

**Innovation** in power conversion

# Solid-State Lighting Solutions

## AC-DC LED Driver ICs

May 2012



# About Power Integrations' Solid-State Lighting Solutions

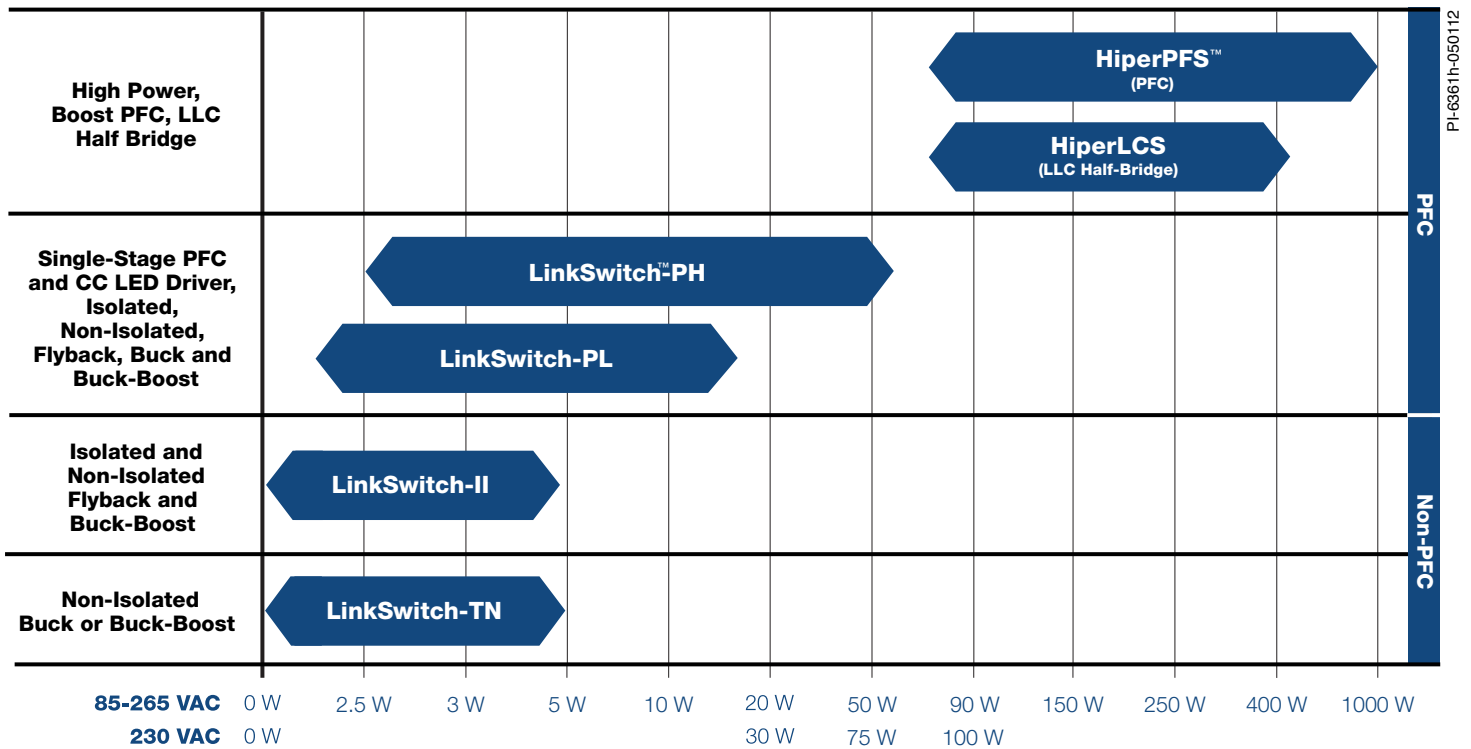
Power Integrations is the leading supplier of high-voltage analog integrated circuits used in energy-efficient power supplies. The company's innovative technology enables compact, energy-efficient power converters for a wide range of electronic products, LED lighting, AC-DC and DC-DC applications. With industry-leading product quality and delivery, the company has shipped billions of devices to customers around the world.

Power Integrations offers a broad range of highly integrated, high-power, constant current LED driver ICs for use in solid-state lighting LED applications where offline power supplies are required. Topologies include buck, buck-boost, resonant, and flyback.

- High efficiency single-stage conversion
- Long life time – no electrolytic bulk capacitors in the power train
- Phase-controlled TRIAC dimmability
- Single-stage power factor correction (PFC) plus accurate constant current (CC) output
- Small size
- Resistance to shock and vibration
- Highly integrated
- Design-in made easy with PI Expert™ design tools

For more detailed information about Power Integrations' LED driver ICs, please visit our Solid-State Lighting microsite at <http://www.powerint.com/led-drivers>.

## AC-DC Product Overview



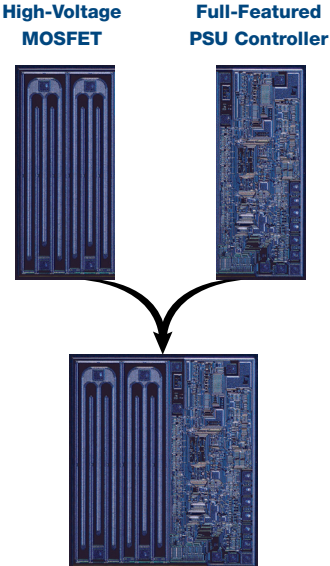
# Design Simplification

## Enabling Predictable Success

Power Integrations' highly integrated ICs enable the design and production of switch-mode power supplies that use up to 70% fewer components compared to discrete solutions. Switchers that incorporate our ICs are smaller, lighter, and more portable than comparable power supplies.

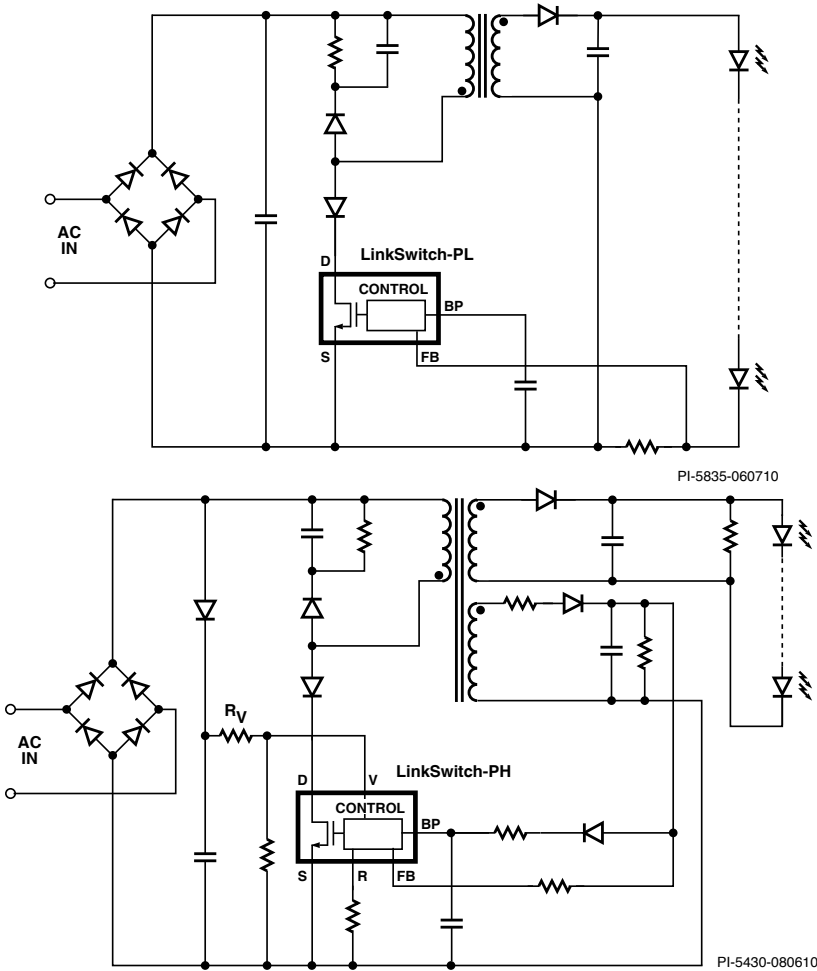
We combine a high-voltage power MOSFET switch with a controller on a single chip to provide key power supply functions, such as:

- High-voltage start-up
- Short-circuit and open-loop protection
- Programmable current limit
- Line undervoltage and overvoltage protection
- Output overvoltage protection
- Accurate over-temperature and over-power protection
- Soft-start
- Feedback compensation
- Remote ON/OFF



## Reducing Component Count

LinkSwitch-PL and LinkSwitch-PH dramatically simplify isolated flyback LED driver designs by eliminating an optocoupler and secondary control circuitry. The devices introduce a revolutionary control technique to provide very tight output regulation, compensating for transformer and internal parameter tolerances, along with input voltage variations.



# Design Tools

## The Green Room

Power Integrations' Green Room web site ([www.powerint.com/greenroom](http://www.powerint.com/greenroom)) offers the latest information in energy-efficient design, including:

- Energy-efficiency regulations: Search by application, regulatory agency or geographic location
- Mr. Green's blog: An informative blog about energy-efficiency standards and other green matters
- Energy FAQs: Answers to frequently asked questions about energy efficiency
- Energy-efficiency resources: Links to other helpful web sites addressing energy issues
- Introduction to green power: Tips for minimizing standby waste

## PI Expert™ Design Software

This powerful, interactive software takes a designer's power supply specifications and automatically determines the critical components (including transformer specifications) needed to generate a working switch-mode power supply. Designs can be optimized for efficiency or cost using auto-design or manual control options. PI Expert simplifies the design of LED drivers, offline power supplies, and DC-DC converters, reducing design time from days to minutes.

To download PI Expert or request a CD, go to [www.powerint.com/designsoftware.htm](http://www.powerint.com/designsoftware.htm)

## PI Forums

Power Integrations provides several forums where designers can discuss technical questions with PI engineers and the extensive Power Integrations' design community:

- Power Supply Design Forum: For general technical questions
- PI Expert Support Forum: For discussing PI Expert Design Software
- Green Energy Forum: For discussing energy efficiency regulations, EcoSmart technology and improving the energy efficiency of electronic products

To participate in PI Forums, go to [www.powerint.com/forum](http://www.powerint.com/forum)

## Total Product Support

- Application notes
- Data sheets
- Design example reports
- Design ideas
- Engineering prototype reports
- PI Expert design software
- Reference design kits

## Reference Designs

Reference Design Kits (RDKs) provide all of the essential materials needed to demonstrate the advanced features of Power Integrations' ICs. Kits include a fully assembled and tested reference design power supply board, product samples, and an unpopulated PCB.

For more information, go to [www.powerint.com/dak.htm](http://www.powerint.com/dak.htm)

## Design Example Report (DER)

Design Example Reports contain a power supply design specification, schematic, bill of materials, transformer documentation, and PCB layout. This design has been built and bench-tested to provide performance data and typical operation characteristics.

## LED Driver Reference Designs

Product Family	AC Input Voltage (V)	Output Power (W)	Output Current (A)	TRIAC Dimming	Power Factor	Efficiency (%)	Topology	Document	RDK	Page Number
LinkSwitch-PL	190-264	3.8	0.080	✓	>0.91	83.5	Buck	DER-301		7
LinkSwitch-PL	90-132	4.5	0.093	✓	>0.95	86	Buck-Boost	DER-315		7
LinkSwitch-PL	90-265	5	0.35	✓	>0.90	78	Flyback	RDR-251	RDK-251	8
LinkSwitch-PH	185-264	6	0.26	✓	>0.90	78	Flyback	DER-269		8
LinkSwitch-PH	90-265	7	0.33	✓	>0.97	82	Flyback	RDR-193	RDK-193	9
LinkSwitch-PH	90-265	7	0.38	✓	>0.90	85	Flyback	DER-277		9
LinkSwitch-PL	185-265	7.2	0.200	✓	>0.90	87	Buck	DER-302		10
LinkSwitch-PH	176-265	7.4	0.112	✓	>0.90	87	Flyback	DER-296		10
LinkSwitch-PL	190-265	7.5	0.800	✓	>0.90	76	Tapped-Buck	DER-327		11
LinkSwitch-PH	198-265	8	0.38	✓	>0.86	74	Flyback	DER-264		11
LinkSwitch-PH	90-265	14	0.5	✓	>0.98	87	Flyback	RDR-195	RDK-195	12
LinkSwitch-PH	180-265	14	0.5	*	>0.97	85.5	Flyback	DER-263		13
LinkSwitch-PH	180-265	15	0.5	✓	>0.90	84	Flyback	DER-281		14
LinkSwitch-PH	185-265	15.3	0.425	✓	>0.90	87	Flyback	DER-314		15
LinkSwitch-PL	85-265	1.2	0.366		>0.90	50	Flyback	RDR-268	RDK-268	16
LinkSwitch-PL	85-135	4.55	0.13		>0.95	85	Buck-Boost	RDR-271	RDK-271	16
LinkSwitch-PL	85-132	4.3	0.090, 0.060, 0.045		>0.90	87	Buck-Boost	DER-297		17
LinkSwitch-PL	190-265	4.5	0.093		>0.90	85.5	Buck-Boost	DER-304		18
LinkSwitch-PL	90-132	7	0.030		>0.95	90	Boost	DER-324		19
LinkSwitch-PL	185-265	7.2	0.200		>0.90	90	Buck	DER-303		20
LinkSwitch-PL	185-265	10	0.200		>0.90	91	Buck	DER-305		20
LinkSwitch-PL	90-135	10	0.278		>0.90	89	Buck	DER-306		21
LinkSwitch-PH	90-265	12	0.33		>0.99	88	Buck	RDR-257	RDK-257	21
LinkSwitch-PH	90-265	12	0.33		>0.97	85	Buck-Boost	DER-273		22
LinkSwitch-PH	90-265	15	0.3		>0.96	87	Flyback	DER-256		23
LinkSwitch-PH	90-265	15	0.5		>0.90	90.7	Flyback	DER-278		23
LinkSwitch-PH	90-265	15	0.5		>0.90	91.7	Flyback	DER-284		24
LinkSwitch-PH	90-265	15	0.5		>0.90	85	Flyback	DER-288		24
LinkSwitch-PH	90-265	15	0.5		>0.90	94	Flyback	DER-289		25
LinkSwitch-PL	185-265	18	0.222		>0.99	93.4	Buck	DER-312		26
LinkSwitch-PL	195-265	18	0.230		>0.90	93	Buck	DER-322		26
LinkSwitch-PH	90-265	18	0.090		>0.90	90	Buck-Boost	DER-298		27
LinkSwitch-PL	90-135	18	0.200		>0.99	88	Buck-Boost	DER-323		27
LinkSwitch-PH	185-265	23	0.430		>0.90	87	Flyback	DER-318		28
LinkSwitch-PH	180-265	25	0.25		>0.90	91.35	Buck-Boost	DER-287		29
LinkSwitch-PH	180-265	25	0.35		>0.90	90.55	Buck-Boost	DER-285		29
LinkSwitch-PH	90-308	30	1		>0.90	91	Flyback	DER-286		30
LinkSwitch-PH	180-300	75	2.1		>0.95	92	Flyback	RDR-290	RDK-290	31
LinkSwitch-PH	184-277	150	4.2		>0.95	92	Flyback	DER-291		32
HiperLCS	100-265	150	48		>0.90	93	LLC+Boost PFC	RDR-292	RDK-292	33
LinkSwitch-TN	85-265	0.5	0.04			70	Buck-Boost	DER-92, DI-92		35

\*Analog dimming

# Reference Designs

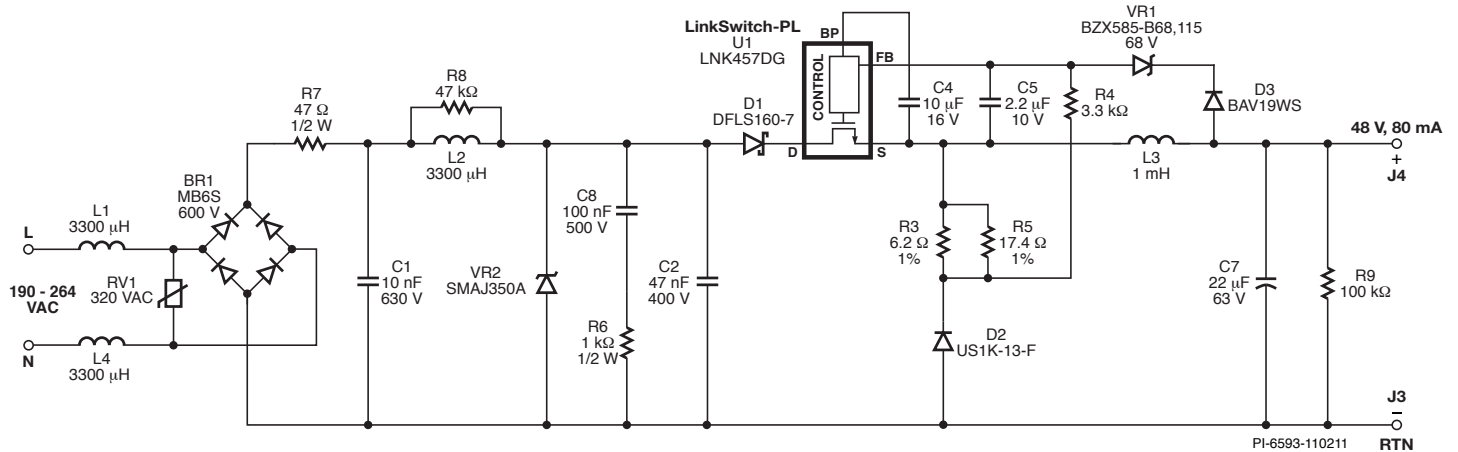
Product Family	AC Input Voltage (V)	Output Power (W)	Output Current (A)	TRIAC Dimming	Power Factor	Efficiency (%)	Topology	Document	RDK	Page Number
LinkSwitch-TN	85-265	1.25	0.1			60	Buck-Boost	DI-74		35
LinkSwitch-TN	85-265	3	0.3			62	Buck	RDR-131, DI-131	RDK-131	36
LinkSwitch-II	90-265	3.6	0.35			75	Flyback	DI-206		37
LinkSwitch-II	85-265	4.2	0.35			82	Tapped Buck	DER-186, DI-186		37
LinkSwitch-II	85-265	4.2	0.35			75	Flyback	DER-185, DI-185		38
LinkSwitch-II	85-265	5.32	0.7			72	Flyback	DER-184, DI-184		38
LinkSwitch-II	85-265	8.4	0.7			80.1	Flyback	DER-215		39
LinkSwitch-TN	108-132	9	0.13		>0.90	85	Buck-Boost	DI-171		39
LinkSwitch-TN	90-132	9.1	0.13			92	Buck	DER-172, DI-172		40
LinkSwitch-TN	85-265	11	0.02			91	Boost	DI-210		40
TinySwitch-III	185-265	18	1.8	✓		84	Flyback	DI-130		34

\*Analog dimming

# TRIAC Dimmable, High Power Factor Design Examples

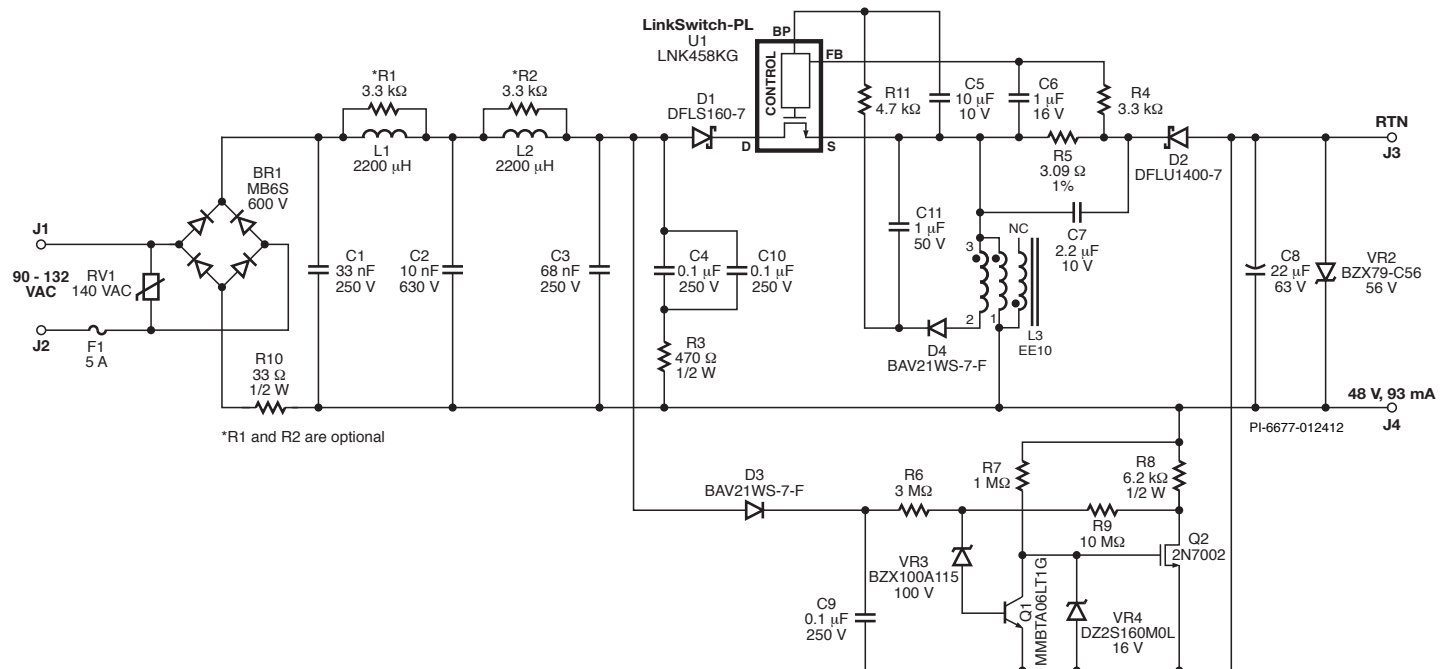
## LinkSwitch-PL – Non-Isolated TRIAC Dimmable, Power Factor Corrected LED Driver (DER-301)

3.8 W, 48 V, 80 mA OUTPUT, 190 – 264 VAC INPUT, SINGLE-STAGE PFC, BUCK POWER SUPPLY



## LinkSwitch-PL – Non-Isolated TRIAC Dimmable, Power Factor Corrected LED Driver (DER-315)

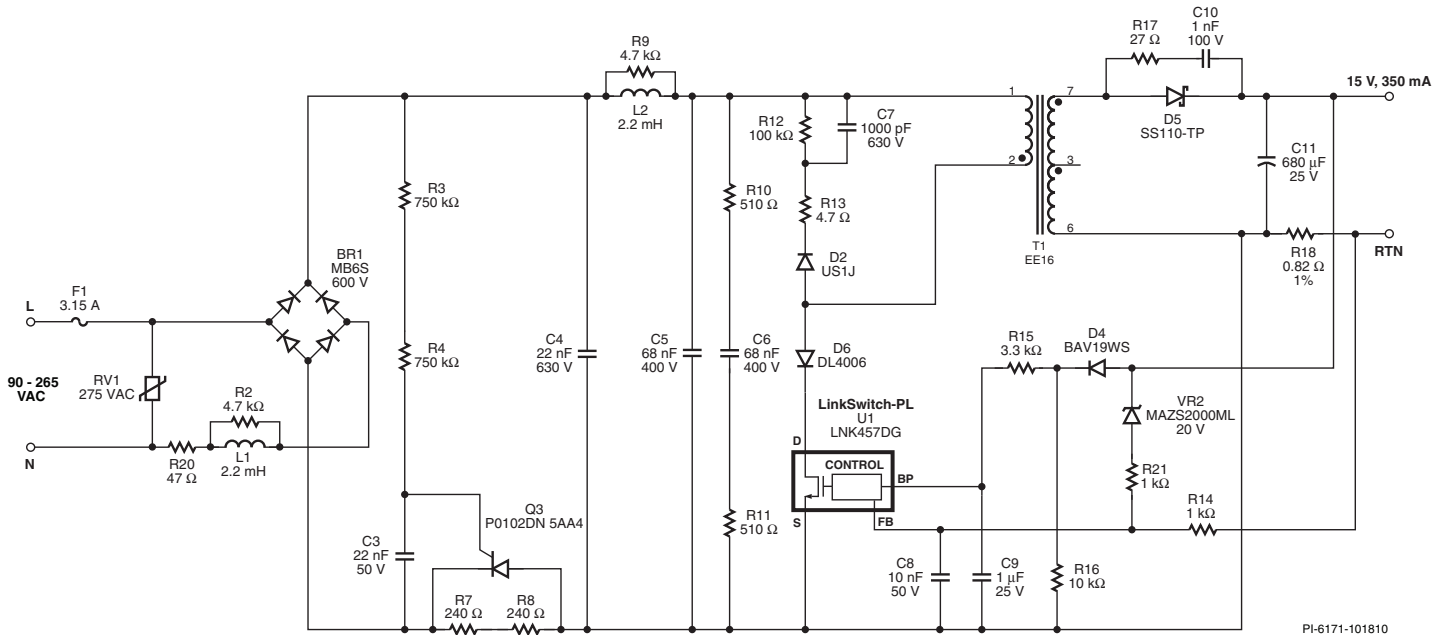
4.5 W, 48 V, 93 mA OUTPUT, 90 – 132 VAC INPUT, SINGLE-STAGE PFC, BUCK-BOOST POWER SUPPLY



# TRIAC Dimmable, High Power Factor Design Examples

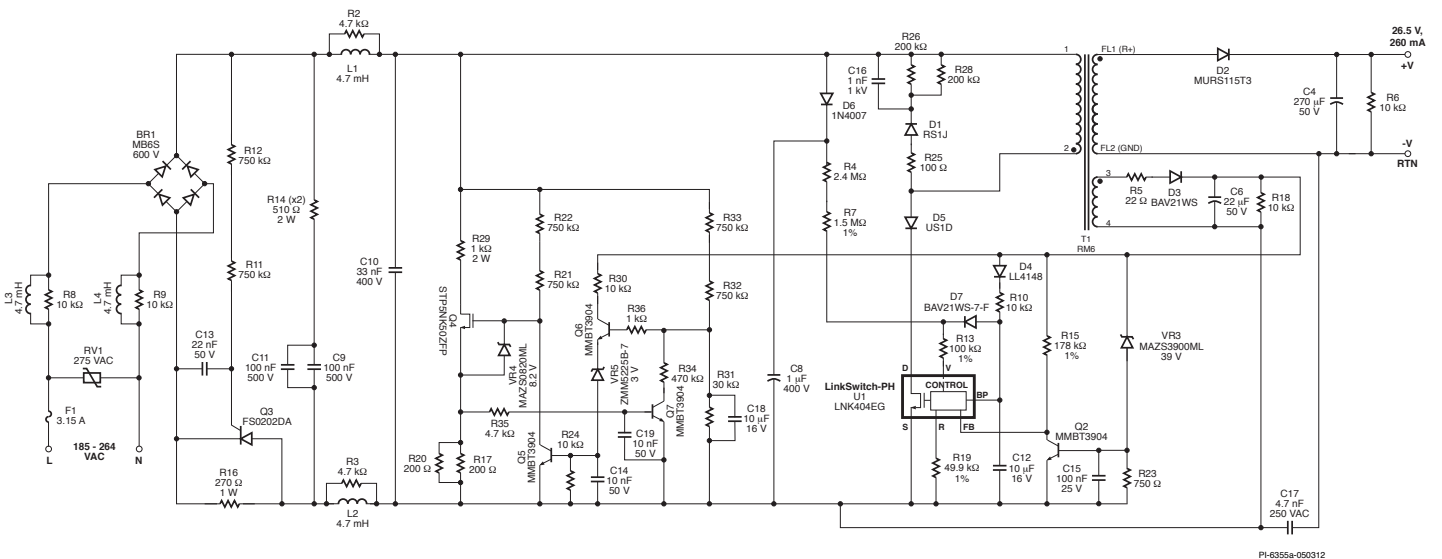
## LinkSwitch-PL – Non-Isolated TRIAC Dimmable, Power Factor Corrected LED Driver (RDK-251)

5 W, 15 V, 350 mA OUTPUT, 90 – 265 VAC INPUT, SINGLE-STAGE PFC, FLYBACK POWER SUPPLY



## LinkSwitch-PH – Isolated TRIAC Dimmable, Power Factor Corrected, LED Driver with Smart Active Load for Wide Dimming Range with High Power Dimmers (DER-269)

6 W, 26.5 V, 260 mA OUTPUT, 185 – 264 VAC INPUT, SINGLE-STAGE PFC, FLYBACK POWER SUPPLY

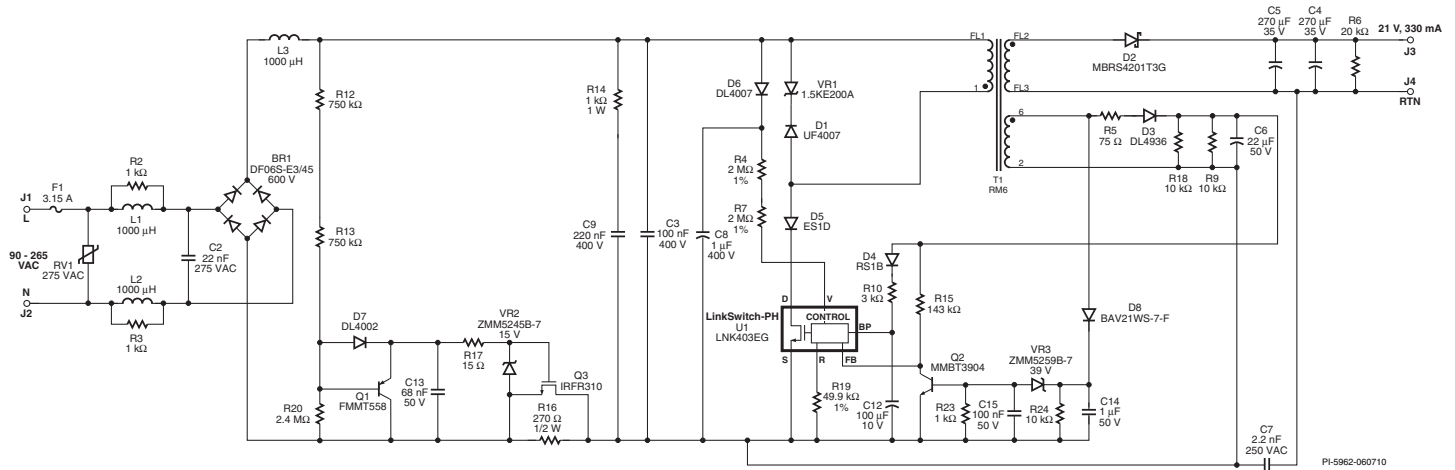




# TRIAC Dimmable, High Power Factor Design Examples

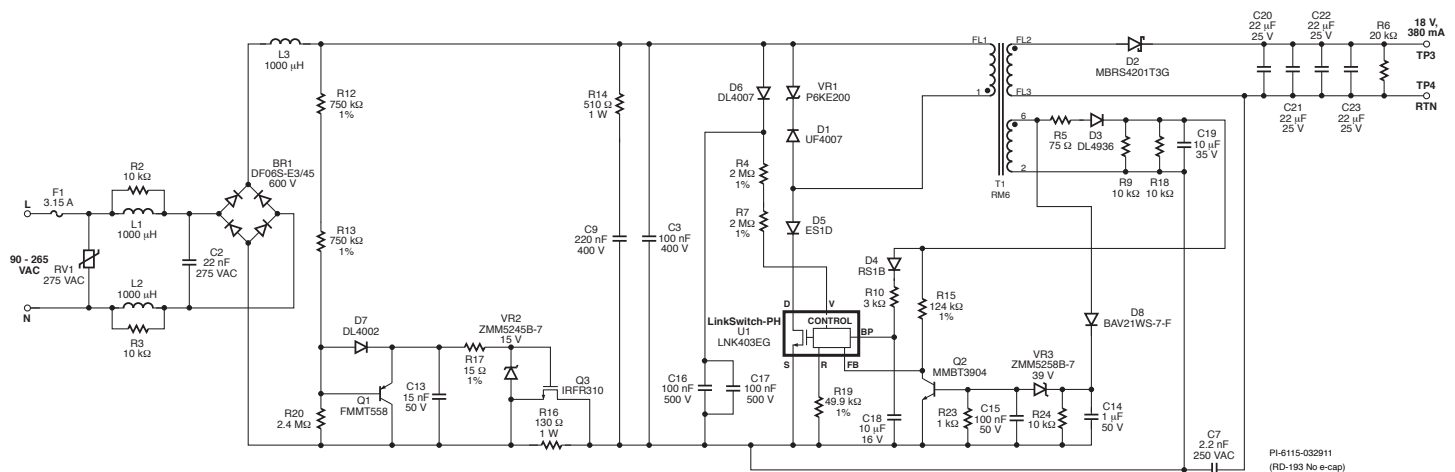
## LinkSwitch-PH – High Efficiency, High Power Factor, TRIAC Dimmable LED Driver (RDK-193)

7 W, 21 V, 330 mA OUTPUT, 90 – 265 VAC INPUT, Single-stage PFC, FLYBACK POWER SUPPLY



## LinkSwitch-PH – High Efficiency, High Power Factor, TRIAC Dimmable LED Driver (DER-277)

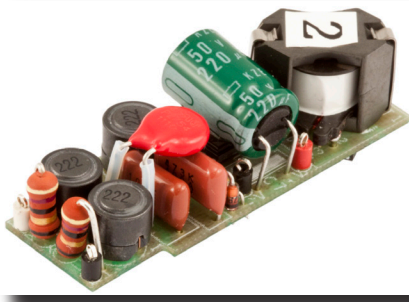
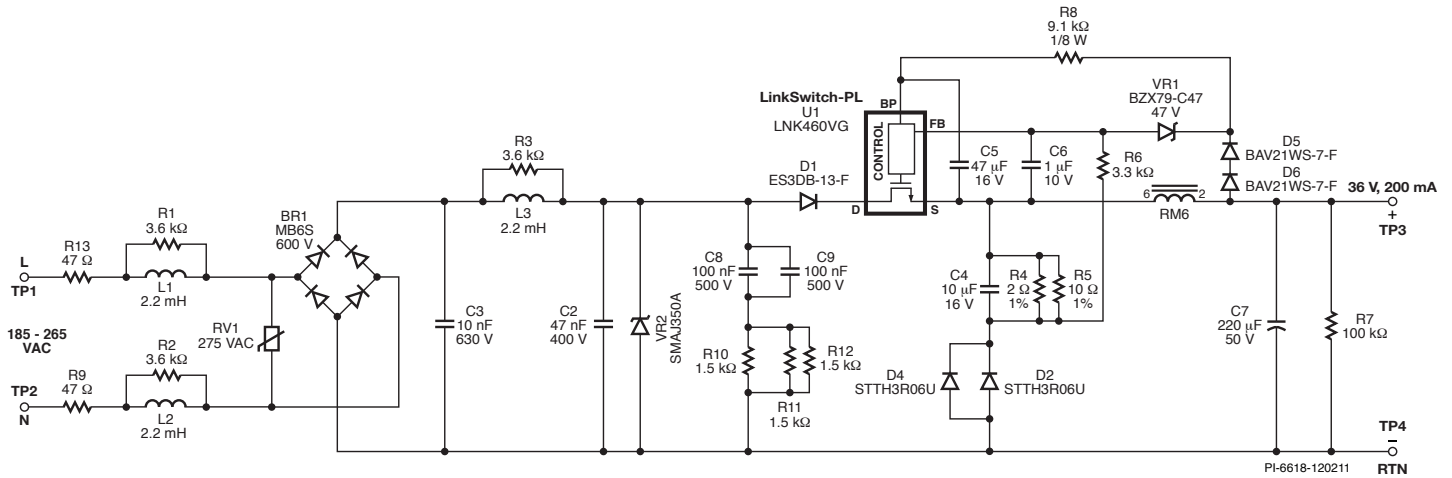
7 W, 18 V, 380 mA OUTPUT, 90 – 265 VAC INPUT, SINGLE-STAGE PFC, FLYBACK POWER SUPPLY



# TRIAC Dimmable, High Power Factor Design Examples

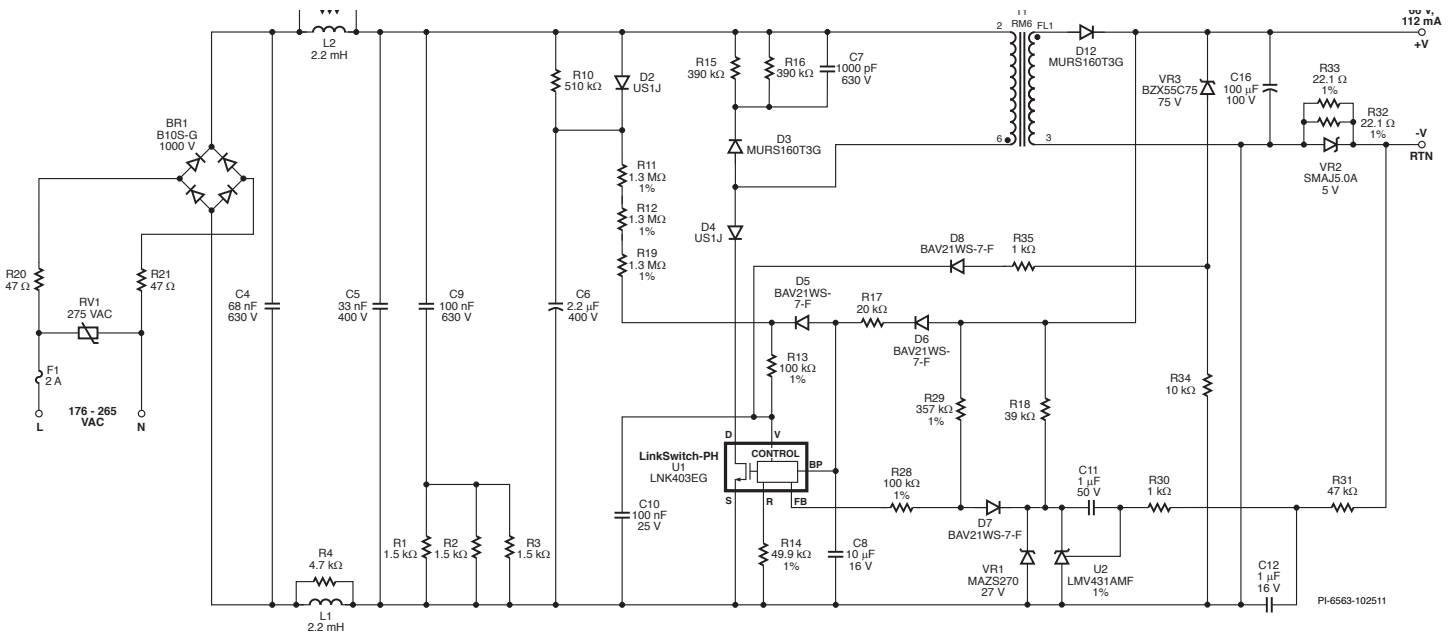
## LinkSwitch-PL – High Efficiency, High Power Factor, TRIAC Dimmable LED Driver (DER-302)

7.2 W, 36 V, 200 mA OUTPUT, 185 – 265 VAC INPUT, SINGLE-STAGE PFC, BUCK POWER SUPPLY



## LinkSwitch-PH – High Efficiency, High Power Factor, TRIAC Dimmable LED Driver (DER-296)

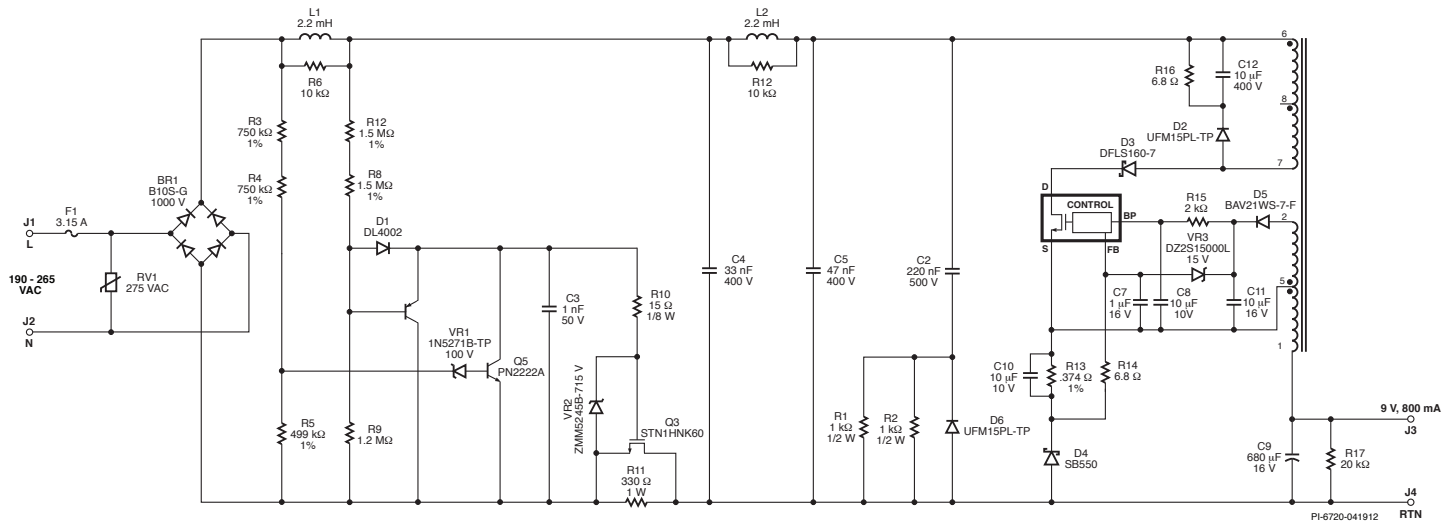
7.4 W, 66 V, 112 mA OUTPUT, 176 – 265 VAC INPUT, SINGLE-STAGE PFC, FLYBACK POWER SUPPLY



# TRIAC Dimmable, High Power Factor Design Examples

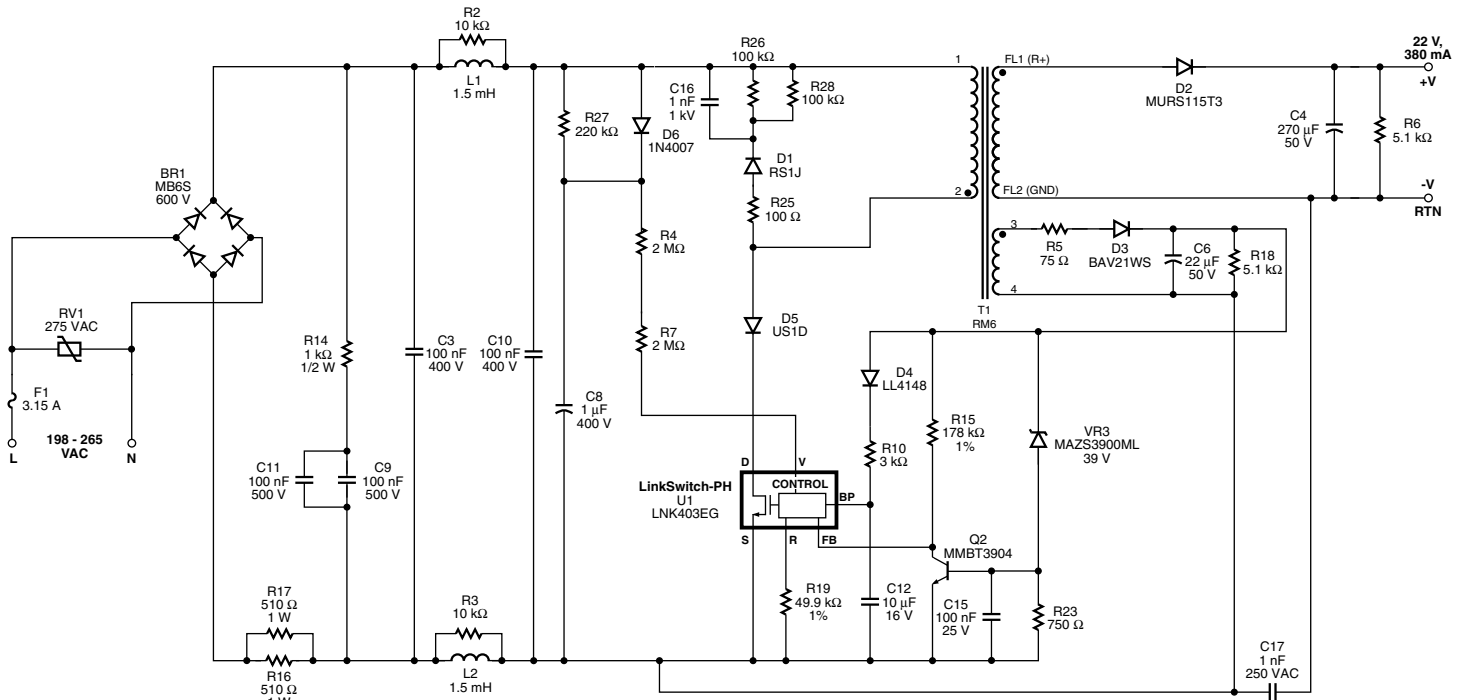
## LinkSwitch-PL – High Efficiency, High Power Factor, TRIAC Dimmable LED Driver (DER-327)

7.5 W, 9 V, 800 mA OUTPUT, 190 – 265 VAC INPUT, SINGLE-STAGE PFC, TAPPED-BUCK POWER SUPPLY



## LinkSwitch-PH – High Efficiency, High Power Factor, High Power TRIAC Dimmable LED Driver (DER-264)

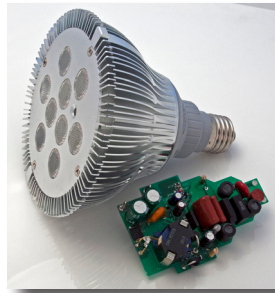
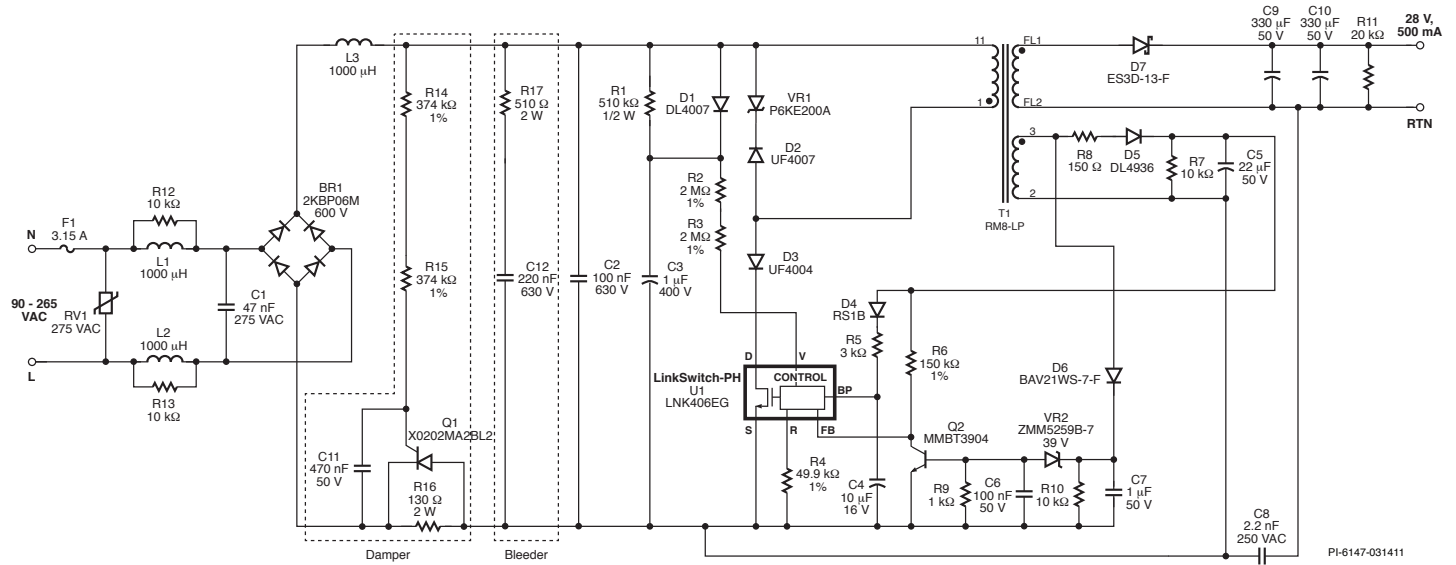
8 W, 22 V, 380 mA OUTPUT, 198 – 265 VAC INPUT, SINGLE-STAGE PFC, FLYBACK POWER SUPPLY



# TRIAC Dimmable, High Power Factor Design Examples

## LinkSwitch-PH – High Efficiency, High Power Factor, TRIAC Dimmable LED Driver (RDK-195)

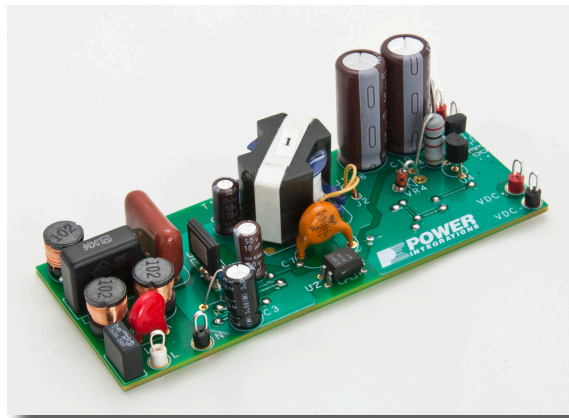
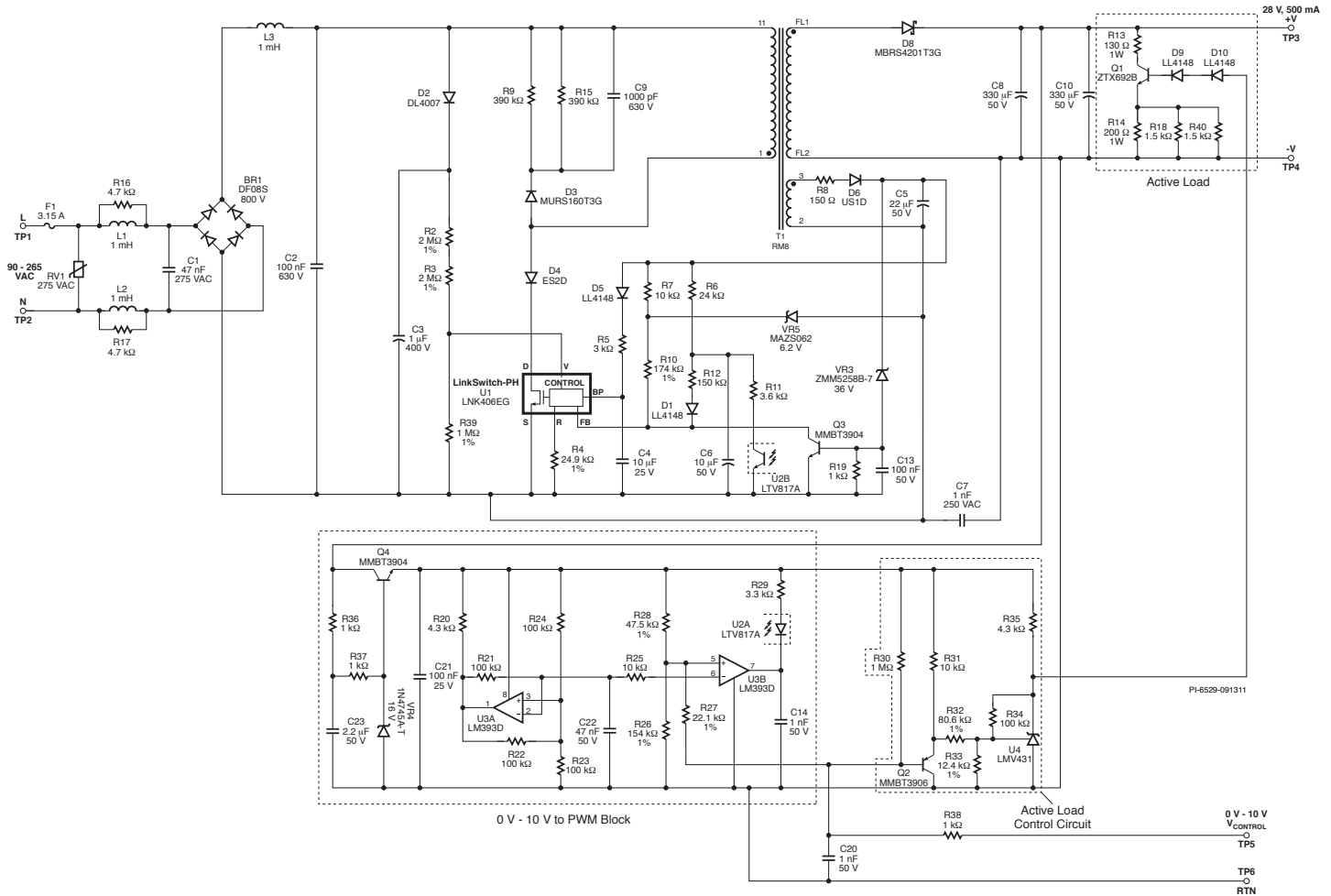
14 W, 28 V, 500 mA OUTPUT, 90 – 265 VAC INPUT, Single-stage PFC, FLYBACK POWER SUPPLY



# TRIAC Dimmable, High Power Factor Design Examples

## LinkSwitch-PH – High Efficiency, High Power Factor, PWM Dimming LED Driver (DER-263)

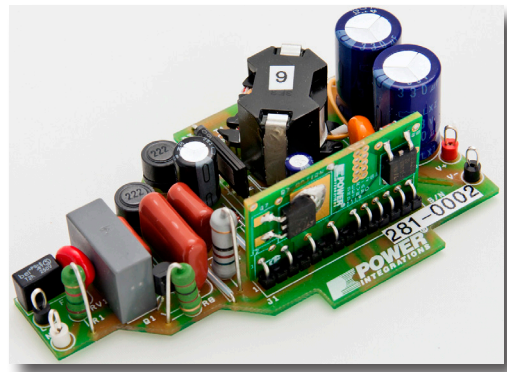
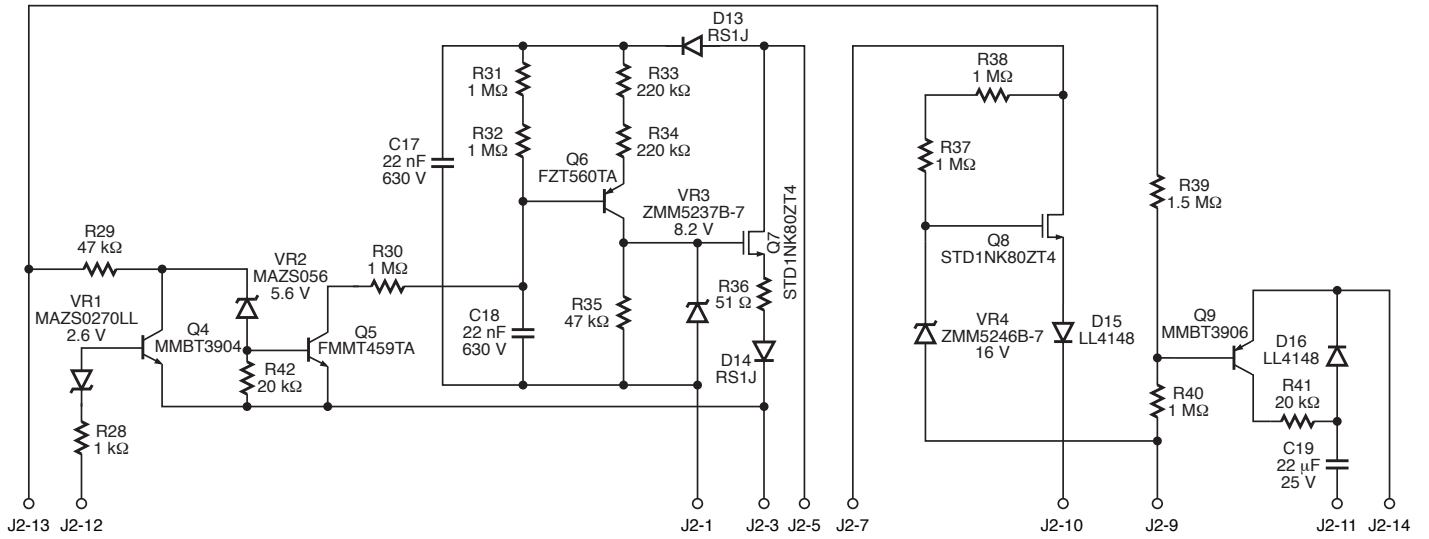
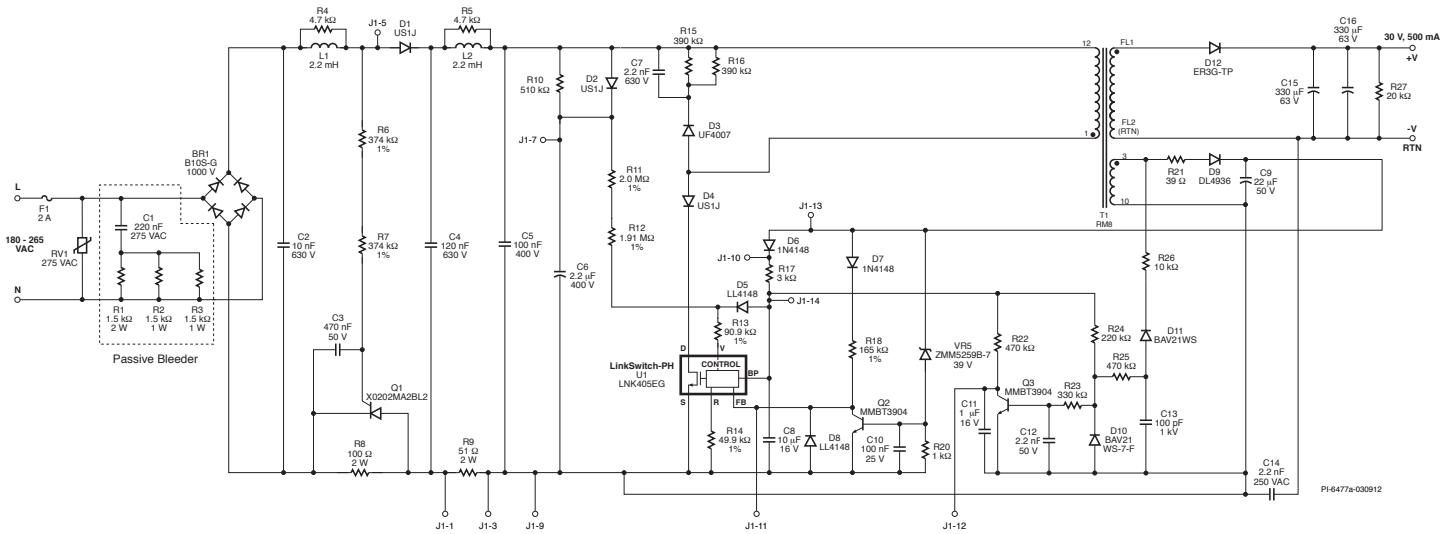
14 W, 28 V, 500 mA OUTPUT, 90 – 265 VAC INPUT, SINGLE-STAGE PFC, FLYBACK POWER SUPPLY



# TRIAC Dimmable, High Power Factor Design Examples

## LinkSwitch-PH – High Efficiency, High Power Factor, Wide TRIAC Compatibility Dimmable LED Driver (DER-281)

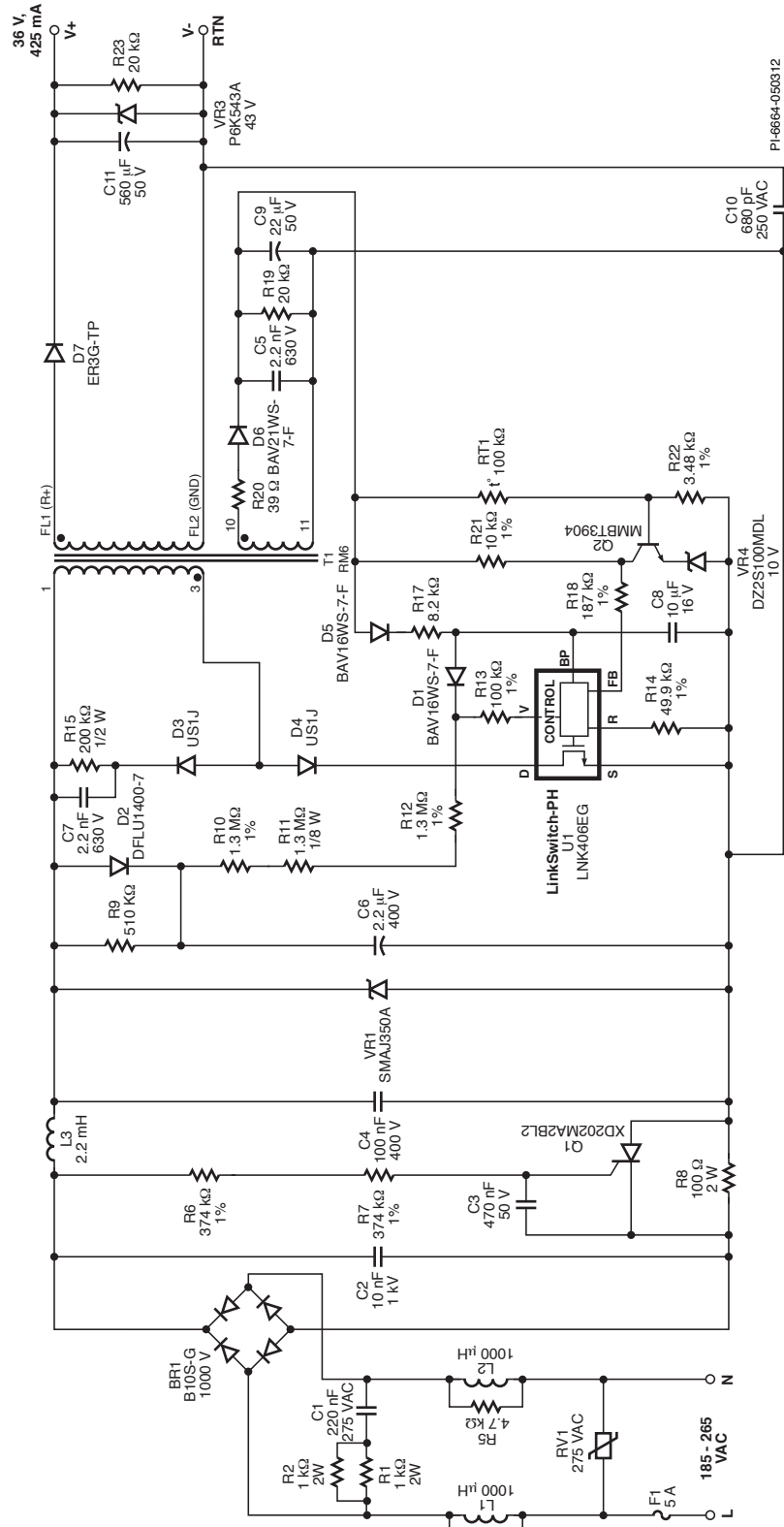
15 W, 30 V, 500 mA OUTPUT, 180 – 265 VAC INPUT, SINGLE-STAGE PFC, FLYBACK POWER SUPPLY



# TRIAC Dimmable, High Power Factor Design Examples

## LinkSwitch-PH – High Efficiency, High Power Factor, TRIAC Dimmable LED Driver (DER-314)

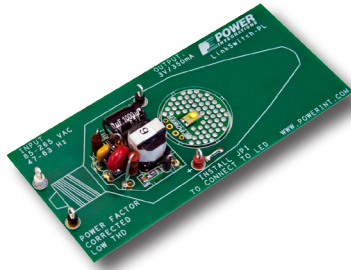
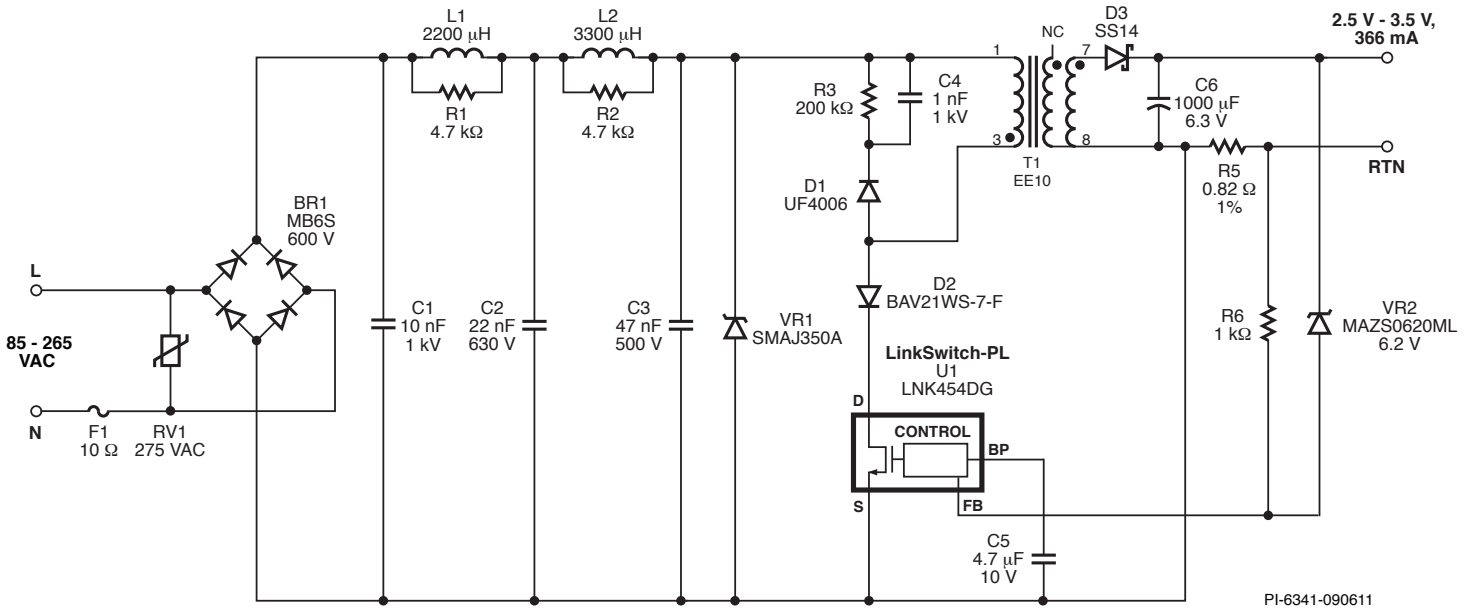
15.3 W, 36 V, 425 mA OUTPUT, 185 – 265 VAC INPUT, SINGLE-STAGE PFC, FLYBACK POWER SUPPLY



# High Power Factor Design Examples

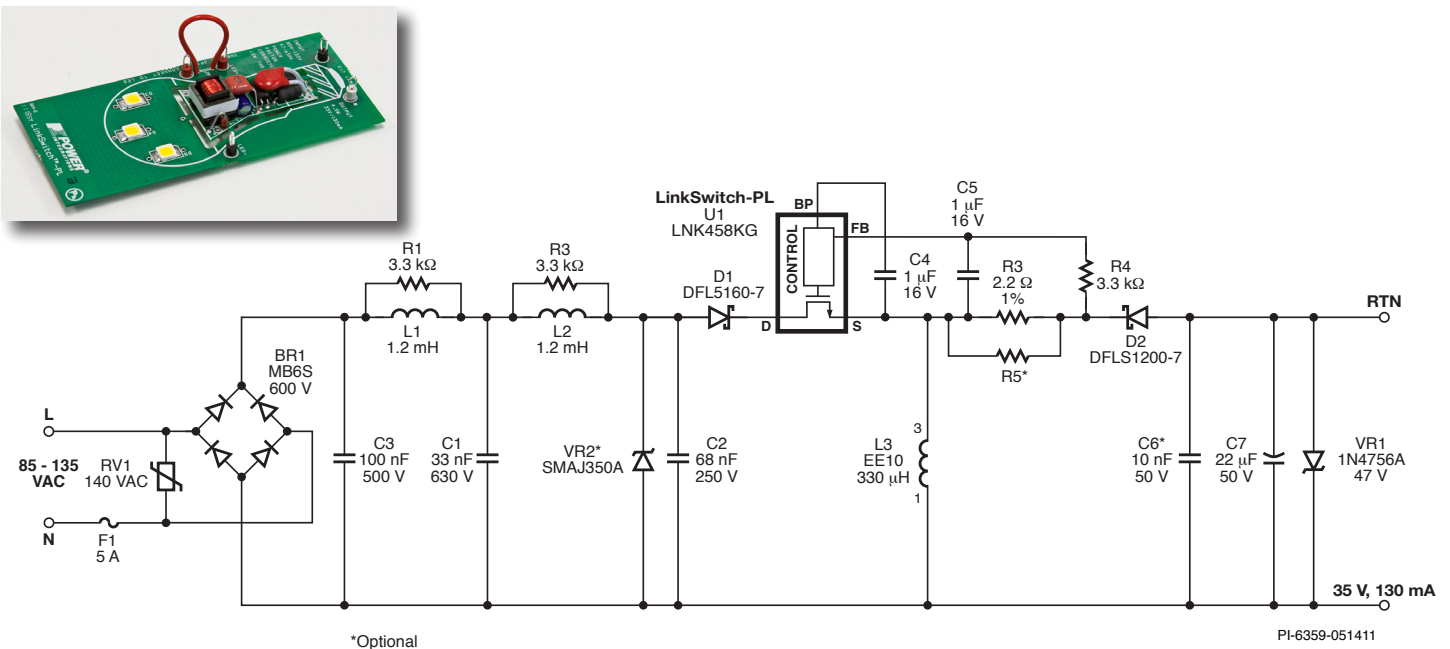
## LinkSwitch-PL – High Efficiency, High Power Factor, LED Driver (RDK-268)

1.2 W, 2.5 V – 3.5 V, 366 mA OUTPUT, 85 – 265 VAC INPUT, SINGLE-STAGE PFC, FLYBACK POWER SUPPLY



## LinkSwitch-PL – High Efficiency, High Power Factor, LED Driver (RDK-271)

4.5 W, 35 V, 130 mA OUTPUT, 85 – 135 VAC INPUT, SINGLE-STAGE PFC, BUCK-BOOST POWER SUPPLY



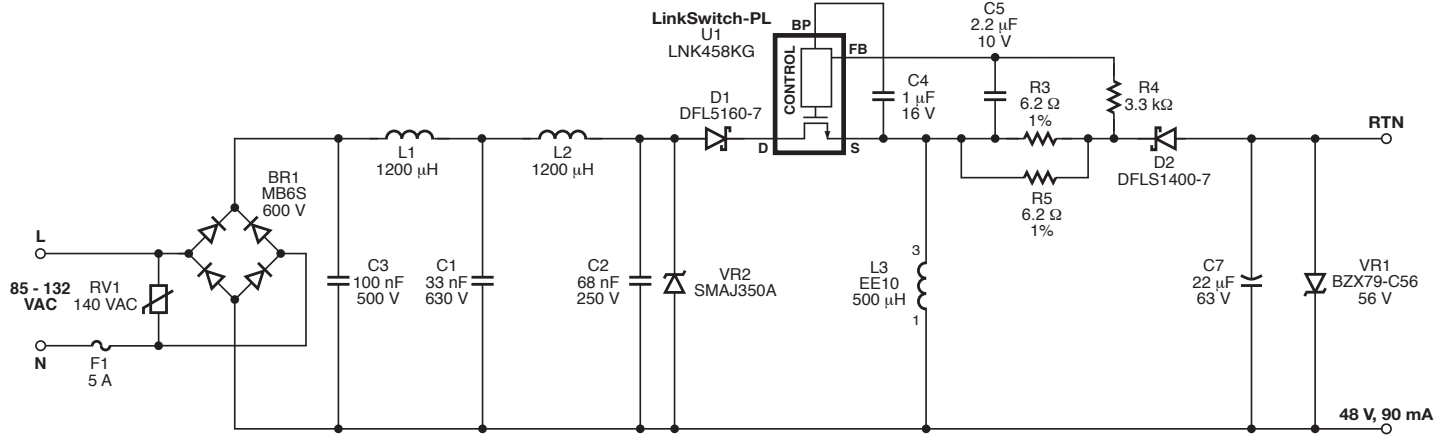
\*Optional



# High Power Factor Design Examples

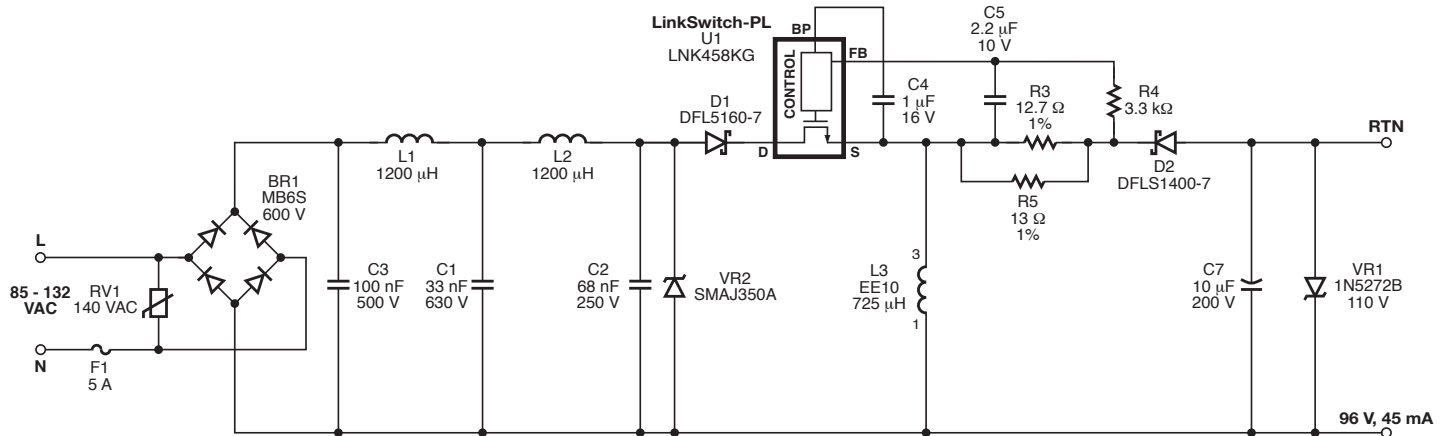
## LinkSwitch-PL – High Efficiency, High Power Factor, LED Driver (DER-297)

4.3 W, 48 V, 90 mA OUTPUT, 85 – 132 VAC INPUT, SINGLE-STAGE PFC, BUCK-BOOST POWER SUPPLY



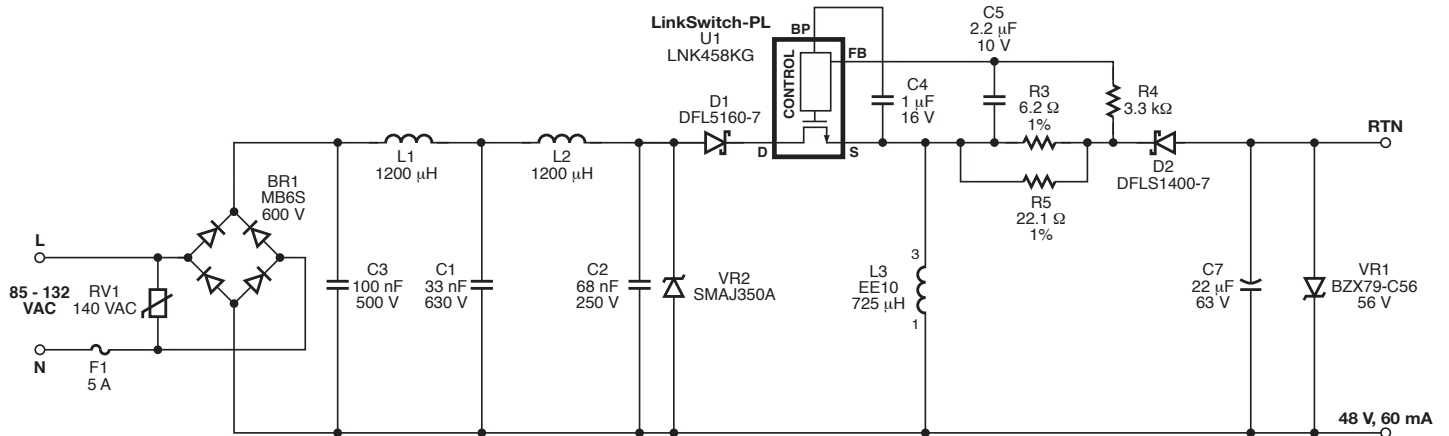
PI-6558-110711

4.3 W, 96 V, 45 mA OUTPUT, 85 – 132 VAC INPUT, SINGLE-STAGE PFC, BUCK-BOOST POWER SUPPLY



PI-6558a-110711

4.3 W, 48 V, 60 mA OUTPUT, 85 – 132 VAC INPUT, SINGLE-STAGE PFC, BUCK-BOOST POWER SUPPLY

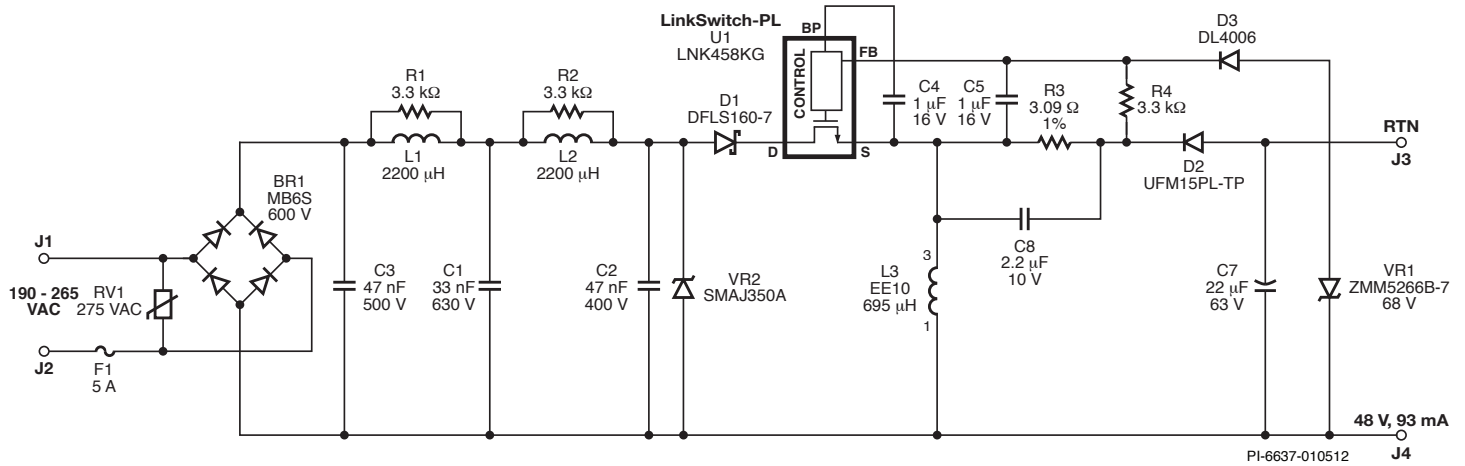


PI-6558b-110711

# High Power Factor Design Examples

## LinkSwitch-PL – High Efficiency, High Power Factor, LED Driver (DER-304)

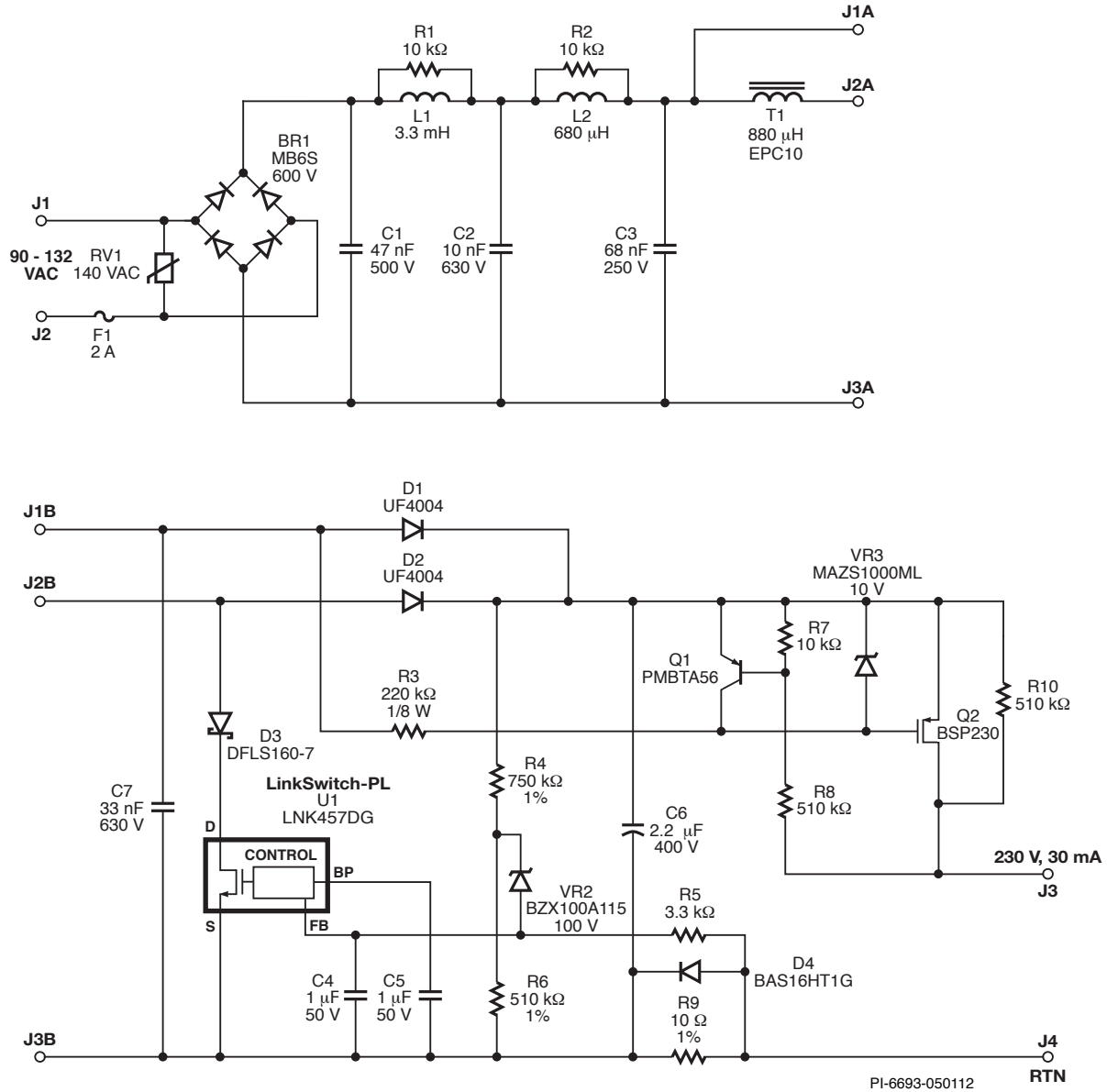
4.5 W, 48 V, 93 mA OUTPUT, 190 – 265 VAC INPUT, SINGLE-STAGE PFC, BUCK-BOOST POWER SUPPLY



# High Power Factor Design Examples

## LinkSwitch-PL – High Efficiency, High Power Factor, LED Driver (DER-324)

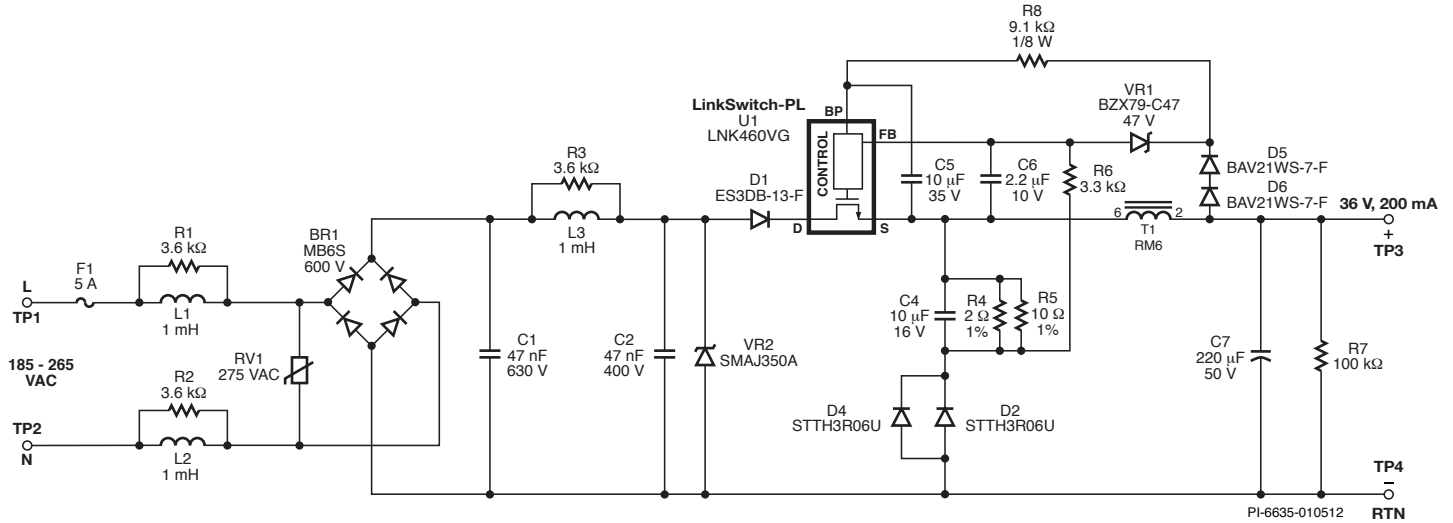
7 W, 230 V, 30 mA OUTPUT, 90 – 132 VAC INPUT, SINGLE-STAGE PFC, BOOST CONVERTER POWER SUPPLY



# High Power Factor Design Examples

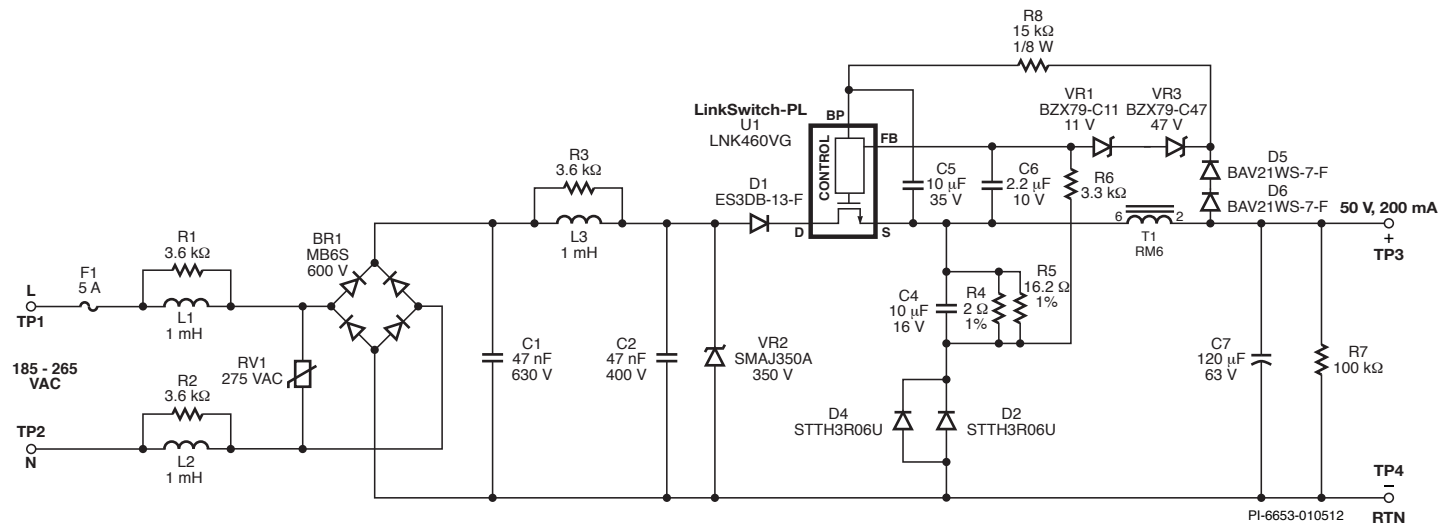
## LinkSwitch-PL – High Efficiency, High Power Factor, LED Driver (DER-303)

7.2 W, 36 V, 200 mA OUTPUT, 185 – 265 VAC INPUT, SINGLE-STAGE PFC, BUCK CONVERTER POWER SUPPLY



## LinkSwitch-PL – High Efficiency, High Power Factor, LED Driver (DER-305)

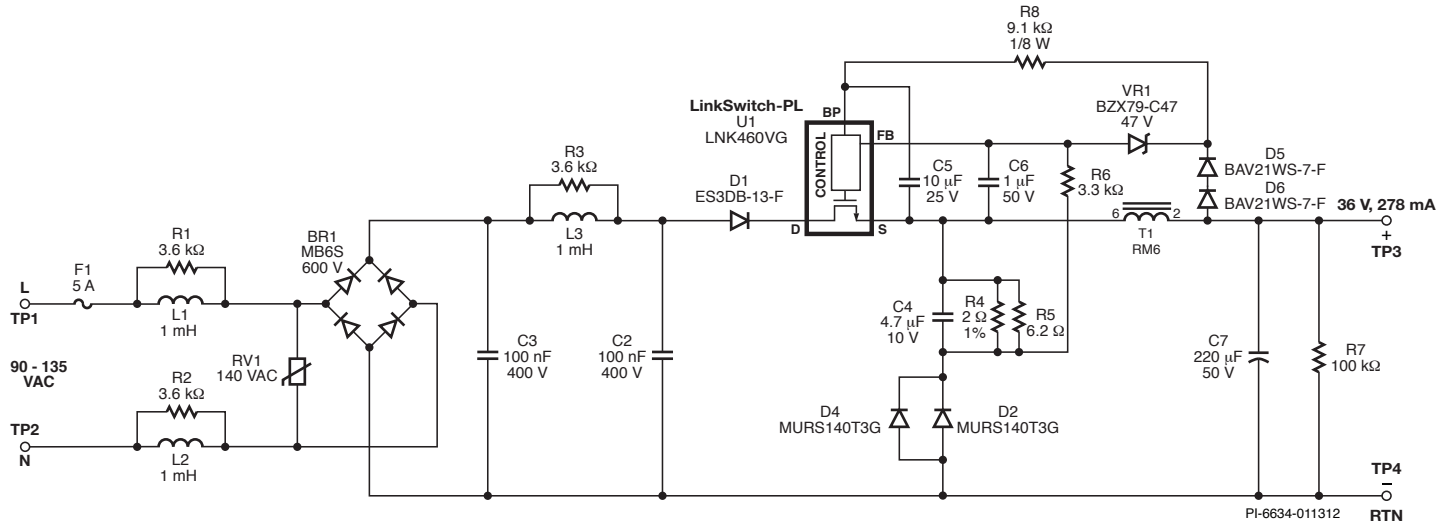
10 W, 50 V, 200 mA OUTPUT, 185 – 265 VAC INPUT, SINGLE-STAGE PFC, BUCK CONVERTER POWER SUPPLY



# High Power Factor Design Examples

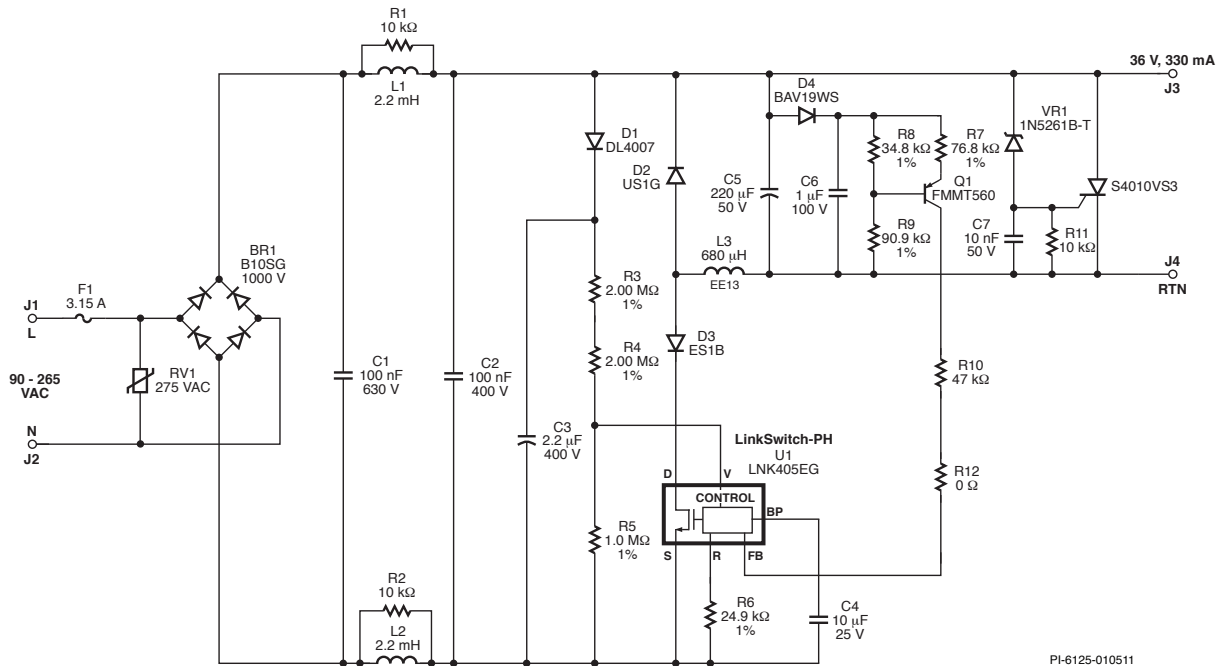
## LinkSwitch-PL – High Efficiency, High Power Factor, LED Driver (DER-306)

10 W, 36 V, 278 mA OUTPUT, 90 – 135 VAC INPUT, SINGLE-STAGE PFC, BUCK CONVERTER POWER SUPPLY



## LinkSwitch-PH – High Efficiency, High Power Factor, LED Driver (RDK-257)

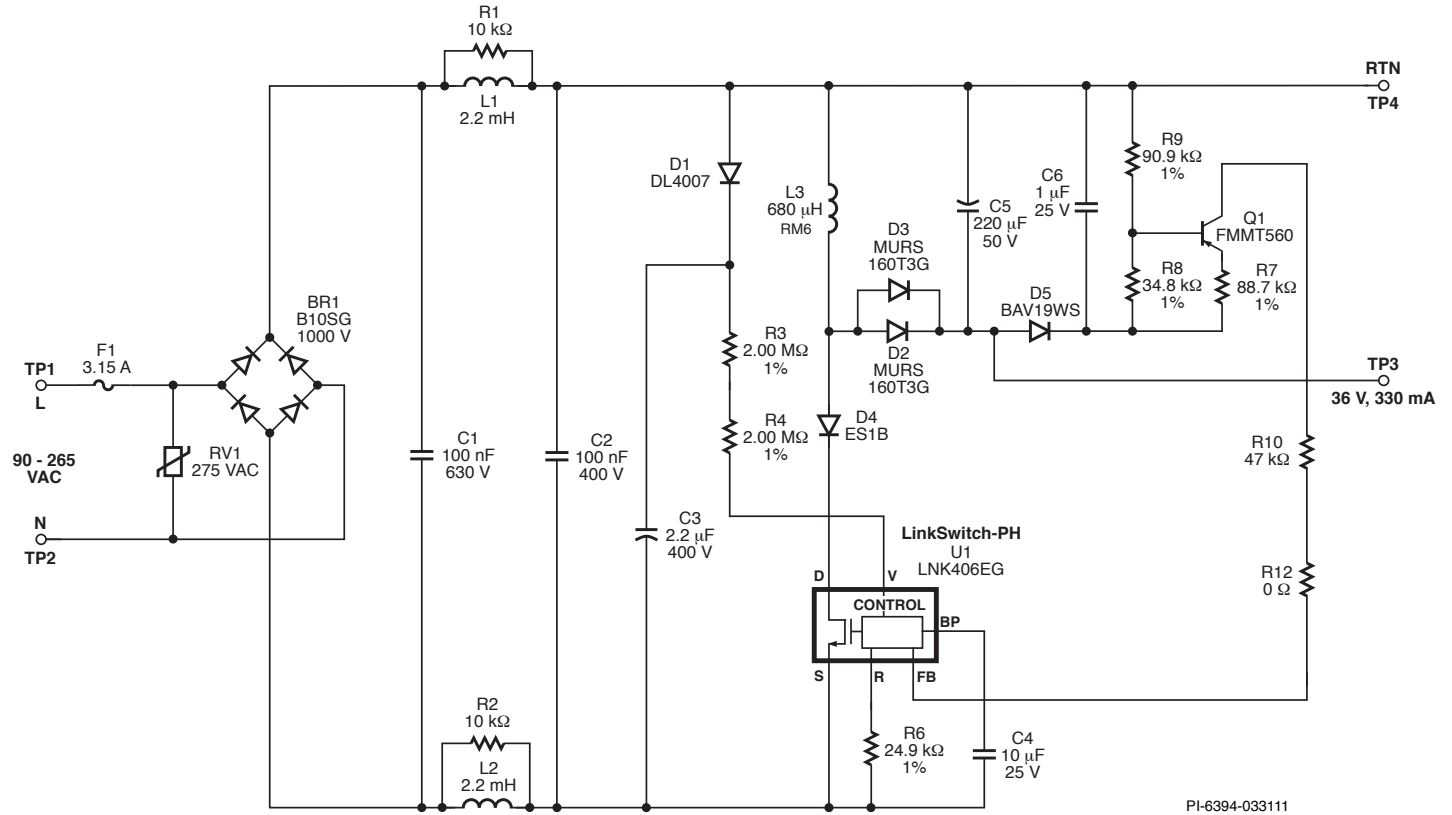
12 W, 36 V, 330 mA OUTPUT, 90 – 265 VAC INPUT, SINGLE-STAGE PFC, BUCK CONVERTER POWER SUPPLY



# High Power Factor Design Examples

## LinkSwitch-PH – Power Factor Corrected, LED Driver (DER-273)

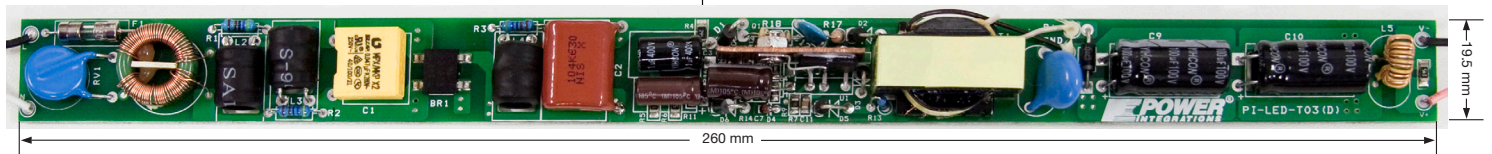
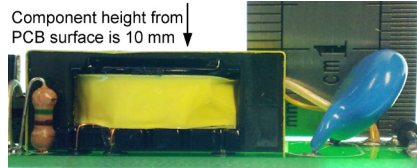
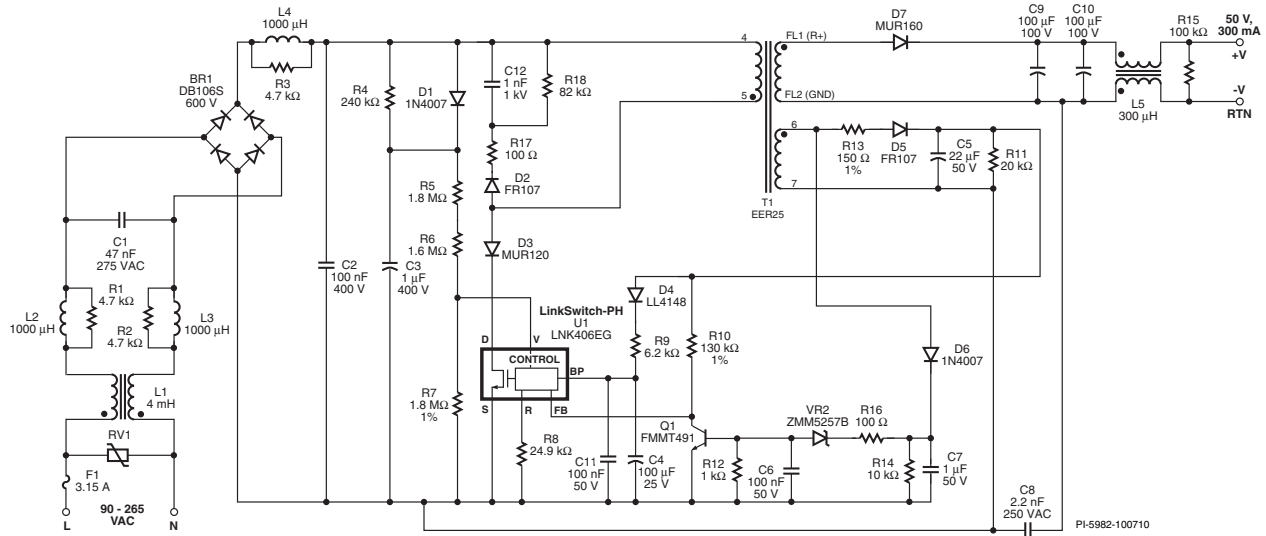
12 W, 36 V, 330 mA OUTPUT, 90 – 265 VAC INPUT, SINGLE-STAGE PFC, BUCK-BOOST CONVERTER POWER SUPPLY



# High Power Factor Design Examples

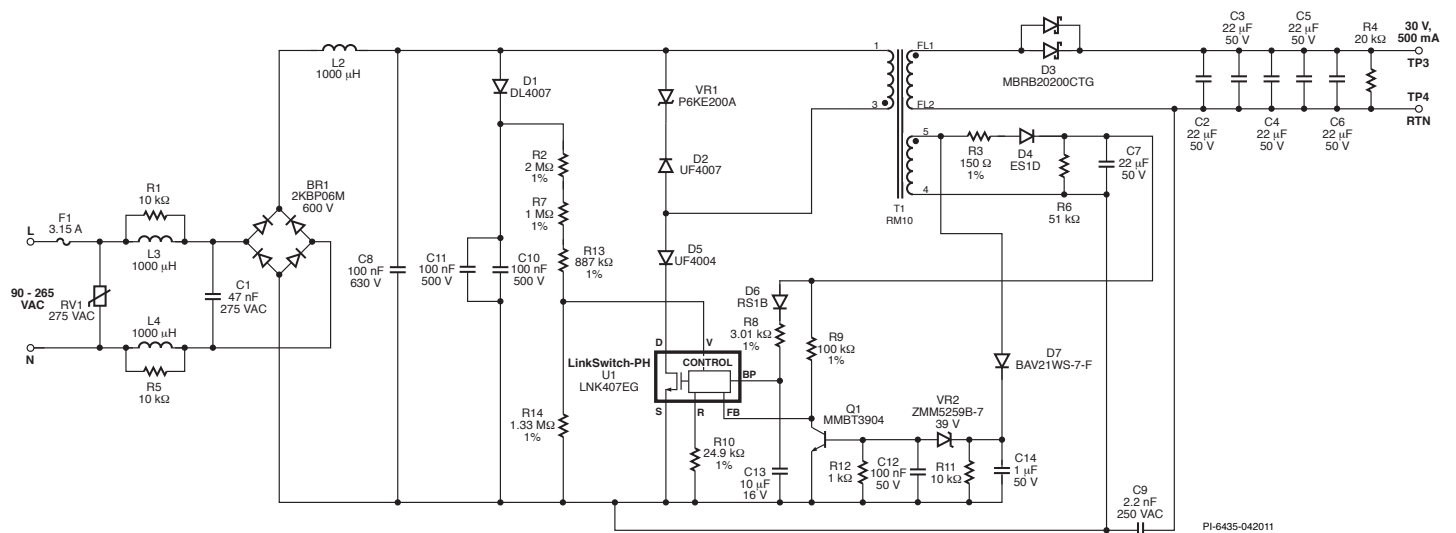
## LinkSwitch-PH – High Efficiency, High Power Factor, LED Driver (DER-256)

15 W, 50 V, 300 mA OUTPUT, 90 – 265 VAC INPUT, SINGLE-STAGE PFC, FLYBACK POWER SUPPLY



## LinkSwitch-PH – High Efficiency, High Power Factor, LED Driver (DER-278)

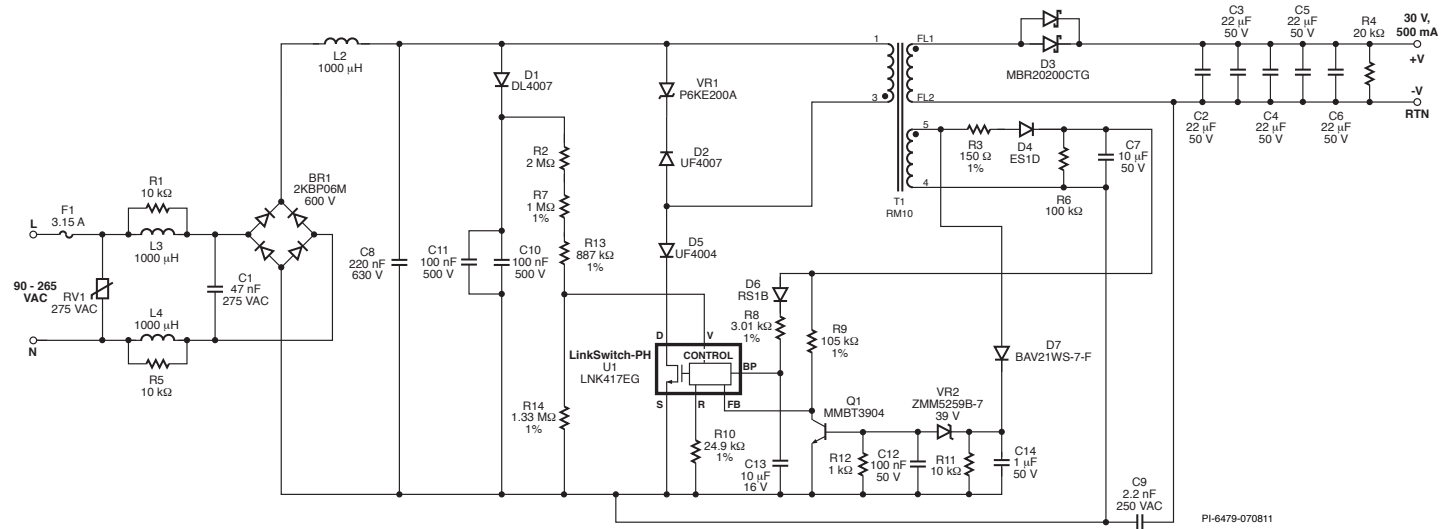
15 W, 30 V, 500 mA OUTPUT, 90 – 265 VAC INPUT, SINGLE-STAGE PFC, FLYBACK POWER SUPPLY



# High Power Factor Design Examples

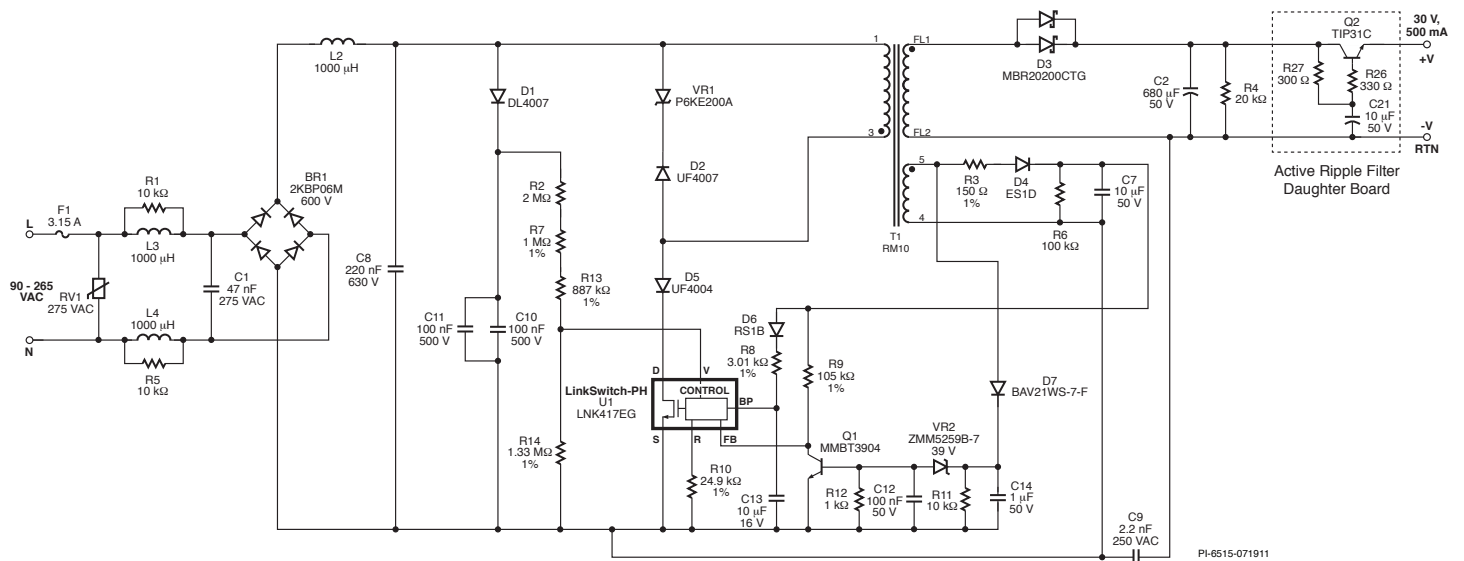
## LinkSwitch-PH – High Efficiency, High Power Factor, LED Driver (DER-284)

15 W, 30 V, 500 mA OUTPUT, 90 – 265 VAC INPUT, SINGLE-STAGE PFC, FLYBACK POWER SUPPLY



## LinkSwitch-PH – High Efficiency, High Power Factor, LED Driver (DER-288)

15 W, 30 V, 500 mA OUTPUT, 90 – 265 VAC INPUT, SINGLE-STAGE PFC, FLYBACK POWER SUPPLY

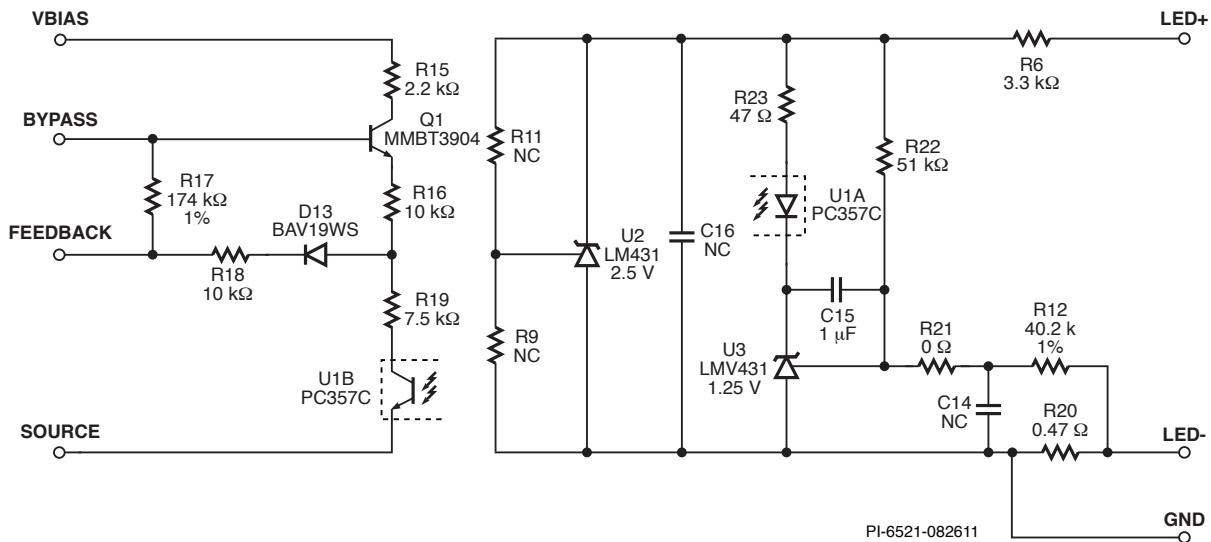
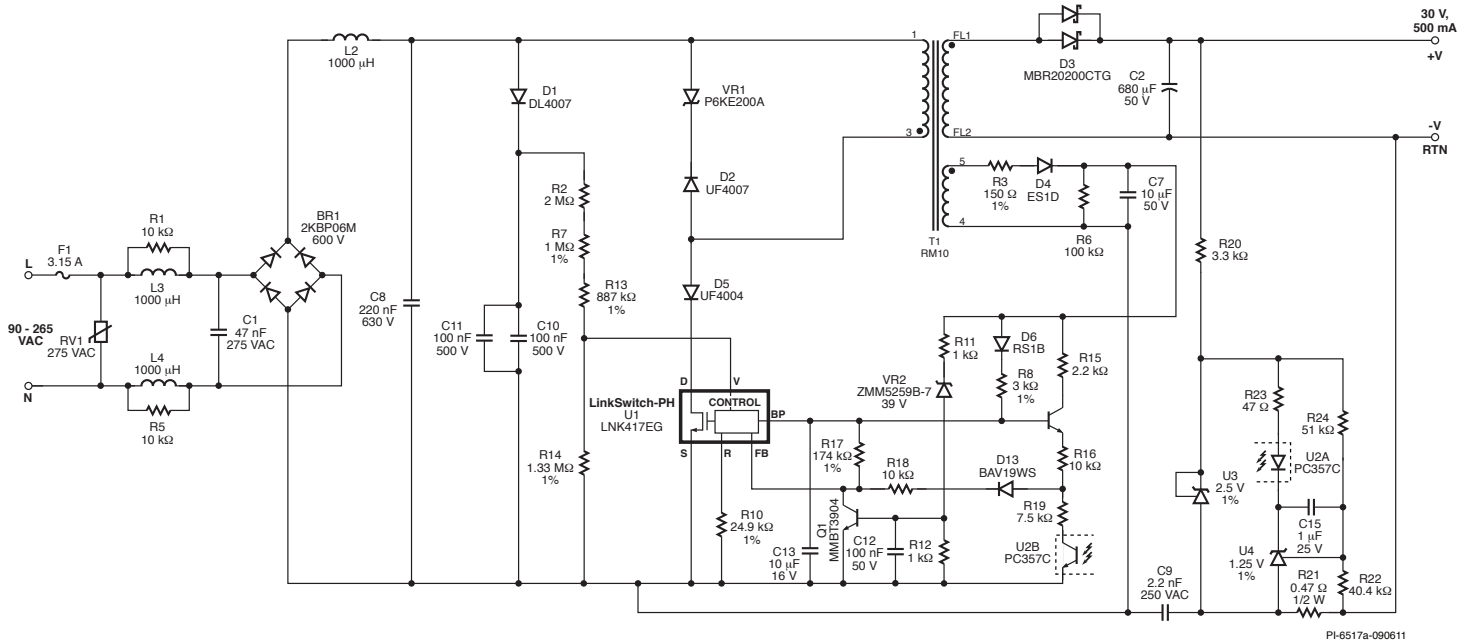




# High Power Factor Design Examples

## LinkSwitch-PH – High Efficiency, High Power Factor, LED Driver (DER-289)

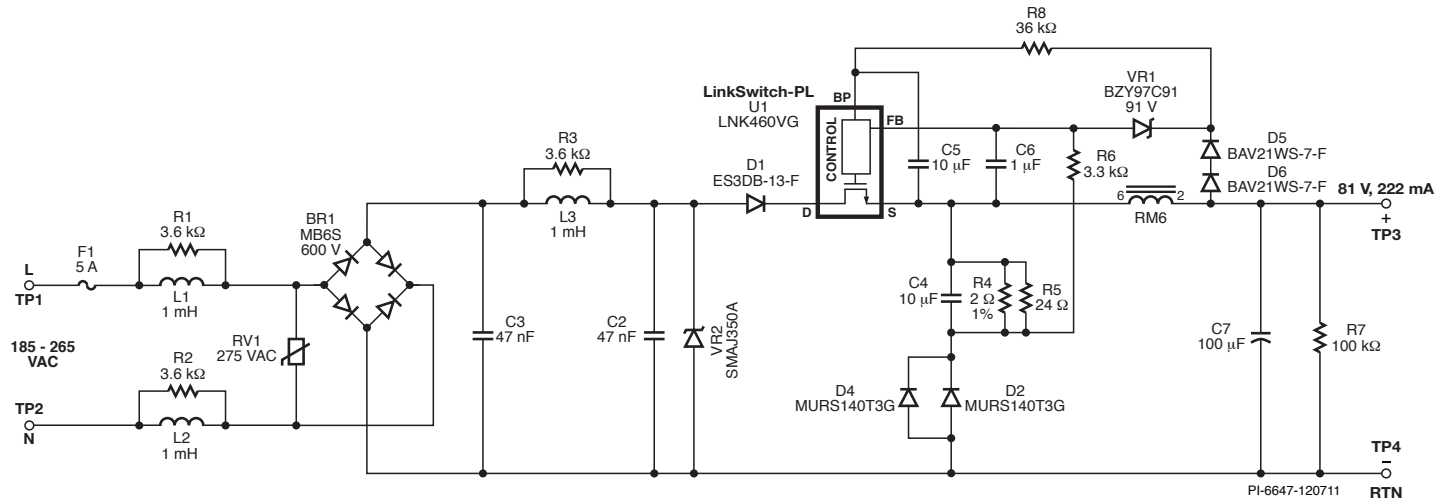
15 W, 30 V, 500 mA OUTPUT, 90 – 265 VAC INPUT, FLYBACK POWER SUPPLY



# High Power Factor Design Examples

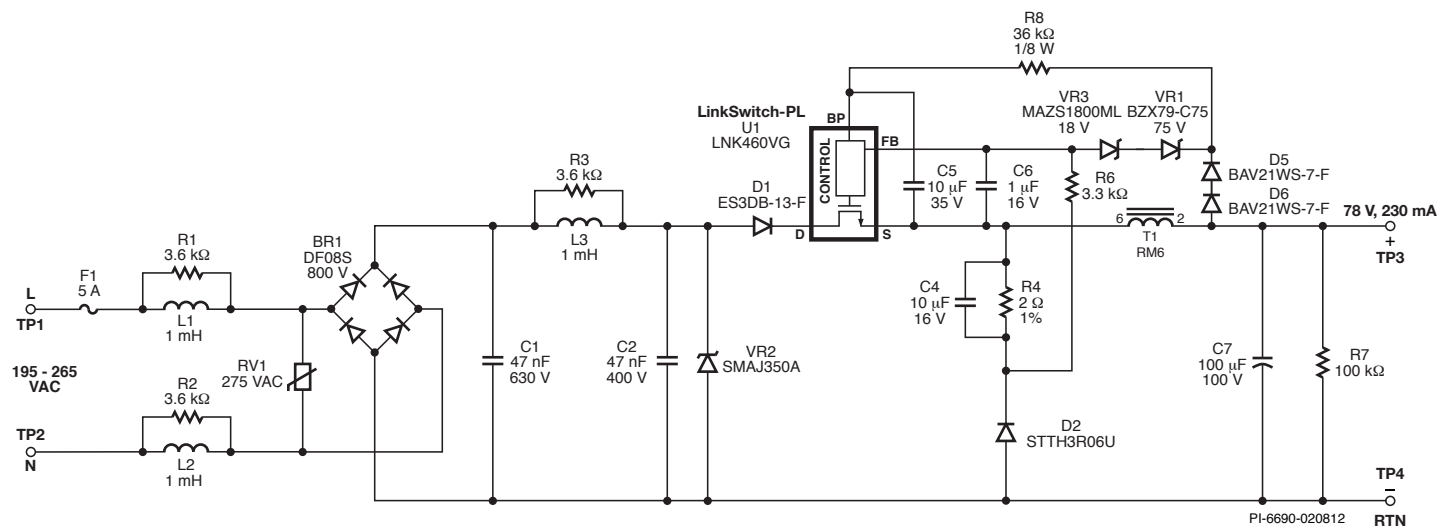
## LinkSwitch-PL – High Efficiency, High Power Factor, LED Driver (DER-312)

18 W, 81 V, 222 mA OUTPUT, 185 – 265 VAC INPUT, SINGLE-STAGE PFC, BUCK CONVERTER POWER SUPPLY



## LinkSwitch-PL – High Efficiency, High Power Factor, LED Driver (DER-322)

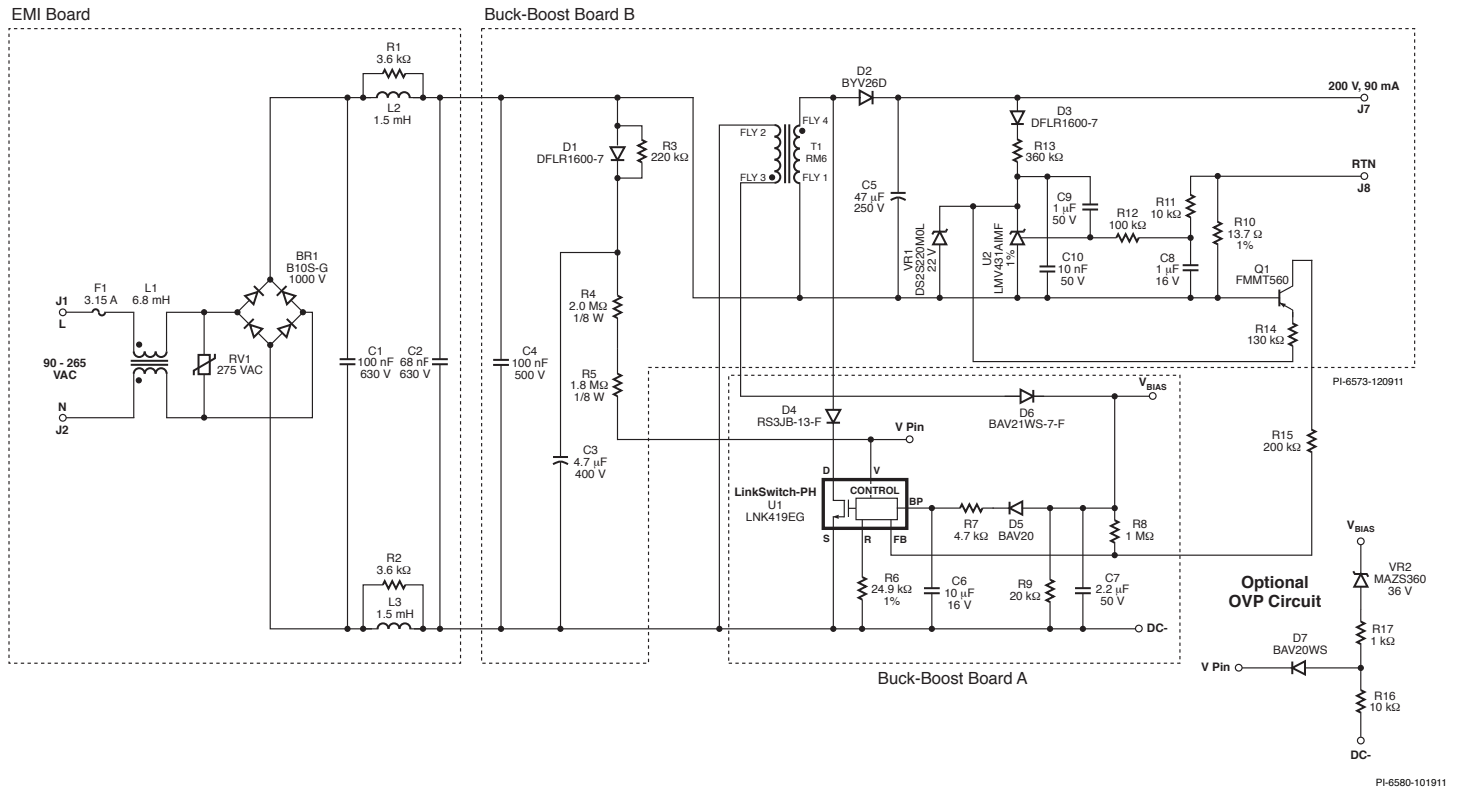
18 W, 78 V, 230 mA OUTPUT, 195 – 265 VAC INPUT, SINGLE-STAGE PFC, BUCK CONVERTER POWER SUPPLY



# High Power Factor Design Examples

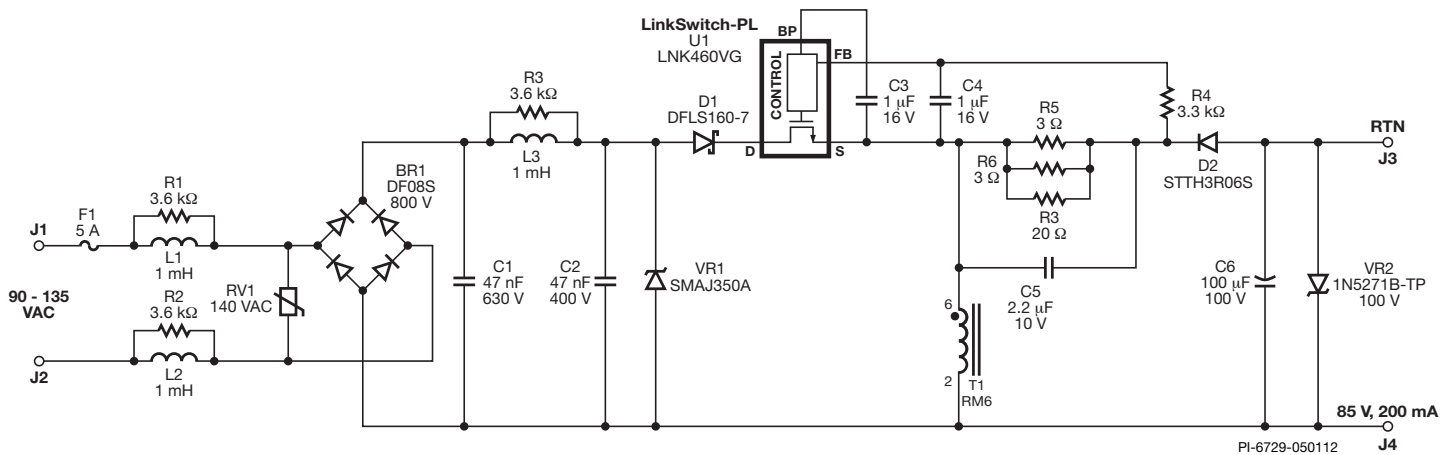
## LinkSwitch-PH – High Efficiency, High Power Factor, LED Driver (DER-298)

18 W, 200 V, 90 mA OUTPUT, 90 – 265 VAC INPUT, SINGLE-STAGE PFC, NON-ISOLATED, BUCK-BOOST POWER SUPPLY



## LinkSwitch-PL – High Efficiency, High Power Factor, LED Driver (DER-323)

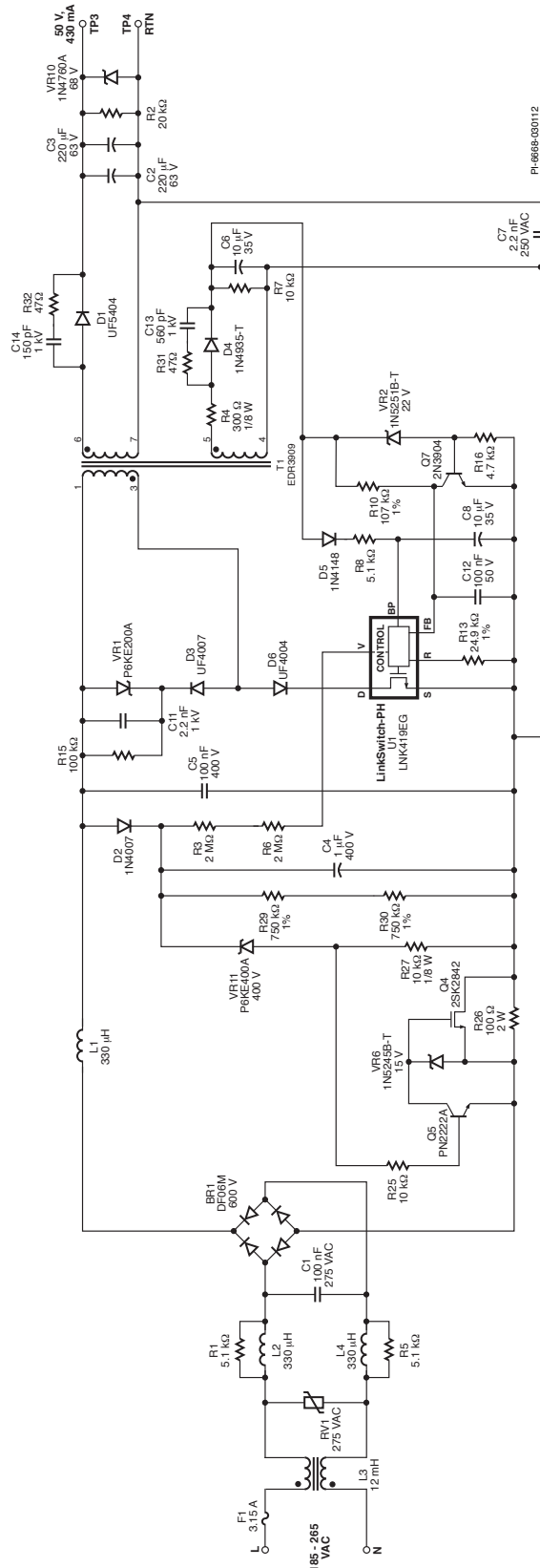
18 W, 85 V, 200 mA OUTPUT, 90 – 135 VAC INPUT, SINGLE-STAGE PFC, BUCK-BOOST CONVERTER POWER SUPPLY



# High Power Factor Design Examples

## LinkSwitch-PH – High Efficiency, High Power Factor, LED Driver (DER-318)

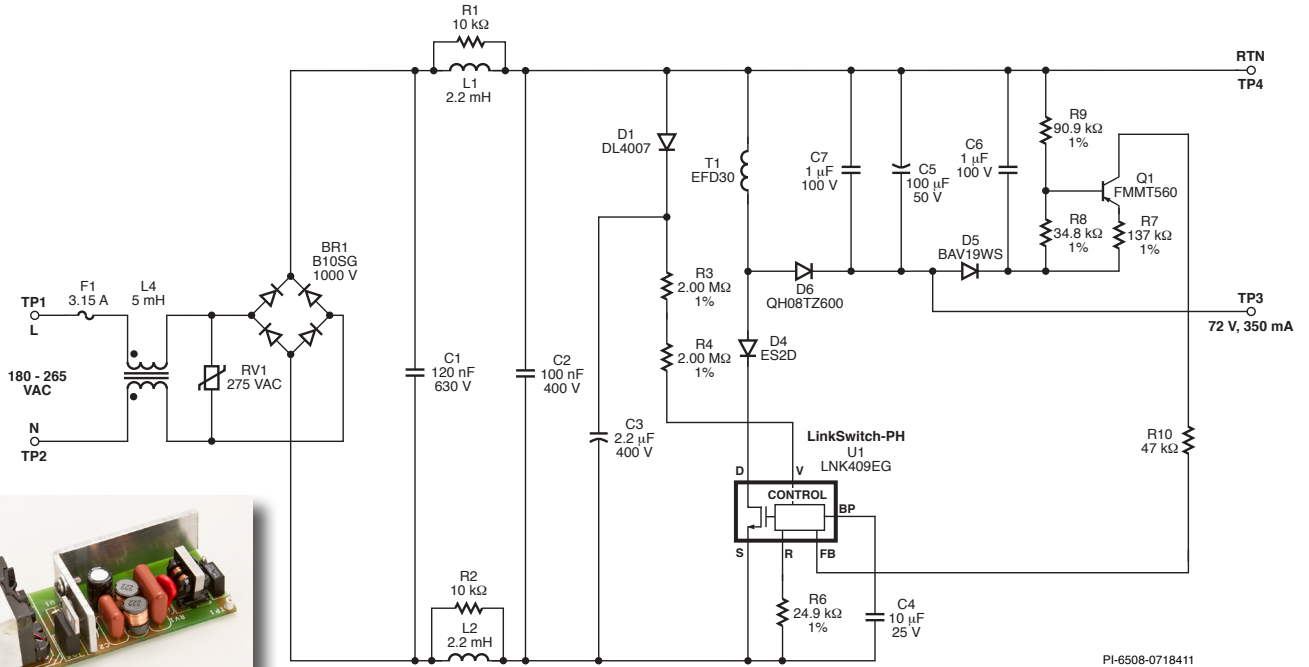
23 W, 50 V, 430 mA OUTPUT, 185 – 265 VAC INPUT, SINGLE-STAGE PFC, FLYBACK POWER SUPPLY



# High Power Factor Design Examples

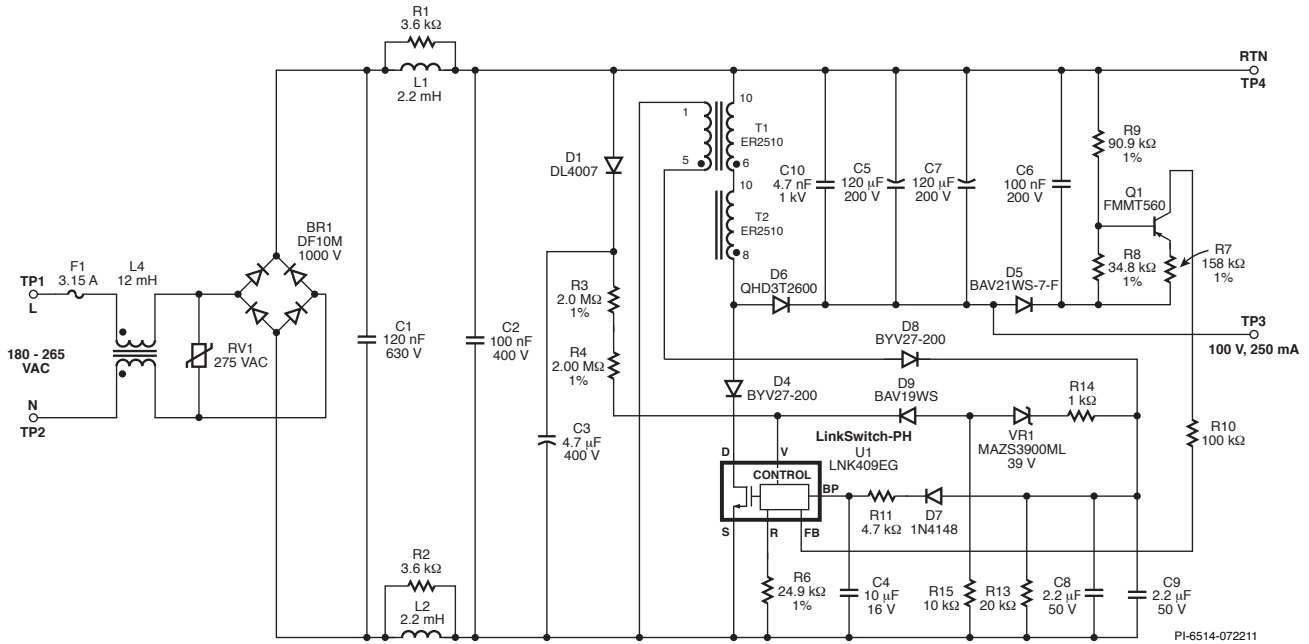
## LinkSwitch-PH – High Efficiency, High Power Factor, LED Driver (DER-285)

25 W, 72 V, 350 mA OUTPUT, 180 – 265 VAC INPUT, SINGLE-STAGE PFC, NON-ISOLATED, BUCK-BOOST POWER SUPPLY



## LinkSwitch-PH – High Efficiency, High Power Factor, LED Driver (DER-287)

25 W, 100 V, 250 mA OUTPUT, 180 – 265 VAC INPUT, SINGLE-STAGE PFC, NON-ISOLATED, BUCK-BOOST POWER SUPPLY

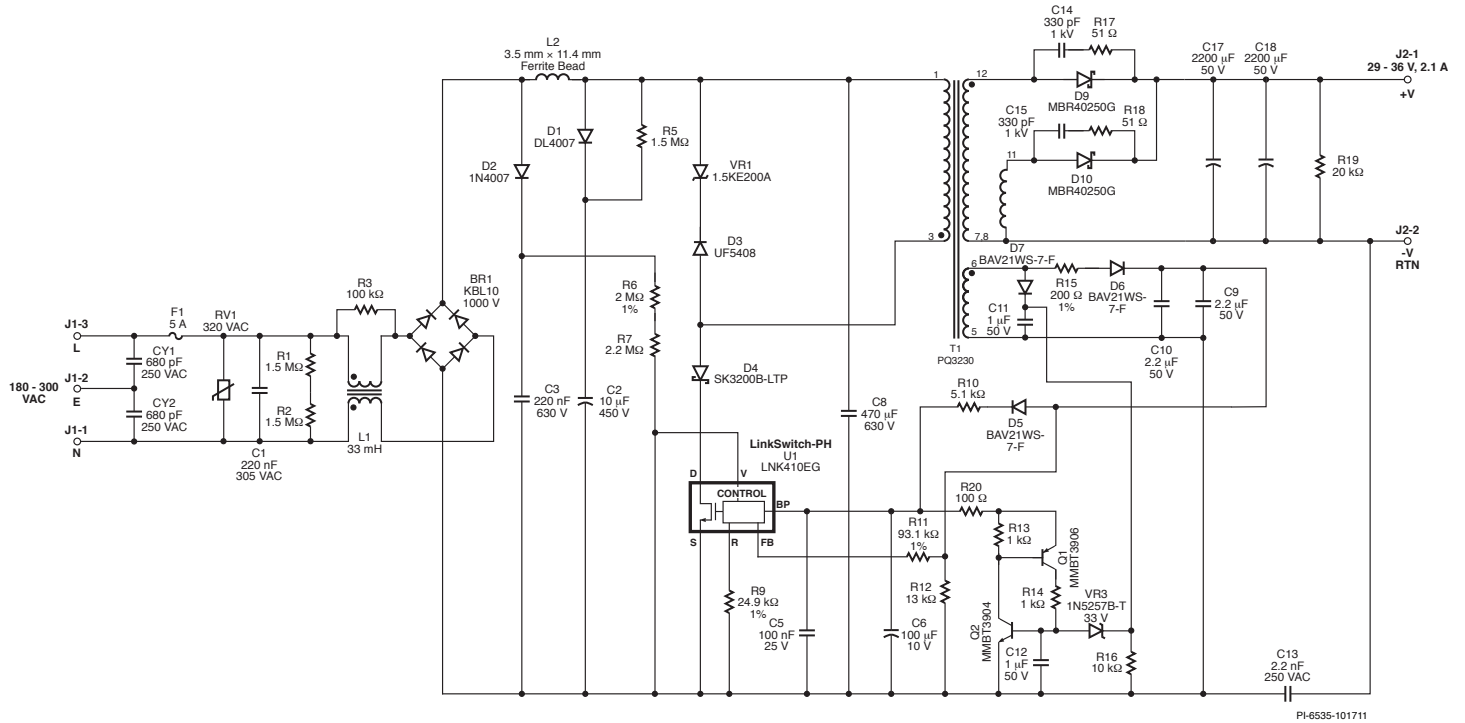




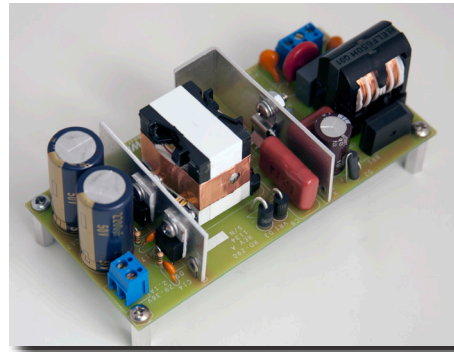
# High Power Factor Design Examples

## LinkSwitch-PH – High Efficiency, High Power Factor, LED Driver (RDK-290)

75 W, 29 – 36 V, 2.1 A, 180 – 300 VAC INPUT, SINGLE-STAGE PFC, FLYBACK POWER SUPPLY



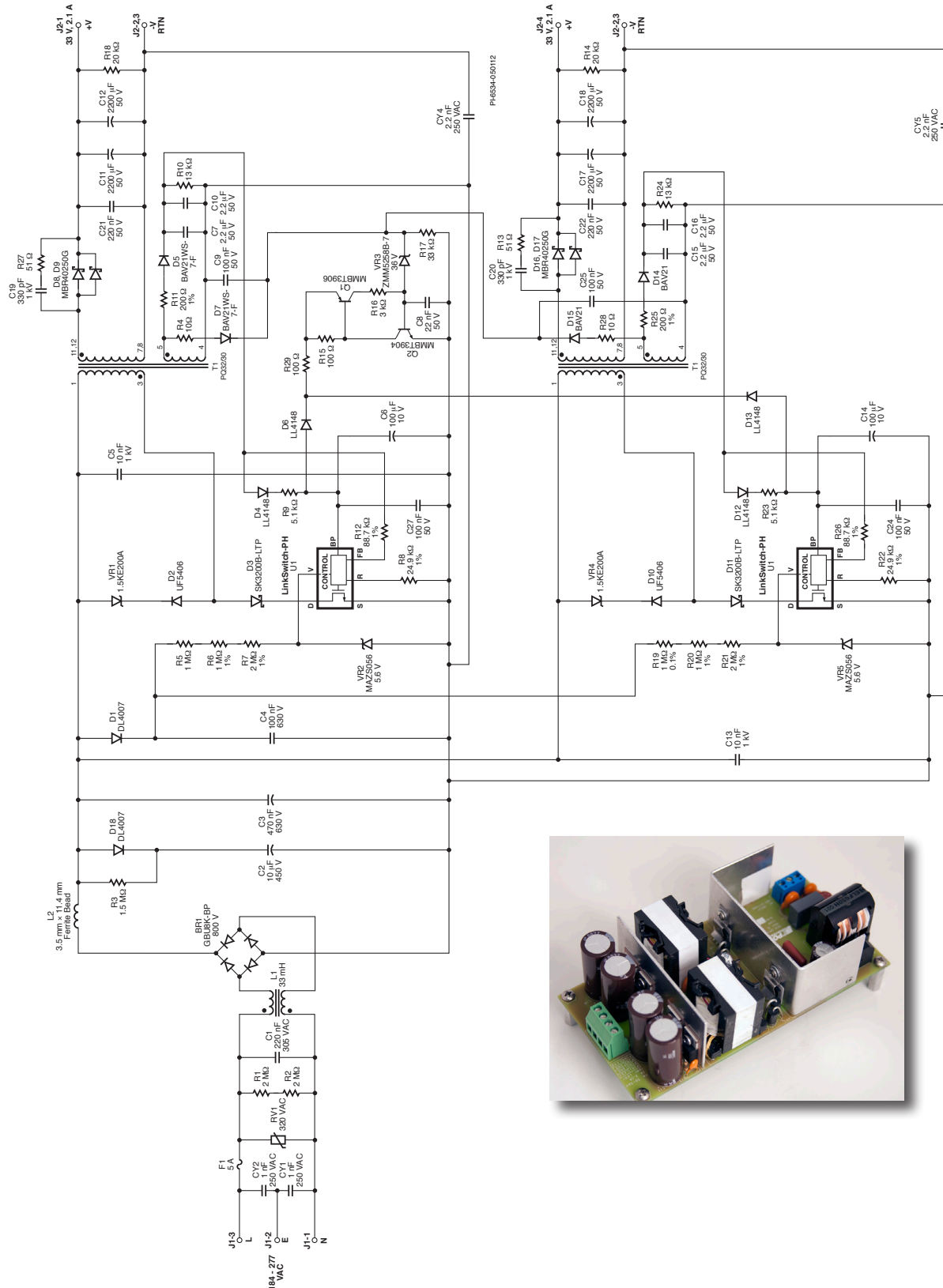
PI-6535-101711



# High Power Factor Design Examples

## LinkSwitch-PH – High Efficiency, High Power Factor, LED Driver (DER-291)

150 W, 30 – 36 V, 4.2 A, 184 – 277 VAC INPUT, SINGLE-STAGE PFC, FLYBACK POWER SUPPLY

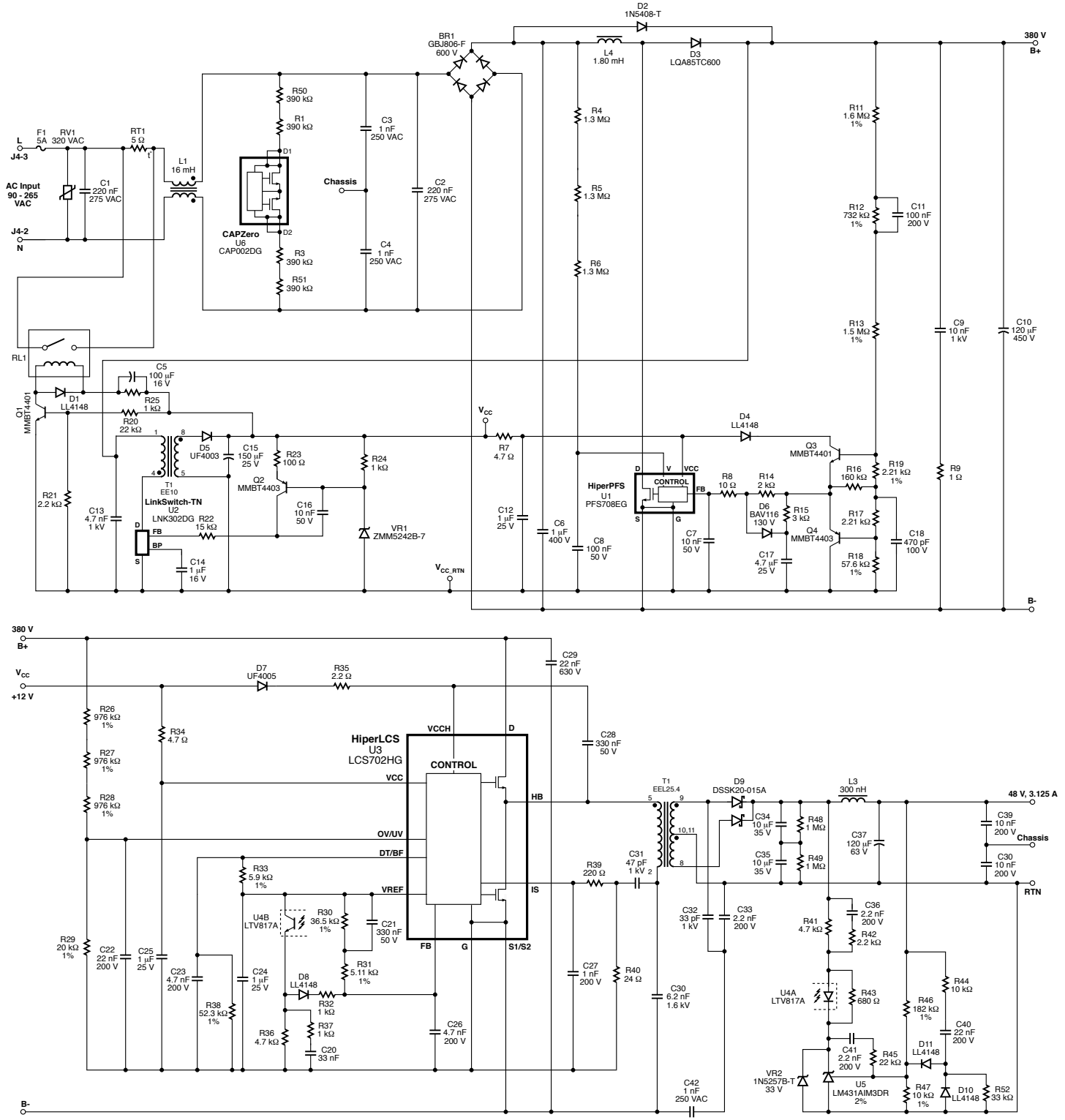




# High Power Factor Design Examples

## LinkSwitch-PH – High Efficiency, High Power Factor, Streetlight LED Driver (RDK-292)

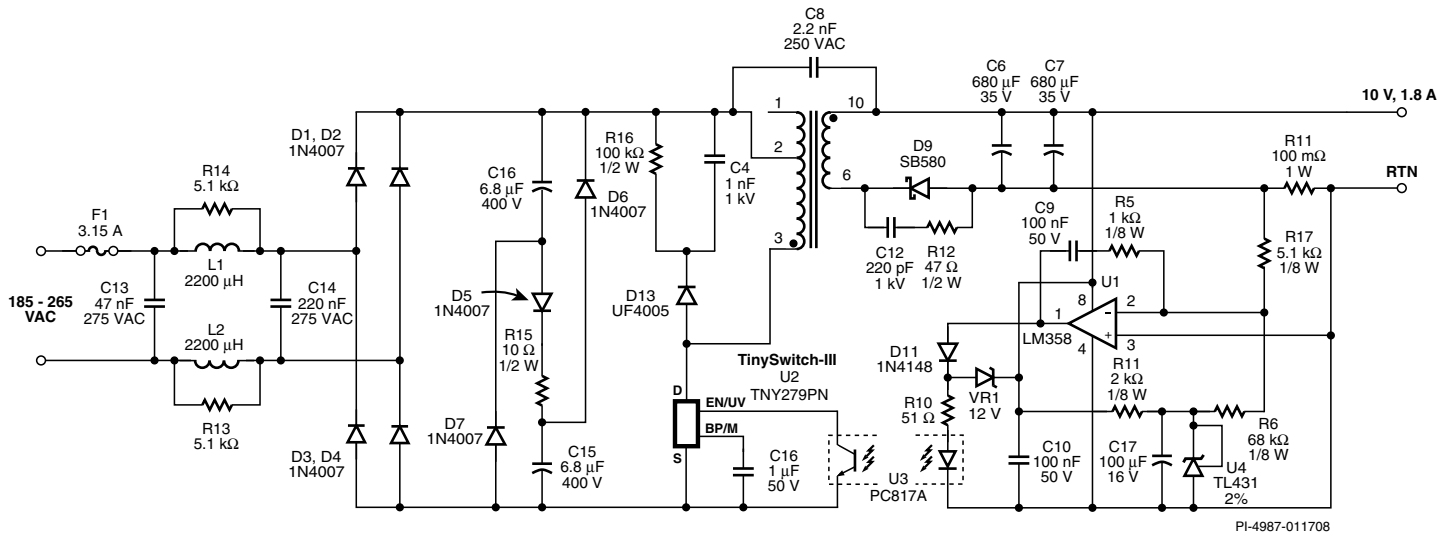
150 W, 48 V, 3.125 A, 90 – 265 VAC INPUT, LLC AND BOOST PFC FLYBACK POWER SUPPLY



# High Power Factor Design Examples

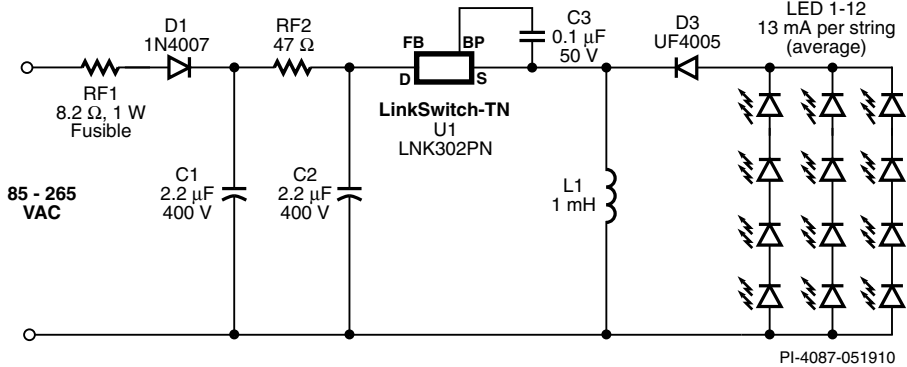
## TinySwitch-III – Passive PFC, Constant Current LED Driver (DI-130)

18 W, 10 V, 1.8 A OUTPUT, 185 – 265 VAC INPUT, PASSIVE PFC FLYBACK POWER SUPPLY



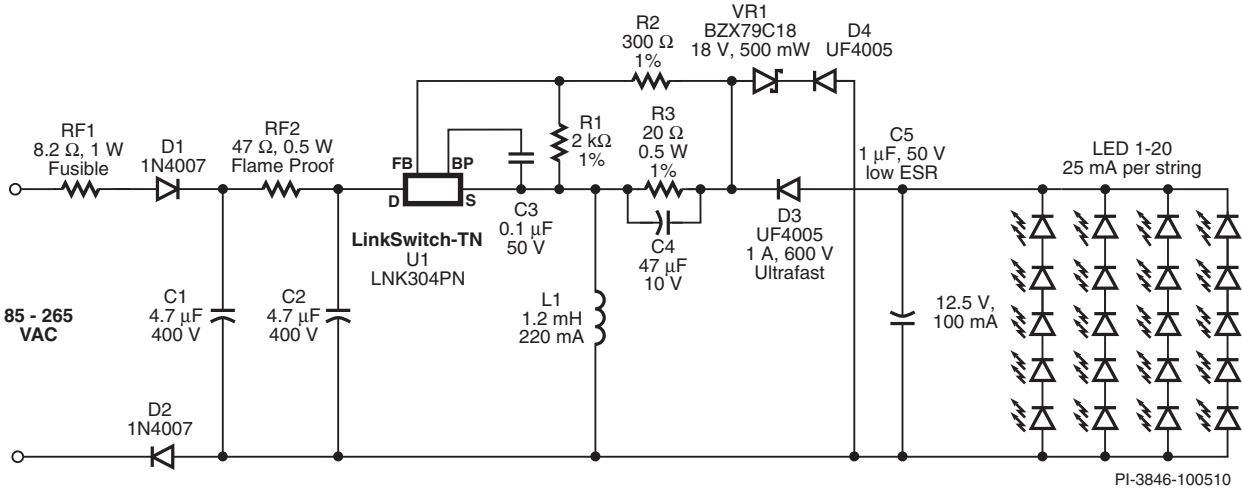
## LinkSwitch-TN – Non-Isolated, Buck-Boost LED Driver (DER-92)

0.5 W, 13 V, 40 mA, 85 – 265 VAC INPUT, BUCK-BOOST POWER SUPPLY



## LinkSwitch-TN – Non-Isolated, Constant Current LED Driver (DI-74)

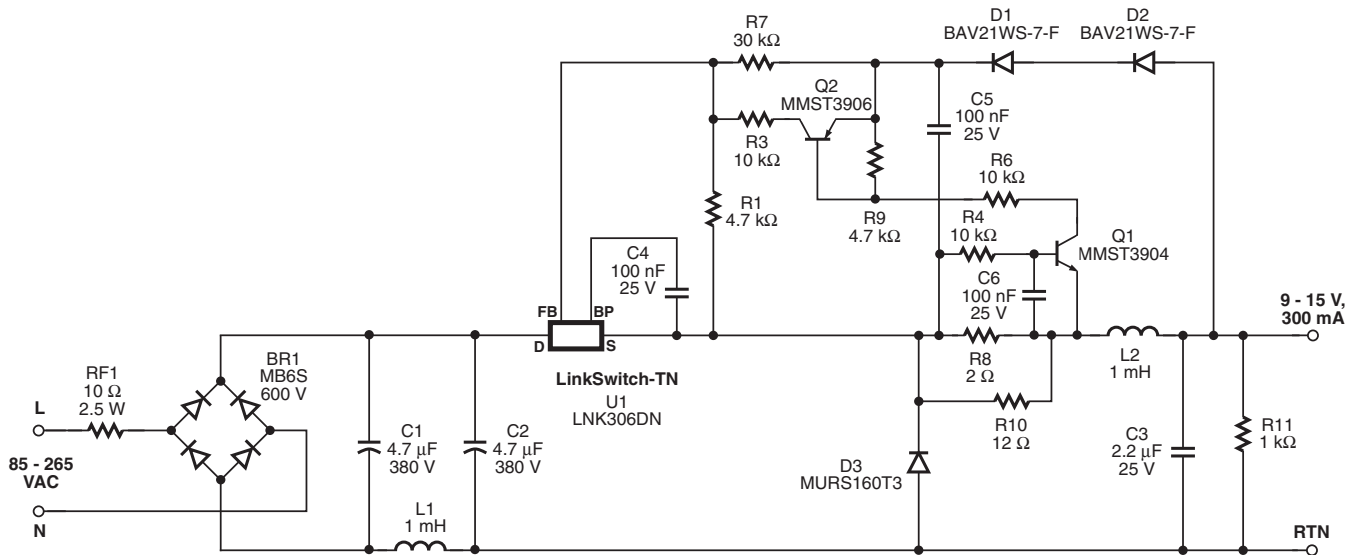
1.25 W, 12.5 V, 100 mA, 85 – 265 VAC INPUT, BUCK-BOOST POWER SUPPLY



# Design Examples

## LinkSwitch-TN – Non-Isolated, Constant Current Light Bulb Replacement (RDK-131)

3 W, 9 V – 15 V, 300 mA OUTPUT, 85 – 265 VAC INPUT, BUCK CONVERTER POWER SUPPLY

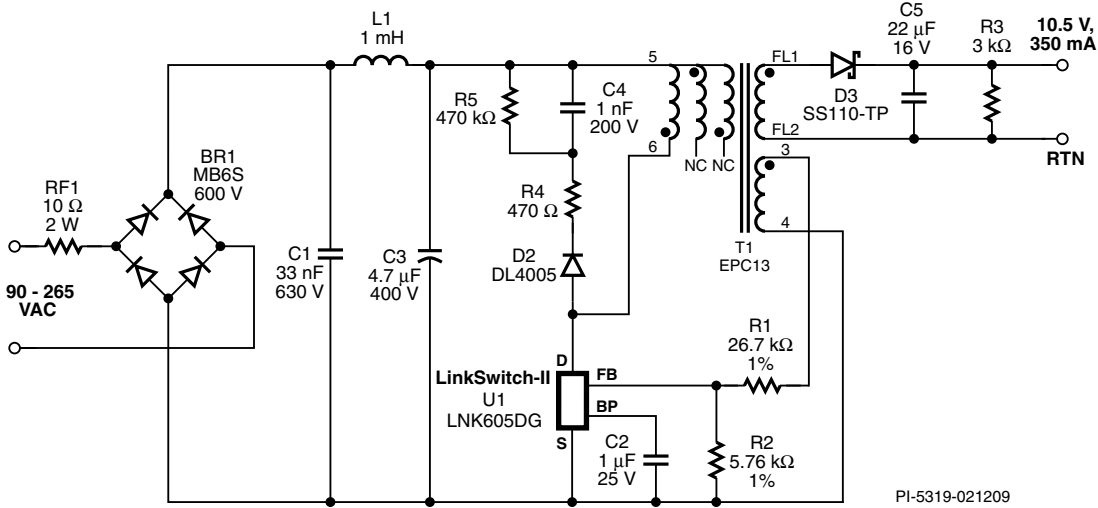


PI-4986-011708



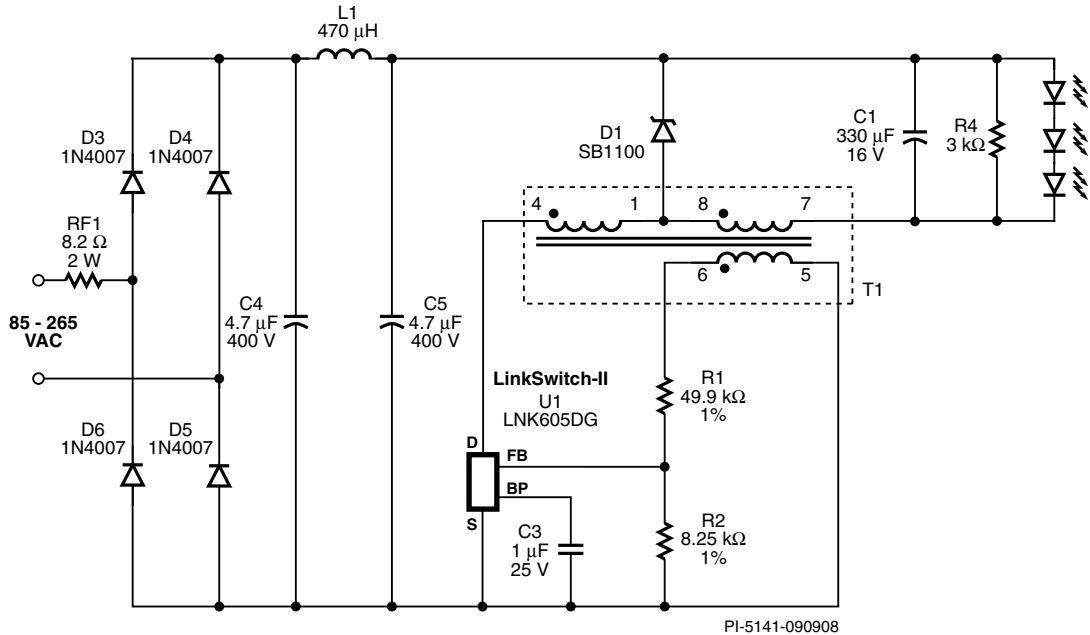
## LinkSwitch-II – Isolated Constant Voltage, Constant Current LED Driver (DER-206)

3.67 W, 10.5 V, 350 mA OUTPUT, 90 – 265 VAC INPUT, FLYBACK POWER SUPPLY



## LinkSwitch-II – Non-Isolated Constant Voltage, Constant Current, Tapped Buck LED Driver (DER-186)

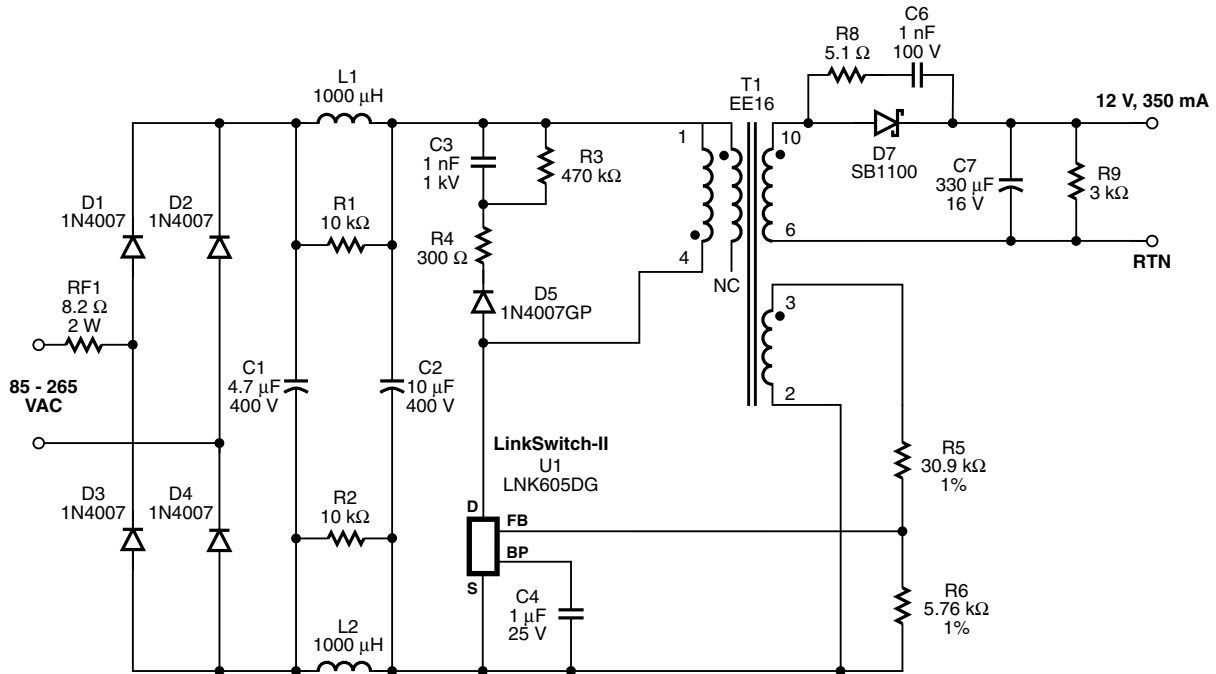
4.2 W, 12 V, 350 mA OUTPUT, 85 – 265 VAC INPUT, TAPPED BUCK CONVERTER POWER SUPPLY



# Design Examples

## LinkSwitch-II – Constant Voltage, Constant Current LED Driver (DER-185)

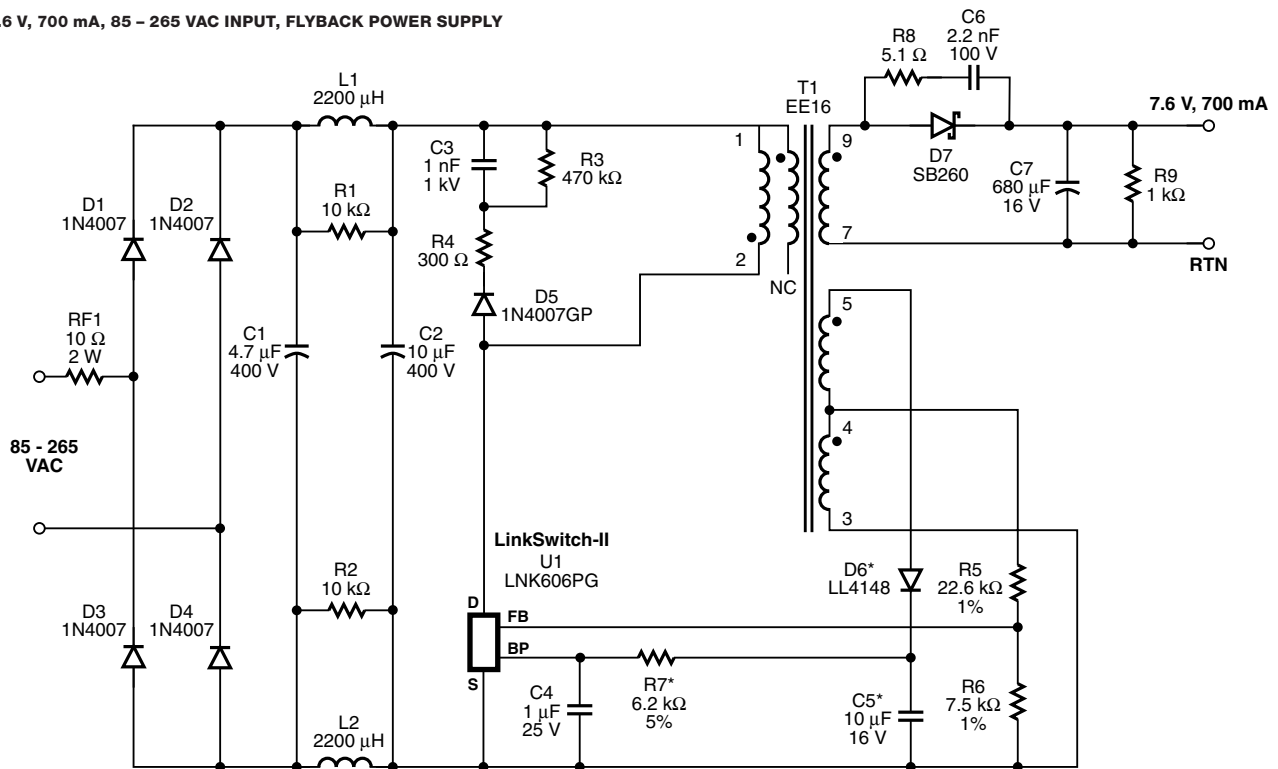
4.2 W, 12 V, 350 mA OUTPUT, 85 – 265 VAC INPUT, FLYBACK POWER SUPPLY



PI-5117-042308

## LinkSwitch-II – Constant Voltage, Constant Current LED Driver (DER-184)

5.32 W, 7.6 V, 700 mA, 85 – 265 VAC INPUT, FLYBACK POWER SUPPLY

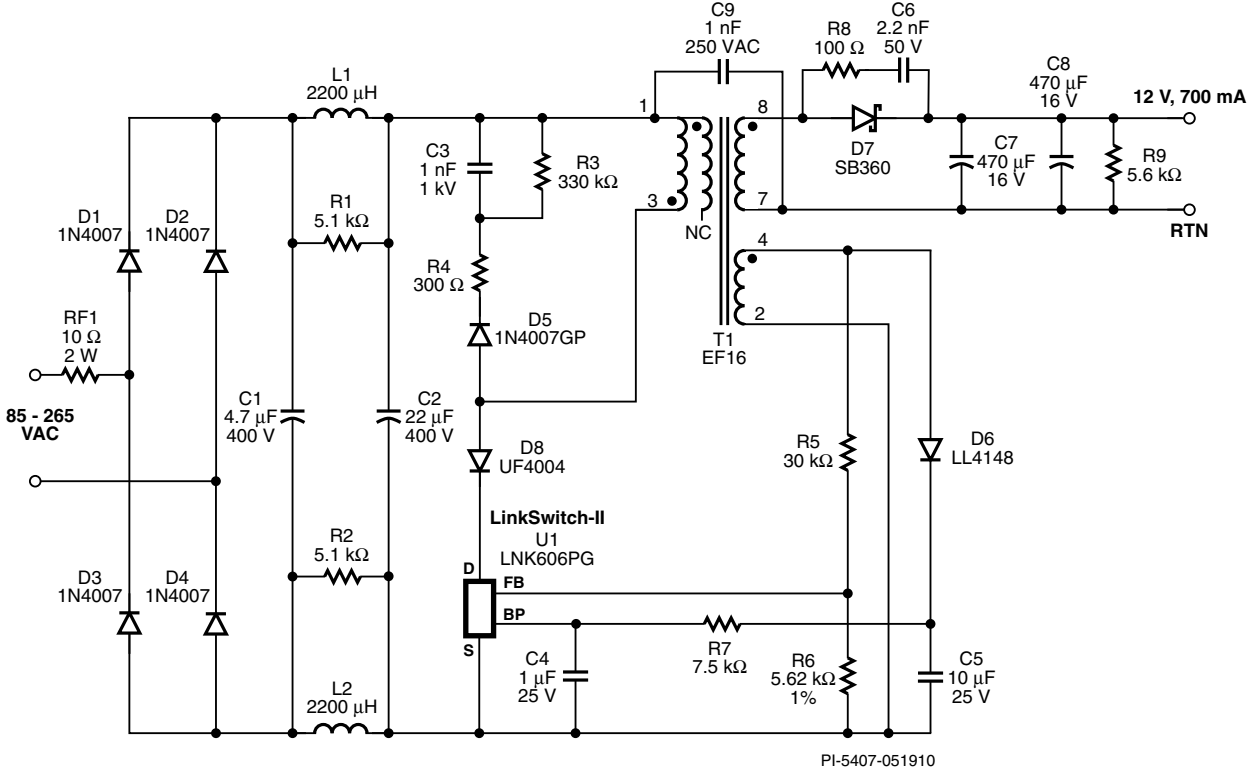


\*Optional components

PI-5028-051910

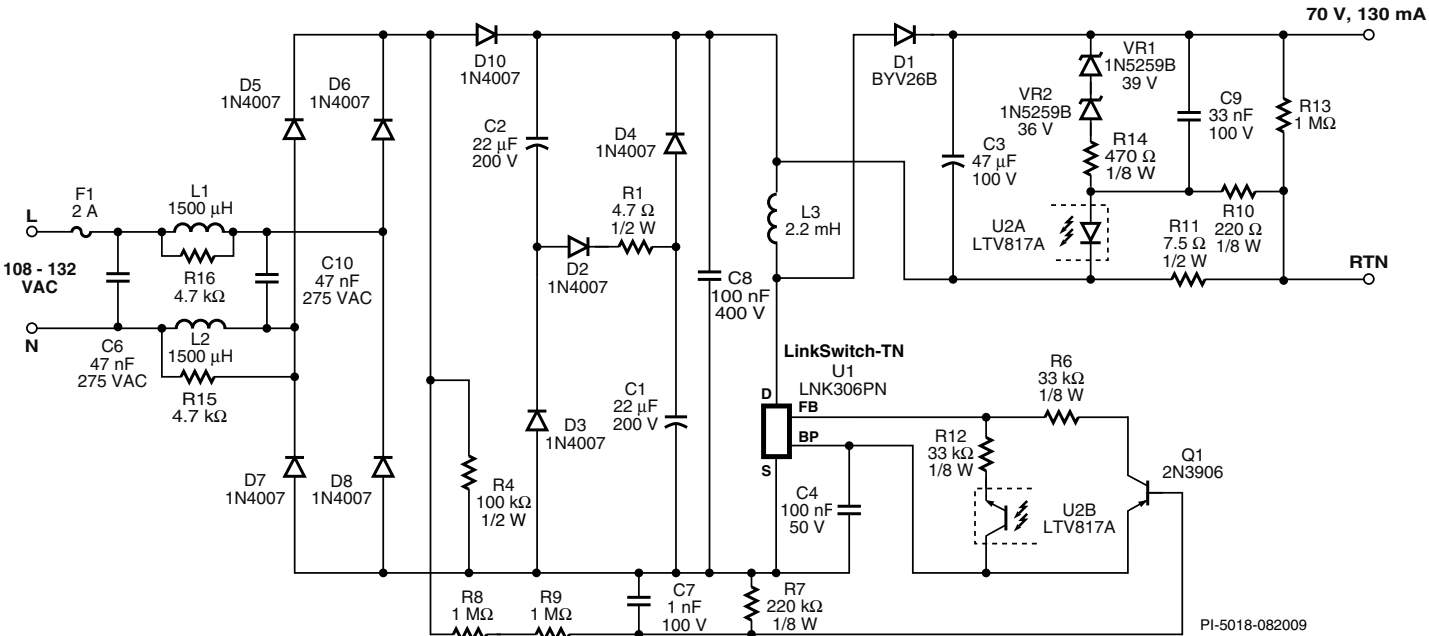
## LinkSwitch-II – Constant Voltage, Constant Current LED Driver (DER-215)

8.4 W, 12 V, 700 mA, 85 – 265 VAC INPUT, FLYBACK POWER SUPPLY



## LinkSwitch-TN – Low-Cost Dimmable LED Ballast (DI-171)

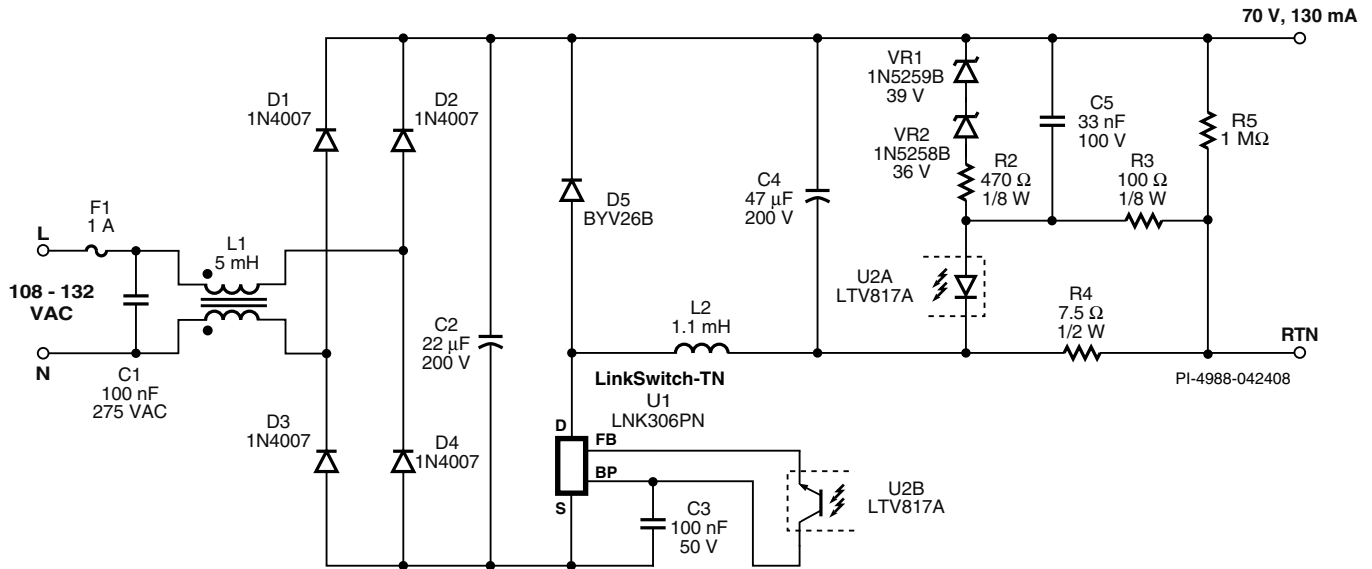
9 W, 70 V, 130 mA OUTPUT, 108 – 132 VAC INPUT, BUCK-BOOST POWER SUPPLY



# Design Examples

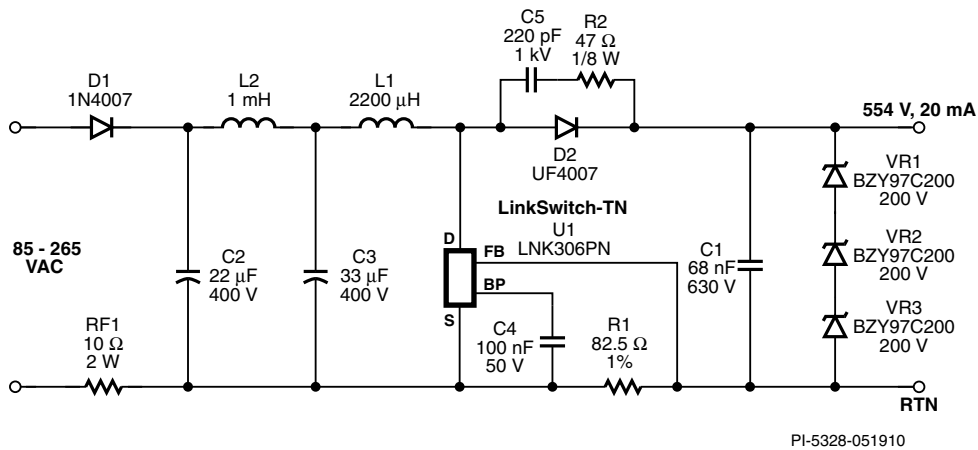
## LinkSwitch-TN – Constant Current Buck Converter LED Driver (DER-172)

9.1 W, 70 V, 130 mA OUTPUT, 108 – 132 VAC INPUT, BUCK CONVERTER POWER SUPPLY



## LinkSwitch-TN – Constant Current LED Driver (DI-210)

11 W, 554 V, 20 mA OUTPUT, 85 – 265 VAC INPUT, BOOST POWER SUPPLY

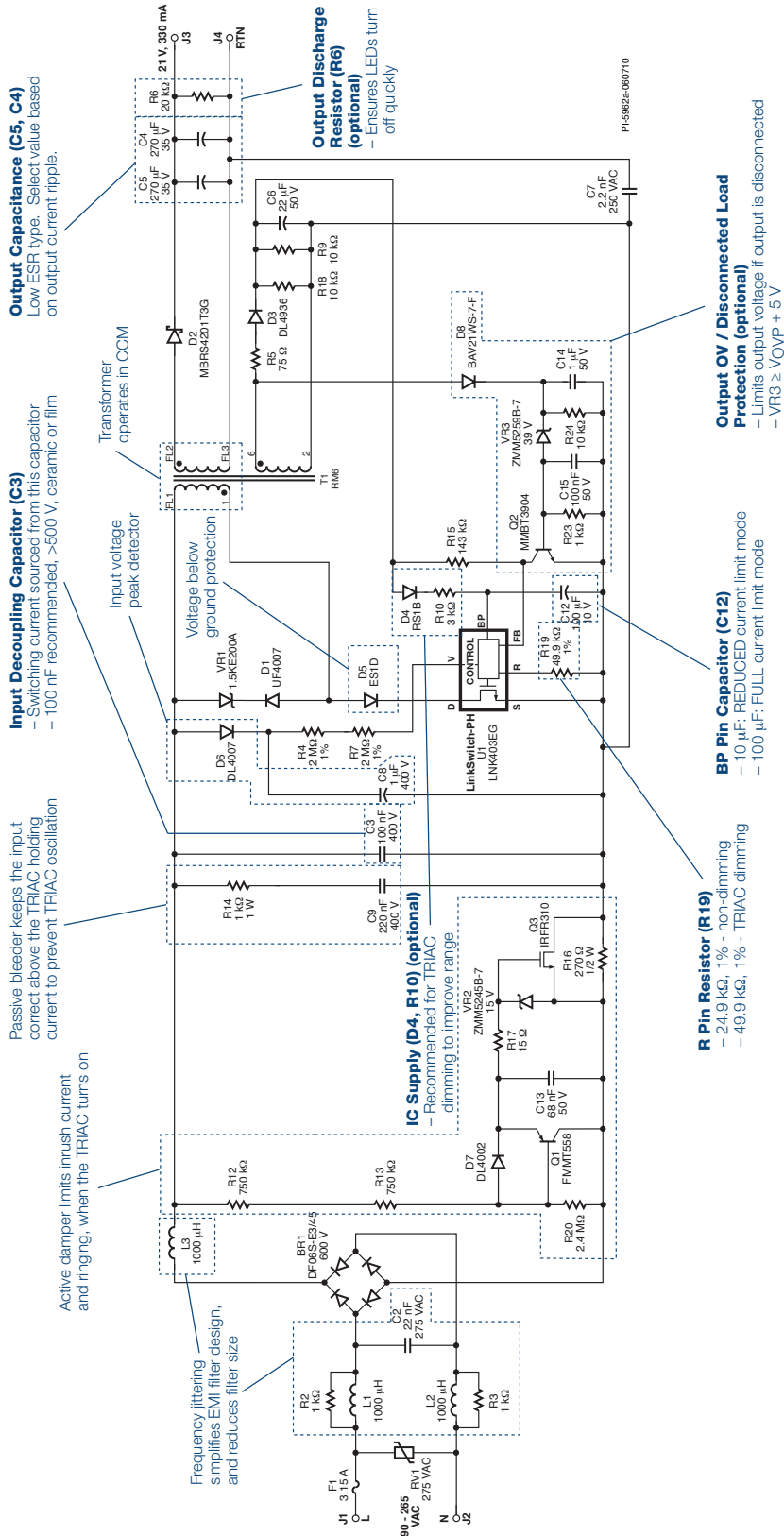




# LED Circuit Operations

## LinkSwitch-PH – High Efficiency, High Power Factor, TRIAC Dimmable LED Driver (RDK-193)

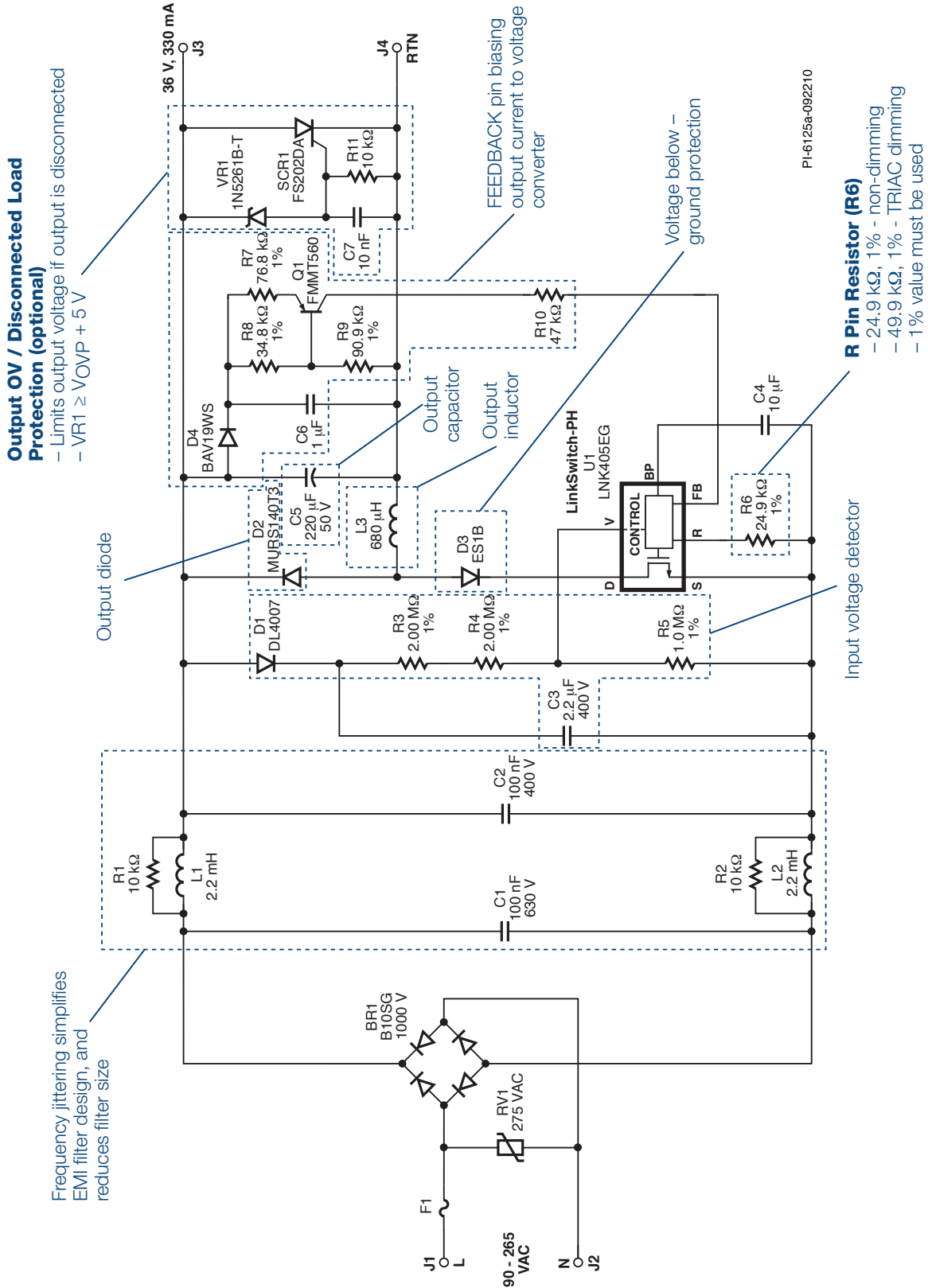
7 W, 21 V, 330 mA OUTPUT, 90 – 265 VAC INPUT, SINGLE-STAGE PFC, FLYBACK POWER SUPPLY



# LED Circuit Operations

## LinkSwitch-PH – High Efficiency, High Power Factor, LED Driver (RDK-257)

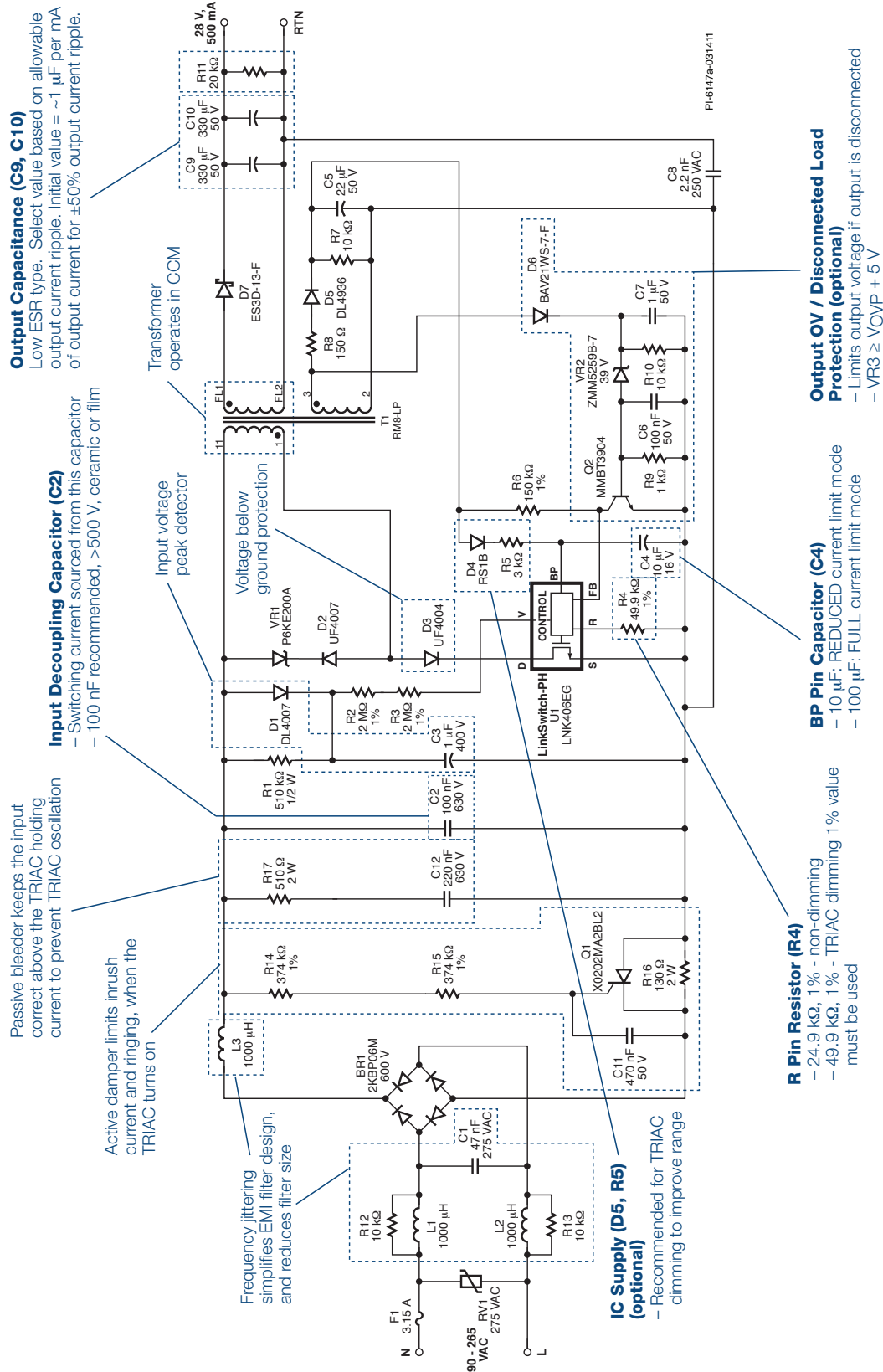
12 W, 36 V, 330 mA OUTPUT, 90 – 265 VAC INPUT, SINGLE-STAGE PFC, BUCK CONVERTER POWER SUPPLY



# LED Circuit Operations

## LinkSwitch-PH – High Efficiency, High Power Factor, TRIAC Dimmable LED Driver (RDK-195)

14 W, 28 V, 500 mA OUTPUT, 90 – 265 VAC INPUT, SINGLE-STAGE PFC, FLYBACK POWER SUPPLY



**Output Capacitance (C9, C10)**

Low ESR type. Select value based on allowable output current ripple. Initial value = ~1 μF per mA of output current for ±50% output current ripple.

**Input Decoupling Capacitor (C2)**

– Switching current sourced from this capacitor  
– 100 nF recommended, >500 V, ceramic or film

Passive bleeder keeps the input correct above the TRIAC holding current to prevent TRIAC oscillation

Active damper limits inrush current and ringing, when the TRIAC turns on

Frequency jittering simplifies EMI filter design, and reduces filter size

Transformer operates in CCM

Voltage below ground protection

Input voltage peak detector

**IC Supply (D5, R5) (optional)**

– Recommended for TRIAC dimming to improve range

**R Pin Resistor (R4)**

– 24.9 kΩ, 1% - non-dimming  
– 49.9 kΩ, 1% - TRIAC dimming 1% value must be used

**BP Pin Capacitor (C4)**

– 10 μF: REDUCED current limit mode  
– 100 μF: FULL current limit mode

**Output OV / Disconnected Load Protection (optional)**

– Limits output voltage if output is disconnected  
– VR3 ≥ VOVP + 5 V

# IC Product Tables

## TRIAC Dimmable, Single-Stage PFC, Medium-Power AC-DC Power Conversion<sup>1,2</sup>

Product <sup>5</sup>	Minimum Output Power <sup>3</sup> (W)		Maximum Output Power <sup>4</sup> (W)	
	$R_V = 2 \text{ M}\Omega$		$R_V = 4 \text{ M}\Omega$	
<b>LinkSwitch-PH</b>	85-132 VAC		85-308 VAC	
<b>LNK403/413E/L</b>	2.5	4.5	6.5	12
<b>LNK404/414E/L</b>	2.5	5.5	6.5	15
<b>LNK405/415E/L</b>	3.8	7.0	8.5	18
<b>LNK406/416E/L</b>	4.5	8.0	10	22
<b>LNK407/417E/L</b>	5.5	10	12	25
<b>LNK408/418E/L</b>	6.8	13.5	16	35
<b>LNK409/419E/L</b>	8.0	20	18	50
<b>LNK410/420E/L</b>	18	31	40	78

### Additional Features:

- Single-stage power factor correction and accurate constant current (CC) output
- Flicker-free phase-controlled TRIAC dimming
- Primary side control eliminates optocoupler and all secondary current control circuitry
- Eliminates electrolytic bulk capacitor
- Eliminates all control loop compensation circuitry
- Simple PWM dimming interface

### Notes:

1. Continuous power in an open frame with adequate heat sinking at device local ambient of 70 °C.
2. Power level calculated on typical LED string voltage with efficiency >80%.
3. Minimum output power with  $C_{BP} = 10 \mu\text{F}$ .
4. Maximum output power with  $C_{BP} = 100 \mu\text{F}$ . LNK4x3EG  $C_{BP} = 10 \mu\text{F}$ .
5. Package: eSIP-7C, eSIP-7F.

## TRIAC Dimmable, Single-Stage PFC, Low-Power AC-DC Power Conversion (Up to 16 W)

Product <sup>1</sup>	Minimum Output Power <sup>2</sup> (W)	Maximum Output Power <sup>2</sup> (W)
<b>LinkSwitch-PL</b>	85-265 VAC	
<b>LNK454D</b>	1.5	3
<b>LNK456D</b>	3	6
<b>LNK457D/K/V</b>	4	8
<b>LNK458K/V</b>	6	11.5
<b>LNK460K/V</b>	8	16

### Additional Features:

- Single-stage power factor correction and accurate CC output
- Flicker-free phase-controlled TRIAC dimming
- Very low component count with small non-electrolytic bulk capacitor, for compact replacement lamp designs
- Compact SO-8C package
- Completely eliminates control loop compensation

### Notes:

1. Packages: D: SO-8C, K: eSOP<sup>TM</sup>-12, V: eDIP<sup>TM</sup>-12.
2. Maximum practical continuous power in an open frame design with adequate heat sinking, measured at +50 °C ambient.

## Low-Power AC-DC, Non-Isolated Power Conversion ( $\leq 360 \text{ mA}$ )

Product <sup>1</sup>	Output Current <sup>2</sup> (mA)		Output Current <sup>3</sup> (mA)	
	MDCM <sup>3</sup>	CCM <sup>4</sup>	MDCM <sup>3</sup>	CCM <sup>4</sup>
<b>LinkSwitch-TN</b>	230 VAC $\pm$ 15%		85-265 VAC	
<b>LNK302P/G/D</b>	63	80	63	80
<b>LNK304P/G/D</b>	120	170	120	170
<b>LNK305P/G/D</b>	175	280	175	280
<b>LNK306P/G/D</b>	225	360	225	360

### Additional Features:

- 700 V internal MOSFET rating
- Self-powered
- ON/OFF control
- Hysteresic thermal shutdown
- Power limiting
- Frequency jitter reduces EMI
- EcoSmart<sup>TM</sup> low standby/no-load power consumption

### Notes:

1. Packages: P: DIP-8B, G: SMD-8B, D: SO-8C.
2. Typical output current in a non-isolated buck converter. Output power capability depends on respective output voltage.
3. Mostly discontinuous conduction mode.
4. Continuous conduction mode.

## Low-Power AC-DC Power Conversion (Up to 6.1 W)

Product <sup>1</sup>	Continuous Output Power (W)		Continuous Output Power (W)	
	Adapter <sup>2</sup>	Open Frame <sup>3</sup>	Adapter <sup>2</sup>	Open Frame <sup>3</sup>
<b>LinkSwitch-II</b>	230 VAC ± 15%		85-265 VAC	
<b>LNK603/613P/D</b>	2.5	3.3	2.5	3.3
<b>LNK604/614P/D</b>	3.5	4.1	3.5	4.1
<b>LNK605/615P/D</b>	4.5	5.1	4.5	5.1
<b>LNK606/616P/G/D</b>	5.5	6.1	5.5	6.1
<b>LNK632D</b>	3.1	3.1	3.1	3.1

### Additional Features:

- 700 V internal MOSFET rating
- Self-powered
- ON/OFF control
- Hysteretic overtemperature protection
- Power limiting
- Frequency jitter reduces EMI
- EcoSmart low standby/no-load power consumption

### Notes:

1. Packages: P: DIP-8C, G: SMD-8C, D: SO-8C.
2. Minimum continuous power in a typical non-ventilated enclosed adapter measured at 50 °C ambient.
3. Minimum practical continuous power in an open frame design with adequate heat sinking, measured at 50 °C ambient.

## Medium-Power AC-DC Power Conversion (Up to 36.5 W)

Product <sup>1</sup>	Continuous Output Power (W)		Continuous Output Power (W)	
	Adapter <sup>2</sup>	Open Frame <sup>3</sup>	Adapter <sup>2</sup>	Open Frame <sup>3</sup>
<b>TinySwitch-III</b>	230 VAC ± 15%		85-265 VAC	
<b>TNY274P/G</b>	6	11	5	8.5
<b>TNY275P/G</b>	8.5	15	6	11.5
<b>TNY276P/G</b>	10	19	7	15
<b>TNY277P/G</b>	13	23.5	8	18
<b>TNY278P/G</b>	16	28	10	21.5
<b>TNY279P/G</b>	18	32	12	25
<b>TNY280P/G</b>	20	36.5	14	28.5

### Additional Features:

- 700 V internal MOSFET rating
- Self-powered
- Hysteretic overtemperature protection
- Frequency jitter reduces EMI
- EcoSmart low standby/no-load power consumption
- On-time extension
- Latching output overvoltage protection
- Line undervoltage lockout
- Selectable current limit

### Notes:

1. Packages: P: DIP-8C, G: SMD-8C.
2. Minimum continuous power in a typical non-ventilated encased adapter with minimal heat sinking, measured at a device ambient of 50 °C.
3. Minimum continuous power in an open frame with adequate heat sinking. TinySwitch-III operates without bias winding.

# IC Product Tables

## HiperPFS – High-Efficiency Integrated LLC Controller (75 W to 440 W)

Product	Maximum Continuous Output Power Ratings at 90 VAC (W)	Peak Output Power Rating at 90 VAC (W)
PFS704E	110	120
PFS706E	140	150
PFS708E	190	205
PFS710E	240	260
PFS712E	300	320
PFS714E	350	385
PFS716E	388	425

Product	Maximum Continuous Output Power Ratings at 180 VAC (W)	Peak Output Power Rating at 180 VAC (W)
PFS723E	255	280
PFS724E	315	350
PFS725E	435	480
PFS726E	540	600
PFS727E	675	750
PFS728E	810	900
PFS729E	900	1000

Notes:

1. See Key Application considerations.
2. Maximum practical continuous power at 90 VAC in an open-frame design with adequate heat sinking, measured at 50 °C ambient.
3. Recommended lower range of maximum continuous power for best light load efficiency; HiperPFS will operate and perform below this level.
4. Maximum practical continuous power at 180 VAC in an open-frame design with adequate heat sinking, measured at 50 °C ambient.
5. Internal output power limit.

### Additional Features:

- Single chip solution for boost power factor correction (PFC)
  - EN61000-3-2 Class C and D compliant
- High light load efficiency at 10% and 20% load
  - >95% efficiency from 10% load to full load
  - <130 mW no-load consumption at 230 VAC with output in regulation
  - <50 mW no-load consumption at 230 VAC in remote off-state
- Frequency adjusted over line voltage, and line cycle
  - Spread-spectrum across >60 kHz window to simplify EMI filtering requirements
  - Lower boost inductance
- Provides up to 1 kW peak output power
  - >1 kW peak power delivery in power limit voltage regulation mode
- High integration allows smaller form factor, higher power density designs
  - Incorporates control, gate driver, and high-voltage power MOSFET
  - Internal current sense reduces component count and system losses
- Protection features include: UV, OV, OTP, brown-in/out, cycle- by-cycle current limit, and power limiting for overload protection
- Halogen free and RoHS compliant

## HiperLCS – High-Efficiency Integrated LLC Controller (75 W to 440 W)

Product	Power <sup>1</sup> (W)
LCS700H/L	110
LCS701H/L	170
LCS702H/L	220
LCS703H/L	275
LCS705H	350
LCS708H	440

Notes:

1. Maximum practical power is the power the part can deliver when properly mounted to a heat sink and a maximum heat sink temperature of 90 °C.

### Additional Features:

- LLC half-bridge power stage incorporating controller, high and low-side gate drives, and high-voltage power MOSFETs
  - Highly integrated – eliminates external components
- High maximum operating frequency of 1 MHz
  - Nominal steady-state operation up to 500 kHz
  - Dramatically reduces magnetics size and allows use of SMD ceramic output capacitors
- Accurate programmable minimum and maximum frequency limits
- Precise duty symmetry balances output rectifier current, improving efficiency
  - 50% ±0.3% typical at 300 kHz
- Comprehensive fault handling and current limiting
  - Programmable brown-in/out thresholds and hysteresis
  - Undervoltage (UV) and overvoltage (OV) protection
  - Programmable over-current protection (OCP)
  - Short-circuit protection (SCP)
  - Over-temperature protection (OTP)
- Programmable dead-time
- Programmable burst mode maintains regulation at no-load and improves light load efficiency
- Programmable soft-start time and delay before soft-start
- Single package designed for high-power and high-frequency
  - Reduces assembly cost and reduces PCB layout loop areas
  - Simple single clip attachment to heat sink
  - Exposed thermal pad connected to ground potential – no insulators required between package and heat sink
  - Staggered pin arrangement for simple PC board routing and high-voltage creepage requirements
- Paired with HiperPFS PFC product gives complete, high efficiency, low part count LED driver

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