Application Note for PI3EQX4951 SATA ReDriver™ Family
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1.0 Introduction

PI3EQX4951 SATA ReDriver^{TM} family was developed using Pericom cutting-edge technology to compensate the deterministic jitter and insertion loss caused by long traces and cables to achieve signal integrity at the end of the traces or cables, and have low power consumption. Figure1, 2 and 3 are typical application.
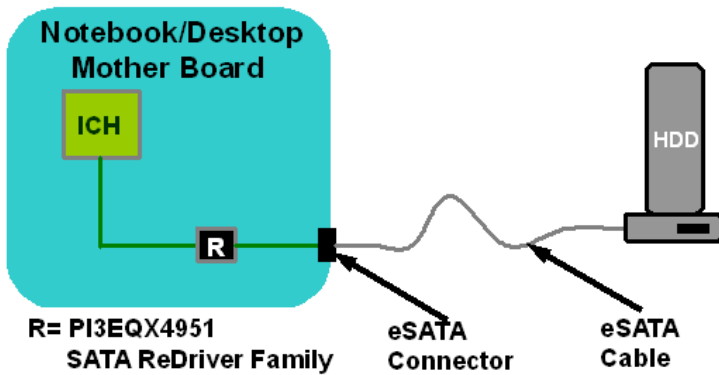

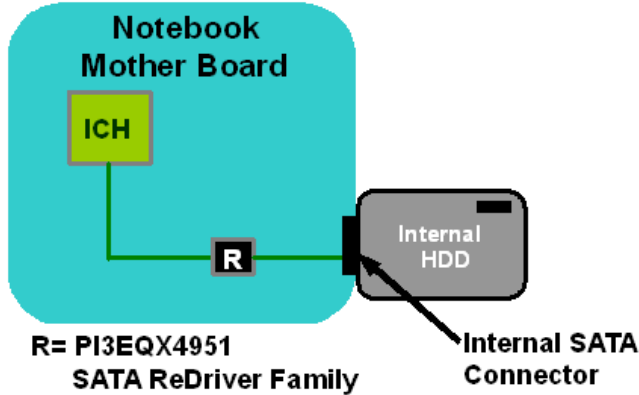**Figure 1 Typical Application in Notebook and Desktop**

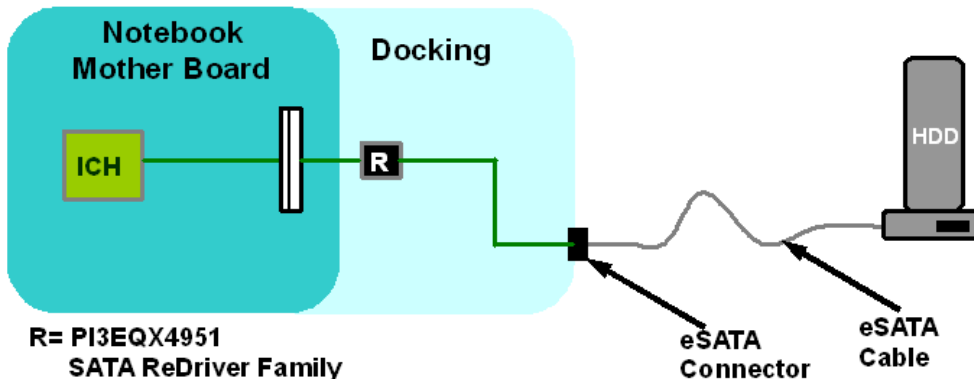**Figure 2. A Typical Application in Notebook**

Figure 3. A Typical Application in Notebook with Docking

2.0 How to select PI3EQX4951 SATA ReDriver™ Family for various applications

Table 1. Choosing the Correct Product

Applications	Standards	Recommended PI3EQX4951 devices and features	Package
Internal HDD Docking station Desktop, 1.4~1.9V VDD;	SATAi (G1-1.5g, G2-3.0g) SATAm (G1-1.5g, G2-3.0g) SATAx (G1-1.5g, G2-3.0g)	PI2EQX4951SLZDE (flexible EQ and analog/digital pre-emphasis settings) PI2EQX4951SLAZDE (flexible EQ and analog/digital pre-emphasis settings, HDD auto detection)	TQFN-20
NB eSATA Laptop docking Desktop, server, Cable Backplane, SAS 3.3V VDD;	SATAi (G1-1.5g, G2-3.0g) SATAm (G1-1.5g, G2-3.0g) SATAx (G1-1.5g, G2-3.0g) SAS (G1-1.5g, G2-3.0g)	PI2EQX4951STZDE (flexible EQ, analog/digital pre-emphasis settings, AUTO-SLUMBER mode) PI2EQX4951STAZDE (flexible EQ and analog/digital pre-emphasis settings, HDD auto detection)	TQFN-20
		PI2EQX4951BZDE (flexible EQ and analog/digital pre-emphasis settings)	TQFN-20

Table 2. Power Comparison for PI3EQX4951 SATA ReDriver™ Family

Comparison of Feature (Part Number)	VDD Voltage (V)	Power consumption		Auto-Slumber Mode	
		Max. (mW)	Standby (mW)	Y/N	Power Consumption(mW)
PI3EQX4951SLZDE PI3EQX4951SLAZDE	1.4~1.9	150	0.04	√	20
PI3EQX4951STZDE PI3EQX4951STAZDE	3.3	300	0.1	√	30
PI3EQX4951BZDE	3.3	500	2	X	X

3.0 Recommended Settings of PI3EQX4951 SATA ReDriver[TM] Family

Table 3. The Settings of PI3EQX4951 SATA ReDriver[TM] Family for Various Input Trace Lengths

Input and output trace lengths		For Standard&Enhanced Mode of PI2EQX4951SL/A, PI3EQX4951ST/A, PI3EQX4951B, 3.0gbs	
Input	Output	Pre-emphasis	Equalization
<8"	<2"	0dB	2.5dB
>8"	<2"	0dB	6.5db

Table 4. The Settings of PI3EQX4951 SATA ReDriver[TM] Family for Various Output Trace Lengths

Input and output trace lengths		For Standard Mode of PI2EQX4951SL/A, PI3EQX4951ST/A, PI3EQX4951B, 3.0gbs	
Input	Output	Pre-emphasis	Equalization
<2"	<8"	0dB	2.5dB
<2"	>8"	3.0dB	2.5dB

Table 5, the settings for PI3EQX4951 SATA ReDriver[TM] Family for various output trace lengths.

Input and output trace lengths		For Enhanced Mode of PI2EQX4951SL/A, PI3EQX4951ST/A, PI3EQX4951B, 3.0gbs	
Input	Output	Pre-emphasis	Equalization
<2"	<8"	0dB	2.5dB
<2"	<16"	3.0dB	2.5dB
<2"	<24"	4.5dB	2.5dB
<2"	<32"	6.0dB	2.5dB

Please note:
1. **Trace lengths are suggested values based on Pericom lab measurements (taken with output pre-emphasis enabled on both Channels) to meet SATA loss and jitter specifications.**
2. **Actual trace length supported by PI3EQX4951 SATA ReDriver[TM] may be more or less than suggested values and depend on board layout, number of connectors used in the SATA signal path, and SATA host and esata connector design.**

4.0 Board Design and Layout Guidance for PI3EQX4951 SATA ReDriver^{TM} Family

4.1 The Trace Width and Clearance
- The trace length miss-matching shall be less than 5 mils for the "+" and "–" traces in the same pairs
- Match the length between the pairs less than 3 inches
- Use wider trace width, with 100ohm differential impedance, to minimize the loss for long routes
- More pair-to-pair spacing for minimal crosstalk
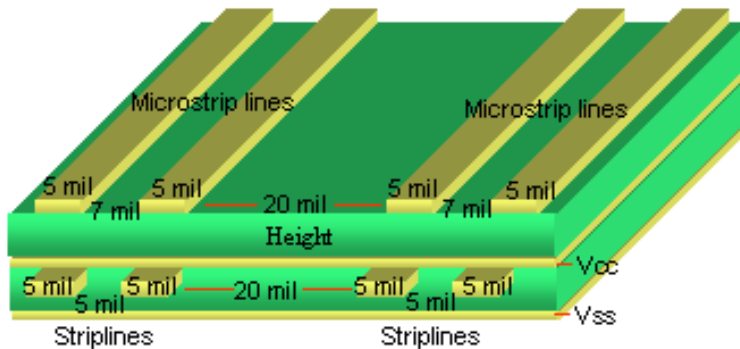- Target differential Zo of 100ohm ±20%

Figure 4, the trace width and clearance

4.2 The PCB Layers Stackup

- No new PCB technology required. Use FR4 is fine.
- Using standard 4 to 8 layers stack-up with 0.062 inch thick PCB.
- For micro strip lines, using ½ OZ Cu plated is ok.
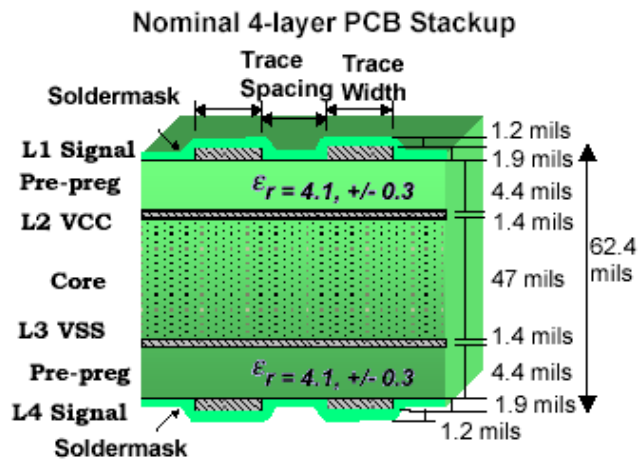- For strip line in 6 plus players, using 1 OZ Cu is better.

Figure 4. The Stack-up

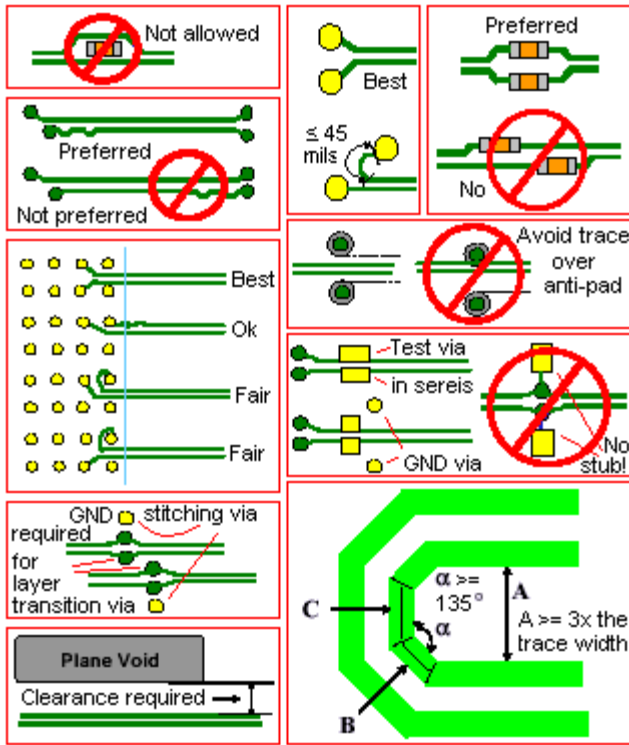## 4.3 The Layout Guidance for the Trace Routings

Figure 6. The Layout Guidance for the Trace Routings

4.4 The Topology and Layout Guidance for PI3EQX4951 SATA ReDriver^{TM} Family

- Use VDD de-coupling capacitors, 0.1uf to 0.22uf in size of 0402, for all the Vdd pins of PI3EQX4951 family, as close to the Vdd pins as possible, within 2-3mm if feasible.
- Use dedicated VDD and GND planes for to minimize the jitters coupled between channel trough power sources.
- The differential traces shall be away from the strong EMI source and devices, such as the single-ended TTL traces and devices, with at least 30mil to 50mil space.
- No other components shall piggy ride on the differential traces.
- Locate the PI3EQX4951 family device as close to the SATA connector as possible, 5" to 7" traces between the the PI3EQX4951 family and the SATA connector is allowed, but with 2" to 3" is preferred.

5.0 Appendix

Application Reference Schematics and Layout

5.1 PI3EQX4951STZDE (Standard Mode)
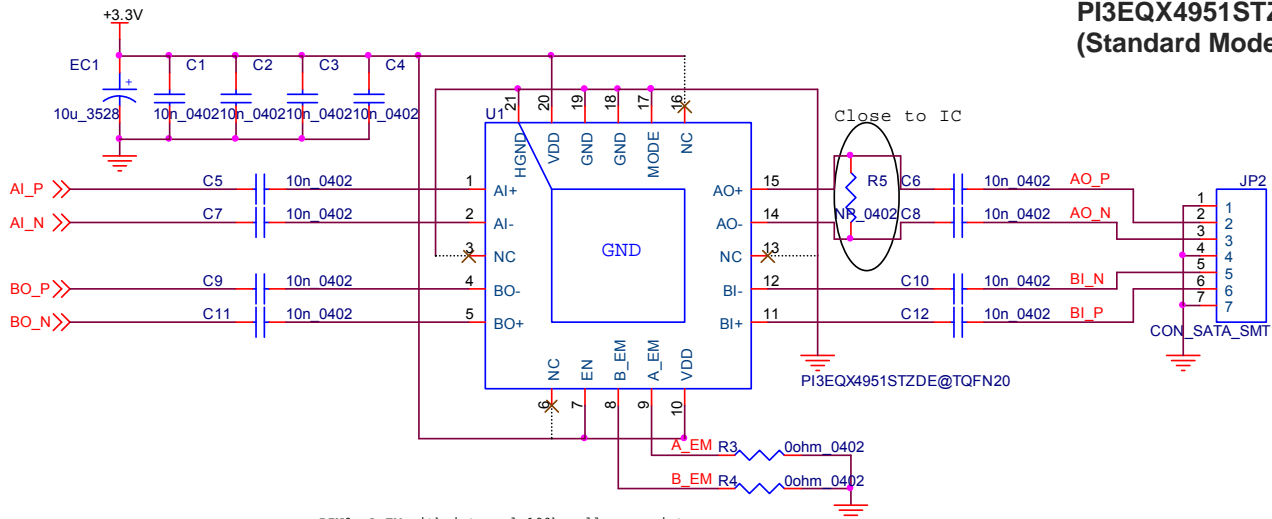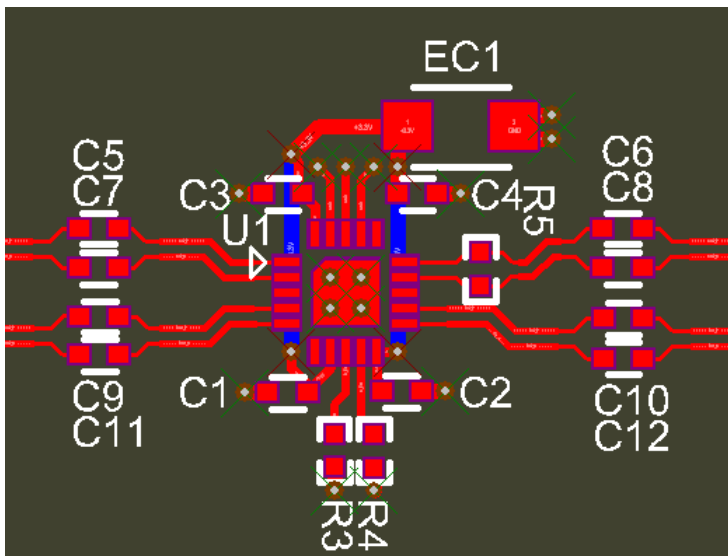
APP Circuit for PI3EQX4951STZDE (Standard Mode)

PIN9: A_EM with internal 100k pull-up resistor

R3 is unpopulated	Channel A has 3.0dB pre-emphasis output
R3 is populated	Channel A has 0dB pre-emphasis output

PIN8: B_EM with internal 100k pull-up resistor

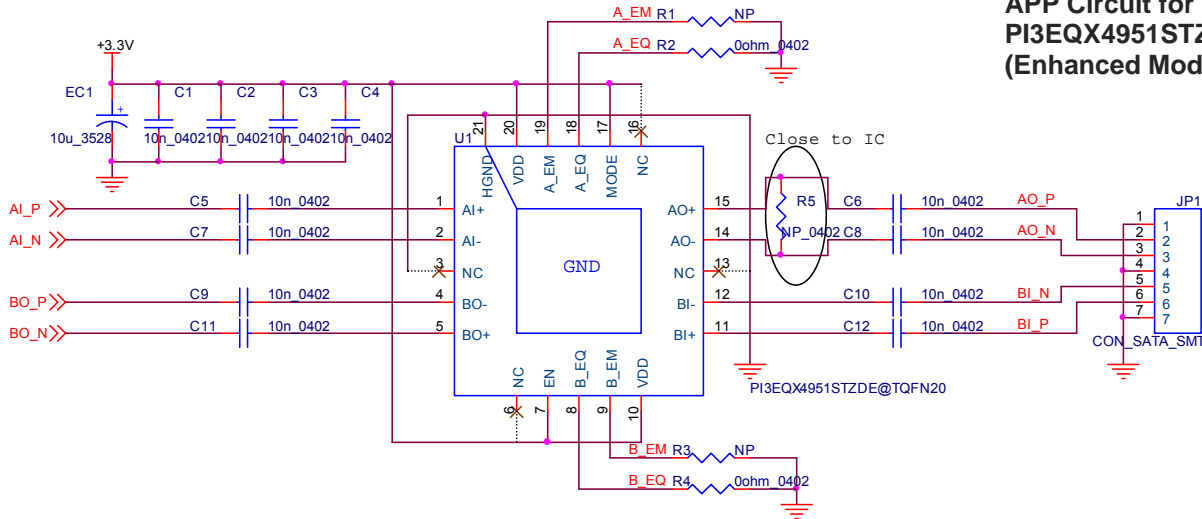| R4 is unpopulated	Channel B has 3.0dB pre-emphasis output
R4 is populated	Channel B has 0dB pre-emphasis output

PIN6 and 16 could be connected to VDD
PIN3 and 13 could be connected to GND

APP Layout for PI3EQX4951STZDE (Standard Mode)

5.2 PI3EQX4951STZDE (Enhanced Mode)

APP Circuit for PI3EQX4951STZDE (Enhanced Mode)

PIN18: A_EQ with internal 100k pull-up resistor

R2 is unpopulated	Channel A has 6.5dB equalization
R2 is populated	Channel A has 2.5dB equalization

PIN19: A_EM can be adjusted by analog resistor

R1 Value	Pre-emphasis Output for Channel A
OPEN	0dB
6.98k	+1.0dB
5.76k	+2.0dB
4.70k	+2.5dB
3.90k	+3.0dB
3.40k	+3.5dB
2.94k	+4.0dB
2.49k	+4.5dB
2.21k	+5.0dB
1.91k	+5.5dB
1.69k	+6.0dB

PIN8: B_EQ with internal 100k pull-up resistor
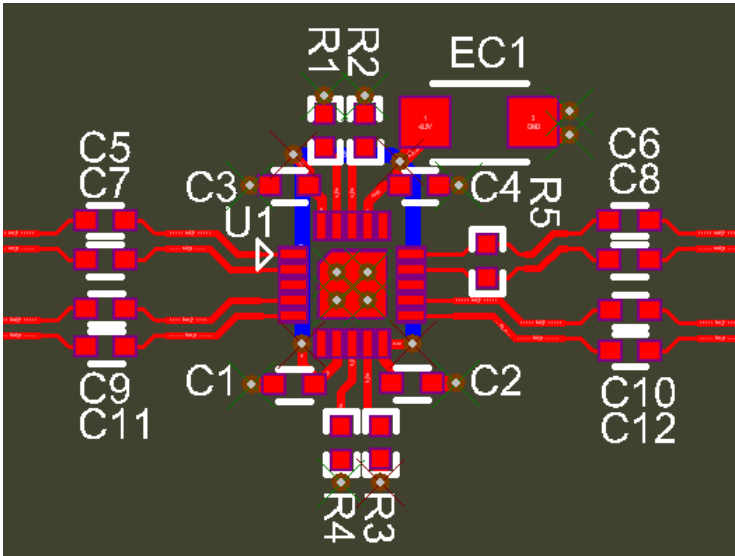
R4 is unpopulated	Channel B has 6.5db equalization
R4 is populated	Channel B has 2.5db equalization

PIN9: B_EM can be adjusted by analog resistor

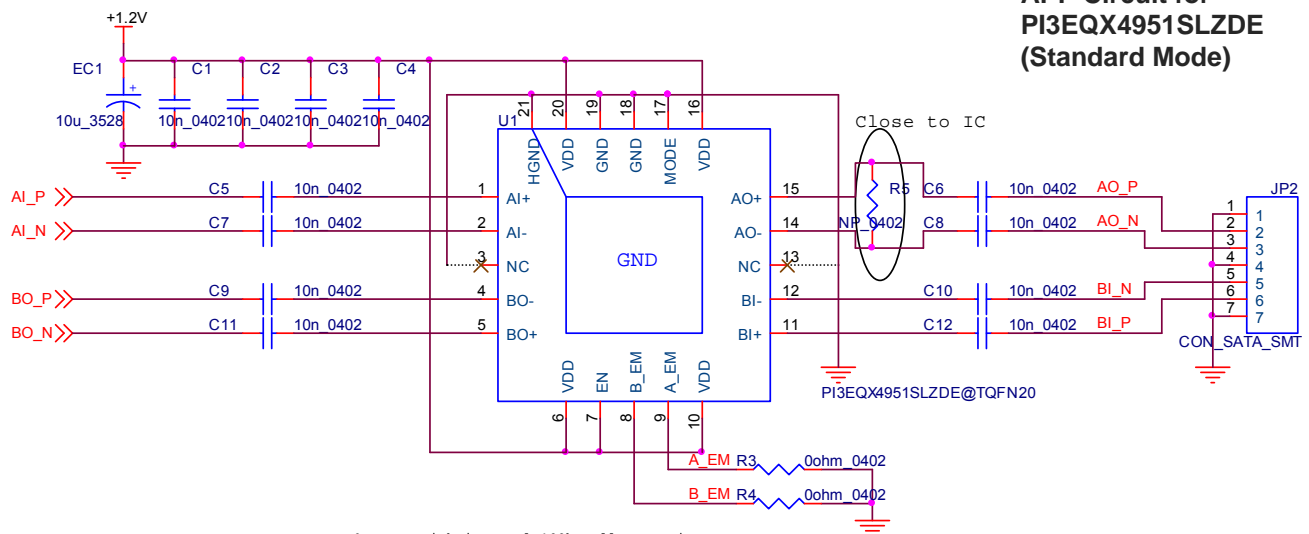| R3 Value	Pre-emphasis Output for Channel B
OPEN	0dB
6.98k	+1.0dB
5.76k	+2.0dB
4.70k	+2.5dB
3.90k	+3.0dB
3.40k	+3.5dB
2.94k	+4.0dB
2.49k	+4.5dB
2.21k	+5.0dB
1.91k	+5.5dB
1.69k	+6.0dB

PIN6 and 16 could be connected to VDD
PIN3 and 13 could be connected to GND

**APP Layout for
PI3EQX4951STZDE
(Enhanced Mode)**

5.3 PI3EQX4951SLZDE (Standard Mode)
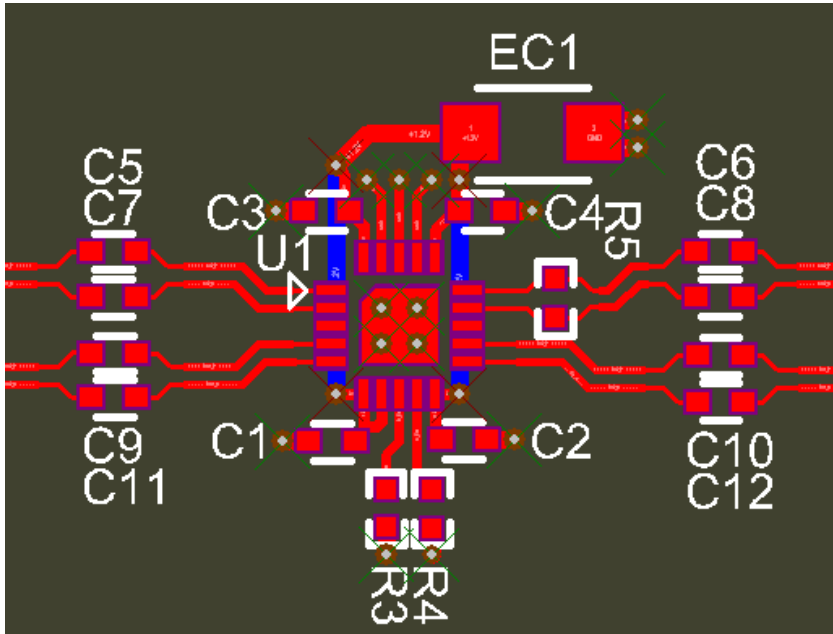
**APP Circuit for
PI3EQX4951SLZDE
(Standard Mode)**

PIN9: A_EM with internal 100k pull-up resistor

R3 is unpopulated	Channel A has 3.0dB pre-emphasis output
R3 is populated	Channel A has 0dB pre-emphasis output

PIN8: B_EM with internal 100k pull-up resistor

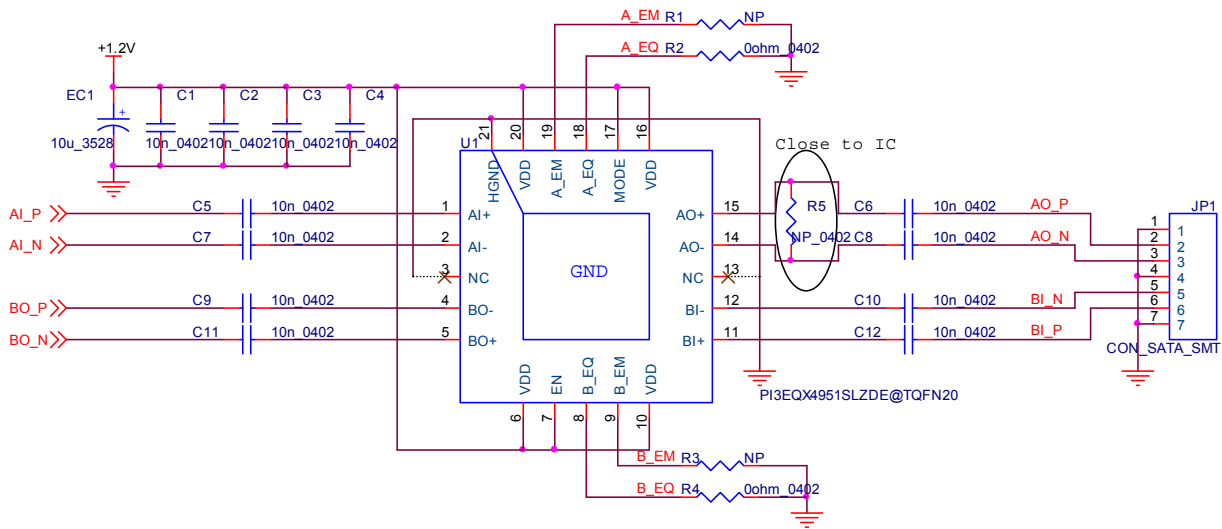| R4 is unpopulated	Channel B has 3.0dB pre-emphasis output
R4 is populated	Channel B has 0dB pre-emphasis output

PIN3 and 13 could be connected to GND

**APP Layout for
PI3EQX4951SLZDE
(Standard Mode)**

5.4 PI3EQX4951SLZDE (Enhanced Mode)

**APP Circuit for
PI3EQX4951SLZDE
(Enhanced Mode)**

PIN18: A_EQ with internal 100k pull-up resistor

R2 is unpopulated	Channel A has 6.5dB equalization
R2 is populated	Channel A has 2.5dB equalization

PIN19: A_EM can be adjusted by analog resistor

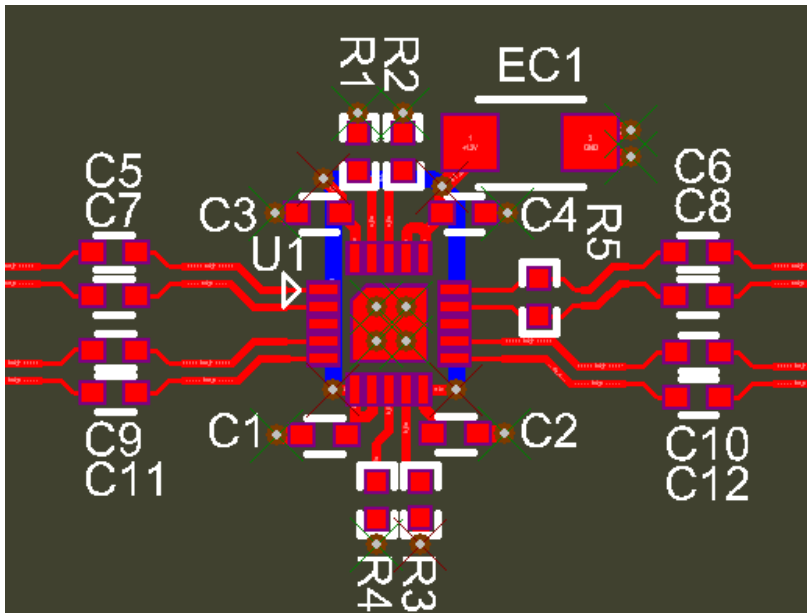| R1 Value	Pre-emphasis Output for Channel A
OPEN	0dB
1.1k to 15k	6dB to 0dB

PIN8: B_EQ with internal 100k pull-up resistor

R4 is unpopulated	Channel B has 6.5db equalization
R4 is populated	Channel B has 2.5db equalization

PIN9: B_EM can be adjusted by analog resistor

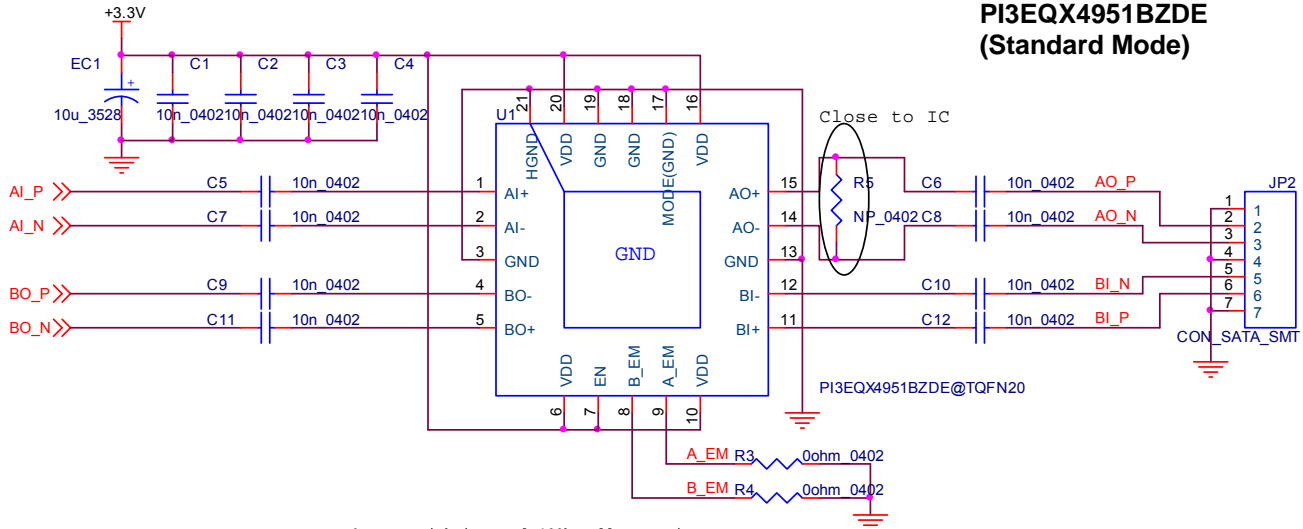| R3 Value	Pre-emphasis Output for Channel B
OPEN	0dB
1.1k to 15k	6dB to 0dB

PIN3 and 13 could be connected to GND

**APP Layout for
PI3EQX4951SLZDE
(Enhanced Mode)**

5.5 PI3EQX4951BZDE (Standard Mode)
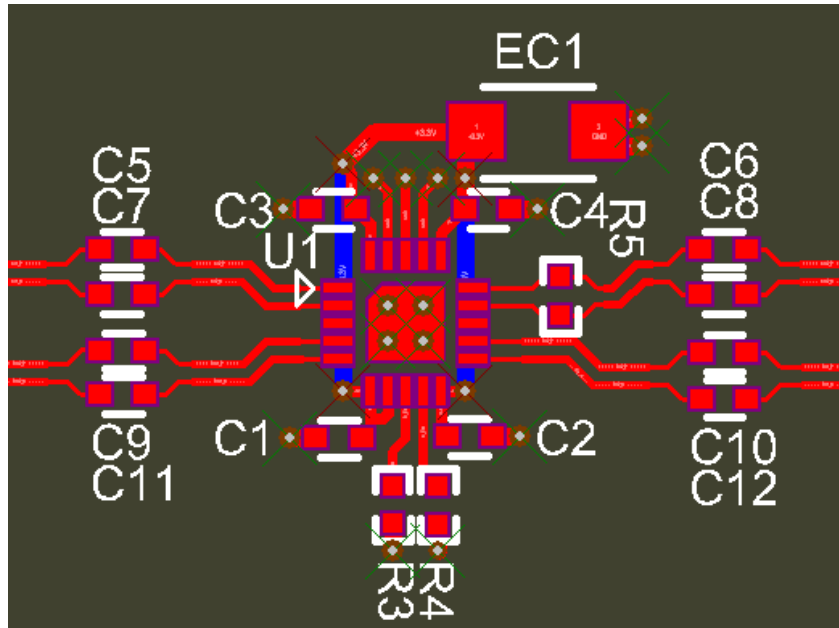
**APP Circuit for
PI3EQX4951BZDE
(Standard Mode)**

PIN9: A_EM with internal 100k pull-up resistor

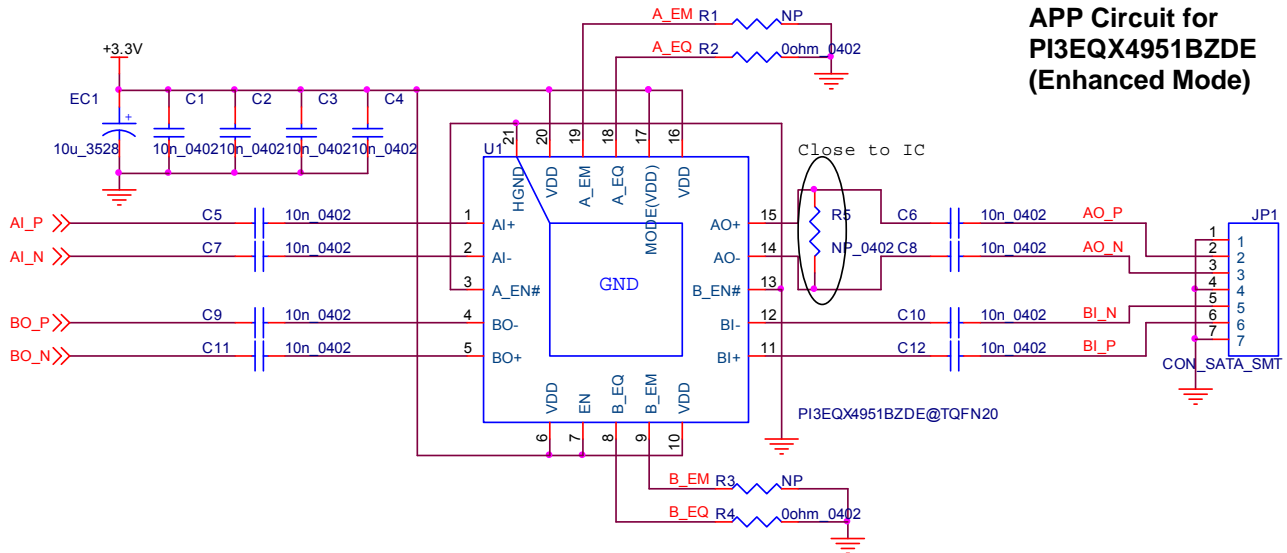| R3 is unpopulated	Channel A has 3.0dB pre-emphasis output
R3 is populated	Channel A has 0dB pre-emphasis output

PIN8: B_EM with internal 100k pull-up resistor

R4 is unpopulated	Channel B has 3.0dB pre-emphasis output
R4 is populated	Channel B has 0dB pre-emphasis output

**APP Layout for
PI3EQX4951BZDE
(Standard Mode)**

5.6 PI3EQX4951BZDE (Enhanced Mode)

APP Circuit for PI3EQX4951BZDE (Enhanced Mode)

PI3EQX4951BZDE@TQFN20

PIN18: A_EQ with internal 100k pull-up resistor

R2 is unpopulated	Channel A has 6.5dB equalization
R2 is populated	Channel A has 2.5dB equalization

PIN8: B_EQ with internal 100k pull-up resistor
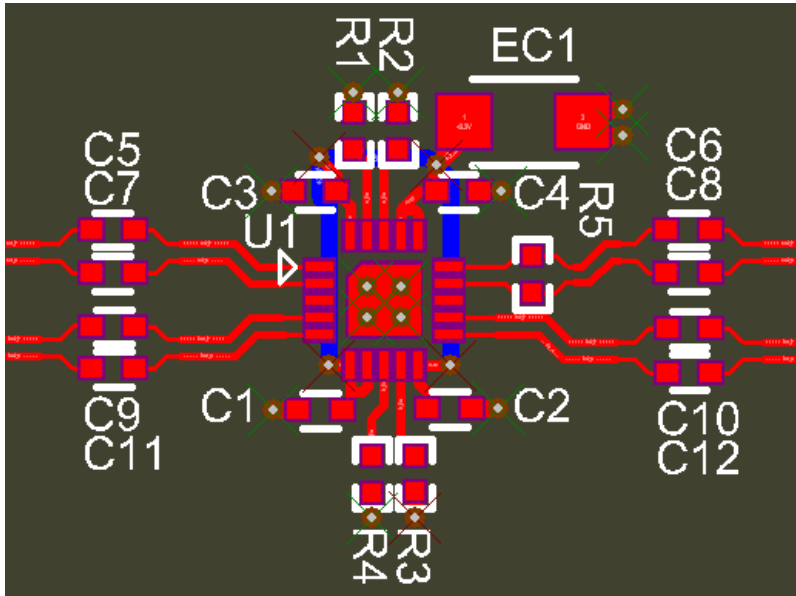
R4 is unpopulated	Channel B has 6.5db equalization
R4 is populated	Channel B has 2.5db equalization

PIN19: A_EM can be adjusted by analog resistor

R1 Value	Pre-emphasis Output for Channel A
OPEN	0dB
6.98k	+1.0dB
5.76k	+2.0dB
4.70k	+2.5dB
3.90k	+3.0dB
3.40k	+3.5dB
2.94k	+4.0dB
2.49k	+4.5dB
2.21k	+5.0dB
1.91k	+5.5dB
1.69k	+6.0dB

PIN9: B_EM can be adjusted by analog resistor

R3 Value	Pre-emphasis Output for Channel B
OPEN	0dB
6.98k	+1.0dB
5.76k	+2.0dB
4.70k	+2.5dB
3.90k	+3.0dB
3.40k	+3.5dB
2.94k	+4.0dB
2.49k	+4.5dB
2.21k	+5.0dB
1.91k	+5.5dB
1.69k	+6.0dB

Application Note

**APP Layout for
PI3EQX4951BZDE
(Enhanced Mode)**

AN302   04/22/10   Pericom Semiconductor Corp.
www.pericom.com   2/15/2011