

**Polarities for Differential Pair Signals  
(RS-422 and RS-485)**

[RS-485 Quick Guide](#) - Just the Essentials on a Single Piece of Paper  
[RS-485 Problem Solver](#) - Trouble Shooting Guide Walks You Step by Step

B&B Electronics labels the data lines on RS-422 and RS-485 with an "A", for negative or "B" for positive, to indicate the positive and negative relationship between the two data lines. It is important to label the data lines because this positive and negative relationship between the lines must be maintained when connecting one device to another.

Some manufacturers of RS-422/485 equipment label the data lines on their devices with "+" or "-", Signal and Inverted Signal, or an "A" and "B" that are opposite to other converters or devices in the network. This can add confusion when making connections or troubleshooting a network with devices from different manufacturers. This application note addresses some of these differences, show how they've come about, and try to relate them to each other so that the system designer can interconnect devices from different manufacturers.

**What the Standards Say:**

The RS-422 and RS-485 Standards define the two differential signal lines as the "A" and "B" line. The signal state (0 or 1) is defined as the difference in voltage between the two lines. At any receiver, a "1", (Idle, Mark, or Stop bit), state is defined when the voltage on the "B" line is greater than the voltage on the "A" line by at least 200 mV. A "0" (Space or Start bit), state is defined when the voltage on the "A" line is greater than the voltage on the "B" line by at least 200mV. Shown in the equations below:

$$V_a - V_b < -0.2V = "1"$$

$$V_a - V_b > 0.2V = "0"$$

Where  $V_a$  and  $V_b$  are the voltages on the "A" and "B" lines respectively.

**What Really Matters:**

Regardless of the naming scheme used, the main consideration in any RS-422/485 system is that the inversions remain constant throughout the system. If we relate the above states to standard TTL logic, when the "A" line is greater than the "B" line, this would equal a 0 Volt TTL level. Conversely, when the "B" line is greater than the "A" line, this would equal a 5 Volt TTL level. Figure 1 shows a typical asynchronous data byte and it's corresponding signal levels in TTL, RS-232, and RS-422/485.

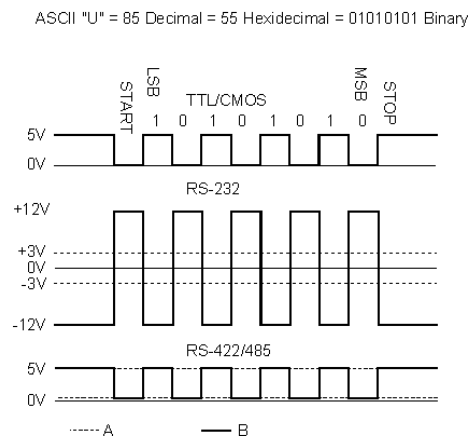


Figure 1.

### What Else We See:

"A" and "B" are opposite of what is shown in the standard.

This has mainly arisen because manufacturers of RS-422 and RS-485 interface IC's have always used the convention of labeling the inverted pin of a differential transceiver as "B" and the non-inverting pin as "A". Even differential transceivers that pre-date or are not specifically designed for RS-422 or RS-485 use this naming scheme. Unfortunately, the "A" and "B" pin labeled on the IC data sheet does not necessarily have to correspond to the "A" and "B" in the RS-422/485 standard. It depends on the logic on the TTL side of the device. Many equipment manufacturers use the IC data sheet labeling and transfer the signal names to the names for their interfaces.

The signals are labeled "+" and "-"

We don't know where this scheme originated, but it may have started with an attempt to clear up the ambiguities of the "A" and "B." "+" and "-" is certainly more descriptive than "A" and "B" as to the relationship between the signals. In almost all cases that we've seen, the "+" line will correspond to the RS-422/485 "B" line and the "-" will correspond to the "A" line.

The signals are labeled "Signal" and "Signal\*" or "Inverted Signal"

In this case the signal names used definitely correspond to the inverting and non-inverting pins on the transceiver IC. The "Signal" line will almost always correspond to the "B" line of the standard, and the "Signal\*" or "Inverted Signal" will correspond to the "A" line in the standard.

### What B&B Does:

B&B tries to include the RS-422/485 specifications' naming scheme on all of our products. Because of its common use, most of our data sheets and product labels also include the "+" and "-" naming scheme along with the "A" and "B".

### What if I'm Unsure?

Reversing the two lines in the differential signal is by far the most common initial error when connecting two pieces of RS-422 or RS-485 equipment. The good news is that it won't cause any damage to your equipment to try it the wrong way. If you try it connected one way and are seeing garbled data, reverse the leads and try again.

If this doesn't instill a level of confidence you are comfortable with, or you have tried both combinations with negative results, you can usually use a DC voltmeter to determine which line is which.

1. Measure the voltage across the two lines at the receiver without the driver connected. On an RS-485 device the driver and receiver are on the same pair.
2. Note which signal line the positive lead of the voltmeter is connected to.
3. Is the reading positive or negative?
4. If the reading is positive, the signal line going to the positive lead of the voltmeter corresponds to the "B" line of the RS-422/485 standards.
5. If the reading is negative, the signal line going to the positive lead of the voltmeter corresponds to the "A" line of the RS-422/485 standards.