

High **VOLT** Interactive

Where power supply design meets collaboration

Modern LED Lighting Solutions
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What will I get out of this session?

- Purpose:
- Understand key challenges faced in the design of modern industrial/commercial LED drivers
- Winning features and how they address system challenges
- Introduce TI solutions which address these issues today
- Part numbers mentioned:
 - TPS92210
 - UCC28810
- Relevant End Equipment's:
 - High Bay/ Low Bay Industrial
 - Commercial Troughers
 - Other indoor lighting fixtures
 - Parking / Street / Stadium Light
 - Other outdoor lighting fixtures

Question #1: What are key industry trends driving change in LED Driver design

- A) Improved efficacy driving adoption of flyback PFC
- B) Light is a intelligent hub and not a dumb source of light
- C) CA-Title 22 and EU driving standby power requirements
- D) Digital programmability enabling “one size fits all” approach

Question #2: What are the key standards driving complexity

- A) FMEA – **F**ailure **M**odes and **E**ffects **A**nalysis
- B) SELV – **S**afety **E**xtended **L**ow **V**oltage (IEC61140 Class III)
 - Remain within 60V on the secondary side or pay more for insulation.....
- C) UL Class 2 Insulation Limits (UC1310 Class 2 & National Electric Code)
 - <100W of steady state power under all normal and abnormal operating conditions
- D) California Title 22
 - Standby power <0.5W total consumption from wall

UCC28810/1 LED Lighting Power Controller

Features

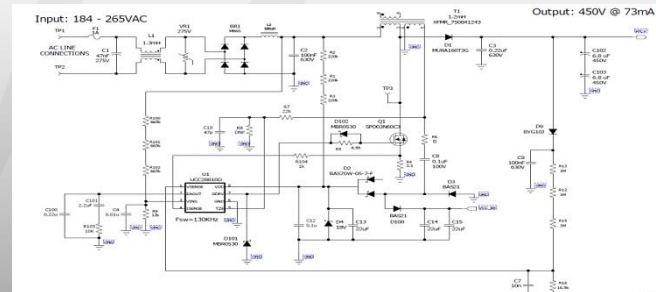
- Implements Single Stage Power Factor Correction
- Transformer Zero Energy Detection
 - Transition Mode Control
- Application Circuit Implements Phase-Cut Dimming
- Advanced Transient Response, Accurate Internal Vref, Low Start Up Current, 750mA Gate Drive
- UVLO, Over-Voltage, and Open-Loop Detection

Applications

- AC Input General Illumination, HB LED Applications
- PFC Front-End for Multi-Stage Lighting Designs

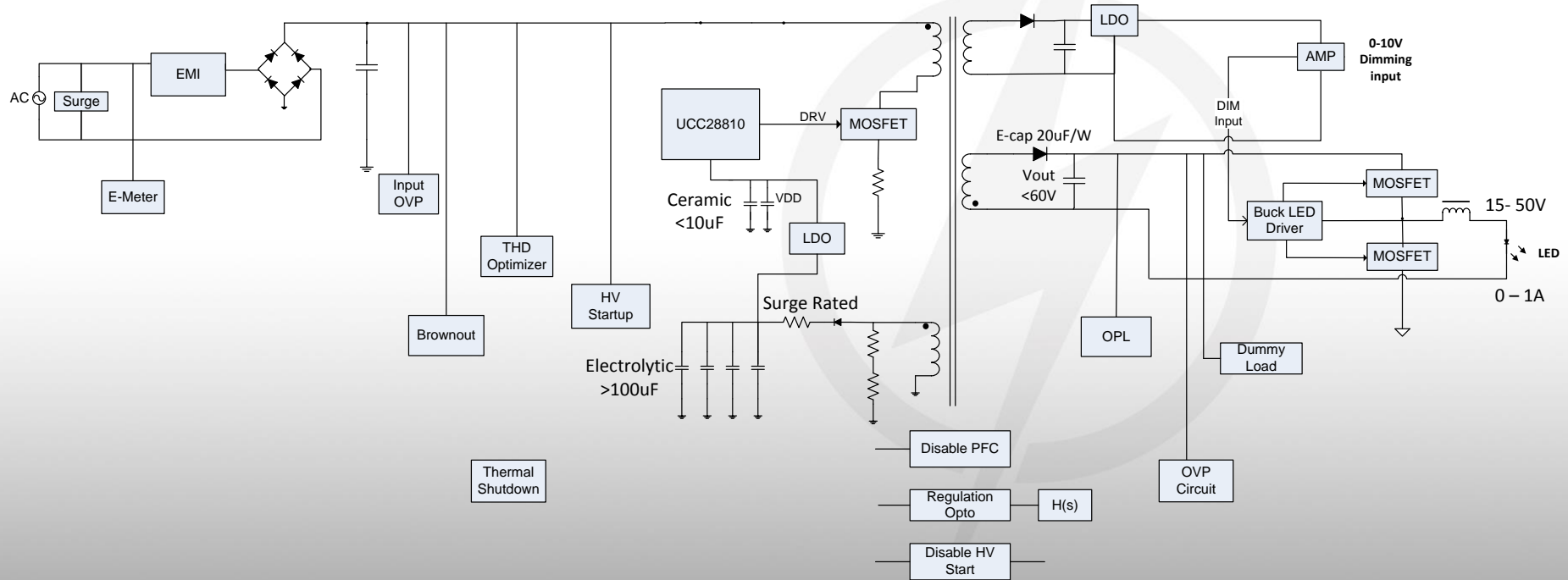
Benefits

- Meets Power Factor Correction Standards for Lighting Products
- High Efficiency, Low EMI Performance
- Compatible with Large Installed base of TRIAC Based Dimmers
- Improves Reliability and Life Time of Lighting Fixture
- Protects Against Faults and Abnormal Conditions

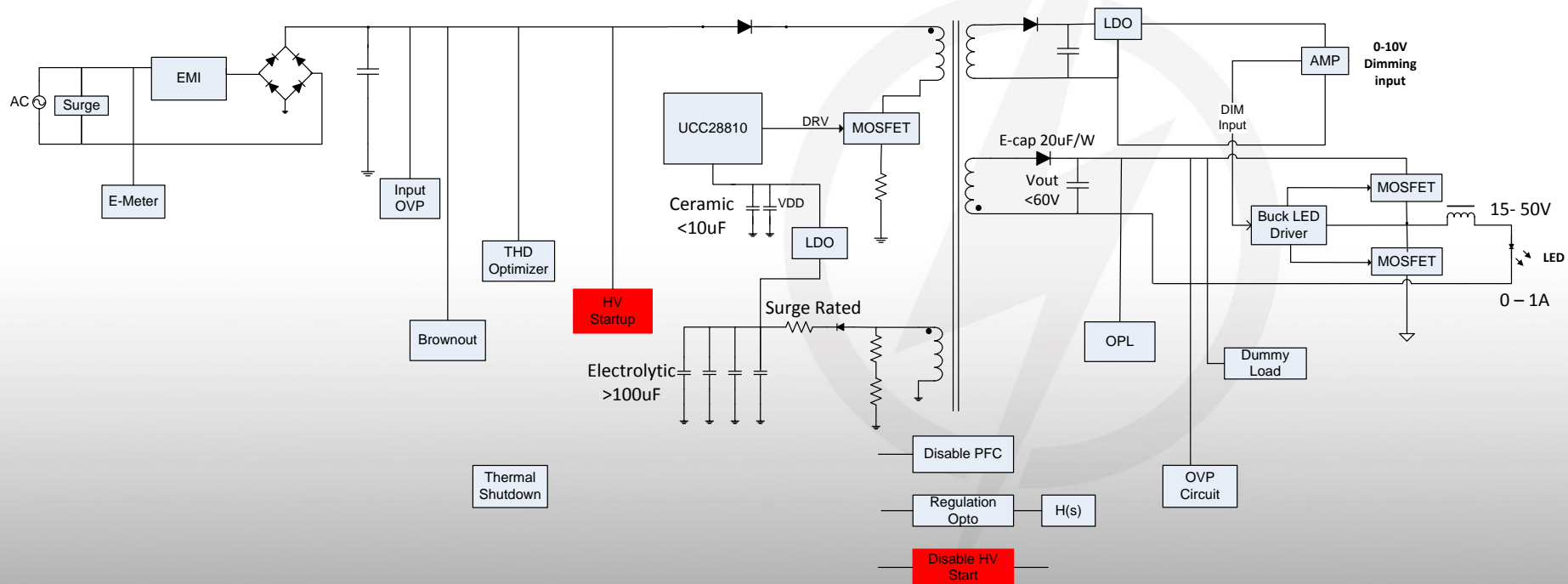


PART I – KEY REQUIREMENTS DRIVING COMPLEXITY

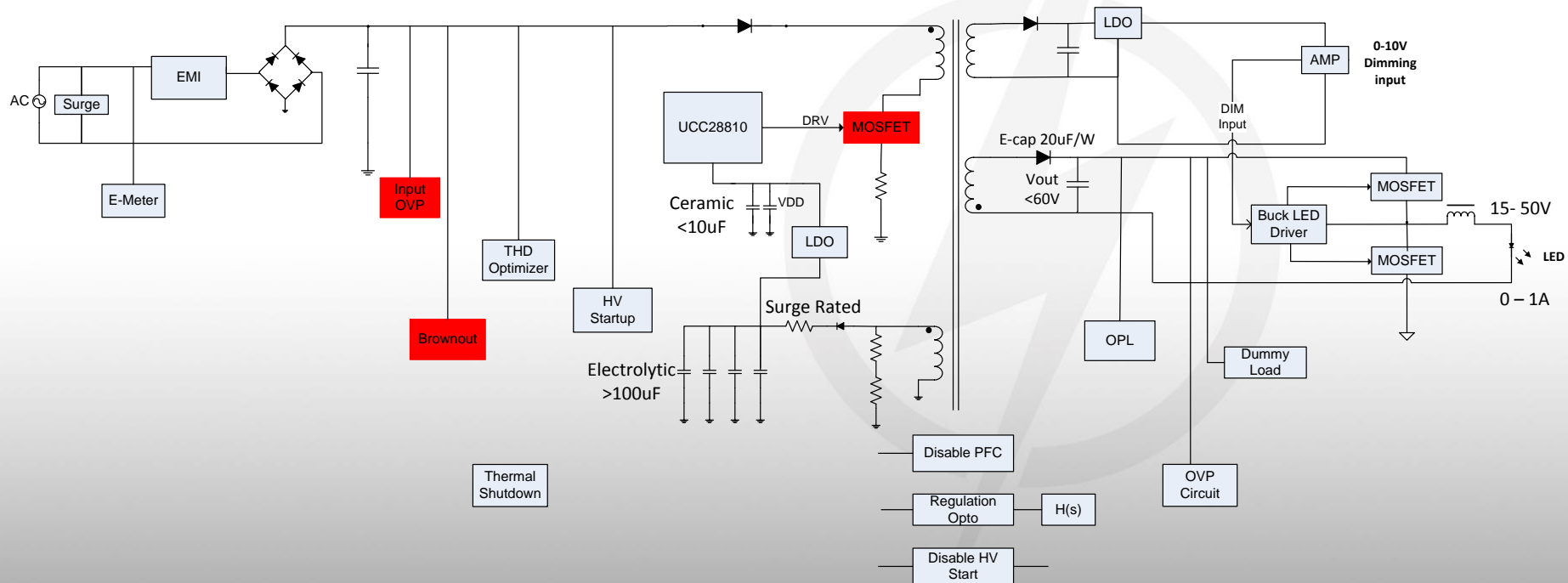
UCC28810 Based LED Driver



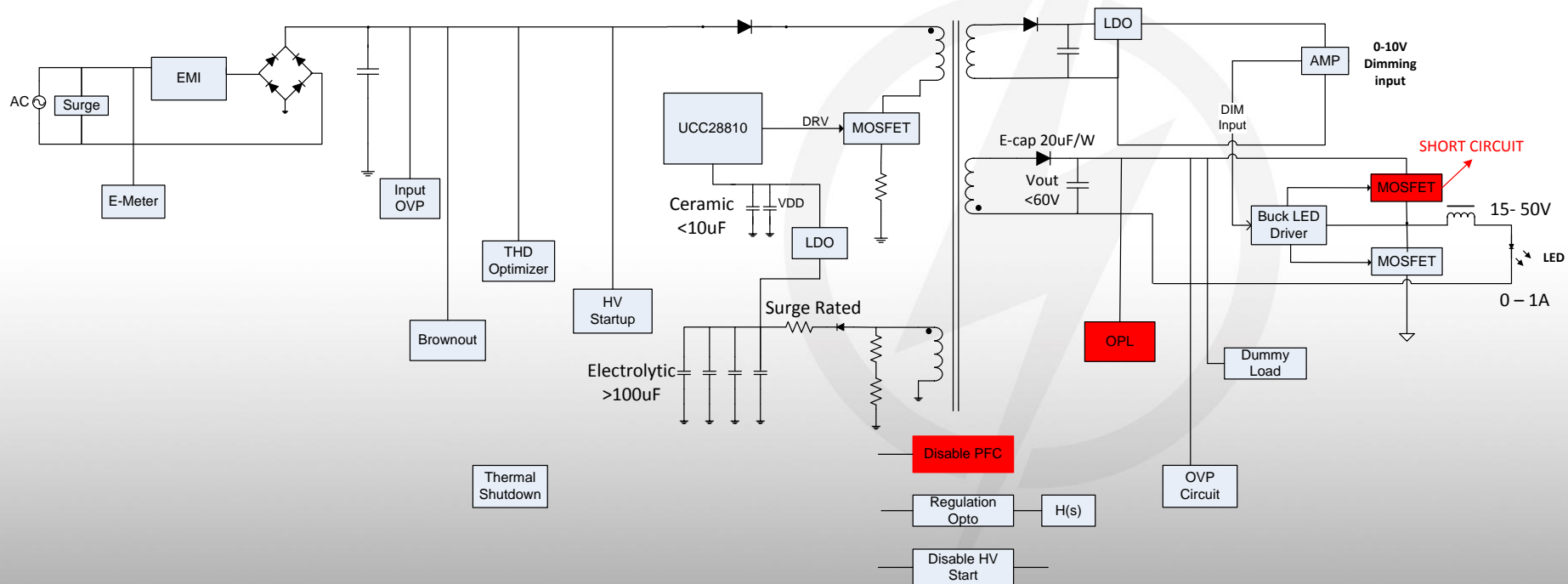
Requirement #1: High Voltage Startup Circuit



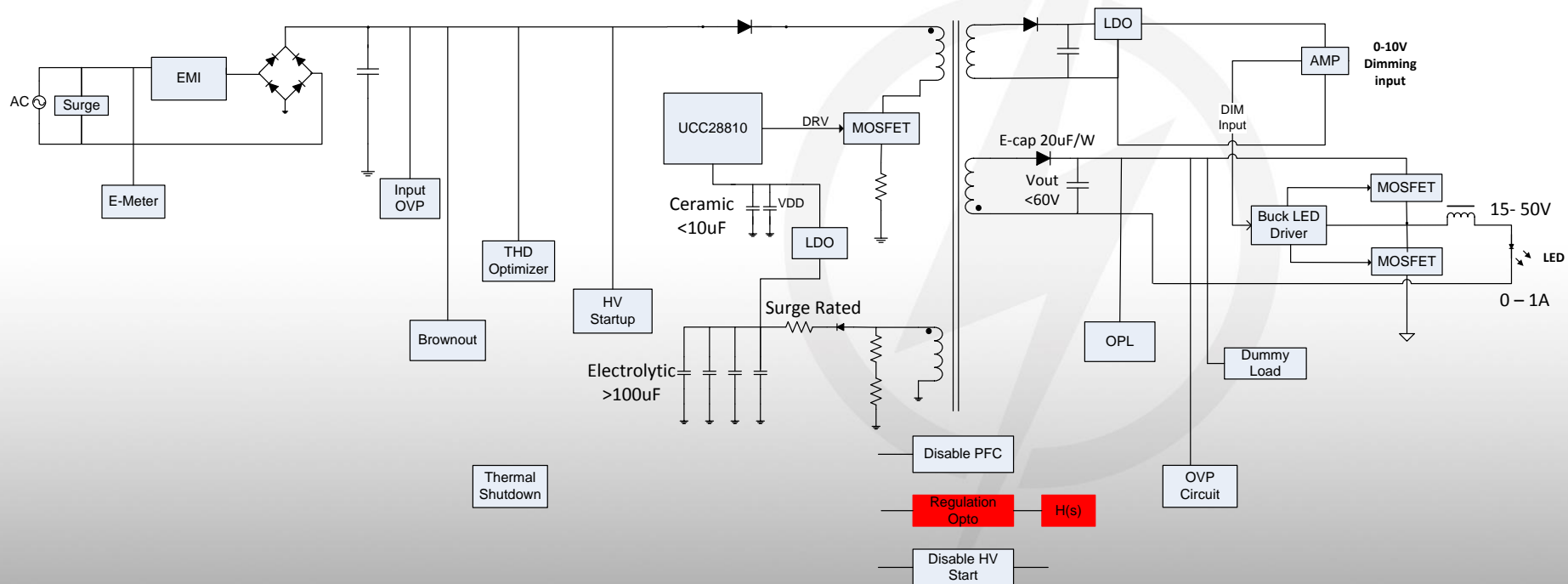
Requirement #2: Input Voltage Fluctuation Immunity



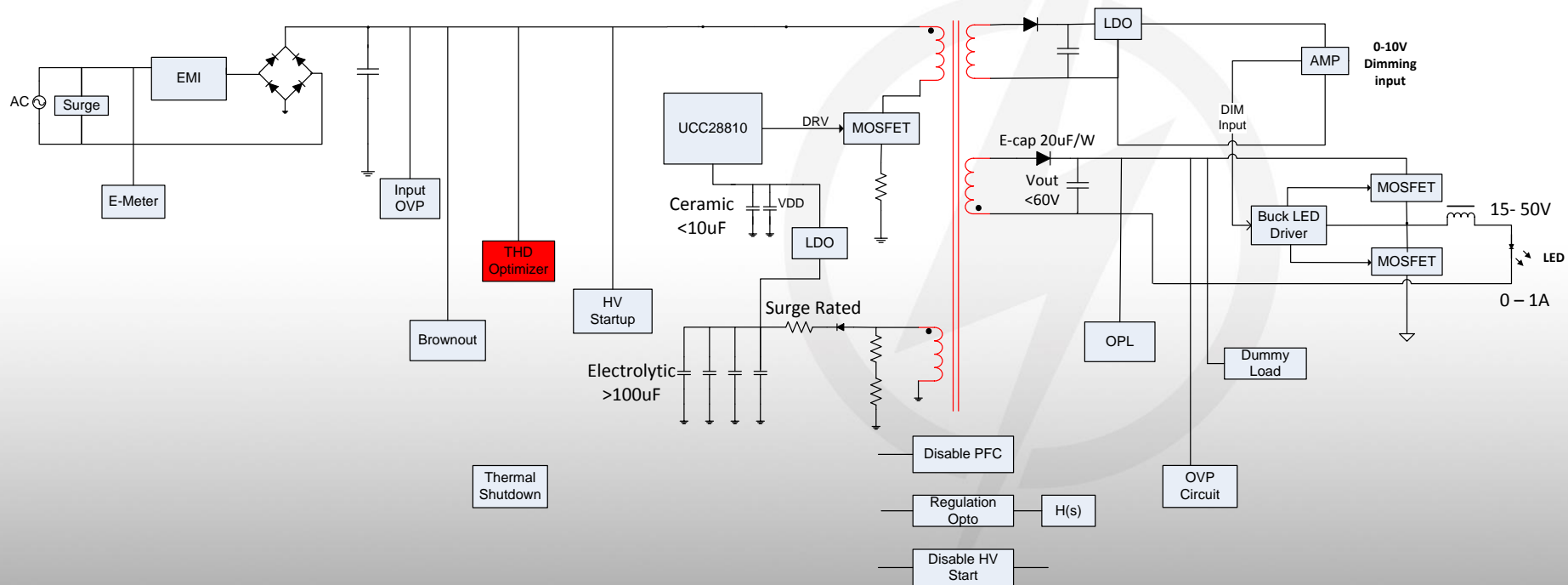
Requirement #3: Over Power Limit and UL1310 Class 2



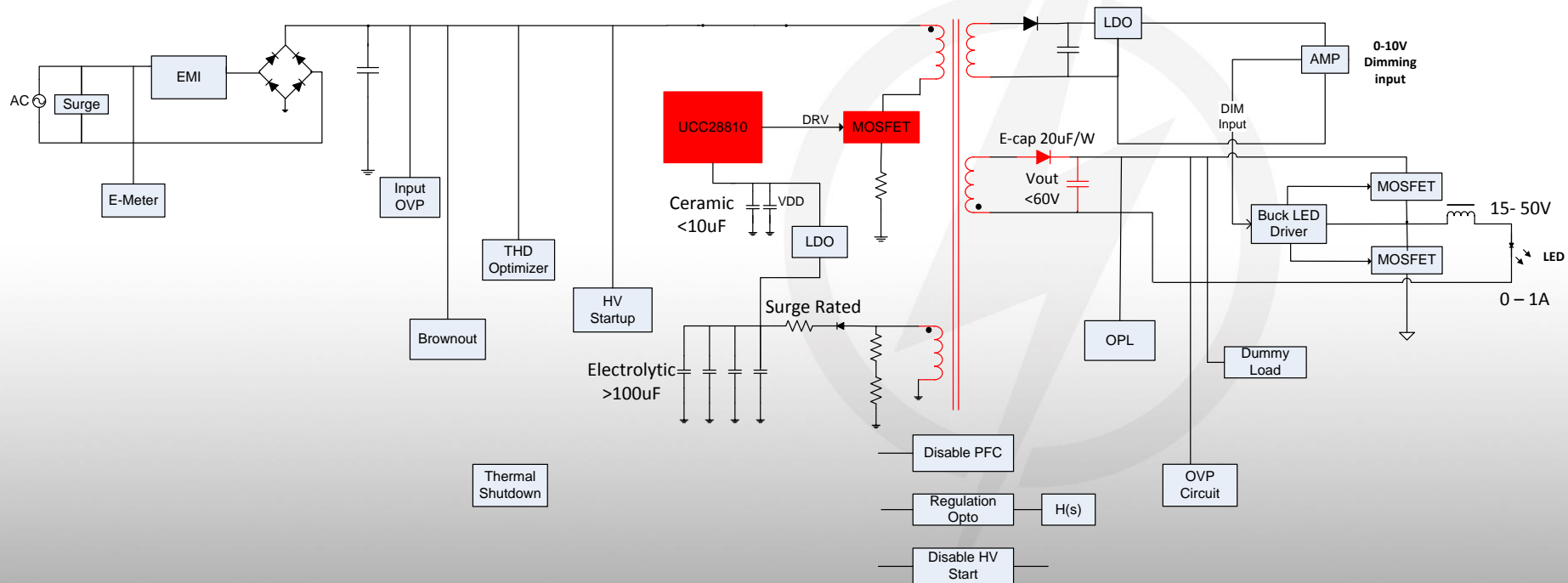
Requirements #4: Output Regulation



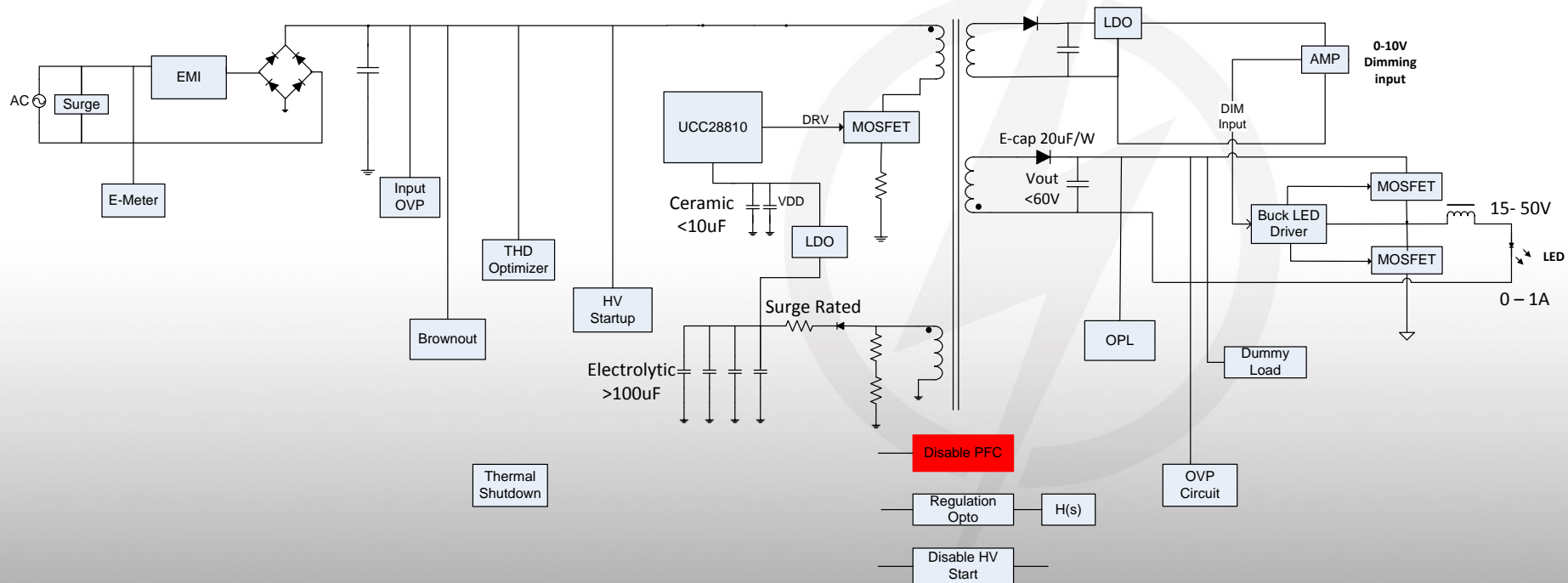
Requirements #5: Total Harmonic Distortion @ Light Load



Requirement #7: Light Load Efficiency



Requirement #8: FMEA Output Voltage Consideration



Part II: Impact of Requirements on System Costs

Total System Cost Stack Up – Part I

Feature	Implementation Components	BOM Cost
Fast Startup with Low Standby	HV MOSFET, LV MOSFET, Zener Diode, Optocoupler, Diodes, Power Resistor	0.12
Input Voltage Immunity	Comparator for IOVP fast response, Zener diode and npn Transistor based circuit for brownout	0.1
Bias Capacitor	Based on standby power, startup time, input voltage range, and IC operation, capacitance can be >100uF on VCC. For wide VOUT, LDO can also be used to improve VCC efficiency	0.05

Total System Cost Stack Up – Part II

Feature	Implementation Components	BOM Cost
Over Power Limit	OPL Accuracy < 10% - need circuit to detect output current and send a disable signal. Need optocoupler – shared with all disable functions	0.1
Regulation	Need shunt regulator and optocoupler	0.05
THD and Light Load Efficiency	Additional cost due to more surge rated X capacitors, bigger transformer, higher reflected voltage (800V MOSFET)	0.05
Total		0.47

Key Takeaways

- General purpose Constant TON controllers need ~\$0.5 of additional costs
- Need modern controllers that meet these requirements

TPS92210 Single Stage Flyback PFC LED Driver

Features

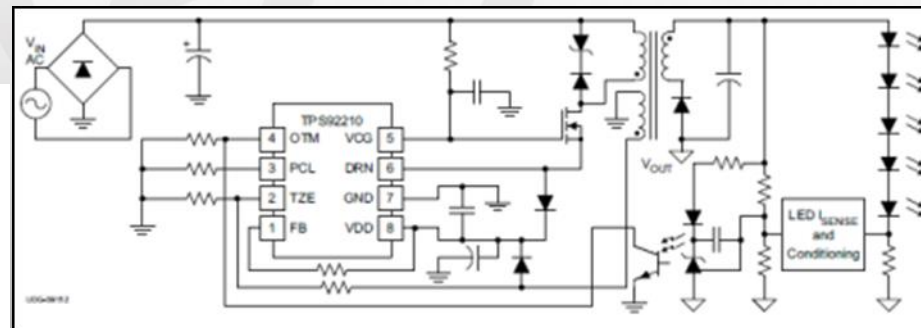
- Flexible Operating Modes: Peak Primary Current, Constant On-Time, or both
- Cascoded MOSFET Configuration
- Works with TRIAC Dimmers
- Transformer Zero Energy Detection
- Discontinuous Conduction or Transition Mode Operation
- Advanced Over-Current Protection and Integrated Over-voltage Protection

Applications

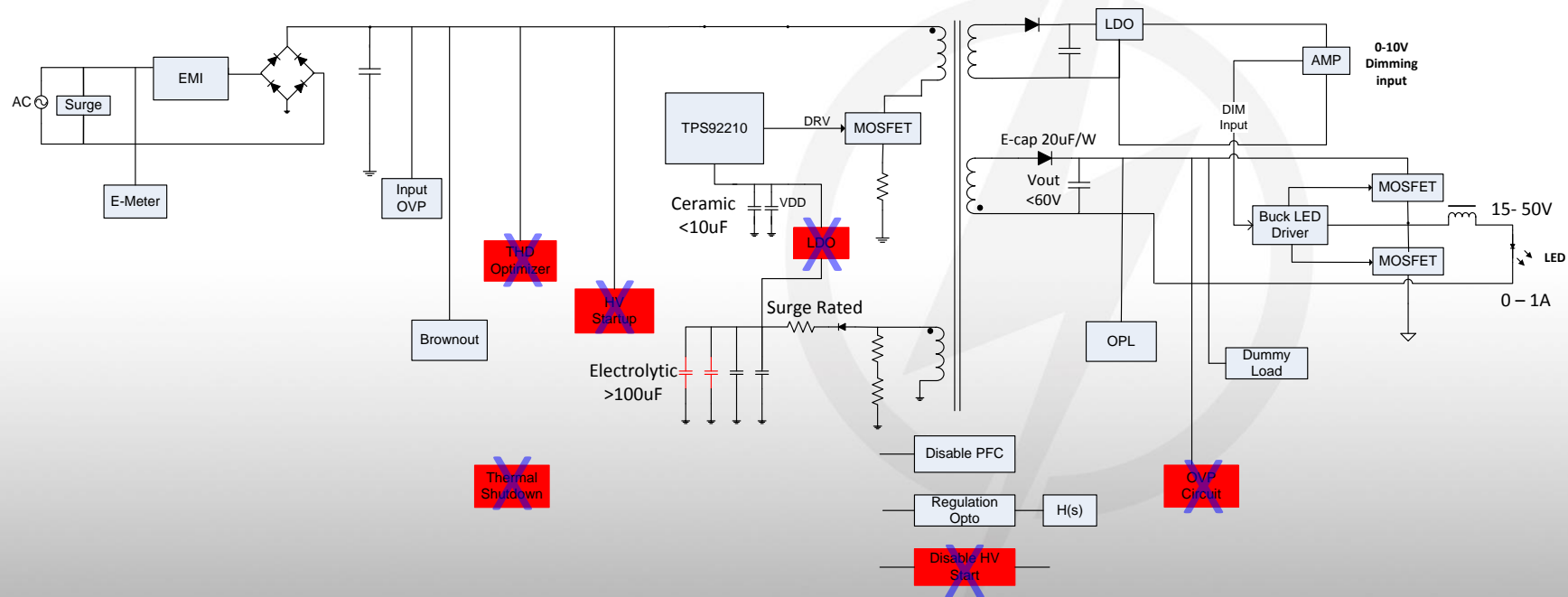
- Residential LED Lighting Drivers: A19 (E26/27, E14), PAR30/38, GU10
- Lighting Applications: Light Bulb Replacement, Sconces, Wall Washers, Architectural and Display Lighting, Commercial Troffers and Downlights

Benefits

- Constant On-Time implements Single Stage Power Factor Correction (PFC)
- Fast start up; Line Surge Ruggedness Better Than Internal HV FET
- Continuous Exponential Dimming
- High Efficiency, Low EMI
- No Reverse Recovery Loss in Output Rectifier
- Protects Driver Against Fault Conditions



TPS92210 Based LED Driver



How Does TPS92210 stack up

Requirement	TPS92210	Cost Savings
Fast Startup	YES	0.12
Integrated Primary OVP for FMEA	YES	0.05
Low THD Considerations	YES	0.05
Small VCC capacitor	YES	0.05
Total		0.37

Conclusion

- Modern lighting requirements require dedicated solutions which are designed to help designer reduce overall system costs and simplify external BOM.
- TPS92210 can offer
 - great THD,
 - very good efficiency across line and load
 - Fast startup at low standby
 - Integrated protections
- All in all, it caters to the needs of the modern lighting market