



Gigabit Ethernet Consortium

Clause 37 Auto Negotiation Conformance Test Suite

v1.4.3 Report

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Enclosed are the results from the Clause 37 Auto Negotiation Conformance testing performed on:

Device Under Test (DUT):	Product Model (if it's a module state that and what chassis was used)
Hardware Version:	Hardware Version (if not available use N/A)
Firmware Version:	Firmware Version (if not available use N/A)
Software Version:	Software Version (if not available use N/A)
Miscellaneous:	Ports used, any configuration info, Driver OS, etc

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

ftp://ftp.iol.unh.edu/pub/ethernet/test_suites/CL37_ANEG/ANEG37_Test_Suite_v1.4.3.pdf

Issues Observed While Testing

37.1.2 Ill-Formed and Invalid /C/ Code Handling: The DUT did not restart auto-negotiation upon reception of invalid codes, the DUT was observed to send abilities with the Acknowledge bit set.

37.4.1 Full/Half Duplex Resolution: Full/Half Duplex Resolution shows that the DUT was observed to establish a link when no common duplex modes were advertised between the DUT and the link partner.

37.4.2 Pause Mode Resolution: The DUT was observed to improperly implement the Pause Mode Resolution Function.

For specific details regarding issues please see the corresponding test result.

Testing Completed 02/08/2006

Review Completed 02/08/2006

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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 or 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.

Group 1: Configuration Ordered Sets

Test # and Label	Part(s)	Result(s)
37.1.1 Configuration Ordered Set Format	a	PASS
	b	PASS
Expected Results and Procedural Comments		
<p>Purpose: To verify that Config_Reg is properly encoded into the Configuration Ordered Sets and that the ordered sets are properly transmitted.</p> <p>a. All transmitted Configuration ordered sets should alternate in form between /C1/ and /C2/.</p> <p>b. The Config_Reg should be mapped to the /C/ ordered sets whereby the first byte contains tx_Config_Reg<D7:0> and the second byte contains tx_Config_Reg<D15:8>.</p>		
Comments on Test Results		
<p>a. With the DUT's receiver disconnected, /C/ ordered set transmission of 0000h was observed over several minutes. All /C/ ordered sets properly alternated between /C1/ and /C2/. With the DUT's receiver connected, and receiving a constant stream of 0000h /C/ codes, /C/ ordered set transmission of 00A0h was observed over several minutes from the DUT. Again, all /C/ ordered sets properly alternated between /C1/ and /C2/. Additionally, the transition from /C/ ordered set transmission of 0000h to 00A0h was observed and verified to properly alternate between /C1/ and /C2/.</p> <p>b. The Config_Reg sent by the DUT is 00A0, and is properly mapped to /C/ codes via /K28.5/(D21.5 or D2.2) /D0.5/D0.0/. When the DUT set the ACK bit, the observed /C/ codes properly changed to: /K28.5/(D21.5 or D2.2) /D0.5/D0.2/.</p>		

Test # and Label	Part(s)	Result(s)
37.1.2 Ill-Formed and Invalid /C/ Code Handling	a	PASS
	b	FAIL
Expected Results and Procedural Comments		
<p>Purpose: To verify that invalid codes, received while xmit=(CONFIGURATION+IDLE), cause auto-negotiation to restart, and that only Ordered Sets that are four bytes in length, that begin with /K28.5/(D21.5 or D2.2)/ are treated as valid configuration ordered sets.</p> <p>a. Reception of non-alternating /C/ codes should not effect the DUT's setting of its ACK bit in its outgoing Config_Reg.</p> <p>b. Continuous reception of sequences with invalid codes should result in transitions to RX_INVALID and cause auto-negotiation to continuously restart. All transitions to RX_INVALID defined in Figure 36-7a are explored.</p>		
Comments on Test Results		
<p>a. The DUT properly sets its ACK bit upon reception of either a continuous stream of valid /C1/ codes, or /C2/ codes.</p> <p>b. When the following code sequences were sent continuously, the DUT sent abilities with ACK bit set:</p> <ul style="list-style-type: none"> • /K28.5/D21.5/K28.5/D21.5 ... • /K28.5/D2.2/K28.5/D2.2 ... • /K28.5/D21.5/D0.3 /K28.5/D2.2/D0.3 /K28.5/D21.5/D0.3 /K28.5/D2.2/D0.3 ... • /K28.5/D21.5/D0.3/D0.0/D0.3/K28.5/D2.2/D0.3/D0.0/D0.3/K28.5/D21.5/D0.3/D0.0/D0.3 /K28.5/D2.2/D0.3/D0.0/D0.3 ... • /K28.5/D0.3/D0.0 ... • /K28.5/D16.2/K27.7/D16.2 /K28.5/D16.2/K27.7/D16.2 ... • /K27.7/D16.2/K27.7/D16.2 ... • /K27.7/D21.5/D0.3/D0.0 /K27.7/D2.2/D0.3/D0.0 /K27.7/D21.5/D0.3/D0.0 /K27.7/D2.2/D0.3/D0.0 ... • (Ending RD+) /+K28.5/+D2.2/-D0.3/+D0.0 /+K28.5/-D21.5/-D0.3/+D0.0 ... {D2.2 RD is flipped} • (Ending RD+) /+K28.5/-D21.5/+D0.3/-D0.0 /-K28.5/+D2.2/-D0.3/+D0.0 ... {1st D0.3 RD is flipped} • (Ending RD+) /+K28.5/-D21.5/-D0.3/-D0.0 /-K28.5/+D2.2/-D0.3/+D0.0 ... {1st D0.0 RD is flipped} • (Ending RD+) /+K28.5/-D21.5/-D0.3/+D0.0 /-K28.5/+D2.2/-D0.3/+D0.0 /+K28.5/-D21.5/-D0.3/+D0.0 /+K28.5/-D2.2/+D0.3/-D0.0 /-K28.5/+D21.5/+D0.3/-D0.0 /-K28.5/+D2.2/-D0.3/+D0.0 ... {1st -K28.5 is invalid, should be +K28.5} • (Ending RD+) /+K28.5/-D21.5/-D0.3/+D0.0 /+K28.5/-D2.2/+D0.3/-D0.0 /+K28.5/-D21.5/-D0.3/+D0.0 /+K28.5/-D2.2/+D0.3/-D0.0 /-K28.5/+D21.5/+D0.3/-D0.0 /-K28.5/+D2.2/-D0.3/+D0.0 ... {3rd +K28.5 is invalid, should be -K28.5} • (Ending RD-) /K28.5/D21.5/D0.3 /K28.5/D2.2/D0.3 ... {begins with RD- but ends with RD+} 		

Group 2: Config_Reg Transmission

Test # and Label	Part(s)	Result(s)
37.2.1 Base Page Advertised Abilities	a	PASS
	b	PASS
	c	PASS
Expected Results and Procedural Comments		
<p>Purpose: To verify that the DUT transmits acceptable technology abilities, and proper initial values for reserved, RF, ACK and NP bits.</p> <ol style="list-style-type: none"> The DUT should not advertise any abilities that it does not possess. The reserved bits should be transmitted as zero. The NP bit should be transmitted as one only if the DUT has next pages to transmit 		
Comments on Test Results		
<ol style="list-style-type: none"> DUT advertises 01A0: Full duplex , Symmetric Pause (PS1), and Asymmetric Pause (PS2). All reserved bits were always observed to be zero. The NP bit was set to zero by default. 		

Test # and Label	Part(s)	Result(s)
37.2.2 Link Timer	a	PASS
Expected Results and Procedural Comments		
<p>Purpose: To verify that the implemented link_timer is within 10 ms to 20 ms.</p> <ul style="list-style-type: none"> To measure the transition from AN_RESTART to ABILITY_DETECT, the DUT was sent a repeating sequence of break link, then 20 /C/ ordered sets encoded with 41A0, then 20 /C/ ordered sets encoded with 0000, then Idle then the sequence repeats. This sequence causes an auto-negotiation restart, however as the DUT already is synchronized, the duration of the transmission of /C/ ordered sets encoded with 0000 (break link) should be approximately link timer in duration. To measure the transition from COMPLETE_ACKNOWLEDGE to IDLE_DETECT, the DUT was sent a stream of Idle, then 20 /C/ ordered sets encoded with 41A0, then a constant stream of Idle. The duration for which the DUT sent /C/ ordered sets with ACK was monitored To measure the transition from IDLE_DETECT to LINK_OK, the DUT was sent the same sequence as described above. The duration for which the DUT sent /I/ ordered sets was monitored. 		
Comments on Test Results		
<ul style="list-style-type: none"> On the transition from AN_RESTART to ABILITY_DETECT - /C/ ordered sets encoded with 0000 were observed several times, the minimum observed time was 10.00 ms. On the transition from COMPLETE_ACKNOWLEDGE to IDLE_DETECT - abilities with ACK set were observed several dozen times, the minimum observed time was 10.00 ms. 		

Test # and Label	Part(s)	Result(s)
37.2.3 Break Link Content	a	PASS
	b	PASS
	c	PASS
Expected Results and Procedural Comments		
<p>Purpose: To verify that the DUT transmits Break Link containing rx_Config_Reg<D15:D0>=0 prior to entering ABILITY_DETECT.</p> <p>a. The DUT should constantly source break link when no signal is received.</p> <p>b. When a link is attached, the DUT should transmit break link for only link_timer, then source its abilities.</p> <p>c. Upon auto-negotiation restart, the DUT should source break link.</p>		
Comments on Test Results		
<p>a. When no fiber was attached to the receiver of the DUT, the DUT was observed to constantly source break link.</p> <p>b. Once valid signaling was received, after a fixed time, the DUT transitioned from sending break link to its abilities.</p> <p>c. When the device restarts auto-negotiation, it properly transmitted /C/ ordered sets containing all zeros.</p>		

Test # and Label	Part(s)	Result(s)
37.2.4 Next Page Bit	a	PASS
Expected Results and Procedural Comments		
<p>Purpose: To verify that the DUT sets the Next Page (NP) bit while the DUT desires the NP exchange.</p> <p>a. The DUT should keep NP = 1 for all pages exchanged, excluding the final page the DUT desires to transmit.</p>		
Comments on Test Results		
<p>a. The DUT was observed to set NP = 1 if no more next pages were desired.</p>		

Test # and Label	Part(s)	Result(s)
37.2.5 Null Message Page	a	PASS
Expected Results and Procedural Comments		
<p>Purpose: To verify that the DUT properly sends Null Message Pages when the DUT desires to cease NP exchange.</p> <p>a. The DUT should send null message pages with NP = 1 when it desires to cease NP exchange.</p>		
Comments on Test Results		
<p>a. The DUT was observed to properly transmit null message pages.</p>		

Test # and Label	Part(s)	Result(s)
37.2.6 Toggle Bit	a	PASS
Expected Results and Procedural Comments		
<p>Purpose: To verify that the DUT properly sets the toggle bit (T) in all transmitted next pages.</p> <p>The value of the toggle bit of the next page transmitted by the DUT should always take the opposite value of the toggle bit of the previous next page.</p>		
Comments on Test Results		
a. The DUT was observed to properly alternate the toggle bit with every different next page it transmitted.		

Test # and Label	Part(s)	Result(s)
37.2.7 Message Page and Unformatted Page Encoding	a	PASS
Expected Results and Procedural Comments		
<p>Purpose: To verify that the DUT properly encodes Message and Unformatted pages.</p> <p>a. All Message pages should have MP=1, and all Unformatted pages should have MP=0. All Message pages transmitted by the DUT should contain a valid message code.</p>		
Comments on Test Results		
a. The DUT was observed to properly encode message and unformatted pages		

Group 3: Config_Reg Reception

Test # and Label	Part(s)	Result(s)
37.3.1 Ability Match	a	PASS
	b	PASS
	c	PASS
	d	PASS
	e	PASS
	f	PASS
Expected Results and Procedural Comments		
<p>Purpose: To verify that the DUT enters the ACKNOWLEDGE_DETECT state upon reception of three consecutive and consistent Config_Reg values, ignoring the ACK bit.</p> <p>a. The DUT should not exit the ABILITY_DETECT state when receiving /C/ ordered sets containing all zeros.</p> <p>a. When receiving identical Config_Reg values, the DUT should exit ABILITY_DETECT regardless of the Config_Reg value. The following values will be tested: 0020, 0040, 0060, 00a0, 00c0, 00e0, 0120, 0140, 0160, 01a0, 01c0, 01e0, and 0fff.</p> <p>b. When receiving inconsistent (alternating) Config_Reg values, the DUT should not exit ABILITY_DETECT, with the exception of an alternating value of the ACK bit. The DUT is sent a sequence of /C/ ordered sets encoded with 01e0 and a value one bit different from 01e0. All one bit different values are tested.</p> <p>c. The DUT should exit the ABILITY_DETECT state only when three consecutive and identical /C/s are received.</p> <p>d. An Idle code received between the reception of identical /C/s should reset the match count.</p> <p>e. A non-identical /C/ code received between the reception of identical /C/s should reset the match count.</p>		
Comments on Test Results		
<p>a. The DUT did not exit ABILITY_DETECT when receiving a repeating pattern of /C/ ordered sets containing all zeros.</p> <p>b. DUT enters ACKNOWLEDGE_DETECT and sets the ACK bit for all sets of Config_Reg values tested.</p> <p>c. The DUT was not observed to send abilities with ACK. When the Config_Reg values differ only by the ACK bit, the DUT properly sends abilities with ACK.</p> <p>d. The DUT was observed to exit the ABILITY_DETECT state when 3 /C/ ordered sets were received.</p> <p>e. The DUT was observed to reset its match count upon reception of /I/ ordered sets in between /C/ ordered sets.</p> <p>f. The DUT was observed to reset its match count upon reception of a non-identical /C/ code in between identical /C/ codes.</p>		

Test # and Label	Part(s)	Result(s)
37.3.2 Acknowledge Match	a	PASS
	b	PASS
	c	PASS
	d	PASS
Expected Results and Procedural Comments		
<p>Purpose: To verify that the DUT enters the COMPLETE_ACKNOWLEDGE state upon reception of three consecutive and consistent Config_Reg values, including the ACK bit.</p> <p>a. The DUT was sent a repeating sequence of 20 /C/ ordered sets encoded with 01a0 (ACK bit not set), then a fixed number of identical /C/ codes with ACK bit set.</p> <p>b. When receiving alternating Config_Reg values (all with the ACK bit set) the DUT should not exit the ACKNOWLEDGE_DETECT state. The DUT is sent a sequence of /C/ ordered sets encoded with 41A0 and a value one bit different from 41A0. All one bit different values are tested.</p> <p>c. An Idle code received between the reception of identical /C/s with ACK set should reset the match count.</p> <p>d. A non-identical /C/ code received between the reception of identical /C/s should reset the match count.</p>		
Comments on Test Results		
<p>a. The DUT was observed to enter the COMPLETE_ACKNOWLEDGE state upon the reception of 3 identical /C/ codes with ACK bit set.</p> <p>b. The DUT was not observed to exit the ACKNOWLEDGE_DETECT state for all 15 values tested.</p> <p>c. The match count was observed to be reset upon the reception of Idle codes.</p> <p>d. The match count was observed to be reset upon the reception of /C/ codes.</p>		

Test # and Label	Part(s)	Result(s)
37.3.3 Consistency Match	a	PASS
	b	PASS
	c	PASS
Expected Results and Procedural Comments		
<p>Purpose: To verify that the DUT performs a consistency match test based on results of the ability_match and acknowledge_match function.</p> <p>a. The DUT is sent break link, then a continuous Config_Reg values of 01e0 followed by a continuous pattern of Config_Reg values with the ACK bit set but otherwise one bit different from 01e0. The DUT should restart auto-negotiation.</p> <p>b. The DUT is sent break link for several seconds followed by a continuous pattern of /C/ ordered sets encoded with 0140, followed by a continuous pattern of /C/ ordered sets encoded with 01E0, followed by a continuous pattern of /C/ ordered sets encoded with 41E0, and finally Idle constantly. The DUT should break link and restart auto-negotiation.</p> <p>c. The DUT is sent break link, then 3, 4 or 5 /C/ ordered sets encoded with 41a0, and finally Idle constantly. The DUT should establish a link once 4 /C/ ordered sets have been received.</p>		
Comments on Test Results		
<p>a. The DUT was observed to restart auto-negotiation when all /C/ ordered set combinations were received.</p> <p>b. The DUT was observed to restart auto-negotiation.</p> <p>c. The DUT was observed to establish a link after receiving 4 /C/ ordered sets.</p>		

Test # and Label	Part(s)	Result(s)
37.3.4 Idle Match	a	PASS
	b	PASS
	c	PASS
Expected Results and Procedural Comments		
<p>Purpose: To verify that the DUT enters the LINK_OK state upon reception of three consecutive /I/ ordered sets and expiration of link_timer.</p> <p>a. Reception of any two code-group pattern beginning with /K28.5/ followed by a D code other than D21.5 or D2.2 should be treated as the reception /I/ ordered sets.</p> <p>b. Reception of /C/ ordered sets prior to the reception of three consecutive /I/ ordered sets should prevent the DUT from entering LINK_OK.</p> <p>c. A continuous pattern of 3 /I/ ordered sets followed by one /C/ should allow the DUT to enter and remain in the LINK_OK state.</p>		
Comments on Test Results		
<p>a. The following Idle stream test patterns properly allowed the DUT to establish a link, as indicated by the passing of traffic between the DUT and testing station:</p> <ul style="list-style-type: none"> • /-K28.5/+D16.2/-K28.5/+D16.2/-K28.5/+D16.2 ... • /+K28.5/-D5.6/-K28.5/+D5.6/+K28.5/-D5.6 ... • /+K28.5/-D5.6/-K28.5/+D16.2/-K28.5/+D5.6/+K28.5/-D16.2 ... • /-K28.5/+D16.2/-K28.5/+D10.2/+K28.5/-D16.2/+K28.5/-D10.2 ... • /-K28.5/+D10.2/+K28.5/-D10.2/-K28.5/+D10.2 ... • /+K28.5/-D16.2/+K28.5/-D16.2 ... • /+K28.5/-D5.6/-K28.5/+D10.2/+K28.5/-D5.6/-K28.5/+D10.2 ... <p>EDIT ME</p> <p>b. The following Idle stream test patterns properly caused the DUT to not establish a link when sent continuously.</p> <ul style="list-style-type: none"> • /-K28.5/+D16.2/-K28.5/+D2.2/-D0.0/-D0.3/+K28.5/-D5.6/-K28.5/+D21.5/+D0.0/+D3.0 ... • 2x(/-K28.5/+D16.2)/-K28.5/+D2.2/-D0.0/-D0.3/+K28.5/-D5.6/-K28.5/+D16.2/-K28.5/+D21.5/+D0.0/+D0.3 <p>EDIT ME</p> <p>c. When this pattern was sent, the DUT was observed to establish a link.</p>		

Test # and Label	Part(s)	Result(s)
37.3.5 Reception of NP Bit	a	PASS
	b	PASS
<p>Purpose: To verify that the DUT properly enters into a next page exchange upon receipt of NP=1.</p> <p>a. The DUT should enter into Next Page exchange only when its NP bit is set and it receives a base page with the NP bit set.</p> <p>b. The DUT should not enter into a Next Page exchange when either link partner's NP bit is not set.</p>		
Comments on Test Results		
<p>a. The DUT was observed to enter into the Next Page exchange only when the NP bit was set and it received a base page with the NP bit set.</p> <p>b. The DUT was not observed to enter into a Next Page exchange when receiving /C/ codes with the NP bit set while the NP bit of the DUT was not set.</p>		

Test # and Label	Part(s)	Result(s)
37.3.6 Reception of RF Bits	a	PASS
	b	PASS
Expected Results and Procedural Comments		
<p>Purpose: To observe the behavior of the DUT upon receipt of non-zero Remote Fault (RF) bits, and verify that the RF bit (1.4) is set in management.</p> <p>a. The DUT should properly complete the auto-negotiation process regardless of the RF bit values received in the Base Page sent by its link partner.</p> <p>b. The DUT should set bit 1.4 (Remote Fault) in the GMII Management Registers if the Remote Fault function is supported.</p>		
Comments on Test Results		
<p>a. The DUT was observed to establish a link when receiving /C/ ordered sets with any of the RF bits set.</p> <p>b. Bit 1.4 was set in the GMII Management Register when the Remote Fault function was enabled.</p>		

Test # and Label	Part(s)	Result(s)
37.3.7 Reception of Reserved Bits	a	PASS
Expected Results and Procedural Comments		
<p>Purpose: To observe the behavior of the DUT upon receipt of non-zero Reserved bits.</p> <p>a. The DUT should properly complete the auto-negotiation process regardless of the Reserved bit values received in the Base Page sent by its link partner.</p>		
Comments on Test Results		
<p>a. The DUT was observed to establish a link when the Reserved bits were set.</p>		

Test # and Label	Part(s)	Result(s)
37.3.8 Reception of Toggle Bit	a	PASS
Expected Results and Procedural Comments		
<p>Purpose: To verify the DUT checks the value of the toggle bit (T) when transitioning from NEXT_PAGE_WAIT to ACKNOWLEDGE_DETECT.</p> <p>a. At any time the DUT is receiving a new next page, with bit D11 untoggled, the DUT should not set its ACK bit in its outgoing Config_Reg.</p>		
Comments on Test Results		
<p>a. The DUT was not observed to set its ACK bit if bit D11 was not toggled.</p>		

Test # and Label	Part(s)	Result(s)
37.3.9 NP_RX Flag	a	PASS
Expected Results and Procedural Comments		
<p>Purpose: To verify the DUT properly stores the received Config_Reg NP value in the np_rx flag.</p> <p>a. The DUT should continue to transmit new next pages while the link partners NP bit is set to 1.</p>		
Comments on Test Results		
<p>a. The DUT was observed to complete the proper exchange of all pages sent.</p>		

Test # and Label	Part(s)	Result(s)
37.3.10 Message and Unformatted Page Handling	a	PASS
	b	PASS
	c	PASS
Expected Results and Procedural Comments		
<p>Purpose: To verify that the DUT properly receives Message and Unformatted pages.</p> <p>a. All Message/Unformatted pages should be received by the device following the typical base-page exchange protocol as per the Auto-Negotiation state diagram.</p> <p>b. Upon receipt of Message code #4, followed by an unformatted code of #0, the DUT may provide a Remote Fault indication in its transmitted Config_Reg.</p> <p>c. If observable (either at the MDI or via management), Message codes sent without MP=1, should have no effect.</p>		
Comments on Test Results		
<p>a. The DUT properly receives both message and unformatted next pages.</p> <p>b. The DUT did not automatically transmit RF bits, see tests 6.1-6.3 for more details.</p> <p>c. Next pages sent without MP = 1 did not effect the DUT.</p>		

Group 4: Link Resolution

Test # and Label	Part(s)	Result(s)
37.4.1 Full/Half Duplex Resolution	a	Informative
	b	FAIL
	c	FAIL
Expected Results and Procedural Comments		
<p>Purpose: To verify that the DUT properly configures the highest common denominator duplex mode.</p> <p>a. If the DUT advertises both full and half duplex capability, then it should resolve to a full duplex mode in all cases where the FD bit received is set.</p> <p>b. The DUT is configured to advertise only full duplex. The DUT is sent break link, sufficient /C/ ordered sets encoded with 0040 (half duplex only) followed by /C/ ordered sets encoded with 4040 followed by Idle. No link should be permanently established as no common duplex mode is supported between the two link partners. This procedure is repeated with the device configured to advertise only half duplex, and sent 0020 and 4020 accordingly.</p> <p>c. The DUT is sent Idle, sufficient /C/ ordered sets encoded with 4000 followed by Idle. No link should be permanently established as no duplex mode was specified.</p>		
Comments on Test Results		
<p>a. The DUT was not observed to advertise half duplex capability.</p> <p>b. The DUT was observed to establish a link.</p> <p>c. The DUT was observed to establish a link.</p>		

Test # and Label	Part(s)	Result(s)
37.4.2 Pause Mode Resolution	a	FAIL
	b	Not Applicable
	c	Not Applicable
Expected Results and Procedural Comments		
<p>Purpose: To verify that the DUT properly configures the proper pause mode based upon table 37-4.</p> <p>a. Full duplex links are established with the DUT via auto-negotiation, with all applicable pause modes advertised. Depending on the DUT's advertised pause capabilities, the proper pause mode should be resolved as per table 37-4. This can be verified by observing if the DUT ceases frame transmission upon receipt of pause frames, or generates pause frames when heavily loaded. As such, the DUT is sent a continuous sequence of valid 64-byte ICMP echo requests and valid Pause frames with a maximum pause time, all frames are separated with a minimum inter-packet gap. b. The DUT should not respond to or send pause frames when the link resolved is half duplex.</p> <p>a.</p>		
Comments on Test Results		
<p>a. This test was not performed since the DUT does not explicitly show what pause mode has been resolved. Please see the Flow Control report for additional information pertaining to this subject.</p> <p>b. The DUT was not observed to resolve a half duplex link.</p>		

Test # and Label	Part(s)	Result(s)
37.4.3 Link resolution with a Manually Configured Port	a	PASS
Expected Results and Procedural Comments		
<p>Purpose: To verify that the DUT does not establish a link when auto-negotiation is disabled on the link partner.</p> <p>a. When the DUT with auto-negotiation enabled is connected to a link partner with auto-negotiation disabled, the DUT should not leave the ABILITY_DETECT state.</p>		
Comments on Test Results		
<p>a. The DUT was not observed to exit the ABILITY_DETECT state.</p>		

Group 5: Auto-Negotiation Restart

Test # and Label	Part(s)	Result(s)
37.5.1 Reception of Break link	a	PASS
	b	PASS
Expected Results and Procedural Comments		
<p>Purpose: To verify that the DUT restarts auto-negotiation upon receipt of rx_Config_Reg<D15:D0>=0000.</p> <p>a. The DUT is constantly sent /C/ ordered sets encoded with 0000. Once the DUT commences transmission of /C/ ordered sets encoded with a non-zero value, the continued reception of 0000 from the link partner should not cause the DUT to restart auto-negotiation.</p> <p>b. Reception of a Config_Reg of all zero while the DUT is in the ACKNOWLEDGE_DETECT, COMPLETE_ACKNOWLEDGE, NEXT_PAGE_WAIT, or IDLE_DETECT states should restart auto-negotiation, causing the DUT to transmit a zero Config_Reg.</p>		
Comments on Test Results		
<p>a. Once the DUT commenced transmission of its abilities, the continued reception of 0000 was not observed to cause the DUT to restart auto-negotiation.</p> <p>b. In this part the transition from two states was tested, and both properly restarted auto-negotiation.</p> <ul style="list-style-type: none"> • For the transition from ACKNOWLEDGE_DETECT, the DUT was sent Idle, 20 /C/ codes encoded with 01A0 then 20 /C/ codes encoded with 0000 then Idle. The DUT was observed to properly transmit break link and restart auto-negotiation. • For the transition from COMPLETE_ACKNOWLEDGE, the DUT was sent Idle, 100 /C/ codes encoded with 41A0, then 20 /C/ codes encoded with 0000 then Idle. Again, the DUT was observed to properly transmit break link and restart auto-negotiation. 		

Test # and Label	Part(s)	Result(s)
37.5.2 Reception of an_sync_status FAIL	a	PASS
	b	PASS
Expected Results and Procedural Comments		
<p>Purpose: To verify that the DUT properly restarts auto-negotiation upon indication of an_sync_status=FAIL and resumes auto-negotiation upon an_sync_status=OK.</p> <p>a. A link is established with the DUT. The DUT is then sent a stream of D0.0 codes where every code is an RD error. Simultaneously, the number of Idle codes transmitted by the DUT is counted. The DUT should continue to send Idle codes for approximately link_timer before restarting auto-negotiation and transmitting break link.</p> <p>b. With the DUT still receiving the invalid stream in part a, the DUT is then sent valid /C/ codes and the number of break link codes transmitted by the DUT are counted. The DUT should detect an_sync_status=OK almost instantly and then cease break link transmission link_timer after an_sync_status=OK.</p>		
Comments on Test Results		
<p>a. The DUT was observed to properly cease Idle transmission 10.00 ms after the reception of the invalid stream.</p> <p>b. The DUT was observed to cease break link transmission 10.00 ms after reception of the valid stream.</p>		

Test # and Label	Part(s)	Result(s)
37.5.3 Reception of /C/ Codes in Link OK	a	PASS
	b	PASS
Expected Results and Procedural Comments		
<p>Purpose: To verify that the DUT restarts auto-negotiation upon receipt /C/ codes which cause ability_match=TRUE while xmit=DATA.</p> <p>a. Auto-negotiation is completed between the DUT and the testing station. The DUT is then sent Idle then one to (x) number of consecutive identical /C/ ordered sets followed by Idle where (x) is one less than the value required to set ability_match=TRUE. The DUT should not restart auto-negotiation due to the reception of /C/ ordered sets which does not cause an ability_match=TRUE to occur.</p> <p>b. Auto-negotiation is completed between the DUT and the testing station. The DUT is then sent Idle then a sufficient number of consecutive identical /C/ codes to cause ability_match=TRUE. The DUT should restart auto-negotiation.</p>		
Comments on Test Results		
<p>a. The DUT was not observed to restart auto-negotiation due to the reception of two /C/ codes in Link OK.</p> <p>b. The DUT was observed to restart auto-negotiation due to the reception of three /C/ codes in Link OK.</p>		

Test # and Label	Part(s)	Result(s)
37.5.4 Reception of an_enableCHANGE=TRUE	a	PASS
	b	PASS
Expected Results and Procedural Comments		
<p>Purpose: To verify that the DUT properly restarts auto-negotiation upon indication of an_enableCHANGE=TRUE which should occur whenever the auto-negotiation mode is enabled/disabled.</p> <p>a. Auto-negotiation is enabled on the DUT and it is sent a valid stream such that it remains in the ABILITY_DETECT state. Auto-negotiation is then disabled on the DUT. The DUT should immediately transition to a manual link and transmit Idle.</p> <p>b. Auto-negotiation is now enabled on the DUT. The DUT should immediately transition to the transmission of break link.</p>		
Comments on Test Results		
<p>a. The DUT was observed to send Idle after auto-negotiation was disabled.</p> <p>b. The DUT was observed to source break link after auto-negotiation was enabled.</p>		

Group 6: Remote Fault Function

Test # and Label	Part(s)	Result(s)
37.6.1 Possible Offline Indication	a	PASS
Expected Results and Procedural Comments		
<p>Purpose: To observe if the DUT uses the Remote Fault function to signal Offline prior to being removed from the active configuration</p> <p>a. A device that elects to support the Remote Fault function may use the remote fault encoding of 0b01 in the transmitted Config_Reg to indicate that the station is about to go offline. This may occur prior to the station powering off, running transmitter tests, or removing itself from the active configuration.</p>		
Comments on Test Results		
<p>a. The DUT is capable of correctly transmitting a config_reg with a remote fault encoding of 0b01, however the software required to implement this function was not present at the time of testing.</p>		

Test # and Label	Part(s)	Result(s)
37.6.2 Possible Link_Failure Indication	a	PASS
Expected Results and Procedural Comments		
<p>Purpose: To observe if the DUT uses the Remote Fault function to indicate a previous link failure.</p> <p>a. A device that elects to support the Remote Fault function may use the remote fault encoding of 0b10 in the transmitted Config_Reg to indicate it has previously detected a link failure. A link failure may be signaled when an_sync_status=FAIL. Once an_sync_status=TRUE the stored remote fault signaling may be transmitted.</p>		
Comments on Test Results		
<p>a. The DUT is capable of correctly transmitting a config_reg with a remote fault encoding of 0b10, however the software required to implement this function was not present at the time of testing.</p>		

Test # and Label	Part(s)	Result(s)
37.6.3 Auto_Negotiation Error	a	PASS
Expected Results and Procedural Comments		
<p>Purpose: To observe if the DUT uses the Remote Fault function to indicate that the link partners are incompatible.</p> <p>a. A device that elects to support the Remote Fault function must use the remote fault encoding of 0b11 in the transmitted Config_Reg to indicate that auto-negotiation cannot resolve the link partners abilities to a compatible link. One possible scenario is a device that supports only full duplex operation and a link partner that supports only half duplex operation.</p>		
Comments on Test Results		
<p>a. The DUT is capable of correctly transmitting a config_reg with a remote fault encoding of 0b11, however the software required to implement this function was not present at the time of testing.</p>		

Test # and Label	Part(s)	Result(s)
37.6.4 RF Set Duration	a	PASS
Expected Results and Procedural Comments		
<p>Purpose: When the Remote Fault function is in use, this test verifies that RF remains set until the DUT enters the IDLE_DETECT state.</p> <p>a. A device that elects to support the Remote Fault function must not reset the RF encoding until the device transitions to the IDLE_DETECT state during Base Page exchange, thus ensuring that the link partner receives the fault indication. This test observes the DUT's transmitted RF bits when signaling a remote fault, in order to determine if the device continues sending the RF code until the IDLE_DETECT state is entered.</p>		
Comments on Test Results		
<p>a. The DUT was keep the remote fault bits properly set until it reached the IDLE_DETECT state.</p>		

Test # and Label	Part(s)	Result(s)
37.6.5 Possible Remote Fault Message Page	a	PASS
Expected Results and Procedural Comments		
<p>Purpose: To observe if the DUT uses Remote Fault Message Pages to communicate additional fault information.</p> <p>a. A device that elects to support the Remote Fault function may use the Next Page exchange process to convey additional information regarding the fault. To do so, the device must enter into a Next Page exchange with its link partner and send a Message Page whose Message Code Field contains the value 4 signifying that "one Unformatted Page with Binary coded Remote fault information follows", and then the device must transmit an Unformatted Page whose Message Code Field contains one of four defined values: 0- "RF Test", used to test Remote Fault operation, 1- "Link Loss", 2- "Jabber", 3- "Parallel Detection Fault" (not applicable in 802.3z).</p>		
Comments on Test Results		
<p>a. The DUT is capable of next page exchange with the proper message and unformatted pages.</p>		

Group 7: Management

Test # and Label	Part(s)	Result(s)
37.7.1 AN Advertisement Register	a	PASS
Expected Results and Procedural Comments		
<p>Purpose: To verify that the Advertisement Register is reflected in the /C/ codes transmitted by the DUT.</p> <p>a. The first non-zero /C/ ordered sets transmitted from the DUT should contain the bit values 15,13:12 and 8:5 written to register 4.</p>		
Comments on Test Results		
<p>a. The DUT was observed to transmit the proper /C/ ordered set encoded with the values of register 4.</p>		

Test # and Label	Part(s)	Result(s)
37.7.2 AN Link Partner Ability Register	a	PASS
Expected Results and Procedural Comments		
<p>Purpose: To verify that the Link Partner Ability Register is set according to table 37-6 based on the received /C/ codes transmitted to the DUT.</p> <p>a. The DUT should convert the received /C/ ordered set and store it in register 5.</p>		
Comments on Test Results		
<p>a. Register 5 contained the exact values of the /C/ ordered set that was received by the DUT.</p>		

Test # and Label	Part(s)	Result(s)
37.7.3 AN Next Page Transmit Register	a	PASS
Expected Results and Procedural Comments		
<p>Purpose: To verify that the Link Partner Ability Register is set according to table 37-6 based on the received /C/ codes transmitted to the DUT.</p> <p>b. The DUT should convert the received /C/ ordered set and store it in register 5.</p>		
Comments on Test Results		
<p>a. Register 5 contained the exact values of the /C/ ordered set that was received by the DUT.</p>		

Test # and Label	Part(s)	Result(s)
37.7.4 AN Link Partner Ability Next Page Register	a	PASS
Expected Results and Procedural Comments		
<p>Purpose: To verify that the Link Partner Ability Next Page Register is set according to table 28-4 based on the received /C/ codes transmitted to the DUT.</p> <p>a. The DUT should convert the received message page and store it in register 8.</p>		
Comments on Test Results		
<p>a. Register 8 contained the exact values of the message page that was received by the DUT.</p>		

Test # and Label	Part(s)	Result(s)
37.7.5 Auto-Negotiation Complete	a	PASS
Expected Results and Procedural Comments		
<p>Purpose: To verify that bit 1.5 is set upon entrance to the LINK_OK state.</p> <p>a. With auto-negotiation enabled, the DUT should not set bit 1.5 until it has entered the LINK_OK state.</p>		
Comments on Test Results		
<p>a. The DUT was not observed to set bit 1.5 until it entered the LINK_OK state.</p>		

Test # and Label	Part(s)	Result(s)
37.7.6 Auto-Negotiation Enable	a	PASS
Expected Results and Procedural Comments		
<p>Purpose: To verify that bit 0.12 sets mr_an_enable, which selects Auto-Negotiation/Manual mode.</p> <p>a. The DUT should only attempt auto-negotiation if bit 0.12 is set.</p>		
Comments on Test Results		
<p>a. When bit 0.12 is not set, the DUT is in manual configuration mode and is observed to transmit idle. When bit 0.12 is set, the DUT was observed to begin the auto-negotiation process.</p>		

Test # and Label	Part(s)	Result(s)
37.7.7 Main Reset	a	PASS
Expected Results and Procedural Comments		
<p>Purpose: To verify that bit 0.15 causes Auto-Negotiation to restart.</p> <p style="margin-left: 40px;">a. When bit 0.15 is set, the DUT should completely reset all the PHY settings to their default values and restart auto-negotiation.</p>		
Comments on Test Results		
<p>a. The DUT was observed to restart auto-negotiation and reset the PHY settings.</p>		

Test # and Label	Part(s)	Result(s)
37.7.8 Auto-Negotiation Restart	a	PASS
Expected Results and Procedural Comments		
<p>Purpose: To verify that bit 0.9 causes auto-negotiation to restart.</p> <p style="margin-left: 40px;">a. When bit 0.9 is set, the DUT should restart auto-negotiation without changing the PHY settings back to their default values.</p>		
Comments on Test Results		
<p>a. The DUT was observed to properly restart auto-negotiation when bit 0.9 was set.</p>		

Test # and Label	Part(s)	Result(s)
37.7.9 Page Received Setting/Resetting	a	PASS
Expected Results and Procedural Comments		
<p>Purpose: To verify that mr_page_rx is set when a new page is received, and cleared when the AN Expansion register is read.</p> <p style="margin-left: 40px;">a. The DUT should set bit 6.1 once for every new page received.</p>		
Comments on Test Results		
<p>a. The DUT was observed to only set bit 6.1 once for each new page received.</p>		

Test # and Label	Part(s)	Result(s)
37.7.10 mr_np_loaded	a	PASS
Expected Results and Procedural Comments		
<p>Purpose: To verify that mr_np_loaded is set on write to the Next Page Transmit Register, and cleared in states AN_RESTART or NEXT_PAGE_WAIT.</p> <p>a. The DUT should not transmit next pages unless the link partner acknowledges its base pages, the DUT should also not transmit a second next page unless the link partner has acknowledged its first next page.</p>		
Comments on Test Results		
<p>a. The DUT was not observed to transmit a new next page until the link partner set its ACK bit.</p>		

Test # and Label	Part(s)	Result(s)
37.7.11 Link Status	a	PASS
Expected Results and Procedural Comments		
<p>Purpose: To verify that bit 1.2 is properly set based on the value of XMIT.</p> <p>a. The DUT should set bit 1.2 if XMIT = DATA.</p>		
Comments on Test Results		
<p>a. The DUT was observed to set bit 1.2 if XMIT = DATA when auto-negotiation was enabled as well as when auto-negotiation was disabled.</p>		

Annex A: Test Setup

Test Equipment

The following test equipment was used in performing all Clause 37 ANEG testing:

Testing Equipment	Brand and Version Information
PC Requirements	Win2K with LabVIEW 7.1 and a GPIB interface
Software	SmartWindows 8.00.162, UNH-IOL TIGER System Software, UNH-IOL Custom PCS Testing software v3.0
Logic Analyzer	HP 16500B with Logic Analyzer module 16555A and Pattern Generator module 15552A
Traffic Generator/Sniffer	SMB 2000 Chassis with GX-1405B 1000BASE-SX module
TIGER Board with Cub	Custom Testing System designed by UNH-IOL in collaboration with Texas Instruments
Splitter	Two AMP Multimode Splitters: 2-107842-3

Test Configuration

The following configuration was used in performing all Clause 37 ANEG testing:

