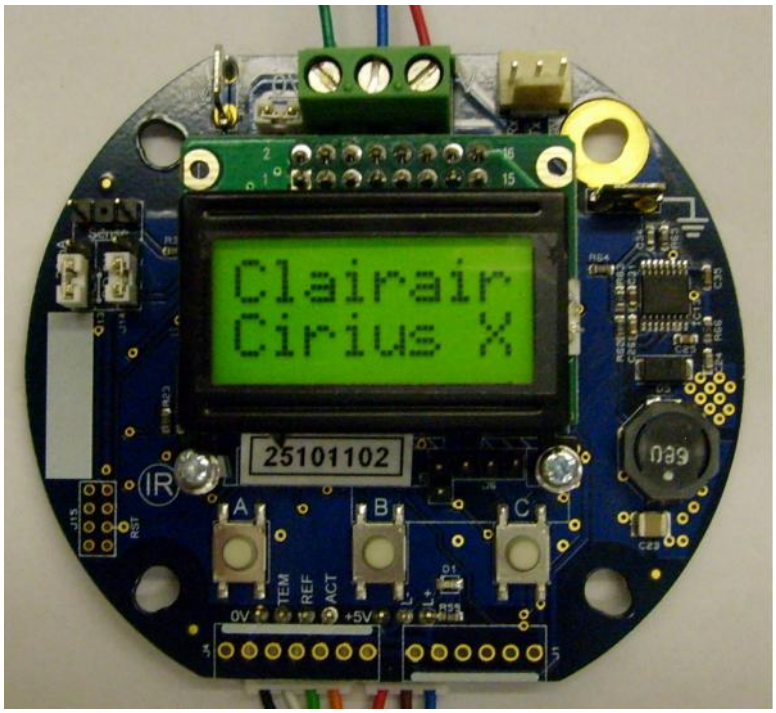
Clairair Ltd

Sensor People

Cirius X OEM 4-20mA Transmitter



Document: CM-X-001

Software version: 1.2.5

Hardware version: Issue F

Little Braxted Hall, Little Braxted, Witham, Essex, CM8 3EU, U.K
Tel: +44 (0) 1376 516414, Fax: +44 (0) 1376 516415

Little Braxted Hall, Little Braxted, Witham, Essex, CM8 3EU, U.K
Tel: +44 (0) 1376 516414, Fax: +44 (0) 1376 516415

1) Introduction

1.1 General Description & Specification

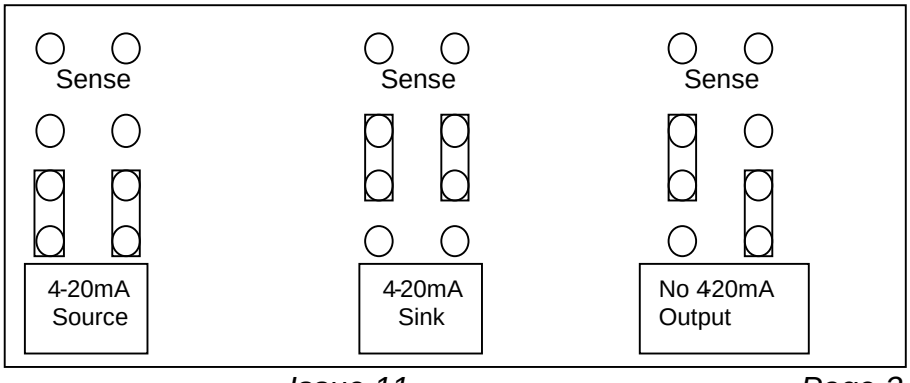
The transmitter is designed to allow original equipment manufacturers to use a range of NDIR gas sensors within their own equipment. Key features are:

- Sensor types supported: 7 pin NDIR sensors including Cirius1, Cirius2 and Cirius3
- Fully configurable for a wide range of gas types and ranges
- Voltage supply range: 8V – 32V
- Current consumption (excluding 4-20mA output and display backlight): 50mA typical
- Plug-in 2 line x 8 character display with selectable LED backlight
- Pushbutton interface (disabled when display is not connected)
- Robust 12 bit resolution link selectable source/sink 4-20mA output
- Operating temperature range (excluding display): -40°C to +75°C
- Operating temperature range (including display): -20°C to +60°C
- RS232 interface
- Lamp frequency fully adjustable between 1.0Hz and 5.0Hz
- Amplifier gains (for active and reference signals) fully adjustable over 256 settings
- 500mA resettable fuse

1.2 External Connections:

- 3 way electrical connector : PCB mounted screw terminals:
  0V = 0V supply connection
  4-20mA signal**.**
  V+ = Positive supply connection

The 4-20mA signal is link selectable as source or sink with an internal or external load. The 4-20mA sense terminals provide a 1mV/mA sense signal. The link arrangement is as follows:



Little Braxted Hall, Little Braxted, Witham, Essex, CM8 3EU, U.K
Tel: +44 (0) 1376 516414, Fax: +44 (0) 1376 516415

Note: A load MUST be connected between the 4-20mA signal and 0V terminals if the 4-20mA source links are selected. An external voltage supply MUST be connected to the 4-20mA signal terminal if the 4-20mA sink links are selected.

- RS-232 connector: 3 way SIL header:
  Rx data
  Tx data
  0V
- Earth connection spade terminal
- Additional 0V connection spade terminal

2) Configuration

The transmitter is normally provided fully configured and calibrated with an associated sensor. Any changes to the configuration will affect the performance and are the responsibility of the user. Configurations are available for both the system and the sensor. Both can be inspected and adjusted by use of the pushbutton and display interface and via the RS232 connection. Note that the pushbutton interface is disabled if the display is not connected.

2.1 Sensor Configuration:

The sensor configuration allows inspection and adjustments of the following parameters:

Full Scale Value:	Full-scale concentration
Active Gain:	Value of active signal at zero
Reference Gain:	Value of reference signal at zero
Restore:	Restore original sensor setup

2.2 System Configuration:

The system configuration allows inspection and adjustments of the following parameters:

4mA DAC zero:	4mA zero output
20mA DAC span:	16mA of full-scale output
Source frequency:	Frequency of sensor source toggling in Hz (1.0Hz – 5.0 Hz)
Positive BLK suppression:	% of full scale used for blanking the positive output to zero (maximum 5%)
Negative BLK suppression:	% of full scale used for blanking the negative output to zero (maximum 5%)
Gas Type:	Gas Type and concentration

Little Braxted Hall, Little Braxted, Witham, Essex, CM8 3EU, U.K
Tel: +44 (0) 1376 516414, Fax: +44 (0) 1376 516415

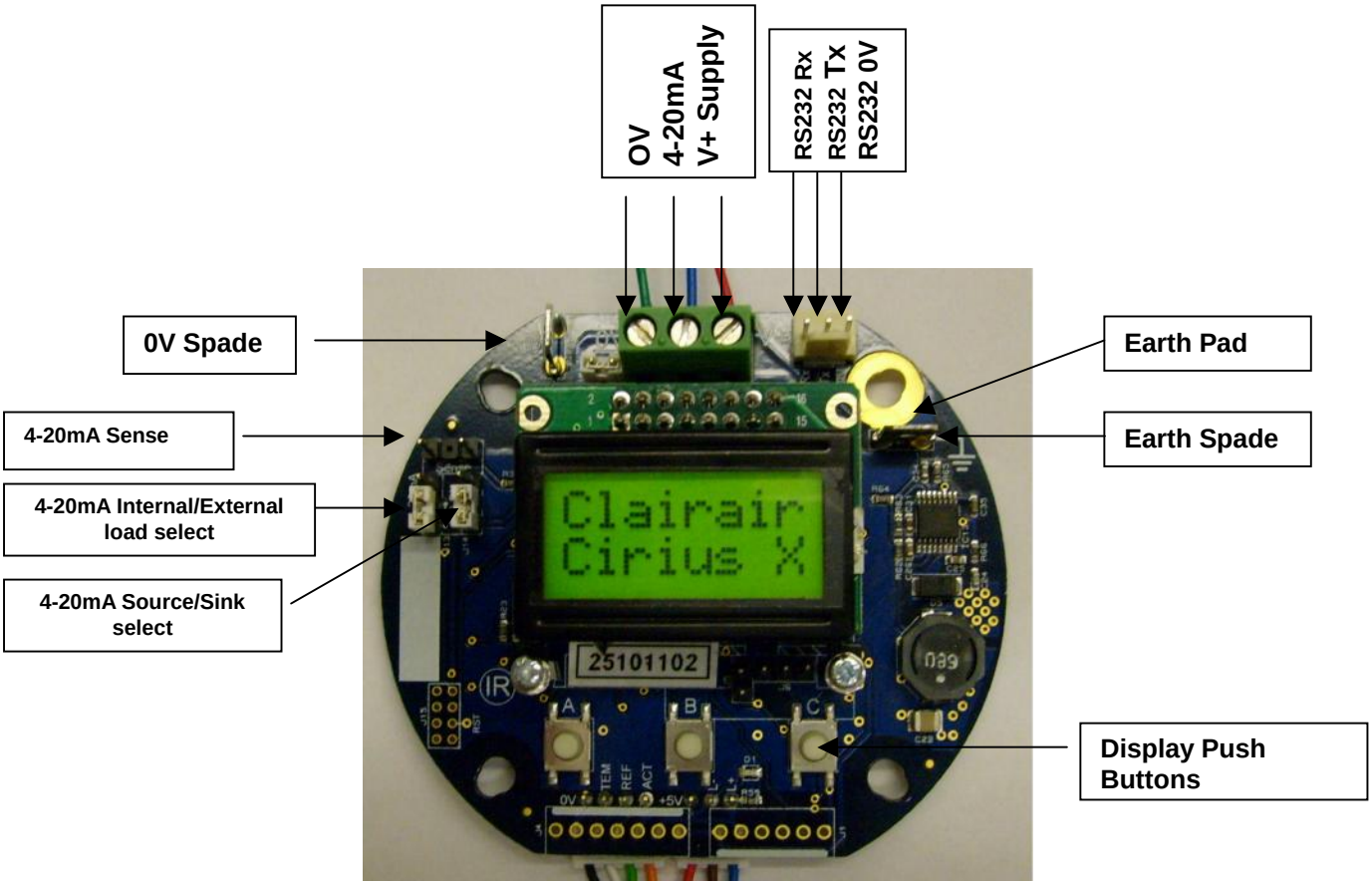
3) Operation

3.1 Field Connections:

A 3 way screw terminal connector block is provided on the top of the transmitter PCB for field connections of incoming power and the 4-20mA output. An earthing pad is also provided for field earth connections if required. Additionally, a 3-way SIL header is provided for RS232 connections. Sensor connections are made to a 7 way header located beneath the switches. Connections are also provided for an optional Hall effect switch PCB to allow "through the glass" calibration. Four fixing holes are provided to enable the transmitter to be fitted into various standard junction boxes, one fixing hole includes the optional earthing pad if required.

Basic connections required:

1) Connect the sensor to the PCB using the 3 and 4 way sensor connectors.
2) Connect the incoming power supply to 0V and V+ supply terminals
3) Connect the 4-20mA signal via an appropriate load resistor to 0V in 4-20mA source mode
4) Connect the 4-20mA signal to an appropriate external voltage (>5V, <30V) in 4-20mA sink mode



Optional connections:

1) Connect the RS232 header connections to a suitable RS232 interface

Little Braxted Hall, Little Braxted, Witham, Essex, CM8 3EU, U.K
Tel: +44 (0) 1376 516414, Fax: +44 (0) 1376 516415

3.2 Initial Startup and Normal Operation:

Once all the appropriate connections have been made the transmitter can be powered up. The display will show a sign on message followed by a 20 second warm up countdown. Following the warm up period, gas level, concentration and gas type will be displayed during normal monitoring mode.

Allow to stabilise for at least 30 minutes

Three switches are available for interfacing with the transmitter. These are labelled “A”, “B” and “C”. When in a menu the bottom line of the display shows the action available for each switch in the order “A” on the left, “B” in the centre and “C” on the right. The following instructions refer to the actions shown on the display line where appropriate and the relevant switch is inferred from the position on the display line.

3.3 Resetting the Transmitter:

In the event that the transmitter needs to be reset, there are two ways to do this: Either press and hold all 3 buttons “A”, “B” and “C” then release button “A” or reset via the system menu as described in section 7.7. The transmitter will reset and enter the initial startup phase.

4) Calibration Mode:

Before performing a zero or span calibration, test gas should be applied to the sensor for sufficient time to ensure the sensor has stabilised, as indicated by the reading on the display. To maintain balance with ambient air humidity levels when using calibration gases it is recommended that a short length of Nafion tubing be used in the gas sampling line. A gas flow rate of between 250ml/min and 500ml/min is recommended. The three push buttons are a positional representation of the commands at the bottom of the display.

4.1 Zero Calibration

Before performing a zero calibration the signal levels should be checked by entering the “View Data” mode (see 5.1 below) while applying zero gas to the sensor. Should either active or reference signals exceed 3800 counts then the appropriate gain level should be reduced (see 6.2 and 6.3 below).

Press button “A” to enter “Cal Mode” and then press “Y” to go to “Set Zero”. Press “Y” again to enter “Set Zero”. Once the zero gas has been applied long enough for the reading to stabilse, the zero calibration is performed by holding down “Z” as indicated on the display. The displayed concentration will be set to zero. “Z” can be pressed as often as necessary to set the zero level. Press “X” to return to Cal Mode.

To return to normal monitoring press “X” when in “Cal Mode”.

4.2 Span Calibration

Press button “A” to enter “Cal Mode” and then press “Y” followed by “→” to go to “Set Span”. Press “Y” again to enter “Set Span”. If necessary, adjust the span gas concentration to the gas level using the “+” and “–“ buttons then accept the calibration gas level by pressing “Y”. Press “Y” to enter the span calibration mode. Once the span gas has been applied long enough for the reading to stabilse, the span calibration is performed by pressing “S” as indicated on the display. “S” can be pressed as often as necessary in order to set the span. Now press “X” to return to “Cal Mode”.

To return to normal monitoring press “X” when in “Cal Mode”.

Little Braxted Hall, Little Braxted, Witham, Essex, CM8 3EU, U.K
Tel: +44 (0) 1376 516414, Fax: +44 (0) 1376 516415

5) View Data

5.1 View Data

In the View Data mode it is possible to view the active and reference counts, the gas concentration and the temperature inside the sensor. To enter “View Data” press button A to enter “Cal Mode” and then scroll to “View Data” by pressing “→”. Press “Y” to enter the view data mode. This then starts the display rolling between the two screens that indicate the active and reference counts, gas concentration and sensor temperature.

To return to normal monitoring press any button and then “X”.

6) Sensor Configuration Menu:

There are several sensor configuration functions that can be interrogated and/or adjusted. It is recommended that a copy of the configuration be made before any changes are performed.

6.1 Full Scale Value

To adjust the Full Scale Value, press button “A” to enter “Cal Mode” and then scroll to “Sen Menu” by pressing “→” twice. In “Sen Menu” press “Y” and select “Set FSD” by pressing “Y” again. Now the FSD reading can be adjusted using the “+” or “–“ buttons and accepted by pressing “Y” and returning to the “Sen Menu”.

To return to normal monitoring press “X”.

6.2 Active Gain

The amplifier gain for the active channel is set by a 256 step digital potentiometer. Note that zero calibration gas must be applied during this procedure. To adjust the Active Gain press button “A” to enter “Cal Mode” and then scroll to “Sen Menu” by pressing “→” twice. In “Sen Menu” press “Y” to enter “Set FSD” followed by “→” to scroll to “Set gAct”. Press “Y” to enter “Set gAct”. The display shows the peak to peak counts for the active signal. Press “+” or “–“ to change the value if required. A recommended displayed counts value is 3200 in zero gas at 20°C. Press “Y” to accept the value and return to the “Sen Menu”.

To return to normal monitoring press “X”.

6.3 Reference Gain

The amplifier gain for the reference channel is set by a 256 step digital potentiometer. To adjust the Reference Gain press button “A” to enter “Cal Mode” and then scroll to “Sen Menu” by pressing “→” twice. In “Sen Menu” press “Y” to enter “Set FSD” followed by “→” twice to scroll to “Set gRef”. Press “Y” to enter “Set gRef”. The display shows the peak to peak counts for the reference signal. Press “+” or “–“ to change the value if required. A recommended displayed counts value is 3200 in zero gas at 20°C. Press “Y” to accept the value and return to the “Sen Menu”.

To return to normal monitoring press “X”.

Little Braxted Hall, Little Braxted, Witham, Essex, CM8 3EU, U.K
Tel: +44 (0) 1376 516414, Fax: +44 (0) 1376 516415

6.4 Relative Response

The relative response is adjustable between 0.3 and 3.3 with a default value of 1.0. The relative response is applied as a linear factor to the gas concentration so increasing the relative response results in larger concentration values for a given sensor response.

To adjust the relative response press button “A” to enter “Cal Mode” and then scroll to “Sen Menu” by pressing “→” twice. In “Sen Menu” press “Y” to enter “Set FSD” followed by “→” three times to scroll to “RelResp?”. Press “Y” to enter “RelResp”. The display shows the current relative response as "RR = X.X" where X.X is the relative response. Press “+” or “–“ to change the value if required. Press “Y” to accept the value and return to the “Sen Menu”.

To return to normal monitoring press “X”.

6.5 Restore

In the event of accidentally corrupting the sensor setup or the calibration the system can be restored to the original settings by using the restore facility.

To restore the sensor setup press button “A” to enter “Cal Mode” and then scroll to “Sen Menu” by pressing “→” twice. In “Sen Menu” press “Y” to enter “Set FSD” followed by “→” four times to scroll to “Restore?”. Press “Y” to enter the restore facility or “X” to return to “Sen Menu”. If “Y” is pressed, the display will respond with “Confirm?”. Press “Y” to restore the sensor setup or “X” to return to the “Sen Menu”.

To return to normal monitoring press “X”.

7) System Configuration Menu:

There are several system configuration functions that can be interrogated and/or adjusted. It is recommended that a copy of the configuration be made before any changes are performed.

7.1 4mA DAC Zero

The transmitter provides a 4-20mA output derived from a 12 bit DAC output, allowing 4096 steps over the range 0mA – 25mA. The DAC zero is defined as the counts required to generate 4mA. In order to adjust the 4-20mA zero output without disrupting the output current the display shows the current flowing. To check the current a voltmeter can be connected to the two 4-20mA sense connector pins J8 where the reading is 1mV/mA. Alternatively, the 4-20mA output current can be measured directly.

To adjust the 4mA DAC Zero press button “A” to enter “Cal Mode” and then scroll to “Sys Menu” by pressing “→” three times. Once in “Sys Menu” press “Y” to select “Set 4mA”. Press “Y” to display the current flowing and use the “+” or “–“ buttons to change the DAC zero until 4.00mA is shown on the display. Press “Y” to save the value and return to the “Sys Menu”.

To return to normal monitoring press “X”.

Little Braxted Hall, Little Braxted, Witham, Essex, CM8 3EU, U.K
Tel: +44 (0) 1376 516414, Fax: +44 (0) 1376 516415

7.2 20mA DAC Span

The DAC span is defined as the counts required to generate 16mA, the standard output range of the 4-20mA output. Typically this will be in the region of 2620 counts. At full-scale gas the output will be 20mA.

To adjust the 20mA DAC Span press button "A" to enter "Cal Mode" and then scroll to "Sys Menu" by pressing "→" three times. Once in "Sys Menu" press "Y" to enter "Set 4mA" followed by "→" to scroll to "Set 20mA". Press "Y" to display the current flowing and use the "+" or "–" buttons to change the DAC span until 20.00mA is shown on the display. To check the current a voltmeter can be connected to the two 4-20mA sense connector pins J8 where the reading is 1mV/mA. Alternatively, the 4-20mA output current can be measured directly. Press "Y" to save the value and return to the "Sys Menu".

To return to normal monitoring press "X".

7.3 Source Frequency

The source frequency can be set to any value between 1.0Hz and 5.0Hz. Setting a lower frequency results in larger signals and reduced signal gain requirement (see active and reference gain setting 6.2 and 6.3 above). Typically a frequency of 2.5Hz generates signals of sufficient size not requiring large amounts of amplifier gain.

To adjust the Source Frequency press button "A" to enter "Cal Mode" and then scroll to "Sys Menu" by activating "→" three times. Once in "Sys Menu" press "Y" to enter "Set 4mA" followed by "→" until "Set Freq" is reached. Press "Y" to enter "Set Freq". Press the "+" or "–" buttons to change the reading if required. Press "Y" to store the frequency and return to "Sys Menu".

If the frequency is changed then the active and reference gains must be reset as in 6.2 and 6.3 above.

To return to normal monitoring press "X".

7.4 Positive Suppression

Positive suppression is a level between 0 and 5% of full scale that is used to blank the output to zero if the concentration is between 0 and the suppression level.

To adjust the Positive Suppression press button "A" to enter "Cal Mode" and then scroll to "Sys Menu" by pressing "→" three times. Once in "Sys Menu" press "Y" to enter "Set 4mA" followed by "→" until "Set + Blk" is reached. Press "Y" to enter "Set + Blk". Press the "+" or "–" buttons to change the blanking level if required. Press "Y" to store the value and return to "Sys Menu".

To return to normal monitoring press "X".

7.5 Negative Suppression

Negative suppression is a level between 0 and -5% of full scale that is used to blank the output to zero if the concentration is between 0 and the suppression level.

To adjust the Positive Suppression press button "A" to enter "Cal Mode" and then scroll to "Sys Menu" by pressing "→" three times. Once in "Sys Menu" press "Y" to enter "Set 4mA" followed by "→" until "Set - Blk" is reached. Press "Y" to enter "Set - Blk". Press the "+" or "–" buttons to change the blanking level if required. Press "Y" to store the value and return to "Sys Menu".

To return to normal monitoring press "X".

Little Braxted Hall, Little Braxted, Witham, Essex, CM8 3EU, U.K
Tel: +44 (0) 1376 516414, Fax: +44 (0) 1376 516415

7.6 Gas Type

Gas type can be selected as shown below. **Note that changing the gas type or accepting the current gas type will permanently alter the sensor parameters. Recovery is available by using the restore facility.**

0 - 100%lel CH_4
0 – 100%vol CH_4
0 – 100%lel CxHy (generic alkanes)
ppm CO_2 (default 0-5000ppm)
Low %CO_2 (default 0 – 5%vol)
0 – 100%vol CO_2
User Type
0 – 10%vol CO_2
0 – 30%vol CO_2
0 – 5%vol CH_4

To change the gas type press Switch “A” to enter “Cal Mode” and then scroll to “Sys Menu” by pressing “→” three times. Once in “Sys Menu” press “Y” to enter “Set 4mA” followed by “→” until “Gas Type” is reached. Press “Y” to enter “Gas Type”. Press the “+” button to cycle through the available Gas Types. Press “Y” to save the displayed type and return to return to “Gas Type”. To return to “Sys Menu” without making a change press “X”.

To return to normal monitoring activate “X”.

Once a gas type is selected the sensor parameters are set to default for the selected gas type. The frequency, active gain, reference gain and zero calibration are not altered but all other sensor configuration parameters including the span are set to default values. Once a gas type has been selected the system must therefore be recalibrated.

7.7 Reset

The transmitter can be additionally reset via the system menu. To reset the transmitter by this method press Switch “A” to enter “Cal Mode” and then scroll to “Sys Menu” by pressing “→” three times. Once in “Sys Menu” press “Y” to enter “Set 4mA” followed by “→” until “Reset?”” is reached. Press “Y” to reset the transmitter.

Little Braxted Hall, Little Braxted, Witham, Essex, CM8 3EU, U.K
Tel: +44 (0) 1376 516414, Fax: +44 (0) 1376 516415

8) System Message Codes:

Messages via the RS232 link are self explanatory with messages describing the event in sufficient detail. Messages shown on the display are shortened or coded to fit within the display area. In particular should any fault be detected then fault codes are displayed whereas description of the fault is sent via the RS232 link.

8.1 Fault Codes

Extensive fault monitoring is carried out within the transmitter software. Some tests are carried out continuously and other tests are carried out at regular intervals. Should a fault be detected then a code for the fault is displayed and the transmitter enters a fault condition. In this condition the display shows “Fault” on the top line and a fault designation on the bottom line. The 4-20mA output is set to 2mA to register a fault condition. The displayed fault code designations are as follows:

"VDDerror":	The external supply voltage or the internal regulated voltage is outside limits
"A/Derror":	The 1.25V circuit reference voltage is outside limits
"FLASHerr":	A Flash memory corruption has been detected
"RAMerror":	A RAM memory corruption has been detected
“4-20mA”:	A fault has been detected in the 4-20mA output
“Code 2”:	An EEPROM error had been detected
“Code 6”:	An I^2C error has been detected
“Code 8”:	The internal reference voltage for the A/D converter is outside limits
“Code 9”:	The internal analogue ground for the A/D converter is outside limits
“Code B”:	A sensor signal failure is detected
“Code C”:	A 4-20mA output fault has been detected
“Code D”:	An internal Vdd voltage fault has been detected
“Code E”:	An internal A/D fault has been detected
“Code 10”:	A supply voltage fault has been detected
“Act high”:	Active signal is too high
“Ref high”:	Reference signal is too high

8.2 Fault Recovery

Hardware faults “A/Derror”, Code 6”, “Code 8”, “Code 9”, “Code D” and “Code E” are normally permanent. Processor faults “FLASHerr”, “RAMerror” and “Code 2” are also normally permanent. However, the first action is to reset the transmitter as described in section 3.3 and check if the fault persists.

For 4-20mA errors check that the 4-20mA link selection, external connections and field wiring are correct and that contacts are sound. **Note: A load resistance MUST be connected between the 4-20mA terminal and 0V when in 4-20mA source mode or an external voltage MUST be applied to the 4-20mA terminal when in 4-20mA sink mode otherwise a 4-20mA fault will be detected because no current flows.**

The supply voltage being outside limits will cause a “VDDerror”, a “Code D” error or a “Code 10” error. Measure the supply voltage and confirm it is within limits. If the supply voltage is within limits then reset the transmitter as described in section 3.3 and check if the fault persists.

A “Code B” error indicates a problem with the sensor signals. The cause may be a lamp failure, a poor connection between the sensor and the transmitter or an amplifier fault. Check that the sensor connections are correct and are firmly made. If the sensor connections are valid then turn off the transmitter, change the sensor and restart the transmitter.

Faults "Act high" and "Ref high” indicate the gain for the active or reference is too high and the gain must be reduced. Reset the transmitter and press button “A” at any time during the warmup countdown period to enter the menu system. Once in the menu system the gains can be reduced as described in 6.2 and 6.3 above.

Little Braxted Hall, Little Braxted, Witham, Essex, CM8 3EU, U.K
Tel: +44 (0) 1376 516414, Fax: +44 (0) 1376 516415