# LFS / LFS-mA

- IP 65 (*) and NEMA 4X (*) front protection.
- **SMART** function for the self-tuning of control parameters.
- Proprietary algorithm for heating/cooling control with automatic setting of control parameters according to the selected cool transferring media (air, oil or water).
- **Universal input (TC, RTD, mV, mA, 5V and 10V).**
- **Up to 2 independent alarms** programmable as process alarm, band alarm or deviation alarm with automatic or manual reset of the alarm condition.
- Masking of the alarms during start up or after a set-point change.
- Manual control mode, output can be set in % of the power.
- **2 independent ramps** (ramp up and ramp down) for set point change.
- Output failure detection alarm with load current measurement (OFD function).

(*) Test were performed in accordance with CEI 70-1 and NEMA 250-1991 STD.

## CONFIGURATION

By front keyboard

or

through RS 485 serial link

How to order the configuration program
- *For LFS relay: 6ER.LFS.RLY.CON*
- *For LFS-mA:  6ER.LFS.0MA.CON*

## SDDE - DDE Communication Driver for ERO Devices

How can you simply interface ERO instruments to a PC running Windows?
Now it is quick and inexpensive by using SDDE driver developed by ERO Electronic to make available as Windows objects the process data handled by the instruments as well as their run-time and configuration parameters. The integration of Ero instruments in the Windows work environment allows to link them to any Windows based package (In-Touch, Fix, Us-Data, Lab-View), or to build up your own application by using any other tool like Visual Basic, Excel, Word.

# PROGRAMMABLE PROTOCOLS

## ModBus, JBus, ERO
## (RS 485)

## AUTO TUNING AND SELF-TUNING FUNCTION

These instrument are equipped with a proprietary self-tuning algorithm named SMART.
During start-up and control, monitoring continuously the process variable, the smart is able to adjust automatically the P.I.D. parameters according to the response of the process variable.
**The advantage of this continuous self-tuning algorithm is the ability to operate without injecting any artificial change into the system.**
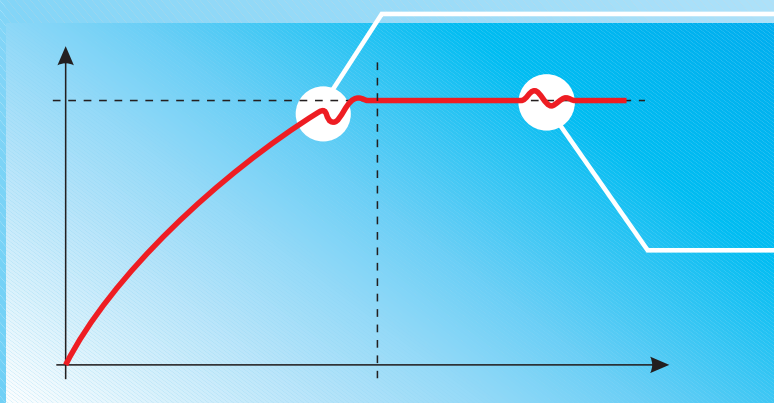


### During start-up
The SMART implements the self-tuning function calculating the value of the P.I.D. parameters in order to optimize the set point approach and decrease overshoot.

### During control
The SMART implements the self-tuning function updating, if necessary, the P.I.D. parameters according to the type of response due to a set point change or to a load change.

3

# LFS / LFS-mA
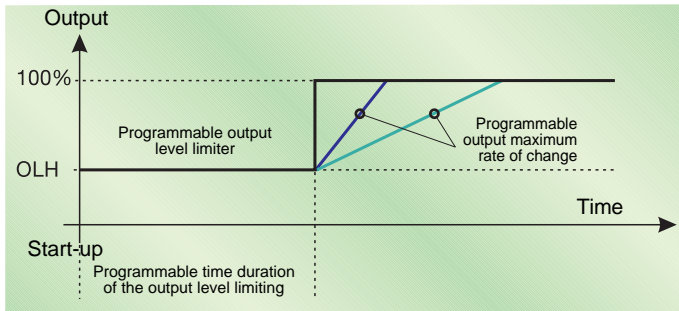


## Soft Start function
*This function allows to gradually pre-heat the controlled process in order to increase the heater life.*
*In order to use this function, it is necessary to program the level of power output to be used during pre-heating and its time duration. The alarm masking function assures that no false indication will occur during pre-heat.*
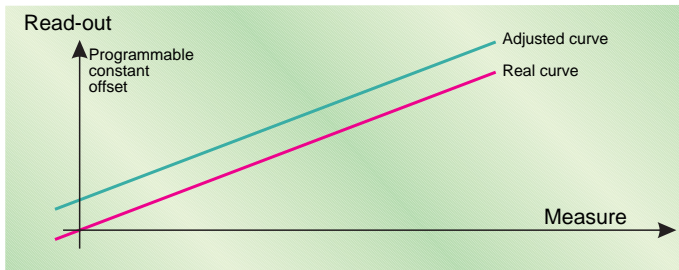
*With these instruments is also possible to program the output power maximum rate of change in order to avoid thermal shock during normal operation.*
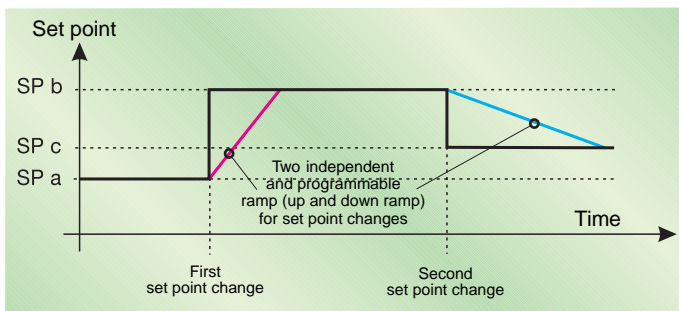


## Two independent ramps (ramp up and ramp down) for set point changes
*This product family allows to program a ramp for increasing a set point and a ramp for decreasing a set point. This solution is essential where it is necessary to produce a gradual set point variation.*
*Moreover, a process may need an heating speed different from cooling.*



## OFFSET on the measured value
*These instruments offer the possibility to program a constant offset applied to the measured value in order to re-align the measured value with the real value of the process.*
*Ex. In many cases it is quite difficult to place your sensor in an ideal position.*
*The incorrect positioning of the sensor may produce a measured value that is not a true representation of the process value.*

## REAR OF BOARD VERSION



The LFS family product encompasses also the rear of board version for omega DIN rail mounting in accordance with EN 50022 (35 x 7.5 mm or 35 x 15 mm).

This version was designed in order to simplify the installation, to reduce the panel space and to reduce the wiring cost. Furthermore the rear of board mounting will protect the instrument from possible tampering with the settings.

The current trend aimeid to improve the quality of production, discards reduction and the machinary efficiency optimization, has driven many manufacturers to separate the control (which it is yet executed by PLC) from the regulation (removed from PLC to dedicated instrumentation).

As a matter of fact, dedicated instrumentation guarantees high speed and accuracy while the separation of functions allows to relieve the very complicated PLC programs.

In addition to advantages previously described, rear of board instrumentation allows to safeguard:
- the dimensions and layout of the control panel,
- the machine operativity,
- continuity of the product.

Moreover, the LFS-mA may be used as a transmitter, offering at the same time, the analogical (4-20 mA) and digital (RS 485) retransmissions, besides the 2 threshold alarms.

The electronic circuitry installed into the rear of board instruments is the same used for panel version and therefore offer the same electrical characteristics, functionality and ease of use which have brought success for the panel version.

**UPPER DISPLAY**
*It shows the actual measured value or the selected parameter value.*

**OUT 1**
*For LFS - lit when OUT 1 is ON. For LFS mA - flashing with a duty cycle proportional to the power outputs.*

**OUT 2**
*Lit when OUT 2 is ON or alarm 1 is in alarm condition.*

**OUT 3**
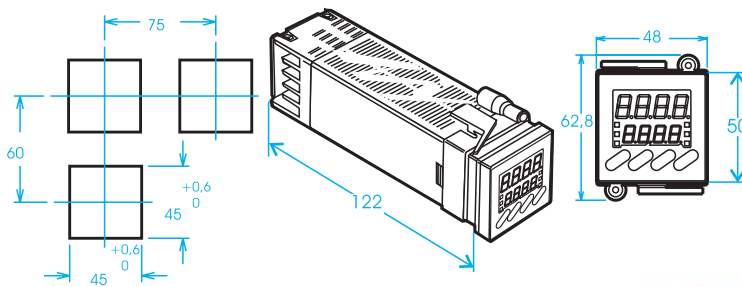*Lit when OUT 3 is ON or alarm 2 is in alarm condition.*

**MAN**
*Flashing when the instrument is in MANUAL mode.*

**LOWER DISPLAY**
*During the run time mode it shows the operative set point.*
*- In manual mode it shows the output level.*
*- During parameter modifications it shows the abbreviated name of the selected parameter.*

**REM**
*Lit when device is controlled by serial link.*

**°C**
*Lit when the process variable is shown in Celsius degree.*

**°F**
*Lit when the process variable is shown in Fahrenheit degree.*

**SMRT**
*Lit when the SMART algorithm is active.*

**SP2**
*Lit when SP2 is operative.*



## DIMENSIONS AND PANEL CUT-OUT

STANDARD VERSION



REAR-OF-BOARD VERSION

# LFS / LFS-mA

| | |
|---|---|
| **Case:** | self-extinguishing material according to UL 746C standard. |
| **Front protection:** | - designed and tested for IP 65 (*) and NEMA 4X (*) for indoor locations (when panel gasker is installed). |
| | - IP 20 for rear of board version. |
| | - (*) Test were performed in accordance with IEC 529, CEI 70-1 and NEMA 250-1991 STD. |
| **Installation:** | - panel mounting version by means of tie rods. |
| | - Rear of board version on wall or omega DIN rail. |
| **Rear terminal board:** | with screw terminals, connection diagram and safety rear cover. |
| **Dimensions:** | 48 x 48 mm (according to DIN 43700); depth 122 mm. |
| **Weight:** | 250 g. max. (1 lb.). |
| **Power supply:** (switching mode) | from 100 to 240 V A.C. 50/60 Hz (+10% to -15% of the nominal value) or 24 V AC/DC (±10% of the nominal value). |
| **Power consumption:** | 8 VA. |
| **Insulation:** | a double or reinforced insulation is guaranteed between the power supply input and all the instrument inputs and outputs. |
| **Common mode rejection ratio:** | 120 dB @ 50/60 Hz. |
| **Normal mode rejection ratio:** | 60 dB @ 50/60 Hz. |
| **Electromagnetic compatibility and safety requirements:** | This instrument is marked CE. Therefore, it is conforming to council directive 89/336/EEC (reference harmonized standard EN-50081-2 and EN-50082-2) and to council directives 73/23/EEC and 93/68/EEC (reference harmonized standard EN 61010-1). |
| **Installation category:** | II. |
| **D/A conversion:** | dual slope integration. |
| **Sampling time:** | - for linear inputs = 250 ms. |
| | - for TC or RTD inputs = 500 ms. |
| **Accuracy:** | ±0.2% f.s.v. @ 25 °C and nominal power supply voltage. |
| **Operative temperature:** | from 0 to +50 °C. |
| **Storage temperature:** | from -20 to +70 °C. |
| **Humidity:** | from 20% to 85% RH not condensing. |
| **Protections:** | 1) WATCH DOG for automatic reset. |
| | 2) DIP SWITCHES for configuration and calibration parameters. |

## MEASURING INPUTS

All the inputs are factory calibrated and selectable by front keyboard.

### Thermocouples

| | |
|---|---|
| **Type:** | J, K, L, R, S, N, T are keyboard programmable. |
| **Engineering unit:** | °C and °F keyboard programmable. |
| **Burn out:** | Detection of input opening (wires or sensor) with underrange or overrange selectable. |
| **Cold junction:** | automatic compensation for an ambient temperature between 0 and 50 °C. |
| **Cold junction compensation error:** | 0.1 °C/°C. |
| **Input impedance:** | > 1 MΩ. |
| **Calibration:** | according to IEC 584-1. |

**STANDARD RANGES TABLE**

| TC type | °C Range | °F |
|---|---|---|
| L | 0  /  400,0 | 0  / 1650 |
| L | 0  /  900 | |
| J | -100,0  /  400,0 | -150  / 1830 |
| J | -100  / 1000 | |
| K | -100,0 /  400,0 | -150  / 2190 |
| K | -100  / 1200 | |
| N | -100  / 1400 | -150  / 2550 |
| R | 0  / 1760 | 0  / 3200 |
| S | 0  / 1760 | 0  / 3200 |
| T | -199,9 /  400,0 | -330  /  750 |

**NOTE:** For TC inputs it is possible to select a measuring range, within the standard input range, with a minimum span of 300 °C or 600 °F.
In this way it is possible to increase the sensibility of the control parameters.

### RTD input

| | |
|---|---|
| **RTD type :** | Pt 100 3 wires connection. |
| **Calibration:** | according to DIN 43760. |
| **Line resistance:** | Max 20 Ω/wire with no appreciable error. |
| **Engineering unit:** | °C and °F keyboard programmable. |
| **Burn out:** | Detection of sensor opening and of one or more wires opening. Detection of sensor short circuit . |

**STANDARD RANGES TABLE**

| °C | °F |
|---|---|
| -199.9/ 400,0 | -199.9/ 400,0 |
| -200 / 800 | -330 / 1470 |

**NOTE:** For RTD inputs it is possible to select a measuring range, within the standard input range, with a minimum span of 100 °C or 200 °F.
In this way it is possible to increase the sensibility of the control parameters.

## mA and V linear inputs

**mA input (standard):** 0-20 mA or 4-20 mA keyboard programmable.
**Read-out:** keyboard programmable from -1999 to 4000.
**Decimal point :** programmable in any position.

**STANDARD RANGES TABLE**

| Input | | Impedance | |
|---|---|---|---|
| 0 - 20 | mA | > 5 | Ω |
| 4 - 20 | mA | > 5 | Ω |
| 0 - 60 | mV | > 1 | MΩ |
| 12 - 60 | mV | > 1 | MΩ |
| 0 - 5 | V | > 200 | kΩ |
| 1 - 5 | V | > 200 | kΩ |
| 0 - 10 | V | > 400 | kΩ |
| 2 - 10 | V | > 400 | kΩ |

## LOGIC INPUTS

These instruments are equipped with a logic input to be used to select between main set point and auxiliary set point (SP or SP2)

**Note:** this function excludes the current transformer input (Output 1 load break down alarm). (For LFS-Relay only).

## SET POINTS

Two set points are available: main set point (SP) - auxiliary set point (SP2)

**Set point transfer**
Transfer from SP to SP2 and viceversa may be driven by logic input (contact closure).

**Note:** the transfer may be done by a step transfer or by a ramp with two different programmable rates of rise (ramp up and ramp down).
**Set point limiters:** set point low limit and set point high limit are programmable.

## ALARMS

**Output action:** direct or reverse function programmable.
**Alarm functions:** each alarm can be configured as process alarm, band alarm or deviation alarm.
**Alarm reset:** automatic or manual reset programmable on each alarm.
**Alarm indications:** 2 indicators lit when the respective alarm is ON.
**Alarm outputs:** 2 relay SPST. Contact rated at 2 A, 250 V AC on resistive load.

### Process alarm

**Operative mode:** minimum or maximum programmable.
**Threshold:** programmable in engineering unit within the whole range.
**Hysteresis:** programmable from 0.1% to 10.0% of the input span.

### Band alarm

**Operative mode:** Inside or outside programmable.
**Threshold:** programmable from 0 to 500 units.
**Hysteresis:** programmable from 0.1% to 10.0% of the input span.

### Deviation alarm

**Operational mode:** High or low programmable.
**Threshold:** programmable from -500 to +500 units.
**Hysteresis:** programmable from 0.1% to 10.0% of the input span.

## OUTPUT "TURN OFF" FUNCTION

This function allows to disable the control output. Therefore, it removes power from the controlled load and makes the instrument to operate as an indicator.
Therefore, this function allows to maintain the monitoring of the process variable even when the load is OFF.
When the control mode is resumed, the instrument will become operative as follows: the integral component of the output signal will be set to zero and the soft start and the alarm masking functions will be enabled.
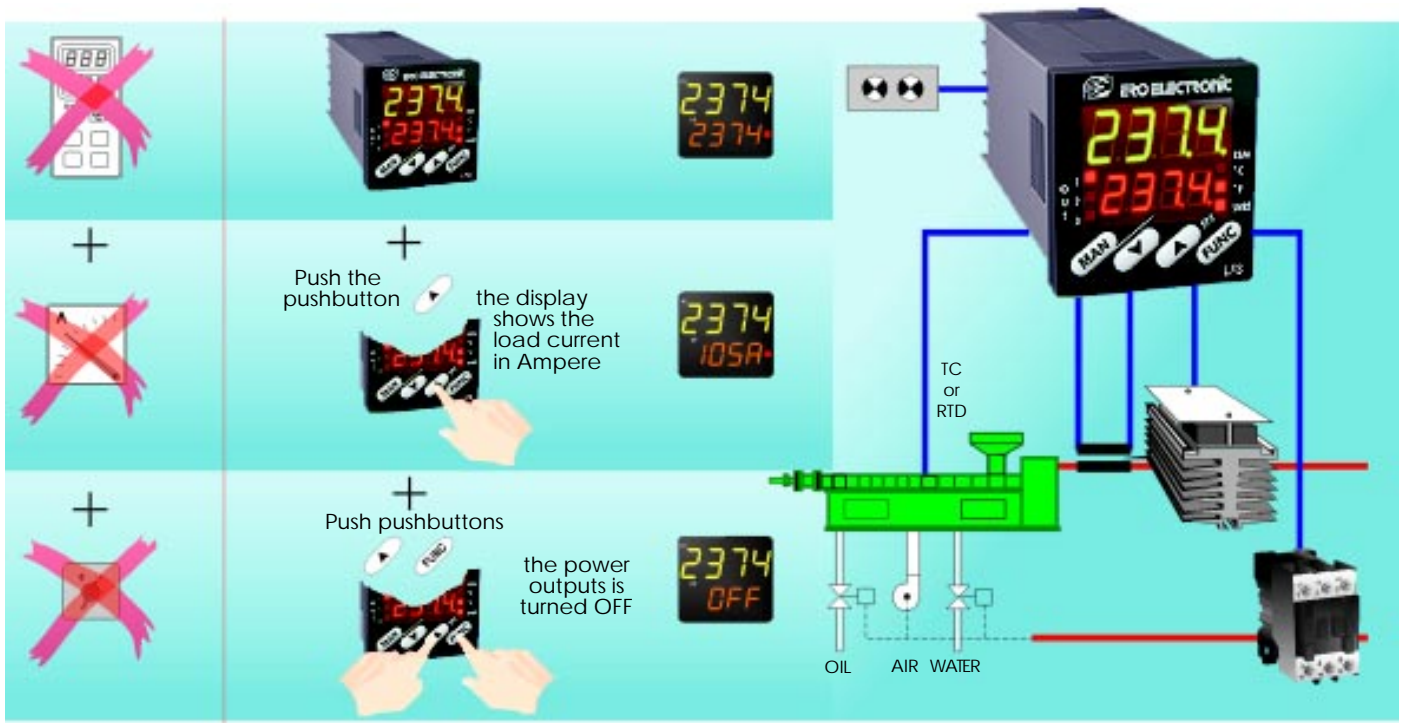
## SERIAL INTERFACE
**(optional)**

**Type:** isolated RS-485.
**Protocol type:** MODBUS, JBUS, ERO polling/selecting.
**Baud rate:** keyboard programmable from 600 to 19200 BAUD.
**Byte format:** 7 or 8 bit programmable.
**Parity:** even, odd or none programmable.
**Stop bit:** one.
**Address:** from 1 to 95 for ERO protocol
from 1 to 255 for all the other protocols
**Output voltage levels:** according to EIA standard.

## ACCESSORIES

| | Code |
|---|---|
| RS-232/RS-485 converter with 110/220 V AC power supply | CON.VX3.200.000 |
| RS-232/RS-485 converter with 120/240 V AC power supply | CON.VX6.200.000 |

# LFS relay



Push the pushbutton — the display shows the load current in Ampere

Push pushbuttons — the power outputs is turned OFF

TC or RTD

OIL    AIR WATER

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**CONTROL ACTION**

| | |
|---|---|
| **Algorithm:** | PID + SMART |
| **Type:** | One (heating) or two (heating and cooling) control outputs. |
| **Proportional Band:** | programmable<br>- from 1.0% to 100.0% of the input span for process with one control output.<br>- from 1.5% to 100% of the input span for process with two control outputs<br>Setting a PB equal to 0 the control action becomes ON/OFF. |
| **Hysteresis (for ON/OFF control action):** | programmable from 0.1% to 10.0 % of the input span. |
| **Integral time:** | programmable from 1 second to 20 minutes or excluded. |
| **Derivative time:** | programmable from 1 second to 10 minutes or excluded. |
| **Integral preload:** | programmable<br>- for one control output, from 0 to 100% of the output range<br>- for two control outputs, from -100% to +100% of the heating/cooling output range. |
| **Out 1 cycle time:** | from 1 second to 200 seconds. |
| **AUTO/MANUAL mode:** | selectable by front pushbutton or logic input. |
| **AUTO/MANUAL transfer:** | bumpless method type |

**Two control outputs (heating/cooling)**

| | |
|---|---|
| **Relative out 2 gain:** | keyboard programmable from 0.20 to 1.00 referred to the proportional band. |
| **Out 2 cycle time:** | from 1 second to 200 seconds. |
| **Overlap/dead band:** | keyboard programmable from -20% (dead band) to +50% (overlap) of the proportional band. |
| **NOTE:** | by setting, during configuration procedure, the proper cooling medium: (air, oil or water) the instrument will set automatically the output 2 parameters. |

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**CONTROL OUTPUTS**

This instrument is equipped with 2 independent outputs programmable as:
- heating + alarm 1
- heating + cooling

In addition to the standard outputs, it can be equipped with an optional output (OUT 3) programmable as:
- alarm 2 output
- alarm 2 output + OFD alarm output.

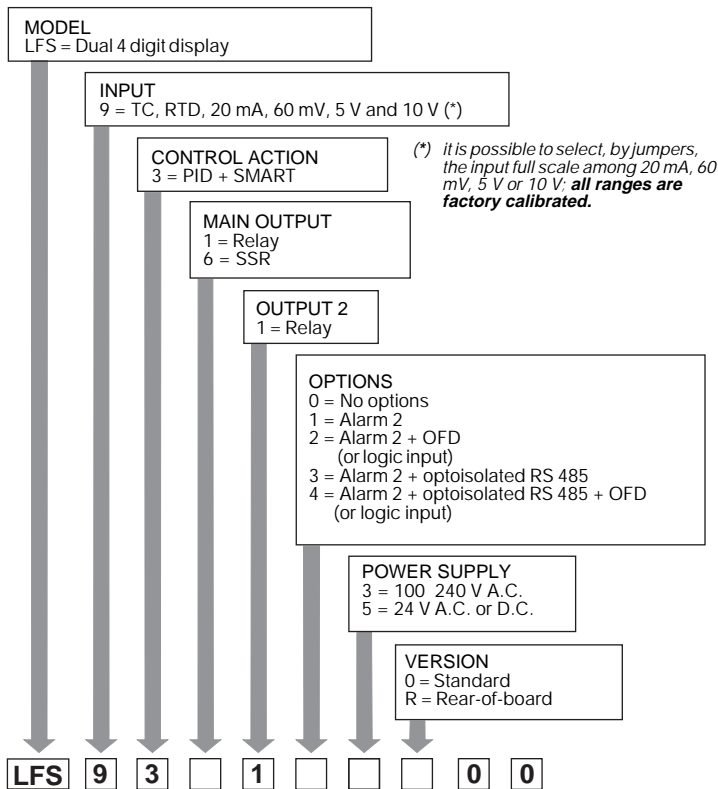| | |
|---|---|
| **Type:** | time proportioning |
| **Updating time:** | - for linear inputs = 250 ms<br>- for TC or RTD inputs = 500 ms. |
| **Direct/reverse action:** | keyboard programmable. |
| **Output level indication:** | the instrument displays separately the output 1 level (heating) and the output 2 level (cooling). |
| **Output status indication:** | two indicators (OUT 1 and OUT 2) are lit when the respective output is in ON condition. |
| **Output level limiter:** | for one control medium: from 0 to 100%.<br>For two control mediums: from -100 to +100%.<br>This function may be operative at instrument start up for a programmable time (To avoid thermal shock and/or preheating the plant). |

## Relay outputs

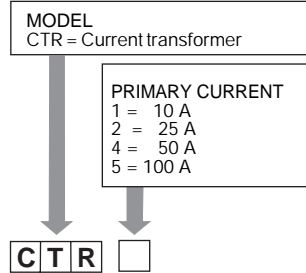|  |  |
|---|---|
| **Output cycle time:** | programmable from 1s to 99 s. |
| **Output 1** (heating)**:** | SPDT contact with rated current 3 A at 250 V AC on resistive load. |
| **Output 2** (cooling): | SPST contact with rated current 2 A at 250 V AC on resistive load. |
| **Output 3** (optional): | SPST contact with rated current 2 A at 250 V AC on resistive load. |
| **Logic voltage for SSR driver (output 1 only):** | logic level 0: Vout < 0.5 V DC.<br>logic level 1: 14 V < Vout < 24 V DC (@ 20 mA)<br>maximum current = 20 mA. |

## OFD FUNCTION
**(Optional)**

The instruments equipped with this feature are capable to measure by means of a CT, the out 1 running current.
- During the ON period of the output 1, the instrument measures the out 1 running current and it generates an alarm condition when this current is lower than a pre-programmed threshold value (a low current shows a partial or total break down of the load or of the actuator).
- During the OFF period of the output 1, the instrument measures the leakage current running in the load and it generates an alarm condition when this current is higher than a pre-programmed threshold value (an high leakage current shows a short circuit of the actuator).

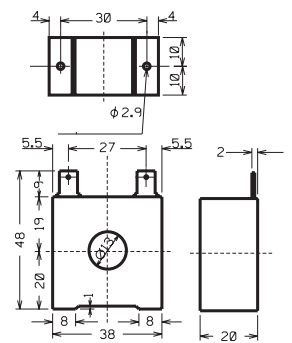|  |  |
|---|---|
| **Input range:** | 50 mA AC. |
| **Scaling:** | programmable from 10 A to 100 A (with 1 A step). |
| **Resolution:** | - for full scale up to 20 A: 0.1 A.<br>- for full scale from 21 A to 100 A: 1 A. |
| **Active period:** | - for relay output: NO or NC programmable<br>- for SSR output: logic level 1 or 0 programmable. |
| **Minimum active period to perform the measurement:** | 400 ms. |
| **Note:** | this function excludes the logic input (external set point selection). |

## HOW TO ORDER



MODEL
LFS = Dual 4 digit display

INPUT
9 = TC, RTD, 20 mA, 60 mV, 5 V and 10 V (*)

CONTROL ACTION
3 = PID + SMART

*(*) it is possible to select, by jumpers, the input full scale among 20 mA, 60 mV, 5 V or 10 V; **all ranges are factory calibrated.**

MAIN OUTPUT
1 = Relay
6 = SSR

OUTPUT 2
1 = Relay

OPTIONS
0 = No options
1 = Alarm 2
2 = Alarm 2 + OFD
   (or logic input)
3 = Alarm 2 + optoisolated RS 485
4 = Alarm 2 + optoisolated RS 485 + OFD
   (or logic input)

POWER SUPPLY
3 = 100  240 V A.C.
5 = 24 V A.C. or D.C.

VERSION
0 = Standard
R = Rear-of-board

| LFS | 9 | 3 |  | 1 |  |  |  | 0 | 0 |

## Optional ACCESSORIES

### CURRENT TRANSFORMER

MODEL
CTR = Current transformer

PRIMARY CURRENT
1 =  10 A
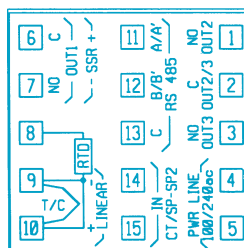2 =  25 A
4 =  50 A
5 = 100 A

| C | T | R |  |

*This accessory is applicable only to models with OFD alarm function.*



REAR TERMINAL BLOCK
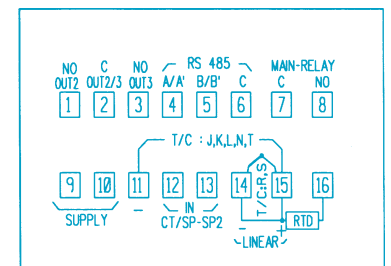
STANDARD VERSION          REAR-OF-BOARD VERSION

# LFS mA

4 - 20 mA
LINEAR
OUTPUT
PROGRAMMABLE

2 set points
selectable
by contacts



| analog retransmission of the measured value | or | control output | or | analog retransmission of the operative set point |

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## CONTROL ACTION

| | |
|---|---|
| **Algorithm:** | PID + SMART |
| **Type:** | One (heating) or two (heating and cooling) control outputs. |
| **Proportional Band:** | programmable from 1.0% to 200.0% of the input span. Setting a PB equal to 0 the control action becomes ON/OFF. |
| **Hysteresis (for ON/OFF control action):** | programmable from 0.1% to 10.0 % of the input span. |
| **Integral time:** | programmable from 1 second to 20 minutes or excluded. |
| **Derivative time:** | programmable from 1 second to 10 minutes or excluded. |
| **Integral preload:** | programmable<br>- for one control output, from 0 to 100% of the output range<br>- for two control outputs, from -100% to +100% of the heating/cooling output range. |
| **Out 1 cycle time:** | from 1 second to 200 seconds. |
| **AUTO/MANUAL mode:** | selectable by front push-button or logic input. |
| **AUTO/MANUAL transfer:** | bumpless method type |

## Two control outputs (heating/cooling)

| | |
|---|---|
| **Relative out 2 gain:** | keyboard programmable from 0.20 to 1.00 referred to the proportional band. |
| **Out 2 cycle time:** | from 1 second to 200 seconds. |
| **Overlap/dead band:** | keyboard programmable from -20% (dead band) to +50% (overlap) of the proportional band. |
| **NOTE:** | by setting, during configuration procedure, the proper cooling medium: (air, oil or water) the instrument will set automatically the output 2 parameters. |

## CONTROL OUTPUTS

This instrument is equipped with 3 independent outputs programmable as follows:

| OUT 1 linear (mA) | OUT 2 relay | OUT 3 relay |
|---|---|---|
| Heating | AL 1 | AL 2 |
| Heating | Cooling | AL 2 |
| Heating | AL 1 | Cooling |
| Cooling | AL 1 | AL 2 |
| Cooling | Heating | AL 2 |
| Cooling | AL 1 | Heating |
| Retransm. | Heating | AL 2 |
| Retransm. | AL 1 | Heating |
| Retransm. | Cooling | AL 2 |
| Retransm. | AL 1 | Cooling |
| Retransm. | Heating | Cooling |
| Retransm. | Cooling | Heating |
| Retransm. | AL 1 | AL 2 |

| Updading time: | - for linear inputs = 250 ms |
|---|---|
| | - for TC or RTD inputs = 500 ms. |
| Action: | direct/reverse programmable by front keyboard. |
| Output level indication: | the instrument displays separately the output 1 level (heating) and the output 2 level (cooling). |
| Output status indication: | the OUT 1 LED will flash with a duty cycle proportional tp the output 1 power. Two indicators (OUT 2 and/or OUT 3) are lit when the respective output is in ON cindition. |
| Output level limiter: | for one control medium: from 0 to 100%. For two control mediums: from -100 to +100%. This function may be operative at instrument start up for a programmable time (To avoid thermal shock and/or preheating the plant). |

## OUTPUT 1

| Type: | optoisolated 0-20 mA or 4-20 mA programmable. |
|---|---|
| Function: | programmable as: |
| | - control output (heating or cooling) |
| | - retransm. of the measured value |
| | - retransm. of the operative set point. |
| Scaling: | programmable from -1999 to 4000. |
| Maximum load: | 500 Ω. |
| Resolution: | - 0.1% when used a control output |
| | - 0.05% when used as analog retransmission. |
| Digital filter: | it is possible to enable digital filter, on the output retransmission, with the same time constant for the read-out. |
| Output level indication (as control output only): | from 00.0 to 100%. |
| Output status indication: | the indicator OUT 1 flashes with a duty cycle proportional to the output level. |

## OUTPUT 2

| Type: | relay SPST contact (NO or NC selectable by jumper). |
|---|---|
| Function: | programmable as: |
| | - control output (heating or cooling) |
| | - alarm 1 output. |
| Output cycle time (when used as control output): | programmable from 1 s to 99 s. |

## OUTPUT 3

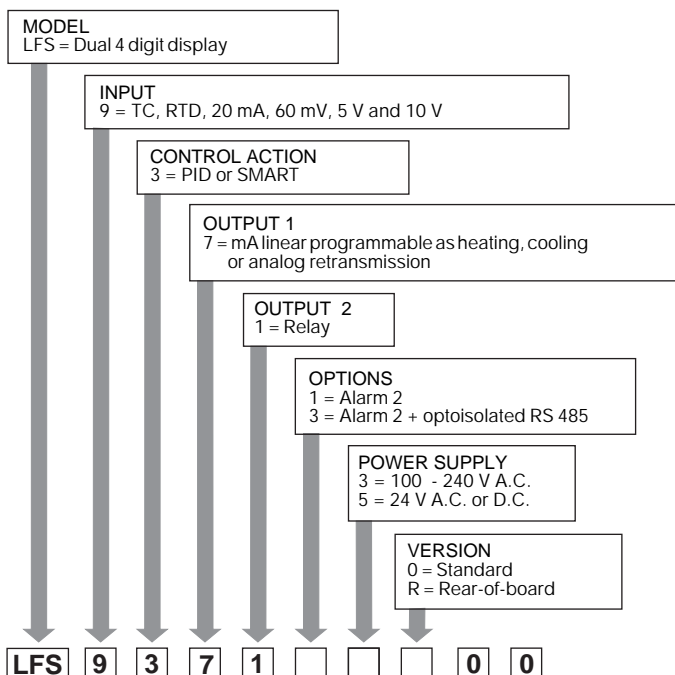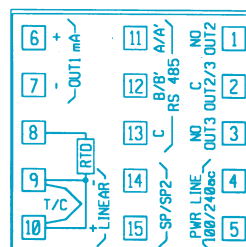| Type: | relay with SPST contact with rated current 2 A at 250 V AC on resistive load. |
|---|---|
| Function: | programmable as: |
| | - control output (heating or cooling) |
| | - alarm 2 output. |
| Output cycle time (when used as control output): | programmable from 1 s to 99 s. |

## HOW TO ORDER

MODEL
LFS = Dual 4 digit display

INPUT
9 = TC, RTD, 20 mA, 60 mV, 5 V and 10 V

CONTROL ACTION
3 = PID or SMART

OUTPUT 1
7 = mA linear programmable as heating, cooling or analog retransmission

OUTPUT 2
1 = Relay

OPTIONS
1 = Alarm 2
3 = Alarm 2 + optoisolated RS 485

POWER SUPPLY
3 = 100 - 240 V A.C.
5 = 24 V A.C. or D.C.

VERSION
0 = Standard
R = Rear-of-board

| LFS | 9 | 3 | 7 | 1 | | | | 0 | 0 |

REAR TERMINAL BLOCK

STANDARD VERSION

REAR-OF-BOARD VERSION