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LXT332 Redundancy Applications

Application Note

January 2001

Order Number: 249170-001

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1.0 Introduction

The primary concern in most high speed data networks is reliability. Redundancy is one way to protect and ensure reliability in the event of catastrophic failure.

At low data rates, redundancy may not make sense, but as the number of lower data ports are multiplexed to the higher bit streams, it begins to play a major role. Because of this, most major network multiplexers and bandwidth managers use redundancy techniques to ensure data integrity.

The Intel LXT332 transceiver offers an unique tri-state function that allows the sharing of a single trunk for redundancy purposes.

This application note provides some guidelines for implementing redundancy systems both for T1 and E1 operation.

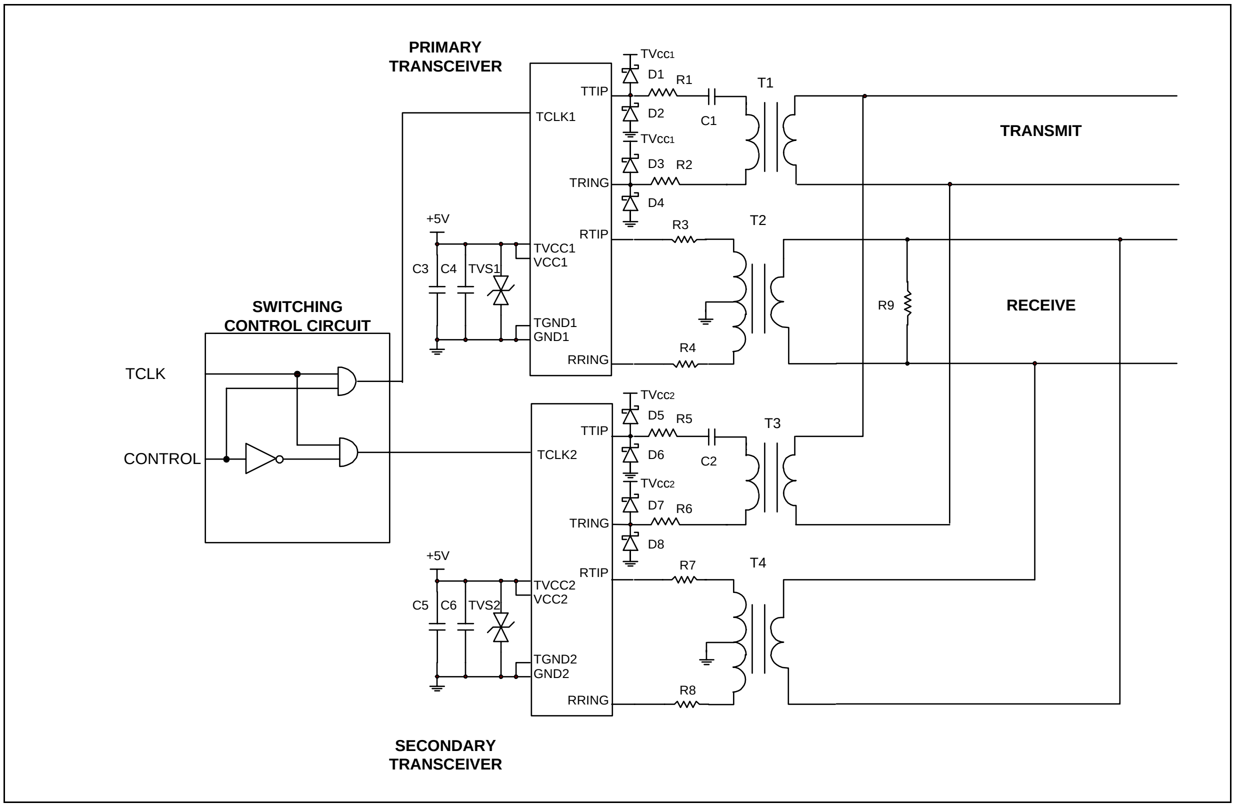
Note: This application note is not intended for designs that require error free switching.

1.1 General Description

Below is a block diagram showing two LXT332 transceivers with one used as a redundancy circuit. The redundant transceiver is tri-stated while the working transceiver carries the traffic.

The transceivers are connected at the secondary side of the transformers to provide DC isolation. This configuration was also tested with the redundant transceiver powered-down.

Figure 1. LXT332 Block Diagram



1.2 Circuit Description

The LXT332 allows two transceiver output drivers to be tied together on the secondary side of the transformer. This is allowable if one driver is in a high impedance state (tri-state).

1.2.1 Driver Tri-state Mode

To configure the transceiver for this option, simply remove TCLK of the driver that needs to be tri-stated. A TCLK monitor internal to the transceiver senses the absence of TCLK and then activates the tri-state mode for that driver. While in the tri-state mode the output driver enters a high impedance state which will have no adverse effects on the pulse shape of the operating driver.

1.2.2 Receive Circuit

The transceiver's receive circuit uses a single terminating resistor R9. Because of the internal high impedance of the receive circuit, reflections are minimized and high return loss capabilities are maintained.

Resistors R3, R4, R7, and R8 limit current into the receivers under a single device power down condition. The value of these resistors is 1kΩ, which will help to isolate the powered down device and prevent it from loading the live transceiver's received data.

1.2.3 Transmit Circuit

The transceiver’s transmit circuit must ensure that the current into the TTIP/TRING pins is minimized. The use of series resistors R1, R2 and R5, R6 is thus essential in this type of configuration, and is required if the redundant transceiver is powered down. The purpose of capacitors C1 and C2 is to block the DC component from saturating the transformer. Additional protection against excessive surge currents is provided by including Schottky diodes D1-D8. In this case, a TVS, bi-directional 5V transient voltage suppressor, is needed to clamp surges coupled onto the power supply by the Schottky diodes (TVS1 and TVS2).

1.3 Transceiver Pulse Pictures

This configuration was tested for both E1 (75Ω and 120Ω) and T1 operation. The tests were performed using two separate LXT332 demo boards. The cable connections between the two demo board transmitters were kept at less than 6 inches in order to minimize reflections. Figure 2 through Figure 5 show the pulse shapes obtained with and without the redundant circuit in both a tri-state mode and also under a power-down condition. Note that the difference in the pulse shapes, with and without the redundant transceiver, is nearly indistinguishable.

Figure 2. T1 at 133’ With and Without Redundant Transceiver

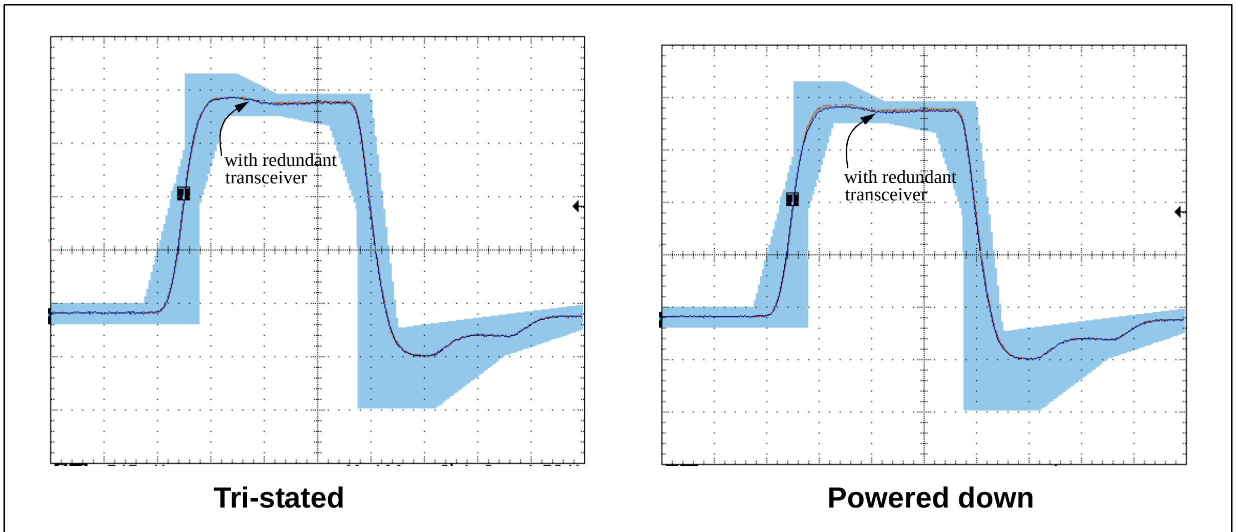


Figure 3. T1 at 655’ With and Without Redundant Transceiver

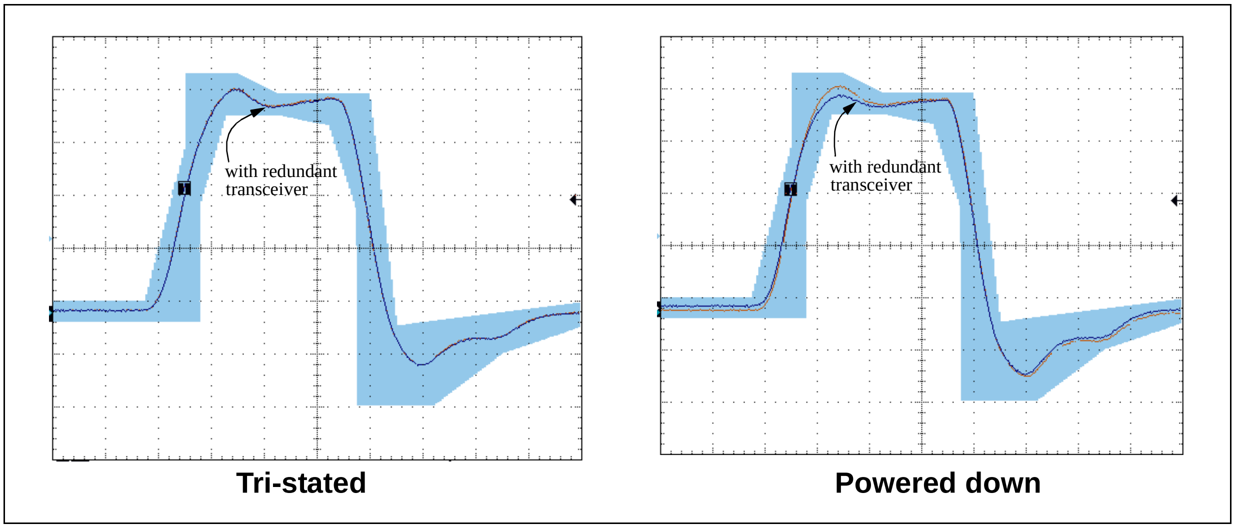


Figure 4. E1, 75 Ω With and Without Redundant Transceiver

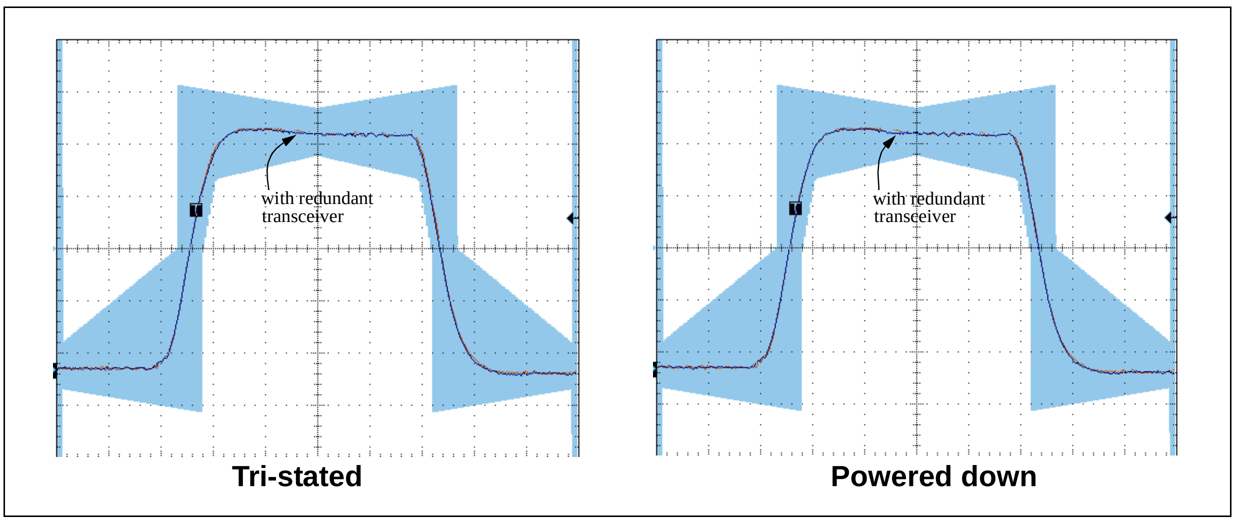
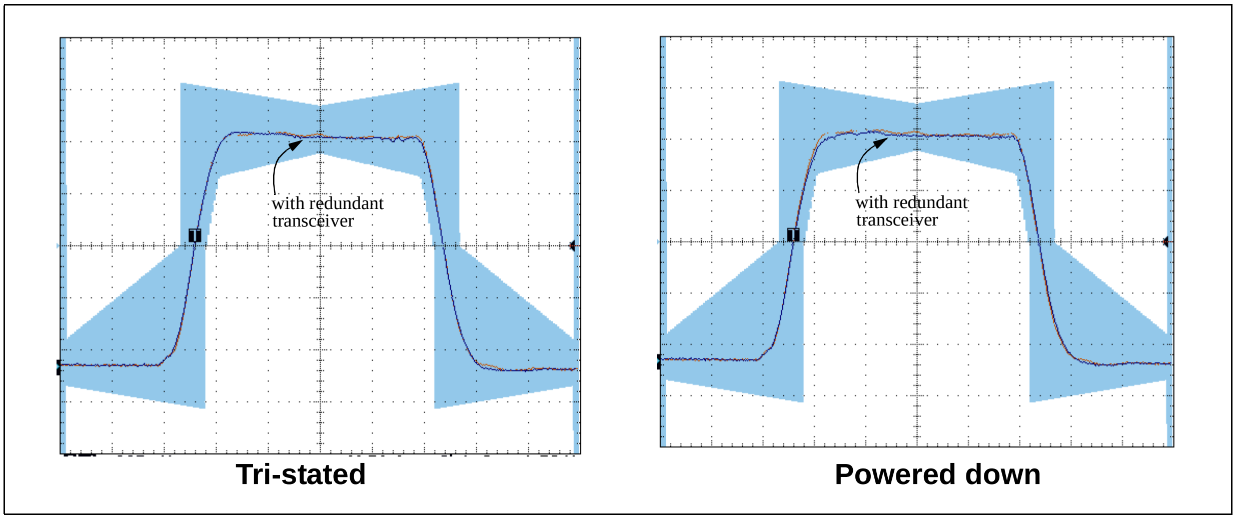


Figure 5. E1, 120 Ω With and Without Redundant Transceiver



1.4 Return Loss

Return loss is an important factor to consider when designing redundancy systems. For E1 operation, recommendation G.703 and ETSI 300 166 clearly define the minimum return loss to be achieved both at the input and output ports.

1.4.1 Receive Return Loss

Table 1 shows the minimum limits imposed by G.703 and typical values obtained with the LXT332 using the configuration described before (redundant board powered off). The receive transformers used in this configuration should have a minimum primary inductance of 2mH. The transformer inductance is the main factor determining the receive return loss at low frequencies. By using two transformers in parallel on the receive side, the total inductance is reduced to 1mH. This value should be kept as a minimum in order to meet G.703 low frequency band requirements with a comfortable margin.

1.4.2 Transmit Return Loss

Table 2 contains the transmit return loss measured using the same configuration against ETSI, ETS 300 166.

Table 1. Receive Return Loss

Config	Frequency Band (kHz)		
	50 -102	102 - 2048	2048 - 3072
G.703 minimum	12 dB	18 dB	14 dB
LXT332 E1, 120 Ω with redundancy	19.6 dB	19.3 dB	16.0 dB

Table 2. Transmit Return Loss

Config	Frequency Band (kHz)		
	50 -102	102 - 2048	2048 - 3072
ETS 300166 minimum	6 dB	8 dB	8 dB
LXT332 E1, 120 Ω with redundancy	12.8 dB	12.5 dB	12.1 dB

Table 3. Component Specifications

Component	Description	Manufacturer	Part Number
T1, T2	transformer, 1:2 CT + 1:2 CT	Pulse Engineering	PE64953
T3, T4	transformer, 1:2 CT + 1:2 CT	Pulse Engineering	PE64953
D1 - D4	Schottky diode	International Rectifier	11DQ04
TVS1, TVS2	bi-directional TVS	Semtech	SMCJ5.0AC
R1, R2, R5, R6	resistor, 9.1 Ω, 1%		
R3, R4, R7, R8	resistor, 1k Ω, 5%		
R9	**T1** = 100 Ω, 5% resistor **E1, 75** Ω = 75 Ω, 5% resistor **E1, 120** Ω = 120 Ω, 5% resistor		
C1, C2	capacitor, 0.47 µF		
C3, C5	capacitor, 68 µF		
C4, C6	capacitor, 0.1µF		

1.4.3 Test Conditions

- All pulse pictures were taken at ambient temperature
- DC Supply voltage = + 5.00V
- A Mountain Engineering Line simulator was used from 0- 655’
- Intel demonstration boards were used to configure a redundancy system