Gigabit Ethernet Consortium
Clause 28, 40, 55, & 78 Auto-Negotiation Management System Test Suite v3.0 Report

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Report Rev. 1.0

Enclosed are the results from the Clause 28, 40, 55, & 78 Auto-Negotiation Management System Conformance testing performed on:

Device Under Test (DUT):	Ethernet 9000 Switch
UNH-IOL Device Identification Number:	123456
Hardware Version:	9000
Firmware Version:	1.05
Software Version:	2014.05
System Commands:	See Auto-Negotiation Management settings table
Miscellaneous:	Port 5 tested

The test suite referenced in this report is available at the UNH-IOL website:

https://www.iol.unh.edu/sites/default/files/testsuites/ethernet/Management_System_Suite/Management_System_Test_Suite_v3.0.pdf

Testing Completed 05/14/2014

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Digitally signed by UNH-IOL
Date: 2014.05.19 16:02:11 -04'00'

Review Completed 05/15/2014

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The tables below contain summarized test results. For more details please see the detailed test results:

The Following Tests Exhibited Non-Conformant Behavior
No conformance issues were discovered during the testing process.

The Following Tests Were Either Not Performed Or Have Additional Comments	
Sys.3.3 – Parallel Detection of 100BASE-T4 Devices	The DUT was observed to not support a 100BASE-T4 PMA.

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SHA-1 Fingerprint: 44 51 9E 22 66 59 1A D3 A1 F9 0B EE BD 01 90 80 BE 61 A4 A8

Result Key

The following table contains possible results and their meanings:

Result	Interpretation
PASS	The Device Under Test (DUT) was observed to exhibit conformant behavior.
PASS with Comments	The DUT was observed to exhibit conformant behavior however an additional explanation of the situation is included, such as due to time limitations only a portion of the testing was performed.
FAIL	The DUT was observed to exhibit non-conformant behavior.
Warning	The DUT was observed to exhibit behavior that is not recommended.
Informative	Results are for informative purposes only and are not judged on a pass of fail basis.
Refer to Comments	From the observations, a valid pass or fail could not be determined. An additional explanation of the situation is included.
Not Applicable	The DUT does not support the technology required to perform these tests.
Not Available	Due to testing station or time limitations, the tests could not be performed.
Borderline	The observed values of the specified parameters are valid at one extreme, and invalid at the other.
Not Tested	Not tested due to the time constraints of the test period.

Initialization Information

The following table contains the steps taken to initialize the DUT prior to testing:

Component	Description
Software	PuTTY
Initialization Script	None
Additional Commands	None

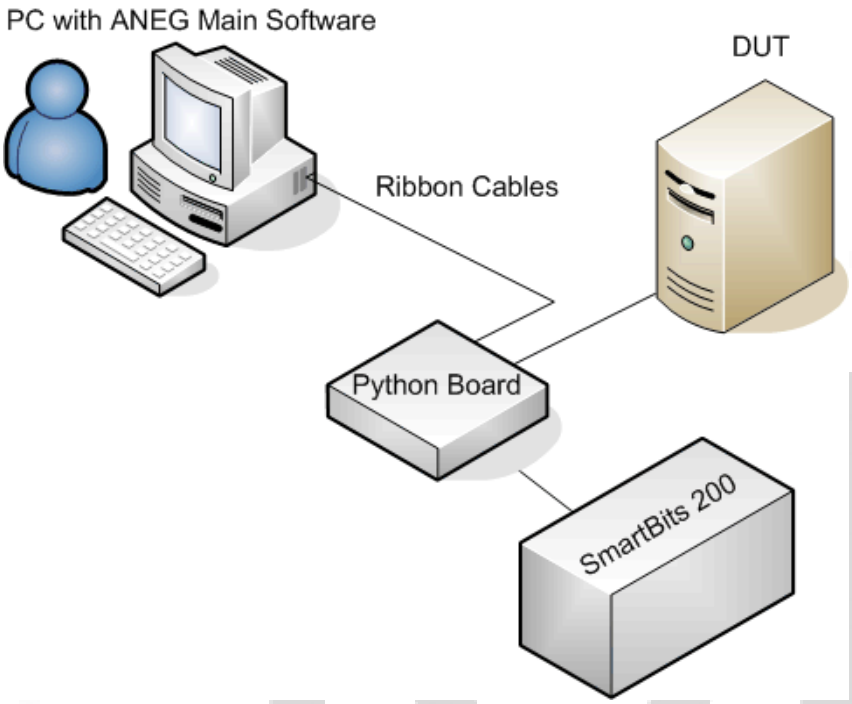
Revision History

The following table contains a revision history for this report:

Revision	Explanation
1.0	Initial version.

Test Setup

All tests were completed using the UNH-IOL created Python Board. This board allows us to view signaling transmitted and received before establishing a link, along with viewing the type of link signaling a device is transmitting. Some of our testing tools can be viewed at: http://www.iol.unh.edu/consortiums/ethernet/tools/aneg/ Some tests required the use of specific Smart Bits cards to establish a link and send packets.



DEFINITIONS

DUT: Device under test.

EEE: Energy Efficient Ethernet.

Link partner: The device at the opposite end of a link segment from the local station.

Page Sequence: A group of FLP Bursts containing a Message Page and its specified number of Unformatted Pages with proper Flag field bit values.

AUTO-NEGOTIATION MANAGEMENT SETTINGS:

Access to the necessary management controls was reached using PuTTY:

Management Settings	Command	Options
Auto-Negotiation Enable	**AN**	On/Off
Speed selection	**SP**	10G, 1000h, 1000f, 100h, 100f, 10h, 10f
Duplex selection	**Full-Duplex**	True/False
PAUSE Mode Configuration	**TXPause, RXPause**	On/Off
MASTER/SLAVE configuration	**MASTER/SLAVE**	manual_MASTER, manual_SLAVE, Auto
Energy Efficient Ethernet Enable	**EEE**	Enable/Disable

GROUP 1: ABILITY ADVERTISEMENT

Test # and Label	Part(s)	Result(s)
Sys.1.1 – Auto-Negotiation On/Off	**a**	**PASS**
	b	**PASS**
	c	**Informative**

Expected Results and Procedural Comments

Purpose: To verify that when management enables or disables Auto-Negotiation, that the DUT responds to management by transmitting a Base Page or the appropriate link signaling, respectively.

a. When Auto-Negotiation is enabled, the DUT should wait break_link_timer before transmitting a Base Page and attempting to establish a link using the Auto-Negotiation process.The DUT should not transmit link signaling until the DUT enters the FLP LINK GOOD CHECK state.
b. When Auto-Negotiation is disabled, the DUT should cease current transmission and commence transmission of appropriate link signaling.
c. INFORMATIVE: The DUT should cease Auto-Negotiation and transmit valid link signaling (based on management settings). The DUT may or may not pause before transmitting appropriate signaling. When changing between speeds and duplexes the DUT may or may not pause before sending link signaling.

Comments on Test Results

a. The DUT was observed to properly wait break_link_timer before transmitting a Base Page.
b. When the "SP" was set to:
   - "10G" – the DUT was observed to send 10GBASE-T signaling on the MDI channel.
   - "1000HD" – the DUT was observed to send 1000BASE-T signaling on the MDI channel.
   - "1000FD" – the DUT was observed to send 1000BASE-T signaling on the MDI.
   - "100HD" – the DUT was observed to send 100BASE-TX signaling on the MDI channel.
   - "100FD" – the DUT was observed to send 100BASE-TX signaling on the MDI channel.
   - "10HD" – the DUT was observed to send 10BASE-T NLPs on the MDI channel.
   - "10FD" – the DUT was observed to send 10BASE-T NLPs on the MDI channel.
c. INFORMATIVE: The DUT was observed to cease transmissions for break_link_timer before sending appropriate link signaling.

Test # and Label	Part(s)	Result(s)
Sys.1.2 – Base Page Advertisments	**a**	**PASS**
	b	**PASS**

Expected Results and Procedural Comments

Purpose: To verify that the DUT's management advertises appropriate abilities in its transmitted Base Page.

a. The technology ability field should advertise the proper abilities as indicated in Table 28-10 for the DUT's capability and current management setting.
b. The DUT should advertise Next Page and extended Next Page support if appopriate for the current managment settings.
c. The DUT should not advertise any abilities that it does not possess.

Comments on Test Results

a. On power up the DUT was observed to properly transmit a Base Page advertising 81E1.

This link codeword advertises:

- A Selector Field corresponding to 802.3.
- A Technology Ability Field corresponding to 10BASE-T half duplex, 10BASE-T full duplex, 100BASE-TX half duplex and 100BASE-TX full duplex.
- PAUSE and ASM_DIR PAUSE bits set to zero.
- Extended Next Page bit set to zero.
- Remote fault (RF) and Acknowledge (ACK) bits both set to zero.
- Next Page (NP) bit set to one.

When "SP" and "Full-Duplex" were set to:

- "1000" and "True" – the DUT was observed to transmit a Base Page advertising 81E1 and a Next Page sequence. This Next Page Sequence advertises 1000BASE-T abilities. This Base Page advertises 100BASE-TX Full-Duplex and all Full-Duplex speeds below 100BASE-TX Full-Duplex.
- "100" and "True" – the DUT was observed to transmit a Base Page advertising 100BASE-TX Full-Duplex and all Full-Duplex speeds below 100BASE-TX Full-Duplex.
- "100" and "False" – the DUT was observed to transmit a Base Page advertising 100BASE-TX Half-Duplex and all Full-Duplex speeds below 100BASE-TX Half-Duplex.
- "10" and "True" – the DUT was observed to transmit a Base Page advertising only 10BASE-T Full-Duplex.
- "10" and "False" – the DUT was observed to transmit a Base Page advertising only 10BASE-T
- Half-Duplex.

When "TXPause" and "RXPause" were set to:

- "true" and "true" – the DUT was observed to transmit a Base Page advertising 8DE1. This Base Page advertises PAUSE and ASM_DIR abilities.
- "true" and "false" – the DUT was observed to transmit a Base Page advertising 85E1. This Base Page advertises PAUSE abilities.
- "false" and "false" – the DUT was observed to transmit a Base Page advertising 81E1. This Base Page advertises no PAUSE abilities.
- "false" and "true" – the DUT was observed to transmit a Base Page advertising 89E1. This Base Page advertises ASM_DIR abilities.

When "EEE" was set to:

- "true" – the DUT was observed to transmit a Base Page advertising 81E1 and a Next Page sequence. This Next Page Sequence advertises EEE abilities.
- "false" – the DUT was observed to transmit a Base Page advertising 81E1 and a Next Page sequence. This Next Page Sequence did not advertise EEE abilities.

b. The DUT was observed to properly advertise Next Page and extended Next Page capabilities when appropriate.
c. The DUT was observed to properly possess all advertised abilities.

Test # and Label	Part(s)	Result(s)
Sys.1.3 – Next Page and Extended Next Page Advertisments	**a**	**PASS**
	b	**PASS**
	c	**PASS**

Expected Results and Procedural Comments

Purpose: To verify that the management of the DUT advertises valid Next Page and Extended Next Page abilities.

a. The first Unformatted Next Page transmitted by the DUT is observed. UP1 should advertise proper abilities as indicated in Table 40-4 for the DUT's capability and current management setting.
b. The DUT should advertise appropriate EEE abilities based on the current management settings.
c. The DUT should advertise appropriate 10GBASE-T abilities based on the current management settings.

Comments on Test Results

a. On power up the DUT was observed to source Next Pages advertising a UP1 of C018.
This Unformatted Page advertises: Single-Port, 1000BASE-T half duplex and 1000BASE-T full duplex,.

When “SP” and “Full-Duplex” were set to:
- “1000” and “True” – the DUT was observed to source Next Pages advertising a UP1 of C018. This Unformatted Page advertises: Single-Port, 1000BASE-T half duplex and 1000BASE-T full duplex,
- “1000” and “False” – the DUT was observed to source Next Pages advertising a UP1 of C010. This Unformatted Page advertises: Single-Port and 1000BASE-T half duplex

When “MASTER/SLAVE” was set to:
- “manual_MASTER” – the DUT was observed to source Next Pages advertising a UP1 of C01B. This Unformatted Page advertises: Single-Port, 1000BASE-T half duplex, 1000BASE-T full duplex, and Manual_MASTER
- “manual_SLAVE” – the DUT was observed to source Next Pages advertising a UP1 of C019. This Unformatted Page advertises: Single-Port, 1000BASE-T half duplex, 1000BASE-T full duplex, and Manual_SLAVE

b. The DUT was observed to properly source a Next Page Sequence advertising EEE. This Next Page Sequence advertises: 100BASE-TX EEE, 1000BASE-T EEE, 10GBASE-T EEE.

When “EEE Enable” was set to:
- “False” – the DUT was observed to not send a EEE Next Page Sequence.

c. On power up the DUT was observed to properly source extended Next Pages advertising E809-0000-0001.
This extended Next Page advertises: 10GBASE-T, Single-Port, Manual_SLAVE.

When “MASTER/SLAVE” was set to:
- “manual_MASTER” – the DUT was observed to source extended Next Pages advertising E809-1800-0001. This extended Next Page advertises: 10GBASE-T, Single-Port, Manual_MASTER.
- “manual_SLAVE” – the DUT was observed to source extended Next Pages advertising E809-0800-0001. This extended Next Page advertises: 10GBASE-T, Single-Port, Manual_SLAVE.

GROUP 2: PRIORITY RESOLUTION

Test # and Label	Part(s)	Result(s)
Sys.2.1 – Speed Resolution and Verification	**a**	**PASS**
	b	**PASS**
	c	**PASS**

Expected Results and Procedural Comments

Purpose: To verify that the DUT resolves a link to the highest speed possible.

a. The DUT is sent a Page Sequence advertising only one speed. All speeds are attempted. For each speed that is supported by the DUT, proper link signaling should be observed for the duration of link_fail_inhibit_timer, followed by a gap of break_link_timer.
b. The DUT is sent a Page Sequence advertising all speeds. This should cause the DUT to source link signaling of its highest common denominator for the duration of link_fail_inhibit_timer, followed by a gap of break_link_timer.
c. The DUT is sent a Page Sequence advertising no speed capabilities. This should cause the DUT to cease Base Page transmissions for break_link_timer. No link signaling should be observed.

Comments on Test Results

a. The following cases were examined:
- 10BASE-T: A Base Page advertising 4061 were sent to the DUT. The DUT was observed to source NLPs for 758.840 ms on the MDI channel (~link_fail_inhibit_timer), followed by a gap of 1.280 s (~break_link_timer). After break_link_timer expired, the DUT continued transmitting its Base Page.
- 100BASE-TX: A Base Page advertising 4181 were sent to the DUT. The DUT was observed to source constant 100BASE-TX signaling on the MDI channel for 754.210 ms (~link_fail_inhibit_timer), followed by a gap of 1.270 s (~break_link_timer). After break_link_timer expired, the DUT continued transmitting its Base Page.
- 100BASE-T4: A Base Page advertising 4201 were sent to the DUT. The DUT was observed to cease Base Page transmissions for 1.270 s (~break_link_timer) and continue transmitting its Base Page. Non-FLP Burst transmissions were not observed.
- 100BASE-T2: A Base Page advertising C001, followed by a 100BASE-T2 Next Page Sequence sent to the DUT. The DUT was observed to cease FLP Burst transmissions for 1.270 s (~break_link_timer) and continue transmitting its Base Page. Non-FLP Burst transmissions were not observed.
- 1000BASE-T: A Base Page advertising C001, followed by a 1000BASE-T Next Page Sequence were sent to the DUT. The DUT was observed to source constant 1000BASE-T signaling for 754.210 ms (~link_fail_inhibit_timer), followed by a gap of 1.270 s (~break_link _timer). After break_link_timer expired, the DUT continued transmitting its Base Page.
- 10GBASE-T: A Base Page advertising D001, followed by a 10GBASE-T extended Next Page Sequence were sent to the DUT. The DUT was observed to source constant 10GBASE-T signaling for 2005.210 ms (~link_fail_inhibit_timer), followed by a gap of 1.270 s (~break_link _timer). After break_link_timer expired, the DUT continued transmitting its Base Page.

b. The DUT was sent a Base Page advertising D001, followed by an extended Next Page Sequence advertising 1000BASE-T half duplex, 1000BASE-T full duplex, 10GBASE-T, and LD loop timing ability. The DUT was observed to source constant 10GBASE-T signaling for 2005.210 ms (~link_fail_inhibit_timer), and ceased FLP Burst tansmissions for 1.360 s (~break_link_timer).
c. The DUT was sent a Base Page advertising D001, followed by an extended Next Page Sequence with no speeds advertised. The DUT was observed to cease transmissions for 1.299 s(~break_link_timer) and then resume tranmsitting its Base Page.

Test # and Label	Part(s)	Result(s)
Sys.2.2 – Duplex Resolution and Verification	**a**	**PASS**
	b	**PASS**
	c	**PASS**

Expected Results and Procedural Comments

Purpose: To verify that the DUT will resolve a link to the highest common duplex mode.

a. A full duplex link should be established whenever both devices support full duplex for the given speed.
b. A half duplex link should be established whenever at least one device supports half duplex only.
c. When sent abilities with incompatible duplex settings, no link should be established.

Comments on Test Results

Note: The DUT advertised 10BASE-T half duplex, 10BASE-T full duplex, 100BASE-TX half duplex, 100BASE-TX full duplex, 1000BASE-T half duplex, 1000BASE-T full duplex and 10GBASE-T.

a. The DUT was observed to always establish a full duplex link whenever full duplex was the only advertised mode, and also when both full duplex and half duplex were advertised.
b. The DUT was observed to always establish a half duplex link whenever half duplex was the only advertised mode.
c. The DUT was observed to not establish a link when incompatible duplexes were advertised.

Test # and Label	Part(s)	Result(s)
Sys.2.3 – Pause Mode Resolution	**a**	**PASS**
	b	**PASS**
	c	**PASS**

Expected Results and Procedural Comments

Purpose: To verify that the DUT resolves to the proper pause mode as seen in Table 28B-3.

a. In full duplex mode, the DUT should resolve its pause mode based on Table 28B-3 and respond appropriately to PAUSE frames.
b. In full duplex mode, the DUT should resolve its pause mode based on Table 28B-3 and may tranmit PAUSE frames when appropriate.
c. The DUT should neither tranmsit nor respond to PAUSE frames while in half duplex mode.

Comments on Test Results

a. The DUT could be controlled to advertise PAUSE or no pause settings. The DUT exhibited the following behavior:

Link Partner Advertisments		Expected DUT Behavior	Observed DUT Behavior
Pause Setting	**ASM_DIR Setting**	**Receive Pause Frame**	**Receive Pause Frame**
DUT advertises PAUSE=1 ASM_DIR=1			
Yes	Yes	Yes	**Yes**
Yes	No	Yes	**Yes**
No	Yes	Yes	**Yes**
No	No	No	**No**
DUT advertises PAUSE=0 ASM_DIR=1			
Yes	Yes	No	**No**
Yes	No	No	**No**
No	Yes	No	**No**
No	No	No	**No**
DUT advertises PAUSE=1 ASM_DIR=0			
Yes	Yes	Yes	**Yes**
Yes	No	Yes	**Yes**
No	Yes	No	**No**
No	No	No	**No**
DUT advertises PAUSE=0 ASM_DIR=0			
Yes	Yes	No	**No**
Yes	No	No	**No**
No	Yes	No	**No**
No	No	No	**No**

b. The DUT could be controlled to advertise PAUSE or no pause settings. The DUT exhibited the following behavior:

Link Partner Advertisments		Expected DUT Behavior	Observed DUT Behavior
Pause Setting	**ASM_DIR Setting**	**Transmit Pause Frame**	**Transmit Pause Frame**
DUT advertises PAUSE=1 ASM_DIR=1			
Yes	Yes	Yes	**Yes***
Yes	No	Yes	**Yes***
No	Yes	No	**No***
No	No	No	**No***
DUT advertises PAUSE=0 ASM_DIR=1			
Yes	Yes	Yes	**Yes***
Yes	No	No	**No***
No	Yes	No	**No***
No	No	No	**No***
DUT advertises PAUSE=1 ASM_DIR=0			
Yes	Yes	Yes	**Yes***
Yes	No	Yes	**Yes***
No	Yes	No	**No***
No	No	No	**No***
DUT advertises PAUSE=0 ASM_DIR=0			
Yes	Yes	No	**No***
Yes	No	No	**No***
No	Yes	No	**No***
No	No	No	**No***

*Note: Even though the DUT might not be observed to source PAUSE frames, the DUT might be capable of doing so in these cases. Since there is no standardized method to cause a device to source a PAUSE frame, the DUT's behavior cannot be determined in these cases.

c. When a half duplex connection is established, the DUT was observed to not react to received PAUSE frames.

Test # and Label	Part(s)	Result(s)
Sys.2.4 – 1000BASE-T MASTER/SLAVE Resolution	**a**	**PASS**
	b	**PASS**

Expected Results and Procedural Comments

Purpose: To verify that the Master-Slave configuration for 1000BASE-T and 10GBASE-T links are resolved via Table 40-5 and 55-16.

a. The DUT should resolve the link according to Table 40-5.
b. The DUT should resolve the link according to table 55-16

Comments on Test Results

a. The DUT exhibited the following behavior.

Link Partner Advertisments with seed value	Expected DUT Behavior	Observed DUT Behavior
DUT advertises Multi-port		
Manual_MASTER (0000*h*)	SLAVE	**SLAVE**
Multi-port (0000*h*)	MASTER	**MASTER**
Multi-port (47FF*h*)	SLAVE	**SLAVE**
Multi-port (SAME)	MASTER-SLAVE Configuration Fault	**MASTER-SLAVE Configuration Fault**
Single-port (0000*h*)	MASTER	**MASTER**
Manual_SLAVE (0000*h*)	MASTER	**MASTER**
DUT advertises Manual_MASTER		
Manual_MASTER (000*h*)	MASTER-SLAVE Configuration Fault	**MASTER-SLAVE Configuration Fault**
Multi-port (0000*h*)	MASTER	**MASTER**
Single-port (0000*h*)	MASTER	**MASTER**
Manual_SLAVE (0000*h*)	MASTER	**MASTER**
DUT advertises Manual_SLAVE		
Manual_MASTER (0000*h*)	SLAVE	**SLAVE**
Multi-port (0000*h*)	SLAVE	**SLAVE**
Single-port (0000*h*)	SLAVE	**SLAVE**
Manual_SLAVE (0000*h*)	MASTER-SLAVE Configuration Fault	**MASTER-SLAVE Configuration Fault**

b. The DUT exhibited the following behavior.
DUT with Loop Timing

Link Partner Advertisments with seed value	Expected DUT Behavior	Observed DUT Behavior
DUT advertises Multi-port, & Loop Timing		
Manual_MASTER (0000*h*) & Loop Timing	SLAVE	**SLAVE**
Multi-port (0000*h*) & Loop Timing	MASTER	**MASTER**
Multi-port (47FF*h*) & Loop Timing	SLAVE	**SLAVE**
Multi-port (SAME) & Loop Timing	MASTER-SLAVE Configuration Fault	**MASTER-SLAVE Configuration Fault**
Single-port (0000*h*) & Loop Timing	MASTER	**MASTER**
Manual_SLAVE (0000*h*) & Loop Timing	MASTER	**MASTER**
DUT advertises Manual_MASTER & Loop Timing		
Manual_MASTER (000*h*) & Loop Timing	MASTER-SLAVE Configuration Fault	**MASTER-SLAVE Configuration Fault**
Multi-port (0000*h*) & Loop Timing	MASTER	**MASTER**
Single-port (0000*h*) & Loop Timing	MASTER	**MASTER**
Manual_SLAVE (0000*h*) & Loop Timing	MASTER	**MASTER**
DUT advertises Manual_SLAVE & Loop Timing		
Manual_MASTER (0000*h*) & Loop Timing	SLAVE	**SLAVE**
Multi-port (0000*h*) & Loop Timing	SLAVE	**SLAVE**
Single-port (0000*h*) & Loop Timing	SLAVE	**SLAVE**
Manual_SLAVE (0000*h*) & Loop Timing	MASTER-SLAVE Configuration Fault	**MASTER-SLAVE Configuration Fault**
DUT advertises Multi-port, & Loop Timing		
Manual_MASTER (0000*h*)	SLAVE	**SLAVE**
Multi-port (0000*h*)	SLAVE	**SLAVE**
Single-port (0000*h*)	SLAVE	**SLAVE**
Manual_SLAVE (0000*h*)	MASTER-SLAVE Configuration Fault	**MASTER-SLAVE Configuration Fault**
DUT advertises Manual_MASTER & Loop Timing		
Manual_MASTER (000*h*)	MASTER-SLAVE Configuration Fault	**MASTER-SLAVE Configuration Fault**
Multi-port (0000*h*)	MASTER-SLAVE Configuration Fault	**MASTER-SLAVE Configuration Fault**
Single-port (0000*h*)	MASTER-SLAVE Configuration Fault	**MASTER-SLAVE Configuration Fault**
Manual_SLAVE (0000*h*)	MASTER-SLAVE Configuration Fault	**MASTER-SLAVE Configuration Fault**

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DUT advertises Manual_SLAVE & Loop Timing		
Manual_MASTER (0000*h*)	SLAVE	**SLAVE**
Multi-port (0000*h*)	SLAVE	**SLAVE**
Single-port (0000*h*)	SLAVE	**SLAVE**
Manual_SLAVE (0000*h*)	MASTER-SLAVE Configuration Fault	**MASTER-SLAVE Configuration Fault**

Test # and Label	Part(s)	Result(s)
Sys.2.5 – Energy Efficient Ethernet Resolution and Verification	**a**	**PASS**
	b	**PASS**
	c	**PASS**

Expected Results and Procedural Comments

Purpose: To verify that an Energy Efficient Ethernet (EEE) link is resolved properly.

a. The DUT should resolve a EEE link if both devices advertise 100BASE-TX EEE when 100BASE-TX is the HCD.
b. The DUT should resolve a EEE link if both devices advertise 1000BASE-T EEE when 1000BASE-T is the HCD.
c. The DUT should resolve a EEE link if both devices advertise 10GBASE-T EEE when 10GBASE-T is the HCD.

Comments on Test Results

a. When both devices advertised 100BASE-TX EEE, and 100BASE-TX was the HCD, the DUT was observed to establish a 100BASE-TX EEE link. When the Link Partner did not advertise 100BASE-TX EEE, the DUT was observed to establish a 100BASE-TX link.
b. When both devices advertised 1000BASE-T EEE, and 1000BASE-T was the HCD, the DUT was observed to establish a 1000BASE-T EEE link. When the Link Partner did not advertise 1000BASE-T EEE, the DUT was observed to establish a 1000BASE-T link.
c. When both devices advertised 10GBASE-T EEE, and 10GBASE-T was the HCD, the DUT was observed to establish a 10GBASE-T EEE link. When the Link Partner did not advertise 10GBASE-T EEE, the DUT was observed to establish a 10GBASE-T link.

GROUP 3: PARALLEL DETECTION

Test # and Label	Part(s)	Result(s)
Sys.3.1 – Parallel Detection of 10BASE-T Devices	**a**	**PASS**
	b	**PASS**
	c	**Informative**

Expected Results and Procedural Comments

Purpose: To verify that a 10BASE-T capable DUT can properly parallel detect a fixed speed 10BASE-T link partner.

a. When connected to a fixed speed 10BASE-T device, a 10BASE-T capable Auto-Negotiating device should parallel detect a 10BASE-T link.
b. If a 10BASE-T link is established using Parallel Detection, it should be established in half duplex mode.
c. INFORMATIVE: If 10BASE-T is supported, and the DUT's management allows the advertisement of 10BASE-T half duplex to be disabled, then the DUT's management may also prevent Parallel Detection of 10BASE-T.

Comments on Test Results

a. When Auto-Negotiation was enabled, the DUT was observed to properly parallel detected a 10BASE-T link when 10BASE-T link signaling was received on the MDI channel.
b. After a 10BASE-T link was established, the DUT was observed to properly transmit a collision fragment indicating the DUT was in a half duplex mode of operation.
c. The DUT was observed to not allow a 10BASE-T link to be established when 10BASE-T half duplex was disabled.

Test # and Label	Part(s)	Result(s)
Sys.3.2 – Parallel Detection of 100BASE-TX Devices	**a**	**PASS**
	b	**PASS**
	c	**Informative**

Expected Results and Procedural Comments

Purpose: To verify that a 100BASE-TX capable DUT can properly parallel detect a fixed speed 100BASE-TX link partner.

a. When connected to a fixed speed 100BASE-TX device, a 100BASE-TX capable Auto-Negotiating device should parallel detect a 100BASE-TX link.
b. If a 100BASE-TX link is established using Parallel Detection, it should be established in half duplex mode.
c. INFORMATIVE: If 100BASE-TX is supported, and the DUT's management allows the advertisement of 100BASE-TX half duplex to be disabled, then the DUT's management may also prevent Parallel Detection of 100BASE-TX.

Comments on Test Results

a. When Auto-Negotiation was enabled, the DUT was observed to properly parallel detected a 100BASE-TX link when 100BASE-TX link signaling was received on the MDI channel.
b. After a 100BASE-TX link was established, the DUT was observed to properly transmit a collision fragment indicating the DUT was in a half duplex mode of operation.
c. The DUT was observed to not allow a 100BASE-TX link to be established when 100BASE-TX half duplex was disabled.

Test # and Label	Part(s)	Result(s)
Sys.3.3 – Parallel Detection of 100BASE-T4 Devices	**a**	**Not Applicable**
	b	**Not Applicable**

Expected Results and Procedural Comments

Purpose: To verify that a 100BASE-T4 capable DUT can properly parallel detect a fixed speed 100BASE-T4 link partner.

a. When connected to a fixed speed 100BASE-T4 device, a 100BASE-T4 capable Auto-Negotiating device should parallel detect a 100BASE-T4 link.
b. INFORMATIVE: If 100BASE-T4 is supported, and the DUT's management allows the advertisement of 100BASE-T4 to be disabled, then the DUT's management may also prevent Parallel Detection of 100BASE-T4.

Comments on Test Results

a. The DUT was observed to not support 100BASE-T4; therefore, this test could not be performed.
b. The DUT was observed to not support 100BASE-T4; therefore, this test could not be performed.

GROUP 4: GENERIC NEXT PAGE FUNCTIONALITY

Test # and Label	Part(s)	Result(s)
Sys.4.1 – Next Page Bit	**a**	**PASS**
	b	**PASS**
	c	**PASS**

Expected Results and Procedural Comments

Purpose: To verify that the device under test makes proper use of the Next Page bit throughout the next page exchange process.

a. When the DUT and the link partner desire to exchange the same number of Next Pages, the DUT should keep the NP bit set in all but the last Next Page sent.
b. The DUT should keep the NP bit set up until the second to last Next Page that it desires to send. The last desired Next Page and all subsequent Null Message Pages should have NP=0.
c. When the DUT desires to send more Next Pages than its link partner, the DUT should still keep the NP bit set in all but the last Next Page sent.

Comments on Test Results

a. When sent 3 Next Pages, the NP bit sent by the DUT was set in all but the last Next Page.
b. When sent 5 Next Pages, the NP bit sent by the DUT was set in all but the last 3 Next Pages.
c. When sent only Null Message Pages with NP=0, the NP bit sent by the DUT was set in all but the last Next Page.

Test # and Label	Part(s)	Result(s)
Sys.4.2 – Null Message Page Generation	**a**	**PASS**
	b	**Informative**

Expected Results and Procedural Comments

Purpose: To verify that the device under test transmits proper Null Message Pages if it completes sending Message and Unformatted Pages before its link partner.

a. When the link partner desires to send 2 more Next Pages than the DUT, the DUT should transmit validly formed Null Message Pages.
b. INFORMATIVE: When the link partner desires to send the same number of Next Pages as the DUT, the DUT may terminate the Next Page exchange by transmitting a Null Message Page.

Comments on Test Results

a. Following the last desired Next Page transmission, the DUT properly exchanged two Null Message Pages, ceasing Next Page transmissions when the last page exchanged with the link partner had NP=0.
b. The DUT did transmit a Null Message Page when the Link Partner sent 3 Next Pages to the DUT.

Test # and Label	Part(s)	Result(s)
Sys.4.3 – Reception of Next Pages	**a**	**PASS**
	b	**PASS**
	c	**PASS**

Expected Results and Procedural Comments

Purpose: To verify that the DUT behaves appropriately upon reception of Message and Unformatted Pages, for all defined Message Codes.

The DUT is sent the following Next Page Sequences, one per trial:

Message Code	Message Code Definition	Number of 16-bit Unformatted Pages
1	Null Message Code	0
2	Technology Ability Extension Code 1	1
3	Technology Ability Extension Code 2	2
4	Remote Fault Number Code	1
5	OUI Tag Code	4
6	PHY Identifier Tag Code	4
7	1000BASE-T2 Technology Message Code	2
8	1000BASE-T Technology Message Code	2
9	10GBASE-T and 1000BASE-T Technology Message Code	2
10	EEE Technology Message Code	1
11	OUI Tag Message	2 or 5

a. The DUT is sent each defined Next Page Sequence.
b. The DUT is sent each defined Next Page Sequence after a 1000BASE-T Next Page Sequence.
c. The DUT is sent each defined Next Page Sequence after a EEE Next Page Sequence

Comments on Test Results

a. The DUT was observed to accept all defined Next Page Sequences and properly complete the Next Page exchange by attempting to establish the HCD link.
b. The DUT was observed to accept all defined Next Page Sequences and properly complete the Next Page exchange by attempting to establish the HCD link.
c. The DUT was observed to accept all defined Next Page Sequences and properly complete the Next Page exchange by attempting to establish the HCD link.

GROUP 5: GENERIC EXTENDED NEXT PAGE FUNCTIONALITY

Test # and Label	Part(s)	Result(s)
Sys.5.1 – Extended Next Page and Next Page Bits	**a**	**PASS**
	b	**PASS**
	c	**PASS**
	d	**PASS**

Expected Results and Procedural Comments

Purpose: To verify that the DUT makes proper use of the Next Page and extended Next Page bits throughout the extended Next Page exchange process.

a. When the DUT and the link partner both desire to exchange extended Next Pages, the DUT should begin an extended Next Page exchange. If the DUT and the link partner do not both desire to exchange extended Next Pages, the DUT should begin a Next Page exchange.
b. When the DUT and the link partner desire to exchange the same number of extended Next Pages, the DUT should keep the NP bit set in all but the last extended Next Page sent.
c. The DUT should keep the NP bit set up until the second to last extended Next Page that it desires to send. The last desired extended Next Page and all subsequent extended Null Message Pages should have NP=0.
d. When the DUT desires to send more extended Next Pages than its link partner, the DUT should still keep the NP bit set in all but the last extended Next Page sent.

Comments on Test Results

a. When both the DUT and the Link Partner had the XNP bit set to one, the DUT was observed to send its first extneded Next Page. Otherwise, the DUT was observed to send its first Next Page.
b. When sent 1 extended Next Page, the NP bit sent by the DUT was set in all but the last extended Next Page.
c. When sent 3 extended Next Pages, the NP bit sent by the DUT was set in all but the last 3 extended Next Pages.
d. When sent only Null Message Pages with NP=0, the NP bit sent by the DUT was set in all but the last extended Next Page.

Test # and Label	Part(s)	Result(s)
Sys.5.2 – Extended Null Message Page Generation	**a**	**PASS**
	b	**Informative**

Expected Results and Procedural Comments

Purpose: To verify that the DUT transmits proper Null Message Pages if it completes sending extended Message Pages and extended Unformatted Pages before its link partner.

a. When the link partner desires to send 2 more extended Next Pages than the DUT, the DUT should transmit validly formed extended Null Message Pages.
b. INFORMATIVE: When the link partner desires to send the same number of extended Next Pages as the DUT, the DUT may terminate the extended Next Page exchange by transmitting an extended Null Message Page.

Comments on Test Results

a. Following the last desired extended Next Page transmission, the DUT properly exchanged 2 extended Null Message Pages, ceasing extended Next Page transmissions when the last page exchanged with the link partner had NP=0.
b. The DUT did transmit an extended Null Message Page when the Link Partner sent 1 extended Next Pages to the DUT.

Test # and Label	Part(s)	Result(s)
Sys.5.3 – Reception of Extended Next Pages	**a**	**PASS**
	b	**PASS**

Expected Results and Procedural Comments

Purpose: To verify that the DUT behaves appropriately upon reception of extended Message Pages and extended Unformatted Pages, for all defined Message Codes.

The DUT is sent the following sequences of extended Next Pages, one per trial:

Message Code	Message Code Definition	Number of 16-bit Unformatted Pages
1	Null Message Code	0
2	Technology Ability Extension Code 1	1
3	Technology Ability Extension Code 2	2
4	Remote Fault Number Code	1
5	OUI Tag Code	4
6	PHY Identifier Tag Code	4
7	1000BASE-T2 Technology Message Code	2
8	1000BASE-T Technology Message Code	2
9	10GBASE-T and 1000BASE-T Technology Message Code	2
10	EEE Technology Message Code	1
11	OUI Tag Message	2 or 5

a. The DUT is sent each defined extended Next Page Sequence.
b. The DUT is sent each defined extended Next Page Sequence after a 10GBASE-T extended Next Page Sequence.

Comments on Test Results

a. The DUT was observed to accept all defined extended Next Page Sequences and properly complete the extended Next Page exchange by attempting to establish the HCD link.
b. The DUT was observed to accept all defined extended Next Page Sequences and properly complete the extended Next Page exchange by attempting to establish the HCD link.

GROUP 6: 1000BASE-T NEXT PAGE FUNCTIONALITY

Test # and Label	Part(s)	Result(s)
Sys.6.1 – 1000BASE-T Message and Unformatted Page Transmission Order	**a**	**PASS**
Expected Results and Procedural Comments		

Purpose: To verify that the 1000BASE-T DUT transmits its Base Page, followed immediately by a properly formatted 1000BASE-T Message Page and two Unformatted Pages.

a. The DUT should transmit its Base Page, followed immediately by a Message Page, and two Unformatted Pages.
   - The Message Page should contain a Message Code #8.
   - The MP bit (D13 the 14th of the 16 bits) should be set to 1 in the first Next Page and 0 in the second and third pages.

Comments on Test Results

a. The DUT desired to transmit four pages. The DUT was observed to transmit a Base Page, a Message Page advertising Message Code #8, with bit D13 set to 1, followed by two Unformatted Pages with bit D13 set to 0.

Test # and Label	Part(s)	Result(s)
Sys.6.2 – Content and Format of 1000BASE-T UP2	**a**	**PASS**
Expected Results and Procedural Comments		

Purpose: To verify that the DUT transmits random seed values in its second Unformatted Page after the 1000BASE-T Message Page.

a. The second Unformatted Page (UP2) transmitted after the 1000BASE-T Message Page should contain a pseudo-random value.

Comments on Test Results

a. In five observations, the second Unformatted Page transmitted by the DUT was observed to contain: 4BB1, 4B6D, 4ECE, 4ED1, and 4BDC. Based on these observations, and observations made throughout the testing process, the Unformatted Code Field value transmitted appeared to be pseudo-random.

Test # and Label	Part(s)	Result(s)
Sys.6.3 – 1000BASE-T Next Page Sequence Reception	**a**	**PASS**
	b	**PASS**
	c	**PASS**
	d	**PASS**
	e	**PASS**

Expected Results and Procedural Comments

Purpose: To verify that the DUT only attempts to establish a 1000BASE-T link upon reception of a 1000BASE-T Next Page Sequence where the Page Sequence is properly encoded.

The following test cases were sent to the DUT:

a. A Base Page, followed by a 1000BASE-T Next Page Sequence with a Null Message Page in place of UP2.
b. A Base Page, followed by a 1000BASE-T Next Page sequence with the Message Page bit not set in the first Next Page.
c. A Base Page, followed by a 1000BASE-T Next Page sequence but with the Message Page bit set in UP1.
d. A Base Page, followed by a 1000BASE-T Next Page sequence but with the Message Page bit set in both UP1 and UP2.
e. A Base Page followed by a Message Code #0 followed by two Unformatted Pages that conform to valid 1000BASE-T Unformatted Next Pages. This is repeated 8 more times with the following Message Code values: 0x9, 0x101, 0x108, 0x109, 0x501, 0x508, 0x509, and 0x7FF.

In all cases, if the link partner has not finished transmission of Message and Unformatted Pages, transmit the appropriate number of Null Pages.

a.-d.The DUT should not attempt to establish a 1000BASE-T link when the Message Page bit is improperly set during the Next Page exchange.
e. The DUT should not establish a 1000BASE-T link with the Link Partner when the Link Partner transmitted a Message Page with a Message Code not equal to Message Code #8.

Comments on Test Results

a. The DUT was observed to not establish a 1000BASE-T link.
b. The DUT was observed to not establish a 1000BASE-T link.
c. The DUT was observed to not establish a 1000BASE-T link.
d. The DUT was observed to not establish a 1000BASE-T link.
e. The DUT was observed to not establish a 1000BASE-T link.

Test # and Label	Part(s)	Result(s)
Sys.6.4 – 1000BASE-T Message Page Reception	**a**	**Informative**
	b	**PASS**

Expected Results and Procedural Comments

Purpose: To verify that the DUT establishes a 1000BASE-T link upon reception of a properly formatted 1000BASE-T Message Page regardless of any additional pages sent after the 1000BASE-T exchange.

a. INFORMATIVE: The DUT may establish a 1000BASE-T link when a 1000BASE-T Next Page Sequence is sent not immediately after the Base Page. The DUT was sent a Base Page followed by Messsage Code #20 and 2 Unformatted Pages, followed by a 1000BASE-T Next Page Sequence.
b. The DUT should establish a 1000BASE-T link regardless of any Message Codes exchanged after a 1000BASE-T Next Page Sequence. The DUT was sent a Base Page followed by a 1000BASE-T Next Page Sequence followed by a Message Code #0 and 2 Unformatted Pages. This is repeated 8 more times with the following Message Code values: 0x9, 0x101, 0x108, 0x109, 0x501, 0x508, 0x509, and 0x7FF.

Comments on Test Results

a. The DUT was observed to not establish a 1000BASE-T link.
b. The DUT was observed to establish a 1000BASE-T link.

GROUP 7: 10GBASE-T EXTENDED NEXT PAGE FUNCTIONALITY

Test # and Label	Part(s)	Result(s)
Sys.7.1 – 10GBASE-T Message Page Transmission	**a**	**PASS**
Expected Results and Procedural Comments		
Purpose: To verify that the 10GBASE-T DUT transmits its Base Page, followed immediately by a properly formatted 10GBASE-T extended Message Page. a. The DUT should transmit its Base Page, followed immediately by a 10GBASE-T extended Message Page. • The Message Page should contain a Message Code #9. • The MP bit (D13 the 14th of the 48 bits) should be set to 1 in the first extended Next Page.		
Comments on Test Results		
a. The DUT desired to transmit two pages. The DUT was observed to transmit a Base Page and an Extended Next Page advertising Message Code #9 with bit D13 set to 1.		

Test # and Label	Part(s)	Result(s)
Sys.7.2 – Content and Format of 10GBASE-T Unformatted Code Field	**a**	**PASS**
Expected Results and Procedural Comments		
Purpose: To verify that the DUT transmits random seed values in bits U10:0 of the 10GBASE-T extended Message Page. a. Bits U10:0 transmitted in the 10GBASE-T Message Page should contain a pseudo-random value.		
Comments on Test Results		
a. In five observations, bits U10:0 transmitted in the 10GBASE-T Message Page was observed to contain: 7BA, 6DE, 54D, 3EC, and ABC. Based on these observations, and observations made throughout the testing process, the Unformatted Code Field value transmitted appeared to be pseudo-random.		

Test # and Label	Part(s)	Result(s)
Sys.7.3 – 10GBASE-T Page Reception	**a**	**PASS**
	b	**PASS**

Expected Results and Procedural Comments

Purpose: To verify that the DUT only attempts to establish a 10GBASE-T link upon reception of a 10GBASE-T extended Next Page Sequence where the flag field is properly encoded.

The following test cases were sent to the DUT:

a. A Base Page, followed by a 10GBASE-T Message Page with the Message Page bit not set.
b. A Base Page followed by an extneded Message Code #0 with an Unformatted Code Field that conform to valid 10GBASE-T Code Field. This is repeated 7 more times with the following Message Code values: 0x101, 0x108, 0x109, 0x501, 0x508, 0x509, and 0x7FF.

In all cases, if the link partner has not finished transmission of extended Message Pages, transmit the appropriate number of extended Null Pages.

a. The DUT should not attempt to establish a 10GBASE-T link when the Message Page bit is improperly set during the extended Next Page exchange.
b. The DUT should not establish a 10GBASE-T link with the Link Partner when the Link Partner transmitted an extended Message Page with a Message Code not equal to Message Code #9.

Comments on Test Results

a. The DUT was observed to not establish a 10GBASE-T link.
b. The DUT was observed to not establish a 10GBASE-T link.

Test # and Label	Part(s)	Result(s)
Sys.7.4 – Message Page Reception Before and Following a 10GBASE-T Exchange	**a**	**Informative**
	b	**PASS**

Expected Results and Procedural Comments

Purpose: To verify that the DUT only receives properly formatted extended Message Pages.

a. INFORMATIVE: The DUT may establish a 10GBASE-T link when a 10GBASE-T extended Next Page Sequence is sent not immediately after the Base Page. The DUT was sent a Base Page followed by Messsage Code #20 followed by a 10GBASE-T extended Next Page Sequence.
b. The DUT should establish a 10GBASE-T link regardless of any Message Codes exchanged after a 10GBASE-T extended Next Page Sequence. The DUT was sent a Base Page followed by a 10GBASE-T extended Next Page Sequence followed by a Message Code #0. This is repeated 7 more times with the following Message Code values: 0x101, 0x108, 0x109, 0x501, 0x508, 0x509, and 0x7FF.

Comments on Test Results

a. The DUT was observed to not establish a 10GBASE-T link.
b. The DUT was observed to establish a 10GBASE-T link.

GROUP 8: ENERGY EFFICIENT ETHERNET NEXT PAGE FUNCTIONALITY

Test # and Label	Part(s)	Result(s)
Sys.8.1 – EEE Message and Unformatted Page Transmission Order	**a**	**PASS**

Expected Results and Procedural Comments

Purpose: To verify that a EEE capable DUT transmits its Base Page, and EEE Message and Unformatted Pages immediately after its ability advertisements.

a. The DUT should transmit its Base Page, followed immediately by a Message Page, and 1 Unformatted Page. The Message Page should contain a Message Code #10. The MP bit should be set to 1 in the first Next Page and 0 in the second page.
b. The DUT should transmit its Base Page, followed immediately by a 1000BASE-T Next Page Sequence, followed immediately by a Message Page, and 1 Unformatted Page. The Message Page should contain a Message Code #10. The MP bit should be set to 1 in the first and the fourth Next Page and set to 0 in the second, and third and fifth Next Pages.
c. The DUT should tranmsit its Base Page, followed immeidately by a 10GBASE-T extended Next Page advertising EEE abilities.

Comments on Test Results

a. The DUT desired to transmit three pages. The DUT was observed to transmit a Base Page, a Message Page advertising Message Code #10 with bit D13 set to 1 followed by one Unformatted Page with bit D13 set to 0.
b. The DUT desired to transmit six pages. The DUT was observed to transmit a Base Page, a 1000BASE-T Next Page Sequence followed by a Message Page advertising Message Code #10 with bit D13 set to 1 followed by one Unformatted Page with bit D13 set to 0.
c. The DUT desired to transmit two pages. The DUT was observed to transmit a Base Page and an Extended Next Page advertising Message Code #9 with bit D13 set to 1.

Test # and Label	Part(s)	Result(s)
Sys.8.2 – EEE Page Sequence Reception	**a**	**PASS**
	b	**PASS**
	c	**PASS**
	d	**PASS**
	e	**PASS**

Expected Results and Procedural Comments

Purpose: To verify that the DUT only attempts to establish a EEE link upon reception of a EEE Next Page Sequence where the Page Sequence is properly encoded.

The following test cases were sent to the DUT:

a. A Base Page, followed by a EEE Next Page Sequence with the Message Page bit not set in the first Next Page. This is repeated inserting a 1000BASE-T Next Page Sequence before the EEE Next Page Sequence.
b. A Base Page, followed by a EEE Next Page Sequence but with the Message Page bit set in UP1 This is then repeated inserting a 1000BASE-T Next Page Sequence before the EEE Next Page Sequence.
c. A Base Page followed by a Message Code #0 followed by one Unformatted Page that conform to valid EEE Unformatted Next Page. This is repeated 7 more times with the following Message Code values: 0x8, 0x9, 0x101, 0x10A, 0x501, 0x50A, and 0x7FF.

In all cases, if the link partner has not finished transmission of Message and Unformatted Pages, transmit the appropriate number of Null Pages.

a.-b. The DUT should not attempt to establish a 1000BASE-T link when the Message Page bit is improperly set during the Next Page exchange.
c. The DUT should not establish a EEE link with the Link Partner when the Link Partner transmitted a Message Page with a Message Code not equal to Message Code #10.

Comments on Test Results

a. The DUT was observed to not establish a EEE link.
b. The DUT was observed to not establish a EEE link.
c. The DUT was observed to not establish a EEE link.

Test # and Label	Part(s)	Result(s)
Sys.8.3 – EEE Message Page Reception	**a**	**Informative**
	b	**PASS**

Expected Results and Procedural Comments

Purpose: To verify that the DUT only receives properly formatted Message Pages.

a. INFORMATIVE: The DUT may establish a EEE link when a 1000BASE-T Next Page Sequence is sent not immediately after the Base Page or 1000BASE-T Next Page Sequence. The DUT was sent a Base Page followed by Messsage Code #20 followed by a EEE Next Page Sequence. This is repeated, inserting a 1000BASE-T Next Page Sequence immediately before the EEE Next Page Sequence.
b. The DUT should establish a EEE link regardless of any Message Codes exchanged after a EEE Next Page Sequence. The DUT was sent a Base Page followed by a EEE Next Page Sequence followed by a Message Code #0. This is repeated 7 more times with the following Message Code values: 0x101, 0x108, 0x109, 0x501, 0x508, 0x509, and 0x7FF. This procedure is repeated, inserting a 1000BASE-T Next Page Sequence immediately before the EEE Next Page Sequence.

Comments on Test Results

a. The DUT was observed to not establish a EEE link.
b. The DUT was observed to establish a EEE link.