

FCO520

AirPro

USERS GUIDE

Please read carefully before using.

Manufactured by:

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TABLE OF CONTENTS

TABLE OF CONTENTS	2
REVISION RECORD	4
SAFETY NOTES AND RECOMMENDATIONS.....	5
INTRODUCTION	6
<i>General Description</i>	<i>6</i>
OPERATION	7
<i>Instrument Functions (direct access from buttons).....</i>	<i>7</i>
MENU DETAILS	9
<i>Log Rec. (Log Record Number).....</i>	<i>9</i>
<i>Log Pt. (Log Point Number).....</i>	<i>9</i>
<i>Print.....</i>	<i>9</i>
<i>Pr. Comp (Pressure Compensation).....</i>	<i>9</i>
<i>Pr. Val. (Pressure Value).....</i>	<i>10</i>
<i>Temp. Comp. (Temperature Compensation).....</i>	<i>10</i>
<i>Temp. Val (Temperature Value)</i>	<i>10</i>
<i>Area</i>	<i>10</i>
<i>R.Dens. (Relative Density).....</i>	<i>10</i>
<i>K.Fact. (K Factor).....</i>	<i>10</i>
MEASUREMENT MODES.....	11
<i>Differential Pressure</i>	<i>11</i>
<i>Velocity.....</i>	<i>11</i>
<i>Volume Flow.....</i>	<i>12</i>
<i>Mass Flow</i>	<i>13</i>
<i>Temperature</i>	<i>13</i>
<i>Absolute Pressure</i>	<i>13</i>
<i>Gauge Pressure</i>	<i>13</i>
DATALOGGING	14
<i>Storing Data</i>	<i>14</i>
<i>Viewing Logged Data</i>	<i>14</i>
<i>Printing Logged Data.....</i>	<i>15</i>
<i>Deleting Logged Data.....</i>	<i>15</i>
PITOT CONNECTION METHODS.....	16
<i>MO521 Pitot Static Tube</i>	<i>16</i>
<i>FCO522 Temperature probe</i>	<i>17</i>
<i>FCO521 Pitot Static Tube</i>	<i>18</i>
RS232 INTERFACE.....	19
<i>Power Supply Considerations.....</i>	<i>19</i>
<i>Communication Settings.....</i>	<i>19</i>
<i>Connecting to a Printer</i>	<i>19</i>
<i>Connecting to a Computer.....</i>	<i>19</i>
SERVICING	20
<i>Battery Replacement.....</i>	<i>20</i>

<i>Contrast Adjustment</i>	<i>20</i>
<i>Calibration</i>	<i>21</i>
<i>Spares</i>	<i>21</i>
CONNECTIONS	22
<i>External Power Connector</i>	<i>22</i>
<i>RS232 Output.....</i>	<i>22</i>
<i>Temperature sensor port.....</i>	<i>22</i>
ERROR MESSAGES	23
MENU STRUCTURE	24
SPECIFICATION	25
INDEX	26

REVISION RECORD

<u>Issue</u>	<u>Date</u>	<u>Summary of changes</u>
1	19.02.1997	First release.
2	30.10.2007	Change of manual format. Accuracy statement amended.
3	03.06.2015	Specification updated

SAFETY NOTES AND RECOMMENDATIONS

PLEASE READ CAREFULLY

1. Do not use the instrument in wet conditions.
2. Servicing should only be carried by a qualified engineer.
3. Do not use the soft tubing supplied at pressures greater than ± 0.5 bar gauge (0.5 to 1.5 bar absolute).
4. The maximum static pressure is 1 bar gauge (2 bar absolute).
5. The maximum differential overload is 10 times the instrument range.
6. When running from an external DC supply ensure the supply is adequate for the purpose: 7.5 VDC $\pm 25\%$ minimum 100mA.
7. The maximum recommended recalibration interval is 12 months.

INTRODUCTION

General Description

The FCO520 ***AirPro*** is a hand held, pressure and flow meter that has been developed to meet the needs of heating and ventilation engineers. It features multiple measurement capabilities and can be used to measure:

- ◆ Differential Pressure
- ◆ Velocity
- ◆ Volumetric Flow
- ◆ Mass Flow
- ◆ Temperature
- ◆ Absolute Pressure
- ◆ Gauge Pressure

As standard, the ***AirPro*** can measure differential pressure using the inbuilt, sensitive Furness Controls transducer. The instrument is supplied with a pitot static tube for velocity and flow measurements. For accurate measurements, the temperature and pressure need to be known. These can either be entered into the ***AirPro*** using the instruments easy to use menu system or they can be measured. To measure temperature, an additional temperature sensor is required. This can be the FCO521 Pitot Static Tube which incorporates a temperature probe or the FCO522 temperature probe. An optional absolute pressure transducer fitted within the ***AirPro*** allows absolute pressure and gauge pressures to be measured.

Through the use of microprocessor technology, the ***AirPro*** offers many features that facilitate easy measurement under varying conditions. Some of the main features that have been designed in for ease of use are:

- ◆ 2500 point **Datalogger** with calculation of **minimum, maximum and average**.
- ◆ **RS232 interface** allows retrieval of logged data to a printer or computer
- ◆ **Multiple Engineering Units** accessible from single push button
- ◆ **Clear front panel** layout
- ◆ **Easy entry** of Duct area, Density temperature and pressure
- ◆ **Variable damping** for measurement of fluctuating pressures or flows
- ◆ **Large character display** for easy readout
- ◆ **High brightness** backlighting for easy viewing in poor light

OPERATION

Instrument Functions (direct access from buttons)

A yellow rounded rectangular button with the text "ON/OFF" in black.**ON/OFF**

Turns power to the instrument on and off. If no buttons are pressed for 20 minutes the FCO520 will automatically turn itself off to conserve the batteries. On power up the display shows the issue number of the software.

A yellow rounded rectangular button with the text "LIGHT" in black.**LIGHT**

Turns the display backlight on and off. If no buttons are pressed for 5 minutes the backlight will automatically be turned off to conserve the batteries.

A yellow rounded rectangular button with the text "Esc." on the top line and "DAMPING" on the bottom line, both in black.**Esc.
DAMPING**

This button has a dual function:

Esc: In the menu system Esc can be used to exit from setting a value without saving the altered data. This button also returns to the measuring display from the menu system.

Damping:

When the measuring display is active the button switches between FAST, MEDIUM and SLOW damping. The first press of the button displays the current setting; subsequent button presses change the setting. With traditional instruments a large damping factor causes a very slow rise time on selection of a high damping level. The FCO520 resets the damping filter when the damping button is pressed and so can eliminate this delay.

A yellow rounded rectangular button with the text "ENTER" on the top line and "MODE" on the bottom line, both in black.**ENTER
MODE**

This button has a dual function:

Enter:

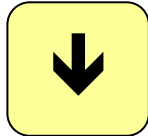
In the menu system the Enter button changes between the parameter's label and it's set value. The button is also used to accept the new value and return to the parameter label display.

Mode:

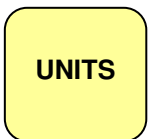
At the measuring display, the Mode button is used to toggle the display between D.P., Velocity, Volume Flow, Mass Flow, Temperature, Absolute Pressure, and Gauge Pressure. Note that Temperature, Absolute Pressure and Gauge Pressure are only displayed if the appropriate sensors are fitted. The first press of the button will display the mode in operation, pressing again will toggle to the next mode.



The ↑ button steps through the menu system, view and store data options or increments the value of numeric data.



The ↓ button steps through the menu system, view and store data options or decrements the value of numeric data.



The units button is used to change the engineering units of the measuring display (where appropriate). It can be used at the main measuring display and within the menu system.



This is used to manually zero the differential pressure (D.P.) and to offset the Absolute Pressure sensor in gauge mode.

If the display mode is D.P., Velocity, Volume Flow, or Mass Flow, pressing the button will zero the display and store the data.

If the display mode is Gauge Pressure, the current Absolute Pressure is stored as a zero offset.

The differential pressure transducer used in the FCO520 is attitude sensitive. It is therefore important to take measurements with the FCO520 in the same plane as it was last zeroed.



The store button stores the displayed value in the next free memory location. The record number and log point are displayed for a short time (e.g., RO1 Pt10). 'Rec. Full' is displayed if there is no space left in the selected record. Each time this button is used the log point number is incremented automatically.



The VIEW button puts the data logger into view mode. The ↑ or ↓ and **ENTER** buttons are then used to view the logged points within the selected data log record.

MENU DETAILS

To access the menus press the ↑ or ↓ button from the measuring display. The details are shown in the order of pressing the ↑ key. Press the Enter button to show the current setting. The ↑ and ↓ buttons can be used to change the current setting. To save changes press the Enter button.

To exit without storing any changes press Esc.

The display will revert back to the menu title after a period of 20 seconds if no buttons are pressed.

Log Rec. (Log Record Number)

Purpose: Selects the record number (1...50) for the datalogger to use for storing, viewing or printing.

Log Pt. (Log Point Number)

Purpose: Selects the next point to log in the selected record. This is to allow the last point (Or few points) to be retaken. Note you can only step back from the last point taken. If the point is set to 1, all data in the log record is erased and the record is reinitialised.

Print

Purpose: When Enter is pressed the data for the Log Record selected will be printed. To exit without printing press the Esc button instead of Enter. While the data is being printed a "*" character is displayed. To stop printing press the Esc button.

Pr. Comp (Pressure Compensation)

Purpose: Choose the source of the pressure compensation value used for velocity and flow calculations. This menu is not available if the optional sensor is not fitted.

Options: Sensor, Value.

Sensor: The pressure signal from the Internal absolute pressure sensor is used.

Value: The value entered for the "Pr. Val" parameter is used (See below).

Pr. Val. (Pressure Value)

- Purpose: To provide a value for absolute pressure if the absolute pressure sensor is not to be used or is not fitted. This value is used in the velocity and flow calculations.
- Options: Value from 800 to 1500mb. Set to 1013mb if no compensation is required.

Temp. Comp. (Temperature Compensation)

- Purpose: Choose the source of temperature compensation for velocity and flow calculations. This automatically corrects for air density changes with temperature.
- Options: Sensor, Value

Sensor: The temperature signal from the external sensor is used.

Value: The value entered in the Tmp.Val parameter is used (see below).

Temp. Val (Temperature Value)

- Purpose: To provide a value for temperature if the external sensor is not to be used or is not fitted. This value is used in the velocity and flow calculations.
- Options: Value from -10°C to 500°C. Set to 15°C if no compensation is required.

Area

- Purpose: To allow calculations of mass flow and volumetric flow.
- Options: Enter the duct area in the range of 10 to 30000cm² or 0.01 to 30ft².

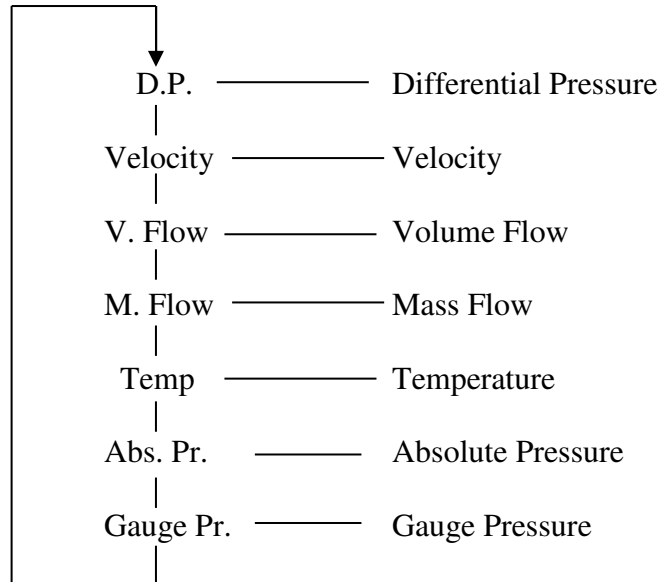
R.Dens. (Relative Density)

- Purpose: To enter the value for the relative density of the gas being measured to calculate velocity, mass flow and volumetric flow.
- Options: The range of values is 0.50 to 3.00. The value for air is 1.00.

K.Fact. (K Factor)

- Purpose: The K factor is a pitot static tube scaling factor. Different designs of pitot static tubes give different differential pressures for the same flow.
- Options: The K factor limits are from 0.5 to 3.0. The standard Furness Controls pitot static tube has a K factor of 1.0. The FCO521 Pitot Static Tube with temperature sensor has a K factor of 1.6.

MEASUREMENT MODES



Pressing the mode button once to show which mode is in operation. Double pressing changes to the next mode.

Differential Pressure

The D.P mode displays differential pressure directly in any of the following units.

Pa	Pascals
kP	Kilo Pascals
mb	millibar
PS	Pounds per square inch (PSI)
mm	mmH ₂ O
"	Inches H ₂ O

Velocity

The velocity mode converts the differential pressure signal from a pitot static tube to give velocity readings. The velocity calculation uses the pressure compensation, temperature compensation, K factor and Relative Density parameters. The units available are as follows:

m/s	Metres/Second
f/s	Feet/Second

For velocity readings with Pitots and no temperature or absolute pressure sensors set the following data.

Pr Comp	To Value
Pr Val	Set the absolute pressure of the system. If this is not known set to 1013mbar. Setting to 1013mbar will in effect disable the compensation for absolute pressure.
Tmp.Comp.	To Value
Tmp. Val	Set to the temperature of the system if known or as near as possible. Setting to a value of 15°C will effectively disable the temperature compensation.
R.Dens.	Set to 1.00 for air.
K. Fact.	For the bent type pitot static tube, the K. factor is 1.0. For the straight type tube (Fore & Aft) the K factor is 1.6. For other pitot static tubes, contact the manufacturer for details of factors.

For the FCO521 Pitot Static Tube with temperature sensor and an instrument with an absolute pressure sensor set the data as follows.

PR Comp.	Sensor
T.Comp.	Sensor
K.Fact.	1.6

Note: Pr.Val and Tmp.Val. are not used.

Volume Flow

The volume flow is calculated from the velocity and the duct area. Set the data as for velocity and the duct area as required.

All readings are corrected to volume at standard conditions of 1013mb, 15°C.
The units available are as follows:

m ³ /s	cubic metres/second
m ³ /h	cubic metres/hour
f ³ /s	cubic feet/second
CFM	cubic feet/minute

Mass Flow

Mass flow is calculated from Volume flow and density. Set the data as for volume flow which already includes density. The units available are as below:

kg/s	Kilograms/Second
lb/s	Pounds/Second

Temperature

When fitted with an external sensor the temperature can be displayed as °C or °F. If no sensor is connected, the message "ERROR T" is displayed.

Absolute Pressure

When the instrument is fitted with the absolute pressure sensor this mode is available and will show the absolute pressure. The units displayed are as follows:

mbar	millibar
"Hg	inches of Mercury
PSI	Pounds per square inch

Gauge Pressure

The absolute pressure sensor can be offset to give a gauge pressure reading. With the gauge pressure display active and the FCO520's pressure ports open to atmosphere press the zero button. This will zero the display removing any offset due to the atmospheric pressure.

Note: The zero is held in internal memory and will not change if the display mode is changed. Atmospheric pressure will vary and the zero of the gauge pressure display should be checked at regular intervals. If using the FCO520 as a pressure gauge, both ports must be connected to the pressure source to ensure that a differential pressure beyond the instruments D.P range is not applied to the instrument.

The units available are:

mbar	millibar
"Hg	inches of Mercury
PSI	Pounds per square inch

DATALOGGING

The datalogger allows 50 records each with up to 50 points to be logged into non-volatile memory (EEPROM). From the points stored values for average, minimum and maximum are calculated and can be displayed or printed.

Storing Data

To store data select a record number using the **Log Rec** Menu. For a new instrument the **Log Pt** will be set to 1. If a record has data previously stored the **Log Pt** will automatically start at the end of the stored data. To overwrite a record reset the **Log Pt** to 1. Select the mode and units required for the record and press the store button to log the displayed data. If the data is stored successfully the record number and Log point number is displayed for a short time. If the record is full a warning message is given. If data is being added to an existing record which already contains data the same mode must be used for the new data as the existing data. Each record can only hold data stored using the same mode as the first Pt. If the mode is not set as per the original, no data is stored.

If an incorrect entry is made or a particular point re-taken then use the **Log Pt** menu to select the point to be changed and then use the Store button to enter the new information.

Note: Any further store operations will continue from this point. All points above this number will be erased and will need to be re-logged.

Viewing Logged Data

To view data, use the **Log Rec** menu to select the record to view. Press the **View** button and the selected record and last logged point number will be displayed. To view the point press **Enter**. To view other points in the same record use the **↑** and **↓** buttons. The **↑** and **↓** buttons are also used to display the minimum, maximum and average values as shown below:

R01 Pt03
R01 Pt02
R01 Pt01
AVRG
MAX
MIN

Printing Logged Data

Data can be sent out using the RS232 interface to a printer or P.C. To print data use the **Log Rec** menu to select the record to be printed. Use the **Print** menu to output the information. Only the record selected will be printed. To print more than one record use the **Log Rec** menu to select another record and then print that. All the points held in the record will be printed including the Minimum, Maximum, Average and units.

Sample:

Record 2: Eleven differential pressures logged.

MIN	0.00mm
MAX	8.21mm
AVRG	4.85mm
R02 Pt01	5.71mm
R02 Pt02	5.76mm
R02 Pt03	5.94mm
R02 Pt04	6.22mm
R02 Pt05	6.67mm
R02 Pt06	7.12mm
R02 Pt07	7.70mm
R02 Pt08	8.21mm
R02 Pt09	0.00mm
R02 Pt10	0.00mm
R02 Pt11	0.00mm

Record 3: Eight Velocity readings logged.

MIN	6.6m/s
MAX	9.3m/s
AVRG	8.5m/s
R03 Pt01	6.6m/s
R03 Pt02	6.9m/s
R03 Pt03	8.3m/s
R03 Pt04	9.2m/s
R03 Pt05	9.3m/s
R03 Pt06	9.3m/s
R03 Pt07	9.3m/s
R03 Pt08	9.0m/s

Deleting Logged Data

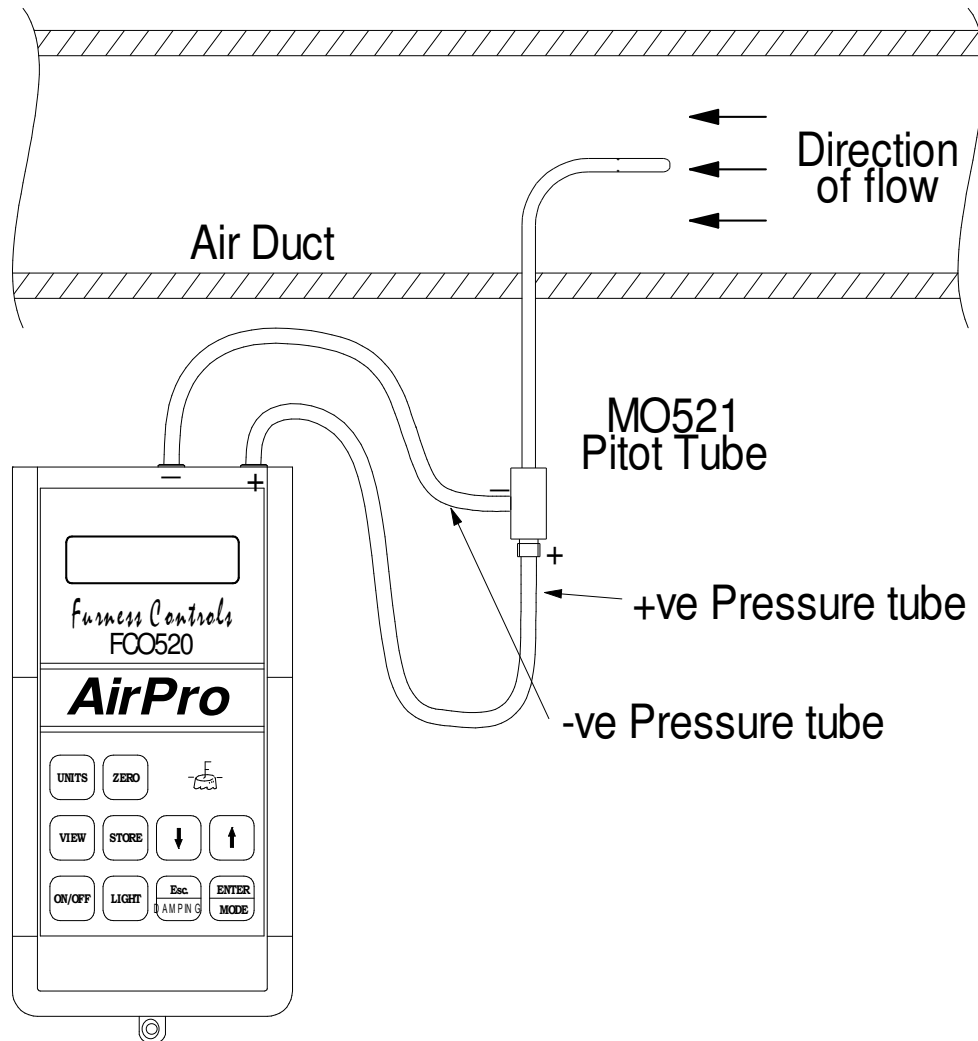
To delete logged data:

- Select a record number using the **Log Rec** Menu.
- Enter the **Log Pt** menu. The last data point will be displayed.
- Use the ↓ button to set the log point to 1 then press **ENTER**.

Note that each record must be erased separately.

PITOT CONNECTION METHODS

MO521 Pitot Static Tube

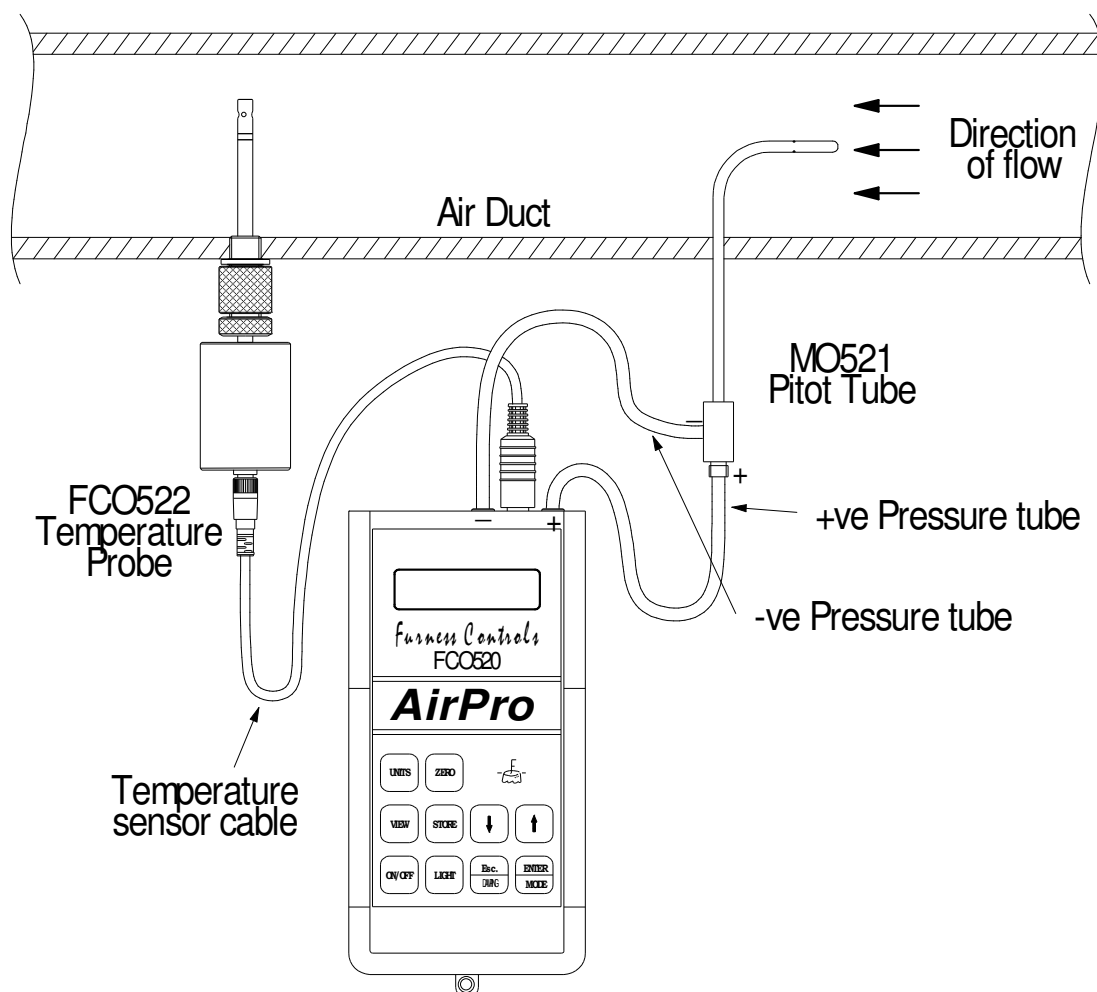


When using the MO521 Pitot Static Tube to measure flow or velocity, the nose of the pitot static tube must be pointing directly into the flow stream. The Positive pressure port of the FCO520 is connected to the lower pressure port of the pitot static tube and the negative pressure port of the FCO520 is connected to the upper pressure port of the pitot static tube.

The MO521 has a K factor of 1. This must be set in the FCO520's **K. Fact** menu. The temperature of the air in the duct must be measured or estimated and entered into the FCO520's **Temp.Val** menu. If the FCO520 is not fitted with an absolute sensor, the absolute pressure in the duct must also be measured or estimated and entered into the FCO520's **Pr.Val.** menu.

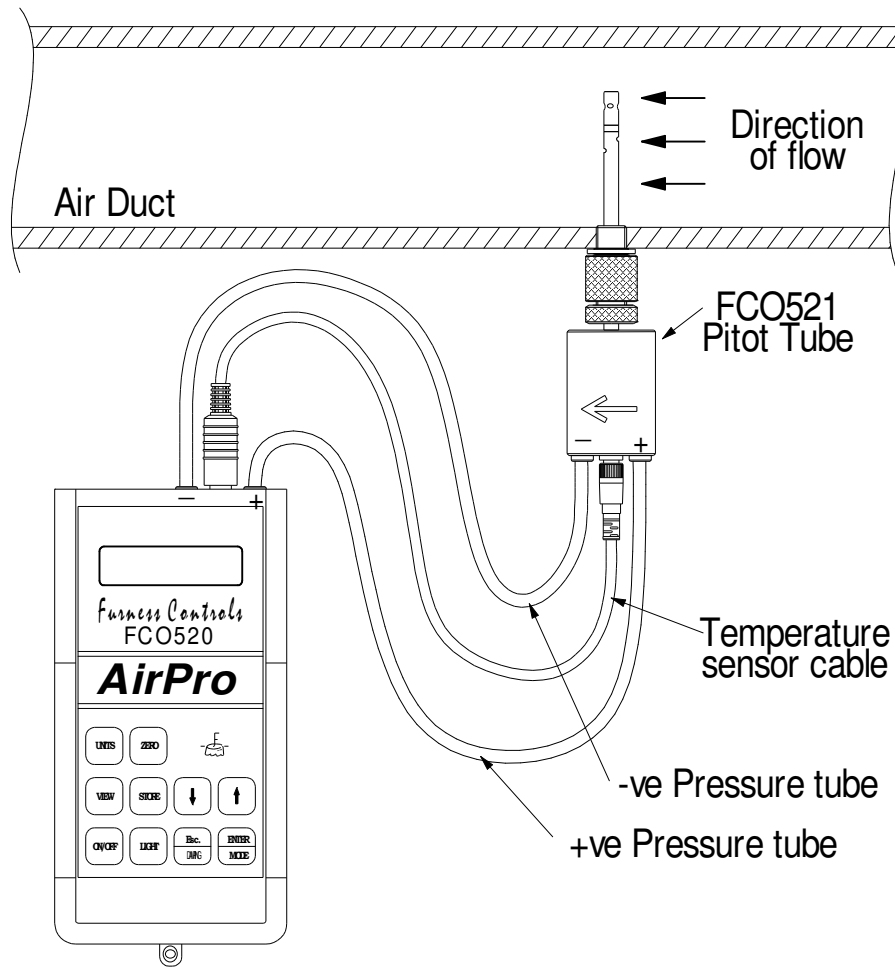
Remember to enter the duct area into the FCO520 if volumetric or mass flow measurements are being made.

FCO522 Temperature probe



The FCO522 temperature probe can be used with any pitot static tube or on its own to measure the gas temperature within a duct. The FCO520 must have its **Temp. Comp.** menu set to **Sensor** if the measured temperature is to be used when the FCO520 calculates velocity or flow readings.

FCO521 Pitot Static Tube



When using the FCO521 Pitot Static Tube to measure flow or velocity, the arrow on the pitot static tube body must be in the same direction as the flow in the duct. The Positive pressure port of the FCO520 is connected to the positive pressure port of the pitot static tube and the negative pressure port of the FCO520 is connected to the negative pressure port of the pitot static tube.

The FCO521 has a K factor of 1.6. This must be set in the FCO520's **K. Fact** menu.

The temperature of the air in the duct is measured by the sensor in the tip of the FCO521. The FCO520 must have its **Temp. Comp.** menu set to **Sensor** if the measured temperature is to be used when the FCO520 calculates velocity or flow readings.

If the FCO520 is not fitted with an absolute sensor, the absolute pressure in the duct must be measured or estimated and entered into the FCO520's **Pr.Val.** menu.

Remember to enter the duct area into the FCO520 if volumetric or mass flow measurements are being made.

RS232 INTERFACE

Power Supply Considerations

If the RS232 is being used, the instrument should be powered from an external power supply to prolong battery life. To save power the RS232 output only uses power when the enable pins are linked. These pins are linked in the MO1294 adapter cable supplied with the instrument and hence the cable should be disconnected when the RS232 port is not being used.

Communication Settings

The FCO520 uses fixed settings for the RS232 interface. These are:

Baud Rate - 2400
Parity - None
Start bits - 1
Data bits - 8
Stop bits - 1
Handshake - Hardware (using CTS line)

As there is no output handshake line from the FCO520, it is not possible to disable the handshaking. It is important therefore that the CTS line on the FCO520 is connected to the DTR pin on the attached printer or computer.

Connecting to a Printer

PRINTER		MO1294 Adapter cable	
25-way D connector		9-way D connector	
2	Tx -----	2	Rx
3	Rx -----	3	Tx
7	GND -----	5	GND
20	DTR -----	8	CTS

Connecting to a Computer

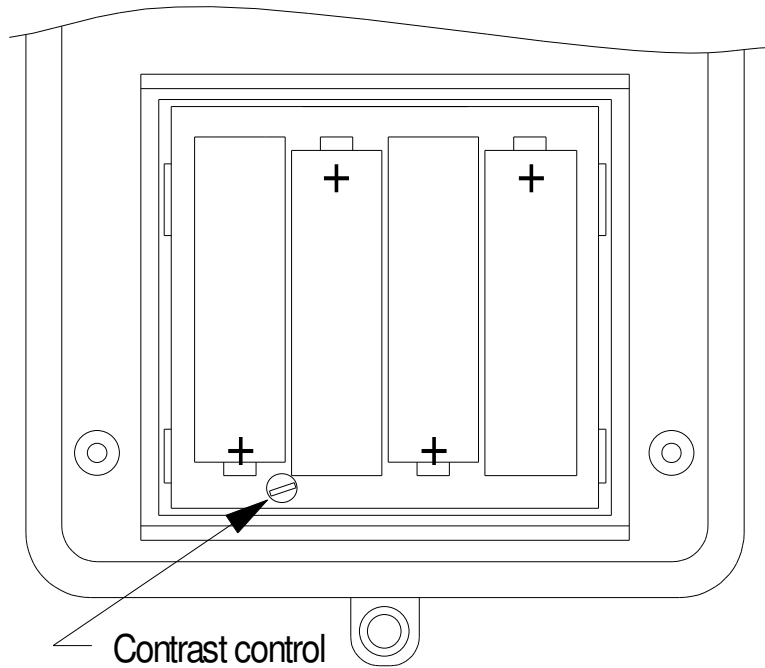
The MO1294 adapter cable will plug directly into a 9-pin RS232 port of a P.C.

To receive data from the FCO520 a proprietary communication program can be used, such as Procom or Windows Terminal.

SERVICING

Battery Replacement

Access to the batteries is obtained by pressing, sliding down and removing the battery compartment cover at the rear of the FCO520.



The FCO520 will operate from any battery type e.g.: Alkaline Nicad, Zinc Carbon etc. However for best performance and battery life, alkaline cells should be used.

All batteries should be replaced at the same time. Use only 1.5V AA size batteries.

Contrast Adjustment

The contrast adjustment for the FCO520 display is accessible through the battery compartment. Using a thin flat bladed instrument screwdriver it is possible to adjust the contrast with the batteries still fitted. If an external power supply is available, this can be used and the batteries can then be removed to make the adjustment easier.

Calibration

There are no user adjustments or serviceable parts inside the FCO520 and all re-calibration must be carried out at Furness Controls. It is recommended that the instruments calibration is checked every twelve months. Contact Furness Controls for advice.

Spares

FCO521	Straight Pitot Static Tube with built-in temperature probe
FCO522	Straight Temperature probe
MO521	90° Pitot Static Tube
A5030	Twin silicon tubing 1 metre length
A4603	Twin silicon tubing 2 metre length
MO1248	Temperature probe cable 1 metre length
MO1303	Temperature probe cable 2 metre length
MO1294	FCO520 to 9 pin computer cable 1 metre length
A5032	Power supply UK
A5033	Power supply European
FCO65	90° Pitot Static Tube
FCO66	Straight Pitot Static Tube
FCO68	Averaging Pitot Static Tube

Note: The absolute sensor option for the FCO520 needs to be installed and set-up at Furness Controls. Please contact Furness controls for more information.

CONNECTIONS

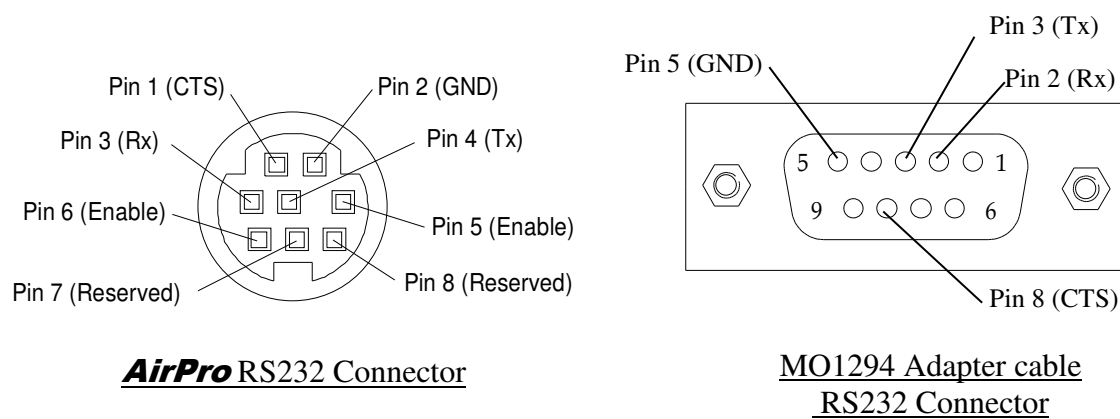
External Power Connector

The external power connector uses a 2.5mm power connector.

External Supply: Regulated 7.5VDC, 100mA

+V Centre Pin
-V Outer Connector

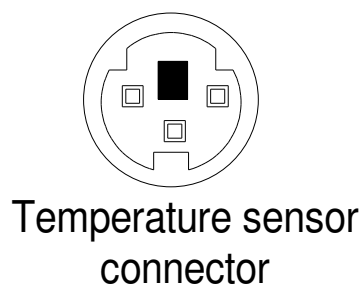
RS232 Output



The RS232 port uses an 8 pin mini DIN Connector.

Note: Pins 5 & 6 must be linked to enable the RS232 port. These pins are already linked in the adapter cable.

Temperature sensor port



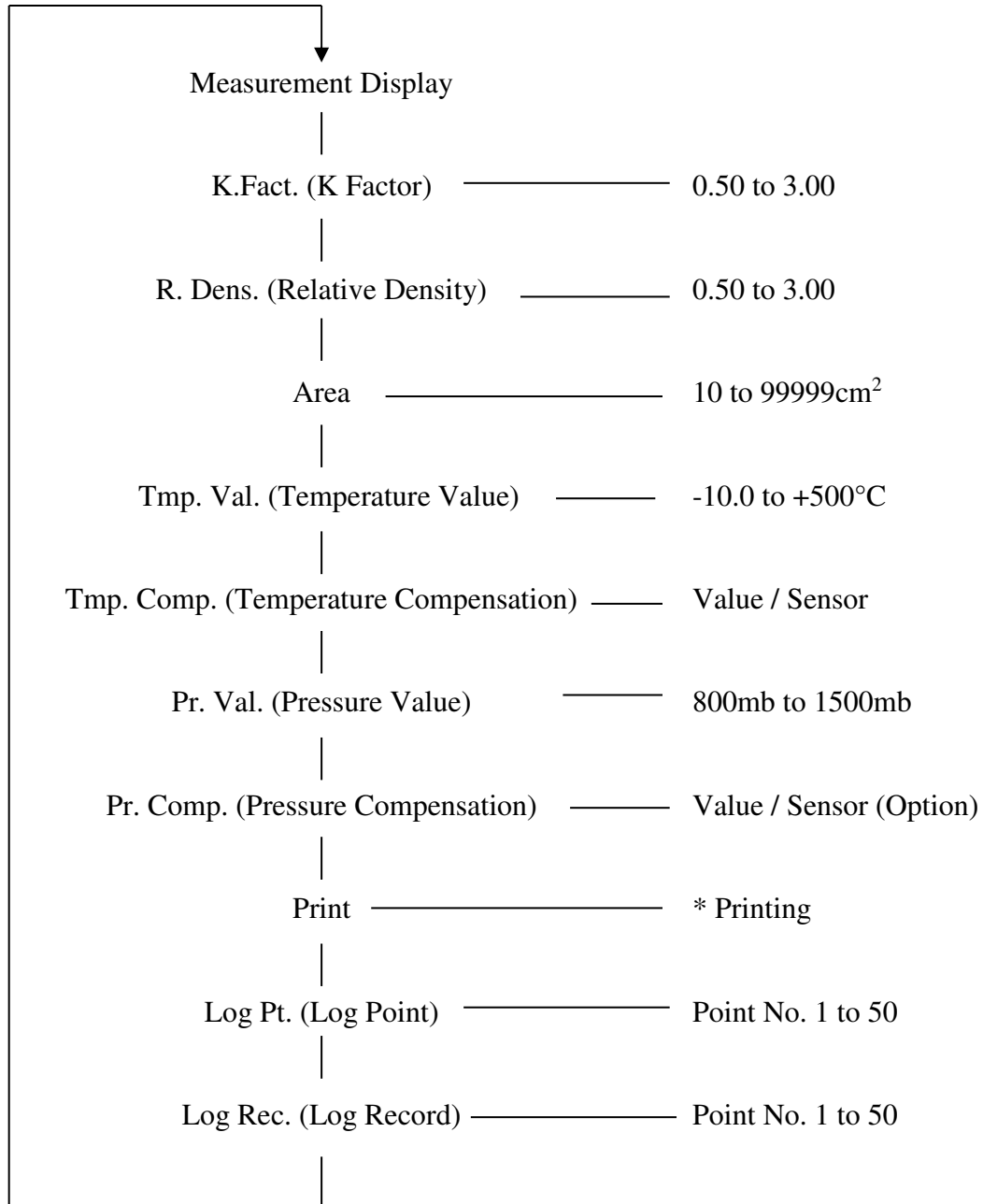
The temperature sensor port uses a 3 pin mini DIN Connector.

Only temperature probes supplied by Furness Controls can be connected to this port.

ERROR MESSAGES

- Message: **Error C**
The calibration figures stored in EEPROM may have been corrupted. Contact Furness Controls.
- Message: **Error U**
The User set data stored in EEPROM may have been corrupted. Check all set data. Setting any value will reset the checksum and clear the error message.
- Message: **Error T**
Temperature sensor error. Instruments that have the temperature probe option will display this error message when the sensor is unplugged or damaged. The message will be seen when the main display is set for temperature, or when the main display is set for velocity/flow and temperature compensation is set to use the sensor. Velocity/flow displays can be restored by setting "Pr. Comp" to "Value" and setting the correct temperature in "Tmp Val."
- Message: **Rnn Full**
The datalogger record is full. (all to points are filled). The log point must be set back to 1 to clear the record. Retrieve any logged data from the record if it required before erasing it.

MENU STRUCTURE



To move up or down the menu use the ↑ and ↓ buttons. To alter parameters use Enter and then the ↑ and ↓ buttons. After changing parameters use the Enter button to confirm the change or Esc to return to the menu without saving changes.

SPECIFICATION

Features

Ranges	Model 1 $\pm 600.0\text{Pa}$ 31m/s Model 2 $\pm 6.000\text{kPa}$ 100m/s Model 3 $\pm 20.00\text{kPa}$ 180m/s
Engineering Units	Differential Pressure: Pa, kPa, mbar, mmH2O, "H2O, PSI Velocity: m/s, ft/s Volume Flow: m ³ /s, ft ³ /s, CFM Mass Flow: kg/s, lb/s
Damping	Fast 0.4 sec, medium 3.2 sec, slow 12.8 sec
Optional Absolute pressure	800 to 1600mbar absolute (1mbar resolution)
Optional Temperature probe	-10 to 100°C (0.1°C resolution)

Performance

Differential Pressure Accuracy @ 20°C	10% to 100% range: $< \pm (0.25\% \text{ reading} + 1 \text{ digit})$ 0 to 10% range: $< \pm (0.025\% \text{ range} + 1 \text{ digit})$
Resolution	1:6000
Overload	20 x Range
Long Term Drift (span)	< 1% per year
Static Pressure	0.5 to 1.6 bar absolute
Absolute pressure Accuracy @ 20°C	0.5% span
Temperature Accuracy	0.15°C
Battery Life	Minimum 100 hours (without backlight)
Operating Temperature	0 to 50°C
IP Rating	IP40

Construction

Enclosure	Robust ABS Plastic
Dimensions	100 x 216 x 40mm (W x H x D)
Media Compatibility	Clean dry non-corrosive gas
Power Requirements	4 x AA battery
External Power Supply	7.5VDC $\pm 25\%$
Weight	630g

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

INDEX

A

Absolute Pressure Measurement, 13
Absolute Pressure Sensor, 9, 10
Absolute Pressure Units, 13
Area, 10
Average, 14

B

Backlight, 7
Battery, 20

C

Calibration, 21
Computer Connection, 19
Contrast Adjustment, 20

D

Damping, 7
Datalogger, 14
Datalogger - Deleting, 15
Datalogger - Full, 14
Datalogger - Print, 15
Datalogger - Store, 8, 14
Datalogger - View, 8, 14
Differential Pressure Measurement, 11
Differential Pressure Units, 11
Differential Pressure Zero, 8
Down Button, 8
Duct Area, 10

E

Enter Button, 7
Error Messages, 23
Escape Button, 7
External Power Supply, 19, 22

F

FCO521 Pitot Static Tube, 12, 18
FCO522 Temperature Probe, 17

G

Gauge Pressure Measurement, 13
Gauge Pressure Units, 13
Gauge Pressure Zero, 8

K

K Factor, 10

L

Light, 7
Log Point, 9, 14
Log Record, 9, 14
Logged Data Sample, 15

M

Mass Flow Measurement, 13
Mass Flow Units, 13
Menu Structure, 24
MO1294 Cable, 19
MO1294 Cable Pin-Out, 22
MO521 Pitot Static Tube, 16
Mode Button, 7

O

On/Off, 7

P

Pitot Static Tube, 10
Pitot Static Tube Installation, 16
Power Down, 7, 14
Power Supply, 19, 22
Pressure Compensation, 9
Pressure Value, 10
Print, 9
Printer Connection, 19
Printing Logged Data, 15
Printout - Sample, 15

R

Relative Density, 10
RS232, 15
RS232 Connector, 22
RS232 Interface, 19
RS232 Pin-Out, 22
RS232 Settings, 19

S

Spares, 21
Store, 8
Storing Logged Data, 14

T

Temperature Compensation, 10
Temperature Measurement, 13
Temperature Probe Installation, 17, 18
Temperature Sensor, 10, 22
Temperature Value, 10

U

Units, 8
Up Button, 8

V

Velocity Measurement, 11

Velocity Units, 11
View, 8
Viewing Logged Data, 14
Volumetric Flow Measurement, 12
Volumetric Flow Units, 12

Z

Zero, 8