Introduction

The ISL8106EVAL1Z evaluation board demonstrates the performances of the ISL8106, synchronous buck PWM controller with Intersil's Robust Ripple Regulator (R3) technology.

The ISL8106 features a 1.5ms digital soft-start and can be started into a pre-biased output voltage. The PWM switching frequency can be programmed from 200kHz to 600kHz. The ISL8106 can be configured to operate in Forced-Continuous-Conduction-Mode (FCCM) or in Diode-Emulation-Mode (DEM), which improves light-load efficiency. An audio filter prevents the PWM switching frequency from entering the audible spectrum due to extremely light load while in DEM. Refer to the ISL8106 data sheet for a more detailed operation by clicking on the following link.

http://www.intersil.com/data/fn/fn9283.pdf

ISL8106EVAL1Z Reference Design

The ISL8106EVAL1Z design criteria is listed in Table 1.

TABLE 1. ISL8106EVAL1Z DESIGN CRITERIA

PARAMETERS	VALUE
Input Voltage	7V to 25V
Output Voltage	1.8V
Rated Output Current	25A
Switching Frequency	300kHz

Setting Switching Frequency

The switching frequency of ISL8106EVAL1Z can be adjusted through the resistor, R_5, that is connected from the FSET pin to the GND pin. Programming the approximate PWM switching frequency can be estimated from Equation 1:

$$R_{FSET} = \frac{1}{60 \cdot F_{OSC} \cdot [1 \times 10^{-12}]} \quad \text{(EQ. 1)}$$

Setting Overcurrent Protection Threshold

An overcurrent protection fault will occur when the ISEN pin has measured more than the OCP threshold current I_{OC} (26µA, typ.), on consecutive PWM pulses, for a period exceeding 20µs. It does not matter how many PWM pulses are measured during the 20µs period. If a measurement falls below I_{OC} before 20µs has elapsed, then the timer is reset to zero. A short circuit protection fault will occur when the ISEN pin has measured more than the short-circuit threshold current $I_{SC,}$ in less than 10µs, on consecutive PWM pulses.

The value of RSEN can then be calculated by Equation 2:

$$R_{SEN} = \frac{\left[I_{FL} + \frac{I_{P-P}}{2}\right] \cdot OC_{SP} \cdot r_{DS(ON)}}{I_{OC}} \quad \text{(EQ. 2)}$$

Where:

- R_{SEN} (Ω) is the resistor used to program the overcurrent setpoint
- I_{OC} is the I_{SEN} threshold current value sourced from the ISEN pin that will activate the OCP circuit
- I_{FL} is the maximum continuous DC load current
- I_{P-P} is the inductor peak-to-peak ripple current
- OC_{SP} is the desired overcurrent setpoint expressed as a multiplier relative to I_{FL}

Power and Load Connections

INPUT VOLTAGE

The PVIN post (J1) is connected to the drain of the upper MOSFET and the VIN pin of the IC. The post (J2) is connected to PGND.

OUTPUT VOLTAGE LOADING AND MONITORING

Connect the positive and negative leads of an electronic load to J3 and J4 respectively. Terminal TP4 (PGND) and TP5 (V_{OUT}) can be used to measure the output voltage.

Switch Descriptions

TABLE 2. ISL8106EVAL1Z SWITCH DESCRIPTIONS

TOGGLE SWITCHES	FUNCTION
SW1	OFF: Shorts the EN pin to GND (Disable the controller) ON: Enable the controller, EN pin is pulled to V_{IN} and clamped by D1.
SW2	DEM: FCCM pin is pulled to GND to enable diode-emulation mode FCCM: FCCM pin is pulled to VCC to inhibits diode-emulation mode

Test-point Descriptions

TABLE 3. ISL8106EVAL1Z TEST POINT DESCRIPTIONS

TEST POINTS	SIGNALS
TP1	VCC
TP2	PGND
TP3	PGOOD
TP4	PGND
TP5	VOUT
TP6	PVIN
TP6	LX

CAUTION: These devices are sensitive to electrostatic discharge; follow proper IC Handling Procedures.
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Typical Performance Curves

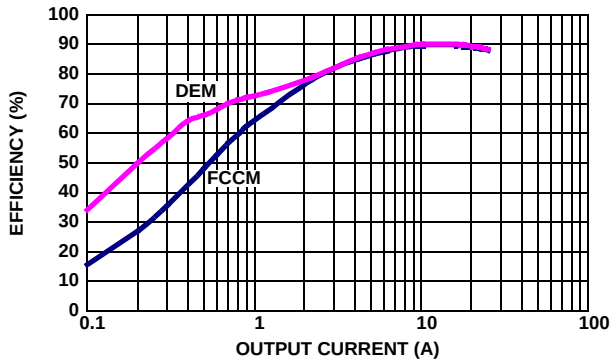


FIGURE 1. EFFICIENCY (V_{IN} = 12V, V_{OUT} = 1.8V, F_{SW} = 300kHz)

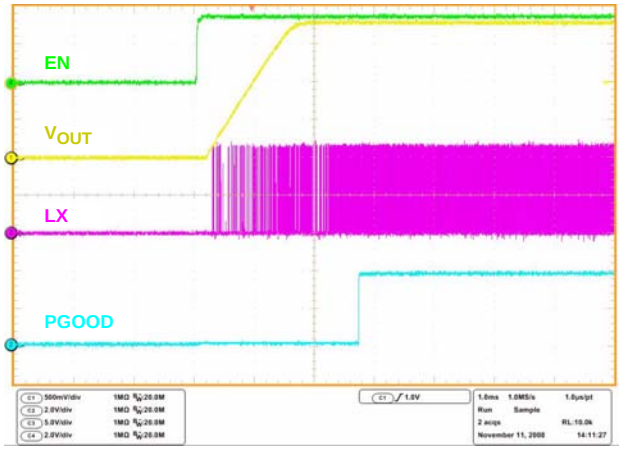


FIGURE 2. SOFT-START: 25A LOAD, FCCM = HIGH

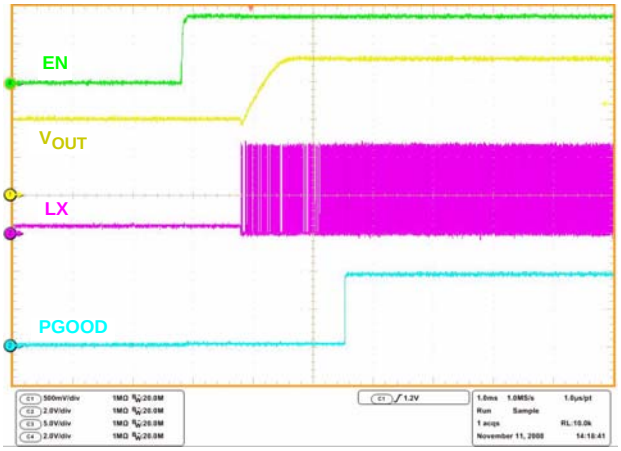


FIGURE 3. PRE-BIASED START-UP (1V PRE-BIASED)

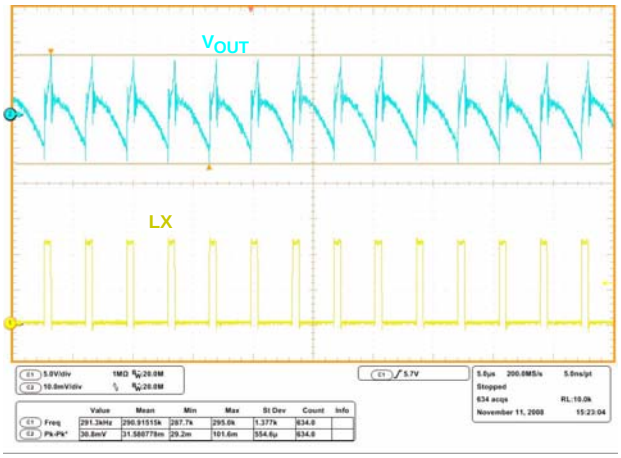


FIGURE 4. STEADY STATE: 25A LOAD

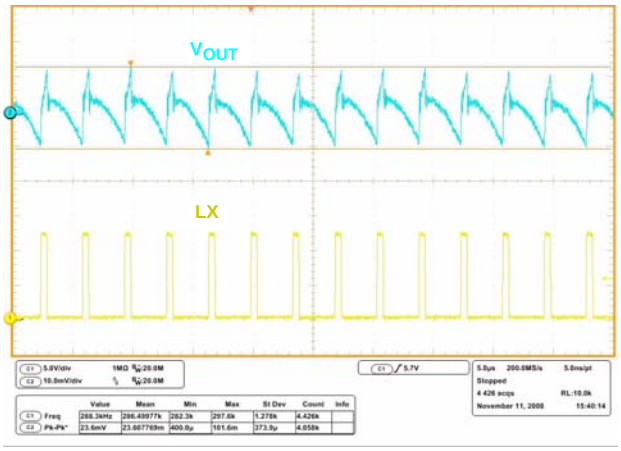


FIGURE 5. STEADY STATE: NO LOAD (FCCM)

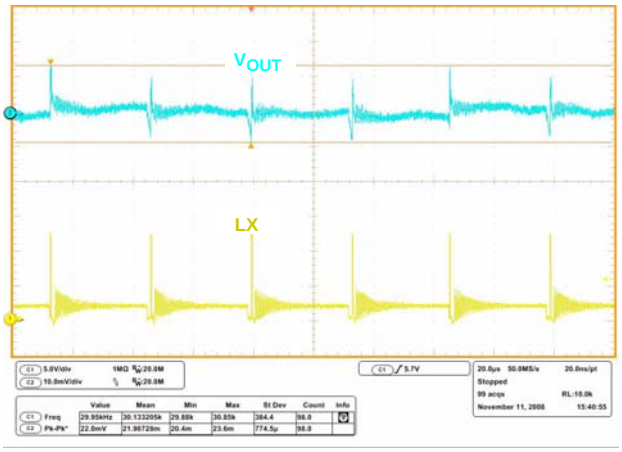


FIGURE 6. STEADY STATE: NO LOAD (DEM)

Typical Performance Curves (Continued)

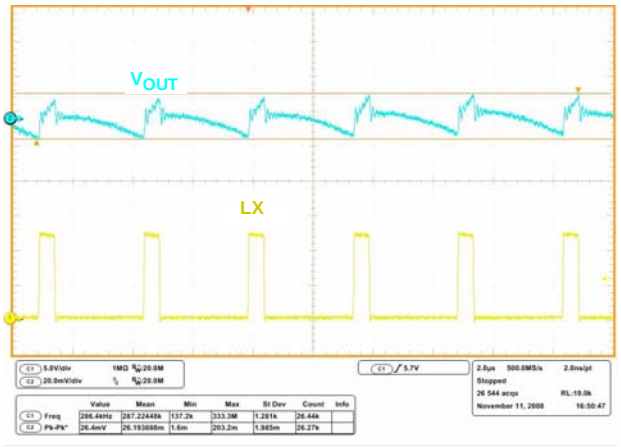


FIGURE 7. STEADY STATE: 1A LOAD (FCCM)

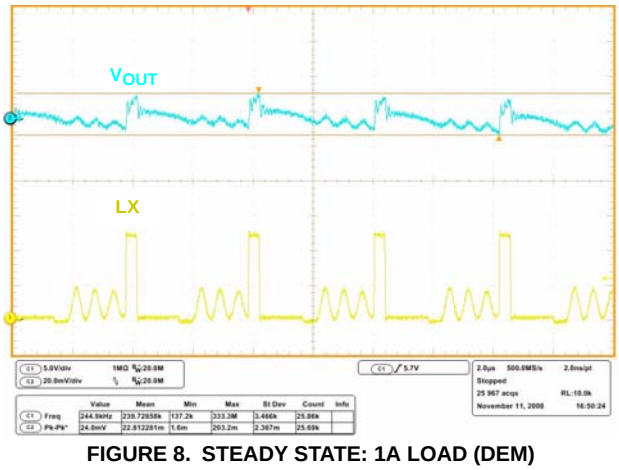


FIGURE 8. STEADY STATE: 1A LOAD (DEM)

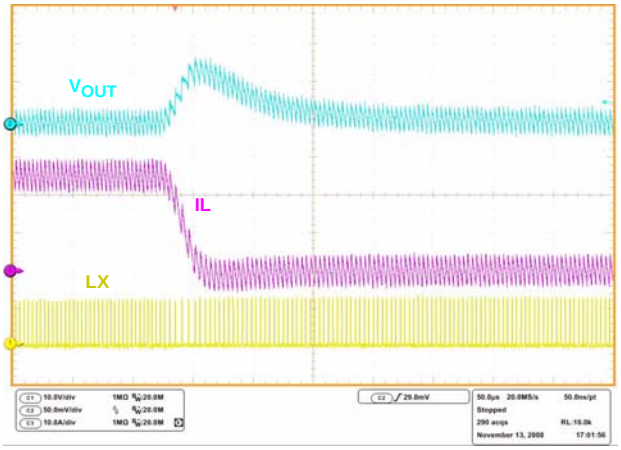


FIGURE 9. LOAD TRANSIENT: 25A TO 0A (CCM)

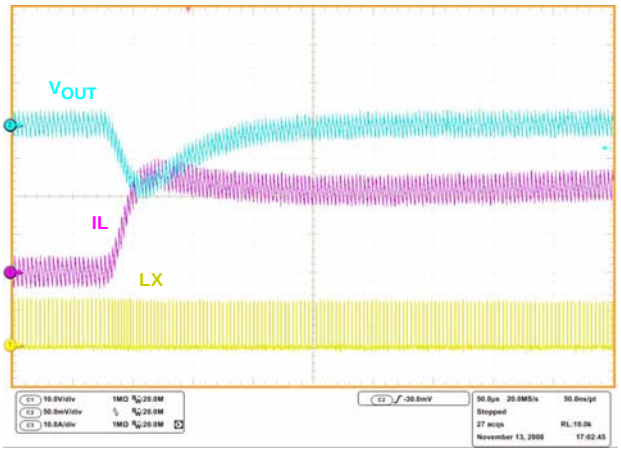


FIGURE 10. LOAD TRANSIENT: 0A TO 25A (CCM)

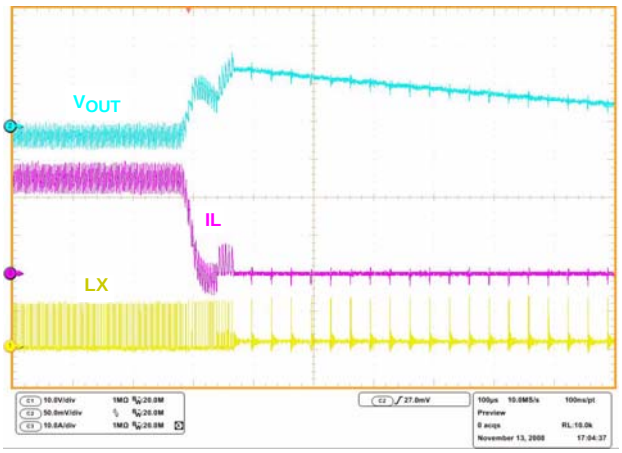


FIGURE 11. LOAD TRANSIENT: 25A TO 0A (DCM-CCM)

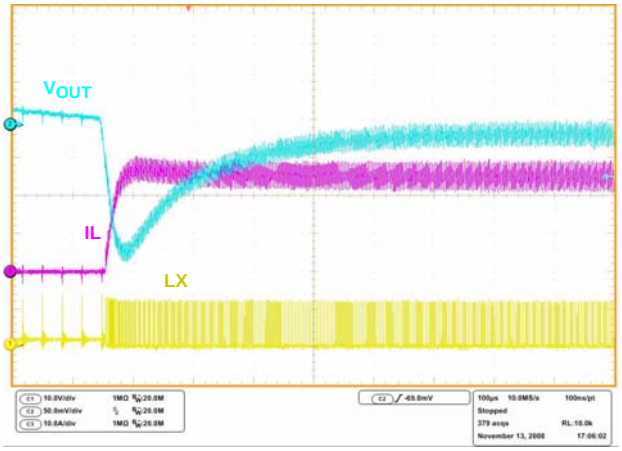
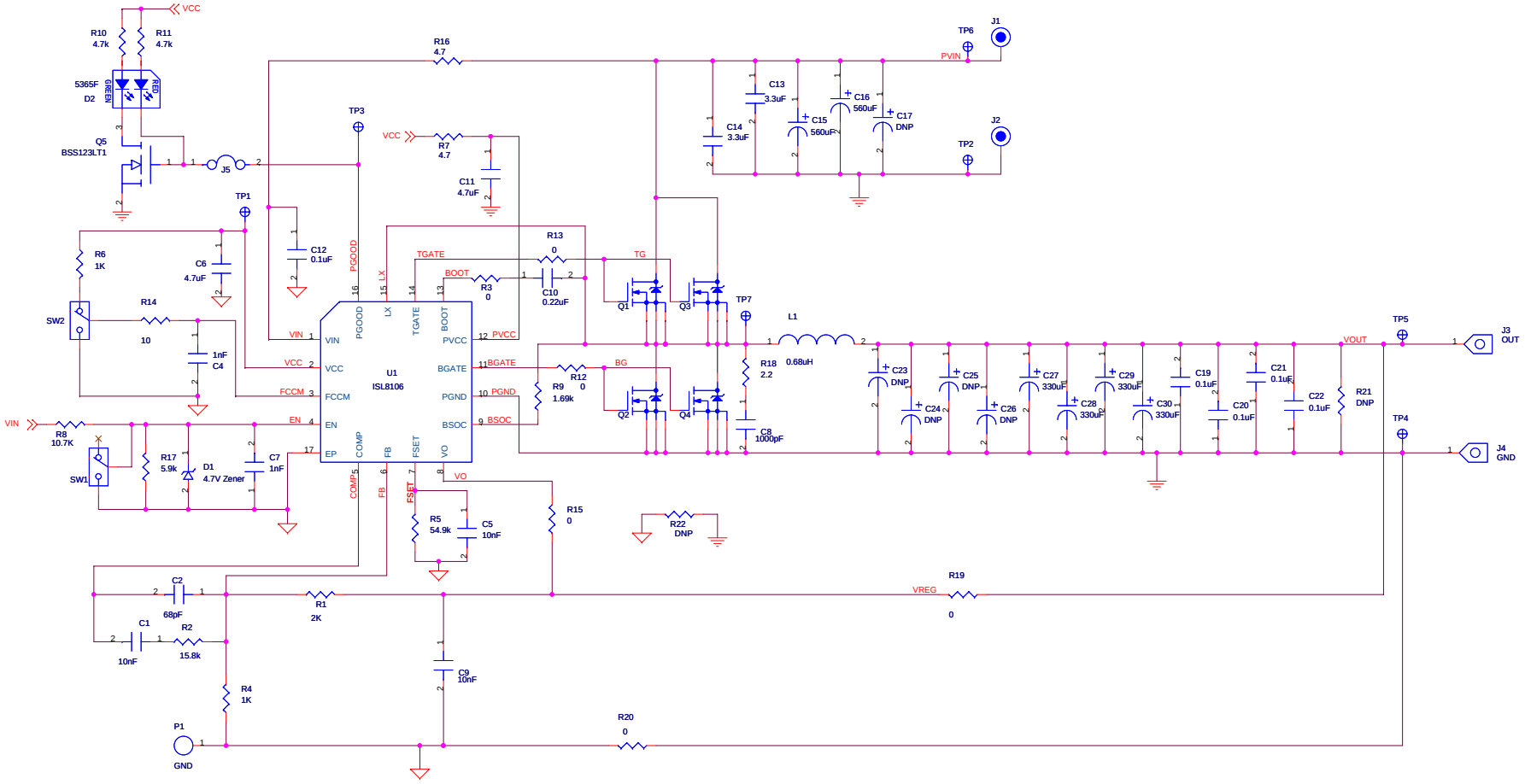


FIGURE 12. LOAD TRANSIENT: 0A TO 25A (CCM-DCM)

ISL8106EVAL1Z Schematic



ISL8106EVAL1Z Bill of Materials

ID	REFERENCE	QTY	PART NUMBER	PART TYPE	DESCRIPTION	PACKAGE	VENDOR
1	U1	1	ISL8106IRZ	IC, Linear	IC, Single PWM Controller	16Ld QFN	Intersil
2	Q1, Q3	2	BSC059N04LS G	MOSFET, Single	N-Channel, 40V	TDSON-8	Infineon
3	Q2, Q4	2	BSC018N04LS G	MOSFET, Single	N-Channel, 40V	TDSON-8	Infineon
4	Q5	1	BSS123LT1G	MOSFET	N-Channel	SOT-23	On Semi
5	D1	1	BST52C4V7-7-F	Zener Diode	4.7V, 500mW Zener Diode	SOD-123	Diode Inc.
6	D2	1	SSL-LXA3025IGC-TR	LED	RED/GREEN SMD LED	SMD 3mmx2.5mm	Lumex
7	L1	1	IHLP-5050FD-01-R68-M01	Inductor	0.68µH Power Inductor	SMD	Vishay
CAPACITORS							
8	C15, C16	2	EKZE350ELL561MJ25S	Capacitor, Alum. Elec.	560µF, 20%, 35V	RAD 10x25	United Chemi-con
9	C13, C14	2	C3225X7R1H335M	Capacitor, Ceramic, X7R	3.3µF, 10%, 50V	SM_1210	TDK/Generic
10	C4, C7, C8	3		Capacitor, Ceramic, X7R	1000pF, 10%, 50V	SM_0603	Generic
11	C1, C5, C9	3		Capacitor, Ceramic, X7R	0.01µF, 10%, 50V	SM_0603	Generic
12	C12, C19, C20, C21, C22	5		Capacitor, Ceramic, X7R	0.1µF, 10%, 50V	SM_0603	Generic
13	C10	1		Capacitor, Ceramic, X7R	0.22µF, 10%, 25V	SM_0603	Generic
14	C6, C11	2		Capacitor, Ceramic, X5R	4.7µF, 10%, 6.3V	SM_0603	Generic
15	C27, C28, C29, C30	4	6TPF330M9L	Capacitor, POSCAP	330µF, 20%, 6.3V, 0.009Ω	Case D3L	SANYO
16	C2	1		Capacitor, Ceramic, X5R	68pF, 10%, 50V	SM_0603	Generic
17	C17, C23, C24, C25, C26	0	Do Not Populate				
RESISTORS							
18	R1	1		Resistor, Film	2kΩ, 1%, 1/16W	SM_0603	Panasonic/Generic
19	R2	1		Resistor, Film	15.8kΩ, 1%, 1/16W	SM_0603	Panasonic/Generic
20	R4,R6	1		Resistor, Film	1kΩ, 1%, 1/16W	SM_0603	Panasonic/Generic
21	R21, R22	0	Do Not Populate			SM_0603	
22	R5	1		Resistor, Film	54.9kΩ, 1%, 1/16W	SM_0603	Panasonic/Generic
23	R7, R16	1		Resistor, Film	4.7Ω, 1%, 1/16W	SM_0603	Panasonic/Generic
24	R8	1		Resistor, Film	10.7kΩ, 1%, 1/16W	SM_0603	Panasonic/Generic
25	R3, R12, R13, R15, R19, R20	6		Resistor, Film	0Ω, 1%, 1/16W	SM_0603	Panasonic/Generic
26	R9	1		Resistor, Film	1.69kΩ, 1%, 1/16W	SM_0603	Panasonic/Generic
27	R10, R11	2		Resistor, Film	4.7kΩ, 1%, 1/16W	SM_0603	Panasonic/Generic
28	R14	1		Resistor, Film	10Ω, 1%, 1/16W	SM_0603	Panasonic/Generic
29	R17	1		Resistor, Film	5.9kΩ, 1%, 1/16W	SM_0603	Panasonic/Generic
30	R18	1		Resistor, Film	2.2Ω, 1%, 1/16W	SM_0603	Panasonic/Generic

ISL8106EVAL1Z Bill of Materials (Continued)

ID	REFERENCE	QTY	PART NUMBER	PART TYPE	DESCRIPTION	PACKAGE	VENDOR
OTHERS							
31	SW1, SW2	2	GT11MSCKE		Toggle Switch	SMD	C&K
32	P1	1	Do Not Populate				
33	TP1-TP6	6	5002	TEST POINT vertical, white	PC test jack	PTH	Keystone
34	TP7	0	Do Not Populate				
35	J1, J2	2			Blinding Post		
36	J5	1			1X2 Header		
37	J3, J4	2	KPA8CTP		Cable Terminal		BERG/FCI

ISL8106EVAL1Z Printed Circuit Board Layers

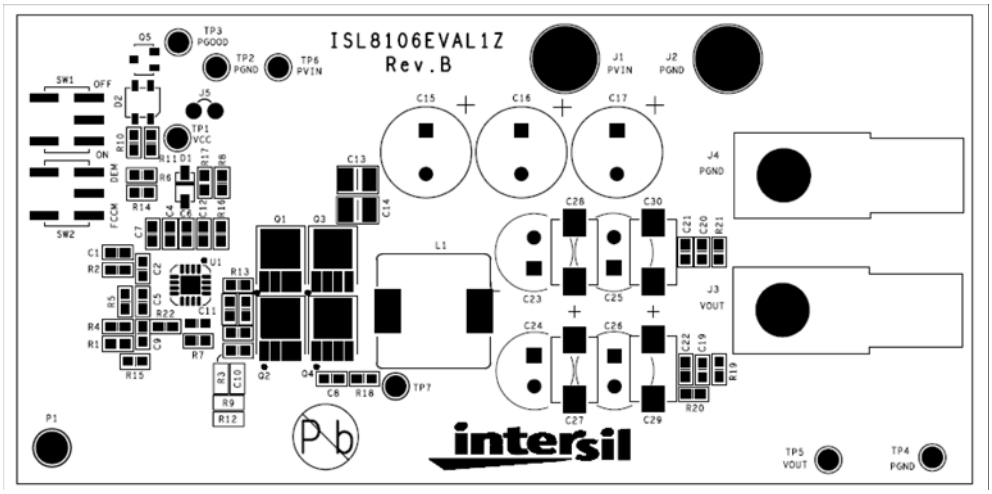


FIGURE 13. ISL8106EVAL1Z - TOP LAYER (SILKSCREEN)

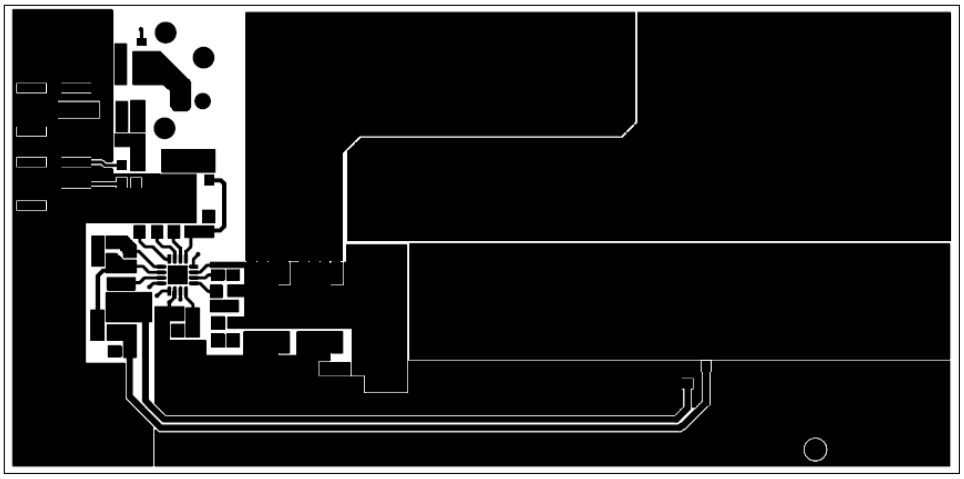


FIGURE 14. ISL8106EVAL1Z - TOP LAYER (COMPONENT SIDE)

ISL8106EVAL1Z Printed Circuit Board Layers (Continued)

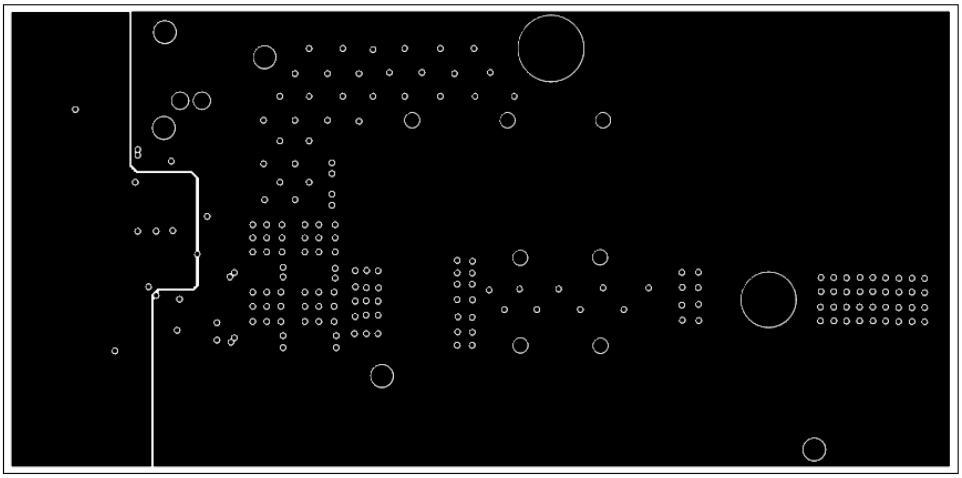


FIGURE 15. ISL8106EVAL1Z - LAYER 2

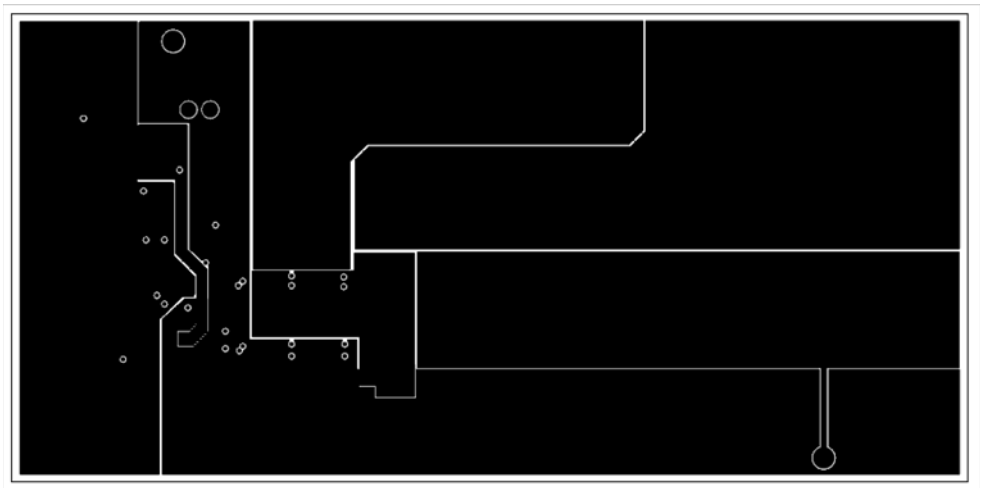


FIGURE 16. ISL8106EVAL1Z - LAYER 3

ISL8106EVAL1Z Printed Circuit Board Layers (Continued)

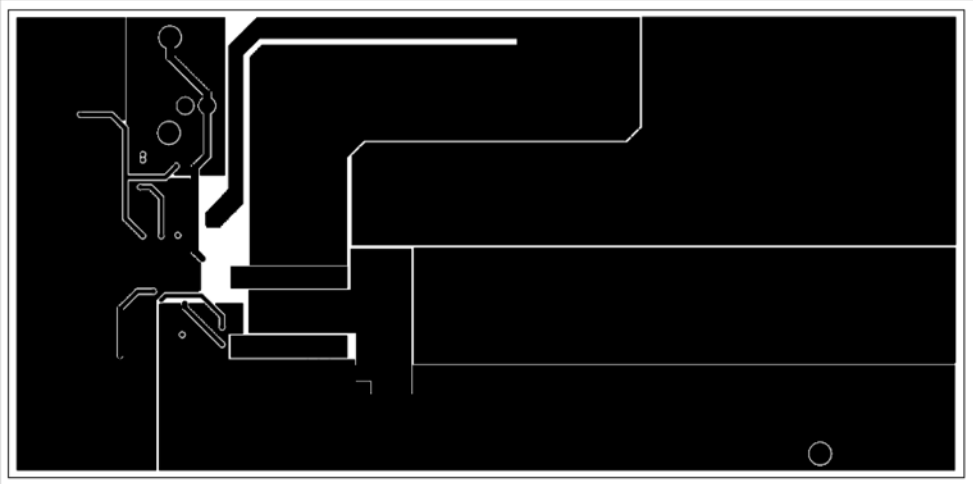


FIGURE 17. ISL8106EVAL1Z - BOTTOM LAYER (SOLDER SIDE)

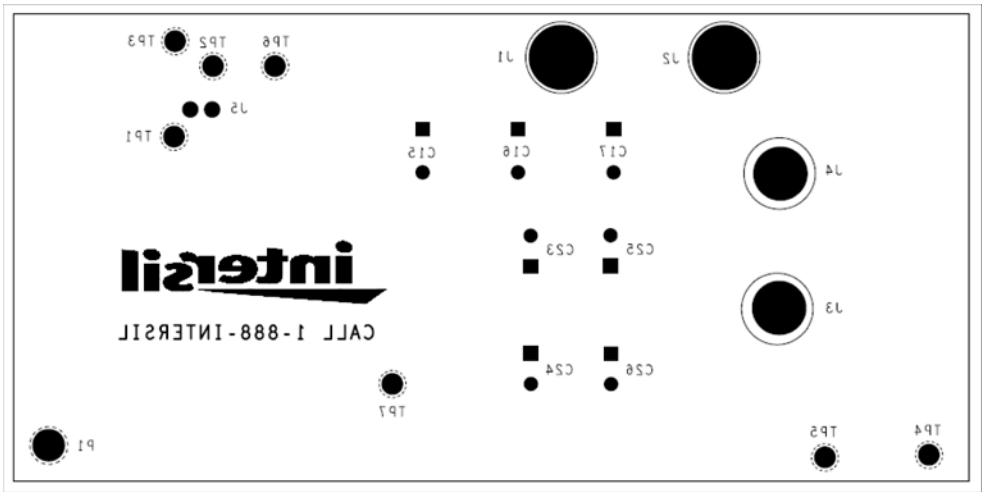


FIGURE 18. ISL8106EVAL1Z - BOTTOM LAYER (SILKSCREEN)

Intersil Corporation reserves the right to make changes in circuit design, software and/or specifications at any time without notice. Accordingly, the reader is cautioned to verify that the Application Note or Technical Brief is current before proceeding.

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