

# *Instruction Manual*

## nEXT Turbomolecular Pumps nEXT240, nEXT300 and nEXT400



Description	Item Number
nEXT240D	B812XXXXX
nEXT240T	B813XXXXX
nEXT300D	B822XXXXX
nEXT300T	B823XXXXX
nEXT400D	B832XXXXX
nEXT400T	B833XXXXX

# Declaration of Conformity

We,



declare under our sole responsibility, as manufacturer and person within the EU authorised to assemble the technical file, that the product(s)\*

B812 XXXXX	nEXT 240D
B813 XXXXX	nEXT 240T
B822 XXXXX	nEXT 300D
B823 XXXXX	nEXT 300T
B832 XXXXX	nEXT 400D
B833 XXXXX	nEXT 400T

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

EN ISO 12100-2: 2003	Safety of Machinery. Basic Concepts, General Principles for Design. Technical Principals
+ A1: 2009	
EN1012-2:1996, A1: 2009	Compressors and Vacuum Pumps. Safety Requirements. Vacuum Pumps
EN61010-1: 2010	Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use. General Requirements
EN 61326-1: 2006	Electrical equipment for measurement, control and laboratory Use. EMC requirements. General requirements.
EN50581:2012	Technical Documentation for the Assessment of Electrical and Electronic Products with respect to the Restriction of Hazardous Substances
C22.2 61010-1-04: 2004	Safety requirements for electrical equipment for measurement, Control and laboratory use - Part 1: General requirements
UL61010A: 2002	Safety requirements for electrical equipment for measurement, Control and laboratory use - Part 1: General requirements

and fulfils all the relevant provisions of

2006/42/EC	Machinery Directive
2006/95/EC	Low Voltage Directive
2004/108/EC	Electromagnetic Compatibility (EMC) Directive
2011/65/EU <sup>†</sup>	Restriction of Certain Hazardous Substances (RoHS) Directive

\* The material numbers cover a family of pumps where the following component features may vary according to the variant; 'X' denotes combinations of variants of the geometry of pump inlet ports, geometry or position of exhaust port and the material and geometry of the pump casing.

<sup>†</sup> *i.e. The product(s) contain less than - 0.1wt% for hexavalent chromium, lead, mercury, PBB and PBDE; 0.01wt% for cadmium - in homogeneous materials (subject to the exemptions allowed by the Directive). The RoHS Directive does not legally apply to industrial vacuum equipment until July 2019 (July 2017 for instruments).*

**Note:** This declaration covers all product serial numbers from the date this Declaration was signed onwards.

*This product has been manufactured under a quality system certified to ISO9001:2008*

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# 1 Introduction

## 1.1 Scope and definitions

This manual provides installation, operation and maintenance instructions for Edwards nEXT Turbomolecular Pumps. The pumps must be used as specified in this manual. Read this manual before installing and operating the pumps.

Important safety information is highlighted as WARNING and CAUTION instructions; these instructions must be obeyed. 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

---

The units used throughout this manual conform to the SI international system of units of measurement; where appropriate US equivalent units of measurement are also given. When flow rates are specified, the abbreviation 'sccm' is used to mean standard cubic centimetres per minute. This is a flow of  $1 \text{ cm}^3 \text{ min}^{-1}$  at an ambient temperature of  $0 \text{ }^\circ\text{C}$  and a pressure of 1013 mbar ( $1.013 \times 10^5 \text{ Pa}$ ).

The following warning labels are on the pump:



Warning - refer to accompanying documentation.



Warning - risk of electric shock.



Warning - hot surfaces.



Protective conductor terminal.

## 1.2 General description



### **WARNING**

Improper use of the equipment could cause damage to it or injury to people. The user is responsible for the safe operation, installation and monitoring of the system.



### **WARNING**

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

### **CAUTION**

Do not attempt to separate the controller from the pump since this will cause damage to the electrical connections.

A nEXT pump consists of a turbomolecular pump with a permanently attached controller containing drive electronics.

The controller controls the electrical supply to the pump with the exception of standby speed control. It has no manual controls and can only be operated through the logic interface. To operate the nEXT pump, connect it to the customer control equipment and power supply or, alternatively, use the Edwards TIC Turbo Instrument Controller or TIC Turbo Controller.

The controller drives the brush-less d.c. motor in the pump.

There are three main variants of the nEXT pump,

- The 'S' or 'Simplex' variant contains only turbomolecular blades.
- The 'D' or 'Duplex' variant contains turbomolecular blades and a drag mechanism allowing operation at higher backing pressures than pure turbomolecular pumps.
- The 'T' or 'Triplex' variant contains turbomolecular blades, a drag mechanism and a regenerative mechanism. The regenerative stage offers the option to utilise 'boost' mode.

Also available is an 'iD' or 'iT' interstage variant, which provides an interstage port between the turbomolecular blades and drag mechanism. For SEM and TEM applications, an 'L' variant is available, which offers considerably lower vibration and stray magnetic field emissions.

nEXT pumps are supplied with an inlet screen fitted into the centering O-ring for ISO version pumps and into envelope for CF version pumps. nEXT pumps with an NW25 interstage port are supplied with an inlet strainer that fits into the interstage port. The inlet screen and inlet strainer protect the pump against damage that would be caused by debris entering the pump.

The nEXT pumps have a vent port for venting the pump and vacuum system to atmospheric pressure. The pump is supplied with a manual vent valve fitted; this can be replaced with a TAV5 or TAV6 solenoid-operated vent valve (available as accessories - refer to [Section 7](#)). The TAV valve can be directly controlled by the on-board controller.

The nEXT pumps have a purge port: an inert purge gas can be introduced to protect the bearing and motor from corrosion. An optional vent port adapter and purge restrictor can be fitted to the purge port to control the flow rate of the purge gas and to filter the gas supply. (Refer to [Section 7](#)).

Air coolers and a water-cooling block are available as optional accessories to cool the nEXT pumps. (Refer to [Section 7](#)).

## 1.3 Pump controller

The pump controller contains the drive electronics that control the pump operation and the TAV vent valve. There is a connector socket on the side of the controller where the TAV vent valve can be plugged in. (Refer to [Section 2.9](#))

The controller has three indicator LED's that signal the general status, operation and service status of the pump. The LEDs can be used for fault finding if a problem should occur. (Refer to [Section 2.10](#))

The drive electronics system has a number of built-in safety features to protect the nEXT pumps from damage in the event of sustained high pressure or temperature.

- The electronics constantly monitors the temperature inside the controller and the temperature of the motor within the pump. If either part becomes too hot, the controller reduces the power supplied to the pump motor and the pump speed will drop. If the pump rotational speed falls below 50% of full speed, the electronics may trip into a Fail condition, depending on the system configuration. (Refer to [Section 1.4.3](#)).
- If the pump inlet pressure increases, the power supplied to the pump motor increases to counteract the gas frictional load. However, when the built-in maximum power limit is reached, the speed of the pump will start to drop. If the pump rotational speed falls below 50% full speed, the electronics may trip into Fail condition, depending on how the system has been configured. (Refer to [Section 1.4.3](#)).
- In the event of an electrical supply failure, the controller uses the motor within the pump as a generator. This means the nEXT pumps have their own regenerative supply and do not require a separate battery for emergency power backup. The regenerated energy is used to maintain the electrical supply to the controller and any vent valve or fan attached to the controller connector until the pump speed falls to below 50% of full rotational speed: this will ensure that the vent valve remains shut until below 50% of full rotational speed and will prevent the pump from venting at full speed. It also ensures that the serial link and signals on the parallel interface remain active until the pump speed falls below 50%.

## 1.4 Operational features

In addition to the basic start and stop commands, the nEXT pumps have several other features that allow pump operation to be tailored to a particular application. Refer to [Table 10](#) for factory default settings of the parameters discussed in the following sections.

OEM supplied pumps may have drive parameters and default user-selectable settings which differ from those stated in this instruction manual in order to suit certain process requirements. Please contact the OEM in the first instance for further information and advice.

### 1.4.1 Power limit setting

Select the maximum power that will be drawn by the pump (refer to [Section 4.1.1](#)). The more power supplied, the quicker the pump will accelerate to reach full speed. If the application requires fast cycling, set the power limit to the maximum value. If ramp time is not important in the application, use a lower power limit, down to a minimum value (refer to [Table 1](#)).

Table 1 - Power limits

Pump	Standard default setting	Maximum value setting	Minimum value setting
nEXT240, nEXT300 and nEXT400	160 W	200 W	50 W

Ensure that the power supply is capable of delivering sufficient power to the nEXT pump. By choosing a lower power limit setting, a smaller power supply may be used. For more information, refer to [Section 2.7](#).

### 1.4.2 Standby speed

In standby mode, the pump rotational speed is lower than the full rotational speed. The default setting for standby speed is 70% of full speed. Note that in order to run at standby speed, the pump must also be in the start condition.

If the application does not require the pump to be running at maximum speed at all times, use the standby speed feature rather than switching the pump off. This feature can be used for vacuum system tuning or as a system power saving option.

The standby speed is a user-selectable value (refer to [Section 4.1.4](#)).

### 1.4.3 Timer

When the pump is started, an internal timer is automatically started within the drive electronics. The default timer setting is 8 minutes. If the pump fails to reach 50% of full rotational speed within the timeout period, the controller will signal a Fail and will decelerate the pump to rest. This feature prevents the controller from driving the pump at maximum power for a long time. The pump may fail to reach 50% speed if the gas load is too high (for example if there is a leak in the system), if the backing pump fails or if the pump is too hot.

The timeout period is a user-selectable feature (refer to [Section 4.1.6](#)). If the application requires the pump to ramp up slowly, extend the timeout period. The timer is permanently enabled for ramp-up.

The timer has an additional function: if the pump rotational speed drops below 50% of full speed for any reason, the pump time can be set to recover rather than trigger a fail condition. The timer starts as soon as the speed drops to below 50% full speed. If, during the timeout period, the pump recovers to above 50% full speed then the timer will be reset. If the pump rotational speed fails to recover by the end of the timeout period, the controller will trigger a fail condition and will decelerate the pump to rest. When the pump is shipped, the timer function is enabled, however, it can be disabled. With the timer disabled, the pump will fail and decelerate to rest as soon as pump rotational speed falls below 50%.

### 1.4.4 Analogue output

The pump controller produces an analogue output for monitoring four different system parameters:

- Measured pump rotational speed (default condition)
- Measured motor power
- Measured motor temperature
- Measured controller temperature

The analogue output signal ranges from 0 to 10 V and is directly proportional to the system parameter (refer to [Section 2.8](#)).

Connect the analogue output to a suitable meter or indicator to display the appropriate system parameter or connect it to the customer control equipment (for example, to operate other components in the pumping system at preset values).

Only one system parameter can be monitored at a time using the analogue output. However, it is easy to configure the controller to monitor a different system parameter (refer to [Section 4.1.7](#)).

### 1.4.5 Automatic vent options

An Edwards TAV vent valve can be connected directly to the nEXT pump's controller. The controller is capable of providing a number of different venting options.

The drive electronics can control the rate of venting. Using this feature the pump can be vented from full rotational speed in a controlled manner that will not damage the pump bearings. Once the pump rotational speed has dropped to below 50% of maximum speed, it is safe to hard vent (open the vent valve fully).

There are many venting options available, including:

- Hard vent when rotational speed drops below 50%
- Controlled vent when above 50% speed and hard vent below 50% speed
- Hard vent immediately through a suitable restrictor

Controlled venting gives the benefit of a quicker ramp down time by controlling the vent rate through a single large orifice across the pump speed range. A full list of the venting options is given in [Section 3.9](#)

In addition there is a feature that allows a delayed start of the nEXT pump. With this feature, the vent valve can be closed before starting the nEXT pump. This allows the backing pump to reduce the pressure in the vacuum system before starting the nEXT pump.

If the controller is not used to control a TAV vent valve, it can be used to run a fan instead. The controller can be configured so that the fan is permanently enabled.

### 1.4.6 Normal speed setting

The normal speed is a user-selectable parameter that can be set anywhere from 50% to 100% of full rotational speed. When the pump reaches normal speed, a signal is available on the normal pin of the logic interface connector. This signal can be used to control the application since it shows that pump speed, and therefore vacuum performance, has reached a specific minimum level. The default setting is 80% of full rotational speed. Refer to [Section 4.1.5](#) for instructions on altering the normal speed setting.

## 1.5 Logic interface

The pump controller can only be operated through the logic interface. The signals on the logic interface are of three types:

- Control inputs: these are switch-type signals that are used to control the pump
- Status outputs: these outputs identify the status of the system
- Analogue output: this provides a 0 - 10 V output for a number of pump parameters.

The logic interface has been designed to support both serial and parallel control and monitoring, operating through one connector. For serial control either RS232 (default) or RS485 can be selected using the RS485/RS232 slide switch located on the controller (refer to [Section 3.7](#)).

The logic interface can be plugged directly into the Edwards TIC Turbo Controller or TIC Turbo Instrument Controller and then use the functionality that they provide. Alternatively, the logic interface can be connected to the customer control system. The most useful arrangements are described in the sections below.

For more information about the logic interface, refer to [Section 2.8](#).

### 1.5.1 Parallel control and monitoring

The simple parallel interface is a quick and easy way to control the pump. This is the same interface used on existing 24 V Edwards Turbo Pumps. The controls that are available to use are start and standby. The system status can be monitored using the normal, fail and analogue output signals.

**Note:** *The serial enable switch MUST be open (no connection) and the slide switch must be in the RS232 position (refer to [Section 3.7](#)).*

Refer to [Section 3.6](#) for more detailed instructions of how to use the parallel interface.



A system operating with only a parallel connection is not capable of adjusting the configuration settings stored in the controller (for example, power limit setting or controlled venting options). In this case, all these features would be at their factory default settings. It is possible to manually adjust the standby speed if standby mode is selected, however, the controller should be configured separately before fitting the nEXT pump to the system. This is covered in more detail in [Section 1.5.5](#).

### 1.5.2 Serial control and monitoring

The serial communications link provides complete control and monitoring by using just three signal lines. The serial data lines share the same connector pins as the parallel signals standby and fail. The serial data lines can be configured to provide an RS485 compliant or RS232 compatible interface by setting the position of the RS485/RS232 slide switch (refer to [Section 3.7](#))

The serial enable signal **MUST** be linked to 0 V for the system to accept commands from the serial link. This is a safety feature and acts as an interlock. For pure serial control, the parallel start signal will be left unconnected.

The controller will still provide the normal and analogue signals on the logic interface connector even when operating under serial control. The status of the normal signal and the value of the system parameter on the analogue output can also be obtained by interrogating the system status via the serial link.

For more information about the serial interface, refer to [Section 3.7](#).

### 1.5.3 Serial control with parallel monitoring

Since normal and analogue signals remain available even using serial control, it is possible to control the pump via the serial link whilst monitoring these signals in the parallel interface.

The serial link uses the same connector pins as the parallel signals standby and fail so these parallel control and monitoring signals are not available. The serial enable signal **MUST** be linked to 0 V and the parallel start signal will be left unconnected.

### 1.5.4 Parallel control with serial monitoring or serial configuration

This method of control is best for users who normally wish to operate the pump in parallel control mode but occasionally want to adjust the configuration settings stored in the controller or to monitor operational status of the pump via the serial link.

The serial enable signal must be linked to 0 V for serial communications to take place. Whilst operating under parallel control with the serial link active, the parallel start control signal is available (as described in [Section 1.5.1](#).) but the standby control line is not since it is used as a serial data line.

If the serial enable line is deactivated at any time whilst the RS485/RS232 slide switch is in the RS232 position, the serial link should also be disconnected. Edwards suggests making a special cable for serial communications that includes a link between serial enable and 0 V. This way, serial enable is automatically activated when the cable is connected and then deactivated when the cable is removed.

### 1.5.5 Controller configuration (serial configuration)

All the configuration settings stored within the controller are retained even when power to the nEXT pump is removed. This means that it is possible to use a separate system to configure the controller before fitting the nEXT pump to the application. This gives the benefit of tailoring the pump functionality to a customer application and allows the pump to be operated using a simple parallel interface system.

To configure the nEXT pump, either use a customer simple serial system or use the Edwards TIC Turbo Controller or Turbo Instrument Controller. The TICs have a feature which allows storage of a nEXT pump's configuration. The configuration can then be downloaded to another nEXT pump. This is useful when configuring a number of nEXT pumps with the same settings before they are fitted to a system.

**Note:** *The RS485/RS232 slide switch must be in the (default) RS232 position if the TIC is to be used to configure the nEXT pump. Refer to [Section 3.7.1](#).*

The TIC is supplied with a Windows™ based PC program which allows the nEXT pump to be configured from a single PC. The program has a simple user interface which means that it is not necessary to use the ASCII message protocol described in [Section 3.7](#). The TIC PC program has a facility to save multiple nEXT pump configurations which can then be downloaded into other nEXT pumps.

## 2 Technical data

### 2.1 General

Table 2 - General data

General items	Reference data
Performance	Refer to Table 3, 4 and 5; Figure 1, 2 and 3
Dimensions	Refer to Figure 4, 5 and 6
Maximum inlet flange temperature	
	nEXT240 75 °C
	nEXT300 80 °C
	nEXT400 70 °C
Maximum permitted external magnetic field	5 mT Radial *
Pollution degree	EN61010 Pollution degree 2
Equipment type	Fixed equipment, for indoor use only
Enclosure protection (installed)	IP40

\* Reduce gas load when operating in magnetic field

### 2.2 Pumping media



#### WARNING

Vent dangerous gases and gas mixtures safely. Do not expose people to these gases. If pumping hazardous gases or vapours, observe the safety recommendations of the supplier of the gas/vapour.



#### WARNING

Do not use the nEXT pump to pump pyrophoric or explosive gas mixtures as it is not suitable for this purpose. The pump and its connections are not designed to contain an explosion.



#### WARNING

In the interstage and booster versions of the nEXT pumps, gas pumped through the interstage port will mix with gas pumped through the pump inlet. Ensure that the gases will not react or combine to form dangerous gases and substances.



#### WARNING

Do not exceed the maximum continuous operating pressure. Doing so can result in dangerous rotor temperatures and will shorten the life of the pump.



**WARNING**

Do not expose any part of the human body to vacuum.



**WARNING**

Do not use a nEXT pump to pump mercury vapour and do not allow mercury (for example, from a McLeod gauge) to come into contact with the pump. If mercury vapour is pumped, the pump rotor may corrode and fail.

*Note:* Concentrations of gases may be modified by the compression of the pump.

The pumps are designed to pump the following residual gases normally used in high-vacuum systems:

- Air
- Methane
- Propane
- Butane
- Carbon monoxide
- Nitrogen
- Hydrogen
- Carbon dioxide
- Neon
- Krypton
- Helium
- Ethane
- Argon

The pump can be used to pump oxygen and water vapour, subject to the following conditions:

- Oxygen - when the pump is purged by an inert gas, oxygen can be pumped at concentrations above 20% by volume. Refer to [Section 2.4](#) for Purge gas specification. However, if the pump is not purged, the oxygen concentration must be less than 20% by volume.
- Water vapour - ensure that vapour does not condense inside the pump; refer to [Section 3.10.3](#).

If pumping a gas not listed above, contact the supplier for advice. If the supplier is not contacted, the pump warranty may be invalidated. The pump is not suitable for pumping aggressive or corrosive gases.

Table 3 - nEXT 240 pumps technical data

Parameter	nEXT240D ISO100	nEXT240D CF100	nEXT240T ISO100	nEXT240T CF100
Mass	5.7 kg	8.8 kg	6 kg	9.1 kg
Inlet flange	DN100ISO-K	DN100CF	DN100ISO-K	DN100CF
Outlet flange	DN25NW	DN25NW	DN25NW	DN25NW
Vent port	1/8 inch BSPP	1/8 inch BSPP	1/8 inch BSPP	1/8 inch BSPP
Purge port	1/8 inch BSPP	1/8 inch BSPP	1/8 inch BSPP	1/8 inch BSPP
Interstage port	DN25NW	DN25NW	DN25NW	DN25NW
Booster port	DN25NW	DN25NW	DN25NW	DN25NW
Inlet pumping speed				
N <sub>2</sub>	240 l/s	240 l/s	240 l/s	240 l/s
He	230 l/s	230 l/s	230 l/s	230 l/s
H <sub>2</sub>	165 l/s	165 l/s	165 l/s	165 l/s
Inlet compression ratio				
N <sub>2</sub>	>1 x 10 <sup>11</sup>	>1 x 10 <sup>11</sup>	>1 x 10 <sup>11</sup>	>1 x 10 <sup>11</sup>
He	3 x 10 <sup>5</sup>	3 x 10 <sup>5</sup>	1 x 10 <sup>6</sup>	1 x 10 <sup>6</sup>
H <sub>2</sub>	1 x 10 <sup>4</sup>	1 x 10 <sup>4</sup>	1.5 x 10 <sup>4</sup>	1.5 x 10 <sup>4</sup>

Table 3 - nEXT 240 pumps technical data (continued)

Parameter	nEXT240D ISO100	nEXT240D CF100	nEXT240T ISO100	nEXT240T CF100
Interstage pumping sSpeed				
N <sub>2</sub>	13 l/s	13 l/s	13 l/s	13 l/s
He	13 l/s	13 l/s	13 l/s	13 l/s
H <sub>2</sub>	11 l/s	11 l/s	11 l/s	11 l/s
Peak booster pumping speed (nitrogen)				
RV12 backing pump	-	-	26 m <sup>3</sup> h <sup>-1</sup>	26 m <sup>3</sup> h <sup>-1</sup>
XDS10 backing pump			24 m <sup>3</sup> h <sup>-1</sup>	24 m <sup>3</sup> h <sup>-1</sup>
Ultimate pressure*	<6 x 10 <sup>-8</sup> mbar	<5 x 10 <sup>-10</sup> mbar	<6 x 10 <sup>-8</sup> mbar	<5 x 10 <sup>-10</sup> mbar

\* Ultimate pressure 48 hours after bakeout for CF version and without bakeout for ISO version with 2-stage rotary vane backing pump.

*Note:* Pumping speeds quoted are without an inlet screen.

Table 4 - nEXT 300 pumps technical data

Parameter	nEXT300D ISO100	nEXT300D CF100	nEXT300T ISO100	nEXT300T CF100
Mass	5.7 kg	8.5 kg	6 kg	8.8 kg
Inlet flange	DN100ISO-K	DN100CF	DN100ISO-K	DN100CF
Outlet flange	DN25NW	DN25NW	DN25NW	DN25NW
Vent port	1/8 inch BSPP	1/8 inch BSPP	1/8 inch BSPP	1/8 inch BSPP
Purge port	1/8 inch BSPP	1/8 inch BSPP	1/8 inch BSPP	1/8 inch BSPP
Interstage port	DN25NW	DN25NW	DN25NW	DN25NW
Booster port	DN25NW	DN25NW	DN25NW	DN25NW
Inlet pumping speed				
N <sub>2</sub>	300 l/s	300 l/s	300 l/s	300 l/s
He	340 l/s	340 l/s	340 l/s	340 l/s
H <sub>2</sub>	280 l/s	280 l/s	280 l/s	280 l/s
Inlet compression ratio				
N <sub>2</sub>	>1 x 10 <sup>11</sup>	>1 x 10 <sup>11</sup>	>1 x 10 <sup>11</sup>	>1 x 10 <sup>11</sup>
He	1 x 10 <sup>6</sup>	1 x 10 <sup>6</sup>	3 x 10 <sup>6</sup>	3 x 10 <sup>6</sup>
H <sub>2</sub>	5 x 10 <sup>4</sup>	5 x 10 <sup>4</sup>	1 x 10 <sup>5</sup>	1 x 10 <sup>5</sup>
Interstage pumping speed				
N <sub>2</sub>	13 l/s	13 l/s	13 l/s	13 l/s
He	13 l/s	13 l/s	13 l/s	13 l/s
H <sub>2</sub>	11 l/s	11 l/s	11 l/s	11 l/s
Peak booster Pumping speed (nitrogen)				
RV12 backing pump	-	-	26 m <sup>3</sup> h <sup>-1</sup>	26 m <sup>3</sup> h <sup>-1</sup>
XDS10 backing pump			24 m <sup>3</sup> h <sup>-1</sup>	24 m <sup>3</sup> h <sup>-1</sup>
Ultimate pressure*	<6 x 10 <sup>-8</sup> mbar	<5 x 10 <sup>-10</sup> mbar	<6 x 10 <sup>-8</sup> mbar	<5 x 10 <sup>-10</sup> mbar

\* Ultimate pressure 48 hours after bakeout for CF version and without bakeout for ISO version with 2-stage rotary vane backing pump.

*Note:* Pumping speeds quoted are without an inlet screen.

Table 5 - nEXT 400 pumps technical data

Parameter	nEXT400D ISO160	nEXT400D CF160	nEXT400T ISO160	nEXT400T CF160
Mass	6.5 kg	9.5 kg	6.8 kg	9.8 kg
Inlet flange	DN160ISO-K	DN160CF	DN160ISO-K	DN160CF
Outlet flange	DN25NW	DN25NW	DN25NW	DN25NW
Vent port	1/8 inch BSPP	1/8 inch BSPP	1/8 inch BSPP	1/8 inch BSPP
Purge port	1/8 inch BSPP	1/8 inch BSPP	1/8 inch BSPP	1/8 inch BSPP
Interstage port	DN25NW	DN25NW	DN25NW	DN25NW
Booster port	DN25NW	DN25NW	DN25NW	DN25NW
Inlet pumping speed				
N <sub>2</sub>	400 l/s	400 l/s	400 l/s	400 l/s
He	390 l/s	390 l/s	390 l/s	390 l/s
H <sub>2</sub>	325 l/s	325 l/s	325 l/s	325 l/s
Inlet compression ratio				
N <sub>2</sub>	>1 x 10 <sup>11</sup>	>1 x 10 <sup>11</sup>	>1 x 10 <sup>11</sup>	>1 x 10 <sup>11</sup>
He	1 x 10 <sup>8</sup>	1 x 10 <sup>8</sup>	>1 x 10 <sup>8</sup>	>1 x 10 <sup>8</sup>
H <sub>2</sub>	5 x 10 <sup>5</sup>	5 x 10 <sup>5</sup>	1 x 10 <sup>6</sup>	1 x 10 <sup>6</sup>
Interstage pumping speed				
N <sub>2</sub>	13 l/s	13 l/s	13 l/s	13 l/s
He	13 l/s	13 l/s	13 l/s	13 l/s
H <sub>2</sub>	11 l/s	11 l/s	11 l/s	11 l/s
Peak booster Pumping speed (nitrogen) RV12 backing pump XDS10 backing pump	-	-	26 m <sup>3</sup> h <sup>-1</sup> 24 m <sup>3</sup> h <sup>-1</sup>	26 m <sup>3</sup> h <sup>-1</sup> 24 m <sup>3</sup> h <sup>-1</sup>
Ultimate pressure*	<1 x 10 <sup>-8</sup> mbar	<1 x 10 <sup>-10</sup> mbar	<1 x 10 <sup>-8</sup> mbar	<2 x 10 <sup>-10</sup> mbar

\* Ultimate pressure 48 hours after bakeout for CF version and without bakeout for ISO version with 2-stage rotary vane backing pump.

*Note:* Pumping speeds quoted are without an inlet screen

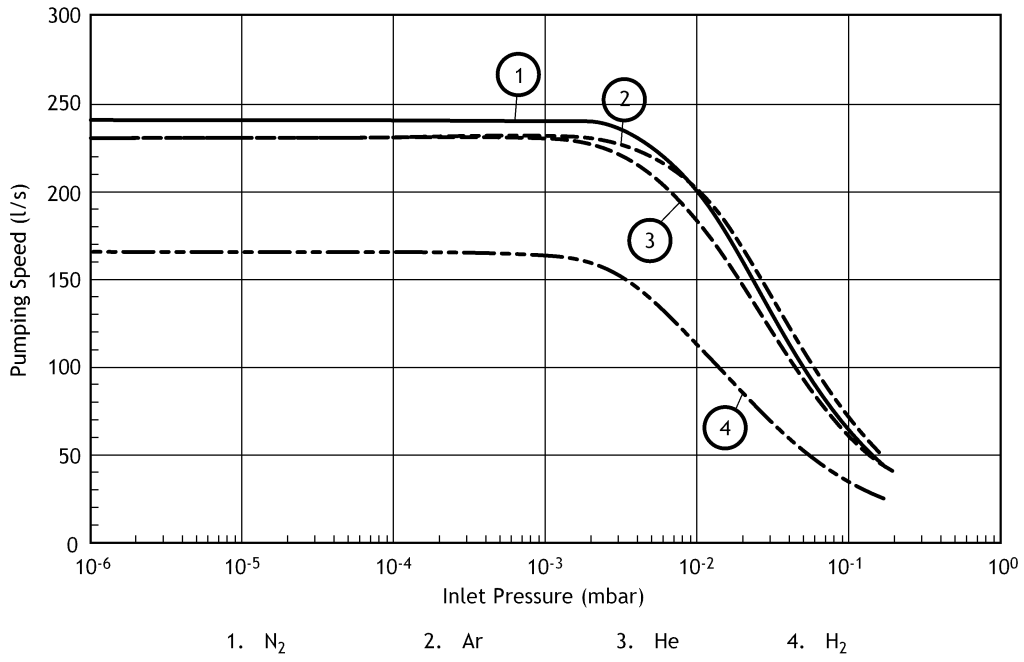
Table 6 - nEXT pumps technical data

Parameter	nEXT240D	nEXT240T	nEXT300D	nEXT300T	nEXT400D	nEXT400T
Critical backing pressure N <sub>2</sub>	9.5 mbar	20 mbar	9.5 mbar	20 mbar	10 mbar	20 mbar
Critical backing pressure He	7 mbar	8.5 mbar	7.5 mbar	8.5 mbar	8.5 mbar	8.5 mbar
Critical backing pressure H <sub>2</sub>	2.5 mbar	3 mbar	2.9 mbar	3 mbar	3 mbar	3 mbar
Maximum continuous inlet flow (at ultimate backing pressure)*						
Nitrogen:						
Water cooling (40 °C Ambient) <sup>†</sup>	45 sccm	55 sccm	95 sccm	65 sccm	105 sccm	50 sccm
Force air cooling (35 °C Ambient)	30 sccm	50 sccm	115 sccm	100 sccm	90 sccm	105 sccm
Natural convection (30 °C Ambient)	10 sccm	10 sccm	35 sccm	25 sccm	45 sccm	25 sccm
Argon:						
Water cooling (40 °C Ambient)	35 sccm	35 sccm	63 sccm	42 sccm	70 sccm	49 sccm
Force air cooling (35 °C Ambient)	20 sccm	28 sccm	76 sccm	70 sccm	70 sccm	77 sccm
Natural convection (30 °C Ambient)	7 sccm	7 sccm	20 sccm	20 sccm	28 sccm	20 sccm
Maximum continuous backing pressure (at ultimate inlet pressure)*						
Nitrogen:						
Water cooling (40 °C Ambient) <sup>†</sup>	6 mbar	2.75 mbar	6.75 mbar	4.75 mbar	7.5 mbar	4 mbar
Force air cooling (35 °C Ambient)	4.75 mbar	2.75 mbar	7 mbar	8 mbar	7.5 mbar	9 mbar
Natural convection (30 °C Ambient)	1 mbar	0.4 mbar	2.75 mbar	1 mbar	4 mbar	1.25 mbar
Argon:						
Water cooling (40 °C Ambient)	4.75 mbar	2.75 mbar	6 mbar	3.75 mbar	6.5 mbar	4 mbar
Force air cooling (35 °C Ambient)	3 mbar	1.5 mbar	6.5 mbar	7 mbar	6.5 mbar	8 mbar
Natural convection (30 °C Ambient)	0.5 mbar	0.2 mbar	2 mbar	0.75 mbar	3 mbar	1.2 mbar
Recommended backing pump	RV12 / XDS10					
Operation attitude	Vertical and upright to horizontal ± 2°					
	Vertical only for 'nL' variant pumps					
Normal rotational speed	60,000 revolutions per minute					
Starting Time to 90% Speed (160 W)	115 sec	140 sec	155 sec	175 sec	175 sec	200 sec
Starting Time to 90% Speed (200 W)	95 sec	120 sec	135 sec	150 sec	150 sec	170 sec
Sound pressure level (1 metre away)	< 45 dB(A) ± 3dB(A) Declared dual number noise emission values in accordance with ISO4871					

\* Values for maximum continuous inlet pressure obtained using a RV12 backing pump at sea level in negligible magnetic field. Values for maximum continuous backing pressure obtained under no flow conditions at sea level in negligible magnetic field. Refer to Section 3.9 for cooling conditions. Above these pressures, rotational speed drops below nominal.

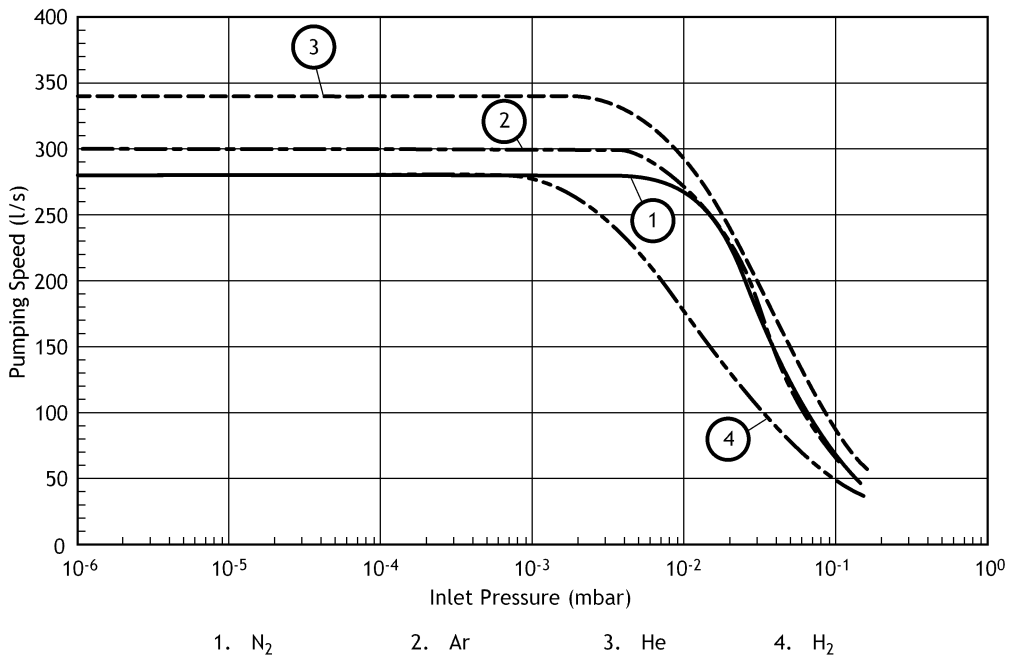
<sup>†</sup> Cooling water temperature 15 °C at a flow rate of 30 l hr<sup>-1</sup>.

Figure 1 - nEXT240 performance curve



dcs/8831/005

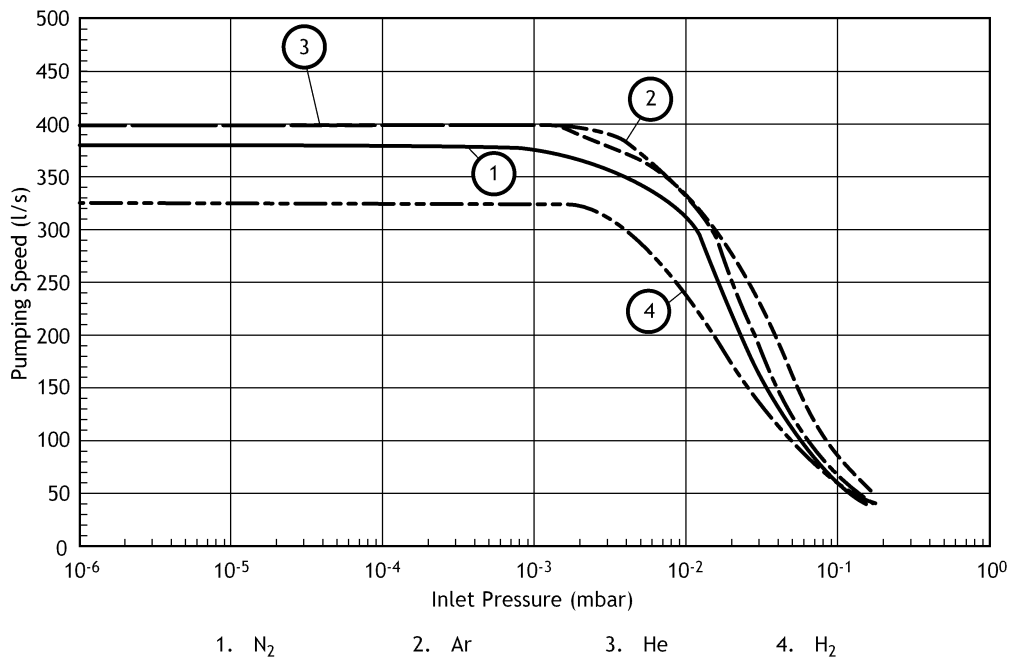
Figure 2 - nEXT300 performance curve



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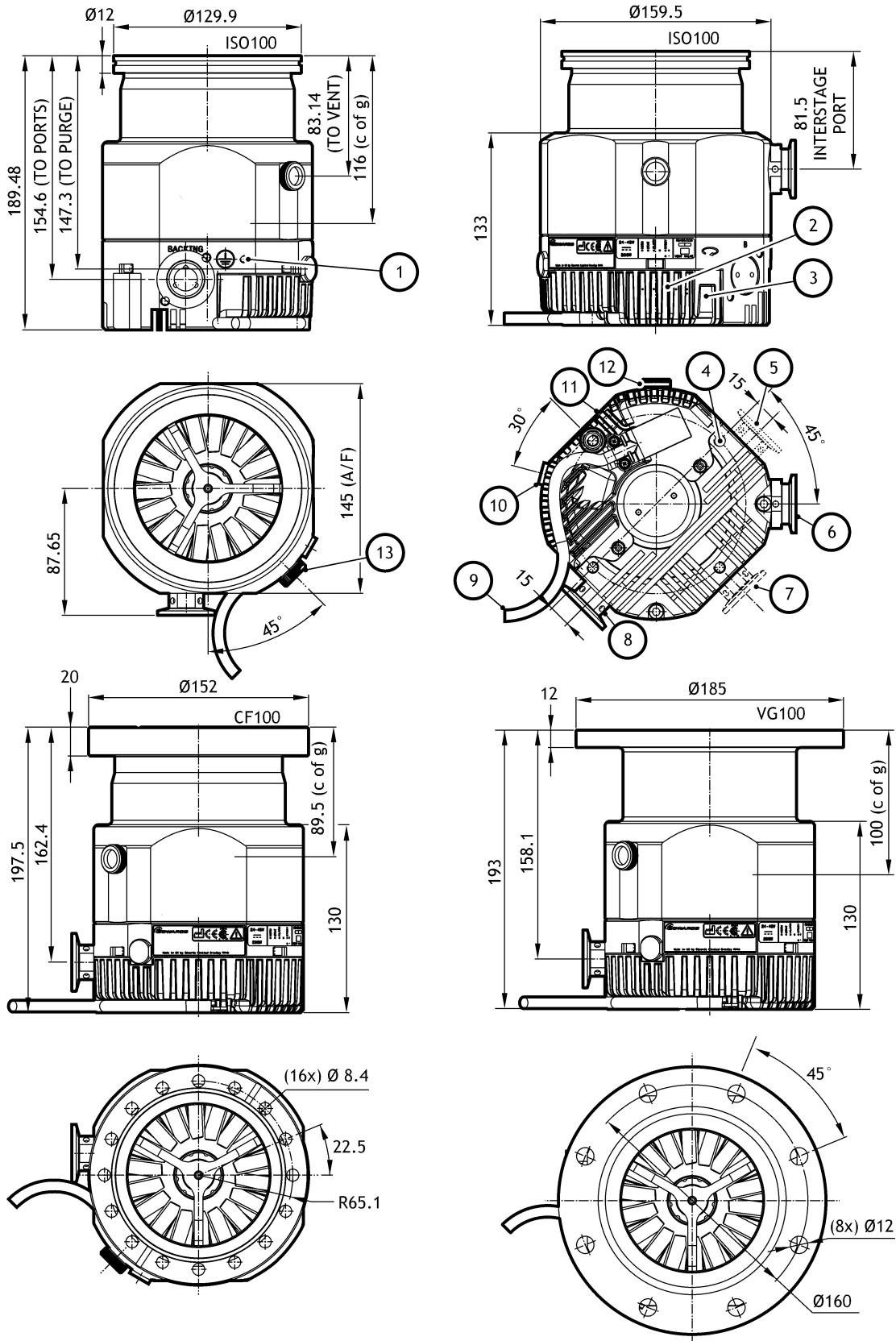


Figure 3 - nEXT400 performance curve



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Figure 4 - nEXT 240 dimensions (mm)

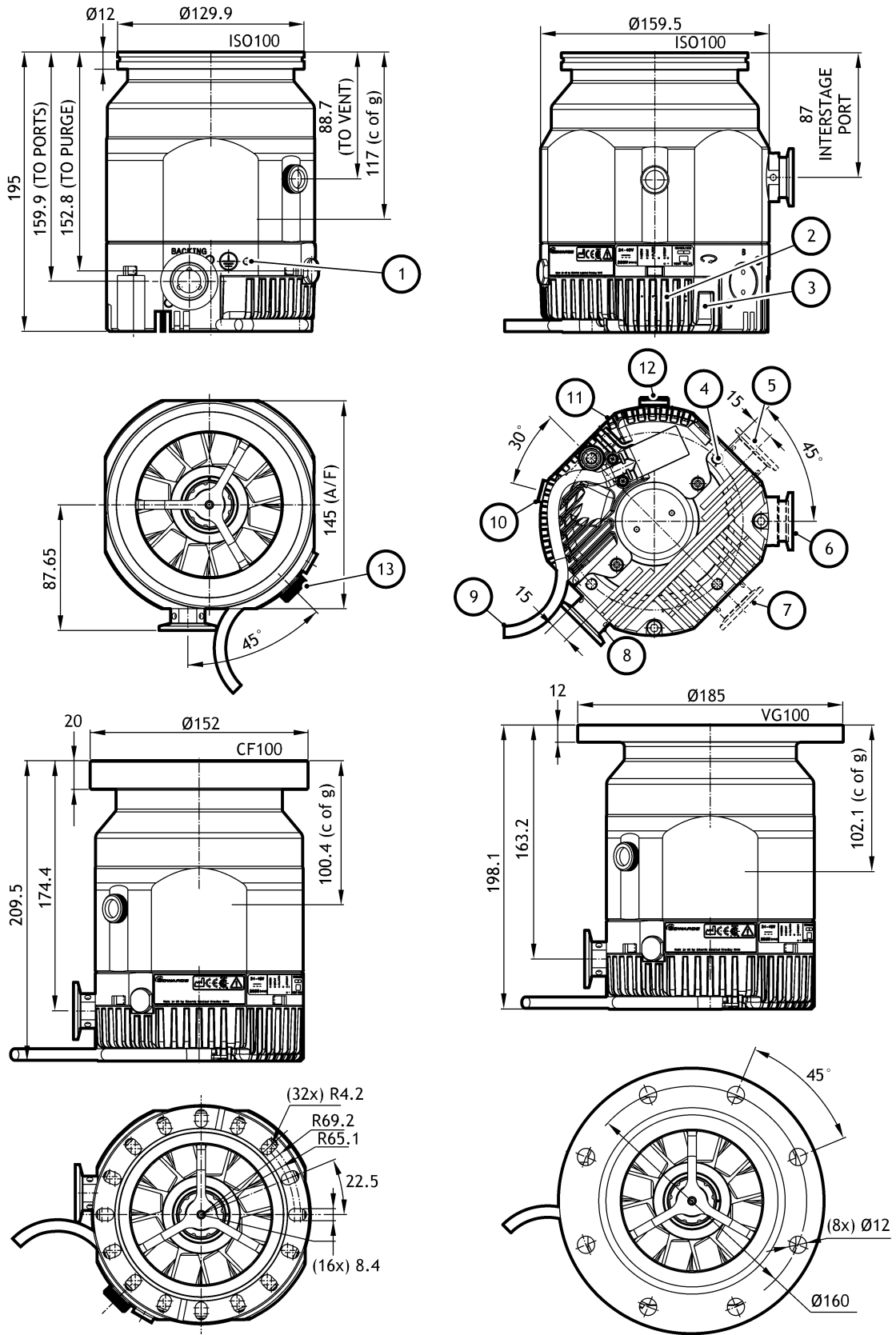


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Figure 4 - nEXT 240 dimensions (mm) - figure legend

1. Earth point
2. LED indicators on drive unit
3. Removable cap RS485/RS232 switch vent valve socket
4. Base mounting holes and fan mountings
5. Booster port B
6. Interstage port
7. Booster port A
8. Backing port
9. 24/48 V Supply
10. Body purge port
11. Electrical drive unit
12. Envelope vent port 1/8 inch BSP
13. Envelope vent

Figure 5 - nEXT 300 dimensions (mm)

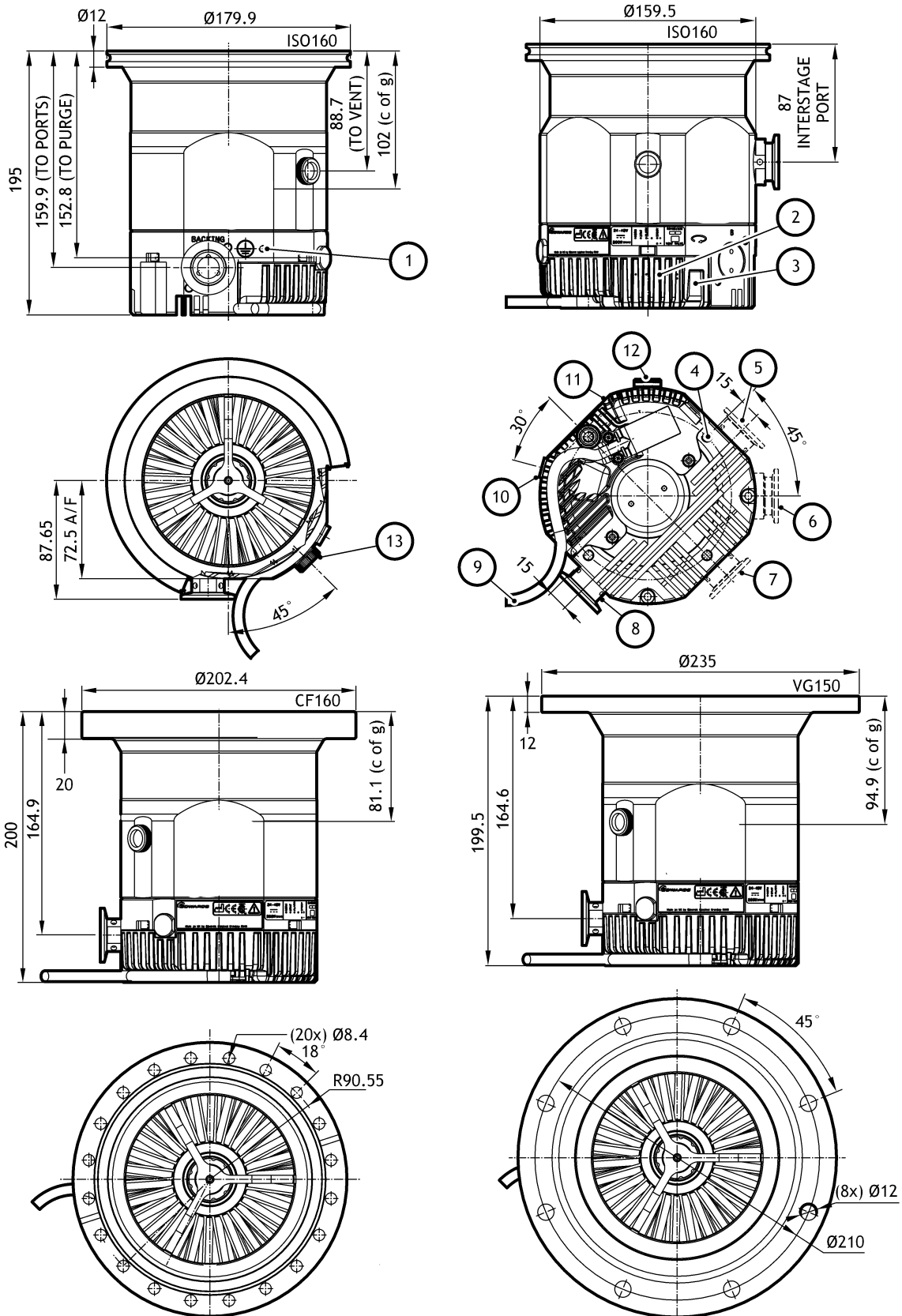


dcs/8831/002

Figure 5 - nEXT 300 dimensions (mm) - figure legend

1. Earth point
2. LED indicators on drive unit
3. Removable cap RS485/RS232 switch vent valve socket
4. Base mounting holes and fan mountings
5. Booster port B
6. Interstage port
7. Booster port A
8. Backing port
9. 24/48 V Supply
10. Body purge port
11. Electrical drive unit
12. Envelope vent port  $\frac{1}{8}$  inch BSP
13. Envelope vent

Figure 6 - nEXT 400 dimensions (mm)



dcx/8831/003

Figure 6 - nEXT 400 dimensions (mm) - figure legend

1. Earth point
2. LED indicators on drive unit
3. Removable cap RS485/RS232 switch vent valve socket
4. Base mounting holes and fan mountings
5. Booster port B
6. Interstage port
7. Booster port A
8. Backing port
9. 24/48 V Supply
10. Body purge port
11. Electrical drive unit
12. Envelope vent port  $\frac{1}{8}$  inch BSP
13. Envelope vent

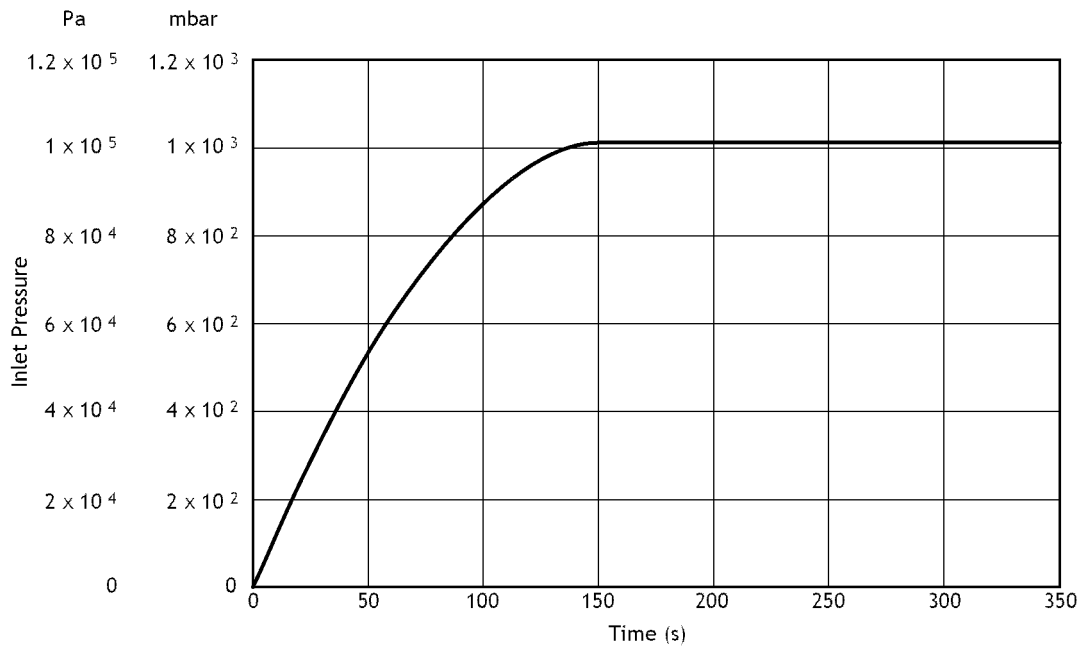
## 2.3 Vent gas specification and vent control data

Although the pump may be vented to atmosphere, high relative humidity of the air may greatly increase the subsequent pump-down time. To reduce pump-down times, vent with dry, clean gases. Refer to [Section 3.9](#) for a description of the vent options and the vent valve connection. Refer to [Section 4.1.3](#) for configuring the venting options.

Table 7 - Vent gas specification and vent control

Vent gas specification and control	Reference data
Vent gas	Dry air, nitrogen, argon or other inert gases
Maximum dew point at atmospheric pressure	-22 °C
Maximum size of particulates	1 µm
Maximum concentration of oil	0.1 parts per million
Recommended time for rotational speed to reach 50%	> 15 seconds
Maximum allowed rate of pressure rise	Refer to <a href="#">Figure 7</a>

Figure 7 - Max allowed rate of pressure rise during venting: pressure against time (pump initially at full speed)



dics/8831/008



## 2.4 Purge gas specification

Table 8 - Purge gas specification

Purge gas specification	Reference data
Purge gas	Dry air, nitrogen, argon or other inert gases
Maximum dew point at atmospheric pressure	-22 °C
Maximum size of particulates	1 µm
Maximum concentration of oil	0.1 parts per million
Allowable purge gas flow (when required)	20 to 50 sccm (0.33 to 0.84 mbar l s <sup>-1</sup> or 33 to 84 Pa l s <sup>-1</sup> )
Recommended purge gas flow	25 sccm (0.42 mbar l s <sup>-1</sup> , 42 Pa l s <sup>-1</sup> )
Maximum allowable purge gas supply pressure	1 bar (gauge); 14.5 psig, 2 x 10 <sup>5</sup> Pa

Table 9 - Cooling water specification

Cooling water specification	Reference data
Quality	Mechanically clean and optically clear with no deposits or turbidity
pH value	6.0 to 8.0
Maximum calcium carbonate concentration	75 parts per million
Maximum chloride concentration	100 parts per million
Minimum oxygen concentration	4 parts per million
Minimum cooling water flow rate (at 15 °C)	15 l hr <sup>-1</sup>
Water temperature	10 to 20 °C
Maximum water pressure	5 bar (gauge), 73.5 psig, 6 x 10 <sup>5</sup> Pa
Materials exposed to cooling water	Nickel plated brass

## 2.5 Cooling water

Refer to [Table 9](#) for the cooling water specification. The cooling water supply should correspond to a typical high-quality drinking water specification. Check with the water supply authority if there is any doubt about the quality of the supply.

## 2.6 Materials exposed to gases pumped

The following materials and component types are exposed to the gases pumped: Aluminium alloys, stainless steels, fluoroelastomer and nitrile O-rings, hydrocarbon lubricant, rare earth magnets, silicon nitride, carbon fibre reinforced epoxy resin, fire retardant polypropylene, polyamide, PVC, Titanium, Silicon, Torlon and Ceramic.

## 2.7 Electrical data

nEXT pumps can be driven either by the customer system or by the Edwards TIC Turbo Instrument Controller or TIC Turbo Controller.

If using the customer system, the size of the power supply required depends on the application. The power limit setting determines how quickly the pump ramps up and dictates the size of the power supply required. If serial communications or access to an Edwards TIC is available, the power limit setting of the nEXT pump can be selected. Refer to [Table 10](#) for the maximum power limit settings for nEXT pumps. If the application requires rapid cycling of the pump, faster ramp times can be achieved if the power supply delivers higher current, up to a maximum in accordance with [Table 10](#).

If the facility to adjust the power limit setting is not available, use a power supply capable of delivering enough current to meet the Edwards factory default power limit setting, shown in [Table 10](#).

If the nEXT pump is driven using an Edwards TIC, be aware that there are several variants. Contact Edwards to determine which is most suitable for the application.

## 2.8 Logic interface connector

nEXT pumps have a 15-way logic interface connector on the end of the logic interface cable. The logic interface connector can be plugged directly into the Edwards TIC Turbo Instrument Controller or TIC Turbo Controller. Use a suitable connector mating half (not supplied) to connect the nEXT pump to the customer equipment. Refer to [Table 10](#) for the connector mating half type, to [Table 11](#) for Logic Interface connector pins for the electrical connections and to [Figure 8](#) for the connector interface circuit diagrams.

Table 10 - Logic interface technical data

Logic interface item	
Connector *	15-way D-type male
nEXT pumps electrical supply:	
Allowable voltage range (including any ripple)	24 - 48 V d.c. +5%, -10% (21.6 to 50.4 V d.c.)
Maximum voltage ripple	0.5 V r.m.s.
Fuse rating	10 A for 24 V d.c. supply 5 A to 10 A for 48 V d.c. supply Type 'T' IEC approved or Time delay fuse UL/CSA approved
Limit on power drawn from supply.	
Factory default setting	160 W
Maximum setting	200 W
Minimum setting	50 W
Accuracy of power regulation	+/- 10 W
Start and serial enable control inputs:	
Enabled control voltage: low (close)	0 to 0.8 V d.c. ( $I_{out} = 0.55$ mA nominal)
Disabled control voltage: high (open)	4 to 26.4 V d.c. (Internal pull up to 6.4 V nominal)
Standby control input	
Enabled control voltage: low (close)	0 to 0.8 V d.c. ( $I_{out} = 0.29$ mA nominal)
Disabled control voltage: high (open)	4 to 26.4 V d.c. (Internal pull up to 3.2 V nominal)

Table 10 - Logic interface technical data (continued)

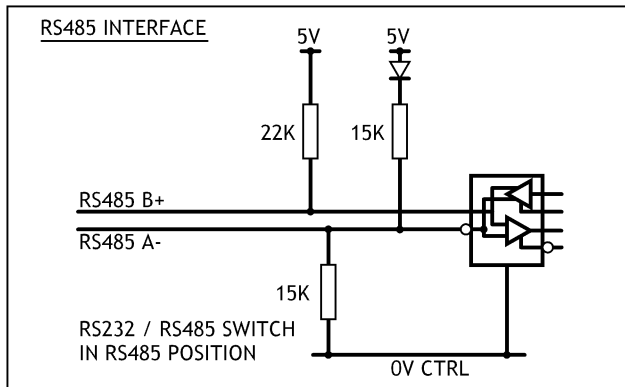
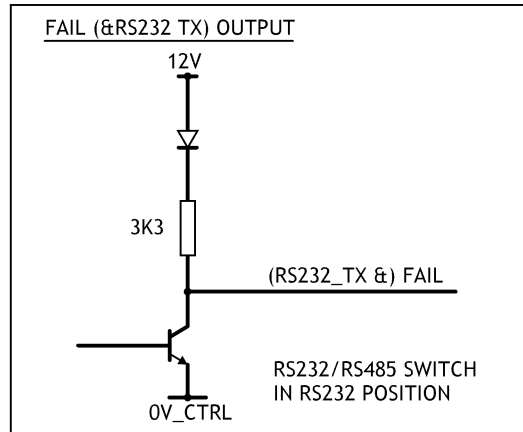
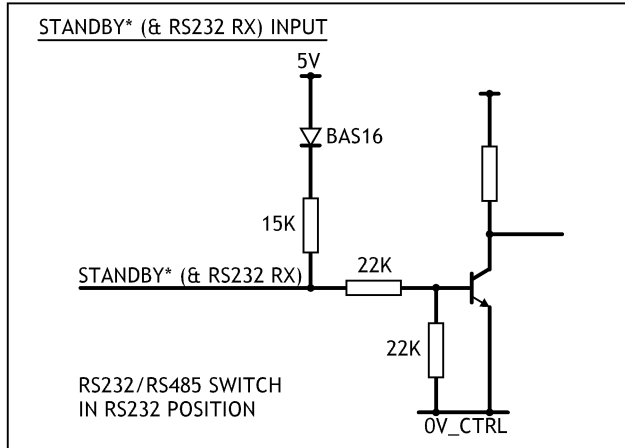
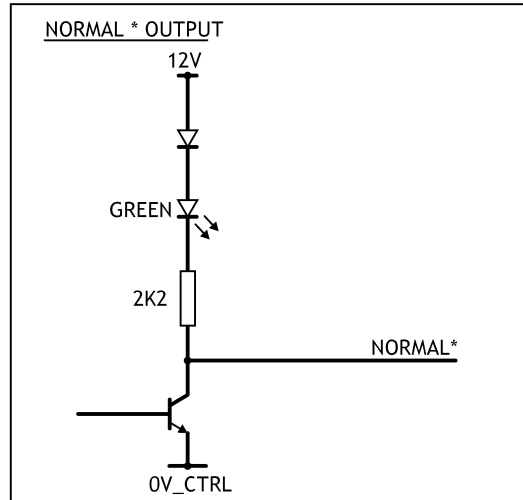
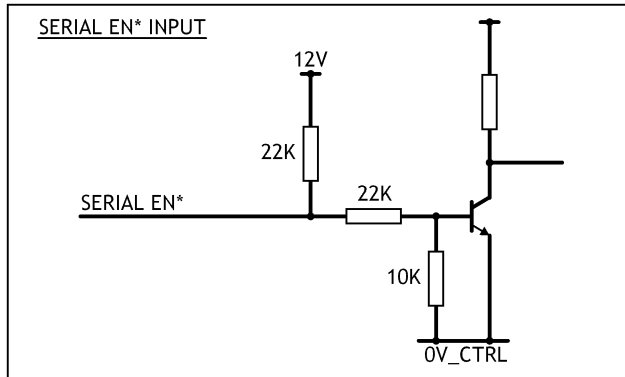
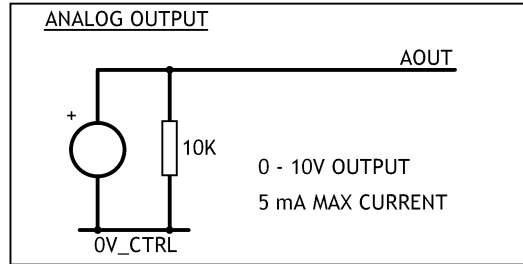
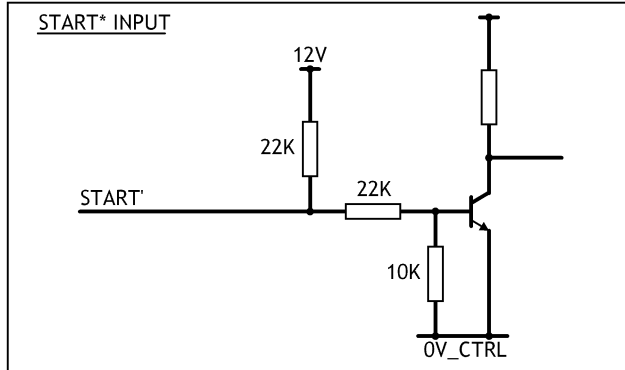
Logic interface item	
Analogue output	
Output voltage	0 to 10 V d.c. (directly proportional to measured parameter) Motor speed: 0 - 1000 Hz (0-100%) Input power: 0 - 200 W Motor temperature: 0 - 100 °C Controller temperature: 0 - 100 °C
Voltage accuracy	± 0.2 V
Output current	≤ 5 mA for specified accuracy
NORMAL status output:	
Type	Open collector transistor plus pull up resistor. Refer to <a href="#">Figure 8</a>
< Normal speed (default 80%)	Off (2.2 kΩ internal pull up to 12 V d.c.)
≥ Normal speed	On (<0.8 V d.c. sinking 20 mA)
Current rating	20 mA to 0 V
Voltage rating	28.8 V d.c. maximum external pull up voltage
FAIL status output:	
Type	Open collector transistor plus pull up resistor. Refer to <a href="#">Figure 8</a> .
Fail	Off (3.3 kΩ pull up to 12 V d.c.)
OK	On (< 0.1 V d.c. sinking 1.7 mA, < 0.8 V d.c. sinking 20 mA)
Current rating	20 mA to 0 V
Voltage rating	28.8 V d.c. maximum external pull up voltage

\* Mating half of connector not supplied.

Table 11 - Logic interface connector pins

Pin Number	Signal	Polarity	Use
2	0 V Control reference	-	0 V reference for all control and status signals below
3	START/STOP control input	-	Connect to Pin 2 to start pump
4	STANDBY control input / Serial RX/RS485 A-	-	Connect to Pin 2 to enable standby speed when serial enable is inactive and RS485/RS232 switch is in the RS232 position.
5	Serial enable	-	Connect to Pin 2 to enable the serial link.
7	FAIL / Serial TX/RS485 B+	-	Logic high when fail condition exists and serial enable is inactive and RS485/RS232 switch is in the RS232 position.
9	Analogue output	Positive	0 - 10 V output proportional to measured output
10	Chassis / Screen	-	Screen
12	Chassis / Screen	-	-
15	NORMAL status output	-	Logic low when pump rotational speed is at normal speed or above
8, 13, 14	Electrical supply: 0 V	-	
1, 6, 11	Electrical supply: 24-48 V	Positive	

Figure 8 - Interface circuits for nEXT turbo pump controllers



## 2.9 Controller connector socket

The nEXT pump has a 3-way controller connector socket in the side of the controller. When the pump is shipped, this connector is concealed by a black protective cover. If the connector will be used, the cover should be removed by levering with a small screwdriver. The mating plug for this connector is supplied with the pump.

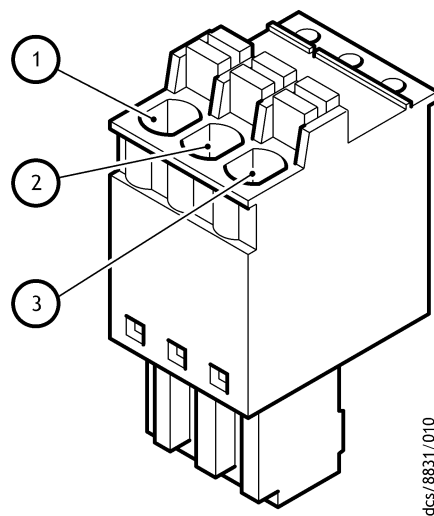
The connector is intended to drive a vent valve or fan connected to the three pins. The connector mating plug is shown in [Figure 9](#), with the polarity of the pins marked when the vent valve/fan is energised.

The 24 V d.c. output on the controller connector is protected against overload or short circuit to 0 V d.c./24 V d.c. Rtn/chassis. The output is guaranteed to supply the current given in [Table 12](#), but for higher currents the output voltage will be reduced and may turn off completely to limit current.

Table 12 - Controller technical data

Description	Data
Connector plug	Phoenix part number FK-MC1881338
Voltage output	24 V d.c. -25%, +10% (18 V d.c. to 26.4 V d.c.)
Current output	500 mA

Figure 9 - Controller connector showing pin numbers



Pin number	Signal	Polarity
1	24 V d.c. Out	+
2	Chassis	
3	24 V d.c. Rtn	-

## 2.10 Indicator LED's

The nEXT pump has three indicator LED's, shown in [Figure 12](#).

Table 13 - Indicator LED's

LED	Description
Normal LED	This green LED remains when the pump rotational speed is above the normal speed setting, irrespective of whether the pump is accelerating or decelerating.
Status LED	This yellow LED flashes with a 50% duty cycle at the rotational frequency of the pump motor. At high speeds it appears continuously on. The LED switches off when the rotational speed is very low or stopped. If a service is due, this LED flashes in a sequence to indicate which service operation is required. Refer to <a href="#">Section 5.5</a> .
Alarm LED	This red LED flashes in a sequence to indicate an error code if a fail condition is preventing pump operation. The error codes can be used for fault finding as described in <a href="#">Section 5.5</a> .

*Note: If an external electrical load is connected to the normal output line, the Normal LED may illuminate.*

## 2.11 Operating and storage environment

Table 14 - Operating and storage environment

Range	Data
Ambient operating temperature range	5 °C to 35 °C
Ambient operating humidity range	10 to 90% RH (non-condensing)
Maximum operating altitude	3000 m
Ambient storage temperature range	-30 °C to 70 °C

## 3 Installation



### WARNING

The controller cable should not be used as a lifting device. Do not attempt to lift or support the pump using the cable.

### 3.1 Unpack and inspect



### WARNING

Use suitable lifting equipment to move the pump. Failure to do so can cause injury to people and damage to the equipment. Refer to [Section 2.2](#) for the mass of the pump.



### WARNING

The inlet screen is a coarse filter for debris and should not be used as a finger guard.

Take care when unpacking the pump to avoid excessive shocks that could damage the bearings and reduce the life of the pump. The pump is supplied with the inlet and outlet sealed to prevent entry of dust and vapour. Do not remove these seals until the pump is installed on the vacuum system.

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

Check that the package contains the items listed in [Table 15](#). If any of these items is missing, notify the supplier in writing within three days.

If the pump is not to be used immediately, store the pump in suitable conditions, following the procedure described in [Section 6.1](#).

Do not discard the packing materials; retain them to re-package the pump if it is returned for service.

Table 15 - Checklist of components

Quantity	Description	Check (✓)
1	nEXT pump with inlet screen fitted (fitted to CF pumps only)	<input type="checkbox"/>
1	Inlet seal (either trapped O-ring with integral inlet screen, Co-seal or copper compression gasket suitable for the inlet flange type)	<input type="checkbox"/>
1	Connector (24 V) - for driving accessories from Controller socket	<input type="checkbox"/>
1	Inlet strainer (fitted in the NW25 interstage and booster port only)	<input type="checkbox"/>

### 3.2 Typical installation

A typical pumping system with a nEXT pump is shown in [Figure 10](#).

The accessories available for the nEXT pumps are detailed in [Section 7.4](#); the accessories are shown in [Figure 20](#) and [21](#).

### 3.3 Connection to the vacuum system



**WARNING**

Ensure that all wires and piping are routed appropriately to avoid the risk of tripping.

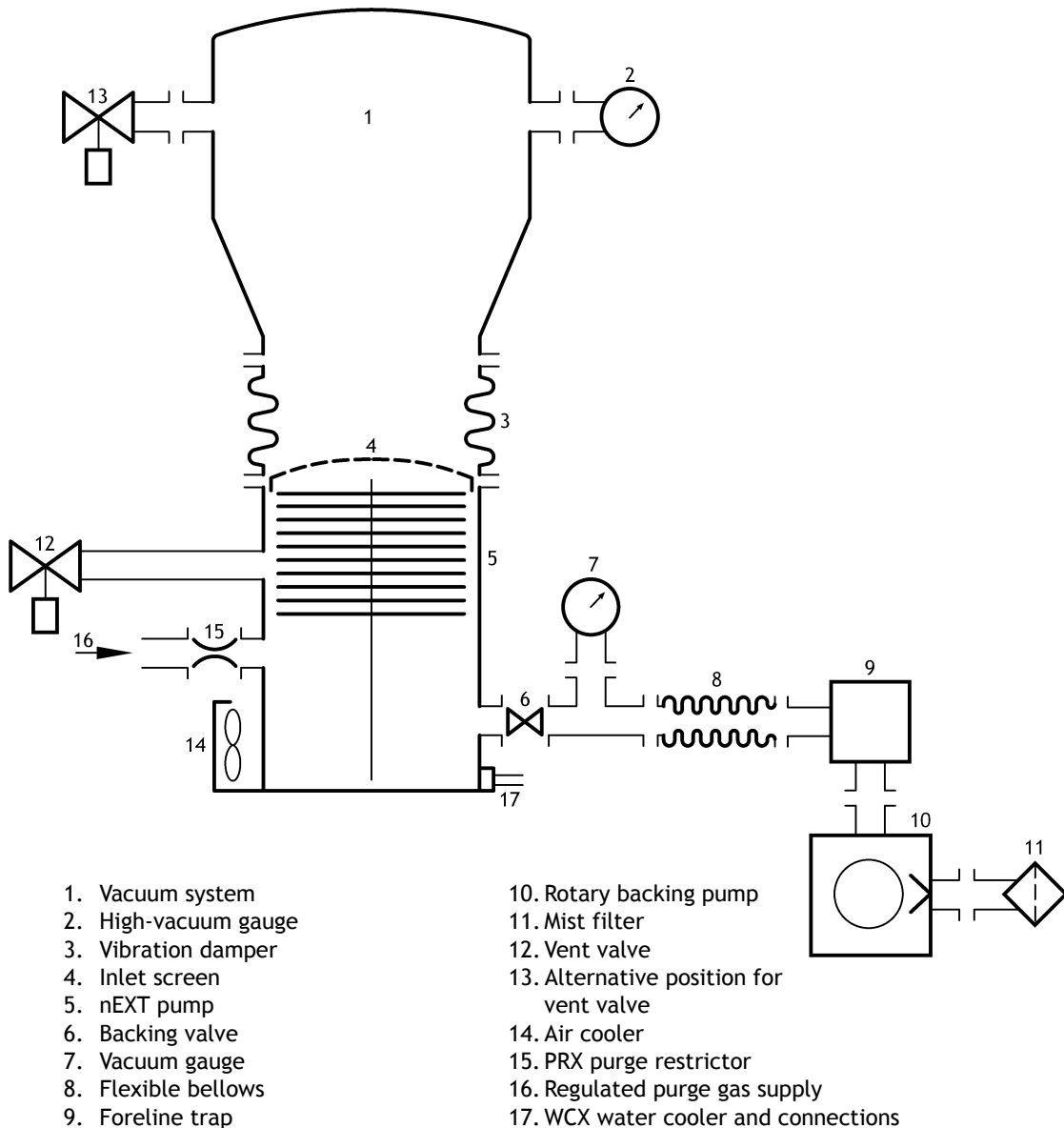


**WARNING**

Install the pump in the vacuum system before the logic interface cable is connected to the control equipment and before the electrical supply is connected. This will ensure that the pump cannot operate accidentally causing injury.

Edwards recommends leak testing the system after installation has been completed.

Figure 10 - Typical pumping system with a nEXT pump



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### 3.3.1 Inlet screen (supplied fitted on CF only)



#### **WARNING**

Removal of the inlet screen will expose the risk of injury from sharp edges.

Remove the inlet screen only if there is no possibility that debris can fall into the pump. If the inlet screen is removed, the pumping speed will increase by up to 10% for coarse and 20% for fine inlet screens. Since the screen protects the pump from contamination, do not remove the inlet screen until the pump is mounted on the system.

To remove the inlet screen from a pump with CF inlet flange, use a bent wire hook or small screwdriver to carefully lever the inlet screen out from the inlet flange.

To replace an inlet screen, locate it as centrally as possible over the CF inlet flange and then, with fingers applying equal pressure around the edge of the screen, push it firmly downwards. If they are not already in place, the tangs must be snapped into the locating groove in the inlet flange using a suitable tool to press them into position. For ISO flanged pumps, Edwards supplies a combination inlet screen/trapped O-ring.

### 3.3.2 Mechanical fixing



#### **WARNING**

Do not operate the pump until it is securely fixed. If the pump seizes, the stored energy of the rotor can cause rapid movement of the pump, which may cause further damage and injury to people.



#### **WARNING**

The inlet screen is a coarse filter for debris and should not be used as a finger guard.



#### **WARNING**

Position system viewports and vulnerable components away from the pump inlet to safeguard against damage from possible ejected parts in the unlikely event of a pump rotor failure.

There are two ways in which the nEXT pumps can be securely fixed. The ideal fixing for a nEXT pump is via its inlet flange to a rigid, firmly fixed vacuum system - refer to [Section 3.3.3](#). If this is not possible because of the nature of the vacuum system, then the base of the pump must be fixed to a firm support. Refer to [Section 3.3.4](#) for instructions on base mounting the pump.

### 3.3.3 Inlet connection and orientation

The pump can be securely fixed to the vacuum system via the inlet flange. The pump can be mounted in any attitude from the vertical and upright through to horizontal ( $\pm 2^\circ$ ). If the pump is mounted horizontally and is used with a rotary vane backing pump, ensure a foreline trap is installed to prevent condensed oil in the backing line from entering the turbo pump. If it is not possible to fit a foreline trap, mount the pump with the backing port pointing vertically downward ( $\pm 45^\circ$ ).

Make sure that the pump inlet and all components fitted to the pump inlet are clean and dust-free. If the pump inlet is not kept clean, the pump-down time may be increased.

The inlet connections for the nEXT pump are CF flange, ISO flange and VG flange.

- If the pump has a CF flange, use the copper compression gasket supplied with the pump and use a full complement of bolts to connect the inlet flange of the pump to the vacuum system.
- If the pump has an ISO flange, use the Edwards combination inlet screen/trapped O-ring supplied with the pump and use a minimum of four claw clamps (each torqued to 30 Nm) to connect the inlet flange of the pump to the vacuum system. Alternatively, use a rotatable collar and the combined inlet screen and trapped O-ring supplied with the pump to connect the inlet flange of the pump to the vacuum system; use a full complement of bolts with the rotatable collar.
- If the pump has a VG flange, use a full complement of 8x M10 bolts and washers to connect the pump to the vacuum system. Flange fixings bolts must be a minimum of 700 MPa tensile strength and evenly tightened in a cross pattern in 3 tightening stages to a final torque of 30 Nm to ensure even compression of the O-ring and clamping of the flanges.

All inlet flange bolts must be re-tightened once the system is under vacuum. Ensure that no torques or other forces are transmitted to the pump from the vacuum system or the associated pipelines. If necessary, fit an inlet vibration damper between the pump inlet and the vacuum system. In this case, fix the base of the pump to a firm support, as described in [Section 3.3.4](#).

### 3.3.4 Base mounting

The base of the nEXT pump can be fixed to a firm support using the tapped fixing holes. Refer to [Figure 4, 5 and 6](#) for fixing hole details.

*Note:* The four rubber feet must be removed from the four tapped fixing holes before the pump can be base mounted.

The following requirements should be met to ensure the pump remains secure in the event of a total pump seizure:

Support must withstand a destructive torque of:	6 KNm
Fixing screws:	4 off M8 to ISO898-1 strength class 12.9 (nom. tensile strength 1200 MPa)
Screw engagement length:	6 mm minimum
Fastening torque:	15 Nm (1.53 kgf.m)

This method of fixing must be used if the pump supports the weight of the vacuum system. The weight of the vacuum system must be no more than 20 kg.

### 3.3.5 Backing connection



#### WARNING

Ensure safe ducting of the backing line if oil mist or hazardous substances are present.



#### WARNING

To avoid over-pressurising the pump, the exhaust line should not be restricted when venting from a positive pressure gas supply.

#### CAUTION

Do not use the nEXT pumps with a backing pressure below  $5 \times 10^{-4}$  mbar ( $5 \times 10^{-2}$  Pa). Lower backing pressures will increase the evaporation rate of the lubricating oil and so may reduce the life of the bearings.

Use suitable vacuum tubing and connectors to connect the NW flange of the backing port to the backing pump. If necessary, use flexible pipe or bellows to reduce the transmission of vibration from the backing pump to the nEXT pump.

Edwards recommends using an Edwards EM, RV or XDS Scroll backing pump. The recommended size of backing pump required is indicated in [Table 6](#). A larger or smaller backing pump may also be suitable, depending upon the application it is intended for.

The nEXT pumps are suitable for use with diaphragm backing pumps although the effect of higher backing pressure on the pump's performance and cooling requirements should be noted. Refer to [Table 6](#) and [Section 2.1](#).

### 3.3.6 Interstage connection (variants only)

Use suitable vacuum tube and connectors to connect the interstage port to the vacuum system or to the outlet flange of another turbo or compound turbomolecular pump (if using an 'i' nEXT pump to back another pump). Leave the inlet strainer in the interstage port, unless it is certain that debris cannot be drawn into the interstage port.

## 3.4 Purge gas connection

### 3.4.1 Connect the purge gas

To supply a purge gas to the pump, remove the plug fitted in the purge port, fit a vent port adaptor (refer to [Section 7.4](#)) and connect the purge gas supply to the vent port adaptor. The purge gas must comply with the specification given in [Section 2.4](#).

### 3.4.2 Recommended purge gas flow

The recommended purge gas flow for typical applications is 25 sccm ( $0.42 \text{ mbar l s}^{-1}$ ,  $42 \text{ Pa l s}^{-1}$ ). This flow will protect the pump when pumping oxygen in concentrations above 20% by volume.

The flow rate of the purge gas must be limited to the allowed range, specified in [Section 2.4](#). To limit the flow rate, use a flow controller or a pressure regulator and calibrated flow restrictor. The PRX10 purge restrictor accessory (refer to [Section 7.4](#)) is suitable for this purpose.

## 3.5 Electrical installation

### 3.5.1 Introduction



#### **WARNING**

Ensure the electrical installation of the nEXT pump conforms with local and national safety requirements. It must be connected to a suitably fused and protected electrical supply with a suitable earth (ground) point.

The electrical installation must be carried out by a qualified person. Always make the electrical connections to the nEXT pump after the pump has been installed on the vacuum system. Always disconnect all electrical connections from the nEXT pump before removing it from the vacuum system.

Earth the pump using the connection provided and refer to [Section 3.5.2](#).

The nEXT pump can be operated using the Edwards TIC Turbo Instrument Controller or TIC Turbo Controller (refer to [Section 3.5.3](#)). The nEXT pump can also be controlled using the customer system. Refer to [Section 3.5.4](#) for information about control and to [Section 3.5.5](#) for instructions on how to connect the electrical supply.

### 3.5.2 Earth (ground) connections

Edwards recommends fitting a separate earth (ground) conductor to earth the nEXT pump. Use an un-insulated braid or a separate insulated green/yellow conductor with a minimum 10 AWG (5.3 mm<sup>2</sup>) conductor to comply with US and Canadian installation codes, and use the M5 x 10 screw and shake proof washer supplied (fitted to the earth hole on the pump) to secure the earth conductor to the pump. The impedance between the pump body and the earth connection point must be < 0.1 Ohm.

### 3.5.3 Connect the logic interface to the TIC

If an Edwards TIC Turbo Instrument Controller or a TIC Turbo Controller is used to power and control the pump, the nEXT pump logic interface cable connects directly into the back of the TIC. Refer to the TIC Instruction Manual for further information.

The RS485/RS232 slide switch must be in the RS232 position if the TIC is to be used to control the nEXT pump. Refer to [Section 3.7.1](#). If the switch is in the RS485 position, the TIC will connect to the pump in parallel mode, indicating the pump type as nEXTp. The serial connection will be disabled but start and stop will be possible.

### 3.5.4 Connect the logic interface to the customer control equipment

If operating the nEXT pump using the customer control system, use a suitable connector mating half (not supplied), to connect the control equipment to the connector on the logic interface cable (refer to [Table 10](#)). When making the electrical connections to the nEXT pump described in the following sections, refer to [Table 11](#) for full details of the logic interface connector pins.

The nEXT pump can be controlled using a hardware parallel control interface and/or via commands sent over a serial interface.

If the nEXT pump is controlled using the hardware parallel interface, refer to [Section 3.6](#) for more information. If the serial interface is used, see the instructions given in [Section 3.7](#). The logic interface provides the facility to work with a mixture of parallel and serial control, refer to [Section 3.8](#).

### 3.5.5 Connect the electrical supply



#### WARNING

This product requires a separate power supply (not included). The power supply should be adequately protected against a hazardous live condition (for example, in case of a short circuit).



#### WARNING

Incorporate a suitable isolation device in the electrical supply. Locate the switch in an easily accessible position and mark it as the disconnecting device for the nEXT pump. If an isolation device is not provided, it will not be possible to switch the nEXT pump off in an emergency.



#### WARNING

Incorporate a suitable fuse as specified in [Section 2.8](#), in the 24 - 48 V supply line to the nEXT pump. To fully protect the pump in case of a fault, a suitable rated fuse should be used - refer to [Table 10](#). The power supply should have a current rating capable of blowing the fuse. If a fuse is not provided and a fault develops, the nEXT pump may develop a hazardous surface temperature or present a fire hazard.

**WARNING**

Do not exceed the maximum supply voltage. Excessive supply voltage will cause permanent damage to the control electronics and may result in a mechanical hazard in some failure conditions.

**WARNING**

When connecting the nEXT pump to the power supply, ensure that all 3 pins for the 24 - 48 V connection and all 3 pins for the 0 V connection on the customer connector mating half are connected to the power supply.

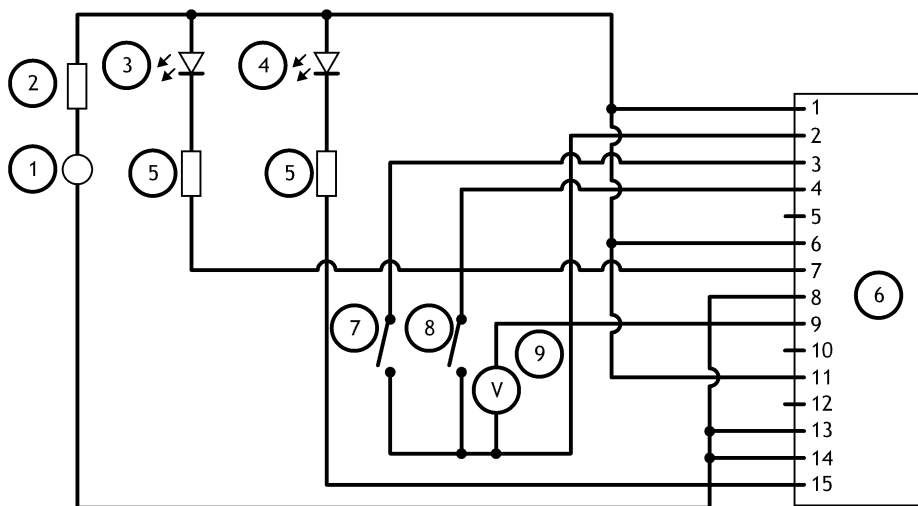
Refer to [Figure 11](#) for a schematic diagram of the logic interface connections.

The electrical supply for the nEXT pump must meet the requirements of BS EN 61010-1 / C22.2 1010-1. Ensure that hazardous voltages as defined in EN61010 cannot be present on the electrical interface to the nEXT pump.

The nEXT pump 0 V is not referenced to earth (ground). Ensure that there is only one path between 0 V and earth. Multiple connections between 0V and earth must be avoided in order to avoid unexpected offset voltages on control and status signals and possible problems with serial communications. If no other connection is present between 0 V and earth, the connection should be made at the power supply. Be aware that other electrical equipment connected to the system could introduce a connection between 0 V and earth, for example a personal computer or measuring equipment.

Refer to [Table 11](#) - logic interface connector pins when connecting the electrical supply to the customer connector mating half.

**Figure 11 - Logic interface connections - parallel control**



- |  |  |
|--|--|
| 1. 24 V d.c. electrical supply           | 6. nEXT pump logic interface                     |
| 2. Fuse                                  | 7. Start switch                                  |
| 3. Optional LED indicator - system OK    | 8. Optional standby switch                       |
| 4. Optional LED indicator - normal speed | 9. Optional voltmeter to monitor analogue output |
| 5. Current limit resistor for LED        |  |

**Note:** The pump controller may be supplied from voltages above 24 V as specified in [Table 10](#), however the circuitry connected to the normal and fail lines must still respect the maximum external pull up voltage rating given in [Table 10](#).

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## 3.6 Connection for parallel control and monitoring

### CAUTION

If using the normal and fail lines to drive the coils of d.c. relays, include a back EMF suppression diode in parallel with each relay coil to protect the nEXT pump.

1. Connect the customer control equipment to the control input pins of the customer logic interface mating half. Refer to [Table 11](#), which identifies the logic interface connector pins. The control inputs are as follows:

- Start
- Standby speed

To activate either of these control inputs, connect the control input pin to the 0 V control reference.

To start the pump, connect pin 3 (Start / Stop) to pin 2 (0 V Reference). To stop the pump, break the connection between pin 3 and pin 2. To put the pump into standby, connect both pin 4 (Standby) and pin 3 (Start/Stop) to pin 2 (0 V reference).

*Notes:* 1 *Serial enable is also a control input but is not required in a system operating purely under parallel control. Make sure that there is no connection to serial enable (pin 5).*

2 *The RS485/RS232 slide switch must be in the (default) RS232 position to use the standby or fail parallel interface signals, refer to [Section 3.7.1](#).*

2. To monitor analogue output, connect the customer control equipment to the pump analogue output (pin 9) and to pin 2 of the customer logic interface mating half.

When the pump is shipped, the analogue output is configured to monitor pump rotational speed. To monitor other parameters, re-configure the nEXT pump using commands over the Serial Interface. Refer to [Section 3.7](#) for further details.

3. To monitor the normal status output, connect the customer control equipment to the normal status output (pin 15) and to pin 2 of the customer logic interface mating half. The output can be used to control other devices in the pumping system. The output can drive a low power relay of up to 24 V coil rating (up to 20 mA).

4. To monitor the fail status output, connect the customer control equipment to the fail output (pin 7) and to pin 2 of the customer logic interface mating half. The output can be used to control other devices in the pumping system. The output can drive a low power relay of up to 24 V coil rating.

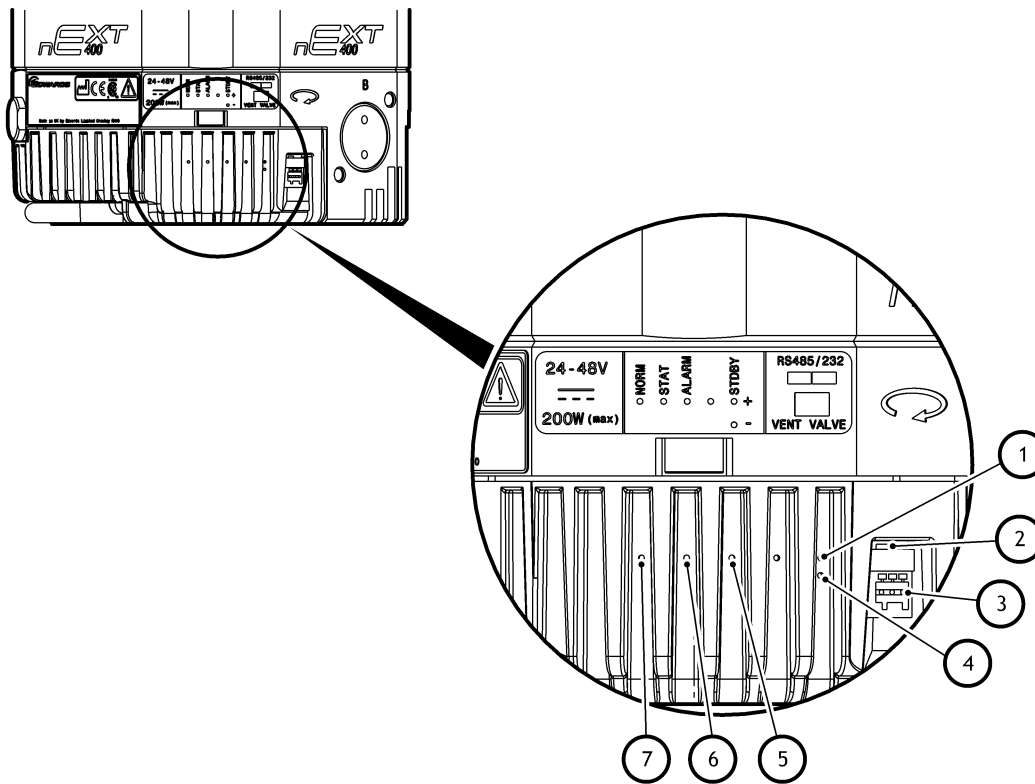
## 3.7 Connection for serial control and monitoring

The serial interface allows the nEXT pump to be controlled and to be interrogated as to its operational status using a number of serial commands. There is a multi-drop mode that allows for the connection of more than one nEXT pump to a single serial port on the control system.

### 3.7.1 Connect the serial interface to the customer control equipment

The serial interface is available in RS485 or RS232 options which can be selected using the slide switch located above the controller connector, shown in [Figure 12](#). To adjust the slide switch simply remove the plastic connector cover on the controller and toggle the slide switch using a small tool. Sliding the switch to the right will enable RS232 serial interface and to the left will enable RS485 serial interface. The controller default setting is RS232 serial interface.

Figure 12 - Controller status information



1. Standby speed increase button
2. RS485/RS232 switch
3. Controller connector socket
4. Standby speed reduce button

5. Alarm LED
6. Status LED
7. Normal LED

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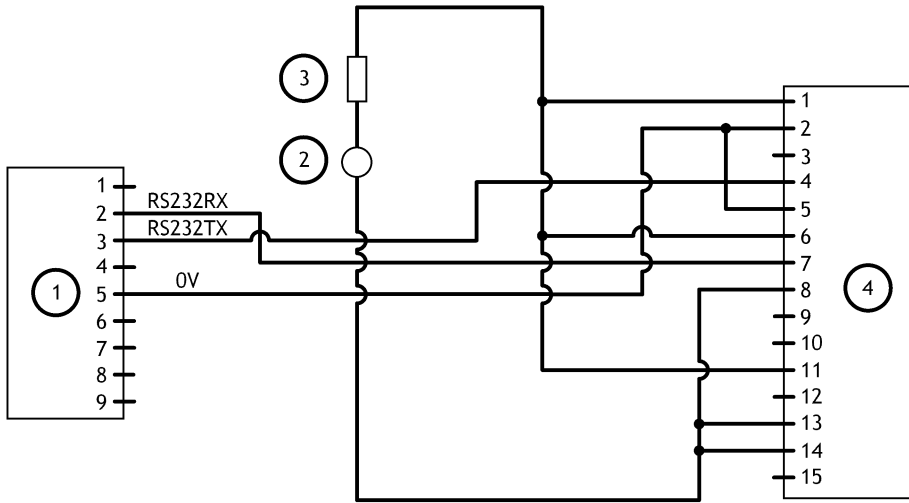
### CAUTION

When connecting the nEXT pump to a PC, remember that the 0 V pin on the RS232 connector may well be connected to earth through the PC. If this is the case, ensure that the 0 V rail of the 24 - 48 V supply is not also connected to earth at some other point such as at the power supply. If the 0 V rail of the 24 - 48 V supply will not be connected to earth at the PC, an opto-isolated interface to the PC should be used.

The nEXT pump can connect directly to the RS485 or RS232 serial input on the control equipment or a PC as shown in [Figure 13](#) and [Figure 14](#). In this configuration the PC is the serial link master and the nEXT pump is the slave. The distance over which the serial link will work is dependent on any difference in voltage between the 0 V at the sending and receiving end. If the 0 V reference at the receiving end is within 0.3 V of the 0 V Control Reference pin on the nEXT pump control connector then the serial link should be capable of operating at distances up to 6 m. An interface circuit external to the nEXT pump may be required for longer distances.

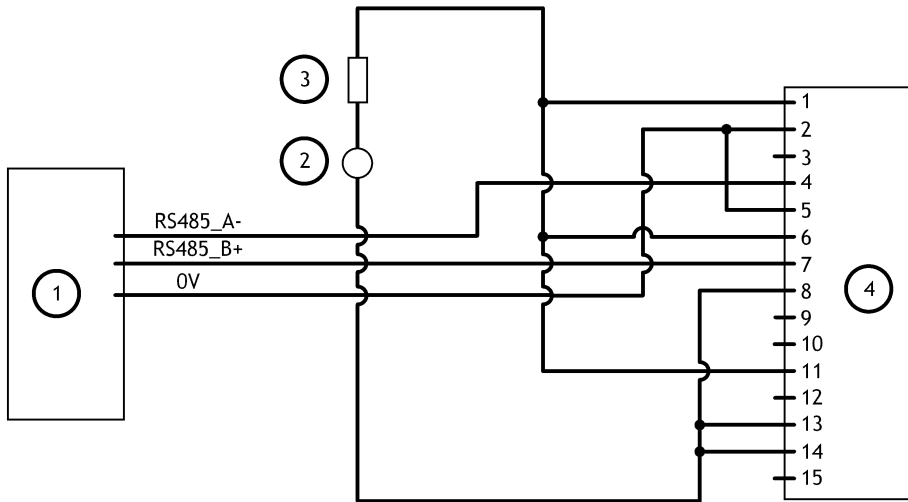
The software in the nEXT pump is capable of operating with several pumps connected to a single serial link master. This is referred to as multi-drop mode. The RS485 option is recommended for multi-drop mode. With the RS232 option selected, some additional hardware will be required to link several nEXT pump units to a single serial link master. A concept drawing of one possible arrangement is shown in [Figure 15](#). Conversely when the RS485 option is selected, connecting several nEXT pumps to a single master becomes a simple wiring exercise as shown in [Figure 16](#).

Figure 13 - Logic interface connections - RS232 serial control



- 1. RS232 interface on control equipment
- 2. 24-48 V d.c. electrical supply
- 3. Fuse
- 4. nEXT pump logic interface

Figure 14 - Logic interface connections - RS485 serial control



- 1. RS485 interface on control equipment
- 2. 24-48 V d.c. electrical supply
- 3. Fuse
- 4. nEXT pump logic interface

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### 3.7.2 Serial Enable

To send a serial message, first activate serial enable. This is achieved by linking the serial enable input signal (pin 5) to pin 2 of the customer logic interface mating half. Edwards recommends incorporating this link into the serial communications cable so that the serial enable is only activated when the serial cable is connected. When the cable is removed, serial enable will become inactive.

Serial Enable acts as an interlock for start commands sent over the Serial Interface. If the pump is running in serial control mode (having been sent a Serial Start command) and the Serial Enable subsequently becomes inactive, the pump will trigger a fail condition and will decelerate to rest. To clear this fail condition, re-activate the serial enable and send a serial stop command.

### 3.7.3 Serial protocol

The serial interface link is set to 9600 Baud, 8 bits, 1 stop, no parity with no handshaking. The commands are made up from printable ASCII characters. The maximum message size that can be sent is 80 characters, including start and end characters.

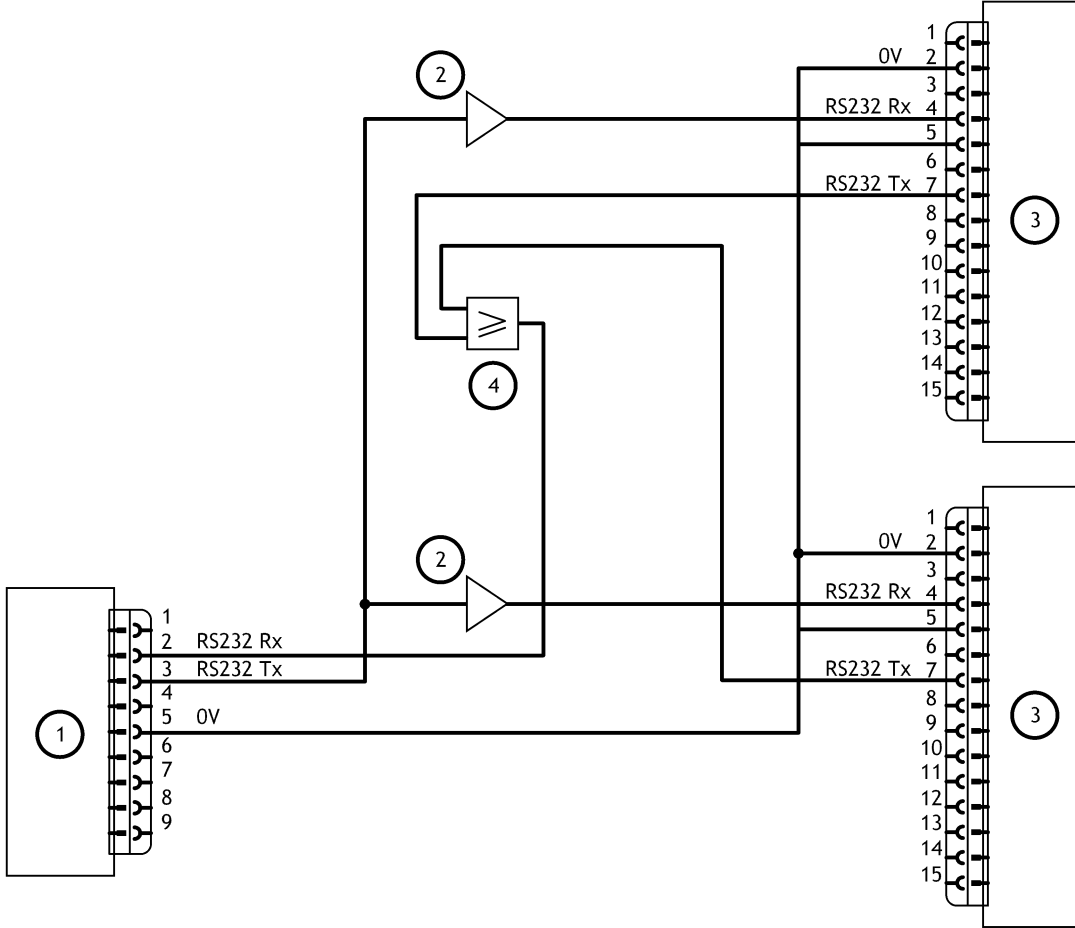
*Note: All alphabetical characters must be sent in upper case format. Response may contain lower case characters.*

Every complete command message sent will receive a response - either a status code or a data return. The nEXT pump can only deal with one message at a time. It will only accept a new message once the response to the previous message has been returned.

If the nEXT pump receives characters that are not framed inside start and stop characters, it will ignore them. Messages with the stop character missing will be discarded with no response when a new start character is received. If the nEXT pump receives an unrecognisable message between the start and stop characters, it will return an appropriate error message.

Refer to [Section 3.7.6](#) for more information about operating the nEXT pumps in multi-drop mode.

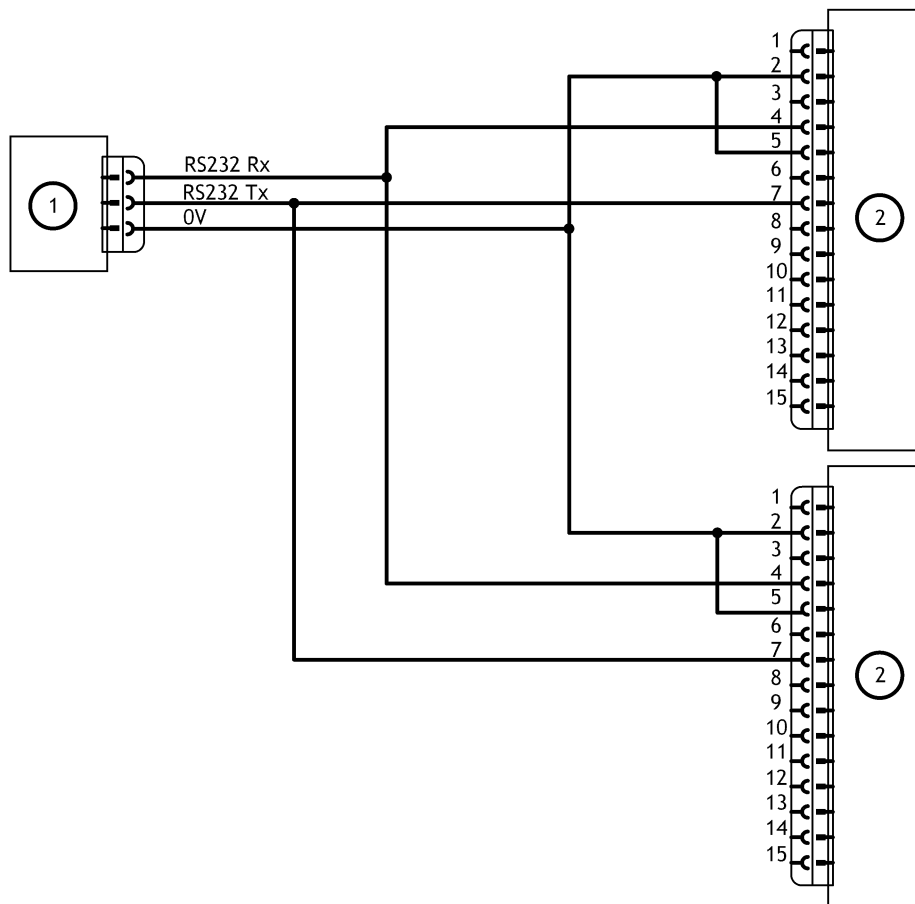
Figure 15 - Conceptual diagram for multi-drop connection using RS232 interface



- 1. RS232 interface on control equipment
- 2. Buffer
- 3. nEXT pump
- 4. OR gate

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Figure 16 - RS485 multi-drop connection



1. RS485 interface on control equipment

2. nEXT pump logic interface

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### 3.7.4 Message structure

The message structure and command set are the same for RS485 and RS232 options. To communicate a message to the nEXT pump, the characters must be sent in a specific order. If the message does not conform to the correct structure it will be ignored and no reply will be sent.

The correct structure to use is as follows:

- a valid start character, either a '!' character for a store operation or a '?' character for a query operation, followed by
- a command, which will be an upper case alphabetical character, followed by
- an object number, comprising three decimal digits, followed by
- for some commands only, a data field, comprising a sequence of characters separated from the object number by a space, followed by
- a terminating carriage return

The message protocol in multi-drop mode is marginally different, refer to [Section 3.7.6](#).

### 3.7.5 Command set

Table 16 shows a summary of the full set of commands available for controlling and monitoring the nEXT pump.

Table 17 shows the abbreviations that are used to define commands in the following sections and Table 18 shows the error codes that might be returned.

Table 16 - Summary of commands that can be sent to the nEXT pump

Object name	Command	Parameter range	Factory setting	Data type	Units	Comments
Node	!S850 ?S850	0.99	-	decimal	address	multi-drop address 0 = disable multi-drop address 99 = wildcard
Pump type	?S851	7; 10; 4	-	string string string	chars chars chars	Pump type DSP software version number (D396496XXX for nEXT) Full speed RPS (1000 for nEXT)
Pump control	!C852  ?V852	0 1  0.1800; 32-bits	- - -	decimal  decimal hex	-  RPS flags	Stop the pump Start the pump  Measured motor speed System status word
Vent options	!S853 ?S853	0 1  2  3  4  5  6 7 8	0	decimal		Hard vent only when < 50% speed Controlled vent if > 50% speed or hard vent if < 50% speed Hard vent if stop or hard vent if fail and < 50% speed Hard vent if stop or controlled vent if fail and > 50% speed or hard vent if fail and < 50% speed Hard vent if fail or hard vent if stop and < 50% speed Hard vent if fail or controlled vent if stop and > 50% speed or hard vent if stop and < 50% speed Hard vent if stop or fail Same as option 6 Vent = Permanently enabled (Fan)
Timer setting	!S854 ?S854	1.30	8	decimal	minutes	Timeout period for both initial ramp up and if speed drops below 50%
Power limit setting	!S855 ?S855	50.200	160	decimal	Watts	Link power maximum
Normal speed setting	!S856 ?S856	50.100	80	decimal	%	Normal speed as a percentage of full speed
Standby speed setting	!S857 ?S857	55.100	70	decimal	%	Standby speed as a percentage of full speed
Temperature readings	?V859	0.100; 0.100	-	decimal decimal	°C °C	Measured motor temperature Measured controller temperature
Link parameter readings	?V860	0.500; 0.300; 0.15000	-	decimal decimal decimal	0.1 Volts 0.1 Amps 0.1 Watts	Measured link voltage Measured link current Measured link power
Factory settings	!S867	1	-	-	-	Reset all configuration options and parameters to the factory settings
PIC software version	?S868	10	-	string	chars	Boot loader software version number (D374796XXX)

Table 16 - Summary of commands that can be sent to the nEXT pump (continued)

Object name	Command	Parameter range	Factory setting	Data type	Units	Comments
Speed control	!C869	0 1	-	decimal	-	Set target speed to full speed Set target speed to standby speed
Timer options	!S870 ?S870	0 1	1	decimal	-	Timer = disabled Timer = enabled Note that the timer is permanently enabled on ramp-up.
Analogue signal options	!S871 ?S871	0 1 2 3	0	decimal	-	Analogue output = measured speed Analogue output = measured power Analogue output = measured motor temp. Analogue output = measured control temp.
Close vent valve	!C875	1	-	decimal	-	Closes the vent valve for delayed start and overrides the current vent option. There is no open vent valve command but the stop command (!C852 0) will clear the override.
Service status	?V881	32 bits	-	hex	flags	Service status word
Controller run time	?V882	0..999999; 0..999999	-	decimal	hours	Hours run by controller Hours until controller service due
Pump run time	?V883	0..999999; 0..999999	-	decimal	hours	Hours run by pump Hours until pump service due
Pump cycles	?V884	0..65535; 0..65535	-	decimal	cycles	Cycles run by pump Cycles until pump service due
Bearing run time	?V885	0..999999; 0..999999	-	decimal	hours	Hours run by bearing Hours until bearing service due
Oil cartridge run time	?V886	0..999999; 0..999999	-	decimal	hours	Hours run by oil cartridge Hours until oil cartridge service due

Table 17 - Command abbreviations

Abbreviation	Meaning
cr	carriage return character
chars	characters
d	decimal ASCII character
	<i>Note: Fields showing multiple d characters are to indicate typical length. All data fields have a maximum of 5 decimal characters (prefixed by a minus number for negative numbers).</i>
h	hexadecimal ASCII character
r	Returned error code - refer to Table 16
sp	space character
string	may have several ASCII characters

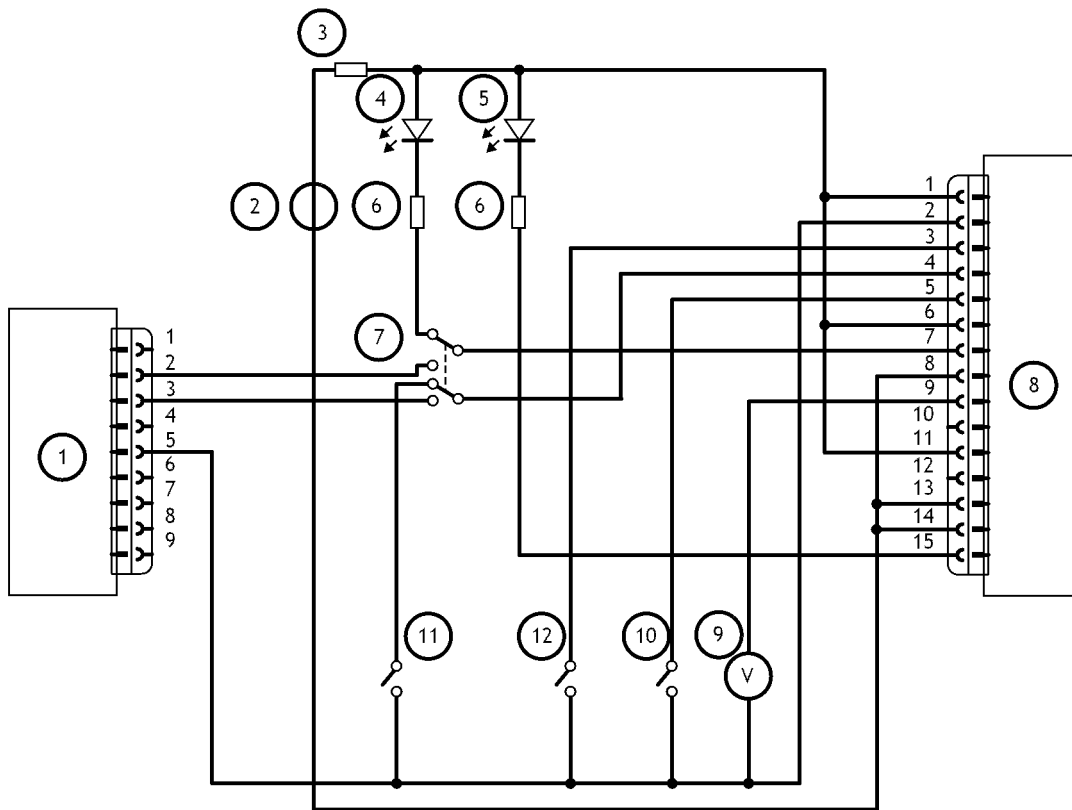
Table 17 - Command abbreviations

Abbreviation	Meaning
X	multi-drop decimal ASCII character <i>Note: Fields showing multiple X characters are to indicate maximum length and not fixed length.</i>

Table 18 - Error codes

Returned error code	Meaning
0	No error
1	Invalid command for object ID
2	Invalid Query/Command
3	Missing parameter
4	Parameter out of range
5	Invalid command in current state - e.g. serial command to start/stop when in parallel control mode

Figure 17 - Logic interface connection - mixed parallel and serial operation



- |  |                                   |
|--|-----------------------------------|
| 1. RS232 interface on control equipment  | 7. Optional serial link selector  |
| 2. 24 V d.c. electrical supply           | 8. nEXT pump                      |
| 3. Fuse                                  | 9. Optional voltmeter             |
| 4. Optional LED indicator - system OK    | 10. Optional serial enable switch |
| 5. Optional LED indicator - normal speed | 11. Optional standby switch       |
| 6. Current limit resistor for LED        | 12. Start switch                  |

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**Note:** The pump controller may be supplied from voltages above 24 V as specified in Table 10, however the circuitry connected to the normal and fail lines must still respect the maximum external pull up voltage rating given in Table 10.

### 3.7.6 multi-drop operation

Using multi-drop mode, a single computer system can communicate with more than one nEXT pump. Each nEXT pump must be assigned its own individual address before it can be fitted into a multi-drop system. The command to assign the multi-drop address is sent in standard nEXT message format (as detailed in [Section 4.1.9](#)).

The message protocol in multi-drop mode is marginally different to that described for serial messages in single pump systems. The main differences in multi-drop message protocol are detailed below:

- All multi-drop commands, queries or replies have the first character #.
- All commands, queries and replies contain a header containing the address of the node that the message is to, followed by the address of the node that the message is from.
- There is a delimiter character: (colon) which separates the two multi-drop addresses in the header.
- The remainder of the message (command, query or reply) follows the same protocol as already described for single pump systems.
- The wild card address 99 is very useful and means 'any' node.

After a nEXT pump has been assigned a multi-drop address, it will ignore any messages in the format for single pumps. An individual nEXT pump will remain silent and ignore all command messages unless the multi-drop address matches its own address.

## 3.8 Connection for mixed parallel and serial operation

The pump can be controlled using parallel interface control inputs and at the same time monitor various pump parameters using the serial interface. Alternatively, the pump can be controlled using commands sent over the serial interface while at the same time monitor the normal signal and analogue output over the parallel interface. [Figure 17](#) shows a schematic diagram of a system that demonstrates how to do this. This connection is a hybrid of the parallel and serial connection which are described in detail in [Section 3.6](#) and [3.7](#) respectively. Many of the options described in those sections are available in mixed parallel and serial operation but note that whilst serial enable is active to enable the serial link, the parallel standby and fail signals are not available. The multi-drop connection shown in [Section 3.7](#). can also be used with mixed parallel and serial operation.

The pump cannot be controlled using both the parallel and serial interfaces simultaneously. For example, if the pump is started by sending a start command over the serial interface, the pump cannot then be stopped by using the start /stop switch on the parallel interface. The pump will ignore the state of the start / stop switch on the parallel interface. To stop the pump, send a serial stop command. Only when the serial stop command has been received by the pump can any commands sent via the parallel interface be acted on.

Similarly, if the pump is started by using the start switch on the parallel interface, the pump cannot then be stopped by sending a stop command over the serial interface. The pump will ignore any start or stop commands received over the serial interface. To stop the pump, use the parallel stop switch. Only when the pump has been stopped using the parallel interface switch will any start or stop commands be accepted via the serial interface.

## 3.9 Vent valve selection, connection and control

---

### CAUTION

If the pump is vented when it is at full rotational speed and the rate of pressure rise is too high, the pump could be damaged and its life may be reduced. We therefore recommend that either the rate of pressure rise is limited (refer to [Figure 7](#)) or that the vent valve is only opened after the nEXT pump speed has fallen to 50% of full rotational speed.

---



To maintain the cleanliness of the vacuum system, Edwards recommends that, whenever the pump is switched off, the pump (or vacuum system) is vented when the speed of the nEXT pump is between full rotational speed and 50% of full rotational speed. Over this speed range, the rotor spins fast enough to suppress any backstreaming of hydrocarbon oil from the backing pump.

Do not connect the vent valve to the backing pipeline, this may lead to contamination. Connect the inlet of the vent valve to the vent gas supply (refer to [Section 2.3](#) for the vent gas specification).

Venting may be accomplished by using one of the following methods described in [Section 3.9.1](#) to [3.9.4](#).

### 3.9.1 Manual vent valve

A manual vent valve is supplied with the nEXT pump. It is not possible to accurately control the rate of pressure rise using the manual vent valve so take care not to open it too quickly. Edwards recommends that the manual vent valve is opened only after the pump speed has fallen to 50% of full rotational speed.

### 3.9.2 TAV5 or TAV6 solenoid vent valve

The TAV5 and TAV6 solenoid valves can be purchased as accessories - refer to [Section 7.4](#). The solenoid valves can be used in the following ways:

- Use a TAV5 or TAV6 solenoid valve in place of the manual vent valve on the pump
- Use a TAV5 or TAV6 solenoid valve connected to a convenient flange on the vacuum system

If a vent valve is connected to the vacuum system, select a point upstream of the nEXT pump to prevent backstreaming of oil from the backing pump.

If using the TAV5 vent valve, the pump may only be hard vented when it is at full speed if the vacuum system has a volume of 5 litres or more. If using the TAV6 vent valve, the pump may only be hard vented when it is at full speed if the vacuum system has a volume of 10 litres or more.

If the volume of the vacuum system is less than 5 litres (when using a TAV5 vent valve), or if the volume of the vacuum system is less than 10 litres (when using a TAV6 vent valve), incorporate a suitable vent restrictor and vent the pump when it is at full speed or else use the controlled venting option. [Table 20](#) gives an indication of the appropriate orifice size to be fitted to the vent valve for given vacuum system volumes in order that the rate of pressure rise remains within the limits shown in [Figure 7](#).

*Note: If a vent restrictor is used, the time required to vent the vacuum system may be unacceptably long. The time may be reduced by using a vent valve without a vent restrictor and waiting until the pump speed has fallen to 50% of full rotational speed before opening the vent valve.*

### 3.9.3 Vent valve control

The TAV5 or TAV6 solenoid valve can be controlled by the controller electronics. To use this function, fit the electrical connector supplied with the pump to the lead of the TAV5 or TAV6 solenoid valve. To ensure cable cores and screen are wired correctly, follow the electrical connection instructions given in the Accessories Manual (supplied with the TAV valve) and refer to [Figure 9](#). Plug the connector into the socket at the side of the controller (refer to [Figure 12](#)).

The controller is capable of controlling a number of different venting options. These are defined in [Table 19](#).

Table 19 - Vent options

Option number	Description of vent function
0	Vent valve opens fully below 50% full rotational speed for either stop command or fail. <i>Note: This is the factory default setting.</i>
1	Controlled venting from 100% to 50% full rotational speed; vent valve opens fully below 50% for either stop command or fail.
2	Vent valve fully opens immediately if stop command is received; vent valve opens fully below 50% full rotational speed if fail.
3	Vent valve fully opens immediately if stop command is received; controlled venting from 100% to 50% full rotational speed if fail then vent valve opens fully below 50%.
4	Vent valve fully opens immediately if fail; vent valve opens fully below 50% full rotational speed if stop.
5	Vent valve fully opens immediately if Fail; controlled venting from 100% to 50% full rotational speed if Stop command received then vent valve opens fully below 50%.
6.7	Vent valve fully opens immediately for either Stop command or Fail.

When the pump is shipped, the controller is configured with the factory default vent option 0, as detailed in Table 19. The controller can be configured to one of the other venting options provided commands can be sent via the serial interface or an Edwards TIC Turbo and Instrument Controller or Turbo Controller.

The controller only energises ('shuts') the TAV solenoid valve when it receives a start command. Prior to that, the valve will be in the 'open' vent state. If the vacuum system is a large system, allow the backing pump to reduce the pressure in the system to an acceptable level before starting the nEXT pump. In this case, send a command via the serial interface to close the vent valve before sending a start command - this is known as a delayed start.

If the nEXT pump is being controlled with an Edwards TIC Turbo and Instrument Controller or TIC Turbo Controller, the TAV solenoid valve can be driven from the TIC. Refer to the TIC Instruction Manuals for more information.

### 3.9.4 Alternative valve connected to the vacuum system

If using another vent valve, ensure that a suitable vent restrictor is fitted to the vacuum system to limit the rate of pressure rise. Refer to Table 20 for information about vent restrictor sizes. If a suitable vent restrictor is not fitted, open the vent valve only after the speed of the pump has fallen to 50% of full rotational speed.

Table 20 - Vent restrictor orifice diameter (with atmospheric pressure at the inlet of the vent valve)

Vacuum system volume (litres)	Orifice diameter (mm)
< 20	≤ 1.0
< 10	≤ 0.7
< 5	≤ 0.5
< 2	≤ 0.35

## 3.10 Cooling

### 3.10.1 Introduction

---

#### *CAUTION*

Ensure that the pump is adequately cooled to prevent damage to the rotor and bearing.

---



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#### *CAUTION*

When using alternative cooling arrangements other than the standard Edwards cooling accessories, please ensure cooling is NOT solely directed or ducted onto the pump controller.

---



---

#### *CAUTION*

If the pump will be located inside an enclosure, ensure that there is adequate ventilation so that the ambient temperature around the pump does not exceed 40 °C.

---

- Natural convection cooling: For some light pumping duties, with an ambient air temperature less than 30 °C, natural convection cooling may be adequate to cool the nEXT pump.
- Forced air cooling: The ambient air temperature when using forced air cooling must be 5 °C to 35 °C. Ensure that there is an adequate supply of cooling air to the pump.
- Water cooling: Use water cooling with an ambient air temperature greater than 35 °C or when using a bakeout band (CF variants only). When using water cooling, ambient air temperature must be less than 40 °C and the water temperature must be between 10 °C and 20 °C.
- Edwards recommends that, wherever possible, the pump is cooled by forced air cooling or water cooling. Refer to [Table 6](#) for further performance information.

### 3.10.2 Forced air cooling

Air cooling accessories are available for nEXT pumps (refer to [Section 7.4](#)). Fit the air cooler as described in the instruction manual supplied with it. If an alternative fan is used for air cooling, ensure that the flow rate is above 100 m<sup>3</sup>h<sup>-1</sup> (60 cfm).

The air cooler can be powered by a customer external power supply, the Edwards TIC Turbo and Instrument Controller, the TIC Turbo Controller or the nEXT Controller. It cannot be powered by the controller if a TAV solenoid valve is already connected to the controller. Follow the electrical connection instructions in the air cooler manual to wire the lead of the air cooler into the controller connector supplied with the pump (refer to [Figure 9](#)). Plug the connector into the socket at the side of the controller (refer to [Figure 12](#)).

The customer controller can be configured to drive an air cooler only if commands can be sent via the serial interface or an Edwards TIC Turbo and Instrument Controller or Turbo Controller.

### 3.10.3 Water cooling

---

#### *CAUTION*

To prevent condensation inside the pump and controller, turn off the cooling water when the pump is switched off.

---

A WCX water cooler accessory is available for the nEXT pumps (refer to [Section 7.4](#)). Fit it as described in the instruction manual supplied with it. The cooling water supply must comply with the specification given in [Section 2.5](#). Pipes in the water cooling circuit may become blocked if the cooling water contains too much calcium carbonate or

if it contains particles that are too large. Corrosion of the water cooling circuit may occur if there is too little calcium carbonate and oxygen in the water. Good quality drinking water is usually suitable. If in doubt, check the quality of the cooling water supply and, if necessary, provide treatment and filtration.

Connect the cooling water supply to the water cooler on the pump as described below. Either of the two push fit connectors on the water cooler can be used for the water supply or return connections.

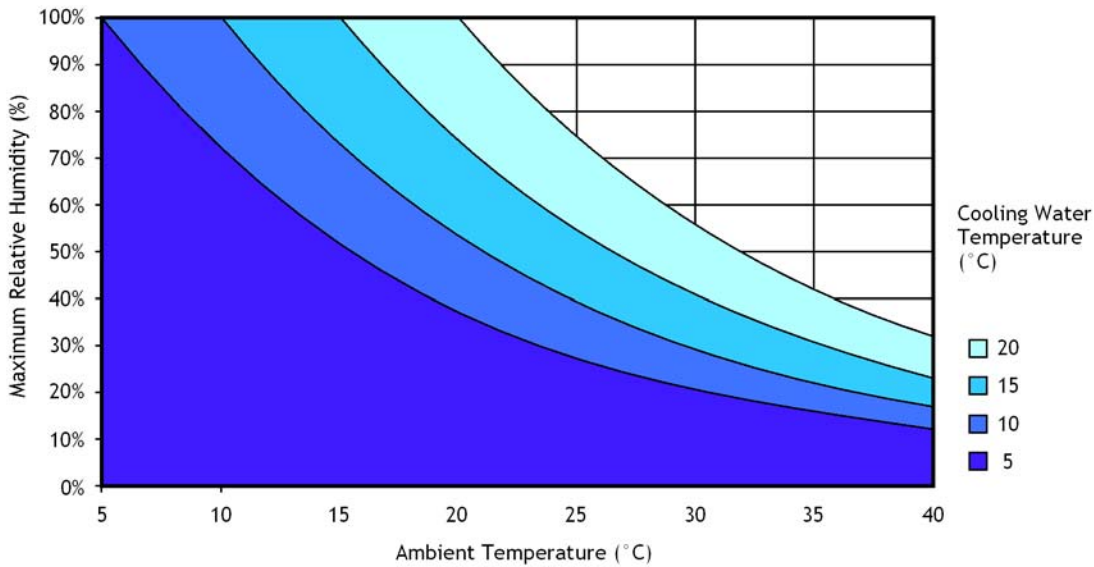
Push nylon hose (approximately 10 mm outer diameter) into the ends of the hose connectors on the water cooler on the pump. Alternatively, remove the hose connectors from the water cooler and make direct connections to the 1/8 inch BSP female threaded fittings on the water cooler.

To avoid breaking the cooling water circuit when removing the pump for maintenance, unscrew the two M4 fixing screws and remove the water cooler from the pump.

**CAUTION**

Condensation may occur if a water cooling block is used in high humidity environments. Protect the pump and other equipment by considered design of the installation; refer to Figure 16 for recommendations.

Figure 18 - Maximum relative humidity to avoid condensation with water cooling



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## 4 Operation



### WARNING

Do not operate the nEXT pump unless it is connected to the vacuum system. The pump rotor rotates at very high speeds and the rotating blades might not be visible. If the pump is run unconnected, the pump rotor can cause injury.

Before operating the pump, it is worthwhile configuring the various controller settings so that they are suitable for the application.

If the system is designed to operate with parallel control and monitoring, there is no facility to change the majority of the controller settings once the nEXT pump is installed on the system. The pump is supplied with all settings at factory default values, as shown in Table 16. If any of the controller settings are to be changed, change them before installing the nEXT pump on the system.

The nEXT pump can be configured using the customer serial system. Section 4.1 details the commands that will be needed to configure the controller. Alternatively, use the Edwards TIC Turbo and Instrument Controller or TIC Turbo Controller. Further information regarding this is detailed in Section 4.2.

*Note:* The standby speed may be adjusted using the button on the controller as described in Section 4.1.4.

If the nEXT pump is operated with parallel control and monitoring and the controller settings will not be reconfigured, go straight to Section 4.3.

### 4.1 Configuring the nEXT pump using serial commands

Refer to Table 16 for a summary of the full set of serial commands, parameter ranges and factory defaults for each setting. The following sections describe the settings in more detail.

#### 4.1.1 Power limit setting

Table 21 shows the power limit setting options for the nEXT pumps. The pump is supplied with a default power limit as shown. If this limit is not suitable for the application, change it to any value between the maximum and minimum shown.

Table 21 - Power limit setting

Maximum value setting	Minimum value setting	Default power setting
200 W	50 W	160 W

Send the command as follows (where the 'd' characters represent the value in Watts that will be set. For example, to set the limit to 90 W, type 90).

Command	!	S	8	5	5	sp	d	d	d	cr
---------	---	---	---	---	---	----	---	---	---	----

The reply will be in the following format:

Reply	*	S	8	5	5	sp	r	cr
-------	---	---	---	---	---	----	---	----

The power limit setting is now stored in memory within the nEXT pump.

To check what power limit is set, send a query as follows:

Command	?	S	8	5	5	cr
---------	---	---	---	---	---	----

The reply will be in the following format:

<i>Reply</i>	=	S	8	5	5	sp	d	d	d	cr
--------------	---	---	---	---	---	----	---	---	---	----

#### 4.1.2 Powering a fan from the Controller

A fan can be powered from the nEXT controller, provided that the controller is not being used to control a vent valve.

To enable the fan, send the following command:

<i>Command</i>	!	S	8	5	3	sp	8	cr
----------------	---	---	---	---	---	----	---	----

The reply will be in the following format:

<i>Reply</i>	*	S	8	5	3	sp	r	cr
--------------	---	---	---	---	---	----	---	----

The permanently enabled fan setting is now stored in memory within the nEXT pump.

When the pump is shipped, it is set up to run a vent valve. Send a query to find out what the setting is as follows:

<i>Command</i>	?	S	8	5	3	cr
----------------	---	---	---	---	---	----

The reply will be in the following format:

<i>Reply</i>	=	S	8	5	3	sp	d	cr
--------------	---	---	---	---	---	----	---	----

If the character 'd' is 8, then the fan is enabled. If it is anything else, configure the controller to run the fan.

#### 4.1.3 Controlled venting options

If the controller is used to automatically control a vent valve, there are a number of venting options available, refer to [Table 19](#).

To set a vent option, send the following command, (where the character 'd' refers to the option number shown in [Table 19](#)):

<i>Command</i>	!	S	8	5	3	sp	d	cr
----------------	---	---	---	---	---	----	---	----

The reply will be in the following format:

<i>Reply</i>	*	S	8	5	3	sp	r	cr
--------------	---	---	---	---	---	----	---	----

The venting option is now stored in memory within the nEXT pump.

To check the venting option that is set, send a query as follows:

<i>Command</i>	?	S	8	5	3	cr
----------------	---	---	---	---	---	----

The reply will be in the following format:

<i>Reply</i>	=	S	8	5	3	sp	d	cr
--------------	---	---	---	---	---	----	---	----

#### 4.1.4 Standby speed setting

The pump can be run at standby speed rather than full rotational speed. The standby speed is a user-configurable option and can be set to any value between 55% and 100% full rotational speed. When the pump is shipped, it is configured with a standby speed of 70% full rotational speed.

The standby speed setting can be changed using the STDBY+ and STDBY- push buttons located on the controller (shown in Figure 12) or by using a serial command. If using the buttons, each button press will adjust the speed by 10 Hz (1%).

To change the standby speed setting using a serial command, send the following command (where the characters 'd' represent the value as a percentage of full rotational speed):

Command	!	S	8	5	7	sp	d	d	d	cr
---------	---	---	---	---	---	----	---	---	---	----

The reply will be in the following format:

Reply	*	S	8	5	7	sp	r	cr
-------	---	---	---	---	---	----	---	----

The standby speed is now stored in memory within the nEXT pump.

To check what standby speed is set, send a query as follows:

Command	?	S	8	5	7	cr
---------	---	---	---	---	---	----

The reply will be as follows:

Reply	=	S	8	5	7	sp	d	d	d	cr
-------	---	---	---	---	---	----	---	---	---	----

#### 4.1.5 Normal speed setting

The normal speed is a user-configurable setting and can be set to any value between 50% and 100% full rotational speed. When the pump is shipped, it is configured with a normal speed of 80% full rotational speed.

To change the normal speed setting, send the following command (where the characters 'd' represent the value as a percentage of full rotational speed):

Command	!	S	8	5	6	sp	d	d	d	cr
---------	---	---	---	---	---	----	---	---	---	----

The reply will be as follows:

Reply	*	S	8	5	6	sp	r	cr
-------	---	---	---	---	---	----	---	----

The normal speed is now stored in memory within the nEXT pump.

To check what normal speed is set, send a query as follows:

Command	?	S	8	5	6	cr
---------	---	---	---	---	---	----

The reply will be as follows:

Reply	=	S	8	5	6	sp	d	d	d	cr
-------	---	---	---	---	---	----	---	---	---	----

### 4.1.6 Timer setting and options

Refer to Section 1.4.3 for a full description of timer functionality.

The timeout period is a user-configurable option and can be set to any value from 1 to 30 minutes. When the pump is shipped, it is configured with a default timeout period of 8 minutes.

To change the timer setting, send the following command (where the characters 'd' represent the timeout period in minutes):

Command	!	S	8	5	4	sp	d	d	cr
---------	---	---	---	---	---	----	---	---	----

The reply will be as follows:

Reply	*	S	8	5	4	sp	r	cr
-------	---	---	---	---	---	----	---	----

The timer setting is now stored in memory within the nEXT pump.

To check what timeout period is set, send a query as follows:

Command	?	S	8	5	4	cr
---------	---	---	---	---	---	----

The reply will be as follows:

Reply	=	S	8	5	4	sp	d	d	cr
-------	---	---	---	---	---	----	---	---	----

The timer is permanently enabled during ramp-up, however it is optional to have it enabled at other times. When the pump is shipped, the timer is enabled by default.

To disable the timer, send the following serial command:

Command	!	S	8	7	0	sp	0	cr
---------	---	---	---	---	---	----	---	----

The reply will be as follows:

Reply	*	S	8	7	0	sp	r	cr
-------	---	---	---	---	---	----	---	----

The state of the timer option is stored in memory within the nEXT pump.

To enable the timer again, send the following serial command:

Command	!	S	8	7	0	sp	1	cr
---------	---	---	---	---	---	----	---	----

The reply will be as follows:

Reply	*	S	8	7	0	sp	r	cr
-------	---	---	---	---	---	----	---	----

To check whether the timer is enabled or disabled, send the following query:

Command	?	S	8	7	0	cr
---------	---	---	---	---	---	----

The reply will be as follows (where d=0 means disabled and d=1 means enabled):

Reply	=	S	8	7	0	sp	d	cr
-------	---	---	---	---	---	----	---	----



### 4.1.7 Analogue signal options

The analogue output can be used to monitor one of four different parameters, as detailed in Table 22.

Table 22 - Analogue signal options

Option number	Description of analogue output number
0	Measured pump rotational speed <i>Note: This is the factory default setting.</i>
1	Measured system power
2	Measured motor temperature
3	Measured controller temperature

To configure the analogue output, send the following command (where the character 'd' denotes the option number detailed in Table 22):

Command	!	S	8	7	1	sp	d	cr
---------	---	---	---	---	---	----	---	----

The reply will be as follows:

Reply	*	S	8	7	1	sp	d	cr
-------	---	---	---	---	---	----	---	----

The analogue output signal setting is now stored in memory within the nEXT pump.

To check which analogue output signal setting is enabled, send a query as follows:

Command	?	S	8	7	1	cr
---------	---	---	---	---	---	----

The reply will be as follows:

Reply	=	S	8	7	1	sp	d	cr
-------	---	---	---	---	---	----	---	----

### 4.1.8 Factory settings

The nEXT pump can be re-configured to its original factory settings with one serial command.

To reset the controller to factory settings, send the following command:

Command	!	S	8	6	7	sp	1	cr
---------	---	---	---	---	---	----	---	----

The reply will be as follows:

Reply	*	S	8	6	7	sp	r	cr
-------	---	---	---	---	---	----	---	----

The factory settings are restored in the memory within the nEXT pump.

### 4.1.9 Assigning a multi-drop address

When the nEXT pump is shipped, multi-drop mode is disabled by default. Each individual pump must be programmed with its own multi-drop address via a point-to-point connection before introduction into a multi-drop network.

Send the following command to assign a multi-drop address (where the 'd' characters represent the address):

Command	!	S	8	5	0	sp	d	d	cr
---------	---	---	---	---	---	----	---	---	----

*Note:* The address can be any decimal number from 1 to 98. The address number 0 is used to disable multi-drop mode. The address number 99 is reserved as a wild card and is used in the query set up detailed later.

The reply will be as follows:

Reply	*	S	8	5	0	sp	r	cr
-------	---	---	---	---	---	----	---	----

The multi-drop address is stored within the nEXT pump.

A query can be sent to the pump to find out if it has a multi-drop address. Send the following command:

Reply	?	S	8	5	0	cr
-------	---	---	---	---	---	----

If the reply is as shown below, the pump has multi-drop mode disabled:

Reply	=	S	8	5	0	sp	0	cr
-------	---	---	---	---	---	----	---	----

If the pump already has a multi-drop address, there will be no reply. Communicate with the pump in multi-drop message protocol. Refer to [Section 3.7.6](#) for more information about multi-drop mode and multi-drop message protocol.

Use the following query (using wild card address 99 which means ‘any’ node) to find out the multi-drop address of the nEXT pump:

Command	#	9	9	:	9	9	?	S	8	5	0	cr
---------	---	---	---	---	---	---	---	---	---	---	---	----

The reply will be as follows, where dd denotes the multi-drop address of the pump:

Reply	#	9	9	:	9	9	=	S	8	5	0	sp	d	d	cr
-------	---	---	---	---	---	---	---	---	---	---	---	----	---	---	----

Multi-drop mode can be disabled by assigning the pump an address 0. To do this, send the following command (where dd denotes the multi-drop address of the pump and XX denotes the address of the node that is sending the command):

Command	#	d	d	:	x	x	!	S	8	5	0	sp	0	cr
---------	---	---	---	---	---	---	---	---	---	---	---	----	---	----

The reply will be as follows:

Reply	#	x	x	:	d	d	*	S	8	5	0	sp	0	cr
-------	---	---	---	---	---	---	---	---	---	---	---	----	---	----

Once multi-drop mode is disabled, the pump will no longer respond to multi-drop commands.

## 4.2 Configuring the nEXT pump using a TIC

The nEXT pump can be configured using the Edwards TIC Turbo and Instrument Controller or TIC Turbo Controller. Refer to [Section 3.5.3](#).

It is possible to set the following parameters of the nEXT pump using the TIC:

- Power limit setting
- Controlled venting options, including running a fan from the Controller
- Standby speed setting
- Normal speed setting
- Timer settings - both enabling/disabling the timer AND setting the timeout period
- Electronic braking options
- Factory default settings

For information on how to perform these settings, refer to the TIC Turbo and Instrument Controller or TIC Turbo Controller Instruction Manuals.

**Note:** *It is not possible to configure the analogue output options using the TIC. There is also no facility within the TIC to assign a multi-drop address to the nEXT pump.*

There is a further option of connecting the TIC to a PC and using the TIC PC program to configure the nEXT pump. The TIC PC program allows for the configuration of all settings shown in the list above as well as allowing configuration of the analogue output options and assignment of a multi-drop address. Refer to the TIC PC program Instruction Manual for more information.

## 4.3 Before starting the pump

Irrespective of the system used to control the nEXT pump, work through the following steps before starting the pump.

### 4.3.1 Close the vent valve

- If using a manual vent valve, turn it clockwise to close it.
- If using the customer control system to drive a vent valve, make sure that the vent valve is closed.
- If driving a TAV solenoid valve from the controller, the TAV valve will automatically shut when the pump is started.
- If using the TIC to operate the vent valve, refer to [Section 4.7](#).

**Note:** *The backing pump and nEXT pump can be started at the same time. The nEXT pump will not be damaged and can operate as an effective baffle, however, if the vacuum system is large (100 litres or larger) it will be more efficient to allow the backing pump to reduce system pressure to 10 mbar before starting the nEXT pump. In this case it will be necessary to close the vent valve in advance of starting the backing pump.*

When using the controller to control a TAV solenoid valve and operating with parallel control and monitoring, the valve can not be shut in advance of starting the nEXT pump because the facility to send the appropriate serial command is not available. If the facility to send serial commands is available, a delayed start can be performed, refer to [Section 4.5.1](#).

### 4.3.2 Pre-start checks

1. Turn on the appropriate cooling device (fan or cooling water supply).

**Note:** *If the controller has been configured to drive a fan, the fan will automatically start when power is supplied to the nEXT pump.*

2. Start the backing pump.
3. Switch on the power supply to the pump. Check that the three LEDs on the controller light up for approximately 0.5 seconds and then extinguish.

If the LEDs do not light up as expected, or if the red or yellow LED begins to flash a repeated sequence or if the red LED is lit, refer to [Section 5.5](#).

## 4.4 Operation with parallel control and monitoring

### 4.4.1 Start the pump

Start the nEXT pump by linking the start/stop control input to the 0 V control reference on the logic interface connector. The pump will then accelerate to full operating speed.

The green indicator on the controller will illuminate when the pump reaches normal speed. This is 80% of full rotational speed by default but a different value may have been selected to suit the application.

### 4.4.2 Running at standby speed

To run the nEXT pump at standby speed, link the standby control input to the 0 V control reference on the logic interface connector. If the pump is currently below standby speed then it will accelerate until it reaches standby speed. If it is running faster than standby speed, it will decelerate until standby speed is reached.

To return the pump to full speed, disconnect the standby control input from the 0 V control reference on the logic interface connector.

### 4.4.3 Stop the pump

Stop the nEXT pump by disconnecting the start/stop control input from the 0 V control reference on the logic interface connector. The pump rotor will decelerate to rest.

### 4.4.4 Parallel monitoring

It is possible to monitor the following parameters:

- Analogue output
- Normal signal
- Fail signal

Refer to [Section 3.6](#) for instructions on how to monitor these signals. The analogue output is described in [Table 10](#).

## 4.5 Operation with serial control and monitoring

### 4.5.1 Delayed start

If using a TAV solenoid valve controlled by the controller, it may be desirable to close it before starting the nEXT pump. This will allow the backing pump to reduce the pressure in the vacuum system.

To close the vent valve, send the following command:

Command	!	C	8	7	5	sp	1	cr
---------	---	---	---	---	---	----	---	----

The reply will be in the following format:

Reply	*	C	8	7	5	sp	r	cr
-------	---	---	---	---	---	----	---	----

**Note:** This command overrides the current vent option and closes the vent valve. There is no open vent valve command but, when a stop command is sent to the pump, the override is cleared.

### 4.5.2 Start the pump

To start the pump, send the following command over the serial communications link:

Command	!	C	8	5	2	sp	1	cr
---------	---	---	---	---	---	----	---	----

The reply will be in the following format:

Reply	*	C	8	5	2	sp	1	cr
-------	---	---	---	---	---	----	---	----

The pump will then accelerate to full operating speed. The green indicator LED will illuminate when the pump reaches normal speed. This is 80% of full rotational speed by default but a different value may have been selected to suit the application.

### 4.5.3 Standby speed

To run the nEXT pump at standby speed, send the following command over the serial communications link:

Command	!	C	8	6	9	sp	1	cr
---------	---	---	---	---	---	----	---	----

The reply will be as follows:

Reply	*	C	8	6	9	sp	r	cr
-------	---	---	---	---	---	----	---	----

If the pump is currently below standby speed then it will accelerate until it reaches standby speed. If it is running faster than standby speed, it will decelerate until standby speed is reached.

To return the pump to full speed, send the following command:

Command	!	C	8	6	9	sp	0	cr
---------	---	---	---	---	---	----	---	----

The reply will be as follows:

Reply	*	C	8	6	9	sp	r	cr
-------	---	---	---	---	---	----	---	----

### 4.5.4 Stop the pump

To stop the nEXT pump, send the following command over the serial communications link:

Command	!	C	8	5	2	sp	0	cr
---------	---	---	---	---	---	----	---	----

The reply will be in the following format:

Reply	*	C	8	5	2	sp	r	cr
-------	---	---	---	---	---	----	---	----

On successful receipt of the stop command, the pump rotor will decelerate to rest.

### 4.5.5 Temperature readings

The temperatures of both the pump motor and the internal electronics of the nEXT pump can be monitored by sending the following query:

Command	?	V	8	5	9	cr
---------	---	---	---	---	---	----

The reply will be as follows, where the first number is the motor temperature and the second number the internal controller temperature, both measured in °C:

Reply	=	V	8	5	9	sp	d	d	d	;	d	d	d	cr
-------	---	---	---	---	---	----	---	---	---	---	---	---	---	----

#### 4.5.6 Link parameter readings

The internal voltage, current and motor power of the nEXT pump can be monitored by sending the following query:

Command	?	V	8	6	0	cr
---------	---	---	---	---	---	----

The reply will be as follows (where the first number refers to voltage (measured in 0.1 Volts - i.e. divide the number by 10 to get an answer in Volts), the second number refers to current (measured in 0.1 Amps) and the third number refers to motor power (measured in 0.1 Watts)):

Reply	=	V	8	6	0	sp	d	d	d	;	d	d	d	;	d	d	d	d	d	cr
-------	---	---	---	---	---	----	---	---	---	---	---	---	---	---	---	---	---	---	---	----

#### 4.5.7 Measured motor speed

The measured rotational speed of the motor inside the nEXT pump can be monitored by sending the following query:

Command	?	V	8	5	2	cr
---------	---	---	---	---	---	----

The reply will be as follows, where the first returned number refers to motor rotational speed in revolutions per second (Hz):

Reply	=	V	8	5	2	sp	d	d	d	d	;	h	h	h	h	h	h	h	h	h	cr
-------	---	---	---	---	---	----	---	---	---	---	---	---	---	---	---	---	---	---	---	---	----

*Note:* The second return number is a 32-bit system status word (set of 8 hexadecimal characters) which is useful for fault finding. Refer to [Section 5.5.9](#) for advice on decoding the system status word.

## 4.6 Mixed parallel and serial operation

In mixed parallel and serial operation the pump may receive commands from both serial and parallel interfaces. To understand how these commands control the pump, refer to [Figure 19](#). The pump will power up with 'None in Control'. From this state a parallel start signal or a serial start command may be received, resulting in the pump moving to parallel control mode or serial control mode respectively. Serial start commands will only be received if the serial enable line is active.

The state of the serial enable line may be switched between active and inactive whilst in mixed parallel and serial operation. The primary function of the serial enable line is to enable the serial link. It has no direct effect on the control mode. The pump will receive and respond to serial commands whenever the serial enable line is active, and conversely will not receive or respond to serial commands when the serial enable line is inactive.

Availability of the parallel standby and fail signals depends on the state of the serial enable line and the position of the RS485/RS232 switch as described in [Table 23](#).

Table 23 - Serial enable matrix

		Serial enable	
		Active	Inactive
RS485/RS232 Switch	RS232	Standby and fail lines are used for RS232 data. Parallel standby control and fail indication are disabled.	Standby and fail lines are used for parallel Standby control and fail indication. Serial communications are disabled.
	RS485	Standby and fail lines are used for RS485 data. Parallel standby control and fail indication are disabled.	Standby and fail lines are in (RS485) high impedance state.* Serial communications are disabled.

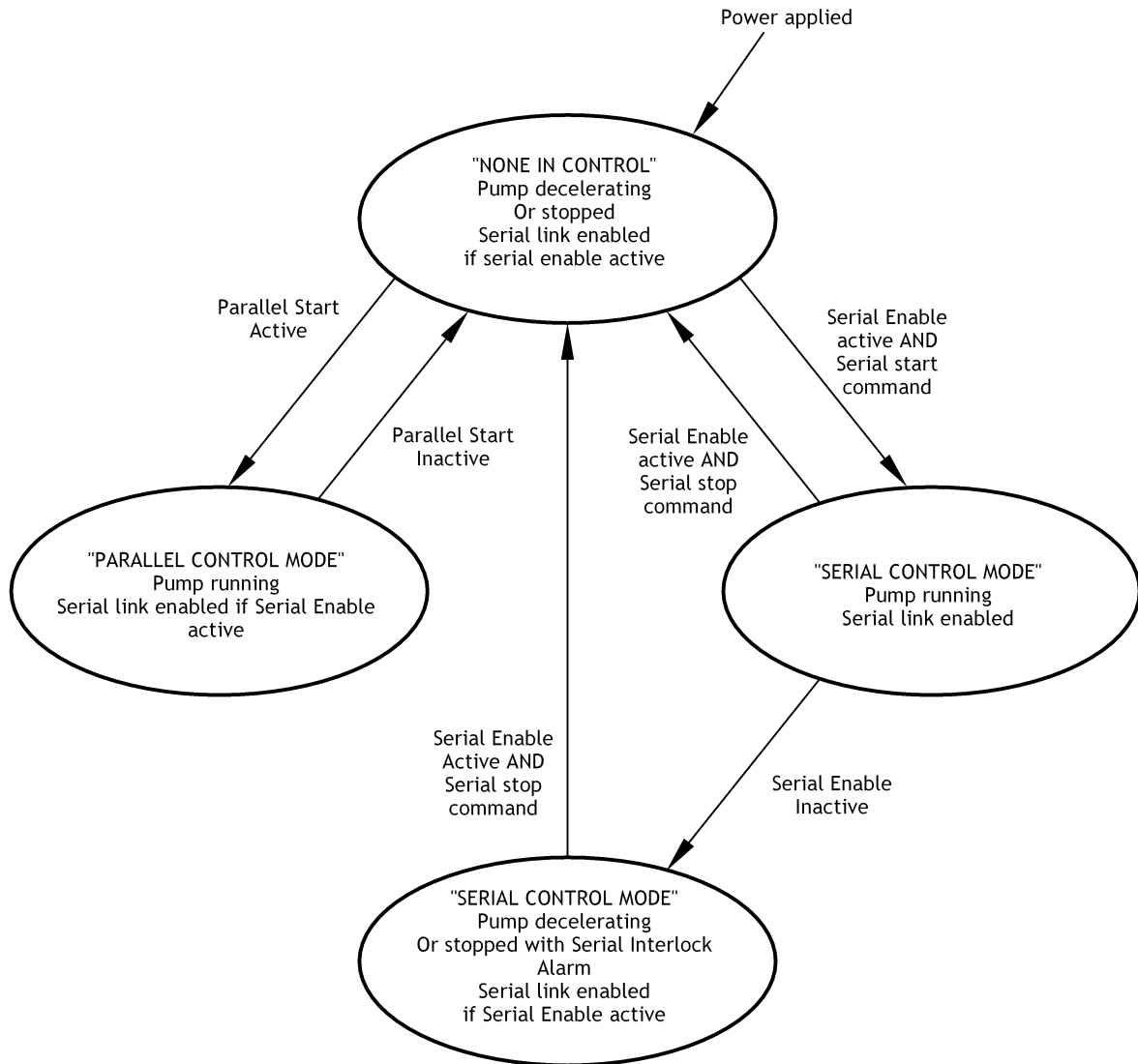
\* Pump target speed will switch between run speed and standby speed in response to any data driven onto the RS485 bus by other devices connected to the bus. Activation of the parallel start line not recommended with the RS485/232 switch in RS485 position and serial enable Inactive. Deactivation of the serial enable line is not recommended with the pump running following a start from the parallel start line when the RS485/232 switch is in the RS485 position.

In parallel control mode, the pump will not accept serial stop commands but will accept all other serial commands. When serial enable is active, the pump will run at standby speed if it has been commanded to do so by a serial standby command. When Serial Enable is inactive and the RS485/RS232 switch is in RS232 position, the pump will run at standby speed when the parallel standby line is active.

In serial control mode, the state of the parallel Start line will be ignored but the serial enable line provides an interlock function as shown in [Figure 19](#). This interlock function only operates with serial start commands and therefore only in serial control mode. In serial control mode, the pump cannot be commanded to standby speed by the standby line, instead a serial standby command must be used.

The parallel normal and analogue output signals provide valid pump status information at all times under mixed parallel and serial operation. The analogue output voltages are described in [Table 10](#).

Figure 19 - Serial and parallel control flowchart



dcx/8831/004

### 4.7 Operation with a TIC

For operation with an Edwards Turbo Instrument Controller or TIC Turbo Controller, the nEXT pump can be connected directly to this type of unit, which will provide the power necessary to drive the nEXT pump. Instructions on the setup and operation with the TIC or TIC Turbo Controller can be found on CD ROM part number D397-00-879 which is supplied with the TIC or TIC Turbo Controller.

### 4.8 Decelerating and venting

Immediately after applying the stop command, whether by the parallel or serial interface or by the TIC, switch off the backing pump. Then the system may be vented in accordance with the advice given in Section 3.9.



---

**CAUTION**

Do not open a manual vent valve until the pump rotational speed has fallen below 50%, otherwise the rate of pressure rise may be too high, which could damage the pump. In an emergency only, open the vent valve quickly to decelerate the pump rotor in the shortest possible time.

---

*Note:* If using the controller to control a TAV solenoid valve, there is a 2-second delay between either a stop command being received or a fault condition being detected and the vent valve opening. This delay allows time for gauges, valves and other equipment to be switched off before venting occurs.

The green indicator LED on the controller will extinguish as rotational speed drops below normal speed. At very low speeds, the yellow indicator LED will flash and will extinguish when the pump has stopped.

## 4.9 Operation at extreme conditions

### 4.9.1 Operation with high inlet pressure

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

If the pump speed falls to below 50% of full rotational speed, the timer will start if it is enabled. If the speed does not recover to above 50% speed before the timeout period expires, the pump will shut down and display a fail signal. If the timer is disabled, the pump will immediately shut down and display a fail signal if the speed drops below 50% of full rotational speed. Refer to [Section 2.7](#) for the maximum power delivered to the pump and to [Table 6](#), for maximum allowable inlet pressure.

### 4.9.2 Operation at high temperatures

Temperature sensors within the pump mechanism and electronics are monitored by an internal system. If the system detects that any internal temperatures are too high, the power supplied to the pump motor is reduced; the pump may not therefore be able to maintain full rotational speed if it is too hot.

If the pump speed falls to below 50% of full rotational speed, the timer will start if it is enabled. If the speed does not recover to above 50% speed before the timeout period expires, the pump will shut down and display a fail signal. If the timer is disabled, the pump will immediately shut down and display a fail signal if the speed drops below 50% of full rotational speed. Refer to [Section 2.11](#) for pump operating ranges and [Section 3.10](#) for advice on pump cooling.

### 4.9.3 Protection against over-speed

Control software within the controller regulates the pump rotational speed and prevents the pump operating above its normal full rotational speed. In the unlikely event of a failure of this control software, the controller has a built-in safety circuit that checks whether the pump is running at over-speed. If an over-speed condition is detected, the controller automatically shuts down power to the pump motor and slows it down to rest. The controller will signal a fail condition if over-speed has been detected.

If the pump appears to be running at over-speed, switch it off and consult Edwards or the supplier.

### 4.9.4 Electrical supply failure

**WARNING**

If the power supply fails when the pump is running, the impeller could continue to spin for approximately 30 minutes. The control circuit may not give any indication that the impeller is still running.

---



**WARNING**

If the parallel start control signal on the logic interface connector is set to start, the pump may automatically restart when the electrical supply is restored after an electrical supply failure. Ensure that people cannot be injured by the rotating blades of the pump.

If the electrical supply to the nEXT pump fails when the pump is rotating, the motor of the pump is used as a generator. The regenerated power is used to maintain the output signals on the logic interface (such as the normal signal and serial communications), to power the three indicator LEDs on the controller and to maintain power at the controller output (to control the vent valve, if fitted).

As the pump rotational speed decreases, the motor's ability to generate power also decreases until it is no longer able to maintain power to the logic interface or LEDs. This will occur at speeds below 50% full rotational speed. In this case, there will be no indication of pump rotational speed, yet the impeller may still be turning.

When the power is reinstated after a power failure, the behaviour of the pump will depend on the control mode at the time of failure (parallel or serial) and the length of time the pump was without power. Table 24 shows a number of scenarios.

**4.10 Bakeout**



**WARNING**

Do not touch the bakeout band or surrounding surfaces during the bakeout process as they will be hot.

**CAUTION**

Pumps with ISO flanges are not suitable for bakeout, only pumps with CF flanges must be used. When baking the pump to above 70 °C at the inlet flange, the pump must be water cooled to prevent damage to the bearing lubricant.

If the pump (and the vacuum system) are heated, the degassing process will speed up and the pump will reach ultimate vacuum in the shortest possible time. Heating the pump will also prevent condensation of vapours inside the pump.

The Edwards BX bakeout band may be used to heat the pump (refer to Section 7.4). Fit the appropriate band around the pump, just below the CF inlet flange. When baking the pump or the system, make sure that the temperature of the inlet flange does not exceed the values specified in Table 2.

When baking the vacuum system, if the temperature of the system exceeds 200 °C, put a radiation shield between the system and the pump. This radiation shield will reduce the heat radiated onto the pump rotor.

Typically, a bakeout of four hours is long enough to remove water condensation from the pump. However, the bakeout time will depend on the amount of condensation in the pump and the vacuum system, and the ultimate pressure desired.

Table 24 - Behaviour of a pump when the power is re-instated after an electrical supply failure

Length of power failure	Control mode	Behaviour of pump
Power is reinstated before pump rotational speed falls below 50%	Either parallel or serial control mode	Regenerative power maintains all output signals during the power failure. The pump will ramp to its designated speed as quickly as possible after the power has been restored.

Table 24 - Behaviour of a pump when the power is re-instated after an electrical supply failure (continued)

Length of power failure	Control mode	Behaviour of pump
Power is reinstated after pump rotational speed falls below 50% but before regenerative power ceases	Either parallel or serial control mode, timer disabled	Regenerative power maintains all output signals during the power failure. As the timer is disabled, the controller will go into fail condition as soon as speed falls below 50% and will display flashing error code 0. When the power is reinstated, the pump will not ramp up until the error is cleared. To clear the error, send a stop command (either parallel or serial, depending on the control mode), then send a start command to ramp the pump up to the designated speed.
	Either parallel or serial control mode, timer enabled	Regenerative power maintains all output signals during the power failure. If power is reinstated before the timer period expires, the pump will ramp up to its designated speed as quickly as possible. If the timer period expires, the controller will go into fail condition and will display flashing error code 3. As above, when the power is reinstated, the pump will not ramp up until the error is cleared. To clear the error, send a stop command (either parallel or serial, depending on the control mode), then send a start command to ramp the pump up to the designated speed
Power is reinstated after pump rotational speed falls below 50% and the regenerative power ceases	Either parallel or serial control mode	Regenerative power ceases and fails to maintain output signals. When power is reinstated, the pump with parallel control will automatically restart if the start control on the logic interface is set to start. The pump with serial control will require a new start command to ramp the pump up to the designated speed. Any fail signals that were triggered during the regenerative power period are lost when the power is reinstated.

## 5 Maintenance



### WARNING

When removing the pump, ensure personal protective equipment is used to safeguard against damage from failed components and possible accumulation of hazardous material that may have been pumped. Check that the pump is vented to atmosphere and at a safe temperature. Be wary of possible spillages, sharp edges and debris. Removal of the pump inlet screen will always expose the risk of injury from sharp edges.



### WARNING

Allow the pump rotor to stop, then disconnect the logic interface cable from the power supply and isolate any other power sources before removing the pump from the vacuum system for maintenance or fault finding procedures.

### 5.1 Introduction

Instructions for bearing maintenance and surface cleaning for the nEXT turbomolecular vacuum pump are described in the following sections. The inlet screens, inlet strainer and inlet flange seals are available as spares (refer to Section 7.3).

### 5.2 Bearing and oil cartridge maintenance

The oil cartridge and oil-lubricated bearing will need to be replaced when it reaches the end of its service life. This is typically more than 17,500 hours for the oil cartridge and 35,000 hours for the bearing.

When the oil cartridge and/or bearing need replacing, Edwards recommends either,

- Send the pump to an Edwards Service Centre for a bearing and/or oil cartridge replacement
- Purchase a oil cartridge or bearing service kit and replace the bearing and/or oil cartridge on-site (refer to Section 7.2)

### 5.3 Rotor life

The fatigue life of nEXT Turbomolecular pump rotors is typically 40,000 to 50,000 cycles. As a precautionary measure, Edwards recommends that pumps are returned for a major service (rotor replacement) after 20,000 cycles of acceleration to full speed and back to a stop, or after ten years of use, whichever occurs first.

### 5.4 Clean the external surfaces of the pump



### WARNING

Clean the external surfaces of the pump in a well-ventilated location. When using cleaning solutions and solvents to clean the pump, observe all precautions specified by the manufacturer. Avoid inhalation of any particulates that may be present in the pump.

**CAUTION**

Do not attempt to clean any parts of the pump other than external surfaces. Do not disassemble the pump or remove the controller from the pump. Use of solvents may damage internal pump components.

If the nEXT pump is contaminated inside, it may not be possible to achieve the specified ultimate vacuum or pump-down time may increase. The pump should be returned to an Edwards Service Centre where the pump will be dismantled and cleaned.

Any organic solvents can be used to clean the external surfaces of the pump. Edwards recommends using non-CFC solvents, such as isopropanol or ethanol. Use a cleaning solution that is suitable for the contaminants on the pump surfaces.

For environmental reasons, keep wastage of cleaning solutions and solvents to a minimum.

## 5.5 Fault finding

**CAUTION**

Do not remove the controller from the pump as the controller may be damaged.

Refer to [Table 25](#) for the possible causes of faults and the recommended actions to rectify faults.

Table 25 - Fault finding

Symptom	Check	Action
The controller LEDs do not flash for 0.5 seconds when system switched on	Has the electrical supply failed?	Ensure that the electrical supply is switched on and the fuses (and current limiting devices) have not been tripped.
	Is the pump impeller rotating?	LEDs may not flash if pump is rotating
The pump does not rotate after a parallel start command is supplied	Check that the electricity supply is on and whether the fail output is active	If there is a fail signal, check whether the red alarm LED is flashing. If it is, refer to <a href="#">Section 5.5.1</a> . If power is supplied, there is no fail signal and the rotor still does not rotate then there is a fault with the pump.
The pump does not rotate after a serial start command is sent	Check whether the pump returns a reply to the start command	If there is no reply then perform the checks given under 'no serial comms' otherwise perform the checks under 'the pump does not rotate after a parallel start command is supplied'
The pump does not respond in multi-drop mode	Check that the multi-drop is enabled	Make sure the pump has a multi-drop address and that commands are sent using the multi-drop protocol.

Table 25 - Fault finding (continued)

Symptom	Check	Action
The green Normal LED does not light or the pump is not rotating at full speed or the pump fails whilst running	Is the inlet pressure too high?	If so reduce the pumping load or check for a gross leak into the system.
	Is the pump running too hot?	Increase the cooling to the pump. Change from air cooling to water cooling (refer to <a href="#">Section 2</a> for maximum inlet pressure and cooling requirements). Increase cooling water flow or decrease the water temperature or do both. Check that external heat sources (such as system bakeout heaters) are not excessive.
	Does the rotor rotate freely?	If not, the pump bearings may be damaged. Contact the supplier or Edwards.
Ultimate pressure cannot be reached	Is the pressure limited by water vapour?	Bake the system and pump.
	Are any of the vacuum gauges contaminated?	If so clean or replace them.
	Is the pumping speed insufficient (due to poor conductance between the pump and the gauge or too large a chamber)?	Increase the conductance or reduce the volume.
	Is the interstage inlet pressure > 0.5 mbar (50 Pa)	If the interstage inlet pressure is too high, inlet pressure at the turbomolecular inlet is increased; ensure that the interstage inlet pressure is < 0.5 mbar (50 Pa).
	Is the backing pressure > 10 mbar ( $1 \times 10^3$ Pa)	If so, the backing pressure may be too high. Check for backing pipeline leaks. If the throughput is high, a larger backing pump may be required.
	Is the high vacuum area of the system contaminated?	If so, clean the high vacuum system.
	Check the rest of the system for leaks and contamination.	If found, repair the leaks and clean the contamination.
	Remove the pump from the system and test the ultimate pressure of the pump alone (refer to <a href="#">Section 2</a> )	If inlet pressure is poor, check the pump for contamination and refer to <a href="#">Section 5</a> . Leak test the pump. If the leak rate > $1 \times 10^{-7}$ mbar l s <sup>-1</sup> ( $1 \times 10^{-5}$ Pa l s <sup>-1</sup> ) contact the supplier or Edwards.
The pump is very noisy or there is excessive vibration or both.	Is the pump rotational speed the same as the resonant frequency of the attached system.	If so, change the natural frequency of the system or isolate the pump using flexible bellows.
	Is the vibration being transmitted from the rotary backing pump?	If so, fit flexible bellows or a vibration isolator in the backing line.
	Is the noise irregular and getting progressively worse?	If so, a bearing is defective. Contact the supplier or Edwards.

Table 25 - Fault finding (continued)

Symptom	Check	Action
	Is the pump making a constant high pitched noise?	If so, the rotor is out of balance. Contact the supplier or Edwards.
No serial comms	Check that the electrical supply is on, that the serial link is connected and that the serial enable line is active	
	Check slide switch is in the correct position for RS232 or RS485 communication.	Left for RS485 Right for RS232 Right for parallel control and monitoring
	Check baud rate and, if operating in multi-drop mode, the node address matches those of the pump.	
	Check that the red light is not on or flashing	If LED is on, perform the checks against the red alarm LED symptoms
Fail signal or standby signal not working	Check the serial enable line is inactive	Must be disconnected or driven high for use of standby and fail lines
	Check slide switch is in the correct position for the RS232 or RS485 communication.	Left for RS485 Right for RS232 Right for parallel control and monitoring
Yellow service LED is flashing a repeated sequence		See flashing service codes in <a href="#">Section 5.5.1</a>
The red alarm LED is on	Normal during the software upgrade process. At other times indicates a problem has been detected in the FLASH memory	If during software upgrade then complete the upgrade process. Otherwise cycle power and if this does not help then perform a software upgrade.
The red alarm LED is flashing	Note the position of the long flashes within the series of 6 flashes to work out the error code.	Look up the flashing error code in <a href="#">Section 5.5.8</a> and follow the advice given.
Any other problems	Contact the supplier or Edwards	Contact the supplier or Edwards.

### 5.5.1 Flashing service codes

Whenever a service is required the standard once per revolution flash on the yellow status LED is replaced with a service flash code. The service flash codes are specified in [Table 26](#).

Table 26 - Flashing service codes

Service flash code	Comments	Actions
LED on 1sec LED off 1sec	Oil cartridge service recommended	It is recommended that the oil cartridge is replaced. Refer to <a href="#">Section 7.2</a> .
LED on 3sec LED off 1sec	Bearing and oil cartridge service recommended	It is recommended that the bearing and oil cartridge are replaced. Refer to <a href="#">Section 7.2</a> .
LED on 3sec LED off 3sec	Pump service required	The turbo impeller or controller has reached its expected life. It is recommended that the pump is returned to an Edwards service centre for service. Refer to <a href="#">Section 7.2</a> .

### 5.5.2 Decoding service status words

The service status may be accessed directly via the serial link. This method of accessing service status will give the most complete picture of current and future service requirements and will allow preventative maintenance activities to be scheduled.

A summary of the current pending service status is provided in response to the service status command:

<i>Command</i>	?	V	8	8	1	cr
----------------	---	---	---	---	---	----

The reply will be as follows:

<i>Reply</i>	=	V	8	8	1	sp	h	h	h	h	h	h	h	h	h	h	cr
--------------	---	---	---	---	---	----	---	---	---	---	---	---	---	---	---	---	----

The service status word is made up of 8 hexadecimal digits. To decode this word, convert each digit into a 4-digit binary number as described in [Section 5.5.9](#).

Each binary digit (bit) represents a flag that is either active (state 1) or not active (state 0). To help decode the service status word, each bit is numbered (starting with 0 for the least significant to 31 for the most significant) as shown in [Section 5.5.3](#). The meaning of each bit in the service status word is given in [Table 27](#).

Table 27 - Service flags

Bit number	Status flag	Active flag means
0	Oil cartridge service due	Set when hours until oil cartridge service due = 0
1	Bearing service due	Set when hours until bearing service due = 0
2	Pump service due	Set when hours until pump service due = 0 or cycles until pump service due = 0
3	Controller service due	Set when hours until controller service due = 0
4	Reserved	-
5	Reserved	-
6	Reserved	-



Table 27 - Service flags (continued)

Bit number	Status flag	Active flag means
7	Service due	Service is due. Specific operation required should be determined by checking the bits above
8 - 31	Reserved	-

### 5.5.3 Controller run time

The run hours and recommended service time of the controller on the nEXT pump can be monitored by sending the following query:

<i>Command</i>	?	V	8	8	1	cr
----------------	---	---	---	---	---	----

The reply will be as follows, where the first number is the hours run by the controller and the second is the number of hours until service is recommended:

<i>Reply</i>	=	V	8	8	2	sp	d	d	d	d	d	d	;	d	d	d	d	d	d	cr
--------------	---	---	---	---	---	----	---	---	---	---	---	---	---	---	---	---	---	---	---	----

Note that the number of hours until the next service is due is estimated by the controller based on the operating conditions of the pump and therefore may reduce at more or less that 1 hour per hour. The dominant factor in extending controller life is reduced pump temperature.

### 5.5.4 Pump run time

The run hours and recommended service time of the impeller in the nEXT pump can be monitored by sending the following query:

<i>Command</i>	?	V	8	8	3	cr
----------------	---	---	---	---	---	----

The reply will be as follows, where the first number is the hours run by the impeller and the second is the number of hours until service is recommended:

<i>Reply</i>	=	V	8	8	3	sp	d	d	d	d	d	d	;	d	d	d	d	d	d	cr
--------------	---	---	---	---	---	----	---	---	---	---	---	---	---	---	---	---	---	---	---	----

### 5.5.5 Pump cycles

The number of start-stop cycles completed and the number remaining until the next service is due can be monitored by sending the following query:

<i>Command</i>	?	V	8	8	4	cr
----------------	---	---	---	---	---	----

The reply will be as follows, where the first number is the start-stop cycles completed by the pump and the second is the number of start-stop cycles until service is recommended:

<i>Reply</i>	=	V	8	8	4	sp	d	d	d	d	d	d	;	d	d	d	d	d	d	cr
--------------	---	---	---	---	---	----	---	---	---	---	---	---	---	---	---	---	---	---	---	----

### 5.5.6 Bearing run time

The run hours and recommended service time of the bearing in the nEXT pump can be monitored by sending the following query:

Command	?	V	8	8	5	cr
---------	---	---	---	---	---	----

The reply will be as follows, where the first number is the hours run by the bearing and the second is the number of hours until service is recommended:

Reply	=	V	8	8	5	sp	d	d	d	d	d	d	;	d	d	d	d	d	d	cr
-------	---	---	---	---	---	----	---	---	---	---	---	---	---	---	---	---	---	---	---	----

### 5.5.7 Oil cartridge run time

The run hours and recommended service time of the oil cartridge in the nEXT pump can be monitored by sending the following query:

Command	?	V	8	8	6	cr
---------	---	---	---	---	---	----

The reply will be as follows, where the first number is the hours run by the oil cartridge and the second is the number of hours until service is recommended:

Reply	=	V	8	8	6	sp	d	d	d	d	d	d	;	d	d	d	d	d	d	cr
-------	---	---	---	---	---	----	---	---	---	---	---	---	---	---	---	---	---	---	---	----

### 5.5.8 Flashing error codes

Whenever a fail condition becomes active, the red alarm lights continuously or shows a flashing sequence. If the error light is on continuously, this indicates a problem with the embedded software. In this case, try cycling the power. If cycling the power does not clear the indication, a software download will be required. Contact the supplier or Edwards. If the alarm LED is flashing, identify the error flash code and consult [Table 28](#).

There is a sufficient off period between each subsequent cycle repetition to clearly mark the start of a new flash sequence. The duration of a long flash (L) is equal to 3 times the duration of a short flash (0.5 s).

Table 28 - Flashing error codes

Error flash position	Error flash code	Comments	Actions
0	ssssss	The speed fell below 50% of full rotational speed with the Timer disabled.	Check whether the pump is too hot or whether the inlet pressure is too high.
1	Lsssss	Controller internal software mismatch.	Cycle the power to the pump and see whether the error code appears again. If it does, contact the supplier or Edwards.
2	sLssss	Controller failed internal configuration and calibration operation.	Cycle the power to the pump and see whether the error code appears again. If it does, contact the supplier or Edwards.
3	ssLsss	Failure to reach or maintain half full speed within the timer setting value.	Check whether the pump is too hot or whether the inlet pressure is too high.
4	sssLss	Overspeed or overcurrent trip activated, or other hardware fault.	Cycle the power to the pump and see whether the error code appears again. If it does, contact the supplier or Edwards.

Table 28 - Flashing error codes

Error flash position	Error flash code	Comments	Actions
5	ssssLs	Pump internal measurement system disconnected or damaged.	Cycle the power to the pump and see whether the error code appears again. If it does, contact the supplier or Edwards.
6	sssssL	Serial enable becomes inactive following a serial start command.	Re-activate serial enable and send a serial stop command to clear the error code.

*Note:* The alarm LED error flash sequence is capable of signalling multiple fail conditions. For example, error flash code sLssLs signifies both error 2 (controller failed internal configuration and calibration operation) and error 5 (pump internal measurement system disconnected or damaged).

### 5.5.9 Decoding system status words

If using the serial communications link, additional information, that may be useful for fault finding, can be accessed. When sending a query to monitor measured motor speed, the pump also returns a system status word.

The send command is as follows:

Command	?	V	8	5	2	cr
---------	---	---	---	---	---	----

The reply will be as follows, where the first returned number refers to motor rotational speed in revolutions per second (Hz):

Reply	=	V	8	5	2	sp	d	d	d	d	;	h	h	h	h	h	h	h	cr
-------	---	---	---	---	---	----	---	---	---	---	---	---	---	---	---	---	---	---	----

The system status word returned is made up of 8 hexadecimal digits. To decode this word, convert each digit into a 4-digit binary number. (Table 29 is provided as an aid.) Follow the example below:

2	2	8	3	0	0	2	2
↓	↓	↓	↓	↓	↓	↓	↓
0 0 1 0	0 0 1 0	1 0 0 0	0 0 1 1	0 0 0 0	0 0 0 0	0 0 1 0	0 0 1 0

Table 29 - Hexadecimal conversion table

Hexadecimal	Binary	Decimal
0	0000	0
1	0001	1
2	0010	2
3	0011	3
4	0100	4
5	0101	5
6	0110	6
7	0111	7
8	1000	8
9	1001	9
A	1010	10
B	1011	11
C	1100	12

Table 29 - Hexadecimal conversion table (continued)

Hexadecimal	Binary	Decimal
D	1101	13
E	1110	14
F	1111	15

Each binary digit (bit) represents a flag that is either active (state 1) or not active (state 0). To help decode the system status word, each bit is numbered (starting with 0 for the least significant to 31 for the most significant) as shown below.

Table 30 contains a list of the lower 16 status flags that will be useful for fault finding. The upper 16 status flags are reserved by Edwards.

Binary digits

0	0	1	0	0	0	1	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0
↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
3	3	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
1	0	9	8	7	6	5	4	3	2	1	0	9	8	7	6	5	4	3	2	1	0	9	8	7	6	5	4	3	2	1	0

Bit numbers

Table 30 - Status flag

Bit number	Status flag	Active flags means
0	Fail	Fail status condition active
1	Stopped speed	Below stopped speed
2	Normal speed	Above normal speed
3	Vent valve closed	Vent valve energised
4	Start	Start command active
5	Serial enable	Serial enable active
6	Standby	Standby active
7	Half full speed	Above 50% full rotational speed
8	Parallel control mode	Exclusive control mode selection
9	Serial control mode	Exclusive control mode selection
10	Invalid Controller software	Controller internal software mismatch
11	Controller upload incomplete	Controller failed internal configuration and calibration operation
12	Timer expired	Failure to reach or maintain half full speed within the timer setting value
13	Hardware trip	Overspeed or Overcurrent trip activated
14	Thermistor error	Pump internal temperature measurement system disconnected or damaged
15	Serial control mode interlock	Serial enable has become inactive following a serial Start command.

The system status word used in the example above was obtained with the pump at rest. By decoding the word, we can learn more about the state of the pump. Refer to Table 31.

Table 31 - Example decoding of system status words

Bit number	Status of bit (in example)	We can deduce
0	0	The pump has not failed
1	1	The pump is at rest
2	0	Speed is below normal speed
3	0	The vent valve is open
4	0	There is no active start command
5	1	Serial enable is active
6	0	Standby is not active
7	0	Speed is below 50% of full rotational speed
8	0	The pump is not in parallel control mode
9	0	The pump is not serial control mode
10	0	There is no controller internal software mismatch
11	0	Controller passed internal configuration and calibration operation
12	0	The timer has not timed out
13	0	Overspeed and overcurrent trip not activated
14	0	Pump internal temperature measurement system is fine
15	0	Serial enable has not become inactive during serial control

5.5.10 Useful service information

If using the serial communications link, additional information about the pump, such as pump type and internal controller software versions, can be accessed. This information is particularly useful for service personnel to determine the model of the pump.

Send the following query to find out pump type:

```
Command ? S 8 5 1 cr
```

The reply will be as follows, where string 1 is the pump type, string 2 is the DSP software version number and string 3 is the designated full speed of the pump (in revolutions per second):

```
Reply = S 8 5 1 sp String 1 ; String 2 ; String 3 cr
```

Send the following query to find out the boot loader software version:

```
Command ? S 8 6 8 cr
```

The reply will be as follows, where string1 is the boot loader software version number:

```
Reply = S 8 6 8 sp String 1 cr
```

## 6 Storage and disposal

### CAUTION

Use of non-Edwards spares may result in reduced reliability and performance and will invalidate your warranty.

### 6.1 Storage

Use the following procedure to store the pump.

1. Place protective covers over the inlet, outlet, interstage (for the 'i' nEXT only), purge, booster (for the 'T' nEXT only) and vent ports.
2. Place the pump in its packing materials. For fastest pump-down when the pump is put back into service, seal the pump inside a plastic bag together with a suitable desiccant.
3. Store the pump in cool, dry conditions until required for use. Refer to [Table 14](#) for recommended storage environment. When required, prepare and install the pump as described in [Section 3](#).
4. Keep the pump upright at all times to prevent the drainage of oil from the bearing reservoir.
5. Avoid long-term storage if possible. When long-term storage is necessary, the pump should be set up and run for at least eight hours every six months.

### 6.2 Disposal

#### WARNING



In the unlikely event of a failure of the pump rotor, use appropriate personal protective equipment when handling and disposing of the pump and ensure that all pump inlets and outlets are capped off before disposal.

Dispose of the nEXT pump and any components and accessories safely in accordance with all local and national safety and environmental requirements.

Particular care must be taken with any components that have been contaminated with dangerous process substances.

Take appropriate action to avoid inhalation of any particles that may be present in the pump.

Do not incinerate the pump. The pump contains phenolic and fluorosilicone materials that can decompose to very dangerous substances when heated to high temperatures.

## 7 Service, spares and accessories

### 7.1 Introduction

Edwards products, spares and accessories are available from Edwards companies in Belgium, Brazil, China, France, Germany, Israel, Italy, Japan, Korea, Singapore, United Kingdom, USA, and a world-wide network of distributors.

Order spare parts and accessories from the nearest Edwards company or distributor. When ordering, please state for each part required:

- Model and Item Number of your equipment
- Serial number (if any)
- Item Number and description of the part

### 7.2 Service

Edwards products are supported by a worldwide network of 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 that has been serviced, repaired or rebuilt is returned with a full warranty.

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

For more information about service options, contact the nearest Edwards Service Centre or other Edwards company.

#### 7.2.1 Returning a pump for service

If returning a pump to a Service Centre, use the returns procedure included at the end of this manual. The instruction in the returns procedure to drain all fluids does not apply to the lubricant in the pump oil reservoirs. Do not return your pump with the accessories fitted. Remove all accessories and retain them for future use.

Ensure that a completed HS2 form is returned with the pump.

If the pump is configured to suit the application, make a record of the configuration before returning the pump. All replacement pumps will be supplied with default factory settings. The TIC/nEXT PC monitor program (available as an accessory) allows for automatic downloading and saving the configuration.

#### 7.2.2 Bearing and oil cartridge on-site maintenance

The oil cartridge and bearing of the nEXT pump can be serviced on-site by any service engineer trained by Edwards.

The following service tool kits and service parts are available,

Table 32 - Service tool kits

Service tool kit	Item number
Oil cartridge tool kit	B800-00-812
Bearing tool kit	B800-00-805

Table 33 - Service kits

Service kit	Item number
Oil cartridge	B800-00-811
Bearing and oil cartridge	B800-00-810

*Note: Both the oil cartridge and bearing tool kits are required when changing a pump bearing.*

## 7.3 Spares

### 7.3.1 ISX inlet screen

An inlet screen is fitted to the CF pump as supplied to prevent damage from the entry of debris into the pump. The Item Numbers of replacement inlet screens are given below. Select the inlet screen according to the pump inlet flange size. The inlet screen on a pump cannot be replaced with an NW inlet flange.

Table 34 - Inlet screens

Flange Size	Inlet Screen	Item Number
DN100CF	Coarse inlet screen	B800-00-821
DN100CF	Fine inlet screen	B800-00-822
DN160CF	Coarse inlet screen	B800-00-823
DN160CF	Fine inlet screen	B800-00-824

### 7.3.2 Inlet strainer

The interstage pumps are supplied with an inlet strainer for the interstage port. The Item Number for a replacement inlet strainer is given below.

Table 35 - Inlet strainers

Flange Size	Inlet Screen
DN25ISO-K	B706-10-817

### 7.3.3 Inlet-flange seals and integrated inlet screens

nEXT pumps are supplied with an inlet seal. The Item Numbers of replacement seals are given in Table 36.

Table 36 - Inlet flange seals and integrated inlet screens

Flange size	Inlet flange seal	Item number
DN100ISO-K	ISO100 trapped O-ring with integrated coarse inlet screen	B810-00-808
DN100ISO-K	ISO100 trapped O-ring with integrated fine inlet screen	B810-00-809
DN160ISO-K	ISO160 trapped O-ring with integrated coarse inlet screen	B800-00-825
DN160ISO-K	ISO160 trapped O-ring with integrated fine inlet screen	B800-00-826
DN100ISO-K	ISO100 trapped O-ring	C105-23-001
DN160ISO-K	ISO160 trapped O-ring	C105-24-001
DN100CF	100CF copper compression gasket (pack of 5)	C082-00-003
DN160CF	160CF copper compression gasket (pack of 5)	C083-00-003



### 7.3.4 NW16 and NW25 Ports

nEXT pumps are supplied with NW25 exhaust and booster ports. The item numbers of replacement ports are given below.

Table 37 - NW16 and NW25 ports

Port	Item Number
NW25	B800-00-809
NW16	B800-00-806

## 7.4 Accessories

### 7.4.1 Installation

The accessories available for use with the nEXT pumps are described in the following section. [Figure 20](#) and [21](#) shows how the accessories are fitted to the pump.

### 7.4.2 ACX air cooler

An ACX air cooler can be fitted to the nEXT pump, refer to [Section 3.10](#) to check the suitability of air cooling in a particular application.

Table 38 - ACX air cooler

Air Cooler	Current draw	Item number
ACX nEXT radial fan	135 mA	B580-53-175
ACX nEXT axial fan	135 mA	B580-53-185
ACX nEXT radial fan (with Phoenix connector)	135 mA	B580-53-170
ACX nEXT axial fan (with Phoenix connector)	135 mA	B580-53-180

### 7.4.3 WCX water cooler

A water cooler can be fitted to the nEXT pump refer to [Section 2.5](#) to check the suitability of the cooling water supply.

Table 39 - WCX water cooler

Water Cooler	Item Number
WCX nEXT water cooling kit	B800-00-815

#### 7.4.4 BX bakeout band

A BX bakeout band accelerates the degassing of the pump to enable it to achieve lower pressures. It may also be used to protect the pump from condensation of contaminants. The bakeout bands are available in 110 - 120 V or 220-240 V versions.

*Note: The bakeout band is only for use with CF variants*

Table 40 - BX bakeout band

Bakeout Band	Item Number	For use with
BX250 (110 V)	B580-52-041	nEXT240
BX250 (240 V)	B580-52-061	nEXT240
BX300 (110 V)	B800-00-814	nEXT300
BX300 (240 V)	B800-00-816	nEXT300
BX450 (110 V)	B580-52-043	nEXT400
BX450 (240 V)	B580-52-063	nEXT400

#### 7.4.5 TAV vent valve and vent port adaptor

Two solenoid-operated vent valves are available for system venting. The valves are 24 V d.c., normally-open and can be driven by the controller. The solenoid valve is fitted in place of the manual valve, or alternatively can be fitted with an adaptor (supplied with the valve) and can be used with any suitable NW10 flanged port on the vacuum system.

TAV5 is suitable for smaller vacuum systems. TAV6 has a higher conductance and is suitable for larger vacuum systems (typically with volume greater than 10 litres).

Table 41 - TAV vent valve and vent port adaptor

Product	Orifice Diameter	Item Number
TAV5 vent valve	0.5 mm	B580-66-010
TAV6 vent valve	1.0 mm	B580-66-020

#### 7.4.6 VRX vent restrictor

Use a VRX fixed orifice vent restrictor to restrict flow of vent gas into the pump. A VRX vent restrictor can be fitted to the inlet of a TAV5 or TAV6 vent valve or to a PRX10 purge restrictor. Refer to [Table 20](#) for information on the selection of the correct VRX vent restrictor and to [Table 42](#) for the item numbers of the vent restrictors available.

Table 42 - Vent restrictors

Vent restrictor	Orifice diameter (mm)	Item number
VRX10	0.1	B580-66-021
VRX20	0.2	B580-66-022
VRX30	0.3	B580-66-023
VRX50	0.5	B580-66-024
VRX70	0.7	B580-66-025

### 7.4.7 Vent port adaptor

The vent port adaptor has a 1/8 inch BSP male thread that can be screwed into both the vent port and purge port, making them suitable for NW10 fittings.

Table 43 - Vent port adaptor

Vent port adaptor	Item Number
Vent port adaptor NW10 -1/8 inch BSP male	B580-66-011

### 7.4.8 PRX purge restrictor

The PRX10 is a modified DN10NW centring ring that filters the purge gas and restricts its flow rate to the recommended flow of 25 sccm. A vent port adaptor must be fitted to the purge port in order to connect a purge restrictor to the pump.

Table 44 - PRX purge restrictor

Item	Item Number
PRX10 purge restrictor	B580-65-001

### 7.4.9 C-Clamp Adaptor Kit

The NW25 exhaust and booster port of the nEXT pump can be removed and replaced with a C-clamp connection.

The following tool kit and parts are available

Table 45 - C-clamp adaptor tool kit

Tool kit	Item Number
Port removal and insertion tool	B800-00-807

Table 46 - C-clamp adaptor port kit

Port kit	Item Number
C-Clamp and NW25 flange adaptor	B800-00-813

### 7.4.10 Interface Cable

An interface cable connects the nEXT pump to a PC. Serial commands are then used to control and monitor the nEXT pump.

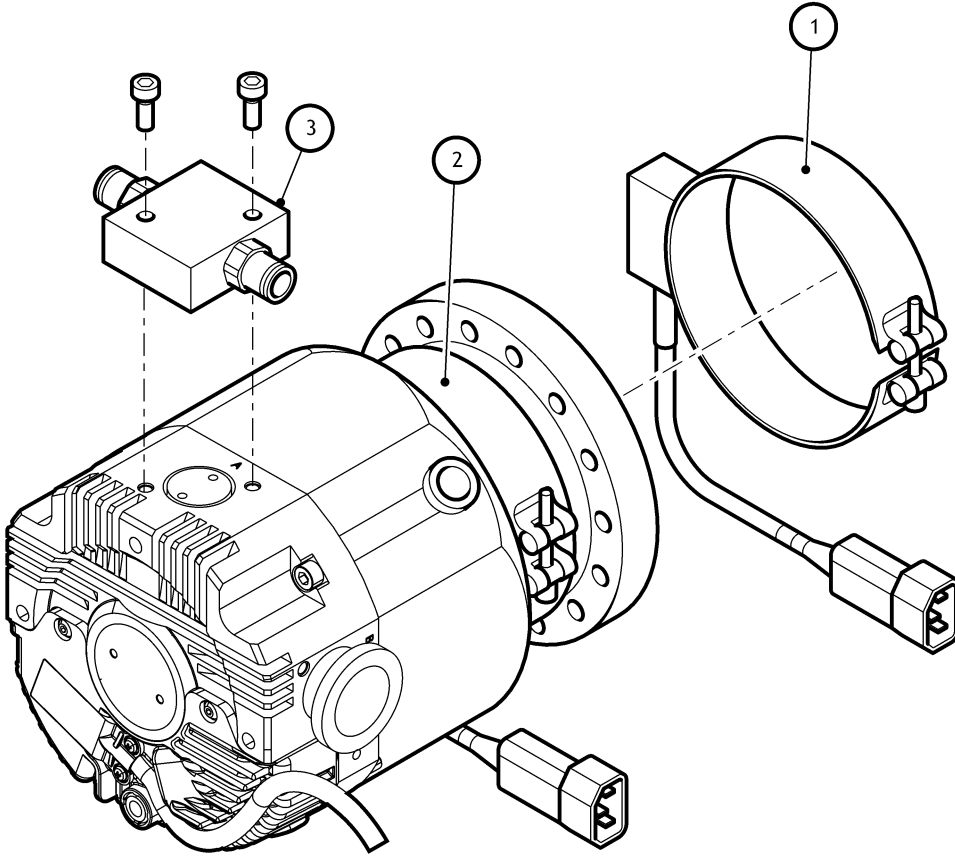
Table 47 - Interface cable

Item	Item Number
nEXT Interface Cable	B800-00-808

### 7.4.11 TIC PC Program

The TIC PC program is a piece of PC-based software that can be used for retrieving and setting the user configurable parameters in the pump. It also enables monitoring and data logging of the pumping system.

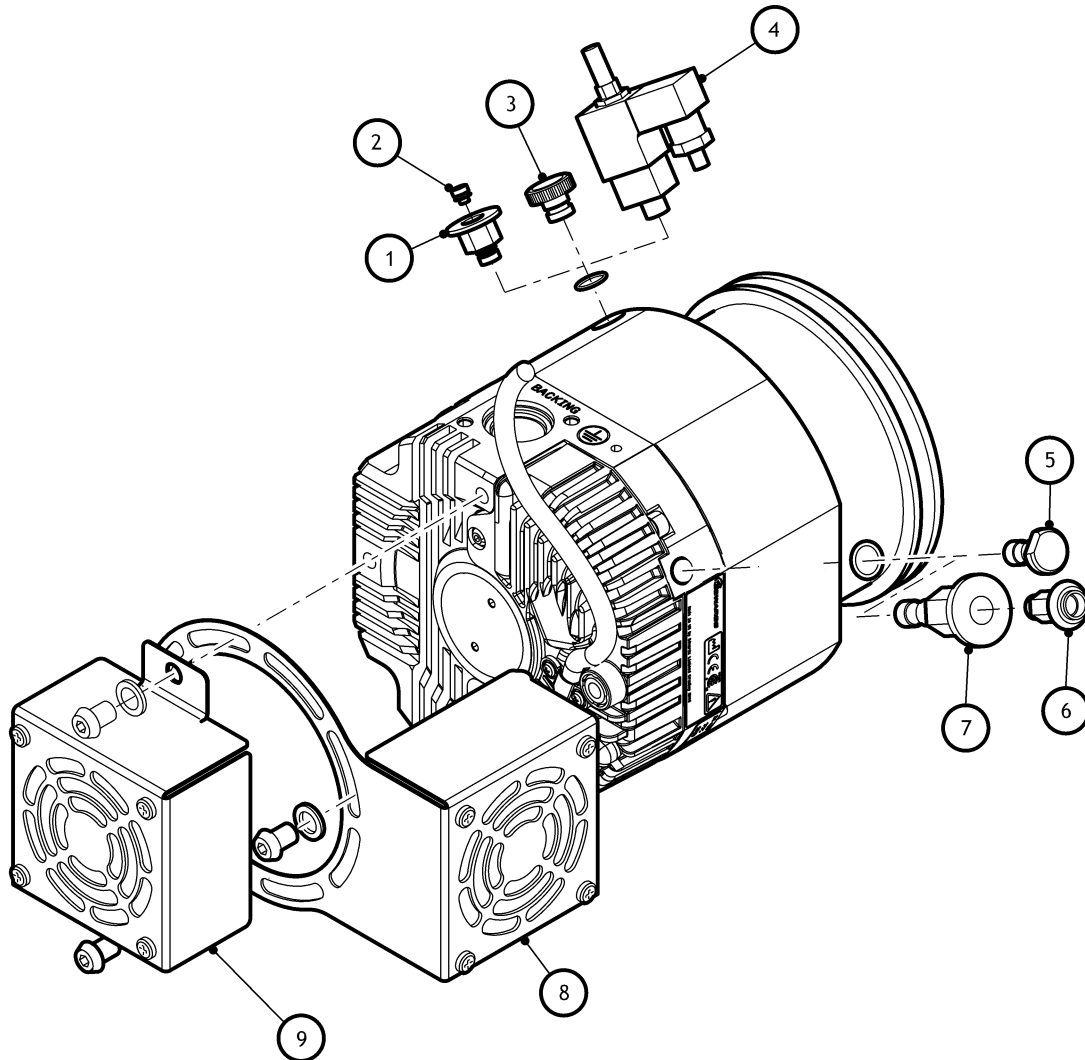
Figure 20 - nEXT exploded accessories view



- 1. BX 250 bake out band (DN100CF envelope shown)
- 2. BX 250 bake out band position
- 3. WCX water cooling accessory

dcx/8831/020

Figure 21 - nEXT exploded accessories view



1. DN10NW adaptor
2. VRX vent restrictor
3. Manual vent valve (fitted)
4. TAV solenoid vent valve
5. Purge plug (fitted)

6. PRX purge restrictor
7. DN10NW adaptor
8. ACX nEXT air cooler (radial)
9. ACX nEXT air cooler (axial)

dcs/8831/019