auma®

Triple Play Matic Modbus with CDN455

Operation Instructions

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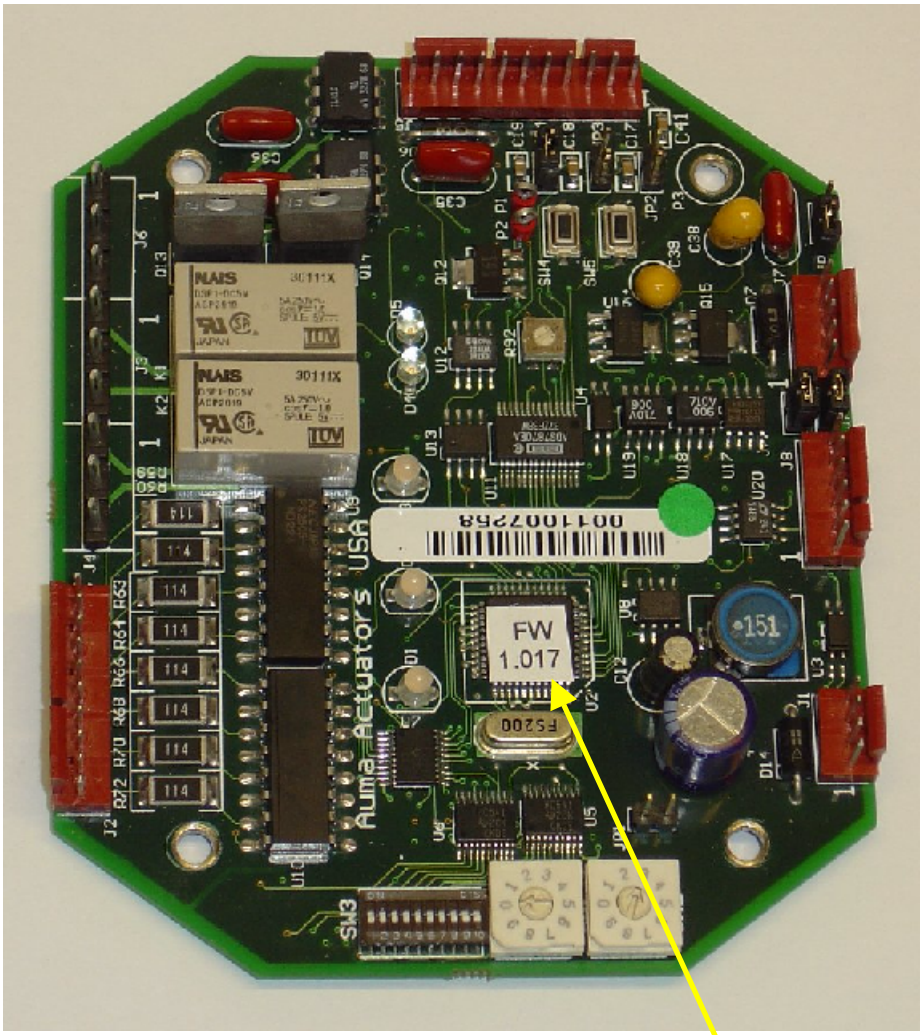
Scope of these instructions:
These instructions cover the Triple Play Matic Modbus with the CDN455 control board covering firmware versions 1.011 thru 1.017. The firmware version can be determined by the sticker on the CDN455 board. See figure below.



CDN455 Software Version Sticker

Legend: FW 1 . 017

Firmware:

Major Revision:

Minor Revision:

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1 Safety Instructions

1.1 Range of application

AUMA actuators are designed for the operation of industrial valves, e.g. globe valves, gate valves, butterfly valves and ball valves.

For other applications please consult us. AUMA is not liable for any possible damage resulting from use in other than the designated applications. Such risk lies entirely with the user.

Observance of these operation instructions is considered as part of the controls designated use.

1.2 Short description

AUMA actuators have a modular design. Motor and gearing are mounted in a common housing.

The actuators are driven by an electric motor and controlled with the electronic controls TriplePlay Matic. The electronic controls are included in the scope of delivery.

1.3 Commissioning (electrical connection)

During electrical operation certain parts inevitably carry lethal voltages. Work on the electrical system or equipment must only be carried out by a skilled electrician and in accordance with the applicable electrical engineering rules.

1.4 Maintenance

The maintenance instructions must be observed, otherwise a safe operation of the actuator is no longer guaranteed.

1.5 Warnings and notes

Non-observance of the warnings and notes may lead to serious injuries or damage. Qualified personnel must be thoroughly familiar with all warnings and notes in these operation instructions.

Correct transport, proper storage, mounting and installation, as well as careful commissioning are essential to ensure a trouble-free and safe operation.

The following references draw special attention to safety-relevant procedures in these operation instructions. Each is marked by the appropriate pictograph.

This pictograph means: Note!

“Note” marks activities or procedures, that have major, influence on the correct operation. Non-observance of these notes may lead to consequential damage.

This pictograph means: Electrostatically endangered parts!

If this pictograph is attached to a printed circuit board, it contains parts, which may be damaged or destroyed by electrostatic discharges. If the boards need to be touched during setting, measurement or for exchange, it must be assured that immediately before a discharge through contact with an earthed metallic surface (e.g. the housing) has taken place.

This pictograph means: Warning!

“Warning marks activities or procedures that, if not carried out correctly, can affect the safety of persons or material.

2 Transport and storage

- Transport to place of installation in sturdy packing.
- Do not attach ropes or hooks to the hand wheel for the purpose of lifting by hoist.
- Store in well-ventilated, dry room.
- Protect against floor dampness by storage on a shelf or on a wooden pallet.
- Cover to protect against dust and dirt.
- Apply suitable corrosion protection agent to bright surfaces.

3 General Information

The CDN455 TriplePlay Board is furnished in the AUMA Matic motor control housing for controlling electric motor driven actuators used on valves, dampers and other devices. The board serves as the actuator's interface with the plant control system.

The Triple Play Matic can be configured in the following control modes:

- DeviceNet digital control mode
- Modbus digital control mode
- Analog control mode (4-20mA) with or without bus monitoring.

This manual covers the operation of Modbus digital control and Analog control mode with or without bus monitoring.

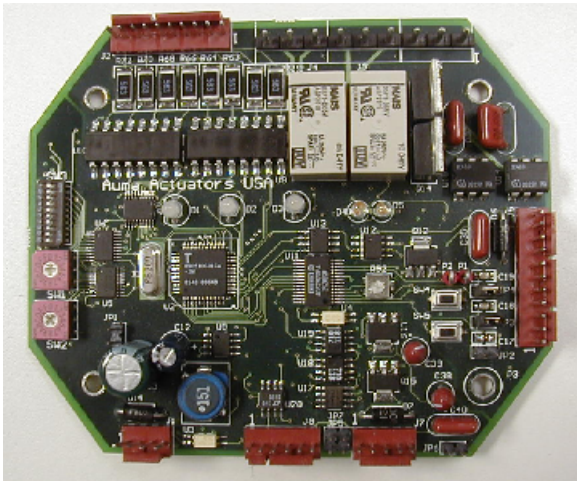


Figure 3-1
CDN455 Control Board

4 Electrical Commissioning

4.1 General Modbus Information

For the exchange of information among automation systems and between automation system and the connected decentralized field devices, serial fieldbuses are used today as the main communication system Thousands of applications have proved impressively the cost savings of up to 40% in wiring, commissioning and maintenance can be achieved by using field bus technology. Just two wires are needed to transmit all relevant information for the field devices, such as input and output signal, parameters and diagnostics data.

Modbus is an open international fieldbus system, which is also used successfully throughout the world. The application range includes automation in the areas of manufacturing, processing and building. For a through introduction to Modbus the Modbus Organization web site is a good source. http://www.modbus.org/ .

Modbus uses a linear bus line topology. As a basic guideline the following table lists the allowable cable lengths and data rates allowed. This list includes the available baud rates for the CDN455

Baud rate	Maximum distance Without Repeaters
1200 bits/s	1200m
2400 bits/s	1200m
9600 bits/s	1200m
19200 bits/s	1200m

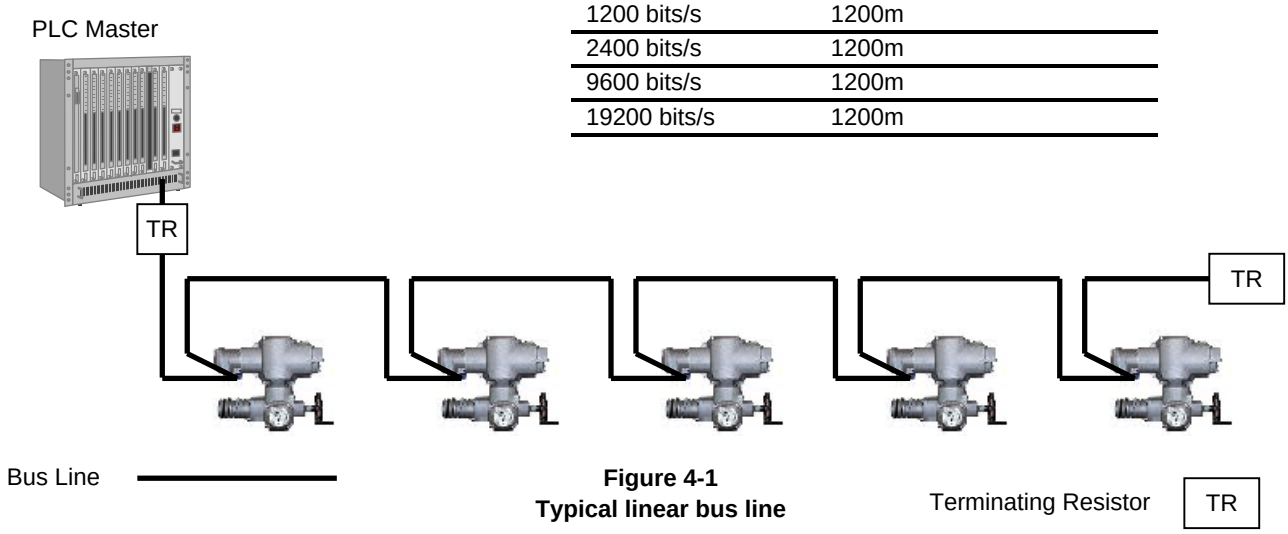


Figure 4-1
Typical linear bus line

Cable designed specifically for Modbus should be used to ensure proper communication. One cable that meets the Modbus requirements is Belden Cable 3105A which has 2 conductors and a shield.

4.2 CDN455 Technical Information

4.2.1 Analog Inputs

The CDN455 provides two analog inputs AI1 and AI2 for customer use. If the actuator is configured for Analog control, input AI1 is used to provide the position command to the actuator. If the actuator is configured for Network control, inputs AI1 and AI2 are available for customer use.

4.2.2 Analog Outputs

The analog output is a 4-20mA self-powered signal providing actuator position feedback. This is in addition to the actuator position feedback available from the Modbus process I/O.

4.2.3 Output Relay 2

Relay 2 is a dry contact Form C (SPDT) relay rated 5A @ 250VAC for customer use. This relay is energized from the Command Word via Modbus.

4.2.4 ESD

ESD is an emergency function that when set, will cause the actuator to either fail as is, or fail to a preset position. The actuator will respond the same as if it went into a fail mode. The setting of the Fail Mode determines how the actuator will respond to ESD. **This function is active only when the local selector switch is in Remote. The actuator can still be operated in the Local mode.**

4.2.5 Technical data table

Interface	EIA-485 (RS-485)	
Transmission medium	Shielded twisted pair	
Communication protocol	Modbus (RTU or ASCII)	
Network topology	Linear bus (line)	
Data transfer rate	Data transfer rate in bit/s	distance / segment length in m
	1,200 2,400 9,600 19,200	1,200 1,200 1,200 1,000 The maximum distance can be multiplied with repeaters
Number of nodes	32 stations in each segment without repeaters, up to 247 stations with repeaters (6)	
No. active nodes (masters)	1	
Bus access	Master-Slave	
Function Codes	• 01 Read Coil Status • 02 Read Input Status • 03 Read Holding Registers • 04 Read Input Registers • 05 Single Coil Write • 06 Single Register Write • 15 Multiple Coil Write • 16 Multiple Register Write	
Control features	• OPEN • STOP • CLOSE • Run to Setpoint Position	
Indications	• End-of-travel positions OPEN, CLOSE • Selector switch in position LOCAL / OFF / REMOTE • Open torque switch tripped • Closed torque switch tripped • Continuous valve position	
Fault Indications	• Motor protection tripped – Thermal overload • Phase failure, wrong phase sequence	
Communication fail function	• Actuator performs fail action when it doesn't receive a valid Modbus telegram for more than 10 sec (default value).	
Analog / digital I/O	• 3 analog inputs • 8 digital inputs • 4 digital outputs • 1 analog output (4..20mA)	
Connection	Typical • Connection Board with integrated Termination Resistor circuit and Surge Protection • Screw type clamp terminals. • Conduit entries: 2 x ¾" and 1 x 1" NPT (standard) Note: In certain configurations such as an actuator with NEMA4/6 with a disconnect switch the connection board cannot be used. In these instances a plug and socket connection will be used.	

4.3 Electrical Connection

4.3.1 Mains connection

Work on the electrical system or equipment must only be carried out by a skilled electrician and in accordance with the applicable electrical engineering rules.

- Refer to Figures 4.2 and 4.3
- Remove Terminal Housing for access to Plug and Socket .
- Remove Socket to gain access to Main connection terminals on socket.
- Insert mains cable thru Mains conduit entry
- Connect to terminals per supplied wiring diagram.

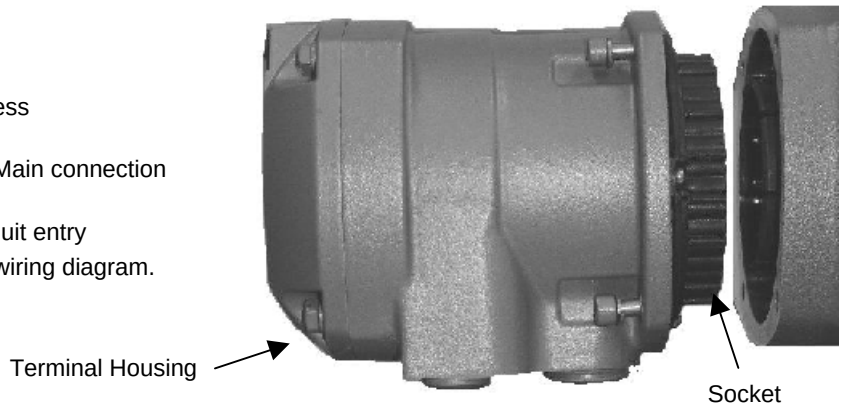


Figure 4-2

4.3.2 Bus connection

Disconnect power before removing the plug cover.

- The Modbus connection board is located in the terminal housing (figure 4-3)
- Loosen and remove plug cover (figure 4-3).
- Insert cable thru Bus conduit entry.
- Connect incoming Modbus cable to X1 Pins1&2 (figure 4-4).
- Connect outgoing Modbus cable to X1 Pins 3&4 (figure 4-4).
- See Table 4-5 for pinout of X1.

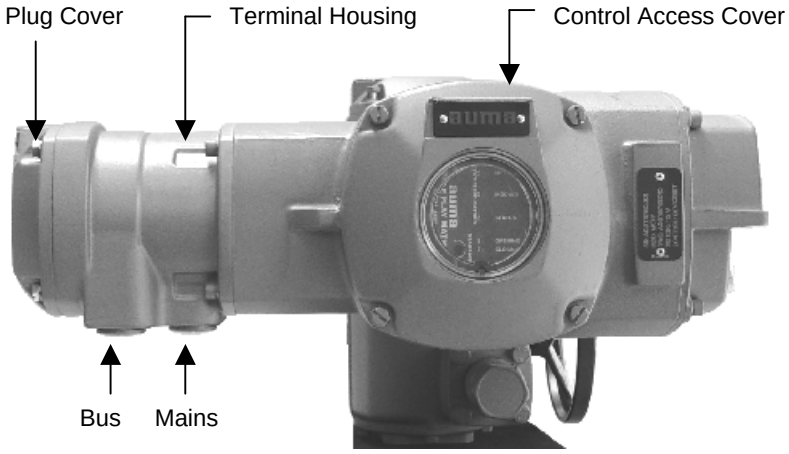


Figure 4-3

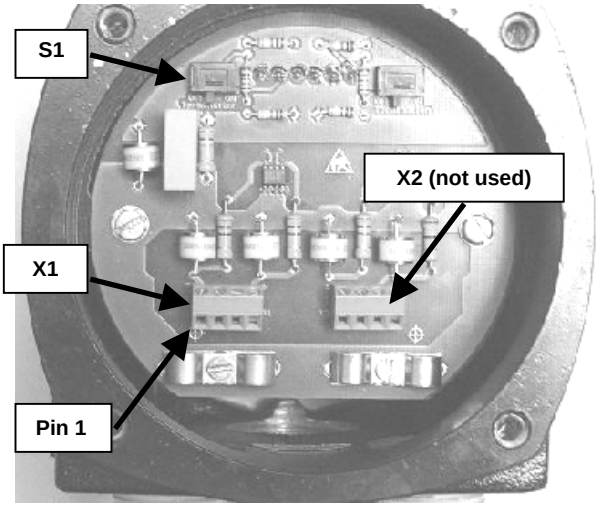


Figure 4-4
Modbus Connection Board

Pin	Connection X1
1	RS485/A (-) In
2	RS485/B (+) In
3	RS485/A (-) Out
4	RS485/B (+) Out

Table 4-5

The Modbus connection board provides a 120 ohm termination resistor that can be switched ON and OFF with switch S1 (figure 4-4). The termination resistor should be switched ON only if the actuator is the first or last node on the bus and no other termination resistors are installed elsewhere on the bus.

5 Configuration

This section covers the setting of the switches to configure the CDN455 board for DeviceNet control or Analog control with Modbus monitoring. To gain access to the switches loosen and remove the Control Access Cover to gain access to the CDN455 board (figure 5-1). Figure 5-1shows the CDN455 control board with the access cover removed and the cover plate installed over the CDN455 control board. To gain access to the board itself remove the cover plate. Appendix A Board Layout also provides the locations of board components.

5.1 Setting Node Address

Default Address: 99

The allowable Modbus node addresses are 0-247. To set the node address use rotary switches SW1 and SW2 and dipswitch SW3.
SW1 – 10's Digit
SW2 – 1's Digit
SW3-9 Adds 200 to address
SW3-10 Adds 100 to address
Examples:

Switch	Node 27	Node 148	Node 215
SW1	2	4	1
SW2	7	8	5
SW3-9	OFF	OFF	ON
SW3-10	OFF	ON	OFF

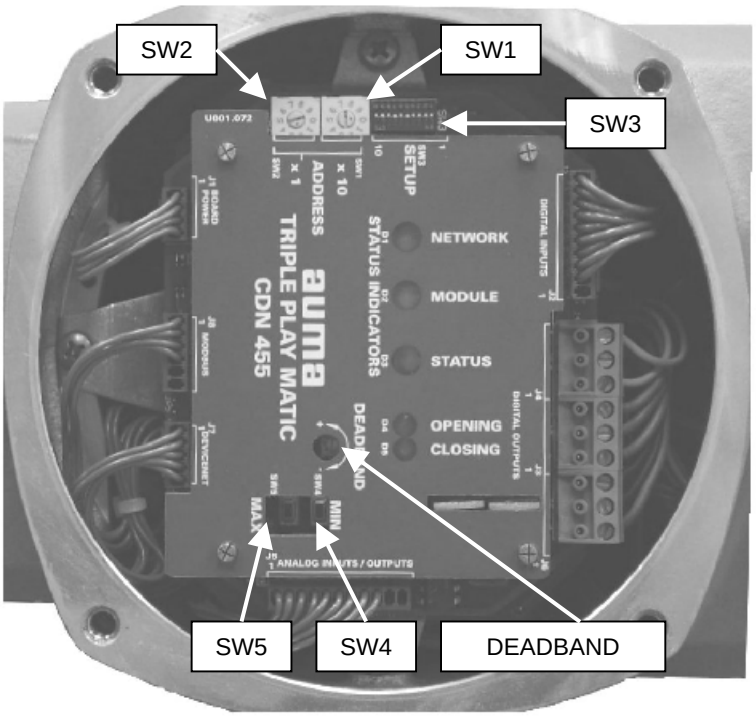


Figure 5-1

5.2 Bus Select

Default Bus: Modbus

The CDN455 can communicate via DeviceNet or Modbus.

- DeviceNet – SW3-2= Off
- Modbus – SW3-2 =On

5.3 RTU/ASCII

Default Bus: RTU

The CDN455 can communicate Modbus RTU or ASCII.

- ASCII – SW3-8= Off
- RTU – SW3-8 =On

5.4 Data Rate (Baud Rate)

Default Data Rate: 19.2kbits/s

The CDN455 supports four data rates:
1.2Kbits/s, 2.4Kbits/s, 9.6Kbits/s and 19.2Kbits/s.
See table 5-2.

SW3-3	SW3-4	Date Rate
Off	Off	1.2Kbits/s
On	Off	2.4Kbits/s
Off	On	9.6Kbits/s
On	On	19.2Kbits/s

Table 5-2

5.5 Control Mode

Default Control Mode: Network

The control mode determines if the actuator will be controlled via the network (Modbus) or by an analog signal

- Network – SW3-1 = Off
- Analog – SW3-1 = On

5.6 Control Type

Default Control Type: Combination

This setting selects either Combination or Modulating. When Combination is selected either open/close or modulating control is possible. When Modulating control is selected only modulating control is possible.

- Combination Control – SW3-5 = Off
- Modulating Control – SW3-5 = On

5.7 Fail Mode

Default Fail Mode: Fail As Is

Fail Mode determines the action of the actuator when in fail mode or the ESD mode is set. Fail Mode is defined as a loss of communication (Modbus) after communication has first been established, or if the actuator is in analog control, the current signal is lost. See section 6.2 for setting the "Fail to Preset" position.

- Fail As Is – SW3-6 = Off
- Fail Preset – SW3-6 = On

5.8 Jumpers

Refer to Appendix A for jumper locations.

5.8.1 JP1

Jumper	Description	In	Out	Default
JP1	Used to download program- ***Factory use only***	Download program	Normal operation	Out

5.8.2 JP2 JP3&JP4

Jumper	Description	In	Out	Default
JP2	Selects Current or Voltage for analog input AI0	Current (0-20mA)	Voltage (0-5Vdc)	Out
JP3	Selects Current or Voltage for analog input AI1	Current (0-20mA)	Voltage (0-5Vdc)	In
JP4	Selects Current or Voltage for analog input AI2	Current (0-20mA)	Voltage (0-5Vdc)	In

5.8.3 JP5 & JP7

Jumper	Description	In	Out	Default
JP5	Connects board power Vloop to the DeviceNet V+	Connected	Not connected	Out
JP7	Connects board Gnd to the DeviceNet V-	Connected	Not connected	Out

5.8.4 JP5 & JP7

Jumper	Description	In	Out	Default
JP6	Connects DeviceNet Shield to earth Gnd	Connected	Not connected	Out

6 Calibration

This section describes the procedures to calibrate the position feedback, setting the Fail to Preset position, setting the analog position control and Deadband. Refer to Figure 5-1 or Appendix A for location of push buttons used in the calibration procedures.

6.1 Position Feedback

The CDN455 automatically calibrates the position feedback based on the open and close limit switches. In order for the position feedback to be calibrated, the open and close limit switches must first be set per the appropriate actuator manual. Once the limit switches are set the CDN455 will calibrate the position feedback each time the open and close limit switches are made.

6.2 Setting the analog position setpoint

When the actuator is configured for Analog Mode, the position setpoint is provided via analog input AI1. This input can be either current or voltage input (See 5.7.2). The actuator does not need to be operated to set the Zero (full close) and Span (full open). Note: the Zero signal must be less than the Span; cannot have a 20mA Zero and a 4mA Span.

- Set Zero (full close)
  - Apply analog signal desired for full close (Example: 4mA)
  - Press SW4 for approx. 5 seconds. LEDs D1, D2 & D3 will flash amber then solid green when accepted
- Set Span (full open)
  - Apply analog signal desired for full open (Example: 20mA)
  - Press SW5 for approx. 5 seconds. LEDs D1, D2 & D3 will flash amber then solid green when accepted

6.3 Setting the Deadband

The Deadband is a potentiometer adjustment on the CDN455 board (See Figure 5-1). This sets the allowable error around the setpoint when the actuator is in modulating mode. To prevent the actuator from constantly changing direction trying to reach the setpoint the deadband may need to be adjusted. To increase the deadband turn the potentiometer counter-clockwise to decrease turn clockwise. The actual deadband value can be read from parameter 20 of the EDS file (see section7.4.2)

6.4 Setting "Fail to Preset" position

The "Fail to Preset" is the position the actuator will move to if it losses communication or the ESD function is set. This can be any position between 0-100% open.

- Move the actuator to the desired "Fail to Preset" position (0-100% open).
- Press SW4 and SW5 at the same time for approx. 5 seconds. LEDs D1, D2 & D3 will flash amber then solid green when accepted

7 Control System Integration Modbus

Modbus uses Function Codes for the exchange of information from the control system master to the slave devices. The table below describes the Modbus function codes. Sections 7.2 and 7.3 maps the actuator process I/O and the function codes to use for control of the actuator.

Definitions:

Function	Function Code	Description
Read Coil Status	01	Reads the status of individual output bit information from the slave
Read Input Status	02	Reads the status of individual input bit information from the slave
Read Holding Registers	03	Reads the contents of the holding registers from the slave
Read Input Registers	04	Reads the contents of the input data registers from the slave
Force Single Coil	05	Sets an individual bit in the slave to ON or OFF
Preset Single Register	06	Writes data into individual Holding Registers of the slave
Force Multiple Coils	15	Sets several consecutive bits in the slave to ON or OFF
Preset Multiple Registers	16	Writes data into consecutive Holding Registers in the slave

- Holding Register: Data space which contains or holds the commands to a slave. (Example: Open/Close commands)
- Input Register: Data space which contains the information about the slave. (Example: Position of Actuator)
- Input information: Information about the slave sent to the master
- Output Information: Commands sent to the slave from the master
- Register: A 16bit word

7.1 CDN455 Serial Interface format

- 8 Data Bits
- No Parity
- 1 Stop Bit

7.2 Input Data

Reading the actuator signals from the actuator using register functions

Function Code to use:

Read Input Register (04)

Variable	Offset (Decimal)	Contents															
		Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Status Word	0	Control Mode	Fail Mode	—	Control Type	Alarm Active	Communication Failure	Loss of Local Setpoint	Loss of Position	Selector Sw. Local	Selector Sw. Remote	Thermo Alarm	Phase Alarm	Open Limit	Close Limit	Open Torque	Close Torque
Analog Input AI1	1	Analog Input AI1 (0-1000)															
Actuator Position	2	Actuator Position (0-1000)															
Analog Input AI2	3	Analog Input AI2 (0-1000)															

7.3 Output Data

Sending or reading run commands from the control system to the actuator

Function Codes to use:
Preset Single Register (06)
Preset Multiple Register (16)
Read Holding Register (03)

Variable	Offset (Decimal)	Contents															
		Bit 15	Bit 14	Bit 13	Bit 12	Bit 11	Bit 10	Bit 9	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Command Word	0	ESD	—	—	—	—	—	—	—	—	—	—	Enable Setpoint	—	Relay 2	Close	Open
Setpoint Word	1	Position command (0-1000)															

7.4 Description of Process I/O

7.4.1 Status Word

Bit	Designation	Value	Description
0	Close Torque	1	Close Torque Switch set
		0	
1	Open Torque	1	Open Torque Switch set
		0	
2	Close Limit	1	Close Limit Switch set -actuator fully closed
		0	
3	Open Limit Switch	1	Open Limit Switch set -actuator fully open
		0	
4	Phase Alarm	1	
		0	Phase alarm set – phase of incoming power incorrect
5	Thermo Alarm	1	
		0	Motor thermal switch tripped
6	Selector sw. Remote	1	Actuator controlled remotely
		0	
7	Selector sw. Local	1	Actuator controlled from actuator control push buttons
		0	
8	Loss of Position	1	Loss of Position set when the actuator position feedback has been lost
		0	
9	Loss of Local Setpoint Alarm	1	Set if actuator is in Analog Mode and the analog position setpoint (AI1) is lost.
		0	
10	Communication Failure	1	Loss of DeviceNet connection
		0	
11	Alarm Active	1	Indicates one or more of the following: Loss of Position, Loss of Local Setpoint, Comm. Failure, Torque Switch Set, Thermo alarm, Phase Alarm
		0	
12	Control Type	1	Modulating mode only
		0	Combination mode- open/close or modulating mode possible.
13	-		
14	Fail Mode	1	Fail to Preset – if actuator losses communication or the ESD is active the actuator will move to a Preset position
		0	Fail as is – if actuator losses communication or the ESD is active the actuator will stay at its current position
15	Control Mode	1	Network – actuator will be controlled from DeviceNet
		0	Analog – actuator will be controlled via analog signal.

7.4.2 Analog Input AI1

The Analog Input AI1 input word has two possible meanings depending on the setting of the Control Mode.

- **Control Mode set to Network**: In this case a transmitter (temperature, pressure, etc.) can be wired to analog input AI1 and this information can be read back via Modbus
- **Control Mode set to Analog**: In this case this word sends back the Local Setpoint via Modbus. The Local Setpoint is defined as the Position Command via analog input AI1.

7.4.3 Analog Input AI2

This is a spare analog input that a transmitter (temperature, pressure, etc.) can be wired to analog input AI2 and this information can be read back via Modbus.

7.4.4 Command Word

Bit	Designation	Value	Description
0	Open	1	Run Command
		0	
1	Close	1	Run Close Command Word
		0	
2	Relay 2	1	Energize Relay 2
		0	
3	-		
4	Enable Setpoint	1	When the Control Type is set to Combination Mode setting this bit puts the actuator in Modulating Mode control
		0	If the Control Type is set to Combination Mode and this bit in not set, the control is open/close.
5	-		
6	-		
7	-		
8	-		
9	-		
10	-		
11	-		
12	-		
13	-		
14	-		
15	ESD	1	ESD mode set
		0	

7.4.5 Setpoint Word

Provides the position command when the actuator is in Modulating mode. Scale is 0-1000 (0-100.0% Open).

8 Troubleshooting Guide – Modbus

The CDN455 board has 5 LEDs that can be used to assist in troubleshooting. LED D1 shows the status of the network communication. LED D2 shows the status of module (CDN455 board). LED D3 shows the status of the actuator. LED D4 indicates the actuator is given an Open command and LED D5 indicates the actuator is given a Close command. The following tables assist in interpreting the meaning of the LED indications. Refer to Appendix A for LED locations.

8.1 LED D1-Network

State	Indicates	Action
Off	Board is not on-line. No communication established with a Master	Ensure Master is configured properly Check Bus wiring.
Flashing Amber	When normal Modbus communication is established D1 will flash amber for 100mSec. If D1 does not flash amber there is no Modbus communication. If there is no communication to a node within 10 seconds the board will go into communication failure.	Normal state, No action required

8.2 LED D2-Module

LED D2	Event	Action
Solid Green.	The board configured for Modbus communication	Normal state, No action required.
Not Solid Green	Board is not configured for Modbus.	Check board configuration

8.3 LED D3-Status (actuator)

LED D3	Event	Modes
Solid Green	Normal state, No error	All modes
Flashing Green/Red	Thermal error or Phase error	All modes
Flashing Red blinking	Open Torque or Close Torque Error	All modes
Flashing Amber	Loss of Setpoint Signal	only active in Analog Mode
Solid Amber	Local ESD	All modes
Solid Red	Loss of communication	All modes
Flashing Green/Amber	Remote ESD	All modes
Flashing Green	Selector Switch not in Remote	All modes

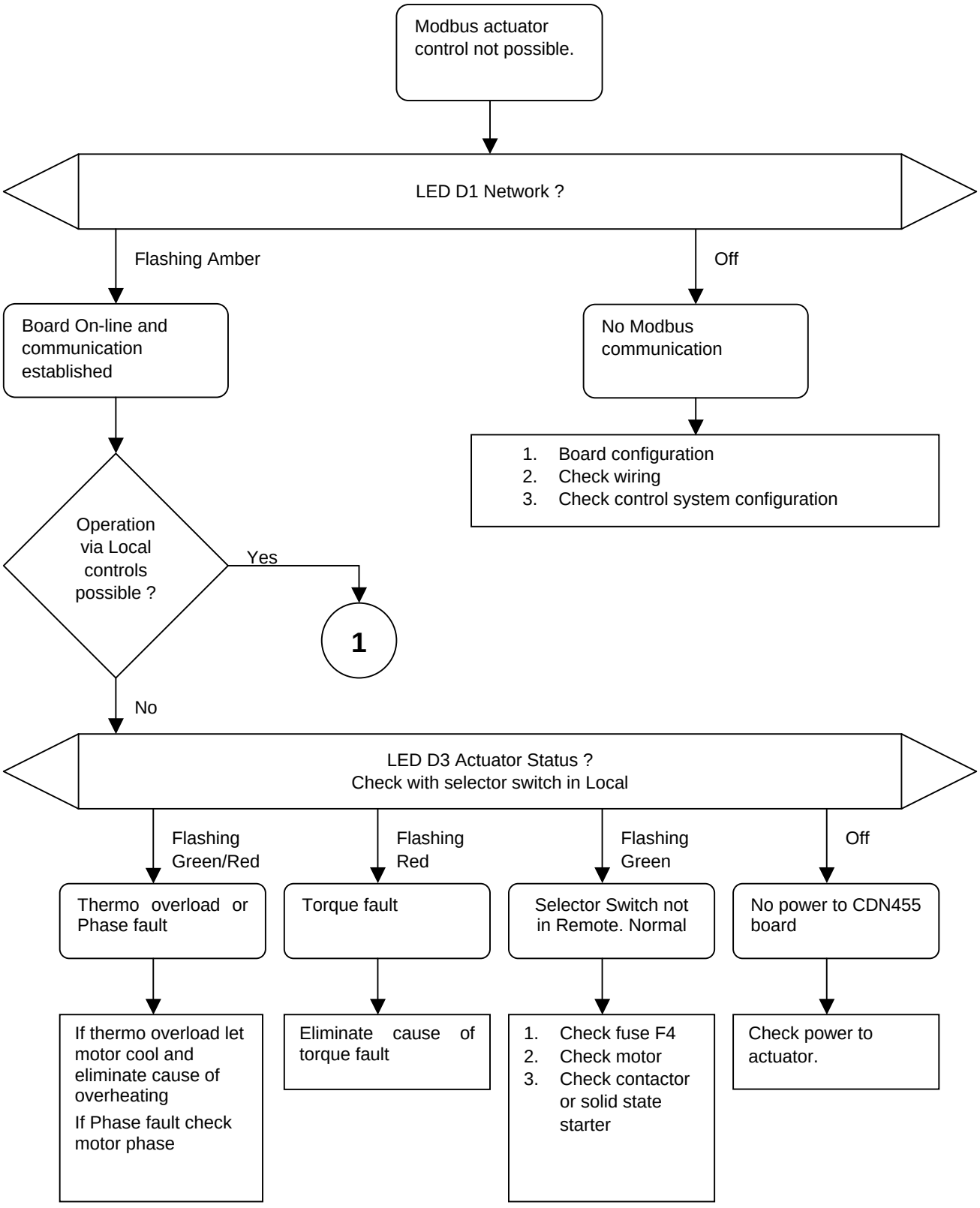
8.4 LED D4

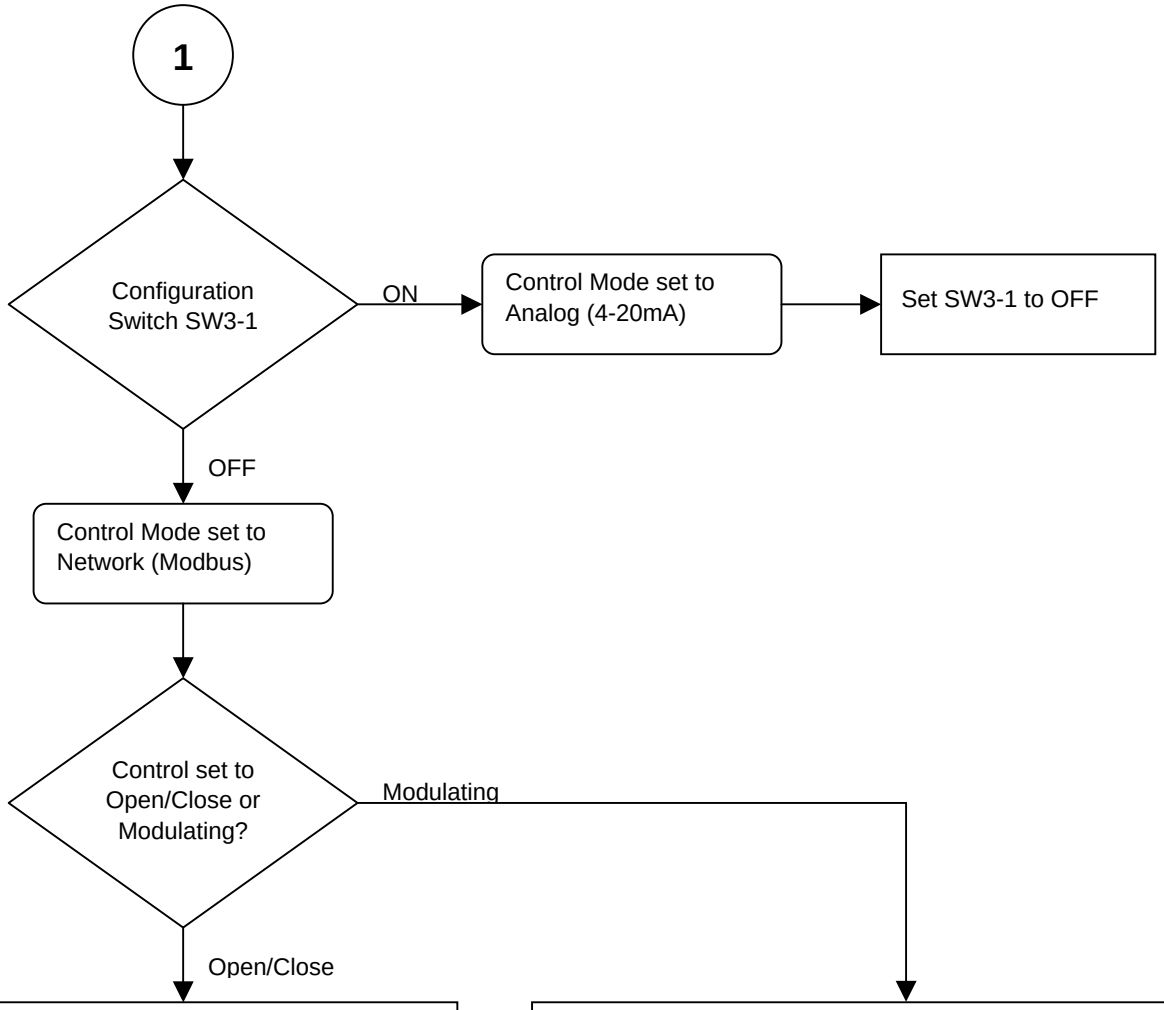
Indicates the Open digital output is activated.

8.5 LED D5

Indicates the Close digital output is activated.

8.6 Actuator cannot be controlled by Modbus





1. Check Control Type setting. Should be set to Combination Mode (SW3-5 set to OFF).

2. With selector switch in Remote position give an Open command and check if LED D4 lights up.
   a. No – Check control system programming
   b. Yes – ensure 115VAC is at (J6) pin 1 on CDN455 board.

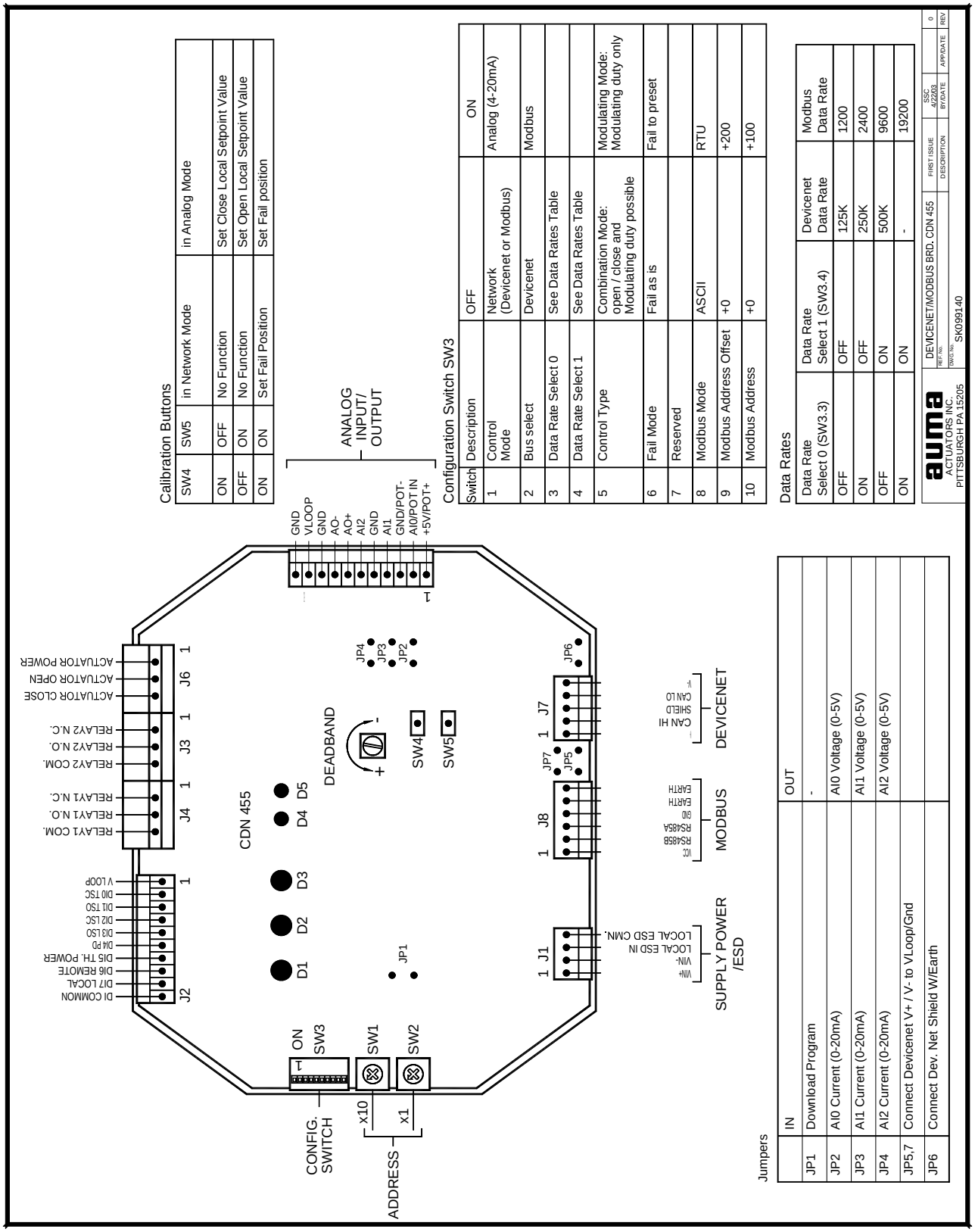
3. With selector switch in Remote position give a close command and check if LED D5 lights up.
   a. No – Check control system programming
   b. Yes – ensure 115VAC is at (J6) pin 1 on CDN455 board.

1. With selector switch in Remote position give the actuator a setpoint value above the current position of the actuator and check if LED D4 lights up.
   a. No – Check Programming and items 3 this box.
   b. Yes – ensure 115VAC is at (J6) pin 1 on CDN455 board

2. With selector switch in Remote position give the actuator a setpoint value below the current position of the actuator and check if LED D5 lights up.
   a. No – Check Programming and items 3.
   b. Yes – ensure 115VAC is at (J6) pin 1 on CDN455 board
   c. Check actuator Position Word to ensure actuator

3. Check Deadband of actuator and adjust if necessary.

9 Appendix A CDN455 Board Layout



Calibration Buttons

SW4	SW5	in Network Mode	in Analog Mode
ON	OFF	No Function	Set Close Local Setpoint Value
OFF	ON	No Function	Set Open Local Setpoint Value
ON	ON	Set Fail Position	Set Fail position

Configuration Switch SW3

Switch	Description	OFF	ON
1	Control Mode	Network (Devicenet or Modbus)	Analog (4-20mA)
2	Bus select	Devicenet	Modbus
3	Data Rate Select 0	See Data Rates Table	
4	Data Rate Select 1	See Data Rates Table	
5	Control Type	Combination Mode: open / close and Modulating duty possible	Modulating Mode: Modulating duty only
6	Fail Mode	Fail as is	Fail to preset
7	Reserved		
8	Modbus Mode	ASCII	RTU
9	Modbus Address Offset	+0	+200
10	Modbus Address	+0	+100

Data Rates

Data Rate Select 0 (SW3.3)	Data Rate Select 1 (SW3.4)	Devicenet Data Rate	Modbus Data Rate
OFF	OFF	125K	1200
ON	OFF	250K	2400
OFF	ON	500K	9600
ON	ON	-	19200

auma ACTUATORS INC. PITTSBURGH PA 15205

DEVICENET/MODBUS BRD. CDN 455
REF. No:
DWG No: SK0991.40

REV.	DESCRIPTION	BY/DATE	APP/DATE
0	FIRST ISSUE	SSC 4/22/03	

Jumpers

	IN	OUT
JP1	Download Program	-
JP2	AI0 Current (0-20mA)	AI0 Voltage (0-5V)
JP3	AI1 Current (0-20mA)	AI1 Voltage (0-5V)
JP4	AI2 Current (0-20mA)	AI2 Voltage (0-5V)
JP5,7	Connect Devicenet V+ / V- to VLoop/Gnd	
JP6	Connect Dev. Net Shield W/Earth	

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