Instruction manual
MTL gas analysers & systems

January 2017
INM MTL 130-0126 Rev 13

CROUSE-HINDS SERIES

K1650 & K6050

MTL alternator purge gas analysers

Powering Business Worldwide

DECLARATION OF CONFORMITY

A printed version of the Declaration of Conformity has been provided separately within the original shipment of goods. However, you can find a copy of the latest version at -

http://www.mtl-inst.com/certificates

CONTENTS

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1 INTRODUCTION

This manual covers the K1650 & K6050 models of gas analysers designed specifically to analyse the gas mixtures encountered when using hydrogen to purge alternator generators and similar equipment. Carbon Dioxide is used to displace the air in the system, then Hydrogen displaces the Carbon Dioxide. This ensures that Hydrogen does not mix with Oxygen and form a potentially explosive mixture. Once filled with hydrogen the plant can be operated and the analyser used to measure the hydrogen purity. The analysers are equipped with three ranges so that each stage of the process can be monitored.

The K1650 comprises an electronic module and zener barrier mounted onto a sub-panel suitable for convenient combined mounting.

The K6050 is a portable free-standing instrument with an integral sensor and packaged in a rugged waterproof carrying case.

Common to both instruments is an advanced microprocessor based core, which provides a fully featured, yet easy to use gas analyser. Gas analysis takes place using thermal conductivity measurements made using a highly-stable, non-depleting katharometer sensor.

The K1650 is supplied with zener barriers to provide an intrinsically safe interface between the sensor unit and the electronics allowing the sensor to be located in a hazardous area.

1.1 Manual symbols

The following methods are used in this manual to alert the user to important information:-

WARNING

Warnings are provided to ensure operator safety and MUST be followed.

CAUTION

A Caution is provided to prevent damage to the instrument.

NOTE

These are used to give general information to ensure correct operation

1.2 Information

Waste Electrical and Electronic Equipment directive (WEEE) 2002/96/EC
(RoHS) directive 2002/95/EC

WARNING

This equipment must only be used in accordance with the manufacturer's specification, instructions for installation, use and maintenance to ensure that the protection of the operator is not impaired. It is the responsibility of the installer to ensure the safety and EMC compliance of any particular installation.

2 SPECIFICATION

2.1 Display

Dot Matrix LCD showing 2 or 4 lines of alphanumeric characters

2.2 Ranges

CO_2 in Air:	0 to 100%
H_2 in CO_2:	0 to 100%
H_2 in Air:	90 to 100%

2.3 Resolution

H_2 ranges:	0.1%
CO_2 in Air:	0.5%

2.4 Accuracy

+/- 1% of span (typically)

2.5 Stability

Better than 1% f.s.d./month

2.6 Speed of response

(T90): < 5 secs typical

2.7 Sample flow

100 to 300 ml/min for optimum performance

2.8 Sample pressure

Absolute maximum - 6 Bar.
Operating – For stated accuracy the sample outlet should be at atmospheric pressure

2.9 Sample condition

Must be non-condensing and free of particulates

2.10 Sample connections

Standard Sample System-

Inlet and Outlet 0.25" (suitable for 6mm) diameter tube. Both ports are fitted with captive seal compression fittings.

Stainless Steel System-

Inlet and Outlet suitable for $^1/_8$" diameter tube on the sample inlet and sample outlet.

2.11 Analogue outputs

K1650

4 to 20mA proportional to 0 to 100% of selected range
Maximum load 500 ohms

K6050

0 to 1V proportional to 0 to 100% of selected range
Minimum load 10K ohms

2.12 Alarm outputs (K1650 only)

4 alarms, volt free C/O contacts rated at 30V ac or dc, 1A - normally energised

Alarm 1 – configurable as either concentration of Carbon Dioxide in Air or 'Fault'

Alarm 2 - configurable as either concentration of Hydrogen in Carbon Dioxide or 'Hydrogen Purity Range Selected'

Alarm 3 and 4 - concentration of Hydrogen in Air

When configured as a concentration alarm each is user programmable for:-

Mode - HIGH, LOW or OFF

Level - over full display range of instrument

Hysteresis - 0% to 10% of set point.

2.13 Environmental conditions

Ambient operating temperature range

K6050 -5°C to 40 °C
K1650 instrument -5°C to 40°C, sensor -10°C to 55°C
(0 - 80% RH non-condensing)

Storage temperature range

K6050 -20°C to 55°C
K1650 instrument -20°C to 50°C, sensor -20°C to 60°C
(0 - 80% RH non-condensing)

Altitude
Up to 2000m

Pollution degree
Pollution degree 2

2.14 Power supply

K1650
110 to 120V or 220 to 240V at 50 to 60 Hz at 12VA

K6050
Internal rechargeable battery, supplied with an external switch mode supply:
Input 110V to 240V at 47 to 63Hz
Output 12V at 1.25A max.

2.15 Enclosure details

K6050

Material: ABS case with mild steel instrument panel.
Protection: With lid closed IP65, with lid in open position IP41
Weight: Approximately 5.5kg excluding packaging.
Dimensions: 338mm wide x 295mm deep x 152mm high with lid closed - see Figure 1.

K1650
Material: Instrument assembly - glass fibre reinforced Noryl. Mounting panel - mild steel

Protection: When panel mounted (rear of instrument not exposed) IP40, IP30 otherwise.

Weight: 2kg approx.

3 INSTALLATION

WARNING

Please familiarize yourself with this entire section before beginning installation. Failing to do so may adversely affect the performance of the instrument and/or violate local legislation.

3.1 Unpacking and visual checking

Take all standard precautions when opening packages. In particular avoid the use of long bladed cutters. Search packing before discarding it to ensure that all of the components have been removed. Check that all pipe connections have captive seal nuts.

WARNING

RECOMMENDED TWO-MAN LIFT: The K1550 EEx d instrument weighs approximately 25kg excluding packaging. Observe appropriate manual handling precautions when unpacking / installing the analyser.

3.2 Siting

The K1650 instrument is designed principally for panel mounting (see Figure 1), with a remote sensor installed in a GRP enclosure (see Figure 2). It may also be provided in an EEx d certified enclosure for applications where the instrument also needs to mounted in a hazardous atmosphere (see Figure 3).

The K6050 is a portable instrument mounted in a rugged case. See Figure 4.

Ensure that the environmental requirements of Section 2.13 are met.

3.3 Electrical connections

3.3.1 K1650

Three plug-in terminal blocks are provided at the rear of the instrument.
Refer to Figure 1 for details.

WARNING

K1650 instruments must be installed with a disconnecting switch close by, within easy reach of the operator and compliant with the relevant parts of IEC 60947-1 and IEC 60947-3. It must be marked to indicate this function and show ON and OFF positions. Wiring should conform to local codes.

Only the live conductor has an internal equipment fuse. European regulations recommend that fuses be fitted in both the live and neutral of the mains supply to the instrument.

NOTE

The relay operation and labelling 'Normal' relates to process normal and not the electrical rest position of the relays, In process normal the relays are energised (refer to figure 11).

3.3.2 K6050

Connections consist of a charge socket (connect only the supplied charger) and 4mm sockets for analogue output.

3.3.3 Routing of wires

To minimise the pick-up of electrical noise all signal wiring should be routed away from power cables. The K1650 is shipped with a pre-assembled sensor cable. See Section 4.7 for details.

3.4 Sampling and piping

The connections are captive seal compression fittings suitable for 0.25" (or 6mm) diameter tube or double ferrule stainless steel compression fittings suitable for $^1/_8$" diameter tube on the sample inlet and sample outlet.

NOTE

Optimum analyser performance is achieved with the flow rate specified in Section 4.7 Consider also installing pipe work for a calibration gas inlet - this avoids the need to remove the sample connection when connecting a calibration gas. It is much more convenient to have a 'T' piece and valves installed permanently in the sample feed lines (refer to figure 11).

WARNING

Ensure that the exhaust of the sample gas is taken to a safe area.

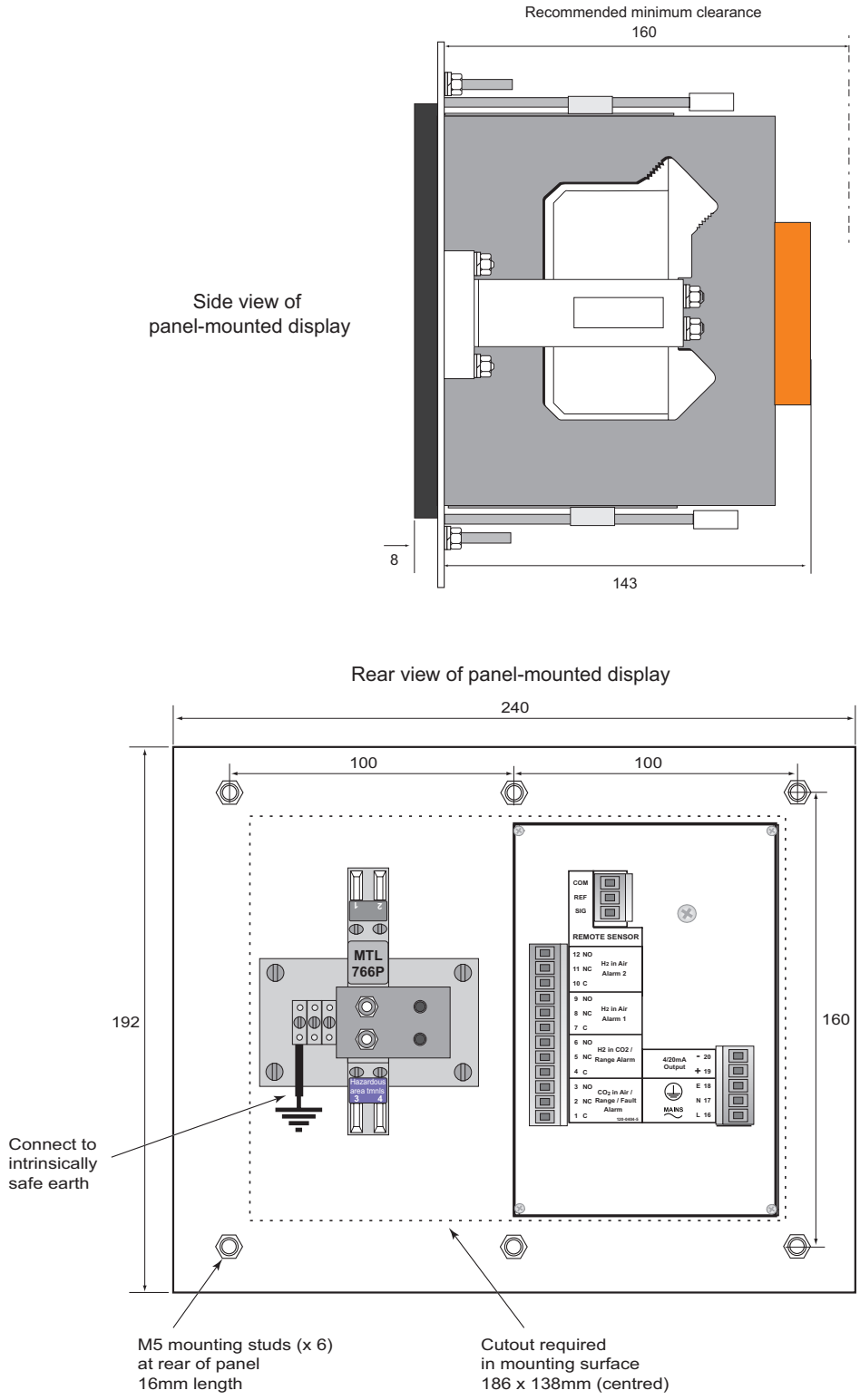


Figure 1- Panel mounting dimensions (K1650)

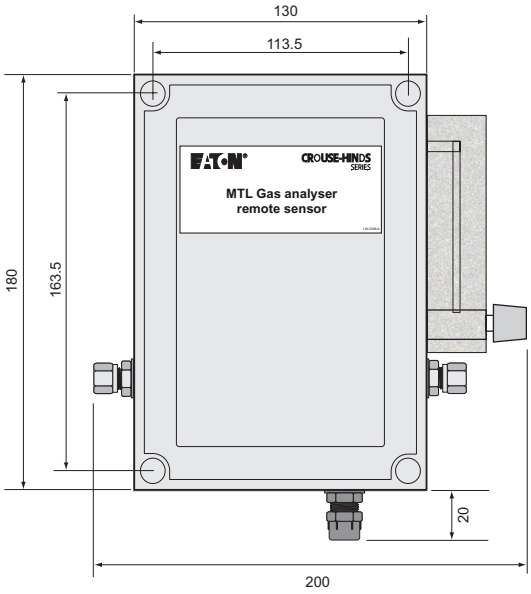


Figure 2a- Standard sample system

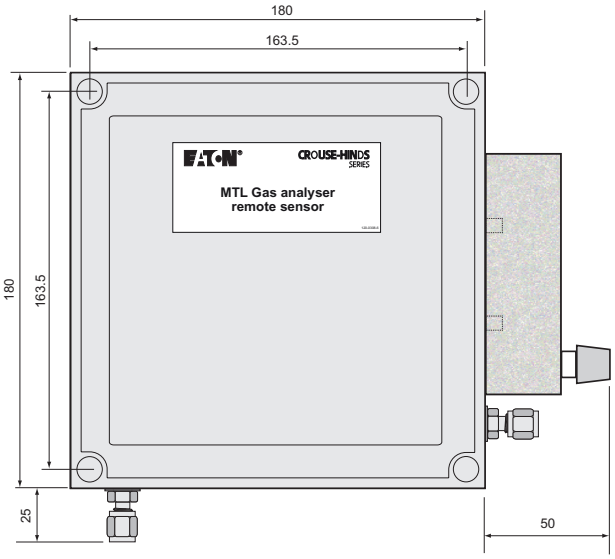


Figure 2b- Stainless steel sample system

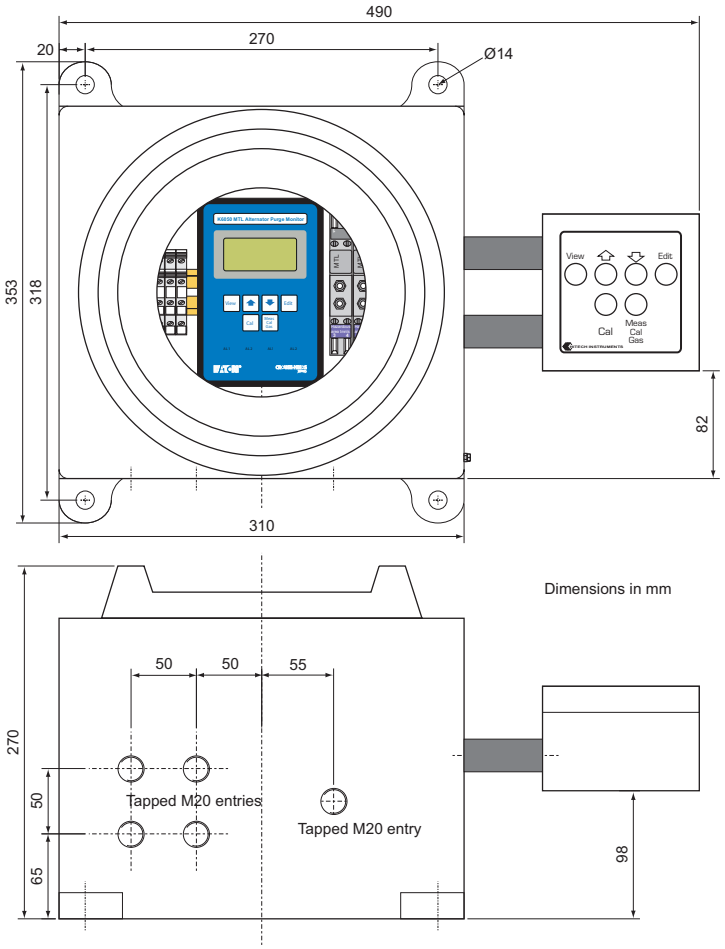
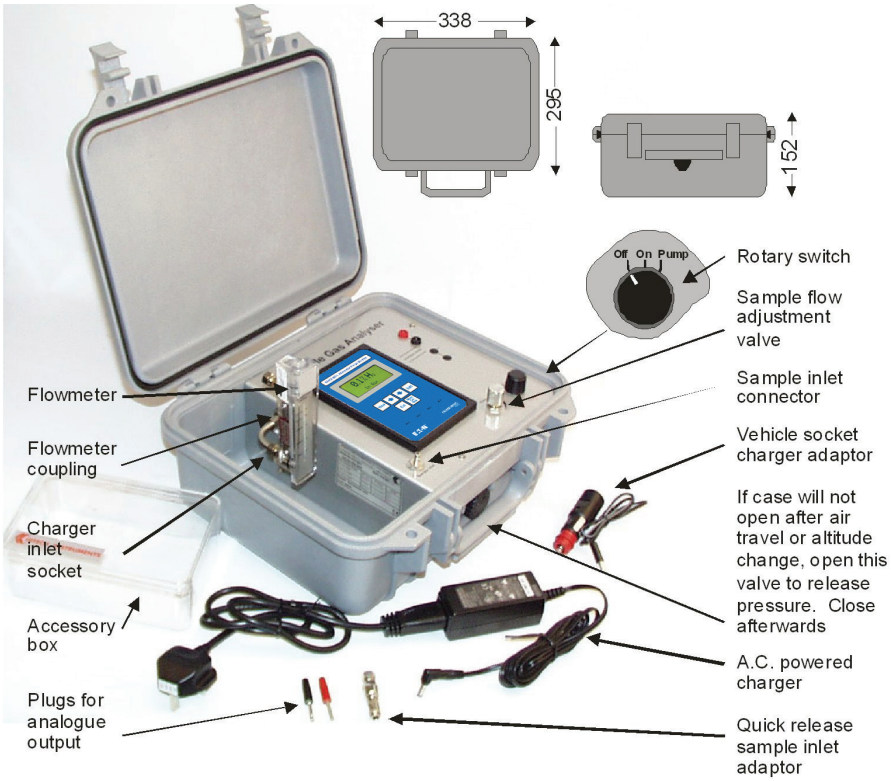


Figure 3- K1550 in EEx d enclosure



3.5 Flow meter

3.5.1 K6050

The instrument is supplied with a flow meter to enable the sample flow to be monitored. Attach this as shown in Figure 4 above.

3.5.2 K1650

The remote sensor enclosure (see Figure 2) is fitted with a flow meter.

3.6 Electronic module installation (K1650)

The display & control unit is designed to be panel mounted, refer to Figure 1 for further details.

3.7 Sensor and control/display-unit connections

CAUTION

The sensor and control unit are matched during manufacture. Each instrument will operate correctly only with its own sensor. The sensor serial number is recorded on the test certificate supplied with the instrument.

3.7.1 Sensor connections

The connections for the sensor are located inside the sensor enclosure on the circuit-board backplane, adjacent to the cable entry gland. The connections SIG, REF and COM correspond to the same connections on the rear of the control/display unit and should be wired accordingly.

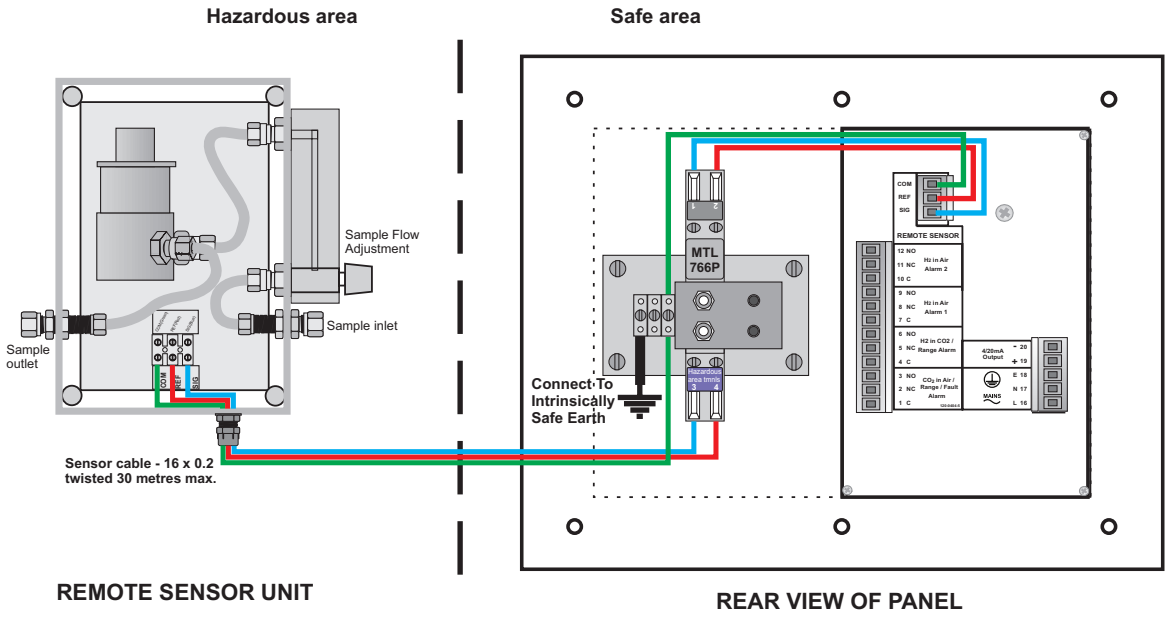


Figure 5- Connections when sensor is in a hazardous area (K1650)

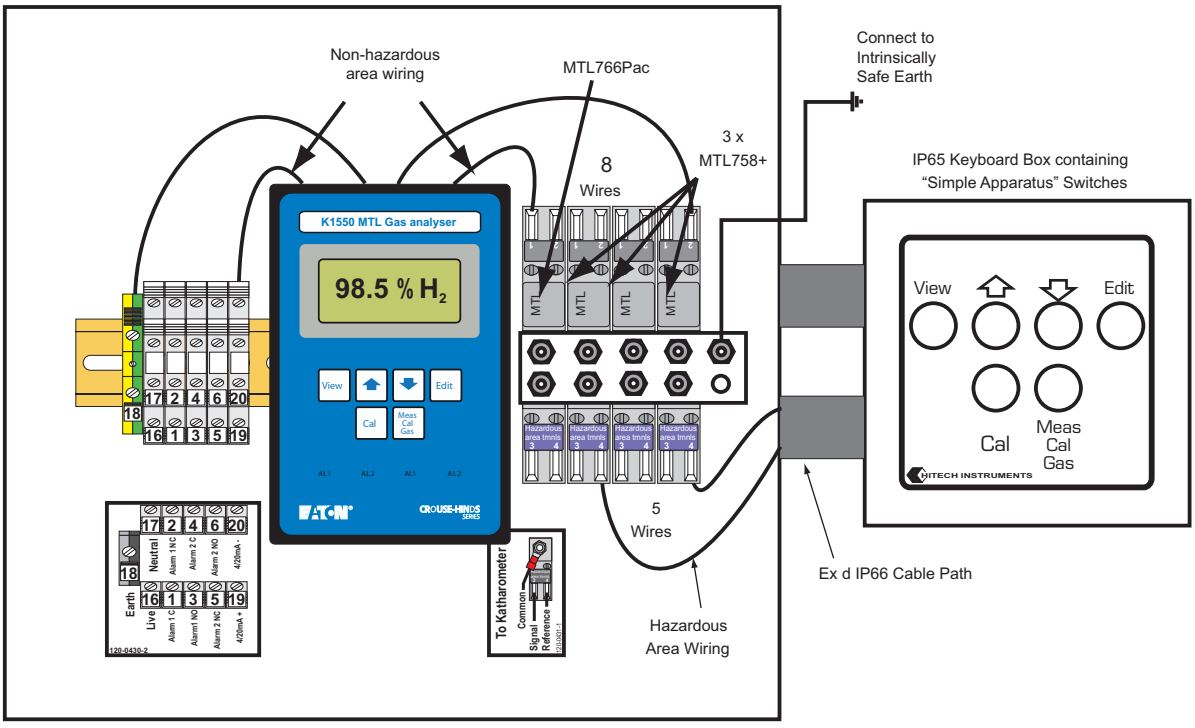


Figure 6- Internal wiring for K1550 control unit mounted in a hazardous area

NOTE

For all installations the cable length connecting the sensor to the instrument must not exceed 30 metres.

Figure 5 shows details of connections for installations where the control unit is mounted in a non-hazardous environment but the sensor has to be located in a hazardous area, i.e. where there is a known risk of a potentially explosive atmosphere being encountered.

Figure 6 shows the internal wiring connections for a "flameproof" Ex d enclosure where the electronic control unit also needs to be mounted in the hazardous area.

3.7.2 Control/display unit connections

The connections for the control/display unit are located on the rear of the case - except when it is mounted in the flameproof box, in which case the connections are provided at DIN-rail mounted terminals.

WARNING

AC mains power (115 or 230V AC) is required to power the K1650 control/ display unit. Ensure that supplies are isolated at some external point before working on connections to the unit.

CAUTION

Check the supply voltage rating of the control unit before connecting it to the AC power source. The unit will be damaged by the application of a voltage exceeding the specified range.

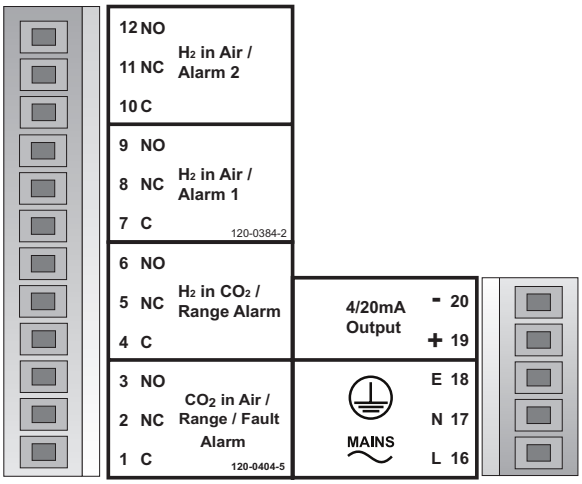


Figure 7 - Connections at rear of control/display unit

Figure 7 shows the connections provided at the rear of the K1650, including the 4/20mA analogue output (terminals 19 & 20), the alarm outputs (terminals 1-12) and the AC power inputs (16-18).

AC power signals should be kept apart from the input signal cabling, as much as possible, to avoid potential interference and any hazard from the high voltage cabling.

In normal operation (i.e a non-alarm state) the alarm relays are energised, providing continuity between the 'C' and 'NC' terminals.

continued

K1550 model mounted in a hazardous area

Connections to this display/control unit are provided on DIN-rail mounted terminals to the left of the display. Terminal identities are provided on a label below them - see Figure 8.

M20 threaded holes are provided in the bottom of the flameproof enclosure for these connections - see Figure 3. They must be fitted with appropriately certified cable glands or similarly approved blanking plugs for any unused ones.

Only one cable can be passed through a cable gland, so four holes are provided to accommodate the following:

- AC power
- 4/20mA analogue output signal
- Alarm 1- Fault alarm (as terminals 1- 3 in Fig. 8)
- Alarm 2- Range alarm (as terminals 4- 6 in Fig. 8)

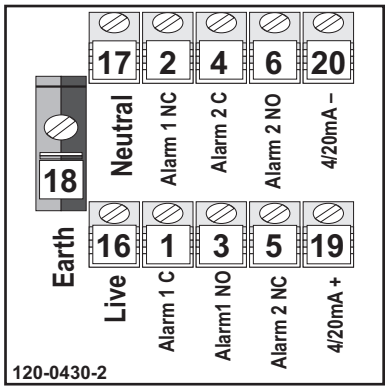


Figure 8 - Power and ouput terminals

4 OPERATION

4.1 Switching on

4.1.1 K6050

This instrument is switched on by turning the front panel rotary switch to “On”. Turning the switch to “Pump” additionally activates the internal sample pump.

The instrument is normally powered by its internal rechargeable batteries and these are fully charged when dispatched from the factory. A mains (A.C.) powered switch-mode power supply is supplied along with an adapter for a 12v vehicle outlet socket. When the power supply is attached and powered up, the internal batteries are charged automatically, irrespective of whether the instrument is on or off.

4.1.2 K1650

These instruments power up immediately power is applied to the supply terminals.

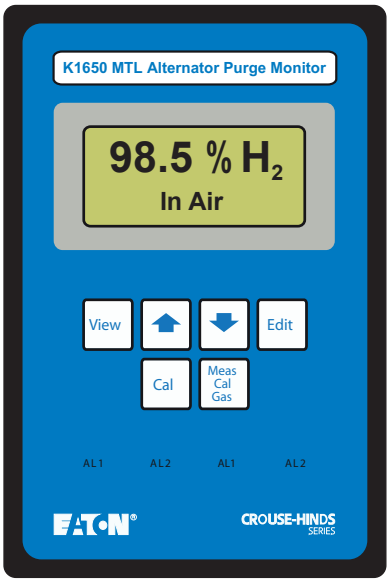


Figure 9 - K1650 Front Panel

4.2 Initialization

On power-up the screen will display details of the instrument’s name and software number. This display will remain for a few moments, then the instrument will automatically enter Measurement Mode and set itself to Range 3 (hydrogen in air). The concentration of gas in the measurement chamber is displayed. If the sample is something other than air, hydrogen or a mixture of the two, then the value shown will not be accurate or a fault code message will be displayed – see Section 4.6.

In the measurement mode the display and the analogue outputs are continually updated with the latest measured values.

NOTE

During initialisation the K1650’s 4 to 20mA output goes to 2mA to indicate an invalid measurement. If the instrument is outside of its operating range (fault code displayed) then the 4 to 20mA output goes to 3.7mA to indicate this. The K6050, which has 0 to 1V analogue outputs, gives 0v during initialisation and 0V or 1V for fault conditions.

4.3 Making measurements

The sample flow rate should be set at 100-300 ml/min.

It is essential that the range setting is appropriate to the measurement being made. The ranges are as follows

- Range 1: 0 to 100% Carbon Dioxide in Air
- Range 2: 0 to 100% Hydrogen in Carbon Dioxide
- Range 3: 90 to 100% Hydrogen in Air (or Hydrogen purity range, automatically selected when the instrument is powered up)

4.3.1 K6050

For low pressure samples (less than 25mm water gauge) turn the front panel rotary switch to "Pump" to increase the flow rate if necessary.

4.4 Changing range

From Range 1, press the up arrow key once for Range 2 and once again for Range 3.

The down arrow key ("⇩") scrolls back through the ranges and the selected range is shown at the bottom of the display.

Using a combination of the H_2 in CO_2/Range relay and the CO_2 in Air/Range relay it is possible to monitor externally which of the three ranges has been selected.

To acieve this, the mode setting in both the H_2 in CO_2 and CO_2 in Air alarm settings needs to be set to range. (refer to section 5.5)

Table 2 indicates the status of these relays when they are set to range.

Note:- These settings are based on the relays being energised in process normal operation

Instrument mode	Condition	H_2 in CO_2 Relay set to range	CO_2 in Air Relay set to range	CO_2 in Air Relay set to range
Measure	CO_2 in air range selected	De-energised	Energised	Always off
	H_2 in CO_2 range selected	De-energised	De-energised	Always off
	H_2 in air range selected	H_2 in air range selected	De-energised	Always off
Calibration	All conditions	Energised	Energised	Always off

Table 2 - Range alarm function

4.5 Viewing and changing the K1650 alarm settings

Press the "View" button to view the alarm settings. Use the "⇧" or "⇩" buttons to scroll through the alarm screens.

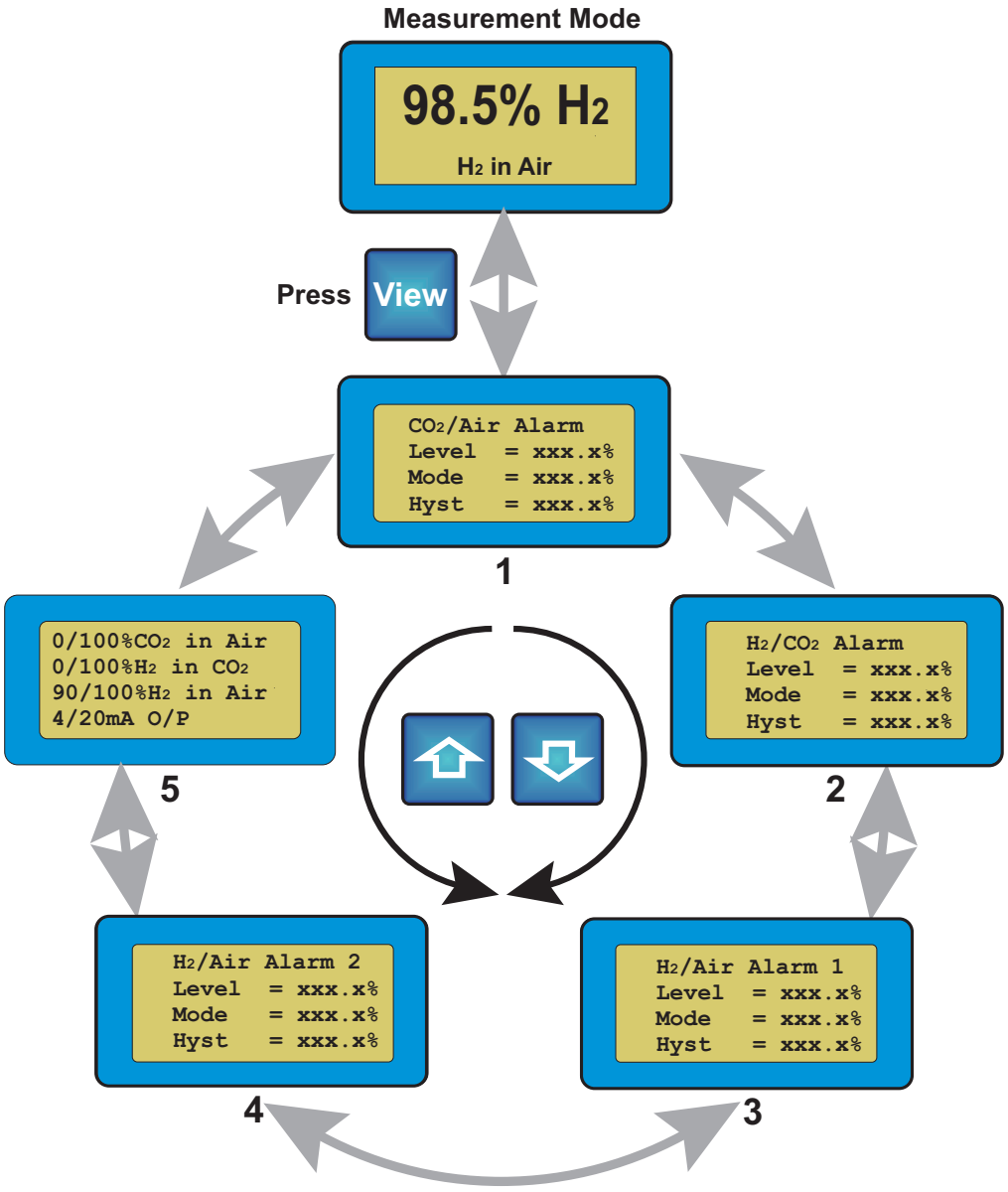


Figure 10 - Alarm menu

Any of the values with an arrow can be changed by entering edit mode. To enter edit mode press the "Edit" button.
A warning screen will be displayed- ensure that continuing will not cause any plant malfunction or safety problems due to locking of the outputs, then press "Edit" again.
A flashing block cursor will appear on the first character of the parameter to be edited.

Use the "⇧" or "⇩" buttons to change the digit to that required and then use the "Edit" button to move the cursor to the next digit to be changed. When the "View" button is pressed (or if the "Edit" button is pressed on the final digit) the new value is stored and the instrument returns to view mode.

NOTE: H_2 purity alarm relays are not included if the EExd enclosure option is chosen.

NOTE

Hysteresis is the difference between the levels at which an alarm triggers and resets. For example, an instrument with a 100% range with an alarm set to mode = HIGH, level = 5% and hysteresis = 1% will trigger the alarm as the reading exceeds 5%, and reset it once the level has fallen to 4%.

The maximum hysteresis that can be set is 10% of the span of the particular channel. It is important not to set the hysteresis to a level greater than the alarm point otherwise the alarm will never reset.

Alarms only operate when the range they apply to is selected. E.g. If Range 3 (90 to100% Hydrogen in Air) was selected only alarms 3 and 4 would be active; alarms 1 and 2 would be automatically set to the 'OFF' mode until the appropriate range was selected. This is not the case for alarms 1 and 2 if they are programmed as 'Fault' and 'Range Selected' indicators.

NOTE

The analogue output is set to 2mA when the instrument is initialising, in calibration mode or a fault code is being displayed.

4.6 Fault codes

Fault code	Meaning
1	Indicates fault while instrument is in the CO_2 in air range
2	Indicates fault while instrument is in the H_2 in CO_2 range
4	Indicates fault while instrument is in the H_2 in air range
8	Temperature channel A/D reading out of range low
16	Temperature channel A/D reading out of range high
32	CO_2 offset too low (< 4% H_2 based on H_2 in CO_2 range)
64	CO_2 offset too high (> 4% H_2 based on H_2 in CO_2 range)
128	Air offset too low (< 10% H_2 based on H_2 in air range)
256	Air offset too high (> 10% H_2 based on H_2 in CO_2 range)
512	CO_2 scale too low (CO_2 reading < 60% based on CO_2 in air range)
1024	CO_2 scale too high (CO_2 reading > 140% CO_2 based on CO_2 in air range)
2048	H_2 in air scale too low (H_2 reading < 60% H_2 based on H_2 in air range)
4096	H_2 in air scale too high (H_2 reading > 140% H_2 based on H_2 in air range)
8192	H_2 in CO_2 scale too low (H_2 reading < 60% H_2 based on H_2 in air range)
16384	H_2 in CO_2 scale too high (H_2 reading > 140% H_2 based on H_2 in air range)
32768	Measure channel A/D reading < (-)4090 counts
65536	Measure channel A/D reading > 4090 counts

NOTE

If a fault occurs a code is reported on the screen. Multiple faults are shown as their sum. For example a high air offset combined with a fault in the hydrogen in air range would be reported as fault code 260 (256+4). In all cases alarm relay 1, if configured as a fault alarm, will switch.

5 CALIBRATION

5.1 General

The MTL katharometer based analysers are extremely stable instruments and require only very occasional calibration. The exact calibration period depends on the type of sample and environment the instrument is placed in. In practice it is unlikely that check periods of less than one month would be necessary and three to six months would normally be in order. We recommend that any quality assurance procedures written for the instrument are written to allow verification as opposed to calibration. Verification involves checking that the instrument provides the correct analysis of a standard gas within the limits of the instrument and only calibrating when a result outside of limits is produced. The frequency of the verification would need to be in line with the quality regime being operated by the user.

WARNING

The analogue output is set to 2mA (K1650) or 0v (K6050) while the instrument is being calibrated. Ensure that any control loops that are connected to the instrument are disabled prior to verifying or calibrating the instrument. Also ensure that the process is in a safe state and the exhaust of the standard gas is vented to a safe area. Calibration mode can only be entered by pressing the Calibrate button for approximately 8 seconds whilst in Measurement Mode.

5.2 Piping

Ensure that the piping and connectors are of good quality with no possibility of leaks. Metal piping is preferred as it is less prone to damage and sealing problems. Pressure regulators and gauges that may be in the calibration gas lines all have a certain amount of dead space within them and so may require purging for several minutes before the delivered gas matches that of the cylinder contents. The regulator etc. may be connected to the instrument and the purge monitored by using the instrument in measurement mode. Only when the reading is steady has the dead space been purged.

NOTE

For permanent installations (K1650) in may be convenient to include a 'T' piece and appropriate valves in the sample inlet line so that the calibration gas is easily connected.

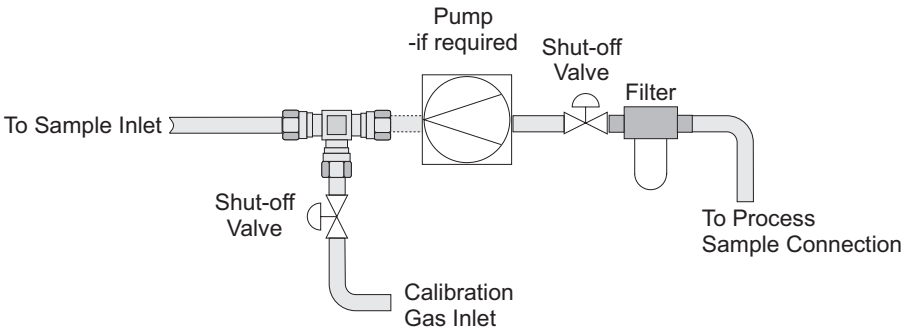


Figure 11 - Sample and calibration gas piping

5.3 Calibration gases

Three are required.

- 100% Hydrogen
- 100% Carbon Dioxide
- Dry Air

The diagram that follows illustrates the calibration process.

5.3.1 Analysers working at alternator casing pressure

When this is the case the analyser must be calibrated at the appropriate pressure(s) for best accuracy.

A typical filling regime for an alternator is described below.

- From the alternator casing filled with air at atmospheric pressure, CO_2 is introduced to purge out the air. At the end of this operation, when CO_2 level is high (approaching 100%), the system is pressurised to some pressure- we will refer to it as 'x' barg.
- H_2 is then introduced at x barg to purge out the CO_2. When the H_2 level is high (approaching 100%), system is pressurised to a higher pressure – we will refer to it as 'y' barg.

The following assumptions are made in advising this alternative calibration process.

- The 0 to 100% CO_2 in air range is only used as an approximate indicator until the CO_2 level gets near to 100%. Only at high CO2 level is the reading required to be reasonably accurate.
- The 0 to 100% H_2 in CO_2 range is again only used as an approximate indicator until the hydrogen level gets near to 100%.
- The 90 to 100% H_2 in air is the most important range and requires best accuracy throughout.

To accommodate this situation the following techniques and processes are used.

The instrument's three calibration points must be performed at the pressures indicated below.

- 100% Air calibration – at atmospheric pressure
- 100% Hydrogen calibration – at y barg
- 100% Carbon dioxide – at x barg

This approach will produce the 'best fit'.

5.3.2 K1650 and K6050 alternator purge calibration

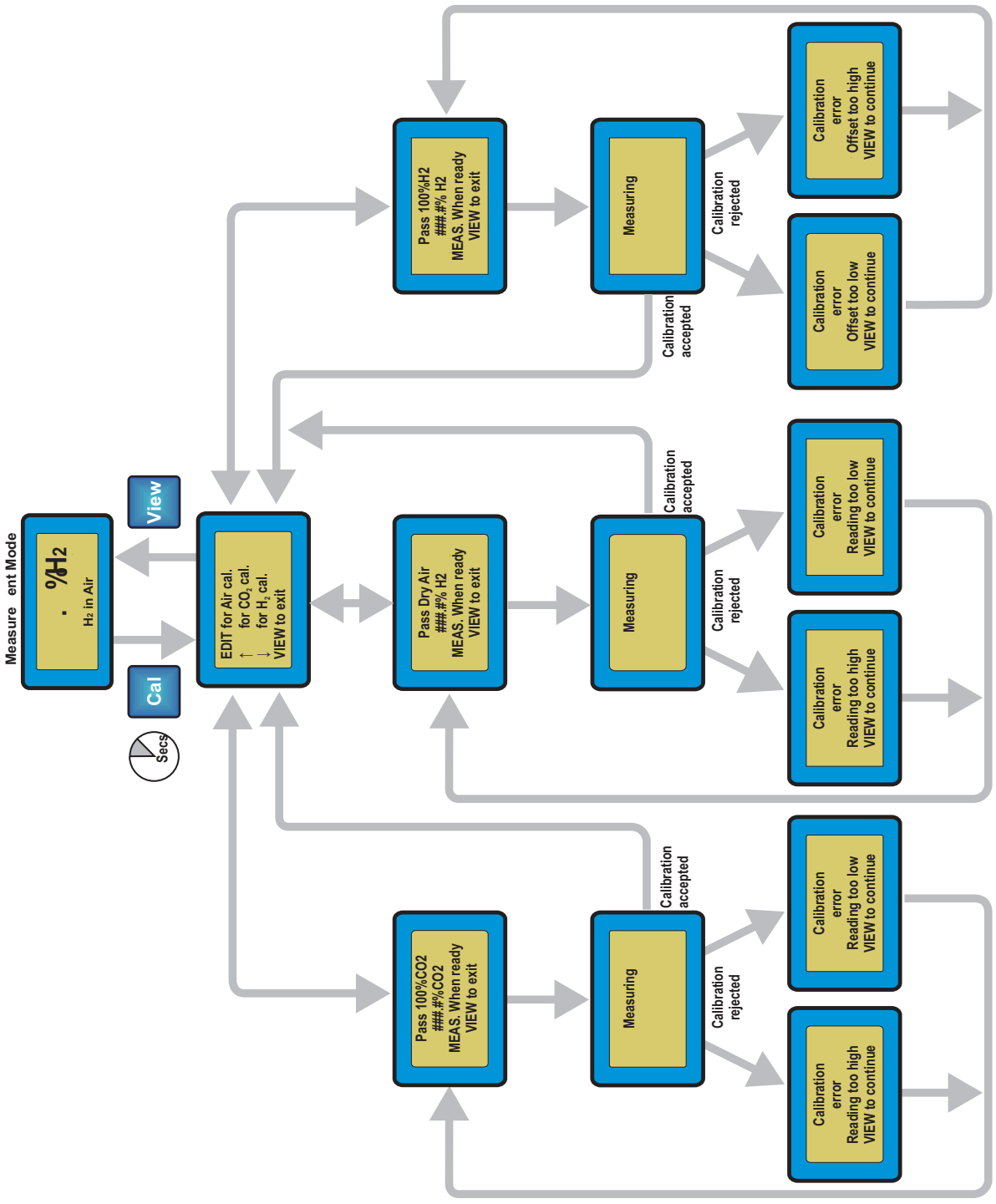


Figure 12 - Purge calibration menu options

6 SERVICING

WARNING

These instruments contain no user serviceable parts. Do not open the analyser case as to do so may expose you to hazardous voltages.

The katharometer sensor is non-depleting and will last for a long time if it is not subjected to misuse. If a replacement is required, it must be returned to Eaton's MTL product line, or their agent, because the sensor can only be replaced with the use of specialist equipment.

NOTE

When ordering spare parts or raising queries on an instrument, it is important that the serial number is quoted. This will be found on the data label attached to the instrument.

6.1 Battery replacement

K6050 analysers contain a NiMH battery which is not a serviceable part, therefore the instrument should be returned to Eaton's MTL product line, or their local representative for battery replacement.

6.2 Product - end of life

The crossed-out wheeled bin means that within the European Union the product must be recycled in accordance with the WEEE directive and local environment regulations. K6050 analysers contain a NiMH battery.

DO NOT THROW BATTERIES INTO MUNICIPAL WASTE. DISPOSAL OF BATTERIES MUST BE IN ACCORDANCE WITH LOCAL ENVIRONMENT REGULATIONS

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