Application Note

Comparison Between TX7364 and TX7332 for 128-Channel Transmit, 64-Channel Receive

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ABSTRACT

Currently, the need for portable ultrasound systems is rapidly growing. Higher channel integration, along with small form factor, optimized layout for performance, reduced board size, cost and power consumption are some of the critical challenges faced in this domain while developing a system level design. With past products, TI has a reference design that demonstrates a 128-Ch transmit, 64-Ch receive design. The current reference design uses TX7332 (32 ch, 1.2A drive) as the transmitter and AFE5832LP (32-ch receiver). This application note illustrates the advantages of a next generation design that replaces TX7332 with TX7364 which is TI's latest 64-Channel, 1A drive transmitter. The application note further highlights the advantages of TX7364 over TX7332 that leads to simpler layout, board size reduction, build cost without compromising on performance.

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1 Introduction of TX7364 and Key Specifications

TX7364 is a highly integrated, high-performance transmitter device for ultrasound imaging system. The device has total 64 pulser circuits, 64 transmit/ receive switches (referred to as T/R or TR switches) and supports on-chip beamformer (TxBF). The device also integrates the passives inside the package, reducing the number of external decaps that have to be placed on the board. Each pulser circuits of TX7364 is capable of generating a 3-level waveform, supporting a maximum peak voltage of ±100V, with a maximum current drive of 1A. The following are some of the key specifications of TX7364.

- The device offers a second harmonic performance of 40dBc at 5MHz.
- The device offers a 3dB bandwidth of 22MHz for a 400Ω || 125pF load.
- The ON resistance of T/R Switch is about 26Ω, while the receiver power of the device is 0.1mW/ch.
- Maximum beamformer clock supported is 200MHz.
- Beamforming delay resolution is half beamformer clock period, that is, 2.5ns.
- The device offers a 512x32 on-chip RAM to store pattern and delay information for a group of four channels. 16 such RAMs are present to store the information for the entire 64 channels.

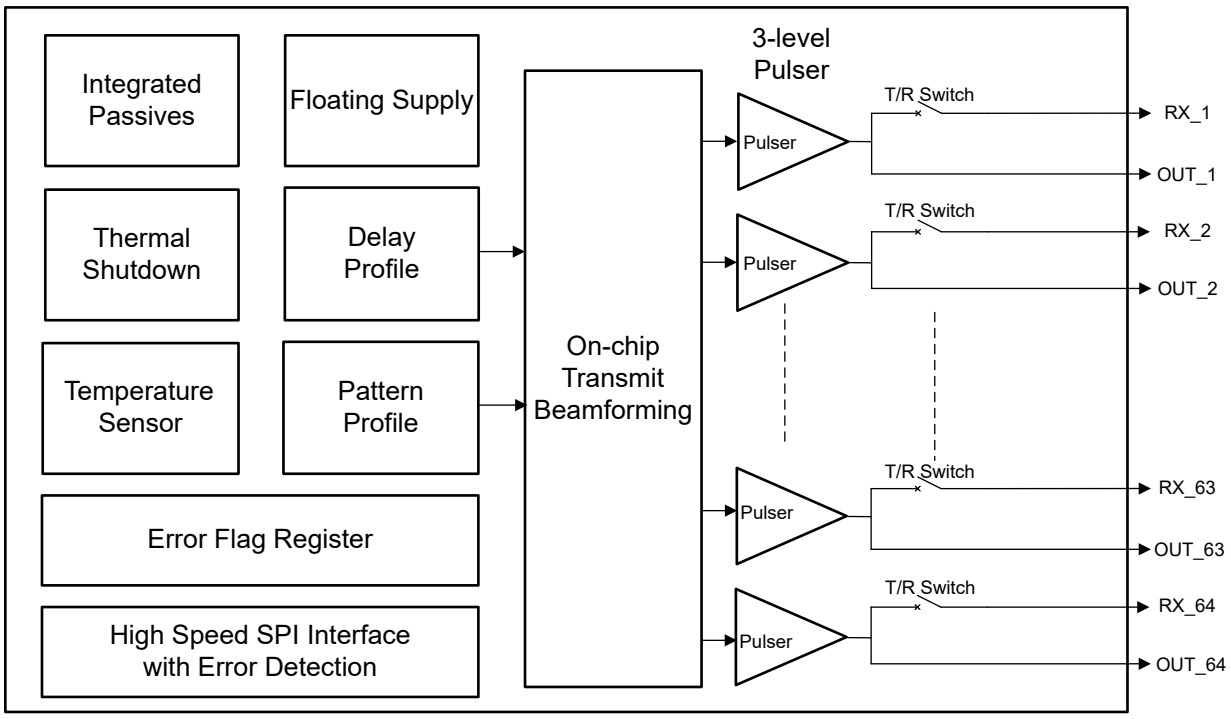

Figure 1-1. Block Diagram

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2 Existing Design

TI's reference design demonstrates how TX7332 can be used in conjunction with AFE5832LP to build a 128-Ch transmitter, 64-Ch receiver design. Figure 2-1 and Figure 2-2 show the Top Layer and the Bottom Layer layout of the PCB respectively. With TX7332 offering 32-channels in a single device, four devices are used, two of them placed on the Top Layer and two placed on the bottom layer while the two AFE5832LPs are placed on the Top Layer as shown in Figure 2-1. Owing to so many input and output signals in a small space, the board makes use of blind vias to fan out the signals from the devices which are generally quite expensive as compared to thru vias.

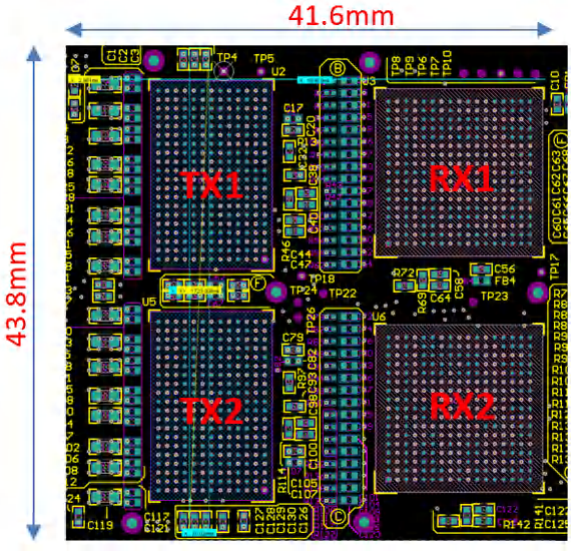

Figure 2-1. Top Layer of EVM

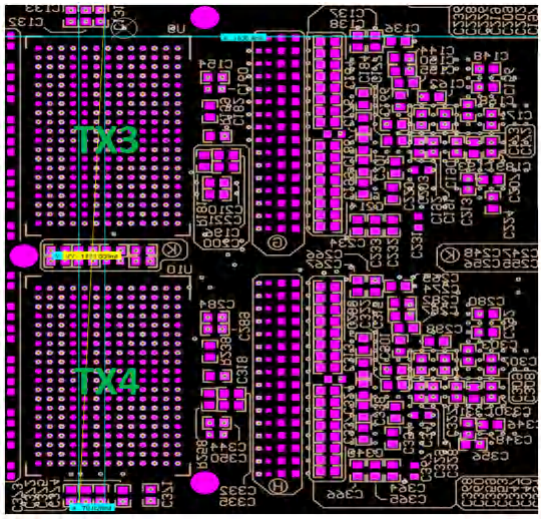

Figure 2-2. Bottom Layer of EVM

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3 Advantages of TX7364 over TX7332

Table 3-1 highlights the advantages of TX7364 over TX7332.

Table 3-1. Advantages of TX7364 over TX7332

Nominal Specifications	TX7332	TX7364	Units	Comments
Analog Specifications				
Pk-Pk Drive Capability	200	200	V	
Channels	32	64		TX7364 offers 2x integration
Drive	1.2	1	A	
True RTZ	Yes	Yes		
TRSW ON Impedance	24	26	Ω	
Power Consumption	Higher	Lower	mW	TX7364 provides a lower power consumption, leading to increased Pulser efficiency for driving the same transducer load.
Thermal Shutdown	Yes	Yes		
Integrated Passives	No	Yes		TX7364 requires less decaps on board, saving board space.
Board Decaps	More decaps required	Lesser decaps required		TX7364 requires far less number of caps on the PCB, saving board area.
Digital Specifications				
BF Clock Resolution	5	2.5	ns	TX7364 offers half clock resolution
Max delay possible	41 (13bits)	82 (14 bits)	Us	TX7364 offers 2x delay at max beamformer clock speed of 200MHz
States for wave definition	32 profiles	On-chip RAM capable of storing multiple profiles, much larger than 32.		TX7364 has 16 on-chip RAMs for storing delay and pattern information
SPI mode	CMOS	LVDS		LVDS interface allows higher speed, lower switching power
SPI speed	100	400	MHz	TX7364 offers 4x faster programming speed
SPI error detection	None	CRC Check		TX7364 offers added reliability to prevent erroneous information getting written into the device
Package Specifications				
Package Dimensions	17x11	12x12	mm	TX7364 comes in 25% lower area, but 2x the number of channels
Pins	260	196		Lower number of pins for easier layout and routing
Pitch	0.8	0.8	Mm	Meets IEC requirements, easier for signal routing with space constraint

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4 New Reference Design with TX7364

Figure 4-1 and Figure 4-2 show the modified layout, with TX7364 replacing the TX7332. With 64 channels in a single device, only two TX7364 ICs are required per board which are placed in the Top Layer. Multiple bias caps are integrated in the package, requiring only supply decaps on board, which saves up board space that can be used for signal routing. Note that the following figures show a comparison between the older layout and the modified layout and that TI does not have a physical hardware that uses TX7364 in conjunction with AFE5832LP.

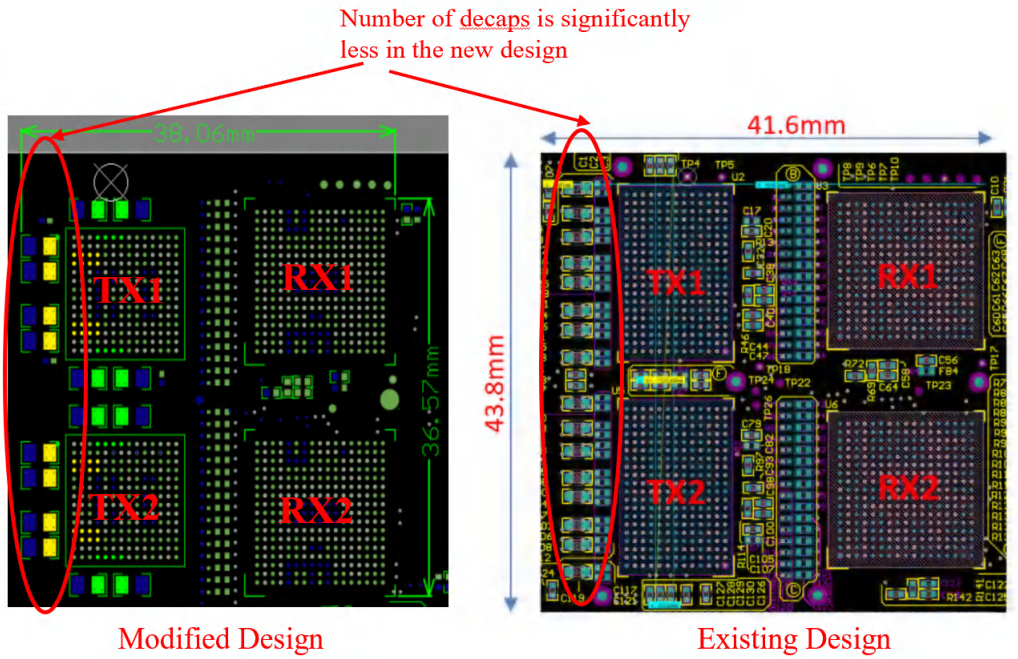

Figure 4-1. Comparison of Top Layer of PCB between Old and New Design

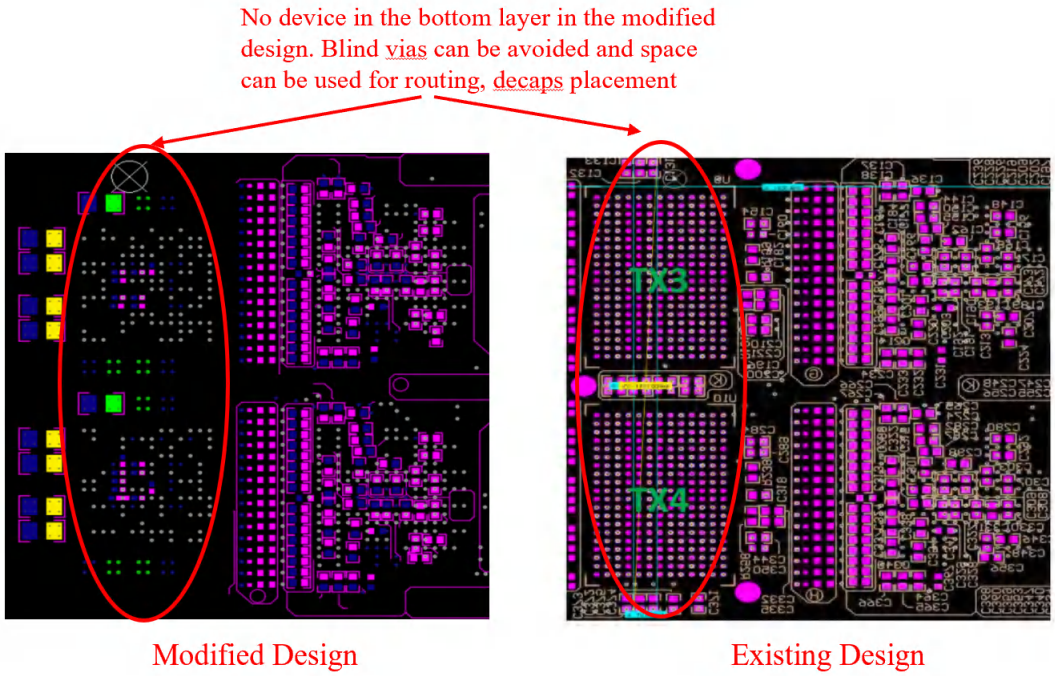

Figure 4-2. Comparison of Bottom Layer of PCB between Old and New Design

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5 Benefits of New Design

Table 5-1. Benefits of New Design

Feature	Older Design	New Design	Comments
Blind Vias	Required	Not required	Only Thru hole vias required in new design
Signal Routing	Complex	Easier	Lesser number of signals to route
Board Area	Higher	Lower	Form factor for the device layout is 38mm × 37mm in the new design as compared to 42mm × 44mm in older design. Almost 30 % reduction in area.
EVM Cost	Higher	Lower	
Passives required	Higher	Very Less	Lesser number of decaps required for TX chips in new design
Power consumption	Higher	Lower	The new design using TX7364 provides a higher power efficiency for driving the same transducer load.
Number of TX devices needed	4	2	With higher integration, only 2 TX chips required instead of 4.

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6 Summary

This application note explores the advantages of a new reference design aimed for the portable ultrasound systems. The application note goes on to show how adopting one of TI's latest ultrasound transmitter, TX7364 has several advantages over the existing design that uses TX7332. The application note highlights the advantages TX7364 has over TX7332, and how using the design in the EVM design can bring down the board area, cost, and improving the overall simplicity of the layout as compared to the existing design.

7 References

- A Programmable Platform for Accelerating the Development of Smart Ultrasound Transducer Probe

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