LINEAR TECHNOLOGY

DESIGN NOTES

Number 39 in a series from Linear Technology Corporation *September, 1990*

Low Power CMOS RS485 Transceiver

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Introduction

The EIA RS485 data transmission standard has become popular because it allows for balanced data transmission in a party line configuration. Users are able to configure inexpensive local area networks and multi-drop communication links using twisted pair wire and the protocol of their choice.

Previous RS485 transceivers have been designed using bipolar technology because the common mode range of the device must extend beyond the supplies and be immune to ESD damage and latchup. Unfortunately, the bipolar devices draw a large amount of supply current and are unacceptable for low power applications. The LTC485 is the first CMOS RS485 transceiver featuring ultra low power consumption (I_{CC} = 500μA max.) without sacrificing ESD and latchup immunity.

Proprietary Output Stage

The LTC485 driver output stage of Figure 1 features a common mode range that extends beyond the supplies while virtually eliminating latchup and providing excellent ESD protection. Two Schottky diodes SD3 and SD4 are added to a conventional CMOS inverter output stage. The Schottky diodes are fabricated by a proprietary modification to a standard N-well CMOS process. When the output stage is operating normally, the Schottky diodes are forward biased and have a small voltage drop across them. When the output is in the high impedance state and is driven above V_{CC} or below ground by another driver on the party line, the parasitic diode D1 or D2 will forward bias, but SD3 or SD4 will reverse bias and prevent current from flowing into the N-well or substrate. Thus, the high impedance state is maintained even with the output voltage beyond the supplies. With no current flow into the N-well or substrate, latchup is virtually eliminated.

Propagation Delay

Using the test circuit of Figure 4 with only one foot of twisted pair wire, Figures 2 and 3 show the typical propagation delays.

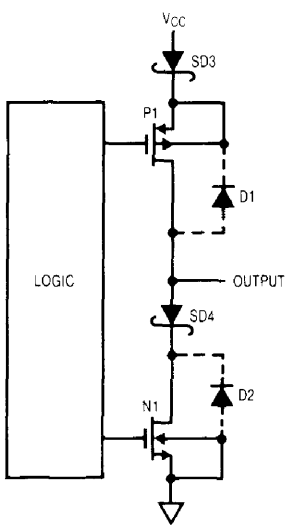

Figure 1. LTC485 Output Stage

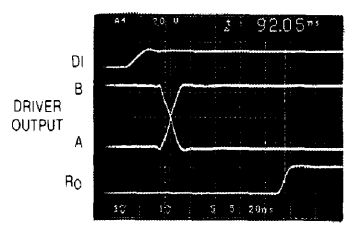

Figure 2. LTC485 System Waveforms

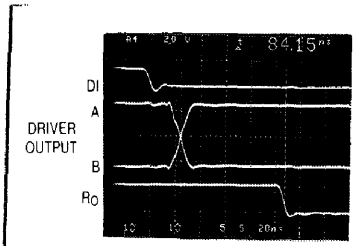

Figure 3. LTC485 System Waveforms

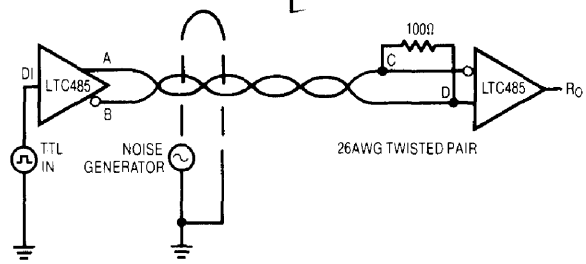

Figure 4. LTC485 System Test Circuit

LTC485 Line Length vs Data Rate

The maximum line length allowable for the RS422/RS485 standard is 4000 feet. Using the test circuit of Figure 4 with 4000 feet of twisted pair wire, Figure 5 and 6 show that with ≈20Vp-p common mode noise injected on the line, the LTC485 is able to reconstruct the data stream at the end of the wire.

Figures 7 and 8 show that the LTC485 is able to comfortably drive 4000 feet of wire at 110kHz.

When specifying line length vs maximum data rate the curve in Figure 9 should be used:

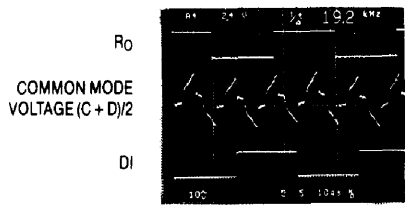

Figure 5. System Common Mode Voltage @19.2kHz

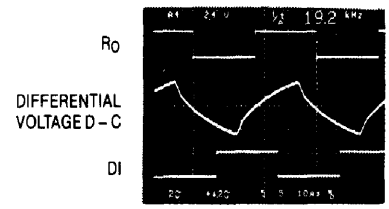

Figure 6. System Differential Voltage @19.2kHz

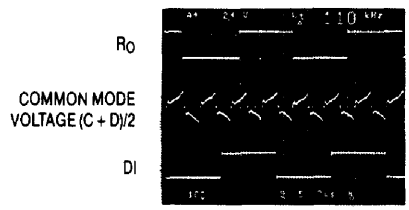

Figure 7. System Common Mode Voltage @110kHz

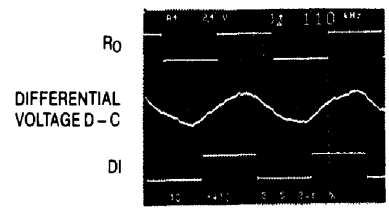

Figure 8. System Differential Voltage @110kHz

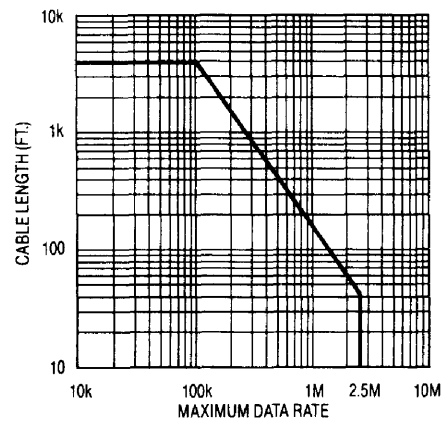

Figure 9. Cable Length vs Maximum Data Rate

For literature of our Low Power Transceivers call **(800) 637-5545.** For applications help, call (408) 432-1900, Ext. 456.

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