



Application Note

BRTSYS_AN_069

LDSBus Quad T-Junction Usage

Version 1.0

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Table of Contents

1	Introduction	3
2	Product Features	4
3	LDSBus Connection Diagram	5
3.1	Quad T-Junctions LDSU Port Connection	6
3.2	Quad T-Junctions Daisy-Chain Connection	6
3.3	Connection Limitation of Quad T-Junctions with IoTPortal Gateway	7
3.3.1	LDSBus Quad T-Junction	7
3.3.2	LDSBus Quad T-Junction 2	7
4	LDSBus Quad T-Junction 2 Feature Description	8
4.1	Power Up Sequencing	8
4.2	Short Circuit Protection	8
4.2.1	LDSBus Power Short Circuit	8
4.2.2	LDSU Port Power Short Circuit occurs during operation	9
4.2.3	LDSU port power short circuit occurs during start-up	10
5	Combination of Quad T-Junctions Example	11
5.1	Use case to handle inrush current	11
5.2	Use case to handle short circuit	14
5.2.1	LDSBus Power Short Circuit	14
5.2.2	LDSU Port Power Short Circuit	15
6	Contact Information	18
Appendix A	– References	19
Document / Web References		19
Acronyms and Abbreviations		19
Appendix B	– List of Tables & Figures	20
List of Tables		20
List of Figures		20
Appendix C	– Revision History	21

1 Introduction

The Quad T-Junctions (LDSBus Quad T-Junction and LDSBus Quad T-Junction 2) connect LDSBus devices, such as sensors and actuators, to the LDSBus network. This application note explains the key features and uses of Quad T-Junctions.

This guide provides an overview of the following key aspects:

- **Connecting Devices:** How the Quad T-Junctions are used to connect devices to LDSBus network.
- **Product Features:** The key features of both Quad T-Junction models.
- **Connection Limits:** Any limitations on using the Quad T-Junctions.
- **Power-Up Process:** How LDSBus Quad T-Junction 2 handles device startup.
- **Short Circuit Protection:** LDSBus Quad T-Junction 2 safety features.
- **Using Both Models Together:** Benefits of combining two Quad T-Junction models.

Note:

1. The product model can be distinguished by the product name on the enclosure as shown in Figure 1.



Figure 1 - LDSBus Quad T-Junction Models

2 Product Features

Item	Description	LDSBus Quad T-Junction	LDSBus Quad T-Junction 2
LDSU	Ports	4	4
	Total Output Power (Max)	5V, 800mA/4W	5V, 800mA/4W
	Per Port Power	5V, 200mA/1W	5V, 200mA/1W
	Port Power on Sequencing	No	Yes
	Short Circuit Protection	No	Yes
LDSBus	Ports	2	2
	Direction	Bi direction	Bi direction
	Bus Voltage	24V	24V
	Port Power on Sequencing	No	Yes
	Short Circuit Protection	No	Yes
Connection	LDSBus Devices in chaining units	Depend on Rating Values of LDSBus Devices Refer to LDSBus Quad T-Junction Technical Note	Depends on Gateway port power and the total of individual LDSU power rating. Refer to Gateway datasheet for port power rating and the respective LDSU datasheets for LDSU power rating.
	Combination Chaining LDSBus Quad T-Junction and LDSBus Quad T-Junction 2	Yes	Yes

Table 1 - Product Features

3 LDSBus Connection Diagram

Figure 2 shows how the LDSBus devices are connected to the LDSBus system using the Quad T-Junctions (LDSBus Quad T-Junction and LDSBus Quad T-Junction 2). Depending on the LDSBus host system being used, the LDSBus host could be an IoTPortal gateway or a PanL Hub.

Setup Instructions:

- ❶ Connect the Quad T-Junctions (LDSBus Quad T-Junction and LDSBus Quad T-Junction 2) to any of the LDSBus Host Systems using an RJ45 (CAT5e) cable.
- ❷ Connect the configured LDSBus Device(s) to the Quad T-Junctions.
- ❸ If there is more than one Quad T-Junction, daisy-chain them together. The chaining of Quad T-Junctions can be either individual of LDSBus Quad T-Junction / LDSBus Quad T-Junction 2 or combination of LDSBus Quad T-Junction / LDSBus Quad T-Junction 2.

Appendix A – References provides the reference links to view the full application, setup, and installation guides.

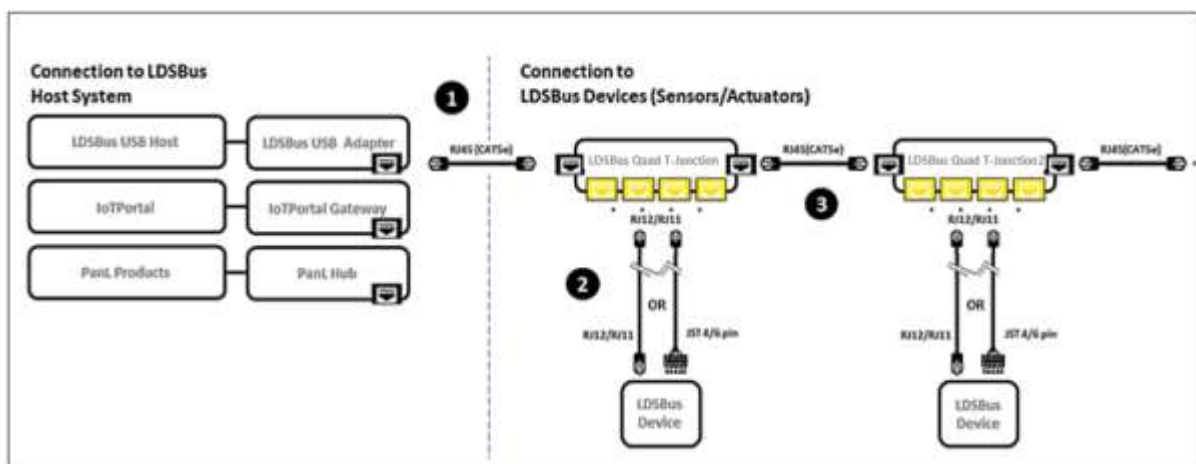


Figure 2 - Quad T-Junctions in LDSBus System – Connection Diagram

3.1 Quad T-Junctions LDSU Port Connection

Up to four LDSBus devices can be connected to each Quad T-Junction. Figure 3 illustrates how to connect these devices to the LDSU ports on the Quad T-Junctions using an RJ11 or RJ12 cable.

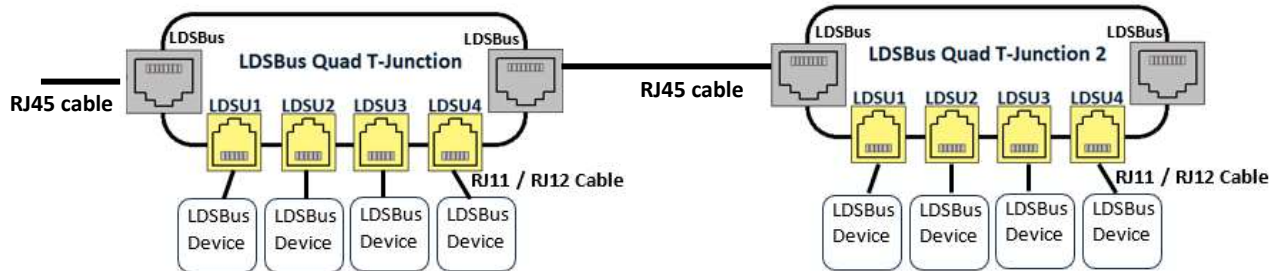


Figure 3 - Quad T-Junction Port Connection

3.2 Quad T-Junctions Daisy-Chain Connection

Besides direct connections, the Quad T-Junctions also support daisy chain configurations. With this feature, multiple Quad T-Junctions can be connected in series, expanding the network's capacity beyond four devices, as illustrated in

Figure 4. By using this configuration, not only can more devices be connected, but it also maintains efficient communication and power distribution across the network. LDSBus communication is based on the RS485 interface, so it's important to ensure that the last device of the LDSBus has termination enabled.

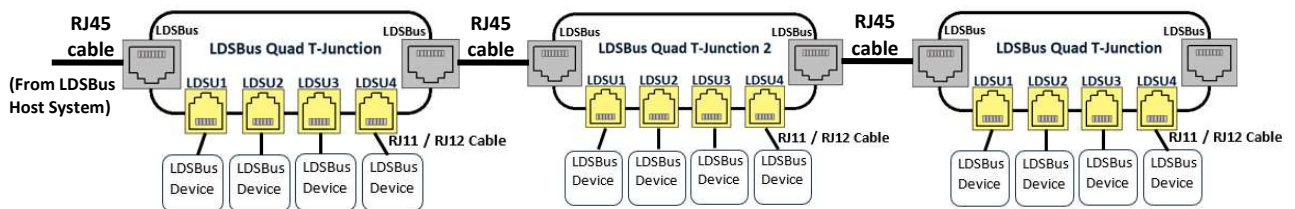


Figure 4 - Daisy-chained LDSBus Quad T-Junction

Note: The last device on the bus shall have its termination enabled. The last device is the device attached to the final Quad T-Junction in the daisy chain and which has the longest RJ11/RJ12 cable.

3.3 Connection Limitation of Quad T-Junctions with IoTPortal Gateway

3.3.1 LDSBus Quad T-Junction

Each LDSBus device has a device load rating that is described in [LDSBus Quad T-Junction Technical Note](#). When connecting multiple devices to the IoTPortal gateway's LDSBus ports, care must be taken not to exceed the total rating value specified in the technical note.

- For PSU Gateway, the maximum allowed Total Rating per LDSBus port is less than 100 units
- For POE Gateway, the maximum allowed Total Rating per LDSBus port is less than 90 units.

If the Total Rating Value exceeds the limit, the IoTPortal gateway will enter into protection mode and turn off the LDSBus power.

3.3.2 LDSBus Quad T-Junction 2

The LDSBus Quad T-Junction 2 overcomes the limitation of LDSBus Quad T-Junction and allows any combination of LDSBus devices to be connected to a single LDSBus port, whether it be a POE Gateway or a PSU Gateway.

Note: LDSBus Quad T-Junction and LDSBus Quad T-Junction 2 can be combined and daisy-chained. Please refer to [Section 5](#).

4 LDSBus Quad T-Junction 2 Feature Description

4.1 Power Up Sequencing

LDSBus Quad T-Junction 2 features a sequential power-up mechanism, preventing inrush current issues, by ensuring that each device is powered up sequentially. By turning on the LDSU port in an orderly manner, any inrush current that can potentially trigger the current limiter in the IoTPortal Gateway LDSBus port is prevented.

As shown in Figure 5, when the power is applied to the first LDSBus Quad T-Junction 2, LDSU1 will be the first port to power ON, followed sequentially by LDSU2, LDSU3, and LDSU4 ports. Once all four LDSU ports in first LDSBus Quad T-Junction 2 powered ON, the second LDSBus Quad T-Junction 2 will begin to power ON in a sequential manner. Starting from LDSU1 to LDSU4, it will continue for any subsequently added LDSBus Quad T-Junction 2.

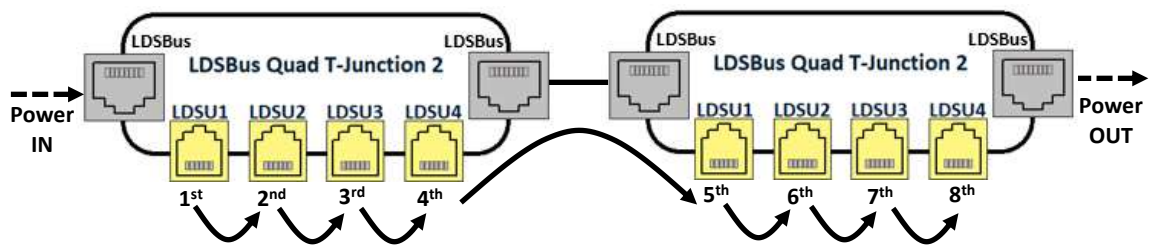


Figure 5 - Power Up Sequencing

4.2 Short Circuit Protection

LDSBus Quad T-Junction 2 includes short circuit protection for both LDSBus power and LDSU port power. A feature like this prevents damage to connected devices as well as interruptions in the operation of the LDSBus Host System.

There are two types of short circuit protection feature in LDSBus Quad T-Junction 2:

1. LDSBus power short circuit protection.
2. LDSU port power short circuit protection.

The system can recover from a short circuit by removing the fault device from LDSU port without requiring any power cycle process.

4.2.1 LDSBus Power Short Circuit

If the short circuit occurs in the LDSBus power of any of the LDSBus Quad T-Junction 2 devices, the following actions will occur:

- Power will be cut off only from the point of the encountered short circuit and for any subsequent LDSBus Quad T-Junction 2 devices (**indicated by a dotted line in Figure 6**).
- The host system and any LDSBus Quad T-Junction 2 devices before the point of short circuit will remain operational and unaffected.

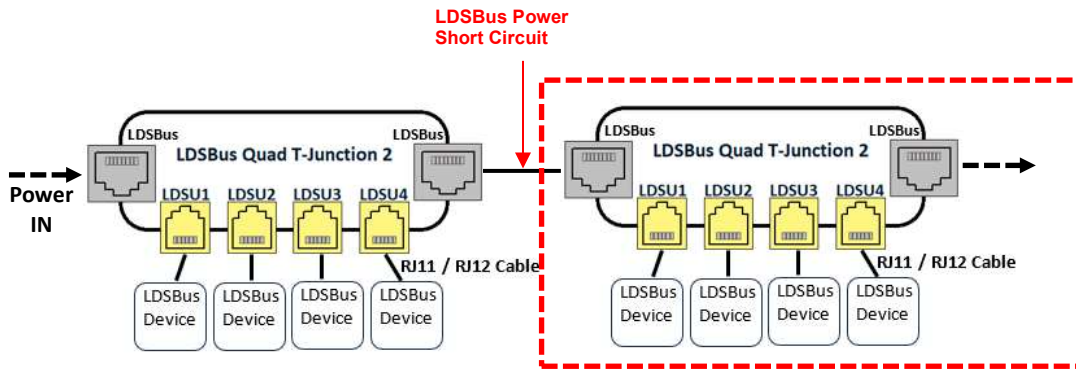


Figure 6 - Short Circuit at LDSBus Power

4.2.2 LDSU Port Power Short Circuit occurs during operation

If the short circuit occurs in the LDSU3 port on the first LDSBus Quad T-Junction 2 during operation, the following action will occur:

- Power will be cut off only for the affected LDSU3 port and any subsequent LDSU ports in that particular LDSBus Quad T-Junction 2 (**indicated by a dotted line in Figure 7**).
- All other LDSBus devices and the Host System will remain operational and unaffected.

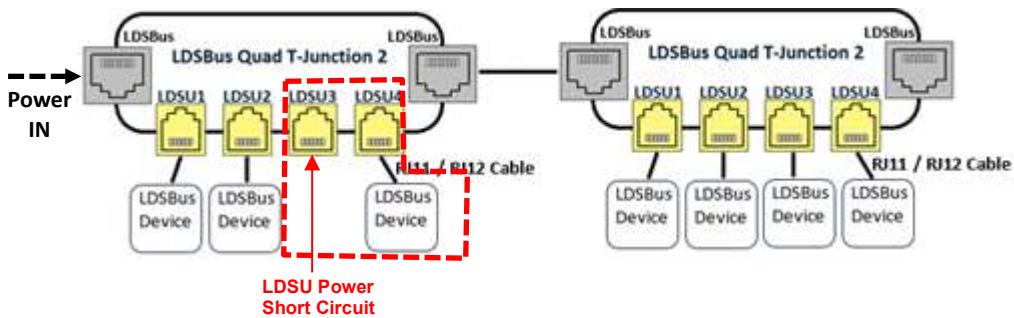


Figure 7 - Short Circuit at 5V output port during operation

4.2.3 LDSU port power short circuit occurs during start-up

If the short circuit occurs in the LDSU3 port on the first LDSBus Quad T-Junction 2 during start-up, the following action will occur:

- Power will be cut off on LDSU3 port including any subsequent LDSU ports and LDSBus (indicated by a dotted line in Figure 8).
- The host system and any LDSU ports before the point of short circuit will remain operational and unaffected.

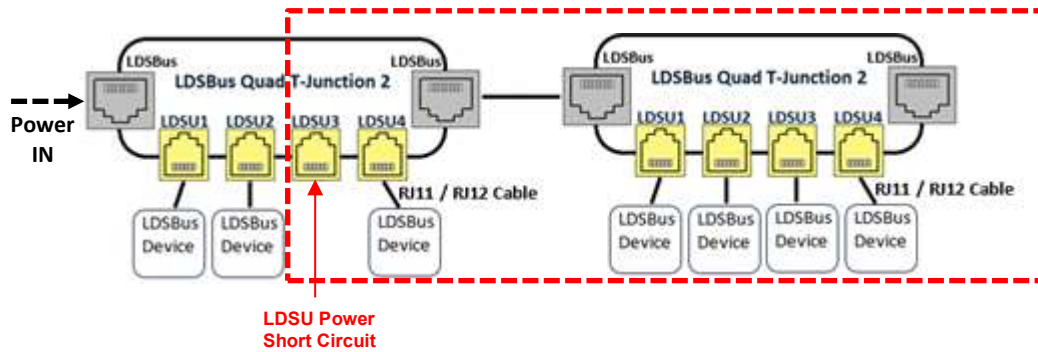


Figure 8 - Short Circuit at 5V output port during start-up

5 Combination of Quad T-Junctions Example

5.1 Use case to handle inrush current

This section describes how to daisy chain LDSBus Quad T-Junction and LDSBus Quad T-Junction 2, and how these devices can be implemented in a variety of applications. The following conditions must be considered before daisy chaining LDSBus Quad T-Junction and LDSBus Quad T-Junction 2:

- LDSBus Quad T-Junction should not exceed the maximum level of Total Rating Value of LDSBus devices connected to a single LDSBus port.
- Whenever LDSBus Quad T-Junction 2 is used, any LDSBus devices connected to it will have a Total Rating Value of "0".
- LDSBus Quad T-Junction 2 will reset the Total Rating Value of all upstream connected LDSBus Quad T-Junction units to "0".

Note: The rating values used in the following examples are for illustration purposes only. For the updated or actual rating values, refer to [LDSBus Quad T-Junction Technical Note](#).

Example:

The following example shows how to increase the number of LDSU devices on the bus and manage a Total Rating Value that exceeds 100 units.

Consider a system with the following devices connected to a single LDSBus of the PSU Gateway:

Thermocouple : 2 units
pH Sensor : 24 units
EC Sensor : 10 units
DO Sensor : 3 units
ORP Sensor : 30 units
ORP Sensor1 : 30 units
IO Controller : 32 units
IO Controller1 : 32 units
Relay : 10 units

The Total Rating Value is calculated as:

$$2 + 24 + 10 + 3 + 30 + 30 + 32 + 32 + 10 = 173 \text{ units.}$$

In this case, there are more than 100 units on a single LDSBus. In order to accommodate this system setup, use the following combination of LDSBus Quad T-Junction and LDSBus Quad T-Junction 2 in a single bus configuration from the IoTPortal Gateway:

Combination 1:

1st LDSBus Quad T-Junction:

- Devices: Thermocouple (2) + pH Sensor (24) + EC Sensor (10) + DO Sensor (3)
- Total Rating Value: $2 + 24 + 10 + 3 = 39$ units
- This is within the maximum Total Rating Value limit.

2nd LDSBus Quad T-Junction 2:

- Devices: ORP Sensor (30) + IO Controller (32) + Relay (10)
- Total Rating Value: The Total Rating Value of devices connected to this T-Junction is considered as 0 units. It also resets the upstream LDSBus Quad T-Junction 1's Total Rating Value to 0 units.

3rd LDSBus Quad T-Junction:

- Devices: ORP Sensor (30) + IO Controller (32)
- Total Rating Value: $30 + 32 = 62$ units
- This is also within the maximum Total Rating Value limit of 100 units.

Using this combination of Quad T-Junctions, the Total Rating Value is managed effectively, ensuring that no single LDSBus exceeds 100 units.

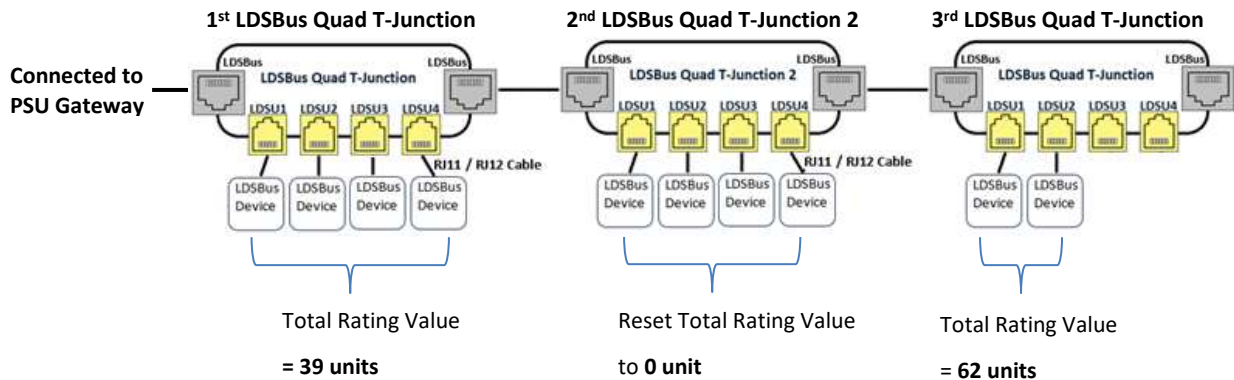


Figure 9 - Example: Combination 1

Combination 2:

1. 1st LDSBus Quad T-Junction:

- Devices: Thermocouple (2) + pH Sensor (24) + EC Sensor (10) + DO Sensor (3)
- Total Rating Value: $2 + 24 + 10 + 3 = 39$ units
- This is within the maximum Total Rating Value limit.

2. 2nd LDSBus Quad T-Junction:

- Device: IO Controller (32)
- Total Rating Value: 32 units
- This is also within the maximum Total Rating Value limit.

3. 3rd LDSBus Quad T-Junction 2:

- Devices: ORP Sensor (30) + ORP Sensor (30) + IO Controller (32) + Relay (10)
- Total Rating Value: The Total Rating Value of devices connected to this T-Junction is considered as 0 units. It also resets the Total Rating Value of all subsequent LDSBus Quad T-Junction units to 0 units.

Using this combination of Quad T-Junctions, the Total Rating Value of each T-Junction is managed effectively within the limits.

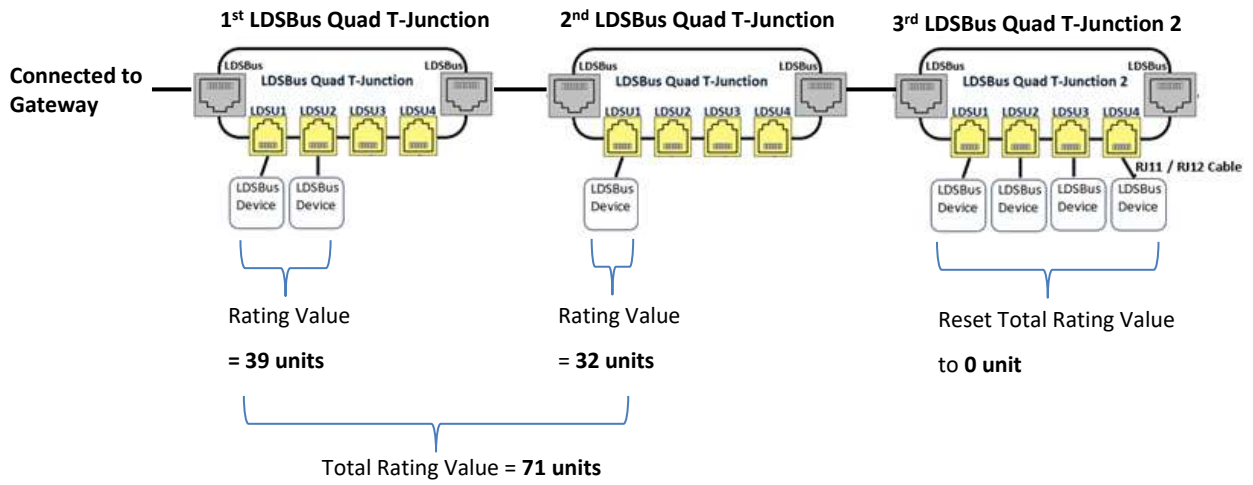


Figure 10 - Example: Combination 2

5.2 Use case to handle short circuit

5.2.1 LDSBus Power Short Circuit

These use cases will provide more understanding, if there is short circuit occur at the LDSBus power. It may happen in the different locations of the LDSBus.

The below connection diagram shows, there are 3 pcs of Quad T-Junction that have been used and connected to the Host. Its mixed combination between LDSBus Quad T-Junction (2pcs) and LDSBus Quad T-Junction 2 (1pc).

Use Case -1:

If the short circuit occurs between 1st and 2nd Quad T-Junction

Since LDSBus Quad T-Junction doesn't have short circuit protection, which is placed at the 1st position. The host will trigger the short circuit protection. It may lead to switch off the entire bus.

In Figure 11, the dotted area indicates that all devices will be switched off.

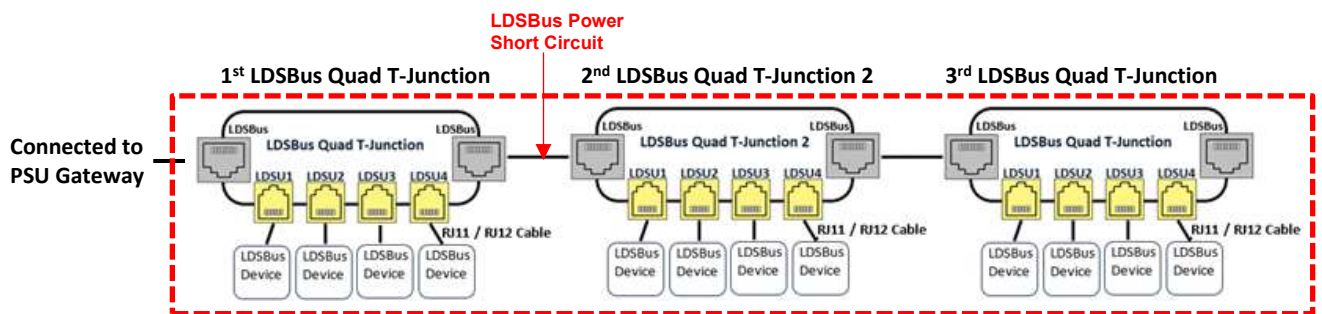


Figure 11 - Use Case-1

Use Case -2:

If the short circuit occurs between 2nd and 3rd Quad T-Junction

Since LDSBus Quad T-Junction 2 has short circuit protection, which is placed at the 2nd position in the bus. It will trigger short circuit protection. So, the subsequent Quad T-Junctions will switch off the power. But the 1st quad T-Junction will not be switched off. Also, will not affect the host.

In Figure 12, the dotted area indicates that the subsequent LDSBus devices will be switched off.

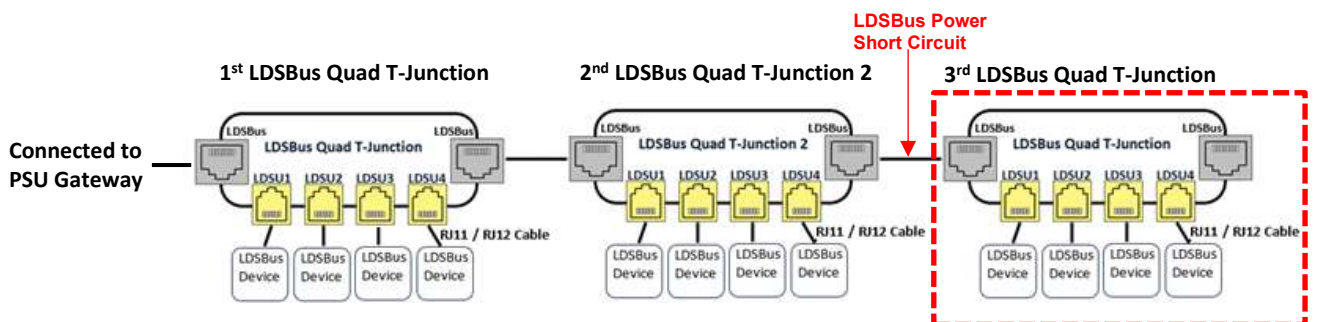


Figure 12 - Use Case-2

Use Case -3:

If the short circuit occurs after 3rd Quad T-Junction

Since LDSBus Quad T-Junction doesn't have short circuit protection, which is placed at the 3rd position. It will switch off the power and the short circuit passes through to the 2nd position of Quad T-Junction, which has short circuit protection. It will trigger the short circuit protection, and the host and 1st quad T-Junction will not be switched off.

In Figure 13, the dotted area indicates that the affected Quad T-Junction and subsequent devices will be switched off.

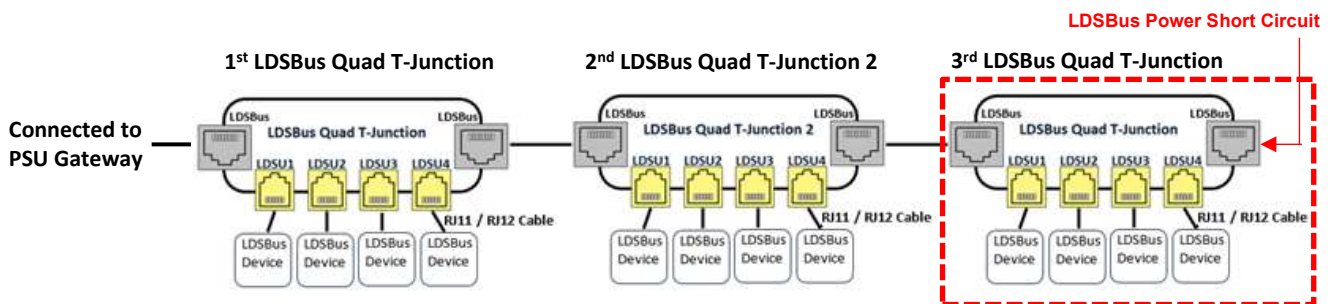


Figure 13 - Use Case-3

5.2.2 LDSU Port Power Short Circuit

These use cases will provide more understanding, if there is short circuit occur at the LDSBU port power. It may happen in the different LDSBU port in different Quad T-Junction.

The below connection diagram shows, there are 3 pcs of Quad T-Junction that have been used and connected to the Host. It's mixed combination between LDSBus Quad T-Junction (2pcs) and LDSBus Quad T-Junction 2 (1pc).

Use Case 4: If the short circuit occurs at LDSU3 port of 1st Quad T-Junction during operation or start up

Since LDSBus Quad T-Junction doesn't have short circuit protection, which is placed at the 1st position. The host will trigger the short circuit protection. It may lead to switching off the entire bus.

In Figure 14, the dotted area indicates that all devices will be switched off.

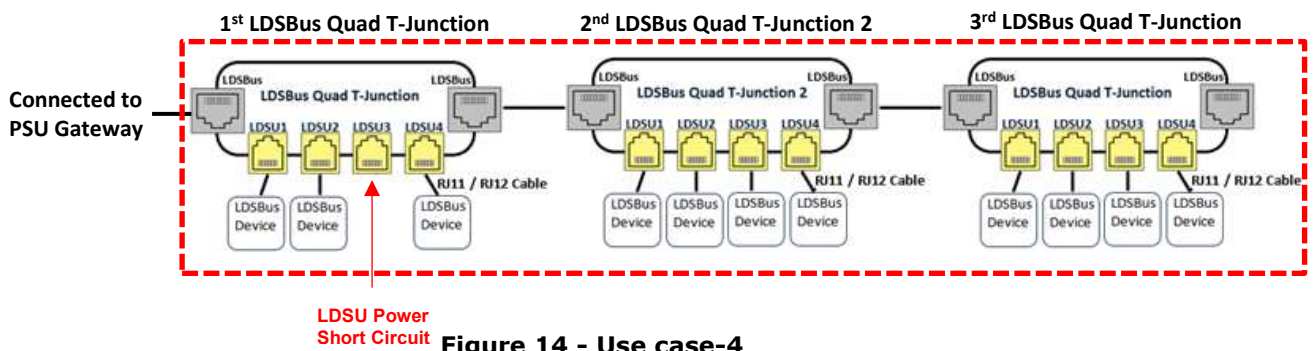


Figure 14 - Use case-4

Use Case 5: If the short circuit occurs at LDSU3 port of 2nd Quad T-Junction during operation

Since LDSBus Quad T-Junction 2 has short circuit protection, which is placed at the 2nd position in the bus. It will trigger short circuit protection during operation. It will only be affected LDSU3 port and LDSU4 port. 1st Quad T-Junction and 3rd Quad T-Junction will not be switched off. Also, will not affect the host.

In Figure 15, the dotted area indicates that the particular port and the subsequent port in the same Quad T-Junction will be switched off. All other LDSBus devices and the Host System will remain operational and unaffected.

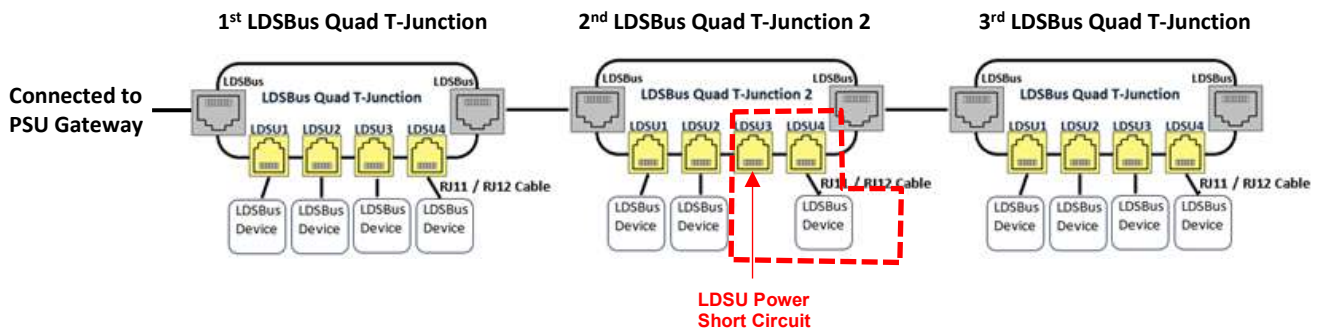


Figure 15 - Use Case-5

Use Case 6: If the short circuit occurs at LDSU3 port of 2nd Quad T-Junction during star up

Since LDSBus Quad T-Junction 2 has short circuit protection, which is placed at the 2nd position in the bus. It will trigger the short circuit protection during start up. It will switch off LDSU3 port and all other subsequent LDSU ports in that particular Quad T-Junction and subsequent Quad T-Junction. The host system and any LDSU ports before the point of short circuit will remain operational and unaffected.

In Figure 16, the dotted area indicates that the port and the subsequent port in the same and subsequent Quad T-Junction will be switched off. All other LDSBus devices and the Host System will remain operational and unaffected.

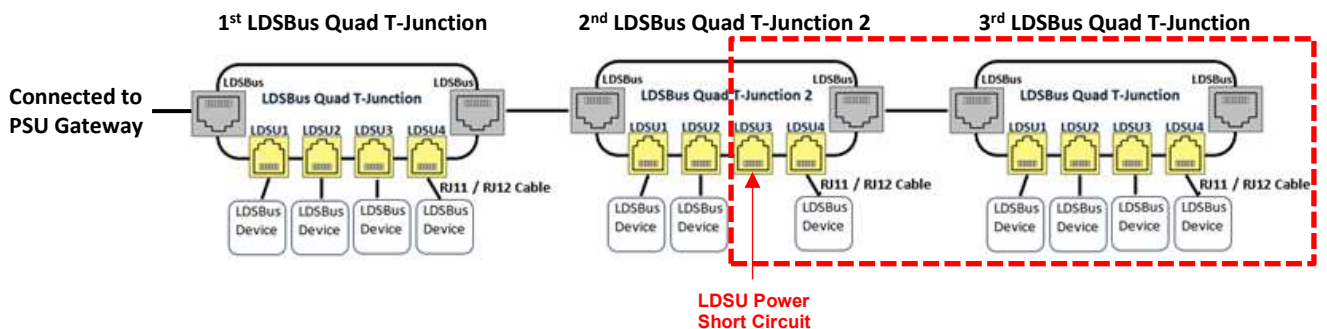


Figure 16 - Use Case-6

Use Case 7: If the short circuit occurs at LDSU3 port of 3rd Quad T-Junction during operation or start up

Since LDSBus Quad T-Junction doesn't have short circuit protection, which is placed at the 3rd position. It will switch off the power and the short circuit passes through to the 2nd position of Quad T-Junction, which has short circuit protection. It will trigger the short circuit protection, and the host and 1st quad T-Junction will not be switched off.

In Figure 17, the dotted area indicates that the affected Quad T-Junction and subsequent devices will be switched off. All other LDSBus devices and the Host System will remain operational and unaffected.

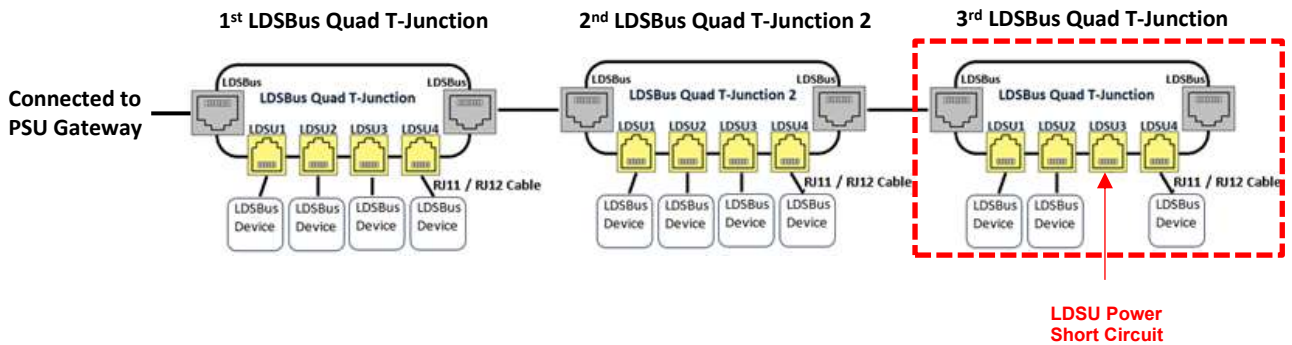


Figure 17 - Use Case-7

6 Contact Information

Refer to <https://brtsys.com/contact-us/> for contact information.

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Appendix A – References

Document / Web References

[LDSBus Quad T-Junction Datasheet](#)

[LDSBus Quad T-Junction 2 Datasheet](#)

[LDSBus Configuration Utility Guide](#)

[LDSBus Quad T-Junction Quick Start Guide](#)

[LDSBus Configuration Utility Setup](#)

[LDSBus Python SDK Guide](#)

Acronyms and Abbreviations

Terms	Description
DO	Dissolved Oxygen
EC	Electrical Conductivity
LDSBus	Long Distance Sensor Bus
ORP	Oxidation Reduction Potential
POE	Power Over Ethernet
PSU	Power Supply Unit

Appendix B – List of Tables & Figures

List of Tables

Table 1 - Product Features	4
----------------------------------	---

List of Figures

Figure 1 - LDSBus Quad T-Junction Models.....	3
Figure 2 - Quad T-Junctions in LDSBus System – Connection Diagram.....	5
Figure 3 - Quad T-Junction Port Connection.....	6
Figure 4 - Daisy-chained LDSBus Quad T-Junction	6
Figure 5 - Power Up Sequencing	8
Figure 6 - Short Circuit at LDSBus Power	9
Figure 7 - Short Circuit at 5V output port during operation	9
Figure 8 - Short Circuit at 5V output port during start-up.....	10
Figure 9 - Example: Combination 1	12
Figure 10 - Example: Combination 2	13
Figure 11 - Use Case-1	14
Figure 12 - Use Case-2	14
Figure 13 - Use Case-3	15
Figure 14 - Use case-4.....	15
Figure 15 - Use Case-5	16
Figure 16 - Use Case-6	16
Figure 17 - Use Case-7	17

Appendix C – Revision History

Document Title: BRTSYS_AN_069 LDSBus Quad T-Junction Usage
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Document Feedback: [Send Feedback](#)

Revision	Changes	Date
1.0	Initial Release	06-11-2024