Interfacing the DP8392 to 93Ω and 75Ω Cable

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The DP8392 Ethernet Coaxial Transceiver Interface (CTI) is designed primarily for 10BASE2 and 10BASE5 applications which use 50Ω coaxial cable. However, with minor modifications it is possible to use this transceiver with larger impedance cables. This article shows how to use the DP8392 with 75Ω or 93Ω cable. The trade off is that segment span is reduced to accommodate for higher series DC resistance of these cables. The CTI is a current driver. The two important factors that must be handled properly in using the chip with 75Ω and 93Ω cables are the dynamic range of the transmitter and collision detection levels.

DYNAMIC RANGE

The dynamic range of the transmitter is important in the following case:

Suppose two stations collide with one-another. To detect collisions properly, each station must sink at least as much DC current as it would in a non-collision case. This would mean that with the 93Ω cable when a collision occurs the chips should be able to sustain approximately −4V DC level. If the signals from the colliding stations are in phase the AC signal could be 8V peak to peak.

The DP8392's transmitter clamps before it pulls to −8V. However, when it clamps it also changes the duty cycle enough to sustain the −4V DC collision level.

An internal diode is included in series with the transmitter's output to isolate its capacitance and thereby minimizing the tap capacitance. For more dynamic range margin, it is recommended that external isolating diodes at the transmitter output not be used. It is also advisable to design the power supply to operate at the higher end of the 8.55V to 9.45V range.

COLLISION LEVELS—RECEIVE MODE

In order to understand the concerns with collision levels, it is necessary to calculate the levels for Cheapernet (10BASE2) 50Ω cable (RG58AU) as an example.

50Ω Cable Example (RG58A/U)

Table I shows the parameter values that are used in calculating the collision levels. Please note that all the levels in this article are for receive mode collision detection.

TABLE I. Assumptions and Definitions

R_T	= Termination Resistor at 20°C	= 50 ±1%	802.3
t_T	= Temp. Coef. of the Terminator	= 0.0001/°C	ASSUMPTION
L	= Maximum Segment Length	= 185m	802.3
R_{DC}	= Maximum Cable DC Res. at 20°C	= 0.0489Ω/m	BELDEN
tc	= Temp. Coef. of Copper	= 0.004/°C	PHYSICS
Tm	= Maximum Cable Temp.	= 50°C	ASSUMPTION
SR	= Step Response at Max Cable Length	= 0.98	NATIONAL
R_C	= Max Connector Res./Station	= 0.0034Ω	MIL SPEC
I_{B+}	= Max Positive Bias Current	= 2 μA	802.3
I_{B-}	= Max Negative Bias Current	= 25 μA	802.3
I_{max}	= Max DC Drive Current	= 45 mA	802.3
I_{min}	= Min. DC Drive Current	= 37 mA	802.3
R_O	= Non Transmitting Output Impedance	= 100 kΩ	802.3
N	= Max Nodes per Segment	= 30	802.3
SK	= Skew Factor, Effect of Encoder Skew on DC Level = (SKEW × 4)/100	= 0.02 for 0.5 ns Skew	802.3
R_S	= Max DC Loop Res. of a Segment		DEFINITION
R_L	= Load Resistance Seen by a Driver		DEFINITION
SEO	= Sending End Overshoot	= 0.08	ASSUMPTION

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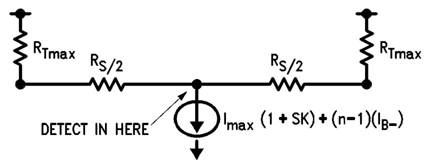
The collision levels that need to be calculated are V_{max} and V_{min}. The V_{max} or ''no detect'' level is the maximum DC voltage generated by one node. The worst case here occurs when the transmitting node is at the center of a maximum length cable, and the collision is being detected either by itself or by a station right next to it. On the other hand, the V_{min} or ''must detect'' level is the minimum DC voltage generated by two minimum stations transmitting at one end of a maximum length cable, and the collision is being detected by a node on the other side of the cable.

The filter impulse response is not included in these calculations since it is mutually exclusive with the Sending End Overshoot. If the impulse response is larger than the Sending End Overshoot, the exceeding portion should be added on to the limits.

Maximum Non Collision Level V_{max} (No-Detect)—Receive Mode—50Ω Cable



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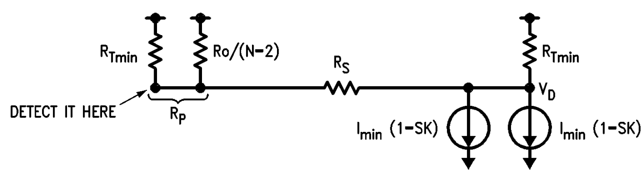
R_{Tmax}	$= R_T \times 1.01 \times [(Tm - 20) \times t_T + 1]$	
R_S	$= R_{DC} \times L \times [(Tm - 20) \times tc + 1] + N \times R_C$	
R_L	$= (R_{Tmax} + R_S/2)/2$	
V_{max}	$= [I_{max} \times (1 + SK) + (N - 1)(I_{B-})] \times R_L \times (1 + SEO)$	
R_{Tmax}	$= 50 \times 1.01 \times [(50 - 20) \times 0.0001 + 1]$	$= 50.652\Omega$
R_S	$= 0.0489 \times 185[(50 - 20) \times 0.004 + 1] + 30 \times 0.0034$	$= 10.234\Omega$
R_L	$= (50.652 + 10.234/2)/2$	$= 27.885\Omega$
V_{max}	$= [45 \times 1.02 + 29 \times 0.025] \times 27.885 \times 1.08$	**= 1404 mV**

Minimum Collision Level V_{min} (Must-Detect)—Receive Mode—50Ω Cable



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R_P	= NEAR END SHUNT RESISTANCE	
	$= [R_O/(N - 2)]//R_{Tmin}$	
R_{Tmin}	$= R_T \times 0.99$	
V_D	= TRANSMITTER'S END DC VOLTAGE	
	$= 2 \times I_{min} \times (1 - SK) \times [R_{Tmin}//(R_S + R_P)]$	
V_{min}	$= V_D \times [R_P/(R_S + R_P)] \times SR$	
R_P	$= [100k/28]//(50 \times 0.99) = 3571//49.5$	$= 48.823\Omega$
V_D	$= 2 \times 37 \times 0.98 \times [49.5//(10.234 + 48.823)]$	= 1952 mV
V_{min}	$= 1952 \times [48.823/(10.234 + 48.823)] \times 0.98$	**= 1581 mV**

The calculations show that the V_{max} and V_{min} are properly placed outside the collision threshold range of the DP8392 (1450 mV to 1580 mV).

93Ω Cable Collision Level Calculation

A few parameters need to be changed when using a different impedance cable. Here are those parameters for 93Ω cable (RG62A/U TYPE, BELDEN 9269);

TABLE II

R_T	= termination resistor at 20°C	= 93 ±1%	
L	= maximum segment length	= 130m	
R_{DC}	= maximum cable DC res. at 20°C	= 0.1437 Ω/m	BELDEN

Considering the new values the V_{max} and V_{min} levels are;

Maximum Non Collision Level V_{max} (No Detect)—Receive Mode—93Ω Cable

R_{Tmax}	$= 93 \times 1.01 \times [(50 - 20) \times 0.0001 + 1]$	= 94.212Ω
R_S	$= 0.1437 \times 130[(50 - 20) \times 0.004 + 1] + 30 \times 0.0034$	= 21.025Ω
R_L	$= (94.212 + 21.025/2)/2$	= 52.362Ω
V_{max}	$= [45 \times 1.02 + 29 \times 0.025] \times 52.362 \times 1.08$	**= 2636.692 mV**

Minimum Collision Level V_{min} (Must Detect)—Receive Mode—93Ω Cable

R_P	$= [100k/28]//(93 \times 0.99) = 3571//92.07$	= 89.756Ω
V_D	$= 2 \times 37 \times 0.98 \times [92.070//(21.025 + 89.756)]$	= 3646.396 mV
V_{min}	$= 3646.396 \times [89.756/(21.025 + 89.756)] \times 0.98$	**= 2895.272 mV**

93Ω IMPLEMENTATION WITH DP8392

Figure 1 shows the connection diagram with 93Ω cable (100 meters and 30 stations). The design parameters defined below are summarized in Table III. The resistor divider ratio needs to be calculated to attenuate the receiver input signal. The two resistors R_1 and R_2 should center the calculated thresholds (2636 mV to 2895 mV) to the internal level of DP8392 (1450 mV to 1580 mV).

The resistor divider and the capacitor Cp, *Figure 1*, (Cp includes the RXI input capacitance, typically 1 pF, and the pc trace capacitance associated with it) form a low pass filter effect. It may be necessary to add the capacitor Cc (capacitor Cc creates a high pass effect) to compensate the low pass effect. The equation to calculate the capacitor Cc is;

$$Cc \times R_2 = Cp \times R_1$$

It is also necessary to add the resistor R_3 ($R_3 = R_1//R_2$) in series with the CDS pin. This will assure that the voltage drop due to the biasing currents into CDS and RXI pins are duplicated.

To check the design;

$[54.8k/(54.8k + 45.2k)] \times 2636\ mV = 1444\ mV$
$[54.8k/(54.8k + 45.2k)] \times 2895\ mV = 1586\ mV$

The DP8932's internal collision range is within this window.

75Ω CABLE IMPLEMENTATION

This method can also be successfully implemented for 80 meters of 75Ω cable (RG59/U BELDEN 8241). The collision thresholds are 2127.8 mV and 2339.6 mV. The corresponding R_1 and R_2 values are 67.8 kΩ and 32.2 kΩ respectively. Table IV summarizes the design parameters.

TABLE III

CABLE	BELDEN RG62A/U Type 93Ω Cable
L	130 meters
R_{DC}	0.1437 Ω/m
N	30
R_1	54.8k
R_2	45.2k

TABLE IV

CABLE	BELDEN RG59/U 75Ω Cable
L	80 meters
R_{DC}	0.1894 Ω/m
N	30
R_1	67.8k
R_2	32.2k

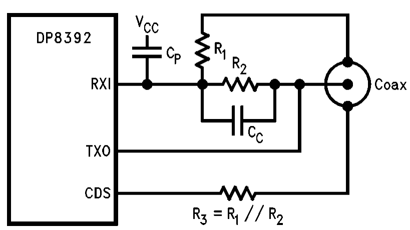

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FIGURE 1

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