



# ICON 2000

## ELECTRIC ACTUATOR

# Section 618/9

## Operating and configuration

# ICON 2000\_HART

## *HART bus*

### *Module*

# *HART*

## *Fieldbus*

File : man618-9.doc rev. 0

**NOTES:**

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**REVISION LIST**

0	02-04-03	Instruction for rev. 2.11 base, 7 hart	M.B.	A.A.
Rev.	Date	DESCRIPTION	Prepared	Approved

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## 1. Introduction

The **ICON\_2000\_HART** is an electronic module that allows to connect the BIFFI electrical actuator ICON 2000 to an HART serial communication line. The module has its microprocessor, it is controlled by a program stored internally, it works as a pure bus interface and does not affect the actuator control integrity. It is installed inside the actuator housing, and takes the electrical power from the actuator power supply module. The HART hardware modem is located on the module board. The data lines are fully isolated from the actuator electronics.

## 2. Operation and storage

The module is designed to work and to be stored in the same environment of the actuator.

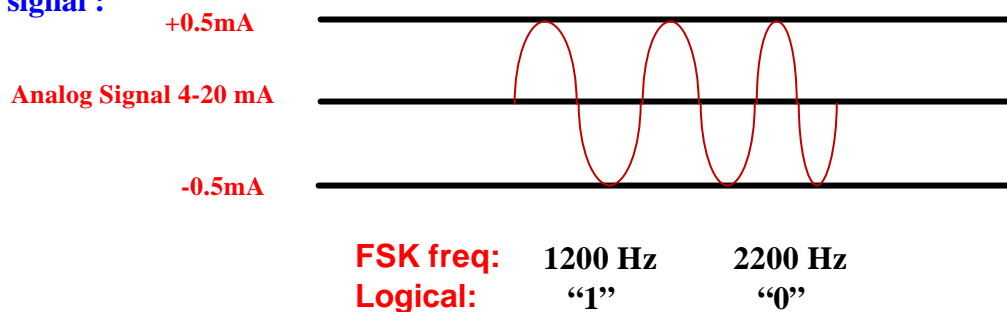
## 3. Communication features

The Hart bus combines the familiarity of using the 4-20mA signals with the benefits of the bus technology. In fact, by means of the simultaneous analogue and digital signals, additional information can be carried out on the same pair of wires together with the analogue 4-20mA signal. The main features are listed below:

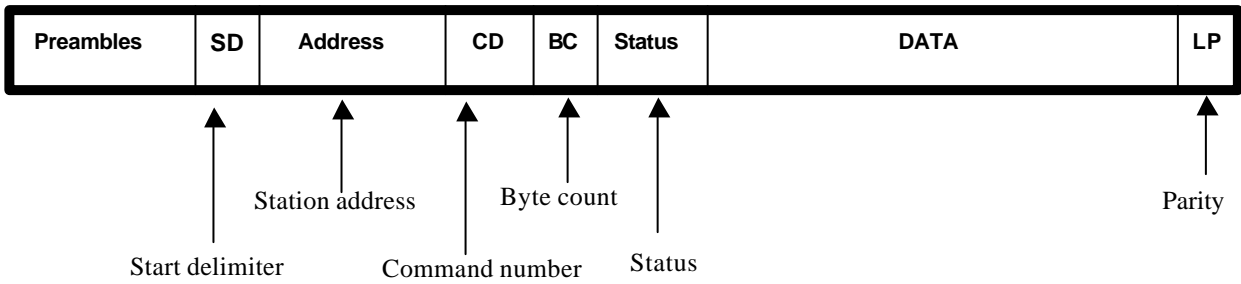
- Physical signals:
  - 4-20mA analog
  - digital FSK Frequency Shift Keying (Bell 202 standard)
  - 1200 baud
- Data transmission
  - Master / Slave and Burst communication modes
  - Secure error checking
  - Multidrop capability
- Messaging
  - Command based
  - Universal commands common to all products
  - Device specific commands for product features

The following figure shows the electrical signal, the HART message and the bus topologies.

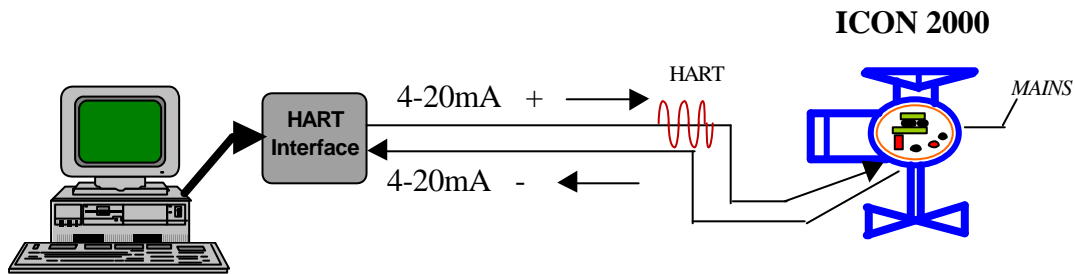
**Electrical signal :**



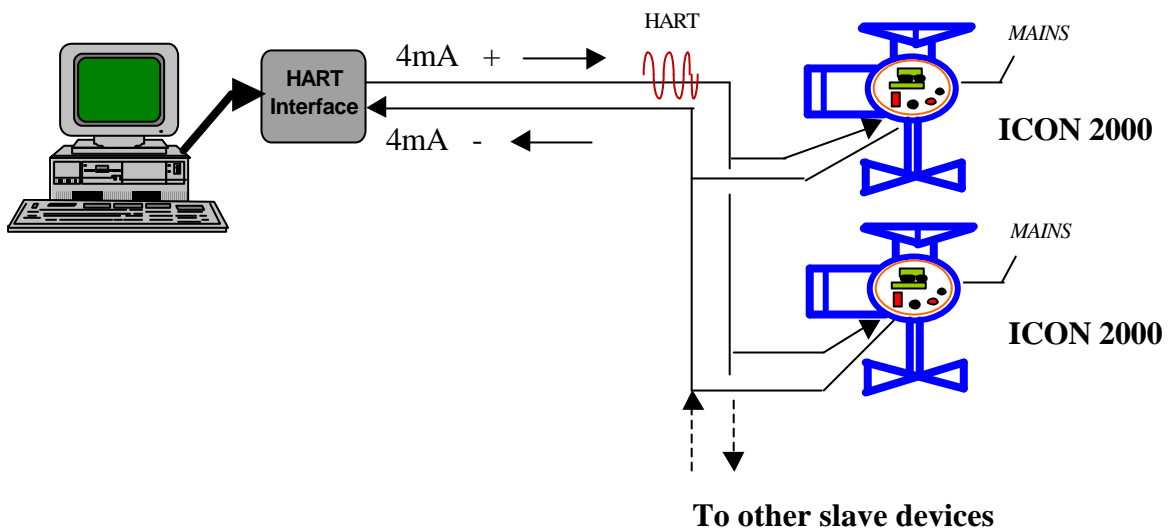
**HART message :**



**3.1. MASTER-SLAVE POINT TO POINT TOPOLOGY WITH OPTIONAL BURST MODE**

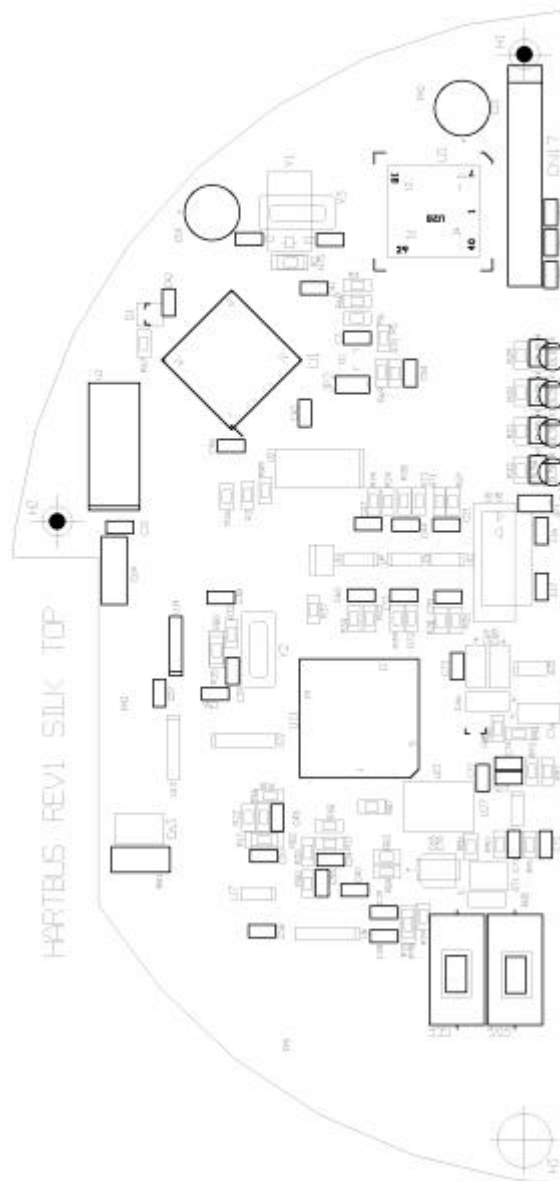


**3.2. MASTER-SLAVE MULTI-DROP MODE TOPOLOGY**



## 4. ICON 2000 HART module

The module consists in a single PCB that is installed inside the actuator housing. It is connected to the ICON 2000 base card via strip connector. The internal wiring connects the HART data lines to the actuator terminal board.



## 5. HART COMMAND SET

### 5.1. UNIVERSAL COMMANDS

Command		Data in Command		Data in Response	
N°	Function	Byte	Function	Byte	Function
0	Read Unique Identifier		None	0 1 2 3 4 5 6 7 (bit 3-7) 7(bit 0-2) 8 9-11	"254" manufacturer ID = 183 device type = 127 number of preambles (default=20) universal command revision specific command revision software revision hardware revision physical signalling code=1 device function flag=0 device ID (set by local oper inter)
1	Read Primary Variable		None	0 1-4	position unit code (%) position % (float)
2	Read Loop Current and Percent of Range		None	0-3 4-7	position request in mA position request in %
3	Read Dynamic Variab. and Loop Current		None	0-3 4 5-8 9 10-13 14 15-18	position request in mA position unit code (%) position value % torque unit code (%) torque value (%) temperature unit code (°C) temperature value
6	Write Polling Address	0	Polling address of Device (byte)	0 1	polling address (loc oper interf) loop current mode =250
7	Read Loop Configuration		None	0	polling address (loc oper interf) loop current mode =250
8	Read Dynamic Variable Classification		None	0 1 2 3	position classification =91 secondary var. classification =91 temperature classification =64 not used = 250
11	Read Unique Identifier associated with Tag	0-5	Tag (packed ASCII)	0-16	tag (packed ASCII)
12	Read Message		None	0-23	message (packed ASCII)
13	Read Tag, Descriptor, Date		None	0-5 6-17 18-20	valve tag (packed ASCII) actuator type (packed ASCII) test date

14	Read Primary Variable Transducer Informat.		None	0-2 3 4-7 8-11 12-15	serial number (unused) limits / min span unit code = 57 upper limit = unused lower limit = unused minimum span = 20
15	Read Device Information		None	0 1 2 3-6 7-10 11-14 15 16 17	alarm selection code = 250 transfer function code = 250 upper / lower unit code = 57 (%) upper range value = 100 lower range = 0 damping value = unused write protect code = 251 private label code = manufact. ID analog channel flag = 0
16	Read Final Assembly Number		None	0-2	final assembly number
17	Write Message	0-23	Message (pack. ASCII)	0-23	message (packed ASCII)
18	Write Tag, Descriptor, Date	0-5 6-17 18-20	Valve tag (pack. ASCII) Act. type (pack. ASCII) Test date	0-5 6-17 18-20	valve tag (packed ASCII) actuator type (packed ASCII) test date
19	Write Final Assembly Number	0-2	Final assembly number	0-2	final assembly number
20	Read Long Tag		None	0-31	actuator serial number (Latin-1)
21	Read Unique Identifier Associated with Long Tag	0-31	Long tag (Latin-1)	0-16	Same as command 0
22	Write Long Tag	0-31	Long tag (Latin-1)	0-31	Long tag (Latin-1)



### 5.2. COMMON PRACTICE COMMANDS

Command		Data in Command		Data in Response	
N°	Function	Byte	Function	Byte	Function
59	Write Number of Response Preambles	0	Number of preambles	0	Number of preambles (u-byte)
105	Read Burst Mode Configuration	0	None	0 1 2 3 4 5	Burst mode control code (u-byte) Command number (u-byte) Slot 0: Dev. Variable code or 250 Slot 1: Dev. Variable code or 250 Slot 2: Dev. Variable code or 250 Slot 3: Dev. Variable code or 250
107	Write Burst Device Variables	0 1 2 3	Slot 0 : dev. variab code Slot 1 : dev. variab code Slot 2 : dev. variab code Slot 3 : dev. variab code	0 1 2 3	Slot 0 : Device Variable code Slot 1 : Device Variable code Slot 2 : Device Variable code Slot 3 : Device Variable code
108	Write Burst Mode Command Number	0	Command number (u-byte)	0	Command number (u-byte)
109	Burst Mode Control	0	Burst mode control code (u-byte)	0	Burst mode control code (u-byte)

### 5.3. DEVICE SPECIFIC COMMANDS

Command		Data in Command		Data in Response	
N°	Function	Byte	Function	Byte	Function
128	Read Device Variables with Status	0 1 2 3	Device variable code (max 4, see "device variable code")	0 1 2 3 4-7 8 9 10 11 12-15 16 17 18 19 20-23 24 25 26 27 28-31 32	extended field device status slot 0 : device variable code slot 0 : device variable classificat. slot 0 : unit code slot 0 : device variable value slot 0 : device variable status slot 1 : device variable code slot 1 : device variable classificat. slot 1 : unit code slot 1 : device variable value slot 1 : device variable status slot 2 : device variable code slot 2 : device variable classificat. slot 2 : unit code slot 2 : device variable value slot 2 : device variable status slot 3 : device variable code slot 3 : device variable classificat. slot 3 : unit code slot 3 : device variable value slot 3 : device variable status
129	Write Device Variable	0 1 2 3-6 7	Device variable code Write command code Units code Device variable value Device variable status  (see "device variable code")	0 1 2 3-6 7	device variable code (u-Byte) write device variable cmd code units code device variable value (float) device variable status

#### 5.4. DEVICE VARIABLE CODE

N°	Bit	Range	Class	Type	Description	Read	Write
0	0 = 1 1 = 1 2 = 1 3 = 1 4 = 1		0	251	<b>COMMANDS</b> Command OPEN Command CLOSE Command STOP Command ESD Command ENABLE POSITIONER		X
1	0 = 1 1 = 1 2 = 1 3 = 1 4 = 1 5 = 1 6 = 1 7 = 1 8 = 1 9 = 1 10 = 1 11 = 1 12 = 1 13 = 1 14 = 1		0	251	<b>ACTUATOR STATUS</b> Close limit Open limit Moving Monitor relay Local selector in LOCAL Local selector in REMOTE Local selector in OFF *Configured D. IN #1 *Configured D. IN #2 *Configured D. IN #3 *Configured D. IN #4 *Configured D. IN #5 *Configured D. IN #6 Interlock open active Interlock close active  Condition associated to bits D. IN #1,...,6 , should be configured via local operator interface (see par. 6).	X	
2	0 = 1 1 = 1 2 = 1 3 = 1 4 = 1 5 = 1 6 = 1 7 = 1 8 = 1 9 = 1 10 = 1 11 = 1 12 = 1		0	251	<b>ACTUATOR STATUS</b> Fail safe action active Opening Closing ESD active Hard-wired remote mode active Positioner mode active Motion inhibited Aux in open Aux in close Aux in stop Aux in bus-on Alarm Warning	X	
3		0.0 – 100.0	91	57	Position request %		X
4		0.0 – 25.5	91	57	Dead band	X	X
5		0-255	70	51	Motion inhibit time	X	X
6/7		dd-mm-yy	251	251	Next maintenance date	X	X
8/9		dd-mm-yy	251	251	Last maintenance date	X	X

10	0 = 1 1 = 1 2 = 1 3 = 1 4 = 1 5 = 1 6 = 1 7 = 1 8 = 1 9 = 1 10 = 1 11 = 1 12 = 1 13 = 1 14 = 1 15 = 1		251	251	<b>ALARM</b> Motor thermostat Hi Hi torque in opening Hi Hi torque in closing Valve blocked in opening Valve blocked in closing Hi_hi temperature Position sensor Speed sensor Main voltage K1 contactor K2 contactor Configuration Hardware Low battery Lost phase Request signal	X	
11	0 = 1 1 = 1 2 = 1 3 = 1 4 = 1 5 = 1 6 = 1 7 = 1		251	251	<b>WARNING</b> Hi torque in opening Hi torque in closing Hi temperature Main voltage Contactor cycles Maintenance request Motor current Wrong stroke limits	X	
12		0-65535	70	51	Opening time	X	
13		0-65535	70	51	Closing time	X	
14/15		u-4bytes	251	251	Contactor cycles	X	
16/17		u-4bytes	70	52	Motor run time	X	
18/19		u-4bytes	70	52	Time without electrical power	X	
20		0-100	91	57	Utilisation rate	X	
21/22		dd-mm-yy	251	251	Start up date	X	
23		0-100	91	57	Pos min	X	X
24		0-100	91	57	Pos max	X	X
25		0-255	251	251	Reserved	X	X
26		0-255	70	51	Reserved	X	X
27		0-100	91	57	Reserved	X	X

## 6. Configuration via local operator interface of ICON 2000

The HART interface allows to connect the ICON 2000 to a Hart fieldbus. The module can be used with either the **base version** or the **optional modules AOC, APTM/APTM1, PSM/PSM1** of ICON 2000. Here below are described the facilities available by the **view and setup menu** of ICON 2000.

### 6.1. BUS CONTROL

- **DIN 1,..., DIN 6:** by this routine it is possible to choose the condition associated to command 128 , device variable 1 (actuator status) bits 7,...,12 . Here below there is the list of the available conditions:

STATUS	ALARM
<ul style="list-style-type: none"> <li>• open limit</li> <li>• closed limit</li> <li>• position &gt;= xx %</li> <li>• position &lt;= xx %</li> <li>• closing</li> <li>• opening</li> <li>• motor running</li> <li>• blinker</li> </ul>	<ul style="list-style-type: none"> <li>• mid-travel position</li> <li>• local selected</li> <li>• remote selected</li> <li>• local stop active</li> <li>• ESD signal on</li> <li>• manual operation</li> <li>• motor over-temperature</li> <li>• over-torque</li> <li>• over-torque in OP</li> <li>• over-torque in CL</li> <li>• valve jammed</li> <li>• warnings</li> <li>• valve jammed in OP</li> <li>• valve jammed in CL</li> <li>• low alkaline battery (if present)</li> <li>• mid travel alarm in CL/OP</li> </ul>

The following setting is supplied as standard:

- DIN 1: mid-travel position
  - DIN 2: local stop active
  - DIN 3: motor over-temperature (motor thermostat alarm)
  - DIN 4: over-torque (hi\_hi torque alarm)
  - DIN 5: valve jammed alarm
  - DIN 6: mid-travel alarm in OP/CL
- **Node:** by this function it is possible to enter the node address. Each device must have its address. Each address must be associated to one only device. The available address range is from **1 to 63**. Set **0** for point to point mode .
  - **Device number:** by this routine it is possible to set the hart device number. The number is normally set in factory and should not be changed.

#### Configuration procedure:

- *Move the local selector to OFF and then press simultaneously OPEN and STOP. Select the language and then enter the password according to the instructions "entering the set-up mode". When the message of display is "SET-UP MODE OK?" press YES. Press YES to select actuator set-up menu, press NO to scroll the list of available routines and then press YES to select the routine **BUS** .*
- *Press YES if the configured value of the node address (NODE) is correct (from 1 to 63), or press NO to change, then press YES.*
- *Press YES to confirm the configured Device number*

#### View procedure:

- *Move the local selector to OFF and then press simultaneously OPEN and STOP. Select the language and then enter the password according to the instructions "entering the view mode". When the message of display is "VIEW MODE OK?" press YES. Press YES to select actuator set-up menu, press NO to scroll the list of available routines and then press YES to select **BUS** .*

- Press **YES** to scroll the list of **BUS** parameters.

## **6.2. POSITIONER FUNCTION**

The function is available only on the **modulating actuators**. The value 0.0 of position request, received from bus, corresponds to close request and the value 100.0 corresponds to open request. The ICON 2000 compares the **present position %** of the actuator with the **position request % received from the bus**, and if the difference is greater than the **dead band**, the actuator is driven to reach the new requested position.

The following options can be configured via either bus or local operator interface:

- dead band: configurable from 0.0% to 25.5% of the maximum position error (difference among position request % and present position %). The configured value should be great enough to avoid "hunting" effect of the actuator.
- Motion inhibit time: it allows adjusting the length of the delay time between two cycles of the motor. It can be configured from 0 to 255 sec and allows to set the maximum number of start / hour of electrical motor.

### **Configuration procedure:**

- Move the local selector to **OFF** and then press simultaneously **OPEN** and **STOP**. Select the language and then enter the password according to the instructions "entering the set-up mode". When the message of display is "SET-UP MODE OK?" press **YES**. Press **YES** to select actuator set-up menu, press **NO** to scroll the list of available routines and then press **YES** to select **POSITIONER**.
- Press **YES** if the configured value of the Dead Band is correct (from 0 to 25.5% of position error), or press **NO** to change, then press **YES**.
- Press **YES** if the configured value of the Motion Inhibit Time is correct (from 0 to 255 sec), or press **NO** to change, then press **YES**.

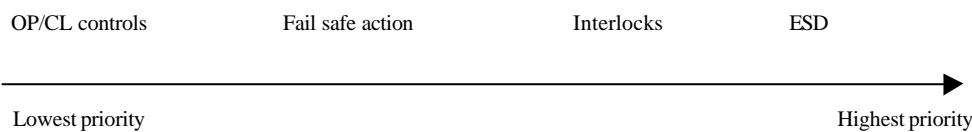
### **View procedure:**

- Move the local selector to **OFF** and then press simultaneously **OPEN** and **STOP**. Select the language and then enter the password according to the instructions "entering the view mode". When the message of display is "VIEW MODE OK?" press **YES**. Press **YES** to select actuator set-up menu, press **NO** to scroll the list of available routines and then press **YES** to select **the routine (POSITIONER)**.
- Press **YES** to scroll the list of parameters.

### 6.3. FAIL SAFE FUNCTION

**This function is available only if requested on order.** It allows configuring the action of the actuator in case of loss of the 4-20mA signal. The action takes place only if the local selector is in REMOTE and if bus is operating. When the bus signal restores, also the actuator restores at its normal functioning. The fail safe function can be configured via either bus or local operator interface.

The hard-wired controls ESD and INTERLOCKS override the Fail Safe action according to the following diagram (the hard-wired controls INTERLOCKS are available only if optional modules APTM/APTM1 or PSM/PSM1 are present).



The following options can be configured:

- Fail safe action: open, close, stay-put, go to position %, no action (OFF)
- Length of the delay time before than the fail safe action takes place (length = 10sec + configured value)

#### **Configuration procedure:**

- *Move the local selector to OFF and then press simultaneously OPEN and STOP. Select the language and then enter the password according to the instructions "entering the set-up mode". When the message of display is "SET-UP MODE OK?" press YES. Press YES to select actuator set-up menu, press NO to scroll the list of available routines and then press YES to select **FAIL SAFE**.*
- *Press YES if the configured ACTION is correct (open, close, stay-put, go to position xx% , off), or press NO to change, then press YES.*
- *Press YES if the configured value of the DELAY is correct (from 0 to 255 sec), or press NO to change, then press YES.*

#### **View procedure:**

- *Move the local selector to OFF and then press simultaneously OPEN and STOP. Select the language and then enter the password according to the instructions "entering the view mode". When the message of display is "VIEW MODE OK?" press YES. Press YES to select actuator set-up menu, press NO to scroll the list of available routines and then press YES to select **the routine(FAIL SAFE)** .*
- *Press YES to scroll the list of parameters.*

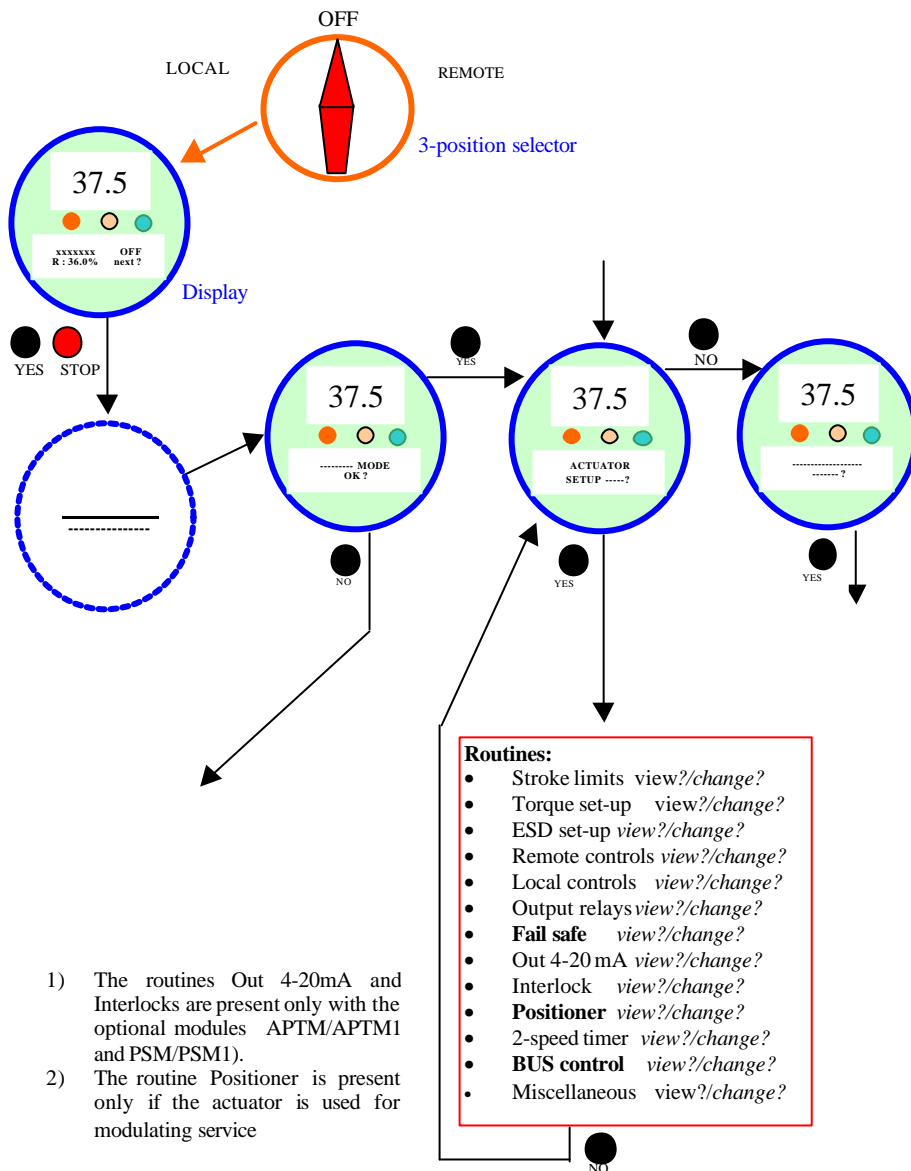
### 6.4. VIEWING TRANSMISSION INFO

The following procedure allows seeing the most significant info relevant to the bus data transmission:

- *Move the local selector to OFF or REMOTE and then press YES until the display shows NODE REPORT. Press NO to exit or press YES to scroll the list of transmission info*

### 6.5. BUS SIGNAL FAILURE INDICATION

In case of loss of 4-20mA signal a warning is generated. It is signalled by the flashing of the relevant ALARM/WARNING LED and by indication on the local 2 lines /16 char. display .  
The figure below shows the list of routines available in the ICON 2000 **view or setup menu**.



- 1) The routines Out 4-20mA and Interlocks are present only with the optional modules APTM/APTM1 and PSM/PSM1).
- 2) The routine Positioner is present only if the actuator is used for modulating service

