PROGRAMMABLE CONVERTER / THRESHOLD RELAY USER MANUAL

Programmable converter / threshold relay type:

BPX / LPX

ProgressX Family

Summary

BPX / LPX

Programmable converter, threshold relay for process signals and temperature probes.

1. General Presentation

The BPX / LPX converter is designed for the supervision or regulation of standard physical values (temperature, pressure, position, etc.).
The value to process can be measured directly by a sensor or from a measuring transmitter (current 4-20 mA, voltage 0-10V, voltage 0_100mV).
Various options enable suitable outputs for the required supervision to be chosen: relay contacts combined with programmable thresholds, proportional 4-20mA analogue outputs.
The BPX / LPX comes in small-sized plastic housing that can be installed easily on DIN rails compliant with standard EN50022 found in control cabinets.
An "intrinsic safety" version [EEx ia] IIC enables it to be used as a separation barrier for measurement of signals coming from hazardous areas.

1.1 Input values

The metrological specifications can be consulted at: www.georgin.com
- Current from 4-20 mA measurement transmitters

The BPX / LPX can be connected as to passive or active transmitters (respectively 2 or 3/4 wires).
A passive transmitter can be supplied with power by the BPX / LPX.
- 20 mA current

This input operates in milliammeter mode; please consult the sections "Sensor faults" and "Special functions" for the differences between the "current" and "transmitter" inputs.
- 100 mVcc voltage

This input operates in millivoltmeter mode with very high input impedance (>1000 MΩ).
- 10 Vcc voltage

This input operates in voltmeter mode with an input impedance of 1 MΩ.
- Temperature by thermocouple sensor

Input that supports all standard thermocouple sensors.
The user can opt for the cold-junction compensation within the BPX / LPX or realise this compensation with an external circuit.
- Temperature by 100 Ω platinum resistance probe

Measurement by the resistance probe in a two, three or four wires configuration with compensation for line impedances.
The measuring current is 500 µA.
- Position by potentiometric sensor

Measurement of the ratio (0 to 100%) between the voltage available on the slider and the supply voltage of the potentiometric sensor (supplied by the BPX / LPX).

1.2 Output values

Depending on the outputs selected (consult the commercial references table to determine the possible combinations on the outputs), the BPX / LPX can manage:
- Two or four threshold supervision relays for the input value.
- One or two 4-20 mA analogue outputs

Caution: For a BPX / LPX with 2 analogue outputs, only one can supply the current loop that is connected to it ("active" output).

1.3 Power supply

The BPX / LPX is available for two power supplies

- Power supply for a 50 Hz/60 Hz alternating current network. The voltage value lies between 98 Vac and 255 Vac.
- Power supply for a direct current network. Voltage value lies between 21 Vdc and 53 Vdc.

2. Operating principle

The BPX / LPX is fully controlled by a microcontroller with an internal flash memory that supports all the configuration settings in addition to the embedded program.

2.1 Analog to digital conversion – input stage

The microcontroller receives the digital value of the input signal, this value is provided by a DeltaSigma type ADC with 16-bit resolution. The analogue-to-digital conversion time is approximately 150 ms.
All the inputs are formatted before conversion then multiplexed and amplified according to their source:
- 20 mA or 4-20 mA current: the signal passes through a 4 Ω shunt
- 100 mV voltage: the signal is injected directly into the multiplexer
- 10 V voltage: the signal is divided by 100 through a resistive bridge
- temperature by 100 Ω platinum resistance probe: a constant current of 500 µA is injected into the resistance to be measured. Depending on the configuration (2,3 or 4 wires), the voltages at the resistor terminals are successively processed and the influence of the line resistance is eliminated by computation.
- Temperature by thermocouple sensor:

The voltage supplied by the thermocouple is applied directly to the multiplexer input.
When selected "internally", the cold-junction compensation is computed by measuring the temperature of the connection using a platinum resistance probe soldered under the terminal.
- Position par potentiometric sensor

The voltages from the power supply and potentiometer slider are alternatively measured using the same process as for the 100 mV input.
The position of the slider is determined by the calculation of these two signal values.

2.2 Digital-to-analogue conversion. Output stage

The microcontroller produces the value of the analogue output from the input value measured and the configuration settings. It then generates a signal with a duty cycle that is a function of the required analogue value.
After isolation by the optocouplers, a voltage-to-current converter converts the mean value of this signal into a current that is injected into the 4/20 mA analogue output.

2.3 Threshold relay supervision

Threshold processing (overshoot, hysteresis and timeout) is provided by the microcontroller, which also controls the associated relays.
The direction of operation of the relays in the event of a threshold overshoot depends on the parameters set for the configuration.
Threshold overshoot is signalled by LEDs on the front panel.

2.4 RS232 link

The BPX / LPX is configured using a PC type computer. The information is transferred to the BPX / LPX via an RS-232 link.
The computer manages the dialogue through optocouplers and a specific interface circuit responsible for adapting the logical levels.

2.5 Power supply. Galvanic isolation

BPX / LPX power supply uses the chopping technique with a FLYBACK topology. Regulation is provided by a specific circuit with a 50 kHz working frequency, which enables good electromagnetic compatibility performances to be obtained.
The transformer used in the power supply provides galvanic isolation between three electric potentials:
- electric potential of the mains supply.
- electric potential of the input stages (including the power supply of the passive transformers) to which the microcontroller is also connected.
- electric potential of the output stages: analogue output and RS 232.

Caution: For a BPX / LPX with two analogue outputs, these outputs are galvanically isolated, but only one can supply the current loop to which it is connected.
Note: On request, an operation performed in factory isolates the electric potential of the RS-232 link from the analogue output potential, which then becomes "passive".

3. Digital data processing

In order to fully understand all the possibilities offered by the BPX / LPX or to correctly configure the software, here are a few operating definitions and descriptions.

3.1 Input values

This is the digital value of the input signal. It is expressed in °C, °F or K for measurements from temperature probes and in mV, V, mA, % for the measurements from the other sensors.
The input value varies within a scale (also called rating) outside of which measurement is impossible; if the signal to measure leaves the scale, the input value then takes the maximum or minimum value of the scale depending on the direction of overshoot.

3.2 Range

This is the part of the scale that corresponds to a variation of 4 mA (low range) to 20 mA (high range) of the analogue outputs.
Caution: If the BPX / LPX has two analogue outputs, they share the **same** range!
If the input value lies outside the range, the analogue outputs change to reach either the upper or lower limit.
If two analogue outputs are present on the BPX / LPX, they can have different upper and lower limits.
Note: For a BPX / LPX without an analogue output, the range corresponds to the "normal" dynamics of use of the input value (This dynamic is often determined by the sensor used).

3.3 Physical value represented

This is the physical value represented by the input value (e.g. 0-100 mV/0-50 bar sensor, for 50 mv of input value, the physical value represented 25 bar).
It is defined by configuring the physical values that correspond to the lower and upper values of the range.
Caution: The physical value is the value taken into account for configuring the threshold set values.
For the temperature inputs, setting the parameters of the physical value represented is prohibited (and impossible!).

Régulateurs GEORGIN
14-16 rue Pierre Sémard – BP 107 – 92323 CHATILLON cedex France
Tel. : 33 (0)1 46 12 60 00 – Fax : 33 (0)1 47 35 93 98
Email : regulateurs@georgin.com Web : www.georgin.com

Belgium
Email: info@georgin.be

3.4 Special functions allotted to input sensors

Some sensors can have specific processing:

- 4-20 mA transmitter - square root: the input value I is transformed into I' using the formula $I' = 4+4\sqrt{(I-4)}$

This quadratic transformation can be applied only to the 4-20 mA input of the transmitter and not the 20 mA input current!

(this function is generally used for flow transmitters operating by differential pressure measurement: $d = k\sqrt{\Delta p}$)

- 4-20 mA transmitter - upper/lower limit: restricts the input value beyond which the sensor or transmitter is considered to be faulty; these limits can be set in the configuration.
- two-wires configured platinum probe – line resistance: this value is subtracted from the measured resistance of the platinum resistance sensor seen from the two connection points.

The configuration software enables the line resistance value either to be entered on the keyboard or to be measured.

- potentiometer – "shadow zone":

The value measured (in %) can be corrected to account for the real movement of the slider.

The configuration software enables the two "shadow zones" of the potentiometer either to be entered on the keyboard or to be measured.

After correction, the input value varies between 0 to 100% when the signal lies between the "shadow zones".

- temperature by thermocouple sensor - internal cold-junction compensation:

When the measurement is taken with INTERNAL cold-junction compensation, the BPX / LPX corrects the voltage from the sensor to account for the temperature of its connections on the BPX / LPX terminal (cold- junction) to obtain the temperature of the hot junction.

3.5 Sensor faults

A fault in the input sensor is detected in the following cases:

- 4-20 mA transmitter: input signal outside of the lower or upper limits set in the configuration.
- temperature by platinum resistance sensor: break in one of the connecting wires.
- temperature by thermocouple: broken sensor or internal cold-junction compensation sensor.
- position by potentiometric sensor: break in one of the connecting wires.
- voltage and current inputs (100 mV, 10V, 20mA): input signal outside of the scale.

When a sensor fault appears, the BPX / LPX can, depending on its settings:

- Process the fault.
- by forcing the state of one or more threshold relays; in this case, the sensor fault is signalled by the relevant flashing LED on the BPX / LPX front panel.
- by forcing the value of the current(s) on the 4-20 mA analogue outputs (substituted value).
- Ignore the fault.
- the input value then takes the low or high value of the scale (according to the type of break!).

3.6 Alarm threshold operation

Each alarm threshold is defined by four parameters:

The set value: this is the value with which the measured value is compared (expressed by a physical value!)

Operating mode and hysteresis:

Hysteresis (H in the diagrams) is expressed as a % of the range.

In practice, hysteresis prevents the repeated switching of a relay when the input value varies around the set point value.

Timeout: expressed in ms, this is the minimum time for which a threshold can be exceeded (for rise or fall) so that the relay is active (or disabled!).

In practice, the timeout enables brief variations in the input value to be ignored but introduces a delay into the recognition of the threshold overshoot by the relay.

Note: The status of the thresholds is signalled on the front panel: an LED on means that the relevant threshold has been overshot.

3.7 Operation of the analogue outputs

The "lower range" and "upper range" settings of the input value give the points of the scale that correspond respectively to 4 and 20 mA on the analogue output(s).

When the BPX / LPX has two analogue outputs, the "low range" and "high range" settings are the same for both outputs.

However, the other settings can be different:

- direct/reverse output: for reverse output, the "high range" point of the scale corresponds to 4 mA on the output and the point "low range" point corresponds to 20 mA.
- high/low limitation: the output current of the analogue outputs can never be less than 3.5 mA or above 23 mA. These limits can be replaced by low limit and high limit values.
- substituted value: this is the value that the output current of the analogue output will take in the event of a fault on the input.

3.8 Online measurement acquisition

When the BPX / LPX is connected to a PC type computer, the configuration software enables the following to be read:

- value of the physical value measured.
- any sensor fault.
- status of the threshold relays.
- value of the current(s) on the analogue outputs.

3.9 Online control of outputs

When the BPX / LPX is connected to a PC type computer, the configuration software:

- controls the power to the alarm relay coils: cut-off or triggering.
- imposes a current value on the analogue outputs.

Caution: This operating mode is signalled when the "RUN" LED switches off on the front panel of the BPX / LPX.

3.10 Protection of configuration settings

All the configuration settings are saved in the non-volatile memory of the BPX / LPX.

Access for modifying the settings of the BPX / LPX can also be protected by a password. This password is itself protected in the non-volatile memory.

Description of hysteresis