

# New Product Update

How a self-biasing GaN flyback converter can solve AC/DC adapter design challenges

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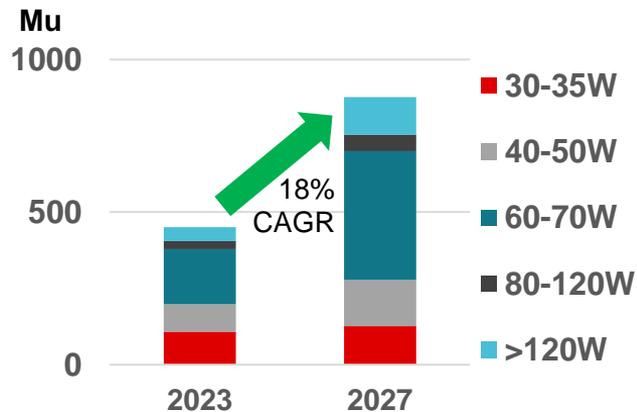
High Voltage Converters

# Agenda

- AC/DC adapter trends and designs challenges
- UCG28826 product overview and AC/DC power supply benefits
- 65-W USB type-C PD adapter design and measurement results

# AC/DC adapter market trends

## Annual USB-PD adapter shipment volume

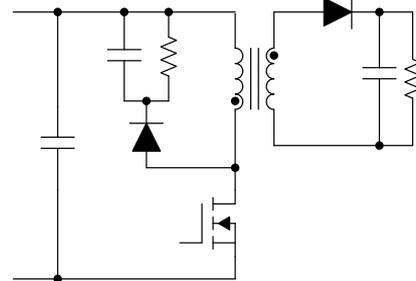
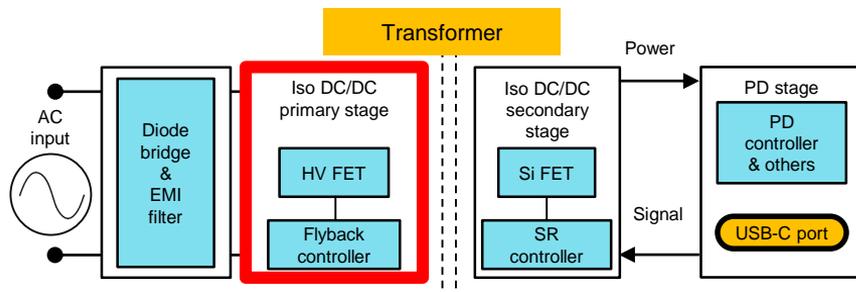


## Growing USB-PD adoption



- ✓ Higher power
- ✓ Higher efficiency
- ✓ Smaller size
- ✓ Lower cost

# AC/DC adapter design trends



Component/feature	Characteristics	Benefits
Flyback converter	Simple operation Lower component count	Faster design time Lower cost
Integrated GaN FET	Lower conduction loss Lower switching loss Smaller die size	Higher efficiency Higher density, smaller size
Quasi-resonant operation	Lower switching loss	Higher efficiency

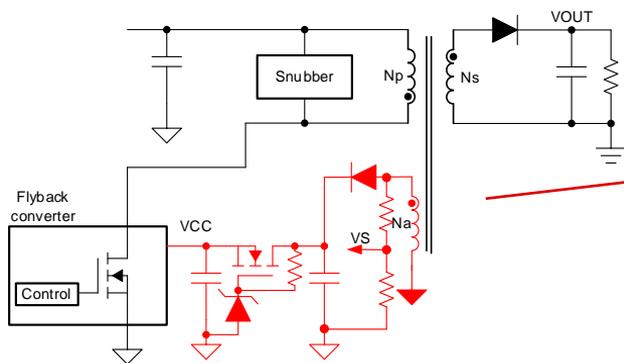
# Design challenges for AC/DC adapters

The transformer auxiliary winding (alongside power-conversion and sensing circuitry) serves two purposes:

- Generate flyback converter bias (VCC)
- Voltage sensing (VS) (e.g. valley detection for QR operation)

This is even more problematic in USB-PD applications due to variable output voltages, requiring additional bias-power conversion circuitry to reduce VCC voltage stress

Output voltage	Auxiliary winding voltage
6x increase 3.3V 20V	6x increase 10V 60.6V



- ✗ Higher component count
- ✗ Higher cost
- ✗ Larger PCB area
- ✗ Lower efficiency

How can we resolve this?

# UCG28826

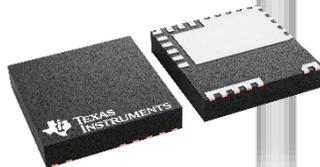
## Self-biased high-frequency QR flyback converter with integrated GaN

### Features

- **Self-bias & auxless-sense** without an aux winding and/or LDO
- Integrated **170mΩ 650V GaN** FET, HV start-up and current sense
- Dynamic CCM/QR/DCM operation with up to **500kHz** sw. freq.
- Enable **<30-mW** standby power with frequency foldback and burst mode control
- **EMI mitigation** with adjustable switching slew rate, frequency dithering, and valley hopping
- **Comprehensive protection features**
  - OTP, OVP, SCP, OCP, OPP, Brown-in/out
  - Consistent OPP trip points meeting the LPS requirement
- **Highly configurable** via external pins

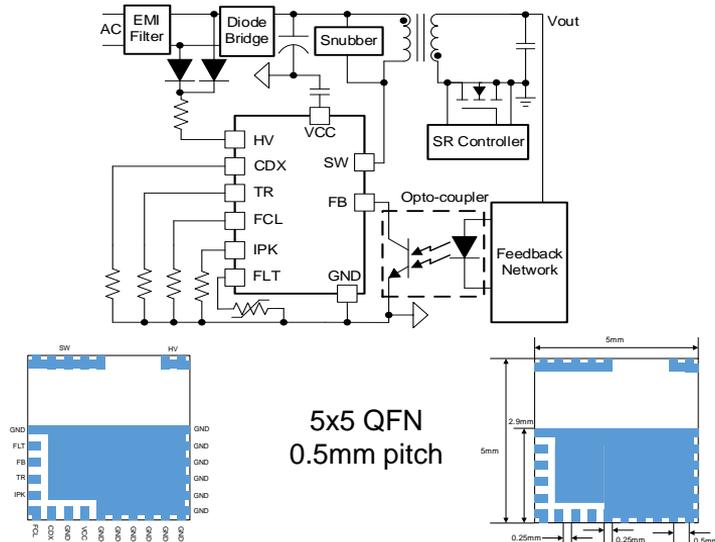
### Applications

- High density AC/DC power supply
- Cell phone fast charger and notebook adapter
- USB type-C wall outlets and docking stations
- Audio soundbars and smart speakers



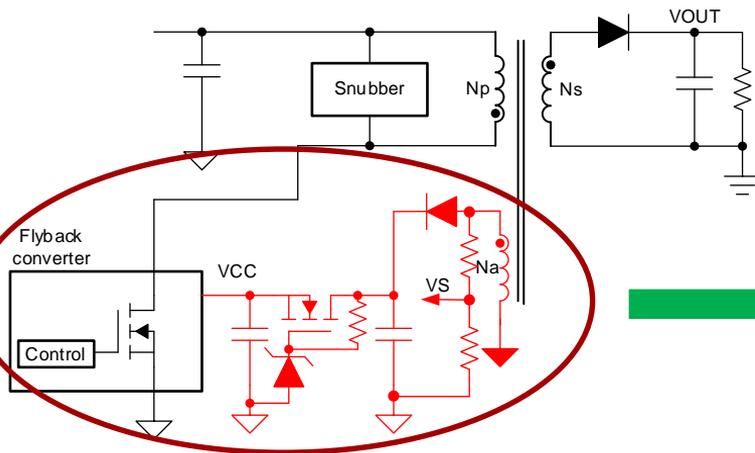
### Benefits

- Simplified system design with fewer external components
- Enables higher power density designs
- Simplified bias supply management for wide Vout applications
- Enables simplified EMI mitigation



# UCG28826 self-bias & auxless-sense feature

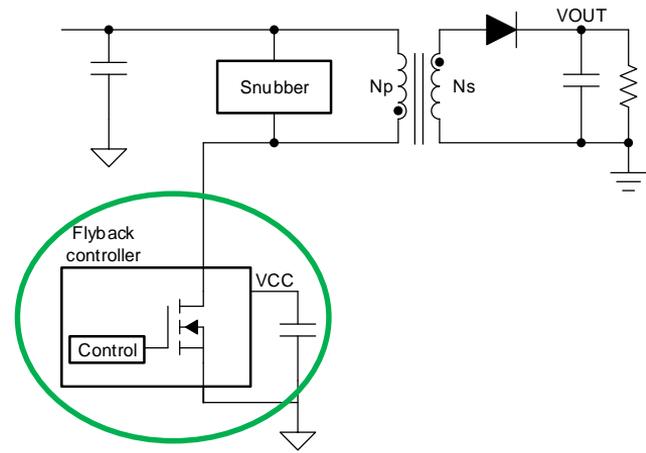
## Typical flyback



### Requires VCC power-conversion and sensing components

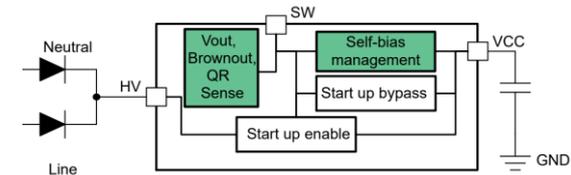
- X Transformer auxiliary winding
- X VCC preregulator
- X HV rectifying diode
- X HV VCC electrolytic capacitor
- X Sensing resistor divider
- X Current-sense resistor

## UCG28826 flyback



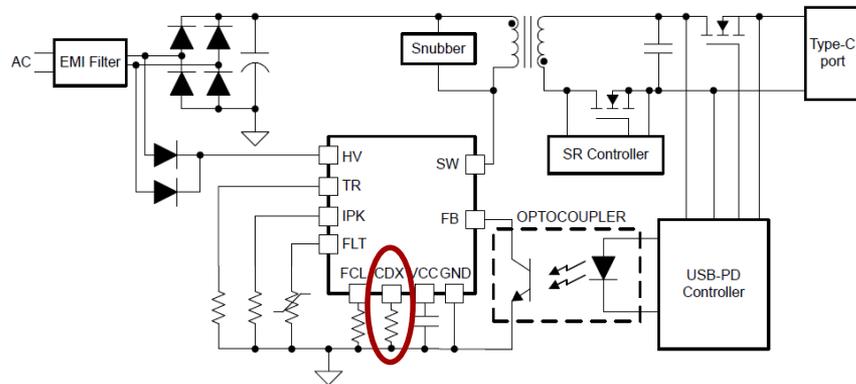
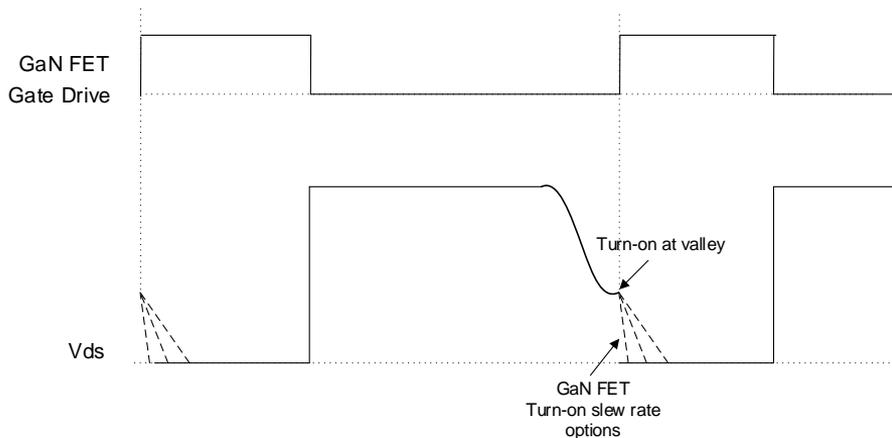
### Eliminate aux winding and power conversion circuitry

- ✓ Lower component count
- ✓ Design simplicity
- ✓ Smaller PCB area
- ✓ Lower cost
- ✓ Higher efficiency



Higher integration with reduced solution cost and size

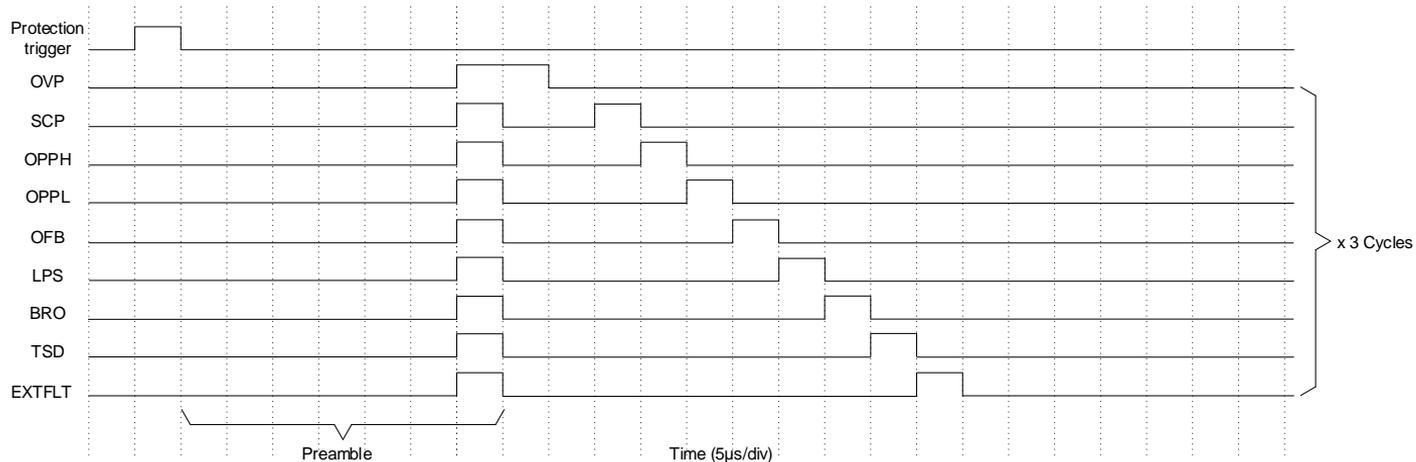
# UCG28826 switch node slew rate control



- Common mode noise is created by switch node  $dv/dt$
- Traditionally, gate resistor is used to adjust  $dv/dt$  to reduce common mode EMI noise
- Turn-on  $dv/dt$  can be adjusted through UCG28826 CDX pin
- 3 step options (3V/ns, 5V/ns, 7V/ns)

# UCG28826 fault code report

- Traditionally, during the design process, the triggered protection has to be guessed and ruled out one by one through trial and error.
- UCG28826 sends an error code out on the CDX pin, dependent on the triggered protection. No more guess work!



# UCG28826EVM-093: 65-W USB Type-C PD design with integrated GaN flyback converter

## Key specifications

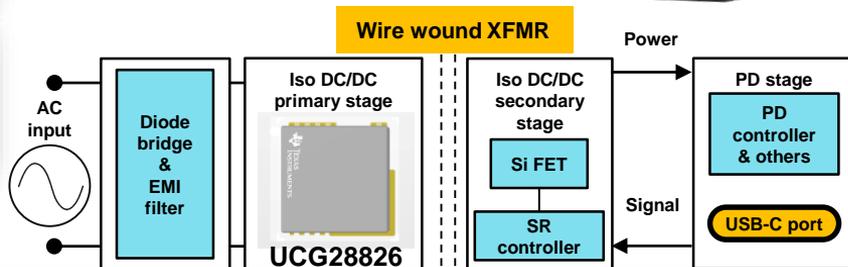
- Input voltage: 90 to 264VAC
- Max output power: 65W
- Output voltage range: 5-20Vdc
- PD output: 5V/3A, 9V/3A, 15V/3A, 20V/3.25A
- EMC compliance CISPR32B / EN55032B
- Average efficiency and standby power to meet DoE level VI and CoC Tier 2 limits
- Peak Efficiency > **94%**
- Power density: **2.8W/cm<sup>3</sup>** without case
- Form factor w/o case: **3.9cm x 3.43cm x 1.71cm= 23cm<sup>3</sup>**

## Applications

- Cell phone chargers
- Notebook adapters
- High density PSU

## Benefits

- Auxless design enables lower component count, higher density
- Supports USB-PD charging protocol
- Quasi-resonant operation with adjustable valley switching function to maximize efficiency at any line and load condition
- SSR topology implementation with an Opto-coupler for accurate step voltage control

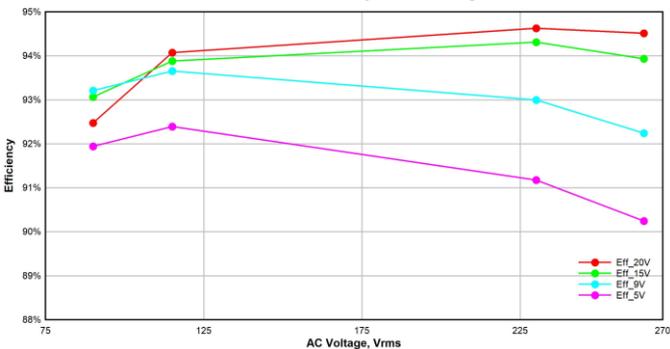


For User's guide and more: <http://www.ti.com/tool/UCG28826EVM-093>

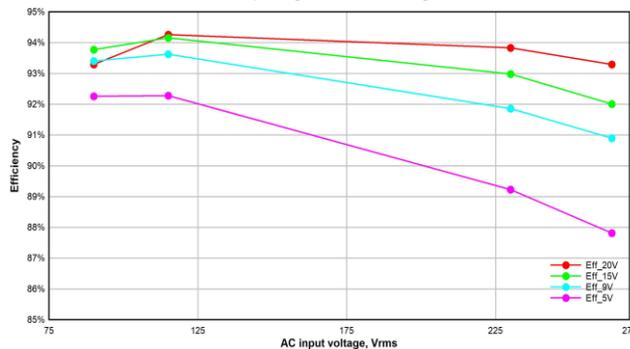


# UCG28826 EVM efficiency performance

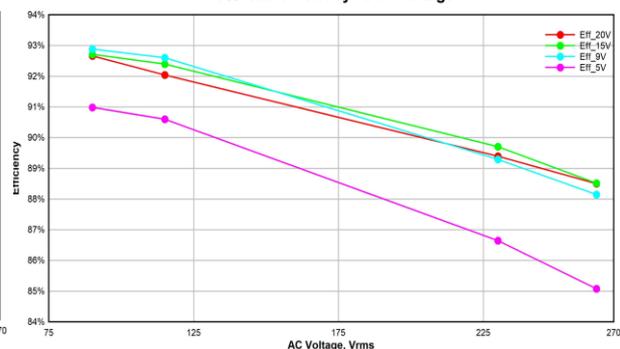
Full load efficiency vs I/P voltage



4-pt Avg. Eff vs I/P voltage



10% load efficiency vs I/P voltage



**10mW standby power @115VAC**  
**26mW standby power @230VAC**

Output	CoC requirement	Pass?
20V/3.25A	89%	Yes
15V/3A	88.85%	Yes
9V/3A	87.3%	Yes
5V/3A	81.8%	Yes

Output	CoC requirement	Pass?
20V/3.25A	79%	Yes
15V/3A	78.9%	Yes
9V/3A	77.3%	Yes
5V/3A	72.5%	Yes



# Getting started

You can start evaluating this device leveraging the following:

Content type	Content title	Link to content or more details
Product folder	Self-biased high frequency QR flyback converter with integrated GaN	<a href="#">UCG28826</a>
Technical blog content or white paper	How an auxless GaN flyback converter can solve AC/DC adapter design challenges	<a href="#">Technical Article</a>
Reference design / evaluation module	65-W high-density USB-C adapter design with UCG28826 GaN flyback converter	<a href="#">UCG28826EVM-093</a>
Reference design	65-W dual port design 65-W dual port slim design And more.....	Coming soon.....

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