epac

Operation & Instruction Manual

MODBUS CONTROLS

INDEX:

INTRODUCTION:

Auma India has developed a new range of electric actuators for Modbus application suitable for both weatherproof and explosion proof applications. These electric actuators have the following features:

1. Status Display: LCD screen for better visibility of status, operation and parameter setting details.

2. 2-wire communication with Channel redundancy: Two wire field bus (Modbus) communication is available with dual separate communication path, viz. Channel A & Channel B

3. No external tool required for configuration/setting: Options can be selected by using the selector switches, push buttons based on the instructions displayed on the LCD screen, without the need of hand held device or PC/laptop.
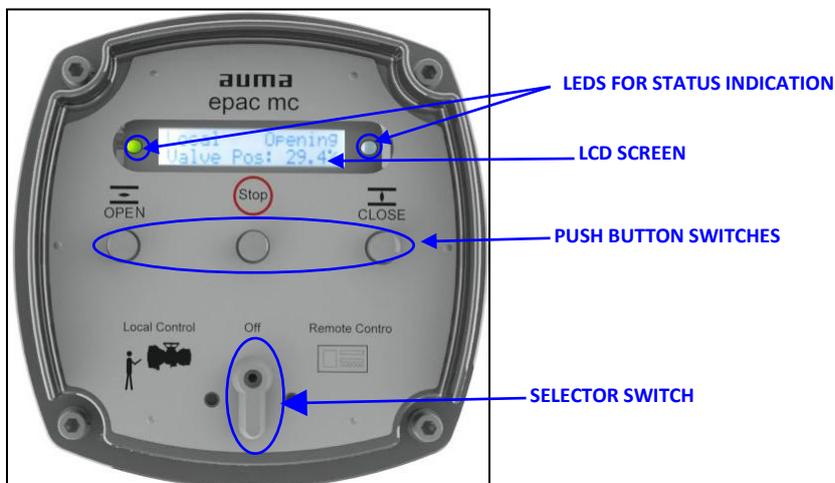
FRONT PANEL DETAILS:

Fig. A: 3.XMP/MODBUS CONTROLS: FRONT PANEL

Selector Switch: There are 3 modes available; LOCAL, OFF & REMOTE. The mode selection can be done by using the selector switch.

Push Button Switches: Actuators are made to run in OPEN or CLOSE direction by pressing the respective push buttons and can be stopped in mid travel by pressing STOP push button. These three push buttons are also used for programming and calibrating the actuator.

LCD Screen: The LCD view is split into two lines. The first line shows the Status details; left side-selector switch position and right hand side-actuator's status. The second line shows the valve position or the faults/warnings if any (Fault/warnings toggle in the sequence of occurrence.) The details are as shown in the Fig. B

Fig. B: 3.XMP LCD SCREEN

2

LEDs: Information regarding the selector switch positions and running indication of the actuator (status) are indicated by the LEDs present on the left and right side (respectively) of the LCD screen which is as shown in Fig. C.
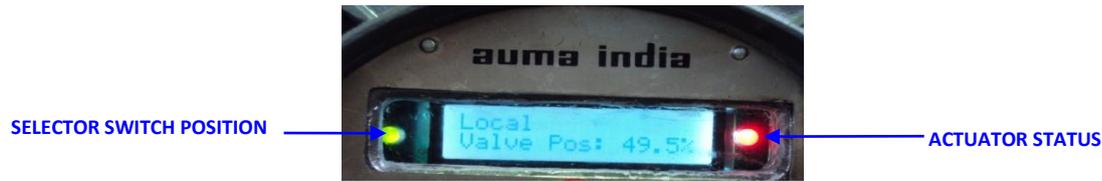

SELECTOR SWITCH POSITION   ACTUATOR STATUS

Fig. C: LEDS ON THE FRONT PANEL

The color change on the LEDS indicates the information as tabulated below:

LED (right side): Color indication for Actuator Status

COLOR	INDICATION	MODE
GREEN	🟢	If LED is blinking then actuator is running in OPEN direction If blinking is stopped then actuator is fully OPENED
ORANGE	🟠	If LED is blinking then actuator is running in CLOSE direction If blinking is stopped then actuator is fully CLOSED
RED	🔴	If LED is blinking -- Fault condition If blinking is stopped– Actuator stopped in Mid Travel

LED (left side): Color indication for Selector Switch Position

COLOR	INDICATION	MODE
GREEN	🟢	Local mode
ORANGE	🟠	Remote mode
RED	🔴	OFF mode

IDENTIFYING THE PROGRAM VERSIONS:

Keep the selector switch in "REMOTE" & then press the "OPEN" push button. The program version will be displayed on the LCD screen as below;

Fig. D: PROGRAM VERSION DETAILS ON LCD SCREEN

Note: Here"VER2:2014-04-06" indicates
- *VER2: 2nd Series of Controller in 3.XMP CPU card*
- *2014-04:'Year & Month' of software release*
- *06: Program Version*
  &
- *VER: Indicates 1st Series of Controller in 3.XMP CPU card*

PROGRAM MODE IN 3.XMP MODULE: To enter into Program mode follow the below steps,

Step1: Keep the selector switch in OFF position

Step2: Press Open + Close keys (together) approximately 6 sec

Step3: Press the STOP key on the display of "Program Mode" as shown in the below Figure.

In this mode the two options available for the users are, EDIT & VIEW which is as shown below;
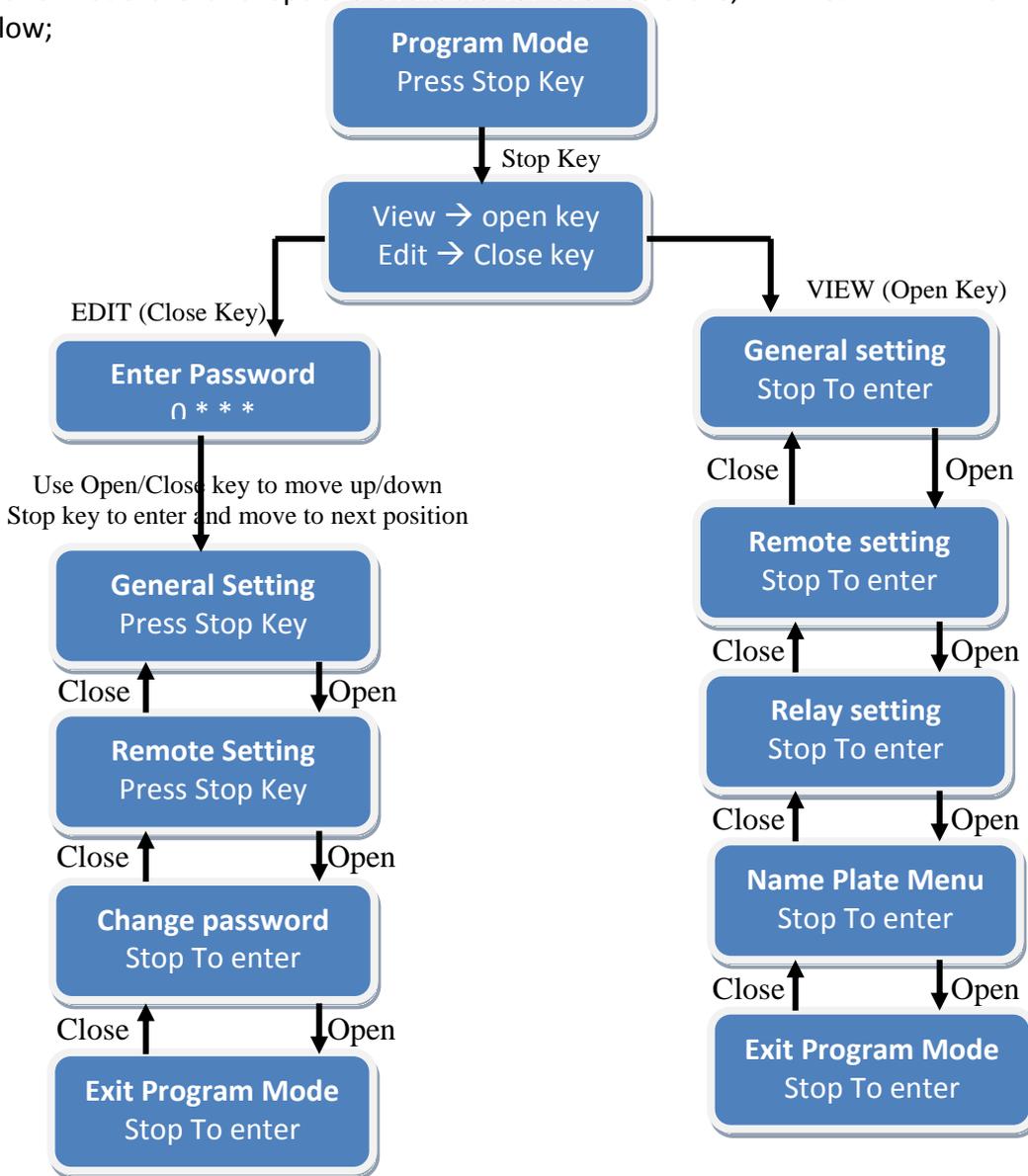

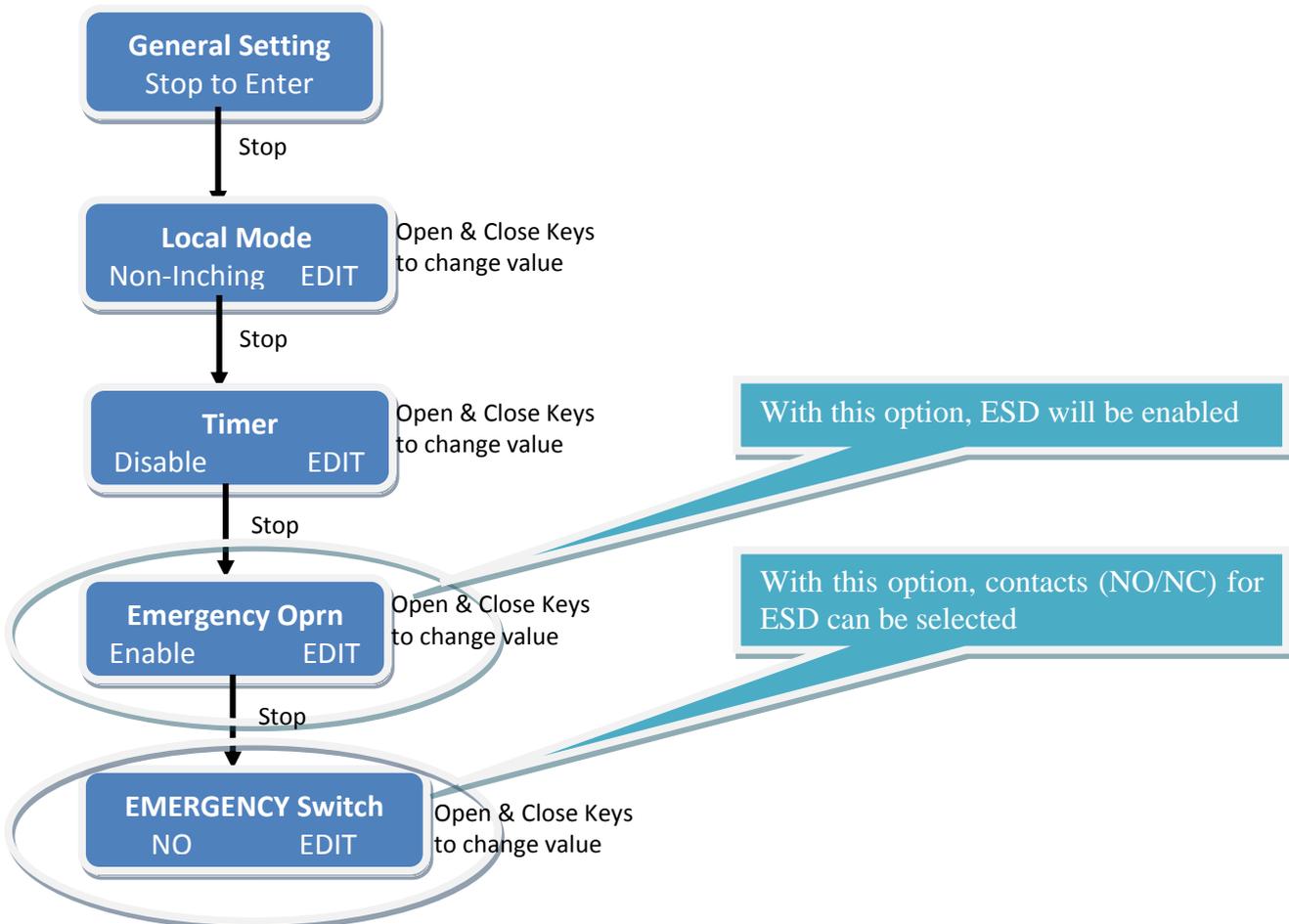**Fig. F: Program Mode Flow chart for 3.XMP (Version 2.0)**

A. **EDIT option of the Program mode**: By entering the appropriate password (default password is 0000 for minor changes & 5555 for major changes), user can enter into the EDIT option. (The features relevant to Modbus communication are explained here);

1. **General Settings**: ESD option
   ESD options can be excited in following ways;
   1. Hardwired ESD: Use the customer end terminals ESD+ & ESD- for the external push button connection (planned usually outside the dyke area), for exciting the ESD over hard wired. This command has the highest priority compared to all other command including Modbus ESD
   2. Soft ESD: To use the ESD command excitation over Modbus, ensure that the option ESD_MB is enabled. Soft ESD command can be excited/de-excited in 2 ways;
      a. ESD excitation on individual actuator
      b. Broadcast ESD
   3. Required option on ESD: There are 3 modes in which the actuator can be made to operate on excitation of ESD command (either hardwired or soft ESD). They are;
      a. Open
      b. Close (*it is the default option*)
      c. Stay as it is

   For enabling "soft/Modbus ESD", select the ESD option in general setting, which is as shown below;

Stop

On Emergency
Close   EDIT

Open & Close Keys
to change value

The intended operation on ESD (as applicable to both hardwired & soft ESD) will be set here

Stop

ESD MB Broadcast
Enable   EDIT

Open & Close Keys
to change value

For 'SOFT/Modbus ESD', this option needs to be enabled

Stop

ESD In OFF Mode
Enable   EDIT

Open & Close Keys
to change value

For enabling ESD in OFF position of selector switch, this option needs to be enabled

Stop

Bypass OLS
(Y/N) ? :   EDIT

Open & Close Keys
to change value

Do not enable this option, else to put the selector switch in OFF mode refer to the document "PROCEDURE TO DISABLE REMOTE SELECTOR SWITCH OPTION: 4-V3.XMP-27709", (which is the initial step for entering into Program Mode or Calibration Mode).

Stop

Remote Sel.Swtch
Disable   EDIT

Open & Close Keys
to change value

Stop

Based on the frequency of operation, select 50Hz/60Hz using this option.

Frequency Select
50Hz   EDIT

Open & Close Keys
to change value
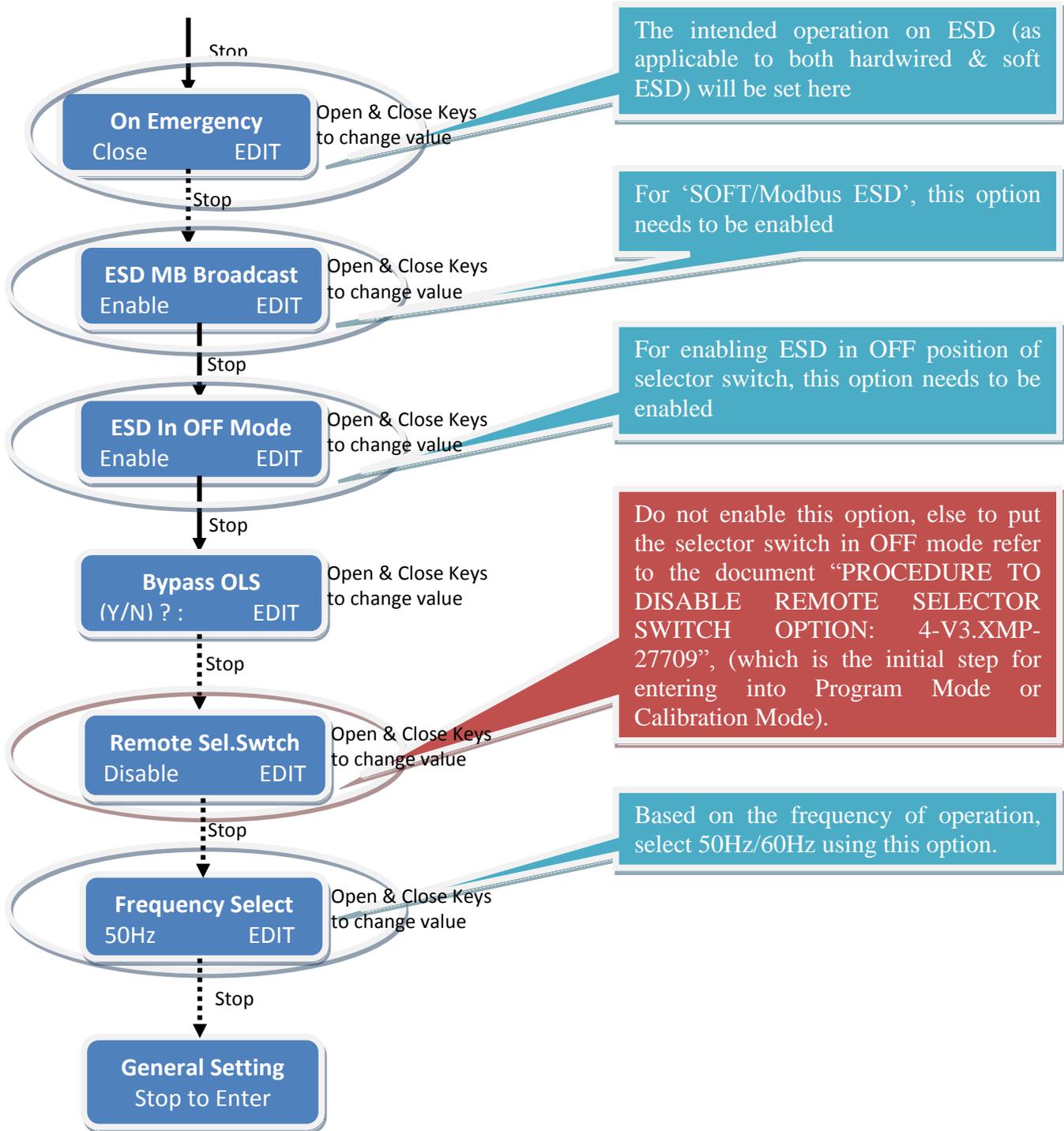
Stop

General Setting
Stop to Enter

Fig. H: Program Mode (EDIT) -General Setting Flow chart for 3.XMP (Version 2.0)

2. **Remote Settings:** This menu is used for setting of the Modbus parameters such as device ID, baud rate, parity etc.

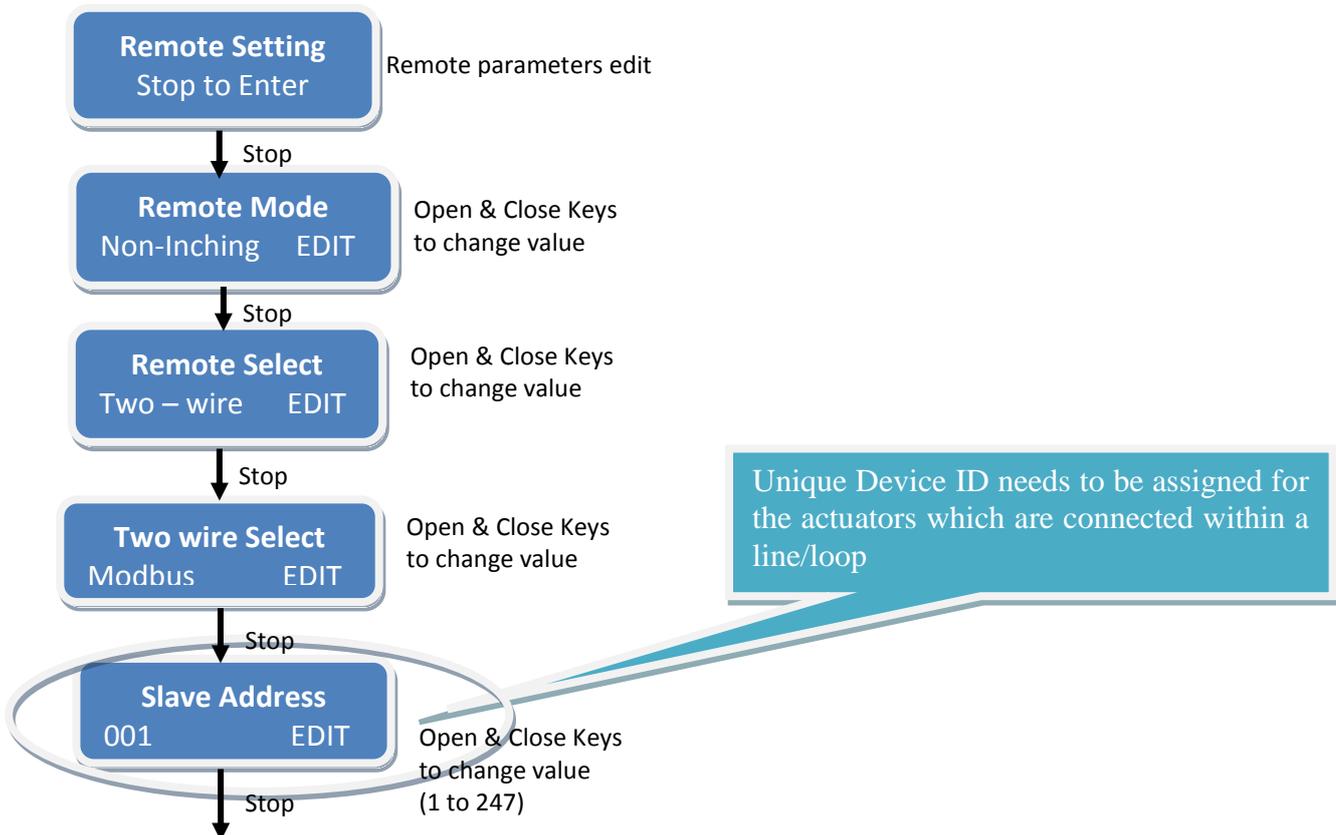Please note the following, before the setting of <u>Modbus parameters</u>;

1. Unique "Device ID" should be set for individual actuators/participants which will be communicating with the DCS/AIMS on a single loop/line
2. Baud Rate (BPS), Parity of the individual actuators communicating over the same loop/line should be same and should match with the settings of the supervisory device (which can be DCS/AIMS)
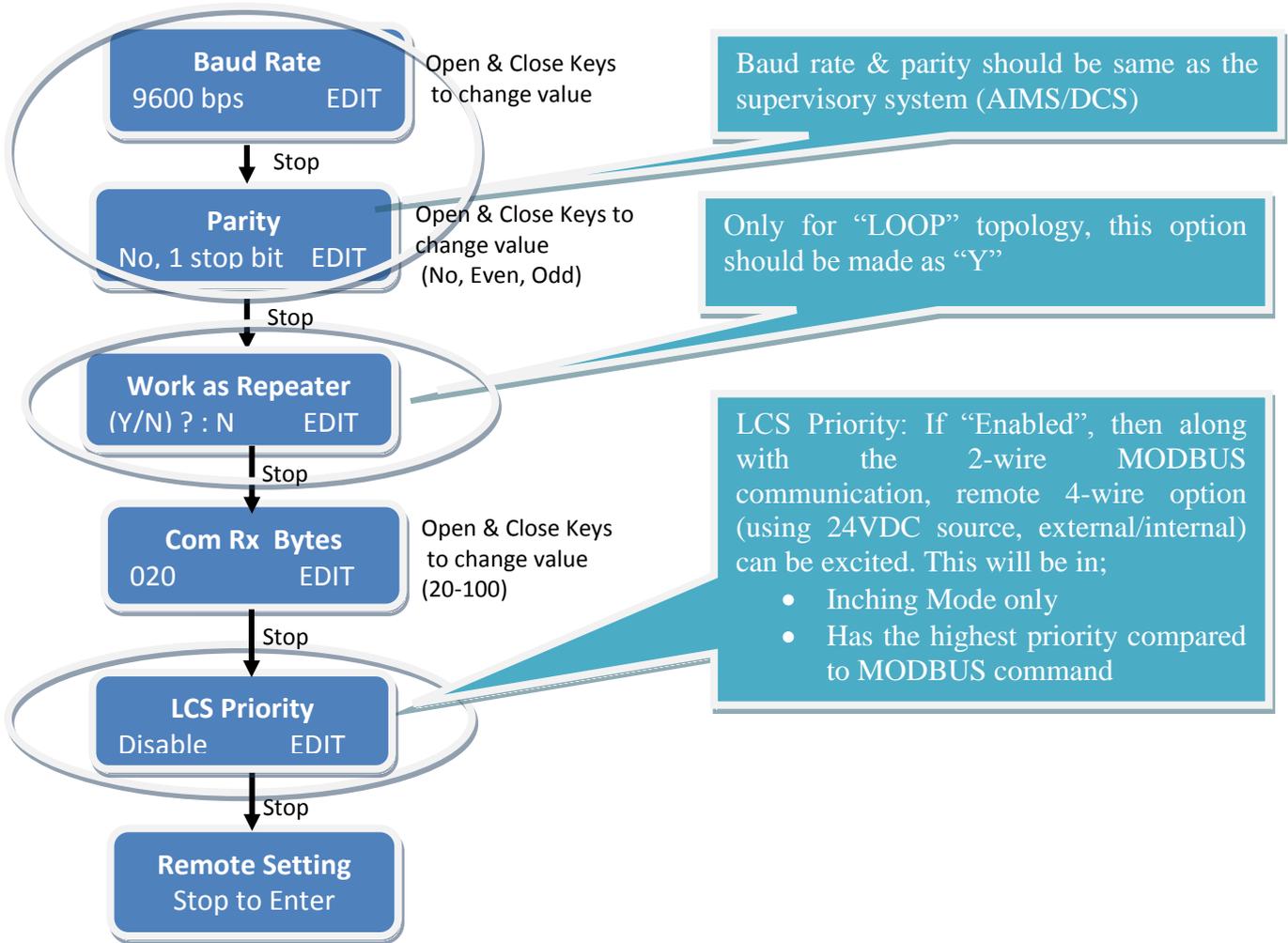3. Repeater functionality will be set to yes "Y", only for loop topology.

Note: Modbus settings of the actuators can be viewed on LCD, by keeping the selector switch in "REMOTE" & then pressing the "CLOSE" push button which is as shown below;

Parity

Device ID ← EA BPS PRITY RP
001 9600 NO,1 Y → **Repeater Function**

Baud Rate

If the above displayed settings are not matching with the intended options for Modbus communication, then for changing the Modbus parameters, use the below flowchart.

The sub options available in this category are

Remote Setting
Stop to Enter   Remote parameters edit

↓ Stop

Remote Mode
Non-Inching   EDIT   Open & Close Keys
to change value

↓ Stop

Remote Select
Two – wire   EDIT   Open & Close Keys
to change value

↓ Stop

Two wire Select
Modbus   EDIT   Open & Close Keys
to change value

↓ Stop

Unique Device ID needs to be assigned for the actuators which are connected within a line/loop

Slave Address
001   EDIT   Open & Close Keys
to change value
(1 to 247)

↓ Stop

Program Mode Flowchart

Baud Rate
9600 bps   EDIT

Open & Close Keys to change value

Baud rate & parity should be same as the supervisory system (AIMS/DCS)

↓ Stop

Parity
No, 1 stop bit   EDIT

Open & Close Keys to change value (No, Even, Odd)

Only for "LOOP" topology, this option should be made as "Y"

↓ Stop

Work as Repeater
(Y/N) ? : N   EDIT

↓ Stop

Com Rx Bytes
020   EDIT

Open & Close Keys to change value (20-100)

LCS Priority: If "Enabled", then along with the 2-wire MODBUS communication, remote 4-wire option (using 24VDC source, external/internal) can be excited. This will be in;
- Inching Mode only
- Has the highest priority compared to MODBUS command

↓ Stop

LCS Priority
Disable   EDIT

↓ Stop

Remote Setting
Stop to Enter

Fig. I: Program Mode (EDIT)-Remote Setting:
2 wire modbus for 3.XMP Version 2.0

Note: <u>LCS priority</u>- LCS stands for Local Control Station.
- To use the 4 wire remote option for Open, Stop & Close along with the regular Modbus mode, this option needs to be enabled.
- By using the 24VDC (+ & -) with the customer end terminals RMO, RMS, RMC & RMN (of the individual actuators), these commands can be excited by using the external push button station assembly.
- LCS will operate only in inching mode
- LCS will have higher priority than Modbus commands

TOPOLOGY CONNECTION:
The actuators can be connected to the DCS/AIMS on 2-wire (data line + & -) field bus mode, in the following ways;
- Loop topology
- Line topology or
- Redundant Line topology

Let us consider the customer end connection of the wiring diagram, to understand the fieldbus interconnection details;
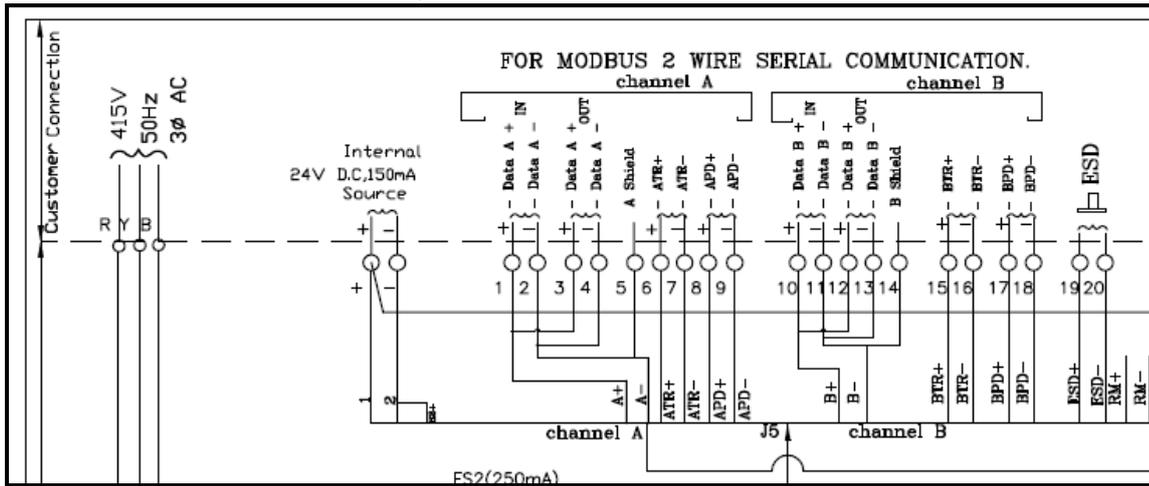
Please note the below (w.r.t. the above WD) points for topology interconnection.

1. Data lines of channel A are A+ & A- which are made available at customer end terminals 1, 3 and 2, 4 respectively.

2. The signal ground/reference line for channel A communication is identified as "A Shield", which should run along the channel (as per Modbus standard) and this is made available at customer end terminal 5.

3. For activating the terminations for channel A terminals ATR+ to be shorted with ATR- & APD+ to be shorted with APD-

4. Data lines of channel B are B+ & B- which are made available at customer end terminals 10, 12 and 11, 13 respectively.

5. The signal ground/reference line for channel B communication is identified as "B Shield", which should run along the channel (as per Modbus standard) and this is made available at customer end terminal 14.

6. For activating the terminations for channel B terminals BTR+ to be shorted with BTR- & BPD+ to be shorted with BPD-

7. If suppose the terminals ATR+, ATR-, APD+, APD-, BTR+, BTR-, BPD+ & BPD- are not shown in the customer end connection of the wiring diagram, then the following can be assumed;

    a. Terminations can be activated using the DIP switch available on the Interface Card **OR**

    b. If DIP switch is not present, then it can be assumed that the Terminations are made ON for each channel (indicating that only loop topology interconnection is possible).
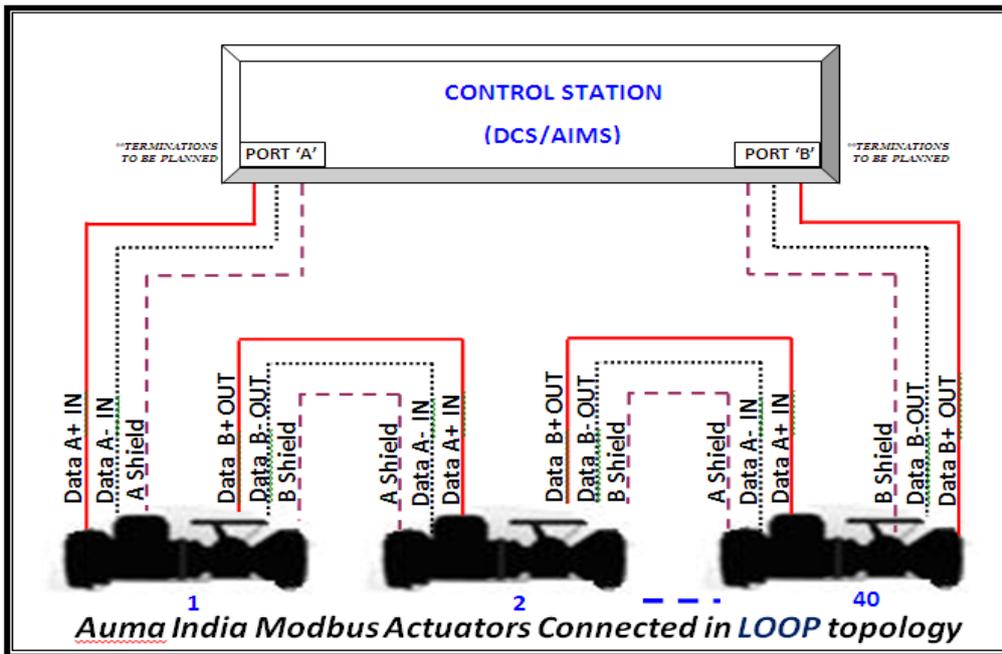
NOTE:

*Use the repeaters if the distance between the active adjacent participants exceeds1.2km*

In case of line/redundant line topology, use repeaters after 32 participants, with proper terminations even at repeaters.

Termination resistors are to be planned at each port of the DCS (AIMS has termination built within)

Pictorial representation of topology (actuator interconnection) details:

Auma India Modbus Actuators Connected in LOOP topology

Note: For Loop configuration, Terminations should be made ON for each channel.

Auma India Modbus Actuators Connected LINE topology

Auma India Modbus Actuators Connected in REDUNDANT LINE topology
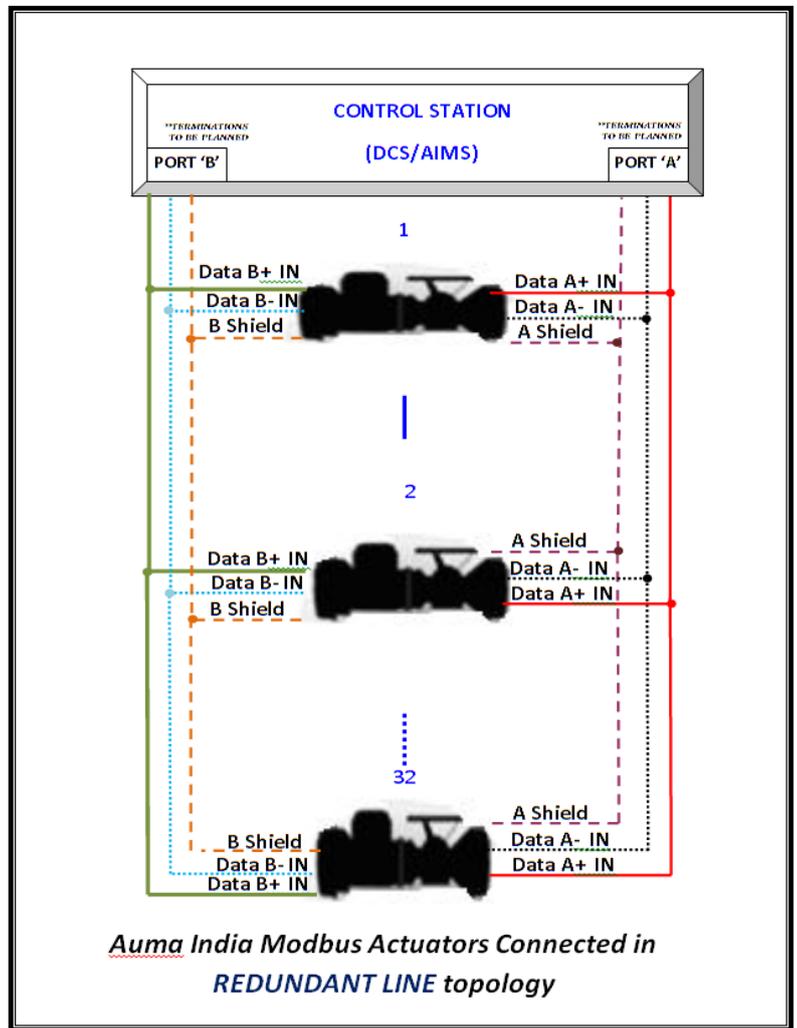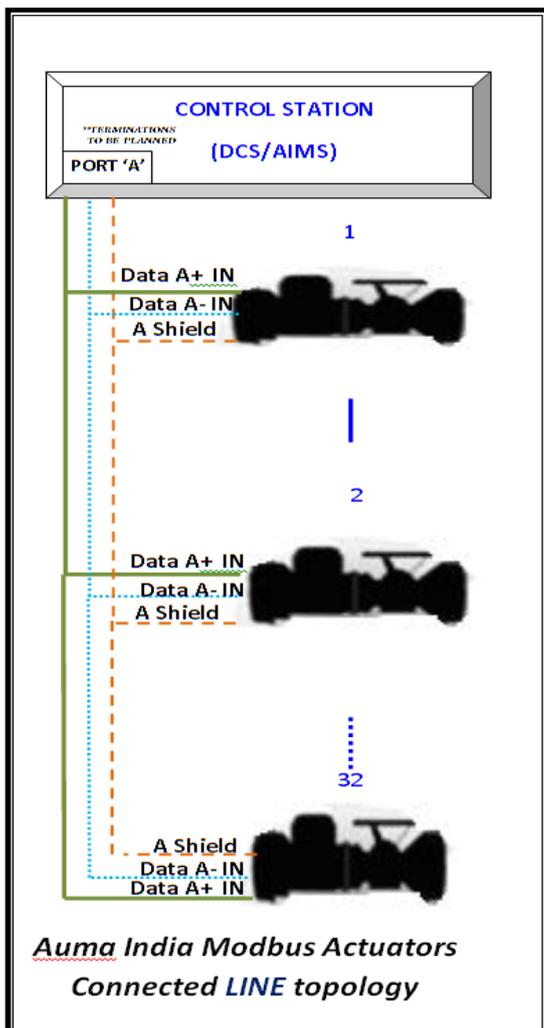
Note: For Line & redundant Line configuration, Terminations should be made ON only at the end of line segment.

REGISTER DETAILS FOR MODBUS COMMUNICATION:

The important register & function code details needed for command excitation and status reading are as below;

COMMAND EXCITATION:
Function Code 0x03, 0x06 & 0x10: The holding register details for read & write operations associated with these function codes are as below;

ADDRESS		DATA		
DESCRIPTION	VALUE	RANGE (MIN-MAX)	NOTE (MEANING)	
REMOTE COMMAND	0x03E8		BIT 8=1	OPEN
			BIT 9=1	CLOSE
			BIT 12=1	STOP
			BIT 10=1	SET POINT BIT
READ VALVE POSITION	0x03E9	0-1000		
SET VALVE POSITION	0x03EA	0-1000		
**REMOTE COMMAND (ESD)	0x0001		BIT 0=1	ESD

The byte sequence for *broadcast ESD (SOFT ESD) command in hexadecimal is:

Broadcast Address	Function Code	Start Address High	Start Address Low	Register Value High	Register Value Low	CRC High	CRC Low
0xF1	0x06	0x00	0x01	0x00	0x01	0x0D	0x3A

Note:
   *: Broadcast ESD is available with the 3.XMP modules having 2nd Series of controller in CPU card & the program version starting from Version 26 onwards in case of 1st series of 3.XMP CPU cards.

   **: Soft ESD at individual actuator is available with 3.XMP modules having 2nd Series of controller in CPU card, starting with the program version"VER2:2014-04-06" & the program version starting from Version 26 onwards in case of 1st series of 3.XMP CPU cards.

STATUS READING:

Function Code 0x04: There are two registers present with the address 0x03E8 & 0x03E9 from which the status details can be got. The details of the data associated with each address are as tabulated below;

ADDRESS		0x3E8	0x3E9	0x3EA
		DATA DETAILS		
BIT POSITION		DESCRIPTION		
0		LOCAL POSITION	TSC	Valve Position (0-1000)
1		REMOTE POSITION	TSO	
2		RUNNING OPEN	LSC	
3		RUNNING CLOSE	LSO	
4		STOPPED	LOCAL POSITION	
5		OPENED POSITION	REMOTE POSITION	
6		CLOSED POSITION	LOSS OF PHASE	
7		TSO	TH FAULT	
8		TSC	COMMON FAULT	
9		TH FAULT	PHASE REVERSE	
10		TOLR	RUNNING CLOSE	x
11		JAMMED VALVE	RUNNING OPEN	x
12		PHASE SEQ. ERROR	ESD-HARDWIRED	x
13		SET POINT REACHED	SET POINT REACHED	x
14		FAULT	CLOSED	x
15		LCS ACTIVATED	OPENED	x

Note:

- *"3.XMP-Version 1.0" refers to 1st Series of Controller in CPU card & "3.XMP-Version 2.0" refers to 2nd Series of Controller in CPU card (For more details refer to page 3)*

The byte sequence for Command & Status consists of following fields;

Device ID (1 Byte)	Function Code (1 Byte)	Address (2 Bytes)		Data Value (2 Bytes)		CRC (2 Bytes)	
		High Byte	Low Byte	High Byte	Low Byte	High Byte	Low Byte

As a general practice function code 0x06 is used for command excitation & for status reading the function code 0x04 will be used:

The other details needed for the modbus communications such as Function Code, address, Data to be written are listed below;

Function Code Details (as implemented by auma):

DESCRIPTION	VALUE
1. READ COIL STATUS	0x01
2. READ INPUT STATUS	0x02
3. READ HOLDING REGISTERS	0x03
4. READ INPUT REGISTERS	0x04
5. FORCE SINGLE COIL	0x05
6. FORCE MULTIPLE COIL	0x0F
7. PRESET SINGLE REGISTER	0x06
8. PRESET MULTIPLE REGISTERS	0x10
9. DIAGNOSTICS	0x08
a. LOOP BACK	0x00
b. CLEAR COUNTERS	0x0A
c. RETURN BUS MESSAGE COUNT	0x0B
d. RETURN BUS COMMUNICATION ERROR COUNT	0x0C
e. RETURN BUS EXCEPTION ERROR COUNT	0x0D
f. RETURN SLAVE MESSAGE COUNT	0x0E
g. RETURN SLAVE NO RESPONSE COUNT	0x0F

Function Code 0x02: The register details associated with this function code (Read Input Status) are as below;

DESCRIPTION	ADDRESS IN HEX
OPEN POSITION	0x0000
CLOSE POSITION	0x0001
SET POINT REACHED	0x0002
RUNNING OPEN	0x0004
RUNNING CLOSE	0x0005
THERMAL FAULT	0x0008
REMOTE SW POSITION	0x000A
LOCAL SW POSITION	0x000B
LSO	0x000C
LSC	0x000D
TSO	0x000E
TSC	0x000F

Note: The data values of this function code is to be indicated in binary (1/0)

Function Code 0x01, 0x05 & 0x0F: The register details for read & write operations associated with these function codes (coil status) are as below;

DESCRIPTION	ADDRESS IN HEX
1. REMOTE OPEN	0x0000
2. REMOTE CLOSE	0x0001
3. REMOTE SET POINT	0x0002
4. REMOTE SW POSITION	0x0020
5. OFF SW POSITION	0x0021
6. LOCAL SW POSITION	0x0022

Note: The data values of these function codes are to be indicated in binary (1/0)

General Guidelines for effective communication:

Ensure the following:

1. No short between the DATA+ & DATA- lines on each channel

2. No interchange/reversing in connection of DATA+ & DATA- lines of each channel, when polling from the external Master.

3. A common reference line/Signal Ground known as "A Shield" for Channel A or "B Shield" for Channel B runs along the communication path

4. Signal Ground is not connected to Earth point and it is referenced (shorted with device) only at one end

5. Minimum setting of Com receive byte value as 20 considering the 2 byte transfer on each poll; If the communication poll needs more than 2 bytes accordingly the Com RX byte to be varied in the range of 20 to 100

6. Repeater mode is kept "YES" only for loop topology

(For more/other details such as troubleshooting, spare part list refer to the manual "EPAC-Operation & Spare Parts Manual: Version V3.XMP")

EPAC nameplate:

Identify the location of the epac name plate on the actuator which is as shown in the Fig. L

Fig. J: Actuator with EPAC

The following relevant details are available on the EPAC name plate to ensure our support after supply
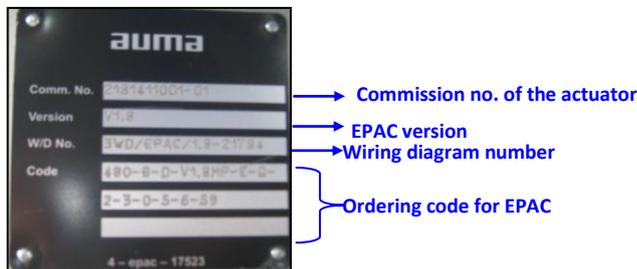

Fig. K: EPAC name plate

Please furnish the above details of the name plate while ordering spare parts/after sales support.

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