



**ON Semiconductor®**

# **Power Conversion Group**

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## **Lighting Segment Selection Guide**



# Lighting Segment



## Product Types

- Low Power = PSR controllers & Switchers
- Medium/High power = PFC+FB & LLC Ctrlrs

## Sub-Segments

- Smart Lighting, Dimmable Bulbs, High Power
- TRIAC compatibility, low component count.

## For ON Customers

- Immediate access to:
  - Direct AC Mains Solutions
  - PRO TRIAC performance
  - CV Control Ics
- Expanded Medium/High Power Portfolio

## For Fairchild Customers

- Expanded Medium/High Power Portfolio
- New Portfolio for TRIAC Dimmable

# Product Portfolio Summary

New Product  
RTM: in 1Q

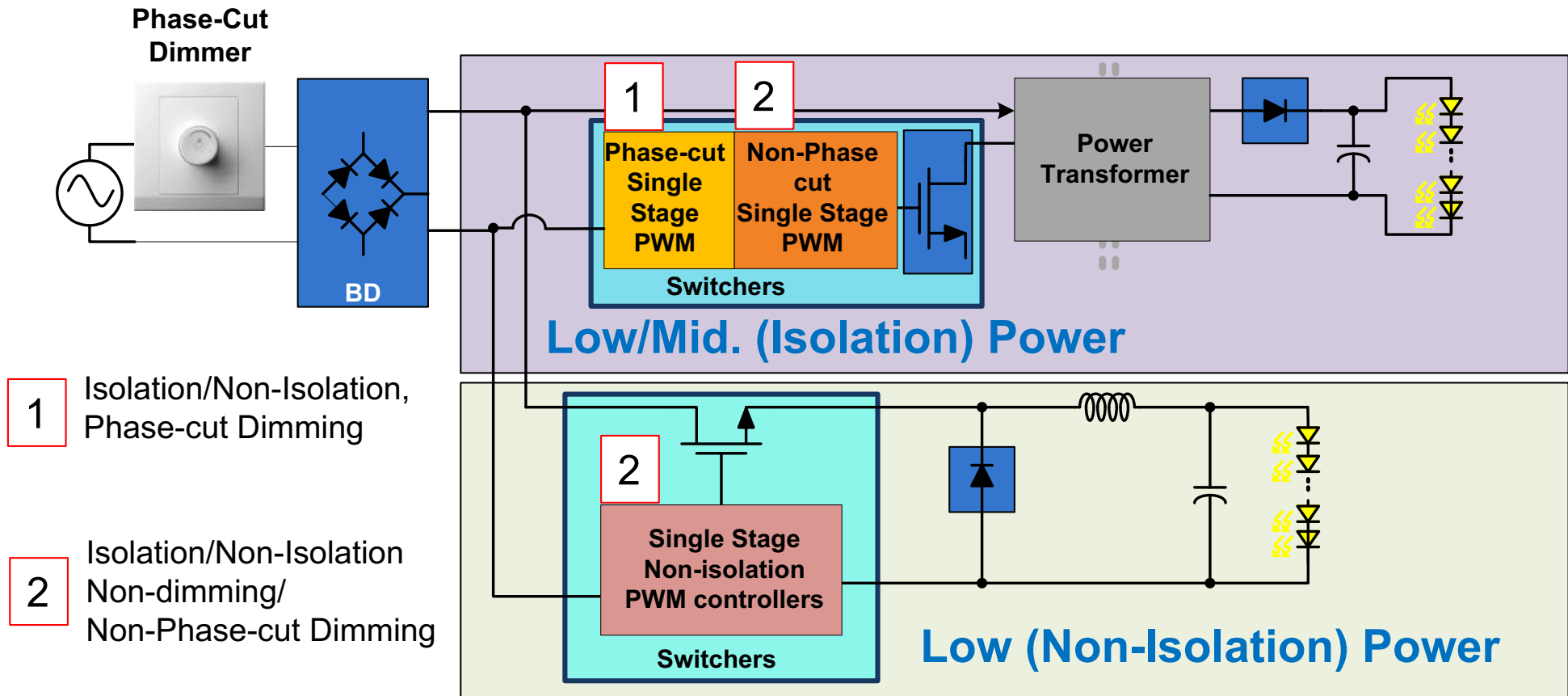


Segments	Non Dimming	Non- Phase-Cut Dimming	Phase-Cut Dimming
	<div style="border: 1px solid black; padding: 5px; display: inline-block;"> <b>FAN73611/80/82/NCP5106</b> 600 V HB Gate Driver                 </div> <div style="border: 1px solid black; padding: 5px; display: inline-block; margin-left: 20px;"> <b>FL3100</b> Low Side Gate Driver                 </div>		
<b>High Power</b> • Troffers • Street light • Flood light • Outdoors	<b>MCU based system</b> <b>Resonant Half Bridge</b>		<div style="border: 1px solid black; padding: 5px; display: inline-block;"> <b>FL5150/60</b> Φ-Cut Dimmer Controller                 </div>
	<div style="border: 1px solid black; padding: 5px; display: inline-block;"> <b>FLS16/7/8/2100</b> VM HBR Control+Sw.                 </div>	<div style="border: 1px solid black; padding: 5px; display: inline-block;">                     ★ <b>NCP1399</b> CM HBR Controller                 </div> <div style="border: 1px solid black; padding: 5px; display: inline-block; margin-top: 5px;">                     ★ <b>NCL30059</b> 8 pin CM HBR Controller                 </div>	
	<div style="border: 1px solid black; padding: 5px; display: inline-block;">                     ★ <b>NCP1602/08/54</b> CRM/CCM PFC                 </div>	<div style="border: 1px solid black; padding: 5px; display: inline-block;">                     ★ <b>NCL30030 (Std.Pw)</b> CM CRM PFC+QR PWM                 </div> <div style="border: 1px solid black; padding: 5px; display: inline-block; margin-top: 5px;">                     ★ <b>FL7921 (THD)</b> VM CRM PFC+QR PWM                 </div>	<div style="border: 1px solid black; padding: 5px; display: inline-block;">                     ★ <b>FL7760</b> Wide ADim. 60 V Buck                 </div>
60W	<div style="border: 1px solid black; padding: 5px; display: inline-block;">                     ★ <b>NCL30388</b> HV CC/CV PFC PSR                 </div>	<b>PFC+QR Flyback</b>	<div style="border: 1px solid black; padding: 5px; display: inline-block;"> <b>NCL30160/1</b> PWM Dim. Buck/+40V Sw.                 </div>
<b>Mid Power</b> • Down light • Flat light • Ceiling light • Tubes • Outdoors	<div style="border: 1px solid black; padding: 5px; display: inline-block;">                     ★ <b>FL7733A</b> HV CC PFC DCM PSR                 </div>		<div style="border: 1px solid black; padding: 5px; display: inline-block;">                     ★ <b>FL7740</b> HV CV PFC PSR                 </div>
	<div style="border: 1px solid black; padding: 5px; display: inline-block;"> <b>NCL30060</b> HV CC PFC QR SSR                 </div>		<div style="border: 1px solid black; padding: 5px; display: inline-block;">                     ★ <b>NCL30386</b> A_P Dim. CC/CV PFC PSR                 </div>
25W	<div style="border: 1px solid black; padding: 5px; display: inline-block;">                     ★ <b>NCL30288</b> 6pin CC PFC PSR                 </div>	<div style="border: 1px solid black; padding: 5px; display: inline-block;"> <b>Direct AC LED Driver (Power scalable: Low to High)</b>  <b>FL77904/5:</b> 8ESOP, 4Ch / 3Ch Dim – 10 W  <b>FL77944:</b> 16ESOP, 4Ch. Dim. – 20 W                 </div>	<div style="border: 1px solid black; padding: 5px; display: inline-block;">                     ★ <b>NCL30167</b> Φ-Cut PFC Boost                 </div>
<b>Low Power</b> • Smart bulb • Tubes • Down light	<div style="border: 1px solid black; padding: 5px; display: inline-block;">                     ★ <b>NCL30188</b> CC PFC QR PSR                 </div>		<div style="border: 1px solid black; padding: 5px; display: inline-block;">                     ★ <b>NCL30095</b> Φ-Cut PFC Boost Switcher                 </div>
	<div style="border: 1px solid black; padding: 5px; display: inline-block;"> <b>FL7701/FLS0116</b> PFC Buck/ +Sw                 </div>		<div style="border: 1px solid black; padding: 5px; display: inline-block;"> <b>NCL30186</b> A_PWM Dim. CC PFC PSR                 </div> <div style="border: 1px solid black; padding: 5px; display: inline-block; margin-top: 5px;"> <b>NCL30185</b> 3step Dim. CC PFC PSR                 </div>



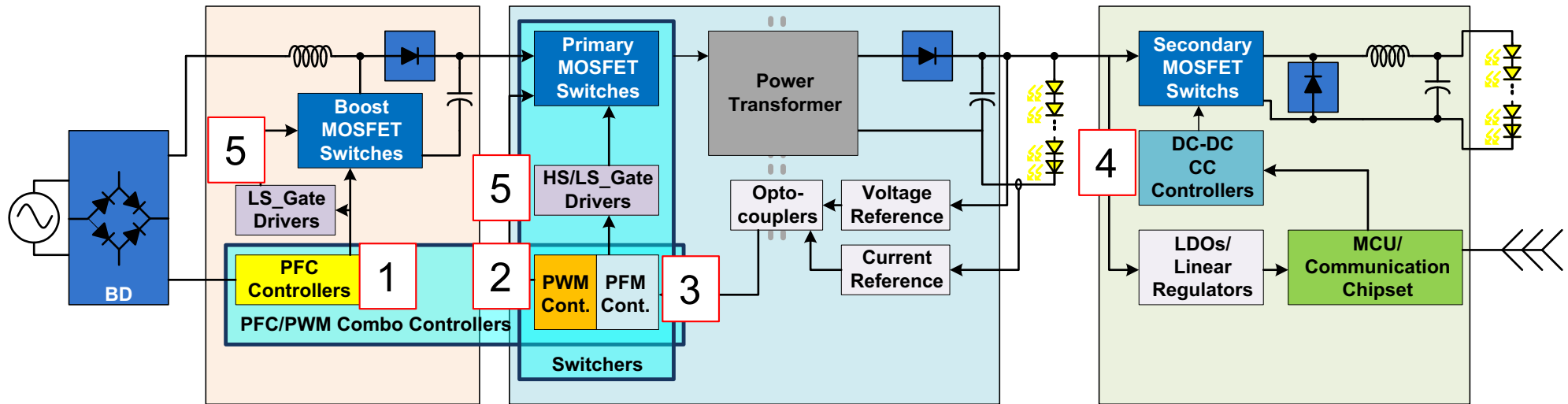


## ➤ Single Stage SMPS Type

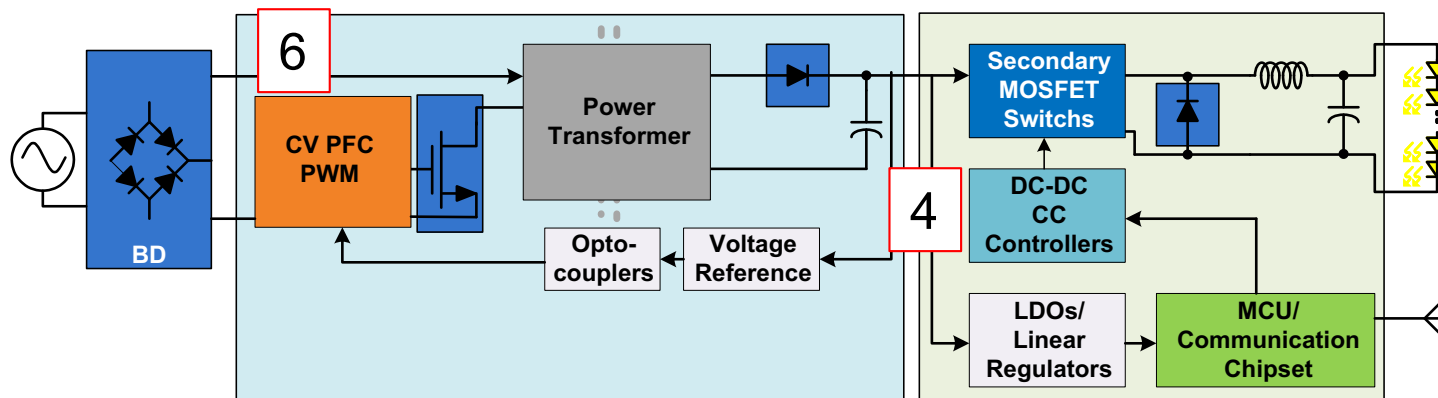




## ➤ Multiple Stage – Boost + Isolated DC-DC (+DC-DC)



## ➤ Multiple Stage – PFC Flyback (+ DC-DC)

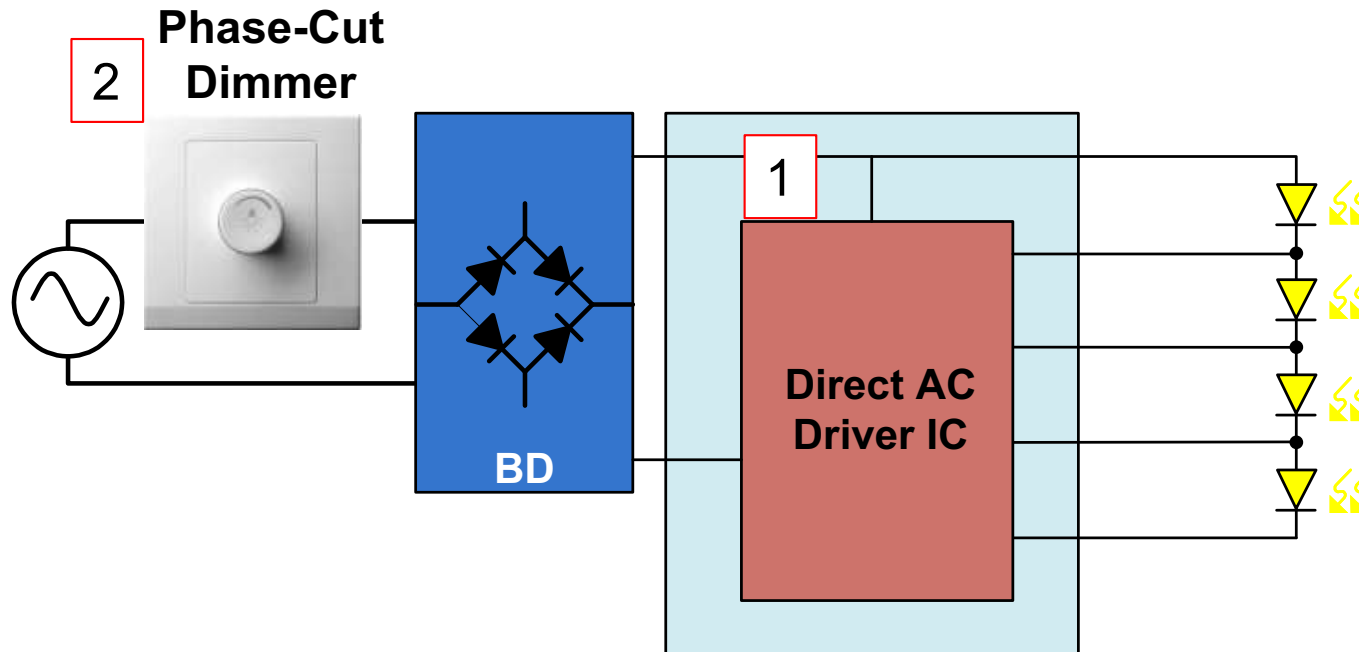


- 1 Boost PFC
- 2 PWM Ctrl
- 3 PFM Ctrl
- 4 2<sup>nd</sup> Dim DC-DC
- 5 High/Low Side Driver
- 6 CV PFC Flyback

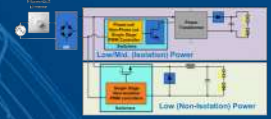




## ➤ Direct AC LED Driver / Phase-Cut Dimmer Controller



# Phase-Cut Dimming Single Stage Solution



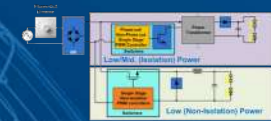
## 1 ➤ Isolation/Non-Isolation, Phase-cut Dimming

Part ID	FL6630	FL7734	NCL30167	NCL30095	NCL30073
<b>Active Dimmer Driving</b>	External (Active Damper/Bleeding)	Internal	Internal	Internal	Internal
<b>Regulation</b>	CC PSR	CC PSR	CC open loop	CC open loop	CC open loop
<b>Conduction mode</b>	DCM	DCM	CRM	CRM	CRM
<b>Topology</b>	BB/Flyback	BB/Flyback	Boost	Boost	BB/Flyback
<b>Active PFC</b>	Yes	Yes	Yes	Yes	Yes
<b>Int. MOSFET</b>	No	No	No	Yes	No (Yes - 400 V)
<b>Key Features</b>	Phase-angle sensing	Universal Input Fast Start up Dimmer compatibility Controllable $I_{Nmin}$ . Controllable Dim. curve	Cascode Driving Thermal Foldback Single Winding Inductor	Cascode Driving Thermal Foldback Single Winding Inductor Internal MOSFET	Single Winding Inductor Low Parts counts Small Package
<b>PKG</b>	8SOP	16SOP	10SOP	14SOP	6TSOP (8SOP)
<b>Reference Design</b>	8 W(L/H)-A19 18 W (L/H)-PAR	6 W (L/H)-GU10 8 W (L/H/U)-A19 40 W (H/U)-Driver 56 W(L)-Driver	-	-	18 W(L/H) -Flyback 18 W(L/H)-BB 9 W (L) -BB

BB: Buck\_Boost



# Single Stage Solution



## 2 ➤ Isolation/Non-Isolation, Non-dimming/Non-Phase-cut Dimming

Part ID	FL7701 FLS0116	NCL30060	FL7733A	NCL30186	NCL30185 NCL30188	NCL30288	NCL30386	NCL30388
Active PFC	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dimming	Analog	-	-	Analog	3Step Dim./-	-	Analog/PWM	-
Topology	Buck	BB/Flyback	BB/Flyback	BB/Flyback	BB/Flyback	BB/Flyback	BB/Flyback	BB/Flyback
Conduction mode	CCM	QR	DCM	QR	QR	QR	QR	QR
Regulation	CC open loop	SSR	CC PSR	CC PSR	CC PSR	CC PSR	CC/CV PSR	CC/CV PSR
Driving Power	Low <30 W / <5 W	Low ~High ~ 100 W	Low ~High ~ 100 W	Low <30 W	Low <30 W	Low ~High ~ 100 W	Low ~High ~ 100 W	Low ~High ~ 100 W
Int. MOSFET	No/Yes	No	No	No	No	No	No	No
PKG	8SOP/7SOP	7SOP	8SOP	10SOP	8SOP	6TSOP	10SOP	8SOP
Strong Advantage	HV Startup Single Inductor No E_Cap.	HV Start up Brown out	±1% CC <10% THD HV Start up	Brown out Shut down pin	Brown out Shut down pin	Brown out	HV Start up Brown out 1% Dim.	HV Start up Brown out
Reference Design	3 W - GU10 8 W - A19 21 W - T Lamp	25 W - A_PWM Dim. Driver	8 W - A19 21 W - T Lamp 30W-Dim.Driver 50 W - Driver	8 W-Smart	10W-StepDim	18 W-Tlamp	60W Dim	60 W

BB: Buck\_Boost, PSR: Primary side regulation, SSR: Secondary side regulation





# Boost PFC Controller



## 1 ➤ CRM/CCM Controller

Part ID	NCP1602	NCP1608	NCP1654
PFC Topology	CRM	CRM	<b>CCM</b>
Operation mode	Voltage mode	Voltage mode	65/133/200 kHz osc.
$V_{CC}^{Max}$	30 V	20 V	24 V
$I_{CC}^{START-UP}$	40 $\mu$ A	35 $\mu$ A	75 $\mu$ A
$I_{CC}^{NORMAL}$	2mA @50kHz	2.1mA @70kHz	4.7mA
Error amp.	Voltage type	<b>Current type</b>	
$V_{GATE}^{MAX}$	$V_{CC}$	$V_{CC}$	
$I_{GATE}^{PEAK}$	+ 500mA /-800mA	+ 500mA /-800mA	$\pm$ 1.5 A
Key Features	<b>Frequency foldback Brown out Second OVP</b>	<b>Program. Ton Program. OVP</b>	<b>Brown out Inrush detection</b>
Pin layout			
Key Message	<b>Low BOM</b>	General Voltage mode	<b>High Power</b>





## 2 > Flyback/ Boost-Flyback Combo

Part ID	FL7921	NCL30030
Topology	CRM PFC+QR PWM	CRM PFC+QR PWM
Operation mode	Voltage mode +Current mode	Current mode+ Current mode
Int. MOSFET	No	No
Dimming	Secondary	Secondary
Strong Advantage	HV Start up Over Power Compensation <b>High PF/Low THD</b>	HV Start up <b>Brown out</b> Line/load Compensation <b>Good standby power</b>
V <sub>CC</sub>	25 V	30 V
Target Application	Driver	Driver
PKG	16SOP	16SOP(1NC)
Reference Design	100 W - 0-10 Dim. Driver FEB_L65	150 W - A__PWM Dim. Driver NCL30030GEVB

A\_\_PWM Dim.: Analog & PWM Dimming





## 3 ➤ Resonant Half Bridge Controller

Part ID	FLS16(7/8)00/2100	NCL30059	NCP1399
Topology	HBR Controller +MOSFETs	HBR Controller	HBR Controller
Operation mode	Voltage Mode	<b>Current Mode</b>	<b>Current Mode</b>
Int. MOSFET	<b>Yes</b>	No	No
Dimming	Secondary	Secondary	Secondary
Strong Advantage	ZVS	<b>Brown out PFC delay timer Small PKG</b>	<b>HV Start up Adaptive DT Brown out PFC Off ZVS</b>
Target Application	Driver	Driver	Driver
PKG	9SIP	8SOP	16SOP(2NC)
Reference Design	100/160W - Driver A_PWM Dim. FEB_14/13	Planing 100 W PSR LCC	150W -CC/CV Driver, NCP1654+NCP1399+NCP4328

HBR: Half Bridge Resonant, A\_PWM Dim.: Analog & PWM Dimming



# Secondary Dimmable DC-DC



## 4 ➤ Buck / Boost PWM Controller


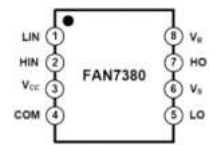
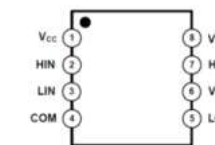
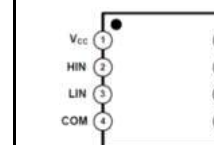
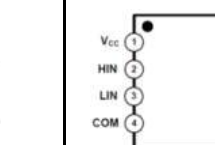
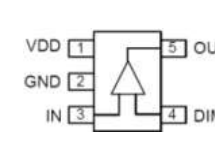
Part ID	NCL30160 NCL30161	FAN7340 FAN73402	FL7760
Topology	Buck	Boost	Buck
Configuration	<b>CC Buck</b>	<b>CC Boost</b>	<b>CC Buck</b>
Operation mode	Hysteresis	Current mode	Hysteresis
Int. MOSFET	Yes/No	No	No
Dimming	<b>PWM</b>	<b>A_PWM</b>	<b>A_PWM</b>
Strong Advantage	HV Start up Brown out	Wide Dim. range Precise CC control Internal Dim. MOSFET	Wide Dim. range CCM 1 MHz Operation
V <sub>CC</sub>	40 V	35 V	60 V
Target Application	Driver	Driver	Driver
PKG	8SOP	16SOP(1NC)	6TSOP
Reference Design	Driver NCL30160GEVB	120 W - Driver A_PWM Dim.	50 W 2CH.



# High Side/ Low Side Switch Gate Driver



## 5 ➤ Gate Driver; MCU based LED Driver

Part ID	FAN73611	FAN7380	FAN7382	NCP5106	FL73282	FL3100
Configuration	High Side	Half Bridge	High & Low side	High & Low side (A) Half Bridge (B)	Half Bridge	Low Side
Voffset [V]	600	600	600	600	900	20
I <sub>o</sub> +/- [mA]	250/500	90/180	350/650	250/500	350/650	2500/1800
t <sub>ON/OFF</sub> [ns]	150/150	135/130	170/200	100/100	150/150	16/16
V <sub>IH/IL</sub> [V]	2.5/0.8	2.8/1.2	2.9/0.8	2.3/0.8	2.5/0.8	2.0/0.8
I <sub>CC</sub> <sup>NORMAL</sup>	0.4 mA	0.6 mA	0.6 mA	0.2 mA	0.5 mA	0.5 mA
Pin layout	8SOP 	8SOP 	8SOP/DIP, 14SOP 	8SOP/DIP 	8SOP 	5SOT23 6MLP 
Key Message	High side only	Low power	Pin to Pin		900 V	Easy PWM Dim. Interface





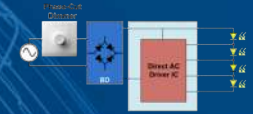
## 6 ➤ Single Stage CV PFC Flyback PWM

Part ID	NCL30060B2	FL7740
Topology	BB/Flyback	BB/Flyback
Operation mode	CRM/ SSR	DCM/ PSR
Int. MOSFET	No	No
Dimming	Secondary	Secondary
Strong Advantage	HV Start up Brown out QR	HV Start up PSR PF Optimizer: >0.9@ Half load&Vuni. Transient Response: < ±10% P <sub>Standby</sub> : <0.3W @30mA I <sub>MCU</sub>
Target Application	Driver	Driver
PKG	8SOP(1NC)	10SOP(1NC)
Reference Design	25 W_Driver NCL30060LED1GEVB	50 W_Driver (Target Release in May)

BB: Buck-Boost



# Direct AC LED Driver

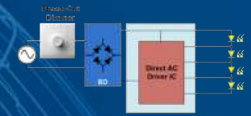


## 1 Parallel Switch configuration

Part ID	FL77904	FL77905	FL77944
Circuit Diagram			
Current Regulator/ Switch's configuration	Parallel	Parallel	Parallel
Package	8SOP	8SOP	16SOP
Channel #	4	3	4
Dimming	Phase-Cut	Phase-cut/Analog/PWM	Phase-cut/Analog/PWM
Driving Power (Low/High Line)	9 W/ 17 W	9 W/ 17 W	18 W / 33 W
Reference Design	35 W (H) - Flood light: FEB_L81	-	12 W (H/L) - Down light: FEB_L80 35 W (H) - Flood light: FEB_L81
Providing IP	<p>Low Ripple (low flicker index)                      Low THD (THD optimizer)                      Phase-cut dimming                      CC tolerance (Line compensation)</p>		



# AC Phase-Cut Dimmer Controller



## 2 ➤ Low Line/High Line, LE/TE Universal Phase-Cut Dimmer

Part ID	FL5150	FL5160
Description	IGBT/MOSFET AC Phase-Cut Dimmer Controller	
Topology	Back to Back AC Switches	
Circuit Diagram	<p>3 Wire Trailing Edge Circuit</p>	<p>2 Wire Leading Edge Circuit</p>
Dimming Mode	Selectable Leading edge and Trailing edge	
Dimming Resolution	226 pulse width with 25 $\mu$ s resolution	
Wiring	Compatible with 2 & 3 line wire both	
Line Frequency	50 Hz	60 Hz
Reference Design	FL5150EVB (2/3 Wire, LE/TE selection)	FL5160EVB (2/3 Wire, LE/TE selection)
Vsupply	Self bias with internal 17 V shunt regulator	
I <sub>Q</sub>	600 $\mu$ A	





# Evaluation Board (Released Products)



# Evaluation Board – Non-Dimming



POUT [W]	VOUT [V] IOUT [A]	VIN [VAC]	Topology	Featured Product(s)	Application	Key Features	Pictures
2.7	28 / 0.1	90 - 264	Buck	FL7701 FLS0116	GU10	Low BOM, High PF	
7.8	31 / 0.25	90 - 150 187 - 264	Buck	FL7701	A19 Bulb	Low BOM, High PF	
8.4	24 / 0.35	90 - 265	Flyback	FL7733A	A19 Bulb	High PF/ Low THD, Good CC, Fast start up	
18.3	39 / 0.47	90 - 265	Buck	FL7701	T8	Low profile, High PF, Low BOM	
18	180 / 0.1	90 - 277	Buck-Boost	NCL30288	Driver	Low profile, High PF, Low BOM	
20	80 / 0.25	190-264	Buck-Boost	NCL30188	T8	Edge socket in, High PF	
21	70 / 0.3	90 - 277	Buck-Boost	FL7733A	T8	Low profile, High PF/Low THD, Good CC, Fast start up	
50	50 / 1.0	90 - 277	Flyback	FL7733A	Driver	Wide Vout, High PF/ Low THD, Good CC, Fast start up	
50	40 / 1.3	90 - 264	Flyback	NCL30188	Driver	Good PF / Low THD, Good CC	
60	40 / 1.5	90 - 277	Flyback	NCL30388	Driver	HV start up, Good CC/CV, High PF/Low THD	
120	40 / 3.0	90 - 305	Boost + Flyback	NCL30030	Driver	Good PF/ Low THD, Low standby power, Fast startup	
120	50 / 2.4	85 - 300	Boost + LLC H/B + Aux. Flyback	FL7930C + FAN7631 + + FLS117	Driver	CV/CC, High PF/Low THD, Low Ripple, Low Std. power	



# Evaluation Board – Dimming



Dimming	POUT [W]	VOUT [V] IOUT [A]	VIN [VAC]	Topology	Featured Product(s)	Application	Key Features	Pictures
Phase-Cut	9 15	72 / 0.12 36 / 0.4 72 / 0.2	108-132 185 - 265	Buck-Boost /Flyback	NCL32073 NCL30073	A19 Bulb Down light	High PF/ Low BOM/ Phase-Cut Dimming	
	8 40 56	24 / 0.35 40 / 1.0 46 / 1.22	108 - 264 108 - 305 108 - 132	Flyback	FL7734	A19 Driver	Wide Vout, Universal Input, High PF/Low THD, High Dimming performance	
Step Dim	20	77 / 0.26	190 - 264	Buck-Boost	NCL30185B	T8	Step Dimming, High PF/Low THD, PSR	
Analog (0-10)	30	52 / 0.58	90 - 305	Flyback	FL7733A	Driver	0-10 Dimming, High PF/Low THD, PSR Fast Start up	
	40	50 / 0.7	90 - 264	Flyback	NCL30060B	Driver	0-10 Dimming, High PF/Low THD, Fast Start up, QR	
	50	40 / 1.3	90 - 264	Flyback	NCL30186B	Driver	0-10 Dimming, High PF/Low THD, PSR Fast Start up, QR	
	60	40 / 1.5	90 - 264	Flyback	NCL30386	Driver	0-10, PWM dimming, High PF/ Low THD, Low Fast startup, Good CC/CV	
	100	50 / 2.0	90 - 305	Boost + Flyback	FL7921R	Driver	0-10 Dimming, Low ripple, High PF/Low THD, Fast Start up	
Analog	50	40 /2Ch.*0.6	90 - 305	Flyback + Buck	FL7740 + FL7760	Driver	0-10, PWM Dimming, High PF/ Low THD, Low BOM, Low P <sub>STBY</sub>	



# Lighting One Pagers (Released Products)



# Phase-Cut Dimming Single Stage Solution

- **FL6630**
- **FL7734**
- **NCL30095/NCL30167**
- **NCL30073**



# FL6630 – $\Phi$ -Cut Dim. Single Stage PSR



## Value Proposition

This highly integrated PSR PWM controller, FL6630, provides precise CC tolerance by TRUECURRENT® tech., excellent PF/THD performance and enables the simplified circuit design for LED lighting applications by PSR control.

## Unique Features

- Phase-cut dimming
- Analog dimming
- High PF (>0.9)
- Low THD (Class C)

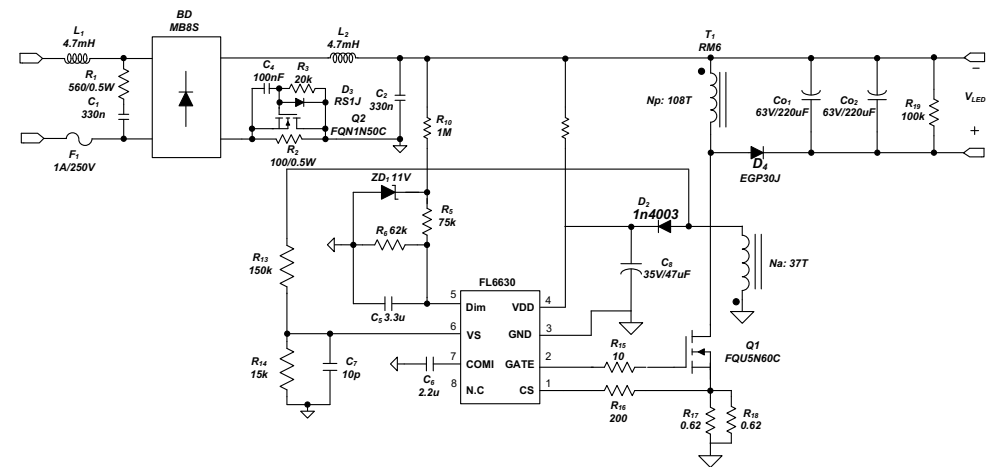
## Benefits

- Low BOM for iso/non-isolation design
- Good light uniformity

## Others Features

- Single Stage PSR tech.
- Tighten CC tolerance:  $<\pm 5\%$  in system
- Protections
  - OLP (Open LED Protection)
  - SLP (Short LED Protection)
  - TSD (Thermal Shut Down)

## Application Data



8 ~ 20 W 110/220 VAC Input Driver



## Market & Applications

- Phase-cut dimmable bulb
- Phase-cut dimmable drivers



## Ordering & Package Information

Ordering Part Number	Package
FL6630MX	8SOP



# FL7734 – Universal $\Phi$ -Cut Dim. Single Stage PSR



## Value Proposition

FL7734 can operate with all types of phase cut dimmers. Phase cut dimming is managed smoothly by bleeding current control to achieve excellent dimmer compatibility without flicker.

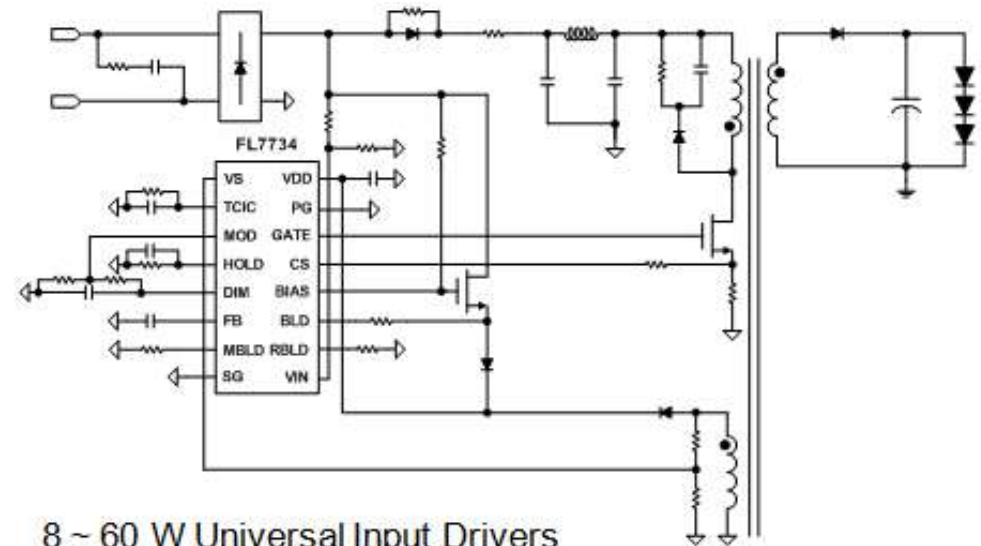
### Unique Features

- Universal Input  $\Phi$ -cut Dim.
- Controllable  $I_{IN}$  min.
- Controllable Dimming curve
- $< \pm 1\%$  Line regulation
- $R_{CS}$  short and open protec.

### Benefits

- Universal input design
- Meet SSL7A & EnergyStar
- Good light uniformity
- High system liability
- Low BOM

### Application Data



### Others Features

- High PF, Low THD :  $>0.9 / <20$
- Fast  $< 0.3$  s Start-up (@ Small phase angle)
- LED Short Protection (SCP)
- LED Open Protection (OVP-VS, OVP-VDD)
- Output Diode Short Protection (OCP)
- Over Temperature Protection (TSD)

### Market & Applications

#### – Phase-Cut Dimmable Lighting Solutions

- A19, PAR30/38, Down Light
- Indoor Flat, Ceiling light



### Ordering & Package Information

Ordering Part Number	Package
FL7734MX	16SOP



# NCL30167 Phase Dimmable Boost Controller



## Overview

The NCL30167 is a **high PF CrM Boost Controller** relying on an external FET for offline LED drivers optimized for new medium power HV LEDs. The Cascoded FET approach allows the use of an off-the-shelf inductor for better bill-of-material. **It supports leading and trailing edge dimmers and the dimming curve complies with NEMA SSL6/7A**

## Key Value Proposition

- Cascode Architecture
- Integrated ZCD detection
- Direct Phase Angle Detection
- NTC based thermal foldback
- Fast startup
- No Aux Winding needed
- Predictable dimming curve monitoring
- Extends product lifetime
- >89% efficiency

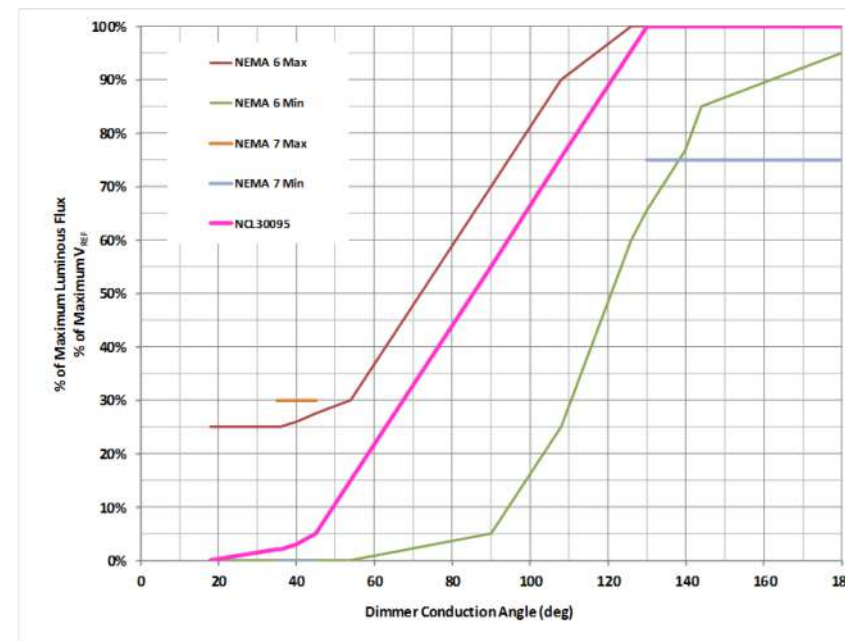
## Others Features

- Near-Unity Power Factor
- CrM Constant On-time Control Architecture
- Accurate Current Regulation  $\pm 2\%$  typical
- Cycle-by-cycle current limiting
- Open LED string protection
- Shorted winding protection
- Vcc overvoltage protection
- - 40 to +125 °C operation
- 8 pin SOIC10

## Market & Applications

- LED Bulbs and engines
- LED Downlights
- LED Luminaires

Eng. Samples: ✓  
Demo Board: ✓  
Production Samples: ✓  
Production Release: Q4 2016



Meets NEMA SSL6 and SSL7A Dimming Window

## Ordering & Package Information

- NCL30167DR2G: SOIC10 Auto-recoverable





# NCL30095 $\phi$ -Cut PFC Boost Switcher



## Overview

The NCL30095 is a high PF CrM **Boost Switcher integrated 400 V FET** for offline LED drivers optimized for under 15 W phase-cut dimmable retrofit. The Cascoded FET approach allows the use of an off-the-shelf inductor for better bill-of-material. It supports leading and trailing edge dimmers and the dimming curve complies with **NEMA SSL6/7A**

## Key Value Proposition

- Cascode Architecture
- Integrated ZCD detection
- Direct Phase Angle Detection monitoring
- NTC based thermal foldback
- Integrated 400 V HV FET
- Fast startup
- No Aux Winding needed
- Predictable dimming curve
- Extends product lifetime
- Low eBOM for Low Line

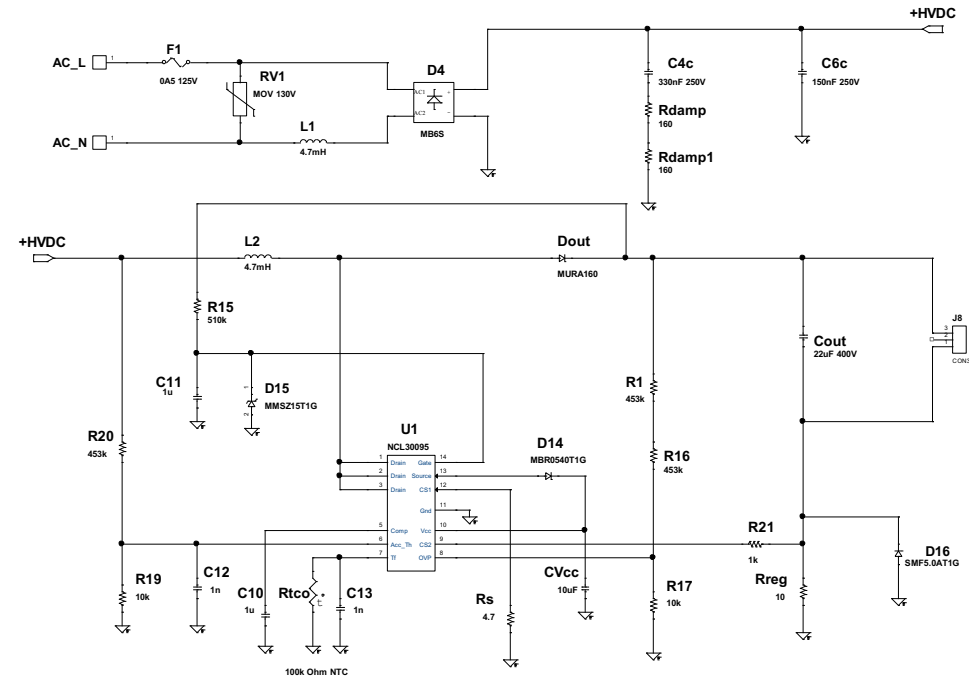
## Others Features

- Near-Unity Power Factor
- CrM Constant On-time Control Architecture
- Accurate Current Regulation  $\pm 2\%$  typical
- Cycle-by-cycle current limiting
- Open LED string & Shorted winding protection
- Vcc overvoltage protection
- - 40 to +125 °C operation
- 14 SOIC

## Market & Applications

- LED Bulbs and engines
- LED Downlights
- LED Luminaires

Production Samples:   
 Production Release: Q1 2017



Meets NEMA SSL6 and SSL7A Dimming Window

## Ordering & Package Information

- NCL30095AR2G: SOIC14



# NCL30073 Phase-Cut Dimming family for <20W app.



## Overview

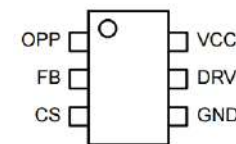
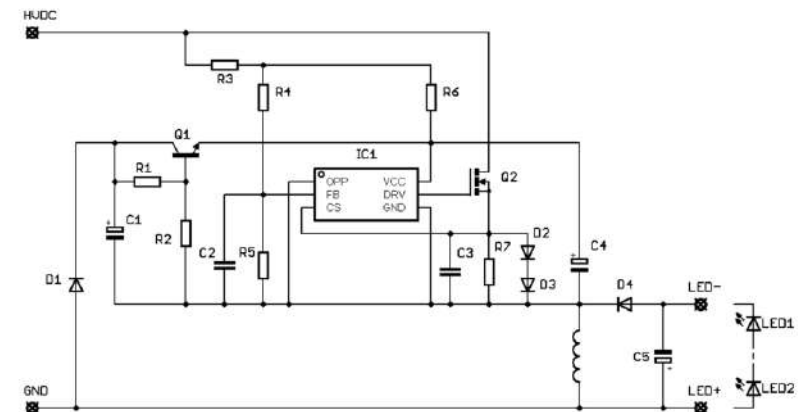
The NCL30073 is a buck/boost topology primary side family targeting dimmable **retrofit and low power fixture** LED applications. 30073 is in a small 6 lead TSOP-6 package as a controller only.

## Value Propositions

- Primary side control
- Up to 25W applications
- Precise current regulation
- <30 eBOM components
- Current Regulation Accuracy ( $\pm 4\%$  typical)
- Power Factor >0.9
- Robust protection suite
- No Aux Winding Needed

## Others Features

- <10% Ripple
- <500ms Start Up Time
- Efficiency >90%
- Optional int. or ext. (NTC) Over Temperature Protection
- Thermal Foldback
- Wide Vcc range (9.5-26 Vdc) to support extend  $V_F$  range
- - 40 to +125 °C operation



15 W Flyback, Buck-Boost EVB

## Market & Applications

- LED Bulbs and tubes
- LED Fixtures / Luminaires

## Ordering & Package Information

- NCL30073BDR2G: Controller Only in TSOP-6



# **Non-Dim/Non-Phase-Cut Dimming Single Stage Solution**

- NCL30060**
- FL7733A**
- FL7701/FLS0116**
- NCL30186**
- NCL30185/8**
- NCL30288**



# NCL30060 – Single Stage CC/CV SSR PWM



## Value Proposition

The NCL30060 is a **power factor corrected** PWM controller targeting isolated flyback single stage LED drivers. Thanks to a constant on time Critical Conduction mode control architecture, high PF, low harmonic distortion and high efficiency approaching 90% can be achieved across a range of line/load. Integrated frequency dithering eases conducted EMI filtering requirements.

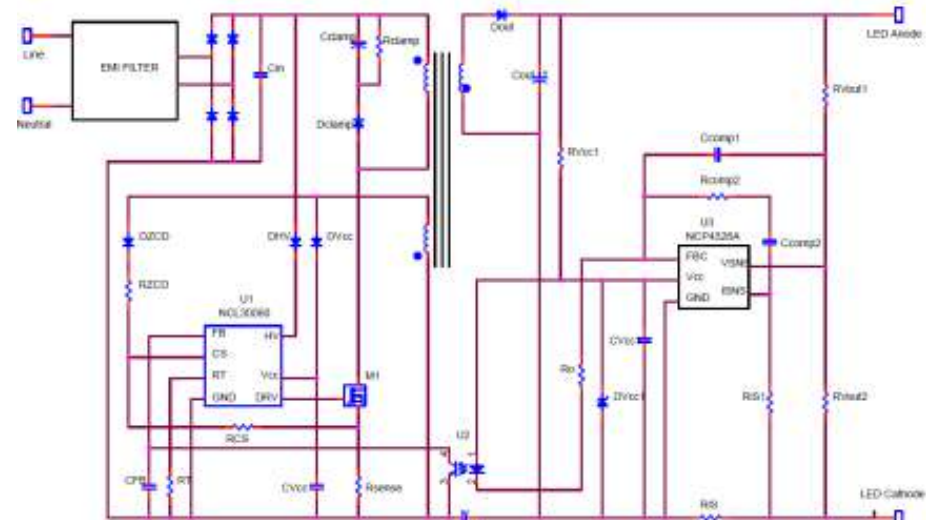
### Unique Features

- **700V High Voltage Startup**
- Constant ON Time Power Factor Control
- **Robust protection suite**
- Frequency Dither
- 25W Demo with 1-10V dim

### Benefits

- Fast startup from the AC mains
- Exceeds global power quality standards for lighting
- Eases safety testing
- Simplified EMI Filtering
- Reduces development time

### Application Data



25 ~ 40 W Universal Input Drivers



## Others Features

- 250/400 mA Gate Driver Capability with 12V Drive Clamp
- Direct opto coupler feedback connection
- Enable/Disable Function
- Output diode and shorted winding protection
- Cycle-by-cycle over current limiting
- Vcc overvoltage protection
- **Integrated Brownout Protection**
- - 40 to +105 °C operation
- SOIC7 with pin removed for enhanced creepage distance

## Market & Applications

- LED Drivers
- Electronic Control Gear
- LED Luminaires

Eng. Samples: ✓  
 Demo Board: ✓  
 Production Samples: ✓  
 Production Release: ✓

## Ordering & Package Information

- NCL30060BDR2G: SOIC8 Auto-Recoverable
- Options for Latched and brownout disable



# FL7740 Single Stage CV PSR Controller



## Overview

The FL7740 provides accurate **CV** (Constant Voltage) regulation with differentiated dynamic function to minimize overshoot and undershoot of output voltage in line and load transient condition. Standby power is less than 0.5 W for smart lighting application and power factor is higher than 0.9 even half load condition and 277 V<sub>AC</sub> when enabling PF optimizer for design scalability

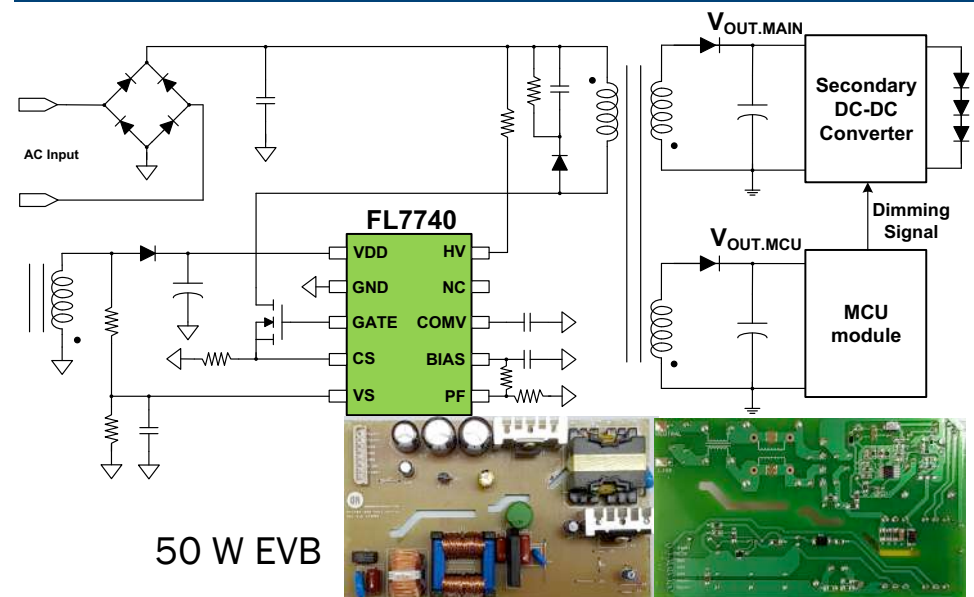
## Key Value Proposition

- <200 ms start up time with integrated **HV Startup JFET**
- CV tolerance (Avg.): **< ± 2 %**
- CV overshoot and undershoot under transient : **< ± 10 %**
- P<sub>Standby</sub>: **<0.15 W @no load, <0.3 W @10 mA I<sub>OUT.MCU</sub>, <0.4 W @20 mA I<sub>OUT.MCU</sub>,**
- Selectable PF optimizer
  - Without PF optimizer (PF/THD)
    - ✓ >0.9/<10 % @ full load & universal input
    - ✓ >0.8/<10 % @ **half load & universal input**
  - With PF optimizer
    - ✓ >0.9/<10% @ full load & universal input
    - ✓ **>0.9/<20 % @ half load & universal input**

## Others Features

- Wide input voltage range (80 V<sub>AC</sub>~382 V<sub>AC</sub>)
- High power driving capability up to 100 W
- Protections: All auto restart mode
  - ✓ Over Load & Output diode short protection
  - ✓ Sensing resistor short/open protection
  - ✓ VDD and Vs over voltage protection

## System Diagram



## Market & Applications

- Mid/High Power LED Driver
- Smart LED Driver

## Ordering & Package Information

- FL7740MX: SOIC10



# FL7733A –Single Stage CC PFC PSR



## Value Proposition

FL7733A can drive 5~ 100% load output voltage range with  $<\pm 3\%$  load/line regulation also provide  $<10\%$  THD performance at universal input condition.

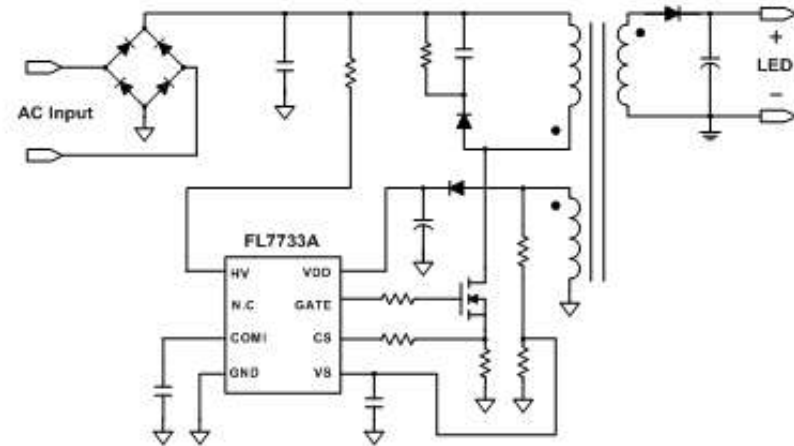
## Unique Features

- 85~308 V<sub>ACIN</sub>/ 5~100% V<sub>OUT</sub>
- $<\pm 3\%$  CC tolerance
- $<10\%$  THD at universal input
- $<\pm 1\%$  Line regulation
- HV start up
- R<sub>CS</sub> short and open protec.

## Benefits

- Single design driver for 10 ~100 W
- Excellent light quality
- High system liability
- Low BOM

## Application Data



8 ~ 60 W Universal Input Drivers



## Others Features

- Fast  $< 0.2$  s Start-up (@85 VAC) with internal Start-up JFET
- Low BOM Count: Single Stage PSR
- High Reliability (All protections – Auto Recovery)
- LED Short (SCP) & LED Open Protection
- Output Diode Short Protection (OCP) & RCS Short and Open Protections (SRSP, SROP)
- Over Temperature Protection (TSD)

## Market & Applications

### – Non-Phase-Cut Dimmable Lighting Solutions

- A19, PAR30/38, Down Light
- Indoor Flat, Ceiling light



## Ordering & Package Information

Ordering Part Number	Package
FL7733AMX	8SOP



# FL7701/FLS0116 – Smart Buck



## Value Proposition

The FL7701 LED lamp driver is a simple IC with PFC function. The special “adopted digital” technique of the IC can automatically detect input voltage condition and send an internal reference signal for achieving high power factor.

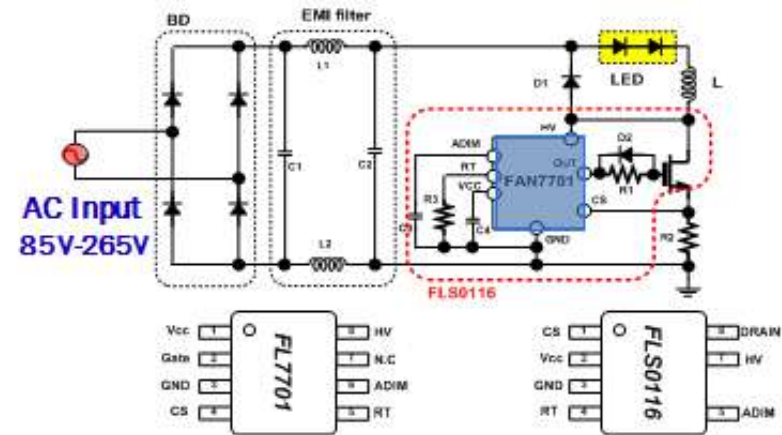
### Unique Features

- Digital PFC generator
- HV start up Vdd shunt regul.
- Automatic line detection

### Benefits

- High PF: >0.9
- No Electrolytic capacitor
- Commercial inductor
- Compatible with AC/DC Input all
- Low BOM

### Application Data



### Others Features

- HV start up
- 550V/1A MOSFET integrated (FLS0116)
- Over temperature protection
- Current sense pin open protection
- Analog/PWM Dimming
- Cycle by cycle current limit

### Market & Applications

- A19, PAR30/38, Down Light, Tube light
- Indoor Flat, Ceiling light



### 3 ~ 20 W Drivers



### Ordering & Package Information

Ordering Part Number	Package
FL7701MX	8SOP
FLS0116MX	7SOP



# NCL30186 – Smart-Dimmable PSR Controller



## Value Proposition

The NCL30186 is a **high PF** PWM primary side current controller for **flyback & non-isolated buck-boost** offline LED drivers. Thanks to a novel control method, the device is able to tightly regulate a constant current from the primary side eliminated the need for secondary side feedback circuitry with **analog and/or digital dimming** and user programmable thermal foldback.

### Unique Features

- Precise current regulation accuracy ( $\pm 2\%$  typical)
- Quasi-resonant control
- Adjustable thermal foldback
- Analog or PWM dimming
- Wide Vcc Range

### Benefits

- Avoids over specifying LEDs to achieve lumen output
- Higher efficiency
- Improved driver reliability
- Supports “Smart” Lighting
- Supports wide LED forward voltage range

### Others Features

- Current control insensitive to normal transformer variation
- Wide Vcc range (9.4-26 Vdc) to support extend  $V_F$  range
- Output diode and shorted winding protection
- Cycle-by-cycle current limiting
- Open LED and shorted output protection
- Vcc overvoltage protection
- 12 V (nom) gate drive clamp
- - 40 to +125 °C operation
- 10 pin SOIC (Same PCB area as SOIC8)

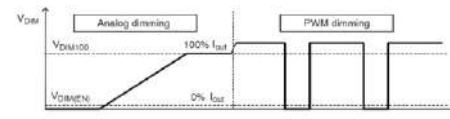
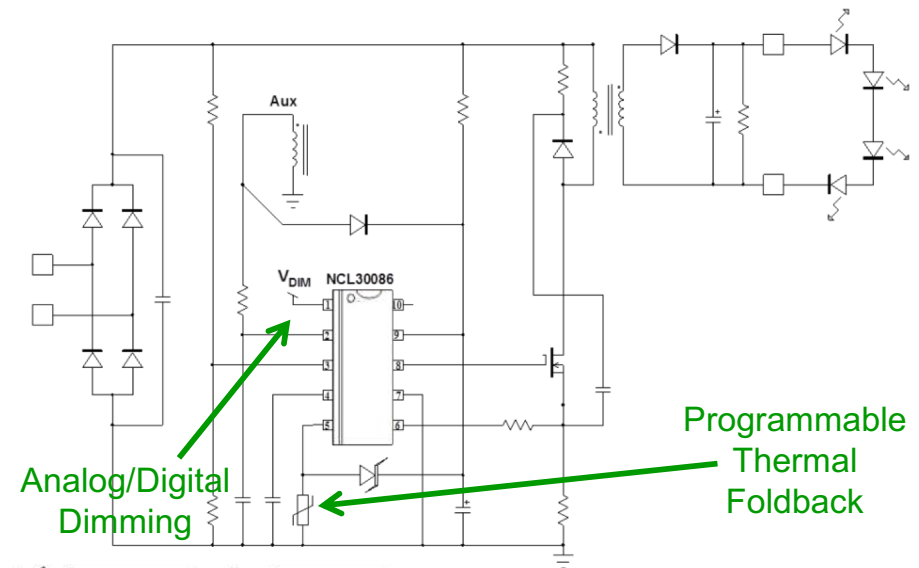


### Market & Applications

- LED Bulbs and tubes
- LED Drivers
- LED Luminaires

Eng. Samples: ✓  
 Demo Board: ✓  
 Production Samples: ✓  
 Production Release: ✓

### Application Data



8 W Smart Light Driver  
 60 W 0-10 Dimming Driver



### Ordering & Package Information

- NCL30186ADR2G: SOIC10 Latched Faults
- NCL30186BDR2G: SOIC10 Auto-Recoverable





# NCL30188 – Single Stage PFC CC PSR



## Value Proposition

The NCL30188 is a **high PF** PWM primary side controller targeting **flyback & non-isolated buck-boost** LED drivers. Thanks to a novel control method, the device regulates a constant current from the primary side eliminated the need for secondary side feedback circuitry and optocoupler. Quasi-resonant operation and embedded protections ensure high efficiency & robust designs.

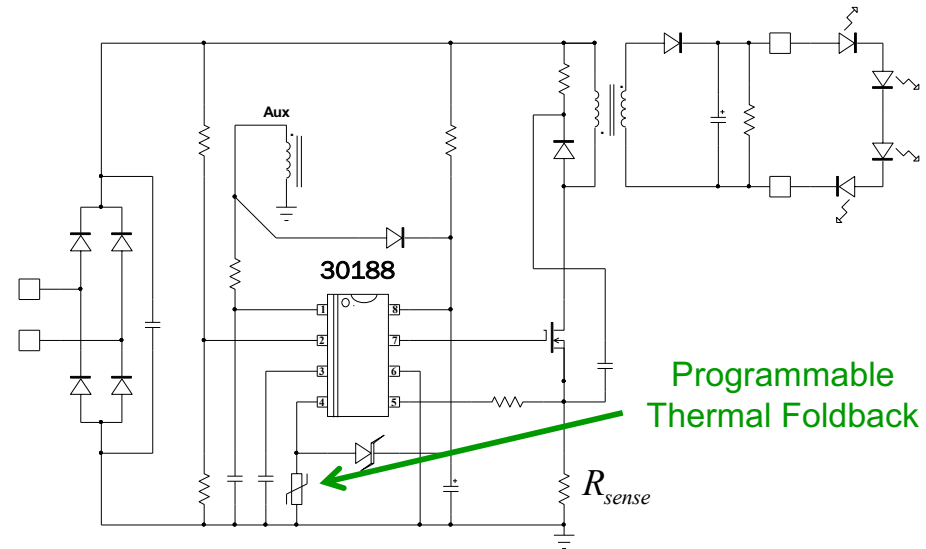
### Unique Features

- Precise current regulation accuracy ( $\pm 2\%$  typical)
- Quasi-resonant control
- Active PF Correction
- Robust protection suite
- Thermal Foldback

### Benefits

- Avoids over specifying LEDs to achieve lumen output
- Higher efficiency
- Exceeds global power quality standards for lighting
- Eases safety testing
- Improved Driver Lifetime

### Application Data



10 ~ 20W Driver

20 W T lamp driver



### Others Features

- Open LED and shorted output protection
- Current control insensitive to normal transformer variation
- Wide Vcc range (9.4-26 Vdc) to support extend V<sub>F</sub> range
- Output diode and shorted winding protection
- Cycle-by-cycle current limiting
- Vcc overvoltage protection
- 10  $\mu$ A typical startup current
- - 40 to +125 °C operation
- Thermal shutdown

### Market & Applications

- LED Bulbs and tubes
- LED Drivers
- LED Luminaires

Datasheet ✓  
 Eng. Samples: ✓  
 Demo Board: ✓  
 Production Samples: ✓

### Ordering & Package Information

- NCL30088ADR2G: SOIC8 Latched Faults
- NCL30088BDR2G: SOIC8 Auto-Recoverable



# NCL30185 – Step-Dim. Single Stage PFC CC PSR



## Value Proposition

The NCL30185 is a **high PF PWM primary side current** controller for **flyback & buck-boost** offline LED drivers. Thanks to a novel control method, the device is able to tightly regulate a constant current from the primary side eliminated the need for secondary side feedback circuitry. It has **3 step dimming by toggling wall switch** and user programmable thermal foldback.

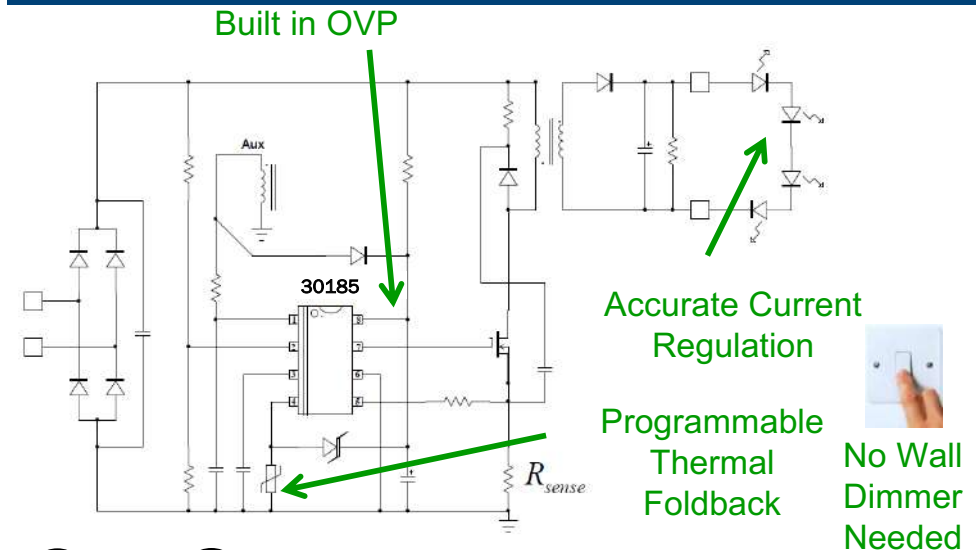
## Unique Features

- Precise current regulation accuracy ( $\pm 2\%$  typical)
- Quasi-resonant control
- Adjustable thermal foldback
- 3 Step Dimmable (70/25/5%)
- Programmable OVP

## Benefits

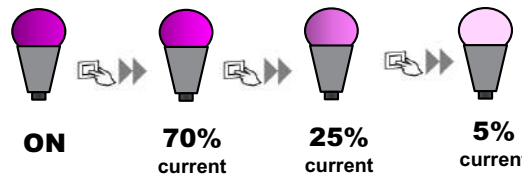
- Avoids over specifying LEDs to achieve lumen output
- Higher efficiency
- Improved driver reliability
- Triac Dimmer Not Required
- User can set over voltage protection level

## Application Data



## Others Features

- Current control insensitive to normal transformer variation
- Wide Vcc range (9.4-26 Vdc) to support extend V<sub>F</sub> range
- Output diode and shorted winding protection
- Cycle-by-cycle current limiting
- Open LED and shorted output protection
- Built-in Vcc overvoltage protection
- 12 V (nom) gate drive clamp
- - 40 to +125 °C operation
- Standard SOIC8 for easy of assembly



10 ~ 20W Step Dim Driver



## Market & Applications

- LED Bulbs and tubes
- LED Drivers
- LED Luminaires

Datasheet ✓  
 Eng. Samples: ✓  
 Demo Board: ✓  
 Production Samples: ✓

## Ordering & Package Information

- NCL30185ADR2G: SOIC8 Latched Faults
- NCL30185BDR2G: SOIC8 Auto-Recoverable



# NCL30288 – Single Stage PFC CC PSR in 6TSOP



## Value Proposition

The NCL30288 is a **high PF** PWM primary side controller targeting **flyback & non-isolated buck-boost** LED drivers. The device regulates a constant current from the primary side eliminating the need for secondary side feedback circuitry and an optocoupler. Due to design and process optimization, fits within a small SOT-23 6 pin package with low system components.

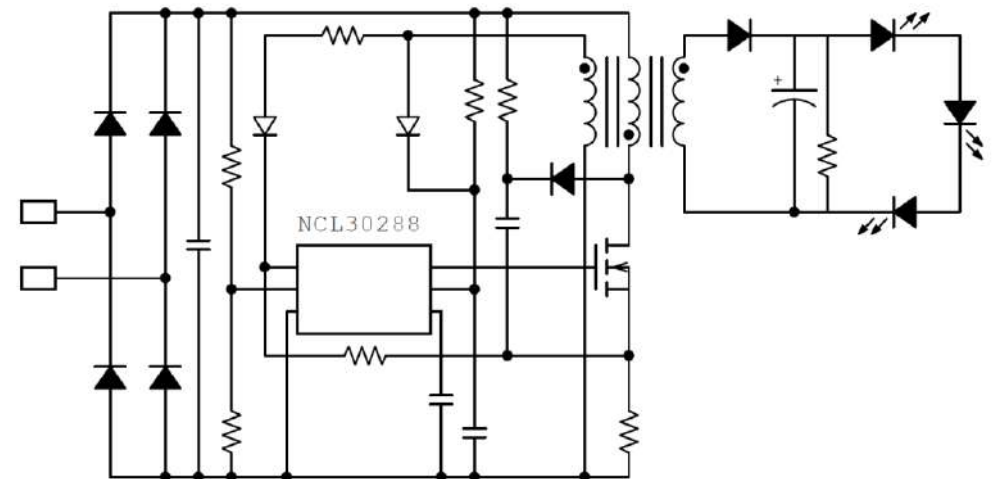
## Unique Features

- Precise current regulation accuracy ( $\pm 3\%$  typical)
- Quasi-resonant control
- Active PF Correction
- Robust protection suite
- Universal Mains (90-305V)
- <22 eBOM components

## Benefits

- Avoids over specifying LEDs to achieve lumen output
- Higher efficiency
- Exceeds global power quality standards for lighting
- Eases safety testing
- Wide operating coverage
- Low profile design

## Application Data



**Non-isolated buck-boost topology can also be supported**

20 W T lamp driver in Feb. 2017



## Others Features

- <10% THD @ 230Vac
- <500ms Start Up Time
- Output Ripple <40% Pk to Pk
- Dual OVP protection
- No Optocoupler needed for Isolated Topology
- Wide Vcc range (9.4-26 Vdc) to support extend  $V_F$  range
- - 40 to +125 °C operation

## Market & Applications

- LED Bulbs and tubes
- LED Drivers
- LED Luminaires

Datasheet: ✓  
Samples: ✓  
Demo Board: ✓, On Ass'y

## Ordering & Package Information

- NCL3028BSNT1G: 6TSOP



# NCL30386 Smart-Dimmable PSR Controller



## Overview

The NCL30386 is a high PF Single stage Constant Current and Constant Voltage PSR PWM controller for Flyback/ Buck-Boost/ Sepic. This controller operates in a QR mode to provide high efficiency. This device is providing very deep analog dimming output current with two dedicated dimming control input pin – ADIM and PDIM.

## Key Value Proposition

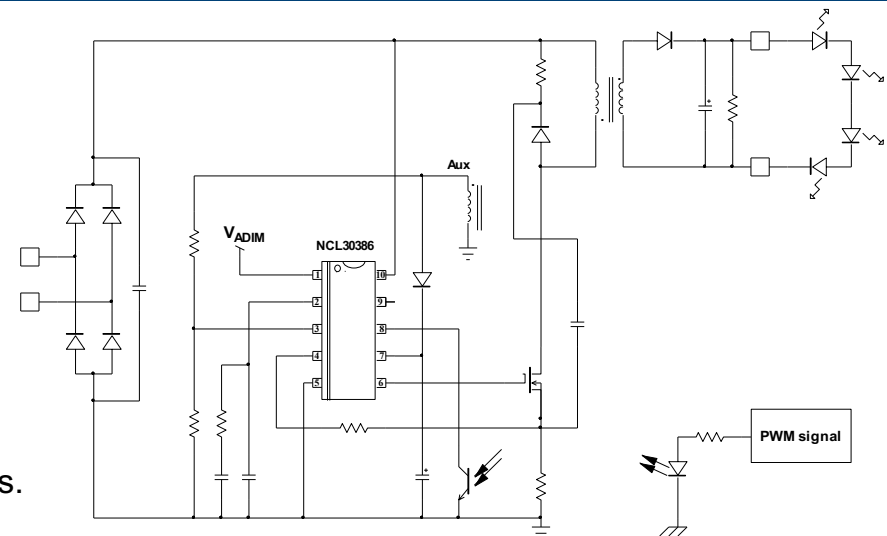
- Integrated **HV Startup**
- Precise **current regulation** accuracy ( $<\pm 2\%$  typical)
- Precise **voltage regulation** accuracy ( $<\pm 2\%$  typical)
- **PF(>0.95)/THD(<10%) @ Univ.**
- **Quasi-resonant** control
- Excellent **Dimming features**
  - Dimming **curve**: Linear/Quadratic
  - **ADIM**: Analog  $I_{OUT}$  with  $V_{DC}$   
PWM  $I_{OUT}$  with  $V_{PWM}$
  - **PDIM**: Analog  $I_{OUT}$  with  $V_{PWM}$
  - 0.5% Min. Dimming ratio
- Fast startup, low Pstdby
- Constant brightness
- Aux. power supply for MCU & cold start up
- Exceeds global standards
- Higher efficiency
- Design flexibility
- Supports “Smart” Lighting
- Use opto. Instead of pulse trans.
- Deep dimming features

## Others Features

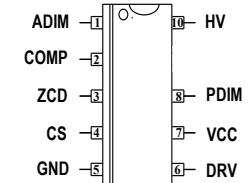
- High reliability with abundant protections; Brown-out, OVP,  $R_{CS}$ , Output, Diode, Winding short protection, TSD
- Wide Vcc range (9.2-26  $V_{DC}$ ) to support extend  $V_F$  range

## Market & Applications

- Analog/PWM Dimmable LED Drivers



20 W 0-10, PWM Dimming Driver



Launch in April '18

## Ordering & Package Information

- NCL30386A1 - 1.5  $\mu s$  ZCD blanking, Min.Dim Clamp, SOIC9
- NCL30386B1 - 1.0  $\mu s$  ZCD blanking, SOIC9



# NCL30388 Single Stage CC/CV PSR Controller



## Overview

The NCL30388 is a high PF Single stage Constant Current and Constant Voltage PSR PWM controller for Flyback/ Buck-Boost/ Sepic. This controller operates in a QR mode to provide high efficiency. The device is highly integrated with a minimum number of external components. A robust suite of safety protection is built in to simplify the design

## Key Value Proposition

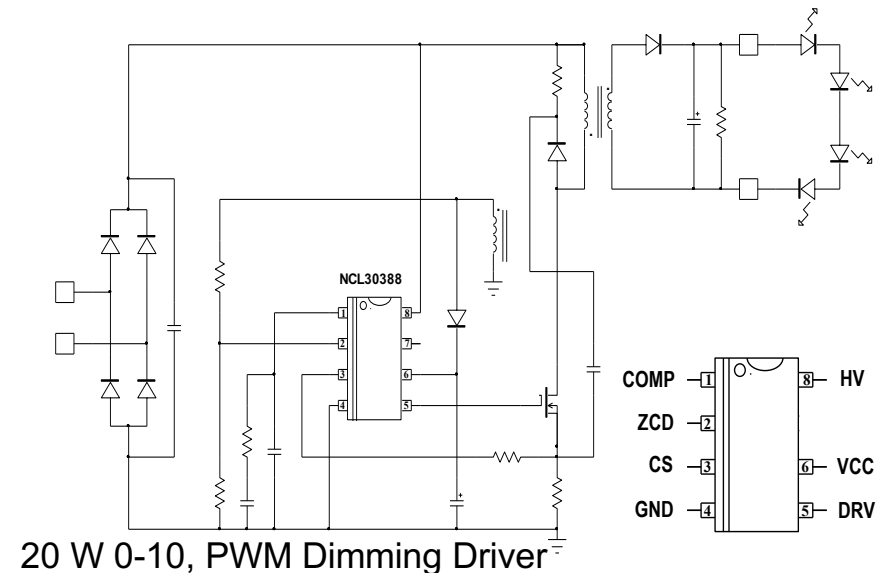
- Integrated **HV Startup**
- Precise **current regulation** accuracy ( $<\pm 2\%$  typical)
- Precise **voltage regulation** accuracy ( $<\pm 2\%$  typical)
- **PF( $>0.95$ )/THD( $<10\%$ ) @ Univ.**
- **Quasi-resonant** control
- Robust Protections
  - Brown-out
  - OVP (Optional OVP level)
  - $R_{CS}$ , Output, Diode, Winding Short
  - TSD
- Fast startup, low Pstdby
- Constant brightness
- Cold start up features
- Exceeds global standards
- Higher efficiency
- High System Reliability

## Others Features

- Wide  $V_{CC}$  range (9.2-26  $V_{DC}$ ) to support extend  $V_F$  range
- Optional Maximum dead time
- Optional ZCD blanking time

## Market & Applications

- Non-Dimmable High Performance LED Driver



Launch in April' 18

## Ordering & Package Information

- NCL30388A1 - 1.5  $\mu s$  ZCD blanking, DSS ON, SOIC7
- NCL30388B1 - 1.0  $\mu s$  ZCD blanking, SOIC7



# **Multiple Stage Boost PFC**

- NCP1602**
- NCP1608**
- NCP1654**





# NCP1608 – Voltage mode CRM PFC IC



## Value Proposition

NCP1608 uses Critical Conduction Mode (CrM) to ensure near unity power factor across a wide range of input voltages and output power. The NCP1608 minimizes the number of external components by integrating safety features, making it an excellent choice for designing robust PFC stages.

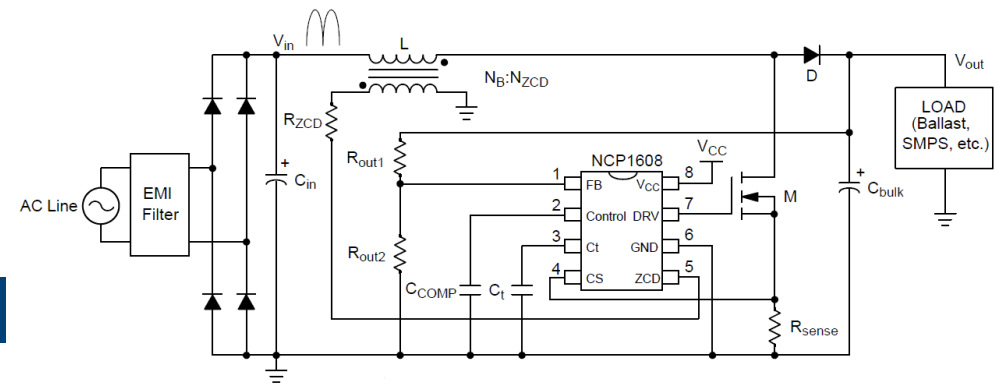
## Unique Features

- Pin to pin compatible with industry standards
- Adjustable Overvoltage Protection (OVP)
- Open loop protection including Floating Pin Protection (FPP)

## Benefits

- Reduce design efforts
- Design flexibility
- Rugged design

## Application Data



## Others Features

- High Precision Voltage Reference ( $\pm 1.6\%$  over the Temp. range)
- Trans-conductance Error Amplifier
- Built-in OCP
- Less than 35  $\mu\text{A}$  start up current
- Drive capability 500/-800 mA (source/sink)

100 W Boost Reference Design



## Market & Applications

- Mid/High Power LED Driver



## Ordering & Package Information

- NCP1608BDR2G: SOIC-8





# NCP1654 – 8 pin CCM PFC IC



## Value Proposition

8pin CCM Boost PFC controller, The NCP1654 simplifies the PFC implementation. It also integrates high safety features that make the NCP1654 a driver for robust and compact PFC stages like an effective input power runaway clamping circuit.

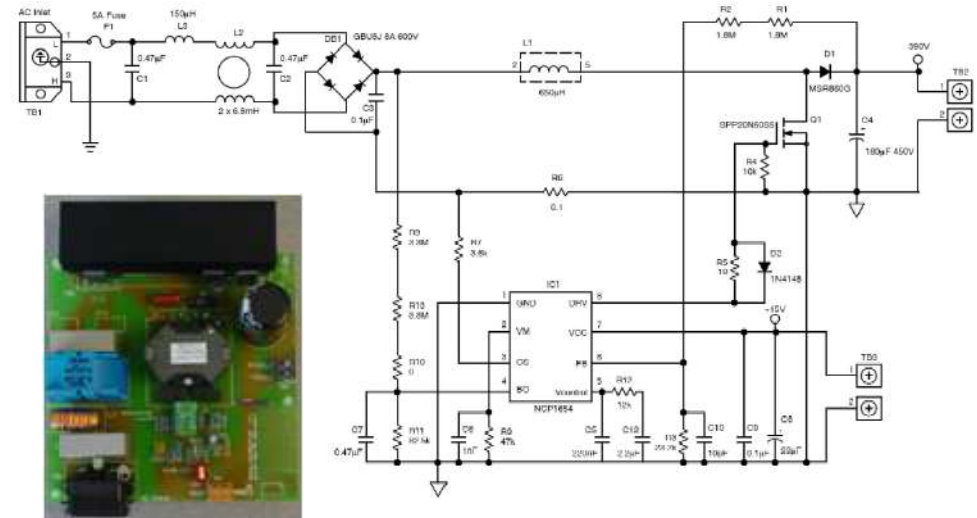
### Unique Features

- Very Few External Components
- Programmable OCP
- Programmable Overpower Limitation
- Continuous Conduction Mode

### Benefits

- Cost-effective design
- Increasing safety
- Rugged design
- High electrical performance

### Application Data



### Others Features

- Fast transient response
- Integrated 65/133/200 KHz oscillator
- Less than 75  $\mu$ A start up current
- Drive capability  $\pm 1.5$  A
- Brown-out/Shut down function

### Market & Applications

- High Power In/Out door light
- Flood light
- Street Light



### 300 W Boost Reference Design

### Ordering & Package Information

- NCP1654BD65R2G: SOIC-8
- NCP1654BD133R2G: SOIC-8
- NCP1654BD6200R2G: SOIC-8



## **Multiple Stage**

### **CRM PFC+QR Flyback PWM**

- **FL7921: VM CRM PFC+QR PWM Combo (Good THD)**
- **NCL30030: CM CRM PFC+QR PWM Combo (Good Std Pw)**



# FL7921 – CRM PFC & QR PWM Combo IC



## Value Proposition

The highly integrated FL7921R combines a Power Factor Correction (PFC) controller and a Quasi-Resonant PWM controller. Integration provides cost-effect design and allows for fewer external components.

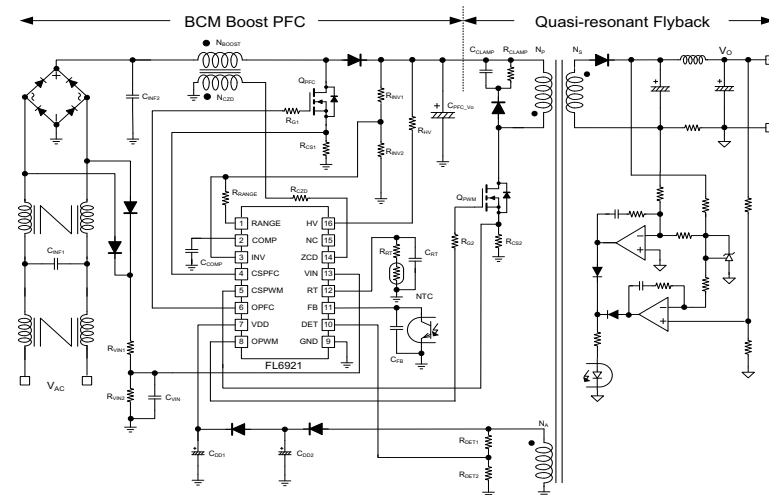
## Unique Features

- HV start up
- THD optimizer
- Over power compensation

## Benefits

- Fast start up
- High PF / Low THD
- Wide in/output operating

## Application Data



100 W Analog Dim. Driver



## Others Features

- PFC Function Always ON Regardless of PWM Load Condition for high PF at Light Load
- Internal Minimum tOFF 8  $\mu$ s for QR PWM Stage
- Internal 9.5 ms Soft-Start Time for PWM
- Brown-out Protection
- Auto-Recovery Over-Current Protection
- Auto-Recovery Open-Loop Protection
- Auto-Recovery Over-Temperature Protection
- Adjustable OTP with external NTC through RT pin
- Auto-Recovery VDD and Output Over-Voltage Protection

## Market & Applications

- Mid/ High Power In/Out door light
- Flood light
- Street Light



## Ordering & Package Information

Ordering Part Number	Package
FL7921RMX	16SOP





## **Multiple Stage**

## **LLC/LCC Resonant Half Bridge Controller**

- **FLS1600/ 1800/ 1900/ 2100**
- **NCL30059**
- **NCP1399**



# FLS1600,1700,1800,2100 – LLC Resonant Switcher



## Value Proposition

The FLS-XS series of general lighting power controllers includes highly integrated power switches for medium- to high-power lumens applications. Offering everything necessary to build a reliable and robust half-bridge resonant converter, the FLS-XS series simplifies designs and improves productivity, while improving performance.

## Unique Features

- Internal UniFET™ with Fast-Recovery Body Diode
- Auto-Restart Operation for All Protections

## Benefits

- Low BOM High reliability
- Design flexibility

## Others Features

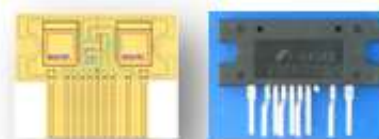
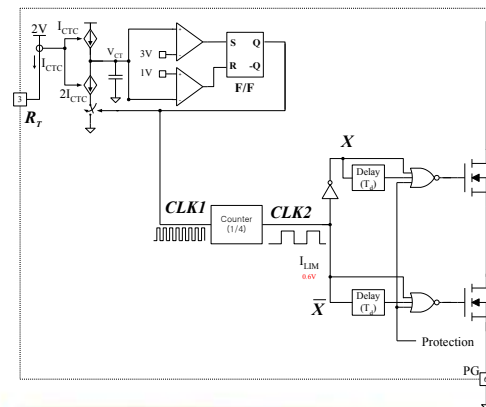
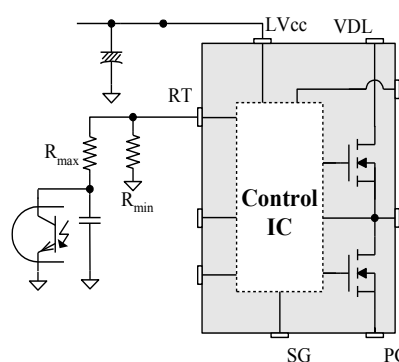
- High efficiency through ZVS
- High side gate driver included
- Up to 300 kHz operating frequency
- Pulse skipping for Frequency limit at light load condition
- Thermal shut down function
- Various Protection functions; OVP, OLP, OCP, AOC

## Market & Applications

- High Power In/Out door light
- Flood light
- Street Light



## Application Data



100 ~ 160 W Driver

## Ordering & Package Information

- FLS1600XS – 9SIP
- FLS1700XS – 9SIP
- FLS1800XS – 9SIP
- FLS2100XS – 9SIP



# NCL30059 – 8 pin Resonant Converter Controller



## Value Proposition

The NCL30059 is a self-oscillating high voltage MOSFET driver primarily tailored for the applications using half-bridge topology. Due to its proprietary high-voltage technology, the driver accepts bulk voltages up to 600 V. Operating frequency of the driver can be adjusted from 25 kHz to 250 kHz using a single resistor.

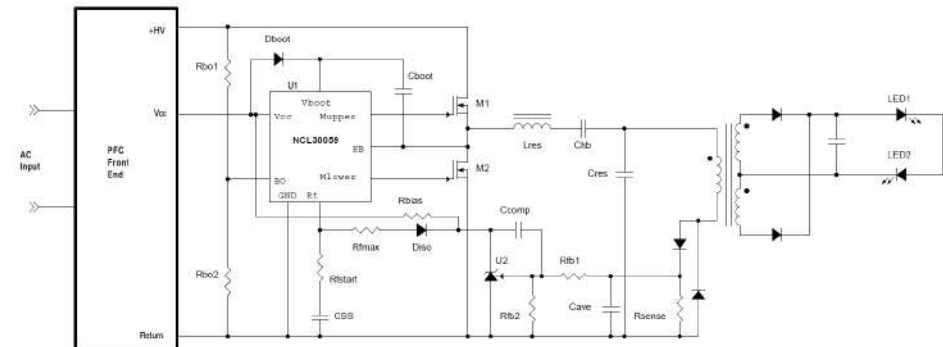
## Unique Features

- Minimum frequency adjust accuracy 3 %
- Brown-out input
- 100 ms PFC delay timer

## Benefits

- Keeps operation in the right region & simplifies design
- Simple PFC association, design flexibility
- Allows PFC out voltage to stabilize before device operation

## Application Data



Under preparing 100 W low BOM PFC+LCC half bridge driver

## Others Features

- Wide operating frequency range: 25 kHz ~ 250 kHz
- Adjustable brown out protection
- Low start up current of 50  $\mu$ A
- Latched input
- Thermal shut down function

## Market & Applications

- High Power In/Out door light
- Flood light
- Street Light



## Ordering & Package Information

- NCL30059BDR2G – SOIC-8



# NCP1399 – Current Mode LLC Controller



## Value Proposition

The NCP1399 is a high performance controller for half bridge LLC resonant converters supporting operation over a wide range of bulk or line voltages. Current mode controller and enhanced light load efficiency makes it ideal for high power designs.

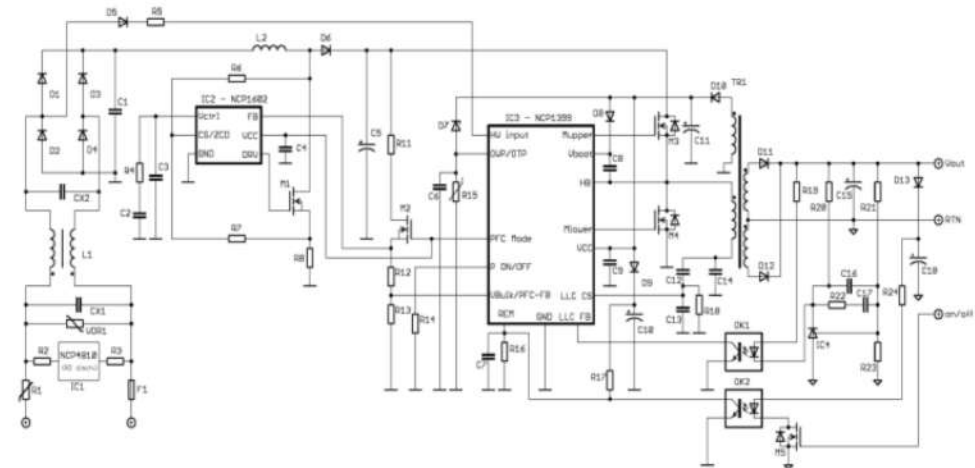
### Unique Features

- Built-in 600V/1A drivers
- Current mode control
- Light load and no load efficiency enhancement

### Benefits

- Compact design
- Inherent anti-capacitive switching protection
- <30 mW off-mode
- <100 mW no load

### Application Data



**PFC Mode provides VCC to PFC controller when  $P_{out} > x W$**   
**Digital Soft-Start with No Hard Switching**

Under preparing 150 W LED lighting driver board

## Others Features

- BO protection
- PFC stage operation control according to load conditions
- Automatic or fixed dead-time adjust options
- Safety design for pin-pin short and open/short
- High flexibility via custom options

## Market & Applications

- High Power In/Out door light
- Flood light
- Street Light



## Ordering & Package Information

- NCP1399 A – Active off off-mode , skip ext. adjustable
- NCP1399 B – Active on off-mode, skip adjust internal





# Multiple Stage

## CC DC-DC

- **NCL30160/1: Buck**
- **FAN7340/73402: Boost**
- **FL7760: Buck**



# NCL30160/1 – PWM Dim. Buck



## Value Proposition

The NCL30160/1 are an NFET hysteretic step-down, constant-current driver for high power LEDs..with PWM dimming function. Operate with an input voltage range from 6.3 V to 40 V. 50 V/ 55 mΩ MOSFET is integrated in to NCL30160.

### Unique Features

- Up to 1.4 MHz Operation
- No Control Loop Compensation Required
- Externally adjustable LED current
- Dedicated EN/DIM Pin

### Benefits

- Allows the use of small inductor
- Ease of design and minimal external components
- Flexibility to design for different types and number of LEDs
- Allows easy PWM dimming

### Others Features

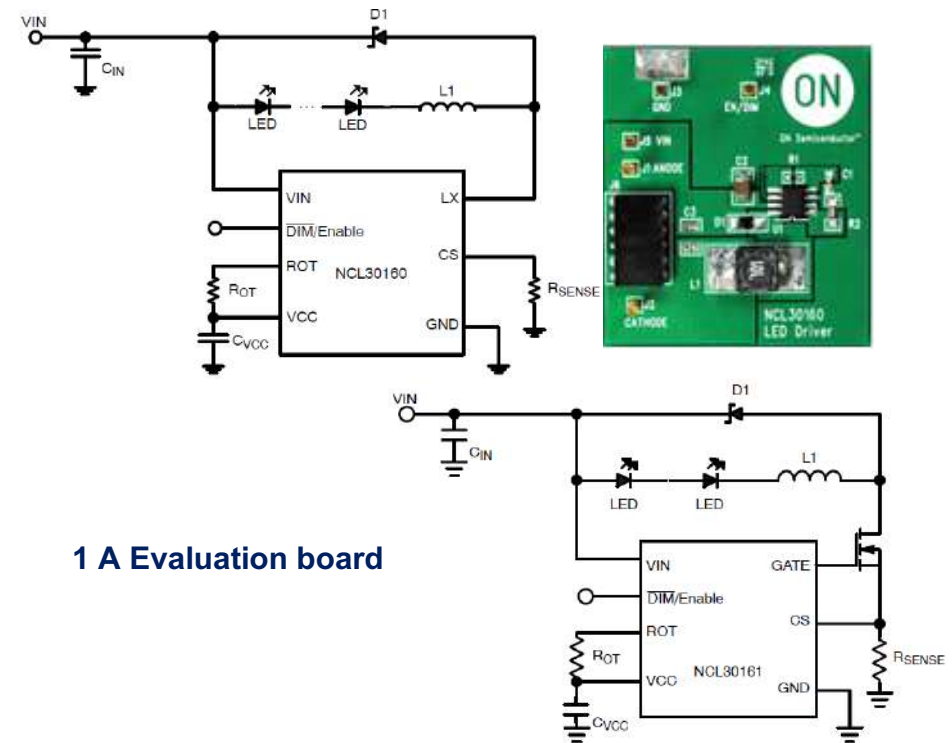
- 50 V/ 55 mΩ MOSFET is integrated in to NCL30160.
- Short LED shutdown protection
- NCL30161 can driver over 40 V input with Vcc supply voltage
- Adjustable LED current
- Capable of 100% duty cycle operation

### Market & Applications

- LED Drivers
- Electronic Control Gear
- LED Luminaires

Eng. Samples: ✓  
 Demo Board: ✓  
 Production Samples: ✓  
 Production Release: ✓

### Application Data



### Ordering & Package Information

- NCL30160DR2G SOIC-8
- NCL30161MNTXG DFN10



# FAN73402 – A\_PWM Dim. Boost Controller



## Value Proposition

The FAN73402 is single-channel boost controller that integrates an N-channel power MOSFET for PWM dimming using ON Semi's proprietary planar Double-diffused MOSFET (DMOS) technology. The IC operates as a constant-current source for driving high-current LEDs..

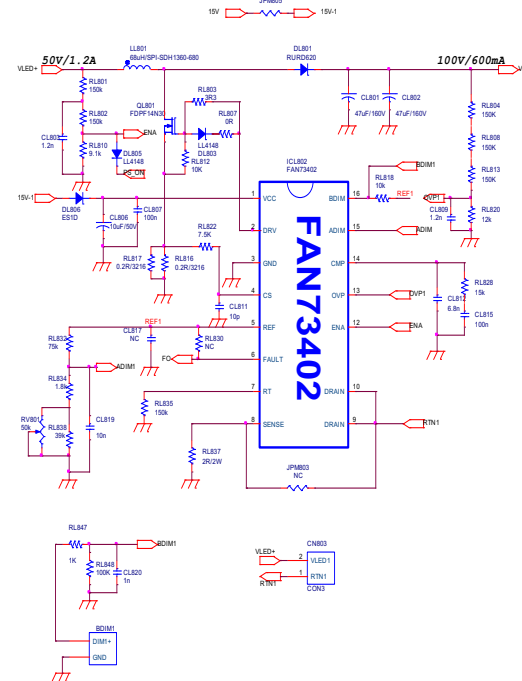
### Unique Features

- LED Current Regulation:  $\pm 1\%$
- Internal Power MOSFET for PWM Dimming:  $R_{DS(ON)}=1.0\Omega$  at  $V_{GS}=10V$ ,  $BV_{DSS}=200V$
- Programmable Frequency: 50 kHz ~ 300 kHz

### Benefits

- Good light uniformity
- Wide dimming range & Low BOM: 0.1 ~ 100% (@200Hz)
- Design flexibility

### Application Data



60 W – 2Ch.  
120 W Driver EVB

### Others Features

- Internal programmable slope compensation
- Wide Supply Voltage Range : 10V to 35V
- Analog and PWM Dimming Function
- Error-Flag & Auto-restart
- Over Voltage Protection, Open LED Protection
- Over Current Protection (Auto-restart)
- Thermal Protection

### Market & Applications

- LED Drivers
- Electronic Control Gear
- LED Luminaires

Eng. Samples: ✓  
Demo Board: ✓  
Production Samples: ✓  
Production Release: ✓

### Ordering & Package Information

- FAN73402MX – SOIC-15



# FL7760 Analog/PWM Dim. 60 V Buck Controller



## Overview

The FL7760 is a high efficiency **step-down** controller for middle to high power lighting applications that operate in **CCM** (Continuous Current Mode). The FL7760 can operate in wide 8 ~ **60 V input** range and support **both PWM and analog dimming** through DIM pin with small **6 pin** package

## Key Value Proposition

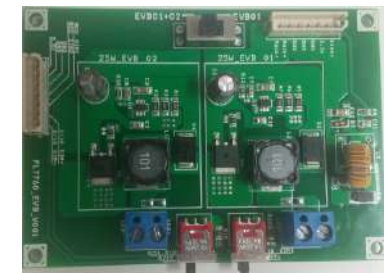
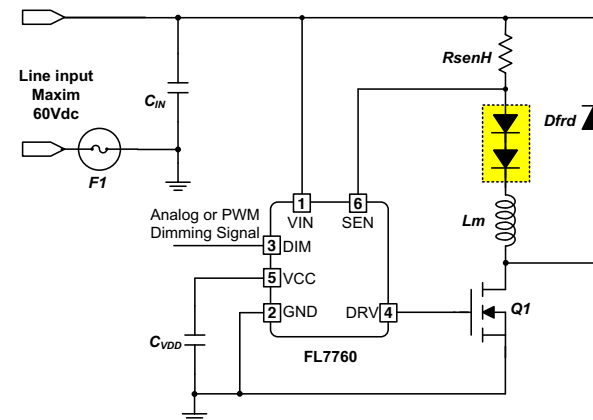
- Wide Input Range (8 V<sub>DC</sub>~60 V<sub>DC</sub>)
- Constant Current Mode Operation
- Hysteresis Control with fixed reference
- **Wide Dimming** range
  - Analog Dimming: 5 ~ 100 %
  - PWM Dimming: 1 ~ 100% (@2 KHz)

## Others Features

- High switching frequency up to 1 MHz
- High source / sink current of 1.5 A / 2.5 A
- Cycle-by-Cycle Current Limit
- Low Operating Current (150 uA)
- Thermal Shutdown
- Over Current Protection
- Small Outline Package (SOT-23-6L)

## Market & Applications

- Mid/High Power LED Driver
- Smart LED Driver



2Ch., 25 W EVB available

## Ordering & Package Information

- FL7760AM6X: Quadratic Dim. Curve, 6L-SOT23
- FL7760BM6X: Linear Dim. Curve, 6L-SOT23



# **Multiple Stage Single Stage CV Flyback (+ CC DC-DC) - NCL30060**



# NCL30060 – Single Stage CC/CV SSR PWM



## Value Proposition

The NCL30060 is a **power factor corrected** PWM controller targeting isolated flyback single stage LED drivers. Thanks to a constant on time Critical Conduction mode control architecture, high PF, low harmonic distortion and high efficiency approaching 90% can be achieved across a range of line/load. Integrated frequency dithering eases conducted EMI filtering requirements.

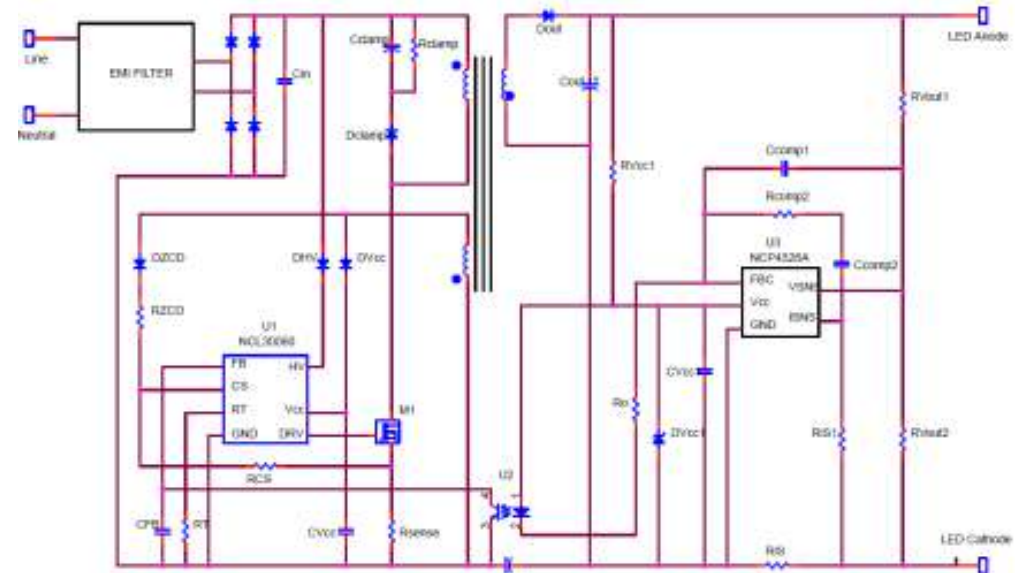
### Unique Features

- **700V High Voltage Startup**
- Constant ON Time Power Factor Control
- **Robust protection suite**
- Frequency Dither
- 25W Demo with 1-10V dim

### Benefits

- Fast startup from the AC mains
- Exceeds global power quality standards for lighting
- Eases safety testing
- Simplified EMI Filtering
- Reduces development time

### Application Data



25 ~ 40 W 0-10 Dim. Driver

## Others Features

- 250/400 mA Gate Driver Capability with 12V Drive Clamp
- Direct opto coupler feedback connection
- Enable/Disable Function
- Output diode and shorted winding protection
- Cycle-by-cycle over current limiting
- Vcc overvoltage protection
- **Integrated Brownout Protection**
- - 40 to +105 °C operation
- SOIC7 with pin removed for enhanced creepage distance

## Market & Applications

- LED Drivers
- Electronic Control Gear
- LED Luminaires

Eng. Samples: ✓  
 Demo Board: ✓  
 Production Samples: ✓  
 Production Release: ✓

## Ordering & Package Information

- NCL30060BDR2G: SOIC8 Auto-Recoverable
- Options for Latched and brownout disable



# FL7740 Single Stage CV PSR Controller



## Overview

The FL7740 provides accurate **CV** (Constant Voltage) regulation with differentiated dynamic function to minimize overshoot and undershoot of output voltage in line and load transient condition. Standby power is less than 0.5 W for smart lighting application and power factor is higher than 0.9 even half load condition and 277 V<sub>AC</sub> when enabling PF optimizer for design scalability

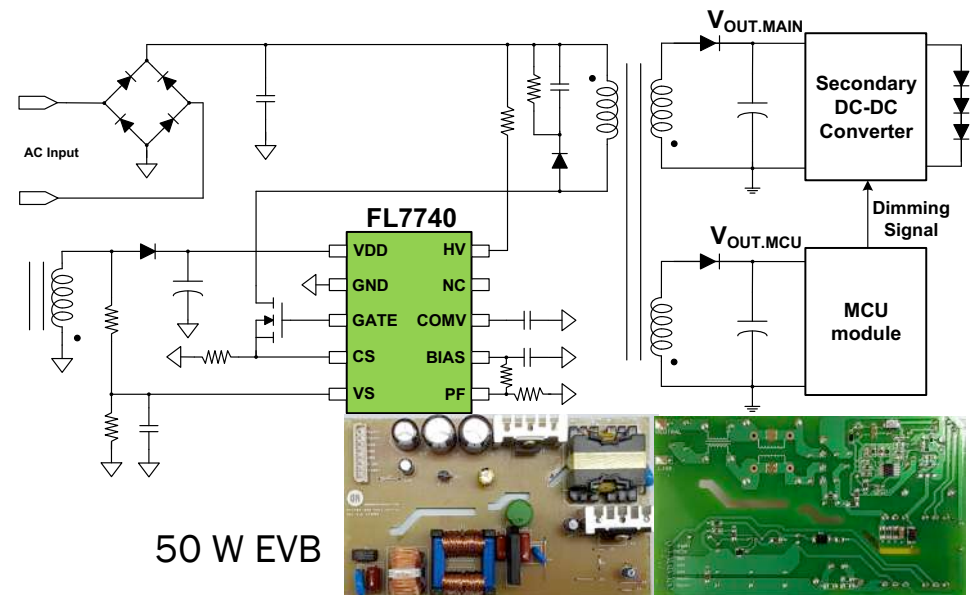
## Key Value Proposition

- <200 ms start up time with integrated **HV Startup JFET**
- CV tolerance (Avg.): **< ± 2 %**
- CV overshoot and undershoot under transient : **<±10 %**
- P<sub>Standby</sub>: **<0.15 W @no load, <0.3 W @10 mA I<sub>OUT.MCU</sub>, <0.4 W @20 mA I<sub>OUT.MCU</sub>,**
- Selectable PF optimizer
  - Without PF optimizer (PF/THD)
    - ✓ >0.9/<10 % @ full load & & universal input
    - ✓ >0.8/<10 % @ **half load & universal input**
  - With PF optimizer
    - ✓ >0.9/<10% @ full load & & universal input
    - ✓ **>0.9/<20 % @ half load & universal input**

## Others Features

- Wide input voltage range (80 V<sub>AC</sub>~382 V<sub>AC</sub>)
- High power driving capability up to 100 W
- Protections: All auto restart mode
  - ✓ Over Load & Output diode short protection
  - ✓ Sensing resistor short/open protection
  - ✓ VDD and Vs over voltage protection

## System Diagram



## Market & Applications

- Mid/High Power LED Driver
- Smart LED Driver

## Ordering & Package Information

- FL7740MX: SOIC10



# Gate Driver

**600/900 V High side/Half bridge Gate driver**

**- FAN73611, FAN7380/2, NCP5106, FL73282**

**Low side gate driver**

**- FL3100**





# 600/900 V High Side/ Half Bridge Gate Driver



## Value Proposition

ONsemi offers high voltage gate-drive (HVICs) which improve system reliability through the implementation of an innovative noise canceling circuit that provides excellent noise immunity.

## Unique Features

- Extended Allowable Negative  $V_S$  Swing to -9.8 V
- Excellent  $V_S$  positive/negative noise immunity
- Matched Propagation Delay Below 50ns

## Benefits

- High system reliability
- Normal operation upto -300 V 100 ns pulse
- Robust system operation

## Market & Applications

- LED Drivers
- Electronic Control Gear
- LED Luminaires

## Line up table

Part ID	FAN73611	FAN7380	FAN7382	NCP5106	FL73282
<b>Configuration</b>	High Side	Half Bridge	High & Low side	High & Low side (A) Half Bridge (B)	Half Bridge
<b>Voffset [V]</b>	600	600	600	600	900
<b>I<sub>o</sub>+/- [mA]</b>	250/500	90/180	350/650	250/500	350/650
<b>t<sub>ON/OFF</sub> [ns]</b>	150/150	135/130	170/200	100/100	150/150
<b>V<sub>IH/IL</sub>[V]</b>	2.5/0.8	2.8/1.2	2.9/0.8	2.3/0.8	2.5/0.8
<b>I<sub>CC</sub><sup>NORMAL</sup></b>	0.4 mA	0.6 mA	0.6 mA	0.2 mA	0.5 mA
<b>Pin layout</b>	8SOP 	8SOP 	8SOP/DIP, 14SOP 	8SOP/DIP 	8SOP 
<b>Key Message</b>	High side only	Low power	Pin to Pin		900 V



# FL3100 T– Low side gate driver with PWM Dim.



## Value Proposition

The FL3100T has two inputs that can be configured to operate in non-inverting (IN) mode with a DIM pin for PWM dimming control of the LED Driver. High accuracy PWM dimming control required in smart LED drivers is possible by adjusting the duty ratio of the DIM input. If one or both inputs are left unconnected, internal resistors bias the inputs such that the output is pulled LOW to hold the power MOSFET off.

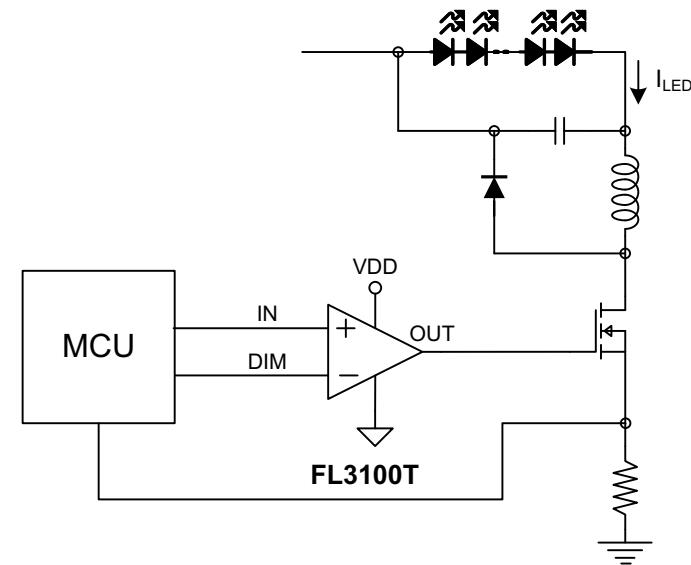
## Unique Features

- Non-inverting Input Logic with DIM Control Input
- Typical Propagation Delay Time Under 20 ns

## Benefits

- PWM Dimming Down to 0.1% for Hybrid Dimming
- Fast switching loop

## Application Data



## Others Features

- 4.5 to 18 V Operating Range
- TTL Inputs Independent of Supply Voltage
- 2.5 A Sink / 1.8 A Source at  $V_{OUT} = 6 V$
- Internal Resistors Turn Driver Off If No Inputs
- $t_R = 13 ns$ (typ.) and  $t_F = 9 ns$ (typ.) with 1 nF Load
- 6-Lead, 2 x 2 mm MLP or 5-Pin, SOT23 Packages

## Market & Applications

- MCU-Driven LED Lighting Driver

## Ordering & Package Information

Ordering Part Number	Package
FL3100TMPX	MLP 2x2 6L
FL3100TSX	SOT23- 5L



# Direct AC LED driver

## - FL77904/5/44



# FL77904/5/44 – Direct AC LED Driver



## Value Proposition

The FL779xx family provides solid-state lighting solutions that have smaller form factors, scalable power, high performance, and longer system lifetimes. These solutions can scale power from 12W to over 120W, reducing the number of different ICs that customers need to have in their inventory.

## Unique Features

- HV Start up
- 3/4 Ch. Internal MOSFET
- Active channel communication
- Self valley fill external IP

## Benefits

- Self bias without Vdd supply circuit
- Low BOM counts
- Low ripple index with High PF/Low THD performance

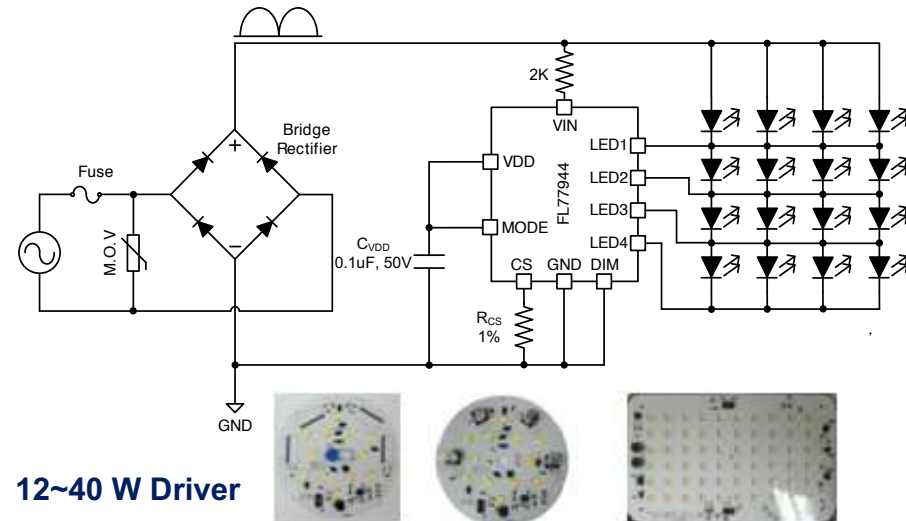
## Others Features

- FL77904: 4Ch. 8SOP <math><9\text{ W @ }120\text{ V}\_{AC}</math>, <math><17\text{ W @ }220\text{ V}\_{AC}</math>
- FL77905: 3Ch. 8SOP <math><9\text{ W @ }120\text{ V}\_{AC}</math>, <math><17\text{ W @ }220\text{ V}\_{AC}</math>
- Analog/PWM Dimming
- FL77944: 4Ch. 16SOP <math><18\text{ W @ }120\text{ V}\_{AC}</math>, <math><33\text{ W @ }220\text{ V}\_{AC}</math>
- Analog/PWM Dimming
- Easy current setting: Control with  $R_{CS}$
- Power scalability with multiple ICs

## Market & Applications

- Phase-Cut Dimming LED Light
- Non Dimming LED Light
- Non-Phase-Cut Dimming LED Lighting

## Application Data



## Ordering & Package Information

Ordering Part Number	Package
FL77904MX	8ESOP
FL77905MX	8ESOP
FL77944MX	16ESOP



# Universal Phase-Cut Dimmer Controller

## - FL5150/60





# Thank You

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