AMD

Board Layout Considerations for the Am79C973/75 Network Interface

Application Note

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TABLE OF CONTENTS

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INTRODUCTION

This application note is intended to assist customers in laying out the network interface section of their circuit board when using the Am79C973/75 PCnet™-*FAST III* Single-Chip 10/100 Mbps Ethernet Controller with Integrated PHY. During layout of the board when using the Am79C973/75, good design rules for high-speed printed circuit board layout must be followed. Special consideration must also be given to the layout of the network interface logic that comprises the Am79C973/75 controller, the transformer, and the RJ-45 jack.

Included in this application note is a suggested board layout that should be considered during the board design of the Am79C973/75 network interface.

BOARD LAYOUT CONSIDERATIONS

On the Am79C973/75 controller, the PHY is integrated in the device and is used to interface with the network interface transformer. Special care must be given to the board layout between the Am79C973/75 and the transformer, and between the transformer and the RJ-45 network interface jack. The primary elements that require consideration are the receive and transmit trace lengths, that the receive and transmit traces are routed as differential pairs with a specific characteristic impedance between traces, and the location of the receive and transmit termination devices. All termination should be placed closest to the driving source of the signals. As shown in Figure 2, for the transmit lines the 100 Ω termination should be closest to the L3 device, and for receive, the 50 Ω termination should be closest to the magnetic module (in this case the H1081 or equivalent). The differential pair characteristic impedance is determined by the 1:1.414 transformer selection for the Am79C973. The recommended board routing is shown in Figure 2 and should adhere to the following:

- Transmit signal traces between the Am79C973/75 and transformer
  - **Must** be routed as differential pairs with 50 Ω characteristic impedance between traces
  - Should have a total trace length of less than one inch
- Receive signal traces between the Am79C973/75 and transformer
  - **Must** be routed as differential pairs with 100 Ω characteristic impedance between traces
  - Should have a total trace length of less than one inch
- Transmit signal traces between the transformer and RJ-45 jack
  - **Must** be routed as differential pairs with 100 Ω characteristic impedance between traces
  - **Must** have a total trace length of less than one inch
- Receive signal traces between the transformer and RJ-45 jack
  - **Must** be routed as differential pairs with 100 Ω characteristic impedance between traces
  - **Must** have a total trace length of less than one inch

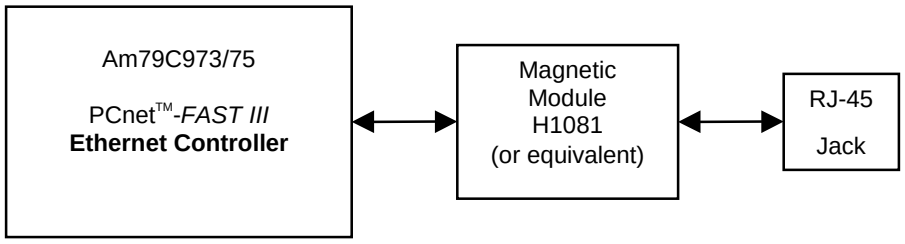
Please note that creating the 50 Ω characteristic impedance for the transmit signal traces between the Am79C973/75 and the transformer module can be accomplished fairly easily. Assuming that the length and width of the differential trace routing for the 100 Ω lines is known, the following procedure can be used.

- To determine the length and width of differential trace routing with a 50 Ω characteristic impedance using information based on differential traces with a known 100 Ω characteristic impedance:
  - Let L equal the length of the known 100 Ω trace
  - Let W equal the width of the known 100 Ω trace
  - To generate a trace that is 50 Ω with a length of L

- Make the 50 Ω trace width approximately 2.5 to 3 times the width of W.
  So for the 50 Ω trace routing
  Length = L
  Width = (2.5 ~ 3) * W

Whenever possible, the distance between the Am79C973/75 and the RJ-45 jack should be kept to less than two inches. This allows the trace lengths between the Am79C973/75 and the transformer, and the transformer and the RJ-45 jack, to be less than one inch in length. Figure 1 illustrates the respective distance dimensions on the board that are considered critical.

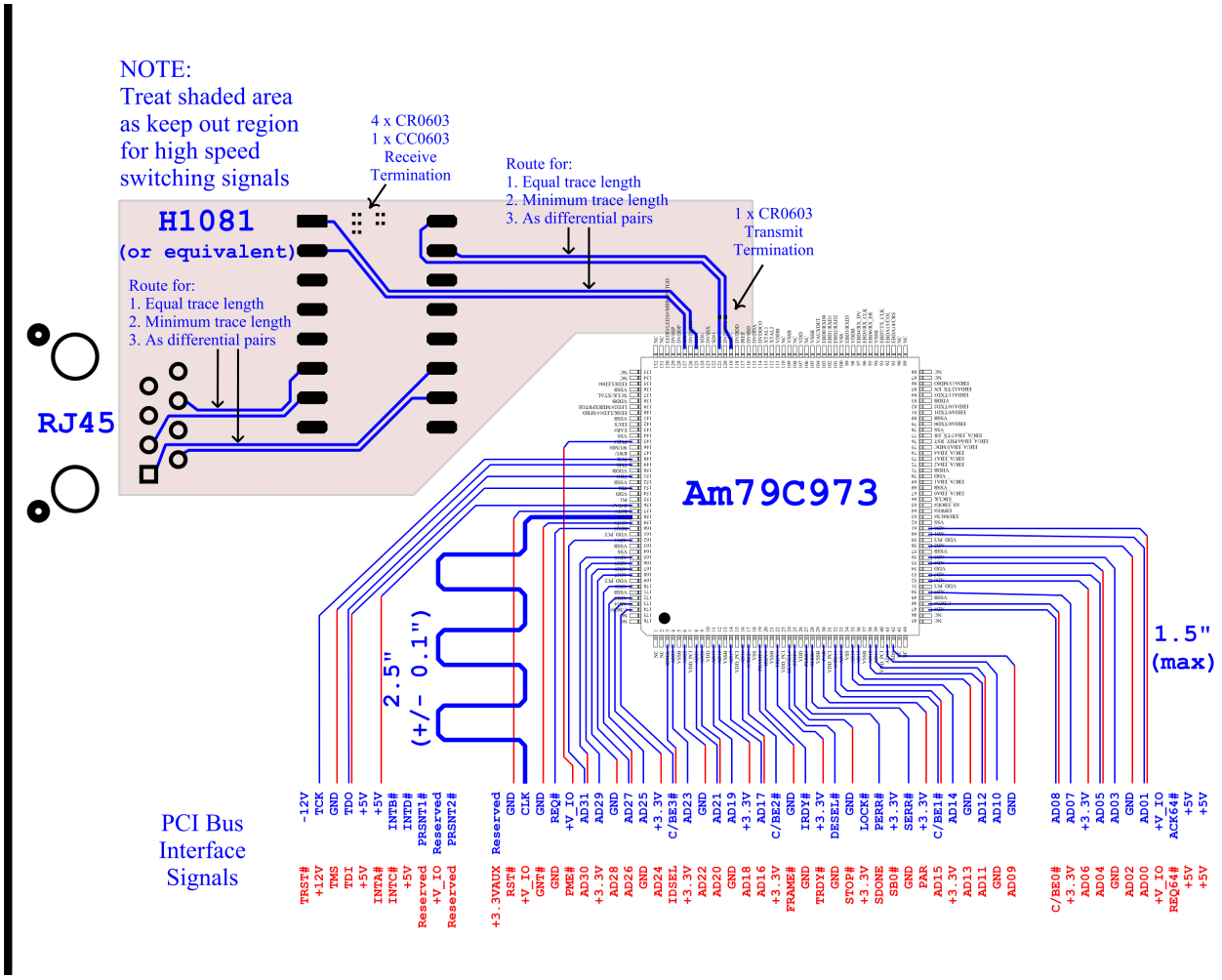
Figure 1 Critical Board Dimensions



The distance between the magnetic module and the RJ-45 jack, shown in Figure 1 as dimension B, is the most critical and must always be less than one inch. The distance between the Am79C973/75 and the magnetic module, shown in Figure 1 as dimension A, is somewhat less critical. However, the distance referred to as dimension A should also be kept to less than one inch wherever possible. In the event that board layout prevents the Am79C973/75 from being placed within two inches of the RJ-45 jack, dimension A may be allowed to exceed one inch. However, because dimension B is the most critical, the trace length between the transformer and the RJ-45 jack must still be kept to less than one inch.

The entire region between the Am79C973/75 and the RJ-45 jack should be considered a keep out area for all other high speed switching signals. This keep out area is indicated in the shaded area of Figure 2. Eliminating the high speed switching signals from this region can greatly improve the overall network interface performance, and reduce errors due to noise induced by high speed signals into the network interface circuit.

Figure 2 Suggested Board Layout for the Network Interface



SUMMARY

Following good design rules and exercising care in the layout of the circuit board can greatly increase the performance and reliability of the Am79C973/75 network interface. If special consideration is not given to the board layout for the network interface logic, poor reliability and reduced performance may occur. In many cases, this can only be corrected by making design changes to the board layout and manufacturing new boards. There is usually little chance of being able to correct the problem with a simple rework of existing boards. For this reason, it is strongly recommended that the network interface section of the board layout receive special care and attention. This will allow the Am79C973/75 Ethernet controller to provide the best, and most reliable, network interface solution possible.