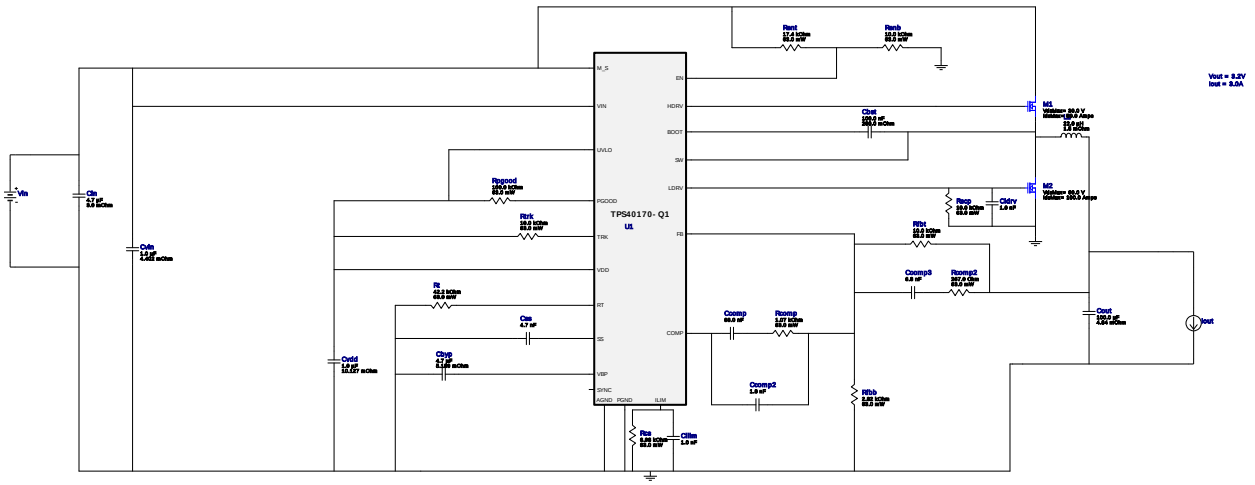
VinMin = 14.0V
VinMax = 22.0V
Vout = 3.2V
Iout = 3.0A

Device = TPS40170QRGYRQ1
Topology = Buck
Created = 8/20/16 3:26:51 AM
BOM Cost = $5.35
BOM Count = 27
Total Pd = 0.67W

WEBENCH® Design Report

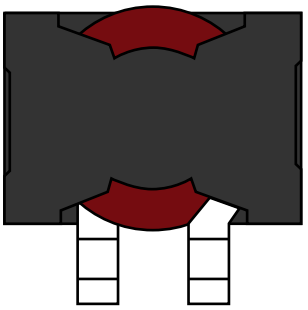
Design : 4772434/1 TPS40170QRGYRQ1
TPS40170QRGYRQ1 14.0V-22.0V to 3.20V @ 3.0A



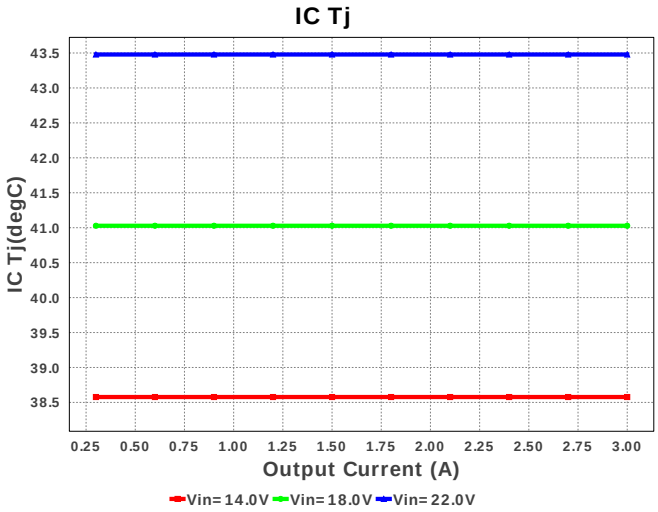
1. This regulator device is qualified for Automotive applications. All passives and other components selected in this design may not be qualified for Automotive applications. The user is required to verify that all components in the design meet the qualification and safety requirements for their specific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

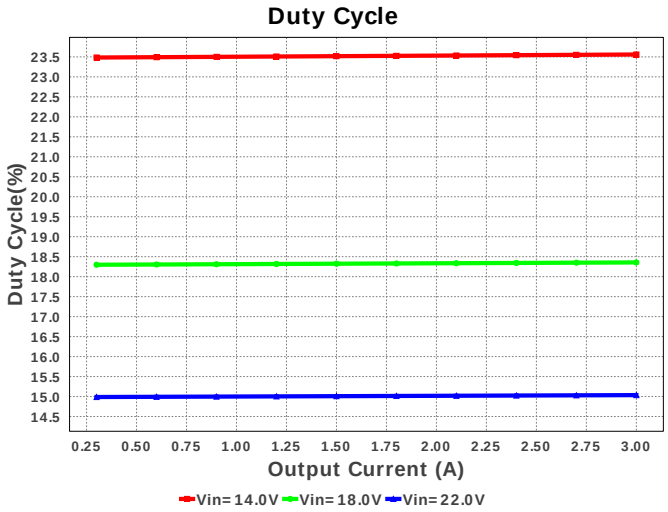
Electrical BOM

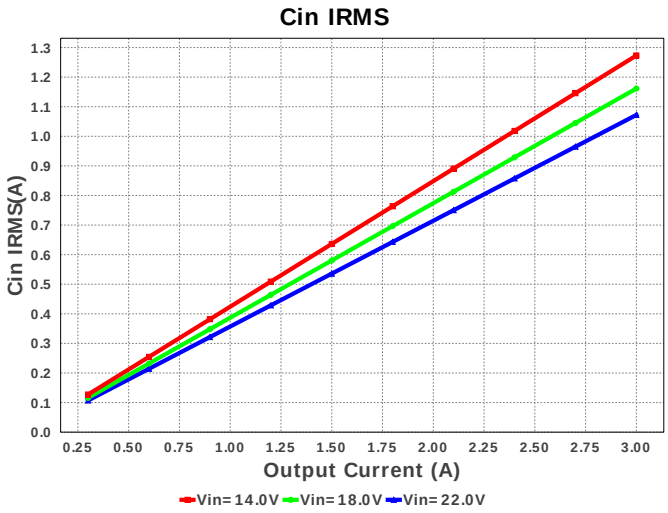
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cbst	AVX	08053C104KAT2A Series= X7R	Cap= 100.0 nF ESR= 280.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm²
2.	Cbyp	MuRata	GRM21BR61E475KA12L Series= X5R	Cap= 4.7 uF ESR= 5.189 mOhm VDC= 25.0 V IRMS= 2.03531 A	1	$0.02	0805 7 mm²
3.	Ccomp	MuRata	GRM155R61A683KA01D Series= X5R	Cap= 68.0 nF VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
4.	Ccomp2	MuRata	GRM033R71A182KA01D Series= X7R	Cap= 1.8 nF VDC= 10.0 V IRMS= 0.0 A	1	$0.01	0201 2 mm²
5.	Ccomp3	Yageo America	CC0805KRX7R9BB682 Series= X7R	Cap= 6.8 nF VDC= 50.0 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	MuRata	GRM31CD80G107ME39L Series= X6T	Cap= 100.0 uF ESR= 4.84 mOhm VDC= 4.0 V IRMS= 4.3381 A	1	$0.14	1206_190 11 mm²

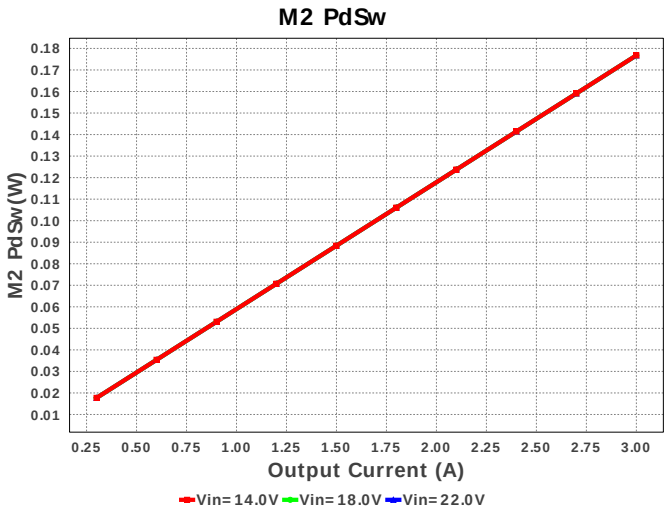
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
10.	Css	MuRata	GRM033R70J472KA01D Series= X7R	Cap= 4.7 nF VDC= 6.3 V IRMS= 0.0 A	1	$0.01	0201 2 mm²
11.	Cvdd	MuRata	GRM188R61C105KA93D Series= X5R	Cap= 1.0 uF ESR= 10.127 mOhm VDC= 16.0 V IRMS= 994.63 mA	1	$0.01	0603 5 mm²
12.	Cvin	MuRata	GRM21BR71H105KA12L Series= X7R	Cap= 1.0 uF ESR= 4.402 mOhm VDC= 50.0 V IRMS= 1.677 A	1	$0.05	0805 7 mm²
13.	L1	Coilcraft	SER2915L-223KL	L= 22.0 µH DCR= 1.5 mOhm	1	$1.88	 SER2915L 652 mm²
14.	M1	Texas Instruments	CSD17308Q3	VdsMax= 30.0 V IdsMax= 50.0 Amps	1	$0.28	 DQG0008A 18 mm²
15.	M2	Texas Instruments	CSD18532Q5B	VdsMax= 60.0 V IdsMax= 100.0 Amps	1	$0.95	 TRANS_NexFET_Q5B 58 mm²
16.	Rcomp	Vishay-Dale	CRCW04021K07FKED Series= CRCW..e3	Res= 1.07 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
17.	Rcomp2	Vishay-Dale	CRCW0402267RFKED Series= CRCW..e3	Res= 267.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
18.	Rcs	Vishay-Dale	CRCW04026K98FKED Series= CRCW..e3	Res= 6.98 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
19.	Renb	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
20.	Rent	Vishay-Dale	CRCW040217K4FKED Series= CRCW..e3	Res= 17.4 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
21.	Rfbb	Vishay-Dale	CRCW04022K32FKED Series= CRCW..e3	Res= 2.32 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
22.	Rfbt	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
23.	Rpgood	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
24.	Rscp	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
25.	Rt	Vishay-Dale	CRCW040242K2FKED Series= CRCW..e3	Res= 42.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
26.	Rtrk	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²

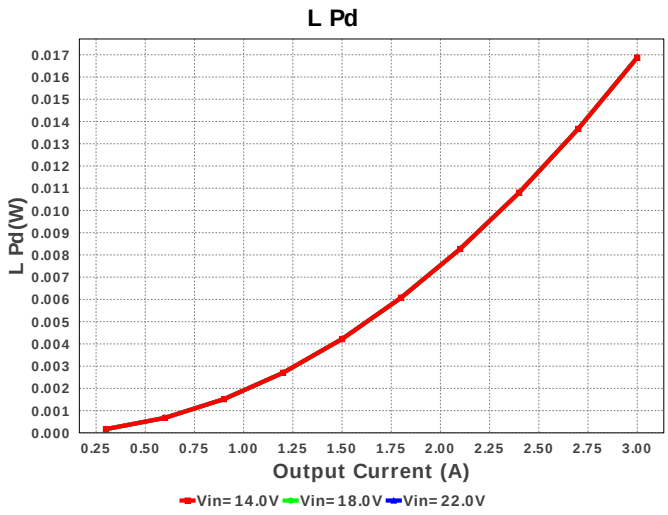
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
27.	U1	Texas Instruments	TPS40170QRGYRQ1	Switcher	1	$1.77	 R-PVQFN-N20 25 mm^2

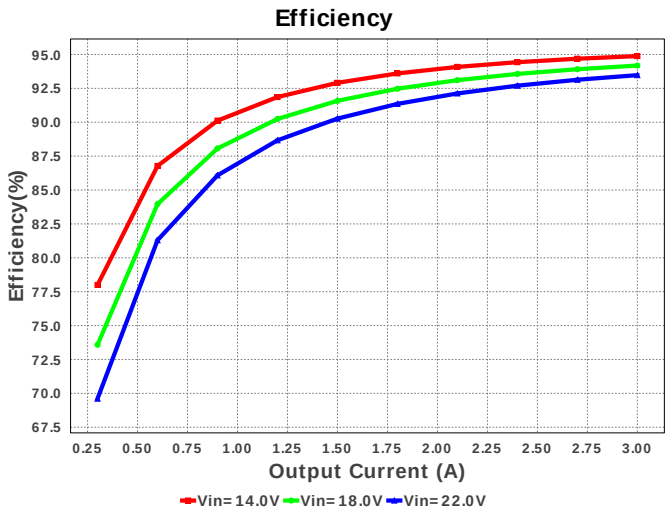


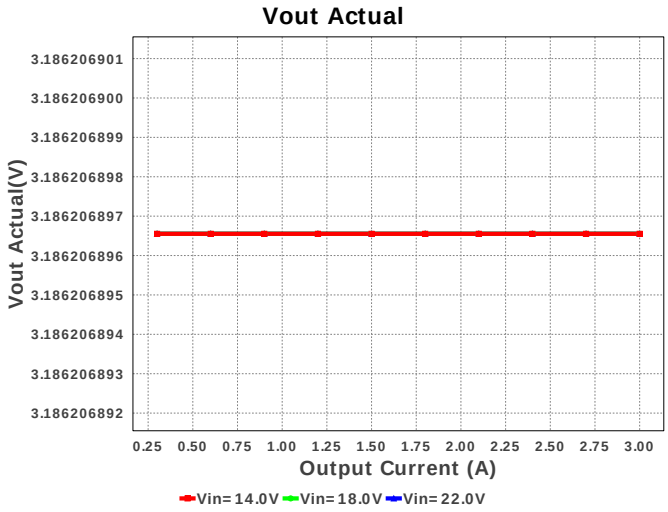


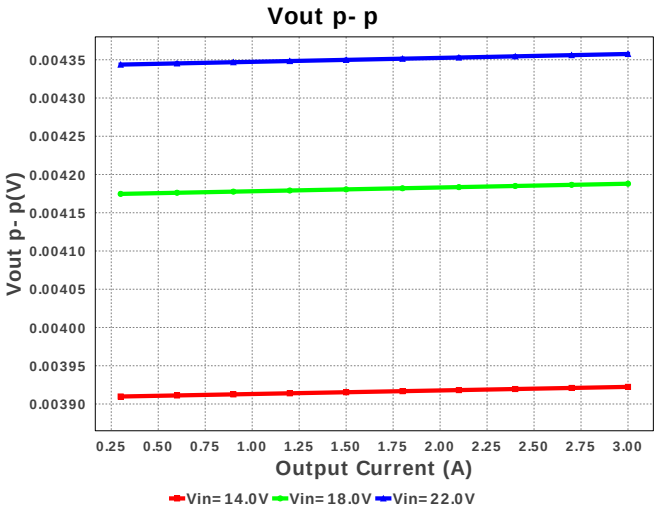


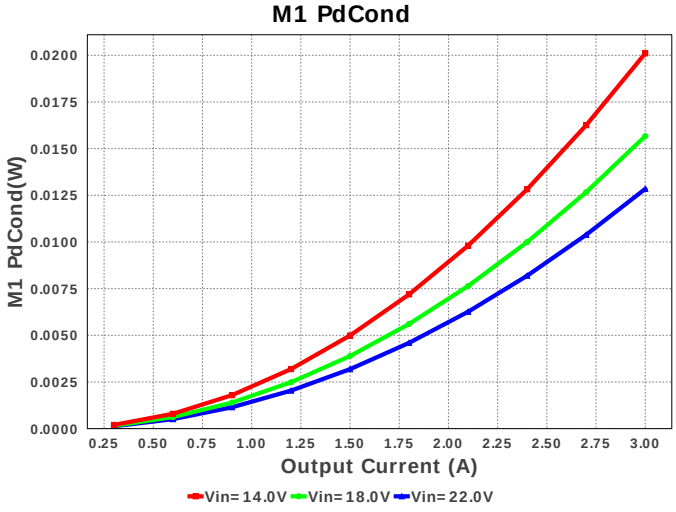


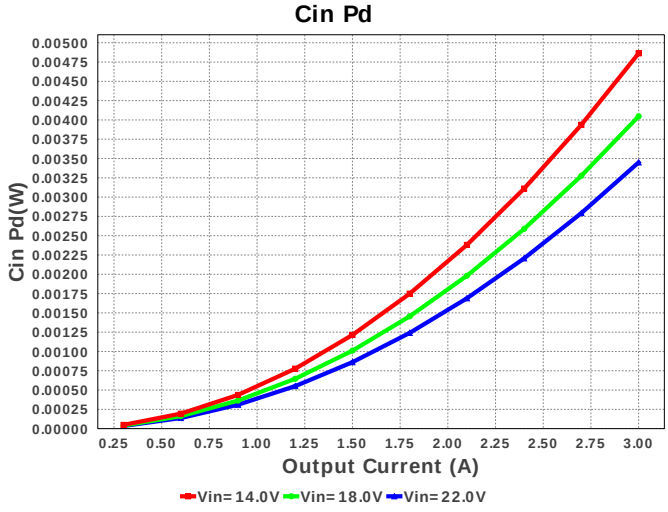


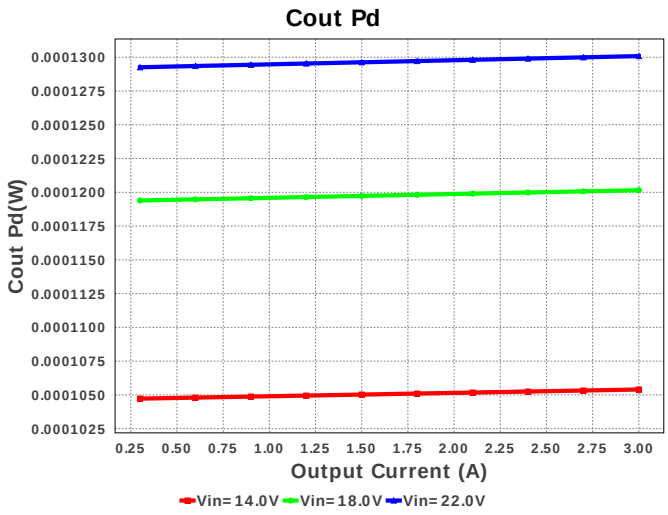


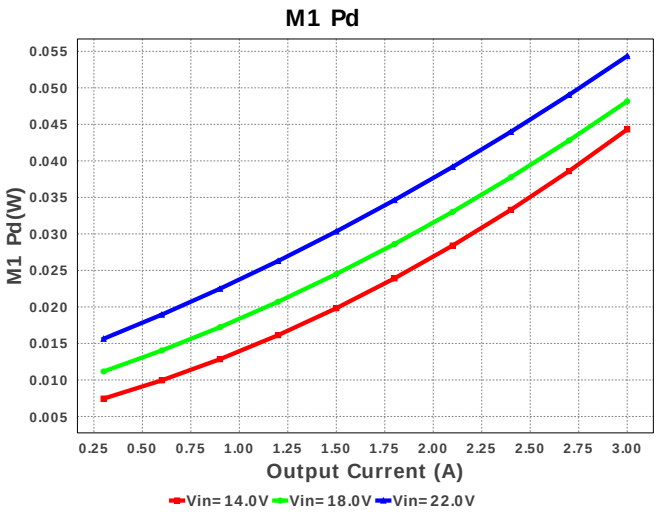


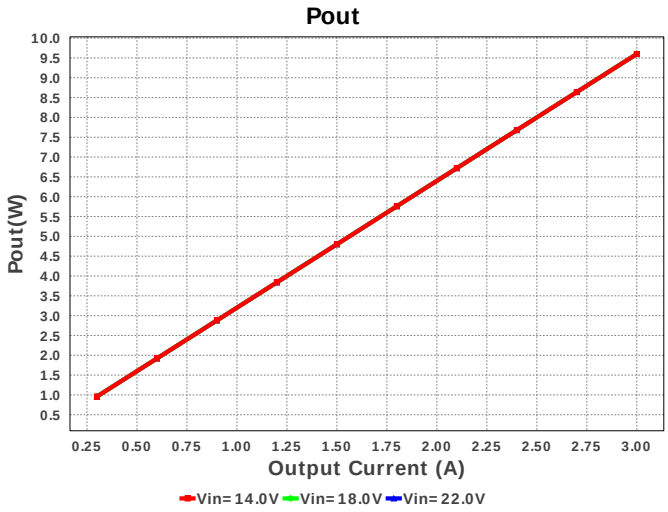


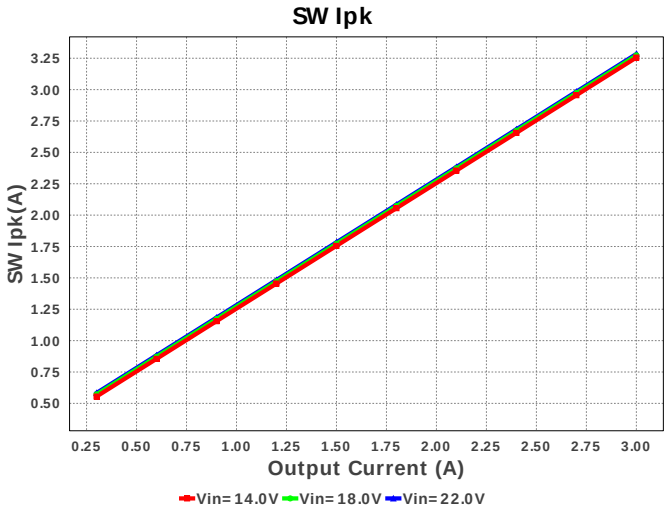


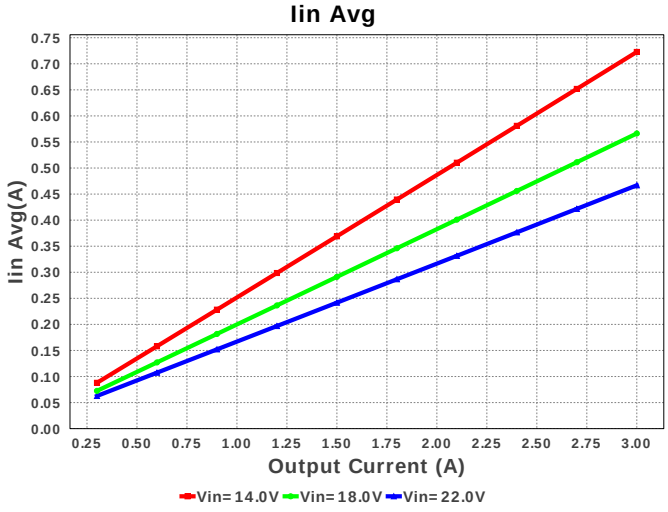


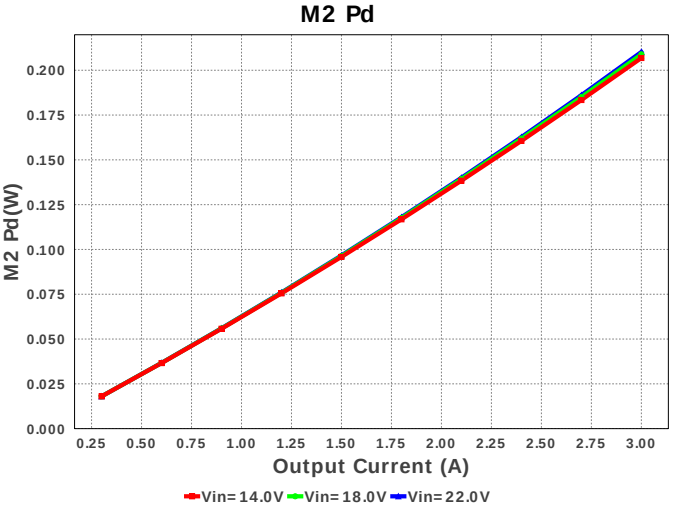


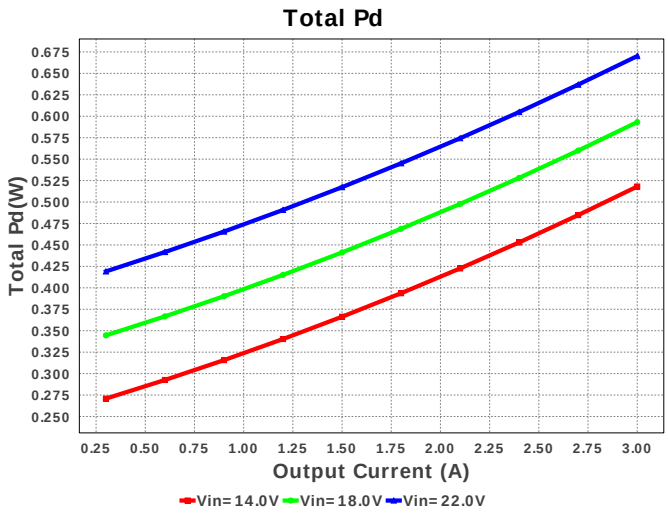


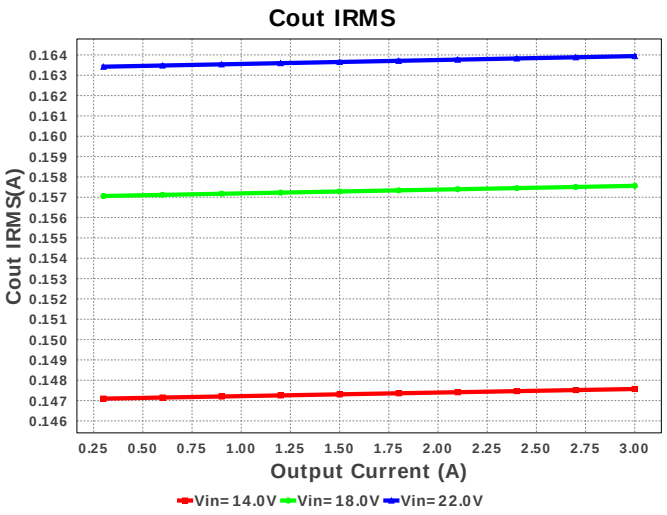


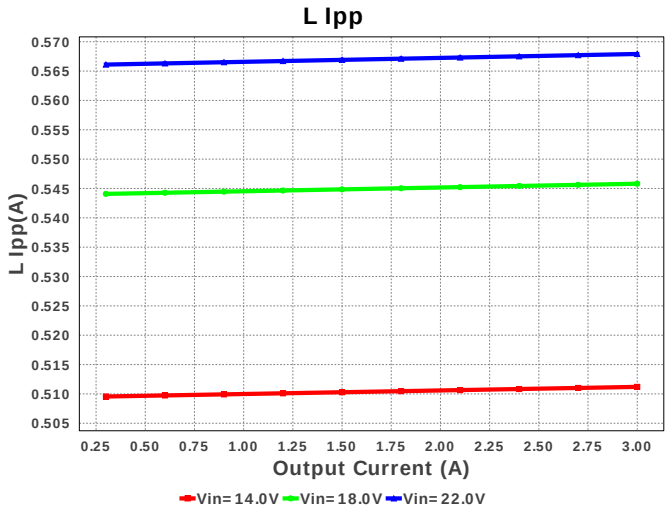


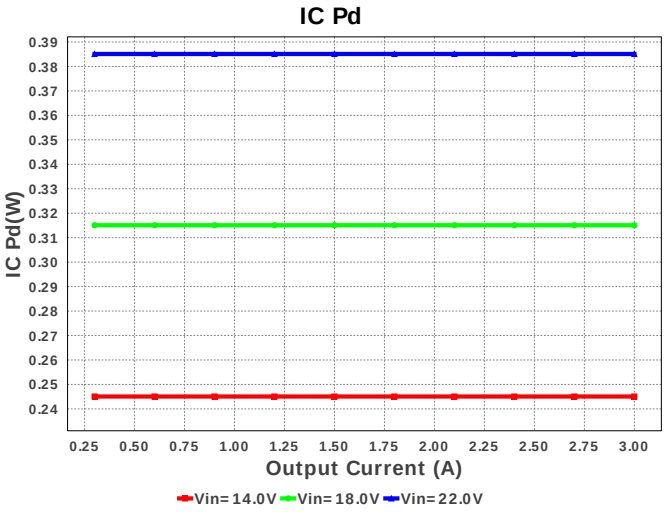


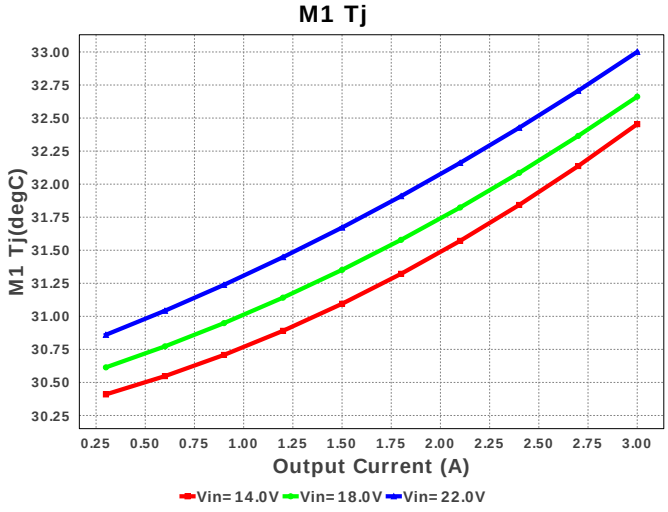


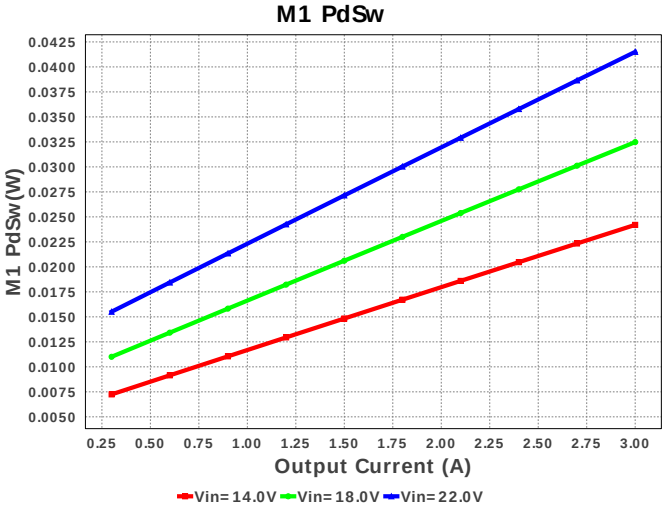


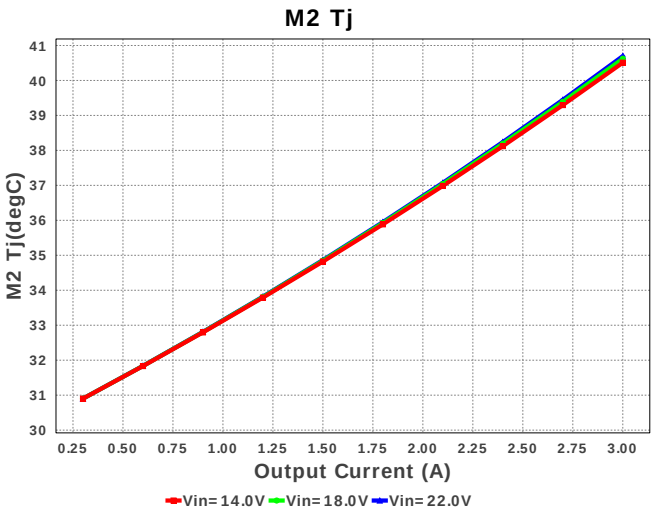


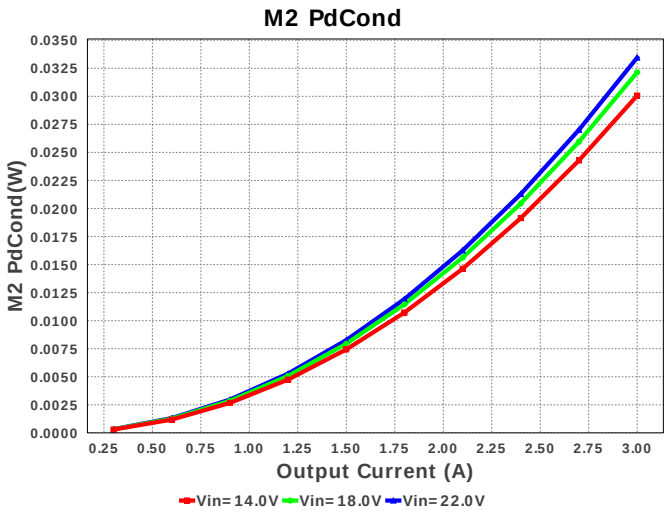


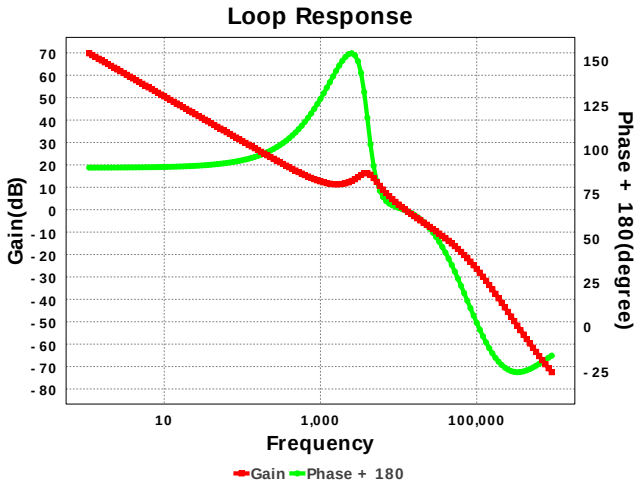












Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	1.072 A	Current	Input capacitor RMS ripple current
2.	Cout IRMS	163.942 mA	Current	Output capacitor RMS ripple current
3.	Iin Avg	466.83 mA	Current	Average input current
4.	L Ipp	567.91 mA	Current	Peak-to-peak inductor ripple current
5.	SW Ipk	3.284 A	Current	Peak switch current
6.	BOM Count	27	General	Total Design BOM count
7.	FootPrint	860.0 mm^2	General	Total Foot Print Area of BOM components
8.	Frequency	226.244 kHz	General	Switching frequency
9.	IC Tolerance	6.0 µV	General	IC Feedback Tolerance
10.	Mode	CCM	General	Conduction Mode
11.	Pout	9.6 W	General	Total output power
12.	Total BOM	$5.35	General	Total BOM Cost
13.	Vout Actual	3.186 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
14.	Cross Freq	12.182 kHz	Op_point	Bode plot crossover frequency
15.	Duty Cycle	15.036 %	Op_point	Duty cycle
16.	Efficiency	93.475 %	Op_point	Steady state efficiency
17.	IC Tj	43.478 degC	Op_point	IC junction temperature
18.	IOUT_OP	3.0 A	Op_point	Iout operating point
19.	M1 Tj	33.001 degC	Op_point	M1 MOSFET junction temperature
20.	M2 Tj	40.697 degC	Op_point	M2 MOSFET junction temperature
21.	Phase Marg	65.987 deg	Op_point	Bode Plot Phase Margin
22.	VIN_OP	22.0 V	Op_point	Vin operating point
23.	Vout p-p	4.358 mV	Op_point	Peak-to-peak output ripple voltage
24.	Cin Pd	3.449 mW	Power	Input capacitor power dissipation
25.	Cout Pd	130.085 µW	Power	Output capacitor power dissipation
26.	IC Pd	385.1 mW	Power	IC power dissipation
27.	L Pd	16.875 mW	Power	Inductor power dissipation
28.	M1 Pd	54.357 mW	Power	M1 MOSFET total power dissipation
29.	M1 PdCond	12.852 mW	Power	M1 MOSFET conduction losses
30.	M1 PdSw	41.505 mW	Power	M1 MOSFET switching losses
31.	M2 Pd	210.242 mW	Power	M2 MOSFET total power dissipation

#	Name	Value	Category	Description
32.	M2 PdCond	33.486 mW	Power	M2 MOSFET conduction losses
33.	M2 PdSw	176.756 mW	Power	M2 MOSFET switching losses
34.	Total Pd	670.134 mW	Power	Total Power Dissipation
35.	Vout Tolerance	1.641 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	3.0	Maximum Output Current
2.	VinMax	22.0	Maximum input voltage
3.	VinMin	14.0	Minimum input voltage
4.	Vout	3.2	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.