EtherNet/IP™ - ODVA Conformance Test Results

Test Information	
Scheduled Test Date	**October 10, 2016**
Composite Test Revision	**CT13**
ODVA File Number	**11566.01**
Test Type	**Single Product**

Vendor Information	
Vendor Name	**Tolomatic**

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)	**1230**			
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)	**9058**		**N/A**	
Attribute 7	Product Name	**ACSI Drive & Controller**		**N/A**	

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

TSP Information	
TSP Location	TSP North America (Ann Arbor)
Engineer Initials or Name	LX
Completion Date	October 12, 2016
Test Result	**PASS**
All advisories, warnings, and failures are summarized and described in Table 1 below.	

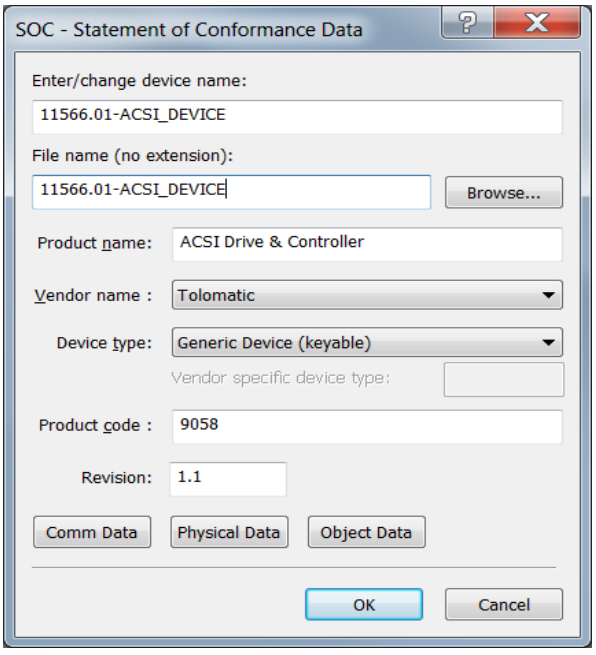
EtherNet/IP™ - ODVA Conformance Test Results

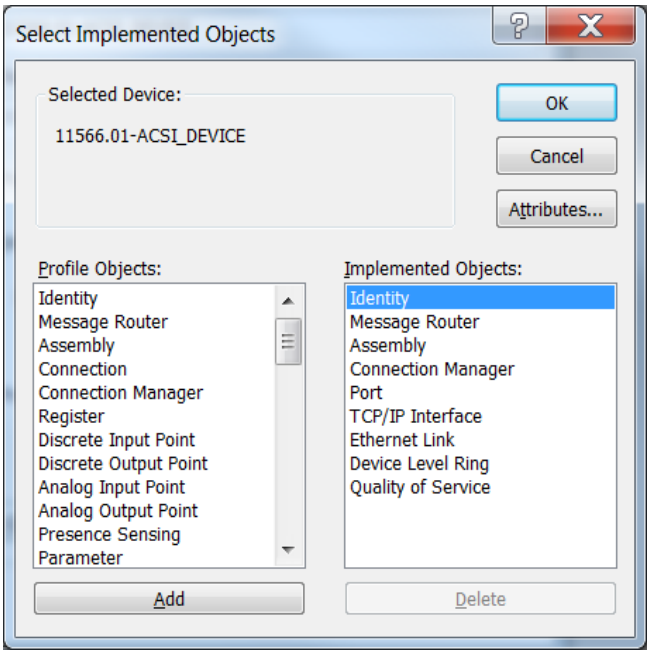
Table 1 Conformance Failures and Advisories

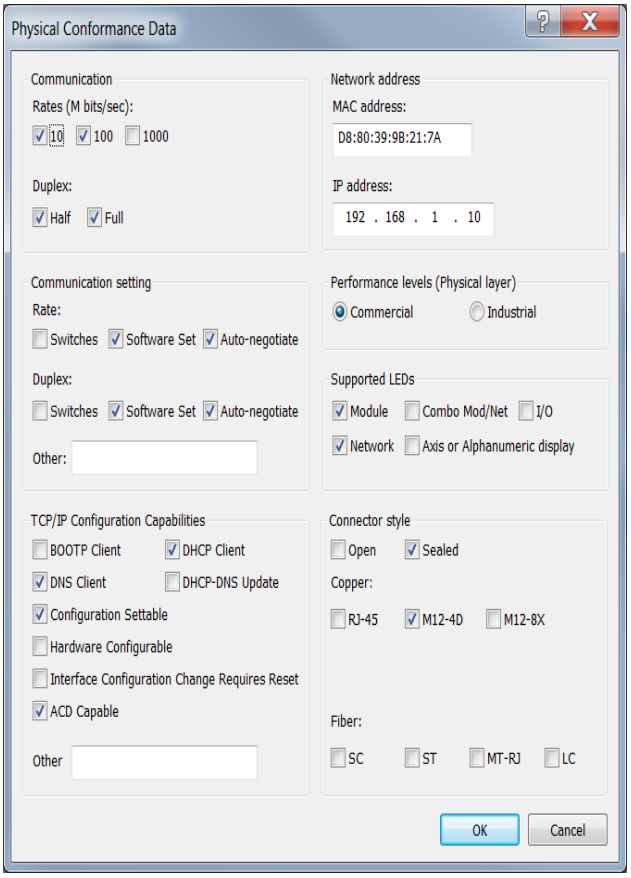
NOTE: **Advisories** indicate recommendations, W**arnings** indicate behavior that may be required to be changed before subsequent tests as indicated in Warning description, and F**ailures** must be resolved to pass

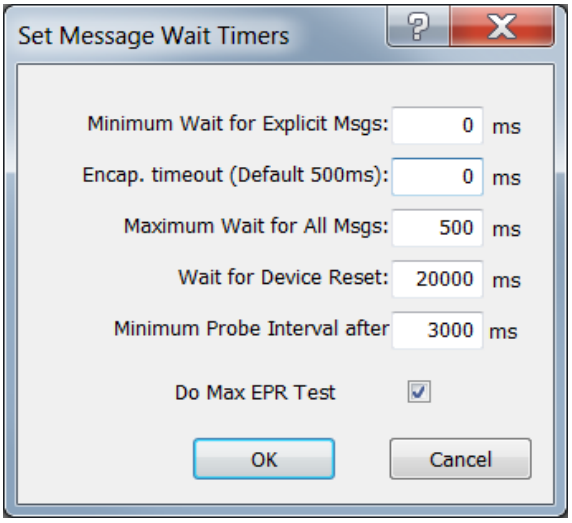
Index	Test Item	Advisories and Failures: Observed DUT Behavior	Required Behavior & Specification Reference
1	**EDS File**	**Advisory:** Port labels in EDS file don't match Ethernet link objects	
2			
3			
4			
5			
6			
7			
8			

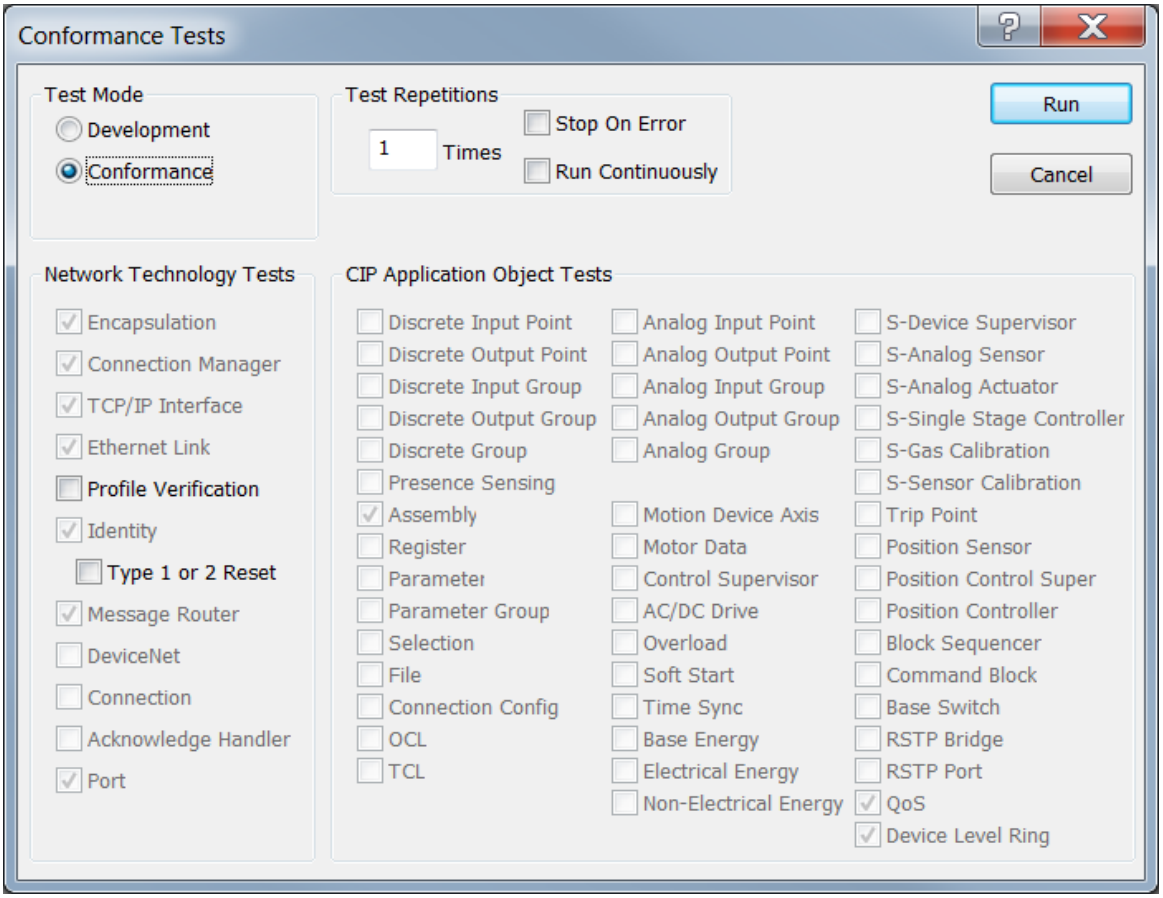
EtherNet/IP™ Device Under Test










Conformance Tests
Test Mode
Development
Conformance
Test Repetitions
1
Times
Stop On Error
Run Continuously
Run
Cancel
Network Technology Tests
Encapsulation
Connection Manager
TCP/IP Interface
Ethernet Link
Profile Verification
Identity
Type 1 or 2 Reset
Message Router
DeviceNet
Connection
Acknowledge Handler
Port
CIP Application Object Tests
Discrete Input Point
Discrete Output Point
Discrete Input Group
Discrete Output Group
Discrete Group
Presence Sensing
Assembly
Register
Parameter
Parameter Group
Selection
File
Connection Config
OCL
TCL
Analog Input Point
Analog Output Point
Analog Input Group
Analog Output Group
Analog Group
Motion Device Axis
Motor Data
Control Supervisor
AC/DC Drive
Overload
Soft Start
Time Sync
Base Energy
Electrical Energy
Non-Electrical Energy
S-Device Supervisor
S-Analog Sensor
S-Analog Actuator
S-Single Stage Controller
S-Gas Calibration
S-Sensor Calibration
Trip Point
Position Sensor
Position Control Super
Position Controller
Block Sequencer
Command Block
Base Switch
RSTP Bridge
RSTP Port
QoS
Device Level Ring

EtherNet/IP™ Conformance Composite Test Results - CT13

DUT Name:	ACSI Drive & Controller

1 Protocol Conformance Test

Protocol Test Software Revision	CT13
SOC File Name	11566.01-ACSI_DEVICE.stc
Protocol Test Log Files	11566.01-ACSI_DEVICE.log
Result Pass/Fail	Pass
Result Pass/Fail with Large_Forward_Open	N/A

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	No		
2.1 Indicator check: LEDs supported		**Present in DUT**	**Result**
Module Status LED		Yes	Pass
Network Status LED		Yes	Pass
2.2 Module status LED operation			**Result**
The product contains a red/green indicator for the module status.			Pass
The indicator is labeled “MS”, “Mod”, “Mod Status”, or “Module Status”.			Pass
Indicator operation (0.25 sec GREEN, then 0.25 sec RED at a self-test).			Pass
2.3 Network status LED operation			**Result**
The product contains a red/green indicator for the network status.			Pass
The indicator is labeled “NS”, “Net”, “Net Status”, or “Network Status”.			Pass
Indicator operation (0.25 sec GREEN, then 0.25 sec RED at a self-test).			Pass
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			N/A

3 EDS File Test

3.1 EDS File Syntax Utility	EZ-EDS Revision:	3.11.1.20151008	
EDS File Name	36043188_ACSI_DRIVE.eds		
EDS File Revision	1		
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 =	9058	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			Advisory

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
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:	00/01	Pass
MCast Test (Attr 9) - See TTL Test Below	Get_AttributeSingle Status Code/Value:	00/00 00 10 00 20 02 C0 EF	Pass

5 Ethernet Link Object Tests Object 0xF6 (246)

Connect straight into the device for speed test cases(**DO NOT USE A HUB - a crossover cable may be needed**)

5.1 Ethernet Link Object Test Cases			**Result**
Speed test cases (Attribute 1) - Force PC NIC to 10Mbps (Full or Half) - Value reported OK			Pass
Speed test cases (Attribute 1) - Force PC NIC to 100Mbps, Full Duplex - Value reported OK			Pass
Interface Flags test cases (Attribute 2) - Force PC NIC to 100Mbps Full - Value reported OK			Pass
Interface Flags test cases (Attribute 2) - Force PC NIC to 100Mbps Half - Value reported OK			Pass
Force DUT and PC NIC to 100Mbps Full Duplex - DUT and PC communicate			Pass
Force DUT and PC NIC to 100Mbps Half Duplex - DUT and PC communicate			Pass
Force DUT and PC NIC to 10Mbps Full Duplex - DUT and PC communicate			Pass
Force DUT and PC NIC to 10Mbps Half Duplex - DUT and PC communicate			Pass
Physical Address test cases (attribute 3) - Match IEEE OUI listings - See wireshark capture			Pass
5.2 Ethernet Link objects - Multiple Interfaces Tests			**Result**
Class Attribute 3 (Number of Instances)	Attribute 3 Value	2	Pass
Class Attribute 2 (Max Instances)	Attribute 2 Value	2	Pass
Class Attribute 1 (Revision)	Attribute 1 Value	4	Pass
Instance 1 Attribute 10 (Interface Label)	Attribute 10 Value	06 50 6F 72 74 5F 31	Pass
Instance 2 Attribute 10	Attribute 10 Value	06 50 6F 72 74 5F 32	Pass
Admin State (Attribute 9) - Port Disable			Pass
Admin State - Port Enable			Pass
Admin State - Last Port not disabled			Pass
Admin State - Enable all ports			Pass

5.3 DLR Specific AutoMDIX Tests	**Result**
Test Procedure, MDIX - Port 1, Forced Duplex and Speed (DUT supporting DLR only): 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. **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 1, Auto-negotiate (DUT supporting DLR only): 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 (DUT supporting DLR only): 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.)	Pass
Test Procedure - Port 2, Auto-negotiate (DUT supporting DLR only): 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>	80, 44818 open	Pass
2	UDP <nmap -n -v -r -p- -scan-delay 1ms -sU -oX UDP.xml DUT.IP.ADDR>	2222, 44818 open|filtered	Pass
3	IP <nmap -n -v -r -p- -scan-delay 1ms -sO -oX IP.xml DUT.IP.ADDR>	1,6 open, 2, 17 open|filtered	Pass

7 QoS Object Tests

Object 0x48 (72)

QoS Object Test Cases	**Result**
QoS Object Attributes Test (See detail below)	Pass
QoS Behavior Test (See detail below)	Pass

8 DLR Object Tests

Object 0x47 (71)

DLR Object Test Cases	**Result**
DLR Object Attributes Test (See detail below)	Pass
DLR Behavior Test (See detail below)	Pass

10 Address Conflict Detection (ACD)Tests

10.1 ACD Test Cases	**Result**
Test Result for ACD Test Plan ran with DUT configured for HW switches or Fixed IP (N/A if no support)	N/A
Test Result for ACD Test Plan ran with DUT configured for DHCP or BOOTP (N/A if no support)	Pass

10.2 ACD Test Cases - Multi-Port devices	**Result**
Repeat 10.1 tests above for all device known CIP ports	Pass

TCP/IP TTL and Mcast Config Test Procedure & Test Report

1- Multicast Message TTL Value - Settable TTL Value

Test Procedure	
Get TCP/IP object instance attribute 8 (TTL Value)	
If General Status = 0x14, Attribute Not Supported, then end test	
Else, note current value and Set attribute 8 value to different from current value. If General Status = 0x0E, Attribute not settable, then end test	
Get TCP/IP object instance attribute 1, and observe bit 4 (Status, Mcast pending) bit	
Start WireShark	
Run Conformance Test: Development - Connection Manager - IO Connections	
Observe the current TTL value of the multicast messages in the WireShark trace	
Requirement	**Result**
Set Attribute Single service for TCP/IP object instance Attribute 8 must return success	Pass
TCP/IP object instance attribute 1, bit 4 (Status, Mcast pending) bit must be 1 if the DUT does not support immediate application of the new TTL value.	Pass
The TTL value of the multicast messages must match the original value in Attribute 8 if Mcast Pending bit is 1 - or the new value if Mcast pending bit is 0	Pass

2- Multicast Messages TTL Value - New TTL Value Applied

Test Procedure	
Power-cycle or reset DUT using reset type 0 - Power-on reset	
Observe TCP/IP object instance attribute 1, bit 4 (Status, Mcast pending) bit	
Restart WireShark	
Run Conformance Test: Development - Connection Manager - IO Connections	
Observe TTL value of DUT initiated multicast message in WireShark	
Requirement	**Result**
TCP/IP object instance attribute 1, bit 4 (Status, Mcast pending) must be reset (0)	Pass
TTL value of DUT multicast messages in WireShark must be the value set in test case above	Pass

3- Multicast Messages TTL Value - TTL Attribute Restored - DUT Reset

Test Procedure	
Perform a Type 1 Reset service to the Identity object if the device supports this reset type OR restore original TTL value (Set TCP/IP object instance attribute 8 (TTL Value) = 01 for example)	
Power cycle or reset the DUT via a Type 0 reset (only if the Set service was used)	
Get TCP/IP object instance attribute 1, and observe bit 4 (Status, Mcast pending) bit	
Start WireShark	
Run Conformance Test: Development - Connection Manager - IO Connections	
Observe TTL value of DUT initiated multicast message in WireShark	
Requirement	**Result**
TCP/IP object instance attribute 8 (TTL Value) must be 01	Pass
TCP/IP object instance attribute 1, bit 4 (Status, Mcast pending) must be 0	Pass
TTL value of DUT initiated multicast message in WireShark must be the expected original value	Pass

4- Multicast Messages Multicast Address - Attribute Changed

Test Procedure	
Get TCP/IP object instance attribute 9 (Multicast Address)	
If General Status = 0x14, Attribute Not Supported, then end test (should be supported if TTL supported) If General Status = 0x0E, Attribute not settable, then end test (should be settable if TTL settable)	
Else, note current value and Set attribute 9 value to different from current value per table to the right	
Get TCP/IP object instance attribute 1, and observe bit 4 (Status, Mcast pending) bit	
Start WireShark	
Run Conformance Test: Development - Connection Manager - IO Connections	
Observe the current Mcast address of the multicast messages in the WireShark trace	
Requirement	**Result**
Set Attribute Single service for TCP/IP object instance Attribute 9 must return success	Pass
TCP/IP object instance attribute 1, bit 4 (Status, Mcast pending) bit must be 1 if the DUT does not support immediate application of the new Mcast value.	Pass
The Mcast address of the multicast messages must match the original value in Attribute 9 if Mcast Pending bit is 1 - or the new value if Mcast pending bit is 0	Pass

5- Multicast Messages Multicast Address - New Address Applied

Test Procedure	
Power-cycle or reset DUT using reset type 0 - Power-on reset	
Observe TCP/IP object instance attribute 1, bit 4 (Status, Mcast pending) bit	
Restart WireShark	
Run Conformance Test: Development - Connection Manager - IO Connections	
Observe the current Mcast address of the multicast messages in the WireShark trace	
Requirement	**Result**
TCP/IP object instance attribute 1, bit 4 (Status, Mcast pending) must be reset (0)	Pass
Address of DUT multicast messages in WireShark must be the value set in test case above (4)	Pass

6- Multicast Messages Multicast Address - Multicast Attribute Restored - DUT Reset

Test Procedure	
Perform a Type 1 Reset service to the Identity object if the DUT supports this reset type OR restore original Mcast value to TCP/IP object instance attribute 09. (Set to 00 00 00 00 00 00 00 00 if DUT supports auto Mcast value.)	
Power cycle or reset the DUT via a Type 0 reset (only if the Set service was used)	
Get TCP/IP object instance attribute 1, and observe bit 4 (Status, Mcast pending) bit	
Get Mcast_Config value, attempt to write it back to Mcast_Config	
Start WireShark	
Run Conformance Test: Development - Connection Manager - IO Connections	
Observe the current Mcast address of the multicast messages in the WireShark trace	
Requirement	**Result**
TCP/IP object instance attribute 9 must be restored to its original value	Pass
TCP/IP object instance attribute 1, bit 4 (Status, Mcast pending) must be 0	Pass
Upon writing back the value of Mcast_Config, the device returns invalid attribute status 0x09	Pass
Address of DUT initiated multicast message in WireShark must be the expected original value	Pass

ACD Behavior Test - Manual Procedures & Test Report

1. Default Values Test Case

Test Procedure	
Connect the DUT to test system according to Figure 1	
Use the Conformance Test tool messaging tool to Get the revision value of the TCP/IP class (attr 1)	
Use the Conformance Test tool messaging tool to send a Type 1 reset request to the DUT (if supported)	
After the Reset completes, perform a Get service for TCP/IP object instance attributes 1, 10 and 11	
Requirement	**Result**
TCP/IP Object Class Attribute 1 value is 04 or higher	Pass
TCP/IP Object Instance Attribute 1 Bit 6 AcdStatus and Bit 7 AcdFault bits are both 0	Pass
TCP/IP Object Instance Attribute 10 value is 01	Pass
TCP/IP Object Instance Attribute 11 value is composed of 35 bytes - each byte is 00	Pass

2. Attribute 10 Behavior Test (Delayed Change, NV, Reset)

2.1 Test Procedure - Attribute 10 delayed change, conflict still detected	
Make sure that the DUT is connected to test system according to Figure 1	
Verify that ACD test fixture node shown in Figure 1 is properly configured: Same IP address as DUT (static address preferably), **ACD disabled**, **not connected** to Hub, Powered.	
Use the Conformance Test tool messaging tool to Set TCP/IP object instance attribute 10 to 00 (Do not power cycle the DUT)	
Start Wireshark trace on the appropriate interface	
Connect the ACD test fixture node to test system according to Figure 1	
Requirement	**Result**
DUT MS LED flashes **red** and NS LED is solid **red** [Volume 2, Ed 1.12, section F-1.2.6]	Pass
DUT does not respond to explicit message request for Device Name - attribute 7 of Identity object (ACD test fixture node responds to request)	Pass
2.2 Test Procedure - Attribute 10, NV check and conflict not detected	
Disconnect ACD test fixture node from test system	
Power cycle the DUT	
Use the Conformance Test tool messaging tool to Get the value of TCP/IP object instance attribute 1	
Use the Conformance Test tool messaging tool to Get the value of TCP/IP object instance attribute 10	
Use the Conformance Test tool messaging tool to Get the value of TCP/IP object instance attribute 11	
Connect the ACD test fixture node to test system according to Figure 1	
Use the Conformance Test tool messaging tool to Get the value of Identity object instance attribute 7	
Requirement	**Result**
Verify (Wireshark trace) that the DUT responds to the Get request for Identity object instance attribute 7 (if not, disconnect ACD test fixture node and clear the Test PC ARP cache: arp -d <<DUT IP Address>> from "DOS" command line window and try again)	N/A
TCP/IP Object Instance Attribute 1 Bit 6 AcdStatus and Bit 7 AcdFault are 0	Pass
TCP/IP Object Instance Attribute 10 value is 00	Pass
TCP/IP Object Instance Attribute 11 value is not composed of 35 - 0x00 bytes	Pass
IP conflict is not detected per [Volume 2, Ed 1.12, section F-1.2.6] - some form of degraded ACD may still be operational for the DUT (one or more LED may be **red** or Flashing **red**) - When Vendor Specific ACD algorithm is used, DUT CIP LED behavior should be consistent with their purpose as defined in [Vol 2, Ed 1.13, section 9-4].	Pass

2.3 Test Procedure - Attribute 10 reset behavior	
Disconnect ACD test fixture node from test system	
Use the Conformance Test tool messaging tool to send a Type 1 reset request to the DUT (if supported), otherwise make sure to set attribute 10 to 01 and 11 to all zeros before proceeding with the test, mark following test results as N/A.	
After the Reset completes, perform a Get service for TCP/IP object instance attributes 1, 10 and 11	
Stop Wireshark trace	
Requirement	**Result**
TCP/IP Object Instance Attribute 1 Bit 6 AcdStatus and Bit 7 AcdFault are 0	Pass
TCP/IP Object Instance Attribute 10 value is 01	Pass
TCP/IP Object Instance Attribute 11 value is composed of 35 bytes - each byte is 00	Pass

3. Conflict Detection Test Case - ACD enabled - Attribute 11 capabilities

Conduct as described below: sequence of procedures and requirements verification

3.1 Test Procedure - Attribute 11 conflict record verification - ACD Activity 02 or 03	
Connect the DUT to test system according to Figure 1	
Verify that ACD test fixture node shown in Figure 1 is properly configured: Same IP address as DUT (static address preferably), **ACD disabled**, **not connected** to Hub, Powered.	
Start Wireshark trace on the appropriate interface	
Connect the ACD test fixture node to test system according to Figure 1	
Requirement	**Result**
DUT MS LED flashes **red** and NS LED is solid **red** [Volume 2, Ed 1.12, section F-1.2.6]	Pass
DUT does not respond to explicit message request for Device Name - attribute 7 of Identity object (ACD test fixture node responds to request)	Pass
3.2 Test Procedure - Attribute 1 and 11 conflict record verification - ACD Activity 02 or 03 (continued)	
Disconnect ACD test fixture node from test system	
Unplug DUT network cable and plug it back, if DUT is unable to communicate, it's N/A. Otherwise read its TCP/IP Object Instance Attribute 1. The AcdStatus (bit 6) shall be 1.	Pass
Cycle the DUT power	
Use the Conformance Test tool messaging tool to perform a Get service for TCP/IP object instance attribute 11 and 1.	
Stop Wireshark trace	
Identify specific Wireshark trace line creating the conflict detected by DUT and copy ARP PDU below	
Conflict ARP PDU:	0001080006040002000bc31e3ffc0a8010ad880399b217ac0a8010a
Identify DUT success reply to attribute 11 get request and cut CIP Command specific data to from Wireshark and paste it in storage below.	
ACD Activity Status (1st Byte): 02	Remote MAC Addr: 00:00:bc:31:e3:ff
ARP PDU Data:	0001080006040002000bc31e3ffc0a8010ad880399b217ac0a8010a
Requirement	**Result**
Verify that the ACD Activity Status byte is 02 or 03 (OngoingDetection or SemiActiveProbe)	Pass
Verify that the Remote MAC Addr recorded is that of the the ACD test fixture node	Pass
Verify that the ARP PDU data logged is the DUT raw ARP PDU that caused it to declare an IP address conflict	Pass
Verify TCP/IP Object Instance Attribute 1 Bit 6 AcdStatus and Bit 7 AcdFault are 0	Pass

3.3 Test Procedure (continued) - Attribute 11 set test	
Set Test 1: Use the Conformance Test tool messaging tool to perform a Set service for TCP/IP object instance attribute 11 using 34 "00-bytes" in the data field	
Set Test 2: Use the Conformance Test tool messaging tool to perform a Set service for TCP/IP object instance attribute 11 using 36 "00-bytes" in the data field	
Set Test 3: Use the Conformance Test tool messaging tool to perform a Set service for TCP/IP object instance attribute 11 using 34 "00-bytes" and add one "FF-byte" at the end of the data field	
Set Test 4: Use the Conformance Test tool messaging tool to perform a Set service for TCP/IP object instance attribute 11 using one "FF-byte" at the beginning and 34 "00-bytes" in the data field	
Set Test 5: Use the Conformance Test tool messaging tool to perform a Set service for TCP/IP object instance attribute 11 using 35 "00-bytes" in the data field	
Use the Conformance Test tool messaging tool to perform a Get service for TCP/IP object instance attribute 11	
Requirement	**Result**
DUT returns a Status Code of 0x13 to the Set Test 1 attempt (Set Failure)	Pass
DUT returns a Status Code of 0x15 to the Set Test 2 attempt (Set Failure)	Pass
DUT returns a Status Code of 0x09 to the Set Test 3 attempt (Set Failure)	Pass
DUT returns a Status Code of 0x09 to the Set Test 4 attempt (Set Failure)	Pass
DUT returns a Status Code of 0x00 to the Set Test 5 attempt (Set Success)	Pass
TCP/IP Object Instance Attribute 11 value is composed of 35 bytes - each byte is 00	Pass
3.4 Test Procedure (continued) - Attribute 11 conflict record verification - ACD Activity 01	
Power down and disconnect the DUT from test system	
Verify that ACD test fixture node shown in Figure 1 is properly configured: Same IP address as DUT (static address preferably), **ACD disabled**, **connected** to Hub, Powered.	
Start Wireshark trace on the appropriate interface	
Connect the DUT to test system according to Figure 1 and power it up	
Requirement	**Result**
DUT MS LED flashes **red** and NS LED is solid **red** [Volume 2, Ed 1.12, section F-1.2.6]	Pass
DUT does not respond to explicit message request for Device Name - attribute 7 of Identity object (ACD test fixture node responds to request)	Pass
3.5 Test Procedure - Attribute 11 conflict record verification - ACD Activity 01 (continued)	
Disconnect ACD test fixture node from test system	
Unplug DUT network cable and plug it back, if DUT is unable to communicate, it's N/A. Otherwise read its TCP/IP Object Instance Attribute 1. The AcdStatus (bit 6) shall be 1.	N/A
Cycle the DUT power	
Use the Conformance Test tool messaging tool to perform a Get service for TCP/IP object instance attribute 1 and 11	
Stop Wireshark trace	
Identify specific Wireshark trace line creating the conflict detected by DUT and copy ARP PDU below	
Conflict ARP PDU:	0001080006040002000 0bc31e3ffc0a8010ad880399b217a00000000
Identify DUT success reply to attribute 11 get request and cut CIP Command specific data to from Wireshark and paste it in storage below.	
ACD Activity Status (1st Byte): 01	Remote MAC Addr: 00:00:bc:31:e3:ff
ARP PDU Data:	0001080006040002000 0bc31e3ffc0a8010ad880399b217a00000000
Requirement	**Result**
Verify that the ACD Activity Status byte is 01 (ProbeIpv4Address)	Pass
Verify that the Remote MAC Addr recorded is that of the the ACD test fixture node	Pass
Verify that the ARP PDU data corresponds to the raw ARP PDU that produced the IP conflict	Pass
Verify TCP/IP Object Instance Attribute 1 Bit 6 AcdStatus and Bit 7 AcdFault are 0	Pass

3.6 Test Procedure - Attribute 11 reset via Type 1 Reset service to the Identity object	
Use the Conformance Test tool messaging tool to send a Type 1 Reset service to the Identity object	
Use the Conformance Test tool messaging tool to perform a Get service for TCP/IP object instance attribute 1, 10, 11	
Requirement	**Result**
TCP/IP Object Instance Attribute 1 Bit 6 AcdStatus is 0 and Bit 7 AcdFault is 0	Pass
TCP/IP Object Instance Attribute 10 value is 01	Pass
TCP/IP Object Instance Attribute 11 value is composed of 35 bytes - each byte is 00	Pass
3.7 Test Procedure (continued) - Attribute 11 conflict record verification - ACD Activity 01	
Power down the DUT	
Verify that ACD test fixture node shown in Figure 1 is properly configured: Same IP address as DUT (static address preferably), **ACD enabled**, **connected** to Hub, Powered.	
Start Wireshark trace on the appropriate interface	
Power up the DUT	
Requirement	**Result**
DUT MS LED flashes **red** and NS LED is solid **red** [Volume 2, Ed 1.12, section F-1.2.6]	Pass
DUT does not respond to explicit message request for Device Name - attribute 7 of Identity object (ACD test fixture node responds to request)	Pass
3.8 Test Procedure - Attribute 1 and 11 conflict record verification - ACD Activity 01 (continued)	
Disconnect ACD test fixture node from test system	
Unplug DUT network cable and plug it back, if DUT is unable to communicate, it's N/A. Otherwise read its TCP/IP Object Instance Attribute 1. The AcdStatus (bit 6) shall be 1.	N/A
Cycle the DUT power	
Use the Conformance Test tool messaging tool to perform a Get service for TCP/IP object instance attribute 1 and 11	
Stop Wireshark trace	
Identify specific Wireshark trace line creating the conflict detected by DUT and copy ARP PDU below	
Conflict ARP PDU:	00010800060400020000bc31e3ffc0a8010ad880399b217a00000000
Identify DUT success reply to attribute 11 get request and cut CIP Command specific data to from Wireshark and paste it in storage below.	
ACD Activity Status (1st Byte): 01	Remote MAC Addr: 00:00:bc:31:e3:ff
ARP PDU Data:	00010800060400020000bc31e3ffc0a8010ad880399b217a00000000
Requirement	**Result**
Verify that the ACD Activity Status byte is 01 (ProbeIpv4Address)	Pass
Verify that the Remote MAC Addr recorded is that of the the ACD test fixture node	Pass
Verify that the ARP PDU data corresponds to the raw ARP PDU that produced the IP conflict	Pass
Verify TCP/IP Object Instance Attribute 1 Bit 6 AcdStatus and Bit 7 AcdFault are 0	Pass
3.9 Test Procedure - Attribute 11 reset via Type 1 Reset service to the Identity object	
Use the Conformance Test tool messaging tool to send a Type 1 Reset service to the Identity object	
Use the Conformance Test tool messaging tool to perform a Get service for TCP/IP object instance attribute 1, 10, 11	
Requirement	**Result**
TCP/IP Object Instance Attribute 1 Bit 6 AcdStatus is 0 and Bit 7 AcdFault is 0	Pass
TCP/IP Object Instance Attribute 10 value is 01	Pass
TCP/IP Object Instance Attribute 11 value is composed of 35 bytes - each byte is 00	Pass

4. ACD Automated Test (Timing and Behavior) with v.1.13.0.1

Test Procedure	
Connect the DUT **configured for fixed IP address (via switches or TCP/IP object instance attribute 3)** to test system according to Figure 1	
Start the Automated **ACD Test Software** from PlugFest Toolset (ACDTest.exe)	
Configure Automated **ACD Test Software** for PC adapter interface, DUT IP address and MAC Id	
Configure Automated **ACD Test Software** to run all tests and check "ACD per volume 2" checkbox as well as the "Multiport device" checkbox if appropriate for the DUT.	
Start Wireshark trace on the appropriate interface	
Click on the Start Button and follow instructions on screen	
Stop Wireshark trace	
Requirement	**Result**
No unwaived failures reported by the **ACD Test Software** (confirmed by Wireshark trace)	Pass

QoS Object Behavior Test - Manual Procedures & Test Report

1.1 Default DSCP Values Scan

Test Procedure	
Start the conformance test software - use STC file from DUT Vendor - and issue a type 1 reset service request to the Identity object	
Verify proper configuration according to Figure 1 or Figure 2 of QoS Test Setup (depends on DUT supported options)	
Use the **Object Scan** menu option of the **Tools** menu to scan instances 0 and 1, attributes 1 to 10 of class ID 72 (0x48) - QoS Object ID - Name the output file appropriately	
Open the output file (.CSV or .Log) located in the conformance tool installation folder and verify default attributes values per [Vol 2, Table 5-6.4]	
Requirement	**Result**
All values for supported instance attributes are conforming to [Vol 2 Ed 1.11 Table 5-6.4]	Pass
Instance attribute 1 value returned by device is 0, or service returns error code 0x14	Pass

1.2 Observe Use of Default DSCP Values

Test Procedure	
Start Wireshark capture on PC interface (192.168.1.1)	
Use the conformance test Messaging Tool to Get_Attribute_Single of any valid DUT object attribute	
Observe DSCP value in IP layer data packet - Differentiated Services Field associated to DUT service response to above request	
Use the conformance test Run Tests Tool in development mode to run the Connection Manager test, I/O Connections only checked	
Observe DSCP value in IP layer data packet - Differentiated Services Field associated to DUT multicast data messages	
Stop Wireshark capture	
Requirement	**Result**
Verify that the DSCP value included in the DUT Get_Attribute_Single response is 0x1b	Pass
Verify that the DSCP value included in the DUT multicast data messages is 0x1f, 0x2b, 0x2f, or 0x37 depending on the I/O connections priority supported by the DUT	Pass

1.4 Change Default DSCP Values

Test Procedure	
Use the conformance test Messaging Tool and attempt to set all the supported QoS object DSCP value attributes to **invalid** values (i.e. set attribute 2 to value 64, attribute 3 to value 65…)	
Use the conformance test Messaging Tool and attempt to set all the supported QoS object DSCP value attributes to **valid** values (i.e. set attribute 2 to value 02, attribute 3 to value 03…)	
Run test cases 1.2 and 1.3 above without power cycling the DUT or sending a type 0 reset request to the identity object	
Requirement	**Result**
Set_Attribute_Single with invalid values for all supported attributes returns an error code	Pass
Set_Attribute_Single with valid values for all supported attributes completes successfully	Pass
DSCP values observed when running test cases 1.2 and 1.3 are the same as in the original test - not the new values set in the two first steps of this test case	Pass

1.5 Observe Use of New DSCP Values

Test Procedure	
Send a type 0 reset request to the DUT identity object or cycle power to the DUT	
Run test case 1.2 above	
Requirement	**Result**
Verify that the DSCP value included in all the observable DUT originated explicit and I/O messages are the new values set in test case 1.4 above	Pass

1.7 Restore Default DSCP Values

Test Procedure	
Send a type 1 reset request to the DUT identity object (if supported) - If type 1 reset service to the identity object is not supported, restore the default values manually and stop the test at this point	
Verify proper configuration according to Figure 1 or Figure 2 of QoS Test Setup (depends on DUT supported options)	
Use the **Object Scan** menu option of the **Tools** menu to scan instances 0 and 1, attributes 1 to 10 of class ID 72 (0x48) - QoS Object ID - Name the output file appropriately	
Open the output file (.CSV or .Log) located in the conformance tool installation folder and verify default attributes values per [Vol 2 Ed 1.11 Table 5-6.4]	
Requirement	**Result**
All values for supported instance attributes are conforming to [Vol 2 Ed 1.11 Table 5-6.4]	Pass
Instance attribute 1 value returned by device is 0, or service returns error code 0x14	Pass

1.8 Observe Use of Default DSCP Values

Test Procedure	
Run test case 1.2 above	
Requirement	**Result**
Verify that the DSCP value included in the DUT Get_Attribute_Single response is 0x1b	Pass
Verify that the DSCP value included in the DUT multicast data messages is 0x1f, 0x2b, 0x2f, or 0x37 depending on the I/O connections priority supported by the DUT	Pass

1.10 Enable 802.1 Q Tagging

Test Procedure (Run only is device supports QoS object attribute 1)	
Verify proper configuration according to Figure 2 of QoS Test Setup	
Start Wireshark on both 192.168.1.1 and 10.10.10.10 interfaces	
Use the conformance test Messaging Tool to set QoS object attribute 1 value to 1 (enabled)	
Use the conformance test Messaging Tool to get attribute 1 of the identity object a few times	
Stop Wireshark capture on both interfaces	
Requirement	**Result**
Verify that QoS attribute 1 is successfully set to 1	Pass
Verify in the 192.168.1.1 Wireshark trace that no 802.1 Q tag frame is observed for the entire test case	N/A
Verify in the 10.10.10.10 Wireshark trace that the DUT does not send packets including 802.1 Q tag frame in all messages sent by the DUT after the successful completion of the setting of QoS object attribute 1 value to 1	Pass

1.11 Observe Use of 802.1 Q Tagging

Test Procedure	
Start Wireshark on both 192.168.1.1 and 10.10.10.10 interfaces	
Use the conformance test Messaging Tool to issue a type 0 reset request to the DUT identity object	
Use the conformance test Messaging Tool to get attribute 1 of the identity object a few times	
Stop Wireshark capture on both interfaces	
Requirement	**Result**
Verify in the 10.10.10.10 Wireshark trace that the DUT sends packets including 802.1 Q tag frame starting after the successful completion of the type 0 reset issued to the DUT identity object	Pass

1.12 Disable 802.1 Q Tagging

Test Procedure	
Start Wireshark on both 192.168.1.1 and 10.10.10.10 interfaces	
Use the conformance test Messaging Tool to set QoS object attribute 1 value to 0 (disabled)	
Use the conformance test Messaging Tool to get attribute 1 of the identity object a few times	
Stop Wireshark capture on both interfaces	
Requirement	**Result**
Verify in the 10.10.10.10 Wireshark trace that the DUT sends packets including 802.1 Q tag frame for all the Get_Attribute_Single messages issued to the DUT identity object	Pass

1.13 Verify Disuse of 802.1 Q Tagging

Test Procedure	
Start Wireshark on both 192.168.1.1 and 10.10.10.10 interfaces	
Use the conformance test Messaging Tool to issue a type 0 reset request to the DUT identity object	
Use the conformance test Messaging Tool to get attribute 1 of the identity object a few times	
Stop Wireshark capture on both interfaces	
Requirement	**Result**
Verify in the 10.10.10.10 Wireshark trace that the DUT does not send packets including 802.1 Q tag frame after the successful completion of the type 0 reset issued to the DUT identity object	Pass

1. DLR Baseline

1. Physical aspect and Configurability Considerations - No Test Procedure (performed above)	
Requirement	**Result**
DUT has at least 2 Ethernet ports	Pass
DUT supports 100 Mbs, full duplex, forced and auto negotiation, and **auto-MDIX in both auto negotiate and forced mode** (see Ethernet Link object test procedure - item 5 above)	Pass

2. Linear Operations

2. Test Procedure	
1. Refer to Figure 1 or Figure 2 and disconnect Cable A to produce a linear configuration	
2. Make sure to disable all DLR supervisors, set VLAN ID to 10, Ring Supervisor Precedence to 255, Becaon Interval to 100ms, Beacon Timeout to 400ms, by writing [00 FF A0 86 01 00 80 1A 06 00 00 00] to attribute 4 of the DLR object, 0x47 (71) of each of potential supervisor)	
3. Start capturing network traffic using Wireshark on Hub/Switch A and Hub/Switch B	
4. Use the Conformance test messaging tool to get all attributes of the DUT DLR object - Service 1 (Get_Attribute_ALL) on class number 71, instance 1	
5. Stop capturing network traffic with Wireshark	
Requirement	**Result**
DUT DLR attributes match **TABLE 1** below when ring is broken and includes no supervisor	Pass
No ring protocol messages were transmitted by DUT (verify with Wireshark capture)	Pass
Verify Device Capabilities recorded in DLR object (attribute 12 - capability flags in table 1) against claimed	Pass

TABLE 1 - Non supervisor capable ring nodes

Network Topology:	0	Linear Topology
Network Status:	0	Normal Operation

Additional attributes for supervisor capable ring nodes

ring supervisor status:	
ring supervisor enable:	
ring supervisor precedence:	
beacon interval:	
beacon timeout:	
DLR VLAN ID:	

Per data returned by the Get_Attribute_All service - Linear operations, step 4. Data is expected to be retruned by supervisor nodes only

Device Capabilities

Capability Flags:	0x0082	*Enter value reported and verify against specification*

3. Physical Ring Operations - No Enabled Ring Supervisor

3. Test Procedure	
1. Refer to Figure 1 or Figure 2 and re-connect Cable A to produce a physical ring configuration	
2. Make sure that all DLR supervisors are still disabled	
3. Start capturing network traffic using Wireshark on Hub/Switch A and Hub/Switch B	
4. Use the Conformance test messaging tool to get all attributes of the DUT DLR object	
5. Stop capturing network traffic with Wireshark	
Requirement	**Result**
DUT DLR attributes match **TABLE 2** below when network is a ring and includes no supervisor	N/A
No ring protocol messages were transmitted by DUT (verify with Wireshark capture)	Pass

TABLE 2 - All DLR nodes

Network Topology:	0	Linear Topology
Network Status:	2	Unexpected loop detected - (2) not required but may note that this criteria is met

4. DLR Operations - Beacon or Announce-Based Nodes

4.1 - Broken Ring/Restore Detection	
4.1.a Test Procedure	
1. Refer to Figure 1 or Figure 2 and disconnect Cable A	
2. Enable DLR supervisor - i.e. ring node @192.168.1.30 (write [01 FA A0 86 01 00 80 1A 06 00 0A 00] to attribute 4 of the supervisor device DLR object) - **Never enable DUT (if supervisor capable)**	
3. Use the Conformance test messaging tool to get all attributes of the DUT DLR object	
Requirement	**Result**
DUT DLR attributes match **TABLE 3** below when network is a broken ring and includes a supervisor	Pass

TABLE 3 - All DLR nodes

Network Topology:	1	Ring Topology
Network Status:	1	Ring Fault
Active Supervisor Address:	Valid	Should be <MACID>192.168.1.30 per figure 1 or 2

4.1.b Test Procedure	
1. Start capturing network traffic using Wireshark on Hub/Switch A and Hub/Switch B	
2. Refer to Figure 1 or Figure 2 and reconnect Cable A	
3. Use the Conformance test messaging tool to get all attributes of the DUT DLR object	
4. Stop capturing network traffic with Wireshark	
Requirement	**Result**
DUT DLR attributes match **TABLE 4** below when network is a ring and includes a supervisor	Pass
verify that beacon and announce frames are properly transmitted on both DUT ports	Pass
Verify that a Sign_on message is received on one DUT port and transmitted on the other port	Pass

TABLE 4 - All DLR nodes

Network Topology:	1	Ring Topology
Network Status:	0	Normal Operation
Active Supervisor Address:	Valid	Should be <MACID>192.168.1.30 per figure 1 or 2

4.1.c Test Procedure - Broken Ring/Restore Detection (continued)	
Repeat test procedure disconnect cable, get attributes and verify against table 3 above, reconnect cable, get DLR object attributes, verify against table 4 above for cables B, C, D and E in figure 1 or 2, and verify that a Sign_on frame is received on one DUT port and transmitted on the other port and that beacon and announce frames are properly transmitted on both DUT ports when the system recovers. Report results in table below	
Requirement - Cable B	**Result**
DUT DLR attributes match **TABLE 3** above when network is a broken ring and includes a supervisor	Pass
DUT DLR attributes match **TABLE 4** above when network is a ring and includes a supervisor	Pass
Requirement - Cable C	**Result**
DUT DLR attributes match **TABLE 3** above when network is a broken ring and includes a supervisor	Pass
DUT DLR attributes match **TABLE 4** above when network is a ring and includes a supervisor	Pass
Requirement - Cable D	**Result**
DUT DLR attributes match **TABLE 3** above when network is a broken ring and includes a supervisor	Pass
DUT DLR attributes match **TABLE 4** above when network is a ring and includes a supervisor	Pass
Requirement - Cable E	**Result**
DUT DLR attributes match **TABLE 3** above when network is a broken ring and includes a supervisor	Pass
DUT DLR attributes match **TABLE 4** above when network is a ring and includes a supervisor	Pass

4.2 - Beacon Passing	
4.2.1 - Forward	
This test is performed at the ODVA TSP with certified ring nodes and a supervisor that has been verified to send the same beacon sequence ID out both ports at the same time for every beacon sent. Sending identical sequence ID in the beacon frames simultaneously is a DLR supervisor requirement ***for this test*** but ***not*** a requirement for DLR Supervisors per the CIP specification. See ODVA for information on obtaining a DLR supervisor that behaves in this manner for this test.	
4.2.2 - Verify that DLR ring can perform this test (required once for DLR test stand readiness).	
1. Refer to figure 1, power off or remove the DUT.	
2. Start DLR Ring, start Wireshark capture. Allow all nodes to initialize. Use Wireshark capture to:	
3. Verify RING_FAULT ring state on Hub/Switch A and Hub/Switch B	
4. Verify consecutive beacon IDs in frames from each supervisor port on Hub/Switch A and Hub/Switch B. (eg. id 1, id 2, etc.)	
5. Connect Cable A into DLR Backup Supervisor in place of Cable D. (Hub/Switch B is not used for this section of the test.)	
6. Start DLR Ring, start Wireshark capture. Allow all nodes to initialize. Use Wireshark capture to:	
7. Verify that the DLR ring is in RING_NORMAL_STATE on Hub/Switch A.	
8. Verify consecutive order of two identical (***duplicate***) Beacon Sequence IDs at Hub/Switch A (eg. id 1, id 1, id 2, id 2, etc.)	
9. Verify Beacon (Sequence ID) Interval is value set in Supervisor (TSPs use 100000us for Beacon Interval)	
10. Verify that the duplicate beacon frames, sent from Supervisor appear well within 100 us of each other, (only a few us).	
4.2.3 - Verify DUT beacon passing.	
1. Configure DLR test ring according to Figure 1 (or Figure 2) with DUT and both Hub/Switches (A and B) in the ring.	
2. Start DLR Ring then start Wireshark capture. Allow all nodes to initialize.	
3. Verify that DLR ring is in RING_NORMAL_STATE for 5 secs, stop capture.	
Requirement	**Result**
Verify ***duplicate*** beacons well within 100 us of each other on Hub/Switch A and B (both sides of DUT)	Pass

4.3 - DUT Power On (Sign_on Frame)	
4.3.1 - DUT Sign_On (Run this test in both DHCP/BOOTP mode and fixed IP mode)	
1. Verify that DLR ring is RING_NORMAL with DUT in ring, then power off DUT (DUT in static IP mode or HW switch mode)	
2. Start Wireshark capture on (Hub/Switch A) and (Hub/Switch B)	
3. Power On DUT - Observe on-going capture in Wireshark - stop capturing the traffic 5 seconds after the ring status contained within the beacon data packet transitions from RING_FAULT_STATE to RING_NORMAL_STATE (See packet capture to the right for an example). If Sign_on only showed up on one port, repeat this step and watch how long it takes for the DUT to forward Sign_on on the second port.	
Requirement	**Result**
Verify that the Sign_on frame is received on one DUT port and transmitted on the other port	Pass
Verify that the DUT adds its own information (MAC ID and IP address) to the Sign_on frame list of devices before passing it on (IP address may not yet be available)	Pass
Send service 77 request to the Ring Supervisor DLR object to restart the Sign_on process. Verify that the DUT adds its IP address in the list.	Pass
Verify that the reserved field pad is set to all zeros. Note: there may be no zero pad bytes required to complete the minimum frame size (60).	Pass
Repeat Test 4.3 with DUT configured in DHCP or BOOTP mode.	Pass
Optional - requires enough ring nodes to fill the Sign On Packet - Verify that the DUT performs as specified under	N/A

4.4 - DUT Fault Response Part 1, Cables A and B

4.4.1.1 - Cable A Disconnect - Verify DUT Link_Status & Neighbor_Check_Response Frames	
1. Verify that DLR ring is functioning in RING_NORMAL state	
2. Start capturing network traffic using Wireshark on (Hub/Switch A) and (Hub/Switch B)	
3. Disconnect Cable A	
4. Stop capturing traffic after 5 seconds (i.e. after RING_FAULT state transition)	
5. Use the Conformance test messaging tool to Get_Attributes_All of the DUT DLR object	
Requirement	**Result**
Verify DUT transmits Link_Status frame on port 2 with **Status** = 0x02 (i.e. port 2 is up, port 1 is down).	Pass
Verify DUT transmits Neighbor_Check_Response on DUT port 2 with **Source Port** = 2, then also…	Pass
…verify **Request Source Port** matches **Source Port** in Neighbor_Check_Request frame from Neighbor (1)	Pass
Verify Link_Status frame header VLAN_ID value matches active ring supervisor (10). (See capture right)	Pass
DUT DLR attributes match **TABLE 3** above when network is a ring and includes a supervisor	Pass
Verify that the reserved field is set to all zeros	Pass
4.4.1.2 - Cable A Reconnect - Verify Ring Heal	
1. Refer to Figure 1 or Figure 2 and reconnect Cable A	
2. Use the Conformance test messaging tool to get all attributes of the DUT DLR object	
Requirement	**Result**
DUT DLR attributes match **TABLE 4** below when network is a ring and includes a supervisor	Pass

4.4.1.3 - Cable B Disconnect - Verify DUT Link Status and Neighbor_Check_Response Frames	
1. Verify that DLR ring is functioning in RING_NORMAL state	
2. Start capturing network traffic using Wireshark on (Hub/Switch A) and (Hub/Switch B)	
3. Referring to Figure 1 or Figure 2 of DLR Test Setup, disconnect Cable B	
4. Stop capturing traffic after 5 seconds (i.e. after RING_FAULT state transition)	
5. Use the Conformance test messaging tool to get all attributes of the DUT DLR object	
Requirement	**Result**
Verify DUT transmits Link_Status frame on port 1 with **Status** = 0x01 (i.e. port 2 is down, port 1 is up).	Pass
Verify DUT transmits Neighbor_Check_Response on DUT port 1 with **Source Port** = 1, then also…	Pass
…verify **Request Source Port** matches **Source Port** in Neighbor_Check_Request frame from Neighbor (2)	Pass
Verify that the Link_Status frame header VLAN_ID value (10) matches that of the active ring supervisor.	Pass
DUT DLR attributes match **TABLE 3** above when network is a ring and includes a supervisor	Pass
Verify that the reserved field is set to all zeros	Pass
4.4.1.4 - Cable B Reconnect - Verify Ring Heal	
1. Refer to Figure 1 or Figure 2 and reconnect Cable B	
2. Use the Conformance test messaging tool to get all attributes of the DUT DLR object	
Requirement	**Result**
DUT DLR attributes match **Table 4** above when network is a ring and includes a supervisor	Pass

4.4.2 - DUT Fault Response Part 2, Cables C and D

4.4.2.1 - Cable C - Disconnect - Verify DUT Neighbor_Status and Neighbor_Check_Request Frames	
1. Verify that DLR ring is functioning in RING_NORMAL state	
2. Start capturing network traffic using Wireshark on (Hub/Switch A) and (Hub/Switch B)	
3. Refer to Figure 1 or Figure 2 and disconnect Cable C	
4. Stop capturing traffic after 5 seconds (i.e. after RING_FAULT state transition)	
5. Use the Conformance test messaging tool to get all attributes of the DUT DLR object	
Requirement	**Result**
Verify DUT transmits Neighbor_Check_Request 3 times following disconnect, with **Source Port** = 1.	Pass
Verify DUT transmits a Neighbor_Status frame on port 2 with **Status** = 0x82 (i.e. port 2 up, port 1 down).	Pass
Verify that the Neighbor_Status frame header VLAN_ID value (10) matches that of the active ring supervisor. (See	Pass
DUT DLR attributes match **TABLE 3** above when network is a ring and includes a supervisor	Pass
Verify that the reserved field is set to all zeros	Pass

4.4.2.2 - Cable C - Reconnect - Verify Ring Heal	
1. Refer to Figure 1 or Figure 2 and reconnect Cable C	
2. Use the Conformance test messaging tool to get all attributes of the DUT DLR object	
Requirement	**Result**
DUT DLR attributes match **TABLE 4** below when network is a ring and includes a supervisor	Pass

4.4.2.3 Test Procedure - Cable D - Disconnect - Verify DUT Neighbor_Status and Neighbor_Check_Request Frames	
1. Verify that DLR ring is functioning in RING_NORMAL state	
2. Start capturing network traffic using Wireshark on (Hub/Switch A) and (Hub/Switch B)	
3. Refer to Figure 1 or Figure 2 and disconnect Cable D	
4. Stop capturing traffic after 5 seconds (i.e. after RING_FAULT state transition and related traffic)	
5. Use the Conformance test messaging tool to get all attributes of the DUT DLR object	
Requirement	**Result**
Verify DUT transmits Neighbor_Check_Request 3 times following disconnect, with **Source Port** = 2.	Pass
Verify DUT transmits a Neighbor_Status frame on port 1 with **Status** = 0x81 (i.e. port 1 up, port 2 down).	Pass
Verify that the Neighbor_Status frame header VLAN_ID value (10) matches that of the active ring supervisor. (See	Pass
DUT DLR attributes match **TABLE 3** above when network is a ring and includes a supervisor	Pass
Verify that the reserved field is set to all zeros	Pass
4.4.2.4 Test Procedure - Cable D - Reconnect - Verify Ring Heal	
1. Refer to Figure 1 or Figure 2 and reconnect Cable D	
2. Use the Conformance test messaging tool to get all attributes of the DUT DLR object	
Requirement	**Result**
DUT DLR attributes match **TABLE 4** below when network is a ring and includes a supervisor	Pass

4.5 - DUT Fault Response Part 3 - Cable E

4.5.1 Cable E - Disconnect - Observe Neighbor_Check_Request Frame	
1. Verify that DLR ring is functioning in RING_NORMAL state	
2. Start capturing network traffic using Wireshark on (Hub/Switch A) and (Hub/Switch B)	
3. Refer to Figure 1 or Figure 2 and disconnect Cable E	
4. Stop capturing the traffic 5 seconds after transition to RING_FAULT_STATE	
5. Use the Conformance test messaging tool to get all attributes of the DUT DLR object	
Requirement	**Result**
Verify that the DUT transmits a Neighbor_Check_Request frame on both ports. (see packet capture screens to the	Pass
DUT DLR attributes match **TABLE 3** above when network is a ring and includes a supervisor	Pass
Verify that the reserved field is set to all zeros	
Test Procedure - Cable E - Reconnect	
1. Refer to Figure 1 or Figure 2 and reconnect Cable E	
2. Use the Conformance test messaging tool to get all attributes of the DUT DLR object	
Requirement	**Result**
DUT DLR attributes match **Table 4** above when network is a ring and includes a supervisor	Pass

4.6 - I/O Connection Data Behavior

Test Procedure - Cable E - Disconnect/Reconnect during I/O Connection	
1. Verify that DLR ring is functional	
2. Start capturing network traffic using Wireshark on (Hub/Switch A) and (Hub/Switch B)	
3. Use the Conformance test tool to run the Connection Manager test - run only for I/O connections	
4. Refer to Figure 1 or Figure 2 and disconnect Cable E and wait for 5 seconds	
5. Reconnect cable E and wait for 2 seconds	
6. Stop capturing network traffic with Wireshark	
Requirement	**Result**
Examine the I/O SequenceNumber in the Wireshark trace to verify that the I/O data keep flowing between the Test PC and the DUT before, while, and after all the phases of the test procedure. There are no more than 3 coninuous I/O packets loss during Normal Ring	
Verify I/O data keep flowing between the Test PC and the DUT before, while, and after all the phases of the test	Pass
No more than 3 continuous unicast I/O packet loss during Normal Ring node.	Pass
No more than 3 continuous multicast I/O packet loss during Normal Ring node.	Pass