Worst Case Circuit Analysis of FPD Repeater Board

Scope: Verifying reliability across extreme operating conditions.

Application: Advanced Driver Assistance Systems.

In automotive applications, FPD (Flat panel Display) Link technology facilitates the transmission of high-quality video signals between components, enabling seamless integration of multiple displays and enhancing the multimedia experience for passengers.

In Camera Monitoring Systems (CMS), precise power management is critical for fast and error-free video processing. Here, Worst Case Circuit Analysis (WCCA) becomes crucial by ensuring reliable power delivery, accounting for component variability. It evaluates circuit performance under extreme conditions, vital for maintaining CMS video processing reliability.

WCCA – Challenge

We were tasked with identifying the power circuit's maximum and minimum voltage thresholds, aiming to mitigate fluctuations that could compromise other circuits. This effort is crucial for ensuring a consistent power supply and maintaining the integrity of connected circuits.

Challenge:

- To determine the worst-case scenario for the power levels in this circuit, particularly focusing on the 1.8V supply.
- There are 5 major integrated circuits (ICs) on this board that rely on this power source (1.8V).
- Worst-case conditions of the power outputs verified based on the recommendations provided by the ICs (like Oscillator, serializer) used in the board.
- Preparing spice models for all power components.

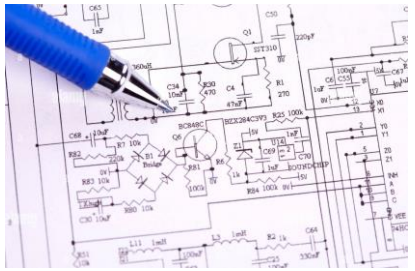
WCCA –SoW

Client reviews are integrated into every phase to ensure adherence to project goals

How We Executed? (Cont.)

Design Study and WCCA Preparation

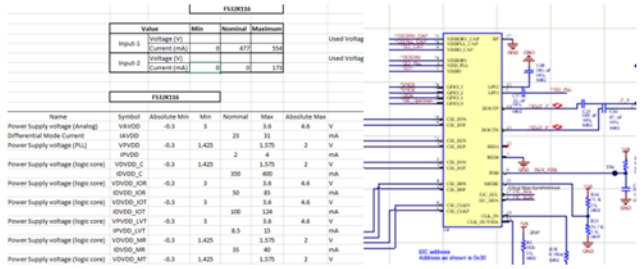
- ✓ The entire circuit schematic is thoroughly analyzed.
- ✓ The first step entails gathering essential input data across the entire circuit to pinpoint notable fluctuations within the 1.8V circuit.
- ✓ This data forms the basis for conducting a Worst Case Circuit Analysis (WCCA).
- ✓ Each power circuit undergoes verification in alignment with the specifications outlined in their respective IC datasheets.

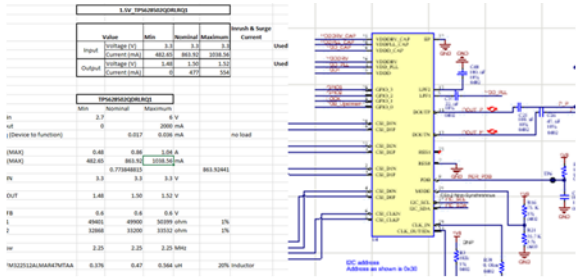


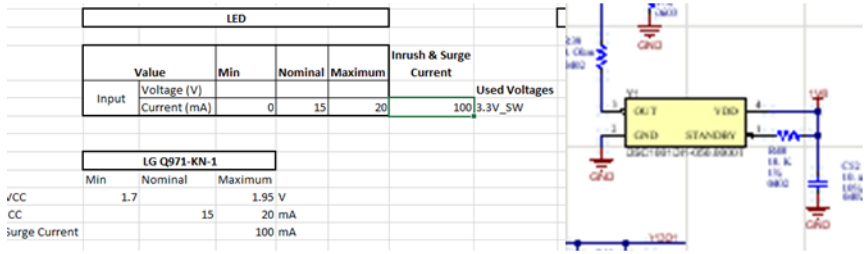
How We Executed? (Cont.)

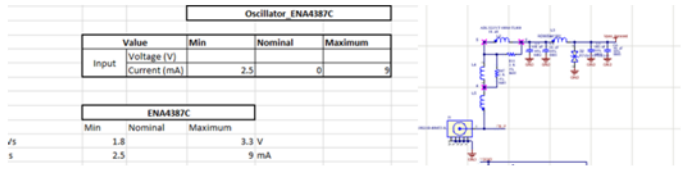
Circuit Calculation Process

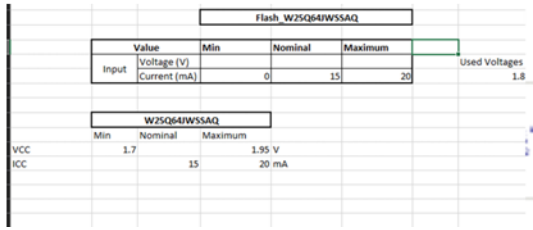
Theoretical calculations for all circuits are performed utilizing the manufacturer datasheets.

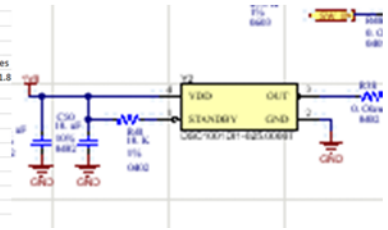


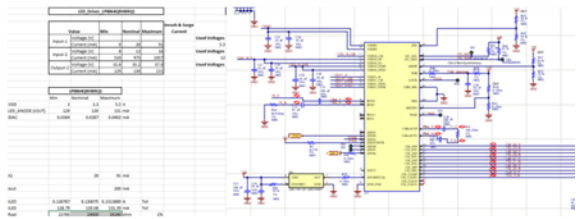








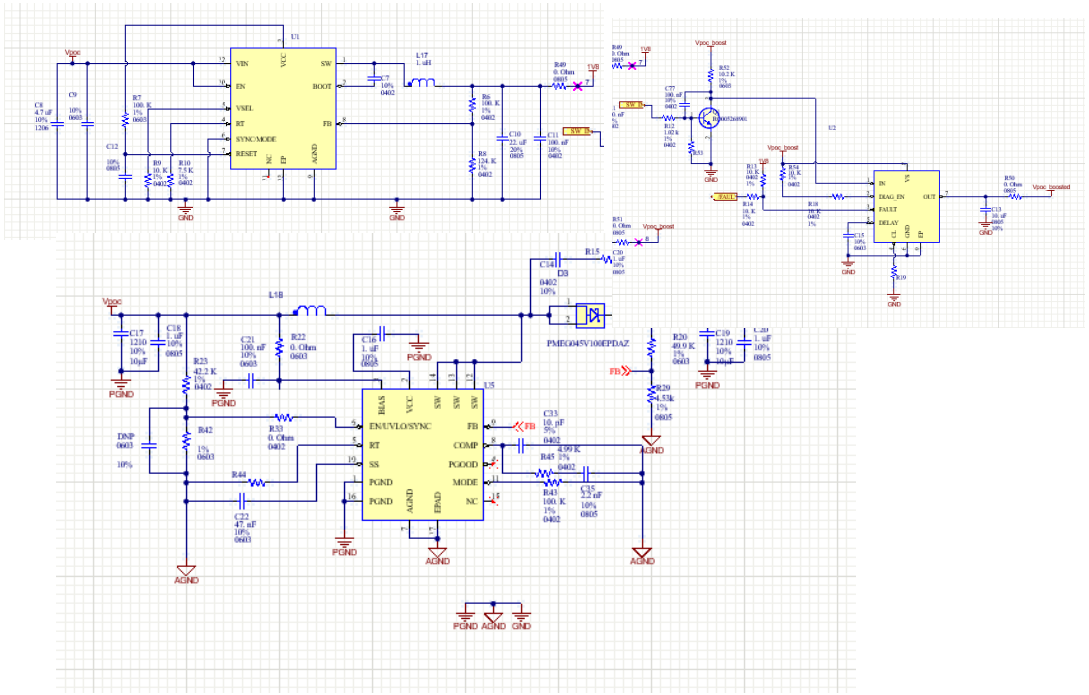




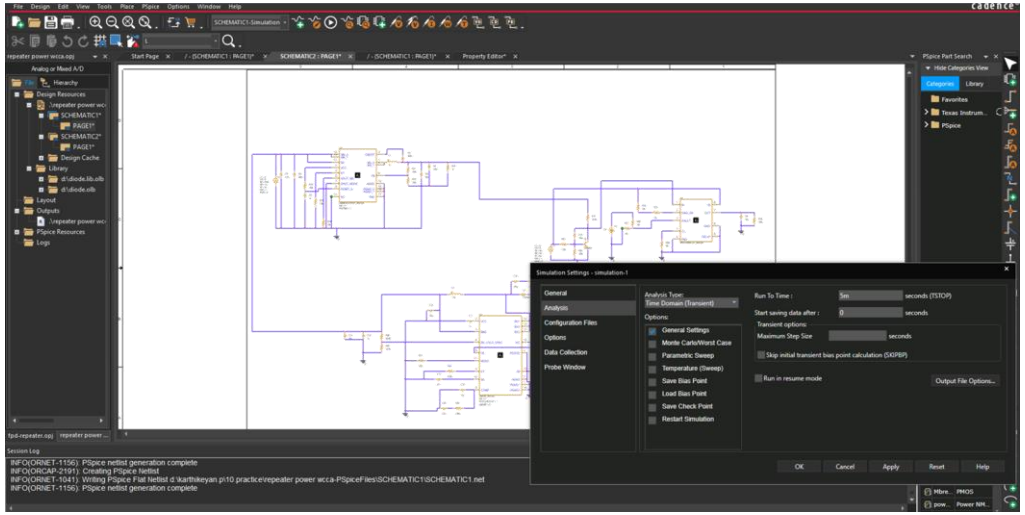
How We Executed? (Cont.)

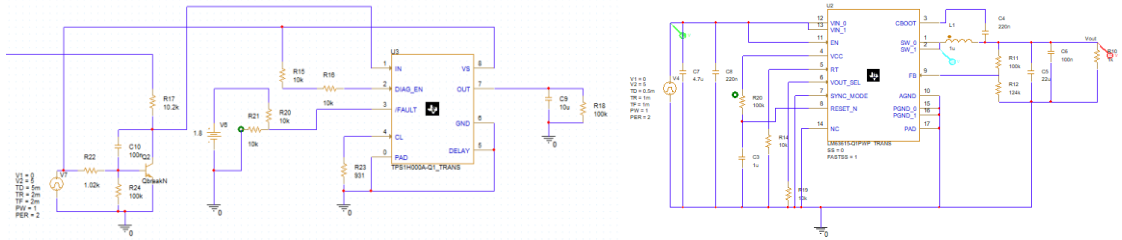
Power Circuits

The analysis of power circuits under worst-case conditions is essential because the outputs in these conditions significantly impact the functionality of other ICs.



Simulation setup



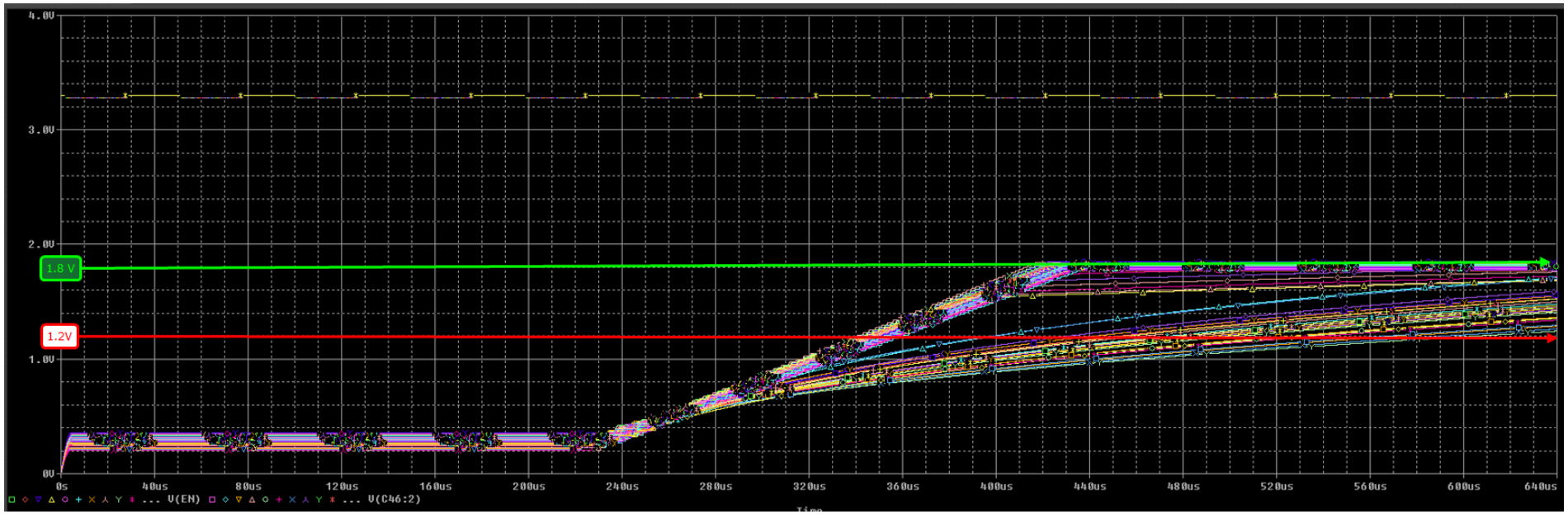


Simulation tool : PSpice

Simulation result & Identification

Simulation result

Output voltage of the step down converter (U1) affected has large change voltage difference (from 1.2V to 1.8V)



Identifying Reason:

We have found that large voltage fluctuations are caused by the switching inductor, and the feedback resistors have significant tolerance levels.

WCCA – Circuit Modification

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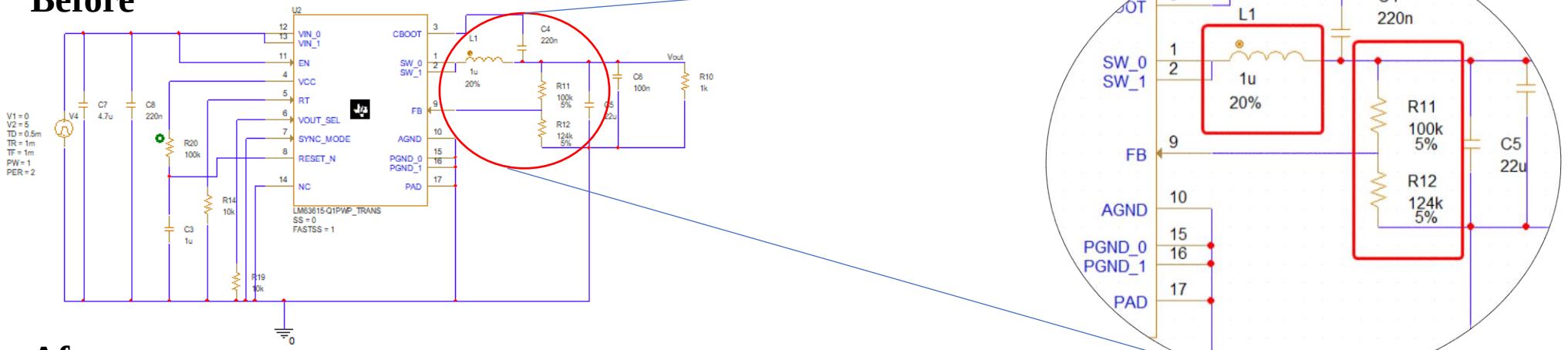
Before



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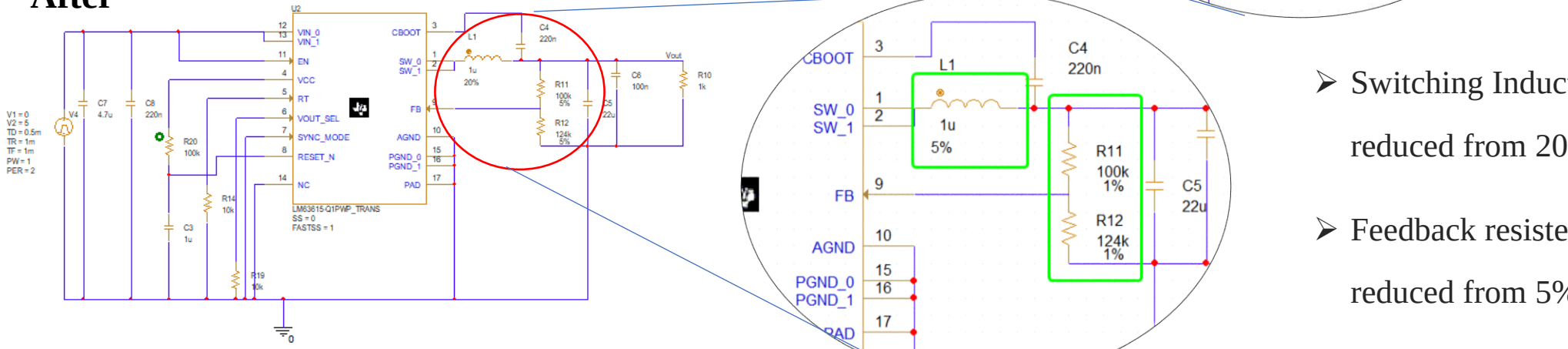
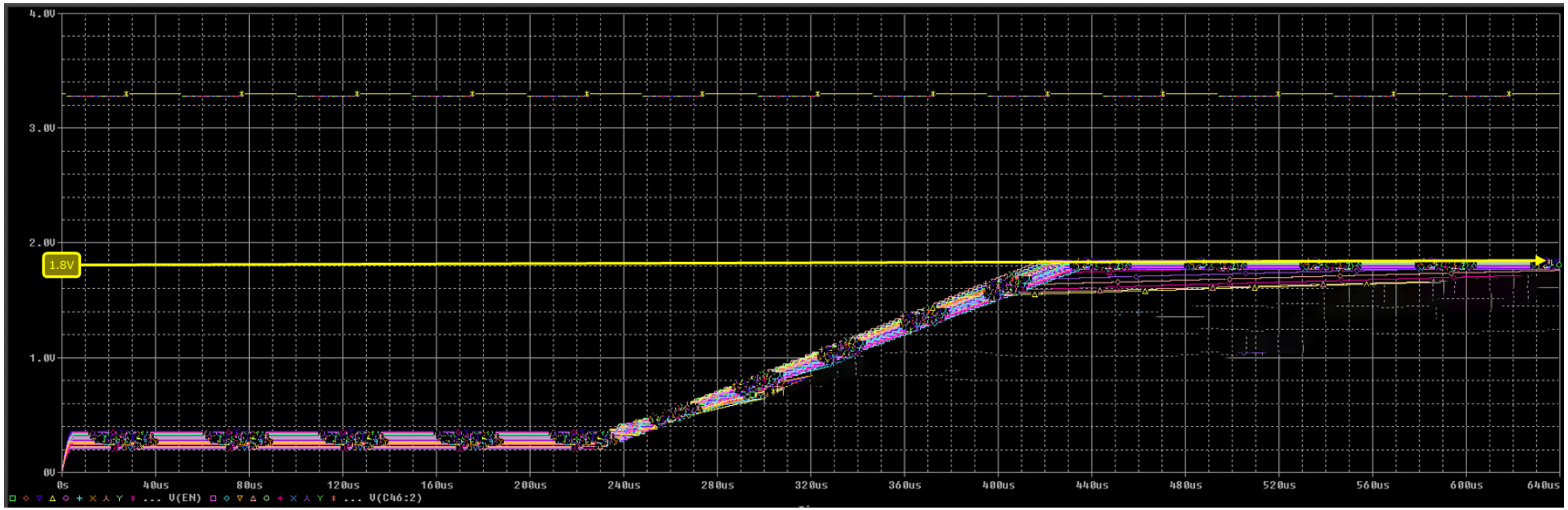


- Switching Inductor tolerance reduced from 20% to 5%
- Feedback resisters tolerances reduced from 5% to 1%

Final Outcome

Simulation result



From the analysis result, the worst case voltage difference is greatly reduced from 0.6V to 0.1V.

	Voltage (V)	
Design	Minimum	Maximum
Existing	1.2	1.8
Proposed	1.7	1.8

Value Add

- Through a thorough analysis of the given circuit, we discovered that the resistor value for the regulator (**U1**) **RT pin** has been modified in accordance with the datasheet recommendations.
- Specifically, the RT value has been changed **from 7.5Kohm to 7.15Kohm.**
- As a result of this modification, the switching frequency has increased, leading to a reduction in output noise (Reduced output Ripple).
- The noise reduction contributes significant value to the project.

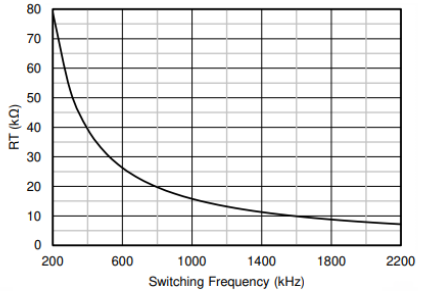


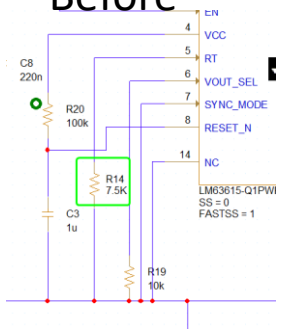
Figure 8-1. Switching Frequency versus R_T

7.6 Switching Characteristics

Limits apply over the junction temperature (T_J) range of –40°C to +150°C, unless otherwise stated. Minimum and maximum limits are specified through test, design or statistical correlation. Typical values represent the most likely parametric norm at T_J = 25°C, and are provided for reference purposes only. Unless otherwise stated, the following conditions apply: V_{IN} = 13.5 V. (1)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
PWM LIMITS (SW PINS)						
t_{ON-MIN}	Minimum switch on-time	V_{IN} = 12 V, I_{SW} = 1 A		50	75	ns
$t_{OFF-MIN}$	Minimum switch off-time	V_{IN} = 5 V		50	100	ns
t_{ON-MAX}	Maximum switch on-time	HS timeout in dropout	5.4	7	10	µs
OSCILLATOR (RT and SYNC PINS)						
f_{OSC}	Internal oscillator frequency	RT = GND	1.85	2.1	2.35	MHz
f_{OSC}	Internal oscillator frequency	RT = VCC	360	400	440	kHz
f_{ADJ1}		RT = 66.5 kΩ, 1%		240		kHz
f_{ADJ2}		RT = 7.15 kΩ, 1%		2200		kHz
f_{SYNC}	Synchronization frequency range		250		2200	kHz

Before



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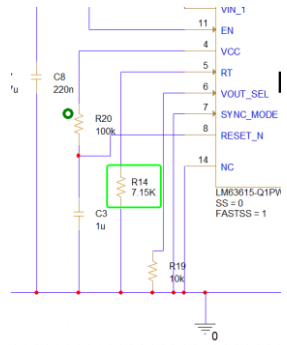

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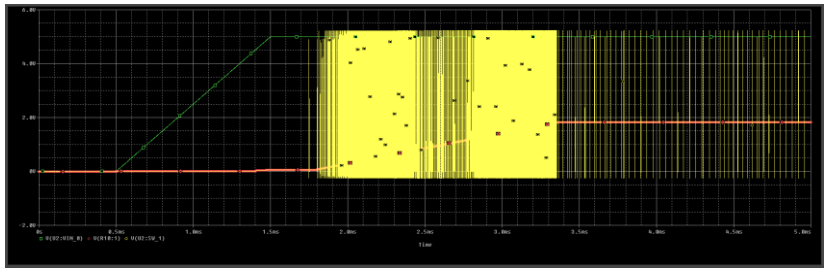

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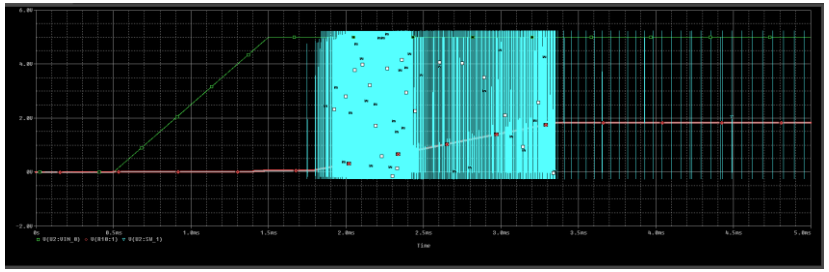

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A Heartfelt Customer's Voice

"We are truly impressed with the exceptional work and dedication demonstrated by the team in overcoming the challenges in our hardware design project through worst-case circuit analysis. Their solution to reduce the tolerance and selecting the low cost yet having best performance. The quick turnaround time in completing this analysis showcases their efficiency and commitment. This modified design aligns perfectly with our requirements and makes other circuit function at high efficiency. It's a significant milestone in our journey, and we look forward to continued collaboration with such a talented and reliable team."

Conclusion

- The successful delivery of analysis results that precisely met the client's requirements demonstrated our commitment to excellence and technical expertise.
- Our partnership not only upholds technical expertise but also delivers personalized service by combining proficiency.
- Our commitment is to deliver top-tier analysis services, showcasing our capacity and dependability in achieving outstanding outcomes.