LMZ13610/8/6 and LMZ12010/8/6 Evaluation Board

Introduction

The LMZ13610/8/6 and LMZ12010/8/6 SIMPLE SWITCH-ER® power modules are easy-to-use DC-DC solution capable of driving up to a 10, 8 or 6 ampere load. They are available in an innovative package that enhances thermal performance and allows for hand or machine soldering. The LMZ13610/8/6 can accept an input voltage rail between 6V and 36V and the LMZ12010/8/6 can accept an input voltage rail between 6V and 20V.

The evaluation board is highly configurable. The output voltage can be adjusted to 5V, 3.3V, 2.5V or 1.2V with a jumper change. The external soft-start capacitor facilitates a controlled and adjustable startup rise time of the output. The board temperature can be measured with the onboard resistor and the UVLO can be adjusted by changing one resistor. In addition the board comes preconfigured with an LC input filter to pass CISPR-22 class B conducted and radiated emissions.

The LMZ13610 and LMZ12010 family is a reliable and robust solution with the following features: loss-less cycle-by-cycle valley current limit to protect for over current or short-circuit fault, thermal shutdown, input under-voltage lockout, and will start up into a pre-biased output.

National Semiconductor Application Note 2134 Marc Davis-Marsh June 6, 2011

Board Specifications

- V_{IN} = 6V to 36V (LMZ13610/8/6)
- V_{IN} = 6V to 20V (LMZ12010/8/6)
- V_{OUT} = 1.2V, 2.5V, 3.3V or 5V (minimum input voltage of 7V required for 5V output)
- I_{OUT} = 0 to 10, 8, or 6 Amps
- $\theta_{JA} = 9.9 \text{ °C} / W, \theta_{JC} = 1.0 \text{ °C/W}$
- Designed on four layers; Inner are 1 oz copper; Outer are 2 oz copper.
- Measures 2.95" x 3.54" (75 mm x 90 mm) and is 62 mils (1.57 mm) thick of FR4 laminate material

For additional circuit considerations, including additional output voltage options, refer to the Applications Section section of the LMZ13610/8/6 or LMZ12010/8/6 data sheets. For negative output voltage connections see AN-2027.



Test Connections

The board should be connected to a power supply and load as shown below in *Figure 2*. The EN post is connected to the UVLO circuit on the back of the board. There is a resistive divider implemented on the board that can be used to establish a precision UVLO level for the board that is currently set to 5.7V. A common user change to this circuit is to adjust the

value of RENT and RENB to adjust the operating UVLO to that of the target application. Refer to the respective data sheet for calculation. Note that if in the end application the EN pin voltage does not exceed 5.5V at maximum Vin, then the enable clamp zener D1 can be omitted. (On revision A of the board the overlay for the zener diode has the cathode and anode incorrectly labeled). Pull EN low to shutdown the module.





The evaluation board is also compatible with the 20-pin edge connector shown in *Figure 3*. The table below explains the functionality of the pins.

Pin	Name	Description
1, 2, 3	VIN	Input supply — Nominal operating range is from 6V to 20V for the LMZ12010/8/6 and from 6V to
		36V for the LMZ13610/8/6.
4, 5, 6, 7	GND	Power Ground — Electrical path for the power circuits within the module.
8, 9, 10	VOUT	Output Voltage — Regulated 5, 3.3, 2.5 or 1.2V.
А	VIN SENSE +	Positive Kelvin Sense of Input voltage — Tied to VIN pin of the LMZ module.
Е	VIN SENSE -	Negative Kelvin Sense of Input voltage — Tied to PGND (EP) of the LMZ module.
L	VOUT SENSE +	Positive Kelvin Sense of Output voltage — Tied to Vout banana jack.
F	VOUT SENSE -	Negative Kelvin Sense of Output voltage — Tied to AGND of the LMZ module.
B, D, H	AGND	AGND Ground — Tied to AGND pin of module.
J	NC	No Connect — This pin must remain floating, do not ground.
С	EN	Enable — Input to the precision enable comparator of the LMZ Module.
К	TEMP SENSE	Connected to top of the Rts temperature sensing resistor. Temperature measurements can be made by measuring the temperature dependant resistance between TEMP SENSE and VIN SENSE
		Convert the resistance to temperature with the following equation: Temperature (C) \approx 2.6245 x
		Resistance (Ω) - 262.7

Adjusting the Output Voltage

The output voltage of the evaluation board is adjusted to either 5V, 3.3V, 2.5V, or 1.2V by moving jumper J1. For other voltage options see the datasheet for adjusting the feedback resistors.

Optional Components

The evaluation board has many options for input and output filtering. C_01 , C_02 and C_05 have been installed to decrease

high frequency noise on the output. Their removal will not effect other performance parameters of the design. Similarly, $C_{\rm IN}$ 1 has been installed to provide a high frequency bypass for the input current. The second order filter consisting of L1 and $C_{\rm IN}$ 6 has been designed to provide enough attenuation of the conducted noise to comply with EN 55022. This filtering is not required for normal operation of the module.





Bill of Materials

TABLE 1. Evaluation Board Bill of Materials, $V_{IN} = 6V$ to 36V (20V), $V_{OUT} = 1.2 / 3.3V / 5V$, $I_{OUT (MAX)} = 10/08/06A$

Designator	Description	Case Size	Manufacturer	Manufacturer P/N	Quantity
U1	SIMPLE SWITCHER®	TO-PMOD-11	National	LMZ13610/08/06 or	1
			Semiconductor	LMZ12010/08/06	
Cin1	0.047uF, X7R, 50V	0805	Kemet	C0805C473K5RACTU	3
Co1					
Co5					
Cin2	10 µF, X7S, 50V	1210	TDK	C3225X7S1H106M	4
Cin3					
Cin4 Cin6					
Cin5	150 uE Aluminum	G	Panasonic	EEE-EK1H151P	1
0110	Electrolytic, 50V	G	1 anasonio		
Co2	47uF, X5R, 10V	1210	Murata	GRM32ER61A476KE20L	1
Co3	330µF, 6.3V, 0.015 ohm,	2917	Kemet	T520D337M006ATE015	2
Co4					
Cff	4700 pF, X7R, 50V	0805	Kemet	C0805C472K5RACTU	1
Css	0.15uF, X7R, 10V	0603	Murata	GRM188R71A154KA01D	2
L1	Shielded Drum Core,		Wurth	744314330	1
	Powdered Iron, 3.3uH,				
	12A, 0.011 ohm				
L1_alternate	Shielded Drum Core,		Toko	892NAS-3R3M	
^used in	3.3uH, 0.011 ohm				
	4.7V 500mW	SOD-123	Viebov	MM974699-V-G909	1
Bent	4.7 V, 300mW	0805	Vishay-Dala	CBCW08054K12EKEA	1
Bonh	1.27k ohm 1% 0.125W	0805	Vishay-Dale		1
 	1.27 K Ohm, 1%, 0.125W	0805	Vishay-Dale		1
	576 ohm 1% 0.125W	0805	Vishay Dale		1
	9.53 ohm 1% 0.125W	0805	Vishay-Dale		1
	9.55 0mm, 1%, 0.125W	0805	Vishay-Dale		
RIDI_2.5	3.74K 01111, 1%, 0.125W	0805	Vishay-Dale		1
	04.5 01111, 1%, 0.125W	0805	Vishay-Dale		1
	160 ohm 1% 0.125W	0805	Vishay-Dale		1
	169 0nm, 1%, 0.125W	0805	Visnay-Dale		
	5.6K onm, 1%, 0.125W	0805	Visnay-Dale		
	73.2 onm, 1%, 0.125W	0805	Visnay-Dale		
	20 Ω	0805	Visnay-Dale		
Hts	Resistor	0805	visnay	PTS08051B100RP 100	1
EN	Test Point, TH,		Keystone Electronics	5000	1
	Miniature, Red				
GND	Test Point, TH,		Keystone Electronics	5001	2
GND	Miniature, Black				
GND	Banana Jack Connector		Keystone Electronics	575-8	4
VOUT					
SH-1	Shunt, 100mil. Gold		Amp	382811-6	1
	plated, Black			30200	
	, · · · ·		<u> </u>		•

Designator	Description	Case Size	Manufacturer	Manufacturer P/N	Quantity
H1	Machine Screw, Round,		B and FFastener	NY PMS 440 0025 PH	4
H2	#4-40 x 1/4, Nylon,		Supply		
H3	Philips panhead				
H4					
H5	Standoff, Hex, 0.5"L		Keystone	1902C	4
H6	#4-40 Nylon				
H7					
H8					
J1	Header, 4x2, Gold	TH, 100mil	Samtec Inc.	TSW-104-07-G-D	1
	plated, 230 mil above				
	insulator				
J2	20-Pin Dual Edge		EDAC	305-020-500-202	0
	Connector, 0.156" pitch				

Performance Characteristics

Efficiency, V_{OUT} = 5.0V



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PCB Layout Diagrams

Gerber and CAD files can be downloaded from the associated product folder.













Notes

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