Product Manual

TCS Basys Controls®

SZ1143b

General Purpose Controller

SUPERSTAT™ Communicating Thermostats

Description

The SZ1143b is a microprocessor-based general purpose controller. Because it has four distinct control sequences, it is designed for use in a wide variety of applications. These applications are: general control, remote setpoint control, general input reset ratio control and differential input (i.e. temperature, pressure, humidity, etc.) control.

Features

- Two 4 to 20 mA analog inputs suitable for a broad variety of transducers
- Two digital inputs for switches, alarms, clocks, etc.
- One 4-20 mA modulating output
- Two relay outputs
- Adjustable P+I+D control on modulating output
- Adjustable offsets and differentials on relay outputs
- Application sequences include:
- Humidification
- Dehumidification
- Dew Point Control
- High/Low Signal Control
- Differential Temperature
- Differential Pressure
- Static Pressure
- Hot or Chilled Water
- Hot or Chilled Water Reset
- Stand-alone or network operation

Mounting

The SZ1143b is designed for mounting using two #10 sheet metal screws.

Contents

Wiring

The SZ1143b uses terminal designations for wiring. See diagram below.

TRANSMITTER WIRING

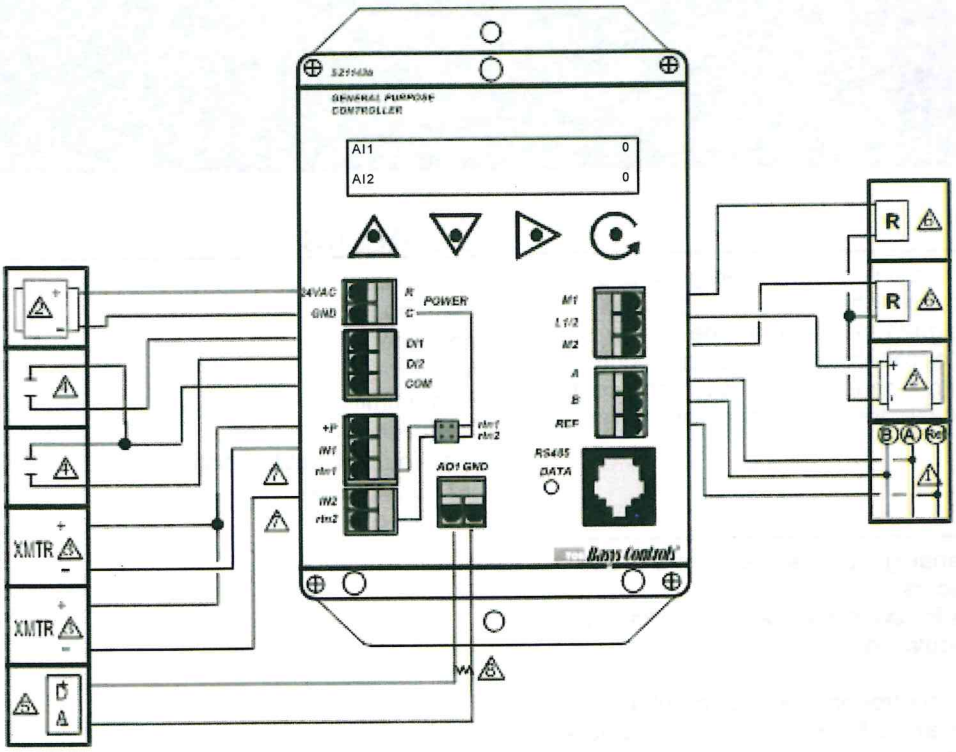
The SZ1143b accepts two 2-wire, 4-20mA transmitters. Use our TH Series for relative humidity sensing, TS/TX Series for temperature sensing, or TD/TL Series for differential air sensing.

POWERING THE SZ1143b

The SZ1143b is powered from 24 VAC +/- 20 %.

Caution: Do not connect to 120 VAC. When multiple TCS Basys Controls devices are using a single transformer, the polarity of the power wiring must be maintained because all TCS devices are half-wave rectified and have common return paths.

If wiring for communications, dedicated power must be used to power the controller. Several S series controllers may be powered from the same transformer, provided that the transformer has sufficient power. (Supertrols require 5 VA @ 24VAC.)



1. For communication wiring, use twisted, shielded 18 AWG. Must be run separately.
2. 24 VAC transformer. See powering instructions.
3. 2-wire, 4-20mA transmitter. Sensor input wiring 18 AWG, twisted, shielded pair.
4. Dry contact. Must not be powered.
5. 4 to 20 mA output. 600 ohm max. Do not power actuator with power from the thermostat. The thermostats are half-wave rectified, whereby the power ground is comon with the signal ground.
6. Dry contact rated 24 VAC @ 2 A.
7. See Analog Inputs in the Operation Section
8. Add 500Ω resistor (included in bag) to convert 0/4 to 20mA to, 0/2 to 10 VDC.

Programming

The SZ1143b may be programmed through the display and keypad, or with a PC.

If programming with a PC, the following must be set through the keypad prior to programming:

- Address (step #2)
- Baud rate (step #3)

For more information on programming through the PC, consult your TCS software manual.

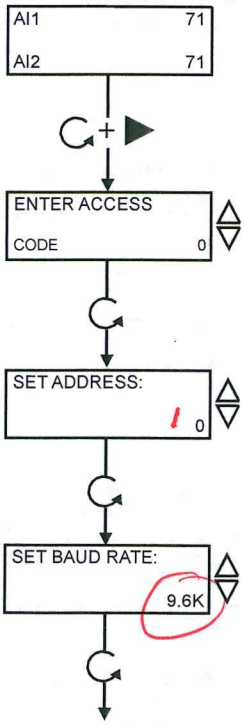
PROGRAMMING THROUGH THE KEYPAD

To access the programming screens, press both the "Scroll" and "Next" keys simultaneously.

Scroll Key - The "Scroll" key is also used to save any changes to the "current" screen and advance to the next screen while programming. The "Scroll" key is used to enter the Programming Mode when pressed with the "Next" key.

Next Key - Used to enter Programming Mode when pressed with the "Scroll" key. Also used to exit programming without saving changes to the current screen. In monitoring mode, the "Next" key is used to scroll backwards.

Increment/Decrement Keys - Used to select the desired value.

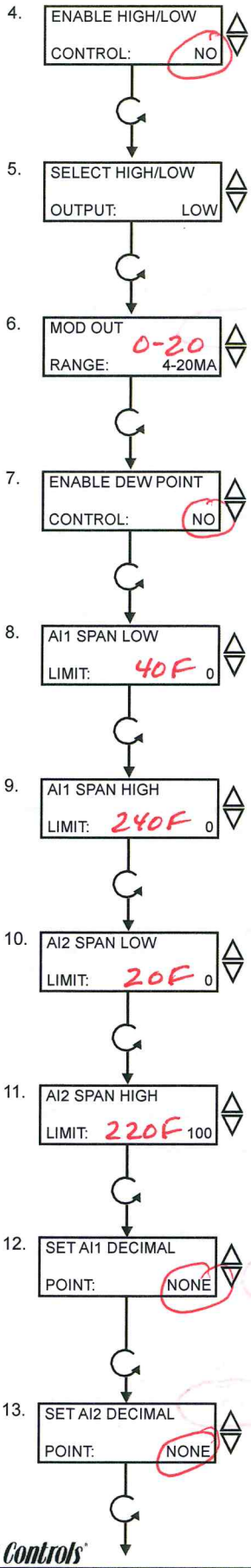


Main Monitoring Screen. Press the scroll and next buttons to access the following screens.

Access Code Entry Screen. Enter the access code. If the wrong code is entered, the program reverts to the main screen. 248 is the default access code.

Controller Address Screen. If using a PC to access the SZ1143b, set a unique address from 0 to 255, excluding 248.

Communication Baud Rate Screen. If using a PC to access the SZ1143b, all controllers on a network must be set to the same baud rate. Choose between 2.4K, 4.8K, 9.6K and 19.2K.



Enable High/Low. Select yes to enable High/Low control.

High/Low Output Screen. Select whether you would like to pass the low or the high analog inout (This screen only appears if High/Low Control mode is enabled).

Analog Output Range Screen. Choose whether the analog output range will be 0-20mA or 4-20mA. (This screen is the last screen if High/Low control mode is enabled, and is the same as step 22 when not enabled).

Enable Dew Point Control. Select yes to enable dew point control. (Skip to step 14 if dew point is selected.)

AI1 Low Limit Span Screen. Enter the lowest value of the span range of the transmitter connected to AI1 (i.e., value at 4mA). Note: Automatically set to 0 if dew point control is selected.

AI1 High Limit Span Screen. Enter the highest value of the span range of the transmitter connected to AI1 (i.e., value at 20mA). Note: Automatically set to 100 if dew point control is selected.

AI2 Low Limit Span Screen. Enter the lowest value of the span range of the transmitter connected to AI2 (i.e., value at 4mA). Note: Automatically set to 0 if dew point control is selected.

AI2 High Limit Span Screen. Enter the highest value of the span range of the transmitter connected to AI2 (i.e., value at 20mA). Note: Automatically set to 100 if dew point control is selected.

AI1 Decimal Point Screen. For display purposes, the SZ1143b allows a decimal point to be turned on. No scaling is done. Enter "0" for no decimal point, "XX.X" for a decimal point in the tenths position, "X.XX" for a decimal point in the hundredth position or ".XXX" for a decimal point in the thousandths position.

AI2 Decimal Point Screen. For display purposes, the SZ1143b allows a decimal point to be turned on. No scaling is done. Enter "0" for no decimal point, "XX.X" for a decimal point in the tenths position, "X.XX" for a decimal point in the hundredth position or ".XXX" for a decimal point in the thousandths position.

14. OCCUPIED DEADBAND: 1%

Occupied Deadband Screen. Enter an occupied deadband. This is +/- the setpoint where no control is done, during the occupied time period. This is a number from 0 to 100% of input span.

15. UNOCCUPIED DEADBAND: 5%

Unoccupied Deadband Screen. Enter an unoccupied deadband. This is +/- the setpoint where no control is done, during the unoccupied time period. This is a number from 0 to 100% of input span.

16. AI2 USED FOR: MONITOR

AI2 Control Mode Screen. Choose the control mode for AI2. Select from Remote Setpoint, Reset or Monitor. Select Monitor if AI2 is not used. Note: Must be MONITOR if dew point control is selected.

17. SETPOINT LOW LIMIT: 90 0

Setpoint Low Limit Value Screen. Enter a setpoint low limit value. The setpoint will not be allowed to be set lower than this setting.

18. SETPOINT HIGH LIMIT: 190 100

Setpoint High Limit Value Screen. Enter a setpoint high limit value. The setpoint will not be allowed to be set higher than this setting.

19. PRIMARY SETPOINT: 75

Setpoint Screen. Enter a setpoint value for control. (This screen does not appear if the AI2 Control Mode is chosen to be Remote Setpoint.)

20. RESET SETPOINT: 75

Reset Setpoint Screen. Enter a setpoint value for AI2. (This screen only appears if the AI2 Control Mode is chosen to be Reset.)

21. RESET RATIO FACTOR: 1.0

Reset Ratio Factor Screen. Enter a reset ratio factor. This is the number of units +/- (%RH, °F, etc.) that the AI1 Setpoint is raised when the AI2 input falls 1 unit below its setpoint. (This screen only appears if the AI2 Control Mode is chosen to be Reset.)

22. MOD OUT RANGE: 4-20MA

Analog Output Range Screen. Choose whether the analog output range will be 0-20mA or 4-20mA.

23. MOD OUT ACTION: DIRECT

Analog Output Action Screen. Choose whether the analog output will be direct or reverse acting. (When DI2 is set to Aquastat, the output will automatically reverse action when DI2 is closed.)

24. MOD OUT TYPE: MIDPOINT

Analog Output Type Screen. Select whether the analog output will be modulated from an endpoint or the midpoint. Note: Set to MIDPOINT if dew point control is selected.

25. MOD OUT UNOCC ACTION: MOD

Analog Output Unoccupied Action Screen. Select whether during unnoccupied mode the analog output will modulate go to 0 to 4 mA, or go to 20 mA.

26. MOD OUT IS: HEAT

Analog Output Mode Screen. Choose whether the analog output mode will be Heat or Cool. With heat mode, modulation occurs when the input is below the setpoint. With cool mode, modulation occurs when the input is above the setpoint. (This screen only appears if the Analog Output Type is chosen to be Endpoint.)

27. MOD OUT SETPOINT OFFSET: 1 0%

Analog Output Setpoint Offset Screen. Enter a setpoint offset. This is a value below the setpoint (Heat Mode) or above the setpoint (Cool Mode) where the analog output begins to modulate. (This screen only appears if the Analog Output Type is chosen to be Endpoint.)

28. MOD OUT UNOCC ACTION: MOD

Analog Output Unoccupied Action Screen. Choose whether the unoccupied analog output will be Modulating, 0mA or 4mA, or 20mA.

29. AO PROPORTIONAL BAND: 3 1

Analog Output Proportional Band Screen. Enter a proportional band. This is in percent of input span. It is how much AI1 must change to have the analog output change from 0 or 4 mA to 20mA.

30. AO INTEGRAL FACTOR: 20 15

Analog Output Integral Value Screen. Enter a integral value. This a number between 0 and 100%. Choose 0 if integral is not used.

31. AO DIFFERENTIAL FACTOR: 200 2

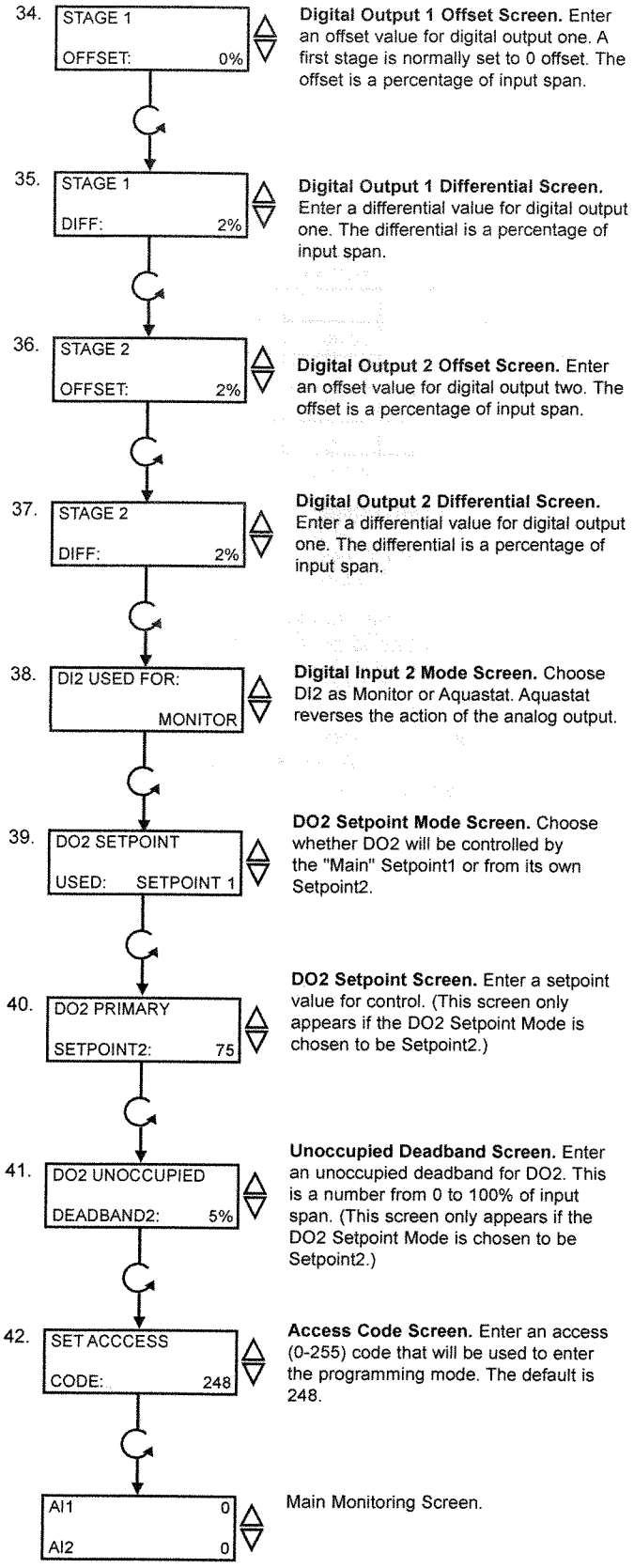
Analog Output Differential Value Screen. Enter a derivative value. This a number between 0 and 100%. Choose 0 if derivative is not used.

32. STAGE OUTPUT 1 AS: HEAT

Digital Output 1 Mode Screen. Choose whether the mode for digital output one will be Heat or Cool. With heat mode, relay energizes when the input is below the setpoint. With cool mode, relay energizes when the input is above the setpoint.

33. STAGE OUTPUT 2 AS: COOL

Digital Output 2 Mode Screen. Choose whether the mode for digital output two will be Heat or Cool. With heat mode, relay energizes when the input is below the setpoint. With cool mode, relay energizes when the input is above the setpoint.



Digital Output 1 Offset Screen. Enter an offset value for digital output one. A first stage is normally set to 0 offset. The offset is a percentage of input span.

Digital Output 1 Differential Screen. Enter a differential value for digital output one. The differential is a percentage of input span.

Digital Output 2 Offset Screen. Enter an offset value for digital output two. The offset is a percentage of input span.

Digital Output 2 Differential Screen. Enter a differential value for digital output one. The differential is a percentage of input span.

Digital Input 2 Mode Screen. Choose DI2 as Monitor or Aquastat. Aquastat reverses the action of the analog output.

DO2 Setpoint Mode Screen. Choose whether DO2 will be controlled by the "Main" Setpoint1 or from its own Setpoint2.

DO2 Setpoint Screen. Enter a setpoint value for control. (This screen only appears if the DO2 Setpoint Mode is chosen to be Setpoint2.)

Unoccupied Deadband Screen. Enter an unoccupied deadband for DO2. This is a number from 0 to 100% of input span. (This screen only appears if the DO2 Setpoint Mode is chosen to be Setpoint2.)

Access Code Screen. Enter an access (0-255) code that will be used to enter the programming mode. The default is 248.

Main Monitoring Screen.

Operation

UNOCCUPIED SETBACK

The SZ1143b operates in either an occupied or unoccupied mode. During the occupied mode, the occupied deadband will be used. During the unoccupied mode, the unoccupied deadband will be used.

Digital Input 1 is used to set the occupied and unoccupied mode of the SZ1143b. If the connection from "DI1" to "COM" (ground) is "Open", the SZ1143b functions in Occupied Mode. If the connection from "DI1" to "COM" (ground) is "Closed", or "Shorted", the SZ1143b functions in Unoccupied Mode.

ANALOG INPUT

The SZ1143b's 4 to 20mA inputs utilize differntial input circuits. The +P terminal is a DC power supply for 2-wire (loop powered) 4 to 20mA inputs. To connect a 2-wire 4 to 20mA transmitter (temperature, pressure, humidity) to the SZ1143b, connect the +P terminal of the SZ1143b to the (+) terminal of the transmitter and connect the IN1 (or IN2) terminal of the SZ1143b to the (-) terminal of the transmitter. Leave the respective RTN1 or RTN2 jumper installed. This jumper connects terminal RTN1 or RTN2 to the GND or C terminal and completes the circuit.

If connecting a self powered 4 to 20mA signal to the SZ1143b, connect the (+) signal to the IN1 (or IN2) terminal of the SZ1143b and the (-) signal or return to the RTN1 (or RTN2) terminal of the SZ1143b. Remove the respective RTN1 or RTN2 jumper.

If sending one signal to two SZ1143b units, for example outdoor air temperature, Connect the +P terminal one of the SZ1143b's to the (+) terminal of the transmitter. Connect the (-) terminal of the transmitter to the IN1 (or IN2) terminal of the second SZ1143b. Connect the RTN1 (or RTN2) terminal of the second SZ1143b to the IN1 (or IN2) terminal of the first SZ1143b. Remove the RTN1 (or RTN2) jumper from the second SZ1143b. Refer to "Sharing analog inputs on an SZ1143b" Application note for more detail.

HIGH / LOW CONTROL

The analog input and analog outputs can be setup to perform High/Low signal selection. This is done by selecting "YES" in programming step # 4. When using the SZ1143b as a High/Low signal selector no other modes of operation work.

Simplty wire 2 4-20mA devices into IN1 and IN2, in programming step #4 select "YES", step # 5 select whether you would like to pass the "LOW" or the "HIGH" of the 2 4-20mA signal that are wired. Either the highest or to lowest shall be passed directly to the AO1. Step # 6 in the programming screens allows yo to rescale the IN's for 4-20mA to 0-20mA be selecting "0-20mA". See conversion chart below.

4-20mA	0-20mA		4-20mA	0-20mA		4-20mA	0-20mA		4-20mA	0-20mA		4-20mA	0-20mA
4.00	0.00		8.00	5.00		12.00	10.00		16.00	15.00		20.00	20.00
5.00	1.25		9.00	6.25		13.00	11.25		17.00	16.25			
6.00	2.50		10.00	7.50		14.00	12.50		18.00	17.50			
7.00	3.75		11.00	8.75		15.00	13.75		19.00	18.75			

DEW POINT CONTROL

The analog output and digital outputs on the SZ1143b can be setup to use a calculated dew point temperature as the actual input. This is done by selecting "YES" in programming step # 7. When using dew point control, AI1 is the temperature input (automatically scaled for 0 to 100 °F) and AI2 is the relative humidity input (automatically scaled for 0 to 100 %RH). In programming screen #19, you are asked to enter a primary setpoint which is the dew point setpoint. This setpoint will typically be the temperature of the area where condensation is a potential problem , (i.e. cooler temperature, freezer temperature, supply air temperature). The analog and digital outputs behave as they normally would but use the calculated dew point, the primary setpoint, and their programmed parameters (heat/cool, proportional band offsets, differentials, etc.).

Example: Door Heater Control in a Convenience Store. The temperature inside the store is 76°F with 49% relative humidity. The coolers are kept at 37°F (entered as the setpoint in programming screen #19).

The calculated dew point comes out to be 55°F, so:

DO1 will be OPEN (if factory defaults are used and stage 1 is set to HEAT).

DO2 will be CLOSED (if factory defaults are used and stage 2 is set to COOL).

AO1 will modulate based on the setpoint of 37°F, an input of 55°F, the deadband

(programming screens #14 and #15), and the settings chosen in programming screens #22 through #31.

AI2 MODE / PARAMETERS

Analog input two can be selected as either "Monitor", "Remote Setpoint" or "Reset".

If monitor is chosen, the analog output and digital outputs are controlled based on a comparison between the scaled AI1 value and the setpoint entered in programming step #19.

If remote setpoint is chosen, the analog output and digital outputs are controlled based on a comparison between the scaled AI1 value, and the "setpoint" or "scaled AI2 value".

If reset is chosen, the analog output and digital outputs are controlled based on a comparison between AI1 and a calculated setpoint derived from the scaled AI2 value, the reset setpoint entered in programming step #17 and the reset factor entered in programming step #18.

RESET

The analog output and digital outputs on the SZ1143b can be setup to use a reset function. This is done by selecting "Reset" in programming step # 16. When using the reset function, AI1 is the "Primary" input and AI2 is the "Reset" input.

In programming screen #19, you are asked to enter a primary setpoint. This setpoint will be adjusted up and down based on the AI2 value, the reset setpoint and the reset factor. AI1 will be controlled to this calculated setpoint by modulating the device connected to the analog output.

In programming screen #20, you are asked to enter a reset setpoint. A comparison between AI2 and this setting will be used in determining the calculated setpoint for AI1.

In programming screen #21, you are asked to enter a reset ratio factor. This is the number of units that the AI1 setpoint is raised when the AI2 value falls below the reset setpoint by 1 unit, or the number of units that the AI1 setpoint is lowered when the AI2 value rises above the reset setpoint by 1 unit.

Example: A hot water valve is controlled using an out-

door air reset schedule. If the outdoor air is 0°F, the hot water is controlled at 180°F. If the outdoor air is 60°F, the hot water is controlled at 110°F.

The setpoint in programming step #19 is set to 145.

(180 + 110) / 2 = 145

The reset setpoint in programming step #20 is set to 30.

(0 + 60) / 2 = 30

The reset factor in programming step #211 is set to 1.167.

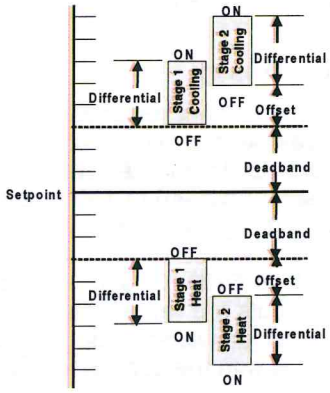
(180 - 110) / (60 - 0) = 70 / 60 = 1.167

DO2 MODE / PARAMETERS

Digital output two can be selected as either Setpoint1 or as Setpoint2 entered in programming step #39.

If SP is chosen, programming step #40 will not be shown. Digital output two will function normally, being controlled by the Main Setpoint1 entered in programming steps #16 through #21.

If Setpoint2 is chosen, digital output two will be controlled independently based on the setpoint entered in programming step #40, the mode entered in programming step #33 and the offset and differential entered in programming step #36 and #37, and the occupied deadband entered in programming step #15 or the unoccupied deadband entered in programming step #41.



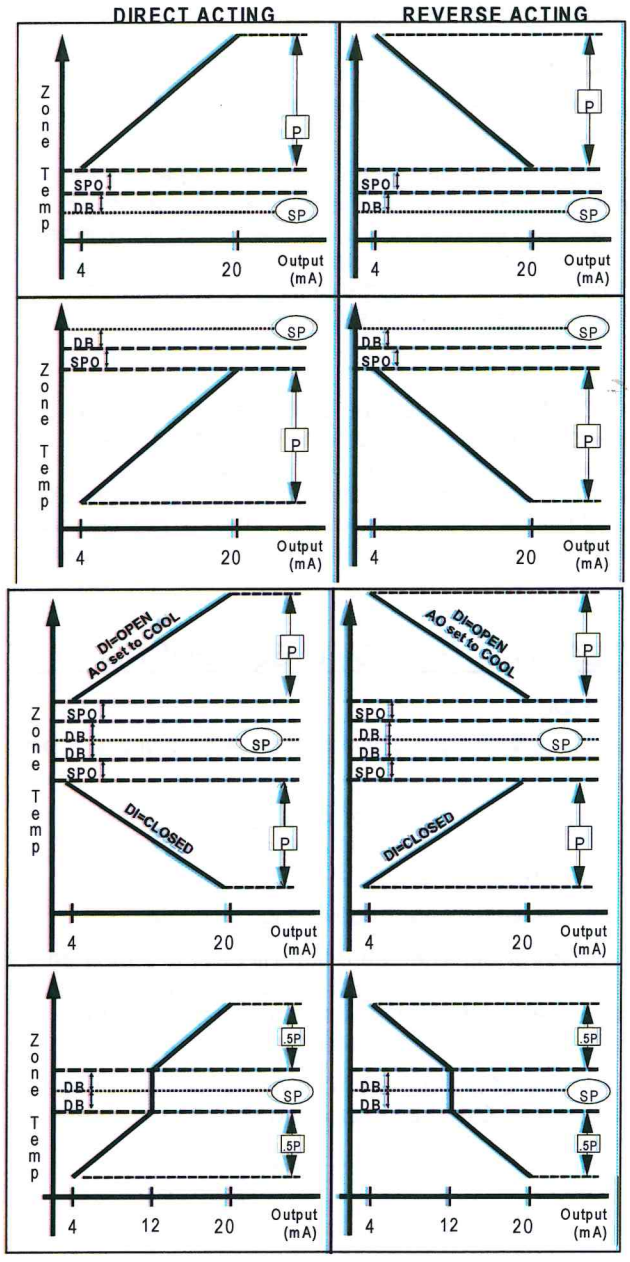
STAGE OUTPUT PARAMETERS

The SZ1143b will control either two stages of "heating" or "cooling" or will control one stage of each. Heating refers to the Relay Output energizing on a "fall in input", while Cooling refers to the Relay Output energizing on a "rise in input".

For each stage, you may specify an offset and a differential value. The offset value is the amount away from the setpoint a stage will turn off. By assigning a stage a value other than zero, you "anticipate" that the residual heat or cooling in the duct or the other stages will bring the temperature back to setpoint. In most cases, the first stage is set to zero. The differential value is the difference between the on and off points.

ANALOG OUTPUT PARAMETERS

Use programming steps #22 through #31 to program the operating parameters for the analog output. Select whether the analog output modulates from midpoint or endpoint. If endpoint is chosen, select whether the analog output is for "heating" or "cooling" and enter a setpoint offset. "Heating" refers to the analog output operating below the setpoint. "Cooling" refers to the analog output operating above the setpoint. Select direct or reverse action. Select whether you want the analog output to modulate from 4 to 20mA or 0 to 20mA. Select the unoccupied action ("20mA, 0mA or 4mA" will hold



the analog output device open or closed during unoccupied times. "Modulating" will modulate the analog output device to maintain the "unoccupied" setpoint.). Enter a proportional band (throttling range) in percent.

For proportional only control, set the integral and derivative values to zero.

If using integral and/or derivative control, also enter the integral and derivative values. If either the integral or the derivative values is non-zero, the proportional band is no longer a proportional value, but a gain value.

For PID control, lowering each of the three constants slows down the response, and raising each of the three constants speeds up the response.

DI2 AQUASTAT

When DI2 is selected to have an aquastat function, operation is as follows.

With DI2 "Open", the analog output operates in its programmed mode. When DI2 is "Closed", the analog output uses the opposite of the selected direct or reverse action, and if the analog output has been selected to modulate from endpoint, the analog output uses the opposite of the selected heat or cool mode.

BUILT-IN DELAYS

The SZ1143b has delays built into the programming sequences to protect equipment. Each stage has a minimum on and off time of two minutes. There is a minimum of two minutes between when one stage turns on until the next stage is allowed to turn on, as well as when one stage turns off until the next stage is allowed to turn off.

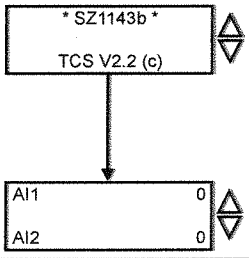
Checkout & Troubleshooting

CHECKOUT

Note: The stages have a minimum on and off time of 2 minutes.

You may verify the status of the stages and analog output in monitoring screens 3, 4, and 5, which are accessed by pressing the "Scroll" key.

1. Verify all wiring prior to powering the controller.
2. Turn power on. The controller will display a momentary screen with the model number, another momentary screen with the version number and then the main monitoring screen with the current AI1 value.
3. Take note of the current AI1 reading. Go into programming mode. Go to programming step #16 and set AI2 mode to monitor.



4. Go to programming step #16 and make the setpoint much higher than the current AI reading. If the digital output(s) are set for heat mode, the digital output(s) should come on. If the digital output(s) are set for cool mode, the digital output(s) should go off. If the analog output is set to direct acting, it should go to 0% (0 or 4mA). If the analog output is set to reverse acting, it should go to 100% (20mA).
5. Go to programming step #21 and make the setpoint much lower than the current AI reading. If the digital output(s) are set for heat mode, the digital output(s) should go off. If the digital output(s) are set for cool mode, the digital output(s) should come on. If the analog output is set to direct acting, it should go to 100% (20mA). If the analog output is set to reverse acting, it should go to 0% (0 or 4mA).
6. Go back and reprogram programming step #16 and/or #21 for operation.

TROUBLESHOOTING

No Display

Check for 24 VAC on terminals 24VAC "R" and GND "C".

Relay Outputs Do Not Come On

Check the setpoint, deadbands, offsets and differentials. Check to be sure that the digital outputs are programmed properly for "heating" or "cooling" (make on fall, make on rise), and that they are not disabled. Short "L1/2" to "M1" to bypass digital output one, and "L1/2" to "M2" to bypass digital output two. This is a check for a mechanical relay failure.

Wrong Temperature Display

If either of the two analog input readings is slightly high or low, the respective Low and High scaling limits can be adjusted slightly. Let's say that the AI1 value is 5° Low and that AI1 has a span from -40 to 160°F. Change the scaling for the Low and High scaling limits to be -35°F to 165°F, instead of -40°F to 160°F. You can also measure DC voltage from "AI1" to GND "C" and "AI2" to GND "C". The 4 to 20mA inputs are represented as 1 to 5VDC signals here. Using this knowledge, you can determine whether the problem is with the controller or your input device.

Outputs Will Not Shut Off

First check the AI1 value and the setpoint and deadbands, then determine whether the output should be on. There are delays and minimum on and off times for the relay stages. Also, check the monitoring menus to verify that the digital outputs are on. Pulling the terminal with the 24VAC "R" and GND "C" wires off, will instantly turn all outputs off and reset the controller.

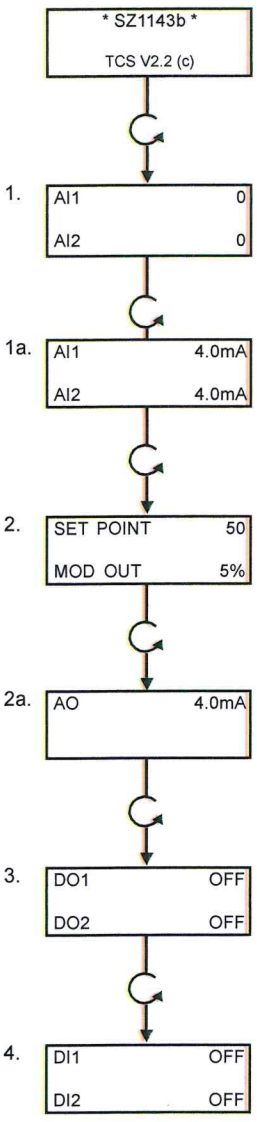
Analog Output Not Working Properly

Check wiring. A separate transformer should be used for the SZ1143b and a separate transformer should be used for the modulating device. Check to make sure that the analog output is programmed correctly.

Check the Monitoring Screens. The "AO" Screen will tell you what the SZ1143b is trying to put out for an output. Compare this with the actual position of the modulating device.

MONITORING SCREENS

Continually pressing the scroll button allows more extensive monitoring. The screens are shown below.



Power Up Screen.

Main Monitoring Screen. Shows the scaled value for analog input one and analog input two.*

Main Monitoring Screen. Shows the actual value for analog input one and two.(This screen only appears if High/Low control mode is enabled)

Setpoint and Analog Output Screen. Shows the current setpoint used for control and the output value for the analog output. The analog output is displayed as a percentage (0 - 100%).*

Analog Output Screen. Shows the actual analog output. (This screen only appears if High/Low control mode is enabled)

Relay One and Relay Two Status Screen. Shows the status of digital output one and two as either being On (Energized) or Off (De-energized).*

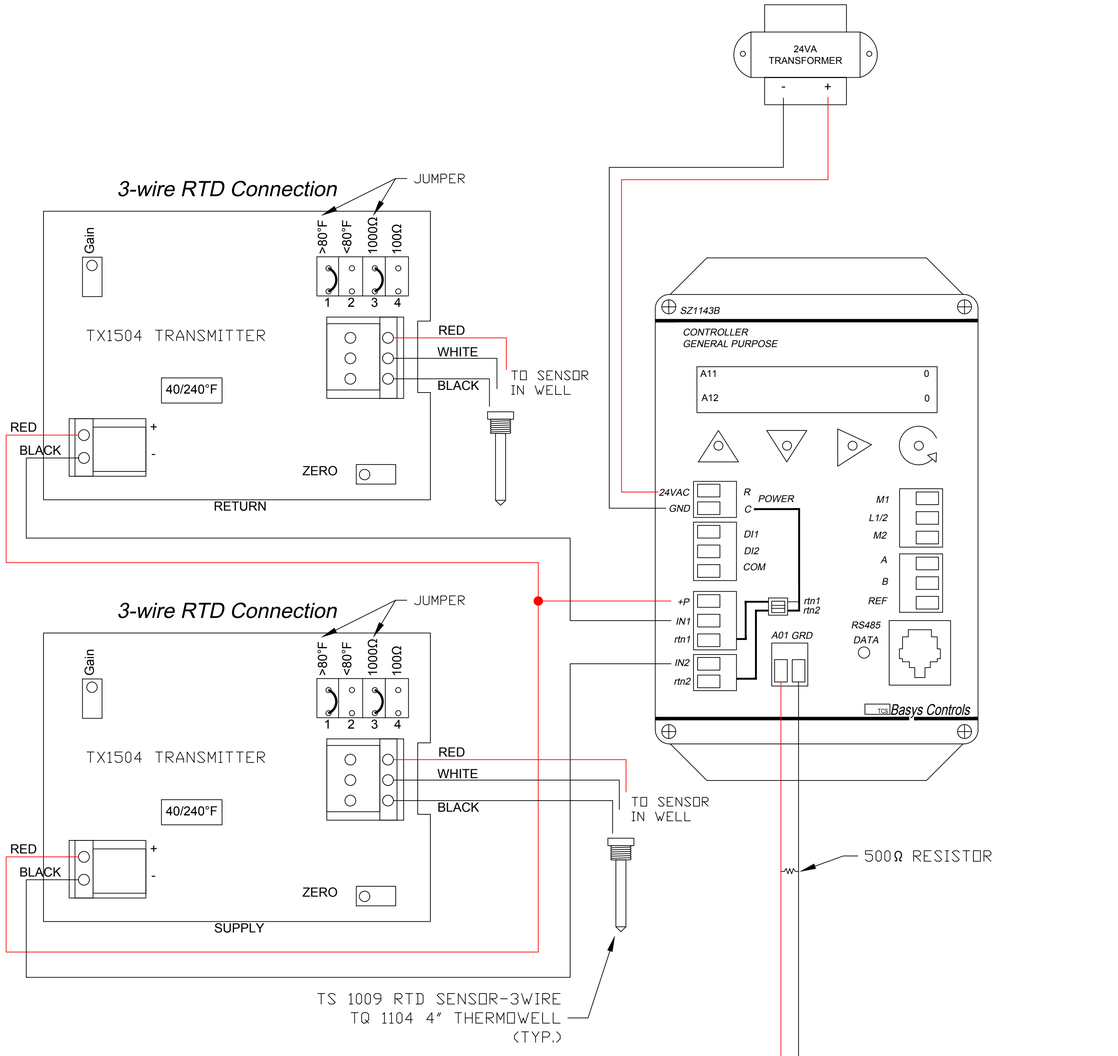
DI1 and DI2 Status Screen. Shows the status of digital input one and two as either being On (Closed) or Off (Open). Digital input One is a time clock input. Off is occupied and On is unoccupied.*

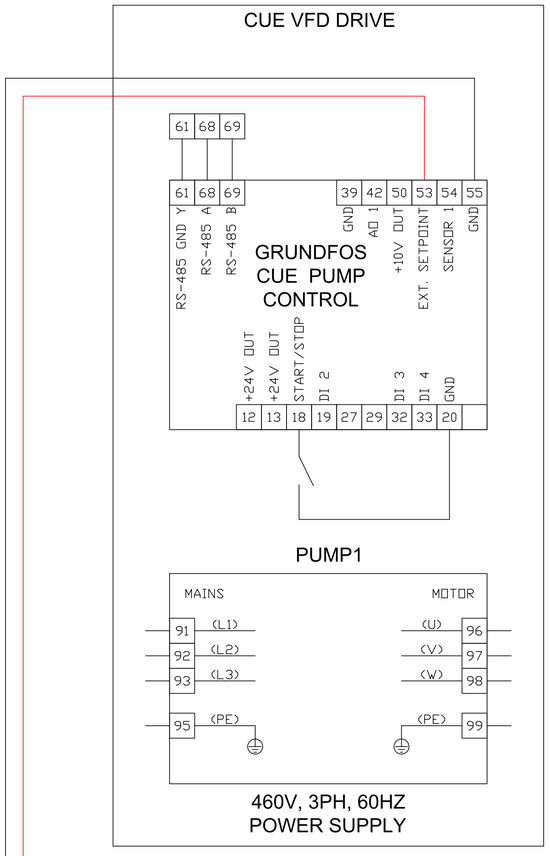
* (This screen does not appear if High/Low control mode is enabled)

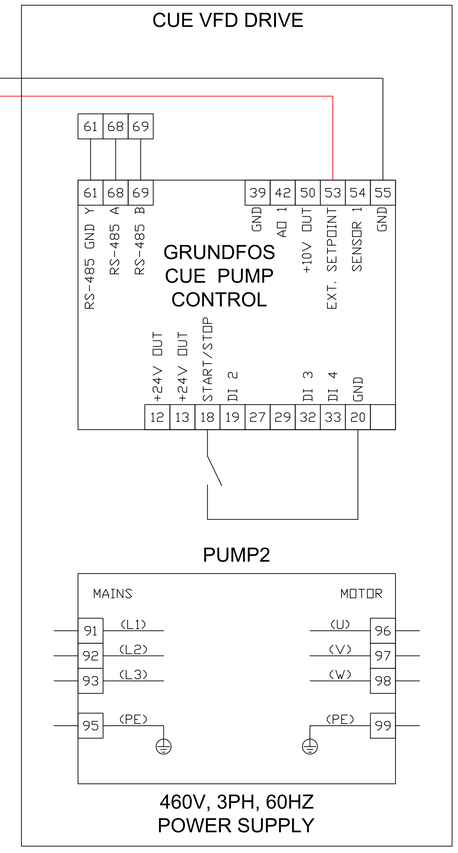
LED Description

PROGRAM/DATA

The Program/Data LED will be lit when the controller is within the programming or clock setup menus. It will blink when the unit is being accessed by a PC.







NOTE:
SYSTEM IS WIRED TO CONTROL
ONE PUMP AT A TIME

CONTROLS DIAGRAM
NOT TO SCALE

CONTROLS
SCALE: NONE

CONSULTANTS:
PAUL BENGAL
MICHIGAN

thaw-PAK
Pipe Freeze & Radiant Heating Systems

PROJECT NAME:
OTSEGO APT. CONTROLS
MICHIGAN

THAW-PAK DISTRIBUTOR:
PERFORMANCE engineering group

DRAWN BY:	*Gordon Faustich*
REVIEWED BY:	*JT*
APPROVED BY:	*JT*

ISSUED FOR

08/23/10	INITIAL DESIGN
08/30/10	FINALIZED
10/11/10	CHANGED TO BASYS CONTROL

PROPERTY OF THAW-PAK

This drawing is the property of THAW-PAK, it has been prepared to assist in the installation of our system. Customer agrees to keep confidential and not disclose this drawing or copies thereof without our written consent.

DRAWING NO.
10-016C_B

SHEET NO.
M1

XFYRE CONTROL CONFIGURATIONS: D.N.C. = Factory Set: Do Not Change OSTEGO APTS

Lag 1 H7-850 0912090127 **XFYRE CONTROL - REFERENCE / PROGRAMMING CHART**

Screen No:	Default Setting (options)	Programmed Setting	Screen No:	Default Setting (options)	Programmed Setting
S-1 Operate Mode	HYDRONIC	NO OPTIONS	S-19 Indirect Temp.	180F (119F - 190F)	DF
S-2 DHW CombiMax	149F (104F - 149F)	NOT USED	S-20 WPS Input	Flow Switch (D.N.C.)	DF
S-3 DHW Tnk Max	180F (95F - 185F)	DF	S-21 ErrorOutdSensor	OFF (OFF / ON)	DF
S-4 Offset	36F (1 - 45F)	NOT USED	S-22 MaxFanSpeed	100% (50% - 100%)	DF
S-5 DHW DIFF	5F (1 - 18F)	DF	S-23 CascadeConfig	OFF/VIS3 (OFF/All926)	ALL 926
S-6 DHWPmpDelay	0 Min (0 - 10 Minutes)	DF	S-24Cascade Rotation	24hrs (0 - 240hrs)	DF
S-7 OutdoorCutOff	68F (41F - 122F)	75°F	S-25 CasDHW Config.	DHW Entire Cascade	DF
S-8 ResetMinOut	5F (-49 - 32F)	DF	S-26 SysPmpFreeze	Protect Off (Off-104F)	DF
S-9 ResetMaxTemp	190F (77F - 190F)	DF	S-27 SysSenseFault	ON (ON - OFF)	DF
S-10 ResetMaxOut	68F (32F - 95F)	75°F	S-28 FreezeProtect	ON (ON - OFF)	DF
S-11 ResetMinTemp	95F (32F - 190F)	DF	S-29 DHWDemandStart	MAX (MAX - MIN)	DF
S-12 HydMinTemp	90F (32F - 190F)	DF	S-30 Extra Boiler	OFF (OFF / 50-100)	DF
S-13 HydPmpDelay	0 Min (0-10 Minutes)	DF	S-31SingBoilCascade	OFF (ON - OFF)	DF
S-14 DHWPriority	30Min (0-60 Minutes)	DF	S-32MaintenanceMode	OFF (Off/RunHrs/Date)	DF
S-15 CascadeAddr	0 (1 - 7)	1	UM#1 Cascade Loop	159°F (50-190°F)	180
S-16 0-10V Config	DHW Thermister	off	UM#2 Cascade Diff	30°F (2-45°F)	DF
S-17 0-10V Mode	Temperaturre	DF	UM#3 DHW Set pt.	140°F (95-185°F)	DF
S-18 Step Mod	ON (ON - OFF)	off	UM#4 DHW Diff	5°F (1-18°F)	DF

^ Screens 33, 34, 35 & 36 are not active, "Unless" Screen # 32 has been set for RunHours or Date, Then these screens are use for programming the selected mode (see manual).

Please make a copy of this page and fill it out for every XFYRE installation.

XFYRE CONTROL CONFIGURATIONS: D.N.C. = Factory Set: Do Not Change Ostego Apts

Master H7-850 1001090160 **XFYRE CONTROL - REFERENCE / PROGRAMMING CHART**

Screen No:	Default Setting (options)	Programmed Setting	Screen No:	Default Setting (options)	Programmed Setting
S-1 Operate Mode	HYDRONIC	NO OPTIONS	S-19 Indirect Temp.	180F (119F - 190F)	DF
S-2 DHW CombiMax	149F (104F - 149F)	NOT USED	S-20 WPS Input	Flow Switch (D.N.C.)	DF
S-3 DHW Tnk Max	180F (95F - 185F)	DF	S-21 ErrorOutdSensor	OFF (OFF / ON)	DF
S-4 Offset	36F (1 - 45F)	NOT USED	S-22 MaxFanSpeed	100% (50% - 100%)	DF
S-5 DHW DIFF	5F (1 - 18F)	DF	S-23 CascadeConfig	OFF/VIS3 (OFF/All926)	ALL 926
S-6 DHWPmpDelay	0 Min (0 - 10 Minutes)	DF	S-24Cascade Rotation	24hrs (0 - 240hrs)	DF
S-7 OutdoorCutOff	68F (41F - 122F)	75°F	S-25 CasDHW Config.	DHW Entire Cascade	DF
S-8 ResetMinOut	5F (-49 - 32F)	DF	S-26 SysPmpFreeze	Protect Off (Off-104F)	DF
S-9 ResetMaxTemp	190F (77F - 190F)	DF	S-27 SysSenseFault	ON (ON - OFF)	DF
S-10 ResetMaxOut	68F (32F - 95F)	75°F	S-28 FreezeProtect	ON (ON - OFF)	DF
S-11 ResetMinTemp	95F (32F - 190F)	DF	S-29 DHWDemandStart	MAX (MAX - MIN)	DF
S-12 HydMinTemp	90F (32F - 190F)	DF	S-30 Extra Boiler	OFF (OFF / 50-100)	DF
S-13 HydPmpDelay	0 Min (0-10 Minutes)	DF	S-31SingBoilCascade	OFF (ON - OFF)	DF
S-14 DHWPriority	30Min (0-60 Minutes)	DF	S-32MaintenanceMode	OFF (Off/RunHrs/Date)	DF
S-15 CascadeAddr	0 (1 - 7)	0	UM# 1 Cascade Loop	159°F (50-190F)	180
S-16 0-10V Config	DHW Thermister	off	UM# Cascade Diff	30°F (2-45F)	DF
S-17 0-10V Mode	Temperaturre	DF	UM# DHW Set pt.	140°F (95-185F)	DF
S-18 Step Mod	ON (ON - OFF)	OFF	UM# DHW Diff	5°F (1-18°F)	DF

^ Screens 33, 34, 35 & 36 are not active, "Unless" Screen # 32 has been set for RunHours or Date, Then these screens are use for programming the selected mode (see manual).

Please make a copy of this page and fill it out for every XFYRE installation.

PERFORMANCE engineering group
32995 industrial road ■ livonia, michigan 48150
ph: 734. 266. 5300 ■ fx: 734. 266. 5310

October 2010

Variable Speed Pumping Logic for Otsego Apartments, Jackson, Michigan

Control: TCS Basys Microprocessor-Based PID Controller—Addendum
VFD: Grundfos CUE—Variable Frequency Drive

Control Logic:
The Basys control monitors the system's supply and return water temperatures using a water sensor in a well. Each sensor sends a signal to its own transmitter which in turn sends a signal to the control's microprocessor. The microprocessor has been programmed** to maintain a 20 degree F differential between the supply water temperature and the returning water temperature. If the control sees the differential getting less than 20F (ie 16F) it sees this as a building load reduction and signals (0-10VDC) the VFD Drive to slow down the pump's RPM. If the differential increases greater than 20F (ie 24F) the control sees this as an increase in building load and signals the drive to speed up the RPM.
** Please refer to the Basys Manual for all program settings and operation.
NOTE: Per Basys, Only One (1) CUE may be turned on at any given time, so the Basys control may deliver a proper operating signal.

CUE VFD Settings & Logic:
In the CUE's Start-Up Guide, you first scroll down through the start-up menu putting in the pump information from the pump's Data Rating Plate.
SCREENS: 1/16 thru 8/16 (screen 8/16 control mode– set to "Open Loop")
The CUE will then operate the pump and will check the pump's direction of rotation. Once this is correct, the CUE exits the set-up mode.

Now, using side arrows, scroll to 3.0 Installation Mode (scroll down for settings)
3.1 Control Mode set for Open Loop.
3.3 External Setpoint is set to Active.
3.3A External Setpoint is set for: Minimum 0.00V and Maximum 10.0V
3.6 Set to Active
3.8 Set for Pump 1
3.18 Operating Range: Set Minimum to 25% and Maximum to 100%
NOTE: In the terminal section, Dip Switch "A53" must be set to the "U" position.

The CUE receives a 0 to 10VDC signal from the Basys Control and uses this signal as the External Setpoint. Based on the signal provided, the CUE either increases or decreases the pump's RPM. A 0VDC signal equals 25%^^ RPM operation and a 10VDC signal equals 100%^^ RPM operation. The 0—10VDC signal is supplied to terminals 53 (external setpoint) and 55 (ground).

Page 2 & 3 are setting pages from the CUE Manual (manual pages 20 & 21).
^^NOTE: VSP Logic Addendum
There is a possibility, under some conditions, that the pump can be operating at its minimum set point (25%) and the differential could be less than 20F. This **IS NOT** a problem, it just means that even at minimum operation the building load is less than the minimum set point. This logic could also occur in reverse at 100% pump operation with a greater than 20F differential potential.

US

9. Menu overview

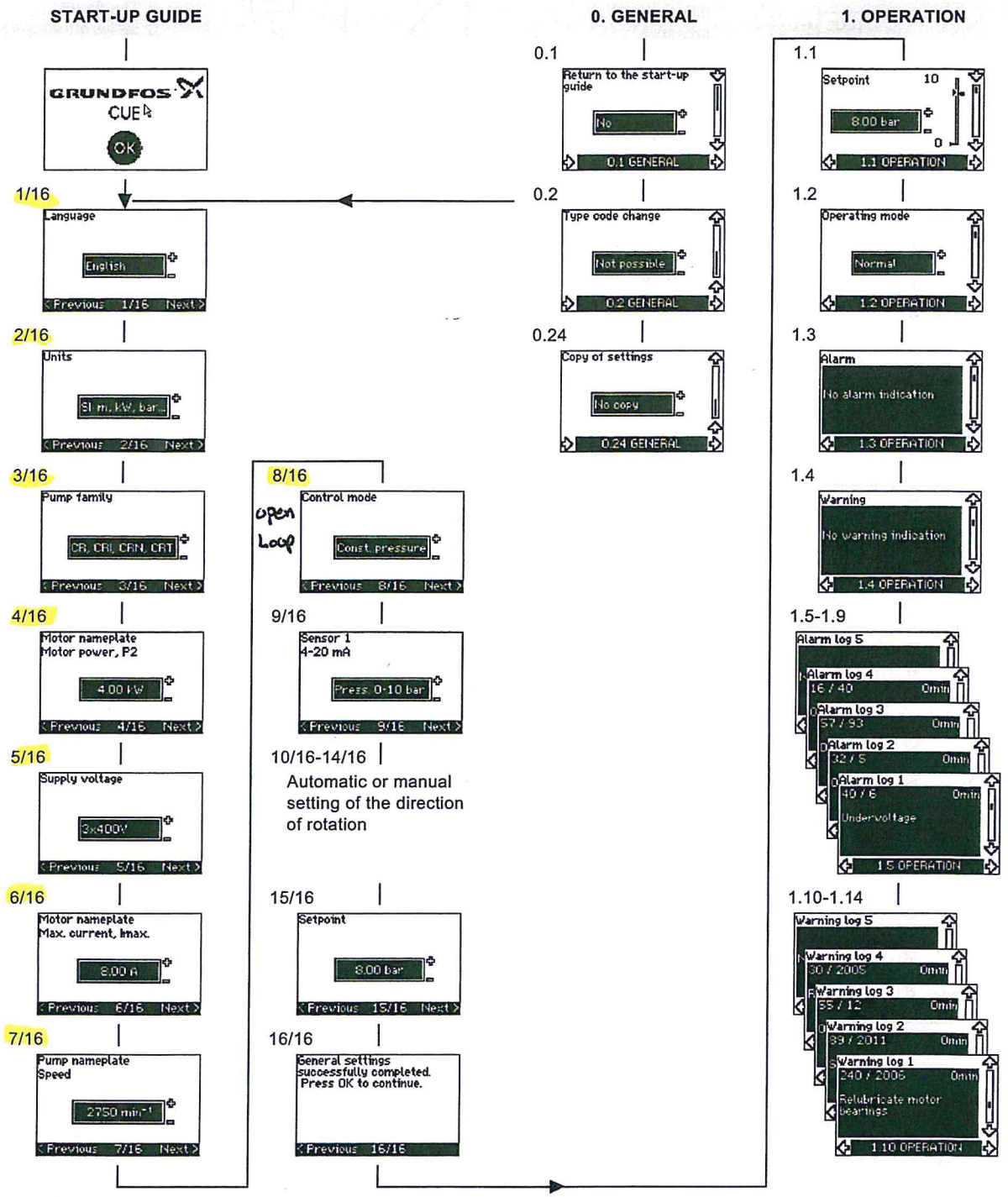
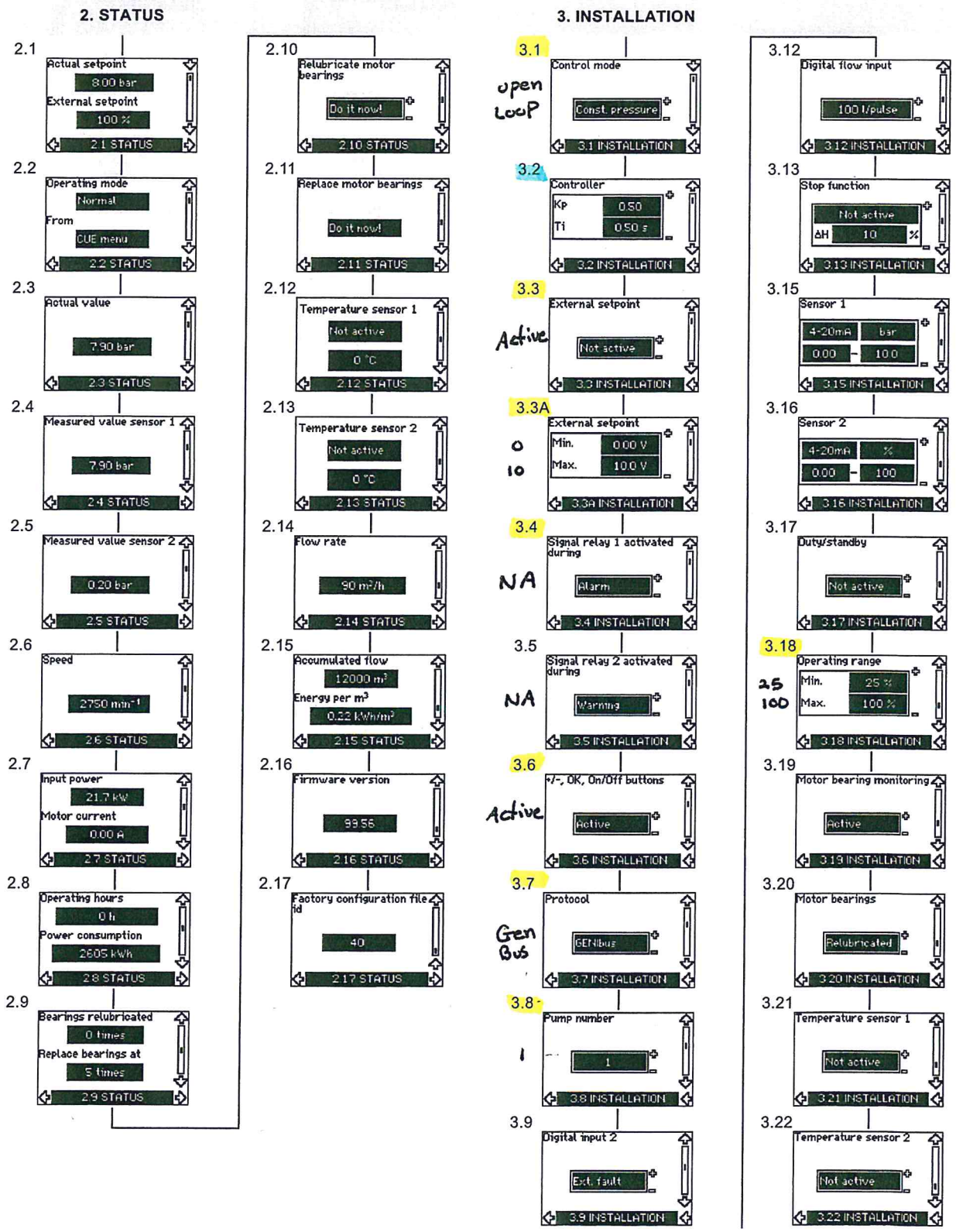


Fig. 46 Menu overview

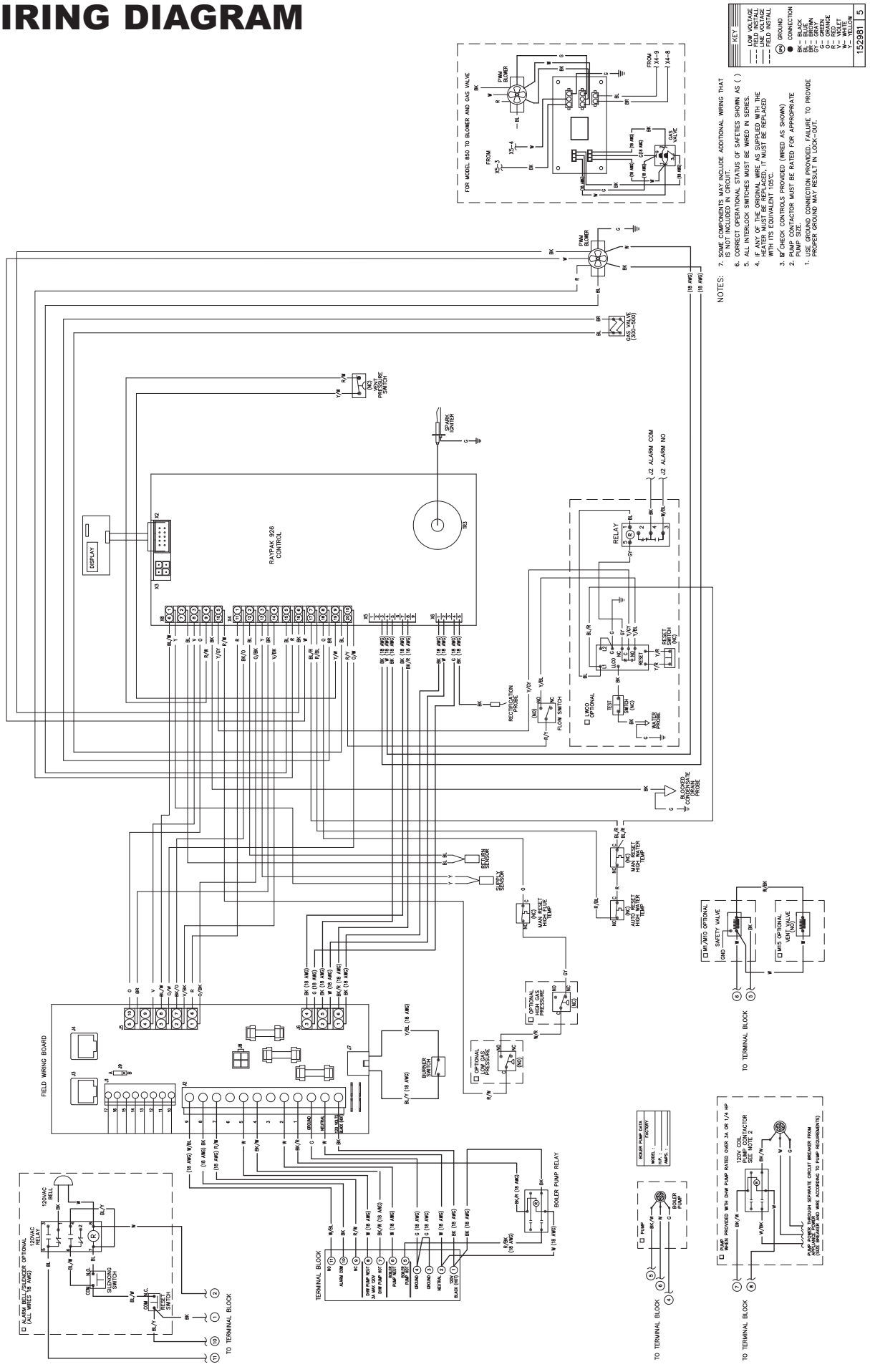
Menu structure

The CUE has a start-up guide, which is started at the first start-up. After the start-up guide, the CUE has a menu structure divided into four main menus:

1. **GENERAL** gives access to the start-up guide for the general setting of the CUE.
2. **OPERATION** enables the setting of setpoint, selection of operating mode and resetting of alarms. It is also possible to see the latest five warnings and alarms.
3. **STATUS** shows the status of the CUE and the pump. It is not possible to change or set values.
4. **INSTALLATION** gives access to all parameters. Here a detailed setting of the CUE can be made.

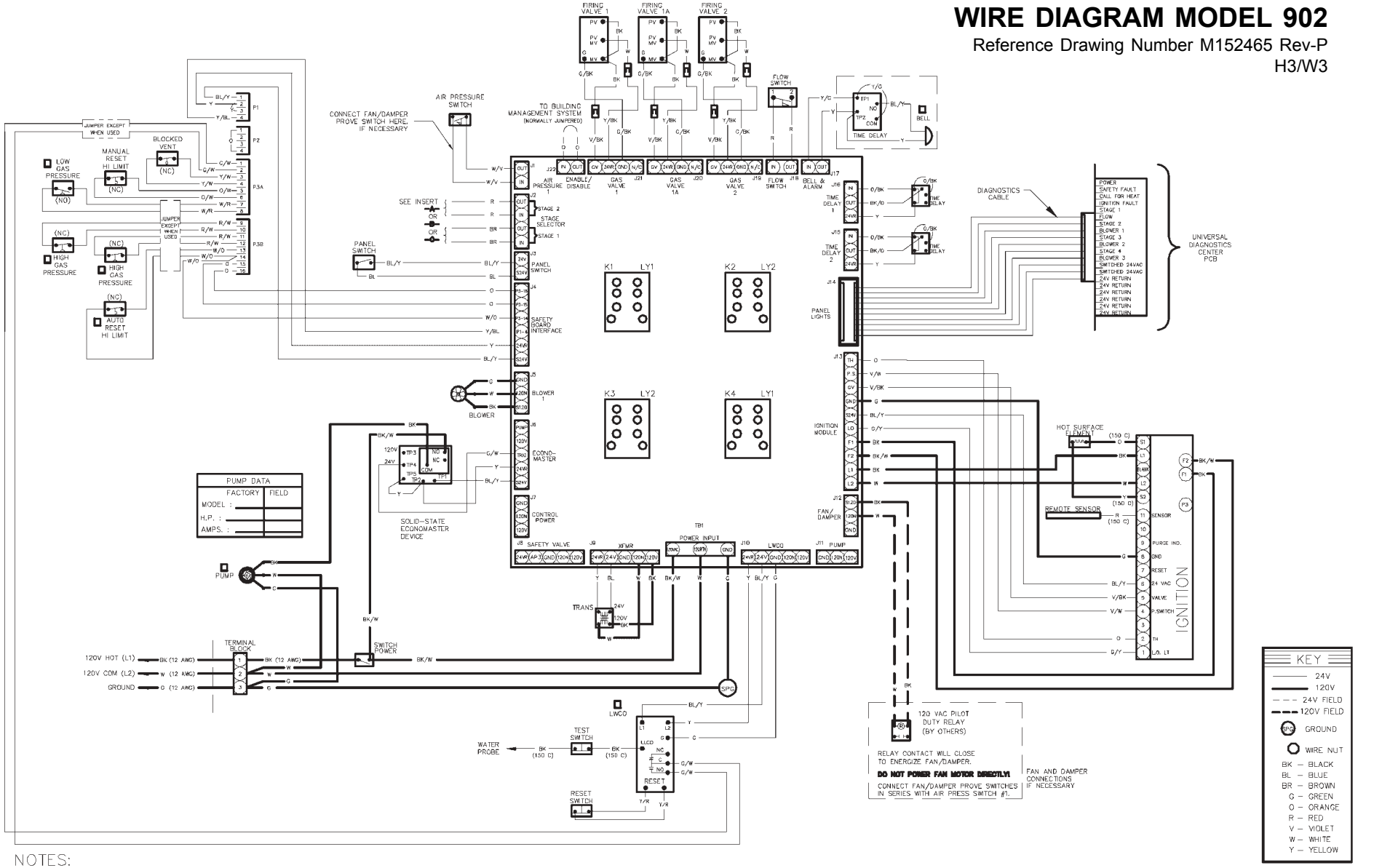

2. STATUS
2.1
Actual setpoint
8.00 bar
External setpoint
100 %
2.1 STATUS
2.2
Operating mode
Normal
From
CUE menu
2.2 STATUS
2.3
Actual value
7.90 bar
2.3 STATUS
2.4
Measured value sensor 1
7.90 bar
2.4 STATUS
2.5
Measured value sensor 2
0.20 bar
2.5 STATUS
2.6
Speed
2750 min-1
2.6 STATUS
2.7
Input power
21.7 kW
Motor current
0.00 A
2.7 STATUS
2.8
Operating hours
0 h
Power consumption
2605 kWh
2.8 STATUS
2.9
Bearings relubricated
0 times
Replace bearings at
5 times
2.9 STATUS
2.10
Relubricate motor bearings
Do it now!
2.10 STATUS
2.11
Replace motor bearings
Do it now!
2.11 STATUS
2.12
Temperature sensor 1
Not active
0 °C
2.12 STATUS
2.13
Temperature sensor 2
Not active
0 °C
2.13 STATUS
2.14
Flow rate
90 m³/h
2.14 STATUS
2.15
Accumulated flow
12000 m³
Energy per m³
0.22 kWh/m³
2.15 STATUS
2.16
Firmware version
9356
2.16 STATUS
2.17
Factory configuration file id
40
2.17 STATUS
3. INSTALLATION
3.1
open loop
Control mode
Const. pressure
3.1 INSTALLATION
3.2
Controller
Kp 0.50
Ti 0.50 s
3.2 INSTALLATION
3.3
Active
External setpoint
Not active
3.3 INSTALLATION
3.3A
0
10
External setpoint
Min. 0.00 V
Max. 10.0 V
3.3A INSTALLATION
3.4
NA
Signal relay 1 activated during
Alarm
3.4 INSTALLATION
3.5
NA
Signal relay 2 activated during
Warning
3.5 INSTALLATION
3.6
Active
+/-, OK, On/Off buttons
Active
3.6 INSTALLATION
3.7
Gen Bus
Protocol
GENIbus
3.7 INSTALLATION
3.8
1
Pump number
1
3.8 INSTALLATION
3.9
Digital input 2
Ext. fault
3.9 INSTALLATION
3.12
Digital flow input
100 l/pulse
3.12 INSTALLATION
3.13
Stop function
Not active
ΔH 10 %
3.13 INSTALLATION
3.15
Sensor 1
4-20mA bar
0.00 - 10.0
3.15 INSTALLATION
3.16
Sensor 2
4-20mA %
0.00 - 100
3.16 INSTALLATION
3.17
Duty/standby
Not active
3.17 INSTALLATION
3.18
25
100
Operating range
Min. 25 %
Max. 100 %
3.18 INSTALLATION
3.19
Motor bearing monitoring
Active
3.19 INSTALLATION
3.20
Motor bearings
Relubricated
3.20 INSTALLATION
3.21
Temperature sensor 1
Not active
3.21 INSTALLATION
3.22
Temperature sensor 2
Not active
3.22 INSTALLATION

WIRING DIAGRAM



WIRE DIAGRAM MODEL 902

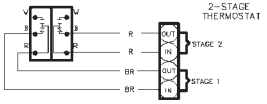
Reference Drawing Number M152465 Rev-P
H3/W3



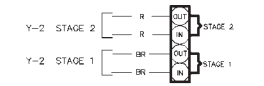
NOTES:

1. USE GROUND CONNECTION PROVIDED. FAILURE TO PROVIDE PROPER GROUND MAY RESULT IN LOCK-OUT.
2. PUMP USED MUST BE RATED 10 AMPS MAX OR 3/4 HP MAX.
3. PUMP DELAY ADJUSTABLE BETWEEN 3 – 10 MINUTES.
4. ALL 120V WIRE SHALL BE 12 AWG UNLESS NOTED OTHERWISE.
5. ☑ CHECK CONTROLS PROVIDED (WIRED AS SHOWN).
6. IF ANY OF THE ORIGINAL WIRE AS SUPPLIED WITH THE HEATER MUST BE REPLACED, IT MUST BE REPLACED WITH ITS EQUIVALENT, 105°C OR 150°C AS NOTED.

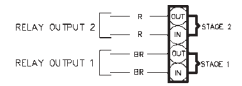
INSERT –A–
(B-4, B-6 OR B-8)



INSERT –B–
(Y-2 CONNECTION)



INSERT –C–
(B-12, B-13
DIGITAL CONTROLLER)



CUE, 0.75 - 125 hp

Installation and operating instructions

US F E

CUE, 0.75 - 125 hp

LIMITED WARRANTY

US

Products manufactured by GRUNDFOS PUMPS CORPORATION (Grundfos) are warranted to the original user only to be free of defects in material and workmanship for a period of 24 months from date of installation, but not more than 30 months from date of manufacture. Grundfos' liability under this warranty shall be limited to repairing or replacing at Grundfos' option, without charge, F.O.B. Grundfos' factory or authorized service station, any product of Grundfos' manufacture. Grundfos will not be liable for any costs of removal, installation, transportation, or any other charges which may arise in connection with a warranty claim. Products which are sold but not manufactured by Grundfos are subject to the warranty provided by the manufacturer of said products and not by Grundfos' warranty. Grundfos will not be liable for damage or wear to products caused by abnormal operating conditions, accident, abuse, misuse, unauthorized alteration or repair, or if the product was not installed in accordance with Grundfos' printed installation and operating instructions.

To obtain service under this warranty, the defective product must be returned to the distributor or dealer of Grundfos' products from which it was purchased together with proof of purchase and installation date, failure date, and supporting installation data. Unless otherwise provided, the distributor or dealer will contact Grundfos or an authorized service station for instructions. Any defective product to be returned to Grundfos or a service station must be sent freight prepaid; documentation supporting the warranty claim and/or a Return Material Authorization must be included if so instructed.

GRUNDFOS WILL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES, LOSSES, OR EXPENSES ARISING FROM INSTALLATION, USE, OR ANY OTHER CAUSES. THERE ARE NO EXPRESS OR IMPLIED WARRANTIES, INCLUDING MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, WHICH EXTEND BEYOND THOSE WARRANTIES DESCRIBED OR REFERRED TO ABOVE.

Some jurisdictions do not allow the exclusion or limitation of incidental or consequential damages and some jurisdictions do not allow limit actions on how long implied warranties may last. Therefore, the above limitations or exclusions may not apply to you. This warranty gives you specific legal rights and you may also have other rights which vary from jurisdiction to jurisdiction.

CONTENTS

US

Warning

Prior to installation, read these installation and operating instructions. Installation and operation must comply with local regulations and accepted codes of good practice.

1. Symbols used in this document

Warning

If these safety instructions are not observed, it may result in personal injury!

Caution ***If these safety instructions are not observed, it may result in malfunction or damage to the equipment!***

Note ***Notes or instructions that make the job easier and ensure safe operation.***

2. Introduction

This manual introduces all aspects of your Grundfos CUE variable frequency drive in the output current range of 1.8 to 177 A.

Always keep this manual close to the CUE.

2.1 General description

The CUE is a series of external variable frequency drives especially designed for pumps.

Thanks to the start-up guide in the CUE, the installer can quickly set central parameters and put the CUE into operation.

Connected to a sensor or an external control signal, the CUE will quickly adapt the pump speed to the actual demand.

2.2 Applications

The CUE series and Grundfos standard pumps are a supplement to the Grundfos E-pumps range with integrated variable frequency drive.

A CUE solution offers the same E-pump functionality

- in the supply voltage or power ranges not covered by the E-pump range.
- in applications where an integrated variable frequency drive is not desirable or permissible.

US

2.3 References

Technical documentation for Grundfos CUE:

- The manual contains all information required for putting the CUE into operation.
- The data booklet contains all technical information about the construction and applications of the CUE.
- Service instructions contain all required instructions for dismantling and repairing the variable frequency drive.

Technical documentation is available on www.grundfos.com > International website > WebCAPS.

If you have any questions, please contact the nearest Grundfos company or service workshop.

3. Safety and warnings

3.1 Warning

Warning

Any installation, maintenance and inspection must be carried out by trained personnel.

Warning

Touching the electrical parts may be fatal, even after the CUE has been switched off.

Before making any work on the CUE, the mains supply and other input voltages must be switched off at least for as long as stated below.

Voltage	Min. waiting time		
	4 minutes	15 minutes	20 minutes
200-240 V	1 - 5 hp	7.5 - 60 hp	
380-500 V	0.75 - 10 hp	15 - 125 hp	
525-600 V	1 - 10 hp		
525-690 V			15 - 125 hp

Wait only for shorter time if stated so on the nameplate of the CUE in question.

3.2 Safety regulations

- The On/Off button of the control panel does not disconnect the CUE from the power supply and must therefore not be used as a safety switch.
- The CUE must be grounded correctly and protected against indirect contact according to national regulations.
- The leakage current to ground exceeds 3.5 mA.
- Enclosure class NEMA 1 must not be installed freely accessible, but only in a panel.
- Enclosure class NEMA 12 must not be installed outdoors without additional protection against water and the sun.
- Always observe national and local regulations as to cable gauge size, short-circuit protection and overcurrent protection.

3.3 Installation requirements

The general safety necessitates special considerations as to these aspects:

- fuses and switches for overcurrent and short-circuit protection
- selection of cables (mains current, motor, load distribution and relay)
- net configuration (IT, TN, grounding)
- safety on connecting inputs and outputs (PELV).

3.3.1 IT mains

Warning

Do not connect 380-500 V CUE variable frequency drives to mains supplies with a voltage between phase and ground of more than 440 V.

In connection with IT mains and grounded delta mains, the supply voltage may exceed 440 V between phase and ground.

3.3.2 Aggressive environment

Caution ***The CUE should not be installed in an environment where the air contains liquids, particles or gases which may affect and damage the electronic components.***

The CUE contains a large number of mechanical and electronic components. They are all vulnerable to environmental effects.

3.4 Reduced performance under certain conditions

The CUE will reduce its performance under these conditions:

- low air pressure (at high altitude)
- long motor cables.

The required measures are described in the next two sections.

3.4.1 Reduction at low air pressure

Warning

At altitudes above 6600 ft, PELV cannot be met.

PELV = Protective Extra Low Voltage.

At low air pressure, the cooling capacity of air is reduced, and the CUE automatically reduces the performance to prevent overload.

It may be necessary to select a CUE with a higher performance.

3.4.2 Reduction in connection with long motor cables

The maximum cable length for the CUE is 1000 ft for unscreened and 500 ft for screened cables. In case of longer cables, contact Grundfos.

The CUE is designed for a motor cable with a maximum gauge size as stated in section *16.6 Fuses and cable gauge size*.

4. Identification

4.1 Nameplate

The CUE can be identified by means of the nameplate. An example is shown below.

TM04 3272 3808

Fig. 1 Example of nameplate

Text	Description
T/C:	CUE (product name) 202P1M2... (internal code)
Prod. no:	Product number: 12345678
S/N:	Serial number: 123456G234 The last three digits indicate the production date: 23 is the week, and 4 is the year 2004.
1.5 kW	Typical shaft power on the motor
IN:	Supply voltage, frequency and maximum input current
OUT:	Motor voltage, frequency and maximum output current. The maximum output frequency usually depends on the pump type.
CHASSIS/ IP20	Enclosure class
Tamb.	Maximum ambient temperature

4.2 Packaging label

The CUE can also be identified by means of the label on the packaging.

5. Mechanical installation

The individual CUE cabinet sizes are characterised by their enclosures. The table in section *16.1* shows the relationship of enclosure class and enclosure type.

5.1 Reception and storage

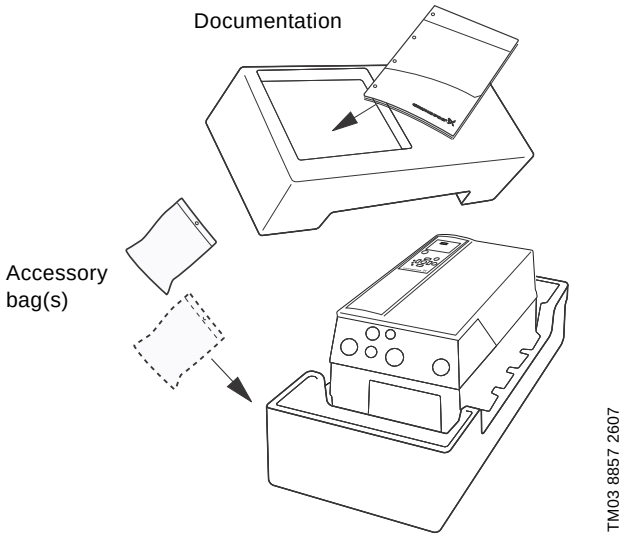
Check on receipt that the packaging is intact, and the unit is complete. In case of damage during transport, contact the transport company to complain.

Note that the CUE is delivered in a packaging which is not suitable for outdoor storage.

5.2 Transportation and unpacking

The CUE must only be unpacked at the installation site to prevent damage during the transport to the site.

The packaging contains accessory bag(s), documentation and the unit itself. See fig. 2.



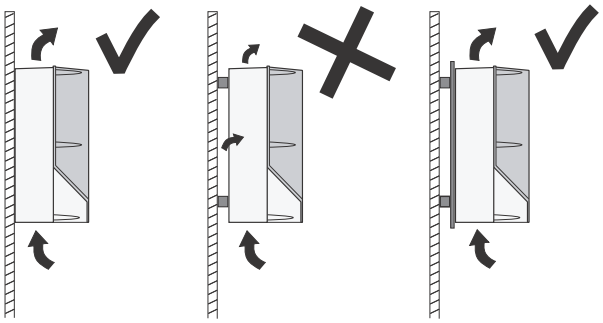
TM03 8857 2607

Fig. 2 CUE packaging

5.3 Space requirements and air circulation

CUE units can be mounted side by side, but as a sufficient air circulation is required for cooling these requirements must be met:

- Sufficient free space above and below the CUE. See table below.
- Ambient temperature up to 122 °F.
- Hang the CUE directly on the wall, or fit it with a back plate. See fig. 3.



TM03 8859 2607

Fig. 3 CUE hung directly on the wall or fitted with a back plate

Required free space above and below the CUE

Enclosure	Space [in]
A2, A3, A5	3.9
B1, B2, B3, B4, C1, C3	7.9
C2, C4	8.9

For information about enclosure, see table in section *16.1*.

US

US

5.4 Mounting

Caution ***The user is responsible for mounting the CUE securely on a firm surface.***

1. Mark and drill holes. See the dimensions in section *16.2*.
2. Fit the screws, but leave loose. Mount the CUE, and tighten the four screws.

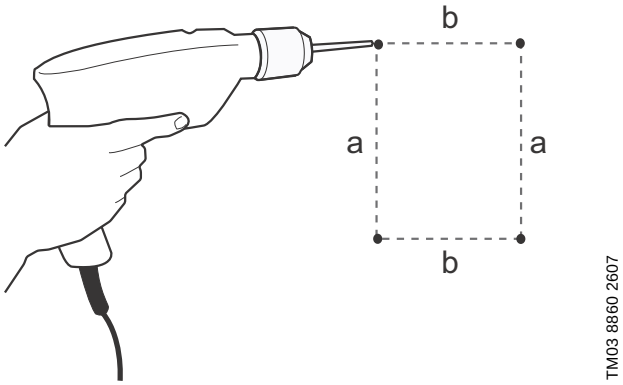


Fig. 4 Drilling of holes

6. Electrical connection

Warning

The owner or installer is responsible for ensuring correct grounding and protection according to national and local standards.

Warning

Before making any work on the CUE, the mains supply and other voltage inputs must be switched off for at least as long as stated in section 3. Safety and warnings.

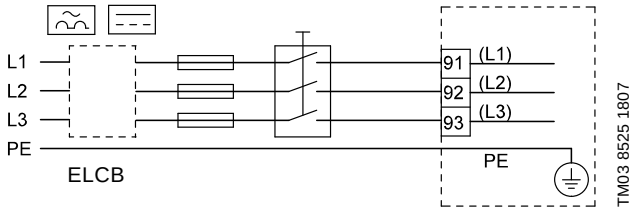


Fig. 5 Example of three-phase mains connection of the CUE with mains switch, back-up fuses and additional protection

6.1 Electrical protection

6.1.1 Protection against electric shock, indirect contact

Warning

The CUE must be grounded correctly and protected against indirect contact according to national regulations.

Caution ***The leakage current to ground exceeds 3.5 mA, and a reinforced ground connection is required.***

Protective conductors must always have a yellow/green (PE) or yellow/green/blue (PEN) color marking.

Instructions according to EN IEC 61800-5-1:

- The CUE must be stationary, installed permanently and connected permanently to the mains supply.
- The ground connection must be carried out with duplicate protective conductors or with a single reinforced protective conductor with a gauge size of minimum 8 AWG.

6.1.2 Protection against short-circuit, fuses

The CUE and the supply system must be protected against short-circuit.

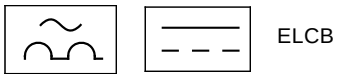
Grundfos demands that the back-up fuses mentioned in section *16.6* are used for protection against short-circuit.

The CUE offers complete short-circuit protection in case of a short-circuit on the motor output.

6.1.3 Additional protection

Caution ***The leakage current to ground exceeds 3.5 mA.***

If the CUE is connected to an electrical installation where an earth leakage circuit breaker (ELCB) is used as additional protection, the circuit breaker must be of a type marked with the following symbols:



The circuit breaker is **type B**.

The total leakage current of all the electrical equipment in the installation must be taken into account.

The leakage current of the CUE in normal operation can be seen in section *16.7.1 Mains supply (L1, L2, L3)*.

During start and in asymmetrical supply systems, the leakage current can be higher than normal and may cause the ELCB to trip.

6.1.4 Motor protection

The motor requires no external motor protection. The CUE protects the motor against thermal overloading and blocking.

6.1.5 Protection against overcurrent

The CUE has an internal overcurrent protection for overload protection on the motor output.

6.1.6 Protection against supply voltage transients

The CUE is protected against supply voltage transients according to EN 61800-3, second environment.

6.2 Mains and motor connection

The supply voltage and frequency are marked on the CUE nameplate. Make sure that the CUE is suitable for the power supply of the installation site.

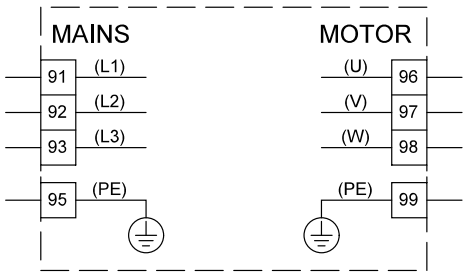
Note ***The maximum output voltage of the CUE is equal to the input voltage.***
Example: If the supply voltage is 208 V, choose a 208 V rated motor.

6.2.1 Mains switch

A mains switch can be installed before the CUE according to local regulations. See fig. 5.

6.2.2 Wiring diagram

The wires in the terminal box must be as short as possible. Excepted from this is the protective conductor which must be so long that it is the last one to be disconnected in case the cable is inadvertently pulled out of the cable entry.



TM03 8799 2507

Fig. 6 Wiring diagram, three-phase mains connection

Terminal		Function
91	(L1)	Three-phase supply
92	(L2)	
93	(L3)	
95/99	(PE)	Ground connection
96	(U)	Three-phase motor connection, 0-100 % of supply voltage
97	(V)	
98	(W)	

For single-phase connection, use L1 and L2.

Note

Cable sizing:

To determine the conductor gauge size for single-phase mains input cable, multiply the CUE's max. current output by 2, and choose the gauge size based on that amperage.

For three-phase input, use the same conductor gauge size as selected for the motor.

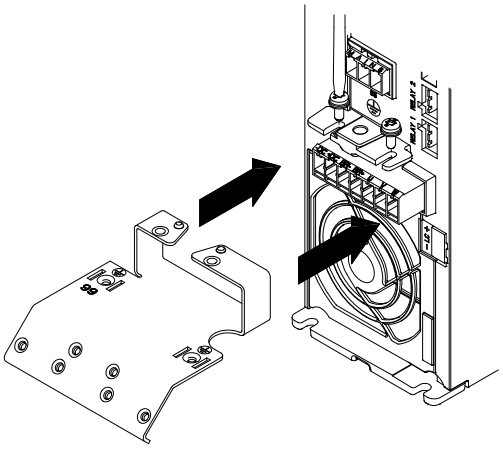
For CUE to motor, use standard published three-phase wiring charts based on motor size.

6.2.3 Mains connection, enclosures A2 and A3

For information about enclosure, see table in section *16.1*.

Caution ***Check that mains voltage and frequency correspond to the values on the nameplate of the CUE and the motor.***

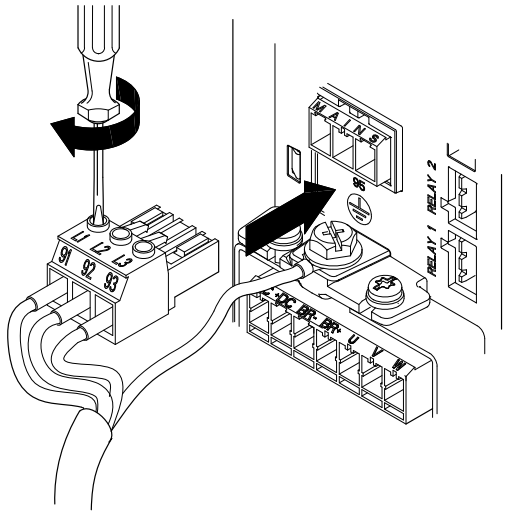
1. Fit the mounting plate with two screws.



TM03 9010 2807

Fig. 7 Fitting the mounting plate

2. Connect the ground conductor to terminal 95 (PE) and the mains conductors to the terminals 91 (L1), 92 (L2), 93 (L3) of the mains plug. Put the mains plug into the socket marked MAINS.

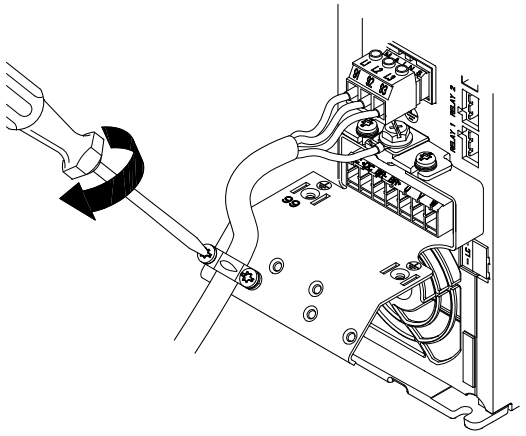


TM03 9011 2807

Fig. 8 Connecting the ground conductor and mains conductors

Note ***For single-phase connection, use L1 and L2.***

3. Fix the mains cable to the mounting plate.



TM03 9014 2807

Fig. 9 Fixing the mains cable

US

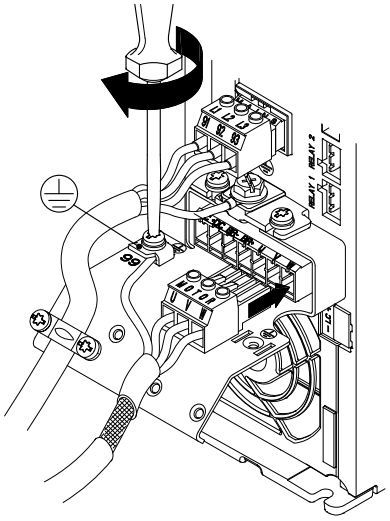
US

6.2.4 Motor connection, enclosures A2 and A3

For information about enclosure, see table in section *16.1*.

Caution ***The motor cable must be screened for the CUE to meet EMC requirements.***

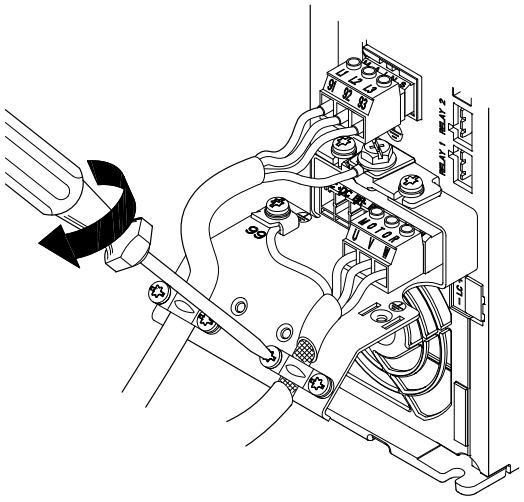
1. Connect the ground conductor to terminal 99 (PE) on the mounting plate. Connect the motor conductors to the terminals 96 (U), 97 (V), 98 (W) of the motor plug.



TM03 9013 2807

Fig. 10 Connecting the ground conductor and motor conductors

2. Put the motor plug into the socket marked MOTOR. Fix the screened cable to the mounting plate with a cable clamp.



TM03 9012 2807

Fig. 11 Connecting the motor plug and fixing the screened cable

Note ***Cable screens must be grounded at both ends.***

Note ***The cable screen must be exposed and in physical contact with the mounting plate and clamp.***

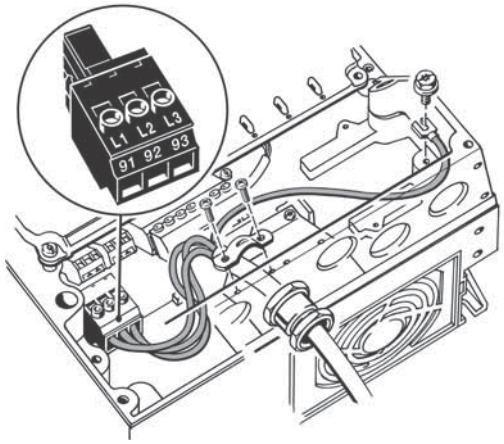
6.2.5 Enclosure A5

For information about enclosure, see table in section *16.1*.

Mains connection

Caution ***Check that mains voltage and frequency correspond to the values on the nameplate of the CUE and the motor.***

1. Connect the ground conductor to terminal 95 (PE). See fig. 12.
2. Connect the mains conductors to the terminals 91 (L1), 92 (L2), 93 (L3) of the mains plug.
3. Put the mains plug into the socket marked MAINS.
4. Fix the mains cable with a cable clamp.



TM03 9017 2807

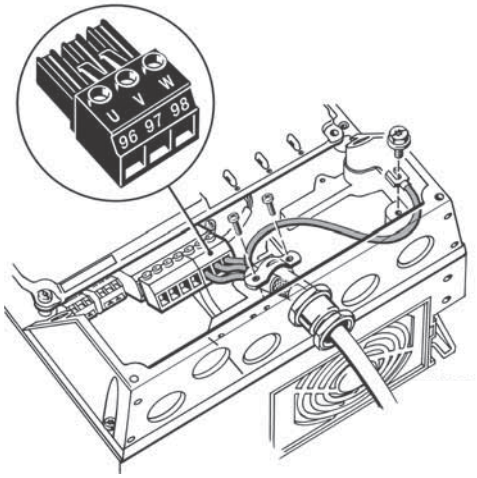
Fig. 12 Mains connection, A5

Note ***For single-phase connection, use L1 and L2.***

Motor connection

Caution ***The motor cable must be screened for the CUE to meet EMC requirements.***

1. Connect the ground conductor to terminal 99 (PE). See fig. 13.
2. Connect the motor conductors to the terminals 96 (U), 97 (V), 98 (W) of the motor plug.
3. Put the motor plug into the socket marked MOTOR.
4. Fix the screened cable with a cable clamp.



TM03 9018 2807

Fig. 13 Motor connection, A5

Note ***The cable screen must be exposed and in physical contact with the mounting plate and clamp.***

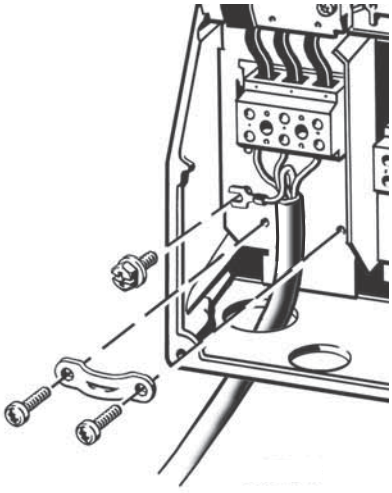
6.2.6 Enclosures B1 and B2

For information about enclosure, see table in section *16.1*.

Mains connection

Caution ***Check that mains voltage and frequency correspond to the values on the nameplate of the CUE and the motor.***

1. Connect the ground conductor to terminal 95 (PE). See fig. 14.
2. Connect the mains conductors to the terminals 91 (L1), 92 (L2), 93 (L3).
3. Fix the mains cable with a cable clamp.



TM03 9019 2807

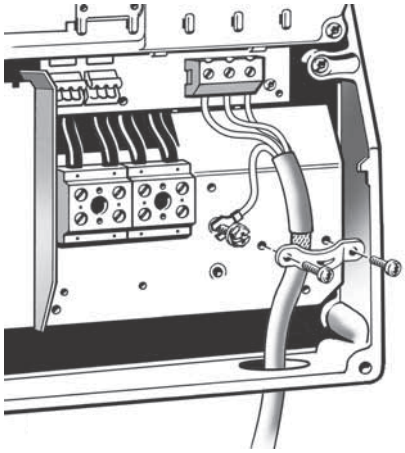
Fig. 14 Mains connection, B1 and B2

Note ***For single-phase connection, use L1 and L2.***

Motor connection

Caution ***The motor cable must be screened for the CUE to meet EMC requirements.***

1. Connect the ground conductor to terminal 99 (PE). See fig. 15.
2. Connect the motor conductors to the terminals 96 (U), 97 (V), 98 (W).
3. Fix the screened cable with a cable clamp.



TM03 9020 2807

Fig. 15 Motor connection, B1 and B2

Note ***The cable screen must be exposed and in physical contact with the mounting plate and clamp.***

6.2.7 Enclosures B3 and B4

For information about enclosure, see table in section *16.1*.

Mains connection

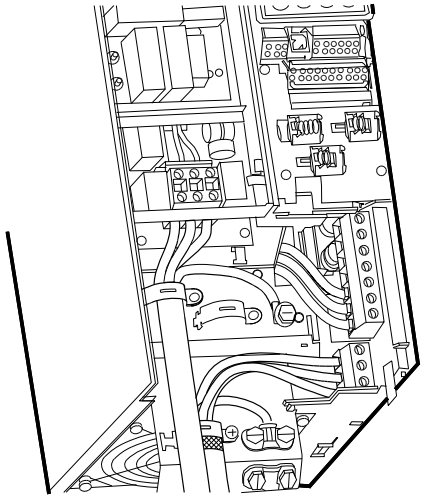
Caution ***Check that mains voltage and frequency correspond to the values on the nameplate of the CUE and the motor.***

1. Connect the ground conductor to terminal 95 (PE). See figs 16 and 17.
2. Connect the mains conductors to the terminals 91 (L1), 92 (L2), 93 (L3).
3. Fix the mains cable with a cable clamp.

Motor connection

Caution ***The motor cable must be screened for the CUE to meet EMC requirements.***

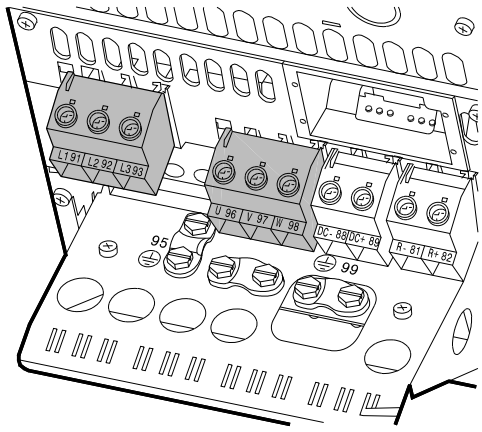
1. Connect the ground conductor to terminal 99 (PE). See figs 16 and 17.
2. Connect the motor conductors to the terminals 96 (U), 97 (V), 98 (W).
3. Fix the screened cable with a cable clamp.



TM03 9446 4007

Fig. 16 Mains and motor connection, B3

Note ***The cable screen must be exposed and in physical contact with the mounting plate and clamp.***



TM03 9449 4007

Fig. 17 Mains and motor connection, B4

US

US

Note ***The cable screen must be exposed and in physical contact with the mounting plate and clamp.***

6.2.8 Enclosures C1 and C2

For information about enclosure, see table in section *16.1*.

Mains connection

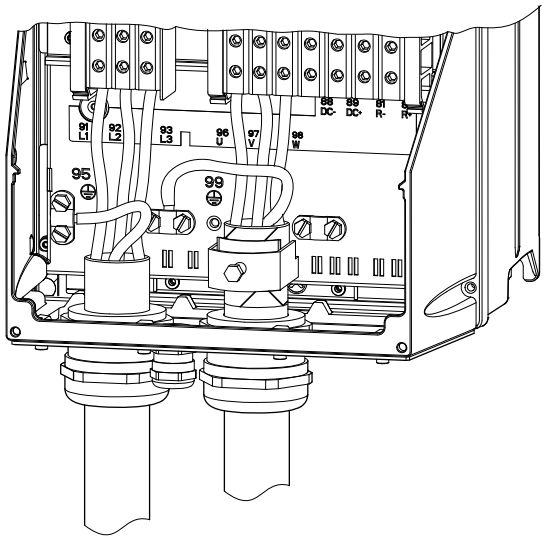
Caution ***Check that mains voltage and frequency correspond to the values on the nameplate of the CUE and the motor.***

1. Connect the ground conductor to terminal 95 (PE). See fig. 18.
2. Connect the mains conductors to the terminals 91 (L1), 92 (L2), 93 (L3).

Motor connection

Caution ***The motor cable must be screened for the CUE to meet EMC requirements.***

1. Connect the ground conductor to terminal 99 (PE). See fig. 18.
2. Connect the motor conductors to the terminals 96 (U), 97 (V), 98 (W).
3. Fix the screened cable with a cable clamp.



TM03 9016 2807

Fig. 18 Mains and motor connection, C1 and C2

Note ***The cable screen must be exposed and in physical contact with the mounting plate and clamp.***

6.2.9 Enclosures C3 and C4

For information about enclosure, see table in section *16.1*.

Mains connection

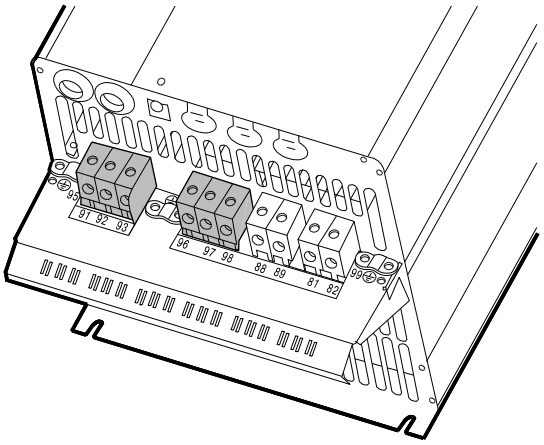
Caution ***Check that mains voltage and frequency correspond to the values on the nameplate of the CUE and the motor.***

1. Connect the ground conductor to terminal 95 (PE). See figs 19 and 20.
2. Connect the mains conductors to the terminals 91 (L1), 92 (L2), 93 (L3).

Motor connection

Caution ***The motor cable must be screened for the CUE to meet EMC requirements.***

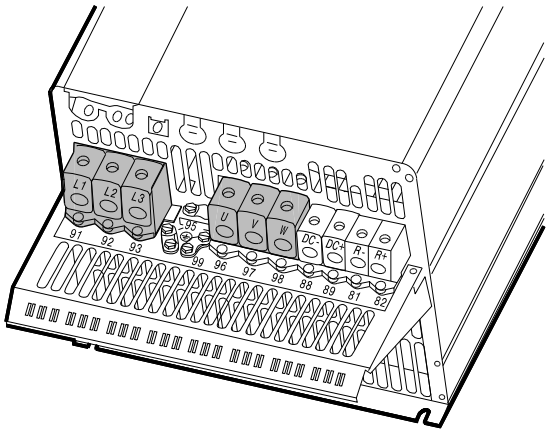
1. Connect the ground conductor to terminal 99 (PE). See figs 19 and 20.
2. Connect the motor conductors to the terminals 96 (U), 97 (V), 98 (W).
3. Fix the screened cable with a cable clamp.



TM03 9448 4007

Fig. 19 Mains and motor connection, C3

Note ***The cable screen must be exposed and in physical contact with the mounting plate and clamp.***



TM03 9447 4007

Fig. 20 Mains and motor connection, C4

Note ***The cable screen must be exposed and in physical contact with the mounting plate and clamp.***

6.3 Connecting the signal terminals

Caution ***As a precaution, signal cables must be separated from other groups by reinforced insulation in their entire lengths.***

Note ***If no external on/off switch is connected, short-circuit terminals 18 and 20 using a short wire.***

Connect the signal cables according to the guidelines for good practice to ensure EMC-correct installation. See section *6.6 EMC-correct installation*.

- Use screened signal cables with a conductor gauge size of min. 22 AWG and max. 16 AWG.
- Use a 3-conductor screened bus cable in new systems.

6.3.1 Wiring diagram, signal terminals

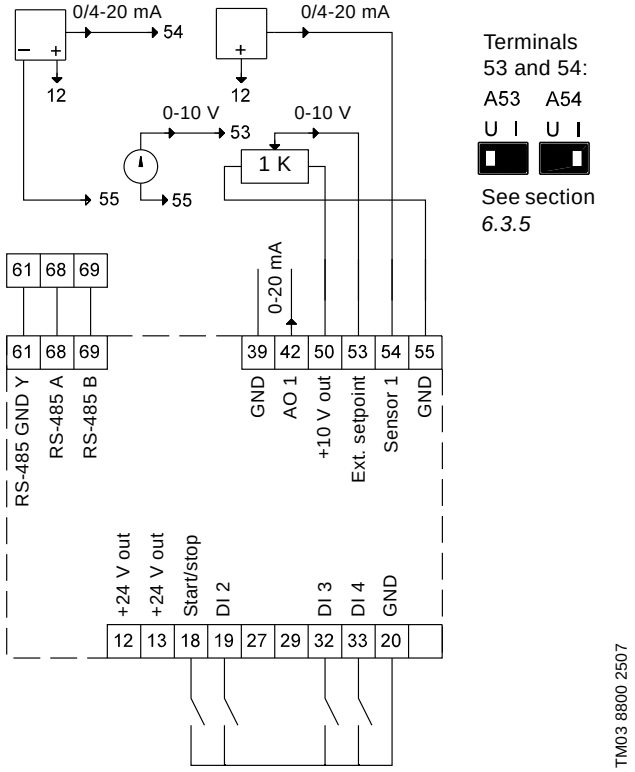


Fig. 21 Wiring diagram, signal terminals

Terminal	Type	Function
12	+24 V out	Supply to sensor
13	+24 V out	Additional supply
18	DI 1	Digital input, start/stop
19	DI 2	Digital input, programmable
20	GND	Ground for digital inputs
32	DI 3	Digital input, programmable
33	DI 4	Digital input, programmable
39	GND	Ground for analog output
42	AO 1	Analog output, 0-20 mA
50	+10 V out	Supply to potentiometer
53	AI 1	External setpoint, 0-10 V/0/4-20 mA
54	AI 2	Sensor input, sensor 1, 0/4-20 mA
55	GND	Ground for analog inputs
61	RS-485 GND Y	GENIbus, GND
68	RS-485 A	GENIbus, signal A (+)
69	RS-485 B	GENIbus, signal B (-)

Terminals 27, 29 and 37 are not used.

Note ***The RS-485 screen must be connected to ground.***

6.3.2 Minimum connection, signal terminals

Operation is only possible when the terminals 18 and 20 are connected, for instance by means of an external on/off switch or a short wire.

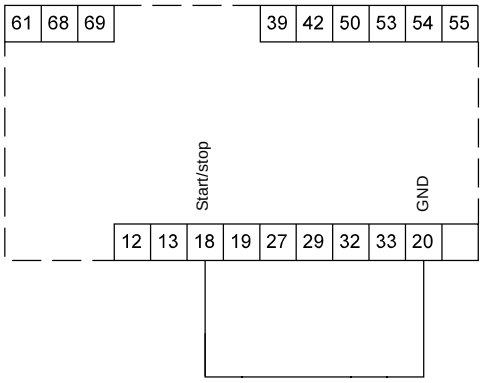


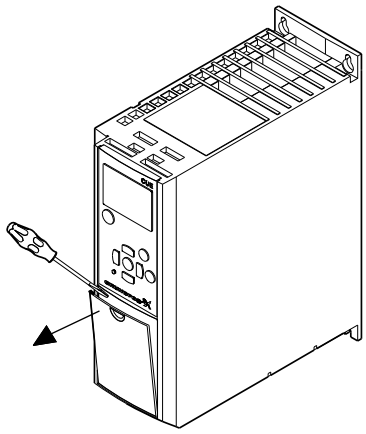
Fig. 22 Required minimum connection, signal terminals

US

US

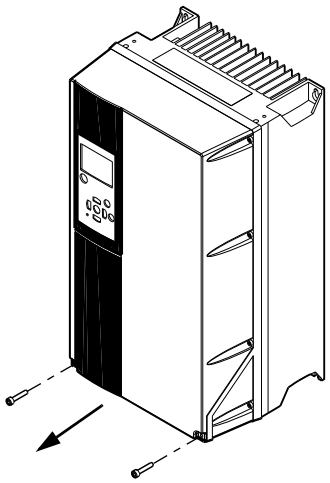
6.3.3 Access to signal terminals

All signal terminals are behind the terminal cover of the CUE front. Remove the terminal cover as shown in figs 23 and 24.



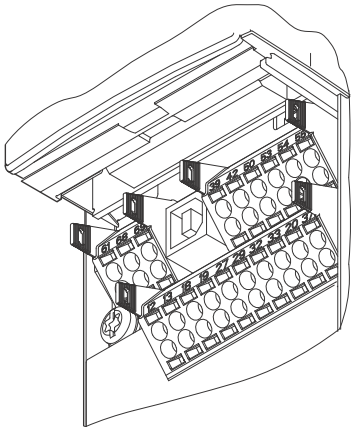
TM03 9003 2807

Fig. 23 Access to signal terminals, A2 and A3



TM03 9004 2807

Fig. 24 Access to signal terminals, A5, B1, B2, B3, B4, C1, C2, C3 and C4

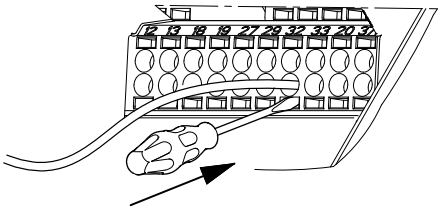


TM03 9025 2807

Fig. 25 Signal terminals (all enclosures)

6.3.4 Fitting the conductor

1. Remove the insulation at a length of 0.34 - 0.39 in (9-10 mm).
2. Insert a screwdriver with a tip of maximum 0.015 x 0.1 in (0.4 x 2.5 mm) into the square hole.
3. Insert the conductor into the corresponding round hole. Remove the screwdriver. The conductor is now fixed in the terminal.



TM03 9026 2807

Fig. 26 Fitting the conductor into the signal terminal

6.3.5 Setting the analog inputs, terminals 53 and 54

The contacts A53 and A54 are positioned behind the control panel and used for setting the signal type of the two analog inputs.

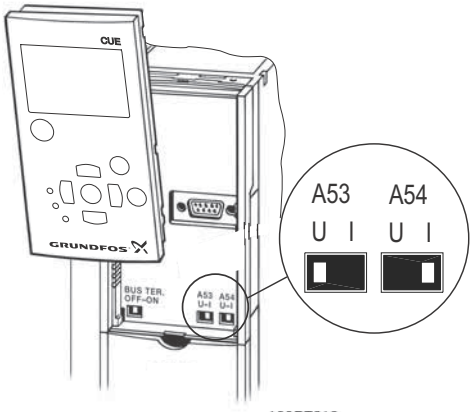
The factory setting of the inputs is voltage signal "U".

Note

If a 0/4-20 mA sensor is connected to terminal 54, the input must be set to current signal "I".

Switch off the power supply before setting the A54.

Remove the control panel to set the contact. See fig. 27.

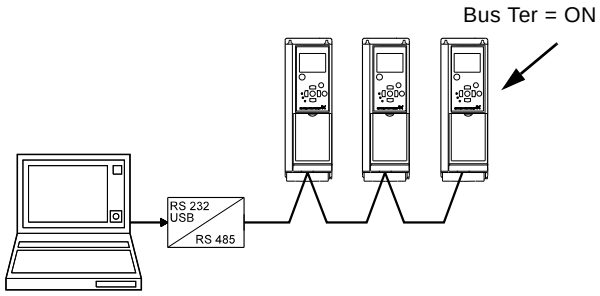


TM03 9104 3407

Fig. 27 Setting contact A54 to current signal "I"

6.3.6 RS-485 GENIbus network connection

One or more CUE units can be connected to a control unit via GENIbus. See the example in fig. 28.



TM03 9005 2807

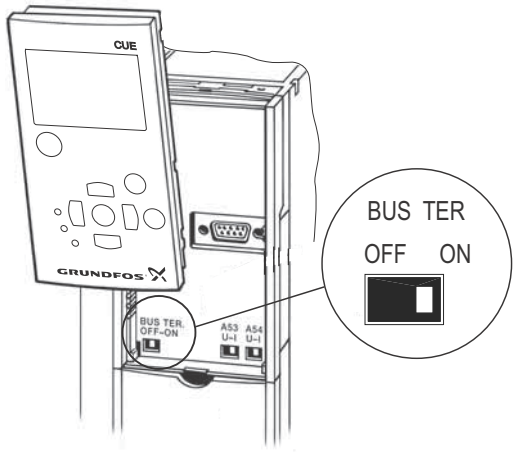
Fig. 28 Example of an RS-485 GENIbus network

The reference potential, GND, for RS-485 (Y) communication must be connected to terminal 61.

If more than one CUE unit is connected to a GENIbus network, the termination contact of the last CUE must be set to "ON" (termination of the RS-485 port).

The factory setting of the termination contact is "OFF" (not terminated).

Remove the control panel to set the contact. See fig. 29.

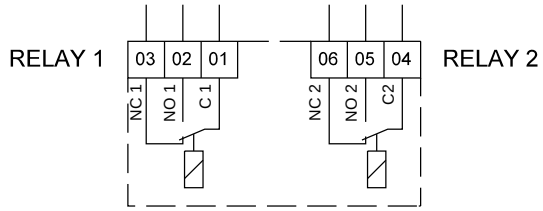


TM03 9006 2807

Fig. 29 Setting the termination contact to "ON"

6.4 Connecting the signal relays

Caution ***As a precaution, signal cables must be separated from other groups by reinforced insulation in their entire lengths.***



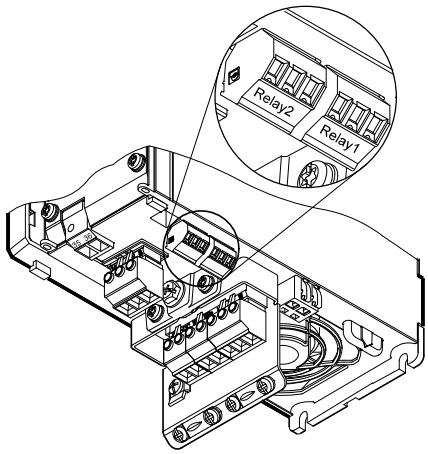
TM03 8801 2507

Fig. 30 Terminals for signal relays in normal state (not activated)

Terminal		Function
C 1	C 2	Common
NO 1	NO 2	Normally open contact
NC 1	NC 2	Normally closed contact

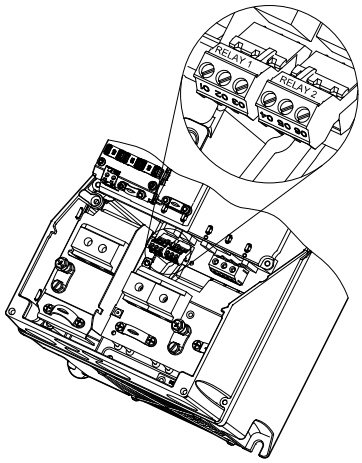
Access to signal relays

The relay outputs are positioned as shown in figs 31 to 36.



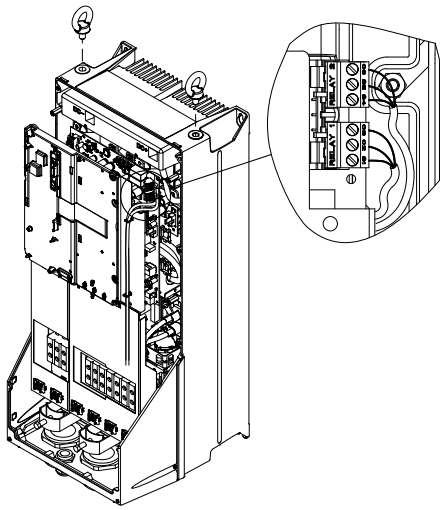
TM03 9007 2807

Fig. 31 Terminals for relay connection, A2 and A3



TM03 9008 2807

Fig. 32 Terminals for relay connection, A5, B1 and B2

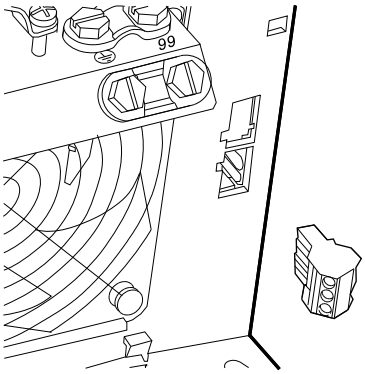


TM03 9009 2807

Fig. 33 Terminals for relay connection, C1 and C2

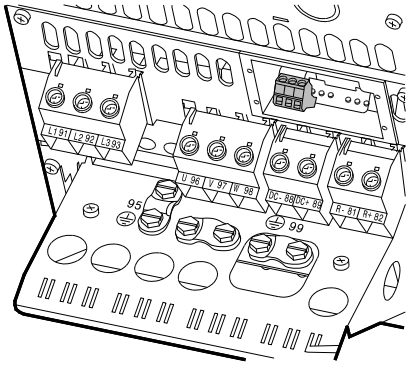
US

US



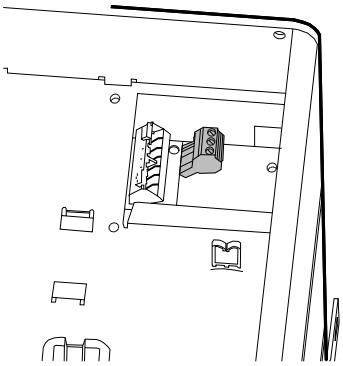
TM03 9442 4007

Fig. 34 Terminals for relay connection, B3



TM03 9441 4007

Fig. 35 Terminals for relay connection, B4



TM03 9440 4007

Fig. 36 Terminals for relay connection, C3 and C4, in the upper right corner of the CUE

6.5 Connecting the MCB 114 sensor input module

The MCB 114 is an option offering additional analog inputs for the CUE.

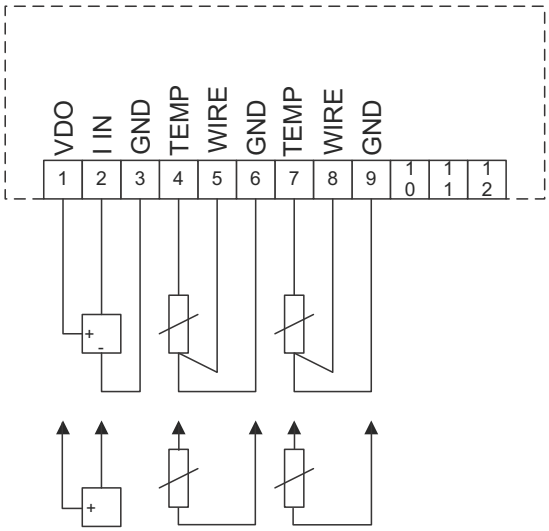
6.5.1 Configuration of the MCB 114

The MCB 114 is equipped with three analog inputs for these sensors:

- One additional sensor 0/4-20 mA.
  See section *10.7.13 Sensor 2 (3.16)*.
- Two Pt100/Pt1000 temperature sensors for measurement of motor bearing temperature or an alternative temperature, such as liquid temperature. See sections *10.7.18 Temperature sensor 1 (3.21)* and *10.7.19 Temperature sensor 2 (3.22)*.

When the MCB 114 has been installed, the CUE will automatically detect if the sensor is Pt100 or Pt1000 when it is switched on.

6.5.2 Wiring diagram, MCB 114



TM04 3273 3908

Fig. 37 Wiring diagram, MCB 114

Terminal	Type	Function
1 (VDO)	+24 V out	Supply to sensor
2 (I IN)	AI 3	Sensor 2, 0/4-20 mA
3 (GND)	GND	Ground for analog input
4 (TEMP) 5 (WIRE)	AI 4	Temperature sensor 1, Pt100/Pt1000
6 (GND)	GND	Ground for temperature sensor 1
7 (TEMP) 8 (WIRE)	AI 5	Temperature sensor 2, Pt100/Pt1000
9 (GND)	GND	Ground for temperature sensor 2

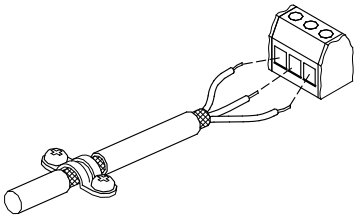
Terminals 10, 11 and 12 are not used.

6.6 EMC-correct installation

This section gives guidelines for good practice when installing the CUE. Follow these guidelines to meet EN 61800-3, first environment.

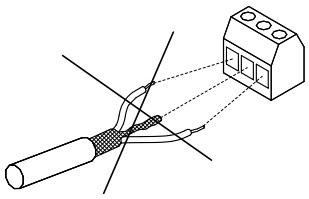
- Use only motor and signal cables with a braided metal screen in applications without output filter.
- There are no special requirements to supply cables, apart from local requirements.
- Leave the screen as close to the connecting terminals as possible. See fig. 38.
- Avoid terminating the screen by twisting the ends. See fig. 39. Use cable clamps or EMC screwed cable entries instead.
- Connect the screen to ground at both ends for both motor and signal cables. See fig. 40. If the controller has no cable clamps, connect only the screen to the CUE. See fig. 41.
- Avoid unscreened motor and signal cables in electrical cabinets with variable frequency drives.
- Make the motor cable as short as possible in applications without output filter to limit the noise level and minimise leakage currents.
- Screws for ground connections must always be tightened whether a cable is connected or not.
- Keep main cables, motor cables and signal cables separated in the installation, if possible.

Other installation methods may give similar EMC results if the above guidelines for good practice are followed.



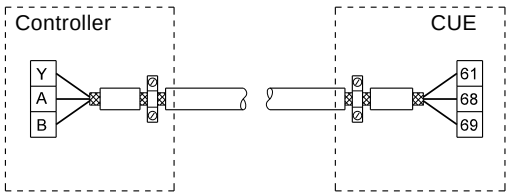
TM02 1325 0901

Fig. 38 Example of stripped cable with screen



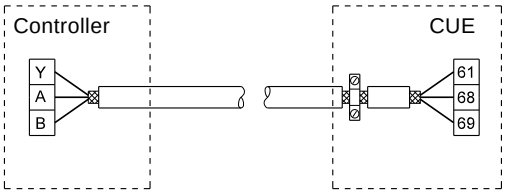
TM03 8812 2507

Fig. 39 Do not twist the screen ends



TM03 8732 2407

Fig. 40 Example of connection of a 3-conductor bus cable with screen connected at both ends



TM03 8731 2407

Fig. 41 Example of connection of a 3-conductor bus cable with screen connected at the CUE (controller with no cable clamps)

US

6.7 RFI filters

To meet the EMC requirements, the CUE comes with the following types of built-in radio frequency interference filter (RFI):

Voltage	Typical shaft power P2	RFI filter type
1 x 200-240 V*	1.5 - 10 hp	C1
3 x 200-240 V	1 - 60 hp	C1
3 x 380-500 V	0.75 - 125 hp	C1
3 x 525-600 V	1 - 10 hp	C3
3 x 525-690 V	15 - 125 hp	C3

* Single-phase input - three-phase output.

Description of RFI filter types

C1:	For use in domestic areas
C3:	For use in industrial areas with own low-voltage transformer

RFI filter types are according to EN 61800-3.

6.7.1 Equipment of category C3

- This type of power drive system (PDS) is not intended to be used on a low-voltage public network which supplies domestic premises.
- Radio frequency interference is expected if used on such a network.

6.8 Output filters

Output filters are used for reducing the voltage stress on the motor windings and the stress on the motor insulation system as well as for decreasing acoustic noise from the variable-frequency-driven motor.

Two types of output filter are available as accessories for the CUE:

- dU/dt filters
- sine-wave filters.

Use of output filters

Pump type	Typical shaft power P2	dU/dt filter [ft]	Sine-wave filter [ft]
SP, BM, BMB with 380 V motor and up	Up to 10 hp	–	0-1000
	15 hp and up	0-500	500-1000
Other pumps, noise reduction	Up to 10 hp	–	0-1000
	15 hp and up	0-500	500-1000
Other pumps, higher noise reduction	Up to 10 hp	–	0-1000
	15 hp and up	–	0-1000
Pumps with 690 V motor	All	–	0-1000

The lengths stated apply to the motor cable.

US

Figures 42 and 43 show installations with and without filter and where to use screened and unscreened cable.

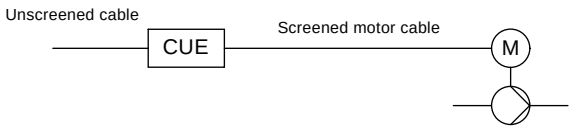


Fig. 42 Example of installation without filter

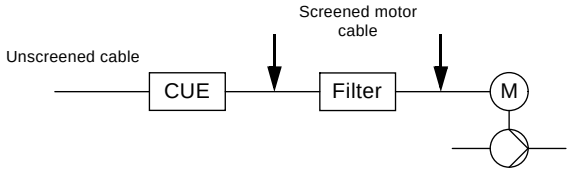


Fig. 43 Example of installation with filter. The cable between the CUE and filter must be short.

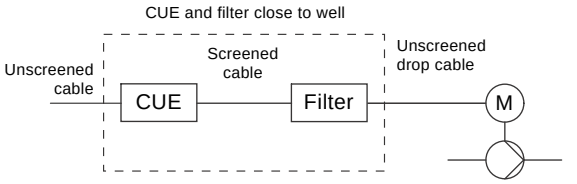
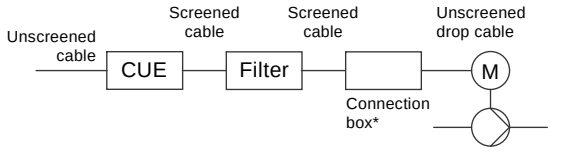


Fig. 44 Submersible pump without connection box. Variable frequency drive and filter installed close to the well.



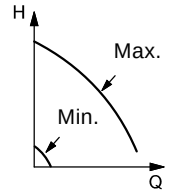
* Both ends of the screened cable between filter and connection box must be connected to ground.

Fig. 45 Submersible pump with connection box and screened cable. Variable frequency drive and filter installed close to the well.

7. Operating modes

The following operating modes are set on the control panel in menu OPERATION, display 1.2. See section *10.5.2*.

Operating mode	Description
Normal	The pump is running in the control mode selected.
Stop	The pump has been stopped (green indicator light is flashing).
Min.	The pump is running at minimum speed.
Max.	The pump is running at maximum speed.



Min. and max. curves.
The pump speed is kept at a given set value for minimum and maximum speed, respectively.

Example: Max. curve operation can for instance be used in connection with venting the pump during installation.

Example: Min. curve operation can for instance be used in periods with a very small flow requirement.

8. Control modes

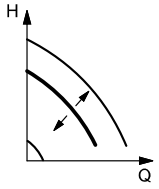
The control mode is set on the control panel in menu INSTALLATION, display 3.1. See section *10.7.1*.

There are two basic control modes:

- Uncontrolled operation (open loop)
- Controlled operation (closed loop) with a sensor connected.

See sections *8.1* and *8.2*.

8.1 Uncontrolled operation (open loop)

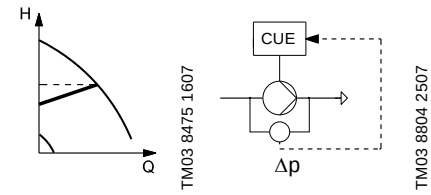


Constant curve.
The speed is kept at a set value in the range between the min. and max. curve.
The setpoint is set in % corresponding to the required speed.

Example: Operation on constant curve can for instance be used for pumps with no sensor connected.

Example: Typically used in connection with an overall control system such as the MPC or another external controller.

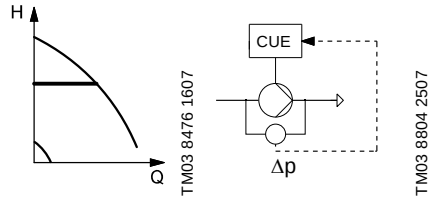
8.2 Controlled operation (closed loop)



TM03 8475 1607

TM03 8804 2507

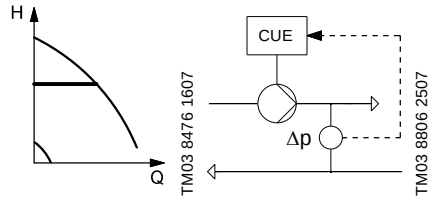
Proportional differential pressure.
The differential pressure is reduced at falling flow rate and increased at rising flow rate.



TM03 8476 1607

TM03 8804 2507

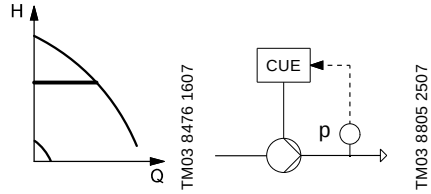
Constant differential pressure, pump.
The differential pressure is kept constant, independently of the flow rate.



TM03 8476 1607

TM03 8806 2507

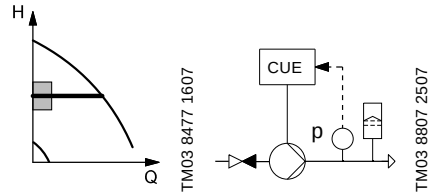
Constant differential pressure, system.
The differential pressure is kept constant, independently of the flow rate.



TM03 8476 1607

TM03 8805 2507

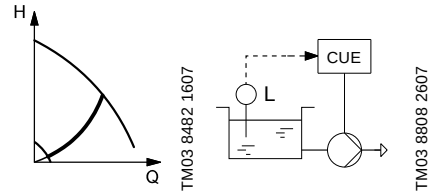
Constant pressure.
The pressure is kept constant, independently of the flow rate.



TM03 8477 1607

TM03 8807 2507

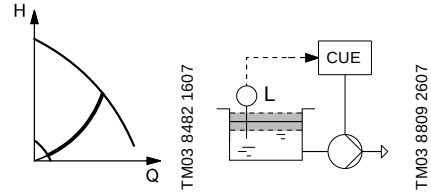
Constant pressure with stop function.
The outlet pressure is kept constant at high flow rate.
On/off operation at low flow rate.



TM03 8482 1607

TM03 8808 2607

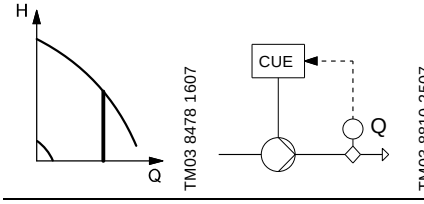
Constant level.
The liquid level is kept constant, independently of the flow rate.



TM03 8482 1607

TM03 8809 2607

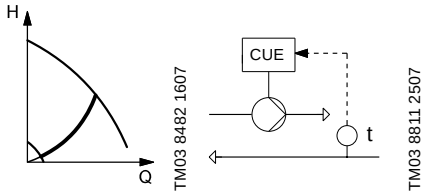
Constant level with stop function.
The liquid level is kept constant at high flow rate.
On/off operation at low flow rate.



TM03 8478 1607

TM03 8810 2507

Constant flow rate.
The flow rate is kept constant, independently of the head.



TM03 8482 1607

TM03 8811 2507

Constant temperature.
The liquid temperature is kept constant, independently of the flow rate.

US

US

9. Menu overview

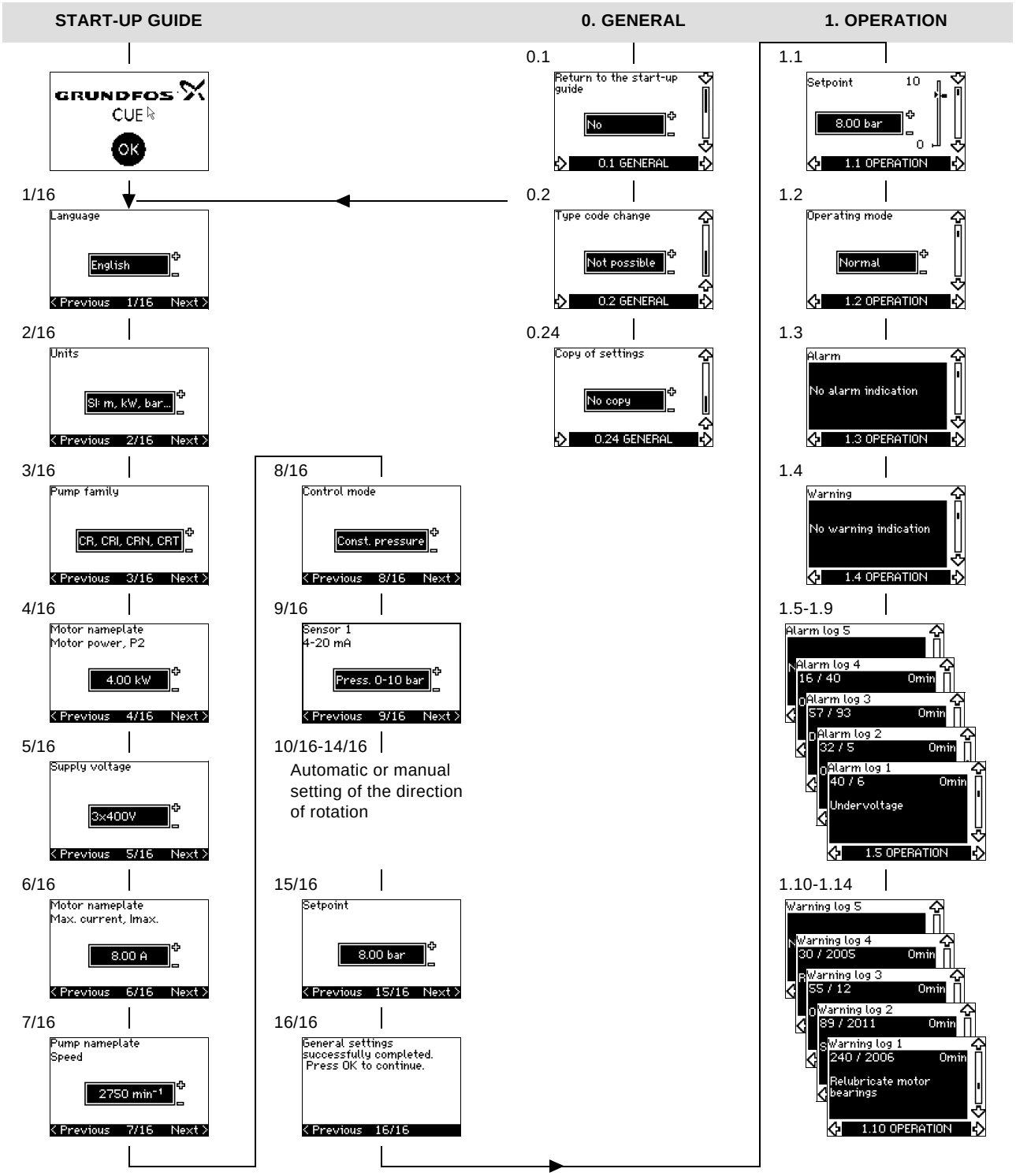


Fig. 46 Menu overview

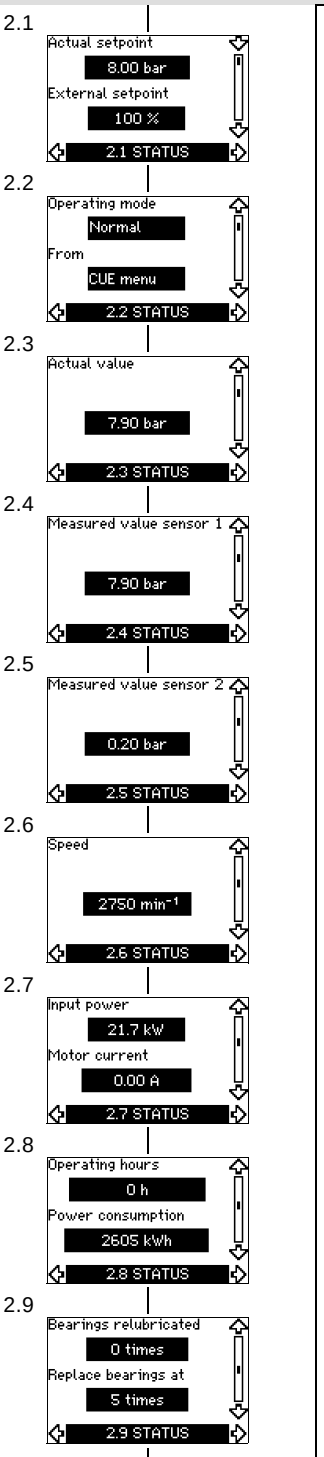
Menu structure

The CUE has a start-up guide, which is started at the first start-up. After the start-up guide, the CUE has a menu structure divided into four main menus:

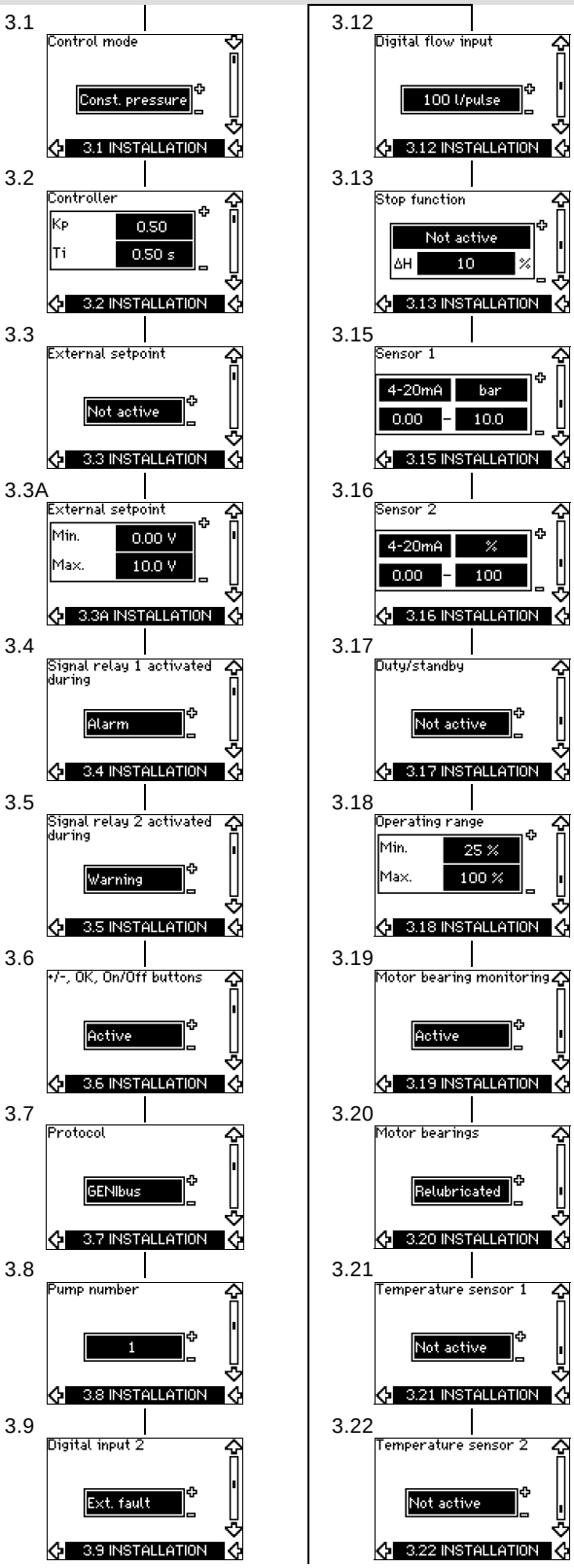
1. **GENERAL** gives access to the start-up guide for the general setting of the CUE.
2. **OPERATION** enables the setting of setpoint, selection of operating mode and resetting of alarms. It is also possible to see the latest five warnings and alarms.
3. **STATUS** shows the status of the CUE and the pump. It is not possible to change or set values.
4. **INSTALLATION** gives access to all parameters. Here a detailed setting of the CUE can be made.

US

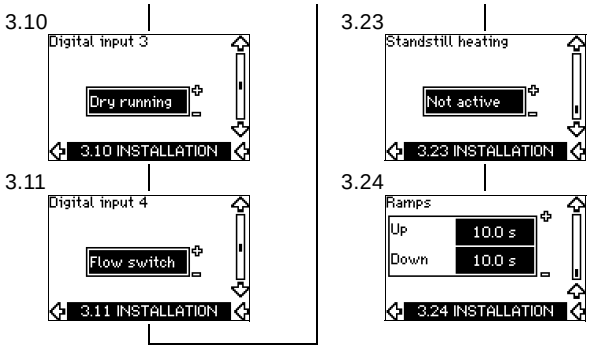
2. STATUS



3. INSTALLATION



US


3.10
Digital input 3
Dry running
3.10 INSTALLATION
3.11
Digital input 4
Flow switch
3.11 INSTALLATION
3.23
Standstill heating
Not active
3.23 INSTALLATION
3.24
Ramps
Up
10.0 s
Down
10.0 s
3.24 INSTALLATION

10. Setting by means of the control panel

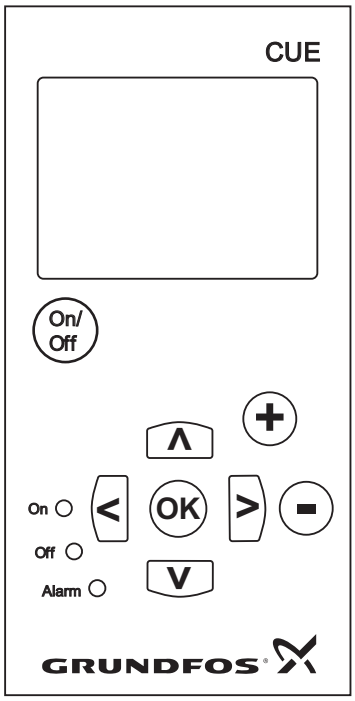
10.1 Control panel

Warning

The On/Off button on the control panel does not disconnect the CUE from the power supply and must therefore not be used as a safety switch.

The On/Off button has the highest priority. In "off" condition, pump operation is not possible.

The control panel is used for local setting of the CUE. The functions available depend on the pump family connected to the CUE.



TM03 8719 2507

Fig. 47 Control panel of the CUE

Editing buttons

Button	Function
On/ Off	Makes the pump ready for operation/starts and stops the pump.
OK	Saves changed values, resets alarms and expands the value field.
+ −	Changes values in the value field.

Navigating buttons

Button	Function
< >	Navigates from one menu to another. When the menu is changed, the display shown will always be the top display of the new menu.
∧ ∨	Navigates up and down in the individual menu.

The editing buttons of the control panel can be set to these values:

- ***Active***
- *Not active*.

When set to *Not active* (locked), the editing buttons do not function. It is only possible to navigate in the menus and read values.

Activate or deactivate the buttons by pressing the arrow up and arrow down buttons simultaneously for 3 seconds.

Adjusting the display contrast

Press OK and + for darker display.

Press OK and – for brighter display.

Indicator lights

The operating condition of the pump is indicated by the indicator lights on the front of the control panel. See fig. 47.

The table show the function of the indicator lights.

Indicator light	Function
On (green)	The pump is running or has been stopped by a stop function.
	If flashing, the pump has been stopped by the user (CUE menu), external start/stop or bus.
Off (orange)	The pump has been stopped with the On/Off button.
Alarm (red)	Indicates an alarm or a warning.

Displays, general terms

Figures 48 and 49 shows the general terms of the display.

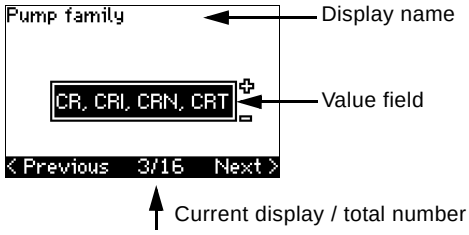


Fig. 48 Example of display in the start-up guide

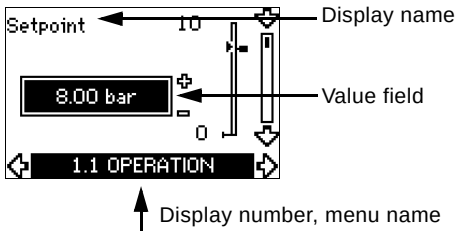


Fig. 49 Example of display in the user menu

10.2 Back to factory setting

Follow this procedure to get back to the factory setting:

1. Switch off the power supply to the CUE.
2. Press On/Off, OK and + while switching on the power supply.

The CUE will reset all parameters to factory settings. The display will turn on when the reset is completed.

US

US

10.3 Start-up guide

Note

Check that equipment connected is ready for start-up, and that the CUE has been connected to power supply.

Have nameplate data for motor, pump and CUE at hand.

Use the start-up guide for the general setting of the CUE including the setting of the correct direction of rotation.

The start-up guide is started the first time when the CUE is connected to supply voltage. It can be restarted in menu GENERAL. Please note that in this case all previous settings will be erased.

Bulleted lists show possible settings. Factory settings are shown **in bold**.

10.3.1 Welcoming display

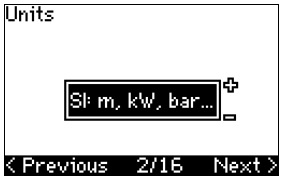
- Press OK. You will now be guided through the start-up guide.

10.3.2 Language (1/16)

Select the language to be used in the display:

- ***English UK***
- *English US*
- *German*
- *French*
- *Italian*
- *Spanish*
- *Portuguese*
- *Greek*
- *Dutch*
- *Swedish*
- *Finnish*
- *Danish*
- *Polish*
- *Russian*
- *Hungarian*
- *Czech*
- *Chinese*
- *Japanese*
- *Korean.*

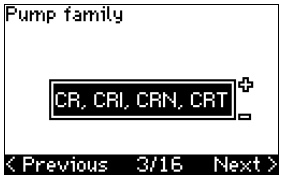
10.3.3 Units (2/16)



Select the units to be used in the display:

- ***SI: m, kW, bar***...
- *US: ft, HP, psi...*

10.3.4 Pump family (3/16)

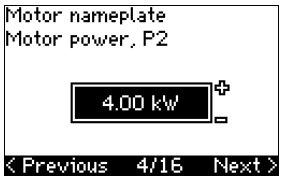


Select pump family according to the pump nameplate:

- ***CR, CRI, CRN, CRT***
- *SP, SP-G, SP-NE*
- *...*

Select "Other" if the pump family is not on the list.

10.3.5 Rated motor power (4/16)

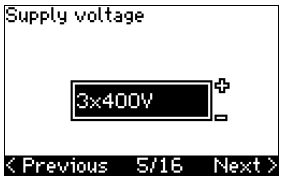


Set the rated motor power, P2, according to the motor nameplate:

- 0.75 - 125 HP (0.55 - 90 kW).

The setting range is size-related, and the factory setting corresponds to the rated power of the CUE.

10.3.6 Supply voltage (5/16)



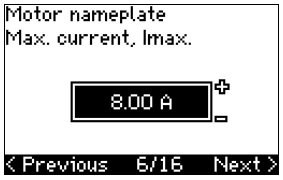
Select supply voltage according to the rated supply voltage of the installation site.

Unit 1 x 200-240 V:*	Unit 3 x 200-240 V:	Unit 3 x 380-500 V:
• *1 x 200 V*	• *3 x 200 V*	• *3 x 380 V*
• *1 x 208 V*	• *3 x 208 V*	• *3 x 400 V*
• *1 x 220 V*	• *3 x 220 V*	• *3 x 415 V*
• *1 x 230 V*	• *3 x 230 V*	• *3 x 440 V*
• *1 x 240 V.*	• *3 x 240 V.*	• *3 x 460 V*
		• *3 x 500 V.*
Unit 3 x 525-600 V:	Unit 3 x 525-690 V:	
• *3 x 575 V.*	• *3 x 575 V*	
	• *3 x 690 V.*	

* Single-phase input - three-phase output.

The setting range depends on the CUE type, and the factory setting corresponds to the rated supply voltage of the CUE.

10.3.7 Max. motor current (6/16)



Set the maximum motor current according to the motor nameplate:

- 0-999 A.

The setting range depends on the CUE type, and the factory setting corresponds to a typical motor current at the motor power selected.

10.3.8 Speed (7/16)

Set the rated speed according to the pump nameplate:

- 0-9999 rpm.

The factory setting depends on previous selections. Based on the set rated speed, the CUE will automatically set the motor frequency to 50 or 60 Hz.

10.3.9 Frequency (7A/16)

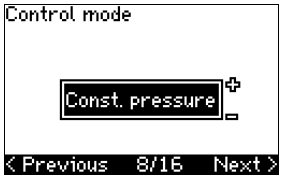
This display appears only if manual entering of the frequency is required.

Set the frequency according to the motor nameplate:

- 40-200 Hz.

The factory setting depends on previous selections.

10.3.10 Control mode (8/16)



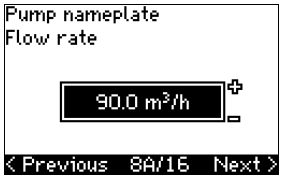
Select the desired control mode. See section *10.7.1*.

- *Open loop*
- *Const. pressure*
- *Const. diff. pressure*
- *Prop. diff. pressure*
- *Const. flow rate*
- *Const. temperature*
- *Constant level*
- *Const. other value.*

The possible settings and the factory setting depend on the pump family.

The CUE will give an alarm if the control mode selected requires a sensor and no sensor has been installed. To continue the setting without a sensor, select "Open loop", and proceed. When a sensor has been connected, set the sensor and control mode in menu INSTALLATION.

10.3.11 Rated flow rate (8A/16)

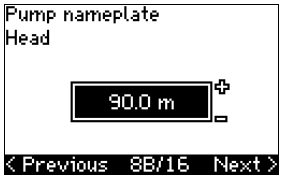


This display appears only if the control mode selected is proportional differential pressure.

Set the rated flow rate according to the pump nameplate:

- 1-28840 gpm (1-6550 m^3/h).

10.3.12 Rated head (8B/16)



This display only appears if the control mode selected is proportional differential pressure.

Set the rated head according to the pump nameplate:

- 1-3277 ft (1-999 m).

10.3.13 Sensor connected to terminal 54 (9/16)

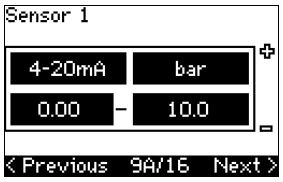
Set the measuring range of the connected sensor with a signal range of 4-20 mA. The measuring range depends on the control mode selected:

Proportional differential pressure: • *0-20 ft* • *0-33 ft* • *0-54 ft* • *0-84 ft* • *0-200 ft* • *0-334 ft* • *Other.*	Constant differential pressure: • *0-20 ft* • *0-33 ft* • *0-54 ft* • *0-84 ft* • *0-200 ft* • *0-334 ft* • *Other.*
Constant pressure: • *0-58 psi* • *0-87 psi* • *0-120 psi* • *0-145 psi* • *0-232 psi* • *0-362 psi* • *0-580 psi* • *0-870 psi* • *Other.*	Constant flow rate: • *Other.*
Constant temperature: • *Other.*	Constant level: • *Other.*

US

If the control mode selected is "Const. other value", or if the measuring range selected is "Other", the sensor must be set according to the next section, display 9A/16.

10.3.14 Another sensor connected to terminal 54 (9A/16)

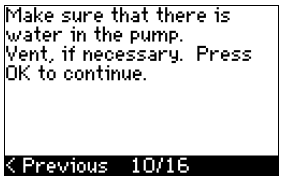


This display only appears when the control mode "Const. other value" or the measuring range "Other" has been selected in display 9/16.

- Sensor output signal:
  0-20 mA
  4-20 mA.
- Unit of measurement of sensor:
  ***bar**, mbar, m, kPa, psi, ft, m^3/h, m^3/min, m^3/s, l/h, l/min, l/s, gal/h, gal/m, gal/s, ft^3/h, ft^3/min, ft^3/s,°C, °F, %.*
- Sensor measuring range.

The measuring range depends on the sensor connected and the measuring unit selected.

10.3.15 Priming and venting (10/16)



See the installation and operating instructions of the pump.

The general setting of the CUE is now completed, and the start-up guide is ready for setting the direction of rotation:

- Press OK to go on to automatic or manual setting of the direction of rotation.

10.3.16 Automatic setting of the direction of rotation (11/16)

Warning

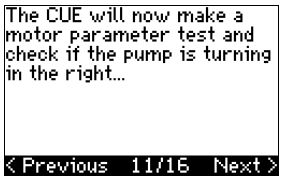
During the test, the pump will run for a short time. Ensure no personnel or equipment is in danger!

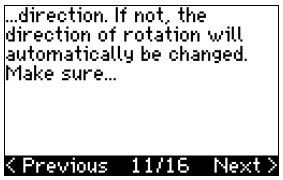
Note

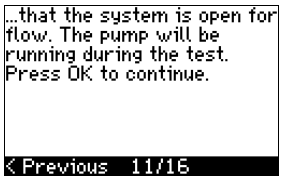
Before setting the direction of rotation, the CUE will make an automatic motor adaptation of certain pump types. This will take a few minutes. The adaptation is carried out during standstill.

The CUE automatically tests and sets the correct direction of rotation without changing the cable connections.

This test is not suitable for certain pump types and will in certain cases not be able to determine for certainty the correct direction of rotation. In these cases, the CUE changes over to manual setting where the direction of rotation is determined on the basis of the installer's observations.

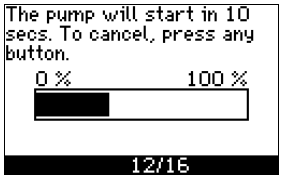






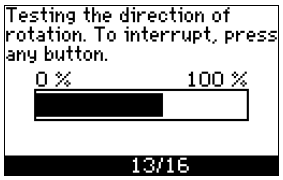
Information displays.

- Press OK to continue.



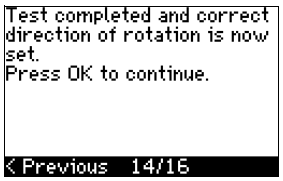
The pump starts after 10 seconds.

It is possible to interrupt the test and return to the previous display.



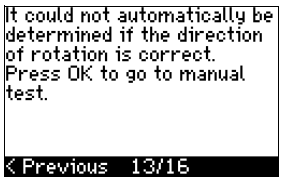
The pump runs with both directions of rotation and stops automatically.

It is possible to interrupt the test, stop the pump and go to manual setting of the direction of rotation.



The correct direction of rotation has now been set.

- Press OK to set the setpoint.
  See *Setpoint (15/16)* on page 26.



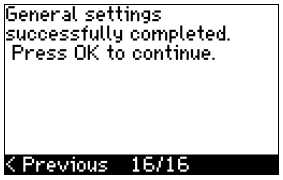
The automatic setting of the direction of rotation has failed.

- Press OK to go to manual setting of the direction of rotation.

10.3.17 Setpoint (15/16)

Set the setpoint according to the control mode and sensor selected.

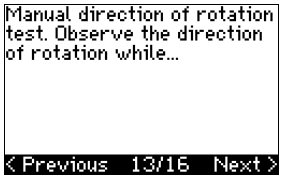
10.3.18 General settings are completed (16/16)

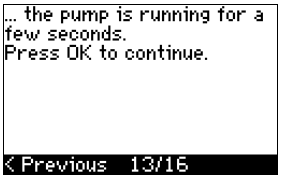


- Press OK to make the pump ready for operation or start the pump in the operating mode *Normal*. Then display 1.1 of menu OPERATION will appear.

10.3.19 Manual setting when the direction of rotation is visible (13/16)

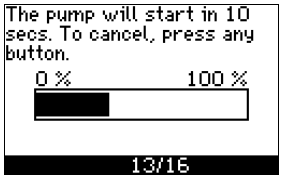
It must be possible to observe the motor fan or shaft.





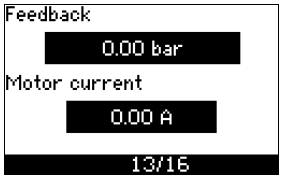
Information displays.

- Press OK to continue.

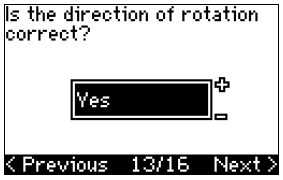


The pump starts after 10 seconds.

It is possible to interrupt the test and return to the previous display.

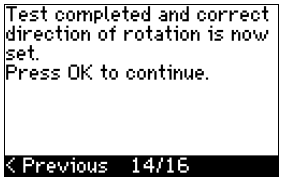


The pressure will be shown during the test if a pressure sensor is connected. The motor current is always shown during the test.



State if the direction of rotation is correct.

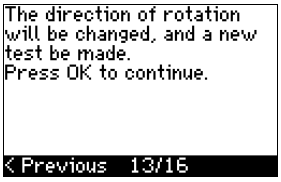
- **Yes**



The correct direction of rotation has now been set.

- Press OK to set the setpoint. See *Setpoint (15/16)* on page 26.

- **No**

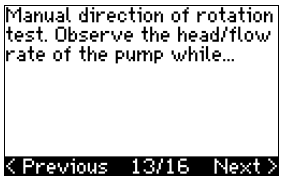


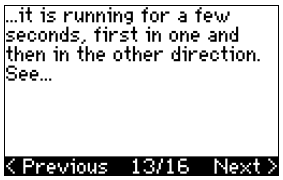
The direction of rotation is not correct.

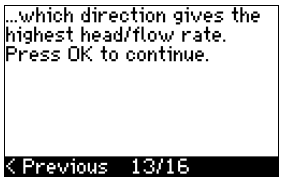
- Press OK to repeat the test with the opposite direction of rotation.

10.3.20 Manual setting when the direction of rotation is not visible (13/16)

It must be possible to observe the head or flow rate.

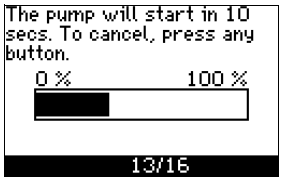






Information displays.

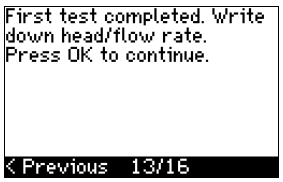
- Press OK to continue.

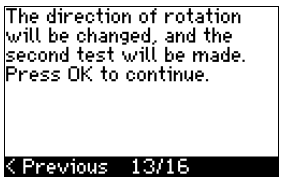


The pump starts after 10 seconds.

It is possible to interrupt the test and return to the previous display.

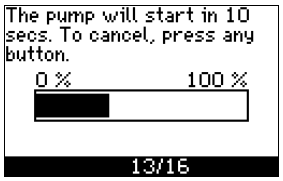
The pressure will be shown during the test if a pressure sensor is connected. The motor current is always shown during the test.





The first test is completed.

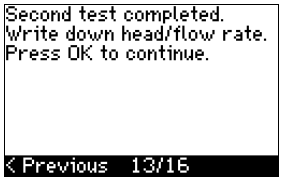
- Write down the pressure and/or flow rate, and press OK to continue the manual test with the opposite direction of rotation.

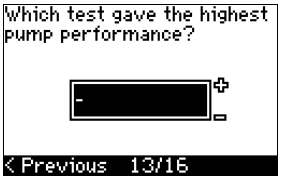


The pump starts after 10 seconds.

It is possible to interrupt the test and return to the previous display.

The pressure will be shown during the test if a pressure sensor is connected. The motor current is always shown during the test.

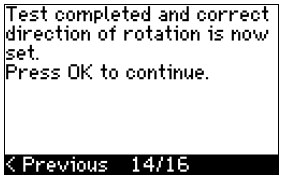




The second test is completed.

Write down the pressure and/or flow rate, and state which test gave the highest pump performance:

- First test
- Second test
- Make new test.



The correct direction of rotation has now been set.

- Press OK to set the setpoint. See *Setpoint (15/16)* on page 26.

10.4 Menu GENERAL

Note ***If the start-up guide is started, all previous settings will be erased!***

Note ***The start-up guide must be carried out on a cold motor!***

Repeating the start-up guide may lead to a heating of the motor.

The menu makes it possible to return to the start-up guide, which is usually only used during the first start-up of the CUE.

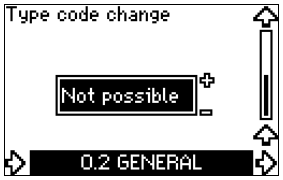
10.4.1 Return to start-up guide (0.1)

State your choice:

- *Yes*
- *No.*

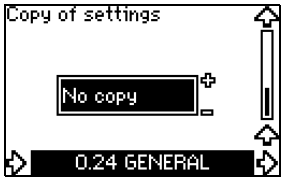
If *Yes* is selected, all settings will be erased, and the entire start-up guide must be completed.

10.4.2 Type code change (0.2)



This display is for service use only.

10.4.3 Copy of settings



It is possible to copy the settings of a CUE and reuse them in another one.

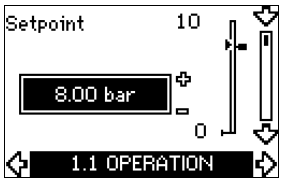
Options:

- *No copy.*
- *to CUE* (copies the settings of the CUE).
- *to control panel* (copies the settings to another CUE).

The CUE units must have the same firmware version. See section *10.6.16 Firmware version (2.16)*.

10.5 Menu OPERATION

10.5.1 Setpoint (1.1)



- Setpoint set
- Actual setpoint
- Actual value

Set the setpoint in units of the feedback sensor.

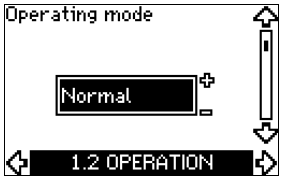
In control mode **Open loop**, the setpoint is set in % of the maximum performance. The setting range will lie between the min. and max. curves. See fig. 56.

In **all other** control modes except proportional differential pressure, the setting range is equal to the sensor measuring range. See fig. 57.

In control mode **Proportional differential pressure**, the setting range is equal to 25 % to 90 % of max. head. See fig. 58.

If the pump is connected to an external setpoint signal, the value in this display will be the maximum value of the external setpoint signal. See section *13.2 External setpoint.*

10.5.2 Operating mode (1.2)



Set one of the following operating modes:

- ***Normal*** (duty)
- *Stop*
- *Min.*
- *Max*.

The operating modes can be set without changing the setpoint setting.

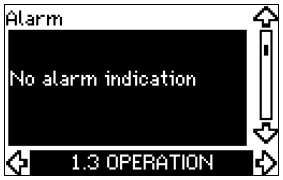
10.5.3 Fault indications

Faults may result in two types of indication: Alarm or warning.

An **"alarm"** will activate an alarm indication in CUE and cause the pump to change operating mode, typically to stop. However, for some faults resulting in alarm, the pump is set to continue operating even if there is an alarm.

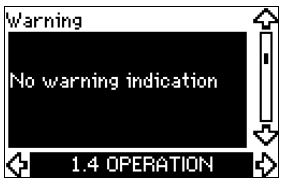
A **"warning"** will activate a warning indication in CUE, but the pump will not change operating or control mode.

Alarm (1.3)



In case of an alarm, the cause will appear in the display.
See section *15.1 Warning and alarm list*.

Warning (1.4)

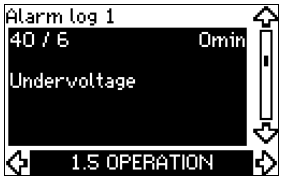


In case of warning, the cause will appear in the display.
See section *15.1 Warning and alarm list*.

10.5.4 Fault log

For both fault types, alarm and warning, the CUE has a log function.

Alarm log (1.5-1.9)

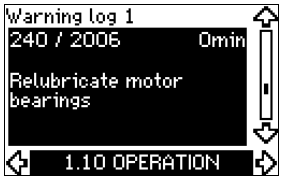


In case of an "alarm", the last five alarm indications will appear in the alarm log. "Alarm log 1" shows the latest alarm, "Alarm log 2" shows the latest alarm but one, etc.

The display shows three pieces of information:

- the alarm indication
- the alarm code
- the number of minutes the pump has been connected to the power supply after the alarm occurred.

Warning log (1.10-1.14)



In case of a "warning", the last five warning indications will appear in the warning log. "Warning log 1" shows the latest fault, "Warning log 2" shows the latest fault but one, etc.

The display shows three pieces of information:

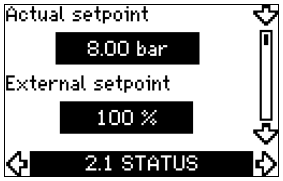
- the warning indication
- the warning code
- the number of minutes the pump has been connected to the power supply after the warning occurred.

10.6 Menu STATUS

The displays appearing in this menu are status displays only. It is not possible to change or set values.

The tolerance of the displayed value is stated under each display. The tolerances are stated as a guide in % of the maximum values of the parameters.

10.6.1 Actual setpoint (2.1)

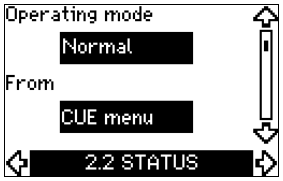


This display shows the actual setpoint and the external setpoint.

The **actual setpoint** is shown in units of feedback sensor.

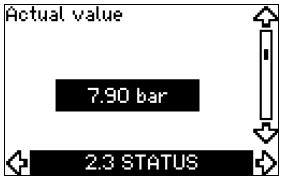
The **external setpoint** is shown in a range of 0-100 %. If the external setpoint influence is disactivated, the value 100 % is shown. See section *13.2 External setpoint.*

10.6.2 Operating mode (2.2)



This display shows the actual operating mode (*Normal*, *Stop*, *Min.* or *Max.*). Furthermore, it shows where this operating mode was selected (*CUE menu*, *Bus*, *External* or *On/off button*).

10.6.3 Actual value (2.3)



This display shows the actual value controlled.

If no sensor is connected to the CUE, "–" will appear in the display.

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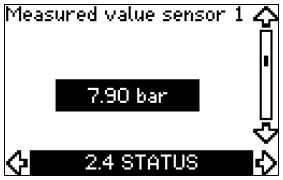
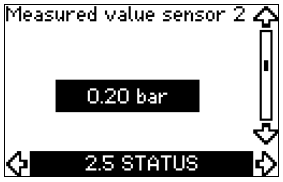
10.6.4 Measured value, sensor 1 (2.4)



This display shows the actual value measured by sensor 1 connected to terminal 54.

If no sensor is connected to the CUE, "–" will appear in the display.

10.6.5 Measured value, sensor 2 (2.5)



This display is only shown if an MCB 114 sensor input module has been installed.

This display shows the actual value measured by sensor 2 connected to an MCB 114.

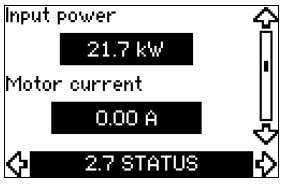
If no sensor is connected to the CUE, "–" will appear in the display.

10.6.6 Speed (2.6)

Tolerance: ± 5 %

This display shows the actual pump speed.

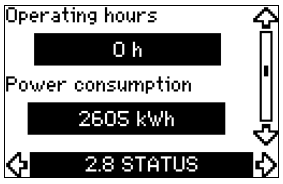
10.6.7 Input power and motor current (2.7)



Tolerance: ± 10 %

This display shows the actual pump input power in W or kW and the actual motor current in Ampere [A].

10.6.8 Operating hours and power consumption (2.8)



Tolerance: ± 2 %

This display shows the number of operating hours and the power consumption. The value of operating hours is an accumulated value and cannot be reset. The value of power consumption is an accumulated value calculated from the unit's birth, and it cannot be reset.

10.6.9 Lubrication status of motor bearings (2.9)

This display shows how many times the user has given the lubricated information and when to replace the motor bearings.

When the motor bearings have been relubricated, confirm this action in the INSTALLATION menu. See section *10.7.17 Confirming relubrication/replacement of motor bearings (3.20)*. When relubrication is confirmed, the figure in the above display will be increased by one.

10.6.10 Time until relubrication of motor bearings (2.10)

This display is only shown if display 2.11 is not shown.

This display shows when to relubricate the motor bearings. The controller monitors the operating pattern of the pump and calculates the period between bearing relubrications. If the operating pattern changes, the calculated time till relubrication may change as well.

The estimated time until relubrication takes into account if the pump has been running with reduced speed.

See section *10.7.17 Confirming relubrication/replacement of motor bearings (3.20)*.

10.6.11 Time until replacement of motor bearings (2.11)

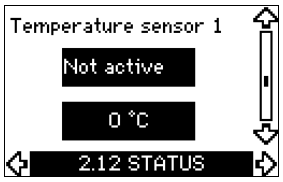
This display is only shown if display 2.10 is not shown.

This display shows when to replace the motor bearings. The controller monitors the operating pattern of the pump and calculates the period between bearing replacements.

The estimated time until replacement of motor bearings takes into account if the pump has been running with reduced speed.

See section *10.7.17 Confirming relubrication/replacement of motor bearings (3.20)*.

10.6.12 Temperature sensor 1 (2.12)

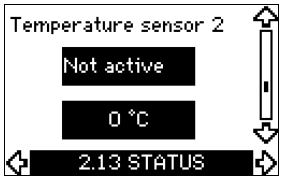


This display is only shown if an MCB 114 sensor input module has been installed.

This display shows the measuring point and the actual value measured by Pt100/Pt1000 temperature sensor 1 connected to the MCB 114. The measuring point is selected in display 3.21.

If no sensor is connected to the CUE, "–" will appear in the display.

10.6.13 Temperature sensor 2 (2.13)

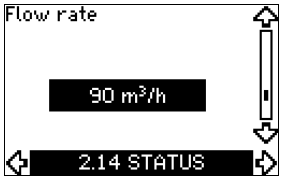


This display is only shown if an MCB 114 sensor input module has been installed.

This display shows the measuring point and the actual value measured by Pt100/Pt1000 temperature sensor 2 connected to the MCB 114. The measuring point is selected in display 3.22.

If no sensor is connected to the CUE, "–" will appear in the display.

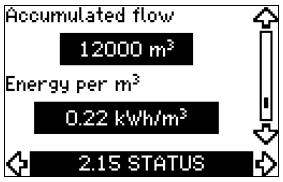
10.6.14 Flow rate (2.14)



This display is only shown if a flowmeter has been configured.

This display shows the actual value measured by a flowmeter connected to the digital pulse input (terminal 33) or the analog input (terminal 54).

10.6.15 Accumulated flow (2.15)

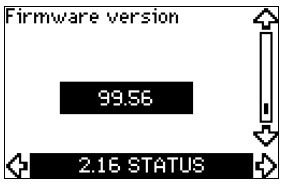


This display is only shown if a flowmeter has been configured.

This display shows the value of the accumulated flow and the specific energy for the transfer of the pumped liquid.

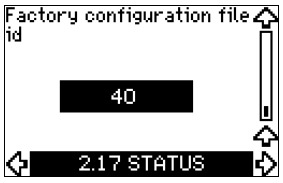
The flow measurement can be connected to the digital pulse input (terminal 33) or the analog input (terminal 54).

10.6.16 Firmware version (2.16)



This display shows the version of the software.

10.6.17 Configuration file (2.17)



This display shows the configuration file.

10.7 Menu INSTALLATION

10.7.1 Control mode (3.1)

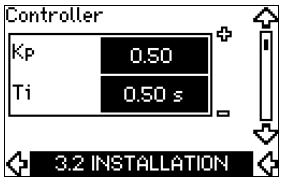
Select one of the following control modes:

- *Open loop*
- *Const. pressure*
- *Const. diff. pressure*
- *Prop. diff. pressure*
- *Const. flow rate*
- *Const. temperature*
- *Constant level*
- *Const. other value.*

Note

If the pump is connected to a bus, the control mode cannot be selected via the CUE. See section 13.3 GENIbus signal.

10.7.2 Controller (3.2)



The CUE has a factory setting of gain (K_p) and integral time (T_i). However, if the factory setting is not the optimum setting, the gain and the integral time can be changed in the display.

- The gain (K_p) can be set within the range from *0.1* to *20*.
- The integral time (T_i) can be set within the range from *0.1* to *3600 s*. If *3600 s* is selected, the controller will function as a P controller.
- Furthermore, it is possible to set the controller to inverse control, meaning that if the setpoint is increased, the speed will be reduced. In the case of inverse control, the gain (K_p) must be set within the range from *–0.1* to *–20*.

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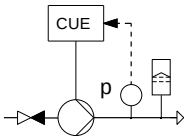
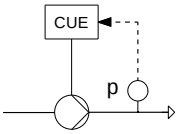
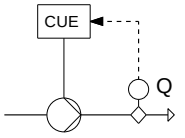
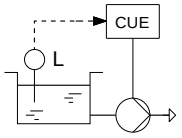
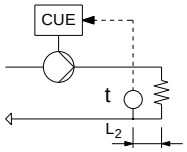
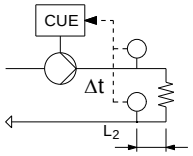
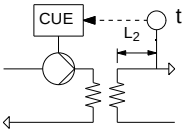
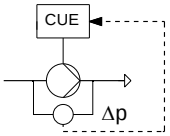
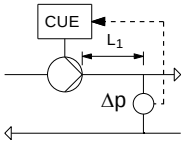
The table below shows the suggested controller settings:

System/application	K_p		T_i
	Heating system [1]	Cooling system [2]	
	0.2		0.5
	SP, SP-G, SP-NE: 0.5		0.5
	0.2		0.5
	SP, SP-G, SP-NE: 0.5		0.5
	0.2		0.5
	–2.5		100
	0.5	–0.5	$10 + 5L_2$
	0.5		$10 + 5L_2$
	0.5	–0.5	$30 + 5L_2$*
	0.5		0.5*
	0.5		L_1 < 5 m: 0.5* L_1 > 5 m: 3* L_1 > 10 m: 5*

* T_i = 100 seconds (factory setting).

1. Heating systems are systems in which an increase in pump performance will result in a **rise** in temperature at the sensor.
2. Cooling systems are systems in which an increase in pump performance will result in a **drop** in temperature at the sensor.

L_1 = Distance in [m] between pump and sensor.

L_2 = Distance in [m] between heat exchanger and sensor.

How to set the PI controller

For most applications, the factory setting of the controller constants K_p and T_i will ensure optimum pump operation. However, in some applications an adjustment of the controller may be needed.

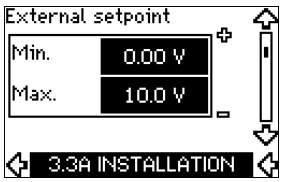
Proceed as follows:

1. Increase the gain (K_p) until the motor becomes unstable. Instability can be seen by observing if the measured value starts to fluctuate. Furthermore, instability is audible as the motor starts hunting up and down.
   As some systems, such as temperature controls, are slow-reacting, it may be difficult to observe that the motor is unstable.
2. Set the gain (K_p) to half the value of the value which made the motor unstable. This is the correct setting of the gain.
3. Reduce the integral time (T_i) until the motor becomes unstable.
4. Set the integral time (T_i) to twice the value which made the motor unstable. This is the correct setting of the integral time.

General rules of thumb:

- If the controller is too slow-reacting, increase K_p.
- If the controller is hunting or unstable, dampen the system by reducing K_p or increasing T_i.

10.7.3 External setpoint (3.3)



The input for external setpoint signal (terminal 53) can be set to the following types:

- *Active*
- ***Not active***.

If *Active* is selected, the actual setpoint is influenced by the signal connected to the external setpoint input. See section *13.2 External setpoint*.

10.7.4 Signal relays 1 and 2 (3.4 and 3.5)

The CUE has two signal relays. In the display below, select in which operating situations the signal relay should be activated.

Signal relay 1

- *Ready*
- ***Alarm***
- *Operation*
- *Pump running*
- *Not active*
- *Warning*
- *Relubricate*.

Signal relay 2

- *Ready*
- *Alarm*
- *Operation*
- *Pump running*
- *Not active*
- ***Warning***
- *Relubricate*.

Note ***For distinction between alarm and warning, see section 10.5.3 Fault indications.***

10.7.5 Buttons on the CUE (3.6)

The editing buttons (+, –, On/Off, OK) on the control panel can be set to these values:

- ***Active***
- *Not active.*

When set to *Not active* (locked), the editing buttons do not function. Set the buttons to *Not active* if the pump should be controlled via an external control system.

Activate the buttons by pressing the arrow up and arrow down buttons simultaneously for 3 seconds.

10.7.6 Protocol (3.7)

This display shows the protocol selection for the RS-485 port of the CUE. The protocol can be set to these values:

- ***GENIbus***
- *FC*
- *FC MC.*

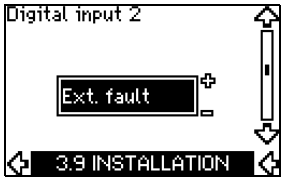
If *GENIbus* is selected, the communication is set according to the Grundfos GENIbus standard. FC and FC MC is for service purpose only.

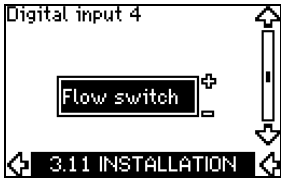
10.7.7 Pump number (3.8)

This display shows the GENIbus number. A number between 1 and 199 can be allocated to the pump. In the case of bus communication, a number must be allocated to each pump.

The factory setting is "–".

10.7.8 Digital inputs 2, 3 and 4 (3.9 to 3.11)





The digital inputs of the CUE (terminal 19, 32 and 33) can individually be set to different functions.

Select one of the following functions:

- *Min.* (min. curve)
- *Max.* (max. curve)
- *Ext. fault* (external fault)
- *Flow switch*
- *Alarm reset*
- *Dry running* (from external sensor)
- *Accumulated flow* (pulse flow, only terminal 33)
- *Not active.*

The selected function is active when the digital input is activated (closed contact). See also section *13.1 Digital inputs*.

Min.

When the input is activated, the pump will operate according to the min. curve.

Max.

When the input is activated, the pump will operate according to the max. curve.

Ext. fault

When the input is activated, a timer will be started. If the input is activated for more than 5 seconds, an external fault will be indicated. If the input is deactivated, the fault condition will cease and the pump can only be restarted manually by resetting the fault indication.

Flow switch

When this function is selected, the pump will be stopped when a connected flow switch detects low flow.

It is only possible to use this function if the pump is connected to a pressure sensor or a level sensor, and the stop function is activated. See sections *10.7.10* and *10.7.11*.

Alarm reset

When the input has been activated, the alarm is reset if the cause of the alarm no longer exists.

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Dry running

When this function is selected, lack of inlet pressure or water shortage can be detected. This requires the use of an accessory, such as:

- a Grundfos Liqtec® dry-running switch
- a pressure switch installed on the suction side of a pump
- a float switch installed on the suction side of a pump.

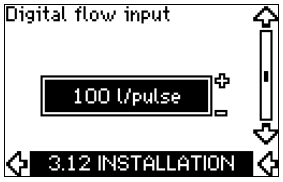
When lack of inlet pressure or water shortage (*Dry running)* is detected, the pump will be stopped. The pump cannot restart as long as the input is activated.

Restarts may be delayed by up to 30 minutes, depending on the pump family.

Accumulated flow

When this function is set for digital input 4 and a pulse sensor is connected to terminal 33, the accumulated flow can be measured.

10.7.9 Digital flow input (3.12)



This display appears only if a flowmeter has been configured in display 3.11.

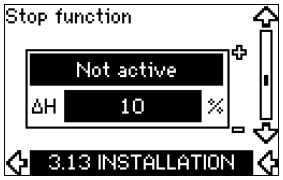
The display is used for setting the volume for every pulse for the function *Accumulated flow* with a pulse sensor connected to terminal 33.

Setting range:

- 0-265 gal/pulse (0-1000 litre/pulse).

The volume can be set in the unit selected in the start-up guide.

10.7.10 Constant pressure with stop function (3.13)



Settings

The stop function can be set to these values:

- *Active*
- ***Not active***.

The on/off band can be set to these values:

- ΔH is factory-set to **10 % of actual setpoint**.
- ΔH can be set within the range from 5 % to 30 % of the actual setpoint.

Operating conditions for the stop function

It is only possible to use the stop function if the system incorporates a pressure sensor, a check valve and a diaphragm tank.

Descriptions

The stop function is used for changing between on/off operation at low flow and continuous operation at high flow.

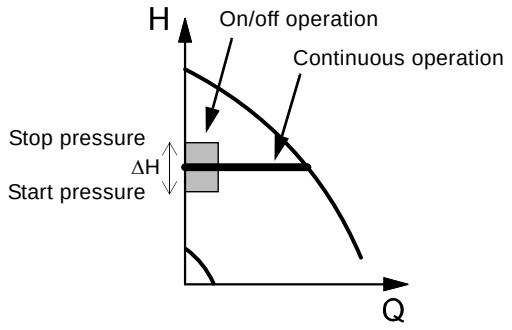


Fig. 50 Constant pressure with stop function. Difference between start and stop pressures (ΔH)

Low flow can be detected in two different ways:

1. A built-in "low-flow detection function" which functions if the digital input is not set up for flow switch.
2. A flow switch connected to the digital input.

1. Low-flow detection function

The pump will check the flow regularly by reducing the speed for a short time. If there is no or only a small change in pressure, this means that there is low flow.

The speed will be increased until the stop pressure (actual setpoint + 0.5 x ΔH) is reached and the pump will stop after a few seconds. The pump will restart at the latest when the pressure has fallen to the start pressure (actual setpoint – 0.5 x ΔH).

If the flow in the off period is higher than the low-flow limit, the pump will restart before the pressure has fallen to the start pressure.

When restarting, the pump will react in the following way:

1. If the flow is higher than the low-flow limit, the pump will return to continuous operation at constant pressure.
2. If the flow is lower than the low-flow limit, the pump will continue in start/stop operation. It will continue in start/stop operation until the flow is higher than the low-flow limit. When the flow is higher than the low-flow limit, the pump will return to continuous operation.

2. Low-flow detection with flow switch

When the digital input is activated because there is low-flow, the speed will be increased until the stop pressure (actual setpoint + 0.5 x ΔH) is reached, and the pump will stop. When the pressure has fallen to start pressure, the pump will start again. If there is still no flow, the pump will reach the stop pressure and stop. If there is flow, the pump will continue operating according to the setpoint.

The check valve must always be installed before the pressure sensor. See figs 51 and 52.

Caution ***If a flow switch is used to detect low flow, the switch must be installed on the system side after the diaphragm tank.***

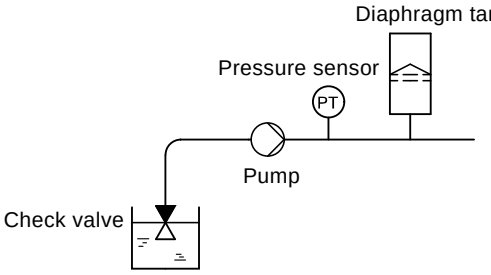


Fig. 51 Position of the check valve and pressure sensor in system with suction lift operation

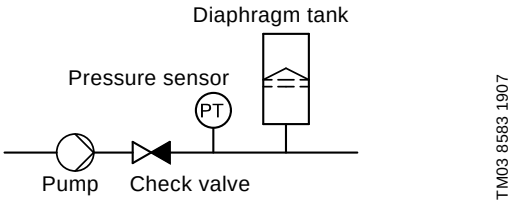


Fig. 52 Position of the check valve and pressure sensor in system with positive inlet pressure

Diaphragm tank

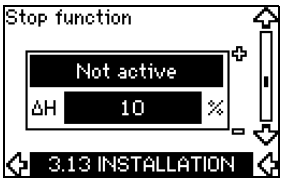
The stop function requires a diaphragm tank of a certain minimum size. The tank must be installed as close as possible after the pump and the precharge pressure must be 0.7 x actual setpoint.

Recommended diaphragm tank size:

Rated flow rate of pump [gpm]	Typical diaphragm tank size [gallons]
0-26	2
27-105	4.4
106-176	14
177-308	34
309-440	62

If a diaphragm tank of the above size is installed in the system, the factory setting of ΔH is the correct setting.
If the tank installed is too small, the pump will start and stop too often. This can be remedied by increasing ΔH.

10.7.11 Constant level with stop function (3.13)



Settings

The stop function can be set to these values:

- *Active*
- ***Not active***.

The on/off band can be set to these values:

- ΔH is factory-set to **10 % of actual setpoint**.
- ΔH can be set within the range from 5 % to 30 % of actual setpoint.

A built-in low-flow detection function will automatically measure and store the power consumption at approx. 50 % and 85 % of the rated speed.

If *Active* is selected, proceed as follows:

1. Close the isolating valve to create a no-flow condition.
2. Press OK to start the auto-tuning.

Operating conditions for the stop function

It is only possible to use the constant level stop function if the system incorporates a level sensor, and all valves can be closed.

Description

The stop function is used for changing between on/off operation at low flow and continuous operation at high flow.

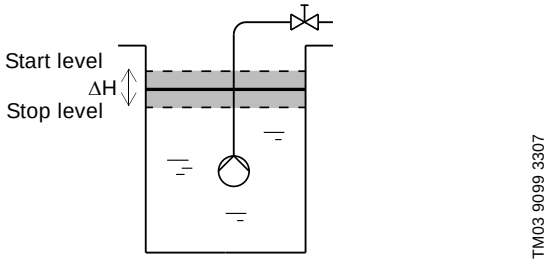


Fig. 53 Constant level with stop function. Difference between start and stop levels (ΔH)

Low flow can be detected in two different ways:

1. With the built-in low-flow detection function.
2. With a flow switch connected to a digital input.

1. Low-flow detection function

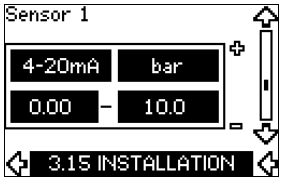
The built-in low-flow detection is based on the measurement of speed and power.

When low flow is detected, the pump will stop. When the level has reached the start level, the pump will start again. If there is still no flow, the pump will reach the stop level and stop. If there is flow, the pump will continue operating according to the setpoint.

2. Low-flow detection with flow switch

When the digital input is activated because of low flow, the speed will be increased until the stop level (actual setpoint – 0.5 x ΔH) is reached, and the pump will stop. When the level has reached the start level, the pump will start again. If there is still no flow, the pump will reach the stop level and stop. If there is flow, the pump will continue operating according to the setpoint.

10.7.12 Sensor 1 (3.15)



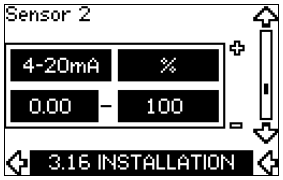
Setting of sensor 1 connected to terminal 54. This is the feedback sensor.

Select among the following values:

- Sensor output signal:
  0-20 mA
  4-20 mA.
- Unit of measurement of sensor:
  bar, mbar, m, kPa, psi, ft, m^3/h, m^3/s, l/s, gpm, °C, °F, %.
- Sensor measuring range.

US

10.7.13 Sensor 2 (3.16)



Setting of sensor 2 connected to an MCB 114 sensor input module.

Select among the following values:

- Sensor output signal:
  0-20 mA
  4-20 mA.
- Unit of measurement of sensor:
  bar, mbar, m, kPa, psi, ft, m^3/h, m^3/s, l/s, gpm, °C, °F, %.
- Sensor measuring range:
  0-100 %.

10.7.14 Duty/standby (3.17)

Settings

The duty/standby function can be set to these values:

- *Active*
- ***Not active***.

Activate the duty/standby function as follows:

1. Connect one of the pumps to the mains supply.
   Set the duty/standby function to *Not active*.
   Make the necessary settings in menu OPERATION and INSTALLATION.
2. Set the operating mode to *Stop* in menu OPERATION.
3. Connect the other pump to the mains supply.
   Make the necessary settings in menu OPERATION and INSTALLATION.
   Set the duty/standby function to *Active*.

The running pump will search for the other pump and automatically set the duty/standby function of this pump to *Active*. If it cannot find the other pump, a fault will be indicated.

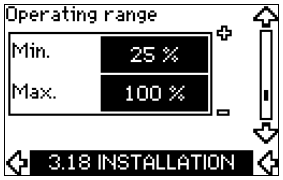
Note ***The two pumps must be connected electrically via the GENIbus, and nothing else must be connected on the GENIbus.***

The duty/standby function applies to two pumps connected in parallel and controlled via GENIbus. Each pump must be connected to its own CUE and sensor.

The primary targets of the function is the following:

- To start the standby pump if the duty pump is stopped due to an alarm.
- To alternate the pumps at least every 24 hours.

10.7.15 Operating range (3.18)



How to set the operating range:

- Set the min. speed within the range from a pump-dependent min. speed to the adjusted max. speed. The factory setting depends on the pump family.
- Set the max. speed within the range from adjusted min. speed to the pump-dependent maximum speed. The factory setting will be equal to 100 %, i.e. the speed stated on the pump nameplate.

The area between the min. and max. speed is the actual operating range of the pump.

The operating range can be changed by the user within the pump-dependent speed range.

For some pump families, oversynchronous operation (max. speed above 100 %) will be possible. This requires an oversize motor to deliver the shaft power required by the pump during oversynchronous operation.

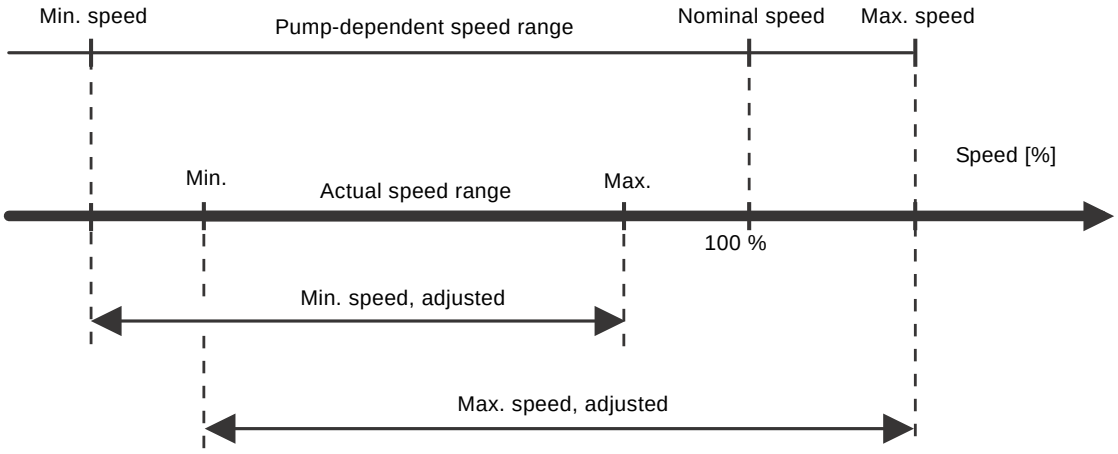


Fig. 54 Setting of the min. and max. curves in % of maximum performance

10.7.16 Motor bearing monitoring (3.19)

The motor bearing monitoring function can be set to these values:

- ***Active***
- *Not active.*

When the function is set to *Active*, the CUE will give a warning when the motor bearings are due to be relubricated or replaced.

Description

The motor bearing monitoring function is used to give an indication when it is time to relubricate or replace the motor bearings. See display 2.10 and 2.11.

The warning indication and the estimated time take into account if the pump has been running with reduced speed. Furthermore, the bearing temperature is included in the calculation if temperature sensors are installed and connected to an MCB 114 sensor input module.

Note ***The counter will continue counting even if the function is switched to Not active, but a warning will not be given when it is time for relubrication.***

10.7.17 Confirming relubrication/replacement of motor bearings (3.20)

This function can be set to these values:

- *Relubricated*
- *Replaced*
- ***Nothing done***.

When the motor bearings have been relubricated or replaced, confirm this action in the above display by pressing "OK".

Note ***Relubricated cannot be selected for a period of time after confirming relubrication.***

Relubricated

When the warning *Relubricate motor bearings* has been confirmed,

- the counter is set to 0.
- the number of relubrications is increased by 1.

When the number of relubrications has reached the permissible number, the warning *Replace motor bearings* appears in the display.

US

Replaced

When the warning *Replace motor bearings* has been confirmed,

- the counter is set to 0.
- the number of relubrications is set to 0.
- the number of bearing changes is increased by 1.

10.7.18 Temperature sensor 1 (3.21)

This display is only shown if an MCB 114 sensor input module has been installed.

Select the function of a Pt100/Pt1000 temperature sensor 1 connected to an MCB 114:

- *D-end bearing*
- *ND-end bearing*
- *Other liq. temp. 1*
- *Other liq. temp. 2*
- *Motor winding*
- *Pumped liq. temp.*
- *Ambient temp.*
- *Not active.*

10.7.19 Temperature sensor 2 (3.22)

This display is only shown if an MCB 114 sensor input module has been installed.

Select the function of a Pt100/Pt1000 temperature sensor 2 connected to an MCB 114:

- *D-end bearing*
- *ND-end bearing*
- *Other liq. temp. 1*
- *Other liq. temp. 2*
- *Motor winding*
- *Pumped liq. temp.*
- *Ambient temp.*
- *Not active.*

10.7.20 Standstill heating (3.23)

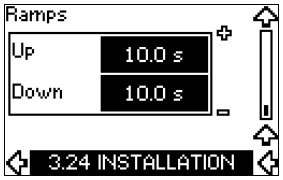
The standstill heating function can be set to these values:

- *Active*
- ***Not active***.

When the function is set to *Active* and the pump is stopped by a stop command, a current will be applied to the motor windings.

The standstill heating function pre-heats the motor to avoid condensation.

10.7.21 Ramps (3.24)



Set the time for each of the two ramps, ramp-up and ramp-down:

- Factory setting:
  Depending on power size.
- The range of the ramp parameter:
  1-3600 s.

The ramp-up time is the acceleration time from 0 rpm to the rated motor speed. Choose a ramp-up time such that the output current does not exceed the maximum current limit for the CUE.

The ramp-down time is the deceleration time from rated motor speed to 0 rpm. Choose a ramp-down time such that no overvoltage arises and such that the generated current does not exceed the maximum current limit for the CUE.

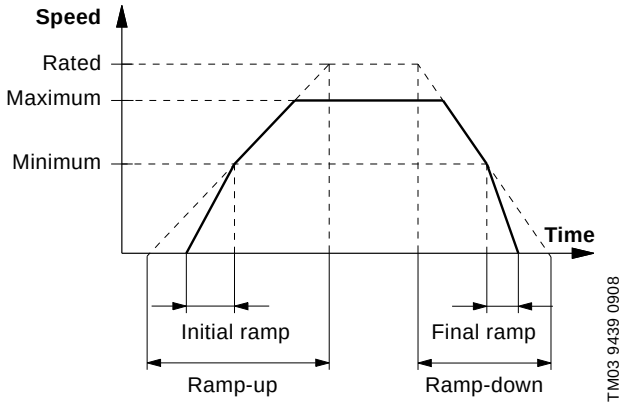


Fig. 55 Ramp-up and ramp-down, display 3.24

11. Setting by means of PC Tool E-products

Special setup requirements differing from the settings available via the CUE require the use of Grundfos PC Tool E-products. This again requires the assistance of a Grundfos service technician or engineer. Contact your local Grundfos company for more information.

12. Priority of settings

The On/Off button has the highest priority. In "off" condition, pump operation is not possible.

The CUE can be controlled in various ways at the same time. If two or more operating modes are active at the same time, the operating mode with the highest priority will be in force.

12.1 Control without bus signal, local operating mode

Priority	CUE menu	External signal
1	Stop	
2	Max.	
3		Stop
4		Max.
5	Min.	Min.
6	Normal	Normal

Example: If an external signal has activated the operating mode *Max.*, it will only be possible to stop the pump.

12.2 Control with bus signal, remote-controlled operating mode

Priority	CUE menu	External signal	Bus signal
1	Stop		
2	Max.		
3		Stop	Stop
4			Max.
5			Min.
6			Normal

Example: If the bus signal has activated the operating mode *Max.*, it will only be possible to stop the pump.

13. External control signals

13.1 Digital inputs

The overview shows functions in connection with closed contact.

Terminal	Type	Function
18	DI 1	• *Start/stop of pump*
19	DI 2	• *Min.* (min. curve) • *Max.* (max. curve) • *Ext. fault* (external fault) • *Flow switch* • *Alarm reset* • *Dry running* (from external sensor) • *Not active.*
32	DI 3	• *Min.* (min. curve) • *Max.* (max. curve) • *Ext. fault* (external fault) • *Flow switch* • *Alarm reset* • *Dry running* (from external sensor) • *Not active.*
33	DI 4	• *Min.* (min. curve) • *Max.* (max. curve) • *Ext. fault* (external fault) • *Flow switch* • *Alarm reset* • *Dry running* (from external sensor) • *Accumulated flow* (pulse flow) • *Not active.*

The same function must not be selected for more than one input. See fig. 21.

13.2 External setpoint

Terminal	Type	Function
53	AI 1	• *External setpoint (0-10 V)*

The setpoint can be remote-set by connecting an analog signal transmitter to the setpoint input (terminal 53).

Open loop

In control mode *Open loop* (constant curve), the actual setpoint can be set externally within the range from the min. curve to the setpoint set via the CUE menu. See fig. 56.

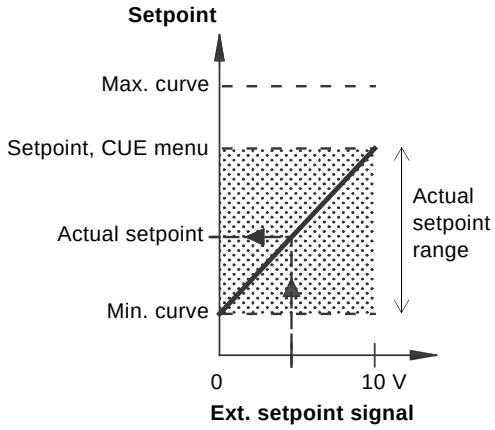


Fig. 56 Relation between the actual setpoint and the external setpoint signal in control mode Open loop

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Closed loop

In all other control modes, except proportional differential pressure, the actual setpoint can be set externally within the range from the lower value of the sensor measuring range (sensor min.) to the setpoint set via the CUE menu. See fig. 57.

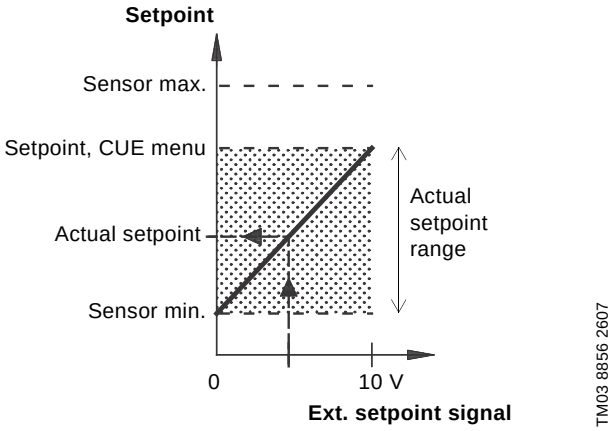

Fig. 57 Relation between the actual setpoint and the external setpoint signal in control mode Controlled

Example: At a sensor min. value of 0 bar, a setpoint set via the CUE menu of 3 bar and an external setpoint of 80 %, the actual setpoint will be as follows:

Actual setpoint = (setpoint set via the CUE menu – sensor min.) x % external setpoint signal + sensor min.

= (3 – 0) x 80 % + 0

= 2.4 bar.

Proportional differential pressure

In control mode *Proportional differential pressure,* the actual setpoint can be set externally within the range from 25 % of maximum head to the setpoint set via the CUE menu. See fig. 58.

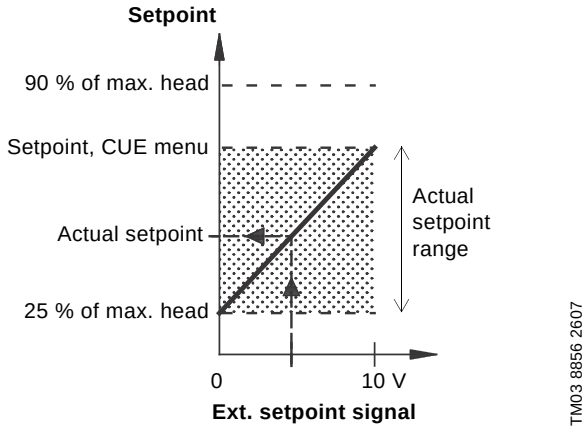

Fig. 58 Relation between the actual setpoint and the external setpoint signal in control mode Proportional differential pressure

Example: At a maximum head of 12 metres, a setpoint of 6 metres set via the CUE menu and an external setpoint of 40 %, the actual setpoint will be as follows:

Actual setpoint = (setpoint, CUE menu – 25 % of maximum head) x % external setpoint signal + 25 % of maximum head

= (6 – 12 x 25 %) x 40 % + 12/4

= 4.2 m.

13.3 GENIbus signal

The CUE supports serial communication via an RS-485 input. The communication is carried out according to the Grundfos GENIbus protocol and enables connection to a building management system or another external control system.

Operating parameters, such as setpoint and operating mode can be remote-set via the bus signal. At the same time, the pump can provide status information about important parameters, such as actual value of control parameter, input power and fault indications.

Contact Grundfos for further details.

Note ***If a bus signal is used, the number of settings available via the CUE will be reduced.***

13.4 Other bus standards

Grundfos offers various bus solutions with communication according to other standards.

Contact Grundfos for further details.

14. Maintenance and service

14.1 Cleaning the CUE

Keep the cooling fins and fan blades clean to ensure sufficient cooling of the CUE.

14.2 Service parts and service kits

For further information on service parts and service kits, visit www.grundfos.com > International website > WebCAPS.

15. Troubleshooting

15.1 Warning and alarm list

Code	Display text	Status: Warning	Status: Alarm	Status: Locked alarm	Operating mode	Resetting
1	Too high leakage current			●	Stop	Man.
2	Mains phase failure		●		Stop	Aut.
3	External fault		●		Stop	Man.
16	Other fault		●		Stop	Aut.
				●	Stop	Man.
30	Replace motor bearings	●			–	Man.[3]
32	Overvoltage	●			–	Aut.
			●		Stop	Aut.
40	Undervoltage	●			–	Aut.
			●		Stop	Aut.
48	Overload		●		Stop	Aut.
				●	Stop	Man.
49	Overload		●		Stop	Aut.
55	Overload	●			–	Aut.
			●		Stop	Aut.
57	Dry running		●		Stop	Aut.
64	Too high CUE temperature		●		Stop	Aut.
70	Too high motor temperature		●		Stop	Aut.
77	Communication fault, duty/standby	●			–	Aut.
89	Sensor 1 outside range		●		[1]	Aut.
91	Temperature sensor 1 outside range	●			–	Aut.
93	Sensor 2 outside range	●			–	Aut.
96	Setpoint signal outside range		●		[1]	Aut.
148	Too high bearing temperature	●			–	Aut.
			●		Stop	Aut.
149	Too high bearing temperature	●			–	Aut.
			●		Stop	Aut.
155	Inrush fault		●		Stop	Aut.
175	Temperature sensor 2 outside range	●			–	Aut.
240	Relubricate motor bearings	●			–	Man.[3]
241	Motor phase failure	●			–	Aut.
			●		Stop	Aut.
242	AMA[2] did not succeed	●			–	Man.

[1] In case of an alarm, the CUE will change the operating mode depending on the pump type.

[2] AMA, Automatic Motor Adaptation. Not active in the present software.

[3] Warning is reset in display 3.20.

15.2 Resetting of alarms

In case of fault or malfunction of the CUE, check the alarm list in menu OPERATION. The latest five alarms and latest five warnings can be found in the log menus.

Contact a Grundfos technician if an alarm occurs repeatedly.

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15.2.1 Warning

The CUE will continue the operation as long as the warning is active. The warning remains active until the cause no longer exists. Some warnings may switch to alarm condition.

15.2.2 Alarm

In case of an alarm, the CUE will stop the pump or change the operating mode depending on the alarm type and pump type. See section *15.1 Warning and alarm list*.

Pump operation will be resumed when the cause of the alarm has been remedied and the alarm has been reset.

Resetting an alarm manually

- Press OK in the alarm display.
- Press On/Off twice.
- Activate a digital input DI 2-DI 4 set to *Alarm reset* or the digital input DI 1 (*Start/stop)*.

If it is not possible to reset an alarm, the reason may be that the fault has not been remedied, or that the alarm has been locked.

15.2.3 Locked alarm

In case of a locked alarm, the CUE will stop the pump and become locked. Pump operation cannot be resumed until the cause of the locked alarm has been remedied and the alarm has been reset.

Resetting a locked alarm

- Switch off the power supply to the CUE for approx. 30 seconds. Switch on the power supply, and press OK in the alarm display to reset the alarm.

15.3 Indicator lights

The table show the function of the indicator lights.

Indicator light	Function
On (green)	The pump is running or has been stopped by a stop function.
	If flashing, the pump has been stopped by the user (CUE menu), external start/stop or bus.
Off (orange)	The pump has been stopped with the On/Off button.
Alarm (red)	Indicates an alarm or a warning.

15.4 Signal relays

The table show the function of the signal relays.

Type	Function	
Relay 1	• *Ready*	• *Pump running*
	• ***Alarm***	• *Warning*
	• *Operation*	• *Relubricate.*
Relay 2	• *Ready*	• *Pump running*
	• *Alarm*	• ***Warning***
	• *Operation*	• *Relubricate.*

See also fig. 30.

US

16. Technical data

16.1 Enclosure

The individual CUE cabinet sizes are characterised by their enclosures. The table shows the relationship of enclosure class and enclosure type.

Example:

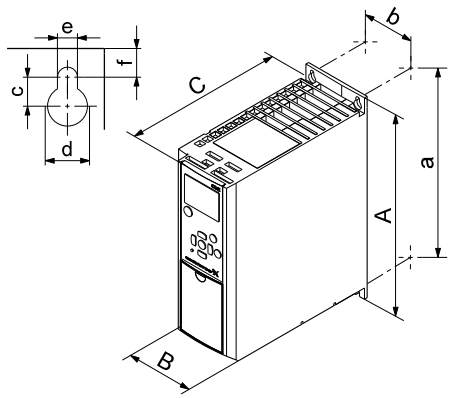
Read from the nameplate:

- Supply voltage = 3 x 380-500 V.
- Typical shaft power = 1.5 kW.
- Enclosure class = IP20.

The table shows that the CUE enclosure is A2.

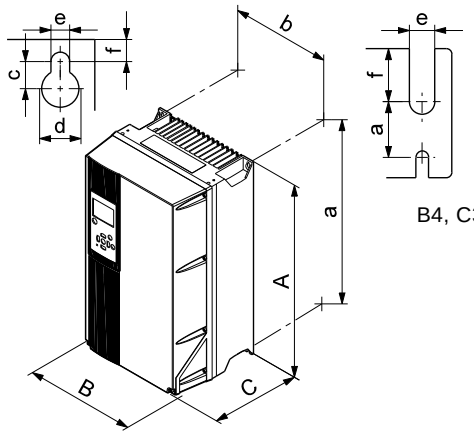
Typical shaft power P2		Enclosure class and type									
		1 x 200-240 V			3 x 200-240 V		3 x 380-500 V		3 x 525-600 V		3 x 525-690 V	
[kW]	[HP]	IP20 NEMA0	IP21 NEMA1	IP55 NEMA12	IP20 NEMA0	IP55 NEMA12	IP20 NEMA0	IP55 NEMA12	IP20 NEMA0	IP55 NEMA12	IP21 NEMA1	IP55 NEMA12
0.55	0.75											
0.75	1											
1.1	1.5	A3		A5	A2	A5	A2	A5	A3	A5		
1.5	2		B1	B1								
2.2	3											
3	4				A3							
3.7	5											
4	5						A2	A5	A3	A5		
5.5	7.5		B1	B1	B3	B1	A3					
7.5	10		B2	B2								
11	15						B3	B1			B2	B2
15	20				B4	B2						
18.5	25					C1						
22	30				C3		B4	B2				
30	40											
37	50				C4	C2		C1			C2	C2
45	60						C3					
55	75											
75	100						C4	C2				
90	125											

16.2 Main dimensions and weight



TM03 9000 2807

Fig. 59 Enclosures A2 and A3



TM03 9002 2807

Fig. 60 Enclosures A5, B1, B2, B3, B4, C1, C2, C3 and C4

Enclosure	Height [in] 1)		Width [in] 1)		Depth [in] 1)		Screw holes [in]				Weight [lb]
	A	a	B	b	C	C 2)	c	∅d	∅e	f	
A2	10.6	10.1	3.5	2.8	8.1	8.6	0.31	0.43	0.22	0.35	10.8
with IP21/NEMA1 option	14.8	13.8	3.5	2.8	8.1	8.6	0.31	0.43	0.22	0.35	11.7
A3	10.6	10.1	5.1	4.3	8.1	8.6	0.31	0.43	0.22	0.35	14.6
with IP21/NEMA1 option	14.8	13.8	5.1	4.3	8.1	8.6	0.31	0.43	0.22	0.35	15.4
A5	16.5	15.8	9.5	8.5	7.9	7.9	0.32	0.47	0.26	0.35	30.9
B1	18.9	17.9	9.5	8.3	10.2	10.2	0.47	0.75	0.35	0.35	50.7
B2	25.6	24.6	9.5	8.3	10.2	10.2	0.47	0.75	0.35	0.35	59.5
B3	15.7	15.0	6.5	5.5	9.8	10.3	0.31	0.47	0.27	0.31	26.5
with IP21/NEMA1 option	18.7	–	6.5	–	9.8	10.3	0.31	0.47	0.27	0.31	–
B4	20.5	19.5	9.1	7.9	9.5	9.5	–	–	0.33	0.59	51.8
with IP21/NEMA1 option	26.4	–	10.0	–	9.7	9.7	–	–	0.33	0.59	–
C1	26.8	25.5	12.1	10.7	12.2	12.2	0.47	0.75	0.35	0.39	99.2
C2	30.3	29.1	14.6	13.1	13.2	13.2	0.47	0.75	0.35	0.39	143
C3	21.7	20.5	12.1	10.6	13.1	13.1	–	–	0.33	0.67	77.2
with IP21/NEMA1 option	29.7	–	13.0	–	13.3	13.3	–	–	0.33	0.67	–
C4	26.0	24.8	14.6	13.0	13.1	13.1	–	–	0.33	0.67	110
with IP21/NEMA1 option	37.4	–	15.4	–	13.3	13.3	–	–	0.33	0.67	–

1) The dimensions are maximum height, width and depth. Dimensions are without options.

16.3 Surroundings

Relative humidity	5-95 % RH
Ambient temperature	Max. 122 °F
Average ambient temperature over 24 hours	Max. 113 °F
Minimum ambient temperature at full operation	32 °F
Minimum ambient temperature at reduced operation	14 °F
Temperature during storage and transportation	–13 to 149 °F
Storage duration	Max. 6 months
Maximum altitude above sea level without performance reduction	3280 ft
Maximum altitude above sea level with performance reduction	9840 ft

Note ***The CUE comes in a packaging which is not suitable for outdoor storage.***

16.4 Terminal tightening torques

Enclosure type	Tightening torque [lb-ft]			
	Mains	Motor	Ground	Relay
A2	1.3	1.3	2.2	0.4
A3	1.3	1.3	2.2	0.4
A5	1.3	1.3	2.2	0.4
B1	1.3	1.3	2.2	0.4
B2	3.3	3.3	2.2	0.4
B3	1.3	1.3	2.2	0.4
B4	3.3	3.3	2.2	0.4
C1	7.4	7.4	2.2	0.4
C2	10.3 1) / 17.7 2)	10.3 1) / 17.7 2)	2.2	0.4
C3	7.4	7.4	2.2	0.4
C4	10.3 1) / 17.7 2)	10.3 1) / 17.7 2)	2.2	0.4

1) Conductor gauge size ≤ 4/0 AWG.
2) Conductor gauge size ≥ 4/0 AWG.

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16.5 Cable length

Maximum length, screened motor cable	500 ft
Maximum length, unscreened motor cable	1000 ft
Maximum length, signal cable	1000 ft

16.6 Fuses and cable gauge size

Warning

Always comply with national and local regulations as to cable gauge sizes.

16.6.1 Cable gauge size to signal terminals

Maximum cable gauge size to signal terminals, rigid conductor	14 AWG
Maximum cable gauge size to signal terminals, flexible conductor	18 AWG
Minimum cable gauge size to signal terminals	20 AWG

16.6.2 Non-UL fuses and conductor cross-section (gauge size) to mains and motor

Typical shaft power P2	Maximum fuse size	Fuse type	Maximum conductor cross-section [1]
[kW]	[A]		[mm^2]
1 x 200-240 V			
1.1	20	gG	4
1.5	30	gG	10
2.2	40	gG	10
3	40	gG	10
3.7	60	gG	10
5.5	80	gG	10
7.5	100	gG	35
3 x 200-240 V			
0.75	10	gG	4
1.1	20	gG	4
1.5	20	gG	4
2.2	20	gG	4
3	32	gG	4
3.7	32	gG	4
5.5	63	gG	10
7.5	63	gG	10
11	63	gG	10
15	80	gG	35
18.5	125	gG	50
22	125	gG	50
30	160	gG	50
37	200	aR	95
45	250	aR	120
3 x 380-500 V			
0.55	10	gG	4
0.75	10	gG	4
1.1	10	gG	4
1.5	10	gG	4
2.2	20	gG	4
3	20	gG	4
4	20	gG	4
5.5	32	gG	4
7.5	32	gG	4
11	63	gG	10
15	63	gG	10
18.5	63	gG	10
22	63	gG	35
30	80	gG	35
37	100	gG	50
45	125	gG	50
55	160	gG	50
75	250	aR	95
90	250	aR	120
3 x 525-600 V			
0.75	10	gG	4
1.1	10	gG	4
1.5	10	gG	4
2.2	20	gG	4
3	20	gG	4
4	20	gG	4
5.5	32	gG	4
7.5	32	gG	4
3 x 525-690 V			
11	63	gG	35
15	63	gG	35
18.5	63	gG	35
22	63	gG	35
30	63	gG	35
37	80	gG	95
45	100	gG	95
55	125	gG	95
75	160	gG	95
90	160	gG	95

[1] Screened motor cable, unscreened supply cable. AWG, see section *16.6.3*.

16.6.3 UL fuses and conductor cross-section (gauge size) to mains and motor

Typical shaft power P2	Fuse type							Maximum conductor cross-section [1]
[kW]	Bussmann RK1	Bussmann J	Bussmann T	SIBA RK1	Littel Fuse RK1	Ferraz-Shawmut CC	Ferraz-Shawmut RK1	[AWG] [2]
1 x 200-240 V								
1.1	KTN-R20	–	–	–	–	–	–	10
1.5	KTN-R30	–	–	–	–	–	–	7
2.2	KTN-R40	–	–	–	–	–	–	7
3	KTN-R40	–	–	–	–	–	–	7
3.7	KTN-R60	–	–	–	–	–	–	7
5.5	–	–	–	–	–	–	–	7
7.5	–	–	–	–	–	–	–	2
3 x 200-240 V								
0.75	KTN-R10	JKS-10	JJN-10	5017906-010	KTN-R10	ATM-R10	A2K-10R	10
1.1	KTN-R20	JKS-20	JJN-20	5017906-020	KTN-R20	ATM-R20	A2K-20R	10
1.5	KTN-R20	JKS-20	JJN-20	5017906-020	KTN-R20	ATM-R20	A2K-20R	10
2.2	KTN-R20	JKS-20	JJN-20	5017906-020	KTN-R20	ATM-R20	A2K-20R	10
3	KTN-R30	JKS-30	JJN-30	5012406-032	KTN-R30	ATM-R30	A2K-30R	10
3.7	KTN-R30	JKS-30	JJN-30	5012406-032	KTN-R30	ATM-R30	A2K-30R	10
5.5	KTN-R50	JKS-50	JJN-50	5012406-050	KLN-R50	–	A2K-50R	7
7.5	KTN-R50	JKS-60	JJN-60	5012406-050	KLN-R60	–	A2K-50R	7
11	KTN-R60	JKS-60	JJN-60	5014006-063	KLN-R60	A2K-60R	A2K-60R	7
15	KTN-R80	JKS-80	JJN-80	5014006-080	KLN-R80	A2K-80R	A2K-80R	2
18.5	KTN-R125	JKS-150	JJN-125	2028220-125	KLN-R125	A2K-125R	A2K-125R	1/0
22	KTN-R125	JKS-150	JJN-125	2028220-125	KLN-R125	A2K-125R	A2K-125R	1/0
30	FWX-150	–	–	2028220-150	L25S-150	A25X-150	A25X-150	1/0
37	FWX-200	–	–	2028220-200	L25S-200	A25X-200	A25X-200	4/0
45	FWX-250	–	–	2028220-250	L25S-250	A25X-250	A25X-250	250 MCM
3 x 380-500 V								
0.55	KTS-R10	JKS-10	JJS-10	5017906-010	KTN-R10	ATM-R10	A2K-10R	10
0.75	KTS-R10	JKS-10	JJS-10	5017906-010	KTN-R10	ATM-R10	A2K-10R	10
1.1	KTS-R10	JKS-10	JJS-10	5017906-010	KTN-R10	ATM-R10	A2K-10R	10
1.5	KTS-R10	JKS-10	JJS-10	5017906-010	KTN-R10	ATM-R10	A2K-10R	10
2.2	KTS-R20	JKS-20	JJS-20	5017906-020	KTN-R20	ATM-R20	A2K-20R	10
3	KTS-R20	JKS-20	JJS-20	5017906-020	KTN-R20	ATM-R20	A2K-20R	10
4	KTS-R20	JKS-20	JJS-20	5017906-020	KTN-R20	ATM-R20	A2K-20R	10
5.5	KTS-R30	JKS-30	JJS-30	5012406-032	KTN-R30	ATM-R30	A2K-30R	10
7.5	KTS-R30	JKS-30	JJS-30	5012406-032	KTN-R30	ATM-R30	A2K-30R	10
11	KTS-R40	JKS-40	JJS-40	5014006-040	KLS-R40	–	A6K-40R	7
15	KTS-R40	JKS-40	JJS-40	5014006-040	KLS-R40	–	A6K-40R	7
18.5	KTS-R50	JKS-50	JJS-50	5014006-050	KLS-R50	–	A6K-50R	7
22	KTS-R60	JKS-60	JJS-60	5014006-063	KLS-R60	–	A6K-60R	2
30	KTS-R80	JKS-80	JJS-80	2028220-100	KLS-R80	–	A6K-80R	2
37	KTS-R100	JKS-100	JJS-100	2028220-125	KLS-R100	–	A6K-100R	1/0
45	KTS-R125	JKS-150	JJS-150	2028220-125	KLS-R125	–	A6K-125R	1/0
55	KTS-R150	JKS-150	JJS-150	2028220-160	KLS-R150	–	A6K-150R	1/0
75	FWH-220	–	–	2028220-200	L50S-225	–	A50-P225	4/0
90	FWH-250	–	–	2028220-250	L50S-250	–	A50-P250	250 MCM
3 x 525-600 V								
0.75	KTS-R10	JKS-10	JJS-10	5017906-010	KTN-R10	ATM-R10	A2K-10R	10
1.1	KTS-R10	JKS-10	JJS-10	5017906-010	KTN-R10	ATM-R10	A2K-10R	10
1.5	KTS-R10	JKS-10	JJS-10	5017906-010	KTN-R10	ATM-R10	A2K-10R	10
2.2	KTS-R20	JKS-20	JJS-20	5017906-020	KTN-R20	ATM-R20	A2K-20R	10
3	KTS-R20	JKS-20	JJS-20	5017906-020	KTN-R20	ATM-R20	A2K-20R	10
4	KTS-R20	JKS-20	JJS-20	5017906-020	KTN-R20	ATM-R20	A2K-20R	10
5.5	KTS-R30	JKS-30	JJS-30	5012406-032	KTN-R30	ATM-R30	A2K-30R	10
7.5	KTS-R30	JKS-30	JJS-30	5012406-032	KTN-R30	ATM-R30	A2K-30R	10
3 x 525-690 V								
11	KTS-R-25	JKS-25	JJS-25	5017906-025	KLSR025	HST25	A6K-25R	1/0
15	KTS-R-30	JKS-30	JJS-30	5017906-030	KLSR030	HST30	A6K-30R	1/0
18.5	KTS-R-45	JKS-45	JJS-45	5014006-050	KLSR045	HST45	A6K-45R	1/0
22	KTS-R-45	JKS-45	JJS-45	5014006-050	KLSR045	HST45	A6K-45R	1/0
30	KTS-R-60	JKS-60	JJS-60	5014006-063	KLSR060	HST60	A6K-60R	1/0
37	KTS-R-80	JKS-80	JJS-80	5014006-080	KLSR075	HST80	A6K-80R	1/0
45	KTS-R-90	JKS-90	JJS-90	5014006-100	KLSR090	HST90	A6K-90R	1/0
55	KTS-R-100	JKS-100	JJS-100	5014006-100	KLSR100	HST100	A6K-100R	1/0
75	KTS-R125	JKS-125	JJS-125	2028220-125	KLS-125	HST125	A6K-125R	1/0
90	KTS-R150	JKS-150	JJS-150	2028220-150	KLS-150	HST150	A6K-150R	1/0

[1] Screened motor cable, unscreened supply cable.

[2] American Wire Gauge.

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16.7 Inputs and outputs

16.7.1 Mains supply (L1, L2, L3)

Supply voltage	200-240 V ± 10 %
Supply voltage	380-500 V ± 10 %
Supply voltage	525-600 V ± 10 %
Supply voltage	525-690 V ± 10 %
Supply frequency	50/60 Hz
Maximum temporary imbalance between phases	3 % of rated value
Leakage current to ground	> 3.5 mA
Number of cut-ins, enclosure A	Max. 2 times/min.
Number of cut-ins, enclosures B and C	Max. 1 time/min.

Note ***Do not use the power supply for switching the CUE on and off.***

16.7.2 Motor output (U, V, W)

Output voltage	0-100 % [1]
Output frequency	0-100 Hz [2]
Switching on output	Not recommended

[1] Output voltage in % of supply voltage.
[2] Depending on the pump family selected.

16.7.3 RS-485 GENIbus connection

Terminal number	68 (A), 69 (B), 61 GND (Y)

The RS-485 circuit is functionally separated from other central circuits and galvanically separated from the supply voltage (PELV).

16.7.4 Digital inputs

Terminal number	18, 19, 32, 33
Voltage level	0-24 VDC
Voltage level, open contact	> 19 VDC
Voltage level, closed contact	< 14 VDC
Maximum voltage on input	28 VDC
Input resistance, R_i	Approx. 4 kΩ

All digital inputs are galvanically separated from the supply voltage (PELV) and other high-voltage terminals.

16.7.5 Signal relays

Relay 01, terminal number	1 (C), 2 (NO), 3 (NC)
Relay 02, terminal number	4 (C), 5 (NO), 6 (NC)
Maximum terminal load (AC-1) [1]	240 VAC, 2 A
Maximum terminal load (AC-15) [1]	240 VAC, 0.2 A
Maximum terminal load (DC-1) [1]	50 VDC, 1 A
Minimum terminal load	24 V DC 10 mA 24 V AC 20 mA

[1] IEC 60947, parts 4 and 5.

C = Common
NO = Normally open
NC = Normally closed

The relay contacts are galvanically separated from other circuits by reinforced insulation (PELV).

16.7.6 Analog inputs

Analog input 1, terminal number	53
Voltage signal	A53 = "U" [1]
Voltage range	0-10 V
Input resistance, R_i	Approx. 10 kΩ
Maximum voltage	± 20 V
Current signal	A53 = "I" [1]
Current range	0-20, 4-20 mA
Input resistance, R_i	Approx. 200 Ω
Maximum current	30 mA
Maximum fault, terminals 53, 54	0.5 % of full scale
Analog input 2, terminal number	54
Current signal	A54 = "I" [1]
Current range	0-20, 4-20 mA
Input resistance, R_i	Approx. 200 Ω
Maximum current	30 mA
Maximum fault, terminals 53, 54	0.5 % of full scale

[1] The factory setting is voltage signal "U".

All analog inputs are galvanically separated from the supply voltage (PELV) and other high-voltage terminals.

16.7.7 Analog output

Analog output 1, terminal number	42
Current range	0-20 mA
Maximum load to ground	500 Ω
Maximum fault	0.8 % of full scale

The analog output is galvanically separated from the supply voltage (PELV) and other high-voltage terminals.

16.7.8 MCB 114 sensor input module

Analog input 3, terminal number	2
Current range	0/4-20 mA
Input resistance	< 200 Ω
Analog inputs 4 and 5, terminal number	4, 5 and 7, 8
Signal type, 2- or 3-wire	Pt100/Pt1000

Note ***When using Pt100 with 3-wire cable, the resistance must not exceed 30 Ω.***

16.8 Sound pressure level

The sound pressure of the CUE is maximum 70 dB(A).

The sound pressure level of a motor controlled by a variable frequency drive may be higher than that of a corresponding motor which is not controlled by a variable frequency drive. See section *6.7 RFI filters*.

17. Disposal

This product or parts of it must be disposed of in an environmentally sound way:

1. Use the public or private waste collection service.
2. If this is not possible, contact the nearest Grundfos company or service workshop.

Subject to alterations.

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