

DESIGN NOTES

RS485 Transceivers Reduce Power and EMI – Design Note 102

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Recent innovations in process and circuit design have enabled the release of three new RS485 transceivers: the LTC[®]1481, LTC1483 and LTC1487. These devices share an improved receiver circuit which features 80 μ A quiescent current operation (driver disabled) with no loss in AC performance relative to standard RS485 devices, and a new 1 μ A shutdown mode (Figure 1). All three new devices are pin compatible with the industry standard LTC485 pinout, and feature Linear Technology's exclusive ± 10 kV ESD protection (Human Body Model) at the line I/O pins, eliminating the need for external ESD protection in most cases.

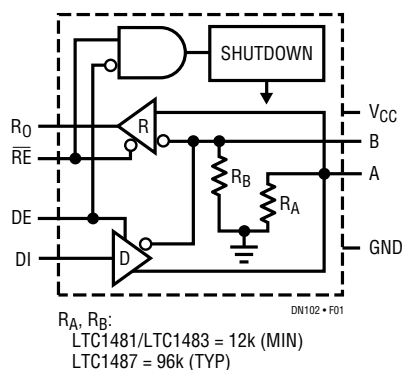


Figure 1. LTC1481/LTC1483/LTC1487 Block Diagram

LTC1481

The LTC1481 provides full 2.5Mbaud driver and receiver speeds with the low power and improved ruggedness features shared by all three members of the family. Like all Linear Technology RS485 products, it features full RS485 and RS422 compatibility, guaranteed operation over the -7 V to 12 V common-mode range and a unique driver output circuit that prevents CMOS latch-up and maintains high impedance at the line pins, even when the power is off. An internal driver short-circuit current limit and a thermal overload protection circuit prevent damage under severe fault conditions. The LTC1481 is ideally suited for designs which need to transmit high speed data with minimum power consumption.

LTC1483

The LTC1483 is a reduced EMI version of the LTC1481 intended for use in systems where electromagnetic interference concerns take precedence over high data rates. The LTC1483 driver slew rate is deliberately limited to reduce the high frequency electromagnetic emissions (Figures 2a and 2b) while improving signal fidelity by reducing reflections due to mismatched cables. The

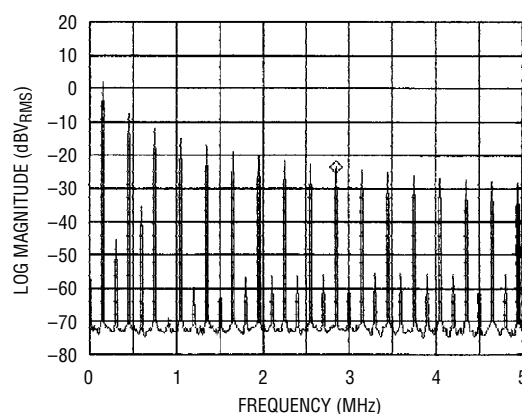


Figure 2a. Typical RS485 Driver Output Spectrum Transmitting at 150kHz

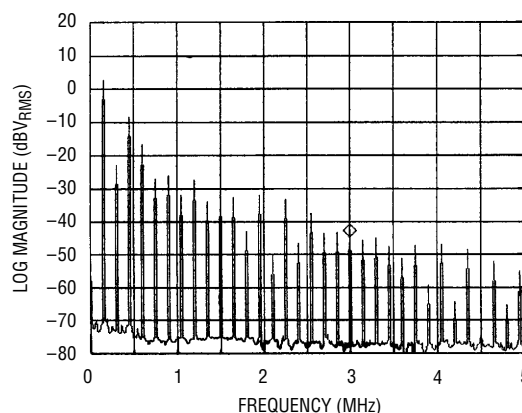


Figure 2b. Slew Rate Limited LTC1483 Driver Output Spectrum Transmitting at 150kHz

maximum operating frequency of the LTC1483 driver is limited to 250kbaud. All other performance parameters are unchanged from the LTC1481, including the low power receiver operation and the 1 μ A shutdown mode.

LTC1487

The LTC1487 shares the low power and low slew rate features of the LTC1483. Additionally, the LTC1487 is designed with a high input impedance of 96k Ω (typical) to allow up to 256 transceivers to share a single RS485 differential data line. This exceptionally high input impedance enables additional transceivers to be connected to a single RS485 line, reducing cabling costs and complexity in systems with many nodes.

The RS485 specification requires that a transceiver be able to drive as many as 32 "unit loads." One unit load (UL) is defined as an impedance that draws a maximum of 1mA with up to 12V across it. Most standard RS485 transceiv-

ers, including the LTC1481 and LTC1483, have an input resistance of approximately 12k, equivalent to 1UL, which limits a single RS485 bus to 32 nodes. With its high 96k Ω input impedance, the LTC1487 presents only 0.125UL to the line, allowing up to 256 transceivers ($32\text{UL}/0.125\text{UL} = 256$) to be connected to the data bus line without overloading the driver (Figure 3).

Conclusions

The LTC1481, LTC1483 and LTC1487 make up the third generation of the Linear Technology CMOS RS485 transceiver family, all started by the original CMOS RS485 transceiver, the LTC485. These three new devices put exceptional ruggedness features and the lowest power operation available in the industry into three unique niches in the RS485 market: high performance (LTC1481), low EMI (LTC1483) and high input impedance (LTC1487).

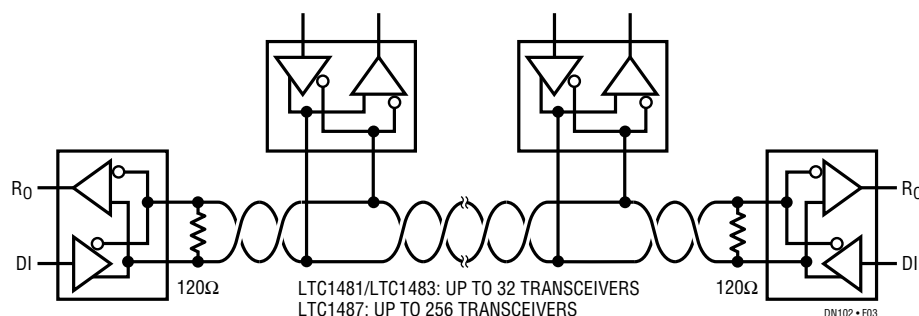


Figure 3. Multiple Transceivers On One RS485 Bus

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