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.

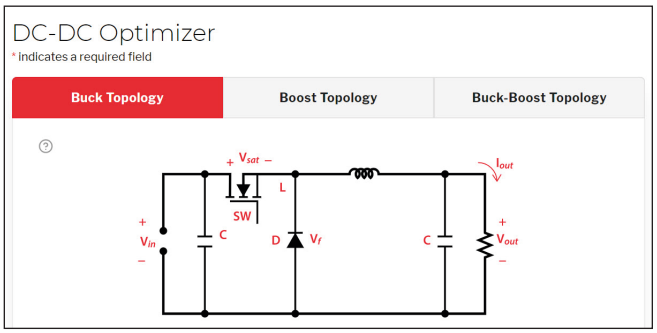
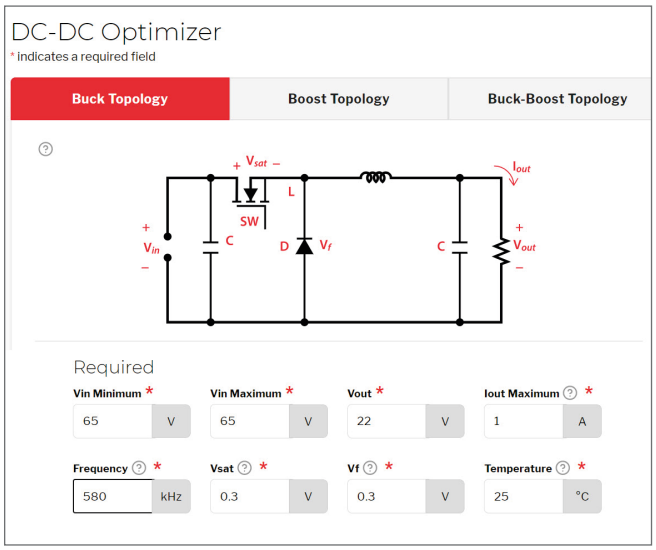


Table 1. Typical White LEDs

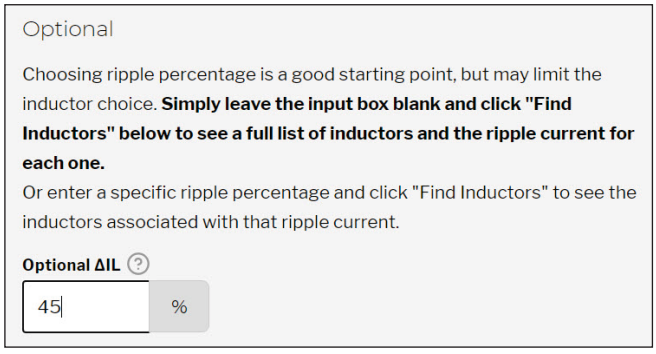
Company	Part Number	Vf (V)	Io (mA)	Color	Url
Nichia	NJSW170C	3.0	350	White	www.nichia.com
Osram Opto	KW DPLS31.SB	3.05	120	White	www.osram.com
Everlight	A09K-C71501H-AM	3.1	150	Cool White	www.everlight.com
Samsung	SPMWHT346EA3	3.5	140	White	www.samsung.com/led/
Seoul Semiconductor	SZ8-Y11-W0	2.8	150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

The second step requires inputting the operating parameters: Vin, Vout, Iout, switching frequency and the selection of the allowed peak-peak ripple current.



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.



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 Ipeak (µH)	I peak (A)	ΔIL%	Isat (A)	Irms (A)	DCR Typ @ 25°C (mΩ)	Total losses (mW)	Part temp. (°C)	Temp. rating	Length (mm)	Width (mm)	Height (mm)	Mount	Shielded
XFL6060-473	47.0	42.9	1.3	57%	1.8	3.7	68.4	126	31°C	165°C	6.76	6.56	6.1	SM	Yes
MSS7348-473	47.0	36.1	1.3	60%	1.4	1.6	132	788	118°C	125°C	7.3	7.3	4.8	SM	Yes
XAL7050-473	47.0	43.7	1.3	56%	3.5	3.5	105	825	51°C	165°C	8.0	7.7	5.0	SM	Yes
LPS8045B-473	47.0	44.6	1.3	56%	1.8	1.5	153	210	49°C	125°C	8.08	8.08	4.7	SM	Yes
LPS8045B-683	68.0	64.0	1.2	39%	1.4	1.4	193	229	51°C	125°C	8.08	8.08	4.7	SM	Yes
XAL8080-473	47.0	45.1	1.3	55%	4.4	4.7	73.3	365	34°C	165°C	8.8	8.3	8.0	SM	Yes
MSS1038-473	47.0	43.1	1.3	57%	2.2	2.2	115	382	52°C	125°C	10.5	10.2	4.0	SM	Yes
MSS1038-563	56.0	51.5	1.2	48%	2.0	1.9	162	377	52°C	125°C	10.5	10.2	4.0	SM	Yes
MSS1038-683	68.0	61.1	1.2	40%	1.8	1.8	192	375	51°C	125°C	10.5	10.2	4.0	SM	Yes
MSS1038-823	82.0	73.2	1.2	34%	1.6	1.5	235	391	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 Ipeak (µH)	I peak (A)	ΔIL%	Isat (A)	Irms (A)	DCR Typ @ 25°C (mΩ)	Total losses (mW)	Part temp. (°C)	Temp. rating	Length (mm)	Width (mm)	Height (mm)	Mount	Shielded
DO3308P-473	47.0	45.1	1.3	55%	1.3	1.0	288	340	72°C	125°C	12.95	9.4	3.0	SM	No
MSS1038-473	47.0	43.1	1.3	57%	2.2	2.2	115	382	52°C	125°C	10.5	10.2	4.0	SM	Yes
MSS1038-563	56.0	51.5	1.2	48%	2.0	1.9	162	377	52°C	125°C	10.5	10.2	4.0	SM	Yes
MSS1038-683	68.0	61.1	1.2	40%	1.8	1.8	192	375	51°C	125°C	10.5	10.2	4.0	SM	Yes
MSS1038-823	82.0	73.2	1.2	34%	1.6	1.5	235	391	55°C	125°C	10.5	10.2	4.0	SM	Yes
MSS1038T-473	47.0	44.5	1.3	56%	2.2	2.2	115	371	52°C	165°C	10.5	10.2	4.0	SM	Yes
MSS1038T-563	56.0	51.9	1.2	48%	2.0	1.9	162	374	52°C	165°C	10.5	10.2	4.0	SM	Yes
MSS1038T-683	68.0	63.3	1.2	39%	1.8	1.8	192	365	50°C	165°C	10.5	10.2	4.0	SM	Yes
MSS1038T-823	82.0	74.3	1.2	33%	1.6	1.5	235	386	54°C	165°C	10.5	10.2	4.0	SM	Yes
LPS8045B-473	47.0	44.6	1.3	56%	1.8	1.5	153	210	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 Isat is recommended.

Part Number	L nominal (µH)	L actual at Ipeak (µH)	I peak (A)	ΔIL%	Isat (A)	Irms (A)	DCR Typ @ 25°C (mΩ)	Total losses (mW)	Part temp. (°C)	Temp. rating	Length (mm)	Width (mm)	Height (mm)	Mount	Shielded
DO5040H-473	47.0	47.0	1.3	54%	7.8	3.7	46.8	56	28°C	125°C	18.54	15.24	12.0	SM	No
MSS1583-473	47.0	46.9	1.3	54%	7.3	3.7	48.0	149	34°C	125°C	15.5	15.5	8.6	SM	Yes
DO5040H-683	68.0	68.0	1.2	37%	6.7	3.4	60.3	66	29°C	125°C	18.54	15.24	12.0	SM	No
MSS1583-683	68.0	67.8	1.2	37%	6.0	3.4	61.0	126	32°C	125°C	15.5	15.5	8.6	SM	Yes
MSS1210-473	47.0	46.6	1.3	54%	5.8	3.0	48.0	140	38°C	125°C	12.3	12.3	10.2	SM	Yes
MSS1278T-473	47.0	46.8	1.3	54%	5.7	2.9	72.3	173	36°C	165°C	12.3	12.3	8.05	SM	Yes
SER2211-473	47.0	46.9	1.3	54%	5.6	10.6	8.9	112	29°C	125°C	22.5	19.2	10.5	SM	Yes
MSS1278-473	47.0	46.8	1.3	54%	5.3	2.9	72.3	165	36°C	125°C	12.3	12.3	8.05	SM	Yes
MSS1278T-563	56.0	55.8	1.2	45%	5.3	2.7	80.2	159	36°C	165°C	12.3	12.3	8.05	SM	Yes
MSS1278-563	56.0	55.7	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 Ipeak (µH)	I peak (A)	ΔIL%	Isat (A)	Irms (A)	DCR Typ @ 25°C (mΩ)	Total losses (mW)	Part temp. (°C)	Temp. rating	Length (mm)	Width (mm)	Height (mm)	Mount	Shielded
DO5040H-473	47.0	47.0	1.3	54%	7.8	3.7	46.8	56	28°C	125°C	18.54	15.24	12.0	SM	No
DO5040H-683	68.0	68.0	1.2	37%	6.7	3.4	60.3	66	29°C	125°C	18.54	15.24	12.0	SM	No
SER2211-473	47.0	46.9	1.3	54%	5.6	10.6	8.9	112	29°C	125°C	22.5	19.2	10.5	SM	Yes
DO3340P-473	47.0	47.0	1.3	54%	3.8	1.6	99.0	121	35°C	105°C	12.95	9.4	11.43	SM	No
MSS1583-683	68.0	67.8	1.2	37%	6.0	3.4	61.0	126	32°C	125°C	15.5	15.5	8.6	SM	Yes
XFL6060-473	47.0	42.9	1.3	57%	1.8	3.7	68.4	126	31°C	165°C	6.76	6.56	6.1	SM	Yes
MSS1210-683	68.0	67.3	1.2	38%	4.9	2.8	68.0	132	35°C	125°C	12.3	12.3	10.2	SM	Yes
MSS1210-473	47.0	46.6	1.3	54%	5.8	3.0	48.0	140	38°C	125°C	12.3	12.3	10.2	SM	Yes
MSS1210H-683	68.0	67.6	1.2	37%	3.6	3.4	56.0	144	34°C	165°C	12.3	12.3	10.2	SM	Yes
MSS1583-473	47.0	46.9	1.3	54%	7.3	3.7	48.0	149	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.