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INSTALLATION AND OPERATING INSTRUCTIONS

IVS SENSORLESS SERIES

Product shown with guards removed to show external mechanical seal detail.

Please refer to the relevant section as follows:

Section 1 - Units With Motor Power Ratings 0.55 to 7.5kW

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 73/23/EEC

EN50178

EMC DIRECTIVE 89/336/EEC

EN50081-1, EN50081-2, EN50082-1, EN50082-2, EN61800-3, EN55011, EN55014, EN55022

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. 4280 Starbloc, 4380 Starline 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 recirculation of exhausted warm air.

With reference to figure 1, the pump should not be installed with the inverter in the underside position. This guidance pertains to all pump types and overrides any instruction in the particular pump Installation, Operation and Maintenance Instruction.

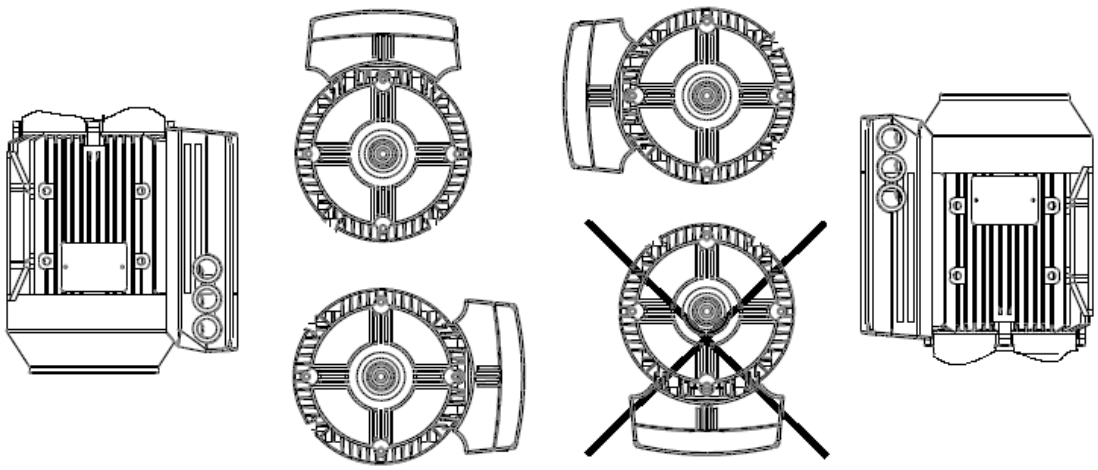


Figure 1. Allowable Installation Orientation - On-board Inverter Position

2.1 ENCLOSURE RATING

The standard enclosure rating for IVS Sensorless pumps is IP55. If the pump is to be installed in a wet or dusty environment then a higher enclosure rating may be required (IP56 or IP66 option).

2.2 AMBIENT TEMPERATURE

To avoid the inverter unit getting overheated, the ambient temperature is not to exceed 40° C and the 24 hour average temperature is not to exceed 35°C. If the ambient temperature is in the range of 40°C - 55°C, a reduction of the service life of the inverter part is to be expected.

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 5 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 2 mins.

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, no additional overload or over-temperature protection is required. Motor / inverter protection includes:

- Mains phase loss
- Over voltage
- Under voltage
- Over current
- Short circuit
- Over temperature

3.4 SUPPLY VOLTAGE

The supply voltage details can be found on the motor nameplate. Please ensure that the motor 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 380/400/415/440/460/480V +/- 10%

Supply frequency - 50/60Hz

3.5 TOOLS FOR INSTALLATION

1 Cross point screwdriver, 1 Large screwdriver,

1 Small screwdriver

3.6 CABLE ENTRY SIZES

0.55kW - 4.0kW: 3 x M20 x 1.5

5.5kW - 7.5kW: 1 x M25 x 1.5, 2 x M20 x 1.5

One cable entry is factory fitted with a plug kit for external keypad connection.

3.7 MAX. CABLE CROSS SECTION

Mains cable supply: 4.0mm^2

Control cable: 1.5mm^2

Serial communication cable: 1.5mm^2

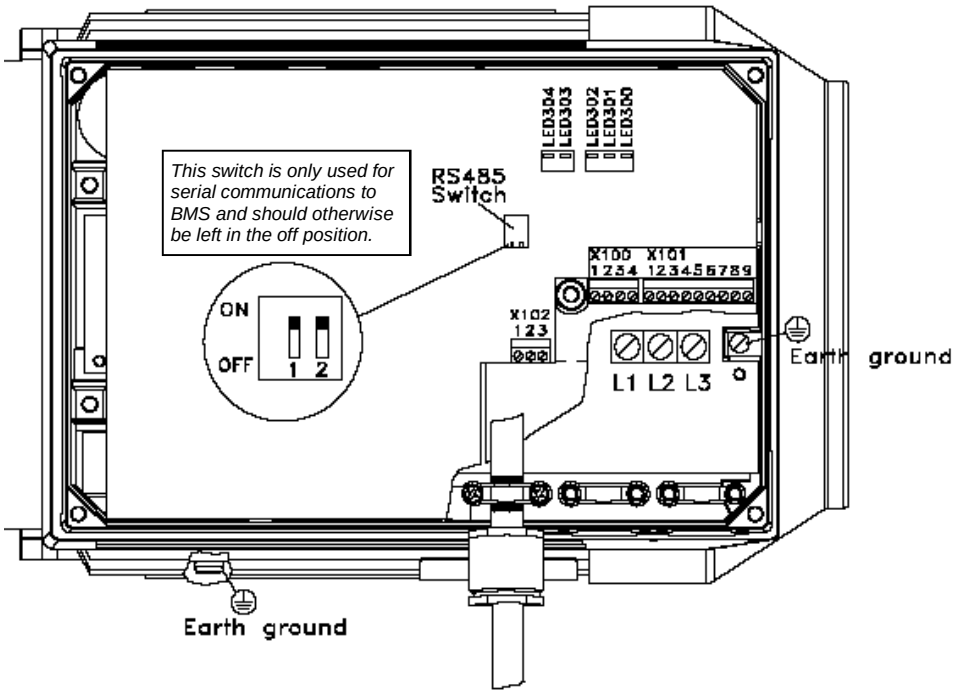


Figure 2. Inverter Terminal Arrangement

3.8 MAINS SUPPLY CONNECTION

i. Remove the inverter box cover, which is held by four screws (6 on 5.5 and 7.5kW units), to obtain access to the terminals.

ii. Remove the detachable terminal plugs from the terminal blocks X100 and X101 to obtain access to the mains terminals.

iii. Lift only the corner of the black plastic cover by the cable entries to expose the mains terminals L1, L2 and L3.

DO NOT lift or remove the entire plastic cover. This is part of the inverters protective arrangements.

Mains Terminals L1, L2 and L3

Make sure that your mains supply corresponds to the voltage required by the IVS Sensorless unit (see motor nameplate), TT and TN mains.

iv. Remove the gland plug furthest from the drive end of the motor (to the right in fig. 2) and feed the mains cable through the hole.

v. Connect the three mains phases to terminals L1, L2 and L3 and the earth to the separate terminal provided.

DO NOT over-tighten the mains terminals as this will damage the unit!

0.55 - 4.0kW torque - 0.5 to 0.6Nm

5.50 - 7.5kW torque - 1.2 to 1.5Nm

Earth terminal - 3.4Nm

vi. Remove the middle gland plug and feed the control cable through the hole (see the section on control connections for wiring details).

vii. The third entry is fitted with a plug kit to facilitate key-pad connection. Do not remove the kit or wiring unless as serial communications link (to BMS) is required.

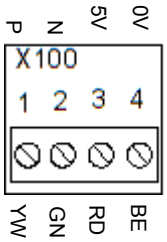
You cannot change the rotational direction of the pump by shifting around the input mains phases. The direction of rotation is factory set.

3.9 CONTROL CONNECTIONS

Terminal blocks X100, X101 and X102 are used for control connections. Individual terminal allocation is as follows:

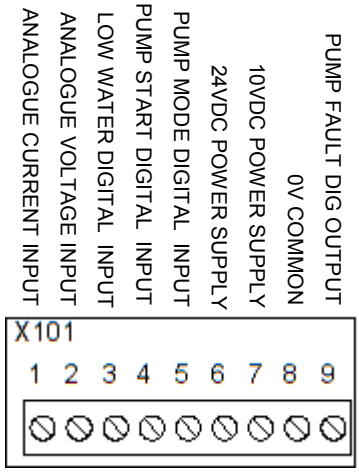
X100 TERMINALS

The X100 terminals are used for data communications, either as part of a serial communications network or for connection to the cable gland mounted plug kit for key pad connection (Default).



X101 TERMINALS - CONTROL TERMINALS

The X101 terminals are used for analogue and digital signals that will determine the operation of the pump (see the section on Control Modes).

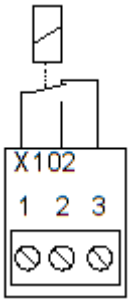


- *Terminal 1* - 4-20mA input for a remote feedback device (when Sensorless control is not used).
- *Terminal 2* - 0-10V input for a reference signal (when Sensorless control is not used).
- *Terminal 3* - Digital input for a low water device (pump only runs if input is 'logic 1') - factory linked with zero ohm resistor to terminal 6.
- *Terminal 4* - Digital input for pump start (pump enabled when 'logic 1').
- *Terminal 5* - Digital input for pump mode (if left at 'logic 0' then pump will be in sensorless mode).
- *Terminal 6* - 24VDC supply for terminals 3 to 5 (max 150mA).
- *Terminal 7* - 10VDC supply for terminal 2 when used with a potentiometer (max 15mA).
- *Terminal 8* - 0V for terminals 1 to 7 and 9.
- *Terminal 9* - Digital output for 'pump fault' connection to BMS (voltage level will be 24VDC when pump has a fault).

NB: Terminal 9 is not a volt-free contact. Connection of an external voltage will destroy the unit.

X102 TERMINALS - PUMP RUNNING

The X102 terminals provide a relay changeover contact for identification of pump running.



Terminals 1 - 2 will be made when the pump is running.

Voltage level at contact/load (AC) 250VAC, 5A

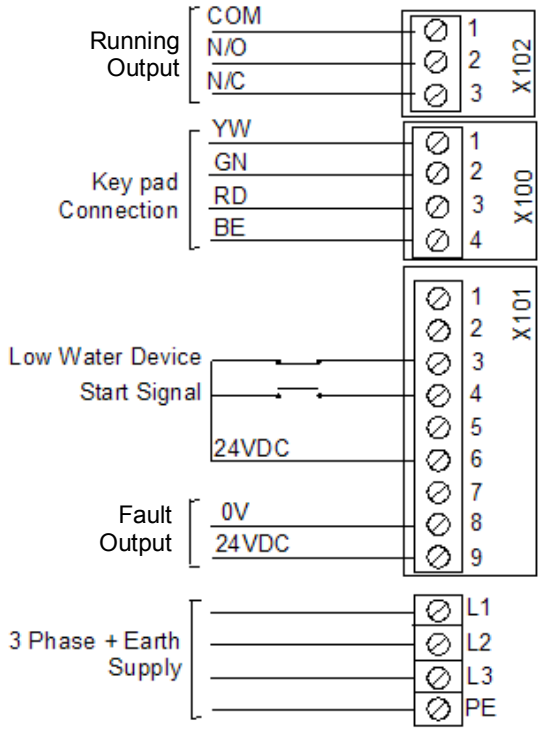
Voltage level at contact/load (DC) 30VDC, 5A; 40VDC, 2A; 100VDC, 0.5A

3.9.1 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.

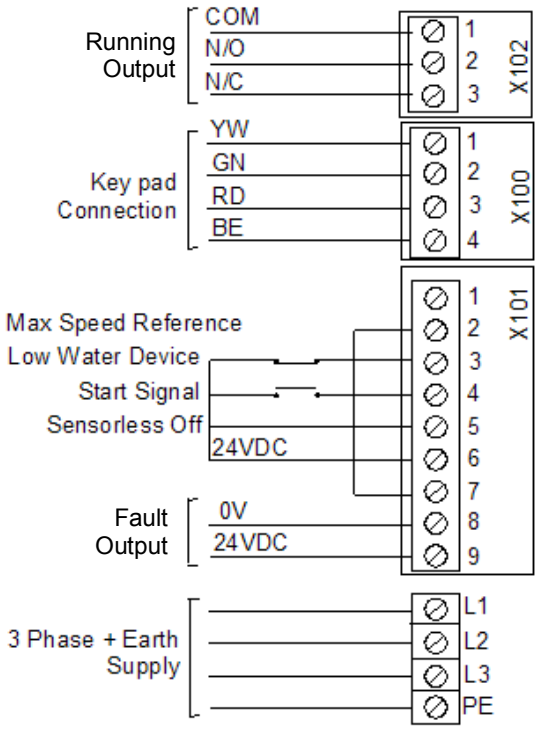
i. SENSORLESS PRESSURE CONTROL - CONNECTION DETAILS

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.



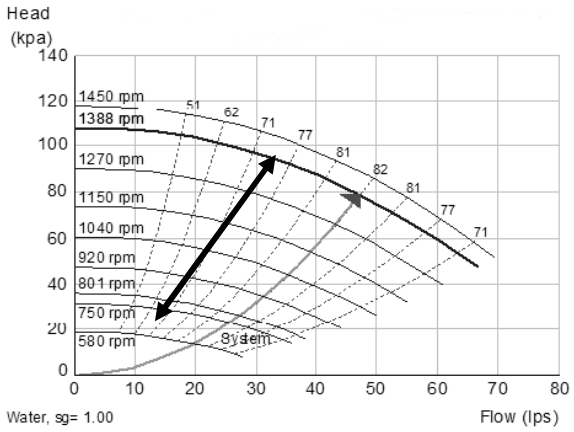
ii. FULL SPEED OVERIDE - CONNECTION DETAILS

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.

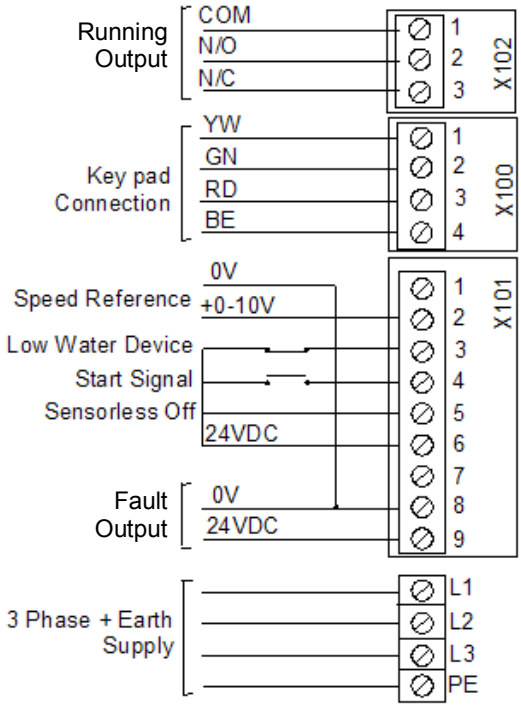


iii. CONSTANT CURVE MODE - BMS SPEED CONTROL

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.

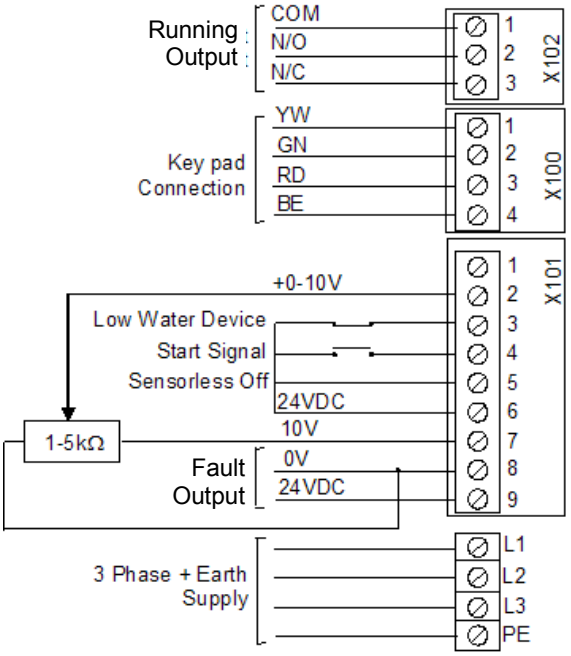


As shown above, in Constant Curve mode the pump will speed up and slow down according to the voltage level of the reference signal. On a unit configured for 50Hz pump speed the reference signal is scaled (by default) so that 0V on X101 terminal 2 will equate to 0Hz and 10V will equate to 50Hz.



iv. CONSTANT CURVE MODE - POTENTIOMETER SPEED CONTROL

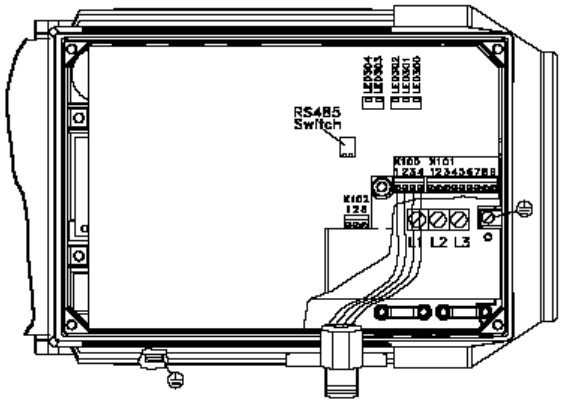
If a potentiometer is to be installed for manual control of pump speed then the control connections will be as follows:



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

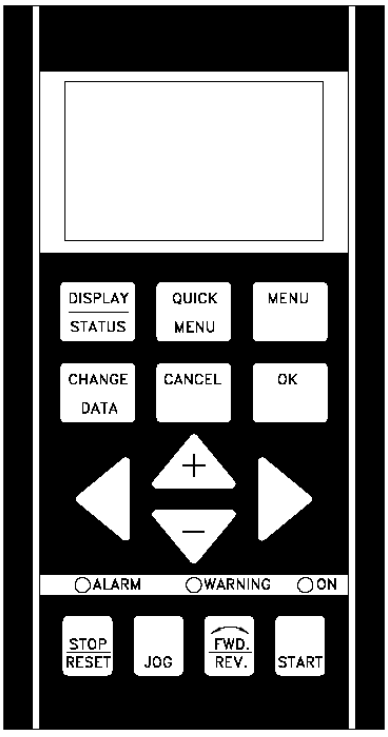
4. PROGRAMMING, MONITORING AND DIAGNOSTICS

A key pad tool (LCP) is available for IVS Sensorless Pumps as an option. The LCP gives the user full programming and monitoring capabilities and it is recommended that at least one LCP and cable kit are purchased for each installation site.



The LCP is connected via a cable to the 'plug kit' mounted in one of the inverter cable entries as shown above.

4.1 LCP FUNCTIONS AND OPERATION

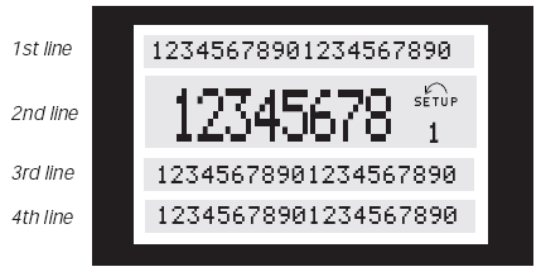


The functions of the control panel can be divided into three groups:
- Display
- Keys for changing program parameters
- Keys for local operation

All data is indicated by means of a 4-line alphanumeric display, which in normal operation is able show 4 measurements and 3 operating conditions continuously. During programming, all the information required for quick, effective parameter Setup of the IVS Sensorless Pump will be displayed. As a supplement to the display, there are three LEDs for voltage, warning and alarm. All program parameters of the IVS Sensorless Pump can be changed immediately from the control panel, unless this function has been blocked via parameter 018.

4.1.1 DISPLAY

The LCD-display has rear lighting and a total of 4 alpha-numeric lines together with a box that shows the direction of rotation (arrow) and the chosen Setup as well as the Setup in which programming is taking place if that is the case.

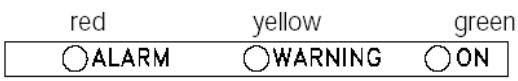


1st line shows up to 3 measurements continuously in normal operating status or a text which explains the 2nd line.
2nd line shows a measurement with related unit continuously, regardless of status (except in the case of alarm/warning).
3rd line is normally blank and is used in the menu mode to show the selected parameter number or parameter group number and name.
4th line is used in operating status for showing a status text or in data change mode for showing the value of the selected parameter.

An arrow indicates the direction of rotation of the pump (factory set). Furthermore, the Setup which has been selected as the Active Setup in parameter 004 is shown. When programming another Setup than the Active Setup, the number of the Setup which is being programmed will appear to the right. This second Setup number will flash.

4.1.2 LED'S

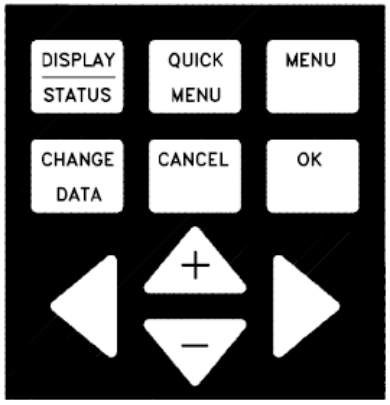
At the bottom of the control panel is a red alarm LED and a yellow warning LED, as well as a green voltage LED.



If certain threshold values are exceeded, the alarm and/or warning lamp lights up together with a status and alarm text on the control panel. The voltage LED is activated when the IVS Sensorless Pump receives voltage; at the same time the rear lighting of the display will be on.

4.1.3 CONTROL KEYS

The control keys are divided into functions. This means that the keys between display and indicator LEDs are used for parameter Setup, including choice of display indication during normal operation.



Keys for local control are found under the indicator LEDs.

Control key functions

DISPLAY / STATUS — [DISPLAY / STATUS] is used for selecting the mode of display or for changing back to Display mode from either the Quick menu mode or the Menu mode.

QUICK MENU — [QUICK MENU] is used for programming the parameters that belong under the Quick menu mode. It is possible to switch directly between Quick menu mode and Menu mode.

MENU — [MENU] is used for programming all parameters. It is possible to switch directly between Menu mode and Quick menu mode.

CHANGE DATA — [CHANGE DATA] is used for changing the parameter selected either in the Menu mode or the Quick menu mode.

CANCEL — [CANCEL] is used if a change of the selected parameter is not to be carried out.

OK — [OK] is used for confirming a change of the parameter selected.

+ / − — [+/-] is used for selecting parameter and for changing the chosen parameter or for changing the read out in line 2.

◄ ► — [<>] is used for selecting group and to move the cursor when changing numerical parameters.

STOP RESET — [STOP / RESET] is used for stopping or for resetting the pump after a drop-out (trip). Can be selected via parameter 014 to be active or inactive. If stop is activated, line 2 will flash, and [START] must be activated.

NB!:
Pressing [STOP/RESET] will prevent the pump from running also with disconnected LCP. Restarting is only possible via the LCP [START] key.

JOG — [JOG] overrides the output frequency to a preset frequency while the key is kept down. Can be selected via parameter 015 to be active or inactive.

FWD. / REV. — [FWD / REV] changes the direction of rotation of the motor, which is indicated by means of the arrow on the display although only in Local. This key is inactive by default.

START — [START] is used for starting the pump after stop via the [Stop] key. Is always active, but cannot override a stop command given via the terminal strip.

4.1.4 DISPLAY MODE

In normal operation, up to 4 different operating variables can be indicated continuously: 1,1 and 1,2 and 1,3 and 2, and in line 4 the present operating status or alarms and warnings that have arisen.

There are three options in connection with the choice of read-out state in the Display mode - I, II and III. The choice of read-out state determines the number of operating variables read out.

Read-out state:	I:	II:	III:
Line 1	Description for operating variable in line 2	Data value for 3 operating variables in line 1	Description for 3 operating variables in line 1

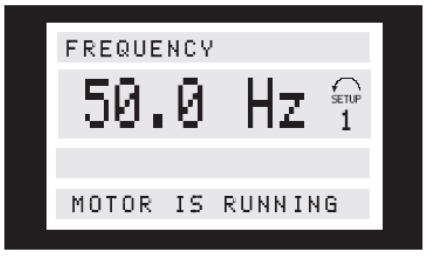
The table below gives the units linked to the variables in the first and second line of the display (see parameter 009).

Operating variable:	*Unit:*
Reference	[%]
Reference	[unit]*
Feedback	[unit]*
Frequency	[Hz]
Frequency x scaling	[-]
Motor current	[A]
Torque	[%]
Power	[kW]
Power	[HP]
Motor voltage	[V]
DC-link voltage	[V]
FC thermal	[%]
Hours run	[Hours]
Input status, dig. Input	[Binary code]
External reference	[%]
Status word	[Hex]
Heat sink temp.	[ºC]
Alarm word	[Hex]
Control word	[Hex]
Warning word 1	[Hex]
Warning word 2	[Hex]
Analog input 1	[mA]
Analog input 2	[V]
Sensorless power	[W]
Sensorless flow	[l/s]
Sensorless head	[kpa]

*) Select in parameter 416. The unit is shown in readout state 1 line 1 otherwise 'U' is shown.

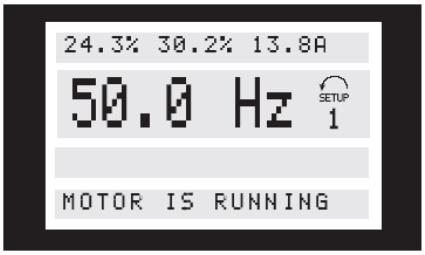
Operating variables 1,1 and 1,2 and 1,3 in the first line, and operating variable 2 in the second line are selected via parameter 009, 010, 011 and 012.

Read-out state I:
This read-out state is standard after starting up or after initialisation.



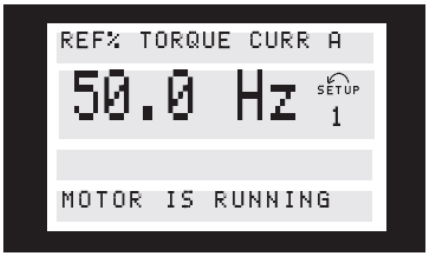
Line 2 gives the data value of an operating variable with related unit, and line 1 provides a text which explains line 2, cf. table. In the example, Frequency has been selected as variable via parameter 009. During normal operation another variable can immediately be read out by using the [+/-] keys.

Read-out state II:
Switching between read-out states I and II is effected by pressing the [DISPLAY / STATUS] key.



In this state, data values for four operating values are shown at the same time, giving the related unit, cf. table. In the example, Reference, Torque, Current and Frequency are selected as variables in the first and second line.

Read-out state III:
This read-out state can be held as long as the [DISPLAY/STATUS] key is pressed. When the key is released, the system switches back to Read-out state II, unless the key is pressed for less than approx. 1 sec.

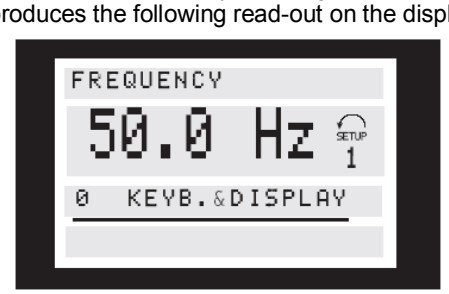


This is where parameter names and units for operating variables in the first line are given—operating variable 2 remains unchanged.

4.1.5 QUICK MENU
Quick menu gives access to a limited number of parameters but does not include parameters that may need to be changed when utilising sensorless control. It is therefore recommended that parameter changes are made in the standard menu.

4.1.6 MENU MODE
The Menu mode makes it possible to select and change all parameters at the user's option. However, some parameters will be "missing", depending on the choice of configuration (parameter 100), e.g. open loop hides all the PID parameters. In addition to having a name, each parameter is linked up with a number which is the same regardless of the programming mode. In the Menu mode, the parameters are divided into groups, with the first digit of the parameter number (from the left) indicating the group number of the parameter in question. Regardless of the mode of programming, a change of a parameter will take effect and be visible both in the Menu mode and in the Quick menu mode.

The Menu mode is started by pressing the [MENU] key, which produces the following read-out on the display:

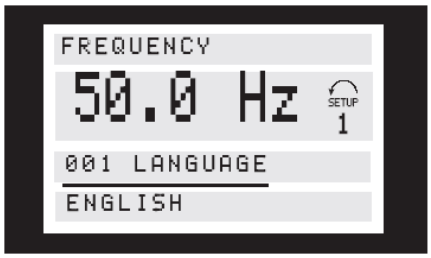


Line 3 on the display shows the parameter group number and name.

Parameter Groups
In the Menu mode the parameters are divided into groups. Selection of parameter group is effected by means of the [<>] keys. The following parameter groups are accessible:

Group no.	*Parameter group:*
0	Operation & Display
1	Load & Motor
2	References & Limits
3	Inputs & Outputs
4	Special functions
5	Serial communication
6	Technical functions
7	Sensorless Control

When the desired parameter group has been selected, each parameter can be chosen by means of the [+/-] keys:



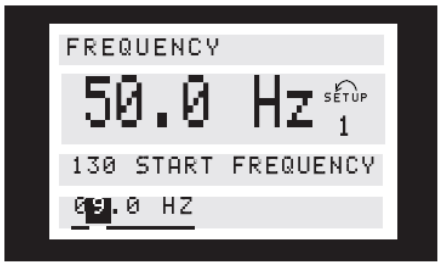
The 3rd line of the display shows the parameter number and name, while the status/value of the selected parameter is shown in line 4.

Changing Data
Regardless of whether a parameter has been selected under the Quickmenu or the Menu mode, the procedure for changing data is the same. Pressing the [CHANGE DATA] key gives access to changing the selected parameter, following which the underlining in line 4 will flash on the display. The procedure for changing data depends on whether the selected parameter represents a numerical data value or a text value.

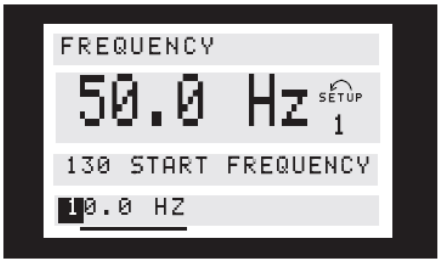
Changing a Text Value
If the selected parameter is a text value, the text value is changed by means of the [+/-] keys.

The bottom display line shows the text value that will be entered (saved) when acknowledgement is given [OK].

Infinitely variable change of numeric data value
If the chosen parameter represents a numeric data value, a digit is first selected by means of the [<>] keys.

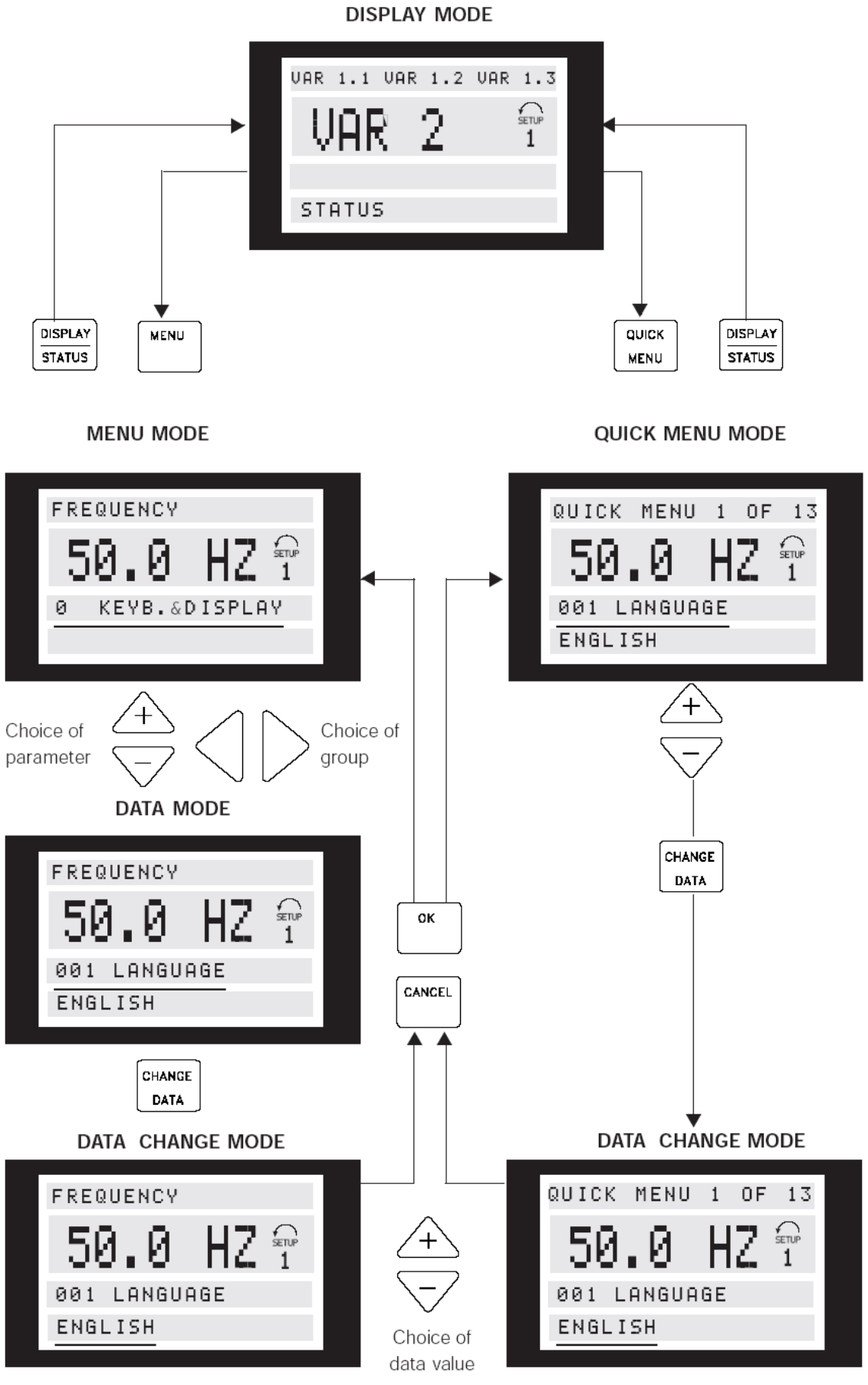


Then the chosen digit is changed infinitely variably by means of the [+/-] keys:



The chosen digit is indicated by the digit flashing. The bottom display line shows the data value that will be entered (saved) when signing off with [OK].

Menu Structure



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.

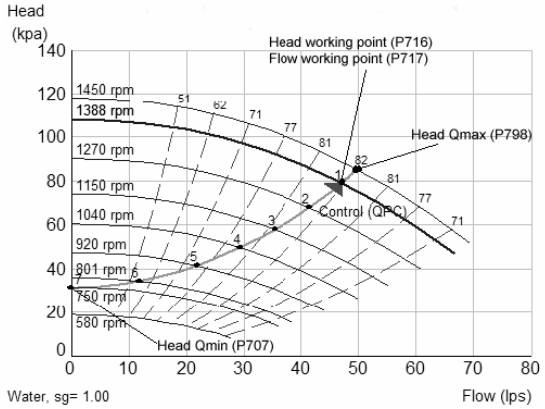
These measurements enable the pump to continuously identify the head and flow at any point in time, giving accurate pressure control without the need for external feedback signals. Patented software technology within the controller ensures trouble-free operation in all conditions.

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 above 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 'Head Qmin'.

5.1.1 DESCRIPTION OF SETTINGS

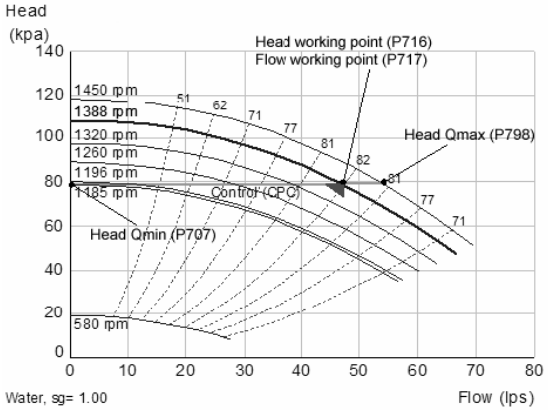
The design duty head and flow of the pump (provided at time of order) is defined by the controller as 'head working point' and 'flow working point'. The minimum head (Head Qmin) is defined as a percentage of the head working point. The maximum controllable head (Head Qmax) is the head developed when the pump reaches full speed and is calculated by the other two head settings.

5.1.2 SETTING PARAMETERS FOR QUADRATIC PRESSURE CONTROL

- *Parameter 716* - Enter the head (kPa) at design flow.
- *Parameter 717* - Enter the design flow (l/s).
- *Parameter 707* - Enter the minimum head requirement (as a percentage of P716).
- *Parameter 705* - Quadratic Head should be set to 'ON'.
- *Parameter 798* - This is a calculated value from the settings above and should not be changed.

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.

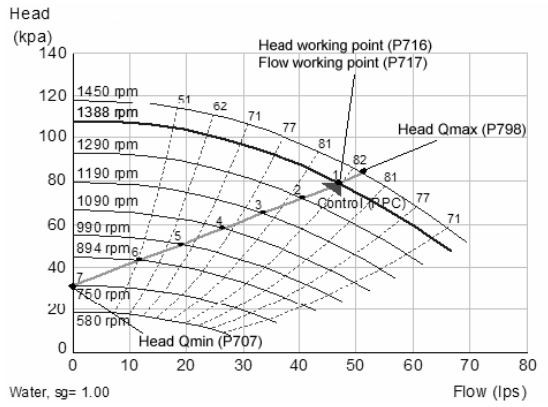


5.2.1 SETTING PARAMETERS FOR CONSTANT PRESSURE CONTROL

- *Parameter 716* - Enter the head (kPa) at design flow.
- *Parameter 717* - Enter the design flow (l/s).
- *Parameter 707* - Enter the minimum head requirement (as a percentage of P716) which will be 100% for constant pressure.
- *Parameter 705* - Quadratic Head should be set to 'OFF'.
- *Parameter 798* - This is a calculated value from the settings above and should not be changed.

5.3 PROPORTIONAL PRESSURE CONTROL

Where a linear reduction in head is required with reducing flow then the quadratic curve should be turned off.



5.3.1 SETTING PARAMETERS FOR PROPORTIONAL PRESSURE CONTROL

- *Parameter 716* - Enter the head (kPa) at design flow.
- *Parameter 717* - Enter the design flow (l/s).
- *Parameter 707* - Enter the minimum head requirement (as a percentage of P716).
- *Parameter 705* - Quadratic Head should be set to 'OFF'.
- *Parameter 798* - This is a calculated value from the settings above and should not be changed.

6.0 CONTROL USING EXTERNAL FEEDBACK (CLOSED LOOP CONTROL).

IVS Sensorless pumps can be configured (using the key-pad) to accept a feedback signal from a remote sensor (e.g. temperature transmitter for constant temperature).

The connection of an external device will depend on the device itself although typical devices are 4-20mA, 2 wire where the supply will be provided by 24VDC on terminal 6 of X101 and the output signal connected to terminal 2 of X101.

The parameter list following this section gives typical set-tings for closed loop control.

6.0 PARAMETER GROUPS AND DESCRIPTIONS.

Group 0 – Operation and Display.

Language/Local Control – Parameters 001, 002, 003
Not normally changed.

Active Set-up – Parameter 004
It is possible to program two separate sets of data for controlling the inverter.

Program Set-up – Parameter 005
The active set-up can be either set-up 1, set-up 2 or can be remotely switched between the two.

Copying of Set-ups – Parameter 006
A copy is made from the set-up selected in parameter 005 and copied to the set-up selected in parameter 006.

Copying of Set-ups Between Inverters – Parameter 007
- Connect key pad to the inverter from which the desired set-up is to be copied.
- Select 1 in parameter 007 to upload all parameters into the key pad.
- Connect key pad to the inverter to which the desired set-up is to be copied.
- Select 3 in parameter 007 to download all parameters into the inverter.
- By selecting 3 in parameter 007, copying from one size of inverter to a different size will not affect the power settings.

Display Scaling – Parameter 008
Multiplication factor of frequency (normally set at 1).

Display Configuration – Parameters 009-012
Allows choice of data to displayed in lines 1 and 2 of the key pad.

Local Operations – Parameters 013-019
Not normally changed.

Group 1 – Load and Motor.

Configuration – Parameter 100
Sets the configuration under which the inverter is con-trolled.

ATTN: Set to **Process Closed Loop** for control via the 4-20mA transducer feedback input set to **Speed Open Loop** for Potentiometer, BMS or Sensorless control.

Motor Settings – Parameters 101-141

ATTN: Are motor related parameters and are not normally changed.

Group 2 – Reference and Limits.

Rotation Direction – Parameter 200

ATTN: Sets rotation direction, normally set at 132Hz counter clockwise.

Minimum Output Frequency – Parameter 201
Minimum output frequency is normally set at 0 to 21Hz dependant on the mode of operation.

Maximum Output Frequency – Parameter 202

Maximum output frequency is normally set at 50Hz.
This figure should not be exceeded as the inverter could be overloaded.

Reference Feedback – Parameter 203
Set to Min-Max and not normally changed.

Minimum Reference – Parameter 204
If operating in closed loop mode, set to minimum scale of the feedback sensor, normally set to 0.0.

Note: Units of measurement are selected in parameter 416.
If operating in open loop mode, the units can only be dis-played as Hz, normally set to minimum speed 0.0Hz.

Maximum Reference – Parameter 205
If operating in closed loop mode, set to maximum scale of the sensor which is normally 4.0 Bar. In all other modes of operation this is normally set at 50Hz.

Note: Units of measurement are selected in parameter 416.
If operating in open loop mode, the units can only be dis-played in Hz. Normally set to a maximum speed of 50.0Hz.

Ramp Up/Down Times – Parameters 207, 208, 211, 212

Ramp up times normally set to 10 seconds.

ATTN: Ramp down times normally set to 3 seconds.
Longer times should be used with higher kW motors.

Jog Frequency – Parameter 213
Normally set to 50Hz when the jog function is activated it will override the normal reference input and run the pump at the preset jog reference.

Reference Function – Parameter 214
Set to Sum. Not normally changed.

Preset Reference 1 – Parameter 215
(Set Point) if operating in closed loop mode, this parameter should be set to the required set point as a percentage of the maximum range of the feedback sensor. *i.e.* Sensor range 0-4.0 Bar, set point required 2.0 Bar, parameter would be set to 50%. If operating in open loop mode or sensorless mode this parameter should be set to 0%.

Preset Reference 2 – Parameter 216
Set to 0% and not normally used.

Catch Up/Slow Down – Parameter 219
Set to 0% and not normally used.

Current limit for Motor – Parameter 221
This should be set to 160% except for 0.75–1.1 kW 2 pole motors where the setting should be restricted to 120%.

Frequency Bypass Bandwidth – Parameter 229
If a skip frequency is entered at parameter 230 or 231 a % bandwidth either side of these frequencies can be defined in this parameter.

Frequency Bypass – Parameters 230-231
If resonance problems occur at particular frequencies, It is possible to program two frequencies to be avoided.

Group 3 – Inputs and Outputs.

Inputs and Outputs – Parameters 317-340
These parameters are not normally changed.

Group 4 – Special Functions.

Special Functions – Parameters 400-446
These parameters are not normally changed.

Group 5 – Serial Communications.

Bus Address – Parameter 500
This parameter allows specification of the address for each inverter. Used in conjunction with PLC/PC connection.
Address 0 is used for the master unit, addresses 1-126 for slave units. A repeater unit will be required if the total number of slave units exceeds 30.

Baudrate – Parameter 501
Sets the speed of communication, set to a value that corresponds with the transmission speed of the PLC/PC.

Drive Control – Parameters 502-508
Allows control via terminal inputs and/or the Bus.

Bus Jog Frequency – Parameters 509-510
Activates the jog frequency via the Bus.

Protocol – Parameter 512
Selects the control word profile 0=Profidrive, 1=FC Drive.

Data Output – Parameters 513-635
Read only values of various functions.

For further information on serial communication, contact Armstrong.

Group 6 – Technical Functions.

Operating Hours – Parameter 600
Readout of inverter operating time, updated hourly.

Run Hours – Parameter 601
Readout of inverter running time, updated hourly.

Power Ups – Parameter 603
Readout of number of power-ups.

Over Temperatures – Parameter 604
Readout of temperature faults.

Over Voltages – Parameter 605
Readout of over-voltage faults.

Fault Log – Parameter 615
Readout of last 10 trip codes, the lowest log number contains the latest fault. (See Page 5 for Fault Code list).

Fault Log Time – Parameter 616
Readout shows total number of operating hours before trip occurred. The lowest log number contains the latest data.

Fault Log Value – Parameter 617
Readout shows current or voltage when the trip occurred.

Reset Hours Run Counter – Parameter 619
To reset the hours run counter in parameter 601 to zero select 1.

Inverter Data – Parameters 620-635
Read only values of inverter identification numbers.

Group 7 – Sensorless Functions.

Sensorless Control On/Off – Parameter 700
Set to 'On' for Sensorless control. For all other modes of control set to 'Off'.

Power Error – Parameter 701
Normally set to 20W, this allows a fast but rough response to the output Hz. Not normally changed.

Delta Frequency – Parameter 702
Normally set to 0.2Hz, as parameter 701, this allows a fast but rough response to the output Hz. Not normally changed.

Integral Power – Parameter 703
Normally set to 20, this allows more precise adjustments to the output Hz. Not normally changed.

Integral Frequency – Parameter 704
Normally set to 20, as parameter 703, this allows more precise adjustments to the output Hz. Not normally changed.

Quadratic Head – Parameter 705
Normally set to 'ON'. In the 'Off' position a linear curve between Min/Max head is produced. In the 'On' position a quadratic curve between Min/Max head is produced.

Head Minimum – Parameter 707
Normally set to 40%. This will provide a 60% reduction in head at 'No Flow' conditions. Set to 100% if a constant head is required across the full flow range.

Power Consumption – Parameter 708
Normally set to 0 option correction factor that mainly affects the head reference at high flow values.

Temperature Rise Rated – Parameter 710

Normally set to 80°C. This specifies the estimated difference in rotor temperature from idle running conditions to maximum loaded conditions.

TAU Therm. – Parameter 711

Normally set to 300 Seconds. This specifies the estimated time it will take the rotor temperature to rise from idle temperature to 67% of the maximum temperature, at maximum loaded conditions.

Slip 0°C – Parameter 712

Normally set to 0%. This specifies the estimated change in motor slip at the idle temperature compared with the nominal slip of the motor at idle load.

Slip 100°C – Parameter 713

Normally set to 0%. This specifies the estimated change in motor slip at the temperature 100vC above the idle temperature, compared with the nominal slip of the motor at maximum load.

Head Working Point - Parameter 716

Design duty head value (kPa)

Flow Working Point - Parameter 717

Design duty flow value (l/s)

Head Maximum – Parameter 798

Shows the maximum controlled head (at max speed). This parameter is automatically calculated using parameter 716,717 and 707.

ARMSTRONG

Recommended Parameter Settings

Description	Parameter	Sensorless	Open Loop	Closed Loop
Language	001	English	English	English
Local/Remote Control	002	Local	Remote	Remote
Local Reference	003	000.000	000.000	000.000
Active Setup	004	Multi Setup	Setup 1	Setup 1
Programming Setup	005	Active Setup	Active Setup	Active Setup
Copying of Setups	006	No Copy	No Copy	No Copy
LCP Copy	007	No Copy	No Copy	No Copy
Display Scaling of Motor Frequency	008	001.00	001.00	001.00
Display Line 2	009	Frequency [Hz]	Frequency [Hz]	Frequency [Hz]
Display Line 1.1	010	Sensorless Head [kpa]	Reference [%]	Reference [Unit]
Display Line 1.2	011	Sensorless Power [W]	Motor Current [Amps]	Feedback [Amps]
Display Line 1.3	012	Sensorless Flow [L/S]	Power [kW]	Power [kW]
Local Control/Configuration	013	LCP Dig Control/Par 100	LCP Dig Control/Par 100	LCP Dig Control/Par 100
Local Stop	014	Enable	Enable	Enable
Local Jog	015	Enable	Disable	Disable
Local Reversing	016	Disable	Disable	Disable
Local Reset of Trip	017	Enable	Enable	Enable
Lock for Data Change	018	Not Locked	Not Locked	Not Locked
Operating State at Power Up, Local Control	019	Auto Restart	Local = Stop	Local = Stop
Configuration	100	Speed Open Loop	Speed Open Loop	Process Closed Loop
Torque Characteristics	101	Constant Torque	Variable Torque – Med	Variable Torque – Med
Motor Power	102	Unit Dependant	Unit Dependant	Unit Dependant
Motor Voltage	103	Unit Dependant	Unit Dependant	Unit Dependant
Motor Frequency	104	Unit Dependant	Unit Dependant	Unit Dependant
Motor Current	105	Unit Dependant	Unit Dependant	Unit Dependant
Rated Motor Speed	106	Unit Dependant	Unit Dependant	Unit Dependant
Resonance Damp	117	Off	Off	Off
DC Braking Time	126	10.0 Seconds	10.0 Seconds	10.0 Seconds
DC Brake Cut-in Frequency	127	Off	Off	Off
Motor Thermal Protection	128	Disable	Disable	Disable
DC Braking Voltage	132	Off	Off	Off
Start Voltage	133	Motor Dependant	Motor Dependant	Motor Dependant
Start Compensation	134	100.0%	100.0%	100.0%
U/F Ratio	135	Motor Dependant	Motor Dependant	Motor Dependant
Slip Compensation	136	0.00%	100.0%	100.0%
DC Holding Voltage	137	Off	0%	0%
Brake Cut-Out Frequency	138	3.0Hz	3.0Hz	3.0Hz
Brake Cut-in Frequency	139	3.0Hz	3.0Hz	3.0Hz
Rotation Direction	200	132Hz Ctr-Clockwise	132Hz Ctr-Clockwise	132Hz Ctr-Clockwise
Minimum Frequency	201	21Hz	0Hz	0Hz
Maximum Frequency	202	50Hz (60 some models)	50Hz (60 some models)	50Hz (60 some models)
Reference/Feedback Range	203	Min-Max	Min-Max	Min-Max
Minimum Reference	204	0Hz	0Hz	(Sensor min)
Maximum Reference	205	50Hz (60 some models)	50Hz (60 some models)	(Sensor max)
Ramp Up Time 1	207	10.00 Seconds	10.00 Seconds	10.00 Seconds
Ramp Down Time 1	208	3.0 Seconds	3.0 Seconds	3.0 Seconds
Ramp Up Time 2	209	3.0 Seconds	3.0 Seconds	3.0 Seconds
Ramp Down Time 2	210	3.0 Seconds	3.0 Seconds	3.0 Seconds
Jog Ramp Time	211	10.00 Seconds	10.00 Seconds	10.00 Seconds
Quick Stop Ramp Down Time	212	3.0 Seconds	3.0 Seconds	3.0 Seconds
Jog Frequency	213	50Hz	50Hz	50Hz
Reference Function	214	Sum	Sum	Sum
Preset Reference 1 (Copy of Parameter 241)	215	000.00%	000.00%	As Required [%]
Preset Reference 2	216	000.00%	000.00%	000.00%
Catch Up/Slow Down Value	219	000.00%	000.00%	000.00%
Current Limit for Motor Mode	221	100%	100%	100%
Frequency Bypass Bandwidth	229	Off	Off	Off
Frequency Bypass 1	230	0.00Hz	0.00Hz	0.00Hz
Frequency Bypass 2	231	0.00Hz	0.00Hz	0.00Hz
Preset Reference 1 (Copy of Parameter 215)	241	000.00%	000.00%	As Required [%]
Preset Reference 2 - 7	242 - 247	000.00%	000.00%	000.00%

ARMSTRONG

Recommended Parameter Settings

Description	Parameter	Sensorless	Open Loop	Closed Loop
Time Out	317	10 Seconds	10 Seconds	10 Seconds
Function After Time Out	318	Off	Off	Stop and Trip
X102 Relay Function	323	Running	Running	Running
Pulse Reference/Feedback Max Frequency	327	5000Hz	5000Hz	5000Hz
Terminal 1, Analogue Input Current	331	No Operation	Feedback	Feedback
Terminal 2, Digital Input	332	Reference	Reference	Reference
Terminal 3, Digital Input	333	Quick Stop Inverse	Quick Stop Inverse	Quick Stop Inverse
Terminal 4, Digital Input	334	Stop Inverse	Start	Start
Terminal 5, Digital Input	335	Setup Select	Setup Select	Jogging
Terminal 1, Minimum Scaling	336	4.0mA	4.0mA	4.0mA
Terminal 1, Maximum Scaling	337	20.0mA	20.0mA	20.0mA
Terminal 2, Minimum Scaling	338	0.0V	0.0V	0.0V
Terminal 2, Maximum Scaling	339	10.0V	10.0V	10.0V
Output Functions	340	Fault	Fault	Fault
Brake Function	400	Off	Off	Off
Sleep Mode Timer	403	Off	Off	Off
Sleep Frequency	404	0Hz	0Hz	0Hz
Reset Function	405	Automatic x 10	Automatic x 10	Automatic x 10
Boost Setpoint	406	100%	100%	100%
Wake Up Frequency	407	50Hz	50Hz	50Hz
Switching Frequency	411	8000 Hz	8000 Hz	8000 Hz
Variable Switching Frequency	412	Temp. Dep. Frequency	Temp. Dep. Frequency	Temp. Dep. Frequency
Overmodulation Function	413	On	On	On
Minimum Feedback	414	0.00	0.00	(Sensor Min)
Maximum Feedback	415	4.00	4.00	(Sensor Max)
Reference/Feedback Unit	416	Bar	Bar	(Sensor Unit)
Process PID Normal/Inverse Control	437	N/a	N/a	Normal
Process PID Anti-Windup	438	N/a	N/a	Enable
Process PID Start Frequency	439	N/a	N/a	20Hz
Process PID Proportional Gain	440	N/a	N/a	0.5
Process PID Integral Time	441	N/a	N/a	1.00 Second
Process PID Differentiation Time	442	N/a	N/a	0.00 Second
Process PID Differentiation Gain Limit	443	N/a	N/a	5.0
Process PID Lowpass Filter Time	444	N/a	N/a	0.50
Flying Start	445	OK Same Direction	OK Same Direction	OK Same Direction
Switching Pattern	446	SFAVM	SFAVM	SFAVM
Feedback Conversion	461	Linear	Linear	Linear
Bus Address	500	001	001	001
Baudrate	501	9600 Baud	9600 Baud	9600 Baud
Coasting	502	Logic Or	Logic Or	Logic Or
Quick Stop	503	Logic Or	Logic Or	Logic Or
DC-Brake	504	Logic Or	Logic Or	Logic Or
Start	505	Logic Or	Logic Or	Logic Or
Reversing	506	Logic Or	Logic Or	Logic Or
Selection of Setup	507	Logic Or	Logic Or	Logic Or
Selection of Speed	508	Logic Or	Logic Or	Logic Or
Bus Jog 1	509	10.0Hz	10.0Hz	10.0Hz
Bus Jog 2	510	10.0Hz	10.0Hz	10.0Hz
Telegram Profile	512	FC Drive Profile	FC Drive Profile	FC Drive Profile
Bus Time Interval	513	1 Second	1 Second	1 Second
Bus Time Interval Function	514	Off	Off	Off
Serial Communication Parameters	515 – 543	Read Out Only Parameters – Not Editable		
Technical Function Parameters	600 – 635	Read Out Only Parameters – Not Editable		
Sensorless Control	700	On	Off	Off
Power Error	701	20W	20W	20W
Delta Frequency	702	0.2Hz	0.2Hz	0.2Hz
Integral Power	703	20	20	20
Integral Frequency	704	20	20	20
Quadratic Head	705	On	On	On
Head Q Min	707	40%	40%	40%
Power Consumption	708	0W	0W	0W
Temperature Rise Rated	710	80°C	80°C	80°C
TAU Therm	711	300 Seconds	300 Seconds	300 Seconds
Slip 0°C	712	0	0	0
Slip 100°C	713	0	0	0
Head Working Point	716	Default	Default	Default
Flow Working Point	717	Default	Default	Default
Head Q Max	798	Default	Default	Default

7.0 WARNINGS AND ALARMS

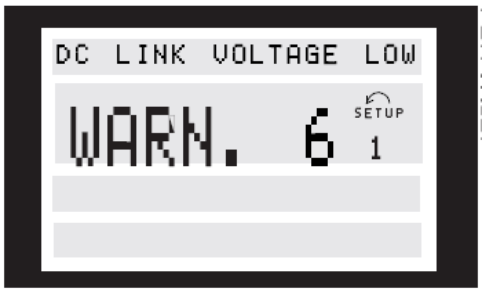
There are two means of notification of warnings and alarms on an IVS Sensorless pump. The keypad tool (LCP) will display alarm information and in addition to this there are 5 status LED's that can be viewed on removal of the inverter cover (see figure 2, page 3).

The table below gives the different warnings and alarms and indicates whether the fault locks the pump. After Trip locked, the mains supply must be cut and the fault must be corrected. Reconnect the mains supply and reset (auto-reset by default) the pump before starting. Wherever a cross is placed under both Warning and Alarm, this can mean that a warning precedes the alarm. It can also mean that it is possible to program whether a given fault is to result in a warning or an alarm. After a trip, alarm and warning will flash, but if the fault is removed, only alarm will flash. After a reset, the pump will be ready to start operation again.

No.	Description	Warning	Trip Alarm	Trip locked
2	Live zero fault (LIVE ZERO ERROR)	X	X	
4	Phase loss (MAINS PHASE LOSS)	X	X	X
5	Voltage warning high (DC LINK VOLTAGE HIGH)	X		
6	Voltage warning low (DC LINK VOLTAGE LOW)	X		
7	Overvoltage (DC LINK OVERVOLT)		X	X
8	Undervoltage (DC LINK UNDERVOLT)		X	
9	Inverter overload (INVERTER TIME)	X	X	
11	Motor thermistor (MOTOR THERMISTOR)		X	
12	Torque limit (TORQUE LIMIT)	X		
13	Overcurrent (OVERCURRENT)		X	X
14	Earth fault (EARTH FAULT)		X	X
15	Supply fault (SWITCH MODE FAULT)		X	X
16	Short-circuit (CURR.SHORT CIRCUIT)		X	X
17	Standard bus timeout (STD BUS TIMEOUT)	X	X	
18	HPFB bus timeout (HPFB TIMEOUT)	X	X	
33	Out of frequency range (OUT FREQ RNG/ROT LIM)	X		
34	HPFB error (HPFB ALARM)	X	X	
35	Inrush fault (INRUSH FAULT)		X	X
36	Overtemperature (OVERTEMPERATURE)	X	X	
37	Internal error (INTERNAL ERROR)		X	X

WARNINGS

The display flashes between normal state and warning. A warning comes up on the first and second line of the display.



ALARMS

The alarm comes up in the 2. and 3. line of the display.

WARNING/ALARM 2
Live zero fault (LIVE ZERO ERROR):
The current signal on terminal 1 is less than 50% of the value set in parameter 336 *Terminal 1, min. scaling*.

WARNING/ALARM 4
Phase loss (MAINS PHASE LOSS):
Phase missing on the supply side. Check the supply voltage to the inverter.

WARNING 5
Voltage warning high (DC LINK VOLTAGE HIGH):
The intermediate circuit voltage (DC) is higher than the overvoltage limit of the control system, see table on the next page. The inverter is still active.

WARNING 6
Voltage warning low (DC LINK VOLTAGE LOW):
The intermediate circuit voltage (DC) is below the undervoltage limit of the control system, see table on the next page. The inverter is still active.

ALARM 7
Overvoltage (DC LINK OVERVOLT):
If the intermediate circuit voltage (DC) exceeds the inverter overvoltage limit (see table on the next page), the inverter will trip. Furthermore, the voltage will be stated in the display.

ALARM 8
Undervoltage (DC LINK UNDERVOLT):
If the intermediate circuit voltage (DC) drops below the inverter lower voltage limit (see table on this page), the inverter will trip after 3 - 28 sec., depending on unit. Furthermore, the voltage will be stated in the display. Check whether the supply voltage matches inverter motor.

WARNING/ALARM 9
Inverter overload (INVERTER TIME):
The electronic, thermal inverter protection reports that 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 95% and trips at 100%, while giving an alarm. The inverter cannot be reset until the counter is below 90%.

Trip/Alarm/Warning Limits:	
FC motor Series	3 x 380 - 480
Undervoltage	410[VDC]
Voltage warning low	440[VDC]
Voltage warning high	760[VDC]
Overvoltage	760[VDC]*

* 760V in 5 sec. or 800V immediately.
The voltages stated are the intermediate circuit voltage of the inverter.

ALARM 11
Motor thermistor (MOTOR THERMISTOR):
If a thermistor is mounted and parameter 128 is set to *Enable* [1], the FCmotor will trip if the motor gets too hot.

WARNING 12
Current limit (CURRENT LIMIT):
The current is higher than the value in parameter 221 (in motor operation).

ALARM 13
Overcurrent (OVERCURRENT):
The inverter peak current limit (approx. 230% of the rated current) has been exceeded. The inverter will trip, while giving an alarm.
Turn off the inverter and check whether the motor shaft can be turned.

ALARM: 14
Earth fault (EARTH FAULT):
There is a discharge from the output phases to earth, either between the inverter and the motor or in the motor itself.

ALARM: 15
Supply fault (SWITCH MODE FAULT):
Fault in the switch mode power supply (internal 24 V supply). Contact Armstrong Holden Brooke Pullen.

ALARM: 16
Short-circuiting (CURR.SHORT CIRCUIT):
There is short-circuiting on the motor terminals or the motor itself. Contact Armstrong.

ALARM: 17
Standard bus timeout (STD BUSTIMEOUT)
There is no communication to the inverter (when using serial communications). The warning will only be active when parameter 514 has been set to another value than *OFF*.
If parameter 514 has been set to *stop and trip*, it will first give a warning and then ramp down until it trips, while giving an alarm.
Parameter 513 Bus time interval could possibly be increased.

WARNING 33
Out of frequency range:
This warning is active if the output frequency has reached parameter 201 *Output frequency low limit or parameter* 202 *Output frequency high limit*.

WARNING/ALARM 34
HPFB error (HPFB ALARM):
The profibus communication is not working correctly.

ALARM 35
Inrush fault (INRUSH FAULT):
This warning occurs when the unit has been switched on too many times within 1 minute.

WARNING/ALARM 36
Overtemperature (OVERTEMPERATURE):
A warning occurs at 78°C and the inverter trips at 90°C. The unit can be reset when the temperature is below 70°C.

ALARM: 37
Internal error (INTERNAL ERROR):
An error has occurred in the system. Contact Armstrong Holden Brooke Pullen.

7.1 INTERNAL LED DESCRIPTIONS

The LED's (shown in figure 2, page 3) can be used to determine the status of the IVS Sensorless pump when an LCP is not available.

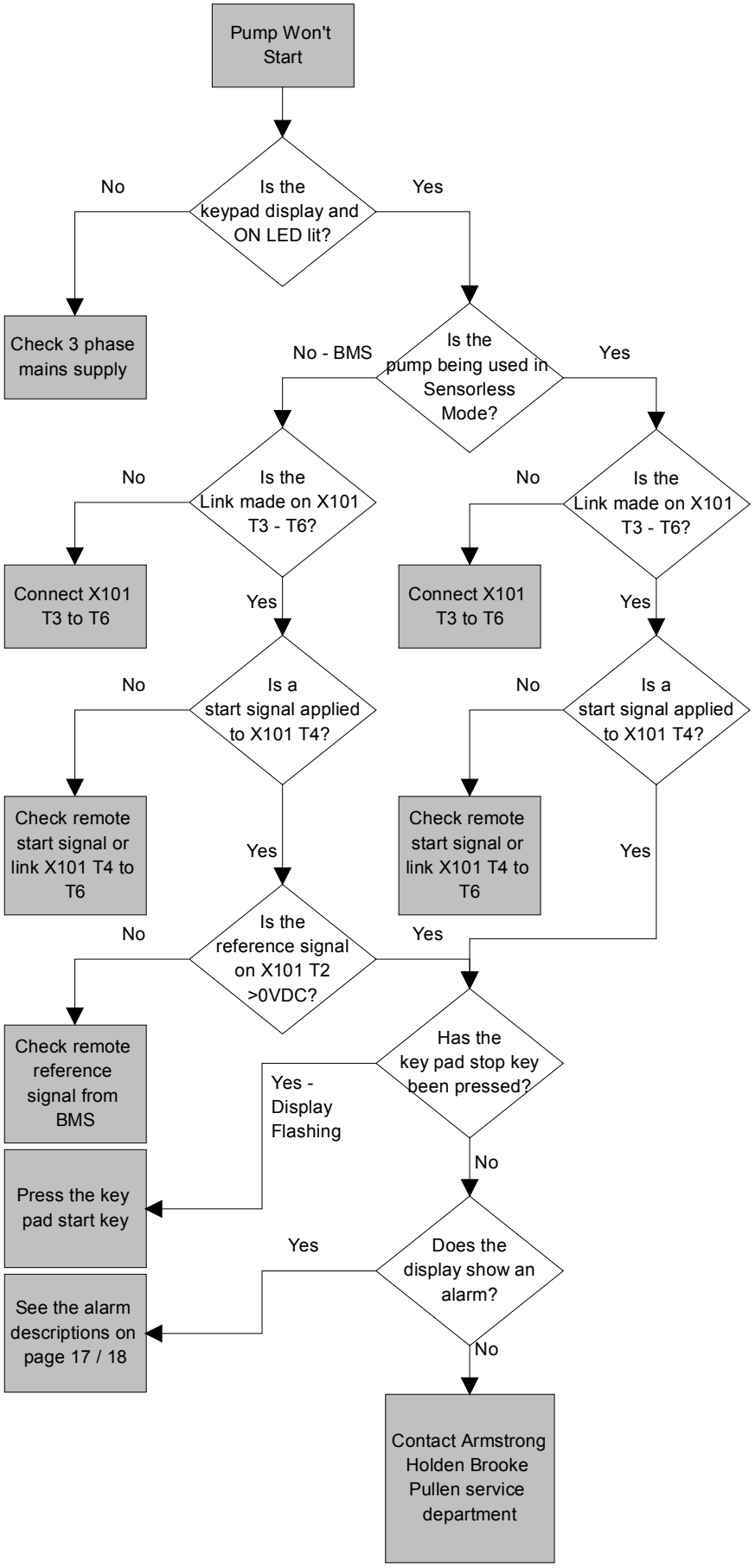
SAFETY, RISK OF DEATH

To view the LED's the cover will need to be removed with the power supply switched on. This is very dangerous and all necessary precautions should be taken to eliminate the risk of electrocution.

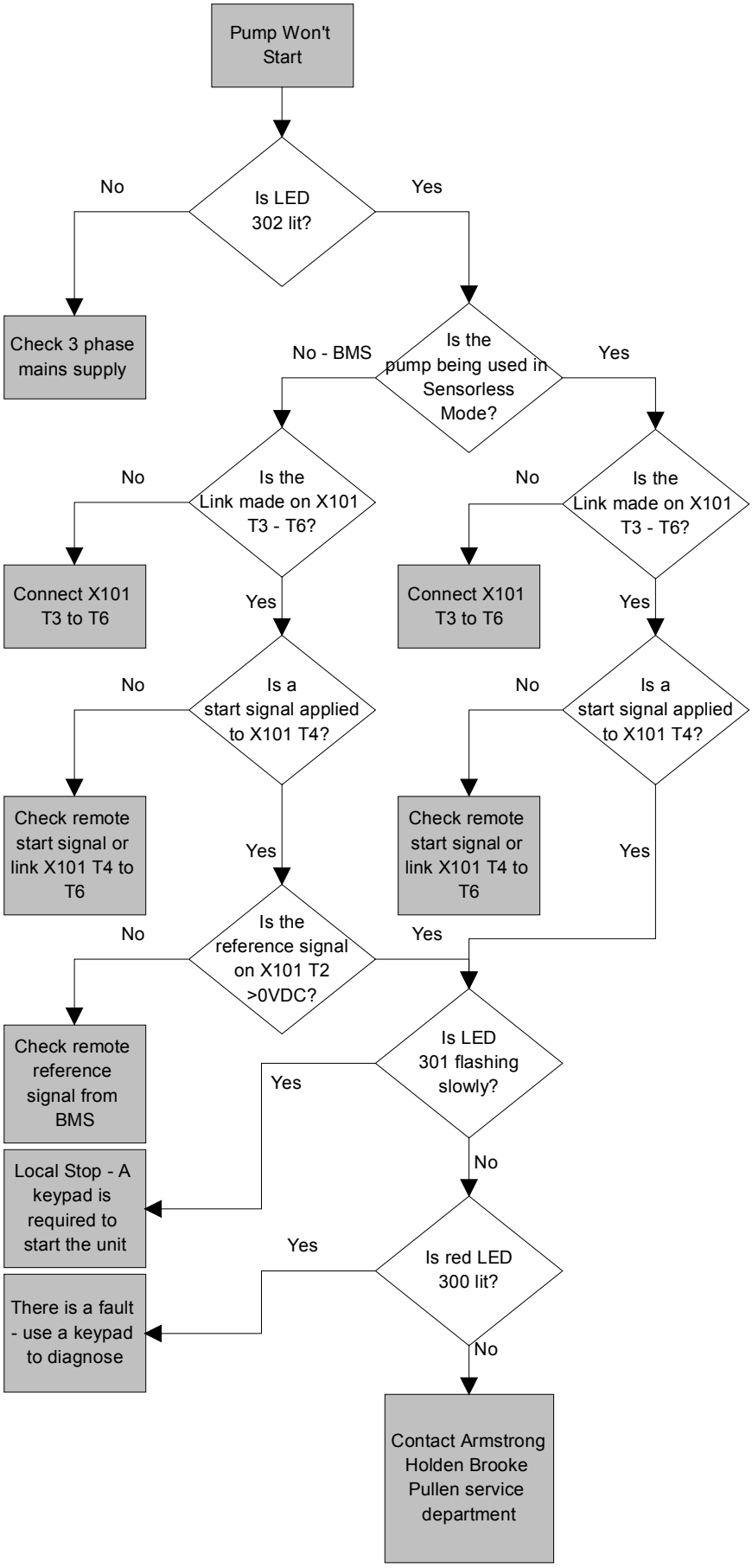
LED 300-304
LED 300 (red): Fault trip
LED 301 (yellow): Warning
LED 302 (green): Power on
LED 303-304: Communication (LCP or RS485)

Note!
If LED301 flashes slowly then the pump has been given a stop command via an LCP (keypad) and can only be started by an LCP start command.

Fault Finding Chart - Keypad Available



Fault Finding Chart - No Keypad Available



Section 2 - Units With Motor Power Ratings 11.0 to 55.0kW

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 recirculation of exhausted warm air.

With reference to figure 1, the pump should not be installed with the inverter in the underside position. This guidance pertains to all pump types and overrides any instruction in the particular pump Installation, Operation and Maintenance Instruction.

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

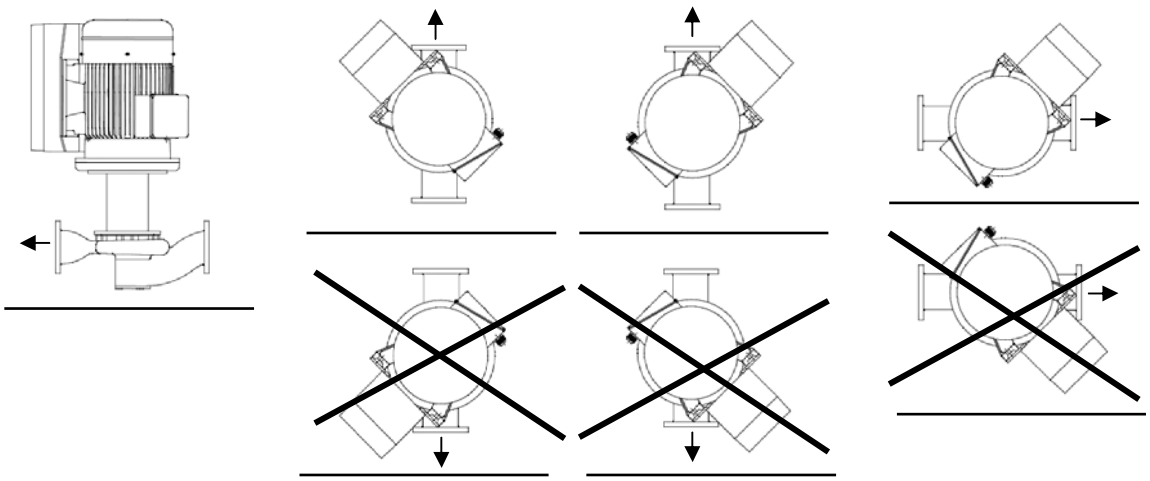


Figure 1. Allowable Installation Orientation - On-board Inverter Position

2.1 ENCLOSURE RATING

The standard enclosure rating for IVS Sensorless pumps is IP55. 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 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 380-480V +/- 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.

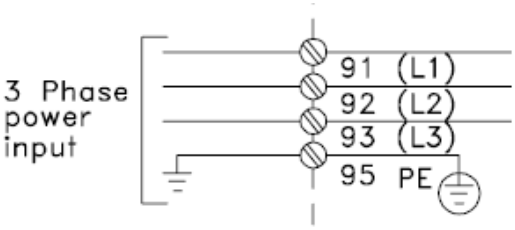


Figure 2. Terminals for Mains and Earthing

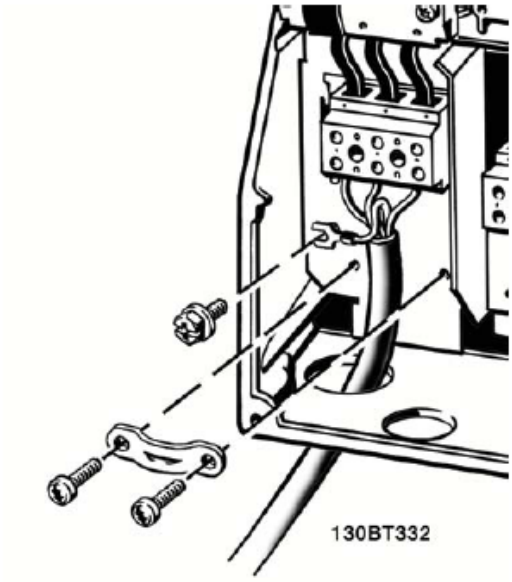


Figure 3. Mains and Earthing Connections for 11kW to 30kW Units

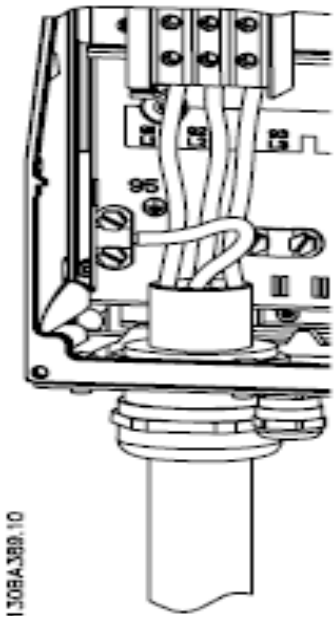


Figure 4. Mains and Earthing Connections for 37kW to 55kW Units

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

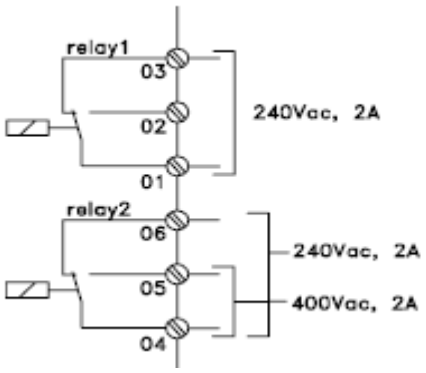


Figure 5. Relay Contact Details

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:

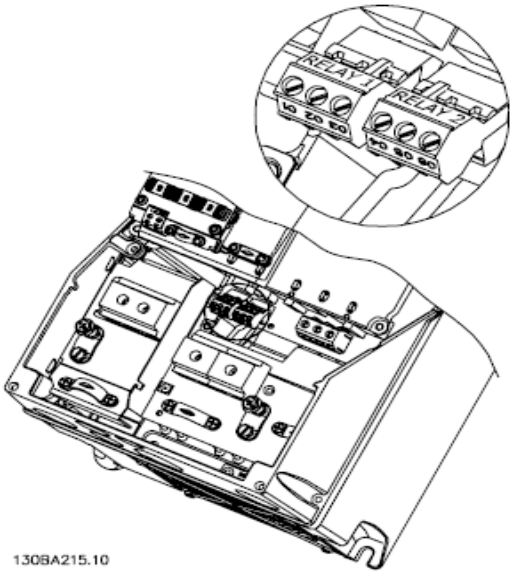


Figure 6. Relay Connection Terminals for Units 11kW to 30kW

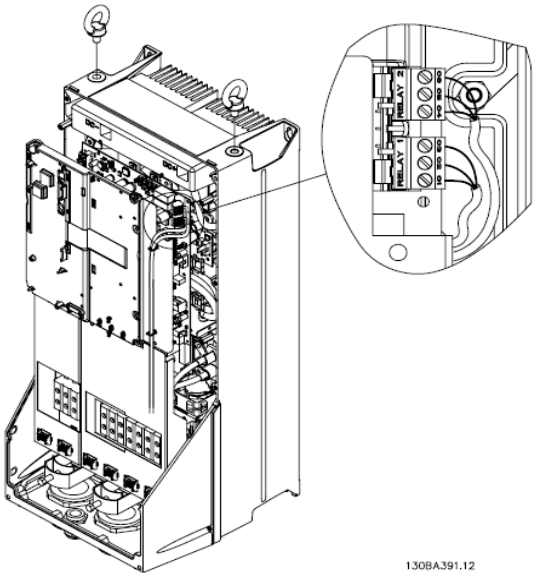
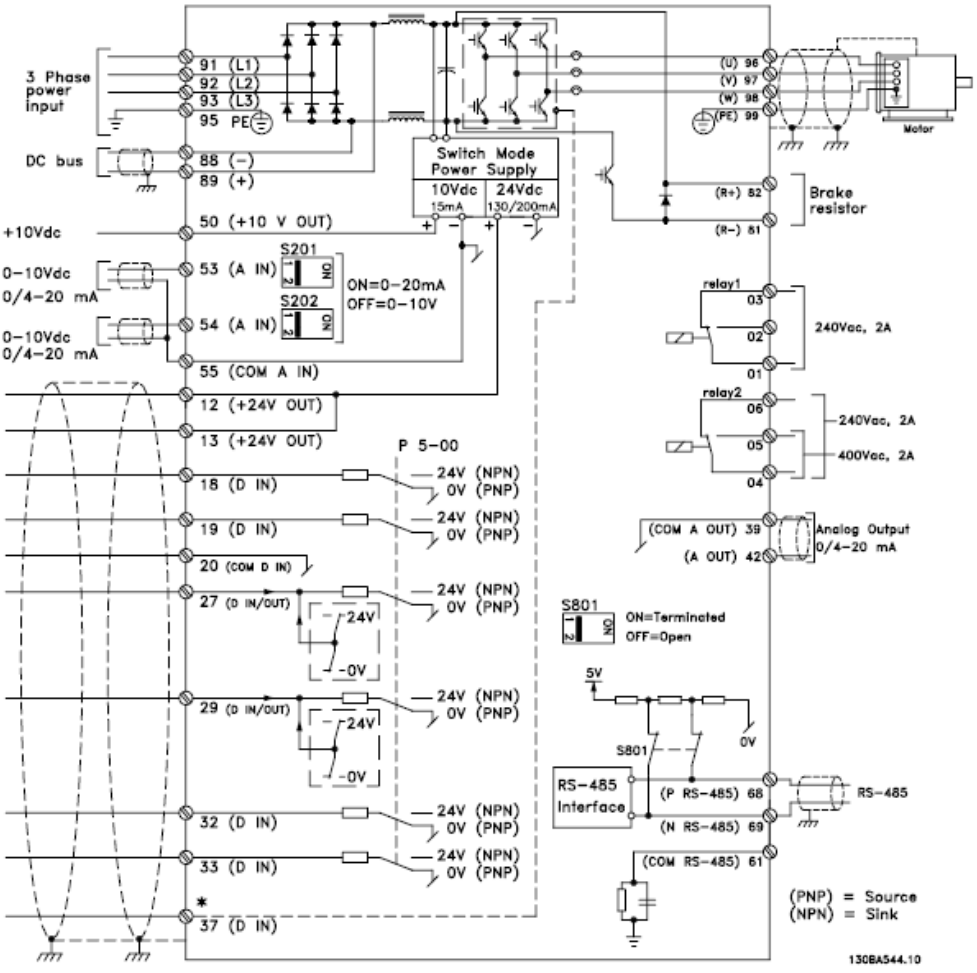


Figure 7. Relay Connection Terminals for Units 37kW to 55kW

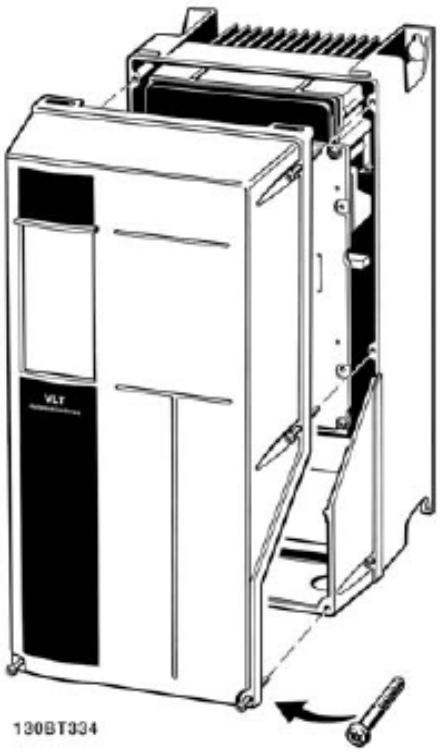
3.8 ELECTRICAL INSTALLATION AND CONTROL CONNECTIONS



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

Figure 8. Diagram Showing all Electrical Connections

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

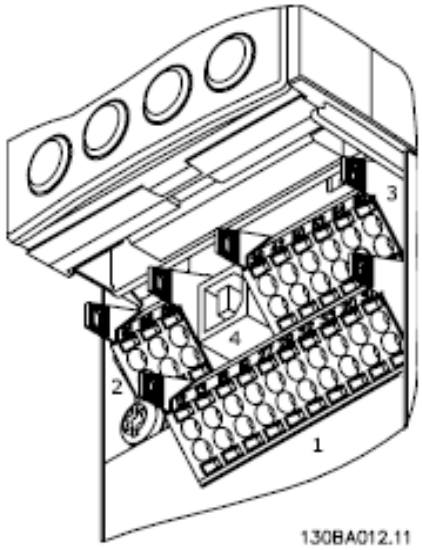


Figure 9. Control Connections

With reference to figure 9:

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:

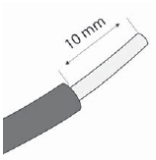
Terminal No	Type / Desc	Factory Setting
1,2,3	Relay 1	Running
4,5,6	Relay 2	Alarm
12	Supply	+24V DC
13	Supply	+24V DC
18	Digital Input	Start
19	Digital Input	Pump Operating Mode
20	Common	0V
27	Digital Input	Low Water Interlock
29	Digital Input	No Operation
32	Digital Input	No Operation
33	Digital Input	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

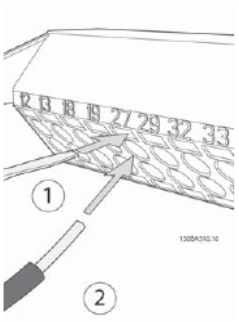
Inserting Cables into Control Terminals

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.



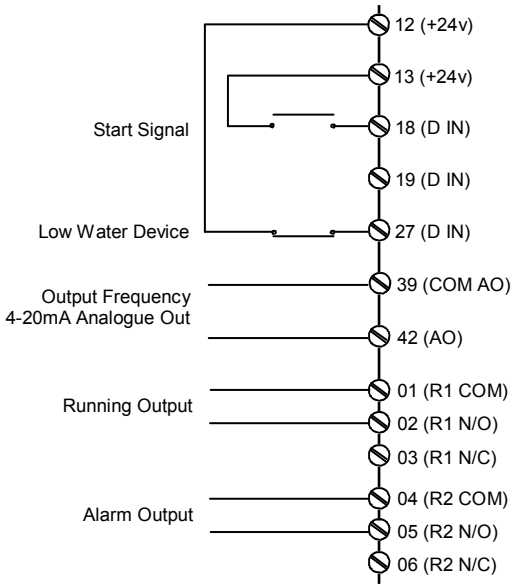
Note: Terminal plugs can be easily removed for improved access when making connections.

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.

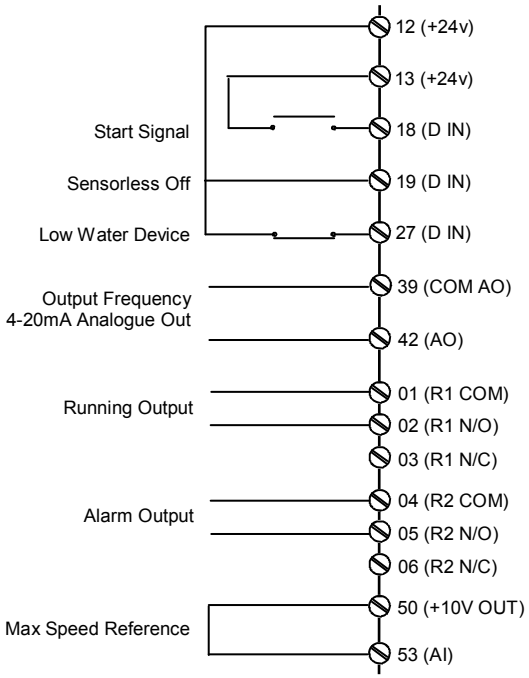
i. SENSORLESS PRESSURE CONTROL - CONNECTION DETAILS

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.



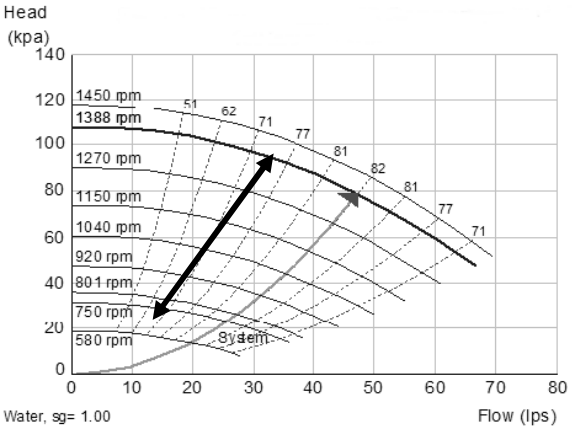
ii. FULL SPEED OVERIDE - CONNECTION DETAILS

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.

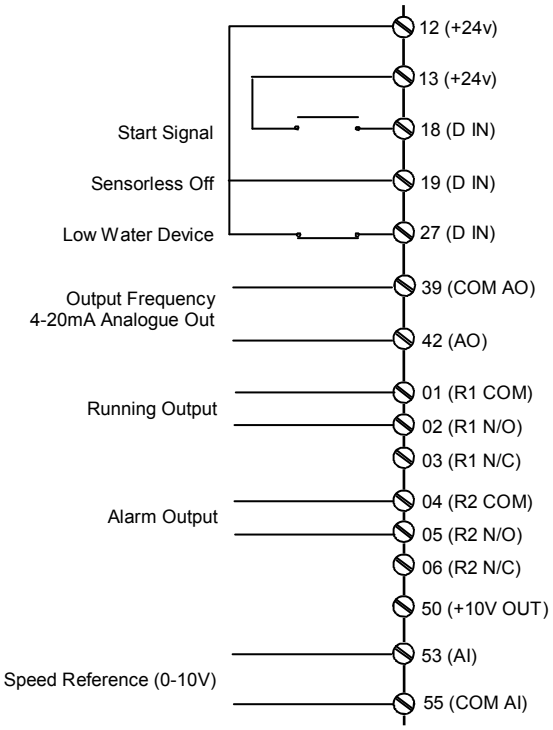


iii. CONSTANT CURVE MODE - BMS SPEED CONTROL

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 50Hz pump speed the reference signal is scaled (by default) so that 0V on terminal 53 will equate to 0Hz and 10V will equate to 50Hz.

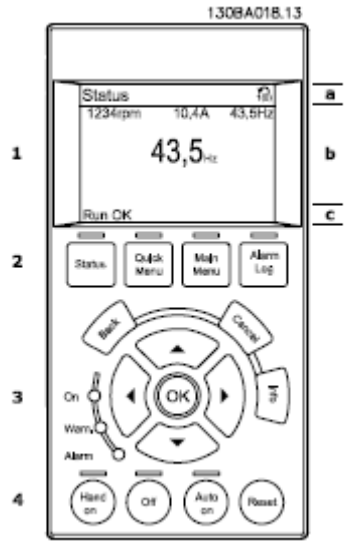


The recommended minimum speed for IVS Sensorless pumps is 580rpm. Running for long periods below this speed can damage the mechanical seal.

4. PROGRAMMING, MONITORING AND DIAGNOSTICS

IVS Sensorless pumps with power ratings 11.0kW and above 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.

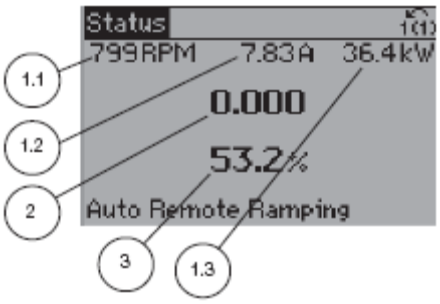
It is possible to toggle between three status read-out displays by pressing the [Status] key.

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.

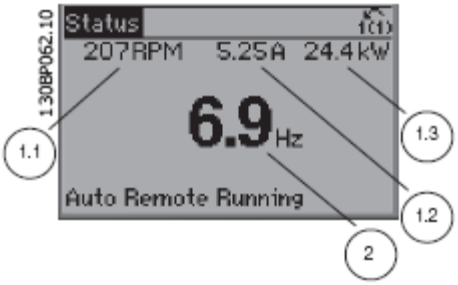
Use [INFO] to obtain information about the value/ measurement linked to the displayed operating variables (1.1, 1.2, 1.3, 2, and 3).See the operating variables shown in the display in this illustration. 1.1,1.2 and 1.3 are shown in small size. 2 and 3 are shown in medium size.



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]

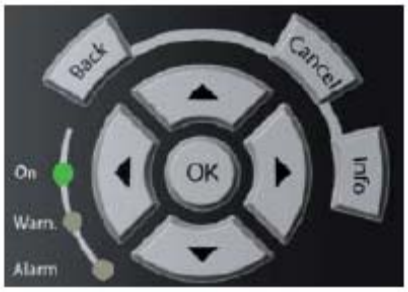
Last change or command will be cancelled as long as the display has not been changed.

[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.

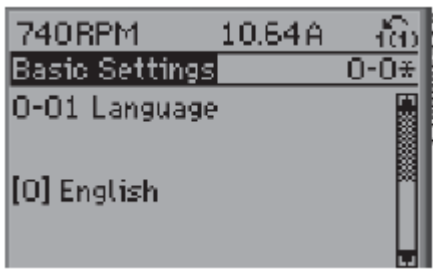
4.4.1 PARAMETER SELECTION

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.

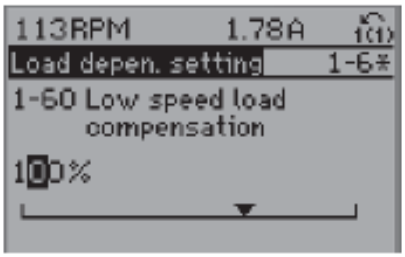


4.4.2 CHANGING DATA

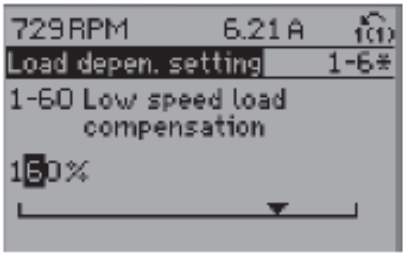
The procedure for changing data depends on whether the selected parameter represents a numerical data value or a text value.

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

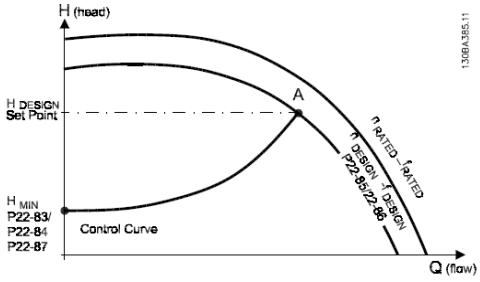
curves for ten different speeds are embedded in the memory of the speed controller during manufacture. This data includes power, pressure and flow across the flow range of the pump. During operation, the power and speed of the pump are monitored, enabling the controller to establish the hydraulic performance 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.

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

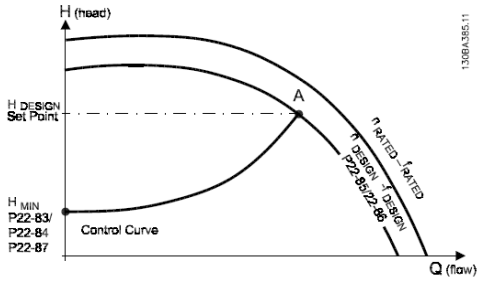


Figure 10. Quadratic Control Settings

head (at zero flow - 'H_{MIN}') will be set as 40% of the design head 'H_{DESIGN}'. The minimum head is set using Par. 22-87.

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.

The flow at design point is set using Par. 22-89 which should be a flow value in l/s.

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%'

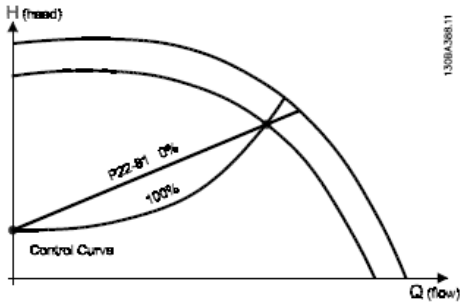


Figure 11. Curve Approximation Settings

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.

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 over-voltage 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 ex-changed. 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 follow-ing:

- 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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