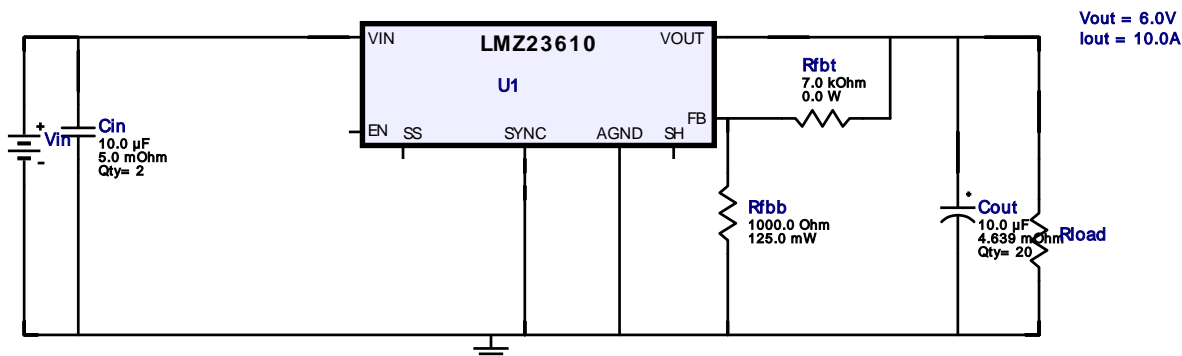


## WEBENCH® Design Report

Design : 4105594/19 LMZ23610TZ/NOPB  
LMZ23610TZ/NOPB 20.0V-36.0V to 6.00V @ 10.0A




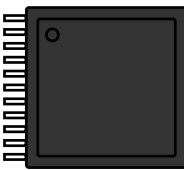


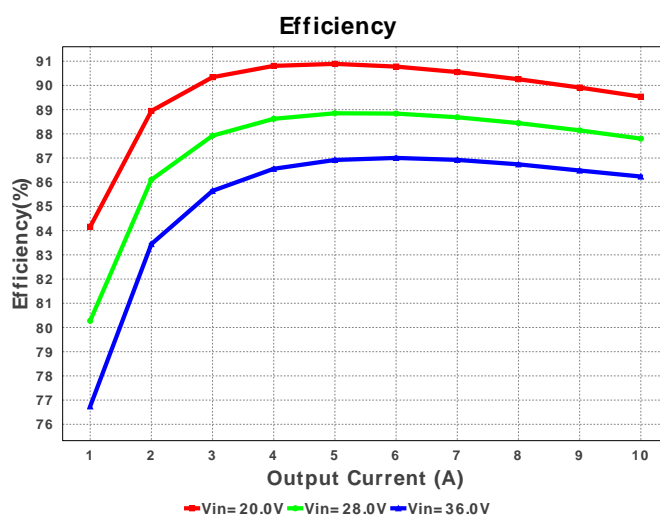
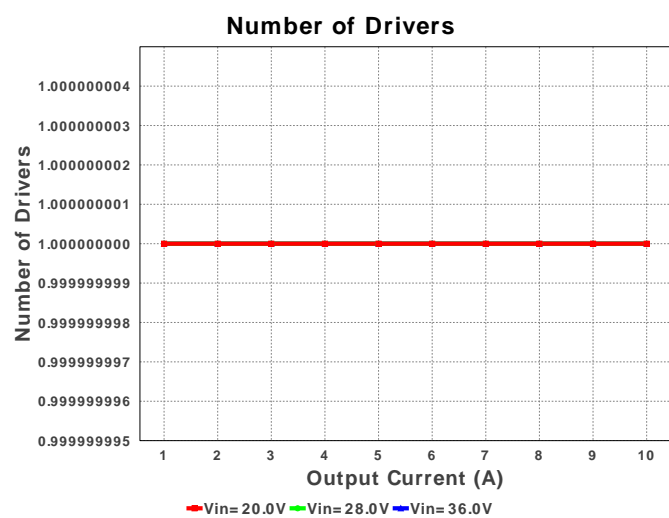
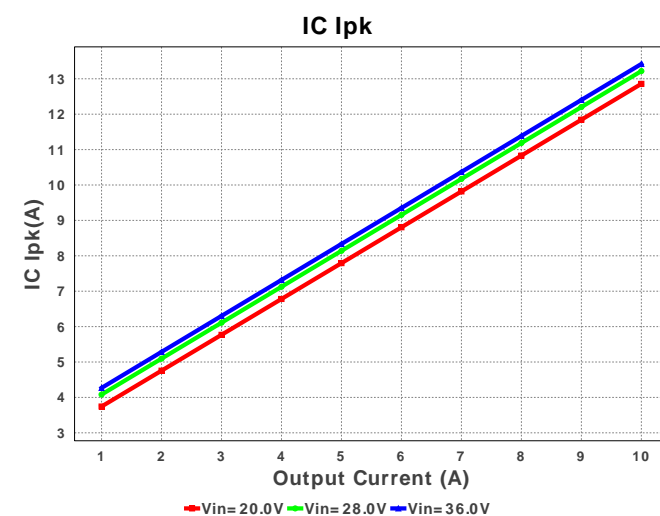
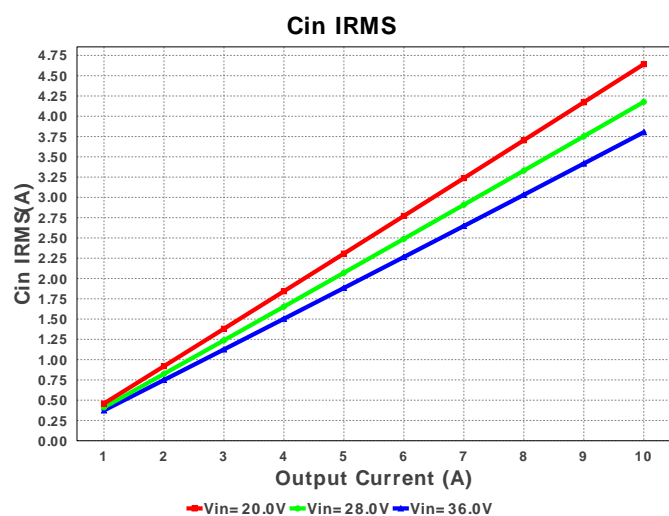
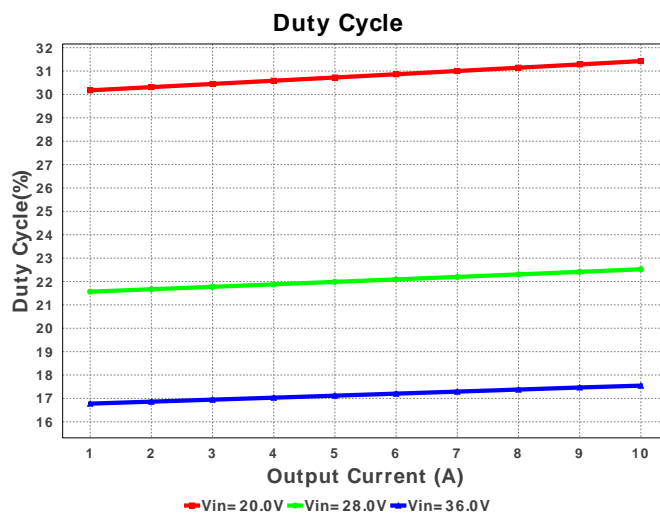
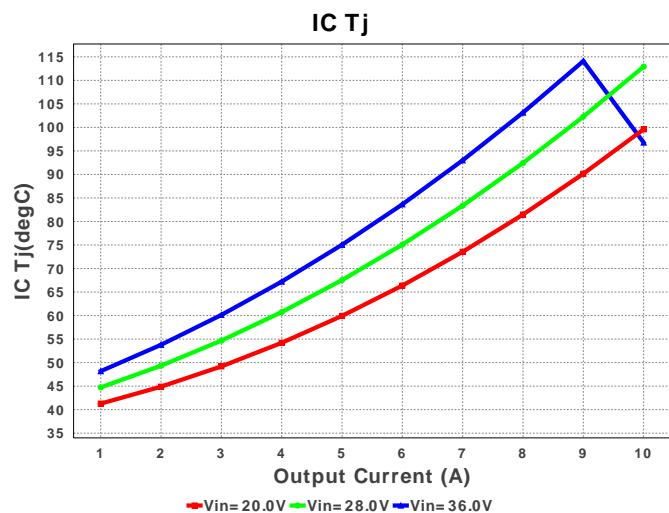
1. This design cannot function without airflow at maximum input voltage and full load current. An airflow of 225LFM is required to bring down the ThetaJA of the IC.

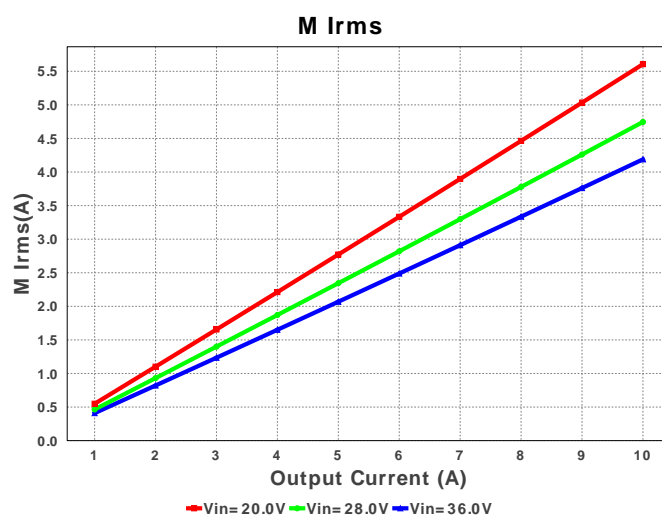
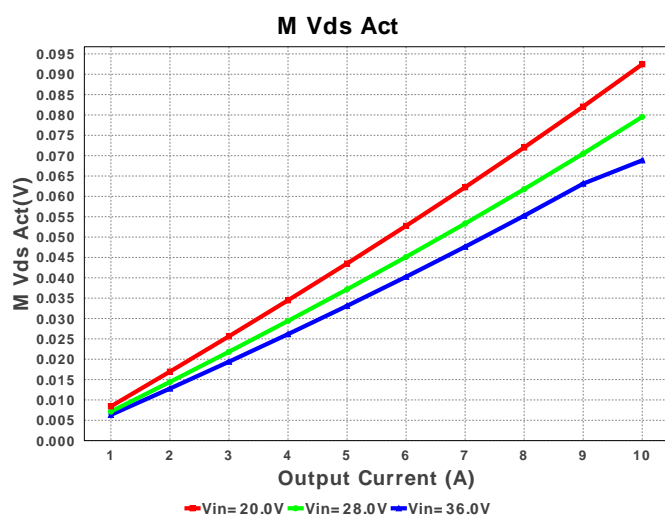
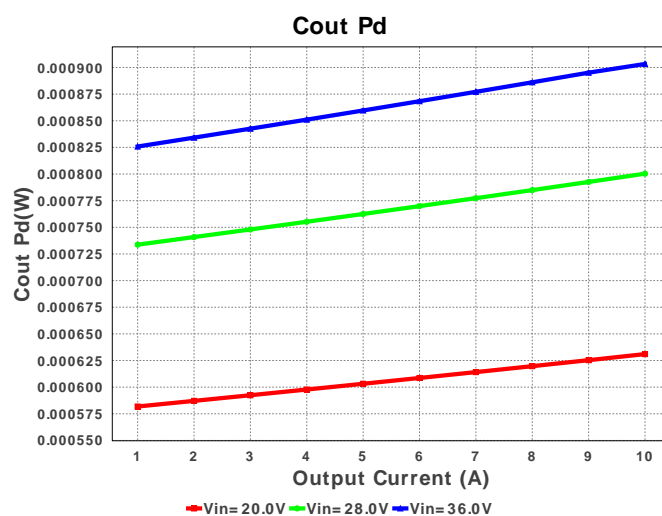
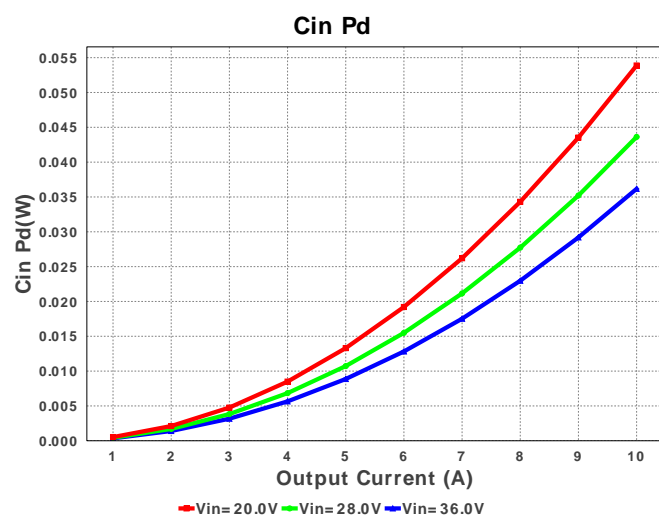
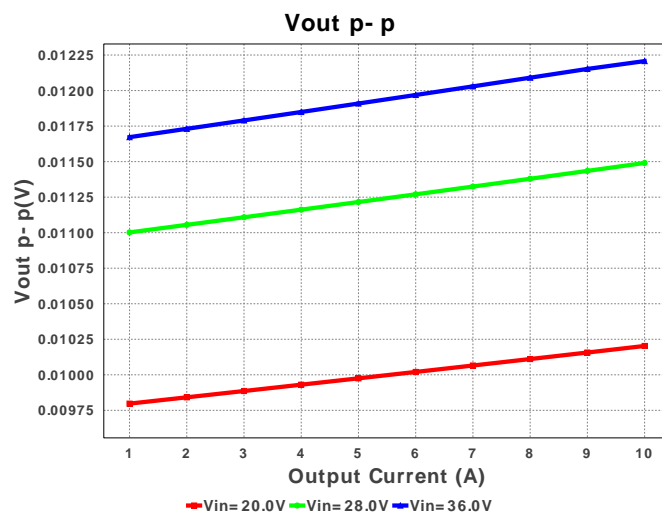
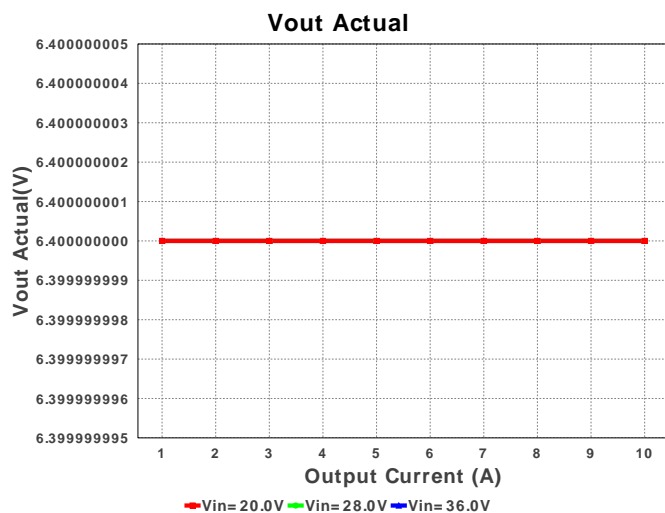
### My Comments

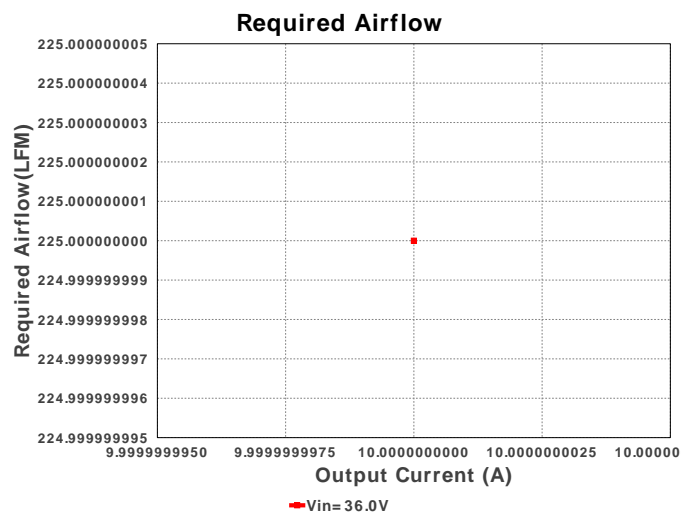
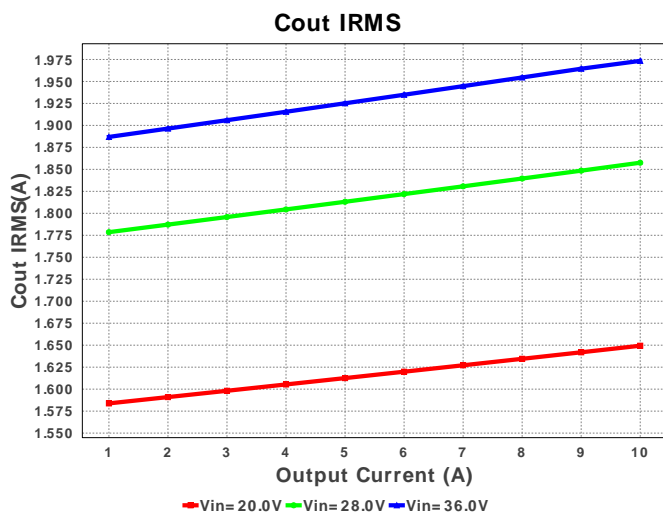
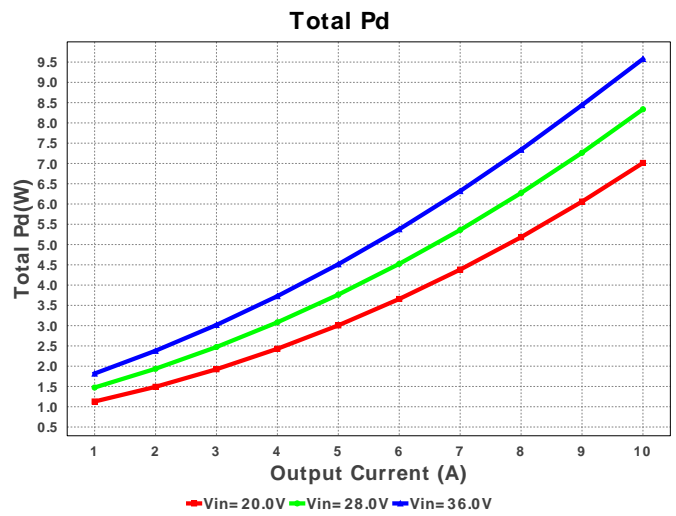
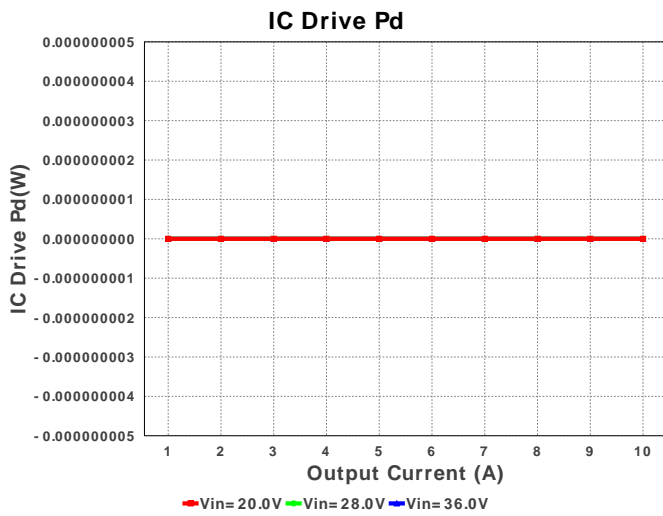
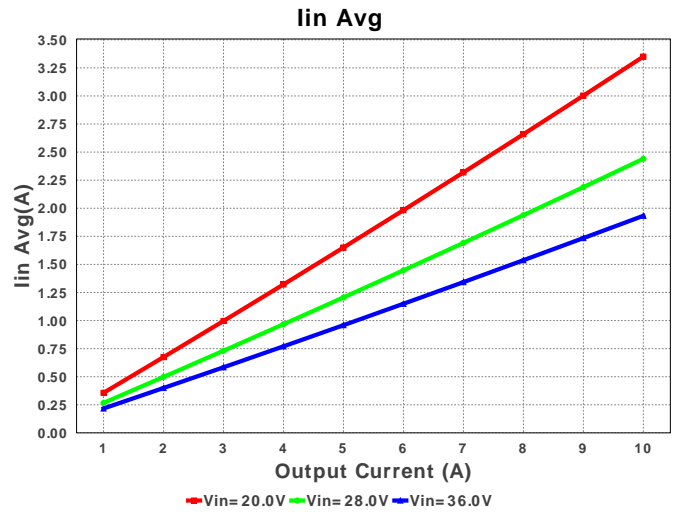
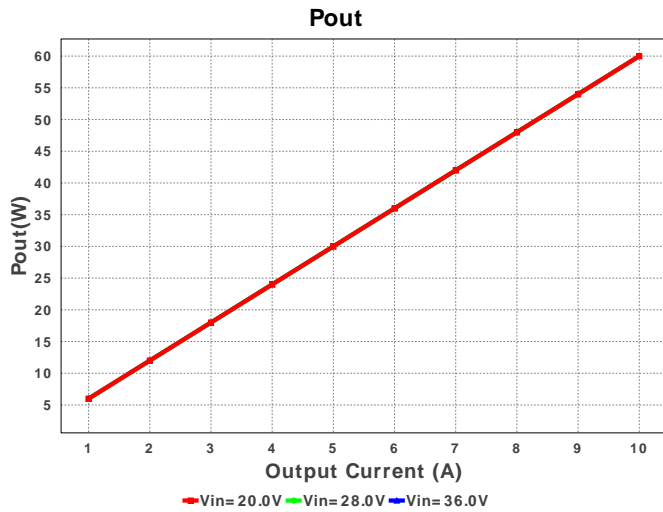
No comments

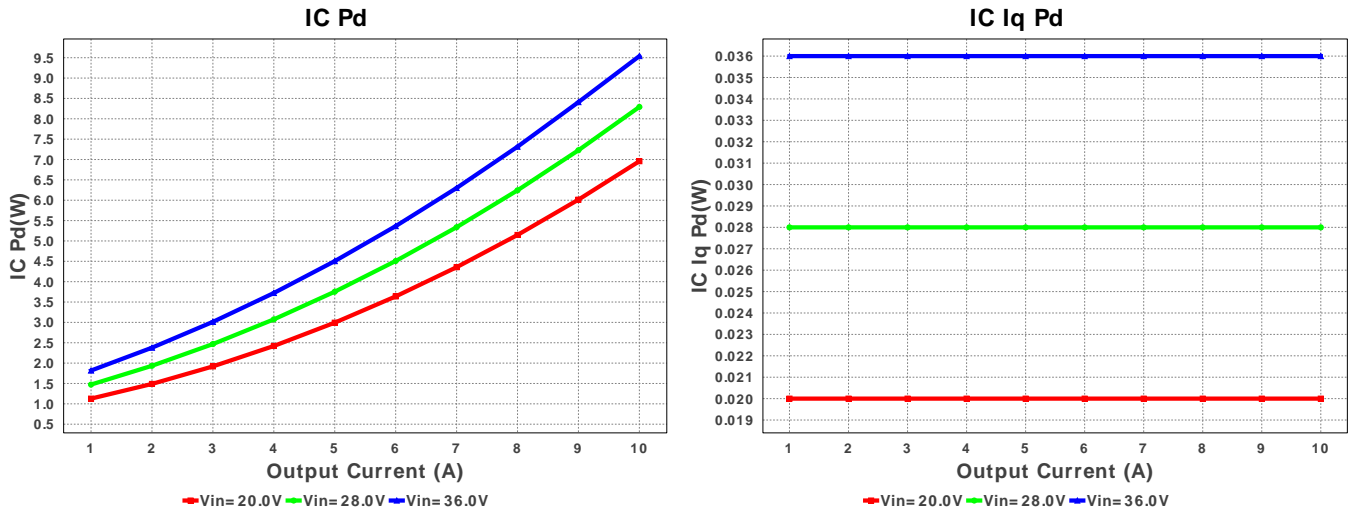
### Electrical BOM

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cin	TDK	C5750X7S2A106M230KB Series= X7S	Cap= 10.0 uF ESR= 5.0 mOhm VDC= 100.0 V IRMS= 6.45 A	2	NA	 2220 54 mm <sup>2</sup>
2.	Cout	TDK	C1608X5R1A106K080AC Series= X5R	Cap= 10.0 uF ESR= 4.639 mOhm VDC= 10.0 V IRMS= 2.4141 A	20	\$0.10	 0603 5 mm <sup>2</sup>
3.	Rfbb	Panasonic	ERJ-6ENF1001V Series= ERJ-6E	Res= 1000.0 Ohm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	 0805 7 mm <sup>2</sup>
4.	Rfbs	CUSTOM	CUSTOM Series= ?	Res= 7.0 kOhm Power= 0.0 W Tolerance= 0.0%	1	NA	CUSTOM 0 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.	BOM Count	25		Total Design BOM count
2.	Total BOM	\$0.0		Total BOM Cost
3.	Cin IRMS	3.804 A	Current	Input capacitor RMS ripple current
4.	Cout IRMS	1.973 A	Current	Output capacitor RMS ripple current
5.	IC Ipk	13.418 A	Current	Peak switch current in IC
6.	Iin Avg	1.933 A	Current	Average input current
7.	M1 Irms	4.189 A	Current	Q lavg
8.	FootPrint	555.0 mm <sup>2</sup>	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	68.845 mV	General	Voltage drop across the MosFET
12.	Pout	60.0 W	General	Total output power
13.	Vout Actual	6.4 V	Op_Point	Vout Actual calculated based on selected voltage divider resistors
14.	Vout OP	6.0 V	Op_Point	Operational Output Voltage
15.	Cross Freq	13.923 kHz	Op_point	Bode plot crossover frequency
16.	Duty Cycle	17.546 %	Op_point	Duty cycle
17.	Efficiency	86.236 %	Op_point	Steady state efficiency
18.	IC Tj	96.777 degC	Op_point	IC junction temperature
19.	ICThetaJA	7.0 degC/W	Op_point	IC junction-to-ambient thermal resistance
20.	IOUT_OP	10.0 A	Op_point	Iout operating point
21.	Phase Marg	39.857 deg	Op_point	Bode Plot Phase Margin
22.	VIN_OP	36.0 V	Op_point	Vin operating point
23.	Vout p-p	12.207 mV	Op_point	Peak-to-peak output ripple voltage
24.	Cin Pd	36.168 mW	Power	Input capacitor power dissipation
25.	Cout Pd	903.295 μW	Power	Output capacitor power dissipation
26.	IC Drive Pd	0.0 W	Power	Driver power dissipation
27.	IC Iq Pd	36.0 mW	Power	IC Iq Pd
28.	IC Pd	9.54 W	Power	IC power dissipation
29.	Total Pd	9.577 W	Power	Total Power Dissipation
30.	Number of Drivers	1.0		Number of drivers in current sharing mode.
31.	Required Airflow	225.0 LFM		Required Air Flow to keep the IC cool at full load current. This design is not possible without this much air flow.
32.	Vout Tolerance	3.406 %		Vout Tolerance based on IC Tolerance (no load) and voltage divider resistors if applicable

## Design Inputs

#	Name	Value	Description
1.	Iout	10.0	Maximum Output Current
2.	VinMax	36.0	Maximum input voltage
3.	VinMin	20.0	Minimum input voltage
4.	Vout	6.0	Output Voltage
5.	base_pn	LMZ23610	Base Product Number
6.	source	DC	Input Source Type
7.	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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