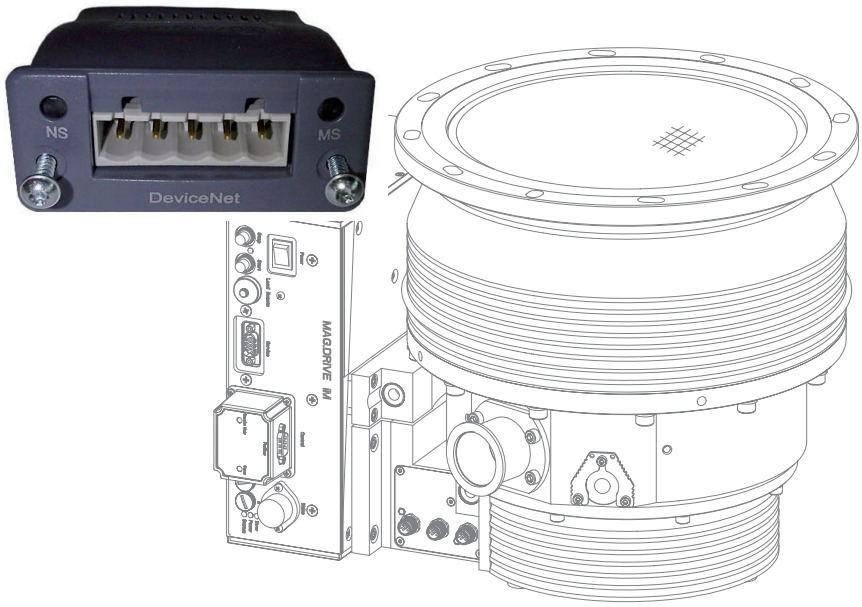
Leybold

MAG integra

MAG W 1300 – 2200

DeviceNet

Operating Instructions 300444304_002_C0



Contents

Original installation and operating Instructions.

Safety Information

Important Safety Information
Before installing and commissioning the DeviceNet Interface for TURBOVAC MAG integra, carefully read these Operating Instructions and follow the information so as to ensture optimum and safe working right from the start.

NOTICE

The Leybold **DeviceNet Interface for TURBOVAC MAG integra** has been designed for safe and efficient operation when used properly and in accordance with these Operating Instructions. It is the responsibility of the user to carefully read and strictly observe all safety precautions described in this section and throughout the Operating Instructions. The Interface **must only be operated in the proper condition and under the conditions described in the Operating Instructions**. It must be operated and maintained by trained personnel only. Consult local, state, and national agencies regarding specific requirements and regulations. Address any further safety, operation and/or maintenance questions to our nearest office. Before making any connections, deenergise the frequency converter and wait until the pump no longer turns. Since in spite of this dangerous voltages can remain present, the equipment must only be opened by a trained electrician.

DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

DANGER

WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

WARNING

CAUTION indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury.

CAUTION

NOTICE is used to notify users of installation, operation, programming or maintenance information that is important, but not hazard related.

NOTICE

We reserve the right to alter the design or any data given in these Operating Instructions. The illustrations are not binding.

Retain the Operating Instructions for further use.

Description

Fig. 1.1 DeviceNet Interface for TURBOVAC MAG integra

1 Description

These Operating Instructions describe the functionality of DeviceNet for programming purposes. For more information refer to the “DeviceNet specifications” of the Open DeviceNet Vendor Association (ODVA) and the corresponding European standard.

For specifications and operation instructions of the turbo vacuum pump and the converter itself refer to the appropriate documents.

The following description of the DeviceNet Interface is compliant to the DeviceNet specification of the Open DeviceNet Vendor Association.

1.1 Baud Rate and Address selection

Address adjustment

Selectable via explicit message by using a DeviceNet slave configuration tool.

Baud rate selection

3 fixed baud rates selectable via explicit message by using a DeviceNet slave configuration tool.

1.2 Technical Data

Device Type	Turbomolecular Pump
Baud Rates	125 k, 250 k, 500 k Baud

This manual describes the functionality of a DeviceNet Group 2 Only Slave and supports Explicit Messaging and I/O Polling.

Isolated Physical Layer

Input voltage range for DeviceNet option	5 volt / 24 volt

Voltage levels CAN Lines:

Transmitter Requirements

Differential Output level (nominal)	2.0 volt p-p
Differential Output level (minimum)	1.5 volt p-p
Connector, 50 Ohms load	
Minimum Recessive Bus voltage	2.0 volt[1)]
CAN H and CAN L	
Maximum Recessive Bus voltage	3.0 volt[1)]
CAN H and CAN L	
Output short circuit protection	internally limited

Receiver Requirements

Differential Input Voltage dominant	0.95 volt min
Differential Input Voltage recessive	0.45 volt max
Hysteresis	150 millivolt typically

[1)] Voltages at CAN H and CAN L are referenced to the transceiver IC ground pin. This voltage (IC ground pin) is app. 0.6 Volt higher than the V-terminal.

Fig. 1.2 Front view of the DeviceNet Interface

1.3 DeviceNet plug and status indication LEDs

Network Status

State	Indication
Off	Not online / no power
Green	Online, one or more connections are established
Flashing Green (1 Hz)	Online, no connections established
Red	Critical link failure
Flashing Red (1 Hz)	One or more connections timed-out
Alternating Red / Green	Self test

Module Status

State	Indication
Off	No power
Green	Operating in normal condition
Flashing Green (1 Hz)	Missing or incomplete configuration, device needs commissioning
Red	Unrecoverable fault(s)
Flashing Red (1 Hz)	Recoverable fault(s)
Alternating Red / Green	Self test

DeviceNet Connector

This connector priovides DeviceNet connectivity.

Pin	Signal	Description
1	V -	Negative bus supply voltage [1)]
2	CAN_L	CAN low bus line
3	SHIELD	Cable shield
4	CAN_H	CAN high bus line
5	V +	Positive bus supply voltage [1)]

[1)] DeviceNet bus power. For more information, see C-1 „Technical Specification“.

2 Setting the MAC ID and the baud rate

2.1 General

The system has two different memory locations for the baud rate and the MAC ID. These memories are located in the frequency converter as well as inside the interface module.

The corresponding values (parameter value or setting of the hardware address switch) are stored in the frequency converter. In a valid range these values will always be used. In this case the corresponding value cannot be changed via the bus (DeviceNet Object).

If the frequency converter specifies invalid values, the interface module ignores these and falls back to the last known valid values used. In this case there is the possibility of changing these values via the DeviceNet Object. For the MAC ID changes will have an instant impact (directly active), with changed baud rates the system has to be re-initialised.

2.2 Important parameters

The following table shows important parameters for setting the MAC ID and the baud rate. With corresponding software tools provided by Leybold these values can be changed via the service interface.

No.	Designation	Min	Max	Def.	Unit	r/w	Format	Description
759	Required baudrate Device Net	0	4	0	-	r/w	u16	0 = 125kBaud 1 = 250kBaud 2 = 500kBaud 3 = not valid 4 = from network side
760	Required MAC ID	0	64	63	-	r/w	u16	0 – 63 = valid address >63 = 64 = from network side
923	Actual MAC ID	0	63			r	u16	
924	Source of MAC ID	0	2	2	-	r/w	u16	0 = not valid 1 = valid from Parameter 760 2 = value from rotary switch

2.2.1 Setting the MAC ID

Via the address switches of the hardware
By factory default Parameter 924 is set to ADDRESS SWITCH. Therefore the MAC ID will be determined through the switches' position at the system's front. Turning the switches will automatically lead to a resetting of the interface module. If the value changed is within the valid address range (0 – 63), the updated value will be saved in the interface module. With the address switch active (Parameter 924=2) the values of Parameter 760 and the address switch are both identical.

If the setting is to be changed by means of Object 03H via bus, the address switches have to be set to an invalid range (>63dec). Any value >63 will be regarded and treated as a value 64 and will automatically lead to a resetting of the interface module, too. Subsequently the module can be addressed through the bus via the last valid MAC ID, and the MAC ID can be changed via the DeviceNet Object.

By factory default both address switches are set to the MAC ID address 63 (i.e. the device's delivery status). Both switches are hex-coded. Use position 3F to set address 63 (i.e. turn Switch x10 to position 3, and Switch x1 to position F).

Via parameter
Set the value of Parameter 924 to 1. Then set the value of Parameter 760 to the desired MAC ID. In this case, too, the interface module will be reset automatically and will store the value.

If the setting is to be changed by means of Object 03H via bus, the value for Parameter 760 has to be set to an invalid range (>63dec). Any value >63 will be regarded and treated as a value 64 and will automatically lead to a resetting of the interface module. Subsequently the module can be addressed through the bus via the last valid MAC ID, and the MAC ID can be changed via the DeviceNet Object.

Via bus
Setting the MAC ID via the DeviceNet Object is only possible, if either the address switches or Parameter 760 is set to a value >63 and saved regarding Parameter 760.

In this case the MAC ID may be changed via the DeviceNet Object. In parallel with the writing operation the new value will take immediate effect and will be stored in the interface module. A secondary save for the frequency converter is unnecessary.

2.2.2 Setting the baud rate

Via (Parameter 759)
The baud rate can be changed via the service interface or via the bus (DeviceNet Object). By factory default the value of Parameter 759=0 (i.e. the device's delivery status). If this value is changed between 0 and 2, the interface module will automatically be reset. However the value changed has to be permanently saved within the frequency converter, to stay active after the following Power OFF/ON.

Via bus
If the baud rate is to be set via the bus, set the Parameter 759 to 4. The interface module will be reset automatically, if the parameter value is changed. Similar to the MAC ID, the interface module detects an invalid value and will activate the setting option via the bus.

To keep the changed parameter value active after the following Power OFF/ON the value has to be saved. Hence the baud rate may be set via the bus by means of the DeviceNet Object.

If the baud rate's value is changed via the bus, the new value is stored independently inside the interface module, but only in effect after a re-initialisation. Therefore turn off the mains and then power on the system.

3 Objects

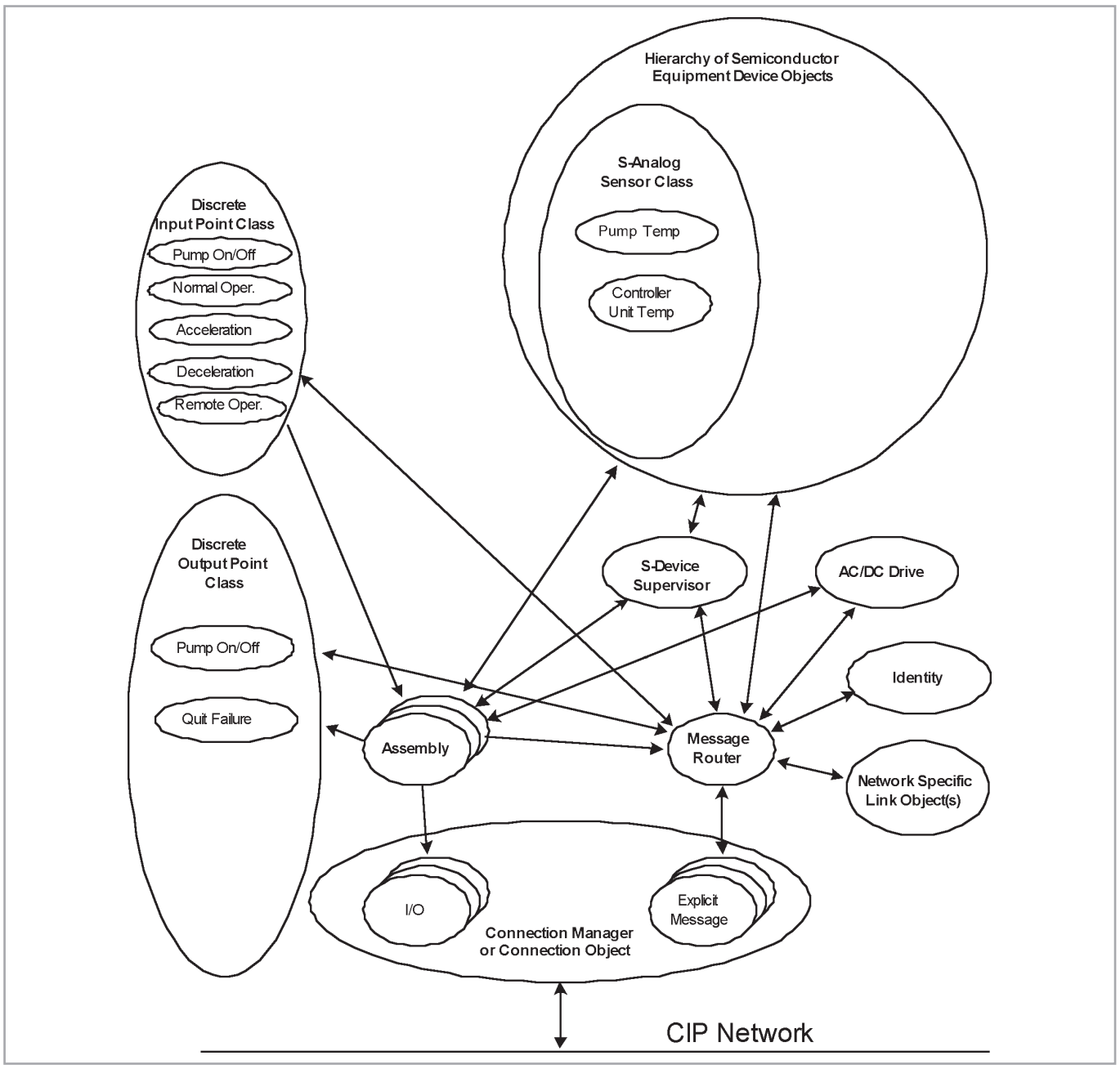


Fig. 3.1 Object structure

Objects

3.1 Object Structure

The Object Structure is shown in the table below and representing a Turbo Pump Device.

The table below indicates:

- the object classes present in this device
- whether or not the class is required
- the number of instances present in each class

Object Class	Class Identifier	Number of Instances
Identity	1	1
Message Router	2	1
DeviceNet	3	1
I/O Assembly	4	4 Input and 5 Output
Connection	5	1 I/O and 1 Explicit
Discrete Input Point	8	10
Discrete Output Point	9	4
AC / DC Drive	42	1
S-Device Supervisor	48	1
S-Analog Sensor	49	3
Leybold Warning Class	100	1
Leybold Failure Class	101	1
DeviceNet Host Object	252	1

Services

Service Code	Name
14 ($0E_{hex}$)	Get Attribute Single
16 (10_{hex})	Set Attribute Single

3.2 Identity Objects

Class Code: 1 (01_{hex})

Instance ID: 1 (01_{hex})

Attribute ID	Access Rule	Name	Data Type	Description
1 (01_{hex})	Get	Vendor Identification	UINT	Vendor Identification 144 dec = 90 00 hex ≙ Leybold
2 (02_{hex})	Get	Device type	UINT	Device Type 33 dec = 21 00 hex ≙ Turbo Molecular Pump
3 (03_{hex})	Get	Product Code	UINT	211 dec = D3 00 hex ≙ MAG.DRIVE M
4 (04_{hex})	Get	Revision	STRUCT of:	Revision of the item the Identity Object represents
		Major Revision	USINT	02
		Minor Revision	USINT	01
5 (05_{hex})	Get	Status	USINT	**Status of the entire device;** **Bit# Meaning** 0 Moduled owned 1 Reserved 2 Configured 3 Reserved 4 to 6 Extended Device **Status Values:** 000 = unknown 001 = reserved 010 = Faulted IO Conn. 011 = No IO Connection 100 = Nonvol. Config. Bad 101 = reserved 110 = Connection in Run mode 111 = Connection in Idle mode 7 Reserved 8 minor recoverable faults 9 minor unrecoverable faults 10 major recoverable faults 11 major unrecoverable faults 12 – 15 Reserved
6 (06_{hex})	Get	Serial Number	UDINT	Serial number of the turbo pump controller truncated to 32 bit unsigned integer format. Sample: S.N. 30000987654 result = 987654
7 (07_{hex})	Get	Product Name	SHORT_ STRING	Name of the turbo pump controller “MAG.Drive M”

3.3 I/O Assembly Object

3.3.1 Input Assembly

Class Code: 4 (04_{hex})

Attribute ID: 3 (03_{hex})

Instance ID	Type	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1 (01_{hex})	Input	0	**Exception Status**							
		1	**Speed Status** (see the "Speed Control Attribute and Speed Status Attribute Bit Map" below)							
		2	0	0	0	0	0	0	0	Pump On Status
2 (02_{hex})	Input	0	**Exception Status** (see the "Exception Status Bit Map" below)							
		1	**Speed Status** (see the "Speed Control Attribute and Speed Status Attribute Bit Map" below)							
		2	0	0	0	0	0	0	0	Pump On Status
		3 – 4	**Pump speed** (revolutions per second)							
3 (03_{hex})	Input	0	**Exception Status** (see the "Exception Status Bit Map" below)							
		1	**Speed Status** (see the "Speed Control Attribute and Speed Status Attribute Bit Map" below)							
		2	0	0	0	0	0	0	0	Pump On Status
		3 – 4	**Pump speed** (revolutions per second)							
		5 – 6	**ignore**							
		7 – 8	**Current [1/10 Amps]** (actual motor current)							
100 (64_{hex}) default predefined input connection set	Input	0	**Exception Status** (see the "Exception Status Bit Map" below)							
		1	**Speed Status** (see the "Speed Control Attribute and Speed Status Attribute Bit Map" below)							
		2					General Alarm	General Warning		Pump On Status
		3 – 4	**Pump speed; actual** (revolutions per second)							
		5 – 6	**ignore**							
		7 – 8	**Current [1/10 Amps]** (actual motor current)							

For selection of the predefined connection set, please refer to: 3.9 DeviceNet Host Object

An input assembly instance is only accessible by explicit messaging, when selected as predefined connection set. The accordant instances of discrete input object or the AC/DC drive object can be used, to reach the same functionality.

Exception Status Bit Map

Bit	Function
0	ALARM / device-common
1	ALARM / device-specific
2	ALARM / manufacturer-specific
3	0 (reserved)
4	WARNING / device-common
5	WARNING / device-specific
6	WARNING / manufacturer-specific
7	1 (expanded method)

Speed Status Attribute Bit Map

Bit	Speed Status	Status Description
0	Running	On and SpeedActual > 0
1	At Idle	Zero current
2	At Standby Speed	SpeedActual = SpeedStandby (actual not selectable via DeviceNet)
3	Coasting	Zero Torque (generator mode)
4	Stopped	SpeedActual = 0
5	Accelerating	SpeedActual is increasing
6	At Reference	SpeedActual = SpeedRef
7	Decelerating	SpeedActual is decreasing

3.3.2 Output Assembly

Class Code: 4 (04_{hex})

Attribute ID: 3 (03_{hex})

Instance ID	Type	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
5 (05_{hex})	Output	0	**Reserved, all bits must be set to “0”**							Pump On
6 (06_{hex})	Output	0	**Reserved, all bits must be set to “0”**							Pump On
		1	**Speed Control** (see the ”Speed Control Attribute and Speed Status Attribute Bit Map” below)							
7 (07_{hex})	Output	0	**Reserved, all bits must be set to “0”**							Pump On
		1	**Speed Control** (see the ”Speed Control Attribute and Speed Status Attribute Bit Map” below)							
		2 – 3	**Speed Target** pump speed or pump rotating frequency in r.p.m. (“revolutions per second” or Hz) Attention: value must be set within the designated speed range of the pump							
101 (65_{hex}) default predefined output connection set	Output	0	Quit failure		Standby active / inactive	Reserved, must be set “0”	Vent Valve	Purge Valve	Reserved, must be set “0”	Pump On
102 (66_{hex})	Output	0	Quit failure		Standby active / inactive	Reserved, must be set to “0”	Vent Valve	Purge Valve	Reserved, must be set “0”	Pump On
		1 – 2	**Speed Target** pump speed or pump rotating frequency in r.p.m. (“revolutions per second” or Hz) Attention: value must be set within the designated speed range of the pump							

For selection of the predefined connection set, please refer to: 3.9 DeviceNet Host Object

An output assembly instance is only accessible by explicit messaging, when selected as predefined connection set. The accordant instances of discrete input object or the AC/DC drive object can be used, to reach the same functionality.

When cyclic process data exchange is established, the process control is assigned to the DeviceNet interface connection.

The pump control is also directed to the DeviceNet Interface, if the Discrete Output Point Object (#9), any of the Attributes, Instance #9 is activated, or if the AC/DC Object (#42) Instance #1, Attribute #38: Speed Control is used (at least 1 bit is set to “1”).

Speed Control Attribute Bit Map

Bit	Speed Control	Description
0	Run Request	A “1” starts the pump, if bit 1 is set to “0”
1	Idle Request	A “1” stops the pump, regardless of setting of the other bits
2	Standby Request	A “1” selects the standby frequency, if bit 0 is set to “1” and bit 1 is set to “0”
3	Reserved	**All the time all bits must be set to “0”**
4	Reserved	
5	Reserved	
6	Reserved	
7	Reserved	

3.4 Discrete Input Point Object

Class Code: 8 (08_{hex})

Instance ID	Attribute ID	Access Rule	Name	Data Type	Description
1 (01_{hex})	3	Get	Pump On / Off	BOOL	0 = Pump Off (or Pump On and Speed = 0) 1 = Pump On (pump running)
	7	Get	Off_On Cycles	UDINT	Count value of pump start to normal sequences
100 (64_{hex})	3	Get	Normal	BOOL	Normal speed reached
101 (65_{hex})	3	Get	Acceleration	BOOL	The pump increases speed
102 (66_{hex})	3	Get	Deceleration	BOOL	The pump decreases speed
103 (67_{hex})	3	Get	Generator Mode	BOOL	The pump runs in generator mode; mains voltage is missing
104 (68_{hex})	3	Get	Standby Speed	BOOL	The pump acts in standby mode
105 (69_{hex})	3	Get	Standstill	BOOL	0 = Pump rotates or drive is active 1= Pump stopped and drive is not active
106 ($6A_{hex}$)	3	Get	Remote Operation	BOOL	The pump is under control of DeviceNet interface connection
108 ($6C_{hex}$)	3	Get	Standby Speed Reached	BOOL	The pump runs at standby speed

3.5 Discrete Output Point Object

Class Code: 9 (09_{hex})

If at least one of the DOP Activate Pump control functions is set, the control of the pump is directed to the DeviceNet interface connection.

The pump control is also directed to the DeviceNet Interface if the cyclic process data exchange is established, or if the AC/DC Object (#42) Instance #1, Attribute #38: Speed Control is used (at least 1 bit is set to “1”).

Instance ID	Attribute ID	Access Rule	Data Type	Name	Description
1 (01_{hex})	3	Set	BOOL	Pump On / Off	0 = Pump Off 1 = Pump On
	9	Set	BOOL	Activate Pump control	Enables the control of the pump by the DeviceNet interface connections
3 (03_{hex})	3	Set	BOOL	Purge Gas Valve	0 = Valve closed 1 = Valve open
	9	Set	BOOL	Activate Pump control	Enables the control of the pump by the DeviceNet interface connections
101 (65_{hex})	3	Set	BOOL	Quit Failure	0 = do not reset error condition 1 = Reset only possible if Pump On/Off is set to Off
	9	Set	BOOL	Activate Pump control	Enables the control of the pump by the DeviceNet interface connections
102 (66_{hex})	3	Set	BOOL	Standby	0 = Pump will run at target speed 1 = Pump will run at standby speed
	9	Set	BOOL	Activate Pump control	Enables the control of the pump by the DeviceNet interface connections
104 (68_{hex})	3	Set	BOOL	Vent Valve	0 = Valve closed 1 = Valve open
	9	Set	BOOL	Activate Pump control	Enables the control of the pump by the DeviceNet interface connections

NOTICE

Setting one of the control instances (Attribute ID 9) to TRUE enables the control of the pump and enables the discrete output point object functionality by the DeviceNet interface connection.

Setting one of the control instances (Attribute ID 9) to FALSE disables the control of the pump and disables the discrete output point object functionality by the DeviceNet interface connection.

3.6 AC/DC Drive Object

Class Code: 42 ($2A_{hex}$)

Instance ID: 1 (01_{hex})

Attribute ID	Access Rule	Name	Data Type	Description
3 (03_{hex})	Get	AtReference	BOOL	Normal operation status
4 (04_{hex})	Get / Set	NetRef	BOOL	Requests process control reference to be local or from the network. 0 = Set reference speed not from DeviceNet 1 = Set reference speed from DeviceNet Default value is 0 will be activated automatically, if cyclic process data exchange Output Assembly Attribute ID #3, Instance #7 is selected and in progress
5 (05_{hex})	Set / Get	NetProc	BOOL	Requests process control reference to be local or from the network. 0 = Set Process not DN Control 1 = Set Process at DN Control Default value is 0 without cyclic process data established; will be set to “1” automatically, if cyclic process data exchange is in progress, or is set with one of the associated explicit messages
6 (06_{hex})	Get	DriveMode	INT	Always set to “2” = Closed Loop Operation
7 (07_{hex})	Get	SpeedActual	INT	Actual counted speed of the pump [R.P.S.]
8 (08_{hex})	Set / Get	SpeedRef	INT	Reference speed of the pump [R.P.S.]; can be overridden by Output Assembly #7 selected or by Standby selected
9 (09_{hex})	Get	Current Actual	INT	Actual motor current [0.1 Ampere]
10 ($0A_{hex}$)	Get	CurrentLimit	INT	Limit of the motor current [0.1 Ampere]
15 ($0F_{hex}$)	Get	PowerActual	INT	Actual value of the direct current link power [0.1 Watt]
16 (10_{hex})	Get	InputVoltage	INT	Actual value of the direct current link voltage
20 (14_{hex})	Get	LowSpd Limit	UINT	Low limit of the pump speed [RPS]
21 (15_{hex})	Get	HighSpd Limit	UINT	High limit of the pump speed [RPS]
38 (26_{hex})	Set	Speed Control	USINT	**Bit / Speed Control / Description** 0 / Run Request / A “1” starts the pump, if bit 1 is set to “0” 1 / Idle Request / A “1” stops the pump, regardless of setting of the other bits 2 / Standby Request / A “1” selects the standby frequency, if bit 0 is set to “1” and bit 1 is set to “0” 3 / Coast Request / not supported (no function), always set to “0”
	The pump control is directed to the DeviceNet Interface connection, if this AC/DC Object (#42) Instance #1, Attribute #38: Speed Control is used (at least 1 bit is set to “1”), or if the Discrete Output Point Object (#9), any of the Attributes, Instance #9 is activated, or if the cyclic process data exchange is established. Refer to Section 3.3.2 Output Assembly (Class Code #4) Attribute ID #3			

Objects

Attribute ID	Access Rule	Name	Data Type	Description		
39 (27_{hex})	Get	Speed Status	USINT	**Bit**	**Speed Control**	**Description**
				0	Running	On and Speed Actual > 0
				1	At Idle	Zero current
				2	At Standby Speed	Speed Actual = Speed Standby
				3	Coasting	Zero Torque (generator mode)
				4	Stopped	Speed Actual = 0
				5	Accelerating	Speed Actual is increasing
				6	At Reference	Speed Actual = Speed Reference
				7	Decelerating	Speed Actual is decreasing
40 (28_{hex})	Get / Set	Speed Trip Time	UINT	Maximum run up time; maximum overload time. (Exceeding of this limit leads to the corresponding error message)		
41 (29_{hex})	Get	Max Rated Speed	INT	High limit of the pump speed [RPS]		
43 ($2B_{hex}$)	Set	Speed Standby	INT	Speed setting for the standby function [RPS] Set command will only accepted at standstill of the turbopump.		
44 ($2C_{hex}$)	Get	Speed actual Data Units	UINT	Fixed value: RPS --> $1F0E_{hex}$ (rotations per second)		
45 ($2D_{hex}$)	Get	Speed Ref Data Units	UINT	Fixed value: RPS --> $1F0E_{hex}$ (rotations per second)		
46 ($2E_{hex}$)	Get	Drive On Hours	DINT	Actual value of the pump drive on hours		
100 (64_{hex})	Get	Operating Cycles	UINT	Operating Cycles of the pump: number of complete (from zero speed) and standby acceleration cycles		
101 (65_{hex})	Get	Converter hours	UINT	Number of converter operating hours		
102 (66_{hex})	Get / Set	StartTrip Time	UINT	Maximum run up time until error		

3.7 S-Device Supervisor Object

Class Code: 48 (30_{hex})
Instance ID: 1 (01_{hex})

Attribute ID	Access Rule	Name	Data Type	Description
3 (03_{hex})	Get	Device Type	SHORT STRING	Type of the DeviceNet Device; “TVP”
4 (04_{hex})	Get	SEMI Standard Revision Level	SHORT STRING	Revision level of the SEMI S/A Network Standard of the device; “E54-0997”
5 (05_{hex})	Get	Manufacturer’s Name	SHORT STRING	Manufacturer of the device; “Leybol”
6 (06_{hex})	Get	Manufacturer’s Model Number	SHORT STRING	Catalogue number of the turbo controller; format example: 400001431
7 (07_{hex})	Get	Software Revision Level	SHORT STRING	Software revision of the turbo controllers main firmware; format example: 18001
8 (08_{hex})	Get	Hardware Revision Level	SHORT STRING	Hardware revision of the turbo controller; format example: 010212
9 (09_{hex})	Get	Manufacturer’s Serial Number	SHORT STRING	Serial number of the turbo controller; format example: 30000187517
11 ($0B_{hex}$)	Get	Device Status	USINT	Status of the DeviceNet Interface Gateway and the internal data exchange 0 = Undefined 1 = Self Testing 2 = Idle 3 = Self-Test Except. 4 = Executing 5 = Abort 6 = Critical Fault 100 = Internal Serial Fault (internal data communication between DeviceNet gateway and pump controller fails) 101 = Invalid Mapping Table (an error was detected in the pump controller specific parameter translation file)
12 ($0C_{hex}$)	Get	Exception Status	BYTE	“Expanded Method” of the Exception Status Bit Map: bit 0: ALARM/device-common bit 1: ALARM/device-specific bit 2: ALARM/manufacturer-specific bit 3: 0 bit 4: WARNING/device-common bit 5: WARNING/ device-specific bit 6: WARNING/ manufacturer-specific bit 7: 1 = Expanded Method
13 ($0D_{hex}$)	Get	Exception Detail Alarm	STRUCTs of in summary 14 bytes	Structure of three structures containing a bitmap representation of alarm details; cf. table below for a detailed description of contents
14 ($0E_{hex}$)	Get	Exception Detail Warning	STRUCTs of in summary 14 bytes	Structure of three structures containing a bitmap representation of warning details; cf. table below for a detailed description
15 ($0F_{hex}$)	Get / Set	Alarm Enable	BOOL	Controls setting of Alarm bits 1 = Alarms enabled (always enabled! Set to “0” is not possible)
16 (10_{hex})	Get / Set	Warning Enable	BOOL	Controls setting of Warning bits 1 = Alarms enabled (always enabled! Set to “0” is not possible)
19 (13_{hex})	Get	Last Maintenance Date	DATE	The date on which the turbo pump was last serviced
100 (64_{hex})	Get	Pump Name	SHORT STRING	Complete name of the pump
101 (65_{hex})	Get	Pump Catalog No.	SHORT STRING	Catalog number of the pump
102 (66_{hex})	Get	Pump Serial Number	SHORT STRING	Serial number of the pump
103 (67_{hex})	Get	Pump Identifier Revision Level	SHORT STRING	Revision level of the pump identifier data set

3.7.1 Alarms

Data Component	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Common Exception Detail Size	**0**	**0**	**0**	**0**	**0**	**0**	**1**	0
Common Exception Detail Byte 0	0	Real-time Fault	0	Data Memory	Non-Volatile Memory	Code Memory	Micro-processor	Diagnostic
Common Exception Detail Byte 1	0	0	0	Scheduled Maint. Due	0	0	0	0
Turbo Pump Device Exception Detail Size	0	0	0	0	0	0	1	0
Turbo Pump Device Exception Detail Byte 0	0	Startup Timeout	0	0	Over-speed	Mains Failure	0	CNT Failure
Turbo Pump Device Exception Detail Byte 1	0	0	Bearing Fault	Cable Fault	Controller Overheat	Bearing Overheat	0	Motor Coil Overheat
Manufacturer Exception Detail Size **	0	0	0	0	1	0	0	1
Turbo Pump Device Exception Detail Byte 0 [1]	*Dropped to minimal frequency*	*Overload time exceeded*	*System overloaded*	*Motor current high*	*0*	*0*	*Frequency Error*	*0*
Turbo Pump Device Exception Detail Byte 1 [1]	*Run Time Error*	*0*	*Converter temperature too high*	*0*	*0*	*0*	*0*	*Motor temperature high*
Turbo Pump Device Exception Detail Byte 2 [1]	*0*	*Max. frequency exceeded*	*0*	*Acceleration time exceeded*	*No motor current*	*Commun. Profile failure*	*Internal commun. failed*	*Commun. to Turbo-pump failed*
Turbo Pump Device Exception Detail Byte 3 [1]	*Motor phase failure*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Turbo Pump Device Exception Detail Byte 4 [1]	*Aux. bearings worn out*	*Unidentified pump error*	*Pump memory failure*	*Bearing system overloaded*	*Orbit failure in Z-axis*	*Orbit Failure XY2*	*Orbit Failure XY1*	*0*
Turbo Pump Device Exception Detail Byte 5 [1]	*External Device Error*	*Interface Options Error*	*Pump Config. failure*	*Parameter failure*	*Display parameter failure*	*0*	*0*	*Main power out of tolerances*
Turbo Pump Device Exception Detail Byte 6 [1]	*Initial. failed*	*System communic. timeout*	*Serial com. Timeout (USS)*	*Fieldbus communic. timeout 0*	*0*	*Bearing Temp. Sensor failure*	*0*	*Motor Temp. Sensor failure*
Turbo Pump Device Exception Detail Byte 7 [1]	*Low frequency bearing current overload failure*	*Bearing current overload failure 6*	*Bearing current overload failure 5*	*Bearing current overload failure 4*	*Bearing current overload failure 3*	*Bearing current overload failure 2*	*Bearing current overload failure 1*	*Bearing current overload failure 0*
Turbo Pump Device Exception Detail Byte 8 [1]	*Bearing fault Z axis*	*Bearing fault level 2*	*Bearing fault level 1*	*Bearing power stage 4 overloaded*	*Bearing power stage 3 overloaded*	*Bearing power stage 2 overloaded*	*Bearing power stage 1 overloaded*	*Bearing power stage 0 overloaded*

[1] Italicised entries in the table above have not been finalized yet and are subject to alterations.

3.7.2 Warnings

Data Component	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Common Exception Detail Size	**0**	**0**	**0**	**0**	**0**	**0**	**1**	0
Common Exception Detail Byte 0	0	0	0	0	0	0	0	0
Common Exception Detail Byte 1	0	0	0	Scheduled Maint. Due	0	0	0	0
Turbo Pump Device Exception Detail Size	0	0	0	0	0	0	1	0
Turbo Pump Device Exception Detail Byte 0	0	0	0	0	Over-speed	Mains failure	0	0
Turbo Pump Device Exception Detail Byte 1	Motor start disabled	0	0	0	Controller Overheat	Bearing Overheat	0	Motor Coil Overheat
Manufacturer Exception Detail Size **	0	0	0	0	1	0	0	1
Turbo Pump Device Exception Detail Byte 0 [1]	*0*	*Overload time exceeded const "0"*	*System overloaded*	*0*	*0*	*0*	*0*	*0*
Turbo Pump Device Exception Detail Byte 1 [1]	*0*	*0*	*Converter temperature too high*	*0*	*0*	*0*	*0*	*Motor temperature high*
Turbo Pump Device Exception Detail Byte 2 [1]	*0*	*Max. frequency exceeded*	*0*	*0*	*0*	*0*	*0*	*0*
Turbo Pump Device Exception Detail Byte 3 [1]	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Turbo Pump Device Exception Detail Byte 4 [1]	*0*	*0*	*0*	*Bearing syst. overloaded*	*Unbalance in Z-axis*	*Unbalance in Y-axis*	*Unbalance in X-axis*	*Magnet bearing system deactivated*
Turbo Pump Device Exception Detail Byte 5 [1]	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*Main power out of tolerances const "0"*
Turbo Pump Device Exception Detail Byte 6 [1]	*reserved*	*reserved*	*reserved*	*reserved*	*reserved*	*reserved*	*reserved*	*reserved*
Turbo Pump Device Exception Detail Byte 7 [1]	*0*	*Bearing current high 6*	*Bearing current high 5*	*Bearing current high 4*	*Bearing current high 3*	*Bearing current high 2*	*Bearing current high 1*	*Bearing current high 0*
Turbo Pump Device Exception Detail Byte 8 [1]	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*

[1] Italicised entries in the table above have not been finalized yet and are subject to alterations.

3.8 S-Analog Sensor Object

Class Code: 49 (31_{hex})

3.8.1 Motor Coil Temperature (Instance 1)

Attribute ID	Access Rule	Name	Data Type	Description
5 (05_{hex})	Get	Reading Valid	BOOL	Indicates that the Value attribute contains a valid value. 0 = value invalid 1 = value valid
6 (06_{hex})	Get	Value	INT	Actual motor coil temperature value [1/10 degrees Centigrade (Celsius)]
7 (07_{hex})	Get	Status	BYTE	Alarm and Warning State of the motor temperature
17 (11_{hex})	Get	Alarm Trip Point High	INT	Motor temperature Alarm limit (determines the Value above which an Alarm condition will occur) [1/10 degrees Centigrade (Celsius)]
21 (15_{hex})	Get	Warning Trip Point High	INT	Motor temperature Warning limit (determines the Value above which an Warning condition will occur) [1/10 degrees Centigrade (Celsius)]

3.8.2 Bearing Temperature (Instance 3)

Attribute ID	Access Rule	Name	Data Type	Description
5 (05_{hex})	Get	Reading Valid	BOOL	Indicates that the Value attribute contains a valid value. 0 = value invalid 1 = value valid
6 (06_{hex})	Get	Value	INT	Bearing temperature value [1/10 degrees Centigrade (Celsius)]
7 (07_{hex})	Get	Status	BYTE	Alarm and Warning State of the bearing temperature
17 (11_{hex})	Get	Alarm Trip Point High	INT	Bearing temperature Alarm limit (determines the Value above which an Alarm condition will occur) [1/10 degrees Centigrade (Celsius)]
21 (15_{hex})	Get	Warning Trip Point High	INT	Bearing temperature Warning limit (determines the Value above which an Warning condition will occur) [1/10 degrees Centigrade (Celsius)]

3.8.3 Control Unit Temperature (Instance 4)

Attribute ID	Access Rule	Name	Data Type	Description
5 (05_{hex})	Get	Reading Valid	BOOL	Not supported; value always = 1
6 (06_{hex})	Get	Value	INT	Actual controller unit temperature value [1/10 degrees Centigrade (Celsius)]
7 (07_{hex})	Get	Status	BYTE	Alarm and Warning State of the controller unit temperature Hiigh Alarm Exception: 0 = cleared; 1 = set High Warning Exception: 0 = cleared; 1 = set
17 (11_{hex})	Get	Alarm Trip Point High	INT	Control unit temperature Alarm limit (determines the Value above which an Alarm condition will occur) [1/10 degrees Centigrade (Celsius)]
21 (15_{hex})	Get	Warning Trip Point High	INT	Control unit temperature Warning limit (determines the Value above which an Alarm condition will occur) [1/10 degrees Centigrade (Celsius)]

3.9 DeviceNet Host Object

Class Code: 252 (FC_{hex})

Instance ID: 1 (01_{hex})

Attribute ID	Access Rule	Name	Data Type	Description
7 (07_{hex})	Get / Set	Poll Produce Assembly Instance	USINT	Instance number of the assembly used to send data cf. Input Assembly Connection Object …. and CIP documentation Connection Object 5-6
8 (08_{hex})	Get / Set	Poll Consume Assembly Instance	USINT	Instance number of the assembly used to receive data cf. Input Assembly Connection Object …. and CIP documentation Connection Object 5-6

Note

On setting a valid Instance number for produce or consume assembly on the Devcie Net interface, the circuitry will perform automatically an initialization procedure, which is indicated by the same LED flashing procedure at the interface module when the MAG.DRIVE is powered on. Any invalid number will not be accepted and the initialization will not be performed. Everytime after power on of the system the default value will be activated!
The IO assemblies can changed and stored permanently by using the service interface.

3.10 Warning Class

Class Code: 100 (0x64)
Instance 1

Attribute ID	Access Rule	Name	Data Type	Description
1 (0x01)	Get	Warning Bits 1	INT	See Table below
2 (0x02)	Get	Warning Bits 2	INT	See Table below
3 (0x03)	Get	Warning Bits 3	INT	See Table below

Warning Bits 1	Designation	Possible Cause	Remedy
Bit 0	Converter Power Stage Temperature to high	The cooling water flow is too low or the cooling water temperature is too high. The converter is overloaded due to too high gas load. Frequent acceleration and deceleration of the pump.	Cooling system needs to be improved. The gas load needs to be reduced. Allow converter to cool down between the cycles.
Bit 1	Converter Housing Termperature too high	The converter is overloaded due to too high gas load.	The gas load needs to be reduced.
Bit 2	Pump Motor Temperature too high	The cooling water flow is too low or the cooling water temperature is too high.	Cooling system needs to be improved
Bit 3-4	Supply Voltage too high or too low	Usage of a wrong power supply unit. Misaligned output voltage. Too high load. Voltage drop across the supply cable.	Use correct power supply. Adjust the output voltage of the power supply. Replace the power supply by a more powerful one. Increase the copper area of the cable
Bit 5	Overspeed	The frequency setpoint has been set during operation with serial interface e.g. RS232.	Provide for correct speed setting.
Bit 6	Overload	Backing pressure too high during operation. Too high amount of gas flow during operation. Parameter «Normal Operation» is not set correctly.	Reduce backing pressure or process gas flow. Check the chamber pressure during operation. Check the «normal operation» level adjustment.

Objects

Warning Bits 1	Designation	Possible Cause	Remedy
Bit 7	Bearing Temperature too high	Frequent acceleration and deceleration of the pump.	Cooling system needs to be improved
Bit 8	Motor Start Locked	There was a fatal error before, which is not resetable.	When the pump is stillstanding, disconnect the pump from the power supply and reconnect it. If this behaviour is repeated by the pump, then contact the Leybold service department.
Bit 9	High load	Backing pressure too high during operation. Too high amount of gas flow during operation	Reduce backing pressure or process gas flow. Check the chamber pressure during operation.
Bit 10	Max. Number of Pump Operation Hours are reached	The recommended max. number of operating hours of the pump are reached.	Arrange a service date at Leybold for this pump.
Bit 11	Max. Number of Pump Runup Cycles are reached	The recommended max. number of start cycles of the pump are reached.	Arrange a service date at Leybold for this pump.
Bit 12	Magnetic Bearing has not lifted	There was a fatal error before, which is not resetable.	When the pump is stillstanding, disconnect the pump from the power supply and reconnect it. If this behaviour is repeated by the pump, then contact the Leybold service department
Bit 13	reserved		
Bit 14	MAG Bearing Overload 5	The magnetic bearing current for the individual axes is too high. The environmental vibration might be too heavy.	Reduce vibration which might affect the pump.
Bit 15	MAG Bearing Overload 6	The magnetic bearing current for the individual axes is too high. The environmental vibration might be too heavy.	Reduce vibration which might affect the pump.

Warning Bits 2	Designation	Possible Cause	Remedy
Bit 0	MAG Bearing Overload 0	The magnetic bearing current for the individual axes is too high. The environmental vibration might be too heavy.	Reduce vibration which might affect the pump.
Bit 1	MAG Bearing Overload 1	The magnetic bearing current for the individual axes is too high. The environmental vibration might be too heavy.	Reduce vibration which might affect the pump.

Warning Bits 2	Designation	Possible Cause	Remedy
Bit 2	MAG Bearing Overload 2	The magnetic bearing current for the individual axes is too high. The environmental vibration might be too heavy.	Reduce vibration which might affect the pump.
Bit 3	MAG Bearing Overload 3	The magnetic bearing current for the individual axes is too high. The environmental vibration might be too heavy.	Reduce vibration which might affect the pump.
Bit 4	MAG Bearing Overload 4	The magnetic bearing current for the individual axes is too high. The environmental vibration might be too heavy.	Reduce vibration which might affect the pump.
Bit 5	MAG Unbalance at the Upper Bearing	Deposition of material from the pumped edia at the turbo rotor Due to aggressive media, abrasion at the turbo rotor.	Check the pumped media for suitability with this pump design
Bit 6	MAG Unbalance at the Lower Bearing	Deposition of material from the pumped media at the turbo rotor Due to aggressive media, abrasion at the turbo rotor.	Check the pumped media for suitability with this pump design
Bit 7	MAG Oscillation at the Axial Bearing	The environmental vibration might be too heavy.	Reduce vibration which might affect the pump.
Bit 8	MAG Upper Radial Bearing Displacement X1	The magnetic bearing close to the high vacuum flange has been shifted radially. The environmental vibration might be too heavy.	Reduce vibration which might affect the pump.
Bit 9	MAG Upper Radial Bearing Displacement Y1	The magnetic bearing close to the high vacuum flange has been shifted radially. The environmental vibration might be too heavy.	Reduce vibration which might affect the pump.
Bit 10	MAG Lower Radial Bearing Displacement X2	The magnetic bearing close to the foreva-cuum lange has been shifted radially. The environmental vibration might be too heavy.	Reduce vibration which might affect the pump.
Bit 11	MAG Lower Radial Bearing Displacement Y2	The magnetic bearing close to the foreva-cuum lange has been shifted radially. The environmental vibration might be too heavy.	Reduce vibration which might affect the pump.
Bit 12	MAG Axial Bearing Displacement Z	The magnetic bearing has been shifted axially. The environmental vibration might be too heavy.	Reduce vibration which might affect the pump.

Warning Bits 2	Designation	Possible Cause	Remedy
Bit 13	High Number of Auxiliary Bearing Impacts	The environmental vibration might be too heavy or to many shocks or impacts interfered the pump. Too many f ull or partial auxiliary bearing run downs affected the pump.	Reduce vibration which might affect the pump. Avoid shocks or impacts at the pump. Avoid stopping the pump by switching off the mains power. Avoid disconnecting the pump cable, when the pump is still running.
Bit 14	High Amount of Cumulated Bearing Touch Down Time	The environmental vibration might be too heavy or to many shocks or impacts interfered the pump. Too many f ull or partial auxiliary bearing run downs affected the pump.	Reduce vibration which might affect the pump. Avoid shocks or impacts at the pump. Avoid stopping the pump by switching off the mains power. Avoid disconnecting the pump cable, when the pump is still running.
Bit 15	High No. of Touch Down Bearing Run Downs	The number of partial or full touchdowns into the touchdown bearings is too high. The environmental vibration might be too heavy or to many shocks or impacts interfered the pump Too many full or partial auxiliary bearing run downs affected the pump.	Reduce vibration which might affect the pump. Avoid shocks or impacts at the pump. Avoid stopping the pump by switching off the mains power. Avoid disconnecting the pump cable, when the pump is still running.

Warning Bits 3	Designation	Possible Cause	Remedy
Bit 0	Flange temperature above warning limit.	The Cooling water flow is too low or the cooling water temperature is too high. The Converter is overloaded due to too high gas load. Frequent acceleration and deceleration of the pump.	The cooling system needs to be improved. The gas load needs to be reduced. Allow converter to cool down between the cycles.
Bit 1	Temperature power stage bearing electronic	The Cooling water flow is too low or the cooling water temperature is too high. The Converter is overloaded due to too high gas load. Frequent acceleration and deceleration of the pump.	Improve cooling conditions. Reduce the vibration or shocks influence which might affect the pump
Bit 2	-	-	-
Bit 3	-	-	-
Bit 4	-	-	-
Bit 5	-	-	-
Bit 6	-	-	-
Bit 7	-	-	-
Bit 8	-	-	-
Bit 9	-	-	-
Bit 10	-	-	-
Bit 11	-	-	-
Bit 12	-	-	-
Bit 13	-	-	-
Bit 14	-	-	-
Bit 15	-	-	-

3.11 Failure Class

Class Code: 101 (0x65)
Instance 1

Attribute ID	Access Rule	Name	Data Type	Description
1 (0x01)	Get	Actual error code	INT	See Table below
2 (0x02)	Get	Error frequency	INT	Frequency when actual error occured [xxx Hz]
3 (0x03)	Get	Error hours	INT	Pump operation hours when actual error occured [xxx hour]

Error code	Designation	Description	Possible cause	Remedy
2	Motor temperature error	The motor temperature has exceeded the error threshold.	Forevacuum pressure too high, gas flow too high, defective fan, Water cooling switched off.	Check ultimate pressure of the forevacuum pump and if required install a larger forevacuum pump. Seal off leak, check process. Replace fan. Switch water cooling on.
3	Supply voltage failure	Intermediate circuit voltage is too low or maximum generator operating mode duration exceeded.	Mains supply voltage is too low. Mains voltage has failed.	Check voltage at the mains feed point. Remedy mains power failure.
4	Converter temperature failure	Overtemperature at the power output stage or inside the frequency converter.	Ambient temperature too high. Inadequate cooling owing to cooling water which is too warm.	Do not exceed the maximum ambient temperature of 45 °C. Improve cooling, comply with specified cooling water temperature and cooling water quantity.
5	Overload failure	Rotational speed has dropped below the minimum speed.	Forevacuum pressure is too high. Gas flow is too high.	Check ultimate of the forevacuum pump and if required install a larger forevacuum pump. Seal off leak, check process.
6	Run-up failure	Pump has not attained its normal operating frequency after the maximum run-up time has elapsed.	Forevacuum pressure is too high. Gas flow is too high.	Check ultimate pressure of the forevacuum pump and if required install a larger forevacuum pump. Seal off leak, check process.
7	Run-up time failure	Maximum permissible bearing temperature was exceeded.	Forevacuum pressure is too high. Gas flow is too high.	Check ultimate pressure of the forevacuum pump and if required install a larger forevacuum pump. Seal off leak. Check process.
9	Bearing temperature failure	Maximum permissible bearing temperature was exceeded.	Forevacuum pressure is too high. Gas flow is too high. Water cooling switched off. Water cooling disabled or cooling water throughput or cooling water temperature inadequate.	Check ultimate pressure of the forevacuum pump and if required install a larger forevacuum pump. Seal off leak. Replace fan. Ensure sufficient water cooling.

Objects

Error code	Designation	Description	Possible cause	Remedy
12	Orbit monitoring, level XY1	Deflection of the rotor at the radial magnetic bearing on the high vacuum side is too high.	Mechanical impacts, possibly through maintenance work. Cross influences of vibrations between several pumps. Vibration influences through external exciting. Balancing condition of the rotor insufficient due to deposits or wear.	Remove external influences. Should the error still occur inform Leybold Service; have the pump replaced.
13	Orbit monitoring, level XY2	Deflection of the rotor at the radial magnetic bearing on the forevacuum side is too high.	Mechanical impacts, possibly through maintenance work. Cross influences of vibrations between several pumps. Vibration influences through external exciting. Balancing condition of the rotor insufficient due to deposits or wear.	Remove external influences. Should the error still occur inform Leybold Service; have the pump replaced.
14	Axial orbit monitoring	Deflection of the rotor at the axial bearing is too high.	Venting gas flow is too high, mechanical impacts, possibly through maintenance work. Cross influences of vibrations between several pumps. Vibration influences through external exciting.	Remove external influences. Should the error still occur inform Leybold Service; have the pump replaced.
16	Overload duration failure	After having attained its normal operating frequency the pump was operated for a longer period of time below its normal operating frequency.	Forevacuum pressure too high. Gas flow too high.	Check ultimate pressure of the forevacuum pump and if required install a larger forevacuum pump. Seal off leak. Check process.
17	Motor current failure	Motor current below setpoint current.	With start command being present: frequency converter not properly connected to the pump or damaged connector between pump and frequency converter. Internal fault within the frequency converter.	Inform Leybold Service; have connectors and if required the cable checked. Have the converter replaced.
19	Passthrough time failure	The pump did not attain its minimum speed within the maximum passthrough time.	Forevacuum pressure too high when starting the system. Seized rotor.	Reduce forevacuum pressure. Check to ensure that the rotor rotates freely.
26	Bearing temperature sensor failure	Bearing temperature sensor is defective.	Component is defective, sensor short-circuit or interruption.	Inform Leybold Service. If required have converter respectively pump replaced.
28	Motor temperature sensor failure	Motor temperature sensor is defective.	Component is defective, sensor short-circuit or interruption.	Inform Leybold Service. If required have converter respectively pump replaced.

Error code	Designation	Description	Possible cause	Remedy
31	High load duration failure	Motor current has exceeded the warning threshold too long (time span defined through parameter “Overload time 2”).	Forevacuum pressure is too high. Gas flow is too high.	Check ultimate pressure of the forevacuum pump and if required install a larger forevacuum pump. Seal off leak. Check process conditions.
39	Magnetic bearing start-up failure	Magnetic bearing is not able to lift the rotor properly.	Pump was shock vented. Excessively high vibrations or mechanical impacts from the system. Vibration influences between several pumps.	Refer to the pump manual for correct venting of the pump. Avoid vibrations or mechanical impacts.
43	Overspeed failure	The actual frequency exceeds the setpoint frequency.	Setpoint frequency was changed during operation via a serial interface, RS 232, for example.	Provide for correct speed setting.
63	Internal parameter failure		There is a parameter mismatch which occurred during start-up or while saving the parameters. The pump was disconnected from its power supply while storing important system data was in progress.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.
65	Internal communication failure	Failure of internal data communication with the frequency converter.	Cyclic pump communication has failed.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON.
66	Magnetic bearing current too high	Overloading of one or several magnetic bearing power output stages.	Excessively high vibrations or mechanical impacts from the system.	Reduce the level of vibrations or mechanical impacts.
67	Internal overload		Internal drive overload.	Stop the pump. Wait for standstill. Switch mains power OFF and ON again and restart the system.
71	First time initialisation failure of the parameter list.	Interface parameter/table mapping error.	First time initialisation of the pump parameters has failed.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON.
73	First time initialisation failure of the parameter list.	The registered number of start and standby cycles exceeds the maximum permissible number for safe operation.	Very high number of starts respectively much use of the standby function.	Have the pump serviced.
74	Number of operating hours exceeded.	The number of operating hours of the pump exceeds the maximum permissible number of hours for safe operation.	The number of operating hours of the system has reached the level necessary for servicing.	Have the pump serviced.
75	Failure during the initialisation of the pump data.	Failure during identification and initialisation of the pump.	Failure in frequency converter or in the pump.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.

Error code	Designation	Description	Possible cause	Remedy
77	Too many touchdown bearing contacts were detected.	The registered number of touchdown bearing contacts exceeds the permissible alarm limit.	Due to external or internal influences of the pump the turbo rotor makes contact with the emergency bearings (touchdown bearings): mechanical impacts, possibly due to maintenance work. Vibration influences between several pumps. Vibration influences due to external exciting. Balancing condition of the rotor inadequate due to deposits or wear. Magnetic suspension is defective. Full or partial shutdown of the pump without magnetic bearing support due to mains power failure or failure in the frequency converter.	Have the pump serviced. If required check frequency converter and the connections. Check installation orientation of the pump and if required correct it. Avoid external influences (vibrations, impacts etc.). Review electric power supply and control concept.
78	Bearing contact time too long was detected.	The registered total duration of all touchdown bearing contacts exceeds the permissible alarm limit.	Due to external or internal influences of the pump the turbo rotor makes contact with the emergency bearings (touchdown bearings): mechanical impacts, possibly due to maintenance work. Vibration influences between several pumps. Vibration influences due to external exciting. Balancing condition of the rotor inadequate due to deposits or wear. Magnetic suspension is defective. Full or partial shutdown of the pump without magnetic bearing support due to mains power failure or failure in the frequency converter.	Have the pump serviced. If required check frequency converter and the connections. Check installation orientation of the pump and if required correct it. Avoid external influences (vibrations, impacts etc.). Review electric power supply and control concept.
79	Internal communication failure.	Failure of the internal data communication of the frequency converter.	Failure in the frequency converter.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.
80	Invalid interface module combination.	Configuration of the interface module slots is inconsistent.	Two active Fieldbus modules were inserted, the X1 24 V PLC module has been inserted into the “Service” slot.	Correct installation of the interface modules: use control interface slot (CONTROL) with Fieldbus module (Profibus), RS 485, RS 232 or X1. Equip the service slot with a RS 232, a RS 485 or an USB module only.
81	Watchdog for monitoring of USS communication has responded.	Cyclic communication has failed for a longer period of time than defined through P 182.	Cable running to the controller was removed. Controller has interrupted communication. Interface module is defective.	Reinsert cable. Check controller. Inform Leybold Service.

Error code	Designation	Description	Possible cause	Remedy
82	Watchdog for monitoring Fieldbus communication has responded.	Cyclic communication has failed for a longer period of time than defined through P 925.	Cable running to the controller was removed. Controller has interrupted communication. Fieldbus interface is defective.	Reinsert cable. Check controller. Inform Leybold Service; have frequency converter replaced.
90	Setpoint speed setting higher than permissible.	Frequency setpoint is higher than the maximum value defined through parameter 45.	Incorrect setpoint entry or parameterisation of the pump is in error.	Correct setpoint entry or run a software respectively parameter update.
200	Pump identification temperature failure	Temperature in the pump identification is too high.	Forevacuum pressure is too high. Gas flow is too high. Water cooling switched off.	Check ultimate pressure of the forevacuum pump and if required install a larger forevacuum pump. Seal off leak. Check process. Water cooling disabled or cooling water throughput or cooling water temperature inadequate.
201	Unidentifiable failure on control board	Failure affecting the control computer of the frequency converter.	External interference or hardware failure affecting the frequency converter electronics.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.
203	Failure during self test	Failure affecting the parameter table mapping.	External interference or hardware failure affecting the frequency converter electronics.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.
204	RAM area insufficient for scope functionality	Failure in the control computer of the frequency converter.	External interference or hardware failure affecting the frequency converter electronics.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.
206	Pump parameter failure	Failure during identification and initialisation of the pump or the frequency converter.	Failure in the frequency converter, in the pump respectively in the pump's cables.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.
209	Pump initialisation failure	Failure during identification and initialisation of the pump or the frequency converter.	Failure in the frequency converter, in the pump respectively in the pump's cables.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.
210	Non-cyclic data transfer to pump identification interrupted (parameter transfer)	Communication malfunction with data memory of pump identification.	Temporary EMC interference. Defective hardware.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.
213	Intermediate circuit overvoltage	The power supply voltage is too high.	The frequency converter has detected an intermediate circuit voltage which is too high.	Check power supply on the mains power side.

Objects

Error code	Designation	Description	Possible cause	Remedy
913	Temperature Power Stage Bearing electronic	The temperature has exceeded the error threshold.	The Cooling water flow is too low or the cooling water temperature is too high. Ambiant temperature to high. Too high amplitude or force of mechanical shocks or vibration fto the system.	Check cooling conditions Check ambiant conditions Reduce the vibration or shocks influence which might affect the pump
914	Initialisation of parameter 893 was not yet run	Movement range in yM saved in the pump's memory needs to be updated.	When shifting the values this failure should no longer be able to occur.	
915	Intermediate circuit voltage is too low	Intermediate circuit voltage has dropped below the necessary value.	Unstable mains power supply. Equipment failure.	Check the mains power supply
916	Sensor alignment Channel Z	Automatic sensor alignment for channel Z resulted for parameter SGAIN and/or SOFFS values outside the range which can be typically tolerated.	Parameter changes in the pump's memory.	System needs to be recalibrated and aligned by Leybold.
917	Sensor alignment channel Y2	Automatic sensor alignment for channel Y2 resulted for parameter SGAIN and/or SOFFS in values outside the range which can be typically tolerated.	Parameter changes in the pump's memory.	System needs to be recalibrated and aligned by Leybold.
918	Sensor alignment Channel X2	Automatic sensor alignment for channel X2 resulted for parameter SGAIN and/or SOFFS in values outside the range which can be typically tolerated.	Parameter changes in the pump's memory.	System needs to be recalibrated and aligned by Leybold.
919	Sensor alignment Channel Y1	Automatic sensor alignment for channel Y1 resulted for parameter SGAIN and/or SOFFS in values outside the range which can be typically tolerated.	Parameter changes in the pump's memory.	System needs to be recalibrated and aligned by Leybold.
920	Sensor alignment Channel X1	Automatic sensor alignment for channel X1 resulted for parameter SGAIN and/or SOFFS in values outside the range which can be typically tolerated.	Parameter changes in the pump's memory.	System needs to be recalibrated and aligned by Leybold.
921	Current controller initialisation	Initialisation failure affecting the current controllers.		Re-initialisation attempt by the system by restarting.
922	Initialisation MM module	Initialisation failure of different controller modules.		Re-initialisation attempt by the system by restarting.

Error code	Designation	Description	Possible cause	Remedy
923	Initialisation position task 2	Initialisation failure of software module position task 2.		Re-initialisation attempt by the system by restarting.
924	Initialisation position task 1	Initialisation failure of software module position task 1.		Re-initialisation attempt by the system by restarting.
925	Software not capable of running on the target system	Software is not capable of running on this control board.	Uploading of an incorrect software version.	Load correct software version.
926	Floating point error has occurred	The floating point unit has signalled a failure, error code in debug variable, error code floating point, message after software reset.		Re-initialisation attempt by the system by restarting.
927	System stack overflow	Not enough unoccupied memory in the system stack, message after software reset.		Re-initialisation attempt by the system by restarting.
928	User stack overflow	Not enough unoccupied memory any more.		Re-initialisation attempt by the system by restarting.
929	System stack overflow	System stack overflow, message after software reset.		Re-initialisation attempt by the system by restarting.
930	System stack underflow	System stack underflow, message after software reset.		Re-initialisation attempt by the system by restarting.
931	Word access failure	Illegal word access, message after software reset.		Re-initialisation attempt by the system by restarting.
932	Undefined operation code for protected commands	Programme was detected as incorrect and cannot be run.	Temporary problem or inadmissible changes in the flash/RAM memory.	After the system has arrived at standstill, disconnect it from the power supply to re-initialise the software.
933	Memory access error	Access to the system memory has been found to be in error.	Temporary problem or inadmissible changes in the flash/RAM memory.	After the system has arrived at standstill, disconnect it from the power supply to re-initialise the software.
934	Undefined operation code	Programme code was detected as being in error and cannot be run.	Temporary problem or inadmissible changes in the flash/RAM memory.	After the system has arrived at standstill, disconnect it from the power supply to re-initialise the software.
935	External failure affecting the safety processors	At least one of the safety processors has detected a failure.	For further analysis the status words and control words of the processors need to be read out.	System locks the power output stage of the drive unit. Wait for the system to arrive at standstill and try to enable the system by switching the mains power off and on again.
936	The current offset and gain values deviate from the initial data.			
937	The Soffset values are outside of the defined range (initialisation).			

Objects

Error code	Designation	Description	Possible cause	Remedy
938	Cable parameters soffs, sgain and xgain are at their factory defaults.			
939	Cancellation during calculation of the checksum across the range of the static parameters in the pump identification.			
940	Cancellation during the calculation of the checksum across the range of the static parameters in the frequency converter.			
941	Incompatible compiling of the profile adapter version.	Interface parameter table mapping error.	Failure during software update.	If required repeat the software update, respectively check combination of software and profile adapter file.
949	Checksum error during initialisation of the equipment settings.	Failure while operating or identifying and initialising the pump.	Failure in the frequency converter, in the pump respectively in the pump's cable.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.
950	Checksum error during initialisation of the autosave parameters	Failure while operating or identifying and initialising the pump.	Failure in the frequency converter, in the pump respectively in the pump's cable.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.
951	Error while writing a string parameter to the fixed parameter memory.	Failure while operating or identifying and initialising the pump.	Failure in the frequency converter, in the pump respectively in the pump's cable.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.
952	Failure during reading of the permanent parameter memory during the start-up phase.	Failure during operation or while identifying and initialising the pump.	Malfunction in the frequency converter, in the pump respectively in the pump's cable.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.
953	Failure while writing to the fixed parameter memory.	Failure during operation or while identifying and initialising the pump.	Malfunction in the frequency converter, in the pump respectively in the pump's cable.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.
955	Watchdog for monitoring the communication via Lustbus has responded.	Failure affecting the internal data communication of the frequency converter.	Malfunction in the frequency converter.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.
956	Profile adapter: no opcode	Failure affecting the internal data communication of the frequency converter.	Malfunction in the frequency converter.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.
957	Profile adapter: invalid opcode	Profile adapter: invalid opcode	Malfunction in the frequency converter.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.

Error code	Designation	Description	Possible cause	Remedy
958	Profile adapter: failure during reading of parameters.	Failure affecting the internal data communication of the frequency converter.	Malfunction in the frequency converter.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.
959	Profile adapter: failure during writing of parameters	Failure affecting the internal data communication of the frequency converter.	Malfunction in the frequency converter.	
979	General failure during floating point calculation	Failure affecting the control computer of the frequency converter.	External interference or hardware fault of the frequency converter electronics.	
980	Not enough memory for module parameters	Failure affecting the control computer of the frequency converter.		
982	Failure during initialisation of the generator mode.	Internal frequency converter failure.		
983	Failure during initialisation of the speed controller.	Internal frequency converter failure.		
984	Failure during initialisation of rotational speed calculation.	Internal frequency converter failure.		
985	Failure during initialisation of the current controller.	Internal frequency converter failure.		
986	Failure during initialisation of the controller.	Internal frequency converter failure.		
987	Internal failure of the state machine controller.	Internal frequency converter failure.		
988	Failure during initialisation of the motor protection module.	Internal frequency converter failure.		
989	Internal failure affecting the number formats.	Internal frequency converter failure.		
990	Failure during internal parameter access via KP 200. A parameter could not be read or written.	Internal frequency converter failure.		

Error code	Designation	Description	Possible cause	Remedy
991	Failure during initialisation of a parameter with its saved setting.	Internal frequency converter failure.	External interference or hardware fault in the frequency converter electronics.	If required, stop the pump respectively wait for it to arrive at standstill, switch power supply voltage OFF and ON; if required have the frequency converter replaced.
992	User stack has exceeded the maximum size.			
994	Runtime error during checking of the assisting parameter			
995	An exception was initiated.			
996	Non-identifiable parameter access level.			
997	Runtime error during enabling of an assisting parameter.			

Theoretically there are further error codes. Should these be displayed, please contact Leybold.
In the case of malfunctions also note the troubleshooting information provided in the Operating Instructions for the pump.

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