

ISL73847SEHEV2Z

The ISL73847SEHEV2Z evaluation board benchmarks the performance of the [ISL73847SEH](#) dual-phase buck controller. The evaluation board is optimized for a 4.5V to 15V input operation to generate a 50A max, 1V output. Input and output connections, test points, and jumper settings on the board provide customers an easy-to-use evaluation platform for point-of-load power applications.

Features

- Power-Good LED indicator
- On-board transient load current generator
- Integrated LDO (VCC)
- External Clock Synchronization (SYNCI & SYNCO)
- Droop regulation set by a single resistor

Specifications

- Buck Power Supply input (PVIN): 4.5V to 15V
- Controller Analog Supply input (VDD): 4.5V to 19V
- Preset output voltage: 1V
- Preset Switching Frequency: 500kHz
- Maximum dual-phase output current: 50A
- Maximum single-phase output current: 25A
- Preset droop regulation

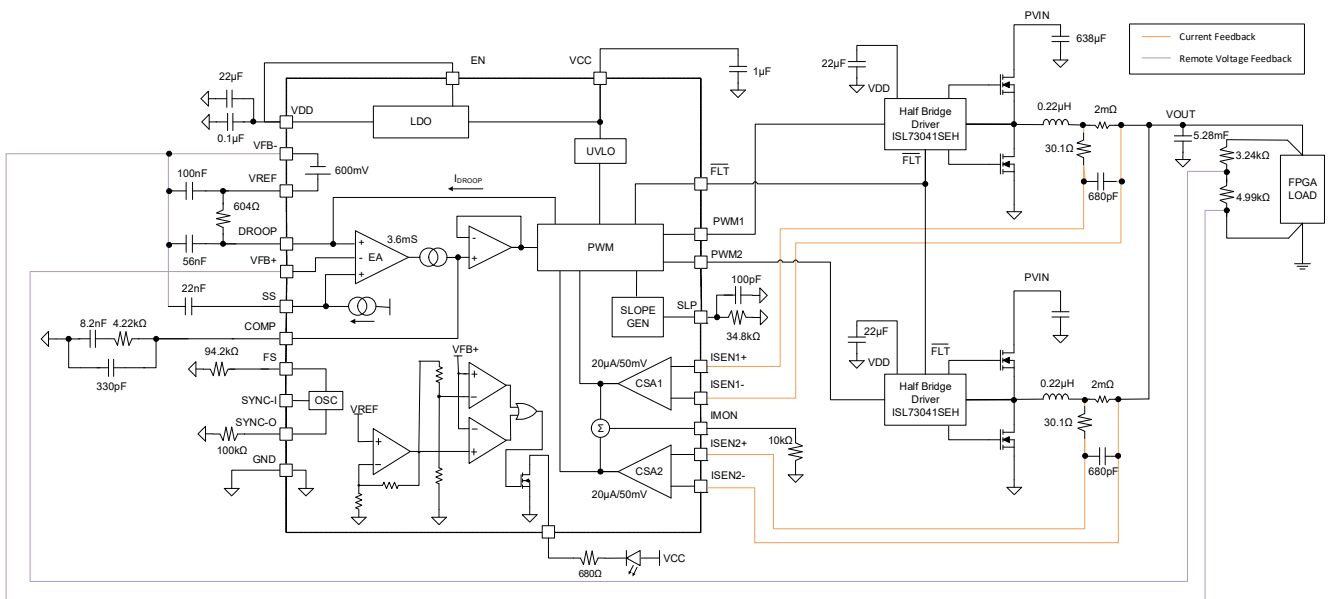


Figure 1. ISL73847SEHEV2Z Block Diagram

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1. Functional Description

1.1 Operating Range

The ISL73847SEHEV2Z evaluation board requires two supply rails to operate properly. One for the ISL73847SEH controller analog supply input (VDD) and one for the on-board buck power supply input (PVIN). The VDD rail accepts an input voltage range of 4.5V to 19V. The PVIN should be set from 4.5V to 15V. The buck regulator circuit is preset for a 1V output voltage and a switching frequency of 500kHz with a 0.22 μ H output inductor and 2.64mF output capacitance per phase with the option of being synchronized to an external clock using SYNC1.

1.2 Quick-Start Guide

See [Table 1](#) to get an overview of all the default jumper settings and their different configurations.

1. Ensure JP1, JP4, and JP5 is connected to position 2-3.
2. Ensure JP2 and JP3 is removed.
3. Ensure JP6 is connected.
4. Apply a 4.5V to 15V voltage to PVIN metal banana plug connectors as shown in [Figure 2](#).
5. Apply a 4.5V to 19V voltage to the VDD banana connectors as shown in [Figure 2](#).
6. If required, a resistor or electronic load can be connected to the VOUT metal banana plug connectors as shown in [Figure 2](#). If using an electronic load, you can add 4w sense lines on the TP29 test jumper.

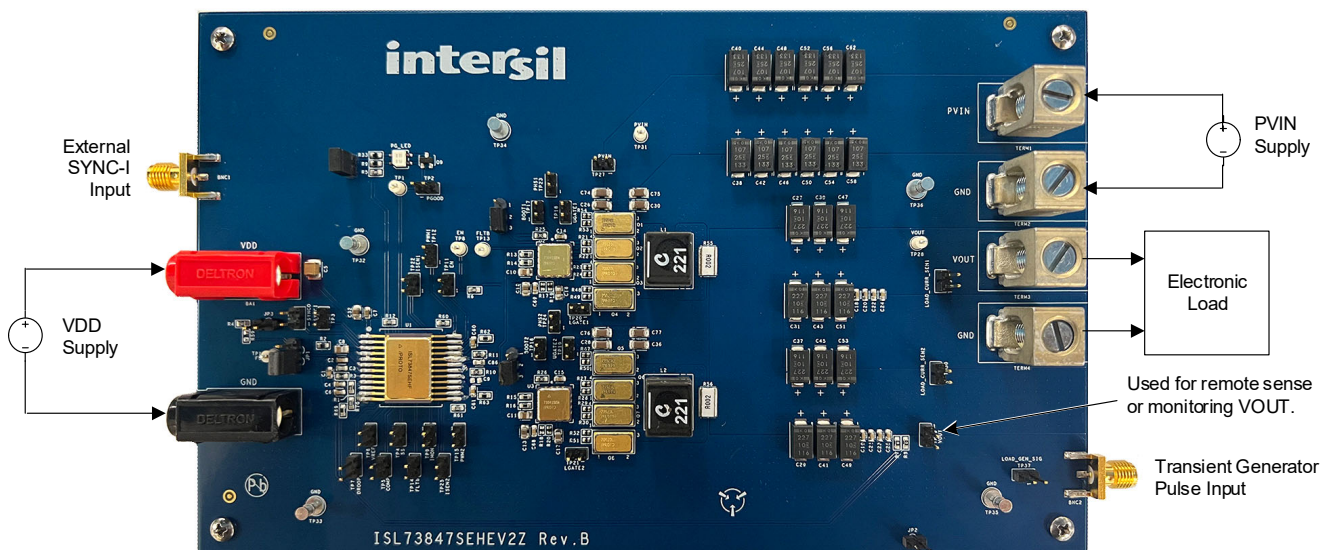


Figure 2. ISL73847SEHEV2Z Board Setup

Table 1. Default Jumper Settings and Alternate Configurations

| Jumper | Function/Description | Default Configuration | Alternate Configuration |
|--------|--|--|--|
| JP1 | Sets the frequency of the ISL73847SEH Controller | Jumper in 2-3 position connects a 94.2kΩ pull-down from FS to GND, which sets the oscillator frequency to 1MHz. | Jumper in 1-2 position ties FS to VCC, which sets the oscillator frequency to 1MHz. |
| JP2 | Powers the ISL70040SEH FET driver, which is part of the load transient generator circuit | Remove Jumper to disconnect VDD and disable the FET driver. | Populate Jumper to connect VDD to enable the FET driver. |
| JP3 | Sets the output of the SYNC-O pin | Populate Jumper and connect a 100kΩ pull-down from SYNC-O to GND (R_4), and remove the SYNC-O to VCC pull-up (R_{59}). This outputs the internal oscillator or SYNC-I external oscillator. | Populate Jumper and remove the 100kΩ pull-down from SYNC-O to GND (R_4), and populate the SYNC-O to VCC pull-up (R_{59}) with a 100kΩ. This outputs 1/2 of the frequency of the internal oscillator or SYNC-I external oscillator. |
| JP4 | Disables the phase 1 output of the buck regulator | Jumper in 2-3 position ties PWM of the ISL73041SEH FET Driver (U2) to PWM1 of the ISL73847SEH controller, which enables phase 1 output of the buck regulator. | Jumper in 1-2 position ties PWM of the ISL73041SEH FET Driver (U2) to VCC, which disables phase 1 output of the buck regulator. |
| JP5 | Disables the phase 2 output of the buck regulator | Jumper in 2-3 position ties PWM of the ISL73041SEH FET Driver (U3) to PWM2 of the ISL73847SEH controller, which enables phase 2 output of the buck regulator. | Jumper in 1-2 position ties PWM of the ISL73041SEH FET Driver (U3) to VCC, which disables phase 2 output of the buck regulator. |
| JP6 | Disables or enables LED lights driven by PG | Populate jumper to enable LED PG indication. | Remove Jumper to disable LED PG indication. |

1.3 Changing the Switching Frequency

The ISL73847SEHEV2Z is configured for a 500kHz switching frequency by a JP1 connecting a 94.2kΩ pull-down resistor (R_2) on the FS pin. The evaluation board includes a 0.22μH inductor and an array of output bypass capacitors for a 2.64mF output capacitance per phase, which makes up the LC filter. If you need to select a different switching frequency, see [Figure 3](#) for selecting the appropriate R_2 value on FS. An alternate on-board configuration is to connect JP1 to position 1-2, which ties FS to VCC. This setting defaults the switching frequency to 500kHz. For more information on the FS pin, refer to the *ISL73847SEH datasheet*.

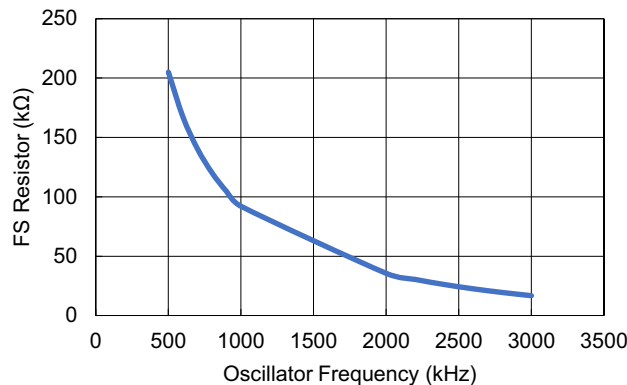


Figure 3. R_{FS} vs Frequency

1.4 External Clock Synchronization

If you need to synchronize the buck switching frequency to an external clock, a SMA female connector (BNC1) is available on the board. TP3 can be used to monitor the external clock signal on SYNC-I. For the external oscillator to be used in place of the internal oscillator, the external oscillator frequency needs to be 15% greater than the internal oscillator frequency. For more information on the external clock synchronization, refer to the *ISL73847SEH datasheet*.

1.5 Clock Output

The SYNC-O pin is configured to output the internal oscillator frequency (1MHz) through a jumper (JP2) connecting a 100kΩ pull-down (R_4) to GND. The SYNC-O pin can be monitored using the TP26 test jumper.

Note: If you are using an external clock signal on the SYNC-I pin, that external clock is output on SYNC-O in place of the internal clock if the external oscillator frequency is 15% greater than the internal oscillator frequency. If you need to output half of the internal or external oscillator frequency, move the 100kΩ resistor from R_4 to R_{59} . For more information on SYNC-O, refer to the *ISL73847SEH datasheet*.

1.6 Soft-Start Adjustment

The ISL73847SEHEV2Z is configured for a 2ms soft-start time by a 22nF bypass capacitor (C_2) connected to the SS pin. The SS time can be adjusted from 2ms to 200ms by changing the C_2 capacitor. If you need to select a different soft-start time use [Equation 1](#) below which shows how to calculate the capacitance given the desired soft-start time. For more information on SS, refer to the *ISL73847SEH datasheet*.

$$(EQ. 1) \quad C_{SS} = \frac{t_{SS} \times 1 \times 10^{-5}}{V_{REF}}$$

where:

- C_{SS} is the soft-start capacitance in Farads
- t_{SS} is the required soft-start time in seconds
- V_{REF} is the reference voltage, which is nominally 0.6V

1.7 Droop Regulation

The ISL73847SEHEV2Z is configured to minimize peak-to-peak transient response excursions by using a 604Ω resistor (R_1) connected between V_{REF} and DROOP pin. If droop regulation is not needed, replace the 604Ω with a 0Ω resistor to short V_{REF} and DROOP pin together. For more information on the droop regulation, refer to the *ISL73847SEH datasheet*.

1.8 IMON

The ISL73847SEHEV2Z is configured to monitor the average current through the inductor as a voltage on the IMON pin. A 10kΩ pull-down resistor (R_{10}) is connected to this pin. TP29 test jumper is provided to monitor the IMON pin voltage. If required, a bypass capacitor (C_9) can be added in parallel to R_{10} to improve the averaging. For more information on the IMON pin, refer to the *ISL73847SEH datasheet*.

1.9 Enabling/Disabling

The ISL73847SEHEV2Z is configured to automatically enable when VDD reaches a certain voltage on power-up by 4.99kΩ resistor (R_6) connected between EN and VDD. To disable the part in this default configuration, apply 0V or ground to the TP8 test point. To disable automatic enabling on power-up and to control EN by an external supply, remove R_6 and connect another external supply to TP8. For more information on the enabling and disabling the controller, refer to the *ISL73847SEH datasheet*.

1.10 Using the On-Board Load Transient Generator

An on-board load transient generator is made available to evaluate the buck-regulator output. The circuit is shown in [Figure 8](#). The circuit comprises an NMOS FET load switch driven by a Renesas ISL70040SEH Rad-Hard, GAN FET driver requiring 0-5V logic signals. Logic HIGH drives the load ON and logic LOW turns the load OFF. The load current is preset by six parallel 220mΩ resistors on each output phase (25A) for a total load current of 50A. Complete the following steps to properly set-up and operate the load transient generator.

1. Connect an external pulse generator to the on-board SMA connector (BNC2).
2. To monitor the pulse generator signal, use the TP37 test jumper.
3. Connect jumper to JP2 to connect VDD to power the FET driver.
4. Monitor the output voltage using TP29.

2. Board Design

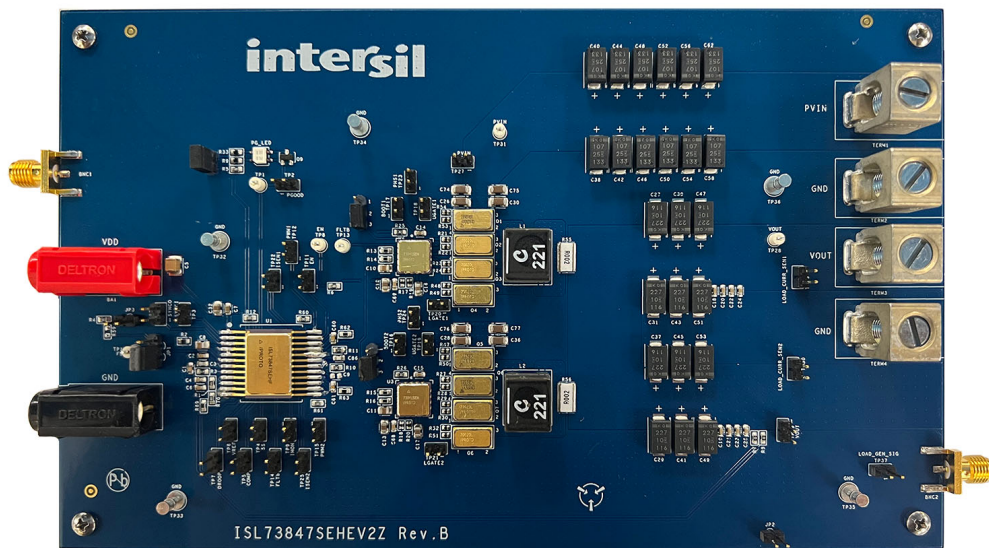


Figure 4. ISL73847SEHEV2Z Evaluation Board (Top)

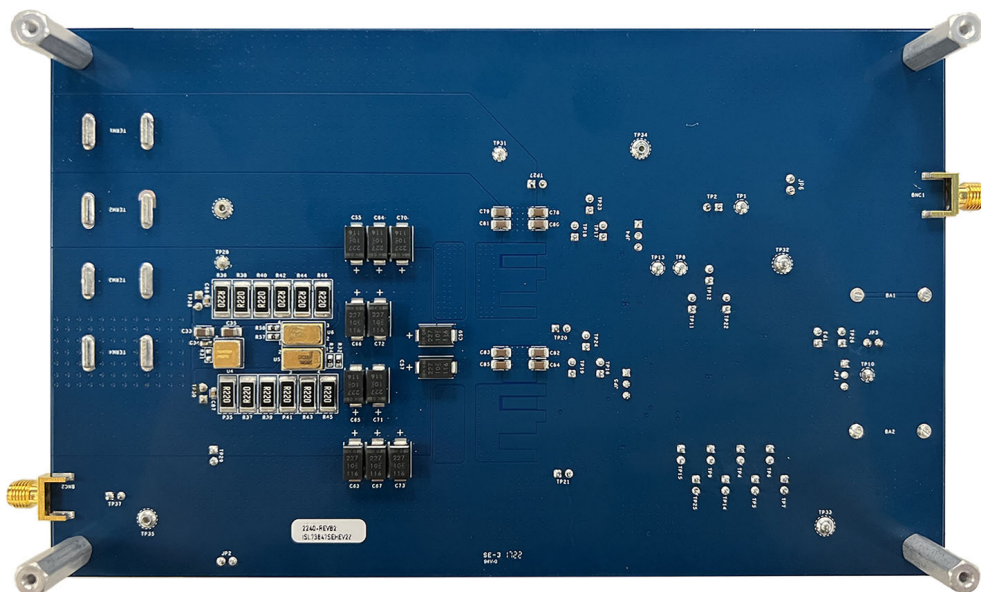
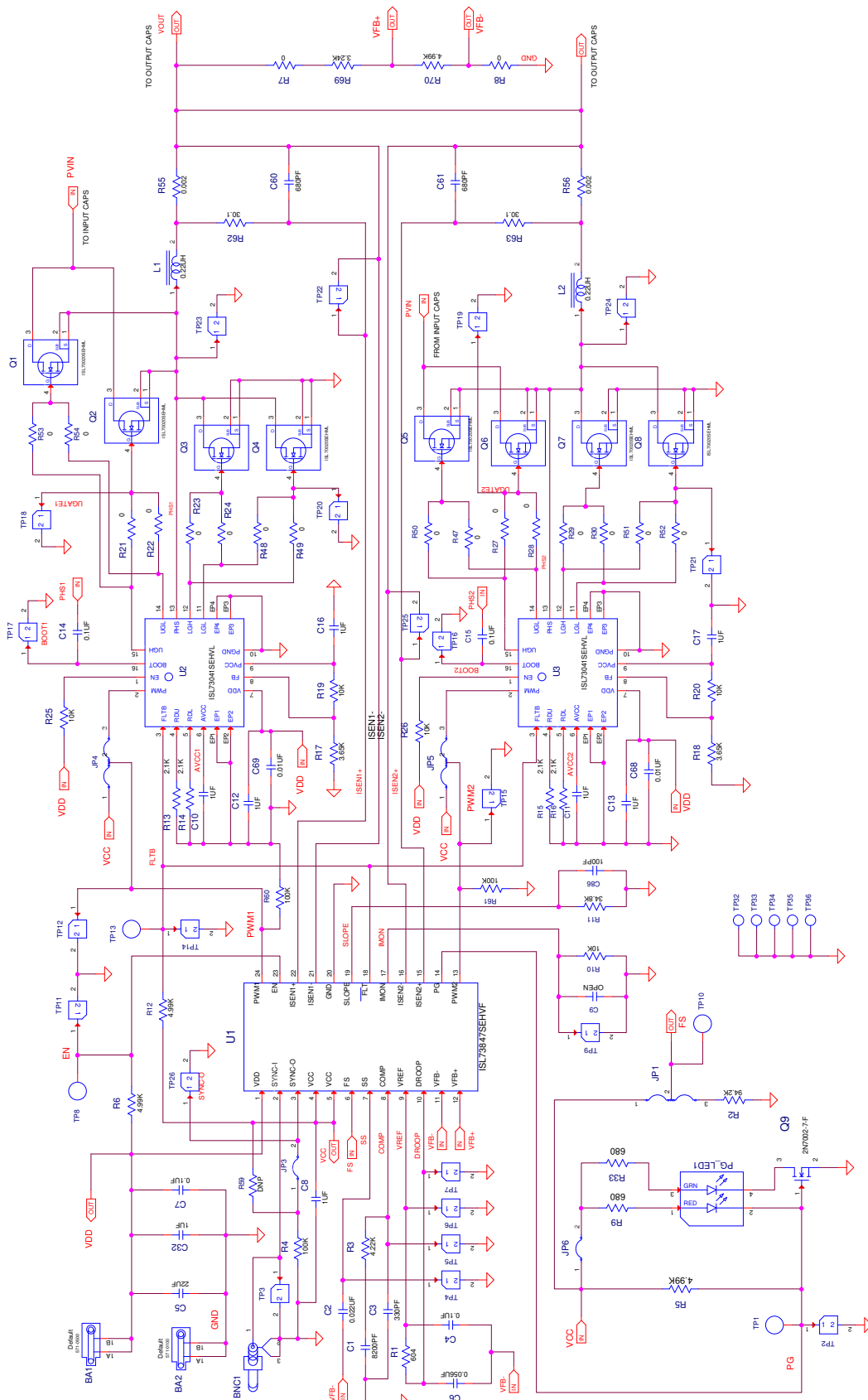


Figure 5. ISL73847SEHEV2Z Evaluation Board (Bottom)

2.1 Schematic Diagrams



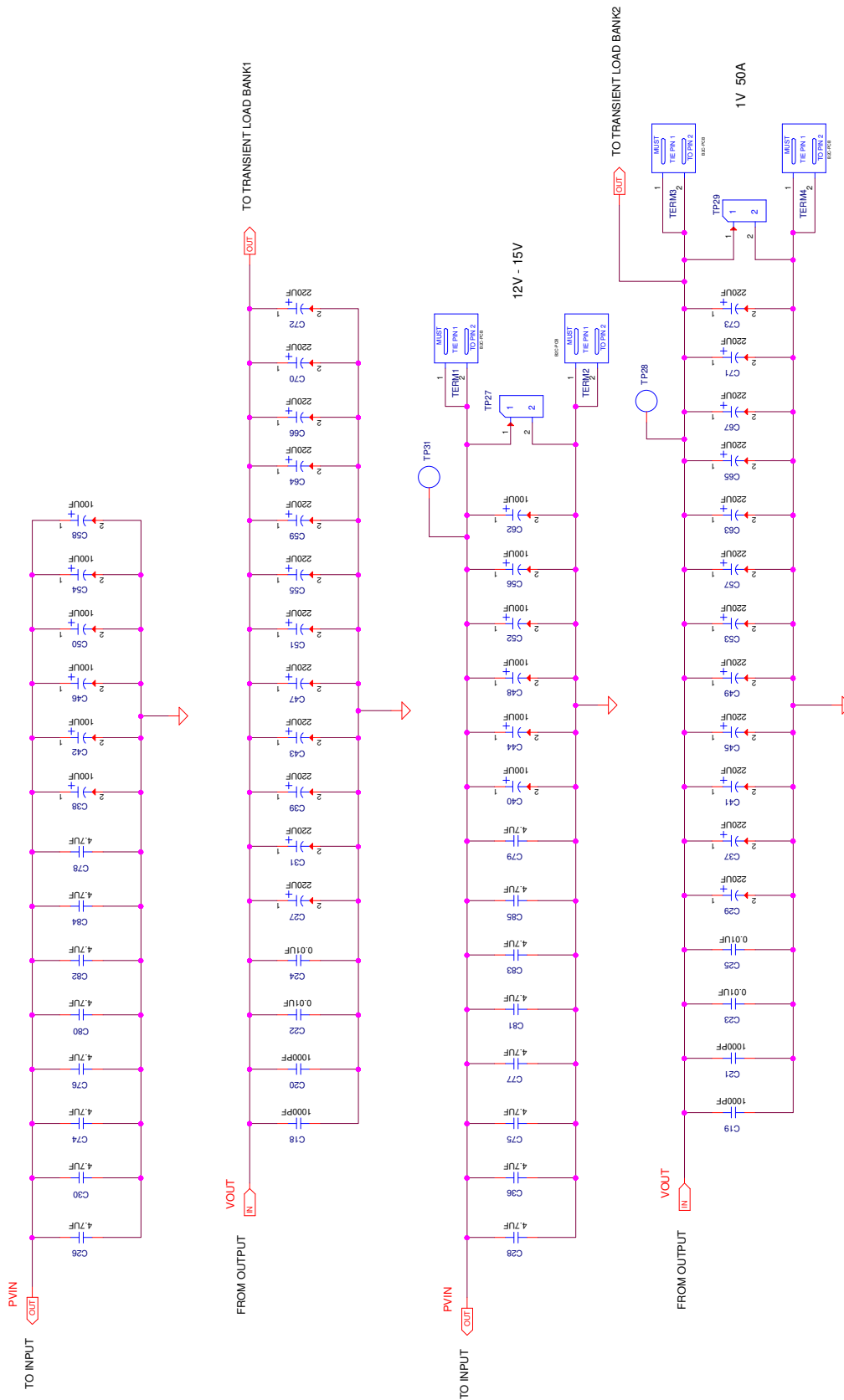


Figure 7. ISL73847SEHEV2Z Schematic (Page 2)

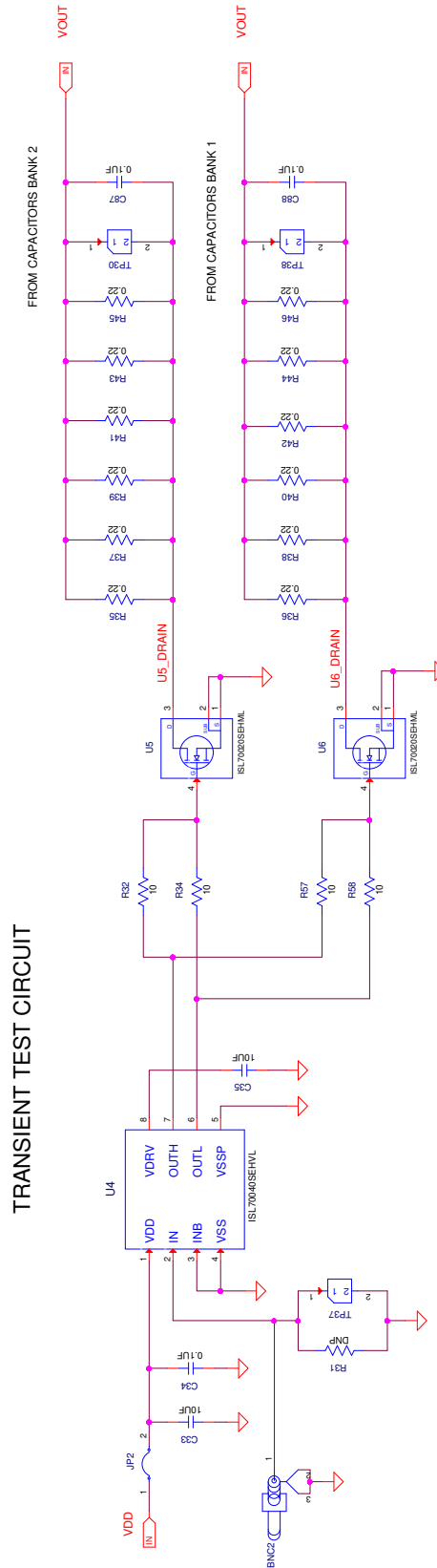


Figure 8. ISL73847SEHEV2Z Schematic (Page 3)

2.2 Bill of Materials

| Qty | Reference Designator | Description | Manufacturer | Manufacturer Part |
|-----|---|--|------------------|------------------------|
| 1 | | PWB-PCB, ISL73847SEHEV2Z, REVB, ROHS | Imagineering Inc | ISL73847SEHEV2ZREVBPCB |
| 2 | C87, C88 | CAP-BOARDFLEX, SMD, 0603, 0.1 μ F, 25V, 10%, X7R, ROHS | Kemet | C0603X104K3RACTU |
| 1 | C6 | CAP, SMD, 0603, 0.056 μ F, 50V, 10%, X7R, ROHS | Kemet | C0603X563K5RAC7867 |
| 3 | C8, C10, C11 | CAP, SMD, 0805, 1.0 μ F, 25V, 10%, X7R, ROHS | TDK | C2012X7R1E105K |
| 16 | C26, C28, C30, C36, C74, C75, C76, C77, C78, C79, C80, C81, C82, C83, C84, C85 | CAP, SMD, 1206, 4.7 μ F, 25V, 10%, X7R, ROHS | TDK | C3216X7R1E475K |
| 1 | C5 | CAP, SMD, 1210, 22 μ F, 25V, 10%, X7R, ROHS | Murata | GRM32ER71E226KE15L |
| 1 | C86 | CAP, SMD, 0603, 100pF, 25V, 10%, X7R, ROHS | Kemet | C0603C101K3RAC7867 |
| 4 | C18-C21 | CAP, SMD, 0603, 1000pF, 16V, 10%, X7R, ROHS | Venkel | C0603X7R160102KNE |
| 4 | C22-C25 | CAP, SMD, 0603, 0.01 μ F, 16V, 10%, X7R, ROHS | Venkel | C0603X7R160-103KNE |
| 2 | C68, C69 | CAP, SMD, 0603, 0.01 μ F, 25V, 10%, X7R, ROHS | Venkel | C0603X7R250-103KNE |
| 4 | C4, C14, C15, C34 | CAP, SMD, 0603, 0.1 μ F, 25V, 10%, X7R, ROHS | Yageo | CC0603KRX7R8BB104 |
| 1 | C7 | CAP, SMD, 0603, 0.1 μ F, 50V, 10%, X7R, ROHS | AVX | 06035C104KAT2A |
| 1 | C2 | CAP, SMD, 0603, 0.022 μ F, 16V, 10%, X7R, ROHS | Venkel | C0603X7R160-223K |
| 1 | C3 | CAP, SMD, 0603, 330pF, 50V, 5%, NP0, ROHS | Panasonic | ECJ-1VC1H331J |
| 2 | C60, C61 | CAP, SMD, 0603, 680pF, 50V, 10%, X7R, ROHS | Murata | GRM188R71H681KA01D |
| 0 | C9 | CAP, SMD, 0603, DNP- PLACE HOLDER, ROHS | | |
| 5 | C12, C13, C16, C17, C32 | CAP, SMD, 0805, 1.0 μ F, 25V, 10%, X5R, ROHS | AVX | 08053D105KAT4A |
| 2 | C33, C35 | CAP, SMD, 1206, 10 μ F, 25V, 10%, X7R, ROHS | Venkel | C1206X7R250-106KNE |
| 12 | C38, C40, C42, C44, C46, C48, C50, C52, C54, C56, C58, C62 | CAP-TANT, SMD, 7.3x4.3mm, 100 μ F, 25V, 20%, 30m Ω at 100MHz, ROHS | Kemet | T521X107M025ATE030 |

| Qty | Reference Designator | Description | Manufacturer | Manufacturer Part |
|-----|--|---|---------------------|--------------------|
| 24 | C27, C29, C31, C37, C39, C41, C43, C45, C47, C49, C51, C53, C55, C57, C59, C63, C64, C65, C66, C67, C70, C71, C72, C73 | CAP-TANT, SMD, 7.3×4.3×2.8, 220µF, 10V, 20%, 6mΩ, ROHS | Kemet | T530D227M010ATE006 |
| 1 | C1 | CAP, SMD, 0603, 8200pF, 50V, 5%, X7R, ROHS | Vishay/Vitramon | VJ0603Y822JXACW1BC |
| 2 | L1, L2 | COIL-PWR INDUCT, AEC-Q200, SMD, 11.3×10mm, 0.22µH, 20%, 98.8A, ROHS | Coilcraft | XAL1010-221MEB |
| 2 | BNC1, BNC2 | CONN-RF, SMA JACK, 50Ω, 18GHz, TAB-END LAUNCH, ROHS | Amphenol | 132357-11 |
| 5 | TP32-TP36 | CONN-TURRET, TERMINAL POST, TH, ROHS | Keystone | 1514-2 |
| 6 | TP1, TP8, TP10, TP13, TP28, TP31 | CONN-MINI TEST POINT, VERTICAL, WHITE, ROHS | Keystone | 5002 |
| 1 | BA2 | CONN-PLUG, BANA-INSUL-SDRLESS, BLACK, 4mm, RA | Deltron | 571-0100 |
| 1 | BA1 | CONN-PLUG, BANA-INSUL-SDRLESS, RED, 4mm, RA | Deltron | 571-0500 |
| 3 | JP1, JP4, JP5 | CONN-HEADER, 1×3, BREAKAWY 1×36, 2.54mm, ROHS | BERG/FCI | 68000-236HLF |
| 30 | TP2, TP3, TP4, TP5, TP6, TP7, TP9, TP11, TP12, TP14-TP26, TP27, TP29, TP30, TP37, TP38, JP2, JP3, JP6 | CONN-HEADER, 1×2, RETENTIVE, 2.54mm, 0.230×0.120, ROHS | BERG/FCI | 69190-202HLF |
| 4 | JP6, JP1-Pins 2-3, JP4-Pins 2-3, JP5-Pins 2-3 | CONN-JUMPER, SHUNT, 2P, 2.54mmPITCH, BLK, 6mm, OPEN, ROHS | Sullins | SPC02SYAN |
| 1 | PG_LED | LED, SMD, 3×2.5mm, 4P, RED/GREEN, 12/20MCD, 2V | Lumex | SSL-LXA3025IGC-TR |
| 10 | Q1-Q8, U5, U6 | IC-PROTO, RAD HARD, 40V GAN FET, 4P, CLCC, ROHS | Renesas Electronics | ISL70020SEHL/PROTO |
| 1 | U4 | IC-100V, RAD-HARD, GAN FET DRIVER, SMD, 8P, CLCC, ROHS | Renesas Electronics | ISL70040SEHL/PROTO |
| 2 | U2, U3 | IC-RAD LIGHT GaN FET, HALF BRIDGE DRIVER, 14P, CLCC, ROHS | Renesas Electronics | ISL73041SEHL/PROTO |
| 1 | U1 | IC-RAD LIGHT BUCK CONTROLLER, 24P, FP, ROHS | Renesas Electronics | ISL73847SEHF/PROTO |

| Qty | Reference Designator | Description | Manufacturer | Manufacturer Part |
|-----|---------------------------|--|-----------------|----------------------|
| 1 | Q9 | TRANSISTOR, N-CHANNEL, 3LD, SOT-23, 60V, 115mA, ROHS | Diodes, Inc. | 2N7002-7-F |
| 16 | R21-R24, R27-R30, R47-R54 | RES-AEC-Q200, SMD, 0402, 0Ω, 1/16W, TF, ROHS | Vishay/Dale | CRCW04020000Z0ED |
| 2 | R9, R33 | RES-AEC-Q200, SMD, 0603, 680Ω, 1/10W, 1%, TF, ROHS | Vishay/Dale | CRCW0603680RFKEA |
| 12 | R35-R46 | RES-CURR.SENSE, SMD, 2512, 0.22Ω, 2W, 1%, TF, ROHS | Bourns | CRM2512-FX-R220ELF |
| 0 | R31, R59 | RESISTOR, SMD, 0603, 0.1%, MF, DNP-PLACE HOLDER | | |
| 2 | R19, R20 | RES, SMD, 0402, 10K, 1/16W, 1%, TF, ROHS | Panasonic | ERJ-2RKF1002X |
| 2 | R17, R18 | RES, SMD, 0402, 3.65K, 1/16W, 1%, TF, ROHS | Panasonic | ERJ-2RKF3651 |
| 2 | R7, R8 | RES, SMD, 0603, 0Ω, 1/10W, TF, ROHS | Venkel | CR0603-10W-000T |
| 3 | R10, R25, R26 | RES, SMD, 0603, 10K, 1/10W, 1%, TF, ROHS | Venkel | CR0603-10W-1002FT |
| 4 | R4, R60, R61 | RES, SMD, 0603, 100K, 1/10W, 1%, TF, ROHS | Venkel | CR0603-10W-1003FT |
| 4 | R13-R16 | RES, SMD, 0603, 2.1K, 1/10W, 1%, TF, ROHS | Panasonic | ERJ-3EKF2101V |
| 2 | R62, R63 | RES, SMD, 0603, 30.1Ω, 1/10W, 1%, TF, ROHS | Yageo | RC0603FR-0730R1L |
| 1 | R69 | RES, SMD, 0603, 3.24K, 1/10W, 1%, TF, ROHS | Panasonic | ERJ-3EKF3241V |
| 1 | R11 | RES, SMD, 0603, 34.8K, 1/10W, 1%, TF, ROHS | Venkel | CR0603-10W-3482FT |
| 1 | R3 | RES, SMD, 0603, 4.22K, 1/10W, 1%, TF, ROHS | Rohm | MCR03EZPFX4221 |
| 4 | R5, R6, R12, R70 | RES, SMD, 0603, 4.99K, 1/10W, 1%, TF, ROHS | Panasonic | ERJ-3EKF4991V |
| 1 | R1 | RES, SMD, 0603, 604Ω, 1/10W, 1%, TF, ROHS | Panasonic | ERJ-3EKF6040V |
| 2 | R55, R56 | RES-AEC-Q200, SMD, 2512W, 0.002Ω, 3W, 2%, MF, ROHS | Susumu Co., Ltd | KRL6432E-M-R002-G-T1 |
| 4 | R32, R34, R57, R58 | RES-AEC-Q200, SMD, 0603, 10Ω, 1/10W, 1%, TF, ROHS | Rohm | KTR03EZPF10R0 |
| 1 | R2 | RES, SMD, 0603, 94.2K, 1/10W, 0.1%, THINFILM, ROHS | Yageo | RT0603BRD0794K2L |

| Qty | Reference Designator | Description | Manufacturer | Manufacturer Part |
|-----|----------------------|--|------------------------------|-------------------|
| 4 | Four corners | SCREW, 4-40×1/4in, PHILLIPS, PANHEAD, STAINLESS, ROHS | Building Fasteners | PMSSS 440 0025 PH |
| 4 | Four corners | STANDOFF, 4-40×3/4in, F/F, HEX, ALUMINUM, 0.25 OD, ROHS | Keystone | 2204 |
| 4 | TERM1-TERM4 | HDWARE-WIRE LUG, TH, 11.8×10.3mm, SLOTTED SCREW, 2-14AWG, ROHS | International Hydraulics Inc | B2C-PCB |

2.3 Board Layout

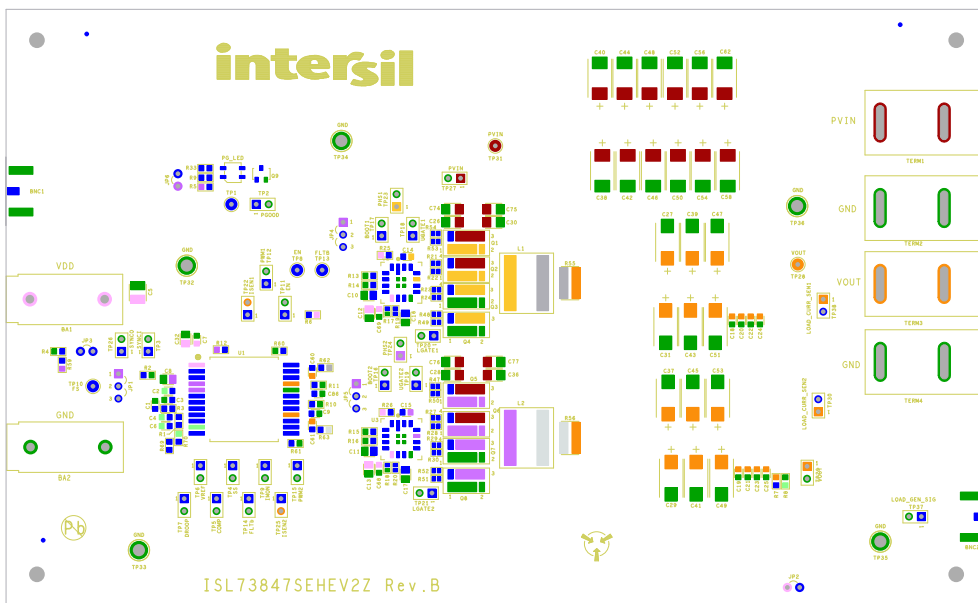


Figure 9. Silkscreen Top Layer

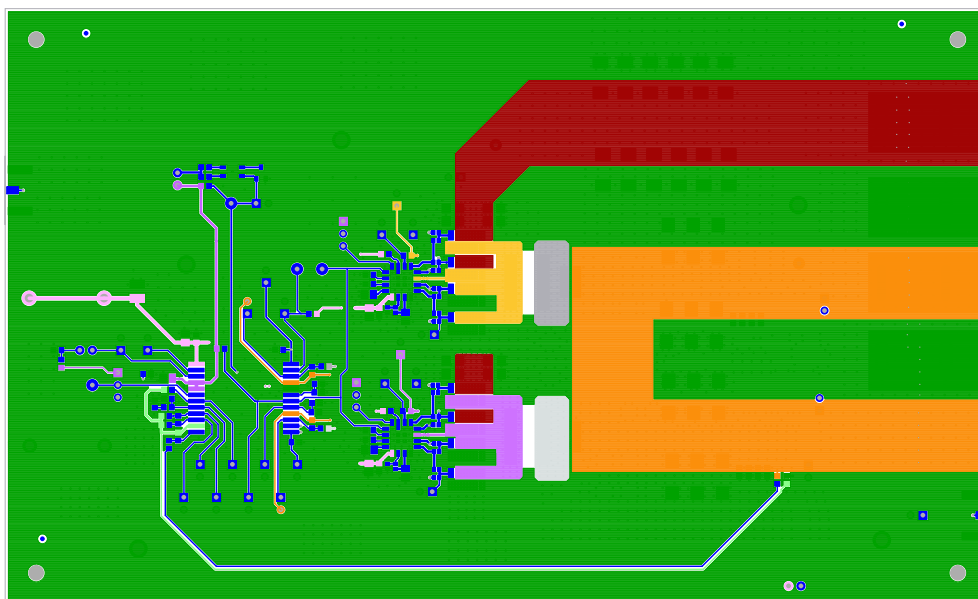


Figure 10. Top Layer

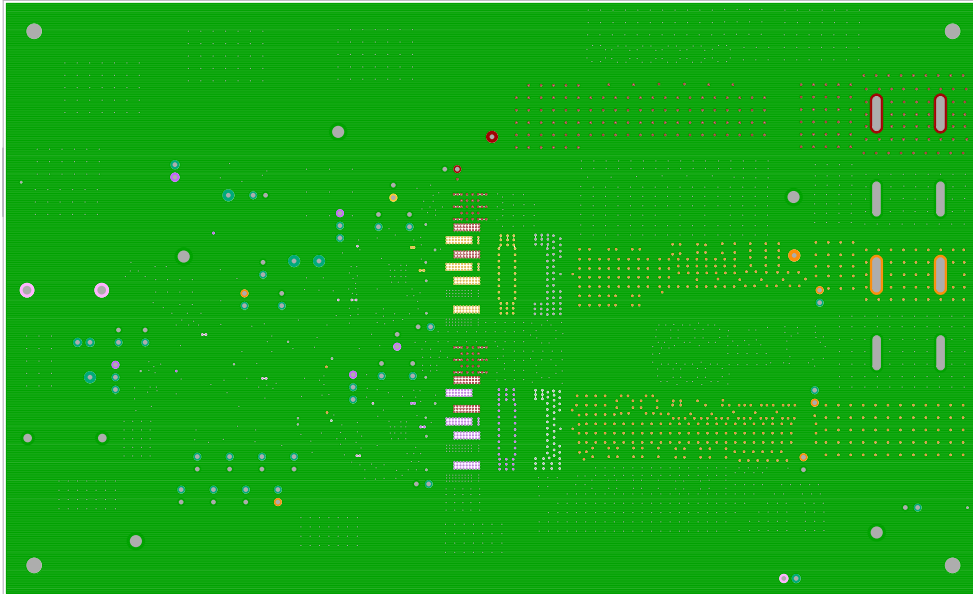


Figure 11. Layer 2

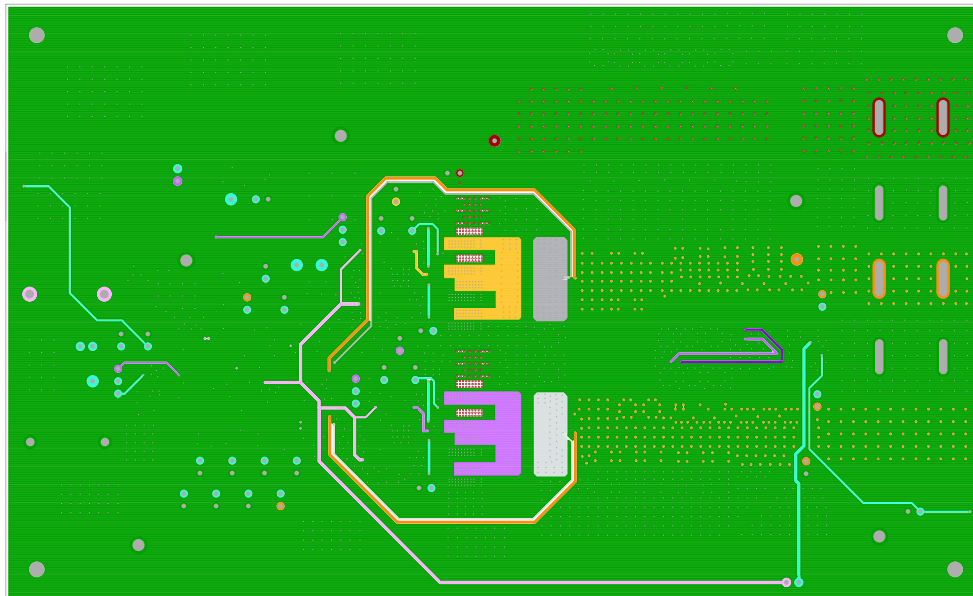


Figure 12. Layer 3

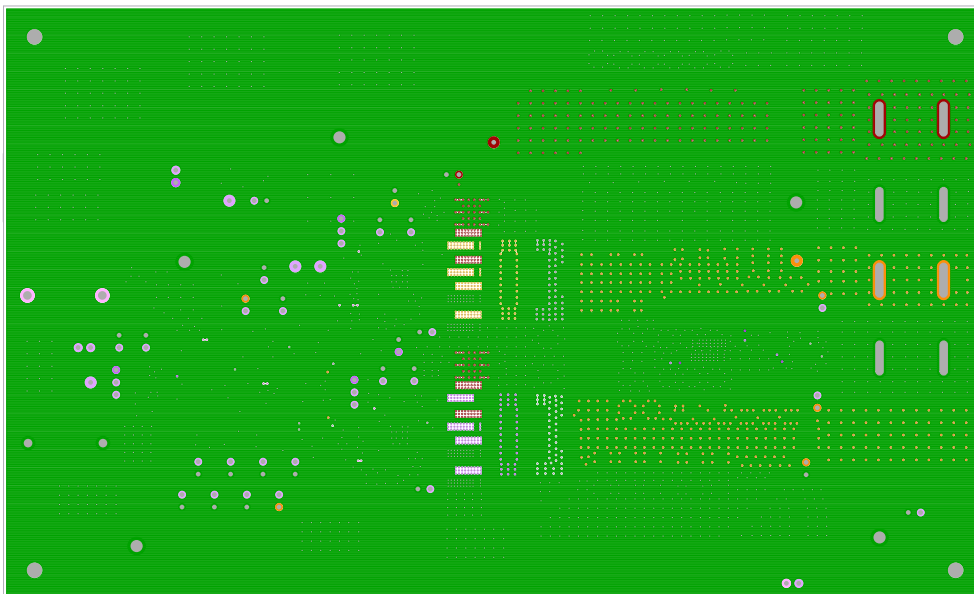


Figure 13. Layer 4

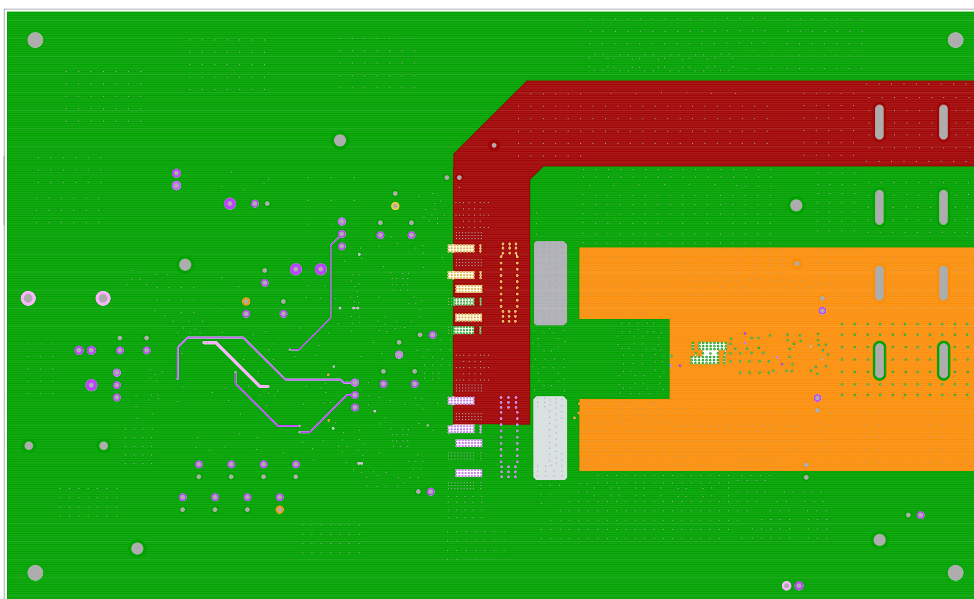


Figure 14. Layer 5

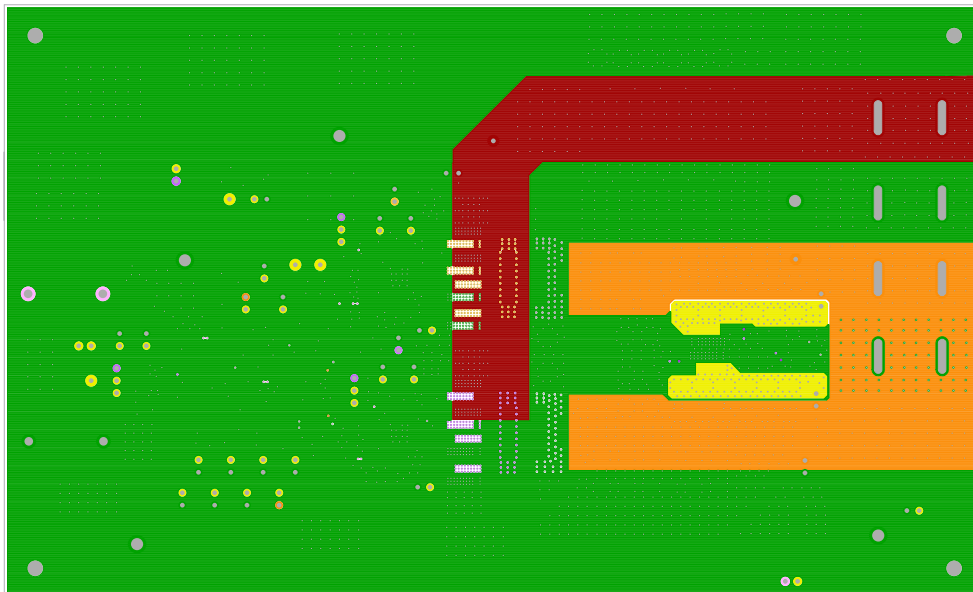


Figure 15. Layer 6

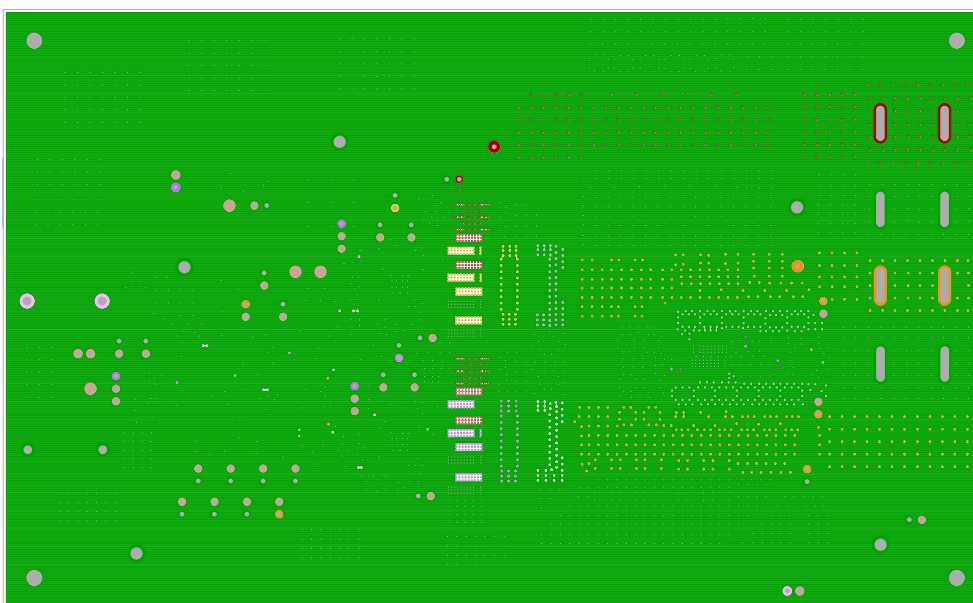


Figure 16. Layer 7

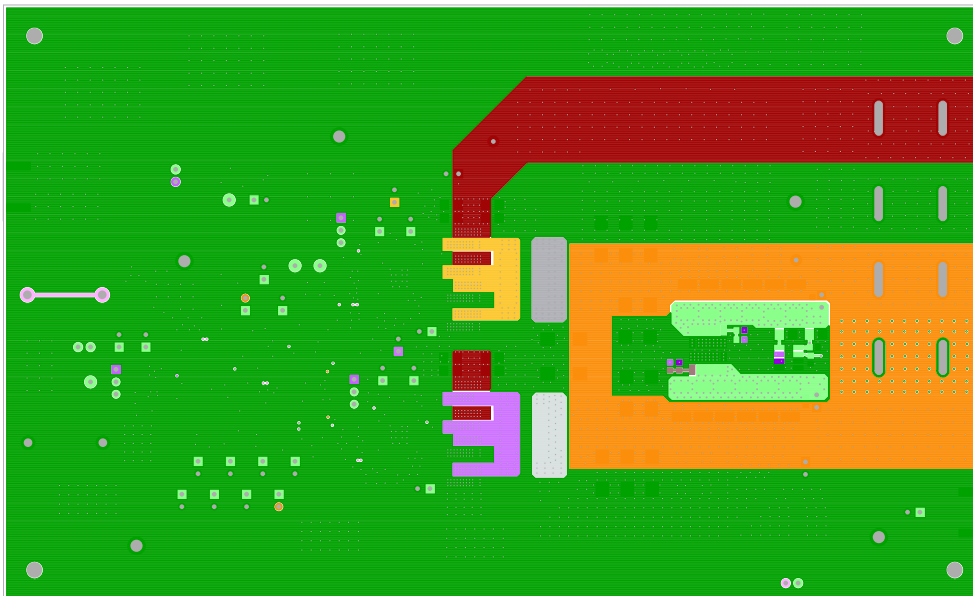


Figure 17. Bottom Layer

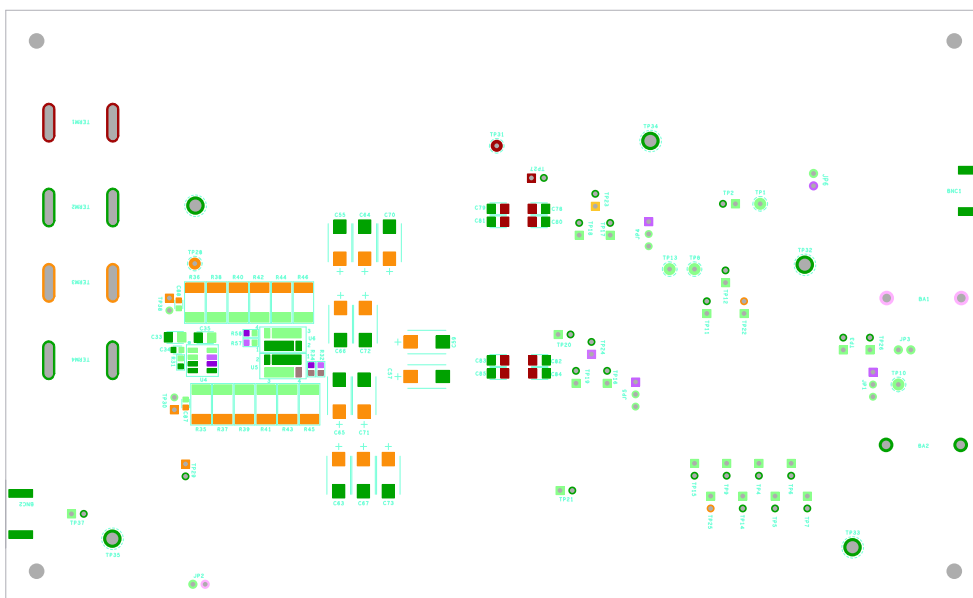


Figure 18. Silkscreen Bottom Layer

3. Typical Performance Graphs

Unless otherwise noted, $V_{OUT} = 1V$; $L_{OUT} = 220nH$ per phase, $C_{OUT} = 2.64mF$ per phase, $C_{DROOP} = 56nF$, $C_{VREF} = 100nF$, $R_{DROOP} = 0\Omega$, $R_{FS} = 94.2k\Omega$, $C_{SS} = 22nF$, $C_{COMP} = 8.2nF$, $R_{COMP} = 4.22k\Omega$, $C_{POLE} = 330pF$, $C_{VCC} = 1\mu F$, $R_{SLP} = 34.8k\Omega$, $C_{SLP} = 100pF$, $T_A = +25^\circ C$

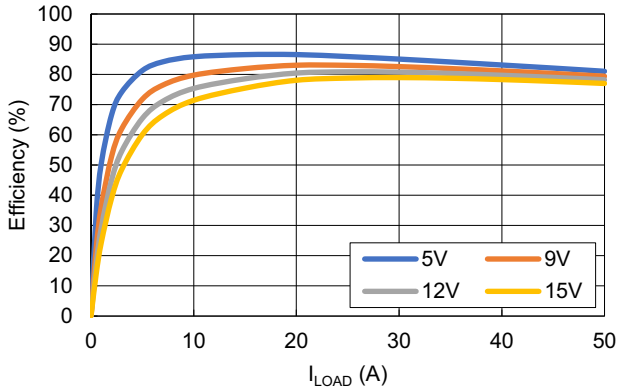


Figure 19. Conversion Efficiency for Various V_{IN} ($f_{SW} = 500kHz$, ISL70020SEHML, XAL1010-221ME)

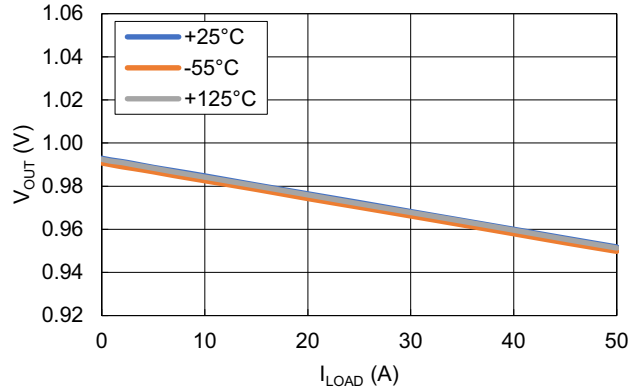


Figure 20. Droop Regulation for Various Temperatures ($V_{IN} = 12V$, $R_{DROOP} = 604\Omega$)

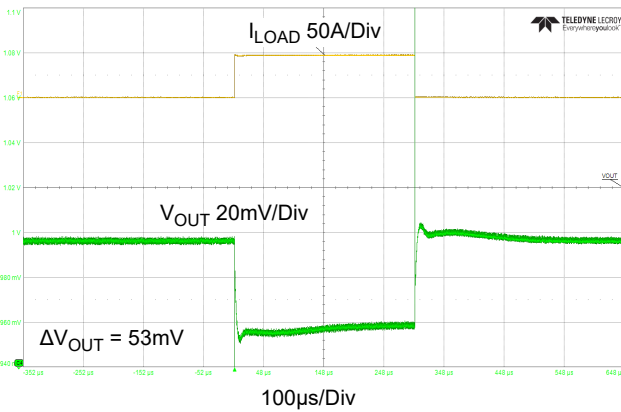


Figure 21. Load Transient Response ($V_{IN} = V_{DD} = 12V$, $R_{DROOP} = 604\Omega$)

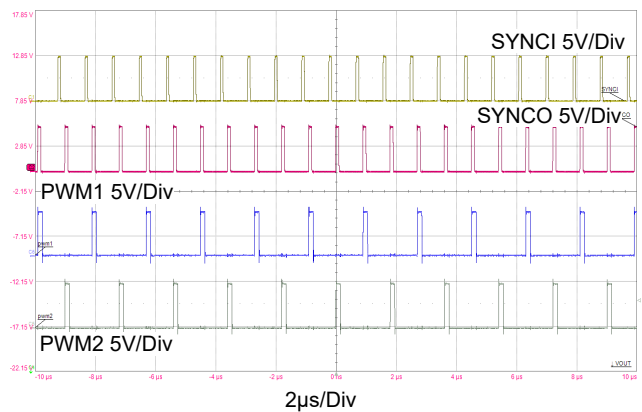


Figure 22. SYNC-O Frequency = SYNC-I Frequency ($V_{DD} = 12V$, $V_{IN} = 12V$, $R_{SYNC-O} = 100k\Omega$ to GND)

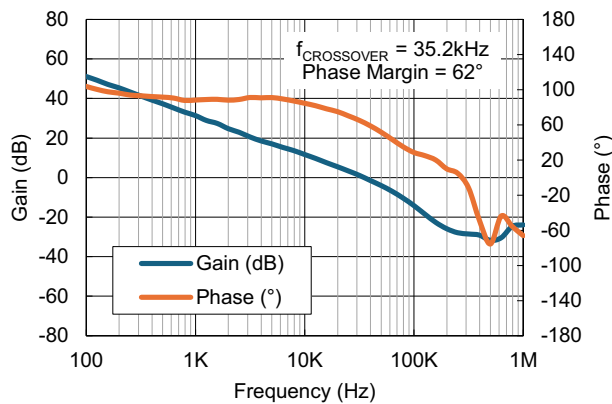


Figure 23. Gain and Phase vs Frequency ($V_{IN} = 5V$, $I_{LOAD} = 0A$, $f_{SW} = 500kHz$)

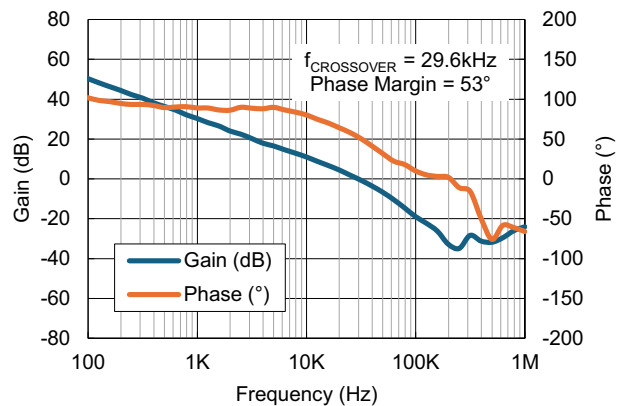


Figure 24. Gain and Phase vs Frequency ($V_{IN} = 12V$, $I_{LOAD} = 0A$, $f_{SW} = 500kHz$)

Unless otherwise noted, $V_{OUT} = 1V$; $L_{OUT} = 220nH$ per phase, $C_{OUT} = 2.64mF$ per phase, $C_{DROOP} = 56nF$, $C_{VREF} = 100nF$, $R_{DROOP} = 0\Omega$, $R_{FS} = 94.2k\Omega$, $C_{SS} = 22nF$, $C_{COMP} = 8.2nF$, $R_{COMP} = 4.22k\Omega$, $C_{POLE} = 330pF$, $C_{VCC} = 1\mu F$, $R_{SLP} = 34.8k\Omega$, $C_{SLP} = 100pF$, $T_A = +25^\circ C$ (Cont.)

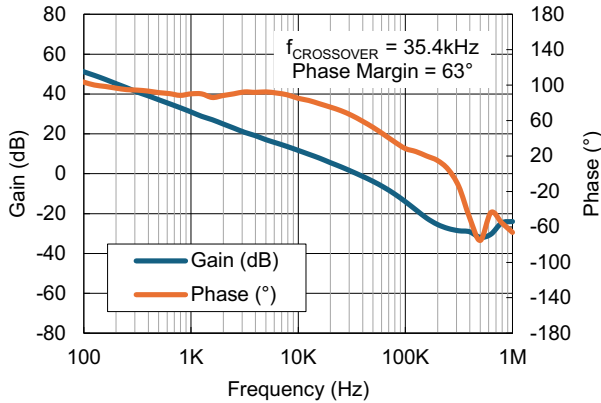


Figure 25. Gain and Phase vs Frequency ($V_{IN} = 5V$, $I_{LOAD} = 25A$, $f_{SW} = 500kHz$)

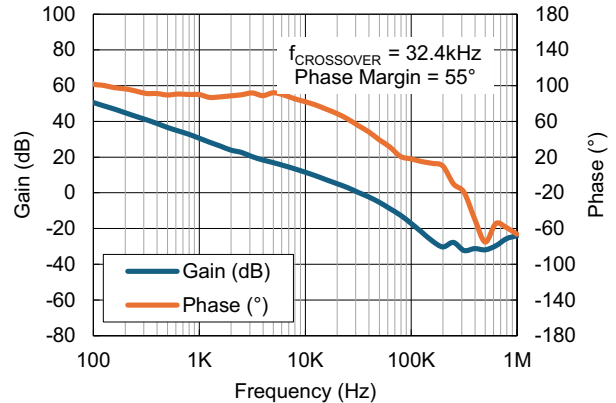


Figure 26. Gain and Phase vs Frequency ($V_{IN} = 12V$, $I_{LOAD} = 25A$, $f_{SW} = 500kHz$)

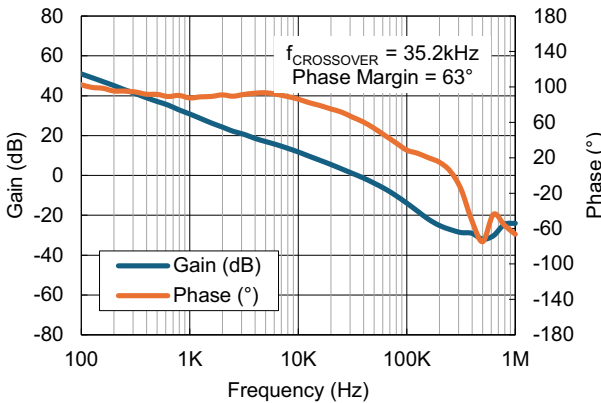


Figure 27. Gain and Phase vs Frequency ($V_{IN} = 5V$, $I_{LOAD} = 50A$, $f_{SW} = 500kHz$)

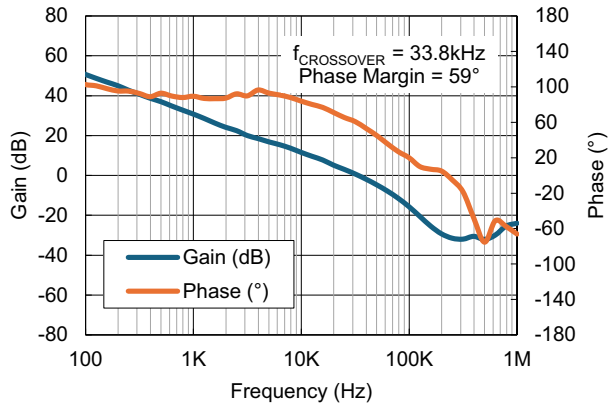


Figure 28. Gain and Phase vs Frequency ($V_{IN} = 12V$, $I_{LOAD} = 50A$, $f_{SW} = 500kHz$)

4. Ordering Information

| Part Number | Description |
|-----------------|------------------------------|
| ISL73847SEHEV2Z | ISL73847SEH evaluation board |

5. Revision History

| Revision | Date | Description |
|----------|--------------|------------------------------|
| 1.01 | May 13, 2024 | Added Figures 23 through 28. |
| 1.00 | Nov 21, 2022 | Initial release |

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TOYOSU FORESIA, 3-2-24 Toyosu,
Koto-ku, Tokyo 135-0061, Japan
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