

# Interfacing the DP8392 to 93Ω and 75Ω Cable

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Interfacing the DP8392 to 93Ω and 75Ω Cable

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
$t_c$	= Temp. Coef. of Copper	= 0.004/°C	PHYSICS
$T_m$	= 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

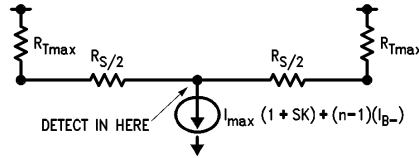
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The collision levels that need to be calculated are  $V_{max}$  and  $V_{min}$ . The  $V_{max}$  or "no detect" level is the maximum DC voltage generated by one node. The worst case here occurs when the transmitting node is at the center of a maximum 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.

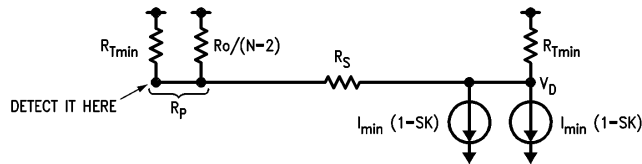
### Maximum Non Collision Level $V_{max}$ (No-Detect)—Receive Mode—50Ω Cable



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$$\begin{aligned}
 R_{Tmax} &= R_T \times 1.01 \times [(T_m - 20) \times t_T + 1] &&= 50.652\Omega \\
 R_S &= R_{DC} \times L \times [(T_m - 20) \times t_c + 1] + N \times R_C &&= 10.234\Omega \\
 R_L &= (R_{Tmax} + R_S/2)/2 &&= 27.885\Omega \\
 V_{max} &= [I_{max} \times (1 + SK) + (N - 1)(I_{b-})] \times R_L \times (1 + SEO) &&= 1404 \text{ mV} \\
 R_{Tmin} &= 50 \times 1.01 \times [(50 - 20) \times 0.0001 + 1] &&= 50.652\Omega \\
 R_S &= 0.0489 \times 185[(50 - 20) \times 0.004 + 1] + 30 \times 0.0034 &&= 10.234\Omega \\
 R_L &= (50.652 + 10.234/2)/2 &&= 27.885\Omega \\
 V_{max} &= [45 \times 1.02 + 29 \times 0.025] \times 27.885 \times 1.08 &&= 1404 \text{ mV}
 \end{aligned}$$

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



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

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);

$R_T$	= 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

**TABLE II**

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
$V_{max}$	= $[45 \times 1.02 + 29 \times 0.025] \times 52.362 \times 1.08$	= <b>2636.692 mV</b>

#### 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
$V_{min}$	= $3646.396 \times [89.756 / (21.025 + 89.756)] \times 0.98$	= <b>2895.272 mV</b>

### 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  $C_p$ , Figure 1, ( $C_p$  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  $C_c$  (capacitor  $C_c$  creates a high pass effect) to compensate the low pass effect. The equation to calculate the capacitor  $C_c$  is;

$$C_c \times R_2 = C_p \times R_1$$

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;

$$[54.8k / (54.8k + 45.2k)] \times 2636 \text{ mV} = 1444 \text{ mV}$$

$$[54.8k / (54.8k + 45.2k)] \times 2895 \text{ mV} = 1586 \text{ mV}$$

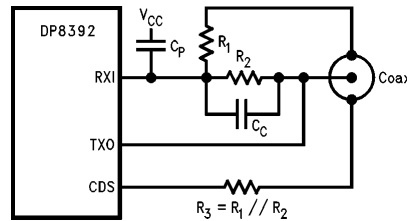
The DP8392's internal collision range is within this window.

### 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.

<b>TABLE III</b>	
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

<b>TABLE IV</b>	
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



**FIGURE 1**

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