

Instruction Manual

EXC250E and EXC250L Turbomolecular Pump Controllers

Description

EXC250E Turbomolecular Pump Controller
EXC250L Turbomolecular Pump Controller

Item Number

D396-35-000
D396-36-000



Declaration of Conformity

We, BOC Edwards,
Manor Royal,
Crawley,
West Sussex RH10 2LW, UK

declare under our sole responsibility that the product(s)

EXC250E Turbomolecular Pump Controller	D396-35-000
EXC250L Turbomolecular Pump Controller	D396-36-000

to which this declaration relates is in conformity with the following standard(s)
or other normative document(s)

EN61010-1:1993/A2	Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use.
EN61326 (Industrial location, Class B Emissions)	Electrical Equipment for Measurement, Control and Laboratory Use - EMC Requirements.

following the provisions of

73 / 023 / EEC	Low Voltage Directive.
89 / 336 / EEC	Electromagnetic Compatibility Directive.



Dr. J.D. Watson, Senior Technical Manager, VED

11/10/01 BURGESS HILL

Date and Place

This product has been manufactured under a quality system registered to ISO9001

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1 INTRODUCTION

1.1 Scope and definitions

This manual provides installation, operation and maintenance instructions for the BOC Edwards EXC250E and EXC250L Turbomolecular Pump Controllers. You must use the Controller as specified in this manual.

Read this manual before you install and operate the Controller. Important safety information is highlighted as **WARNING** and **CAUTION** instructions; you must obey these instructions. The use of **WARNINGS** and **CAUTIONS** is defined below.

	WARNING Warnings are given where failure to observe the instruction could result in injury or death to people.
--	--

CAUTION Cautions are given where failure to observe the instruction could result in damage to the equipment, associated equipment and process.
--

Throughout this manual, page, figure and table numbers are sequential.

The units used throughout this manual conform to the SI international system of units of measurement; US equivalent units of measurement are also given.

The following IEC warning labels appear on the controller:



Warning - refer to accompanying documentation.



Warning - risk of electric shock.



Protective earth (ground).



Direct current only.

1.2 Description

The EXC controller generates the electrical supply and the control signals necessary to operate an EXT pump and its accessories. Refer to Section 2 for compatible EXT pumps.

The Controller has a high-efficiency, auto-ranging power supply that adjusts itself to any external electrical supply in the specified voltage range (refer to Section 2). The power supply converts the single-phase electrical supply into a regulated d.c. electrical supply to control the operation of the EXT pump. The pump has three Hall effect devices that operate as rotor position sensors. These sensors ensure that the drive current is correctly switched to the phase-windings of the pump-motor. The Hall effect devices also generate a speed signal, which the Controller uses to regulate the rotational speed of the pump.

The Controller has a secondary regenerative supply that uses the d.c. motor of the EXT pump as a generator. If the electrical supply fails, the regenerative supply provides the Controller with a back-up source of power without the need for batteries. The Controller uses the regenerative supply to maintain the electrical supplies to the vent valve, air cooler and AIM gauge (if connected), until the pump speed falls below 50% of full rotational speed (refer to Section 1.5.2)

The Controllers have a number of control features that limit the power supplied to the EXT pump in the event of sustained high pressure or temperature:

- If the EXT pump inlet pressure rises, the power supplied to the pump-motor increases to counteract the gas frictional load. The pumps rotational speed remains constant until the Controller peak power level is reached; beyond this power level, the speed of the pump starts to reduce. If the pump speed falls to below 50% of its full rotational speed, the Controller may trip into a fail condition; this depends on how the Controller has been configured (refer to Section 1.6.2)
- If the Controller detects that its temperature or the pumps temperature is too high, it reduces the power supplied to the pump-motor; the pump may therefore not be able to maintain full rotational speed if it is too hot. If the pump speed falls below 50% of its full rotational speed, the Controller may trip into a fail condition; this depends on how you have configured your controller (refer to Section 1.6.2)

The Controller has no front-panel controls and can only be operated through a logic interface. To operate the EXT pump, you must connect your controller to your own control equipment. Alternatively, you can configure the mating-plug for the logic interface connector so that the EXT pump starts to operate as soon as the electrical supply to the Controller is switched on (refer to Section 3.9)

The rear-panel of the Controller has a Normal LED indicator that lights when the TMP Normal status output signal is low (refer to Section 1.4.4)

The EXC250L Controller has an integral pump-to-controller cable. The EXC250E Controller has a mating connector suitable for a pump-to-controller cable accessory (not supplied). (refer to Section 7)

1.3 Connection of an Active Gauge

Note: The Controller contains a regenerative power supply that maintains the electrical supply to the AIM gauge in the event of a failure of the external electrical supply of the Controller (refer to Section 1.5.2)

A BOC Edwards AIM Active Inverted Magnetron Gauge can be connected directly to the active gauge connector which uses the Controllers TMP Normal signal to switch the gauge on. This allows control of the AIM gauge without the need to use an additional high pressure gauge (and associated control equipment) to interlock the operation of the AIM Gauge to system pressure. Refer to Section 3.8 for details about how to connect an AIM gauge to the Controller.

If you want to use another type of gauge, you must connect the gauge to the Controller through the logic interface (refer to Section 3.9).

1.4 Logic Interface

1.4.1 Introduction

The rear panel of the Controller has a 15-way logic interface connector (Figure 1, item 4), that can be used to connect the Controller to your own equipment.

Signals on the logic interface are of four types:

- Electrical supplies - These are electrical supplies for optional accessories connected to your pump, such as the vent-valve and the air-cooler.
- Control inputs - These are switch-type input signals, which are used to control the operation of the EXT pump.
- Status outputs - These output signals identify the status of the pump and the Controller.
- Analogue output - The Controller can be configured to provide a speed output or a power output. This output gives an indication of the EXT pump speed or power consumption.

Refer to Table 3 and to Figure 4 for detailed information about the logic interface pins and their uses. A general description of the logic interface connections follows.

1.4.2 Electrical Supplies

Two nominal 24V supplies are provided, as described below:

Vent-valve supply

This electrical supply is provided to operate a vent-valve fitted to your EXT pump or vacuum system. The Controller is supplied configured to automatically open the valve when the speed of the pump falls to below 50% of the full rotational speed. The Controller can also be configured to operate the valve in other specific conditions (refer to Sections 1.5 and 3.2).

Air-cooler supply

This electrical supply is provided to operate an ACX air-cooler fitted to your EXT pump. The electrical supply is on whenever the controller is powered. Alternatively, if the pump is water-cooled, this supply can be used to operate a solenoid-valve to control the flow of water through the water-cooler.

1.4.3 Control Inputs

These inputs can be used to control the operation of the EXT pump. The input signals are switch-type signals; link (close) two pins on the logic interface to set the required signal and un-link (open) the pins when the signal is not required to be set. The input signals are as follows:

Start/Stop

Use the Start/Stop input to start and to stop the EXT pump. The pump is started by closing the Start/Stop input and the pump is stopped by opening it (refer to Sections 4.1 and 4.5).

Stand-by

Close the stand-by input to select pump stand-by (refer to Section 4.2)

1.4.4 Status Outputs

The Controller provides Normal, Fail and Pump On status output signals (TMP Normal, TMP Fail and TMP On), through open collector transistor outputs on the logic interface connector. These signals can be used to control devices in the pumping system or to provide remote status output signals. The signals operate as described below.

TMP Normal

TMP Normal is initially high and goes low when the EXT pump reaches its 'Normal' speed. The Normal speed is determined by a potentiometer on the side of the Controller. The Controller is supplied with the potentiometer adjusted so the Normal speed is 80% of the full rotational speed. The Normal speed can be adjusted as described in Section 3.10. The Normal LED on the rear panel of the Controller (Figure 1, item 6), is on when the TMP Normal signal is low.

TMP Fail

TMP Fail is normally low and goes high when the Controller trips into a Fail condition (refer to Section 1.6).

TMP On

The TMP On signal mimics the operation of the vent-valve. If Vent On Stop is selected (refer to Section 1.5.2), TMP On is normally high and goes low when the electrical supply to the vent-valve is switched on by the Controller.

1.5 Vent-Valve Control

1.5.1 Introduction

Note: The factory settings for the vent options are shown in Table 2.

If the Controller electrical supply fails, the Controller maintains the electrical supply to the vent-valve until the pump speed falls below 50% of full rotational speed, then the Controller switches off the vent-valve electrical supply. This feature of the Controller cannot be reconfigured.

The configuration links in the Controller can be used (refer to Section 3.2.4), to select a combination of vent options in response to the Stop input signal and the TMP Fail output signal.

When a selected vent option condition is detected, the Controller:

- Waits approximately two seconds, to allow a vacuum system isolation-valve (if fitted) to close,
- Then switches off the electrical supply to the vent-valve.

1.5.2 Vent On Stop

If Vent On Stop is selected when power is applied to the Controller, the vent-valve electrical supply is available immediately. When Start is selected, the Controller maintains the vent-valve electrical supply on. If stop is then selected, the Controller switches the vent-valve electrical supply off again.

If Vent On Stop is not selected when the Controller is switched on, the vent-valve electrical supply remains off until Start is selected. When Start is selected, the Controller switches the vent-valve electrical supply on. If stop is then selected, the EXT pump will decelerate and the vent-valve electrical supply will remain on until the pump speed falls to below 50% of full rotational speed; the vent-valve electrical supply will then be switched off.

1.5.3 Vent On Fail

If Vent On Fail is selected, then the setting of the Vent On Stop option determines how the vent-valve is controlled in response to a fail condition, as follows:

- If you have selected Vent On Stop and a failure occurs, the Controller switches the vent-valve electrical supply off approximately two seconds after the Fail condition is detected.
- If you have not selected Vent On Stop, the EXT pump will decelerate and the vent-valve electrical supply will remain on until the pump speed falls to below 50% of the full rotational speed; the vent-valve electrical supply will then be switched off.

If Vent On Fail was not selected, the electrical supply to the vent-valve will not be switched off when a fail condition is detected.

1.6 Controller Fail Conditions

1.6.1 General

Note: If you enable the internal timer (refer to Sections 1.6.2 and 3.2.3), the Controller will trip into the fail condition only after the preset time has elapsed.

Note: The Controller will trip into the Fail condition if either of the following occurs:

- The EXT pump does not reach 50% of the full rotational speed within a preset time after it starts (the time is set by the adjustable internal timer (refer to Sections 1.6.2 and 3.2.3)).
- The EXT pump speed falls to below 50% of its full rotational speed.

When the Controller trips into the Fail condition, the electrical supply to the EXT pump-motor is switched off and the TMP Fail status output signal on the logic interface goes high. The operation of the vent-valve depends on how the Controller has been configured (refer to Sections 1.5 and 3.2). To reset the Controller after a Fail condition has occurred, refer to Section 4.7.

1.6.2 Internal Timer

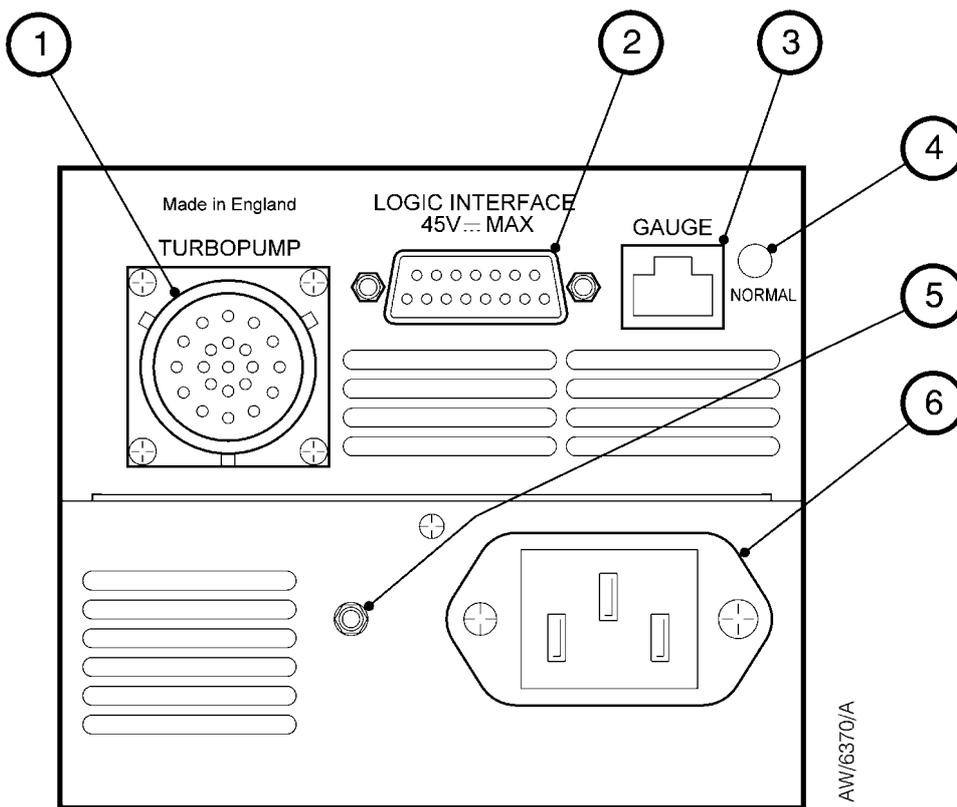
The internal timer has two functions:

Firstly, when the EXT pump is started by the Controller, the internal timer in the Controller also starts. If the EXT pump does not reach 50% of the full rotational speed within a preset time measured by the timer, the Controller will trip into Fail condition. This function cannot be disabled.

Secondly, the Controller can be configured to enable or disable the internal timer if the pump speed falls during pump operation:

- If you disable the internal timer, the Controller will trip into Fail condition as soon as the pump speed falls below 50% of the full rotational speed.
- If the internal timer is enabled, it will start as soon as the pump speed falls below 50% of the full rotational speed; the Controller will trip into Fail condition if the pump speed is still below 50% of the full rotational speed at the end of the preset time.

The Controller is supplied with the internal timer disabled and adjusted for a preset time of eight minutes. To adjust the timer for a specific application refer to Section 3.11.



- | | |
|------------------------------|--------------------------------|
| 1. EXT pump connector* | 4. Normal LED |
| 2. Logic interface connector | 5. Earth (ground) stud |
| 3. Active gauge connector | 6. Electrical supply connector |

* EXC250E only; the EXC250L has an integral pump to controller cable.

Figure 1 - Rear panel of the Controller (EXC250E shown)

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2 TECHNICAL DATA

2.1 Operating and Storage Data

Ambient operating temperature range	0°C to 40 °C
Ambient storage temperature range	-20°C to 70°C
Maximum ambient operating humidity	10 to 90% RH (non-condensing to DIN40040)
Maximum operating altitude	3000m
Cooling	Forced Air Fan

2.2 Mechanical Data

Dimensions	Refer to Figure 2
Mass	
EXC250E	1.8kg
EXC250L	2.0kg
Enclosure protection	IP20 (as defined by IEC529)
Pollution degree	IEC664, category 2

2.3 Electrical Data

Electrical supply	
Voltage	90 to 264 V a.c., single phase
Frequency)	47 to 63 Hz
Maximum input power)	440 VA
Peak inrush current	22A at 110V a.c. 48A at 240V a.c.
Over-voltage transients	IEC664, category 2
Radiated electromagnetic emissions	EN61326
Electromagnetic immunity	EN61326

2.4 EXT Pump Electrical Output Data

*Compatible EXT pumps	EXT250 80V family, Splitflow 80V family EXT555H
Maximum continuous output power	250W
Maximum output voltage	56V a.c. r.m.s.
Switching frequency	32kHz
Nominal output frequency	600Hz to 1kHz
Maximum output frequency	1.07 x nominal
Stand-by frequency	95% of nominal

* Not suitable for the EXT70 series family of pumps.

2.5 Logic Interface

Remote control signals	
Control voltage: low (close)	<0.8V d.c.
Control voltage: high (open)	4 to 24V d.c.
Maximum input current (at 24V)	100µA
Maximum output current (at 0V d.c.)	160µA
Air-cooler electrical supply	
Voltage range	+20 to +26V d.c.
Maximum output current	250mA
Vent-valve electrical supply	
Voltage range	+16 to +26V d.c.
Maximum output current	80mA
Analogue output	
Output voltage	0 to 10V d.c. proportional to speed or power 0 to 10V \cong 0 to 100% of pump speed, or 0 to 10V \cong 0 to 250W motor power (may peak above 10V during ramp)
Maximum output current	5mA
TMP Normal and TMP Fail status outputs	
Maximum output voltage (high)	26V d.c.
Maximum output current	
Vout (low) \geq 0.8V	20mA
Vout (low) <0.8V (TTL level)	1mA
TMP On status output	
Logic high output voltage at 8µA	4V
Logic low output voltage at 42µA	0.8V

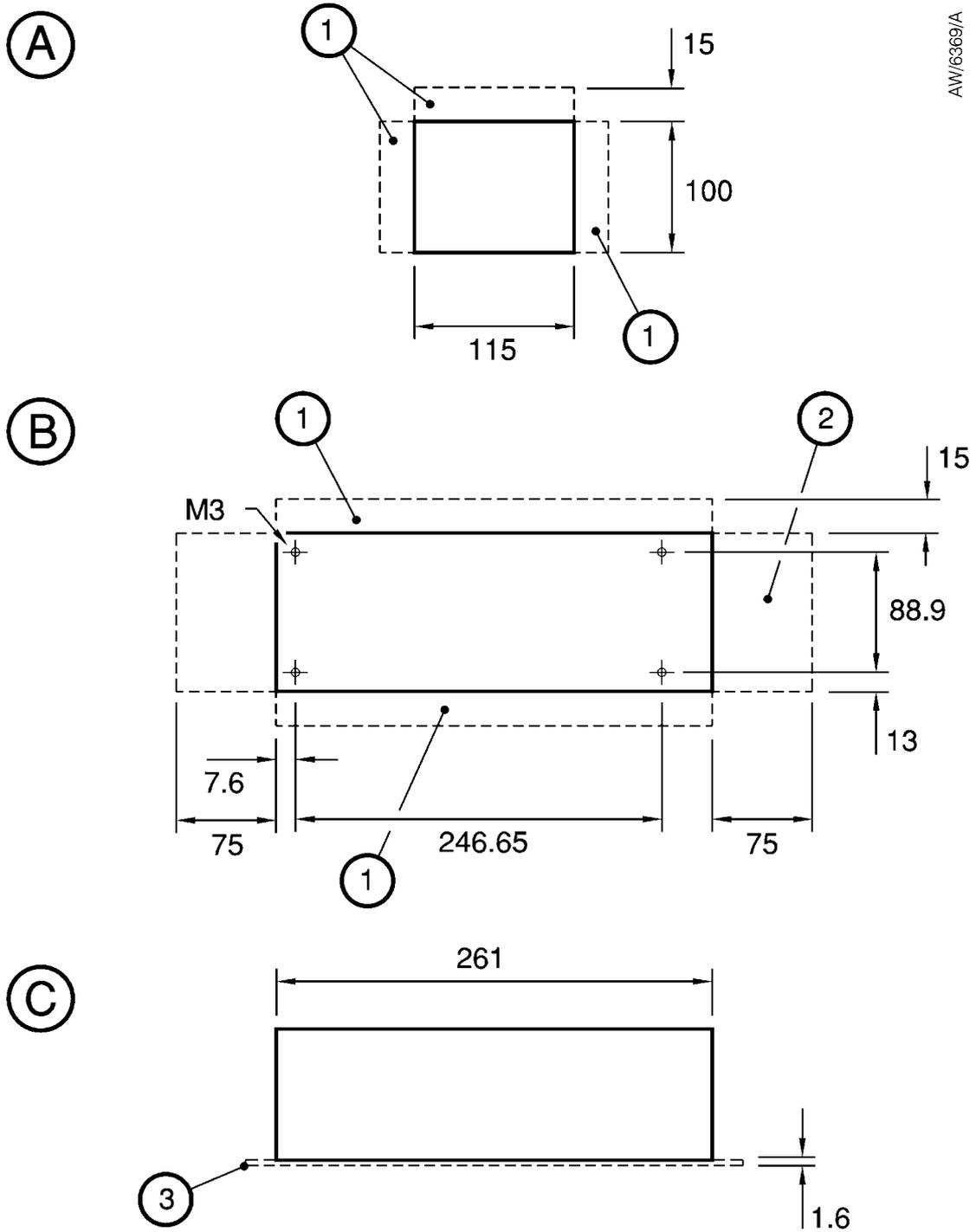
2.6 Factory Settings

Normal speed	80%
Internal timer	8 min, enabled
Vent options	Refer to Table 2
Analogue output	Speed output

2.7 Electrical Connectors

Note: Do not connect voltages greater than 45V to the logic interface. If you do, the Controller will not comply with the low voltage safety recommendations of EN61010.

Electrical supply connector socket type	CEE/IEC 320
Earth (ground) stud (on rear panel)	M4
Active gauge connector	
Signals on the connector pins	Refer to Figure 6 and Table 4
Socket type	FCC68, 8-way
Manufacturer	Western Electric
Maximum power	3W
Logic interface connector	15-way sub-miniature 'D' type socket



- A Rear view
- B Top view
- C Side view

- 1. Clearance for ventilation
- 2. Clearance for cables
- 3. Optional mounting plate

Figure 2 - Dimensions (mm): EXC250E shown

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3 INSTALLATION

3.1 Unpack and Inspect

Remove all the packaging materials and check the Controller. If the Controller is damaged, notify your supplier and the carrier in writing within three days; state the Item Number of the Controller together with your order number and your supplier’s invoice number. Retain all packaging materials for inspection. Do not use the Controller if it is damaged.

If the Controller is not to be used immediately, store the Controller in suitable conditions as described in Section 6.1.

3.2 Configure the Controller



WARNING

To avoid the risk of electrical shock, ensure that the controller is disconnected from the electrical supply prior to configuring the controller via the internal links.

3.2.1 Introduction

The Controller has four links, which can be used to configure the Controller for your application, refer to Table 1. Each link can be in one of two positions as shown in Figure 3 and described in Sections 3.2.2 and 3.2.4.

To reconfigure the controller, undo and remove the seven screws (Figure 3, item 1) and remove the top cover (2) of the Controller to access the links. Use the links as described in the following sections.

Link	Use
LK1	Select speed or power analogue output
LK4	Disable the internal timer
LK5	Select Vent On Stop or no Vent On Stop
LK6	Select Vent On Fail or no Vent On Fail

Table 1 - Configuration Links

3.2.2 Select Speed or Power Analogue Output

Note: The Controller is supplied with the link LK1 configured to provide the pump speed analogue output signal on the logic interface.

Refer to Figure 3. To select the pump speed analogue output signal on the logic interface, insert link LK1 in the upper position (5).

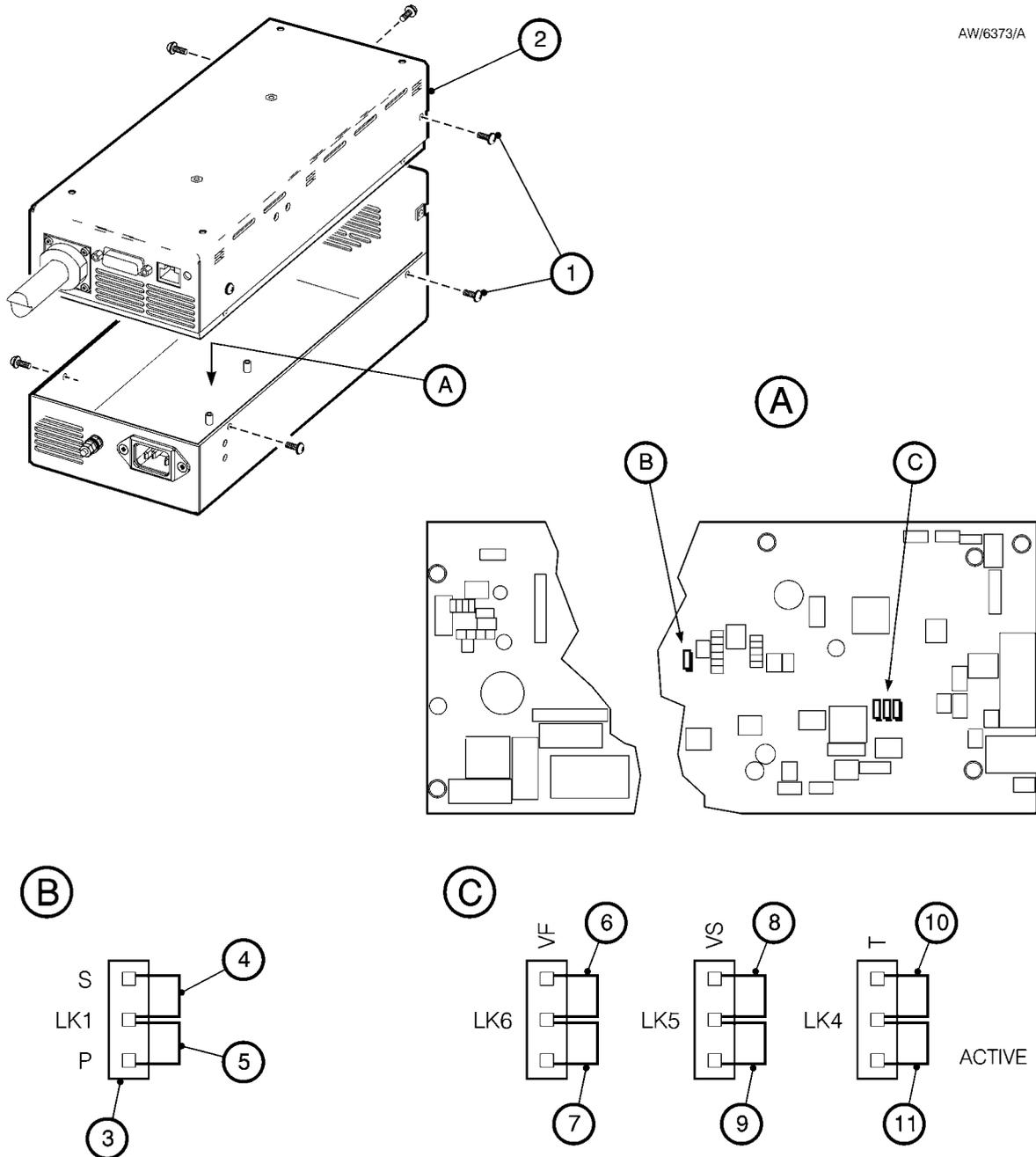
To select the pump power analogue output signal on the logic interface, insert link LK1 in the lower position (6).

3.2.3 Internal Timer Mode Selection

Note: If pumping a high gas load when the internal timer is enabled (link LK4 in the inactive position, Figure 3, item 11), the EXT pump may stall before the Controller trips into the fail condition. Ensure that oil, which backstreams from the baking pipeline will not adversely affect your process. Disable the internal timer to provide the greatest protection against backstreaming if a Fail condition occurs.

Set link LK4 active to disable the use of the internal timer when the pump rotational speed falls below 50% of the full rotational speed during operation (refer to Section 1.6.2).

- **Insert link LK4 in the inactive position (Figure 3, item 11) to enable the timer.** The internal timer will then start as soon as the pump rotational speed falls to below 50% of the full rotational speed. If the pump speed remains below 50% of the full rotational speed after the preset time, The Controller will trip into the Fail condition.
- **Insert link LK4 in the active position (Figure 3, item 12) to disable the timer.** The Controller will then trip into Fail condition as soon as the pumps rotational speed falls to below 50% of the full rotational speed.



1. Screw
2. Top cover
3. Speed/power link:LK1
4. Link LK1 in speed configuration
5. Link LK1 in power configuration
6. Link LK6 inactive: Vent On Fail not selected

7. Link LK6 active: Vent on Fail selected
8. Link LK5 inactive: Vent On Stop not selected
9. Link LK5 active: Vent On Stop selected
10. Link LK4 inactive: Timer enabled
11. Link LK4 active: Timer disabled

Figure 3 - Reconfigure the Controller (EXC250L shown)

LK6 (Vent On Fail)	LK5 (Vent On Stop)	Vent Options
not active	not active	Vent when EXT pump speed falls to 50% of full speed after Stop is selected.
not active	active	Vent On Stop.
active*	not active*	Vent on Fail; vent when the EXT pump speed falls to 50% of full speed.
active	active	Vent on Fail and Vent on Stop.

Table 2 - Selection of vent valve control options

*Link positions as supplied.

3.2.4 Vent Options

Links LK5 and LK6 are used to select the vent-valve control options (refer to Section 1.5). Each of the links can be in one of two positions, the link not active position and the link active position. Position the links to select the required vent options as shown in Table 2.

Note: IF the electrical supply to the Controller fails, the Controller will always switch off the electrical supply to the vent-valve when the EXT pump speed falls below 50% of the full speed (refer to Section 1.6.1).

3.3 Fit the Controller



WARNING

The Controller contains electrolytic capacitors and, under certain fault conditions, may emit dangerous fumes. Ensure that the Controller is operated in a well-ventilated area.

CAUTION

To avoid contacting the internal components, the M3 bolts used to mount the controller, must not penetrate further than 6mm into it.

CAUTION

You must allow the correct clearances for air circulation and you must fit the Controller onto a thermally conductive surface. If you do not, the performance and reliability of the Controller may be affected at high operating temperatures.

The Controller must be fitted in a rack or a cabinet. The Controller can be operated in a horizontal or vertical position with the side vents at the top.

When fitting the Controller a 15mm clearance must be allowed at the sides and a 75mm clearance at the front for good air circulation also a 75mm clearance at the back is required for the cables.

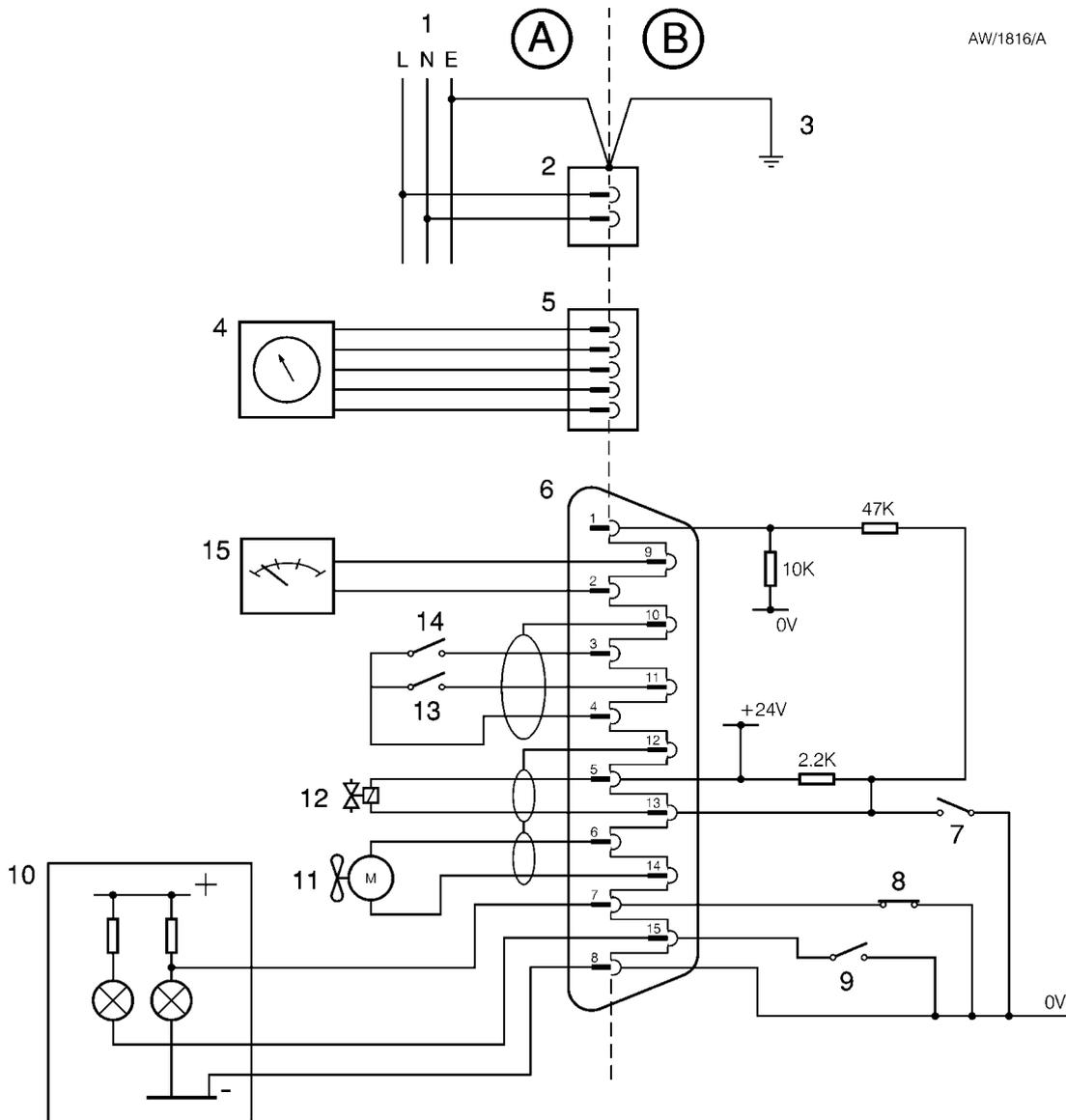
The Controller must be fitted firmly to a thermally conductive material, for example, aluminium or steel. The location of the bottom panel fixing holes are shown in Figure 2.

EXC250E and EXC250L Turbomolecular Pump Controllers

Pin Number	Signal	Polarity ^a	Signal Type
1	TMP On (low when pump is on)	N/A	Status Outputs
7	TMP Fail (high when fail condition exists)	N/A	
8	Status output common	N/A	
15	TMP Normal (low when pump is at normal speed) ^b	N/A	
3	Start/Stop: Close for Start	+	Control input
4	Start/Stop: Close for Start	-	
11	Stand-by: Close for stand-by	+	Control input
4	Stand-by: Close for stand-by	-	
10	RFI screen	N/A	N/A
5	Vent-valve electrical supply:24V	+	Supply
13	Vent-valve control ^c	-	
6	Air-cooler electrical supply: 24V	+	Supply
14	Air-cooler electrical supply: 0V	-	
9	Pump speed or power	+	Analogue output
2	Pump speed or power	-	

Table 3 - Logic interface pins

- a. + = positive, - =negative, N/A = Not Applicable
- b. This output is only TTL compatible when the current drawn is 1mA. Refer to Section 2.
- c. This supply line is raised to +24V to de-energize the valve coil and vent the system.



- | | | | | | |
|---|----------------------------------|----|-------------------------------------|-----|------------------------------------|
| A | Vacuum and control system | 1. | External electrical supply | 9. | TMP normal output (normally open)* |
| B | EXC controller | 2. | Electrical supply connector | 10. | Remote indicator equipment |
| L | Live electrical supply | 3. | Earth (ground) | 11. | Air-cooler |
| N | Neutral electrical supply | 4. | AIM active gauge | 12. | Vent-valve |
| E | Earth (ground) electrical supply | 5. | Active gauge connector | 13. | External standby switch |
| | | 6. | Logic interface connector | 14. | External start/stop switch |
| | | 7. | Vent-valve control (normally open)* | 15. | Speed/power indicator |
| | | 8. | TMP Fail (normally closed)* | | |

* These are solid state switches in the controller.

Figure 4 - Schematic diagram of the Controller electrical connections

3.4 Introduction to Controller Electrical Connections

When the electrical connections to the Controller are made as described in the following sections, refer to Table 3 for full details of the logic interface connections and refer to Figure 4, which shows a schematic diagram of the electrical connections.

Suitable strain-relief must be provided on the cables that are fitted to the Controller.

3.5 Connect the Electrical Supply

	<p>WARNING</p> <p>High voltages exist in the Controller when it is operating. Ensure that the Controller is earthed (grounded) and observe all appropriate safety precautions for the safe installation and handling of electrical equipment. If you do not, there will be a danger of injury or death to people by electric shock.</p>
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You must use a suitable electrical supply cable to connect the Controller to the electrical supply. An electrical supply cable is not supplied with the Controller, but is available as an accessory, refer to Section 7.

1. Connect the wires at one end of the electrical supply cable to a suitably rated and fused electrical supply; if required, connect the wires to a suitably rated plug. Connect the wires as shown in Table 4.

Wire Colour	Use
Green/Yellow	Earth (ground)
Brown	Live (Line)
Blue	Neutral

Table 4 - Electrical supply cable wires

2. Fit the connector on the other end of the electrical supply cable to the electrical supply connector on the rear of the Controller (refer to Figure 1).

3.6 Connect Additional Earth (Ground) Bonding (if required)

Protective earthing (grounding) for electrical safety of the Controller and accessories is provided by the electrical supply cables and connectors. A protective earth connection is required on the pump, refer to the appropriate EXT pump manual for details. However, additional earth (ground) bonding may be required to improve the reliability of the system by reducing any effects of RFI (Radio Frequency Interference), particularly if the vacuum system is prone to high voltage discharges or other radio frequency emissions.

Use good EMC (electromagnetic compatibility) practices and take note of the following EMC earthing (grounding) guidelines to reduce the susceptibility of the system to RFI:

- Connect the Controller, the EXT pump and the vacuum chamber to a common earth (ground) point on the pumping system; this 'star' earth (ground) is typically in the electrical power distribution box.
- Clamp the Controller earthing (grounding) terminal between the two lock-nuts provided on the earth (ground) stud on the rear panel of the Controller.
- Use suitable heavy duty cable or braid to ensure a low impedance bond to the earth (ground) point (typically less than 0.1Ω for each leg of the star).
- Use screened cable for all wiring to the logic interface connector. (The TAV5 vent-valve and the ACX Air-cooler accessories are provided with screened cable). Connect each screen to the Controller earth (ground) stud to ensure that they are properly earthed (grounded).

3.7 Connect the EXT Pump

If you have an EXC250L Controller, fit the connector on the end of the integral pump-to-controller cable to the connector on the EXT pump.

If you have an EXC250E Controller, use a pump-to-controller cable (not supplied) to connect the Controller to the EXT pump (available as an accessory, refer to Section 7). Fit the connectors on the ends of the cable to the appropriate mating-halves on the rear of the Controller and the EXT pump.

3.8 Connect an AIM Active Inverted Magnetron Gauge (Optional)

Use a BOC Edwards Active gauge cable (available as an accessory, refer to Section 7) to connect a BOC Edwards AIM Active Inverted Magnetron Gauge to the Controller through the active gauge connector (Figure 1, item 3) on the rear of the connector.

If another type of gauge is required to be connected to the Controller it will need to be connected to the logic interface, refer to Section 3.9.

3.9 Connect the Logic Interface to your Equipment

3.9.1 Introduction

CAUTION

Do not earth (ground) the logic interface 0V line (pins 13 and 14). If you do, you will provide an earth (ground) return path for any electrical fault in the pump-motor and this could damage the Controller or your control equipment.

Use the appropriate pins on a suitable mating-plug (not supplied) for the logic interface connector to connect your control equipment and accessories to the Controller, as described in the previous sections and as shown in Table 3 and Figure 4. We recommend that wire of 0.24 mm² cross-sectional area is used.

Alternatively, if you do not connect the Controller to your control equipment, link pins 3 and 4 in the mating-plug. The EXT pump will then start to operate as soon as the electrical supply to the Controller is switched on and the pump will stop when the electrical supply to the Controller is switched off.

3.9.2 Connect a Vacuum Gauge to the Logic Interface

A BOC Edwards APG Active Pirani Gauge can be connected to the Controller so that the setpoint output of the gauge sets the Start/Stop input on the logic interface, to switch on the EXT pump. We recommend that the following procedure is adopted:

1. Fit an active gauge connector to a suitable break-out box.
2. Connect wires from the break-out box to the logic interface on the Controller, as shown in Table 5.

APG Connector Pin Number	Logic Interface Pin Number
1	6
2	14
3	-
4	-
5	-
6	3

Table 5 - APG to logic interface connctions

To connect another type of gauge, refer to the instruction manual supplied with it for information on the electrical connections to the gauge.

3.10 Adjust the Normal Speed Status Output

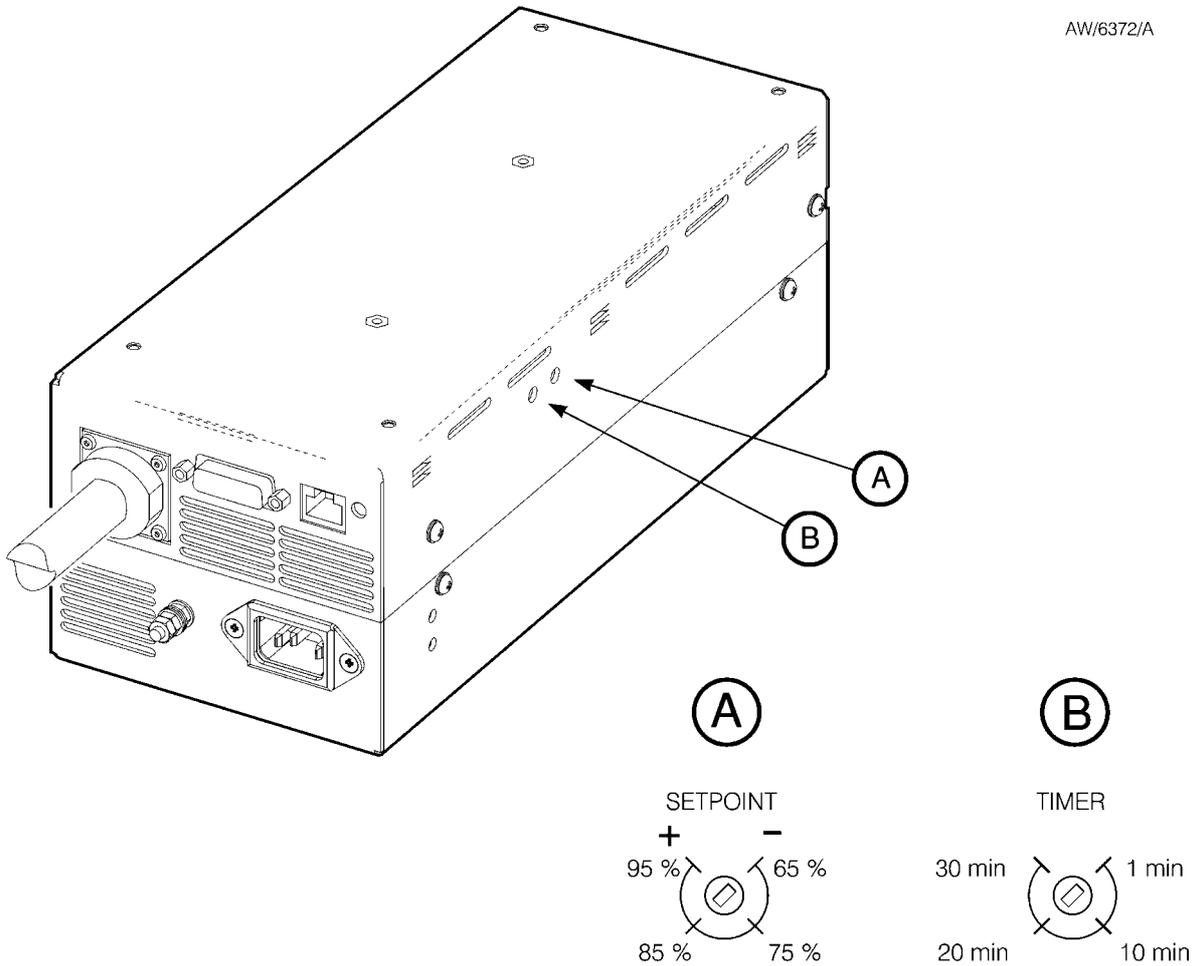
The Normal speed status output setting can be adjusted (at which the TMP Normal output goes low, refer to Section 1.4.4) between 65 and 95% of full rotational speed.

Refer to Figure 5. To adjust the Normal speed, use a small screwdriver to turn the SETPOINT potentiometer (A). Figure 5 also shows the approximate Normal speed settings for different potentiometer adjustments.

3.11 Adjust the Internal Timer

The internal timer can be adjusted between approximately 1 and 30 minutes. The Controller is supplied with the internal timer adjusted to eight minutes (refer to Section 1.6.2).

To adjust the internal timer, use a small screwdriver to turn the TIMER potentiometer (B). Figure 5 also shows the different timer settings for different potentiometer adjustments; these settings are only approximate. If the timer setting is critical for your application, you must check the time and readjust the potentiometer as necessary, until the correct time is obtained.



- A Normal speed potentiometer
- B Timer potentiometer

Figure 5 - Normal speed and Internal Timer potentiometers (EXC250L shown)

4 OPERATION

4.1 Start-up

Note: The backing pump and the EXT pump can be started at the same time; the EXT pump will not be damaged and can operate as an effective baffle. However, if the system pressure remains too high for the EXT pump to reach 50% of the full rotational speed in the preset time (set by the internal timer), the Controller will trip into Fail condition. Refer to Section 3.11 for adjustment of the internal timer.

Note: The following sections assume that the Controller is connected to the control equipment and use the control input signals on the logic interface connector to operate the pumping system.

When Start is selected, the Controller will switch on the electrical supply to the EXT pump and the pump rotor will start to accelerate.

Use the following procedure to start-up the system. This procedure assumes that the vent-valve and the backing pump will be operated manually, however, the Controller can be configured to automatically operate the vent-valve, (refer to Section 3.2.4).

1. Close the vent-valve (if fitted).
2. Start the backing pump.
3. Start the EXT pump: close the Start/Stop input on the logic interface (refer to Section 1.4.3)

4.2 Standby

To select standby, close the standby input on the logic interface (that is, ensure that the appropriate pins are linked, refer to Section 1.4.3.).

If standby is selected when the pump is operating, the speed of the pump will be reduced to the standby speed. If Standby is selected before the pump is switched on, the pump will run up to standby speed, not full speed.

4.3 Operation with High Inlet Pressure

If the EXT pump inlet pressure rises, the power supplied by the Controller to the pump-motor will increase to counteract the gas frictional load. The pump rotational speed will remain constant until the Controller peak power level is reached; beyond this power level, the speed of the pump will start to reduce.

If the pump speed falls below 50% of the full rotational speed, the Controller may trip into a Fail condition; this depends on the Controller has been configured (refer to Sections 1.6 and 3.2).

Refer to EXT pump instruction manual for the maximum allowable inlet pressure, and refer to Section 2.4 for the maximum controller output power.

4.4 Operation with High Pump Temperature

Temperature sensors in the Controller and the EXT pump are monitored by the Controller. If the Controller detects that the pump temperature is too high, the power supplied to the pump-motor is reduced; the pump therefore may not be able to maintain full rotational speed if it is too hot.

If the pump speed falls below 50% of the full rotational speed, the Controller may immediately trip into a Fail condition, or trip into a Fail condition after a set time; this depends on how the Controller is configured (refer to Sections 1.6 and 3.2).

Refer to the EXT pump instruction manual for the pump operating temperature ranges.

4.5 Normal Shutdown

Use the following procedure to shutdown your system. This procedure assumes that the vent-valve and the backing pump will be operated manually, however, the Controller can be configured to automatically operate the vent-valve, (refer to Section 3.2.4). Refer to the Instruction manual for the EXT pump for details of the maximum allowable vent rate.

1. Select Stop: open the Start/Stop input on the logic interface connector (refer to Section 1.4.3).
2. Open the vent-valve when the EXT pump speed is at about 50% of the full rotational speed.
3. Switch off the backing pump.

4.6 Automatic Shutdown After a Fail Condition

	<p>WARNING</p> <p>If the Start/Stop control signal on the logic interface connector is set to Start, the Controller will automatically restart the EXT pump when the electrical supply is restored after an electrical supply failure. Ensure that people cannot be injured by the rotating rotor blades of the EXT pump.</p>
---	--

The Controller will automatically switch off the electrical supply to the EXT pump if the Controller trips into a Fail condition (refer to Section 1.6).

The operation of the vent-valve in all Fail conditions depends on how the Controller has been configured, refer to Sections 1.6 and 3.2.

4.7 Reset the Controller After a Fail Condition

To reset a Fail condition, open the Start/Stop input on the logic interface for at least 300ms and then close the input.

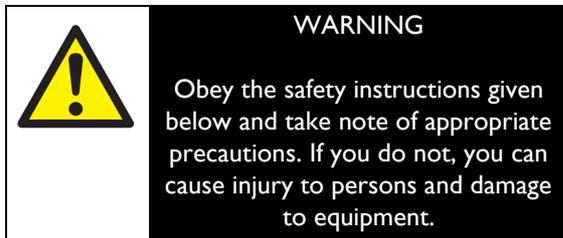
4.8 Electrical Supply Failure

If the electrical supply to the Controller fails when the EXT pump is rotating:

- The motor of the EXT pump is used as a generator and the electrical supplies for the vent-valve, air-cooler and the AIM gauge (if connected) and the associated control logic are maintained until the pump speed falls to 50% of the full rotational speed, then the electrical supplies are switched off.
- The controller will then shutdown.

5 MAINTENANCE

5.1 Safety



- A suitably trained and supervised technician must perform maintenance work.
- Isolate the Controller and other components in the pumping system from the electrical supply so that they cannot be operated accidentally.
- Dispose of the components safely (refer to Section 6.2).

5.2 Clean the Controller

If necessary, use a soft dry cloth to clean the exterior of the Controller.

If the interior of the Controller needs to be cleaned, we recommend that the Controller is returned to your supplier or the nearest BOC Edwards Service Centre.

5.3 Fault Finding

If the Controller shuts down due to a Fail condition, refer to the appropriate sections of this instruction manual to determine the cause of the Fail condition. If necessary, refer to the appropriate section of the instruction manual supplied with the EXT pump.

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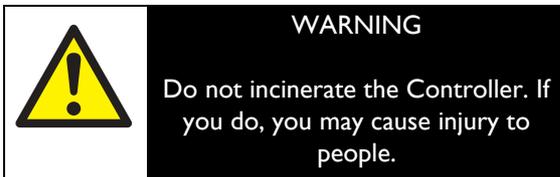
6 STORAGE AND DISPOSAL

6.1 Storage

Fit protective covers over the electrical connections and store the Controller in clean dry conditions until required.

When required for use, prepare and install the Controller as described in Section 3 of this instruction manual.

6.2 Disposal



Dispose of the Controller and any components safely in accordance with all-local and national safety and environmental requirements.

Do not incinerate the Controller. If the Controller is heated to very high temperatures, dangerous gases may be emitted and internal components may explode.

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7 SERVICE, SPARES AND ACCESSORIES

7.1 Introduction

BOC Edwards products, spares and accessories are available from BOC Edwards companies in Belgium, Brazil, Canada, China, France, Germany, Israel, Italy, Japan, Korea, Singapore, Switzerland, United Kingdom, U.S.A. and a world wide network of distributors. The majority of these centres employ service engineers who have undergone comprehensive BOC Edwards training courses.

Order spare parts and accessories from your nearest BOC Edwards company or distributor. When you order please state for each part required:

- Model and item number of your equipment.
- Serial number (if any)
- Item number and description of part.

7.2 Service

BOC Edwards products are supported by a world wide network of BOC Edwards Service Centres. Each Service Centre offers a wide range of options including: equipment decontamination, service exchange, repair, rebuild and testing to factory specifications. Equipment which has been serviced, repaired or rebuilt is returned with a full warranty.

Your local service Centre can also provide BOC Edwards engineers to support on-site maintenance, service or repair of your equipment.

For more information about service options, contact your nearest service centre or other BOC Edwards company.

7.3 Accessories

7.3.1 Electrical supply cable

A suitable electrical supply cable must be used to connect the Controller to the electrical supply. An electrical supply cable is not supplied with the Controller.

Cable	Item Number
Electrical supply cable (2m length, unterminated)	D385-01-102

7.3.2 Pump-to-Controller Cable

A pump-to-Controller cable must be used with each pump. It is not supplied with the EXT pump or with the EXC250E Controller. The following cables are available:

Cable	Item Number
Pump-to-Controller cable, 1m	D396-18-010
Pump-to-Controller cable, 3m	D396-18-030
Pump-to-Controller cable, 5m	D396-18-050
Pump-to-Controller cable (OEM*), 5M	D396-18-325

* The OEM cable is supplied with a separate connector so that you can fit the cable through a bulkhead, if required.

7.3.3 TAV Vent-valve

A solenoid-operated vent-valve is available for system venting. The valve is 24V d.c. 2W, normally-open, and can be operated automatically from the EXC Controller. The solenoid-valve is fitted in place of the manual vent-valve, or alternatively can be fitted with an adaptor (supplied with the valve) and used with any suitable NW10 flanged port on your vacuum system.

Vent-valve	Item Number
TAV5 vent-valve	B580-66-010
TAV6 vent-valve	B580-66-020

7.3.4 ACX Air-cooler

An ACX air-cooler can be fitted to the EXT pump and can be operated automatically from the Controller. However, please refer to Section 2 and 3 of the EXT pump instruction manual to check the suitable air cooling in a particular application.

Air-cooler	Item Number
ACX250H	B580-53-160
ACX555H	B580-53-561

7.3.5 Active Vacuum Gauges

Examples of suitable gauges and accessories, which can be connected to the EXC Controllers are listed below.

Note: An AIM gauge can only be connected directly to the active gauge connector on the Controller; All other gauges must be connected through the logic interface, refer to Section 3.9.

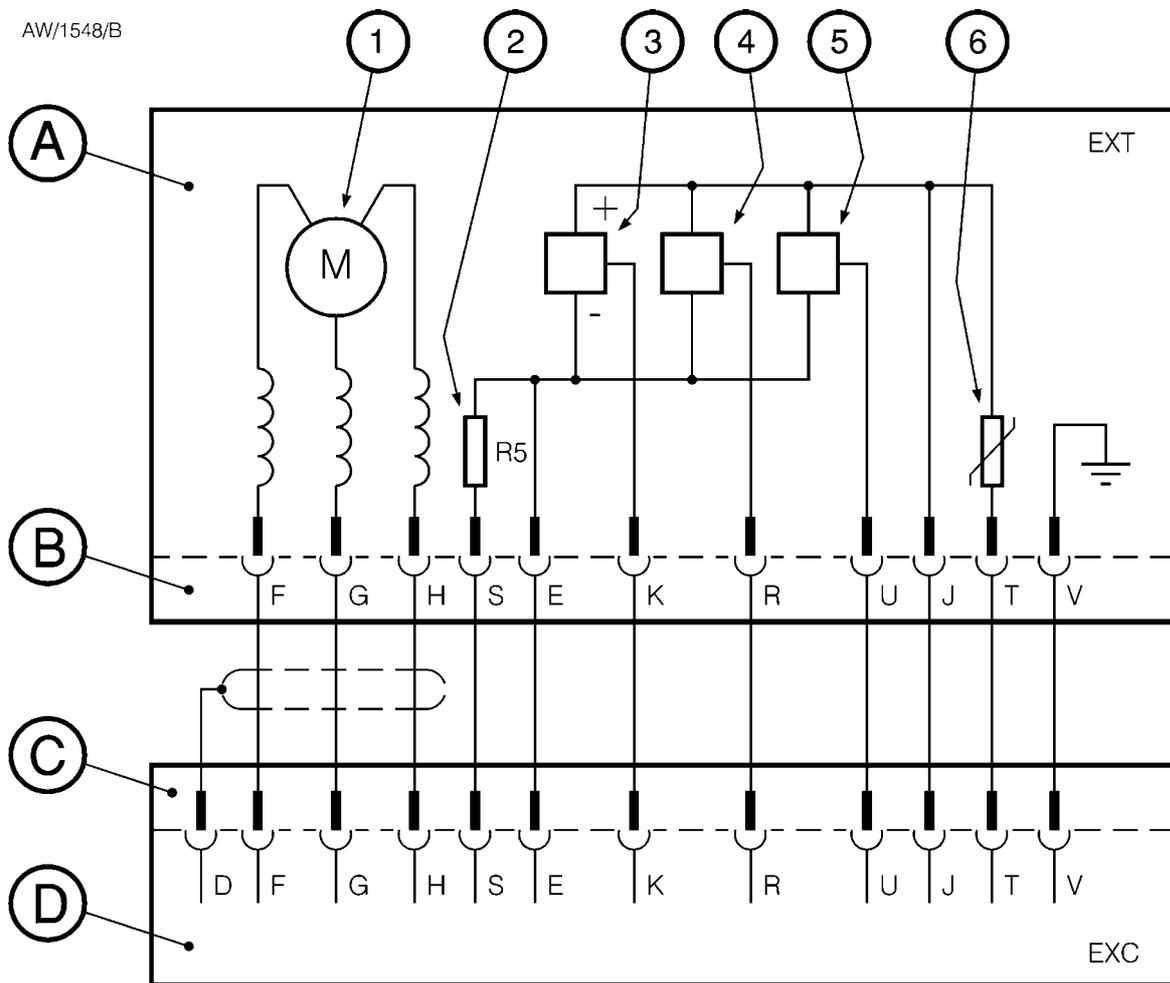
Description	Item Number
AIM-S-NW25 Active Inverted Magnetron Gauge	D145-45-000
AIM-SL-NW25 Active Inverted Magnetron Gauge	D145-48-000
APG-M-NW16 Active Pirani Gauge	D021-71-000
APG-L-NW16 Active Pirani Gauge	D021-73-000
ATC-E Active Thermocouple Gauge	D351-08-000
ATC-D 1/8" NPT Thermocouple Gauge Tube	D351-12-000
ATC-M 1/8" NPT Thermocouple Gauge Tube	D351-13-000
Active Gauge Cable, 0.5m long	D400-01-005
Active Gauge Cable, 1m long	D400-01-010
Active Gauge Cable, 3m long	D400-01-030

8 ENGINEERING DIAGRAMS

To assist in fault finding (refer to Section 5), the connections between the Controller and the EXT pump are shown in Figure 6.

The Active Gauge connector (which is specific to the EXC Controller) is shown in Figure 7.

AW/1548/B



- | | | | |
|---|-------------------------|----|-------------------------|
| A | EXT pump | 1. | d.c. motor |
| B | EXT connector on cable | 2. | Speed set resistor |
| C | EXC connector on cable* | 3. | Hall effect device 1 |
| D | EXC Controller | 4. | Hall effect device 2 |
| | | 5. | Hall effect device 3 |
| | | 6. | Pump temperature sensor |

* EXC250E controller only - (the EXC250L has an integral cable)

Figure 6 - EXC Controller to EXT pump connections

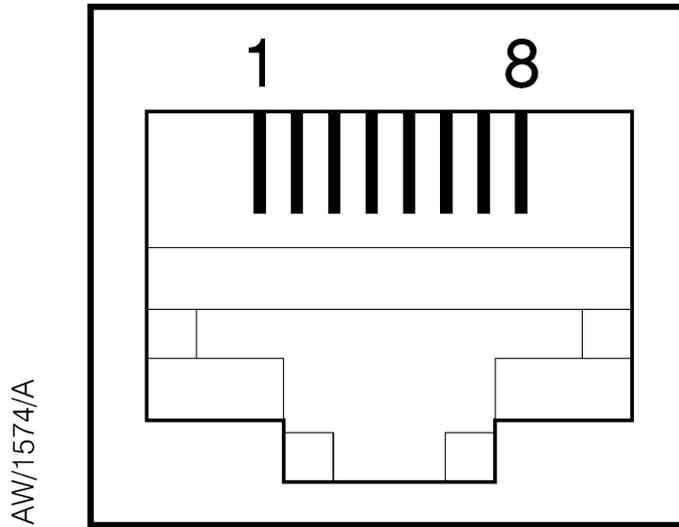


Figure 7 - Active gauge connector pins

Pin	Signal
1	Power supply +24V d.c.
2	Power supply 0V d.c.
3	Not used
4	Gauge identification signal
5	Not used
6	Not used
7	TMP Normal status output
8	Not used

Table 6 - Active Gauge Connector Pins

Introduction

Before you return your equipment you must warn your supplier if the substances you used (and produced) in the equipment can be dangerous. You must do this to comply with health and safety at work laws.

You must complete the Declaration (HS2) on the next page and send it to your supplier before you dispatch the equipment. If you do not, your supplier will assume that the equipment is dangerous and he will refuse to accept it. If the Declaration is not completed correctly, there may be a delay in processing your equipment.

Guidelines

Take note of the following guidelines:

- Your equipment is '**uncontaminated**' if it has not been used or if it has only been used with substances that are not dangerous. Your equipment is '**contaminated**' if it has been used with any dangerous substances.
- If your equipment has been used with radioactive substances, you must decontaminate it before you return it to your supplier. You must send independent proof of decontamination (for example a certificate of analysis) to your supplier with the Declaration (HS2). Phone your supplier for advice.
- We recommend that contaminated equipment is transported in vehicles where the driver does not share the same air space as the equipment.

PROCEDURE

Use the following procedure:

1. Contact your supplier and obtain a Return Authorisation Number for your equipment.
2. Turn to the next page(s), photocopy and then complete the Declaration (HS2).
3. Remove all traces of dangerous gases: pass an inert gas through the equipment and any accessories which will be returned to your supplier. Drain all fluids and lubricants from the equipment and its accessories.
4. Disconnect all accessories from the equipment. Safely dispose of the filter elements from any oil mist filters.
5. Seal up all of the equipment's inlets and outlets (including those where accessories were attached). You may seal the inlets and outlets with blanking flanges or heavy gauge PVC tape.
6. Seal contaminated equipment in a thick polythene bag. If you do not have a polythene bag large enough to contain the equipment, you can use a thick polythene sheet.
7. If the equipment is large, strap the equipment and its accessories to a wooden pallet. Preferably, the pallet should be no larger than 510mm x 915mm (20" x 35"); contact your supplier if you cannot meet this requirement.
8. If the equipment is too small to be strapped to a pallet, pack it in a suitable strong box.
9. If the equipment is contaminated, label the pallet (or box) in accordance with laws covering the transport of dangerous substances.
10. Fax or post a copy of the Declaration (HS2) to your supplier. The Declaration must arrive before the equipment.
11. Give a copy of the Declaration to the carrier. You must tell the carrier if the equipment is contaminated.
12. Seal the original Declaration in a suitable envelope; attach the envelope securely to the outside of the equipment package. **WRITE YOUR RETURN AUTHORISATION NUMBER CLEARLY ON THE OUTSIDE OF THE ENVELOPE OR ON THE OUTSIDE OF THE EQUIPMENT PACKAGE.**

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