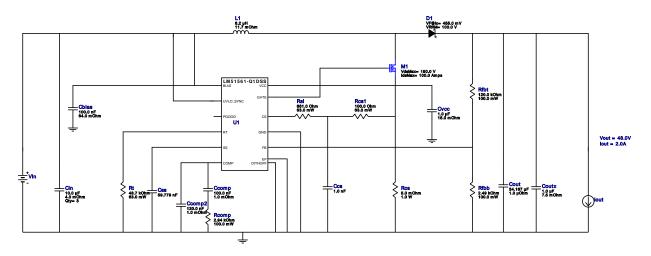
VinMin = 8.0V VinMax = 18.0V Vout = 48.0V Iout = 2.0A Device = LM51561QDSSRQ1 Topology = Boost Created = 2022-06-03 11:18:42.349 BOM Cost = NA BOM Count = 23 Total Pd = 10.78W

# WEBENCH® Design Report

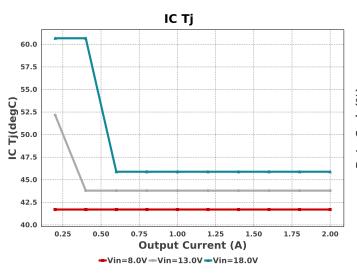
Design: 44 LM51561QDSSRQ1 LM51561QDSSRQ1 8V-18V to 48.00V @ 2A

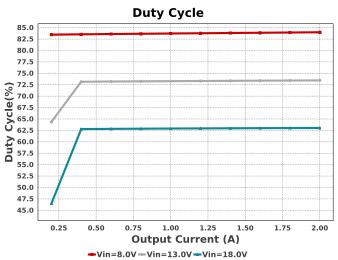


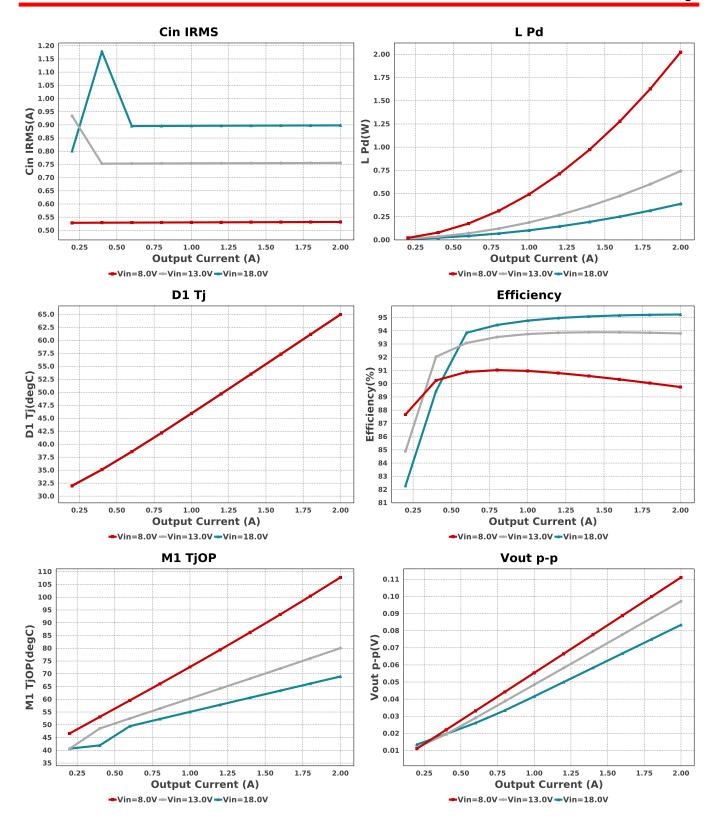
#### **Electrical BOM**

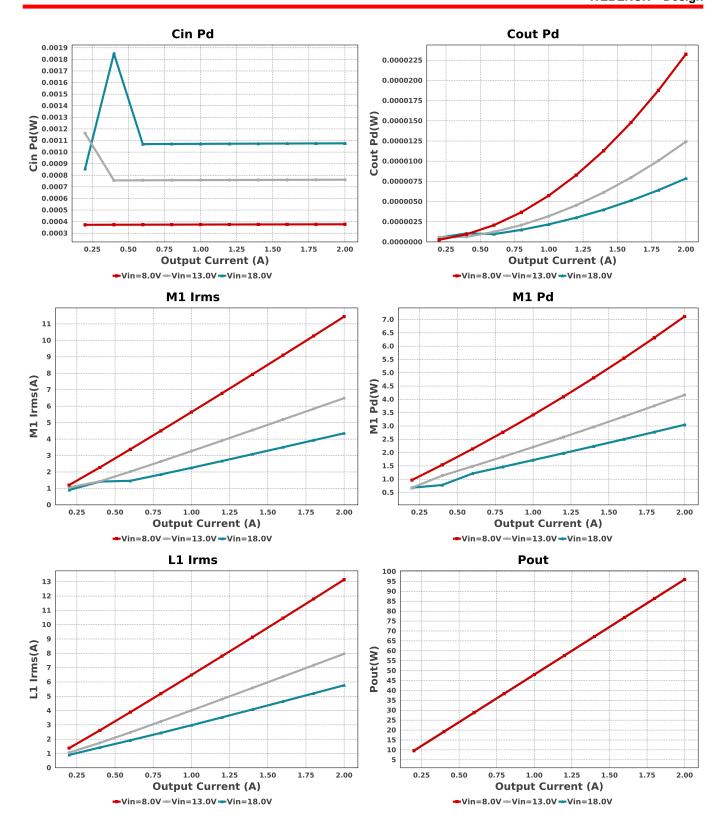
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cbias	Kemet	C0805C104M5RACTU Series= X7R	Cap= 100.0 nF ESR= 64.0 mOhm VDC= 50.0 V IRMS= 1.64 A	1	\$0.01	0805 7 mm <sup>2</sup>
Ccomp	Yageo	CC0805KRX7R8BB104 Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	\$0.02	0805 7 mm <sup>2</sup>
Ccomp2	MuRata	GRM188R71E124KA01D Series= X7R	Cap= 120.0 nF ESR= 1.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	\$0.02	0603 5 mm <sup>2</sup>
Ccs	MuRata	GRM1555C1H102JA01J Series= C0G/NP0	Cap= 1.0 nF VDC= 50.0 V IRMS= 0.0 A	1	\$0.01	0402 3 mm <sup>2</sup>
Cin	MuRata	GRM31CR71E106KA12L Series= X7R	Cap= 10.0 uF ESR= 4.0 mOhm VDC= 25.0 V IRMS= 6.0 A	3	\$0.22	1206_180 11 mm <sup>2</sup>
Cout	CUSTOM	CUSTOM Series= ?	Cap= 34.167 uF ESR= 1.0 uOhm VDC= 72.0 V IRMS= 9.5304 A	1	NA	CUSTOM 0 mm <sup>2</sup>
Coutx	TDK	C3216X7R2A105M160AA Series= X7R	Cap= 1.0 uF ESR= 7.5 mOhm VDC= 100.0 V IRMS= 5.9235 A	1	\$0.12	1206 11 mm <sup>2</sup>
Css	CUSTOM	CUSTOM Series= ?	Cap= 59.779 nF VDC= 0.0 V IRMS= 0.0 A	1	NA	CUSTOM 0 mm <sup>2</sup>
Cvcc	Kemet	C0805C105K4RACTU Series= X7R	Cap= 1.0 uF ESR= 15.0 mOhm VDC= 16.0 V IRMS= 8.19 A	1	\$0.02	0805 7 mm <sup>2</sup>

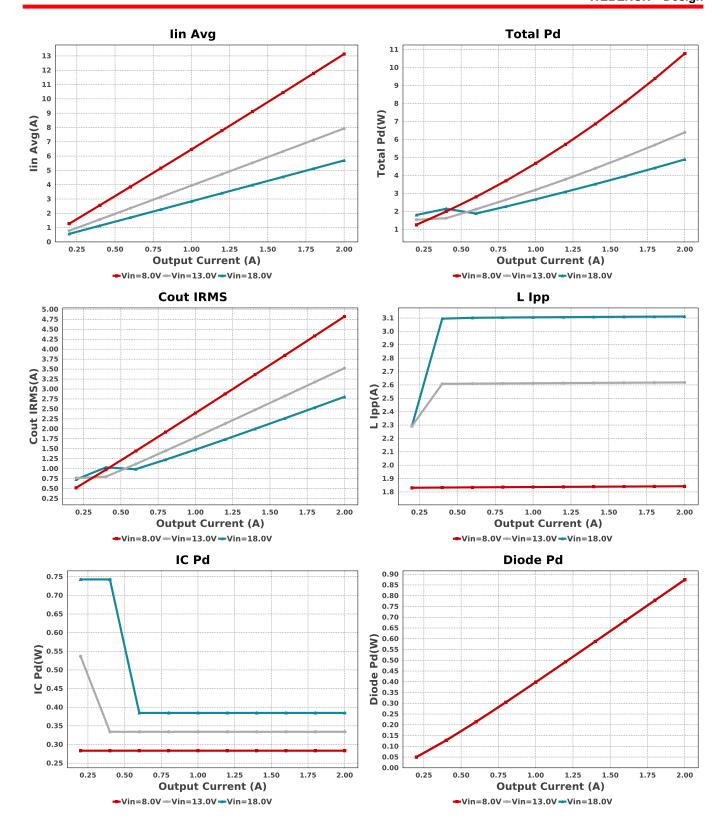
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
D1	STMicroelectronics	STPS20M100SG-TR	VF@Io= 455.0 mV VRRM= 100.0 V	1	\$1.33	DDPAK 210 mm <sup>2</sup>
L1	Coilcraft	XAL1010-822MEB	L= 8.2 μH 11.7 mOhm	1	\$1.71	XAL1010 160 mm²
M1	Infineon Technologies	IPP075N15N3GXKSA1	VdsMax= 150.0 V IdsMax= 100.0 Amps	1	\$2.88	TO-220-3 127 mm <sup>2</sup>
Rcomp	Yageo	RT0603BRD072K94L Series= ?	Res= 2.94 kOhm Power= 100.0 mW Tolerance= 0.1%	1	\$0.04	0603 5 mm <sup>2</sup>
Rcs	Susumu Co Ltd	PRL1632-R005-F-T1 Series= PRL1632	Res= 5.0 mOhm Power= 1.0 W Tolerance= 1.0%	1	\$0.20	0612 11 mm <sup>2</sup>
Rcs1	Vishay-Dale	CRCW0402100RFKED Series= CRCWe3	Res= 100.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm <sup>2</sup>
Rfbb	Susumu Co Ltd	RG1608P-2491-B-T5 Series= RG1608	Res= 2.49 kOhm Power= 100.0 mW Tolerance= 0.1%	1	\$0.06	0603 5 mm <sup>2</sup>
Rfbt	Susumu Co Ltd	RG1608P-124-B-T5 Series= RG1608	Res= 120.0 kOhm Power= 100.0 mW Tolerance= 0.1%	1	\$0.06	0603 5 mm <sup>2</sup>
Rsl	Vishay-Dale	CRCW0402681RFKED Series= CRCWe3	Res= 681.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm <sup>2</sup>
Rt	Vishay-Dale	CRCW040248K7FKED Series= CRCWe3	Res= 48.7 kOhm Power= 63.0 mW Tolerance= 1.0%	1	\$0.01	0402 3 mm <sup>2</sup>
U1	Texas Instruments	LM51561QDSSRQ1	Switcher	1	\$0.86	DSS0012B 12 mm <sup>2</sup>

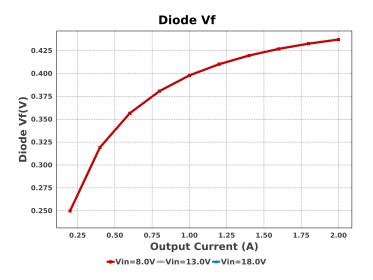


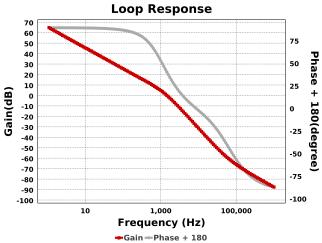












### **Operating Values**

#	Name	Value	Category	Description
1.	Cin IRMS	531.795 mA	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	377.08 μW	Capacitor	Input capacitor power dissipation
3.	Cout IRMS	4.821 A	Capacitor	Output capacitor RMS ripple current
4.	Cout Pd	23.244 µW	Capacitor	Output capacitor power dissipation
5.	D1 Tj	64.971 degC	Diode	D1 junction temperature
6.	Diode Pd	874.28 mW	Diode	Diode power dissipation
7.	Diode Vf	437.139 mV	Diode	Forward voltage drop of diode D1
8.	IC Pd	283.39 mW	IC	IC power dissipation
9.	IC Tj	41.704 degC	IC	IC junction temperature
	ICThetaJA	41.3 degC/W	IC	IC junction-to-ambient thermal resistance
	lin Avg	13.136 A	IC	Average input current
12.	L lpp	1.842 A	Inductor	Peak-to-peak inductor ripple current
	L Pd	2.022 W	Inductor	Inductor power dissipation
	L1 Irms	13.146 A	Inductor	Inductor ripple current
	M1 Irms	11.446 A	Mosfet	Q lavg
-	M1 Pd	7.114 W	Mosfet	MOSFET power dissipation
	M1 TjOP	107.75 degC	Mosfet	M1 MOSFET junction temperature
	Cin Pd	377.08 μW	Power	Input capacitor power dissipation
		•		
	Cout Pd	23.244 µW	Power	Output capacitor power dissipation
	Diode Pd	874.28 mW	Power	Diode power dissipation
	IC Pd	283.39 mW	Power	IC power dissipation
	L Pd	2.022 W	Power	Inductor power dissipation
	M1 Pd	7.114 W	Power	MOSFET power dissipation
24.	Total Pd	10.776 W	Power	Total Power Dissipation
25.	BOM Count	23	System Information	Total Design BOM count
26.	Cross Freq	794.822 Hz	System Information	Bode plot crossover frequency
27.	Duty Cycle	83.992 %	System Information	Duty cycle
28.	Efficiency	89.746 %	System Information	Steady state efficiency
29.	FootPrint	1.862 k mm <sup>2</sup>	System Information	Total Foot Print Area of BOM components
30.	Frequency	444.713 kHz	System Information	Switching frequency
31.	lout	2.0 A	System Information	lout operating point
32.	Mode	CCM	System Information	Conduction Mode
33.	Phase Marg	57.795 deg	System Information	Bode Plot Phase Margin
34.	Pout	96.0 W	System Information	Total output power
35.	Total BOM	NA	System Information	Total BOM Cost
36.	Vin	8.0 V	System Information	Vin operating point
37.	Vout Actual	49.193 V	System Information	Vout Actual calculated based on selected voltage divider resistors
38.	Vout Tolerance	2.801 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divide resistors if applicable

#	Name	Value	Category	Description
39.	Vout p-p	110.569 mV	System Information	Peak-to-peak output ripple voltage

## Design Inputs

Name	Value	Description
lout	2.0	Maximum Output Current
VinMax	18.0	Maximum input voltage
VinMin	8.0	Minimum input voltage
Vout	48.0	Output Voltage
base_pn	LM51561-Q1	Base Product Number
source	DC	Input Source Type
Та	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

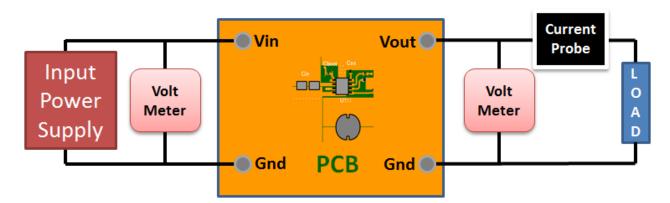
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 8.0V 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 lout 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. Feature Highlights: Output Current up to 10A, up to 60 V Input Voltage Range, Integrated Thermal Protection, Ideal for automotive applications.
- 2. Master key: 4252A3B24B4CB103[v1]
- 3. LM51561-Q1 Product Folder: http://www.ti.com/product/LM51561%2DQ1: contains the data sheet and other resources.

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