APPLICATION NOTE ANI#21

SP3070E-SP3078E Guidelines for Failsafe Biasing when Applied in Multi-Voltage Networks

Introduction

The SP3070E-SP3078E offer an advanced receiver failsafe feature that ensures the receiver output will be in a known state when the network is not being driven. The advanced failsafe will commit the receiver output to a logic “high” if the receiver input is tri-stated (idle), is left open by fault or cable disconnect, or is shorted together. This advanced receiver failsafe eliminates problems associated with typical receiver failsafe and can reduce system cost. This application note will discuss the advantages of advanced receiver failsafe and assist users to avoid potential problems.

RS485 Receiver Failsafe – Standard Versus Advanced

Common RS485 transceivers, such as SP485E, offer a standard receiver failsafe feature that will commit the output to logic “high” when the inputs are floating. Internal to the receiver is a very weak pull up on the non-inverting input that will force the non-inverting input to be at least +200mV greater than the inverting input, when inputs are floating. This, for the most part, works fine when the data cable is disconnected and there are no termination resistors present at receiver input. When RS485 protocol was first being used, the termination resistor would be housed within data cable. Under this configuration, the receiver failsafe would operate with no problems anytime data cable was disconnected. However, this type of configuration made data cables more costly and not all applications required the use of termination. Data cable manufacturers have stopped offering internal termination resistors in the cable. Thus, applications that required or used termination resistors would simply include termination resistors into printed circuit board at receiver input terminals. Figure 1 shows a simple driver to receiver connection using data cable and termination resistor (RT).

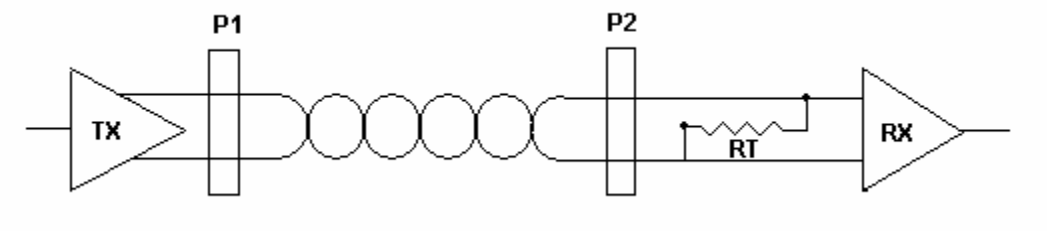

Figure 1. Driver to Receiver connection with data cable

A RS485 transceiver offering standard receiver failsafe will have problems with failsafe when data cable is disconnected because of the presence of termination resistor. A standard receiver failsafe device offers proper operation only when inputs are floating or open, and not terminated. The problem here is that the termination resistor provides a potential difference of 0V at receiver input and the internal pull-up current is not able to provide a large enough current to overcome the loading of termination resistor. Since the end user was not able to remove the termination resistor effectively, a different solution was needed. This solution, or fix, is to add a biasing network to the receiver input.

Receiver Biasing

This biasing network consists of a pull-up resistor to Vcc on the Non-inverting input and a pull-down resistor to GND from the Inverting input (figure 2). The values of these resistors are selected to provide a minimum of +200mV differential at receiver input across the termination resistor when data cable is removed. To overcome this termination failsafe problem, Sipex has developed the SP3070E-SP3078E family that offers advanced receiver failsafe. The advanced receiver failsafe does not require a biasing network in terminated applications for proper operation. This improved feature allows for lower system cost due to not requiring biasing networks. Users are advised not to use biasing networks when designing SP3070E-SP3078E.

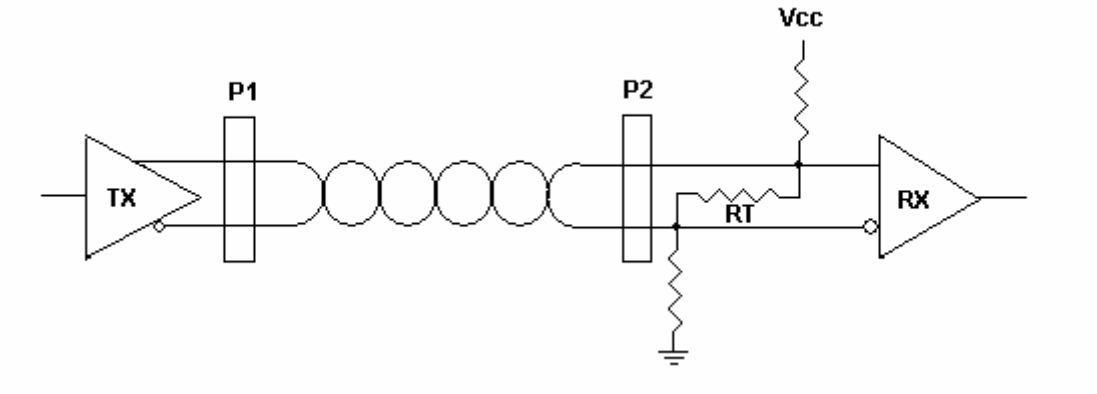

Figure 2. Receiver Termination and Biasing network configuration

Receiver Biasing and Multi-voltage transceivers

The SP3070E-SP3078E devices are 3.3V powered RS485 transceivers that may be connected to any RS485 network. Since these parts offer advanced receiver failsafe, there is no need to implement receiver biasing networks. However, some applications require their design to connect to another or different type of product in which biasing technique is not controlled. The SP3070E-SP3078E may be connected to a RS485 network that has other transceivers being powered from 5.0V, provided that a certain 5V biasing condition does not exist. The SP3070E-SP3078E devices may have driver output problems if the connected receiver has a biasing network to 5.0V without a termination resistor. A sample of this biasing condition is shown in figure 3.

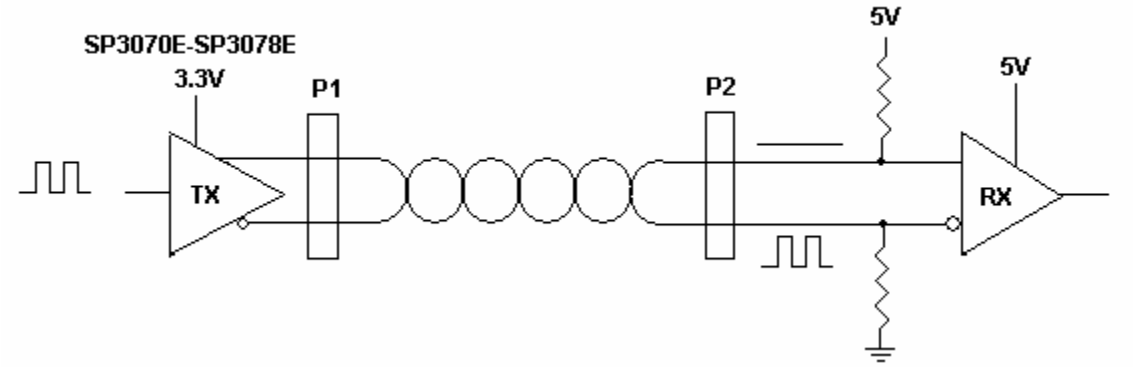

Figure 3 Biasing network concern

In figure 3, the device is connected to a 5V powered RS485 transceiver with biasing network and no termination resistor. Under this operating condition, the driver non-inverting output will sense 5V through the pull-up resistor at receiver input and will force the non-inverting driver output into tri-state. Figure 3 shows TTL signal at driver input with correct driver output at inverting output but no signal at non-inverting output. Upon start up, if the driver output senses a voltage of 1.0V greater than Vcc (3.3V) it will force that output into tri-state. There are a few of remedies for this particular issue and is shown below.

1. Remove external pull-up / pull-down biasing resistors at 5V powered receiver (advanced failsafe receivers do not require biasing)
2. Add termination resistor at receiver input to reduce voltage sensed at non-inverting driver output
3. Ensure SP3070E-SP3078E device is powered on first before down stream nodes are powered on.

For further assistance:

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