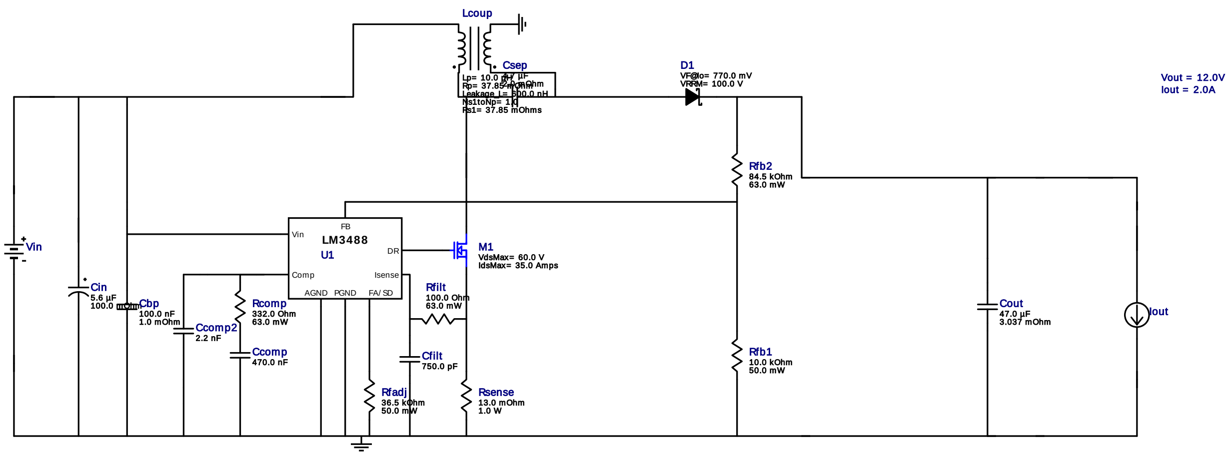
TEXAS INSTRUMENTS

WEBENCH ® Design Report

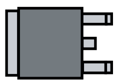
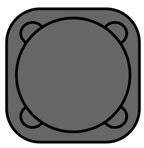
VinMin = 11.0V
VinMax = 17.0V
Vout = 12.0V
Iout = 2.0A

Device = LM3488MMX/NOPB
Topology = SEPIC
Created = 2020-03-11 19:13:59.649
BOM Cost = $NaN
BOM Count = 7
Total Pd =

Design : 4 LM3488MMX/NOPB
LM3488MMX/NOPB 11V-17V to 12.00V @ 2A

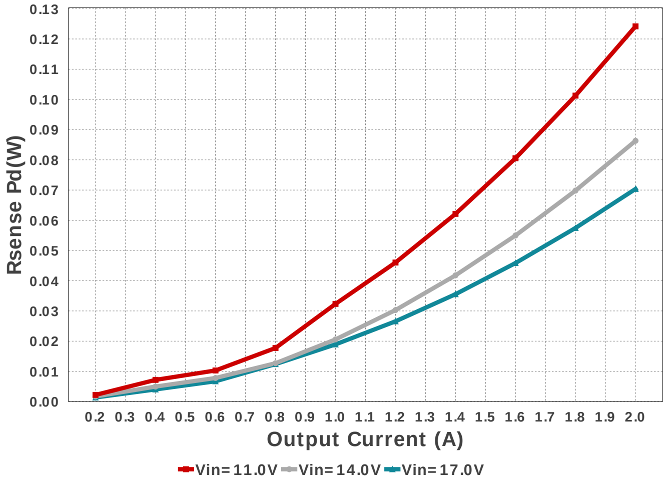


Electrical BOM

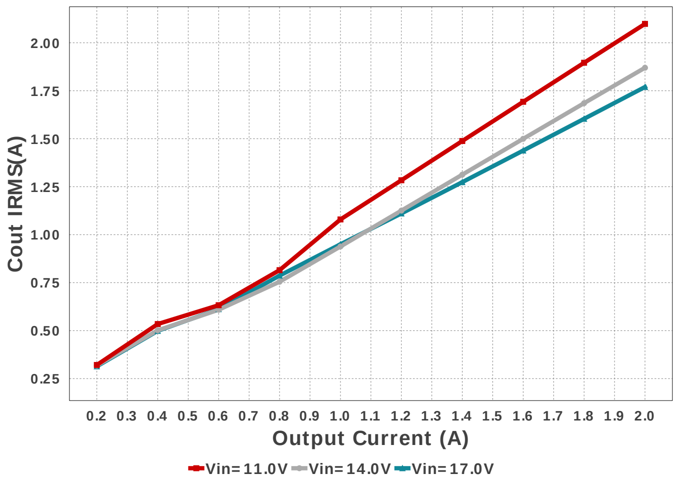
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cbp	Yageo	CC0805KRX7R9BB104 Series= X7R	Cap= 100.0 nF ESR= 1.0 mOhm VDC= 50.0 V IRMS= 0.0 A	1	$0.02	0805 7 mm²
Ccomp	Panasonic	ECPU1C474MA5 Series= ECPU(A)	Cap= 470.0 nF VDC= 16.0 V IRMS= 0.0 A	1	$0.20	 1206 11 mm²
Ccomp2	Samsung Electro-Mechanics	CL21C222JBFNNNE Series= C0G/NP0	Cap= 2.2 nF VDC= 50.0 V IRMS= 0.0 A	1	$0.03	0805 7 mm²
Cfilt	Samsung Electro-Mechanics	CL10C751JB8NNNC Series= C0G/NP0	Cap= 750.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.02	0603 5 mm²
Cin	Panasonic	25TQC5R6M Series= TQC	Cap= 5.6 uF ESR= 100.0 mOhm VDC= 25.0 V IRMS= 800.0 mA	1	$0.61	 3528-21 17 mm²
Cout	MuRata	GRM32ER61C476ME15L Series= X5R	Cap= 47.0 uF ESR= 3.037 mOhm VDC= 16.0 V IRMS= 4.59346 A	1	$0.38	1210_280 15 mm²
Csep	MuRata	GRM21BR61E475MA12L Series= X5R	Cap= 4.7 uF ESR= 2.0 mOhm VDC= 25.0 V IRMS= 7.29 A	1	$0.06	0805 7 mm²
D1	Vishay-Semiconductor	50WQ10FNPBF	VF@Io= 770.0 mV VRRM= 100.0 V	1	$0.80	 DPAK 102 mm²
Lcoup	Coiltronics	DRQ125-100-R	Lp= 10.0 µH Rp= 37.85 mOhm Leakage_L= 600.0 nH Ns1toNp= 1.0 Rs1= 37.85 mOhms	1	$0.91	 DRQ125 210 mm²

Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
M1	Texas Instruments	CSD18543Q3A	VdsMax= 60.0 V IdsMax= 35.0 Amps	1	$0.25	DNH0008A 18 mm²
Rcomp	Vishay-Dale	CRCW0402332RFKED Series= CRCW..e3	Res= 332.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rfadj	Yageo	RC0201FR-0736K5L Series= ?	Res= 36.5 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm²
Rfb1	Yageo	RC0201FR-0710KL Series= ?	Res= 10.0 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm²
Rfb2	Vishay-Dale	CRCW040284K5FKED Series= CRCW..e3	Res= 84.5 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rfilt	Vishay-Dale	CRCW0402100RFKED Series= CRCW..e3	Res= 100.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
Rsense	Susumu Co Ltd	PRL1632-R013-F-T1 Series= PRL1632	Res= 13.0 mOhm Power= 1.0 W Tolerance= 1.0%	1	$0.20	0612 11 mm²
U1	Texas Instruments	LM3488MMX/NOPB	Switcher	1	$0.83	MUA08A 24 mm²

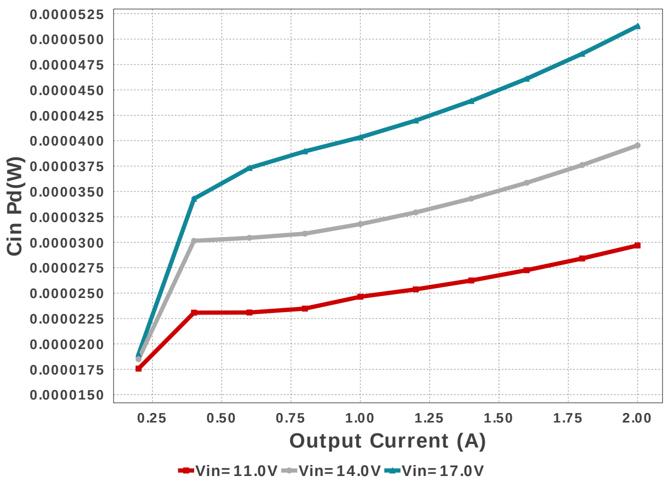
Rsense Pd



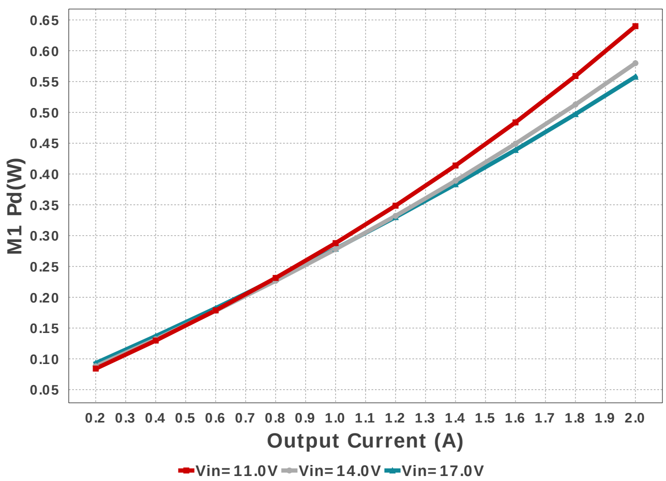
Cout IRMS



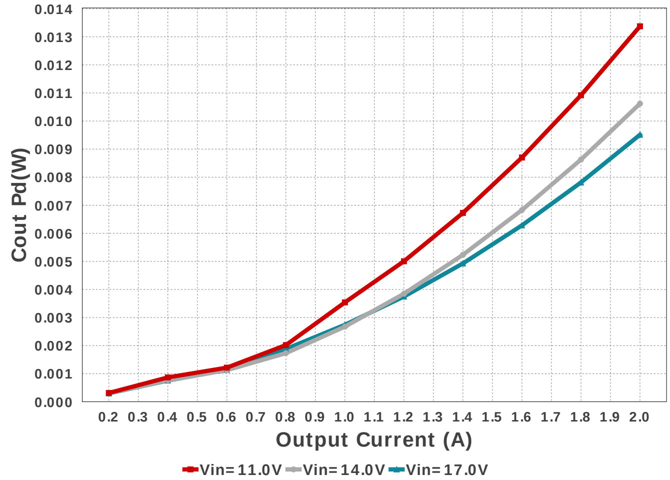
Cin Pd



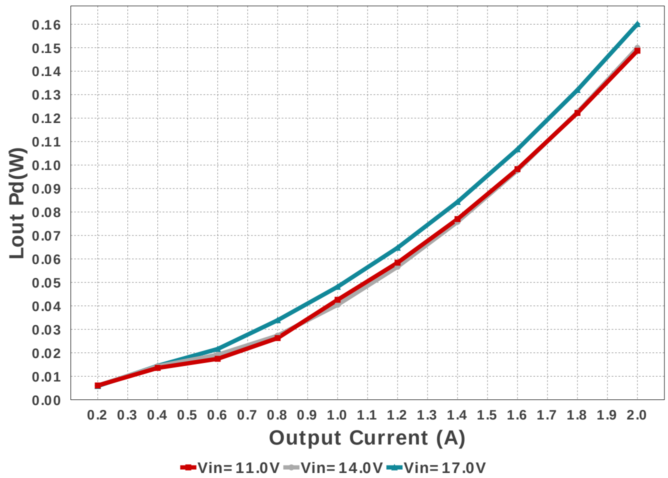
M1 Pd



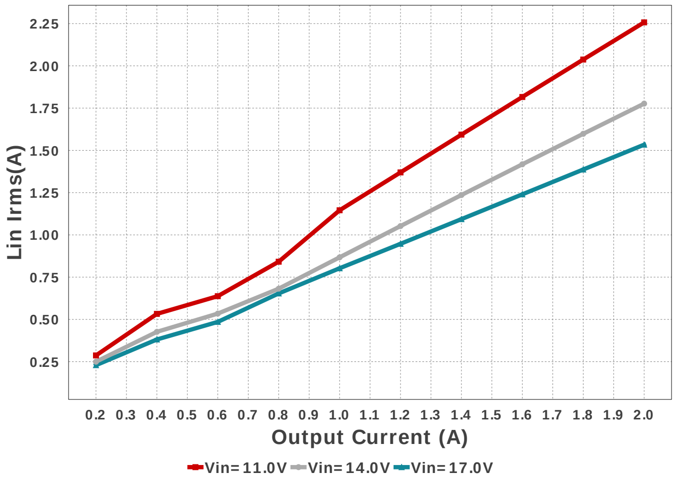
Cout Pd



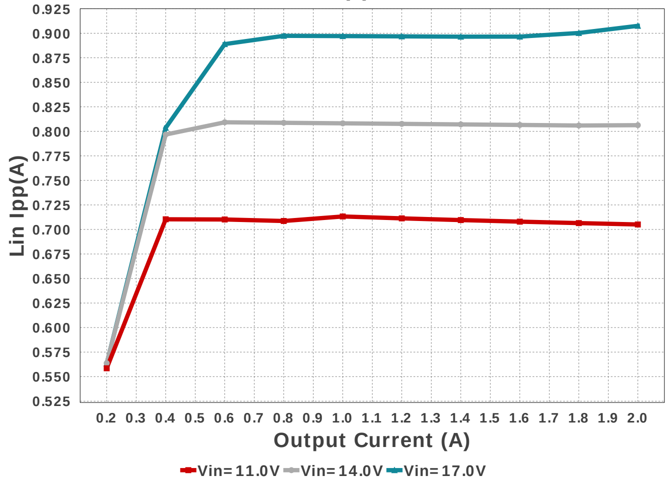
Lout Pd



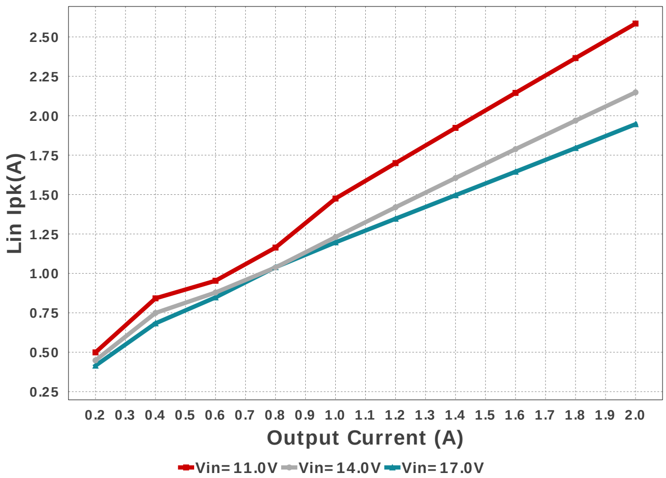
Lin Irms



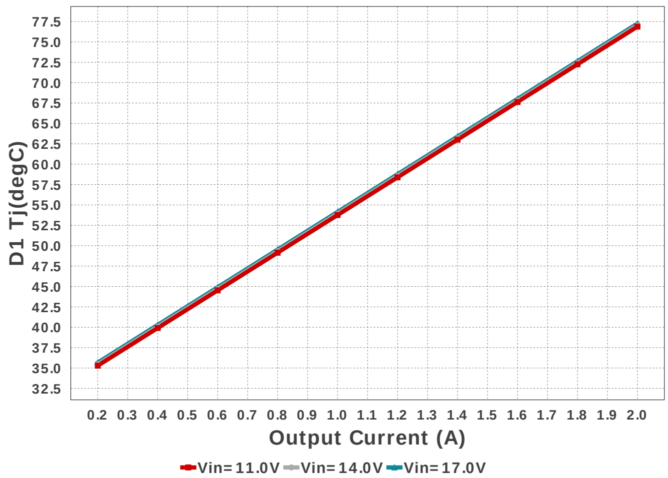
Lin Ipp



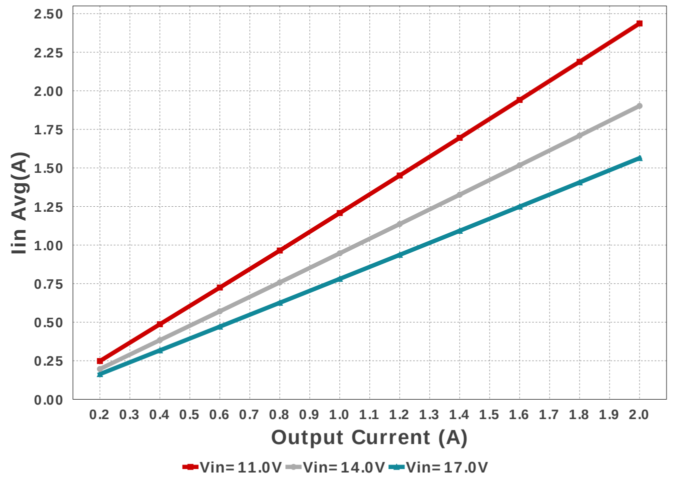
Lin Ipk



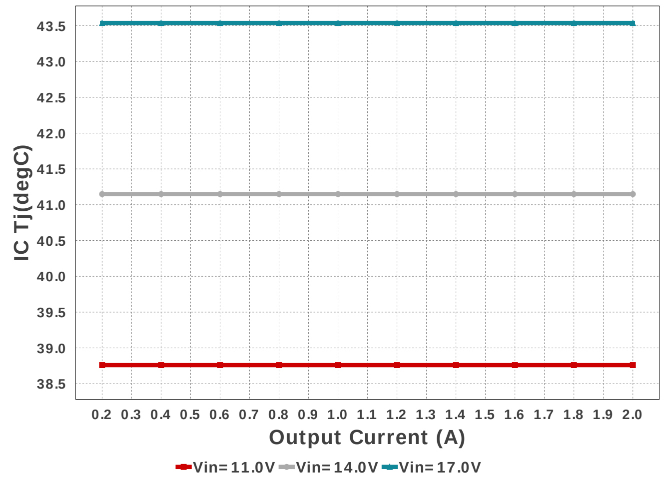
D1 Tj



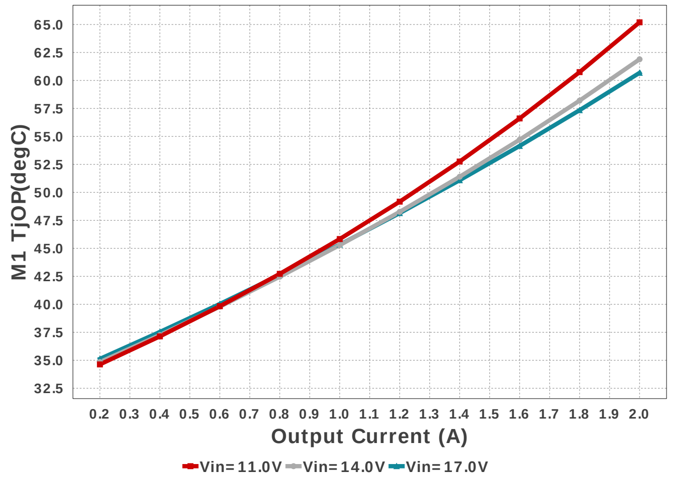
Iin Avg



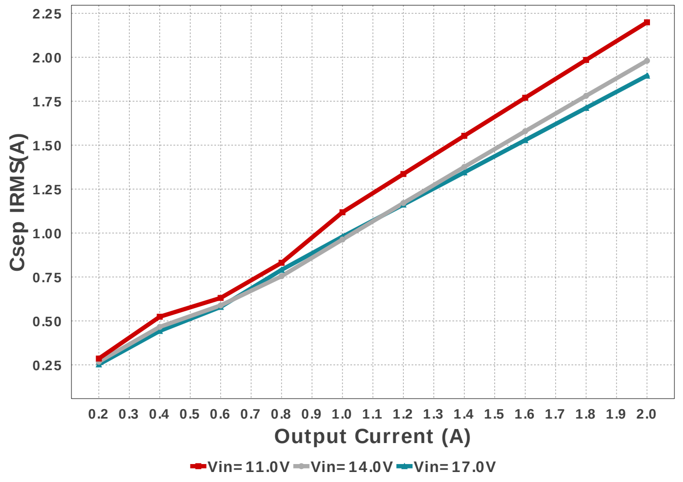
IC Tj



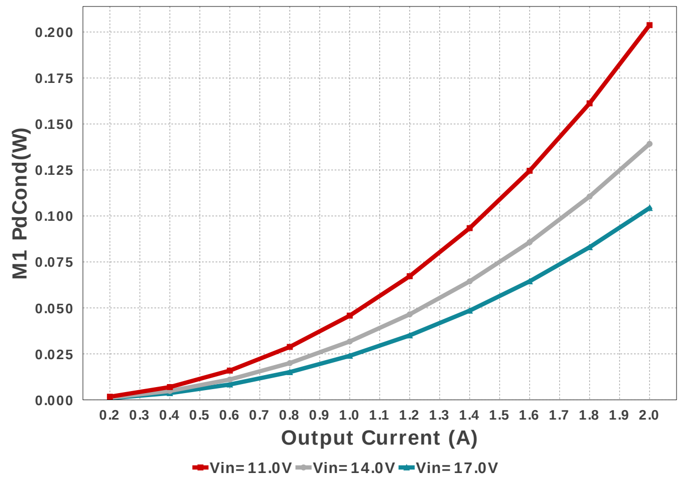
M1 TjOP



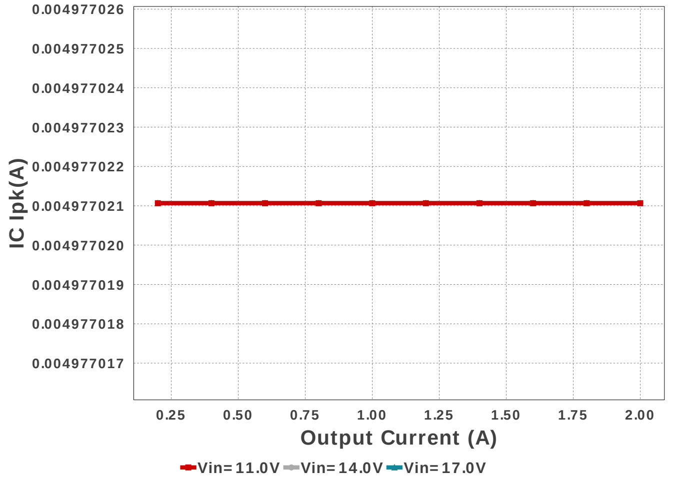
Csep IRMS

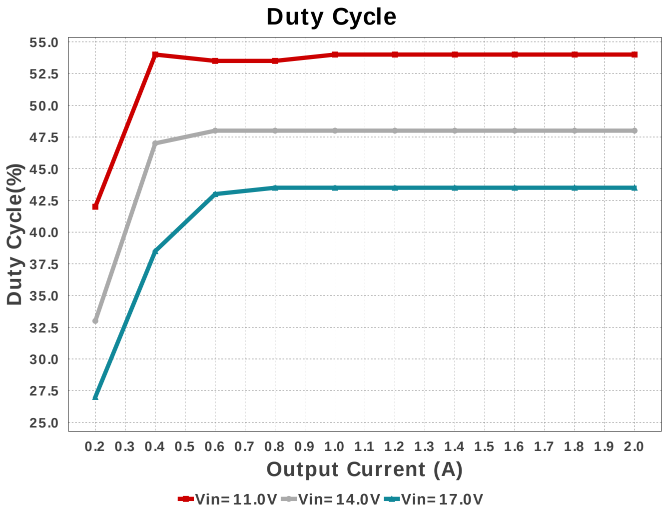


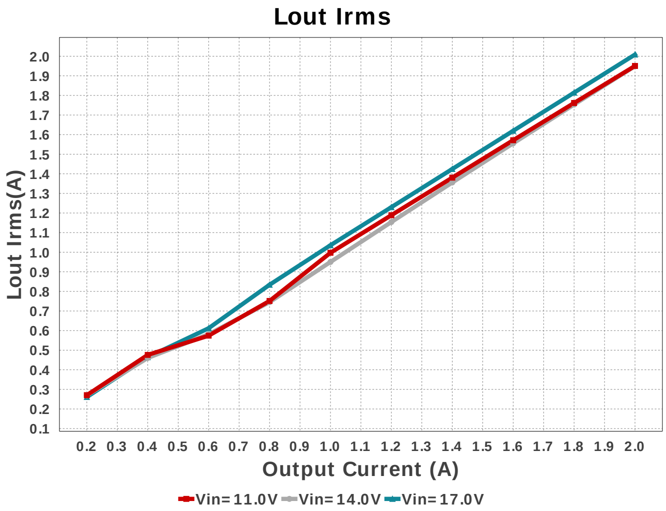
M1 PdCond

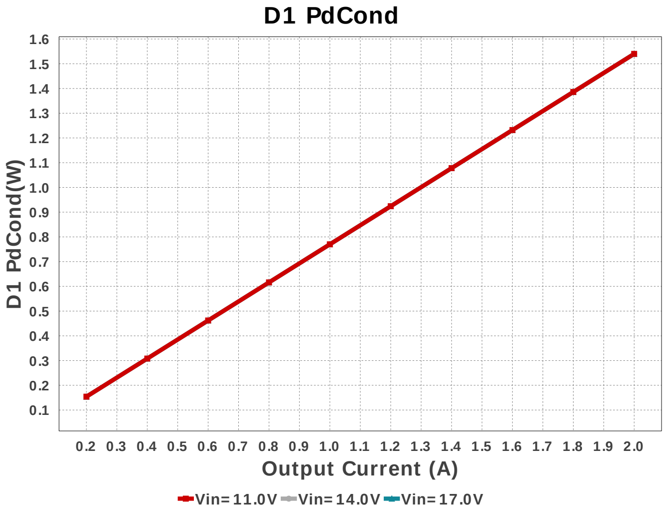


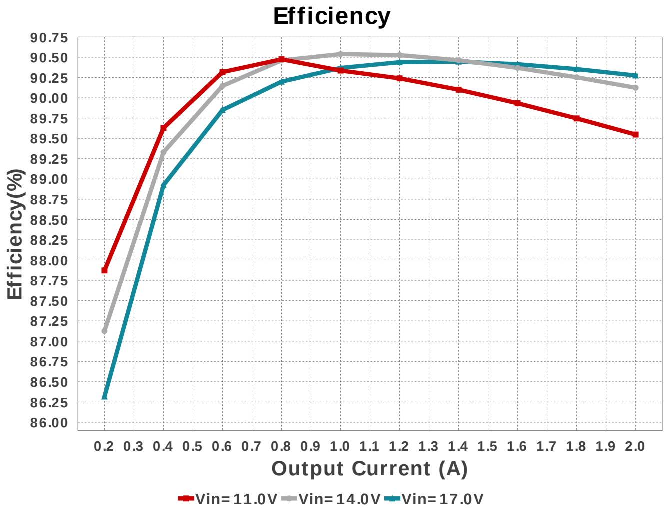
IC Ipk

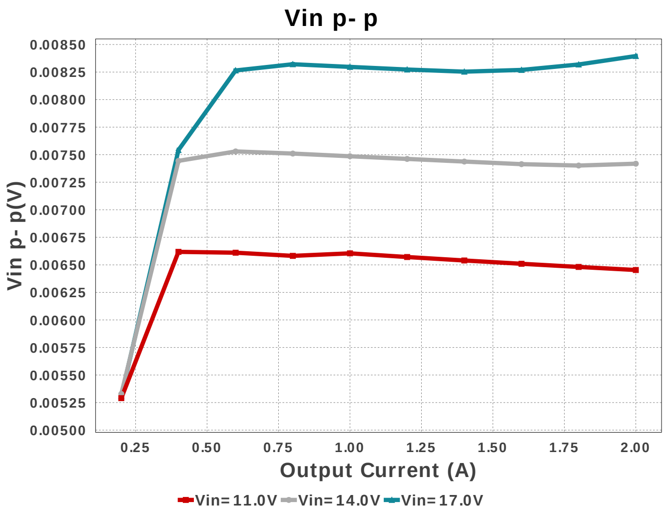


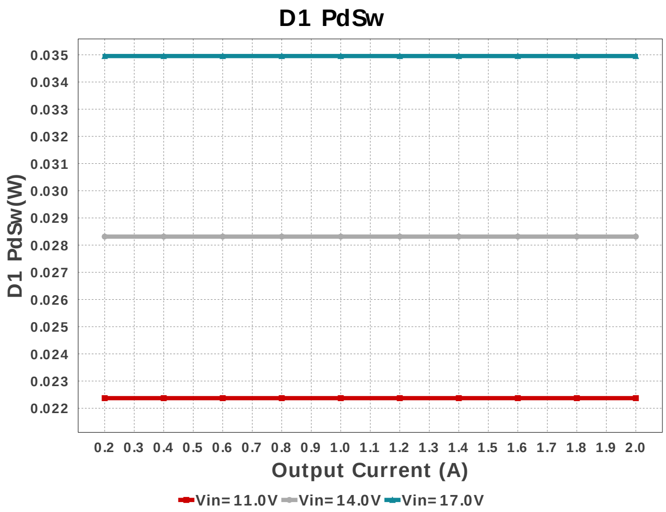

Duty Cycle
Duty Cycle(%)
55.0 52.5 50.0 47.5 45.0 42.5 40.0 37.5 35.0 32.5 30.0 27.5 25.0
0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2.0
Output Current (A)
Vin=11.0V Vin=14.0V Vin=17.0V

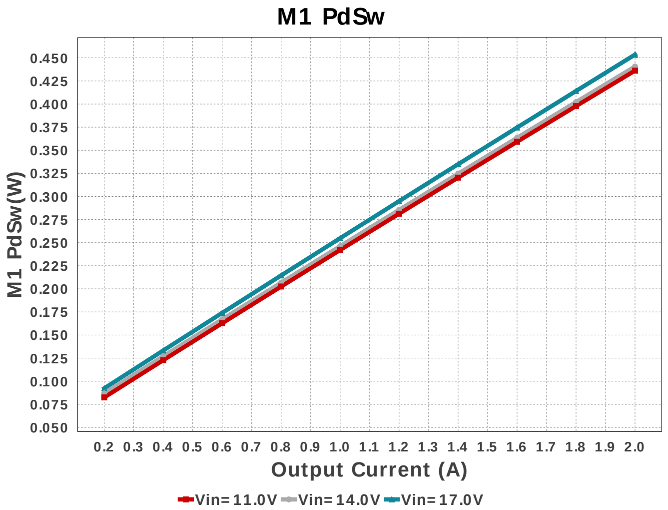

Lout Irms
Lout Irms(A)
2.0 1.9 1.8 1.7 1.6 1.5 1.4 1.3 1.2 1.1 1.0 0.9 0.8 0.7 0.6 0.5 0.4 0.3 0.2 0.1
0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2.0
Output Current (A)
Vin=11.0V Vin=14.0V Vin=17.0V

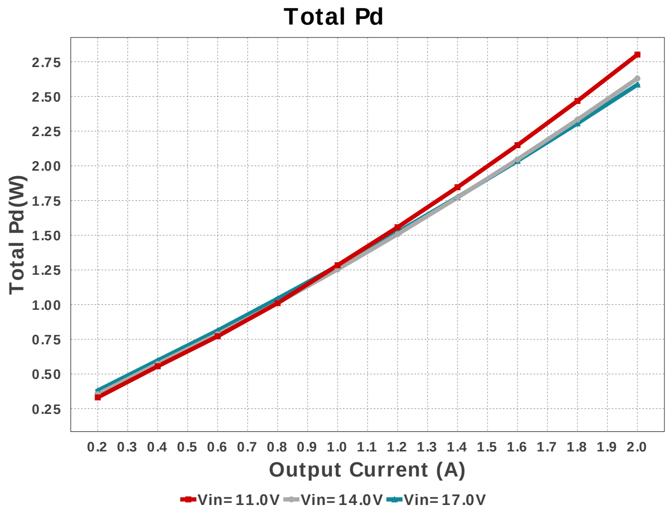

D1 PdCond
D1 PdCond(W)
1.6 1.5 1.4 1.3 1.2 1.1 1.0 0.9 0.8 0.7 0.6 0.5 0.4 0.3 0.2 0.1
0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2.0
Output Current (A)
Vin=11.0V Vin=14.0V Vin=17.0V

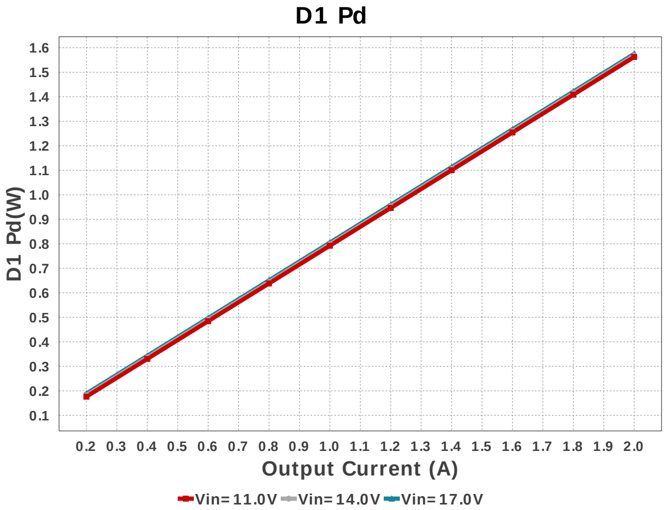

Efficiency
Efficiency(%)
90.75 90.50 90.25 90.00 89.75 89.50 89.25 89.00 88.75 88.50 88.25 88.00 87.75 87.50 87.25 87.00 86.75 86.50 86.25 86.00
0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2.0
Output Current (A)
Vin=11.0V Vin=14.0V Vin=17.0V

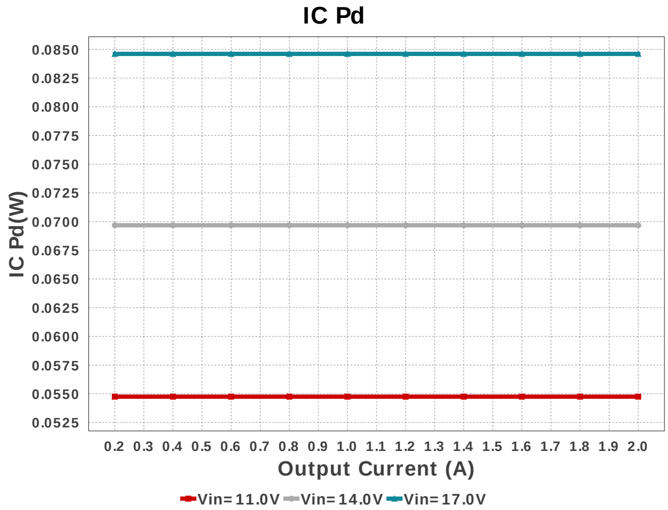

Vin p-p
Vin p-p(V)
0.00850 0.00825 0.00800 0.00775 0.00750 0.00725 0.00700 0.00675 0.00650 0.00625 0.00600 0.00575 0.00550 0.00525 0.00500
0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00
Output Current (A)
Vin=11.0V Vin=14.0V Vin=17.0V

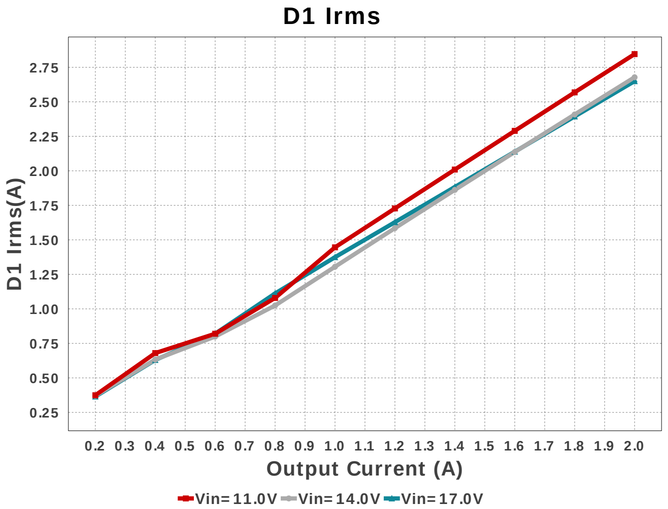

D1 PdSw
D1 PdSw(W)
0.035 0.034 0.033 0.032 0.031 0.030 0.029 0.028 0.027 0.026 0.025 0.024 0.023 0.022
0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2.0
Output Current (A)
Vin=11.0V Vin=14.0V Vin=17.0V

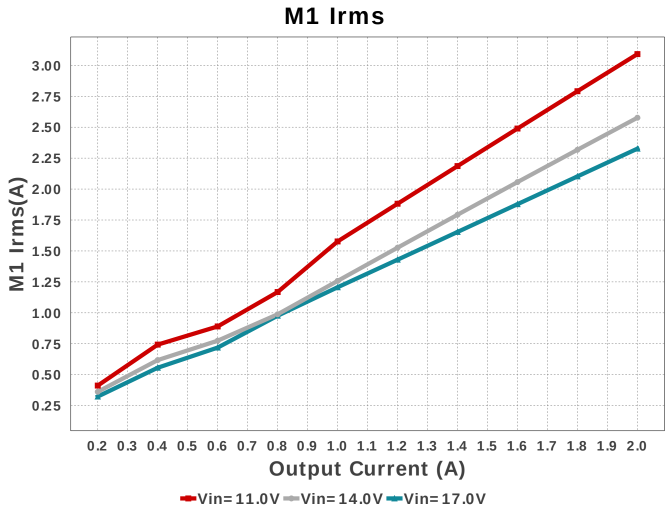

M1 PdSw
M1 PdSw(W)
Output Current (A)
Vin=11.0V Vin=14.0V Vin=17.0V

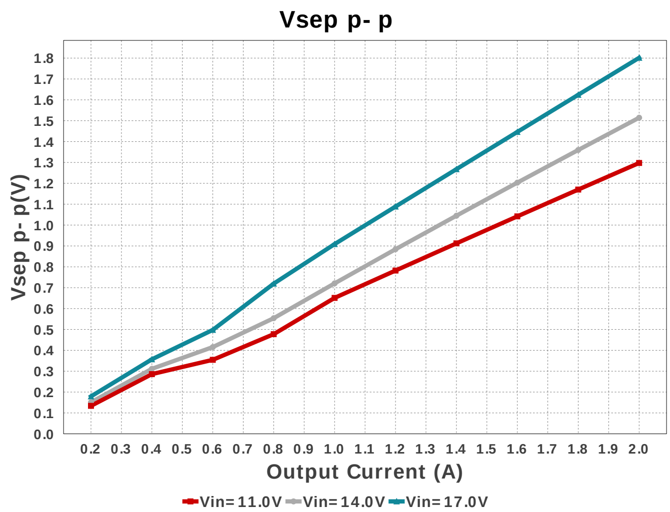

Total Pd
Total Pd(W)
Output Current (A)
Vin=11.0V Vin=14.0V Vin=17.0V

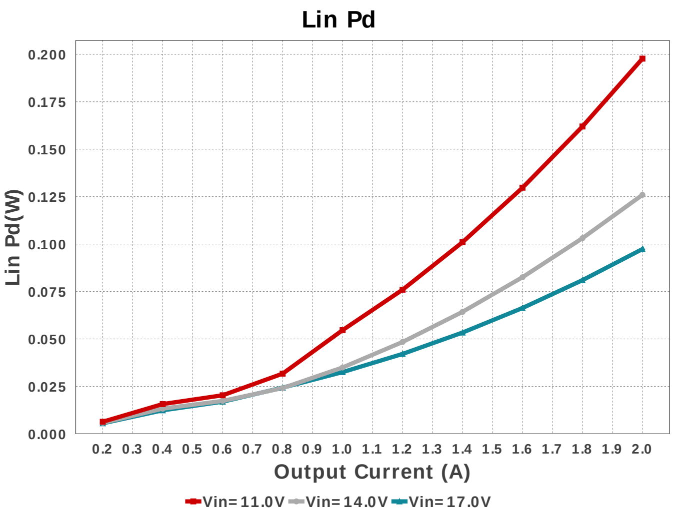

D1 Pd
D1 Pd(W)
Output Current (A)
Vin=11.0V Vin=14.0V Vin=17.0V

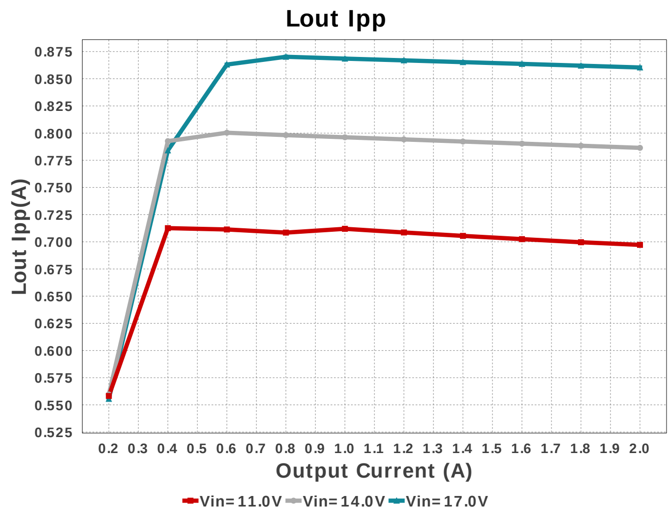

IC Pd
IC Pd(W)
Output Current (A)
Vin=11.0V Vin=14.0V Vin=17.0V

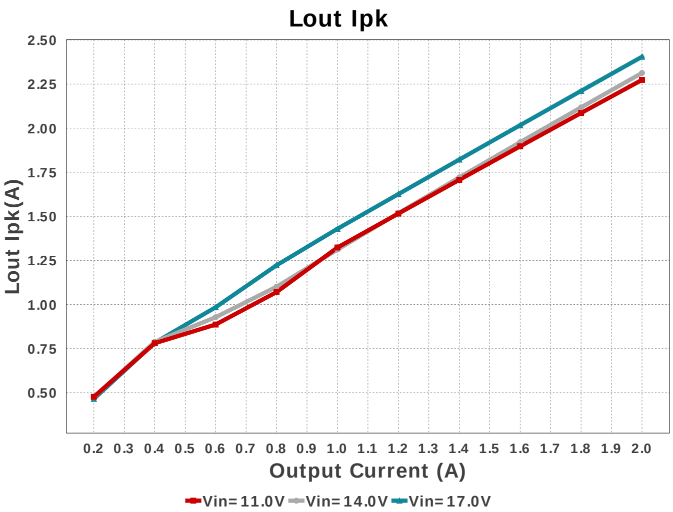

D1 Irms
D1 Irms(A)
Output Current (A)
Vin=11.0V Vin=14.0V Vin=17.0V

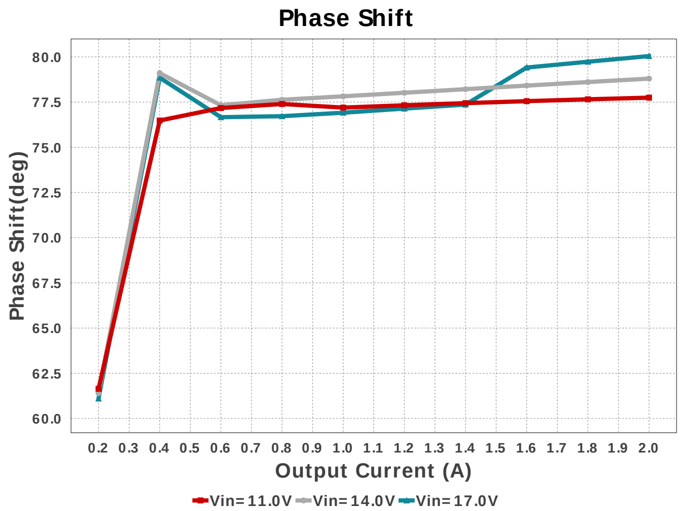

M1 Irms
M1 Irms(A)
Output Current (A)
Vin=11.0V Vin=14.0V Vin=17.0V

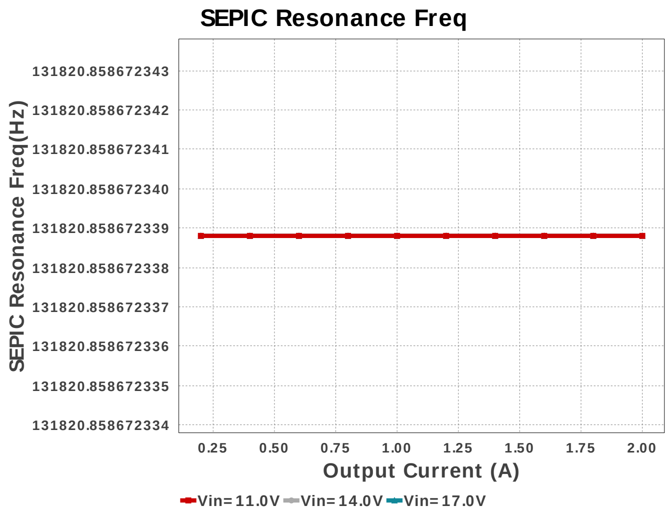

Vsep p- p
Vsep p- p(V)
Output Current (A)
Vin= 11.0V Vin= 14.0V Vin= 17.0V

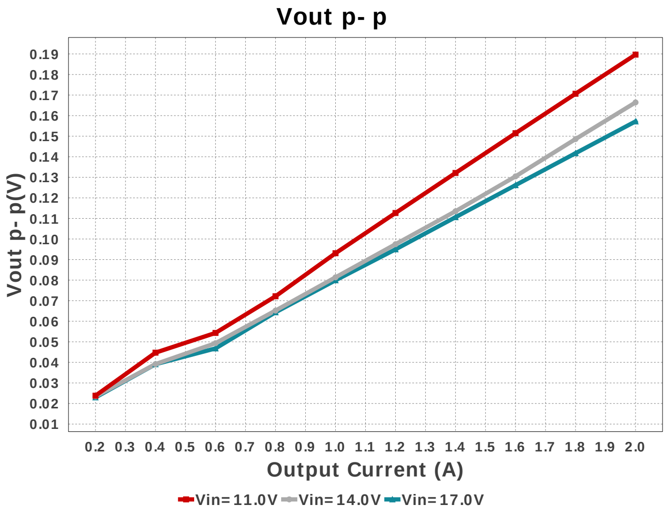

Lin Pd
Lin Pd(W)
Output Current (A)
Vin= 11.0V Vin= 14.0V Vin= 17.0V

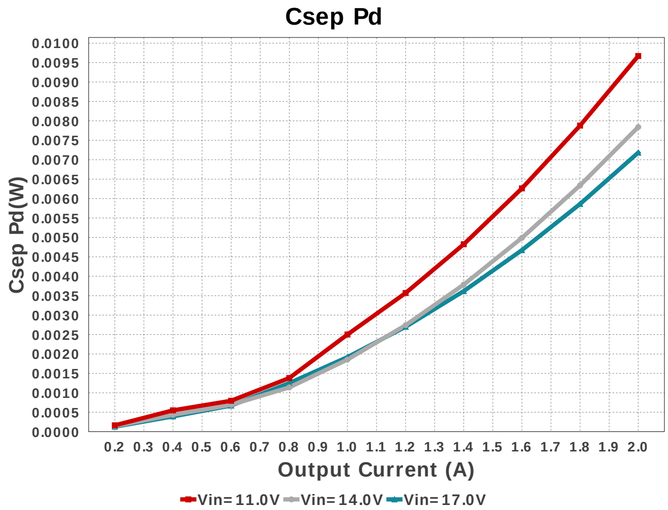

Lout Ipp
Lout Ipp(A)
Output Current (A)
Vin= 11.0V Vin= 14.0V Vin= 17.0V

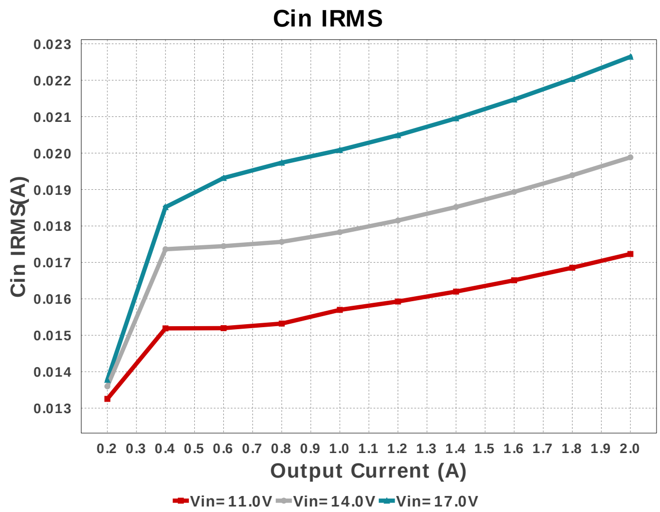

Lout Ipk
Lout Ipk(A)
Output Current (A)
Vin= 11.0V Vin= 14.0V Vin= 17.0V

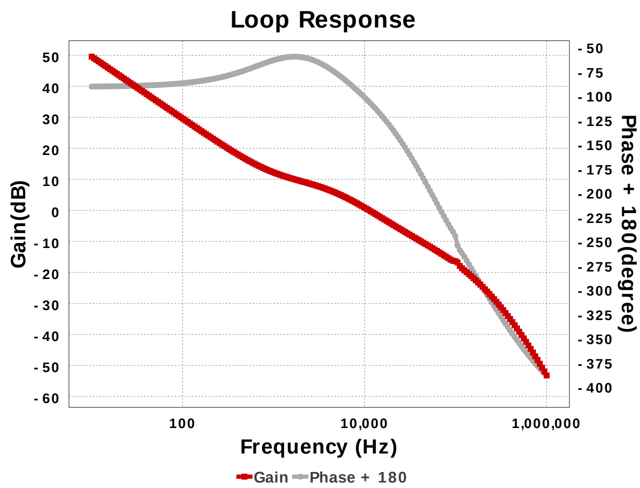

Phase Shift
Phase Shift(deg)
Output Current (A)
Vin= 11.0V Vin= 14.0V Vin= 17.0V


SEPIC Resonance Freq
SEPIC Resonance Freq(Hz)
Output Current (A)
Vin= 11.0V Vin= 14.0V Vin= 17.0V









Operating Values

#	Name	Value	Category	Description
1.	BOM Count	7	System Information	Total Design BOM count

Design Inputs

Name	Value	Description
Iout	2.0	Maximum Output Current
VinMax	17.0	Maximum input voltage
VinMin	11.0	Minimum input voltage
Vout	12.0	Output Voltage
base_pn	LM3488	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

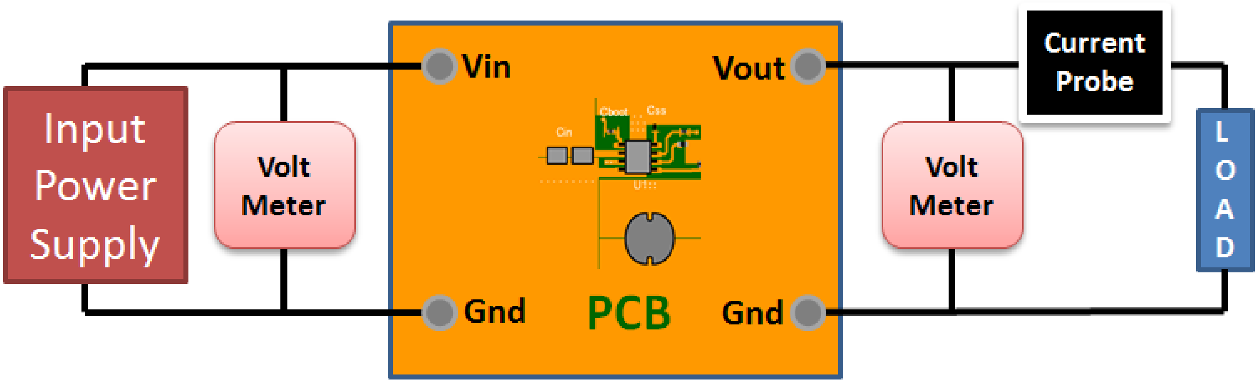
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 11.0V 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. Master key : 3ADD0724B632D79A[v1]

2. **LM3488** Product Folder : http://www.ti.com/product/LM3488 : contains the data sheet and other resources.

Important Notice and Disclaimer

TI provides technical and reliability data (including datasheets), design resources (including reference designs), application or other design advice, web tools, safety information, and other resources AS IS and with all faults, and disclaims all warranties. These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

Providing these resources does not expand or otherwise alter TI's applicable Terms of Sale or other applicable terms available either on ti.com or provided in conjunction with TI products.