ISL6420BEVAL6Z - User Guide

Introduction

The ISL6420B is a wide input range, synchronous buck controller. It is designed to drive N-Channel MOSFETs in a synchronous rectified buck topology for up to 25A load current. The ISL6420B integrates control, output adjustment, monitoring and protection functions into a single package. All the necessary components are within the 2.1 inch by 1.25 inch PCB area.

The ISL6420B provides simple, voltage mode control with fast transient response. The operating frequency can be adjustable from 100kHz to 1.4MHz.

The 6420B is offered in space saving 4x4 QFN and easy-to-use 20 Ld QSOP packages.

Key Features

- Operates From:
  - - 4.5V to 5.5V Input
  - - 5.5V to 28V Input
- Resistor-Selectable Switching Frequency from 100kHz to 1.4MHz
- Voltage Margining and External Reference Tracking Modes
- Upper MOSFET $r_{DS(ON)}$ for Current Sensing
- Programmable Soft-start
- Extensive Protection Functions:
  - Overvoltage, Overcurrent, Undervoltage
- Power-Good Indicator

Recommended Equipment

The following equipment is recommended for evaluation:

- 0V to 30V power supply with 15A source current capability
- Electronic load capable of sinking 25A
- Digital Multimeters (DMMs)
- 100MHz Quad-Trace Oscilloscope

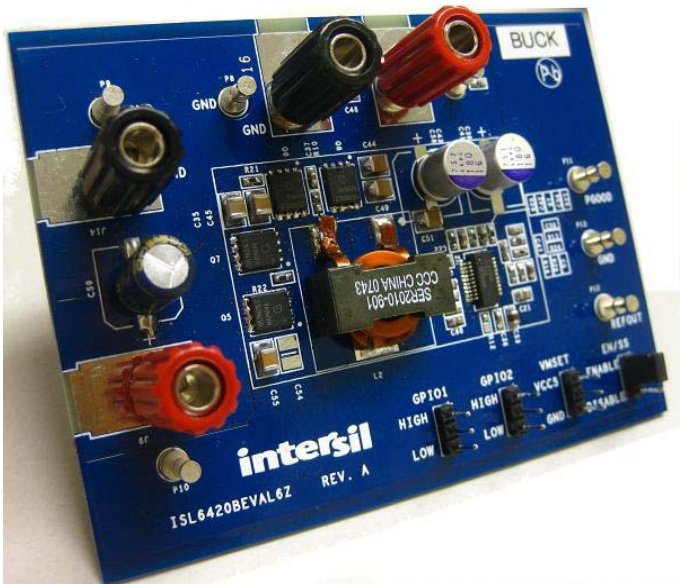

FIGURE 1. ISL6420BEVAL6Z TOP VIEW (ONE-SIDE PLACEMENT)

TABLE 1. RECOMMENDED COMPONENT SELECTION FOR QUICK EVALUATION

VOUT	IOUT	UPPER MOSFET	LOWER MOSFET	INDUCTOR	FSW/RT
5V	25A	2 X BSC057N03 LS	2 X BSC057N03 LS	SER2010-901ML	300kHz/52.3kΩ
5V	15A	1 X BSC057N03 LS	1 X BSC030N03 LS	SER2009-901ML	500kHz/31.6kΩ
3.3V	25A	2 X BSC057N03 LS	2 X BSC030N03 LS	SER2010-901ML	300kHz/52.3kΩ
3.3V	15A	1 X BSC057N03 LS	1 X BSC030N03 LS	SER2009-901ML	500kHz/31.6kΩ

NOTE: Please contact Intersil Sales for assistance.

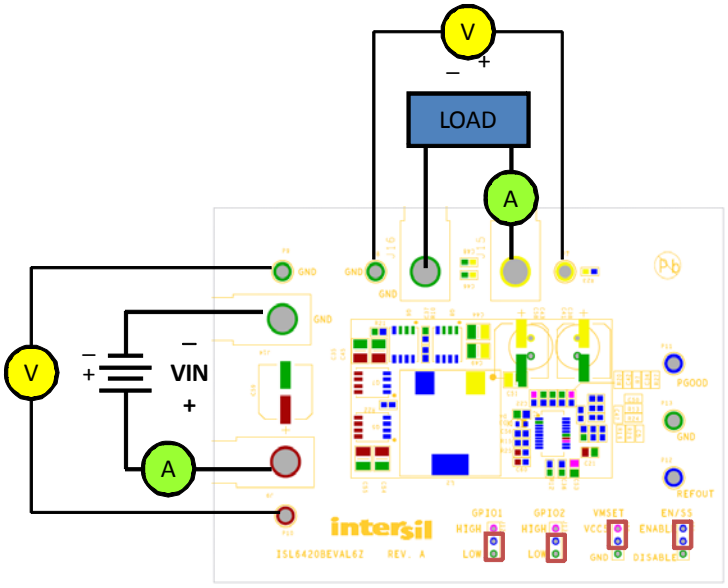

FIGURE 2. ISL6420BEVAL6Z TEST SET-UP

TABLE 2. JUMPER POSITION

JUMPER #/NAME	J12/GPIO1	J13/GPIO2	J10/VMSET	J11/EN/SS
SHUTDOWN	LOW	LOW	DOES NOT MATTER	DISALBLE
NORMAL	LOW	LOW	VCC5	ENABLE
Margining Up	LOW	HIGH	OPEN/R12 set ΔVO	ENABLE
Margining Down	HIGH	LOW	OPEN/R12 set ΔVO	ENABLE

Quick Test Setup

1. Ensure that the evaluation board is correctly connected to the power supply and the electronic load prior to applying any power. Please refer to Figure 2 for proper set-up.
2. Connect jumpers J12, J13, J10 and J11 in the positions specified in Table 2.
3. Turn on the power supply, VIN< 16V
4. Adjust input voltage VIN within the specified range and observe output voltage. The output voltage variation should be within 5%.
5. Adjust load current within 25A. The output voltage variation should be within 5%.
6. Use oscilloscope to observe output ripple voltage and phase node ringing. For accurate measurement, please refer to Figure 3 for proper probe set-up.
7. Optimization. Please refer to Table 1 on page 1 for optimization recommendation.
8. For 5V input applications, please tie VCC5V to VIN and do not allow VIN to go above 5.5V.

NOTE: Test points: P7, 8, 9, 10(VOUT, GND, GND, VIN) are for voltage measurement only. Do not allow high current through these test points.

Probe Set-up

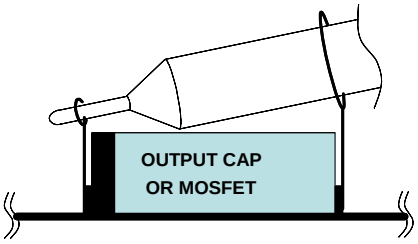

FIGURE 3. OSCILLASCOPE PROBE SET-UP

Margining Features

The ISL6420B margin function can be enabled by connecting a resistor from the VMSET pin to GND, which is R12 on the ISL6402BEVAL6Z. R12 and the feedback resistor, R24 together set the margin amount. Please refer to Equation 1.

$$\frac{\Delta V_{MARGIN}}{V_{OUT}} = \frac{2.468V \times R_{24}}{R_{12} \times V_{OUT}} \quad \text{(EQ. 1)}$$

For example, if 5% margin is desired, R12 should be:

$$R_{12} = \frac{2.468V \times R_{24}}{0.05 \times V_{OUT}} = \frac{2.468V \times 121K\Omega}{0.05 \times 5V} = 1210k\Omega \quad \text{(EQ. 2)}$$

Table 2 shows the position of GPIO1 and GPIO2 for margin up/down.

Typical Performance Curves

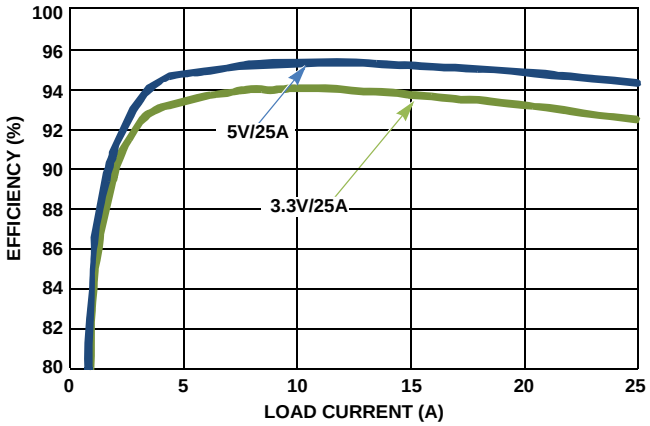

FIGURE 4. EFFICIENCY vs LOAD CURRENT

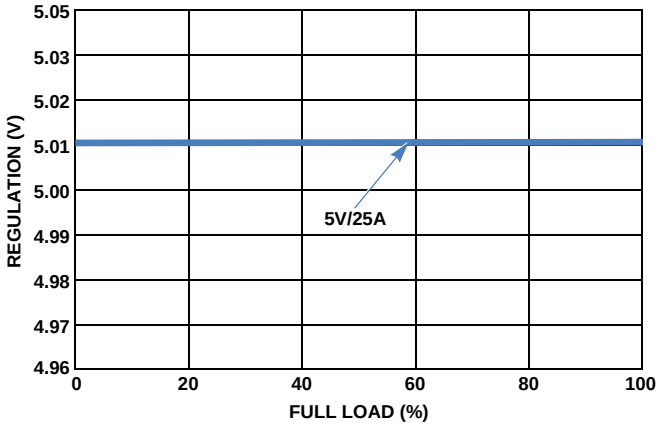

FIGURE 5. LOAD REGULATION, (VIN = 12V, I_{MAX} = 25A)

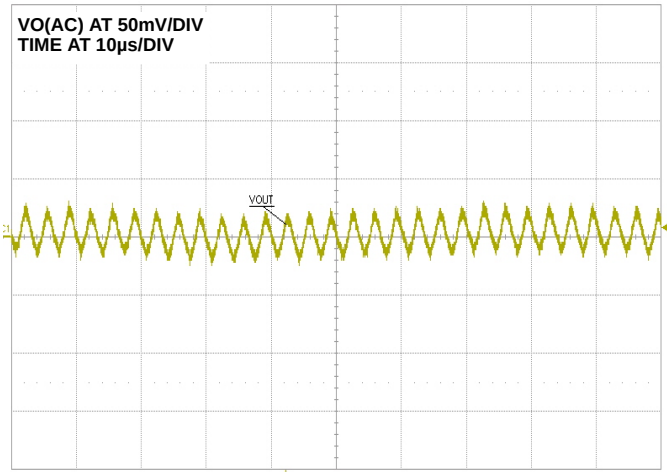

FIGURE 6. OUTPUT RIPPLE (VO = 5V, LOAD = 25A)

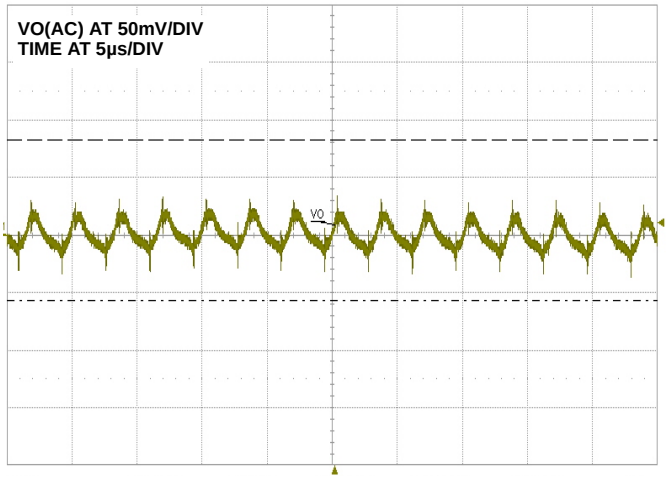

FIGURE 7. OUTPUT RIPPLE (VO = 3.3V, LOAD = 25A)

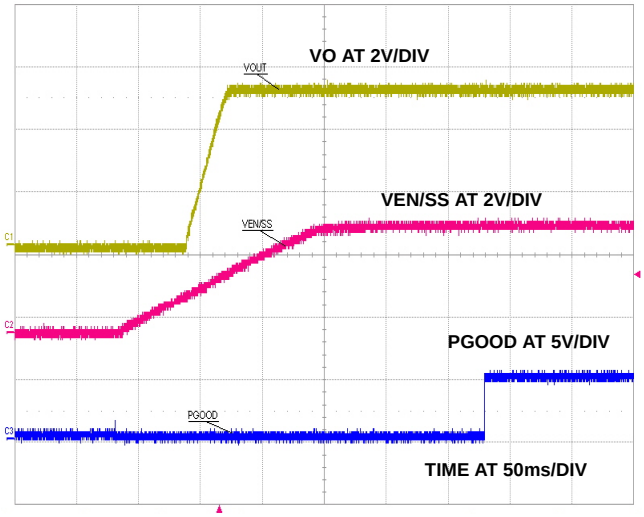

FIGURE 8. SOFT-START (C_{SS} - 0.47µF, C_{DEL} = 0.1µF)

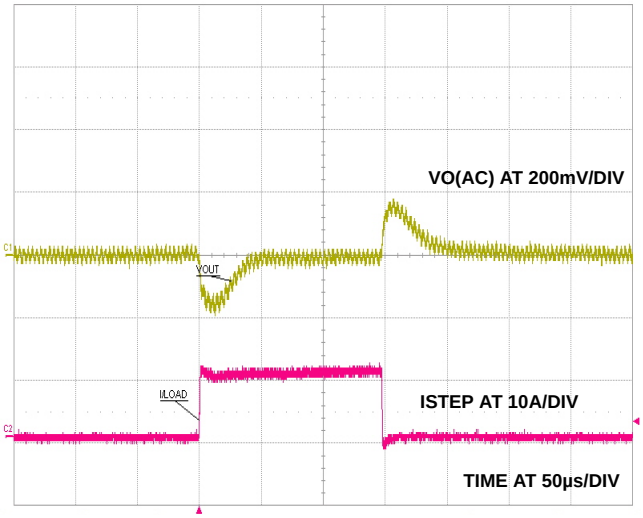

FIGURE 9. LOAD TRANSIENT (LOADSTEP FROM 6.25A TO 18.75A)

Schematic

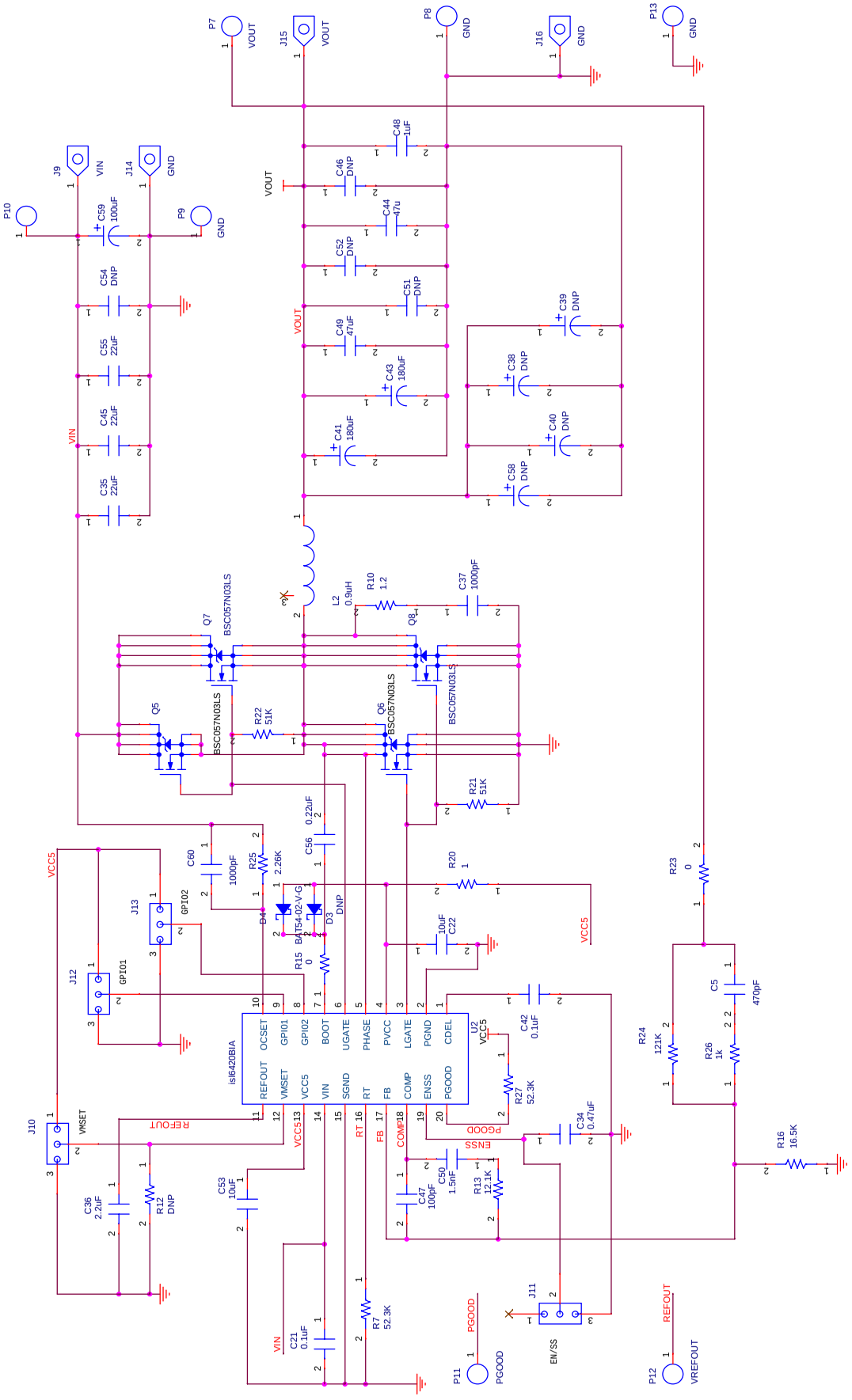
P7
VOUT
J15
VOUT
P8
GND
J16
GND
P13
GND
J9
VIN
J14
GND
P10
P9
GND
C59 100uF
C54 DNP
C55 22uF
C45 22uF
C35 22uF
C48 1uF
C46 DNP
C44 47u
C52 DNP
C51 DNP
C49 47uF
C43 180uF
C41 180uF
C39 DNP
C38 DNP
C40 DNP
C58 DNP
L2 0.9uH
R10 1.2
C37 1000pF
Q7 BSC057N03LS
Q8 BSC057N03LS
Q5 BSC057N03LS
Q6 BSC057N03LS
R22 51K
R21 51K
C56 0.22uF
C60 1000pF
R25 2.26K
D4 BAT54-02-V-G
D3 DNP
R20 1
C22 10uF
R15 0
J13 GPIO2
J12 GPIO1
J10 VMSET
R23 0
C5 470pF
R24 121K
R26 1k
R16 16.5K
C42 0.1uF
R27 52.3K
C34 0.47uF
C50 1.5nF
C47 100pF
R13 12.1K
C53 10uF
C36 2.2uF
R12 DNP
C21 0.1uF
R7 52.3K
J11 EN/SS
P11 PGOOD
P12 VREFOUT
U2 ISL6420BIA
REFOUT
OCSET
GPI01
GPI02
BOOT
UGATE
PHASE
PVCC
LGATE
PGND
CDEL
VMSET
VCC5
VIN
SGND
RT
FB
COMP
ENSS
PGOOD
VCC5
VIN
RT
FB
COMP
ENSS
PGOOD
REFOUT

TABLE 3. BILL OF MATERIALS

ITEM	QTY	PART REFERENCE	VALUE	DESCRIPTION	PART NUMBER	MANUFACTURER
ESSENTIAL COMPONENTS						
1	1	C5	470pF	Ceramic CAP, NP0 or C0G, sm0603	GENERIC	GENERIC
2	2	C21, C42	0.1µF	Ceramic CAP, X5R, 50V, sm0603	GENERIC	GENERIC
3	2	C22, C53	10µF	Ceramic CAP, X5R, 10V, sm0805	GENERIC	GENERIC
4	1	C34	0.47µF	Ceramic CAP, X5R, 16V, sm0603	GENERIC	GENERIC
5	3	C35, C45, C55	22µF	Ceramic CAP, X5R, 25V, sm1210	GENERIC	GENERIC
6	1	C36	2.2µF	Ceramic CAP, X5R, 16V, sm0603	GENERIC	GENERIC
7	2	C37, C60	1000pF	Ceramic CAP, NP0 or C0G, sm0603	GENERIC	GENERIC
8	2	C41, C43	180µF	OSCON, 16V, Radial 8 X 9	16SEPC180MX	SANYO
9	2	C44, C49	47µF	Ceramic CAP, X5R, 10V, sm1210	GENERIC	GENERIC
10	1	C47	100pF	Ceramic CAP, NP0 or C0G, sm0603	GENERIC	GENERIC
11	1	C48	1µF	Ceramic CAP, X5R, 25V, sm0603	GENERIC	GENERIC
12	1	C50	1500pF	Ceramic CAP, NP0 or C0G, sm0603	GENERIC	GENERIC
13	1	C56	0.22µF	Ceramic CAP, X5R, 16V,sm0603	GENERIC	GENERIC
14	1	C59	100µF	Alum. Cap, 50V	EMVA500ADA101MHA0G	United Chemi-Con
15	1	D4		Schottky Diode, 30V, SOD523	BAT54-02-V-G	Vishay
16	1	L2	0.9µH	Inductor	SER2010-901ML	Coilcraft
17	4	Q5, Q7, Q8, Q6		Single Channel NFET, 30V	BSC057N03LS G	Infineon
18	2	R7, R27	52.3kΩ	Resistor, sm0603, 1%	GENERIC	GENERIC
19	1	R10	1.2Ω	Resistor, sm0603, 10%	GENERIC	GENERIC
20	1	R13	12.1kΩ	Resistor, sm0603, 1%	GENERIC	GENERIC
21	2	R15, R23	0Ω	Resistor, sm0603, 10%	GENERIC	GENERIC
22	1	R16	16.5kΩ	Resistor, sm0603, 1%	GENERIC	GENERIC
23	1	R20	1Ω	Resistor, sm0603, 1%	GENERIC	GENERIC
24	2	R21, R22	51kΩ	Resistor, sm0603, 10%	GENERIC	GENERIC
25	1	R24	121kΩ	Resistor, sm0603, 1%	GENERIC	GENERIC
26	1	R25	2.26kΩ	Resistor, sm0603, 1%	GENERIC	GENERIC
27	1	R26	1kΩ	Resistor, sm0603, 1%	GENERIC	GENERIC
28	1	U2		PWM CONTROLLER, 20 Ld QSOP	ISL6420BIAZ	INTERSIL
OPTIONAL COMPONENTS						
29		D3, R12, C38, C39, C40, C46, C51, C52, C54, C58	DO NOT POPULATE			
EVALUATION HARDWARE						
30	4	J9, J14, J15, 16		HDWARE, MTG, CABLE TERMINAL, 6-14AWG, LUG & SCREW, ROHS	KPA8CTP	BERG/FCI
31	4	J10, J11, J12, J13		1X3 Header	GENERIC	GENERIC
32	4	J10, J11, J12, J13		Connector Jumper	SPC02SYAN	Sullins
33	7	P11, P10, P12, P8, P9, P13, P7		Test Points	1514-2	Keystone

ISL6420BEVAL6Z PCB Layout

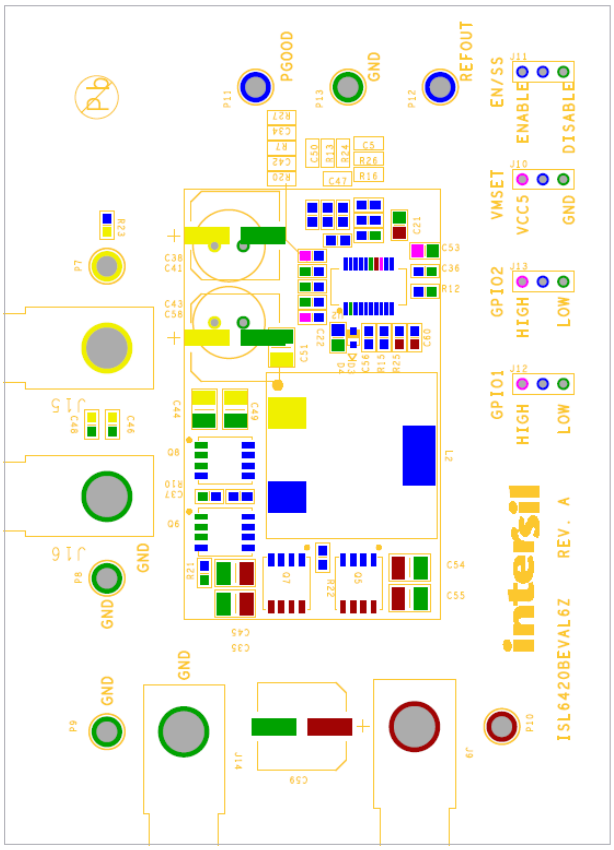

FIGURE 10. TOP SILKSCREEN

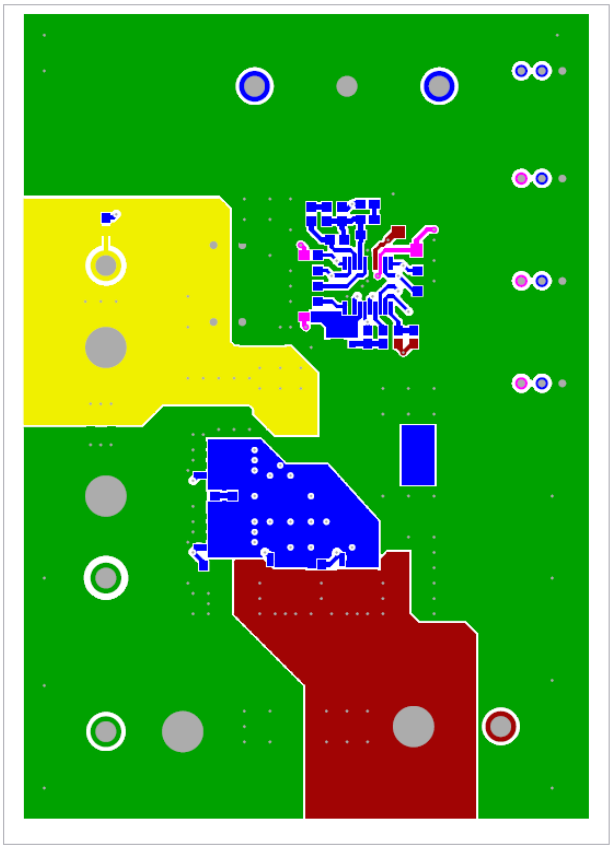

FIGURE 11. TOP LAYER

ISL6420BEVAL6Z PCB Layout (Continued)

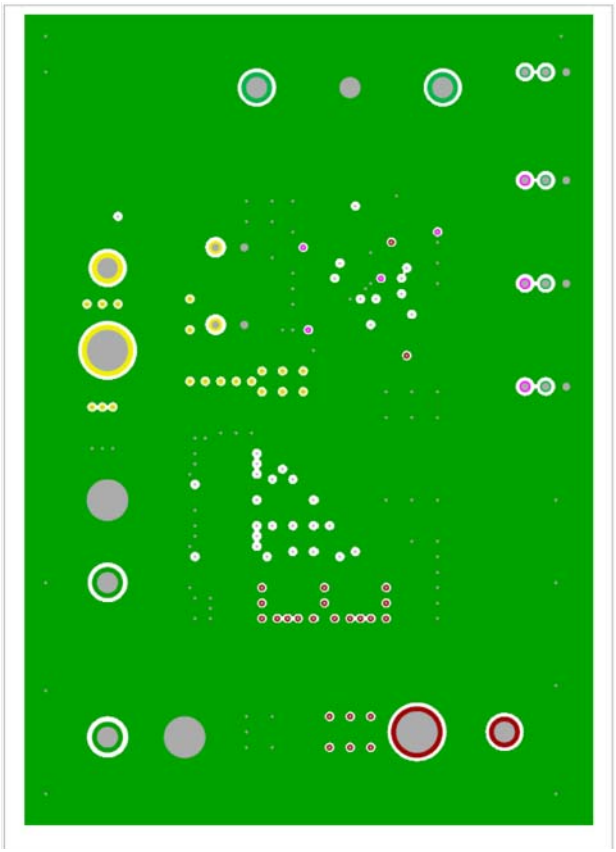

FIGURE 12. SECOND LAYER(SOLID GROUND)

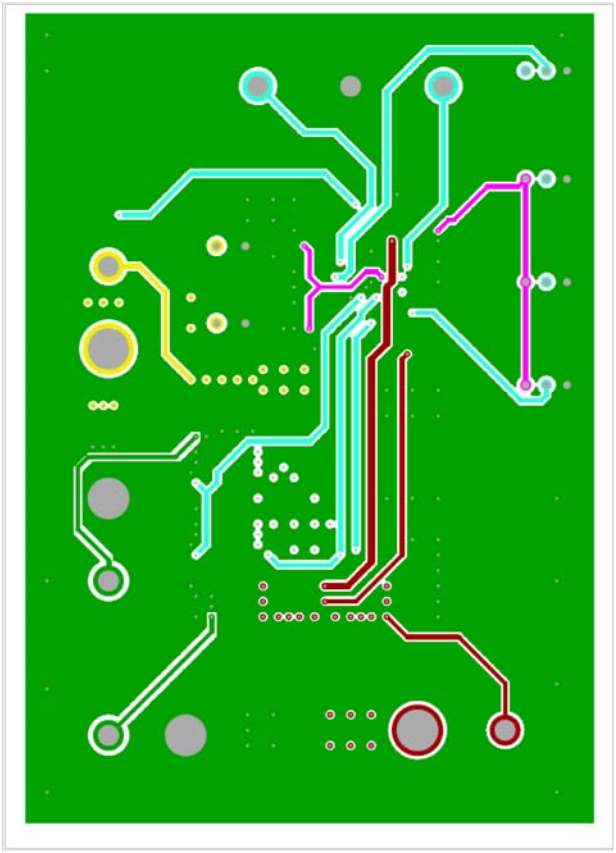

FIGURE 13. THIRD LAYER

ISL6420BEVAL6Z PCB Layout (Continued)

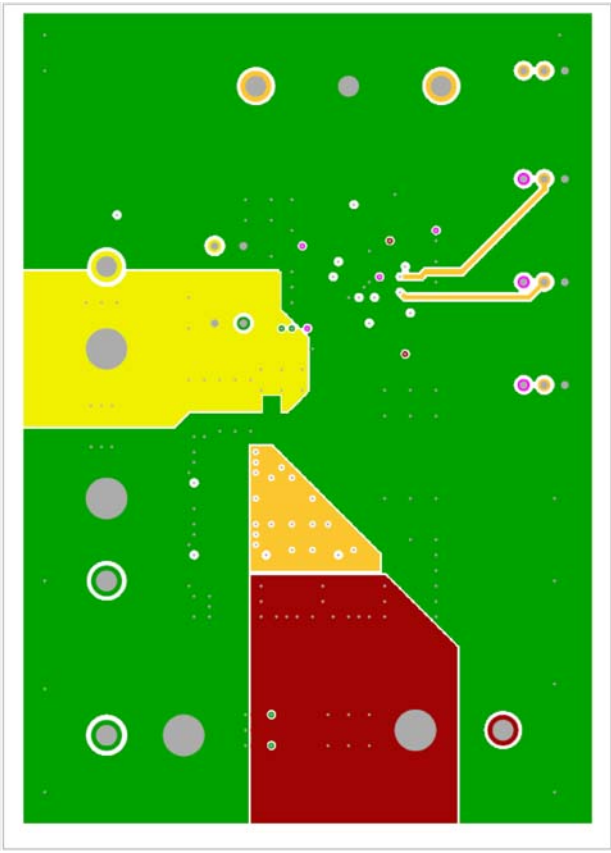

FIGURE 14. BOTTOM LAYER

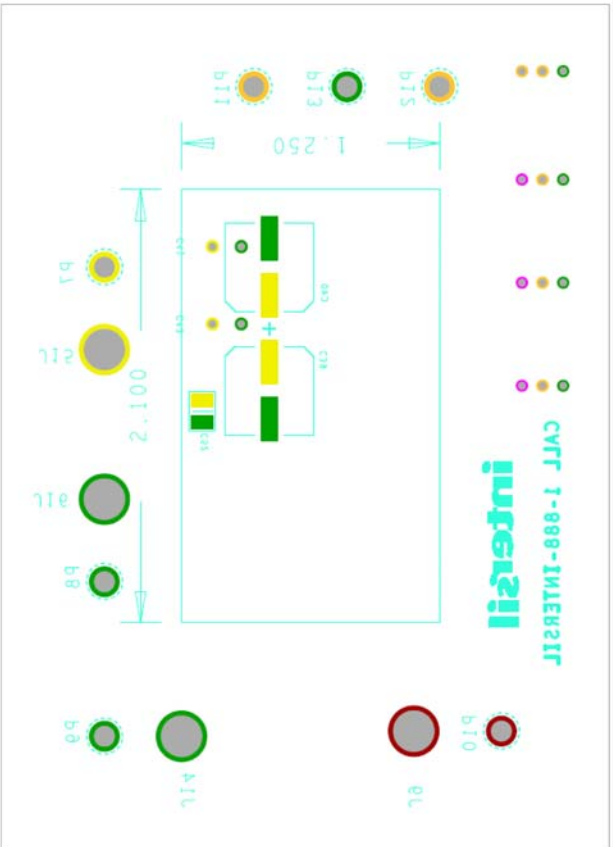

FIGURE 15. BOTTOM SILKSCREEN