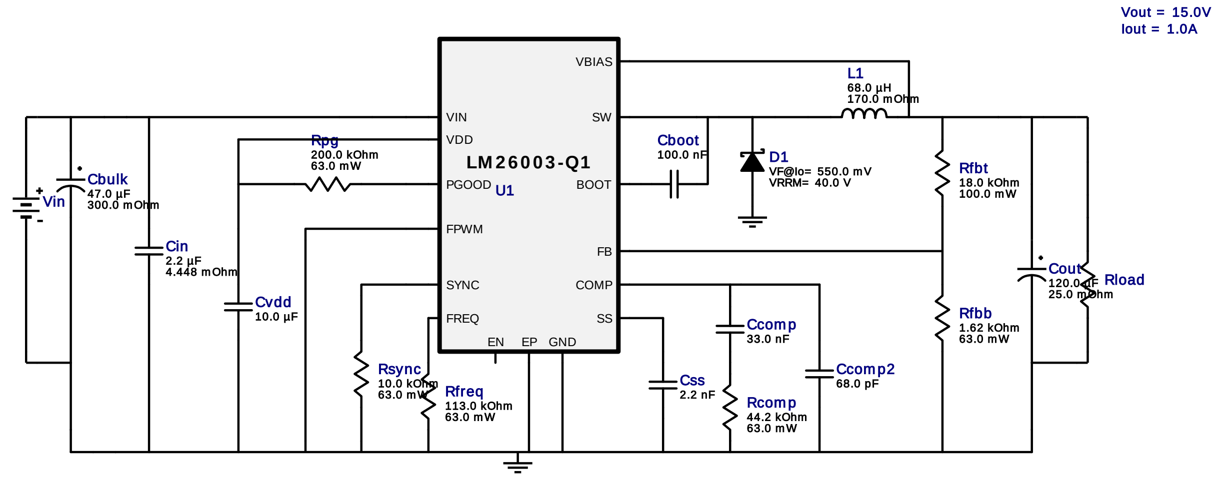
VinMin = 26.0V VinMax = 30.0V Vout = 15.0V Iout = 1.0A	Device = LM26003QMHX/NOPB Topology = Buck Created = 2022-07-23 05:20:13.485 BOM Cost = $3.18 BOM Count = 17 Total Pd = 0.64W

WEBENCH ® Design Report

Design : 6 LM26003QMHX/NOPB
LM26003QMHX/NOPB 26V-30V to 15.00V @ 1A



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.

Design Alerts

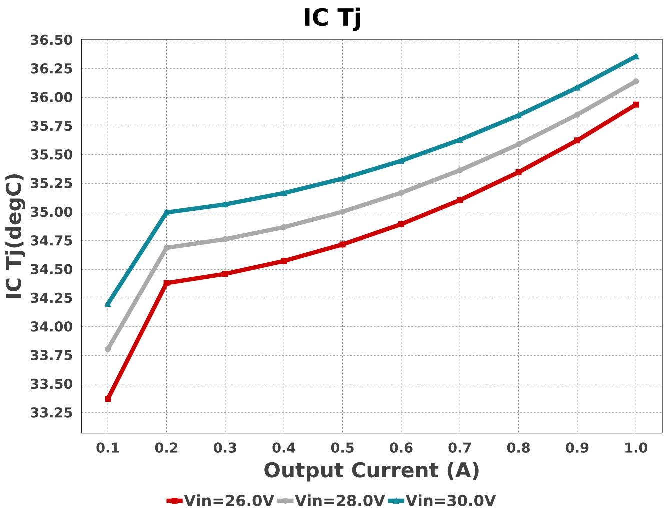
Component Selection Information

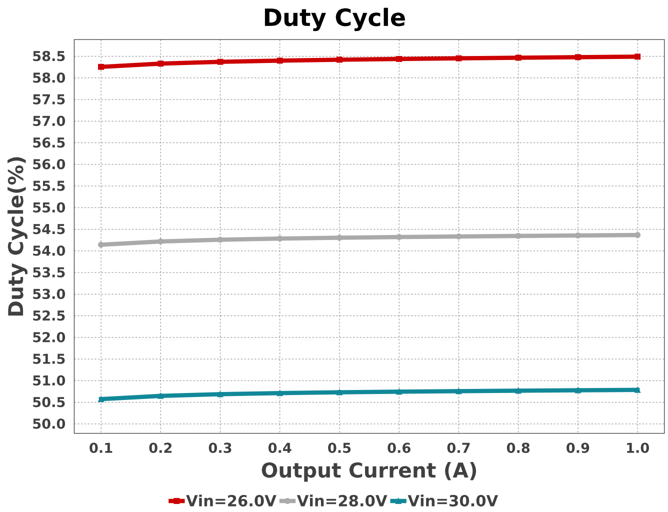
The LM26003-Q1 is qualified for Automotive applications. All passives and other components selected in this design may not be qualified for Automotive applications. The user is required to verify that all components in the design meet the qualification and safety requirements for their specific application.

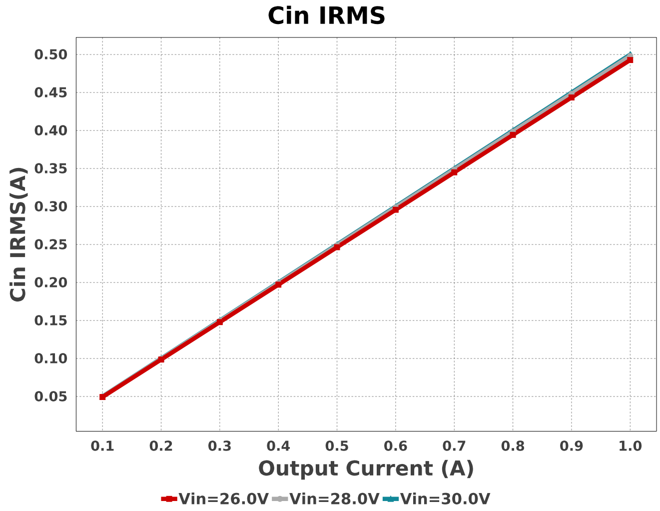
Electrical BOM

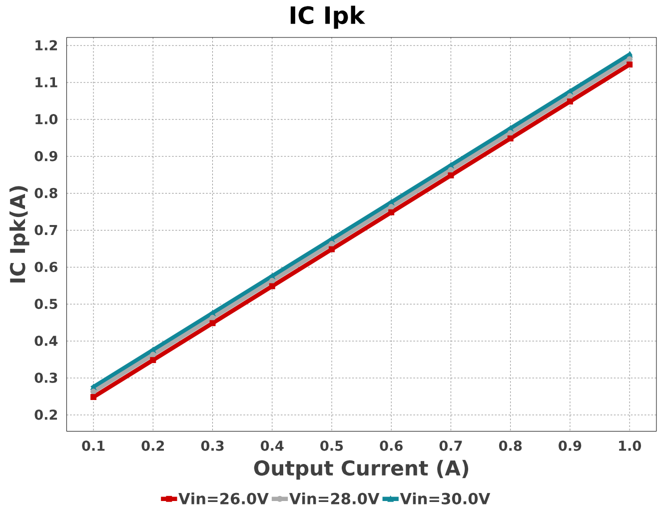
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cboot	AVX	08053C104JAZ2A Series= X7R	Cap= 100.0 nF VDC= 25.0 V IRMS= 0.0 A	1	$0.06	0805 7 mm^2
Cbulk	Panasonic	EEE-FC1H470P Series= FC	Cap= 47.0 uF ESR= 300.0 mOhm VDC= 50.0 V IRMS= 500.0 mA	1	$0.22	SM_RADIAL_G 172 mm^2
Ccomp	TDK	CGA4J2C0G1H333J125AA Series= C0G/NP0	Cap= 33.0 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.09	0805 7 mm^2
Ccomp2	Samsung Electro-Mechanics	CL21C680JBANNNC Series= C0G/NP0	Cap= 68.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0805 7 mm^2
Cin	MuRata	GRM31CR61H225KA88L Series= X5R	Cap= 2.2 uF ESR= 4.448 mOhm VDC= 50.0 V IRMS= 2.2252 A	1	$0.10	1206_190 11 mm^2
Cout	Panasonic	20SVPF120M Series= SVPF	Cap= 120.0 uF ESR= 25.0 mOhm VDC= 20.0 V IRMS= 3.2 A	1	$0.44	CAPSMT_62_F61 74 mm^2

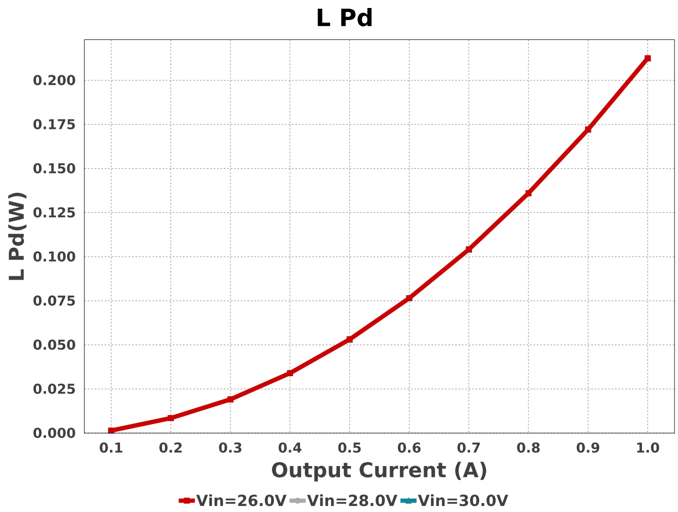
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Css	Samsung Electro-Mechanics	CL21C222JBFNNNE Series= C0G/NP0	Cap= 2.2 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.03	0805 7 mm²
Cvdd	Samsung Electro-Mechanics	CL10A106MQ8NNNC Series= X5R	Cap= 10.0 uF VDC= 6.3 V IRMS= 0.0 A	1	$0.02	0603 5 mm²
D1	Fairchild Semiconductor	SS14FL	VF@Io= 550.0 mV VRRM= 40.0 V	1	$0.04	SOD-123F 12 mm²
L1	NIC Components	NPI34W680MTRF	L= 68.0 µH 170.0 mOhm	1	$0.32	IND_NPI34W 172 mm²
Rcomp	Yageo	AC0402FR-0744K2L Series= ?	Res= 44.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rfbb	Vishay-Dale	CRCW04021K62FKED Series= CRCW..e3	Res= 1.62 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rfbt	Yageo	RC0603FR-0718KL Series= ?	Res= 18.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm²
Rfreq	Vishay-Dale	CRCW0402113KFKED Series= CRCW..e3	Res= 113.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rpg	Vishay-Dale	CRCW0402200KFKED Series= CRCW..e3	Res= 200.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rsync	Vishay-Dale	CRCW040210K0FKED Series= CRCW..e3	Res= 10.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
U1	Texas Instruments	LM26003QMHX/NOPB	Switcher	1	$1.78	MXA20A 71 mm²

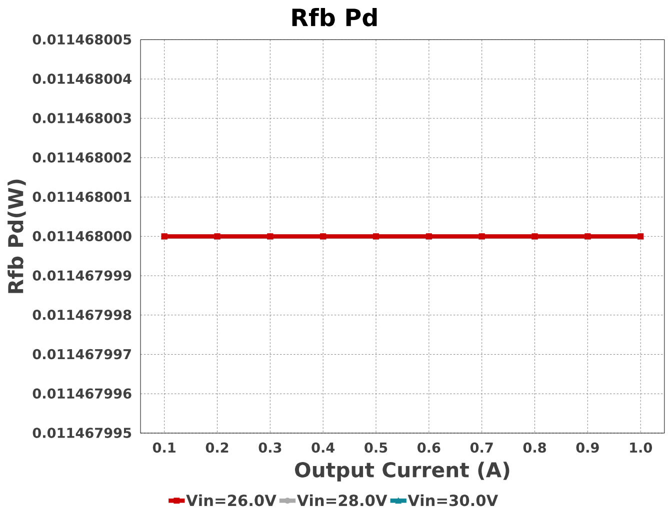


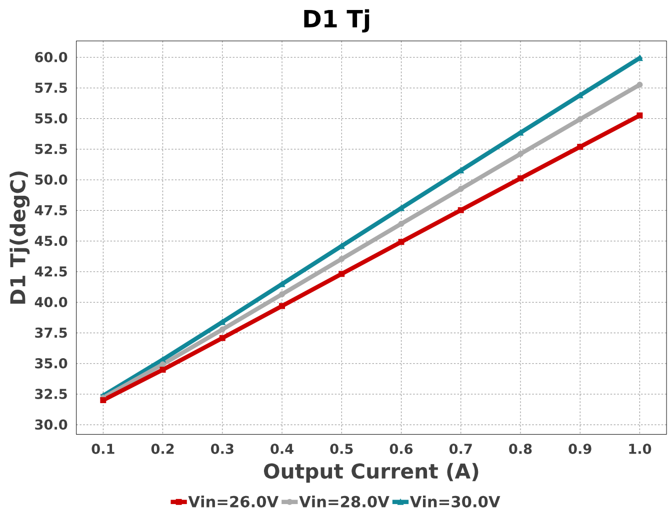


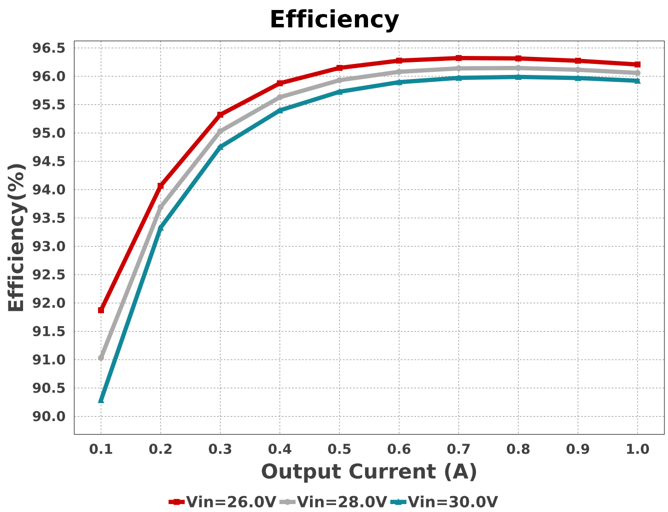

Cin IRMS
Cin IRMS(A)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=26.0V Vin=28.0V Vin=30.0V

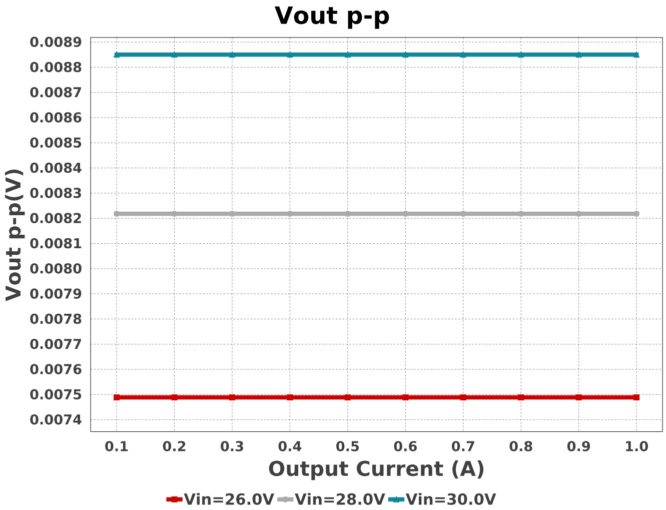

IC Ipk
IC Ipk(A)
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=26.0V Vin=28.0V Vin=30.0V

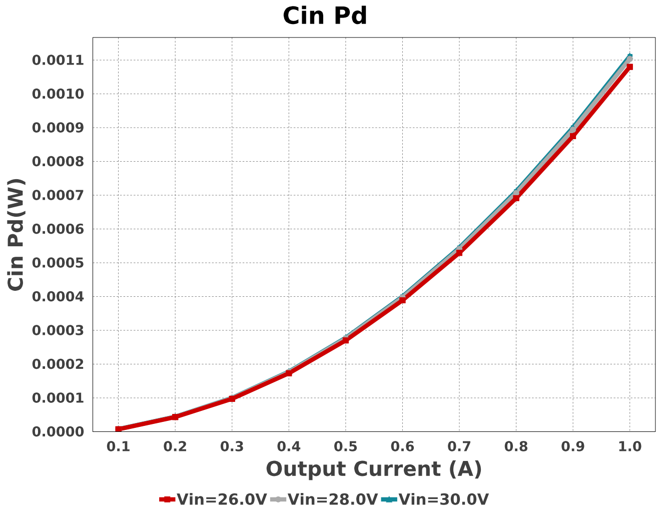

L Pd
L Pd(W)
0.200
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0.000
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=26.0V Vin=28.0V Vin=30.0V

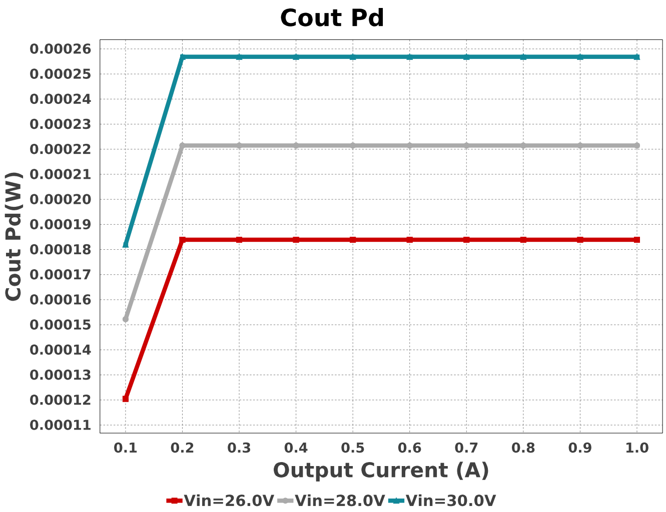

Rfb Pd
Rfb Pd(W)
0.011468005
0.011468004
0.011468003
0.011468002
0.011468001
0.011468000
0.011467999
0.011467998
0.011467997
0.011467996
0.011467995
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=26.0V Vin=28.0V Vin=30.0V

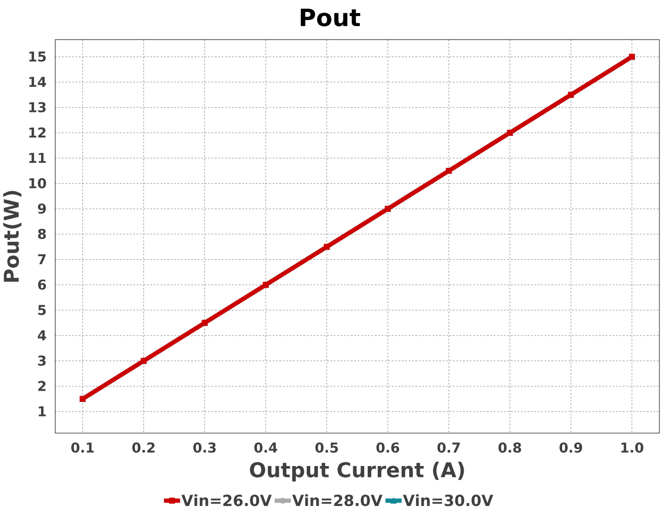

D1 Tj
D1 Tj(degC)
60.0
57.5
55.0
52.5
50.0
47.5
45.0
42.5
40.0
37.5
35.0
32.5
30.0
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=26.0V Vin=28.0V Vin=30.0V

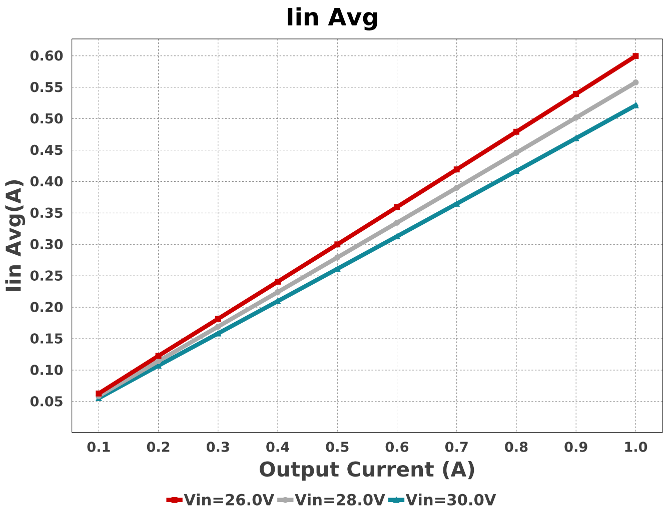

Efficiency
Efficiency(%)
96.5
96.0
95.5
95.0
94.5
94.0
93.5
93.0
92.5
92.0
91.5
91.0
90.5
90.0
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=26.0V Vin=28.0V Vin=30.0V

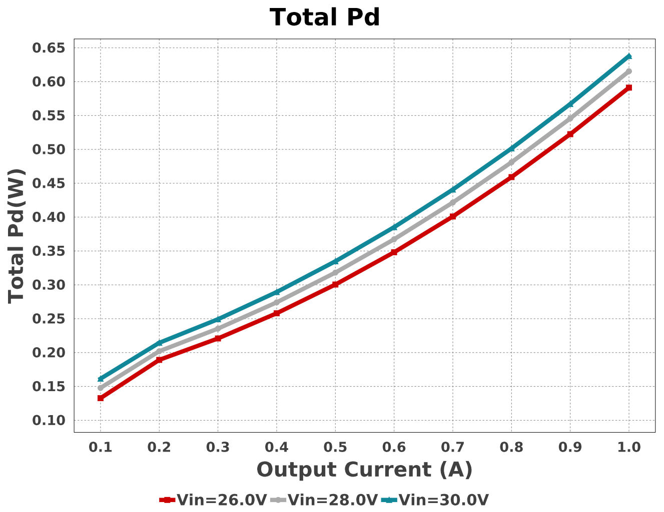

Vout p-p
Vout p-p(V)
0.0089
0.0088
0.0087
0.0086
0.0085
0.0084
0.0083
0.0082
0.0081
0.0080
0.0079
0.0078
0.0077
0.0076
0.0075
0.0074
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=26.0V Vin=28.0V Vin=30.0V

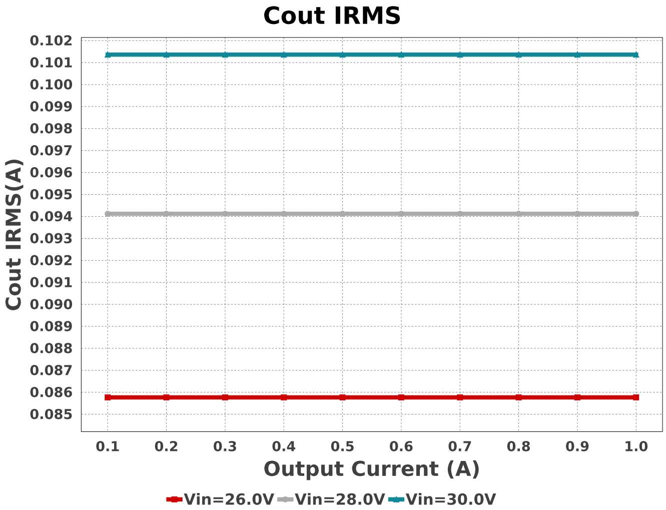

Cin Pd
Cin Pd(W)
0.0011
0.0010
0.0009
0.0008
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0.0000
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=26.0V Vin=28.0V Vin=30.0V

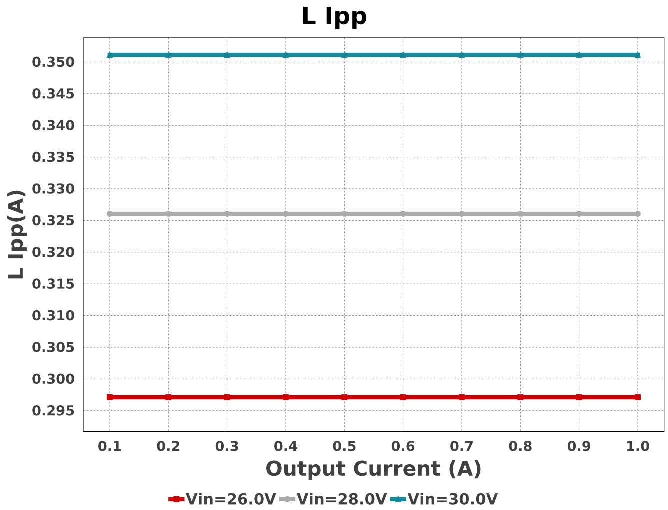

Cout Pd
Cout Pd(W)
0.00026
0.00025
0.00024
0.00023
0.00022
0.00021
0.00020
0.00019
0.00018
0.00017
0.00016
0.00015
0.00014
0.00013
0.00012
0.00011
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=26.0V Vin=28.0V Vin=30.0V

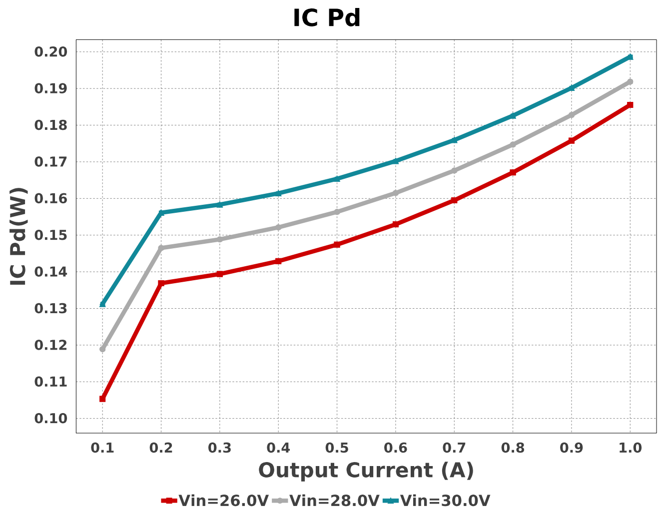

Pout
Pout(W)
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=26.0V Vin=28.0V Vin=30.0V

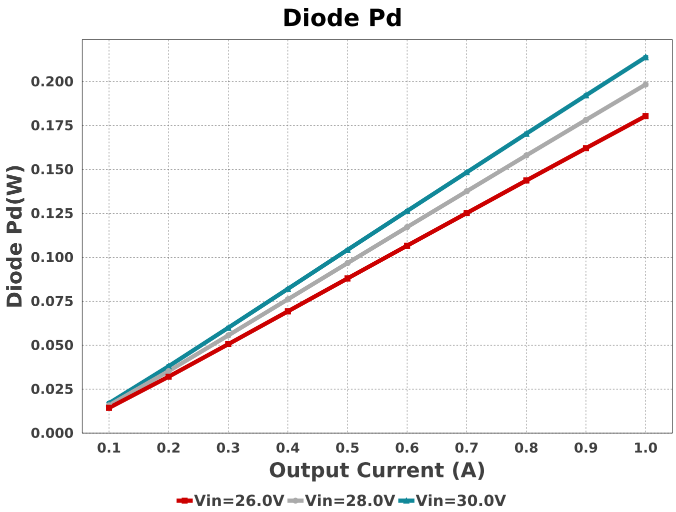

Iin Avg
Iin Avg(A)
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=26.0V Vin=28.0V Vin=30.0V

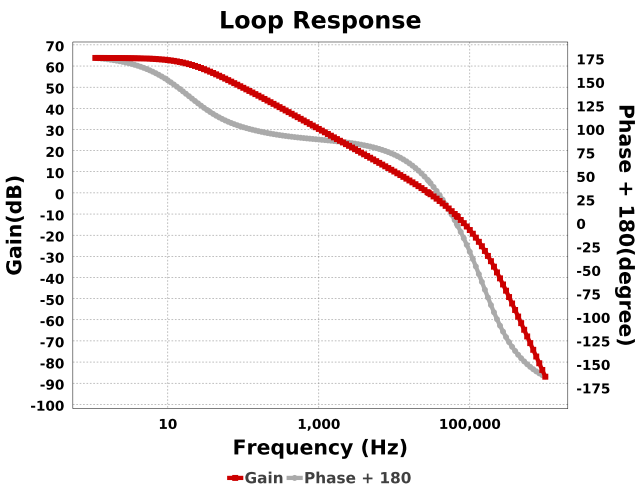

Total Pd
Total Pd(W)
0.65
0.60
0.55
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
Output Current (A)
Vin=26.0V Vin=28.0V Vin=30.0V











Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	499.938 mA	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	1.112 mW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	101.362 mA	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	256.86 µW	Capacitor	Output capacitor power dissipation
5.	D1 Tj	59.944 degC	Diode	D1 junction temperature
6.	Diode Pd	213.88 mW	Diode	Diode power dissipation
7.	IC Ipk	1.176 A	IC	Peak switch current in IC
8.	IC Pd	198.65 mW	IC	IC power dissipation
9.	IC Tj	36.357 degC	IC	IC junction temperature
10.	ICThetaJA	32.0 degC/W	IC	IC junction-to-ambient thermal resistance
11.	Iin Avg	521.26 mA	IC	Average input current

#	Name	Value	Category	Description
12.	L Ipp	351.13 mA	Inductor	Peak-to-peak inductor ripple current
13.	L Pd	212.5 mW	Inductor	Inductor power dissipation
14.	Cin Pd	1.112 mW	Power	Input capacitor power dissipation
15.	Cout Pd	256.86 µW	Power	Output capacitor power dissipation
16.	Diode Pd	213.88 mW	Power	Diode power dissipation
17.	IC Pd	198.65 mW	Power	IC power dissipation
18.	L Pd	212.5 mW	Power	Inductor power dissipation
19.	Rfb Pd	11.468 mW	Power	Rfb Power Dissipation
20.	Total Pd	637.866 mW	Power	Total Power Dissipation
21.	Rfb Pd	11.468 mW	Resistor	Rfb Power Dissipation
22.	BOM Count	17	System Information	Total Design BOM count
23.	Cross Freq	28.504 kHz	System Information	Bode plot crossover frequency
24.	Duty Cycle	50.787 %	System Information	Duty cycle
25.	Efficiency	95.921 %	System Information	Steady state efficiency
26.	FootPrint	564.0 mm^2	System Information	Total Foot Print Area of BOM components
27.	Frequency	324.583 kHz	System Information	Switching frequency
28.	Gain Marg	-10.934 dB	System Information	Bode Plot Gain Margin
29.	Iout	1.0 A	System Information	Iout operating point
30.	Low Freq Gain	63.83 dB	System Information	Gain at 1Hz
31.	Mode	SleepMode	System Information	Conduction Mode
32.	Phase Marg	45.83 deg	System Information	Bode Plot Phase Margin
33.	Pout	15.0 W	System Information	Total output power
34.	Total BOM	$3.18	System Information	Total BOM Cost
35.	Vin	30.0 V	System Information	Vin operating point
36.	Vout	15.0 V	System Information	Operational Output Voltage
37.	Vout Actual	14.969 V	System Information	Vout Actual calculated based on selected voltage divider resistors
38.	Vout Tolerance	3.419 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
39.	Vout p-p	8.85 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	1.0	Maximum Output Current
VinMax	30.0	Maximum input voltage
VinMin	26.0	Minimum input voltage
VinTyp	28.0	Typical input voltage
Vout	15.0	Output Voltage
base_pn	LM26003-Q1	Base Product Number
source	DC	Input Source Type
Ta	30.0	Ambient temperature

WEBENCH® Assembly

Component Testing

Some published data on components in datasheets such as Capacitor ESR and Inductor DC resistance is based on conservative values that will guarantee that the components always exceed the specification. For design purposes it is usually better to work with typical values. Since this data is not always available it is a good practice to measure the Capacitance and ESR values of Cin and Cout, and the inductance and DC resistance of L1 before assembly of the board. Any large discrepancies in values should be electrically simulated in WEBENCH to check for instabilities and thermally simulated in WebTHERM to make sure critical temperatures are not exceeded.

Soldering Component to Board

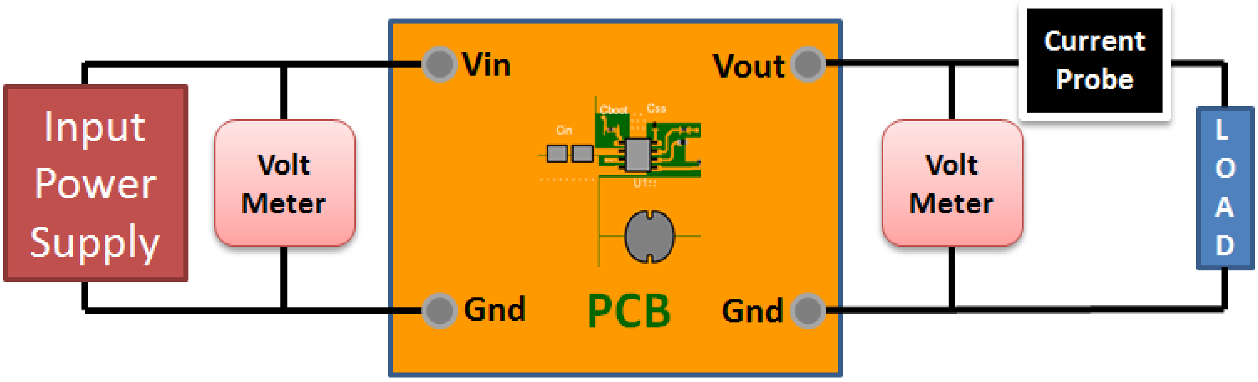
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. To solder the tab town to the board place the iron down on the board while resting against the tab, heating both surfaces simultaneously. Apply light pressure to the top of the plastic case until the solder flows around the part and the part is flush with the PCB. If the solder is not flowing around the board you may need a higher wattage iron (generally 25W to 30W is enough).

Initial Startup of Circuit

It is best to initially power up the board by setting the input supply voltage to the lowest operating input voltage 26.0V and set the input supply's current limit to zero. With the input supply off connect up the input supply to Vin and GND. Connect a digital volt meter and a load if needed to set the minimum Iout of the design from Vout and GND. Turn on the input supply and slowly turn up the current limit on the input supply. If the voltage starts to rise on the input supply continue increasing the input supply current limit while watching the output voltage. If the current increases on the input supply, but the voltage remains near zero, then there may be a short or a component misplaced on the board. Power down the board and visually inspect for solder bridges and recheck the diode and capacitor polarities. Once the power supply circuit is operational then more extensive testing may include full load testing, transient load and line tests to compare with simulation results.

Load Testing

The setup is the same as the initial startup, except that an additional digital voltmeter is connected between Vin and GND, a load is connected between Vout and GND and a current meter is connected in series between Vout and the load. The load must be able to handle at least rated output power + 50% (7.5 watts for this design). Ideally the load is supplied in the form of a variable load test unit. It can also be done in the form of suitably large power resistors. When using an oscilloscope to measure waveforms on the prototype board, the ground leads of the oscilloscope probes should be as short as possible and the area of the loop formed by the ground lead should be kept to a minimum. This will help reduce ground lead inductance and eliminate EMI noise that is not actually present in the circuit.



Design Assistance

1. The LM26003-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. Master key : 82F3BB5AD0B953A69044792478707C05[v1]

3. **LM26003-Q1** Product Folder : http://www.ti.com/product/LM26003%2DQ1 : contains the data sheet and other resources.