



Cortina Systems® LXT9785/9785E 8-port Fast Ethernet 10/100 Mbps Physical Layer Transceiver Cable Diagnostics

Application Note

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Contents

1.0	Introduction.....	5
1.1	What You Will Find In This Document.....	5
2.0	Overview of Cable Diagnostics.....	6
2.1	Registers Used for Cable Diagnostics.....	6
2.1.1	Enabling Cable Diagnostics.....	6
2.1.2	Starting a Cable Diagnostics Test.....	6
2.1.3	Completion of the Cable Diagnostics Test.....	6
2.1.4	Detecting a Short Circuit.....	7
2.1.5	Detecting an Open Circuit.....	7
2.1.6	Detecting an Improperly Terminated Cable.....	7
2.2	Distance to the Fault.....	8
3.0	Design Considerations.....	9
3.1	Link Partner Activity.....	9
3.2	Auto-Negotiation.....	9
3.3	Auto MDI/MDIX, MDIX, and MDI Considerations.....	9
3.3.1	Timing Constraints for Switching Between MDI/MDIX.....	10
3.4	Internal Loopback.....	10
3.5	Power-Down and Transmit Disable.....	10
3.6	IP Phone.....	11
3.7	Possible Link Partners and Cable Conditions.....	11
3.7.1	Expected Results.....	11
4.0	Recommended Algorithm.....	12
4.1	Main Test Suite.....	12
4.2	Secondary Test.....	13
4.3	Processing of Secondary Test Results.....	13
4.4	End_of_Test.....	14
4.5	Options to Polling.....	14
4.6	Indeterminate Faults.....	14
5.0	Example Cable Diagnostic Results.....	16
5.1	Tests with No Link Partner.....	16
5.1.1	Test Setups With No Link Partner.....	16
5.1.2	No Link Partner – Open.....	16
5.1.3	Short Between Each Twisted-Pair.....	18
5.2	Tests With Link Partners.....	19
5.2.1	Test Setup With Link Partners.....	19
5.2.2	10BASE-T Link Partners.....	20
5.2.3	100BASE-T Link Partners.....	21
5.2.4	Auto-Negotiation Link Partners.....	22
5.2.5	IP Phone Link Partners.....	23
5.2.6	Auto MDI/MDIX Link Partners.....	24
6.0	Summary.....	26

Figures

1	Recommended Cable Diagnostics Flow Chart Algorithm.....	15
2	Test Setup With No Link Partner	16
3	Test Setup for Link Partners	19
4	IP Phone Test Setup	19

Tables

1	Cable Diagnostics Test Results With No Link Partner	17
2	Cable Diagnostics Test Results for Shorts on Both Pairs	18
3	Cable Diagnostics Test Results with a 10BASE-T Link Partner	20
4	Cable Diagnostics Test Results with a 100BASE-T Link Partner	21
5	Cable Diagnostics Test Results with an Auto-Negotiation Link Partner	22
6	Cable Diagnostics Test Results with an IP Phone	23
7	Cable Diagnostics Test Results with an Auto MDI/MDIX Link Partner in Auto-Negotiation	24
8	Cable Diagnostics Test Results with an Auto MDI/MDIX Link Partner in Forced 100 Mbps	25

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1.0 Introduction

This application note provides detailed information and recommendations for the Cortina Systems® LXT9785/9785E 8-port Fast Ethernet 10/100 Mbps Physical Layer Transceiver (LXT9785/9785E Transceiver) Cable Diagnostics features.

Each port contains Cable Diagnostics capabilities that assist system designers in detecting severe cable problems and network managers in debugging network cable behavior.

1.1 What You Will Find In This Document

This document contains the following sections:

- [Section 2.0, *Overview of Cable Diagnostics*, on page 6](#) provides an overview of the LXT9785/9785E Transceiver Cable Diagnostics features.
- [Section 3.0, *Design Considerations*, on page 9](#) lists items to consider when initiating Cable Diagnostics testing.
- [Section 4.0, *Recommended Algorithm*, on page 12](#) provides an example algorithm used for Cable Diagnostics testing.
- [Section 5.0, *Example Cable Diagnostic Results*, on page 16](#) provides example Cable Diagnostics testing results.
- [Section 6.0, *Summary*, on page 26](#).

2.0 Overview of Cable Diagnostics

The LXT9785/9785E Transceiver Cable Diagnostics function detects the following severe cable problems:

- A short circuit between wires of a single twisted-pair and the distance to the short circuit
- An open circuit and the distance to the open circuit
- An improperly terminated cable by the link partner

Cable Diagnostics utilizes the PHY transmit driver and receiver to test a single twisted-pair. A transmit pulse is driven down the twisted-pair under test and the reflected signal is analyzed. Reflected pulse analysis detects any indicated cable-related problems. Packet transmission and reception is disabled when Cable Diagnostics is enabled.

2.1 Registers Used for Cable Diagnostics

Register 29 was added to the LXT9785/9785E Transceiver, Revision D0, to control cable testing and report cable-testing results (refer to the Cortina Systems® LXT9785/9785E 8-port Fast Ethernet 10/100 Mbps Physical Layer Transceiver Specification Update, document number 249357). Register 29 allows the system designer to analyze the results of the twisted-pair under test.

Note: Refer to the LXT9785/9785E Transceiver Datasheet for full details.

2.1.1 Enabling Cable Diagnostics

Set Register bit 29.10 to enable the Cable Diagnostics function. Cortina recommends that the system designer review the design considerations in [Section 3.0, Design Considerations, on page 9](#) before developing an algorithm for Cable Diagnostics. Refer to [Section 2.1.2](#) for Cortina recommended Cable Diagnostics test methods.

2.1.2 Starting a Cable Diagnostics Test

Register bits 29.13:11 initiate a Cable Diagnostics test. Use the following two methods for testing cable:

- **Long Cable Test:** Write '101' to Register bits 29.13:11 to start a long cable test.
- **Short Cable Test.** Write '110' to Register bits 29.13:11 to start a short cable test.

Note: Cortina recommends performing both long and short cable tests on each twisted-pair when using the Cable Diagnostics test.

Long and short cable tests performed sequentially provide the most accurate results. Both tests are necessary to reach full precision. Enabling Cable Diagnostics (Register bit 29.10 [CD_EN = 1]) and performing long and short cable tests is accomplished by writing 6C00 hex to Register 29, waiting for the long cable test to complete, and writing 7400 hex to Register 29 to start the short cable test.

2.1.3 Completion of the Cable Diagnostics Test

Register bit 29.9 is set and Register bits 29.8:0 are valid for analysis when the Cable Diagnostics test is complete. Read Register bit 29.9 to verify test completion. Alternatives to polling are described in [Section 4.5, Options to Polling, on page 14](#).

2.1.4 Detecting a Short Circuit

The LXT9785/9785E Transceiver Cable Diagnostics tool detects a short circuit between a single twisted-pair under test and reports the distance to the short circuit. Register bit 29.8 is set when a short circuit is detected.

2.1.5 Detecting an Open Circuit

The LXT9785/9785E Transceiver Cable Diagnostics tool detects an open circuit on a single twisted-pair under test and reports the distance to the open circuit. Register bit 29.8 is cleared when an open circuit is detected.

2.1.6 Detecting an Improperly Terminated Cable

The LXT9785/9785E Transceiver Cable Diagnostics tool detects a cable improperly terminated on the twisted-pair under test. If the link partner termination is significantly higher than the IEEE specified $100 \pm 15 \Omega$, the result indicates an open at the cable distance to the link partner. If the termination is significantly lower, the result indicates a short at the distance to the termination.

2.2 Distance to the Fault

Cable Diagnostics estimates the distance to the closest open or short fault up to 150 meters. The test results are the most accurate when using Category 5 cable or better. Using a lower-quality cable produces less accurate results on long cable lengths. The distance to a cable fault is based on the velocity of signal propagation. Signal propagation characteristics determine the electrical length to a fault. The electrical length may vary slightly from the physical cable length. This variance (coupled with the variation in delay of the transmit and receive logic) limits the accuracy of the measurement to ± 2 m. Use [Equation 1](#) to calculate the distance to a fault.

Equation 1 $\text{Distance_to_Fault} = (\text{Reg29}[7:0] - 3.5) / 1.16$

Register bits 29.7:0 indicate the distance to a detected fault when Register bits 29.7:0 display any value other than FF hex. If a fault is detected, the value returned in Register 29 must be recorded for both long and short cable tests. The values are compared – the smaller value is used to determine the actual distance to the fault. The example results of long and short cable tests are 6649 hex and 66FF hex, respectively. In this case, 49 hex is chosen to calculate the distance to the fault. Register bit 8 equals 0, so the fault is an open.

3.0 Design Considerations

Section 3.0 lists the items a system designer and network manager must consider before initiating Cable Diagnostics testing.

3.1 Link Partner Activity

Cable Diagnostics provides a method to determine the distance to opens and shorts when the link partner is not transmitting on the twisted-pair under test. Link partners transmitting Normal Link Pulses (NLPs), Fast Link Pulses (FLPs), Multi-Level Signaling, 3-levels (MLT3s), or other Time Domain Reflectometry (TDR) pulses, may interfere with the ability of the LXT9785/9785E Transceiver to analyze the reflected Cable Diagnostics pulse. Algorithms implemented must avoid these potential situations when verifying valid test results. The example algorithm described in Section 4.0 account for these situations.

Perform additional tests to confirm exact cable status if the initial cable test results in a fault. The test results are considered indeterminate if the cable test results are not consistent. One of the tests Cortina recommends trying is a 100BASE-T link with MDI and MDIX sequentially to determine if a 100BASE-TX-only link partner is present. If a link partner is in forced 100BASE-TX mode and transmitting MLT-3, the Cable Diagnostics test result will be undefined because the MLT-3 will interfere with the reflected Cable Diagnostics pulse processing. See Section 5.2.3, *100BASE-T Link Partners*, on page 21 for test results.

Auto MDI/MDIX on the link partner may also generate a fault. Additional tests are required to confirm if auto MDI/MDIX is the cause of the fault. Section 5.2.6, *Auto MDI/MDIX Link Partners*, on page 24 provides example results when the LXT9785/9785E Transceiver is the link partner with auto MDI/MDIX enabled. Other link partners may generate different fault patterns based on the timing of the auto MDI/MDIX algorithm implemented by the link partner.

3.2 Auto-Negotiation

Disable auto-negotiation on the Cable Diagnostics test device to ensure proper operation of Cable Diagnostics.

3.3 Auto MDI/MDIX, MDIX, and MDI Considerations

Cortina recommends disabling auto MDI/MDIX on the port running the Cable Diagnostics test. Both the transmit and receive twisted-pairs must be tested one at a time with long and short cable tests. This requirement creates a minimum of four test permutations that must be completed to determine if a fault exists, along with the distance to the fault.

The auto MDI/MDIX control bits in Register 27 can be used to select the twisted-pair to be tested. Writing 0800 hex selects the MDI twisted-pair and writing 0900 hex selects the MDIX twisted-pair. Refer to the Twisted-Pair Signal Description section in the LXT9785/9785E Transceiver Datasheet to determine the twisted-pair signal pins used when MDI and MDIX are selected in a specific application.

3.3.1 Timing Constraints for Switching Between MDI/MDIX

After writing to Register 27 to switch from MDI to MDIX or MDIX to MDI, a 100 μ s delay is required before a Cable Diagnostics test can be performed. This ensures that the transmitter and receiver have completed the transition to the new state. If a test is attempted before the time has transpired, the test may be performed on the incorrect twisted pair or not performed at all.

3.4 Internal Loopback

Disable the internal loopback for proper Cable Diagnostics operation. If internal loopback is enabled, the analog interface is disabled, preventing Cable Diagnostics testing.

3.5 Power-Down and Transmit Disable

An open-connection result is indicated by Cable Diagnostics testing when an LXT9785/9785E Transceiver link partner is powered down using the PWRDWN hardware configuration pin. The PWRDWN hardware configuration pin disables the internal transmit and receive termination resistors and creates high impedance connections equivalent to an open circuit on each twisted-pair.

The LXT9785/9785E Transceiver Transmit Disable Register bit 16.13 and the Software Controlled Power-Down Register bit 0.11 functions disable the transmit circuit but do not affect the receive circuitry. When either register bit is enabled, the transmit circuit looks like an open circuit and the receive circuit looks like a properly terminated connection.

Note: Other PHY manufacturer power-down modes have not been evaluated.

3.6 IP Phone

The result of Cable Diagnostics tests on IP Phone link partners may indicate an open or short fault at the approximate distance to the IP Phone. When an IP Phone is not powered, the effects on the terminations and power-detection circuit are unknown; results may or may not indicate a proper termination or a properly terminated cable. The IP Phone design affects the reflected Cable Diagnostics pulse, which affects the test results. See [Section 5.2.5, IP Phone Link Partners, on page 23](#) for a test result example.

3.7 Possible Link Partners and Cable Conditions

Different link partners and cable conditions must be considered in designing a system with Cable Diagnostics testing. The following link partners and cable conditions may be present when running Cable Diagnostic tests (examples are found in [Section 5.0, Example Cable Diagnostic Results, on page 16](#)):

- Forced 10 Mbps (half-duplex or full-duplex)
- Forced 100 Mbps (half-duplex or full-duplex)
- Auto-negotiation (any capability)
- Fault on transmit pair only
- Fault on receive pair only
- Fault on both transmit and receive pairs
- Termination impedance significantly out of IEEE specification on either twisted-pair
- Auto MDI/MDIX in a forced speed mode

3.7.1 Expected Results

The following lists expected results from link partner interference:

- **Forced 10 Mbps:** Almost always detected as properly terminated cable; however, an NLP might cause a false fault condition.
- **Forced 100 Mbps:** Inconsistent fault types indicating shorter distances on one twisted-pair. The other pair always indicates a properly terminated cable.
- **Auto-negotiation:** Usually detected as a properly terminated cable; however, an FLP burst might cause a false fault condition.
- Impedance mismatch:
 - Open indicated for significantly higher termination impedance than IEEE specified terminations.
 - Short indicated for significantly lower termination impedance than IEEE specified terminations.
- **Auto MDI/MDIX:** Faults may be detected on either twisted-pair depending on the auto MDI/MDIX algorithm timing of the link partner. [Section 5.2.6, Auto MDI/MDIX Link Partners, on page 24](#) provides an example using the LXT9785/9785E Transceiver as the link partner.

4.0 Recommended Algorithm

Section 4.0 provides an algorithm example for implementing the LXT9785/9785E Transceiver Cable Diagnostics feature. The recommended test sequence is described below. The LXT9785/9785E Transceiver Datasheet provides specific register definitions.

4.1 Main Test Suite

1. Read and store state of Register 27 and Register 0 into variables reg27 and reg0
2. Select MDI with auto MDI/MDIX off (AMDIX = 0)
 - Write 0800 hex to Register 27
3. Select forced 100 Mbps half duplex with auto-negotiation disabled
 - Write 2000 hex to Register 0
4. Enable Cable Diagnostics and perform a long-cable test
 - Write 6C00 hex to Register 29
5. Wait approximately 1.2 seconds
6. Poll Register 29. Wait for the test to be completed (Register bit 29.9 = 1)
7. Store the Register 29 value as a variable long_MDI
8. Perform a short-cable test
 - Write 7400 hex to Register 29
9. Poll Register 29. Wait for the test to be completed (Register bit 29.9 = 1).
10. Store the Register 29 value as a variable short_MDI
11. Select MDIX
 - Write 0900 hex to Register 27
12. Wait 100 μ s for the transmitter and receiver to switch to selected pair
13. Perform Long Cable Test
 - Write 6C00 hex to Register 29
14. Poll Register 29. Wait for test to be completed (Register bit 29.9 = 1)
15. Store the Register 29 value as a variable long_MDIX
16. Perform a Short Cable Test
 - Write 7400 hex to Register 29
17. Poll Register 29. Wait for test to be completed (Register bit 29.9 = 1)
18. Store the Register 29 value as a variable short_MDIX
19. Compare respective variables for faults:
 - Check long_MDI and short_MDI for fault – any non FF value in Register bits 29.7:0
 - Check long_MDIX and short_MDIX for fault – any non FF value in Register bits 29.7:0
20. If no faults are detected (all tests results indicate 66FF hex), set “Cable Okay” status and go to End_of_Test
21. If there are faults, perform the secondary test.

4.2 Secondary Test

Cortina recommends that the secondary test be performed three times to minimize false fault detection due to link partner configurations (that is, auto-negotiation and forced 10BASE-T modes). The proper selection of MDI and MDIX modes is required using Register 27. If both MDI and MDIX twisted-pairs detect faults, both the MDI and MDIX twisted-pairs must be retested. If only the MDI pair detects a fault, only the MDI twisted-pair must be retested. If only the MDIX pair detects a fault, only the MDIX twisted-pair must be retested. Perform the following secondary test algorithm if a fault is detected:

1. Wait approximately 2.2 ms from last test performed
 - The wait period is required to ensure that FLP bursts from auto-negotiation or NLPs from a forced 10BASE-T link partner do not cause false fault detections from the tests being performed.
2. Perform a Long Cable Test:
 - Write 6C00 hex to Register 29
3. Poll Register 29. Wait for the test to complete (Register bit 29.9 = 1)
4. Store the Register 29 value as a variable long_MDIX (use a unique variable)
5. Perform a Short Cable Test:
 - Write 7400 hex to Register 29
6. Poll Register 29. Wait for the test to complete (Register bit 29.9 = 1)
7. Store the Register 29 value as a variable short_MDIX (use a unique variable)

Auto-negotiation FLP bursts and 10BASE-T NLPs are spaced a minimum of 8 ms apart (typically 12 ms). FLP bursts have a duration of 2 ms. The tests are spaced approximately 2.2 ms apart to minimize test result interference from these signals. The intent is to complete all tests within the 8 ms window.

4.3 Processing of Secondary Test Results

The following algorithm is an example of secondary test result processing:

1. Compare respective twisted-pair test results for consistent fault indications for all three tests performed in the Secondary Test.
 - If a long cable test fault is detected:
 - All three long cable tests on a twisted-pair must indicate the same type of fault (open or short) and the indicated distance to a fault must be within a range of 0-2 hex of each result.
 - If a short cable test fault is detected:
 - All three short cable tests on a twisted-pair must indicate the same type of fault (open or short) and the indicated distance to a fault must be within a range of 0-2 hex of each result.
2. If the results are consistent for the respective tests completed:
 - Determine the results for each of the three individual long/short tests (see paragraph 2 of [Section 2.2, Distance to the Fault, on page 8](#))

3. Choose the result that best represents the cable condition:
 - If the Register 29 test results equal 66FF hex for all three tests, indicate “Cable Okay” status and go to End_of_Test.
 - If the Register 29 test results equal 67xx hex for all three tests, indicate “Short” at the shortest distance indicated and go to End_of_Test.
 - If the Register 29 test results equal 66xx hex for all three tests, indicate “Open” at the shortest distance indicated and go to End_of_Test.
 - If none of the above conditions are met, indicate indeterminate fault and go to End_of_Test.

Both twisted-pairs are processed before reporting results if both MDI and MDIX tests are required to be performed.

4.4 End_of_Test

Use the following process to exit the Cable Diagnostics mode and restore the PHY configuration saved in Step 1 of the [Section 4.1, Main Test Suite](#):

1. Exit Cable Diagnostics
 - Write 4000 hex to Register 29
2. Restore the original PHY configuration of auto MDI/MDIX and MDI/MDIX
3. Write variable reg27 to Register 27
4. Restore the original PHY configuration of auto-negotiation or forced speed and duplex settings
 - Write variable reg0 to Register 27
5. The previous PHY operation resumes

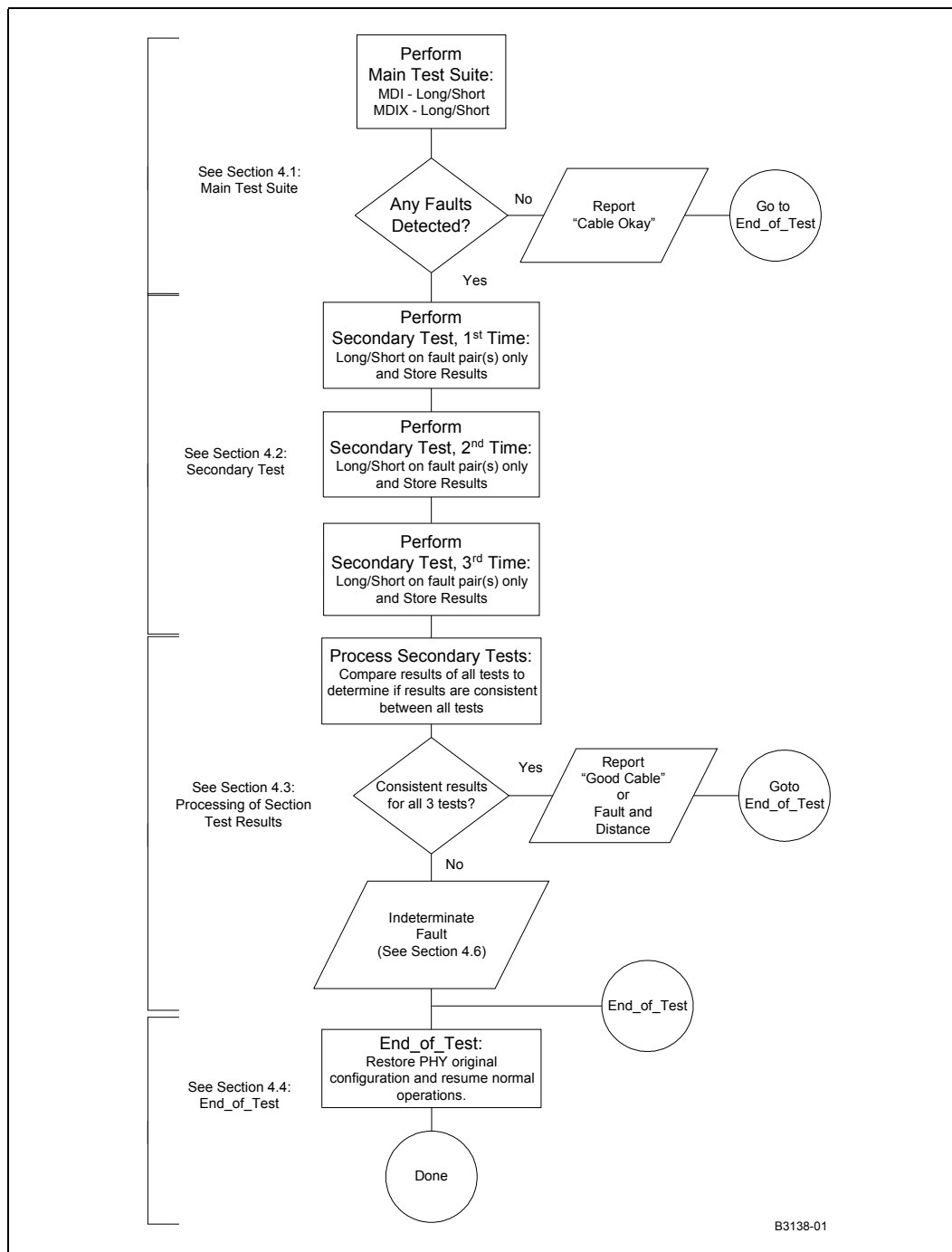
4.5 Options to Polling

If the polling option is not preferred, use delays followed by a one-time read of Register 29. The first test performed when Cable Diagnostics is enabled (see step 4 of the [Section 4.1, Main Test Suite](#)) requires a delay of 1.3 seconds for test completion. After performance of the first algorithm test, individual long or short tests are completed within 20 μ s of being enabled by writing to Register 29. Longer delays between the tests may be used; however, the goal should be to complete the initial test and the three secondary tests (if needed) within 8 ms.

4.6 Indeterminate Faults

Indeterminate faults resulting from the Cable Diagnostics algorithm are indicated by inconsistent test results. An example of a potential link partner generating inconsistent test results is a 100 Mbps link partner. Example results for this link partner are found in [Section 5.2.3, 100BASE-T Link Partners, on page 21](#). The results may be further quantified based on the design goal required of the system designer. It may be possible to detect and indicate the link partner is in 100BASE-T mode by attempting a forced link at 100BASE-T settings. Other PHY configurations may be attempted at your discretion to further define this blanket category of indeterminate test results. The time to complete additional tests to achieve this may limit a practical implementation. [Figure 1](#) illustrates the recommended flow chart algorithm for the Cable Diagnostics function.

Figure 1 Recommended Cable Diagnostics Flow Chart Algorithm



5.0 Example Cable Diagnostic Results

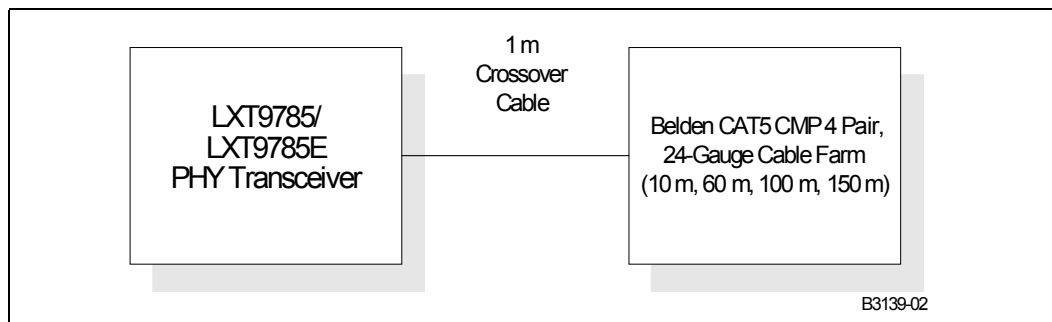
Cortina performed a series of tests using the LXT9785/9785E Transceiver Cable Diagnostics algorithm. [Section 5.0](#) shows example results with various link partners and configurations.

5.1 Tests with No Link Partner

5.1.1 Test Setups With No Link Partner

[Figure 2](#) illustrates the test setup used to conduct Cable Diagnostics tests with no link partner. An LXT9785/9785E Transceiver demo board was connected to a Category 5 cable plant using a 1 meter crossover cable (see [Figure 2](#)). The cable plant consisted of several cable lengths. For purposes of this application note, only 10 m, 60 m, 100 m, and 150 m cable lengths were used on a CAT 5 cable farm.

Figure 2 Test Setup With No Link Partner



5.1.2 No Link Partner – Open

[Table 1](#) shows example test results with no link partner at various cable lengths. An algorithm similar to the one in [Section 4.0, Recommended Algorithm, on page 12](#) was implemented to provide the data. Distances to the fault are indicated by the shortest distance value. As an example (the case with No Cable), the test values are 6604 hex and 660C hex. The 6604 hex indicates the distance to the fault since it is a smaller value than 660C hex. The shaded values in [Table 1 on page 17](#) indicate the hex value chosen for the final result.

Table 1 Cable Diagnostics Test Results With No Link Partner

Cable Length	MDI Long Cable Test (Hex)	MDI Short Cable Test (Hex)	MDIX Long Cable Test (Hex)	MDIX Short Cable Test (Hex)
No Cable	660C	6604 660C		6604
	660C	6604 660C		6604
	660C	6604 660C		6604
	660C	6604 660C		6604
1 Meter	660C	6605 660C		6605
	660C	6605 660C		6605
	660C	6605 660C		6605
	660C	6605 660C		6605
11 Meters	6610 6613		6611 6614	
	6610 6613		6611 6614	
	6610 6613		6611 6614	
	6610 6613		6611 6614	
61 Meters	6649 66F	F	664A 66	FF
	6649 66F	F	664A 66	FF
	6649 66F	F	664A 66	FF
	6649 66F	F	664A 66	FF
101 Meters	6676 66F	F	6678 66	FF
	6676 66F	F	6678 66	FF
	6676 66F	F	6678 66	FF
	6676 66F	F	6678 66	FF
151 Meters	66B1 66F	F	66B4	66FF
	66B1 66F	F	66B4	66FF
	66B1 66F	F	66B4	66FF
	66B1 66F	F	66B4	66FF

5.1.3 Short Between Each Twisted-Pair

Table 2 shows example test results with a short between each of the twisted-pairs. The value chosen for the distance to the short is the result of the long cable test in the example data below. The shaded values in Table 2 indicate the hex value chosen for the final result.

Table 2 Cable Diagnostics Test Results for Shorts on Both Pairs

Cable Length	MDI Long Cable Test (Hex)	MDI Short Cable Test (Hex)	MDIX Long Cable Test (Hex)	MDIX Short Cable Test (Hex)
No Cable	6704	66FF	6704	66FF
	6704	66FF	6704	66FF
	6704	66FF	6704	66FF
	6704	66FF	6704	66FF
1 Meter	6706	66FF	6706	66FF
	6706	66FF	6706	66FF
	6706	66FF	6706	66FF
	6706	66FF	6706	66FF
11 Meters	6710	66FF	6711	66FF
	6710	66FF	6711	66FF
	6710	66FF	6711	66FF
	6710	66FF	6711	66FF
61 Meters	6749	66FF	674A	66FF
	6749	66FF	674A	66FF
	6749	66FF	674A	66FF
	6749	66FF	674A	66FF
101 Meters	6776	66FF	6778	66FF
	6776	66FF	6778	66FF
	6776	66FF	6778	66FF
	6776	66FF	6778	66FF
151 Meters ¹	67B1	66FF	67B4	66FF
	67B1	66FF	67B4	66FF
	67B0	66FF	67B4	66FF
	67B1	66FF	67B4	66FF

1. 67B1 was the most consistent test result and was therefore chosen as the final result.

5.2 Tests With Link Partners

Section 5.2.1 through Section 5.2.6 show test results with various link partners at various cable lengths. An algorithm similar to the one in Section 4.0, *Recommended Algorithm*, on page 12 was used to provide the raw data.

5.2.1 Test Setup With Link Partners

Figure 3 and Figure 4 illustrate the test setups used for conducting Cable Diagnostics tests with a link partner. Figure 3 illustrates the link partner as another port on the LXT9785/9785E Transceiver Demo Board. Figure 4 illustrates the IP Phone as a link partner. An LXT9785/9785E Transceiver demo board was connected to the Cortina laboratory Category 5 cable plant using a 1 meter crossover cable and a 2 m straight cable (see Figure 3 and Figure 4) for link partner and IP phone tests. The cable plant consisted of several different cable lengths. For purposes of this application note, only 10 m, 60 m, 100 m and 150 m cable lengths were used on the CAT 5 cable farm.

Figure 3 Test Setup for Link Partners

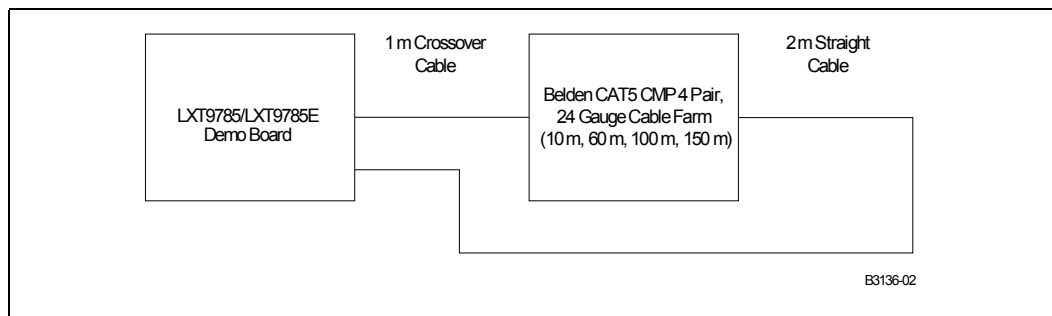
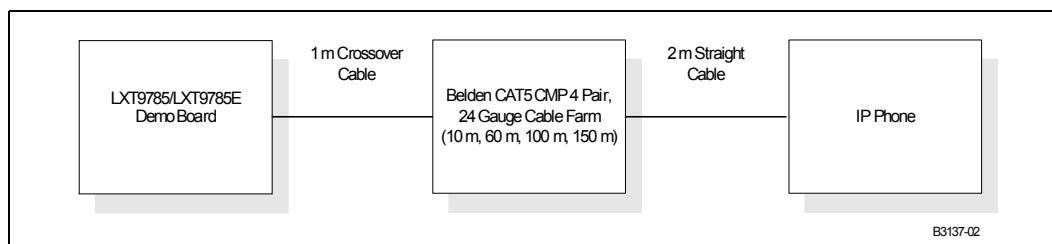


Figure 4 IP Phone Test Setup



5.2.2 10BASE-T Link Partners

Table 3 shows example test results with a properly terminated 10BASE-T link partner. All the values on the line fault counter for Register bits 29.7:0 indicate no fault. Each cable length was tested four times with identical results. The data indicates that a 10BASE-T link partner (NLP) is unlikely to interfere with a Cable Diagnostic test.

Table 3 Cable Diagnostics Test Results with a 10BASE-T Link Partner

Cable Length	MDI Long Cable Test (Hex)	MDI Short Cable Test (Hex)	MDIX Long Cable Test (Hex)	MDIX Short Cable Test (Hex)
1 Meter	66FF	66FF	66FF	66FF
	66FF	66FF	66FF	66FF
	66FF	66FF	66FF	66FF
	66FF	66FF	66FF	66FF
13 Meters	66FF	66FF	66FF	66FF
	66FF	66FF	66FF	66FF
	66FF	66FF	66FF	66FF
	66FF	66FF	66FF	66FF
63 Meters	66FF	66FF	66FF	66FF
	66FF	66FF	66FF	66FF
	66FF	66FF	66FF	66FF
	66FF	66FF	66FF	66FF
103 Meters	66FF	66FF	66FF	66FF
	66FF	66FF	66FF	66FF
	66FF	66FF	66FF	66FF
	66FF	66FF	66FF	66FF
153 Meters	66FF	66FF	66FF	66FF
	66FF	66FF	66FF	66FF
	66FF	66FF	66FF	66FF
	66FF	66FF	66FF	66FF

5.2.3 100BASE-T Link Partners

Table 4 shows example test results with a 100BASE-T link partner. All the values on the line fault counter for Register bits 29.7:0 indicate no fault for the MDI (long and short) cable tests and indeterminate fault results for the MDIX (long and short) cable tests. Table 4 shows that the MLT-3 signals interfere with the test and affect the results in MDIX. 100BASE-T link partner results typically show one twisted-pair indicating “cable okay” (no fault) and one twisted-pair indicating an indeterminate fault at a variety of shorter distances. This is due to the continuous activity of the 100BASE-T MLT-3 transmit signal.

Table 4 Cable Diagnostics Test Results with a 100BASE-T Link Partner

Cable Length	MDI Long Cable Test (Hex)	MDI Short Cable Test (Hex)	MDIX Long Cable Test (Hex)	MDIX Short Cable Test (Hex)
1 Meter	66FF	66FF	670C 660D	
	66FF	66FF	6701 6601	
	66FF	66FF	6701	660A
	66FF	66FF	6702 6604	
13 Meters	66FF	66FF	6707 6601	
	66FF	66FF	670D 6608	
	66FF	66FF	6701 6604	
	66FF	66FF	660D 6606	
63 Meters	66FF	66FF	670C 660	A
	66FF	66FF	660C 6609	
	66FF	66FF	6702 6603	
	66FF	66FF	6706 6605	
103 Meters	66FF	66FF	670C 6605	
	66FF	66FF	660C 6608	
	66FF	66FF	660C 6601	
	66FF	66FF	6610 6603	
153 Meters	66FF	66FF	660E 6606	
	66FF	66FF	670D 6607	
	66FF	66FF	660C 660C	
	66FF	66FF	661D 660	A

5.2.4 Auto-Negotiation Link Partners

Table 5 shows example test results with an auto-negotiation link partner. All the values on the line fault counter for Register bits 29.7:0 indicate no fault. Each cable length was tested four times with identical results. The data indicates that an auto-negotiation link partner (FLP burst) is unlikely to interfere with a Cable Diagnostic test.

Table 5 Cable Diagnostics Test Results with an Auto-Negotiation Link Partner

Cable Length	MDI Long Cable Test (Hex)	MDI Short Cable Test (Hex)	MDIX Long Cable Test (Hex)	MDIX Short Cable Test (Hex)
1 Meter	66FF	66FF	66FF	66FF
	66FF	66FF	66FF	66FF
	66FF	66FF	66FF	66FF
	66FF	66FF	66FF	66FF
13 Meters	66FF	66FF	66FF	66FF
	66FF	66FF	66FF	66FF
	66FF	66FF	66FF	66FF
	66FF	66FF	66FF	66FF
63 Meters	66FF	66FF	66FF	66FF
	66FF	66FF	66FF	66FF
	66FF	66FF	66FF	66FF
	66FF	66FF	66FF	66FF
103 Meters	66FF	66FF	66FF	66FF
	66FF	66FF	66FF	66FF
	66FF	66FF	66FF	66FF
	66FF	66FF	66FF	66FF
153 Meters	66FF	66FF	66FF	66FF
	66FF	66FF	66FF	66FF
	66FF	66FF	66FF	66FF
	66FF	66FF	66FF	66FF

5.2.5 IP Phone Link Partners

Table 6 shows example test results with an un-powered Cisco* IP phone (model 7960) as a link partner. The IP phone tested used the LXT9785/9785E Transceiver DTE Discovery detection method. All the values for short MDI and MDIX cable tests on the line fault counter for Register bits 29.7:0 indicate “cable okay” (no fault). The indicated distances are an approximation of the cable distances to the IP phone. This type of IP Phone looks like an open or a short at the approximate cable distance to the phone or a properly terminated cable (cable okay, no fault). IP Phones or other powered devices (defined by the newest IEEE Standard) have not been evaluated and may produce different results. The shaded values in Table 6 indicate the hex value chosen for the final result.

Table 6 Cable Diagnostics Test Results with an IP Phone

Cable Length	MDI Long Cable Test (Hex)	MDI Short Cable Test (Hex)	MDIX Long Cable Test (Hex)	MDIX Short Cable Test (Hex)
1 Meter	660C 66F	F	6707 66F	F
	660C 66F	F	6707 66F	F
	660C 66F	F	6707 66F	F
	660C 66F	F	6707 66F	F
13 Meters	6714 66F	F	6714 66F	F
	6714 66F	F	6714 66F	F
	6714 66F	F	6714 66F	F
	6714 66F	F	6614 66F	F
63 Meters	6654 66F	F	674E 66F	F
	6654 66F	F	674E 66F	F
	6654 66F	F	674E 66F	F
	6654 66F	F	674D	66FF
103 Meters	66FF 66F	F	66FF	66FF
	66FF	66FF	66FF	66FF
	66FF 66F	F	66FF	66FF
	66FF	66FF	66FF	66FF
153 Meters	66FF 66F	F	66FF	66FF
	66FF	66FF	66FF	66FF
	66FF 66F	F	66FF	66FF
	66FF	66FF	66FF	66FF

5.2.6 Auto MDI/MDIX Link Partners

Table 7 shows example test results with an auto MDI/MDIX link partner in auto-negotiation. All the values on the line fault counter for Register bits 29.7:0 indicate no fault. Each cable length was tested four times with identical results. The data indicates that an auto-negotiation link partner (FLP burst) with auto MDI/MDIX enabled is unlikely to interfere with a Cable Diagnostic test.

Table 7 Cable Diagnostics Test Results with an Auto MDI/MDIX Link Partner in Auto-Negotiation

Cable Length	MDI Long Cable Test (Hex)	MDI Short Cable Test (Hex)	MDIX Long Cable Test (Hex)	MDIX Short Cable Test (Hex)
1 Meter	66FF	66FF	66FF	66FF
	66FF	66FF	66FF	66FF
	66FF	66FF	66FF	66FF
	66FF	66FF	66FF	66FF
13 Meters	66FF	66FF	66FF	66FF
	66FF	66FF	66FF	66FF
	66FF	66FF	66FF	66FF
	66FF	66FF	66FF	66FF
63 Meters	66FF	66FF	66FF	66FF
	66FF	66FF	66FF	66FF
	66FF	66FF	66FF	66FF
	66FF	66FF	66FF	66FF
103 Meters	66FF	66FF	66FF	66FF
	66FF	66FF	66FF	66FF
	66FF	66FF	66FF	66FF
	66FF	66FF	66FF	66FF
153 Meters	66FF	66FF	66FF	66FF
	66FF	66FF	66FF	66FF
	66FF	66FF	66FF	66FF
	66FF	66FF	66FF	66FF

Table 8 shows example test results with an LXT9785/9785E Transceiver auto MDI/MDIX link partner in forced 100 Mbps mode. Resulting fault patterns may vary based upon the timing of the auto MDI/MDIX implemented in the specific link partner. All the values on the line fault counter for Register bits 29.7:0 indicate no fault for the MDI (long and short) cable tests and indeterminate fault results for MDIX (long and short) cable tests. The MLT-3 signals interfere with the test and affect the results in MDIX. 100BASE-T link partner results typically show one twisted-pair indicating cable okay results (no fault) and one twisted-pair indicating indeterminate fault at a variety of shorter distances. This is due to the continuous activity of 100BASE-T MLT-3 transmit signal.

Table 8 Cable Diagnostics Test Results with an Auto MDI/MDIX Link Partner in Forced 100 Mbps

Cable Length	MDI Long Cable Test (Hex)	MDI Short Cable Test (Hex)	MDIX Long Cable Test (Hex)	MDIX Short Cable Test (Hex)
1 Meter	66FF	66FF	6704	6602
	66FF	66FF	670C	660A
	66FF	66FF	6702	6606
	66FF	66FF	6704	6602
13 Meters	66FF	66FF	6702	6602
	66FF	66FF	660E	6601
	66FF	66FF	660C	6605
	66FF	66FF	660C	6602
63 Meters	66FF	66FF	660F	6601
	66FF	66FF	660C	6606
	66FF	66FF	660C	6603
	66FF	66FF	670C	6604
103 Meters	66FF	66FF	6701	6603
	66FF	66FF	670C	6607
	66FF	66FF	671B	6603
	66FF	66FF	6612	6606
153 Meters	66FF	66FF	6701	660D
	66FF	66FF	6701	6607
	66FF	66FF	660E	6616
	66FF	66FF	6713	6605

6.0 Summary

Cable Diagnostics is gaining in popularity because it provides an accurate method to debug network cable problems. The algorithm and test results outlined in this document will aid the system designer and network manager in the development of a specific algorithm to meet customer project requirements.



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