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Power Supply Control

1Q 2002

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Compact push-pull controller
- 3** Zero voltage transition PWM
Primary side start-up PWM
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Power Supply Support

- 4** Dual MOSFET gate driver ICs

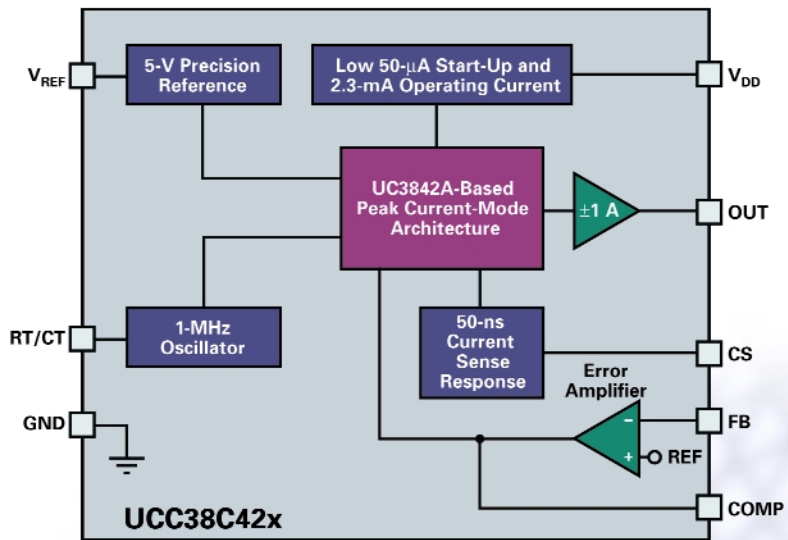
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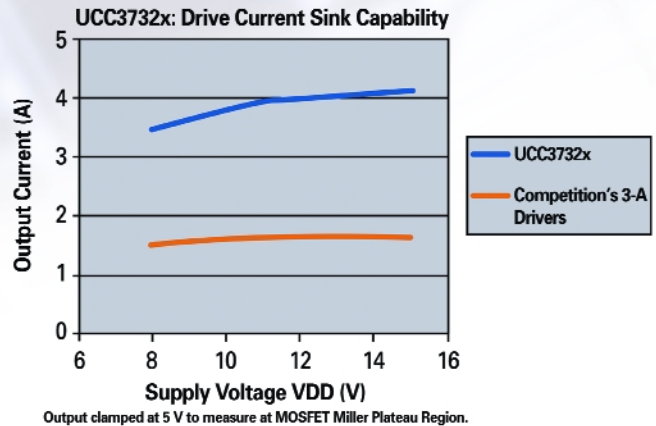


Page 2

Next-generation, current-mode PWM controllers reduce power consumption by 10x

Page 4

Dual MOSFET gate driver ICs provide higher current and enhance noise immunity in power supply and motor control applications



Read other issues at www.ti.com/sc/sineon

PWM Controllers

Next-generation, current-mode PWM controllers offer lowest power and improved efficiency

UCC38C42



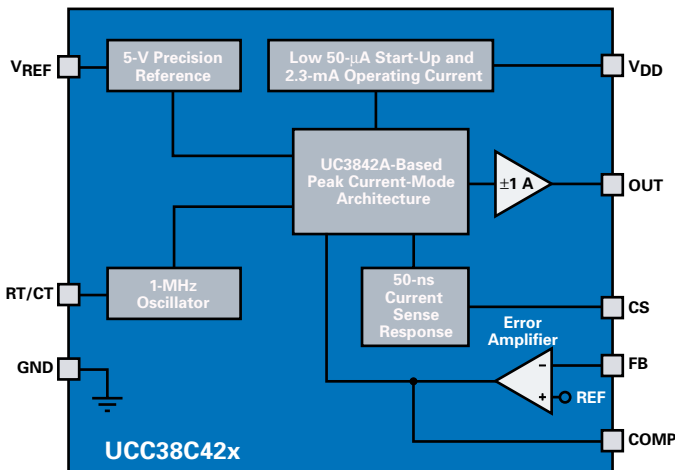
Get samples and datasheets at:

www.ti.com/sc/device/partnumber

Replace **partnumber** in URL with UCC38C40, UCC38C41, UCC38C42, UCC38C43, UCC38C44 or UCC38C45

- Fastest overcurrent protection: 35-ns delay
- Low, 50- μ A start-up current
- Low operating current: 2.3 mA at 50 kHz
- ± 1 -A peak output current
- Rail-to-rail output swings with 25-ns rise and 20-ns fall times
- $\pm 1\%$ initial trimmed 2.5-V error amplifier reference
- Trimmed oscillator discharge current
- Packaging: Available in 8-pin DIP, 8-pin SOIC and 8-lead MSOP which minimizes space
- Suggested resale price starts at \$0.99 each in quantities of 1,000

UCC38C42 Typical Application



Applications include:

- Merchant and OEM power supply manufacturers
- Telecom and datacom modular and brick manufacturers

Compact push-pull controller needs only 5-V supply and 8 pins

UCC3808A-1/2

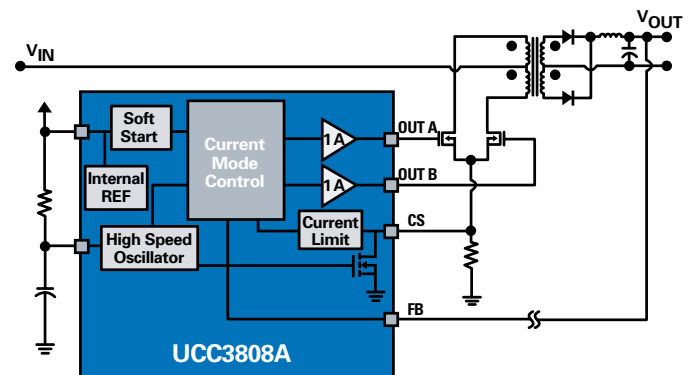


Get samples and datasheets at:

www.ti.com/sc/device/UCC3808A

- Dual output drivers in push-pull configuration in an 8-pin package
- Current sense discharge transistor improves noise immunity and dynamic performance
- 1-MHz oscillator and 2-MHz gain bandwidth error amp
- On-board 1-A output drivers
- Fully functional from 4.3-V supply
- Two UVLO levels (UCC3808A-2 has minimum operating voltage of 4.3 V) ideal for 5-V systems
- Low start-up (130 μ A) increases efficiency
- Packaging: Available in 8-pin SOIC or 8-pin PDIP
- Suggested resale price starts at \$1.51 in quantities of 1,000

UCC3808A Typical Application



Applications include:

- Off-line or DC/DC fixed frequency push-pull current mode switching power supplies requiring high efficiency 50-W to 350-W DC/DC converters

PWM Controllers

Zero voltage transition PWM outperforms all others in high-efficiency, high-power switching

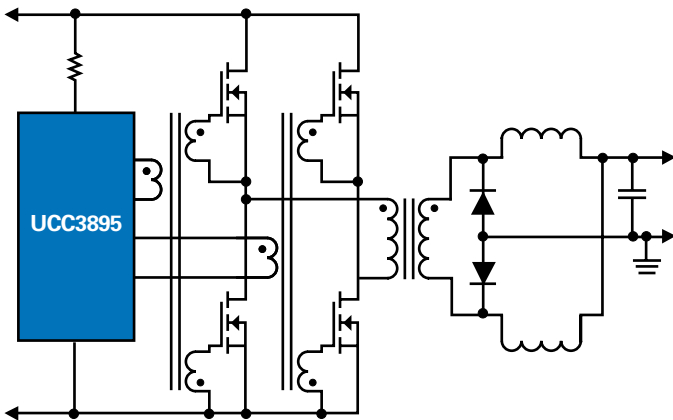
UCC3895



Get samples, datasheets, app notes and EVMs at:
www.ti.com/sc/device/UCC3895

- Programmable output turn-on delay
- Adaptive delay set
- Bi-directional oscillator synchronization
- Voltage mode or current mode control
- Programmable soft start/soft stop and chip disable
- Duty cycle control of 0% to 100%
- Error amplifier of 7 MHz
- Operation to 1 MHz
- Low current consumption: 5 mA typical at 500 kHz
- Low current start-up current: 150 μ A typical
- Packaging: Available in 20-pin wide-body SOIC, 20-pin plastic DIP, 20-pin PLCC or 20-pin ceramic DIP
- Suggested resale price starts at \$4.10 each in quantities of 1,000

UCC3895 Typical Application



Applications include:

- High-power (>400 watts) bus power supplies where density and efficiency are important

Industry's first primary side start-up PWM uses digital feedback

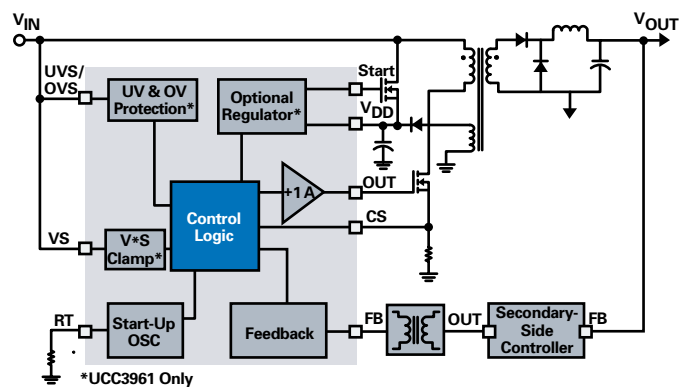
UCC3960/61



Get samples and datasheets at:
www.ti.com/sc/device/UCC3960
www.ti.com/sc/device/UCC3961

- Over current protection with soft start
- Programmable maximum duty cycle clamp (UCC3960)
- Programmable volt second clamp (UCC3961)
- Programmable UV and OV sense (UCC3961)
- Self-bias regulator for external start switch in UCC3961
- Provides primary-side start-up functions for secondary-side controlled converters
- Isolated PWM command through a pulse transformer
- Low current start-up with optional disconnect
- Up to 400-kHz synchronizable switching frequency
- High-current FET drive (1.5-A sink, 0.75-A source)
- Packaging: Available in 8-pin SOIC, PDIP for the UCC3960 and 14-pin SOIC, PDIP for the UCC3961
- Suggested resale price starts at \$1.18 each in quantities of 1,000 for the UCC3960 and \$1.28 each for the UCC3961

UCC3960 Typical Application



Applications include:

- Isolated off-line converters where secondary side PWM control is desired
- Secondary side control systems without a bias regulator

PWM Controllers

Achieve highly-efficient, zero-voltage switching with active clamp/Reset PWM controller

UCC3580



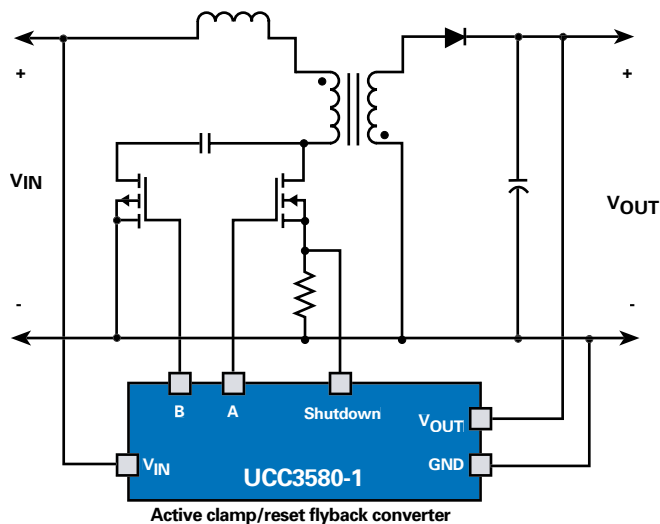
Get samples and datasheets at:

www.ti.com/sc/device/partnumber

Replace **partnumber** in URL with UCC3580-1, UCC3580-2, UCC3580-3 or UCC3580-4

- Auxiliary switch activation complementary to main power switch drive
- Programmable deadtime (turn-on delay) between outputs
- Voltage mode control with feed-forward
- Programmable volt-second product and duty cycle limits
- High current gate drive for main and auxiliary outputs
- Protection features include latched shutdown and soft restart
- Low supply current: 100 μ A start-up, 1.5 mA run
- Packaging: Available in 16-pin SOIC or 20-pin PLCC
- Suggested resale price starts at \$3.41 each in quantities of 1,000

UCC3580 Typical Application



Applications include:

- High density AC/DC and DC/DC power supplies where efficiency and low EMI are critical

Power Supply Support

Dual MOSFET gate driver ICs provide higher current and enhanced noise immunity

UCC37323/4/5



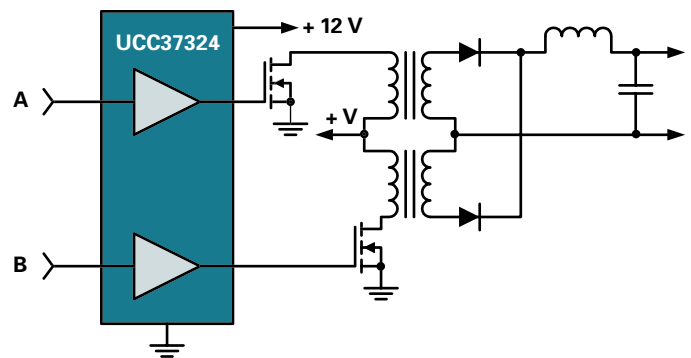
Get samples and datasheets at:

www.ti.com/sc/device/partnumber

Replace **partnumber** in URL with UCC37323, UCC37324 or UCC37325

- Higher peak current: 4 amp at Miller plateau
- Industry standard 8-pin pin-out
- 25-nanosecond rise and fall times into 18-nF load
- TTL/CMOS compatible inputs
- Thermally enhanced MSOP PowerPAD™ package
- Unique bipolar and CMOS output stage for efficient constant current sourcing
- Propagation delay times of 30 ns
- Packaging: Available in 8-pin MSOP, 8-pin SOIC, 8-pin DIP
- Suggested resale price starts at \$0.99 each in quantities of 1,000

UCC37324 Typical Application



Applications include:

- Merchant and OEM power supply manufacturers
- Telecom and datacom modular and brick manufacturers

PFC Controllers

Combined PFC and PWM functions in a single IC controller

UCC38500/1/2/3



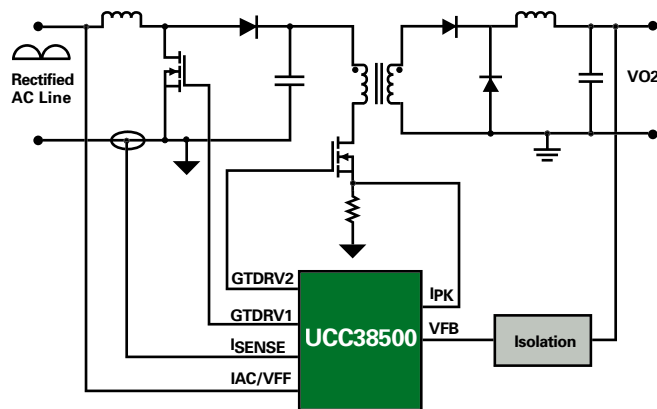
Get samples, datasheets, app notes and EVMs at:

www.ti.com/sc/device/partnumber

Replace **partnumber** in URL with UCC38500, UCC38501, UCC38502 or UCC38503

- Combines PFC and 2nd stage down converter PWM function
- Controls boost PWM to near unity power factor
- Accurate power limiting
- Average current mode control in PFC stage
- Low offset current amplifier
- Programmable oscillator
- Packaging: Available in 20-pin SOIC or 20-pin PDIP
- Suggested resale price starts at \$2.24 each in quantities of 1,000

UCC38500 Typical Application



Applications include:

- Off-line power supplies, from 75 W to 2 kW that must meet EN61000-1-2 harmonic-reduction requirements and/or operate over a wide or universal input voltage range (85-V to 270-V AC)

Leading-edge modulation reduces ripple current in PFC applications

UCC3817/18/19



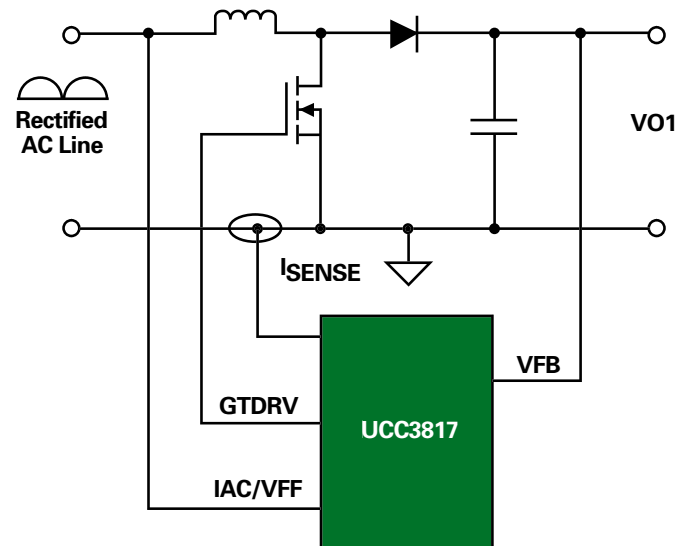
Get samples, datasheets, app notes and EVMs at:

www.ti.com/sc/device/partnumber

Replace **partnumber** in URL with UCC3817, UCC3818 or UCC3819

- Leading-edge modulation
- Controls boost preregulator to near unity power factor
- Limits line distortion
- Average current mode control
- Improved feed-forward line regulation
- Improved noise immunity
- Overvoltage protection
- Accurate power limiting
- High-bandwidth, low-offset current amplifier
- Packaging: Available in 16-pin SOIC, 20-pin PLCC
- Suggested resale price starts at \$2.07 each in quantities of 1,000

UCC3817 Typical Application



Applications include:

- Off-line power supply from 75 W to 2 kW, that must meet EN6100-1-2 harmonic reduction requirements and/or operate over a wide or universal input voltage range (85-V to 270 V-AC)

Application Reports



To access any of the following application reports, type the URL www-s.ti.com/sc/techlit/litnumber and replace **litnumber** with the number in red.

UCC3817/18/19

- DN-66 UC3854A/B and UC3855A/B Provide Power Limiting with Sinusoidal Input **slua196**
- Synchronizing a PFC Controller from a Down Stream Controller Gate Drive **slua245**

UCC38500/1/2/3

- DN-66 UC3854A/B and UC3855A/B Provide Power Limiting with Sinusoidal Input **slua196**

- TL5001 Designing with the TL5001 PWM Controller **slva034**

- TL1454 Designing with the TL1454 PWM Controller Application Report **slva036**

TPS5633/25/18/15

- Using the TPS56xx to Power DSPs **slva083**

Attention: Power Supply Designers!

To reference all available power supply design topics from past seminars, go to power.ti.com and click on "Training." You will find all the topics from past seminars, along with some very useful online training.

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Check out the 1Q 2002 Analog Applications Journal that features articles on:

- **Data Acquisition**
Intelligent sensor system maximizes battery life: Interfacing the MSP430F123 Flash MCU, ADS7822, and TPS60311
- **Power Management**
Power control design key to realizing InfiniBandSM benefits
Comparing magnetic and piezoelectric transformer approaches in CCFL applications
Why use a wall adapter for AC input power?
- **Interface (Data Transmission)**
Power consumption of LVPECL and LVDS
- **Audio Amplifiers**
Audio power amplifier measurements, Part 2

Selection Guides

Switching DC/DC Controllers

Power Supply Controllers

Device	V _{IN} (V)	V _O (max) (V)	V _O (min) (V)	V _{ref} Tol (%)	Driver Current (A)	Output Current (A) ²	Multiple Outputs	Adaptive Voltage Positioning	Protection ³	Comments
TL1451A	3.6 - 50	50	2.5	4	0.02	Depends On FET Driver	Yes	No	UVLO, SCP	Dual PWM Buck/Boost
TL5001	3.6 - 40	50	1	5	0.02	Depends On FET Driver	No	No	UVLO, SCP	PWM Buck/Boost
TL5001A	3.6 - 40	50	1	3	0.02	Depends On FET Driver	No	No	UVLO, SCP	PWM Buck/Boost
TL5002	3.6 - 40	50	1	3	0.02	Depends On FET Driver	No	No	UVLO	Voltage Tracking Termination Regulator for Double Data Rate Memory
TPS43000*	1.8 - 9	8	0.8	2	1	8	No	No	OCP, UVLO, SCP	Multi-Topology, High Frequency PWM
TPS5102	4.5 - 25	24	1.2	1.5	1.5	15 (Each)	Yes	No	OCP, UVLO	Dual Controller for Notebook System Power
TPS5103	4.5 - 25	24	1.2	1.5	1.5	20	No	No	OCP, UVLO	Wide Input Voltage Controller
TPS5120	4.5 - 28	26	0.9	1.5	1.5	15 (Each)	Yes	No	OCP, UVLO, PG, OVP	Dual 180 Degree Out-of-Phase Operation
TPS5300	4.3 - 28	26	0.925	1	2	30	Yes	Yes	OCP, UVLO, PG, OVP	DC/DC Controller and 2 Linear Regulators With Speedstep for Notebook PCs
TPS5602	4.5 - 25	24	1.2	2	1	15 (Each)	Yes	No	OCP, UVLO	Powering Core and I/O of Processors
TPS56300	2.8 - 5.5	3.3	1.3	1.5	2	30	Yes	Yes	OCP, OVP, UVLO, PG	Switcher for Core(s), LDO for I/O Power
TPS56302	2.8 - 5.5	3.3	1.3	1.5	2	30	Yes	Yes	OCP, OVP, UVLO, PG	LDO for Core, Switcher for I/O and Rest of System Power
UC3572	4.75 - 30	0	-48	2	0.5	5	No	No	OCP, UVLO	Inverting
UC3573	4.75 - 30	24	1.5	2	0.5	5	No	No	OCP, UVLO	PWM Simple Buck
UC3585	3 - 6	5	0.9	1	1	8	No	Yes	OCP, UVLO	Low Output Voltage Application

(1) Through Voltage Amp Programming

(2) Current Levels of this Magnitude and Beyond can be Supported

(3) Over-Current Protection (OCP), Under-Voltage Lockout (UVLO), Short-Circuit Protection (SCP), Power Good (PG), Over-Voltage Protection (OVP)

* New Product

Selection Guides

Power Factor Correction Controllers							
Feature	UC3852	UC3853	UC3854	UC3854A/B	UCC3817/8/9	UCC38500/1/2/3	UC3855A/B
Typical Power Level	<150 W	75 W to 300 W	200 W to 2 kW+	200 W to 2 kW+	75 W to 2 kW+	75 W to 1 kW+	400 W to 2 kW+
Soft Switching	Zero Current Transition						Zero Voltage Transition
Max. Frequency	200 kHz	125 kHz	200 kHz	200 kHz	250 kHz	250 kHz	500 kHz
Wide Bandwidth Current Amplifier with Low Offset Voltage Feedforward Technique		Proportional Bias Voltage	Yes	Yes	Improved (Mirrored Iac)	Improved (Mirrored Iac)	Yes
Over Voltage Protection	No	Yes	No	No	Yes	Yes	Yes
Oscillator Features		Sync Input, Internal Oscillator	Synchronizable	Synchronizable	Easily Synchronizable	Internal Synchronization between 2 Foldback	Sync Input and Output Stages
Special Inputs		Multiplexed Sync Input	Soft start, Enable	Soft start, Enable	Enable/OVP	Second Stage Switch Current, Secondary Error Voltage	Inductor Current Synthesizer, ZVS Sensing
Special Outputs	Yes	No	Yes	Yes	Yes	Yes	ZVT Output Yes
Overcurrent Protection							
Other Features		Low Parts Count			Higher Noise Immunity	Combination PFC-PWM Control	Current Synthesizer

PWM Selection Guide

Low- to Medium-Power Applications

Feature	UCC35701	UCC3581	UCC3800-5	UCC3807	UCC3809	UCC3813	UCC35705/6	UCC3960/1	UCC38C42-5
Voltage Mode Control	Yes	Yes			Yes		Yes	Yes	
Peak Current Mode			Yes	Yes	Yes	Yes			Yes
Maximum Practical Frequency	700 kHz	100 kHz	1 MHz	1 MHz	1 MHz	1 MHz	4 MHz	400 kHz	1 MHz
Low Start-up Current	130 μ A	85 μ A	100 μ A	100 μ A	50 μ A	100 μ A	70 μ A	150 μ A	50 μ A
Low Operating Supply Current	750 μ A	300 μ A	500 μ A	1.3 mA	500 μ A	500 μ A	4.2 mA	2.3 mA	2.3 mA
Undervoltage Lockout	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Reference Voltage	1.0%	1.5%	1.5%		5.0%	2.0%		2.5%	1.0%
On Board Error Amplifier			Yes	Yes		Yes			Yes
Programmable Maximum Duty Cycle	Yes	Yes		Yes	Yes		Yes	Yes	Yes
Programmable Volt-Second Clamp	Yes						Yes	Yes	
Soft Start	Yes	Yes	Yes	Yes	Yes	Yes		Yes	
Voltage Feedforward	Yes				Yes		Yes		
Output Drive (Sink/Source)	1.2 A / 1.2 A	1 A / 1 A	1 A / 1 A	1 A / 1 A	0.8 A / 0.4 A	1 A / 1 A	0.1 A / 0.1 A	0.75 A / 1 A	1 A / 1 A
Dedicated Synchronization Pin	Yes	Yes						Yes	
Internal Leading Edge Blanking			Yes	Yes		Yes			
Opto-Coupler Interface	Yes	Yes			Yes		Yes	Yes	
Opto-Coupler Interface	Yes	Yes			Yes		Yes	Yes	

Selection Guides

PWM Selection Guide

Medium- to High-Power Applications

Feature	UCC3580	UCC3824	UCC3806	UCC3808A	UC3825	UC3825A	UC3846	UC3856	UC3875/6/7/8	UC3879	UCC3895
Typical Power Level	50 W to 350 W	50 W to 350 W	50 W to 350 W	50 W to 350 W	50 W to 800 W	50 W to 800 W	50 W to 800 W	50 W to 800 W	400 W to 3 kW	400 W to 3 kW	400 W to 3 kW
Peak Current		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mode Control											
Voltage Mode Control	Yes	Yes			Yes	Yes			Yes	Yes	Yes
Complementary Outputs	Yes	Yes									
Alternating Outputs			Yes	Yes	Yes	Yes	Yes	Yes			
Phase Shifted Outputs									Yes	Yes	Yes
Max. Practical Operating Frequency	500 kHz	1 MHz	500 kHz	1 MHz	1+ MHz	1+ MHz	600 KHz	1+ MHz	1+ MHz	400 kHz	1+ MHz
Start-up Current	100 μ A	1.1 mA	100 μ A	130 μ A	1.1 mA	100 μ A			150 μ A	150 μ A	150 μ A
Operating Supply Current	1.5 mA	22 mA	1.4 mA	1 mA	22 mA	28 mA	17 mA	18 mA	45 mA	27 mA	5 mA
Undervoltage Lockout Options	Yes			Yes	Yes	Yes			Yes		
Reference Voltage Initial Accuracy	2.4%	1.0%	2.0%	2.5%	1.0%	1.0%	1.0%	1.0%	1.6%	1.6%	1.2%
Programmable Delay Times for ZVT	Yes	Yes							Yes	Yes	Yes
Programmable Max. Duty Cycle	Yes		Yes			Yes		Yes	Yes	Yes	Yes
On-chip Error Amplifier		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Programmable Soft Start	Yes	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pulse-by-pulse Current Limiting		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Overcurrent Propagation Delay Time		50 ns	125 ns	100 ns	50 ns	50 ns	300 ns	65 ns	85 ns	160 ns	75 ns
Output Drive (Sink/Source)	0.5 A / 1.2 A, 0.3 A	1.5 A / 1.5 A	1 A / 1 A	0.5 A / 1.0 A	1 A / 1 A	2 A / 2 A	0.5 A / 0.5 A	1.5 A / 1.5 A	Four at 2 A	Four at 0.1 A	Four at 0.1 A
Programmable Fault Response			Yes			Yes	Yes	Yes	Yes	Yes	Yes
Bidirectional Synchronization Pin	Yes	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes
Programmable Leading Edge Blanking						Yes					
Latest Generation PWM	Yes			Yes		Yes		Yes			Yes

Free Resources

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The latest issues of *Sine On™*, a catalog of high-performance analog and mixed-signal products from Texas Instruments, feature current technical specifications on the latest products. For each featured product family, a URL provides quick access to online resources like samples, evaluation modules (EVMs), datasheets, selection guides and block diagrams. Each of these *Sine On* publications are available at www.ti.com/sc/sineon



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Evaluation Modules



To order any of the following evaluation modules (EVMs), please call the order desk, **1-800-477-8924, ext. 5800**, in North America. To order from other regions, please contact the TI Product Information Center (see listings on back cover) or local TI distributor.

DC/DC Controllers:

TL5001AEVM-108	5 V to 3.3 V, 3-A synchronous buck converter with 3% reference voltage tolerance	\$50
TPS5102EVM-135	Dual controller with 3.3-V/3.5-A and 5-V/3.5-A outputs	\$50
TPS5103EVM-136	Single PWM/hysteretic controller with 1.8-V/4-A output	\$50
TPS56302EVM-163	TPS5630x universal evaluation board with sequencing for low voltage DSPs	\$50

Power Factor Correction:

UCC3817	BiCMOS Power Factor Preregulator EVM	\$50
UCC38500	UCC38500EVM Evaluation Module	\$50
UCC3895	UCC3895EVM Evaluation Module	\$50

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DATES AND LOCATIONS:

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