LXT9784 Octal 10/100 Transceiver MDIX Functional Overview

Application Note

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As of January 15, 2001, this document replaces the Level One document known as *AN122*.

Application Note

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1.0 Connection Types

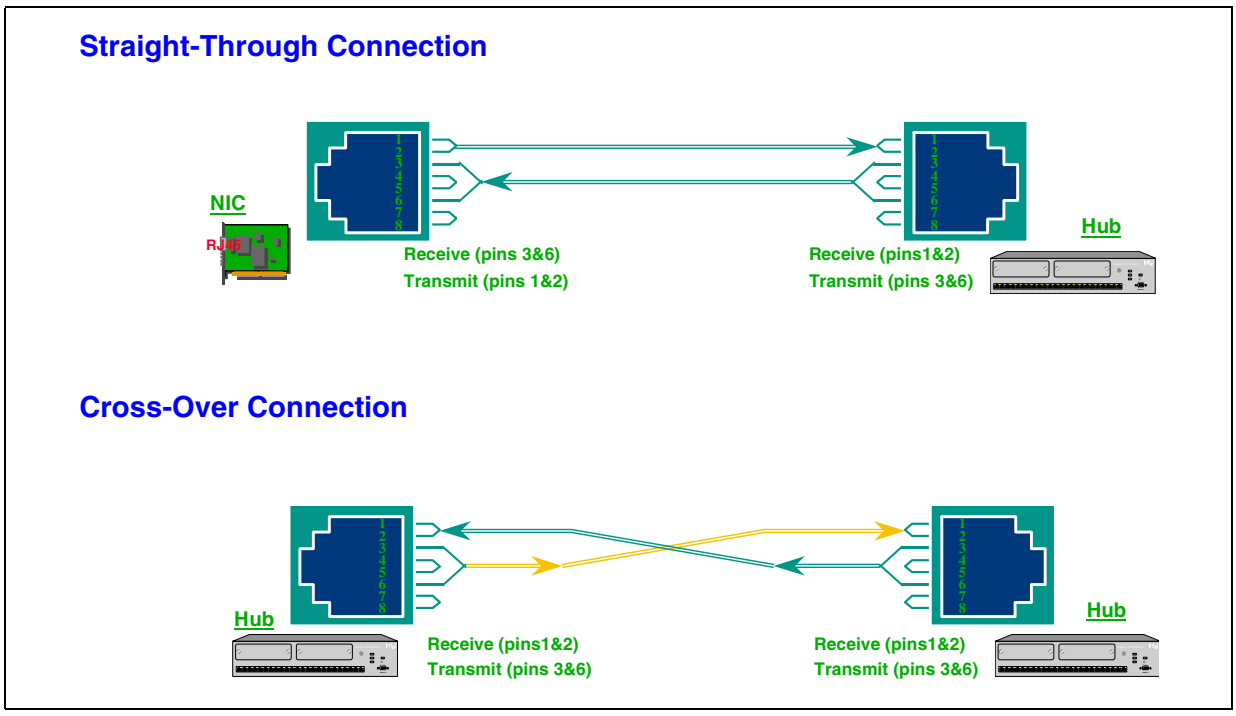
Two types of cables are used to connect Ethernet devices together: straight-through and crossed-over cables. The equipment used determines which type of cable is required. In a networking environment the need to manage two different types of connections consumes maintenance time and costs money. Implementing networking systems with manual or automatic correction of cross-over/straight-through cables adds to the system cost, as it requires dedicated hardware. The LXT9784 10/100 Ethernet Octal PHY offers an innovative solution for this problem, lowering the system solution cost and simplifying ease of maintenance.

In a typical DTE-to-Repeater/Switch connection, for example, the cross-over is implemented in the Repeater/Switch **M**edium **A**ttachment **U**nit (MAU). In this case a straight-through cable is required.

However, in connections between two MAUs of the same type (i.e. hub-to-switch, or switch-to-switch uplink connections), an external cross-over cable is required. If the cable type does not match the MAU configuration on both ends, the cable must be replaced. If the cable that must be replaced is located in a wiring closet then typically the installation or replacement of a "patch panel" is required.

In a typical medium-sized business there are perhaps 100's of Ethernet ports that connect to a central switch or hub. If the hub or switch had the ability to sense and switch the wire pairs internally on a port basis, overall savings would be realized both in maintenance time and money.

Figure 1. RJ-45 Cable Connection Types



2.0 The MDIX Feature

2.1 Introduction

The LXT9784 MDI/MDI-X feature provides the ability to automatically detect the required cable connection type and configure the MAU to the cable type. This feature effectively allows all properly wired Ethernet cables usable with any Ethernet device to be connected to the LXT9784 without any additional external logic.

This advanced feature enables auto-correction of incorrect cabling with respect to crossed-over versus straight-through cables. The LXT9784 PHY can identify the cable connection type and adjust its MDI port to the cable by switching between the TD and RD pairs. The auto switching is done prior to the auto-negotiation algorithm.

In a standard straight-through RJ-45 port configuration, the transmit pair is on contacts 1 and 2, and the receive pair on contacts 3 and 6. These are defined by Clause 23.7.1 of the IEEE 802.3u standard.

Table 1 lists the connections for both straight-through and cross-over RJ-45 ports for comparison.

Table 1. RJ-45 Connections

RJ-45 Contact	Straight-Thru [1] MDI Signal	Cross-Over [2] MDIX Signal
1	TD+	RD+
2	TD-	RD-
3	RD+	TD+
4	Not used	Not used
5	Not used	Not used
6	RD-	TD-
7	Not used	Not used
8	Not used	Not used

1. Straight-Through connections used on DTE applications.
2. Cross-Over connections used on Hub and Switch applications

3.0 MDI/MDI-X Auto Switching Activation

The LXT9784 provides an external pin, MDIX, sampled during reset, which enables or disables auto-switching. When this pin is externally pulled up or left unconnected, auto-switching is enabled. When MDIX is externally pulled down auto switching is disabled. In the case that auto-switching was disabled during reset, after reset the MDIX pin is used to configure the connection type (straight-through or crossed-over). A "1" forces a crossed-over connection, a "0" forces a straight-through connection. The LXT9784 needs to be in Auto-Negotiation mode in order to use the MDI/MDI-X capability.

The LXT9784 provides a register for software to enable or disable the feature on a per port basis. The register is accessed via the MII Management Interface. Writing to the software register overrides the external pin MDIX.

When auto-switching is enabled, the PHY attempts to detect link activity in a given configuration (MDI or MDI-X) for duration of 80 - 100ms. If no link activity is detected during this slot time, the PHY waits a random amount of time greater than 80ms, and switches the MDI pairs to the other configuration.

Table 2. Register 28 (1C Hex) MDI/MDIX Control Register Bit Assignments

ADR	D7	D6	D5	D4	D3	D2	D1	D0	R/W
PHY (1C 'h)	Auto-Switch Enable	Switch	Status	Auto-Switch Complete	Resolution Timer				-

Table 3. Register 28 (1C Hex) MDI/MDIX Control Register Bit Definitions

Bit(s)	Name	Definition	Type[1]
28.7	Auto Switch Enable	Enables the MDI/MDIX feature (writing to this bit will overwrite the default value). 1 = Enabled. 0 = Disabled. **default** reflects "1" if MDIX pin is set to "1", otherwise reflects "0".	R/W P
28.6	Switch	Manual switch (valid only when 28.7 is "0") 1 = forces MDI port to be in MDIX (cross over). **default 0** = forces port to be in MDI (straight through).	R/W
28.5	Status	Indicates the state of the MDI pair. 1 = MDIX (cross over). 0 = MDI (straight through).	RO
28.4	Auto Switch Complete	1 = resolution algorithm is completed, right configuration is achieved.	RO
28.3:0	Resolution Timer	Defines minimum slot time the algorithm uses in order to switch between one configuration to the other. The granularity of the timer is 26.4msec. **default** "0000" (i.e. : 26.4ms).	R/W

1. R/W = Read / Write
   RO = Read Only.
   P = Affected by external pin.