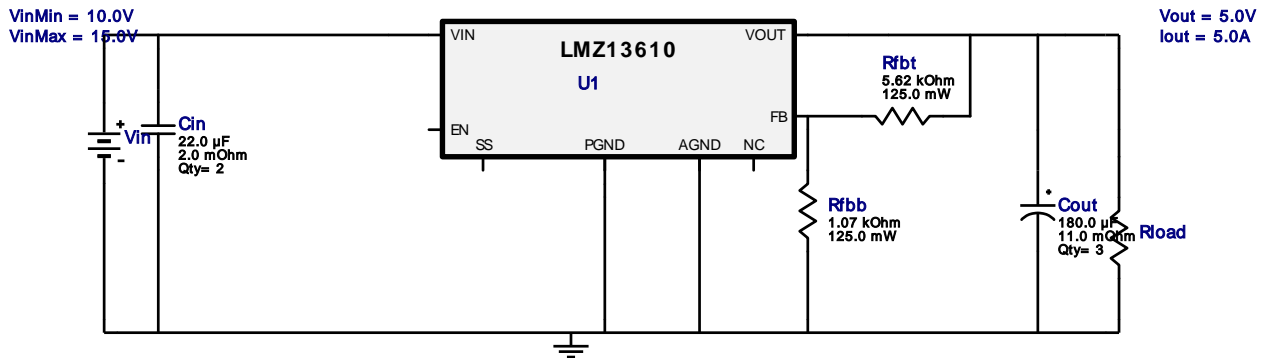




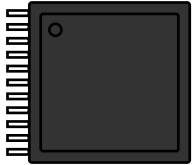
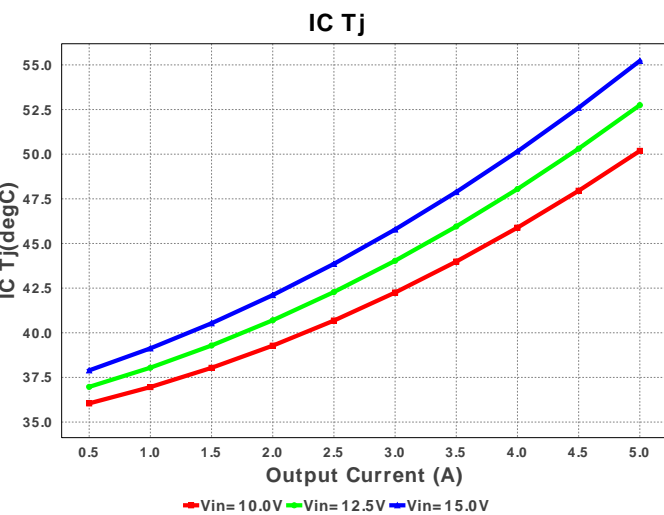
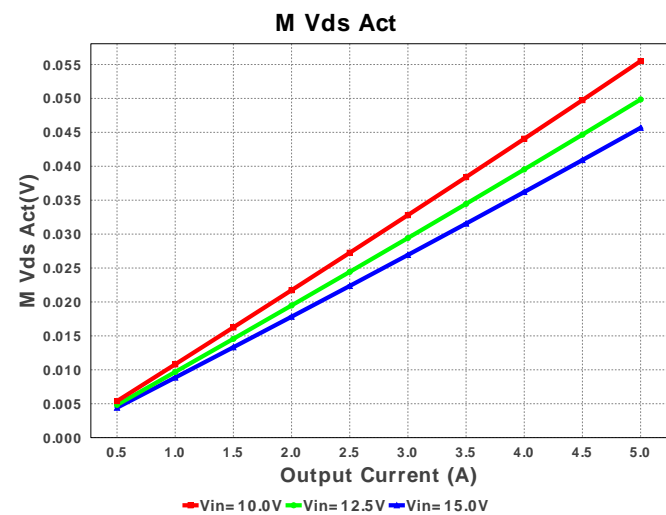
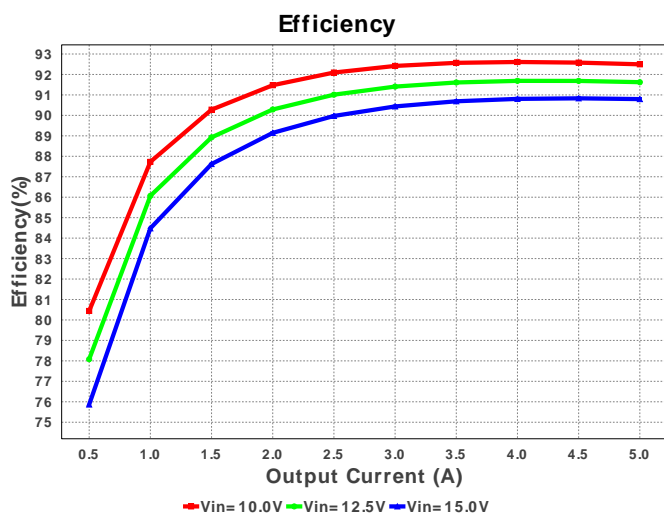
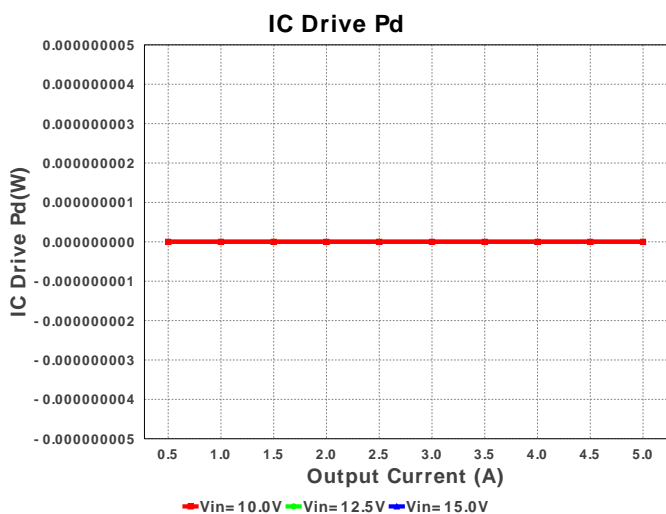
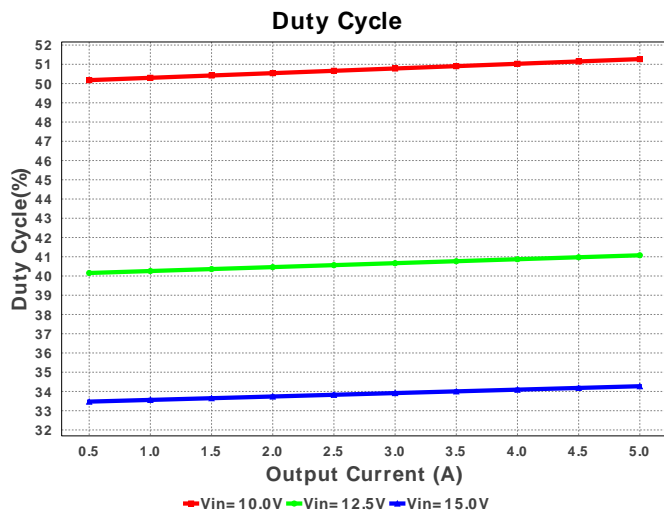
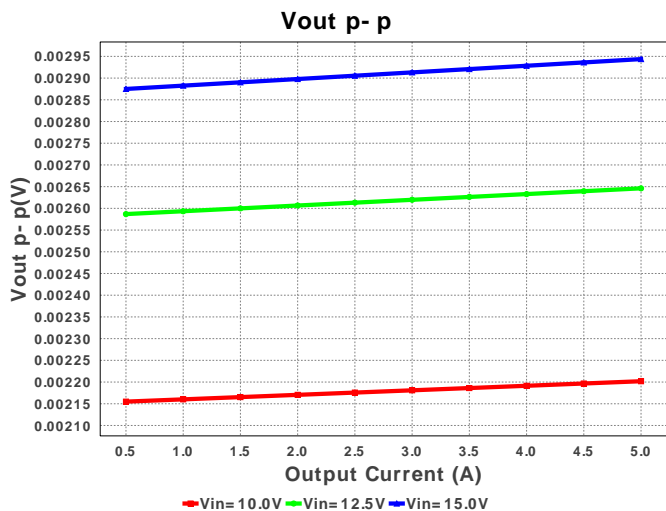
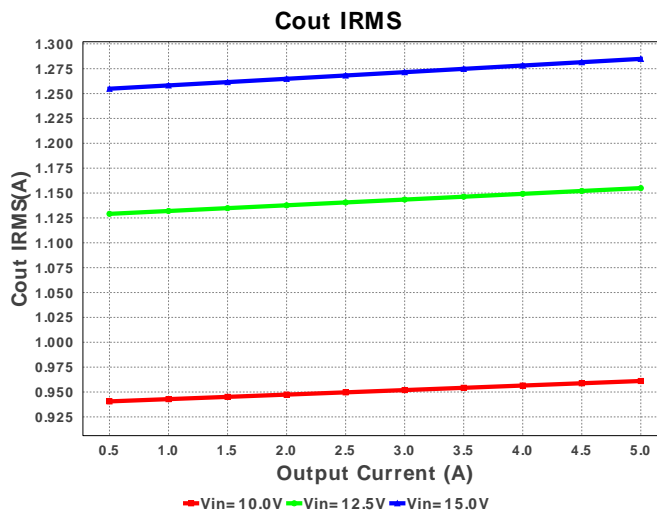
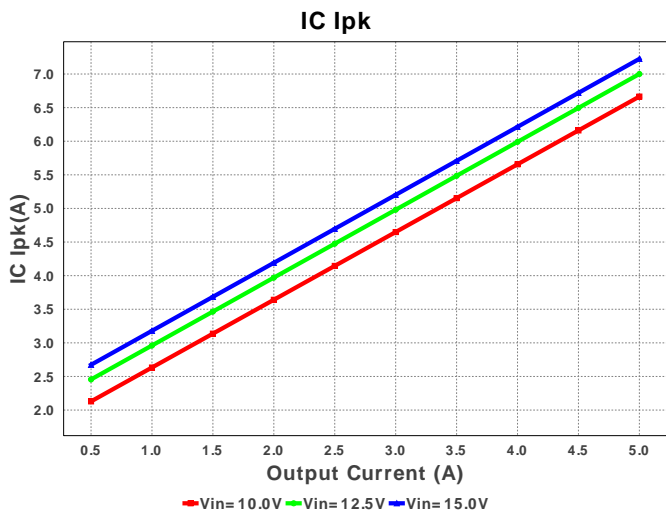
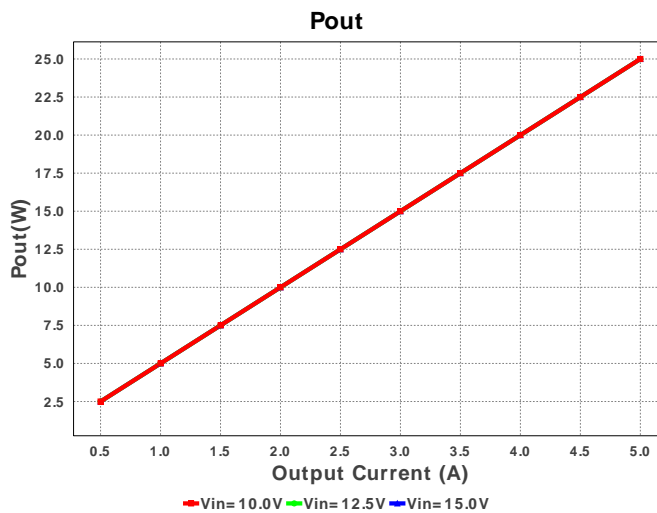
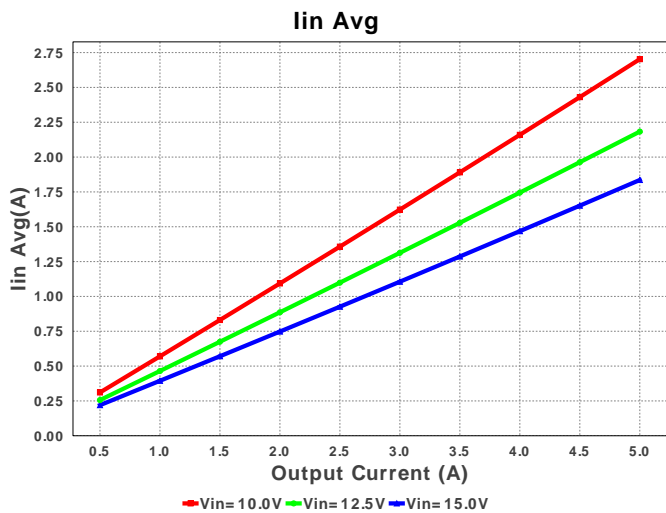
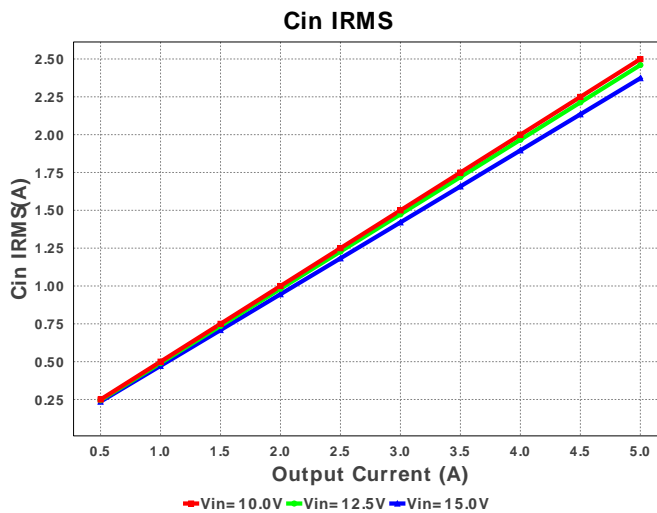
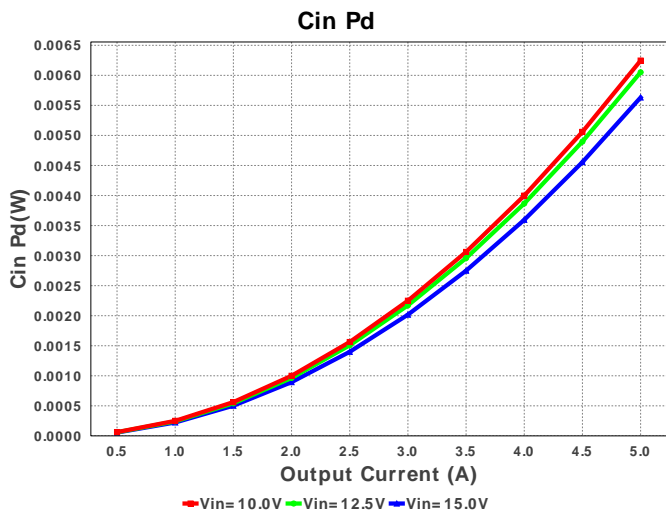


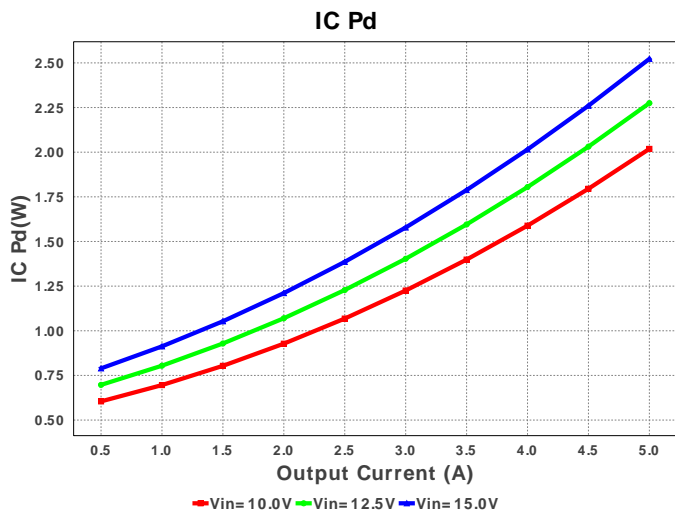
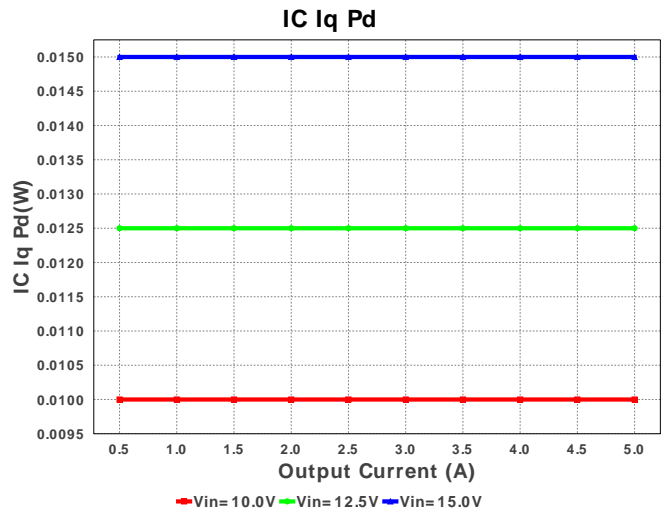
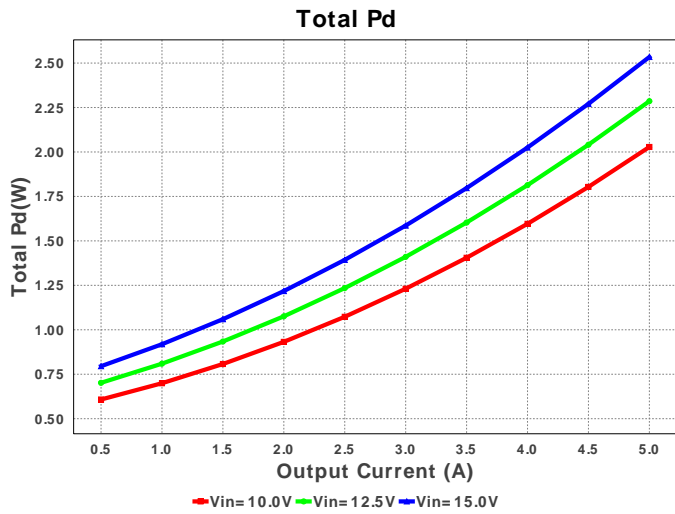
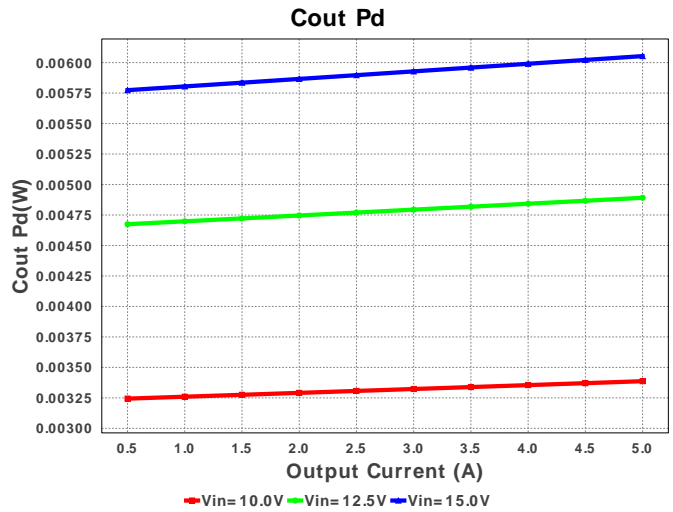
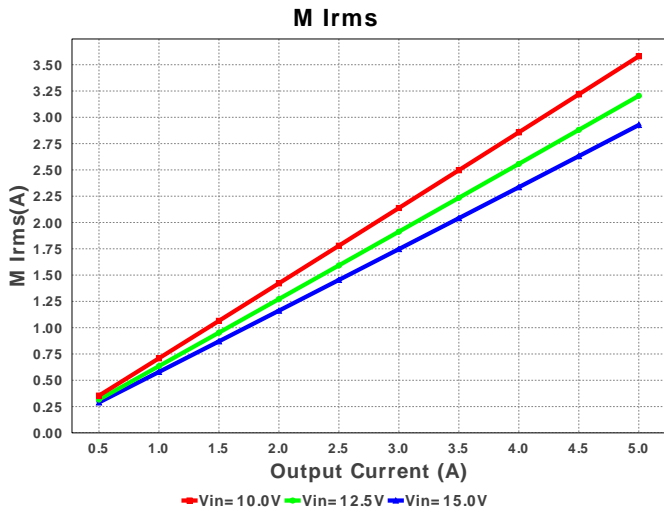
WEBENCH[®] Design Report

 Design : 433359/117 LMZ13610TZ/NOPB
 LMZ13610TZ/NOPB 10.0V-15.0V to 5.00V @ 5.0A

Electrical BOM

#	Name	Manufacturer	Part Number	Properties	Qty	Price	Footprint
1.	Cin	MuRata	GRM32ER61E226KE15L Series= X5R	Cap= 22.0 uF ESR= 2.0 mOhm VDC= 25.0 V IRMS= 3.67 A	2	\$0.16	 1210 15 mm ²
2.	Cout	Panasonic	16SVPE180M Series= SVPE	Cap= 180.0 uF ESR= 11.0 mOhm VDC= 16.0 V IRMS= 4.46 A	3	\$0.49	 CAPSMT_62_C10 74 mm ²
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 ²
4.	Rfbb	Panasonic	ERJ-6ENF5621V Series= ERJ-6E	Res= 5.62 kOhm Power= 125.0 mW Tolerance= 1.0%	1	\$0.01	 0805 7 mm ²
5.	U1	Texas Instruments	LMZ13610TZ/NOPB	Switcher	1	\$14.10	 TZA011A 342 mm ²







Operating Values

#	Name	Value	Category	Description
1.	Cin IRMS	2.373 A	Current	Input capacitor RMS ripple current
2.	Cout IRMS	1.285 A	Current	Output capacitor RMS ripple current
3.	IC Ipk	7.225 A	Current	Peak switch current in IC
4.	Iin Avg	1.836 A	Current	Average input current
5.	M1 Irms	2.927 A	Current	Q Iavg
6.	BOM Count	8	General	Total Design BOM count
7.	FootPrint	606.0 mm ²	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	45.676 mV	General	Voltage drop across the MosFET
11.	Pout	25.0 W	General	Total output power

#	Name	Value	Category	Description
12.	Total BOM	\$15.91	General	Total BOM Cost
13.	Vout OP	5.0 V	Op_Point	Operational Output Voltage
14.	Cross Freq	7.73 kHz	Op_point	Bode plot crossover frequency
15.	Duty Cycle	34.272 %	Op_point	Duty cycle
16.	Efficiency	90.796 %	Op_point	Steady state efficiency
17.	IC Tj	55.225 degC	Op_point	IC junction temperature
18.	ICThetaJA	10.0 degC/W	Op_point	IC junction-to-ambient thermal resistance
19.	IOUT_OP	5.0 A	Op_point	Iout operating point
20.	Phase Marg	47.43 deg	Op_point	Bode Plot Phase Margin
21.	VIN_OP	15.0 V	Op_point	Vin operating point
22.	Vout p-p	2.944 mV	Op_point	Peak-to-peak output ripple voltage
23.	Cin Pd	5.632 mW	Power	Input capacitor power dissipation
24.	Cout Pd	6.053 mW	Power	Output capacitor power dissipation
25.	IC Drive Pd	0.0 W	Power	Driver power dissipation
26.	IC Iq Pd	15.0 mW	Power	IC Iq Pd
27.	IC Pd	2.523 W	Power	IC power dissipation
28.	Total Pd	2.534 W	Power	Total Power Dissipation

Design Inputs

#	Name	Value	Description
1.	Iout	5.0	Maximum Output Current
2.	Iout1	5.0	Output Current #1
3.	SoftStart	1.6 ms	Soft Start Time (ms)
4.	VinMax	15.0	Maximum input voltage
5.	VinMin	10.0	Minimum input voltage
6.	Vout	5.0	Output Voltage
7.	Vout1	5.0	Output Voltage #1
8.	base_pn	LMZ13610	Base Product Number
9.	source	DC	Input Source Type
10.	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. **LMZ13610 Product Folder** : <http://www.ti.com/product/LMZ13610> : 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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