Isolated RS-485 Reference Design

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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

Device	Transmission	Data Rate [Mbps]	Rise Time [ns] (Typical)	Primary-Supply Voltage Range [V]	Secondary-Supply Voltage Range [V]
ISO3082	Half-duplex	0.2	900	3.15 – 5.5	4.5 – 5.5
ISO15		1	185	3.15 – 3.6	3.15 – 3.6
ISO3088		20	7	3.15 – 5.5	4.5 – 5.5
ISO3080	Full-duplex	0.2	900	3.15 – 5.5	4.5 – 5.5
ISO35		1	185	3.15 – 3.6	3.15 – 3.6
ISO3086		20	7	3.15 – 5.5	4.5 – 5.5

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 (shaded cells in Table 1) 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.

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.

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.

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 RSZ-3.305HP 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 RSZ-3.33.3HP for power isolation.

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References

For more specific information on devices presented in this design note, see one of the following links:

- For isolated RS-485 transceivers see www.ti.com
- For isolated DC-to-DC modules see www.recom-power.com or www.recom-international.com
- For transient voltage suppressors see www.protekdevices.com

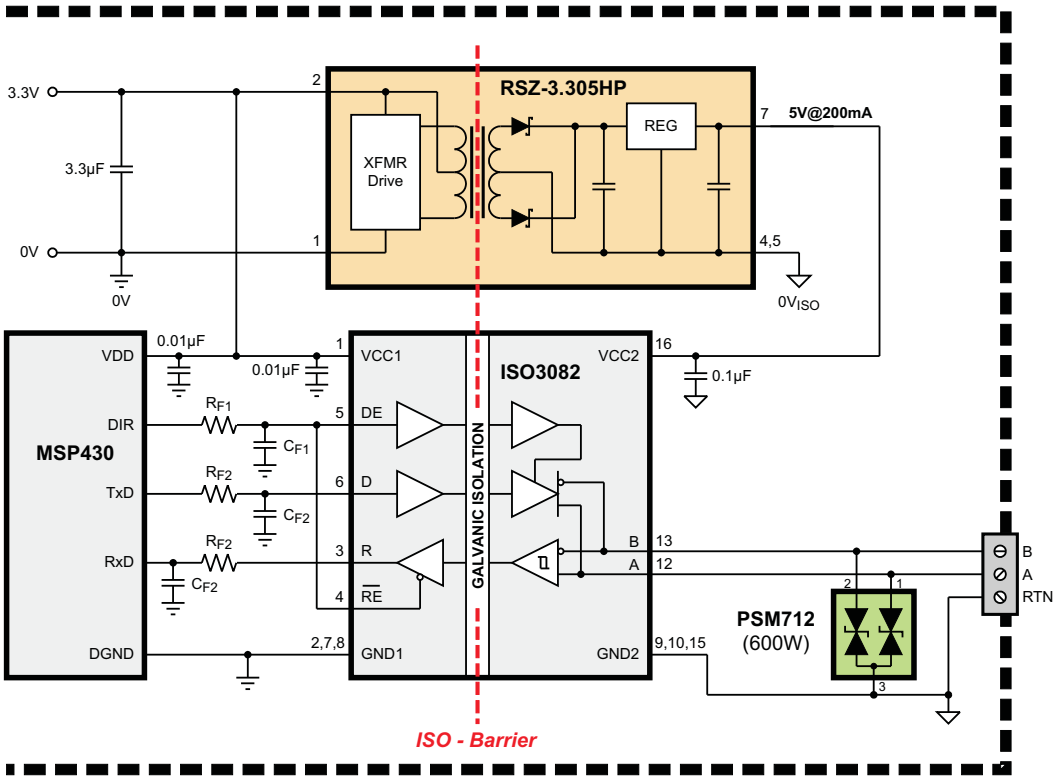

Figure 1. 2-kV, Isolated RS-485 Node for 200-kbps, Half-Duplex Operation

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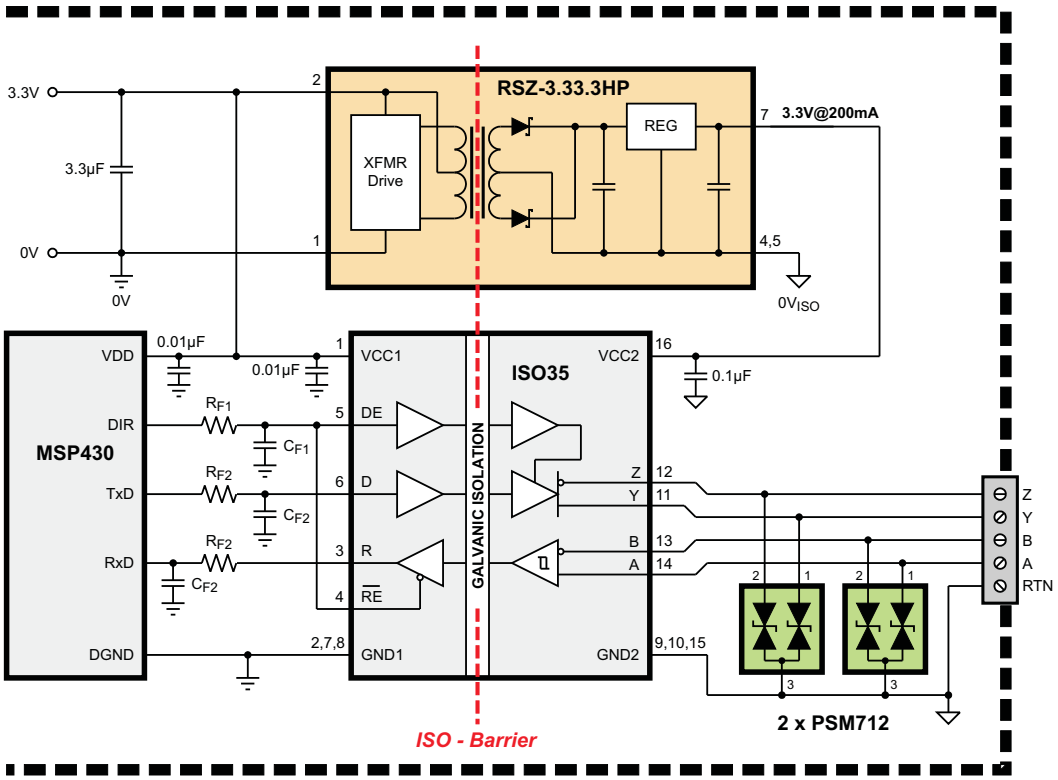

Figure 2. 2-kV, Isolated RS-485 node for 1-Mbps, Full-Duplex Operation

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