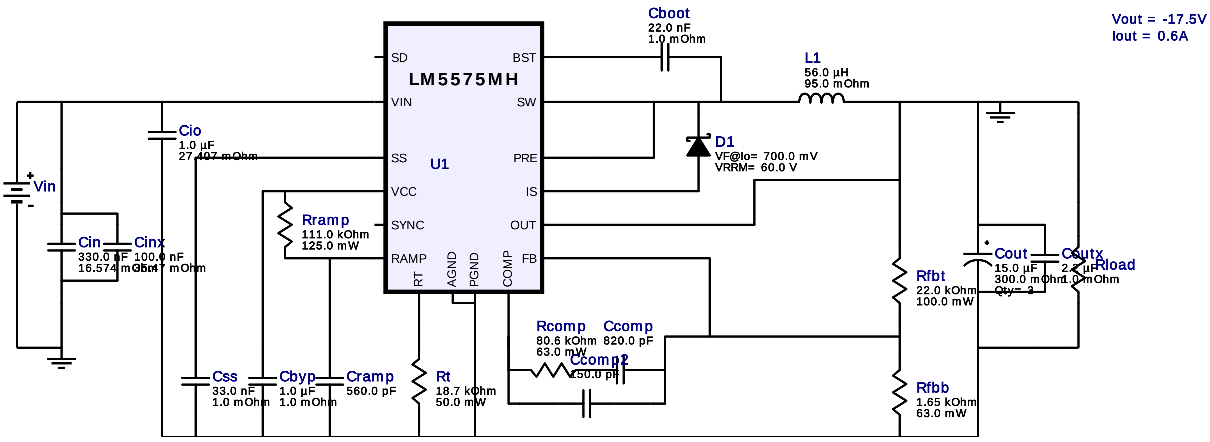
TEXAS INSTRUMENTS

WEBENCH ® Design Report

VinMin = 19.0V
VinMax = 21.0V
Vout = -17.5V
Iout = 0.6A

Device = LM5575MH/NOPB
Topology = Inverting_Buck_Boost
Created = 2026-02-05 21:39:40.977
BOM Cost = $4.45
BOM Count = 21
Total Pd = 1.29W

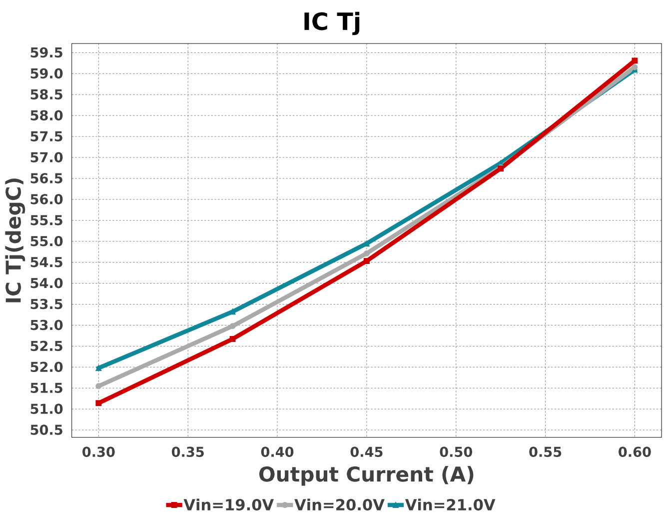
Design : 1 LM5575MH/NOPB
LM5575MH/NOPB 19V-21V to -17.50V @ 0.6A

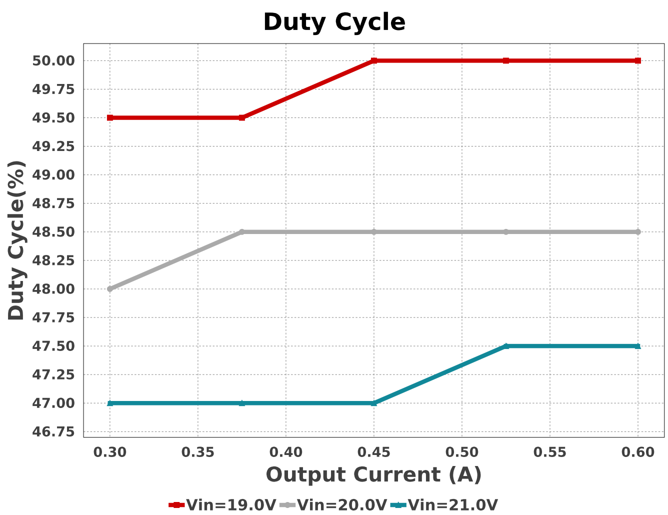


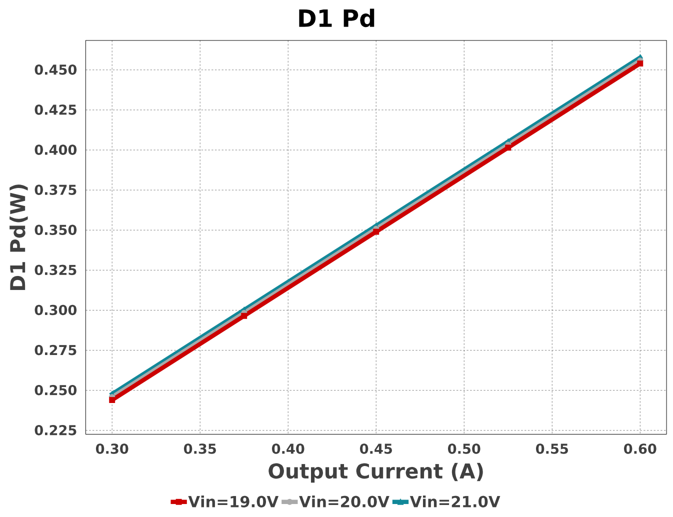
Electrical BOM

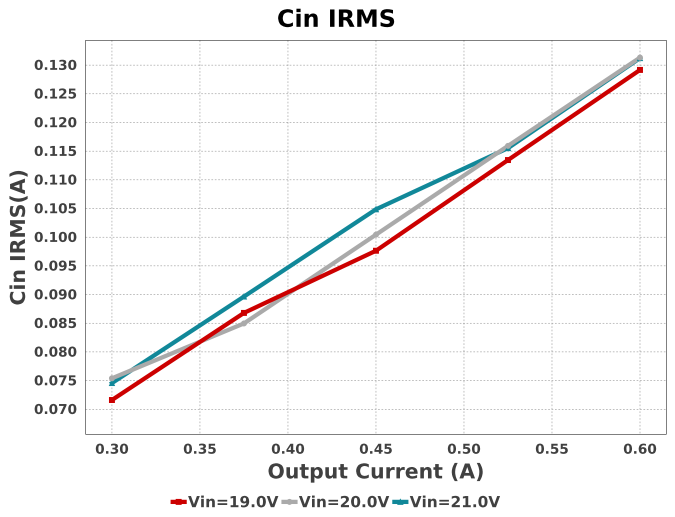
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cboot	MuRata	GRM155R71H223KA12D Series= X7R	Cap= 22.0 nF ESR= 1.0 mOhm VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
Cbyp	Taiyo Yuden	EMK107B7105KA-T Series= X7R	Cap= 1.0 uF ESR= 1.0 mOhm VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm²
Ccomp	Samsung Electro-Mechanics	CL05C821JB5NNNC Series= C0G/NP0	Cap= 820.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
Ccomp2	Taiyo Yuden	UMK105CG151JV-F Series= C0G/NP0	Cap= 150.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
Cin	TDK	C1608X5R1H334K080AB Series= X5R	Cap= 330.0 nF ESR= 16.574 mOhm VDC= 50.0 V IRMS= 1.28367 A	1	$0.03	0603 5 mm²
Cinx	Kemet	C0805C104M5RACTU Series= X7R	Cap= 100.0 nF ESR= 35.47 mOhm VDC= 50.0 V IRMS= 1.64 A	1	$0.01	0805 7 mm²
Cio	Taiyo Yuden	MSASH31LSB5105MTNA01 Series= X5R	Cap= 1.0 uF ESR= 27.407 mOhm VDC= 100.0 V IRMS= 1.53483 A	1	$0.09	1206 11 mm²
Cout	Vishay-Sprague	593D156X9035D2TE3 Series= 593D	Cap= 15.0 uF ESR= 300.0 mOhm VDC= 35.0 V IRMS= 710.0 mA	3	$0.37	7343-31 59 mm²
Coutx	TDK	C1005X5R1V225K050BC Series= X5R	Cap= 2.2 uF ESR= 1.0 mOhm VDC= 35.0 V IRMS= 0.0 A	1	$0.06	0402_065 3 mm²

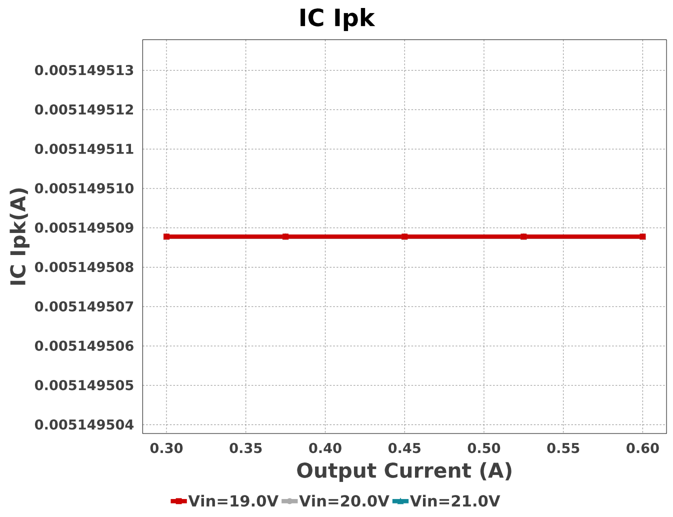
Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
Cramp	MuRata	GRM1555C1H561JA01J Series= C0G/NP0	Cap= 560.0 pF VDC= 50.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
Css	MuRata	GRM155R71E333KA88D Series= X7R	Cap= 33.0 nF ESR= 1.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm^2
D1	Fairchild Semiconductor	SS26FL	VF@Io= 700.0 mV VRRM= 60.0 V	1	$0.11	SOD-123F 12 mm^2
L1	Bourns	SDR1307-560KL	L= 56.0 µH 95.0 mOhm	1	$0.51	SDR1307 226 mm^2
Rcomp	Vishay-Dale	CRCW040280K6FKED Series= CRCW..e3	Res= 80.6 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rfbb	Vishay-Dale	CRCW04021K65FKED Series= CRCW..e3	Res= 1.65 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
Rfbt	Yageo	RC0603FR-0722KL Series= ?	Res= 22.0 kOhm Power= 100.0 mW Tolerance= 1.0%	1	$0.01	0603 5 mm^2
Rramp	Yageo	RT0805BRD07111KL Series= RT0805	Res= 111.0 kOhm Power= 125.0 mW Tolerance= 0.1%	1	$0.05	0805 7 mm^2
Rt	Yageo	RC0201FR-0718K7L Series= ?	Res= 18.7 kOhm Power= 50.0 mW Tolerance= 1.0%	1	$0.01	0201 2 mm^2
U1	Texas Instruments	LM5575MH/NOPB	Switcher	1	$2.38	MXA16A 59 mm^2

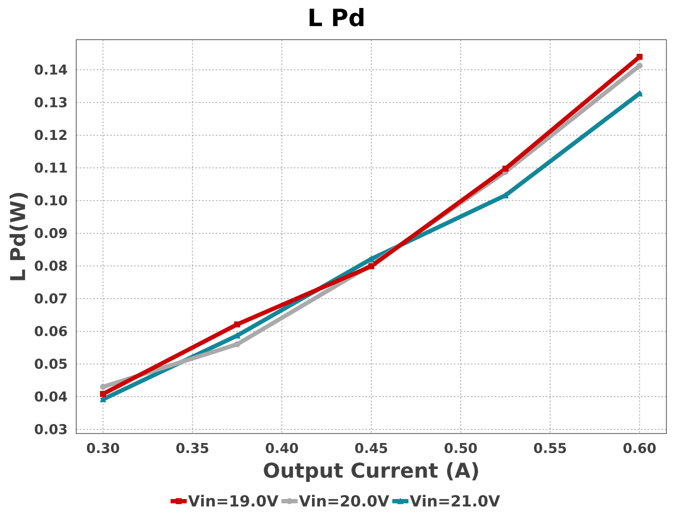


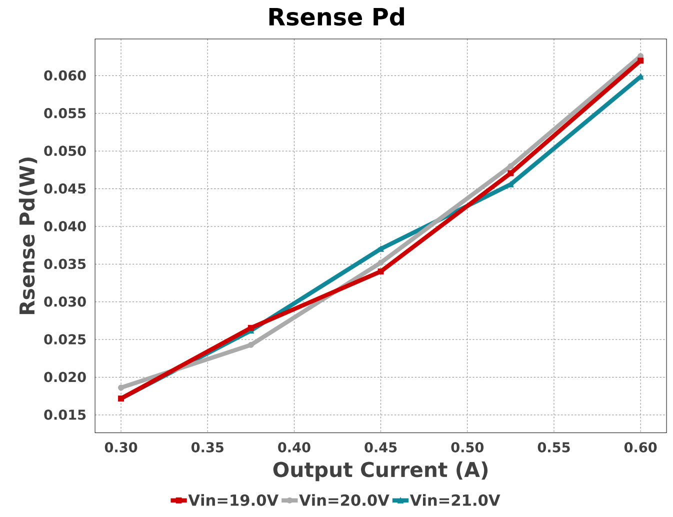


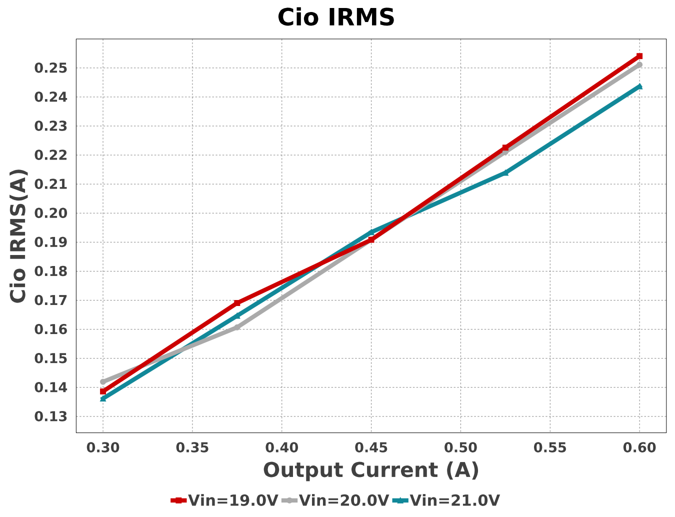

D1 Pd
D1 Pd(W)
0.450
0.425
0.400
0.375
0.350
0.325
0.300
0.275
0.250
0.225
0.30
0.35
0.40
0.45
0.50
0.55
0.60
Output Current (A)
Vin=19.0V
Vin=20.0V
Vin=21.0V

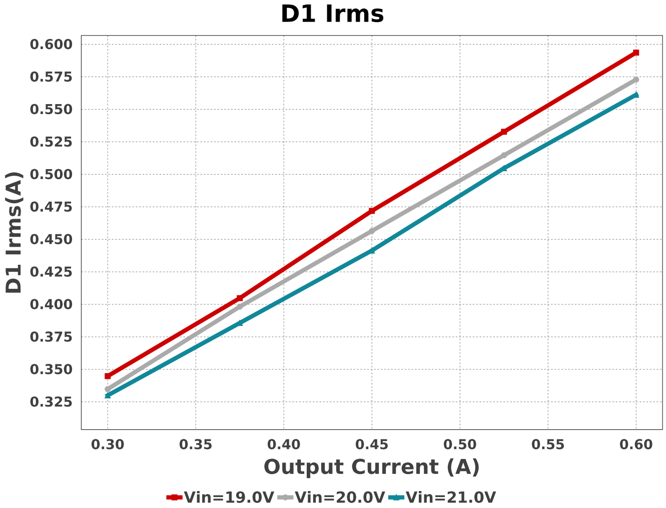

Cin IRMS
Cin IRMS(A)
0.130
0.125
0.120
0.115
0.110
0.105
0.100
0.095
0.090
0.085
0.080
0.075
0.070
0.30
0.35
0.40
0.45
0.50
0.55
0.60
Output Current (A)
Vin=19.0V
Vin=20.0V
Vin=21.0V

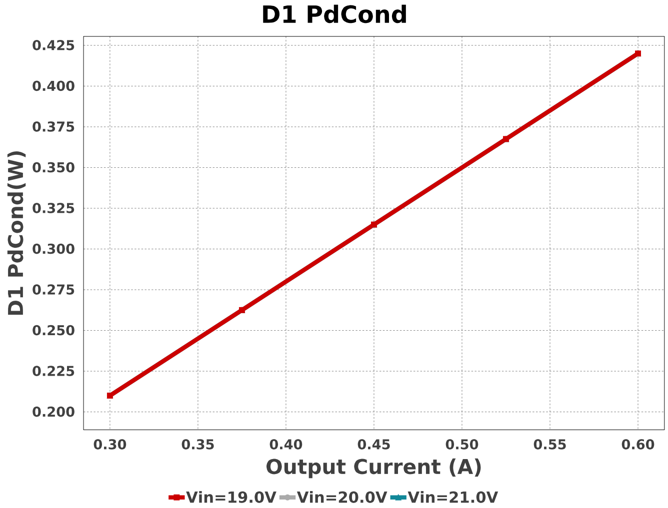

IC Ipk
IC Ipk(A)
0.005149513
0.005149512
0.005149511
0.005149510
0.005149509
0.005149508
0.005149507
0.005149506
0.005149505
0.005149504
0.30
0.35
0.40
0.45
0.50
0.55
0.60
Output Current (A)
Vin=19.0V
Vin=20.0V
Vin=21.0V

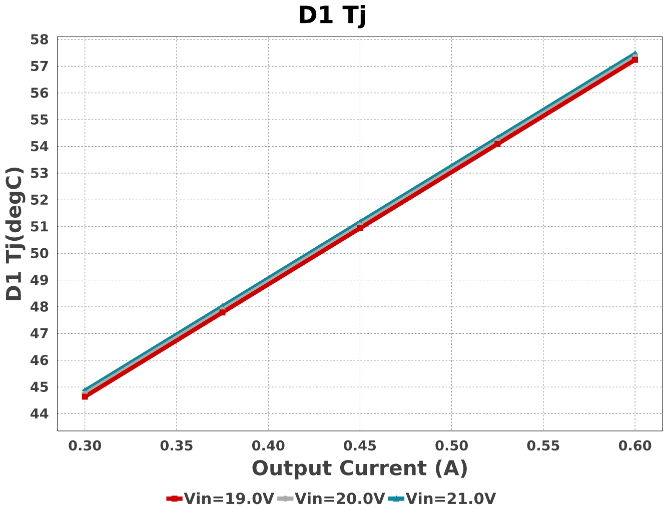

L Pd
L Pd(W)
0.14
0.13
0.12
0.11
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.30
0.35
0.40
0.45
0.50
0.55
0.60
Output Current (A)
Vin=19.0V
Vin=20.0V
Vin=21.0V

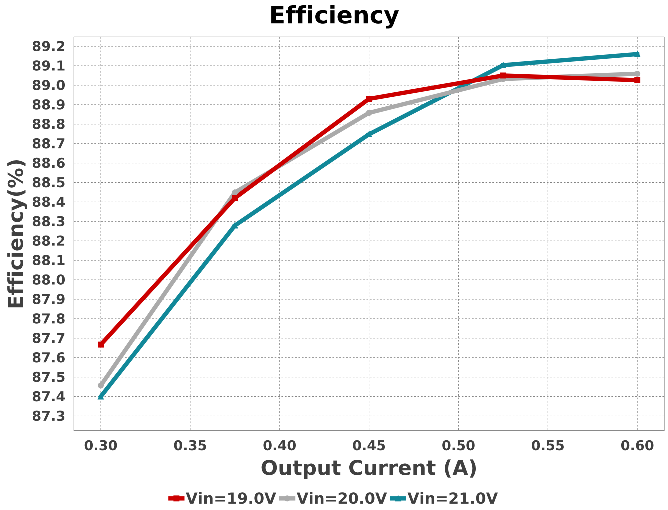

Rsense Pd
Rsense Pd(W)
0.060
0.055
0.050
0.045
0.040
0.035
0.030
0.025
0.020
0.015
0.30
0.35
0.40
0.45
0.50
0.55
0.60
Output Current (A)
Vin=19.0V
Vin=20.0V
Vin=21.0V

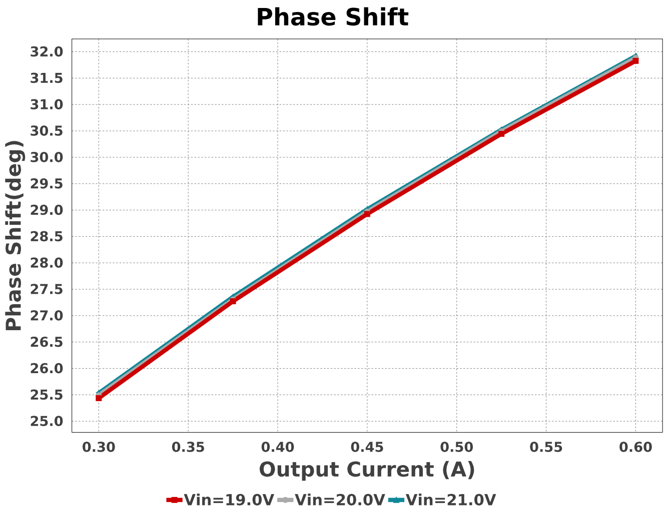

Cio IRMS
Cio IRMS(A)
0.25
0.24
0.23
0.22
0.21
0.20
0.19
0.18
0.17
0.16
0.15
0.14
0.13
0.30
0.35
0.40
0.45
0.50
0.55
0.60
Output Current (A)
Vin=19.0V
Vin=20.0V
Vin=21.0V

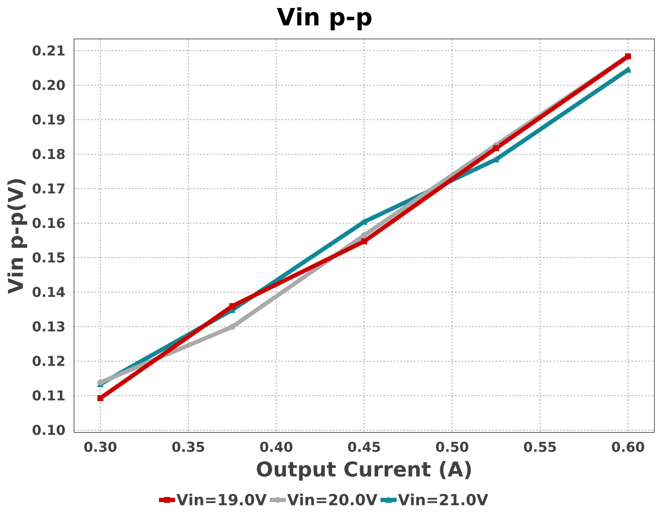

D1 Irms
D1 Irms(A)
0.600
0.575
0.550
0.525
0.500
0.475
0.450
0.425
0.400
0.375
0.350
0.325
0.30
0.35
0.40
0.45
0.50
0.55
0.60
Output Current (A)
Vin=19.0V
Vin=20.0V
Vin=21.0V


D1 PdCond
D1 PdCond(W)
0.425
0.400
0.375
0.350
0.325
0.300
0.275
0.250
0.225
0.200
0.30
0.35
0.40
0.45
0.50
0.55
0.60
Output Current (A)
Vin=19.0V
Vin=20.0V
Vin=21.0V

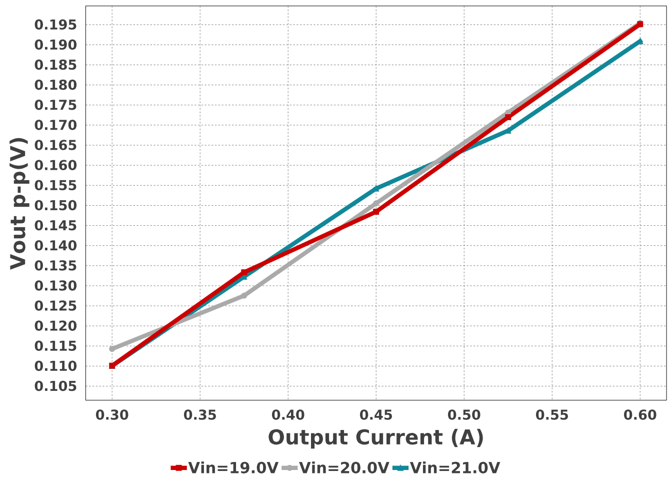

D1 Tj
D1 Tj(degC)
58
57
56
55
54
53
52
51
50
49
48
47
46
45
44
0.30
0.35
0.40
0.45
0.50
0.55
0.60
Output Current (A)
Vin=19.0V
Vin=20.0V
Vin=21.0V


Efficiency
Efficiency(%)
89.2
89.1
89.0
88.9
88.8
88.7
88.6
88.5
88.4
88.3
88.2
88.1
88.0
87.9
87.8
87.7
87.6
87.5
87.4
87.3
0.30
0.35
0.40
0.45
0.50
0.55
0.60
Output Current (A)
Vin=19.0V
Vin=20.0V
Vin=21.0V

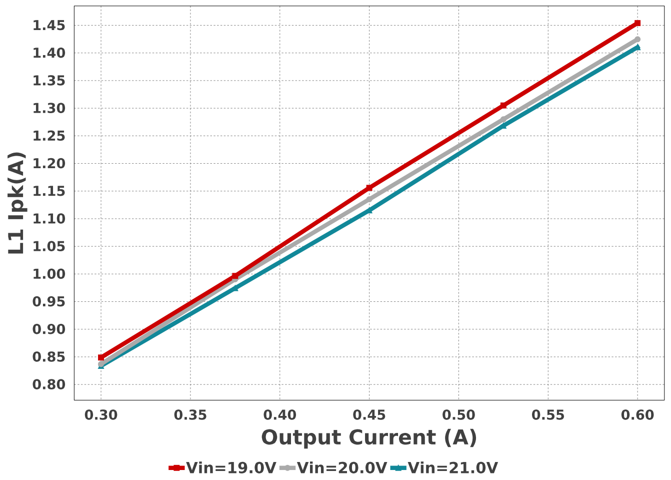

Phase Shift
Phase Shift(deg)
32.0
31.5
31.0
30.5
30.0
29.5
29.0
28.5
28.0
27.5
27.0
26.5
26.0
25.5
25.0
0.30
0.35
0.40
0.45
0.50
0.55
0.60
Output Current (A)
Vin=19.0V
Vin=20.0V
Vin=21.0V


Vin p-p
Vin p-p(V)
0.21
0.20
0.19
0.18
0.17
0.16
0.15
0.14
0.13
0.12
0.11
0.10
0.30
0.35
0.40
0.45
0.50
0.55
0.60
Output Current (A)
Vin=19.0V
Vin=20.0V
Vin=21.0V

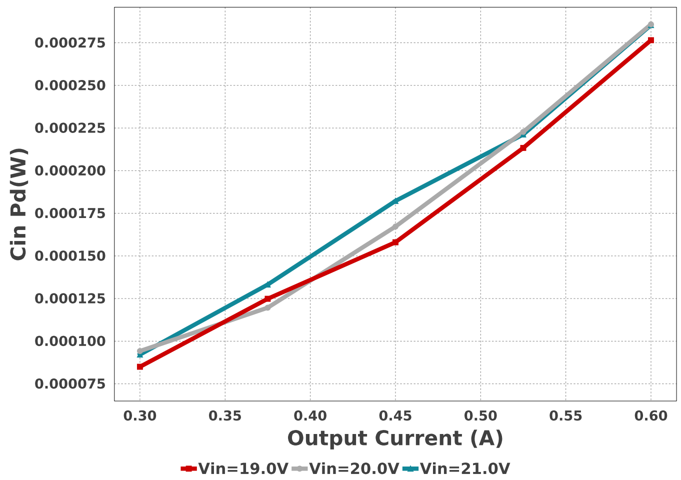
Vout p-p



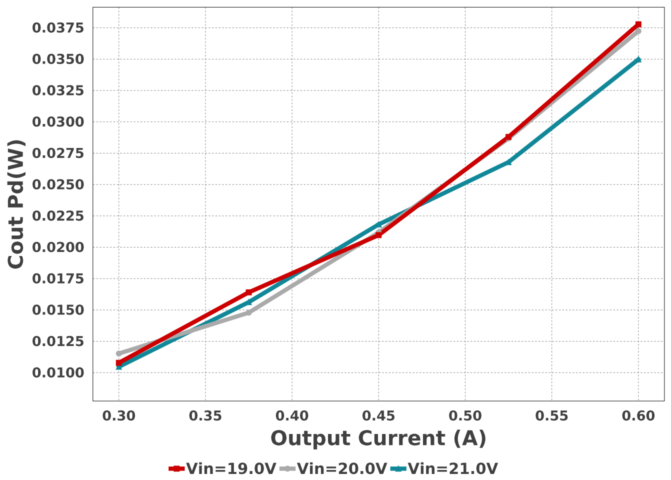
L1 Ipk



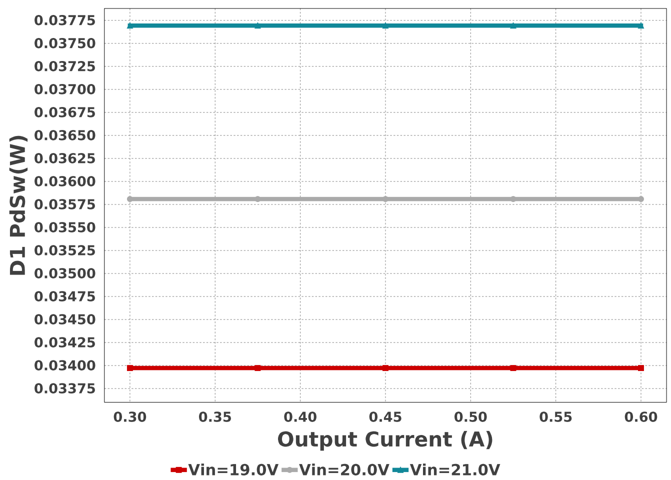
Cin Pd



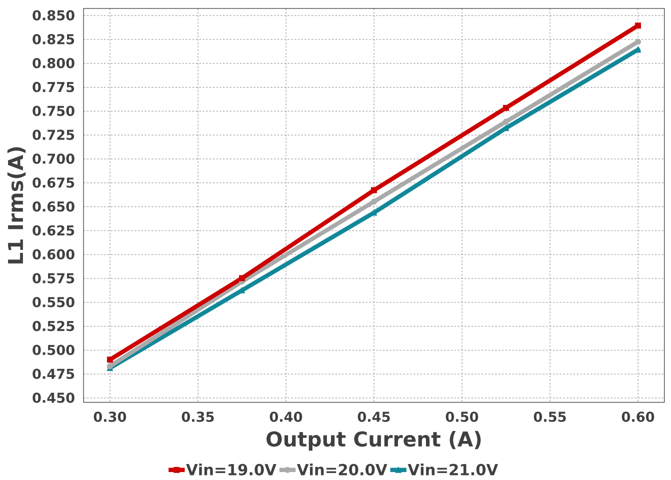
Cout Pd

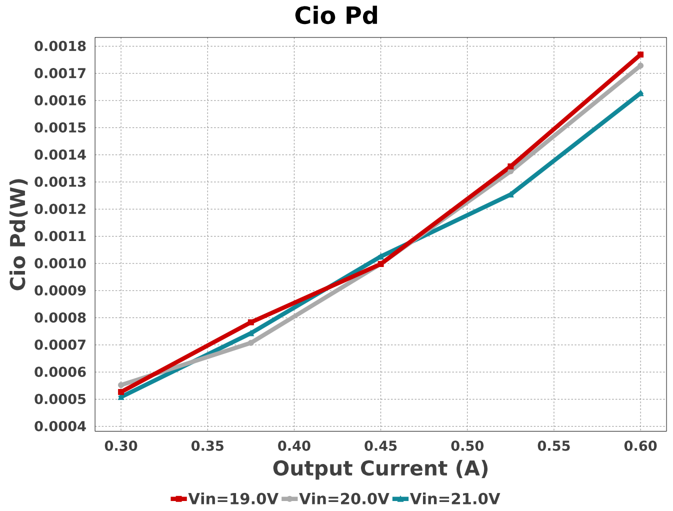


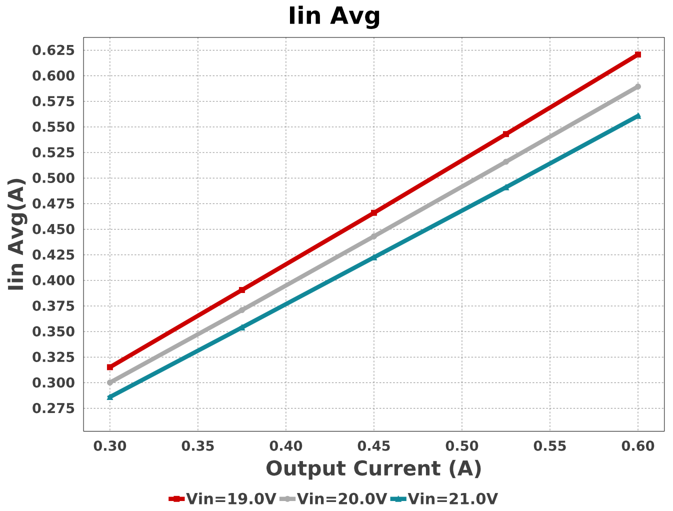
D1 PdSw

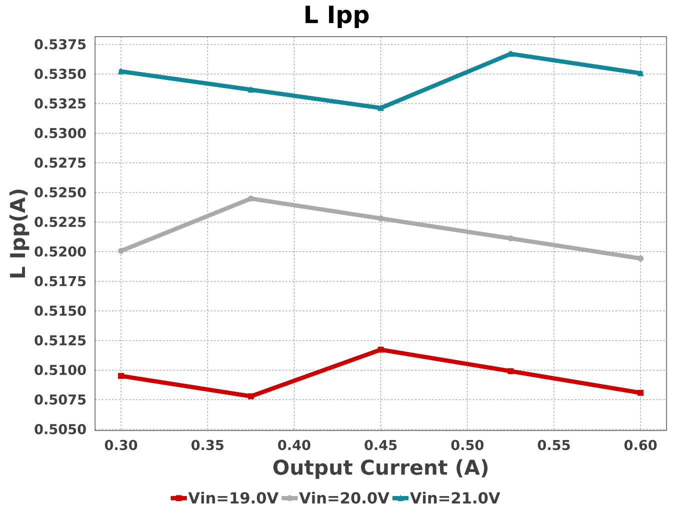


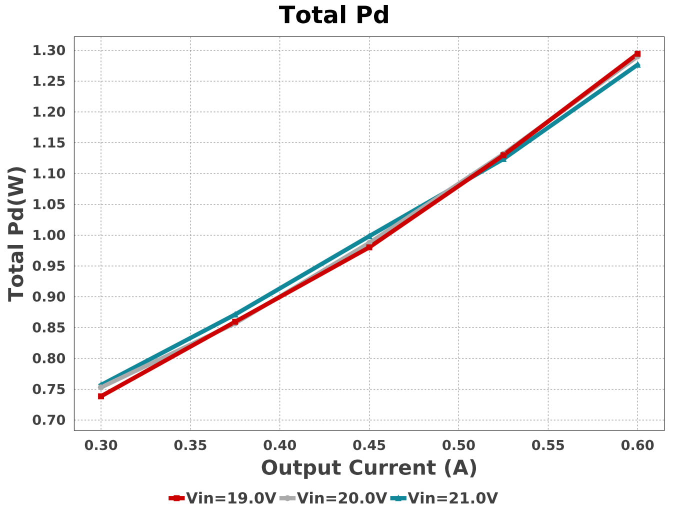
L1 Irms

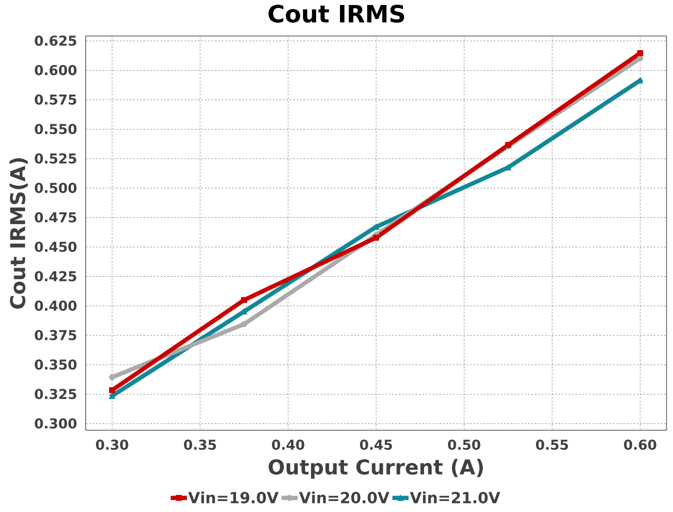


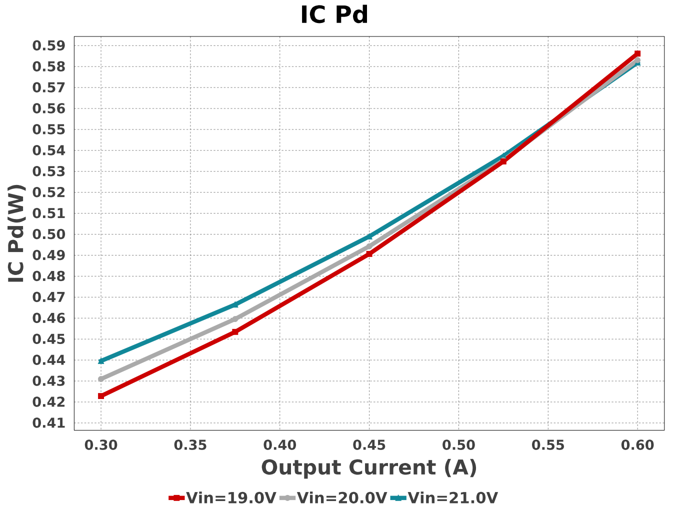

Cio Pd
Cio Pd(W)
0.0018
0.0017
0.0016
0.0015
0.0014
0.0013
0.0012
0.0011
0.0010
0.0009
0.0008
0.0007
0.0006
0.0005
0.0004
0.30
0.35
0.40
0.45
0.50
0.55
0.60
Output Current (A)
Vin=19.0V
Vin=20.0V
Vin=21.0V

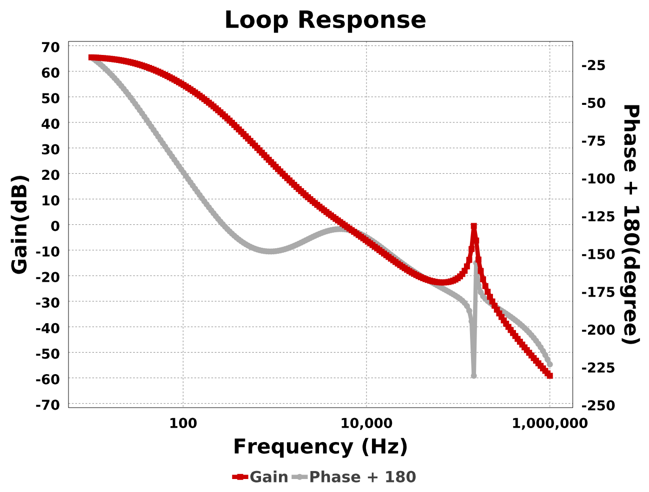

Iin Avg
Iin Avg(A)
0.625
0.600
0.575
0.550
0.525
0.500
0.475
0.450
0.425
0.400
0.375
0.350
0.325
0.300
0.275
0.30
0.35
0.40
0.45
0.50
0.55
0.60
Output Current (A)
Vin=19.0V
Vin=20.0V
Vin=21.0V


L Ipp
L Ipp(A)
0.5375
0.5350
0.5325
0.5300
0.5275
0.5250
0.5225
0.5200
0.5175
0.5150
0.5125
0.5100
0.5075
0.5050
0.30
0.35
0.40
0.45
0.50
0.55
0.60
Output Current (A)
Vin=19.0V
Vin=20.0V
Vin=21.0V


Total Pd
Total Pd(W)
1.30
1.25
1.20
1.15
1.10
1.05
1.00
0.95
0.90
0.85
0.80
0.75
0.70
0.30
0.35
0.40
0.45
0.50
0.55
0.60
Output Current (A)
Vin=19.0V
Vin=20.0V
Vin=21.0V


Cout IRMS
Cout IRMS(A)
0.625
0.600
0.575
0.550
0.525
0.500
0.475
0.450
0.425
0.400
0.375
0.350
0.325
0.300
0.30
0.35
0.40
0.45
0.50
0.55
0.60
Output Current (A)
Vin=19.0V
Vin=20.0V
Vin=21.0V


IC Pd
IC Pd(W)
0.59
0.58
0.57
0.56
0.55
0.54
0.53
0.52
0.51
0.50
0.49
0.48
0.47
0.46
0.45
0.44
0.43
0.42
0.41
0.30
0.35
0.40
0.45
0.50
0.55
0.60
Output Current (A)
Vin=19.0V
Vin=20.0V
Vin=21.0V



Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	127.162 mA	Capacitor	Input capacitor RMS ripple current
2.	Cin Pd	268.003 µW	Capacitor	Input capacitor power dissipation
3.	Cio IRMS	246.367 mA	Capacitor	Input to output capacitor RMS ripple current
4.	Cio Pd	1.664 mW	Capacitor	Input to output capacitor power dissipation
5.	Cout IRMS	620.932 mA	Capacitor	Output capacitor RMS ripple current
6.	Cout Pd	38.556 mW	Capacitor	Output capacitor power dissipation
7.	D1 Irms	601.238 mA	Current	D1 Irms
8.	D1 Pd	451.641 mW	Diode	Diode power dissipation
9.	D1 PdCond	420.0 mW	Diode	Diode conduction losses
10.	D1 PdSw	31.641 mW	Diode	Diode switching losses
11.	D1 Tj	57.098 degC	Diode	D1 junction temperature
12.	IC Ipk	5.05 mA	IC	Peak switch current in IC
13.	IC Pd	575.385 mW	IC	IC power dissipation
14.	IC Tj	58.769 degC	IC	IC junction temperature
15.	IC Tolerance	18.0 mV	IC	IC Feedback Tolerance
16.	Iin Avg	620.34 mA	IC	Average input current
17.	L Ipp	545.451 mA	Inductor	Peak-to-peak output inductor ripple current
18.	L Pd	147.112 mW	Inductor	Inductor power dissipation
19.	L1 Ipk	1.473 A	Inductor	Inductor peak current
20.	L1 Irms	850.279 mA	Inductor	Inductor ripple current
21.	IOUT_OP	600.0 mA	Op Point	Iout operating point
22.	VIN_OP	19.0 V	Op Point	Vin operating point
23.	Total Pd	1.286 W	Power	Total Power Dissipation
24.	Rsense Pd	63.285 mW	Resistor	LED Current Rsns Power Dissipation
25.	BOM Count	21	System Information	Total Design BOM count
26.	Cross Freq	5.479 kHz	System Information	Bode plot crossover frequency
27.	Duty Cycle	50.0 %	System Information	Duty cycle
28.	Efficiency	89.086 %	System Information	Steady state efficiency
29.	FootPrint	537.0 mm^2	System Information	Total Foot Print Area of BOM components
30.	Frequency	300.0 kHz	System Information	Switching frequency
31.	Gain Marg	19.335 db	System Information	Bode Plot Gain Margin
32.	Mode	DCM	System Information	Conduction Mode
33.	Phase Marg	46.67 deg	System Information	Bode Plot Phase Margin
34.	Phase Shift	31.885 deg	System Information	Bode Plot Phase Shift
35.	Total BOM	$4.45	System Information	Total BOM Cost
36.	Vin p-p	207.966 mV	System Information	Peak-to-peak input voltage
37.	Vout p-p	197.632 mV	System Information	Peak-to-peak output ripple voltage

Design Inputs

Name	Value	Description
Iout	600.0 m	Maximum Output Current
VinMax	21.0	Maximum input voltage
VinMin	19.0	Minimum input voltage
Vout	-17.5	Output Voltage
base_pn	LM5575	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

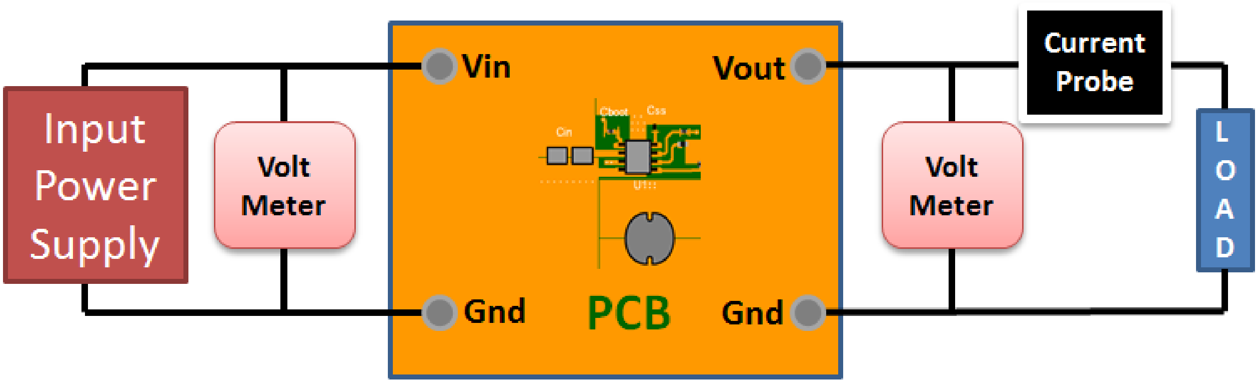
If board assembly is done in house it is best to tack down one terminal of a component on the board then solder the other terminal. For surface mount parts with large tabs, such as the DPAK, the tab on the back of the package should be pre-tinned with solder, then tacked into place by one of the pins. 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 19.0V 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 : 1E239587F1FF5D60C244D52FD4758933[v1]

2. **LM5575** Product Folder : http://www.ti.com/product/LM5575 : contains the data sheet and other resources.