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## Adding an External Ethernet RJ-45 Connector and PCB Layout Guidelines for NetBurner -200 Version Modules

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### Introduction

Most NetBurner modules are available in two Ethernet build configurations:

- A RJ-45 Ethernet connector with integrated magnetics and LEDs.
- A 10-pin header that provides Ethernet signals and LED control, enabling the magnetics and/or the RJ-45 connector to be placed elsewhere.

### Hardware Compatibility

The table below provides the Ethernet PHY chip used in each assembly, as well as tested Ethernet jacks with integrated magnetics. You can choose any type of connector and magnetics you wish if they are compatible with the Ethernet PHY chip.

Module	Ethernet PHY	Ethernet Jack Type
MOD5234-200IR	Microchip KSZ8721BLI	1
MOD5270-200IR	Microchip KSZ8721BLI	1
MOD5282-200IR	Microchip KSZ8721BLI	1
MOD54415-200IR	Microchip KSZ8041NLI	1
MOD54417-200IR	Microchip KSZ8081RNAIA	2
MODM7AE70-200IR	Microchip KSZ8081RNAIA	1
NANO54415-200IR	Microchip KSZ8041NLI	1
SB70LC-200IR	Microchip KSZ8721BLI	1
SBE70LC-200IR	Microchip KSZ8721BLI	1
SBL2E-200IR	Internal	1
SOMRT-1061	Texas Instruments DP83825IRMQR	1

### ***Compatible RJ-45 Jacks with Integrated Magnetics***

Ethernet jacks are available for purchase from NetBurner.

#### **Type 1**

Halo Electronics: HFJ11-E2450E-L11

Yuan Dean Scientific: 13F-641GGDP2NL

#### **Type 2**

Abracrom: ARJ-177

Yuan Dean Scientific: 62F-1204GYD2Z2NL

## Hardware Design

Pin tables and example schematics are provided in the following sections. No additional components are required if you are using one of the compatible RJ-45 Ethernet jacks with integrated magnetics and LEDs, other than center tap bypass caps where noted.

You may also use discrete magnetics if you prefer if they are compatible with the Ethernet PHY on the module. **If you do decide to use alternate components, we strongly recommend contacting NetBurner Support for the latest revision information before you begin your design.**

## PCB Layout Considerations

There are many considerations that can affect the layout of high frequency signals. The following are useful guidelines in most situations.

1. Avoid using cables or discrete wires, all signals should be routed on the PCB.
2. The trace distance between the module's 10-pin header and Ethernet magnetics should be kept as short as possible and must be less than 3 inches.
3. A RJ-45 with integrated magnetics is preferred, but if using discrete magnetics, the trace distance between the magnetics and the RJ-45 should be less than 1 inch.
4. The RX+/RX- and TX+/TX- signals should be routed in pairs and the traces of each differential pair should be of equal length. Separate the TX/RX differential pairs with a ground trace or plane, and route them far enough apart to avoid coupling. Otherwise, an outgoing signal on the TX pair may create noise and false data in the RX pair.
5. Avoid any right-angle trace bends, use at least a 45-degree angle or a curved trace. Do not vary the trace widths. Individual trace impedance should be kept below 50 ohms.
6. For designs that require 0.1uF capacitors on the center tap connections to the magnetics, a continuous ground or ground plane should be routed to the ground pin of the module's Ethernet interface.

## Power Considerations

Noise from the power supply will show up on the Ethernet signals. The 3.3VDC power supplied to your NetBurner module should be within +/-5%. The power signals provided on the 10-pin Ethernet header have additional noise filtering on the module itself.

## Design Notes

Unlike most PHY transceiver designs that have a single signal pin providing link and activity status, the SBL2e PHY has link and activity on separate pins. The result is that on the SBL2e, one LED indicates 10/100 speed, and the other LED indicates link only, not activity.

## Ethernet Signal Wiring

The tables below describe the signals to connect from the Ethernet signal pins on the NetBurner modules to the RJ-45 Ethernet connector with integrated magnetics.

### ***MODM7AE70, MOD5270, MOD5234, MOD5282, SBE70LC***

10-Pin Ethernet Header	Type 1 RJ-45	Signal Description
1	2	Transmit Data -
2	1	Transmit Data +
3	4	Transmit Data Center Tap
4	3	Receive Data +
5	6	Receive Data -
6	5	Receive Data Center Tap
7	8	Ground
8	7	No connect
9	12	LED control sink, link/activity
10	10	LED control sink, speed
	9	3.3V LED power
	11	3.3V LED power

### ***MOD54415***

10-Pin Ethernet Header	Type 1 RJ-45	Signal Description
1	2	Transmit Data -
2	1	Transmit Data +
3	4	Transmit Data Center Tap
4	3	Receive Data +
5	6	Receive Data -
6	5	Receive Data Center Tap
7	8	Ground
8	7	No connect
9	12	LED control sink, speed
10	10	LED control sink, link/activity
	9	3.3V LED power
	11	3.3V LED power

## MOD54417

10-Pin Ethernet Header	Type 2 RJ-45	Signal Description
1	2	Receive Data -
2	1	Receive Data +
3		No connect
4	3	Transmit Data +
5	6	Transmit Data -
6		No connect
7	8	Ground
8		No connect
9	10	LED control sink, link/activity
10	11	LED control sink, link/activity
	9	3.3V LED power
	12	3.3V LED power
	4, 5	Transmit and Receive Data Center Taps on the magnetics must be connected to 0.1uF capacitors to ground pin 7 on the 10-pin header

## NANO54415-200IR

P1	Type 1 RJ-45	Signal Description
46	2	Transmit Data -
44	1	Transmit Data +
41	4	Transmit Data Center Tap
43	3	Receive Data +
44	6	Receive Data -
41	5	Receive Data Center Tap
48	8	Ground
	7	No connect
40	12	LED control sink, speed
42	10	LED control sink, link/activity
	9	3.3V LED power
	11	3.3V LED power

## **SB70LC**

<b>10-Pin Ethernet Header</b>	<b>Type 1 RJ-45</b>	<b>Signal Description</b>
1	2	Transmit Data -
2	1	Transmit Data +
3	12	LED control sink, link/activity
4	3	Receive Data +
5	6	Receive Data -
6	4, 5	Transmit Data Center Tap (4) Receive Data Center Tap (5)
7	10	LED control sink, speed
8	7	No connect
9		No connect
10	8	Signal ground
	9	3.3V LED power
	11	3.3V LED power

## **SBL2e**

<b>10-Pin Ethernet Header</b>	<b>Type 1 RJ-45</b>	<b>Signal Description</b>
1	1	Transmit Data +
2	2	Transmit Data -
3	3	Receive Data +
4		No Connect
5	4, 5, 9, 11	VCC 3.3V - Transmit Data Center Tap - Receive Data Center Tap - Speed LED power - Link/Activity LED power
6	6	Receive Data -
7	8	Same as 10-pin header pin 5
8		Signal ground
9	10	LED control sink, speed
10	12	LED control sink, link/activity

## **SOMRT1061**

Ethernet 0

<b>SOM Pin Number</b>	<b>Type 1 RJ-45</b>	<b>Signal Description</b>
66	1	Transmit Data +
65	2	Transmit Data -
64	3	Receive Data +
	4	Transmit Data Center Tap. Must add 0.1uF capacitor to ground on pin 60
	5	Receive Data Center Tap. Must add 0.1uF capacitor to ground on pin 60
63	6	Receive Data -
	7	No connect
60	8	Signal ground
	9	VCC 3.3V LED power
61	10	LED control sink, speed
	11	VCC 3.3V LED power
62	12	LED control sink, link/activity

## Revision History

4/2/2010	1.0	Initial release
4/28/2010	1.1	Added Design Notes section
11/10/2016	1.2	Added MOD54417
7/1/2021	1.3	Added wiring tables, SBE70LC and SOMRT1061