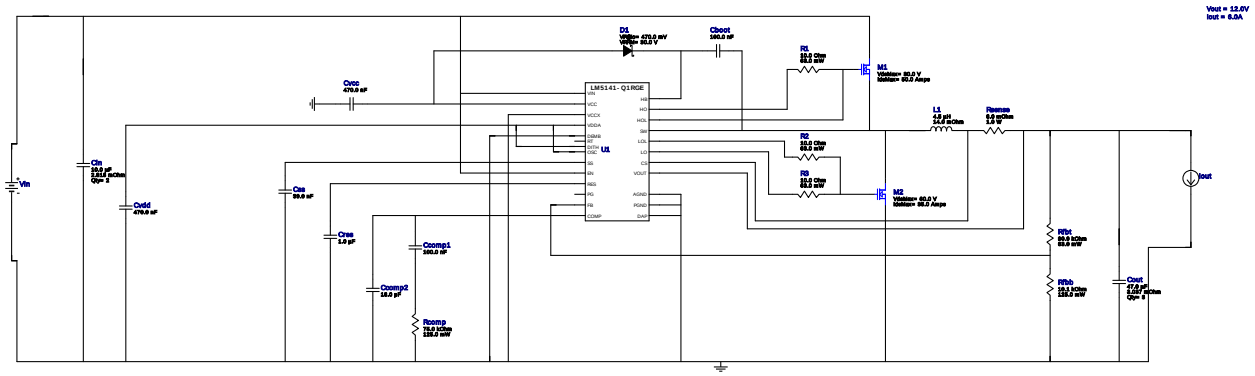
WEBENCH® Design Report

VinMin = 20.0V
VinMax = 20.0V
Vout = 12.0V
Iout = 6.0A

Device = LM5141QRGERQ1
Topology = Buck
Created = 3/1/17 1:11:16 PM
BOM Cost = $4.70
BOM Count = 3
Total Pd = 2.51W

Design : 1209005/529 LM5141QRGERQ1
LM5141QRGERQ1 20.0V-20.0V to 12.00V @ 6.0A



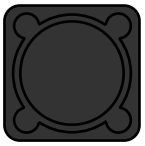
1. This regulator device is qualified for Automotive applications. All passives and other components selected in this design may not be qualified for Automotive applications. The user is required to verify that all components in the design meet the qualification and safety requirements for their specific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

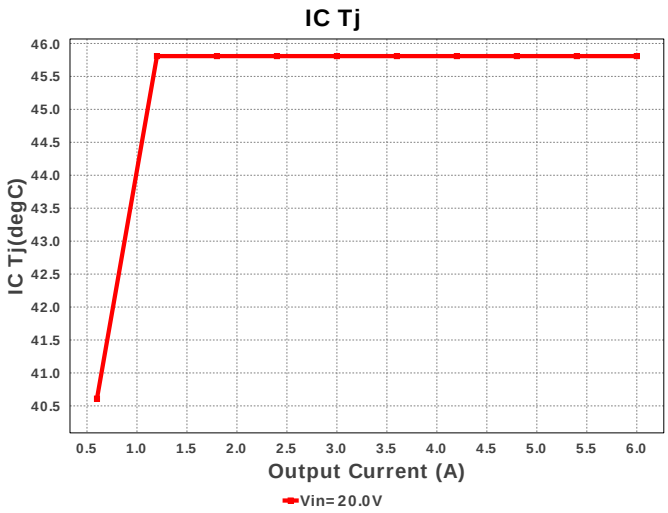
My Comments

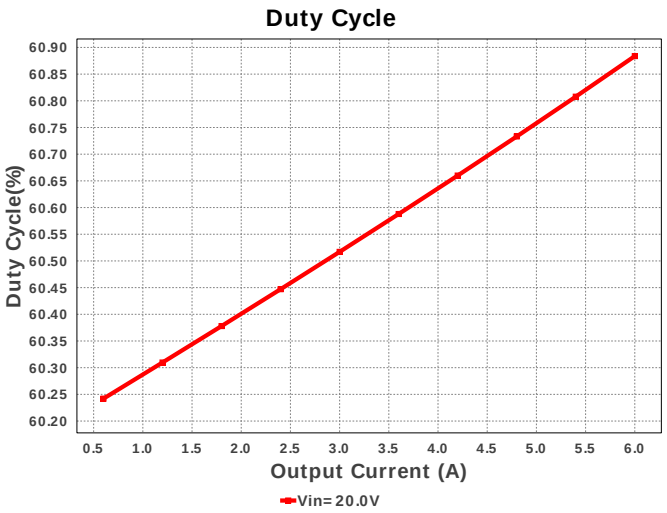
No comments

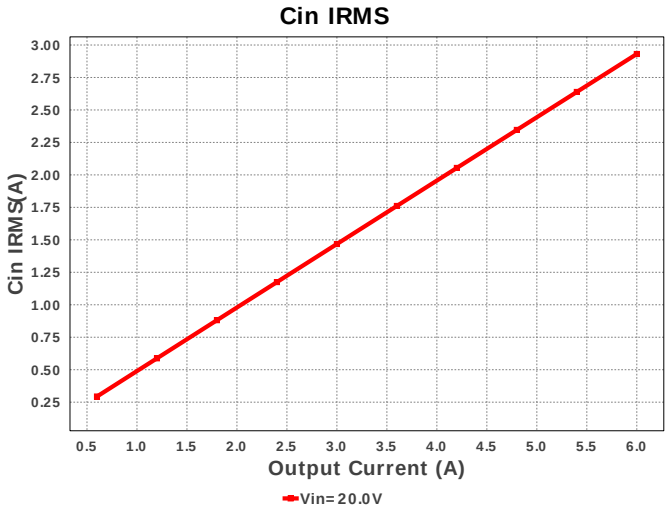
Electrical BOM

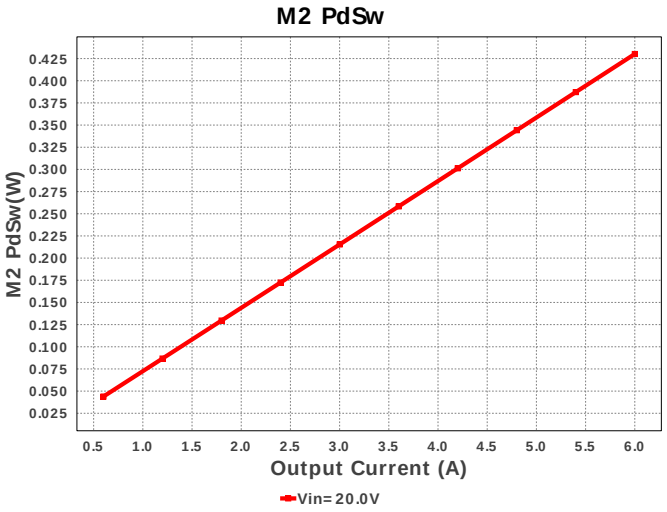
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cboot	MuRata	GRM155R60J104KA01D Series= X5R	Cap= 100.0 nF VDC= 6.3 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
2.	Ccomp1	Yageo America	CC0805KRX7R8BB104 Series= X7R	Cap= 100.0 nF VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
3.	Ccomp2	Kemet	C0805C180K5GACTU Series= C0G/NP0	Cap= 18.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
4.	Cin	TDK	C2012X5R1V106K085AC Series= X5R	Cap= 10.0 uF ESR= 2.818 mOhm VDC= 35.0 V IRMS= 3.8868 A	2	$0.15	0805 7 mm²
5.	Cout	MuRata	GRM32ER61C476ME15L Series= X5R	Cap= 47.0 uF ESR= 3.037 mOhm VDC= 16.0 V IRMS= 4.59346 A	3	$0.24	1210_280 15 mm²
6.	Cres	Taiyo Yuden	EMK212B7105KG-T Series= X7R	Cap= 1.0 uF VDC= 16.0 V IRMS= 0.0 A	1	$0.02	0805 7 mm²
7.	Css	MuRata	GRM155R71A393KA01D Series= X7R	Cap= 39.0 nF VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
8.	Cvcc	MuRata	GRM155C80J474KE19D Series= X6S	Cap= 470.0 nF VDC= 6.3 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
9.	Cvdd	MuRata	GRM155C80J474KE19D Series= X6S	Cap= 470.0 nF VDC= 6.3 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
10.	D1	Torex USA Corporation	XBS053V15R-G	VF@Io= 470.0 mV VRRM= 30.0 V	1	$0.12	SOD-523 5 mm²

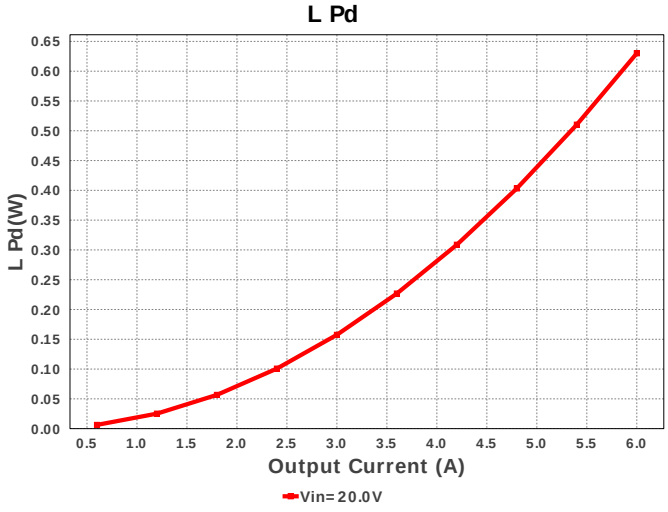
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
11.	L1	Bourns	SRR1208-4R5ML	L= 4.5 µH DCR= 14.0 mOhm	1	$0.37	 SRR1208 216 mm^2
12.	M1	Texas Instruments	CSD17308Q3	VdsMax= 30.0 V IdsMax= 50.0 Amps	1	$0.25	 DQG0008A 18 mm^2
13.	M2	Texas Instruments	CSD18543Q3A	VdsMax= 60.0 V IdsMax= 35.0 Amps	1	$0.34	 DNH0008A 18 mm^2
14.	R1	Vishay-Dale	CRCW040210R0FKED Series= CRCW..e3	Res= 10.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
15.	R2	Vishay-Dale	CRCW040210R0FKED Series= CRCW..e3	Res= 10.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
16.	R3	Vishay-Dale	CRCW040210R0FKED Series= CRCW..e3	Res= 10.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
17.	Rcomp	Panasonic	ERJ-6ENF7502V Series= ERJ-6E	Res= 75.0 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	 0805 7 mm^2
18.	Rfbb	Yageo America	RT0805BRD0710K1L Series= ?	Res= 10.1 kOhm Power= 125.0 mW Tolerance= 0.1%	1	$0.04	 0805 7 mm^2
19.	Rfbt	Vishay-Dale	CRCW040290K9FKED Series= CRCW..e3	Res= 90.9 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
20.	Rsense	Susumu Co Ltd	PRL1632-R008-F-T1 Series= PRL1632	Res= 8.0 mOhm Power= 1.0 W Tolerance= 1.0%	1	$0.19	 0612 11 mm^2
21.	U1	Texas Instruments	LM5141QRGERQ1	Switcher	1	$2.24	 RGE0024H 25 mm^2

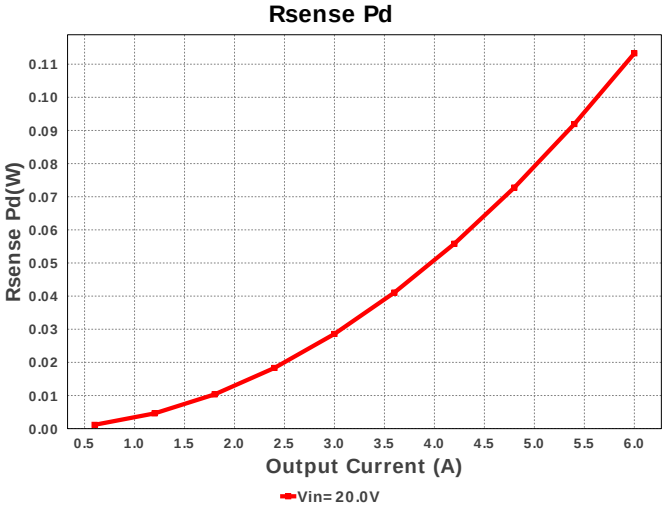


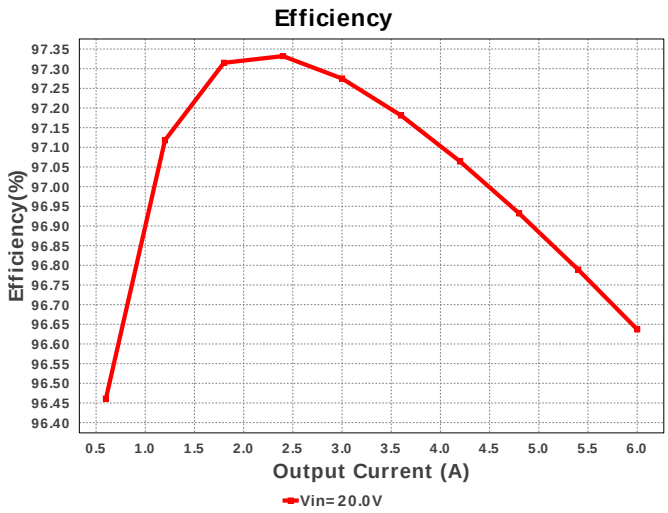


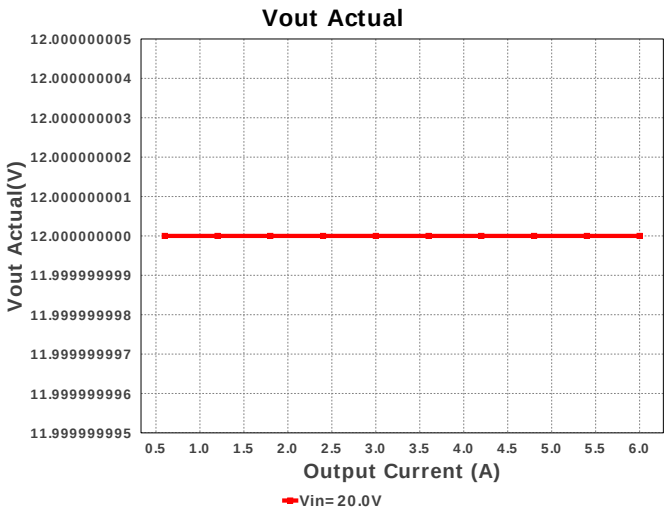


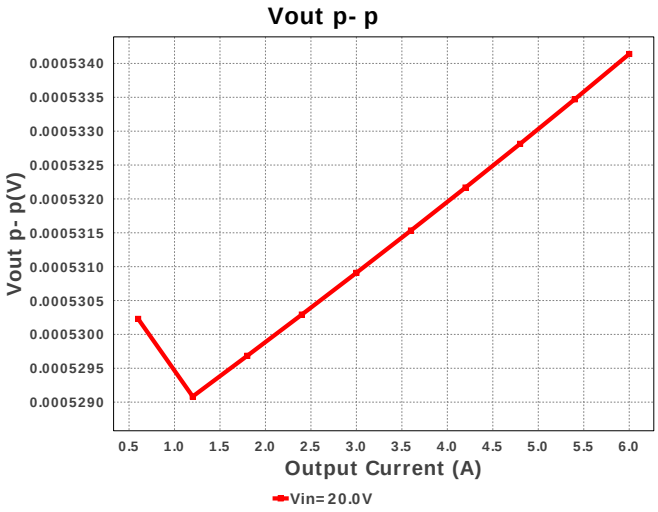


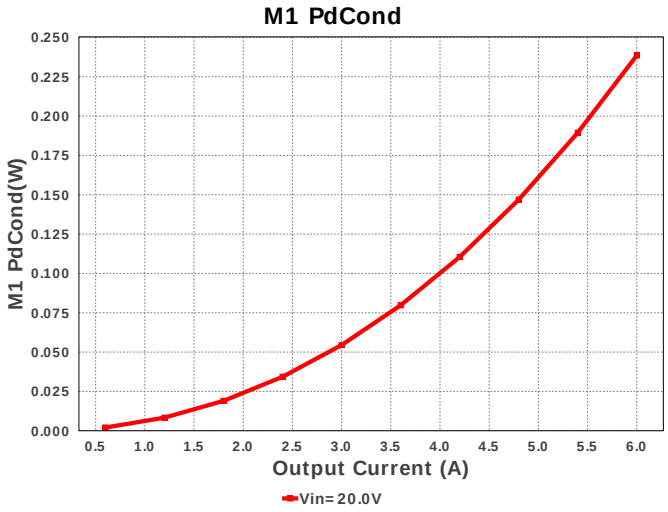


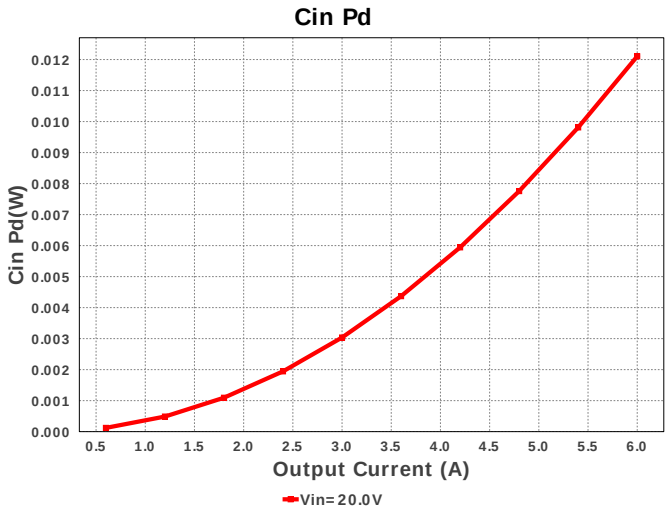


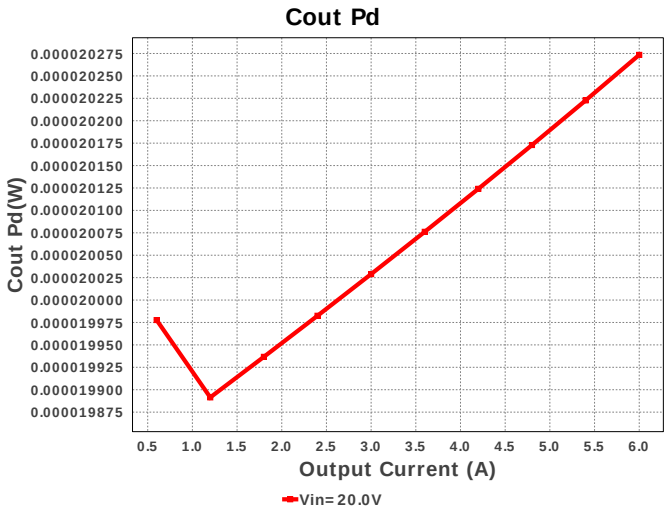


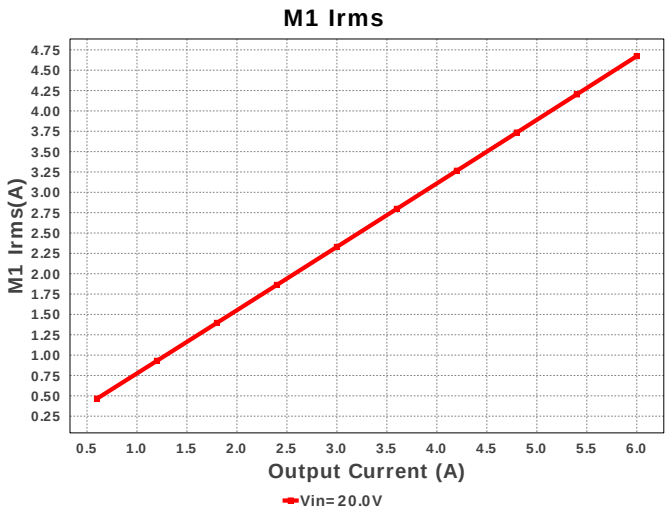


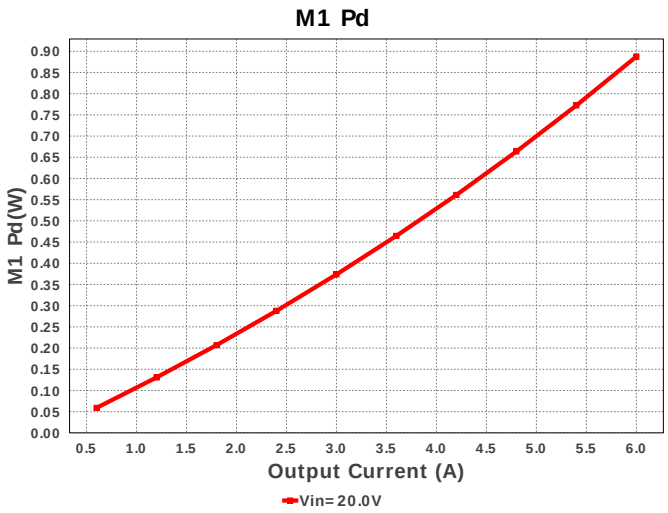


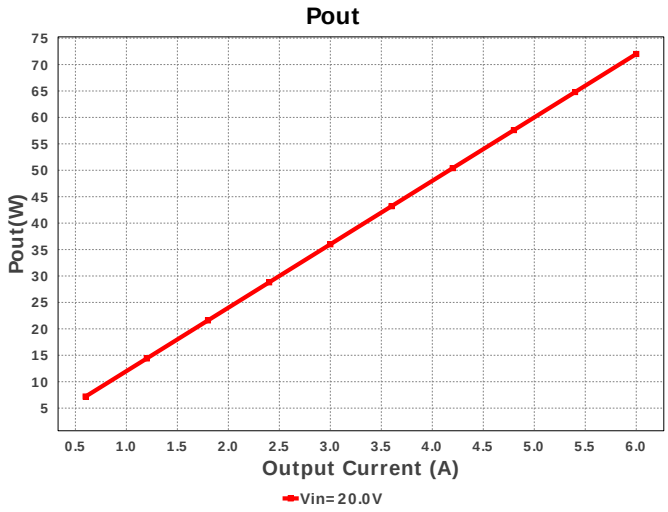


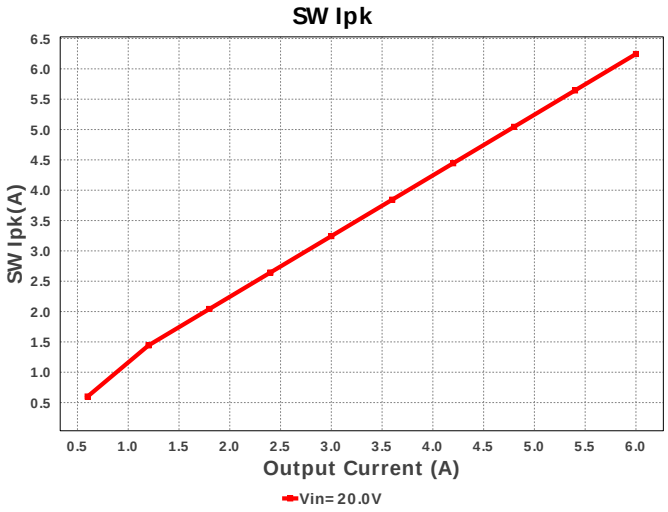


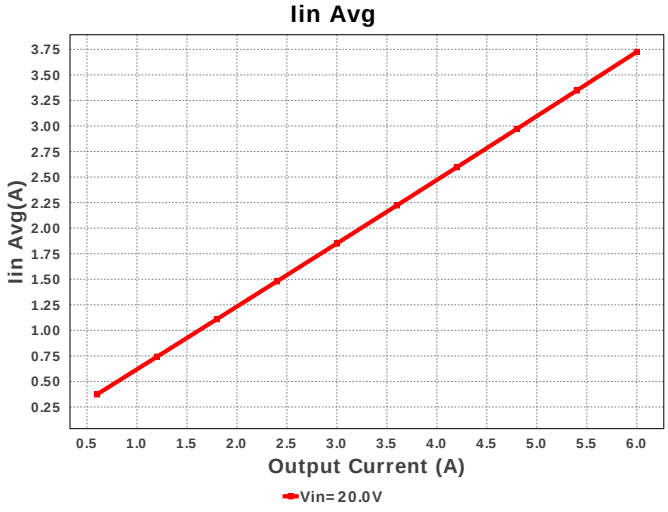


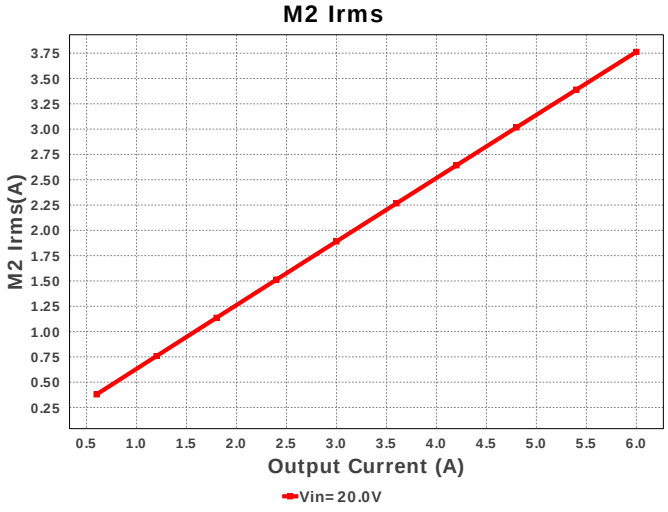


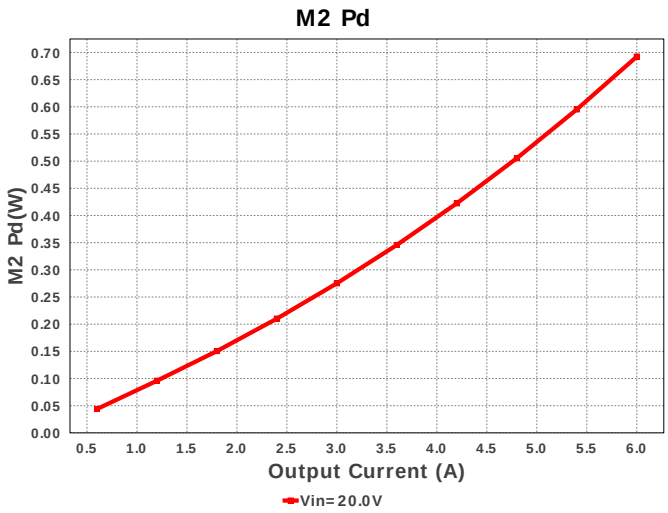


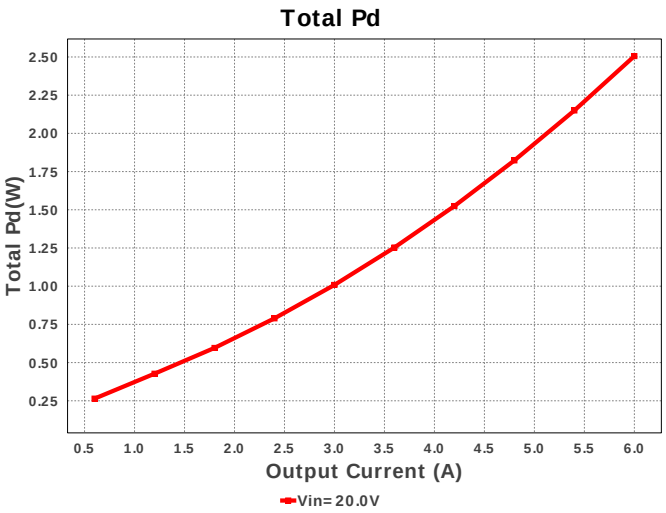


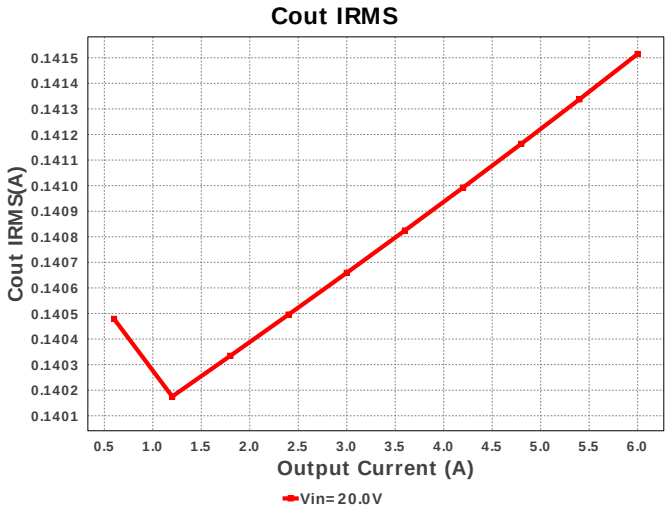


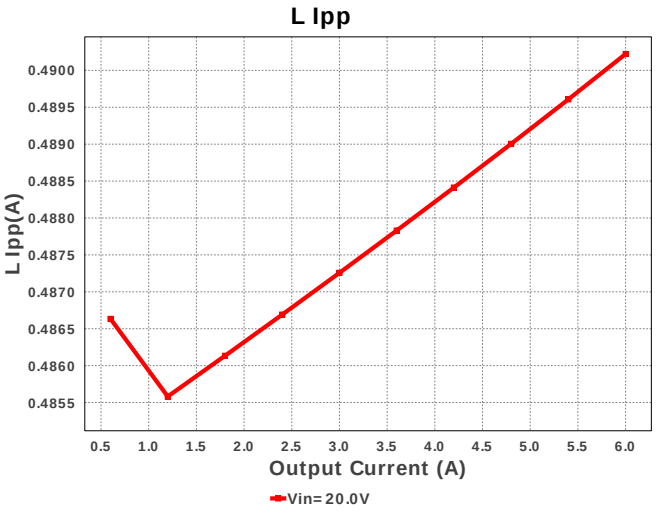


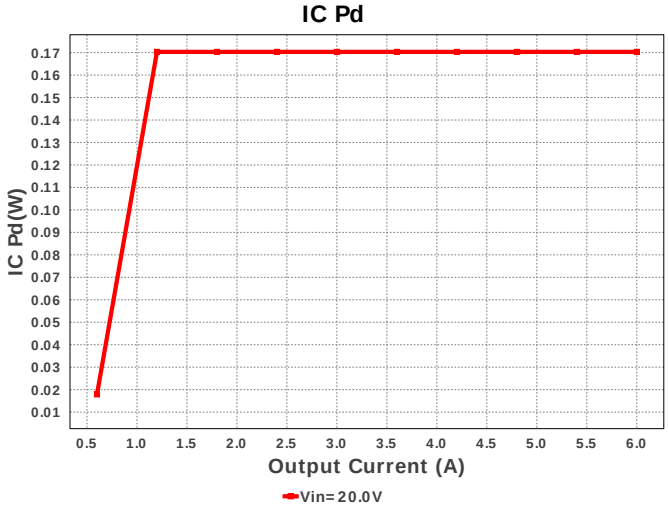


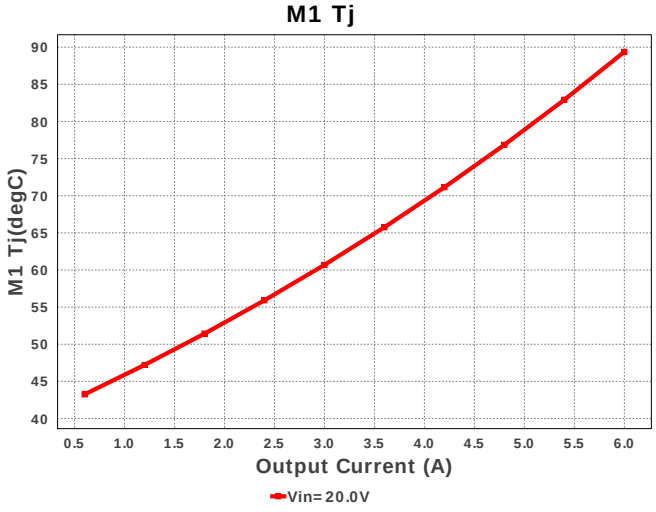


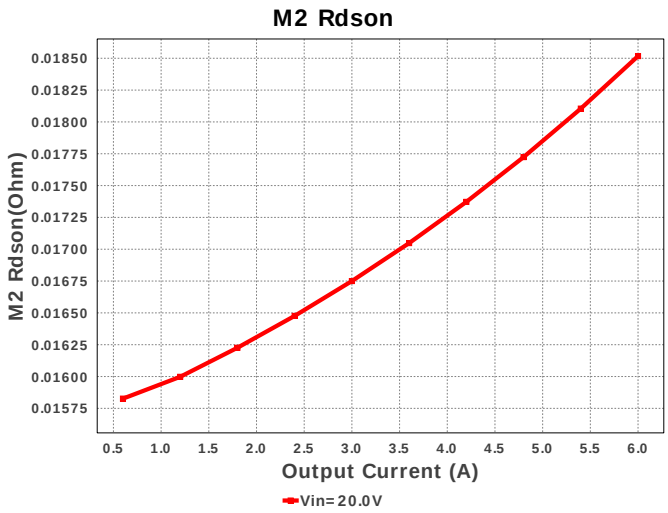


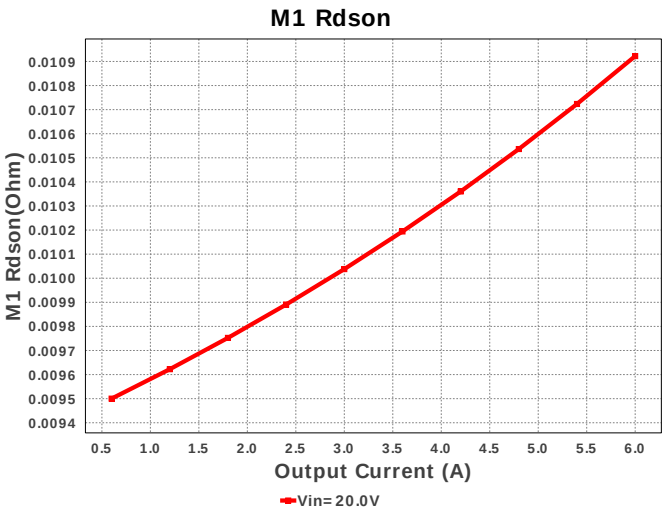


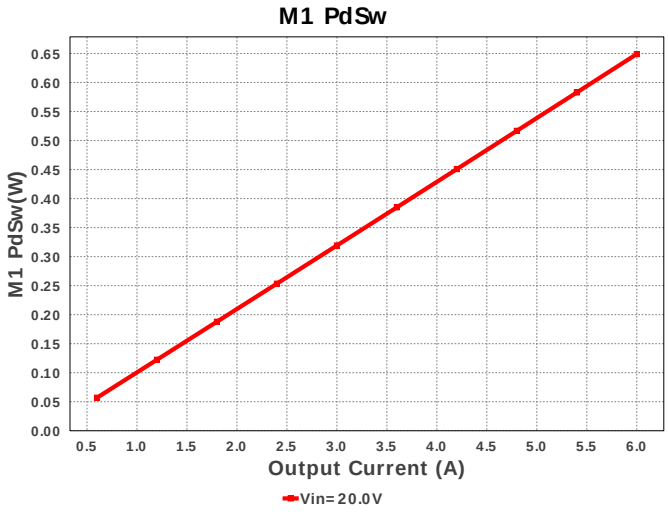


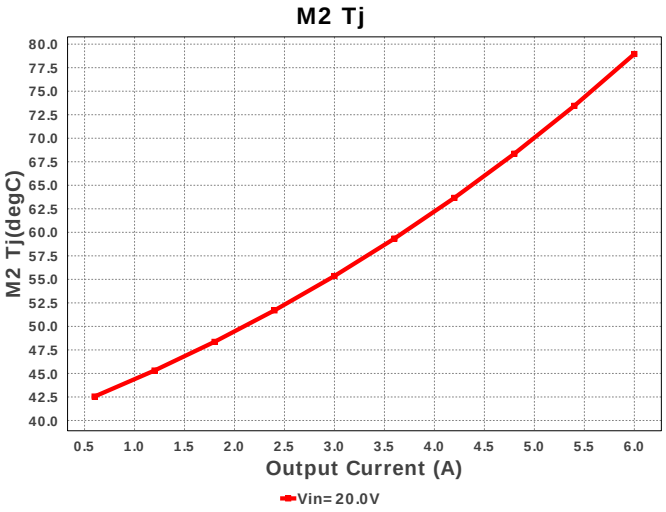


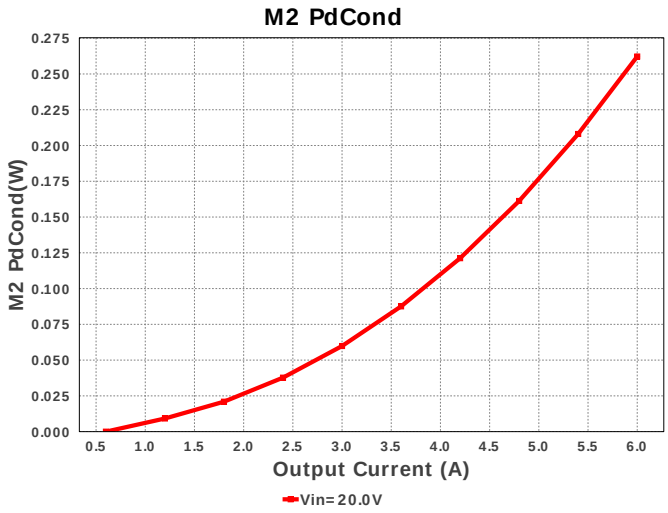


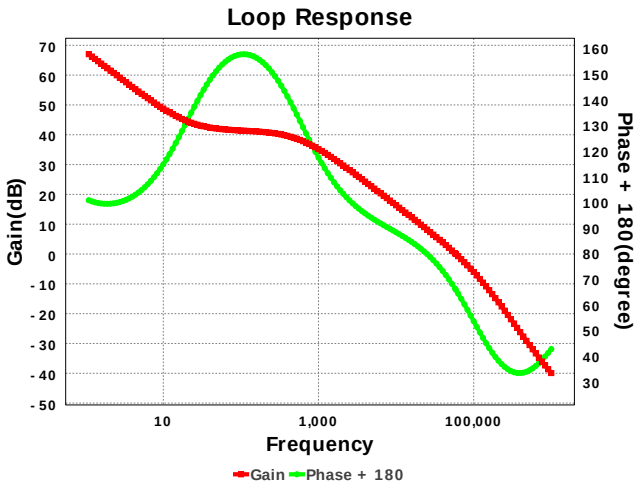












Operating Values

#	Name	Value	Category	Description
1.	Total BOM	$4.696		Total BOM Cost
2.	Cin IRMS	2.931 A	Current	Input capacitor RMS ripple current
3.	Cout IRMS	141.515 mA	Current	Output capacitor RMS ripple current
4.	Iin Avg	3.725 A	Current	Average input current
5.	L Ipp	490.222 mA	Current	Peak-to-peak inductor ripple current
6.	M1 Irms	4.673 A	Current	MOSFET RMS ripple current
7.	M2 Irms	3.763 A	Current	MOSFET RMS ripple current
8.	SW Ipk	6.245 A	Current	Peak switch current
9.	BOM Count	3	General	Total Design BOM count
10.	FootPrint	409.0 mm^2	General	Total Foot Print Area of BOM components
11.	Frequency	2.2 MHz	General	Switching frequency

#	Name	Value	Category	Description
12.	IC Tolerance	12.0 mV	General	IC Feedback Tolerance
13.	M1 Rdson	10.922 mOhm	General	Drain-Source On-resistance
14.	M2 Rdson	18.517 mOhm	General	Drain-Source On-resistance
15.	Mode	CCM	General	Conduction Mode
16.	Pout	72.0 W	General	Total output power
17.	Low Freq Gain	67.011 dB	Op_Point	Gain at 10Hz
18.	Vout Actual	12.0 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
19.	Cross Freq	58.854 kHz	Op_point	Bode plot crossover frequency
20.	Duty Cycle	60.884 %	Op_point	Duty cycle
21.	Efficiency	96.637 %	Op_point	Steady state efficiency
22.	Gain Marg	-45.254 dB	Op_point	Bode Plot Gain Margin
23.	IC Tj	45.808 degC	Op_point	IC junction temperature
24.	IOUT_OP	6.0 A	Op_point	Iout operating point
25.	M1 Tj	89.372 degC	Op_point	M1 MOSFET junction temperature
26.	M2 Tj	78.956 degC	Op_point	M2 MOSFET junction temperature
27.	Phase Marg	66.151 deg	Op_point	Bode Plot Phase Margin
28.	VIN_OP	20.0 V	Op_point	Vin operating point
29.	Vout p-p	534.14 µV	Op_point	Peak-to-peak output ripple voltage
30.	Cin Pd	12.104 mW	Power	Input capacitor power dissipation
31.	Cout Pd	20.273 µW	Power	Output capacitor power dissipation
32.	IC Pd	170.33 mW	Power	IC power dissipation
33.	L Pd	630.0 mW	Power	Inductor power dissipation
34.	M1 Pd	887.567 mW	Power	M1 MOSFET total power dissipation
35.	M1 PdCond	238.535 mW	Power	M1 MOSFET conduction losses
36.	M1 PdSw	649.033 mW	Power	M1 MOSFET switching losses
37.	M2 Pd	692.382 mW	Power	M2 MOSFET total power dissipation
38.	M2 PdCond	262.212 mW	Power	M2 MOSFET conduction losses
39.	M2 PdSw	430.17 mW	Power	M2 MOSFET switching losses
40.	Rsense Pd	113.285 mW	Power	LED Current Rsns Power Dissipation
41.	Total Pd	2.506 W	Power	Total Power Dissipation
42.	Vout Tolerance	2.001 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	6.0	Maximum Output Current
2.	VinMax	20.0	Maximum input voltage
3.	VinMin	20.0	Minimum input voltage
4.	Vout	12.0	Output Voltage
5.	base_pn	LM5141-Q1	Base Product Number
6.	source	DC	Input Source Type
7.	Ta	40.0	Ambient temperature

Design Assistance

1. The LM5141-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. **LM5141-Q1** Product Folder : http://www.ti.com/product/LM5141%2Dq1 : contains the data sheet and other resources.