

Application Note AN-60

LYTSwitch-0 Family



Design Guide

Introduction

The LYTSwitch-0 family combines a high-voltage power MOSFET with an ON/OFF controller into a single device. LYTSwitch-0 parts are completely self-powered from the DRAIN pin, have frequency jitter for low EMI and are fully fault protected. Auto-restart limits device and circuit dissipation during overload and output short-circuit. The LYT0002 IC is the only member of the family that does not have this feature. While over-temperature protection shuts down switching during thermal overload. The high thermal shutdown threshold is ideal for applications such as LED replacement bulbs where the ambient temperature is high, while the large hysteresis protects the PCB and surrounding components from high temperatures.

LYTSwitch-0 is designed for non-isolated drivers in LED lighting applications such as candelabra, GU10, A19, tubes, night lights, and emergency exit signs. LYTSwitch-0 can be configured to operate in all common lighting topologies giving a line or neutral referenced output or an inverted/non-inverted output (see Table 1).

Input current is passively shaped to meet US (0.7) and EU (0.55) power factor (PF) requirements.

Scope

This application note is for engineers designing a non-isolated power supply using the LYTSwitch-0 family of devices. This document describes the design procedure for a buck topology. Complete design procedure and guidelines are provided for the selection of the converter's key components.

Since the power MOSFET and controller are integrated into a single IC, the design process is greatly simplified. The buck configuration has few parts and a transformer is not required. In addition to this application note, a design spread-sheet is available within the PIXIs tool, which is part of the PI Expert™ suite design software. The designer may also find the LYTSwitch-0 Reference Design Kits (RDK) and Design Examples (DER) useful as examples of working power supplies. Further details of support tools and updates to this document can be found at www.power.com.

LYTSwitch-0 can be used in many topologies depending on the LED string voltage as shown in Table 1. However the buck converter is recommended whenever the LED string voltage is suitable as this gives the lowest overall system cost.

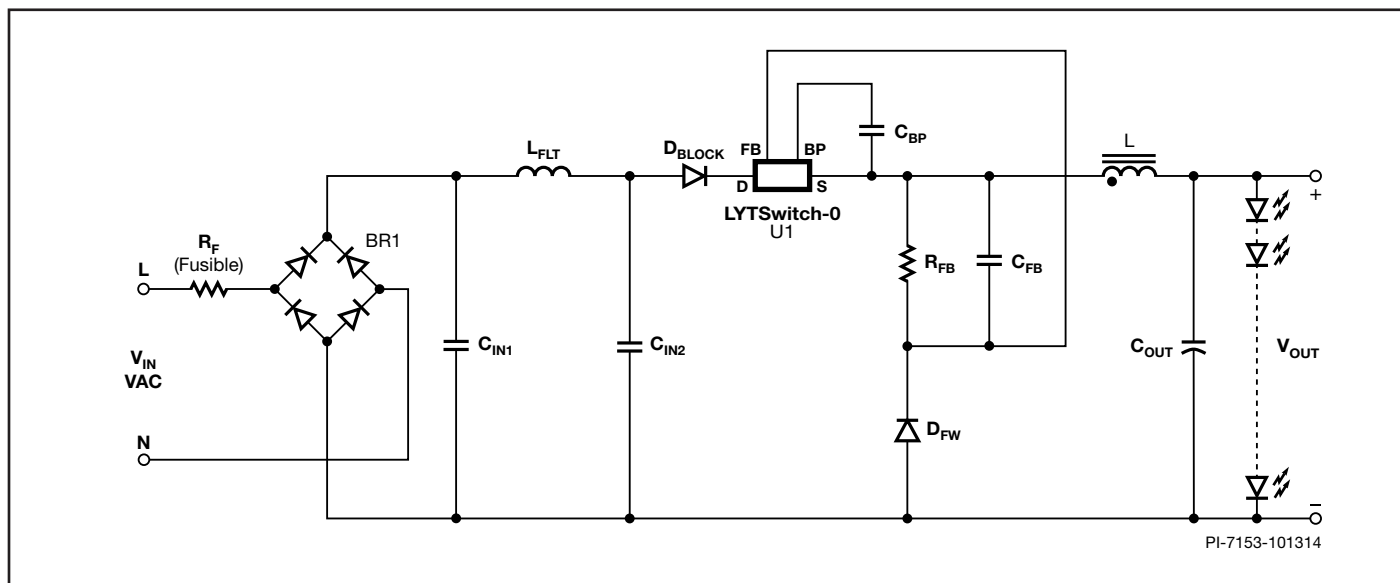


Figure 1. Typical LYTSwitch-0 LED Driver using the Buck Topology.

Topology	Basic Circuit Schematic	Key Features
High-Side Buck – Direct Feedback Constant Current LED Driver		<ul style="list-style-type: none"> Output referenced to input Positive output (V_O) with respect to $-V_{IN}$ Step down – $V_O < V_{IN}$ Low cost direct feedback (CC output $\pm 5\%$ typ.)
High-Side Buck-Boost – Constant Current LED Driver		<ul style="list-style-type: none"> Output referenced to input Negative output (V_O) with respect to $+V_{IN}$ Step up/down – $V_O > V_{IN}$ or $V_O < V_{IN}$ Low-cost direct feedback ($\pm 5\%$ typ.) Fail-safe – output is not subjected to input voltage if the internal power MOSFET fails Ideal for driving LEDs – better accuracy and temperature stability than high-side buck constant current LED driver
Low-Side Boost – Constant Current LED Driver		<ul style="list-style-type: none"> Output referenced to input Positive output (V_O) with respect to $-V_{IN}$ Step up – $V_O > V_{IN}$ Low-cost direct feedback ($\pm 5\%$ typ.) Ideal for driving high-voltage LEDs string – good accuracy and temperature stability

Table 1. Common Circuit Configurations Using LYTSwitch-0 for Driving LEDs.

Design Flow for Buck Converter

The buck converter topology results in the simplest and lowest cost designs. Figure 2 illustrates the design flow chart showing the complete design procedure.

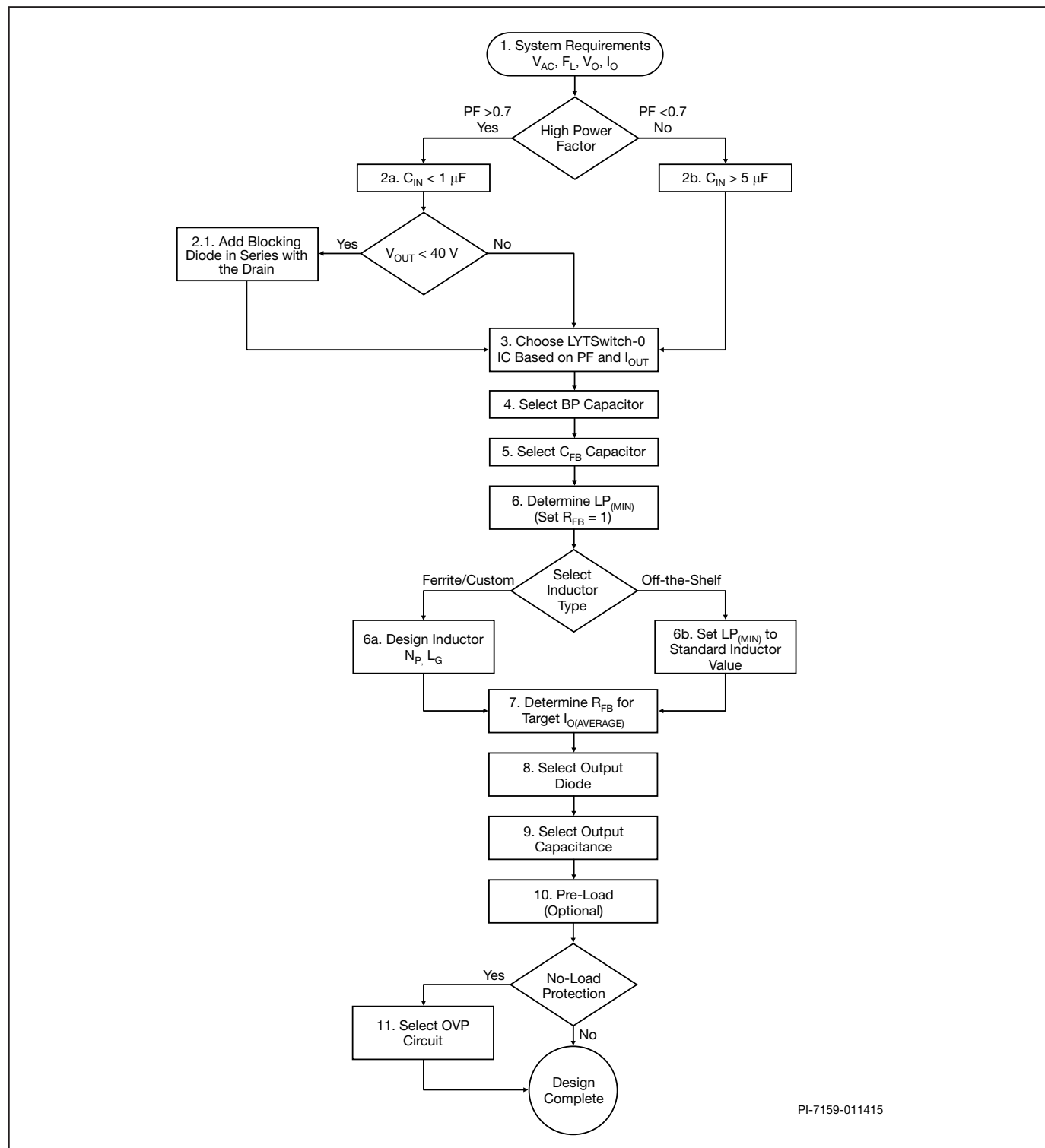


Figure 2. LYTSwitch-0 Design Flowchart.

LYTSwitch-0 Circuit Design

LYTSwitch-0 Operation

The basic circuit configuration for a buck converter using LYTSwitch-0 is shown in Figure 1.

To regulate the output, an ON/OFF control scheme is used as illustrated in Table 2. As the decision to switch is made on a cycle-by-cycle basis, the resultant power supply has extremely good transient response and removes the need for control loop compensation components. If feedback is not received for 50 ms, then the supply enters auto-restart (LYT0004, LYT0005 and LYT0006).

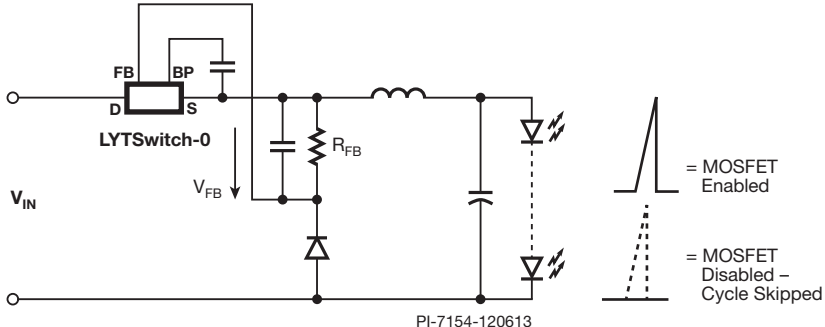
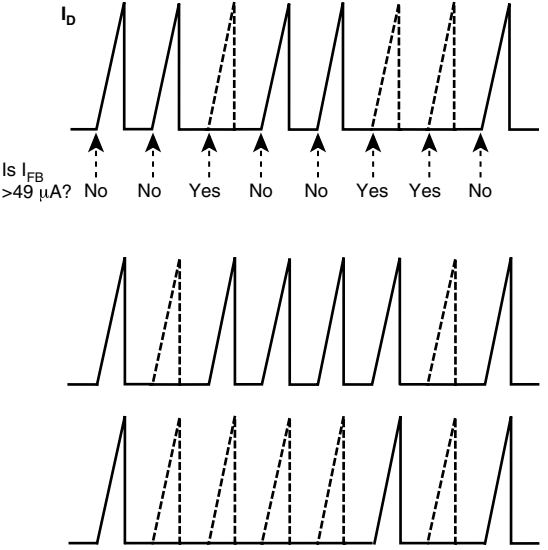
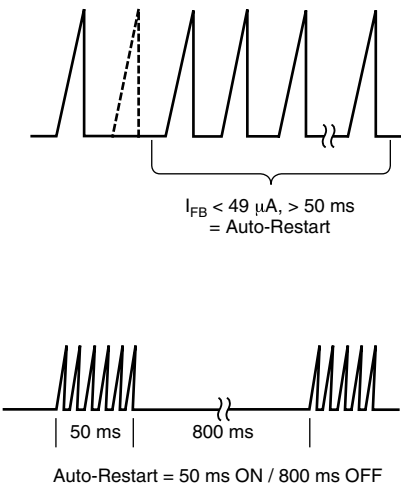
Reference Schematic and Key	 <p>PI-7154-120613</p>
Normal Operation	 <p>PI-3767-121903</p> <p>At the beginning of each cycle, the FEEDBACK (FB) pin is sampled.</p> <ul style="list-style-type: none"> • If $I_{FB} < 49 \mu A$ then next switching cycle occurs • If $I_{FB} > 49 \mu A$ ($V_{FB} > 1.65 V$) then next switching cycle is skipped <p>Low input voltage – few cycles skipped</p> <p>High input voltage – many cycles skipped</p>
Auto-Restart (LYT0004 to LYT0006 only)	 <p>PI-3768-083004</p> <p>$I_{FB} < 49 \mu A, > 50 ms$ = Auto-Restart</p> <p>Auto-Restart = 50 ms ON / 800 ms OFF</p> <p>If no feedback ($V_{FB} < 1.65 V$) for >50 ms, then output switching is disabled for approximately 800 ms.</p>

Table 2. LYTSwitch-0 Operation.

Output Voltage Range for Buck Converter

The recommended output voltage range for a buck converter is limited by the input voltage, bus voltage characteristic (DC or half sinusoidal waveform) and inductance.

Input Voltage Range (VAC)	V _{OUT} Range (V) (PF >0.5)	V _{OUT} Range (V) (PF <0.5)
90-265 or 90-132	25-70	12-120
190-265	25-125	12-180

Table 3. Buck Topology Output Voltage Range vs. Input Voltage and Desired PF.

Selecting the Conduction Operating Mode – MDCM and CCM Operation

At the start of a design, select either mostly discontinuous conduction mode (MDCM) or continuous conduction mode (CCM). This choice effects the selection of the LYTSwitch-0 device, freewheeling diode and inductor. MDCM is recommended, CCM can be chosen for applications that require the maximum output current from a given device size but device dissipation

will be higher. If there is a choice between two devices sizes, either the smaller in CCM or the larger in MDCM, selecting the larger in MDCM will give lower device temperature and higher efficiency. Table 4 summarizes the trade-offs between the two operating modes.

Additional differences between CCM and MDCM include better transient response for DCM and lower switching output ripple (for same capacitor ESR) for CCM. However these differences, for high PF (low C_{IN}) LYTSwitch-0 applications, are not normally significant.

The choice of conduction mode (CCM or MDCM) for a buck converter primarily depends on input voltage, output voltage, output current inductance and device current limit. For high input capacitance (low PF), the input voltage, output voltage and output current are fixed parameters. The current limit of the LYTSwitch-0 device and the power inductor (L) are the design parameters that can be used to set the conduction mode.

For low input capacitance (high PF) CCM, cycles will appear every half-line cycle when the rectified input voltage is low and the device is operating with a large duty cycle. The phrase “mostly discontinuous” is used with ON/OFF control, since a

Comparison of CCM and MDCM Operating Modes

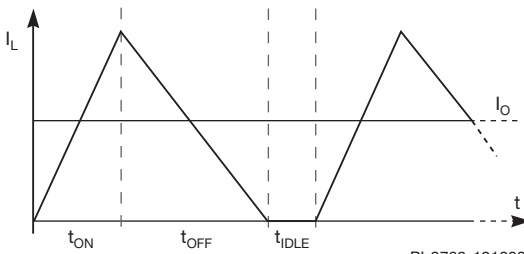
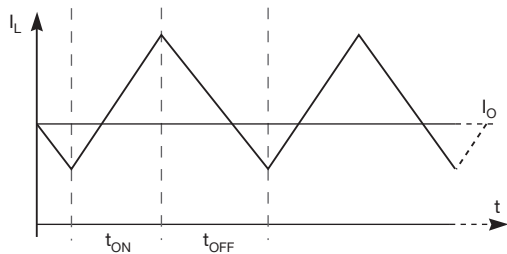
Operating Mode	MDCM	CCM
Operating Description	 <p>Inductor current falls to zero during t_{OFF}, borderline between MDCM and CCM when t_{IDLE} = 0. An enabled switching cycle immediately following a skipped cycle may be CCM.</p>	 <p>Current flows continuously in the inductor for the entire duration of a switching cycle.</p>
Inductor	Lower Cost Lower value, smaller size.	Higher Cost Higher value, larger size.
Freewheeling Diode	Lower Cost 75 ns ultrafast reverse recovery type. (≤35 ns for ambient temperature >70 °C).	Higher Cost 35 ns ultrafast recovery type required.
LYTSwitch-0	Potentially Higher Cost May require larger device to deliver required output current – depends on required output current. Lower device temperature.	Potentially Lowest Cost May allow smaller device to deliver required output current—depends on required output current. Higher device temperature.
Efficiency	Higher Efficiency Lower switching losses.	Lower Efficiency Higher switching losses.
Overall	Typically Lower Cost	Typically Higher Cost

Table 4. Comparison of Mostly Discontinuous Conduction (MDCM) and Continuous Conduction (CCM) Modes of Operation.

few switching cycles may exhibit continuous inductor current flow, but the majority of the switching cycles will be in discontinuous conduction mode.

Step-by-Step Design Procedure

Step 1 – Determine System Requirements VAC_{MIN} , VAC_{NOM} , VAC_{MAX} , V_o , I_o , f_L

Use Table 3 to confirm that for a given input voltage and PF, the required output voltage can be achieved. Use the values in Table 5 to enter VAC_{MIN} , VAC_{NOM} and VAC_{MAX} in the PIXIs spreadsheet.

Input Voltage Range	VAC_{MIN}	VAC_{NOM}	VAC_{MAX}
Low-Line Only	90	120	132
High-Line Only	190	230	265
Wide Range (Recommended only for low C_{IN} designs for best line regulation)	90	180	265*

Table 5. AC Input Voltage Ranges.

Line Frequency, f_L : 50 or 60 Hz

Output Voltage, V_o : in Volts

Output Current, I_o : in mA

*The converter can be designed to operate above 265 VAC provided that the maximum voltage rating for the DRAIN pin is not exceeded at any condition. Design above the minimum inductance to avoid hitting the absolute maximum rating of the DRAIN pin:

$$LP_{MIN} > L_{MIN(SOA)} = \frac{V_{IN(PEAK)}}{0.9 \times I_{D(PEAK)}} \times t_{ON(MIN)}$$

where:

LP_{MIN} : Minimum power inductance value including tolerance

$L_{MIN(SOA)}$: Minimum power inductance to avoid hitting absolute maximum drain current rating

$V_{IN(PEAK)}$: Maximum instantaneous peak input voltage

$I_{D(PEAK)}$: Absolute maximum peak drain current rating from data sheet

$t_{ON(MIN)}$: Minimum on-time

Step 2 – Design Input Stage

The input stage comprises fusible resistor(s), input rectification diodes and line filter network. The fusible resistor should be fusible, flameproof, and (depending on the differential line input surge requirements), a wire-wound type may be required. The fusible resistor(s) provides protection from catastrophic failure, inrush current limiting and attenuates differential mode noise. Input rectification should be achieved with a full-bridge to prevent visible shimmer. Use 4 discrete diodes (if space is available) or use a packaged full-bridge for a more compact design. For long life, optimum line regulation and high PF applications (passive approach; >0.7 at low-line and >0.5 at high-line), the use of a capacitance of <1 μF is recommended. Estimate the value for $C_{IN(Total)}$ ($C_{IN1} + C_{IN2}$) in Table 6. Larger values of C_{IN1} reduce the differential mode EMI noise of the driver. However make $C_{IN1} \ll C_{IN2}$ so that RMS input current is minimized. Adjust these values depending on the actual performance of the unit.

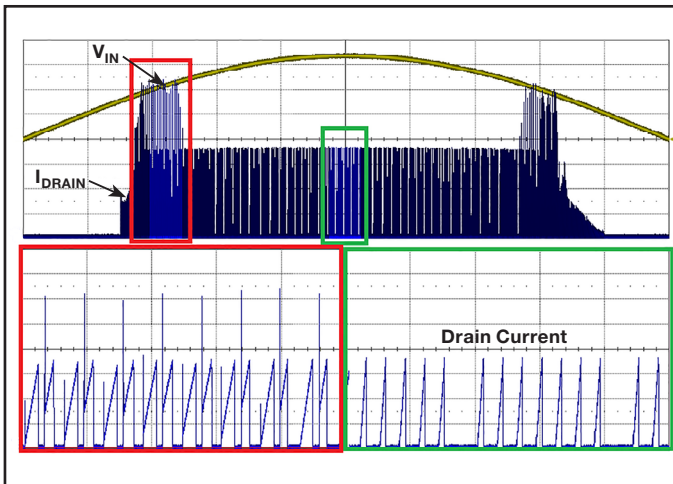
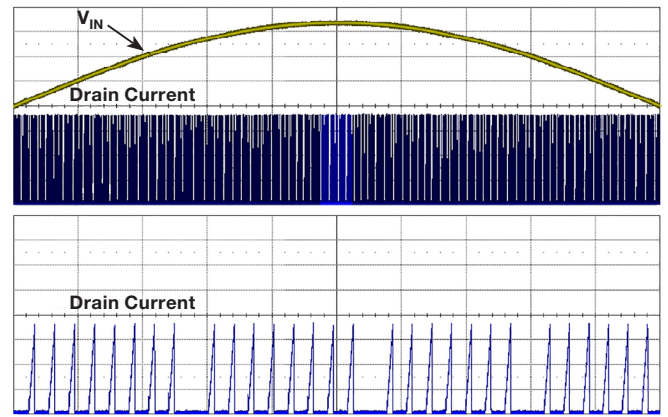
If the application does not require a high power factor, then the use of high input capacitance is appropriate. An electrolytic capacitor is lower cost than film type capacitor and may also eliminate the need for a MOV in the input to pass 2.5 kV differential ring wave and 500 V differential line surge. Another advantage is that the output current regulation ($\pm 5\%$ at nominal input voltage) over the operating temperature range (-20 °C to +125 °C) is better. The recommended capacitance is 1 μF / W for high-line only (HLO) and 2 μF / W for low-line only (LLO) or wide-range applications.

Output Power (W)	Input Voltage	Output Voltage (VDC)	L1 Filter	$\approx C_{IN1}$	$\approx C_{IN2}$	$\approx C_{IN(TOTAL)}$
2-3	Low-Line (PF >0.7)	>38 V	4.7 mH	22 nF	100 nF	122 nF
2-3	High-Line (PF >0.5)	>25 V	4.7 mH	22 nF	330 nF	352 nF
2-3	Wide Range	>43 V	4.7 mH	22 nF	100 nF	122 nF
3-5	Low-Line (PF >0.7)	>36 V	2.2 mH	22 nF	220 nF	242 nF
3-5	High-Line (PF >0.5)	>25 V	4.7 mH	47 nF	680 nF	727 nF
3-5	Wide Range	>36 V	4.7 mH	33 nF	220 nF	253 nF
5-7	Low-Line (PF >0.7)	>31 V	4.7 mH	47 nF	470 nF	517 nF
5-7	High-Line (PF >0.5)	>25 V	4.7 mH	47 nF	680 nF	727 nF
6-8	Low-Line (PF >0.7)	>44 V	4.7 mH	47 nF	330 nF	377 nF
6-8	Wide Range	>50 V	4.7 mH	47 nF	330 nF	377 nF
>7	High-Line (PF >0.5)	>50 V	4.7 mH	47 nF	470 nF	517 nF

Table 6. Reference Table for Input Capacitance Estimation for use in the Design Spreadsheet.

Parameter	Low $C_{IN(TOTAL)} < 1 \mu F$	High $C_{IN(TOTAL)} > 5 \mu F$
Power Factor	High	Low
Line Regulation	Best	Good (single input voltage range)
Output Current Temperature Variation	Good	Best
Line Surge	MOV required for > 500 V	MOV not required
Film Capacitor for Longer Life	Yes	No
EMI	Good	Best
Output Current Ripple	High	Low
Blocking Diode in Series with the DRAIN Pin Required	Yes (if $V_{OUT} < 40 V$)	No
Output Voltage Selection Range	Limited (Table 6)	Wider (Table 3)
Cost	Low	Lowest

Table 7. Input Capacitance Comparison.

Figure 3. Drain Current Waveform for Low C_{IN} . There is Always Some Continuous Mode Operation.Figure 4. Sample Drain Current Waveform for High C_{IN} .**Step 2.1 – Blocking Diode D_{BLOCK} ($V_{OUT} < 40 V$)**

For low input capacitance, add a blocking diode in series with the device in order to avoid reverse current during start-up and turn-off. The diode should be $\geq 200 V$ rated with a $t_{rr} \leq 150 ns$.

Device	Blocking Diode
LYT0002-5	BAV21 or Equivalent
LYT0006	RS1D or Equivalent

Table 8. Blocking Diode Reference for Designs with $V_{OUT} < 40 V$.**Step 3 – Select LYTSwitch-0 Device Based on Output Current and Current Limit**

Decide on the operating mode – refer to Table 4.

For MDCM operation, the output current (I_O) should be less than or equal to half the value of the minimum current limit of the chosen device from the data sheet.

$$I_{LIMIT_MIN} \geq 2 \times I_{OUT}$$

For CCM operation, the device should be chosen such that the output current I_O is more than 50%, but less than 80% of the minimum current limit I_{LIMIT_MIN} .

$$0.5 \times I_{LIMIT_MIN} < I_{OUT} < 0.8 \times I_{LIMIT_MIN}$$

Please see the product data sheet for LYTSwitch-0 current limit values.

Step 4 – Select the Bypass Capacitor (C_{BP})

Use a minimum of $0.1 \mu F$, $16 V_{MIN}$ ceramic-type capacitor rated for $125^\circ C$.

Step 5 – Select the Feedback Capacitor (C_{FB})

Capacitor C_{FB} filters the voltage across R_{FB} , which is modulated by the ripple current. The value of C_{FB} should be large enough to minimize the ripple voltage applied to the FEEDBACK pin, especially in MDCM designs. A value of C_{FB} is selected such

that the time constant (t) of R_{SENSE} and C_{FB} is greater than 20 times that of the switching period (15 μs). The peak voltage seen by C_{FB} is $\approx V_{\text{FB}}$ (1.65 V). This also reduces the current sensing loss for R_{FB} by providing a parallel current path. Use a 22 μF , 10 V ceramic capacitor as a starting point.

Step 6 – Determine the Minimum Inductance for the Output Inductor

The PIXls spreadsheet tool in the PI Expert software design suite is used to calculate the exact minimum inductance value and RMS current rating. The minimum inductance is calculated to deliver 110% of the output current at minimum input voltage at open-loop (limit of regulation with all switching cycles enabled). Enter $R_{\text{FB}}=1$ to set the open-loop power calculation in the spreadsheet. Then use goal-seek or manually key in the LP_{MIN} until:

$$I_{O_VAC_MIN} = 1.1 \times I_{OUT}$$

Use this value as the minimum reference for the inductance value. Then:

$$LP_{\text{TYP}} = LP_{\text{MIN}} \times (1 + L_{\text{TOL}})$$

Where:

- $I_{O_VAC_MIN}$: Output current at minimum AC input voltage.
- LP_{TYP} : Nominal inductance of power inductor.
- LP_{TOL} : Tolerance of power inductor.

Step 7 – Select the Type of Output Inductor

Decide if a ferrite/custom or standard inductors will be used. (Use standard inductors if the typical calculated inductance is very close to that of the standard inductor.) Consider the case of the end design – will it create a potential magnetic flux short-circuit? If the enclosure is a fully enclosed metal case then it would be better to use a shielded core type. Table 9 provides standard inductor values. Select the next nearest (higher) inductance and current for the output specification. Consider the tolerance of standard drum core / “dog-bone” (I core) inductors and the drop in inductance as the current increases. Use a -20% tolerance to allow for worst-case conditions.

Standard Off-The-Shelf Inductor Values

680 μH	2.2 mH
820 μH	2.7 mH
1 mH	3.3 mH
1.2 mH	3.9 mH
1.5 mH	4.7 mH
1.8 mH	5.6 mH

Table 9. Standard Inductor Values.

It is recommended that the value of inductor chosen should be closer to LP_{MIN} than $1.5 \times LP_{\text{MIN}}$ due to lower DC resistance and higher RMS rating. The lower limit of 680 μH limits the maximum di/dt to prevent very high peak current values at 265 VAC input.

$$680 \mu\text{H} < LP_{\text{MIN}} < L < 1.5 \times LP_{\text{MIN}}$$

If size is a problem it is more appropriate to use a custom inductor. This helps to shield and maintain the inductance better than standard inductors.

After deciding the type of inductor, calculate the actual minimum inductance (LP_{MIN}). Then use this value in the PIXls.

Step 8 – Select the Feedback Sense Resistors (R_{FB})

The value of R_{FB} is selected such that the output current is regulated and optimized over line, when the voltage on the FEEDBACK pin reaches V_{FB} (1.65 V). This voltage is specified for a FEEDBACK pin voltage (V_{FB}) and a threshold sinking current of 49 μA .

Using the inductance in Step 6, R_{FB} can be calculated by goal-seek or by manually entering the closest value that will yield the $I_{O(AVERAGE)}$.

Output line regulation is estimated at the bottom of the PIXls spreadsheet.

*Note: During open-loop operation ($R_{\text{FB}}=1$), the output current rises with input voltage. Observe that as R_{FB} is increased there is a point where $I_{O(AVERAGE)}$ will start to go down. Increase R_{FB} until the target output current is reached. This avoids unwanted triggering of auto-restart during normal operation.

Power rating of R_{FB} is,

$$P_{RFB} = \frac{1.65 V^2}{R_{FB}}$$

Step 9 – Select the Freewheeling Diode

Typically for an LED lighting application, the internal ambient temperature of the driver is 80 $^{\circ}\text{C}$, an ultrafast diode type is recommended (with a $t_{\text{RR}} \leq 35 \text{ ns}$).

Select peak inverse voltage (PIV) with 25% margin for the freewheeling diode:

$$V_{\text{PIV}} > 1.25 \times V_{\text{MAX}}$$

The diode must be able to conduct the full load current. Thus:

$$I_F > 1.25 \times I_{OUT}$$

Step 10 – Select the Output Capacitor

There is no output capacitance limitation for this driver. It will operate from 100 nF up to the maximum amount of capacitance the board can accommodate. For a long life LED driver application, the driver can employ non-electrolytic output capacitors. To limit output capacitance, the maximum peak current to the LEDs will be equivalent to the current limit of the IC. For tube applications a 100 nF capacitor or a common mode choke may be required to reduce radiated and conducted noise due to the size of the LED string.

In some applications where the maximum LED current is limited, the use of electrolytic capacitor is recommended. In this case select the minimum capacitance with RMS current rating of 80% of I_{OUT} . The output current ripple is inversely proportional to the output capacitance and resistance of the LED load. It is recommended to finalize the design using the actual LED load.

With low input capacitance, the output current ripple is dominated by input line frequency. The output current ripple has a frequency of twice the input line frequency as shown in Figures 5 and 6 below.

For non-PF applications (high input capacitance), the output capacitor should be chosen based on the output current ripple requirement and is typically dominated by the ESR of the capacitor. It can be estimated as:

$$ESR_{MAX} = \frac{R_D \times I_{OUT_RIPPLE}}{I_{LIM}}$$

where R_D is the total resistance of LED load, I_{OUT_RIPPLE} is the maximum output ripple specification and I_{LIM} is the LYTSwitch-0 current limit. The capacitor ESR value should be specified at the switching frequency (66 kHz.)

Step 11 – Select the Pre-load Resistor (Optional)

A pre-load resistor is not necessary for LED driver applications unless fast output decay is needed to eliminate output persistence.

Step 12 – Select the Overvoltage Protection (Optional)

In actual operation (LED retrofit lamp), the load is always connected, so the OVP circuit can be omitted to save cost. To protect against output overshoot in the event of disconnected load during testing (in manufacturing), 40 VAC can be applied to the input; if no output current is measured then the load is not connected. This test will allow safe, non-destructive initial power-up of the board, without the need of an overvoltage protection circuit.

Figure 7 shows a simple and lowest cost approach is to add a Zener diode VR1 across the output terminals. In case of no-load, the Zener diode will fail short-circuit and protect the output capacitor. Zener short-circuit current will be limited by IC U1 current limit. Note that the Zener diode will need to be replaced after the overvoltage event.

Figure 8 shows an auto-recovery circuit once AC input is recycled for 2s, the unit will function normally once load is connected. Advantage is lowest no-load consumption and

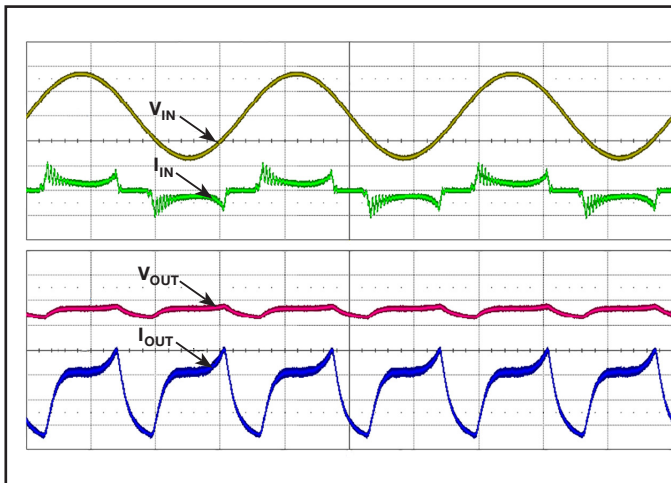


Figure 5. Sample Waveform of Low Input Capacitance.

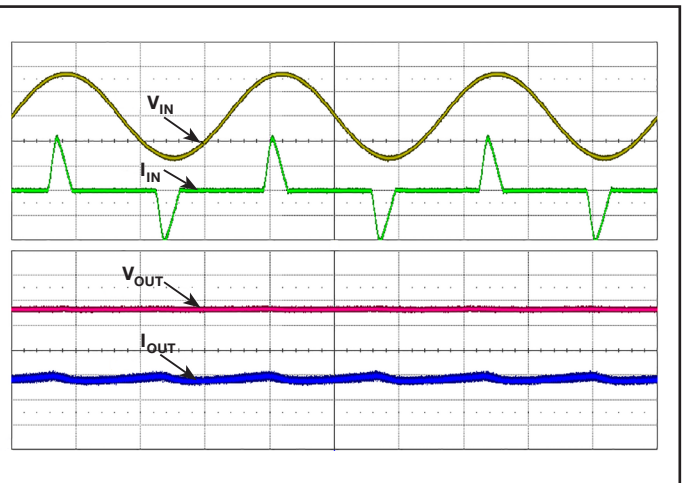


Figure 6. Sample Waveform of High Input Capacitance.

OVP Protection	Advantages	Disadvantages
Zener	<ol style="list-style-type: none"> 1. Cheapest and simple. 2. $V_{OUT} \approx 0$ V at no-load; safe. 	<ol style="list-style-type: none"> 1. Non-auto recovery. Requires Zener replacement to make driver functional.
SCR Latch	<ol style="list-style-type: none"> 1. Auto-recovery. 2. Lowest no-load consumption. 3. $V_{OUT} \approx 0$ V at no-load; safe. 	<ol style="list-style-type: none"> 1. Cost. 2. Requires AC recycle for recovery. <p>Note: Zener diode may also fail open-circuit after next AC power cycle.</p>
Constant Voltage Mode	<ol style="list-style-type: none"> 1. Hot-plug, load can be connected anytime. 	<ol style="list-style-type: none"> 1. Consumes extra power. 2. Residual voltage at no-load. 3. Cost.

Table 10. OVP Circuit Options Summary.

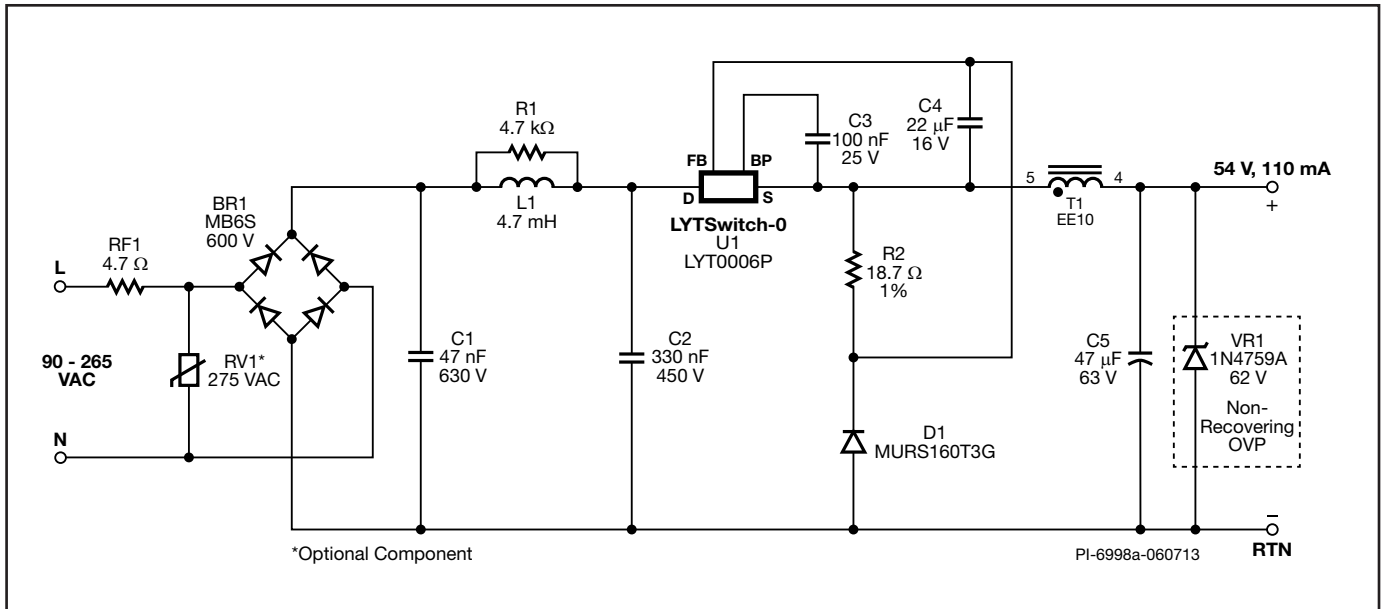


Figure 7. Lowest Cost Disconnected Load Protection using a Zener Diode.

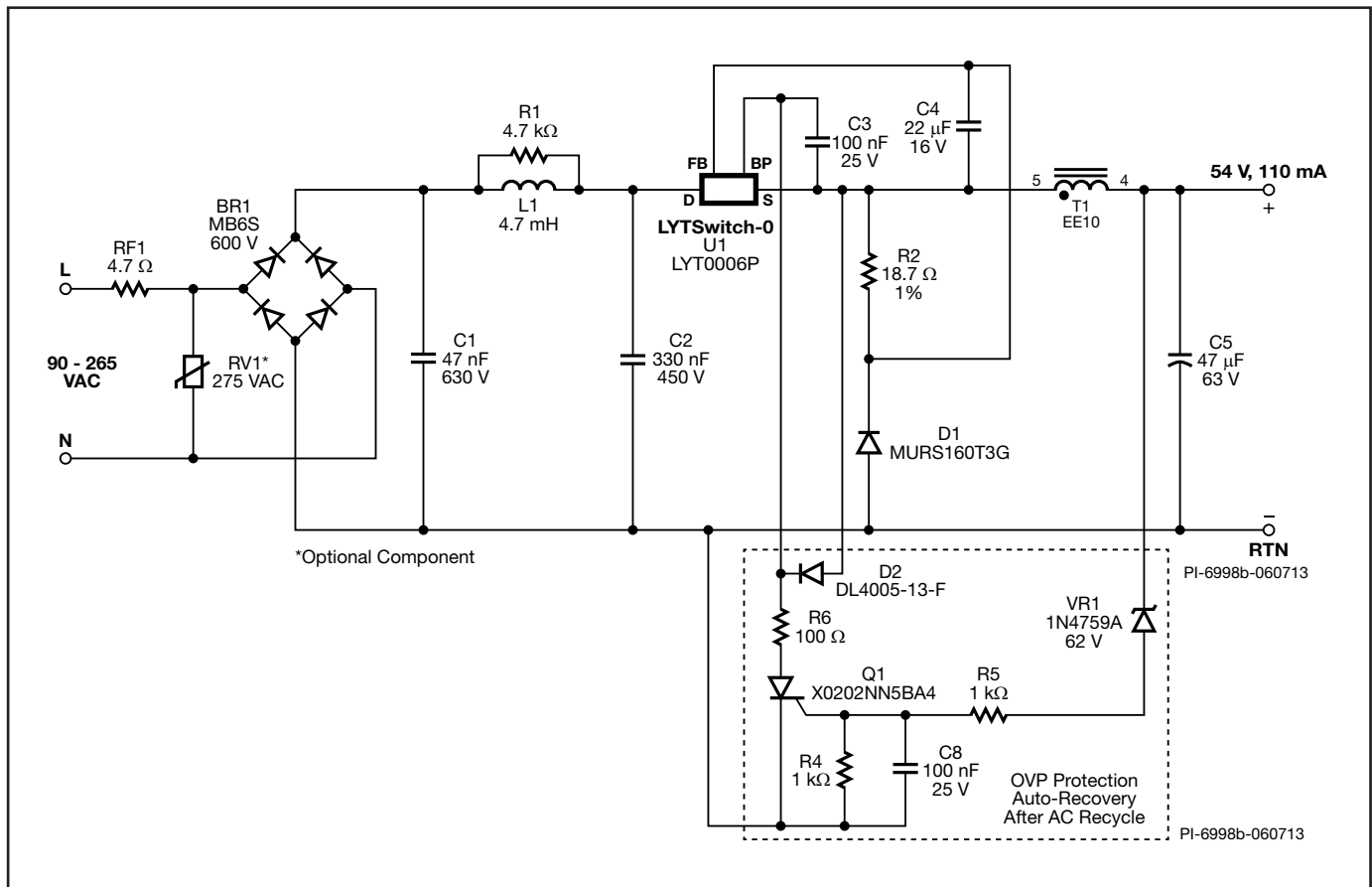


Figure 8. Auto-Recovering Disconnected Load Protection using a SCR.

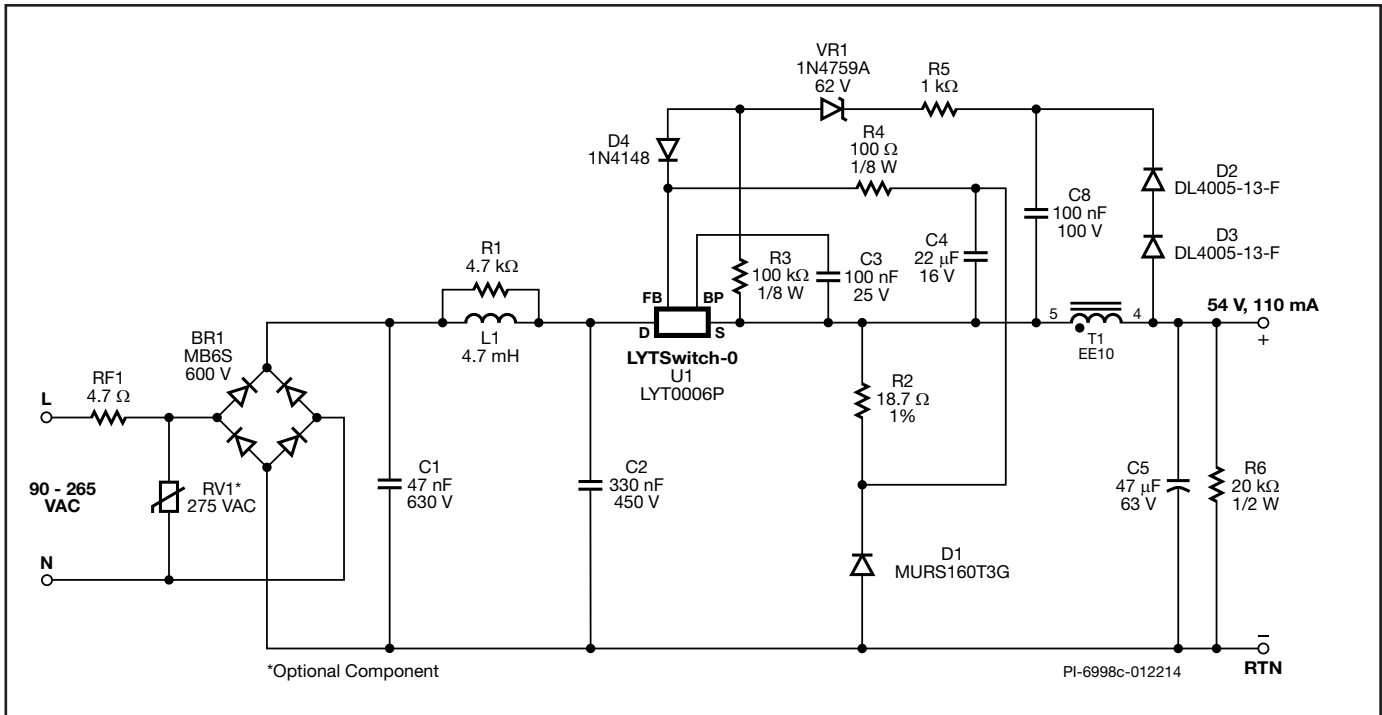


Figure 9. Constant Voltage (CV) Mode Disconnected Load Protection.

circuit is resettable.

Figure 9 shows the configuration for constant voltage operation. The load can be connected at time without AC recycle. A disadvantage is that the output needs some pre-load resistance which decreases efficiency. Pre-load can be replaced by an appropriately rated Zener in series with a resistor to improve efficiency.

Other Information

Optimum Output Voltage

Design the output voltage (LED string) within the optimum range (if possible) for most cost-effective design. For low-line only (LLO) the range is from 50 V to 70 V and for high-line only (HLO) it is between 80 V and 120 V.

Optimum Inductance

Design with the lowest inductance possible (MDCM) to minimize the switching losses due to the leading-edge spike from the output diode.

Always check the voltage rating of the inductor to avoid arcing between core and windings. Some standard inductors are rated below 200 V. Insulation damage and arcing could be a potential source of failure.

Audible Noise

Varnish magnetic components if audible noise occurs. Reduce inductance to future limit audible noise. Normally a drum choke is quiet due to controlled winding area and a more uniform coverage of the winding area.

Thermal Environment

To ensure good thermal performance the SOURCE pin should be kept below 100 °C. Build and test the power supply at the maximum operating ambient temperature and ensure that there is adequate thermal margin.

All parts should be rated above 100 °C temperature rating when used in a lamp design.

Derate all resistors according to the maximum operating temperature. Normally the power rating for a resistor will start to roll-off above 70 °C.

Recommended Layout Considerations

Traces carrying high currents should be as short and as wide as possible. These are the traces which connect the input capacitor, LYTSwitch-0 and freewheeling diode.

Most off-the-shelf inductors are “drum-core” or “dog-bone” type. These type of inductors are not shielded and can be a source of differential noise coupling. Consider placing the inductors away as far as possible from the AC inputs and EMI filters.

Position the non-shielded EMI filter inductors away from the bayonet/screw base (lamp application) to avoid shorting of the magnetic flux of the inductor.

Revision	Notes	Date
A	Initial Release.	01/15

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2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

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