MOX Unity Field Controller
User Guide

0742-602-2301-002

Preface

Scope of the User Guide

This MOX Unity User Guide contains information on the hardware installation, software configuration and operation for products:

- MX602-5XXX-XXX-XXXX

This guide has been organized for the installer and operator, and it is expected that the user is an engineer or similar with an understanding of the operating and programming requirements of similar field control products.

Related Documents

All MOX network architectures contain a collection of MOX equipment and several software packages. For this reason, a number of related documents should be read in conjunction with this user guide.

The related documents are noted below:

- MOX 603 Rack Base IO User Guide
- MOX 603 Standalone IO User Guide
- MOXGRAF V5 Online Help

Conventions Used

	*When you see the "exclamation mark" icon in the left-hand margin, the text to its immediate right will be a special note. Please ensure that you read this information to increase your understanding of the systems operation.*

	*When you see the "stop sign" icon in the left-hand margin, the text to its immediate right will be a warning. This information could prevent injury loss of property or even death (in extreme cases). It is very important that you stop and read this information and ensure that you have complete understanding before continuing with the procedure.*

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1 Overview

MOX Unity Field Controllers are the leading edge open-system controllers with enhanced Remote Terminal Unit (RTU) capabilities for use in SCADA, telemetry and remote data monitoring applications.

The MOX Unity is designed from the ground up to provide control and monitoring functions for field devices, and to provide an interface for industry standard SCADA systems to monitor the control process.

A typical installation consists of a MOX Unity controller, a DC power supply and any suitable combination of onboard I/O modules. Standard onboard components include:

- RS232/RS485 serial communication ports
- 10Mbps and 10/100Mbps Ethernet ports

Some of the onboard options include:

- GSM/GPRS module
- Multi-optional onboard I/Os
- UPS battery charger
- Image capture module

The MOX Unity has an array of status indication LEDs. Communication ports, power, communication status, various configuration and operational states can be quickly viewed via the array of LEDs.

The MOX Unity together with MOXGRAF (Windows based programming software) forms a high performance, flexible system suitable for a wide range of applications.

The key features of the MOX Unity include:

- Modular and open design architecture
- Functions in single or multiple controller installations
- Scalable I/O architecture via MOX 603 I/O modules
- Integrated and transportable IEC61131-3 control software
- TCP/IP communications
- MODBUS communications
- DNP3 communications
- IPSec communications
- IEC 60870 communications

2 MX602-5XXX-XXX-XXXX

2.1 Familiarization

The following diagram shows the rule of the part numbers for the MX602-5XXX-XXX-XXXX serial of the MOX Unity.

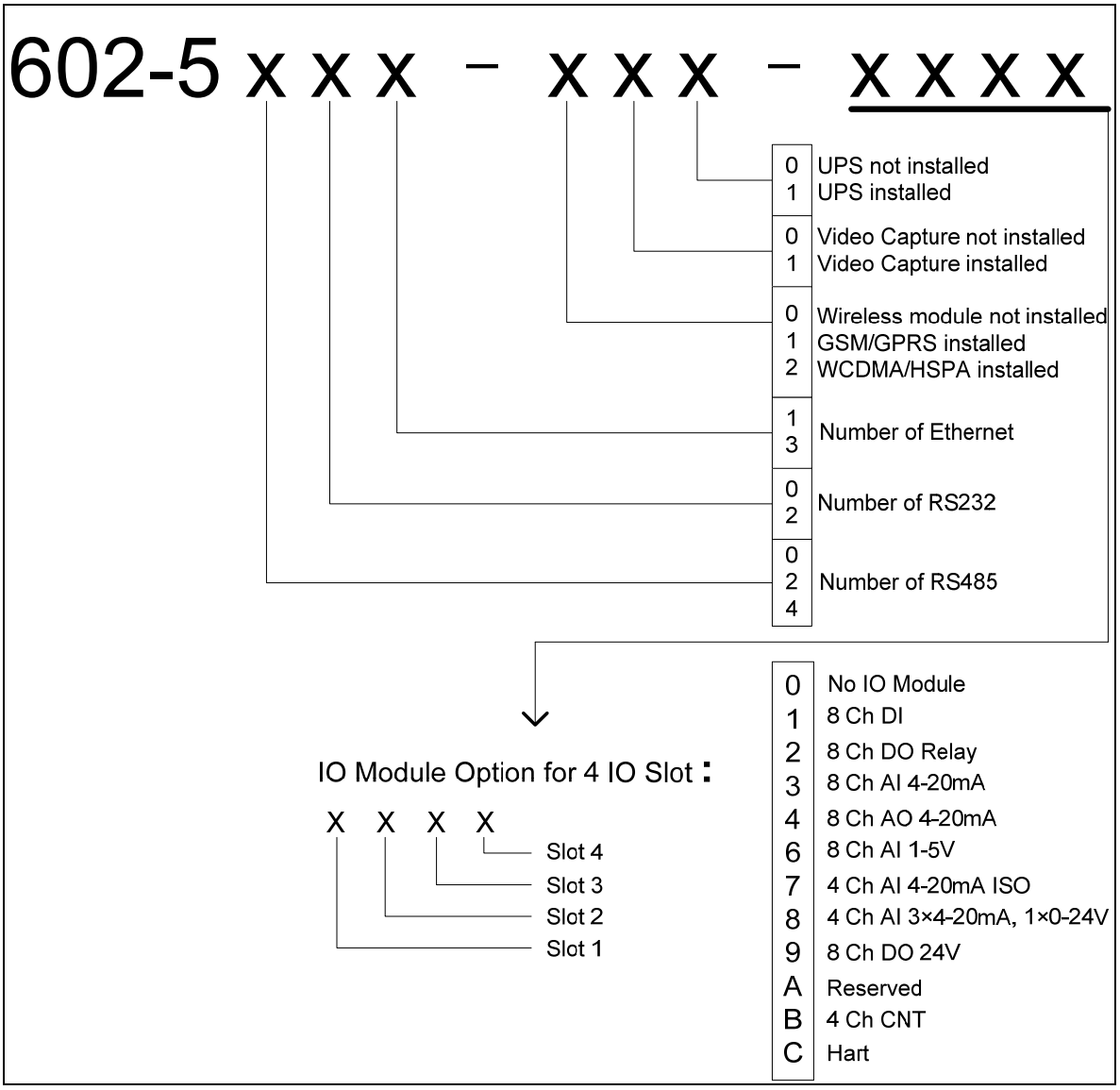


Figure 1 Rules of Part Number for MX602-5XXX-XXX-XXXX

The following diagram gives a detailed description of a typical MOX Unity with part number MX602-5423-111-XXXX. The GPRS, Video Capture and UPS modules are optional. In terms of part numbers, they are MX602-5423-***XXX***-XXXX according to different combinations. Please note that this also apply to Unitys with other part numbers mentioned later in this chapter.

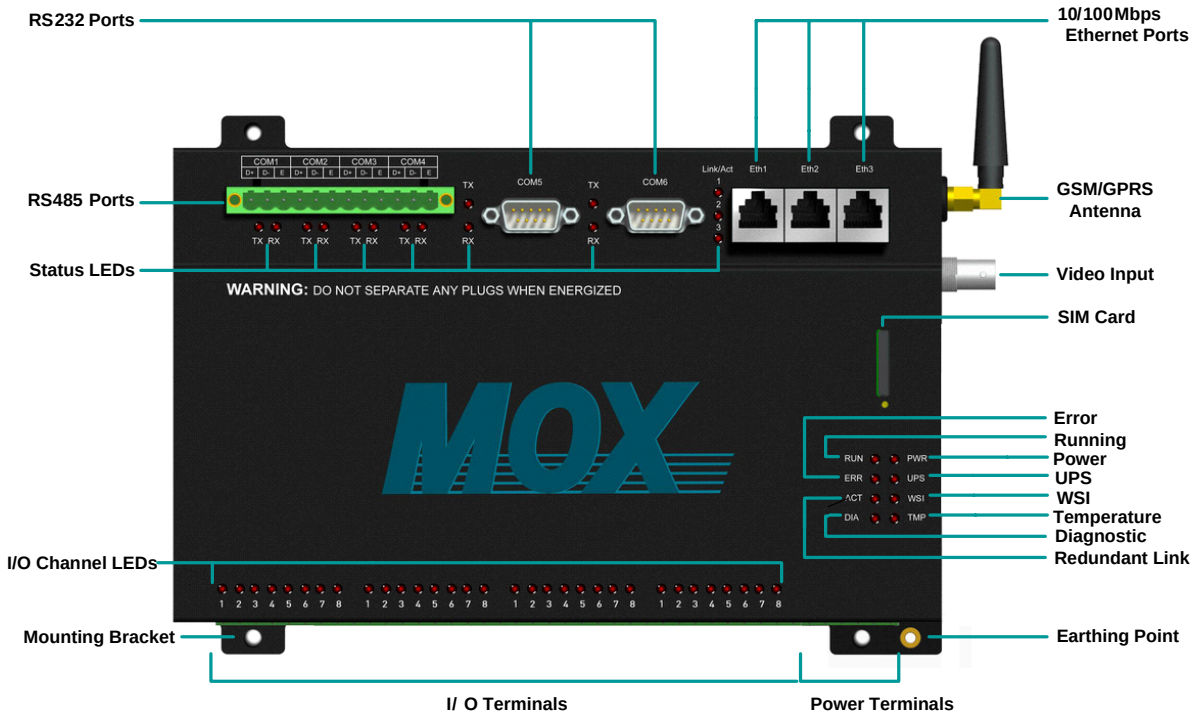


Figure 2 MX602-5423-111-XXXX Unity

The following diagrams demonstrate the typical MOX Unitys with the following part numbers:

- MX602-5021-111-XXXX
- MX602-5201-111-XXXX
- MX602-5221-111-XXXX

Please find the detailed descriptions of each part from the Unity MX602-5423-111-XXXX which gives the full explanations.

Figure 3 MX602-5021-111-XXXX Unity

Figure 4 MX602-5201-111-XXXX Unity

Figure 5 MX602-5223-111-XXXX Unity

2.2 Datasheet

Power Requirements	
Power Voltage	9VDC ~ 30VDC with no UPS mounted 18VDC ~ 30VDC with UPS mounted
Power Dissipation (without I/O modules, GPRS and UPS)	<5W
Fuse Type	51NM-050H
Fuse Value	5A 250V
CPU Specifications	
Clock Speed	400MHz (max)
DDR RAM	64MBytes
Flash Memory	128Mbytes
Communication Specifications	
RS485 (Isolated)	0 or 2 or 4
	Baud Rate: 1200bps to 115200bps
	Isolated Voltage: 2500Vrms
RS232	0 or 2
	Baud Rate: 1200bps to 115200bps
Ethernet	1 or 3 x 10/100Mbps ports
	Auto-Negotiation
	Auto-Crossover Detection
Extended Communication Specifications	
GPRS/GSM	EGSM 900 / GSM 1800
UPS Specifications	
UPS Module	On-board UPS
Battery Type	12V VRLA Battery
Constant Voltage Charge	Yes
Constant Voltage Charge Value	13.4V to 13.7V, Configurable
Constant Current Charge	Yes
Constant Current Charge Value	0.1A, 0.5A, 1.5A
Pulse Current Charge	Yes
Pulse Current Charge Value	100mA
Pulse Current Width	100ms
Pulse Current Duty Cycle	1/10
Max Charge Current	500mA
Battery Energy Measure	Yes

Battery Energy Report	Yes
Battery Energy Bellow Secure Level Alarm	Yes
Cut off System when Battery Energy Working out	Yes
Onboard I/O	
I/O Module Slots	4
Supported I/O Type	DI, DO, AI, AO
I/O Module Combination	Any (factory set)
Onboard RTC	
Onboard RTC	Yes
Accuracy	Module energized: ±2ppm@25±2°C, ±2.5ppm@-30~85°C
	Module de-energized ±2ppm@0~40°C, ±3.5ppm@-40~0°C and 40~85°C
Backup Battery	Yes
Battery Type	BR2032
Battery Voltage	3V
Battery Capacity	190mAh
RTC Retention	>5 Years
Other Characteristic	
Temperature Monitor	Yes
Temperature Alarm	Yes
Environmental Conditions	
Operating Temperature	-20 to 70°C (without GSM/GPRS)
	-20 to 55°C (with GSM/GPRS)
Storage Temperature	-40 to 85°C
Relative Humidity	5 to 90%, non-condensing
Approvals	
CE Approval	Application Field: Industry
	Noise Emission Requirements: EN 61000-6-4: 2007
	Noise Immunity Requirements: EN61000-6-2: 2005
IECEx Approval	Ex nA II T4

Table 1 MOX Unity MX602-5XXX-XXX-XXXX Datasheet

When MOX Unity MX602-5XXX-XXX-XXXX is used in the hazardous area, some restrictions shall be complied:

(1) The total power consumption of the module should be less than 20W.

(2) The module should be mounted in a housing which complies with IP54 protection degree.

(3) When a VRLA battery is used, the battery should be placed out of the hazard area. The capacity of the battery should be less than 10AH. The battery capacity must be configured correctly in the UPS parameter table within MOXGRAF. The peak charge current is limited to 0.5A.

(4) All the external wires must not be added or removed while the module is energized.

(5) The RTC backup battery can only be replaced by the manufacturer.

(6) The ambient temperature is relevant with the usage of the GSM/GPRS module. When a GSM/GPRS module is applied in the module, the ambient temperature is -20°C to 55°C. When a GSM/GPRS module is absent from the module, the ambient temperature is -20°C to 70°C.

2.3 LED Indication

LED	State	Description
RUN	ON	Running normally.
	OFF	System not started.
	Flashing in 0.5 Hz	There is no MOXGRAF code (control code) present.
ERR	ON	MOX I/O communication error. (allocated I/O in the control code is not replying to communication requests)
	OFF	MOX I/O communication OK.
ACT	ON	CPU active & partner CPU alive.
	OFF	CPU inactive or no redundancy configuration.
	Flashing in 2 Hz	CPU active & partner CPU lost.
	Flashing in 0.5 Hz	CPU inactive & partner CPU lost.
DIA	OFF	System not started
	Flashing in 0.5Hz	System is running
PWR	ON	24VDC power supply or UPS
	OFF	No 24VDC power supply nor UPS
UPS	ON	Uninterruptible power supply is working with 24VDC power supply connected to the Unity
	OFF	No uninterruptible power supply
	Flash	Uninterruptible power supply is working without 24VDC power supply connected to the Unity
WSI (For GSM/GPRS)	OFF	GSM is OFF or run in SLEEP, Alarm or Charge-only mode
	Flash	Indicating GPRS data transfer: When a GPRS transfer is in progress, the LED goes ON within 1 second after data packets were exchanged. Flash duration is approximately 0.5s.
	ON	Depending on type of call: Voice call - connected to remote party. Data call - connected to remote party or exchange parameters while setting up or disconnecting a call.
TMP	OFF	Temperature is within range
	ON	Temperature is out of range

Table 2 MX602-5XXX-XXX-XXXX Status LED Indicator

The following table shows all combinations of RUN, ERR and ACT LED states and the operational status of each combination.

LED	State	Description
RUN ERR ACT	ON OFF OFF	This CPU is running normally as inactive or as a single standalone installation.
RUN ERR ACT	Flashing in 2 Hz OFF OFF	There is no MOXGRAF code present.
RUN ERR ACT	ON ON OFF	This CPU is running as inactive or as a single standalone installation. There is an I/O communication error.
RUN ERR ACT	ON OFF ON	This CPU is running normally as active.
RUN ERR ACT	ON OFF Flashing in 2 Hz	This CPU is running as active. The partner CPU has been lost.
RUN ERR ACT	ON OFF Flashing in 0.5Hz	This CPU is running normally as inactive. The partner CPU has been lost.
RUN ERR ACT	ON ON Flashing in 0.5Hz	This CPU is running as inactive. The partner CPU has been lost. There is an I/O Communication Error.
RUN ERR ACT	Flashing in 0.5Hz Flashing in 0.5Hz Flashing in 0.5Hz	Fatal error.

Table 3 MX602-5XXX-XXX-XXXX Status LED Trouble Shooting

MX602-5XXX-XXX-XXXX provides a maximum of six serial ports and three Ethernet ports. Each port has its respective LED(s) to indicate the link state.

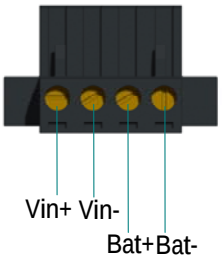
Type	LED	Status	Description
RS232/RS485	TX	OFF	No communication
		Flash	There is attempted outgoing communication
	RX	OFF	No communication
		Flash	There is attempted incoming communication
Ethernet	Link/Act	ON	Connected to another Ethernet device

		Flash	Transmitting or receiving data

Table 4 MX602-5XXX-XXX-XXXX Communication Status LED

2.4 Power Supply

STOP	*To avoid electric shock or damage, power should only be applied after all wiring terminations are complete.*



Generally, DC power supplies will withstand brief power losses without affecting the operation of the system. The duration of the power supply hold-up time depends on the type and state of the controller and any connected I/O devices.

If your DC supply line is unreliable or your application is affected by a processor shutdown, then it is recommended that the UPS be wired. The UPS will delay processor shutdown if external power is unavailable.

The UPS & Battery function is enabled only when the main power supply is energized.

For MX602-5XXX-XX1-XXXX, the MOX Unity is provided with an onboard UPS module as an option. The following table gives a detailed specification:

Charge Characteristics	
Battery Type	12V Lead Acid Battery
Constant Voltage Charge	Yes
Constant Voltage Charge Value	13.4 to 13.7 Configurable
Constant Current Charge	Yes
Constant Current Charge Value	100mA; 500mA; 1.5A
Pulse Current charge	Yes
Pulse Current charge Value	100mA
Pulse Current Width	100mS
Pulse Current Duty Cycle	1/10
Max Charge Current	1.5A (0.5A in hazard locations)

Constant Current Output Error	
100mA	100mA±20mA
500mA	500mA±50mA
1.5A	1.5A±150mA
Accuracy	
Battery's Voltage	<1%(Range 0 to 30V)
Battery's Current	<1%(Range 0 to 3A)
External 24V power's Voltage	<1%(Range 0 to 30V)
External 24V power's Current	<1%(Range 0 to 3A)
Battery Energy Measure	
Battery Energy Measure	Yes
Battery Energy Report	Yes
Alarm Function	
Battery Energy Bellow secure level Alarm	Yes
Safety	
Cut-off System when Battery Energy Low	Yes

Table 5 UPS & Battery Charger Specifications for MX602-5XX1-XXX-XXXX

As soon as the UPS module detects a DC failure, it will immediately provide a supplementary supply to the MOX Unity.

	*Ensure the battery polarity is correct to avoid risk of damage to the battery or the MOX Unity.*

	When MOX Unity is used in the hazardous area, the VRLA battery should be placed out of the hazard area. The capacity of the battery should be less than 10AH. The battery capacity must be configured correctly in the UPS parameter table within MOXGRAF. The peak charge current is limited in 0.5A.

2.5 Serial Ports

The following tables detail the serial port connector assignment for RS232 and RS485:

RS232 Serial Communication Pin Assignments		
Pin	**Signal**	**Function**
1	CD	Data Carrier Detect

RS232 Serial Communication Pin Assignments		
Pin	**Signal**	**Function**
2	RXD	Receive Data
3	TXD	Transmit data
4	DTR	Data Terminal Ready
5	GND	Signal Ground
6	DSR	Data Set Ready
7	RTS	Request to Send
8	CTS	Clear to Send
9	RI	Ring Indicator

Table 6 RS232 Connector Assignment

The RS485 serial communication pin assignments are shown below:

Com1			Com2			Com3			Com4		
D+	D-	E	D+	D-	E	D+	D-	E	D+	D-	E

Table 7 RS485 Connector Assignment

Note:

D+: Data+; D-: Data1 E: Frame Ground

2.5.1 Carrier Detection

MOX Unity MX602-5XXX-XXX-XXXX with isolated RS485 port implements the Carrier Detection function to improve the quality of the communication.

Carrier Detection describes the fact that a transmitter listens for a carrier before trying to send. It detects the presence of an encoded signal from another station before attempting to transmit. If a carrier is sensed, the station waits for the transmission in progress to finish before initiating its own transmission. That is to say, data is only sent when no carrier is observed and the bus is therefore idle.

However, the Carrier Detection alone is unable to prevent all the collisions. When more than one Unity detect the idle state and try to transmit at the same time, a collision will thus occur.

This could be explained in following illustration. In this idealized model, both Unity A and Unity B have Carrier Detection function and identical serial port settings. Unity A is supposed as reference.

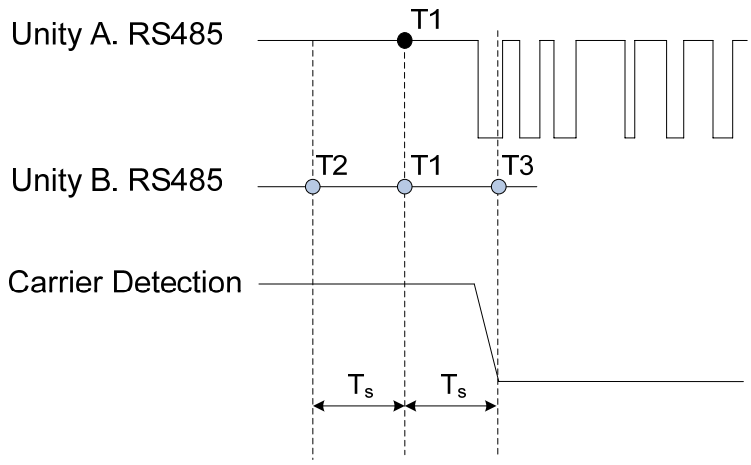


Figure 6 Carrier Detection Function Illustration

1) Unity A is supposed to detect the bus occupation at T1 and start transmitting. Due to system delay Ts, Unity B will detect the bus occupation from T3.
2) If Unity B starts detecting after T3, Unity B will definitely detect that bus is occupied by Unity A and postpone the transmission till it is free. Thus, the collision is avoided.
3) If Unity B starts detecting before T2, Unity A will definitely detect that bus is occupied by Unity B at T1 and postpone the transmission till it is free. Thus, the collision is avoided.
4) If Unity B detects the bus occupation between T2 and T3, the collision will occur.

In this idealized case, a probability (P) of collision is defined as following.

P = Collision_Happened / Collision_Avoided

[T2, T3] is regarded as the collision area, so P could be expressed approximately for qualitative analysis as,

P = 2 * Ts / Frame_Time

For MOX Unity MX602-5XXX-XXX-XXXX, the typical value of Ts is,

Ts (typ.) = 1/Baudrate + 10μs

Frame_Time is dependent on baudrate (other settings like data bits are assumed to be fixed) and number of bits of one frame in application, as

$$Frame\_Time = N_{bits}/Baudrate$$

Under moderate data load condition, Carrier Detection function could enhance RS485 communication performance greatly. For instance, if two Unitys (MX602-5XXX-XXX-XXXX) are transmitting data to each other independently, with 115200 baud rate and 200 bytes frame, more than 99% of the possible collisions could be avoided comparing to the situation without this function.

2.6 Ethernet Ports

	*The factory default IP address of Ethernet port 1 is **192.168.1.32.*** *The factory default IP address of Ethernet port 2 is **192.168.0.32.*** *The factory default IP address of Ethernet port 3 is **192.168.199.199.***

All of the three Ethernet ports support auto-negotiation function which can automatically configure the Ethernets to take the maximum advantage of their abilities. They have HP Auto-MDIX function to realize auto crossover detection function.

CAT5 STP (Shielded Twisted Pair) cable is recommended for connection to a switch for 100Mbit/s or 10Mbits operation. The maximum length between the hub and the MOX Unity is 100 meters in all cases, when using high quality 10/100 Base-T STP cabling. Please refer to Ethernet standards documentation or the documentation for your Ethernet communication devices for more details.

2.7 GSM/GPRS

The MOX Unity has the option of an installed onboard GSM/GPRS modem. The modem uses an internal communication port and can be quickly setup using MOXGRAF software. The modem requires 50Ohm antenna for correct operation. The MOX Unity is supplied with a 900/1800 portable antenna. If this does not meet your requirements, there is also a 900/1800 mobile antenna that can be purchased, enabling you to place it up to two meters away from the Unity.

Characteristics	Specifications
Features	Dual-band EGSM900 and GSM 1800
Data	Circuit Switched Data (CSD) up to 14.4 kbps Unstructured Supplementary Service Data (USSD) Coding schemes CS1, CS2, CS3, CS4 PPP-stack
Output Power	Class 4 (2W) at EGSM900 Class 1 (1W) at GSM1800
Approval	R&TTE GCF

Table 8 Optional Onboard GSM/GPRS Modem Specifications

Before powering on the MOX Unity ensure that the GSM/GPRS antenna is firmly attached.

The GSM/GPRS modem also requires a service provider's SIM card to enable connection with the GSM/GPRS network. Remove the SIM socket located at the front of the Unity by pushing in the spring-loaded catch with a small screwdriver or equivalent.

With the metal contacts face-up, align the notch on the SIM card with the notch on the SIM socket and insert the SIM card.

Re-insert the SIM socket into the MOX Unity ensuring that the metal contacts on the SIM card facing to the right.

Note: Make sure to install the SIM card and antenna before powering up the module and not to plug or unplug them after. The antenna's direction can be adjusted though.

2.8 Video Capture

The MOX Unity can support an onboard video capture module. This module captures images from a connected video camera or similar device and stores them to be retrieved later. This form of information can be very useful where visual monitoring is required.

A MOX Unity supplied with the onboard video capture module will have an RCA socket located on its right side. This is the Video-In socket for the video output from the monitoring device.

User configuration of the video capture module is not required. All operations performed using the video capture module, are done via the **FrameGrab** function block in MOXGRAF. Please refer to the *Special Function Block Programming Guide* for further information. The captured images are stored within the memory of the MOX Unity in JPEG format. Support for grey and colour images is available; dependent on the video capture module option selected and installed onboard the MOX Unity.

The stored images can be sent to another MOX Unity by using function block **FileTrans** or be downloaded to Windows PC by using MOXGRAF file transfer utility.

Follow the installation instructions of the video camera to ensure correct mounting and operation. Once both the video camera and the MOX Unity are installed, connect a coaxial cable between the Video-Out of the video camera and the Video-In of the MOX Unity.

Parameter	Specifications
TV Standard	PAL or NTSC

Connector	RCA-type video
Cable Type	75Ω video camera lead
Resolution Supported	704 X 576 pixels

Table 9 Video Capture module Operational Specifications

3 Onboard I/O Modules

The MOX Unity is available with up to 4 onboard I/O modules, factory installed. The available I/O module options include:

- 8 DI 24VDC
- 8 DO Relay
- 8 AI 4-20mA
- 8 AO 4-20mA Module Power
- 8 AI 0-5V
- 4 AI 4-20mA Isolated
- 4 AI (3 4-20mA Isolated & 1 Channel 0-30VDC non-isolated)
- 8 DO 24VDC
- 4 CNT
- HART

Any combinations of the module types can be provided in the four available positions, except 8 DO Relay. A MOX Unity supports a maximum of two digital output modules and is able to automatically identify the module type installed to each position, ensuring correct functionality.

To work out the position of the onboard I/O modules look at the part number of the MOX Unity. The last four digits of the part number represent the position and type of I/O modules included in the Unity, e.g. MX602-26-05-01-ABCD.

- A represents module 1 position
- B represents module 2 position
- C represents module 3 position
- D represents module 4 position

The following values represent the module type:

Identification Value	Module Type
0	No I/O Module
1	8 DI 24VDC
2	8 DO Relay
3	8 AI 4-20mA
4	8 AO 4-20mA Module Power
6	8 AI 1-5V
7	4 AI 4-20mA Isolated
8	4 AI (3 channel 4~20mA isolated & 1 channel 0~30VDC non-isolated)
9	8 DO 24VDC
A	Reserved
B	4 CNT
C	HART

Table 10 I/O Module Identification

Using the part number MX602-26-05-01-1234 as an example, **I/O Module 1** is an 8 Channel Digital Input 24VDC module, **I/O Module 2** is an 8 Channel Digital Output Relay module, **I/O Module 3** is an 8 Channel Analog Input 4-20mA module and **I/O Module 4** is an 8 Channel Analog Output 4-20mA module power.

The following figures show the wiring terminals for installed modules. The combination of modules and their configuration within the MOX Unity will determine their pin-outs on the removable terminal strips located at the base of the controller.

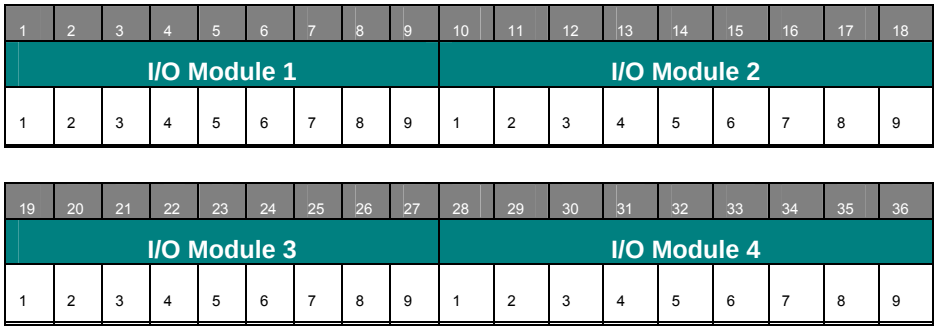


Figure 7 Unity Connector Pin Assignment

3.1 8 DI 24VDC

3.1.1 Input Signals

The digital input module supports eight non-isolated digital input channels.

The input voltage range is 0-30VDC.

- 0-5VDC is classified as logical '0'
- 10-30VDC is classified as logical '1'

3.1.2 Input Wiring

One wire from each of the eight input signals is connected to a single common terminal.

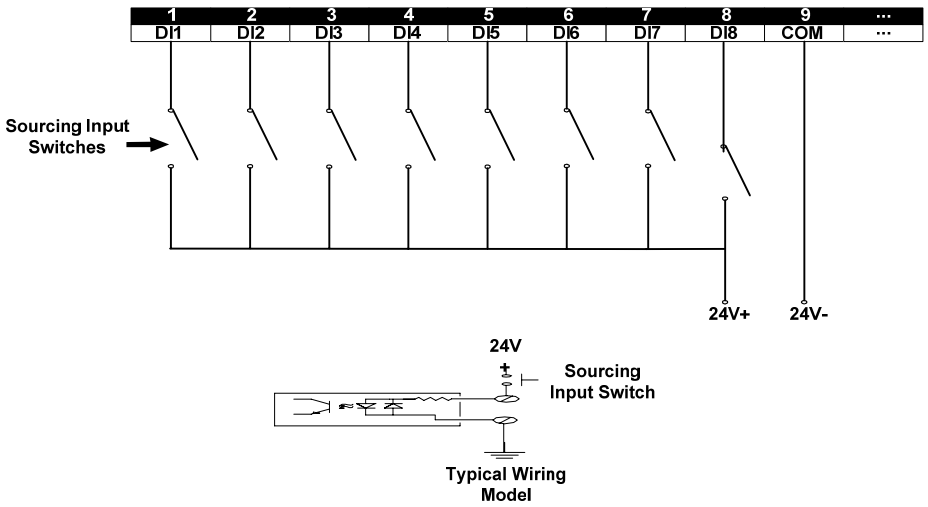


Figure 8 MOX Unity Onboard Digital Input Wiring

3.1.3 Datasheet

Characteristics	Specifications
Channels	8
Power Supply	5VDC
Power Dissipation	1W Maximum
Channel to System Isolation	5,000VDC
ON Voltage	10 to 30 VDC
OFF Voltage	0 to 5 VDC
Input Impedance	2KΩ TYPICAL
Input Current	12mA @ 24VDC ON 1.3mA @ 5VDC OFF
Input Delay Time	OFF to ON: 5 μs TYPICAL ON to OFF: 3 μs TYPICAL
Environmental Conditions	
Operating Temperature	-20 to 70 °C
Storage Temperature	-40 to 85 °C
Relative Humidity	5 to 95%, non-condensing

Table 11 8 DI 24VDC Module Datasheet

3.2 8 DO Relay

The digital output module has eight non-isolated relay output channels with each channel using an individually isolated relay.

3.2.1 Output Power Requirements

The outputs require a user supplied power source. The power from this supply will be passed to the OUT terminal of a given output channel when that channel is switched by the control software.

The power supply may be separated from the DC power that runs the MOX Unity, or the same DC power source may be used. If a separate DC power source is used, connect the DC (-) of the power source to the Supply DC (-) of the MOX Unity.

3.2.2 Output Wiring

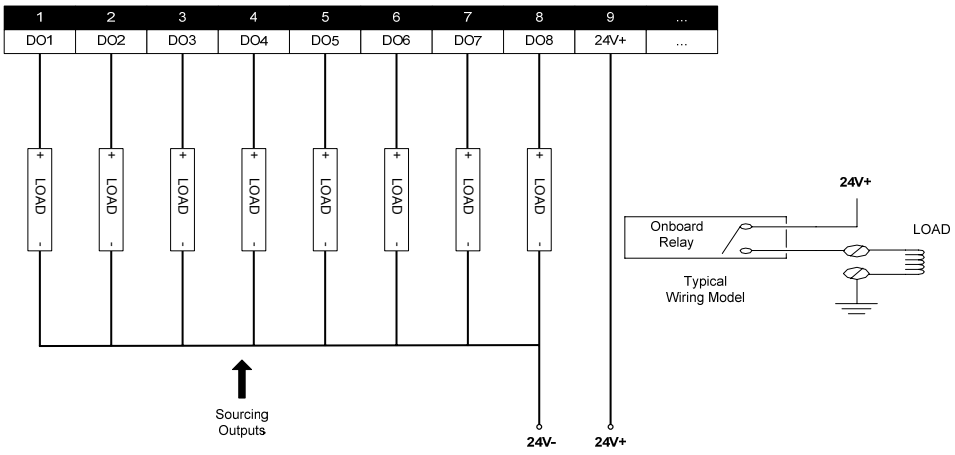


Figure 9 MOX Unity Onboard Discrete Output Wiring

3.2.3 Datasheet

Characteristics	Specifications
Number of Outputs	8
Power Supply	5VDC
Power Dissipation	2W Maximum
Channel to System Isolation	1,000Vrms
Maximum Output Voltage Range	3A 250VAC, 3A 24VDC
Output Current Rating per channel	3A Maximum
Surge Current for the pin 9	Approx. 10A for 10ms
Output Delay Time **OFF to ON** **ON to OFF**	 6ms Maximum 3ms Maximum
Environmental Conditions Operating Temperature Storage Temperature Relative Humidity	 -20 to 70 °C -40 to 85 °C 5 to 95%, non-condensing

Table 12 8 DO Module Datasheet

3.3 8 AI 4-20mA

The 4-20mA input module has eight non-isolated analog 4-20mA input channels. Each channel has 12-bit A/D resolution.

3.3.1 Input Wiring

All of the analog inputs have a common return terminal. One terminal is provided for each analog input signal.

If any of your 4-20mA transmitters require loop power, connect 24 VDC into the loop as shown in the diagram. The 24 VDC should come from the external user supplied DC power source. Connect all self-powered 0-20mA input field devices as shown in the diagram.

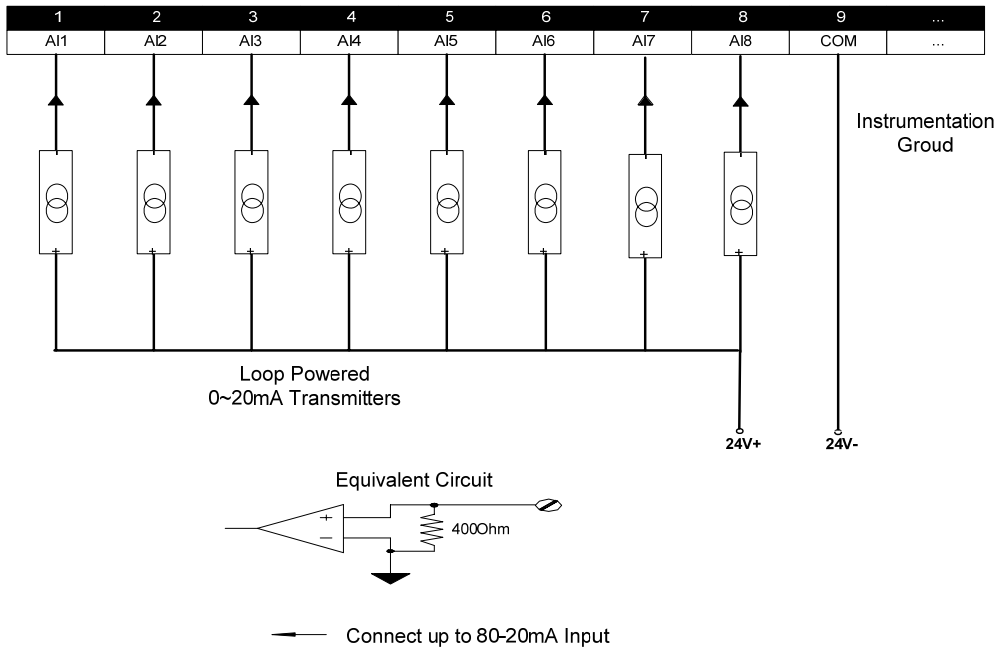


Figure 10 MOX Unity Onboard Analog Current Input Wiring

3.3.2 Datasheet

Characteristics	Specifications
Number of Inputs	8
Power Supply	5VDC
Power Dissipation	1W Maximum
Channel to System Isolation	None
ADC Resolution	12 Bit
Accuracy	< ±0.25% @ 25°C
Over Voltage Protection	40VDC(max)
Temperature Coefficient	60ppm /°C
Environmental Conditions	
Operating Temperature	-20 to 70 °C
Storage Temperature	-40 to 85 °C
Relative Humidity	5 to 95%, non-condensing

Table 13 8 AI 4-20mA Module Datasheet

3.4 8 AO 4-20mA Module Power

The analog output module has eight non-isolated, module-powered, 4-20mA channels. Each channel can drive a maximum loop load of 750Ω and provide output accuracy of ±0.1%.

3.4.1 Output Wiring

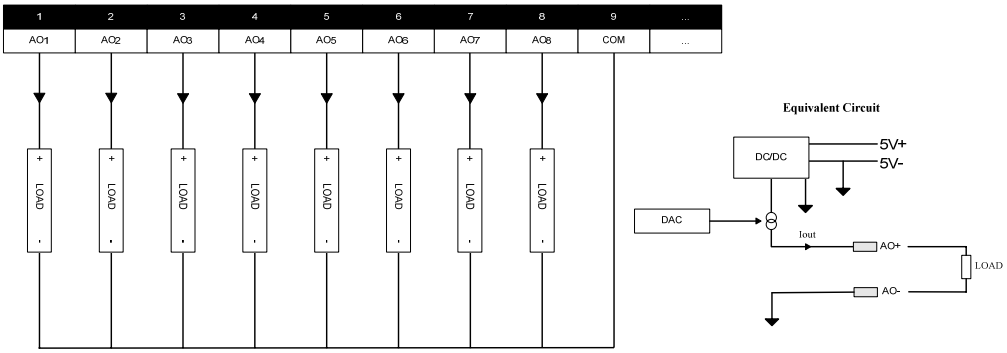


Figure 11 MOX Unity Onboard Analog Current Output Wiring

3.4.2 Datasheet

Characteristics	Specifications
Number of Outputs	8 channels
Power Supply	5VDC
Power Dissipation	0.5W Maximum (With No Load)
Channel to System Isolation	None
Output Current Range	4 to 20mA
DAC Resolution	12 Bit
Accuracy	≤ ±0.25% @ 25°C (± 20 μA)
Maximum Drive Capability	750Ω
Temperature Coefficient	60ppm /°C
Environmental Conditions	
Operating Temperature	-20 to 70 °C
Storage Temperature	-40 to 85 °C
Relative Humidity	5 to 95%, non-condensing

Table 14 8 AO 4-20mA Module Datasheet

3.5 8 AI 1-5V

The analog input module has eight non-isolated 1-5V channels.

3.5.1 Input Wiring

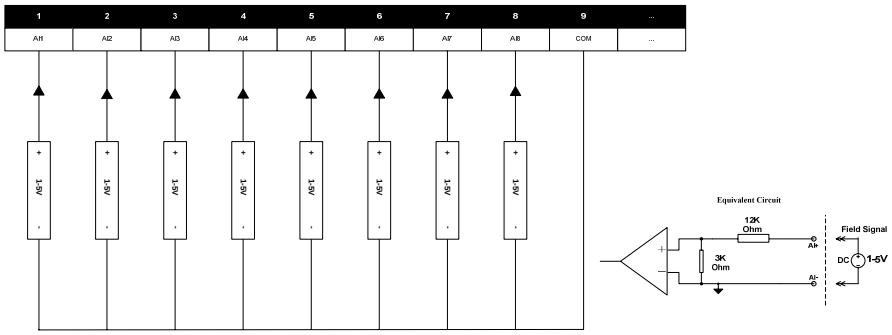


Figure 12 MOX Unity Onboard Analog Voltage Input Wiring

3.5.2 Datasheet

Characteristics	Specifications
Number of Outputs	8 channels
Power Dissipation	100mW Maximum
Channel to system Isolation	None
ADC Resolution	12 Bit
Accuracy	<±0.25% @ 25°C
Maximum input voltage	24VDC
Temperature Coefficient	60ppm/°C
Environmental Conditions	
Operating Temperature	-20 to 70 °C
Storage Temperature	-40 to 85 °C
Relative Humidity	5 to 95%, non-condensing

Table 15 8 AI 1-5V Module Datasheet

3.6 4 AI 4-20mA Isolated

The analog input module has four isolated 4-20mA channels.

3.6.1 Input Wiring

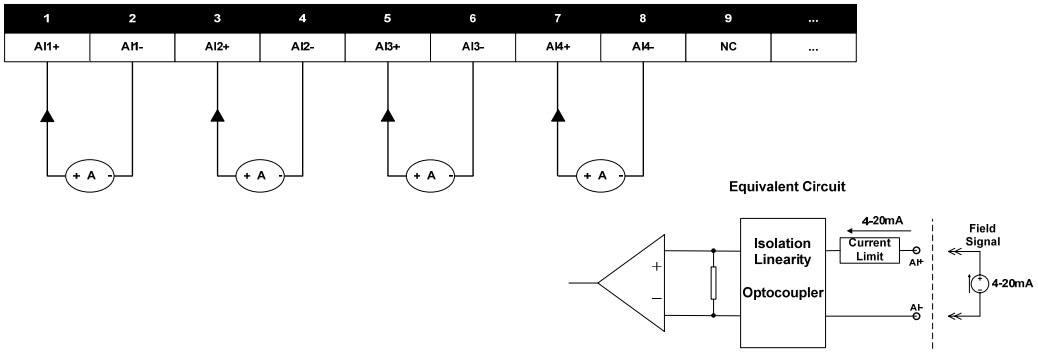


Figure 13 MOX Unity Onboard Analog Input Wiring

3.6.2 Datasheet

Characteristics	Specifications
Number of Inputs	4
Power Supply	5VDC
Power Dissipation	<0.1W
Full Signal Range	0.5-22.0mA
ADC Resolution	12 Bit
Accuracy	<±0.25% @ 25°C
Temperature Stability	6ppm of span per °C
Environmental Conditions	
Operating Temperature	-20 to 70 °C
Storage Temperature	-40 to 85 °C
Relative Humidity	5 to 95%, non-condensing

Table 16 4 AI 4-20mA Module Datasheet

3.7 4 AI (3 Channel 4-20mA & 1 Channel 0-30VDC)

This analog input module has three isolated 4-20mA and one non-isolated 0-30V channels.

3.7.1 Input Wiring

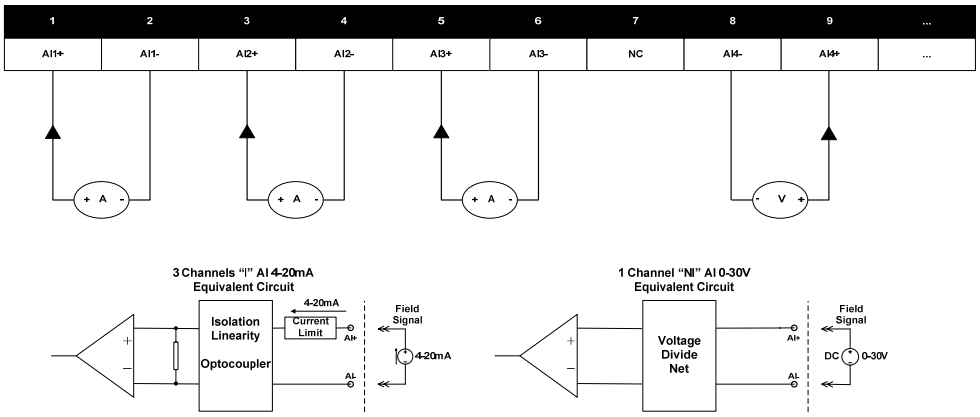


Figure 14 MOX Unity Onboard Analog Input Wiring

3.7.2 Datasheet

Characteristics	Specifications
Number of Inputs	4
CH 1-3	4-20mA
CH 4	0-30VDC
Power Supply	5VDC
Power Dissipation	<0.1W
Full Signal Range	0.5-22.0mA
ADC Resolution	12 Bit
Accuracy	±50uA @ 25°C
Temperature Stability	6ppm of span per °C
Environmental Conditions	
Operating Temperature	-20 to 70 °C
Storage Temperature	-40 to 85 °C
Relative Humidity	5 to 95%, non-condensing

Table 17 3 Channel 4-20mA & 1 Channel 0-30VDC AI Module Datasheet

3.8 8 DO 24VDC

The digital output module has eight non-isolated 24VDC digital output channels with each channel having an output delay time of 2μs.

The 8 CH Digital Output 24VDC can be used to provide time synchronization for MOX 603 I/O SOE module.

3.8.1 Output Power Requirements

The output channels require a user supplied power source, to power up the control loop. The positive source from this supply is passed to the "COM" (common) terminal of a given output channel when that channel is switched by the control software.

The channels require 24VDC supply and it can be different from the DC supply that powers the MOX Unity.

3.8.2 Output Wiring

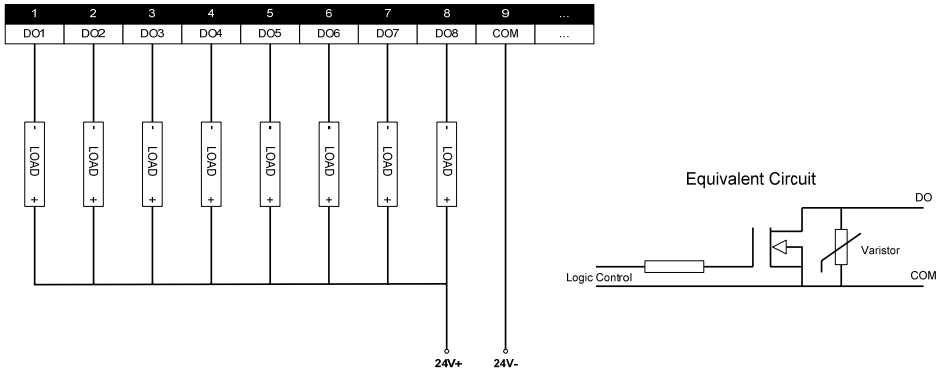


Figure 15 MOX Unity Onboard Digital Output Wiring

3.8.3 Datasheet

Characteristics	Specifications
Number of Outputs	8
Power Supply	5VDC
Power Dissipation	1.5W Maximum
Channel to System Isolation	None
Channel to Channel Isolation	None
Recommended Output Voltage Range	24VDC
Output Voltage Range	10 to 30VDC
Maximum Output Current Rating Per Channel	1A(max)
Maximum Output Current Rating All Channels	4A(max)
Output Delay Time	
OFF to ON	2μs
ON to OFF	2μs
Environmental Conditions	
Operating Temperature	-20 to 70 °C
Storage Temperature	-40 to 85 °C
Relative Humidity	5 to 95%, non-condensing

Table 18 8 DO Module Datasheet

3.1 4 CNT

The 4CNT module supports a maximum of 4 isolated 32 bits counters. The maximum input frequency of the count signal is up to 100 kHz. 24VDC signals can be applied to any channel. This will develop a current of approximately 6mA through the connected channel. When the input voltage is lower than 5VDC, the channel is OFF. When the input voltage is higher than 10VDC, the channel is ON.

The counters are triggered by the user definable edges of the input pulses. The count direction can be configured to up or down. Count range is of 0 ~ 2^{32}-1. If the counter reaches a limit (depending on its count direction) and a further pulse is received, it jumps to the other limit and continues to count from there without any pulse losses.

Seven operating modes are available for the channels. The flexible combination of the modes makes the module suitable for a variety of tasks.

3.1.1 Datasheet

Input Specifications	
Number of channels	4
OFF voltage	<5VDC
ON voltage	>10VDC
Typical wetting current (@24VDC)	6mA
Maximum voltage input	30VDC
Maximum input frequency	100kHz
Digital Output Channel Specifications	
Number of channels	1
Power supply	External 24V power, Range 18~30V
Output Current	100mA±5%
Output Mode	Open Drain
Short Load Protect	1 Minute
Isolation Specifications	
Channel to system	3000Vrms
Channel to channel	3000Vrms
Configurable Parameters	
Operating mode	Continuous Counter (CC), Periodic Counter (PC), Continuous Quadrature Counter (CQC), Periodic Quadrature Counter (PQC), External Start/Stop Counter (EC), Frequency Measurement (FM), External Start/Stop/Direction Counter with DO (ESSD)
Trigger	Rising Edge, Falling Edge
Main counting direction (CC/PC/EC)	Up, Down

Auxiliary logic (CQC/PQC)	0 to Increase 1 to Decrease, 0 to Decrease 1 to Increase
External start/stop logic (EC/ESSD)	0 to Stop 1 to Start, 0 to Start 1 to Stop
Counter period unit (PC/PQC)	1000ms, 100ms, 10ms, 1ms
Counter period length (PC/PQC)	1~250
Frequency internal gate length (FM)	1~1000
Frequency internal gate Unit (FM)	10ms
Predefined counter value (CC/PC/CQC/PQC/EC/ESSD)	The counter value after power on, or reloaded.
DO On Value (ESSD)	Comparison value for DO switching ON
DO Off Value (ESSD)	Comparison value for DO switching OFF
Environmental Conditions	
Operating temperature	-20 to 70°C
Storage temperature	-40 to 85°C
Relative humidity	5 to 95%, non-condensing
Power Dissipation	
Power dissipation within module	<2W

Table 19 MOX Unity Onboard 4 CNT Module Datasheet

3.1.2 Operating Mode

Continuous Counter Mode (CC)

In CC mode, after a “Start” command the counter value is increased or decreased by 1 when a pulse is received and continues until a “Stop” command is given. The count direction is defined by the *Main Counting Direction* parameter. The default status of the counter after reset or power on is stopped.

Periodic Counter Mode (PC)

In the PC mode, after a ”Start” command the counter value is increased or decreased by 1 when a pulse received and continues until a defined time span has elapsed or a “Stop” command is given. The counting direction is defined by the *Main Counting Direction* parameter. The time span is defined by ‘*Counter period unit* x *Counter period length*’. The default status of the counter after reset or power on is stopped.

Continuous Quadrature Counter Mode (CQC)

Only channel 1 and 3 can be configured to this operating mode.

In the CQC mode, after a “Start” command, the counter value is increased or decreased by 1 when a pulse is received and continues until a “Stop” command is given. The counting direction is dynamically changed by auxiliary input (the channel next to it, Channel 2 or Channel 4), which is defined by the *Auxiliary Logic* parameter. The default status of the counter after reset or power on is stopped.

Periodic Quadrature Counter Mode (PQC)

Only channel 1 and 3 can be configured to this operating mode.

In the PQC mode, after a “Start” command, the counter value is increased or decreased by 1 when a pulse is received and continues until a defined time span has elapsed or a “Stop” command is given. The counting direction is dynamically changed by auxiliary input (the channel next to it, Channel 2 or Channel 4), which is defined by the *Auxiliary Logic.* The time span is defined by ‘*Counter period unit* x *Counter period length*’. The default status of the counter after reset or power on is stopped.

Frequency Measurement Mode (FM)

In the FM mode, the counter calculates the pulse frequency in a defined period (*FrequencyInternalGateUnit* x *FrequencyInternalGateLength*). The *FrequencyInternalGateUnit* is fixed to 10ms.

External Start/Stop Counter Mode (EC)

Only channel 1 and 3 can be configured to this operating mode.

In the EC mode, the channel next to it (Channel 2 and 4) is used to provide the external hardware gate signal (Start/Stop). At the same time, the user command “Start/Stop” is reserved and gives an “AND” effect to the external command, which means that the external command could control counting only when the counter is user started. The *External Start/Stop Logic* parameter controls the logic of the external start/stop channel action and the *Main Counting Direction* parameter defines the counting direction. The default status of the counter after reset or power on is stopped. When the external signal has no effect on start/stop of counter, please check if user-start command was made before.

In this mode, the counter can only be continuous and non-quadrature.

External Start/Stop/Direction with DO Counter (ESSD)

Only channel 1 can be configured to this operating mode.

In the ESSD mode, a hardware gate signal is connected to channel 2. This signal “AND” the software Start/Stop command together control the counting process (Start or Stop the counter). After a software Start command, when a pulse is received, the counter is increased or decreased if the hardware gate is start. This continues until a Stop command is given or the hardware gate is stop. The hardware gate signal can be configured by ‘ExternalStartStop’ parameter as ‘*0 to Stop 1 to Start’ or ‘0 to Start 1 to Stop.’*

In order to control count direction, a signal must be connected to channel. The logic level of this signal determines the count direction as 0 to increase, and 1 to decrease.

When working in this mode, the channel 4 acts as a DO channel that is controlled by two configurable comparison values (*DoOnValue* and *DoOffValue*) and software command. The software command determines the DO process in manual mode or linkage mode. In manual mode, the user can override DO to ON or OFF directly. In linkage mode, the user can override DO to OFF; when the user set DO to ON, the DO channel will be ON when the counter value is between DoOnValue and DoOffValue (DoOnValue < DoOffValue); otherwise, the DO channel is OFF.

When 4 CNT module is programmed in MOXGRAF, it is required to initialize the channels of the counter in the user programs before the expected mode (except for FM mode) works. The initialization routine of the channel should be as follows.

1. Stop the channel counting by command 102.This will secure the channel in user-stopped status especially when the MOXGRAF project is re-downloaded.
2. After stop command is accomplished, reload the channel by command 103.
3. After reload command is accomplished, start the channel by command 101.

3.1.3 Typical Wiring Diagram

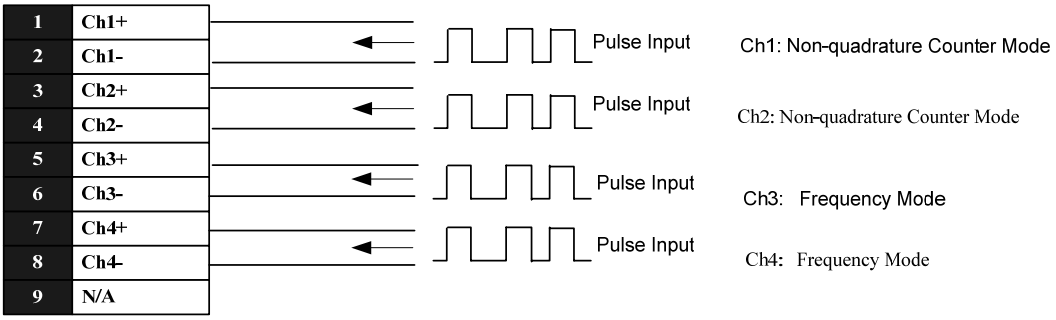


Figure 16 MOX Unity Onboard 4 CNT Wiring 1

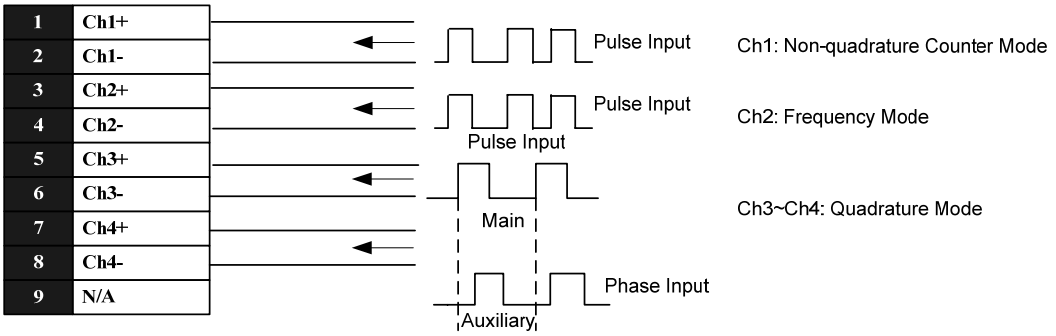


Figure 17 MOX Unity Onboard 4 CNT Wiring 2

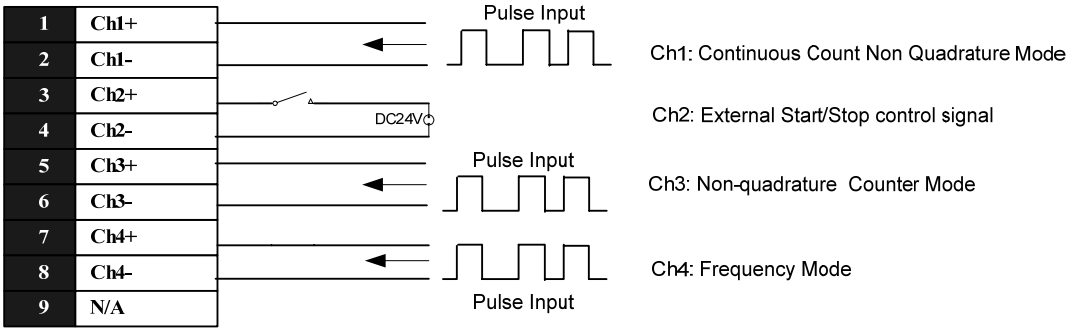


Figure 18 MOX Unity Onboard 4 CNT Wiring 3

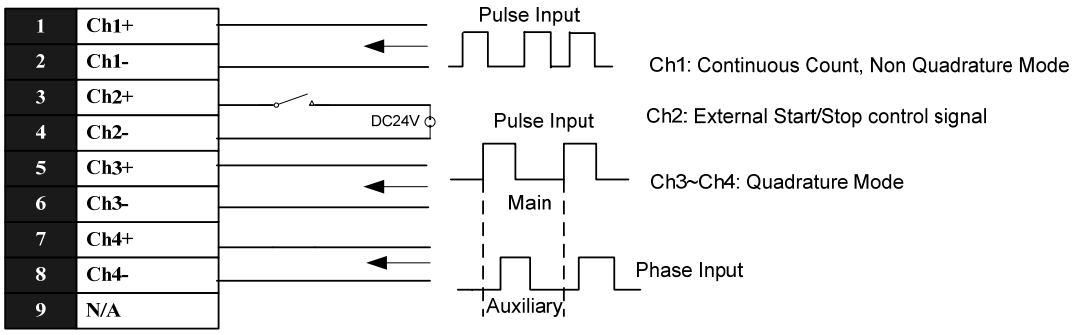


Figure 19 MOX Unity Onboard 4 CNT Wiring 4

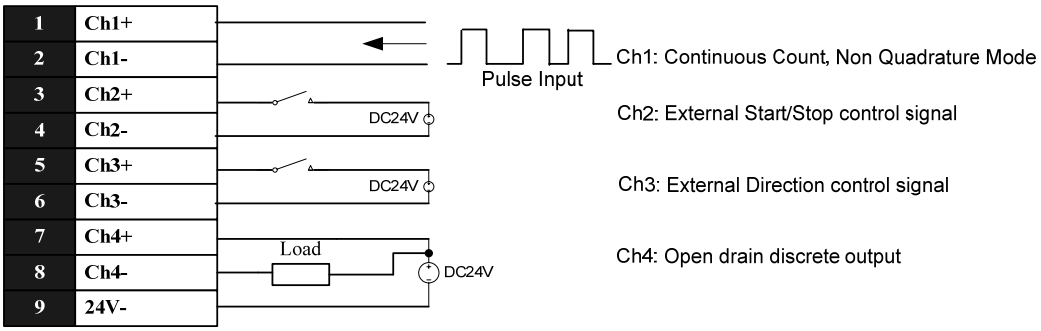


Figure 20 MOX Unity Onboard 4 CNT Wiring 5

3.1.4 Equivalent Circuit

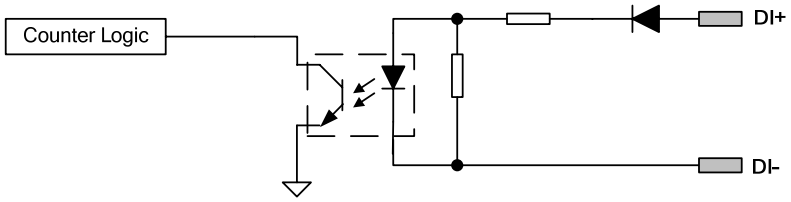


Figure 21 MOX Unity Onboard 4 CNT Equivalent Circuit of Discrete Input

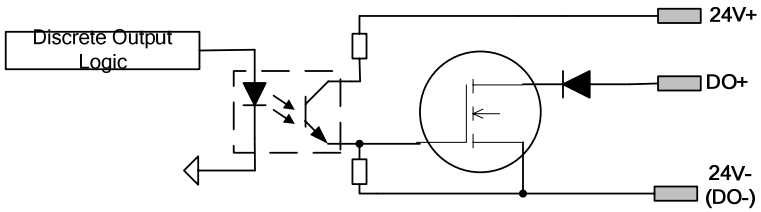


Figure 22 MOX Unity Onboard 4 CNT Equivalent Circuit of Discrete Output

3.2 HART Module

HART module is a 1-channel HART interface that provides communication between the Unity and intelligent field instruments using the industry standard HART communications protocol.

It works as a primary HART master to collect process data from field slave instruments. It supports monodrop and multidrop operations.

3.2.1 Datasheet

Basic Specifications	
Number of channels	1 Short Load Protect
Baud Rate	1200bps
Modulation	Bell 202 Frequency Shift Key (FSK) 1200Hz --- Mark (1) 2200Hz --- Space (0)
Transmit Signal Level	500mV$_{PP}$@250Ohm Load
Receive Sensitivity	>120mV$_{PP}$ guaranteed On, <80mV$_{PP}$ guaranteed Off
Isolation Specifications	
FSK to 4~20mA Analog DC Current	1500Vrms
Configurable Parameters	
Primary /Secondary master	Hardware configurable
Internal / External Load	Hardware configurable
Environmental Conditions	
Operating temperature	-20 to 70°C
Storage temperature	-40 to 85°C
Relative humidity	5 to 95%, non-condensing
Power Dissipation	
Power dissipation within module	<2W

Table 20 MOX Unity Onboard HART Module Datasheet

3.2.2 Terminal Definitions

The terminal definition of the HART module is shown in the following table.

1	HART+
2	HART-
3	Jump+
4	Jump-
5	Terminal+
6	Terminal-
7	Mode+
8	Mode-
9	N/A

Terminal	Descriptions
HART+	HART Signal I/O (+). The current flow in the connection loop must ensure that HART+ is positive than HART-. HART- is internally connected to one side of the load resistor, so it is typically connected to the negative side of the DC Power Supply.
HART-	
Jump+	Jump these two terminals to select the internal 250 Ohm resistor.
Jump-	
Terminal+	Connect to external load resistor. Make sure the resistor is in the range of 230~1100 (ohms). It is recommended to use a 250 Ohm resistor. Larger resistor will reduce the voltage available to power the 2-wire transmitter besides the advantage of increasing the transmitter signal at the master side.
Terminal-	
Mode+	To set the module as a primary master, Leave these two terminals open To set the module as a secondary master, jump these two terminals.
Mode-	
N/A	No connection.

Figure 23 MOX Unity Onboard HART Module Terminal Definitions

3.2.3 Typical Wiring Diagram

The HART module supports primary master and secondary master operating. When used as the primary master, the following two types of wring methods are applied with the internal or external resistance selected respectively.

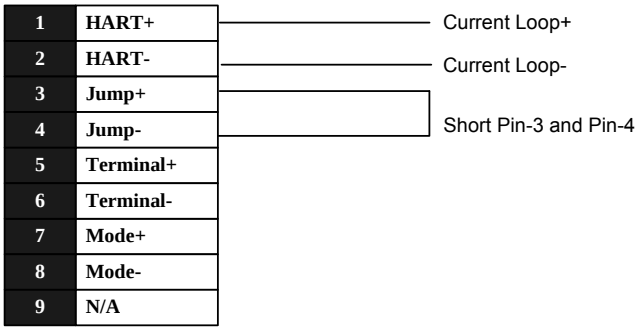


Figure 24 MOX Unity Onboard HART Wiring Diagram of Primary Master, Internal Load Resistance

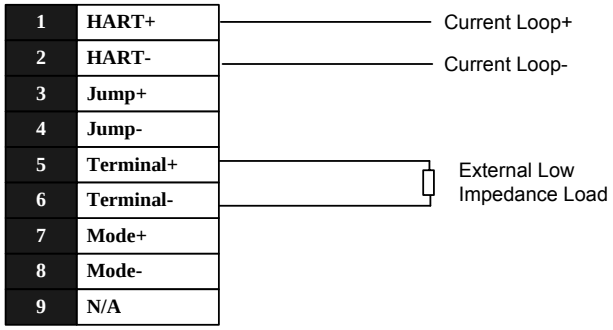


Figure 25 MOX Unity Onboard HART Wiring Diagram of Primary Master, External Load Resistance

When used as the secondary master, connect the terminations as the follows.

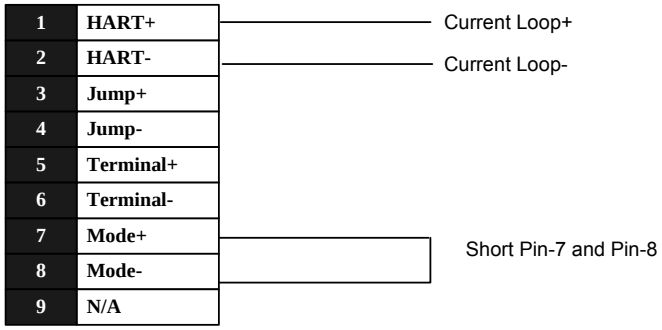


Figure 26 MOX Unity Onboard HART Wiring Diagram of Secondary Master

4 Installation and Handling Considerations

Within this chapter are detailed instructions on mounting, installation and cabling of the MOX Unity system.

The MOX Unity has the expandability to include a combination of onboard I/O modules, a UPS module, a wireless modem, and an optional onboard video capture module in either black & white or 16-bit colour. The integrated terminal strip provides connection to the external power source (18 to 30 VDC), the UPS storage cell, and to the field termination of the onboard I/O (optional).

4.1 Handling Considerations

4.1.1 Electrostatic Discharge

Integrated circuits or semiconductors may be severely damaged by electrostatic discharge. This may be caused if the terminal connector pins come in contact with an electro statically charged object such as hands or clothing. Follow these guidelines when you handle the module.

- Touch a grounded object to discharge static potential.
- Do not touch the terminal connector pins.
- Do not touch circuit components inside the unit.
- Always work with the unit on a grounded surface

4.1.2 Environmental Precautions

To extend the life of the MOX Unity, take the following precautions:

- Avoid storing or operating the device where it could be exposed to a corrosive atmosphere.
- Protect from moisture and direct sunlight.

The MOX Unity has been designed for use in an industrial environment when installed in accordance with these instructions. Within this environment, the equipment is still intended for installation in a clean and dry location.

4.2 Mounting the MOX Unity and Associated Components

Correct placement of the MOX Unity is necessary to avoid overheating due to lack of ventilation. Placement errors should be avoided by using the dimensional specifications provided. Adequate ventilation should be provided to avoid overheating and spacing between components should allow for a suitable working environment.

4.2.1 Installation Considerations

The MOX Unity should be mounted directly to the sub-panel of an electrical enclosure.

5mm mounting holes are located in each corner of the base of the MOX Unity. ***Appropriately sized mounting screws should be inserted in each of the four holes when installing the unit.*** The recommended screw size is 5mm x 12mm (1/8" x 1/2").

	*Do not attempt to drill out the mounting holes to increase the usable screw size. Increasing the mounting holes size decreases the strength of the mounting bracket.*

	*A mounting template is provided within this guide and should be used to ensure correct drilling of the mounting holes and positioning of the MOX Unity.*

The enclosure may also contain expansion MOX 603 I/O modules, terminal strips, circuit breakers and other equipment required in the installation. All items should be appropriately mounted and spaced to ensure good ventilation.

The MOX Unity may be installed in any orientation and order on your panel but MOX 603 I/O modules must be installed horizontally to avoid movement on the DIN rail. MOX 603 I/O modules are typically installed beside one another. End clamps are recommended to restrict side-to-side movement.

4.2.2 Preventing Excessive Heat

For most applications, normal convective cooling keeps the controller within the specified operating range. The following should be considered to ensure that the specified operating range is maintained.

- Providing adequate spacing of components within an enclosure is usually sufficient for heat dissipation. Maintain spacing from enclosure walls, wire ways, adjacent equipment, etc. of 50mm on all sides of the MOX Unity.
- If particularly high or low ambient temperatures occur, additional cooling or heating provisions should be provided.

- In some applications, a substantial amount of heat is produced by other equipment inside or outside the enclosure. In this case, place blower fans inside the enclosure to assist in air circulation and to reduce “hot spots” near the controller.
- Do not bring unfiltered outside air into the enclosure. Place the controller in an enclosure to protect it from a corrosive atmosphere. Harmful contaminants or dirt could cause improper operation or damage to components.

4.2.3 Installation Cleanliness

During installation and placement of items within the cabinet, do not install any components until all drilling is complete. Also, strip and trim cables well away from the MOX Unity. Be sure that debris (metal chips, wire strands, etc.) does not fall onto the MOX Unity’s terminal connections. Such debris could cause damage on power-up. Once wiring is complete, ensure that the unit is free of all metal fragments and other objects that may interfere with correct operation.

4.2.4 Mounting the Controller

The controller should be horizontally screw mounted within an enclosure using the following guidelines

- Print out the included template or create a template for the MOX Unity from the dimensions provided within this document.
- Secure the template to the mounting surface whilst ensuring spacing guidelines are followed. (The controller may be mounted in any orientation)
- Drill correctly sized holes for the MOX Unity and all other equipment to be installed in the cabinet.
- Mount the cable ducting.
- Mount the power supply and other components.
- Mount the MOX Unity controller.

4.2.5 Typical Dimensions

All MOX Unity models have the following dimensions although communication configuration options differ from those displayed.

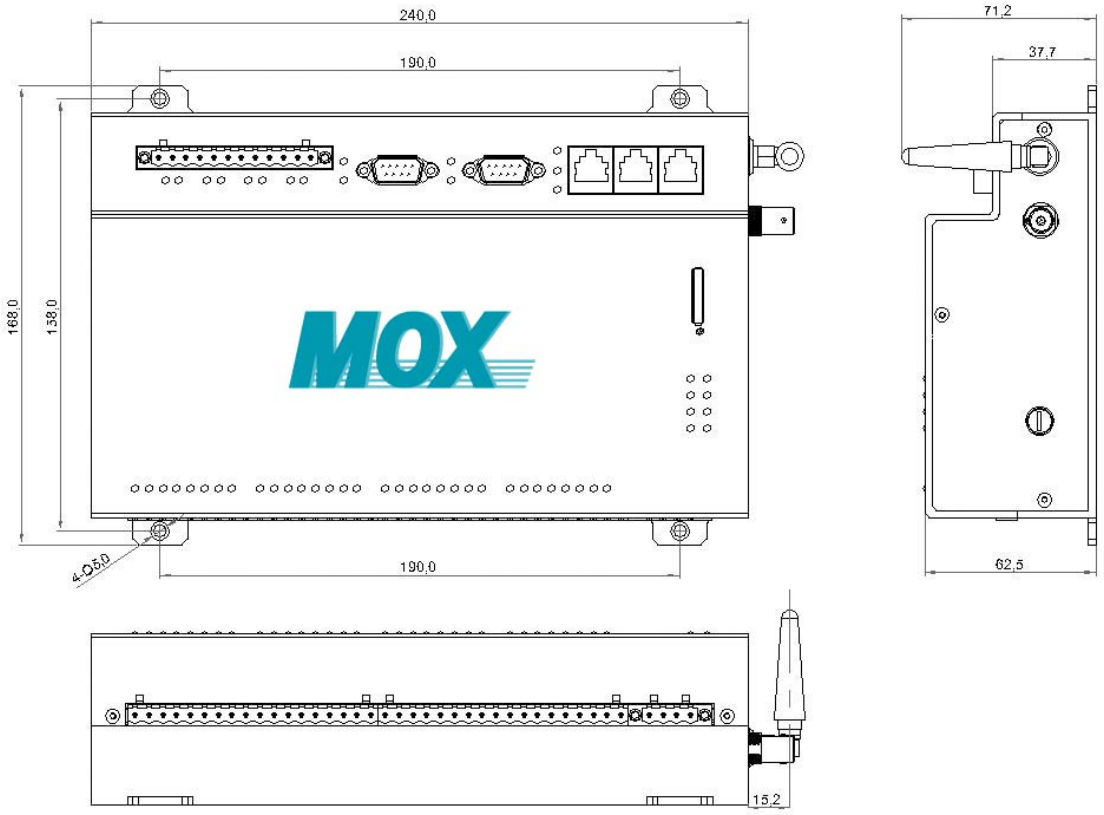


Figure 27 Typical MOX Unity Dimensions

4.2.6 Terminal Connector

Ensure all power sources, including the MOX Unity unit supply and the field I/O supply, are isolated from the terminal connector before removing or inserting the terminal connector.

STOP	*Always isolate the supply power before removal or insertion of connectors. When you remove or insert the connectors with power applied, an electrical arc may occur.*

An electrical arc can cause personal injury or damage to property by:

- Sending an erroneous or excessive signal to your system's field devices
- Causing damage to the product through line spikes
- Cause excessive wear on module contacts due to the electrical arcing
- Create electrical resistance from worn contacts

4.2.7 Grounding Considerations

In solid-state control systems, grounding helps limit the effects of noise due to electromagnetic interference (EMI). It is highly recommended to run a ground connection from any mounting point of the controller to the ground connection point of the cabinet.

The metal construction of the MOX Unity also assists in shielding the circuitry.

4.3 Cable Path Considerations

When installing communication cables, the path of the cables should be planned to avoid electrical interference. Follow these guidelines to reduce electrical interference:

- Keep the communication cable at least 1.52m from any electric motors, transformers, rectifiers, generators, arc welders, induction furnaces, or sources of microwave radiation.
- If you must run the cable across power feed lines, run the cable at right angles to the lines.
- If you do not run the cable through a contiguous metallic wire way or conduit, keep the communication cable at least 150mm from AC power lines of less than 20A, 300mm from lines greater than 20A, but only up to 100kVA, and 600mm from lines of 100kVA or more.
- If you run the cable through a contiguous metallic wire way or conduit, keep the communication cable at least 80mm from AC power lines of less than 20A, 150mm from lines greater than 20A (but only up to 100kVA), and 300mm from lines of 100kVA or more.

Running the communication cable through conduit provides extra protection from physical damage and electrical interference. If you route the cable through conduit, follow these additional recommendations:

- Use ferromagnetic conduit near critical sources of electrical interference. You can use aluminium conduit in non-critical areas.
- Use plastic connectors to couple between aluminium and ferromagnetic conduit. Make an electrical connection around the plastic connector (use pipe clamps and the heavy gauge wire or wire braid) to hold both sections at the same potential.
- Ground the entire length of conduit by attaching it to the building earth ground.
- Do not let the conduit touch the plug on the cable.
- Arrange the cables loosely within the conduit. The conduit should contain only serial communication cables.
- Install the conduit so that it meets all applicable codes and environmental specifications.

4.3.1 Minimizing Electrical Noise on Analog Signal Lines

Analog input channels employ digital high frequency filters that significantly reduce the effects of electrical noise on input signals. However, because of the variety of applications and environments where analog controllers are installed and operating, it is impossible to ensure that the input filters will remove all environmental noise. Several specific steps can be taken to help reduce the effects of environmental noise on analog signals:

- Install the MOX Unity system in a properly rated (i.e. NEMA) enclosure.
- Use Belden cable #8761 for wiring the analog channels making sure that the drain wire and foil shield are properly earth grounded at one end of the cable.
- Route the Belden cable separate from any other wiring. Additional noise immunity can be obtained by routing the cables in grounded conduit.

- Periodically check the system operation, particularly when new machinery or other noise sources are installed near the system.

4.3.2 Analog Signal Cable Grounding

Use shielded communication cable (Belden #8761). The Belden cable has two signal wires (black and clear), one drain wire and a foil shield. The drain wire and foil shield must be grounded at one end of the cable. We recommend grounding the shield to the case of the signal source, so energy coupled to the shield will not be delivered to signal source's electronics.

	*Do not ground the drain wire and foil shield at both ends of the cable.*

4.4 Power Considerations

4.4.1 Power Requirement

The MOX Unity requires 18-30VDC from an external 12W (min) DC power module. This recommendation is for a single MOX Unity. If your implementation makes use of a redundant controller and multiple external I/O, the wattage of the external DC power module will have to meet the complete installations wattage requirement.

4.4.2 Power Isolation

When removing power from the device, interruption of the DC side of the power supply is preferred. This avoids the additional discharge delay of the power supply if the AC line is connected.

Always fuse the AC line of the power supply and place the main power isolation switch where operators and maintenance personnel have quick and easy access to it. If you mount an isolation switch inside the controller enclosure, place a handle on the outside of the enclosure to switch the isolator, so that you can disconnect power without opening the enclosure.

4.4.3 Power Consumption Calculations

To calculate the current requirements, add the wattage required for the MOX Unity controller, I/O Interface, and I/O modules in use, then divide the total wattage by the DC power source voltage. Then add any current needed for user instrumentation loops. Ensure your power supply is sufficiently sized to suit the power requirements of your system.

The following power consumption calculations only involve the relevant MOX Unity module options. For an all incorporated system power consumption calculation, please see the relevant guides for power consumption information.

Determining Power Consumption

In estimating total I/O power requirements, the 'duty cycle' of each I/O channel (onboard I/O) must be estimated. For a non-analog I/O channel, the duty cycle is essentially the percentage of time that the I/O channel is active (maximum power consumption). For example, if a discrete output is active for 15 seconds out of every 60 seconds, the duty cycle is:

Duty Cycle = Active time/ (Active time + Inactive time) = 15 sec/60 sec =0.25

For an analog I/O channel, the duty cycle is approximated by estimating the percentage of the time the channel spends in the upper half of its range (span) of operation. For example, if an analog input wired to a current loop (4-20mA) device operates in the upper half of its range 75% of the time, then 0.75 would be used as the duty cycle. If the analog channel generally operates around the midpoint of its span, use 0.5 as the duty cycle.

To calculate the total power consumed by an I/O channel, read the minimum (Pmin) and (Pmax) power consumption value from the table for the desired I/O channel. Use the following equation to calculate the power consumption for a channel with the duty cycle taken into account:

Power = (Pmax x Duty Cycle) + [Pmin x (1 – Duty Cycle)]

Multiply this value by the quantity (QTY) of I/O channels with the same duty cycle to give a subtotal. Repeat the procedure for all the other I/O channels used. Finally total all subtotals.

Device	Power Consumption(mW) (Max)
Processor & Motherboard without UPS battery connected	7500
UPS battery option	12V/1500mA
Onboard UPS option	4000
Onboard GPRS/GSM modem module option	8400
Onboard video capture card module option	2400
Onboard Analog Input 8 CH 4-20mA module option	100
Onboard Analog Input 1-5VDC module option	100
Onboard *Module Powered* Analog Output 4-20mA module option	5000
Onboard Digital Input 24VDC module option	50
Onboard Digital Output Relay module option	1800
Onboard Analog Input 4 CH 4-20mA module option	100
Onboard Analog Input 3 CH 4-20mA & 1 CH 0-30VDC module option	100
Onboard Digital Output 24VDC module option	1500
Onboard 4 CNT module option	2000
Onboard HART module option	2000

Table 21 Power Consumption of Devices

Totalling Power Requirements

To adequately meet the needs of the system, it is important to determine the total power consumption, size solar panel, and battery backup requirements accordingly. For total power consumption, add all system device power consumption values together, be sure to add the power consumption (in mW) of any non MOX devices used in the same power system.

Convert the total value (in mW) to Watts by dividing it by 1000.

mW / 1000 = Watts

For selecting an adequate power supply, use a safety factor (SF) of 1.25 to account for losses and other variables not factored into the power consumption calculations. To incorporate the safety factor, multiply the total power consumption (P) by 1.25.

$$P_{SF} = P \times 1.25 = \text{Watts}$$

To convert PSF to current consumption in amps (I_{SF}), divide P_{SF} by the system voltage (V) of 24VDC.

$$I_{SF} = P_{SF} / V = \text{Amps}$$

4.4.4 Apply Power

After all field wiring is installed, power up the controller and related peripherals. Observe the status LEDs on the controller and each I/O module. Normal start-up conditions for the MOX Unity will result in the following final conditions.

1) On power up, the PWR LED will display and will remain on continually. If the PWR LED is not displayed, remove power from the controller and double check your wiring. If your wiring is correct, confirm that the user supplied 24VDC power source is supplying the system with the correct voltage and at the correct polarity.
2) A short period of time after power has been supplied to the MOX Unity; the RUN LED will be illuminated.
   - If there is no application program, the RUN LED will start flashing.
   - If there is an application program, the RUN LED will remain on continuously.

5 Configuration

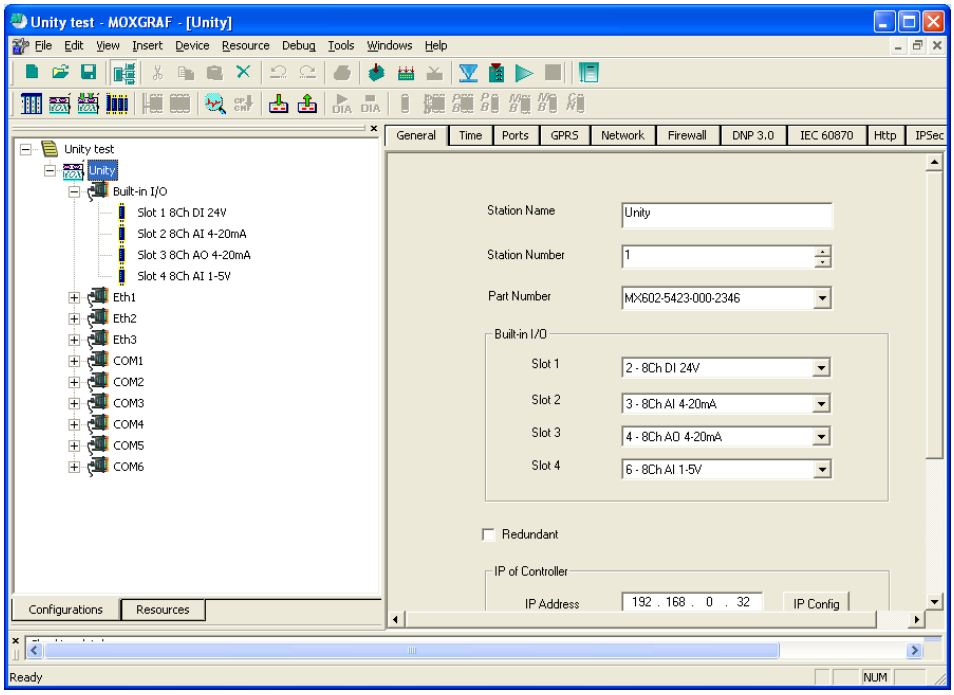
The MOX Unity must be configured and programmed using MOXGRAFV5.

MOXGRAF V5 is a powerful configuration tool as well as a program development environment. It allows the user to alter configurations, monitor all device operations and change operational parameters of individual devices. It is also a development environment for designing applications without knowledge of complex, high-level computer languages. Using IEC 61131-3 programming standards, intuitive graphical and textual editors, results in robust applications developed with simplicity and in the shortest possible timeframe.

The extensive hypertext based online help system includes a thorough cross-reference explanation of the IEC 61131-3 standard.

Before configuration and programming, a MOXGRAF V5 project must be set up. Perform the following steps to set up the project.

1. Create a project by **File | New Project**
2. Add a Unity to the project by **Insert | Unity**
3. Switch to the Configurations View in the Navigation Panel. Change the part number of the Unity and Built-in I/O configuration according to the actually installed target system



4. Check or uncheck "Redundancy" option on the General tab according to the actual redundancy configuration of the target system.
5. Input IP Address of Target Controller
6. Change the Station Name if required.
7. Add CP and I/O, if required.

Please refer to MOXGRAF Online Help for detailed information.

After the project is set up, the following parameters are able to be configured. In this section, they are introduced briefly. For more usage information, please refer to MOXGRAF Online Help.

5.1 Serial Ports

All MOX Unitys are supplied with serial communication ports. Any of the serial communication ports can be used to expand the system with MOX 603 I/O modules and other standard serial devices.

The baud rate and other communication parameters for all serial ports are selectable and configurable within the MOXGRAF '**Ports**' tab in configuration view.

There are a number of selectable protocols that the user can choose from when setting serial port communication parameters. The following is a description of each protocol and its intended use:

Protocol	Definition	Description
Mox	MODBUS Slave	Communication with a MODBUS Master device.
MODBUS Master	MODBUS Master	Communication with MODBUS slave devices.
MODBUSa Master	MODBUS ASCII Master	Communication with MODBUS slave devices, e.g. LCD screen.

MODBUSa Slave	MODBUS ASCII Slave	Communication with a MODBUS Master device, e.g. touch screen slave device.
Transparent		Ethernet to Serial communication between two MOX Unity devices.
MODNET	MODBUS TCP/IP	Ethernet to Serial Gateway.
DNP	DNP 3.0	Distributed Network Protocol (Slave communication only supported)

Table 22 Serial Communication Protocol Definitions

5.2 Ethernet Ports

The MOX Unity contains at least one 10/100Mbps Ethernet port. Configuration and programming of the MOX Unity with MOXGRAF may be conducted via the Ethernet port.

SCADA/HMI interfaces that support the MODBUS TCP/IP protocol and DNP3.0 can communicate with the MOX Unity. Communication between a MOX Unity and MOX 603 I/O modules may also be achieved via the Ethernet port.

The IP address is alterable via MOXGRAF.

1. Input IP address of the target Unity in "IP Address" box on the '**General'** tab.

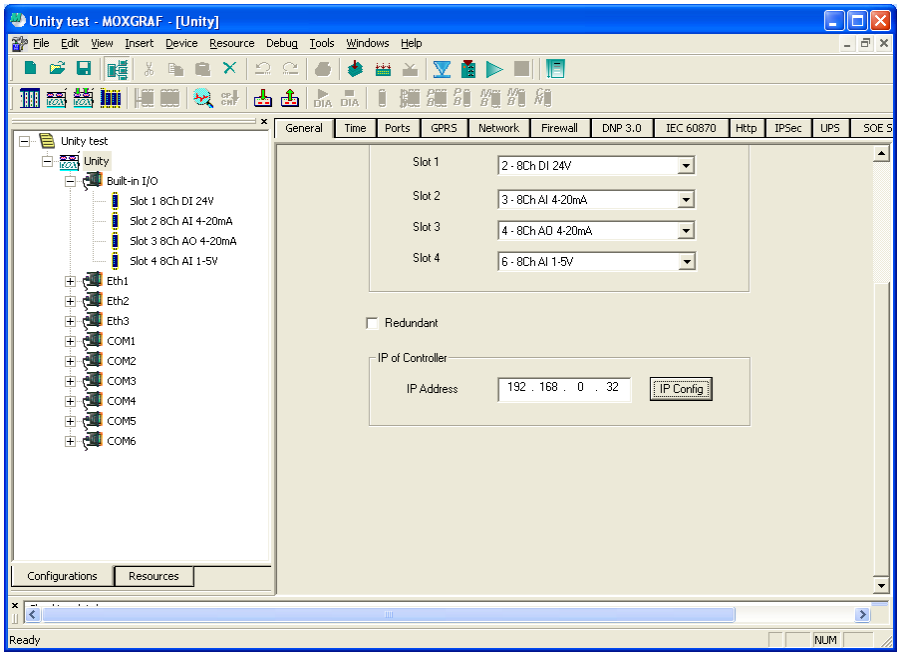


Figure 28 IP Configuration Application

2. If the IP address of the target Unity is unknown, use **Tools | Scan Controller** utility to scan it out, and then put it into the box.

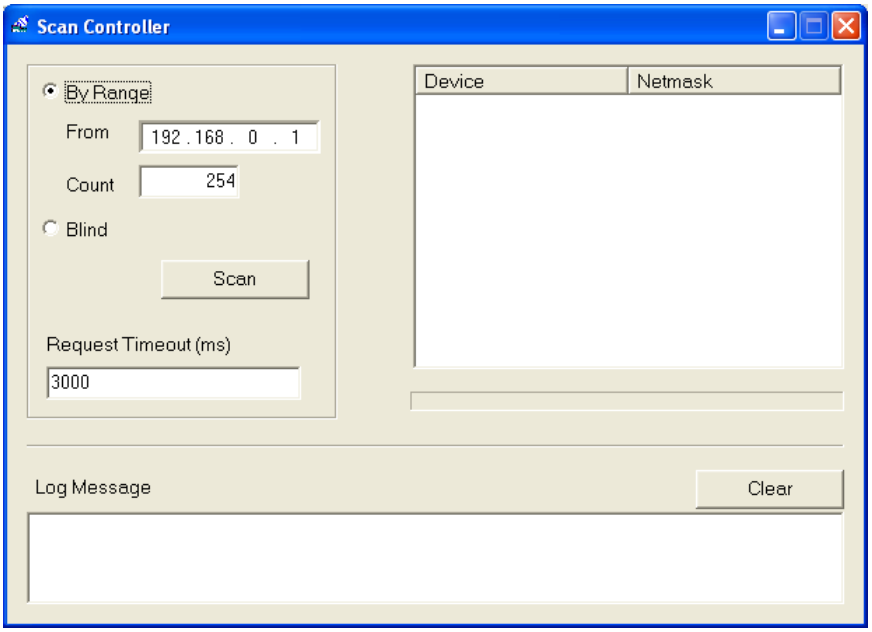


Figure 29 Scanning Controller

3. Click "IP Config" button beside the "IP Address" box on the General tab. the IP Config utility will be popped out as follows. You can change the IP Address, Subnet Mask or Default Gateway in "Target Device IP Configuration" area as the engineering requires.

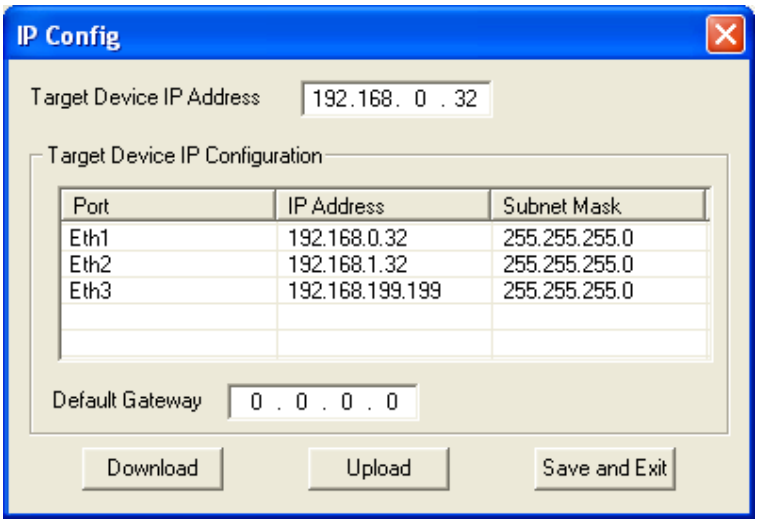


Figure 30 IP Config Utility

4. Click ‘Download’ button to download it to the controller. The new IP address will take effect as soon as the download action is completed.
5. Then click "Save and Exit" to save the IP configuration to the project and exit to the main window of MOXGRAF.

5.3 GPRS Modem

The MOX Unity has the option of an installed GPRS modem. The installed modem uses an internal communication port and can be quickly setup using MOXGRAF '**GPRS**' tab in configuration view.

The GPRS module requires service provider network configuration in order for it to be able to connect to the World Wide Web. The following is a description of each parameter:

Modem Parameters:

- "Serial port" indicates the internal or external GPRS modem location.
- "Baud rate" indicates the GPRS modem communication speed.
- "Extra Initialization Command" indicates that the GPRS modem would accept initial settings by command.

Service Provider Settings Parameters:

- "Phone Number" and "APN" (Access Point Name) are the two main parameters that require changing or verifying.
- "User Name" and "Password" should be given by the service provider if needed.
- "QoS Rqs" and "QoS Min" are the parameters to configure the quality of service when communicating with a wireless module. The configuration details should be given by the service provider.

Advanced Settings Parameters:

- "Define IP" might apply when using a static IP address to communicate.
- "Primary DNS" and "Secondary DNS" might apply when using a web browsing service.

5.4 Store and Forward

The MOX Unity can act as a relay station among connected MOX Unity controllers. It has the ability to forward a received message to its intended Unity.

If the direct communication with a MOX Unity is not possible, the Master Unity can communicate via a set network path to the desired controller.

Configuring the MOX Unity network is performed within the '**Network**' tab in configuration view. The "MoxRxTx" function block must be used in conjunction with the network configuration information for the communication to work correctly.

5.5 Firewall

The MOX Unity has the ability to block out all unauthorised access. This is done by configuring an onboard firewall of the MOX Unity. To configure the firewall select the '**Firewall**' tab in configuration view.

5.6 DNP 3.0

DNP 3.0 is one of the communication functionalities of MOX Unity. A MOX Unity can be set as master or slave.

The '**DNP 3.0**' tab in configuration view enables master and slave configuration of the DNP 3.0 communication protocol.

The tool '**Resource | DNP3 Master Setting**' or '**Resource | DNP3 Slave Setting**' in resource view is used to configure the data addressing in DNP3 protocol.

5.7 IEC 60870

IEC 60870-5 is a series of transport protocol standards, applying to telecontrol, teleprotection, and associated telecommunications for electric power systems.

The '**IEC 60870'** tab in configuration view allows the user to configure the IEC 60870 - 104 Slave.

The tool '**Resource | IEC870 Slave Setting**' in resource view is used to configure the data addressing in IEC870 protocol.

5.8 HTTP Server

The MOX Unity is provided with a HTTP server with XML support. This gives the flexibility to browse controller specific web pages or to simply browse/download files with the web client.

The MOX Unity HTTP server provides a platform to build web sites specifically for managing the controller. The web pages are firstly built and then uploaded to the HTTP server, using File Transfer Protocol (FTP). Once all pages are uploaded to the HTTP server, they can be viewed using a web client. It is important to understand that these are user data files, not configuration files.

Both HTML and XML are supported, however if no default page exists, such as index.html, index.htm, index.xhtml, default.htm, current user directory will be displayed. Use the controller's IP address to access HTTP server directly since MOX Unity has no name of itself, e.g. http://192.168.0.32.

MOXGRAF provides basic HTTP authentication via 'HTTP' tab in configuration view. User name and password can be created as a system security mechanism to access the Unity's web pages.

If the HTTP authentication is not configured in MOXGRAF, no security features will be operational and all access to the user directory of the controller will be possible.

5.8.1 Dynamic MODBUS Data Exchange

Three real MODBUS data access examples are provided on HTTP server:

1) Basic read and write: manual MODBUS reading and writing online

2) HTML with MODBUS: user building HTML pages related with MODBUS variables

3) XML with MODBUS: user building XML files related with MODBUS variables

To view these pages, open your desired Internet Web Explorer and type in the IP address of the connected controller into the “Address” field. This will bring up the index.htm page from which you can select to open any of the above examples.

Basic Read and Write Operations

The basic operations of reading and writing a MODBUS address while online is performed via two simple request pages:

- moxread.htm: reading a group of MODBUS variables
- moxwrite.htm: writing a single MODBUS variable

Select the moxread.htm example from the index page.

Enter the MODBUS start address from where you wish to read variables.

Enter the number of data points (registers) that you wish to read. If you wish to read three DINT variables then it will be six data point as each variable uses two registers.

Select the data type (format) of the desired variables and the refresh time.

Select the submit button. If there is no error in the information that you have selected to read the moxonline.htm web page will be returned displaying the data.

If refresh time is defined, the moxonline.htm web page will refresh automatically at the set intervals.

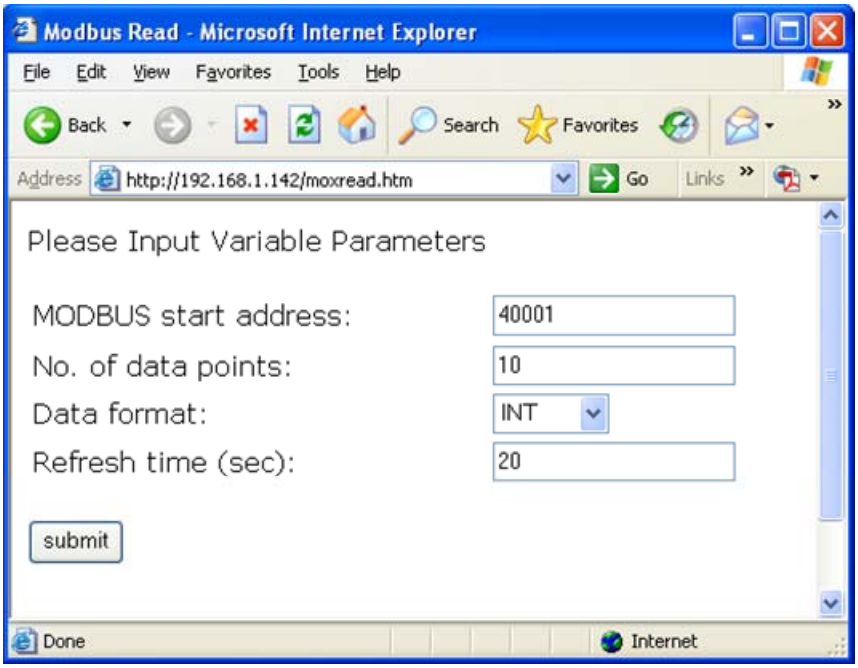


Figure 31 MODBUS Read Request Page

Here are the details of input parameters on this page.

MODBUSAddr: MODBUS address of the source variable

- Coil status: 00001-9999
- Input status: 10001-19999
- Input register: 30001-39999
- Holding register: 40001-49999

DataPoint: Data points to read in http server station, for MODBUS write, only one variable is allowed.

- Range: 1~100

DataFormat: Data format

- Boollean: BOOL, TRUE or FALSE
- Int: DINT
- Float: REAL

Data: The data value for writing.

Refresh: Variables refresh time in second for MODBUS read

If the MODBUS read is successful, the following page will be displayed:

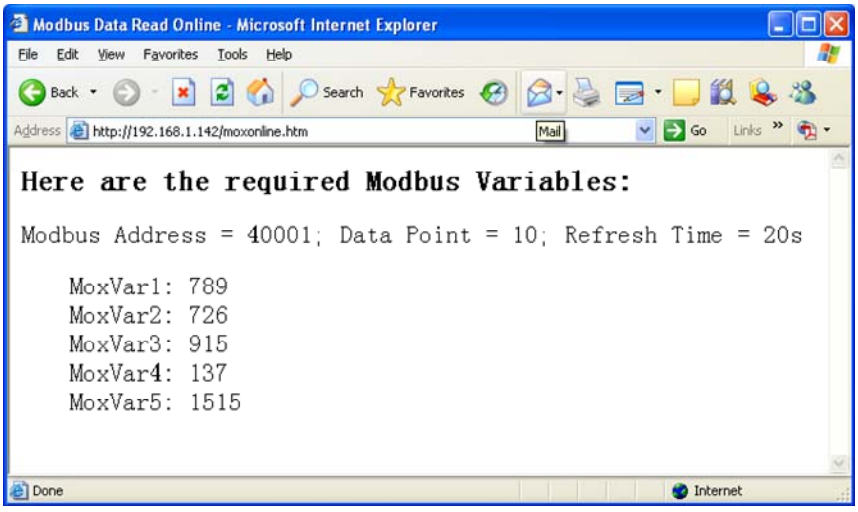


Figure 32 MODBUS Read Success

If the MODBUS read is failed, the following page will be displayed:

Figure 33 MODBUS Read Failure

Select the moxwrite.htm example from the index page.

Enter the MODBUS start address from the variable you wish to write to.

Enter the number of data points (registers) that the variable uses. For example a FLOAT (REAL) uses 4 registers within the MOX Unity.

Select the data type (format) of the desired variables and the data value.

Select the submit button. If there is no error in the information that you have selected to write the moxonline.htm web page will be returned displaying a success message.

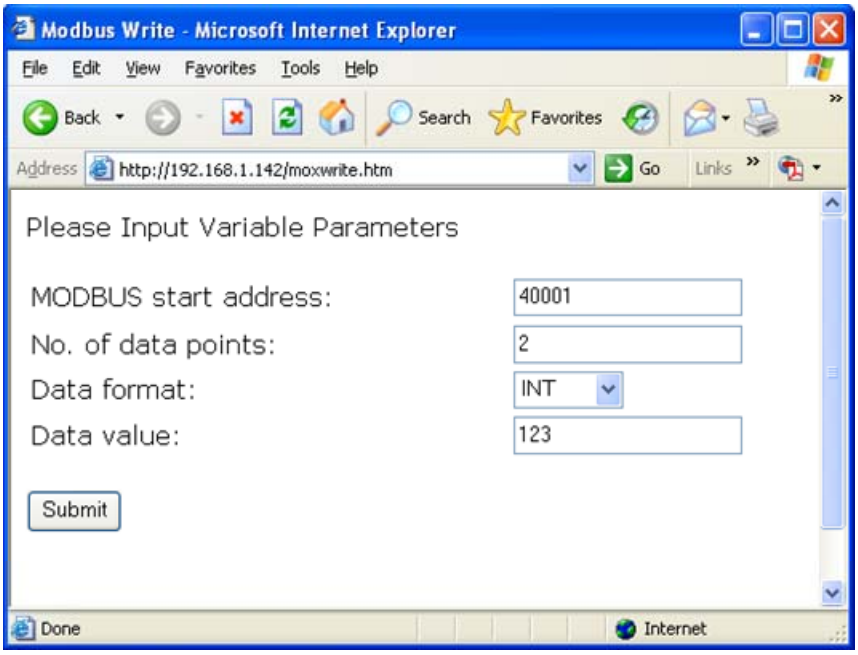


Figure 34 MODBUS Variable Write Request

The following page will be displayed if the MODBUS write request is successful:

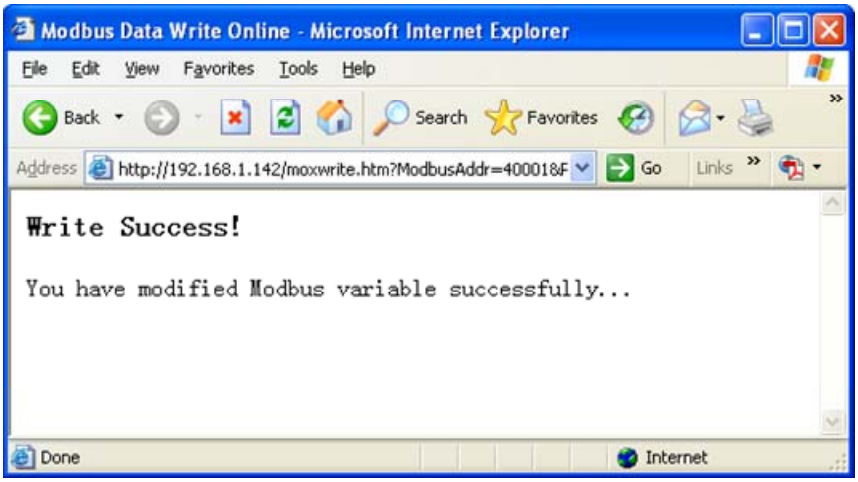


Figure 35 MODBUS Write Success

The following page will be displayed if the MODBUS write request is failed:

Figure 36 MODBUS Write Failure

HTML with MODBUS

HTML with MODBUS enables the user to view variables on a web page without having to request them, as displayed in the previous read operation.

One MODBUS variable tag represents one MODBUS variable.

All HTML pages related with MODBUS variables should be named as mox*.htm. MODBUS variable tags use the combination of type and MODBUS address. Each tag occupies 10 characters, defined as followed:

#BOOL00001, #BOOL10001, #DINT40001, #REAL40003, ……

All these tags will be replaced with the true data directly when user browse them. User should pre-build such HTML pages and put them to HTTP server before browsing.

If user define mox*.htm with no MODBUS variable tags, there is no problem. If there are many such pages, it will affect the performance of http server. If user put MODBUS variable tags on other pages, there is no process for MODBUS variable tags when browsing.

Here is a source code of moxdata.htm. Three MODBUS variable tags are used as #BOOL00001, #DINT40001 and #REAL40021. Be sure the combination of type and address is correct and upload this page to http server.

```
<html>
<head>
<meta http-equiv="Content-Type" content="text/html; charset=gb2312">
<title>An example of MODBUS variables related html page</title>
</head>
<body>
        <p>Here are the required MODBUS Variables:</p>
```

```
<p>A BOOL variable at address 00001: #BOOL00001<br>
 A DINT variable at address 40001: #DINT40001<br>
 A REAL variable at address 40021: #REAL40021</p>
</body>
</html>
```

Select the moxdata.htm example from the index.htm page.

The following page will be displayed if the dynamic read operation is successful:

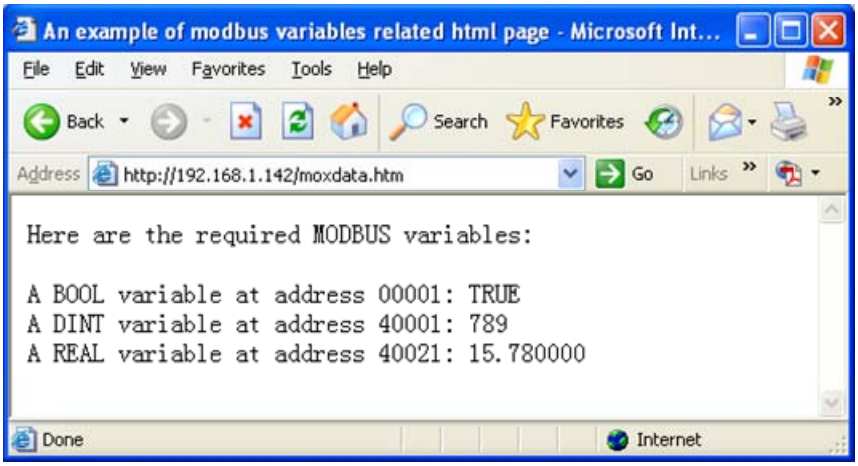


Figure 37 Read MODBUS Variables Success

If the controller is unable to read the MODBUS addresses defined in the HTML page the following screen will be displayed:

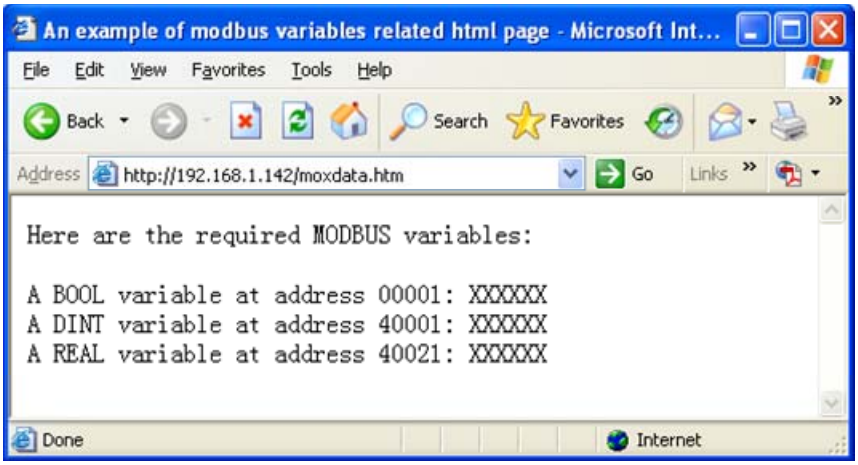


Figure 38 MODBUS Variable Read Failure

XML with MODBUS

A MODBUS variable group tags and attributes method is used to require a group of MODBUS variables. All XML files related with MODBUS variables should be named as mox*.xml. There is no process for other XML files on HTTP server. All MODBUS variable group tags should begin with MoxVar and the attribute of MoxVar should be defined correctly. Sub tags will be returned after MODBUS variable group tag as MoxVar1, MoxVar2, and so on.

Here is a source code of moxdata.xml. Three MODBUS variable group tags are used as MoxVarGroup1, MoxVarGroup2 and MoxVarGroup3. For each tag, there are three attributes displayed in bold font: MODBUSAddr, Point, and Format.

Set all parameter correctly and upload this page to http server.

<?xml version="1.0" encoding="gb2312"?>

<!—an Example to access Mox variables-->

<MoxDataDisplay>

< MoxVarGroup1 **MODBUSAddr**="1" **Point**="2" **Format**="Boollean"></ MoxVarGroup1>

< MoxVarGroup2 **MODBUSAddr**="40001" **Point**="4" **Format**="Int"></ MoxVarGroup2>

< MoxVarGroup3 **MODBUSAddr**="40021" **Point**="4" **Format**="Float"></ MoxVarGroup3>

</ MoxDataDisplay>

Open moxdata.xml on http server.

If success:

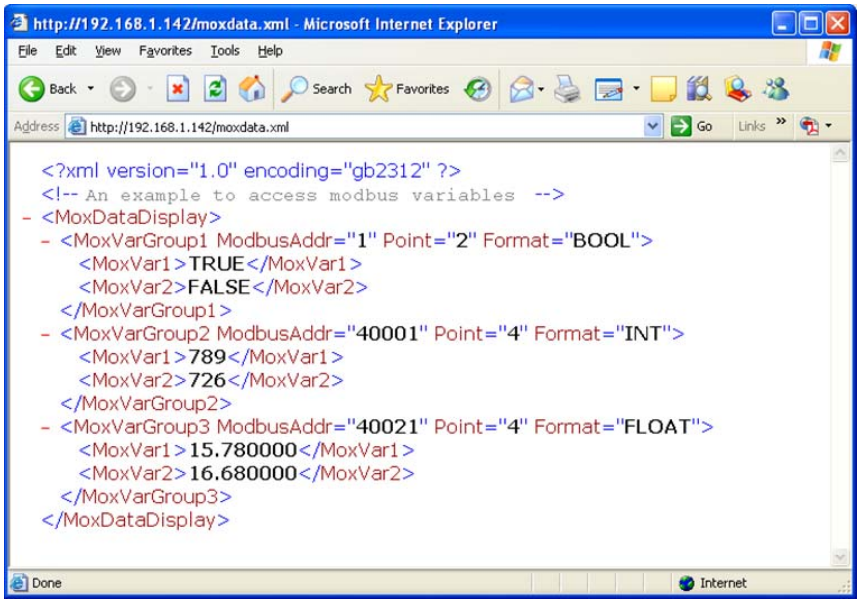


Figure 39 Read moxdata.xml Success

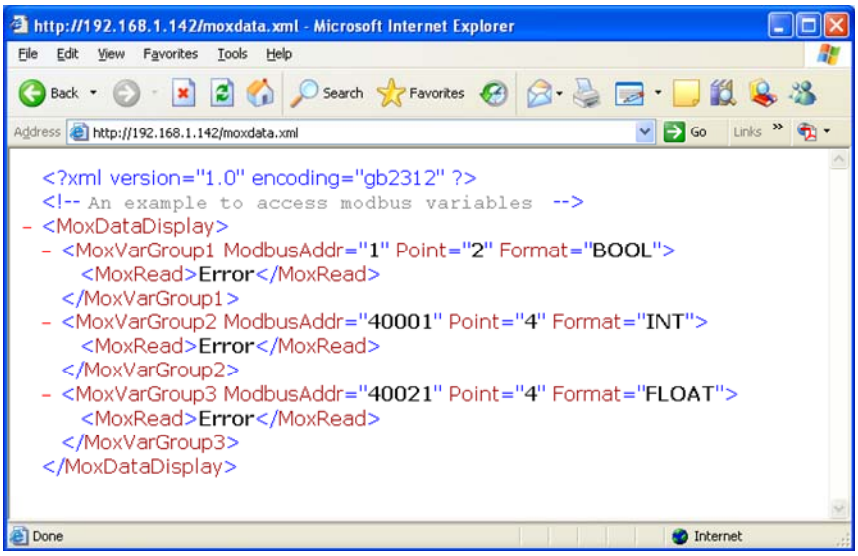


Figure 40 Read moxdata.xml Failure

5.8.2 Downloading User Web Pages

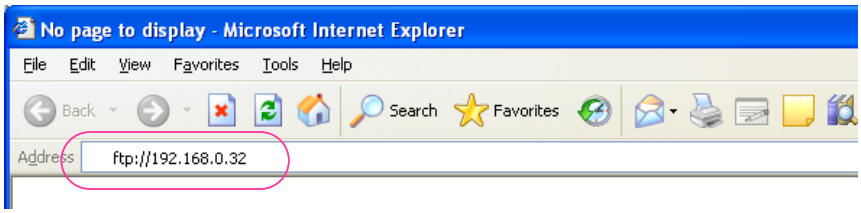
All user web pages and stored data are held in the user specified space on the MOX Unity. Web pages are held within the web folder in this space. Images on the user web pages should be placed in the images folder within the web folder to keep structure and organization for web page trouble shooting.

To download user web pages to the Unity, open Internet Explorer and use the ftp tool, e.g. ftp://192.168.0.32. It is also possible to use an ftp GUI client to perform this operation.

FTP account information is as follows:

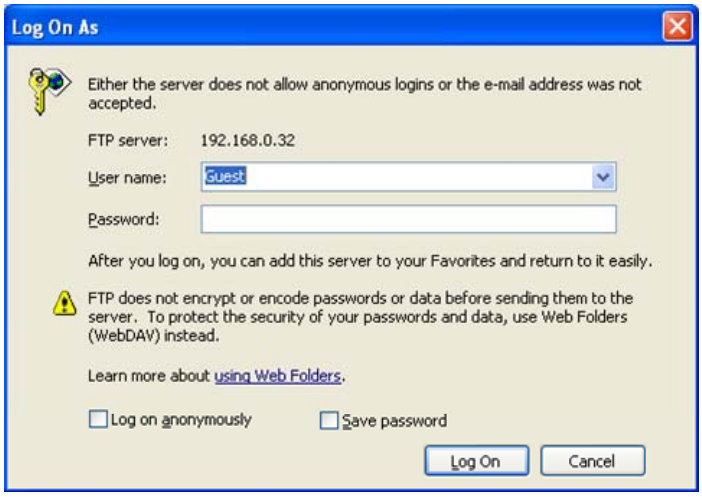
- Username = Guest
- Password = *No Password*
- Port Number = 21

	*FTP username is case sensitive.*

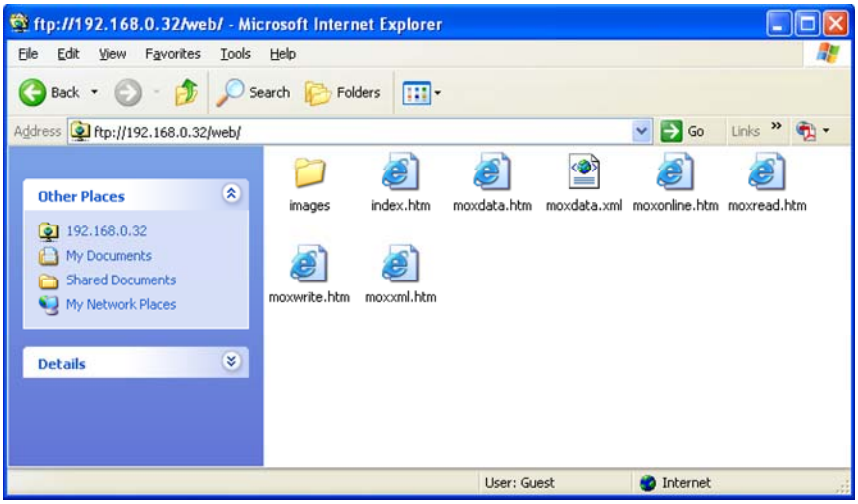


The user will then be prompted to login into the Unity's user space.

- *Username: Guest*
- *Password:*



Once logged into the MOX Unity user space, data can be manipulated to meet the desired requirements.



⚠	*The 'web' and 'images' folders cannot be removed from the system.*

5.9 IPSec

The MOX Unity has the ability to secure the IP traffic with another MOX Unity or Personal Computer. The MOX Unity has implemented IPSec (Internet Protocol Security) Transport operation mode with preshared key as initial authentication. Configuring the MOX Unity IPSec is performed within MOXGRAF 'I**PSec**' tab.

5.10 UPS

The MOXGRAF '**UPS'** configuration tab provides the functionality of UPS (Uninterrupted Power Supply) configuration and monitoring. Both UPS configuration and monitoring updates are the real time values of the connected MOX Unity.

6 Complex System

6.1 How MOX Unity Redundancy Works

Redundancy can be achieved when using MOX Unity with more than one Ethernet port. Port Eth2 could be used as the link between redundant controllers. For MOX Unity with single Ethernet port, redundancy should not be applied.

6.1.1 Definitions

- Primary controller - the controller is configured for primary control
- Standby controller - the controller is configured for standby control
- Active state - the controller has control of the system, not necessarily the primary controller
- Inactive state - the controller is waiting to take control of the system, whilst being continually updated with variable information

6.1.2 Controller Operation

A redundant MOX Unity system comprises of a primary and a standby controller. Both controllers are interconnected for synchronization communications. The controller in the inactive state will not operate control code; however variable values are continually synchronized with the *active state* controller, performed on each scan of the *active state* controller.

When both controllers are powered on simultaneously, the primary controller will take control of the system by entering the active state, unless there is a fault with it, or its connected I/O network.

If communication with the monitoring HMI/SCADA is lost with the controller in the active state, read and write operations on variables can be performed via the controller in the inactive state.

LED Description	Controller State
RUN LED ON, ACT LED ON	Active state controller
RUN LED ON, ACT LED OFF	Inactive state controller

When the *active state* controller fails, e.g. power failure or CPU failure, the *inactive state* controller will take control of the system. The new active controller will also display that it is missing its redundant partner. When the failed controller is repaired and returned to operational state it will remain in the inactive state until it is required to take control.

LED Description	Controller State
RUN LED ON, ACT LED Flashing	Active state controller, and redundant partner is lost

6.1.3 Configuring Redundancy in MOXGRAF

Eth2 ports of two redundant MOX Unity controllers can be used as redundancy ports through which the process data is synchronized between them. It is required that two redundant controllers have different Eth2 IP addresses, e.g. 192.168.0.32 and 192.168.0.33.

It is recommended that you use the same address identifier in the Eth1 IP address as in the Eth2 IP address, the only difference being the subnet. For example if the controller's Eth2 IP address is 192.168.1.32 then the Eth1 IP address would be 192.168.0.32.

The active and inactive controller code performs the redundancy operations. Enabling redundancy operations must be performed when programming and before the controller code is downloaded to the MOX Unity.

In the Configurations View of MOXGRAFV5, check the 'Redundancy' option on the '**General**' tab. Set the IP address of the primary and standby controllers.

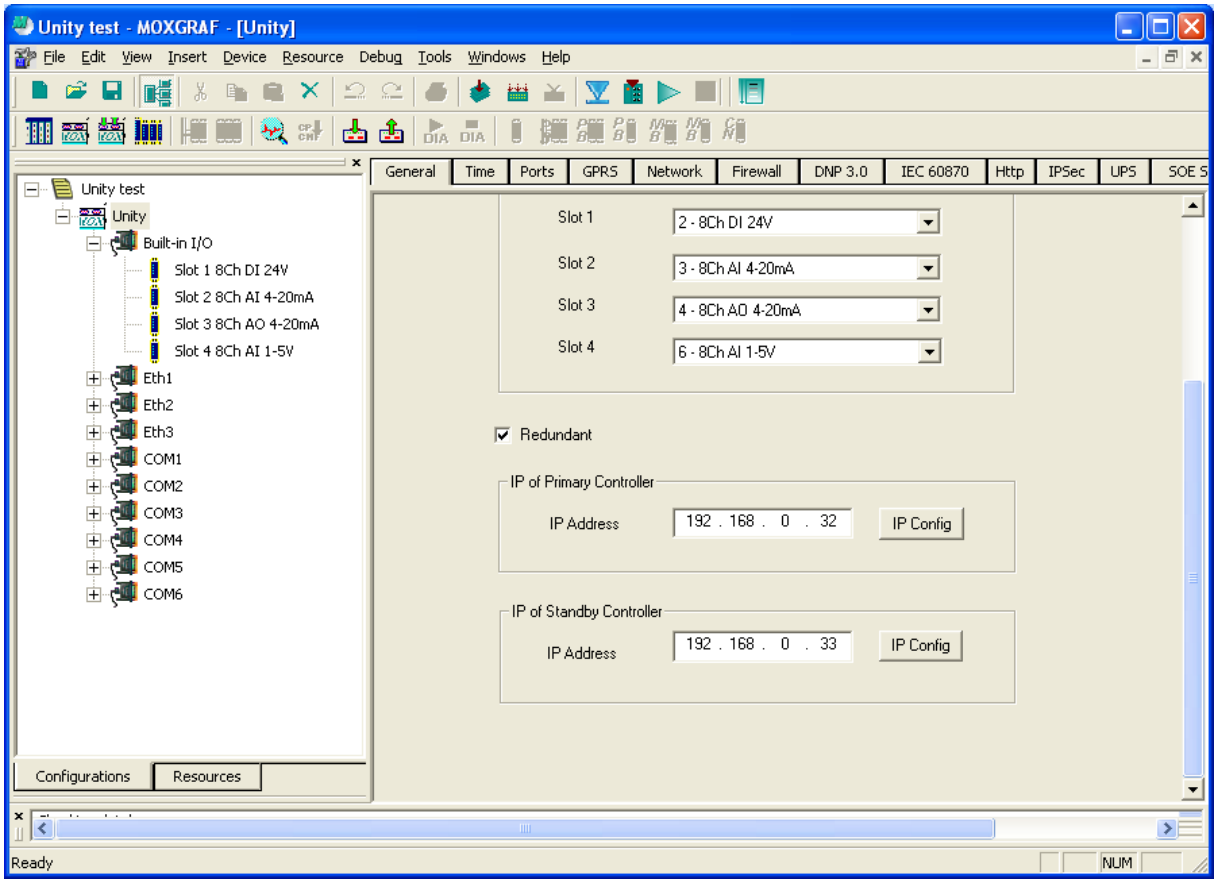


Figure 41 MOXGRAF General Tab

6.1.4 Installing Redundancy Cables

Before connecting MOX Unitys in redundant configuration, make sure the redundancy port on each controller has its own unique IP address. MOXGRAF can be used to alter the IP address of this port.

There are two possible connection configurations when connecting two Unitys in redundant mode.

1) Connecting two controllers where the communication path is via a hub or switch.
2) Directly connecting two controllers establishing a direct communication path.

6.2 MOX Unity to MOX 603 Standalone I/O Modules

6.2.1 Serial to MOX 603 I/O

When connecting MOX 603 I/O modules to the MOX Unity's serial communication ports, it is important that the correct cabling is used. In most cases an RS485 or RS232 cable will have to be fabricated to ensure correct communication between the controller and connected modules.

In RS232 communication format, one RS232 port of MOX Unity can be connected directly to one MOX 603 Standalone I/O module.

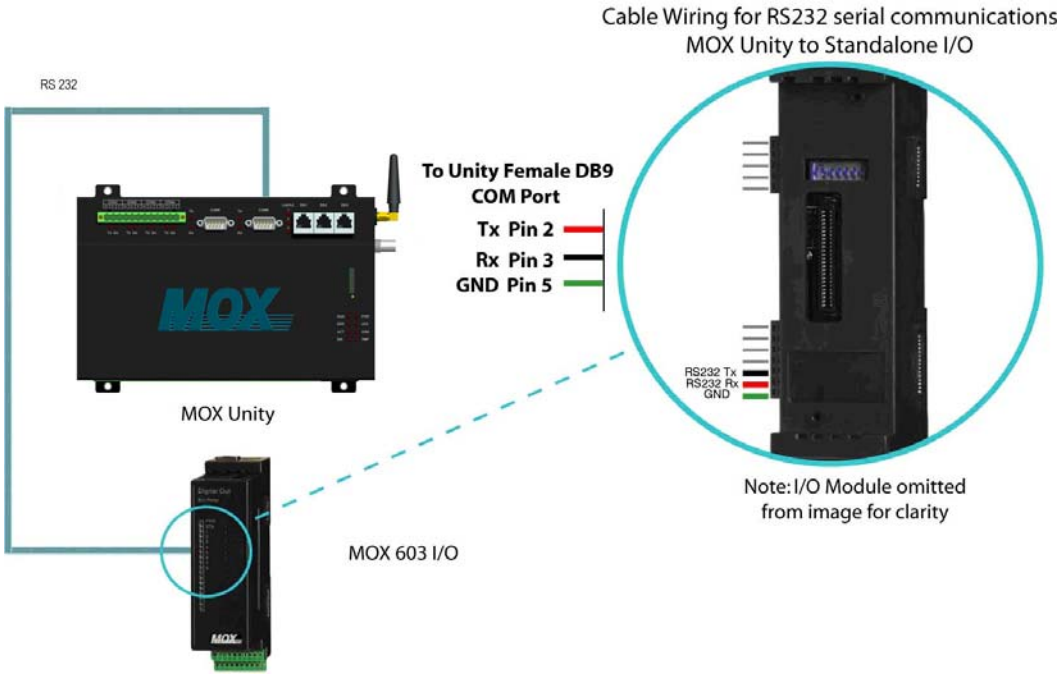


Figure 42 Cable Wiring for RS232 Communication Direct to MOX 603 I/O Modules

In RS485 communication format, MOX Unity can be connected *directly* to a maximum of 30 standalone MOX I/O modules on any of the RS485 serial communication ports.

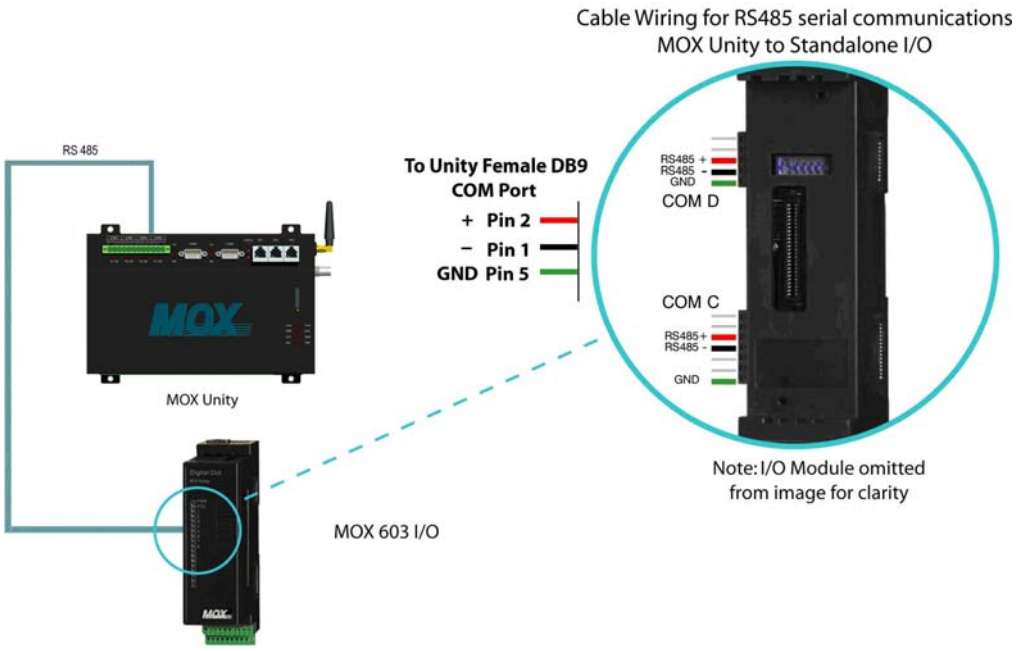


Figure 43 Cable Wiring for RS485 Communication Direct to MOX I/O

When connecting directly to MOX I/O modules, configuration may be required in MOXGRAF dependent on the communication baud rates of the MOX Unity serial port and the connected I/O serial port.

As there are no plug and play drivers for direct I/O communication, relevant code (built within MOXGRAF) must be implemented to initiate the communication process.

To communicate with all directly connected MOX I/O modules using the serial communication ports, the **MODBUSM** Function Block must be used to read all module I/O information. Please refer to the *Special Function Block Programming Guide* and the *MOX 603 Standalone I/O User Guide* for more information on this type of network connection.

To connect MOX 603 I/O module, the **MODBUS Master** Protocol must be set on the connected serial communication port, please refer to chapter 5.1 Serial Ports.

A maximum of 30 standalone MOX I/O modules can be connected to any of the RS485 ports (although this configuration is not recommended due to limited communication performance).

6.2.2 Ethernet to MOX 603 Standalone I/O

With Ethernet communication ports, MOX Unity can directly communicate with MOX 603 Standalone I/O. The Ethernet port of Unity and the I/O module will need to have the same subset.

To communicate with all connected MOX 603 Standalone I/O modules using the Ethernet communication ports, the **MODNETM** Function Block must be used to read all module I/O information. Please refer to the *Special Function Block Programming Guide* and the *MOX 603 CP User Guide* for more information on this type of network connection.

Figure 44 Cable Wiring for Ethernet to MOX 603 Standalone I/O

6.3 MOX Unity to MOX 603 Rack Base I/O

The MOX Communications Processor (MOX CP) acts as an information store and forward module in large scale I/O modules. The MOX CP will collect all connected MOX 603 Rack Base I/O information and then forward it on to the MOX Unity controller.

6.3.1 Serial to MOX CP

When connecting MOX CP modules to the MOX Unity's serial communication ports, it is important that the correct cabling is used. In most cases, an RS485 or RS232 cable will have to be fabricated to ensure correct communication between the controller and connected modules.

For cabling of the MOX I/O PSU, please refer to the MOX 603 Rack Base I/O User Guide.

When using the RS232 communications, one RS232 port of MOX Unity can be connected directly to one MOX CP module.

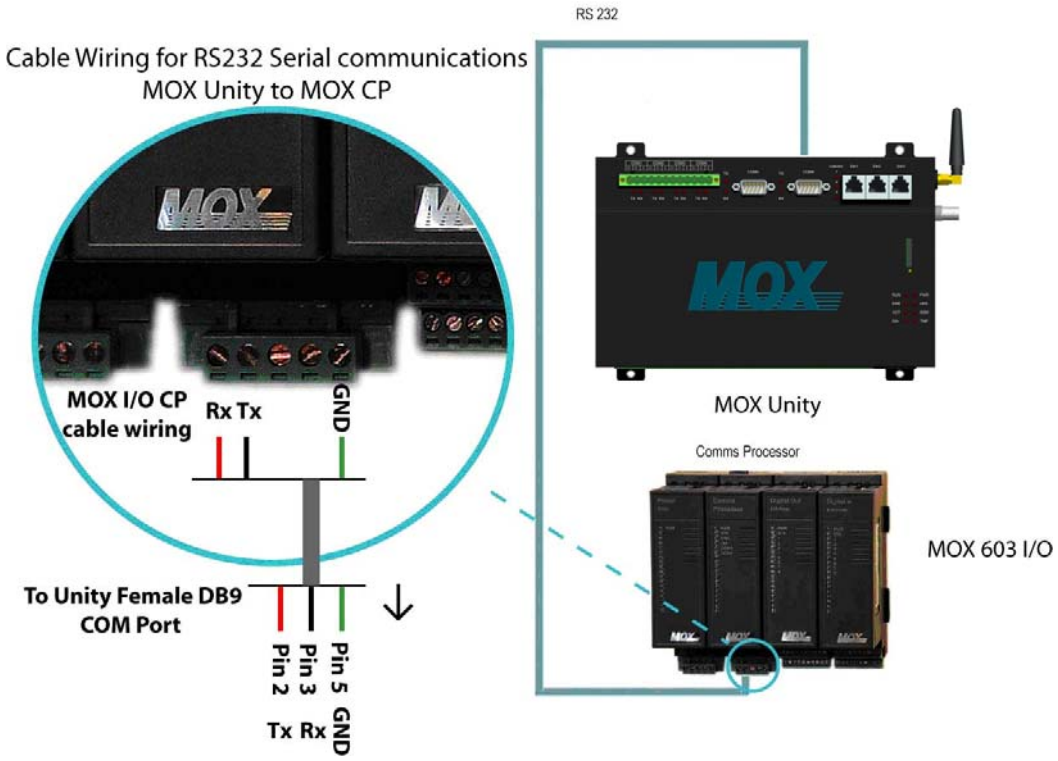


Figure 45 Cable Wiring for RS232 Communication to MOX CP Module

In RS485 communication format, the MOX Unity can be connected to a maximum of 12 MOX CP modules on any of the RS485 serial communication ports.

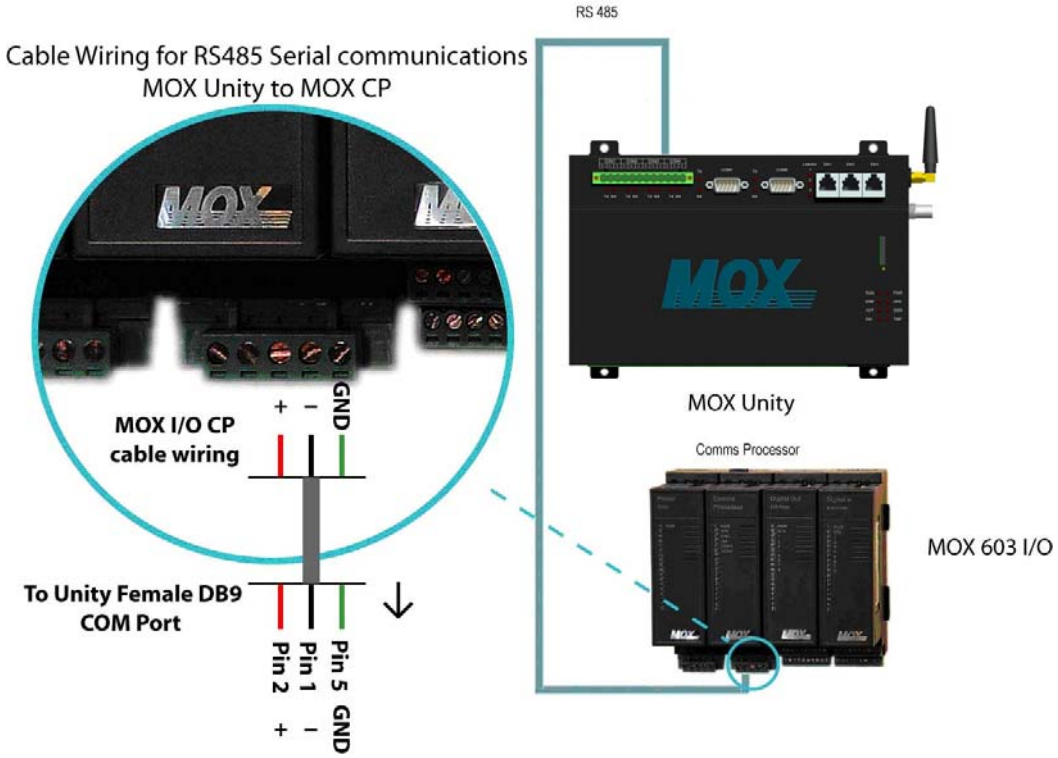


Figure 46 Cable Wiring for RS485 Communication to MOX CP Module

⚠	*It is recommended that a maximum of 10 MOX I/O modules be connected to a MOX CP on any given network rack.* *MOX I/O station numbers must always start at 1 beginning with the first connected module to a MOX CP and no gaps should be left between station addresses.* *When connecting a MOX Unity and MOX CP serial network, all devices are required to have a unique station address.*

To connect one or more serial MOX CP modules to the Unity, the **MODBUS Master** protocol must be set on the connected serial communication port, please refer to chapter 5.1 Serial Ports.

6.3.2 Ethernet to MOX CP

The MOX Unity can connect to a max of 12 MOX CP modules via a single Ethernet port. For systems with a large number of external I/O, you should thoroughly test your system to ensure that any performance requirements will be met.

⚠	*It is recommended that a maximum of 10 MOX I/O modules be connected to a MOX CP on any given network rack.*

Figure 47 Cable Wiring for Ethernet to MOX CP

The MOX Unity must have more than one Ethernet port to connect MOX CP. And the Ethernet port should be assigned to the same subnet as the MOX CP modules to be connected to it.

Please refer to *MOX 603 CP User Guide* for the factory default MOX CP IP address.

6.3.3 MOX CP and I/O Configuration

MOXGRAF is required when configuring a communication network including the use of MOX CP and 603 rack base I/O modules. Please follow the procedures described below:

Step 1: Create MOX CP – MOX I/O Network Architecture

There are two methods of creating your network architecture:

1) Manually create the software configuration in MOXGRAF. Connect your physical hardware identical to the software configuration architecture.

To manually configure your communication network in MOXGRAF, select the MOX Unity controller in MOXGRAF.

Select the Ethernet or COM port the CP is connected to. Select I**nsert | CP** to add the new MOX CP to the port.

Select its “General” page to configure its station information. The Station Number will automatically increment to ensure no clashes occur throughout the network frame; however this value can be altered manually.

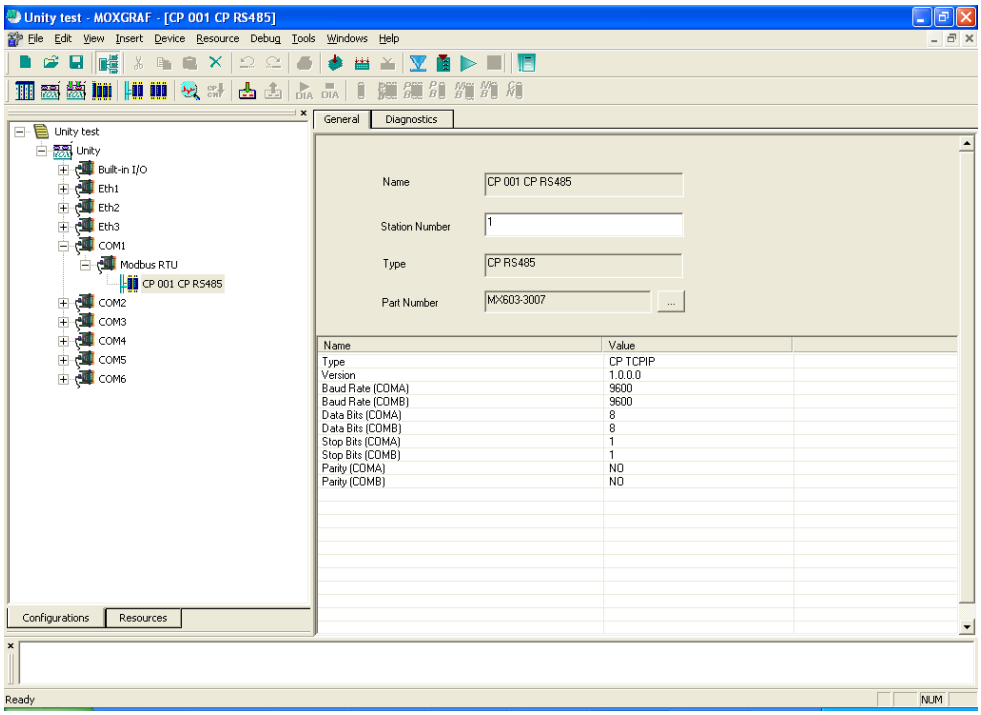


Figure 48 Addition of MOX CP to Network Tree

Select the “Part Number”: Click the browse button on the right end of the Part Number row, the following window will pop up:

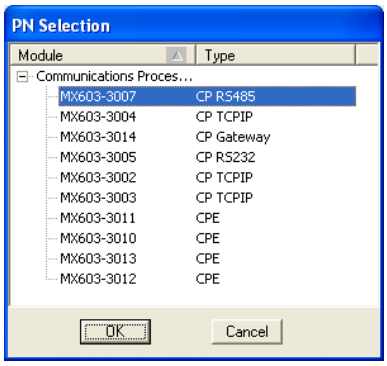


Figure 49 PN Selection Window

Choose a type of CP and confirm by clicking “OK”. Content within “Part Number” item as well as “Name” and “Type” will update automatically according to selected Part Number.

To add a MOX I/O module to MOX CP, select the desired CP module from the network tree and go to **Insert | I/O**. The MOX I/O module should now appear in the network tree under the MOX CP module. To configure the new MOX I/O general information, select its "General" page.

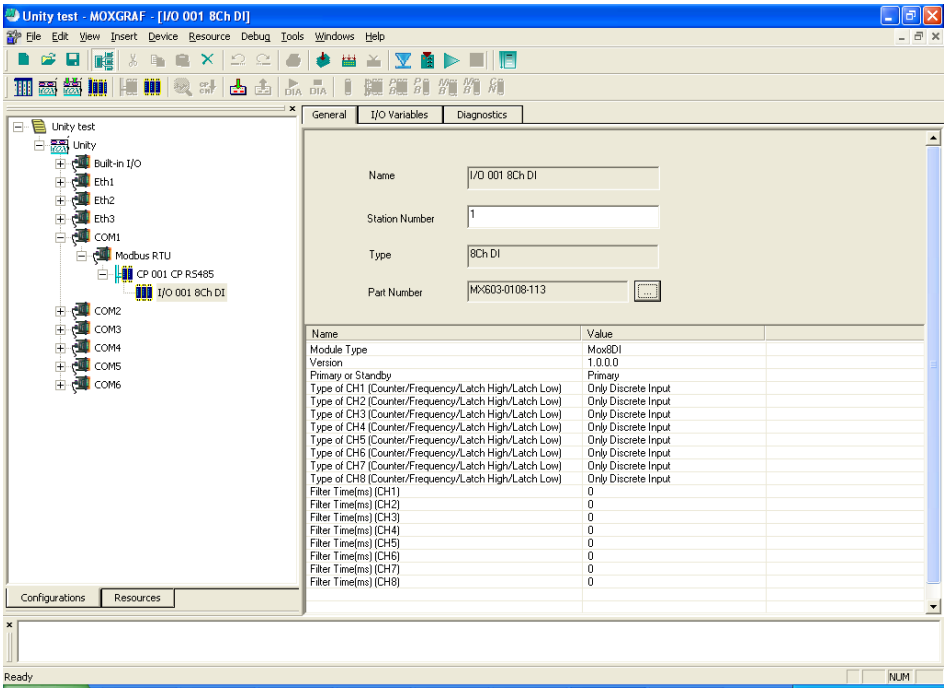


Figure 50 Adding a New MOX I/O Module

The Station Number will increment automatically to remove the possibility of clashes throughout the network; however this value can be altered manually.

Add MOX I/O and MOX CP modules where required to complete the desired network architecture. Ensure that you follow all recommended connection limits for optimum communication. Save the current MOXGRAF project before proceeding.

2) Physically connect your hardware network. Use MOXGRAF scan function to automatically create the software configuration for it.

To scan your physically connected network, select the controller displayed in the network tree. Select **Scan Slave Settings** icon  on the toolbar to start the scan process.

The scan tool enables the user to select the communication port of connected MOX CP modules. It also allows the user to enter in the scan range of the connected MOX CP modules.

- When scanning for connected Ethernet CP modules, the IP identifier range is scanned, i.e. AAA.BBB.CCC.1-15.
- When scanning for connected Serial CP modules, the station address range is scanned, i.e. 1-15.

Select the serial ports and the known range, if the range is unknown scan for the minimum and maximum range values. Then select the “Scan” button:

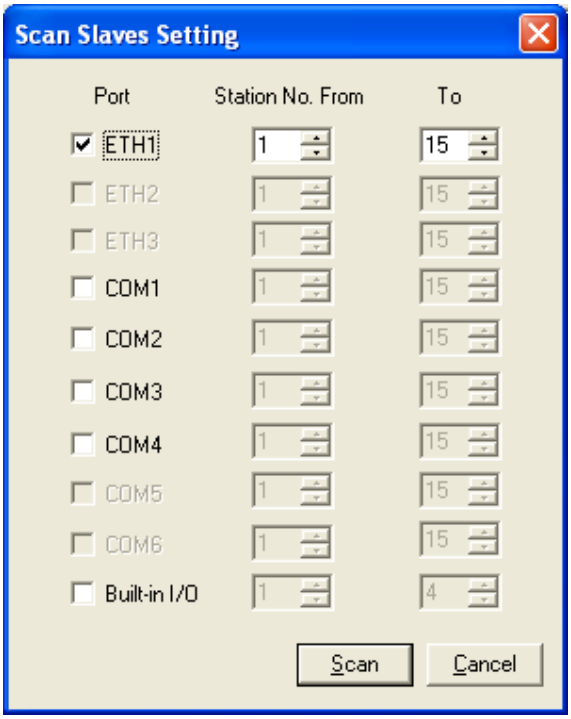


Figure 51 Scan Configuration

The scan function will scan for all connected MOX CP modules. Once all recognized connected MOX CP modules are identified, the scan function will then scan for all I/O modules connected to the MOX CP with the lowest station address.

When the scan function have finished, a prompt will appear querying if you wish to upload all found modules and their information to the network tree. Select “Accept” if you want the information uploaded, otherwise select “Cancel”.

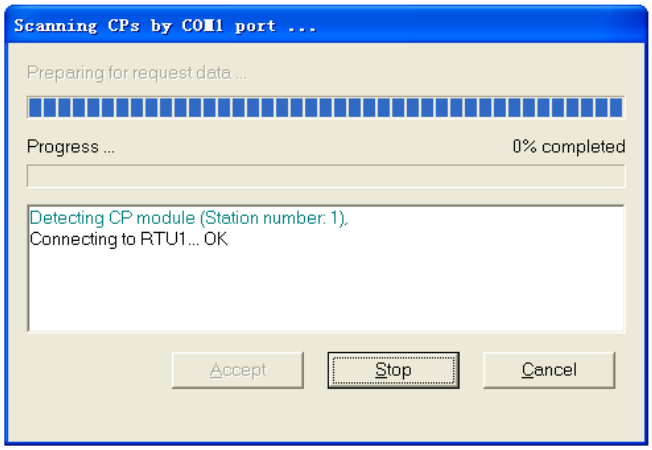


Figure 52 Scanning MOX CP and MOX I/O modules

The displayed network tree, refer to figure below, is not unalterable, the information can be changed manually and updated to suit user needs. If required change module information and download it to the working device. If at any time the network architecture changes, simply use the scan function again to upload the new configuration.

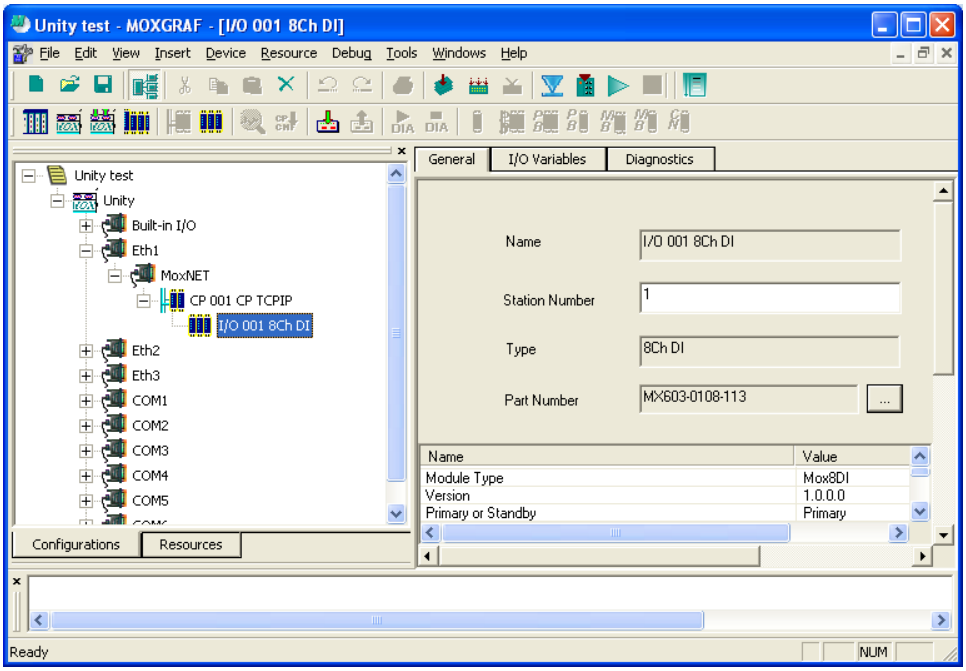


Figure 53 Uploaded Network Tree

	*Ensure that the MOXGRAF network tree matches the physically connected network, e.g. MOX CP station numbers and MOX I/O station numbers, before proceeding.*

Step 2: Configure MOX CP – MOX I/O Network Architecture

Once the required architecture is reached and all physically connected MOX I/O and MOX CP modules have been inserted or recognized in the network tree, it is possible to select one and change its to make sure that each individual MOX I/O module is configured to meet its operational requirements.

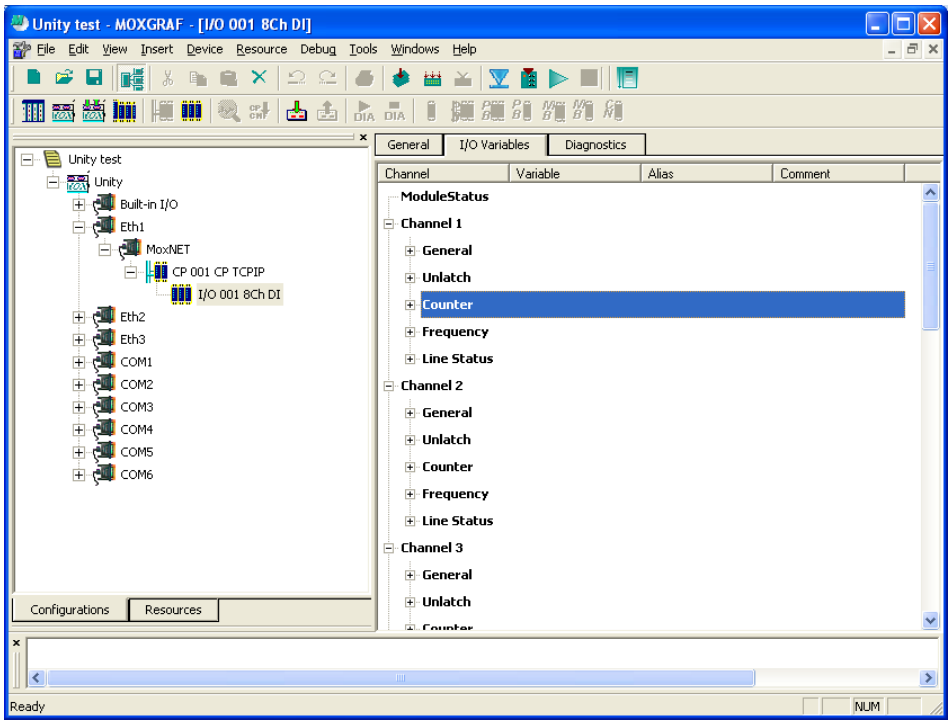


Figure 54 Altering I/O Module Operational Parameters

Open the "I/O Variable" tab and connect all variables to their required device channels.

Then download configuration to the I/O module by Selecting "Download CPCONF" icon  on toolbar.

Step 3: Download MOX I/O Information to MOX CP

The connected MOX I/O network information must be downloaded to their respective MOX CP head. This ensures that the rack controlling MOX CP knows what MOX I/O modules are connected to it, to monitor their status.

Select the desired MOX CP from the network tree. Once the MOX CP is highlighted, select "**Download CPCONF**" icon  on toolbar to download the I/O configuration file to the CP module.

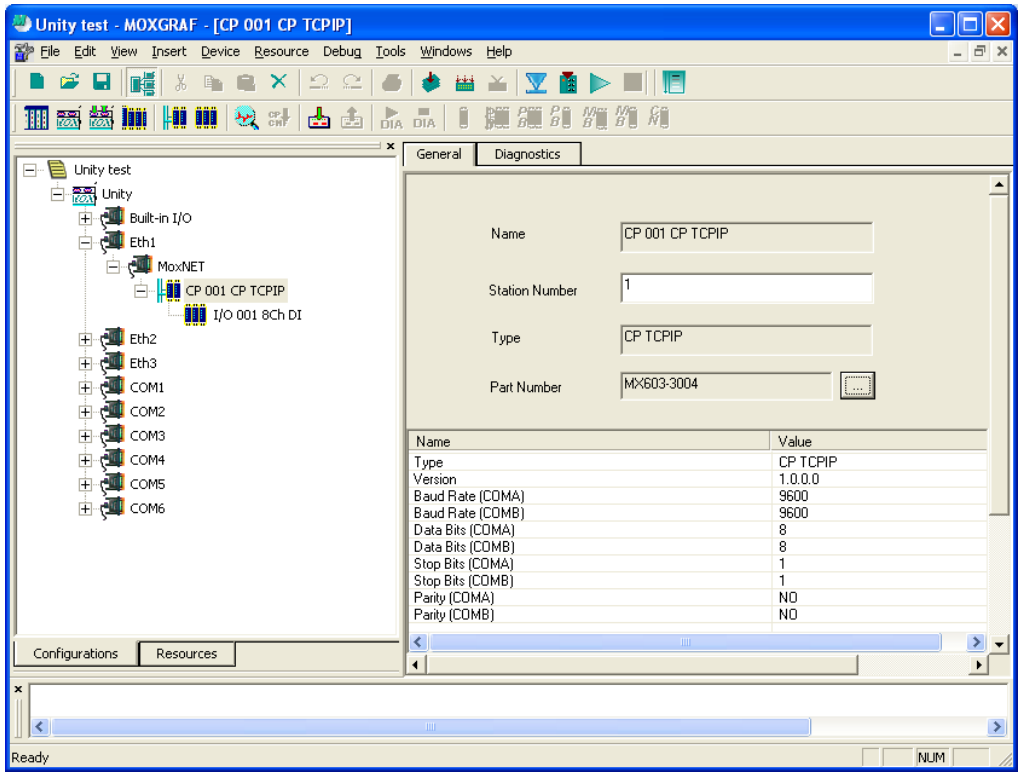


Figure 55 Alter CP Connected I/O Configuration

6.4 SOE Synchronization

MOX Unity supports SOE (Sequence of Event) function, in which, MOX 603 SOE module is provided for the SOE capturing and MOX 602 8CH DO 24V for the time synchronization signal generating.

Time synchronization is a key function of SOE. The detailed configuration of time synchronization can be altered through '**SOE Sync**' tab of MOXGRAF.

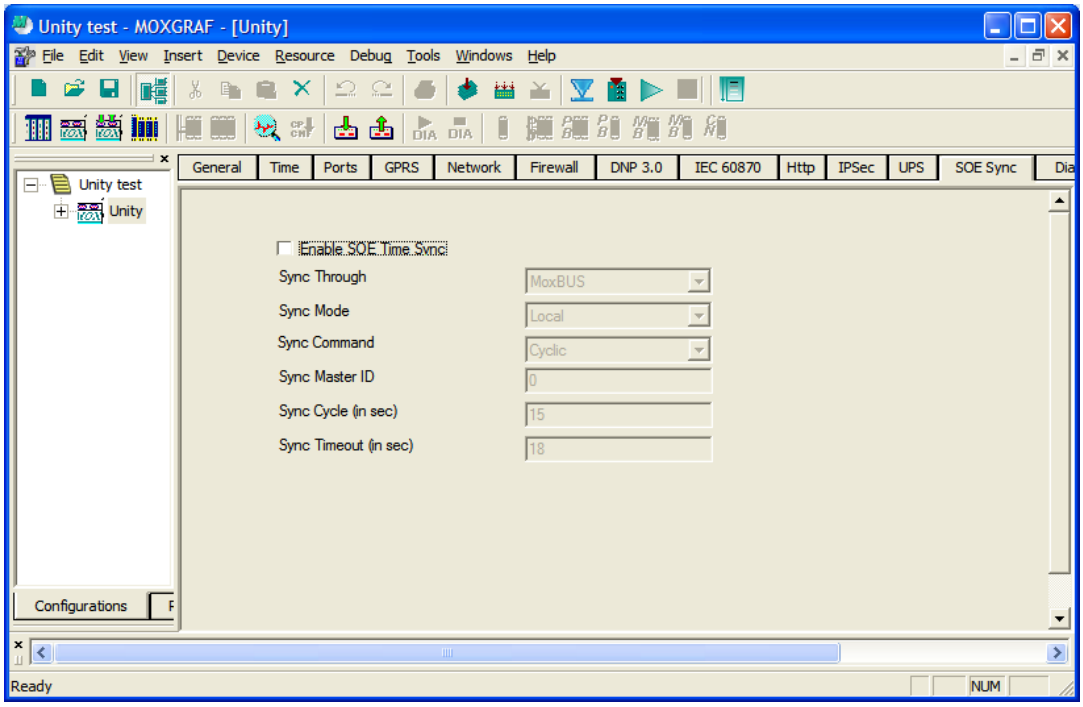


Figure 56 MOX Unity SOE Configuration

MOX Unity can only work in the "Local Mode" when supporting SOE and time synchronization, and this can be configured through '**SOE Sync**' tab of MOXGRAF. When a MOX Unity works in the local mode, it sends a synchronization signal to the SOE modules via a SOE synchronization line which is sourced by built-in 8CH DO 24V module. And at the same time, it sends the time stamp to the SOE module via the communication link. During the synchronization, MOX Unity is used as the time reference.

The following wiring diagram is an example of SOE function in a MOX Unity system with the following conditions.

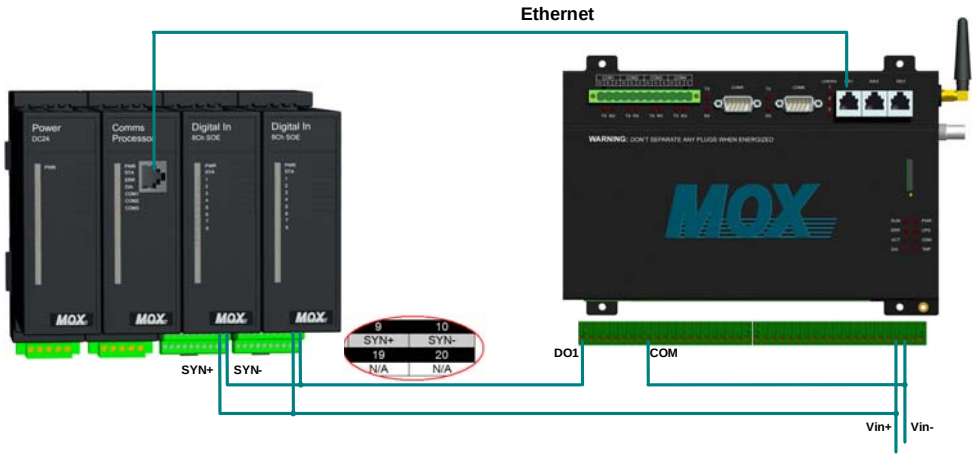
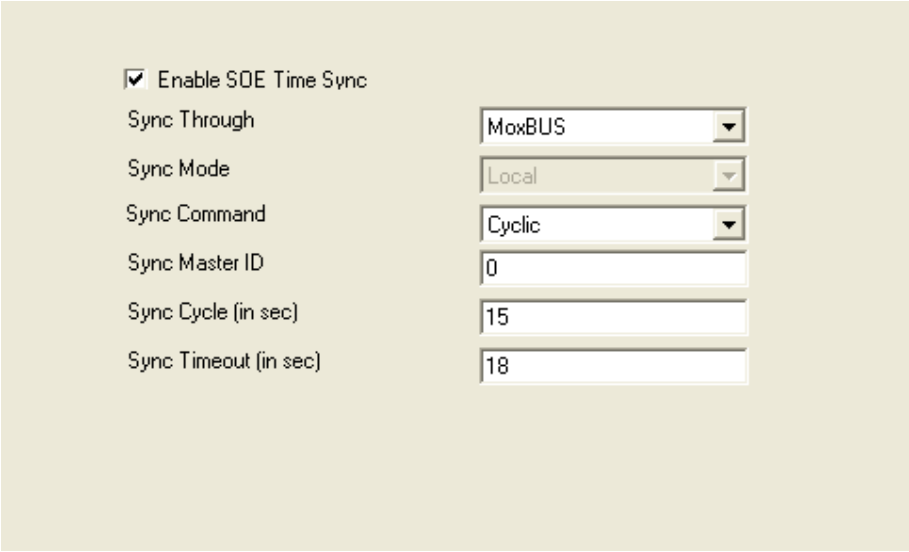


Figure 57 SOE Synchronization Wiring Diagram

1) MOX 602 8CH DO 24V is installed on the **slot 1** of the MOX Unity.
2) Two MOX 603 SOE modules are installed on one rack which communicates with the MOX Unity through the MOX 603 CP over Ethernet.
3) Configure CP and I/O information by MOXGRAF
4) Configure SOE synchronization in MOXGRAF. 'SOE Synch' could be configured as follows.



As described above, the MOX Unity sends a synchronization signal to the SOE modules via channel 1 of built-in 8CH DO 24V module. Meanwhile, it sends a time stamp of this signal to the SOE modules through Ethernet. Thus, all SOE modules are synchronized and capable of reporting captured events with correct time.

SOEViewer utility in MOXGRAF is used for SOE event retrieving.

6.5 MOX Unity to MOX Unity Communication

There are two methods of communication between two or more MOX Unity controllers.

6.5.1 MOX Unity to MOX Unity Serial Communications

Two or more MOX Unity controllers can communicate with each other via serial ports with several master/slave protocols assigned like MODBUS, DNP3.0, IEC60870.

When using MODBUS communications, the master MOX Unity would have the **Modbus Master** protocol assigned to its connected port whilst the slave would have the **Mox** protocol assigned to its connected port. The **MODBUSM** function block would then be used to retrieve information from the slave device. The function block '**MXRxTx'** is used for data exchange between MOX Unity controllers.

6.5.2 MOX Unity to MOX Unity Ethernet Communications

Using MODBUS TCP/IP (MODNET) communications, the **MODNETM** function block can be used to retrieve information from the connected MOX Unity device. Using this function block the MOX Unity can act as both a slave and a master to send and receive information.

6.6 MOX Unity to Standalone GPRS Modem

MX606-3202 is an independent GPRS modem in industrial telemetry application based on GSM 900MHz and GSM 1800MHz frequency. It is designed to transmit data and short messages over GSM/GPRS networks, allowing you to communicate with remote terminals.

MX606-3202 GPRS modem is powered by external 24VDC. It has a standard DB9 connector which can be connected to the host device.

6.6.1 Familiarization

Figure 58 MX606-3202 GPRS Modem Familiarization

Feature	
Dual Band	GSM 900MHz, GSM 1800MHz
	Compliant to GSM Phase 2/2+
GSM Class	Small MS
GPRS Connectivity	GPRS multi-slot class 10
	GPRS mobile station class B
GPRS Data Services	Downlink: up to 85.6 kbps
	Uplink: up to 42.8 kbps
CSD Data Services	CSD transmission rates: 2.4, 4.8, 9.6, 14.4 kbps, non-transparent, V.110
	Unstructured Supplementary Services Data (USSD) support
Coding Schemes	CS1, CS2, CS3, CS4,
SMS	MT, MO, CB, Text and PDU mode
	SMS storage: SIM card plus 25 SMS locations in the mobile equipment
	Transmission of SMS alternatively over CSD or GPRS. Preferred mode can be user-defined.
Fax Service	Group 3: Class 1, Class 2
User Interface	AT-commands
SIM Interface	Supported SIM card: 3V
Antenna Interface	50Ω antenna connector
Power	
Interface	10 pin socket
Input Voltage	Wide range, 9V to 36V
Power Dissipation	8W maximum
Reset Function	
AT Command Reset	Support
Manual Reset	Support
RS232 Port Characteristic	
Connector	Female DB9
Logic Level	EIA/TIA-232E
Speed	1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 bps, Auto-baud
Data Bits	8
Stop Bits	1
Parity	None
Cable Length	0 to 15m
Physical	
Dimension (L * W * H) (mm)	114 * 40 * 93
Installation	DIN Rail
Environmental	
Operating Temperature	-20 to 50 °C
Storage Temperature	-40 to 85 °C
Humidity	5 to 90% non-condensing

Figure 59 MX606-3202 GPRS Module Datasheet

6.6.2 LED Indicators

LED	Colour	Description
PWR	Green	Power supply
COM	Green	GPRS communication state

Table 23 General Status LED Indicators

COM LED State	Diagnostics
OFF	Modem is off or run in SLEEP, Alarm mode.
600ms ON / 600ms OFF	1. No SIM card inserted or no PIN entered 2. Network search in progress 3. Ongoing user authentication 4. Network login in progress
75ms ON / 3s OFF	Logged to network (monitoring control channels and user interactions). No call in progress.
75ms ON / 75ms OFF / 75ms ON / 3s OFF	One or more GPRS contexts activated.
Flashing	Indicates GPRS data transfer: when a GPRS transfer is in progress, the LED goes on within 1 second after data packets were exchanged. Flash duration is approximately 0.5s.
ON	Depending on the type of call: *Voice call:* connected to remote party. *Data call:* connected to remote party or exchange of parameters while setting up or disconnecting a call.

Table 24 COM LED Diagnostics

6.6.3 RS232 Port

MX606-3202 has 1 female DB9 RS232 connector. The terminal definition is shown below:

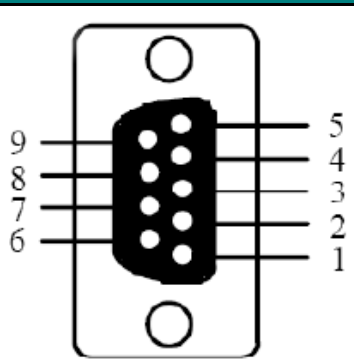
Pin	Signal	Terminal View
1	CD	
2	TXD	
3	RXD	
4	DSR	
5	GND	
6	DTR	
7	CTS	
8	RTS	
9	RI	

Table 25 RS232 DB9 Port Terminal Definition

6.6.4 Reset Function

Method 1: Reset Button

Reset button can be used to reset the GPRS modem manually. It is designed in the way that can prevent unexpected operations, such as accidental touch of the reset button when assembling the antenna.

To reset the modem using this reset button, a small screwdriver or something similar should be used to push the button.

Method 2: AT Command

The AT command used to reset the GPRS Modem is **"at+cfun=1,1".**

A few seconds after the command is sent out, the COM LED will flash several times, which means the modem is reset successfully.

6.6.5 Installation

Follow the procedures shown below to install the MX606-3202 GPRS modem properly.

1) Insert the SIM card into the GPRS modem.
2) Connect the antenna to the modem.
3) Install the modem to DIN track.
4) Connect the GPRS modem to the MOX Unity using RS232 cable with DB9 connector.
5) Connect the power to the modem.

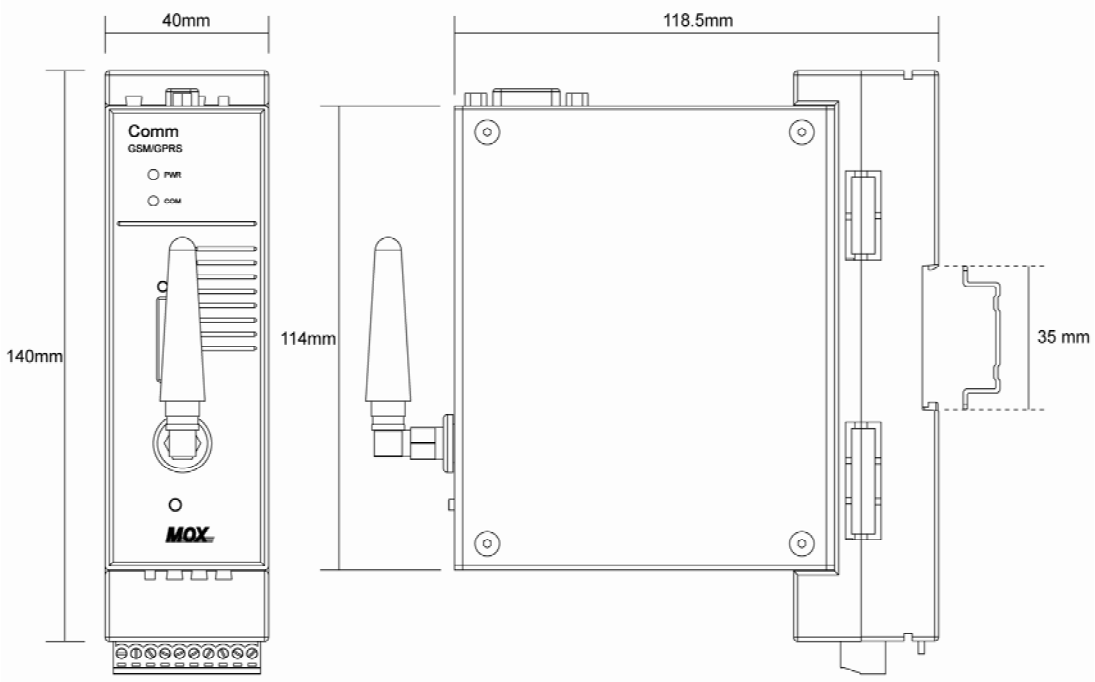


Figure 60 MX606-3202 GPRS Modem Dimensions

Ensure the EN 50022 DIN rail is used, and the dimensions are as follows.

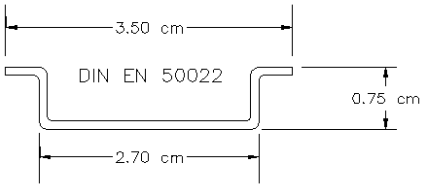


Figure 61 DIN Rail EN 50022

Note: Make sure to install the SIM card and antenna before powering up the module and not to plug or unplug them after. The antenna's direction can be adjusted though.

Figure 62 GPRS Modem to MOX Unity Installation

6.6.6 Configuration

Step 1: Configuration of '**GPRS**' tab.

a. Check '**Enable GPRS**' within GPRS tab.

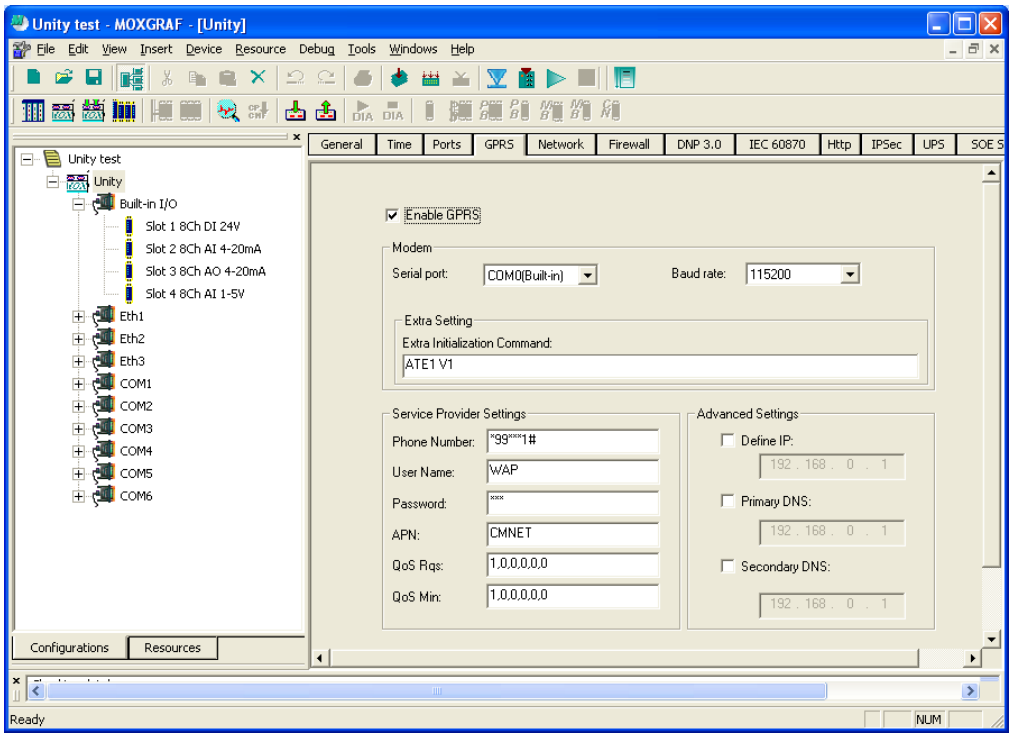


Figure 63 GPRS Settings using MOXGRAF

b. Select serial port and baud rate.

“COM0 (Built-in)” cannot be used because it is dedicated to MOX Unity’s built-in GPRS by default. So when a standalone GPRS modem is required to be connected to the MOX Unity, this port cannot be selected. Meanwhile, make sure that the serial port configured for the standalone GPRS modem is not used for other applications.

c. “Extra Initialization Command” indicates GPRS modem would accept extra command at initialization and use one white space to identify the beginning of the next command.

d. Service Provider Settings. Refer to the table below for the description of each parameter. The default values are for China Mobile only.

Service Provider Settings	Default Value	Description
Phone Number	*99***1#	Used to connect to the local network.
User Name	WAP	Given by service provider.
Password	***	
APN	CMNET	Access Point Name. It defines the type of service that is provided in the packet data connection.
Qos Rqs	1,0,0,0,0,0	Parameters of Quality of service which should be given by the service provider.
Qos Min	1,0,0,0,0,0	

Table 26 Service Provider Settings for GPRS Modem

Step 2: Download the configuration to the MOX Unity by selecting the device in Configuration view, and clicking  on the toolbar.

Step 3: After the configurations, users can start programming using MOXGRAF. There is a special function block with the name of “GPRS” which can be used to implement applications of GPRS modem. Please refer to “Special Function Block Programming Guide” for further details.

6.7 MOX Unity to HMI Communications

The MOX Unity has the ability to communicate with higher-level HMI (Human Machine Interface) software packages. There are numerous HMI software packages widely used for Supervisory Control and Data Acquisition (SCADA) of industrial processes. These SCADA packages enable the user to visualize graphically what the process controller (MOX Unity) is controlling and its current operational state. This includes the ability to read from and write data to the MOX Unity in real time, altering the system at its source.

The preference over one HMI for another is purely dependent on the user. The MOX Unity can be used in conjunction with any HMI that supports the required communication protocols:

- MODBUS - common industry communication protocol
- MODNET (MODBUS TCP/IP) - common industry communication protocol
- DNP3.0

Appendix A Updating the Target

As the MOX Unity's onboard Operating System (OS) is updated with software non-conformance corrections or extended functionality new "target" (OS) updates become available. However, updating the MOX Target should only be undertaken by experienced persons. Several factors, including a loss of power during the update process or selecting the wrong update file, may render the controller inoperable. If in doubt, contact your local MOX Group representative for guidance.

The following chapter details the procedure required.

1) Select '**Tools | Update MOX Target**'. The following window will pop up.

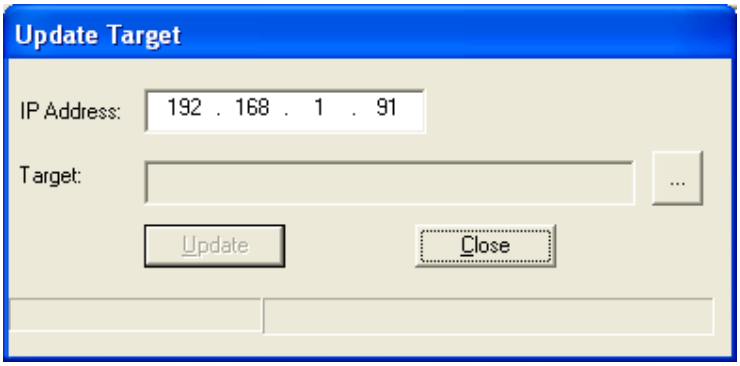


Figure 64 Update MOX Target File

2) Select the "**...**" button. This will open a window that will allow you to search for the required file.

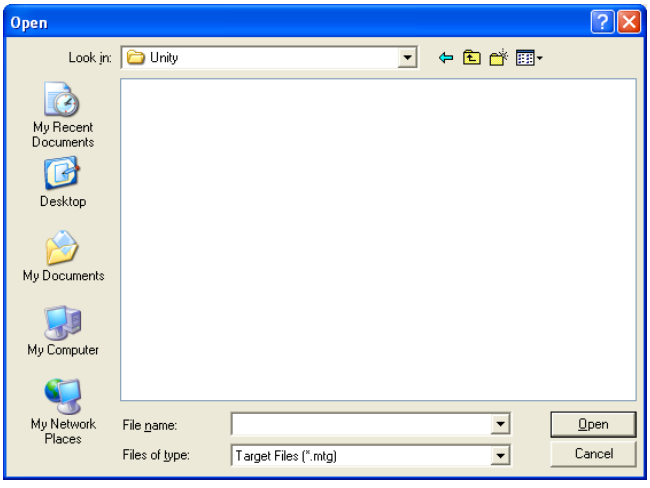


Figure 65 Selecting Update Target File

3) Select the desired file, ensuring that it is the correct target update for the controller and select the **"Open"** to return to the previous window.

4) The **"Update"** button will now be useable. Select the **"Update"** button and wait until confirmation that the MOX IoNix target has been updated.

Appendix B Product Support

Warranty Information

All MOX manufactured products are warranted to be free from defects in material and workmanship. Our obligation under this warranty will be limited to repairing or replacing, at our option, the defective parts within 1 year of the date of installation, or within 18 months of the date of shipment from the point of manufacture, whichever is sooner. Products may only be returned under authorization. The purchaser will prepay all freight charges to return any products with a valid return authorization number to the designated repair facility.

This limited warranty does not cover loss or damage that may occur in shipment of the goods or due to improper installation, maintenance, misuse, neglect or any cause other than ordinary commercial or industrial use. Warranty is also void if case is opened without manufacturer's consent. This limited warranty is in lieu of all other warranties whether oral or written, expressed or implied.

Liability associated with all MOX products shall not exceed the price of the individual unit that is the basis of the claim. In no event will there be liability for any loss of profits, loss of use of facilities or equipment or other indirect, incidental or consequential damages.

Contact Details

To obtain support for MOX products, please contact MOX Group or your designated support provider and ask for MOX Support.

E-mail addresses:

support@mox.com.au

sales@mox.com.au

Visit our web page at:

http://www.mox.com.au

Service Information

If you require service, contact your local MOX Group representative. A trained specialist will help you to quickly determine the source of the problem. Many problems are easily resolved with a single phone call. If it is necessary to return a unit, an RMA (Return Material Authorization) number will be provided.

All returned materials are tracked with our RMA system to ensure speedy service. You must include this RMA number on the outside of the box so that your return can be processed immediately.

Your MOX Group authorised applications engineer will complete an RMA request for you. If the unit has a serial number, we will not need detailed financial information. Otherwise, be sure to have your original purchase order number and date purchased available.

We suggest that you provide a repair purchase order number in case the repair is not covered under our warranty. You will not be billed if the repair is covered under warranty.

Please supply us with as many details about the problem as you can. The information you supply will be written on the RMA form and supplied to the repair department before your unit arrives. This helps us to provide you with the best service, in the fastest manner. Most repairs are completed within two days. During busy periods, there may be a longer delay.

If you need a quicker turnaround, ship the unit to us by airfreight. We give priority service to equipment that arrives by overnight delivery. Many repairs received by midmorning (typical overnight delivery) can be finished the same day and returned immediately.

We apologize for any inconvenience that the need for repair may cause you. We hope that our rapid service meets your needs. If you have any suggestions to help us improve our service, please give us a call. We appreciate your ideas and will respond to them.

For Your Convenience:

Please fill in the following information and keep this manual with your MOX system for future reference:

P.O. #: _____ Date Purchased: _____

Purchased From: _____

MOX Group

Web: http://www.mox.com.au/
Email: info@mox.com.au

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