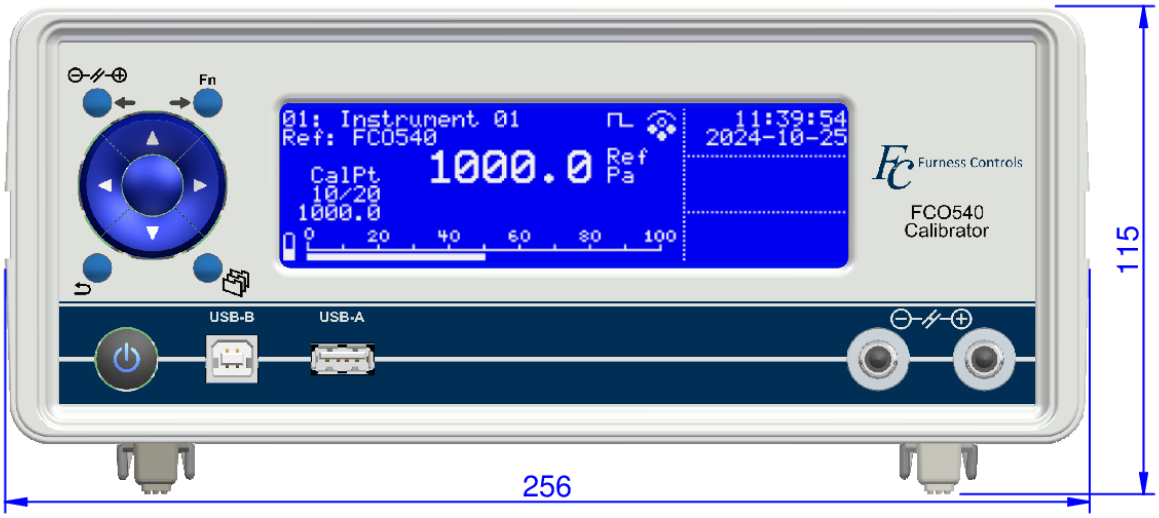
General

Enclosure	Aluminium enclosure with tilt feet
Display	Blue backlit graphic display.
Data logger capacity	Storage of approximately 35,000 single display readings.
Dimensions	W 250mm x H 105mm x D 265mm (without handle)
Operating temperature	+5°C to +45°C
Storage Temperature	-10°C to +50°C
Battery	Low Self Discharge NiMH giving > 8 hours of normal use
Weight	<4.5 kg
Long Term Drift (span)	< 0.25% reading per year
Overload	20 times fsd without damage
Media Compatibility	Clean dry air or non-corrosive gas
Static pressure:	Without internal pump: -1 bar to + 4 bar. With internal pump: -500mbar to + 500 mbar.
Pneumatic Connections	Test Ports: Push-on tube fittings for 6mm o/d, 4mm i/d flexible tube.
Options:	Basic unit (Without pressure generator or battery) Automatic pressure generator Internal battery pack Soft carry case

All information in this document is provisional and is subject to change without notice.

Dimensions


272


Fn
01: Instrument 01
Ref: FCO540
11:39:54
2024-10-25
CalPt
10/20
1000.0
1000.0
Ref
Pa
0
20
40
60
80
100
Furness Controls
FCO540
Calibrator
USB-B
USB-A
115
256

Revision Record

Issue	Date	Description
1a	27/02/25	Clarified the meaning of the display icons for damping on/off. Other minor corrections.
1	01/11/2024	First release

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