



Instruction manual

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10-channel temperature regulator with linear path control





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I) INTRODUCTION

The microcontroller described in this manual holds the control of all the operations of a packaging machine, for what concerns both the glue temperature regulation in the different parts of the machine, tank, hoses and guns, and the glue distribution by means of 4 completely independent channels.

The visualisation and the setting of the control parameters are possible by using a 16 digits led display, 8 led indicators and a 23 keys keyboard present on the front side of the microcontroller. The maximum configuration includes the temperature regulation of 4 hoses, 4 guns and the glue tank that uses other 2 independent channels. The temperature probes are 2 wires Pt100.

The part that concerns the automatic glue distribution drives the sprinkling of 4 guns by means of an external power board. The setting of the glue line lengths are effected in millimeters and they can be programmed up to 4 strokes glue/gap for every channel.

An incremental encoder (1000 pulses per revolution) can carry out the measurement of the distances but it is also possible to work with the time based mode, that is, by using a constant speed.

The scanning on the inputs and outputs of glue distribution is effected every 500 uSec in encoder mode and every 1 mSec in time based mode.



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II) 10 CHANNELS TEMPERATURE CONTROLLER FOR HOT-MELT

2.1) TEMPERATURE SET POINT MODIFICATION

When the microcontroller is turned on, the temperature of the first sector of the tank (t1) along with its set point are visualized on the first display line, while the machine speed in mm/sec and current time are shown on the second display line.

The temperatures and the respective set points of the other channels (t2 / H1 - H4 / G1 - G4) are visualized by pressing the symbol of the wanted channel followed by the identification number on the keyboard.

The working temperature of the microcontroller ranges from $-2\text{ }^{\circ}\text{C}$ to $+249\text{ }^{\circ}\text{C}$. Temperatures lower than $-2\text{ }^{\circ}\text{C}$ are signaled as "S.co" that means "probe in short circuit", while those higher than $+249\text{ }^{\circ}\text{C}$ are signaled as "S.in" that means "probe interrupted".

Beside the symbol related to the selected channel will be shown the measured temperature and its set point. Related to this set point there are two alarm thresholds at $-10\text{ }^{\circ}\text{C}$ and $+8\text{ }^{\circ}\text{C}$. If all the temperature remain inside this gap the "ready" output will be activated; otherwise if just one temperature exceeds these limits for 4 seconds, the value will blink on the display and the "ready" output will be deactivated.

By pressing the <SET> key after selecting any channel, the set point value will blink and it will be possible to modify the value with the numeric keys. To save the new value press the <ENTER>.

NB. If set point = 0 => the channel is disabled.

2.2) STAGGERED THERMO-REGULATION

HOSES ABILITATION:

To enable the hoses thermo-regulation, a fixed value of $50\text{ }^{\circ}\text{C}$ is subtracted to the t1 set point. Every hose will be enabled when the tank temperature will have overcome this value.

GUNS ABILITATION:

As far as the guns thermo-regulation is concerned, a fixed value of $50\text{ }^{\circ}\text{C}$ is subtracted to the set point assigned to every hose. When the measured temperature of each hose overcomes such a value, the regulation of the relative gun is enabled.

2.3) ECONOMY MODE

By pressing the sequence <ECON>, <SET>, the current set for the Economy function is visualized on the first display line. It can be modified by using the numeric keys or confirmed pressing <ENTER>. The Economy function can be toggled by pressing the sequence <ECONOMY>, <ENTER>.



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The active state of this function is signaled by the message "Econ" on the display. When active, the Economy set point you decide will be subtracted to the set point of every channel and the thermo-regulation will work with this new value.

2.4) WEEKLY PROGRAM MODIFICATION

By pressing the <CLOCK> key, the current state of the weekly program operating on the thermo-regulation (Enab yes/no) will be shown on the led display. It can be confirmed by pressing the <ENTER> key or modified by using any numeric key followed by <ENTER>. If it is confirmed "no", the weekly program is disabled and the thermo-regulation is enabled at any time. Instead, if it is confirmed "yes", the thermo-regulation is effected by using daily time periods. In such a case by pressing the <ENTER> key, the display visualizes the scheduled weekly program in a sequence beginning from the starting time (on) for the day 1 (Monday) up to the stopping time (off) for the day 7 (Sunday). To modify the times use standard procedure <SET>, <numeric key>, <ENTER>.

By pressing the <CLOCK> key twice, the setting of the current time will be enabled and it can be performed by using the standard procedure. Once confirmed the hour and minute values, it will blink the value for the current day of the week (1=Monday, ..., 7=Sunday).

2.5) SCANNING CHANNELS

By pressing the <SCAN> key, the microcontroller will show the measured temperatures and the set points of all the enabled channels (set point > 0) one by one with a permanence time of about 4 seconds. To exit the scanning mode, select a specific channel (i.e. <TANK>, <1>, <ENTER>)

By pressing the <SCAN> key twice, all the segments of the displays and leds will light up allowing an immediate check of their proper functioning. To exit this function, press the <SCAN> key again.

2.6) MAXIMUM TEMPERATURE ALARM

A fixed value of temperature equal to 230 °C has been preset as maximum threshold for the working temperature of every channel. If a measured temperature overcomes 230 °C for at least 15 seconds, the Alarm relay output normally ON, switches to OFF and the thermo-regulation is disabled. In such a case, the display will show the "ALL.t" blinking message along with the temperature of the alarmed channel. The Alarm relay can be used to drive an external auxiliary device in order to inhibit the heating loads and to prevent damages due to the machine overheating. To remove this alarm condition, it is necessary to turn off and turn on the microcontroller after having removed the cause of the alarm.



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III) GLUE DISTRIBUTION FUNCTION

On the CPU board there is a jumper (J1) to select the controller operation mode:

J1 on -> only thermo-regulation

J1 off -> thermo-regulation and glue distribution

3.1) GLUE DISTRIBUTION WITH ENCODER

By pressing the <ENC/TIMER> key, the display will show "Enc yes/no" that requires the choice for the glue distribution mode. You can toggle your choice by using any numeric key and confirm it with the <ENTER> key. If you choose "yes" the glue distribution is enabled with the measurement of the distances by using the incremental encoder. In this configuration the following settings can be made:

3.1.1) DISTRIBUTION PROGRAM

By pressing the <PROG NR> key, the "speed" display will show the current value of the selected distribution program ranging from 1 to 99, in which the glue strokes settings related to different manufacturing can be saved. The selected value can be modified by using the standard procedure.

3.1.2) DISTRIBUTION SET POINTS

By pressing the sequence <GUN NR>, <1-4>, the set points of the 4 glue distribution channels will be visualized on display in the following way:

Px.ly xxxx or Px.Fy xxxx

where: X is the program number (1-99) of the selected channel and Y is the number (1-4) of the selected glue stroke. l and F show the start or the end values in millimeters of the glue line. The values can be modified by using the <SET> key, the numeric keys and <ENTER>. If you set lY=0000, Y=2-4 the glue distribution program finishes with the end of the previous glue stroke (Y-1). Instead, if you set FY=0000 with Y=1-4 the glue stroke Y continues until the Reset digital input is activated.

3.1.3) MACHINE DATA

After having confirmed the choice for the glue distribution with encoder, by pressing the <DATA> key, the display will show the following machine data in the sequence:



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- 1) CF.At. = xxx% (0-100%): attenuation coefficient for current output 4-20mA
- 2) inF = xxxx mm/sec (0-9999): minimum speed for current output 4-20mA
- 3) Sup = xxxx mm/sec (0-9999): maximum speed for current output 4-20mA
- 4) cEnc = xxxx mm (200-9999): displacement encoder in mm for every revolution (*)
- 5) Off.1 = xxxx mm (0-9999): distance between photocell and sprinkler of CH1
- 6) Off.2 = xxxx mm (0-9999): distance between photocell and sprinkler of CH2
- 7) Off.3 = xxxx mm (0-9999): distance between photocell and sprinkler of CH3
- 8) Off.4 = xxxx mm (0-9999): distance between photocell and sprinkler of CH4
- 9) CH.1 -> St.x (1-2): is the start assigned to CH1
- 10) CH.2 -> St.x (1-2): is the start assigned to CH2
- 11) CH.3 -> St.x (1-2): is the start assigned to CH3
- 12) CH.4 -> St.x (1-2): is the start assigned to CH4

(*) You have to use 1000 pulse/rev encoder only

3.1.4) ADJUSTMENT PARAMETERS

By pressing the numeric keys <2102> you can modify the adjustment parameters for the glue strokes set points regarding to the gun features. To every channel K1-K4 can be associated an initial and final forestall time in mSec to apply to the on and off action of the guns, in order to obtain the glue strokes of constant length on changing the machine speed. Roughly, as initial and final forestall values, you should set a time correspondent to the opening and closing delay of the solenoid/nozzle system used for each distribution channel.

On the display "speed / clock" you will see:

Ad.i.1 xx.x (xx.x = initial forestall time in msec for K1)

After the modification, confirm the value with the <ENTER> and you will get:

Ad.F.1 xx.x (xx.x = final forestall time in msec for K1)

and so on for the following channels.

3.2) TIME BASED GLUE DISTRIBUTION

If, after having pressed the <ENC/TIMER> key, you select "no", the glue distribution is enabled with measurement of the distances on time based, that is, you set in the machine data the prefixed constant speed of the machine in mm/sec and then the glue strokes in mm assigned to every channel will be carried out calculating the opening time for the nozzles necessary for such a speed. In this configuration the following settings can be done:



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3.2.1) DISTRIBUTION PROGRAM

By pressing the <PROG NR> key, the “speed” display will show the current value of the selected distribution program ranging from 1 to 99.

3.2.2) DISTRIBUTION SET POINTS

By pressing the sequence <GUN NR>, <1-4>, the set points of the 4 glue distribution channels will be visualized on display as explained in the glue distribution with encoder section.

3.2.3) MACHINE DATA

By pressing the <DATA> key, the display will show the following machine data in the sequence:

- 1) Off.1 = xxxx mm (0-9999): distance between photocell and sprinkler of CH1
- 2) Off.2 = xxxx mm (0-9999): distance between photocell and sprinkler of CH2
- 3) Off.3 = xxxx mm (0-9999): distance between photocell and sprinkler of CH3
- 4) Off.4 = xxxx mm (0-9999): distance between photocell and sprinkler of CH4
- 5) CH.1 -> St.x (1-2): is the start assigned to CH1
- 6) CH.2 -> St.x (1-2): is the start assigned to CH2
- 7) CH.3 -> St.x (1-2): is the start assigned to CH3
- 8) CH.4 -> St.x (1-2): is the start assigned to CH4
- 9) SPd. xxxx = prefixed speed in mm/sec

3.2.4) ADJUSTMENT PARAMETERS

This settings are not effective in time based mode.

3.3) MANUAL FUNCTIONING

By pressing the <TEST> key, the display will show the blinking message “test”. In this status, each gun can be toggled on/off by pressing the correspondent numeric keys (1-4). To exit the manual test, press the <TEST> key again.

3.4) DIGITAL INPUTS

There are two digital inputs available on the microcontroller that determine the start of the glue distribution program. As already seen, these inputs can be assigned by the user to one of the 4 distribution channels K1-K4. The shortest appreciable pulse for these inputs is 1 mSec and they can be driven either from a micro-switch with a normally open contact or from a photocell with NPN transistor output type. A 15Vcc power source for these sensors is available on the glue distribution board.



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Besides these two digital inputs, another digital input is available to reset the glue distribution program in progress. The input is normally closed and it can be used to inhibit the sprinklers in case of an emergency intervention.

The digital input for the encoder accepts a continuous voltage ranging from 5 to 15 Vcc supplied by a device with push-pull or PNP output. The highest working frequency for this input is about 20 kHz.

3.5) 4-20mA ANALOGICAL OUTPUT

An analogical output 4-20mA is provided in order to drive a pressure regulator for the glue distribution on the basis of the working speed during the functioning with encoder. This output is disabled in the time based mode. The acceptable maximum impedance on this output is 600 ohms.

IV) RS232C SERIAL LINE PARAMETERS

By pressing the numeric keys <677159> you will enter the settings for the RS232C serial line parameters. You will see:

Addr xx

where xx = 1-50 = is the terminal address of the controller to connect to a personal computer. After this value, by pressing <ENTER> you will see:

bAUd xxxx

where xxxx = 1200/2400/4800/9600 is the transmission speed for the communication. To modify this value press <SET> + <any numeric key> +<ENTER>. Other fixed parameters concerning the serial communication are: 8 bits data, even parity, 1 stop bit.

V) SELF-TEST PROGRAM

By turning on the microcontroller with the <TANK> key pressed for about 4 seconds, the self-test program for the digital inputs/outputs will start. The display will show the active digital input:

St.1 -> start 1
St.2 -> start 2
rES.C -> glue reset

All the digital outputs will be activated one by one with the sequence:

tk1,G1,H1,G2,H2,G3,H3,G4,H4,tk2,ready,all.max,(k1,k2,k3,k4)



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Moreover, there is the possibility to load 2 tables of preset parameters. The first table contains values to reset all the working parameters while the second table contains values for the standard working parameters. To load the reset table, turn the microcontroller on with the <CLOCK> key pressed for at least 4 seconds. To load the standard table, turn the microcontroller on with the <SET> key pressed for at least 4 seconds. In these two cases, before starting the self-test program above described, the message "in Pro" will appear on the display during the memory programming period. When the memory programming is over, the message "End Pro" will be shown on the display and the microcontroller will start the self-test program. Here below you can find the parameters list of each table.

Reset table:

- 1) all thermo-regulation set points = 0
- 2) Economy set point = 0
- 3) all weekly program = 0
- 4) time based glue distribution
- 5) weekly program disabled
- 6) all adjustment parameters = 0
- 7) glue distribution program = 1
- 8) attenuation coefficient 4-20 mA = 100%
- 9) min / max. speed 4-20 mA = 100/1000 mm/sec
- 10) displacement encoder = 1000 mm
- 11) initial offset K1-K4 = 0
- 12) all channels with start 1
- 13) prefixed speed = 1000 mm/sec
- 14) terminal address RS232 = 1
- 15) baud rate = 9600 baud

Standard table:

- 1) thermo-regulation set points: tk1=200, others = 135
- 2) economy set point = 30
- 3) weekly program : mon / fri -> on=7.00/off=18.00
 sat -> on=7.00/off=12.00
 sun -> on=0.10/off=0.09 (always off)
- 4) glue distribution with encoder
- 5) weekly program disabled
- 6) all adjustment parameters = 0
- 7) glue distribution program = 1
- 8) attenuation coefficient 4-20 mA = 100%
- 9) min/max speed 4-20 mA = 100/1000 mm/sec
- 10) displacement encoder = 1000 mm
- 11) initial offset K1-K4 = 0
- 12) channels K1-K2 -> start1 / K3-K4 -> start2
- 13) prefixed speed = 1000 mm/sec
- 14) terminal address RS232 = 1
- 15) baud rate = 9600 baud