# SupIRBuck™

## USER GUIDE FOR IRDC3863 EVALUATION BOARD

## DESCRIPTION

The IR3863 SupIRBuck™ is an easy-to-use, fully integrated and highly efficient DC/DC voltage regulator. The onboard constant on time hysteretic controller and MOSFETs make IR3863 a space-efficient solution that delivers up to 6A of precisely controlled output voltage in a 4mm x 5mm QFN package.

In addition to excellent light load and full load efficiency, the IR3863 offers features such as: a 0.5V reference, programmable switching frequency, temperature compensated over current protection, thermal shutdown and optional forced continuous conduction mode.

Additional features include: pre-bias startup, soft start, power good output, enable input with voltage monitoring capability and over/under voltage protection, making the device a very flexible solution that is suitable for a broad range of applications.

This user guide contains the schematic, bill of materials, and operating instructions of the IRDC3863 evaluation board. Detailed product specifications, application information and performance curves at different operating conditions are available in the IR3863 data sheet.

## BOARD FEATURES

- $V_{IN}$ = +12V
- $V_{CC}$ = +5V
- $V_{OUT}$ = +1.05V
- $I_{OUT}$ = 0 to 6A
- $F_S$ = 300kHz @ CCM
- L = 2.2µH
- $C_{IN}$ = 22µF (ceramic 1210) + 68µF (electrolytic)
- $C_{OUT}$ = 47µF (ceramic 0805) + 150µF (PC-CON)

## CONNECTIONS and OPERATING INSTRUCTIONS

An input supply in the range of 7 to 16V should be connected from VIN to PGND. A maximum load of 6A may be connected to $V_{OUT}$ and PGND. The connection diagram is shown in Fig. 1, and the inputs and outputs of the board are listed in Table 1.

IRDC3863 has two input supplies, one for biasing (VCC) and the other for input voltage (VIN). Separate supplies should be applied to these inputs. VCC input should be a well regulated 4.5V to 5.5V supply connected to VCC and PGND. Enable (EN) is controlled by the first switch of SW1, and FCCM option can be selected by the second switch of SW1. Toggle the switch to the ON position (marked by a solid square) to enable switching or to select FCCM. The absolute maximum voltage of the external signal applied to EN (TP4) and FCCM is +8V.

**Table 1. Connections**

| Connection | Signal Name |
|---|---|
| VIN (TP2) | VIN |
| PGND (TP5) | Ground for VIN |
| VCC (TP16) | VCC Input |
| PGND (TP17) | Ground for VCC Input |
| VOUT (TP7) | $V_{OUT}$ (+1.05V) |
| PGND (TP10) | Ground for $V_{OUT}$ |
| EN (TP4) | Enable Input |

## LAYOUT

The PCB is a 4-layer board. All layers are 1 oz. copper. IR3863 and other components are mounted on the top and bottom layers of the board.

The power supply decoupling capacitors, bootstrap capacitor and feedback components are located close to IR3863. To improve efficiency, the circuit board is designed to minimize the length of the on-board power ground current path.

## CONNECTION DIAGRAM

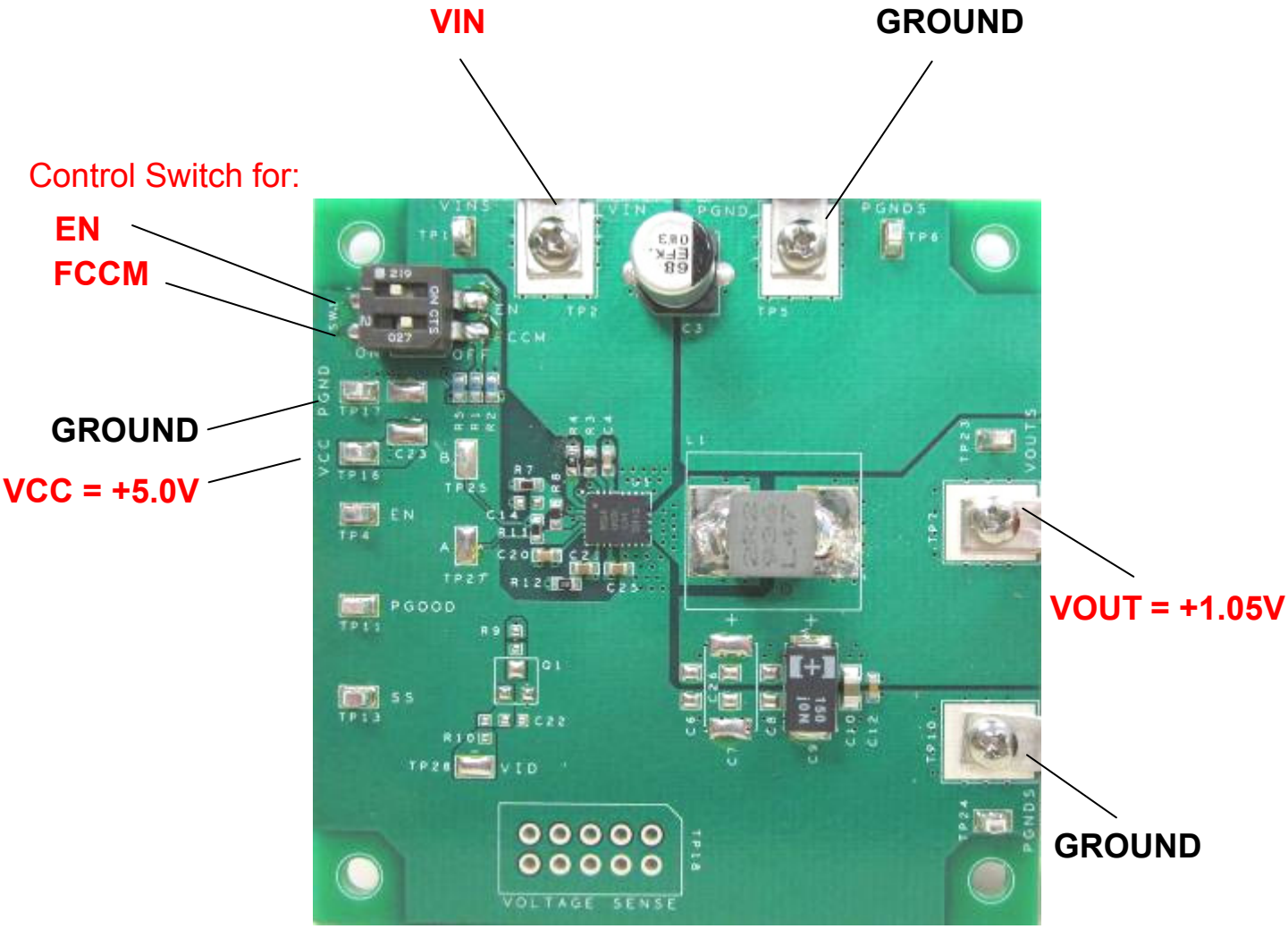



**Fig. 1: Connection Diagram of IRDC3863 Evaluation Board**

## PCB Board Layout

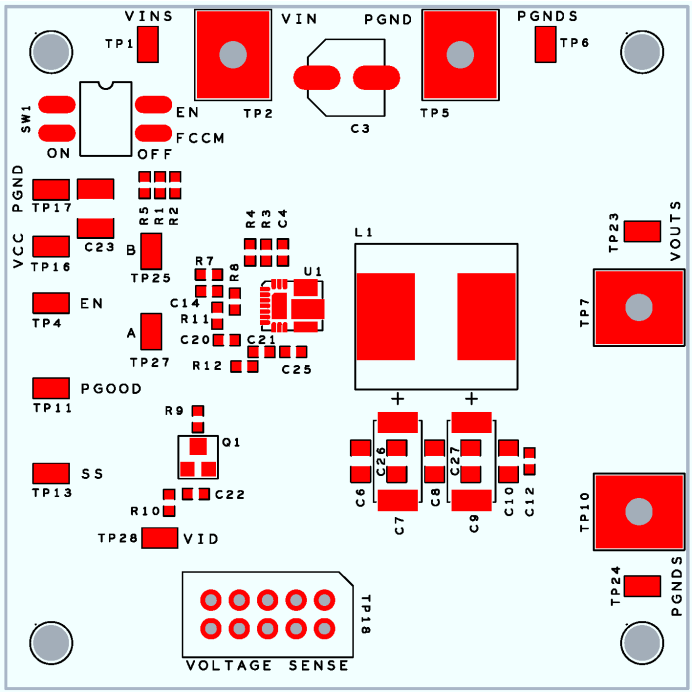



**Fig. 2: Board Layout, Top Components**

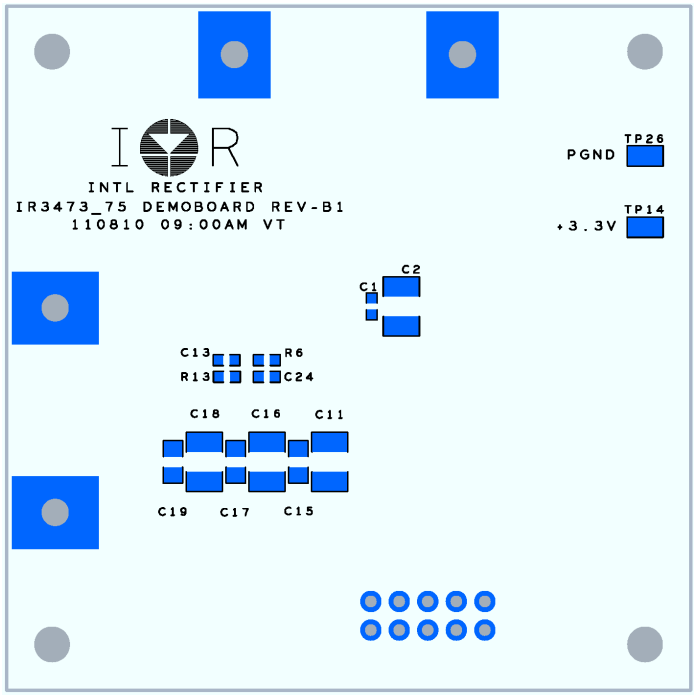



**Fig. 3: Board Layout, Bottom Components**

## PCB Board Layout

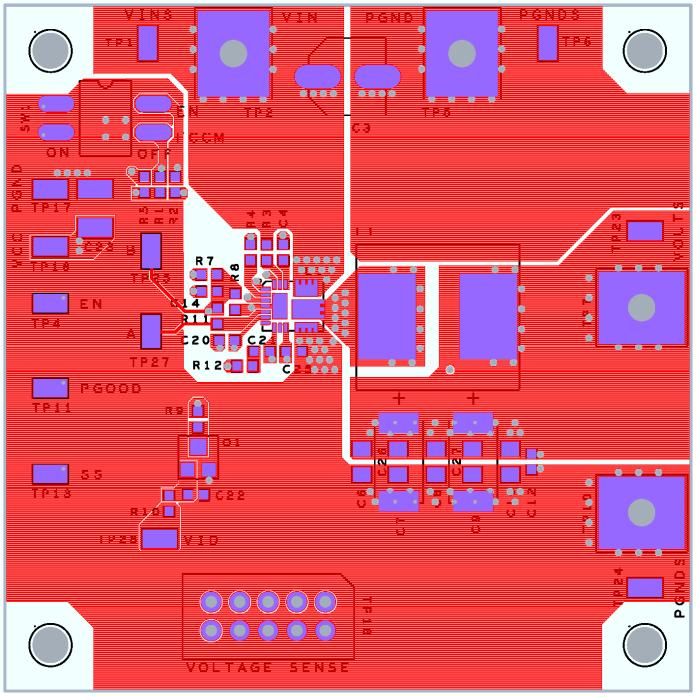



**Fig. 4: Board Layout, Top Layer**

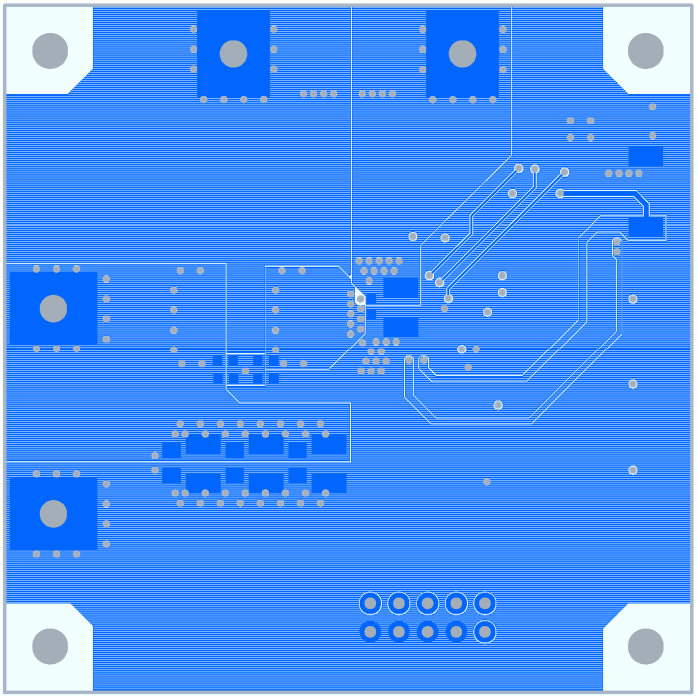


**Fig. 5: Board Layout, Bottom Layer**

## PCB Board Layout

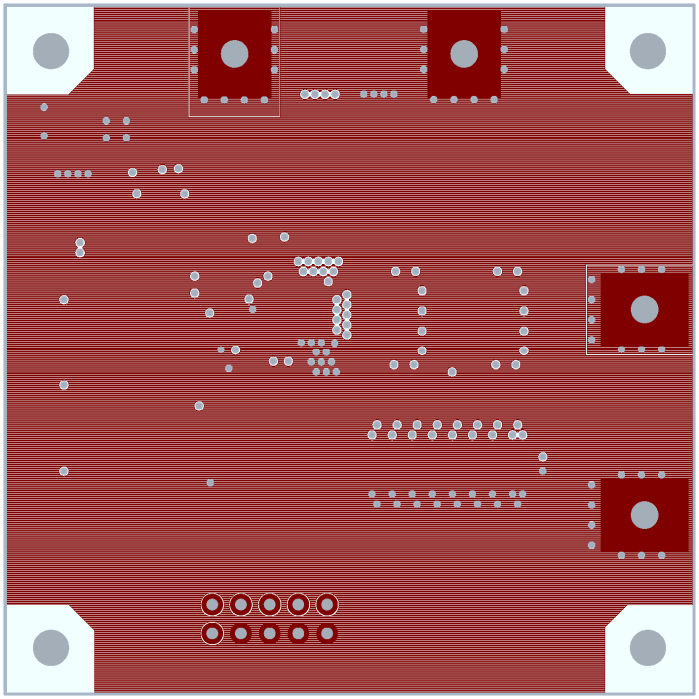


Fig. 6: Board Layout, Mid-layer I

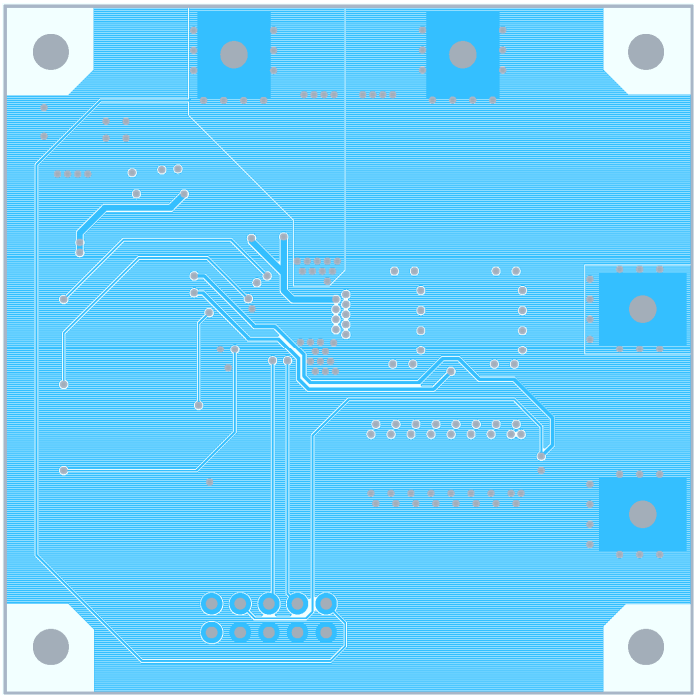


Fig. 7: Board Layout, Mid-layer II

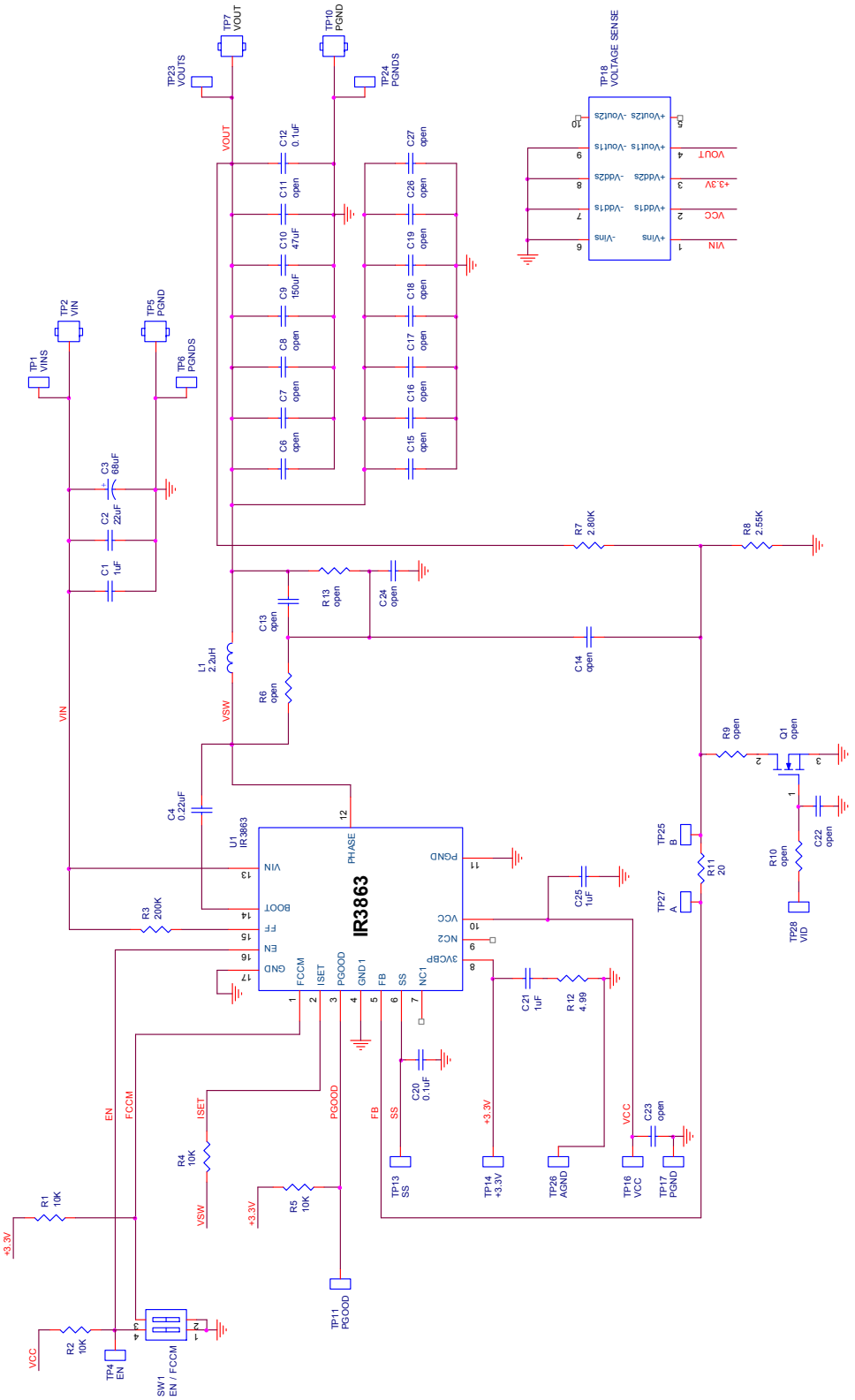



**Fig. 8: Schematic of the IRDC3863 Evaluation Board**

## Bill of Materials

| QTY | REF DESIGNATOR | VALUE | DESCRIPTION | MANUFACTURER | PART NUMBER |
|---|---|---|---|---|---|
| 3 | C1, C21, C25 | 1.00uF | capacitor, X7R, 1.00uF, 25V, 0.1, 0603 | Murata | GRM188R71E105KA12D |
| 1 | C10 | 47uF | capacitor, 47uF, 6.3V, 805 | TDK | C2012X5R0J476M |
| 2 | C12, C20 | 0.100uF | capacitor, X7R, 0.100uF, 25V, 0.1, 603 | TDK | C1608X7R1E104K |
| 1 | C2 | 22.0uF | capacitor, X5R, 22.0uF, 16V, 20%, 1206 | Taiyo Yuden | EMK316BJ226ML-T |
| 1 | C3 | 68uF | capacitor, electrolytic, 68uF, 25V, 0.2, SMD | Panasonic | EEV-FK1E680P |
| 1 | C4 | 0.22uF | capacitor, X5R, 0.22uF, 10V, 0.1, 0603 | TDK | C1608X5R1A224K |
| 1 | C9 | 150uF | capacitor, tantalum polymer, 150uF, 6.3V, 20%, 7343 | Sanyo | 6TPC150M |
| 1 | L1 | 2.2uH | inductor, ferrite, 2.2uH, 8.0A, 11.2mOhm, SMT | Cyntec | PCMB065T-2R2MS |
| 4 | R1, R2, R4, R5 | 10.0K | resistor, thick film, 10.0K, 1/10W, 0.01, 0603 | KOA | RK73H1J1002F |
| 1 | R11 | 20 | resistor, thick film, 20, 1/10W, 0.01, 603 | KOA | RK73H1JLTD20R0F |
| 1 | R12 | 4.99 | resistor, thick film, 4.99, 1/8W, 0.01, 603 | KOA | RK73H1J4R99F |
| 1 | R3 | 200K | resistor, thick film, 200K, 1/10W, 0.01, 603 | KOA | RK73H1JLTD2003F |
| 1 | R7 | 2.80K | resistor, thick film, 2.80K, 1/10W, 0.01, 603 | KOA | RK73H1JLTD2801F |
| 1 | R8 | 2.55K | resistor, thick film, 2.55K, 1/10W, 0.01, 0603 | KOA | RK73H1J2551F |
| 1 | SW1 | SPST | switch, DIP, SPST, 2 position, SMT | C&K Components | SD02H0SK |
| 1 | U1 | IR3863 | 4mm X 5mm QFN | IRF | IR3863MTRPBF |

## TYPICAL OPERATING WAVEFORMS

Tested with demoboard shown in Fig. 8, VIN = 12V, VCC = 5V, VOUT = 1.05V, Fs = 300kHz, $T_A$ = 25°C, no airflow, unless otherwise specified

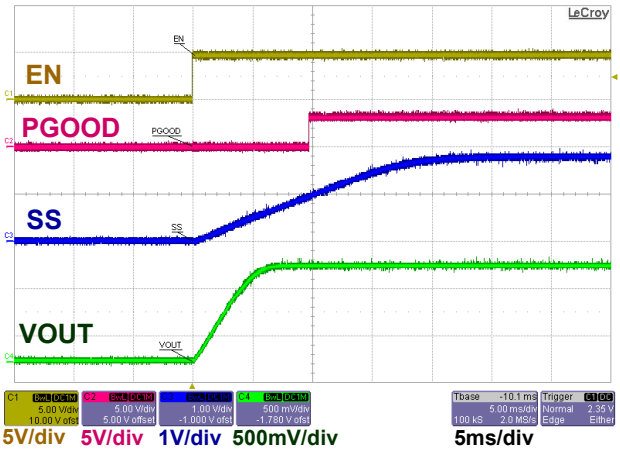



Fig. 9: Startup

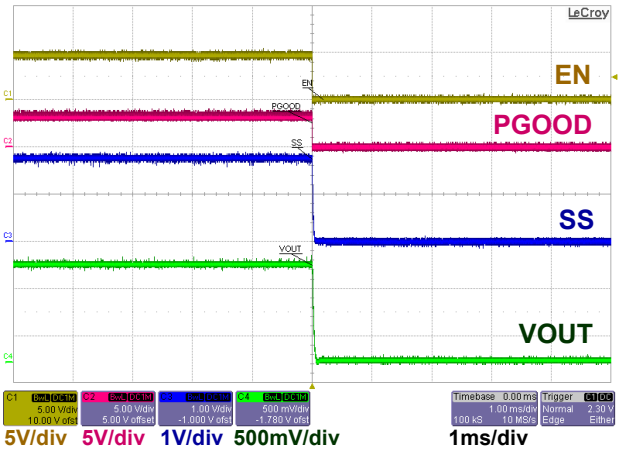



Fig. 10: Shutdown

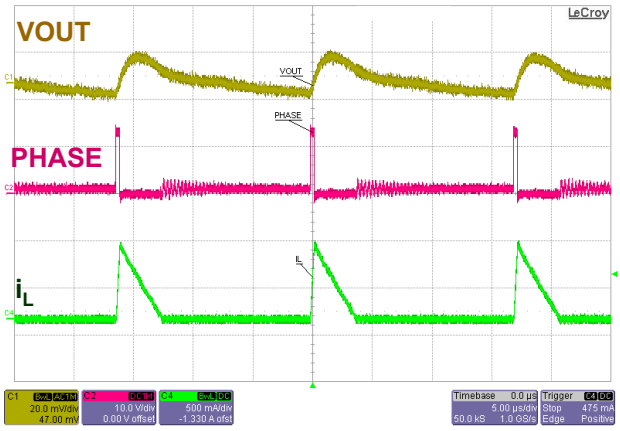



Fig. 11: DCM ($I_{OUT}$ = 0.1A)

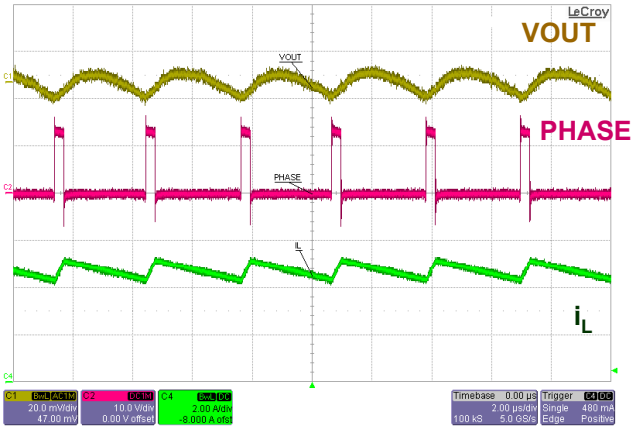



Fig. 12: CCM ($I_{OUT}$ = 5A)

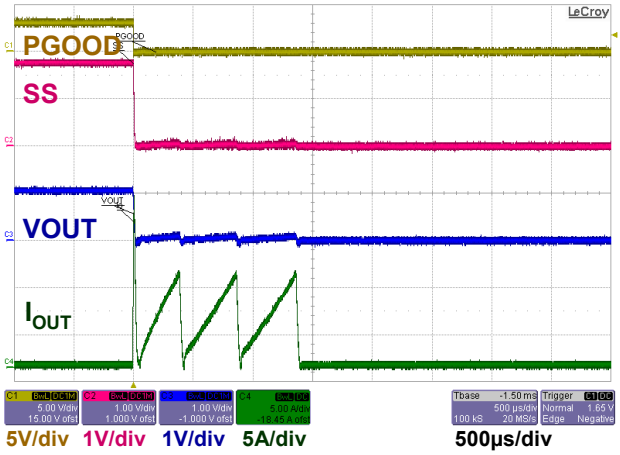



Fig. 13: Over Current Protection (tested by shorting VOUT to PGND)

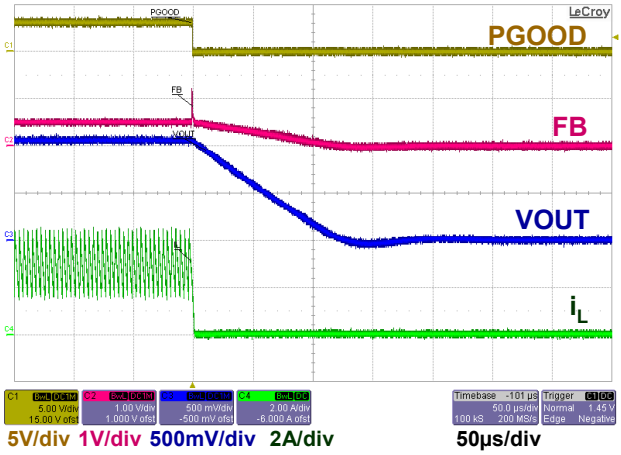



Fig. 14: Over Voltage Protection (tested by shorting FB to VOUT)

## TYPICAL OPERATING WAVEFORMS

Tested with demoboard shown in Fig. 8, VIN = 12V, VCC = 5V, VOUT = 1.05V, Fs = 300kHz, $T_A$ = 25°C, no airflow, unless otherwise specified

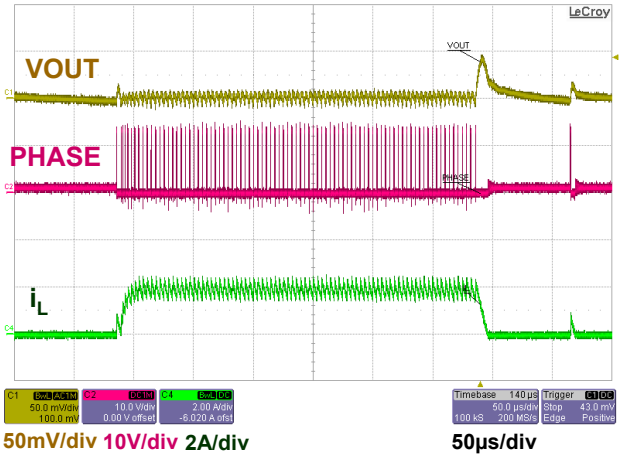



Fig. 15: Load Transient 0-2A

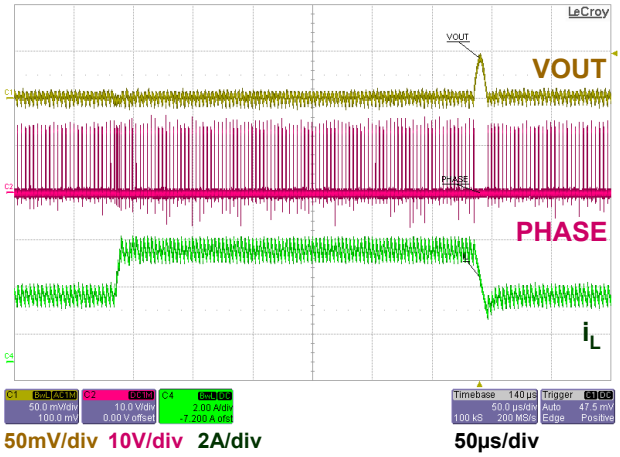



Fig. 16: Load Transient 3-5A

## TYPICAL PERFORMANCE

VIN = 12V, VCC = 5V, VOUT = 1.05V, Fs = 300kHz, IOUT = 6A, $T_A$ = 25°C, no airflow

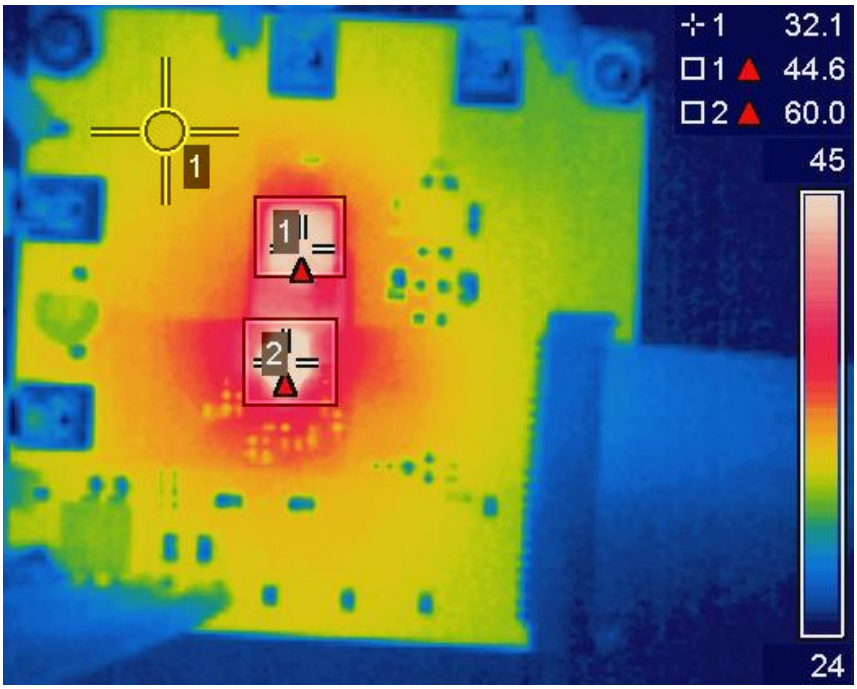



Fig. 17: Thermal Image (IR3863: 60°C, Inductor: 45°C, PCB: 32°C)

## TYPICAL OPERATING DATA

VIN = 12V, VCC = 5V, VOUT = 1.05V, Fs = 300kHz, IOUT = 0 ~ 6A, $T_A$ = 25°C, no airflow, unless otherwise specified

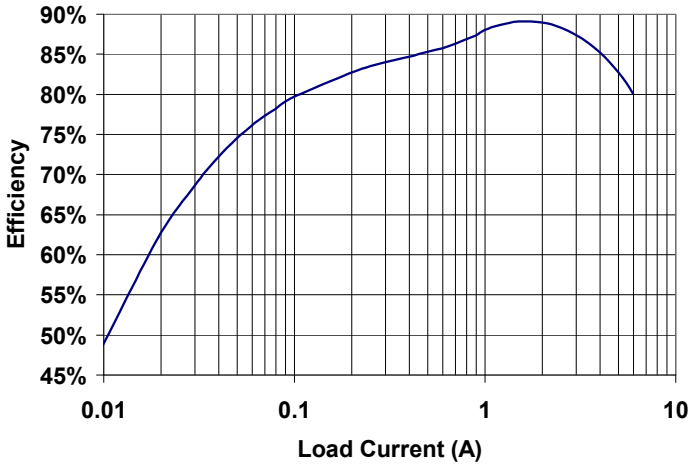



Fig. 18: Efficiency vs. Load Current

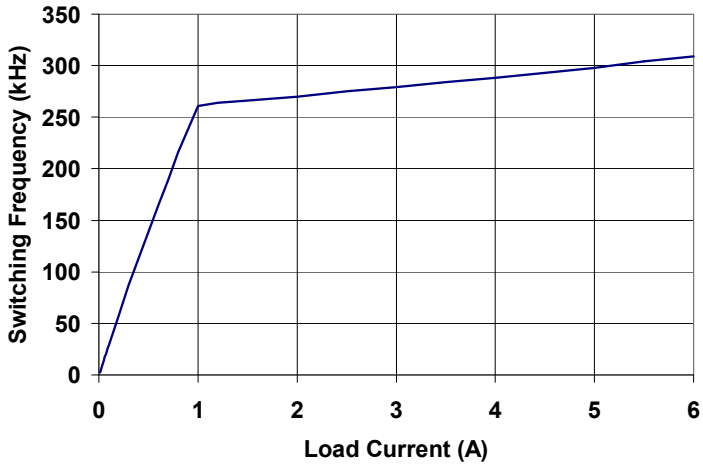



Fig. 19: Switching Frequency vs. Load Current

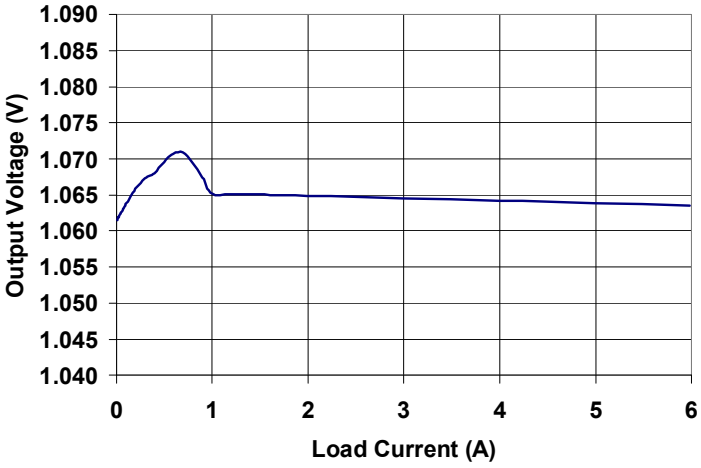



Fig. 20: Load Regulation

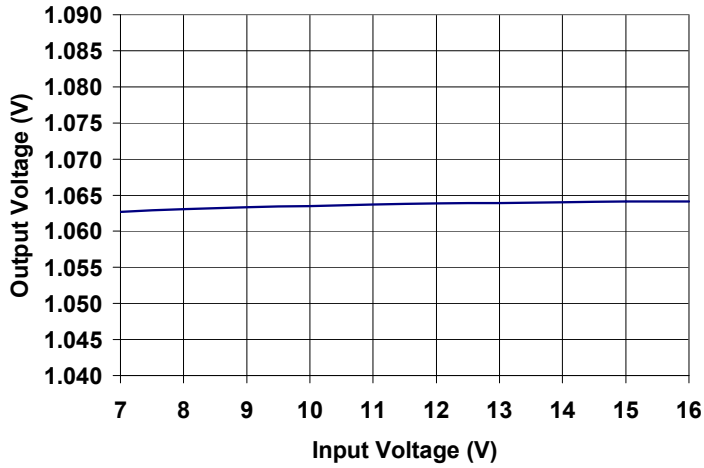


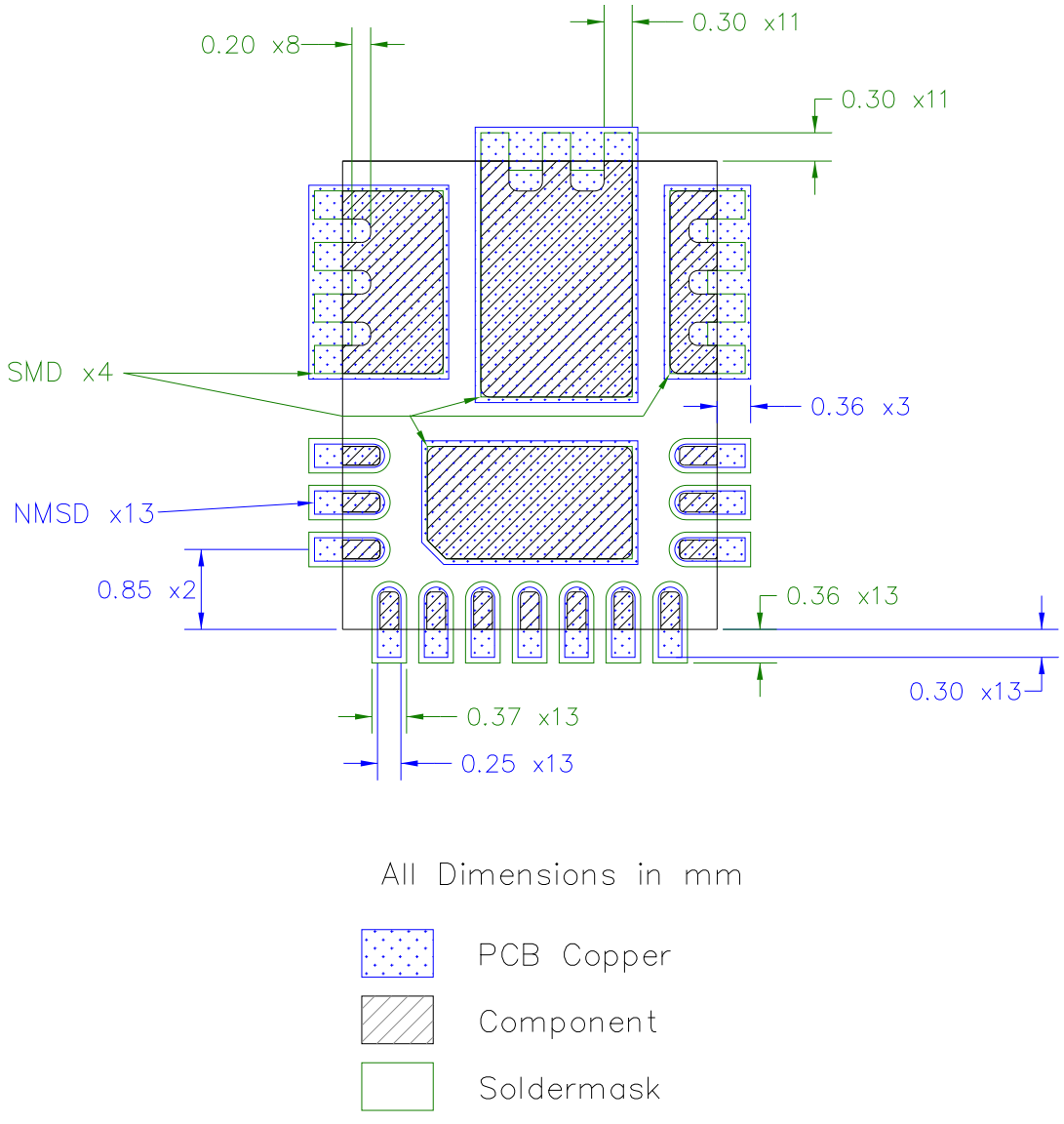

Fig. 21: Line Regulation at 6A Load

## PCB Metal and Components Placement

Lead lands (the 13 IC pins) width should be equal to nominal part lead width. The minimum lead to lead spacing should be ⩾ 0.2mm to minimize shorting.

Lead land length should be equal to maximum part lead length + 0.3 mm outboard extension. The outboard extension ensures a large toe fillet that can be easily inspected.

Pad lands (the 4 big pads) length and width should be equal to maximum part pad length and width. However, the minimum metal to metal spacing should be no less than 0.17mm for 2 oz. Copper, or no less than 0.1mm for 1 oz. Copper, or no less than 0.23mm for 3 oz. Copper.

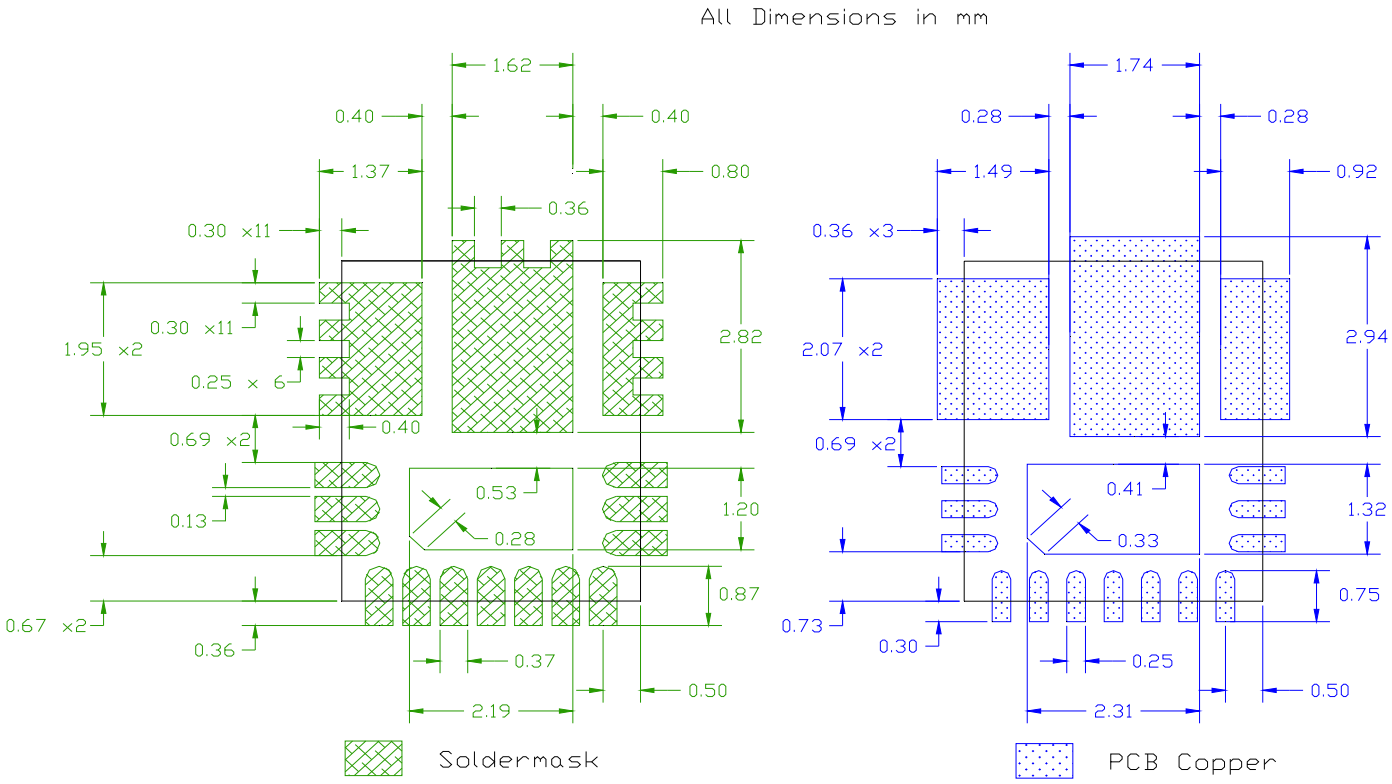


## Solder Resist

It is recommended that the lead lands are Non Solder Mask Defined (NSMD). The solder resist should be pulled away from the metal lead lands by a minimum of 0.025mm to ensure NSMD pads.

The land pad should be Solder Mask Defined (SMD), with a minimum overlap of the solder resist onto the copper of 0.05mm to accommodate solder resist misalignment.

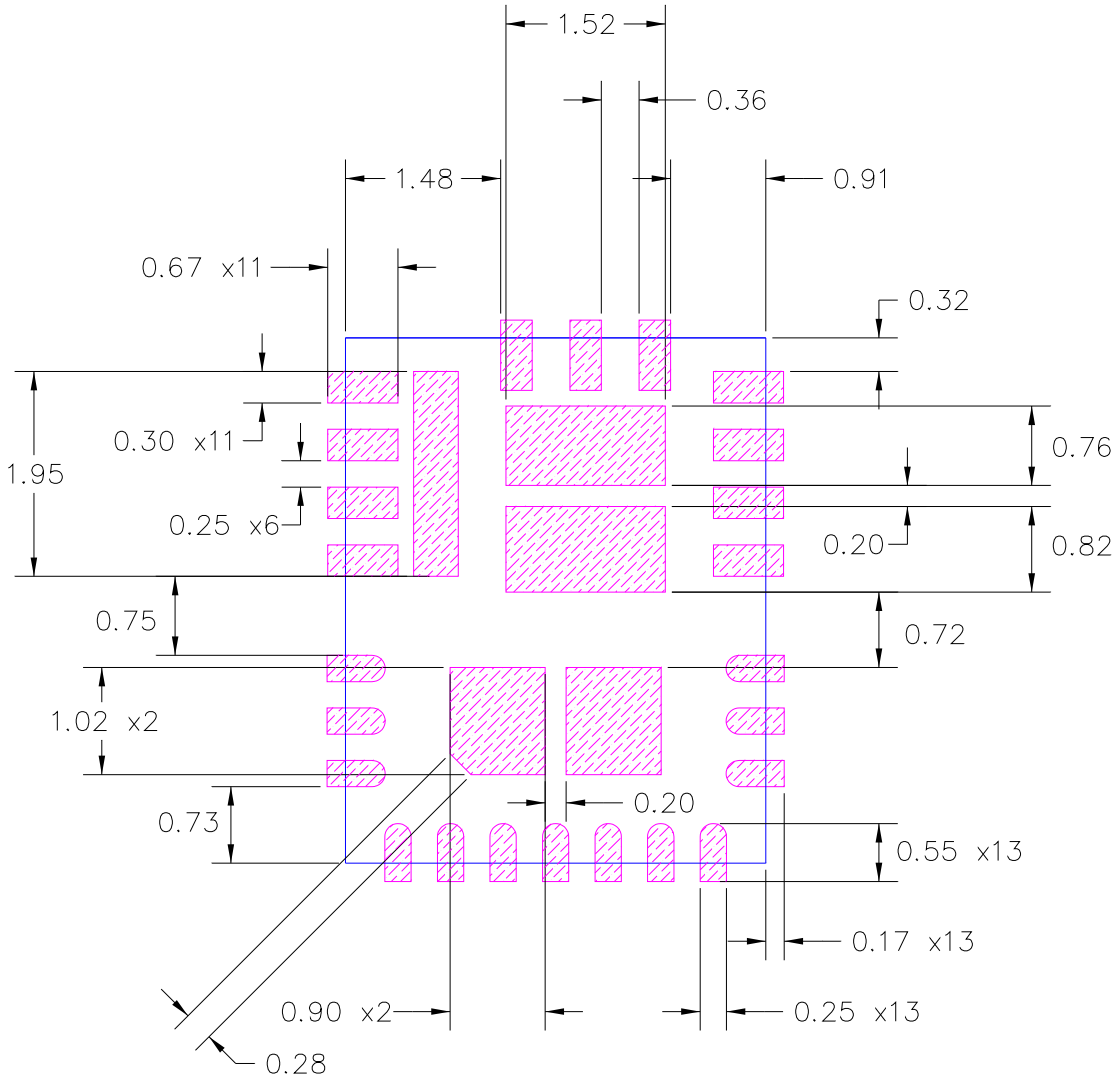
Ensure that the solder resist in between the lead lands and the pad land is ⩾ 0.15mm due to the high aspect ratio of the solder resist strip separating the lead lands from the pad land.



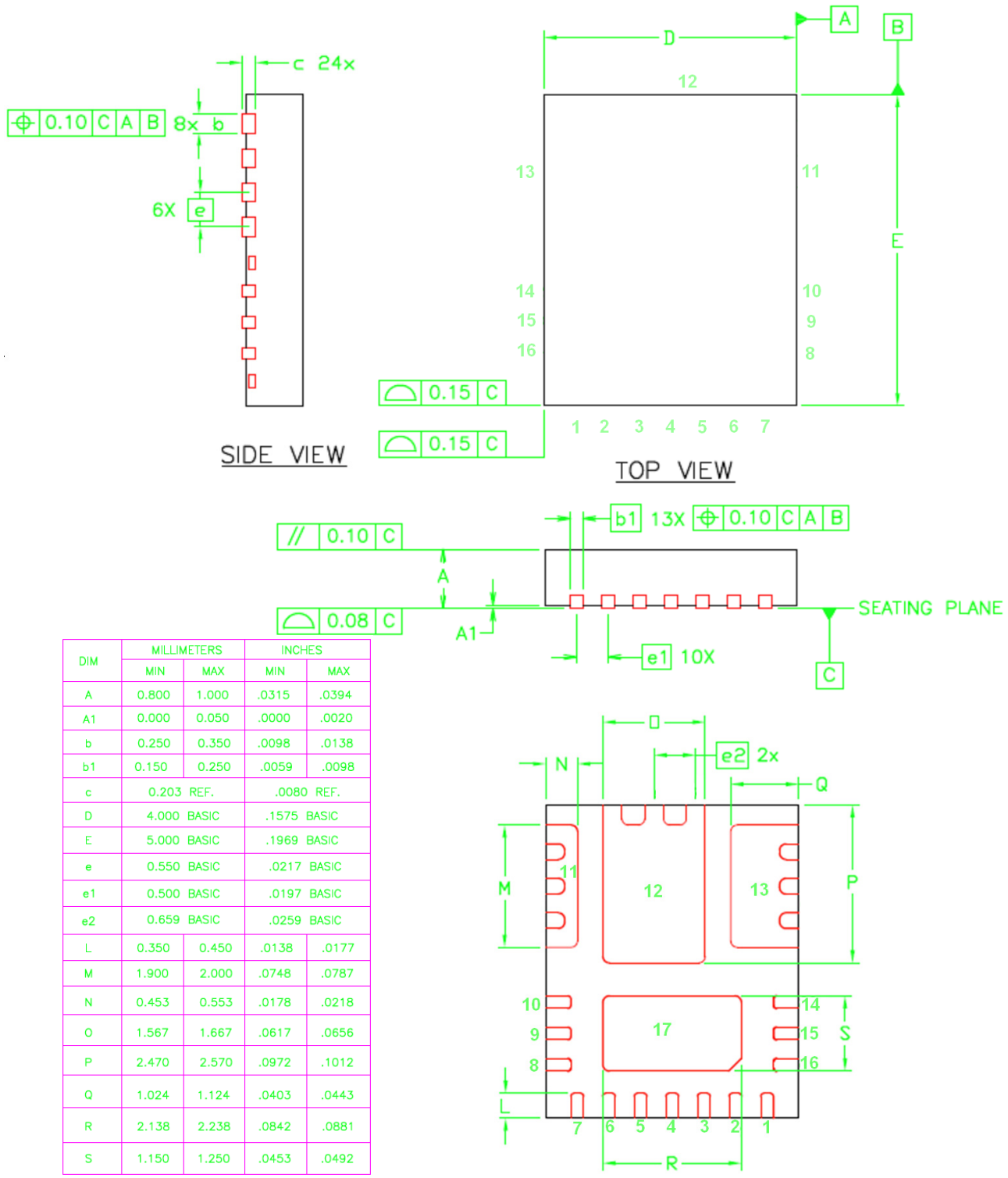
## Stencil Design

The Stencil apertures for the lead lands should be approximately 80% of the area of the lead lads. Reducing the amount of solder deposited will minimize the occurrences of lead shorts. If too much solder is deposited on the center pad, the part will float and the lead lands will open.

The maximum length and width of the land pad stencil aperture should be equal to the solder resist opening minus an annular 0.2mm pull back in order to decrease the risk of shorting the center land to the lead lands when the part is pushed into the solder paste.




Stencil Aperture
All Dimensions in mm




| DIM | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | 0.800 | 1.000 | .0315 | .0394 |
| A1 | 0.000 | 0.050 | .0000 | .0020 |
| b | 0.250 | 0.350 | .0098 | .0138 |
| b1 | 0.150 | 0.250 | .0059 | .0098 |
| c | 0.203 REF. | | .0080 REF. | |
| D | 4.000 BASIC | | .1575 BASIC | |
| E | 5.000 BASIC | | .1969 BASIC | |
| e | 0.550 BASIC | | .0217 BASIC | |
| e1 | 0.500 BASIC | | .0197 BASIC | |
| e2 | 0.659 BASIC | | .0259 BASIC | |
| L | 0.350 | 0.450 | .0138 | .0177 |
| M | 1.900 | 2.000 | .0748 | .0787 |
| N | 0.453 | 0.553 | .0178 | .0218 |
| O | 1.567 | 1.667 | .0617 | .0656 |
| P | 2.470 | 2.570 | .0972 | .1012 |
| Q | 1.024 | 1.124 | .0403 | .0443 |
| R | 2.138 | 2.238 | .0842 | .0881 |
| S | 1.150 | 1.250 | .0453 | .0492 |

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