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AUTOMOBILE RADAR DESIGN

Scope: Hardware Design

Application: Advanced Driver Assistance System(ADAS)

Automobile radar is a technology that uses radio waves to detect the distance, speed and direction of other vehicles on the road. It helps drivers avoid collisions, maintain a safe distance and optimize their driving performance. Automobile radar systems typically consist of a transmitter, a receiver and a processor that analyze the signals and provide feedback to the driver or the vehicle's control system.

Hardware Design – Challenge

We have been assigned the responsibility of designing an automobile radar system from the ground up, as specified by our client.

The hardware design of the radar must meet the following key requirements:

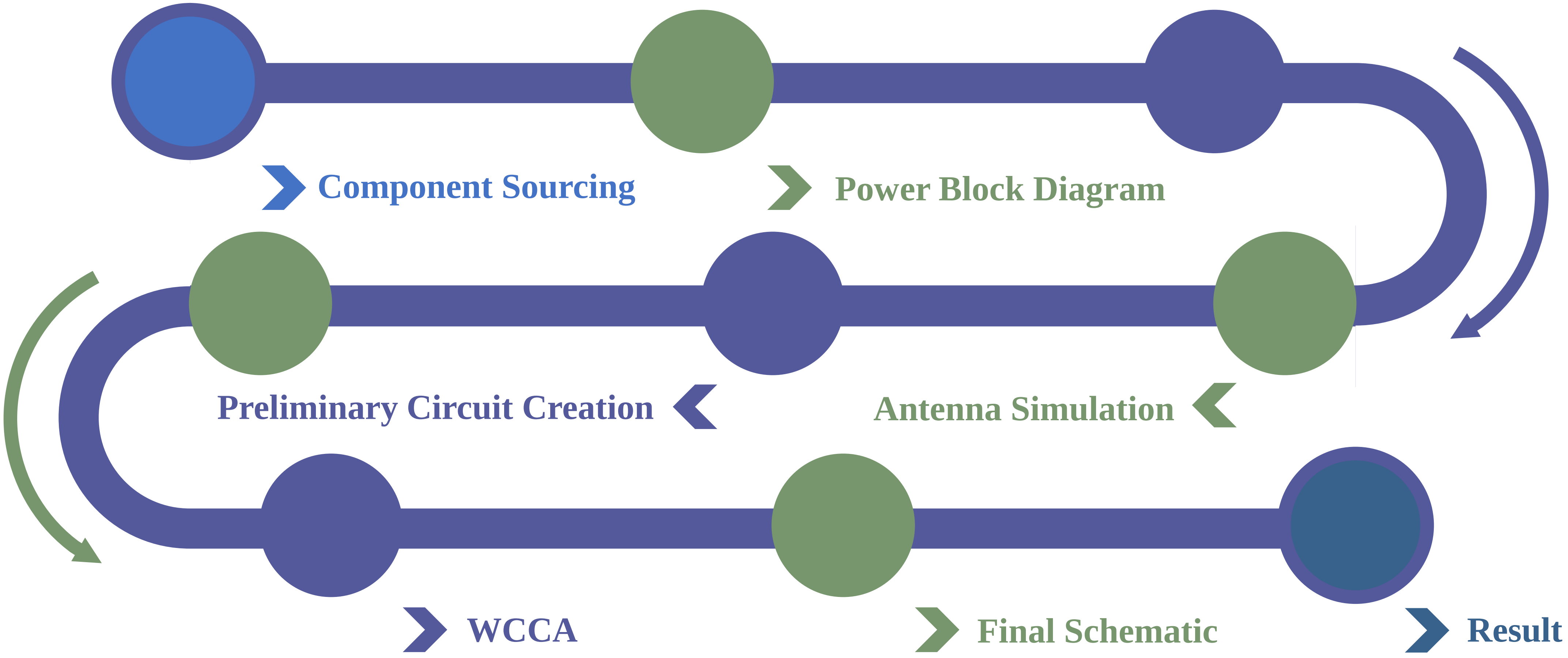
Requirement:

- Small Form Factor.
- Power supply – 12V Battery.
- Low Iq and High Efficient power supply.
- Longer-range TX beamforming and beamsteering.
- High angular resolution MIMO.
- Need to provide Data over CAN-FD, Ethernet or LVDS.

Challenge:

- Hardware design
- Component Search
- Radar resolution
- Circuit analysis for power
- Antenna calculation

Hardware Design –SoW



How We Executed? (Cont.)

Component Sourcing

We sourced multiple manufacturer (like TI, Analog Devices, NxP, RoHM, etc.,) for component.

Radar Transceiver:

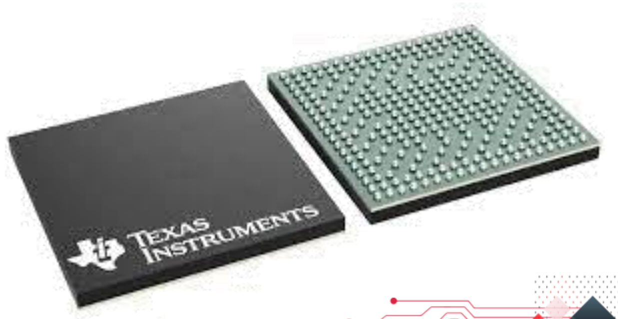
We choose AWR2243 which is capable of low power, self-monitored, ultra-accurate radar systems in the automotive space.

It has 3TX, 4RX system with built-in PLL and ADC

Converters for high resolution of radar image.

Microcontroller:

We choose AM2732R which is highly-integrated, high-performance microcontroller based on the Arm Cortex-R5F and a C66x floating-point DSP cores. This is a device with robust software support, rich user interfaces, and high performance, through the maximum flexibility of a fully integrated, mixed processor solution.



How We Executed? (Cont.)

Component Sourcing

Communication:

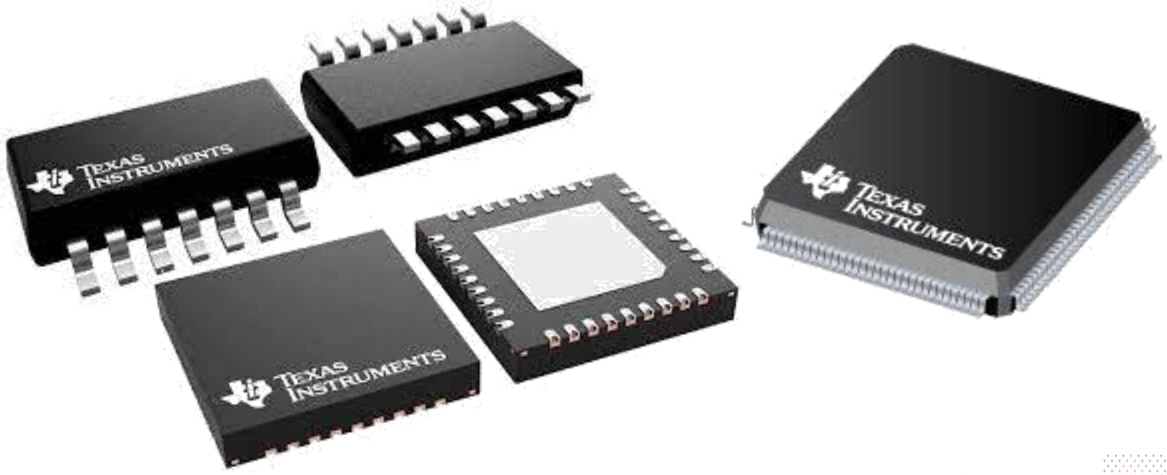
TCAN1043ADYYRQ1: High-speed CAN transceiver with flexible data-rate support for automotive applications.

TCAN1044VDRBTQ1: Fault-protected CAN transceiver with advanced features for robust communication in automotive systems.

DP83TC812R-Q1: Automotive-grade Gigabit Ethernet PHY with integrated diagnostic features for reliable in-vehicle networking.

Microcontroller:

TM4C1294NCPDTT3: Powerful ARM Cortex-M4F microcontroller featuring advanced connectivity options, ideal for industrial applications and IoT devices. Offers high performance and versatility for embedded systems development.



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How We Executed? (Cont.)

Component Sourcing

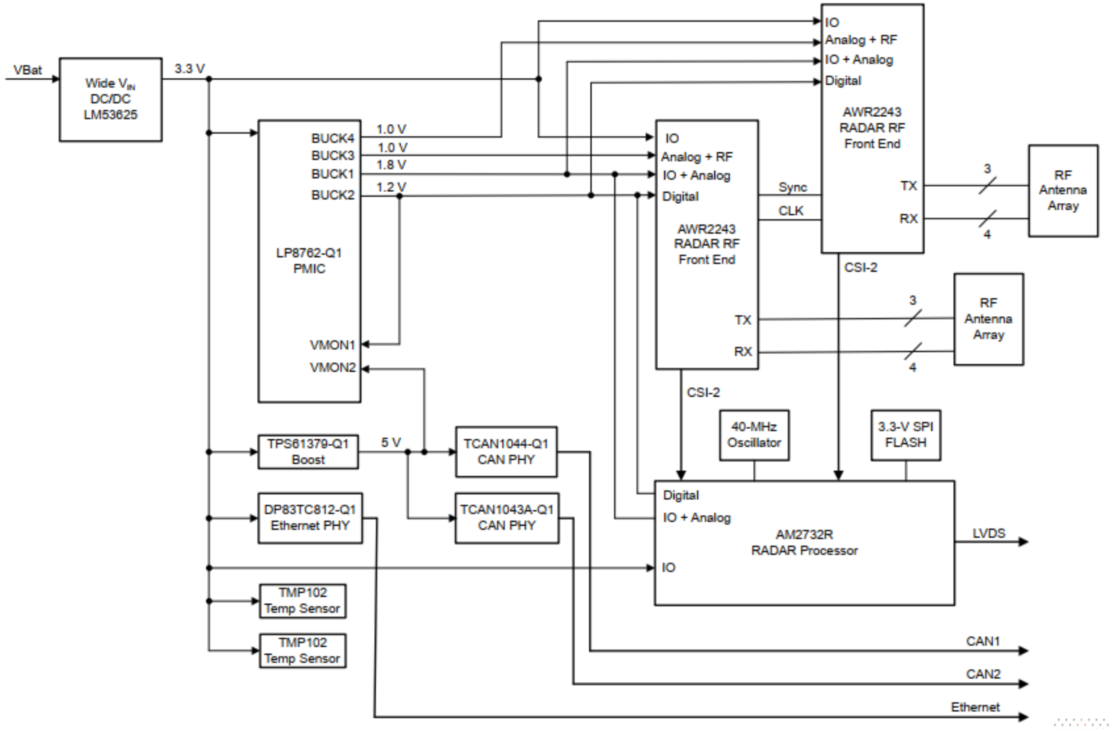
Power Budget:

To determine the high efficient power circuit, we need to determine the power needed for those IC to operate. From that the component for power circuit are selected based on multiple calculation.

The Power IC was selected by also considering the low Iq for least power loss during sleep or off time.

Power Block Diagram

Using the current input the power block diagram was created.



How We Executed? (Cont.)

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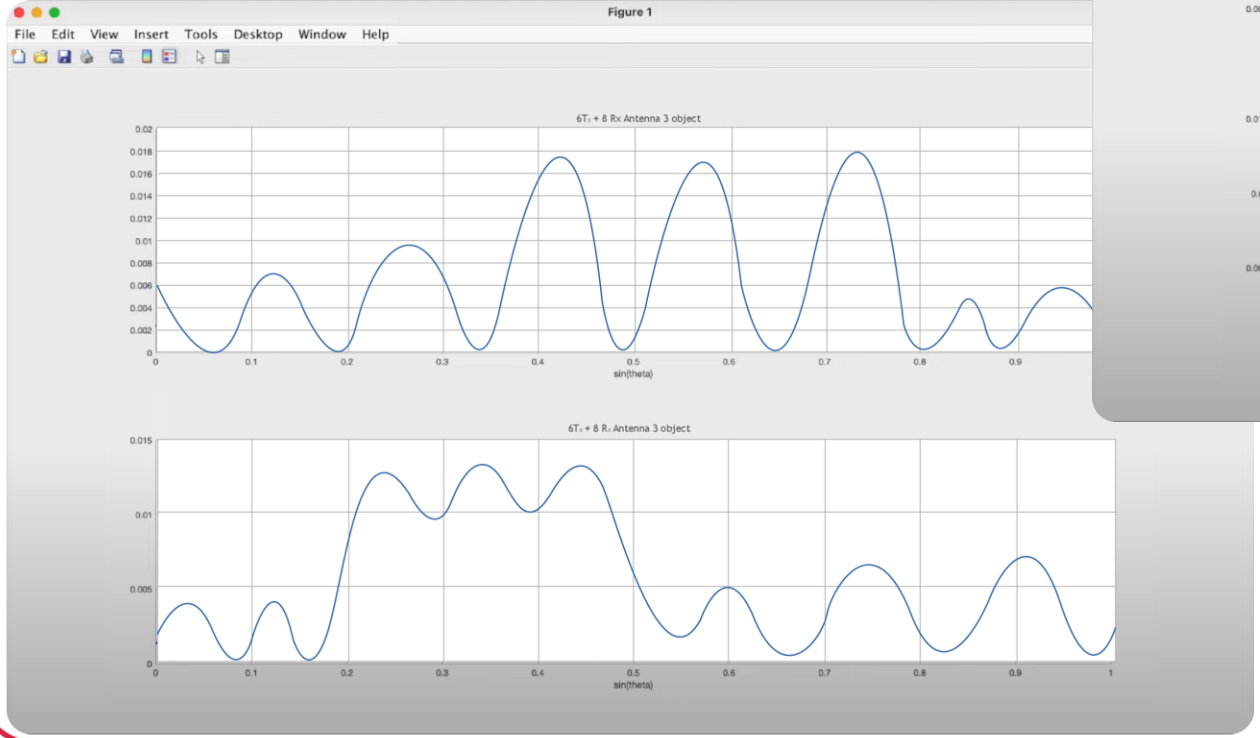
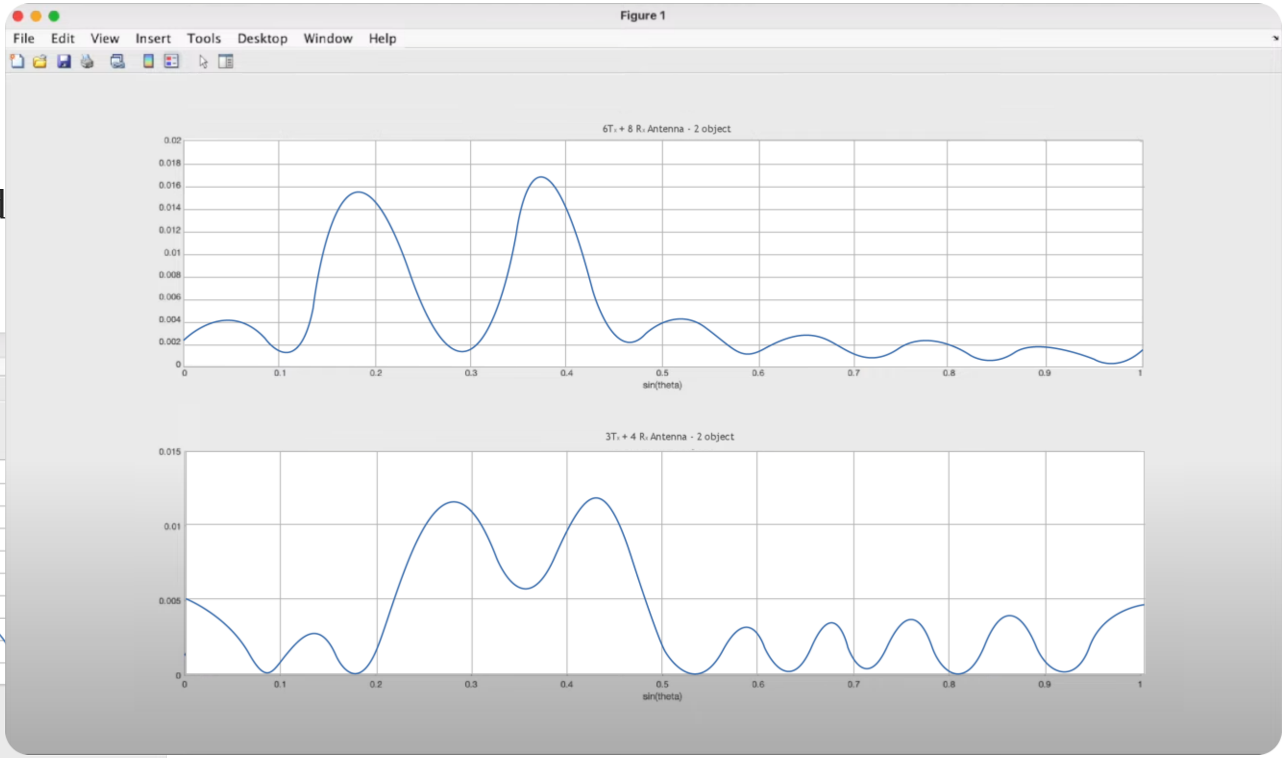
Antenna Simulation

The simulation of antenna is done in MATLAB tool to find high resolution Tx and Rx configuration.





The result shows that the resolution is higher than the 3Tx+4Rx configuration.

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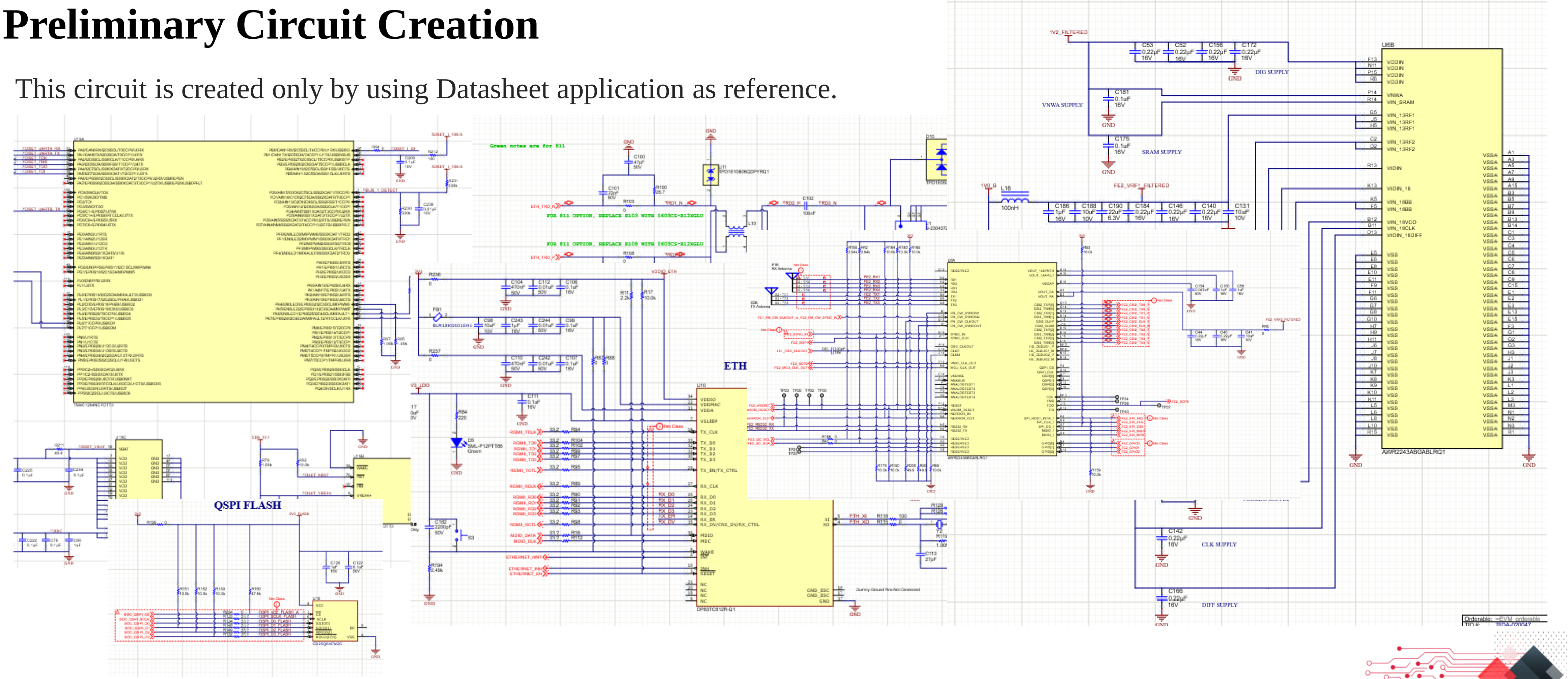
How We Executed? (Cont.)

Preliminary Circuit Creation

This circuit is created only by using Datasheet application as reference.



How We Executed? (Cont.)

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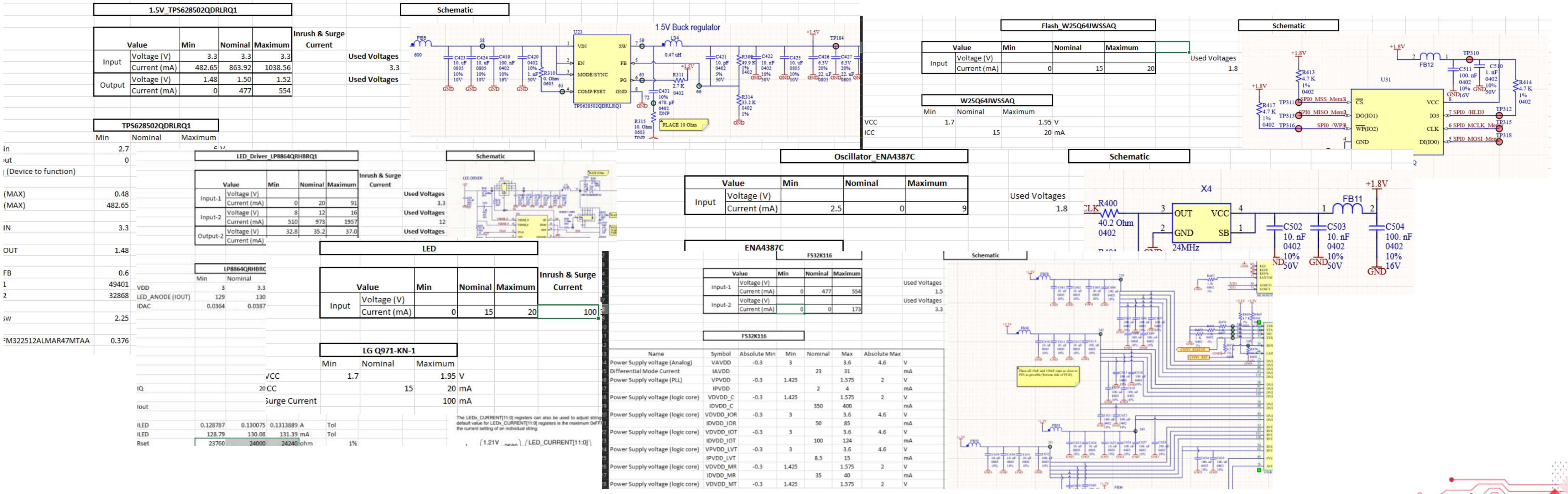
Add's On

Calculation for Worst possibility

The theoretical calculations for all circuits are performed using the manufacturer's datasheet.



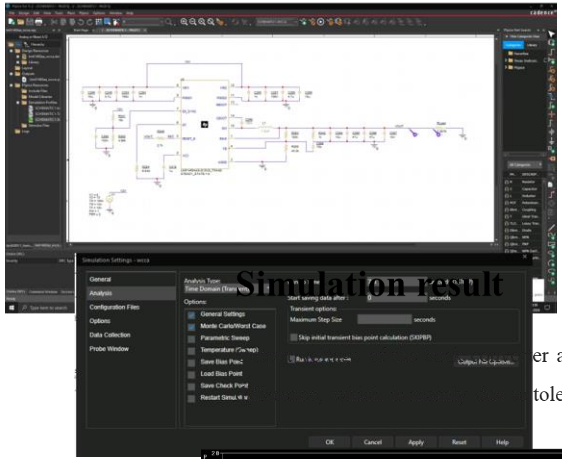
How We Executed? (Cont.)

Add's On

Circuit Simulation (WCCA)

To reduce the output voltage noise, a simulation was performed for the 3.3V power circuit.

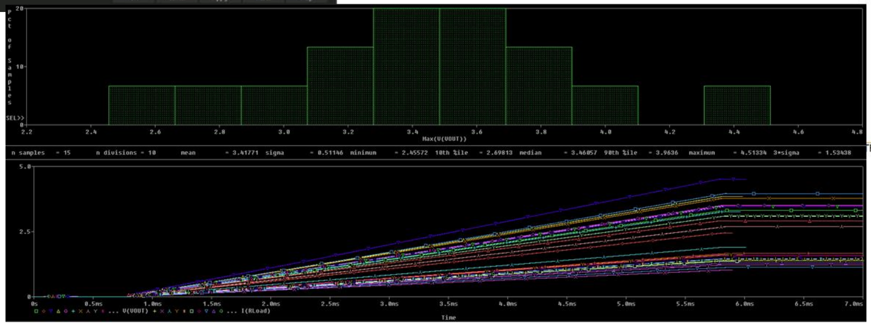
Simulation setup



Simulation result

er affected has large change voltage

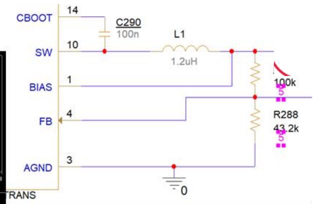
tolerance of the switching inductor.

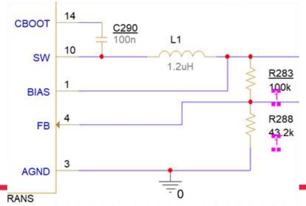


Identify the reason

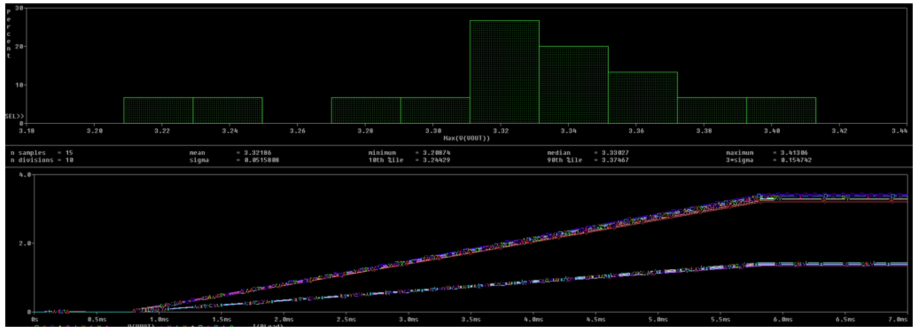
We find the feedback resistor has the 5% tol

large voltage fluctuation.





Simulation result



	Voltage (V)	
Design	Minimum	Maximum
Existing	3.3	4.4
Proposed	3.2	3.4

From the analysis result, the worst case voltage difference is greatly reduced from 1.1V to 0.2V.

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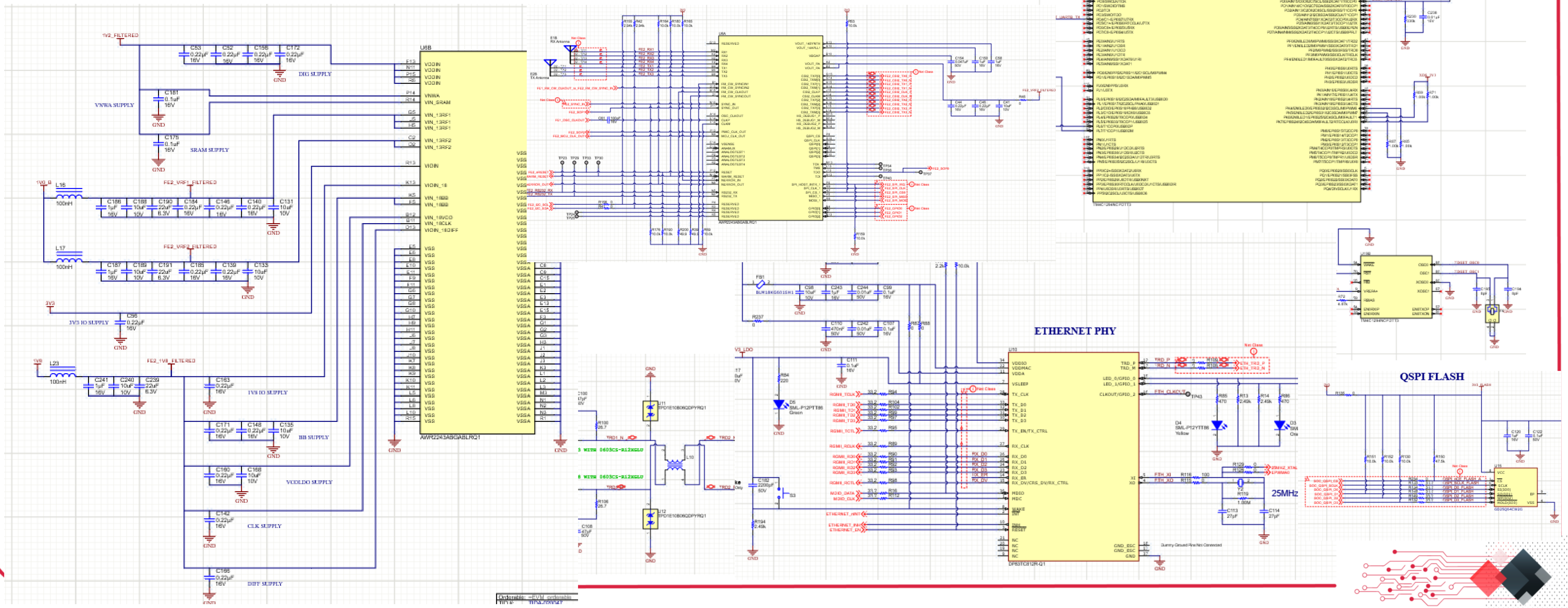
How We Executed?

Final Schematic

Utilizing all the calculations and simulations, the final schematic was prepared.



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A Heartfelt Customer's Voice

I am deeply impressed by the remarkable dedication and exceptional work exhibited by the team in overcoming challenges during the development of our entirely new hardware design project. Their solution, aimed at selecting cost-effective yet high-performing components, has proven to be a pivotal factor in making the product economically viable. The team's efficiency and commitment are evident in the quick turnaround time for completing the analysis. This design not only aligns seamlessly with our specified requirements but also ensures the circuit functions at optimal efficiency even in worst environment. It marks a significant milestone in our project journey, and we eagerly anticipate further collaboration with such a talented and dependable team.

Conclusion

- Our commitment to excellence and technical expertise were demonstrated through the successful delivery of complete Automobile Radar circuit that precisely met the client's requirements.
- In addition to developing the schematic, we enhance the product's reliability by conducting a Worst Case Circuit Analysis (WCCA).
- Our commitment lies in delivering top-tier hardware services, serving as a testament to our capacity and dependability in achieving outstanding outcomes.