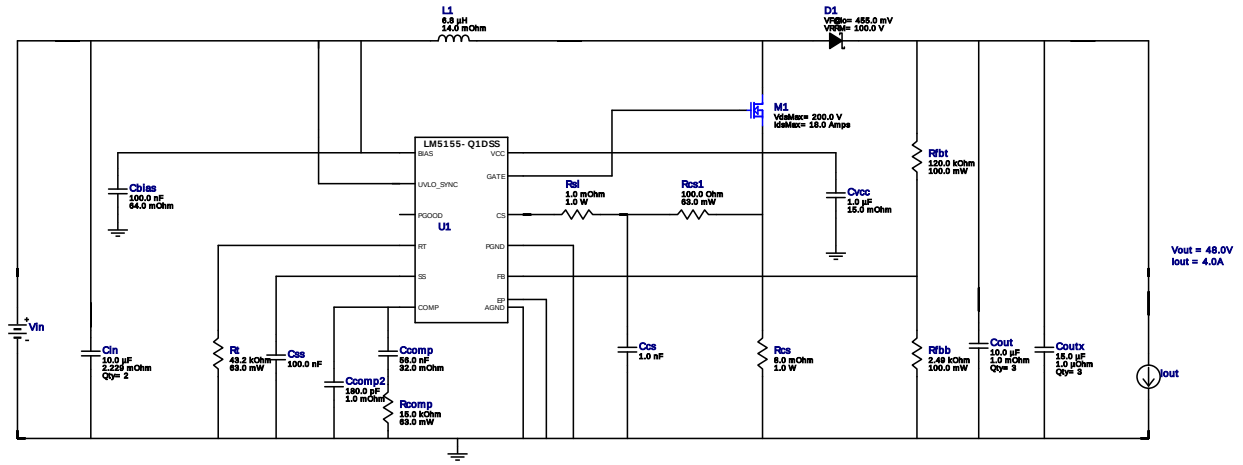
WEBENCH® Design Report

VinMin = 21.6V
VinMax = 26.4V
Vout = 48.0V
Iout = 4.0A

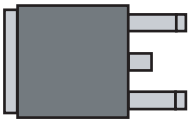
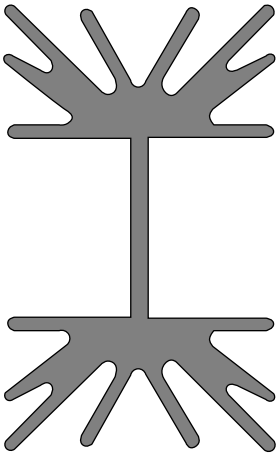
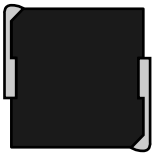
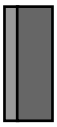
Device = LM5155DSSR
Topology = Boost
Created = 2020-12-03 03:47:34.104
BOM Cost = NA
BOM Count = 26
Total Pd = 16.64W

Design : 13179 LM5155DSSR
LM5155DSSR 21.6V-26.4V to 48.00V @ 4A

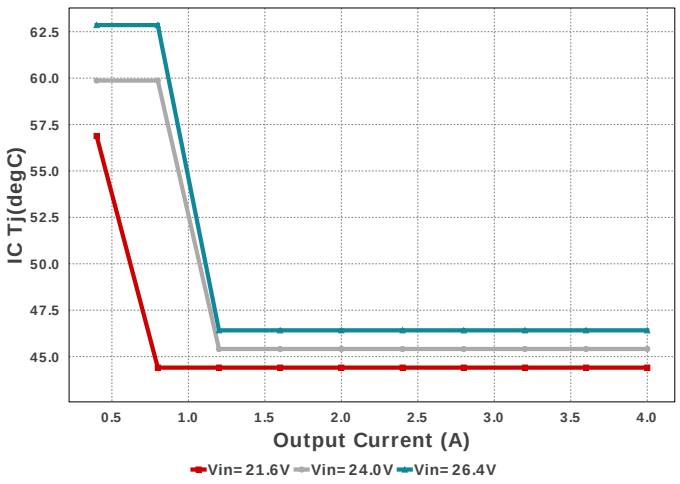


Electrical BOM

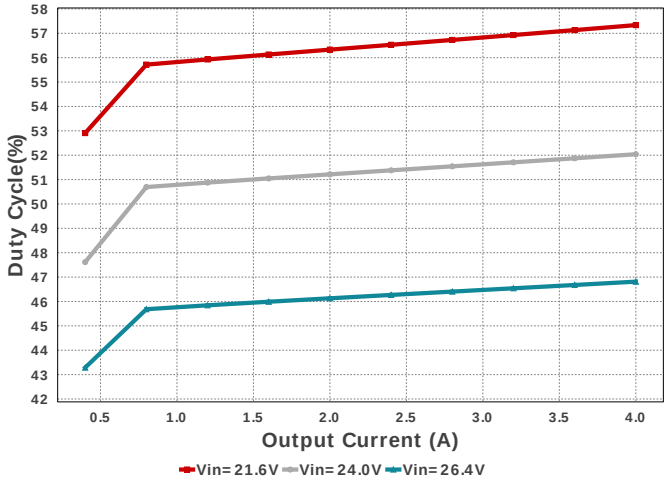
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cbias	Kemet	C0805C104M5RACTU Series= X7R	Cap= 100.0 nF ESR= 64.0 mOhm VDC= 50.0 V IRMS= 1.64 A	1	$0.01	0805 7 mm^2
Ccomp	AVX	08055C563KAT2A Series= X7R	Cap= 56.0 nF ESR= 32.0 mOhm VDC= 50.0 V IRMS= 0.0 A	1	$0.02	0805 7 mm^2
Ccomp2	MuRata	GRM033R71E181KA01D Series= X7R	Cap= 180.0 pF ESR= 1.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0201 2 mm^2
Ccs	MuRata	GRM1555C1H102JA01J Series= C0G/NP0	Cap= 1.0 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
Cin	TDK	C3216X6S1V106K160AC Series= X6S	Cap= 10.0 uF ESR= 2.229 mOhm VDC= 35.0 V IRMS= 4.8593 A	2	$0.18	1206_180 11 mm^2
Cout	TDK	CKG57NX7R2A106M500JH Series= X7R	Cap= 10.0 uF ESR= 1.0 mOhm VDC= 100.0 V IRMS= 4.22 A	3	$1.96	CKG57N 56 mm^2
Coutx	CUSTOM	CUSTOM Series= X7R	Cap= 15.0 uF ESR= 1.0 uOhm VDC= 100.0 V IRMS= 5.9235 A	3	NA	1206 0 mm^2
Css	AVX	08053C104JAZ2A Series= X7R	Cap= 100.0 nF VDC= 25.0 V IRMS= 0.0 A	1	$0.06	0805 7 mm^2
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^2

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^2
HS_M1	Aavid	529802B02500G	Heatsink	1	$0.91	 529802 1203 mm^2
L1	Bourns	SRP1270-6R8M	L= 6.8 µH 14.0 mOhm	1	$0.72	 SRP1270 246 mm^2
M1	Fairchild Semiconductor	IRL640A	VdsMax= 200.0 V IdsMax= 18.0 Amps	1	$0.68	 TO-220AB 79 mm^2
Rcomp	Vishay-Dale	CRCW040215K0FKED Series= CRCW..e3	Res= 15.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
Rcs	Susumu Co Ltd	PRL1632-R008-F-T1 Series= PRL1632	Res= 8.0 mOhm Power= 1.0 W Tolerance= 1.0%	1	$0.20	 0612 11 mm^2
Rcs1	Vishay-Dale	CRCW0402100RFKED Series= CRCW..e3	Res= 100.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
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^2
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^2
Rsl	Rohm	PMR25HZPFV1L00 Series= PMR25	Res= 1.0 mOhm Power= 1.0 W Tolerance= 1.0%	1	$0.19	 1210 15 mm^2
Rt	Vishay-Dale	CRCW040243K2FKED Series= CRCW..e3	Res= 43.2 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	 0402 3 mm^2
U1	Texas Instruments	LM5155DSSR	Switcher	1	$0.66	 DSS0012B 12 mm^2

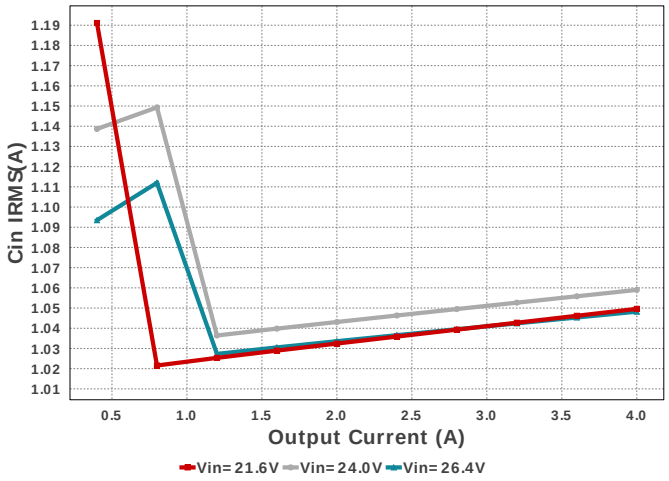
IC Tj



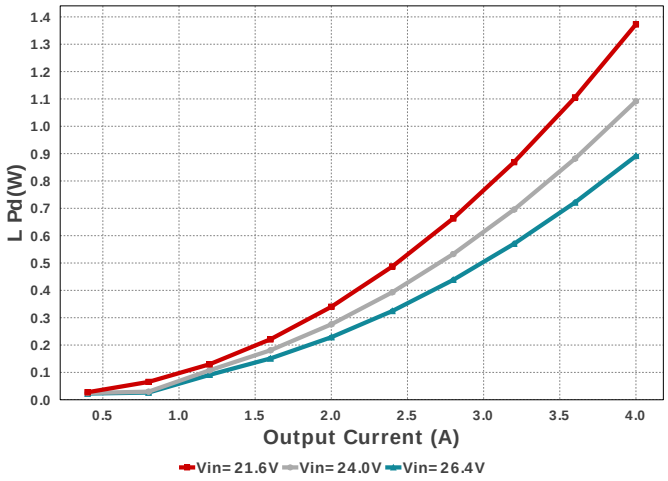
Duty Cycle



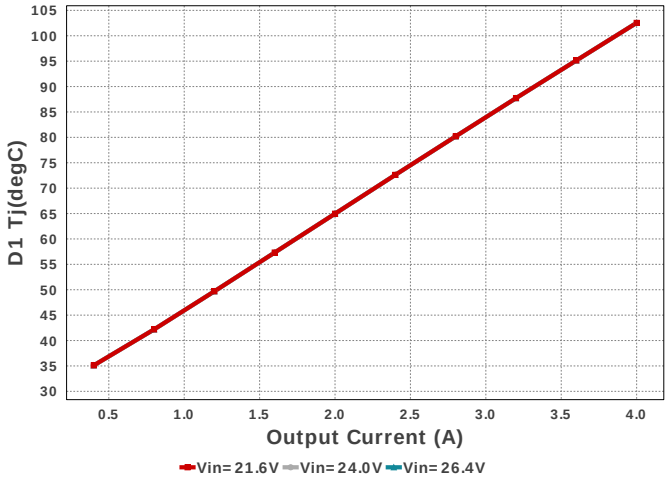
Cin IRMS



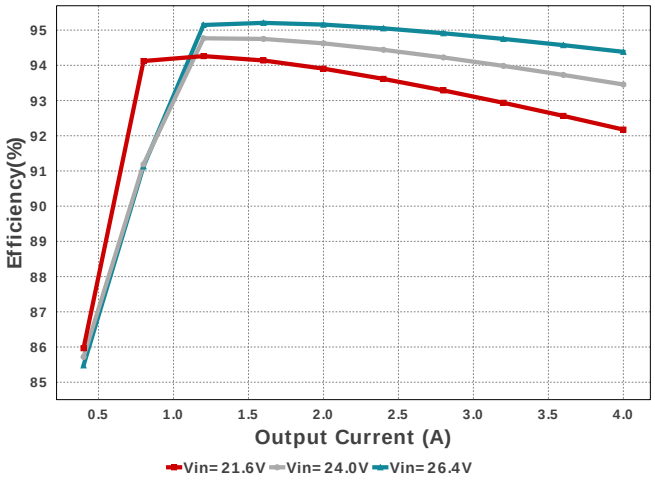
L Pd

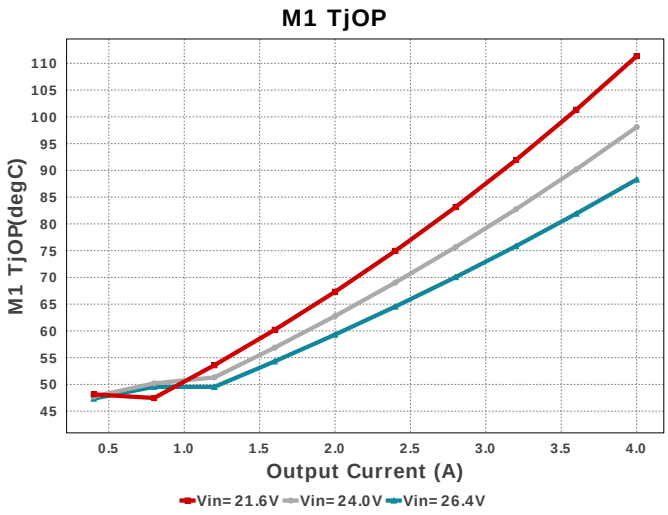


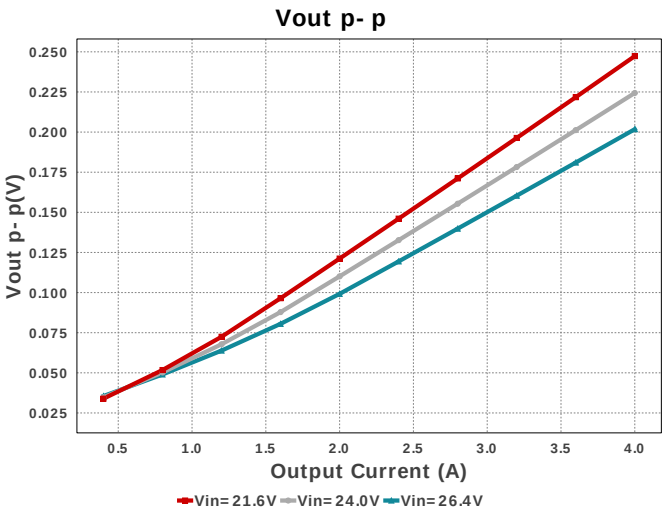
D1 Tj

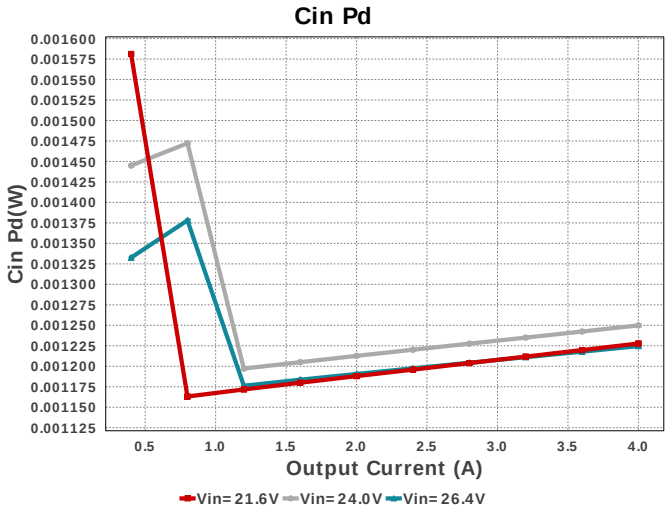


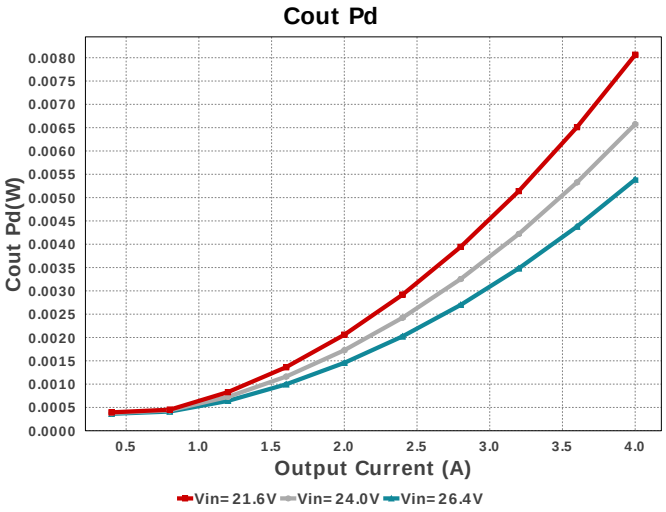
Efficiency

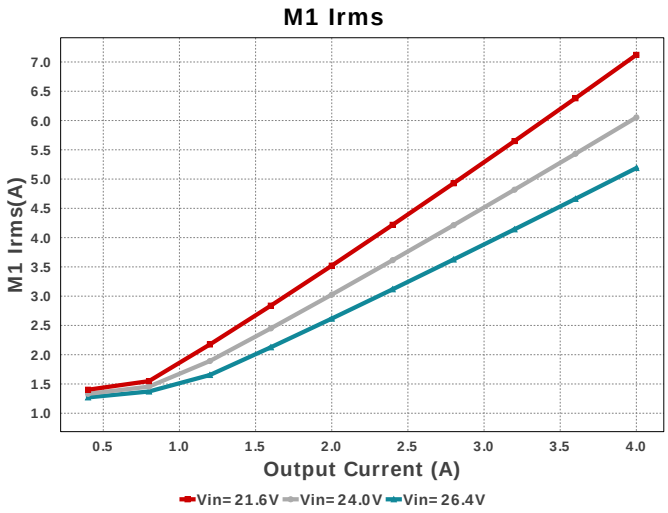


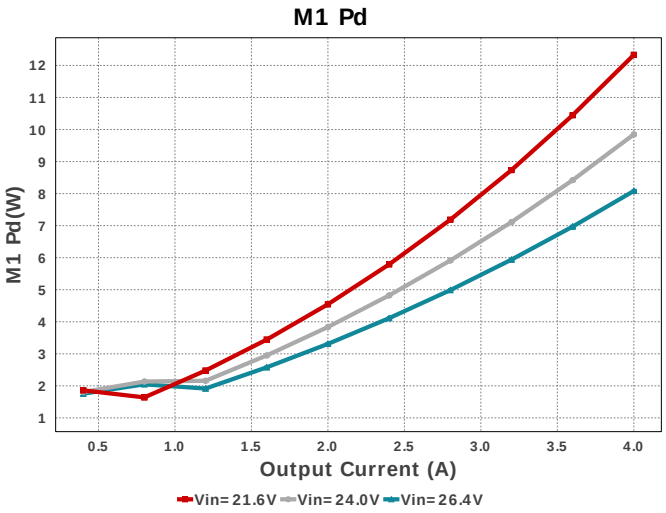


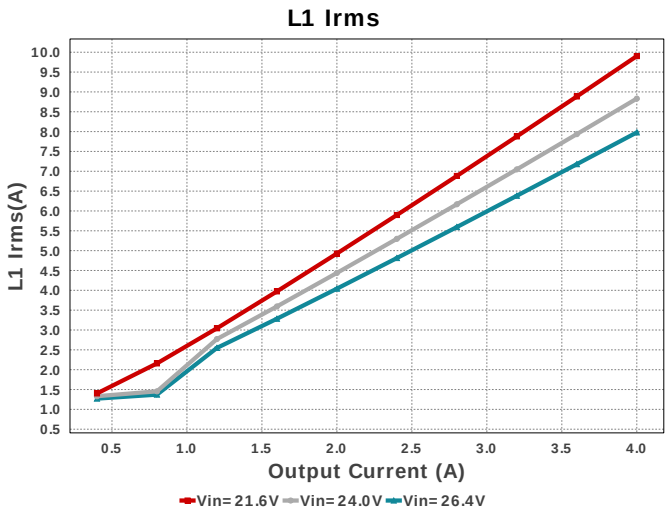


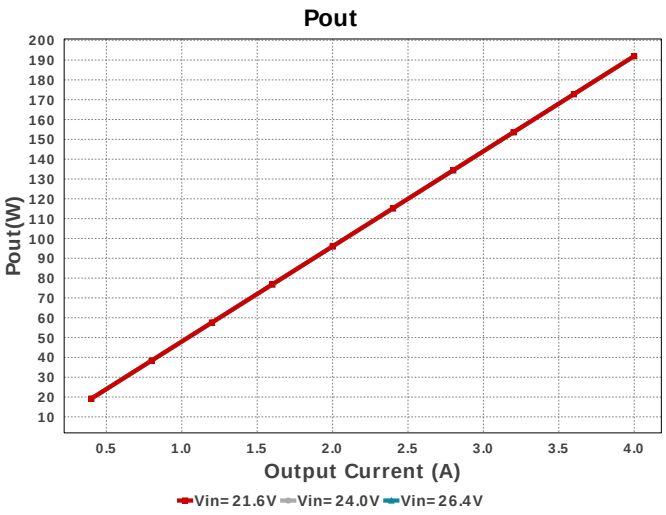


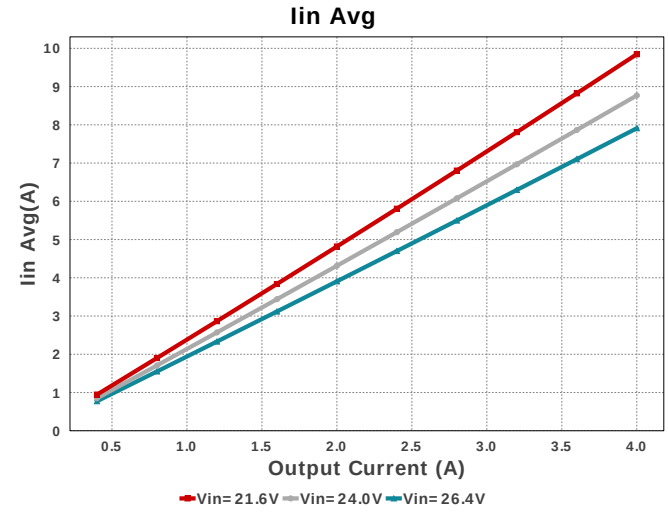


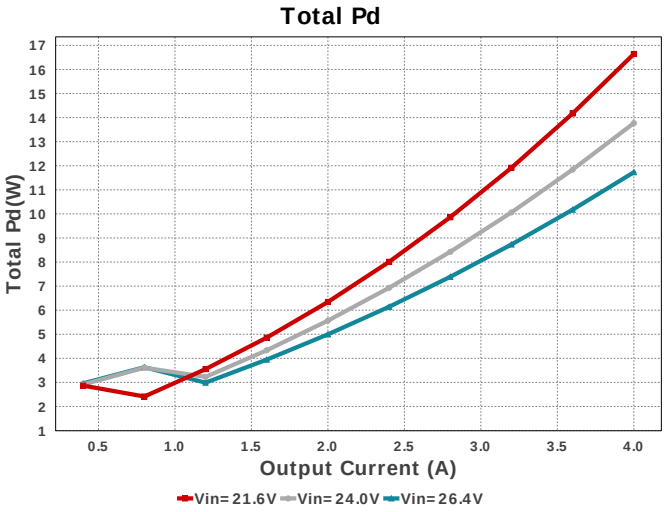


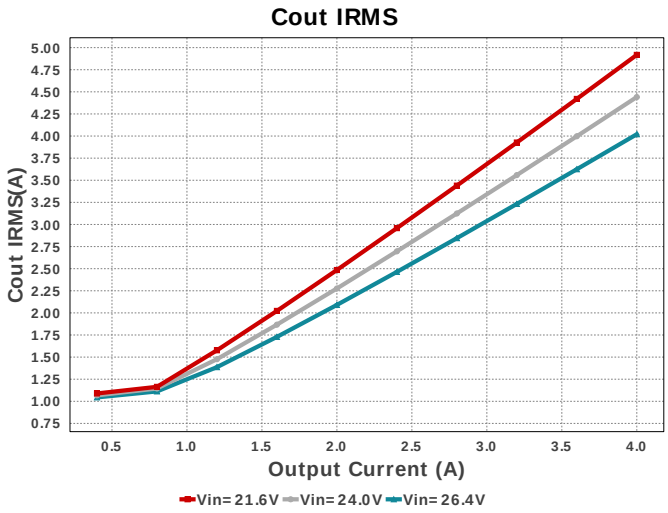


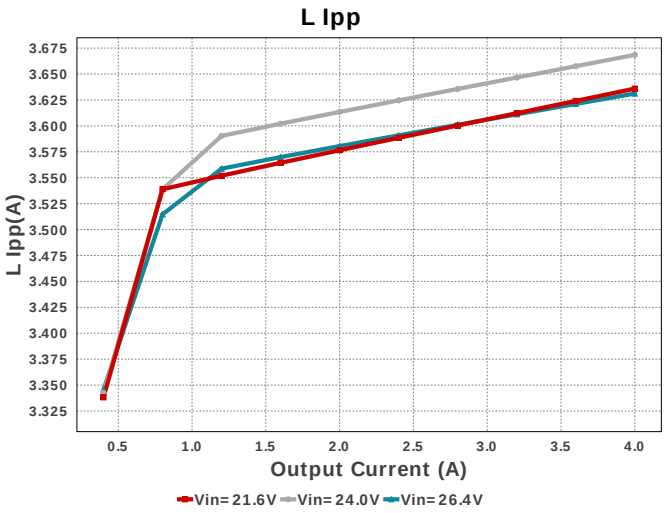


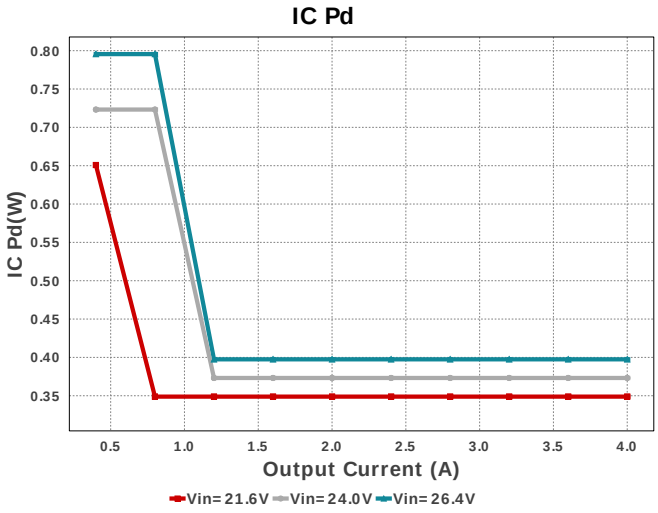


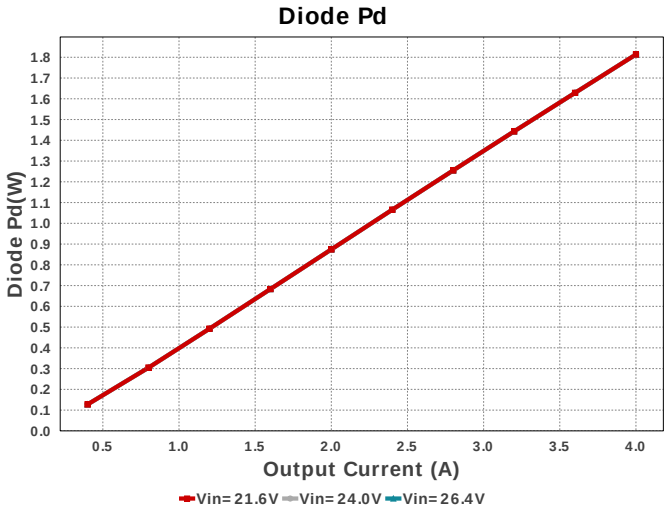


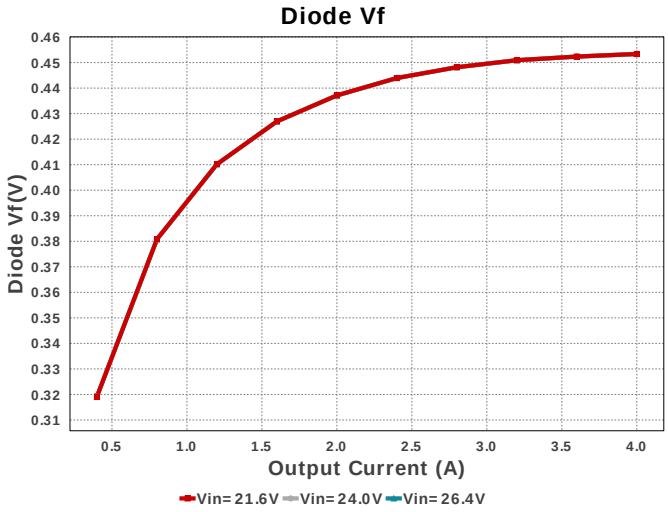












Operating Values

#	Name	Value	Category	Description
1.	BOM Count	26		Total Design BOM count
2.	Total BOM	NA		Total BOM Cost
3.	Cin IRMS	1.05 A	Capacitor	Input capacitor RMS ripple current
4.	Cin Pd	1.228 mW	Capacitor	Input capacitor power dissipation
5.	Cout IRMS	4.918 A	Capacitor	Output capacitor RMS ripple current
6.	Cout Pd	8.062 mW	Capacitor	Output capacitor power dissipation
7.	D1 Tj	102.538 degC	Diode	D1 junction temperature
8.	Diode Pd	1.814 W	Diode	Diode power dissipation
9.	Diode Vf	453.364 mV	Diode	Forward voltage drop of diode D1
10.	IC Pd	348.85 mW	IC	IC power dissipation
11.	IC Tj	44.408 degC	IC	IC junction temperature
12.	ICThetaJA	41.3 degC/W	IC	IC junction-to-ambient thermal resistance
13.	Iin Avg	9.847 A	IC	Average input current
14.	L Ipp	3.636 A	Inductor	Peak-to-peak inductor ripple current
15.	L Pd	1.373 W	Inductor	Inductor power dissipation
16.	L1 Irms	9.902 A	Inductor	Inductor ripple current
17.	M1 Irms	7.122 A	Mosfet	Q Iavg
18.	M1 Pd	12.33 W	Mosfet	MOSFET power dissipation
19.	M1 TjOP	111.355 degC	Mosfet	M1 MOSFET junction temperature
20.	Cin Pd	1.228 mW	Power	Input capacitor power dissipation
21.	Cout Pd	8.062 mW	Power	Output capacitor power dissipation
22.	Diode Pd	1.814 W	Power	Diode power dissipation
23.	IC Pd	348.85 mW	Power	IC power dissipation
24.	L Pd	1.373 W	Power	Inductor power dissipation
25.	M1 Pd	12.33 W	Power	MOSFET power dissipation
26.	Total Pd	16.643 W	Power	Total Power Dissipation
27.	Duty Cycle	57.337 %	System Information	Duty cycle
28.	Efficiency	92.175 %	System Information	Steady state efficiency
29.	FootPrint	2.049 k mm^2	System Information	Total Foot Print Area of BOM components

#	Name	Value	Category	Description
30.	Frequency	500.057 kHz	System Information	Switching frequency
31.	Iout	4.0 A	System Information	Iout operating point
32.	Mode	CCM	System Information	Conduction Mode
33.	Pout	192.0 W	System Information	Total output power
34.	Vin	21.6 V	System Information	Vin operating point
35.	Vout Actual	49.193 V	System Information	Vout Actual calculated based on selected voltage divider resistors
36.	Vout Tolerance	2.801 %	System Information	Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable
37.	Vout p-p	247.339 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	4.0	Maximum Output Current
VinMax	26.4	Maximum input voltage
VinMin	21.6	Minimum input voltage
Vout	48.0	Output Voltage
base_pn	LM5155	Base Product Number
source	DC	Input Source Type
Ta	30.0	Ambient temperature
UserFsw	550.0 k	Customer Selected Frequency

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

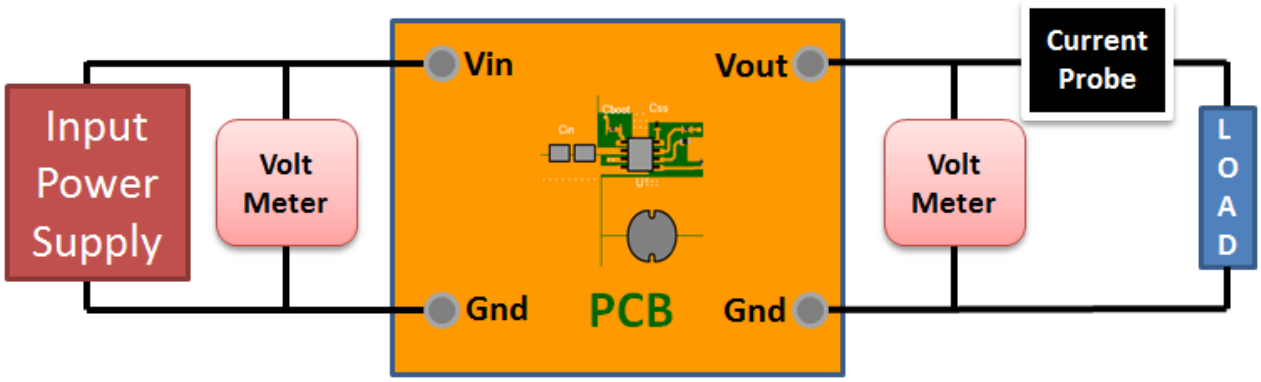
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 21.6V 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.

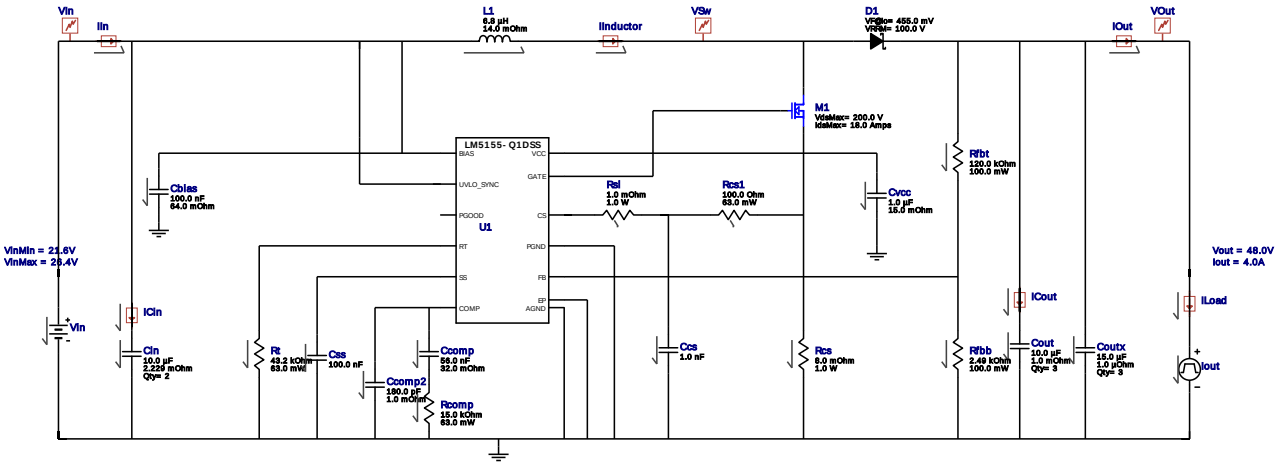


WEBENCH® Electrical Simulation Report

Design Id = 13179

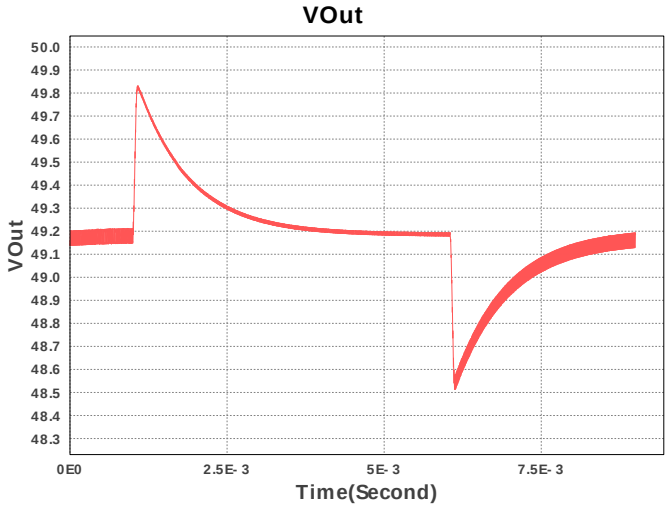
sim_id = 1

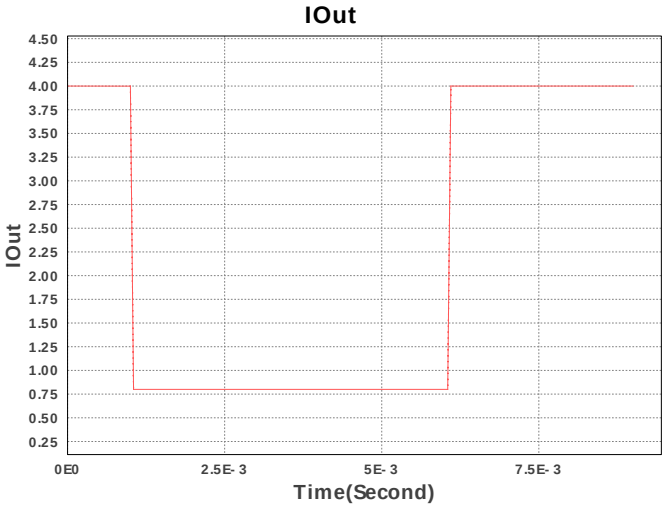
Simulation Type = Load Transient



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	L1	IC	Initial current	Inductor_IC A
2.	Css	IC	Initial condition	1
3.	Cvcc	IC	Initial condition	5
4.	Iout	signal_type	Signal Type	PULSE
		I1	Intial current	4.0 A
		I2	Peak Current	0.8 A
		Td	Initial Delay Time	0.001 Sec
		Tr	Rise Time	50u Sec
		Tf	Fall Time	50u Sec
		Pw	Pulse Width	0.005

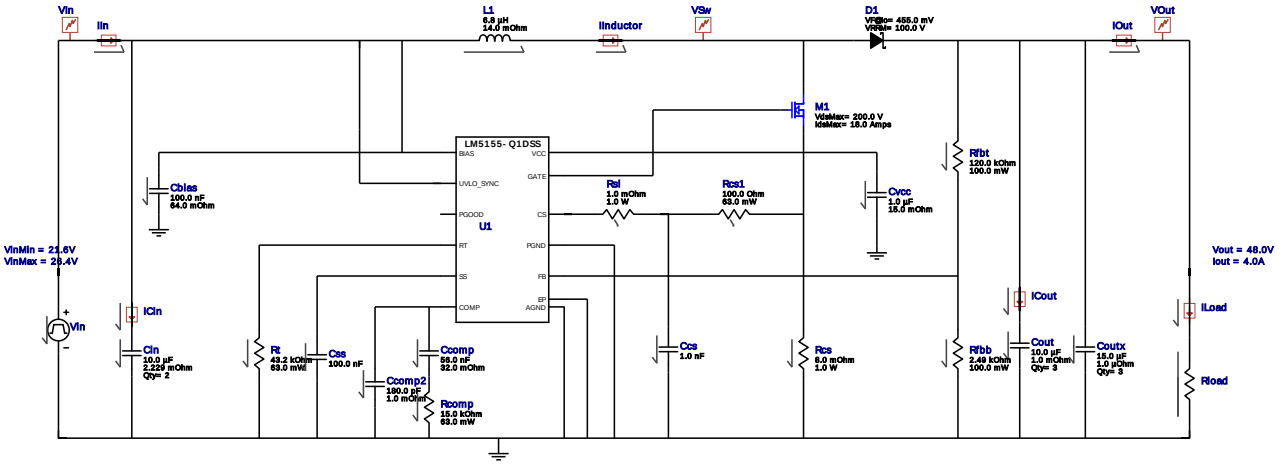




Design Id = 13179

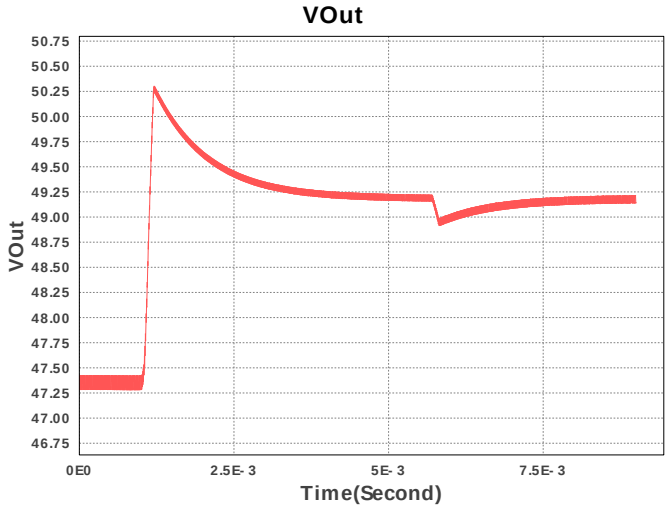
sim_id = 2

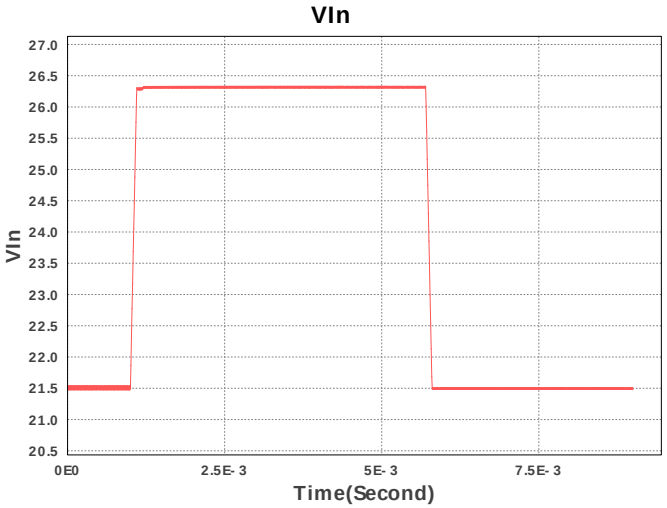
Simulation Type = Input Transient



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	L1	IC	Initial Current	Inductor_IC A
2.	Cout	IC	Initital Voltage	48.0 V
3.	Css	IC	Initial condition	1
4.	Cvcc	IC	Initial condition	5
5.	Rload	R	Load Resistance	12.0

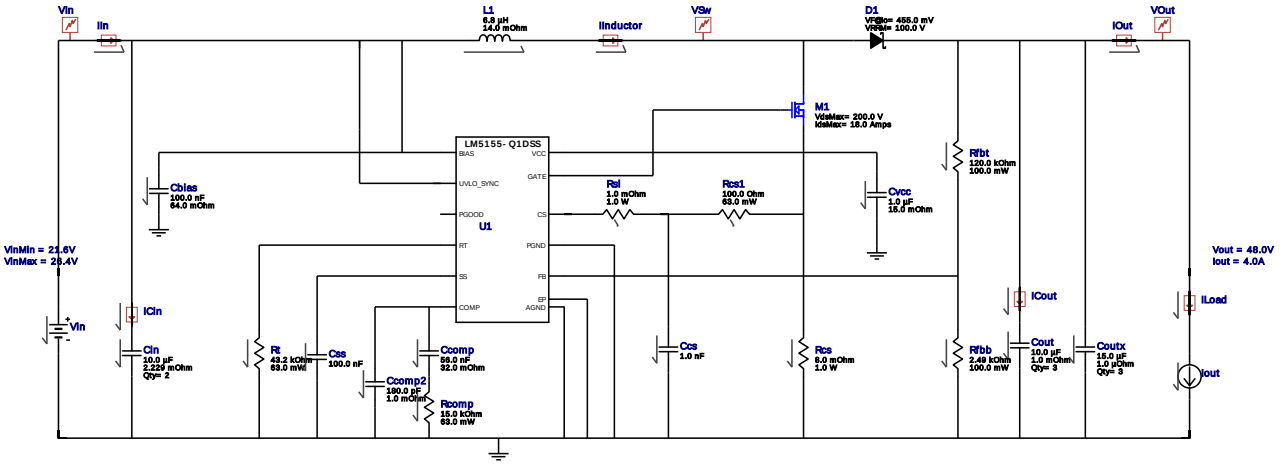




Design Id = 13179

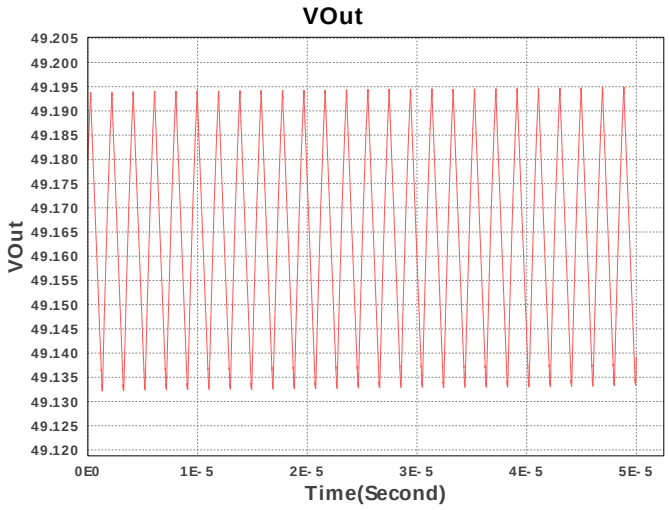
sim_id = 3

Simulation Type = Steady State



Simulation Parameters

#	Name	Parameter Name	Description	Values
1.	L1	IC	Initital Current	Inductor_IC A
2.	Ccomp	IC	no description	0.5
3.	Ccomp2	IC	IC	0.5 V
4.	Cout	IC	Initial Voltage	48.0 V
5.	Css	IC	Initial condition	1
6.	Coutx	IC	IC	48.0
7.	Cin	IC	IC	21.6 V
8.	Cvcc	IC	Initial condition	5
9.	Iout	I	Load current	4.0 A



Design Assistance

1. Master key : 1B0CCE6EBD53FA1F[v1]
2. **LM5155** Product Folder : http://www.ti.com/product/LM5155 : contains the data sheet and other resources.