Instruction Manual

iTIM

Description	Item Number
iTIM E73/A1/T1	D374-20-000
iTIM E73/A1/T1 + Serial	D374-21-000
iTIM MCM/L1	D374-22-000
iTIM MCM/L1 + Serial	D374-23-000

Contents

Section Page

APT 11/07

Contents

Illustrations

Figure Page

Tables

1 Introduction

1.1 Scope and definitions

This manual provides installation, operation and maintenance instructions for the Edwards iTIM. You must use the iTIM as specified in this manual.

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

WARNING

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

CAUTION

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

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

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

The following IEC warning labels appear on the iTIM:

Warning - refer to accompanying documentation.

1.2 General Description

WARNING

Edwards take no responsibility for damage or injury caused by improper use of the equipment.

Four types of iTIM are available (refer to Figures 1 and 2):

- There are two variants of the iTIM both of which allow you to control the operation and monitor the status of the dry pumping system through a parallel interface (for example, connected to your process tool).
- The serial option of the iTIM contains a serial interface card, which allows the user to control the operation and to monitor the status of the dry pumping system through a serial interface. The serial interface card uses RS232 serial communications to communicate with your control equipment (refer to Section 5).For example, it is possible to connect the iTIM to the serial port of a PC (Personal Computer) on which a suitable SCADA (Supervisory Control And Data Acquisition program) has been installed.

Note: *All information sent to or received from the iTIM, except from the emergency stop connections, (Whether serial or parallel data) is software derived.*

1.3 System Connector

Refer to Figure 1. The iTIM is connected to the dry pumping system through the 15-way 'D-Type' system connector (10) on the rear of the iTIM.

CAUTION

Damage to the iTIM may result if connection is made to any other connector on the dry pumping system.

1.4 The Tool Interface Connectors

The Tool Interface Connectors allow you to control the operation and to monitor the status of the dry pumping system.

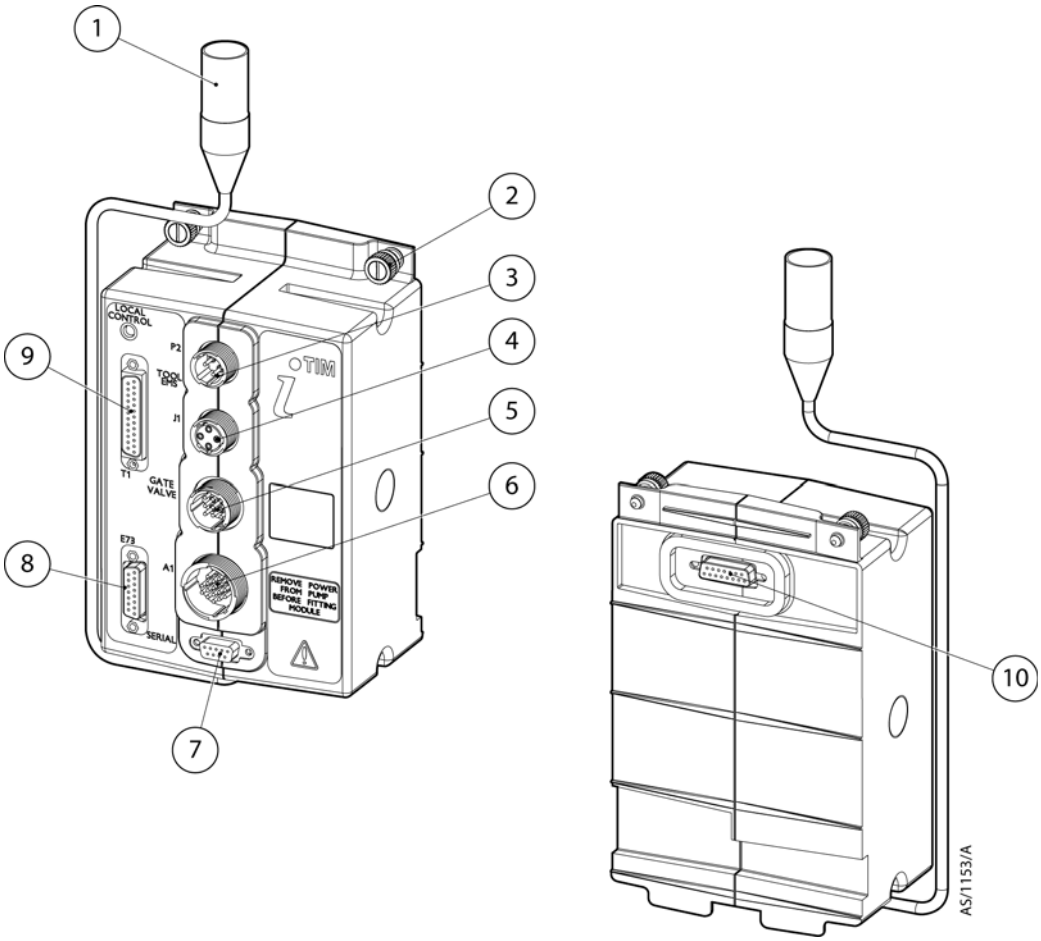
Refer to Section 2.3 for details of the connections and 4 for details of how to use the Tool Interface Connectors.

1.5 Serial Interface Connectors

The Serial Interface Connectors allow you to control the operation and to monitor the status of the dry pumping system.

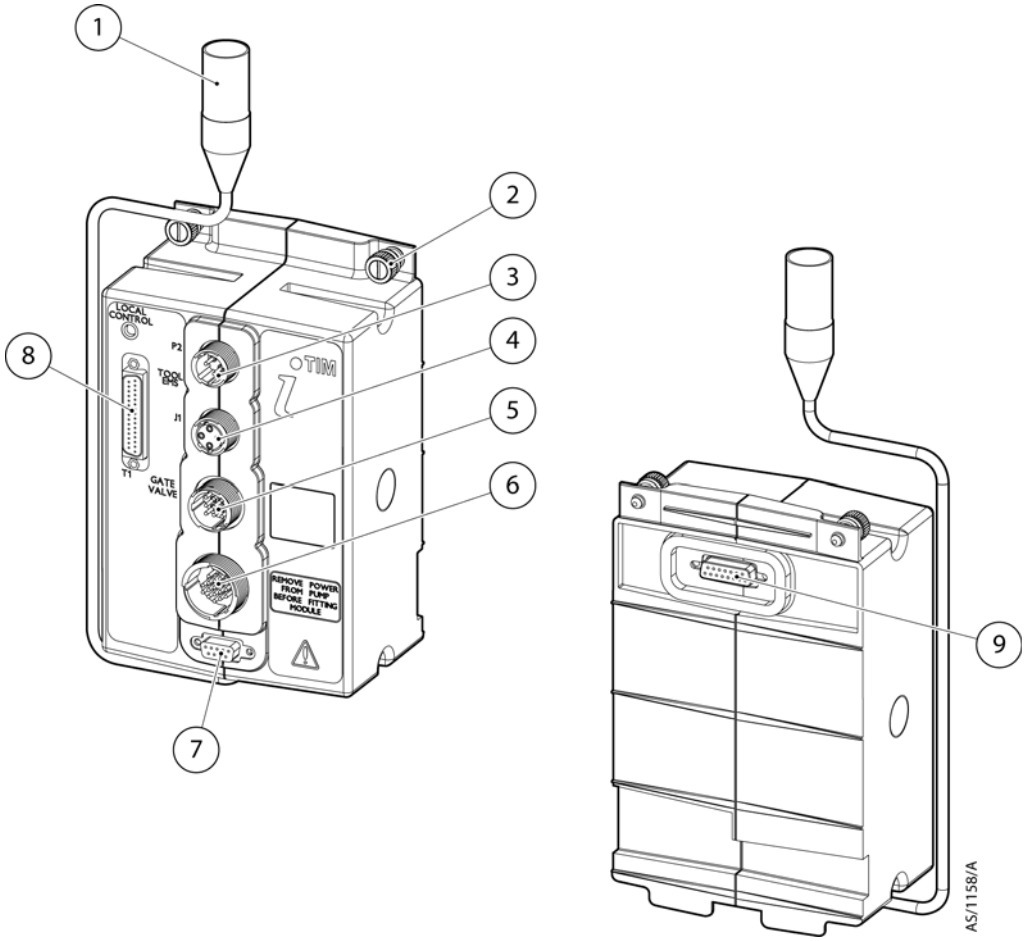
Refer to Section 3.5 for details of the connections and 5 for details of how to use the Serial Interface Connectors.

Figure 1 - Components of the iTIM



1. 6-way XLR connector
2. Module fixing screw
3. Tool EMS connector P2
4. Tool EMS connector J1
5. Gate valve connector
6. Parallel connector A1
7. Serial connector (optional)
8. Parallel connector E73
9. Parallel connector T1
10. System connector

Figure 2 - Components of the iTIM (without E73 connector)



1. 6-way XLR connector
2. Module fixing screw
3. Tool EMS connector L2
4. Tool EMS connector MCM2
5. Gate valve connector
6. Parallel connector MCM
7. Serial connector (optional)
8. Parallel connector L1
9. Systm connector

2 Technical Data

2.1 General

Dimensions	Refer to Figure 3
Maximum mass	2kg
Operating temperature range	0 to 55^{o}C
Storage temperature range	-20 to 65^{o}C
Operating humidity range	25 to 95% RH at 40^{o}C
Maximum storage humidity	90% RH at 65^{o}C for 12 hours
Maximum operating altitude	2000m

2.2 Electrical Data

2.2.1 Parallel Interface Connectors

Inputs:	Type 1	a.c./d.c. input signal
	Number	2
	High input voltage threshold	> 20V
	Low input voltage threshold	< 5V
	Type 2	Volt-free (dry) contacts
	Number	10
	External contact rating	24V
Outputs:	Type	Contacts are normally open
	Number	upto 8
	Rating	1A, 24V

2.2.2 Serial Interface Connectors

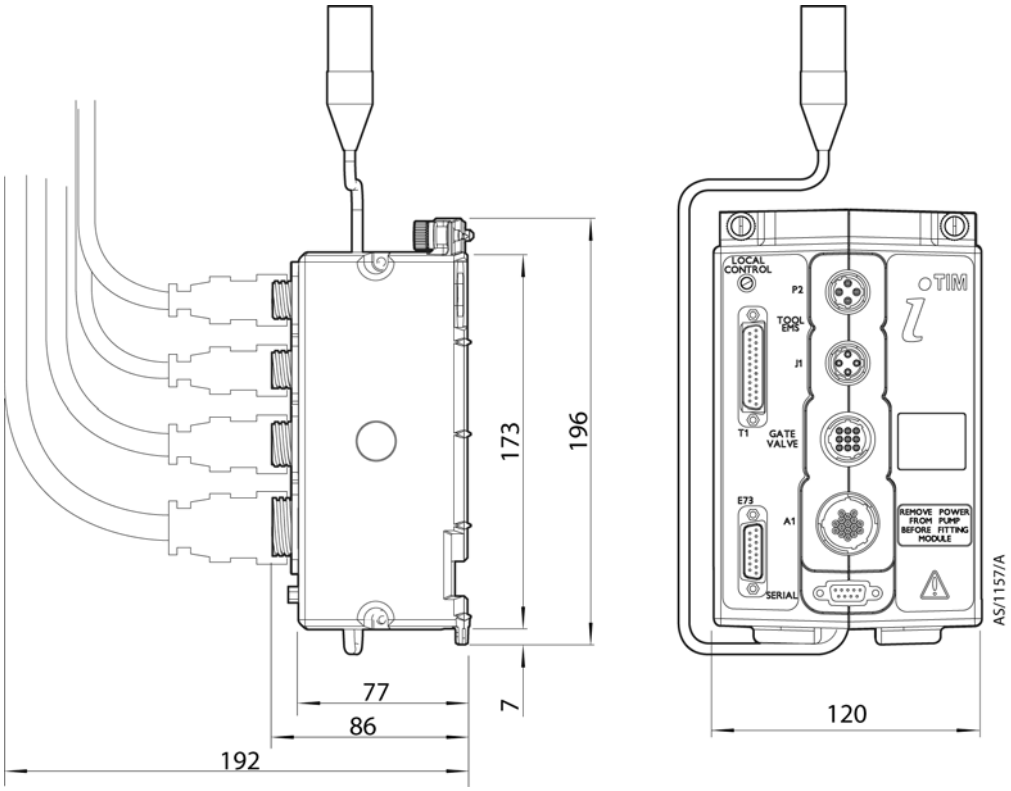
Note: *The signal and earth (ground) connections are isolated from the chassis of the iTIM, with a 500V maximum isolation rating.*

Inputs:	Type	RS232 'RX data'
	Number	1
	Rating	Compliant with EIA RS232
Outputs:	Type	RS232 'TX data'
	Number	1
	Rating	Compliant with EIA RS232
Communications		
	Protocol	EIA RS232
	Baud rate	9600 baud
	Data bits	8
	Stop bits	1
	Parity setting	No parity

2.3 Electrical Connectors

System Connector	15-way ‘D-Type’ socket
A1/MCM	16-way CPC plug
T1	25-way ‘D-type’ plug
E73	15-way ‘D-type’ socket
L1	25-way ‘D-type’ socket
J1/MCM2	4-way CPC plug
P2/L2	4-way CPC socket
Gate Valve	9-way CPC plug
Serial	9-way ‘D-type’ socket

Figure 3 - Dimensions (mm)



3 Installation

3.1 Unpack and Inspect

Remove all of the packaging materials and check the iTIM. If the iTIM is damaged, notify your supplier and the carrier in writing within three days, stating the item number of the iTIM together with your order number and your suppliers invoice number. Do not use the iTIM if it is damaged.

Check that you have received the items listed in Table 1. If any item is missing, notify your supplier in writing within three days. If you will not use the iTIM immediately, replace any packing materials and store it in suitable conditions, as described in Section 7 of this instruction manual.

Table 1 - Checklist of items

Quantity	Description	Check (✔)
1	iTIM	❑
2	iTIM Instruction Manual	❑

3.2 Fit the iTIM

Before the iTIM is fitted, the electrical supply to the dry pumping system must be isolated.

CAUTION

The iTIM may be damaged if it is disconnected while the pump is powered.

The iTIM can be directly fitted to a dry pumping system.

To fit the iTIM directly to a dry pumping system:

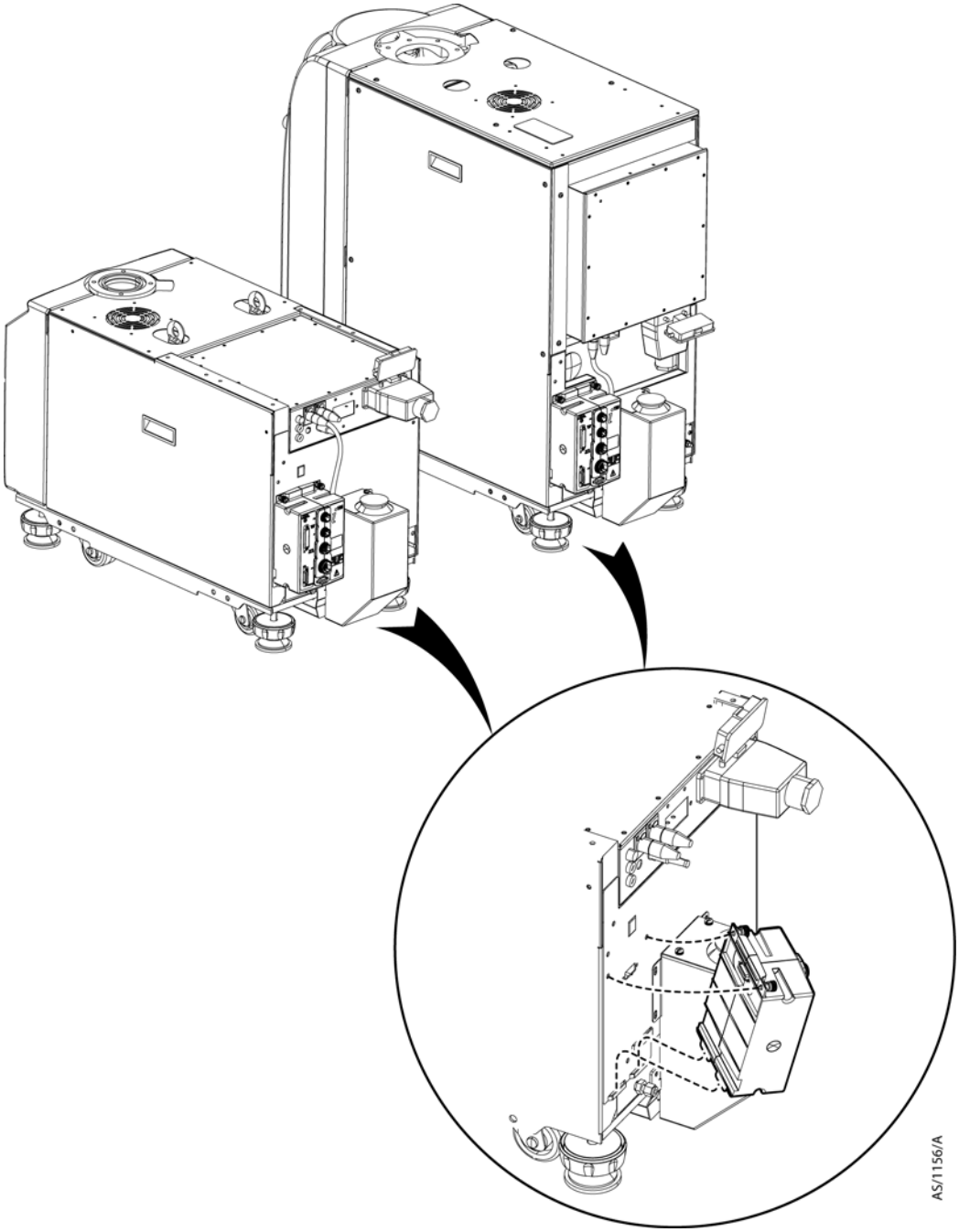
1. Remove active gauge bung.
2. Refer to Figure 4. Fit the pumping system mounting tabs into the fixing slots on the rear panel of the dry pumping system.
3. Position the (captive) pumping system mounting screws into the fixing holes on the rear panel of the dry pumping system, then tighten the screw to secure the iTIM in place.

3.3 Connect the iTIM to the Dry Pumping System

Use the following procedure to connect the iTIM to the dry pumping system, and (optionally) to another pumping system module; where necessary, refer to the instruction manual supplied with the dry pumping system.

1. On an iH or iL dry pumping system, remove the 6-way XLR terminator plug or the module connector cable from the OEM connector on the Electrics and Pump control box.
2. Insert the 6-way XLR connector on the short lead that comes out of the iTIM into the OEM connector on the Electrics and Pump Control Box.

Figure 4 - Fitting the iTIM to a Dry Pumping System



3.4 Parallel Interface Connections

Note: *Refer to Section 4 to determine the signals used in the parallel cable.*

1. Make a suitable parallel cable. Refer to Section 8 for back shell kits if required.
2. Connect one end of the parallel cable to your control equipment.
3. Refer to Figure 1. Fit the socket at the other end of the cable to the appropriate connector on the iTIM.

3.5 Serial Interface Connections

1. Ensure that your control equipment is correctly configured (for example, install the necessary software) to interpret your commands, to send and receive messages to and from the iTIM, and to display information received from the iTIM.
2. Ensure that the serial settings of your control equipment are configured correctly for the iTIM: refer to the information given in Section 4.
3. Make a three-wire RS232 cable to connect your control equipment to the iTIM: Table 2 shows the serial interface connection signals and Table 3 shows the example IBM PC-compatible connections. If the cable between your control equipment and the iTIM is more than 10m long, you must incorporate line drivers in the cable. When you make the cable:
   - Fit a 9-way male 'D-type' plug on one end of the cable.
   - Fit a connector suitable for the serial connector on your control equipment to the other end of the cable. Typically, this will be a 9-way female 'D-type' connector, to fit the COMM port of your PC.

Table 2 - Serial Interface Connections

Signal	Serial Connector (9-way 'D-type' plug)	Direction
RXD	Pin 2	Output
TXD	Pin 3	Input
GND	Pin 5	-

Table 3 - Example IBM PC-Compatible Serial Connections

Signal	Serial Connector (9-way 'D-type' plug)	IBM PC compatible connectors	
		9-way 'D-type' male	25-way 'D-type' male
RXD	Pin 2	Pin 2	Pin 3
TXD	Pin 3	Pin 3	Pin 2
GND	Pin 5	Pin 5	Pin 7

4. Refer to Figure 1. Fit the 9-way 'D-type' plug on one end of the RS232 cable to the serial connector (7) on the iTIM; fit the connector on the other end of your RS232 cable to the appropriate connector on your control equipment.

3.6 Serial Interface Performance

The iTIM has to process both the LON network messages (that arrive when sent by the pumping system) and the serial messages. It is not possible to provide definitive performance figures for the serial interface as it will vary with time according to the pumping system configuration and operation. However, the following information is provided to assist in programming your control equipment for optimum operation with the serial interface.

- The pumping system sends data from each object at relatively low frequencies, usually regularly at 3, 7, 15 or 45 second intervals. Messages are also sent by the pumping system when there is a sudden change in status.
- At 9600 baud, each character in a command/query message or the corresponding reply message will take approximately 1ms. The response for a query takes, typically, 30 to 50ms.
- Command messages can take several seconds to be actioned, as a serial response is sent that is, the command message is sent to the pumping system through the LON network, then the pumping system must action the message.
- We recommend that you do not send a command/query message until the reply message from the previous command/query message has been received. A small delay of 100ms will allow the iTIM to process any LON messages, and to carry out internal 'housekeeping'.
- If the serial link is overloaded, the worst effect will be that the iTIM will miss a data update from the pumping system, however, the new data will then be provided by the pumping system at the next regular update. There will be no direct effect on the operation of the pumping system.

4 Parallel Interface Operation

4.1 Introduction

Use the parallel interface to monitor and control the dry pumping system as described in the following sections. Where necessary, refer to the instruction manual supplied with your dry pumping system, and to the instruction manual(s) supplied with other pumping system components.

4.2 Inputs

Note: *At least 10 seconds must be allowed between successive set/reset inputs.*

The parallel interface has nine inputs; use these to control the operation of the dry pumping system, as shown in Table 4. In Table 4, the terms 'set' and 'reset' are used as follows:

On volt free inputs;

- 'Set' means that you close (link) the appropriate two pins of the input.
- 'Reset' means that you must open (unlink) the appropriate two pins of the input.

On voltage inputs;

- 'Set' means apply > 20V
- 'Reset' means apply < 5V

Table 4 - Parallel Interface Inputs

Input	Pins	Function	Use
1 Voltage Input	A1 - 1 & 2 L1 - 10 & 23 MCM - 1 & 2	Both pumps on/off *	Set the input to switch on the both pumps. Reset the input to switch off both pumps.
2 Voltage Input	A1 - 5 & 6 L1 - 11 & 24 MCM - 15 & 16	Process / AUC On / Off	Set the input to select 'process off'. Reset the input to select 'process on'.
3 Volt-free Input	A1 - 15 & 16 T1 - 1 & 14 MCM - 5 & 6	Both pumps on/off *	Set the input to switch on the both pumps. Reset the input to switch off both pumps.
4 Volt-free Input	E73 - 1 & 9	Dry Pump On / Off	Set the input to switch on the dry pump. Reset the input to switch off the pump.
5 Volt-free Input	E73 - 2 & 10	Mechanical Booster On / Off †	Set the input to switch on the booster pump. Reset the input to switch off the pump.
6 Volt-free Input	T1 - 2 & 15 MCM - 13 & 14	Process / AUC On / Off	Set the input to select 'process off'. Reset the input to select 'process on'.
7 Volt-free Input	T1 - 4 & 17	Run Til Crash On / Off	Set the input to select 'run til crash' on. Reset the input to select 'run til crash' off.
8 Volt-free Input	T1 - 5 & 18	Auto / Fast Shutdown	Set the input to select 'Auto shutdown'. Reset the input to select 'fast shutdown'.
9 Volt-free Input	T1 - 3 & 16	Open / Close Gate Valve	Set the input to open the gate valve. Reset the input to close the gate valve.

* *If a mechanical booster pump has not been fitted then this function will only operate the dry pump.*

† *The mechanical booster pump will not start unless the dry pump is on. The input is ignored if no mechanical booster pump is fitted to the dry pumping system.*

4.3 Outputs

The parallel interface has 11 outputs; use these to monitor the status of the dry pumping system, as shown in Table 5. In Table 5, the terms 'set' and 'reset' are used as follows:

- 'Set' means that the output relay is closed (short circuit).
- 'Reset' means that the output relay is open (open circuit).

Table 5 - Parallel Interface Outputs

Input	Pins	Function	Use
1 Contact Output	E73 - 7 & 15	Remote / Local Control Status	If the output is set, the iTIM may control the pumping system.
2 Contact Output	E73 - 3 & 11	Dry pump running status	If the output is set, the dry pump is on.
3 Contact Output	E73 - 4 & 12	Booster running status	If the output is set, the booster pump is on.
4 Contact Output	A1 - 3 & 4 T1 - 8 & 20 L1 - 2 & 15 MCM - 3 & 4	Both pumps running status	If the output is set, the both pumps are on. If no booster pump is fitted, the output is set when the dry pump is on.
5 Contact Output	A1 - 13 & 14	Final Valve Signal	If the output is set, then the pumps are running and no gas purge flow warning exists.
6 Contact Output	A1 - 7 & 8 T1 - 9 & 21 E73 - 5 & 13 MCM - 7 & 8	General Warning	The signal will be set if no warning exists for any of the configured parameters listed in the 'alerts to tool' configuration (object 135). The default parameters are: Dry pump current (3) Dry pump power (4) Exhaust pressure (39) Dry pump motor temperature (55) Dry pump body temperature (57) Gate valve not closed (152) Gate valve not opened (153)
7 Contact Output	A1 - 11 & 12 T1 - 11 & 23 MCM - 11 & 12	Gas flow warning	If the output is set, no gas purge flow warning condition exists.
8 Contact Output	L1 - 3 & 16	LAM Warning	If the output is set, no general or gas flow warnings exsist.
9 Contact Output	T1 - 13 & 25	Exhaust pressure warning	If the output is set, no exhaust pressure warning condition exists.
10 Contact Output	T1 - 12 & 24	Water flow warning	If the output is set, there is sufficient cooling water flowing through the pumping system.

Table 5 - Parallel Interface Outputs

Input	Pins	Function	Use
11 Contact Output	A1 - 9 & 10 T1 - 10 & 22 E73 - 6 & 14 L1 - 1 & 14 MCM - 9 & 10	General alarm	The signal will be set if no alarm exists for any of the configured parameters listed in the 'alerts to tool' configuration (object 136). The default parameters are: EMS alarm from node object (1) Dry pump current (3) Dry pump power (4) Dry pump thermistor (5) Dry pump no current (11) Exhaust pressure (39) Dry pump motor temperature (55) Dry pump body temperature (57) Dry pump 4th stage temperature (70) Dry pump low speed (184) Dry pump drive (186)

4.4 Setpoints and Configuration Parameters

The parallel interface has a store of sensor setpoints and configuration parameters. This store is preset for your application. Whenever you switch on the dry pumping system, the information in this store is sent to the dry pumping system and overwrites the setpoints already in the system.

To put new information in the store, you must download the new information from a PC, through the Single Equipment Monitor or Fabworks software (refer to the dry pumping system instruction manual).

Note: *If the iTIM is connected to a pumping system, setpoint information stored for another pump type will not be downloaded to the dry pumping system.*

4.5 Take and Release Control

When the parallel interface is used to control the operation of the dry pumping system, it will try to take control. The parallel interface can only take control if no other pumping system module (e.g. a Pump Display Module) already has control.

Once the parallel interface has control, no other module can operate the dry pumping system until it releases control. The parallel interface only releases control when it is used to switch off the dry pumping system.

Note also that:

- If the parallel interface detects an alarm condition, it will release control. This then allows another module to switch on and off the dry pumping system, to clear the alarm.
- The modules connected to a dry pumping system communicate with the system; a time-out occurs if a connected module stops communicating with the dry pumping system for 90 seconds. If a time-out occurs on a module that has control (e.g. if a Pump Display Module that has control is disconnected from the dry pumping system), control is automatically released from the module that has timed out. This allows other modules to take control and switch off the dry pumping system, if required.
- If the parallel interface card has control of the dry pumping system and the mechanical booster pump is automatically shutdown, the Pump Display Module can be used to restart it without the need to release control from the parallel interface card.

4.6 Introduction to Gate Valve Operation

WARNING

Before you select the gate valve open or closed, ensure that it is safe to do so.

The gate valve operation of the iTIM may be configured (through the Single Equipment Monitor software) in one of two ways:

- Default configuration
- Non-default configuration

Refer to the instruction manual supplied with the Single Equipment Monitor for details of how to select these configurations.

4.6.1 Gate Valve Operation: Normal Operation

In the default configuration, the valve will operate as follows:

- The gate valve will open after a specific delay after the dry pump is started; this delay is configurable.
- The gate valve will close after a specific delay after the dry pump is switched off; this delay is configurable.

In the default configuration, you can also use the Process Tool or the Pump Display Module to open and close the gate valve, however the valve will always open/close when the dry pump is started/switched off, as described above.

In the non-default configuration, use the Process Tool or the Pump Display Module to open and close the gate valve as required.

4.6.2 Gate Valve Operation: Emergency Shutdown / Stop

In the default configuration, when the pumping system is automatically shutdown as a result of an alarm, or when emergency stop is selected the iTIM will immediately close the gate valve.

In the non-default configuration, when the emergency stop is selected the iTIM will immediately close the gate valve.

5 Serial Interface Operation

5.1 Message formats

Each message sent by your control equipment to the serial interface card must be a string of ASCII characters terminated by a <CR> (carriage return character, ASCII code 13). You can include spaces in the messages to make them more readable; the spaces are ignored by the serial interface card.

It is possible to send two types of message to the serial interface card and the first character of the message defines the message type, as follows:

- If the first character is "?" (question mark), the message is a query. A query message causes a value (or values) to be returned from the serial interface card. Query messages are described in Section 1.5.
- If the first character is a "!" (exclamation mark), the message is a command. Commands effect some action on the TIC and then return a value to identify whether the command was valid or not. Command messages are described in Section 1.5.

Messages that are sent to the serial interface card are queued in a buffer and then read and actioned by the serial interface card one at a time. You can send the "/" character (ASCII code 47) to clear (empty) the buffer at any time; any unactioned messages are ignored by the serial interface card.

Send the "/" character to reset the serial interface card before you start to send query and command messages.

Note: *The serial interface protocol is case-sensitive. You must therefore use upper case text characters in serial interface messages.*

5.2 Reply messages

When the serial interface card receives a query or command message, it always sends a reply message to your control equipment. A reply message is a string of ASCII characters terminated by the two control characters <CR><LF> (carriage return and line feed, ASCII codes 13 and 10).

The content of a reply messages for a query message depends on the query message sent. If a query message is invalid (that is in the wrong format), the reply message will be in the form "ERR<_>n<CR><LF>", where "<_>" specifies a space and "n" specifies an error number. Refer to Section 1.5 for the meanings of the error numbers.

The reply message for a command message is always in the form "ERR<_>n<CR><LF>". If the command message was valid, "n" (the error number) will be 0. If the message was invalid, "n" specifies an error number: refer to Section 1.5 for the meanings of the error numbers.

5.3 Query Messages

5.3.1 Introduction

The query messages that you send to the serial interface card are shown in Table 8; these are listed in alphabetical message syntax order. The query messages are fully described in Section 5.3.2 to 5.3.13. A reply to a query message can be in one of two formats; short reply or long reply. Use the format mode command message to select long or short reply format (refer to Section 5.4.3).

In Table 8, items enclosed in curled brackets (e.g. {parameter}), are items that you must specify or are variable items. These items are Table 6.

Table 6 - Variable items

{alarm type}	This specifies the type of an alarm. Refer to Table 7.
{bitfield status}	This is a number in the range 0 to 65535. When interpreted as a binary number, the bits set specify the error status of a parameter. Refer to Table 11.
{booster pump}	This is a digit that specifies the mechanical booster pump in the system: 1 = no booster pump fitted, 2 = iQMB250/500, 3 = iQMB1200, 4 = QMBDD, 5 = HCMB600, 6 = HCMB1000.
{control object}	This can take any value between 0 and 255 and specifies the part of the system that has control of the dry pumping system. Refer to Table 13 for typical values.
{dry pump}	This is a digit that specifies the dry pump in the system: 1 = invalid DIP switch setting, 2 = iQDP40, 3 = iQDP80, 4 = iH80 and 5 = iL70.
{node type}	This is a number that represents the pump node type (extracted from the node broadcast): 1 = iQ, 22 = iH and 41 = iL.
{number}	The number of parameters that have a priority level > 0. Refer to Table 10.
{on/off}	This specifies the status of a parameter and can be 0 or 1. Refer to Section 5.3.2 to 5.3.13.
{on process status}	This can be 1 or 0 and specifies whether the On process flag is set (1) or not set (0).
{parameter}	This specifies a selected parameter. Refer to Table 9.
{priority level}	This specifies the priority level of a parameter. Refer to Table 10.
{run til crash status}	This can be 0 or 1 and specifies whether run til crash is selected (1) or not selected (0).
{serial number}	This is a 16 character string that specifies the serial number of the dry pumping system.
{status level}	This specifies the status level of a parameter. Refer to Table 12.
{system type}	This is a number that indicates the type of the dry pumping system: 0 indicates iQ, 1 indicates iH and 2 indicates iL.
{u}	This field is currently unused by the dry pumping system, but is included for possible future use.
{value}	This specifies the current value of a parameter. Refer to Table 9 for the parameters and the units used for each parameter.

Table 7 - Alarm type

Value	Meaning
0	No alarm
1	Digital alarm
9	Low warning
10	Low alarm
11	High warning
12	High alarm
13	Device error*
14	Device not present

Refer to {bitfield status} (see Table 10) to determine the cause of the alarm.

Table 8 - Query Messages

Query Message Name	Message Syntax	Short Reply	Long Reply
Alarm status	?A{parameter}<CR>	{priority level} <CR><LF>	{priority level}, {alarm type}, {bitfield status} <CR><LF>
Bitfield status	?B{parameter}<CR>	{bitfield status} <CR><LF>	{priority level}, {alarm type}, {bitfield status} <CR><LF>
Control status	?C<CR>	{on/off}<CR><LF>	{on/off}<CR><LF>
Gas ballast status	?D<CR>	{on/off}<CR><LF>	{on/off}<CR><LF>
Format mode	?F<CR>	{on/off}<CR><LF>	{on/off}<CR><LF>
Gate valve status †	?G<CR>	{on/off}<CR><LF>	{on/off}, {priority level}, {alarm type}<CR><LF>
Information *	?I<CR>	{number}<CR><LF>	{number} [;{parameter}, {priority level}, {alarm type}, {bitfield status}]<CR><LF>
Load-lock pump status †	?L<CR>	{on/off}<CR><LF>	{on/off}, {priority level}, {alarm type}<CR><LF>
Nitrogen supply status	?N<CR>	{on/off}<CR><LF>	{on/off}<CR><LF>
On process status	?O<CR>	{on/off}<CR><LF>	{on/off}<CR><LF>
Pump status	?P<CR>	{status level}<CR><LF>	{status level}, {priority level}, {alarm type}, {bitfield status}, {run til crash status}, {on process status}, {control object}<CR><LF>
Run til crash status	?R<CR>	{on/off}<CR><LF>	{on/off}<CR><LF>
Serial Number	?S<CR>	{serial number}<CR><LF>	{serial number}<CR><LF>
Pump node type	?T<CR>		{node type}, {system type}, {dry pump}, {booster pump}, {u}, {u}, {u}, {u}<CR><LF>
Inlet purge status	?U<CR>	{on/off}<CR><LF>	{on/off}<CR><LF>
Value	?V{parameter}<CR>	{value}<CR><LF>	{value}, {priority level}, {alarm type}, {bitfield status} <CR><LF>

* *In the long reply, the square brackets specify that the enclosed items may not appear in the reply message, or may not appear a number of times. Refer to Section 5.3.7.*

† *The replies to these query messages will have no meaning if the device (gate valve or load-lock pump) is not controlled through an interface module.*

Table 9 - Parameters

{parameter}	Description	Measurement Unit
1*	Pump control	-
2	Electrical supply voltage	0.1V
3	Dry pump phase current	0.1A
4	Dry pump power	0.1kW
5	Voltage reading from dry pump thermistor	0.1mV
6	Imbalance in dry pump phase current	0.005%
7	Mechanical booster pump phase current	0.1A
8	Mechanical booster pump power	0.1kW
9	Voltage reading from mechanical booster pump thermistor	0.1mV
10	Imbalance in mechanical booster pump phase current	0.005%
11*	Dry pump status	-
12	Mechanical booster pump status	†
13	Gas module supply	†
14	Total running time	hours
16	Hours on process	hours
18	Process cycles	-
20	Pumping system cycles	-
21	Time to stop	seconds
31*	Gas module control	-
32	Final stage purge nitrogen flow	ml s^{-1}
35	Total nitrogen purge flows	ml s^{-1}
39	Exhaust pressure	0.1kPa
40	Shaft-seals purge pressure	0.1kPa
45	Nitrogen supply status	†
46	Interstage purge status	†
47	Inlet purge status	†
48	Time for gas sensors to zero	seconds
51*	Sensor module control	-
52	Analogue water flow	1ml s^{-1}
53	Active gauge pressure	Pa or V^{+}
54	Mechanical booster pump motor temperature	$0.1^{o}K$
55	Dry pump motor temperature	$0.1^{o}K$
56	Exhaust temperature	$0.1^{o}K$
57	Dry pump body temperature	$0.1^{o}K$
58	Dry pump oil status	‡
59	Mechanical booster pump oil status	‡
60	Water flow status	‡
111*	NIM (Network Interface Module)	-
121*	Parallel (tool) interface module	-
131	Parallel (tool) interface input status	Refer to Table 11

Table 9 - Parameters

{parameter}	Description	Measurement Unit
140	Parallel (tool) interface output status	Refer to Table 11
151*	Auxiliary interface	-
160	Auxiliary interface input status	Refer to Table 11
169	Auxiliary interface output status	Refer to Table 11
172	Inverter current	0.1A
173	Inverter power	0.1kW
174	Inverter speed	0.1Hz
175	Inverter torque	0.005%
176	Inverter status	-
245	GRC status	-

* *These parameters can only be specified in ?I query messages.*
† *Information on these parameters is in the form {status level}: Refer to Table 12.*
‡ *0 (oil level or water flow low) or 1 (oil level or water flow acceptable).*

Table 10 - Priority Level

Value	Meaning
0	Indication only; no warning or alarm.
1	Warning condition exists.
2	Alarm condition exists: shut down the pump unless run til crash is set.
3	Alarm condition exists: shut down the pump.

Table 11 - Bitfield status

Value	Meaning
0	Module missing
1	Sensor present at switch-on, but now disconnected
2	Wrong gas module fitted
3	Voltage above valid maximum voltage
4	Voltage below valid minimum voltage
5	ADC (analogue to digital convertor) not operating
6	Electrical supply has been interrupted
7	Watchdog reset has occurred
8	Sensor missing at switch on
9	Module switching on
10	No current consumption at pump switch-on
11	Wrong phase input to pump
12	EMS (emergency stop) has been activated
13	Flow sensor zero out of range
14	Cannot zero sensors
15	Configuration set read error

Table 12 - Status Level

Value	Meaning
0	Switched off
1	Off, switching on
2	On, switching off (shut down after fault)
3	On, switching off (normal shut down)
4	On

Table 13 - Typical Control Object Values

Value	Meaning
0	No module has control
91	Single Pumpset Monitor has control
101	Pump Display Module has control
102	Remote Display has control
121	Parallel (tool) interface has control
181	Serial interface has control

5.3.2 Alarm status query message (?A)

Send this query message to determine the alarm status of the selected parameter.

5.3.3 Bitfield status query message (?B)

Send this query message to determine the bitfield status of the specified parameter. The {bitfield status} part of the reply message specifies the status. Refer to Table 11.

5.3.4 Control status query message (?C)

Send this query message to determine if the serial interface card has control of the dry pumping system. The {on/off} part of the reply message is set as follows:

- {on/off} = 0 means that the serial interface card does not have control of the system.
- {on/off} = 1 means that the serial interface card has control of the system.

5.3.5 Gas ballast status query message (?D)

Send this message to determine the gas ballast status. The {on/off} part of the reply message is set as follows:

- {on/off} = 0 means that the gas ballast is off.
- {on/off} = 1 means that the gas ballast is on.

5.3.6 Format mode query message (?F)

Send this query message to determine if short or long replies are selected. The {on/off} part of the reply message is set as follows:

- {on/off} = 0 means that short replies are selected.
- {on/off} = 1 means that long replies are selected.

5.3.7 Gate valve status query message (?G)

Send this query message to determine the status of the gate valve (if fitted). The {on/off} part of the reply message is set as follows:

- {on/off} = 0 means that the gate valve is closed.
- {on/off} = 1 means that the gate valve is open.

If you have selected long replies, the long reply message will also include the {alarm type}, set as follows:

- {alarm type} = 0 means that there is no alarm.
- {alarm type} = 9 means that the gate valve failed to open after a command message to open the valve.
- {alarm type} = 11 means that the gate valve failed to close after a command message to close the valve.

5.3.8 Information query message (?I)

Send this query message to determine which parameters (if any) have a priority level greater than 0. The {number} part of the reply message specifies the number of parameters that have a priority level greater than 0.

If you have selected long replies and the {number} part of the reply message is not 0, the long reply will also contain information about parameters that have a priority level = 1, followed by information about all of the parameters that have a priority level >1.

The information for each parameter is in the form “{parameter}, {priority level}, {alarm type}, {bitfield status}”. The information for each parameter is seperated from the information for the previous parameter (or from the {number} part of the reply) by a “;” (semicolon) character.

5.3.9 Load-lock pump status query message (?L)

Send this query message to determine the status of the load-lock pump. The {on/off} part of the reply message is set as follows:

- {on/off} = 0 means that the load-lock pump is off.
- {on/off} = 1 means that the load-lock pump is on.

5.3.10 Nitrogen supply status query message (?N)

Send this query message to determine the status of the nitrogen supply. The {on/off} part of the reply message is set as follows:

- {on/off} = 0 means that the nitrogen supply is off.
- {on/off} = 1 means that the nitrogen supply is on.

5.3.11 On process status query message (?O)

Send this query message to determine whether the On process flag is set or not. The {on/off} part of the reply message is set as follows:

- {on/off} = 0 means that the On process flag is not set.
- {on/off} = 1 means that the On process flag is set.

5.3.12 Pump status query message (?P)

Note: *Use the "?V12" query message to determine the status of the mechanical booster pump (if fitted).*

Send this query message to determine the status of the dry pump in the dry pumping system. The {status level} part of the reply message specifies the pump status. Refer to Table 12.

Note: *If {alarm type} in the reply message is set to 0 (no alarm), {priority level} will also be set to 0. {priority level} will only be set to the actual priority level when {alarm level} >0.*

5.3.13 Run til crash status query message (?R)

Send this query message to determine whether run til crash is selected or not. The {on/off} part of the reply message is set as follows:

- {on/off} = 0 means that Run til crash is not selected.
- {on/off} = 1 means that Run til crash is selected.

5.3.14 Serial number query message (?S)

Send this query message to determine the serial number of the dry pumping system. The serial number is specified in the reply message.

5.3.15 Pump node type query message (?T)

Send this query message to determine the pump node type and/or the pumping system type, and/or the type(s) of pump(s) in the pumping system. The fields of the reply message identify the appropriate data. Refer to Table 8.

5.3.16 Inlet purge status query message (?U)

Send this query message to determine the inlet purge status. The {on/off} part of the reply message is set as follows:

- {on/off} = 0 means that inlet purge is off.
- {on/off} = 1 means that inlet purge is on.

5.3.17 Value query message (?V)

Send this query to determine the value of the selected parameter. The {value} part of the reply message specifies the current value of the parameter. Refer to Table 9 for the applicable measurement unit for the parameter.

Note: *If you send this query message for parameters 176 (inverter status) or 245 (GRC status), the {value} part of the reply message comprises eight hexadecimal digits, the meaning of these digits depends on your inverter or GRC equipment.*

5.4 Command Messages

5.4.1 Message syntax

The command messages are shown in Table 14. The messages are described in Section 5.4.2 to 5.4.9. The bracketed items in Table 14 ({0:1} and {0:2}) are variable items that must be specified, as follows:

- {0:1} is a digit and can be 0 or 1.
- {0:2} is a digit and can be 0, 1 or 2.

Table 14 - Command Messages

Command Message Name	Message Syntax
Control	!C{0:1}<CR>
Gas ballast	!D{0:1}<CR>
Format mode	!F{0:1}<CR>
Gate valve	!G{0:1}<CR>
Load-lock pump	!L{0:1}<CR>
Simulation mode	!M{0:1}<CR>
Nitrogen supply	!N{0:1}<CR>
On process	!O{0:1}<CR>
Pump	!P{0:2}<CR>
Run til crash	!R{0:1}<CR>
Inlet purge	!U{0:1}<CR>

5.4.2 Control command message (!C)

Send this command message to take or release control of the dry pumping system, as defined by the {0:1} character:

- If {0:1} = 0, release control.
- If {0:1} = 1, take control.

5.4.3 Gas ballast command message (!D)

Send this command message to control the operation of the gas ballast (if fitted), as follows:

- If {0:1} = 0, switch gas ballast off.
- If {0:1} = 1, switch gas ballast on.

5.4.4 Format mode command message (!D)

Send this command message to define the format of replies to query messages (refer to Section 5.3.1). The {0:1} character defines the required length of replies, as follows:

- If {0:1} = 0, short replies are requested.
- If {0:1} = 1, long replies are requested.

5.4.5 Gate valve command message (!G)

Send this command message to control the operation of the gate valve (if fitted), as follows:

- If {0:1} = 0, close the gate valve.
- If {0:1} = 1, open the gate valve.

5.4.6 Load-lock pump command message (!L)

Send this command message to control the operation of the load-lock (if fitted), as follows:

- If {0:1} = 0, switch off the load-lock pump.
- If {0:1} = 1, switch on the load-lock pump.

5.4.7 Simulation mode command message (!M)

Note: *When this message is sent, all stored data is cleared. Refer to Section 5.5.1.*

Send this command message to enter or exit simulation mode (refer to Section 5.5), as follows:

- If {0:1} = 0, exit simulation mode.
- If {0:1} = 1, enter simulation mode.

5.4.8 Nitrogen supply command message (!N)

Send this command message to control the operation of the nitrogen supply (if fitted), as follows:

- If {0:1} = 0, switch off the nitrogen supply.
- If {0:1} = 1, switch on the nitrogen supply.

5.4.9 On process command message (!O)

Send this command message to set or reset the On process flag, as follows:

- If {0:1} = 0, reset the On process flag.
- If {0:1} = 1, set the On process flag.

5.4.10 Pump command message (!P)

Send this command message to control the operation of the dry pumping system, as follows:

- If {0:2} = 0, Switch off the dry pumping system (Auto shut down).
- If {0:2} = 1, Switch on the dry pumping system.
- If {0:2} = 2, Switch off the dry pumping system (fast shut down).

5.4.11 Run til crash command message (!R)

Send this command message to select or de-select Run til crash, as follows:

- If {0:1} = 0, de-select Run til crash.
- If {0:1} = 1, select Run til crash.

5.4.12 Inlet purge command message (!U)

Send this command message to control the operation of the inlet purge (if fitted), as follows:

- If {0:1} = 0, switch off the inlet purge.
- If {0:1} = 1, switch on the inlet purge.

5.5 Simulation Mode

5.5.1 Introduction

Note: *When the iTIM is first switched on, it automatically enters the normal mode.*

The serial interface card can operate in one of two modes:

1. In normal mode, query and command messages are associated with the dry pumping system to which the serial interface card is connected, as described in Section 5.3 and 5.4.

2. In simulation mode, query and command messages can be sent to the serial interface card as in normal mode, but are associated with a 'simulated pumping system' in the serial interface card. In this mode, command messages do not affect the dry pumping system and replies to query messages contain information about the simulated pumping system, not the dry pumping system.

Use the simulation mode command message (refer to Section 5.4.6) to enter and exit the simulation mode.

Note: *The serial interface card maintains a common store data associated with the actual or associated dry pumping system. When you exit the simulation mode, this store is cleared, it may the take up to 45 seconds for the serial interface card to acquire the new data from the actual dry pumping system.*

5.5.2 Simulated pumping system

When you send a query message in simulation mode, the information returned in the reply message depends on the selected simulated pumping system parameter, as shown in Table 15.

Other defaults in simulation mode are as follows:

- On process flag = reset.
- Run til crash = selected.
- Serial number = "Simulation<string>", where <string> is either a number of spaces, or a number of spaces followed by the issue status of the software in the iTIM.

Table 15 - Simulated Pumping System Data

{parameter}	Description	{priority level}	{alarm type}	{bitfield status}	{value}
1*	Pump control				
2	Electrical supply voltage	0	0	0	2818
3	Dry pump phase current	0	0	0	44
4	Dry pump power	0	0	0	24
5	Voltage reading from dry pump thermistor	0	0	0	230
6	Imbalance in dry pump phase current	0	0	0	30
7	Mechanical booster pump phase current	0	0	0	91
8	Mechanical booster pump power	1	11	0	45
9	Voltage reading from mechanical booster pump thermistor	0	0	0	564
10	Imbalance in mechanical booster pump phase current	0	0	0	10
11*	Dry pump status				
12	Mechanical booster pump status	0	0	0	4
13	Gas module supply	0	0	0	4

Table 15 - Simulated Pumping System Data

{parameter}	Description	{priority level}	{alarm type}	{bitfield status}	{value}
14	Total running time	0	0	0	207
16	Hours on process	0	0	0	3
18	Process cycles	0	0	0	1
20	Pumping system cycles	0	0	0	52
21	Time to stop	0	0	0	75
31*	Gas module control				
32	Final stage purge nitrogen flow	0	0	0	462
35	Total nitrogen purge flows	0	0	0	190
39	Exhaust pressure	0	0	0	59
40	Shaft-seals purge pressure	0	0	0	397
45	Nitrogen supply status	0	0	0	4
46	Interstage purge status	0	0	0	3
47	Inlet purge status	0	0	0	1
48	Time for gas sensors to zero	0	0	0	68
51*	Sensor module control				
52	Analogue water flow	0	0	0	265
53	Active gauge pressure	0	0	0	2.1×10^{-5}
54	Mechanical booster pump motor temperature	0	0	0	3210
55	Dry pump motor temperature	1	13	2	1319
56	Exhaust temperature	0	0	0	4180
57	Dry pump body temperature	0	0	0	3536
58	Dry pump oil status	0	0	0	1
59	Mechanical booster pump oil status	0	0	0	1
60	Water flow status	0	0	0	1
111*	NIM (Network Interface Module)				
121*	Parallel (tool) interface module				
131	Parallel (tool) interface input status	0	15	0	0
140	Parallel (tool) interface output status	0	15	0	0
151*	Auxiliary interface				
160	Auxiliary interface input status	0	0	0	78
169	Auxiliary interface output status	0	0	0	24
172	Inverter current	0	0	0	7
173	Inverter power	0	0	0	6
174	Inverter speed	0	0	0	1000
175	Inverter torque	0	0	0	5
176	Inverter status	0	0	0	000F000F
245	GRC status	1	1	0	000F000F

* *These parameters can only be specified in ?I query messages.*

6 Maintenance

6.1 Inspect the Electrical Connections

Do the following checks regularly when maintaining the dry pumping system:

- Check the iTIM and ensure that it is securely fixed in place.
- Inspect the electrical cables and check that they are not damaged and have not overheated. Repair or replace any damaged or overheated cable.
- Inspect the electrical connections and check that they are secure. Tighten any loose connections.

6.2 Fault Finding

6.2.1 Tool Interface Problems

If the tool appears not be controlling the pump correctly, the state of the input and output signals may be checked using the Single Equipment Monitor.

6.2.2 Error number reply messages

When the serial interface card acts on a command or query message, it sets the error number to indicate the success or failure of the message. The error numbers returned in the error reply message are shown in Table 16.

Table 16 - Serial Interface Error Numbers

Error Number	Meaning	Possible cause/action
0	No error	-
1	Invalid message	The message sent was not a valid query or command message.
2	Number not found	Part of a message (e.g. {parameter}) was not found. Resend the message in the correct format.
3	Number Invalid	Part of a message was outside the valid range (e.g. the {0:1} digit in a command message was higher than 1).
4	Parameter's value not received	The corresponding sensor may be faulty or disconnected. Alternatively, you have requested a parameter value too soon after you have connected or switched on the iTIM or sending the !M0 message. Wait to allow the parameter data to become available (this may take up to 45 seconds) then request the value again.
5	Command not possible	You have tried to take or release control, but another module has control of the dry pumping system. Release control from the other module, then try again.

6.2.3 Determine the pumping system error number

For further information on some of the errors, meanings and recommended actions, you can refer to the corresponding warning or alarm message in the instruction manual supplied with the dry pumping system.

Each warning and alarm message has a pumping system error number. To determine which message(s) to refer to, calculate the error number from information in the serial interface card reply messages as follows:

error number = ({parameter} x 100) + {alarm type}

6.2.4 Serial Communications Problems

If the serial communications do not operate correctly, check the items shown in Table 17.

Table 17 - Serial communications fault finding

Check	Action
Is the control equipment operating?	Ensure that the electrical supply to the control equipment is switched on and that the control equipment is switched on.
Are the communications cables connected?	Ensure that the communications cables are correctly connected to the dry pumping system and to the control equipment.
Are the cables wired correctly?	Ensure that the wires of the communications cables are correctly connected to the dry pumping system and the control equipment connectors. Refer to Table 2 for the RS232 connection details.
Is the control equipment configured correctly?	Ensure that the baud rate, parity and stop bits of the control equipment are correctly configured.
Are the cables too long?	Ensure that the communications cables are less than 10m long. If the communications cables are longer than 10m, ensure that the line-drivers are correctly incorporated into the communications cables.

7 Storage and Disposal

7.1 Storage

Replace any protective packing materials and store the iTIM in clean dry conditions.

When required for use, install the iTIM as described in Section 3.

7.2 Disposal

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

8 Service, Spares and Accessories

8.1 Service

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

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

8.2 Spares

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

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

8.3 Accessories

Accessory	Item Number
Cable TIM to Gate Valve	A532-08-403
Backshell Kit Applied SPI	D374-20-801
Backshell Kit TEL	D374-20-802
Backshell Kit E73	D374-20-803
Backshell Kit Gate valve	D374-20-804
Backshell Kit Serial	D374-21-801
Backshell Kit LAM	D374-22-801
Backshell Kit MCM	D374-22-802
A1 to Novellus C3 Interface cable	D374-21-802
Backshell kit Novellus C3	D374-21-803

Index

Index

T

U

V