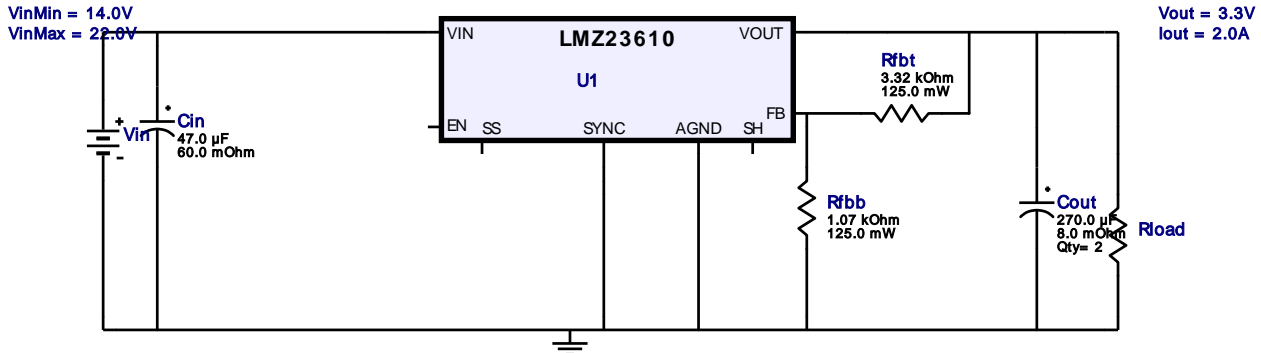






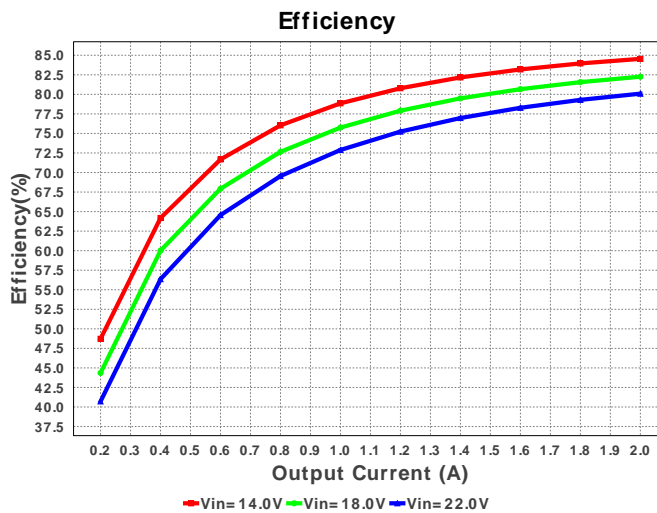
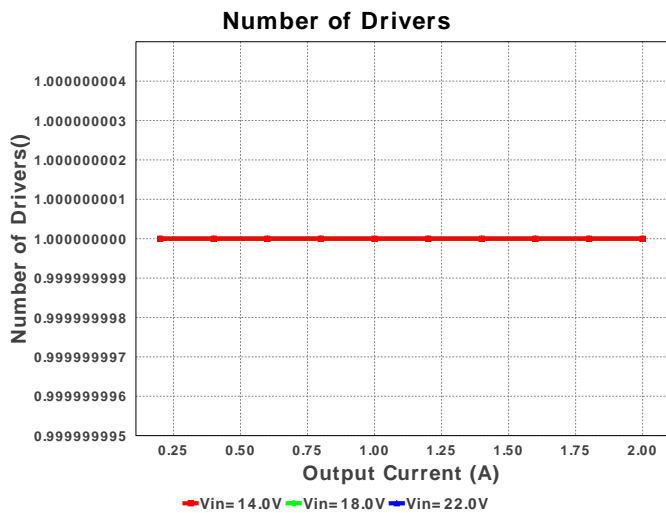
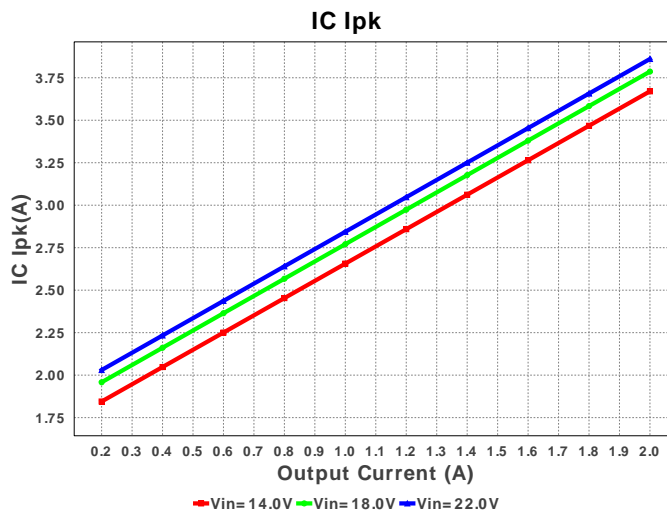
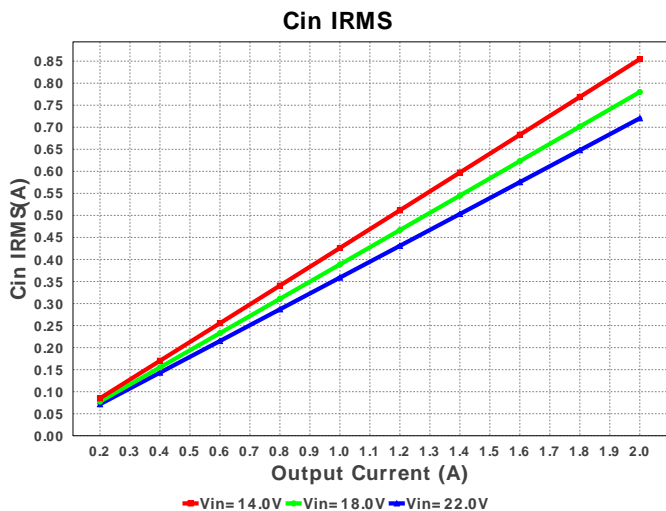
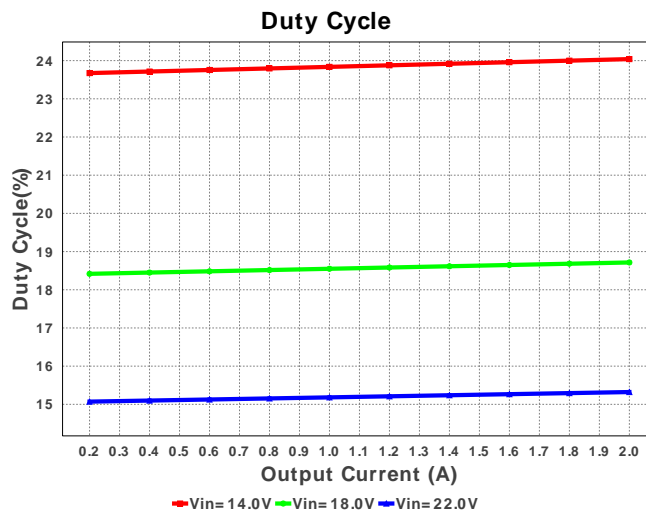
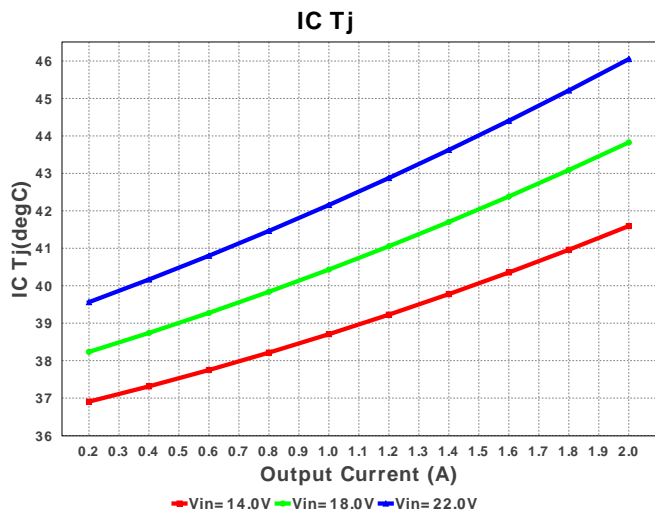
## WEBENCH® Design Report

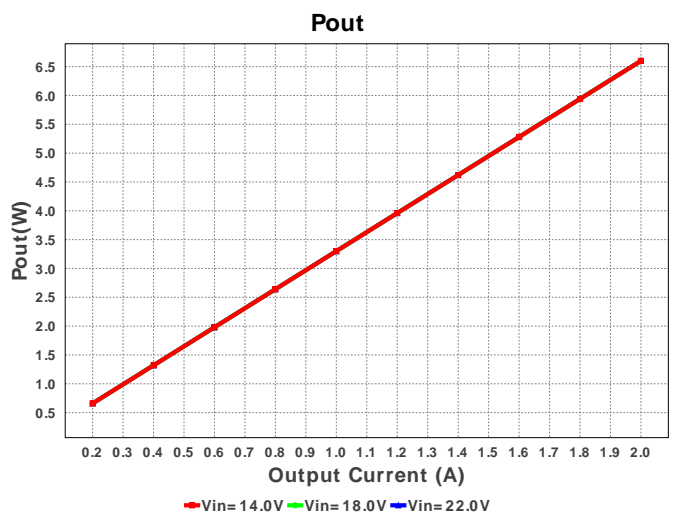
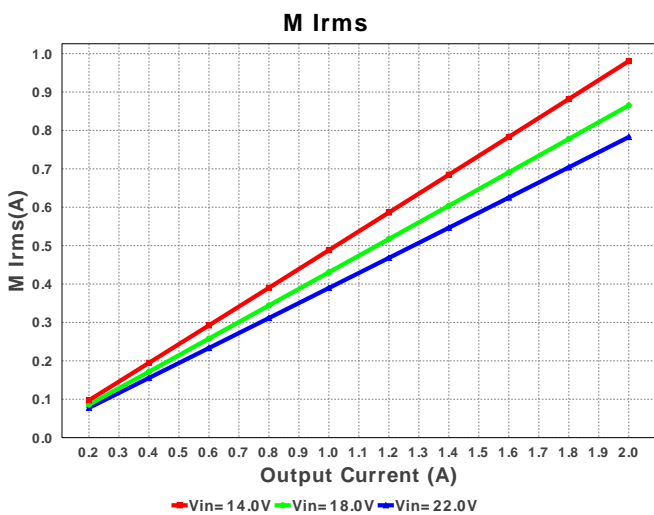
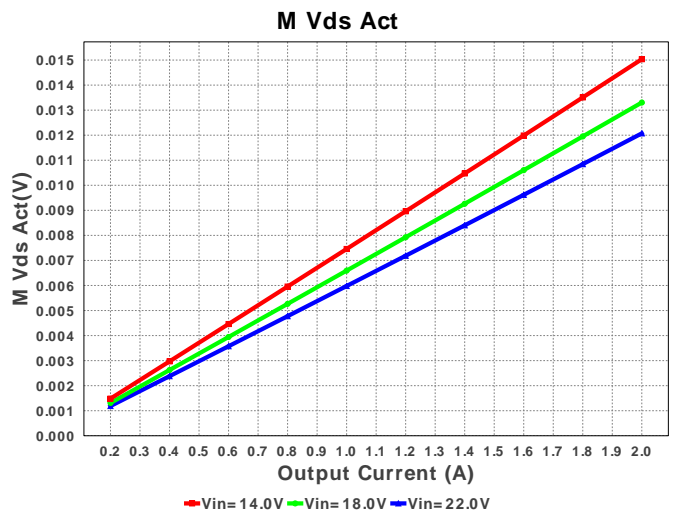
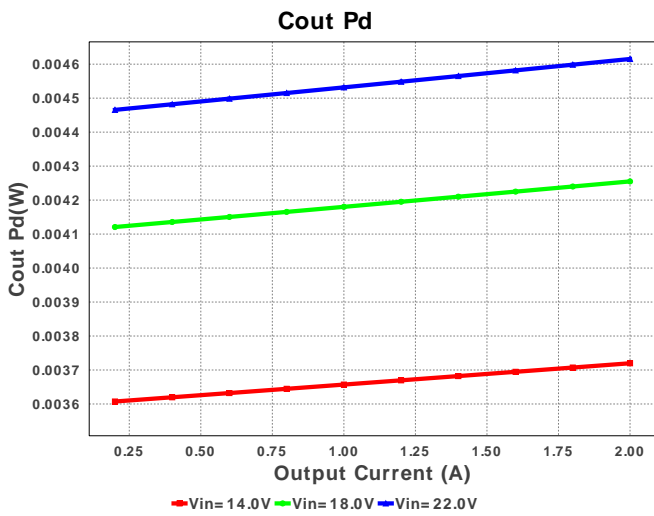
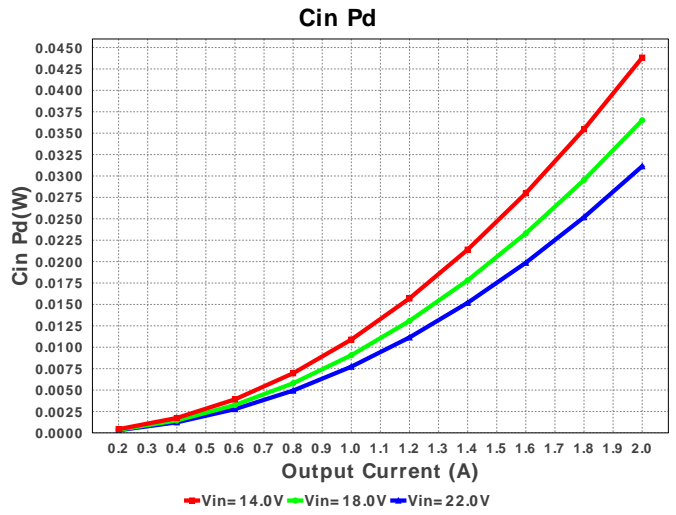
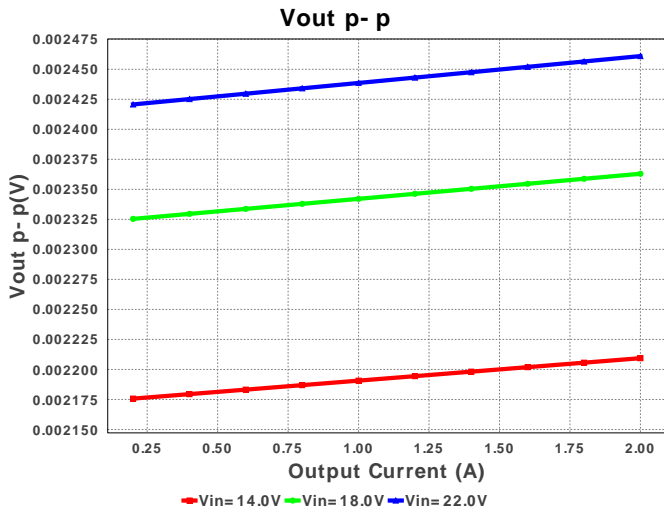
Design : 4417704/7 LMZ23610TZ/NOPB  
 LMZ23610TZ/NOPB 14.0V-22.0V to 3.30V @ 2.0A

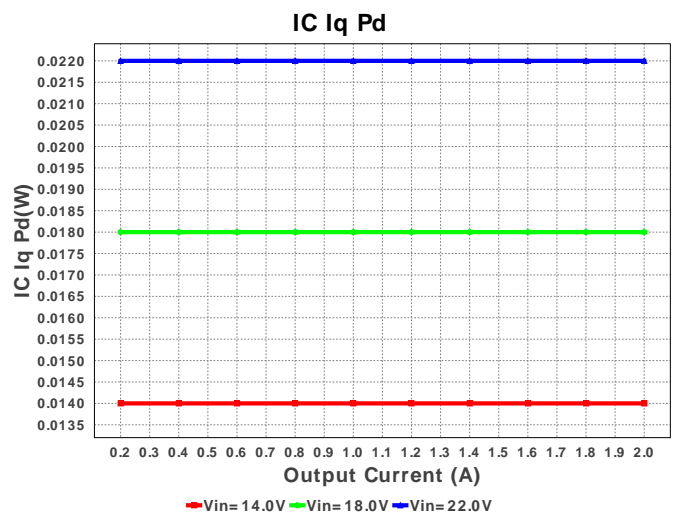
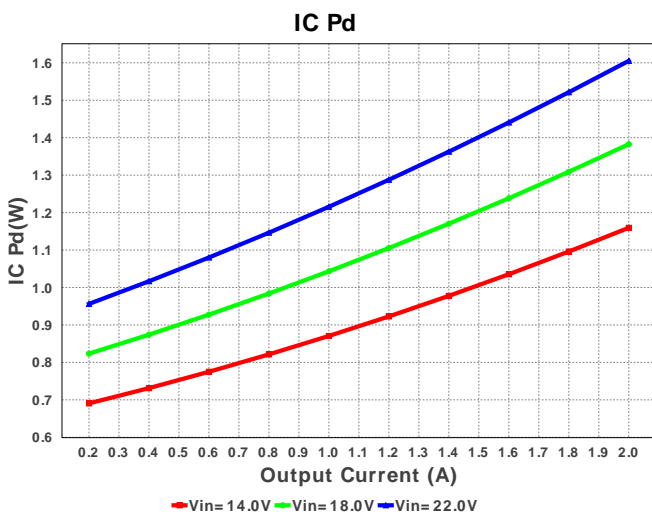
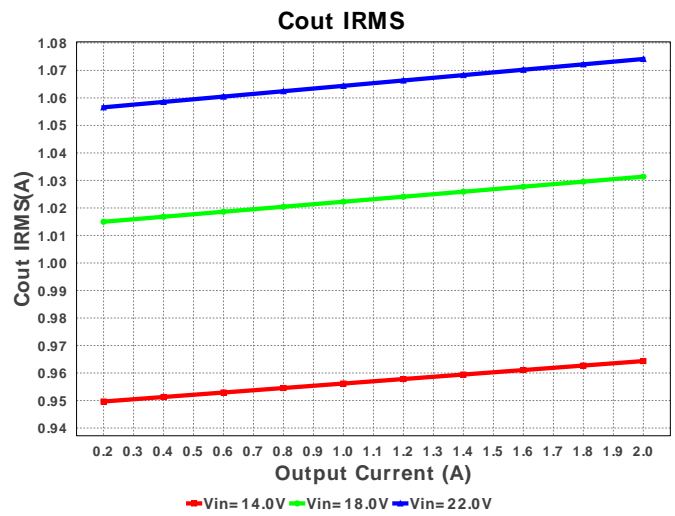
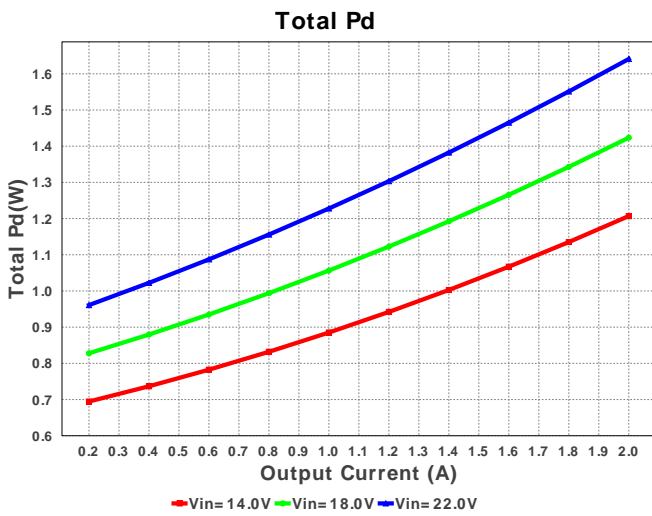
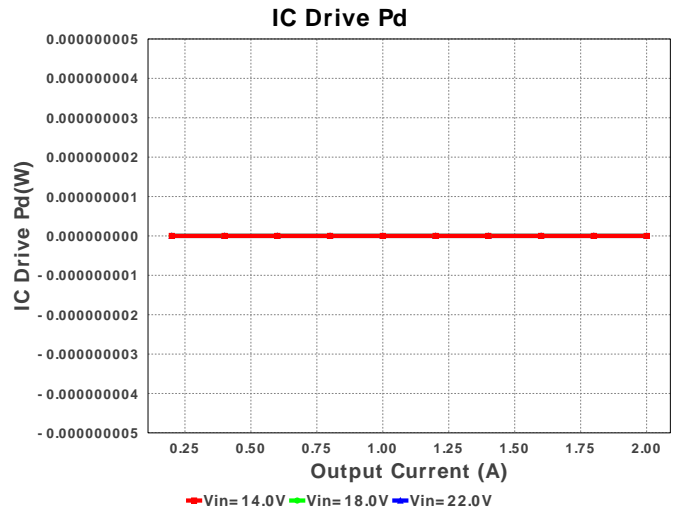
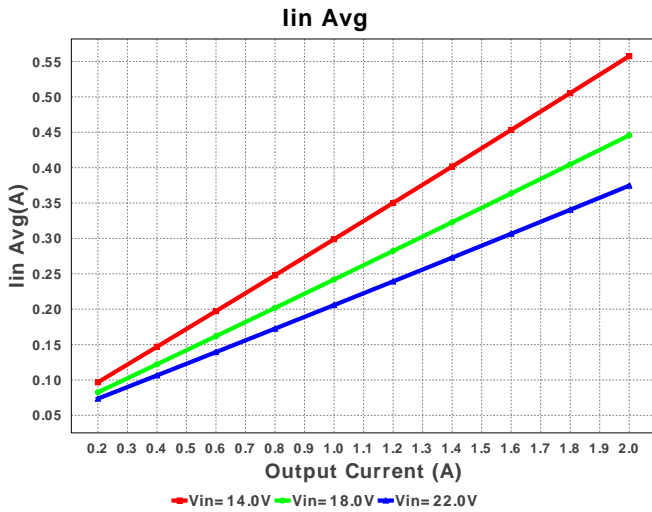


### Electrical BOM

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cin	Panasonic	EEHZA1V470P Series= ZA	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 <sup>2</sup>
2.	Cout	Panasonic	16SVPG270M Series= SVPG	Cap= 270.0 uF ESR= 8.0 mOhm VDC= 16.0 V IRMS= 5.8 A	2	\$0.70	 CAPSMT_62_C10 74 mm <sup>2</sup>
3.	Rfbb	Panasonic	ERJ-6ENF1071V Series= ERJ-6E	Res= 1.07 kOhm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	 0805 7 mm <sup>2</sup>
4.	Rfbb	Panasonic	ERJ-6ENF3321V Series= ERJ-6E	Res= 3.32 kOhm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	 0805 7 mm <sup>2</sup>
5.	U1	Texas Instruments	LMZ23610TZ/NOPB	Switcher	1	\$15.10	 TZA011A 342 mm <sup>2</sup>







### Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	720.394 mA	Current	Input capacitor RMS ripple current
2.	Cout IRMS	1.074 A	Current	Output capacitor RMS ripple current
3.	IC Ipk	3.86 A	Current	Peak switch current in IC
4.	Iin Avg	374.59 mA	Current	Average input current
5.	M1 Irms	782.86 mA	Current	Q avg
6.	BOM Count	6	General	Total Design BOM count
7.	FootPrint	583.0 mm <sup>2</sup>	General	Total Foot Print Area of BOM components
8.	Frequency	350.0 kHz	General	Switching frequency
9.	IC Tolerance	20.0 mV	General	IC Feedback Tolerance
10.	M Vds Act	12.073 mV	General	Voltage drop across the MosFET
11.	Pout	6.6 W	General	Total output power

#	Name	Value	Category	Description
12.	Total BOM	\$17.08	General	Total BOM Cost
13.	Vout OP	3.3 V	Op_Point	Operational Output Voltage
14.	Cross Freq	10.604 kHz	Op_point	Bode plot crossover frequency
15.	Duty Cycle	15.322 %	Op_point	Duty cycle
16.	Efficiency	80.088 %	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	46.013 deg	Op_point	Bode Plot Phase Margin
21.	VIN_OP	22.0 V	Op_point	Vin operating point
22.	Vout p-p	2.461 mV	Op_point	Peak-to-peak output ripple voltage
23.	Cin Pd	31.138 mW	Power	Input capacitor power dissipation
24.	Cout Pd	4.615 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	1.641 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.	VinMax	22.0	Maximum input voltage
4.	VinMin	14.0	Minimum input voltage
5.	Vout	3.3	Output Voltage
6.	Vout1	3.3	Output Voltage #1
7.	base_pn	LMZ23610	Base Product Number
8.	source	DC	Input Source Type
9.	Ta	30.0	Ambient temperature

## 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' LMZ23610 is 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.

Texas Instruments' WEBENCH simulation tools attempt to recreate the performance of a substantially equivalent physical implementation of the design. Simulations are created using Texas Instruments' published specifications as well as the published specifications of other device manufacturers. While Texas Instruments does update this information periodically, this information may not be current at the time the simulation is built. Texas Instruments does not warrant the accuracy or completeness of the specifications or any information contained therein. Texas Instruments does not warrant that any designs or recommended parts will meet the specifications you entered, will be suitable for your application or fit for any particular purpose, or will operate as shown in the simulation in a physical implementation. Texas Instruments does not warrant that the designs are production worthy.

**You should completely validate and test your design implementation to confirm the system functionality for your application prior to production.**

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