

Selecting Inductors to Drive LEDs



Application Design Example

LED lighting is an exciting and fast growing application. LEDs can provide low cost, reliable lighting for a wide variety of applications ranging from architectural and automotive to signage and handheld devices. The designer faces the challenge of choosing from a vast array of LED manufacturers and device styles. Equally challenging can be the selection of components for the LED driver circuit. Fortunately, powerful tools are available that greatly facilitate the power inductor selection.

Since LED applications can use LEDs individually as well as parallel or serial arrays, the driver circuit may need to be a voltage step-up, step-down, or both. The **Coilcraft DC-DC Optimizer** tool (<https://www.coilcraft.com/en-us/tools/dc-dc-optimizer/#/search>) can be used to select the inductor for all of these driver circuit configurations.

Buck Converter Example

This example demonstrates the use of the **Coilcraft DC-DC Optimizer** tool to select the inductor for a Texas Instruments Buck LED driver reference design based on the LED Driver TPS92515-Q1. This design is for a high-brightness LED and features a wide input voltage,

PWM dimming, and an analog dimming capability.

The design has a switching frequency of 125 kHz and an input voltage of 5.5 to 65 V. Electrical performance specifications are:

- Fsw = 125 kHz
- Vin = 5.5 to 65 Vdc
- Vo = Vled = 22 V
- Io = 1000 mA

This is all the information needed to proceed to the **Coilcraft DC-DC Optimizer** tool. The first step is to identify **Buck** as the driver circuit topology.

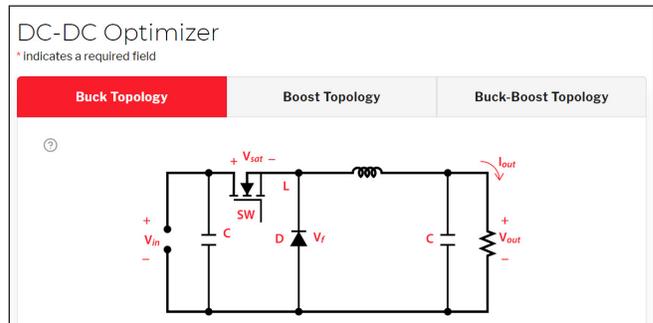


Table 1. Typical White LEDs

Company	Part Number	Vf (V)	Io (mA)	Color	Url
Nichia	NJSW170C	3.0	350	White	www.nichia.com
Osram Opto	KW DPLS31.SB	3.05	120	White	www.osram.com
Everlight	A09K-C71501H-AM	3.1	150	Cool White	www.everlight.com
Samsung	SPMWHT346EA3	3.5	140	White	www.samsung.com/led/
Seoul Semiconductor	SZ8-Y11-W0	2.8	150	White	www.seoulsemicon.com
Cree	JE2835 3V	3.0	150	White	www.cree.com

The second step requires inputting the operating parameters: V_{in} , V_{out} , I_{out} , switching frequency and the selection of the allowed peak-peak ripple current.

DC-DC Optimizer
* Indicates a required field

Buck Topology Boost Topology Buck-Boost Topology

Required

V_{in} Minimum * V_{in} Maximum * V_{out} * I_{out} Maximum *
 65 V 65 V 22 V 1 A

Frequency * V_{sat} * V_f * Temperature *
 580 kHz 0.3 V 0.3 V 25 °C

Note the input voltage as well as the output current and voltage are specified as part of the design requirement. The switching frequency may represent some design freedom if a driver IC is not yet selected, but generally the only degree of freedom in selecting the inductor value is the amount of ripple current to be allowed.

As the default setting, the **DC-DC Optimizer** tool calculates the ripple current for each inductor in the tool. As an option, a specific ripple percentage can be entered into the tool. In this example, the design uses a 1 Amp solution with 45% peak-peak inductor ripple current.

Optional

Choosing ripple percentage is a good starting point, but may limit the inductor choice. **Simply leave the input box blank and click "Find Inductors" below to see a full list of inductors and the ripple current for each one.**

Or enter a specific ripple percentage and click "Find Inductors" to see the inductors associated with that ripple current.

Optional ΔI_L ?
 %

From these inputs, the Coilcraft **DC-DC Optimizer** tool calculates the resulting ripple current for each inductor in the tool within a range of the entered ripple current.

Part Number	L nominal (µH)	L actual at load (µH)	Ipeak (A)	ΔI_L (%)	I _{sat} (A)	I _{rms} (A)	DCR Typ @ 25°C (mΩ)	Total losses (mW)	Part temp. (°C)	Temp. rating	Length (mm)	Width (mm)	Height (mm)	Mount	Shielded
<input type="checkbox"/> Sample Buy XTL6060-473	470	429	1.3	57%	1.8	3.7	68.4	126	31°C	165°C	6.76	6.56	6.1	SM	Yes
<input type="checkbox"/> Sample Buy MST2348-473	470	361	1.3	60%	1.4	1.6	132	298	118°C	125°C	7.3	7.3	4.8	SM	Yes
<input type="checkbox"/> Sample Buy XAL7050-473	470	437	1.3	56%	3.5	3.5	105	825	51°C	165°C	8.0	7.7	5.0	SM	Yes
<input type="checkbox"/> Sample Buy LPS8045B-473	470	446	1.3	56%	1.8	1.5	153	220	49°C	125°C	8.08	8.08	4.7	SM	Yes
<input type="checkbox"/> Sample Buy LPS8045B-683	680	640	1.2	39%	1.4	1.4	193	225	51°C	125°C	8.08	8.08	4.7	SM	Yes
<input type="checkbox"/> Sample Buy XAL8080-473	470	451	1.3	55%	4.4	4.7	73.3	365	34°C	165°C	8.8	8.3	8.0	SM	Yes
<input type="checkbox"/> Sample Buy MSS1038-473	470	431	1.3	57%	2.2	2.2	115	382	52°C	125°C	10.5	10.2	4.0	SM	Yes
<input type="checkbox"/> Sample Buy MSS1038-563	560	515	1.2	48%	2.0	1.9	162	322	52°C	125°C	10.5	10.2	4.0	SM	Yes
<input type="checkbox"/> Sample Buy MSS1038-683	680	611	1.2	40%	1.8	1.8	192	225	51°C	125°C	10.5	10.2	4.0	SM	Yes
<input type="checkbox"/> Sample Buy MSS1038-823	820	732	1.2	34%	1.6	1.5	235	331	55°C	125°C	10.5	10.2	4.0	SM	Yes

With multiple results, the user may optimize the inductor selection based on criteria specific to the application. The tool allows a quick sort of the results by user-selected parameters. For example, for a handheld mobile device or backlight display, component height may be the most important criterion.

Part Number	L nominal (µH)	L actual at load (µH)	Ipeak (A)	ΔI_L (%)	I _{sat} (A)	I _{rms} (A)	DCR Typ @ 25°C (mΩ)	Total losses (mW)	Part temp. (°C)	Temp. rating	Length (mm)	Width (mm)	Height (mm)	Mount	Shielded
<input type="checkbox"/> Sample Buy DO3308P-473	470	451	1.3	55%	1.3	1.0	288	340	72°C	125°C	12.95	9.4	3.0	SM	No
<input type="checkbox"/> Sample Buy MSS1038-473	470	431	1.3	57%	2.2	2.2	115	382	52°C	125°C	10.5	10.2	4.0	SM	Yes
<input type="checkbox"/> Sample Buy MSS1038-563	560	515	1.2	48%	2.0	1.9	162	322	52°C	125°C	10.5	10.2	4.0	SM	Yes
<input type="checkbox"/> Sample Buy MSS1038-683	680	611	1.2	40%	1.8	1.8	192	225	51°C	125°C	10.5	10.2	4.0	SM	Yes
<input type="checkbox"/> Sample Buy MSS1038-823	820	732	1.2	34%	1.6	1.5	235	331	55°C	125°C	10.5	10.2	4.0	SM	Yes
<input type="checkbox"/> Sample Buy MSS1038T-473	470	445	1.3	56%	2.2	2.2	115	371	52°C	165°C	10.5	10.2	4.0	SM	Yes
<input type="checkbox"/> Sample Buy MSS1038T-563	560	519	1.2	49%	2.0	1.9	162	324	52°C	165°C	10.5	10.2	4.0	SM	Yes
<input type="checkbox"/> Sample Buy MSS1038T-683	680	633	1.2	39%	1.8	1.8	192	265	50°C	165°C	10.5	10.2	4.0	SM	Yes
<input type="checkbox"/> Sample Buy MSS1038T-823	820	743	1.2	33%	1.6	1.5	235	286	54°C	165°C	10.5	10.2	4.0	SM	Yes
<input type="checkbox"/> Sample Buy LPS8045B-473	470	446	1.3	56%	1.8	1.5	153	202	49°C	125°C	8.08	8.08	4.7	SM	Yes

If extra margin in the current rating to prevent inductor saturation is preferred, sorting by I_{sat} is recommended.

Part Number	L nominal (µH)	L actual at load (µH)	Ipeak (A)	ΔI_L (%)	I _{sat} (A)	I _{rms} (A)	DCR Typ @ 25°C (mΩ)	Total losses (mW)	Part temp. (°C)	Temp. rating	Length (mm)	Width (mm)	Height (mm)	Mount	Shielded
<input type="checkbox"/> Sample Buy DO5040H-473	470	470	1.3	54%	7.8	3.7	46.8	56	28°C	125°C	18.54	15.24	12.0	SM	No
<input type="checkbox"/> Sample Buy MSS1583-473	470	469	1.3	54%	7.3	3.7	48.0	142	34°C	125°C	15.5	15.5	8.6	SM	Yes
<input type="checkbox"/> Sample Buy DO5040H-683	680	680	1.2	37%	6.7	3.4	60.3	56	29°C	125°C	18.54	15.24	12.0	SM	No
<input type="checkbox"/> Sample Buy MSS1583-683	680	678	1.2	37%	6.0	3.4	61.0	126	32°C	125°C	15.5	15.5	8.6	SM	Yes
<input type="checkbox"/> Sample Buy MSS1210-473	470	466	1.3	54%	5.8	3.0	48.0	140	38°C	125°C	12.3	12.3	10.2	SM	Yes
<input type="checkbox"/> Sample Buy MSS1278T-473	470	468	1.3	54%	5.7	2.9	72.3	123	36°C	165°C	12.3	12.3	8.05	SM	Yes
<input type="checkbox"/> Sample Buy SER2211-473	470	469	1.3	54%	5.6	10.6	8.9	112	29°C	125°C	22.5	19.2	10.5	SM	Yes
<input type="checkbox"/> Sample Buy MSS1278-473	470	468	1.3	54%	5.3	2.9	72.3	165	36°C	125°C	12.3	12.3	8.05	SM	Yes
<input type="checkbox"/> Sample Buy MSS1278T-563	560	558	1.2	45%	5.3	2.7	80.2	159	36°C	165°C	12.3	12.3	8.05	SM	Yes
<input type="checkbox"/> Sample Buy MSS1278-563	560	567	1.2	45%	4.9	2.7	80.2	153	35°C	125°C	12.3	12.3	8.05	SM	Yes

More importantly, you can sort by total loss (DC loss + AC loss) to select an inductor that provides the best power efficiency for your application.

Part Number	L nominal (µH)	L actual at load (µH)	Ipeak (A)	ΔI_L (%)	I _{sat} (A)	I _{rms} (A)	DCR Typ @ 25°C (mΩ)	Total losses (mW)	Part temp. (°C)	Temp. rating	Length (mm)	Width (mm)	Height (mm)	Mount	Shielded
<input type="checkbox"/> Sample Buy DO5040H-473	470	470	1.3	54%	7.8	3.7	46.8	56	28°C	125°C	18.54	15.24	12.0	SM	No
<input type="checkbox"/> Sample Buy DO5040H-683	680	680	1.2	37%	6.7	3.4	60.3	56	29°C	125°C	18.54	15.24	12.0	SM	No
<input type="checkbox"/> Sample Buy SER2211-473	470	469	1.3	54%	5.6	10.6	8.9	112	29°C	125°C	22.5	19.2	10.5	SM	Yes
<input type="checkbox"/> Sample Buy DO3340P-473	470	470	1.3	54%	3.8	1.6	99.0	121	35°C	105°C	12.95	9.4	11.43	SM	No
<input type="checkbox"/> Sample Buy MSS1583-683	680	678	1.2	37%	6.0	3.4	61.0	126	32°C	125°C	15.5	15.5	8.6	SM	Yes
<input type="checkbox"/> Sample Buy XTL6060-473	470	429	1.3	57%	1.8	3.7	68.4	126	31°C	165°C	6.76	6.56	6.1	SM	Yes
<input type="checkbox"/> Sample Buy MSS1210-683	680	673	1.2	38%	4.9	2.8	68.0	132	35°C	125°C	12.3	12.3	10.2	SM	Yes
<input type="checkbox"/> Sample Buy MSS1210-473	470	466	1.3	54%	5.8	3.0	48.0	140	38°C	125°C	12.3	12.3	10.2	SM	Yes
<input type="checkbox"/> Sample Buy MSS1210H-683	680	676	1.2	37%	3.6	3.4	56.0	144	34°C	165°C	12.3	12.3	10.2	SM	Yes
<input type="checkbox"/> Sample Buy MSS1583-473	470	469	1.3	54%	7.3	3.7	48.0	142	34°C	125°C	15.5	15.5	8.6	SM	Yes

The **Coilcraft DC-DC Optimizer** tool features the flexibility to help the user optimize the inductor selection based on the criteria most important to that application.

Conclusion

LED lighting is a growing and exciting application area and Coilcraft design tools can guide the designer quickly and easily to inductors best suited to a variety of applications.