Operating Instructions

Heatable pressure calibrator

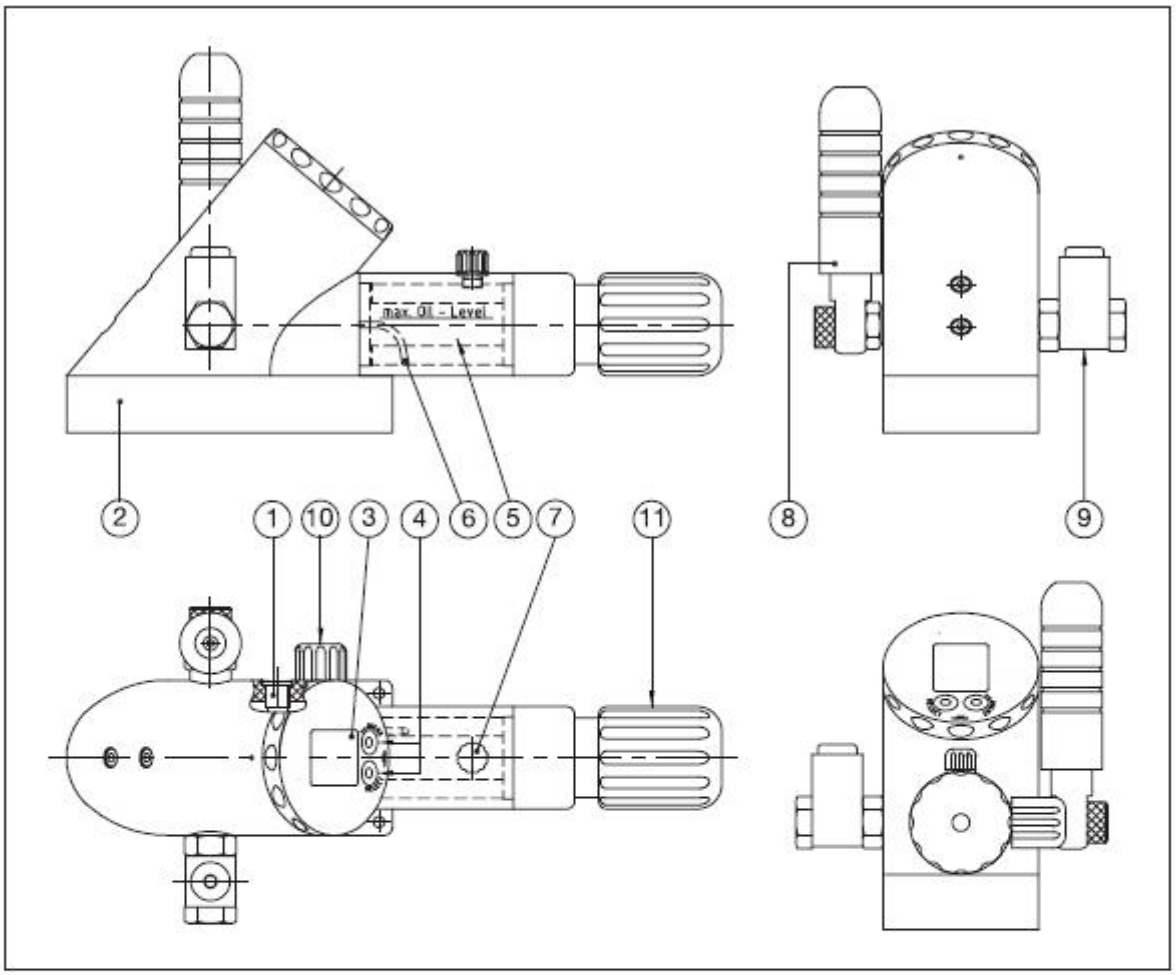
PPS1210

CE

Certified to
ISO 9001:2008

Please read this instruction manual carefully before installing the transducer.

Version 1.0



1 Port for interface cable (K-104A or K-114A)
(PC connection / RS485)
2 Device base
3 Display
4 SELECT and ENTER buttons
5 Oil chamber
6 Recirculation pipe
7 Screwed sealing plug
8 Manual booster pump
9 Pressure connection for test object, without overpressure valve
(700 bar)
10 Drain valve
11 Screw compressor

Notes on the operating instructions

- The operating instructions are intended for specialist workers and trained personnel.
- Before each stage of work, read the relevant notes and warnings carefully, and keep to the sequence as stated.
- Pay particular attention to the section on "General safety warnings".

1. Description of the device

General description

The high pressure calibrator enables pressure to be generated by means of the integrated pressure pump, up to 700 bar relative.
The measurement technology incorporated into this device allows accurate measurement and documentation of the characteristic of a test object that is connected to it. The measured pressure progression can be displayed, evaluated and saved with a computer monitoring program (CCS30).
The calibrator is operated with the two function buttons SELECT and ENTER, located directly below the display. The calibrator itself is powered by a 3,0 V battery, but power can also be supplied externally via the K-114A interface converter. Test objects (transmitters or pressure switches) must be supplied from an external source.

Pressure range for the display

High pressure calibrators are themselves calibrated with the ambient air pressure as the zero point reference. The Zero function (*SET ZERO*) allows any desired pressure value to be set as the new zero point reference.
To reset the pressure zero point to the factory setting, use the *RES ZERO* function (reset zero).

Commissioning

A pressure-resistant connection for the test object is required in order to use the high pressure calibrator. The pressure connection for the test object is already screwed to the pressure distributor of the high pressure calibrator so that it is pressure resistant when it leaves the factory, and it must not be dismantled.
Recommended torque for the test object pressure connection: 30 Nm

IMPORTANT!
Nothing must adhere to the surface of the test object (no oil, grease, water, etc). Impurities could pass through the adapter to reach the high pressure calibrator and damage it.

Overpressure

If the pressure exceeds the measuring range by more than 20%, the measuring cell or the mechanism of the high pressure calibrator may be destroyed.

Recalibration

The recalibration cycle depends on the conditions of use. Recommended recalibration cycle: 1 year.

Intended use

The high pressure calibrator (HPX) may only be used to generate pressure with the type HLP 22 BP hydraulic oil that is supplied with the product. Use of the calibrator with other media will damage it. The operational safety of the device supplied is guaranteed only if it is used as intended. The limit values as stated (see page 19: "Technical data") must never be exceeded.

Before installing the high pressure calibrator, check that it is suitable for your applications.

2. General safety warnings

The current national regulations on accident prevention and workplace

Scope of delivery
High pressure calibrator

safety must be followed whenever work is carried out. Internal regulations issued by the operator must be followed, even if they are not mentioned in these instructions.

Never use the high pressure calibrator together with an external pressure source.

Do not remove any connected components (e.g. test objects) when the high pressure calibrator is under pressure. Open the screwed sealing plug before removing parts.

Do not use Teflon tape to seal the pressure connection. Residues of Teflon tape could penetrate the high-pressure calibrator and damage it.

Only use the adapters and seals that are available as accessories.

Do not store the calibrator under pressure: only store the high pressure calibrator with the drain valve open.

Avoid the action of force of any kind on the high pressure calibrator and its operating controls.

Do not use high pressure calibrators if they are damaged or faulty.

3. Operating the HPX calibrator

Operating the high pressure calibrator is described starting on page 16.

Connect the test object

You can connect your test object to the high pressure calibrator via the pressure connection (9).

Pressure generation

When using the calibrator, the screwed sealing plug (7) must be opened (2 turns), so that overpressure cannot build up in the oil reservoir.
Use the manual booster pump (8) to set the pressure to about 10 bar. You can use the screw compressor (11) to increase or reduce the pressure.

Release pressure

1. Open the screw compressor (11) **completely**
2. Open the drain valve (10)

IMPORTANT!
Do not open if there is high pressure in the system!

If you can no longer reach the desired pressure, please consult the section on "Maintenance" to find out how to vent the system.

Zeroing the device

Open the drain valve (10) to release any pressure that may have built up. If the pressure display does not show zero, perform a zeroing procedure (*SET ZERO*) and then close the drain valve.

Information about the display

If no pressure can be shown on the display, it will show *OFL* (overflow) or *UFL* (underflow).

If pressure outside the device's measuring range is applied, the last valid pressure value that was measured will flash on the display (overload warning).

Reset

4. Description of the functions

Menu navigation

If the selected function or unit is not activated by pressing the ENTER button within 5 seconds, the display will return to measuring mode without changing a setting.

Function	Reset	Description
Min. / max. display		Shows the peak and trough pressure values measured thus far. (Display is shown with reduced resolution)
Leak measurement		Leak mode is used to determine the pressure change over a defined period, which can be changed. (Leak measurement period, factory setting: 10 minutes)
Zero the display		Permanently sets the applied pressure as the new pressure zero point.
Reset display		Resets the pressure zero point to the factory setting.
Automatic switch-off function		(Cont = Continuous) The device switches off automatically after a defined period (which can be changed), starting from the last time a button was pressed. (Switch-off period, factory setting: 15 minutes)
Select units		mbar, bar, hPa, kPa, MPa, cmH2O, mH2O, inH2O, ftH2O, PSI, kp/cm², mmHg, inHg

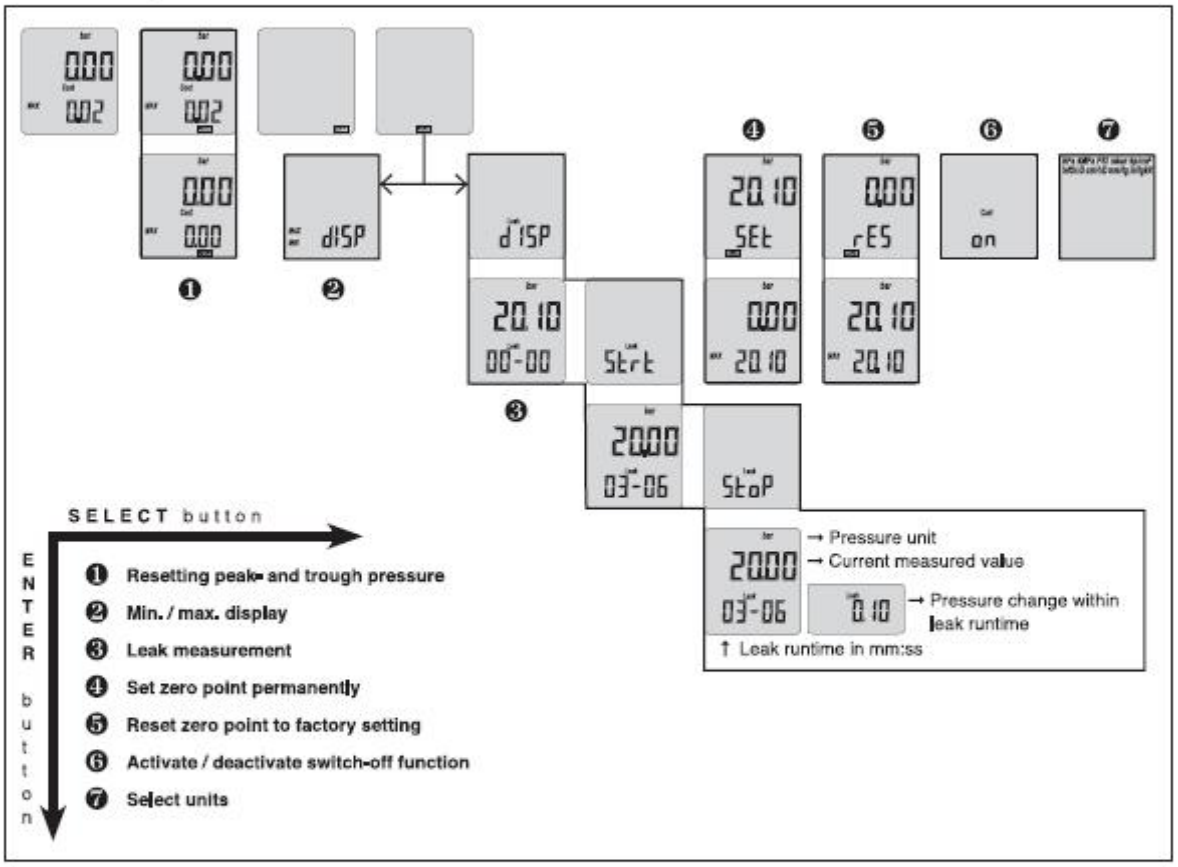
SELECT button

The SELECT button positioned on the front is used to switch the device on, to select a function and to select the various pressure units.

ENTER button

The ENTER button positioned on the front is used to activate the selected function or pressure unit on the device. You can also press the ENTER button to switch between the minimum and maximum pressure values measured thus far.

5. Menu navigation for calibrators



6. Commissioning

Switch the device on

Press the SELECT button to switch the device on. Initially, the device shows the pressure range calibrated in the factory (top) and the software version (year / week).

Switch the device off

Keep the SELECT button pressed down until the display shows *OFF*.

Press the ENTER button to execute the shutdown.

→ The settings made previously are retained when you switch the device on and off.

Display mode

Display mode is the calibrator's basic mode. The upper part of the display shows the pressure unit and the pressure that is currently measured. The lower part of the display shows the last function that was used, either the min./max. display or the Leak function.

Using the functions

Written descriptions of the individual functions are given below (in addition to the diagram above).

Selecting functions

The individual sub-functions are called up from the MANO menu. Keep the SELECT button pressed until *MANO* is

shown, and press ENTER to activate. You can now use SELECT to choose the function you want, and ENTER to execute the function. Depending on the current setting, the first function to be shown is either *MIN/MAX DISP* or *LEAK DISP*.

Leak measurement function

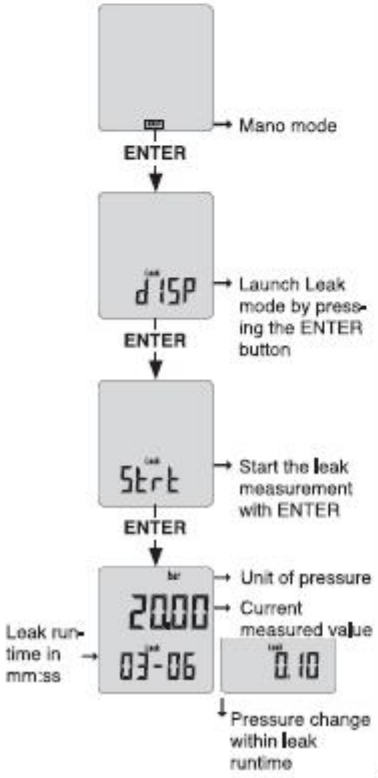
Leak mode is used to determine the pressure change over a defined period, which can be adjusted. The unit to be tested must be connected to the high pressure calibrator on the pressure side.

Start leak measurement

Activate the *MANO* menu. The display shows *LEAK DISP*. Press the ENTER button and then the SELECT button. Press ENTER to confirm *LEAK START*. The leak measurement starts, and the display alternates between the current leak time and the pressure change measured thus far.

Active leak measurement

During leak measurement, the lower part of the display alternates each second between the measurement time that has now elapsed [mm:ss] and the pressure change measured thus far.



End leak measurement early

To end a leak measurement early, press the ENTER button and confirm the *"LEAK STOP"* display by pressing ENTER.

Leak measurement completed

If the leak measurement time has elapsed or if the measurement was manually ended ahead of time, the display alternates between the elapsed leak measurement time and the measured pressure change.

Set leak measurement time

The leak measurement time is preset to 10 minutes in the factory, and it can only be changed with the "Mano Config" software.
(→ Software for calibrators)

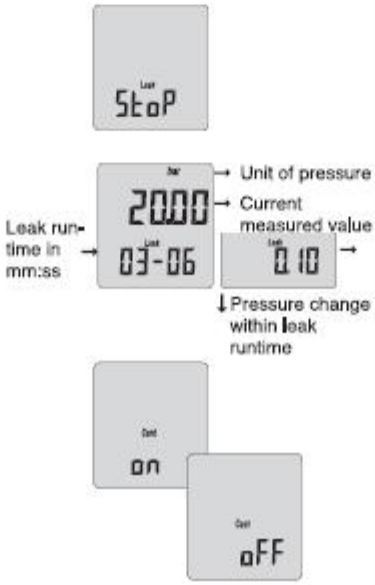
MANO / "Continuous" function

Automatic switch-off function (the device switches off automatically 15 minutes after a button was last pressed). Leak measurements are canceled by the automatic switch-off function if the measurement time is more than the switch-off time.

CONT ON: Disables the automatic switch-off function

CONT OFF: Enables the automatic switch-off function

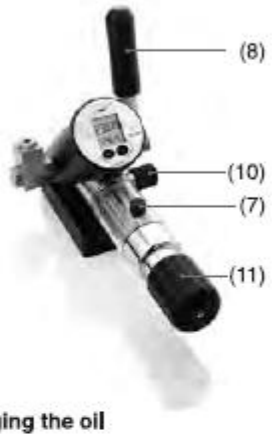
If the "Continuous" function is enabled, *CONT* flashes on the display.



7. Maintenance / disposal

Venting the pressure system

Release the pressure completely and then open the drain valve (10) and the screwed sealing plug (7). Screw the screw compressor (11) in completely. Pump steadily with the manual booster pump (8) to clear the system of air. When no more bubbles come out of the recirculation pipe (6), close the drain valve (10).



Changing the oil

We recommend that you have GNEUSS change the oil. The entire system is cleaned at the same time.
Only use type HLP 22 BP hydraulic oil.

Battery

The pressure calibrator is powered by a 3 V button-cell battery (behind the display). If the battery is low, the battery symbol on the display BAT LOW lights up.

Replacing the battery

Please switch the device off. Turn the display section ring beyond the limit stop until it is released from the housing section (turn through about 180°). Open the battery compartment and change the battery (type CR 2430).

Disposal

This product must not be disposed of as normal household waste at the end of its useful lifetime. To prevent possible damage to the environment or to health due to uncontrolled waste disposal, this product must be separated from other waste and recycled correctly in order to ensure sustainable use of the raw materials.

8. Software for calibrators

The USB interface converter (K-114A) enables communication between the calibrator and a computer. Before you connect the interface converter to the computer, install driver K-104 / K-114 (the software CD is included in the scope of delivery, K-114A, or can be downloaded free of charge at www.keller-druck.com)

Settings on the high pressure software

Device settings such as the leak measurement time or the switch-off time for the pressure calibrator can be adjusted using the "ManoConfig" software.

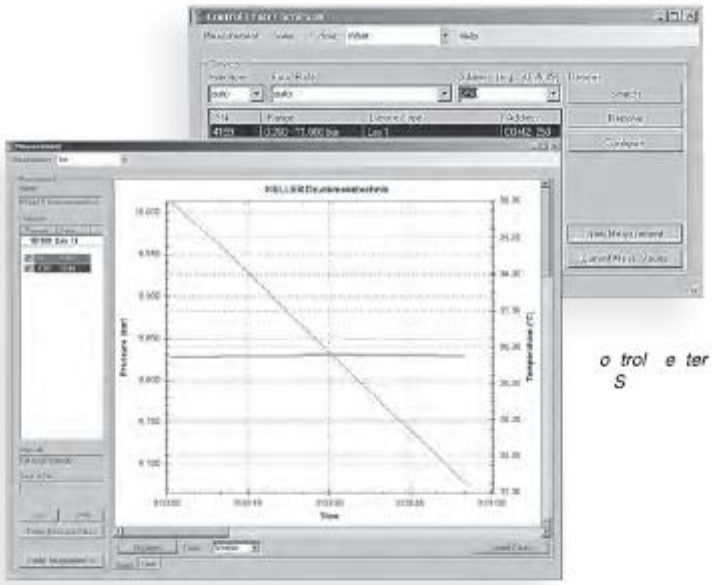
Record measurements with the CCS30 software

The CCS30 software records the data measured by the pressure calibrator, and shows them in both graphic and tabular form. Measured data can be saved or exported for further processing. You will find more information about the software in the CCS30 manual.

Step-by-step software installation

Install from the CD or from www.keller-druck.com:

1.) K-104 / K-114 driver
2.) (CCS30) Control Center Series 30
3.) ManoConfig (if desired)



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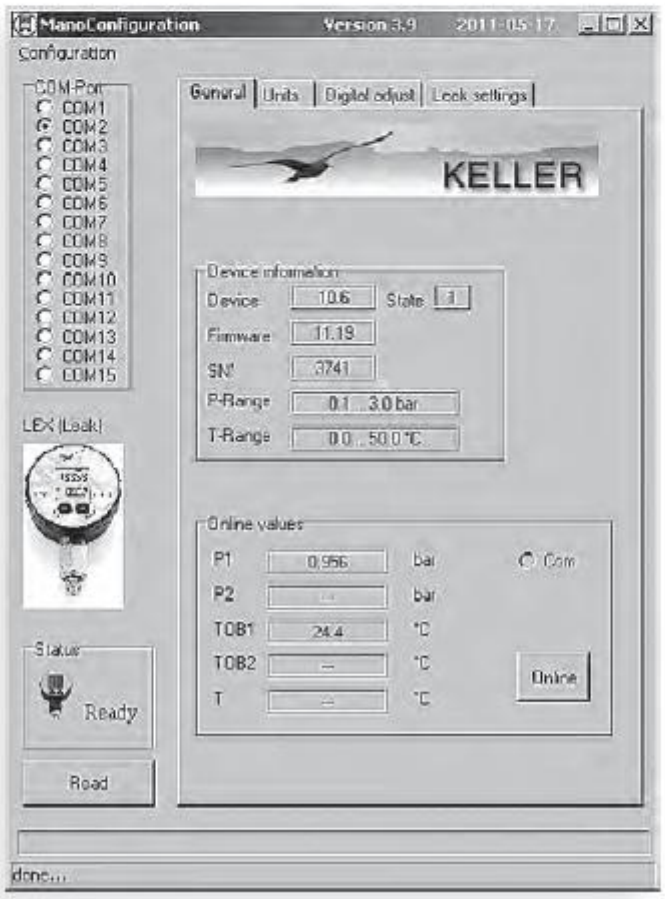


TECHNICAL DATA

Pressure range (FS)	0…700 bar (others on request)
Overpressure	840 bar
Accuracy, error band [1] (10…40 °C)	< 0,05 %FS
Accuracy, error band [1] (0…50 °C)	< 0,1 %FS
Leak rate*	700 bar: -2 bar @ 10 min.
Display resolution	50 mbar
Number of digits on display	5 digits
Measurement interval	0,5 seconds
Interface	RS485; the Fischer cable socket on the side fits the K-104A / K-114A interface converter
Compensated temperature range	0…50 °C
Operating temperature	0…50 °C
Storage temperature	-10…60 °C
Air humidity	5…95% relative humidity
Power supply	Button-cell battery, type CR2430
Battery lifetime:	> 2000 h in continuous operation
Hydraulic oil	HLP 22 BP
Dimensions (L x W x H)	315-337 x 155 x 148 mm
Degree of protection	IP 65
Selectable pressure units	bar, mbar, hPa, kPa, MPa, PSI, kp/cm², cmH2O, mH2O, inH2O, ftH2O, mmHg, inHg

[1] including accuracy, temperature coefficients, zero point and range tolerance

* Physical effects caused by a pressure change lead at first to a clear difference in pressure.
Advice: To minimise the influence of these physical effects increase steadily the last 5% of the target pressure and regulate towards the target pressure for the first minutes.

The stated leakage rate is at a thermal balanced condition (when temperature of pressure media and of the environment is equable).

PID CONTROLLERS INSTRUCTION MANUAL

Table of Contents

INTRODUCTION

This manual contains information for the installation, operation and tuning of your FUZZY ENHANCED auto-tuning microprocessor based controller. The microprocessor controllers are FUZZY ENHANCED "proportional + integral + derivative" (PID) controllers. The input is configurable. They have dual displays that show the input (measured temperature) in the top digital display and the required set point in the lower. The controller boasts a comprehensive range of other features that include a ramp, soft start with power limiting and auto/manual function.

A Adjustment of the controller

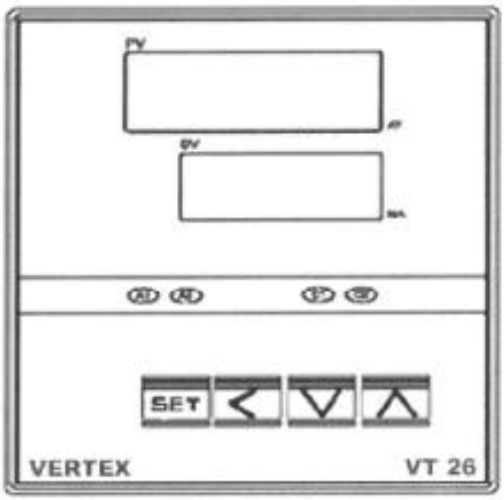
The controller is so predefined that he can be operated except for the upper temperature range with these attitudes. In the description all functions aren't or are described to functions which aren't needed in this application. Changes of the attitudes only by specialist staff. For damages which are caused by faults at the attitudes, the manufacturer doesn't assume any guarantee.

B Changing the upper temperature value (set point)

- push short the SHIFT button
- changes the set point with the or the button
- push short the SET button

1. FRONT PANEL DESCRIPTION

1.1. Controller Face indications



DISPLAY AND INDICATOR

PV (Process Value) Display

- Displays the actual measurement of the input.
- Displays the parameter index code when selected.
- Displays the error message

SV (Set Value) Display

- Displays the set value. (Required Setpoint)
- Displays the parameter data when selected. Displays the output percentage value when selected.

- A1 status LED indicator (Alarm 1 relay status LED)
  This LED is lit in red when the alarm 1 relay is active.
- A2 status LED indicator (Alarm 2 relay status LED)
  This LED is lit in red when the alarm 2 relay is active
- C1 status LED indicator (Main output 1 status LED)
  Illuminates in green when the control output 1 is active.
- C2 status LED indicator (Control output 2 status LED)
  Illuminates in green when the control output 2 is active.
- AT status indicator
  When the controller is auto tuning the rightmost lower decimal point in the PV display will blink. Auto tuning may take from several minutes to several hours depending upon the process in question.
- MA status indicator
  When the manual control mode is selected. The rightmost decimal on SV display will blink.

1.2. KEY FUNCTION

SET key

Press once to access the next configurable parameter within the level you are in.

Press for 5 seconds to reset alarm timer if used.


SHIFT key

Shift digits to be adjusted by up/down key.


DOWN key

Press to decrease the set point or parameter value.


UP key

Press to increase the set point or parameter value.

Press the SET and UP keys once to return the normal operation.

LEVEL key

Press the SET and SHIFT keys simultaneously for 5 seconds and then use the up and down keys to select the programming level required. (ie: User, Soft, PID etc) Now press the SET key to enter that particular level and access the first parameter.


Display Engineering Unit for analog input setting.

Press the UP and DOWN keys simultaneously for 5 seconds to access "LnLo" and "LnHi" parameters. These values are used to set the display engineering units you require to correspond to the analog input being used. Eg: a 4 ~ 20 input may represent 0 ~ 100 °C or any other range you chose.

2. CONFIGURATION AND PARAMETER SETTINGS

All configurable parameters are user friendly and clearly structured in three levels. To change level from one to the next, please press SET keys for at least 5 seconds to access level selection. Use UP/DOWN key to select programming level.

- Soft
- Pid level. (P id)
- Option level. (oPt)
- Scaling for Linear Input

2.1. USER LEVEL

The following parameters are listed in a default sequence. However any unused parameter can be removed and the display sequence is configurable to simplify the operation.

SP: Set point value required for control.

A1SP: Alarm 1 set point value in °C. This will be a time set value while A1FU is set to T.on or T. off and the unit will be HH.MM or MM.SS depending on the choice of unit defined by the "P.tnE" parameter. Range -1999 – 9999 / 00.00~99.59

A2SP: Alarm 2 set point value in °C. This will be a time set value while A2FU is set to T.on or T. off and the unit will be HH.MM or MM.SS depending on the choice of unit defined by the "P.tnE" parameter. Range -1999 – 9999 / 00.00~99.59

AT: Auto tune. Used to set Pb,ti,td (PID) parameters automatically using the auto tuning process. This procedure will also tune the "cooling" PID parameters as well if your controller has that option installed.

no: Auto tuning is disabled.

YES 1: Most commonly used auto tuning procedure. The PV is compared with SV during auto tuning.

YES2: Used when you do not wish the PV (measured temperature) to exceed the SV during auto tuning. The process of auto tuning is done at 10% below the set value.

HAnd: Hand (manual) control. Used to enable or disable the manual mode. Care must be taken when using this function as the output is set manually by the operator, and the controller will not make any automatic corrections should there be overshoot above the set value temperature.

no: Disable the manual mode

YES: Enable the manual mode.

oUt: Output percentage. Indicating the % output set either by hand in manual or by the controller when controlling normally.

AT: Auto tune. Used to set Pb,ti,td (PID) parameters automatically using the auto tuning process. This procedure will also tune the "cooling" PID parameters as well if your controller has that option installed.

2.2. SOFT LEVEL (Please note in order to unlock the soft level the lock parameter must be set to 0101)

rAnP: The ramp can be used separately from the "Soft Start" or in conjunction with as you please. With the Ramp value set to 0 the ramp is disabled. When a value has been set in ℃/min each time a setpoint change is made the setpoint will ramp at the set rate from the original value to the new setpoint value. This can be set between the range of 0 ~ 9999 ℃/min (0.0 – 999.9)

SSP : This is the temperature setpoint below which at startup, the output will be limited to the % value set in the "out" parameter below. This value can be set anywhere between the LoLt – HiLt values of the range.

oUt :Output percentage value to which the output will be limited at startup until the temperature has reached the S.SP setpoint above at which the output will revert to full PID regulation.

2.3. PID LEVEL

Pb: Proportional band value. Setting range from 0.0 to 300.0 % of controller's Span. set to 0.0 for on/off control. This value is automatically calculated by activating the auto tune function. It can also be set manually by the user if so desired.

Ti : Integral (reset) time. This value is automatically calculated by activating the auto tune function. It can also be set manually by the user if so desired.
When PB = 0.0, this parameter will be not available. When Ti is set to zero, make Pb & td ≠0 for PD control.

td: Derivative (rate) time. This value is automatically calculated by activating the auto tune function. It can also be set manually by the user if so desired. When PB=0.0, this parameter will be not available. When td is set to zero, Pb & ti ≠ 0 for PI control.

CY: Cycle time for the main control output. Setting range is from 0 to 100 seconds. Set to 1 for SSR output, set to 0 for 4 ~ 20 mA analog output and set to 15 for relay or contactor.

CPb: Proportional band value for cooling control output when fitted. Set 0.0 for ON/OFF control.

CTi: Integral time for cooling control output. When PB=0.0, this parameter will be not available. When set to zero, Pb & td ≠ 0 for PD control.

CTd: Derivative time for cooling control output. When Pb=0.0, this parameter will be not available. When set to zero, Pb & ti ≠ 0 for PI control.

CCY: Cycle time of second control output.

HYS1/HYS2: Hysteresis (Dead Band) for on/off control on output 1 and output 2. Users can create a dead band around the setpoint from 0.0 to 200.0 deg C. The temperature will continue to heat and rise above the setpoint by the "HyS1" amount set, then cool until it has dropped below the setpoint by the same amount before switching on again.

A1HY/A2HY: Hysteresis for alarm 1 and alarm 2. The setting range is 0.0 to 200.0 and it works in the same way as for the main Hysteresis setting.

db: Dead band value. This defines the dead band between the heating and cooling outputs when used and can be set from -100.0 to 100.0 deg C. If you are using proportional or PID control even though you set a dead band you may get overlapping switching between the heating and cooling. This is a result of the control algorithm action. If you make both the heating and cooling Pb = 0 however it will ensure that there is nothing on between the two.

SPOF: Set point offset. Setting range is from -100.0 to 100.0 or –1000 to 1000. This value will be added to SV to perform control. It mainly used to eliminate offset error between the SV and PV that may be experienced during proportional only control.

PVoF: Process value offset. Setting range form -100.0 to 200.0 or –1000 to 2000 This parameter allows for manual compensation of any process off-set that may exist between the measurement of the probe and the reading on the controller PV display..

LoCP: Parameter lock. This security feature locks out selected levels or single parameters prohibiting tampering and inadvertent programming changes. To change any "Lock" settings you must first make sure that gap "G1" is soldered.

Table 3-1 Parameter lock selection

Setting	Description
0000	All parameters are locked out.
0001	Only SP is adjustable
0010	Only USER level is adjustable
0011	USER and PID levels are adjustable.
0100	USER, PID, OPTI levels are adjustable.
0101	USER,SOFT,PID,OPTI levels are adjustable.
0101~0111	All parameters in all levels are opened.
1000 ~ 1111	1000=0000, 1001=0001, 1010=0010, 1011=0011, 1100=0100 but Output 2 is opened.

2.4. OPTION LEVEL

InPt: Sensor input selection.

Table 3-2 Input and range

TYPE	DISPLAY	RANGE	
J	J	-50℃~1000℃	-58℉~ 1832℉
K	K	-50℃~1370℃	-58℉~2498℉
T	t	-270℃~400℃	-454 ℉ ~752 ℉
E	E	-50℃~1000℃	-58℉~1832℉
B	b	0℃~1800℃	32℉~3272℉
R	r	-50℃~1750℃	-58℉~3182℉
S	S	-50℃~1750℃	-58℉~3182℉
N	n	-50℃~1300℃	-58℉~2372℉
C	C	-50℃~1800℃	-58℉~3272℉
DPT	d-Pt	-200℃~850℃	-328℉~1652℉
JPT	J-Pt	-200℃~600℃	-328℉~1112℉
LINEAR	L inE	-1999~9999	

Unit: Unit of measure selection.
°C: Degrees C.
°F: Degrees F.
EnG: Engineering unit. Only for linear input.
dP: Decimal point selection.
0000: No decimal point.
000.0: 0.1 resolution.
00.00: 0.01 resolution. Only for linear input.
0.000: 0.001 resolution. Only for linear input.
After reconfiguring the decimal point, please reconfirm other parameter settings that may be effected.

Act: Output 1 control action.
rEV: Reverse action. Used for heating control.
dir: Direct action. Used for cooling control.

LoLt: Low limit of span or range. Set the low limit lower than the lowest expected SV and PV display. **Normally set at 0 deg C.** If you make this setting above 0 deg C when the controller PV drops below this setting it will be out of range and cease to operate.

HiLt: High limit of span or range. Note: If you have a PV retransmission output the Hilt and Lolt sets the range that will equal your retransmission signal. Ie: 0~1000 / 4~20 mA or whatever.
FiLt: Software filters.
A1Fu/A2Fu: Alarm function selection. See section 5.1 for detail.
A1md/A2md: Alarm mode selection. See section 5.2 for detail.
Addr: Address of the controller when communicating with a master device using RS485 comms.
bAUd Communication baud rate. 2.4k=2400 bps, 4.8k=4800 bps, 9.6k=9600 bps, 19.2k=19200 bps

2.5. SCALING FOR LINEAR INPUT

- Press the UP and DOWN keys simultaneously for 5 seconds to access "LnLo" parameter.
- Adjust "LnLo" setting to correspond the low scale and after adjustment press SET key once to access "LnHi" Parameter
- Adjust "LnHi" setting to correspond the high scale and after adjustment press SET key once for normal operation

3. OPERATION

3.1. HOW TO CHANGE THE INPUT TYPE

Press the SET and SHIFT keys simultaneously for 5 seconds until the display reads Level in the top display. Then use the up and down keys to select the programming level required. (ie: User, Soft, PID etc) In this case choose the Opti level. Now press the SET key to enter that particular level and access the first parameter.

This should be the Type parameter. Use the up and down key to select the input type you wish to have as listed in the table below

TYPE	DISPLAY	RANGE	
J	J	-50 ~1000	-58 ~1832
K	K	-50 ~1370	-58 ~2498
T	t	-270 ~400	-454 ~752
E	E	-50 ~1000	-58 ~1832
b	b	0 ~1000	32 ~3272
R	r	-50 ~1750	-58 ~3182
S	S	-50 ~1750	-58 ~3182
N	n	-50 ~1300	-58 ~2372
C	C	-50 ~1800	-58 ~3272
DPT	d-Pt	-200 ~850	-328 ~1652
JPT	J-Pt	-200 ~600	-328 ~1112
LINEAR	LinE	-1999~9999	

Now press the SET key a few times until you reach the LoLE parameter and leave this set at 0000 .
Press the SET key again and you will see the HILE. Use the up and down to make this the nearest 100's setting suitable (ie a range of 0~200 or 0~400 or 0~600 etc etc)
Now 

Press the SET and UP keys once to return the normal operation.

3.2. TUNING CONTROLLER (Auto Tuning)

Tuning is the process of setting the Proportional, Integral and Derivative terms of the controllers main output to best suit your application and **give the best possible control** under your specific circumstances. (*Note this tuning will also tune the second cooling output should your controller have this option*) If you are not happy with the stability of control, and wish to have less over and undershoot around the setpoint, it is advisable to do this procedure. It is also advisable always do this on commissioning new installations. The auto tune function is used to "teach" the controller the main characteristics of the process. It "learns" by cycling the output on and

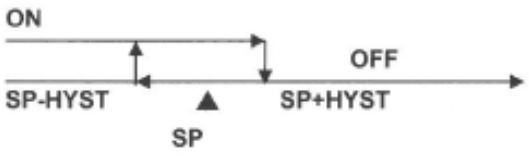
off around the setpoint. The results are measure and used to calculate optimum Pb, ti, td values, which are automatically entered into nonvolatile memory

The auto tune function is triggered manually and can be used during setup of the controller.

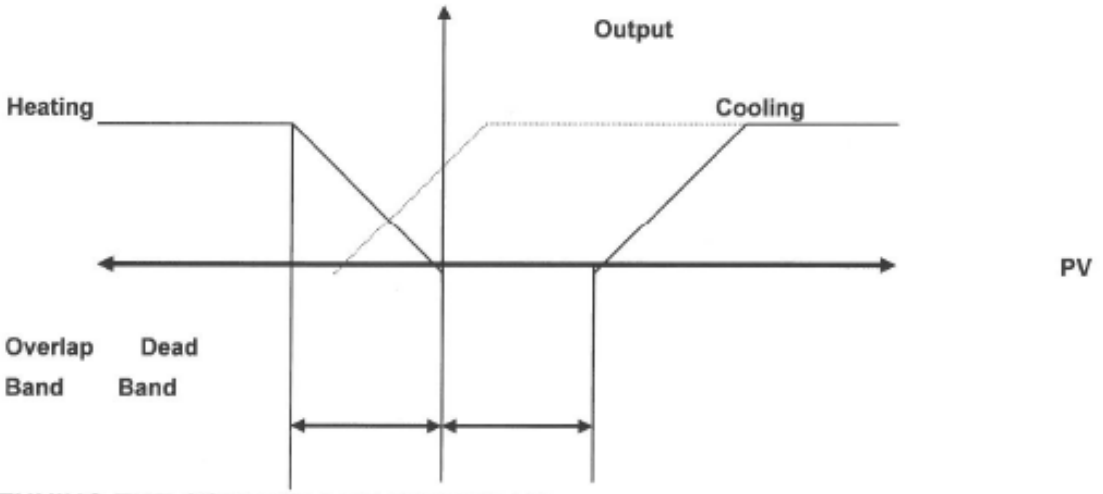
1. Firstly install the controller and get it controlling using the factory settings (As supplied)
2. Always set the setpoint at about half the eventual control temperature the first time you turn it on after installing it during commissioning. This will allow the controller to start controlling and you will easily see if there is something wrong.
3. If the controller is being used as a PID controller, the output will be on and stay on at first, and the temperature will rise towards the setpoint. As it nears the setpoint it will begin to switch on and off. You can monitor this by watching the "C1" light on the display. When the output is on and it is heating, the light will be on.
4. Once the controller has stabilized at that setpoint and is working more or less ok, take the setpoint up to the required temperature and let it re-stabilized there.
5. If you are then not happy with the control results you can make the controller set (tune) the PID parameters itself. Should you wish to do this instruct the controller to do an "auto-tuning" calibration of the parameters.
6. Make sure that the value of Pb is not zero (Pb = 0 forces on/off control). Set the " AE " parameter to "YES 1" ("YES2" will force the tuning process at 10% below the required setpoint and is not generally used.) The rightmost decimal (**AT**) on the PV display will blink during tuning process. (See explanation of difference between "YES 1" and YES2" below)
7. After two oscillatory cycles of on/off control action around the setpoint (SV) the controller will use the measurements learned to set the PID parameters. The controller performs PID control with these "learned" PID values to verify the results. Finally the PID values will be entered into the memory. The controller will now start controlling using fuzzy enhanced PID control.
8. To abort an auto tune process. Simply set the " AE " parameter to " no ".
9. If initially the controller is oscillating badly you may need to perform this procedure a second time to get the best results.
10. DO NOT CHANGE ANYTHING AT ALL IN THE PROCESS OR CONTROLLER WHILE DOING AN AUTO TUNING PROCESS.
11. Do not change anything during this procedure, as it will result in erroneous settings that may not control well at all. (Just leave the system for a few minutes while it does its thing.)
12. Also only do this at the full-required temperature, once the whole system has had a chance to warm up and work for a while.
13. Once it has finished the auto tune light will stop flashing and the controller will start to control using the new parameters.
14. Once this process is completed, you should get good control. It should really only be done once more when the system is in full operation (i.e. under normal working conditions with the process in full swing) if you are not happy with the control results.
15. When doing this on a barrel of an extrusion machine, or on a mould where there is more than one temperature being controlled in close proximity to another, where they may interfere with each other,

always let them all stabilize and then choose the most stable zone and do that one first. Only ever do one zone at a time, let it finish and then do the next most stable zone next to the one you have already done.

The controller can also be set to ON/OFF, PI, PD and P control mode. Set Pb = 0 for ON/OFF control mode. Set ti = 0 for PD control mode. Set td = 0 fro PI control mode and ti, td = 0 fro P control mode. The Hysteresis (dead band) 0f ON/OFF control can be set as follow:



When the second control output (output 2 cooling) is fitted it will behave as shown below. Bear in mind that when using Proportional or PID control there may be an overlap between the heating and cooling depending on the auto PID algorithm calculations. This is perfectly normal. You can make both heating and cooling proportional band = 0 then it will ensure that between the two nothing is switched on.



3.3. TUNING THE CONTROLLER MANUALLY

- To ensure that all parameters are configured correctly.
- Set " Pb" to zero. Set "HYS 1" to smallest.
- Set the controller's set point (SV) to a value, which closely approximates your application.
- The controller will perform the on/off control action. So the process value will oscillate about the set point.
- The following parameters should be noted:
  .1. The peak-to-peak variation (P) in ℃/℉ (i.e. the difference between the highest value of the overshoot and the lowest value of the undershoot).
  .2. The cycle time of the oscillation in seconds.
- The control setting should be then calculated as follows:

Pb= (Px100)÷Span (%)

ti = T

td = T/4

Note: The span is the difference between the "H iLE" high limit value and "LoLE" low limit value.

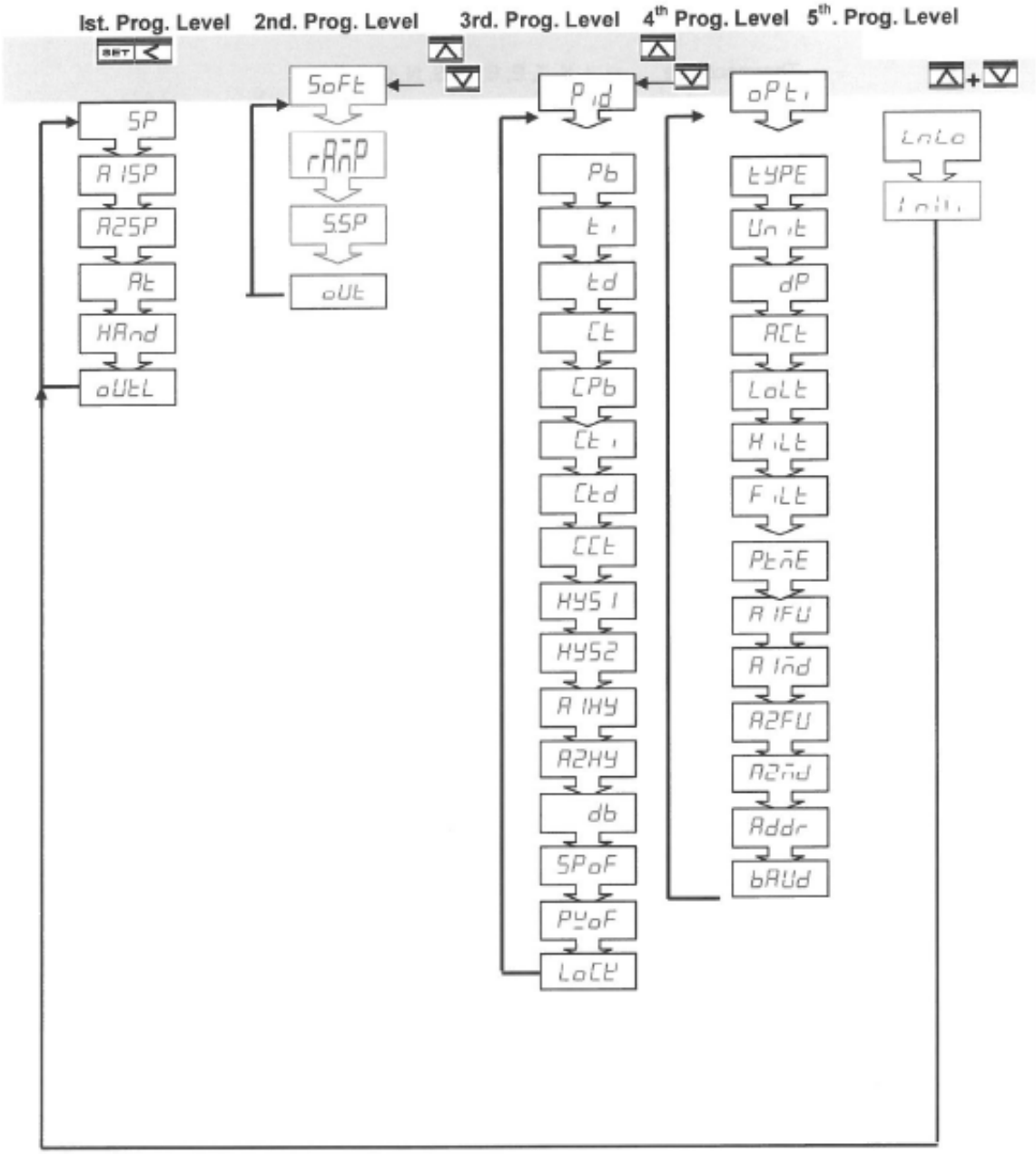
The PID parameters determined by the above procedures are just rough values. If the control results are unsatisfactory. The following rules may be used to further adjust the PID parameters.

Adjustment sequence	Symptom	Solution
1. Proportional Band	Slow response.	Decrease PB.
	High overshoot or Oscillations	Increase PB.
2. Integral Time	Slow response	Decrease ti.
	Instability or Oscillations	Increase ti.
3. Derivative Time	Slow response or Oscillations	Decrease td.
	High overshoot	Increase td.

3.4. MANUAL CONTROL

Manual control allows the user to manually force the output percentage from 0.0 through 100.0% (usually used for testing purposes). To access the manual control mode, set the "HAnd" parameter to "yes", the rightmost decimal (**MA**) on SV display will flash. Then the "oUtL" parameter will display alternately "oUtL" and process value. The output percentage then can be adjusted by using up or down key to increase or decrease the temperature. To abort the manual control just simply set the "HAnd" to " no ". BE AWARE THAT THE CONTROLLER CANNOT MAKE ANY CORRECTIONS SHOULD THE TEMPERATURE GET TOO HOT WHILE YOU HAVE IT IN MANUAL MODE.

4. PROGRAMMING LEVEL PARAMETERS



1. When 2nd Output (Cooling) is not selected, CPb、Cti、Ctd、HYS2 and db parameters are not available.
2. When Pb≠0.0， HYS1 will be skipped.
3. When CPb≠0.0，HYS2 will be skipped.

5. CONTROLLER SPECIFICATIONS

INPUT	Thermocouple J, K, T, E, B, R, S, N, C TYPE
RTD	DIN PT-100; JIS PT-100
Linear	4~20mA; 0~50mV; 1~5V; 0~10V.....
Range	User configurable
Accuracy	±1°C for thermocouple, ±0.2°C for RTD, ±3mA for Linear
Cold Junction Compensation	0.1°C/°C ambient
Sampling Time	0.25 sec.
Normal Mode Rejection	60 dB
Common Mode Rejection	120 dB
CONTROL FUNCTION	
Proportional Band	0.0 ~ 300.0 %
Integral Time	0 ~ 3600 sec.
Derivative Time	0 ~ 900 sec.
Hysteresis	0.0 ~ 200.0/ 0 ~ 2000
Cycle Time	0 ~ 100 sec.
Control Action	Direct (for cooling) or Reverse (for heating)
OUTPUT	
Relay Contact Output	10A/240 VAC (Resistive Load)
Pulsed Voltage Output	0 or 24 VDC (Resistive 250 ohms Min.)
Current Output	4 ~ 20mA (Resistive 600 ohms Max.)
Continuous Voltage Output	0 ~ 50mA, 1 ~ 5V, 0 ~ 10V..... (Resistive 600 ohms Min.)
GENERAL	
Rated Voltage	90 ~ 264 VAC 50/60 Hz or VDC
Consumption	Less than 5 VA
Memory Backup	EEPROM and non-volatile memory (Approx. 10 years)
Ambient Temperature	0 ~ 50°C
Ambient Humidity	0 ~ 90% RH (Non-condensing)

6. Error Messages and Fault identification

Symptom	Probable	Solution
PV display flashing	Incorrect input wiring	Check the terminal connections
	Input signal out of range	Adjust proper values for H iLt and LoLt parameters
	Wrong input type selected	Check sensor type and if proper input type was selected
oPEn	Incorrect input wiring	Check the terminal connections.
	Sensor wires problem	Check if the sensor wire opened or damaged.
	The input hardware damaged by too high current signal	Check input signal level. If hardware is damaged, return for repair.
	Input sensor doesn't correspond to input tYPE	Check sensor type and if proper input type was selected
AtEr	Auto tune failed	Adjust the values of Pb、 t i、 td manually.
All LED's and display not light	-No power to controller -SMPS failure	-Check power lines connection -Replace SMPS
Process Value changed abnormally	-Electromagnetic Interference (EMI) or Radio Frequency Interference (RFI)	-Suppress arcing contacts in system to eliminate high voltage spike sources. Separate sensor and controller wiring from "dirty" power lines. Ground heaters
RdEr	Analog to digital converter circuit abnormal	Unit must be repaired or replaced. Check for outside source of damage such as transient voltage spikes.
	Abnormal high voltage/surge for input signal	
	The actual linear input signal is higher than ordering specification.	
CSEr	Controller memory IC abnormal	Check if the input signal is abnormal and return for repair.
	Abnormal high voltage/surge from power source or input terminal.	
Control function	Control output direction is reversed.	Check the setting of rCt parameter. Change rEn : or d ir for proper direction setting.
	At parameter can't be adjusted	When Pb=0.0, At can't be done.
		When HAnd= YES, At can't be done.
	oUtL Parameter can't be adjusted.	When HAnd= no,oUtL parameter can't be adjusted
	Measure temperature is deferent from actual temperature	Check the value for PvoF. Set PvoF=0 to see if the error is eliminated.
		Check the setting for tYPE and Un it and adjust to the proper values.
	Setpoint is deferent from actual temperature.	Check the value for SPoF. Set SPoF=0 to see if the error is eliminated.
	Control output continues while error message appears.	When HAnd= YES, manual output control isn't limited by error message.
	Control output doesn't stop while PV exceeds setpoint.	When output LED is on, check the value of SPoF. Set SPoF=0 to see if the error is eliminated.
		When HAnd= YES, manual output control isn't limited by SP.

Alarm function	The range of A1SP、A1HY、A2SP、A2HY are limited.	Check if A1FU、A2FU parameters are set properly.
RS-485 communication	RS-485 communication failed	Check if the RS-485 module is installed.
		Communication software should be fit ModBus RTU protocol compliance.
		Check if Addr parameter is corresponding to the software address setting.
		Check if bAUd parameter is corresponding to the software baud rate setting.

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