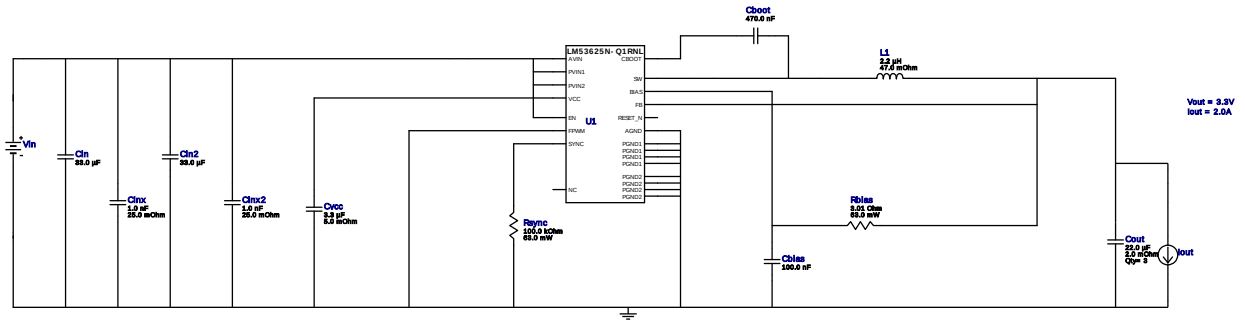
WEBENCH® Design Report

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

Device = LM53625NQRNLRQ1
Topology = Buck
Created = 7/12/16 2:44:15 AM
BOM Cost = $6.48
BOM Count = 14
Total Pd = 1.34W

Design : 4737567/96 LM53625NQRNLRQ1
LM53625NQRNLRQ1 14.0V-22.0V to 3.30V @ 2.0A



1. The input capacitor included in the BOM only contains a small filter capacitor that should be placed near the IC. Depending on where the power supply is laid out in the system additional bulk capacitance may need to be added to filter the line ripple.

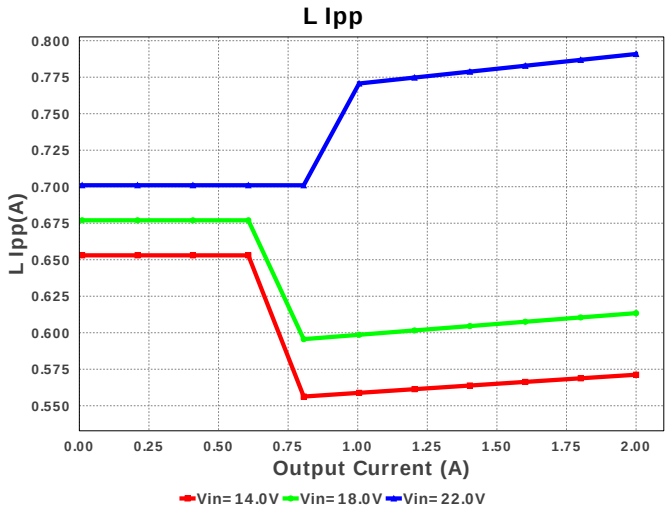
2. If there is no VinTyp specified, WEBENCH will use the VinMax value. To change the VinTyp value, click on the "Change Design Inputs" button under the Optimization Tuning knob. In some applications, while the design requires the input voltage to be a wide range, for a majority of the time, it is operating at a much lower voltage than the maximum input voltage. Sizing the inductor based on the maximum input voltage may yield an inductance much larger than typically needed, causing a larger footprint for the overall design. At the same time, components such as the input capacitor must be rated based on the maximum input voltage. WEBENCH now supports the use of this additional input voltage specification.

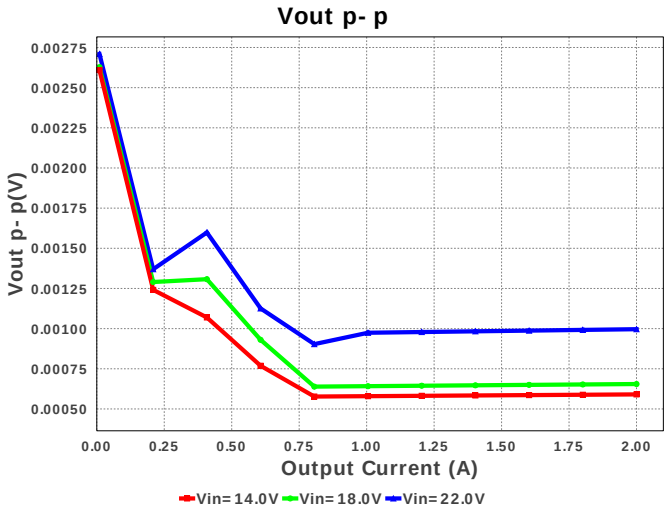
3. This regulator device is qualified for Automotive applications. All passives and other components selected in this design may not be qualified for Automotive applications. The user is required to verify that all components in the design meet the qualification and safety requirements for their specific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

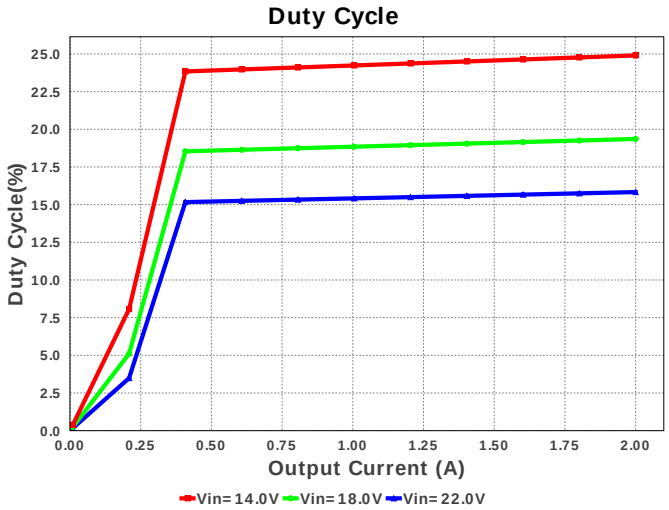
Electrical BOM

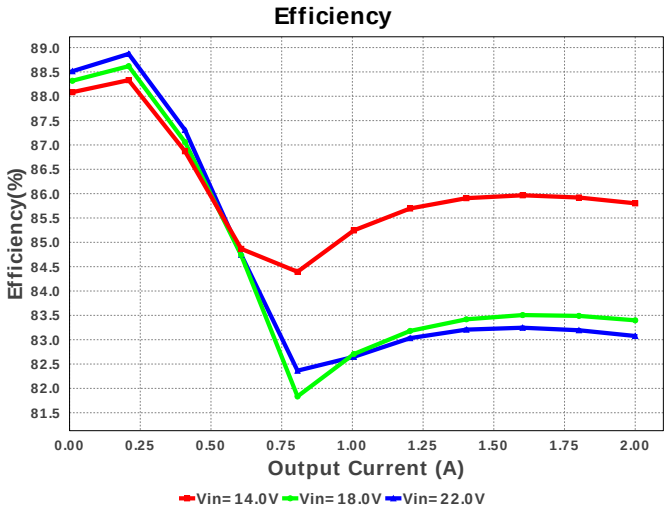
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cbias	MuRata	GRM155R60J104KA01D Series= X5R	Cap= 100.0 nF VDC= 6.3 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
2.	Cboot	Taiyo Yuden	GMK212BJ474KG-T Series= X5R	Cap= 470.0 nF VDC= 35.0 V IRMS= 0.0 A	1	$0.03	0805 7 mm²
3.	Cin	MuRata	KCM55WR7YA336MH01K Series= X7R	Cap= 33.0 uF VDC= 35.0 V IRMS= 0.0 A	1	$1.51	KCM55W 59 mm²
4.	Cin2	MuRata	KCM55WR7YA336MH01K Series= X7R	Cap= 33.0 uF VDC= 35.0 V IRMS= 0.0 A	1	$1.51	KCM55W 59 mm²
5.	Cinx	Kemet	C0805C102J5GACTU Series= C0G/NP0	Cap= 1.0 nF ESR= 25.0 mOhm VDC= 50.0 V IRMS= 1.71 A	1	$0.01	0805 7 mm²
6.	Cinx2	Kemet	C0805C102J5GACTU Series= C0G/NP0	Cap= 1.0 nF ESR= 25.0 mOhm VDC= 50.0 V IRMS= 1.71 A	1	$0.01	0805 7 mm²
7.	Cout	MuRata	GRM32ER61C226ME20L Series= X5R	Cap= 22.0 uF ESR= 2.0 mOhm VDC= 16.0 V IRMS= 3.68 A	3	$0.12	1210 15 mm²
8.	Cvcc	Kemet	C0805C335K8PACTU Series= X5R	Cap= 3.3 uF ESR= 5.0 mOhm VDC= 10.0 V IRMS= 8.13 A	1	$0.05	0805 7 mm²

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
9.	L1	Bourns	SDR0403-2R2ML	L= 2.2 µH DCR= 47.0 mOhm	1	$0.18	SDR0403 28 mm²
10.	Rbias	Vishay-Dale	CRCW04023R01FKED Series= CRCW..e3	Res= 3.01 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
11.	Rsync	Vishay-Dale	CRCW0402100KFKED Series= CRCW..e3	Res= 100.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
12.	U1	Texas Instruments	LM53625NQRNLRQ1	Switcher	1	$2.79	RNL0022A 42 mm²

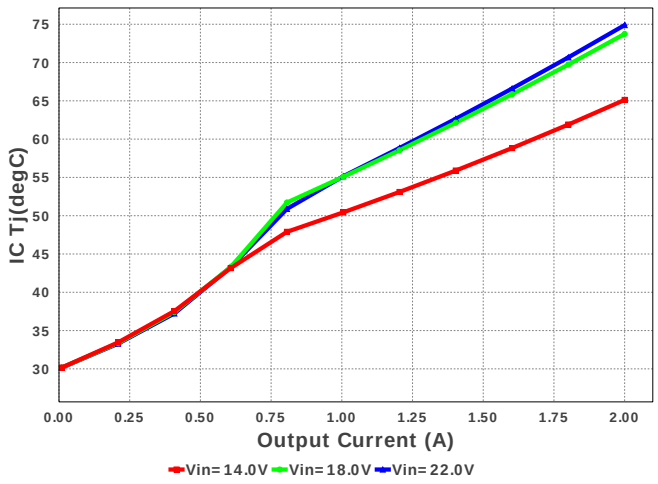




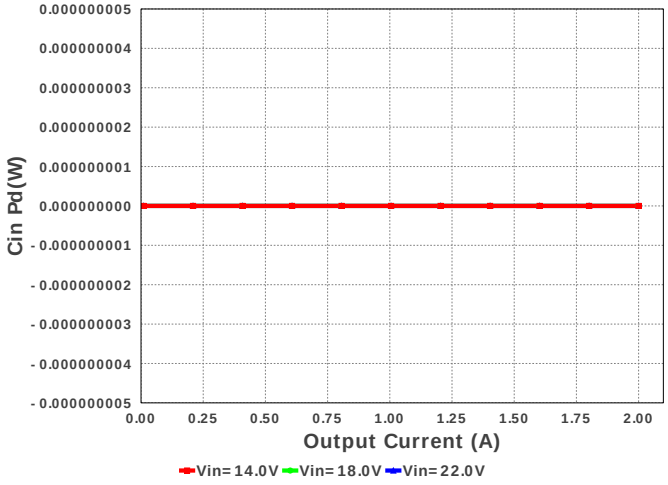




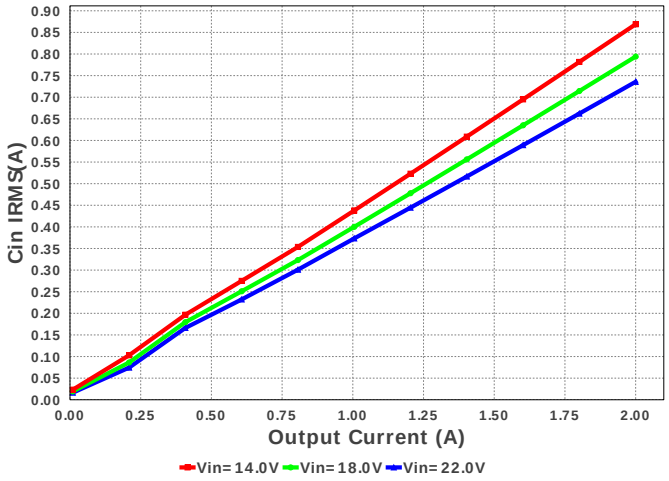
IC Tj



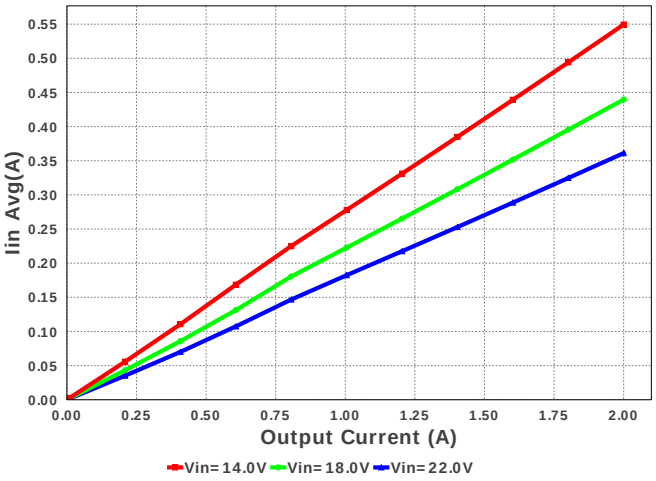
Cin Pd



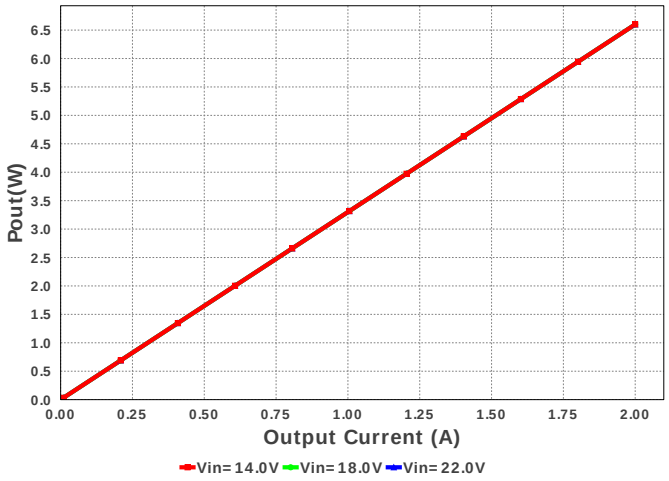
Cin IRMS



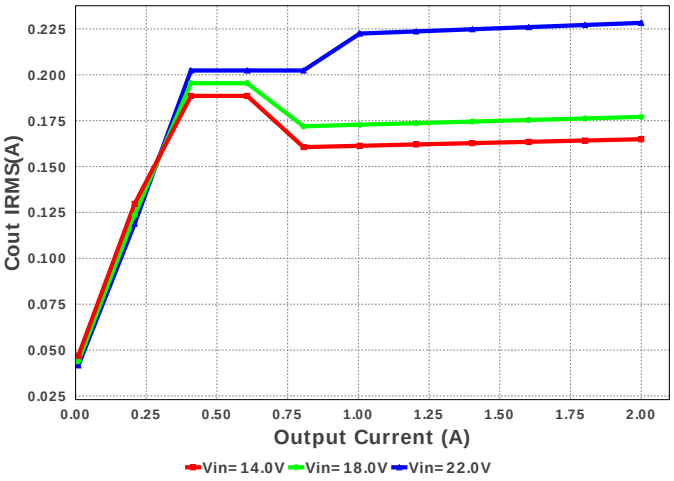
Iin Avg

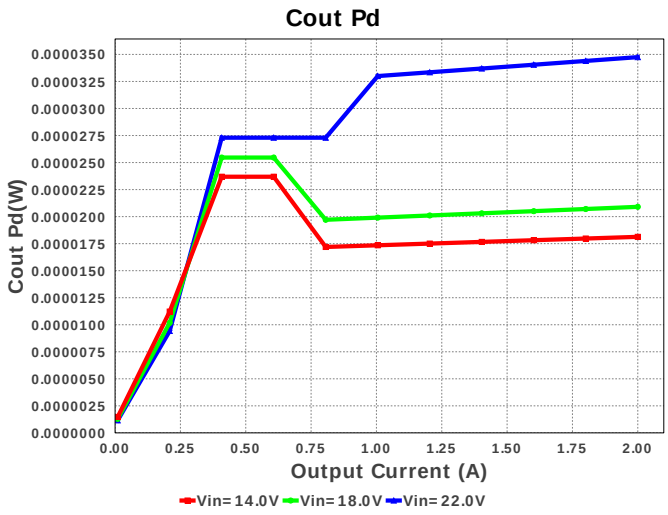


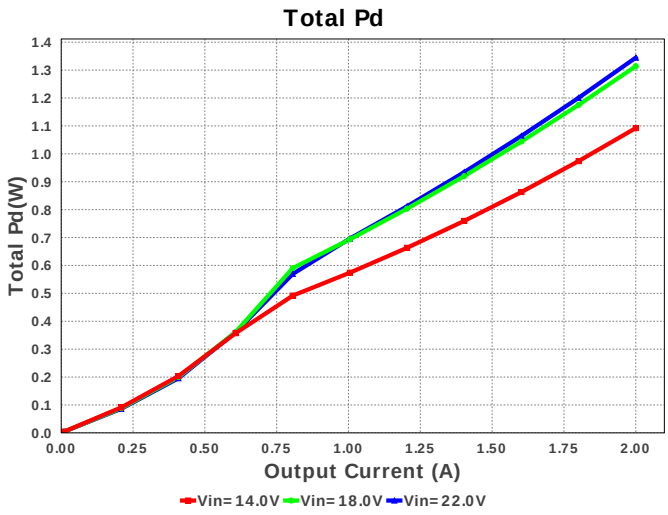
Pout

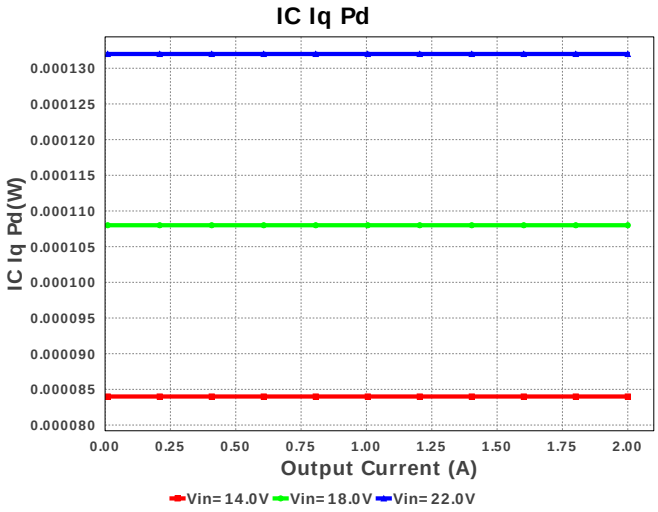


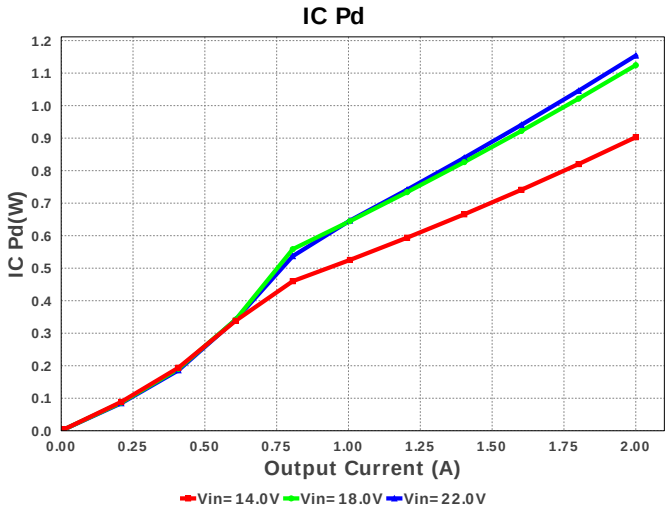
Cout IRMS

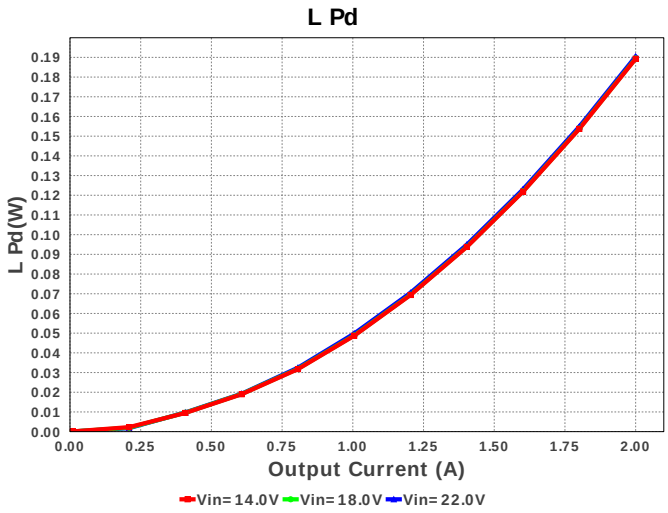


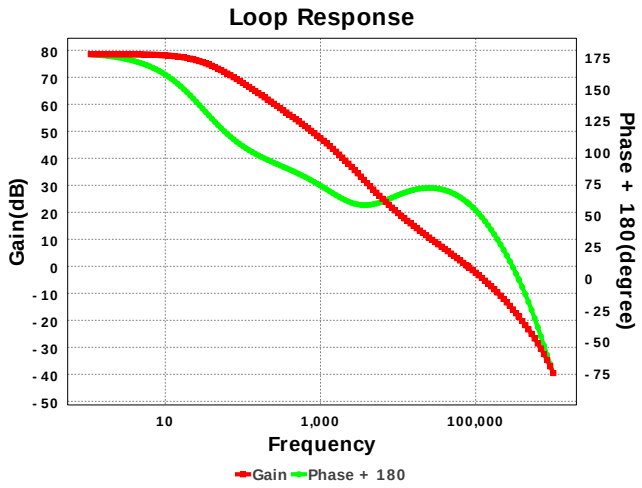

Cout Pd
Cout Pd(W)
0.0000350
0.0000325
0.0000300
0.0000275
0.0000250
0.0000225
0.0000200
0.0000175
0.0000150
0.0000125
0.0000100
0.0000075
0.0000050
0.0000025
0.0000000
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00
Output Current (A)
Vin= 14.0V Vin= 18.0V Vin= 22.0V

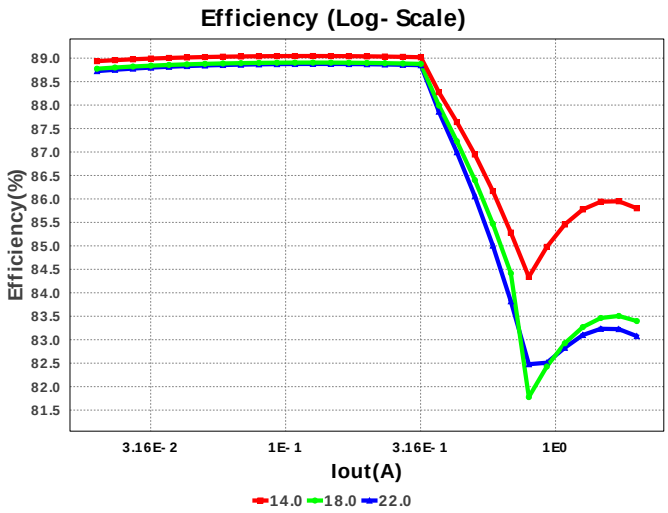

Total Pd
Total Pd(W)
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00
Output Current (A)
Vin= 14.0V Vin= 18.0V Vin= 22.0V


IC Iq Pd
IC Iq Pd(W)
0.000130
0.000125
0.000120
0.000115
0.000110
0.000105
0.000100
0.000095
0.000090
0.000085
0.000080
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00
Output Current (A)
Vin= 14.0V Vin= 18.0V Vin= 22.0V


IC Pd
IC Pd(W)
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00
Output Current (A)
Vin= 14.0V Vin= 18.0V Vin= 22.0V


L Pd
L Pd(W)
0.19
0.18
0.17
0.16
0.15
0.14
0.13
0.12
0.11
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00
Output Current (A)
Vin= 14.0V Vin= 18.0V Vin= 22.0V


Loop Response
Gain(dB)
80
70
60
50
40
30
20
10
0
- 10
- 20
- 30
- 40
- 50
Phase + 180(degree)
175
150
125
100
75
50
25
0
- 25
- 50
- 75
10 1,000 100,000
Frequency
Gain Phase + 180



Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	735.736 mA	Current	Input capacitor RMS ripple current
2.	Cout IRMS	228.306 mA	Current	Output capacitor RMS ripple current
3.	Iin Avg	361.11 mA	Current	Average input current
4.	L Ipp	790.87 mA	Current	Peak-to-peak inductor ripple current
5.	BOM Count	14	General	Total Design BOM count
6.	FootPrint	268.0 mm^2	General	Total Foot Print Area of BOM components
7.	Frequency	1.7 MHz	General	Switching frequency
8.	Pout	6.6 W	General	Total output power
9.	Total BOM	$6.48	General	Total BOM Cost
10.	Low Freq Gain	78.552 dB	Op_Point	Gain at 10Hz
11.	Vout OP	3.3 V	Op_Point	Operational Output Voltage
12.	Cross Freq	79.047 kHz	Op_point	Bode plot crossover frequency
13.	Duty Cycle	15.833 %	Op_point	Duty cycle
14.	Efficiency	83.076 %	Op_point	Steady state efficiency
15.	Gain Marg	-18.525 dB	Op_point	Bode Plot Gain Margin
16.	IC Tj	74.889 degC	Op_point	IC junction temperature
17.	ICThetaJA	38.9 degC/W	Op_point	IC junction-to-ambient thermal resistance
18.	IOUT_OP	2.0 A	Op_point	Iout operating point
19.	Phase Marg	60.237 deg	Op_point	Bode Plot Phase Margin
20.	VIN_OP	22.0 V	Op_point	Vin operating point
21.	Vout p-p	996.443 µV	Op_point	Peak-to-peak output ripple voltage
22.	Cin Pd	0.0 W	Power	Input capacitor power dissipation
23.	Cout Pd	34.749 µW	Power	Output capacitor power dissipation
24.	IC Iq Pd	132.0 µW	Power	IC Iq Pd
25.	IC Pd	1.154 W	Power	IC power dissipation
26.	L Pd	190.45 mW	Power	Inductor power dissipation
27.	Total Pd	1.345 W	Power	Total Power Dissipation
28.	Vout Tolerance	1.0 %		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	LM53625N-Q1	Base Product Number
6.	source	DC	Input Source Type
7.	Ta	30.0	Ambient temperature

Design Assistance

1. The LM53625N-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. **LM53625N-Q1** Product Folder : http://www.ti.com/product/LM53625%2DQ1 : contains the data sheet and other resources.