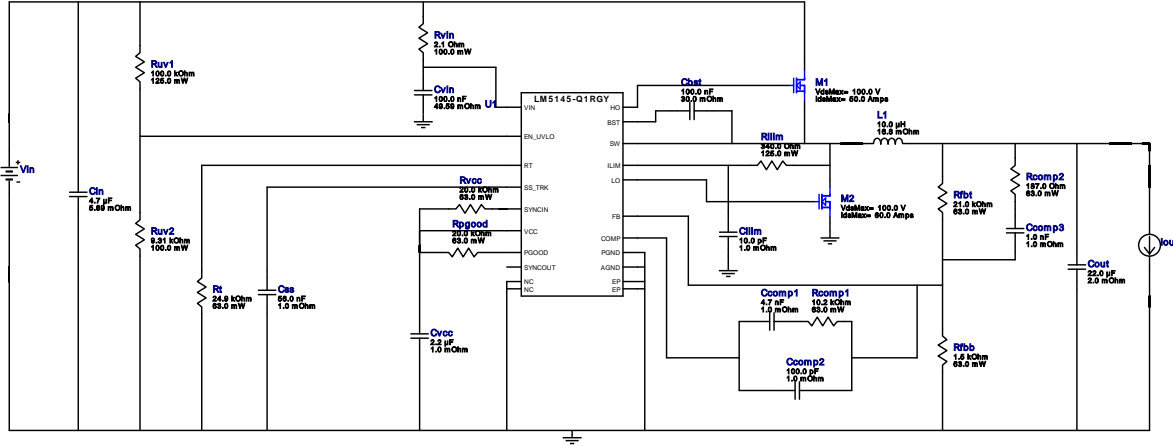


VinMin = 14.0V
 VinMax = 75.0V
 Vout = 12.0V
 Iout = 6.0A

Device = LM5145QRGYRQ1
 Topology = Buck
 Created = 2021-10-20 01:35:23.634
 BOM Cost = \$4.51
 BOM Count = 25
 Total Pd = 5.43W

WEBENCH® Design Report

Design : 88 LM5145QRGYRQ1
 LM5145QRGYRQ1 Design proof : 14V-75V to 12.00V @ 6A



1. This regulator device is qualified for Automotive applications. All passives and other components selected in this design may not be qualified for Automotive applications. The user is required to verify that all components in the design meet the qualification and safety requirements for their specific application. View WEBENCH(R) Disclaimer.




Design Alerts

Component Selection Information

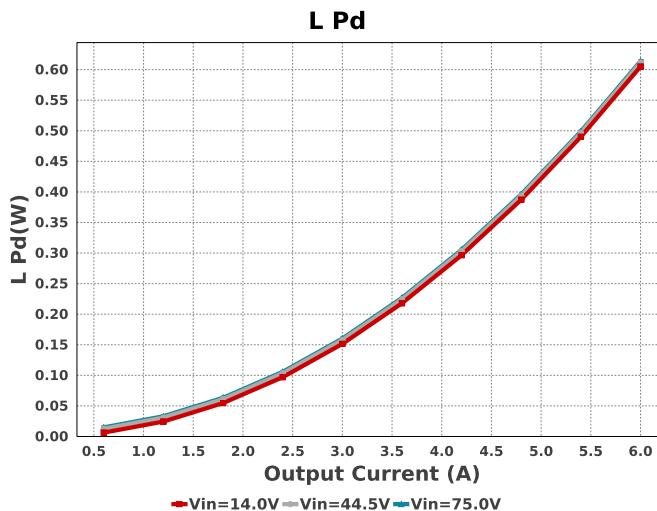
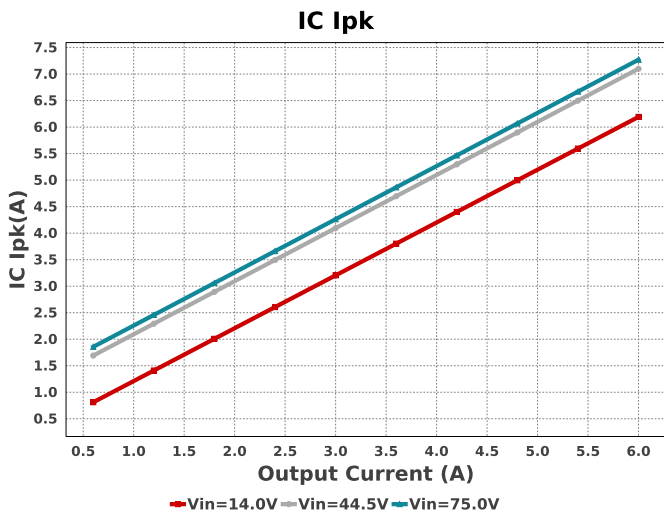
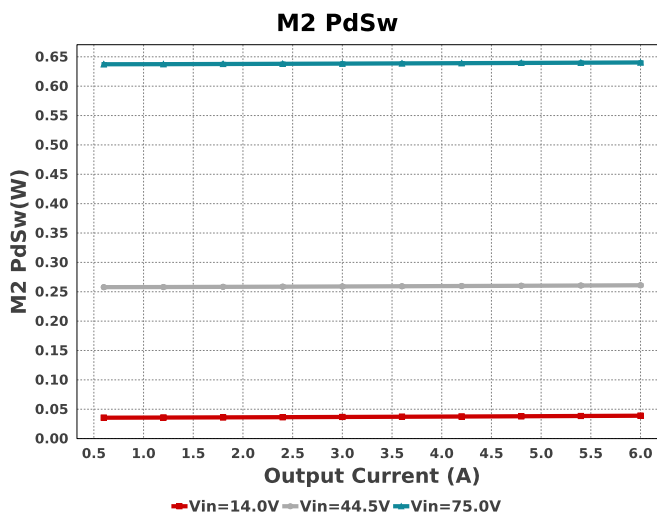
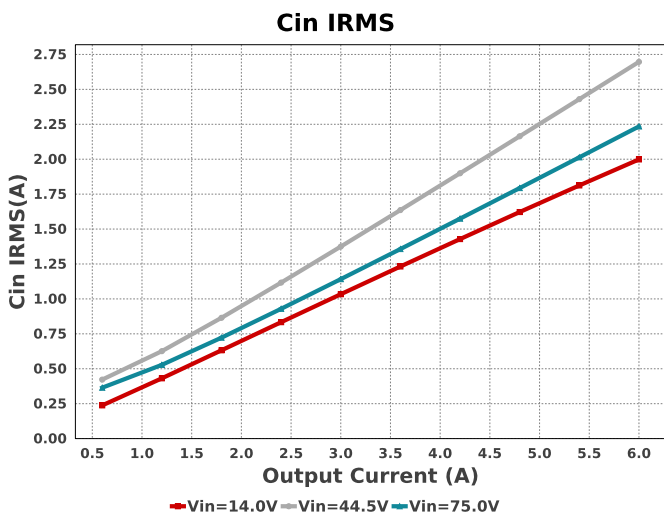
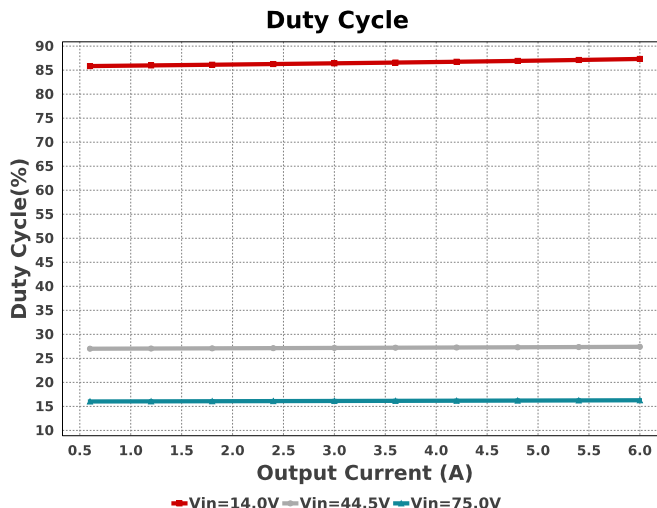
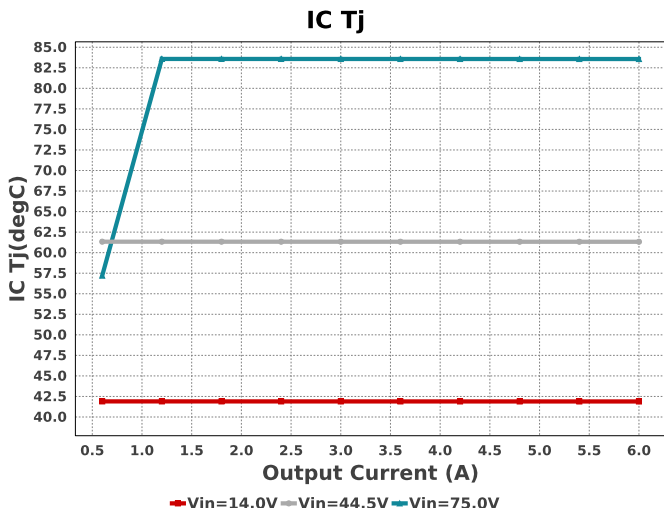
The LM5145-Q1 is qualified for Automotive applications. All passives and other components selected in this design may not be qualified for Automotive applications. The user is required to verify that all components in the design meet the qualification and safety requirements for their specific application.

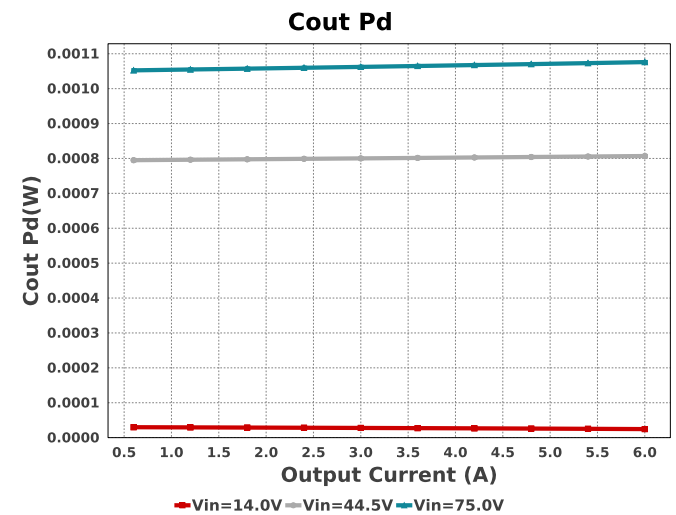
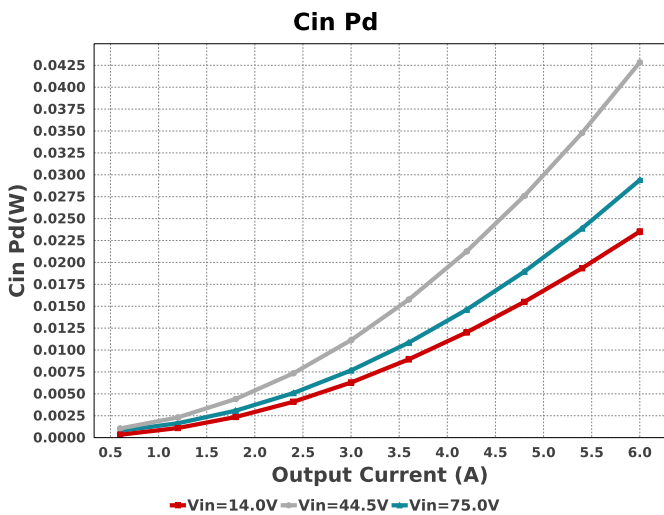
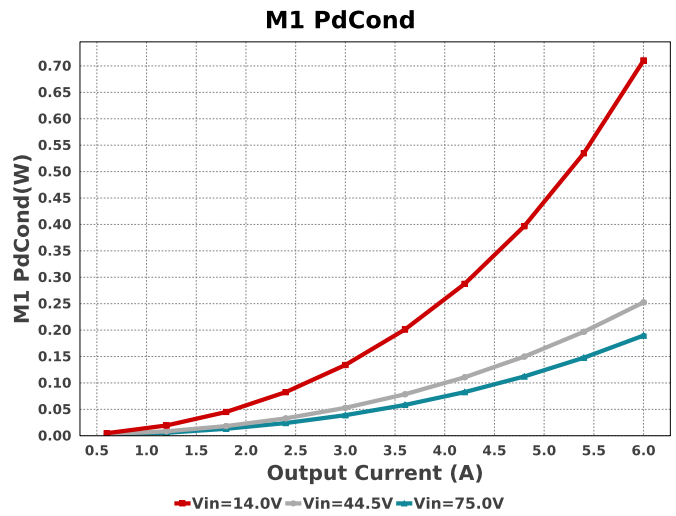
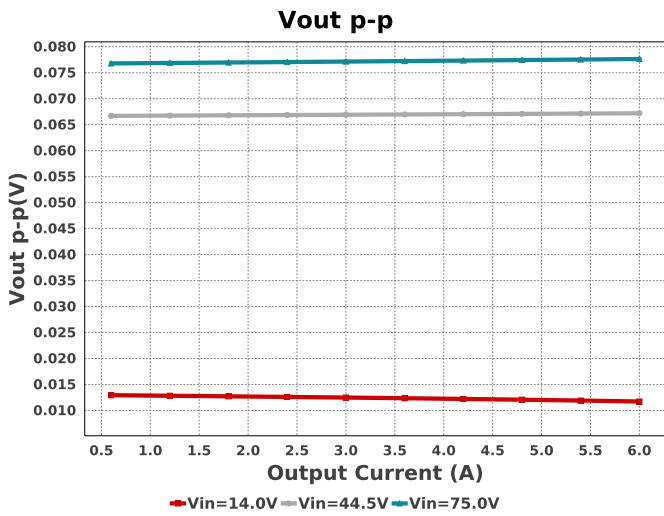
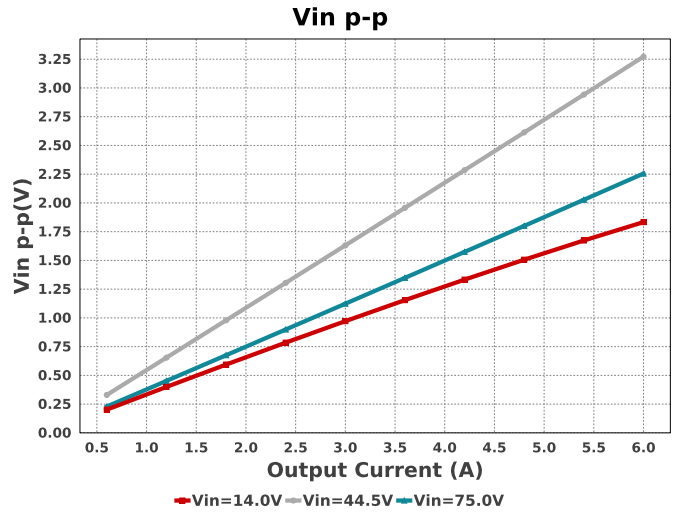
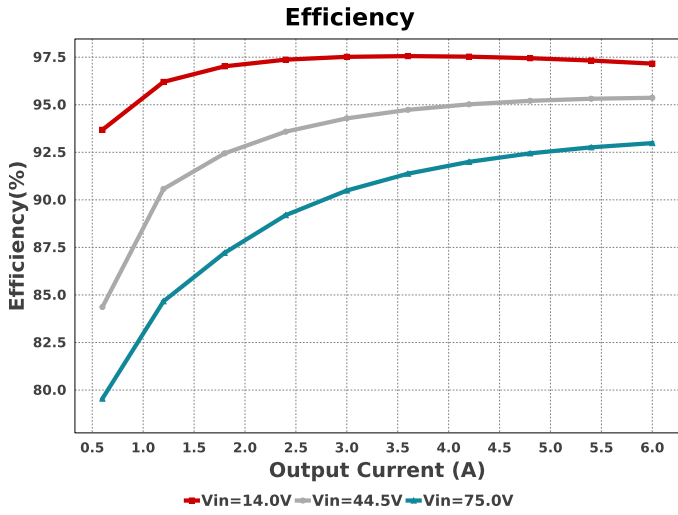
Electrical BOM

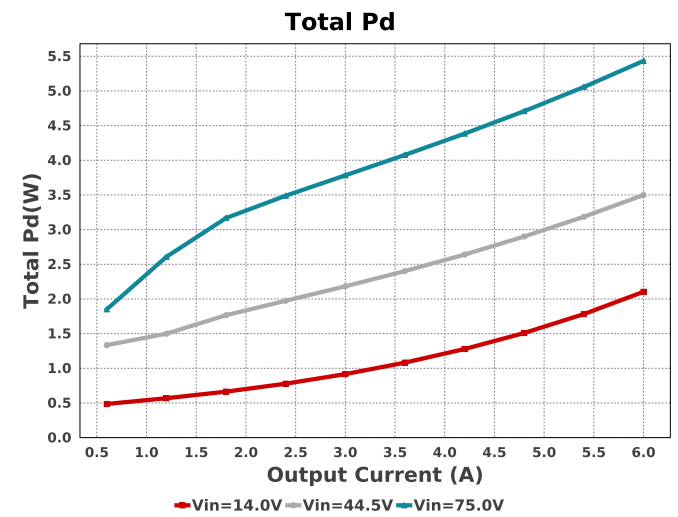
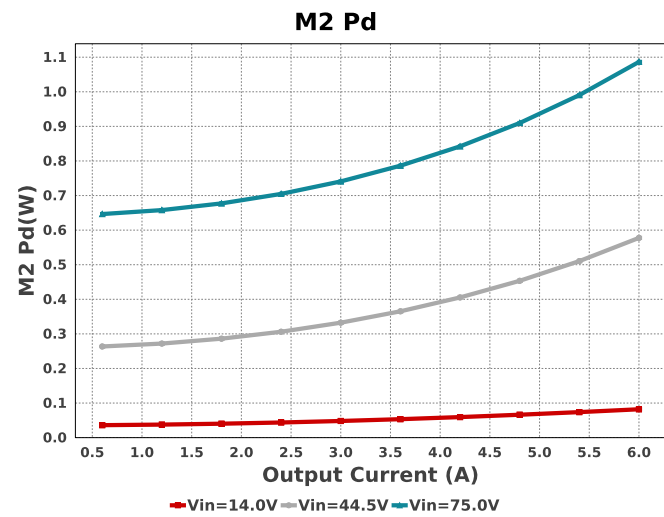
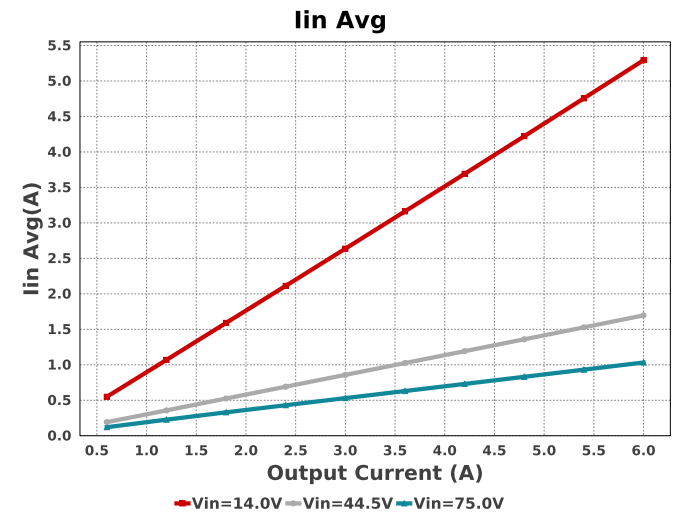
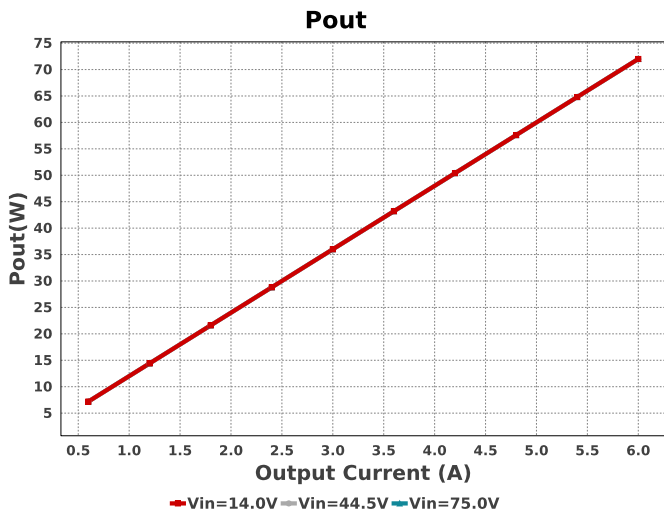
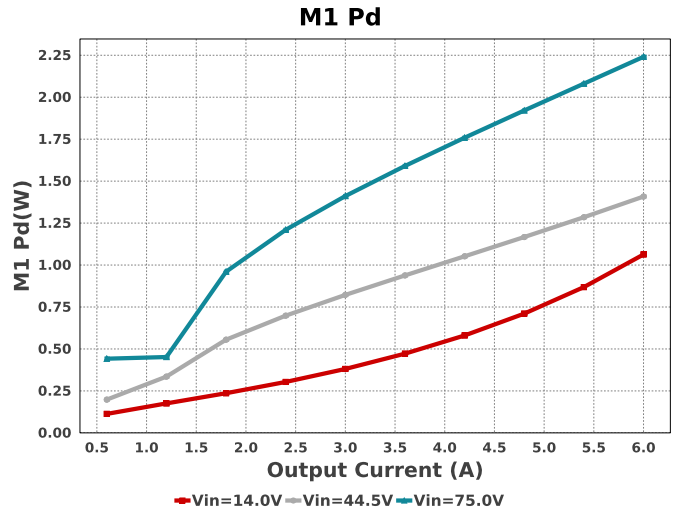
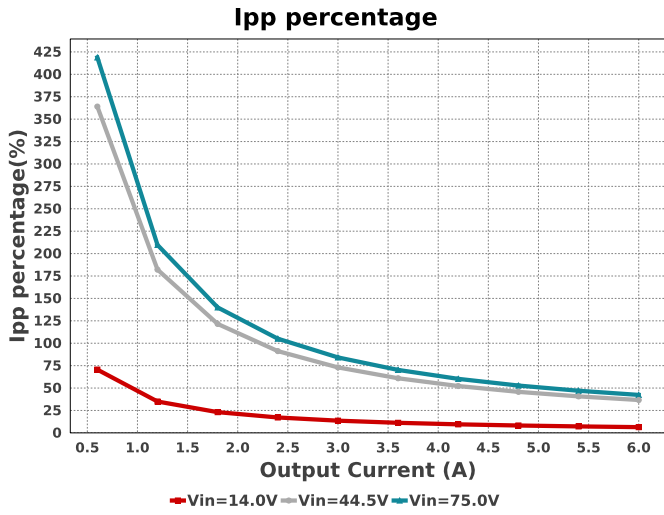
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cbst	MuRata	GRM188R61E104KA01D Series= X5R	Cap= 100.0 nF ESR= 30.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	0603 5 mm ²
Ccomp1	MuRata	GRM155R71C472KA01D Series= X7R	Cap= 4.7 nF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	\$0.01	0402 3 mm ²
Ccomp2	MuRata	GRM1555C1H101JA01D Series= C0G/NP0	Cap= 100.0 pF ESR= 1.0 mOhm VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0402 3 mm ²
Ccomp3	MuRata	GRM155R71H102KA01D Series= X7R	Cap= 1.0 nF ESR= 1.0 mOhm VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0402 3 mm ²
Cilim	MuRata	GRM1885C2A100JA01D Series= C0G/NP0	Cap= 10.0 pF ESR= 1.0 mOhm VDC= 100.0 V IRMS= 0.0 A	1	\$0.02	0603 5 mm ²
Cin	TDK	C3225X7S2A475M200AB Series= X7S	Cap= 4.7 uF ESR= 5.89 mOhm VDC= 100.0 V IRMS= 6.7739 A	1	\$0.50	1210 15 mm ²

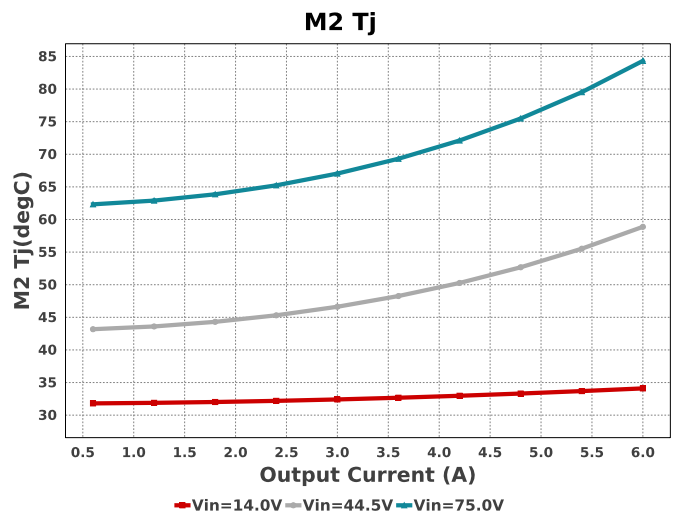
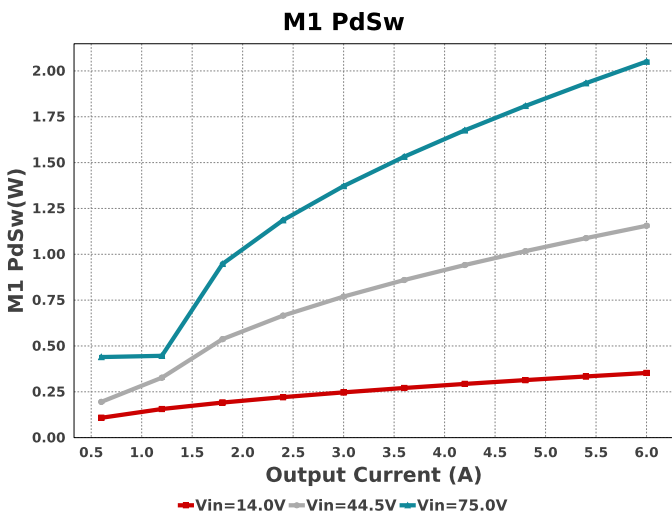
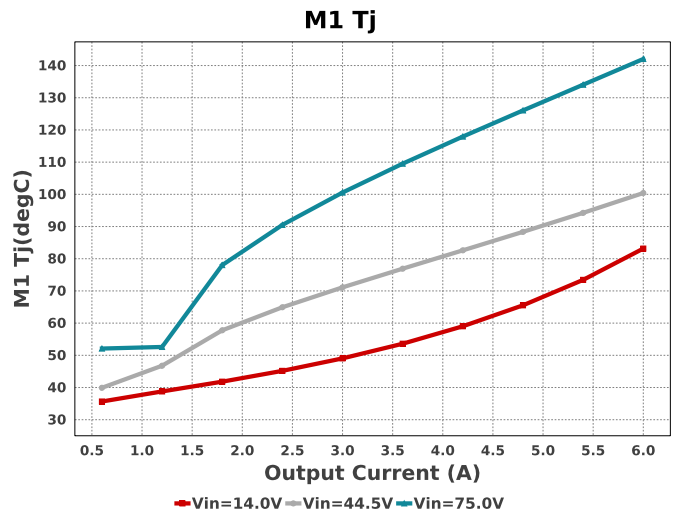
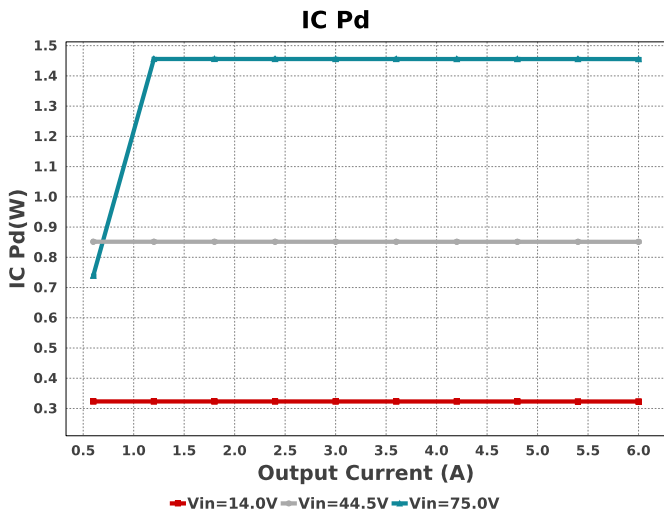
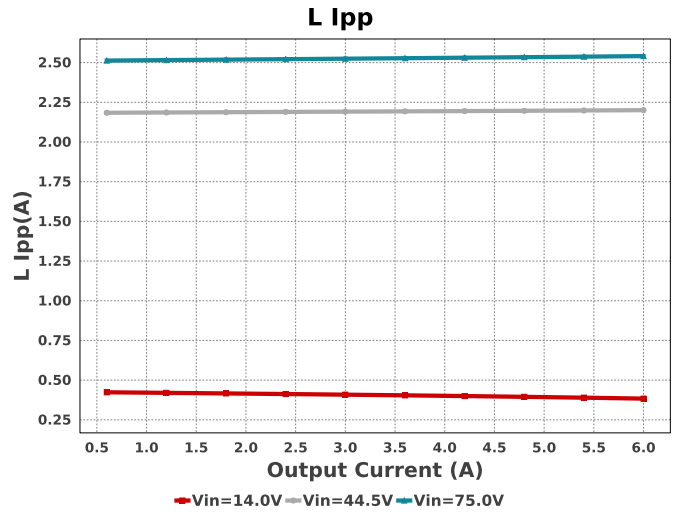
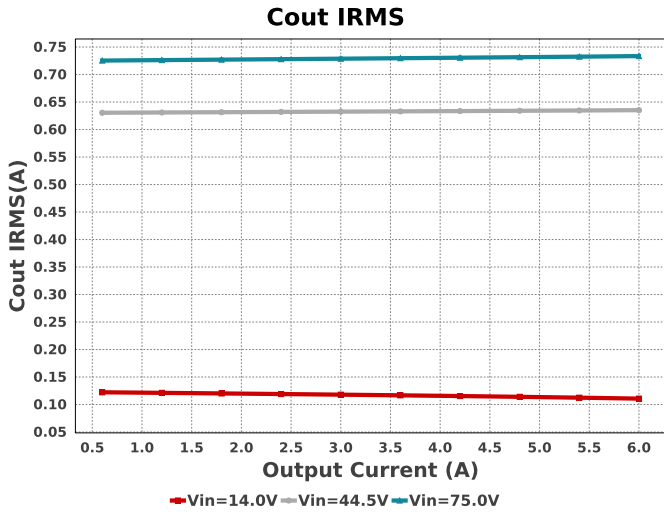
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cout	MuRata	GRM32ER61E226KE15L Series= X5R	Cap= 22.0 uF ESR= 2.0 mOhm VDC= 25.0 V IRMS= 3.67 A	1	\$0.65	 1210 15 mm ²
Css	MuRata	GRM155R71C563KA88D Series= X7R	Cap= 56.0 nF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	\$0.01	 0402 3 mm ²
Cvcc	TDK	C1005X5R1V225K050BC Series= X5R	Cap= 2.2 uF ESR= 1.0 mOhm VDC= 35.0 V IRMS= 0.0 A	1	\$0.07	 0402_065 3 mm ²
Cvin	TDK	C1608X7S2A104K080AB Series= X7S	Cap= 100.0 nF ESR= 49.59 mOhm VDC= 100.0 V IRMS= 751.62 mA	1	\$0.03	 0603 5 mm ²
L1	Bourns	SRP1270-100M	L= 10.0 uH 16.8 mOhm	1	\$0.72	 SRP1270 246 mm ²
M1	Texas Instruments	CSD19534Q5A	VdsMax= 100.0 V IdsMax= 50.0 Amps	1	\$0.34	 TRANS_NexFET_Q5A 55 mm ²
M2	Fairchild Semiconductor	FDMS86101	VdsMax= 100.0 V IdsMax= 60.0 Amps	1	\$0.69	 TRANS_Fairchild_PQFN08A 56 mm ²
Rcomp1	Vishay-Dale	CRCW040210K2FKED Series= CRCW..e3	Res= 10.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
Rcomp2	Vishay-Dale	CRCW0402187RFKED Series= CRCW..e3	Res= 187.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
Rfbb	Vishay-Dale	CRCW04021K50FKED Series= CRCW..e3	Res= 1.5 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
Rfbt	Vishay-Dale	CRCW040221K0FKED Series= CRCW..e3	Res= 21.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
Rilim	Vishay-Dale	CRCW0805340RFKEA Series= CRCW..e3	Res= 340.0 Ohm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	 0805 7 mm ²
Rpgood	Vishay-Dale	CRCW040220K0FKED Series= CRCW..e3	Res= 20.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
Rt	Vishay-Dale	CRCW040224K9FKED Series= CRCW..e3	Res= 24.9 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
Ruv1	Vishay-Dale	CRCW0805100KFKEA Series= CRCW..e3	Res= 100.0 kOhm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	 0805 7 mm ²
Ruv2	Vishay-Dale	CRCW06039K31FKEA Series= CRCW..e3	Res= 9.31 kOhm Power= 100.0 mW Tolerance= 1.0%	1	\$0.01	 0603 5 mm ²
Rvcc	Vishay-Dale	CRCW040220K0FKED Series= CRCW..e3	Res= 20.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²

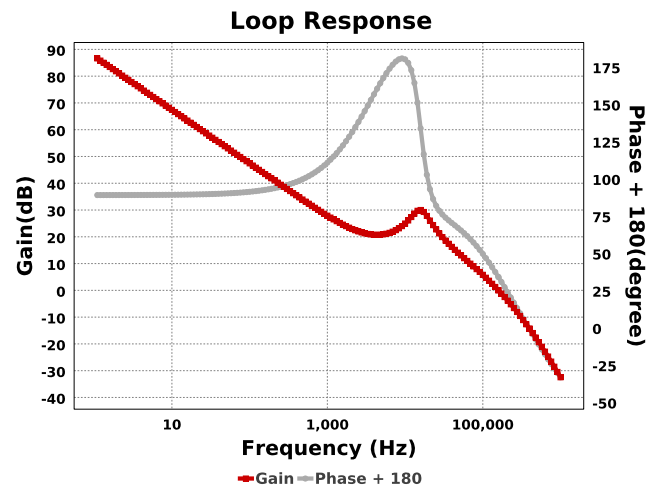
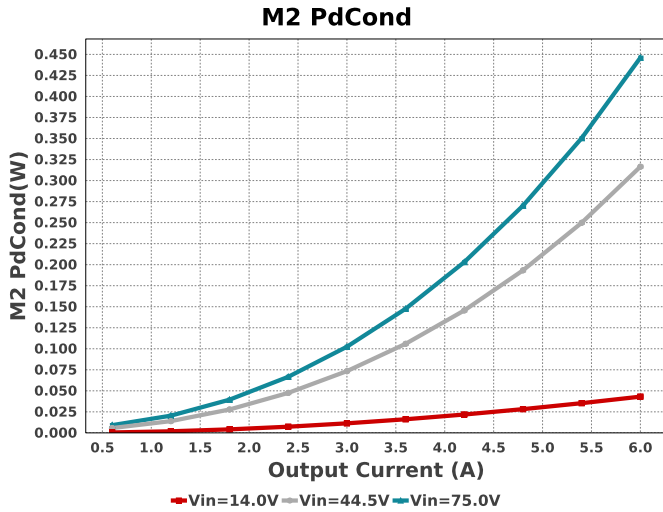
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Rvin	Vishay-Dale	CRCW06032R10FKEA Series= CRCW..e3	Res= 2.1 Ohm Power= 100.0 mW Tolerance= 1.0%	1	\$0.01	0603 5 mm ²
U1	Texas Instruments	LM5145QRGYRQ1	Switcher	1	\$1.33	RGY0020B 25 mm ²











Operating Values

#	Name	Value	Category	Description
1.	BOM Count	25		Total Design BOM count
2.	Total BOM	\$4.513		Total BOM Cost
3.	Cin IRMS	2.234 A	Capacitor	Input capacitor RMS ripple current
4.	Cin Pd	29.407 mW	Capacitor	Input capacitor power dissipation
5.	Cout IRMS	733.523 mA	Capacitor	Output capacitor RMS ripple current
6.	Cout Pd	1.076 mW	Capacitor	Output capacitor power dissipation
7.	IC Ipk	7.27 A	IC	Peak switch current in IC
8.	IC Pd	1.456 W	IC	IC power dissipation
9.	IC Tj	83.568 degC	IC	IC junction temperature
10.	IC Tolerance	8.0 mV	IC	IC Feedback Tolerance
11.	ICThetaJA	36.8 degC/W	IC	IC junction-to-ambient thermal resistance
12.	Iin Avg	1.032 A	IC	Average input current
13.	Ipp percentage	42.35 %	Inductor	Inductor ripple current percentage (with respect to average inductor current)
14.	L Ipp	2.541 A	Inductor	Peak-to-peak inductor ripple current
15.	L Pd	613.84 mW	Inductor	Inductor power dissipation
16.	M1 Pd	2.241 W	Mosfet	M1 MOSFET total power dissipation
17.	M1 PdCond	189.63 mW	Mosfet	M1 MOSFET conduction losses
18.	M1 PdSw	2.051 W	Mosfet	M1 MOSFET switching losses
19.	M1 Tj	142.037 degC	Mosfet	M1 MOSFET junction temperature
20.	M2 Pd	1.086 W	Mosfet	M2 MOSFET total power dissipation
21.	M2 PdCond	446.07 mW	Mosfet	M2 MOSFET conduction losses
22.	M2 PdSw	640.36 mW	Mosfet	M2 MOSFET switching losses
23.	M2 Tj	84.322 degC	Mosfet	M2 MOSFET junction temperature
24.	Cin Pd	29.407 mW	Power	Input capacitor power dissipation
25.	Cout Pd	1.076 mW	Power	Output capacitor power dissipation
26.	IC Pd	1.456 W	Power	IC power dissipation
27.	L Pd	613.84 mW	Power	Inductor power dissipation
28.	M1 Pd	2.241 W	Power	M1 MOSFET total power dissipation
29.	M1 PdCond	189.63 mW	Power	M1 MOSFET conduction losses
30.	M1 PdSw	2.051 W	Power	M1 MOSFET switching losses
31.	M2 Pd	1.086 W	Power	M2 MOSFET total power dissipation
32.	M2 PdCond	446.07 mW	Power	M2 MOSFET conduction losses
33.	M2 PdSw	640.36 mW	Power	M2 MOSFET switching losses
34.	Total Pd	5.433 W	Power	Total Power Dissipation
35.	Duty Cycle	16.274 %	System Information	Duty cycle
36.	Efficiency	92.983 %	System Information	Steady state efficiency
37.	FootPrint	485.0 mm ²	System Information	Total Foot Print Area of BOM components
38.	Frequency	401.606 kHz	System Information	Switching frequency
39.	Iout	6.0 A	System Information	Iout operating point
40.	Mode	FCCM	System Information	Conduction Mode
41.	Pout	72.0 W	System Information	Total output power
42.	Vin	75.0 V	System Information	Vin operating point

#	Name	Value	Category	Description
43.	Vin p-p	2.255 V	System Information	Peak-to-peak input voltage
44.	Vout	12.0 V	System Information	Operational Output Voltage
45.	Vout Actual	12.0 V	System Information	Vout Actual calculated based on selected voltage divider resistors
46.	Vout Tolerance	2.904 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
47.	Vout p-p	77.646 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	6.0	Maximum Output Current
SoftStart	4.0 ms	Soft Start Time (ms)
VinMax	75.0	Maximum input voltage
VinMin	14.0	Minimum input voltage
Vout	12.0	Output Voltage
base_pn	LM5145-Q1	Base Product Number
source	DC	Input Source Type
Ta	30.0	Ambient temperature
UserFsw	400.0 k	Customer Selected Frequency

WEBENCH® Assembly

Component Testing

Some published data on components in datasheets such as Capacitor ESR and Inductor DC resistance is based on conservative values that will guarantee that the components always exceed the specification. For design purposes it is usually better to work with typical values. Since this data is not always available it is a good practice to measure the Capacitance and ESR values of C_{in} and C_{out} , and the inductance and DC resistance of L1 before assembly of the board. Any large discrepancies in values should be electrically simulated in WEBENCH to check for instabilities and thermally simulated in WebTHERM to make sure critical temperatures are not exceeded.

Soldering Component to Board

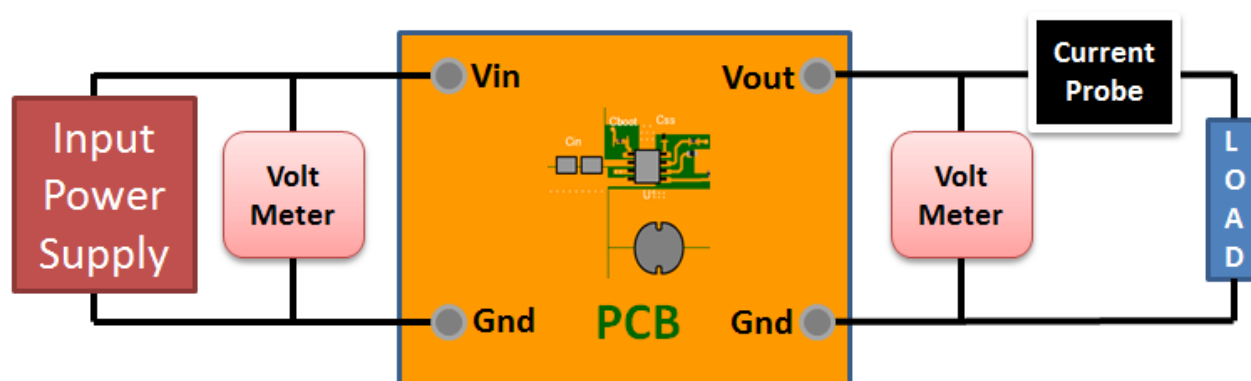
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. To solder the tab down to the board place the iron down on the board while resting against the tab, heating both surfaces simultaneously. Apply light pressure to the top of the plastic case until the solder flows around the part and the part is flush with the PCB. If the solder is not flowing around the board you may need a higher wattage iron (generally 25W to 30W is enough).

Initial Startup of Circuit

It is best to initially power up the board by setting the input supply voltage to the lowest operating input voltage 14.0V and set the input supply's current limit to zero. With the input supply off connect up the input supply to V_{in} and GND. Connect a digital volt meter and a load if needed to set the minimum load of the design from V_{out} and GND. Turn on the input supply and slowly turn up the current limit on the input supply. If the voltage starts to rise on the input supply continue increasing the input supply current limit while watching the output voltage. If the current increases on the input supply, but the voltage remains near zero, then there may be a short or a component misplaced on the board. Power down the board and visually inspect for solder bridges and recheck the diode and capacitor polarities. Once the power supply circuit is operational then more extensive testing may include full load testing, transient load and line tests to compare with simulation results.

Load Testing

The setup is the same as the initial startup, except that an additional digital voltmeter is connected between V_{in} and GND, a load is connected between V_{out} and GND and a current meter is connected in series between V_{out} and the load. The load must be able to handle at least rated output power + 50% (7.5 watts for this design). Ideally the load is supplied in the form of a variable load test unit. It can also be done in the form of suitably large power resistors. When using an oscilloscope to measure waveforms on the prototype board, the ground leads of the oscilloscope probes should be as short as possible and the area of the loop formed by the ground lead should be kept to a minimum. This will help reduce ground lead inductance and eliminate EMI noise that is not actually present in the circuit.



Design Assistance

1. The LM5145-Q1 is qualified for Automotive applications. All passives and other components selected in this design may not be qualified for Automotive applications. The user is required to verify that all components in the design meet the qualification and safety requirements for their specific application
2. Master key : 48C06FEBA112E050[v1]
3. **LM5145-Q1** Product Folder : <http://www.ti.com/product/lm5145%2DQ1> : contains the data sheet and other resources.

Important Notice and Disclaimer

TI provides technical and reliability data (including datasheets), design resources (including reference designs), application or other design advice, web tools, safety information, and other resources AS IS and with all faults, and disclaims all warranties. These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

Providing these resources does not expand or otherwise alter TI's applicable Terms of Sale or other applicable terms available either on ti.com or provided in conjunction with TI products.