

# UCC28720 USB Flyback Controller

TI Consumer Isolated Power  
Training Presentation  
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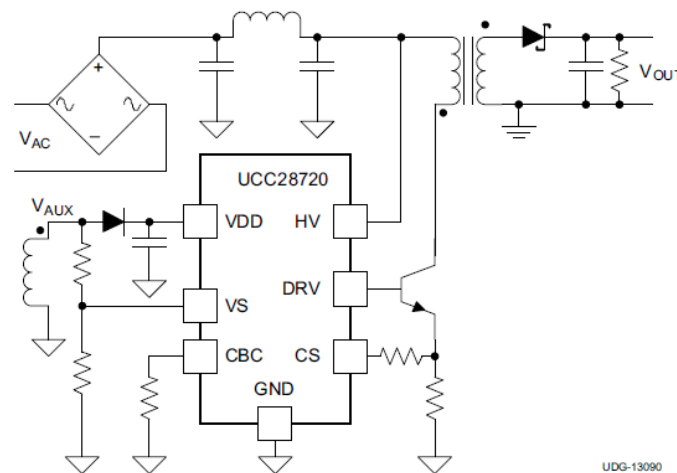
# UCC28720 Flyback Controller

## Features

- < 30mW No Load Input Power (5 star EC IPP rating)
- FM-AM-FM modulation scheme (650 KHz-80 KHz)
- Primary Side Regulation (PSR) eliminates opto-coupler
- +/- 5% Voltage & Current regulation
- Quasi-resonant valley switching operation for high efficiency
- Frequency jitter EMI scheme (Patent Pending)
- Internal JFET Startup Circuitry, 700V
- Cable Comp
- Designed to drive NPN Transistor

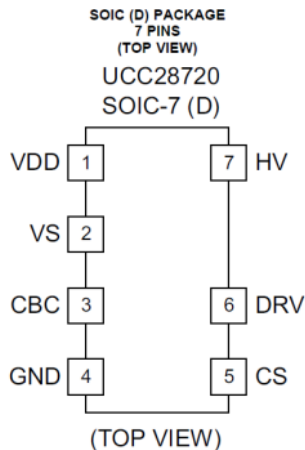
## Control Methodology

- Constant Voltage/Constant Current PWM Modulation

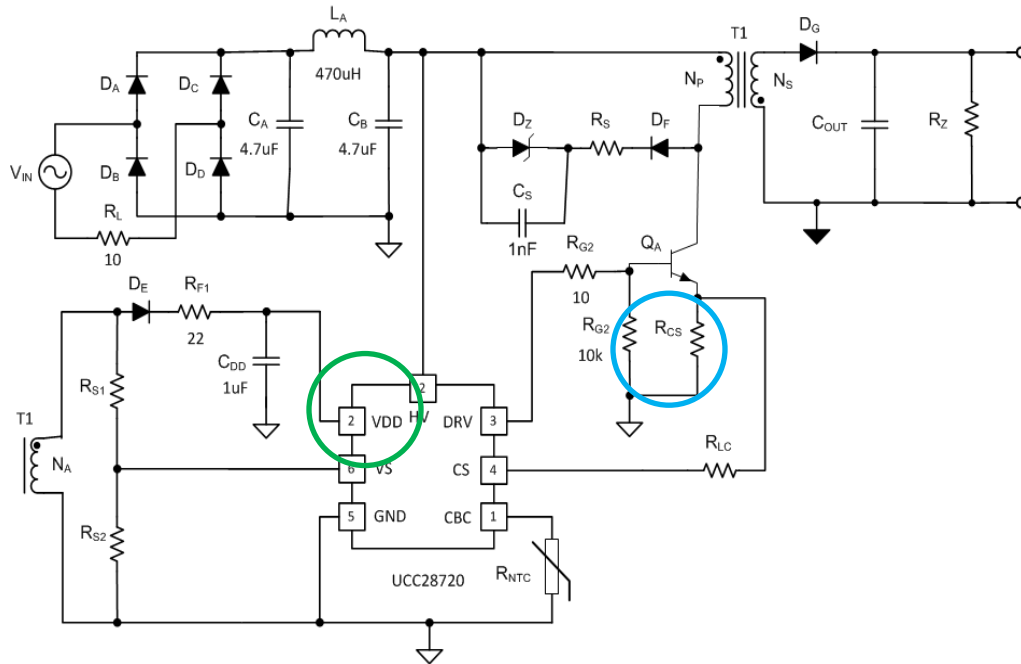


## Applications

- Universal charging Solution AC Adapters
- Low Power AC/DC SMPS
- Power metering



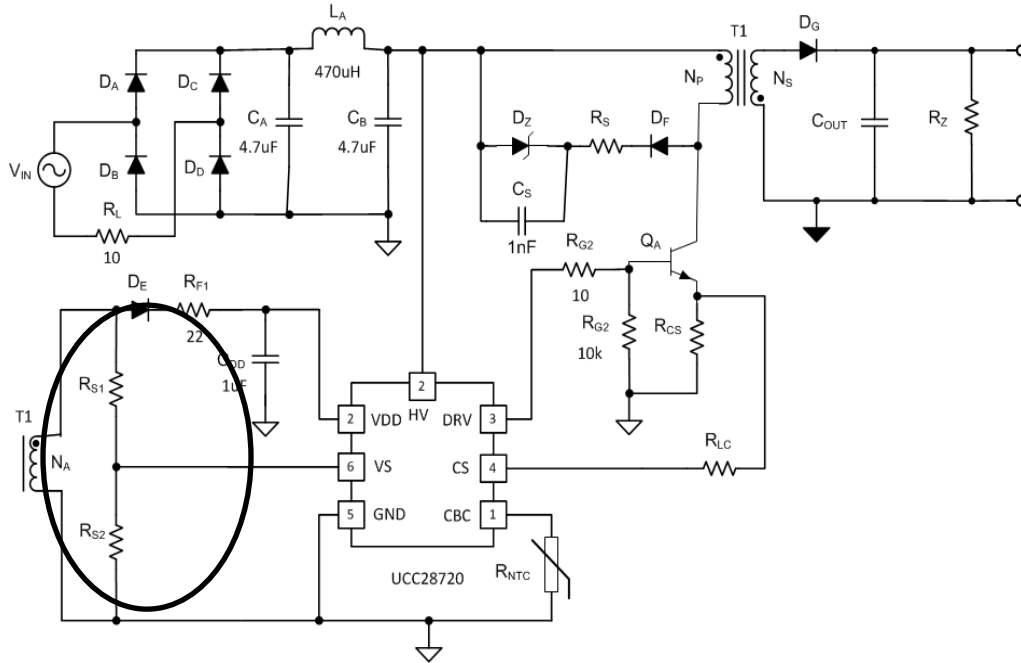
# Device Features



- IC UVLO Turn-on 21V, Turn-off 8V
  - Ideal for trickle charge startup
- CS sensing for controlling peak current and sensing over current (1.5V)



# Aux Sensing



$$V_{VSR} \approx 4.05V$$

$$V_{OUT} = V_{VSR} \frac{R_{S2}}{R_{S1} + R_{S2}} \frac{N_S}{N_A} - V_{DG}$$

$$V_{OVP} \approx 4.6V$$

$$V_{OUT\_OVP} = V_{OVP} \frac{R_{S2}}{R_{S1} + R_{S2}} \frac{N_S}{N_A} - V_{DG}$$

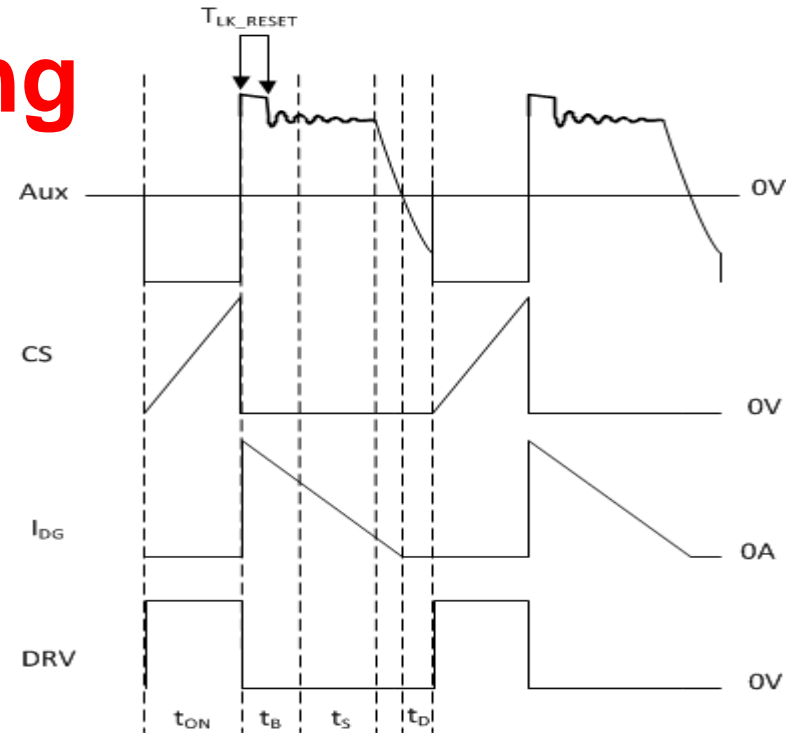
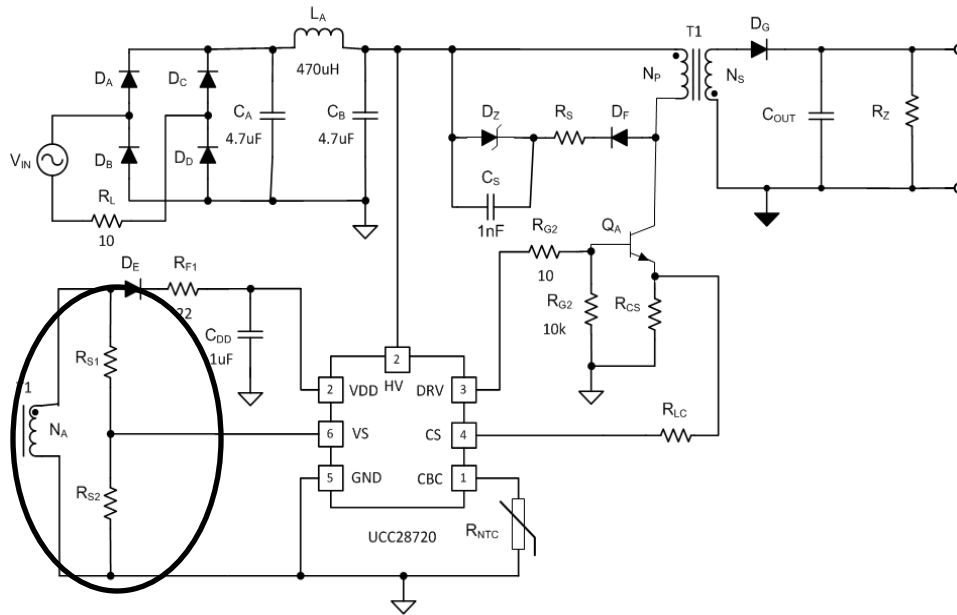
$$I_{VSLRUN} \approx 225\mu A$$

$$V_{IN\_ENABLE} = \frac{R_{S1}}{I_{VSLRUN}} \frac{N_P}{N_A} + 2 \times V_{DA}$$

## ➤ Primary Aux Sensing (VS) $N_S/N_A$ Controls

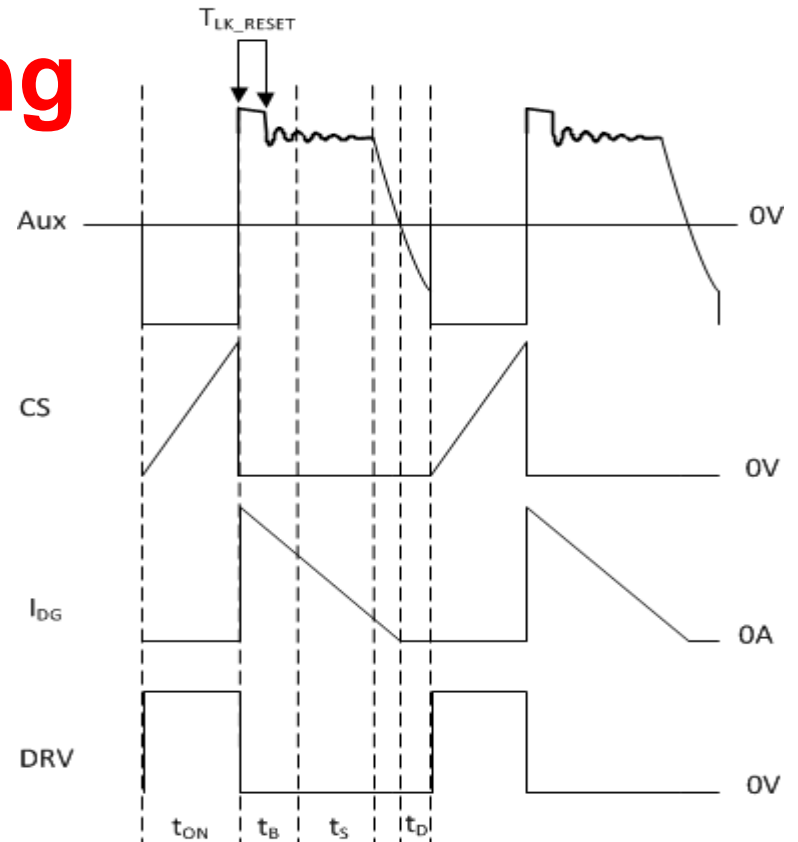
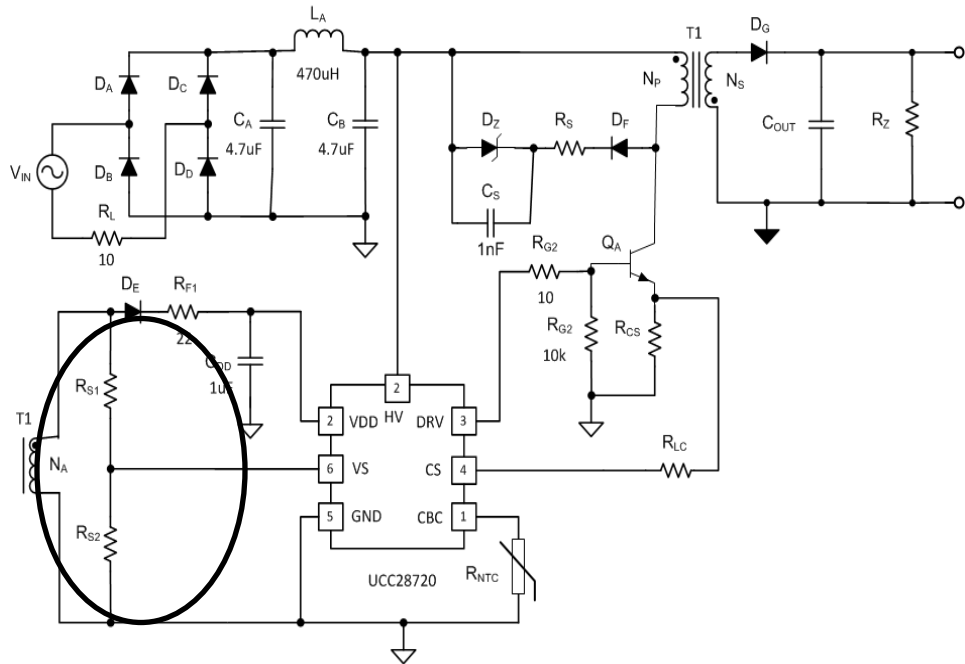
- Output Voltage ( $V_{OUT}$ )
- Input Enable ( $V_{IN\_ENABLE}$ )
- Output Over Voltage Protection ( $V_{OVP}$ )

# Device Timing/Sensing



- After  $t_B$  controller acknowledges VS signal
- VS sampling starts ( $t_S$ ) for OVP and Output Control
- During  $t_S$  the VS pin is continuously sampled
  - Will hold the last VS value sampled before LC tank of switch node ( $QA_d$ )
  - This VS value is used to control the output
    - Helps remove errors caused by aux ringing
    - Ringing after delay needs to be  $< 100\text{mV p-p}$

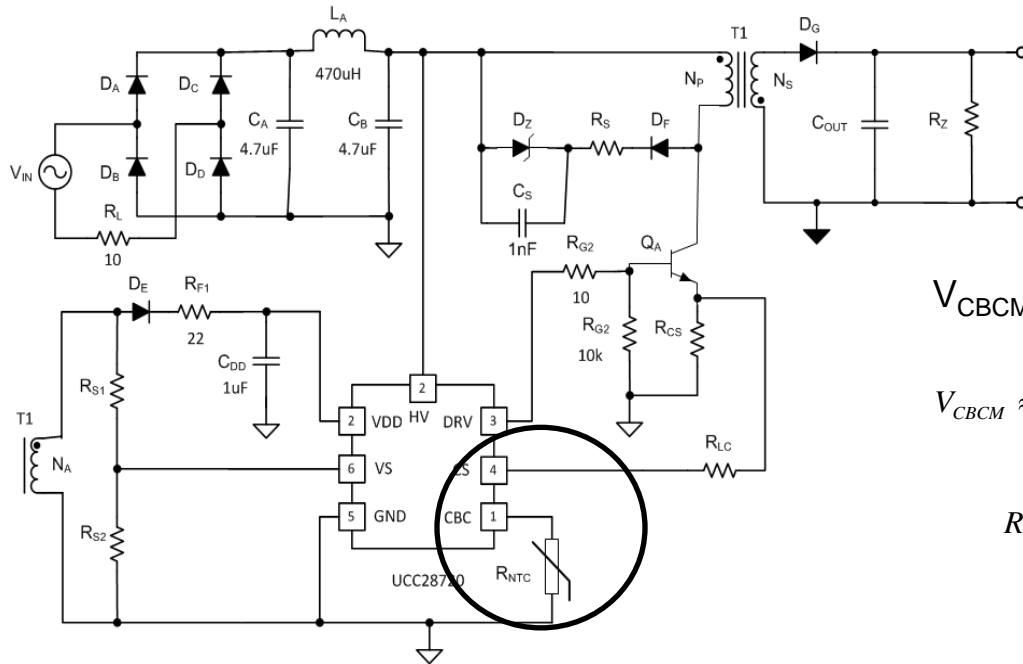
# Device Timing/Sensing



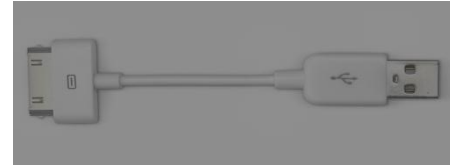
## ➤ Quasi Resonant Control Near Critical Conduction @ Full Load

- FET will stay on until peak current is reached at CS pin ( $V_{CS}$ )
- After  $t_S$  the VS pin will detect zero current in the transformer
  - Once Aux Zero Crossing is detected 150ns delay is added ( $t_D$ ) so Valley switching can be achieved

# UCC28720 Cable Comp ( $R_{CBC}$ )



$$V_{CBC} = I * R$$



$$V_{CBCM} = V @ \text{Pin1}$$

$$V_{VSR} = V_S \text{ Reg. Point}$$

$$V_{CBCM} \approx 3V$$

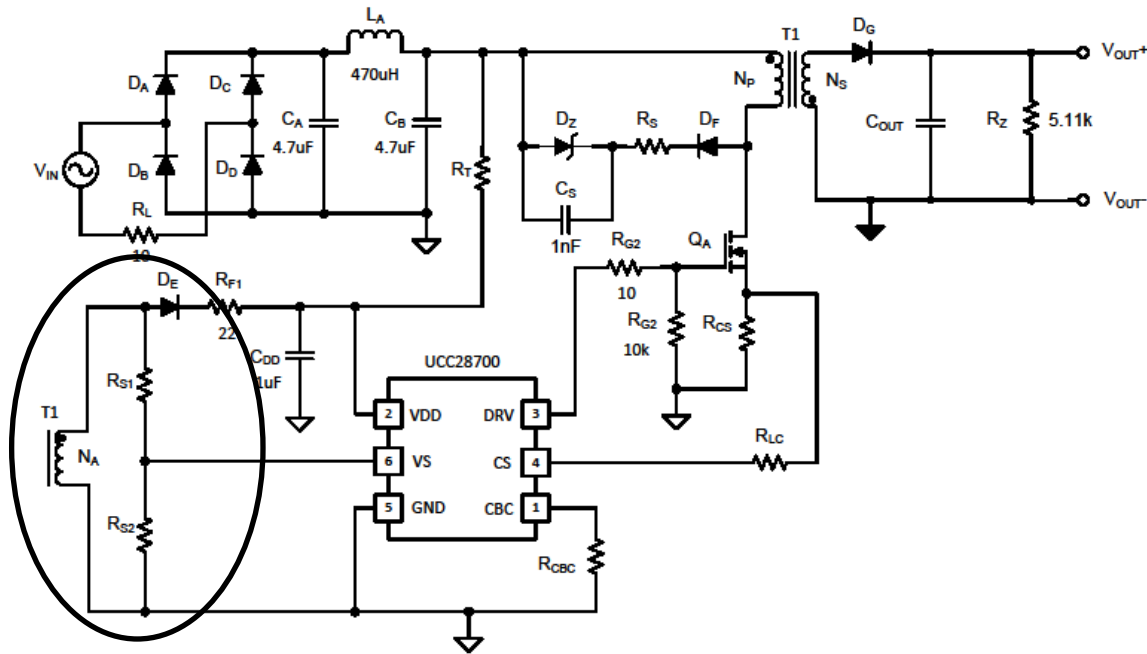
$$V_{VSR} \approx 4.05V$$

$$R_{CBC} = \frac{V_{CBCM} \times 3k\Omega \times (V_{OUT} + V_{DG})}{V_{VSR} \times V_{CBC}} - 28k\Omega$$

- UCC28720 has a cable comp adjustment ( $R_{CBC}$ )
  - Removes the IR drop from the cable
    - Moves with load



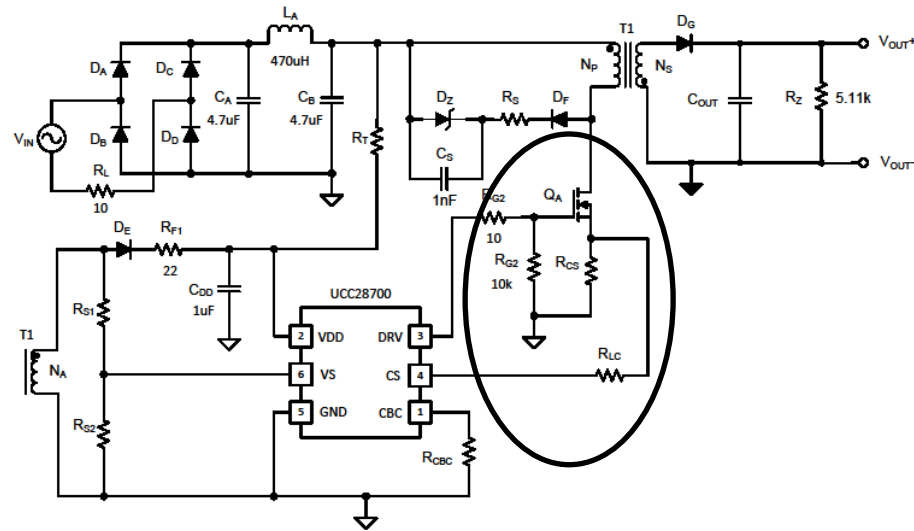
# Design Tips and Recommendations



## ➤ VS Pin Recommendations

- No filtering/High Impedance Pin/Noise Sensitive
- Don't probe the VS pin directly with a scope probe
  - Can estimate behavior @ this pin from D<sub>E</sub>

# Design Tips and Recommendations

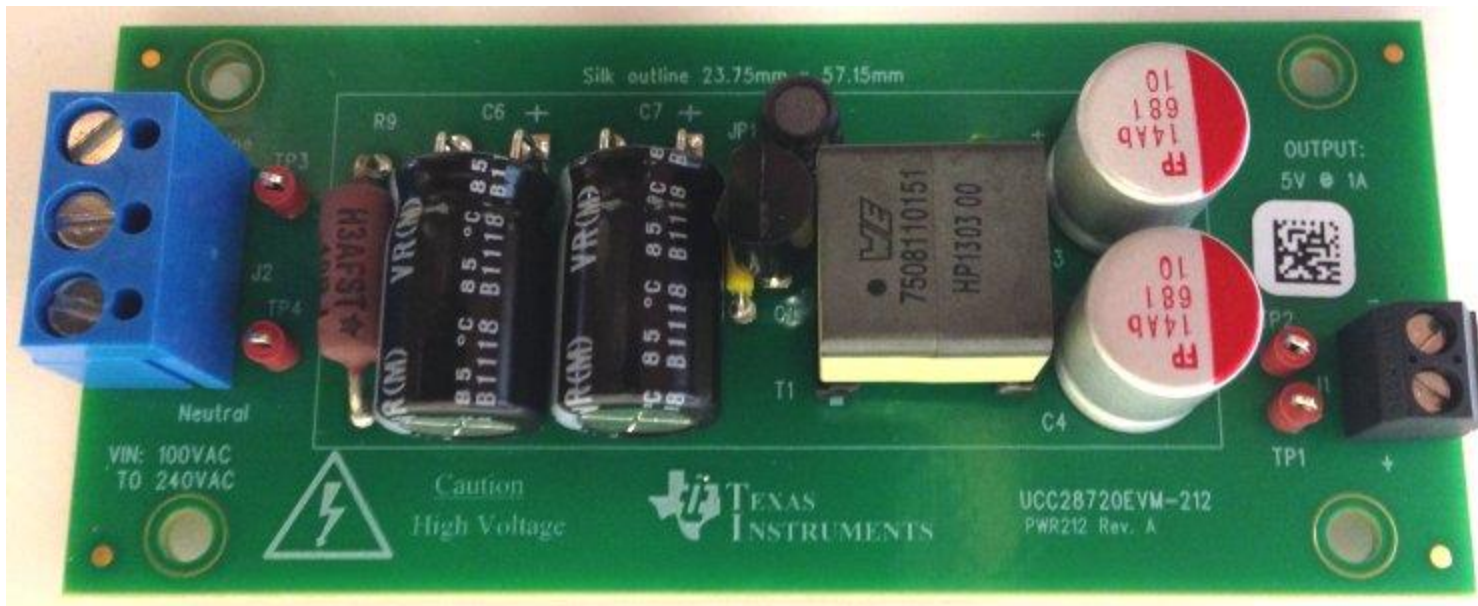


## ➤ CS Pin Recommendations

- Device has 235 ns of leading edge blanking
- Filtering should not be needed on the CS pin

# 5W UCC28720EVM-212

- User's guide SLUU968



# 5W UCC28720EVM-068 Specs

Parameter	Symbol	Notes & Conditions	Min	Nom	Max	Units
<b>INPUT CHARACTERISTICS</b>						
Input Voltage	VIN		100	115/230	240	V
No Load Input Power		VIN = Nom, IOU = 0A			30	mW
<b>OUTPUT CHARACTERISTICS</b>						
Output Voltage	VOU	VIN = Nom, IOU = NOM	4.75	5	5.25	V
Line Regulation	VOU	VIN = Min to Max, IOU = Nom	-	-	3	%
Load Regulation	VOU	VIN = Nom, IOU = Min to Max	-	-	3	%
Output Voltage Ripple	VOU	VIN = Nom, IOU = Max	-	-	0.1	mVpp
Output Current	IOU	VIN = Min to Max			1	A
Output OVP	VOVP	IOU = Min to Max		5.75		V
Transient Response						
Load Step(Vout = 4.1V to 6V)		(0.1 to 0.6A) or (0.6 to 0.1A)	4.1		6	V
<b>SYSTEMS CHARACTERISTICS</b>						
Switching Frequency					107	kHz
Full Load Efficiency (115/230V RMS input)	$\eta$	R Load = 5 ohm	74%		76	%
Operating Temperature Range	Top	VIN = Min to Max, IOU = Min to Max	25		40	°C



# 5W UCC28720EVM-212 Efficiency

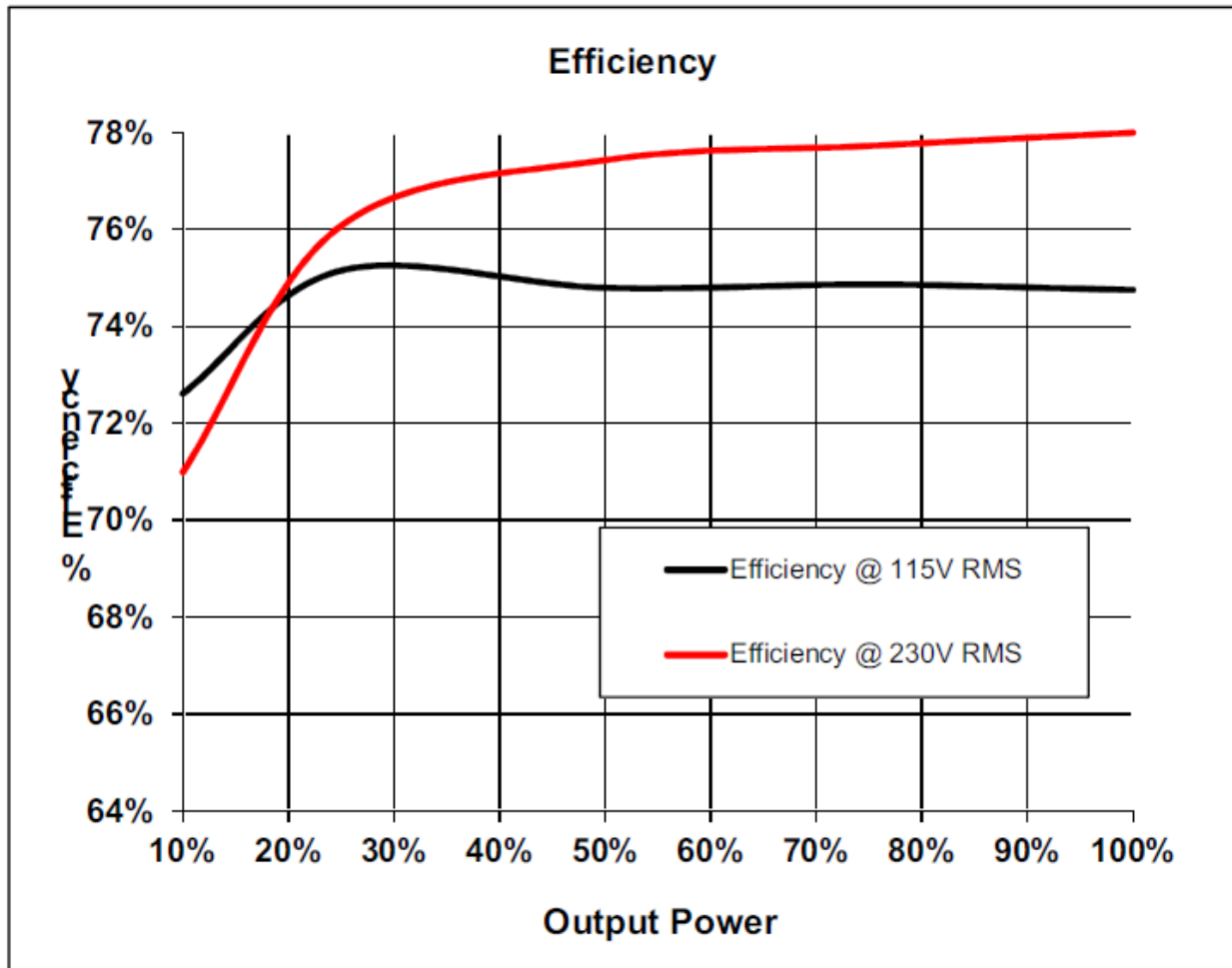


Figure 3. UCC28720EVM-212 Efficiency

# Summary

- UCC28720 RTP Controls a DCM flyback
  - Was designed for USB applications
  - Can be designed with no load input power  $< 30$  mW
  - Designed to drive NPN transistors