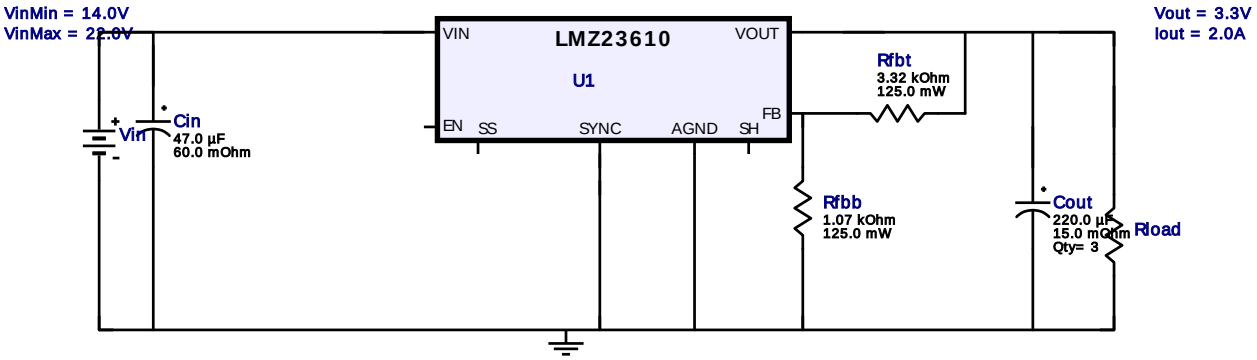
WEBENCH® Design Report

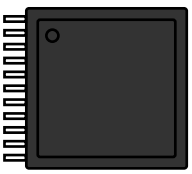
VinMin = 14.0V
VinMax = 22.0V
Vout = 3.3V
Iout = 2.0A

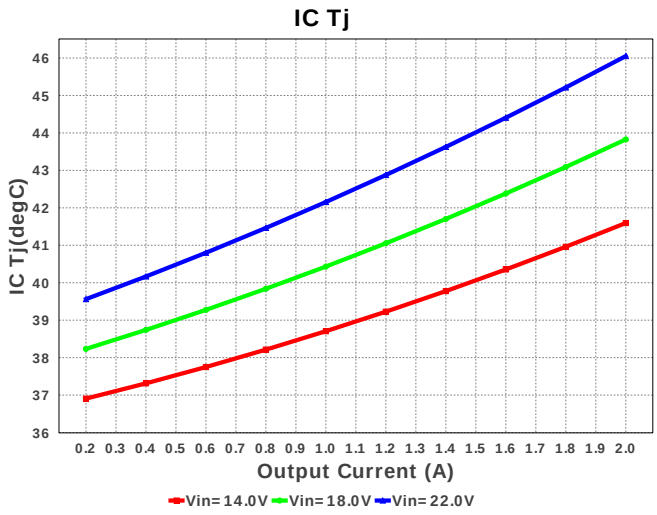
Device = LMZ23610TZ/NOPB
Topology = Buck
Created = 7/1/15 8:55:01 PM
BOM Cost = $16.10
Footprint = 595.0 mm^2
BOM Count = 7
Total Pd = 1.64W

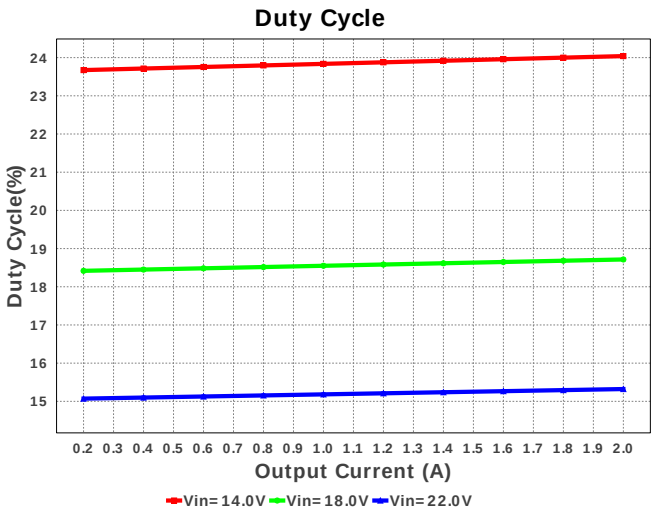
Design : 4414378/3 LMZ23610TZ/NOPB
LMZ23610TZ/NOPB 14.0V-22.0V to 3.30V @ 2.0A

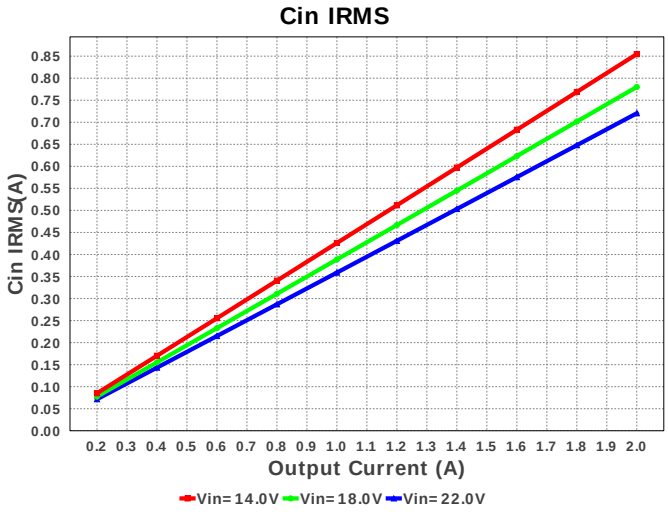


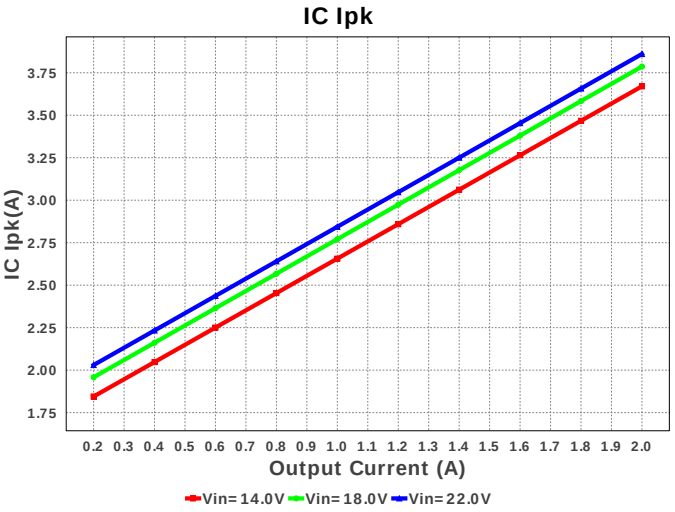
Electrical BOM

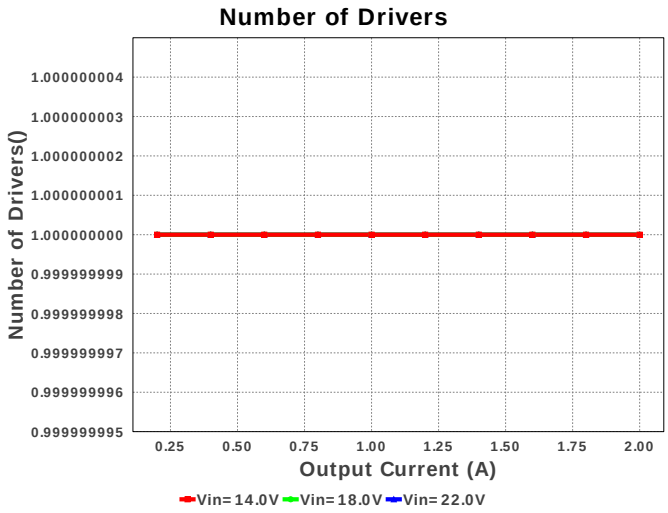
#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cin	Panasonic	EEHZA1V470P Series= 1267	Cap= 47.0 uF ESR= 60.0 mOhm VDC= 35.0 V IRMS= 1.3 A	1	$0.56	 SM_RADIAL_6.3AMM 80 mm^2
2.	Cout	Panasonic	6SVPE220MW Series= 259	Cap= 220.0 uF ESR= 15.0 mOhm VDC= 6.3 V IRMS= 3.15 A	3	$0.14	 CAPSMT_62_E61 53 mm^2
3.	Rfbb	Panasonic	ERJ-6ENF1071V Series= 225	Res= 1.07 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	 0805 7 mm^2
4.	Rfbt	Vishay-Dale	CRCW08053K32FKEA Series= CRCW..e3	Res= 3.32 kOhm Power= 125.0 mW Tolerance= 1.0%	1	$0.01	 0805 7 mm^2
5.	U1	Texas Instruments	LMZ23610TZ/NOPB	Switcher	1	$15.10	 TZA011A 342 mm^2

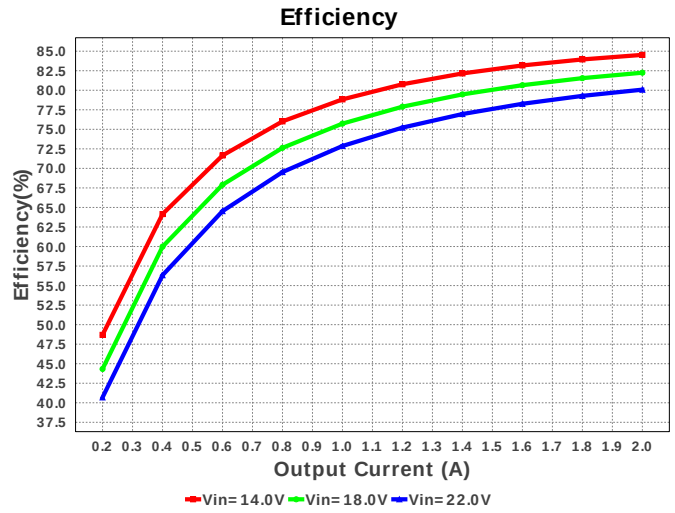


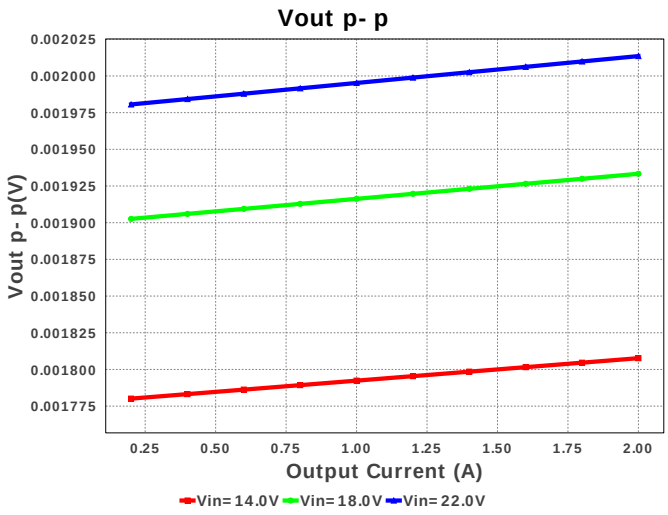


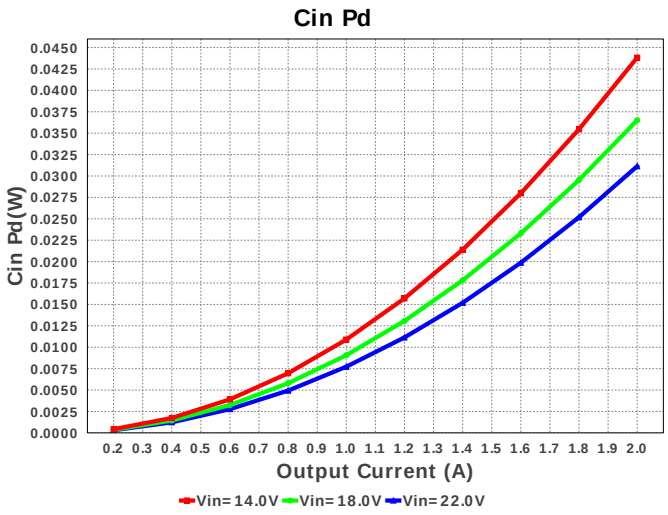


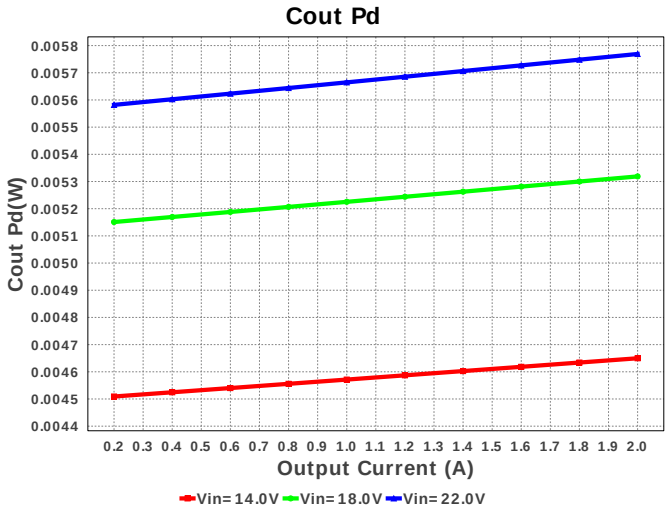


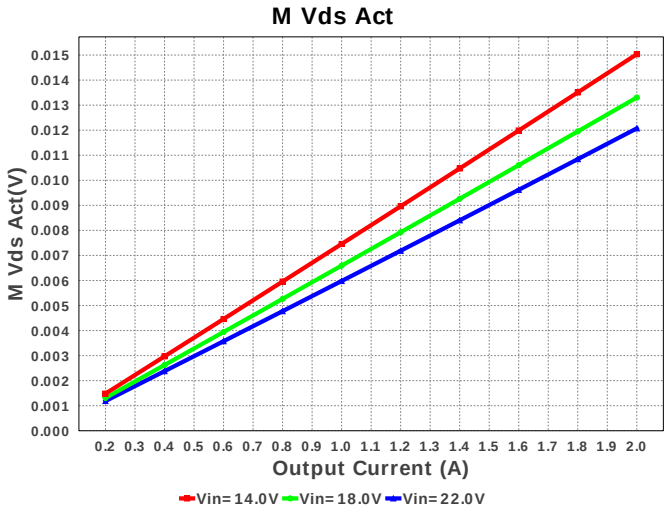


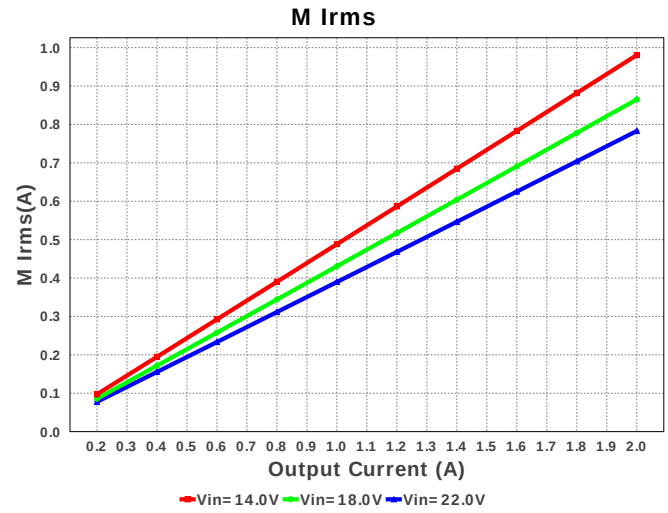


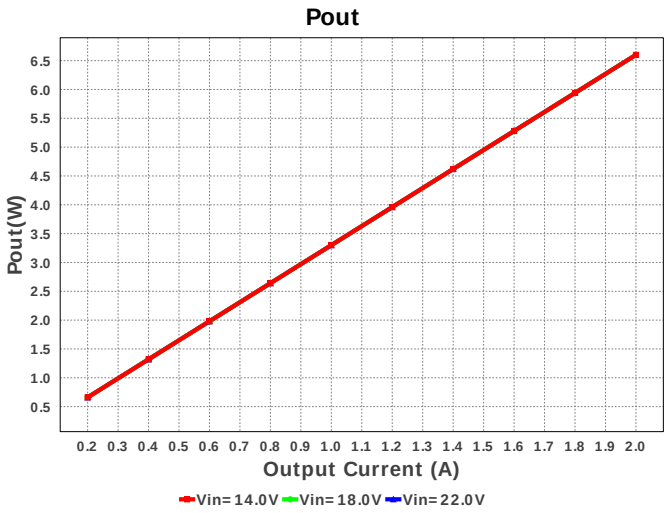


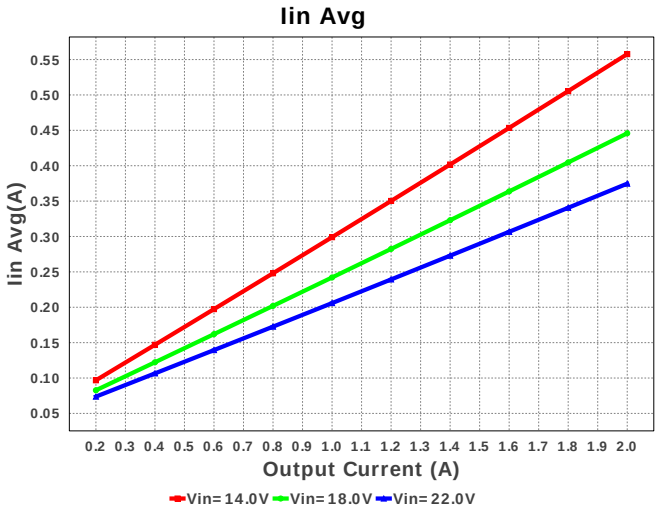


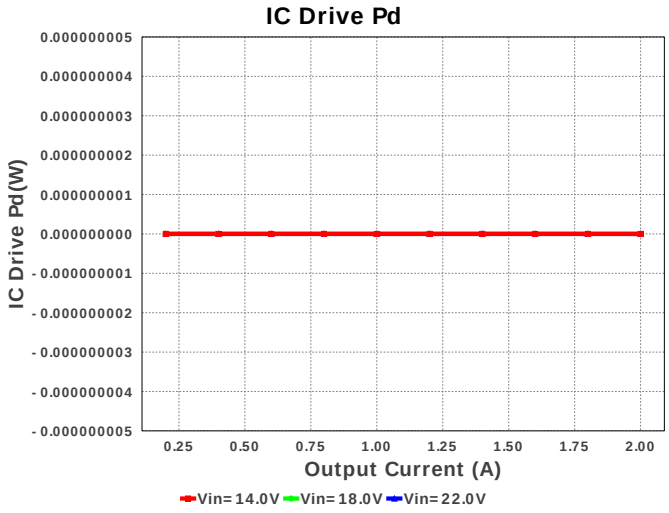


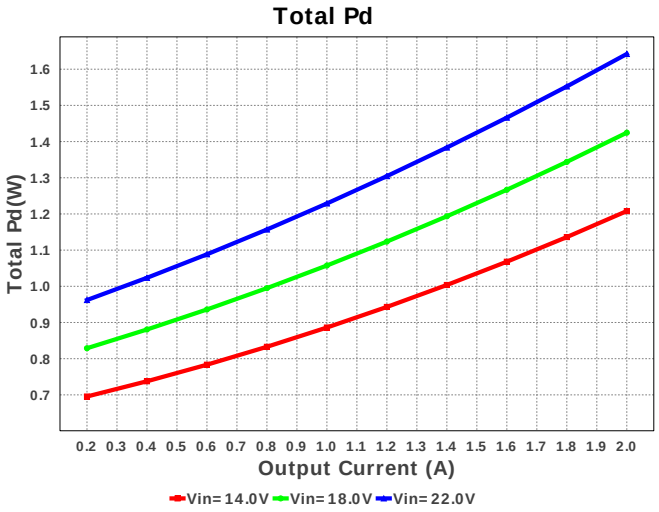


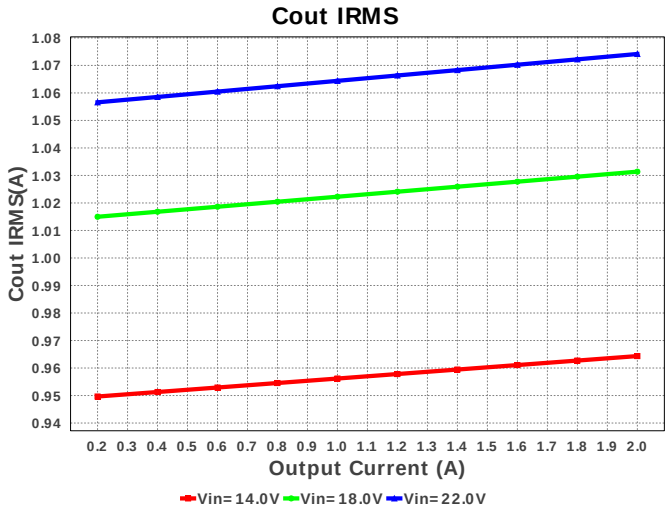


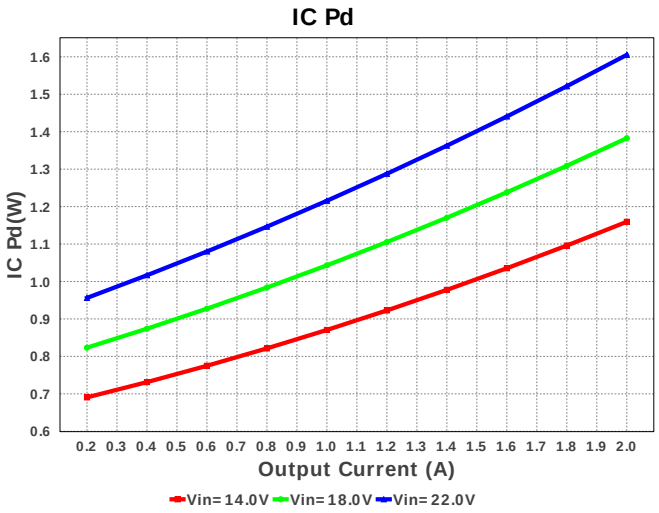


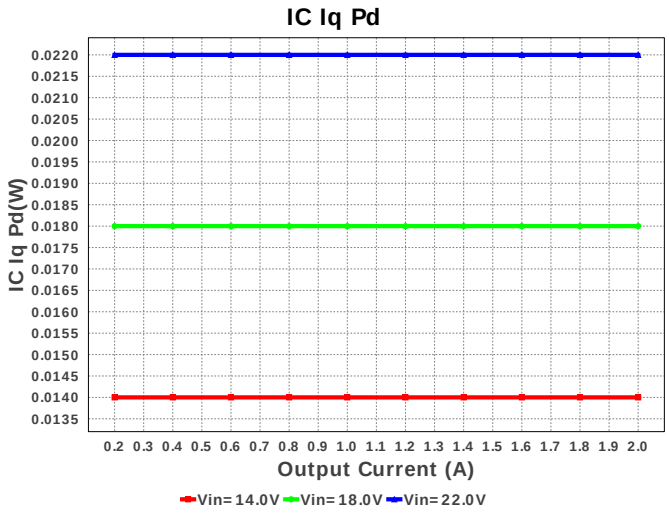












Operating Values

#	Name	Value	Category	Description
1.	BOM Count	7		Total Design BOM count
2.	Total BOM	$16.1		Total BOM Cost
3.	Cin IRMS	720.394 mA	Current	Input capacitor RMS ripple current
4.	Cout IRMS	1.074 A	Current	Output capacitor RMS ripple current
5.	IC Ipk	3.86 A	Current	Peak switch current in IC
6.	Iin Avg	374.64 mA	Current	Average input current
7.	M1 Irms	782.86 mA	Current	Q Iavg
8.	FootPrint	595.0 mm^2	General	Total Foot Print Area of BOM components
9.	Frequency	350.0 kHz	General	Switching frequency
10.	IC Tolerance	20.0 mV	General	IC Feedback Tolerance
11.	M Vds Act	12.073 mV	General	Voltage drop across the MosFET

#	Name	Value	Category	Description
12.	Pout	6.6 W	General	Total output power
13.	Vout OP	3.3 V	Op_Point	Operational Output Voltage
14.	Cross Freq	9.178 kHz	Op_point	Bode plot crossover frequency
15.	Duty Cycle	15.322 %	Op_point	Duty cycle
16.	Efficiency	80.077 %	Op_point	Steady state efficiency
17.	IC Tj	46.052 degC	Op_point	IC junction temperature
18.	ICThetaJA	10.0 degC/W	Op_point	IC junction-to-ambient thermal resistance
19.	IOUT_OP	2.0 A	Op_point	Iout operating point
20.	Phase Marg	49.723 deg	Op_point	Bode Plot Phase Margin
21.	VIN_OP	22.0 V	Op_point	Vin operating point
22.	Vout p-p	2.014 mV	Op_point	Peak-to-peak output ripple voltage
23.	Cin Pd	31.138 mW	Power	Input capacitor power dissipation
24.	Cout Pd	5.769 mW	Power	Output capacitor power dissipation
25.	IC Drive Pd	0.0 W	Power	Driver power dissipation
26.	IC Iq Pd	22.0 mW	Power	IC Iq Pd
27.	IC Pd	1.605 W	Power	IC power dissipation
28.	Total Pd	1.642 W	Power	Total Power Dissipation
29.	Number of Drivers	1.0	Unknown	Number of drivers in current sharing mode.

Design Inputs

#	Name	Value	Description
1.	Iout	2.0	Maximum Output Current
2.	Iout1	2.0	Output Current #1
3.	SoftStart	1.6 ms	Soft Start Time (ms)
4.	VinMax	22.0	Maximum input voltage
5.	VinMin	14.0	Minimum input voltage
6.	Vout	3.3	Output Voltage
7.	Vout1	3.3	Output Voltage #1
8.	base_pn	LMZ23610	Base Product Number
9.	source	DC	Input Source Type
10.	Ta	30.0	Ambient temperature
11.	UserFsw	350.0 k	Customer Selected Frequency

Design Assistance

1. The Modules are very easy to use and just need a basic design using a resistor divider at the feedback and input and output caps to work. To design for UVLO you could click on the drop down menu in the 'Change Inputs' menu and select the 'UVLO Enabled Design'. The internal softstart time is set at 1.6mSec. If a longer softstart time is desired, you could change the preset to the desired amount and click on 'Submit'. Webench will then add an external softstartcap to the schematic. For designs requiring more than 10A of load current, multiple LMZ23610 ICs can be used by connecting their 'SH' pins together. The 'Master' LMZ23610is set by connecting the resistor divider from feedback to the output. The slaves have their feedback pins open. Airflow There should be airflow of about 225LFM provided for the maximum input voltage of 36V and full load requirement. Without airflow the IC will heat up and has a chance of thermal failure.

2. **LMZ23610** Product Folder : http://www.ti.com/product/LMZ23610 : contains the data sheet and other resources.