What’s Happening with These new Offline Controllers?

High Voltage Controllers
Michael O’Loughlin
New Offline Power Supply Controllers

**No Power Factor Correction**

- EMI Filter
- Full Wave Rectifier
- Isolated DC/DC

**Active Power Factor Correction**

- EMI Filter
- Full Wave Rectifier
- Power Factor Correction
- Isolated DC/DC

### < 30 W

- Primary Side Regulated Flyback
  - UCC28704
- Volt-Sec Balance SR
  - UCC24636

### < 75 W

- Active Clamp Flyback
  - UCC28780
  - VDS Sense SR
    - UCC24612

### < 300 W

- Transition Mode PFC
  - UCC28056
  - LLC Resonant
    - UCC25630x
  - VDS Sense SR
    - UCC24612

### < 600 W

- Interleaved TM PFC
  - UCC28064
  - LLC Resonant
    - UCC25630x
  - VDS Sense SR
    - UCC24612

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*Texas Instruments*
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### Power Levels

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  - VDS Sense SR
  - UCC24612

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  - UCC28064
  - LLC Resonant
  - UCC25630x
  - VDS Sense SR
  - UCC24612
Isolated Flyback Background

The Flyback converter is a popular choice
  – Offline low power applications

Advantages
  – Low cost from simplicity of power stage (6 Comp.)

Disadvantages
  – Poor transformer utilization
  – High AC losses.
  – Soft switching is difficult to achieve.
  – Peak switch voltage > Vin
UCC28704 Primary Side Regulation (PSR)

- \( N_S/N_A \) Samples and Measures the Output Voltage (\( V_{OUT} \)) for Power Supply Control
  - **Removes** the need for TL431 feedback
    - Saves Money
    - Reduces Standby Power
UCC28704 DCM Flyback Controller with Valley Switching

- Turns the main FET on (DRV) at the Valley of the Resonant Ring
  - **Soft Switching** Reduces FET Switching Losses, **Better Efficiency**
## Features

- Efficiency performance exceeds DoE Level VI and CoC V5 Tier-2 EPS standards
- Primary Side Regulation (PSR) eliminates all secondary-side feedback components
- Enables less than 30mW no-load input power
- ±5% Output voltage and current regulation accuracy
- Enhanced dynamic load response
- Output under-voltage (CCUV) protection with auto-restart
- 85 kHz maximum switching frequency
- NTC resistor interface
- Fault Protections: Input Low Line, Output Over-Voltage, Over-Current, and Short-Circuit

## Benefits

- PSR eliminates feedback components (TL431, opto, etc.) and issues with opto long term reliability and temperature shifts
- 5V/2A charger compliance with DoE Level VI standard using low cost Schottky diode rectifier (no SR required)
- USB connector over heat or burn out protection from soft short circuit fault

## Applications

- Wall chargers/adapters for phones and tablets
- AC/DC power supplies for Industrial SMPS (Home and Building Automation, Grid etc.)
- AC adapters for consumer electronics
- Auxiliary power supply

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UCC28704 | Offline CV/CC Primary Side Regulation Flyback Controller

Optional low standby power high voltage startup
UCC24636 Volt-Sec Balancing Operation

- Designed for QR, TM and DCM Flyback Converters
- Uses Transformer Volt-Second balance technique to control SR DRV instead of $V_{\text{RDS(\text{on})}}$ sensing.
  - Less Noise Sensitive
## UCC24636 | Volt-Second Balancing SR Controller

### Features
- Volt-Second Balance SR ON-time control and gate driver, Less Noise Sensitive
- Auto Low-power detect, Stand-by IOCC of 110μA
- Integrated 2Ω/6Ω source/sink gate driver compatible with wide VDD voltage, clamped at 13V
- Wide VDD range 3.75V to 28V, UVLO 4.0/3.6V
- 130kHz maximum switching frequency
- Operation only with DCM and TM/QR flyback converters
- Compatible with PSR & SSR flybacks
- Linear programming of blanking/minimum primary on time, from 200ns to 1μs
- Protections: TON Min, TOFF Min & Over Temperature, Pin faults

### Benefits
- SR control technique has several advantages
  - Insensitive to MOSFET RDS,ON & package/PCB layout parasitic
  - Achieves minimum diode conduction, highest efficiency
- Supports AC/DC PSUs from 5V to 24V output
  - Accepts bias from VOUT simplifying design
- Self-manages entry into Stand-by mode, simplifying system design

### Applications
- USB Type-C chargers for Smart phone/Tablets
- 5-24V Output Flyback converters
- Industrial SMPS
Design Tools Available

- UCC28704 Excel Design Tool
  - [www.ti.com/lit/zip/sluc603](http://www.ti.com/lit/zip/sluc603)
  - Step by Step Design Process
- UCC28704 MathCAD Design Tool
  - [www.ti.com/lit/zip/sluc605](http://www.ti.com/lit/zip/sluc605)
  - Step by Step Design Process
UCC28704 Reference Design PMP15002
Universal AC (85V to 265V RMS) Input to 5V 3A Output

Features

- Low cost CC-CV primary side regulated Quasi-Resonant Flyback Controller eliminating the Optical Coupler
- Quasi-resonant/DCM Flyback with Synchronous Rectification
- <75mW standby power
- DOE VI and CoC V5 tier 2 Efficiency Compliant including 150 mΩ cable loss.
- Fully tested and passed EN55022 Class B Conducted & Radiated EMI

Target Applications

- Adapters for Phones and Tablets
- Industry Appliance Aux Power

Tools & Resources

- PMP15002 Tools Folder
- Design Files: Schematics, BOM, PCB file, test report,
- Device Datasheets:
  - UCC28704
  - UCC24636

Benefits

- High efficiency over entire operating range
- Robust design with range of built-in protections
- Simple circuit with low cost Off-the-shelf components
- Reduce design & test cycle
- No need of external compensation components
New Offline Power Supply Controllers

No Power Factor Correction

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  - UCC28704
- Volt-Sec Balance SR
  - UCC24636

Active Power Factor Correction

- Active Clamp Flyback
  - UCC28780
- VDS Sense SR
  - UCC24612
- Transition Mode PFC
  - UCC28056
  - LLC Resonant
    - UCC25630x
    - VDS Sense SR
      - UCC24612
- Interleaved TM PFC
  - UCC28064
  - LLC Resonant
    - UCC25630x
    - VDS Sense SR
      - UCC24612
UCC28780 QR Active Clamp Flyback Advantage

- Replaces Power Dissipative RCD or Diode Clamp with
  - Active Losses Clamp ($Q_C$, $C_C$)
    - $Q_C$ allows bidirectional current $I_C$.
    - Recovers and Returns Leakage Energy to System
    - Removes Clamp Losses ($P_{CLAMP}$) associated with RCD and Diode Clamp

$$P_{CLAMP} = \frac{V_{CLAMP}}{N_P} \times \frac{V_{OUT}}{N_s} \times \frac{1}{2} \times L_{LK} \times I_P^2 \times f_{SW}$$
UCC28780 QRF ACF Advantage

Achieve ZVS 😊

- Controller monitors switch node (Q₁ᵈ)
  - Adjusts $Q_{Cg}$ on time to allow enough $-I_P$ to achieve ZVS.
- This removes QR Switching Losses ($P_{SW(QRF)}$)

$$P_{SW(QRF)} = \frac{1}{2} C_{SW} \left(V_{IN} - \frac{N_P}{N_S} \times V_{OUT}\right)^2 \times f_{SW}$$
**UCC28780 | High Frequency Active Clamp Flyback**

**Features**
- Full ZVS down to light loads designed to be use with both GaN and Si FETs
  - Fast, self correcting ZVS tuning with dead time optimizer
- **Switching frequency up to 1MHz**
- Mix-mode control
  - Adaptive Amplitude Modulation with variable switching frequency control
  - Programmable Light load Adaptive Burst Mode
- Resistor programmability for power stage optimization
- **Internal soft start, open/short pin fault, and programmable Output OVP, brownout protection, OCP, OPP and OTP**
- Secondary-side regulation for CV/CC operation
- Dual purpose ZVS sensing and high voltage startup
- Logic level outputs with enable
- Package: SOIC-16 and 3x3mm QFN (0.50mm pitch)

**Benefits**
- ZVS eliminates switching losses for higher switching frequency
  - Reduced generated EMI and transformer size
- Mixed mode control maximizes performance
  - Maintain ZVS over line, load and component tolerances
  - Highest average efficiency for the entire line/load range
  - Reduces output voltage ripple
  - Eliminates risk of audible noise
- External HV start up FET enables **standby power below 75mW**
- Flexible to work with Si FET driver or GaN power stages
- Accurate OPP reduces required oversize of power stage components
- Satisfies DOE Level VI and CoC v5 tier 2 efficiency standards

**Applications**
- High-density adapters and chargers
- USB PD for cell phone, tablet, and notebook chargers
- AC/DC or DC/DC auxiliary power supplies

[www.ti.com/product/UCC28780](http://www.ti.com/product/UCC28780)
UCC28780 Design Tools Available

• Detailed step by step design guide included in the data sheet

• UCC28780 QR ACF MathCAD design file
  – www.ti.com/lit/zip/sluc644

• Excel design file to be developed and released in the near future
EVM Available 45W GaN FET using UCC28780 & UCC24612

Open Frame Power Density 21.5 W/in³

4 Point Average Efficiency 93.9% at 115 V
92.5% at 230 V

Notes:
1. Fully Compliant with DoE Level VI and CoC Tier 2
2. Input: 85-265VAC RMS, 47-63Hz
3. Output: 20V, 45W
4. Board Dimensions: 2.32in x 1.32in x 0.68in

Online orderable at www.ti.com/tool/UCC28780EVM-002
UCC24612 SR Controller (1MHz)

- **UCC24612-1** Designed for $f_{SW}$ up to 1 MHz CCM/DCM/QR Flyback Converters
- **UCC24612-2** Designed for $f_{SW}$ up to 800 kHz LLC Converters
- Uses $V_{Qds}$ sensing and can operate in both the **High Side (HS)** and **Low Side (LS)** Applications.
UCC24612 Proportional Gate Speeds up FET \( T_{\text{OFF}} \)

- \( V_{\text{Qds}} < V_{\text{THVGON}} \) (-240 mV) Gate is Driven High
  - FET is turned on and gate is driven to \( V_{\text{GATE max}} \) (9.4V)
  - fast turn-on and lowest \( R_{\text{ds(on)}} \)

- \( V_{\text{Qds}} > V_{\text{THREG}} \) (-50 mV)
  - Gate Drive Drops from Max (9.4V) to \( \approx 6V \)
  - This Speeds up FET Turnoff

- \( V_{\text{Qds}} > V_{\text{THVGODD}} \) (-9 mV)
  - Gate drive is pulled low and FET is turned off.
  - Faster than turning of FET from \( V_{\text{GATE max}} \)
  - Will work with \( f_{\text{sw}} \) of up to 1 MHz
UCC24612 is Easy to Use

- Use recommended
  - VDD Cap (C2 = 1 μF)
  - REG Cap (C1 = 2.2 μF)

- Setup R3 C3 snubber
  - Driver Disabled, 10% Load
  - Measure Q1 ring frequency \( f_r \)
  - Calculate Qd switch node capacitance (\( C_S \))
  - Select R3 and C3 to critical damp the ring (Q=1)

- Driver is Setup and Ready to Run

\[
C_S = \frac{1}{\left( 2 \times \pi \times f_r \right)^2 \times L_{slk}} = \frac{1}{(2 \times \pi \times 2\text{MHz})^2 \times 3.8 \mu H} = 1.7nF
\]

\[
R_3 = \frac{1}{Q \sqrt{\frac{L_{slk}}{C_S}}} = \frac{1}{1} \sqrt{\frac{3.8 \mu H}{1.7nF}} \approx 47\Omega
\]

\[
C_3 = \frac{0.01}{5 \times f_{sw} \times R_3} = \frac{0.01}{5 \times 85kHz \times 47\Omega} \approx 497\text{pF}
\]
UCC24612 | Multi-mode Synchronous Rectifier

**Features**
- $V_{DS}$ sensing up to 230 V
- Adaptive off time adjust blanking time according to power stage
- Support QR/DCM and CCM operation
  - Fast turn off propagation delay
  - Proportion drive for light CCM operation
  - Cycle limit for deep CCM operation
- $V_{DD}$ operation up to 28V DC, minimum of 4.2V
- Operation up to 1 MHz
- Automatic sleep mode
- Two variants for support of multiple topologies
  - UCC24612-1 with 70ns turn on delay
    - Best for GaN ACF, DCM, QR/TM, CCM flyback
  - UCC24612-2 with 150ns turn on delay
    - Best for Si ACF, LLC
- Package: SOT-23-5

**Benefits**
- $V_{DS}$ sensing and adaptive off time reduces required parts and eliminates design effort
- High $V_{DS}$ rating supports large output voltages with overshoot
- Sleep mode enables low standby power consumption
- Near-ideal diode emulation enables compliance with EC CoC Tier 2 and DoE Level VI efficiency standards

**Applications**
- High density and USB-PD adapters
- High efficiency AC/DC converter
- AC/DC or DC/DC auxiliary power supplies

www.ti.com/product/UCC24612
UCC24612 Design Tools

**Retrofit Daughter Card EVM**
Replace any diode based design with UCC24612 based SR to measure performance gains
www.ti.com/tool/UCC24612-1EVM

**SIMPLIS Model**
Simulate performance to help finish designs faster
www.ti.com/lit/zip/slum597

**Range Extension App Note**
Learn how to configure UCC24612 to work beyond the typical parameters
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UCC28064
LLC Resonant
UCC25630x
VDS Sense SR
UCC24612
UCC28056 Transition Mode PFC (75 to 300W)

- Critical Conduction or Transition Mode (TM)
  - Peak and Average Current Track Rectified Line Voltage
  - Zero Current Switching Allows for use of slow cheaper diode (D) $$$$

$$\text{PF} = \frac{V_{\text{OUT}} \times I_{\text{OUT}}}{\eta \frac{V_{\text{IN(RMS)}} \times I_{\text{IN(RMS)}}}{}}$$
UCC28056 6 Pin High Performance PFC Controller (< 300W)

- Transition Mode (TM) PFC Pre-regulator
  - Aux winding not needed
    - Cheaper Mag. Reduces BOM Cost $$
  - ZCD, MULT and CS inputs integrated into ZDC/CS pin reduces pin count
    - 8 to 6 pin cheaper package reduces BOM Cost$$
UCC28056 6 Pin High Performance PFC Controller (< 300W)

- Transition Mode (TM) PFC Pre-regulator
  - Meets EN61000-3-2 Harmonic Requirements with Great Transient Response
- Designed to Operate with Low Standby Power Without Turning off PFC
  - Burst Mode
  - PFC $P_{\text{STANDBY}} < 40 \text{ mW} @ 230V \text{ RMS Input}$ Capable
**Features**

- **Inexpensive 6-pin TM PFC Controller** with Valley Switching, **Unity power factor and optimized THD**
- **No aux winding needed for ZCD**
- **<50mW no-load power consumption**
- Fast, Enhanced Dynamic Response (non-linear control)
- Robust Protection:
  - Fast response 2nd OVP on a dedicated Pin
  - Soft-start and soft recovery after OVP
  - Input voltage brown out detection
  - Open-loop protection and under voltage protection
- **Strong drive capability:** -1.0A and 0.8A
- Unified algorithm for working in CRM and DCM with High power factor across the entire operating range
- **Industry best light load efficiency with advanced light load efficiency management**

**Applications**

- Lighting
- DTV
- Computing supply and adapters

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**Benefits**

- **Meets EN61000-3-2 Harmonic Requirements with Great Transient Response**
- Superior No-Load and Light Load Efficiency
- Allows Fast Load Transient Response w/ Small Output Cap
- Option for UCC25630 to provide Vcc to UCC28056
- No Inductor ZCD Winding Required Flexible Design Options
- Full, Robust Protection (Same as 8-pin PFC ICs)
UCC28056 Design Tools

- UCC28056 Excel Design Calculator
- UCC28056 Transient Simplis Model
  - [http://www.ti.com/lit/zip/slum620](http://www.ti.com/lit/zip/slum620)
- UCC28056 PFC Evaluation Model UCC28056EVM-296
  - 85V to 265V RMS to 390V, 165W PFC Pre-regulator
  - [http://www.ti.com/lit/zip/slum620](http://www.ti.com/lit/zip/slum620)
UCC256301/2/3/4 LCC Resonant Controller (75W to 500W)

- Delayed Turn-on of Q1 and Q2 allows time to achieve ZVS at $f_r$
  - Optimal performance with a fixed input voltage or PFC pre-regulator (UCC28056)

$$f_r = \frac{1}{2\pi \sqrt{L_m \times C_r}}$$
UCC25630x Uses Adaptive Delay

- Controller Handles it All
  - No need for programmable resistor to achieve ZVS 😊
UCC25630x LLC Resonant Controller

- Hybrid Hysteretic Mode LLC Control
  - Uses a combination of
    - Voltage Control Oscillator
    - Charge Control/Slope Comp Added
    - Controls VCR peak to peak voltage/current
      - Form of Peak Current Mode Control

\[
VCR = I_{C2} \cdot Z_{C2}
\]

\[
I_{C2} = \frac{VCR}{Z_{C2}}
\]
UCC25630x LLC Resonant Controller

• Peak Current Mode Control Simplifies Control to Output Transfer Function (G_CO)
  • Removes resonant double pole caused Lm and Cr in Gco
    – Old control method f_{MIN} = f_r
    – New control method f_{MIN} < f_r
      » Makes loop compensation easier, wider frequency operation range
UCC25630x | Half Bridge Resonant LLC with Integrated Driver

**Features**

- **Hybrid Hysteretic Control (HHC)**
  - Best in class load and line transient response
  - **Easier voltage loop compensation**
- **Optimized light load burst mode enables 80mW standby power when design with PFC** on or enables 40mW standby power design in single stage LLC
  - Advanced burst mode with adaptive threshold
  - Opto coupler low power operation
  - Fast exit from burst mode
- **Improved ZCS avoidance scheme**
- **Adaptive dead-time**
- **X-capacitor discharge**
- **Wide Operating Frequency Range (35kHz ~ 1MHz)**

**Benefits**

- **Highly integrated feature-set reduces BoM cost**
- **Supports self-start power supplies, eliminates Flyback Aux supply**
- **Meet CoC and US DOE Standby Power and Efficiency Standards**

**Applications**

- **Digital TV SMPS**
- **High Efficiency Compact AC-DC power supplies supporting wide power range (Adapters)**
- **Gaming Power Supplies**
UCC256301/2/3/4 design tools

- Application Note
  - www.ti.com/lit/zip/sluc634

- Excel Design Tool
  - www.ti.com/lit/zip/sluc634

- UCC256301 Simplis Model
  - www.ti.com/lit/zip/slum596

- Variant Selection Guide ucc25601/2/3/4

- 120 W, Evaluation Module
  - UCC25630-1EVM-291)
  - (340 V to 410 V DC) in to 12 V,10 A Output
  - www.ti.com/tool/ucc25630-1evm-291
UCC28056+UCC256301 Reference Design  
_TIDA-0155_

85V to 265V RMS Input to 12V, 200W Output, Max Efficiency > 92.5%

**Target Applications**
- Gaming PC Adapter
- Entry level server
- Desktop PC
- Other low cost AC-DC

**Features**
- CrCM/DCM PFC + LLC topology (UCC28056+UCC256301)
- Great light load efficiency:
  - No Load <0.125W; >50% at 0.25W; > 79% at 2W; >81% at 4W
- Great load transient performance (<40us response time for 15A step load change)
- PF > 0.99 @ 230VAC from 50% to 100% load
- Output OCP, OVP, and Short-circuit Protection
- Meets Norms: IEC61000-2-3 Class D, EN–55022 class B (CE)

**Benefits**
- High efficiency over wide load and AC input range
- Super transient performance, good for computing PSU applications.
- **Meets 80 PLUS Gold efficiency specification**
- Robust protection built-in: OVP, OCP, & SCP
- **Low standby power consumption (<125mW)**
- SFX12 form-factor fit (70 x 125 x 35 mm)

**Tools & Resources**
- TIDA-01577 and Tools Folder
- Design Guide
- Design Files: Schematics, BOM, Gerber Files, Test Performance Data
- Device Datasheets:  
  - UCC28056, UCC25630, UCC24612, TLVH431A
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Active Power Factor Correction

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- Full Wave Rectifier
- Power Factor Correction
- Isolated DC/DC

< 30 W

< 75 W

< 300 W

< 600 W

- EMI Filter Full Wave
- Rectifier
- Isolated DC/DC

EMI Filter
- Full Wave Rectifier
- Isolated DC/DC

EMI Filter
- Isolated DC/DC

Full Wave Rectifier
- Power Factor Correction

Power Level (W)

Standby Power

Comp 1: ~250mW @ 230V
Comp 2: ~164mW @ 230V
Comp 3: ~171mW @ 230V

120mW @ 230V

Dissipation

- EMI Filter
- Full Wave Rectifier
- Isolated DC/DC

- EMI Filter
- Full Wave Rectifier
- Isolated DC/DC

- EMI Filter
- Full Wave Rectifier
- Isolated DC/DC

- EMI Filter
- Full Wave Rectifier
- Isolated DC/DC
UCC28064 Natural Interleaving PFC (< 600W)

- 2-phase interleaved TM PFC converter
  - Operates 180° out of Phase
    - Not easy with Variable Frequency
  - Input Inductor Ripple Current Cancelation
    - Reduces filtering requirements on the input capacitor
  - Reduces output capacitor RMS current
Interleaving Reduces Total Inductor Energy by 50%

- This can lead to a 32% reduction total inductor volume.

\[
E_{Total\_Single\_Phase\_Inductor\_Energy} = \frac{1}{2} LI^2
\]

\[
E_{Total\_Interleaved\_Inductor\_Energy} = \frac{1}{2} L \left( \frac{I}{2} \right)^2 + \frac{1}{2} L \left( \frac{I}{2} \right)^2 = \frac{1}{4} LI^2
\]

\[
\frac{E_{Total\_Single\_Phase\_Inductor\_Energy}}{E_{Total\_Interleaved\_Inductor\_Energy}} \times 100 = 50\%
\]
Interleaving PFC Pre-regulators

- Cuts conduction losses by 50%
  - Low rated components can be used
  - The design is more efficient than single stage

\[ P_{Single} = I^2 R \], single stage conduction losses

\[ P_{Two\_phase} = \left( \frac{I}{2} \right)^2 R + \left( \frac{I}{2} \right)^2 R = \frac{I^2}{2} R \], two phase conduction losses

\[ \frac{P_{Single}}{P_{Two\_phase}} \times 100 = 50\% \], 50% reduction in conduction losses
UCC28064 Next Generation TM PFC Controller

• Improved based on knowledge gained from
  – UCC28060 first transition mode (TM) PFC in the industry
  – UCC28061/2/3/A adapted and developed with improved performance

• This device was developed to meet the challenging standby power and efficiency standards
  – Energy star’s 80 plus
  – CoC tier 2 and DOE level VI

• Easily paired with UCC25630x (LLC) and UCC24612-2 (SR) for
  – Highly efficient AC to DC power systems with PFC
UCC28064 Interleaved Transition Mode PFC

- Natural Interleaving technique
  - FM frequency varies with line and load
    - PFC controller maintains 180 degree phase shift
      - Maintains inductor ripple current cancelation

\[ I_{IN} = I_{L1} + I_{L2} \]

\[ V_{IN} = 265V \]

\[ V_{IN} = 85V \]
Interleaved PFC Does not Come for Free

- At lighter loads switching losses ($P_{SWITCHING}$) will dominate over conduction losses ($P_{CONDUCTION}$)
- At lighter loads turning off a phase would be beneficial
- No worries the UCC28064 can turn off a phase as the load drops
  - Phase Shedding

$$P_{SWITCHING} = I_{DS} V_{DS} (T_{on} + T_{off}) f_s + \frac{C_{oss} \times (V_{DS})^2 f_s}{2} + V_g Q_g f_s$$

$$P_{CONDUCTION} = \left(\frac{I}{2}\right)^2 R + \left(\frac{I}{2}\right)^2 R = \frac{I^2}{2} R$$

$$P_{SWITCHING} \gg P_{CONDUCTION}$$
How does the UCC28064 handle phase shedding

- With a resistor divider from VREF
  - When COMP is Below PHB
    - Light Load
    - Phase shuts off
    - Hysteretic to avoid oscillations
    - Refer to data sheet for details

\[
V_{PHB_{LR}} = \frac{R_D}{R_U + R_D} \cdot V_{REF}
\]

\[
V_{PHB_{HR}} = \frac{R_D}{R_U + R_D} \cdot V_{REF} + \frac{R_D \cdot R_U}{R_U + R_D} \cdot I_{PHB\_RANGE}
\]
UCC28064 | Two Phase Transition Mode PFC Controller

Features

• 16-pin Two-phase interleaved TM PFC controller
• Exceeds Energy Star, CoC Tier 2, DOE level VI standards
• Unity power factor and optimized THD
• Fast, enhanced dynamic response (non-linear EA gain)
• Line Feed Forward Compensation
• Phase shedding capability for high load efficiency
• Line independent phase-off function (Adjustable)
• Burst Mode at very light load
  Soft-in and soft-out from burst cycle
  Burst mode power level independent on line voltage
  (adjustable)
• Reduced I_{CC} consumption in light Load Condition

Benefits

• Interleaving provides input and output current lower ripple
• High efficiency of ~97% even at very light load condition
• Standby power consumption of 120mW @ 230VIN with PFC stage still on exceeds CoC V Tier II standard
• Excellent load transient reducing LLC to start up fast

Applications

• IEC61000-3-2 compliant SMPS for TV, monitor, AIO, projector, gaming, audio equipment and industrial
• AC adapter front end power supplies
• Lighting, display and signage
• Server and telecomm infrastructure power supplies

www.ti.com/product/UCC28064
UCC28064 Design Tools

• Excel Design Calculator
  – www.ti.com/lit/zip/sluc292

• Pspice Transient Model
  – www.ti.com/lit/zip/slum207

• UCC28063A 480W and 200W Reference Design
  – Easily modified for the UCC28064
  – IEC 61000-3-2
  – Meets EN55011 class B
Summary

There have been a lot of new controllers developed for offline power conversion:

- UCC28704 PSR Flyback, no opto feedback - saves money, VS for High Efficiency
- UCC24636 Volt Second Balance SR, Better Noise Immunity
- UCC28780 ACF ZVS
- UCC28056 Six Pin PFC
- UCC28064 TM Interleaved PFC
- UCC25630x LLC, Hybrid Hysteretic Mode
  - A for of Peak Current Mode Control, Simplified G_co

If you had not visited TI’s website in awhile you should:

- Many design tools and reference designs to speed up the design process.