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LED Lighting

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750311650	Common Mode Choke for US and Europe					

Introduction

Lighting an LED used to be as simple as a resistor off a power rail for the proper drive current. Things are just not that simple anymore. We enter the age of "green", global warming, and an awareness of our environment.

LED lighting consumes half as much power as the "fading green" CCFL, and only 10% as much power as incandescent light bulbs. The US Department of Energy (DOE) has taken notice. With lighting using almost 25% of all electrical energy in the country, the DOE has developed an energy goal to reduce lighting consumption by 50% by the year 2025; thereby, saving more than $280 billion over the next 20 years.

High efficiency of LEDs is only the beginning of the benefits. LED lighting truly is:

- **Green**
  - No mercury gas
  - More robust
  - Long-life for less landfill waste
- **Cost effective**
  - Efficient
  - Longer life span
- **Health benefits**
  - No mercury
  - No UV radiation
  - Low electromagnetic radiation

"Wait a minute! I understand the high efficiency and the long life of LED lighting, but it's healthy too?" LED lighting does not contain mercury, like CCFL, which we know is harmful to both our health and the environment. LED lighting also has lower UV and electromagnetic radiation than other lighting types.

ITEM	Incandescent Lamp	Fluorescent Lamp	LED Lamp
Power (W)	400	80	40
Lamp Price (Real)	1.00	4.00	20.00
Natural Life (H)	≤1000	≤4000	≥50000
Replace (Times/Y)	4.38	1.095	0.0876
Consume (KW.h/Y)	1752	350.4	175.2

We see market trends which glimmer of LED lighting in the not-so-distant future. In its new report "LEDs and Laser Diodes: Solid State Lighting Applications, Technologies, and Market Opportunities", NextGen Research forecasts a compound 22% AGR through 2013 with revenues reaching $33B by 2012. The Report Buyer, "U.S. Solid-State (LED) Lighting Market Trends, Opportunities and R&D Activities 2009 – 2014" predictions are even higher, at 30.9%. The future certainly looks bright for LED lighting.

The design centers and laboratories of Wurth Electronics Midcom are aware of these market forces, and we've designed and manufactured magnetics products for this industry. For DC to DC type of applications, we have developed both catalog and custom storage inductors for switching buck regulators. Typically the DC to DC applications are less than 15W, very small, efficient, and inexpensive. These are limited to applications which are not isolated, and where the output voltage is less than the input voltage. Our extensive lines of WE-TPC and WE-PD inductors are suitable for almost any buck lighting application. For DC to DC applications where isolation is required, flyback topologies with our transformers are usually used.

DC to DC Applications

- Automotive
- Bicycles
- Flashlights
- Sporting gear
- Solar fixtures

AC to DC applications have safety-critical agency requirements dictating the design. We have developed design and manufacturing capabilities on standard packages to produce quick turnaround of custom transformers. See our Speedy Design Service for a small, inexpensive, custom solution.

AC to DC Applications

- Lamps/bulbs
- Street lighting
- Bay lighting
- Light fixtures
- Airport lighting
- Traffic lighting

Field Application Engineers (FAEs) and Design Engineers at Wurth Electronics Midcom understand the challenges facing the LED power supply designer. We understand that beyond thermal management and efficiency, one must care for EMI, safety isolation and power factor. Let us help to select the proper common mode choke. We suggest our WE-TFC or our new, Dual Coil series - both developed specifically for lighting EMC.

We'll send you custom transformers from our lab with our next-day Speedy Service. ■

Safety

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Functional, Basic, and Reinforced Insulation

The affect of insulation requirements is significant enough to change the form factor, performance, cost, and of course, reliability of the transformer. In general terms, **functional insulation** is the easiest insulation to achieve. It allows for magnet wire to be in contact with other magnet wire and has no **creepage** or **clearance** requirements. The insulation strength is tested by a simple dielectric (hipot) test.

Both **basic** and **reinforced insulation** are common to parts subject to offline voltages (85-265V_{AC}). The primary difference between these two types of insulation and functional insulation is that basic and reinforced require physical separation between windings, solder joints, and cores. These distances are known as creepage and clearance. There are a several methods to achieve distance requirements; multi-section bobbins, encapsulation, margin tape, and extruded insulated wire are the most common. You can imagine certain drawbacks to the special insulation: increased size, reduced coupling, lower efficiency, decreased manufacturing capacity, and limited pin configuration options.

The distance requirements and lead isolation are set by specific standards. Reinforced insulation is typically twice that of basic insulation. In some cases, special materials can be used to reduce the distance requirements. In other cases, lead-in routing rules can cause significant manual production processes, especially when pin configuration is fixed.

	Functional	Basic/ Reinforced
Size	+	-
Pinout flexibility	+	-
Efficiency	+	-
Coupling	+	-
Manufacturing capacity/leadtime	+	-
Cost	+	-
Safety	-	+
Dielectric withstand	-	+

Definitions

Functional Insulation	Insulation that is necessary only for the functioning of the equipment
Reinforced Insulation	Single insulation system that provides a degree of protection against electric shock equivalent to double insulation
Double Insulation	Insulation comprising both basic insulation and supplementary insulation.
Working Voltage	Highest voltage to which the insulation or the component under consideration is, or can be, subjected when the equipment is operating under conditions of normal use
Creepage Distance	Shortest distance through air along the surface of an insulation material between two conductive parts
Clearance Distance	Shortest distance in air between two conductive parts
Basic Insulation	Insulation applies to hazardous live parts to provide basic protection against electric shock.

Safety *(continued)*

Standards Applicable to LED Lighting

UL8750

- LED Components - Specifies the safety requirements for LED light sources and the components
  - i. Spacing requirement of 0.8mm
  - ii. Dielectric requirements
    1. $1000V_{AC}$ plus twice the AC (RMS) voltage between:
       - a. The primary circuit and accessible dead parts; and
       - b. The primary and secondary circuit or circuits
    2. 500V between a secondary circuit operating at 70V peak or less and accessible dead metal parts

IEC60950-1

- Information Technology Equipment – Specifies the safety requirements for electronic hardware
  - i. Spacing requirements of 8mm for reinforced 400V
  - ii. Dielectric requirement: 1500- $4500V_{AC}$

UL1310

- Class 2 Power Units - Specifies the safety requirements for Class 2 power supplies
  - i. Spacing requirement same as UL8750
  - ii. Dielectric requirements
    1. $1000V_{AC}$ plus twice the maximum rated voltage between:
       - a. The primary circuit and accessible dead metal parts; and
       - b. The primary and secondary circuit or circuits
    2. $1000V_{AC}$ plus two times the sum of secondary voltages between secondary windings for units described in 28.3 or 30.2.3
    3. $500V_{AC}$ between a secondary circuit and dead metal parts

EN61347-2-13

- Lamp Control Gear – Specifies safety requirement for DC or AC supplied electronic control gear for LED modules
  - i. Spacing requirements of 3-6mm
  - ii. Dielectric requirement
    1. Basic insulation: 2U+1000V
    2. Supplementary insulation: 2U+1750V
    3. Reinforced insulation: 4U+2750V

LED Lighting and EMI

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The lighting industry has experienced a rapid shift toward more energy-efficient products due to the marketing of “Green Products”, which focus on lowering the carbon footprint. The use of Light Emitting Diodes (LEDs) for replacement of standard incandescent light bulbs is more popular in residential and consumer lighting products. This transition is due to the success of LED lighting for traffic lighting, automotive lighting, and lower wattage industrial lighting.

Any new innovation experiences obstacles. In LED lighting, one problem is the issue of Electromagnetic Interference (EMI), or unwanted noise signals. There are regulations and standards that govern the EMI levels for equipment classifications. Lighting products fall into a specific set of these classifications. This means that any lighting products using LEDs as replacement products for the standard incandescent light bulbs will need to meet EMI regulations.

LED lighting must be more aggressive to meet EMI, because driver circuits for the LED products operate at higher frequencies than the older incandescent bulbs (which operate directly off of the 50/60Hz line voltage). These higher switching frequencies are the culprit creating the EMI problems. For residential lighting, the unwanted interference occurs as either conducted or radiated signals. The conducted emission frequency ranges from 150kHz up to 30MHz, and the radiated range is for frequencies of greater than 30MHz. (See Figure 1). Even when the circuit designs are constructed and formatted to reduce EMI problems, there can be frequencies in those ranges that will not meet the minimum FCC regulatory standard level. When this occurs, there are different filtering devices or networks used to meet the EMI regulations.

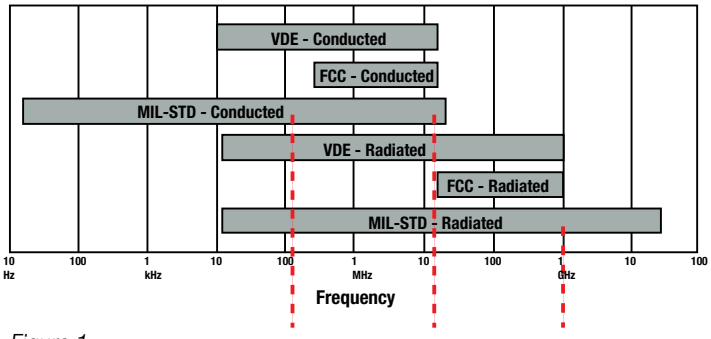


Figure 1

If there are issues with radiated noise interference, the solutions shield certain components, or the entire circuit. Shielding the device blocks the unwanted signals, which are usually over 30MHz. The shielding is usually performed from copper shields to divert, or ferrite shields to absorb, the unwanted signals.

The other failure is conducted noise interference. When conducted emission failures are detected, the problem is from differential mode (symmetrical) interference or common mode (asymmetrical) interference. As seen in Figure 2, differential interference occurs due to an unbalance of the current flow between the line (L1) and neutral (N) nodes. Differential noise appears from the out-phase voltages at these nodes from any unbalance of the signals. The voltage creates a current in these cables. This out of phase current is the differential current. When the signals are not equal and opposite, differential interference occurs.

The usual solution for correcting differential mode interference is to add an inductive component on each of the wires, one on the neutral and an equal value on the line. This employed solution will create impedances that will lower the unwanted signal. The differential mode current flowing in opposite directions through the added inductors will induce magnetic fields in opposite directions. This generates impedances, which will help to suppress the unwanted signal noise and better meet the regulatory maximum values.

The other conducted interference type is a common mode interference. This type of interference occurs from in-phase current flow between line (L1) and neutral (N) with respect to earth ground. All common mode interference develops when each current in the cable flows to earth ground via parasitic capacitance. The solution to lower this unwanted interference is to use a common mode inductor. This is a component that has two windings on a common core. By connecting the component properly in the circuit, the common mode current will flow in the same direction through each inductor winding; thereby, creating equal and in-phase magnetic fields. This results in the part having high impedance to the common mode signal.

Common Mode and Differential Mode Interference

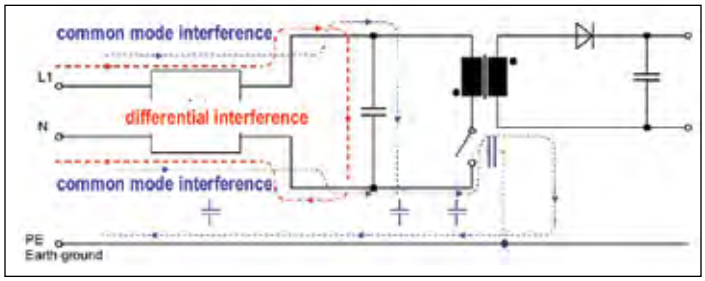
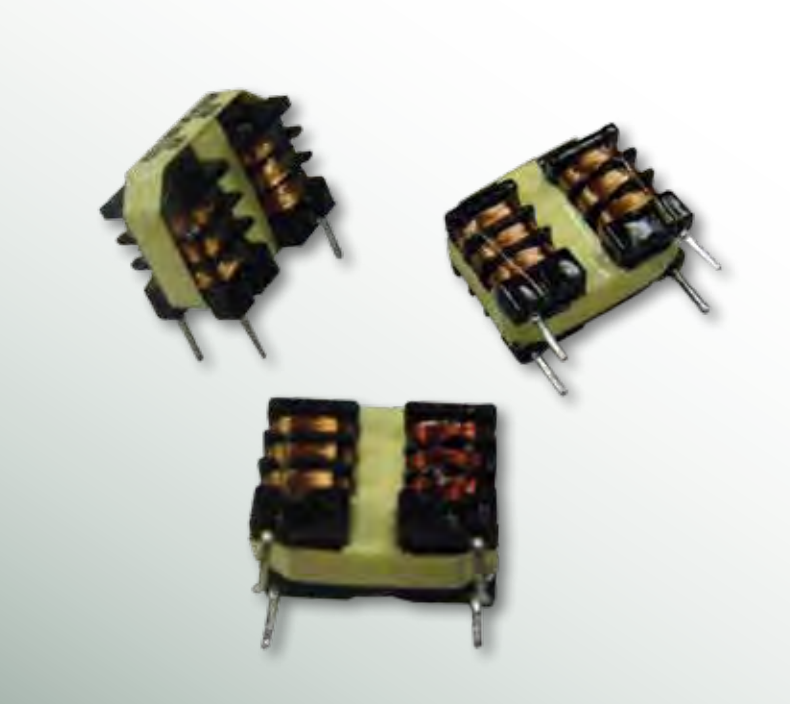


Figure 2

Solutions using both common mode inductors with differential mode inductors are often used for reduction of the unwanted noise, while not losing much operating efficiency. Nevertheless, more circuit board space is needed, and cost increases in added components, but these methods need to be used to meet the FCC regulation levels.

LED Lighting and EMI *(continued)*

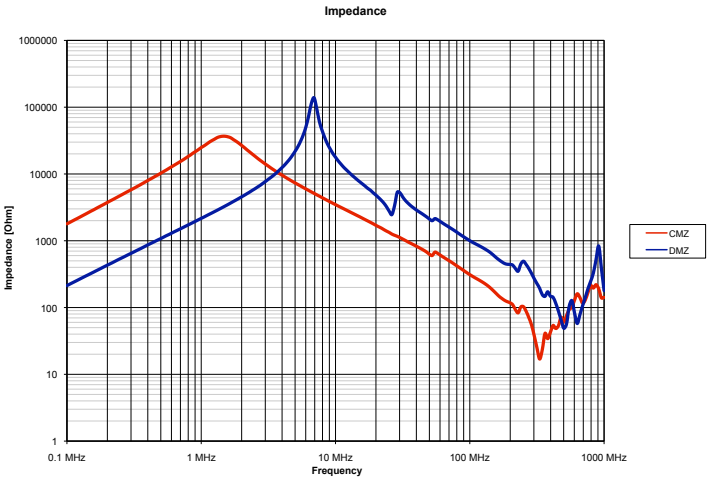


Picture 1 (Dual Coil series by Wurth Electronics Midcom Inc.)

Recognizing the need for a solution to this problem, Wurth Electronics Midcom set out to develop a low-cost, single component that would combine both a common mode and differential mode choke into one device. Utilitzing the nature of stray magnetic fields in a coupled winding to our advantage, we were able to create a common mode choke which exhibited extremely high differential mode inductance as well. Further development of the part for the lighting industry lead to a low-cost part with superb performance and handily solves this problem.

Wurth Electronics Midcom has recently released the Dual Coil chokes, which have unsurpassed common mode and differential mode impedance for this small of a product. The electrical characteristics can be seen in Plot 1 for these new components, the Dual Coil series.

From the illustration in Plot 1, the differential mode impedance (DMZ) is seen to track very closely to the common mode impedance (CMZ). This will help to suppress the unwanted noise signals from each conducted mode, without need for additional magnetic components. The differential noise that occurs even at low frequencies in the kilohertz range can be lowered due to the high impedance values of the Dual Coil common mode inductor.



Plot 1

The understanding of both common mode interference and differential mode interference is important in order to correct EMI issues in an efficient and cost effective solution. As switching frequencies increase in order to increase operational efficiency and decrease driver sizes, the issues for interference also move into higher frequency bands.

The lighting industry will continue to look for energy efficiency to replace the mature, but inefficient incandescent light bulbs. Over time, the more efficient, compact, fluorescent lamps and LED lighting circuits will continue to replace the standard incandescent bulbs. As this moves forward, the issues of EMI will be a concern, and solutions will need to be used to meet FCC and VDE regulations. ■

Cypress Semiconductor CY8CLEDAC02

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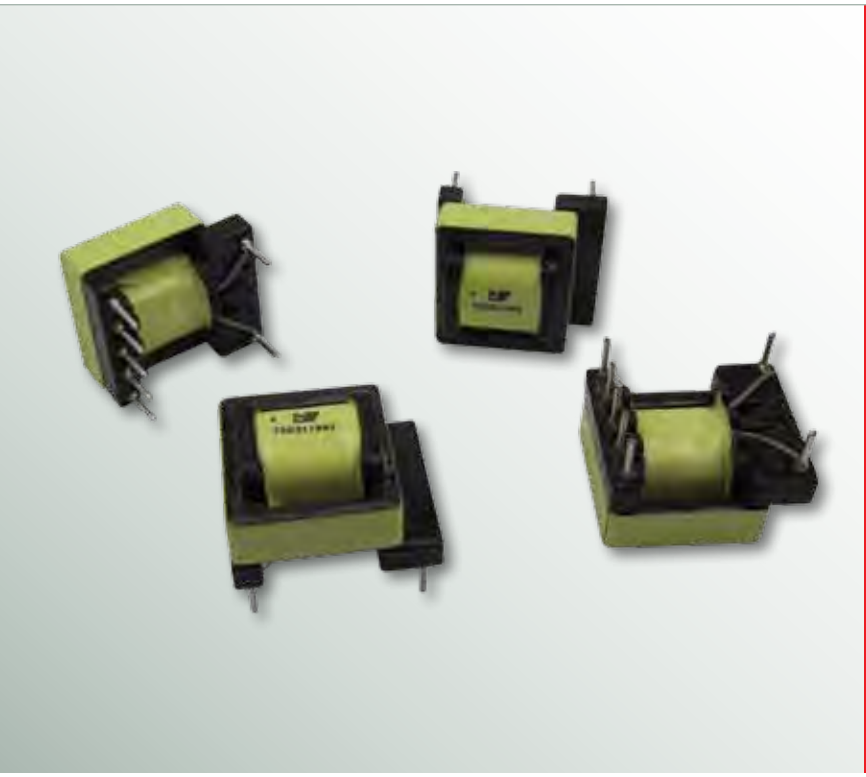
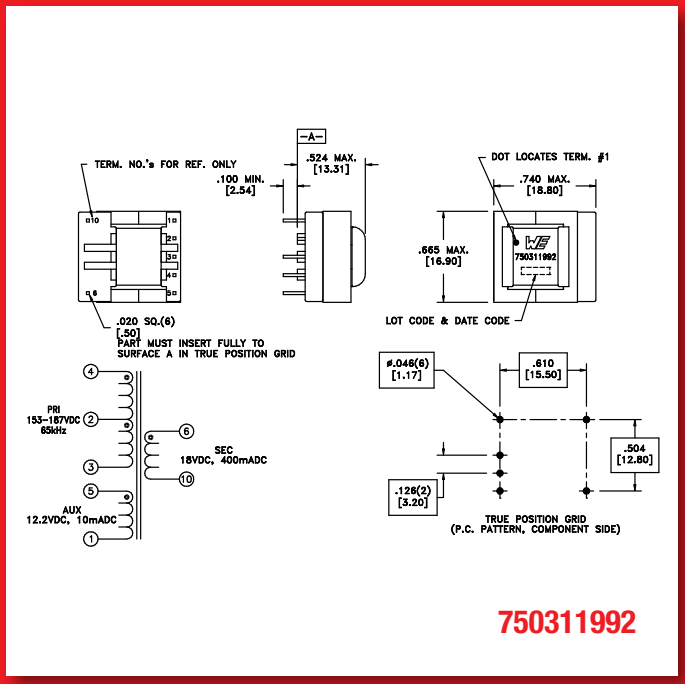




750311992

8W Low-Line Dimmable LED Driver

- LED retro-fit of incandescent bulbs
- Input voltage: 108-132V_{RMS}
- 16.5V at 400mA
- Capable of driving 5 white LEDs
- Phase-cut and PWM dimming
- Leading- or trailing-edge dimming detection

750311992 Flyback Transformer for 108-132V_{RMS}

- High energy storage in compact design
- Low copper losses
- Operating temperature: -40°C to 125°C
- UL1310 compliant
- Package style: EE16/7/5

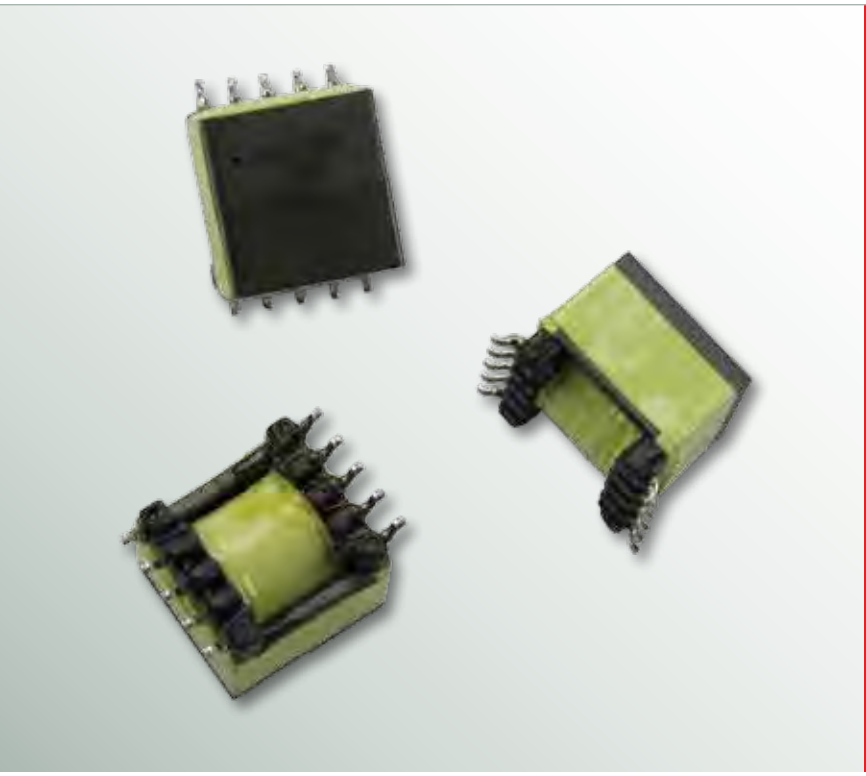
750311907 Boost Inductor

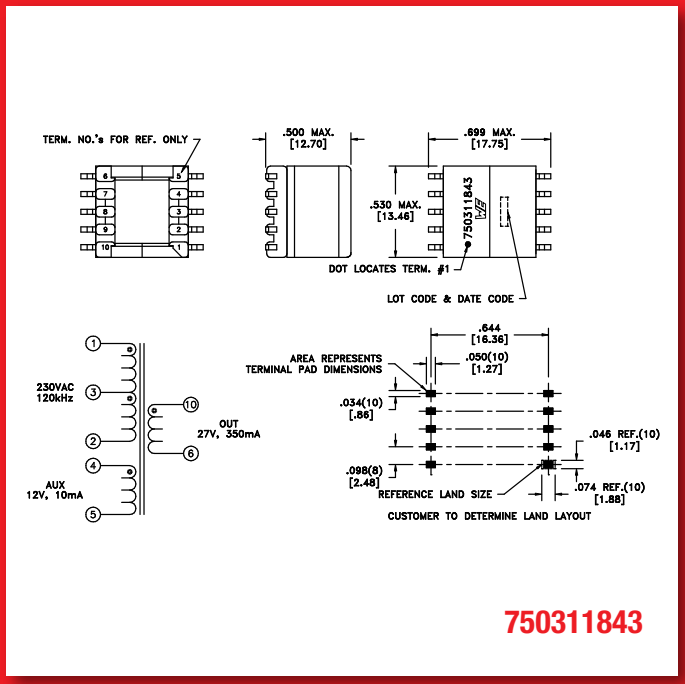
- Very compact design
- Operating temperature: -40°C to 125°C
- High current, small size
- Package style: EP7

CYPRESS

Driving the Communications Revolution™

Cypress Semiconductor
CY8CLEDAC02





12W Dimmable LED Driver Reference Design

- LED retrofit of incandescent bulb
- Input voltage: 180-265 V_{RMS}
- 27V at 350mA
- Leading- or trailing-edge dimming detection
- Power factor correction

750311843 Flyback Transformer

- High energy storage in compact design
- Low copper losses
- Operating temperature: -40°C to 125°C
- EN61347-2-13 basic insulation
- Package style: EP13

750311909 Boost Inductor

- Very compact design
- Operating temperature: -40°C to 125°C
- High current, small size
- Package style: EP7

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Infineon Technologies BCR450, TDA4863

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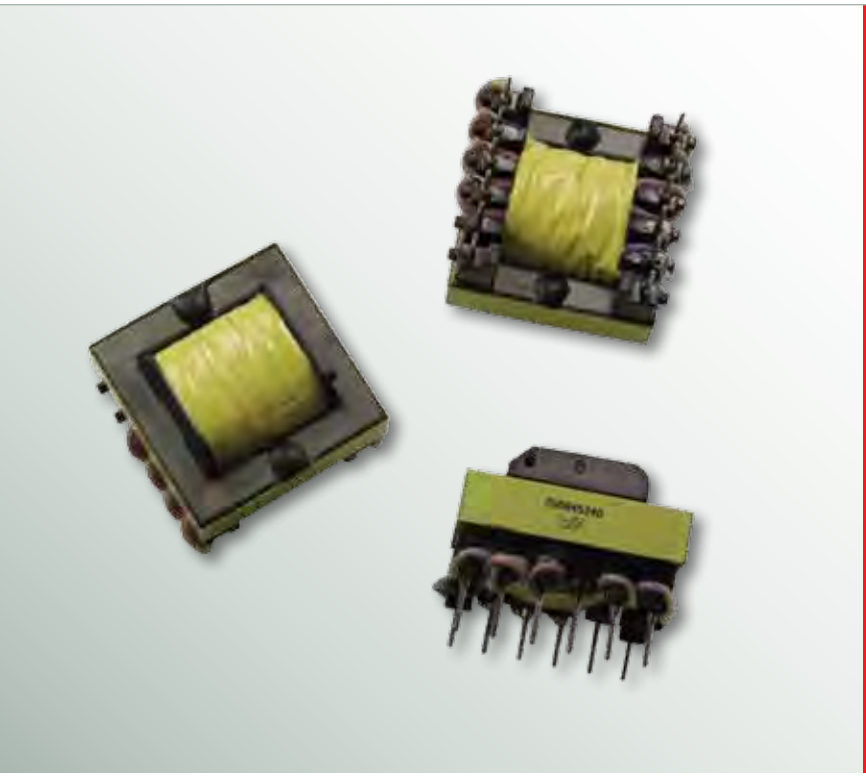
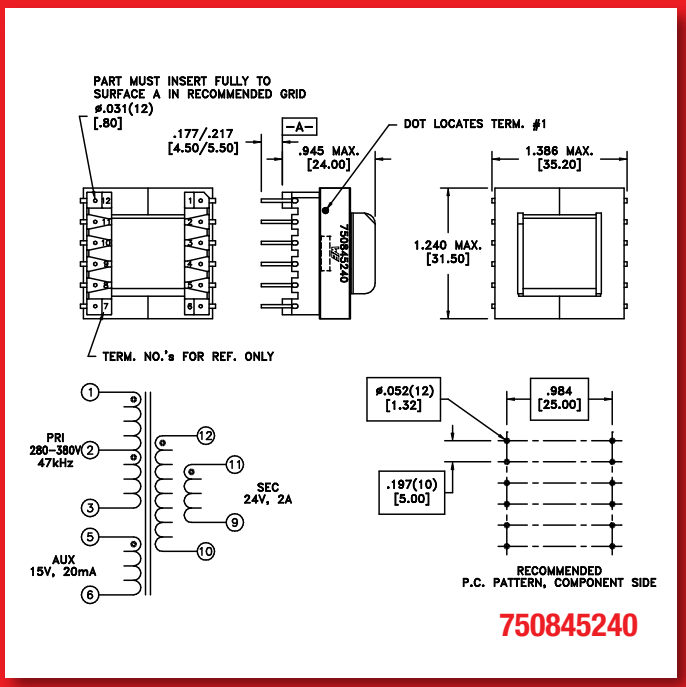




40W LED Street and Indoor Lighting

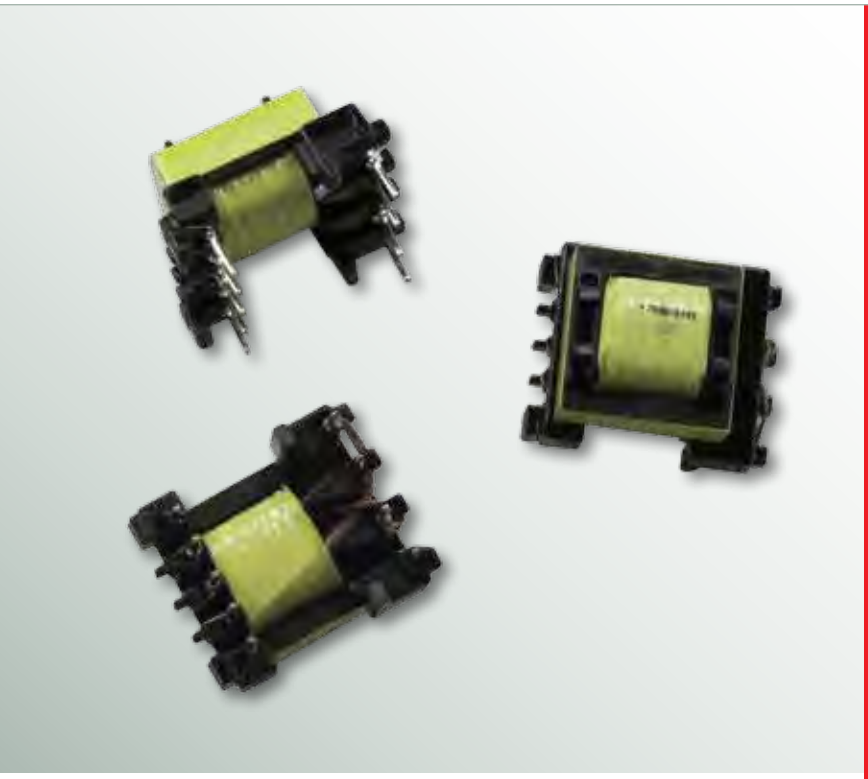
- LED street and indoor lighting applications
- Up to 40W for 180-270V_{RMS}
- Up to 20W for 90-270V_{RMS}
- 15-26V output
- Power factor correction up to 0.98 and low THD
- Efficiency up to 90%

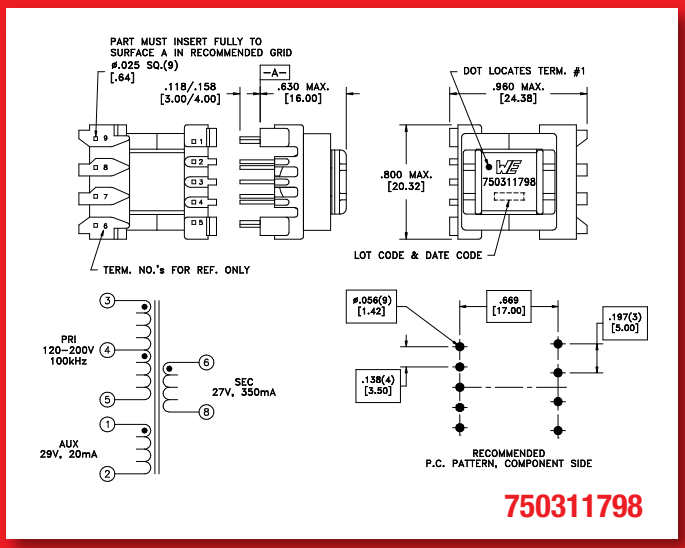
750845240 Flyback Transformer

- 24V output up to 2A
- Low copper losses
- Operating temperature: -40°C to 125°C
- Primary to secondary isolation of 4500V_{AC}
- Package style: EE30/15/7

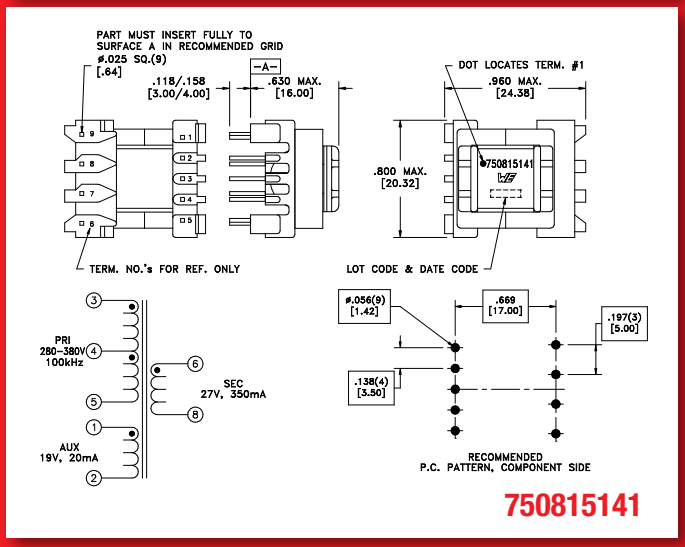
Infineon

Infineon
ICL8001G-Bulb02





750311798



750815141

Quasi-Resonant Flyback Converter

- LED retrofit of 40/60/100W incandescent bulbs
- Input voltage: 90-265V_{RMS}
- 26V at 350mA output
- Quasi-resonant flyback converter
- Phase-cut dimming
- High power factor

750311798 Flyback Transformer for 90-135V_{RMS}

750815141 Flyback Transformer for 180-265V_{RMS}

- High energy storage in compact package
- Low copper losses
- Operating temperature: -40°C to 125°C
- Reinforced insulation to IEC61558-2-17
- Package style: EE16/8/5

744862120 Common Mode Choke

- High asymmetric attenuation at low frequency
- Broadband screening due to low capacitance winding
- Very compact design
- Highest possible current with small size
- Operating temperature: -55°C to 105°C

National Semiconductor LM3444, AN-2082

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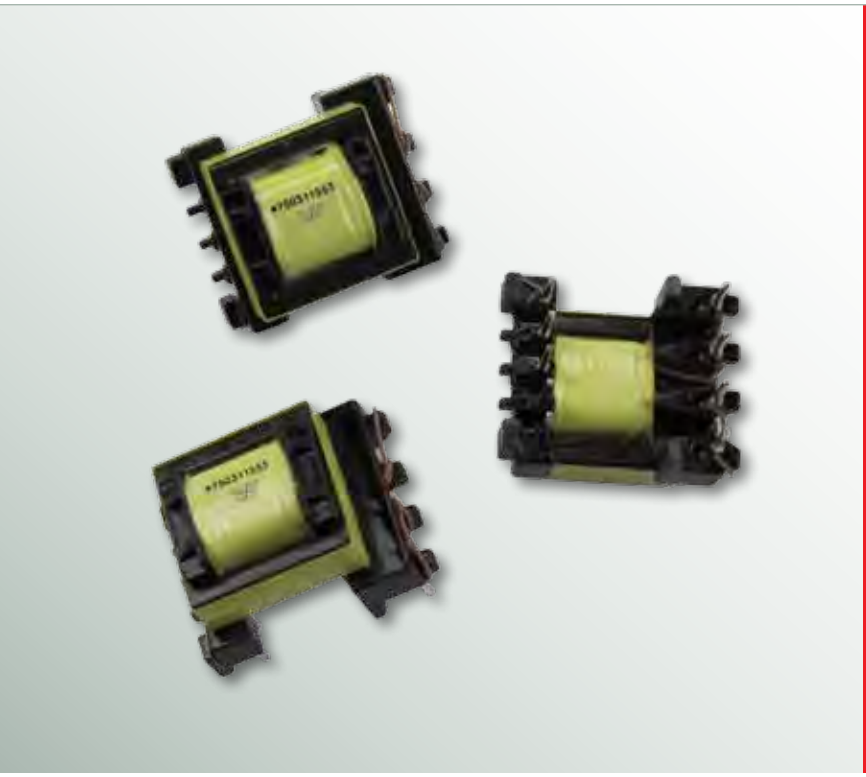
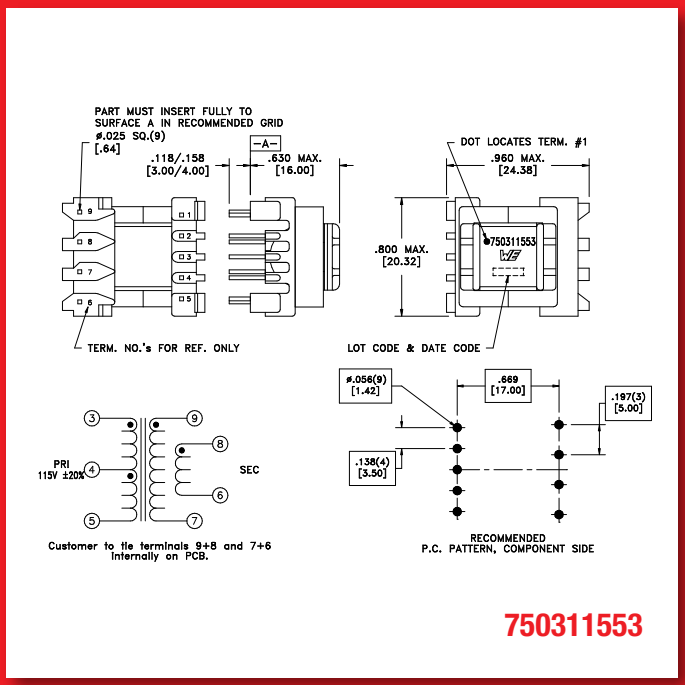




120V_{AC}, 8W Isolated Flyback LED Driver

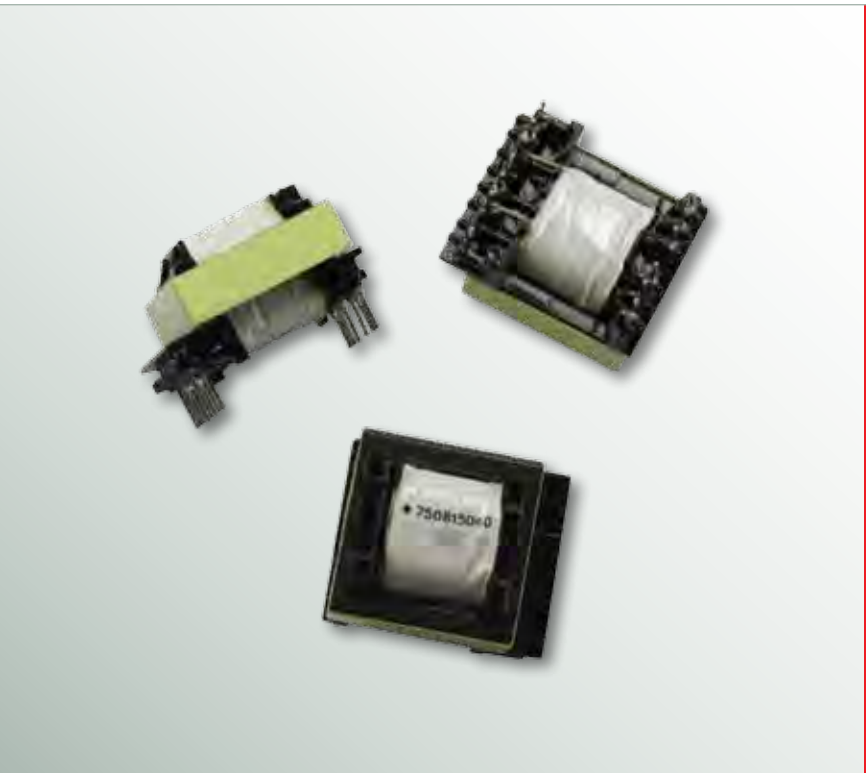
- Input voltage: 90-135V_{RMS}
- V_{OUT} = 12V-30V
- I_{LED} = 350mA
- Line injection circuitry enables PFC > 0.99
- Adjustable LED current and switching frequency
- Non-dimmable

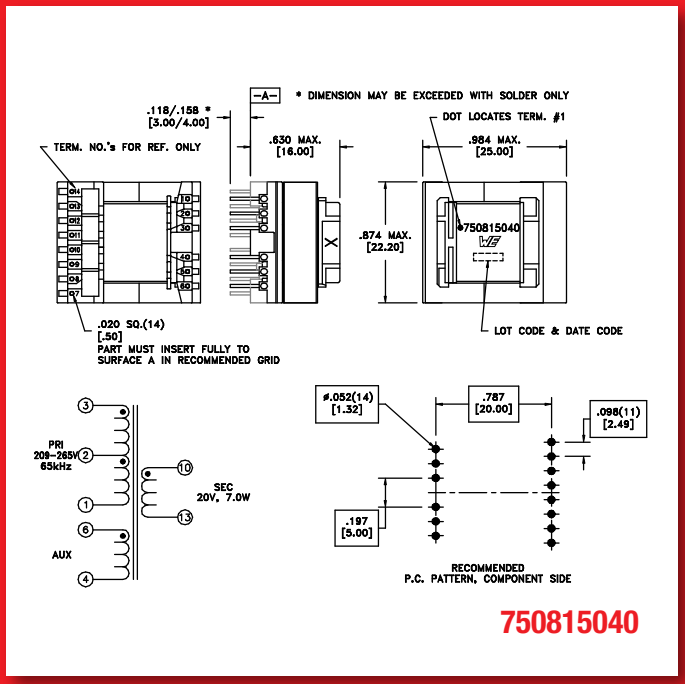
750311553 Flyback Transformer

- High energy in compact design
- Low copper losses
- Operating temperature: -40°C to 125°C
- Design to meet IEC61558-2-17 for reinforced insulation
- Package style: EE16/8/5

National Semiconductor

National Semiconductor
LM3444, AN-2097





230V_{AC}, 8W Isolated Flyback LED Driver

- Input voltage: 180-265V_{RMS}
- V_{OUT} = 13V-36V
- I_{LED} = 350mA
- Line injection circuitry enables PFC > 0.98
- Adjustable LED current and switching frequency
- Non-dimmable

750815040 Flyback Transformer

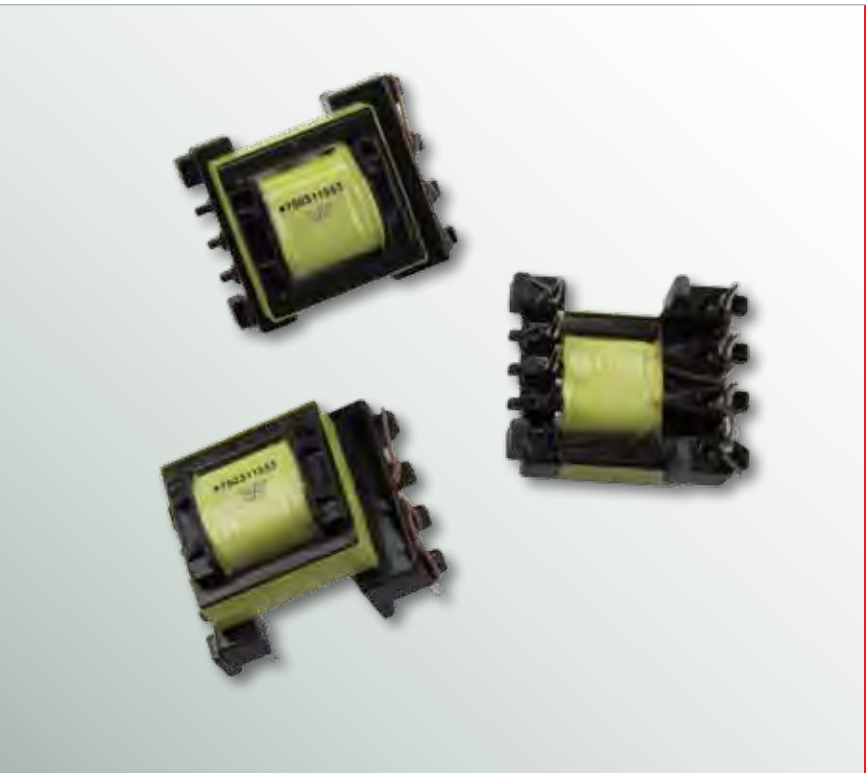
- High energy in compact design
- Low copper losses
- Operating temperature: -40°C to 125°C
- Design to meet IEC61558-2-17 for reinforced insulation
- Package style: EE20/10/6

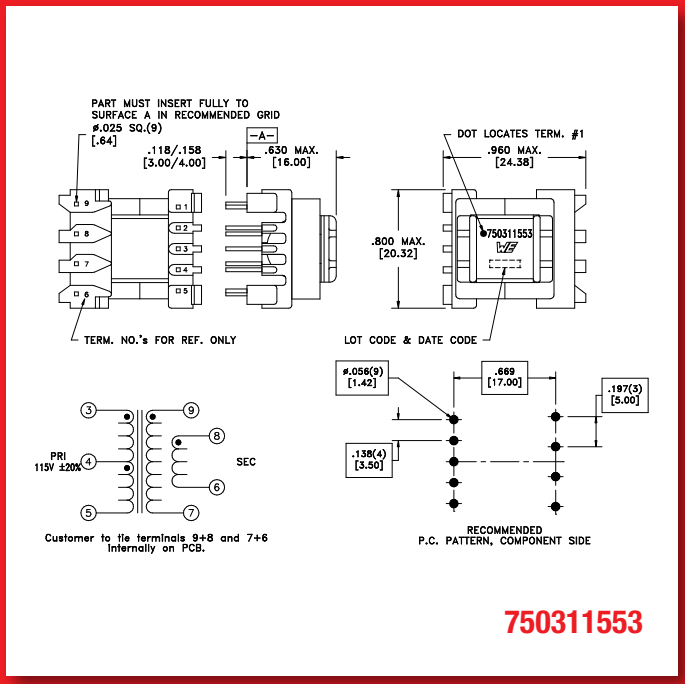
National Semiconductor

National Semiconductor LM3445, AN-2034

Midcom

WÜRTH ELEKTRONIK





120V_{AC}, 8W Isolated Flyback LED Driver

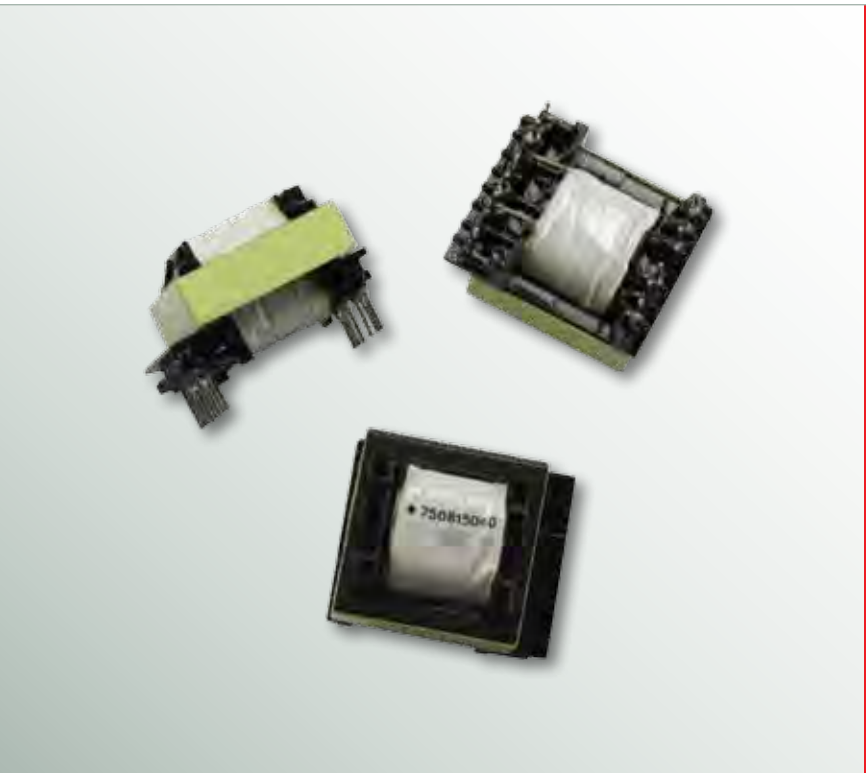
- Input voltage: 90-135V_{RMS}
- V_{OUT} = 13V-27V
- I_{LED} = 365mA
- Drop-in compatibility with TRIAC dimmers
- Line injection circuitry enables PFC > 0.95

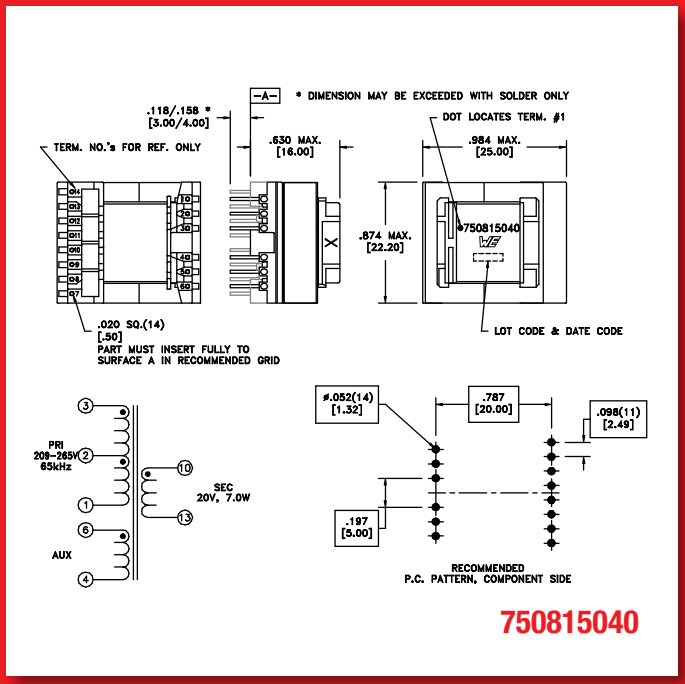
750311553 Flyback Transformer

- High energy in compact design
- Low copper losses
- Operating temperature: -40°C to 125°C
- Design to meet IEC61558-2-17 for reinforced insulation
- Package style: EE16/8/5

National Semiconductor

National Semiconductor
LM3445, AN-2069





230V_{AC}, 6-15W Isolated Flyback LED Driver

- Input voltage: 180-265V_{RMS}
- V_{OUT} = 13V-27V
- I_{LED} = 350mA
- Drop-in compatibility with TRIAC dimmers
- Line injection circuitry enables PFC > 0.95

750815040 Flyback Transformer

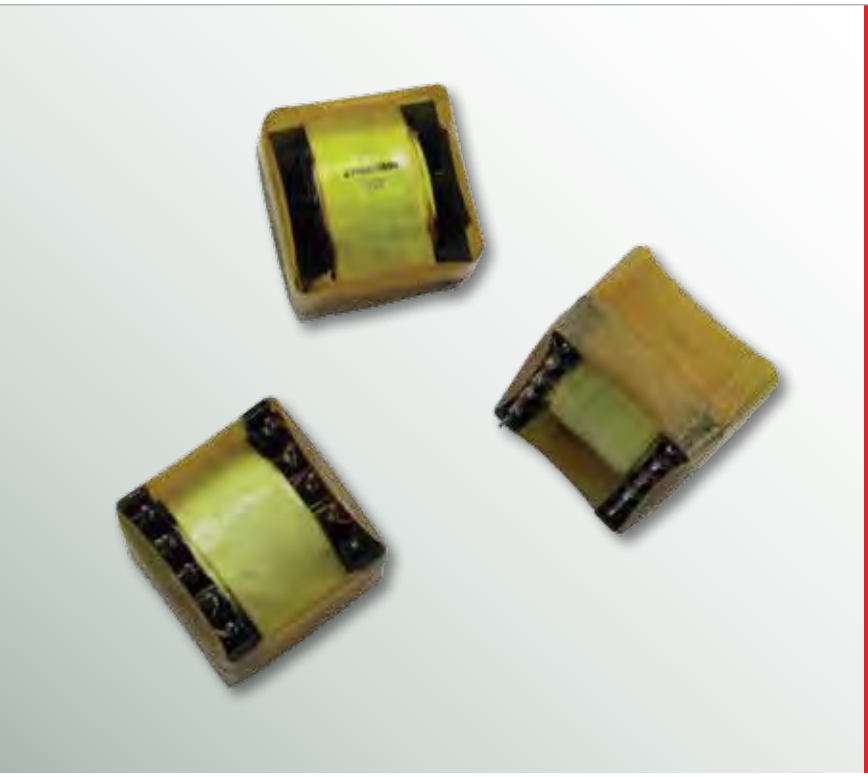
- High energy in compact design
- Low copper losses
- Operating temperature: -40°C to 125°C
- Design to meet IEC61558-2-17 for reinforced insulation
- Package style: EE20/10/6

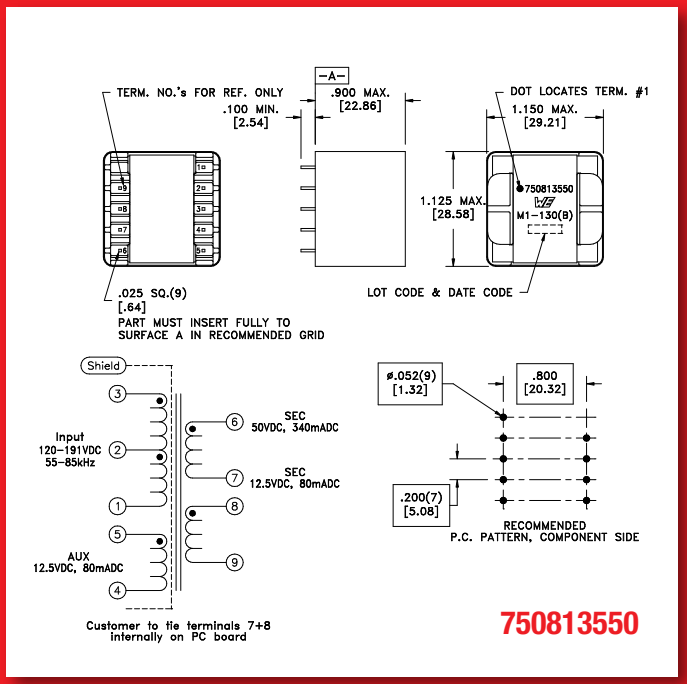
National Semiconductor

National Semiconductor LM3450

Midcom

WÜRTH ELEKTRONIK





LED Driver with Active PFC and Phase Dimming

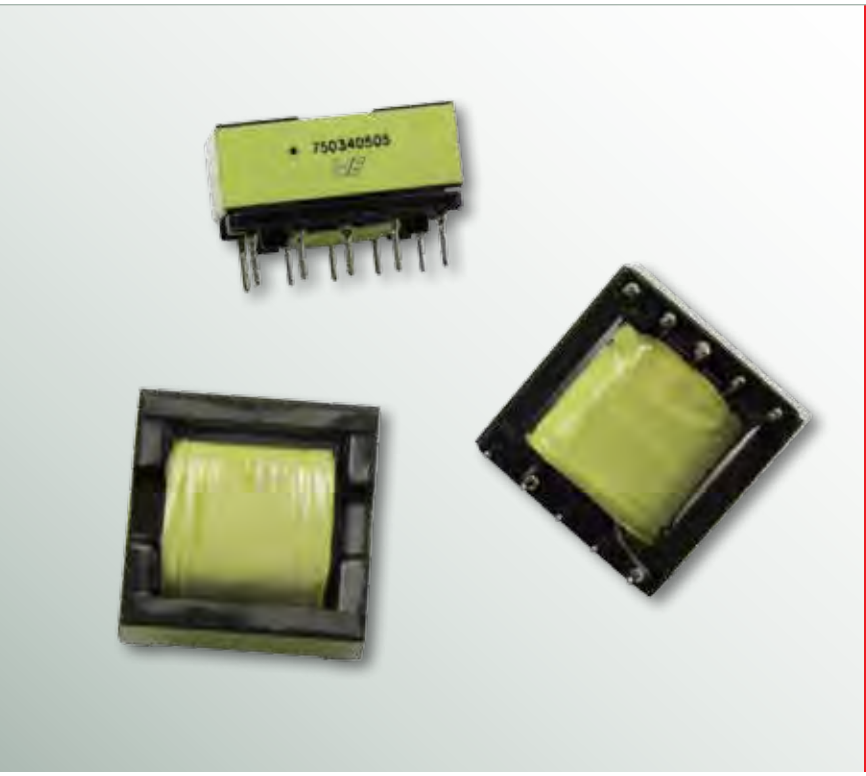
- Input voltage: 90-135V_{RMS}
- Output of 50V at 350mA
- Critical conduction mode PFC
- Phase dimming decoder
- Configurable for 10W-100W loads

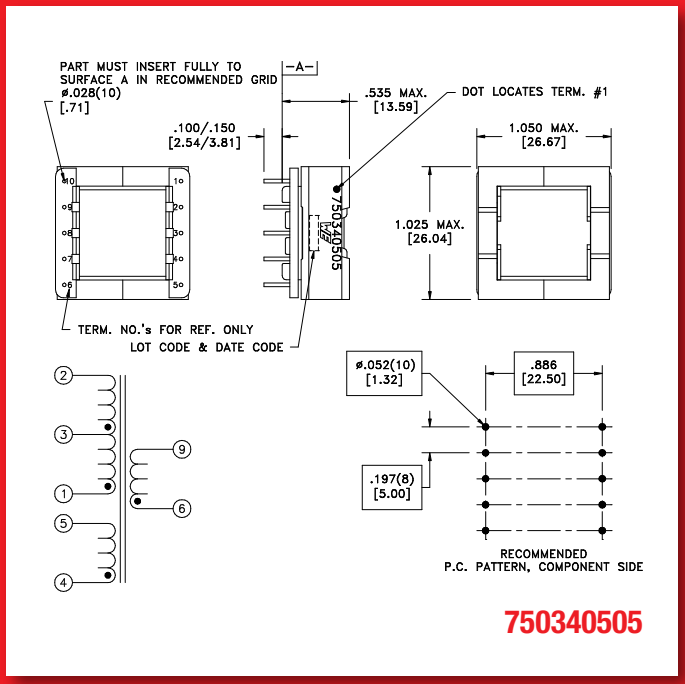
750813550 Flyback Transformer

- Shielded for low EMI
- UL recognized Class B insulation system
- Operating temperature: -40°C to 125°C
- Designed to meet UL60950-1 for reinforced insulation
- Package style: EE25/13/7

National Semiconductor

NXP
SSL210x





12 to 22W Dimmable LED Driver

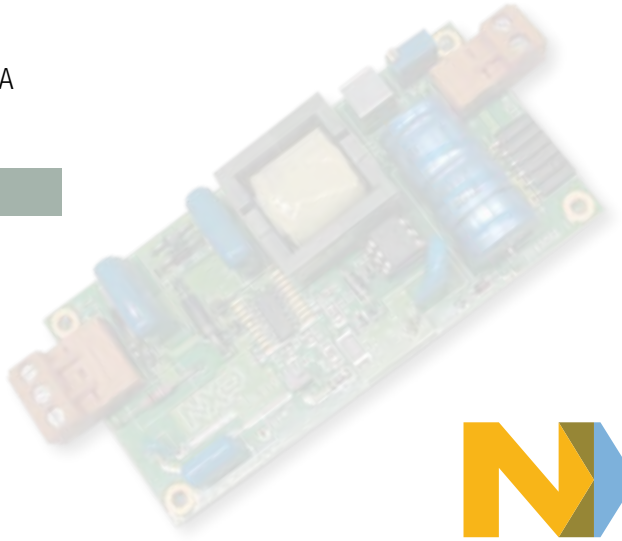
- UM10341 for 12W LED applications
- UM10386 for 22W LED applications
- Retro-fit lamps up to 150W
- Shelf and down lighting applications
- Input voltage: 85-276V_{RMS}
- Output voltage of 9-23V and output current of 400-1050mA
- TRIAC dimming compatible

750340505 Flyback Transformer

- Design for varying loads
- Very low AC and DC copper losses
- Operating temperature: -40°C to 125°C
- Primary to secondary isolation of 4000V_{AC}
- Package style: EFD25

Input and Output Filter Inductors

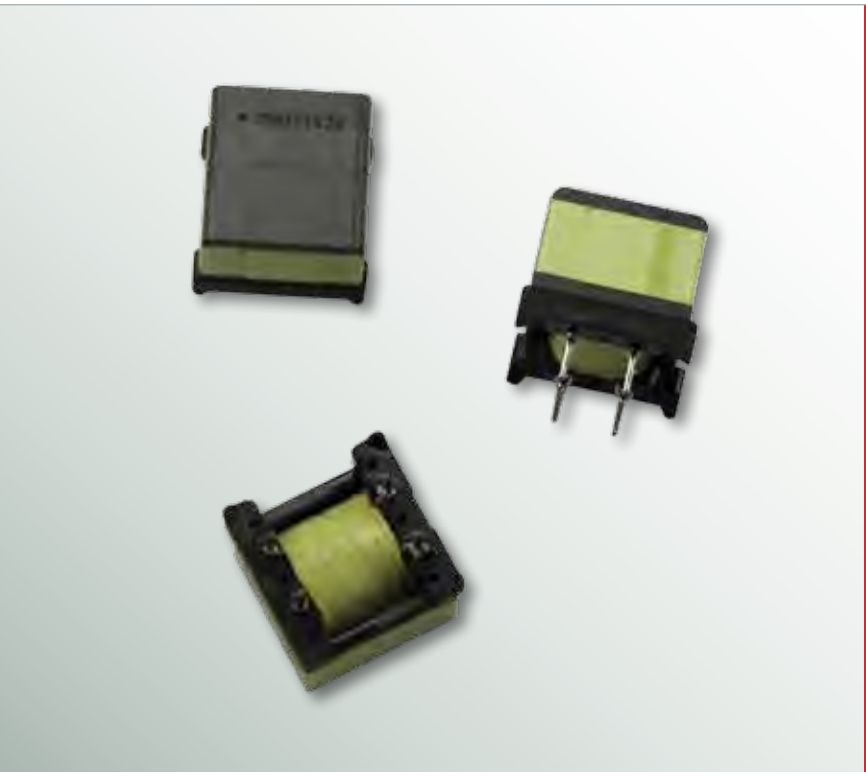
- L1 input inductor 680µH—744776268
- L2 input inductor 330µH—744776233
- L3 output inductor 100µH—74477120

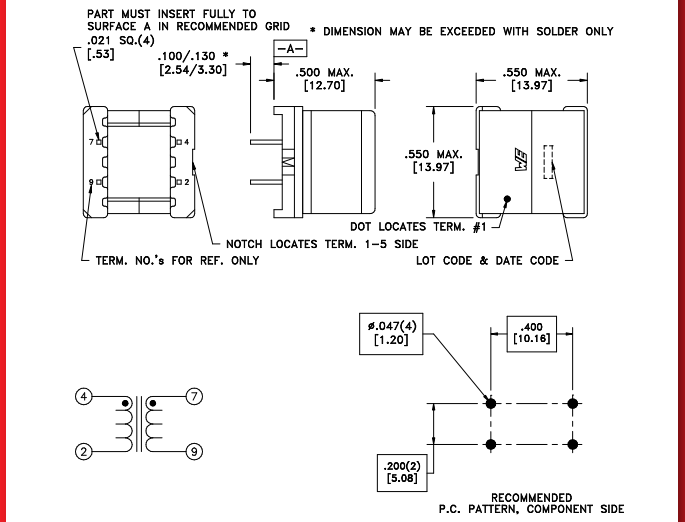


NXP
SSL2101 (PAR30)

Midcom

WÜRTH ELEKTRONIK





750311819
750311524

SSL2101 PAR30 Buck

- Input: 130V or 230V
- Output: ~21V at 450mA
- Power factor of 0.85
- Form factor: 2-inch diameter

750311819 Buck Inductor

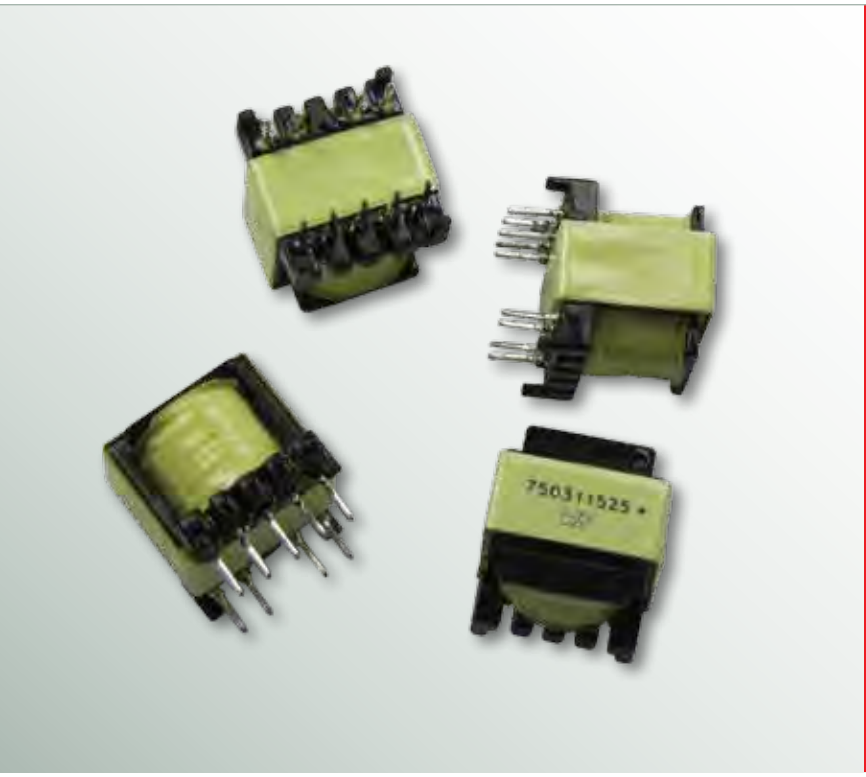
- 130V dimmable or non-dimmable operation
- Small sized
- Winding for aux power
- Low DC resistance
- 1000V_{AC} isolation
- 270µH
- Operating temperature: -40°C to 125°C
- Package style: EP13

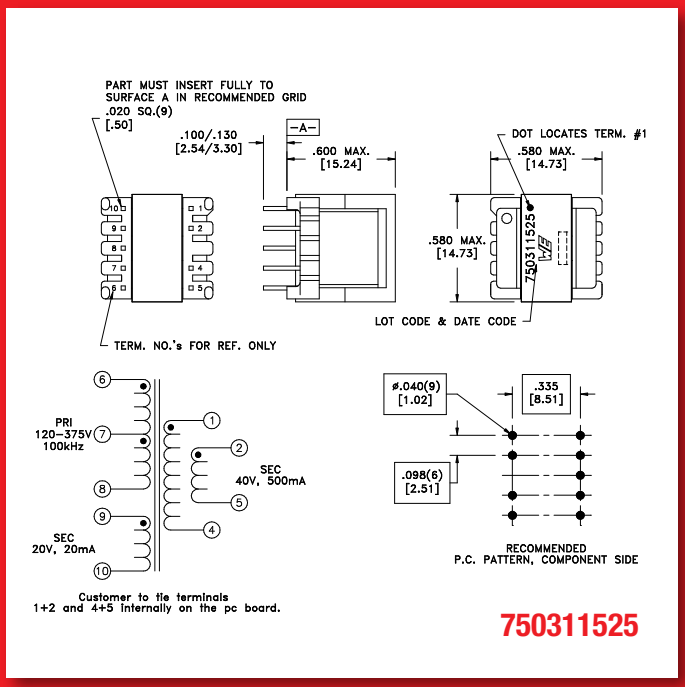
750311524 Buck Inductor

- 230V non-dimmable operation
- Small sized
- Winding for aux power
- Low DC resistance
- 1000V_{AC} isolation
- 180µH
- Operating temperature: -40°C to 125°C
- Package style: EP13

NXP

NXP
SSL2101 (PAR38)





SSL2101 PAR38 Buck

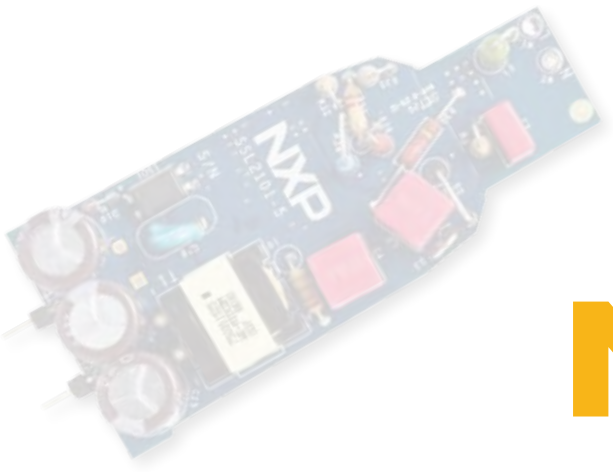
- Input voltage: 90-135V_{RMS}
- 40V at 350mA
- Functional insulation for IEC60950-1
- Designed for long life, high thermal stress and EMC compliance

750311525 Flyback Transformer

- 2000V_{AC} isolation voltage
- High energy storage in compact package
- Low copper losses
- Operating temperature: -40°C to 125°C
- Functional insulation for EN60950-1
- Package style: EE13/6/6

744821120 Common Mode Choke

- Very compact design
- High suppression of asymmetric interferences even at low frequency ranges
- Highest possible current with small size
- Operating temperature: -40°C to 125°C



ON Semiconductor AND8463/D

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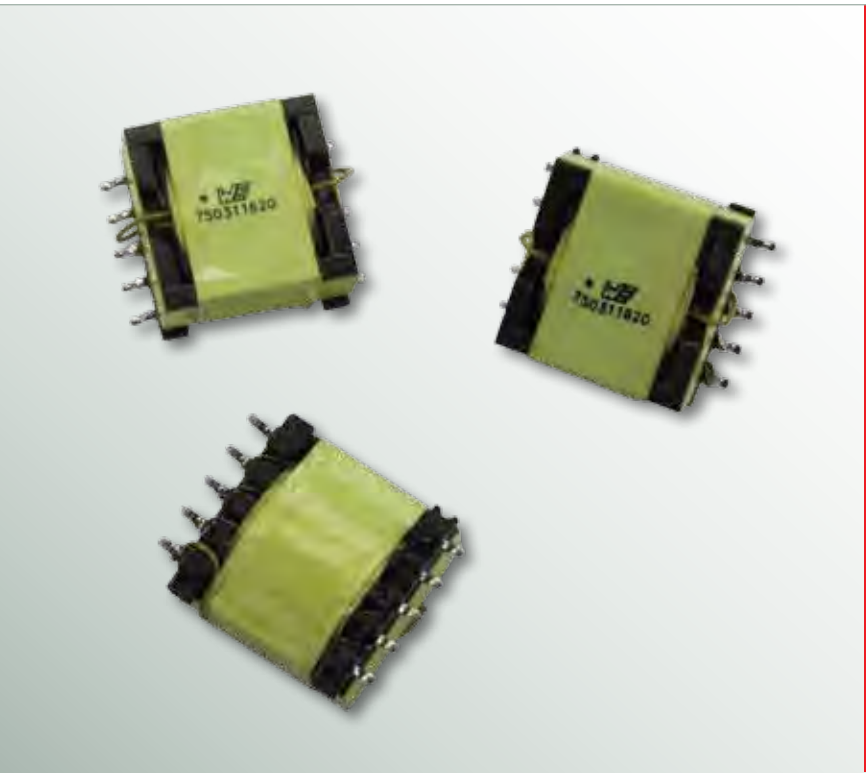
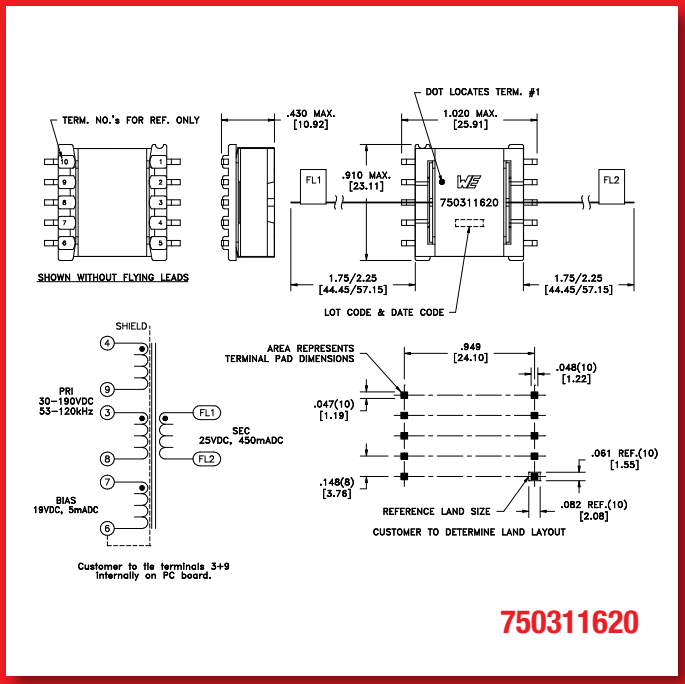
WÜRTH ELEKTRONIK





11W TRIAC Dimmable PAR30 LED Driver

- Retro-fit dimmable PAR30 lamps
- Input voltage: 90-135V_{RMS} or 180-265V_{RMS}
- 21-27V output at 450mA
- Compatible with TRIAC and electronic low voltage dimmers
- Compliant with FCC Class B conducted emissions

750311620 Flyback Transformer

- Completely shielded design
- Low copper losses
- Operating temperature: -40°C to 125°C
- Reinforced insulation for IEC61558-2-17
- Package style: EFD20

Input Filter Inductors

- L2 inductor 800µH—750311431 for US and Europe
- L3 inductor 1.6mH—750311826 for US
- L3 inductor 800µH—750311431 for Europe

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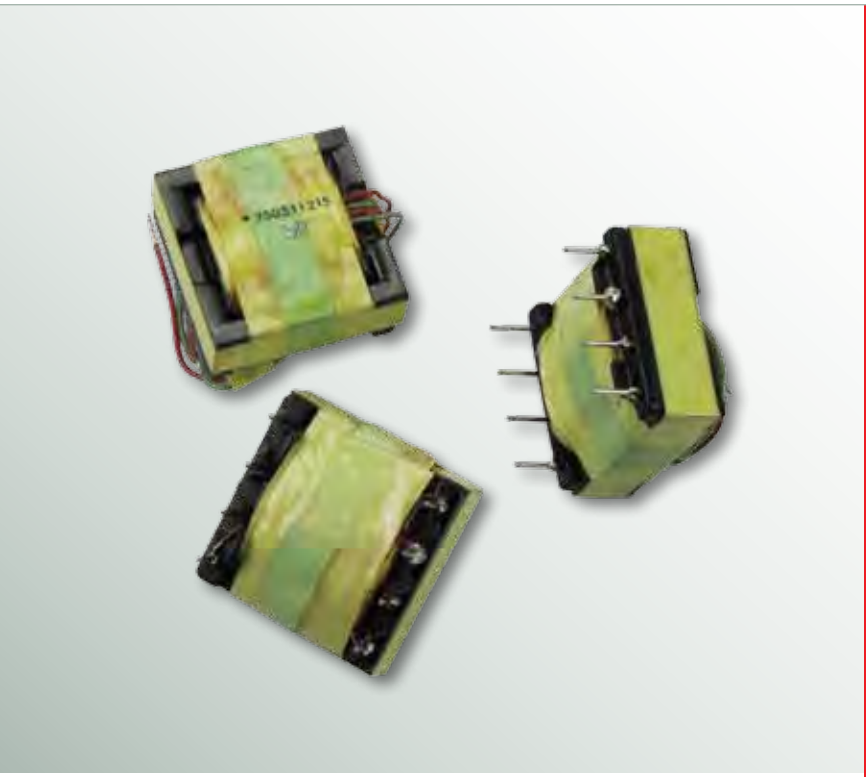
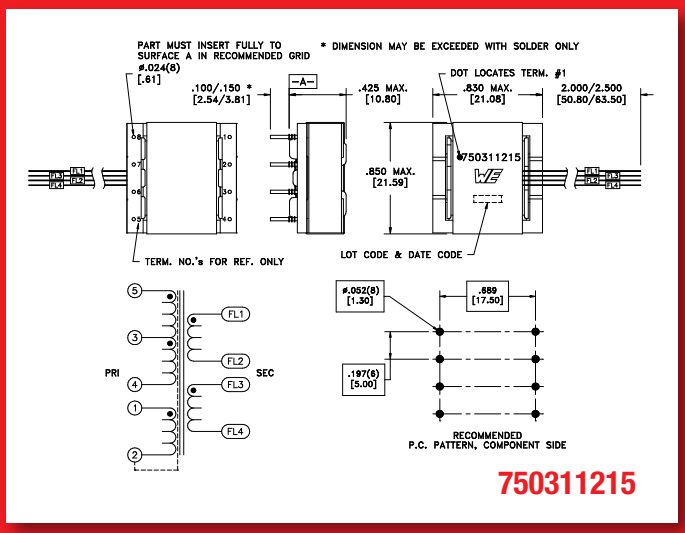
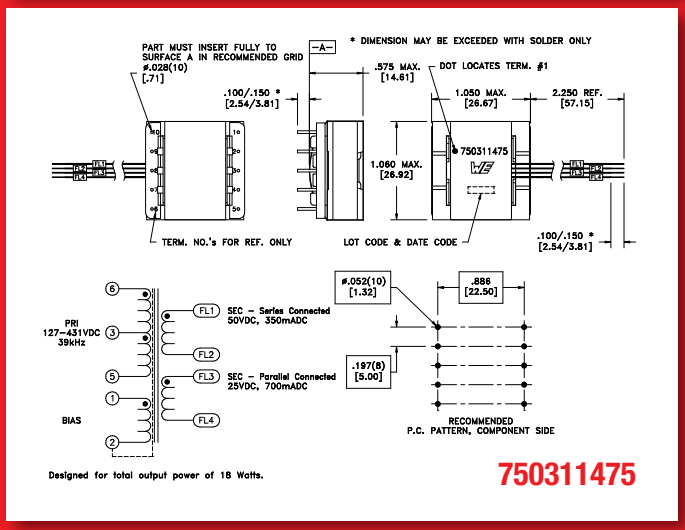
NCL30000LED1GEVB/D







90-135V_{AC}, 15W Dimmable LED Driver

- 90-135V_{RMS} at 15W output
- Output current of 350mA
- Output voltage range 12-50V_{DC}
- Power factor > 0.95
- Class B conducted emissions
- Compatible with TRIAC and electronic dimmers

750311215 Flyback Transformer

750311475 Flyback Transformer

- Low copper losses
- Operating temperature: -40°C to 125°C
- Reinforced insulation for IEC61558-2-17
- Package style: EFD20 for compact designs (750311215)
- Package style: EFD25 for high efficiency designs (750311475)

7446620027 Common Mode Choke

- Rated for 250V_{AC}
- 27mH of inductance
- Nominal current up to 0.4A DC

750311431 Inductor

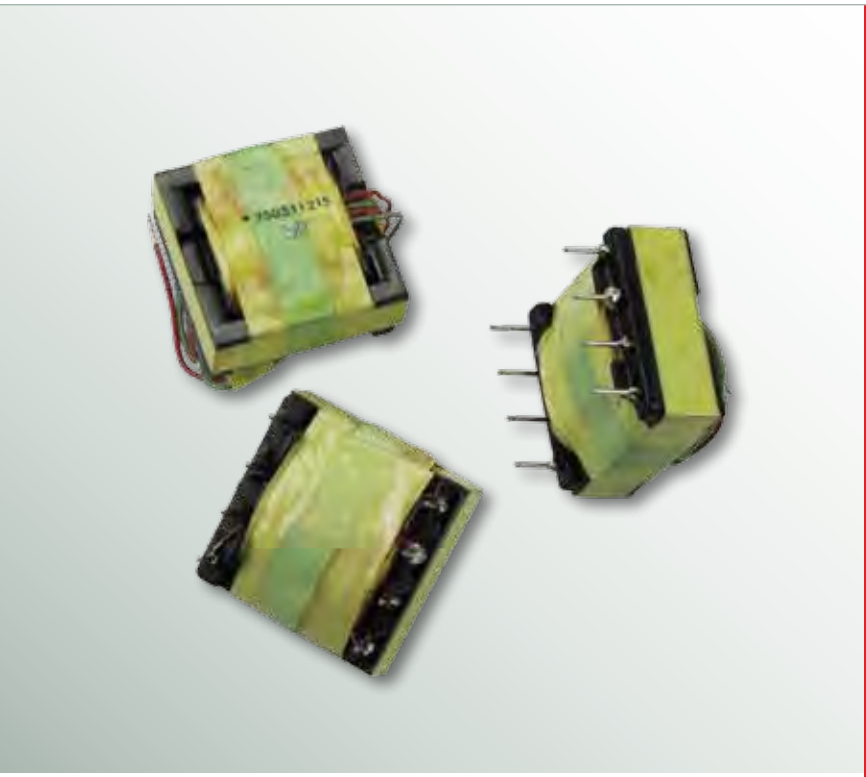
- 750mH of inductance
- Nominal current up to 250mA

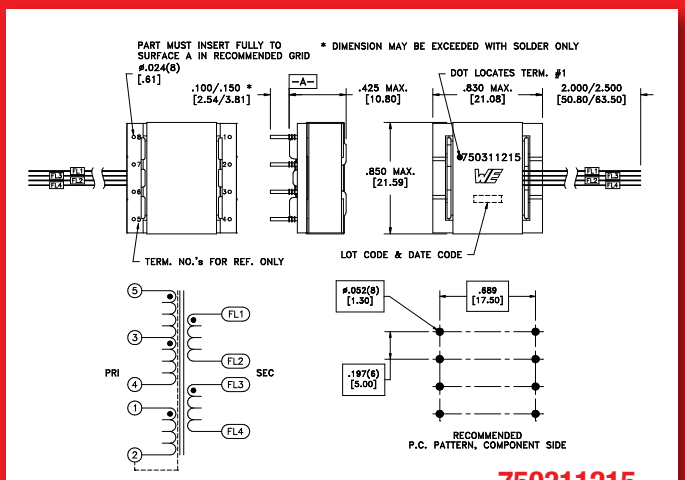
ON Semiconductor®

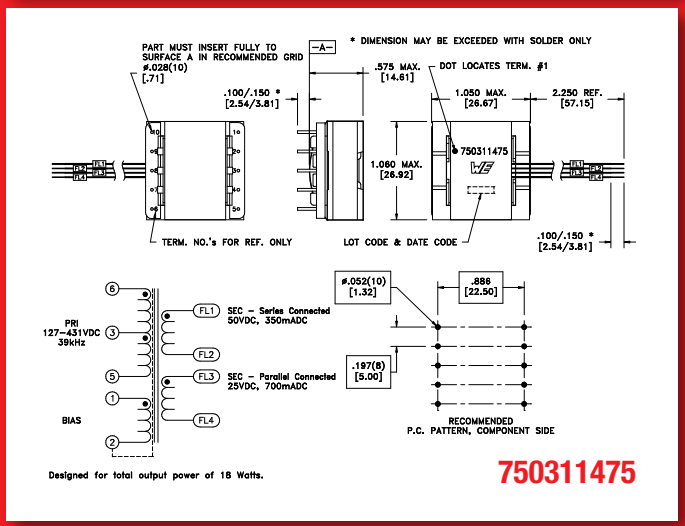
ON Semiconductor NCL30000LED2GEVB/D

Midcom

WÜRTH ELEKTRONIK







180-265V_{AC}, 15W Dimmable LED Driver

- 180-265V_{RMS} at 15W output
- Output current of 350mA
- Output voltage range 12-50V_{DC}
- Power factor > 0.96
- Class B conducted emissions
- Compatible with TRIAC and electronic dimmers

750311215 Flyback Transformer

750311475 Flyback Transformer

- Low copper losses
- Operating temperature: -40°C to 125°C
- Reinforced insulation for IEC61558-2-17
- Package style: EFD20 for compact designs (750311215)
- Package style: EFD25 for high efficiency designs (750311475)

7446620027 Common Mode Choke

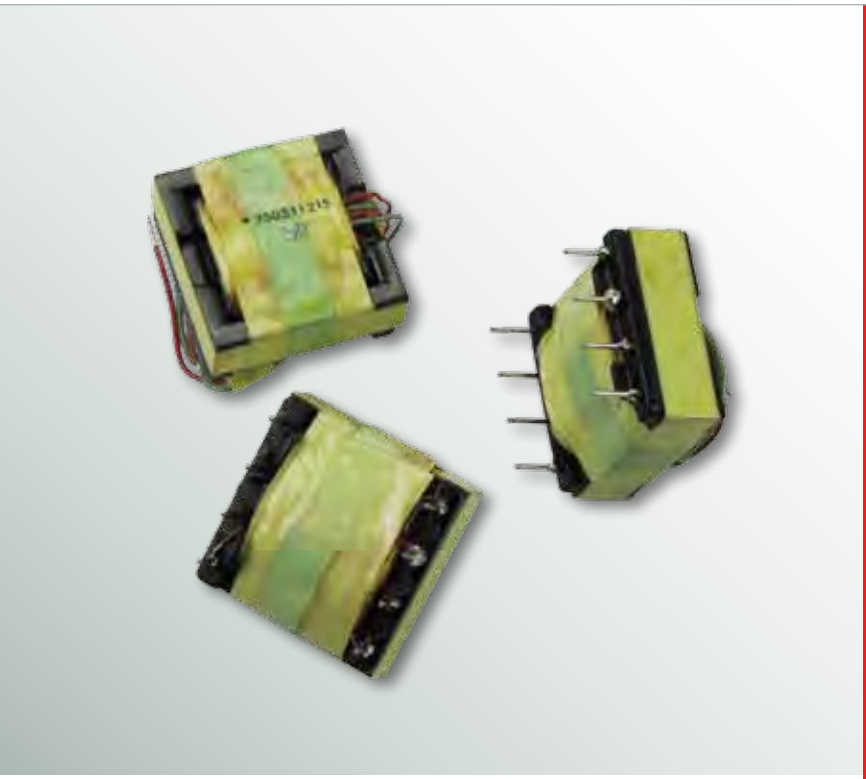
- Rated for 250V_{AC}
- 27mH of inductance
- Nominal current up to 0.4A DC

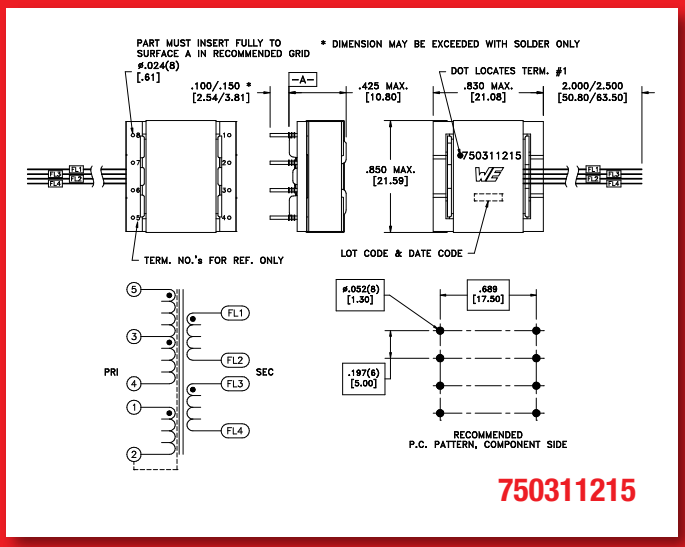
750311505 Inductor

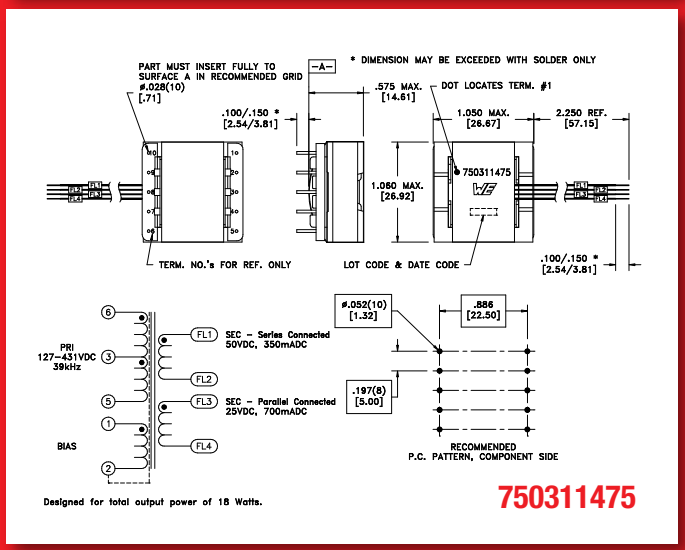
- 470mH of inductance
- Nominal current up to 150mA

ON Semiconductor®

ON Semiconductor NCL30000LED3GEVB







90-305V_{AC}, 17W Non-Dimmable

- 90-305V_{AC} input, 17W output
- Output current of 250mA
- Output voltage range 12-50V_{DC}
- Power factor > 0.93
- Class B conducted emissions

750311215 Flyback Transformer

750311475 Flyback Transformer

- Low copper losses
- Operating temperature: -40°C to 125°C
- Reinforced insulation for IEC61558-2-17
- Package style: EFD20 for compact designs (750311215)
- Package style: EFD25 for high efficiency designs (750311475)

7446620027 Common Mode Choke

- Rated for 250V_{AC}
- 27mH of inductance
- Nominal current up to 0.4A

ON Semiconductor®

ON Semiconductor NCL30001, AND8427/D

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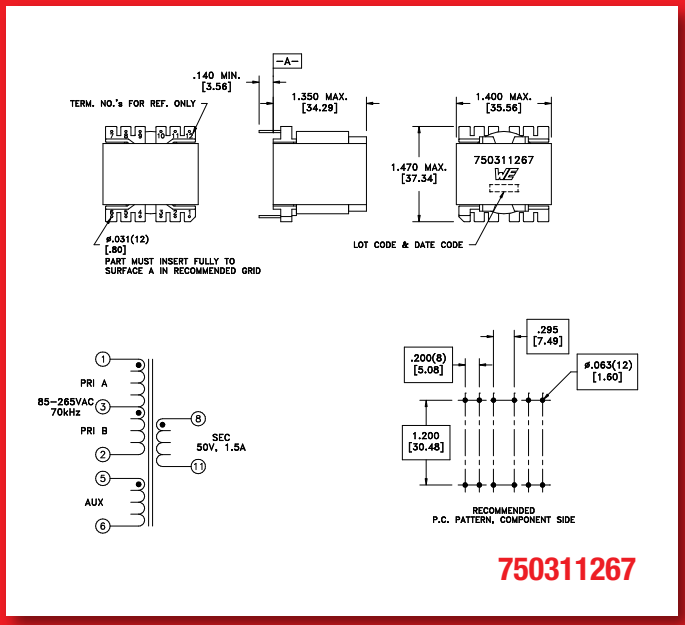
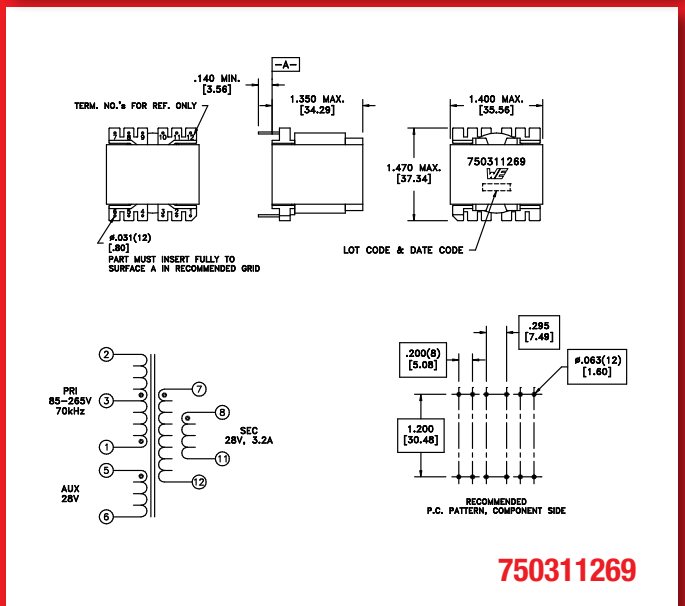
WÜRTH ELEKTRONIK



750311267



750311269

55V Single State Power Factor Corrected LED Power Supply

- Street and low bay LED lighting
- Reduces EMI signature
- High efficiency, up to 92%
- Input voltage: 90-265V_{RMS}
- Optional dimming function available
- Power factor > 0.9

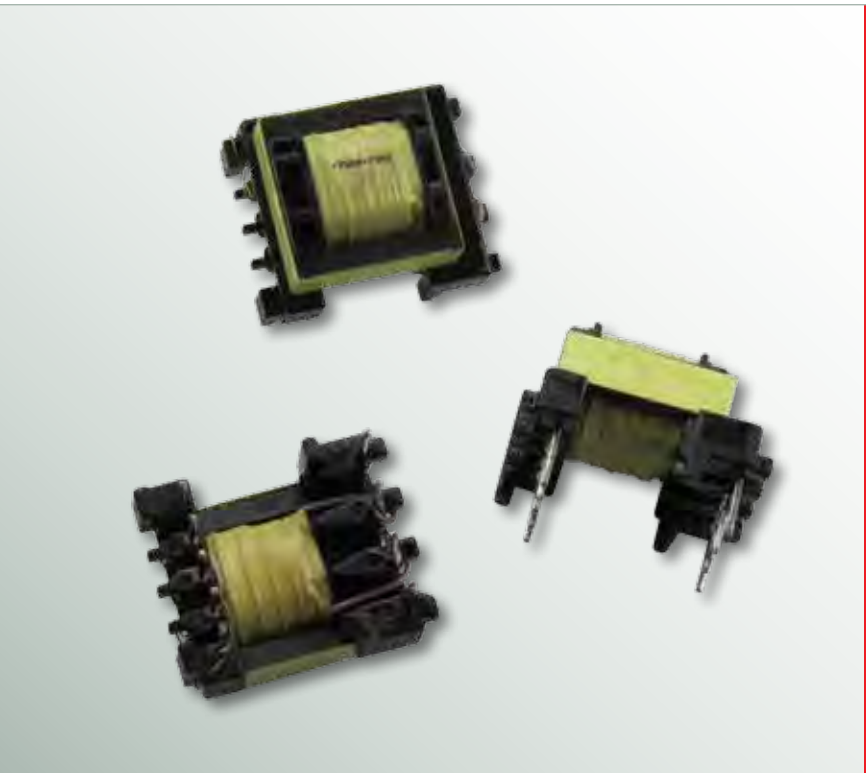
750311267 Flyback Transformer for 50V Output

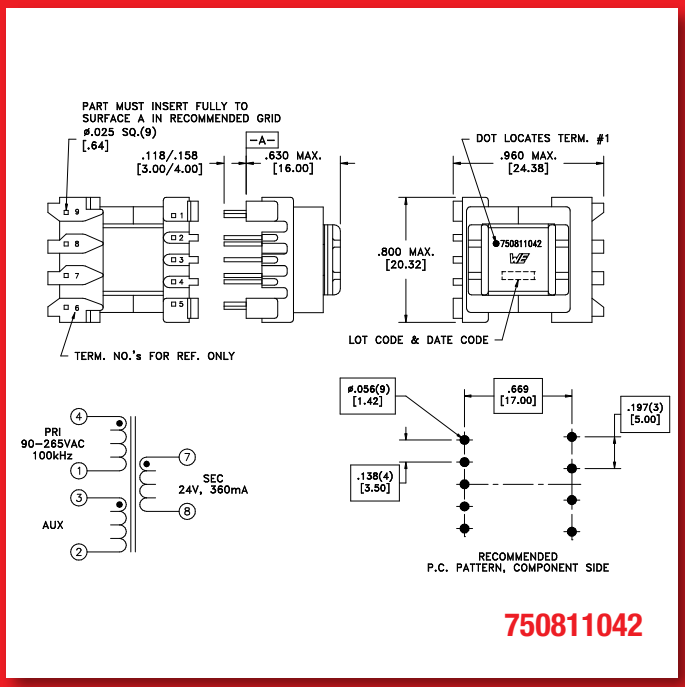
750311269 Flyback Transformer for 28V Output

- 75W output
- Low copper losses
- Operating temperature: -40°C to 125°C
- Package style: PQ3230

ON Semiconductor®

ON Semiconductor
TND371/D





ENERGY STAR® Residential LED Driver

- 8W residential lighting
- ENERGY STAR® compliant
- Input voltage: 90-265V_{RMS}
- 24V at 360mA
- Power factor up to 0.98

750811042 Flyback Transformer

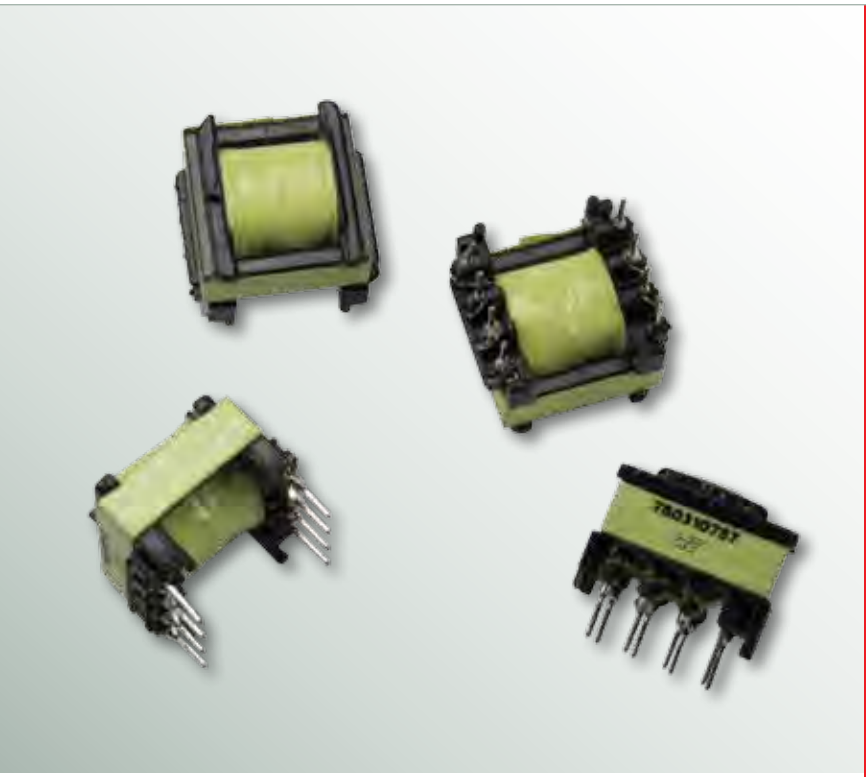
- For universal inputs
- High energy in compact design
- Low copper loss
- Operating temperature: -40°C to 125°C
- Reinforced insulation to IEC61558-2-17
- Package style: EE16/8/5

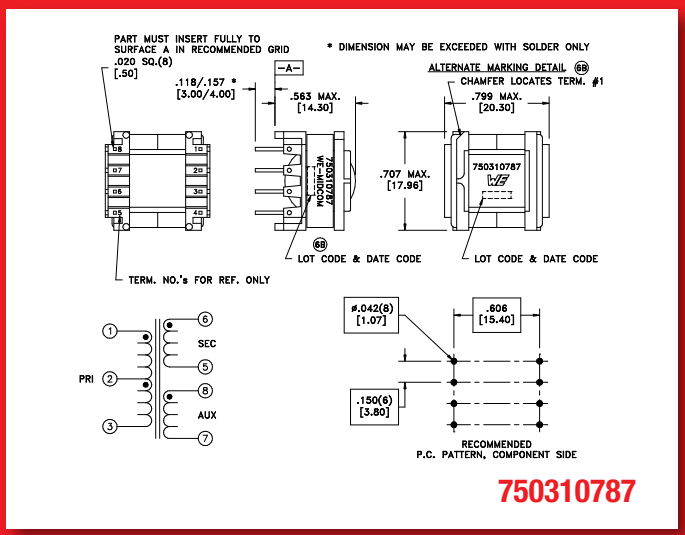
ON Semiconductor®

Texas Instruments TPS92010EVM

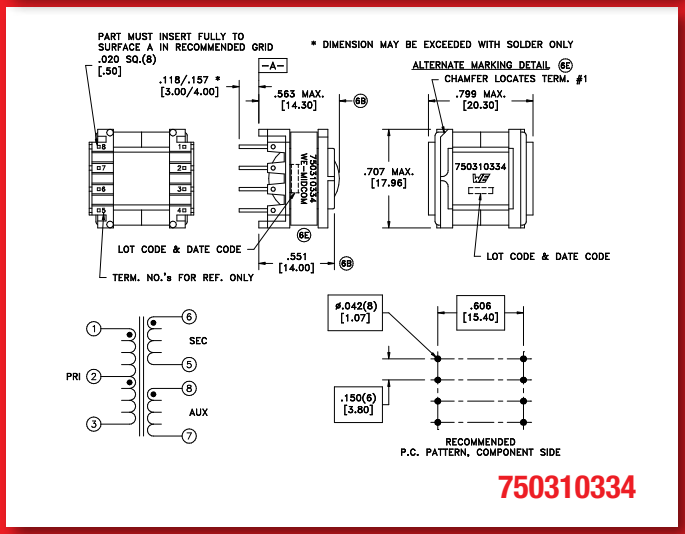
Midcom

WÜRTH ELEKTRONIK





750310787



750310334

Dimmable 6W LED Driver

- Household light bulb replacement
- TPS92010EVM-592 for 100-130V_{RMS}
- TPS92010EVM-631 for 185-265V_{RMS}
- 14-18V output at 340mA
- TRIAC compatible dimming
- Constant current to LEDs
- Modifiable output current

750310787 Flyback Transformer for 100-130V_{RMS}

750310334 Flyback Transformer for 185-265V_{RMS}

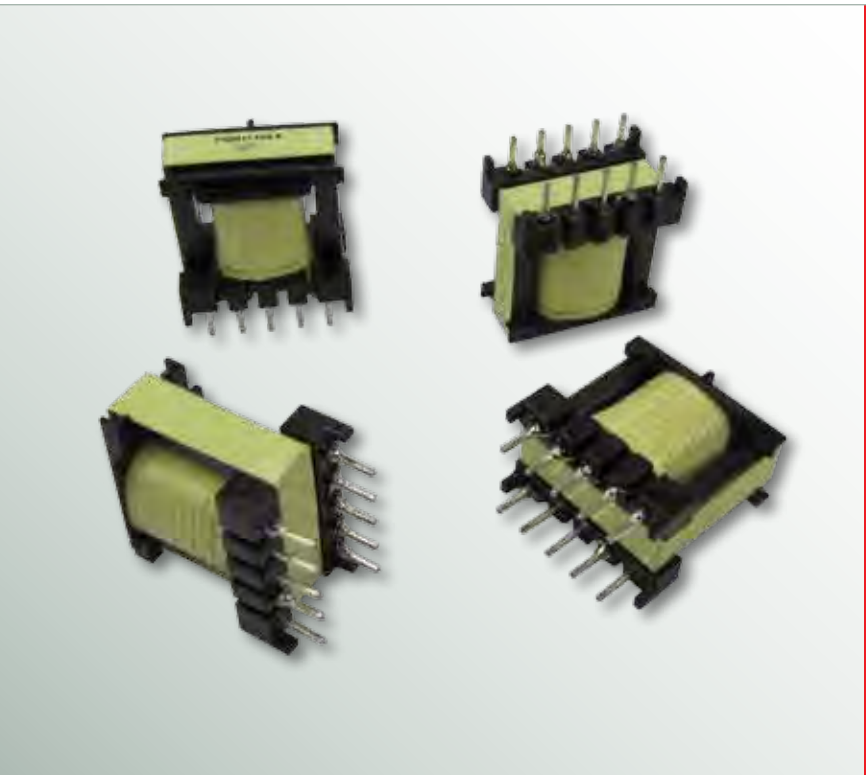
- Compact, high energy design
- Low copper losses
- Operating temperature: -40°C to 125°C
- Functional insulation to IEC60950-1 requirements
- Package style: EE16/8/5

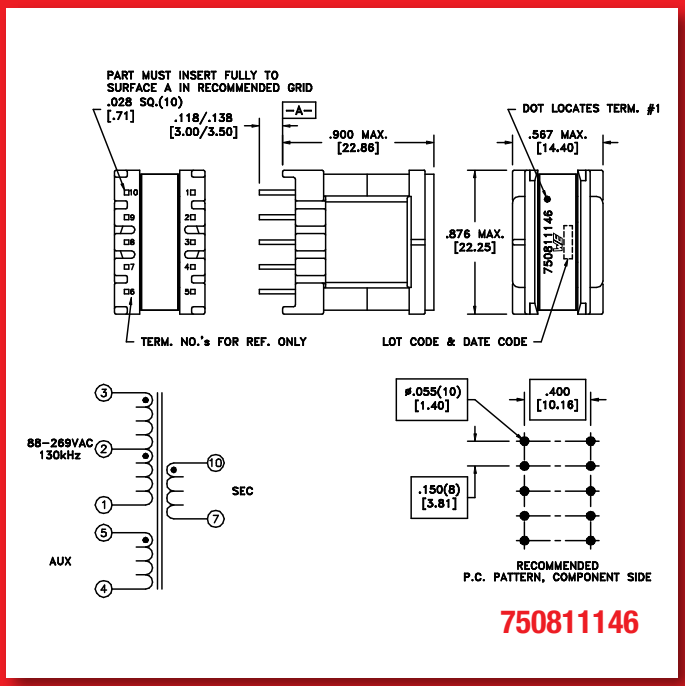
750310784 Common Mode Choke for US and Europe

- Inductance of 50mH minimum
- Rated current of 170mA
- Very high common mode impedance
- Operating temperature: -40°C to 125°C
- Package style: EP7

TEXAS INSTRUMENTS

Texas Instruments
TPS92210-PMP6001





38V, 350mA Non-Dimmable LED Driver

- Non-dimmable light bulb replacement
- Input voltage: 90-265V_{RMS}
- 38V at 350mA
- Single stage power factor correction
- Isolated discontinuous flyback topology

750811146 Flyback Transformer

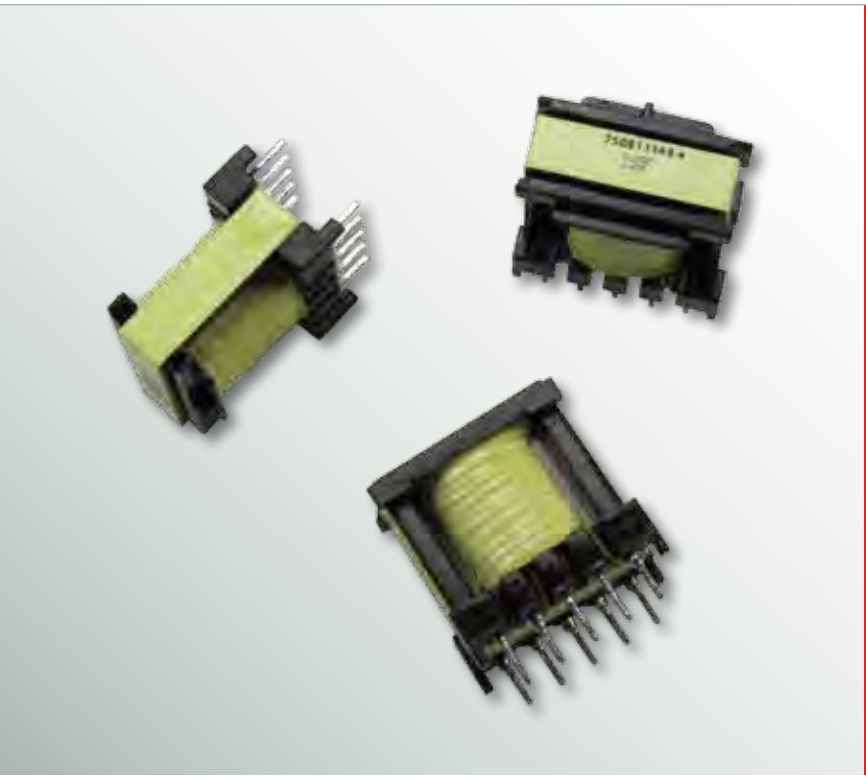
- Compact high energy design
- Low copper losses
- Operating temperature: -40°C to 125°C
- Reinforced insulation to IEC60950-1 requirements
- Package style: EE20/10/6

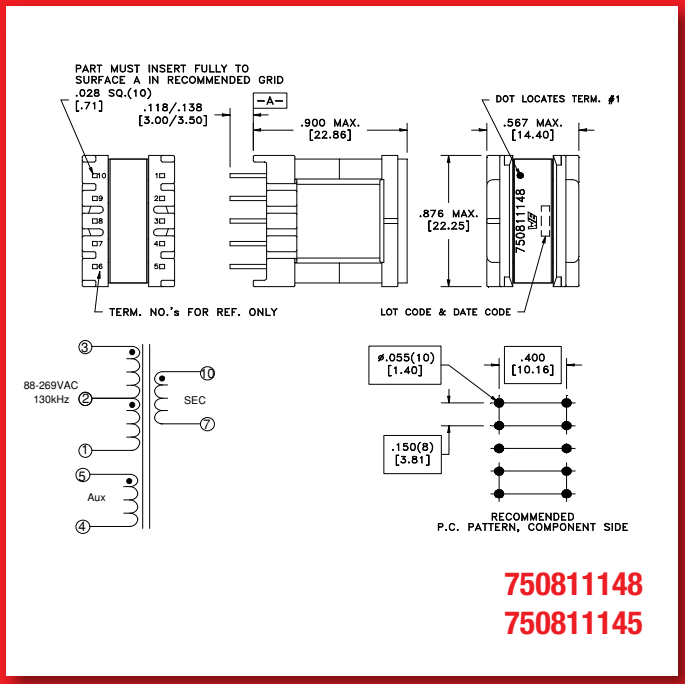
TEXAS INSTRUMENTS

Texas Instruments TPS92210

Midcom

WÜRTH ELEKTRONIK





750811148
750811145

32V Dimmable LED Driver

- Light bulb replacement
- TPS92210-PMP6002 for $120V_{AC}$
- TPS92210-PMP6003 for $230V_{AC}$
- Drive 10 high-brightness LEDs up to 11W
- High power factor correction
- Constant current control
- TRIAC dimming compatible

750811148 Flyback Transformer for $120V_{AC}$

750811145 Flyback Transformer for $230V_{AC}$

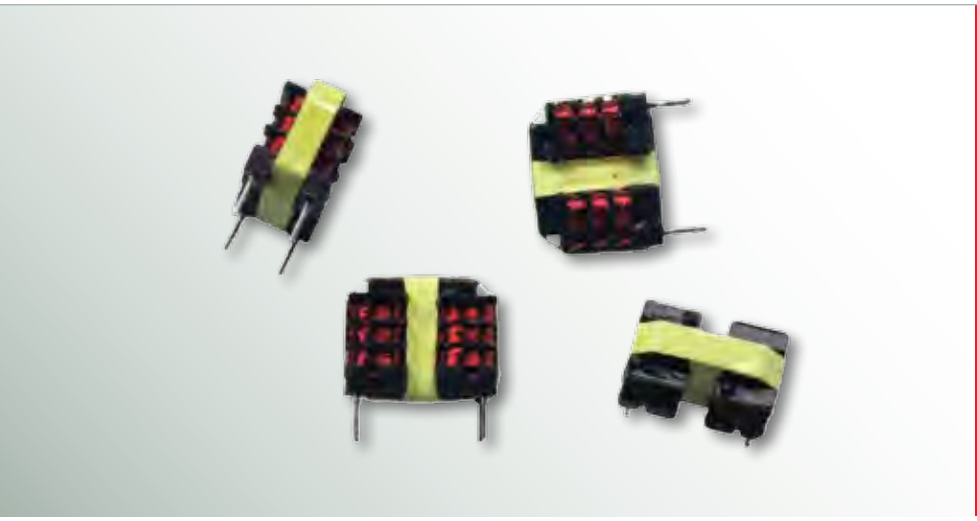
- High energy storage in compact package
- Low AC and DC copper losses
- Operating temperature: -40°C to 125°C
- Reinforced insulation to IEC60950-1
- Package style: EE20/10/6

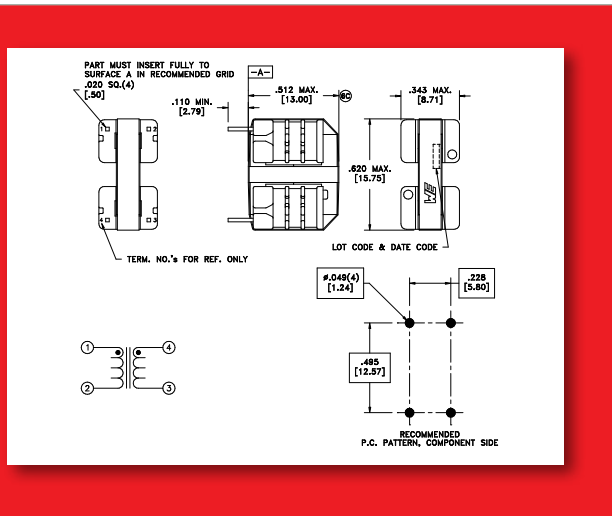
750311650 Common Mode Choke for US and Europe

- Common mode choke and differential mode choke all in one
- High differential inductance
- Reduces number of components
- Operating temperature: -40°C to 125°C

TEXAS INSTRUMENTS

Dual Coil
Common Mode Choke



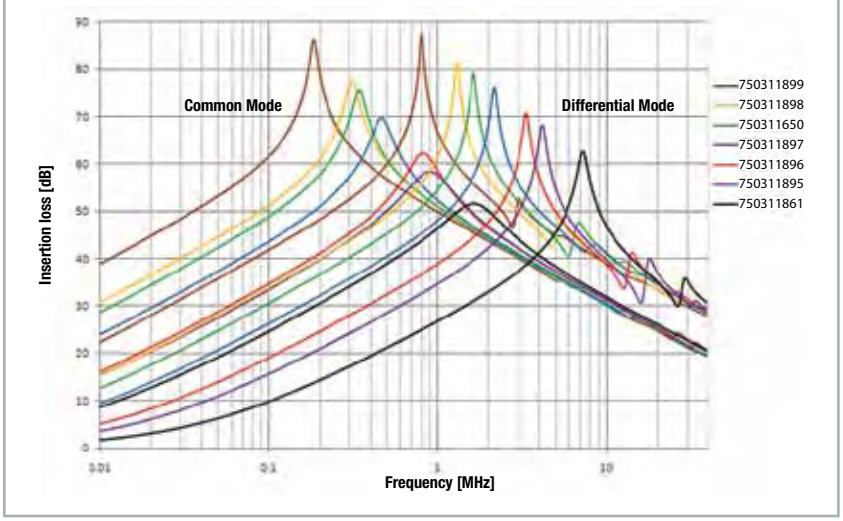


Electrical Properties

Part Number	L_{TYP} (mH)	$L_{LKG-MIN}$ (mH)	I_{SAT} [1] (mA)	I_{RMS} [2] (mA)	SRF_{TYP} (kHz)	DCR[3] (Ω)	Size LxWxH (mm)
750311861	2.5	0.3	800	760	1500	0.7	8.7 x 15.8 x 13.6
750311895	6	0.7	500	450	850	1.6	8.7 x 15.8 x 13.6
750311896	10	1.1	350	370	800	2.5	8.7 x 15.8 x 13.6
750311897	24	2.5	250	240	440	6.3	8.7 x 15.8 x 13
750311650	45	4	200	180	300	10	8.7 x 15.8 x 13
750311898	57	6.5	150	160	280	15.7	8.7 x 15.8 x 13
750311899	140	19	100	900	190	39	8.7 x 15.8 x 13

1. The current which causes 20% roll off from the inductance at no DC.
2. The heating current which causes a temperature rise of 40°C with no heat sinking.
3. Typical DCR is for one coil only; double this for both coils in series.

Common Mode and Differential Mode Attenuation



Characteristics

- Common mode and differential mode choke all-in-one
- High suppression of common mode and differential mode noise
- High differential inductance
- Extremely compact design
- Reduces number of components
- Small PCB footprint
- Operating temperature: -40°C to 125°C

Applications

- LED lighting
- CCFL lighting
- Offline switching power
- Suppression of both common and differential mode noise
- Filtering on device with unstable ground
- Power line input and output filters
- Power electronics
- Electronic ballasts
- White goods
- Power tools

WE-TFC
Common Mode Choke

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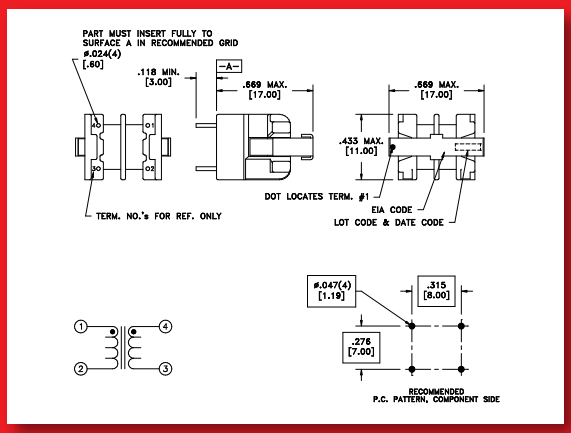
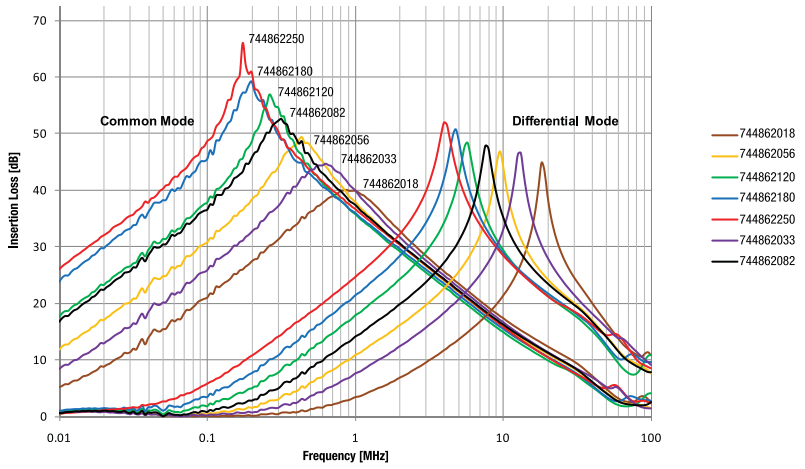


Electrical Properties

Part Number	Inductance (mH)	I_{RMS} (A)	SRF (kHz)	DCR max. (Ω)	Size LxWxH (mm)
744862018	1.8	1.0	1000	0.31	11 x 17 x 17
744862033	3.3	0.8	610	0.51	11 x 17 x 17
744862056	5.6	0.6	450	0.83	11 x 17 x 17
744862082	8.2	0.5	350	1.3	11 x 17 x 17
744862120	12	0.4	240	2.0	11 x 17 x 17
744862180	18	0.3	200	3.1	11 x 17 x 17
744862250	25	0.25	170	3.6	11 x 17 x 17

Common Mode and Differential Mode Attenuation



Characteristics

- Small size
- 4.0mm creepage between windings
- Operating temperature: -55°C to 105°C
- Cost effective
- High common mode and diferential mode impedance

Applications

- 110/240V_{AC} main-line applications
- Perfect for offline and LED applications
- CCFL lighting
- Filtering on device with unstable ground
- Power line input and output filters
- Power electronics
- Electronic ballasts
- White goods
- Power tools

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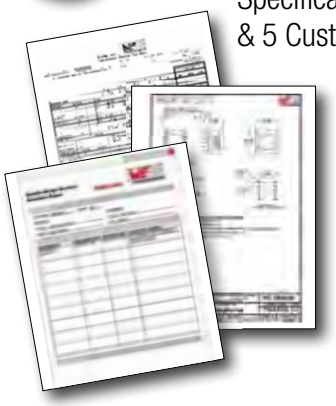

What applications are supported?

- Any applications that fit package styles
- Switch Mode Power:
  - Flyback
  - Forward
  - Push-Pull
  - Coupled Inductors
- Telecom Applications:
  - xDSL
  - POTS Splitter Inductors