Electronic Equipment for Control

INTELLI+

Intelligent Command

BERNARD
SUMMARY

- Intelligent actuator ........................................... 3
- INTELLI+ ........................................................... 4
- Non-intrusive commissioning .................................. 9
- Analysis and preventive maintenance ....................... 10
- Electrical connection ........................................... 11
- Configuration ...................................................... 12
- Control by fieldbus ............................................... 14
Technology is evolving toward more intelligent systems that offer more capabilities, better security and a higher level of user friendliness.

The integrated functions of the actuator efficiently address system requirements by setting and controlling the valve position, as well as controlling the transmitted torque, in order to optimise the customers process.

A standard actuator includes travel and torque limit switches used to stop the motor at the correct position or when the torque setting is reached.

A basic intelligent actuator can be achieved by adding locally an on-board microprocessor to a conventional actuator. However, processing capabilities will be limited due to the low level of information communicated.

Only a specific instrumentation and an efficient local microprocessor will allow the full capacity of an intelligent actuator to be achieved.

Highly accurate and rapid measurements allow not only for the control of the actuator, but also of the driven valve.

The microprocessor guarantees dynamic control of the actuator by testing and validating its components and parameters in real time while storing and transmitting to the system, the requested information which will allow the setting of a preventive maintenance for the actuator and its related valve.

Multi-wired connections allow the intelligent actuator to exchange information with the PLC: each bit of data needs a wire to relay the information.

The fieldbus communication of an intelligent actuator, with a PLC, reduces the number of wires to two, no matter the volume of information and allows the actuator to take full advantage of the capacities offered.
INTELLI+ is the new concept and system solution now available from BERNARD. After analyzing user’s needs and taking part in several French and European research programs about intelligent actuators, (including ESPRIT projects : PRIAM and DIAS), this concept has become reality.

It is based on:

■ ABSOLUTE SENSORS: MORE RELIABILITY
INTELLI+ is the first intelligent actuator to include true absolute sensors. Designed by BERNARD, torque and position sensors are extremely reliable and precise.

Reliable measurement:
- based on mechanical measurement and microprocessor management.

Precise and reliable reading:
- to allow a precise reading, the information is numerized on a specific number of bits.
- reading information is contactless. It is ensured by a system of infra-red transmitters and receptors managed by the microprocessor.
- a back-up battery is not necessary to maintain system measurements.

Position:
- an absolute encoder, mechanically driven by the actuator shaft, mechanically knows the position of up to 914 operating turns in standard configuration, coded on 15 bits.

Torque:
A dynamometric system, set at the factory, indicates the actual torque of the actuator through spring compression, coded on 5 bits.

■ PROGRAMMABLE MICROPROCESSOR: MORE POSSIBILITIES
Thanks to a precise algorithm, the microprocessor guarantees control of the actuator and valve parameters, the position and torque measurement, fault treatment (with different fault tolerance levels), while maintaining the actuator permanently under the user’s control, and giving him the information in changes of performance and capacity functions.

■ IMPORTANT MEMORY CAPACITY: MORE INFORMATION
The INTELLI+ is equipped with a special memory capacity EEPROM, which totally secures all the parameter settings and numerous process data records, such as valve torque values recorded during the last operations, that can be used for valve predictive maintenance.
This memory does not require any type of battery backup to maintain its data.
MULTIPLE COMMUNICATION POSSIBILITIES

The INTELLI+ offers many communication possibilities which does not require opening of any covers:

- **remote control**:
  - wire by wire,
  - by fieldbus (interface module optional),
- **locally**:
  - through a display and local control buttons,
  - through an infra-red link with a computer.

REMOTE CONTROL:

- **WIRE BY WIRE COMMANDS**
  Remote control can be achieved using a 1 to 250 V external voltage supply or by dry contacts, which utilizes the actuators internal 24 VDC voltage supply.
  This control can be configured as a pulse or self-holding remote command during the operation.
  Inputs on the board are completely isolated by opto-isolators.
  It is also possible to control the actuator with an unique external contact, using one of the two functions "Priority to open" or "Priority to close".

- **PROGRAMMABLE AUXILIARY COMMANDS**
  In addition to OPEN / CLOSE / STOP commands, INTELLI+ enables to you to choose 2 Extra commands among 8 possible (see page 12).

- **EMERGENCY CONTROL (ESD)**
  ESD (Emergency Shut Down) is a remote emergency control signal with priority over all other controls. Depending upon the valve operation, ESD can be configured to an Open, Close or Stop command. To increase the availability of the actuator in extreme conditions, ESD can also override the motor thermal sensor and ignore any possible torque overload that may be previously set.

- **REMOTE SIGNALLING**
  Remote indication is done through 4 bi-stable relays, with the possibility of 23 available operating options to select from (see page 12).
  Note: voltage free relays maintain their positions without battery backup.
  An additional card (optional) with 3 mono-stable relays allows for reporting of 3 more remote operating values.

- **FAULT MONITORING RELAY**
  One reversing relay indicates the actuator is unavailable.
  The fault monitoring relay reports 5 operating values as a standard. This relay can be set-up according to a list of available options (see page 13).
  Note: the monitoring relay is always energized and drops out only in event of a fault.
Locally:

■ MULTILINGUAL FULL TEXT DISPLAY: MORE FRIENDLY
A LCD gives the precise status of the actuator and of the control system: position in opening percentage (0% = Closed, 100% = Opened), torque in actuator maximum torque percentage (see manufacturer plate), potential warning signals and the setting/diagnostic MENU all in your selected language.

■ LOCAL INDICATIONS: MORE INFORMATION
The display indicates the precise position of the driven device (ie.: 40% open), the presence of an alarm (black square) and torque (ie.: torque 90%).
2 LEDs (red/green) indicate:
- position (close/open) when they are switched, running direction when they blink.

■ CONTACTLESS CONTROL BUTTONS: NON-INTRUSIVE
The control switches function via a magnetic action on Reed contacts placed inside the actuator. There is no direct penetration between the outside environment and the inside of the housing, thus yielding optimum weather-proof operation.

■ LOCAL COMMAND
The red selector switch is able to be locked in each position (padlock not supplied). This selector enables the operator to choose remote control, local control function and stop during operation. It can also inhibit all use of the actuator (OFF position).
The blue selector allows local operation of the actuator in either direction: OPEN or CLOSE.

■ SETTINGS AND DIAGNOSTICS WITHOUT OPENING HOUSING AND WITHOUT TOOLS: MORE RELIABLE
Even in hazardous locations, local control selectors and full text display allow access to the MENU and setting of the actuator security without the need of special tools.

■ AUTOMATIC SETTING: MORE SIMPLE
The actuator is preset (programmed) at the factory based on the user’s needs. The only setting required of the customer is to precisely set the Open and Close positions.
For certain valves, for example gate valves, the INTELLI+ can automatically make this setting: the actuator detects the closed position, then the opened position and finally tests the inertia in order to optimise this setting.

■ INFRARED COMMUNICATION: EVEN MORE NATURAL
As a standard, the INTELLI+ offers the possibility to communicate with a standard laptop through an infra-red link. The computer must include an infra-red transmitter/receiver as well as the INTELLISOFT communication software. The communication kit, INTELLIKIT, contains the required elements and is available as an option (see page 8).

Interactive commissioning: 2 possibilities
- Local control buttons:
  => INPUT
- Local display:
  Y OUTPUT
- Bi-directional infra-red communication with a laptop PC:
  => INTELLISOFT software
  => Standard PC

All functions (use, settings/configuration, status, etc…) are available through the computer.
Other functions:

■ **TIMER**
This function allows for increasing the operating time of the actuator, to avoid for example water-hammer in a pipe.
It is possible to increase the Open or Close time during the operation by selecting the required time.
The INTELLI+ offers both operating and rest times to reach the required operating time.

■ **ACTIVITY : HELP FOR PREVENTIVE MAINTENANCE**
To help the user understand the activity of the actuator and valve, the INTELLI+ records the actuators total running time since manufacture and also since partial counter reset.
In the same way, the INTELLI+ memorizes the actuators number of starts since manufacture and the partial counter reset within the last 12 hours.
INTELLI+ also signals whether the handwheel has been used since the last electrical operation.
Finally, INTELLI+ permanently monitors the required torque necessary to operate the valve, memorizing these torque values generated during the last open and close operations.

■ **ALARMS**
INTELLI+ validates functioning and performances of the actuator and driven valve.
Thanks to the 19 alarms, it indicates all faults locally or remotely within the fieldbus (optional).
A black square on the local display signals an alarm.
The actuator can still operate normally in case of an alarm, for example there is an alarm of ‘Too many starts’.
The alarms will automatically reset when the fault no longer exists.

■ **PHASE MONITORING**
INTELLI+ includes an automatic phase correction and detection device.
In 3 phase supply, whatever the power connection, the actuator always rotates in the correct direction.
If one of the phases is not present, the actuator stops automatically and the monitoring relay drops.

■ **FAULT TOLERANCE: MORE AVAILABLE ESD**
INTELLI+ can be set to allow or not allow for ESD control. Some of the available options are to override the motor thermal sensor and/or not notice a possible torque overload situation.

■ **DATA SHEET**
INTELLI+ keeps in its memory the data sheet of the actuator: customer tag number, BERNARD serial number, duty rating, classification level, manufacturing date, etc ...

■ **PROTECTION BY PASSWORD**
A password can be entered to protect access to the MENU which allows modification of the parameters.
The password must be entered by the user during first use of the actuator.

■ **PROTECTION OF CHANGE IN ROTATIONAL DIRECTION**
An automatic (200ms) delay protects the actuator and valve from all rapid rotational direction changes while limiting the effects of mechanical pieces in inertia.

■ **FUSE PROTECTION**
The internal board is protected by 3 separate fuses.
INTELLIKIT:
INFRA-RED COMMUNICATION KIT

An INTELLIKIT communication kit is necessary for a computer to communicate with INTELLI+. It is composed of:

- INTELLISOFT communication software developed by BERNARD on WINDOWS 95/98 is available on CD-ROM and ready for use as delivered,
- An infra-red transmitter/receiver connected on the serial port, type RS232, of the computer.

POSITION TRANSMITTER

INTELLI+ can be equipped with an analog interface module that transmits remotely the valve position in current (ex. 4-20mA) and in voltage (ex. 0-10V). This interface does not need an external voltage supply. This signal is electrically isolated from the input signal.

TORQUE TRANSMITTER

Applicable torque is constantly monitored and transmitted remotely in 4-20mA by INTELLI+. This signal is electrically isolated from the input signal. This function is available with the position transmitter interface.

ANALOG INPUT SIGNAL CONTROL: POSITIONER

INTELLI+ is equipped as a standard with the positioner function that drives the valve disc to the chosen position. An additional analog board can be added to drive proportionally the actuator with an analog input signal in current (ex. 4-20mA) or in voltage (ex. 0-10V).

Setting of the positioner is automatic. However, the dead band value can be modified by the user. This Analog input signal interface provides torque and position transmission and is electrically isolated from the input signal.

SIGNALLING EXTRAS

To increase the number of remote signals, 3 mono-stable relays can be added to the 4 existing relays. These voltage free relays are programmable and can be chosen to address one of the 23 possible remote indications (see page 12).

FIELDBUS COMMUNICATION

INTELLI+ can be provided with an interface to communicate via the most important fieldbus international standards (DUPLINE DS200, PROFIBUS, MODBUS, FIELDBUS FOUNDATION...).

All commands and remote signalling are available on the bus.

Setting and commissioning can be achieved remotely. All system information can be reached through the fieldbus (according to the standard used).
Non intrusive commissioning

Thanks to INTELLI +, commissioning is simplified and covers need never be opened.

Based on the user’s needs the actuator is preset at the factory.

The only setting required is when the actuator is fitted on the valve, that of a precise open and close position setting.

■ SETTING ON VALVE : MANUAL OR AUTOMATIC
This operation is managed easily with the local control buttons and the full text display going through the MENU:
For certain valves, as an example gate valves, INTELLI + can automatically make this setting: the actuator detects the closed position, then the opened position and finally tests the inertia in order to optimize this setting.

■ PARAMETERS MODIFICATION
If necessary, operating parameters can be modified with the local control buttons by following information on the display.
Main configurable functions are the following: closing direction, closing on torque or position, priority to opening direction (or closing), torque limitation during operation and eventually for opening and closing torque under load.

■ USE INTELLIKIT : EVEN MORE USER FRIENDLY
All these operations can be achieved with a computer and the INTELLIKIT. The kit is composed of an infra-red transmitter/receiver as well as the INTELLISOFT software (see page 8).

Settings and parameter modifications are made with the mouse, using scrolling menus and by selecting the requested options (FOR MORE DETAILS, REFER TO SOFTWARE MANUAL).
Thanks to special sensors and precise microprocessor algorithms, INTELLI+ ensures control of its components in real time as well as that of the actuator and its measured parameters.

INTELLI+ provides users with a great deal of information to help assist them in system diagnostics and aid in programming their valves maintenance.

INTELLI+ helps users to guarantee maximum availability and greatly reduce downtime for maintenance.

**MONITORING FUNCTIONS**

INTELLI+ checks the functioning of its components, particularly torque sensor, position sensor, microprocessor and EEPROM memory.

INTELLI+ constantly monitors its performance in order to detect any problem of over-travel, motor jammed, rotation direction, lost phase, motor thermal overload and many others.

**TORQUE MONITORING**

INTELLI+ knows in real time the applied torque from the actuator to the valve.

To protect the actuator and the valve, the user has the choice of 2 different values of torque limitation for each rotation direction.

For example, for a gate-valve, one will limit the torque value necessary to seal the valve disc on the seat. The other will choose a different setting for the remaining travel in order to protect the disc from any abnormal constraints.

In particular cases where inertia is very important, INTELLI+ could be set to shunt the torque limit device during each start.

**INSTALLATION MONITORING**

INTELLI+ memorizes the valve torque data during its last opening and closing operation.

This information can be recalled on the actuator display. The data can be up loaded on the computer with INTELLIKIT or by fieldbus (optional) in order to be displayed with the INTELLISOFT software curve form (torque vs. position) or to be used in a spreadsheet.

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**TORQUE MONITORING:**

*Close on torque*

- Torque limit to close on valve seat
- Maximum torque (last operation) on valve seat
- Torque reference
- Torque limit to close

*Maximum torque (last operation) measured when closing*

*Torque reference = current torque saved when commissioning for example*

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**INTELLISOFT Software screen**

*Acquisition*:

- Opening
- Closing

*Position%*:

- Return

By recording these curves and studying their evolutions over time can help the user forecast some maintenance operation events.
Electrical connection

ELECTRICAL CONNECTION FOR WIRE TO WIRE COMMAND

- ACTUATOR
  - Motor
  - Thermal
  - Position sensor
  - Torque sensor
  - LCD display

- Reversing starter

- Fuse 1
- Fuse 2
- Fuse 3

- Power supply
- Emergency supply 24V DC
- Aux DC

- Remote commands
- Indication
  - positions
  - status
  - alarms

- Opto-links
- Reed contact

- Indication
- Fault relay

Connection for control by contact:
- ESD
- Local control inhibition
- Opening
- Closing
- Stop

Connection for control by voltage:
- ESD
- Local control inhibition
- Opening
- Closing
- Stop
INTELLI+

Configuration

- Standard configuration
- Optional configuration

**DATA SHEET**
- Tag number (8 digits)
- Actuator serial number (BERNARD serial n°: unchangeable)
- Manufacturing date (Manufacturing date: unchangeable)
- Password (3 digits)

**SET UP**
- Close direction
  - Clockwise
  - Counter-clockwise
- Closing mode
  - On position
  - On torque

**Setting of torque limit system** (% of actuator max torque: see actuator identification plate)
- Closing torque
  - 100%
  - other values between 40 and 100%
- Opening torque setting
  - 100%
  - other values between 40 and 100%

**And only in case of closing the valve on torque:**
- Valve seat torque
  - 100%
  - other values between 40 and 100%
- Torque to unseat the valve
  - 100%
  - other values between 40 and 100%, or without any limitation

**COMMANDS**
- Auxiliary remote commands

  Each of the 2 auxiliary commands is chosen from the following 9:
  - local command inhibit but local stop available (standard configuration for auxiliary command 1)
  - emergency closing (ESD) (standard configuration for auxiliary command 2)
  - local and remote control or remote control only
  - local control inhibit, and local stop also.
  - open inhibited

  - close inhibited
  - emergency opening (ESD)
  - emergency stop (ESD)

**Fault tolerance degradation (ESD)**
- none
- no thermal overload
- full torque (100%)

**Auxiliary command activated by a contact:**
- close
- open

**LOCAL COMMANDS**
- by pulse (a pulse is enough to achieve an opening or closing command)
- maintained (actuator operates while the operator holds the button)
- increments from 0 to 100% (actuator moves the valve to the position set in % of opening)

**Stop local, while remote command**
- authorized
- inhibited

**OPENING / CLOSING PRIORITY**
- none
- open priority
- close priority
- open and close priority

**INDICATIONS**
- Remote indications

  Each information is chosen from the following 23:
  - valve open (standard configuration for R1 and R3)
  - valve closed (standard configuration for R2 and R4)
  - torque limiter action in the opening direction
  - torque limiter action in the closing direction
  - valve in intermediate position, between x% and y% of opening (for example: 10% to 50%)
  - selector in local
  - selector in remote
  - selector in off
  - the actuator is moving (fixed signal)
  - the actuator is moving (blinking signal)
  - moving in the open direction (fixed signal)
  - moving in the open direction (blinking signal)
  - moving in the close direction (fixed signal)
  - moving in the close direction (blinking signal)
  - emergency command (ESD)
  - stop mid-travel
  - the actuator is normally powered
  - the motor thermal relay has tripped
  - jammed valve
Each contact can be:
- normally open (when something occurs, contact is closed)
- normally closed

**FAULT RELAY**

*Fault relays include several bits of information:*
- control circuit power lost (always included)
- fuse blown (always included)
- thermal relay has tripped (always included)
- lost phase (always included)
- locked rotor (always included)
- local / remote selector set to local
- local / remote selector set to off
- jammed valve
- actuator receives an emergency command (ESD)
- the actuator receives an inhibit command
- overtravel
- 4 - 20 mA signal lost (if positioner option installed)

**ANALOG REMOTE INDICATION CARD**

*(option)*

*Position remote indication*

*Type of signal*
- 4-20mA and 2-10V
- 0-20mA and 0-10V
- 4-12 mA and 2-6V
- 12-20 mA and 6-10V

*Signal variation direction*
- signal increases in the open direction
- signal decreases in the open direction

**REMOTE TORQUE INFORMATION**

- 4-20mA

**ANALOG CONTROL : POSITIONER**

*(option)*

*Positioner*

*Auxiliary command 1*
- switch: automatic control (proportional command) / On-Off (standard Open/Close command)

*Type of signal*
- 4-20mA
- 0-20mA
- 4-12mA
- 12-20mA
- 0-10V

**Signal direction**
- opening when signal increases
- opening when signal decreases

**Dead band setting**
- 1%
- other values between 0.2 and 5%

**In case of 4-20mA signal loss**
- remain in position
- go to fully closed position
- go to fully open position

**FIELDBUS** *(option)*

*In case of loss of communication (depends upon the protocol used)*
- remain in position
- go to close position
- go to open position

For further details, please consult the INTELLI+ controls handbook n° NR1112.

**ELECTROMAGNETIC COMPATIBILITY AND "LOW VOLTAGE" DIRECTIVE**

INTELLI+ is in accordance with the Directive 89/339/CEE and 79/23/CEE.

**YEAR 2000 COMPATIBILITY**

INTELLI+ is fully Y2K compatible.

**ELECTRICAL CHARACTERISTICS**

*Inputs for remote controls:*
- voltage 10 to 250V DC/AC
- current 10mA at 24V
- minimum pulse of 100ms

*Output relays:*
- minimum current 10mA at 5V
- inductive load 5A at 250V AC or 5A at 30V DC

*Analog inputs:*
- in current: impedance of 215Ω
- in voltage: impedance of 8kΩ

*Analog outputs:*
- in current: maximum acceptable load of 300Ω
- in voltage: minimum acceptable load of 1kΩ
INTELLI+ can communicate with the user’s system through a serial type fieldbus connection by adding an electronic card with the protocol of choice.

All communications between the actuator and the system (commands and information), transmit on the same unique line.

**REdundant Dupline**

**DS200 Fieldbus**

DUPLINE protocol used by BERNARD, under the name of DS200, offers a fully redundant system that guarantees optimal security and availability of the communication network and therefore the entire installation.

This system construction, with redundancy at each level, ensures maximum availability of the communication network, even in cases of simultaneous damage without using a fieldbus loop.

**Fieldbus : Type PROFIBUS, MODBUS, FIELDBUS FOUNDATION**

The fieldbus enables access to all INTELLI+ functions: commands, information data and settings, reading of torque/position values in real time, torque values for last open/close operations, activity, and much more.

The actuator is provided with an address list in order to reach each command or information data.

Wired inputs and relay outputs are available:

- 4 inputs can receive indications from external sources in order to be transferred through the fieldbus
- Indication relays, except for the fault monitoring relay, can be used from the system via the fieldbus in order to command external sources by contacts.

**Emergency Command (ESD)**

The ESD special input, wired separately, always allows for remote emergency control with priority over all other controls.
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<th>Country</th>
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