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ARMSTRONG

INSTALLATION AND OPERATING INSTRUCTIONS

Design Envelope HVAC Pumps - 4300 IVS & 4302 IVS Sensorless

1. CE CONFORMITIES

For Declaration of Conformity certificates please contact Armstrong.

The IVS Sensorless product conforms to the requirements in the following directive(s), standard(s) or other normative document(s):

LOW VOLTAGE DIRECTIVE 2006/95/EC

EN61800-5-1, EN50178

EMC DIRECTIVE 2004/108/EC

EN61800-3, EN61000-3-2, EN61000-3-12, EN61000-6-1, EN61000-6-2, EN61000-6-3, EN61000-6-4

2. MECHANICAL INSTALLATION

For notes on mechanical installation for an IVS Sensorless pump, please see the relevant Installation, Operation and Maintenance Instructions for the particular pump type (i.e. 4300 Vertical in line, 4302 DualArm etc).

Install the IVS Sensorless unit with adequate access for routine maintenance. Adequate space, particularly at the fan inlet (50mm), is necessary to facilitate airflow. Where several IVS Sensorless units are installed in close proximity, care must be taken to ensure that there is no re-circulation of exhausted warm air.

Series 4300 IVS and 4302 IVS cannot be mounted with shafts in the horizontal position.

For pump handling instructions please refer to the separate operating instruction for the particular pump type!

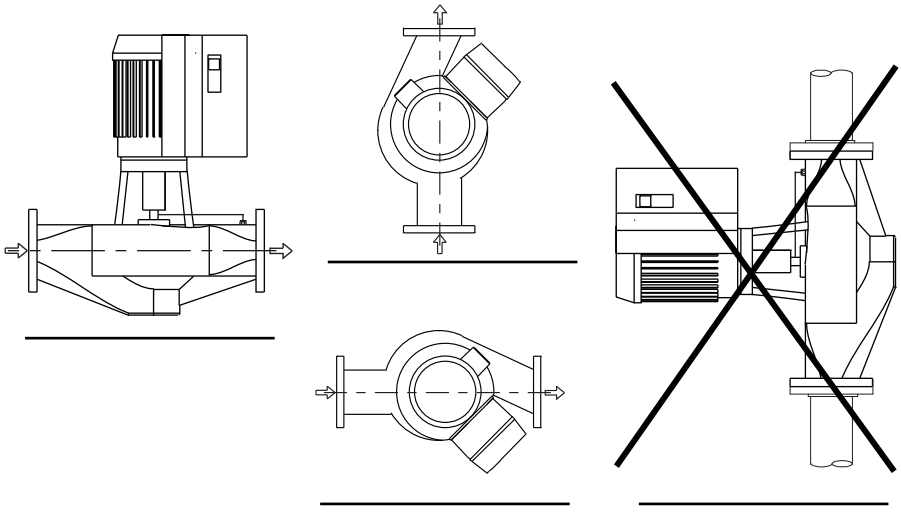


Figure 1. Allowable Installation Orientation - On-board Inverter Position

2.1 ENCLOSURE RATING

The standard enclosure rating for IVS Sensorless pumps is NEMA/UL type 12. If the pump is to be installed in a wet or dusty environment then a higher enclosure rating may be required (contact Armstrong).

2.2 AMBIENT TEMPERATURE

To avoid the inverter unit getting overheated, the ambient temperature is not to exceed 133°F (45°C) operating in higher ambient temperatures will require derating of the inverter.

3. ELECTRICAL INSTALLATION

All electrical connections should be carried out by a qualified and authorised electrician in accordance with local site regulations and the latest issue of the IEE regulations.

SAFETY, RISK OF DEATH

Before removing the inverter cover, the system must be disconnected from the mains supply. After switching off wait for at least 15 minutes for the capacitors to discharge before opening the cover.

CAUTION

High voltage testing (Megging) of the motor / inverter may cause damage to the electronic components and therefore should not be carried out.

3.1 EARTH LEAKAGE CURRENT

Earth leakage current is primarily caused by the capacitance between motor phases and the motor frame. The RFI filter contributes additional leakage current, as the filter circuit is connected to earth through capacitors.

The size of the leakage current to the ground depends of the following factors, in order of priority:

1. Switching frequency
2. Motor grounded on site or not

The leakage current is of importance to safety during handling / operation of the IVS Sensorless pump if (by mistake) the on-board inverter has not been earthed.

NB!

Since the leakage current is >3.5mA (approx 4-20mA), reinforced earthing must be established which is required if EN 50178 is to be complied with. Never use ELCB relays that are not suitable for DC fault currents (type A).

If ELCB relays are used, they must be:

- Suitable for protecting equipment with a direct current content (DC) in the fault current (3-phase bridge rectifier)
- Suitable for power-up with short charging current to earth
- Suitable for a high leakage current

3.2 START / STOP OF PUMP

The number of starts / stops via the mains voltage must not exceed 1 time per 1 min.

If a higher number of starts / stops is required then the start / stop digital input must be used (mains voltage directly connected). This is the preferred method of starting and stopping IVS Sensorless Pumps.

THE 3 PHASE MAINS MUST BE ISOLATED BEFORE PERFORMING MAINTENANCE OF THE PUMP.

3.3 ADDITIONAL MOTOR PROTECTION

With the exception of supply fuses / MCB's to protect the installation (for over-current and short-circuit protection), no additional overload or over-temperature protection is required (i.e. thermal overloads). Protection features include:

- Mains phase loss
- Over voltage
- Under voltage
- Electronic thermal motor protection
- Short circuit on motor terminals
- Earth fault on motor terminals
- Over temperature

3.4 SUPPLY VOLTAGE

The supply voltage details can be found on the inverter nameplate. Please ensure that the unit is suitable for the electrical supply on which it is to be used. The mains supply for IVS Sensorless pumps is as follows:

3 x 200-240V +/-10%

3 x 380-480V +/- 10%

3 x 525-600V +/- 10%

Supply frequency - 50/60Hz

3.5 SUPPLY FUSING

Branch circuit protection

In order to protect the installation against electrical and fire hazard, all branch circuits in an installation, switch gear, machines etc., must be short-circuit and over-current protected according to the national/international regulations.

Short circuit protection

The inverter must be protected against short-circuit to avoid electrical or fire hazard. Armstrong recommends using the fuses detailed in the separate *IVS102 Operating Instructions* to protect service personnel or other equipment in case of an internal failure in the unit. The frequency converter provides full short circuit protection in case of a short-circuit on the motor output.

3.6 EARTHING AND IT MAINS

The earth connection cable cross section must be at least 10 mm2 or 2 rated mains wires terminated separately according to EN 50178 or IEC 61800-5-1 unless national regulations specify differently. Always comply with national and local regulations on cable cross sections.

The mains is connected to the main disconnect switch if this has been included.

NB!
Check the mains voltage corresponds to the mains voltage of the frequency converter name plate.

IT Mains
Do not connect 400 V frequency converters with RFI-filters to mains supplies with a voltage between phase and earth of more than 440 V.
For IT mains and delta earth (grounded leg), mains voltage may exceed 440 V between phase and earth.

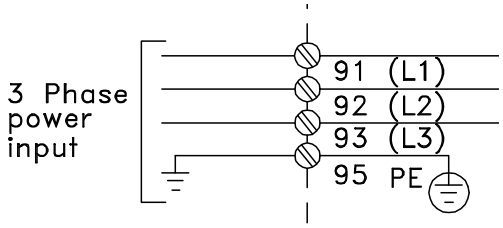


Figure 2. Terminals for Mains and Earthing

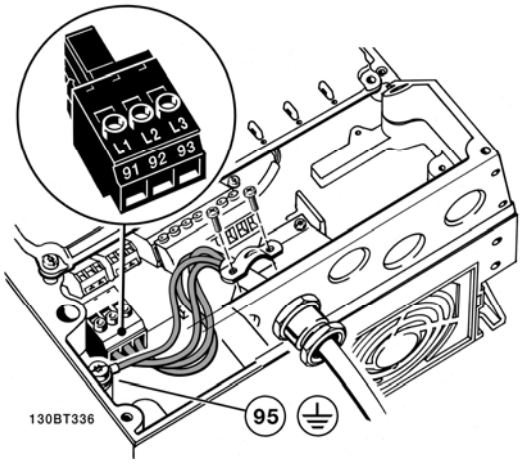


Figure 3. Mains and Earthing Connections for A5 Units (200-240V - 5HP and Below, 380-480V / 525-600V - 10HP and Below,

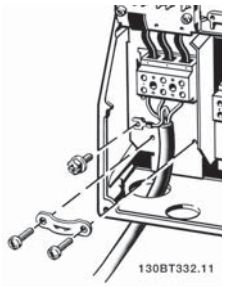


Figure 4a. Mains and Earthing Connections for B1 and B2 Units (200-240V - 7.5 to 20HP, 380-480V - 15 to 40HP, 525-600V - 15 to 50HP)

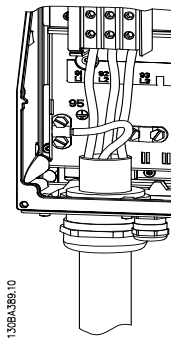


Figure 4b. Mains and Earthing Connections for C1 and C2 Units (200-240V - 25 to 60HP, 380-*480V - 50 to 75HP, 525-600V - 60 to 75HP)*

3.7 RELAY CONNECTIONS

The relays on the IVS Sensorless are configured as follows:

Relay 1 - RUNNING
- Terminal 01: Common
- Terminal 02: Normal Open 240V AC
- Terminal 03: Normal Closed 240V AC

Relay 2 - ALARM
- Terminal 04: Common
- Terminal 05: Normal Open 400V AC
- Terminal 06: Normal Closed 240V AC

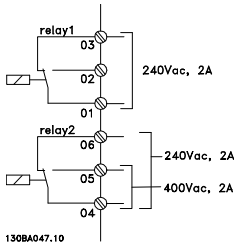


Figure 5. Relay Contact Details

The following illustrations identify the location of the relays within specific inverter sizes:

The illustrations in figures 6 and 7 identify the location of the relays within specific inverter sizes:

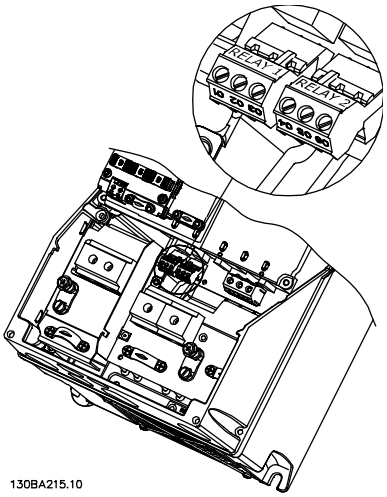


Figure 6. Relay Connection Terminals for A5, B1 and B2 Units

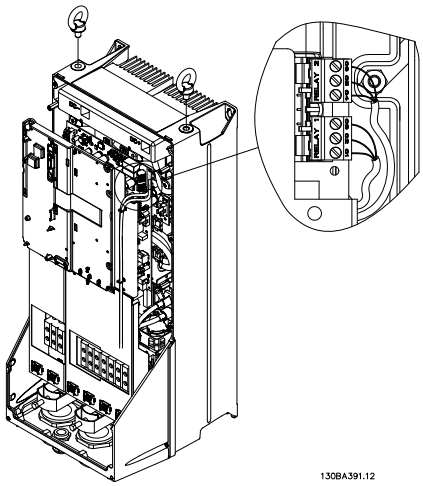
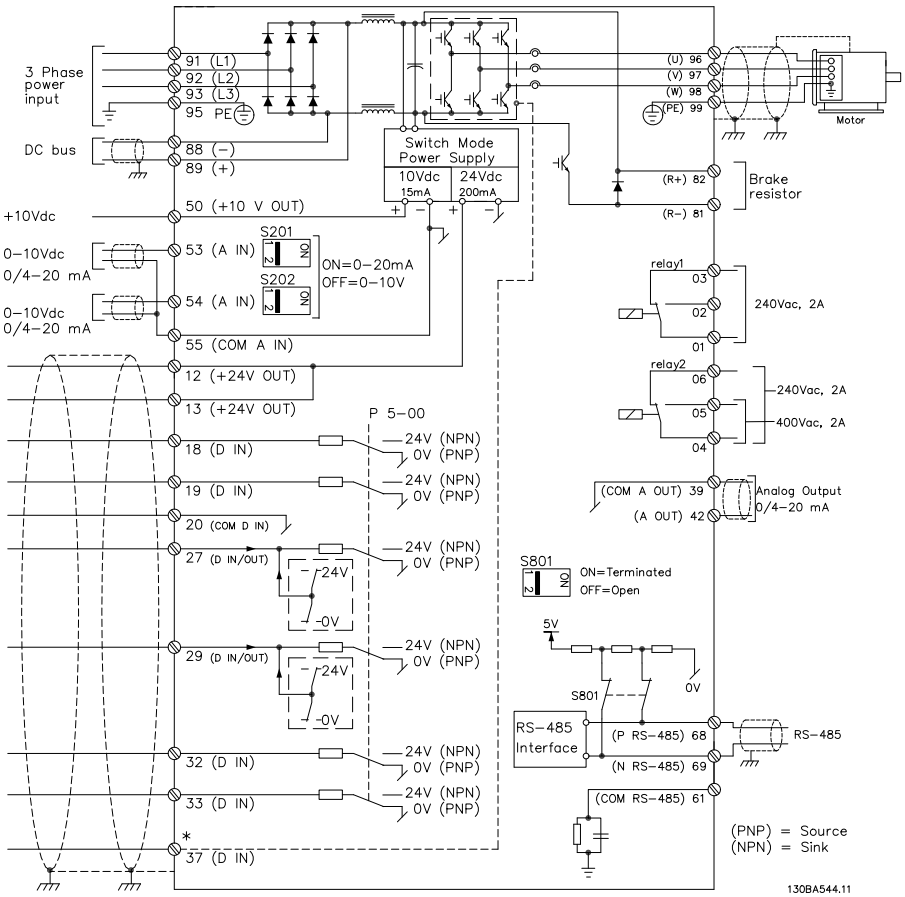


Figure 7. Relay Connection Terminals for C1 and C2 Units

3.8 ELECTRICAL INSTALLATION AND CONTROL CONNECTIONS



*Note:Terminal 37 is not available on IVS Sensorless pumps

Figure 8. Diagram Showing all Electrical Connections

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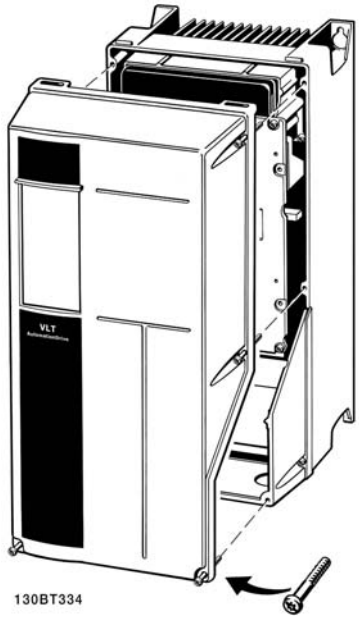
3.8.1 ACCESS TO TERMINALS



Remove front-cover to access control terminals. When replacing the front cover, please ensure proper fastening by applying a torque of 2 Nm.

3.8.2 CONTROL TERMINALS

With reference to figure 9:

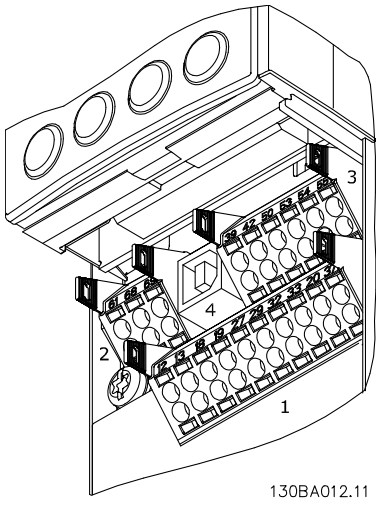


Figure 9. Control Connections

1. 10 way plug for digital I/O
2. 3 way plug for RS485 Bus
3. 6 way plug for analogue I/O
4. USB Connection

Control terminal functions and factory settings are as follows:

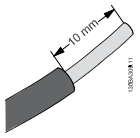
Terminal No	Type / Desc	Factory Setting
1,2,3	Relay 1	Running
4,5,6	Relay 2	Alarm
12	Supply	+24V DC
13	Supply	+24V DC
18	Digital Input	Start
19	Digital Input	Pump Operating Mode
20	Common	0V
27	Digital Input	Low Water Interlock
29	Digital Input	No Operation
32	Digital Input	No Operation
33	Digital Input	No Operation
37	Digital Input	No Operation
42	Analogue Output	Output Frequency (4-20mA - 0-100Hz)
53	Analogue Input	Reference (0-10V)*
54	Analogue Input	Feedback (0-10V)*

*Note that Analogue inputs AI53 and AI54 can be either Voltage (0-10V) or Current (4-20mA) input and by default both inputs are set to Voltage.
Switches S201 and S202 (see figure 8) are used to configure the analogue inputs as follows:

S201 (AI53) OFF = Voltage, ON = Current
S202 (AI54) OFF = Voltage, ON = Current

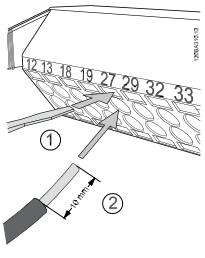
Inserting Cables into Control Terminals

i) Strip 10mm of insulation from the cable:



ii) Insert a suitable terminal screwdriver as shown and then push the cable into the terminal.

Iii) Remove the terminal screwdriver and check the terminal has gripped the cable by gently pulling it.



Note: Terminal plugs can be easily removed for improved access when making connections.

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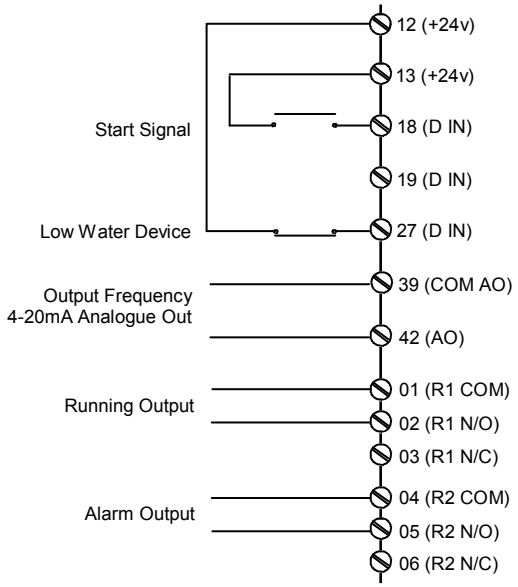
3.8.3 CONNECTION EXAMPLES

There are many ways that an IVS Sensorless pump can be configured. The following is some examples of the most common control configurations.

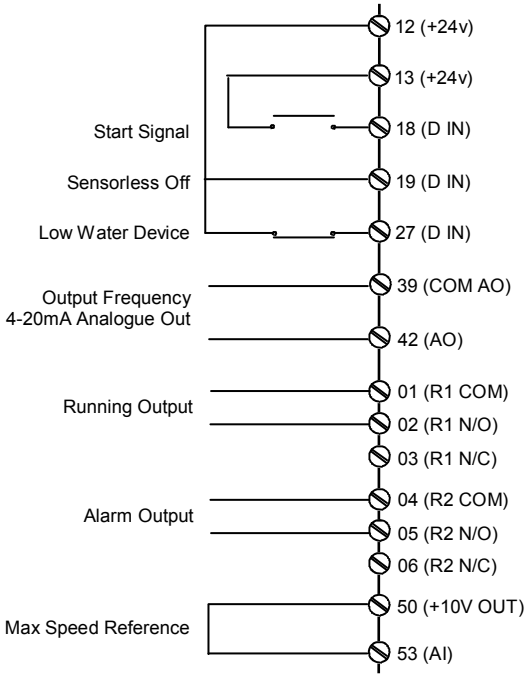
i. SENSORLESS PRESSURE CONTROL - CONNECTION DETAILS

IVS Sensorless pumps are factory configured to be connected as shown below. For a description of sensorless pressure control please refer to the programming section.



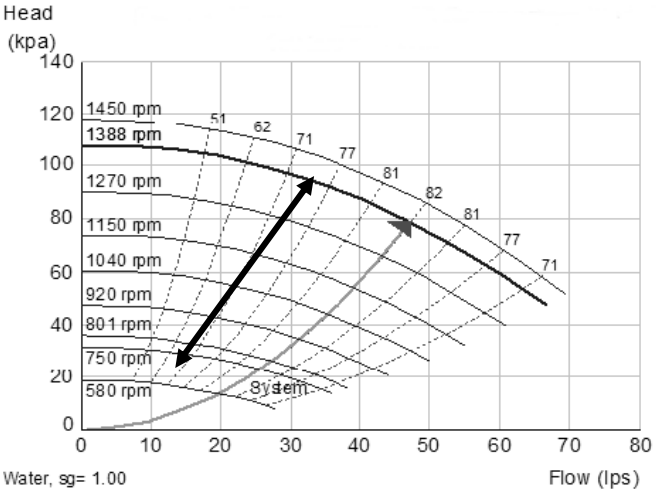
ii. FULL SPEED OVERIDE - CONNECTION DETAILS

It may be required to run the pump at full speed without automatic speed control (e.g. during system commissioning). This can be achieved without programming changes by making the control connections shown below.

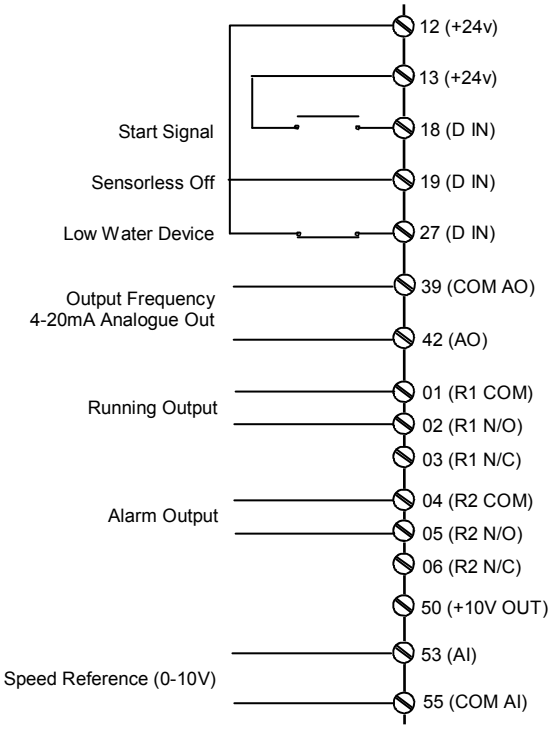


iii. CONSTANT CURVE MODE - BMS SPEED CONTROL

Where the Building Management System is to be used for speed control it is necessary to disable sensorless control and provide the unit with a 0 - 10VDC speed reference signal.



As shown above, in Constant Curve mode the pump will speed up and slow down according to the voltage level of the reference signal. On a unit configured for 60Hz pump speed the reference signal is scaled (by default) so that 0V on terminal 53 will equate to 0Hz and 10V will equate to 60Hz.



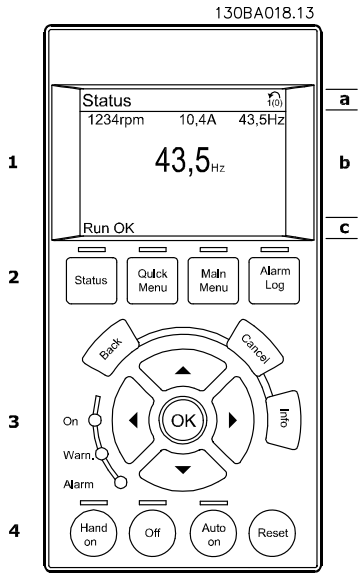
The recommended minimum speed for IVS Sensorless pumps is 580rpm. Running for long periods below this speed can damage the mechanical seal.

4. PROGRAMMING, MONITORING AND DIAGNOSTICS

IVS Sensorless pumps incorporate an integrated graphical local control panel (GLCP).

4.1 GLCP FUNCTIONS AND OPERATION

The GLCP is divided into four functional groups:



1. Graphical display with Status lines.
2. Menu keys and indicator lights (LED's) - selecting mode, changing parameters and switching between display functions.
3. Navigation keys and indicator lights (LEDs).
4. Operation keys and indicator lights (LEDs).

Graphical display: The LCD-display is back-lit with a total of 6 alpha-numeric lines. All data is displayed on the LCP which can show up to five operating variables while in [Status] mode.

Display lines:

a. Status line: Status messages displaying icons and graphics.

b. Line 1-2: Operator data lines displaying data and variables de-fined or chosen by the user. By pressing the [Status] key, up to one extra line can be added.

c. Status line: Status messages displaying text.

The display is divided into 3 sections:

Top section (a) shows the status when in status mode or up to 2 variables when not in status mode and in the case of Alarm/ Warning.

The number of the Active Set-up (Sensorless mode being setup 1) is shown.

The Middle section (b) shows up to 5 variables with related unit, regardless of status. In case of alarm/warning, the warning is shown instead of the variables.

The Bottom section (c) always shows the state of the inverter in Status mode.

It is possible to toggle between three status read-out displays by pressing the [Status] key.

Operating variables with different formatting are shown in each status screen - see below.

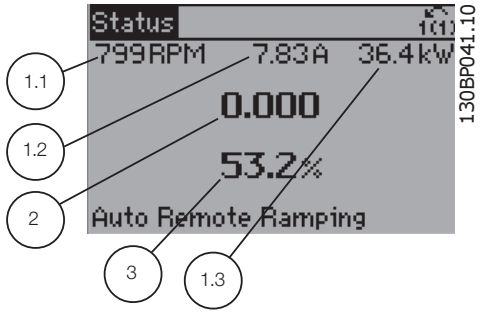
Status display I:

This read-out state is standard after start-up or initialisation.

Use [INFO] to obtain information about the value/ measurement linked to the displayed operating variables (1.1, 1.2, 1.3, 2, and 3).See the operating variables shown in the display in this illustration. 1.1,1.2 and 1.3 are shown in small size. 2 and 3 are shown in medium size.

Status display II:

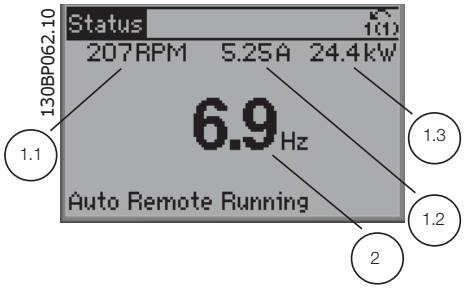
See the operating variables (1.1, 1.2, 1.3, and 2) shown in the display in this illustration.



In the example, Speed, Motor current, Motor power and Frequency are selected as variables in the first and second lines.1.1, 1.2 and 1.3 are shown in small size. 2 is shown in large size.

Display Contrast Adjustment

Press [status] and [▲] for darker display



Press [status] and [▼] for brighter display

4.2 INDICATOR LIGHTS (LEDs)

If certain threshold values are exceeded, the alarm and/or warning LED lights up. A status and alarm text appear on the control panel.

The On LED is activated when the frequency converter receives power from mains voltage, a DC bus terminal, or an external 24 V supply. At the same time, the back light is on.

- Green LED/On: Control section is working.
- Yellow LED/Warn.: Indicates a warning.
- Flashing Red LED/Alarm: Indicates an alarm.

4.3 CONTROL KEYS

Menu keys

The menu keys are divided into functions. The keys below the display and indicator lamps are used for parameter set-up, including choice of display indication during normal operation.

[Status]

Indicates the status of the frequency converter and/or the motor. 3 different readouts can be chosen by pressing the [Status] key:5 line readouts, 4 line readouts or Smart Logic Control.

Use [Status] for selecting the mode of display or for changing back to Display mode from either the Quick Menu mode, the Main Menu mode or Alarm mode. Also use the [Status] key to toggle single or double read-out mode.

[Quick Menu]

Allows quick set-up of the inverter by access to a limited number of parameters. Quick Menu does not include all the parameters that may need to be changed when utilising Sensorless control and it is therefore recommended that parameter changes are made in Main Menu mode.

[Main Menu]

Is used for programming all parameters.

[Alarm Log]

Displays an Alarm list of the five latest alarms (numbered A1-A5). To obtain additional details about an alarm, use the arrow keys to manoeuvre to the alarm number and press [OK]. Information is displayed about the condition of the frequency converter before it enters the alarm mode.

The Alarm log button on the LCP allows access to both Alarm log and Maintenance log.

[Back]

Reverts to the previous step or layer in the navigation structure.

[Cancel]

Last change or command will be cancelled as long as the display has not been changed.

[Info]

Displays information about a command, parameter, or function in any display window. [Info] provides detailed information when needed.

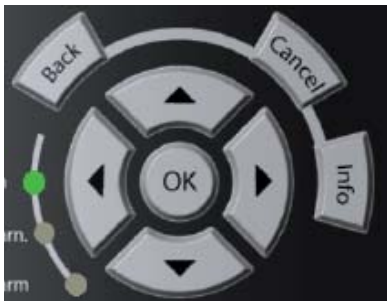
Navigation Keys

The four navigation arrows are used to navigate between the different choices available in [Quick Menu], [Main Menu] and [Alarm Log]. Use the keys to move the cursor.

[OK]

Is used for choosing a parameter marked by the cursor and for enabling the change of a parameter.

Operation Keys for local control are found at the bottom of the control panel.



[Hand On]

Enables control of the pump via the GLCP. It is possible to enter the pump speed data by means of the arrow keys.

NB!

The low water device input must be made for the pump to start in either hand mode or auto mode.

[Off]
Stops the pump.

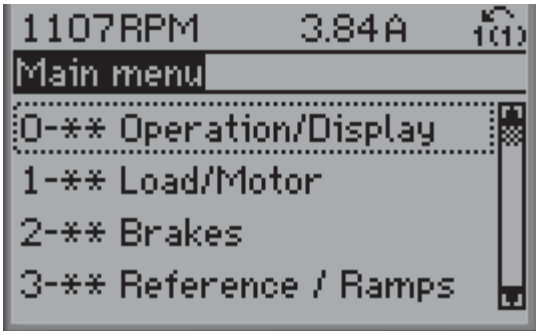
[Auto on]
Enables the pump to be controlled via the control terminals and/or serial communication. When a start signal is applied on the control terminals the pump will start.

NB!
For the pump to operate in either Sensorless mode or any other automatic control mode it is necessary to have pressed the [Auto on] button.

[Reset]
Is used for resetting the frequency converter after an alarm (trip).

4.4 PROGRAMMING

Select the Main Menu mode by pressing the [Main Menu] key. The below read-out appears on the display. The middle and bottom sections on the display show a list of parameter groups which can be chosen by toggling the up and down buttons.



Each parameter has a name and number which remain the same regardless of the programming mode. In the Main Menu mode, the parameters are divided into groups. The first digit of the parameter number (from the left) indicates the parameter group number.
All parameters can be changed in the Main Menu. However, depending on the choice of configuration (par.1-00 Configuration Mode), some parameters can be hidden.

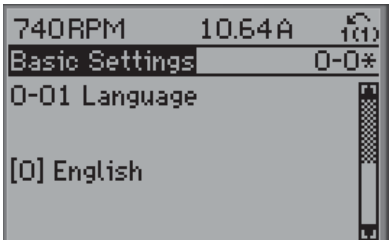
4.4.1 PARAMETER SELECTION

In the Main Menu mode, the parameters are divided into groups. You select a parameter group by means of the navigation keys.

The following parameter groups are accessible:

Group no.	Parameter group:
0	Operation/Display
1	Load/Motor
2	Brakes
3	References/Ramps
4	Limits/Warnings
5	Digital In/Out
6	Analog In/Out
8	Comm. and Options
9	Profibus
10	CAN Fieldbus
11	LonWorks
13	Smart Logic
14	Special Functions
15	FC Information
16	Data Readouts
18	Data Readouts 2
20	Drive Closed Loop
21	Ext. Closed Loop
22	Application Functions
23	Time-based Functions
25	Cascade Controller
26	Analog I/O Option MCB 109

After selecting a parameter group, choose a parameter by means of the navigation keys.
The middle section on the display shows the parameter number and name as well as the selected parameter value.



4.4.2 CHANGING DATA

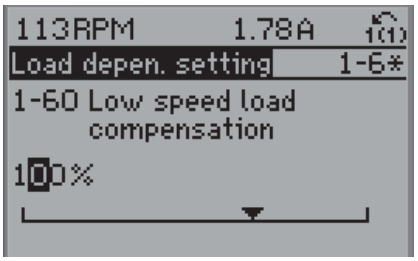
The procedure for changing data depends on whether the selected parameter represents a numerical data value or a text value.

Changing a Text Value

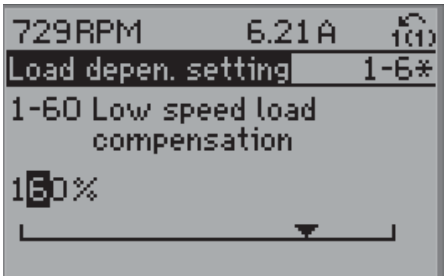
If the selected parameter is a text value, change the text value by means of the [▲] [▼] navigation keys.
The up key increases the value, and the down key decreases the value.
Place the cursor on the value you want to save and press [OK].

Changing Numeric Data Values

If the chosen parameter represents a numeric data value, change thechosen data value by means of the [ ] [ ] navigation keys as well as the [▲] [▼] navigation keys.



Use the [ ] [ ] navigation keys to move the cursor horizontally.
Use the [▲] [▼] navigation keys to change the data value. The up key enlarges the data value, and the down key reduces the data value. Place the cursor on the value you want to save and press [OK].



Readout and Programming of Indexed Parameters

Parameters are indexed when placed in a rolling stack. Par.15-30 Alarm Log: Error Code to par.15-33 Alarm Log: Date and Time contain a fault log which can be read out. Choose a parameter, press [OK], and use the up/down navigation keys to scroll through the value log.

Use par.3-10 Preset Reference as another example: Choose the parameter, press [OK], and use the up/down navigation keys to scroll through the indexed values. To change the parameter value, select the indexed value and press [OK]. Change the value by using the up/down keys. Press [OK] to accept the new setting. Press [CANCEL] to abort.

Press [Back] to leave the parameter.

5. SENSORLESS OPERATION

Sensorless control is an innovative concept in glanded circulating pumps. Pump performance and characteristic curves for ten different speeds are embedded in the memory of the speed controller during manufacture. This data includes power, pressure and flow across the flow range of the pump. During operation, the power and speed of the pump are monitored, enabling the controller to establish the hydraulic performance and position in the pumps head-flow characteristic.

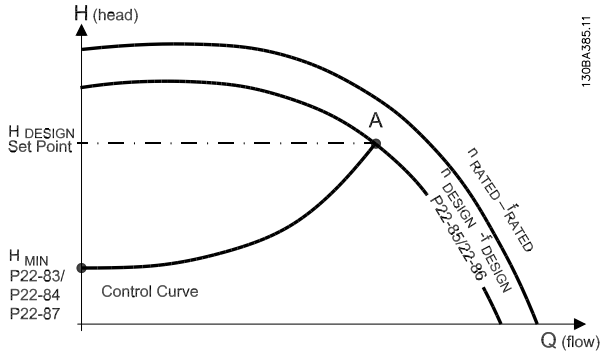
These measurements enable the pump to continuously identify the head and flow at any point in time, giving accurate pressure control without the need for external feedback signals. Patented software technology within the controller ensures trouble-free operation in all

conditions.

Incorporating the pumps hydraulic data into the controller and removing sensors results in true integration of all components and removes the risk of sensor failure.

5.1 DEFAULT OPERATING MODE - QUADRATIC PRESSURE CONTROL

The default control mode for IVS Sensorless pumps 'Quadratic Pressure Control' where the controller is set to control the speed according to a 'control curve' between max and min flow (see below diagram). It is widely recognised that fitting a differential pressure sensor at the most remote load, across the supply piping and return piping encompassing the valve & coil set, is the best installation scheme for energy efficiency.



IVS Sensorless pumps can replicate this control without the need for the remote sensor. As the flow required by the system is reduced, the pump automatically reduces the head developed according to the pre-set control curve.

It is often found that using a remote differential pressure sensor to sense the pressure across a remote load could theoretically result in loads close to the pump being under-pumped. The situation would be where the load at a loop extremity is satisfied and the control valve closes while a load close to the pump needs full flow. The probability of this occurring is remote but it is possible. One answer to this is to move the sensor closer to the pump (two-thirds out in the system is a popular recommendation) although physically re-positioning the sensor at commissioning stage can be a costly exercise. With Sensorless pump control it is possible to replicate the moving of a sensor by adjusting the head setting 'Hmin'.

5.1.1 SETTINGS FOR QUADRATIC (CONTROL CURVE) PRESSURE CONTROL

The design duty head and flow of the pump (provided at time of order) is shown as point 'A' in figure 10 below.

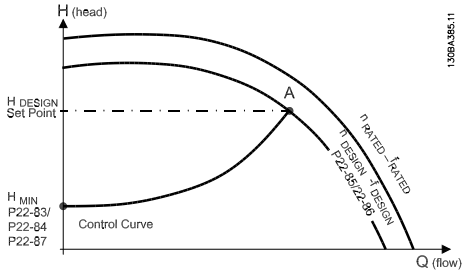


Figure 10. Quadratic Control Settings

It is not always the case that the design duty point required will fall on the maximum speed of the pump and in the majority of cases (as shown in fig 10) it will be at a reduced speed.

The pump will be supplied with point 'A' set as the design duty point provided at the time of order and the minimum head (at zero flow - 'H_{MIN}') will be set as 40% of the design head 'H_{DESIGN}'.

If required, H_{DESIGN} can be adjusted by changing the setting in par. 20-21 (Setpoint 1) which should be a head value in kPa.

Other settings that are set to enable the pump to operate on a control curve are:

Par. 22-80 (Flow Compensation) which should be set to 'Enabled' [1]
Par 22-81 (Square-linear Curve Approximation) which should be set to '100%'

The effect of adjusting par. 22-81 is shown in figure 11 below. A setting of 100% gives the ideal theoretical control curve between the design head and minimum head whilst 0% provides a straight line linear approximation.

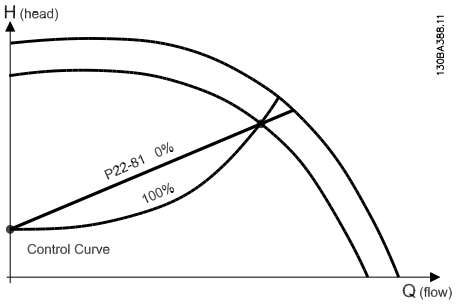


Figure 11. Curve Approximation Settings

In order for the controller to determine the true fit and position of the control curve it is necessary to set some specific parameters with data relating to specific points within the pumps operating range. There are two ways of programming the parameters depending on whether the speed at the design duty is known or unknown.

Example 1: Speed at Required System Design Point is known (Refer to Figure 10):

1) Set the design head, H_{DESIGN}, value in par. 20-21 (Setpoint 1) in units of kPa.
2) Set the speed of the pump at design head, H_{DESIGN}, and design flow using par. 22-85 (Speed at Design Point [RPM]) if the speed in RPM is known or par. 22-86 (Speed at Design Point [Hz]) if the speed in Hz is known (it is not necessary to set both these parameters - choose only one)
3) Set the minimum head required, H_{MIN}, using par. 22-87 (Pressure at No-Flow Speed) in units of kPa.
4) Set the speed of the pump at minimum head, H_{MIN}, using par. 22-83 (Speed at No-Flow [RPM]) if the speed in RPM is known or par. 22-84 (Speed at No-Flow [Hz]) if the speed in Hz is known (it is not necessary to set both these parameters - choose only one)
5) Adjust the shape of the control curve using par. 22-81 as shown in figure 11.

Example 2: Speed at Required System Design Point is not known (Refer to Figure 12):

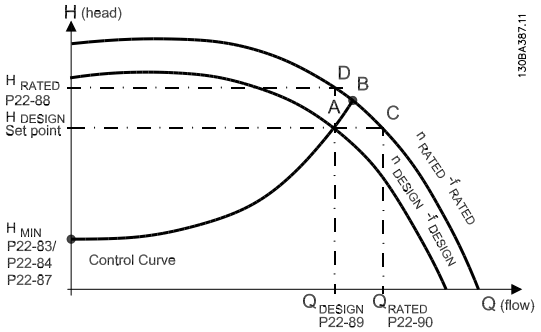


Figure 12. Control Settings When Speed at Design Point is Not Known

1) Set the design head, H_{DESIGN}, value in par. 20-21 (Setpoint 1) in units of kPa.
2) By referring to the specific pump performance curves project the design head horizontally to the maximum rated speed curve for the pump (point C) and at this intersection read off the flow value 'Q_{RATED}' and enter this value, in l/s, in par. 22-90 (Flow at Rated Speed).
3) Again by referring to the pump curves project the design flow horizontally to the maximum rated speed curve for the pump (point D) and at this intersection read off the head value 'HRATED' and enter this value, in kPa, in par 22-88 (Pressure at Rated Speed).
4) Set the minimum head required, H_{MIN}, using par. 22-87 (Pressure at No-Flow Speed) in units of kPa.
5) Set the speed of the pump at minimum head, H_{MIN}, using par. 22-83 (Speed at No-Flow [RPM]) if the speed in RPM is known or par. 22-84 (Speed at No-Flow [Hz]) if the speed in Hz is known (it is not necessary to set both these parameters - choose only one)
6) Adjust the shape of the control curve using par. 22-81 as shown in figure 11.

5.2 CONSTANT PRESSURE CONTROL

IVS Sensorless pumps can be configured to maintain a constant pressure in a system as the demand varies. This effectively simulates the mounting of a differential pressure sensor at, or near, the pump.

5.1.2 SETTINGS FOR CONSTANT PRESSURE CONTROL

To revert to this mode of control simply follow these steps:

1) Set the design head, H_{DESIGN}, value in par. 20-21 (Setpoint 1) in units of kPa.
2) Turn off flow compensation by setting par. 22-80 to 'Disabled' [0]

6.0 WARNINGS AND ALARMS

A warning or an alarm is signalled by the relevant LED on the front of the inverter and indicated by a code on the display.
A warning remains active until its cause is no longer present. Under certain circumstances operation of the pump may still be continued. Warning messages may be critical, but are not necessarily so.
In the event of an alarm, the inverter will have tripped. Alarms must be reset to restart operation once their cause has been rectified. In many cases the auto reset function will restart the pump. Alternatively the [RESET] button on the control panel can be pressed.

NB!
After a manual reset using the [RESET] button on the control panel, the [AUTO ON] button must be pressed to restart the pump.

If an alarm cannot be reset, the reason may be that its cause has not been rectified, or the alarm is trip-locked (see also table on following page).
Alarms that are trip-locked offer additional protection, means that the mains supply must be switched off before the alarm can be reset. After being switched back on, the inveter is no longer blocked and may be reset as described above once the cause has been rectified.
Alarms that are not trip-locked can also be reset using the automatic reset function in par. 14-20 Reset Mode (Warning: automatic wake-up is possible!) If a warning and alarm is marked against a code in the table on the following page, this means that either a warning occurs before an alarm, or it can be specified whether it is a warning or an alarm that is to be displayed for a given fault. This is possible, for instance, in par. 1-90 Motor Thermal Protection. After an alarm or trip, the motor carries on coasting, and the alarm and warning flash on the inverter. Once the problem has been rectified, only the alarm continues flashing.

6.1 FAULT MESSAGES

WARNING 1, 10 Volts low:
The 10 V voltage from terminal 50 on the control card is below 10 V. Remove some of the load from terminal 50, as the 10 V supply is over-loaded. Max. 15 mA or minimum 590 Ω.

WARNING/ALARM 2, Live zero error:
The signal on terminal 53 or 54 is less than 50% of the value set in par.6-10 Terminal 53 Low Voltage, par. 6-12 Terminal 53 Low Current, par.6-20 Terminal 54 Low Voltage, or par. 6-22 Terminal 54 Low Current respectively.

WARNING/ALARM 3, No motor:
No motor has been connected to the output of the inverter.

WARNING/ALARM 4, Mains phase loss:
A phase is missing on the supply side, or the mains voltage imbalance is too high. This message also appears in case of a fault in the input rectifier on the inverter. Check the supply voltage and supply currents to the inverter.

WARNING 5, DC link voltage high:
The intermediate circuit voltage (DC) is higher than the overvoltage limitof the control system. The inverter is still active.

WARNING 6, DC link voltage low:
The intermediate circuit voltage (DC) is below the under voltage limit of the control system. The inverter is still active.

WARNING/ALARM 7, DC over voltage:
If the intermediate circuit voltage exceeds the limit, the inverter trips after a time.

WARNING/ALARM 8, DC under voltage:
If the intermediate circuit voltage (DC) drops below the "voltage warning low" limit, the inverter checks if 24 V back-up supply is connected. If no 24 V backup supply is connected, the inverter trips after a given time depending on the unit.

WARNING/ALARM 9, Inverter overloaded:
The inverter is about to cut out because of an overload (too high current for too long). The counter for electronic, thermal inverter protection gives a warning at 98% and trips at 100%, while giving an alarm. You cannot reset the inverter until the counter is below 90%.The fault is that the inverter is overloaded by more than nominal current for too long.

No.	Description	Warning	Alarm/Trip	Alarm/Trip Lock	Parameter Reference
1	10 Volts low	X			
2	Live zero error	(X)	(X)		par. 6-01 *Live Zero Time-out Function*
3	No motor	(X)			par. 1-80 *Function at Stop*
4	Mains phase loss	(X)	(X)	(X)	par. 14-12 *Function at Mains Imbalance*
5	DC link voltage high	X			
6	DC link voltage low	X			
7	DC over voltage	X	X		
8	DC under voltage	X	X		
9	Inverter overloaded	X	X		
10	Motor ETR over temperature	(X)	(X)		par. 1-90 *Motor Thermal Protection*
11	Motor thermistor over temperature	(X)	(X)		par. 1-90 *Motor Thermal Protection*
12	Torque limit	X	X		
13	Over Current	X	X	X	
14	Earth fault	X	X	X	
15	Incomp. HW		X	X	
16	Short Circuit		X	X	
17	Control word timeout	(X)	(X)		par. 8-04 *Control Time-out Function*
23	Internal fans				
24	External fans				
25	Brake resistor short-circuited	X			
26	Brake resistor power limit	(X)	(X)		par. 2-13 *Brake Power Monitoring*
27	Brake chopper short-circuited	X	X		
28	Brake check	(X)	(X)		par. 2-15 *Brake Check*
29	Power board over temp	X	X	X	
30	Motor phase U missing	(X)	(X)	(X)	par. 4-58 *Missing Motor Phase Function*
31	Motor phase V missing	(X)	(X)	(X)	par. 4-58 *Missing Motor Phase Function*
32	Motor phase W missing	(X)	(X)	(X)	par. 4-58 *Missing Motor Phase Function*
33	Inrush fault		X	X	
34	Fieldbus communication fault	X	X		
36	Mains failure				
38	Internal fault		X	X	
40	Overload T27				
41	Overload T29				
42	Overload X30/6-7				
47	24 V supply low	X	X	X	
48	1.8 V supply low		X	X	
49	Speed limit				
50	AMA calibration failed		X		
51	AMA check U_{nom} and I_{nom}		X		
52	AMA low I_{nom}		X		
53	AMA motor too big		X		
54	AMA motor too small		X		
55	AMA parameter out of range		X		
56	AMA interrupted by user		X		
57	AMA timeout		X		
58	AMA internal fault	X	X		
59	Current limit	X			
60	External interlock				
62	Output Frequency at Maximum Limit	X			
64	Voltage Limit	X			
65	Control Board Over-temperature	X	X	X	
66	Heat sink Temperature Low	X			
67	Option Configuration has Changed		X		
68	Safe Stop Activated		X		
70	Illegal FC configuration				
80	Drive Initialised to Default Value		X		
92	No-Flow	X	X		Par. 22-2*
93	Dry Pump	X	X		Par. 22-2*
94	End of Curve	X	X		Par. 22-5*
95	Broken Belt	X	X		Par. 22-6*
96	Start Delayed	X			Par. 22-7*
97	Stop Delayed	X			Par. 22-7*
98	Clock Fault	X			Par. 0-7*

Table 1. Alarm/Warning Code List

WARNING/ALARM 10, Motor ETR over temperature:
According to the electronic thermal protection (ETR), the motor is too hot. You can choose if you want the inverter to give a warning or an alarm when the counter reaches 100% in par. 1-90 Motor Thermal Protection. The fault is that the motor is overloaded by more than nominal current for too long. Check that the motor par. 1-24 Motor Current is set correctly.

WARNING/ALARM 11, Motor thermistor over temp:
The thermistor or the thermistor connection is disconnected. You can choose if you want the inverter to give a warning or an alarm in par. 1-90 Motor Thermal Protection. Check that the thermistor is connected correctly between terminal 53 or 54 (analog voltage input) and terminal 50 (+ 10 Volts supply), or between terminal 18 or 19 (digital input PNP only) and terminal 50. If a KTY sensor is used, check for correct connection between terminal 54 and 55.

WARNING/ALARM 12, Torque limit:
The torque is higher than the value in par. 4-16 Torque Limit Motor Mode (in motor operation) or the torque is higher than the value in par.4-17 Torque Limit Generator Mode (in regenerative operation).

WARNING/ALARM 13, Over Current:
The inverter peak current limit (approx. 200% of the rated current) is exceeded. The warning will last approx. 8-12 sec., then the inverter trips and issues an alarm. Turn off the inverter and check if the motor shaft can be turned and if the motor size matches the inverter.

ALARM 14, Earth fault:
There is a discharge from the output phases to earth, either in the cable between the inverter and the motor or in the motor itself. Turn off the inverter and remove the earth fault.

ALARM 15, In-complete hardware:
A fitted option is not handled by the present control board (hardware or software).

ALARM 16, Short-circuit:
There is short-circuiting in the motor or on the motor terminals. Turn off the inverter and remove the short-circuit.

WARNING/ALARM 17, Control word timeout:
There is no communication to the inverter.The warning will only be active when par. 8-04 Control Timeout Function is NOT set to OFF. If par. 8-04 Control Timeout Function is set to Stop and Trip, a warning appears and the inverter ramps down to zero speed, while giving an alarm. par. 8-03 Control Timeout Time could possibly be increased.

WARNING 22, Hoist Mech. Brake:
Report value will show what kind it is.0 = The torque ref. was not reached before timeout1 = There was no brake feedback before timeout

WARNING 23, Internal fans:
External fans have failed due to defect hardware or fans not mounted.

WARNING 24, External fan fault:
The fan warning function is an extra protection function that checks if thefan is running / mounted. The fan warning can be disabled in par.14-53 Fan Monitor, [0] Disabled.

WARNING 25, Brake resistor short-circuited:
The brake resistor is monitored during operation. If it short-circuits, the brake function is disconnected and the warning appears. The inverter still works, but without the brake function. Turn off the inverter and replace the brake resistor (see par. 2-15 Brake Check).

ALARM/WARNING 26, Brake resistor power limit:
The power transmitted to the brake resistor is calculated as a percentage, as a mean value over the last 120 s, on the basis of the resistance value of the brake resistor (par. 2-11 Brake Resistor (ohm)) and the intermediate circuit voltage. The warning is active when the dissipated braking power is higher than 90%. If Trip [2] has been selected in par. 2-13 Brake Power Monitoring, the inverter cuts out and issues this alarm, when the dissipated braking power is higher than 100%.

WARNING/ALARM 27, Brake chopper fault:
The brake transistor is monitored during operation and if it short-circuits, the brake function disconnects and the warning comes up. The inverter is still able to run, but since the brake transistor has short-circuited, substantial power is transmitted to the brake resistor, even if it is inactive. Turn off the inverter and remove the brake resistor. Warning: There is a risk of substantial power being transmitted to the brake resistor if the brake transistor is short-circuited.

ALARM/WARNING 28, Brake check failed:
Brake resistor fault: the brake resistor is not connected/ working.

WARNING/ALARM 29, Drive over temperature:
If the enclosure isIP00, IP20/Nema1 or IP21/TYPE 1, the cut-out tem-perature of the heat-sink is 95 °C +5 °C. The temperature fault cannotbe reset, until the temperature of the heatsink is below 70 °C.The fault could be:-Ambient temperature too high-Too long motor cable

ALARM 30, Motor phase U missing:
Motor phase U between the frequency converter and the motor is miss-ing.Turn off the frequency converter and check motor phase U.

ALARM 31, Motor phase V missing:
Motor phase V between the inverter and the motor is missing. Turn off the inverter and check motor phase V.

ALARM 32, Motor phase W missing:
Motor phase W between the inverter and the motor is missing. Turn off the frequency converter and check motor phase W.

ALARM 33, Inrush fault:
Too many power ups have occured within a short time period.

WARNING/ALARM 34, Fieldbus communication fault:
The fieldbus on the communication option card is not working.

WARNING/ALARM 36, Mains failure:
This warning/alarm is only active if the supply voltage to the inverter is lost and par. 14-10 Mains Failure is NOT set to OFF. Possible correction: check the fuses to the frequency converter

WARNING/ALARM 37, Phase Imbalance:
There is a current imbalance between the power units.

ALARM 38, Internal fault:
Contact your local Armstrong supplier.

ALARM 39, Heatsink Sensor:
No feedback from the heatsink sensor.

WARNING 40, Overload of Digital Output Terminal 27:
Check the load connected to terminal 27 or remove short-circuit connection. Check par. 5-00 Digital I/O Mode and par. 5-01 Terminal 27 Mode.

WARNING 41, Overload of Digital Output Terminal 29:
Check the load connected to terminal 29 or remove short-circuit connection. Check par. 5-00 Digital I/O Mode and par. 5-02 Terminal 29 Mode.

WARNING 42, Overload of Digital Output On X30/6 :
Check the load connected to X30/6 or remove short-circuit connection. Check par. 5-32 Term X30/6 Digi Out (MCB 101).

WARNING 42, Overload of Digital Output On X30/7 :
Check the load connected to X30/7 or remove short-circuit connection. Check par. 5-33 Term X30/7 Digi Out (MCB 101).

ALARM 46, Pwr. card supply:
The supply on the power card is out of range.

WARNING 47, 24 V supply low:
The external 24 V DC backup power supply may be overloaded, otherwise contact your Armstrong supplier.

ALARM 48, 1.8 V supply low:
Contact your Armstrong supplier.

WARNING 49, Speed limit:
The speed has been limited by range in par. 4-11 Motor Speed Low Limit [RPM] and par. 4-13 Motor Speed High Limit [RPM].

ALARM 50, AMA calibration failed:
Contact your Armstrong supplier.

ALARM 51, AMA check Unom and Inom:
The setting of motor voltage, motor current, and motor power is presumably wrong. Check the settings.

ALARM 52, AMA low Inom:
The motor current is too low. Check the settings.

ALARM 53, AMA motor too big:
The motor is too big for the AMA to be carried out.

ALARM 54, AMA motor too small:
The motor is too small for the AMA to be carried out.

ALARM 55, AMA par. out of range:
The par. values found from the motor are outside acceptable range.

ALARM 56, AMA interrupted by user:
The AMA has been interrupted by the user.

ALARM 57, AMA timeout:
Try to start the AMA again a number of times, until the AMA is carried out. Please note that repeated runs may heat the motor to a level where the resistance Rs and Rr are increased. In most cases, however, this is not critical.

WARNING/ALARM 58, AMA internal fault:
Contact your Armstrong supplier.

WARNING 59, Current limit:
The current is higher than the value in par. 4-18 Current Limit.

WARNING 60, External Interlock:
External Interlock has been activated. To resume normal operation, apply24 V DC to the terminal programmed for External Interlock and reset the inverter (via Bus, Digital I/O or by pressing [Reset]).

WARNING/ALARM 61, Tracking Error:
Tracking error. Contact your supplier.

WARNING 62, Output Frequency at Maximum Limit:
The output frequency is limited by the value set in par. 4-19 Max Output Frequency

WARNING 64, Voltage Limit:
The load and speed combination demands a motor voltage higher than the actual DC link voltage.

WARNING/ALARM/TRIP 65, Control Card Over Temperature:
Control card over temperature: The cut-out temperature of the control card is 80 °C.

WARNING 66, Heatsink Temperature Low:
The heat sink temperature is measured as 0 °C. This could indicate that the temperature sensor is defective and thus the fan speed is increased to the maximum in case the power part or control card is very hot. If the temperature is below 15 °C the warning will be present.

ALARM 67, Option Configuration has Changed:
One or more options has either been added or removed since the last power-down.

ALARM 68, Safe Stop:
Safe Stop has been activated. To resume normal operation, apply 24 VDC to terminal 37 then send a Reset signal (via Bus, Digital I/O or by pressing [Reset]).

ALARM 69, Pwr. Card Temp:
Power card over temperature.

ALARM 70, Illegal Frequency Converter Configuration:
Actual combination of control board and power board is illegal.

ALARM 90, Feedback Mon.:

ALARM 91, Analogue Input 54 Wrong Settings:
Switch S202 has to be set in position OFF (voltage input), when a KTY sensor is connected to the analogue input terminal 54.

ALARM 92, No Flow:
A no load situation has been detected for the system. See parameter group 22-2*.

ALARM 93, Dry Pump:
A no flow situation and high speed indicates that the pump has run dry. See parameter group 22-2*.

ALARM 94, End of Curve:
Feed back stays lower than the set point, which may be indicates a leak-age in the pipe system. See parameter group 22-5*.

ALARM 95, Broken Belt:
Torque is below the torque level set for no load indicating a broken belt. See parameter group 22-6*.

ALARM 96, Start Delayed:
Start of the motor has been delayed due to short cycle protection is ac-tive. See parameter group 22-7*.

ALARM 250, New Spare Part:
The power or Switch Mode Power Supply has been exchanged. The inverter type code must be restored in the EEPROM. Select the correct type code in par. 14-23 Type code Setting according to the label on unit. Remember to select 'Save to EEPROM' to complete.

ALARM 251, New Type Code:
The frequency converter has got a new type code.

7.0 ACOUSTIC NOISE AND VIBRATION

If the pump or the pipework close to the pump is making noise or vibrations at certain frequencies, try the following:

- Speed Bypass, parameters 4-6*
- Over-modulation, parameter 14-03 set to off
- Switching pattern and -frequency parameters 14-0*
- Resonance Dampening, parameter 1-64

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