EtherNet/IP™ - ODVA Conformance Test Results

Test Information	
Scheduled Test Date	**October 25, 2022**
Composite Test Revision	**CT19**
ODVA File Number	**12326.01**
Test Type	**Single Product**

Vendor Information	
Vendor Name	**Control Concepts, Inc.**

Device Information

Device Information from Identity Object Instance* 1

For multiple identity object instances, additional Device Information tables are inserted into the report.

Identity Object	Attribute	Value			
Attribute 1	Vendor ID (decimal)	**1188**			
Attribute 2	Device Type (hex)	**0x2B**			
Not an Attribute	Device Profile Name	**Generic Device (keyable)**			
Attribute 4	Product Revision (decimal)	Major Rev	**1**	Minor rev	**001**
Identity Object	**Attribute**	**Value for Device 1**		**Value for Device 2**	
Attribute 3	Product Code (decimal)	**4688**		**N/A**	
Attribute 7	Product Name	**ATOM**		**N/A**	

*For multiple instances, additional Device Information tables should be inserted into the report.

TSP Information	
TSP Location	Select TSP Location
Engineer Initials or Name	Ismith
Completion Date	January 16, 2023
Test Result	**PASS**
All advisories, warnings, and failures are summarized and described in Table 1 below.	

EtherNet/IP™ - ODVA Conformance Test Results

Table 1 Conformance Failures and Advisories

NOTE: **Advisories** indicate recommendations, W**arnings** indicate behavior that may be required to be changed before subsequent tests as indicated in Warning description, and F**ailures** must be resolved to pass

Index	Test Item	Advisories and Failures: Observed DUT Behavior	Required Behavior & Specification Reference
1	**Ethernet Link Object Tests**	**Advisory:** Negotiation Status (3) reported when link partner is in forced speed / duplex mode. Shall instead report (2) in this case.	Vol. 2 Ed 1.30, Interface Flags 5-5.3.2.2, Table 5-5.4 Interface Flags: Negotiation Status. (2) "Auto negotiation failed but detected speed. Duplex was defaulted [...]. (3) "Successfully negotiated speed and duplex."

Identify DUT Type and Possible Configurations

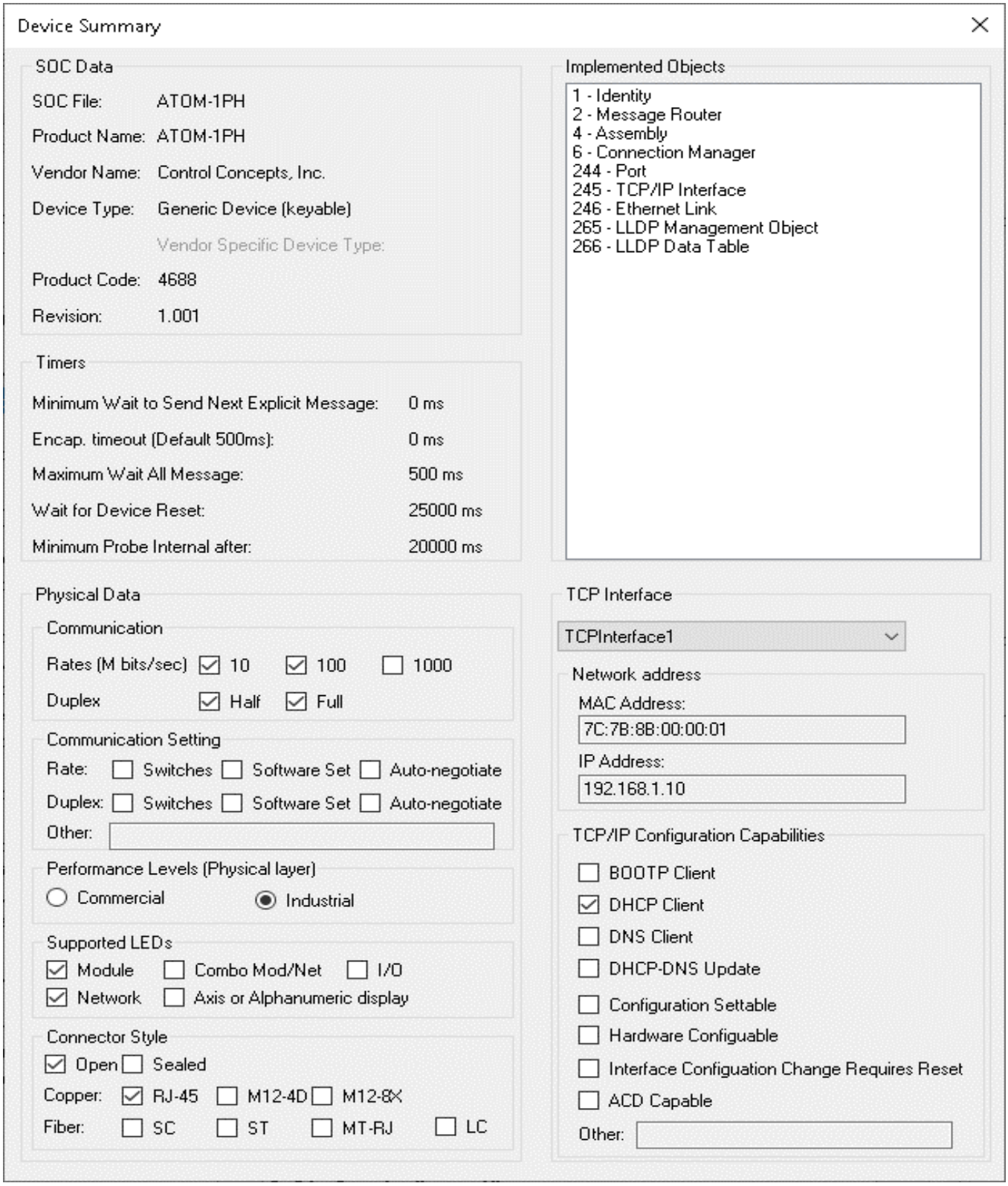
A DUT may support multple IP Configuration modes, such as DHCP, BOOTP, Static IP or Hardware IP. A DUT shall perform EtherNet/IP Conformance Test on each supported IP configuration mode with Class 3 Explicit Messaging or UCMM in cases where Explicit Mesaging Connection is not supported. The Explicit Messaging connection should be established via ForwardOpen (FO) with a connection size of 511 or less; and by Large_Forward_Open (LFO) with the maximum connection size supported by the DUT, if the DUT supports the LFO service.

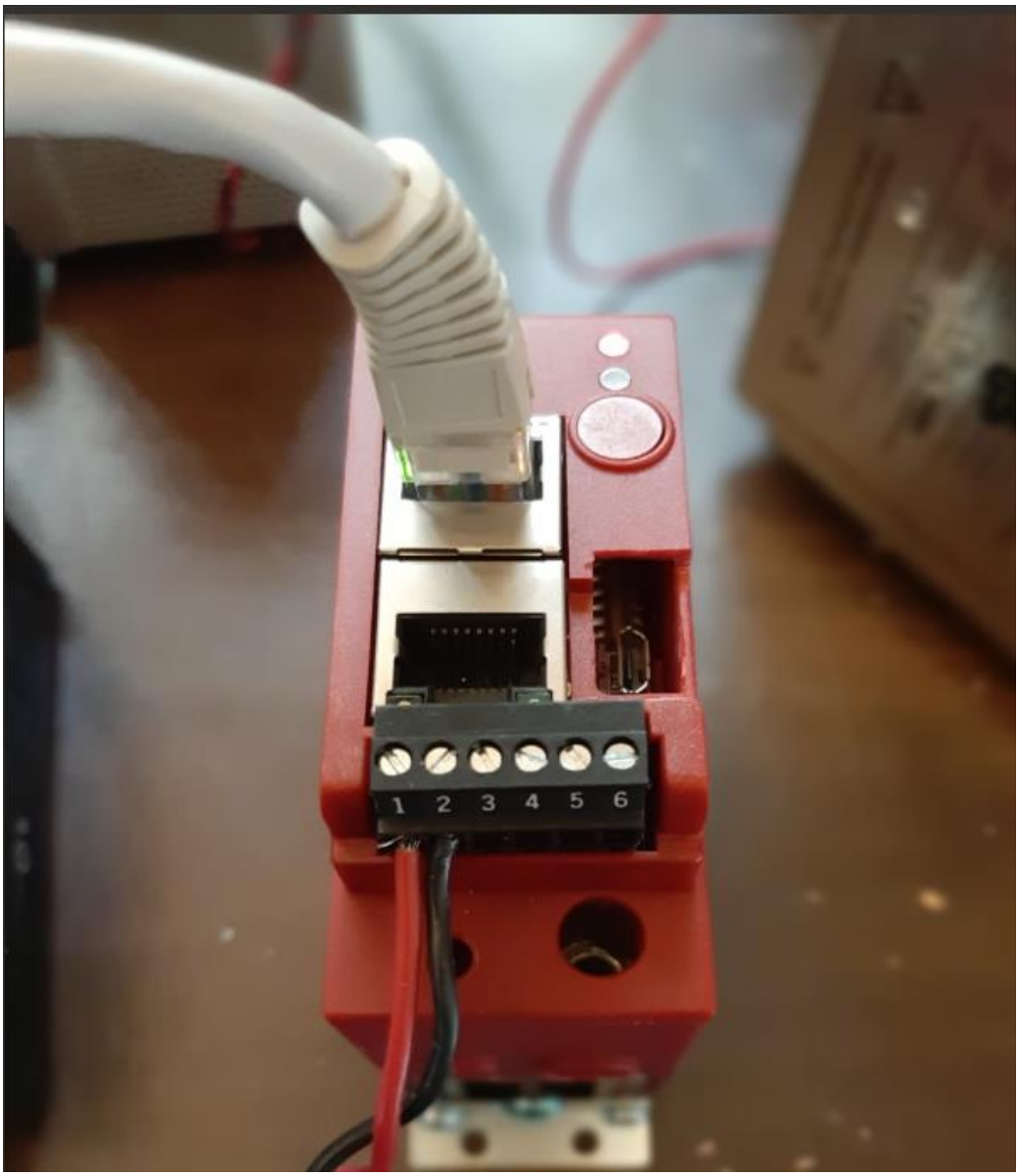
The Test Matrix below outlines the necessary EtherNet/IP Conformance Tests required to be conducted based on the IP configurations the DUT supports and the type of DUT. Perform EtherNet/IP Conformance Test in Conformance Mode plus Profile Verification for all applicable IP configuration modes, in the order they appear in the top row of the table with the DUT configured as described in the column – row intersection for the test and the DUT type. Only perform Type 1 Reset Test if the reset does not cause the IP configuration mode to change. CT test should be run at least once with FO and once with LFO if LFO service is supported. For example, if a DUT only supports one IP mode and implements LFO, the EtherNet/IP CT will need to be run twice, one via connection opened by FO, another via connection opened by LFO.

DUT Type	**Supported IP Configuration**			
	DHCP	**Static IP**	**BOOTP**	**Hardware**
DUT (one Ethernet Port, no LFO)	Run CT on port 1 with IP configured via DHCP through Class 3 connection by FO	Run CT on port 1 with a Static IP address through Class 3 connection by FO	Run CT on port 1 with IP configured via BOOTP through Class 3 connection by FO	Run CT on port 1 with an IP address configured via hardware switch through Class 3 connection by FO
DUT (one Ethernet Port, LFO)	Run CT on port 1 with IP configured via DHCP through Class 3 connection by FO or LFO	Run CT on port 1 with a Static IP address through Class 3 connection by LFO or FO	Run CT on port 1 with IP configured via BOOTP through Class 3 connection by FO or LFO	Run CT on port 1 with an IP address configured via hardware switch through Class 3 connection by LFO or FO
DUT (Multiple Ethernet Ports, no LFO)	Run CT on port 1 with IP configured via DHCP through Class 3 connection by FO	Run CT on port 2 with a Static IP address through Class 3 connection by FO	Run CT on port 3 or port 1 with IP configured via BOOTP through Class 3 connection by FO	Run CT on port 3 or port 1 with an IP address configured via hardware switch through Class 3 connection by FO
DUT (Multiple Ethernet Ports, LFO)	Run CT on port 1 with IP configured via DHCP through Class 3 connection by FO or LFO	Run CT on port 2 with a Static IP address through Class 3 connection by LFO or FO	Run CT on port 3 or port 1 with IP configured via BOOTP through Class 3 connection by FO or LFO	Run CT on port 3 or port 1 with an IP address configured via hardware switch through Class 3 connection by LFO or FO

Support of the Reset service by instantiated Identity instances is required. However, support of Type 1 and Type 2 resets are optional.

EtherNet/IP™ Device Under Test




1 2 3 4 5 6

EtherNet/IP™ Conformance Composite Test Results - CT19

DUT Name:	ATOM

1 Protocol Conformance Test (Please do Wireshark capture while running the protocol test**)**
For CIP Security device, run protocol test by following steps:
1) Set DUT in Factory Default state, select all non-security objects + Profile Verification + Encapsulation and run test in Development mode with non-security session.
2) Run all test + Profile Verification in Conformance mode via Security session.

Protocol Test Software Revision	**CT19**
SOC File Name	ATOM-1PH.soc
Protocol Test Log Files	CT19_ATOM-1PH*.log
Respond to broadcast ListIdentity Requests in randomly delay (verify with Wireshark capture)	Pass
Result Pass/Fail	Pass
Result Pass/Fail with Large_Forward_Open	Pass

2 Physical Layer Test

If the product includes an LED identified by a label name defined in Chapter 9 of EtherNet/IP Adaptation of CIP, the product supports the LED. Supported LEDs must have the behaviors described below.

Industrial Grade Claimed in SOC	Yes		
2.1 Indicator check: LEDs supported		**Present in DUT**	**Result**
Module Status LED		No	N/A
Network Status LED		No	N/A
2.2 Module status LED operation			**Result**
The product contains a red/green indicator for the module status.			N/A
The indicator is labeled “MS”, “Mod”, “Mod Status”, or “Module Status”.			N/A
Indicator operation (0.25 sec GREEN, then 0.25 sec RED at a self-test).			N/A
2.3 Network status LED operation			**Result**
The product contains a red/green indicator for the network status.			N/A
The indicator is labeled “NS”, “Net”, “Net Status”, or “Network Status”.			N/A
Indicator operation (0.25 sec GREEN, then 0.25 sec RED at a self-test).			N/A
2.4 Network connector		**Present in DUT**	**Result**
The DUT has a connector per Volume 2, Chapter 8 - (No "pigtail" allowed)		Yes	Pass
The DUT has a connector per Volume 2 - Section 8-9.2.3 N/A if Industrial Grade is not claimed in SOC		Yes	Pass

3 EDS File Test

3.1 EDS File Syntax Utility	**EZ-EDS Revision:**	**V3.31.20220811**	
EDS File Name	ATOM.eds		
EDS File Revision	1.0		
3.2 EDS File Minimum Content			**Result**
ProdType (must match Identity Object Attribute 2)	ProdType =	43	Pass
ProdCode (must match Identity Object Attribute 3)	ProdCode =	4688	Pass
MajRev (must match Identity Object Attribute 4, byte 0)	MajRev =	1	Pass
EZ-EDS Result - Minimum Content			Pass
3.3 EDS File Connection Entries			**Result**
All connections defined: Keyword - Path and Sizes			Pass
3.4 EDS File Port Labels (multiple Ethernet Ports only)			**Result**
All Ethernet Link Interface sections labels match Ethernet Link object labels			Pass

4 TCP/IP Interface Object Tests Object 0xF5 (245)

(See *EtherNetIP Interop Conformance Test Specification.pdf* for test procedure details)

4.1 Interface Configuration and Subnet Test Cases			**Result**
Interface Configuration - BOOTP (use Attribute 3 or other applicable interface to configure)			N/A
Interface Configuration - DHCP Client (use Attribute 3 or other interface to configure)			Pass
Interface Configuration - SW Configurable (using stored values - use Attribute 3 to configure)			Pass
Interface Configuration - HW Configurable (setting address switches - use switches and attr 3)			N/A
If DUT supports NS/MS and DHCP/BOOTP, verify that LEDs behave correctly w/ no IP Addr.			N/A
Subnet test case 1 (Reply) (DHCP Server used for setup - Get_Attribute_Single for request)			Pass
Subnet test case 2 (No reply) (PC interface Properties - Get_Attribute_Single for request)			Pass
Subnet test case 3 (Reply) (DHCP Server used for setup - Network Settings/DUT power cycle)			Pass
Subnet test case 4 (No reply) (Network Connections -> Properties)			Pass
Subnet test case 5 (Reply) (DHCP Server used for setup - Network Settings/DUT power cycle)			Pass
Subnet test case 6 (Widest Subnet - Reply) (Subnet mask for DUT - use 255.0.0.0)			Pass
TTL Test (Attr. 8) - See TTL Test Below	Get_AttributeSingle Status Code/Value:	0x0E	N/A
MCast Test (Attr 9) - See TTL Test Below	Get_AttributeSingle Status Code/Value:	0x0E	N/A
4.2 Off-Link Routing Test Cases			**Result**
Overall results of manual tests (See Off-Link Routing Test TAB)			Pass

5 Ethernet Link Object Tests Object 0xF6 (246)

Use a managed switch with 4 ports set to 10Mbps/FullDuplex, 10Mbps/HalfDuplex, 100Mbps/FullDuplex, 100Mbs/HalfDuplex

5.1 Ethernet Link Object Test Cases	**Result**
Speed test cases (Attribute 1) - connect the DUT to 10Mbps (Full or Half) - Value reported OK	Pass
Speed test cases (Attribute 1) - connect the DUT to 100Mbps, Full Duplex - Value reported OK	Pass
Interface Flags test cases (Attribute 2) - connect the DUT to 100Mbps Full - Value reported OK	Pass
Interface Flags test cases (Attribute 2) - connect the DUT to 100Mbps Half - Value reported OK	Pass
Force DUT and connect the DUT to 100Mbps Full Duplex - DUT and PC communicate	N/A
Force DUT and connect the DUT to 100Mbps Half Duplex - DUT and PC communicate	N/A
Force DUT and connect the DUT to 10Mbps Full Duplex - DUT and PC communicate	N/A
Force DUT and connect the DUT to 10Mbps Half Duplex - DUT and PC communicate	N/A
Physical Address test cases (attribute 3) - Match IEEE OUI listings - See wireshark capture	Pass

Attribute 11- Interface Capabilities Verification			DUT Reports		Result
Attribute 11 Get_AttributeSingle Value (Hex):	06 00 00 00 00	0110			
Verify - DUT requires reset to apply changes made to Interface Control (Attr 6):			No		Pass
Verify - DUT supports link Auto-Negotiate:			Yes		Pass
Verify - DUT supports Auto MDIX operation:			Yes		Pass
Verify - DUT is capable of Manual Speed/Duplex Via Interface Control (Attr 6):			No		Pass
Verify - Number of elements:			00		Pass
Formated Hex Value:	0600000000		**Speed**	**Duplex**	**Result**
Element Pair #1:			None	None	N/A
Element Pair #2:			None	None	N/A
Element Pair #3:			None	None	N/A
Element Pair #4:			None	None	N/A
Element Pair #5:			None	None	N/A
Element Pair #6:			None	None	N/A

Attribute 11- Interface Capabilities Verification - Additional Instance			DUT Reports		Result
Attribute 11 Get_AttributeSingle Value (Hex):	06 00 00 00 00	0110			
Verify - DUT requires reset to apply changes made to Interface Control (Attr 6):			No		Pass
Verify - DUT supports link Auto-Negotiate:			Yes		Pass
Verify - DUT supports Auto MDIX operation:			Yes		Pass
Verify - DUT is capable of Manual Speed/Duplex Via Interface Control (Attr 6):			No		Pass
Verify - Number of elements:			00		Pass
Formated Hex Value:	0600000000		**Speed**	**Duplex**	**Result**
Element Pair #1:			None	None	N/A
Element Pair #2:			None	None	N/A
Element Pair #3:			None	None	N/A
Element Pair #4:			None	None	N/A
Element Pair #5:			None	None	N/A
Element Pair #6:			None	None	N/A

5.2 Ethernet Link objects - Multiple Interfaces Tests			Result
Class Attribute 3 (Number of Instances)	Attribute 3 Value	0x0002	Pass
Class Attribute 2 (Max Instances)	Attribute 2 Value	0x0002	Pass
Class Attribute 1 (Revision)	Attribute 1 Value	0x0004	Pass
Instance 1 Attribute 10 (Interface Label)	Attribute 10 Value	Port #1	Pass
Instance 2 Attribute 10	Attribute 10 Value	Port #2	Pass
Admin State (Attribute 9) - Port Disable			N/A
Admin State - Port Enable			N/A
Admin State - Last Port not disabled			N/A
Admin State - Enable all ports			N/A

5.3 AutoMDIX Tests - Required for DLR and Auto-MDIX Capable Devices	Result
Test Procedure, MDIX - Port 1, Forced Duplex and Speed: Configure DUT **Port 1** for forced 100 Mbps, full duplex (set Ethernet Link instance 1, attribute 6 to 02 00 64 00). Connect DUT **Port 1** (only) to uplink port of network HUB with uplink button - Connect test PC to any port of the network HUB - Use the conformance test messaging tool to get any attribute of the DUT identity object (Success expected) - push the uplink network HUB button to switch RX and TX lines - Use the conformance test messaging tool to get any attribute of the DUT identity object (Success expected) a few seconds may be needed for the DUT PHY adjusts to the HUB configuration change. Or use a managed switch like Ethernet Link Object MDIX test above. **Pass Result:** Get attribute single success in both HUB configurations. (Multi-port devices NOT supporting the DLR functionality are not required to meet this requirement.)	N/A
Test Procedure MDIX - Port 1, Auto-negotiate: Configure DUT **Port 1** for Auto-negotiate (set Ethernet Link instance 1, attribute 6 to 01 00 00 00). Repeat HUB uplink switch procedure above for DUT **Port 1**. **Pass Result:** Get attribute single success in both HUB configurations. (Multi-port devices NOT supporting the DLR functionality are not required to meet this requirement.)	Pass
Test Procedure, MDIX - Port 2, Forced Duplex and Speed: Configure DUT Port 2 for forced 100 Mbps, full duplex (set Ethernet Link instance 1, attribute 6 to 02 00 64 00). Repeat HUB uplink switch procedure above for DUT **Port 2**. **Pass Result:** Get attribute single success in both HUB configurations. (Multi-port devices NOT supporting the DLR functionality are not required to meet this requirement.)	N/A
Test Procedure - Port 2, Auto-negotiate: Configure DUT Port 2 for Auto-negotiate (set Ethernet Link instance 2, attribute 6 to 01 00 00 00). Repeat HUB uplink switch procedure above for DUT **Port 2.** **Pass Result:** Get attribute single success in both HUB configurations. (Multi-port devices NOT supporting the DLR functionality are not required to meet this requirement.)	Pass

6 Port Scans (Direct connection from PC to DUT)

6.0 Port Scans - Verify Device Reacheable during and after each Ports Scan session			Result
Index	Protocol		
1	TCP <nmap -n -v -r -p- -scan-delay 1ms -oX TCP.xml DUT.IP.ADDR>	44818	Pass
2	UDP <nmap -n -v -r -p- -scan-delay 1ms -sU -oX UDP.xml DUT.IP.ADDR>	68, 137, 44818	Pass
3	IP <nmap -n -v -r -p- -scan-delay 1ms -sO -oX IP.xml DUT.IP.ADDR>	1, 2, 6, 17	Pass

19 Product Name and Label Check

Check Points	Result
Check the Product Name of DUT against the ODVA Identity Guidelines	Pass
Check the label printed on DUT against the ODVA Identity Guidelines	Pass

Off-Link Routing Test Procedure and Results

Test Guideline
According to RFC 1122 section 3.3.1, when sending datagrams, "If the destination is on a connected network, the datagram is sent directly to the destination host; otherwise, it has to be routed to a gateway on a connected network". For details on how to decide the destination is a local or remote host and how to select a gateway, please see section 3.3.1.1 and 3.3.1.2 of the RFC.
Test Procedure - Initial Setup
Connect the PC's Ethernet interface directly to the DUT's Ethernet Interface.
Configure the PC's physical Ethernet interface so that it has three logical TCP/IP interfaces as follows: - IP address 192.168.2.100 with subnet mask 255.255.0.0 (note /16 subnet mask) - IP address 192.168.1.4 with subnet mask 255.255.255.0 (note /24 subnet mask) - IP address 192.168.1.5 with subnet mask 255.255.255.0 (note /24 subnet mask) No default gateway configured.
Set the DUT's IP address to 192.168.1.10 with subnet mask 255.255.255.0 in the DUT's STC file. (SOC->Data->Physical Data)
Select 192.168.2.100 as the PC interface IP Address in the CT Explicit Message (EM) Tool. (Setup->Setup->Available host IP addresses).
1. Routing to non-exsitent Default Gateway Behavior
Test Procedure and Result
With the DUT in either Static IP mode or Dynamic (DHCP/BOOTP) mode, configure the DUT to have IP Address 192.168.1.10, a Network Mask value of 255.255.255.0 and a non-existent Gateway Address (example 192.168.1.2).
Tip: If DUT is statically configurable via CIP (but does not support DHCP/BOOTP), use PC Interface 192.168.1.4 to perform EM configuration of Gateway Address with ***Set*** *to Interface Configuration attribute.Then re-select 192.168.2.100 in EM Tool.*
Send a Get_Attribute_Single request from 192.168.2.100 interface to the DUT.

Requirement	Result
The DUT shall not respond to the Get_Attribute_Single request but shall instead send ARP request frames seeking the configured Gateway Address (192.168.1.2).	Pass

Test Procedure - Routing to existent Default Gateway Setup
Prerequesite: **Test Procedure - Initial Setup** above.
Tip: In some cases, it may be most efficient to copy the original STC file to a new STC file for these tests, so that a limited set of I/O connections are configured, as described next:
In SOC editor, Configure the Connection Manager Object Connections tab to contain one unicast T->O I/O connection and one multicast T->O I/O connection if both types are supported by the DUT; or one connection with both types. All Connections should have only one supported Priority, one Trigger type enabled for this test. If DUT does not support I/O connection, skip this step.
With the DUT in either Static IP mode or Dynamic (DHCP/BOOTP) mode, configure the DUT to have Network Mask value of 255.255.255.0, IP Address value of 192.168.1.10 and Default Gateway Address value of 192.168.1.**5**.
Select address 192.168.2.100 as the PC Interface in the EM Tool.
To verify setup, send a Get_Attribute_Single request from **192.168.2.100** to the DUT, (a *response is expected*).

2. Routing to existent Default Gateway Behavior, TTL = 1	
Test Procedure and Results	
Prerequesite: **Routing to existent Default Gateway Setup** (above).	
Configure the DUT for TTL Value=1. (Note: By default TTL=1 if TTL attribute is not implemented).	
Start Wireshark capture.	
Under the connections setting for Connection Manager, set the connection type to Point-to-Point for testing Unicast I/O. In development mode, start the Connection Manager Object I/O Connections Test and allow for it to complete	
Under the connections setting for Connection Manager, set the connection type to Multicast for testing Multicast I/O. In development mode, start the Connection Manager Object I/O Connections Test and allow for it to complete	
Stop Wireshark capture and save it.	
Open the Wireshark file to verify the following expected results:	
Requirements	**Result**
Encapsulation Commands, UCMM commands and connected Explicit Messages (requests and responses) shall be observed in Wireshark from PC to DUT and from DUT to PC.	Pass
Unicast I/O shall be generated correctly from O->T.	Pass
Unicast I/O shall be generated correctly from T->O (in DUTs which support unicast T->O).	Pass
The TTL value of unicast I/O packets from the DUT shall not be 1, but instead the TTL values shall be carried from the TCP/IP stack. Normally these values are TTL=64 or above.	Pass
For multicast I/O ForwardOpen request, the DUT shall return General Status 0x1 and Extended Status 0x813 (NOT CONFIGURED FOR OFF-SUBNET MULTICAST). (Only in DUTs which support multicast T->O)	Pass

3. Routing to existent Default Gateway Behavior, TTL = 2

Test Procedure and Results	
Prerequesite:**Routing to existent Default Gateway Setup** (above).	
Configure the DUT for TTL Value=2. (Note: By default, TTL=1). If DUT does not support TTL attribute Set, mark this test N/A. *Tip: If required, reset the DUT for the new TTL value to take effect.*	
Start Wireshark capture.	
In development mode, start the Connection Manager Object I/O Connections test and allow it to complete, or stop the test when see both unicast and multicast I/O packets. If the DUT does not support I/O connection, run Identity Object Test.	
Stop Wireshark capture and save it.	
Open the Wireshark file to verify the following expected results:	
Requirements	**Result**
Encapsulation Commands, UCMM commands and connected Explicit Messages (requests and responses) shall be observed in Wireshark from PC to DUT and from DUT to PC.	N/A
Unicast I/O shall be generated correctly from O->T.	N/A
Unicast I/O shall be generated correctly from T->O (in DUTs which support unicast T->O).	N/A
The TTL value of unicast T-> O I/O packets from the DUT shall not be 1, but instead the TTL values shall be carried from the TCP/IP stack. Normally these values are TTL=64 or above. These values shall be the same as the values in the test case 2.	N/A
All Multicast ForwardOpen requests shall succeed.	N/A
The TTL value of T->O multicast I/O packets from the DUT shall be 2.	N/A