TEA2017：可数字配置的LLC与多模式PFC控制器

陈意
系统应用工程师
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SECURE CONNECTIONS
FOR A SMARTER WORLD

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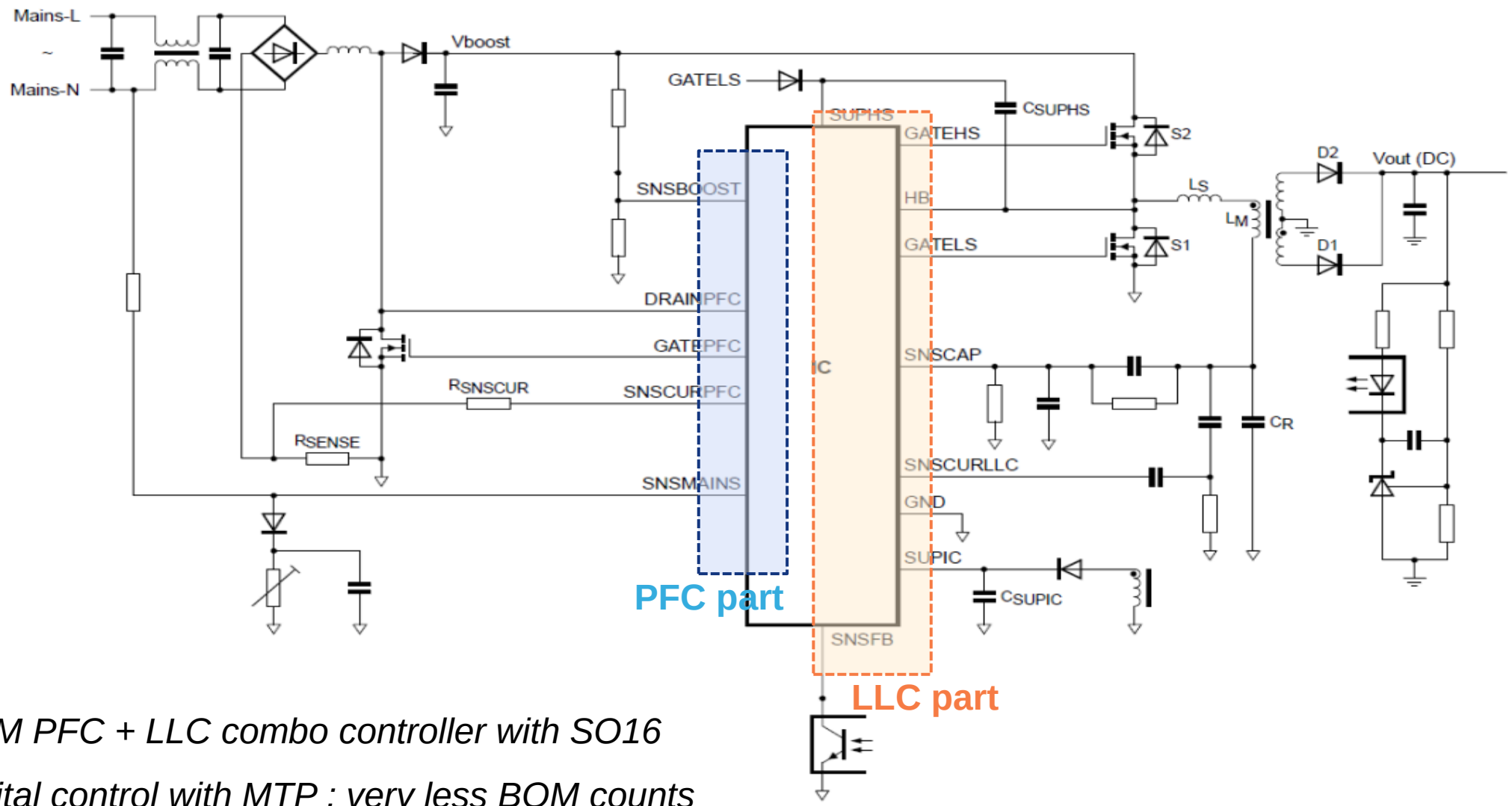
TEA2017 Application Schematic



- ✓ *CCM PFC + LLC combo controller with SO16*
- ✓ *Digital control with MTP ; very less BOM counts*

Contents

- Power Factor and THD improvement
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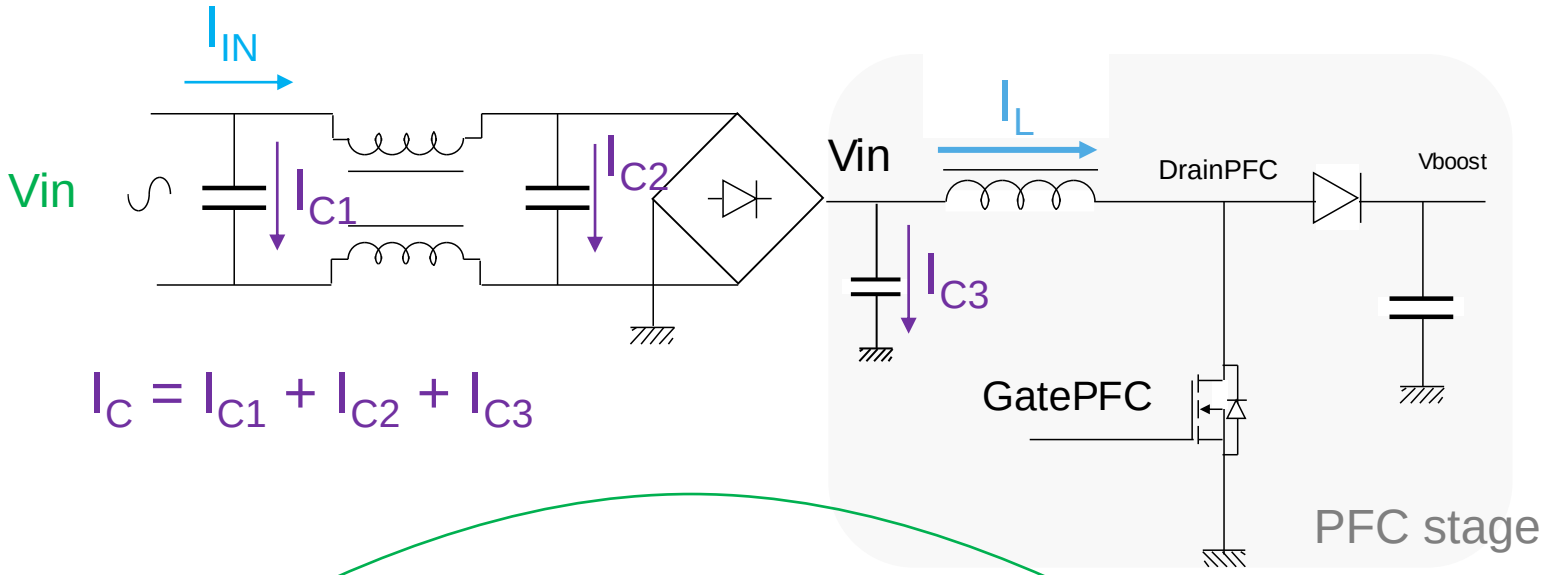
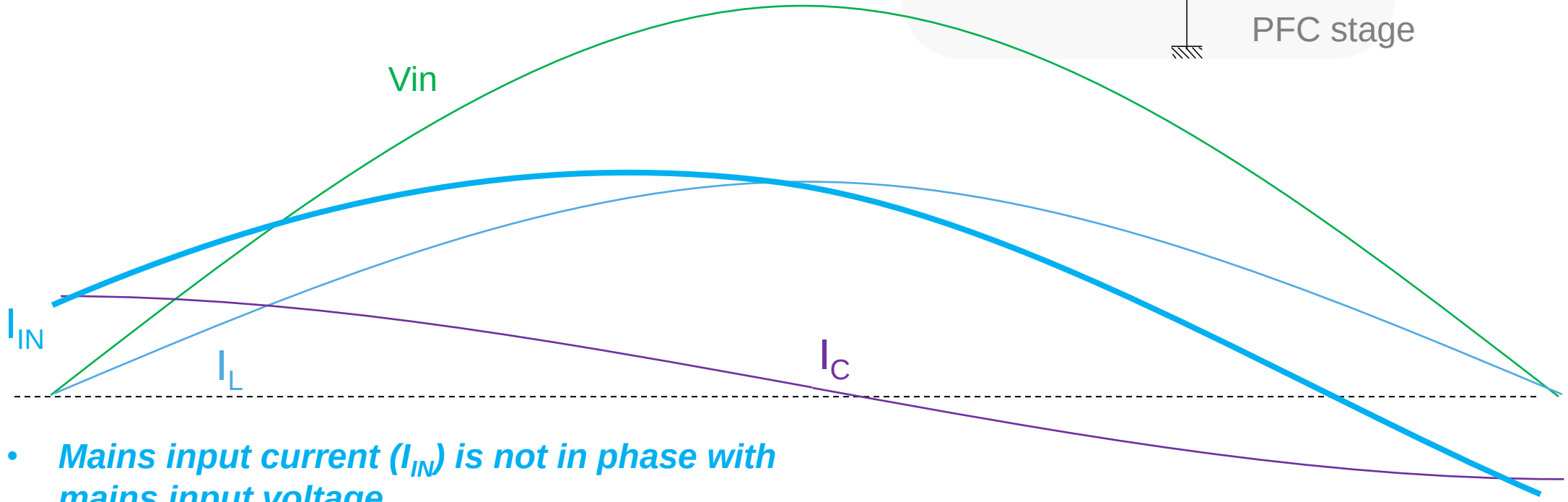
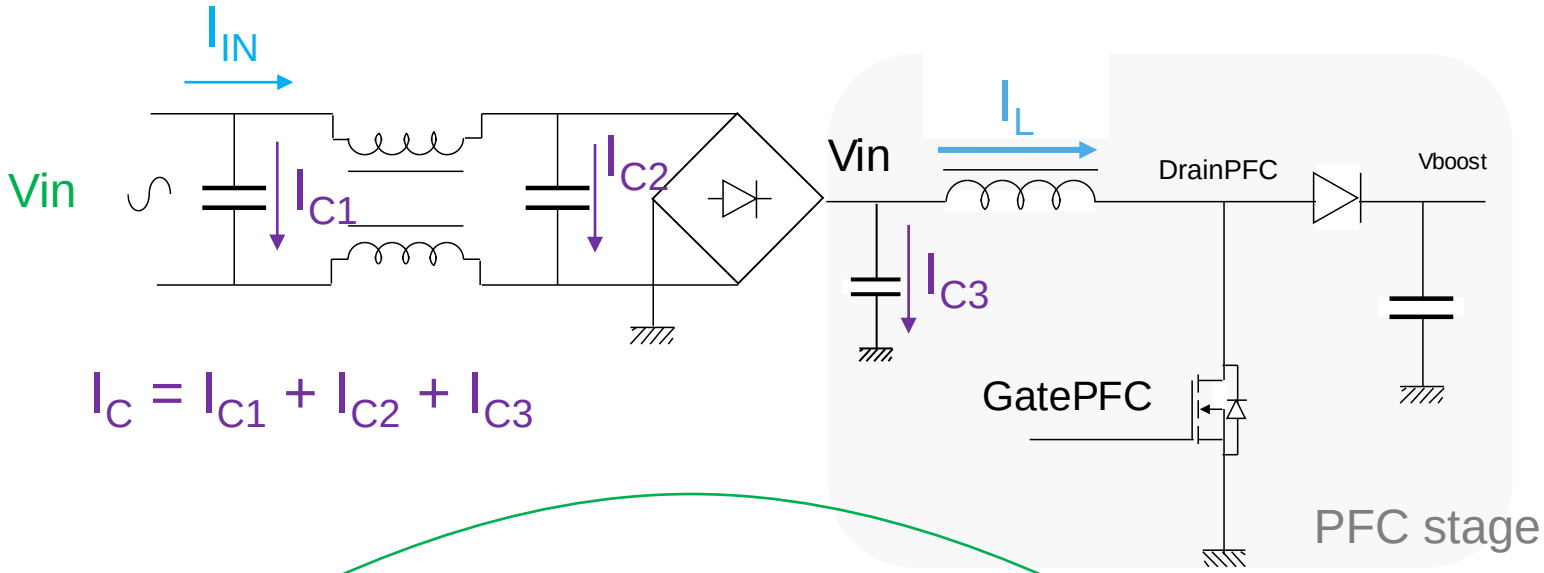
Pure Sinewave on Average Inductor Current Does NOT Mean Good PF/THD



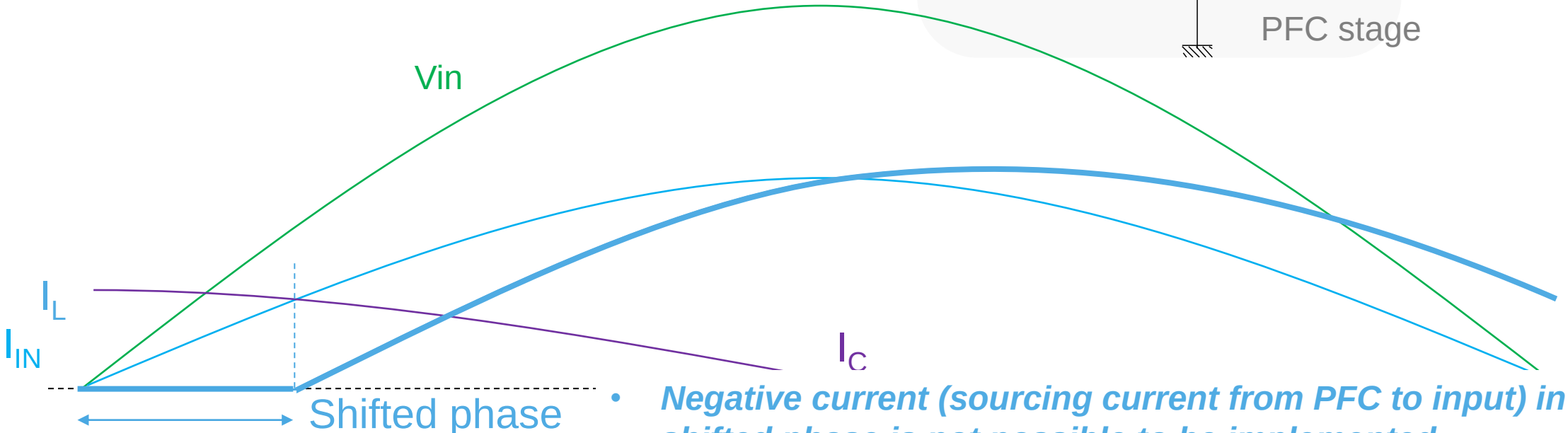


- ***Mains input current (I_{IN}) is not in phase with mains input voltage***

How to Achieve Better PF and THD ?

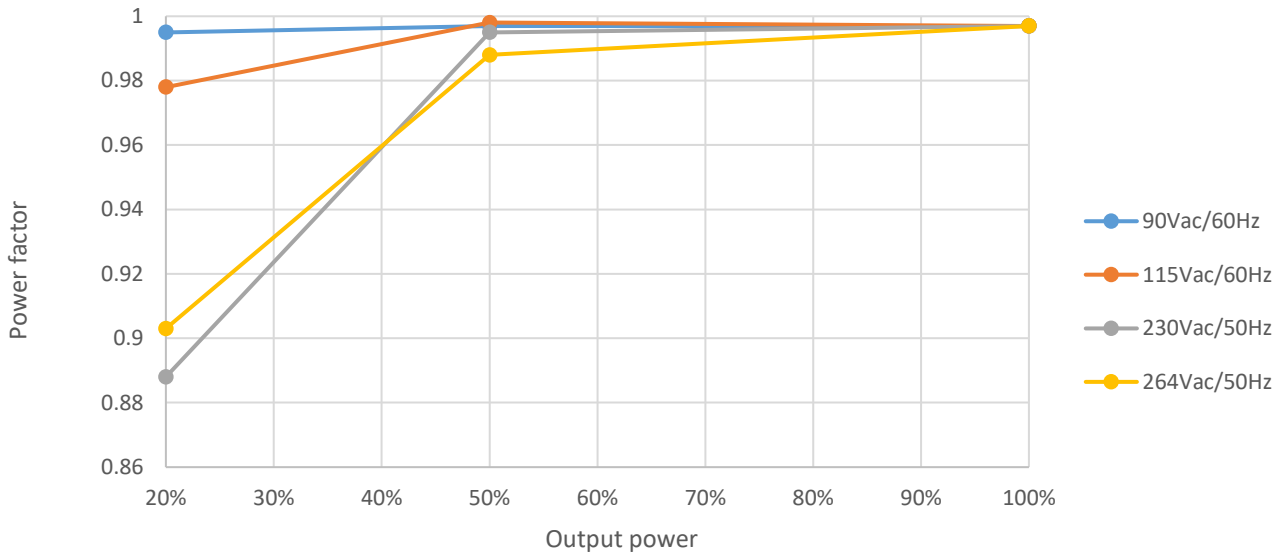


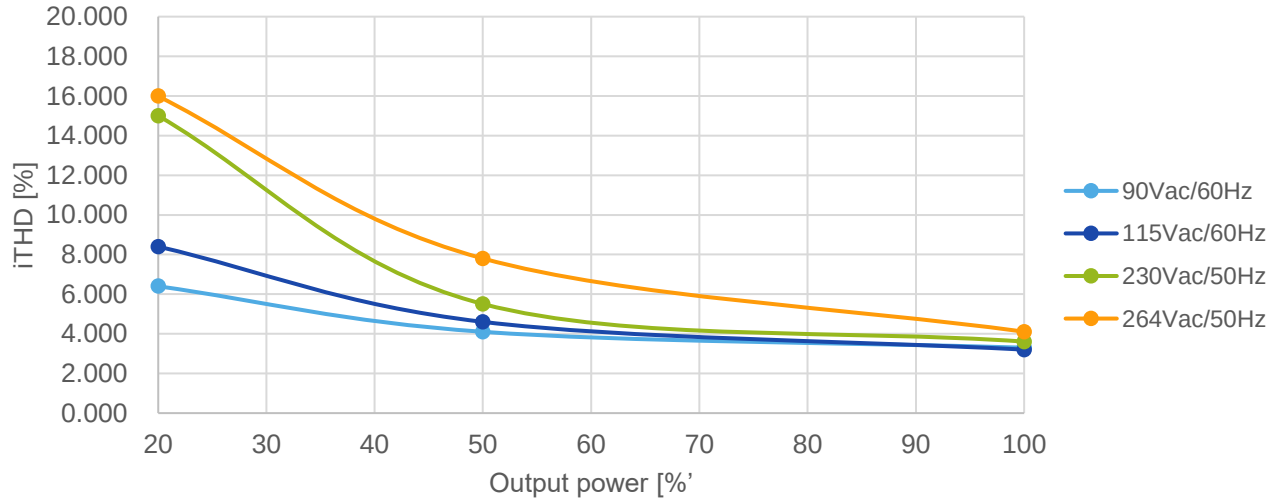
$$I_C = I_{C1} + I_{C2} + I_{C3}$$



- ***Negative current (sourcing current from PFC to input) in shifted phase is not possible to be implemented.***
- ***Therefore, no switching operation during shifted phase.***

Power Factor and THD Test Result





- Power factor > 0.99, iTHD < 10% at 100% load
- Power factor > 0.88, iTHD < 20% at 20% load

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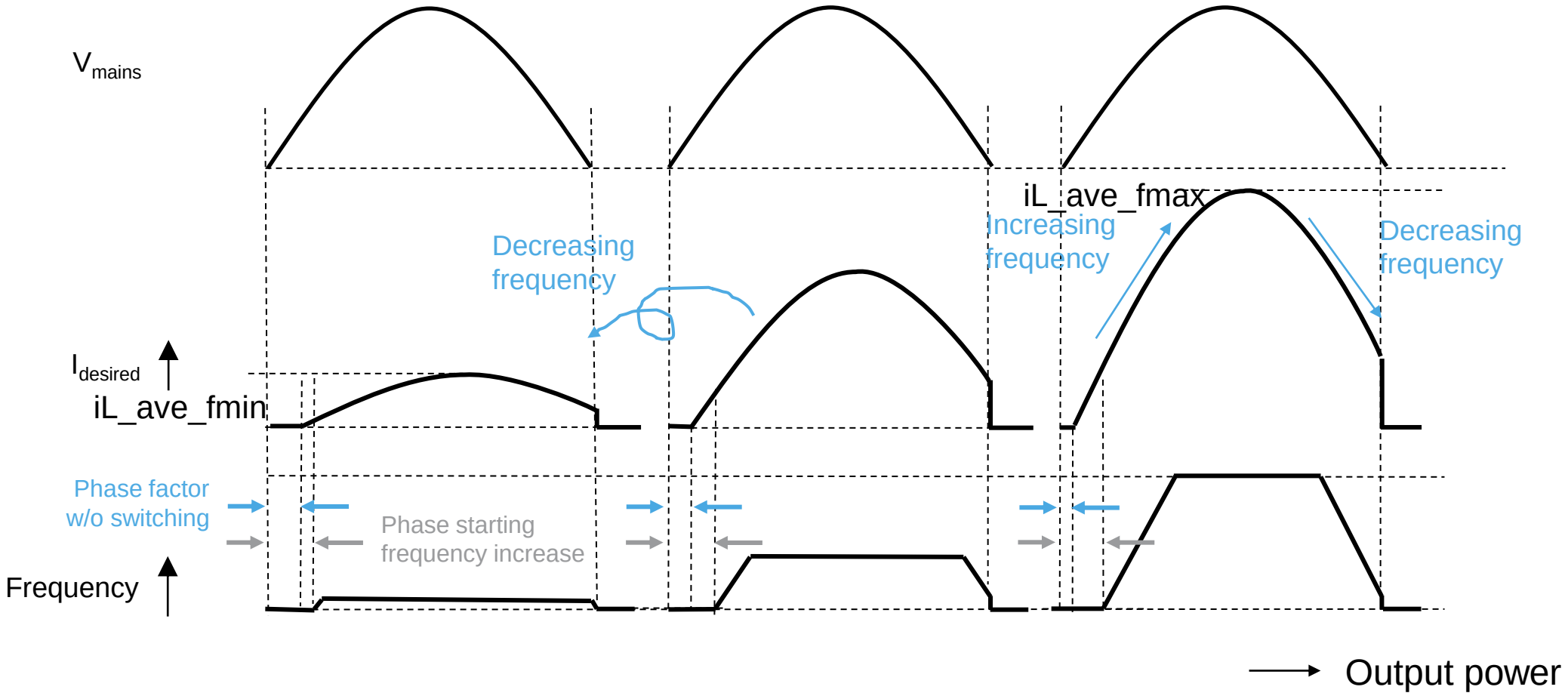
TEA2017 - Frequency By Output Power



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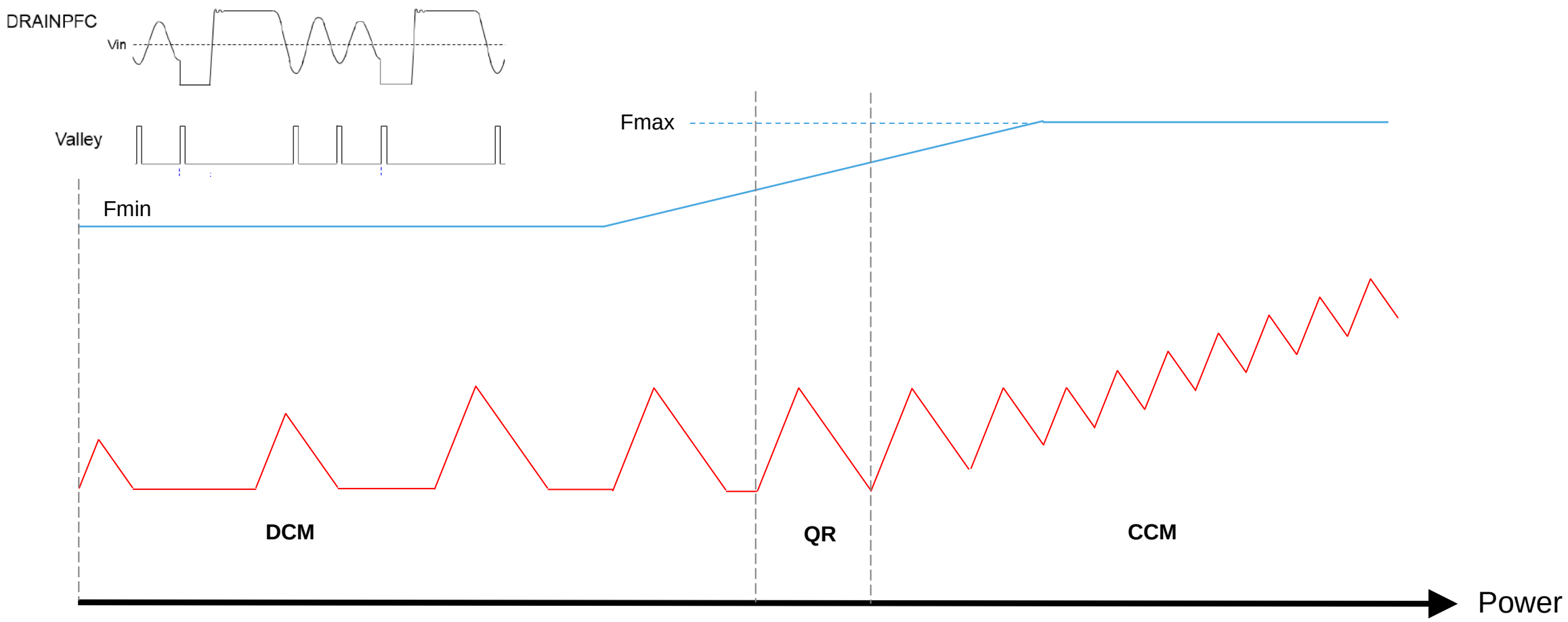
TEA2017 - Mixed Mode PFC Control; CCM/DCM/QR



- ✓ *Typical design for high power application*
- ✓ *Even though frequency control intends to increase frequency at higher power range, the practical frequency is decreased for QR operation.*

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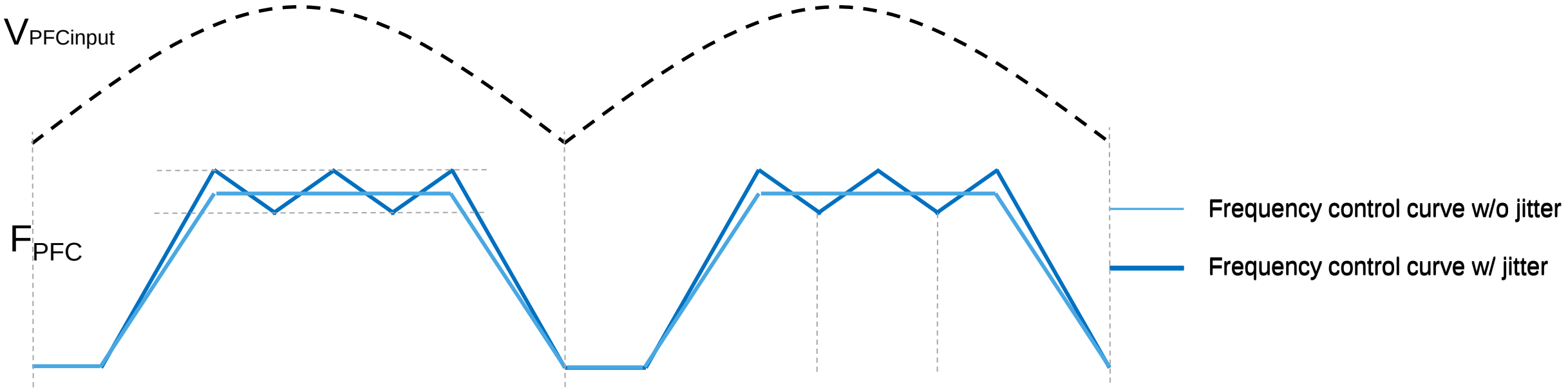
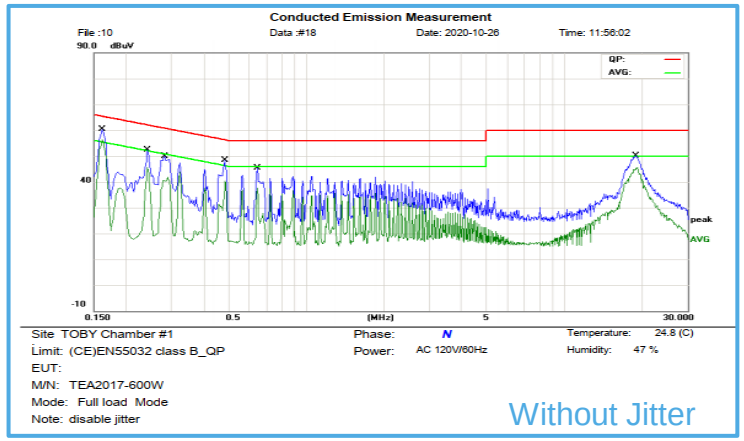
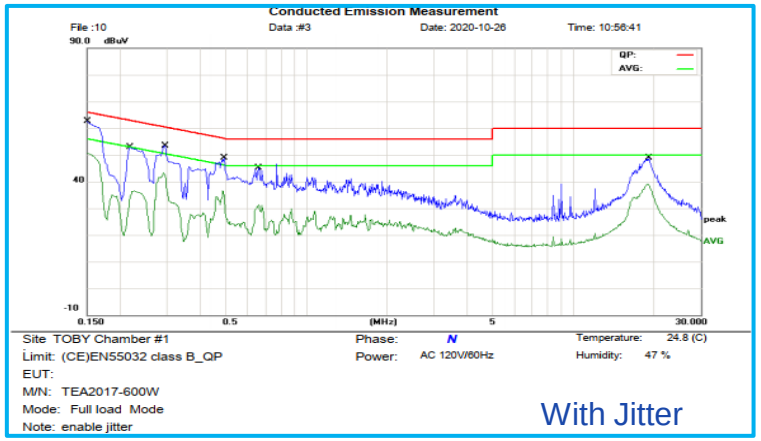
TEA2017 - PFC Jitter Function



Jitter frequency change amplitude

- Average frequency w/ jitter is same as frequency control value.





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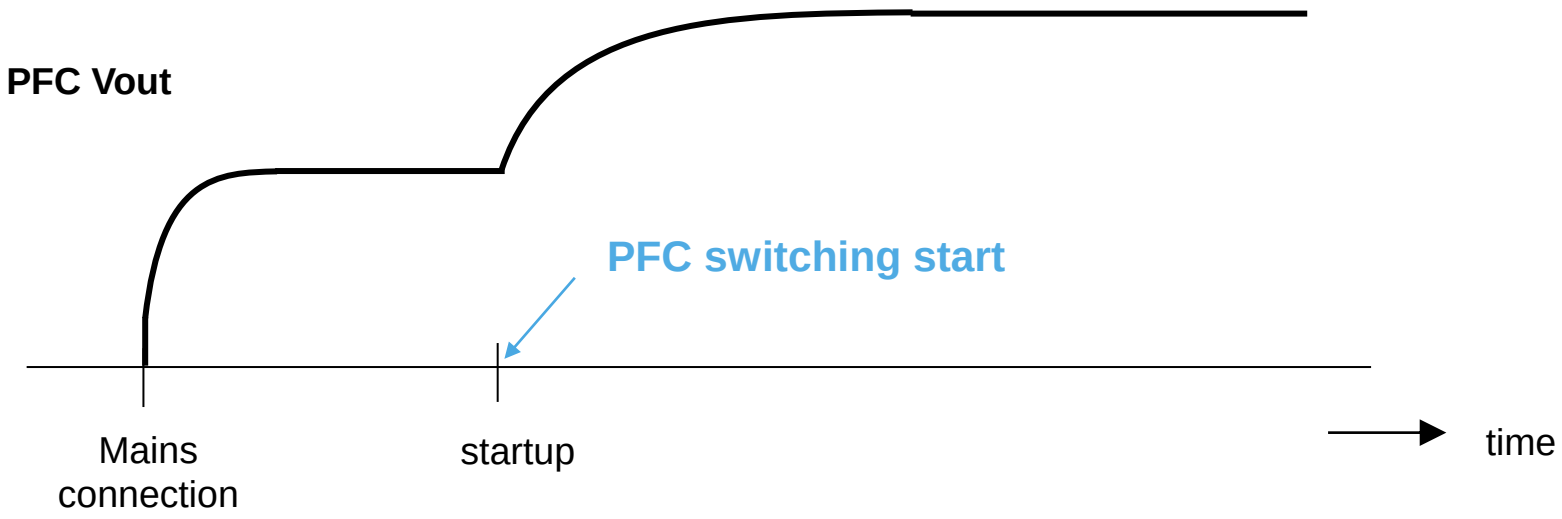
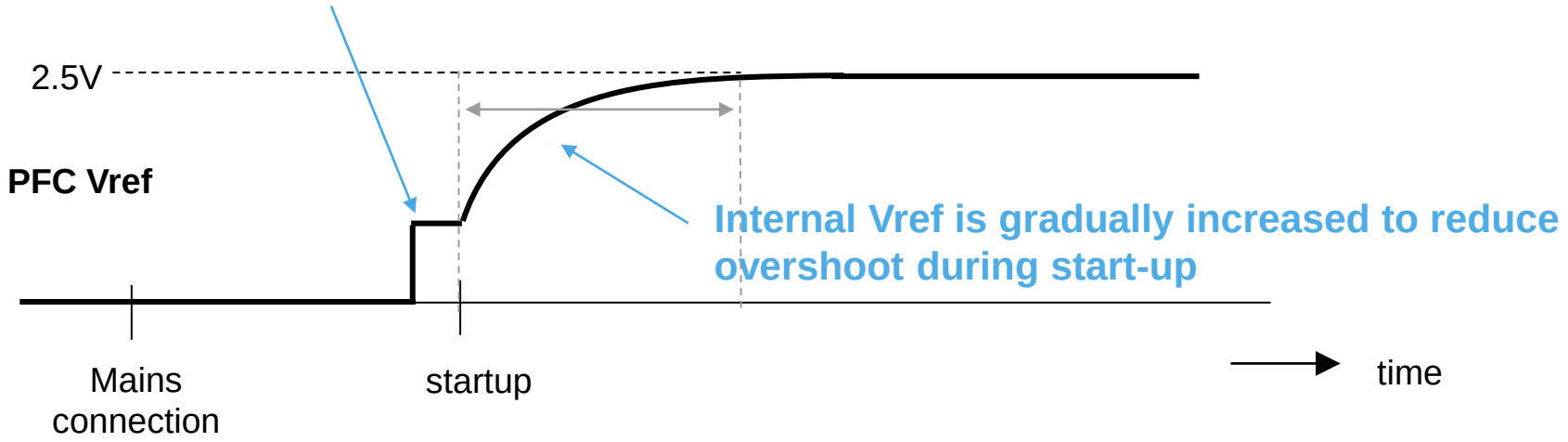
TEA2017 - Start-up



SNSBOOST pin detected mains peak level here.



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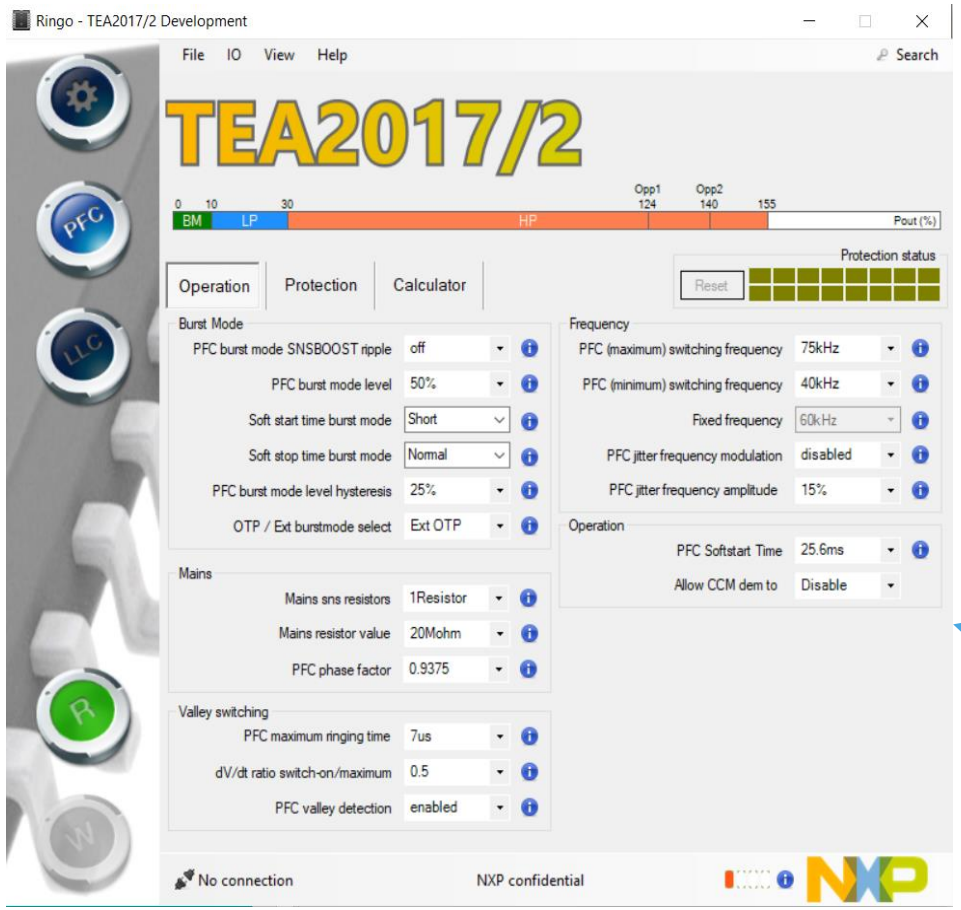
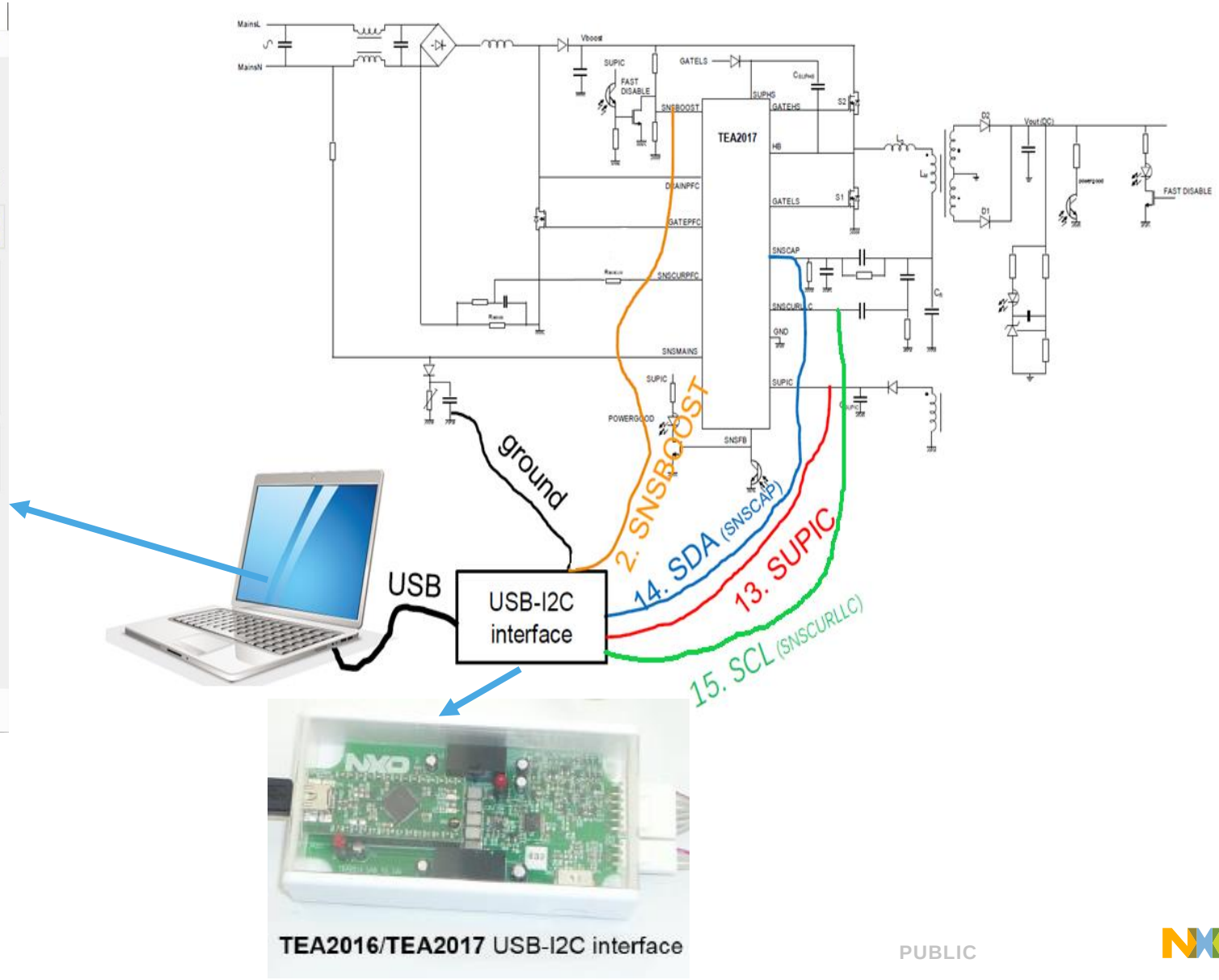
TEA2017 - MTP Setting and Programming





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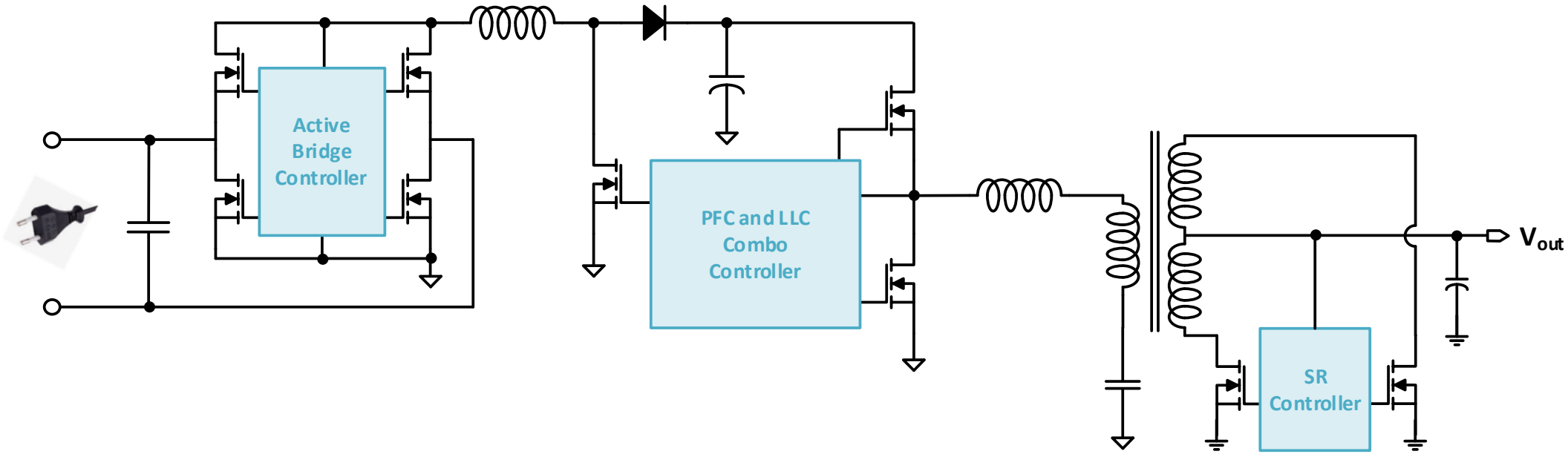
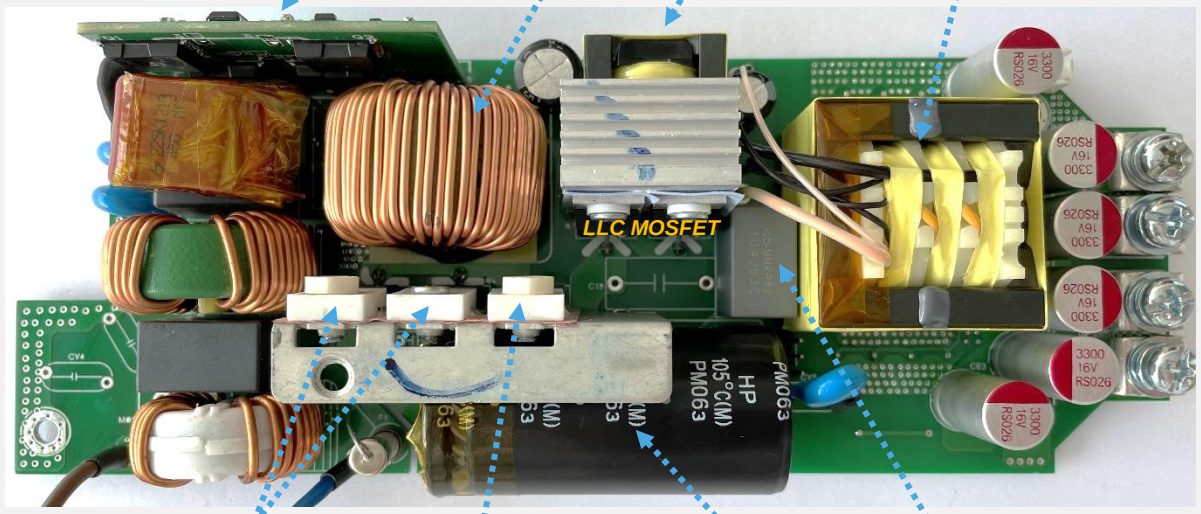
Demo Board Structure



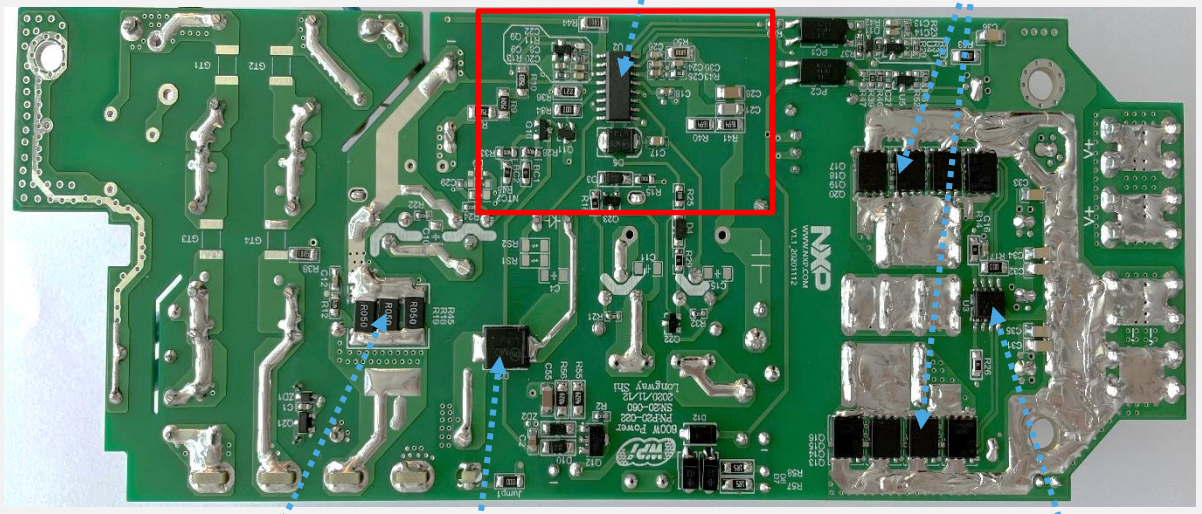
TEA2209	TEA2017	TEA2095
▪ SO16 ▪ Saving Forward conduction losses of diode ▪ Integrated high voltage level shifters ▪ Integrated X-cap discharge ▪ Self-supplying/low IC power consumption(2mW)	▪ CCMPFC+LLC combo in SO16 ▪ High efficiency by Vcap control/cycle by cycle technology ▪ High flexibility and ease of design via GUI ▪ Single platform design for high power ranges between 90-1000W	▪ 2 channel SR for LLC resonant in SO8 ▪ Very wide supply voltage range from 4.5V to 38V ▪ Adaptive gate drive & Lower / selectable driver regulation level ▪ protection to prevent both mosfets to erroneously be driven at the same time

Demo Board Photo (19cm x 7cm x 3.4cm)

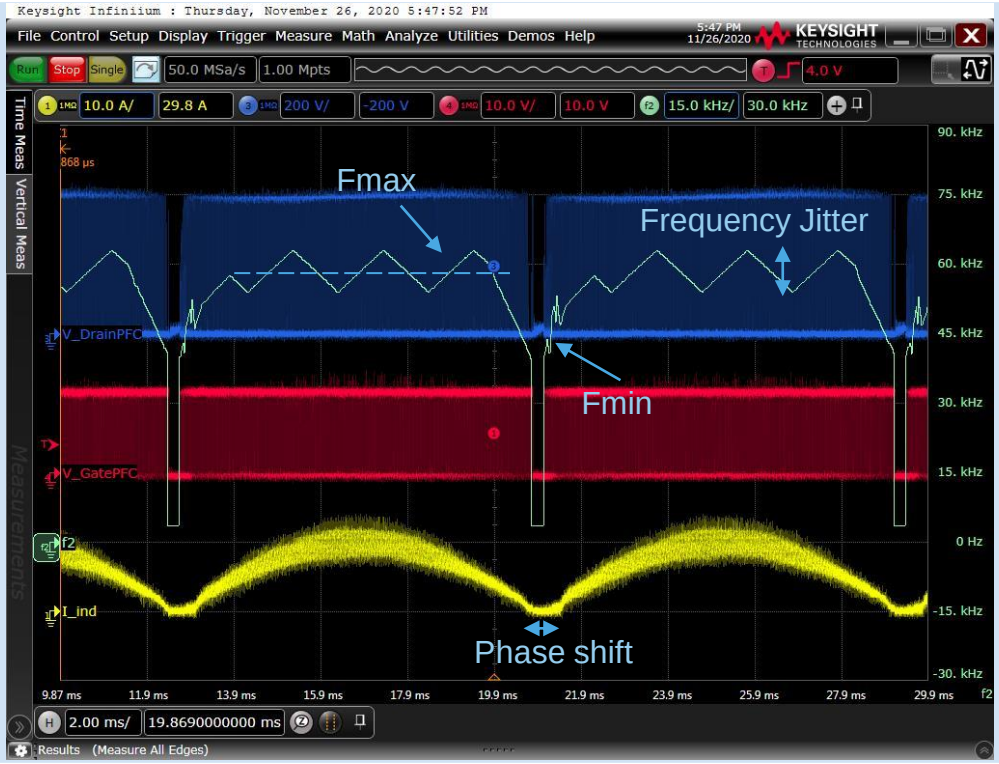
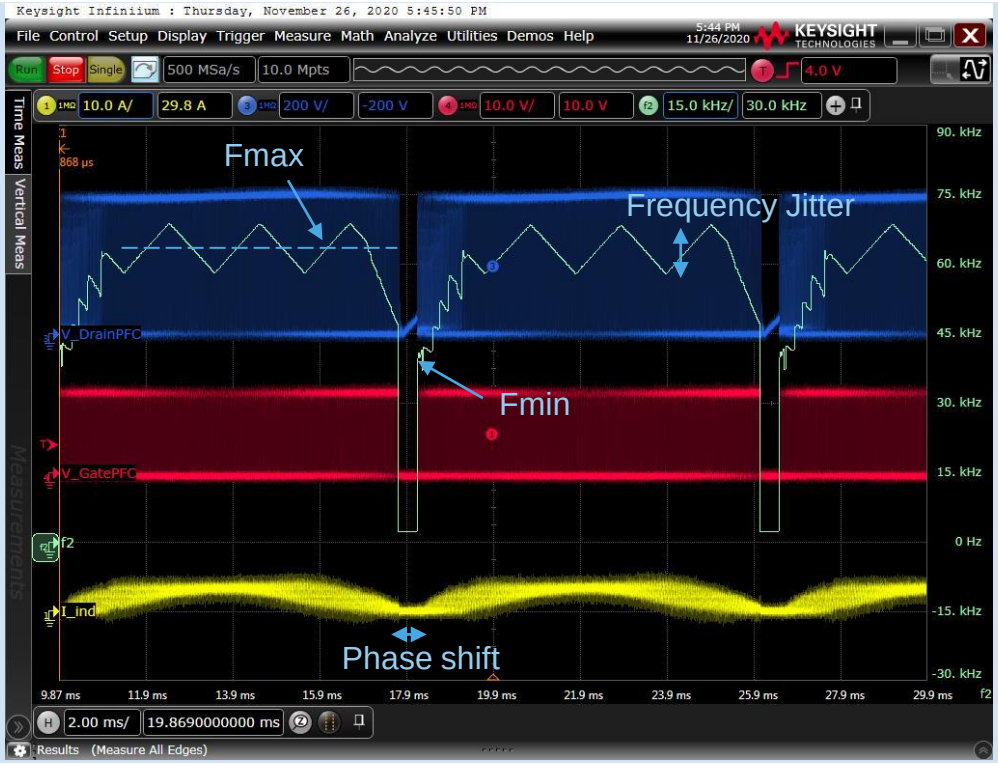
Top side



Bottom side

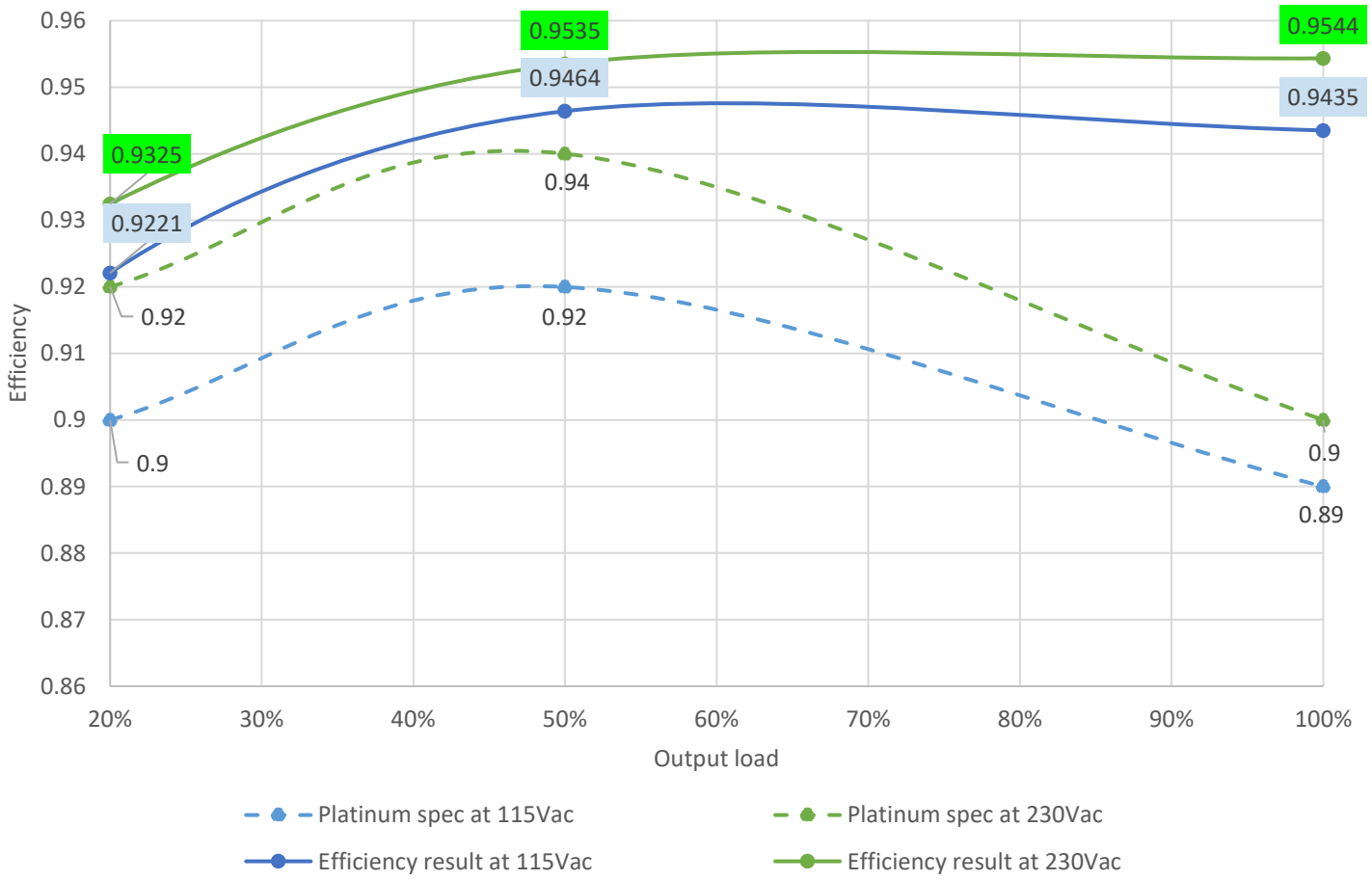


PFC Normal Operation

	90Vac & 12V/50A	264Vac & 12V/50A
Waveform CH1 : Ipfc_inductor CH2 : DrainPFC CH3 : GatePFC F2 : PFC frequency		

- PFC phase shift operates well for good power factor
- PFC frequency is min value nearby zero-crossing. As Ipfc_inductor average is increased, frequency is increased to max value.
- After PFC frequency increased to max value, frequency jitter operates for better EMI

Efficiency Test Result



- Efficiency achievement key points
  - At heavy load condition
    - Active bridge
    - PFC frequency control
    - SR performance
  - At light load condition
    - PFC frequency control
    - PFC valley detection
    - LLC Low power mode operation

- *Test condition : without 2W Fan*

Standby Power Consumption

Input power test result, 115Vac	Input power test result, 230Vac	Output load condition	Specification
0.082 W	0.110 W	No load	0.15 W
0.263 W	0.277 W	0.0125 A	0.5 W
1.628 W	1.579 W	0.104 A	2 W
3.807 W	3.671 W	0.25 A	4 W
6.226 W	6.017 W	0.417 A	6.25 W

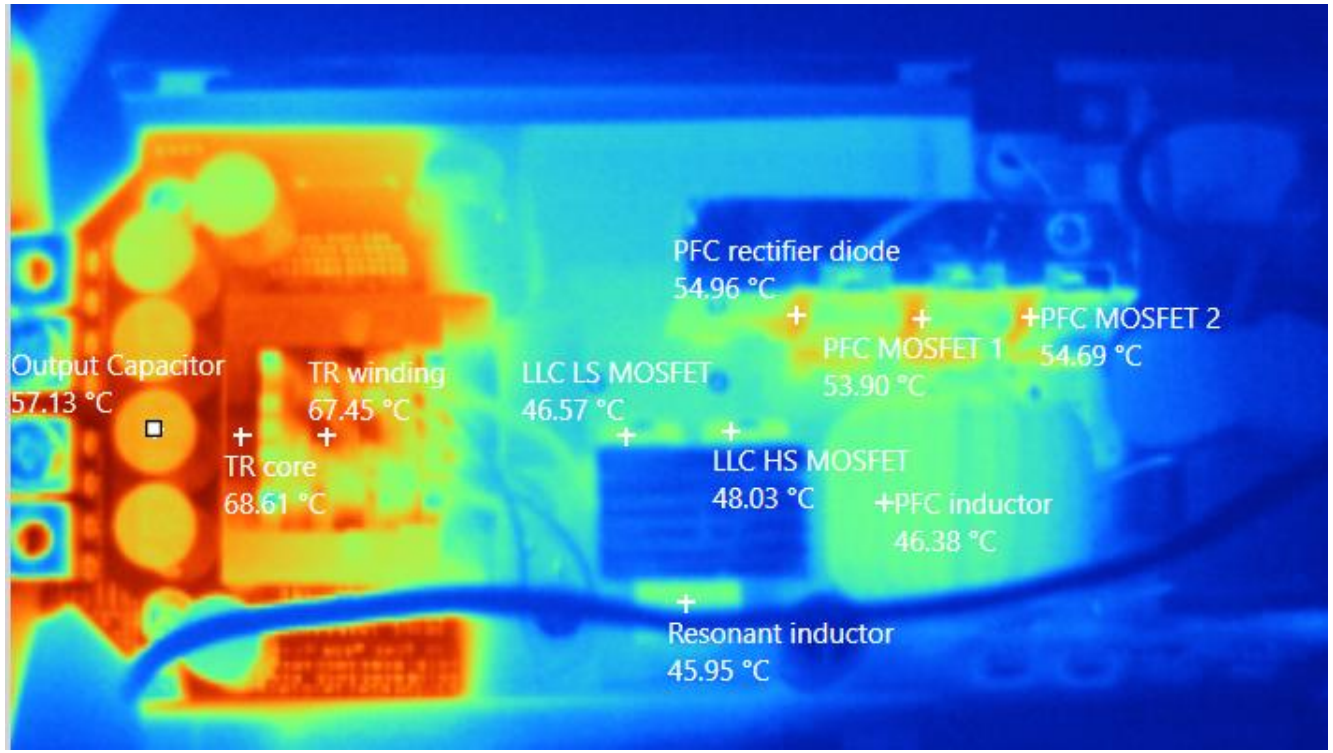
Test equipment ; WT210 with 300s integration time

Additional power loss breakdown at no load condition

1. Compact TEA2017 design (e.g. TEA2017 240W demo) : 70 mW
2. Active bridge : 8 mW
3. 1uF input capacitor: 15 mW
4. LDO and others : 7 mW

Components Temperature

- *90Vac input, 600W load, aging 1hr with FAN with thermal camera*
- Max temp is <70deg at room temp



Components	Part name	Test result	Test equipment
PFC inductor	L1	46.4 ℃	Thermal camera
PFC MOSFET 1	Q5	54.6 ℃	Thermal camera
PFC MOSFET 2	Q6	53.9 ℃	Thermal camera
PFC rectifier diode	D1	54.9 ℃	Thermal camera
LLC HS MOSFET	Q7	48.0 ℃	Thermal camera
LLC LS MOSFET	Q8	46.5 ℃	Thermal camera
Transformer winding	T1	67.4 ℃	Thermal camera
Transformer core	T1	68.6 ℃	Thermal camera
Resonant inductor winding	Lr1	45.9 ℃	Thermal camera
Output capacitor	CE5	57.1 ℃	Thermal camera
SR MOSFET	Q13	61.0 ℃	Thermocouple thermometer
	Q20	55.0 ℃	Thermocouple thermometer
TEA2017T	U2	42.0 ℃	Thermocouple thermometer
TEA2095TE	U3	59.0 ℃	Thermocouple thermometer
Ambient		25 ℃	

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