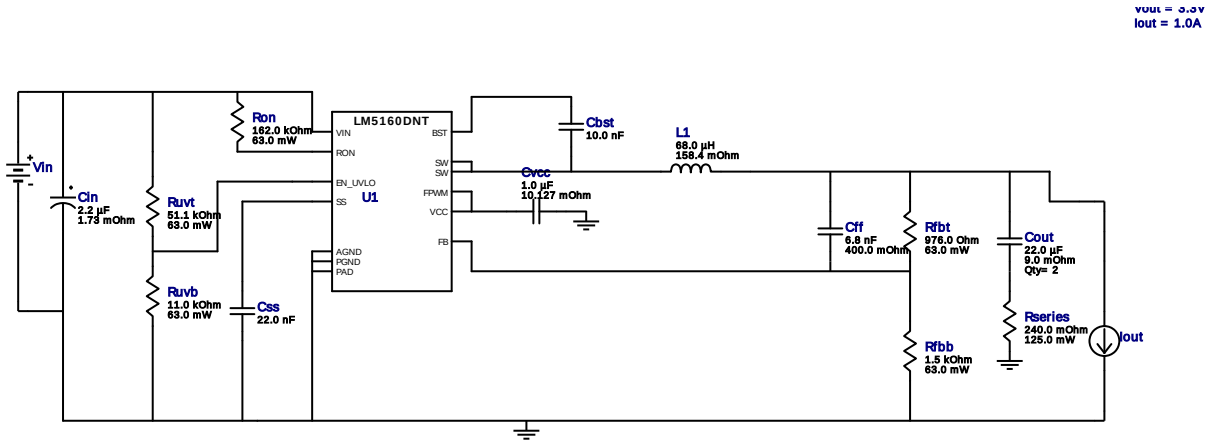
WEBENCH® Design Report

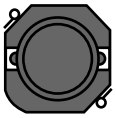
VinMin = 12.0V
VinMax = 65.0V
Vout = 3.3V
Iout = 1.0A

Device = LM5160DNTR
Topology = Buck
Created = 10/18/16 1:40:18 AM
BOM Cost = $2.78
BOM Count = 15
Total Pd = 1.28W

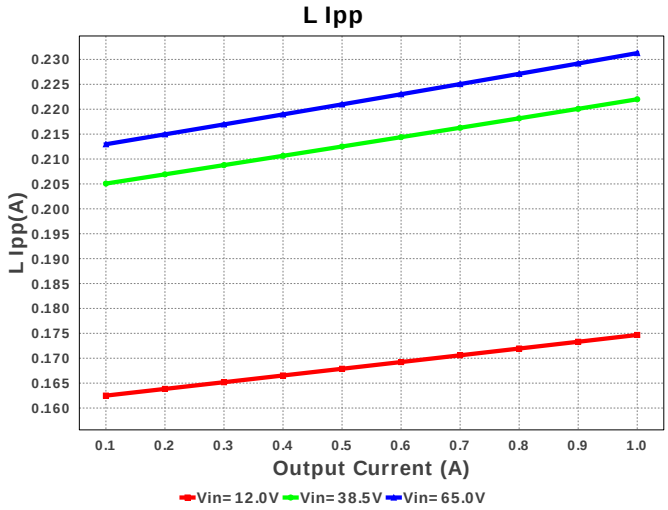
Design : 3531082/14 LM5160DNTR
LM5160DNTR 12.0V-65.0V to 3.30V @ 1.0A

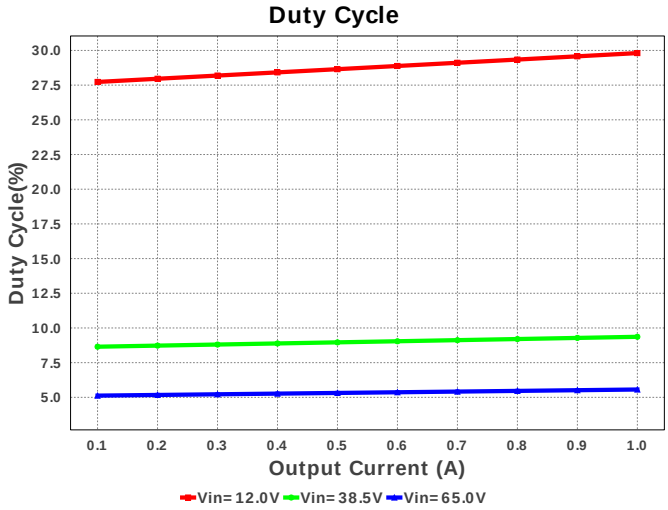


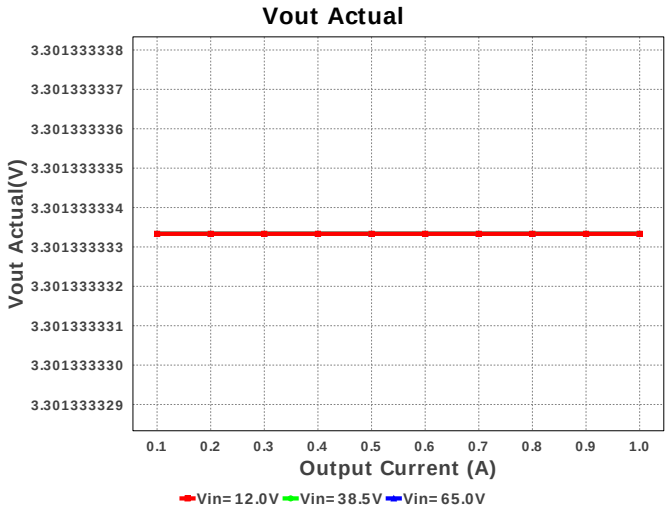
Electrical BOM

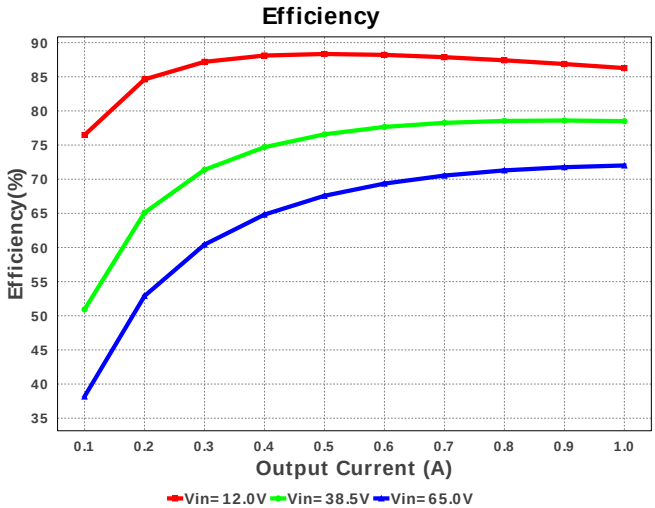
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cbst	MuRata	GRM155R61C103KA01D Series= X5R	Cap= 10.0 nF VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
2.	Cff	MuRata	GRM188R71E682KA01D Series= X7R	Cap= 6.8 nF ESR= 400.0 mOhm VDC= 25.0 V IRMS= 0.0 A	1	$0.01	0603 5 mm²
3.	Cin	TDK	C3225X7R2A225K230AB Series= X7R	Cap= 2.2 uF ESR= 1.73 mOhm VDC= 100.0 V IRMS= 5.5932 A	1	$0.19	1210_250 15 mm²
4.	Cout	MuRata	GRM21BR60J226ME39L Series= X5R	Cap= 22.0 uF ESR= 9.0 mOhm VDC= 6.3 V IRMS= 3.5 A	2	$0.04	0805 7 mm²
5.	Css	MuRata	GRM155R61C223KA01D Series= X5R	Cap= 22.0 nF VDC= 16.0 V IRMS= 0.0 A	1	$0.01	0402 3 mm²
6.	Cvcc	MuRata	GRM188R61C105KA93D Series= X5R	Cap= 1.0 uF ESR= 10.127 mOhm VDC= 16.0 V IRMS= 994.63 mA	1	$0.01	0603 5 mm²
7.	L1	Coilcraft	MSS1048-683MLB	L= 68.0 µH DCR= 158.4 mOhm	1	$0.56	 MSS1048 146 mm²
8.	Rfbb	Vishay-Dale	CRCW04021K50FKED Series= CRCW..e3	Res= 1.5 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
9.	Rfbt	Vishay-Dale	CRCW0402976RFKED Series= CRCW..e3	Res= 976.0 Ohm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²
10.	Ron	Vishay-Dale	CRCW0402162KFKED Series= CRCW..e3	Res= 162.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm²

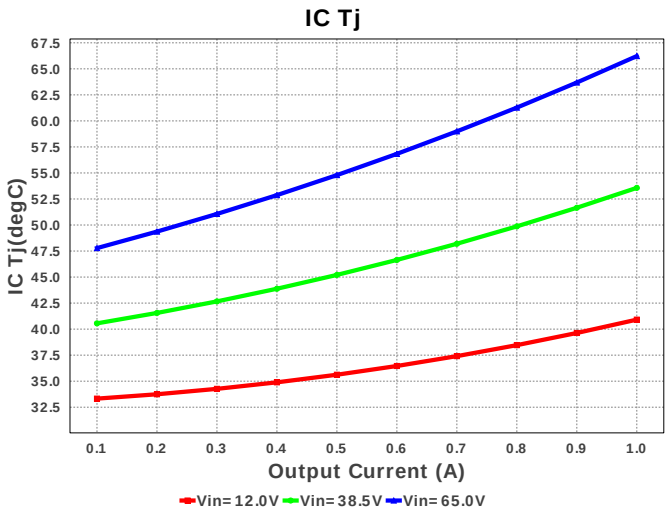
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
11.	Rseries	Panasonic	ERJ-2BQFR24X Series= ERJ-2B	Res= 240.0 mOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.06	0402 3 mm^2
12.	Ruvb	Vishay-Dale	CRCW040211K0FKED Series= CRCW..e3	Res= 11.0 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
13.	Ruvt	Vishay-Dale	CRCW040251K1FKED Series= CRCW..e3	Res= 51.1 kOhm Power= 63.0 mW Tolerance= 1.0%	1	$0.01	0402 3 mm^2
14.	U1	Texas Instruments	LM5160DNTR	Switcher	1	$1.80	DNT0012B 25 mm^2

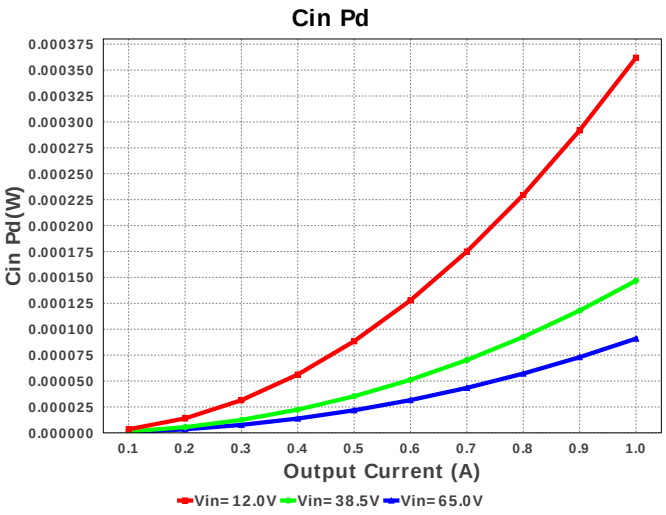


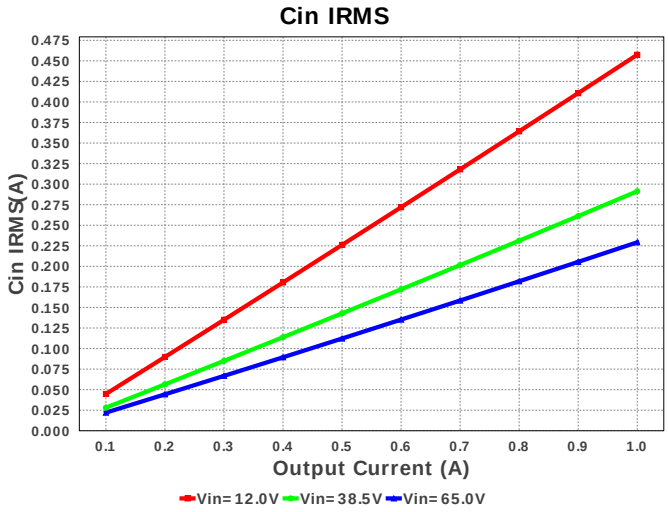


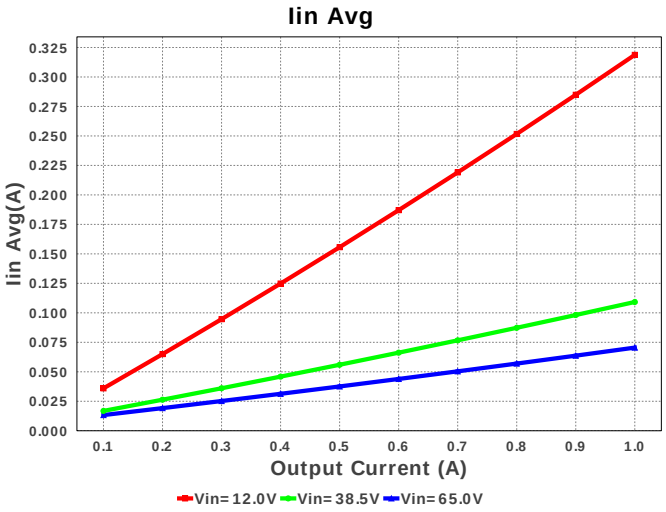


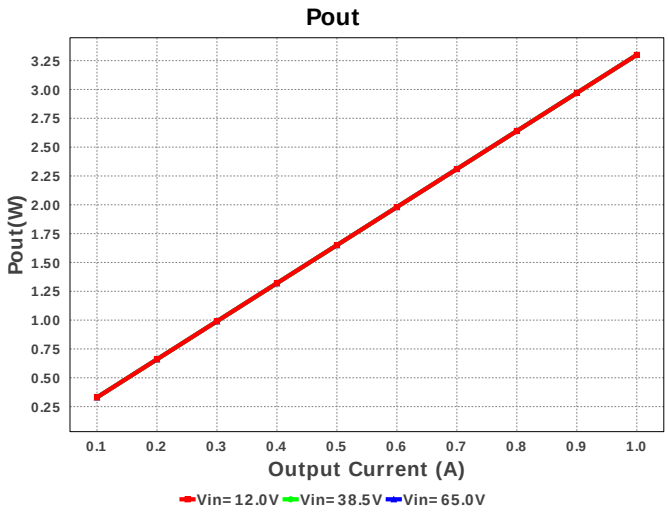


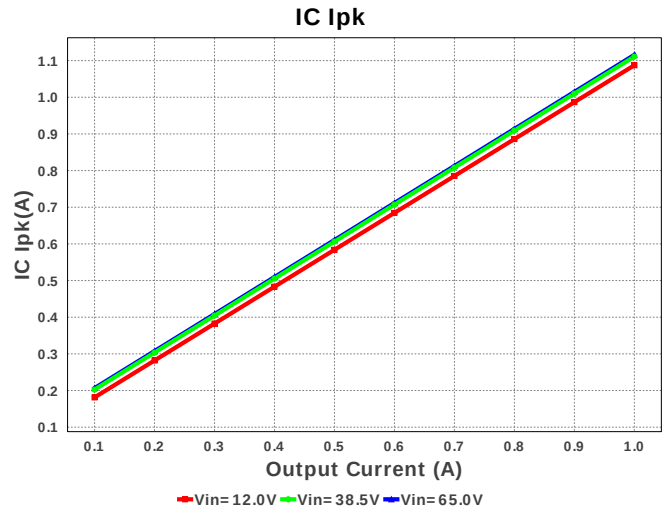


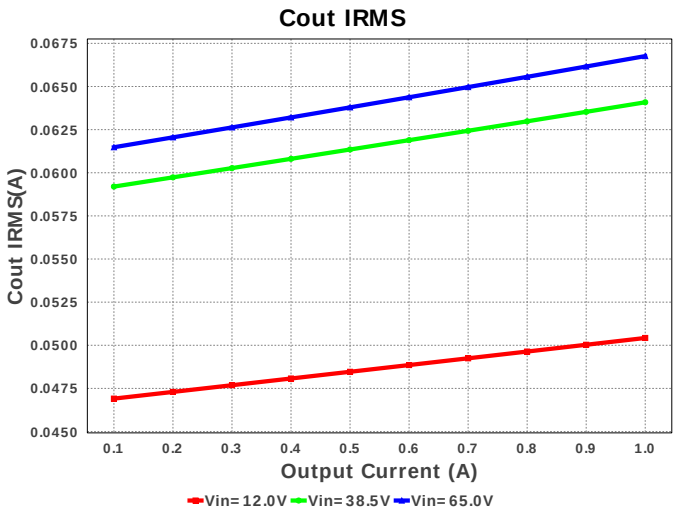


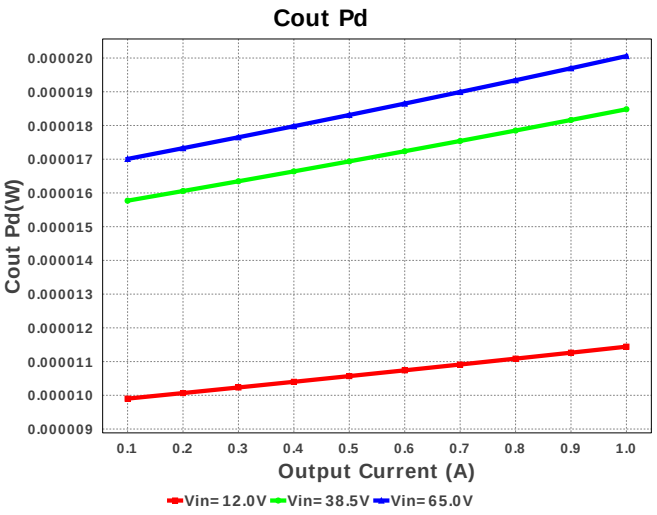


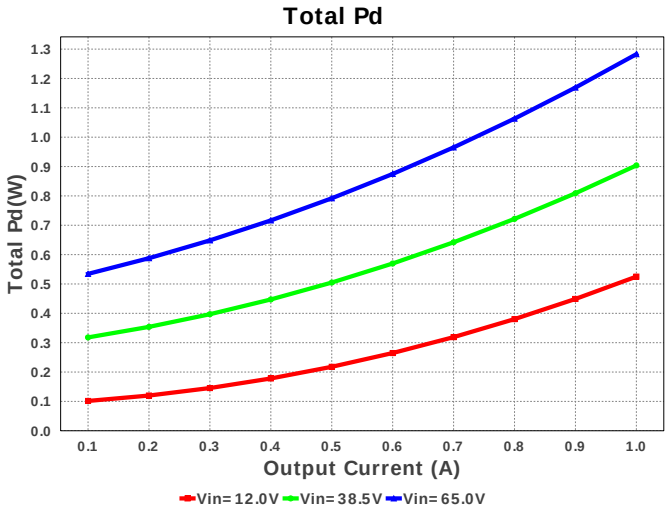


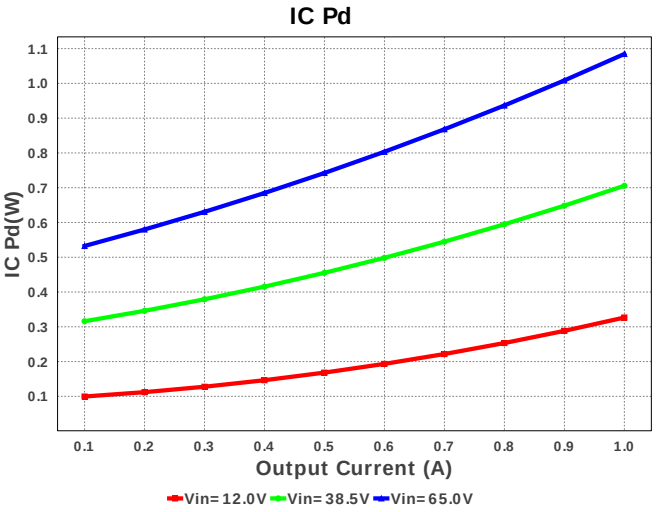


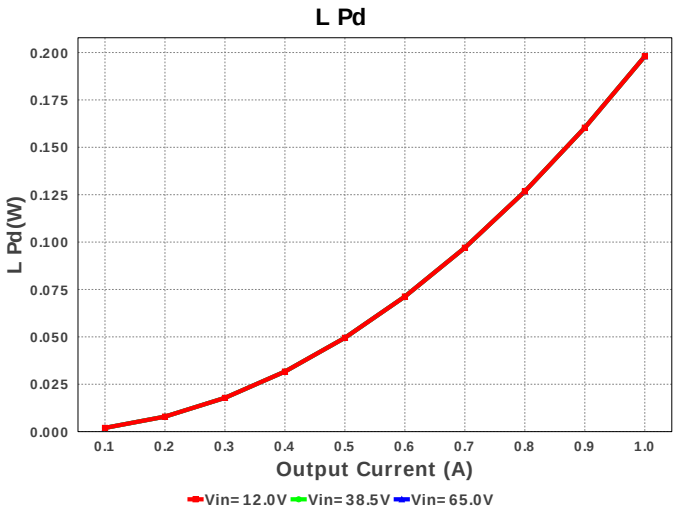












Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	229.243 mA	Current	Input capacitor RMS ripple current
2.	Cout IRMS	66.762 mA	Current	Output capacitor RMS ripple current
3.	IC Ipk	1.116 A	Current	Peak switch current in IC
4.	Iin Avg	70.503 mA	Current	Average input current
5.	L Ipp	231.27 mA	Current	Peak-to-peak inductor ripple current
6.	BOM Count	15	General	Total Design BOM count
7.	FootPrint	233.0 mm^2	General	Total Foot Print Area of BOM components
8.	Frequency	218.332 kHz	General	Switching frequency
9.	Mode	CCM	General	Conduction Mode
10.	Pout	3.3 W	General	Total output power
11.	Total BOM	$2.78	General	Total BOM Cost

#	Name	Value	Category	Description
12.	Vout Actual	3.301 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
13.	Vout OP	3.3 V	Op_Point	Operational Output Voltage
14.	Duty Cycle	5.565 %	Op_point	Duty cycle
15.	Efficiency	72.01 %	Op_point	Steady state efficiency
16.	IC Tj	66.224 degC	Op_point	IC junction temperature
17.	ICThetaJA	33.4 degC/W	Op_point	IC junction-to-ambient thermal resistance
18.	IOUT_OP	1.0 A	Op_point	Iout operating point
19.	VIN_OP	65.0 V	Op_point	Vin operating point
20.	Cin Pd	90.916 µW	Power	Input capacitor power dissipation
21.	Cout Pd	20.057 µW	Power	Output capacitor power dissipation
22.	IC Pd	1.085 W	Power	IC power dissipation
23.	L Pd	198.0 mW	Power	Inductor power dissipation
24.	Total Pd	1.283 W	Power	Total Power Dissipation
25.	Vout Tolerance	2.056 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

Design Inputs

#	Name	Value	Description
1.	Iout	1.0	Maximum Output Current
2.	VinMax	65.0	Maximum input voltage
3.	VinMin	12.0	Minimum input voltage
4.	Vout	3.3	Output Voltage
5.	base_pn	LM5160	Base Product Number
6.	source	DC	Input Source Type
7.	Ta	30.0	Ambient temperature

Design Assistance

1. For a Constant On Time device to be stable, we need to provide a ripple at the feedback comparator. There are various methods to implement the ripple. Depending on the circuit complexity vs. the allowable ripple, we have three options to choose from. The simplest option, 'Low Complexity', would require only a high ESR cap at the output. This means that the BOM count will be small, but the output voltage ripple will be quite large. The 'Optimal Solution' would require a feed-forward cap in parallel with the upper feedback resistor to AC couple the ripple to the feedback node. This increases the BOM count slightly, but now we have more control over the output voltage ripple. If the output voltage requirement is very tight, then the best option is to go for the 'Low Output Ripple' solution. In this option we can go with very low ESR output caps and have very good control over the output voltage ripple.

2. **LM5160** Product Folder : http://www.ti.com/product/LM5160 : contains the data sheet and other resources.