Application Note

Powering the ISOUSB211 – A Guide to Power Supply Configuration Options

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ABSTRACT

The ISOUSB211 and ISOUSB211-Q1 are galvanically-isolated, USB 2.0-compliant repeaters that support low-speed (1.5Mbps), full-speed (12Mbps), and high-speed (480Mbps) signaling. The device features two independently powered sides (Side 1 and Side 2), and each side requires an internal 3.3V rail (V3P3Vx) and an internal 1.8V rail (V1P8Vx) for operation. These 3.3V and I.8V rail can be generated by the internal LDOs or supplied by dedicated external supply rails, thus providing the flexibility to choose the power architecture for the whole system based on other devices and components on the board. This document summarizes the supported supply configurations to help designers select more practical power supply configurations.

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1 Introduction

The ISOUSB211 and ISOUSB211-Q1 are galvanically-isolated, USB 2.0-compliant repeaters that support low-speed (1.5Mbps), full-speed (12Mbps), and high-speed (480Mbps) signaling. The devices support automatic connect and speed detection, reflection of pull-ups and pull-downs, and link power management allowing drop-in USB hubs, host, peripheral and cable isolation. The device also supports automatic role reversal. Automatic role reversal means that if the device detects a new connection on the upstream facing port after a disconnect, then the upstream and downstream port definitions are reversed

A key feature of the ISOUSB211(-Q1) device is the flexibility of the power architecture. The ISOUSB211(-Q1) has two independently powered sides (Side 1 and Side 2), and each side requires an internal 3.3V rail (V3P3Vx) and an internal 1.8V rail (V1P8Vx) for operation. The internal LDOs on the device can supply these rails or the rails can be supplied externally. The device can operate completely from a 4.25V to 5.5V supply (such as USB VBUS power) or from local 3.3V and 1.8V supplies where available, on either side.

This flexibility allows the designer to optimize for thermal performance based on the power rails already available in the system.

2 Power Pins and Internal Rails

Each side of the ISOUSB211 exposes four supply-related pins. Understanding how the pins interact with the internal LDOs is the basis for selecting a power configuration.

Pin[1]	Voltage	Function
VBUS1	4.25V – 5.5V	The VBUSx are the input power pins of the respective side. When a 5V supply (for example, a VBUS from USB port) is connected, the internal 3.3V LDO generates V3P3Vx.
VBUS2		
V3P3V1	3.3V	The V3P3Vx is a 3.3V rail which can be generated internally from VBUSx, or supplied externally by shorting VBUSx and V3P3Vx together to a 3.3V source.
V3P3V2		
VCC1	2.4V – 5.5V	The VCCx is the input to the internal 1.8V LDO, which generates V1P8Vx.
VCC2		
V1P8V1	1.8V	The V1P8Vx is a 1.8V rail which can be generated internally from VCCx, or supplied externally by shorting VCCx and V1P8Vx together to a 1.8V source.
V1P8V2		

(1) Throughout the document, the "x" represents a placeholder referring to the pins with a side 1 and side 2.

Note

Whenever an internal LDO is used to drop a higher input voltage down to 3.3V or 1.8V, that LDO dissipates power inside the package. This self-heating reduces the maximum ambient temperature the device can support. To minimize self-heating, use external rails on sides where a sufficient local supply already exists. For more detail, see Thermal Considerations When Selecting a Supply Configuration.

Figure 2-1 shows how the internal LDOs are connected to different power supply rails on each side of the galvanic isolation barrier.

1. The internal LDO highlighted in the red box generates V3P3Vx from the VBUSx input.
2. The internal LDO highlighted in the blue box generates V1P8Vx from the VCCx inputs.

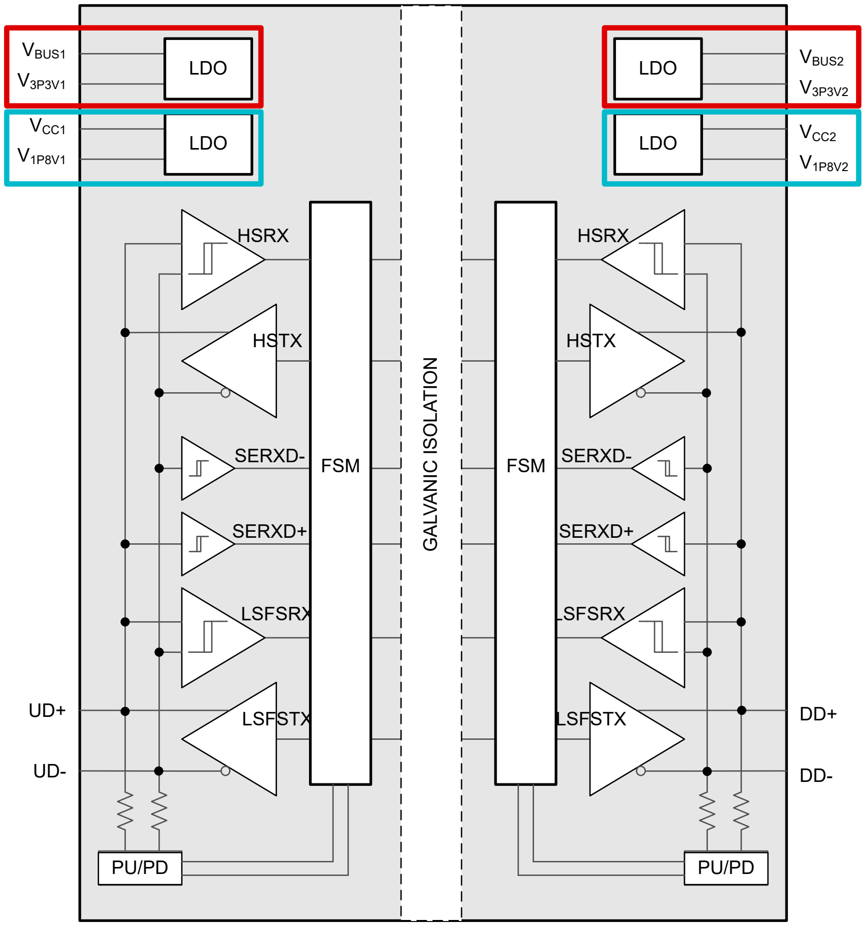

Figure 2-1. ISOUSB211 Simplified Functional Block Diagram with Internal LDOs

3 Available Supply Options

The ISOUSB211 has two independently powered sides (Side 1 and Side 2), and each side requires a 3.3V rail (V3P3Vx) and a 1.8V rail (V1P8Vx) for operation. Each of the two rails on each side can be sourced one of two ways, giving the designer several combinations.

3.1 Generating the 3.3V Rail (V3P3Vx)

- **Internal LDO from VBUS**: Connect a 4.25V to 5.5V supply to VBUSx and let the internal LDO generate V3P3Vx. This design is the natural choice for the side facing the USB connector, where a 5V VBUS is available.
- **External 3.3V supply**: Short VBUSx and V3P3Vx together and drive both from an external 3.3V supply. This design fits well with the side facing a microcontroller, where a 3.3V rail is typically already present and avoids LDO dissipation.

3.2 Generating the 1.8V Rail (V1P8Vx)

- **Internal LDO from VCC:** Connect a 2.4V to 5.5V supply to VCCx and let the internal LDO generate V1P8Vx. In the simplest design, VCCx is tied to VBUS of the USB port on the connector side and to the local 3.3V rail on the microcontroller side.
- **External 1.8V supply:** Short VCCx and V1P8Vx together and drive both from an external 1.8V supply. This removes the internal 1.8V LDO power dissipation and is the lowest-power option for that side.

3.3 Summary of the Four Building Blocks

Rail	Internal-LDO Option	External-Supply Option
3.3V (V3P3Vx)	4.25–5.5V into VBUSx LDO generates 3.3V	VBUSx + V3P3Vx shorted to external 3.3V supply
1.8V (V1P8Vx)	2.4–5.5V into VCCx LDO generates 1.8V	VCCx + V1P8Vx shorted to external 1.8V supply

4 Typical Example Power Configurations

4.1 Power Configuration for an Isolated Host or Hub (Mixed Internal and External)

Figure 4-1 shows an example configuration for isolating a host or a hub using ISOUSB211 where the two sides are powered differently to match the rails available on each:

- Microcontroller side (Side 1): V3P3V1 and VBUS1 are tied together to an external 3.3V supply. V1P8V1 is generated by the internal 1.8V LDO, supplied from the external 3.3V supply on VCC1.
- Connector side (Side 2): VBUS2 is supplied the 5V VBUS from the USB connector, and the internal 3.3V LDO generates V3P3V2. VCC2 and V1P8V2 are tied together to an external 1.8V supply derived from VBUS.

An isolated DC-DC converter (such as the SN6505) provides power across the barrier to the VBUS side using the local 3.3V supply of Side 1.

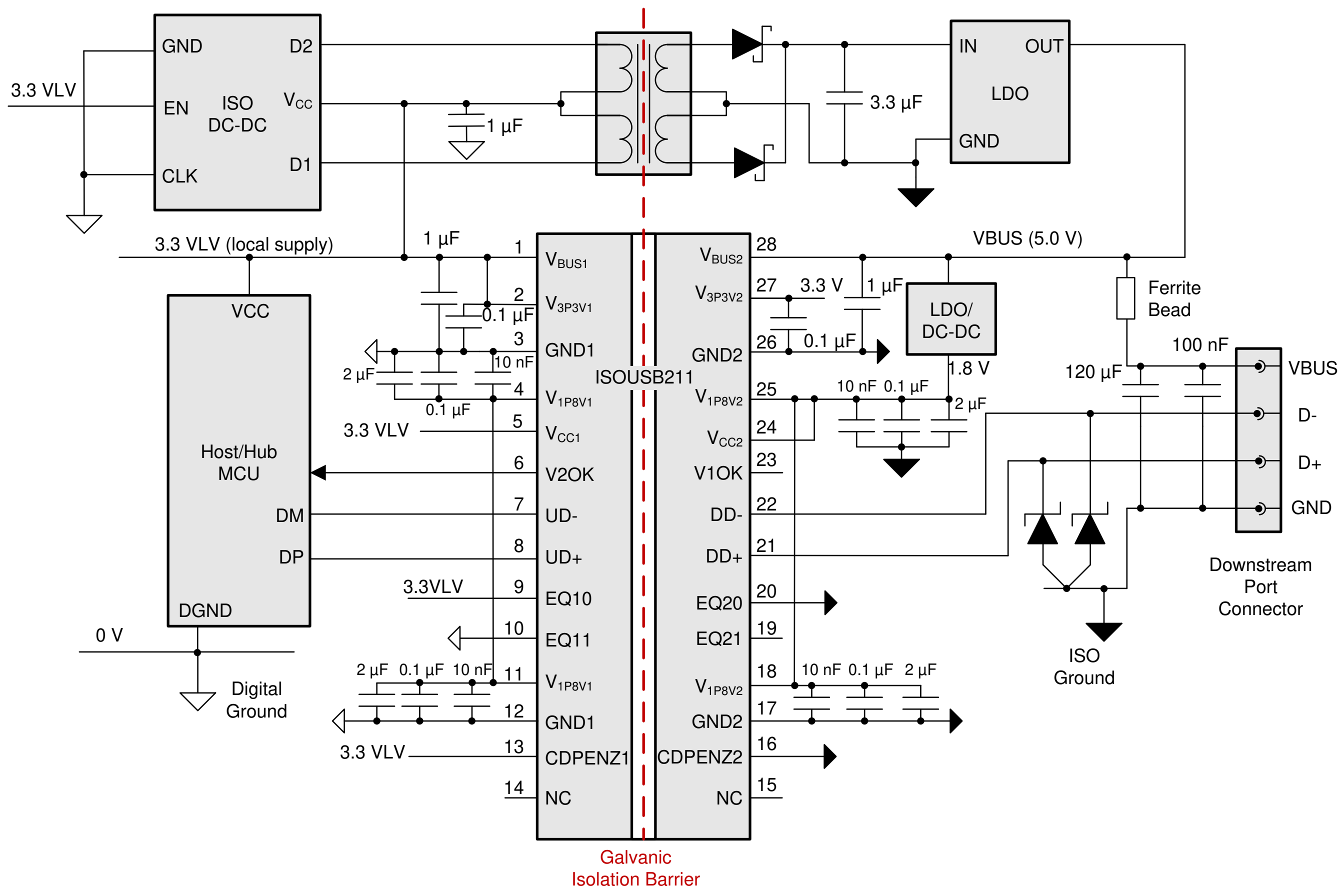

Figure 4-1. Isolated Host or Hub with ISOUSB211

4.2 Power Configuration for Isolating a Self-Powered Peripheral

Figure 4-2 shows the equivalent arrangement for a self-powered peripheral. The roles of the two sides are mirrored relative to Figure 4-1:

- Microcontroller side: V3P3V2 and VBUS2 are tied together to an external 3.3V supply. V1P8V2 is generated by the internal 1.8V LDO supplied from same external 3.3V supply on VCC2.
- Connector side: VBUS1 is supplied by the VBUS of the USB port and the internal 3.3V LDO generates V3P3V1. The VCC1 and V1P8V1 are tied together to an external 1.8V supply derived from the same VBUS. For a peripheral, the total VBUS capacitance must stay below 10µF (at least 5µF recommended), with a 100nF capacitor close to the VBUS pin.

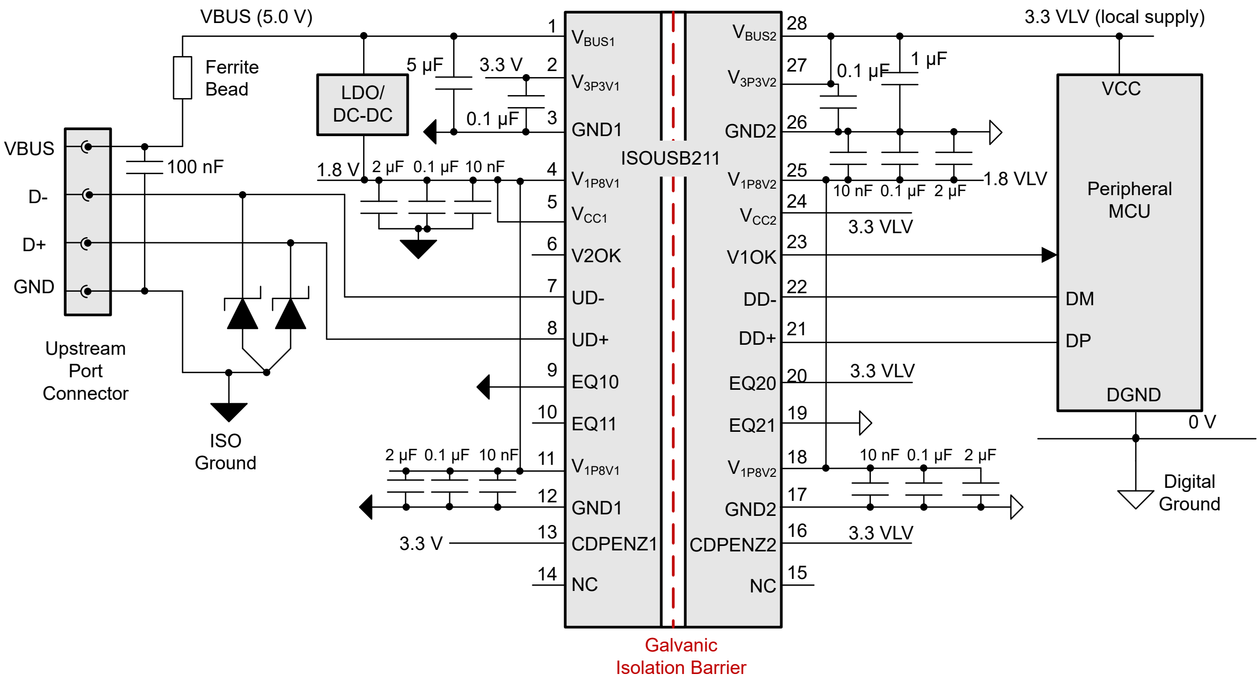

Figure 4-2. Isolated Self-Powered Peripheral with ISOUSB211

4.3 Power Configuration for Isolating a Bus-Powered Peripheral

When the peripheral has no local supply, an isolated DC-DC converter (such as the SN6505) creates a 3.3V local rail from the USB VBUS, as shown in Figure 4-3.

The supply connections on the ISOUSB211 are the same as the Power Configuration for Isolating a Self-Powered Peripheral; the only difference is that the 3.3V local supply on Side 2 is now derived through the isolated converter rather than from an onboard local source. The 10µF VBUS capacitance limit for a peripheral as per USB standard still applies, including any capacitance reflected from the secondary side through the converter.

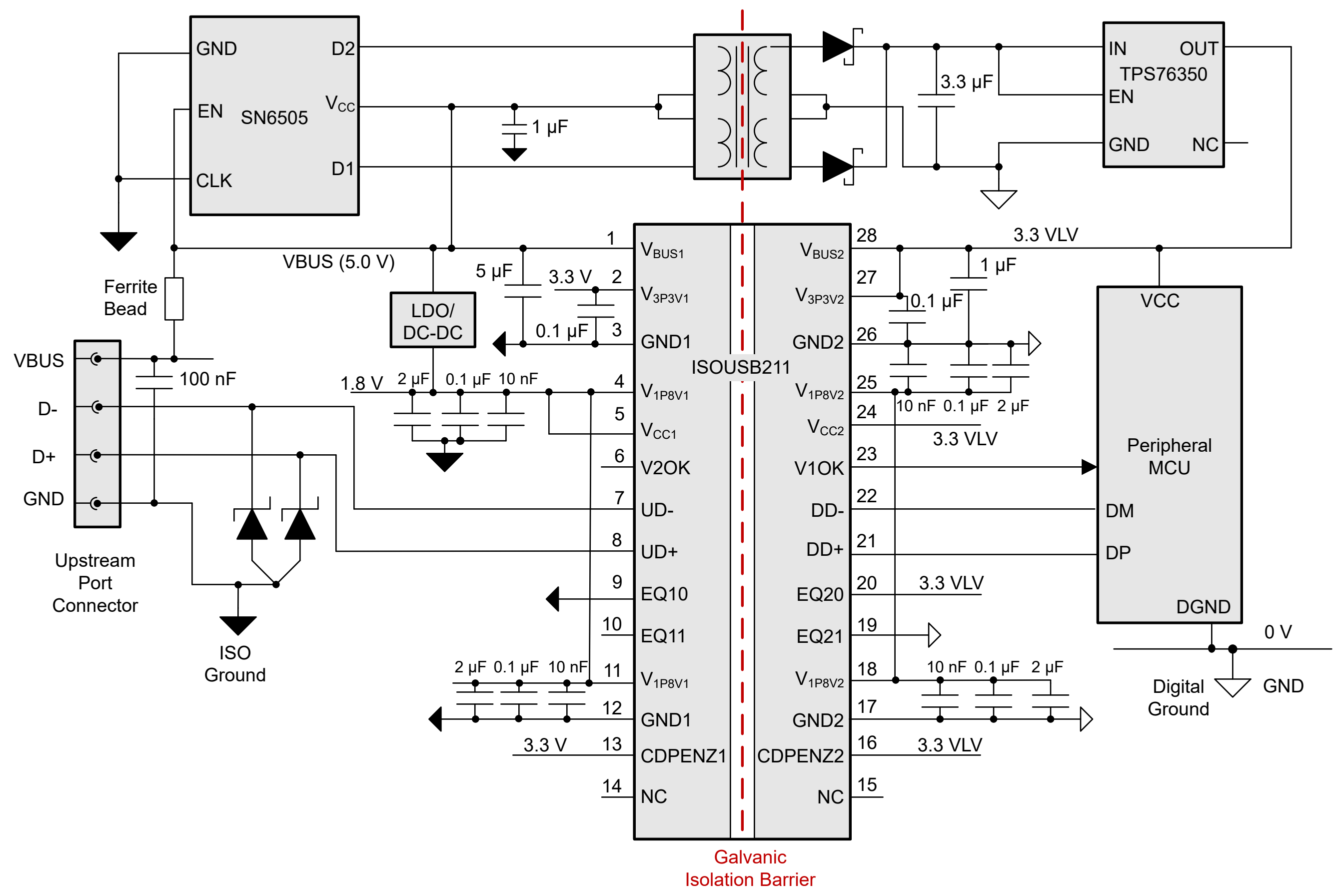

Figure 4-3. Isolated Bus-Powered Peripheral with ISOUSB211

5 Thermal Considerations When Selecting a Supply Configuration

The choice between internal LDOs and external supply rails is primarily a thermal optimization decision, not a functional one. The device works in either case; what changes is internal power dissipation.

- Each internal LDO dissipates power proportional to the input-to-output voltage drop and the current drawn. Feeding an LDO from 5V to generate 1.8V internally dissipates more than feeding an LDO from 3.3V.
- Using more internal LDOs leads to more self-heating. More self-heating reduces the maximum allowable ambient temperature.
- To maximize the ambient temperature range, supply the 3.3V and 1.8V rails externally wherever possible.
- In the case where no external 1.8V supply is present, adding series resistors to the VCCx pins reduces internal power dissipation (see Figure 5-2) and can be useful for cost-sensitive applications. For more information, see Operation Without External 1.8V Supply.
- On the connector side, where typically only the 5V VBUS is available from the USB port, using the internal LDOs is the practical choice as shown in Figure 5-1. However, this design has thermal limitations (see Operation Without External 1.8V Supply).
- For achieving highest ambient temperature range, using external 1.8V supply on both the sides is recommended(see Figure 5-3). For more information, see Operation With External 1.8V Supply.

For detailed guidance on thermal calculations, see the *Thermal Considerations* section of the *ISOUSB211: 480Mbps High-Speed Reinforced USB Isolator* datasheet.

5.1 Operation Without External 1.8V Supply

The device can run without any external 1.8V supply. In this configuration, the internal LDOs generate both 1.8V rails from the VCC pins, so a dedicated 1.8V source is not required. Figure 5-1 shows this configuration.

The trade-off is thermal: relying on the internal 1.8V LDOs adds power dissipation inside the package, which lowers the maximum supported ambient temperature to approximately 107°C. When the 1.8V rails are supplied externally, the supported ambient temperature is approximately 128°C. Whenever an external 1.8V supply is available, supply the rails externally to keep the device cooler. Operation With External 1.8V Supply shows a design using an external supply.

For detailed thermal calculation of operation without the external 1.8V supply, see the *Example Configuration 1* section in the *ISOUSB211: 480Mbps High-Speed Reinforced USB Isolator* datasheet.

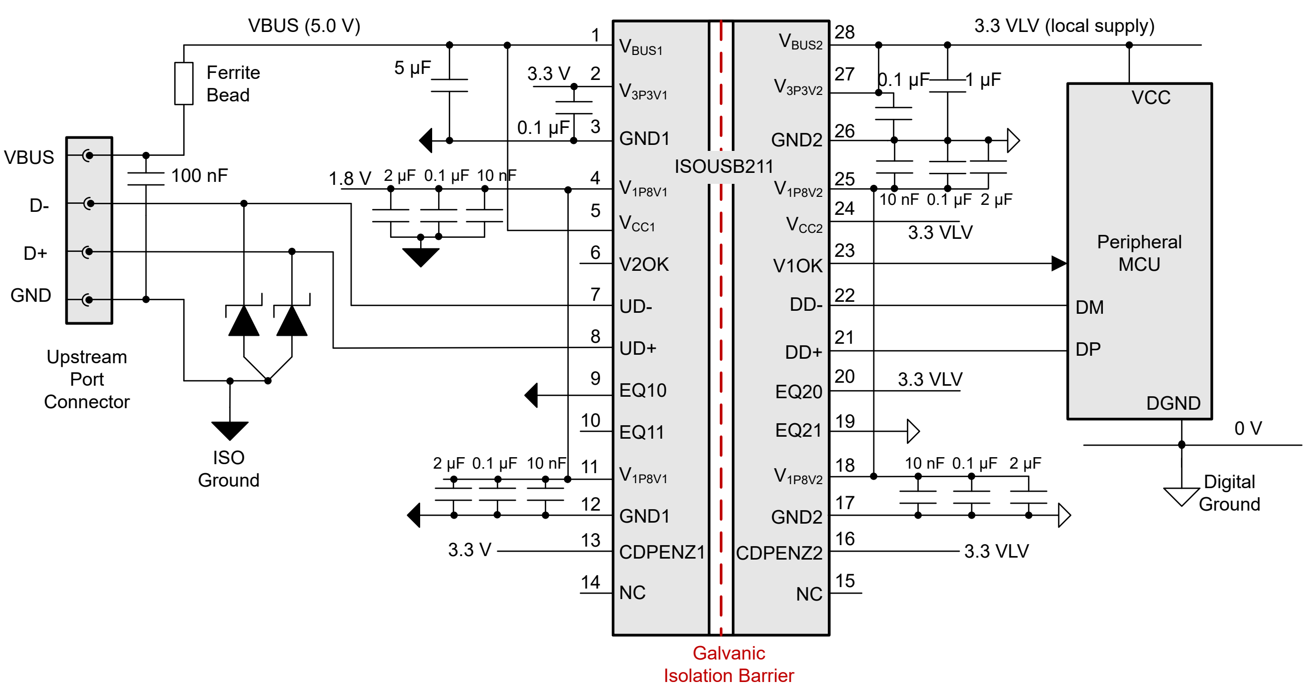

Figure 5-1. Using ISOUSB211 Without External 1.8V Supply

A simple trick to improve thermals without external 1.8V supply: Figure 5-2 shows a smart configuration, which helps in extending the ambient temperature by 10°C from 107°C (in Figure 5-1) to 117°C, without using external 1.8V supply. Extend the ambient temperature by adding a series 5Ω (50mW) resistor for external 3.3V connection to 1.8V LDO (V1P8V2) and 20Ω (250mW) resistor for external 5V connection to internal 1.8V LDO (V1P8V1). When choosing the resistor value, remember that the V_{CCx} voltage can be as low as 2.4V. In that case, an additional 1µF capacitors is needed on V_{CCx} pins.

The external resistors drop voltage and dissipate power, which helps reduce the power dissipation within ISOUSB211 and the corresponding temperature rise. Figure 5-1 shows a net change in internal power dissipation from 960mW to 728mW. This technique saves system cost by replacing two external DC-DC and LDOs with just two resistors and is useful in applications that prioritize cost over maximizing power dissipation and temperature range.

For detailed thermal calculation of operation without the external 1.8V supply and series resistors to VCCx pin, see the *Example Configuration 3* section of the *ISOUSB211: 480Mbps High-Speed Reinforced USB Isolator* datasheet.

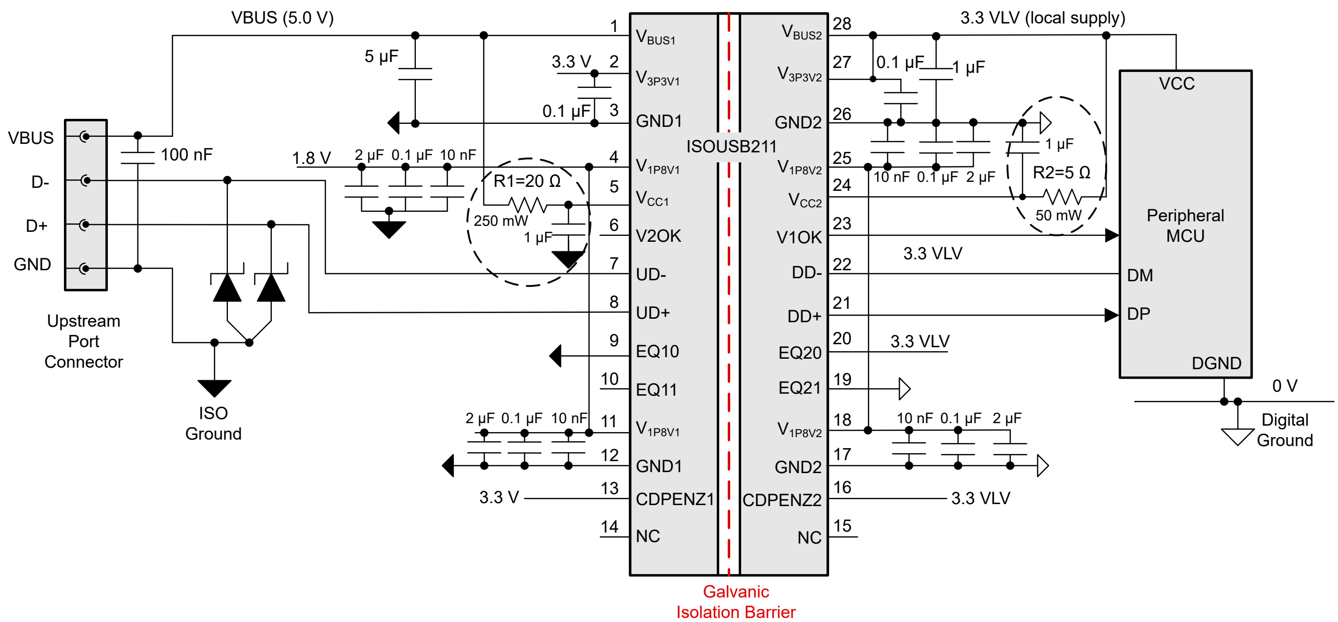

Figure 5-2. Using ISOUSB211 Without External 1.8V Supply - With Resistors in Series With V_{CCx} Pins

5.2 Operation With External 1.8V Supply

The device can also be supplied with external 1.8V supply on both the sides. In this configuration, the internal 1.8V LDOs on both the sides do not consume any power from the VCC pins which minimizes the internal power dissipation of the device. Figure 5-3 shows this example configuration.

This configuration offers the lowest power dissipation and the highest ambient temperature operation up to 128°C. Therefore, supply the device externally whenever a local external 1.8V rail is available to keep the device cooler.

For detailed thermal calculation of operation with the external 1.8V supply, see the *Example Configuration 2* section in the *ISOUSB211: 480Mbps High-Speed Reinforced USB Isolator* datasheet.

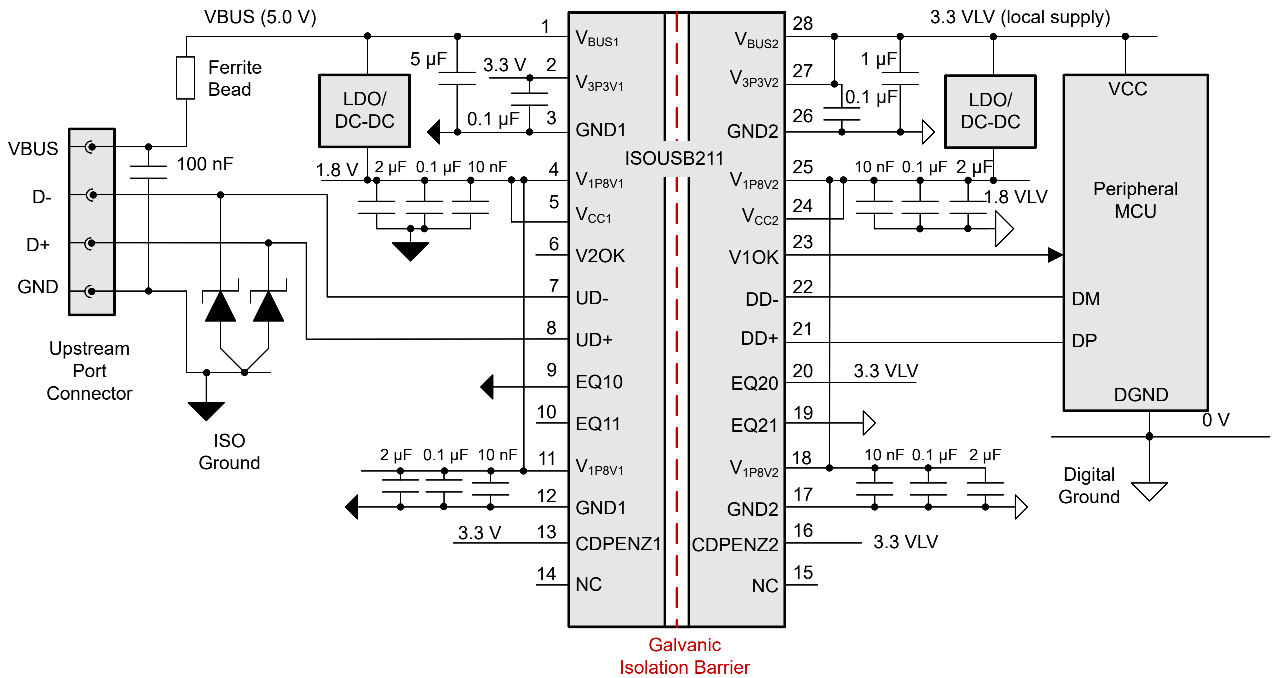

Figure 5-3. Using ISOUSB211 With External 1.8V Supply On Both Sides

6 References

1. Texas Instruments, ISOUSB211 High/Full/Low Speed Isolated USB Repeater datasheet
2. Texas Instruments, Automotive low-emission isolated USB repeater supporting low, high and full speed datasheet
3. Texas Instruments, Isolated USB Repeater product overview
4. Texas Instruments, (+) ISOUSB211-Q1: Design Review TI E2E support forums post

7 Revision History

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

DATE	REVISION	NOTES
July 2026	*	Initial Release