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Texas Instruments New Product Update

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TI GaN's LMG2610

650-V 170/250-mΩ HB for ACF with integrated gate driver and current sense

New Product Update

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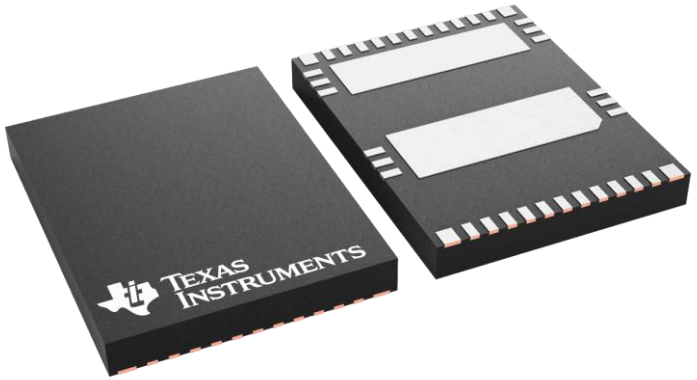
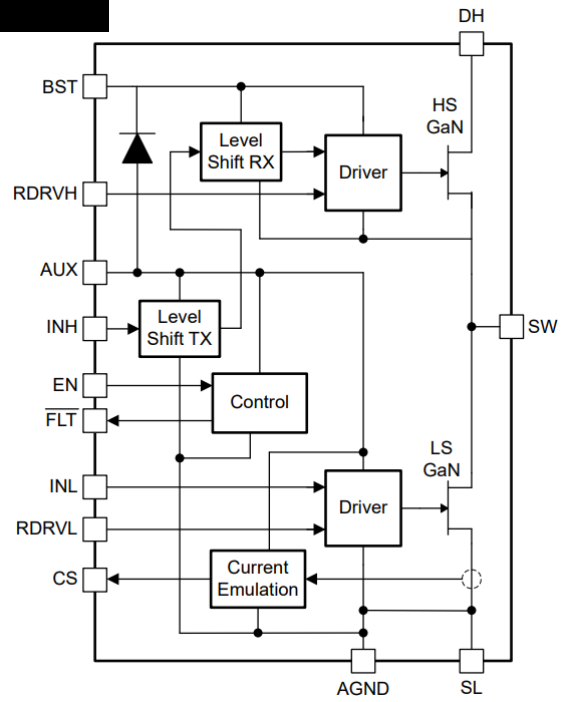
Gallium Nitride





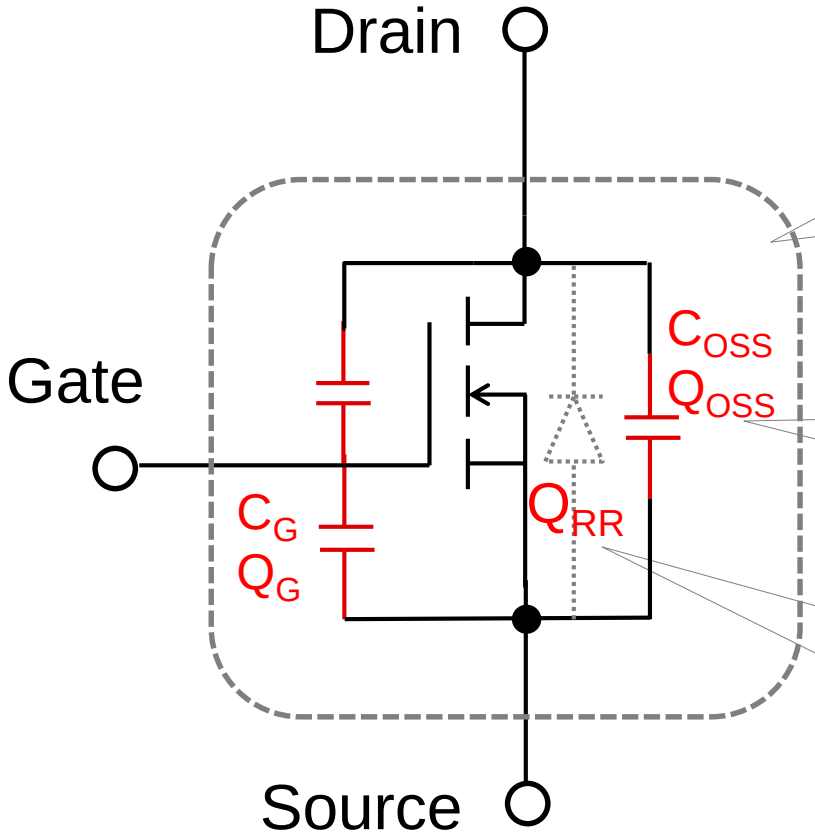
Agenda

1. Quick GaN basics

2. LMG2610 – TI’s latest HB GaN device

3. LMG2610 EVMs and reference designs

GaN FET basics



Low C_G,Q_G gate capacitance/charge (1 nC-Ω vs Si 4 nC-Ω)

- ✓ Faster turn-on and turn-off, higher switching speed
- ✓ Reduced gate drive losses

Low C_{OSS},Q_{OSS} output capacitance/charge (5 nC-Ω vs Si 25 nC-Ω)

- ✓ Faster switching, high switching frequencies
- ✓ Reduced switching losses

Low R_{DSON} (5 mΩ-cm^2 vs Si >10 mΩ-cm^2)

- ✓ Lower conduction losses

Zero Q_{RR} No ‘body diode’

- ✓ No reverse recovery losses
- ✓ Reduces ringing on switch node and EMI

Power adapters addressing consumer needs

- Reduce power adapter size and weight.
- Improve thermal performance and eliminate external components.
- Increase power efficiency and speed up charging times compared to silicon-based solutions.

TI GaN benefits

- The highly integration solution:
  - Ease of use: Gate driver integrated
  - Reduce power loss: Overcurrent detection without using additional shunt resistor
  - EMI performance optimization: Adjustable gate-driving strength control

LMG2610 – Integrated GaN Half-Bridge for ACF

Features

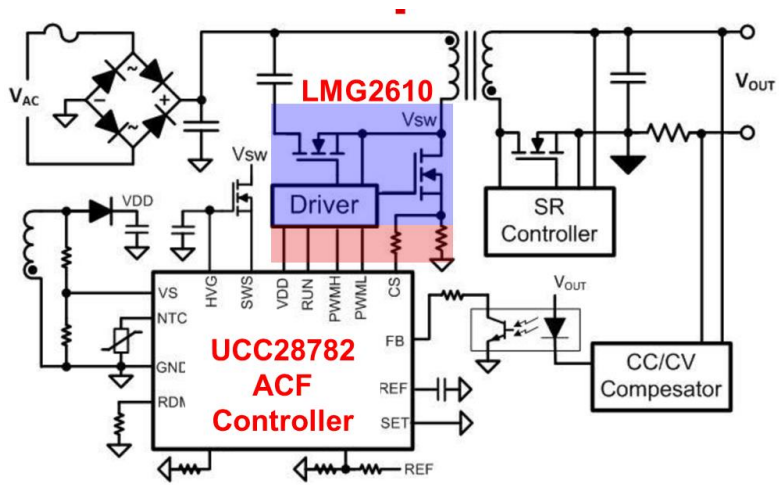
- **650V, 170mΩ / 250mΩ GaN half-bridge with integrated gate driver**
- Up to 1MHz switching frequency
- **Integrated level-shifter and bootstrap diode (0 Qrr)**
- **Integrated LS current shunt emulation: 1mA/A output**
- Adjustable drive strength control
- Low propagation delays
- Overcurrent protection and thermal protection
- Fast high-side power up (< 8 µs)
- Low quiescent standby mode (35µA LS / 60µA HS)
- 7x9mm^2 QFN package with dual thermal pads

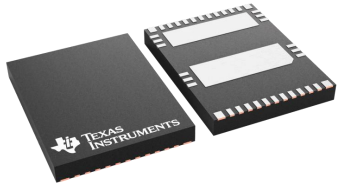
Applications

- Consumer AC/DC chargers, adaptors < 75W without PFC, 140W with active PFC
- Other industrial AC/DC

Benefits

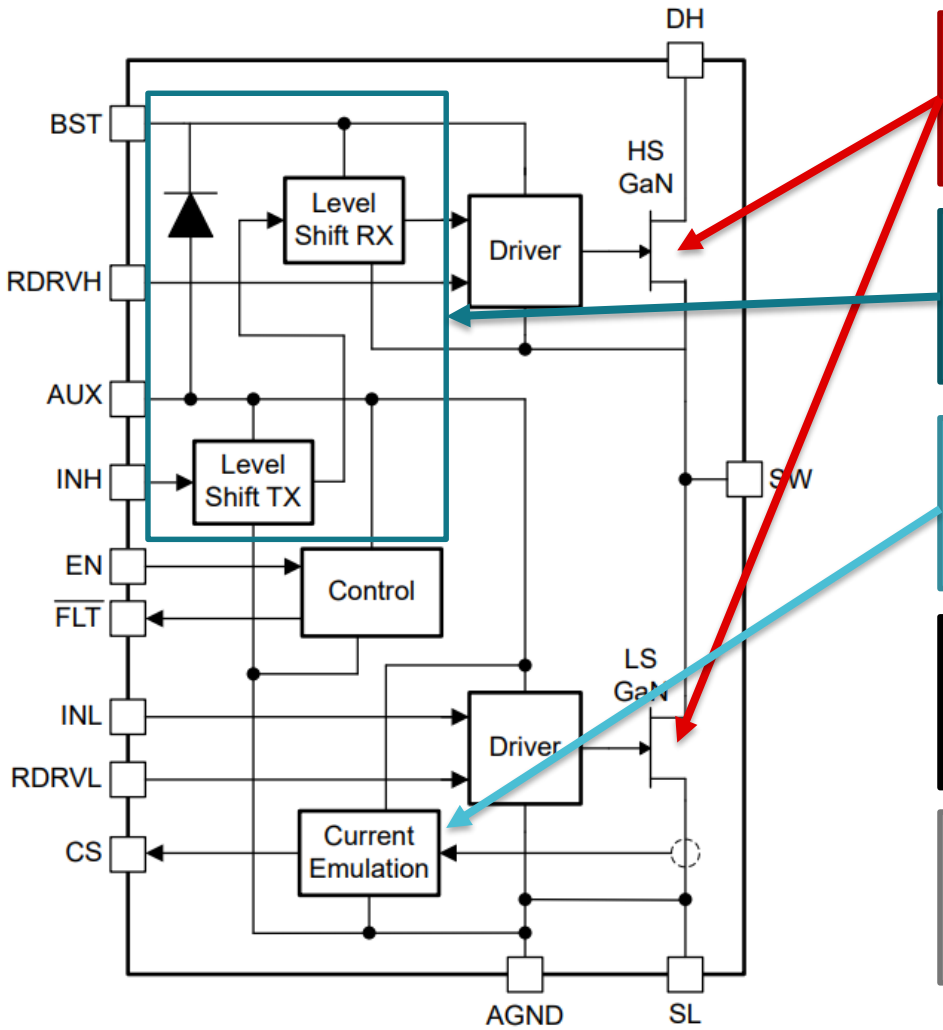
- Improved standby, light load and full load efficiency
- Higher integration, less external components
- Higher frequency capability, faster propagation delay
- Robust, reliable solution with current & temperature protection





7x9mm^2 QFN Package
Dual DAP 0.5mm pitch

LMG2610: Features



650V, 170mΩ / 250mΩ GaN half-bridge
Integrated 1MHz gate drivers for ease-of-use

Integrated level-shifter and bootstrap diode (0 Qrr)

Integrated current shunt emulation: 1mA/A output

Fast high-side power up (< 8 µs)
Low quiescent standby mode (35µA LS / 60µA HS)

Overcurrent protection and thermal protection

Feature: Current Sense Emulation

- Scaled-down replica of GaN drain-source current is sourced out of device pin into external resistor to create current sense signal.
- Achieves both power loss and space savings by eliminating traditional high-power / large-size current sense resistor in series with power FET source.
- Allows device thermal pad to be connected to system ground for improved system thermal performance.

Example Comparison – 65 W Flyback Converter at Low Line

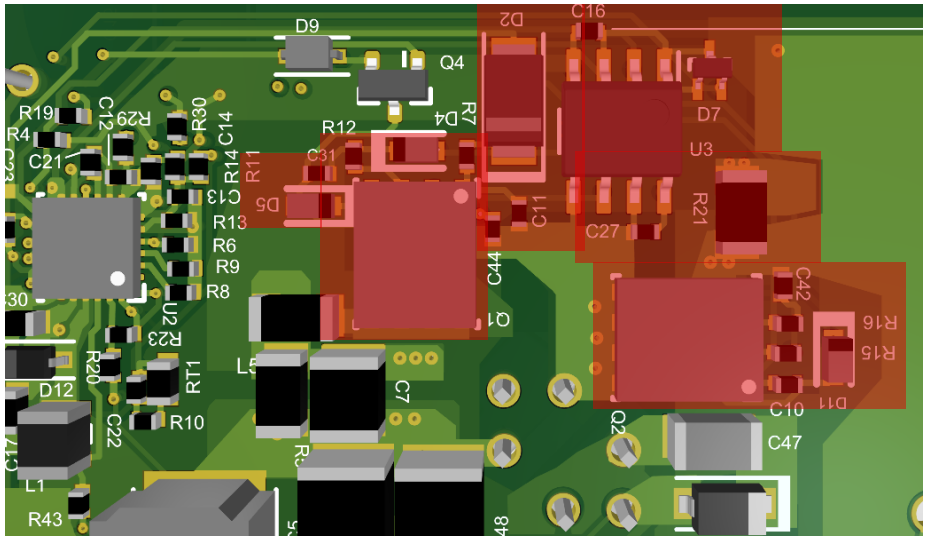
Current Sense Method	Resistor	Power Loss
Traditional	0.12 Ω, 0.5 W, 1206	173 mW
Emulation	120 Ω, 0.063 W, 0402	9.6 mW

Detail Competitive Analysis (BOM & Layout)

Discrete solution

Item	Device	Designator	Description	Qty.
1	GaN FET	Q1,Q2	NV6115 or NV6117	2
2	Isolator driver	U3	ISO7710FD	1
3	Diode	D6,D7	RUN+PWMH to Isolator, 30V	2
4	Capacitor	C16,C11,C18	Isolater VCC caps, 22nF/0402	3
5	Zener	D5,D9	GaN FET internal regulator Ref.	2
6	Zener	D4	Isolater VCC2 zener ,	1
7	Resistor	R12,R16	VDD in series resistor,0402	2
8	Capacitor	C31,C49	GaN FET VDD caps, 0402	2
9	Boost diode	D2	Boost diode, 600V	1
10	Boost resistor	R7	boost resistor, 0805	1
11	Current sense	R21	Current sense resistor , 1206	1
12				
13			Total	18

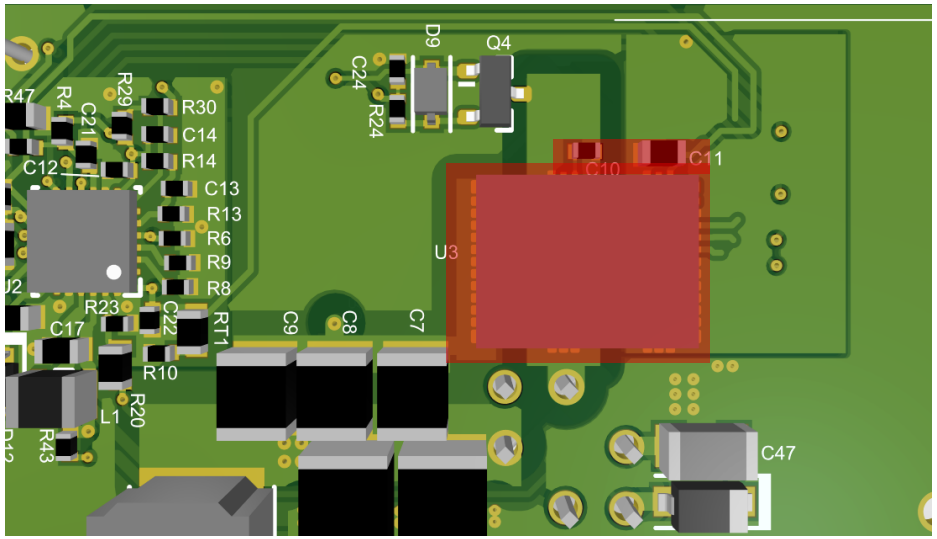
~200mm²



LMG2610

Designator	Description	Qty.
U3	LMG2610	1
/		
/		
C10	Bootstrap cap, 22nf, 0402	1
/		
/		
R11,R12	slew rate setting resistor	2
C11	low side VCC bypass cap, 1uf, 0603	1
/		
/		
R47	0402 Size	1
Rxx	Resistor for FLT pin pullup	1
	Total	7

~75mm²



UCC28782EVM-030 65W EVM with LMG2610

- Universal AC input (90-264 Vac), 65W USB Type-C™ PD 3.0 AC/DC adaptor (5V/3A, 9V/3A, 15V /3A, 20V/3.25A)
- Compliant with CoC Tier 2 and DoE Level VI requirements
- Efficiency 93% @ 90Vac/65W
- 145kHz (90Vac/65W) to 225kHz (265Vac/65W) frequency
- Designed with RM8 transformer
- Density without case: 30-W/in^3 or 2-W/cc
- Size without case: 41mm x 47mm x 17mm (33cc)
- Frequency dithering, x-capacitor discharge simplifies compliance with EMI requirements EN 55022

TI GAN vs. discrete GaN FET

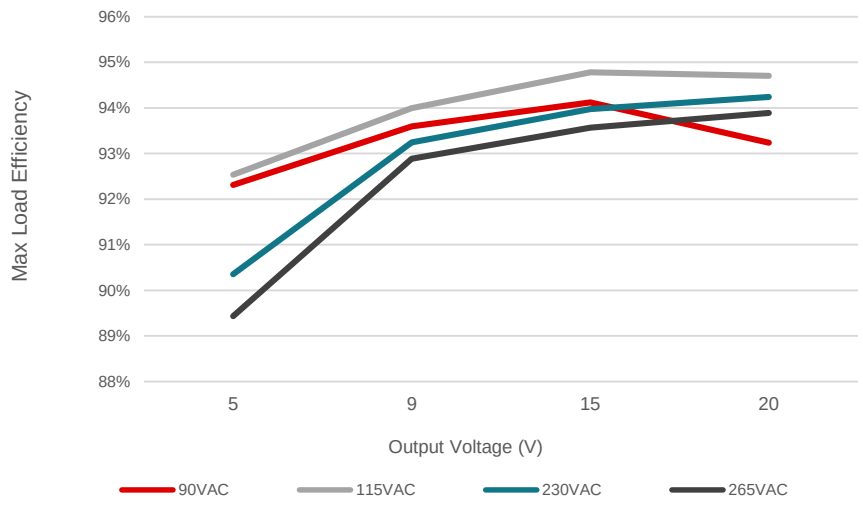
- **System BoM Count Reduction**
  - ✓ Integrated HB Driver
  - ✓ Level shifter
  - ✓ Boot strap diode
  - ✓ Integrate current sense
- **Ease of Use/ simplified design**

65W ACF EVM

H/W available Now

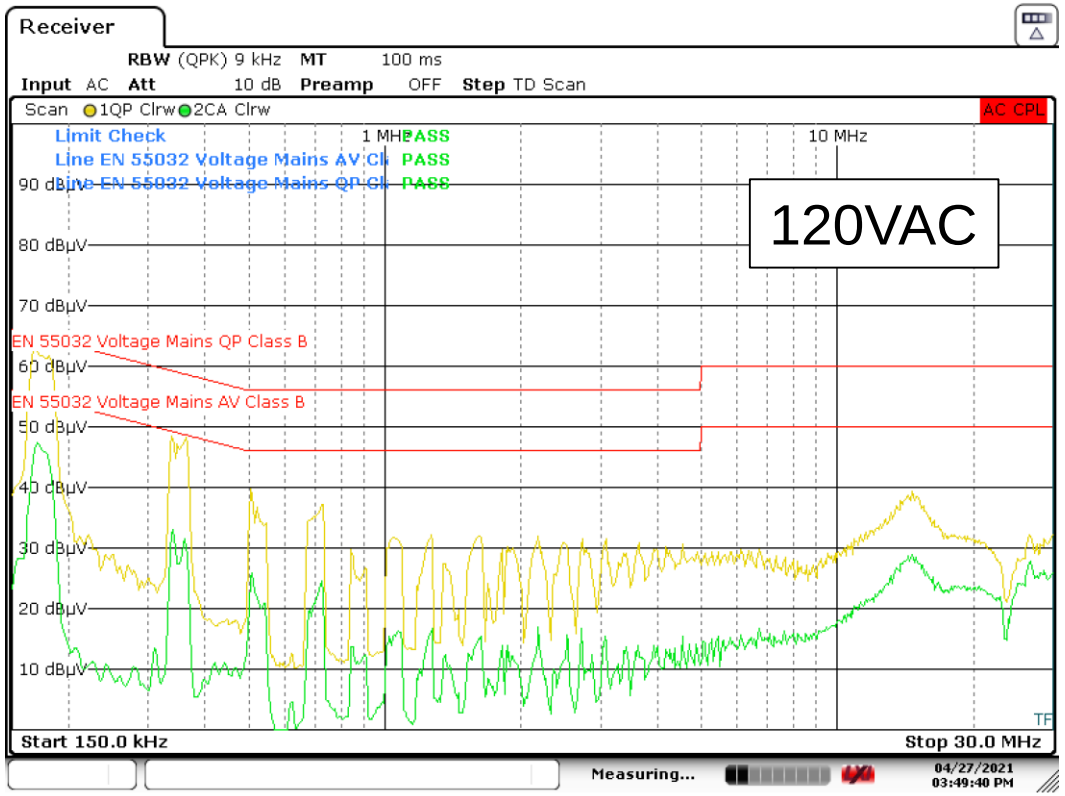
Vout	90VAC	115VAC	230VAC	265VAC
5	91.5%	92%	90.3%	89.4%
9	92.9%	93.5%	93.3%	93%
15	93.4%	94.3%	94%	93.7%
20	92.5%	94.3%	94.2%	94%

5V/9V/15V at 3A; 20V at 3.25A



Conducted EMI

- ✓20V/3.25A; output tied to LISN ground
- ✓Dithering enabled



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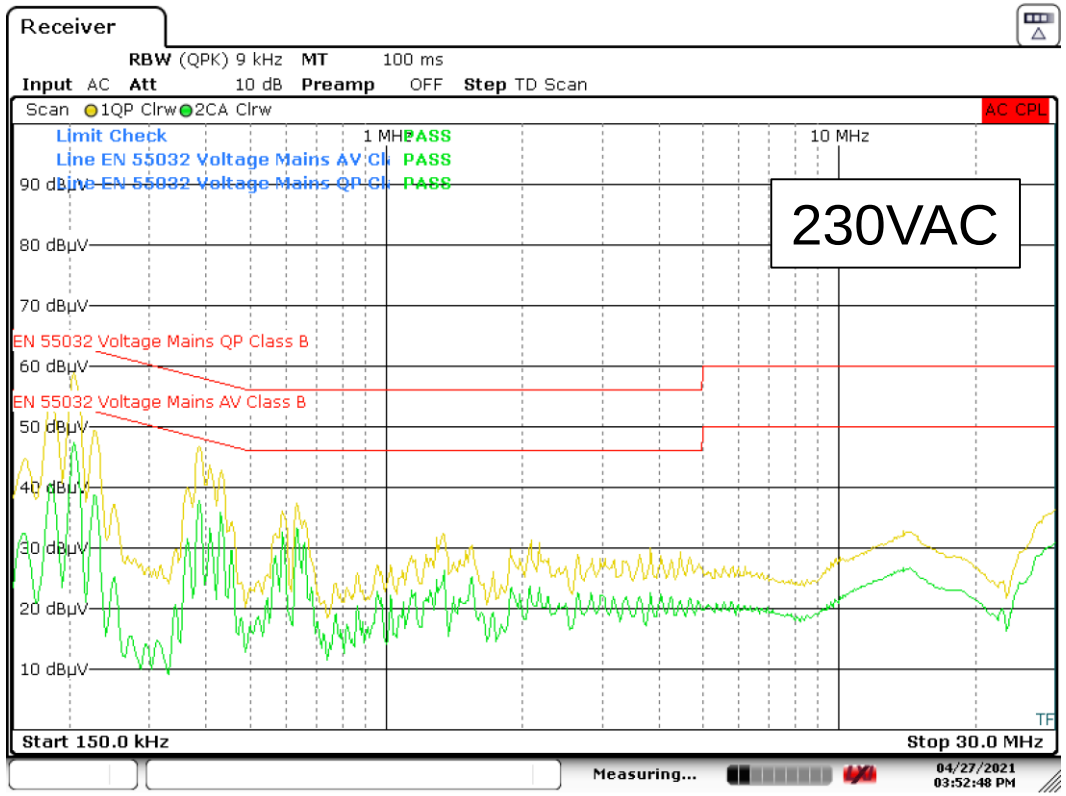

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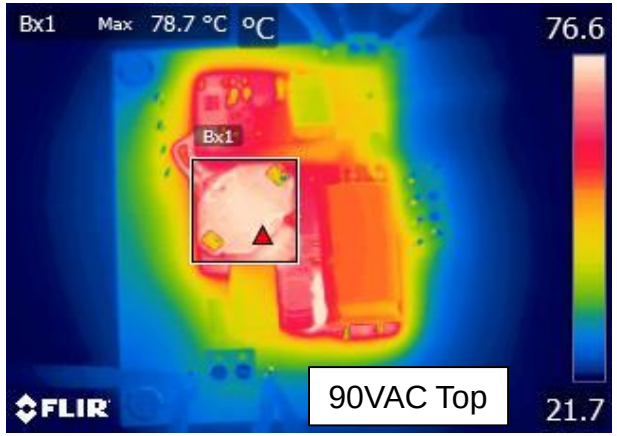
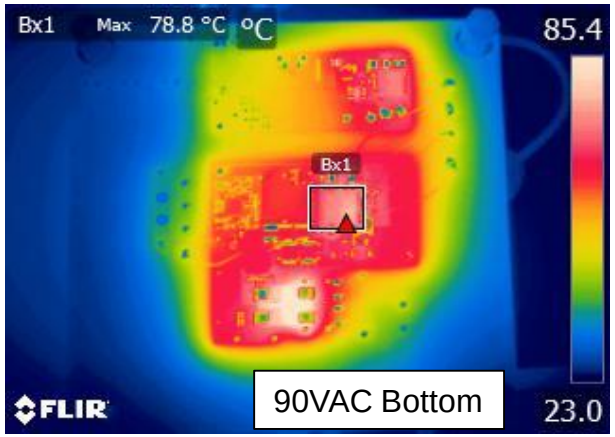
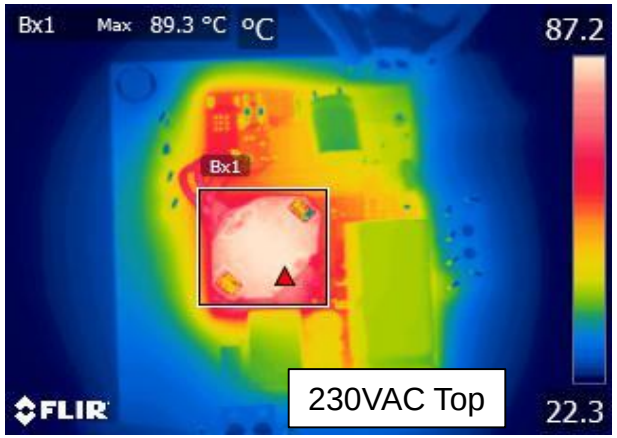
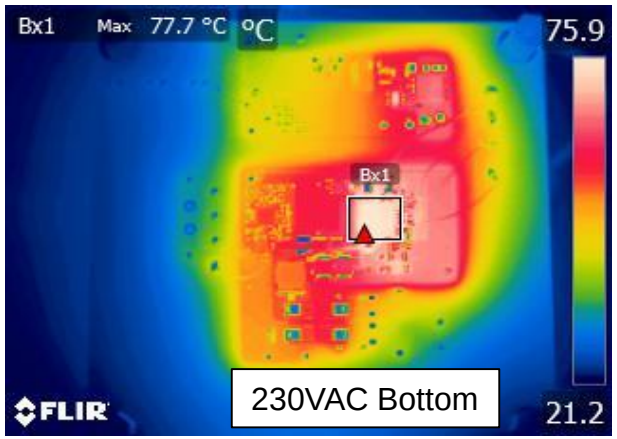
Thermal Data

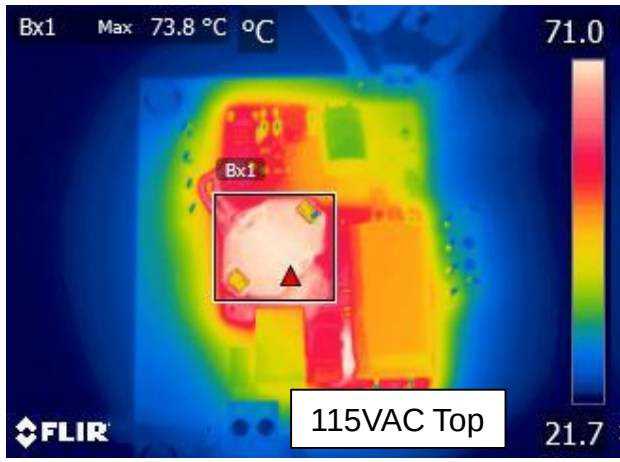
- ✓ Ambient temp: 25C
- ✓ Soak time: 30min
- ✓ Hot spot : Transformer

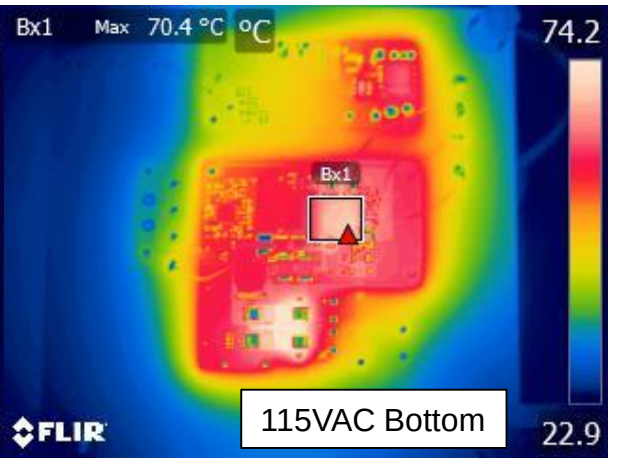


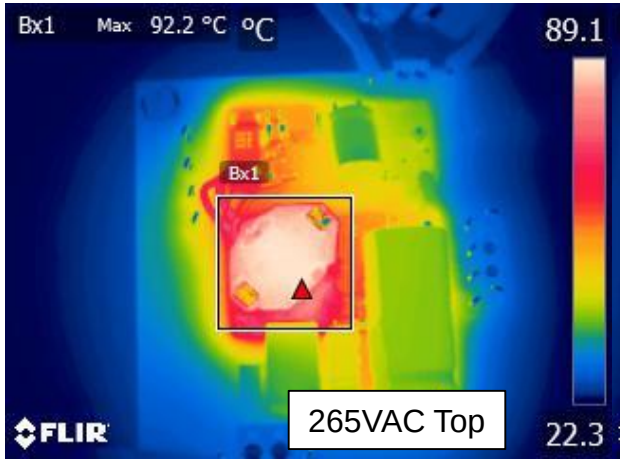


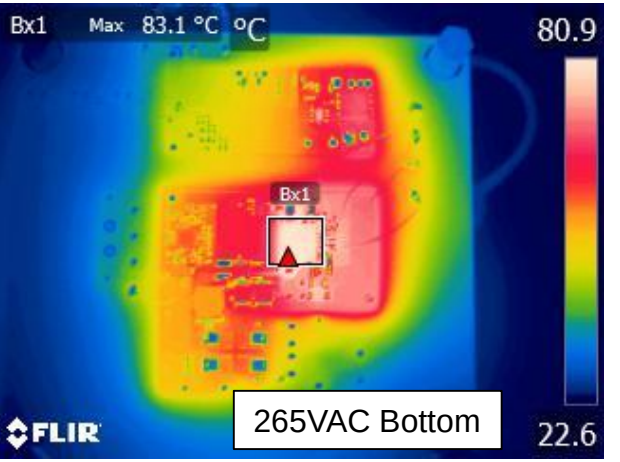












Comparison

- TI device offers more feature integration and less system-level BOMs.

Features	LMG261x	Comp 1	Comp 2	Comp 3
Driver	Integrated	Integrated	Integrated	Discrete
Current emulation	Yes: 1,000x	No	Yes: 3,520x	No
Quiescent current	240µA	850µA		NA
Low standby Mode	Pull low EN pin (20µA)	Ext circuit to cut Vcc	Auto standby mode (275µA)	No
VDD regulation	Internal	Ext Zener	Ext 2 caps	No
Turn on strength adjustable	Yes	Yes	Yes	driver design
FLT signal	Yes	No	No	No
OTP	Yes (save ext NTC)	No	Yes	No
OCP	Pulse by pulse limited	No	Pulse by pulse limited	No
VCC voltage	10-26V	10-24V	9-24V	No
Transient ring peak voltage	800V	800V	800V	750V

PMP22244 60W USB-C PD wall outlet ACF design

Features

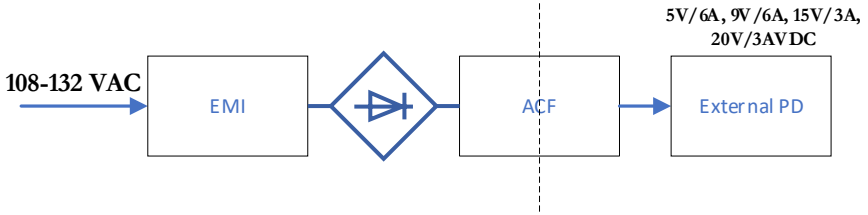
- Supports 20-V/3-A, 15-V/4-A, 9-V/6-A, or 5-V/6-A outputs
- North America 108-132VAC operation
- 94.8% maximum efficiency, maximum power loss of 3.5W
- Compact dimensions of 1.5”x3.35”x1”(37.5mmx85mmx25mm)
- Active clamp flyback (ACF) LMG2610 + UCC28782 ACF controller
- Input voltage range: 108 – 132 VAC

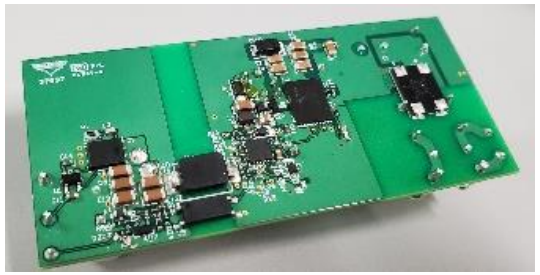
Benefits

- High Power Density Design with Half-bridge Integrated GaN pairing with TI ACF controller
- Low power loss enables reliable performance in small wall outlet enclosure
- Reduced BOM count through integration of half-bridge, bootstrap diode, and level shifter
- Current sense emulation: eliminate conduction losses in external current sensing

Target Applications

- USB wall power outlet





Tools & Resources

- **Design Files:** Schematics, BOM, Gerber
- **Device Datasheets:**
  - LMG2610 – ACF GaN HB 170/250mOhm
  - UCC28782 – High-frequency ACF controller
  - UCC24612 – High-frequency SR controller

On ti.com now!

Other Resources: www.ti.com/gan

Training videos

[Link]

[Link]

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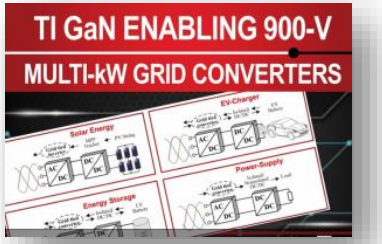

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Mandarin Training

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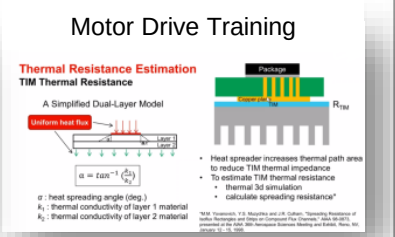
Motor Drive Training



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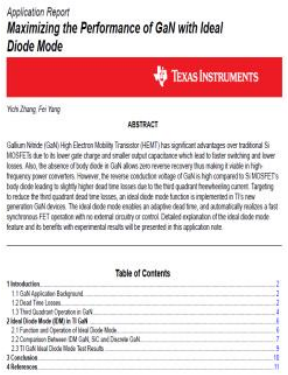
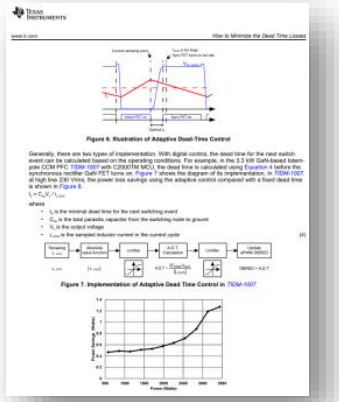
App notes

TI GaN Ideal Diode Mode [Link]

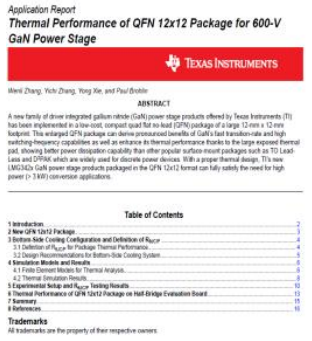


TI GaN 3rd Quadrant Operation [Link]



TI GaN Direct Drive *[Link]*

Thermal Design [Link]



Design tools

GaN Reference Designs

99% efficient 3-phase inverter

1MHz 1.6kW CrM Totem Pole PFC

Bidirectional 3.3kW CCM Totem Pole PFC

GaN Plug-in Daughter Cards

LMG3411R150 Daughter Card

LMG3411R070 Daughter Card

LMG3411R050 Daughter Card

GaN Buck-Boost Motherboard

TEXAS INSTRUMENTS

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