RS-422 Interface Circuits

Adapted from a lab by Bob Nicholson.

Introduction

In this lab you will design, build and test an RS-422/485 interface circuit using the MC3487 line driver and MC3486 receiver ICs. You will measure the line driver's transition time and output current and the receiver input bias current.

The MC3487 and MC3486 datasheets are available on the course web site.

Pre-Lab

Prepare a pre-lab report including the diagrams and answers asked for in the following sections. Submit your report in PDF format to the appropriate dropbox on the course web site.

RS-422 Interfaces

Use the MC3486 and MC3487 datasheets from the course web site to answer the following questions.

1. Sketch the schematic of an RS-422 interface circuit using one MC3487 and one MC3486 IC. *Ensure that the tri-state controls on both chips are enabled.*
2. Why doesn't the MC3287 require a negative supply or charge pump?
3. If the maximum output transition time ($t_{t(OD)}$) represents 10% of the bit period, what is the maximum bit rate?

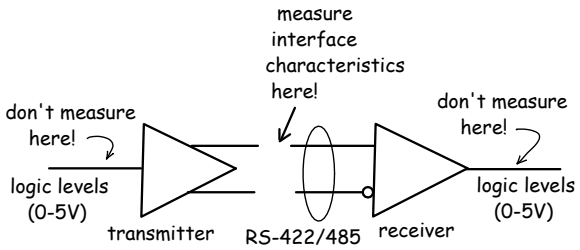
Procedure

Hints

The function of a line driver and receiver is to interface logic levels to line levels. Thus one side of each driver or receiver is a logic-level interface (e.g. TTL) and the other is a line-level interface (e.g. RS-4222). Make sure you don't confuse the two interfaces.

The line drivers expect TTL logic level voltages (0-5V). Set the AWG high and low levels to the correct values. Set the AWG for square-wave output.

We want to measure specifications (impedance, slew rate, etc.) on the *line* side of the interfaces, not on the logic level side. Make sure you are measuring the right interface:



The MC3487 and MC3486 include four drivers or receivers. You can measure any one of the four.

Work Carefully

Marks will be deducted for carelessness resulting in the destruction of components. Devices can be damaged by exceeding any of their "absolute maximum ratings" (e.g. reversed power supply polarity). Use the 'scope to verify power supply voltages and the 'scope to verify AWG output levels *before* hooking them up.

Oscilloscope Measurements

Use the Math trace to measure differential voltages since you cannot connect either signal to ground.

Press the Horizontal Scale knob to switch to the delayed timebase mode. In this mode you can "zoom in" on a portion of the waveform to allow more accurate measurements of, for example, the rising or falling edge of a waveform.

Use the Measurement menu to add the (10% to 90%) rise and fall time measurements to the display.

RS-422 Interface

1. Assemble the MC3487 RS-422 driver interface on your breadboard using the components supplied in the lab. Make sure your design enables the output. Load the differential output with a 100 Ω resistor as shown in the test circuit in the data sheet (Figure 3). The capacitive loading will result from attaching the 'scope probes.

2. Using the AWG, apply a 9600 bps TTL (0-5V) signal to the input of the MC3487. Connect channel two of your scope to the non-inverted output of the MC3487 and channel one to the inverted output. Ensure that both channel inputs are DC coupled.

   Capture the waveforms you observe on both channels for two cycles of V_{in}. Do they fall within the device MC3487 specifications?

3. Set up the scope to measure the differential voltage across the two outputs (see instructions above). Capture the waveform including the rise time measurement of the differential signal.

   If the RS-232 interface limits the slew rate to reduce interference with other devices why might RS-422 interfaces not do the same? (Hint: what kind of transmission lines are typically used with differential signalling?)

4. Assemble the RS-422 receiver circuit, making sure the output is enabled. Connect +3V to one of the receiver inputs in series with a 100 ohm resistor. Measure the voltage drop across the resistor and from this compute the input bias current. Does this fall within the MC3846 specifications?

Lab Report

Submit a lab report showing the measurements (voltages, currents, impedances, slew rates, waveforms, etc), and any calculations and answers to the questions asked in the procedure sections above.

Submit your report, in PDF format, to the appropriate dropbox on the course web site.