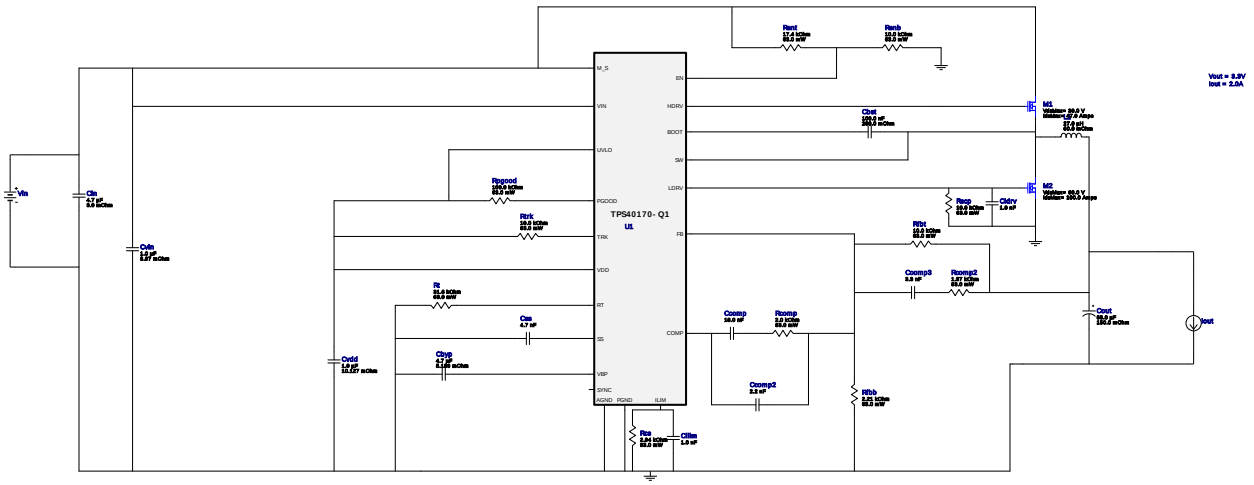
WEBENCH® Design Report

VinMin = 14.0V
VinMax = 22.0V
Vout = 3.3V
Iout = 2.0A

Device = TPS40170QRGYRQ1
Topology = Buck
Created = 7/12/16 2:46:52 AM
BOM Cost = $4.69
BOM Count = 27
Total Pd = 0.81W

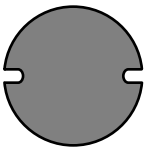
Design : 4737567/101 TPS40170QRGYRQ1
TPS40170QRGYRQ1 14.0V-22.0V to 3.30V @ 2.0A



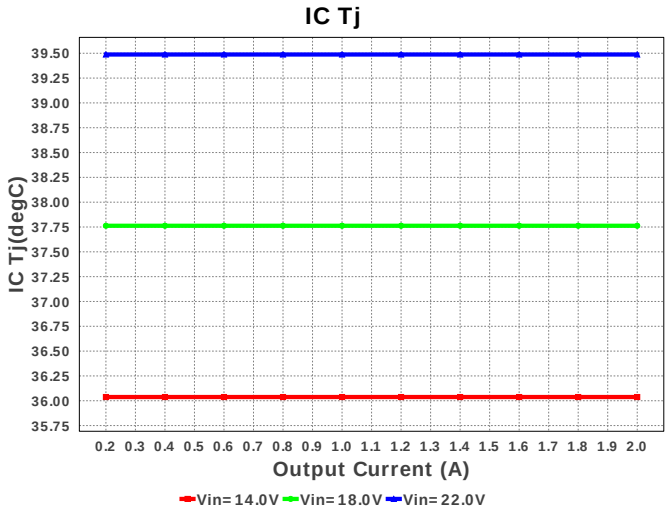
1. This regulator device is qualified for Automotive applications. All passives and other components selected in this design may not be qualified for Automotive applications. The user is required to verify that all components in the design meet the qualification and safety requirements for their specific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

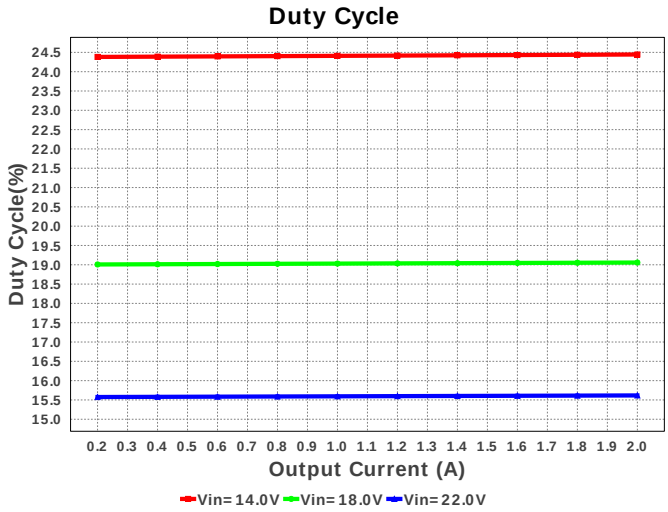
Electrical BOM

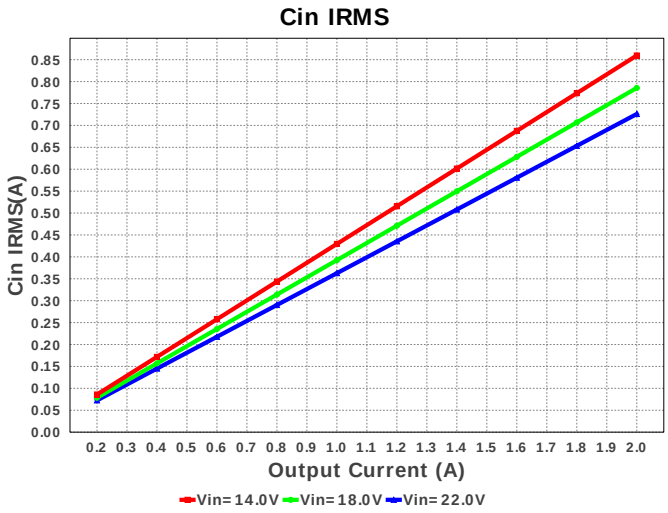
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cbst	AVX	08053C104KAT2A Series= X7R	Cap= 100.0 nF ESR= 280.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
2.	Cbyp	MuRata	GRM21BR61E475KA12L Series= X5R	Cap= 4.7 uF ESR= 5.189 mOhm VDC= 25.0 V IRMS= 2.03531 A	1	$0.02	0805 7 mm²
3.	Ccomp	Yageo America	CC0805KRX7R9BB183 Series= X7R	Cap= 18.0 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
4.	Ccomp2	Yageo America	CC0805KRX7R9BB222 Series= X7R	Cap= 2.2 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
5.	Ccomp3	MuRata	GRM216R71E332KA01D Series= X7R	Cap= 3.3 nF VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
6.	Cilim	MuRata	GRM216R71E102KA01D Series= X7R	Cap= 1.0 nF VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
7.	Cin	MuRata	GRM31CR71H475KA12L Series= X7R	Cap= 4.7 uF ESR= 3.0 mOhm VDC= 50.0 V IRMS= 4.98 A	1	$0.07	1206 11 mm²
8.	Cldrv	MuRata	GRM216R71E102KA01D Series= X7R	Cap= 1.0 nF VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
9.	Cout	Panasonic	4TPH68MHA Series= ?	Cap= 68.0 uF ESR= 150.0 mOhm VDC= 4.0 V IRMS= 510.0 mA	1	$0.34	CAPSMT_6_A09 11 mm²

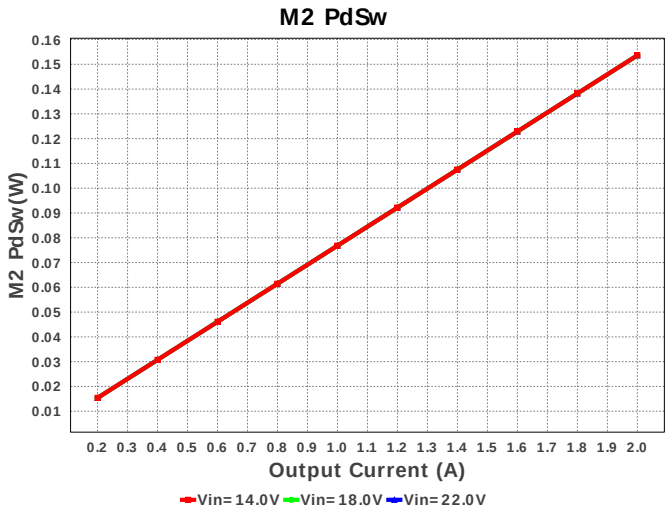
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
10.	Css	MuRata	GRM033R70J472KA01D Series= X7R	Cap= 4.7 nF VDC= 6.3 V IRMS= 0.0 A	1	$0.01	 0201 2 mm^2
11.	Cvdd	MuRata	GRM188R61C105KA93D Series= X5R	Cap= 1.0 uF ESR= 10.127 mOhm VDC= 16.0 V IRMS= 994.63 mA	1	$0.01	 0603 5 mm^2
12.	Cvin	TDK	C3216X5R1H105K Series= X5R	Cap= 1.0 uF ESR= 8.97 mOhm VDC= 50.0 V IRMS= 0.0 A	1	$0.02	 1206 11 mm^2
13.	L1	Bourns	SDR1307-270ML	L= 27.0 µH DCR= 60.0 mOhm	1	$0.35	 SDR1307 227 mm^2
14.	M1	Texas Instruments	CSD17308Q3	VdsMax= 30.0 V IdsMax= 47.0 Amps	1	$0.34	 TRANS_NexFET_Q3 18 mm^2
15.	M2	Texas Instruments	CSD18531Q5A	VdsMax= 60.0 V IdsMax= 100.0 Amps	1	$0.90	 TRANS_NexFET_Q5A 55 mm^2
16.	Rcomp	Vishay-Dale	CRCW04022K00FKED Series= CRCW..e3	Res= 2.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
17.	Rcomp2	Vishay-Dale	CRCW04021K37FKED Series= CRCW..e3	Res= 1.37 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
18.	Rcs	Vishay-Dale	CRCW04022K94FKED Series= CRCW..e3	Res= 2.94 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
19.	Renb	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
20.	Rent	Vishay-Dale	CRCW040217K4FKED Series= CRCW..e3	Res= 17.4 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
21.	Rfbb	Vishay-Dale	CRCW04022K21FKED Series= CRCW..e3	Res= 2.21 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
22.	Rfbt	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
23.	Rpgood	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
24.	Rscp	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
25.	Rt	Vishay-Dale	CRCW040231K6FKED Series= CRCW..e3	Res= 31.6 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
26.	Rtrk	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2

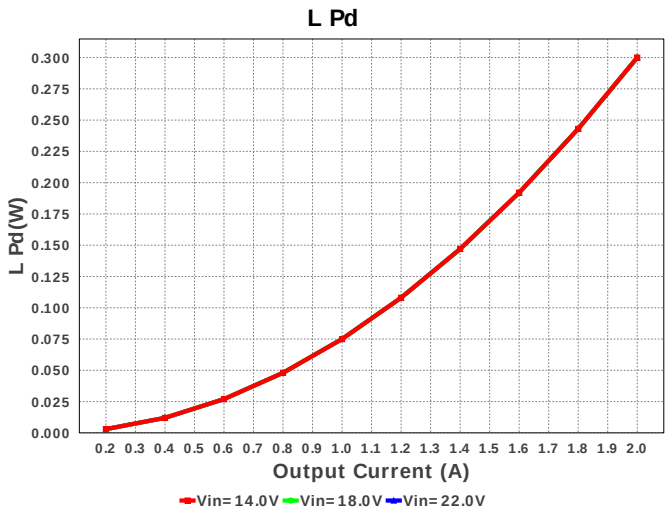
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
27.	U1	Texas Instruments	TPS40170QRGYRQ1	Switcher	1	$2.46	 R-PVQFN-N20 25 mm^2

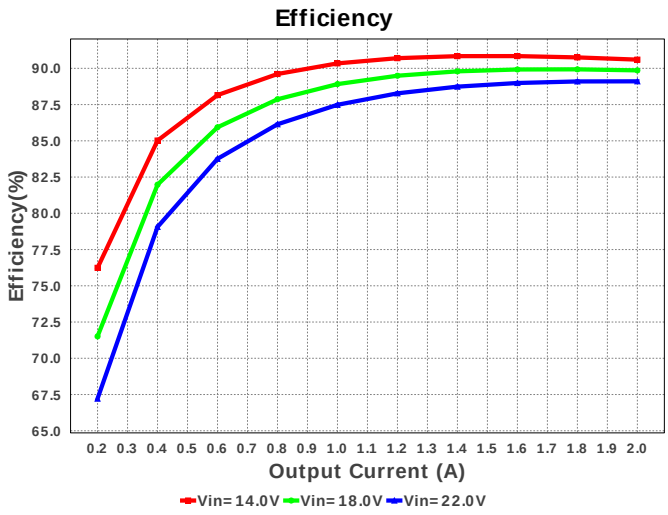


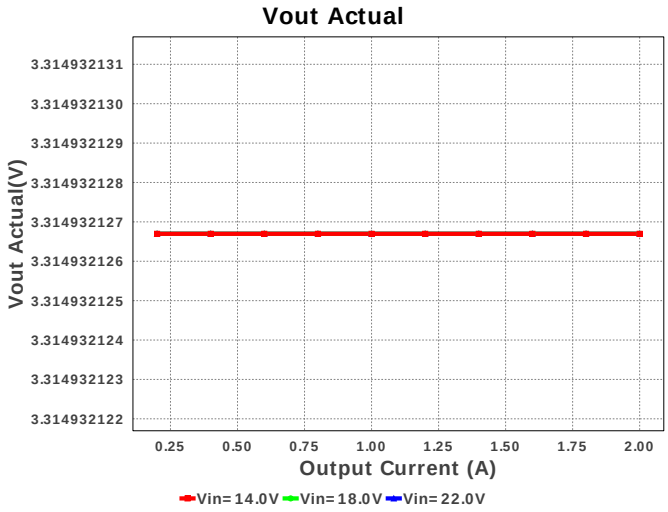


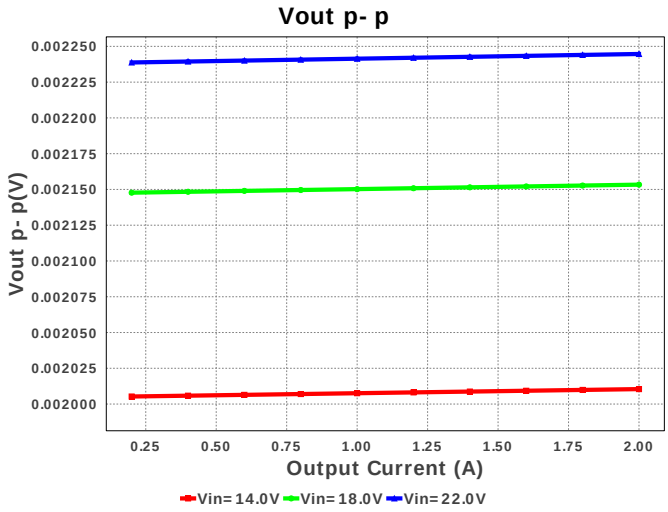


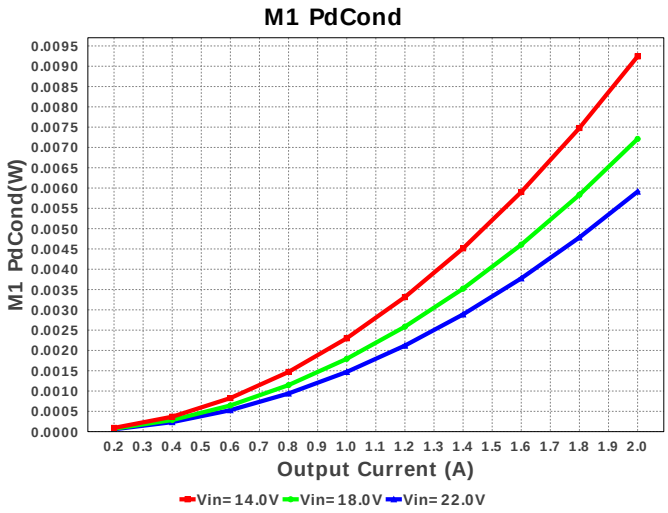


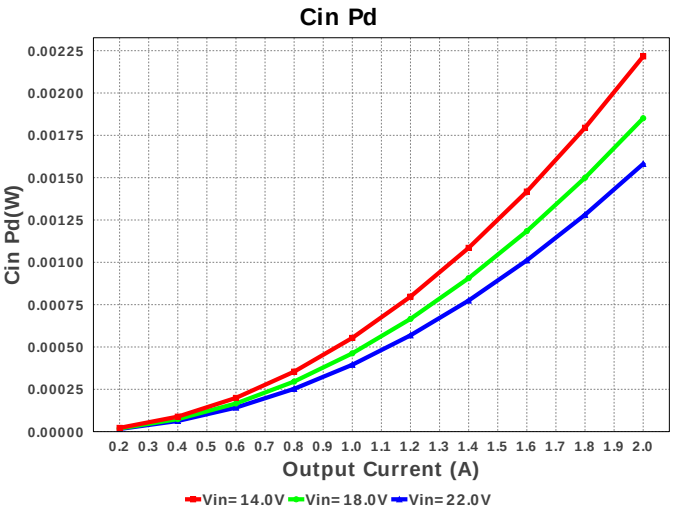


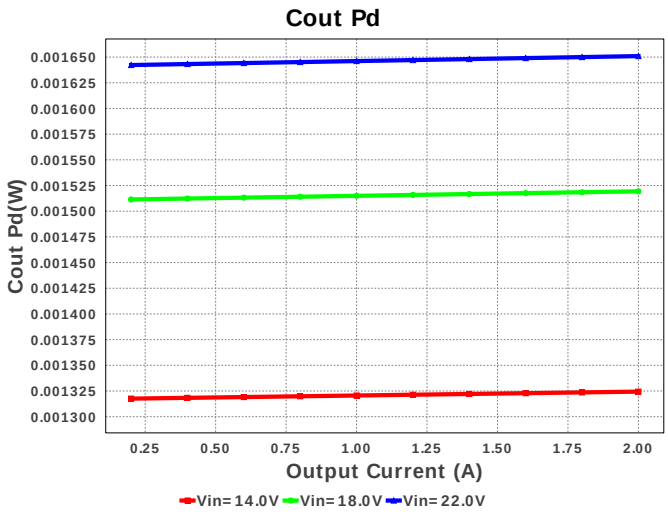


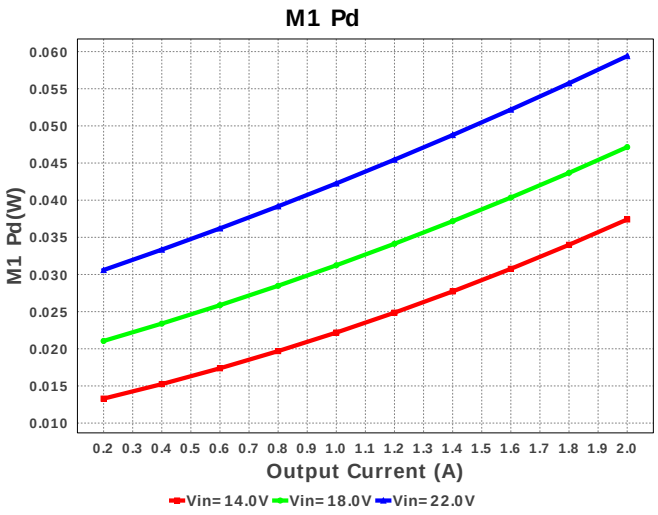


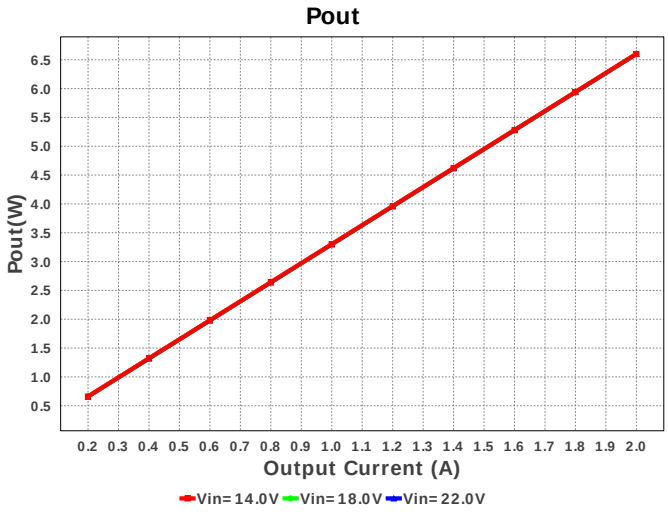


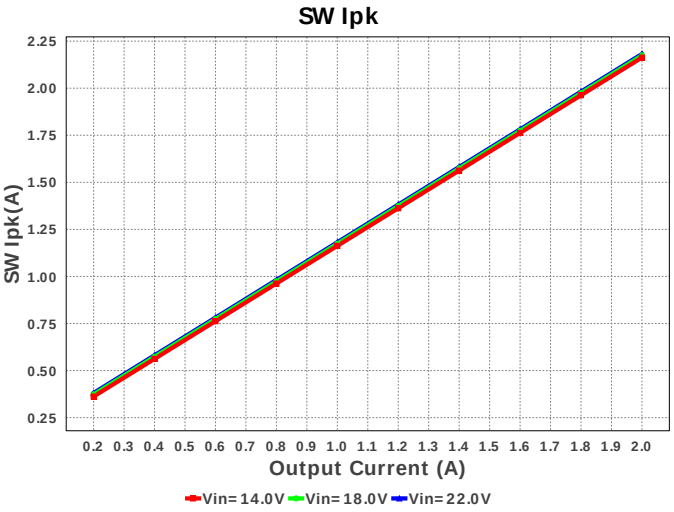


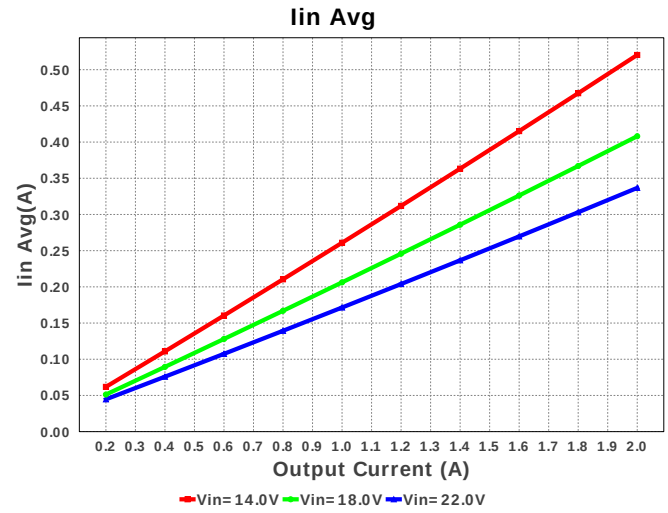


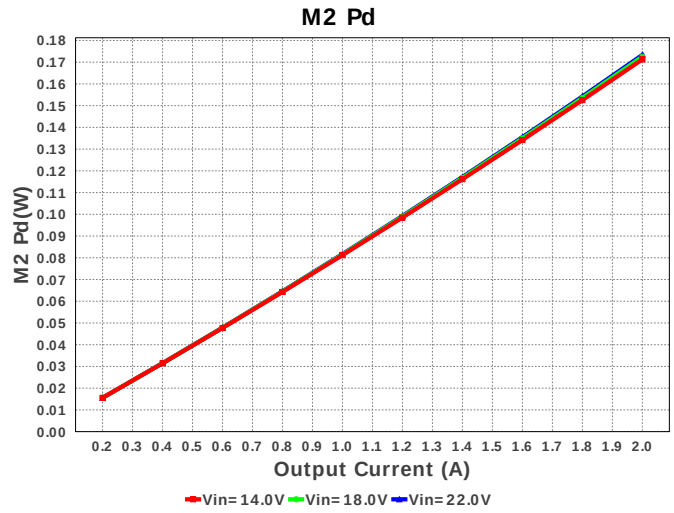


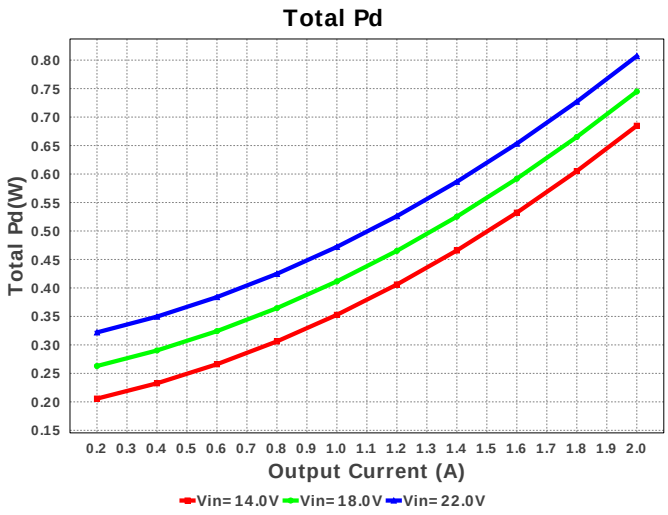


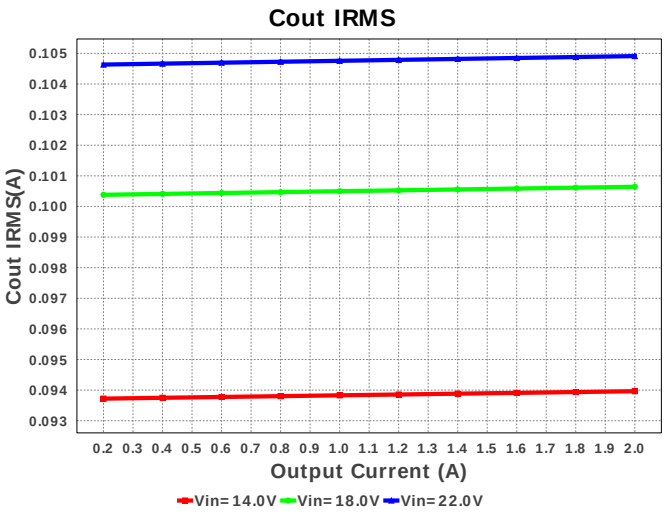


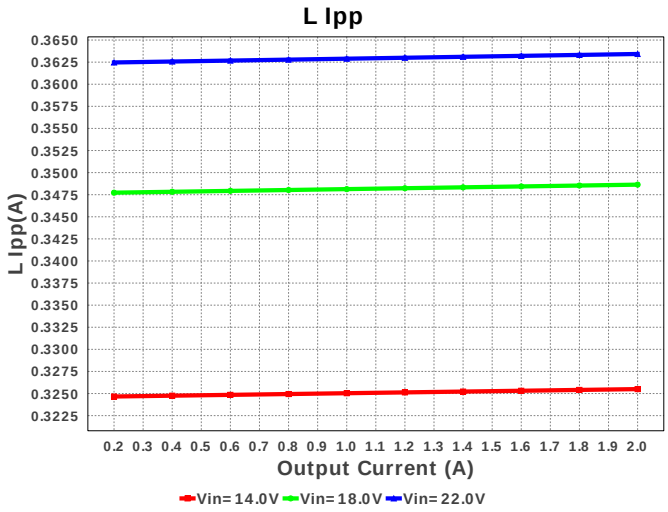


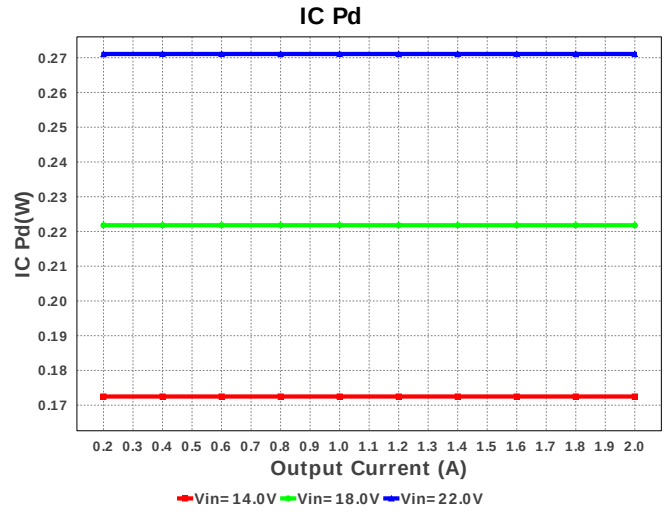


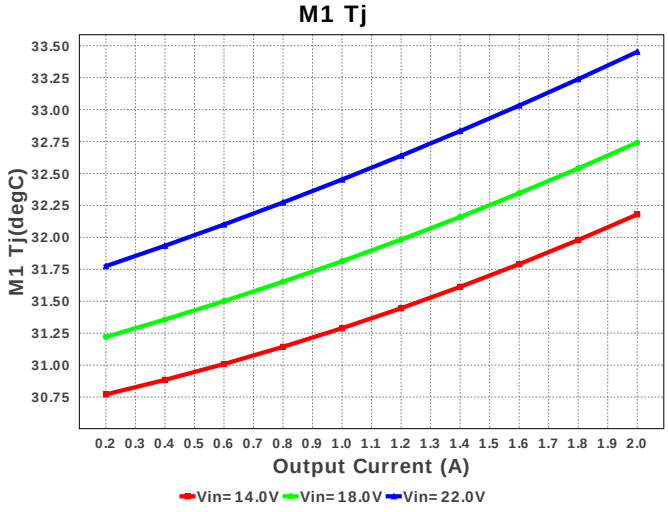


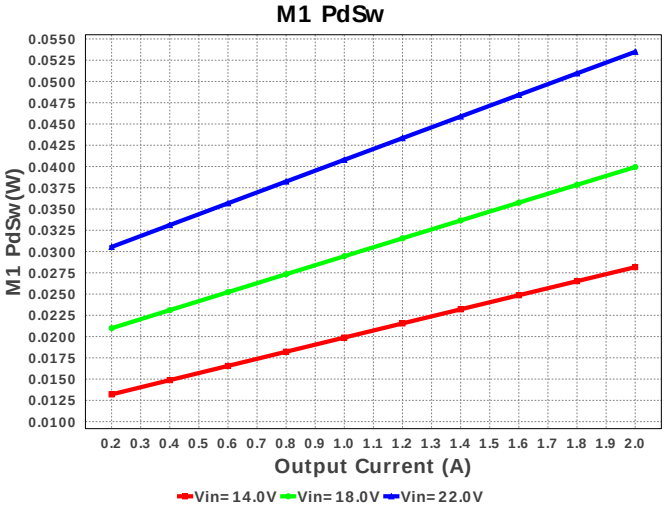


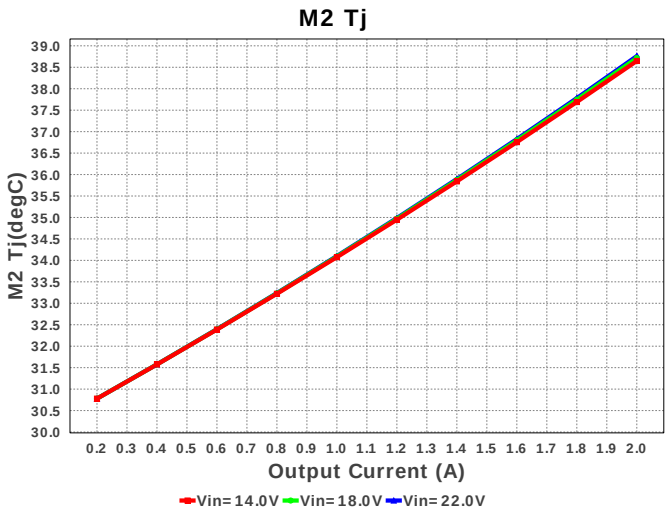


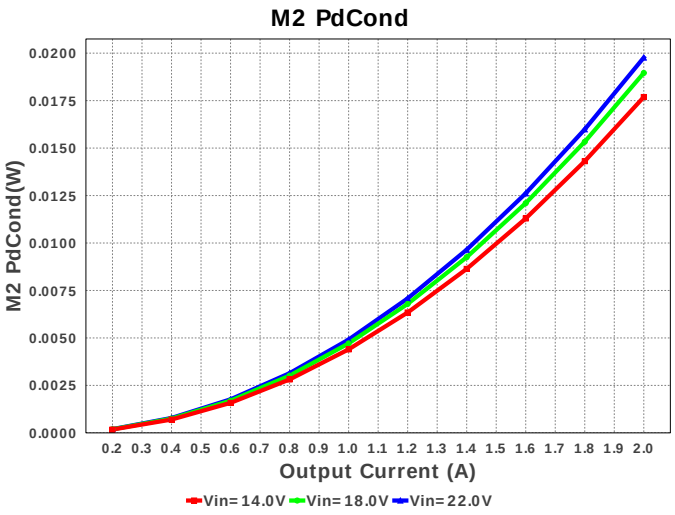


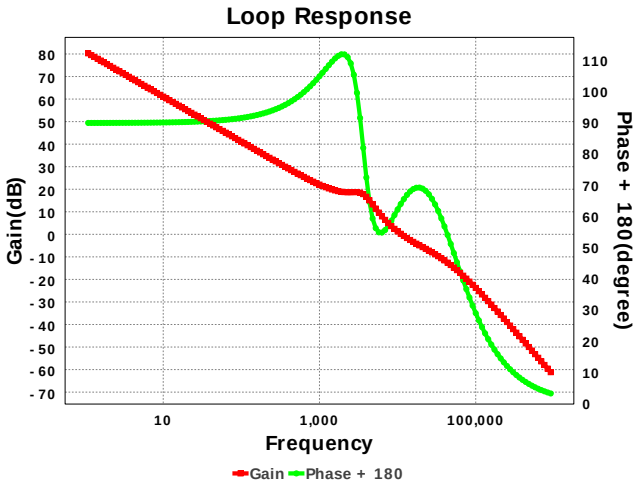












Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	726.031 mA	Current	Input capacitor RMS ripple current
2.	Cout IRMS	104.911 mA	Current	Output capacitor RMS ripple current
3.	Iin Avg	336.68 mA	Current	Average input current
4.	L Ipp	363.42 mA	Current	Peak-to-peak inductor ripple current
5.	SW Ipk	2.182 A	Current	Peak switch current
6.	BOM Count	27	General	Total Design BOM count
7.	FootPrint	445.0 mm^2	General	Total Foot Print Area of BOM components
8.	Frequency	297.619 kHz	General	Switching frequency
9.	IC Tolerance	6.0 µV	General	IC Feedback Tolerance
10.	Pout	6.6 W	General	Total output power
11.	Total BOM	$4.69	General	Total BOM Cost
12.	Vout Actual	3.315 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
13.	Cross Freq	11.238 kHz	Op_point	Bode plot crossover frequency
14.	Duty Cycle	15.617 %	Op_point	Duty cycle
15.	Efficiency	89.104 %	Op_point	Steady state efficiency
16.	IC Tj	39.488 degC	Op_point	IC junction temperature
17.	IOUT_OP	2.0 A	Op_point	Iout operating point
18.	M1 Tj	33.452 degC	Op_point	M1 MOSFET junction temperature
19.	M2 Tj	38.76 degC	Op_point	M2 MOSFET junction temperature
20.	Phase Marg	64.485 deg	Op_point	Bode Plot Phase Margin
21.	VIN_OP	22.0 V	Op_point	Vin operating point
22.	Vout p-p	2.245 mV	Op_point	Peak-to-peak output ripple voltage
23.	Cin Pd	1.581 mW	Power	Input capacitor power dissipation
24.	Cout Pd	1.651 mW	Power	Output capacitor power dissipation
25.	IC Pd	271.071 mW	Power	IC power dissipation
26.	L Pd	300.0 mW	Power	Inductor power dissipation
27.	M1 Pd	59.396 mW	Power	M1 MOSFET total power dissipation
28.	M1 PdCond	5.915 mW	Power	M1 MOSFET conduction losses
29.	M1 PdSw	53.481 mW	Power	M1 MOSFET switching losses
30.	M2 Pd	173.363 mW	Power	M2 MOSFET total power dissipation
31.	M2 PdCond	19.778 mW	Power	M2 MOSFET conduction losses

#	Name	Value	Category	Description
32.	M2 PdSw	153.584 mW	Power	M2 MOSFET switching losses
33.	Total Pd	807.062 mW	Power	Total Power Dissipation
34.	Vout Tolerance	1.656 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	2.0	Maximum Output Current
2.	VinMax	22.0	Maximum input voltage
3.	VinMin	14.0	Minimum input voltage
4.	Vout	3.3	Output Voltage
5.	base_pn	TPS40170-Q1	Base Product Number
6.	source	DC	Input Source Type
7.	Ta	30.0	Ambient temperature

Design Assistance

1. Feature Highlights: Automotive Qualified 4.5V to 60V Wide Input Synchronous PWM Buck Controller

2. The TPS40170-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

3. **TPS40170-Q1** Product Folder : http://www.ti.com/product/TPS40170%2DQ1 : contains the data sheet and other resources.