

AN-1534 Demo Board LMH7220 High Speed LVDS Comparator

1 General Description

This board is designed to demonstrate the LMH7220 high speed comparator with LVDS output. The board consists of two parts; one part acts as a transmitter and one as a receiver. This configuration gives the possibility of testing the signal path using a cable with a specific length. Splitting the board into a transmitter and a receiver makes it possible to use the transmitter to convert signals with slow edges to LVDS levels or data from another logic family to LVDS compliant signals. The receiver part regenerates the distorted signal at the end of the signal path to a LVDS signal which complies to all the LVDS standards.

The transmitter has two input connectors for both the plus and minus inputs. One acts as a signal input and is fed without attenuation to the input and one as a monitor output. This monitor output has an attenuation of 6 dB, relative to the level of the input signal. To maintain the correct levels it is important to have both connectors terminated with 50Ω. The output is a modular jack in order to connect to a standard 100Ω twisted pair line. The receiver has at the input the same modular jack type connector. The regenerated LVDS signal is fed to a 100Ω load resistor which has a measuring point on every pin. This enables a high Ohmic measurement across the load resistance.

2 Basic Operation

2.1 Transmitter

The circuit around the transmitter is fully symmetrical, which offers the following advantages:

- Connecting signals to both the plus or the minus inputs
- Introduce hysteresis
- Examining the effects on the output signal

The inputs for both the plus and minus connection consist of a circuit with two SMA connectors. One connector is directly connected to the input pin of the LMH7220. The other connector has a series resistor of 37.5Ω, which means that an attenuation of 6 dB is introduced for the signals coming to or leaving this connector. The only restriction is that both connectors must have a termination or a source of 50Ω otherwise the attenuation is not 6 dB. Both connectors can be used as input or as output. Normally the connector without attenuation should be connected to the source and the other one used for measuring or monitoring purposes.

The LMH7220 has no standard hysteresis built in, so for small signals or slow edges, oscillations may occur at the output. Oscillations can be suppressed or reduced by introducing external hysteresis. To experiment with this, a resistor can be placed between each of the outputs and its corresponding input. See [Figure 1](#). For some applications there is a need for a couple of millivolts of hysteresis, in order to achieve this, the feedback resistor will need to have a high value. This will result in some delay before the input change takes effect. To compensate for this effect, there is also space for a parallel capacitor across the feedback resistor. This capacitor will speed up the process and eliminate oscillations. For more information about the hysteresis, see the Application Section of *LMH7220 High Speed Comparator with LVDS Output* ([SNOSAL3](#)).

The outputs of the LMH7220 are connected to a 6-pin modular jack telephone line socket. The device is powered by a split supply (V^+ and V^-), but on the pcb there is a jumper, which gives the possibility to short the negative supply pin to ground, creating a single supply powered setup. For all applications the appropriate decoupling capacitors are connected to the device.

2.2 Receiver

The receiver has the same setup as the transmitter regarding the hysteresis possibilities and also, the supply line decoupling is identical. The difference is at the input, where both the plus and the minus input are terminated by a 100 Ω resistor. This is done because LVDS outputs are defined at 100 Ω termination. The input of the receiver has the same telephone socket that was used for the transmitter, so an easy interconnection is possible. In order to make variations to the termination at the input, two 0 Ohm resistors are provided (R16 and R17). The output of the receiver is connected to a 100 Ω resistor to create the correct LVDS output voltages. In parallel to this resistor two measuring pins are provided. Just like the transmitter, this device also has the possibility to add hysteresis by placing a feedback resistor between the output and the input. This process can be improved by adding a parallel capacitor. The receiver is powered by a separate power connector and has the possibility to connect a split supply (V^{+dut} and V^{-dut}) to the part while appropriate decoupling capacitors are provided. The user has two options for both the positive and the negative supply line. For the negative supply line, there is a choice to connect this pin to ground. In the same way as for the transmitter device a single supply setup is created. For the positive supply line, there is a choice to connect this pin to V^+ or to V^{+dut} . Connected to V^{+dut} means that the LMH7220 of the receiver uses a separate positive supply and connected to V^+ means there is only one positive supply for the transmitter and the receiver necessary.

3 Layout Considerations

The setup of the pcb is simple and consists of a double sided pcb with a ground plane on the bottom side and the components and transmission lines on the top side. The transmission lines to the input connections are 50 Ω and as short as possible. The LVDS output lines form a 100 Ω coupled line in order to match as soon as possible the twisted pair line connected between the transmitter and the receiver.

The setup of the receiver follows the same philosophy. This means the input and output lines are as short as possible and also the components for creating a hysteresis voltage are placed as close as possible to the part. At the same time, decoupling capacitors are situated as close as possible to the supply pins.

4 Measurement Hints

For good high speed results it is recommended that measurements be taken via the SMA test connections. If a probe is needed, be sure to connect via short leads and don't use the standard ground leads with alligator clips that are several inches long. These cause ringing while measuring pulsed signals and lead to unwanted pick-up of spurious signals. The use of a differential probe is strongly recommended to view the real LVDS output signal, because of the probes low parasitic capacitance and ease of use. Alternatively, it is possible to use two single probes and construct the LVDS signal by combining both signals.

5 Schematic

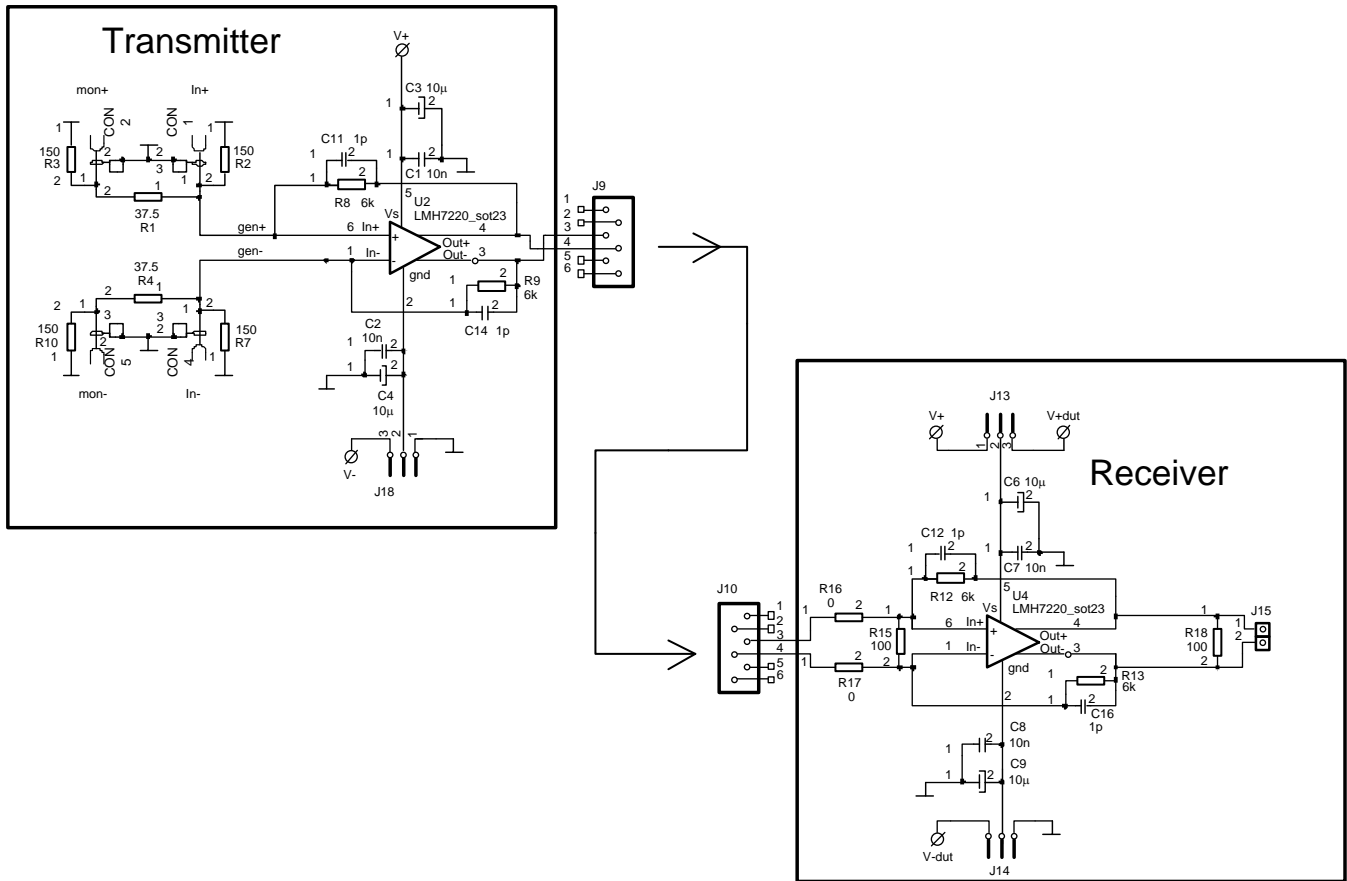


Figure 1. Schematic Diagram Tx and Rx

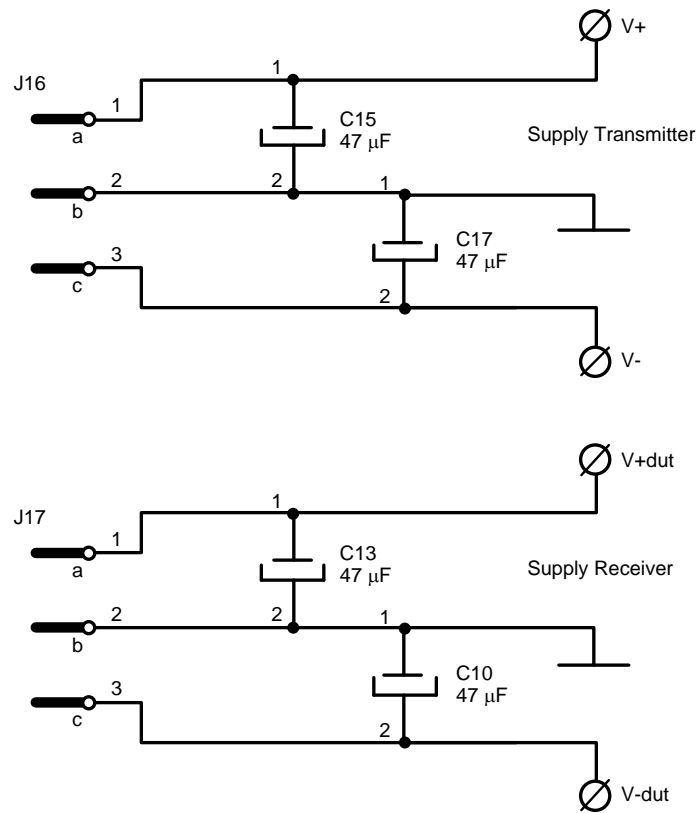


Figure 2. Power Supply Connections

6 Layout

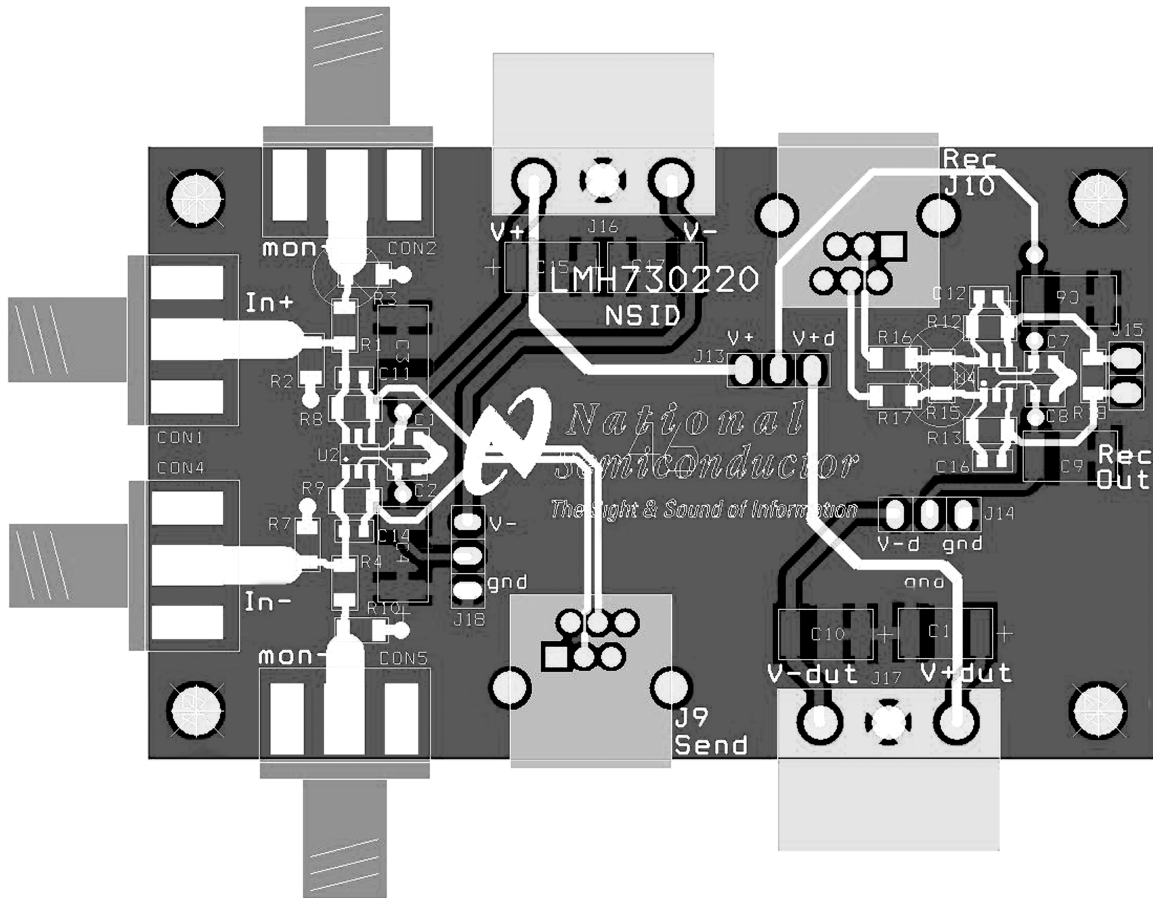


Figure 3. Complete View of Test Board

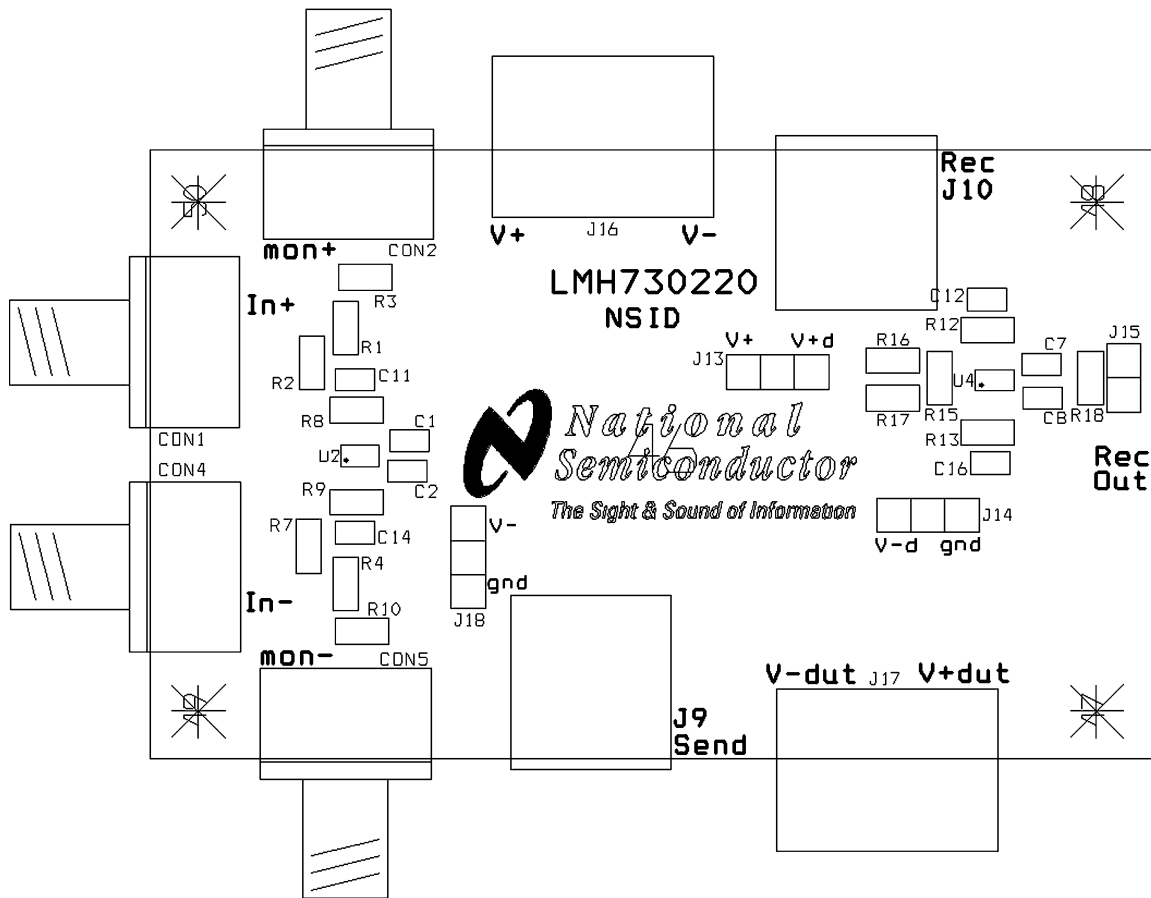


Figure 4. Components Top Layer

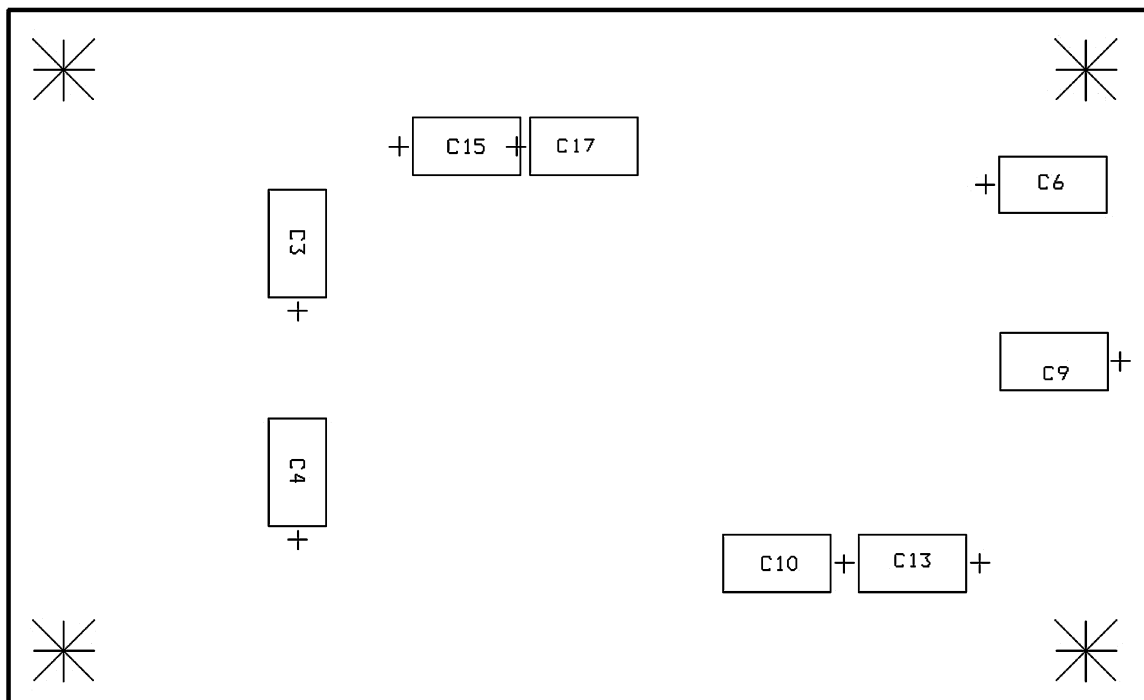


Figure 5. Component Bottom Layer

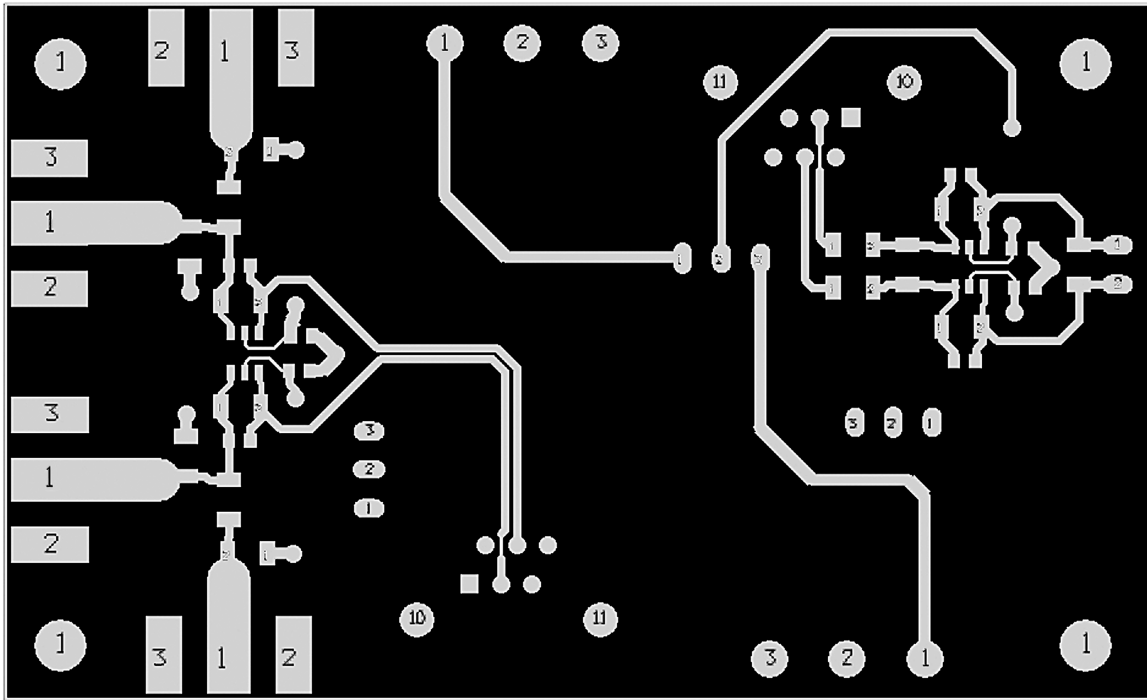


Figure 6. Tracks Top Layer

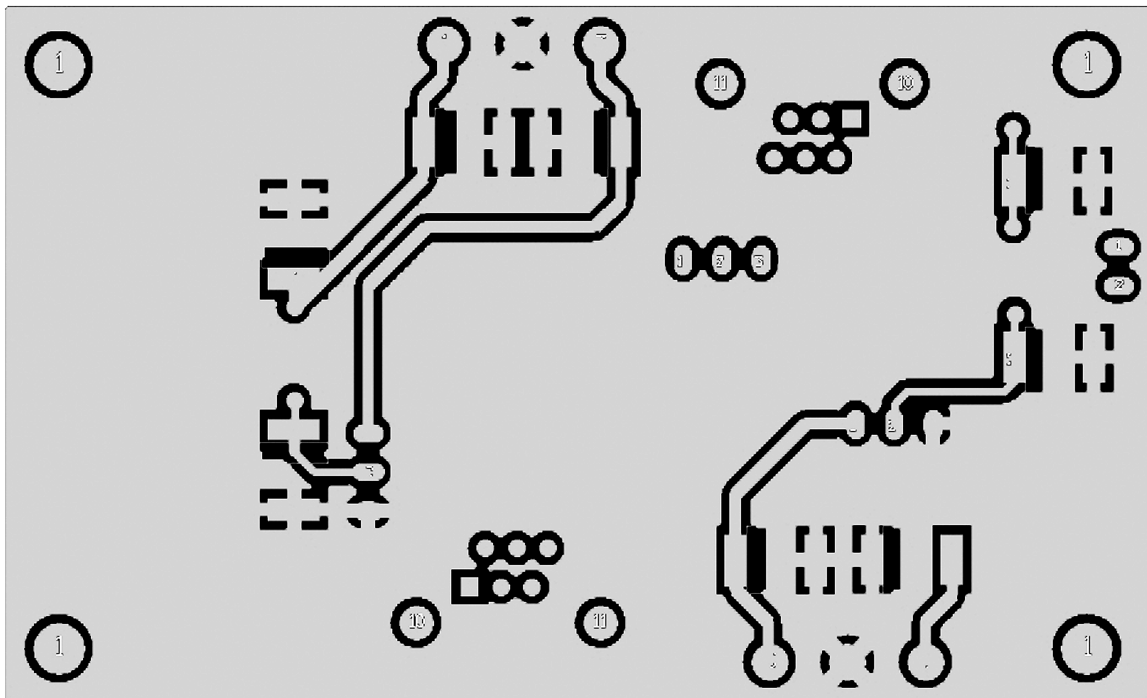


Figure 7. Tracks Bottom Layer

7 Measurement Results

100 mtr Cable and 100 kHz Signal

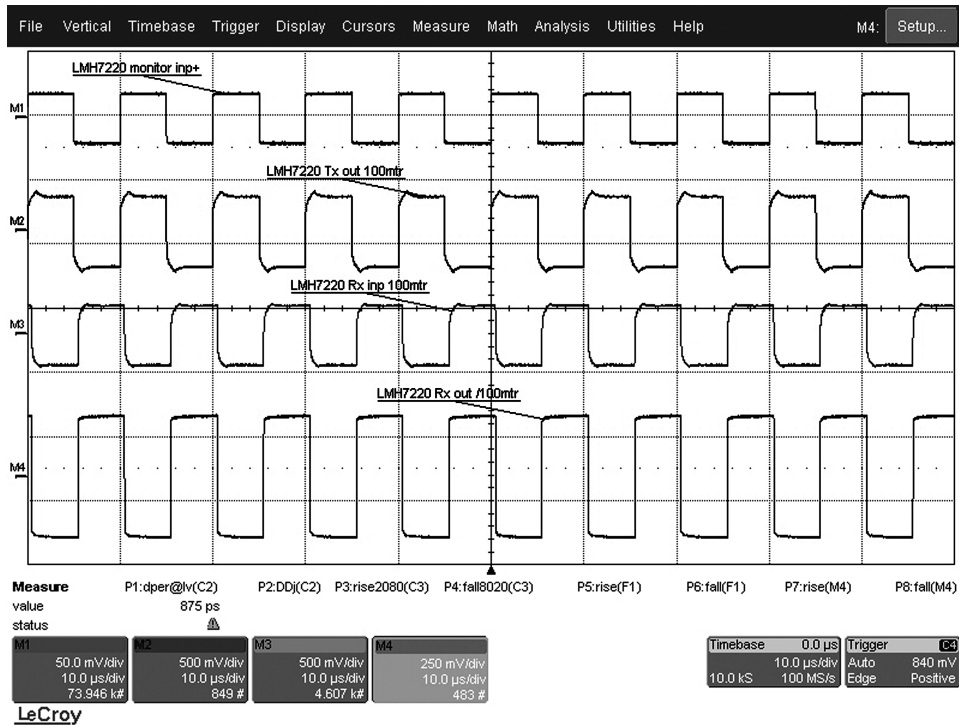


Figure 8. Signal: 100 kHz/ 100 mV_{pp}/ 100 mtr

NOTE: The used cable is: Belden Cat5e unshielded installation cable

400 mtr Cable and 100 kHz Signal

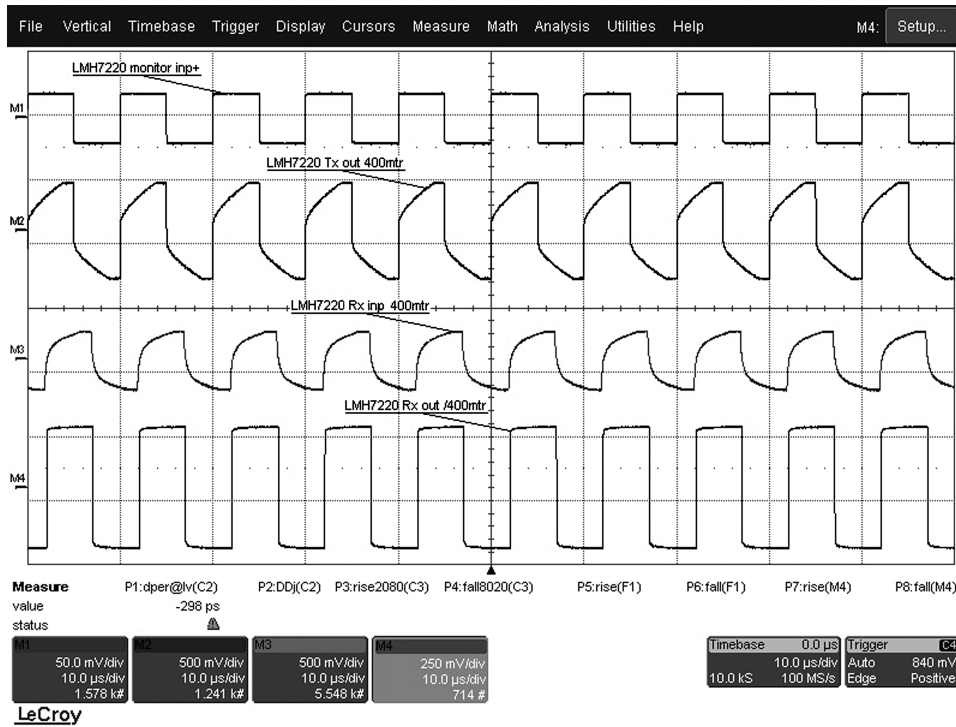


Figure 9. Signal: 100 kHz/ 100 mV_{pp}/ 400 mtr

The measurements in this column are done with equal input conditions and varying cable length. Note that for both length the amplitude at the input of the receiver reaches the full LVDS swing.

100 mtr Cable and 10 MHz Signal

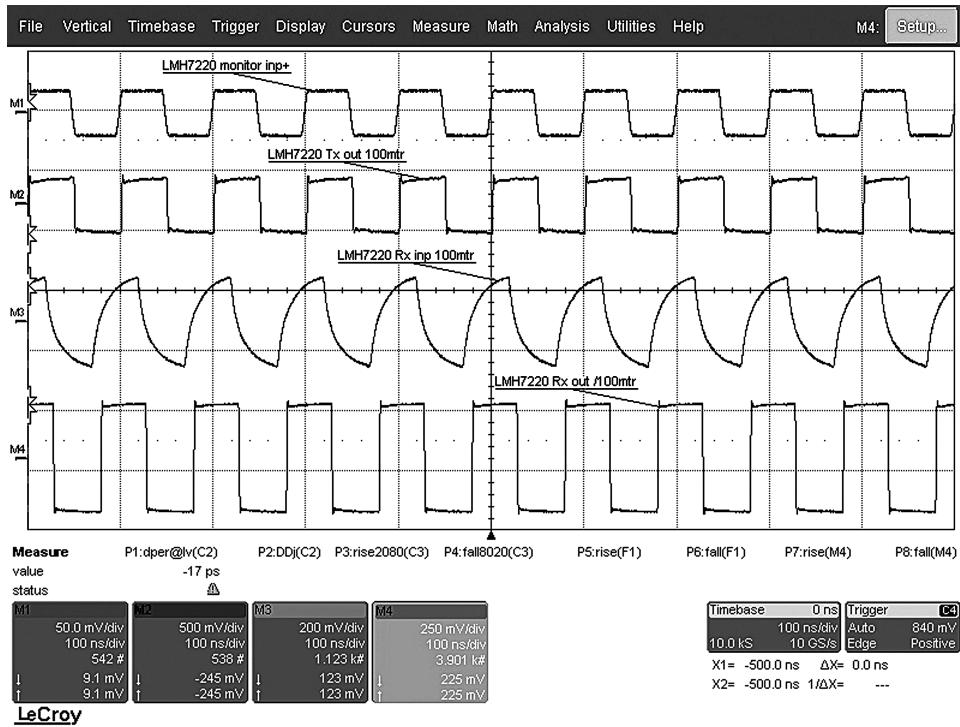


Figure 10. Signal: 10 MHz/ 100 mV_{pp}/ 100 mtr

400 mtr Cable and 10 MHz Signal

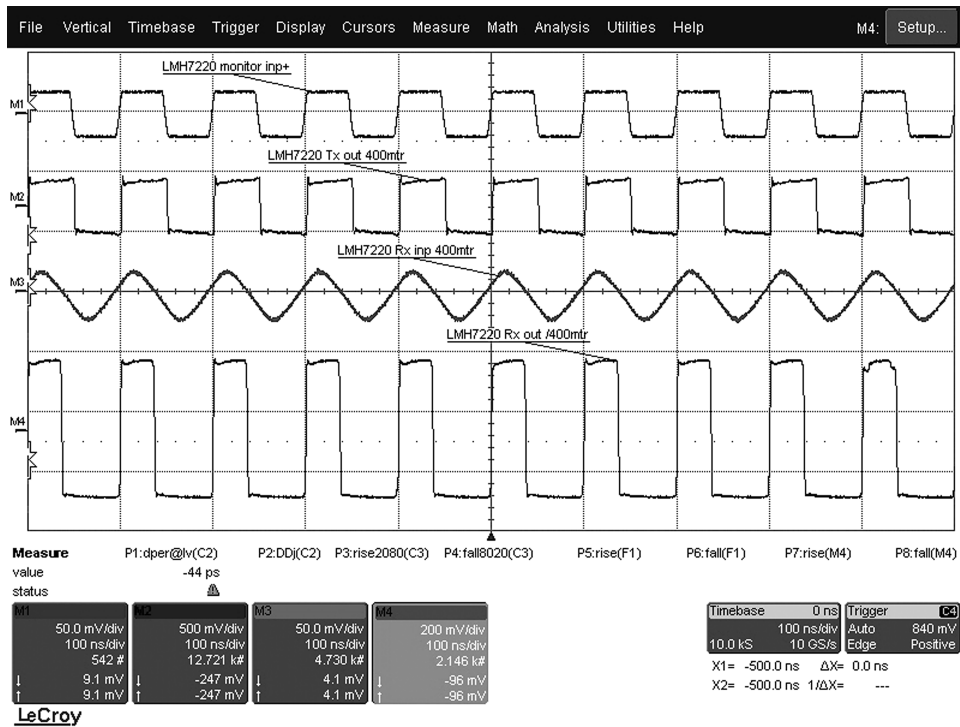


Figure 11. Signal: 10 MHz/ 100 mV_{pp}/ 400 mtr

The measurements in this column are done with equal input conditions and varying cable length.

Note that for both length the amplitude at the input of the receiver do not reach the full LVDS swing due to the higher attenuation along the transmission path.

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