

Application Note:

How to Connect a Lantronix Embedded Module to a Wired Ethernet Port

This app note applies to the following Lantronix Products:

WiPort BG
WiPort NR
MatchPort BG
MatchPort AR
XPort Direct+ w/o RJ45

Overview

This application note shows Hardware Engineers how to connect a wired Ethernet port to a Lantronix embedded module. This application note shows how to add an Ethernet RJ45 and magnetics to any of the following Lantronix Products:

- *WiPort BG*
- *WiPort NR*
- *MatchPort BG*
- *MatchPort AR*
- *XPort Direct+ w/o RJ45*

There are several advantages to providing an Ethernet module with an embedded Phy that requires an external RJ45 connector and magnetics.

1. Allows the OEM more flexibility to select the best version of the RJ45 connector. Depending on the mechanical mounting requirements, horizontal or vertical mount can be used.
2. For harsh environments, it is possible to select a sealed or water tight connector.
3. Allows a way to design a POE interface. There is an application note available that shows how to add a Powered Device (PD) interface.

Circuit diagrams and references component part numbers for the magnetics and the RJ45 connector are also provided.

Connecting a Lantronix Module to a Wired Ethernet

The WiPort BG and the MatchPort BG feature both a wireless 802.11BG and a wired Ethernet port with an embedded Phy. The WiPort NR, MatchPort AR and the XPort Direct+ w/o RJ45 are strictly wired Ethernet modules. In all cases, the wired Ethernet port is a fully integrated 100BASE-TX/10BASE-T Physical Layer. However, the addition of magnetics and an RJ45 connector are required to complete the interface.

There are 2 choices for the addition of magnetics and a connector. One option is to use an external magnetic isolation 802.3 10/100 Base-T Ethernet transformer and a regular RJ45 connector. If PC board space is critical, the second choice is to use an integrated RJ45 connector with a built-in 802.3 10/100 Base-T Ethernet transformer. For use in harsh environments Transient Voltage Suppressors (TVS) are recommended.

There is an option to implement Power-Over-Ethernet (POE) using the WiPort and the wired Ethernet channel. For more information, please contact your local Lantronix Field Application Engineer.

Selecting LAN magnetics

For communications on a local area network, a magnetic filter module is required. The magnetics provide impedance matching, signal shaping and conditioning, high voltage isolation and common-mode noise reduction. 10/100 Base-T Ethernet utilizes Unshielded Twisted Pair (UTP)

transmission cable. The UTP wiring is prone to noise pickup that leads to conducted and radiated noise emission. The magnetics help to filter out the noise, provide good signal integrity and good electrical isolation.

The recommended Magnetics has a 1:1 transmit turns ratio, 1,500 volts isolation, center taps on both sides of the transformer, a choke on both the transmit / receive channels and has been designed for use with 10/100 Base-T Ethernet networks. The following are some additional factors to consider when selecting the Magnetics for LAN communications.

Common-Mode Choke

For 10/100 Mbps communications, a common-mode choke is necessary for a system to pass FCC testing. The choke presents a high impedance to common-mode noise but a low impedance for differential-mode signals. For a WiPort application, both transmit and receive channels must have a choke and both chokes should be wired directly to the RJ-45 connector (see figure 1).

Crosstalk

Another consideration is crosstalk between the transmit and receive channels. This crosstalk can cause trouble during EMC testing. Magnetics with a shield between the two channels can minimize crosstalk and provide an additional 10dB of rejection.

Insertion Loss

Insertion loss is the loss of the transfer energy from the source to the load.

Return Loss

Return loss defines the level of matching between the source and load impedance.

Common-Mode Rejection

Common-mode rejection is the ability to reject a signal which, referenced to ground, has the same amplitude and phase on both inputs. This signal, which is usually the result of noise or a small impedance mismatch, produces a small differential error voltage at the input terminals of the Ethernet. Subsequently, this error gets amplified right along with the desired communications signal. The magnetics plays a major role in knocking down this common-mode noise down to an acceptable level.

PCB layout Considerations

For optimal performance on a high speed Ethernet LAN, differential routing on the Ethernet pairs should be used. The RX+/- pair and the TX+/- pair should be routed as 100 ohm differential pairs on a layer next to the signal ground plane. The use of vias on these nets should be minimized. The pairs should also be routed away from other nets. The area under the magnetics should be voided of all signals and power planes. In the case of separate magnetics and RJ45 signal ground and power planes should be voided between the magnetics and RJ45. In addition, all signals other than the Ethernet pairs should not be routed between the magnetics and RJ45.

Reference components

The following vendor components and part numbers have been used by Lantronix in similar designs. Please review their data sheets carefully before using them in your design. Although they are similar in circuitry, they may not be plug compatible. They are shown here for reference only.

Description	Vendor	Vendor part number
RJ45 connector with integrated magnetics	Bothhand LAN-Mate Series	LU1T041C-43LF
RJ45 connector with integrated magnetics	XFMRs Inc	XFATM2G-COMBO1-4MS
RJ45 connector with integrated magnetics	Bel Fuse	SI-10223 or SI-40101
RJ45 connector without magnetics	Stewart Connector	SS-700810S-A-NF-1-BB
10/100 Base-TX Magnetic module	Halo Electronics Ultra Series	TG110-S055N2
Capacitors – high voltage 250 V AC rated for ESD	Murata Erie	GHM2143B103MAC250 or GA252DB3E2103MY02L

Pin Outs for Lantronix Modules

The following Lantronix module pin outs are provided for referencing with the following diagrams. Please review the modules data sheets and/or Integration Guide carefully before designing them in your circuit. They are shown here for reference only.

Signal description	WiPort BG & WiPort NR	MatchPort BG	MatchPort AR	XPort Direct+ w/o RJ45
Ethernet TX-	29	8	2.8	6
Ethernet TX+	30	6	2.6	4
Ethernet RX center tap	31	12	2.12	18
Ethernet TX center tap	32	10	2.10	8
Ethernet RX-	33	16	2.16	16
Ethernet RX+	34	14	2.14	14
Status LED1	28	18	2.18	12
Status LED2	27	20	2.20	20

External Magnetics and RJ-45 Connector Design

For an Ethernet design that requires external magnetics and a discrete RJ45 connector, the following circuit diagram (Figure 1) provides an overview.

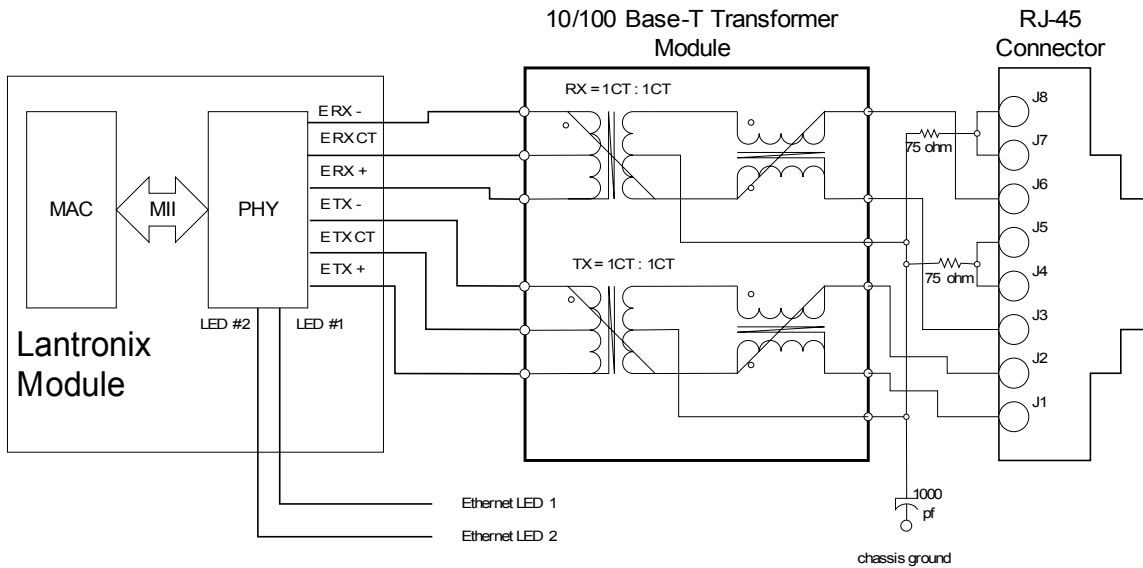


Figure 1

RJ-45 Connector with Integrated Magnetics Design

For an Ethernet design that utilizes an RJ45 connector with integrated magnetics, the following circuit diagram (Figure 1) provides an overview.

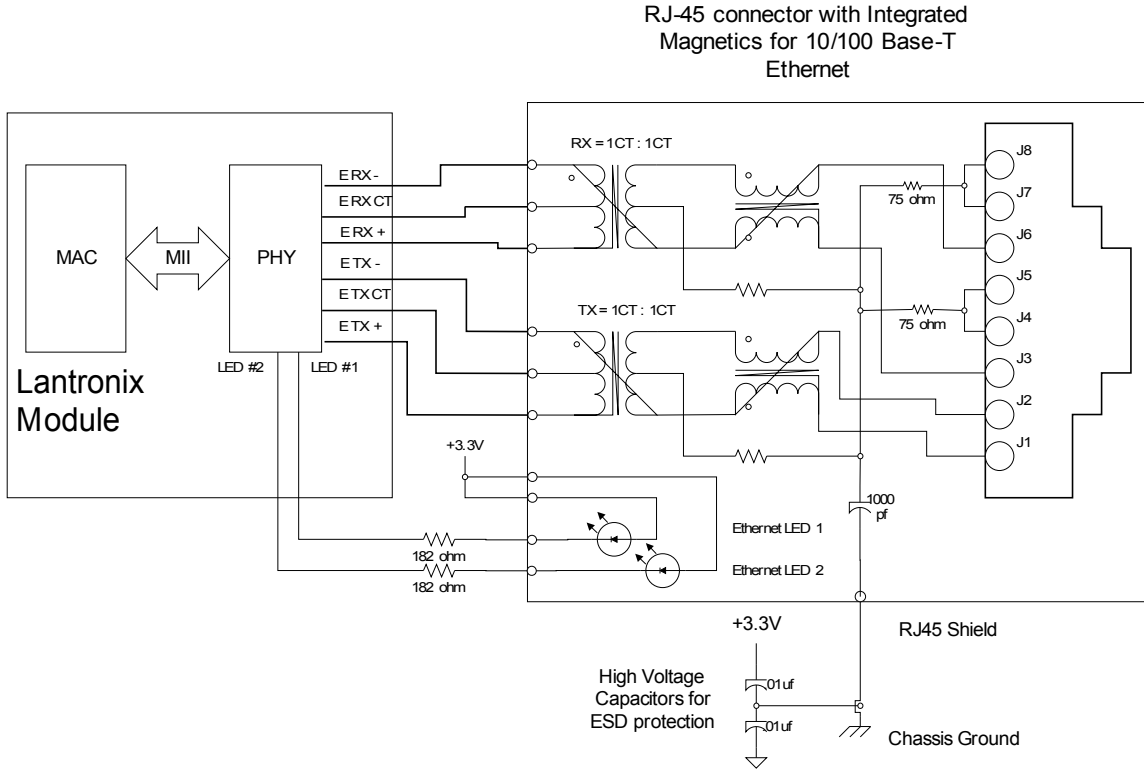


Figure 2