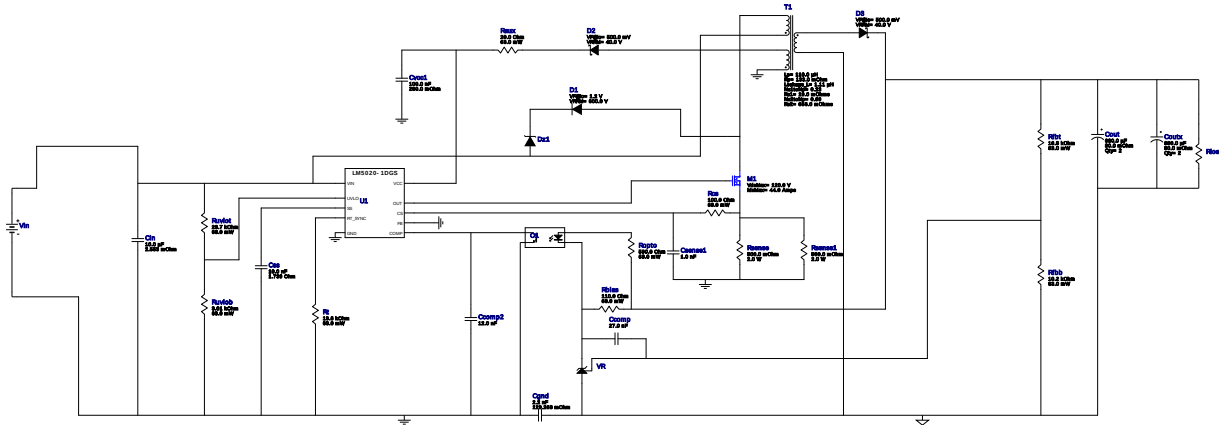
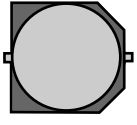
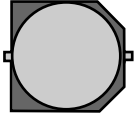


WEBENCH® Design Report

Design : 4394885/13 LM5020MM-1/NOPB
LM5020MM-1/NOPB 14.0V-22.0V to 3.30V @ 2.0A

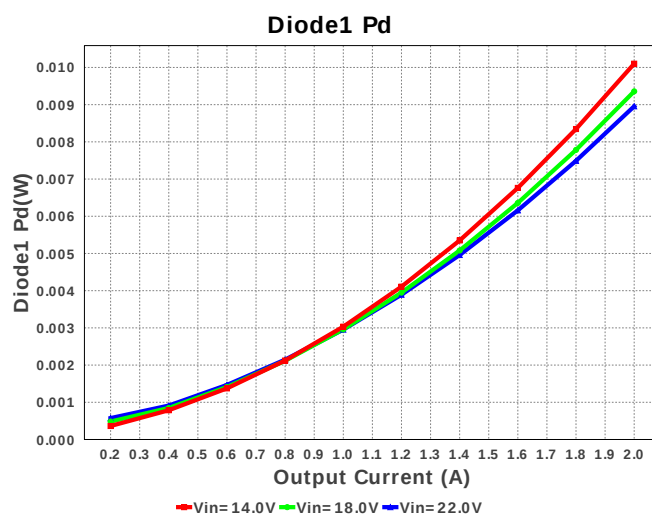
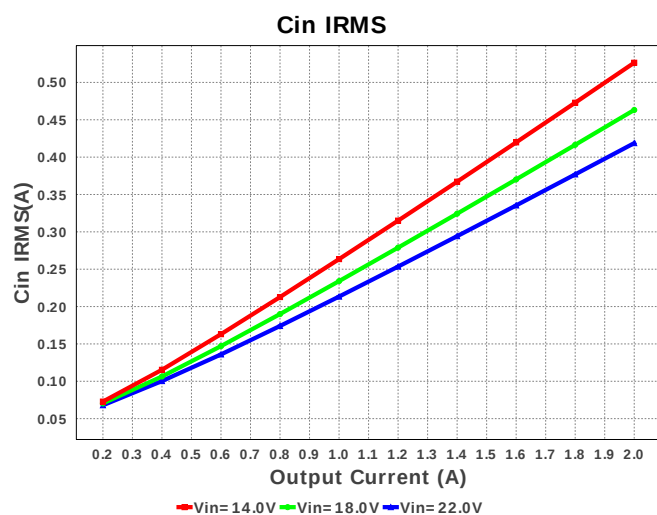
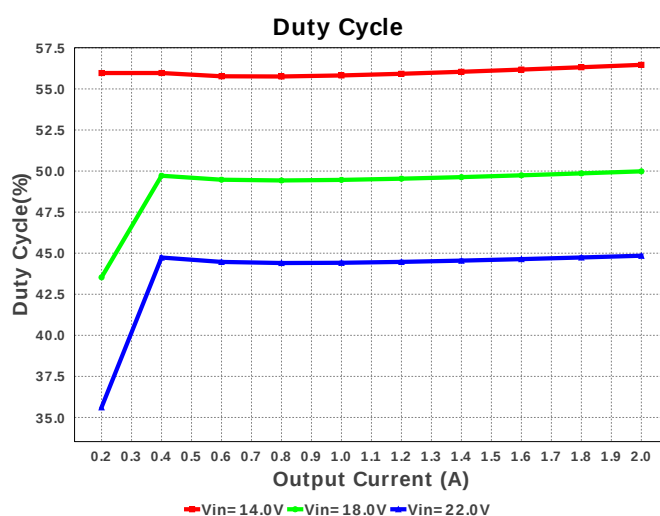
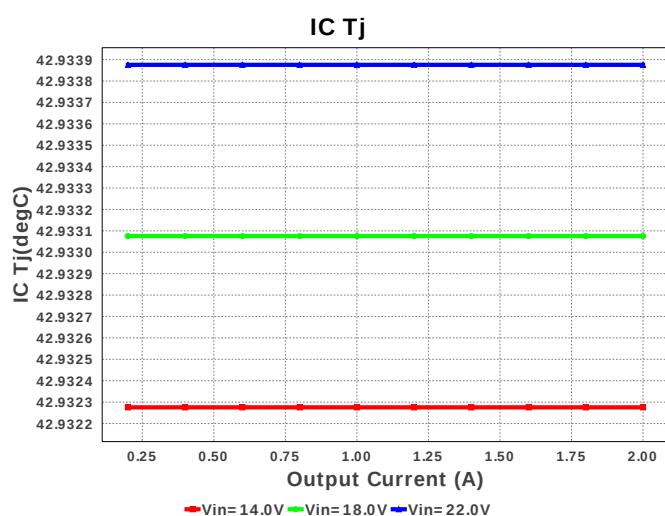


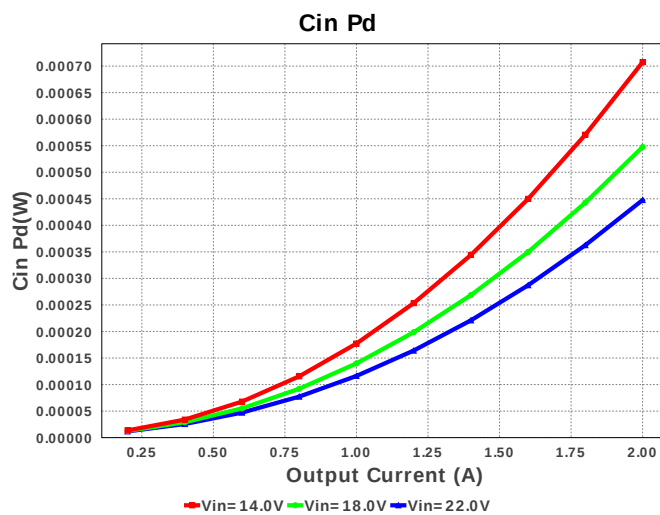
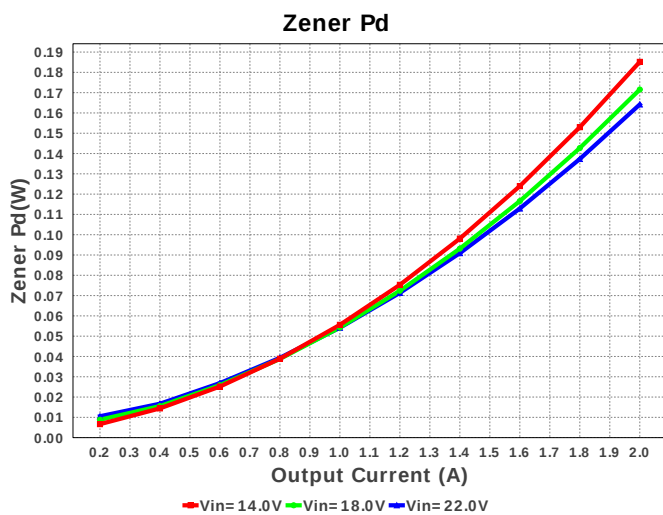
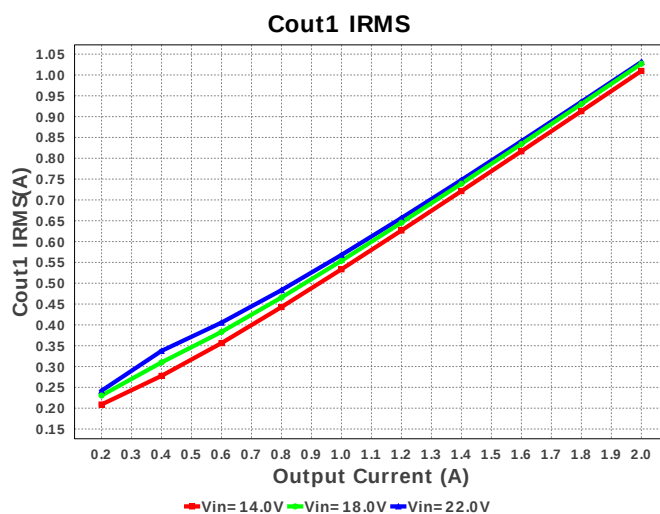
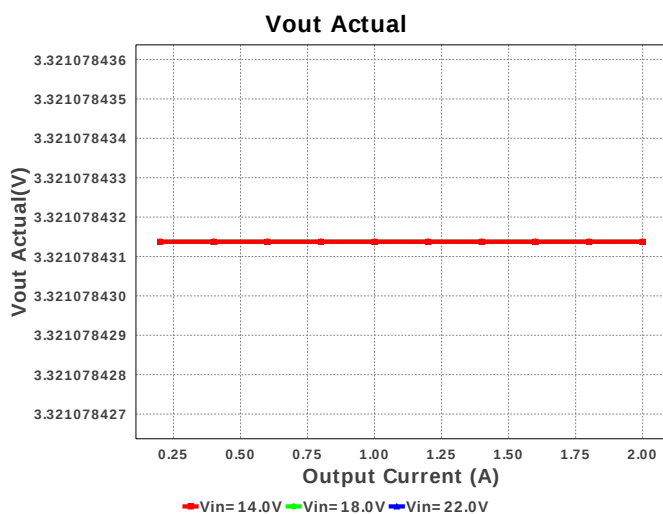
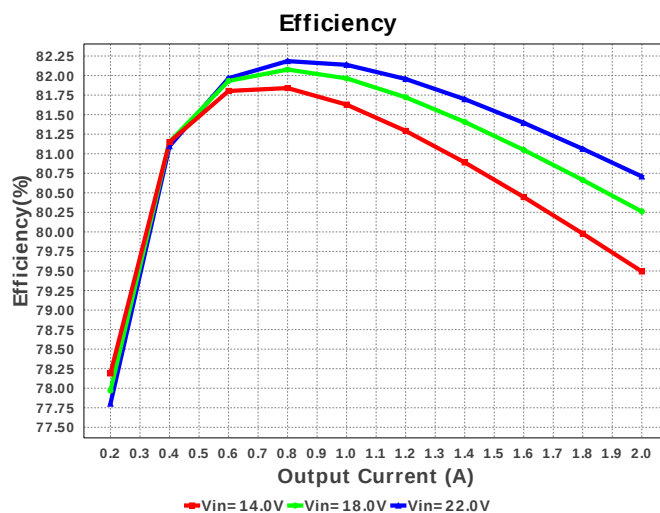
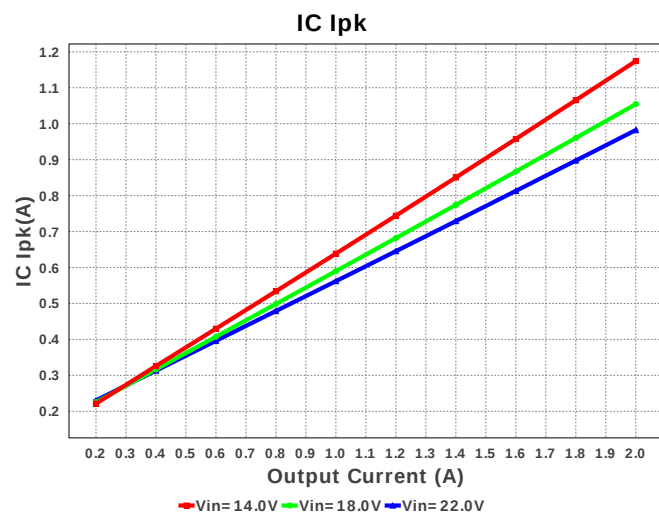
Electrical BOM

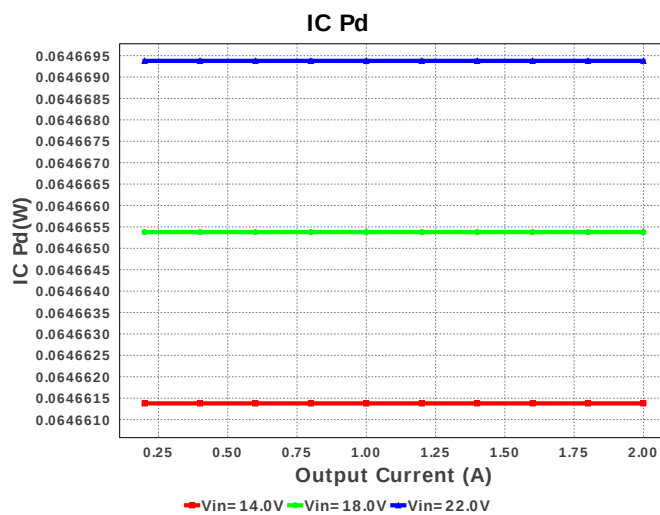
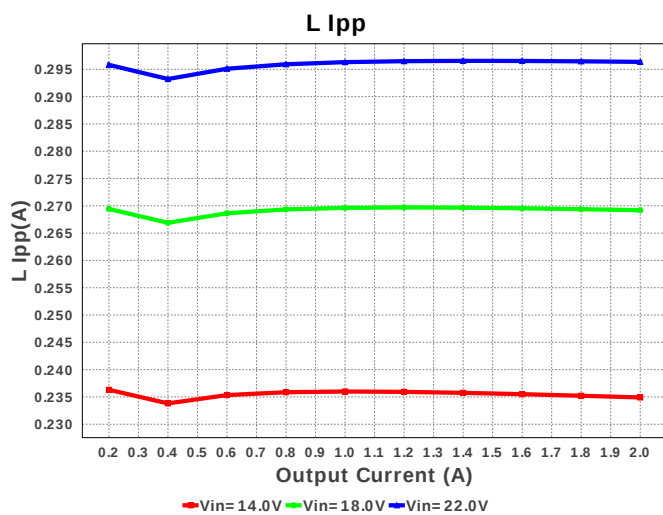
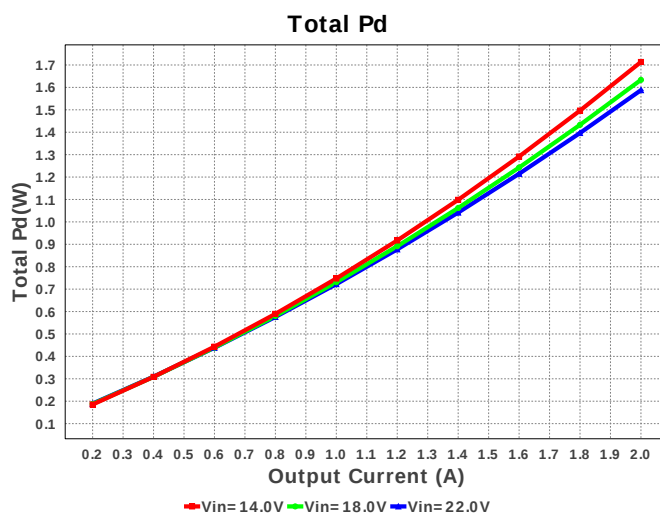
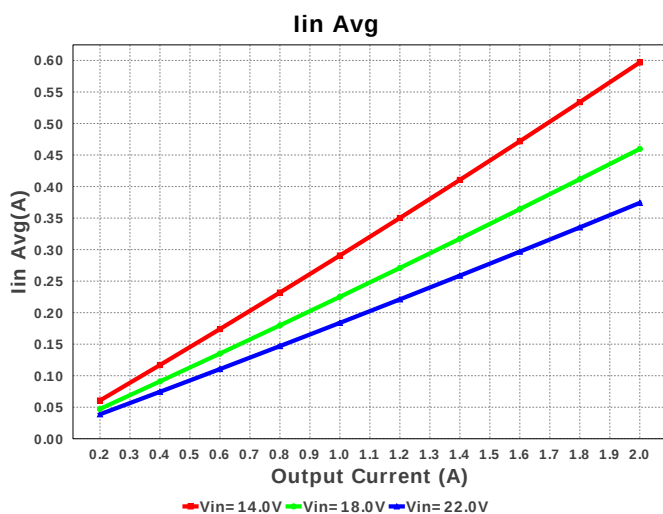
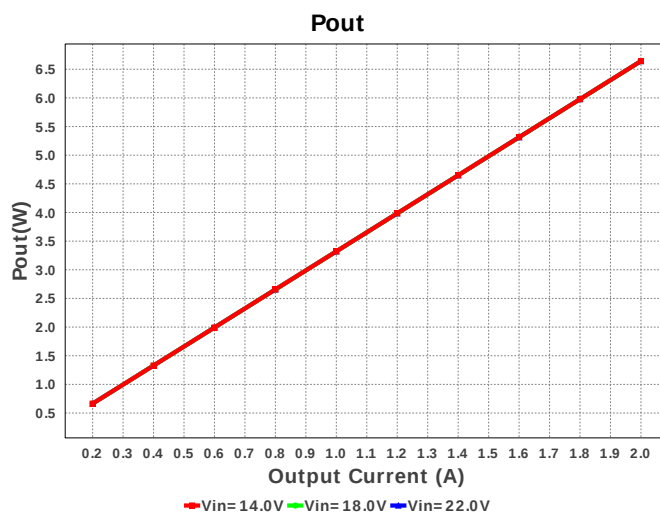
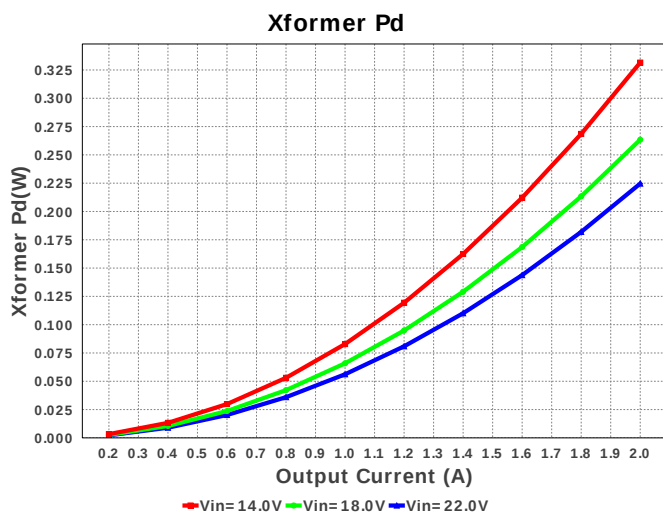
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Ccomp	Yageo America	CC0805KRX7R9BB273 Series= X7R	Cap= 27.0 nF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm ²
2.	Ccomp2	MuRata	GRM033C80J123KE01D Series= X6S	Cap= 12.0 nF VDC= 6.3 V IRMS= 0.0 A	1	\$0.01	 0201 2 mm ²
3.	Cfb	MuRata	GRM155R71E103KA01D Series= X7R	Cap= 10.0 nF VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	 0402 3 mm ²
4.	Cgnd	TDK	C4532JB3D222K Series= JB	Cap= 2.2 nF ESR= 129.263 mOhm VDC= 2.0 kV IRMS= 0.0 A	1	\$0.16	 1812 23 mm ²
5.	Cin	TDK	C3216X6S1E106K Series= X6S	Cap= 10.0 uF ESR= 2.553 mOhm VDC= 25.0 V IRMS= 0.0 A	1	\$0.12	 1206 11 mm ²
6.	Cout	Panasonic	EEE-FK1C681P Series= FK	Cap= 680.0 uF ESR= 80.0 mOhm VDC= 16.0 V IRMS= 850.0 mA	2	\$0.23	 SM_RADIAL_G 172 mm ²
7.	Coutx	Panasonic	EEE-FK1C681P Series= FK	Cap= 680.0 uF ESR= 80.0 mOhm VDC= 16.0 V IRMS= 850.0 mA	2	\$0.23	 SM_RADIAL_G 172 mm ²
8.	Csense1	MuRata	GRM033R71C102KA01D Series= X7R	Cap= 1.0 nF VDC= 16.0 V IRMS= 0.0 A	1	\$0.01	 0201 2 mm ²
9.	Css	Kemet	C0805C103K5RACTU Series= X7R	Cap= 10.0 nF ESR= 1.739 Ohm VDC= 50.0 V IRMS= 411.0 mA	1	\$0.01	 0805 7 mm ²

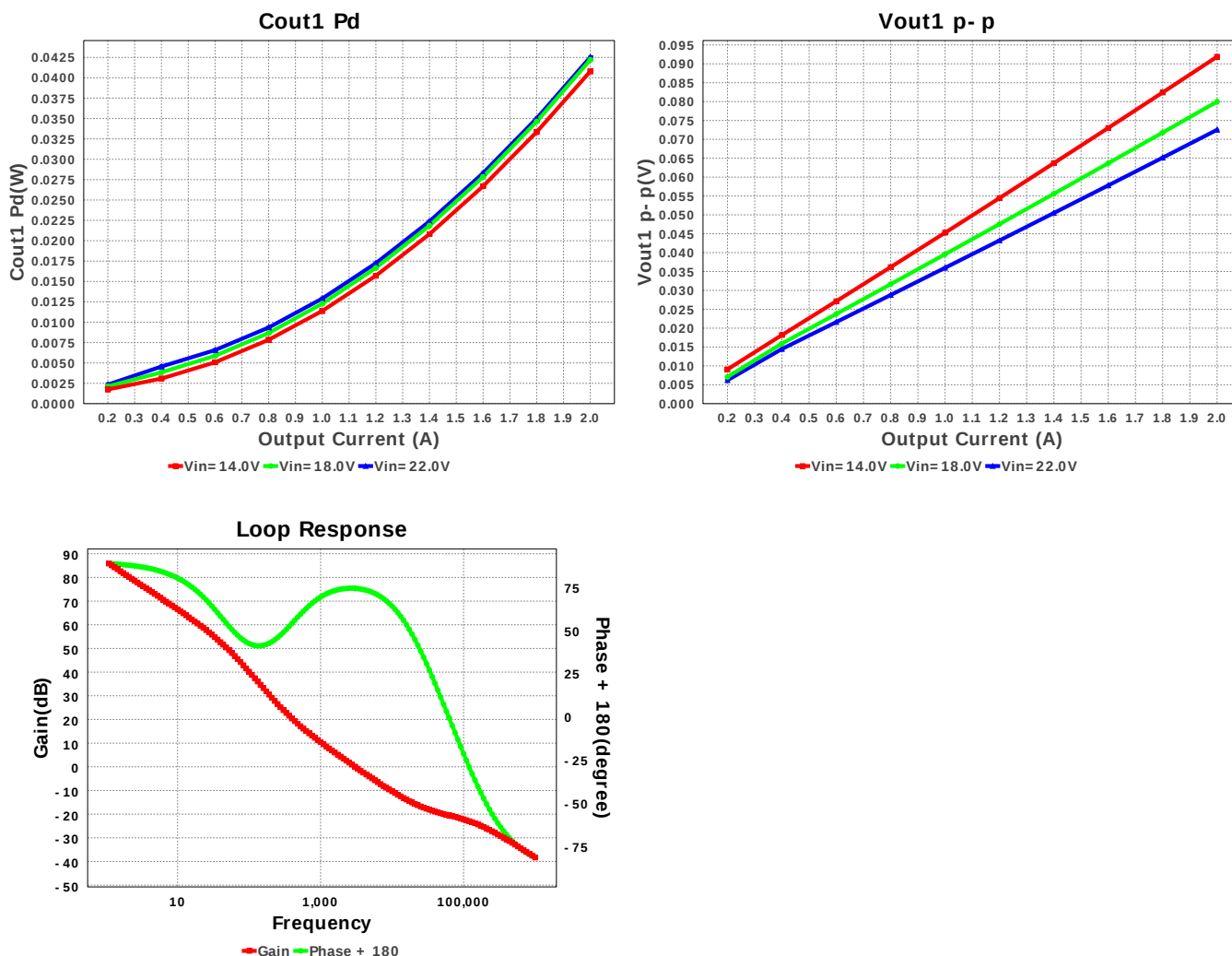
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
10.	Cvcc1	AVX	08053C104KAT2A Series= X7R	Cap= 100.0 nF ESR= 280.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	\$0.01	 0805 7 mm ²
11.	D1	Bourns	CD214B-F3600	VF@Io= 1.2 V VRRM= 600.0 V	1	\$0.14	 SMB 44 mm ²
12.	D2	Vishay-Semiconductor	SS14-E3/61T	VF@Io= 500.0 mV VRRM= 40.0 V	1	\$0.08	 SMA 37 mm ²
13.	D3	Diodes Inc.	B340A-13-F	VF@Io= 500.0 mV VRRM= 40.0 V	1	\$0.11	 SMA 37 mm ²
14.	Dz1	NXP Semiconductor	BZX585-C22,115	Zener	1	\$0.02	 SOD-523 5 mm ²
15.	M1	Infineon Technologies	BSC190N12NS3 G	VdsMax= 120.0 V IdsMax= 44.0 Amps	1	\$0.64	 PG-TDSON-8 55 mm ²
16.	O1	California Eastern Laboratories	PS2811-1	Optocoupler	1	\$0.36	 SSOP-4 111 mm ²
17.	Raux	Vishay-Dale	CRCW040220R0FKED Series= CRCW..e3	Res= 20.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
18.	Rbias	Vishay-Dale	CRCW0402110R0FKED Series= CRCW..e3	Res= 110.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
19.	Rcs	Vishay-Dale	CRCW0402100R0FKED Series= CRCW..e3	Res= 100.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
20.	Rfbb	Vishay-Dale	CRCW040210K2FKED Series= CRCW..e3	Res= 10.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
21.	Rfbt	Vishay-Dale	CRCW040216K9FKED Series= CRCW..e3	Res= 16.9 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
22.	Ropto	Vishay-Dale	CRCW0402590R0FKED Series= CRCW..e3	Res= 590.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
23.	Rsense	Stackpole Electronics Inc	CSRN2512FKR500 Series= ?	Res= 500.0 mOhm Power= 2.0 W Tolerance= 1.0%	1	\$0.09	 2512 43 mm ²
24.	Rsense1	Stackpole Electronics Inc	CSRN2512FKR500 Series= ?	Res= 500.0 mOhm Power= 2.0 W Tolerance= 1.0%	1	\$0.09	 2512 43 mm ²
25.	Rt	Vishay-Dale	CRCW040219K6FKED Series= CRCW..e3	Res= 19.6 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
26.	Ruvlob	Vishay-Dale	CRCW04023K01FKED Series= CRCW..e3	Res= 3.01 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
27.	Ruvlot	Vishay-Dale	CRCW040228K7FKED Series= CRCW..e3	Res= 28.7 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	 0402 3 mm ²
28.	T1	Coilcraft	B0695-ALD	Lp= 110.0 µH Rp= 133.0 mOhm Leakage_L= 1.11 µH Ns1toNp= 0.23 Rs1= 19.0 mOhms Ns2toNp= 0.69 Rs2= 656.0 mOhms	1	\$3.48	NO_ID 0 mm ²

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
29.	U1	Texas Instruments	LM5020MM-1/NOPB	Switcher	1	\$0.80	mpds035b 35 mm ²
30.	VR	Texas Instruments	LMV431CM5/NOPB	Voltage References	1	\$0.16	 R-PDSO-G3 16 mm ²









Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	520.699 mA	Current	Input capacitor RMS ripple current
2.	Cout1 IRMS	1.08 A	Current	Output capacitor1 RMS ripple current
3.	IC Ipk	1.161 A	Current	Peak switch current
4.	Iin Avg	583.92 mA	Current	Average input current
5.	L Ipp	234.79 mA	Current	Peak-to-peak inductor ripple current
6.	BOM Count	32	General	Total Design BOM count
7.	FootPrint	1.21 k mm ²	General	Total Foot Print Area of BOM components
8.	Frequency	325.0 kHz	General	Switching frequency
9.	IC Tolerance	25.0 mV	General	IC Feedback Tolerance
10.	Mode	CCM	General	Conduction Mode
11.	Pout	6.589 W	General	Total output power
12.	Total BOM	\$7.33	General	Total BOM Cost
13.	Low Freq Gain	83.271 dB	Op_point	Gain at 10Hz
14.	Vout Actual	3.295 V	Op_point	Vout Actual calculated based on selected voltage divider resistors
15.	Cross Freq	2.481 kHz	Op_point	Bode plot crossover frequency
16.	Duty Cycle	55.931 %	Op_point	Duty cycle
17.	Efficiency	80.6 %	Op_point	Steady state efficiency
18.	Gain Marg	-16.625 dB	Op_point	Bode Plot Gain Margin
19.	IC Tj	38.511 degC	Op_point	IC junction temperature
20.	ICThetaJA	200.0 degC/W	Op_point	IC junction-to-ambient thermal resistance
21.	IOUT_OP	2.0 A	Op_point	Iout operating point
22.	Phase Marg	70.1 deg	Op_point	Bode Plot Phase Margin
23.	VIN_OP	14.0 V	Op_point	Vin operating point
24.	Vout1 OP	3.295 V	Op_point	Operational Voltage 1
25.	Vout1 p-p	90.767 mV	Op_point	Peak-to-peak output1 ripple voltage
26.	Cin Pd	692.187 μ W	Power	Input capacitor power dissipation
27.	Cout1 Pd	46.677 mW	Power	Output capacitor1 power dissipation
28.	Cout1 Pd	46.677 mW	Power	Output capacitor1 power dissipation
29.	Diode1 Pd	9.976 mW	Power	Diode1 power dissipation
30.	IC Pd	42.557 mW	Power	IC power dissipation
31.	Total Pd	1.586 W	Power	Total Power Dissipation

#	Name	Value	Category	Description
32.	Xformer Pd	398.04 mW	Power	Transformer power dissipation
33.	Zener Pd	182.889 mW	Power	Zener power dissipation
34.	Vout Tolerance	3.301 %		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.	Iout1	2.0	Output Current #1
3.	Iout2	1.0	Output Current #2
4.	Iout3	500.0 m	Output Current #3
5.	VinMax	22.0	Maximum input voltage
6.	VinMin	14.0	Minimum input voltage
7.	Vout	3.3	Output Voltage
8.	Vout1	3.3	Output Voltage #1
9.	Vout2	9.0	Output Voltage #2
10.	Vout3	5.0	Output Voltage #3
11.	base_pn	LM5020-1	Base Product Number
12.	source	DC	Input Source Type
13.	Ta	30.0	Ambient temperature

Design Assistance

1. **LM5020-1** Product Folder : <http://www.ti.com/product/LM5020-1> : contains the data sheet and other resources.

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