Isaac EtherNet/IP™ Guide

Abstract

This document is to be used by control engineers and other technical personal responsible for communications between programmable logic controllers (PLC's) and the Isaac multi-tester by Zaxis Inc. The document assumes the reader is well acquainted with EtherNet/IP™ as defined the ODVA association. The reader should also have a good understanding of TCP/IP and UDP/IP protocols.

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9-Jan-20

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Introduction

Zaxis's Isaac multi-tester is a high-performance air leak tester with unparalleled test stability and repeatability. Depending on the model, the following tests can be performed: pressure decay, vacuum decay, mass flow, pressure cracking, burst pressure, valve cracking pressure and more. From one channel iKits to the four channel Isaac HD models EtherNet I/P is an optional communications method.

Communications with the Isaac can be accomplished in different ways, RS232/485, TCP/IP and EtherNet/IP™. This document will describe how to setup EtherNet/IP™ using an Allen-Bradley 1769 CompactLogix Controller. Other types of PLCs can be used if compliant to the EtherNet/IP™ specifications as defined the ODVA association.

EtherNet/IP™ for the Isaac tester overview

The “IP” in “EtherNet/IP” refers to “Industrial Protocol” and should not be confused with Ethernet or the TCP/IP and UDP/IP protocols. Although EtherNet/IP™ uses these technologies and protocols to accomplish the desired communications between the Isaac and PLC’s.

The Isaac software consists of a number of different modules, as for EtherNet/IP™ the software follows the recommended implementation as defined in the ODVA specifications. See *The CIP Networks LIBRARY Volume 1 and 2.* The Isaac EtherNet/IP™ software levels are: Application, Session, Transport, Network, Data Link, Physical as show below in Table 1.

Application	Isaac EtherNet/IP
Session	Explicit/Implicit Messaging (CIP)
Transport	TCP/UDP
Network	Internet Protocol (IP)
Data Link	ethernet
Physical	Peer-to-peer, multicast, unicast

Table 1 - Isaac EtherNet/IP™ Adaptation of CIP

The Application and Session layers (as shown in top two rows) are customized for the Isaac, while the lower layers (as shown in bottom four rows) follow the IEEE 802.3 standards with little or no customization. Thus, allowing existing ethernet switches and/or networks to communicate with the Isaac using standard TCP/IP and UDP/IP protocols.

The Isaac supports both DHCP and static ethernet configurations. Factory defaults use the following static network configuration:

I/P Address	192.168.2.130
Network Mask	255.255.255.0
Gateway	192.168.2.1

Table 2 - Factory Default Network Configuration

These defaults can be changed using the TSi (Touch Screen interface), the PLC MSG command as described below.

Factory defaults can be restored by holding the red and green push buttons in for approximately eight seconds, until both buttons blink once while the unit is powered on.

It is recommended that a static configuration be used to ensure devices that communicate to the Isaac can rely on the same I/P addresses for each Isaac tester. However, it is possible to use DHCP if the DHCP server and/or Name server is able to resolve an Isaac tester hostname to a I/P address.

Because EtherNet/IP™ relays on TCP/UDP it is necessary that the Isaac tester and any device wishing to communicate with the Isaac tester over ethernet have the correct network configuration. The network *ping* command can be used to diagnose network problems etc.

EtherNet/IP™ uses two forms of messaging:

- **Unconnected messaging** is used to: 1) establish connections, 2) low-priority messages, and 3) infrequent messages. Unconnected messages are handled by the Unconnected Message Manager, e.g. the UCMM software module.
- **Connected messaging** allocates resources that are dedicated to a particular purpose, such as real-time I/O data transfers. Connection resources are reserved and configured by the UCMM (Unconnected Message Manager) and then allocated to the desired resource.

Connections are created by a Connection Originator (or Originator for short) and the device that responds to the connection request, called the Connection Target (or just Target).

EtherNet/IP™ specifics two types of message connections:

- **Explicit message connections** are point-to-point relationships. These would be considered general purpose connections and are used to access general information about the Isaac tester. E.g. revision number, serial number, etc. Explicit messages almost always use TCP/IP connections to communicate.
- **Implicit (I/O data) connections** are created to communicate application-specific I/O data at regular intervals. Implicit messages use UDP/IP resources to communicate.

The Isaac tester uses explicit messages to create a connection with other devices (e.g. a PLC's etc.) and when requested, creates an implicit connection to periodically return the current status of the Isaac tester. E.g. busy, sequence/state, current program etc.

For further information and documentation on message types etc. see OVDA publication PUB00138_EtherNetIP_Ethernet_Technology.pdf.

Isaac Tester Configuration for Ethernet/IP™

Other than configuring the correct ethernet (TCP/IP) parameters on the Isaac, no other configuration is required for Ethernet/IP™ communications. Taking note of the Isaac I/P address, netmask and gateway (see Table 2 - Factory Default Network Configuration) are required to configure the devices that communicate with the Isaac tester.

PLC Configuration for Ethernet/IP™

There are two ways to configure a PLC to communicate with an Isaac tester.

1. Use an EDS (Electronic Data Sheet) file which can be downloaded from the Zaxis web site https://www.zaxisinc.com/downloads/. Then follow the steps described in the Configuration with the EDS file section below.
2. Add a generic EtherNet I/P module to your PLC project. Then follow the steps described in Configuration using a Generic Ethernet Module below.

Configuration with the EDS file

Once the EDS file has been downloaded from the Zaxis, Inc. web site the EDS file should be registered using the Rockwell Automation's EDS Wizard. A number of resources can be found on the Internet showing the proper procedure to register an EDS file.

Once the Isaac tester EDS file has been registered the configuration can be done as follows:

1. Start Logix Designer and Ensure the Communications are offline.
2. Create a new Isaac Ethernet module by right clicking on the **Ethernet** menu item displayed on the **Controller Organizer** window (Figure 1) and select **New Module…**

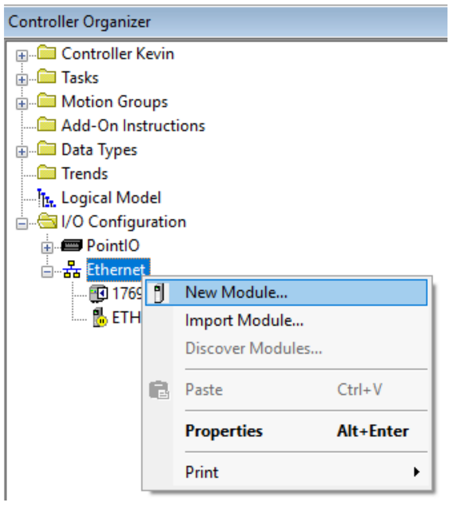
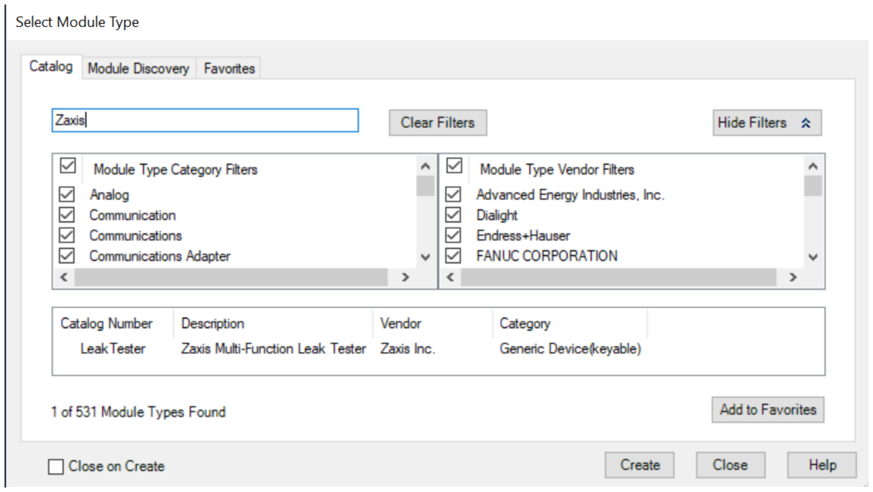


Figure 1 – Create New Ethernet-Module

3. The **Select Module Type** window should be as displayed as seen in Figure 2.
4. Search for Zaxis using the Catalog search field to quickly find the Leak Tester module.


Select Module Type

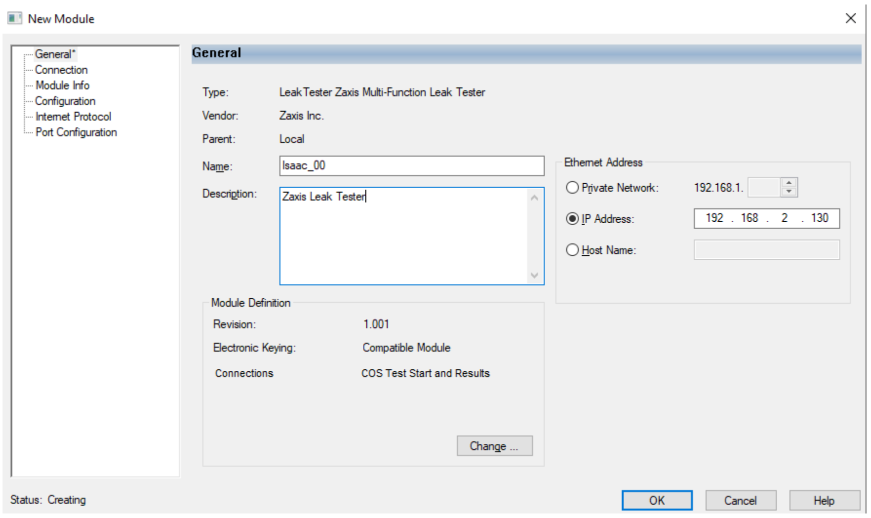
Search: Zaxis

Catalog Number	Description	Vendor	Category
LeakTester	Zaxis Multi-Function Leak Tester	Zaxis Inc.	Generic Device(keyable)

1 of 531 Module Types Found

Figure 2 - Create Zaxis Leak Tester

5. Click the Create button to create the Leak Tester module, which should display the following window, see Figure 3.


New Module

Type: LeakTester Zaxis Multi-Function Leak Tester
Vendor: Zaxis Inc.
Parent: Local
Name: Isaac_00
Description: Zaxis Leak Tester

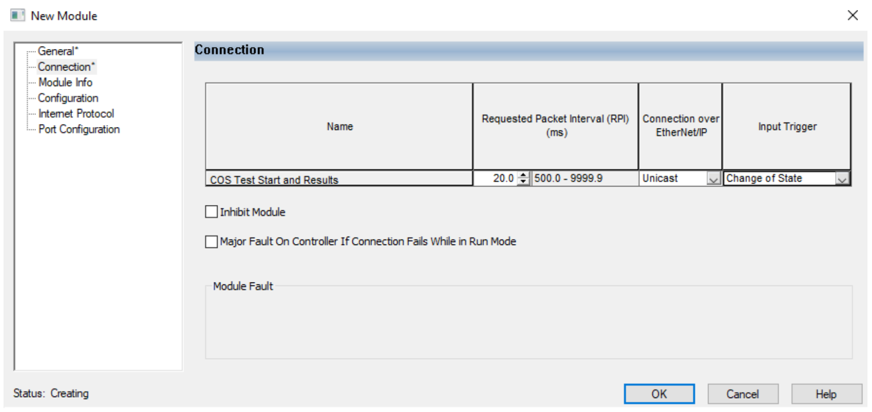
Ethernet Address
Private Network: 192.168.1.
IP Address: 192 . 168 . 2 . 130
Host Name:

Module Definition
Revision: 1.001
Electronic Keying: Compatible Module
Connections: COS Test Start and Results

Status: Creating

Figure 3 - New Zaxis Module

6. Enter a name for the Isaac tester and enter the assigned I/P address for the tester. A unique I/P address is often assigned to the Isaac test when ordered, if this is the case enter the assigned I/P address.
7. Clicking on the **Connection** menu item will allow changing the type of connection between Change of State and Cyclic. Unless suggested by a Zaxis support personal, or if using a non-Allen-Bradly PLC, it is recommended that the Change of State connection be used.



Name	Requested Packet Interval (RPI) (ms)		Connection over EtherNet/IP	Input Trigger
COS Test Start and Results	20.0	500.0 - 9999.9	Unicast	Change of State

☐ Inhibit Module

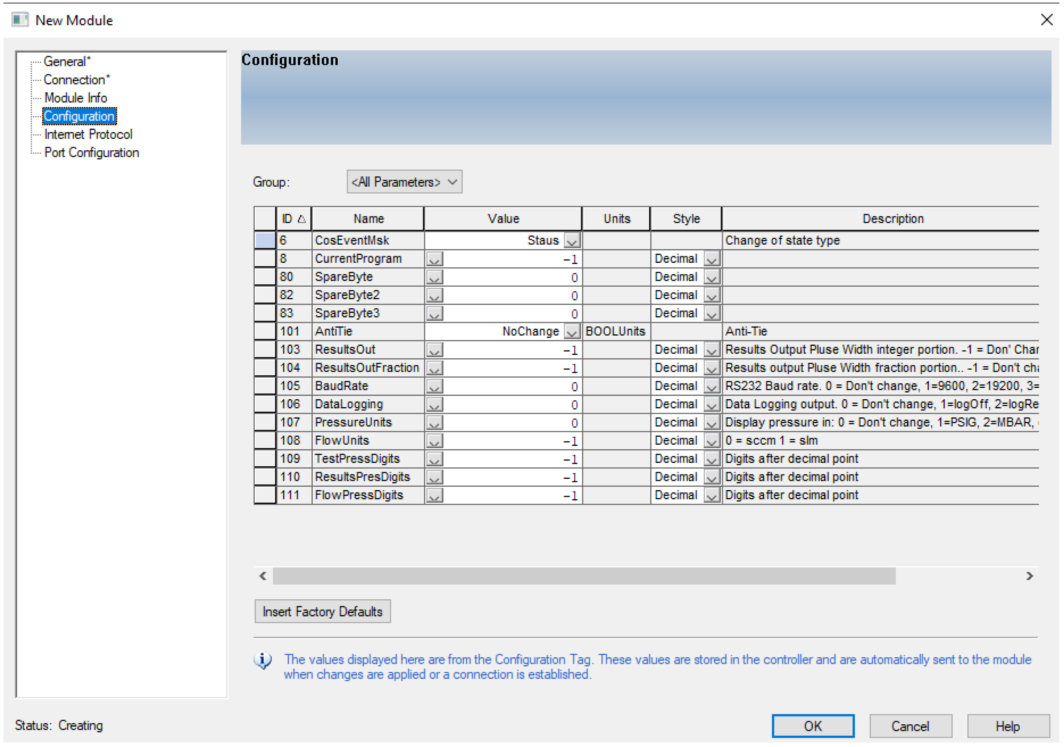
☐ Major Fault On Controller If Connection Fails While in Run Mode

Module Fault

Status: Creating

Figure 4 - Connection Parameters

8. The Connection window allows the Requested Packet Interval (RPI) value to be changed, the default value of 20.0 milliseconds is the recommended value.
9. The Configuration window allows the modification of the configuration parameters. The Configuration parameters are sent to the Isaac whenever the PLC creates an I/O type connection. The definition of each configuration parameters is provided below (see Configuration Tags). If an invalid value is provided (e.g. -1 for CurrentProgram) the current value of the tag contained in the Isaac will be used and the invalid value will be ignored.



Group: <All Parameters>

ID	Name	Value	Units	Style	Description
6	CosEventMsk	Staus			Change of state type
8	CurrentProgram	-1		Decimal	
80	SpareByte	0		Decimal	
82	SpareByte2	0		Decimal	
83	SpareByte3	0		Decimal	
101	AntiTie	NoChange	BOOLUnits		Anti-Tie
103	ResultsOut	-1		Decimal	Results Output Pluse Width integer portion. -1 = Don' Char
104	ResultsOutFraction	-1		Decimal	Results output Pluse Width fraction portion.. -1 = Don't ch
105	BaudRate	0		Decimal	RS232 Baud rate. 0 = Don't change, 1=9600, 2=19200, 3=
106	DataLogging	0		Decimal	Data Logging output. 0 = Don't change, 1=logOff, 2=logRe
107	PressureUnits	0		Decimal	Display pressure in: 0 = Don't change, 1=PSIG, 2=MBAR,
108	FlowUnits	-1		Decimal	0 = sccm 1 = slm
109	TestPressDigits	-1		Decimal	Digits after decimal point
110	ResultsPresDigits	-1		Decimal	Digits after decimal point
111	FlowPressDigits	-1		Decimal	Digits after decimal point

The values displayed here are from the Configuration Tag. These values are stored in the controller and are automatically sent to the module when changes are applied or a connection is established.

Status: Creating

Figure 5 - Configuration Parameters

10. Clicking the **OK** button will finish the creation of the module, causing the newly created item to appear, as shown below in Figure 6 below.

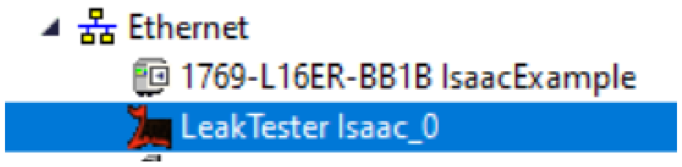


Figure 6 - Ethernet module

Other module configuration items can be completed by double clicking on the newly created module and setting the desired parameters etc.

Configuration using a Generic Ethernet Module

Configuring the PLC for communications with the Isaac tester via EtherNet/IP™ consists of creating a new *Generic Ethernet Module*. Use the following steps.

1. Start Logix Designer and Ensure the Communications are offline.
2. Create a new ETHERNET-MODLE by right clicking on the **Ethernet** menu item displayed on the **Controller Organizer** window (Figure 7) and select **New Module…** which should display the **Select Module Type** window (Figure 8).

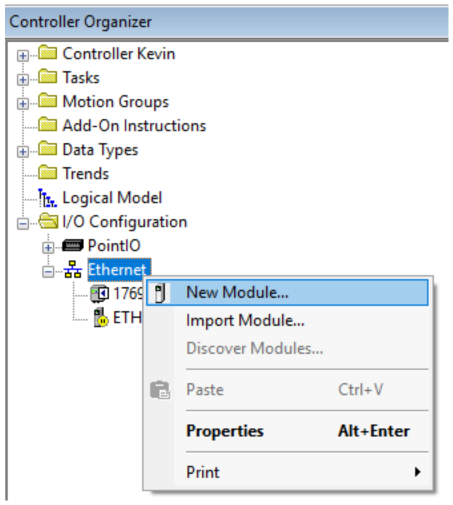
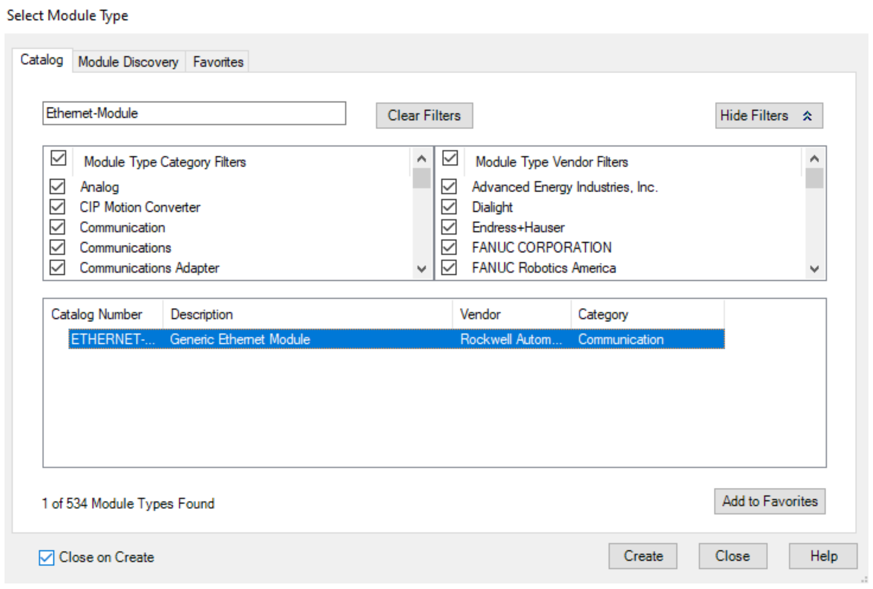


Figure 7 - Create New Ethernet-Module

3. In the **Select Module Type** window use the filter text box to find a **Generic Ethernet Module** as show in Figure 8. Then click the **Create** button.



Select Module Type

Catalog | Module Discovery | Favorites

Ethernet-Module

☑ Module Type Category Filters
☑ Analog
☑ CIP Motion Converter
☑ Communication
☑ Communications
☑ Communications Adapter

☑ Module Type Vendor Filters
☑ Advanced Energy Industries, Inc.
☑ Dialight
☑ Endress+Hauser
☑ FANUC CORPORATION
☑ FANUC Robotics America

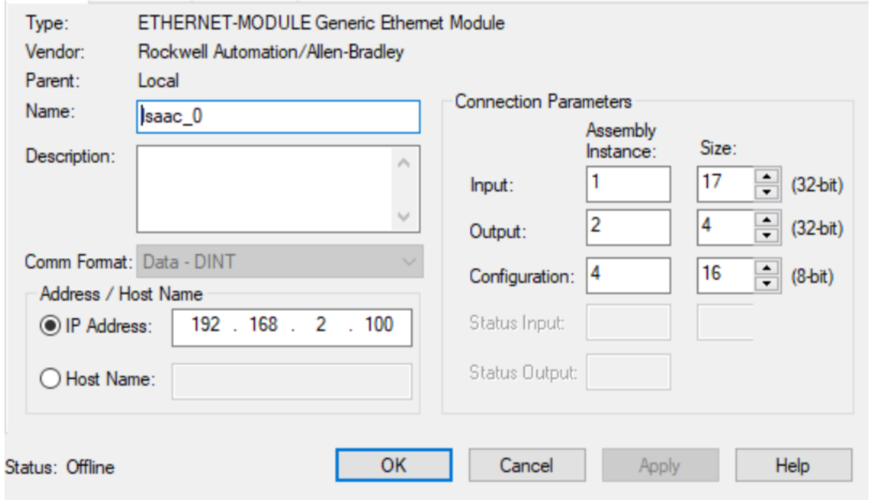
Catalog Number	Description	Vendor	Category
ETHERNET-...	Generic Ethernet Module	Rockwell Autom...	Communication

1 of 534 Module Types Found

☑ Close on Create

Figure 8 - Generic Ethernet Module

4. After clicking on the **Create** button the **New Module** information can be entered.
   a. Enter a valid name.
   b. Enter a description, if desired.
   c. Ensure the **Comm Format** is set to **Data – DINT.**
   d. Enter the **IP address** of the Isaac tester.
   e. Enter **1** for the **Input** Assembly Instance with a Size of **17**.
   f. Enter **2** for the **Output** Assembly Instance with a Size of **4**.
   g. Enter **4** for the **Configuration** with a Size of **16** (or **0** if Configuration data is not desired).



Type: ETHERNET-MODULE Generic Ethernet Module
Vendor: Rockwell Automation/Allen-Bradley
Parent: Local
Name: Isaac_0
Description:
Comm Format: Data - DINT

Address / Host Name
● IP Address: 192 . 168 . 2 . 100
○ Host Name:

Connection Parameters

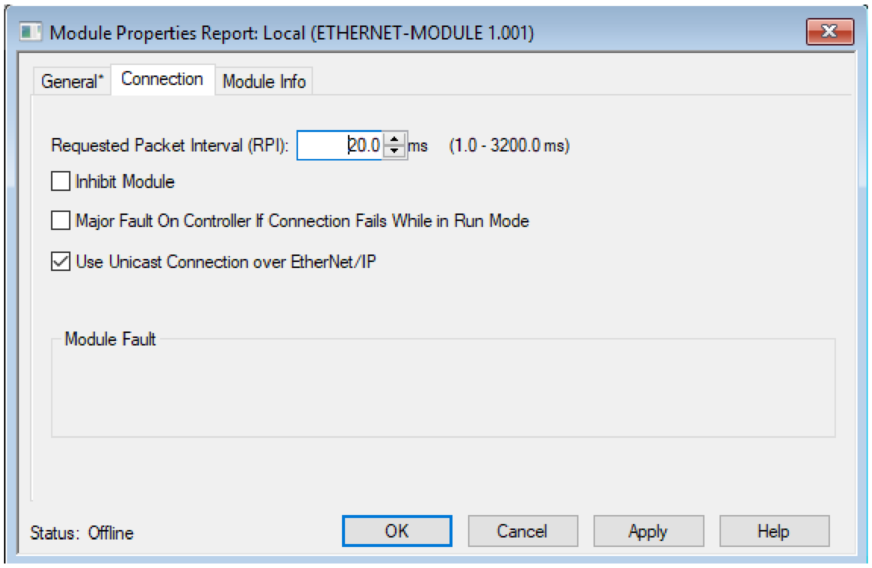
	Assembly Instance:	Size:	
Input:	1	17	(32-bit)
Output:	2	4	(32-bit)
Configuration:	4	16	(8-bit)
Status Input:			
Status Output:			

Status: Offline

Figure 9 - Generic Ethernet Module

The **Configuration** size is optional, it can be 0 (zero) or 16. When zero no initial configuration will be done when communications to the Isaac tester is established. When size is set to 16, a block of 16 bytes will be sent to the tester, used to do initial configuration. See Configuration Tags below.

5. Clicking the **OK** button creates the new module as well as the necessary controller tags used to interface with the Isaac tester and displays the **Connection** tab of the newly created module as seen in Figure 10 below. Set the **Requested Packet Interval (RPI)** to 20 e.g. 20 milliseconds.


Module Properties Report: Local (ETHERNET-MODULE 1.001)

Requested Packet Interval (RPI): 20.0 ms (1.0 - 3200.0 ms)

☐ Inhibit Module

☐ Major Fault On Controller If Connection Fails While in Run Mode

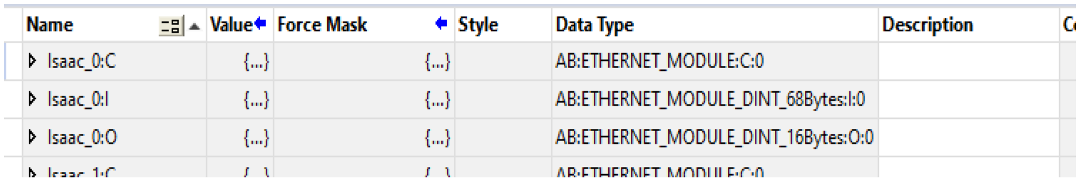
☑ Use Unicast Connection over EtherNet/IP

Module Fault

Status: Offline

Figure 10 - Setting the RPI

6. Click the **Apply** button to save the properties of the newly created module.
7. Currently the Module Info tab is not functioning. The Zaxis vendor information must be registered and published by OVDA before he Module Info tab provides any meaningful information.
8. Open the **Controller Tags** menu item to display the newly created tags for the Isaac module as shown in Figure 11. E.g. the Isaac_0:C, Isaac_0:I, Isaac_0:O tags.



Name	Value	Force Mask	Style	Data Type	Description
Isaac_0:C	{...}	{...}		AB:ETHERNET_MODULE:C:0	
Isaac_0:I	{...}	{...}		AB:ETHERNET_MODULE_DINT_68Bytes:I:0	
Isaac_0:O	{...}	{...}		AB:ETHERNET_MODULE_DINT_16Bytes:O:0	
Isaac_1:C	{...}	{...}		AB:ETHERNET_MODULE:C:0	

Figure 11 - Controller Tags

Isaac Configuration, Input and Output Tag Groups

The *Controller Tags* window (see Figure 11) will always have the Input (`Isaac_0:I`) and Output (`Isaac_0:O`) tags, the Configuration (`Isaac_0:C`) tags will only be available when a size other than zero is placed in the **Size** field of the Configuration Instance. The following tables: Table 3, Table 4 and Table 5, represent the structure of an Isaac tester module.

These three tag groups are defined in the EDS file, or can be imported as UDTs (User Defined Types). Both the EDS file and the UDTs (found in Isaac_Udts.xlsx) are available from Zaxis support and/or the Zaxis download web page.

Configuration Tags

The configuration tags are used to initialize selected parameters within the Isaac tester. These tags are not required and will not be sent to the Isaac if the size of the Configuration instance is set to zero when using the. If the Configuration size is non-zero, it must be set to the size indicated in step 4.g above, or undesirable results will occur.

When using the Configuration with the EDS file method these tags are always sent and therefore must contain the deaired values.

Configuration tags are sent to the Isaac tester when the communications channel is created, e.g. when the Ethernet module comes online.

Name	Data Type	Valid Values	Description
AntiTie	SINT	1,2,4	Test start when: 1 = input 1, 2 = input 1 & 2, 4 = input 1 & start button.
CurrentProgram	SINT	0 thru 99	Starting program number.
ResultsOut	SINT	> 0	Integer value of results out pulse width.
ResultsOutFraction	SINT	> 0	Fraction of results out pulse width.
BaudRate	SINT	1 thru 4	Baud rate for RS232 port. 1 = 9600, 2=19200, 3=57600, 4=115200
DataLogging	SINT	1 thru 4	When to log data on RS232 port. 1=Off, 2=Results, 3=0.1 sec, 4=1 sec
PressureUnits	SINT	1 thru 7	Units for pressure 1=PSIG, 2=MBAR, 3=MMHG, 4=INH2O, 5=KPA, 6=CMH20, 7=INHG
FlowUnits	SINT	0 or 1	Units for flow. 0=sccm, 1=slm
TestPresDigits	SINT	0 thru 3	Number of digits after decimal. 0 thru 3
ResultsPresDigits	SINT	0 thru 5	Number of digits after decimal. 0 thru 5
FlowPressureDigits	SINT	0 thru 3	Number of digits after decimal. 0 thru 3
SpareCfg1	SINT	0	Spare data
cosType	INT	0 to 0xFF	Indicates which change-of-states events should be reported. Should be set to 0.
SpareCfg2	SINT	0	Spare data
SpareCfg3	SINT	0	Spare data

Table 3 – Ethernet-Module Configuration Tags

The TSi (touch screen interface) has input fields with the same or similar names to the configuration tags, more detailed information as to the purpose of these tags may be found in the Isaac User's Manual. These configuration tags preform the same functions as the TSi fields.

When an invalid value is given, such as a -1 for the *CurrentProgram*, is given the value will be ignored by the Isaac tester and the existing value will be used. This prevents the PLC from overwriting these values when they have been set using the TSi. For example, suppose the TSi was used to set the number of test pressure digits to 3 *(TestPresDigits)* if the PLC has a value of 0, each time the PLC connected to the Isaac the 3 would be changed to 0. To prevent this overwriting, if the PLC has a value of -1 (e.g. and invalid value) the -1 will be ignored by the Isaac and the existing value of 3 would be used.

cosType – Change-Of_State flags

The change-of-state flags indicate which events should be reported by the producer (the Isaac tester) to the consumer (usually the PLC). Setting one of the change-of-state flags is the indicator to the Isaac tester which change-of-state events the consumer wants to be notified of. The default is to only report the test results, which means when the EDS file is used to create the Isaac Ethernet modules and the Change of State connection type is selected the only messages sent by the Isaac will be current status message (which will occur every RPI milliseconds) and the test results message. Thus, ensuring that the PLC is sent a "heart beat" e.g. a status message every RPI milliseconds and the test results at the end of each test.

The change-of-state bits indicate the reason the message was produced by the Isaac tester.

- CosStatus – Is set when a status message has been requested by the originator (e.g. the PLC) or when the RPI has expired.
- CosSequencePts – Is set when a test is running and the sequence has changed and/or the elapse time has changed.
- CosTestStart – Is set at the start/beginning of a test.
- CosTestsResults – Is set when a test has completed.
- CosPressure – Is set when a test is not running but the pressure changes.
- CosProgram – Is set when a program parameter has changed.
- CosFirmwareCfg – Is set when a firmware parameter changed.
- CosProgNumb – Is set then the current running program number is changed.
- CosTestValve – Is set when adjusting the pressure and a valve is open/closed.

It is Zaxis recommendation that only the CosTestResults bit be set for normal operation. Setting the other bits may cause communication delays and communication disconnects.

PLC Output Tags

Output tags are sent by the PLC to the Isaac tester every **Request Packet Interval (RPI)** milliseconds as configured above, see Figure 10 - Setting the RPI. Once the Isaac scans i.e. process, the output tags from the PLC, the input tags are sent from the Isaac tester to the PLC.

Name	Data Type	Valid Values	Description
Start	BOOL	0 or 1	Bit 0 = Start the tests
StartAntiTie	BOOL	0 or 1	Bit 1 = Start on input 1 and 2 (Anti-Tie)
Abort	BOOL	0 or 1	Bit 2 = Stop the current test
Retest	BOOL	0 or 1	Bit 3 = Rerun the failed test
Valve1On	BOOL	0 or 1	Bit 4 = Turn pressure valve one on
Valve2On	BOOL	0 or 1	Bit 5 = Turn pressure valve two on
Valve3On	BOOL	0 or 1	Bit 6 = Turn pressure valve three on
Valve4On	BOOL	0 or 1	Bit 7 = Turn pressure valve four on
IgnoreCmds	BOOL	0 or 1	Bit 8 = Ignore EthierNet I/P commands
StatusGet	BOOL	0 or 1	Bit 9 = Get current device status
SpareBit10	BOOL	0	Spare bits 10 thru 31
CurrentProgram	SINT	-1 thru 99	Set to current program. -1 means don't change current program.
SpareByteOut1	SINT		Spare data
SpareIntOut1	INT		
SpareDIntOut1	DINT		
SpareDIntOut2	DINT		

Table 4 - Output Tags

Again, the tag names are similar or the same as the TSi field names, or buttons, e.g. Start is the green push button, Abort the red push button. The IgnoreCmds bit tells the Isaac tester to ignore any commands via EtherNet I/P. This bit should be set when TSi is being used to configure the Isaac tester to ensure there is no conflict between the PLC and the TSi.

The CurrentProgram tag allows the currently running program to be changed to a different program. This could be used if the product being tested needs to have a pressure decay test as well as a flow test. Program zero could be configured to run a pressure decay test and program one a flow test. The PLC could set the CurrentProgram to zero and start the test (set Start) if the product passed the pressure decay test, the PLC could change the CurrentProgram to one and start the test (set Start), which would then run the flow test.

PLC Input Tags

Input tags are sent to the PLC from the Isaac tester after the Output tags have been scanned, or processed, by the Isaac tester. Input tags provide the current state of the Isaac to the PLC. The following table list the tags returned from the Isaac tester.

Name	Data Type	Valid Values	Description
CosStatus	BOOL	0 or 1	Bit 0 = Status Update. E.g. heart beat
CosSequencePts	BOOL	0 or 1	Bit 1 = Test Pressure and/or time
CosTestStart	BOOL	0 or 1	Bit 2 = Test Started
CosTestResults	BOOL	0 or 1	Bit 3 = Test Completed
CosPressure	BOOL	0 or 1	Bit 4 = Pressure changed
CosProgram	BOOL	0 or 1	Bit 5 = Program data changed
CosFirmwareCfg	BOOL	0 or 1	Bit 6 = Firmware configuration changed
CosProgNumb	BOOL	0 or 1	Bit 7 = Current running program number changed
CosTestValve	BOOL	0 or 1	Bit 8 = Test valve changed
ClassId	INT	0 or 1	Id of the class that changed state
Instance	INT	1 thru 99	Instance Id of the class that changed state
Attribute	INT	1 thru 99	Attribute number that changed state
Busy	BOOL	0 or 1	Bit 0 = Isaac is busy
GlobalPass	BOOL	0 or 1	Bit 1 = All the ports passed the test
GlobalFail	BOOL	0 or 1	Bit 2 = One or more ports failed the test
Fail_1	BOOL	0 or 1	Bit 3 = Port 1 failed
Fail_2	BOOL	0 or 1	Bit 4 = Port 2 failed
Fail_3	BOOL	0 or 1	Bit 5 = Port 3 failed
Fail_4	BOOL	0 or 1	Bit 6 = Port 4 failed
Pass_1	BOOL	0 or 1	Bit 7 = Port 1 Passed
Pass_2	BOOL	0 or 1	Bit 8 = Port 2 Passed
Pass_3	BOOL	0 or 1	Bit 9 = Port 3 Passed
Pass_4	BOOL	0 or 1	Bit 10 = Port 4 Passed
AntiTie	BOOL	0 or 1	Bit 11 = Anti Tie is enabled
Interlock	BOOL	0 or 1	Bit 12 = Interlock is required
Abort	BOOL	0 or 1	Bit 13 = Test Aborted
SpareBit14	BOOL	0 or 1	Bit 14 = Spare Bit
Fault	BOOL	0 or 1	Bit 15 = Faulted
SpareByteIn1	SINT	0	Spare data
TestPresValve1	BOOL	0 or 1	Bit 0 = State of Test Pressure Valve 1
TestPresValve2	BOOL	0 or 1	Bit 1 = State of Test Pressure Valve 2
TestPresValve3	BOOL	0 or 1	Bit 2 = State of Test Pressure Valve 3
TestPresValve4	BOOL	0 or 1	Bit 3 = State of Test Pressure Valve 4
CurrentProgram	SINT	0 thru 99	Current program
TestType	SINT	0 thru 11	Type of test being run. PD, POCC, VD, VOCC, Flow, etc.
PortEnabled1	BOOL	0 or 1	Bit 0 = Port 1 enabled
PortEnabled2	BOOL	0 or 1	Bit 1 = Port 2 enabled
PortEnabled3	BOOL	0 or 1	Bit 2 = Port 3 enabled

PortEnabled4	BOOL	0 or 1	Bit 3 = Port 4 enabled
Sequence	SINT	0 thru 9	Current test sequence 0 = Idle.
SpareIntIn1	INT	0	Spare Int
ElapseTime	DINT	> 0	Sequence elapse time in 1/10's seconds.
PortStatus1	SINT	0 thru 17, 250 thru 255	Status of Port 1. E.g. Testing, Leak, Occl, Perr
PortStatus2	SINT		Status of Port 2. E.g. Testing, Leak, Occl, Perr
PortStatus3	SINT		Status of Port 3. E.g. Testing, Leak, Occl, Perr
PortStatus4	SINT		Status of Port 4. E.g. Testing, Leak, Occl, Perr
PressurePort1	DINT		Test pressure * 1000. E.g. fixed-point decimal
PressurePort2	DINT		Test pressure * 1000. E.g. fixed-point decimal
PressurePort3	DINT		Test pressure * 1000. E.g. fixed-point decimal
PressurePort4	DINT		Test pressure * 1000. E.g. fixed-point decimal
TestResults1	DINT		Test 2esults for port 1. The pressure delta between the start and end of the test, or the flow at the end of the test.
TestResults2	DINT		Test results for port 2
TestResults3	DINT		Test results for port 3
TestResults4	DINT		Test results for port 4
Flow	DINT		Current flow * 1000. E.g. fixed-point decimal.
SpareDIntIn1	DINT		Spare data

Table 5 - Input Tags

COS Change-of-State bits

Change-of-state bits indicate to the originator (e.g. usually the PLC) why a message was sent from the Isaac. Allowing the PLC (or originator) to determine the current state of the Isaac. For example, when the CosTestResults bit is set the values in the TestResults fields are valid end of test results.

The Busy bit preforms the same functions as the Busy input signals as described in the User's Manual, e.g. the tester is busy preforming a test.

The other bits are described in the Isaac User's manual.

Isaac Firmware/Program configuration tags

The Isaac has two different types of configuration or setup tags: 1) tags that remain the same regardless of which program is running and 2) tags for each individual program. This document will refer to these different types as firmware paraments and program parameters respectively.

Regardless of the type of parameter (firmware or program) both are saved in flash memory and are read into RAM (random access memory) each time the Isaac is powered up and/or reset. The flash memory doesn't require a battery and is therefore more reliable for longer periods of time than battery backed up RAM.

This also implies that these parameters do not (and should not) be written to the Isaac tester each time a program (test) is run. Doing so causes unnecessary overhead and slows the Isaac's response times which may cause timeout problems.

Firmware Parameters

Firmware parameters are those parameters that remain the same regardless of which program (or test) is being executed. Firmware parameters are typically set once on initial configuratoin of the Isaac tester and very seldom or never, change. The following table describes the Firmware parameters.

Name	Data Type	Valid Values	Description
CosType	INT	Read Only	Change-of-State flags
ClassId	INT	Read Only	Id of the class that changed state
Instance	INT	Read Only	Instance Id of the class that changed state
Attribute	INT	Read Only	Attribute number that changed state
LockPrgEdits	BOOL	0 or 1	Tsi Program parameter editing is locked
LockCurrentPrgEdits	BOOL	0 or 1	Tsi Current program editing is locked
LockCalibrationEdits	BOOL	0 or 1	Tsi Calibration edits are locked
ElectronicReg	BOOL	0 or 1	Electronic regulator installed
ManualReg	BOOL	0 or 1	Manual regulator installed
Concurrent	BOOL	0 or 1	Run test concurrently on all channels
BuzzerEnabled	BOOL	0 or 1	Buzzer is enabled
BusyImm	BOOL	0 or 1	0 = send busy msseage after all overhead, 1 = send busy with pass/fail
DhcpEnabled	BOOL	0 or 1	DHCP is enabled
OkToResetDevice	BOOL	0 or 1	Ok to reset the device because of date/time changes etc.
LinkedFail	BOOL	0	Test fails when linked program fails.
HighBleed	BOOL	0	High bleed valve enabled.
ElectRegAlwaysOn	BOOL	0 or 1	Electronic regulator is always on.
SaveDacOnAbort	BOOL	0 or 1	Save DAC reading on Abort when in settle or test sequence.
SpareBit14	BOOL	0	Spare data
SpareBit15	BOOL	0	Spare data
TesterNumber	SINT	1 to 128	Device number on 485 bus

BaudRate	SINT	0 thru 4	0 = Don't change, 1=9600, 2=19200, 3=57600, 4=1152
DataLogging	SINT	0 thru 4	0 = Don't change, 1=LogOff, 2=logResult, 3=log 0.1 secs, 4= log 1.0 sec
PressureUnits	SINT	0 thru 7	0 = Don't change, 1=PSIG, 2=MBAR, 3=MMHG,4=INH2O, 5=KPA, 6=CMH2O, 7=INHG
FlowUnits	SINT	0 or 1	0 = sccm 1 = slm
TestPresDigits	SINT		Number of digits after test pressures 0 to 3
ResultsPresDigits	SINT	0 thru 5	Number of digits after results pressures 0 to 5
FlowPresDigits	SINT	0 thru 3	Number of digits after flow pressures 0 to 3
BCD	SINT	0 thru 99	BCD Inputs. See documentation
NumberChannels	SINT	1 thru 4	Number of installed channels/ports
Sensors	SINT	1 thru 4	Number of installed sensors. 1st nibble = Pressures sensors, 2nd nibble = Flow.
AntiTie	SINT	1, 2, or 4	Test start when: 1 = input 1, 2 = input 1 & 2, 4 = input 1 & start button
AvailTestTypes	SINT	O thru 10	Types of tests that can be preformed
SpareByte1	SINT	0	Spare data
SpareInit1	INT	0	Spare data
IoResetTime	INT	0 thru 3000	Number of milliseconds the I/O remains in a given state
FilterPress	DINT	0 thru 65000	Read only Pressure filter cutoff
FilterFlow	DINT	0 thru 65000	Read only Flow filter cutoff
FilterFillSettle	DINT	0 thru 65000	Read only Fill filter cutoff
SpareDint1	DINT	0	Spare data
HighBleedPressure	INT	0 thru 65000	High Bleed pressure limit
SpareInt2	INT	0	Spare data
AtmPress	DINT	0 to 100	Atmospheric Pressure
SerialNumber	STRING_16	Read Only	Serial number. 16 bytes.
IpAddress	STRING_16	Valid I/P	I/P Address. 16 bytes.
IpNetmask	STRING_16	Valid I/P	I/P Netmask. 16 bytes.
IpGateway	STRING_16	Valid I/P	I/P Gateway. 16 bytes.
MacAddress	STRING_20	Read Only	MAC Address. 20 bytes.
DateTime	STRING_20	Valid Date/Time	Date and time: YYYY/MM/DD hh:mm:ss
ModelNumber	STRING_24	Read Only	Model number or TIN
OptionsAndFittings	STRING_32	Read Only	Installed options and fittings
SccsRevDate	STRING_24	Read Only	Source Code Control Date stamp
SccsRev	STRING_12	Read Only	Source Code Revision
SccsRevRange	STRING_24	Read Only	Source Coe Revision range

Table 6 - Configuration Parameters

All of the above firmware parameters are typically defined as a User-Defined Type (UDT) and imported from a Microsoft Excel spread sheet (Isaac_Utds.xlsx) which can be downloaded from the Zaxis web site.

Reading and Writing of Firmware Parameters

Firmware parameters can be read and written using the PLC Message (MSG) instruction.

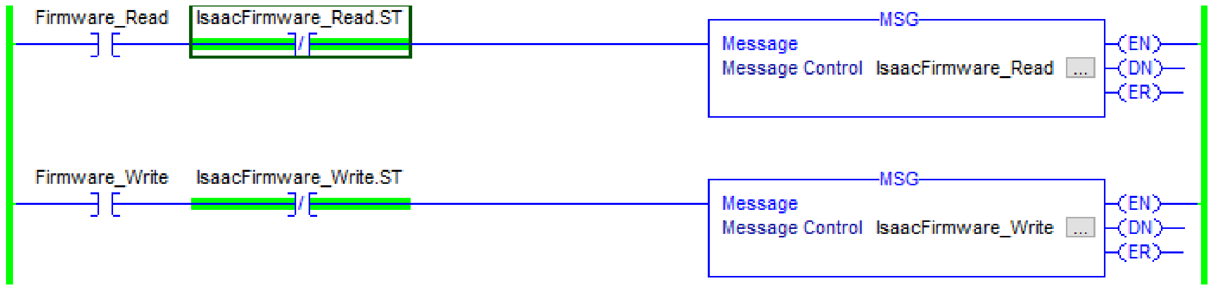
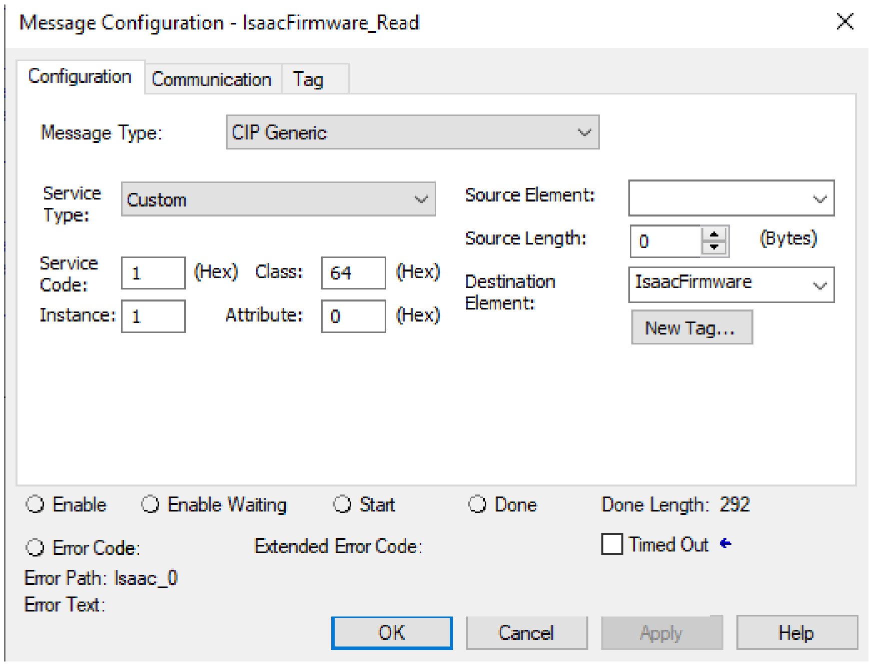


Figure 12 – Firmware Read/Write Ladder Logic

Firmware parameters are read/written using the CIP Read/Write All Attributes message. These CIP messages (Read/Write All Attributes) are created on the PLC using the *CIP Generic* **Message Type** see Figure 12.

Figure 13 shows the required parameters for the MSG tag.

- **Service Code** of 1 (e.g. Read all attributes) or 2 (e.g. Write all attributes)
- Vendor specific **Class** code of 0x64 (Hex)
- **Instance** of 1.
- **Destination Element** should be a *User-Defined* data type which minors the tags described in Table 6.


Message Configuration - IsaacFirmware_Read

Message Type: CIP Generic

Service Type: Custom

Service Code: 1 (Hex) Class: 64 (Hex)

Instance: 1 Attribute: 0 (Hex)

Source Element:

Source Length: 0 (Bytes)

Destination Element: IsaacFirmware

Done Length: 292

Error Code:

Extended Error Code:

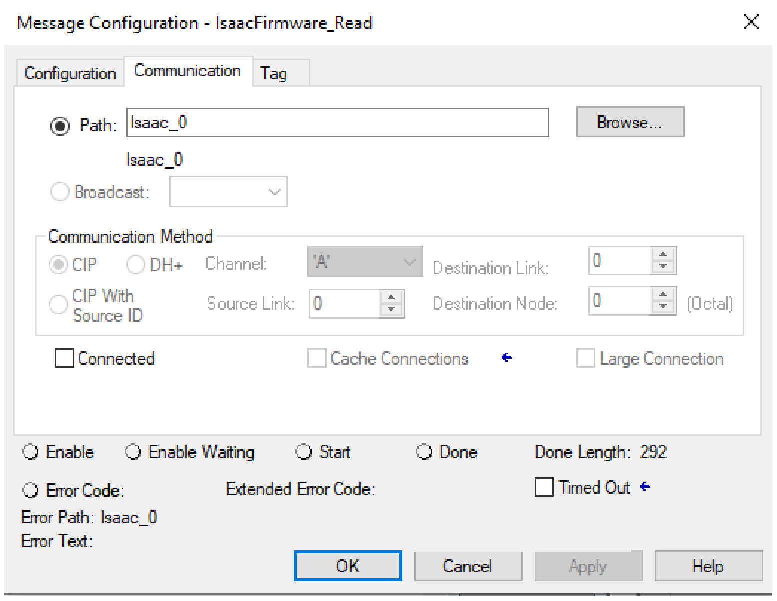
Timed Out

Error Path: Isaac_0

Error Text:

Figure 13 - Read Isaac Configuration MSG

The *Communication* tab references the **Path** of the Isaac Ethernet module that was added above in the Configuration with the EDS file or Configuration using a Generic Ethernet Module sections, see the Path field showbelow in Figure 14.


Message Configuration - IsaacFirmware_Read

Configuration | Communication | Tag

[✓ Path:] Isaac_0 (Browse...)

Isaac_0

Broadcast:

Communication Method: [✓ CIP] DH+ | Channel: 'A' | Destination Link: 0
CIP With Source ID | Source Link: 0 | Destination Node: 0 (Octal)

Connected: ☐ | Cache Connections: ☐ | Large Connection: ☐

Enable | Enable Waiting | Start | Done | Done Length: 292

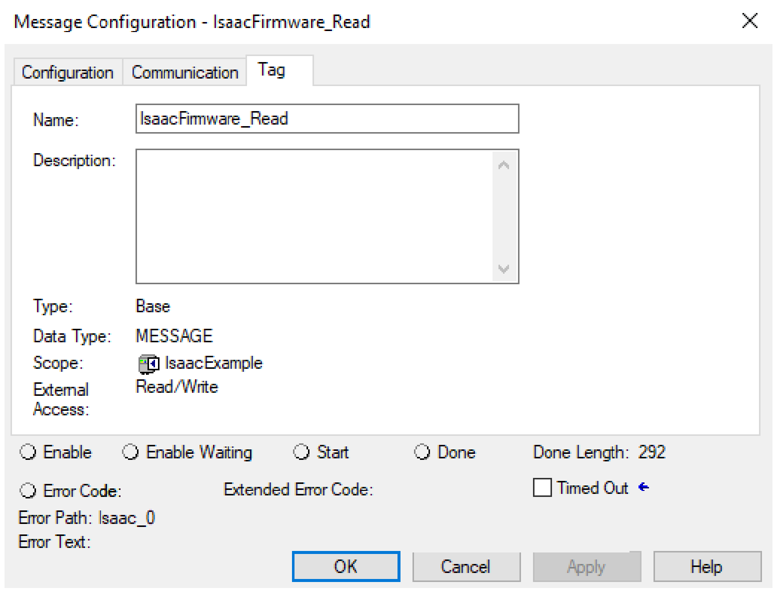
Error Code: | Extended Error Code: | Timed Out ☐

Error Path: Isaac_0

Error Text:

Figure 14 - MSG Communication tab

The MSG Tag can be given any meaningful name as shown in Figure 15 below to complete the configuration.


Message Configuration - IsaacFirmware_Read

Configuration | Communication | Tag

Name: IsaacFirmware_Read

Description:

Type: Base

Data Type: MESSAGE

Scope: IsaacExample

External Access: Read/Write

Enable | Enable Waiting | Start | Done | Done Length: 292

Error Code: | Extended Error Code: | Timed Out ☐

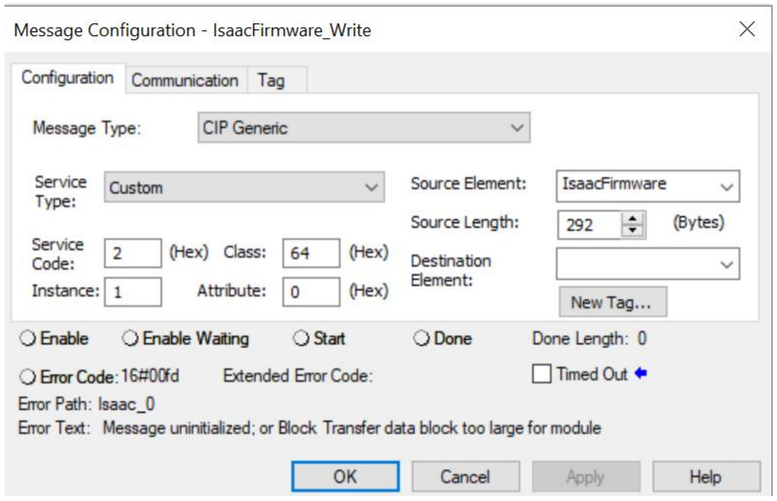
Error Path: Isaac_0

Error Text:

Figure 15 - MSG Tag tab

The basic difference between reading and writing setup parameters is the **Service Code** and the **Source Element**. The Service Code changes from 1 to a 2, and the **Source Element** now references the user defined data to be written. The MSG parameters for writing are show in Figure 16.

The *Communication* tab and *Tag* tab have the same parameters as reading the setup.


Message Configuration - IsaacFirmware_Write

Configuration | Communication | Tag

Message Type: CIP Generic

Service Type: Custom

Service Code: 2 (Hex) Class: 64 (Hex)

Instance: 1 Attribute: 0 (Hex)

Source Element: IsaacFirmware

Source Length: 292 (Bytes)

Destination Element:

New Tag...

Enable Enable Waiting Start Done Done Length: 0

Error Code: 16#00fd Extended Error Code: Timed Out

Error Path: Isaac_0

Error Text: Message uninitialized; or Block Transfer data block too large for module

OK Cancel Apply Help

Figure 16 - Write Isaac Firmware Configuration MSG

Program Parameters

Program parameters allow the Isaac tester to be configured such that different programs, loops or tests can be run by the same tester, yet perform completely different tasks. Programs can be linked allowing one program to execute after the parent program, with each program having different parameters. Table 7 shows the different program parameters and their meaning.

Name	Data Type	Valid Values	Description
CosType	INT	Read Only	Change-of-State flags
ClassId	INT	Read Only	Id of the class that changed state
Instance	INT	Read Only	Instance Id of the class that changed state
Attribute	INT	Read Only	Attribute number that changed state
PrgNumb	SINT	0 thru 99	Program number
SpareByte1	SINT	0	Spare Byte 1
SpareIntIn1	INT	0	Spare integer
PortEnabled1	BOOL	0 or 1	Port 1 is enabled
PortEnabled2	BOOL	0 or 1	Port 2 is enabled
PortEnabled3	BOOL	0 or 1	Port 3 is enabled
PortEnabled4	BOOL	0 or 1	Port 4 is enabled
FixtureValve1	BOOL	0 or 1	Keep Fixture valve 1 on during test step
FixtureValve2	BOOL	0 or 1	Keep Fixture valve 2 on during test step
ClampHoldFail	BOOL	0 or 1	Hold clamps on fail
Rslts232	BOOL	0 or 1	Output results to RS232 port
RsltsEthr	BOOL	0 or 1	Output results to Ethernet port 23
AutoFFill	BOOL	0 or 1	Auto Fast Fill or timed
LeakStd	BOOL	0 or 1	Leak Standard
AutoVent	BOOL	0 or 1	Auto Vent or timed
IncreaseLimit	BOOL	0 or 1	Enable Increase Limit
EvalAtEnd	BOOL	0 or 1	Evaluate at End of Test
ElectReg	BOOL	0 or 1	Read only Use Last Good DAC when Electronic Reg available.
TestType	SINT	0 thru 10	Type of test to run. PD, POCC, VD, VOCC, Flow, Burst, Vburst, Crack, Creep, Flow2, Reseat
NextPrg	SINT	-1 thru 99	Next program to run. -1 means not linked.
ElectRegDelay	SINT	0 thru 100	% of fill timer to allow for Electronic Regulator to seek
SpareByte2	SINT	0	Spare
TimeIdle	DINT	0	Reserved. Do not use.
TimeClmp1	DINT	0 thru 10000	Elapse time in 1/10 seconds for Clamp 1 Sequence
TimeClmp2	DINT	0 thru 10000	Elapse time in 1/10 seconds for Clamp 2 Sequence
TimeFFill	DINT	0 thru 10000	Elapse time in 1/10 seconds for Fast Fill (Pre-Fill) Sequence
TimeFill	DINT	0 thru 10000	Elapse time in 1/10 seconds for Fill Sequence

TimeSettle	DINT	0 thru 10000	Elapse time in 1/10 seconds for Settle Sequence
TimeTest	DINT	0 thru 10000	Elapse time in 1/10 seconds for Test Sequence
TimeVent	DINT	0 thru 10000	Elapse time in 1/10 seconds for Vent Sequence
TimeUnClmp1	DINT	0 thru 10000	Elapse time in 1/10 seconds for Unclamp 2 Sequence
TimeUnClmp2	DINT	0 thru 10000	Elapse time in 1/10 seconds for unclamp 1 Sequence
SpareDInt1	DINT	0	Spare
SpareDInt2	DINT	0	Spare
TestPres	DINT		Test Pressure as a fixed decimal number
TestPresMin	DINT		Minimum Test Pressure as a fixed decimal number
TestPresMax	DINT		Maximum Test Pressure as a fixed decimal number
RegKp	DINT	0 thru 10000	Regulator P-I Kp
RegKi	DINT	0 thru 10000	Regulator P-I Ki
RegKd	DINT	0 thru 10000	Regulator PI Kd
PresFFill	DINT		Pre Fill Pressure
PresTestMin	DINT	0 thru 10000	Minimum test pressure. E.g. Decay, Min Crack/Burst/Flow etc.
PresTestMax	DINT	0 thru 10000	Maximum test pressure e.g. Increase, Max Crack/Burst/Flow etx.
PresTestTrigger	DINT	0 thru 10000	Trigger test pressure e.g. Trigger Crack/Burst etc.
Volume	DINT	0 thru 10000	Air volume used to calculate approx. Leak rate. 0 to disable calculation.
RampRate	DINT	0 thru 100	How fast to ramp up the the Fast Fill pressure
SpareDInt3	DINT	0	Spare
PrgName	STRING_16	Printable Chars	Program name length (4 bytes) + Program name (16 bytes)

Table 7 - Program Configuration Parameters

All of the above program parameters are typically defined as a User-Defined Type (UDT) and imported from a Microsoft Excel spread sheet (Isaac_Utds.xlsx) which can be downloaded from the Zaxis web site.

Reading and Writing of Program Parameters

Program parameters are read and written using the CIP Read/Write All Attributes message. These CIP messages (Read/Write All Attributes) are configured on the PLC using the *CIP Generic* **Message Type** (see Figure 17).

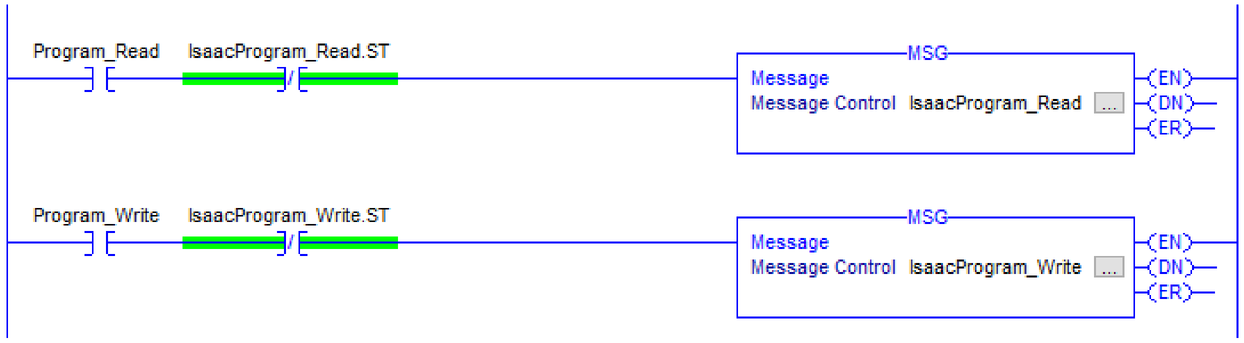
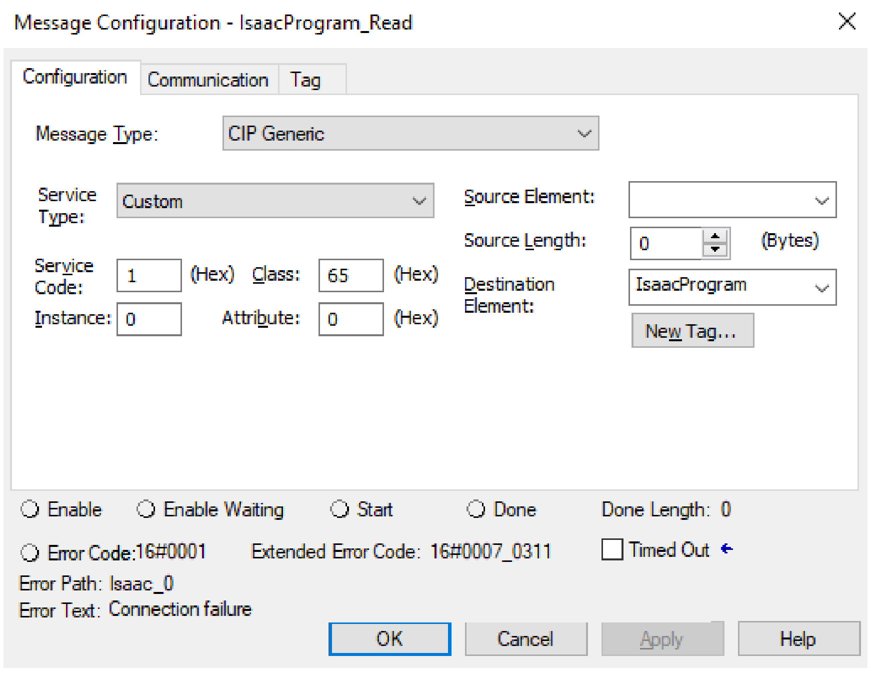


Figure 17 - Program Read/Write Ladder Logic

Figure 18 shows the required parameters for the MSG tag.

- **Service Code** of 1 (e.g. Read all attributes) or 2 (e.g. Write all attributes)
- Vendor specific **Class** code of 0x65 (Hex)
- **Instance** of 0 to 99.
- **Destination Element** should be a *User-Defined* data type which minors the tags described in Table 7.



Message Configuration - IsaacProgram_Read

Message Type: CIP Generic

Service Type: Custom

Service Code: 1 (Hex) Class: 65 (Hex)

Instance: 0 Attribute: 0 (Hex)

Source Element:

Source Length: 0 (Bytes)

Destination Element: IsaacProgram

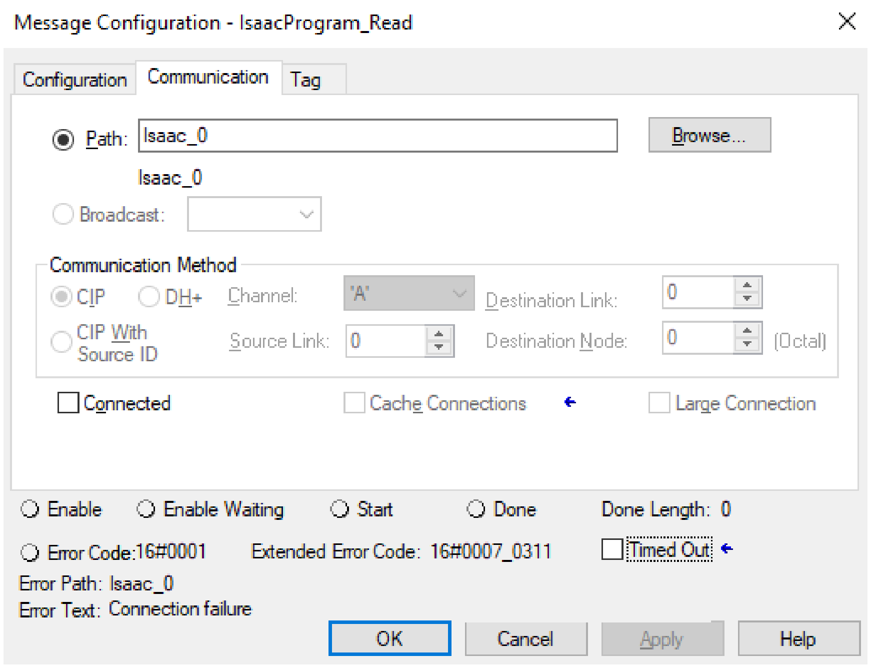
Enable Enable Waiting Start Done Done Length: 0

Error Code:16#0001 Extended Error Code: 16#0007_0311 Timed Out

Error Path: Isaac_0

Error Text: Connection failure

Figure 18 - Read Programs Parameters Configuration Tab


Message Configuration - IsaacProgram_Read

Configuration | Communication | Tag

[● Path]: Isaac_0 Browse...

Isaac_0

○ Broadcast:

Communication Method
[● CIP] ○ DH+ Channel: 'A' Destination Link: 0
○ CIP With Source ID Source Link: 0 Destination Node: 0 (Octal)

☐ Connected ☐ Cache Connections ☐ Large Connection

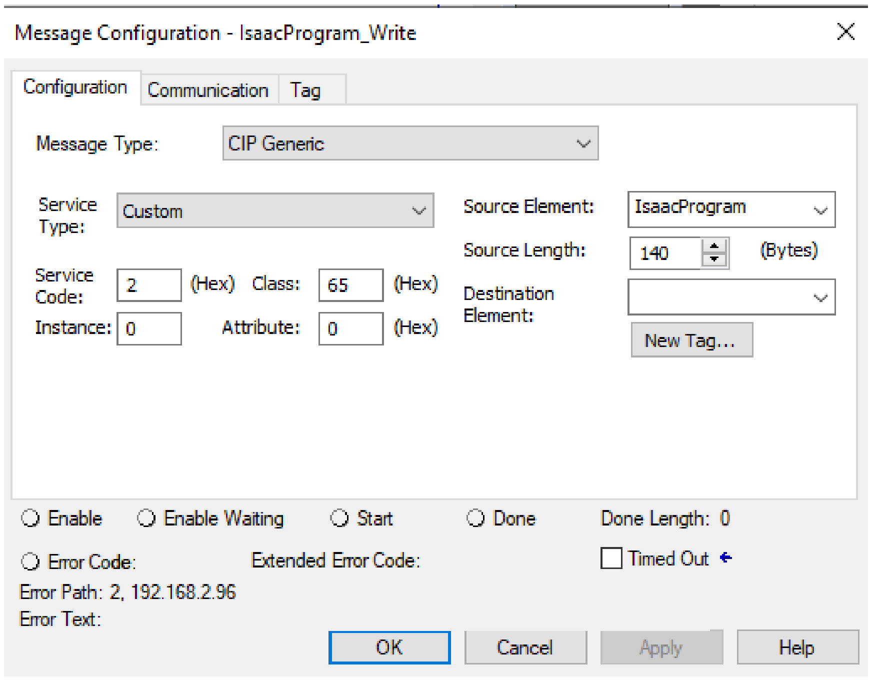
○ Enable ○ Enable Waiting ○ Start ○ Done Done Length: 0

○ Error Code:16#0001 Extended Error Code: 16#0007_0311 ☐ Timed Out

Error Path: Isaac_0
Error Text: Connection failure

Figure 19 – Read Isaac Program Parameters Communication Tab

The basic difference between reading and writing program parameters is the **Service Code** and the **Source Element**. The Service Code changes from 1 to a 2, and the **Source Element** now references the user defined data to be written. The MSG parameters for writing are show in Figure 20.


Message Configuration - IsaacProgram_Write

Configuration | Communication | Tag

Message Type: CIP Generic

Service Type: Custom

Service Code: 2 (Hex) Class: 65 (Hex)

Instance: 0 Attribute: 0 (Hex)

Source Element: IsaacProgram

Source Length: 140 (Bytes)

Destination Element:

Done Length: 0

Error Code: Extended Error Code: Timed Out

Error Path: 2, 192.168.2.96

Error Text:

Figure 20 - Write Isaac Program Parameters Configuration Tab

Reuse of the MSG tag

The MSG tag can be reused to configure multiple Isaac testes following the examples shown in the "Logix 5000 Controllers Message Programming Manual" created by Rockwell automation. See https://literature.rockwellautomation.com/idc/groups/literature/documents/pm/1756-pm012_-en-p.pdf Chapter 3 for more information.

TCP/IP Network Configuration

The default TCP/IP settings are provided in Table 2 above, however these values can be reconfigured using the Firmware Parameters or the predefined CIP TCP/IP object. The CIP TCP/IP object definition is shown in Table 8, and is based on the *TCP/IP Interface Object* in *Volume 2: EtherNet/IP Adaptation of CIP, Chapter 5: Object Library*.

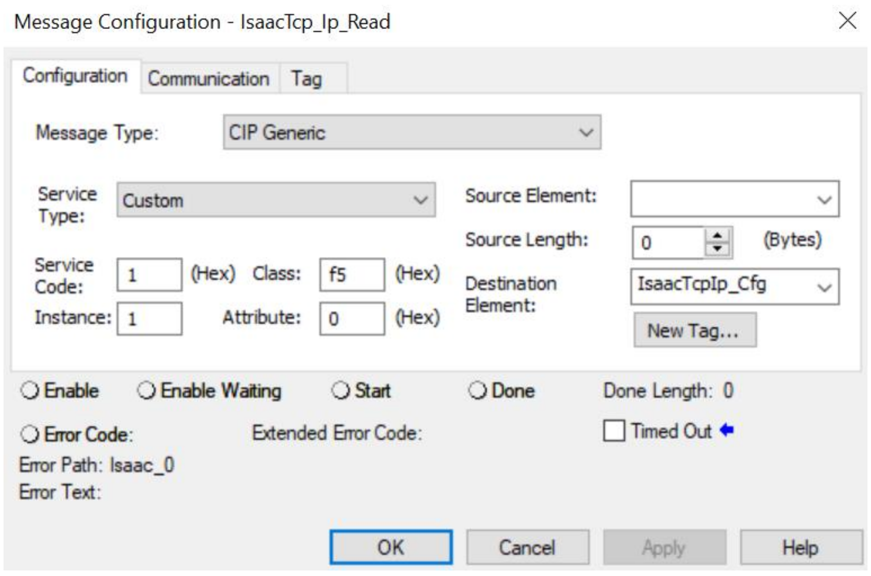
Name	Data Type	Valid Values	Description
Status	DINT	Read only	Interface Status bits. 0x02=Configured from DHCP, 0x04=Hardware configuration.
Configuration Capability	DINT	Read only (0x34)	Bit map of interface capability flags: 0x04=DHCP capable 0x10=Interface configurable 0x20=Hardware configurable
Configuration Control	DINT		Interface control flags: 0x00=Use static configuration 0x02=Use DHCP configuration
Path Size	INT	Read only (3)	Number of 16-bit words in the following padded EPATH.
Path	SINT[4]	Read only	Padded EPATH to physical link object.
IP Address	DINT	0 to 0xFFFFFFFF	Devices I/P address.
Network Address	DINT	0 to 0xFFFFFFFF	Devices network address.
Gateway Address	DINT	0 to 0xFFFFFFFF	Devices gateway I/P address.
Name Server	DINT	0 to 0xFFFFFFFF	Primary name server I/P address.
Name Server 2	DINT	0 to 0xFFFFFFFF	Secondary name server I/P address.
Domain Name	STRING	ASCII Characters	Default domain name.
Host Name	STRING	ASCII Characters	Default host name.
Safety Network Number	SINT[6]	0 to 100	Ignored by Isaac.
TTL	SINT	1 to 255	Time-to-Live value for IP Multicast packets. Ignored by Isaac.
Alloc Control	SINT	0	Multicast address allocation. Ignored by Isaac.
Reserved	SINT	0	Reserved for future use.
Num Mcast	INT	0	Number of multicast addresses to allocate. Ignored by Isaac.
Mcast Start Addr	DINT	0	Starting multicast address. Ignored by Isaac.
Selected Acd	BOOL	0	Activates use of ACD. Ignored by Isaac.
Acd Active	SINT	0	State of ACD activity. Ignored by Isaac.
Remote MAC	SINT[6]	0	MAC Address of remote node. Ignored by Isaac.
Arp Pdu	SINT[28]	0	ARP PDU. Ignored by Isaac.

EthernetIP Quick Connect	BOOL	0	Quick connect feature. Ignored by Isaac.
Encp Inactivity Timeout	INT	0	Inactivity Timeout. Ignored by Isaac.

Table 8 - TCP/IP Object definition

As can be seen from the table above many of the parameters are not required by the Isaac. However, this object does allow the reconfiguration of necessary TCP/IP parameters, e.g. I/P address, enable/disable DHCP etc.

TCP/IP parameters are read using the CIP Read All Attributes message and written using the CIP Write All Attributes message. These CIP messages (Read/Write All Attributes) are configured on the PLC using the *CIP Generic* **Message Type** with a **Service Code** of 1 (e.g. Read all attributes) or 2 (e.g. Write all attributes), a CIP **Class** code of 0xF5 (Hex) and an **Instance** of 1. As show in Figure 21 and Figure 22.


Message Configuration - IsaacTcp_Ip_Read

Message Type: CIP Generic

Service Type: Custom

Service Code: 1 (Hex) Class: f5 (Hex)

Instance: 1 Attribute: 0 (Hex)

Source Element:

Source Length: 0 (Bytes)

Destination Element: IsaacTcpIp_Cfg

Done Length: 0

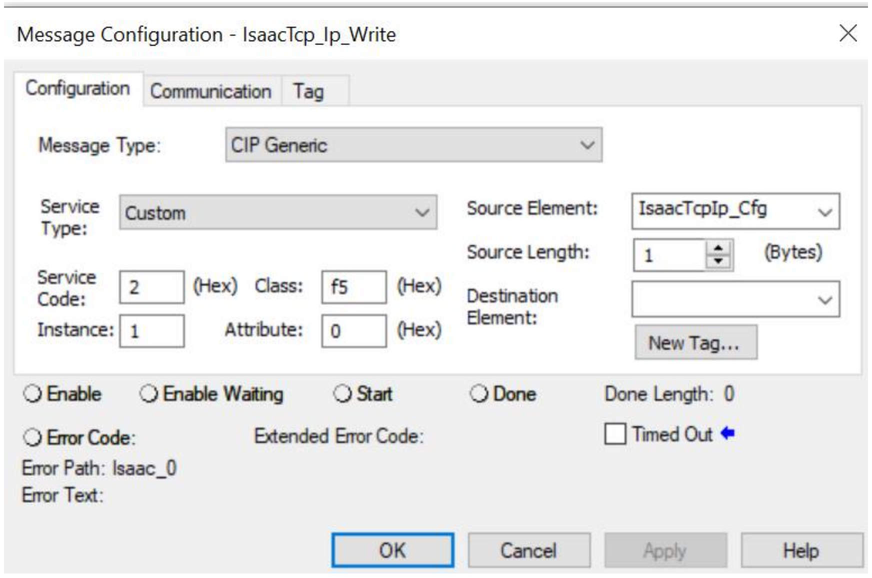
Error Code:

Extended Error Code:

Error Path: Isaac_0

Error Text:

Figure 21 - Reading TCP/IP Configuration Parameters


Message Configuration - IsaacTcp_Ip_Write

Configuration | Communication | Tag

Message Type: CIP Generic

Service Type: Custom

Service Code: 2 (Hex) Class: f5 (Hex)

Instance: 1 Attribute: 0 (Hex)

Source Element: IsaacTcpIp_Cfg

Source Length: 1 (Bytes)

Destination Element:

New Tag...

Enable Enable Waiting Start Done Done Length: 0

Error Code: Extended Error Code: Timed Out

Error Path: Isaac_0

Error Text:

OK Cancel Apply Help

Figure 22 - Write TCP/IP Configuration Parameters

For example, to configure the Isaac to use DHCP, simply set the Configuration Capability field to 0x02 and write the TCP/IP object using the MSG instruction.

To set anyone of the I/P addresses (e.g. I/P address, network address, gateway address, etc.) convert each address octet into hex and enter the hex number into the desired field. For example, to set the I/P address of the Isaac to 192.168.168.100 enter the hex value 0xC0A8A864 into the IP Address field and write the TCP/IP object to the Isaac.

Decimal:	192	168	168	100
Hex:	0xC0	0xA8	0xA8	0x64

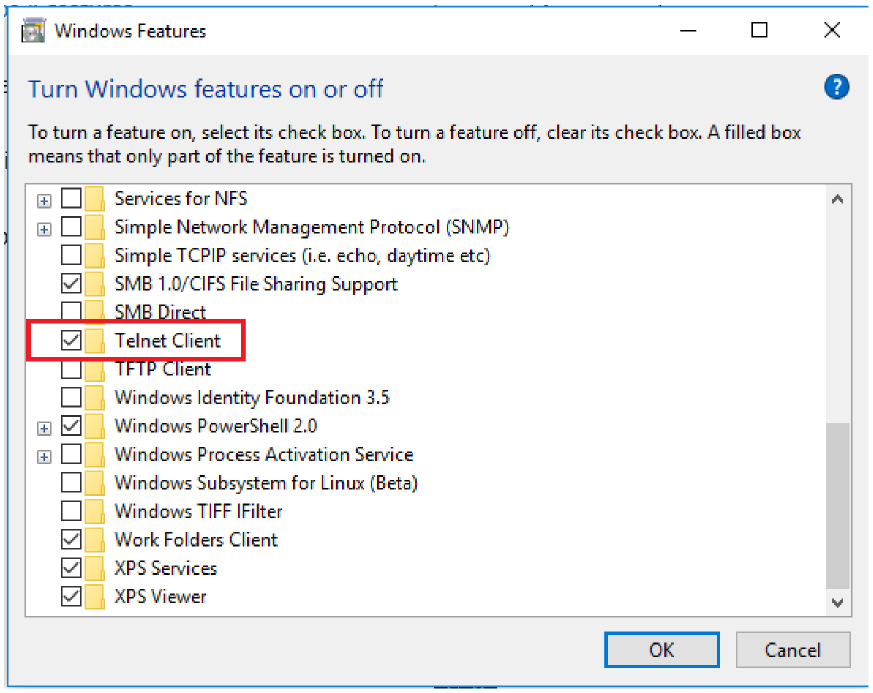
Table 9 - I/P Address to Hex conversion example

The Isaac default TCP/IP configuration can always be restored by holding the red and green push buttons in for approximately eight seconds while turning the unit on until they both buttons blink once. See the EtherNet/IP™ for the Isaac tester overview section for more information.

Trouble Shooting

When problems occur, either in setting up the communications, or communicating with, the Isaac, sometimes it is helpful to get more detailed than a simple fault error. The Isaac displays error and status messages when a network connection has been established on port 8080. These diagnostic messages may give more detail and/or a better understanding of the problems.

A connection to the Isaac diagnostics console can be created using the *Telnet* utility, available on all Unix based system and most Windows system. However, it may need to be turned on under windows. The following figure shows a check mark next to the **Telnet Client**, indicating that it is available for use.



Windows Features

Turn Windows features on or off

To turn a feature on, select its check box. To turn a feature off, clear its check box. A filled box means that only part of the feature is turned on.

- [ ] Services for NFS
- [ ] Simple Network Management Protocol (SNMP)
- [ ] Simple TCPIP services (i.e. echo, daytime etc)
- [✓] SMB 1.0/CIFS File Sharing Support
- [ ] SMB Direct
- [✓] Telnet Client
- [ ] TFTP Client
- [ ] Windows Identity Foundation 3.5
- [✓] Windows PowerShell 2.0
- [ ] Windows Process Activation Service
- [ ] Windows Subsystem for Linux (Beta)
- [ ] Windows TIFF IFilter
- [✓] Work Folders Client
- [✓] XPS Services
- [✓] XPS Viewer

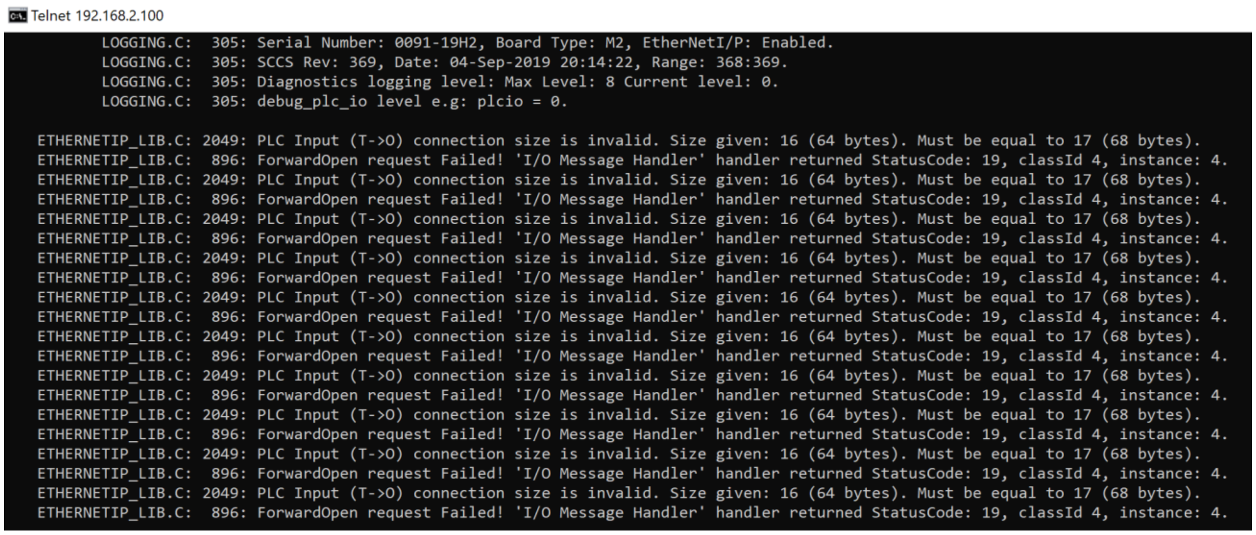
Figure 23 - Windows Telnet Client

With the *Telnet* utility available a connection can, be made using the following command, within a command window (which can be created by "*run cmd*"):

telnet <Isaac_IP_address> 8080 e.g. *telnet 192.168.2.130 8080*

Figure 24 shows the output from the diagnostics console. With a number of lines showing an invalid connection size. In this case the error was caused by using a size of 16 for the Input Assembly Instance when it should have been 17.

Other and more detailed information can be obtained from the diagnostics console; however, it is recommended that a Zaxis support personal help you in diagnosing and resolving more advanced problems.


Telnet 192.168.2.100

```
        LOGGING.C:  305: Serial Number: 0091-19H2, Board Type: M2, EtherNetI/P: Enabled.
        LOGGING.C:  305: SCCS Rev: 369, Date: 04-Sep-2019 20:14:22, Range: 368:369.
        LOGGING.C:  305: Diagnostics logging level: Max Level: 8 Current level: 0.
        LOGGING.C:  305: debug_plc_io level e.g: plcio = 0.

  ETHERNETIP_LIB.C: 2049: PLC Input (T->O) connection size is invalid. Size given: 16 (64 bytes). Must be equal to 17 (68 bytes).
  ETHERNETIP_LIB.C:  896: ForwardOpen request Failed! 'I/O Message Handler' handler returned StatusCode: 19, classId 4, instance: 4.
  ETHERNETIP_LIB.C: 2049: PLC Input (T->O) connection size is invalid. Size given: 16 (64 bytes). Must be equal to 17 (68 bytes).
  ETHERNETIP_LIB.C:  896: ForwardOpen request Failed! 'I/O Message Handler' handler returned StatusCode: 19, classId 4, instance: 4.
  ETHERNETIP_LIB.C: 2049: PLC Input (T->O) connection size is invalid. Size given: 16 (64 bytes). Must be equal to 17 (68 bytes).
  ETHERNETIP_LIB.C:  896: ForwardOpen request Failed! 'I/O Message Handler' handler returned StatusCode: 19, classId 4, instance: 4.
  ETHERNETIP_LIB.C: 2049: PLC Input (T->O) connection size is invalid. Size given: 16 (64 bytes). Must be equal to 17 (68 bytes).
  ETHERNETIP_LIB.C:  896: ForwardOpen request Failed! 'I/O Message Handler' handler returned StatusCode: 19, classId 4, instance: 4.
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```

Figure 24 - Diagnostics Console

Error Codes Generated by the Isaac

The following table lists the different error codes that can be returned from the Isaac tester. This table (General Status Codes) indicates the overall success/failure of the given request. These codes are defined by Common Industrial Protocol (CIP). Typically, these codes are display by the PLC.

General Status Codes

Numeric Status Code	Status Code Name	Description
0x00	Success	Service was successfully preformed by the specified object.
0x01	Communications Related Problem	A communications subsystem related problem was detected along the communications path.
0x03	Invalid parameter value	A parameter associated with the request was invalid. Such as an invalid instance id, invalid I/P address, invalid encapsulation parameter,
0x04	Path segment error	The path segment identifier or the segment syntax was not understood by the Isaac.
0x06	Partial transfer	Only part of the expected data was transferred.
0x08	Service not supported	The requested service was not implemented or was not defined for this Object Class/Instance.
0x0C	Object state conflict	The object cannot perform the requested service in its current mode/state. Usually occurs when a calibration command is sent but the Isaac is not in calibration mode.
0x13	Not enough data	The service did not supply enough data to perform the specified operation. Typically caused by an invalid Assembly size.
0x14	Attribute not supported	The attribute specified in the request is not supported. Typically caused by an invalid Assembly size.

0x15	Too much data	The service supplied more data than was expected.
0x16	Object instance does not exist	The object instance specified does not exist in the device.
0x1A	Routing failure, request packet too large	The service request packet was too large. Typically caused by an invalid Assembly size.
0x1F	Vendor specific error	This occurs when the Isaac fails to resolve an I/P address in the ARP cache. This indicates a slow or faulty hub/switch.
0x25	Key Failure in path	The Key Segment that was included as the first segment in the path does not match the destination module.
0x2E	Service Not Supported for Specified Path	The object supports the service, but not for the designated application path (e.g. attribute).

This second table (Encapsulation Status Codes) are a part of the EtherNet I/P encapsulation header. Generally, these codes are not display by a PLC, but can be seen when using a network analyzer such as Wireshark.

Encapsulation Status Codes

Numeric Status Code	Status Code Name	Description
0x00	Success	Service was successfully preformed by the specified object.
0x01	Invalid Command	An invalid or unsupported EtherNet I/P encapsulation command was received. A command other than: List Services, List Identity, List Interfaces, Register Session, Unregister Session, Send RR data request or Send Unit Data was received.
0x64	Invalid Session Handle	An incorrect session handle was given when registering an EtherNet I/P session.
0x65	Invalid Length	The length of the encapsulation header was invalid.
0x69	Unsupported Protocol	A protocol version other than 1 was given in the EtherNet I/P encapsulation header.