

ISL85402EVAL1Z

Evaluation Board

AN1763
Rev 0.00
June 18, 2012

The ISL85402EVAL1Z board is to demonstrate the synchronous/asynchronous buck or boost buck operation of ISL85402.

The ISL85402EVAL1Z board input voltage range is 3V to 36V.

The output voltage is set to 5V and can be changed by voltage feedback resistors. Note to change the output voltage higher, the output capacitors' voltage rating needs to be checked.

The board output current is 2A typical. The board is set with default 3.6A overcurrent threshold. the OC threshold can be programmed by the resistor at the ILIMIT pin.

The ISL85402EVAL1Z board has setting options to be configured to synchronous buck, asynchronous buck, boost-buck topologies, forced PWM mode or PFM mode.

The board is set to default frequency 500kHz. The frequency can be programmed by the resistor at the FS pin.

The board can be synchronized to external clock. Multiple ISL85402EVAL1Z boards can be synchronized simply by connecting their SYNC pins together.

Recommended Equipment

- 0V to 36V power supply with at least 5A source current capability
- Load capable of sinking current up to 3A
- Multimeters
- Oscilloscope

Input and Output Connectors

The board has 2 main circuits sections - buck and boost as shown in Figure 1.

1. For synchronous/asynchronous buck, the inputs are J1 (VIN+) and J2 (GND). The outputs are J3 (VOUT+) and J4 (GND).
2. For boost buck operation, the boost inputs are J5 (VIN_BOOST+) and J6 (GND) and the boost output positive terminal is J7 (VOUT_BOOST+). By shorting J26 and J27, the boost outputs are connected to inputs of the buck. The output of the buck is still J3 (VOUT+) and J4 (GND).

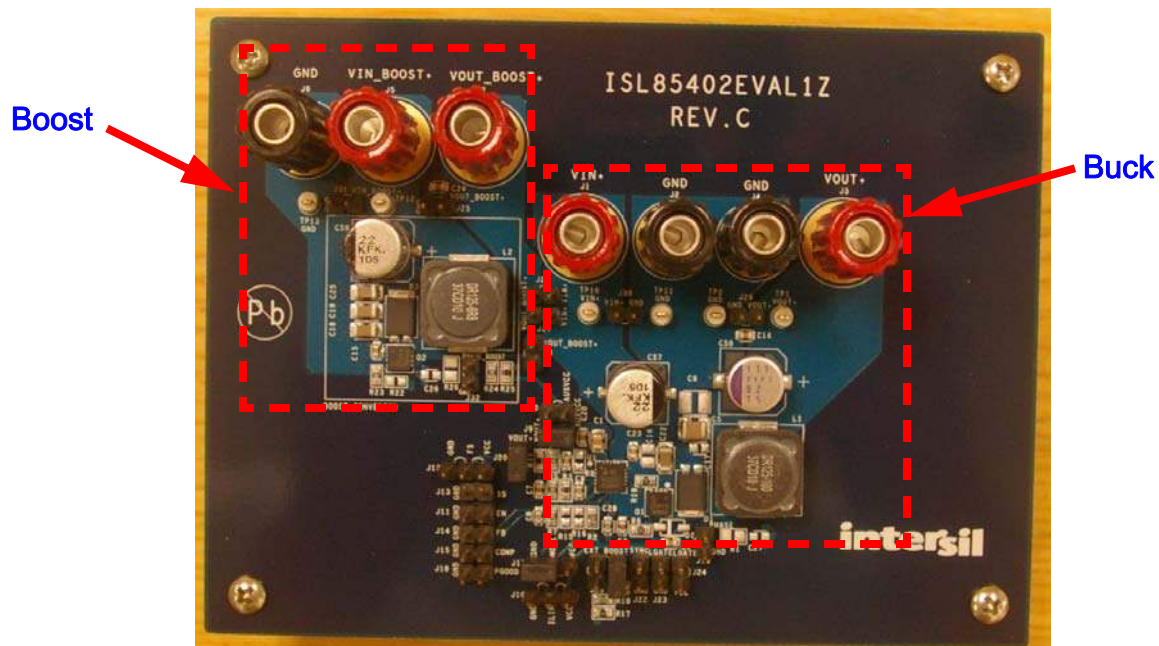


FIGURE 1. ISL85402EVAL1Z BOARD IMAGE

Board Setup and Start-up Sequence

Synchronous Buck

1. Ensure J21 is shorted for non-boost mode.
2. The MODE and GND pins of J17 are shorted for forced PWM mode (no PFM). If PFM mode is desired, short MODE and VCC pins of J17 or leave MODE pin floating.
3. J9 is shorted to have AUXVCC connected to VOUT. If AUXVCC switch-over function is not desired, open J9 and short J10.
4. J20 is shorted to have R11 shorted. R11 is only for loop measurement purposes.
5. Leave all the other jumper connectors open.
6. Connect the power source to inputs J1(VIN+) and J2(GND). Connect the load terminals to buck outputs J3 (VOUT+) and J4 (GND). Make sure the setup is correct prior to applying any power or load to the board.
7. Connect the power source to inputs J1 (VIN+) and J2 (GND). Connect the load terminals to buck outputs J3 (VOUT+) and J4 (GND). Make sure the setup is correct prior to applying any power or load to the board.
8. Adjust the power source to 12V and turn on it.
9. Verify the output voltage is 5V and use oscilloscope to monitor the phase node waveforms (J19).

Asynchronous Buck

1. Ensure J21 is shorted for non-boost mode.
2. The MODE and GND pins of J17 are shorted for forced PWM mode (no PFM). If PFM mode is desired, short MODE and VCC pins of J17 or leave MODE pin floating.
3. J9 is shorted to have AUXVCC connected to VOUT. If AUXVCC switch-over function is not desired, open J9 and short J10.
4. J20 is shorted to have R11 shorted. R11 is only for loop measurement purposes.
5. Remove R19. Change R20 (on bottom of the board) to 0Ω to keep Q1 securely off.
6. Leave all the other jumper connectors open.
7. Connect the power source to inputs J1(VIN+) and J2(GND). Connect the load terminals to buck outputs J3(VOUT+) and J4(GND). Make sure the setup is correct prior to applying any power or load to the board.
8. Adjust the power source to 12V and turn on it.
9. Verify the output voltage is 5V and use oscilloscope to monitor the phase node waveforms (J19).

Boost Buck

1. Remove R19 and leave it open. Change R20 (on bottom of the board) to keep Q1 securely off.
2. Put 0Ω resistor at R22 to set up LGATE to drive the boost switch Q2.
3. Short jumpers J26 and J27 to connect boost outputs to buck inputs.
4. Open J21 and short J28 to set the IC in boost mode. R17 and R18 are used to set up the boost on/off threshold divided from boost input. With R17 = 130kΩ and R18 = 1MΩ, the boost will start to operate when VIN_BOOST+(J5) voltage drops below 7V; and the boost will stop switching when boost input recovers to be above 10V.
5. Open J9 and J10, and short J8 to set up the boost output overvoltage protection. R24 and R25 are used to set up the boost on/off OVP threshold. With 1MΩ at R24 and 42.2kΩ at R25, the boost PWM will be turned off when boost output voltage reaches 25V and recovers switching when it drops below 22V.
6. J20 is shorted to have R11 shorted. R11 is only for loop measurement purposes.
7. Leave all the other jumper connectors open.
8. Short J11 to disable the IC prior to applying the power source to boost inputs.
9. Connect the power source to boost inputs J5 (VIN_BOOST+) and J6 (GND). Connect the load terminals to buck outputs J3 (VOUT+) and J4(GND). Make sure the setup is correct prior to applying any power or load to the board.
10. Adjust the power source to 12V and turn on the power source.
11. Open J11 to enable the IC.
12. Verify the buck output voltage is 5V. Use oscilloscope to monitor the buck phase node waveforms (J19) and the boost phase node waveforms (J32).
13. Adjust the input voltage down to 5V to start-up the boost. Note the boost input voltage cannot be too low and it is limited by the current ratings of the boost switch and boost inductor. The boost input current will increase upon the decrease of boost input voltage. The input current should be estimated before turning the input voltage extremely low under heavy load (refer to the boost operation description section in datasheet for more details).
14. The shutdown sequence must be in the following order: short J11 to shut down the IC first, then turn off the power source at boost input. To turn off the power source (boost input) first with the circuits operating at boost mode could cause boost MOSFET and IC damages resulting from the current stress at boost switches and inductors. In designs to use boost mode, the same shutdown sequence must be followed.

TABLE 1. CONNECTORS/TEST POINTS DESCRIPTIONS

J1	VIN+, positive terminal of buck inputs.
J2	GND, ground terminal of buck inputs.
J3	VOUT+, positive terminal of buck outputs.
J4	GND, ground terminal of buck outputs.
J5	VIN_BOOST+, positive terminal of boost inputs.
J6	GND, ground terminal of boost inputs.
J7	VOUT_BOOST+, positive terminal of boost output.
J8	In boost buck mode, with J8 shorted, the AUXVCC pin monitors the boost output voltage through R24 and R25 for over-voltage protection.
J9	With J9 shorted, VOUT+ is connected to AUXVCC for the switchover function. The IC switches over from main LDO to auxiliary LDO after VOUT+ built up.
J10	Use this connector to apply any voltage to AUXVCC as the AUXLDO input. Short it to ground when not using AUXVCC.
J11	Use this connector to control IC ON/OFF.
J12	Use it to set up switching frequency. With FS pin connected to VCC or GND, or left open, the IC has default 500kHz frequency. R8 is a placeholder for a resistor to program frequency.
J13	Test point connector to monitor the SS pin. Monitoring purpose only and don't short it with jumper.
J14	Test point connector to monitor the FB pin. Monitoring purpose only and don't short it with jumper.
J15	Test point connector to monitor the COMP pin. Monitoring purpose only and don't short it with jumper.
J16	Use it to set up the over current limit threshold. With ILIMIT pin connected to VCC or GND, or left open, the IC has default 3.6A OC threshold. R15 is a placeholder for a resistor to program the OC threshold.
J17	Mode setup connector. To connect MODE pin to GND will set the IC in forced PWM mode; to leave MODE pin open or connected to VCC set the IC to have PFM available under light load condition and the IC has default 0.7A PFM current threshold. R16 is a placeholder for a resistor to program the PFM current threshold.
J18	Test point connector to monitor the PGOOD pin. Monitoring purpose only and don't short it with jumper.
J19	Test point connector to monitor the buck PHASE node. Monitoring purpose only and don't short it with jumper.
J20	Test point connector for loop measurement. Short it to have R11 shorted when it is not used.
J21, J28	Connectors to set up the boost operation. Option 1: to short J21 set the IC in non-boost mode (either synchronous or asynchronous buck mode). Option 2: to open J21 and short J28 set the IC in boost mode. A voltage higher than 0.2V on EXT_BOOST pin before VCC POR ON latches the IC in boost buck mode at startup.
J22	Use it to configure synchronization. Option 1: to apply external clock for the IC to be synchronized with. Option 2: to synchronize multiple ISL85402, simply connect those SYNC pins together.
J23	Test point connectors to monitor the LGATE. Monitoring purpose only and don't short it with jumper.
J24	Short it in asynchronous buck configuration before startup to disable the low-side driver.
J25	Test point connector to monitor the boost output. Monitoring purpose only and don't short it with jumper.
J26, J27	Shorting these connectors with jumpers will connect the boost outputs to buck inputs.
J29	Test point connector to monitor the buck output. Monitoring purpose only and don't short it with jumper.
J30	Test point connector to monitor the buck input. Monitoring purpose only and don't short it with jumper.
J31	Test point connector to monitor the boost input. Monitoring purpose only and don't short it with jumper.
J32	Test point connectors to monitor the boost phase node. Monitoring purpose only and don't short it with jumper.

TABLE 1. BILL OF MATERIALS

REF DES	PART NUMBER	QTY	DESCRIPTION	MANUFACTURER
C57, C59	EEE-FK1K220P	2	CAP, SMD, 8X10.2, 22 μ F, 80V, 20%, ALUM.ELEC., ROHS	PANASONIC
C1	VARIOUS	1	CAP, SMD, 0805, 4.7 μ F, 10V, 10%, X7R, ROHS	VARIOUS
C18, C19, C22, C25	VARIOUS	4	CAP, SMD, 1206, 2.2 μ F, 50V, 10%, X7R, ROHS	VARIOUS
C9	VARIOUS	1	CAP, SMD, 0603, 10pF, 50V,5%, COG, ROHS	VARIOUS
C8, C28	VARIOUS	2	CAP, SMD, 0603, 100pF, 50V, 5%, COG, ROHS	VARIOUS
C20	VARIOUS	1	CAP, SMD, 0603, 0.01 μ F, 16V,10%, X7R, ROHS	VARIOUS
C2, C16, C23, C24	VARIOUS	4	CAP, SMD, 0603, 0.1 μ F, 50V, 10%, X7R, ROHS	VARIOUS
C3	VARIOUS	1	CAP, SMD, 0603, 1.0 μ F, 10V, 10%, X7R, ROHS	VARIOUS
C15	VARIOUS	1	CAP, SMD, 0603, 12000pF, 50V, 10%, X7R, ROHS	VARIOUS
C4	VARIOUS	1	CAP, SMD, 0603, 0.022 μ F, 16V, 10%, X7R, ROHS	VARIOUS
C7	VARIOUS	1	CAP, SMD, 0603, 470pF, 50V, 10%, X7R, ROHS	VARIOUS
C17, C26, C27	DNP	0	CAP, SMD, 0603, DNP-PLACE HOLDER, ROHS	N/A
C14	DNP	0	CAP, SMD, 0805, DNP-PLACE HOLDER, ROHS	N/A
C5	VARIOUS	1	CAP, SMD, 1210, 10 μ F, 25V, 10%, X7R, ROHS	VARIOUS
C6	DNP	0	CAP, SMD, 1210, DNP-PLACE HOLDER, ROHS	N/A
C58	16SVPD82M	1	CAP-OSCON, SMD, 6.9x8.3, 82 μ F, 16V, 20%, 40m Ω , ROHS	SANYO
L1	DR125-100-R	1	COIL-PWR INDUCTOR, SMD, 12.5mm, 10 μ H, 20%, 5.35A, ROHS	COOPER/COILTRONICS
L2	DR125-6R8-R	1	COIL-PWR INDUCTOR, SMD, 12.5mm, 6.8 μ H, 20%, 6.64A, ROHS	COOPER/COILTRONICS
D1, D3	SS3P6LHM3/86A	2	DIODE-SCHOTTKY RECTIFIER, SMD, SMPC, 60V, 3A, ROHS	VISHAY
U1	ISL85402IRZ	1	IC-SWITCHING REGULATOR, 20P, QFN, 4X4, ROHS	INTERSIL
Q1, Q2	BSZ100N06LS3G	2	TRANSIST-MOS, N-CHANNEL, 8P, PG-TSDSON-8, 60V, 20A, ROHS	INFINEON TECHNOLOGY
R11	VARIOUS	1	RES, SMD, 0603, 10 Ω , 1/10W, 1%,TF, ROHS	VARIOUS
R6, R19	VARIOUS	2	RES, SMD, 0603, 0 Ω , 1/10W, ROHS	VARIOUS
R18, R24	VARIOUS	2	RES, SMD, 0603, 1M, 1/10W, 1%, TF, ROHS	VARIOUS
R17	VARIOUS	1	RES, SMD, 0603, 130k, 1/10W, 1%,ROHS	VARIOUS
R2	VARIOUS	1	RES, SMD, 0603, 220k, 1/10W, 1%, ROHS	VARIOUS
R3	VARIOUS	1	RES, SMD, 0603, 232k, 1/10W, 1%,ROHS	VARIOUS
R7	VARIOUS	1	RES, SMD, 0603, 33.2k, 1/10W, 1%,ROHS	VARIOUS
R25	VARIOUS	1	RES, SMD, 0603, 42.2k, 1/10W, 1%,ROHS	VARIOUS
R4	VARIOUS	1	RES, SMD, 0603, 44.2k, 1/10W, 1%,ROHS	VARIOUS
R5, R20, R23	VARIOUS	3	RES, SMD, 0603, 5.11k, 1/10W, 1%,ROHS	VARIOUS
R8, R15, R16, R22	N/A	0	RES, SMD, 0603, DNP-PLACE HOLDER, ROHS	N/A
R1, R26	N/A	0	RES, SMD, 0805, DNP-PLACE HOLDER, ROHS	N/A

ISL85402EVAL1Z Evaluation Board Schematic

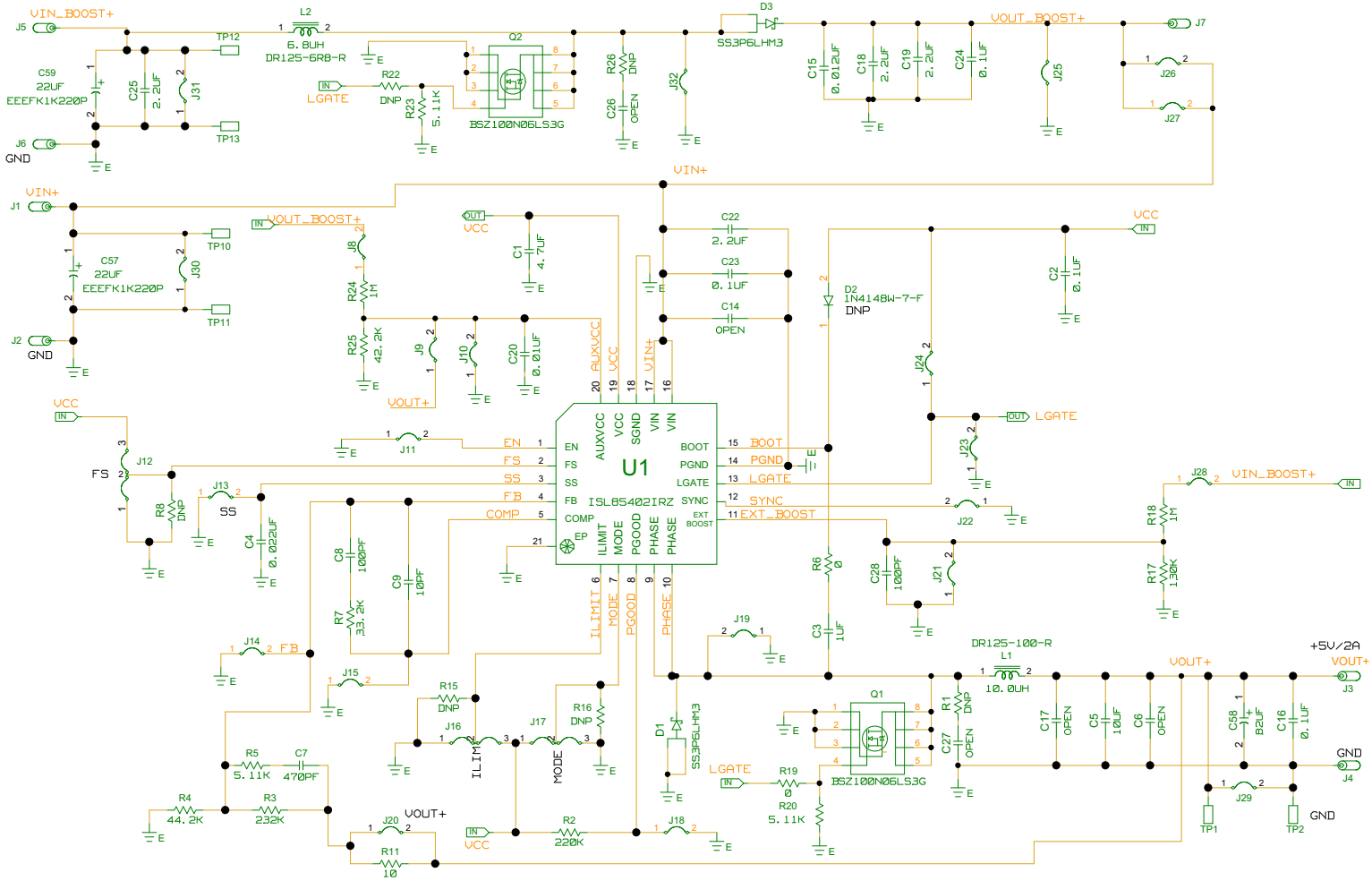


FIGURE 2. ISL85402EVAL1Z EVALUATION BOARD SCHEMATIC

ISL85402EVAL1Z Layout

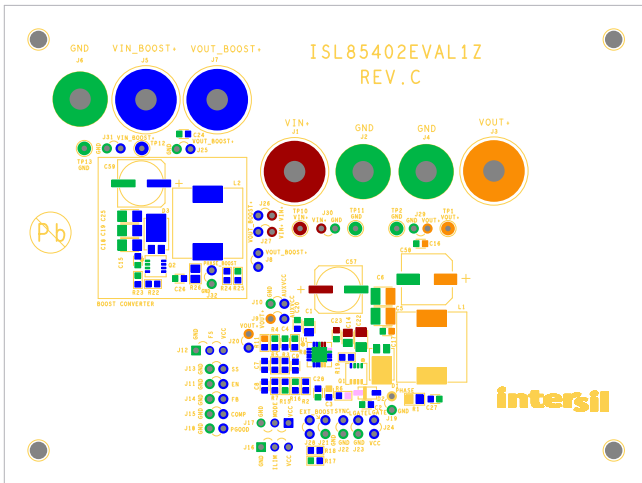


FIGURE 3. SILKSCREEN TOP COMPONENTS

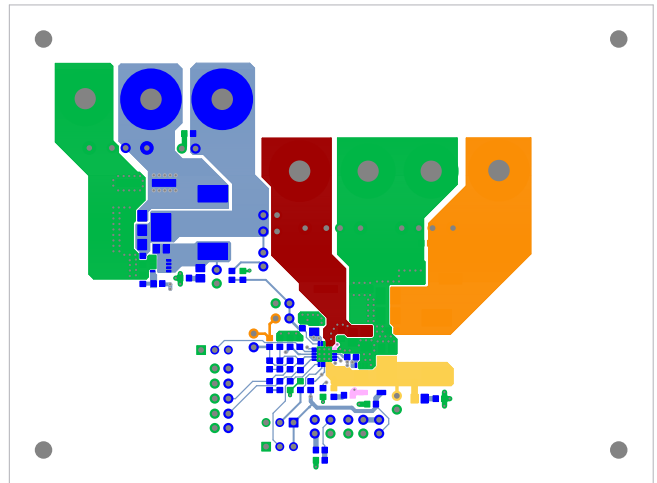


FIGURE 4. TOP LAYER

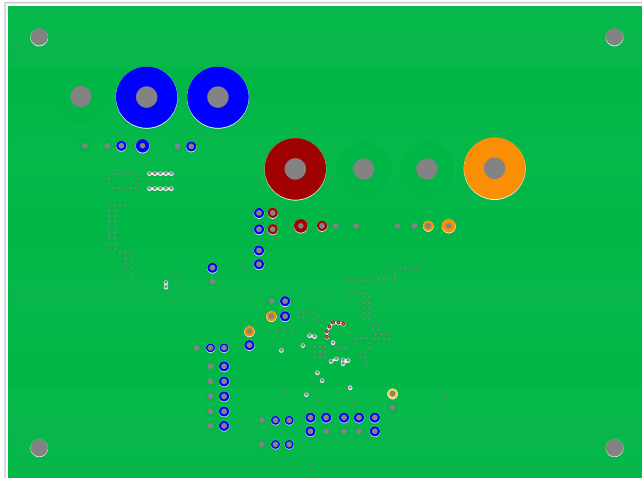


FIGURE 5. 2nd LAYER

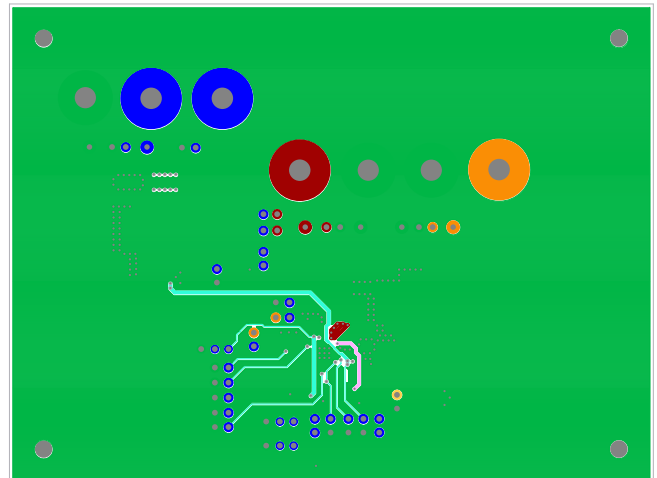


FIGURE 6. 3rd LAYER

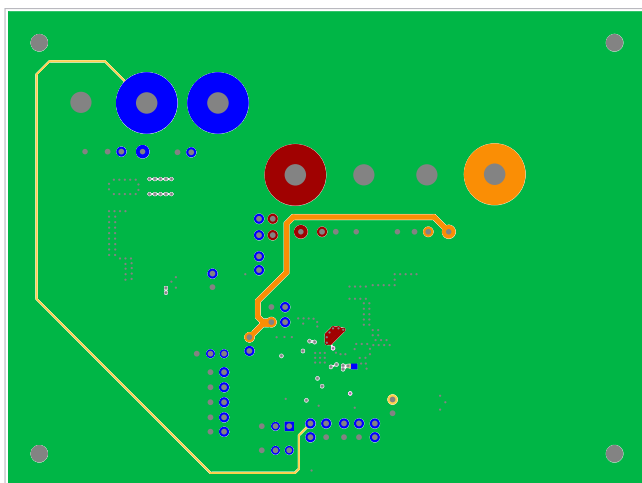


FIGURE 7. BOTTOM LAYER

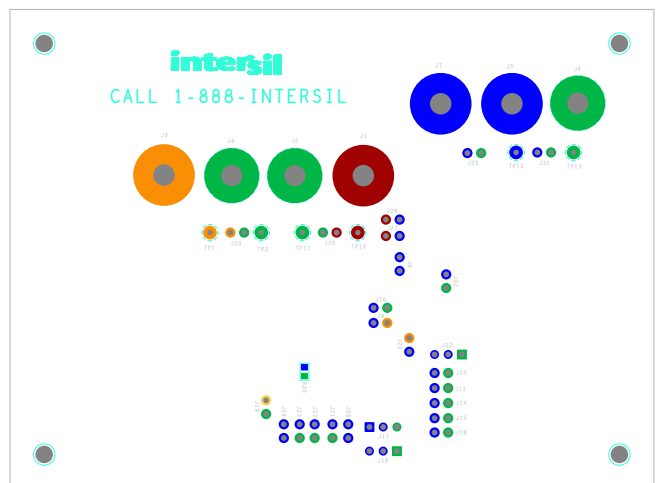


FIGURE 8. SILKSCREEN BOTTOM COMPONENTS

ISL85402EVAL1Z Layout (Continued)

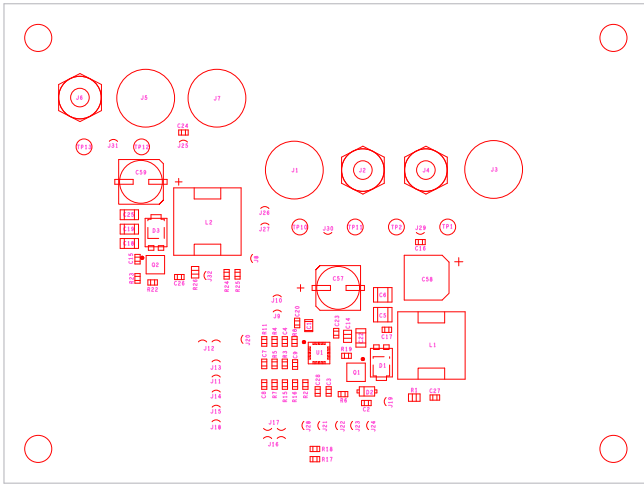


FIGURE 9. TOP COMPONENT ASSEMBLY

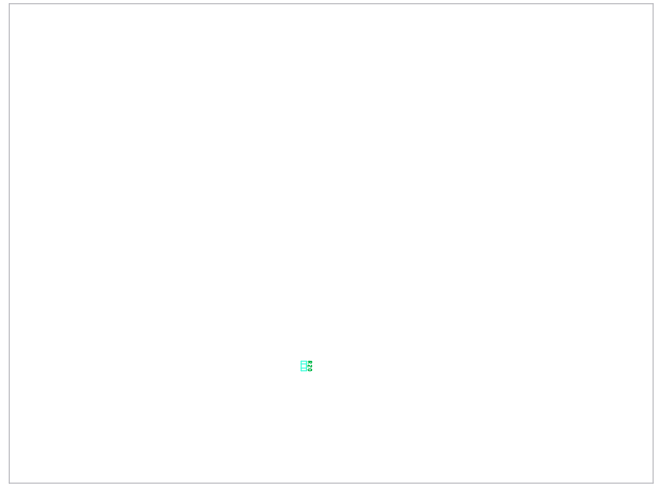


FIGURE 10. BOTTOM COMPONENT ASSEMBLY (MIRRORED)

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(Rev.4.0-1 November 2017)



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