

PRODUCT
Selector
Guide



Solid-State Lighting Solutions

Jan 2012

Company Overview

Founded in 2000, iWatt designs, develops and manufactures power supply control ICs. iWatt technology delivers improvements in size, cost and efficiency that have previously been unattainable without adaptive digital control technology. The company's patented techniques set a new standard in power supply performance by dramatically reducing component count for lower cost and improved reliability. The iWatt team has made a major breakthrough in power supply control by using digital algorithms to replace traditional analog control solutions. One key aspect of the iWatt design is that AC/DC adapters have become easy to design, debug and manufacture. iWatt is currently working with market leaders in notebook computer, flat panel display and portable device arenas to develop high density, low cost AC/DC power supplies.

iWatt is also a leading provider of Analog Front Ends (AFE) for Digital Displays, Portable Audio/Video and Wireless applications. Using our portfolio of advanced data converter technology, high-speed mixed analog solutions and transistor level expertise, iWatt's products enable high bandwidth analog interface and data transfer for Flat Panel Displays, LCD TV, PDAs, Digital Cameras, Video Game Systems and Wireless Appliances. Our technologies are typically licensed as Analog Silicon Intellectual Property (ASIP) modules in hard-layout macro formats.

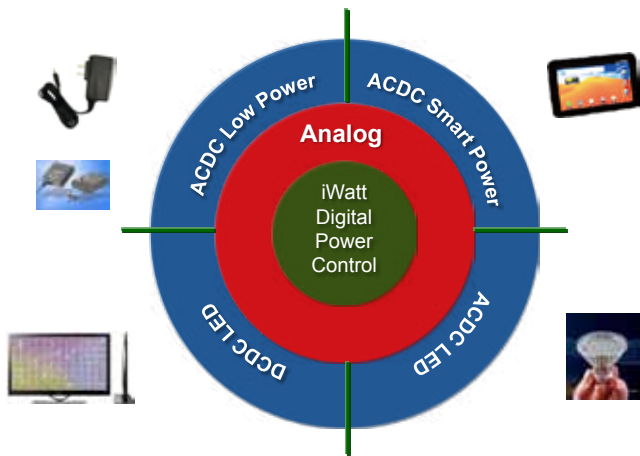
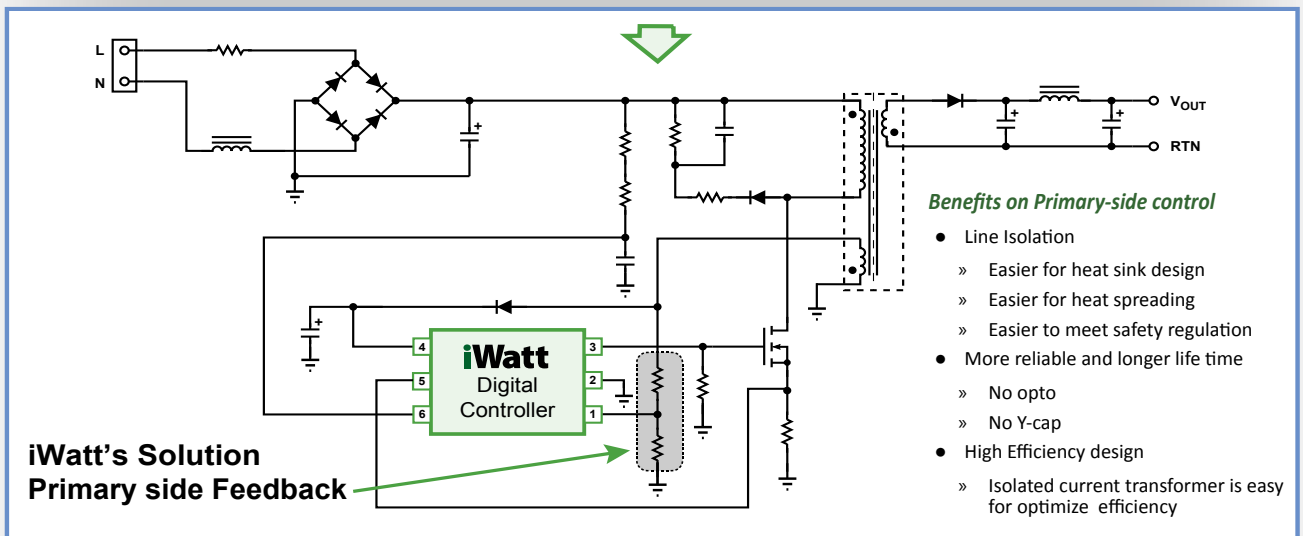
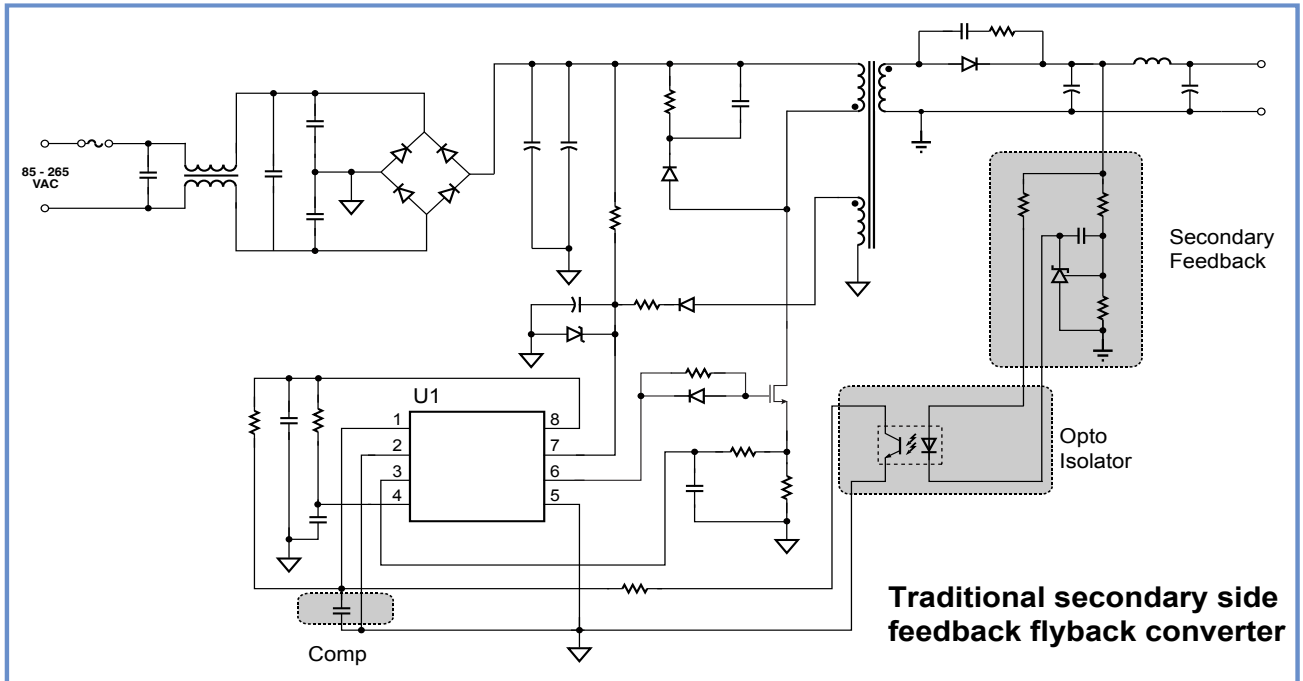


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iWatt's Adaptive Digital™ Control Technology

- Provides Total System Solutions for low-power adapters, chargers, LED lighting drivers and LED-TV backlighting drivers with low cost and high performance
 - Patented digital primary-feedback control technology with tight CV regulation
 - Patented Constant Current (CC) regulation with primary-feedback
 - Advanced multi-layer fault protection technology
 - Green power by innovative design: high efficiency, low EMI, low cost, zero power no-load, etc.

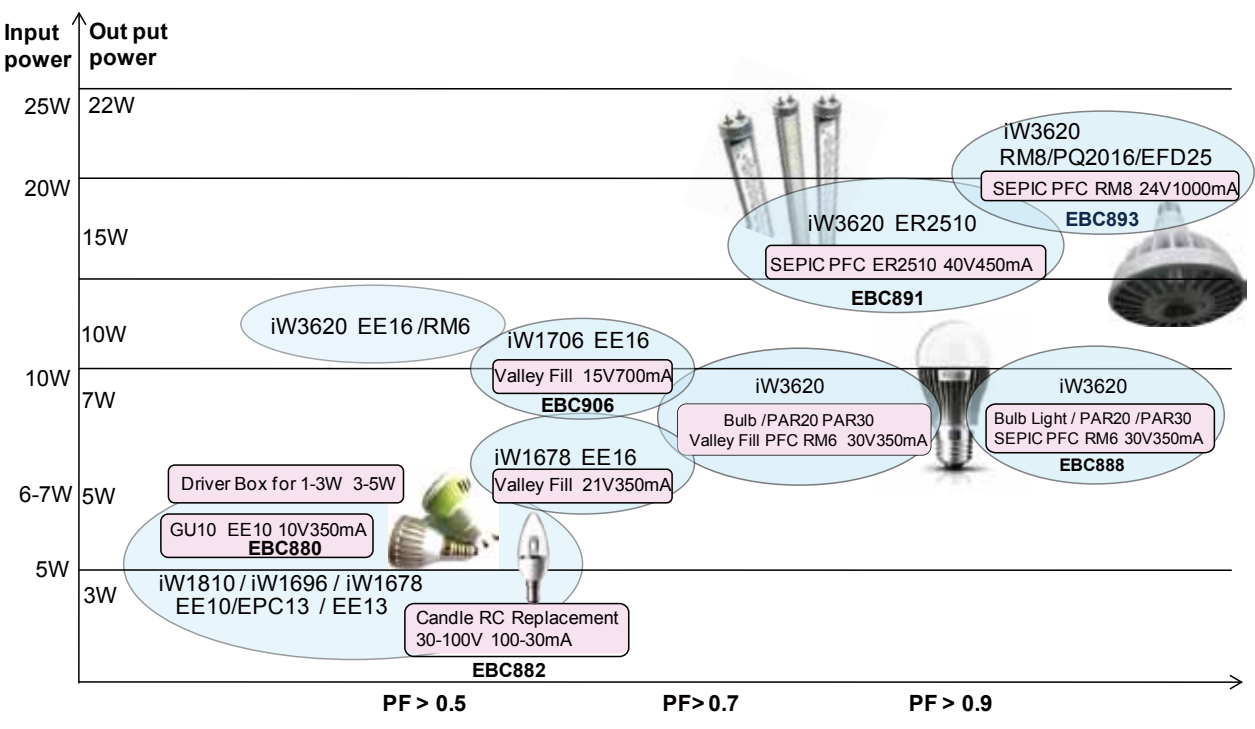


2012 ASSP LED Driver Product Selector Guide

LED Driver Solution

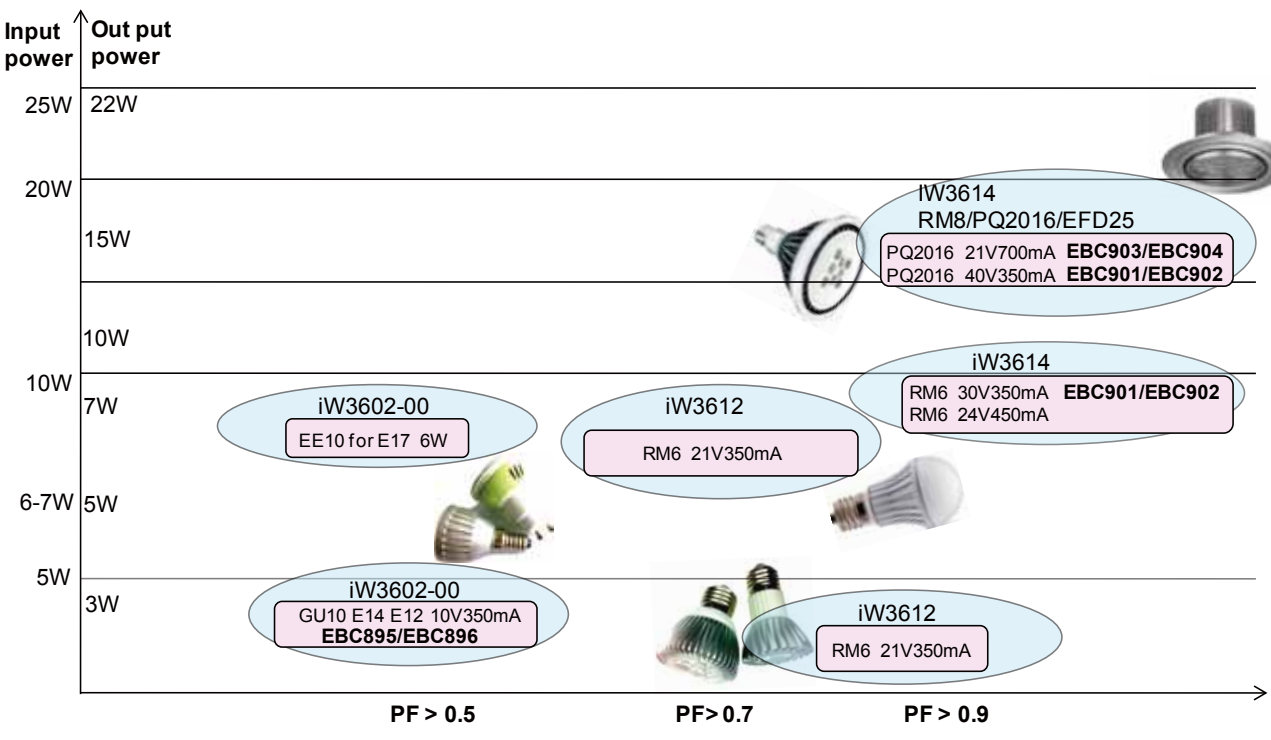
Product	Power	Application	Switching Frequency	CC Tolerance	Driver Type	Package	Reference Design							Doc No.
							Out. Pwr(W)	AC Inpt (VAC)	Vout(V)/Iout(mA)	Eff.	PF	Isolation	Lamp Type	
iW1810	1W - 5W	LED Lighting (No Dimmable)	64kHz for small size	5%	Internal 800V BJT	SO-8	3*1W	90 -264	10/350	>76%		Yes	GU10	EBC880
							2W	180 -264	55/30	>82%	>0.5	No	Candle	EBC881
							3W	180 -264	110/30	>87%	>0.5	No	Candle	EBC882
iW1678	1W - 7W	LED Lighting (No Dimmable)	64kHz for small size	5%	BJT	SOT23-5	6W	180 -264	32/200	>86%	>0.5	No	Candle	EBC883
							5*1W	90 -264	16/350	>85%	>0.8	Yes	Bulb	EBC884
							6W	90 -135	100/60	>86%	>0.5	No	Bulb	EBC885
							5*2W	90 -264	18/500	>86%	>0.5	Yes	Bulb	EBC886
							10W	90 -264	15/700	>86%	>0.5	Yes	Bulb	EBC906
iW3620	3W - 40W	LED Lighting (Non-Dimmable)	130kHz (max) for small size	5%	FET	SO-8	8*1W	90 -264	27/350	>80%	>0.9	Yes	Bulb	EBC887
							9*1W	90 -264	30/350	>80%	>0.9	Yes	Bulb	EBC888
							10W	90 -264	38/280	>87%	>0.75	Yes	Bulb	EBC889
							15W	90 -264	38/400	>88%	>0.88	Yes	Bulb	EBC890
							18W	90 -264	40/450	>86%	>0.9	Yes	T8	EBC891
							10*3W	90 -264	32/700	>83%	>0.9	Yes	EX T8	EBC892
							7*3W	90 -264	24/1000	>85%	>0.9	Yes	EX T8	EBC893
 iW3602-00	3W - 10W	LED Lighting (Dimmable)	200kHz (max) for small size	5%	FET	SO-8	3*1W	90 -135	11/350	>75%	>0.5	No	Candle	EBC894
 iW3602-01	3W - 10W	LED Lighting (Dimmable)	200kHz (max) for small size	5%	FET	SO-8	3*1W	90 -135	11/350	>78%	>0.7	No	GU10	EBC895
							3*1W	180 -264	11/350	>78%	>0.7	No	GU10	EBC896
 iW3612-00	8W - 25W	LED Lighting (Dimmable)	200kHz (max) for small size	5%	FET	SO-8	4*1W	90 -135	13/350	>76%	>0.72	Yes	Bulb	EBC897
 iW3612-01	8W - 25W	LED Lighting (Dimmable)	200kHz (max) for small size	5%	FET	SO-8	4*1W	180 -264	13/350	>76%	>0.74	Yes	Bulb	EBC898
 iW3614	3W - 30W	LED Lighting high PF (>0.9) (Dimmable)	200kHz (max) for small size	5%	FET	SO-8	9*1W	90 -135	30/350	>80%	>0.95	Yes	Bulb	EBC899
							9*1W	180 -264	30/350	>82%	>0.96	Yes	Bulb	EBC900
							12*1W	90 -135	40/350	>81%	>0.97	Yes	PAR38	EBC901
							12*1W	180 -264	40/350	>85%	>0.98	Yes	PAR38	EBC902
							6*3W	90 -135	21/700	>82%	>0.96	Yes	PAR38	EBC903
							6*3W	180 -264	21/700	>84%	>0.97	Yes	PAR38	EBC904
							18W	180 -264	40/450	>84%	>0.97	Yes	T8	EBC905

iWatt LED Driver Solution Selector Guide -- Non-dimmable



LED Driver Solution

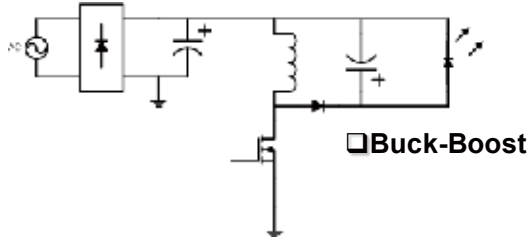
iWatt LED Driver Solution Selector Guide -- Dimmable



Flexible Topologies for Various Applications

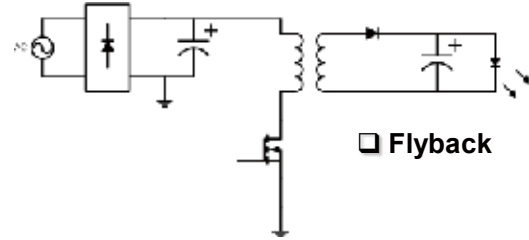
Non-isolated

High voltage & low current



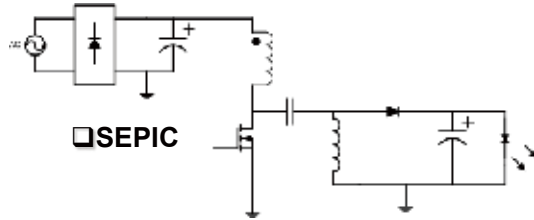
Isolated

Low voltage & high current



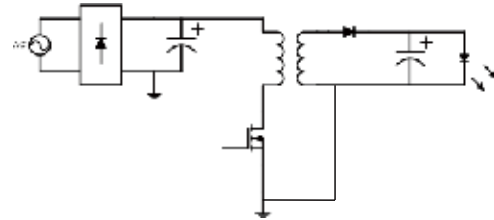
Non-isolated

High or low output voltage

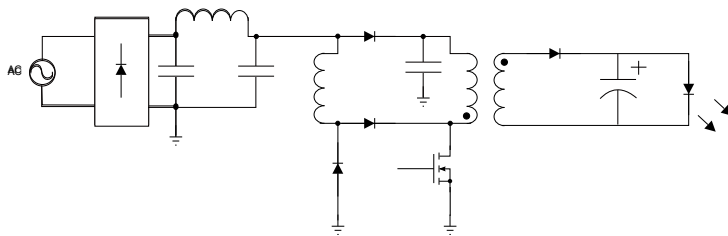


Non-isolated

Low voltage & high current



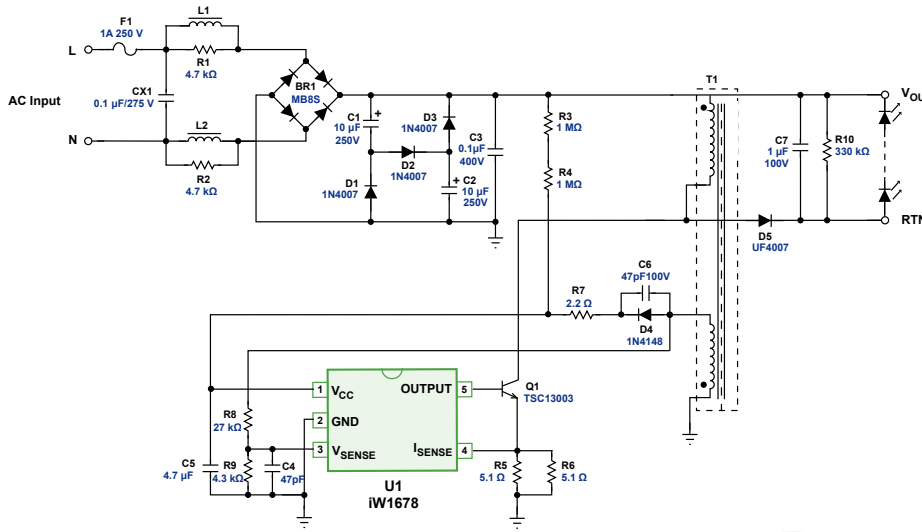
Sepic for Hi-PF solution



Advantage

- High PF and tight CC control with same controller
- Low ripple current
- High efficiency than 2-stage

iWatt PSR Solution for Non-isolated Bulb Lamp



This product is covered by the following patents:

1) To detect / sense the output voltage indirectly through the auxiliary winding: 6,956,750; 6,990,000; 6,882,552; 6,900,995; 6,370,039; 6,385,059;

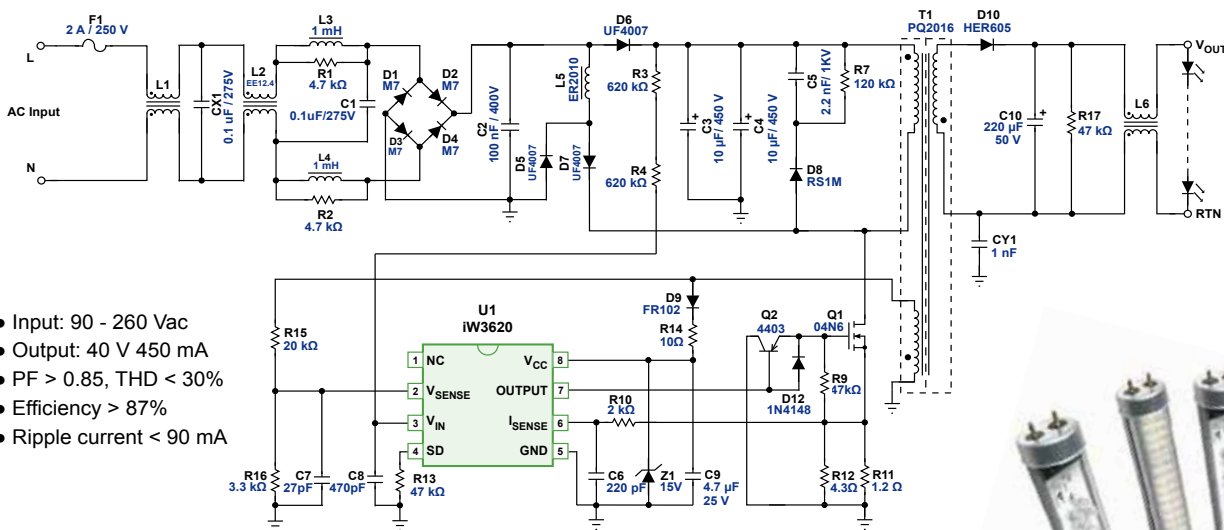
2) To detect / sense the output load current indirectly and control the output load current at constant; and maintain the tight constant-current regulation across wide line-load; 6,944,034; 6,972,969; 7,443,700; 7,876,582; 7,974,107; 7,589,983



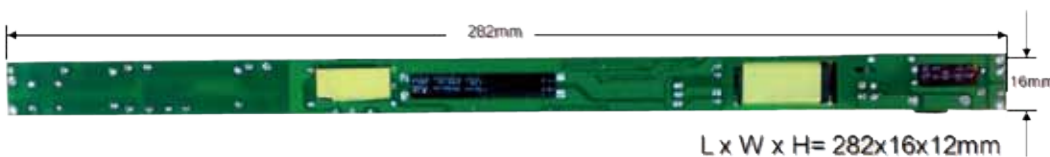
- Input: 230 Vac
- Output: 70 V 86 mA
- PF > 0.85
- Efficiency > 90%
- Non-Isolated



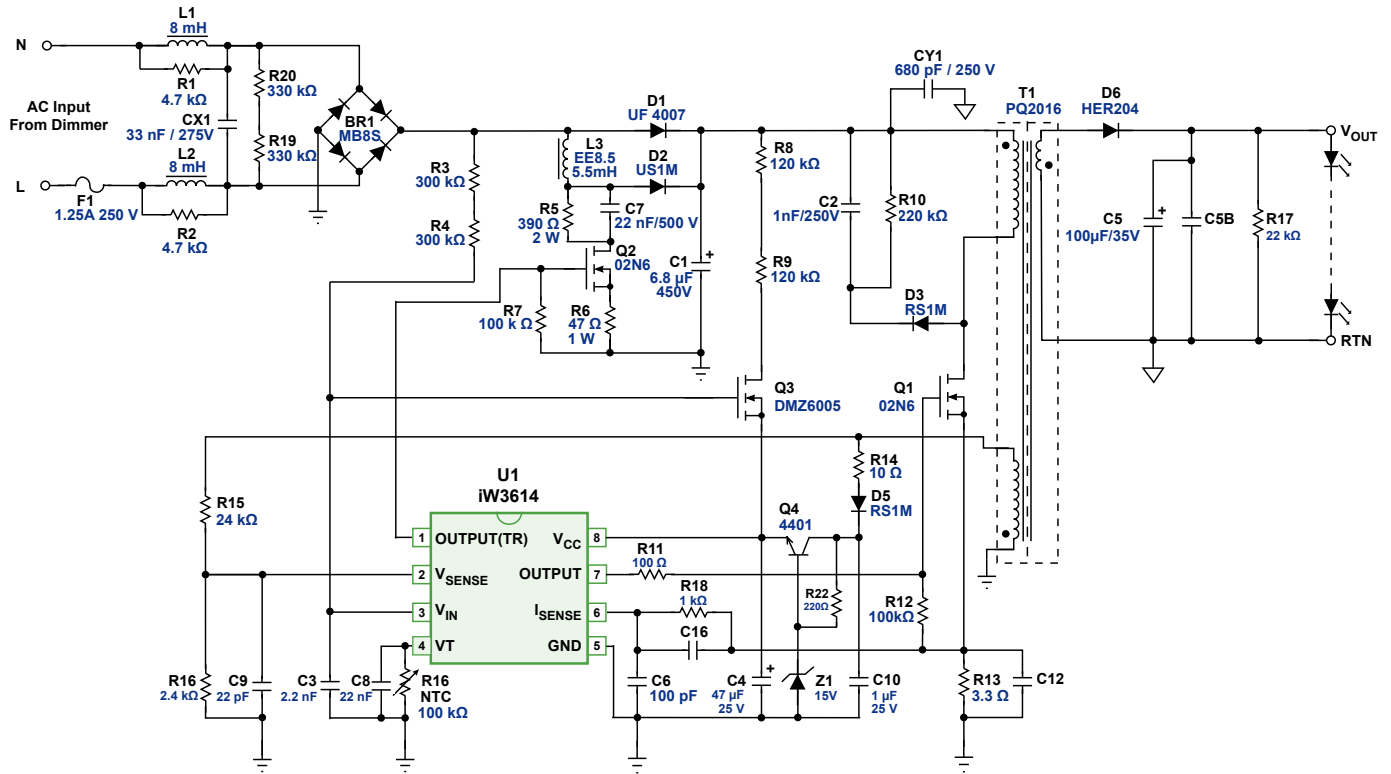
iW3620 with SEPIC for Hi-PF application



- Input: 90 - 260 Vac
- Output: 40 V 450 mA
- PF > 0.85, THD < 30%
- Efficiency > 87%
- Ripple current < 90 mA



iWatt Dimmable Solution for PAR Lamp



LED Driver Solution



- Input: 100 - 120 Vac or 220 - 240 Vac
- Output: 25 V 400 mA
- Efficiency > 82%
- PF > 0.9 @ No-dimmer mode
- THD meet IEC61000-3-2
- Dimming compatibility RC R RL



This product is covered by the following patents:

1) To detect / sense the output voltage indirectly through the auxiliary winding:

6,956,750; 6,990,000; 6,882,552; 6,900,995; 6,370,039; 6,385,059;

2) To detect / sense the output load current indirectly and control the output load current at constant; and maintain the tight constant-current regulation across wide line-load;

6,944,034; 6,972,969; 7,443,700; 7,876,582; 7,974,107; 7,880,447; 7,589,983;

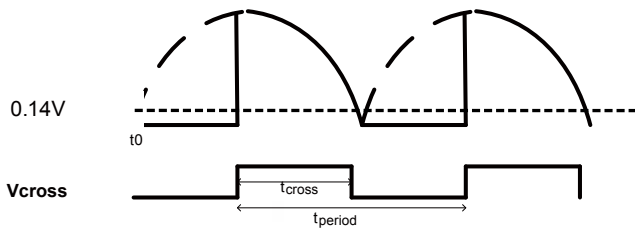
3) To dim the output current and correct power factor:

7,433,211; 7,936,132;

iWatt's Digital Control Technology to detect the dimmer type and phase

The dimmer detection algorithm and the dimmer tracking algorithm both depend on an accurate input voltage period measurement. The V_{IN} period is measured during the second cycle of the dimmer detection process and is latched for use thereafter. Using the measured V_{IN} period in subsequent calculations rather than a constant allows for automatic 50-/60-Hz operation and allows for a 10% frequency variation.

The phase measurement starts when V_{IN} exceeds the rising threshold until V_{IN} falls below the falling threshold.

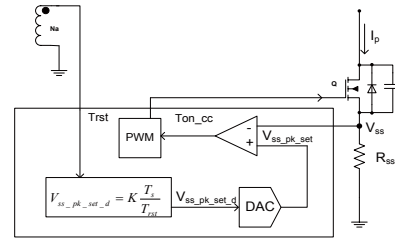


$$\text{Dimmer_phase} = \frac{T_{\text{cross}}}{T_{\text{period}}}$$

$$D_{\text{RATIO}} = \text{Dimmer Phase} \times K_1 - K_2$$

Where, K_1 is set to 1.768 and K_2 is set to 0.238.

Adjust the reference voltage of Peak Current Sense comparator

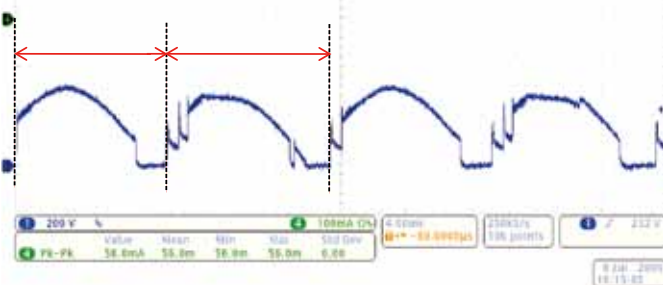


$$\text{LED Current } I_o = \frac{I_{\text{pri_pk}} N_{\text{ps}} T_{\text{rst}}}{2 T_s}$$

Digital Dimming – Improving the Quality of Life Through Improved Light Quality

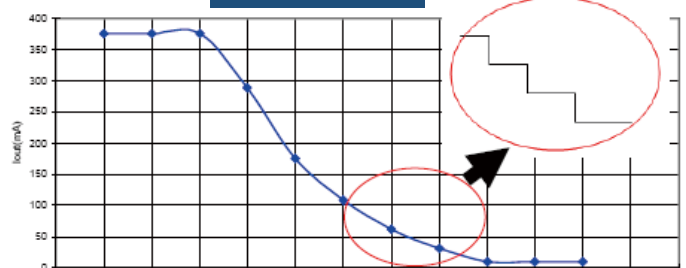
iWatt specializes in novel, innovative solutions that leverage the company's digital power capabilities, and the non-linear attributes of the dimmer problem present a challenge that is ideally suited to the flexibility and configurability inherent to a well executed digital solution. iWatt's solution includes an algorithm that maps the operating characteristics of dimmers and digitally filters the LED drive current to eliminate spikes that would otherwise cause flicker. iWatt has characterized popular dimmers on the market today that are representative of the installed base of dimmers available worldwide to ensure optimized compatibility, resulting in smooth dimming and further ensuring the elimination of low frequency flicker.

Un- balance and multi-fire



- Digital control eliminates flicker caused by un-balance for each half cycle
- Digital control eliminates flicker caused by line voltage dip and distortion

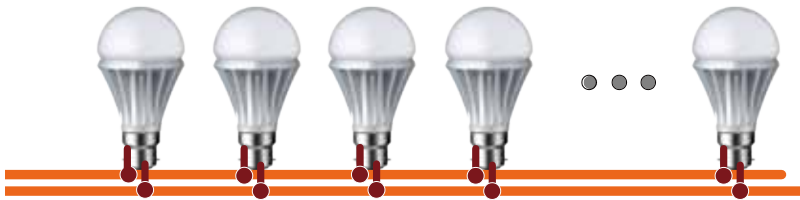
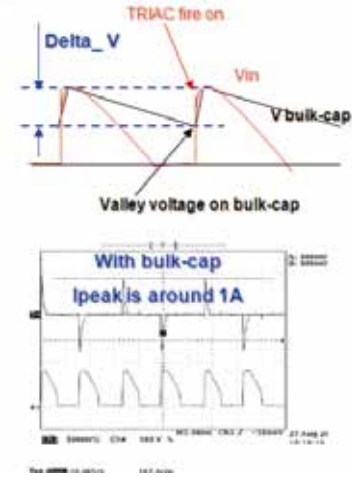
iWatt solution



- Digital mapping of dimming control for wide range of dimming output
- Monotonic (digital step) dimming control eliminates flicker

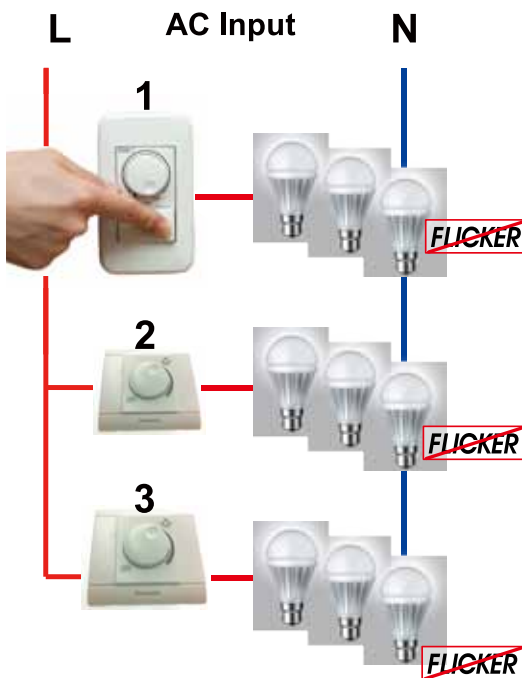
Digital Dimming – Support Multi-lamp Parallel Mode

- Parallel operation mode at end-user, No-flicker
- Reliability for parallel operation mode, No-damaged
Repeatable peak current???
- $P_{\text{dimmer}} \times K > P_{\text{lamp}} \times N / PF$ ($K=0.5\sim0.7$)
- Better dimming performance, same dimming level for each lamp
Each lamp can get accurate phase - cut duty
Each lamp can get better CC tolerance at 100% output



Digital Dimming – Support Multi-Gang Mode

iWatt solution support multi-gang as end-user expected



DIMMER TYPE- XXXXX 40W-400W			MULTI GANG		DIMMING					
1 (6)	2 (4)	3 (3)		2 (4)	3 (3)	1 (6)		3 (3)	1 (6)	2 (4)
MIN	MIN			MIN	MIN			MIN	MIN	
MIN	50%			MIN	50%			MIN	50%	
MIN	100%			MIN	100%			MIN	100%	
50%	MIN			50%	MIN			50%	MIN	
50%	50%			50%	50%			50%	50%	
50%	100%			50%	100%			50%	100%	
100%	MIN			100%	MIN			100%	MIN	
100%	50%			100%	50%			100%	50%	
100%	100%			100%	100%			100%	100%	
	CURRENT			MIN	MAX	LUMENS DIMMING %		Note		
	6 LEDS			33	748	59		1 (6)	CIRCUIT 1 WITH 6 LED DRIVER	
	3 LEDS			20	744	40		2 (4)	CIRCUIT 2 WITH 4 LED DRIVER	
	1 LEDS			17	746	40		3 (3)	CIRCUIT 3 WITH 3 LED DRIVER	

Unacceptable if LED is flicker when adjust other dimmers

Off-Line Digital Green-Mode PWM Controller - iW1810

Overview

The iW1810 is a high performance AC/DC power supply control device, specifically targeted for low cost, high efficiency, and compact power supplies. The iW1810 uses iWatt's proprietary digital primary feedback technology eliminating the need for secondary feedback circuitry while achieving excellent line and load regulation, and maintaining stability over all operating conditions without the use of external loop compensation components. Pulse-by-pulse waveform analysis allows for a loop response that is much faster than traditional solutions, resulting in improved dynamic load response. The built-in power limit function enables optimized transformer design in universal off-line applications and supports a wide input voltage range.

Features

High Performance

- Tight $\pm 3\%$ output voltage regulation
- Tight $\pm 5\%$ output current regulation
- Low start-up current (8 μA typical)
- No audible noise over entire operating range
- **EZ-EMI**® design to easily meet global EMI standards

Low Cost

- Primary-side feedback eliminates opto-isolator and simplifies design
- Internal 800 V switch for high V_{IN} surge
- No external compensation components required
- No Y-Cap Required

High Efficiency

- No-load power consumption < 100 mW at 230 V_{ac} with typical application circuit
- Complies with EPA 2.0 energy-efficiency specifications with ample margin
 - » Adaptive multi-mode PWM/PFM control for improved efficiency
 - » Quasi-resonant operation for highest overall efficiency

Compact

- 64 kHz PWM switching frequency to allow small transformer size
- Built-in soft start
- Built-in protection
 - » Output short circuit and over voltage
 - » Current sense resistor short circuit



Applications

- Low-power AC/DC LED driver
- Output power
 - » 1 W - 3 W

Low-Power Off-line Digital Green-Mode PWM Controller - iW1678

Overview

The iW1810 is a high performance AC/DC power supply control device, specifically targeted for low cost, high efficiency, and compact LED drivers. The iW1678 uses iWatt's proprietary digital primary feedback technology eliminating the need for secondary feedback circuitry while achieving excellent line and load regulation. It also eliminates the need for loop compensation components while maintaining stability over all operating conditions. Pulse-by-pulse waveform analysis allows for a loop response that is much faster than traditional solutions, resulting in improved dynamic load response. The built-in power limit function enables optimized transformer design in universal off-line applications and allows for a wide input voltage range.

Features

High Performance

- Tight $\pm 5\%$ output current regulation
- Low start-up current (8 μA typical)
- No audible noise over entire operating range
- **EZ-EMI**[®] design to easily meet global EMI standards

Low Cost

- Primary-side feedback eliminates opto-isolator and simplifies design
- No external compensation components required

High Efficiency

- Complies with EPA 2.0 energy-efficiency specifications with ample margin
 - » Adaptive multi-mode PWM/PFM control for improved efficiency
 - » Quasi-resonant operation for highest overall efficiency

Compact

- 64 kHz PWM switching frequency to allow small transformer size
- Built-in soft start
- Built-in protection
 - » Output short circuit and over voltage
 - » Current sense resistor short circuit



Applications

- LED lighting
- Output power
 - » 1 W - 7 W

Low-Power Off-Line Digital Green-Mode PWM Controller - iW1706

Overview

The iW1706 is a high performance AC/DC power supply controller, specifically targeted for low cost, high efficiency, and compact power supplies. The iW1706 features a distinctive soft-start scheme, which allows for fast and yet smooth start-up with both small and large capacitive loads. The iW1706 removes the need for secondary feedback circuitry while achieving excellent line and load regulation. It also eliminates the need for loop compensation components while maintaining stability over all operating conditions. Pulse-by-pulse waveform analysis allows for a loop response that is much faster than traditional solutions, resulting in improved dynamic load response. The built-in power limit function enables optimized transformer design in universal off-line applications and allows for a wide input voltage range.

Features

High Performance

- Tight $\pm 3\%$ output current regulation
- Adaptively controlled soft start-up enables fast and smooth start-up for a wide range of capacitive loads (from 330 μF to 6000 μF)
- **EZ-EMI**® design to easily meet global EMI standards
- Intrinsically low common mode noise
- No audible noise over entire operating range

Low Cost

- Primary-side feedback eliminates opto-isolator and simplifies design
- Direct drive of low-cost BJT switch
- No external compensation components required

High Efficiency

- Complies with EPA 2.0 energy-efficiency specifications with ample margin
 - » Adaptive multi-mode PWM/PFM control improves efficiency
 - » Quasi-resonant operation for highest overall efficiency

Compact

- Optimized 72 kHz maximum PWM switching frequency to allow small transformer size
- Built-in protection
 - » Output short circuit and over voltage
 - » Current sense resistor short
 - » output current limit and overload



Applications

- LED lighting
- Output power
 - » 10 W

Digital PWM Current-Mode Controller for AC/DC LED Driver - iW3620

Overview

The iW3620 is a high performance AC/DC offline LED driver which uses digital control technology to build peak current mode PWM flyback power supplies. The device operates in quasi-resonant mode at heavy load to provide high efficiency along with a number of key built-in protection features while minimizing the external component count, simplifying EMI design and lowering the total bill of material cost. The iW3620 removes the need for secondary feedback circuitry while achieving excellent line and load regulation. It also eliminates the need for loop compensation components while maintaining stability over all operating conditions. Pulse-by-pulse waveform analysis allows for a loop response that is much faster than traditional solutions, resulting in improved dynamic load response. The built-in current limit function enables optimized transformer design in universal off-line applications over a wide input voltage range.

Features

High Performance

- Tight $\pm 5\%$ output current regulation
- Low start-up current (10 μA typical)
- **EZ-EMI**[®] design to easily meet global EMI standards

Low Cost

- Primary-side feedback eliminates opto-isolator and simplifies design
- No external compensation components required

High Efficiency

- Quasi-resonant operation for highest overall efficiency

Compact

- Up to 130 kHz switching frequency enables small transformer size
- Built-in soft start
- Built-in protection
 - » Output short circuit and over voltage
 - » Current sense resistor short circuit
 - » Overtemperature Protection
 - » Open circuit protection
 - » Single-fault protection



Applications

- LED lighting
- Output power
 - » 3 W - 40 W

AC/DC Digital Power Controller for Dimmable LED Drivers - iW3602 / iW3612

Overview

The iW3612 is a high performance AC/DC offline power supply controller for dimmable LED luminaires, which uses advanced digital control technology to detect the dimmer type and phase. The dimmer conduction phase controls the LED brightness. The LED brightness is modulated by PWM-dimming. iW3612's unique digital control technology eliminates visible flicker. iW3612 can operate with all dimmer schemes including: leading-edge dimmer, trailing-edge dimmer, as well as other dimmer configurations such as R-type, R-C type or R-L type. When a dimmer is not present, the controller can automatically detect that there is no dimmer.

The iW3612 uses iWatt's advanced primary-side sensing technology to achieve excellent line and load regulation without secondary feedback circuitry. In addition, iW3612's pulse-by-pulse waveform analysis technology allows accurate LED current regulation. The iW3612 maintains stability over all operating conditions without the need for loop compensation components. Therefore, the iW3612 minimizes external component count, simplifies EMI design and lowers overall bill of materials cost.

Features

High Performance

- Tight LED current regulation $\pm 5\%$
- Wide dimming range from 1% up to 100%
- Automatic dimmer detection
 - » Leading / trailing / unsupported / no dimmer

Low Cost

- Primary-side feedback eliminates opto-isolator and simplifies design

High Efficiency

- Resonant control maximizes efficiency
 - » 85% without dimmer

Compact

- Small external components
- Built-in soft start
- Built-in protection
 - » LED open / short circuit protection
 - » Single-fault protection
 - » Over-current protection
 - » Current sense resistor short circuit protection
 - » Over-temperature protection
 - » V_{IN} over-voltage protection



Applications

- Dimmable LED luminaires
- Output power
 - » iW3602 -- up to 10 W
 - » iW3612 -- 8 W - 25 W

AC/DC Digital Controller for High PF Dimmable LED Drivers - iW3614

Overview

The iW3614 is a high performance AC/DC offline power supply controller for dimmable LED luminaires, which uses advanced digital control technology to detect the dimmer type and phase. The dimmer conduction phase is detected and used to control the LED brightness. iW3614's unique digital control technology eliminates visible flicker, and can operate with all dimmer types including: leading-edge, trailing-edge, as well as other dimmer configurations such as R-type, R-C type or R-L type. When a dimmer is not present, the controller will automatically operate in high PF mode.

The iW3614 uses iWatt's advanced primary-side sensing technology to achieve excellent line and load regulation without secondary feedback circuitry. In addition, iW3614's pulse-by-pulse waveform analysis technology allows accurate LED current regulation. The iW3614 maintains stability over all operating conditions without the need for loop compensation components. Therefore, the iW3614 minimizes external component count, simplifies EMI design and lowers overall bill of materials cost.

Features

High Performance

- Tight $\pm 5\%$ LED current regulation
- Wide dimming range: from 1% to 100%
- Automatic dimmer detection
 - » Leading / trailing / unsupported / no dimmer

Low Cost

- Primary-side feedback eliminates opto-isolator and simplifies design

High Efficiency

- Resonant control maximizes efficiency
 - » 85% without dimmer

Compact

- Small external components
- Built-in soft start
- Built-in protection
 - » LED open / short circuit protection
 - » Single-fault protection
 - » Over-current protection
 - » Current sense resistor short circuit protection
 - » Over-temperature protection
 - » V_{IN} over-voltage protection

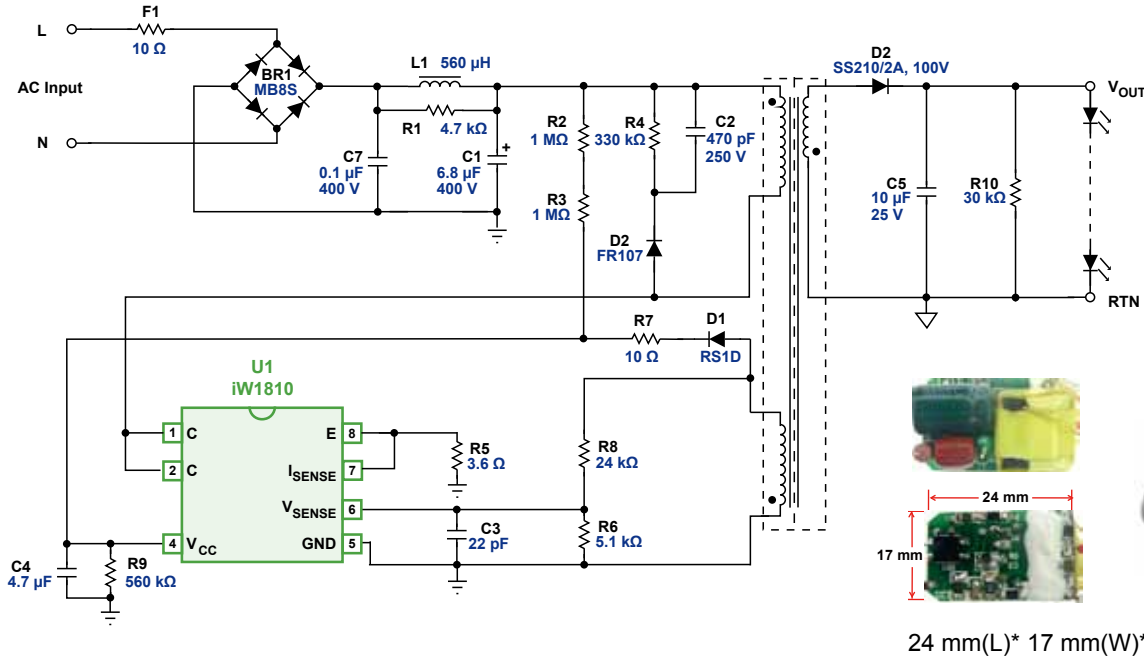


Applications

- Dimmable LED retro-fit bulbs
- Dimmable LED luminaires
- Output power
 - » 3 W - 30 W

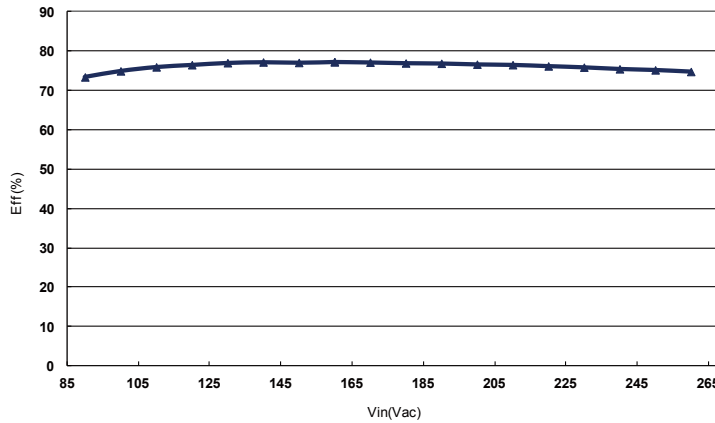
Reference Design - iW1810 For Smallest GU10 (3*1W) LED Driver

Schematic

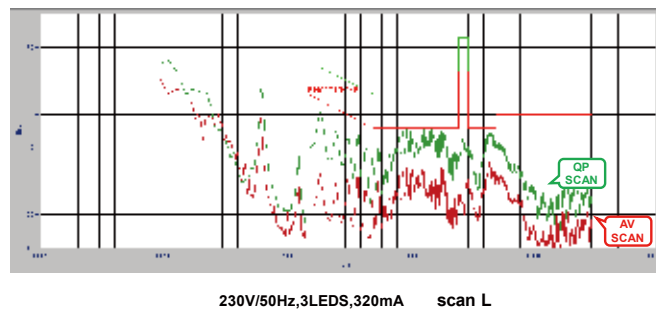


LED Driver Solution

Efficiency Measurement

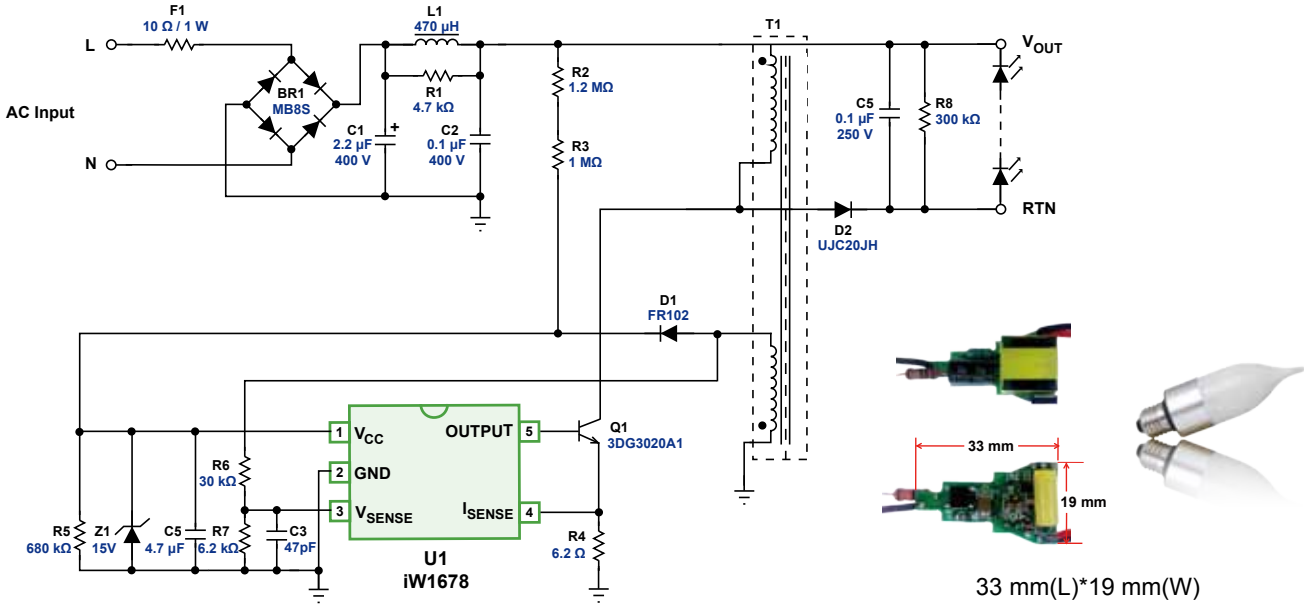


Conducted EMI

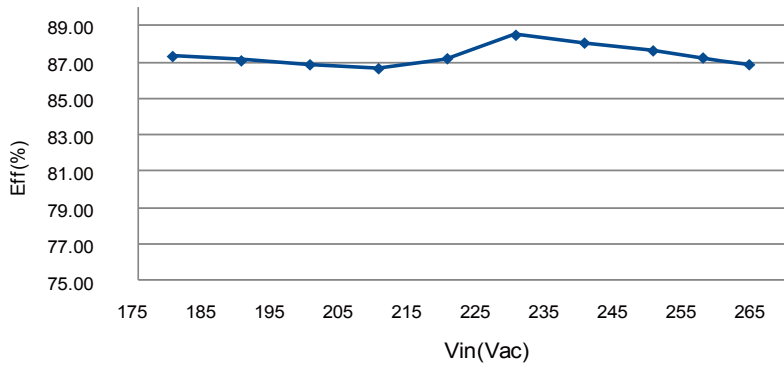


Reference Design - iW1678 For RC replacement (3W) LED Driver

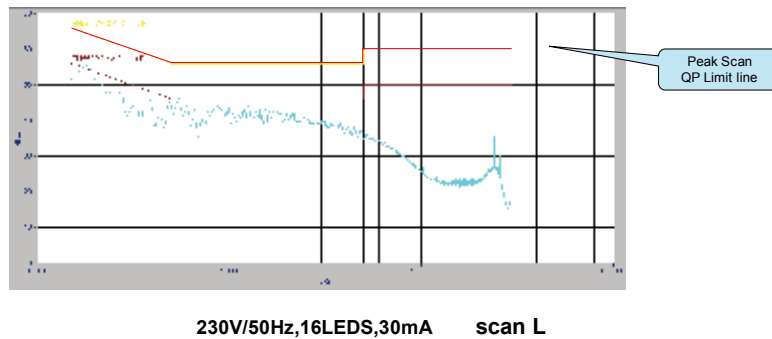
Schematic



Efficiency Measurement

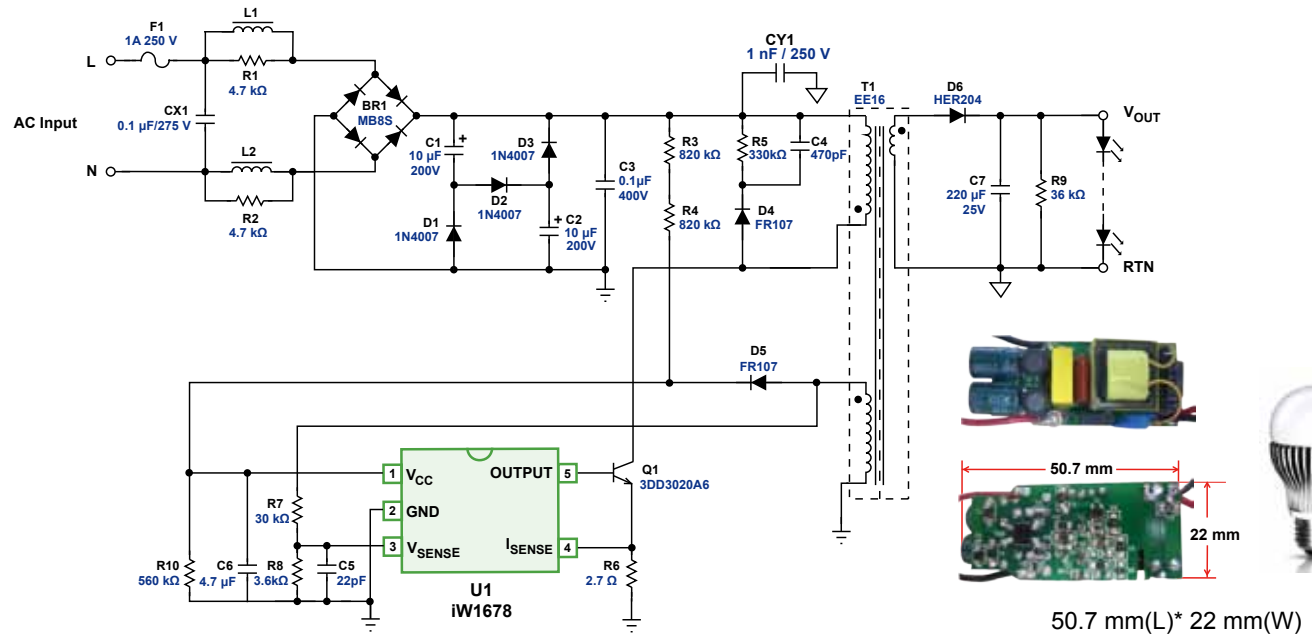


Conducted EMI



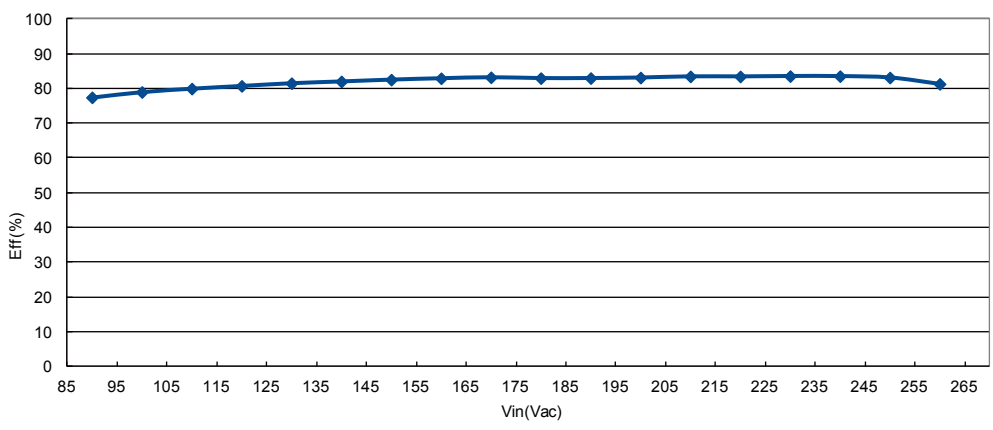
Reference Design - iW1678 for Compact Bulb (5*1W) LED Driver

Schematic

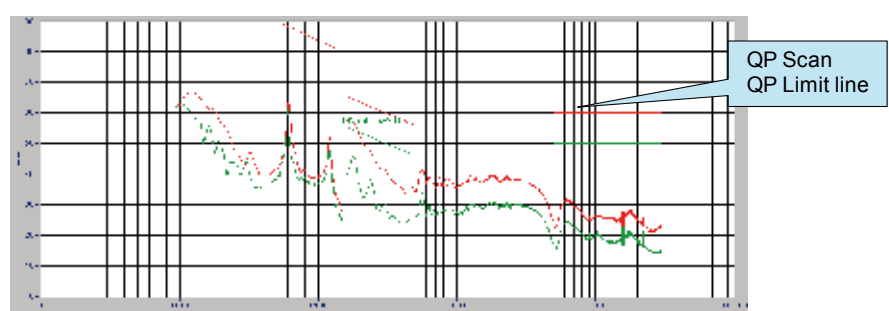


LED Driver Solution

Efficiency Measurement



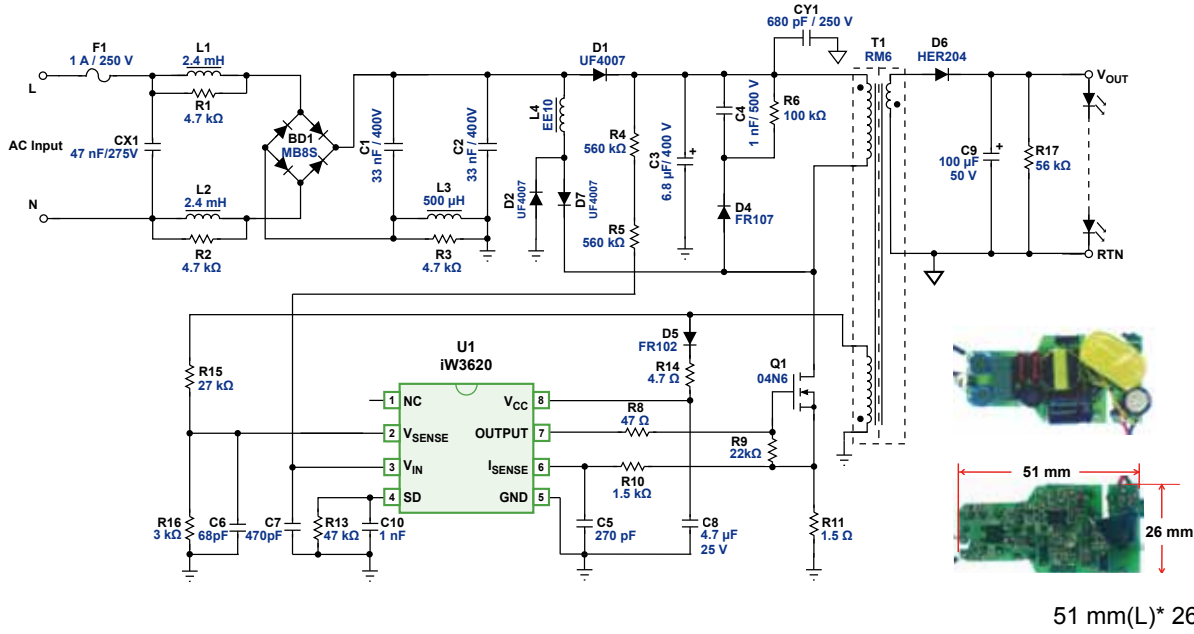
Conducted EMI



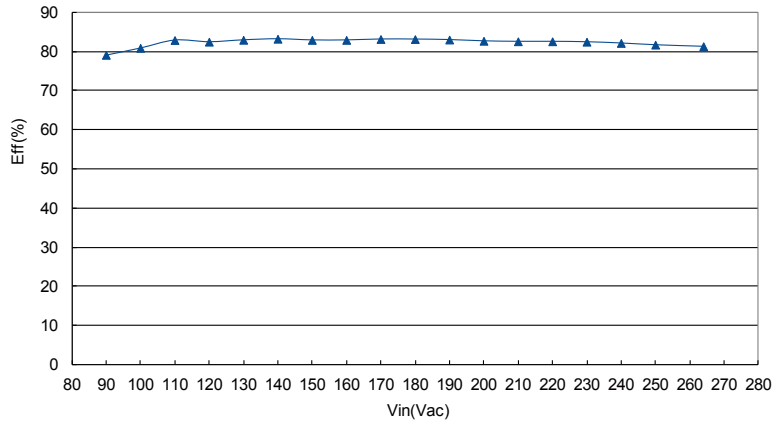
230V/50Hz, Full Load, output floating scan L

Reference Design - iW3620 For Hi PF (8W) LED Driver

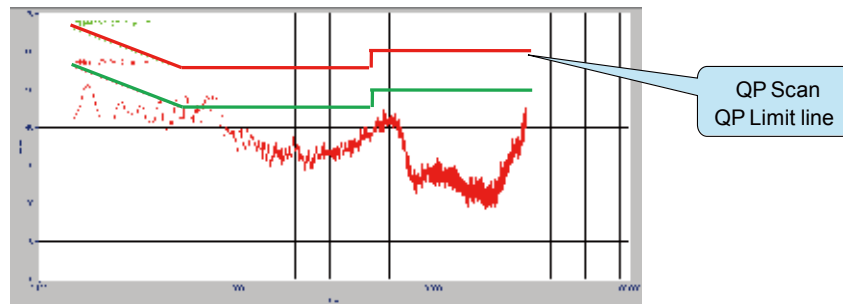
Schematic



Efficiency Measurement



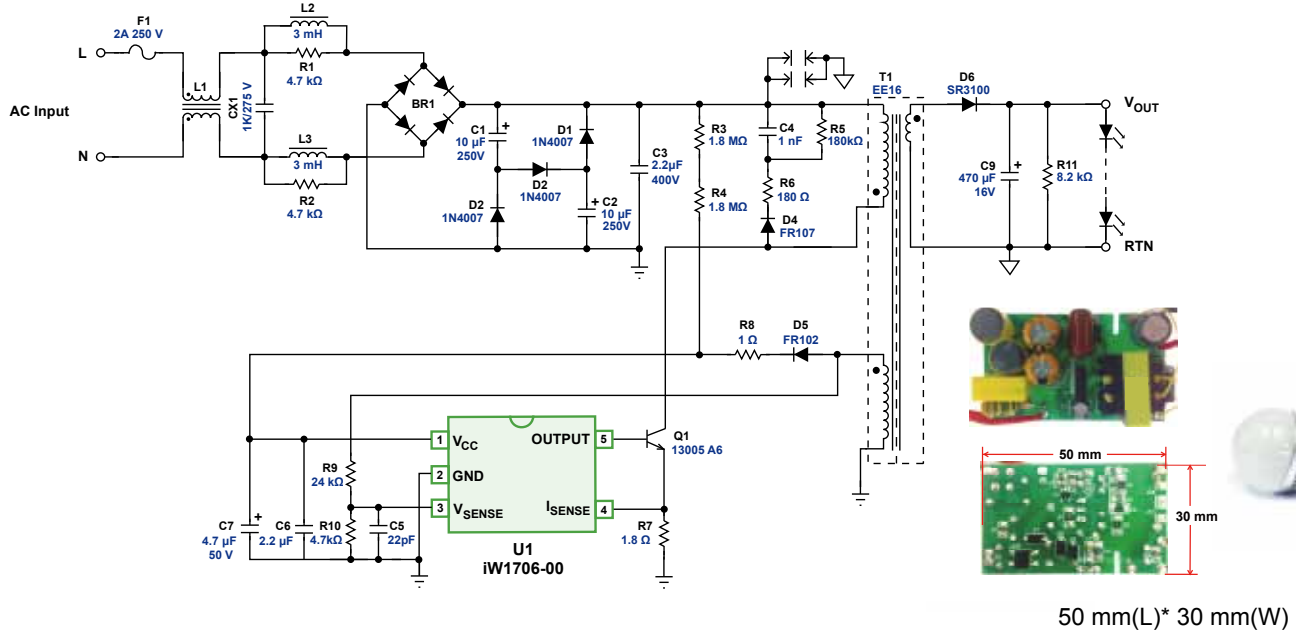
Conducted EMI



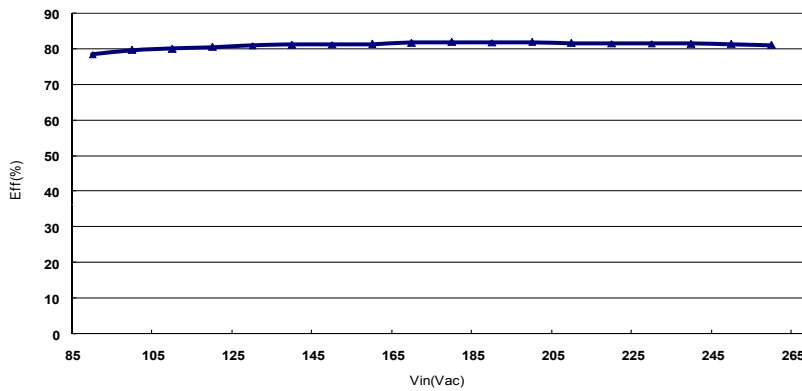
230V/50Hz, Full Load, output floating scan L

Reference Design - iW1706 for Bulb (10W) LED Driver

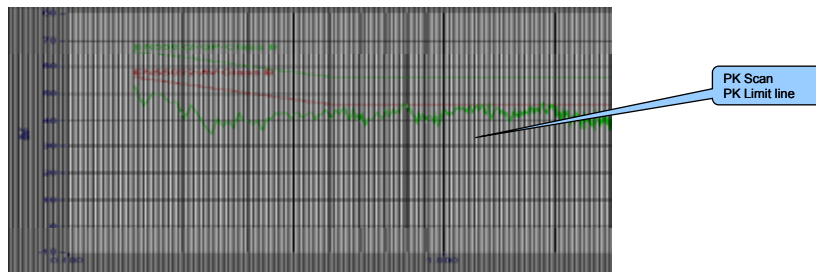
Schematic



Efficiency Measurement



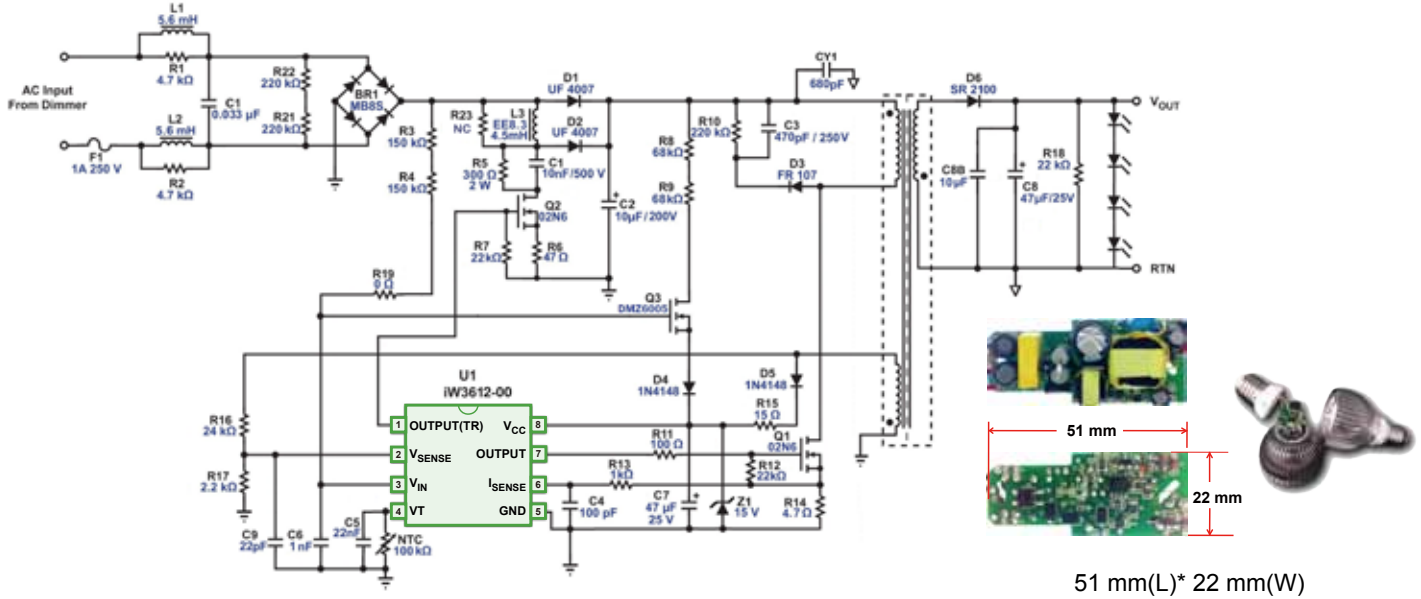
Conducted EMI



230V/50Hz, Full Load, output floating scan L

Reference Design - iW3612 For 4*1W Dimmable LED Driver

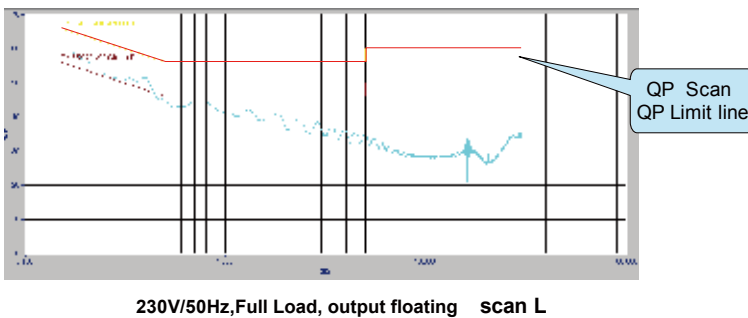
Schematic



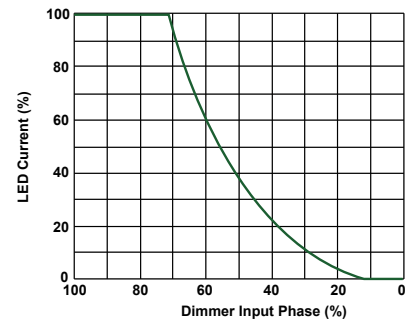
Constant Current and Efficiency - No Dimmer

# of LEDs	V _{IN} (V)	P _{IN} (W)	V _{OUT} (V)	I _{OUT} (mA)	Efficiency	PF
4 LEDs	180	6.040	13.268	0.359	78.86%	0.774
	190	6.080	13.248	0.359	78.22%	0.767
	200	6.080	13.209	0.359	77.99%	0.779
	210	6.100	13.201	0.360	77.93%	0.770
	220	6.100	13.205	0.360	77.93%	0.799
	230	6.140	13.19	0.361	77.55%	0.768
	240	6.180	13.198	0.361	77.10%	0.746
	250	6.220	13.214	0.362	76.90%	0.726
	264	6.250	13.21	0.363	76.72%	0.690

Conducted EMI

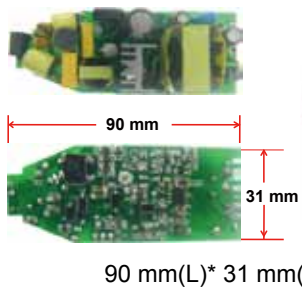
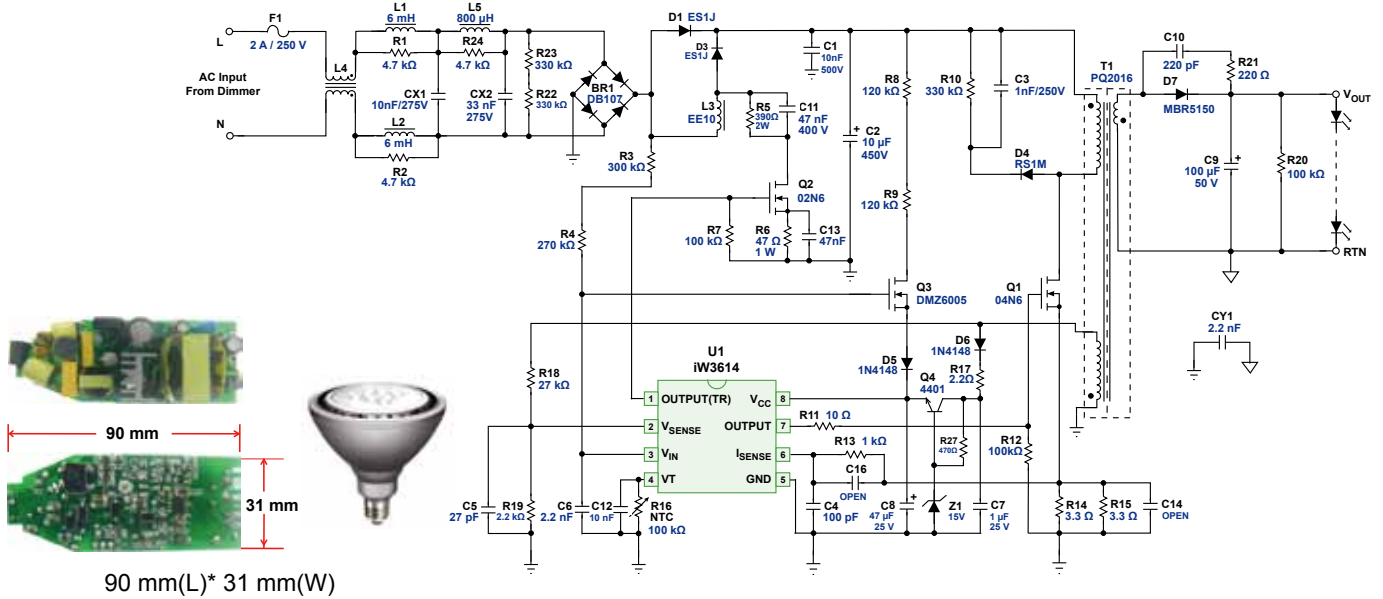


Dimming Curve



Reference Design - iW3614 For Hi PF (12W) Dimmable LED Driver

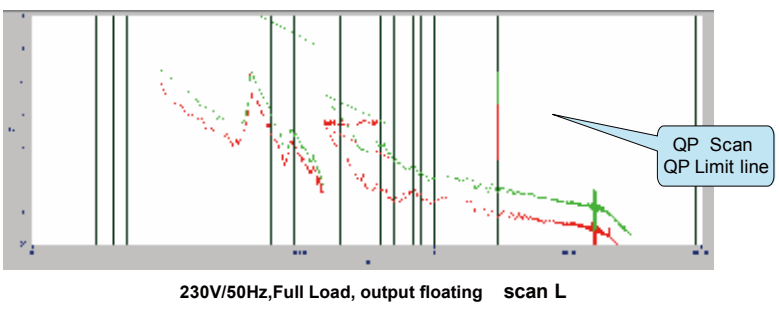
Schematic



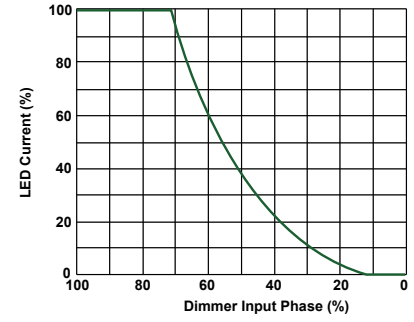
Constant Current and Efficiency - No Dimmer

# of LEDs	V _{IN} (V)	P _{IN} (W)	V _{OUT} (V)	I _{OUT} (mA)	Efficiency	PF
12 LEDs	180	16.82	39.96	354	84.10%	0.945
	190	16.65	39.89	353	84.57%	0.960
	200	16.64	39.85	353	84.54%	0.960
	210	16.50	39.81	353	85.17%	0.978
	220	16.52	39.87	352	84.95%	0.982
	230	16.40	39.84	351	85.27%	0.983
	240	16.37	39.78	351	85.29%	0.981
	250	16.30	39.74	351	85.58%	0.978
	264	16.27	39.67	351	85.58%	0.969

Conducted EMI



Dimming Curve



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