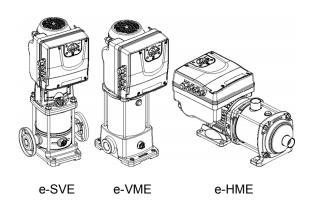
# **Smart Pump Range**

Installation, Operation and Maintenance Manual





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# 1 Introduction and safety

# 1.1 Introduction

Purpose of this manual

The purpose of this manual is to provide necessary information for:

- Installation
- Operation
- Maintenance

#### **CAUTION:**

Read this manual carefully before installing and using the product. Improper use of the product can cause personal injury and damage to property, and may void the warranty.

#### NOTICE:

Save this manual for future reference, and keep it readily available at the location of the unit.

## 1.1.1 Qualified personnel



#### WARNING:

This product is intended to be operated by qualified personnel only.

- Correct and reliable transport, storage, installation, operation, and maintenance are required
  for the trouble-free and safe operation of the frequency converter. Only qualified personnel
  are allowed to install or operate this equipment.
- Qualified personnel are defined as trained staff, who are authorized to install, commission, and maintain equipment, systems, and circuits in accordance with pertinent laws and regulations. Also, the personnel must be familiar with the instructions and safety measures that are described in this document.

# 1.2 Safety



#### WARNING:

- The operator must be aware of safety precautions to prevent physical injury.
- Unintended rotation of motors creates voltage and can charge the unit, resulting in death, serious injury, or equipment damage. Ensure that motors are blocked to prevent unintended rotation.
- Operating, installing, or maintaining the unit in any way that is not covered in this manual could
  cause death, serious personal injury, or damage to the equipment. This includes any
  modification to the equipment or use of parts not provided by Xylem. If there is a question
  regarding the intended
- Do not change the service application without the approval of an authorized Xylem representative.



#### CAUTION:

You must observe the instructions contained in this manual. Failure to do so could result in physical injury, damage, or delays.

## 1.2.1 Safety message levels

#### About safety messages

It is extremely important that you read, understand, and follow the safety messages and regulations carefully before handling the product. They are published to help prevent these hazards:

- · Personal accidents and health problems
- Damage to the product
- Product malfunction

#### **Definitions**

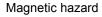
Safety message level		Indication
<u>^</u>	DANGER:	A hazardous situation which, if not avoided, will result in death or serious injury
<u> </u>	WARNING:	A hazardous situation which, if not avoided, could result in death or serious injury
<u> </u>	CAUTION:	A hazardous situation which, if not avoided, could result in minor or moderate injury
A	Electrical Hazard:	The possibility of electrical risks if instructions are not followed in a proper manner
NOTICE:		A potential situation which, if not avoided, could result in undesirable conditions     A practice not related to personal injury

#### Hot surface hazard

Hot surface hazards are indicated by a specific symbol that replaces the typical hazard level symbols:



////





#### **WARNING:**

**CAUTION:** 

A strong magnetic field is created when the rotor is removed from or inserted into the motor housing. This magnetic field can be harmful to pacemaker wearers and others with medical implants. In addition, the magnetic field may attract metal parts to the rotor which can cause injuries and/or damage the bearings of the motor.

# 1.3 User safety

### General safety rules

These safety rules apply:

- Always keep the work area clean.
- Pay attention to the risks presented by gas and vapors in the work area.
- Avoid all electrical dangers. Pay attention to the risks of electric shock or arc flash hazards.
- Always bear in mind the risk of drowning, electrical accidents, and burn injuries.

#### Safety equipment

Use safety equipment according to the company regulations. Use this safety equipment within the work area:

- Hard hat
- Safety goggles, preferably with side shields
- · Protective shoes
- Protective gloves
- Gas mask
- · Hearing protection
- First-aid kit
- · Safety devices

#### NOTICE:

Never operate a unit unless safety devices are installed. Also see specific information about safety devices in other chapters of this manual.

#### Electrical connections

Electrical connections must be made by certified electricians in compliance with all international, national, state, and local regulations. For more information about requirements, see sections dealing specifically with electrical connections.

#### Precautions before work

Observe these safety precautions before you work with the product or are in connection with the product:

- Provide a suitable barrier around the work area, for example, a guard rail.
- Make sure that all safety guards are in place and secure.
- · Make sure that you have a clear path of retreat.
- Make sure that the product cannot roll or fall over and injure people or damage property.
- Make sure that the lifting equipment is in good condition.
- Use a lifting harness, a safety line, and a breathing device as required.
- Allow all system and pump components to cool before you handle them.
- Make sure that the product has been thoroughly cleaned.
- Disconnect and lock out power before you service the pump.
- Check the explosion risk before you weld or use electric hand tools.

#### Precautions during work

Observe these safety precautions when you work with the product or are in connection with the product:

- Never work alone.
- Always wear protective clothing and hand protection.
- Stay clear of suspended loads.
- Always lift the product by its lifting device.
- Beware of the risk of a sudden start if the product is used with an automatic level control.
- Beware of the starting jerk, which can be powerful.
- Rinse the components in water after you disassemble the pump.
- Do not exceed the maximum working pressure of the pump.
- Do not open any vent or drain valve or remove any plugs while the system is pressurized.
   Make sure that the pump is isolated from the system and that pressure is relieved before you disassemble the pump, remove plugs, or disconnect piping.

Never operate a pump without a properly installed coupling guard.

#### Wash the skin and eyes

Follow these procedures for chemicals or hazardous fluids that have come into contact with your eyes or your skin:

Condition	Action
Chemicals or hazardous fluids in eyes	<ol> <li>Hold your eyelids apart forcibly with your fingers.</li> <li>Rinse the eyes with eyewash or running water for at least 15 minutes.</li> <li>Seek medical attention.</li> </ol>
Chemicals or hazardous fluids on skin	<ol> <li>Remove contaminated clothing.</li> <li>Wash the skin with soap and water for at least 1 minute.</li> <li>Seek medical attention, if necessary.</li> </ol>

# 1.4 Inexperienced users



#### **WARNING:**

This product is intended to be operated by qualified personnel only.

Be aware of the following precautions:

- This product is not to be used by anyone with physical or mental disabilities, or anyone
  without the relevant experience and knowledge, unless they have received instructions on
  using the equipment and on the associated risks or are supervised by a responsible person.
- Children must be supervised to ensure that they do not play on or around the product.

# 1.5 Protecting the environment

Emissions and waste disposal

Observe the local regulations and codes regarding:

- Reporting of emissions to the appropriate authorities.
- Sorting, recycling and disposal of solid or liquid waste.
- · Clean-up of spills.

#### **Exceptional sites**



### **CAUTION: Radiation Hazard**

Do NOT send the product to Xylem if it has been exposed to nuclear radiation, unless Xylem has been informed and appropriate actions have been agreed upon.

### Recycling guidelines

Always follow local laws and regulations regarding recycling.

Waste and emissions guidelines



Do not dispose of equipment containing electrical components together with domestic waste.

Collect it separately in accordance with local and currently valid legislation.

# 1.6 Warranty

For information about warranty, see the sales contract

# 1.7 Spare parts



#### WARNING:

Only use original spare parts to replace any worn or faulty components. The use of unsuitable spare parts may cause malfunctions, damage, and injuries as well as void the guarantee.

For more information about the product's spare parts, refer to the Sales and Service department

# 1.8 DECLARATION OF CONFORMITY

## 1.8.1 EC Declaration of Conformity (Original)

Xylem Service Italia S.r.I., with headquarters in Via Vittorio Lombardi 14 - 36075 Montecchio Maggiore VI - Italy, hereby declares that the product:

Electric pump unit with integrated variable speed drive, pressure transmitter and 2-meter cable for pressure transmitter (see label on first page)

fulfills the relevant provisions of the following European directives:

- Machinery 2006/42/EC (ANNEX II natural or legal person authorised to compile the technical file: Xylem Service Italia S.r.l.)
- Eco-design 2009/125/EC, Regulation (EU) No 547/2012 (Water pump) if MEI marked,

A John I

and the following technical standards

- EN 809:1998+A1:2009, EN 60335-1:2012+A11: 2014, EN 60335-2-41:2003+A1:2004+A2:2010, EN 62233:2008
- EN 50598-1:2014, EN 50598-2:2014

Montecchio Maggiore, 22/02/2017 Amedeo Valente

(Director of Engineering and R&D)

rev.01

## 1.8.2 EU Declaration of Conformity (No EMCD19)

1. Apparatus model/Product: see label on first page

2. Name and address of the manufacturer:

Xylem Service Italia S.r.l.

Via Vittorio Lombardi 14

36075 Montecchio Maggiore VI

Italy

- 3. This declaration of conformity is issued under the sole responsibility of the manufacturer.
- Object of the declaration:

Electric pump unit with integrated variable speed drive, pressure transmitter and 2-meter cable for pressure transmitter

5. The object of the declaration described above is in conformity with the relevant Union harmonisation legislation:

Directive 2014/30/EU of 26 February 2014

(electromagnetic compatibility)

6. References to the relevant harmonised standards

used or references to the other technical

specifications, in relation to which conformity is declared:

EN 60730-1:2011, EN 61800-3:2004+A1:2012 (Category C2),

EN 55014-1:2006+A1:2009+A2:2011, EN 55014-2:1997+A1:2001+

A2:2008, EN 61000-6-2:2005, EN 61000-6-3:2007+A1:2011

- 7. Notified body: -
- 8. Additional information:

Signed for and on behalf of: Xylem Service Italia S.r.l.

Montecchio Maggiore, 22/02/2017

Amedeo Valente

(Director of Engineering and R&D)

rev.01

Lowara is a trademark of Xylem Inc. or one of its subsidiaries.

# 2 Storage and Transportation

# 2.1 Inspect the package

- 1. Inspect the package for damaged or missing items upon delivery.
- 2. Note any damaged or missing items on the receipt and freight bill.
- 3. File a claim with the shipping company if anything is out of order.
- 4. If the product has been picked up at a distributor, make a claim directly to the distributor.

Alshuh

# 2.2 Storage guidelines

Storage location

The product must be stored in a covered and dry location free from heat, dirt, and vibrations.

#### NOTICE:

Protect the product against humidity, heat sources, and mechanical damage.

#### NOTICE:

Do not place heavy weights on the packed product.

#### NOTICE:

Refer also to par. 3.5 for storage limits.

# 2.3 Inspect the unit

- 1. Remove packing materials from the product.
- 2. Dispose of all packing materials in accordance with local regulations.
- 3. Inspect the product to determine if any parts have been damaged or are missing.
- 4. If applicable, unfasten the product by removing any screws, bolts, or straps. For your personal safety, be careful when you handle nails and straps.
- 5. Contact the local sales representative if there is any issue.

# 2.4 Transportation guidelines

#### Precautions



#### **WARNING:**

- Stay clear of suspended loads.
- · Observe accident prevention regulations in force.
- Do not damage the cables during transport; do not squeeze, bend or drag the cable.
- Always keep the cable ends dry.
- Secure the unit against tipping over and slipping until it is mounted and fixed in its final location.
- Lift and handle the product carefully, using suitable lifting equipment (stacker, crane, crane mounting device, lifting blocks, sling ropes, etc.).
- · Always lift the unit by its lifting handle.

# 2.5 System lifting



#### **WARNING:**

Assembled units and their components are heavy. Failure to properly lift and support this equipment can result in serious physical injury and/or equipment damage. Lift equipment only at the specifically identified lifting points. Lifting devices such as eyebolts, slings, and spreaders must be rated, selected, and used for the entire load being lifted.



## **WARNING: Crush Hazard**

- 1. Always lift the unit by its designated lifting points.
- 2. Use suitable lifting equipment and ensure that the product is properly harnessed.
- 3. Wear personal protective equipment.
- 4. Stay clear of cables and suspended loads.

## 2.5.1 Lifting diagrams

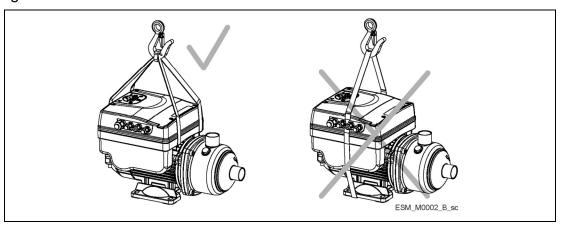


Figure 1: Lifting

# 3 Product Description

# 3.1 System description

System layout

Figure 2 and Figure 3 show a typical single-pump and multi-pump system using the unit. When the system is connected directly to the water supply use a low-pressure switch on the suction side.

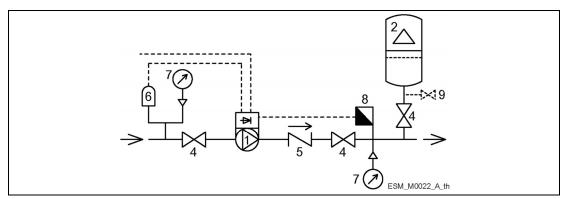


Figure 2: Single-pump system

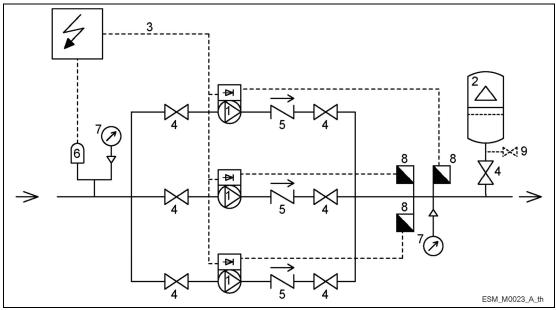


Figure 3: Multi-pump system

- 1. Pump with e-SM Motor Drive
- 2. Diaphragm pressure tank
- 3. Distribution panel
- 4. Gate valve
- 5. Non-return valve
- 6. Low water control
- 7. Pressure gauge
- 8. Pressure sensor
- 9. Drain tap

#### Pressure tank

A diaphragm pressure tank is used on the discharge side of the pump to maintain pressure in the pipes when there is no water demand. The unit stops the pump from continuing to run at zero demand and reduce the size of the tank that is required for supply purposes. The tank must be permitted and suitable for systems pressure.

# 3.2 Product function and use

#### Description

The product is a vertical/horizontal multistage non self-priming variable speed electropump.

#### Intended use

The product can be used to pump:

- Cold water
- Hot water

Refer to the standard Installation, Operation and Maintenance Manual for pump design specification.

The variable speed electropumps are made for the following applications:

- Pressure, level, and flow regulation (open loop systems)
- · Irrigation applications with single or multiple pumps

#### Improper use

The product must not be used for closed loop systems.

#### Approval and certifications

See motor nameplate for approvals:

- . C€only
- . ( E + c **%** us.

# 3.3 Applications

The application alternatives for the product are the following:

### 3.3.1 Actuator (constant speed)

The unit operates as an actuator according to speed set point; this is done through user interface, the corresponding analog input or the communication bus.

### 3.3.2 Controller (constant pressure)

This mode is set as the default operating mode and is used for a unit in a single pump operation.

#### 3.3.3 Cascade serial / Cascade synchronous

The units are connected via the RS485 interface and communicate via the provided protocol. The combination of the different units which are used in a multi-pump system depends on the system requirements.

It is possible to run all pumps in cascade serial mode and cascade synchronous mode as well. If one unit fails, then each pump of the system can become the lead pump and can take control.

# 3.4 Data plates

#### 3.4.1 Motor

### Motor data plate

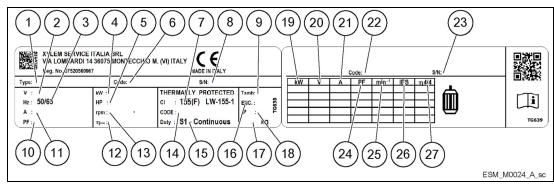


Figure 4: Motor data plate

- Type definition code
   Rated voltage
   Rated frequency
   Rated power [kW]
   Rated power [HP]
   Part number
   Insulation class
   Serial number
   Maximum ambient te
- 9. Maximum ambient temperature10. Power factor
- 12. Motor drive efficiency13. Full power speed range

11. Rated current

14. Code letter for locked rotor

- 15. Duty type
- 16. Enclosure type
- 17. Weight
- 18. Protection class
- 19. Shaft power
- 20. Voltage
- 21. Current
- 22. Part number
- 23. Serial number
- 24. Power factor
- 25. Speed
- Power drive system efficiency class (according to EN 50598-2)
- 27. Full load efficiency

## Motor type definition code

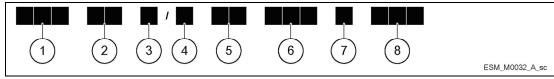


Figure 5: Motor type definition code

1. Series ESM

Motor frame 90R: Oversized Flange dimension 80: Standard Flange

3. Shaft extension □□: Standard shaft extension S8: Custom Shaft extension

4. Power supply 1: single phase power supply

3: three phase power supply

5. Shaft power • 10 [kW] 03: 0.37kW (0.50HP)

05: 0.55kW (0.75HP) 07: 0.75kW (1.00HP) 11: 1.10kW (1.50HP) 15: 1.50kW (2.00HP) 22: 2.20kW (3.00HP)

6. Motor frame SVE: Flange with tapped holes and shaft w/o keyseat

arrangement B14: Flange with tapped holes

B5: Flange with free holes

HMHA:Suitable for 1÷5 e-HM monolithic pumps HMHB:Suitable for 1÷5 e-HM w/sleeve pumps

HMVB:Suitable for 1÷5 e-VM pumps HMHC:Suitable for 10÷22 e-HM pumps HMVC:Suitable for 10÷22 e-VM pumps LNEE: Suitable for In-Line pumps 56J: Compliant to NEMA 56 Jet standard

56C: Compliant to NEMA 56C standard

7. Reference market □□: Standard EU:EMEA

US: North America

208-240: 208-240VAC 50/60Hz 8. Voltage

> 380-460: 380-460VAC 50/60Hz 230/400: 208-240/380-460VAC 50/60Hz

## 3.4.2 Pump

#### e-HME/e-VME data plate

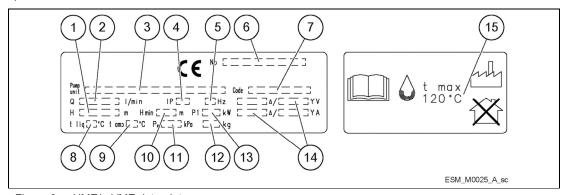


Figure 6: e-HME/e-VME data plate

- 1. Head range
- 2. Capacity range
- 3. Pump/electric pump unit type definition code
- 4. Protection class
- 5. Frequency
- 6. Serial number (date+progressive number)
- 7. Electric pump unit/pump part number
- 8. Maximum operating liquid temperature (uses as EN 60335-2-41)
- Maximum operating ambient temperature
- 10. Mimimum head (EN 60335-2-41)
- 11. Maximum operating pressure
- 12. Electric pump unit weight
- 13. Electric pump unit absorbed power
- 14. Electrical data
- 15. Maximum operating liquid temperature (uses other than as EN 60335-2-41)

#### e-HME type definition code

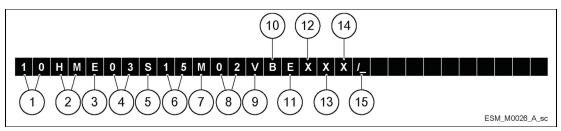


Figure 7: e-HME type definition code

Flow rate [10] = m³/h
 Series name [HM]
 Motor operation [E] = e-SM
 Number of impeller [03] = 3 impellers

5. Material pump [S] = Stainless steel (AISI 304)

6. Motor power kW x 10

7. Phase [M] = Single-phase

[T] = Three-phase

8. Electrical Voltage e-SM Power supply

02 = 1x208-240 V 04 = 3x380-460 V

05 = 3x208-240/380-460 V

9. Rotating part [Q] = Silicon Carbide  $(Q_1)$ 

[V] = Aluminium oxide (Ceramic)

10. Stationary part [Q] = Silicon Carbide  $(Q_1)$ 

[B] = Carbon resin impregnated

11. Elastomers [E] = EPDM

[V] = FPM

[K] = FFPM (Kairez®)

12. Null = None

Z = other

13. Null = None14. Connections Null = Threaded

15. Null or letter assigned by the manufacturer

#### e-VME type definition code

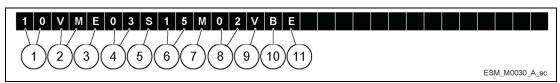


Figure 8: e-VME type definition code

Flow rate [10] = m³/h
 Series name [VM]
 Motor operation [E] = e-SM
 Number of impeller [03] = 3 impellers

5. Material pump [P] = Stainless steel AISI 304 with Noryl™ impellers

6. Motor power kW x 10

7. Phase [M] = Single-phase electric pump

[T] = Three-phase electric pump

8. Electrical Voltage [2] = 1x208-240 V

[4] = 3x380-460 V

[5] = 3x208-240/380-460 V

9. Rotating part [V] = Aluminium oxide (Ceramic)10. Stationary parts Carbon resin impregnated

11. Elastomers [E] = EPDM

#### e-SVE data plate

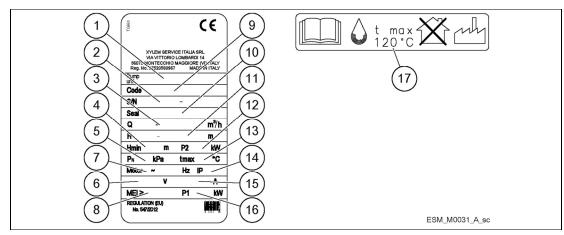


Figure 9: e-SVE data plate

- 1. Pump/electric pump unit type
- 2. Serial number (date+progressive number)
- 3. Capacity range
- 4. Minimum head (EN 60335-2-41)
- 5. Maximum operating pressure
- 6. Rated voltage range
- 7. Frequency
- 8. Minimum efficiency index
- 9. Electric pump unit/ pump part number

- 10. Mechanical seal material identification code
- 11. Head range
- 12. Motor nominal power
- Maximum operating liquid temperature (uses as EN 60335-2-41)
- 14. Protection class
- 15. Current
- 16. Electric pump unit absorbed power
- 17. Maximum operating liquid temperature (uses other than as EN 60335-2-41)

#### e-SVE type definition code

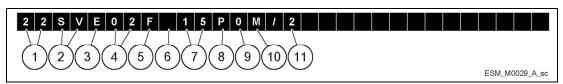


Figure 10: e-SVE type definition code

Flow rate [22] = m³/h
 Series name [SV]
 Motor operation [E] = e-SM
 Number of impeller [02] = 2 impellers

5. Material pump [F] = Stainless steel AISI 304, round flanges (PN 25)

[T] = Stainless steel AISI 304, oval flanges (PN 16)

[R] = Stainless steel AISI 304, discharge port above suction, round flanges (PN 25)

[N] = Stainless steel AISI 316, round flanges (PN 25)

6. Version Null = standard version

7. Motor power
 8. Poles
 9. Frequency
 10. Phase
 kW x 10
 [P] = e-SM
 Null = pump

[M] = Single-phase electric pump [T] = Three-phase electric pump

11. Electrical Voltage [2] = 1x208-240 V

[4] = 3x380-460 V

[5] = 3x208-240/380-460 V

# 3.5 Motor technical data

Table 1: Electrical, Environmetal and Installation specifications

		e-SM Drive model									
	103	105	107	111	115	303	305	307	311	315	322
Input											
Input frequency [Hz]					5	50/60 ±	2				
Mains supply			LN					L1 L	2 L3		
Nominal input voltage [V]		208	3÷240 ±:	10%		2	08÷240	/ 380÷4	160 ±109	%	380÷ 460 ±10%
Max. Input Current Continuous [A]	2,3	3,3	4,4	6,3	8,6	-	-	-	-	-	-
PDS Efficiency Class						IES2					
Output											
Min÷Max Speed [rpm]					8	800÷360	0				
Leakage Current [mA]						< 3,5					
I/O auxiliar + 15VDC power supply [mA]	Imax < 40										
Fault signal relay	1 x N	IO Vmax <	250 [VAC	[] , Imax <	2 [A]		2 x NO V	/max < 250	) [VAC] , I	max < 2 [ <i>A</i>	١]
EMC (Electro Magnetic Compatibility)		Installa		ust be d	one acco	RATION ording to pigtails	e EMC g	ood pra		idelines	
Sound Pressure LpA [dB(A)]			@3000 @3600								
Insulation class					С	lass 155	F				
Enclosure Rate			Protec			nclosure om dire			rainfall		
Relative humidity (storage & operating)					5%	ú ÷ 95%	RH				
Storage temperature [°C] /[°F]	-25÷65 / -13÷149										
Operating temperature [°C] /[°F]	-20÷50 / -4÷122										
Air Pollution	Pollution Degree 2										
Altitude	Max. 1000 [m] /3280 [feet] above sea level. For installation over 1000 [m] above sea level de-rating may occur					bove					

# 3.6 Dimensions and weights

# Reading instructions

Drawings show dimensions only in millimeters. The images are not to scale.

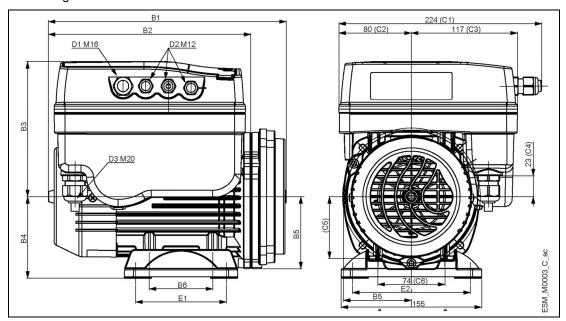


Figure 11: Dimensions

Table 2: Dimensions and weights

Model		k length + drive) g]	B1	В2	В3	В4	В5	В6	C1	C2	СЗ	C4	<b>C</b> 5	C6	D1	D2	D3	E1	E2						
	103, 105, 107	111, 115	[mm]																						
ESM90RLNEE	7.4	8.9	376			-	79											-	-						
ESM 90RS8LNEE	7.3	8.8	343			-	79											-	-						
ESM90RB14-SVE	7.5	9	292			-	79											-	-						
ESM90RB5	7.5	9	292			-	100											-	-						
ESM80HMHA ESM80HMHA US ESM80HMHA EU	7.5	9	263			90	79											100	125						
ESM80HMHB ESM80HMHB US ESM80HMHB EU	7.6	9.2	268			90	80										M20		125						
ESM80HMVB ESM80HMVB US ESM80HMVB EU	7.4	8.9	268	224	149	-	80	70	224	80	117	23	68	74	M16	M12		-	-						
ESM80HMHC ESM80HMHC US ESM80HMHC EU	7.9	9.4	272			90	91											100	125						
ESM80HMVC ESM80HMVC US ESM80HMVC EU	7.6	9.1	272			-	91											-	-						
ESM80BG	7.3	8.8	282		282 307			-				-	108											-	-
ESM90R56J	7.5	9.1	307																89	83					
ESM90R56C	7.2	8.8	294			-	83										1/2"	-	-						
= 103, 105, 107, 111, 115 Blank cell = motor foot is missing																									

#### Free distance

Table 3: Free distance

Area	e-SM Drive model	Free Distance		
Above the unit	103105107111115	> 260mm (10.2 in)		
Center-distance between units (to	103105107111115	> 260mm (10.2 in)		
ensure space for cabling)	303305307311315322	≥ 300mm (11.8 in)		

# 3.7 Design and layout

Parts and descriptions

The unit can be fitted with the features the application requires.

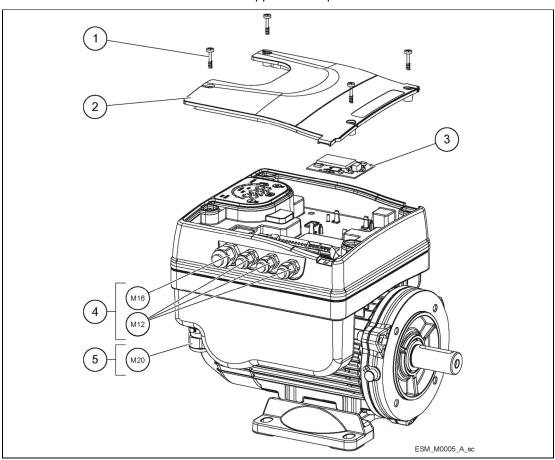


Figure 12: Open terminal box cover on drive models 103, 105, 107, 111, 115

Table 4: Part description

Position	Description	Tightening torque			
number	Description	[Nm]	[in•lbs]		
1	Captive Screws	1.2	11		
2	Terminal Box Cover	-	-		
3	Optional module with strip	-	-		
4	IO Cable gland M12 (3x) / M16 (1x)	0.7/2	6.4/18.3		
5	M20 Power cable gland	2.7	24.75		

# 3.8 Pre-assembled exfactory components

Table 5: Included components

		Cable Oute	er Diameter	e-SM Drive model			
Included compon	ents	[mm] [inches]		103, 105, 107, 111, 115	303, 305, 307, 311, 315, 322		
Cable Gland(s)	M12	3.7 ÷ 7.0	0.145 ÷ 0.275	3	3		
and Lock Nut(s)	M16	4.5 ÷ 10.0	0.177 ÷ 0.394	1	1		
Cable Gland	M20	7.0 ÷ 13.0	0.275 ÷ 0.512	1	1		
	M12	incl	uded	3	3		
Plug(s) for Cable Gland(s)	M16	incl	uded	1	1		
	M20	incl	uded	1	1		

# 3.9 Optional components

Table 6: Optional components

Component	Description			
Sensors	The following sensors can be used with the unit:  • Level-sensor			
RS485 Module	To connect and interact by wire with e-SM Drive			
Wireless Module	To connect and interact wireless with e-SM Drive			
Adaptor	M20 Metric to 1/2" NPT Adapter (item is always supplied for US market)			

# 4 Mechanical Installation

# 4.1 Installation site checklist



#### DANGER:

Never install the unit in an explosive or flammable environment.



## WARNING:

- Always refer to the local and national regulations, legislation, and codes in force regarding selection of installation site, and water and power connections.
- Keep the manual, drawings, and diagrams accessible for detailed installation and operation instructions. It is important that the manual is available for equipment operators.
- Ensure that the ingress protection rating of the Unit (IP 55, Type 1) is suitable for the installation environment.



#### **CAUTION:**

- Ingress protection. IP55 (Type 1) rating can only be guaranteed if the unit is properly closed.
- Make sure that there is no liquid on the unit before opening the plastic cover.
- Ensure all cable glands and unused holes for glands are properly sealed.
- Ensure that the plastic cover is properly closed.
- Device damage through contamination. Do not leave unit without the Terminal Box Cover.

# 4.2 Unit installation

Install the unit according to the systems liquid flow.

- Usually arrows on the pump housing show flow and rotating direction.
- The standard rotating direction for the unit is Clockwise (seen from fan cover). For more information contact Service.
- The unit must be installed according to Figure 13.
- Always install a backflow-prevention device on the delivery side.
- Always install downstream the pressure transmitter (if any) supplied.

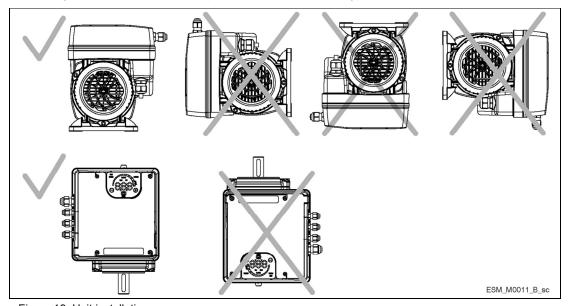


Figure 13: Unit installation

# 4.3 Outdoor installation

When the unit is installed outdoors a suitable cover must be provided. See Figure 14.

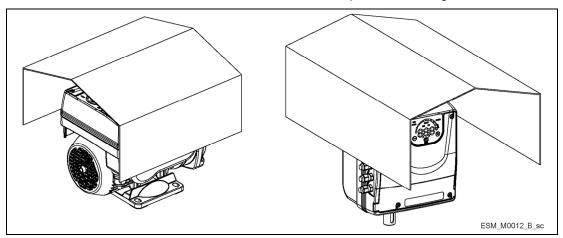


Figure 14: Outdoor installation

The cover must be sized to ensure that the motor is not exposed to snow, rain or direct sunlight. When fitting a cover to the motor, observe the guideline in section 3.6, table 4.

# 5 Electrical Installation

# 5.1 Precautions



#### **WARNING:**

EQUIPMENT HAZARD. Rotating shafts and electrical equipment can be hazardous. All
electrical work must conform to national and local electrical codes. Installation, start-up, and
maintenance must be performed by trained and qualified personnel. Failure to follow these
guidelines could result in death or serious injury.



#### **Electrical Hazard:**

 All electrical wiring must be carried out by an authorized electrician, in accordance with the electrical regulations locally in force.

# 5.2 Electrical requirements

The local regulations in force overrule specified requirements listed below.

Electrical connection checklist

Check that the following requirements are met:

- The electrical leads are protected from high temperature, vibrations, and collisions.
- The current type and voltage of mains connection must correspond to the specifications on the data plate on the pump.
- The power supply line is provided with:
- A high-sensitivity differential switch (30 mA) [residual current device RCD] suitable for earth fault currents with DC or pulsating DC content (a Type B RCD is suggested).
- A mains isolator switch with a contact gap of at least 3 mm.

The electrical control panel checklist

#### NOTICE:

The control panel must match the ratings of the electric pump. Improper combinations could fail to guarantee the protection of the unit.

Check that the following requirements are met:

- The control panel must protect the pump against short-circuit. A time lag fuse or a circuit breaker (Type C model is suggested) can be used to protect the pump.
- The pump has built in overload and thermal protection, no additional overload protection is required.



#### **Electrical Hazard:**

Before starting work on the unit, make sure that the unit and the control panel are isolated from the power supply and cannot be energized.

Grounding (earthing)



## **Electrical Hazard:**

Always connect the external protection conductor to ground (earth) terminal before making other electrical connections.

All electrical equipment must be ground (earth) connected. This applies to the pump unit and related equipment. Verify the pump ground terminal is earthed.

- · Keep the ground wire connections as short as possible.
- Use high-strand wire to reduce electrical noise is recommended.

# 5.3 Wire type and ratings

- All wiring must comply with local and national regulations regarding cross section and ambient temperature requirements.
- Use cables with a minimum heat resistance of +70 °C (158 °F); to obey the UL (Underwriters Laboratories) regulations, it is recommended that all power connections be made with a minimum 75°C rated copper wire of the following types: THW, THWN.
- The cables never have to touch the motor housing or the pump or the pipeline.
- Wires connected to supply terminals and fault signal relay (NO,C) must be separated from others by reinforced insulation.

Table 7: Recommended power connections cables

	Power supply i	nput cable + PE	Tightening torque			
e-SM Drive models	Wire numbers x Max. copper section	Wire numbers x Max. AWG	Mains and motor cable terminals	Earth Conductor		
103, 105, 107, 111, 115	3 x 1.5 mm <sup>2</sup> 3 x 0.0023 sq.in	3 x 15 AWG	Spring connectors	Spring connectors		
303, 305, 307, 311, 315, 322	4 x 1.5 mm <sup>2</sup> 4 x 0.0023 sq.in	4 x 15 AWG	0.8 Nm 7.1 lb-in	3 Nm 26.6 lb-in		

#### Control cables

External volt free contacts must be suitable for switching < 10 VDC.

#### NOTICE:

Control cables must be installed separate both from power supply cable and fault signal relay cable. If control cables are installed in parallel to power supply cable or fault signal relay cable for a longer distance, the distance between these cable should be more than 200 mm. Do not cross power cables. If this is not possible, cross them only in a an angle of 90°.

Table 8: Recommended control cables

e-SM Drive control cables Wires number x Max. copper Section		AWG	Tightening torque
All I/O conductors	0.75÷1.5 mm <sup>2</sup> 0.00012÷0.0023 sq.in	18÷16 AWG	0.6 Nm 5.4 lb-in

# 5.4 Power supply connection



## WARNING:

Do not make any connection in the pump control box unless the power supply has been switched off for at least 2 minutes.

Table 9: Power supply wiring procedure

		Reference Figure	
		e-SM Drive models 103, 105, 107, 111, 115	e-SM Drive models 303, 305, 307, 311, 315, 322
	Open the terminal box cover, remove the screws (1) Use the M20 cable gland for the power cable.	Fig. 12	-
4.	Connect the cable according to the wiring diagram.  Connect the ground (earth) lead. Make sure that the ground (earth) lead is longer than the phase leads.  Connect the phase leads.	Fig. 15 Fig. 16	-
6.	Close the terminal box cover and tight the screws.	Fig. 12	-

Table 10: I/O wiring procedure

		Reference Figure	
		e-SM Drive models 103, 105, 107, 111, 115	e-SM Drive models 303, 305, 307, 311, 315, 322
1.	Open the terminal box cover, remove the screws (1)	Fig. 12	-
2.	Connect the cable according to the wiring diagram.	Fig. 15 Fig. 16	-
3.	Follow additional requirements of table 13		
4.	Close the terminal box cover and tight the screws.	Fig. 12	-

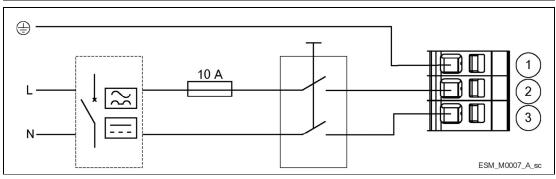


Figure 15: Wiring diagram

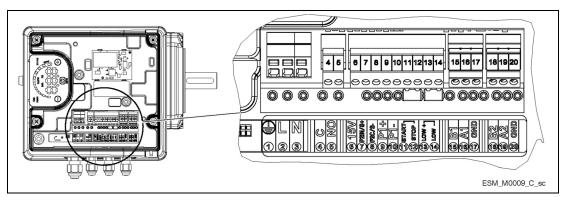


Figure 16: Connection label

Table 11: I/O terminals

Item	Terminals	Number	Description	Comments
Fault Signal	С	4		In case of Power Wires: use
i auit Sigilai	No	5		M20 cable gland
Auxiliary Voltage Supply	15V	6	Voltage Supply	15VDC, Σ max. 100mA
	P2IN/S+	7	Actual value voltage	0÷10 VDC
Analog 0-10V	P2C/S-	8	Ground for external sensor or external speed control	GND, electronic ground (for S+)
External Pressure sensor	P1+	9	Voltage Supply	15VDC, Σ max. 100mA
[also Differential]	P1-	10	Actual value current	4÷20 mA
	START	11	External ON/OFF input	Default short circuited.
External Start/Stop	STOP	12	Ground for external ON/OFF input	Pump is enabled to RUN
	LOW+	13	External Lack of Water	Default short circuited.
External Lack of Water	LOW-	14	Ground for External Lack of Water	Lack of Water Detection: enabled
	B1	15	RS485 port 1: RS485 -1N	ACT, HCS control mode:
	A1	16	RS485 port 1: RS485 -1P	RS 485 port1 for external communication
Communication Bus	GND	17	GND, electronic ground	MSE, MSY control mode: RS 485 port1 for multi-pump systems
	B2	18	RS485 port 2: RS485 -2N	
Communication Bus	A2	19	RS485 port 2: RS485 -2P	RS 485 port2 for external communication
	GND	20	GND, electronic ground	

# 6 Operation

In case of co-existance of two or more of the following conditions:

- · high ambient temperature
- high liquid temperature
- duty points insisting on unit maximum power
- · persisting undervoltage of mains,

life expectancy of the unit may be affected and/or derating may occur: contact your Sales and Service Department for more information.

# 6.1 Discharge time



#### **WARNING:**

Disconnect and lock out electrical power and wait for the minimum waiting time specified below. Failure to wait the specified time after power has been removed before performing service or repair could result in death or serious injury.

Frequency converters contain DC-link capacitors that can remain charged even when the frequency converter is not powered. To avoid electrical hazards, disconnect:

- AC mains
- Any permanent magnet type motors
- Any remote DC-link power supplies, including battery backups, ups and DC-link connections to other frequency converters.

Wait for the capacitors to discharge completely before performing any service or repair work. Refer to the table 12 for wait times.

Table 12: Wait times

e-SM Drive model	Minimum waiting times (min)
103, 105, 107, 111, 115	4
303, 305, 307, 311, 315, 322	

# 7 Programming

## Precautions

#### NOTICE:

Read and follow the operating instructions carefully before you start programming. This is to prevent incorrect settings which cause malfunction. All modifications must be done by qualified technicians.

# 7.1 Control panel

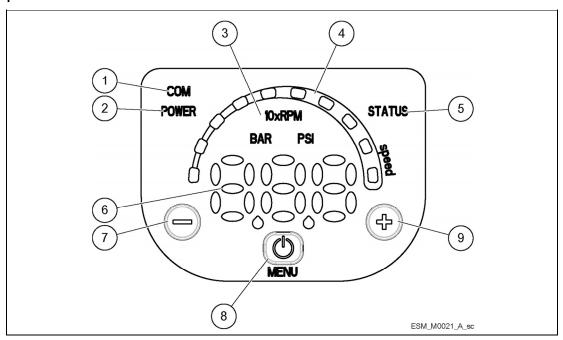


Figure 17: Control panel

Table 13: Part description

Position number	Description	See paragraph
1	Communication LED	7.3.4
2	Power LED	7.3.1
3	Unit of measure LEDs	7.3.5
4	Speed LED bar	7.3.3
5	Status LED	7.3.2
6	Numeric display	7.4
7	Doutton	7.2
8	button	7.2
9	button	7.2

# 7.2 Functions of push buttons

Table 14: Functions of push buttons

Push button	Function
	<ol> <li>Main Visualization (see par. 7.4.1): decrease the required value related to the selected control mode.</li> <li>Parameters Menu Visualization (see par. 7.4.2): decrease the parameter index visualized.</li> <li>Parameters Editing/Visualization (see par. 7.4.2): decrease the displayed parameter value.</li> <li>Zero Pressure Autocalibration (see par. 7.5, P44): perform autocalibration of pressure sensor.</li> </ol>
4	<ol> <li>Main Visualization (see par. 7.4.1): increase the required value related to the selected control mode</li> <li>Parameters Menu Visualization (see par. 7.4.2): increase the displayed parameter index.</li> <li>Parameters Editing/Visualization (see par. 7.4.2): increase the parameter value.</li> <li>Zero Pressure Autocalibration (see par. 7.5, P44): perform autocalibration of pressure sensor.</li> </ol>
	<ol> <li>Main Visualization (see par. 7.4.1): START/STOP the pump</li> <li>Parameters Menu Visualization (see par. 7.4.2): switch to Parameters Edit Visualization.</li> <li>Parameters Edit Visualization (see par. 7.4.2): save the parameter value.</li> </ol>
long press	Main Visualization (see par. 7.4.2): switches to Parameter Selection. Parameters Menu Visualization: switches to Main Visualization
and T	Main Visualization: switch between units of measure Speed and Head (see par. 7.4.1).
and	Main Visualization: switch between units of measure Speed and Head (see par. 7.4.1).

# 7.3 LEDs description

#### 7.3.1 Power LED

When the **POWER** (green) LED is lit, the pump is supplied with power and the electronic devices are operative.

#### 7.3.2 Status LED

- If the STATUS LED is not lit, then the pump is stopped or disabled (the pump motor is not running).
- If the STATUS (green) LED is lit, then the pump is running
- If the STATUS (orange) LED is lit a non-blocking alarm is detected while the pump is stopped.
- If the STATUS (orange) LED is lit alternate with STATUS (green), a non-blocking alarm is detected while the pump is running.
- If the STATUS (red) LED is lit, a blocking error is detected and the pump is stopped (the pump motor is not running).

### 7.3.3 Speed LED bar

The Speed LED bar, is composed by 10 LEDs and each of them represents a % step (from 10% to 100%) of the interval, between the absolute minimum (P27) and maximum (P26) speed parameters values.

LEDs are lit if motor is running and its speed reaches the specific % step represented by each of them.

If motor is running and its speed is lower than the absolute minimum (P27), the first LED blinks. When motor is stopped, all arc's LEDs are switched off.

#### 7.3.4 Communication LED

The way the COM LED is lit (permanently) or blinks, depends on several settings and conditions as below.

#### Condition 1

If no optional communication module is used and the protocol for the communication bus is Modbus RTU (parameter P50 is set to value "Modbus"):

- If the COM LED is not lit, then the drive cannot detect any valid Modbus message on the terminals provided for the communication bus
- If the COM (green) LED is permanently lit, then the drive both detected a communication bus
  on the provided terminals acknowledged the correct addressing
- If the COM (green) LED is blinking with 50% duty every second, then the drive detected a
  communication bus on the provided terminals has not been correctly addressed.

Particular behaviors (in this condition) for this LED are the following:

- If the COM (green) LED switches from being permanently lit to being not lit, then the drive didn't detect any valid Modbus RTU message (at least) for the last 5 seconds
- If the COM (green) LED switches from being permanently lit to blinking with 50% duty every second, then the drive has not been correctly addressed (at least) for the last 5 seconds.

#### Condition 2

If no optional communication module is used and the protocol for the communication bus is Bacnet MSTP (parameter P50 is set to value "Bacnet"):

- If the COM LED is not lit, then the drive didn't receive any valid request, coming from any other Bacnet MSTP device, (at least) for the last 5 seconds
- If the <u>COM</u> (green) LED is permanently lit, then the drive is exchanging information with any
  other Bacnet MSTP device.

#### Condition 3

If no optional communication module is used and a Multipump control mode is selected (Ex. MSE or MSY):

- If the COM LED is not lit, then the drive didn't receive any valid request, coming from other pumps through the Multipump BUS, (at least) for the last 5 seconds
- If the **COM** (green) LED is permanently lit, then the drive is exchanging information with other pump through the Multipump BUS.

#### Condition 4

If the optional communication module is used:

- If the COM LED is not lit, then the connection with the wireless module is damaged or absent
- If the COM (green) LED is blinking with 10% duty every second, then the drive is exchanging information with the communication module.

## 7.3.5 Unit of measure LEDs description

Speed

When Speed (pump impeller speed) is the measurement selected:

- The current rotation speed measure [expressed as revolutions per minute divided by 10] is displayed on the numeric display
- The 10xRPM LED is lit.

Head

When Head (hydraulic water head) is the measurement selected:

- The current water head measured expressed in BAR (or PSI) of water head, (dependent from P41 value, see par. 7.5.4 ) is displayed on the numeric display
- The BAR (or PSI) LED is lit.

# 7.4 Numeric display

### 7.4.1 Main visualization

Off mode

is visualized when the contacts [11,12] (see par. 5.5) are not short circuited. Off mode, has lower visualization priority than Stop mode.

Stop mode

is visualized when the pump is manually stopped.

If the pump is powered-on having previously set P04 = Off (see par. 7.5.1), pump is stopped so pump motor is not running and STP blinks ( $\blacksquare$   $\rightarrow$   $\blacksquare$  ).

To manually stop the pump, follow next examples:

 Example 1 (valid for HCS, MES, MSY control modes with an initial required value (Head) of 4.20 [BAR] and a minimum value of 0.5 [BAR]):

**BAR**  $420 \rightarrow \bigcirc$  single press  $\rightarrow 569$ .

10xRPN

• Example 2 (valid for ACT control mode with an initial required (Speed) value of 200 [10xRPM] and a minimum value of 80 [10xRPM]):

**10xRPM**  $200 \rightarrow \bigcirc$  single press  $\rightarrow \bigcirc$  5LP

Running mode

is visualized for few seconds, when the contacts [11,12] are short circuited and the pump is not in Stop Mode.

This visualization indicates that the pump is switched on and the motor shall start (dependently from selected control mode).

To manually set the pump to Running Mode, follow next examples:

• Example 1 (valid for HCS, MES, MSY control modes reaching a required value (Head) of 4.20 [BAR] by starting with a minimum value of 0.5 [BAR], after a manual stop):

5EP  $\rightarrow$   $\bigcirc$  single press  $\rightarrow$   $\bigcirc$   $\bigcirc$  after few seconds...  $\rightarrow$   $\bigcirc$  BAR.

 Example 2 (valid for ACT control mode reaching a required value (Speed) of 200 [10xRPM] by starting with a minimum value of 80 [10xRPM], after a manual stop):

While pump is running, both Actual Head and Actual Speed can be shown by Numeric display [6] as in the following examples:

• Example 3 (valid for HCS, MES, MSY control modes with an Actual Head of 4.20 [BAR] and a corresponding Actual Speed of 352 [10xRPM]):

BAR H28 → ② + ⊕ → B52 10XRPM → after 10 seconds or ② + □ → H28 BAR

• Example 4 (valid for ACT control mode with an Actual Speed of 200 [10xRPM] and a

corresponding Actual Head of 2.37 BAR): 10xRPM  $200 \rightarrow \bigcirc + \bigcirc + \bigcirc \rightarrow 231 BAR \rightarrow after 10 seconds or <math>\bigcirc + \bigcirc \rightarrow 200$ 

#### 7.4.2 Parameters menu visualization

This menu allows the selection of all drive's parameters (see par. 7.5) and the access (see par. 7.2) to the Parameters Editing/Visualization for each of them.

#### Power on

After power on, accessing to Parameters Menu Visualization, if parameter P23 = ON, the Numeric display [6] shows P20 blinking as follow (see par. 7.2 and par. 7.5.1):

 $\blacksquare \mathsf{CU} \to \blacksquare \mathsf{CU}$ 

Input password is required to unlock parameters visualization and editing.

#### Password timeout

If P23 = ON and no buttons are pressed for more than 10 minutes after last Parameters Menu Visualization accessing (see par. 7.2), the parameters visualization and editing will be locked. Still input password is required to unlock parameters visualization and editing.

#### Parameters Menu

If P23 = OFF or after inputs correct password (P20), parameters visualization and editing will be unlocked.

Accessing to the Parameters Men, the Numeric display [6] shows:



Parameter's index blinks to indicate the possibility of parameter selection.

#### Parameters Editing / Visualization

Accessing to a parameter's value, If the parameter is both readable and writable, its value can be changed using the push buttons or trough communication protocol (Modbus or BACnet). Going back to Parameters Menu, the index of visualized parameter is automatically increased. For a detailed description of each parameter, refers to par. 7.5.

Some examples of Parameters Editing/Visualization, are reported below:

Example 1 (P20) from 000 to 066: 000

Example 2 (P26) from 360 to 300:

$$226 \rightarrow 226 \rightarrow \bigcirc \rightarrow 350 \rightarrow 350 \rightarrow \bigcirc \dots \text{ until } \dots \rightarrow 300 \rightarrow \bigcirc \rightarrow \bigcirc \text{ sets the desired value} \rightarrow 226 \rightarrow 226.$$

## 7.4.3 Multiple pumps priority visualization

Accessing (see par. 7.2) to Multiple Pump Priority Visualization the Numeric display [6] shows the following information:

Pr1) .. Pr3) or (Pr0).

Pr1.. Pr3, indicate that the pump is communicating with others pumps and its priority order, is equal to the visualized number.

If Pr0 is visualized, it means that the pump doesn't detect communication with other pumps and it considers to be alone in the multi pumps bus.

The Multiple Pumps Priority Visualization is accessible also through P63.

#### 7.4.4 Alarms and errors visualization

#### Alarms

If an alarm occurs, the Numeric display [6] shows the alarm code alternatively to the current Main Visualization as follows (Examples of visualizations):

 $0.000 \rightarrow 0.000$  (Ex. BAR) (Ex. 10xRPM)

The A01..A0x error code, indicate the type of alarm detected by the circulator. For more details about the Alarm codes detection and management, see par.7.6.

#### Errors

If a failure occurs, the Numeric display [6] shows a permanently Error code as follows:



•••

The E01..E0x error code, indicate the type of error detected by the circulator. For more details about the Error codes detection and management, see par.7.6.

# 7.5 Software parameters

#### Introduction

The parameters are applicable for all Drives with the following exceptions:

- If a setting is transferred automatically on all drives within one system, this is marked with the symbol (Global) G
- If a parameter is read-only, this is marked with the symbol (Read-only)

#### 7.5.1 Status Parameters

# P01. Required Value

This parameter shows the SOURCE and the VALUE of current required value. Visualization cycles between SOURCE and VALUE every 3 seconds. SOURCES:

SP ( ): internal required value Setpoint related to the control mode selected.

VALUE, can represent a Speed or a Head, dependent from selected control mode.

In case of Head, the unit of measure is defined by parameter P41.

#### P02. Effective Required Value

This parameter is effective only if the control mode is MSE or MSY. P02 shows the current required value that is calculated based on parameters P58 and P59. (See paragraph 10.3, for detailed information about P02 calculation).

# P03. Regulation Restart Value [0÷100] G

This parameter defines (default value 100), in percentage (0-100%) of the required value (P01), the start value after pump stops.

If the REQUIRED VALUE is met and there is no more consumption, then the pump stops. The pump starts again when the pressure drops below P03.

This parameter is effective when: Different from 100% (100%=off), and Control Mode is HCS, MSE or MSY

# P04. Auto-start [OFF-ON] G

If P04 = ON (default value ON), then the drive starts automatically (in case of demand) following a power disconnection.

P05. Operating time months

This parameter shows the amount of months of total operating time (drive supplied with power), to be added to P06.

P06. Operating time hours

This parameter shows the amount of hours of total operating time, to be added to P05.

P07. Motor Time Months

This parameter shows the amount of months of motor operating time, to be added to P08.

P08. Motor time hours

This parameter shows the amount of hours of motor operating time, to be added to P07.

P09. 1<sup>ST</sup> ERROR <sup>©</sup>

This parameter holds the last error happened. The information displayed switches through the values:

- (Exx): xx reports the error code
- (Hyy): yy is the value of hours referred to P05-P06 when the error Exx happened
- (Dww):ww is the value of days referred to P05-P06 when the error Exx happened
- (Uzz): zz is the value of weeks referred to P05-P06 when the error Exx happened Example of visualization:

 $E04 \rightarrow H 10 \rightarrow 608 \rightarrow U 15$ 

P10. 2<sup>ND</sup> ERROR

This parameter holds the second error happened. The information displayed switches through the values:

- (Exx): xx reports the error code
- (Hyy): yy is the value of hours referred to P05-P06 when the error Exx happened
- (Dww):www is the value of days referred to P05-P06 when the error Exx happened
- (Uzz): zz is the value of weeks referred to P05-P06 when the error Exx happened See P09 for a visualization example.

P11. 3<sup>RD</sup> ERROR @

This parameter holds the third error happened. The information displayed switches through the values:

- (Exx): xx reports the error code
- (Hyy): yy is the value of hours referred to P05-P06 when the error Exx happened
- (Dww):www is the value of days referred to P05-P06 when the error Exx happened
- (Uzz): zz is the value of weeks referred to P05-P06 when the error Exx happened See P09 for a visualization example.

#### P12. 4<sup>TH</sup> ERROR <sup>©</sup>

This parameter holds the forth error happened. The information displayed switches through the values:

- (Exx): xx reports the error code
- (Hyy): yy is the value of hours referred to P05-P06 when the error Exx happened
- (Dww):ww is the value of days referred to P05-P06 when the error Exx happened
- (Uzz): zz is the value of weeks referred to P05-P06 when the error Exx happened See P09 for a visualization example.

# P13. Power Module Temperature

This parameter shows the power module temperature, expressed in °C

## P14. Inverter Current

This parameter shows the actual current sourced by the frequency converter, expressed in [Amperes].

## P15. Inverter Voltage

This parameter shows the actual estimated input voltage of the frequency converter, expressed in [Volts].

## P16. Motor Speed

This parameter shows the actual motor rotational speed, expressed in [RPM x 10].

# P17. Software version

This parameter shows the Control Board software version.

#### 7.5.2 Settings Parameters

#### P20. Password [0÷999]

The user can enter here the system password, which gives access to all system parameters: this value is compared with the one stored in P22.

When a correct password is entered, the system remains unlocked for 10 minutes, so that all the parameters are made accessible.

In case the password entered is not matching the value stored in P22, only the parameters up to P20 remain accessible.

#### P21. Jog mode [MIN÷MAX<sup>\*</sup>]

When the user accesses to this parameter, it deactivates the internal controller of the drive and forces the actual Control Mode to ACt for all the time this parameter is in use: motor starts and the value of P21 becomes the set-point of ACt.

It can be changed just selecting a new value on P21 (in the interval between P27 and P26), not confirming it (otherwise the user exits from this temporary control).

#### P22. Set password [1÷999]

Set the system password (default value 66), to which the password entered in P20 PASSWORD has to correspond.

#### P23. Lock Function [OFF, ON]

By using this parameter (default value ON), the user can lock or unlock parameter settings in the main menu; default setting is OFF, so that all parameters are accessible.

In case the user sets P23 = ON, no parameter can be changed without inputting the system password in P20.

#### 7.5.3 Drive Configuration Parameters

#### P25. Control mode [ACt, HCS, MSE, MSY]

This parameter sets the Control Mode (default value HCS).

#### (ACt) Actuator mode

It is the control mode with which a single pump maintains a fixed speed at any flow demand. ACT will always try to minimize the error between the speed set-point and the actual rotational speed of the motor.

(HCS) Hydrovar<sup>®</sup> Controller mode for Single pump.

It is the default control mode, provided for open hydraulic circuits, with which a single pump maintains a constant pressure at any flow demand: Hydrovar® algorithm, based on the set of parameters from P26 to P37 (see par. 7.5.3), is adopted.

For the characteristics of HCS, it is necessary the adoption (on the hydraulic plant) of an absolute pressure sensor, which gives to the drive the feedback pressure signal (by mean of External Pressure Sensor input [9,10] par. 5.5, configured by P40): HCS will always try to minimize the error between the pressure set-point and the feedback pressure signal. (MSE) Hydrovar® Controller mode for Multiple pumps in Serial Cascade.

It is the control mode, provided for open hydraulic circuits, with which a set of pumps, connected by mean of the Multi-pump Protocol, maintains a constant pressure at any flow

-

<sup>\*</sup> It depends on the hydraulic

demand: typical is the use of the Hydrovar<sup>®</sup> algorithm, based on the set of parameters from P26 to P37 (see par. 7.5.3).

#### For the characteristics of MSE:

- It is necessary the adoption (on the hydraulic plant) of an absolute pressure sensor for each pump, which gives to the set of drives the feedback pressure signal (by mean of External Pressure Sensor input [9,10] par. 5.5, configured by P40): MSE will always try to minimize the error between the pressure set-point and the feedback pressure signal.
- Maximum 3 pumps, all of the same type and power, can be connected by mean of the Multipump Protocol.
- The pumps are managed serially, meaning that only the last activated pump modulates its speed for maintaining the set pressure, while all the other running pumps in the system run at maximum speed.
- (MSY) Hydrovar<sup>®</sup> Controller mode for Multiple pumps in Synchronous Cascade
   It is the control mode, provided for open hydraulic circuits, with which a set of pumps, connected by mean of the Multi-pump Protocol, maintains a constant pressure at any flow demand: typical is the use of the Hydrovar<sup>®</sup> algorithm, based on the set of parameters from P26 to P37 (see par. 7.5.3).

#### For the characteristics of MSY:

- It is necessary the adoption (on the hydraulic plant) of an absolute pressure sensor for each pump, which gives to the set of drives the feedback pressure signal (by mean of External Pressure Sensor input [9,10] par. 5.5, configured by P40): MSY will always try to minimize the error between the pressure set-point and the feedback pressure signal.
- Maximum 3 pumps, all of the same type and power, can be connected by mean of the Multipump Protocol.
- All the pumps are synchronized, meaning that all pumps in the system maintain the set pressure by running at the same frequency.

### P26. Max RPM set [ACt set÷Max\*] G

This parameter (default value depends on the hydraulic) sets the maximum speed of the pump, expressed in [RPM x 10]. Maximum speed is model dependant.

## P27. Min RPM set [Min÷ACt set\*] G

This parameter (default value depends on the hydraulic) sets the minimum speed of the pump, expressed in [RPM x 10]. Minimum speed is model dependant.

# P28. Ramp 1 [1÷250] G

This parameter (default value 3) adjusts the fast acceleration time expressed in [seconds], and it affects the control of the pump for HCS, MSE and MSY control modes.

# P29. Ramp 2 [1÷250] G

This parameter (default value 3) adjusts the fast deceleration time expressed in [seconds], and it affects the control of the pump for HCS, MSE and MSY control modes.

#### P30. Ramp 3 [1÷999] G

This parameter (default value 35) adjusts the slow acceleration time expressed in [seconds], thus determining:

- the regulation speed of the internal Hydrovar<sup>®</sup> controller for small changes in demand.
- the constant outgoing pressure.

The ramp depends on the system which has to be controlled, and affects the control of the pump for HCS, MSE and MSY control modes.

It depends on the hydraulic

## P31. Ramp 4 [1÷999] G

This parameter (default value 35) adjusts the slow deceleration time expressed in [seconds], thus determining:

- the regulation speed of the internal Hydrovar® controller for small changes in demand.
- the constant outgoing pressure.

The ramp depends on the system which has to be controlled, and affects the control of the pump for HCS, MSE and MSY control modes.

# P32. Ramp Speed Min Acceleration [2.0÷25.0] G

This parameter (default value 2.0) sets the fast running up time expressed in [seconds], and represents the acceleration ramp used by the internal Hydrovar® controller until the minimum speed of the pump, defined in P27, is reached.

This parameter affects the control of the pump for HCS, MSE and MSY control modes.

## P33. Ramp Speed Min Deceleration [2.0÷25.0] G

This parameter (default value 2.0) sets the fast running down time expressed in [seconds], and represents the deceleration ramp used by the internal Hydrovar<sup>®</sup> controller for stopping the pump once the minimum speed of the pump, defined in P27, is reached.

This parameter affects the control of the pump for HCS, MSE and MSY control modes.

## P34. Speed Min Configuration [STP, SMI] G

This parameter (default value STP) defines the operation of the internal Hydrovar<sup>®</sup> controller once the minimum speed of the pump, defined in P27, is reached.

- If P34 = STP ( ), once the required pressure is reached and no further consumption is needed, the pump speed decreases to the selected P27 value: Hydrovar controller then keeps running for the selected P35 time interval and after this time stops automatically.
- If P34 = SMI ( ), once the required pressure is reached and no further consumption is needed, the pump speed decreases to the selected P27 value: Hydrovar controller then keeps running at that speed (the pump never stops automatically).

This parameter affects the control of the pump for HCS, MSE and MSY control modes.

# P35. Smin time [0÷100] G

This parameter (default value 0s) sets the delay time expressed in [seconds], before a shut-off below P27 occurs, and is used by the internal Hydrovar® controller only if P34 = STP. This parameter affects the control of the pump for HCS, MSE and MSY control modes.

# P36. Window [0÷100] G

This parameter (default value 10), expressed as percentage [%] of the pressure set-point, sets the range for ramp control, thus defining the region, around the pressure set-point, where the internal Hydrovar® controller uses slow acceleration and deceleration ramps instead of fast ones This parameter affects the control of the pump for HCS, MSE and MSY control modes.

## P37. Hysteresis [0÷100] G

This parameter (default value 80), expressed as percentage [%] of P36, sets the regulation hysteresis for slow ramp switching among acceleration and deceleration ones. This parameter affects the control of the pump for HCS, MSE and MSY control modes.

# P38. Speed Lift [0÷MAX\*] G

This parameter (default value P27) sets the speed limit for the required lift value where the required pressure starts to be increased.

## P39. Lift Amount [0÷200] G

This parameter (default value 0) sets the lift amount for the required lift value in HVAC systems or for compensation of friction losses in long pipe work. It determines the increase of the set value until the maximum is reached.

## 7.5.4 Sensor Configuration Parameters

## P41. Pressure Sensor Unit Of Measure [BAR, PSI] G

This parameter ( (default value BAR) sets the unit of measurement for the pressure sensor and affect also the Parameter LED for Head visualization (see par. 7.3.4.2).

## P42.Pressur Sensor Full Scale-4÷20mA [0.0÷25.0BAR] / [0.0÷363PSI] G

This parameter (default value depends on the hydraulic) sets the Full Scale value (in BAR or PSI, depending on P41) for the 4÷20mA pressure sensor connected to the analog input [9,10], described in par. 5.5.

#### P44. Zero Pressure Auto-Calibration

This parameter lets the user perform the initial auto-calibration of the pressure sensor, so that the drive compensates for the offset signal of the sensor at zero pressure (due to the tolerance of the pressure sensor itself).

The steps for performing the auto-calibration are:

- 1. access to P44 when the hydraulic plant is at 0 pressure (no water inside) or with the pressure sensor disconnected from the pipes: the actual value for 0 pressure is displayed
- 2. start the auto-calibration by pressing or push button (see par. 7.2)
- 3. at the end of the auto-calibration, the 0 pressure is displayed (or the message "---" (---) if the sensor signal is out of the admitted tolerance).

### P45. Pressure Minimum Threshold [0÷42] G

This parameter (default value 0) sets a minimum pressure threshold: if the system pressure gets below this value for the time defined in P46, then the drive returns the low pressure error code E14.

### P46. Pressure Minimum Threshold - Delay Time [1÷100] G

This parameter (default value 2) sets the delay time expressed in [seconds], witch the drive shall wait for, remaining the system pressure continuously below P45, before generating the low pressure error code E14.

# P47. Pressure Minimum Threshold – Automatic Error Reset [DIS, ENB] G

This parameter ( ) (default value ENB) enables/disables automatic retries performed by the drive when low pressure error is detected.

# P48. Lack Of Water Switch Input [646], [646]

This parameter (default value ERR) enables/disables for the drive the management of the Lack Of Water Input (see par. 5.5 [13, 14]), and moreover defines the behaviour of the drive when the Lack Of Water Input is enabled and the switch is open:

- If P48 = DIS, the drive doesn't manage at all the information coming from the Lack Of Water Input (which is in practice disabled)
- If P48 = ALr, the drive reads the Lack Of Water Input (which is enabled) and reacts, to the Lack Of Water Switch opening, by displaying the relative alarm A06 on the display, but it keeps on running the motor

If P48 = Err, the drive reads the Lack Of Water Input (which is enabled) and reacts, to the Lack Of Water Switch opening, by stopping the motor and generating the relative error code E11; the

It depends on the hydraulic

error condition is further removed (and the motor started accordingly) when the Lack Of Water Switch closes again.

## 7.5.5 RS485 Interface Parameters

This parameter (default value MOd) selects a specific protocol on the communication port: possible settings are MOd (Modbus RTU) or bAC (BACnet MS/TP)

P51. BMS Comm Protocol – ADDRESS [1÷247] / [0÷127]

This parameter sets the desired address for the drive, when connected to any external device, depending on the protocol selected in P50:

- If P50 = MOd, the address can be any value in the range 1÷247
- If P50 = bAC, the address can be any value in the range 0÷127

P52. BMS Comm Protocol – BAUDRATE [4.8, 9.6, 14.4, 19.2, 38.4, 56.0, 57.6 KBPS]

P53. BACNET Device ID Offset [0÷999]

This parameter (default value 002) sets hundreds, tens and units of the BACnet Device ID. (BACnet Device ID default value = 84002)

P54. BMS Comm Protocol – CONFIGURATION [8N1, 8N2, 8E1, 8o1]

This parameter (default value 8N1) sets the length of the data bits, the parity and the length of the stop bits.

## 7.5.6 Multipump Configuration Parameters

All these parameters affect MSE and MSY control modes.

P55. Multipump – Address [1÷3]

This parameter (default value 1) sets an address (1÷3) for each pump: the user shall manage it following the subsequent rules:

- Each pump needs an individual pump-address (1÷3)
- Each address can only be used once.

P56. Multipump – Max Units [1÷3] G

This parameter (default value 3) sets the maximum number of units that operate simultaneously.

P57. Multipump – Switch Interval [0÷250] G

This parameter (default value 24) sets the switch interval expressed in [hours] for the cyclic changeover: it allows an automatic change-over of the MASTER pump and the assist pumps. As soon as the switch time is reached the next pump becomes MASTER and the counter restarts, thus ensuring a balanced distribution of the operating hours amongst all pumps.

P58. Multipump – Actual Value Increase [0.0÷25.0BAR] / [0.0÷363PSI] G

This parameter (in BAR or PSI, depending on P41, default value 0.35 bar), affects the calculation of P02 to improve the Multipump control as described in the paragraph 10.3.

P59. Multipump – Actual Value Decrease [0.0+25.0BAR] / [0.0+363PSI] G

This parameter (in BAR or PSI, depending on P41, default value 0.15 bar), affects the calculation of P02 to improve the Multipump control as described in the paragraph 10.3.

P60. Multipump - Enable Speed [P27÷P26] G

This parameter (default value depends on the hydraulic) sets the speed that a pump shall reach before starting the next assist pump, after a system pressure drops below the difference: P02 – P59.

# P61. Multipump Synchronous – Speed Limit [P27÷3600] G

This parameter (default value depends on the hydraulic) sets the speed limit: the first assist pump shuts off if the speed goes below this parameter's value.

This parameter only applies to cascade synchronous!

## P62. Multipump Synchronous – Window [0÷100] G

By setting the speed window (default value 150), expressed as [RPMx10], this parameter represents the limit for switching off the next assist pump.

This parameter only applies to cascade synchronous!

## P63. Multipump – Priority

This parameter shows the pump priority value in the Multipump set.

(See par. 7.4.3 for further information)

## P64. Multipump – Revision

This parameter shows the Multipump protocol revision value used.

## 7.5.7 Test Run Configuration Parameters

Test Run is a particular function which starts the pump after the last stop, in order to prevent the pump from blocking.

## P65. Test Run – Time Start [0÷100] G

This parameter (default value 100), expressed in [hours], sets the time after which, once the pump stopped for the last time, the Test Run will start.

## P66. Test Run – Speed [Min÷Max] G

This parameter (default value 200)sets the pump rotational speed for the Test Run expressed in [RPMx10]. Min and Max speed are model dependant.

# P67. Test Run – Time Duration[0÷180] G

This parameter (default value 10)sets the time duration for the Test Run expressed in [seconds].

#### 7.5.8 Special Parameters

# P68. Default Values Reload [ , ES]

This parameter, if sets to RES, after confirmation, performs a factory restore operation that loads the default parameters values.

#### P69. Avoid Frequently Parameters Saving [NO, YES] [6]

By setting this parameter ( (default value NO) to YES, the user can limit the frequency with which the drive stores the required value P02 in its EEPROM memory; this could be particularly useful, not to impact EEPROM retention life, especially in applications with a BMS controller, which could force a continuous variation of the required value for fine regulation purposes.

# 7.6 Fault finding

Referring to par. 7.4.4:

- In case of any alarm that allows the motor to keep on running, the display shows alternatively
  alarm code and the value of the current motor rotational speed or of the current (estimated or
  measured) pressure, while the STATUS indicator becomes orange
- In case of a failure that stops the motor, the display shows the error code permanently and the STATUS indicator becomes red.

# 7.6.1 Alarm codes

Table 15: Alarm codes

Alarm code	Description	Cause
A03	Derating	Temperature too high
A05	Data memory alarm	Data memory corrupted
A06	LOW alarm	Lack of water detection (if = ALR)
A15	EEPROM write failure	
A20	Internal alarm	
A30	Multi-pump connection alarm	Multi-pump connection corrupted
A31	Multi-pump comm. lost	Multi-pump connection lost

# 7.6.2 Error codes

Table 16: Error codes

Error code	Description	Cause
E01	Internal communication error	Internal communication lost
E02	Motor overload error	High motor current
E03	DC-bus overvoltage error	DC-bus overvoltage
E04	Trip control error	Motor stall
E05	EEPROM Data memory error	EEPROM Data memory corrupted
E06	Grid voltage error	Voltage supply out of operating range
E07	Motor winding temperature error	Motor thermal protection trip
E08	Power module temperature error	Frequency converter thermal protection trip
E09	Generic Hardware error	Hardware error
E10	Dry-run error	Dry run detection
E11	LOW error	Lack of water detection (if = ERR)
E12	Pressure sensor error	Missing pressure sensor (not present in ACT)
E14	Low pressure error	Pressure below minimum threshold (not present in ACT)
E30	Multi-pump protocol error	Incompatible multi-pump protocol

# 8 Maintenance

# 8.1 General



#### **Electrical Hazard:**

Before any service or maintenance disconnect the system from the power supply and wait at least 4 minutes before starting work on or in the unit (the capacitors in the intermediate circuit are discharged by the internal discharge resistors).

The unit does not require any special maintenance.

Check list

- Make sure that the cooling fan and the vents are free from dust.
- Make sure that the ambient temperature is correct according to the limits of the unit.
- Make sure that qualified personal perform all modifications of the unit.
- Make sure that the unit is disconnected from the power supply before any work is carried out.
   Always consider the pump and motor instruction.

For further information, contact the local distributor.

# 8.2 Check the functions and parameters

If the hydraulic system is changed then follow this procedure:

- 1. Make sure that all functions and parameters are correct
- 2. Adjust the functions and parameters if necessary.

# 9 Technical Reference

# 9.1 Example: ACT control mode with analog 0-10V input

Graph

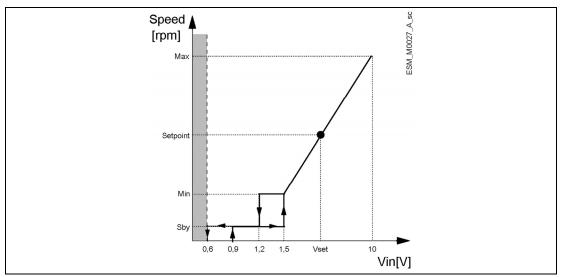


Figure 18: ACT control mode diagram

Table 17: Description

Gray area	→ Missing input Voltage detection threshold
Speed [RPM]	$\rightarrow$ Actual Speed related to analog 0-10V input Voltage value (see par. 5.4, table 13 contacts 7 and 8)
Max	ightarrow P26 (Max RPM set)
Min	ightarrow P27 (Min RPM set)
Setpoint	ightarrow Example of Actual Speed related to a specific Vset Voltage value
Sby	ightarrow Input Voltage at which the motor goes in Stand by
Vin [V]	→ Input Voltage value to control the pump in ACT mode Different thresholds are managed by the pump, from Non-detection to Max speed.)

For further information about ACT control mode and parameters adjustment, see par. 7.5.3.

# 9.2 Example: Ramp Settings

Graph

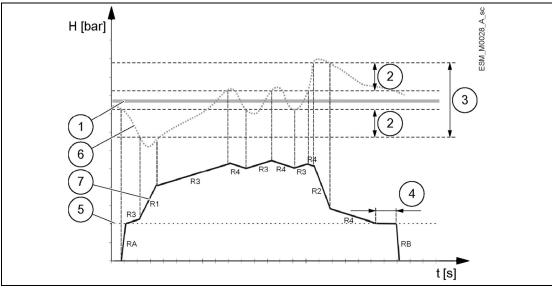


Figure 19: Ramp settings

Table 18: Description

1	P01 (Required Value)
2	P37 (Hysteresys) in % of P36 (Window)
3	P36 (Window) in % of P01 (Required Value)
4	P35 (Smin Time)
5	P27 (Min RPM set)
6	→ Actual Head
7	→ Actual Speed
RA	ightarrow P32 (Ramp Speed Min Acceleration)
RB	ightarrow P33 (Ramp Speed Min Deceleration)
R1	→ P28 (Ramp 1) - speed ramp fast increase

R2	ightarrow P29 (Ramp 2) - speed ramp fast decrease
R3	ightarrow P30 (Ramp 3) - speed ramp slow increase
R4	→ P31 (Ramp 4) - speed ramp slow decrease

For further information about Ramps adjustment, see. par. 7.5.3.

# 9.3 Example: Effective Required Value

Pumps activation in cascade modes:

- 1. Lead pump reaches its P60 (Enable Speed).
- Actual value falls to the cut in-value of the 1st assist pump.
   The 1st assist pump switches on automatically. (Cut in-value = P01 (Required Value) P59 (Actual Value Decrease))
- 3. A new required value, P02 (Effective Required Value) is calculated after the start up.

Calculation of Effective Required Value in Cascade Serial (MSE):

K = number of active pumps (k > 1)

Pr = pump priority

• If K - Pr > 0

P02 (Effective Required Value) = P01 (Required Value) + (K-Pr) \* P58 (Actual Value Increase

• If K - Pr = 0

P02 (Effective Required Value) = P01 (Required Value) + P58 (Actual Value Increase) - P59 (Actual Value Decrease)

Calculation of Effective Required Value in Cascade Synchronous (MSY):

K = number of active pumps (k > 1)

• If K > 1

P02 (Effective Required Value) = P01 (Required Value) + (K-1) \* P58 (Actual Value Increase

• If K = 1

P02 (Effective Required Value) = P01 (Required Value) + P58 (Actual Value Increase) - P59 (Actual Value Decrease)

Behavior of P58 (Actual Value Increase) and P59 (Actual Value Decrease):

- if P58 (Actual Value Increase) = P59 (Actual Value Decrease) → Pressure constant, independent of how many pumps are in operation.
- if P58 (Actual Value Increase) > P59 (Actual Value Decrease) → Pressure rises when assist pump switches on.
- if P58 (Actual Value Increase) < P59 (Actual Value Decrease)  $\rightarrow$  Pressure falls when assist pump switches on.

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