Ethernet Products
Application Note

Using the 83C92A/C CMOS Transceiver for Ethernet

SEEQ
Technology Incorporated

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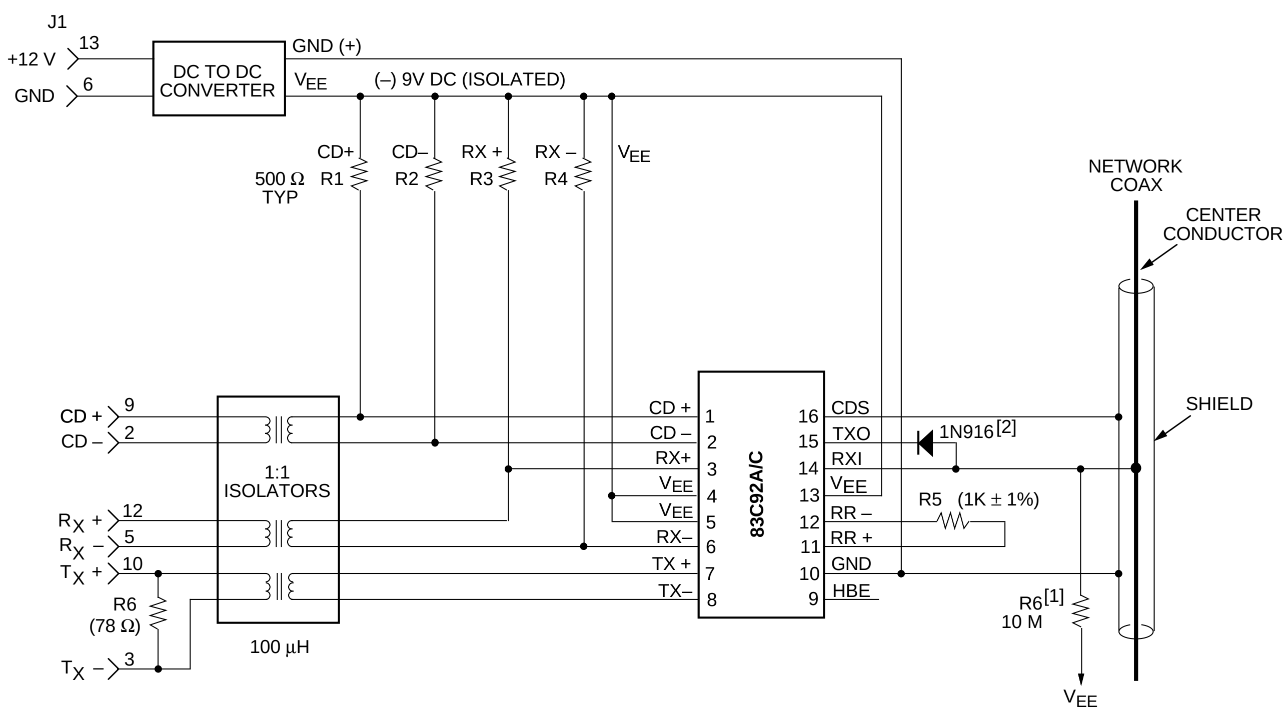
CMOS Transceiver for Ethernet

Introduction

SEEQ's 83C92A/C, the industry's first CMOS Ethernet transceiver, provides the lowest power media interface for the 802.3 Ethernet standard. SEEQ developed its revolutionary transceiver using the company's proprietary CMOS fabrication process. Unlike other CMOS processes, SEEQ invented patented innovations to standard CMOS over ten years of pioneering work on its world renown EEPROMs. This CMOS technology allows the transceiver to function at voltages well within the specified values in the IEEE 802.3 standard and minimizes heat and noise dissipation apparent in BiPolar devices. SEEQ uses a similar CMOS process on its 8023A Manchester Code Converter (MCC). The MCC is a companion device working with the 83C92A/C in the Ethernet media interface layer. As of the third quarter of 1992 SEEQ is offering a CMOS Ethernet LAN controller. With the CMOS controller, the company offers the first and only completely CMOS Ethernet chip-set.

This application note provides supplemental information to the Company's data sheet. As such, this note refers to applications within the general Ethernet guidelines and is not limited to the specification's "letter of the Law." The benefit is that this information shows how designer can drive longer length cable segments. It also describes an interface with cables that do not match the standard 50 Ohm impedance. Additionally, this note provides information for the standard application of Thicknet (IEEE 802.3 10BASE-5) and Thinnet (IEEE 802.3 10BASE-2).

Also provided is information to reduce power and increase the reliability of the media interface connection. To that end, this note contains comparison data for a SEEQ CMOS transceiver's power dissipation and a traditional bipolar transceiver.



Notes:
1. 10 MΩ resistor is optional, 83C92 will assert "collision" signal when coax cable is disconnected even if there is not transmit signal on TXO, with the 10 MΩ resistor option.

2. 1N916 diode or equivalent with low capacitance ≤ to 1pf value. This diode is needed for all 83C92 designs.

Figure 1. MAU Schematic for 10BASE-5 (Thicknet)

Standard Implementation for Thicknet (10BASE-5) Application

In Ethernet the MAU (Media Attachment Unit) provides the signal amplification on the transmit side and preconditioning of the signal on the receive side. The MAU also supplies DC isolation, impedance matching, collision detection and signalling, and the necessary DC power.

The 83C92A/C is the key element in the MAU shown in Figure 1. It provides the receive and transmit functions as well as the collision detection and signal generation. The 83C92A device is compatible to the IEEE 802.3 specification and the National Semiconductor 8392 device. SEEQ's 83C92C is fully compliant to the IEEE specification.

Power Supply Requirements of the 802.3

The isolation specification found in 802.3 requires a transformer in this circuit. This requirement is also the reason that the power supply (–9 Volts) is isolated. The resistors R1, R2, R3, R4 shown on the CD ± and RX ± are the appropriate value for the AUI interface.

AUI Connections

Implementation of Thicknet requires attaching the MAU directly to the coax cable. The connection of the DTE (Data Terminal Equipment) to the MAU occurs through a multi-conductor cable and a DB15 connector (shown as J1 in Figure 1). This connection is the AUI (Access Unit Interface) connection. The AUI cable consists of 78 Ohm balanced shielded twisted pair connections, DC biased at the DTE end, and transformer coupled at the transceiver end.

The active element on the DTE providing the appropriate signals to the MAU, via the AUI interface, is SEEQ's MCC, the 8023A. The CMOS 8023A provides the interface between the MAU and the LAN Controller.

Standard Implementation for Thinnet (10BASE-2) Application

There are significant differences between Thinnet and Thicknet connections. Thicknet requires a connection from the DTE to a transceiver, then to the coax. Thinnet allows the coax to come directly to the DTE because of the

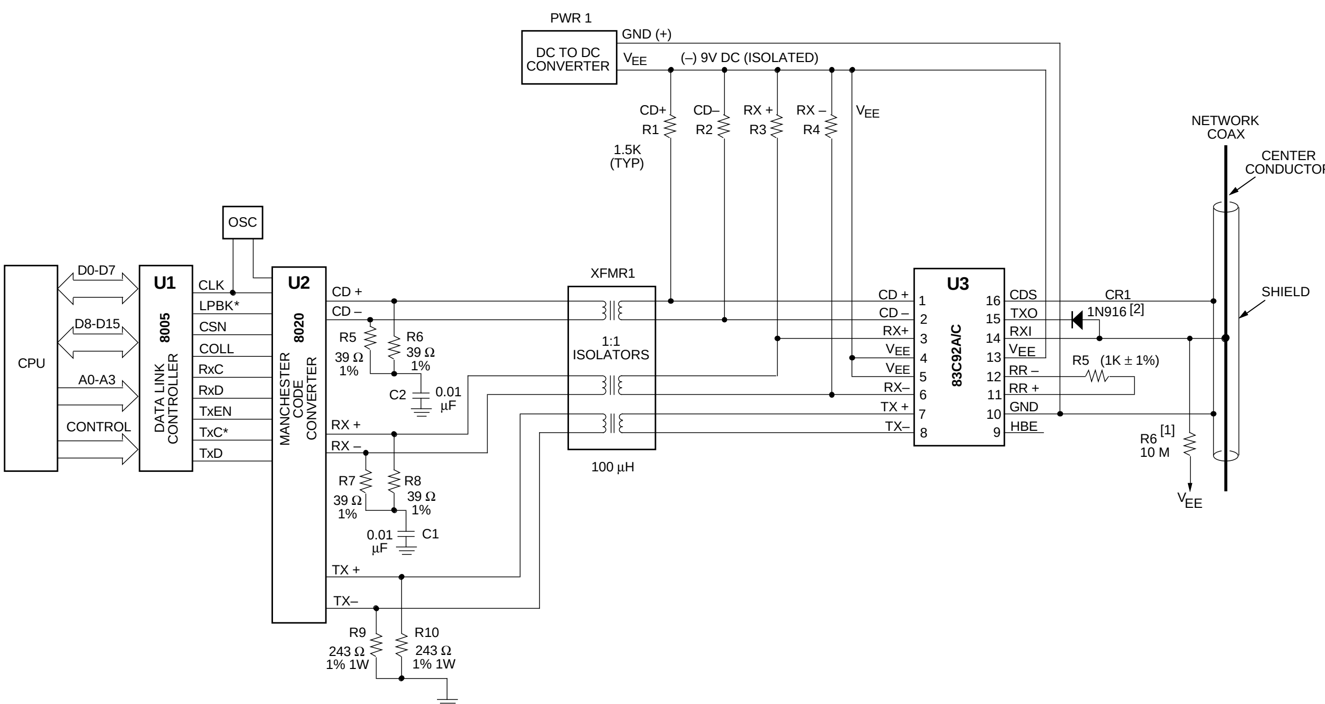


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Figure 2. MAU Schematic for Thinnet (10BASE-2)

flexibility of the media used in Thinnet. The cable used is RG58A/U, a THIN coaxial cable capable of being "pulled" easily due to its bending radius of less than 1 foot. In a Thinnet application connection to the media is typically provided by a BNC T - Connector on the Ethernet Adaptor Card. There is no AUI cable involved in a Thinnet application.

Figure 2 shows a typical MAU for Thinnet. Note the only difference between the Thicknet and Thinnet implementations are the values of the R1, R2, R3, R4 resistors. The 1.5K Ohm value provides for a reduction in overall power consumption. By not having to drive the AUI cable, the resistor value can be increased.

Utilizing Non Standard (Impedance) Coaxial Cable

In some applications in Ethernet it is desirable to connect the DTE to a non-standard impedance coaxial cable. The 2 most commonly used non-standard cables have 75 Ohm and 93 Ohm impedances. The major difference between non standard cables comes down to segment length. This is due to the increase in cable resistance. Because the 83C92A transceiver is a current driver, the parameters primarily effected by the change in cable impedance are the transmitter and collision voltage detection levels.

However, voltage levels can be adjusted by adding a voltage divider to the front end of the 83C92A. This voltage divider will reduce the voltage seen by the 83C92A and

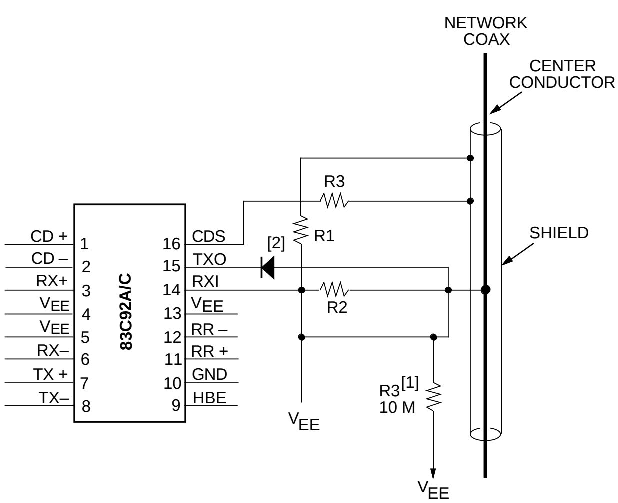

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Figure 3. Configuration for Driving Non-Standard Cables Impedances

increase its operational accuracy. Remember that the voltage levels on the cable will vary depending on type of cable used and number of nodes on the cable segment. The following paragraph contains an example of a typical application and the 83C92A's requirements.

In this example uses 93 Ohm cable with a max DC resistance of .1437 Ohms/m, a cable length of 130 m, and a segment with 30 nodes. The calculated maximum voltage on the cable is 2936.692 mv (or Vmax = 2936.692). The calculated minimum voltage on the cable is 2895.272 mv (or Vmin = 2895.272 mv). The 83C92A/C is looking for Vmax of 1580 mv and a Vmin of 1450 mv. Therefore the voltage divider shown in Figure 3 will place the cable voltage within the specifications of the 83C92A/C. The R3 resistor is the sum of R1 + R2 in order to provide a similar voltage drop on the collision detect sense line. Use the following values of R1, R2, and R3 in this circuit:

R1 = 54.8K Ohms
R2 = 45.2K Ohms
R3 = 100K Ohms

The following example uses 75 Ohm cable with a maximum DC resistance of .1894 Ohms/m, a cable length of 80 m, and a segment with 30 nodes, Vmax = 2339.6 mv and Vmin = 2127.8 mv. Therefore the voltage divider shown in Figure 3 will place the cable voltage within the specifications of the 83C92A/C. The following values of R1, R2, and R3 should be used in this circuit:

R1 = 67.8K Ohms
R2 = 32.2K Ohms
R3 = 100K Ohms

Using Non Standard Length Coaxial Cable

IEEE 802.3 specifies maximum cable length to be 500 meters for 10BASE-5 and 185 meters for 10BASE-2. Extension of this maximum cable length to 1000m and 300m respectively is made possible by means of a technique referred to as, "Transmit Mode Collision Detect." In this scheme it is key that the transmitting node be assured of detecting its own collision and not those of all the stations on the cable. When used, this method allows longer cable segments.

Simply stated, Transmit Mode Collision modifies the collision detect threshold voltage as seen by 83C92A/C. In Ethernet collision detection results from monitoring the DC offset voltage of the coax cable. If the offset is more negative than the collision detect threshold, the 83C92A/C will assert the collision detect output to the MCC. In the case of longer cable segments the resistance of the cable is larger thus reducing the value of DC offset voltage. Adjustments to compensate the Collision Detect Sense (CDS) lines with a voltage divider on the shield of the coax.

The following example uses 1000m of cable for a 10BASE-5 application with 100 nodes on the segment. The calculated maximum voltage on the cable is 1551 mv (or Vmax = 1551 mv). The calculated minimum voltage on the cable is 1701 mv (or Vmin = 1701 mv). The 83C92A/C is looking for Vmax of 1580 mv and a Vmin of 1450 mv. Therefore the voltage divider shown in Figure 4 will place the cable voltage within the specifications of the 83C92A/C.

R1 = 125 Ohms ± 1%
R2 = 10K Ohms ± 1%

The following example uses 300m of cable for a 10BASE-2 application with 100 nodes on the segment. The calculated maximum voltage on the cable is 1571 mv or Vmax = 1571 mv. The calculated minimum voltage on the cable is 1724 mv (or Vmin =1724 mv). The 83C92A/C is looking for Vmax = 1580 mv and a Vmin = 1450 mv. Therefore the voltage divider shown in Figure 4 will place the cable voltage within the specifications of the 83C92A/C.

R1 = 125 Ohms ± 1%
R2 = 10K Ohms ± 1%

Calculation for power information shown assumes a worst case of VEE equal to –9.45 Volts. The power saving provided by the CMOS 83C92A/C translate into a lower cost power supply and a more reliable media connection. The efficiency of most DC/DC converters available is 60% at best. This means that in order to provide the 1.7 Watts for the Bipolar device there must 2.375 Watts drawn from the primary power supply. The 83C92A/C DC power draw from the primary supply would be 1.75 Watts. The power savings of the SEEQ device equates to a 26% reduction in power required by the primary supply to support the media connection.

The Manchester Code Converter also effects the power supply requirement for the media. The Bipolar solutions available today draw 1.41 Watts of power while SEEQ's 8023A draws only .375 Watts. The total power supply required for both the MCC and the coaxial transceiver in CMOS totals 1.625 Watts. Therefore, the SEEQ chip-set has a tremendous advantage in power savings as opposed to 3.1 Watts required by the bipolar pair.

Power Dissipation

The following is a comparison of the power dissipation of SEEQ's 83C92A/C (CMOS) versus 8392 (Bipolar):

	Current		**Power**	
Device	I_{EE}1 (max)	I_{EE}2 (max)	Pwrl (max)	Pwr2 (max)
83C92A	–70 mA	–130 mA	.66 W	1.25 W
8392	–130 mA	–180 mA	1.25 W	1.70 W
Delta	–60 mA	–50 mA	.59 W	.45 W

I_{EE1} = Supply Current Out of V_{EE} Pin – Not Transmitting
I_{EE2} = Supply Current Out of V_{EE} Pin – Transmitting

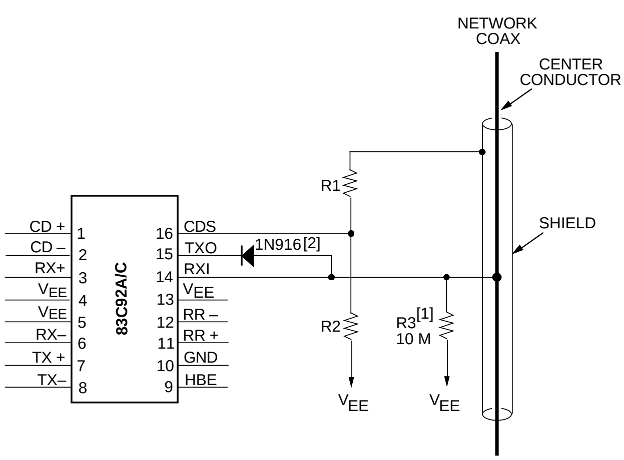

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Figure 4. Configuration for Driving Longer Cables