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INTRODUCTION

1.1 The D111 control Equipment is designed to provide control, alarm and executive action signals for the Detection Instruments Group Limited flammable gas and hydrogen sulphide gas detectors. The equipment is constructed on the modular, rack mounted principle and is supplied either with plug and socket termination for field wiring or hard wired.

1.2. The basic control units required are the Control Card for the Detector Head, either flammable or hydrogen sulphide, a -Channel Output card and a Power Supply unit if the rack is to be powered from mains voltage. If 24 volt D.C. supply is to be used no power unit is required. Up to sixteen control cards may be fitted in one rack (eighteen if no Power Supply unit is required and the rack is hard wired). together with the Channel Output card.

1.3. The complete equipment can be supplied with either-  
a) A motherboard fitted to the rear of the rack and holding a 32 way connector for each card to which the field wiring may be directly connected. The connections available on these 32 way connectors are shown in tables in the body of this handbook.

or-b) Outputs from the individual cards hard wired through 30-way plug and sockets for subsequent connection to rail mounted terminals. In this case a wiring drawing will be supplied with the equipment showing the designation of the inputs/outputs.

DI 1-11 HYDROCARBON CONTROL CARD

2.1 The Dr 1-11 provides the necessary power to the drive Dr 5/6 hydrocarbon Detector Head, accept the from signal this head and raise first and second stage alarms at pre-set gas concentration values.

2.2 The front panel indicators and controls are as follows:-

2.2.1 Indicators

pilot Green L.E.D. that is illuminated when power is supplied to the module.

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Fault	Yellow ~.E.D. that illuminates when the module is in a or fault condition when the channel output card is switched to inhibit (see Chapter 3)
Alarm 1	Red L.E.D. that illuminates when the gas concentration at the Detector Head exceeds the pre-set Alarm 1 value.
Alarm 2	Red L.E.D. that illuminates when the gas concentration at the Detector Head exceeds the pre-set alarm 2 value.
Over Range	Red L.E.D. that illuminates when the gas concentration at the Detector Heads exceeds 100% L.E.L. i.e. the full scale reading of the meter on the channel output card.

### 2.2.2 Controls

Read	A spring loaded press switch which, when depressed allows the concentration of gas at the Detector Head connected to the module to be displayed on the meter of the Channel Output card.
"S"	A pre set potentiometer accessible through the front panel which adjusts the gain of the circuit. It is used when the Detector Head is being calibrated.
"Z"	A pre set potentiometer accessible through the front panel which adjusts the zero of the circuit. It is used to set zero on the meter of the Channel Output card when the Detector Head connected to the module is in clean air.
"HV"	A pre set potentiometer accessible through the front panel which adjusts the voltage applied to the Detector Head. This control must only be adjusted when the voltage at the Detector Head junction box is being monitored. Note that too high a voltage at the Detector Head may destroy the sensors.

"A1" A pre set potentiometer accessible through the front panel which is used to set the level at the which Alarm 1 state is initiated.

"A2" A pre set potentiometer accessible through the front panel which is used to set the level at which the Alarm 2 state is initiated.

### 2.3 Card Outputs

#### 2.3.1

The DI 1-11 is fitted with a 64 way rear connector which is used to connect inputs and outputs from external wiring. Some of these inputs/outputs are taken to a 32 way connector on the rack motherboard when fitted. A full list of these connections is shown in Table 1.

#### 2.3.2 Alarm Outputs.

Both the first and second alarm circuits each drive a double pole changeover relay. The contacts on these relays are volt free and are rated at 1 amp, 24 volts D.C. In addition both alarm circuits have a continuous and a pulse output. These outputs are fed to the DI 2-11 channel output card to initiate the general alarm circuits.

#### 2.3.3 Fault Outputs

The fault circuit drives a single pole changeover relay. The contacts on this relays are volt free and are rated at 1 amp, 24 volts. In addition both pulse and continuous fault outputs are taken to the DI 2-11 Channel Output card to initiate the final fault circuit.

#### 2.3.4 Detector Head Connections

Power is taken to the DI 5/6 Detector Head via three connections which are nominated +ve detector head, -ve detector head and detector head signal. These must be connected in the following manner.

Module	5/6
	Wire Colour Designation +ve
Detector Head	Red D
	-ve Detector Head Black C
	Detector Head Signal Green CT

### 2.3.5 Analogue Output

An Analogue output of gas concentration is available. This is scaled 1 to 5 volts for 0-100% L.E.L

### 2.3.6 Other Signals.

A number of other signals to as shown in Table 1 are used transfer data between 2-11 the 1-11 control card and the channel output card. external These are not available for use.

## 2.4 OPERATION

### NORMAL

Green Pilot L.E.D.- ON, all other L.E.D.'s- OFF. To determine whether there is any gas present at the detector head press READ push, the meter on the channel output card will read the concentration in percentage L.E.L. When the READ push is released the meter on the Channel Output card will revert to zero reading.

### ALARM 1 CONCENTRATION.

Green Pilot L.E.D.-ON, Red Alarm 1 L.E.D.-ON, all other L.E.D. Is-OFF. To read Red concentration press READ push. Alarm 1 L.E.D. concentration reduces Alarm will remain ON even if gas 1 press RESET push below Alarm 1 level. To reset on channel output card.

### ALARM 2 CONCENTRATION.

Green Pilot L.E.D.-ON, Red Alarm 1 L.E.D.-ON, Red Alarm 2 L.E.D.-ON. To read concentration press READ push. Both Red Alarm 1 and 2 L.E.D. 's will remain on even though gas concentration reduces below the alarm levels until the RESET push on channel output card is pressed.

### OVER RANGE.

This condition exists when the concentration of gas at the Detector Head is greater than 100% L.E.L. Alarm 1, Alarm 2, Pilot and Overrange Red L.E.D. 's will be illuminated. This condition will remain until gas clears and RESET push is pressed.

### FAULT.

This condition occurs if there is a short circuit or open circuit on any of the three wires to the Detector Head. The condition is indicated by the yellow Fault

L.E.D.-ON and all other L.E.D.'s including the Pilot OFF. The output of the Detector Head sense amplifier is held at zero in this condition so that the Alarm states are not initiated. Note that when the toggle switch on the channel output card is switched to Inhibit/Calibrate all the control cards in the rack will show Fault Condition. In this state the Detector Head sense amplifier is not held at zero so the Alarm L.E.D. 's will still operate, This facility allows Alarm levels to be set.

TABLE 1  
Dr 1-11 FLAMMABLE GAS CHANNEL CARD.  
MOTHERBOARD

MOTHERBOARD		CONNECTOR.	
A2	Spare	E 2	Linked Spare
A4	Spare 24V	E 4	-VE Analogue alP
A6	Spare	E 6	Sig Det Head
A8	Spare	E 8	-VE Det Head
A10	OV	E10	+VE Det Head
A12	Spare	E12	+VE Analogue O/P
A14	N/O Rly B1 ALM1	E14	N/C Rly B1 ALM 1 C
A16	Spare	E16	Rly B1 ALM 1 N/C
A18	N/O Rly B2 ALM1	E18	Rly B2 ALM 1
A20	Spare	E20	C Rly B2 ALM 1 N/C
A22	N/O Rly A Fault	E22	Rly A Fault
A24	OV	E24	C Rly A Fault
A26	N/O Rly C1 ALM 2	E26	N/C Rly C1 ALM Rly
A28	Spare	E28	C C1 ALM 2
A30	N/O Rly C2 ALM 2	E30	N/C Rly C2 ALM 2
A32	Spare	E32	C Rly C2 ALM 2

NOTE: For relays N/O = **Normally** open.  
N/C = C **Normally** closed.  
Common

### 3. Dr 2-11 CHANNEL OUTPUT CARD

3.1 The 2-11 Channel Output card is designed to accept inputs from all the control cards in its rack. It contains a meter on the front panel scaled 0-100 so that the gas concentration detected by any Control card can be displayed by pressing the READ push on that card. Alarm and Fault signals from control cards are also passed to the Channel Output card for activation of master Alarm and Fault Relays. A sounder mounted on the unit produces an audible alarm when any Alarm or Fault condition is activated.

3.2 The front panel indicators and controls are as follows.

#### 3.2.1 Indicators

Meter	Moving coil meter scaled a to 100.
Pilot	Green L.E.D., illuminates when power is supplied to the card.
Fault	Yellow L.E.D"., illuminates when any control card in the rack is in Fault Condition.
Alarm 1	Red L.E.D., illuminates when any Control card in the rack enters Alarm 1 condition, L.E.D. will flash until Accept switch is pushed and will then illuminate continuously.
Alarm 2	Red L.E.D., illuminates when any Control card in the rack enters the Alarm 2 condition. L.E.D. will flash until Accept switch is pushed and will then illuminate continuously.

#### 3.2.2 Controls

Accept A spring loaded push switch used to accept Alarm states. When any Control card in the rack enters an Alarm condition the Alarm L.E.D. on the Control card will illuminate, the Alarm L.E.D. on the Channel Output card will flash and the internal audible alarm will sound. When the Accept

switch is pushed the Alarm L.E.D. on the channel output card will change from flashing to continuous illumination and the internal audible alarm will be switched off.

**Reset** A spring loaded push switch which is used to reset all alarm circuits and/or fault circuits after the alarm and/or fault condition is removed.

**On/Cal Inhibit** A two position toggle switch. In the "ON" position the system operates in the normal operation configuration. When switched to the "Cal/Inhibit" position all outgoing alarm and fault signals are inhibited and the Fault L.E.D.'s on all control cards in the rack are illuminated. This position is used when calibrating Detector Heads with gas or setting alarm levels. When returning to the Normal position there is a time delay before the Fault L.E.D's are extinguished.

3.3 Card Outputs

The DI 2-11 is fitted with a 64 way rear connector. Some of these inputs/outputs are taken to a 32 way connector on the rack motherboard when fitted. A full list of the pin functions is shown in Table 2.

The following paragraphs show those outputs which are intended for connection to external circuits. It does not include description of signals between the Channel Output card and other control cards.

3.3.3 Alarm Outputs.

Any Alarm from any Control pole changeover alarm relay. pushed the relay de-activates Relay contacts rated at 1 amp, card activates the double When the Accept switch is ready for the next alarm. 24 volts.

3.3.4 Fault Outputs.

Any fault signal from any Control card activates the double pole changeover fault relay. When the Accept switch is pushed the relay de-activates ready for the next Fault condition.. Relay contacts rated at 1 amp 24 volts.

3.3.5 Remote Reset.

An external single pole switch may be fitted to repeat the action of the Reset push on the front panel.



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### 3.3.6 Remote Accept.

An external single pole switch may be fitted to repeat the action of the Accept push on the front panel.

### 3.4 OPERATION.

#### NORMAL.

Under normal conditions all L.E.D's on the channel output card except for the Pilot will be out. The meter reads zero until the Read switch is pressed on a Control card when the meter reads the gas concentration for that channel.

#### ALARM.

When any channel goes -to the Alarm 1 condition the red Alarm 1 L.E.D. will flash, the audible alarm will sound and the alarm relay will activate. When the Accept switch is pushed the Alarm L.E.D. will illuminate continuously, the audible alarm will mute and the alarm relay will de-energize. If subsequently another channel goes to the alarm condition or the original channel reaches Alarm 2 condition the relevant alarm L.E.D. will again flash, the audible alarm will sound, and the alarm relay will energize until the Accept switch is pushed again. When the alarm conditions have been removed pressing the Reset switch will restore normal conditions. If the Reset switch is pressed before the alarm conditions are removed it will have no effect.

#### FAULT

When any channel goes into the Fault condition the Fault L.E.D. will flash, the audible alarm will sound the interrupted tone and the fault relay will energize. When the Accept switch is pushed the Fault L.E.D. will illuminate continuously, the audible alarm will mute and the fault relay will de-energize. When the fault has been cleared operation will revert to normal when the Reset switch is pushed.

#### CALIBRATION

The calibration mode is selected by switching the OnjCal. Inhibit switch to the Cal Inhibit position. In this state all outputs from the equipment are inhibited so that the calibration adjustments can be made without triggering external alarms. Note that all Fault L.E.D's will illuminate in this position.

TABLE 2

2-11 CHANNEL OUTPUT CARD.  
MOTHERBOARD REAR CONNECTOR.

A2	Lamp Test In E 2 Linked Spare Spare 24V E 4 OV
A4	Spare E 6 Spare
A6	Spare E 8 Spare
A8	Remote Accept, OV E10 Remote Accept Spare E12
A10	Spare
A12	N/O Rly 1 Fault E14 N/C Rly 1 Fault Spare E16 C
A14	Rly 1 Fault N/O Rly 2 Fault E18 N/C Rly 2 Fault
A16	L Test Reset E20 C Rly 2 Fault Spare E22 Spare
A18	Remote Reset OV E24 Remote Reset
A20	N/O Rly 1 ALM E26 N/C Rly 1 ALM Spare E28 C Rly
A22	1 ALM
A24	N/O Rly 2 ALM E30 N/C Rly 2 ALM
A26	Spare E32 C Rly 2 ALM
A28	
A30	
A32	

NOTE: For external Lamp Test only connect OV to A2.

For Lamp Test with External Reset link A20 to A2.

4. DI 4-11 HYDROGEN SULPHIDE CONTROL CARD

4.1 The DI 4-11 provides the necessary drive power to the DI8 H<sub>2</sub>S Detector Head, accept the this signal head and raise first and second stage pre-set from gas concentration values. alarms at

4.2 The front panel indicators and controls are as follows:

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#### 4.2.1 Indicators

Pilot.	Green LED that is illuminated when power is supplied to the module.
Fault.	Yellow L.E.D. that illuminates when the module is in a fault condition or when the channel output card is switched to inhibit (see Chapter 3)
Alarm 1.	Red L.E.D. that illuminates when the gas concentration at the Detector Head exceeds the pre set Alarm 1 value.
Alarm 2.	Red L.E.D. that illuminates when the gas concentration at the Detector Head exceeds the pre set Alarm 2 value.
Over Range	Red L.E.D. that illuminates when the gas concentration at the Detector Head exceeds 100 p.p.m. i.e. the full scale reading of the meter on the channel output card.

#### 4.2.2. Controls

"Zero/Read Switch" A spring loaded 2-way toggle switch. In the Read position it allows the signal from the card to be displayed on the meter of the channel output card. In the zero position it still allows the signal to be displayed on the meter but expands the scale such that full scale deflection is approximately 10 p.p.m.

"s" A pre set potentiometer accessible through the front panel which adjusts the gain of the circuit. It is used when the detector head is being calibrated.

"Z" A pre set potentiometer accessible through the front panel which adjusts the zero of the circuit. It is used to set zero on the meter of the channel output card when the Detector Head connected to the module is in clean air. It should only be adjusted when the Zero/Read switch is held in the zero position.

"HV" A pre set potentiometer accessible through the front panel which adjusts the voltage supplied to the Detector Head. This control must only be adjusted when the Detector Head voltage, measured at the Head junction

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box is being monitored. Note that too high a voltage at the Detector Head may destroy the sensors.

"A1" A pre set potentiometer accessible through the front panel which is used to set the level at which the Alarm 1 state is initiated.

"A2" A pre set potentiometer accessible through the front panel which is used to set the level at which the Alarm 2 state is initiated.

#### 4.3 Card Outputs

4.3.1 The Dr 4-11 is fitted with a 64 way rear connector which is used to connect inputs and outputs from external wiring. Some of these inputs/outputs are taken to a 32 way connector on the rack motherboard when fitted. A full list of these connections is shown in Table 3.

##### 4.3.2. Alarm Outputs.

Both the first and second alarm circuits each drive a double pole changeover relay. The contacts on these relays are volt free and are rated at 1 amp at 24 volts D.C. In addition both alarm circuits have a continuous and pulse output. These outputs are fed to the DI 2-11 channel output card to initiate the general alarm circuits. .

##### 4.3.3. Fault Outputs.

The fault circuit drives a single pole changeover relay. The contacts on this relay are volt free and are rated at 1 amp at 24 volts. In addition both pulse and continuous fault outputs are taken to the DI 2-11 channel output card to initiate the final fault circuit.

##### 4.3.4 Detector Head Connections.

Power is taken to the DI8 Detector Head via three connections which are nominated "+ve detector head", "-0 volts" and "detector head sense". These must be connected in the following manner.

Module DI 8 Wire Colour  
+ve Detector Head Red

0 volts	Black
Detector Head Sense	Yellow

##### 4.3.5 Analogue Output

An analogue output of gas concentration is available.

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This is scaled 1 to 5 volts for 0-100 p.p.ro. hydrogen sulphide.

#### 4.3.6 Other Signals.

A number of other signals to as shown in Table 1 are used transfer data between 2-11 the 4-11 Control card and the Channel Output card. external These are not available for use.

#### 4.4 OPERATION

##### NORMAL.

Green Pilot L.E.D. ON, all other L.E.D. 's OFF. To determine whether there is any gas present at the Detector Head press READ push, the meter on the Channel Output card will read the concentration in parts per million. When the READ push is released the meter on the Channel Output card will revert to zero reading.

##### ALARM 1

Green Pilot L.E.D. ON, Red Alarm 1 L.E.D. ON, all other L.E.D.'s OFF. To read concentration press READ push, Red Alarm 1 L.E.D. will remain ON even if below gas concentration reduces Alarm 1 Level. To reset Alarm 1 press RESET push on Channel Output card.

##### ALARM 2.

Green Pilot L.E.D. ON, Red Alarm 1 L.E.D. ON, Red Alarm 2 L.E.D. ON. To read concentration press READ push. Both Red Alarm 1 and 2 L.E.D. 's will remain ON even though gas concentration reduces below the alarm levels until the RESET push on Channel Output card is pressed.

##### OVER RANGE.

This condition exists when the concentration of gas at the Detector Head is greater than 100 p.p.m. Alarm 1, Alarm 2 Pilot and Overrange L.E.D.'s will be illuminated. This condition will remain until gas clears and RESET push is pressed.

##### FAULT.

This condition occurs if there is a short circuit or open circuit on any of the three wires to the Detector Head. The condition is indicated by the yellow FAULT L.E.D. ON and all other L.E.D. 's including the PILOT OFF. The output of the Detector Head sense amplifier is held at zero in this condition so that the Alarm states are not initiated. Note that when the toggle switch is switched to Inhibit/Calibrate all the control cards in the rack will show Fault Condition. In this state the

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Detector Head sense amplifier is not held at zero so the Alarm L.E.D. 's will still operate. This facility allows Alarm levels to be set.

TABLE 3 DI 4-11 TOXIC GAS CHANNEL CARD REAR CONNECTOR

A2 Spares E 2 Linked Spare  
A4 Spare 24V E 4 -VE Analogue O/P  
A6 Spare E 6 Sig Det Head  
A8 Spare E 8 -VE Det Head  
A10 OV E10 +VE Det Head  
A12 Spare E12 +VE Analogue O/P  
A14 N/O Rly B1 ALM 1 E14 N/C Rly B1 ALM 1  
A16 Spare E16 C Rly B1 ALM 1  
A18 N/O RLY B2 ALM 1 E18 N/C Rly B2 ALM 2  
A20 Spare E20 C Rly B2 ALM 1  
A22 N/O Rly A Fault E22 N/C Rly A Fault  
A24 OV E24 C Rly A Fault  
A26 N/O Rly C1 ALM 2 E26 N/C Rly C1 ALM2  
A28 Spare E28 C Rly C1 ALM 2  
A30 N/O Rly C2 ALM 2 E30 N/C Rly C2 ALM 2  
A32 Spare E32 C Rly C2 ALM 2

**5. CALIBRATION**

THIS SECTION SHOULD BE READ TOGETHER WITH THE HANDBOOK FOR THE RELEVANT DETECTOR, i.e. DI-5/6, DI-8 OR DI-9

5.1 Before attempting to calibrate Detector Heads it is essential that the correct calibration gas is available. We recommend that for the DI 5/6 flammable gas detector the calibration gas should be 2.5% by volume methane in air (equivalent to 50% L.E.L.). Sufficient gas is required to flow at a rate of 1 to 1.5 litres per minute for approximately 60 seconds per

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Detector Head. For the DI 8 hydrogen sulphide Detector Head it is essential to use a hydrogen sulphide in air mixture. It is not easy to store very low concentrations of hydrogen sulphide in air in containers. The gas tends to be absorbed by the cylinder walls and become more dilute. A mixture of 20 p.p.m. is more likely to maintain its concentration than 10 p.p.m. and we suggest that 20 p.p.m. mixtures are used. Never feed low concentrations of hydrogen sulphide through long lengths of tubing, particularly rubber tubing. The walls of tubing will absorb the hydrogen sulphide and what emerges from the far end will not be the concentration that is in the container. If available PTFE tubing should be used in preference to other materials. For both the DI 5/6 and the DI 8 allow a flow rate of test gas between 1.0 and 1.5 litres per minute through the calibration cap.

## 5.2 Head Volts

Set the OnjCal.Inhibit switch on the Channel Output card to Cal.Inhibit position. Locate the Detector Heads and having first ensured that it is safe to work, remove the cover of each junction box. Measure the voltage as shown below and adjust HV control on relevant Channel card for the correct reading.

Dr 5/6 voltage measured between Detector Head +ve and Detector Head -ve i.e. between red and black leads.

Sensor types VQ1,VQ2,VQ21,VQ22 V = 2.0 +/- 0.1 volts

Sensor types VQ3,VQ8,VQ16,VQ23 V = 2.5 +/- 0.1 volts

Dr 8 voltage measured between Detector Head +ve and Detector Head -ve, i.e. between red and black leads.

V = 6 +/- 0.2 volts

Replace junction box lids on completion.

## 5.3

Set Alarm 1 level and Alarm 2 level

At the channel card press READ switch and off-set zero control to the required level at which Alarm 1 should occur. Now adjust Al control so that the alarm just triggers. Repeat procedure for Alarm 2 setting. Return zero control so that meter reads zero.

## 5.4

## Set true zero

Ensure that DI 5/6 detectors have been running with correct head voltage for at least one hour and that DI 8 detectors have been running for at least 24 hours. Ensure that Detector Heads are in clean air. On 1-11 (DI 5/6) Channel card press Read switch and adjust zero control for zero reading on meter. On 4-11 (DI 8) card press toggle switch to "zero" position and adjust zero control for Zero reading on meter. For the DI 8 detector it may be necessary to purge with bottle air for 5 minutes before setting zero as interfering vapours may be producing a small reading.

## 5.5

## Set Span

using the correct calibration gas apply the gas to the Detector Head using a Dr calibration cap. Ensure flow rate is between 1.0 and 1.5 litres per minute. On 1-11 Channel card press READ switch or on 4-11 Channel card press toggle switch to READ position. Wait until meter settles, approximately 20 - 30 seconds and adjust span control for correct reading. Remove the gas and the calibration caps and ensure that the Detector Head returns to a zero reading if there is no gas present in the atmosphere.