ABSTRACT

This design note presents the reference designs of isolated RS-485 nodes, using bus voltages of 3.3 V and 5 V. Various transceivers are used to satisfy the requirements for low, medium, and high data rates, as well as to accommodate the need for half- and full-duplex operation. Table 1 lists the family of isolated RS-485 transceivers from Texas Instruments.

Table 1. Isolated RS-485 Transceivers

<table>
<thead>
<tr>
<th>Device</th>
<th>Transmission</th>
<th>Data Rate [Mbps]</th>
<th>Primary-Supply Voltage Range [V]</th>
<th>Secondary-Supply Voltage Range [V]</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO3082</td>
<td>Half-duplex</td>
<td>0.2</td>
<td>3.15 to 5.5</td>
<td>4.5 to 5.5</td>
</tr>
<tr>
<td>ISO15</td>
<td></td>
<td>1</td>
<td>3.15 to 3.6</td>
<td>3.15 to 3.6</td>
</tr>
<tr>
<td>ISO1176</td>
<td></td>
<td>40</td>
<td>3.15 to 5.5</td>
<td>4.75 to 5.25</td>
</tr>
<tr>
<td>ISO3088</td>
<td></td>
<td>20</td>
<td>3.15 to 5.5</td>
<td>4.5 to 5.5</td>
</tr>
<tr>
<td>ISO3080</td>
<td>Full-duplex</td>
<td>0.2</td>
<td>3.15 to 5.5</td>
<td>4.5 to 5.5</td>
</tr>
<tr>
<td>ISO3057</td>
<td></td>
<td>1</td>
<td>3.15 to 3.6</td>
<td>3.15 to 3.6</td>
</tr>
<tr>
<td>ISO3086</td>
<td></td>
<td>20</td>
<td>3.15 to 5.5</td>
<td>4.5 to 5.5</td>
</tr>
</tbody>
</table>

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1 Isolated RS-485 Transceivers ........................................................................ 1

Trademarks

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1 Signal-Path Isolation

All transceivers present a 1/8 unit load to the bus, possess a 4-kV peak isolation voltage, and have a typical transient immunity of 50 kV/µs. Whereas the ISO15 and ISO35 operate from a 3.3-V nominal supply on both the primary side and the secondary side, the transceivers of the ISO308x family allow for mixed-supply operation. This is of particular advantage for applications operating in harsh industrial environments, because the 3.3 V on the primary side enables the connection to low-voltage microcontrollers for power preservation, whereas the 5 V on the secondary side maintains a high signal-to-noise ratio when driving signals across long distances.

2 Transformer Drivers for an Isolated Power Supply

Texas Instruments’s SN6501 and SN6505B devices can drive a transformer in an open loop configuration. The devices provide a compact, efficient, and low noise solution for creating an isolated power supply. The SN6501 devices provides up to 1.5 W of power. The SN6505B device provides a maximum of 5 W of power to systems that need isolated power for multiple devices. The device data sheets include recommended transformers based on the power configurations and required isolation rating of the application. A rectifying LDO regulator on the secondary side can decrease noise, as shown in Figure 1 and Figure 2.

3 Power Supply Isolation

Modern isolated power supplies are available as small, surface-mount modules. They often include the transformer driver, the actual isolation transformer, and the rectifier network. Sophisticated DC-DC modules, such as the RSZ-3.33.3HP (3.3 Vin/3.3 Vout) and RSZ-3.305HP (3.3 Vin/5 Vout), even include a linear regulator with its associated bypass and output capacitors, while providing short-circuit protection and a solid, 2-kV isolation voltage.

4 Noise and Transient Suppression

For effective transient protection, a low-capacitive transient voltage suppressor (TVS), such as PSM712, is recommended. The device provides a 600-W surge capability, 75 pF of capacitance, and up to 40-kV ESD protection, while its stand-off voltages cover the RS-485 common-mode range of –7 V to +12 V.

Implementation of additional noise filtering to the signal paths between the node controller and the single-ended side of the transceiver through simple R-C low-pass filters is recommended. Calculate the filter component values such that $R_f \times C_f = 0.032 / f_s$ with $f_s$ being the highest signal frequency of interest.
5 System Diagrams

Figure 1 shows the system diagram for a 3.3-V/5-V, half-duplex network node using ISO3082 for signal isolation and SN6505B with transformer for power isolation. Figure 2 shows the system diagram for a 3.3-V/3.3-V, full-duplex network node using ISO35 for signal isolation and SN6505B with transformer for power isolation.

Figure 1. 2-kV, Isolated RS-485 Node for 200-kbps, Half-Duplex Operation
Figure 2. 2-kV, Isolated RS-485 node for 1-Mbps, Full-Duplex Operation

6 References

Refer to these references for more information on the devices listed in this application report:

- For isolated RS-485 transceivers see http://www.ti.com/isolation/isolated-rs-485/products.html
- For transformer drivers for isolated power supplies see http://www.ti.com/isolation/transformer-driver/products.html
- For transient voltage suppressors see www.protekdevices.com
Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Original (October 2009) to A Revision Page

• Deleted the Rise Time column and added the ISO1176 device in the Isolated RS-485 Transceivers table .................. 1
• Added the Transformer Drivers for an Isolated Power Supply section................................................................. 2
• Added 10-Ω resistors between the ISO3x device and PSM712 in the Half-Duplex and Full-Duplex Operation figures. Also changed XFMR Drive to the SN6505B device .................................................................................. 3
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