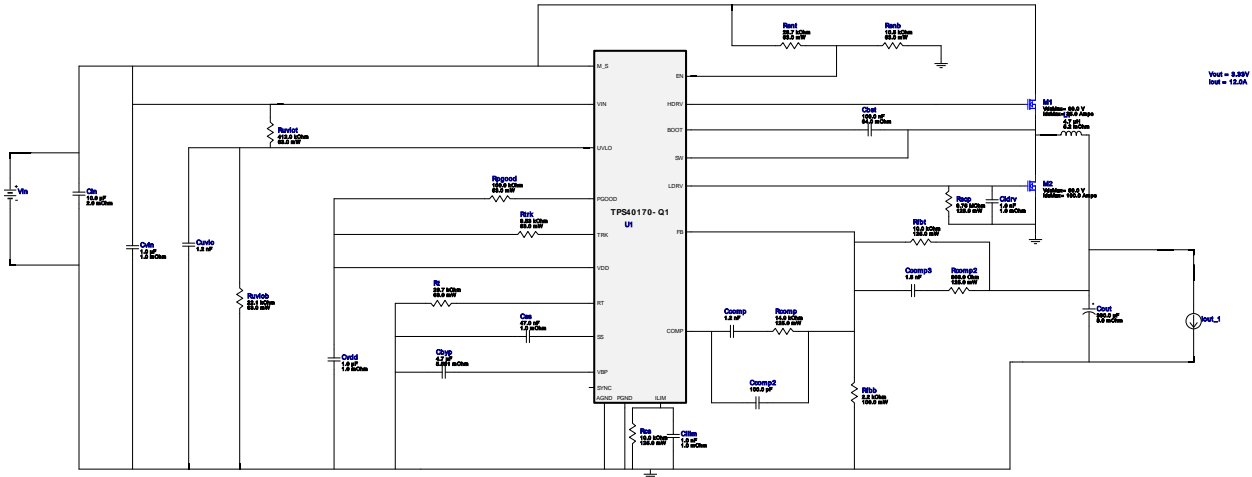


WEBENCH® Design Report

 Design : 855015/239 TPS40170QRGYRQ1
 Copy of Design #238















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

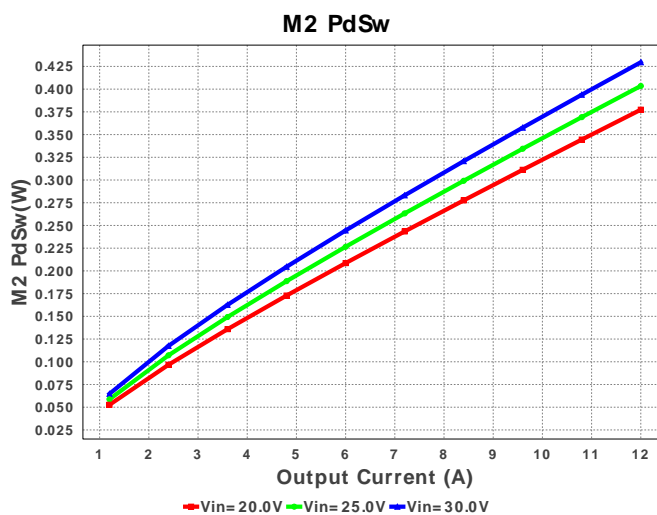
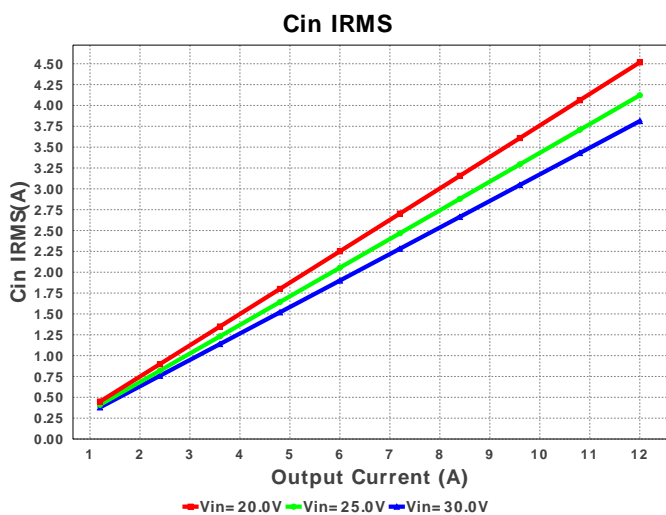
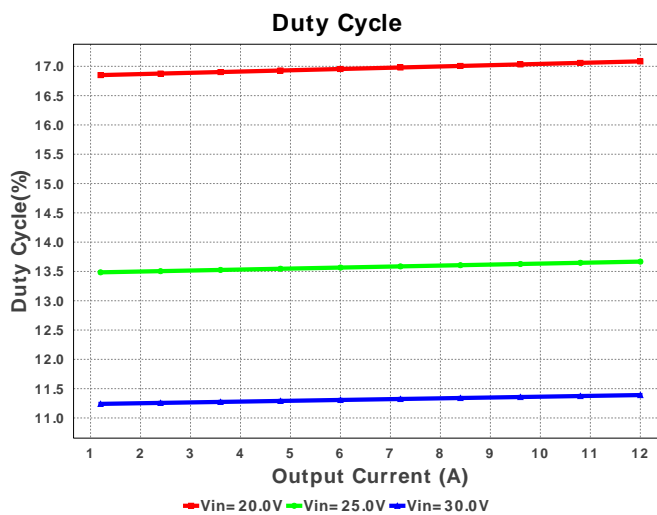
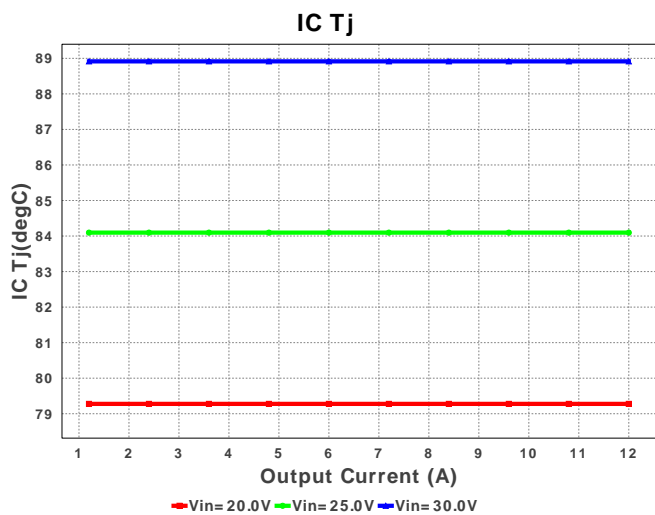
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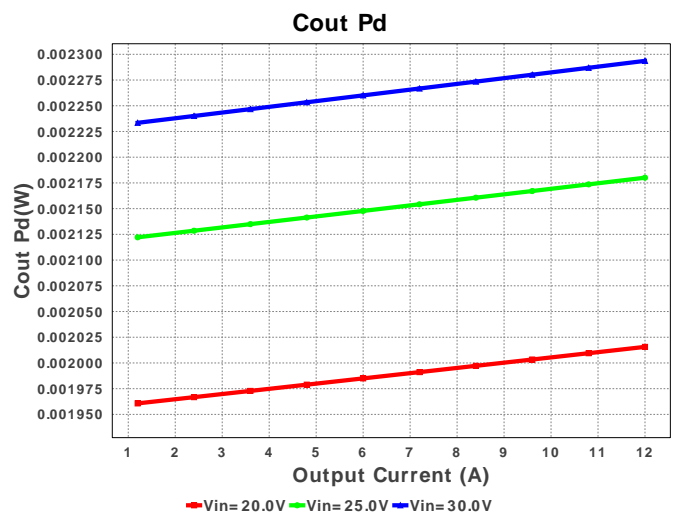
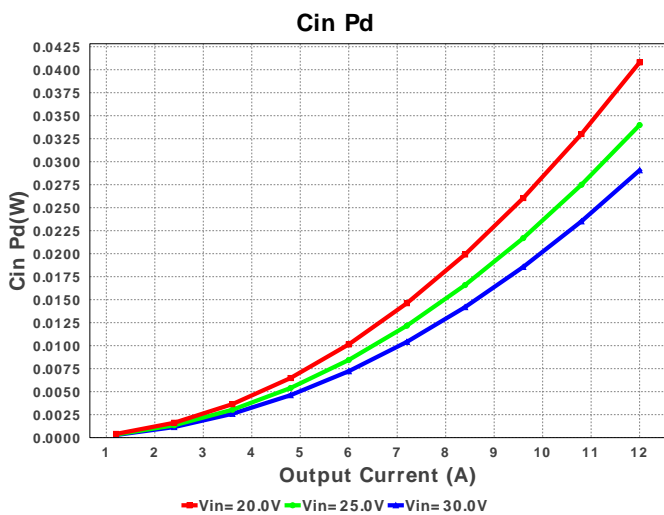
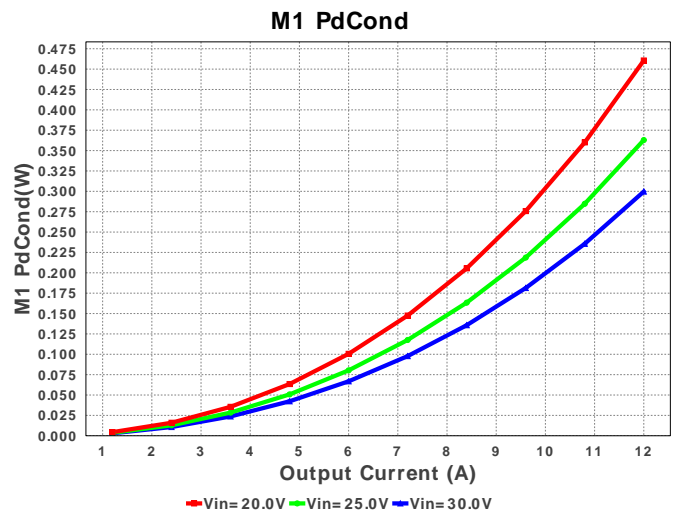
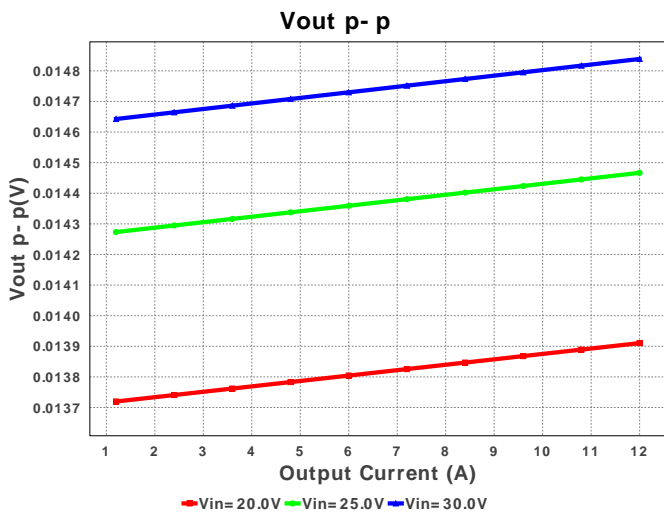
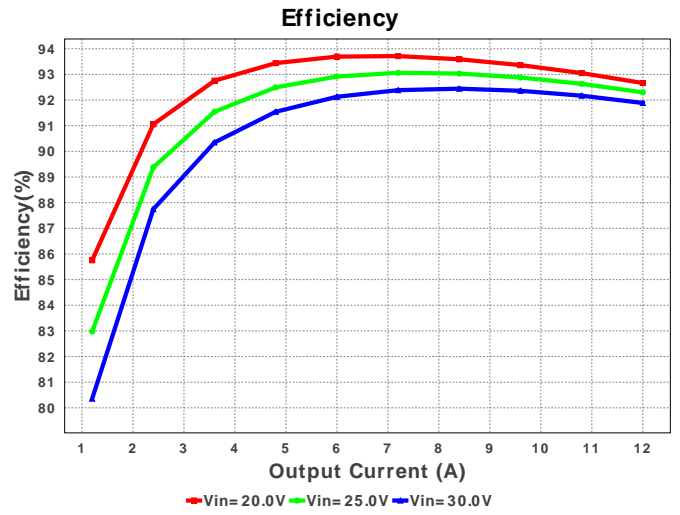
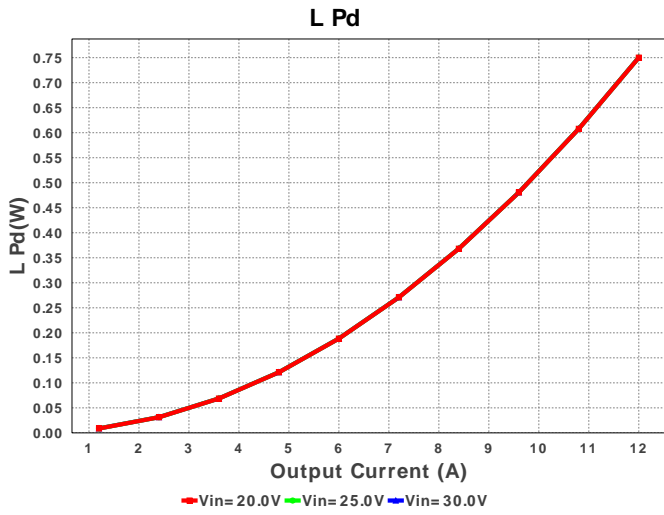
Electrical BOM

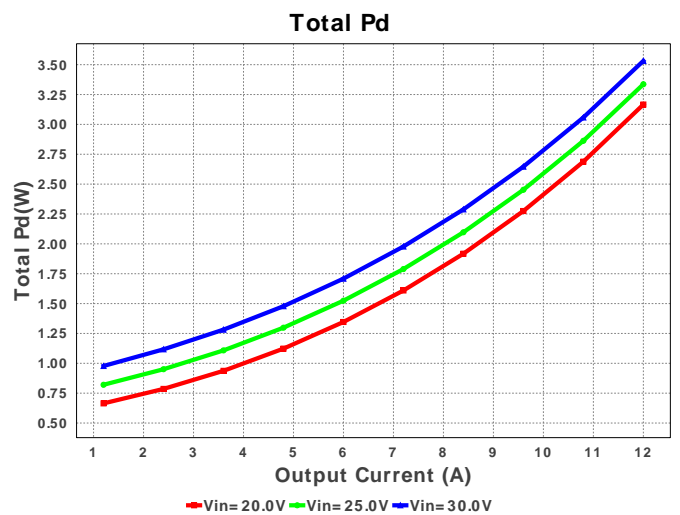
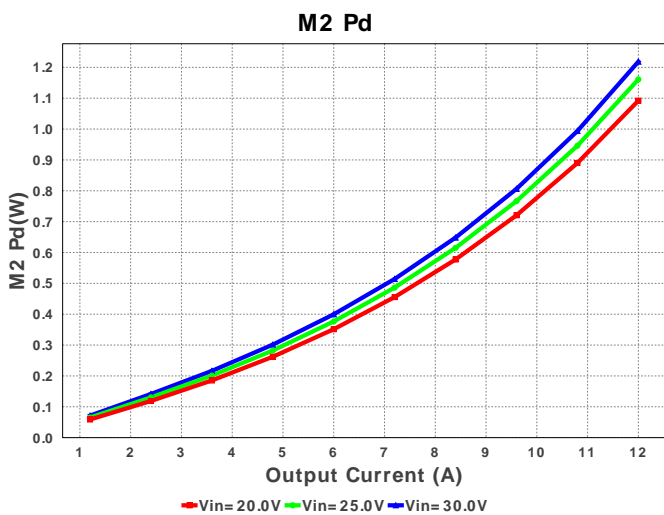
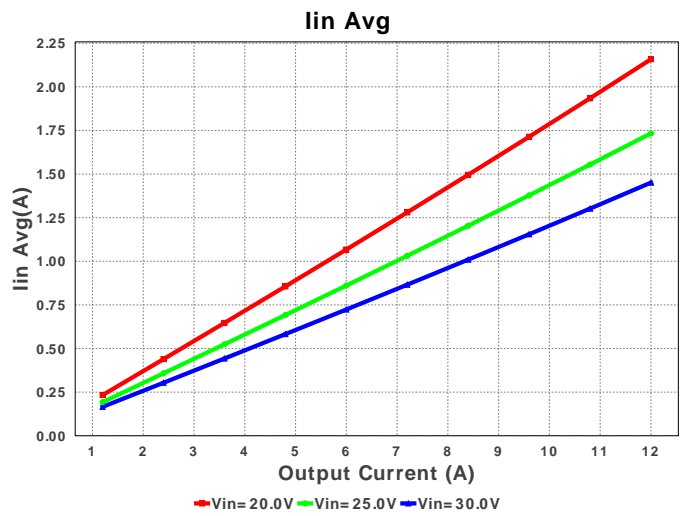
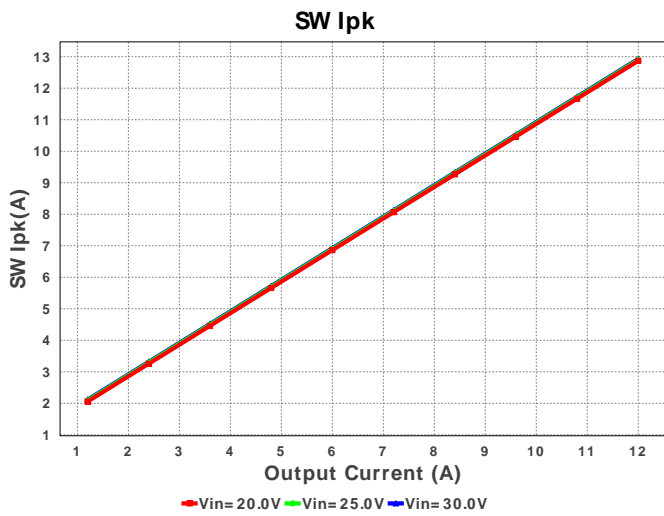
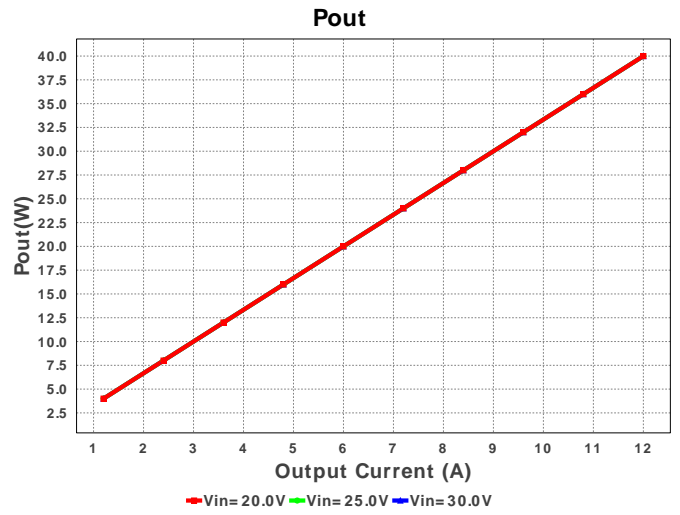
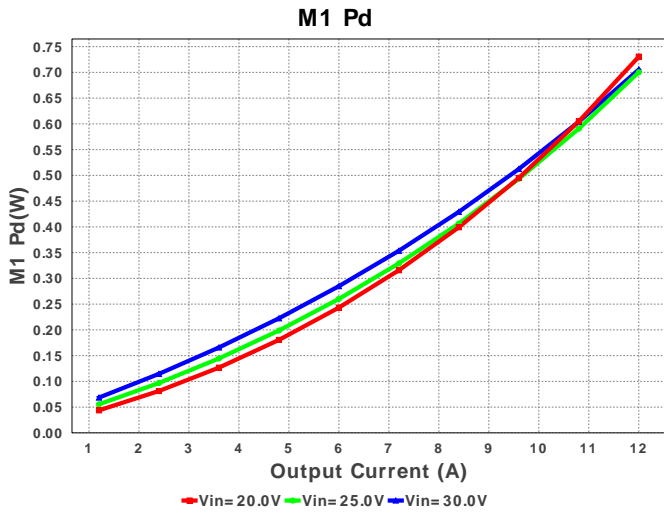
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1.	Cbst	Kemet	C0805C104K5RACTU Series= X7R	Cap= 100.0 nF ESR= 64.0 mOhm VDC= 50.0 V IRMS= 1.64 A	1	\$0.01	0805 7 mm ²
2.	Cbyp	MuRata	GRM219R61C475KE15D Series= X5R	Cap= 4.7 uF ESR= 5.591 mOhm VDC= 16.0 V IRMS= 1.8634 A	1	\$0.03	0805 7 mm ²
3.	Ccomp	Samsung Electro-Mechanics	CL21C122JBFNNWE Series= C0G/NP0	Cap= 1.2 nF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0805 7 mm ²
4.	Ccomp2	Yageo America	CC0805JRNPO9BN101 Series= C0G/NP0	Cap= 100.0 pF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0805 7 mm ²
5.	Ccomp3	TDK	C2012C0G1H152J060AA Series= C0G/NP0	Cap= 1.5 nF VDC= 50.0 V IRMS= 0.0 A	1	\$0.02	0805 7 mm ²
6.	Cilim	MuRata	GRM216R71E102KA01D Series= X7R	Cap= 1.0 nF ESR= 1.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	0805 7 mm ²
7.	Cin	GRM32ER71H106KA12L	CUSTOM_CAP_MD Series= CUSTOM	Cap= 10.0 uF ESR= 2.0 mOhm VDC= 50.0 V IRMS= 5.0 A	1	\$0.10	1210 5 mm ²
8.	Cldrv	MuRata	GRM216R71E102KA01D Series= X7R	Cap= 1.0 nF ESR= 1.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	0805 7 mm ²

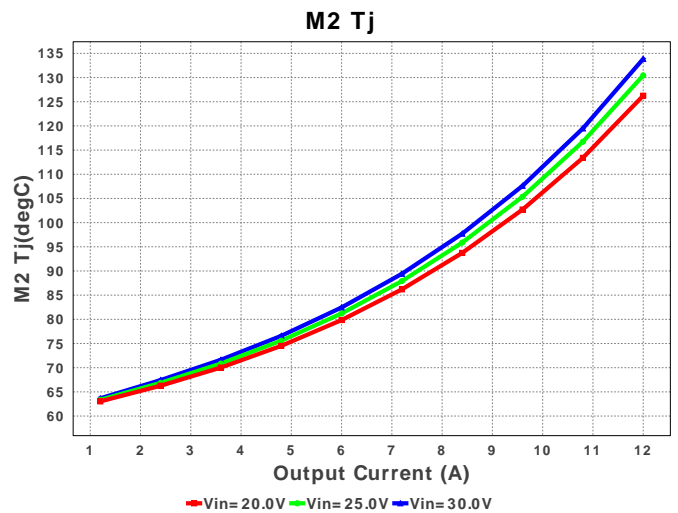
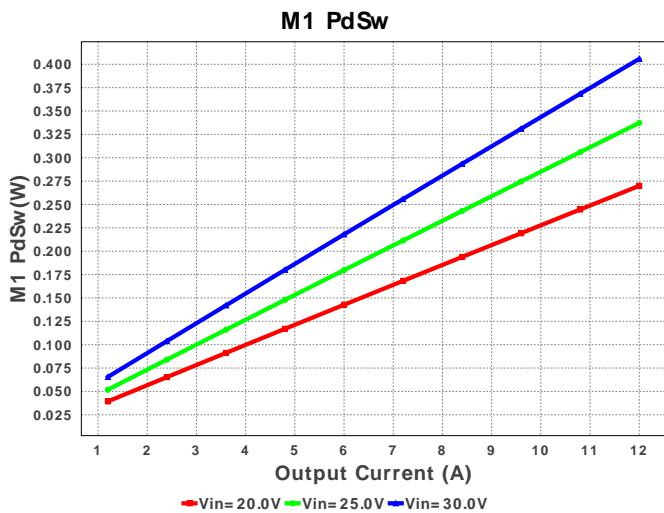
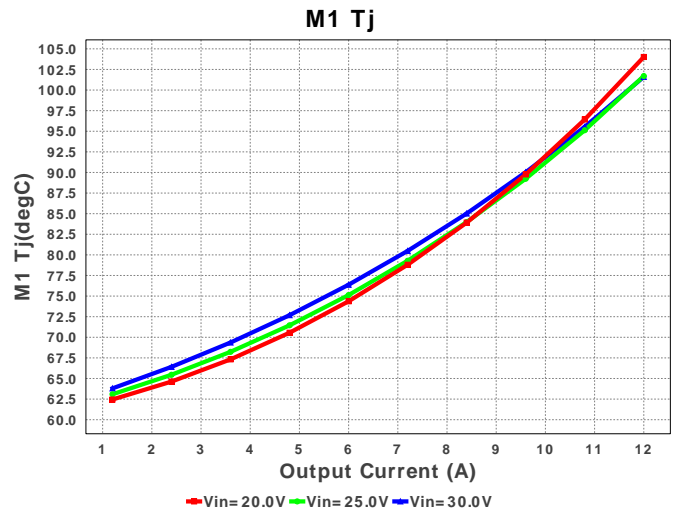
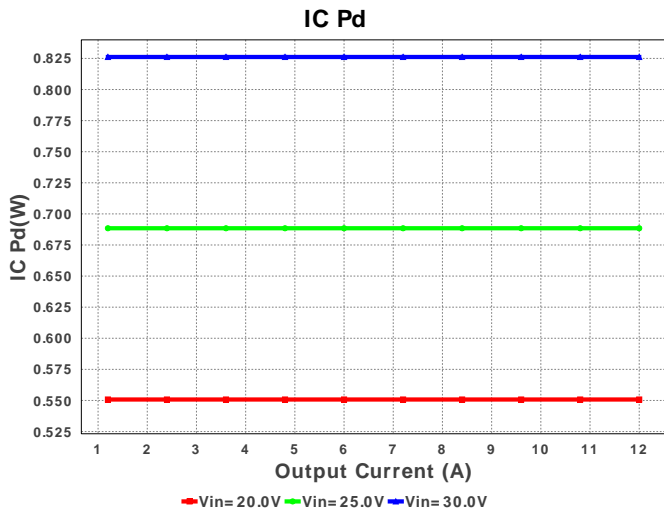
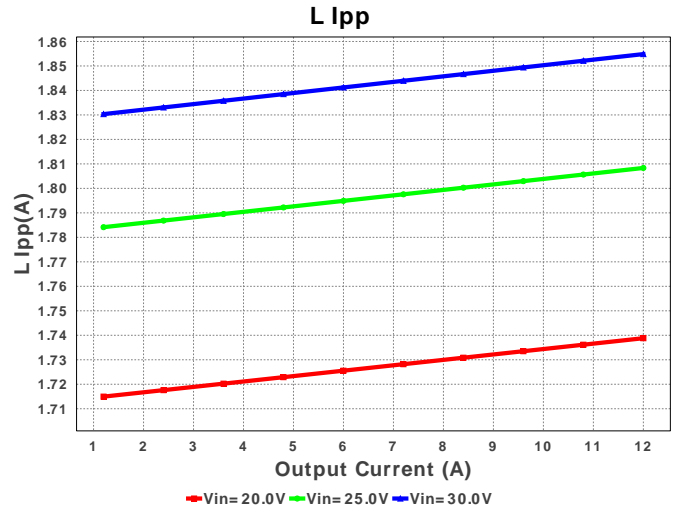
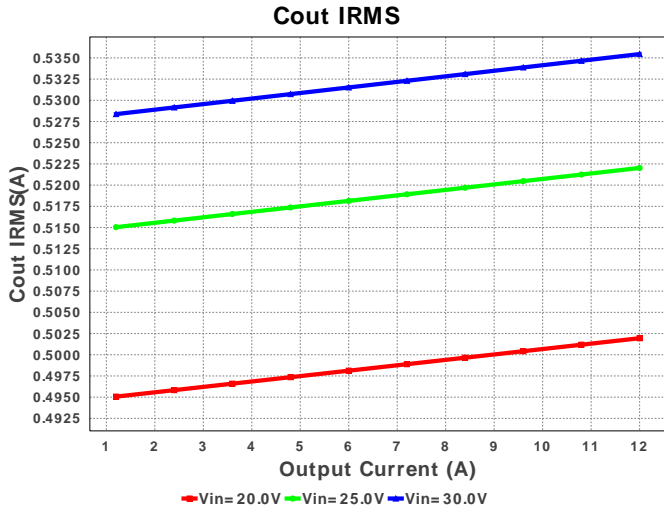
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
9.	Cout	20SVPF390M	CUSTOM_CAP_MD Series= CUSTOM	Cap= 390.0 uF ESR= 8.0 mOhm VDC= 20.0 V IRMS= 4.95 A	1	\$0.10	 1210 96 mm ²
10.	Css	Taiyo Yuden	TMK212B7473KD-T Series= X7R	Cap= 47.0 nF ESR= 1.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	\$0.02	 0805 7 mm ²
11.	Cuvlo	Samsung Electro-Mechanics	CL21C122JBFNNWE Series= C0G/NP0	Cap= 1.2 nF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm ²
12.	Cvdd	Taiyo Yuden	EMK107B7105KA-T Series= X7R	Cap= 1.0 uF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	\$0.01	 0603 5 mm ²
13.	Cvin	AVX	08055C105KAT2A Series= X7R	Cap= 1.0 uF ESR= 1.0 mOhm VDC= 50.0 V IRMS= 0.0 A	1	\$0.06	 0805 7 mm ²
14.	L1	Coilcraft	XAL1010-472MEB	L= 4.7 uH DCR= 5.2 mOhm	1	\$1.71	 XAL1010 160 mm ²
15.	M1	Texas Instruments	CSD18543Q3A	VdsMax= 60.0 V IdsMax= 35.0 Amps	1	\$0.27	 DNH0008A 18 mm ²
16.	M2	Texas Instruments	CSD18532Q5B	VdsMax= 60.0 V IdsMax= 100.0 Amps	1	\$0.84	 TRANS_NexFET_Q5B 58 mm ²
17.	Rcomp	Panasonic	ERJ-6ENF1402V Series= ERJ-6E	Res= 14.0 kOhm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	 0805 7 mm ²
18.	Rcomp2	Vishay-Dale	CRCW0805866RFKEA Series= CRCW..e3	Res= 866.0 Ohm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	 0805 7 mm ²
19.	Rcs	Vishay-Dale	CRCW080510K0FKEA Series= CRCW..e3	Res= 10.0 kOhm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	 0805 7 mm ²
20.	Renb	Vishay-Dale	CRCW040210K5FKED Series= CRCW..e3	Res= 10.5 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
21.	Rent	Vishay-Dale	CRCW040228K7FKED Series= CRCW..e3	Res= 28.7 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
22.	Rfbb	Yageo America	RC0603FR-072K2L Series= ?	Res= 2.2 kOhm Power= 100.0 mW Tolerance= 1.0%	1	\$0.01	 0603 5 mm ²
23.	Rfbt	Vishay-Dale	CRCW080510K0FKEA Series= CRCW..e3	Res= 10.0 kOhm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	 0805 7 mm ²
24.	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
25.	Rscp	Vishay-Dale	CRCW08059M76FKEA Series= CRCW..e3	Res= 9.76 MOhm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	 0805 7 mm ²
26.	Rt	Vishay-Dale	CRCW040226K7FKED Series= CRCW..e3	Res= 26.7 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²

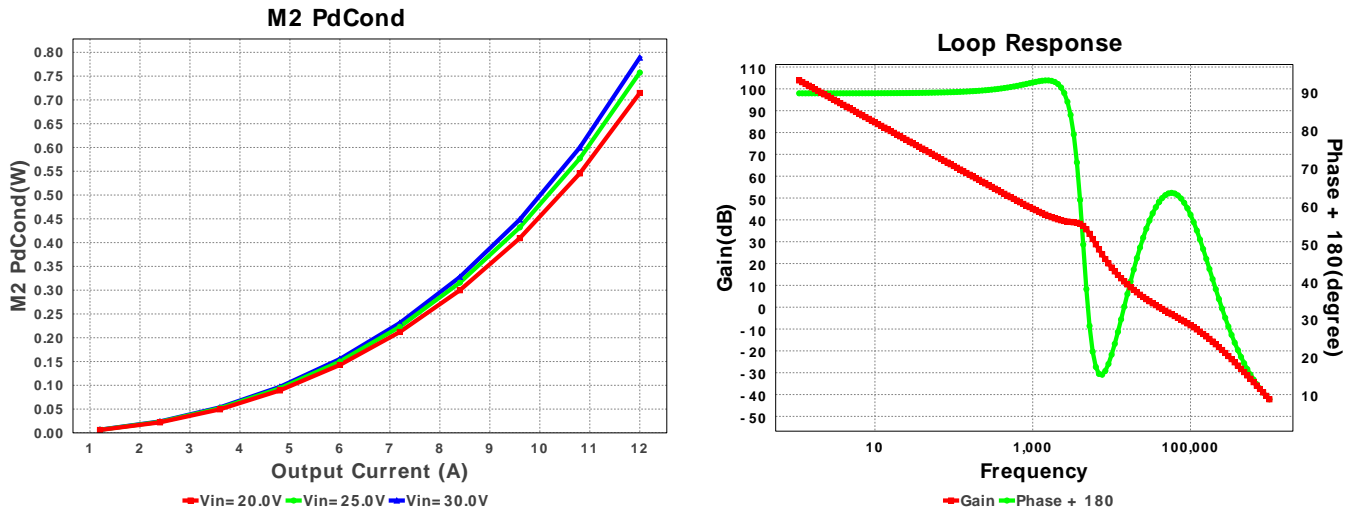
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
27.	Rtrk	Vishay-Dale	CRCW04029K53FKED Series= CRCW..e3	Res= 9.53 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm ²
28.	Ruvlob	Vishay-Dale	CRCW040222K1FKED Series= CRCW..e3	Res= 22.1 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm ²
29.	Ruvlot	Vishay-Dale	CRCW0402412KFKED Series= CRCW..e3	Res= 412.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm ²
30.	U1	Texas Instruments	TPS40170QRGYRQ1	Switcher	1	\$2.83	R-PVQFN-N20 25 mm ²











Operating Values

#	Name	Value	Category	Description
1.	BOM Count	30		Total Design BOM count
2.	Total BOM	\$6.18		Total BOM Cost
3.	Cin IRMS	3.812 A	Current	Input capacitor RMS ripple current
4.	Cout IRMS	535.447 mA	Current	Output capacitor RMS ripple current
5.	Iin Avg	1.451 A	Current	Average input current
6.	L Ipp	1.855 A	Current	Peak-to-peak inductor ripple current
7.	SW Ipk	12.927 A	Current	Peak switch current
8.	FootPrint	543.0 mm ²	General	Total Foot Print Area of BOM components
9.	Frequency	348.432 kHz	General	Switching frequency
10.	IC Tolerance	6.0 μ V	General	IC Feedback Tolerance
11.	Mode	CCM	General	Conduction Mode
12.	Pout	39.996 W	General	Total output power
13.	Low Freq Gain	103.852 dB	Op_Point	Gain at 1Hz
14.	Vout Actual	3.327 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
15.	Cross Freq	40.092 kHz	Op_point	Bode plot crossover frequency
16.	Duty Cycle	11.391 %	Op_point	Duty cycle
17.	Efficiency	91.886 %	Op_point	Steady state efficiency
18.	Gain Marg	-53.484 dB	Op_point	Bode Plot Gain Margin
19.	IC Tj	88.915 degC	Op_point	IC junction temperature
20.	IOUT_OP	12.0 A	Op_point	Iout operating point
21.	M1 Tj	101.606 degC	Op_point	M1 MOSFET junction temperature
22.	M2 Tj	133.865 degC	Op_point	M2 MOSFET junction temperature
23.	Phase Marg	61.339 deg	Op_point	Bode Plot Phase Margin
24.	VIN_OP	30.0 V	Op_point	Vin operating point
25.	Vout p-p	14.839 mV	Op_point	Peak-to-peak output ripple voltage
26.	Cin Pd	29.068 mW	Power	Input capacitor power dissipation
27.	Cout Pd	2.294 mW	Power	Output capacitor power dissipation
28.	IC Pd	826.15 mW	Power	IC power dissipation
29.	L Pd	750.291 mW	Power	Inductor power dissipation
30.	M1 Pd	705.492 mW	Power	M1 MOSFET total power dissipation
31.	M1 PdCond	299.693 mW	Power	M1 MOSFET conduction losses
32.	M1 PdSw	405.799 mW	Power	M1 MOSFET switching losses
33.	M2 Pd	1.219 W	Power	M2 MOSFET total power dissipation
34.	M2 PdCond	788.961 mW	Power	M2 MOSFET conduction losses
35.	M2 PdSw	429.587 mW	Power	M2 MOSFET switching losses
36.	Total Pd	3.532 W	Power	Total Power Dissipation
37.	Vout Tolerance	1.657 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	12.0	Maximum Output Current
2.	VinMax	30.0	Maximum input voltage
3.	VinMin	20.0	Minimum input voltage
4.	Vout	3.333	Output Voltage
5.	base_pn	TPS40170-Q1	Base Product Number
6.	source	DC	Input Source Type
7.	Ta	60.0	Ambient temperature
8.	UserFsw	348.432 k	Customer Selected Frequency

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.

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You should completely validate and test your design implementation to confirm the system functionality for your application prior to production.

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