Chipsmall Limited consists of a professional team with an average of over 10 year of expertise in the distribution of electronic components. Based in Hongkong, we have already established firm and mutual-benefit business relationships with customers from,Europe,America and south Asia,supplying obsolete and hard-to-find components to meet their specific needs.

With the principle of “Quality Parts,Customers Priority,Honest Operation,and Considerate Service”,our business mainly focus on the distribution of electronic components. Line cards we deal with include Microchip,ALPS,ROHM,Xilinx,Pulse,ON,Everlight and Freescale. Main products comprise IC,Modules,Potentiometer,IC Socket,Relay,Connector.Our parts cover such applications as commercial,industrial, and automotives areas.

We are looking forward to setting up business relationship with you and hope to provide you with the best service and solution. Let us make a better world for our industry!


# Contact us

Tel: +86-755-8981 8866 Fax: +86-755-8427 6832
Email & Skype: info@chipsmall.com Web: www.chipsmall.com
Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China

# Sup*IR*Buck™

## USER GUIDE FOR IR3876 EVALUATION BOARD

### DESCRIPTION

The IR3876 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 IR3876 a space-efficient solution that delivers up to 12A of precisely controlled output voltage at 60°C ambient temperature without airflow. IR3876 is housed in a 20-lead 5mmx6mm QFN package.

Key features offered by IR3876 include: programmable switching frequency, soft start, and over current protection allowing a very flexible solution suitable for many different applications and an ideal choice for battery powered applications.

Additional features include pre-bias startup, a very precise 0.5V reference, over/under voltage protection, power good output, and enable input with voltage monitoring capability.

This user guide contains the schematic, bill of materials, and operating instructions of the IR3876 evaluation board. Detailed application information for IR3876 is available in the IR3876 data sheet.

### BOARD FEATURES

- $V_{IN}$ = +12.6V
- $V_{CC}$ = +5V
- $V_{OUT}$ = +1.05V @ 0 ~ 12A
- $F_S$ = 300kHz @ CCM
- L = 1.0µH
- $C_{IN}$ = 22µF (ceramic 1210) + 68µF (electrolytic)
- $C_{OUT}$ = 47µF (ceramic 0805) + 330µF (SP-Cap)

## 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 12A 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.

IRDC3876 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. Toggle the switch to the ON position (marked by a solid square) to enable switching. The absolute maximum voltage of the external signal applied to EN (TP4) 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 |
| AGND (TP26) | Ground for Enable |

## LAYOUT

The PCB is a 4-layer board. All layers are 1 oz. copper. IR3876 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 IR3876. To improve efficiency, the circuit board is designed to minimize the length of the on-board power ground current path.

## CONNECTION DIAGRAM

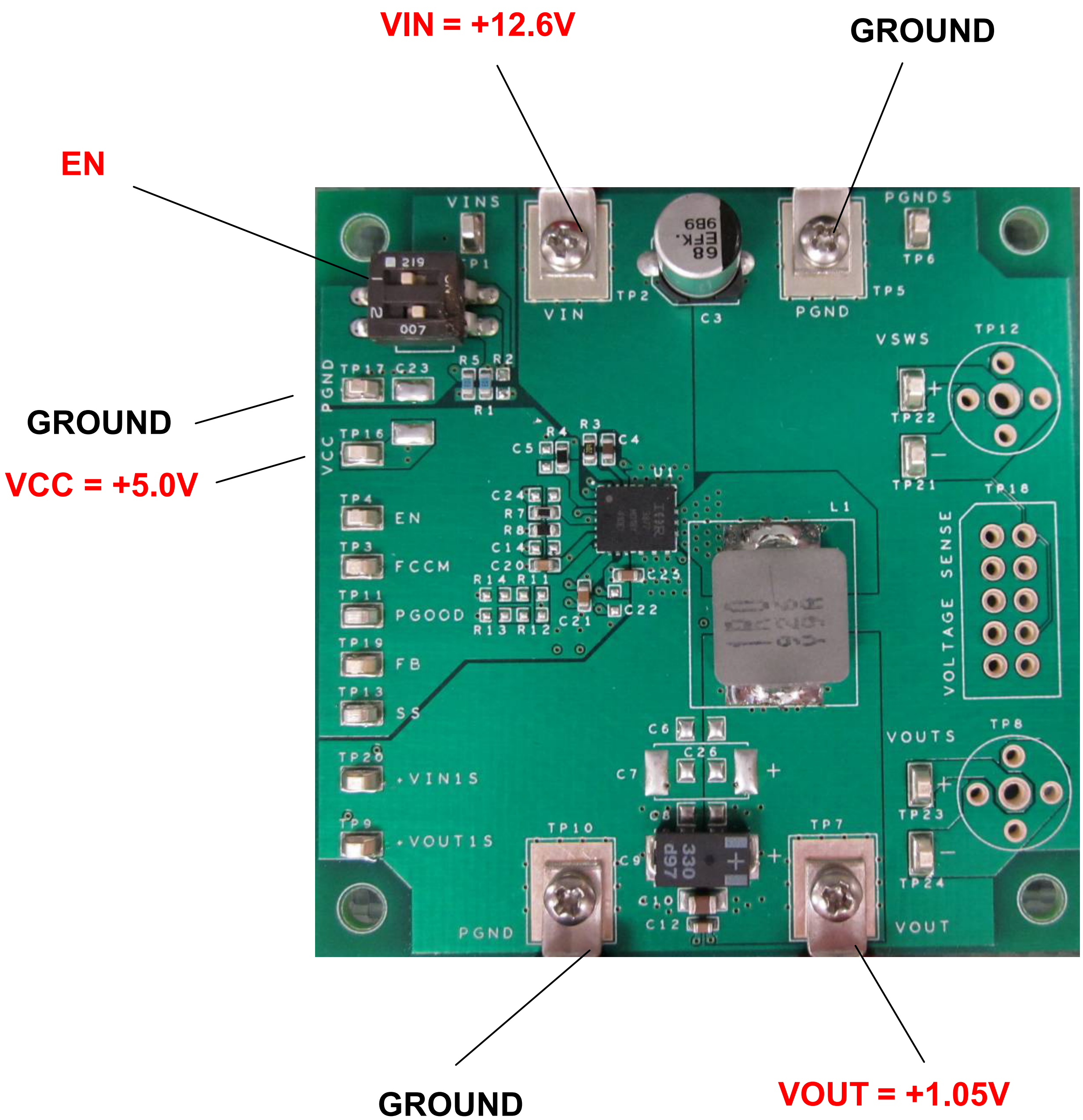



**Fig. 1: Connection Diagram of IR3876 Evaluation Board**

## PCB Board Layout

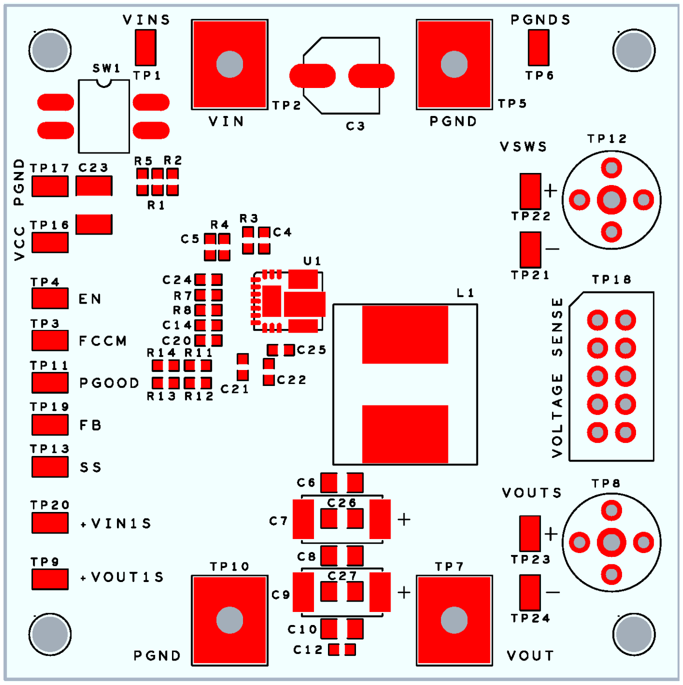



**Fig. 2: Board Layout, Top Components**

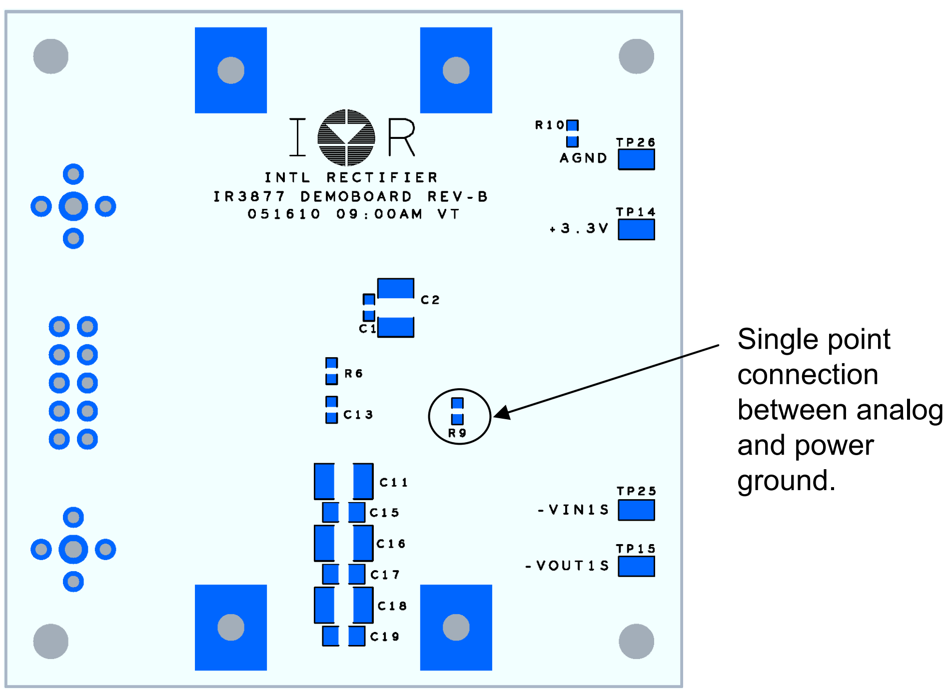



**Fig. 3: Board Layout, Bottom Components**

## PCB Board Layout

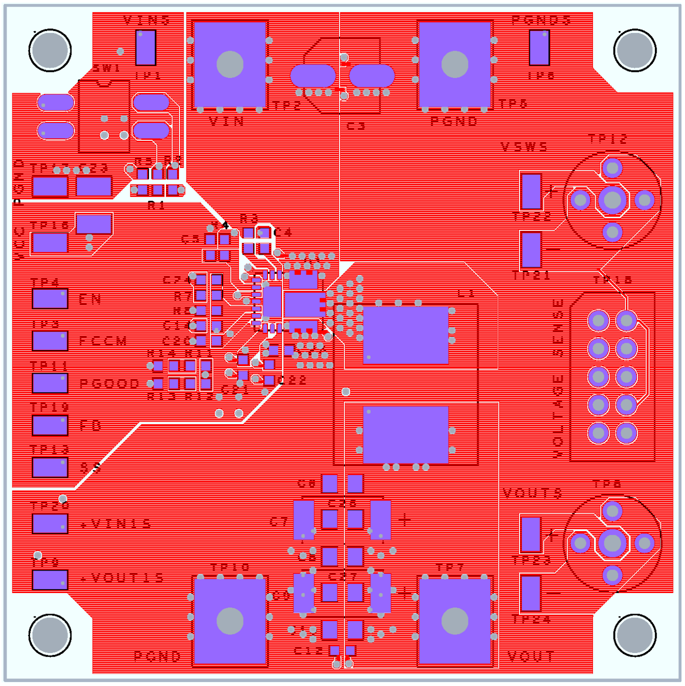



Fig. 4: Board Layout, Top Layer

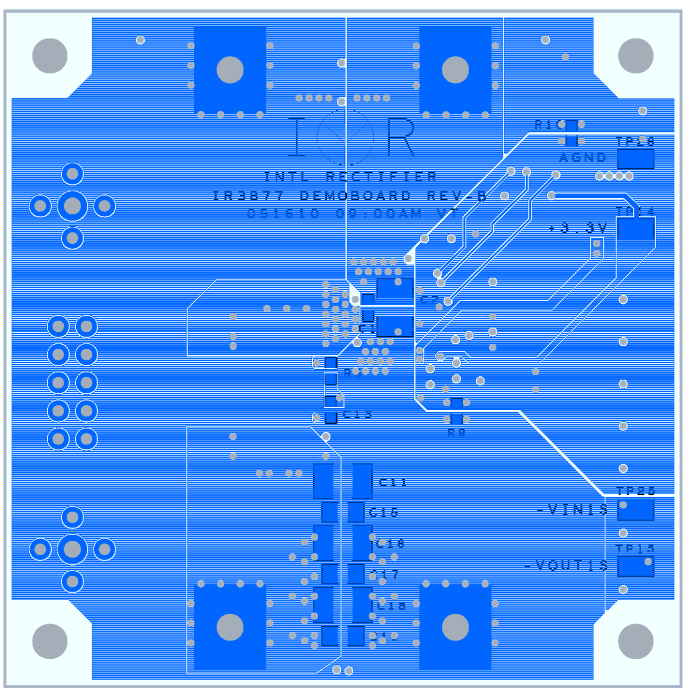



Fig. 5: Board Layout, Bottom Layer

## PCB Board Layout

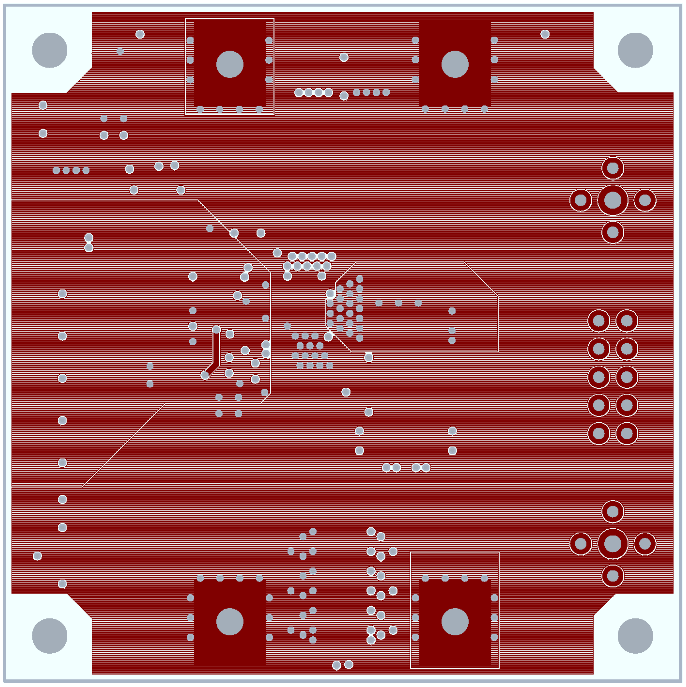


Fig. 6: Board Layout, Mid-layer I

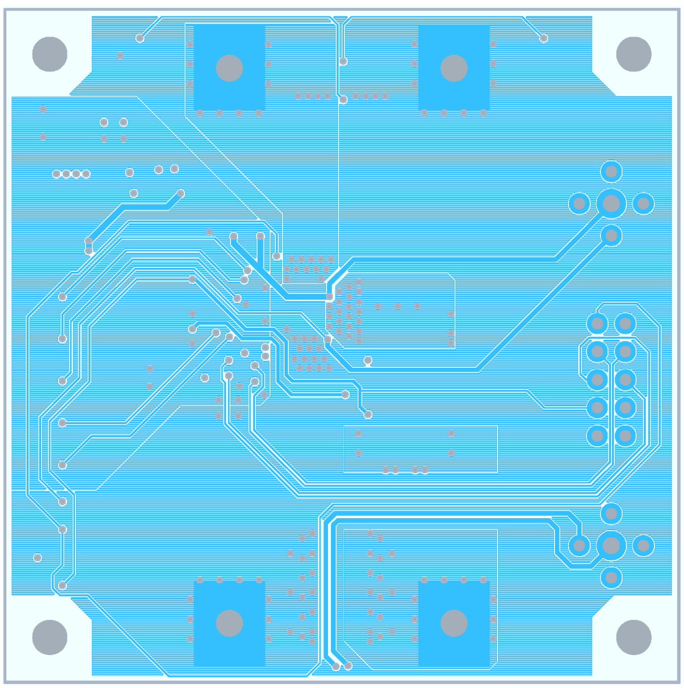


Fig. 7: Board Layout, Mid-layer II

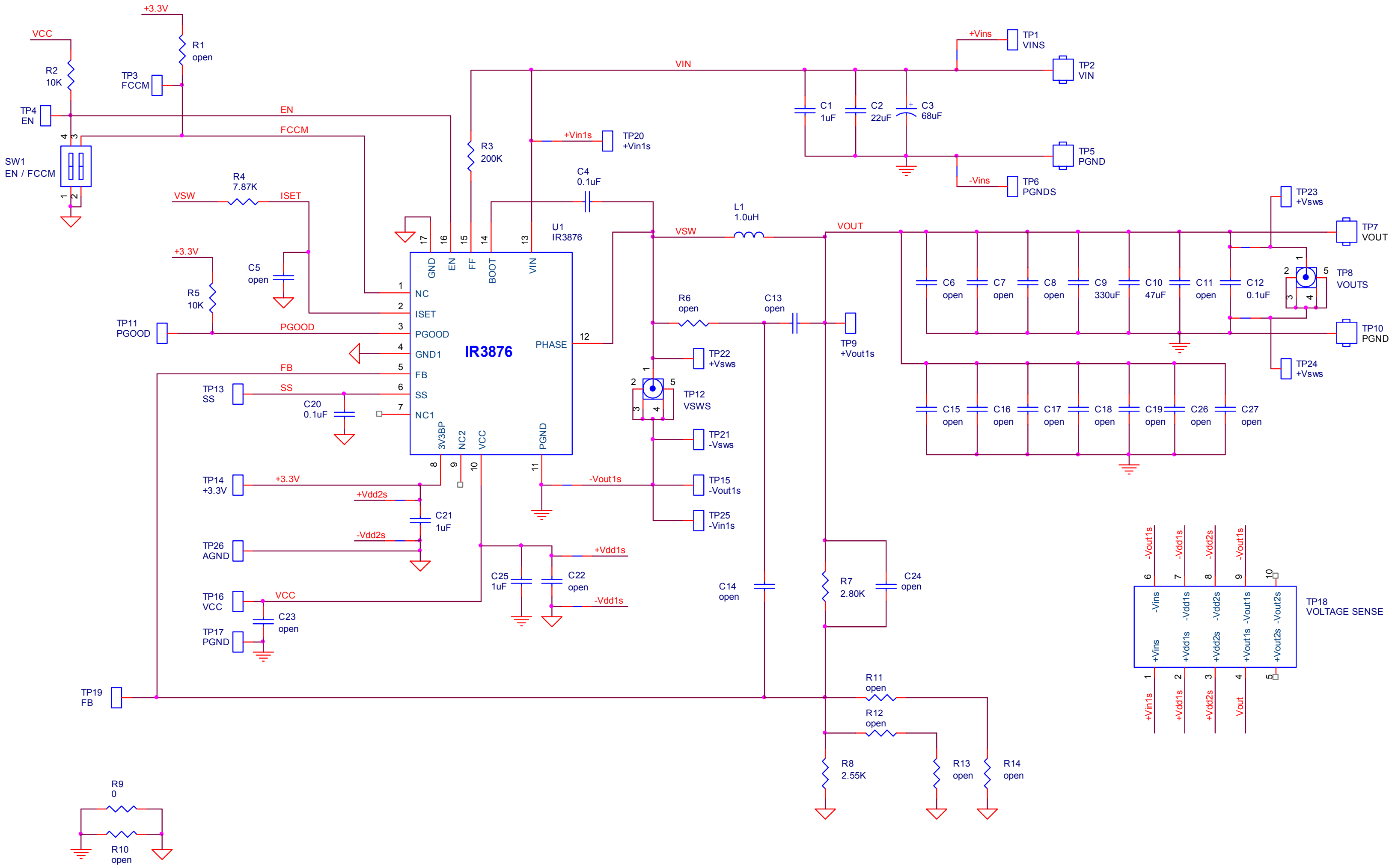


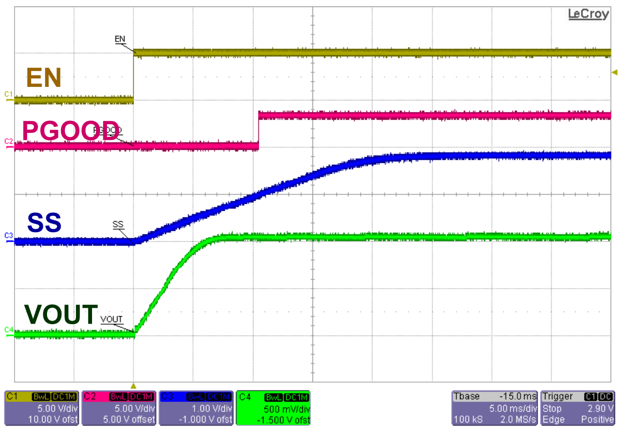

Fig. 8: Schematic of the IR3876 Evaluation Board

## Bill of Materials

| Quantity | Reference | Value | Description | Manufacturer | Part-Number |
|---|---|---|---|---|---|
| 3 | C1, C21, C25 | 1uF | CAP,CER,1.0uF,25V,X7R,0603 | Murata Electronics | GRM188R71E105KA12D |
| 1 | C2 | 22uF | CAP,22uF,25V,CERAMIC,X5R,1210 | Panasonic | ECJ-4YB1E226M |
| 1 | C3 | 68uF | CAP,68uF,25V,ELECT,FK,SMD | Panasonic | EEV-FK1E680P |
| 1 | C9 | 330uF | SP-CAP, 330uF, 2V, 4.5mΩ, 20% | Panasonic | EEF-SX0D331E4 |
| 1 | C10 | 47uF | CAP,CER,47uF,6.3V,X5R,0805 | TDK | C2012X5R0J476M |
| 3 | C4, C12, C20 | 0.1uF | CAP,CER,0.1uF,50V,10%,X7R,0603 | TDK | C1608X7R1H104K |
| 1 | L1 | 1uH | INDUCTOR, 1uH, 20A, 2.7mΩ,SMD | CYNTEC | PIMB103E-1R0MS-39 |
| 2 | R2, R5 | 10K | RES,10.0kΩ,1/10W,1%,0603,SMD | Vishay/Dale | CRCW060310K0FKEA |
| 1 | R9 | 0 | RES,0Ω,1/10W,1%,0603,SMD | Vishay/Dale | CRCW06030000Z0EAHP |
| 1 | R3 | 200K | RES,200kΩ,1/10W,1%,0603,SMD | Vishay/Dale | CRCW0603200KFKEA |
| 1 | R4 | 7.87K | RES,7.87kΩ,1/10W,1%,0603,SMD | Vishay/Dale | CRCW06037K87FKEA |
| 1 | R7 | 2.8K | RES,2.8kΩ,1/10W,1%,0603,SMD | Vishay/Dale | CRCW06032K80FKEA |
| 1 | R8 | 2.55K | RES,2.55kΩ,1/10W,1%,0603,SMD | Vishay/Dale | CRCW06032K55FKEA |
| 1 | SW1 | SPST | SWITCH, DIP, SPST, SMT | C&K Components | SD02H0SK |
| 1 | U1 | IR3876 | 5mm x 6mm QFN | IR | IR3876MPBF |

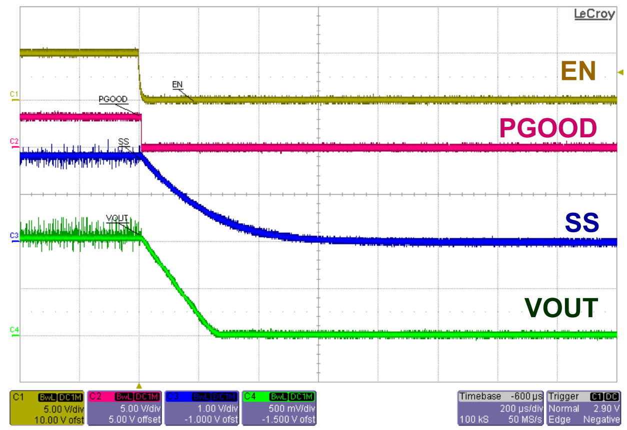
## TYPICAL OPERATING WAVEFORMS

Tested with demoboard shown in Fig. 8, VIN = 12.6V, VCC = 5V, VOUT = 1.05V, Fs = 300kHz, $T_A$ = 25ºC, no airflow, unless otherwise specified



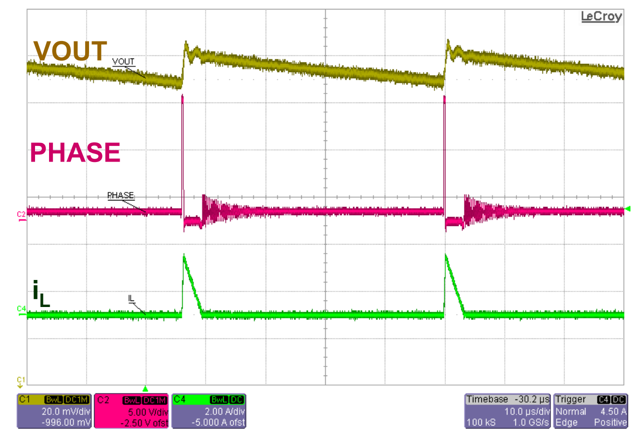

5V/div 5V/div 1V/div 500mV/div 5ms/div

**Fig. 9: Startup[1]**



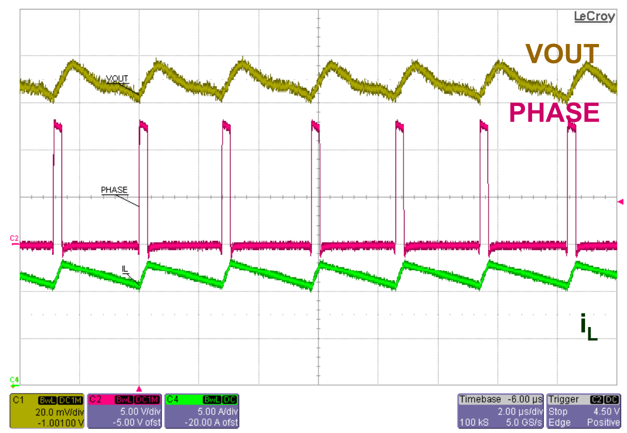

5V/div 5V/div 1V/div 500mV/div 200µs/div

**Fig. 10: Shutdown[1]**



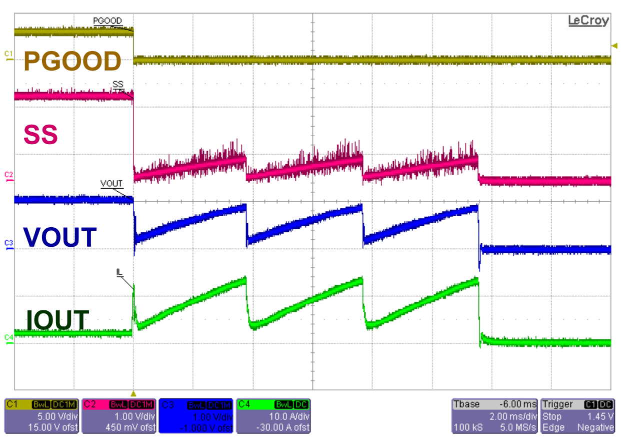

20mV/div 5V/div 2A/div 10µs/div

**Fig. 11: DCM ($I_{OUT}$ = 0.1A)[2]**



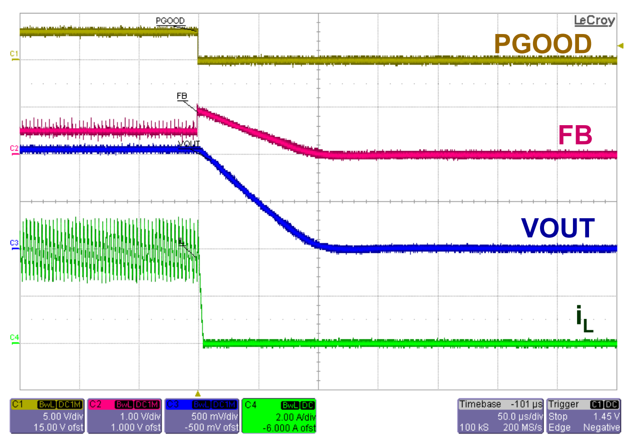

20mV/div 5V/div 5A/div 2µs/div

**Fig. 12: CCM ($I_{OUT}$ = 12A)[2]**




5V/div 1V/div 1V/div 10A/div 2ms/div

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




5V/div 1V/div 500mV/div 2A/div 50µs/div

**Fig. 14: Over Voltage Protection (tested by shorting FB to $V_{OUT}$)**

Note1: EN is pulled up to VCC after VIN = 12.6V and VCC = 5V are applied.
Note2: VOUT ripple is measured across the 47µF output capacitor.

## TYPICAL OPERATING WAVEFORMS

Tested with demoboard shown in Fig. 8, VIN = 12.6V, VCC = 5V, VOUT = 1.05V, Fs = 300kHz, $T_A$ = 25ºC, no airflow, unless otherwise specified

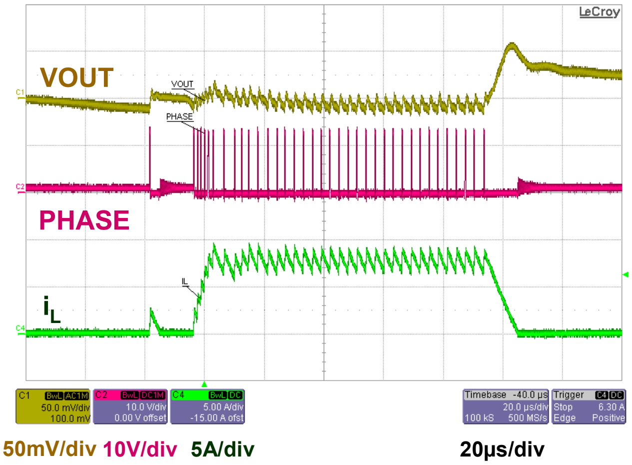



**Fig. 15: Load Transient 0-8A**

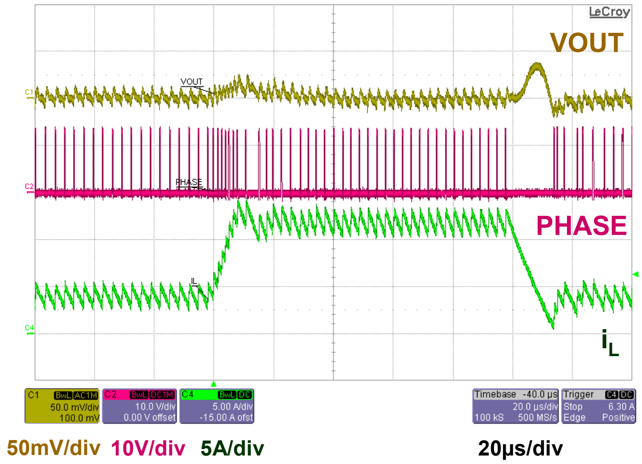



**Fig. 16: Load Transient 4-12A**

## TYPICAL PERFORMANCE

VIN = 12.6V, VCC = 5V, VOUT = 1.05V, Fs = 300kHz, IOUT = 12A, TA = 25ºC, no airflow

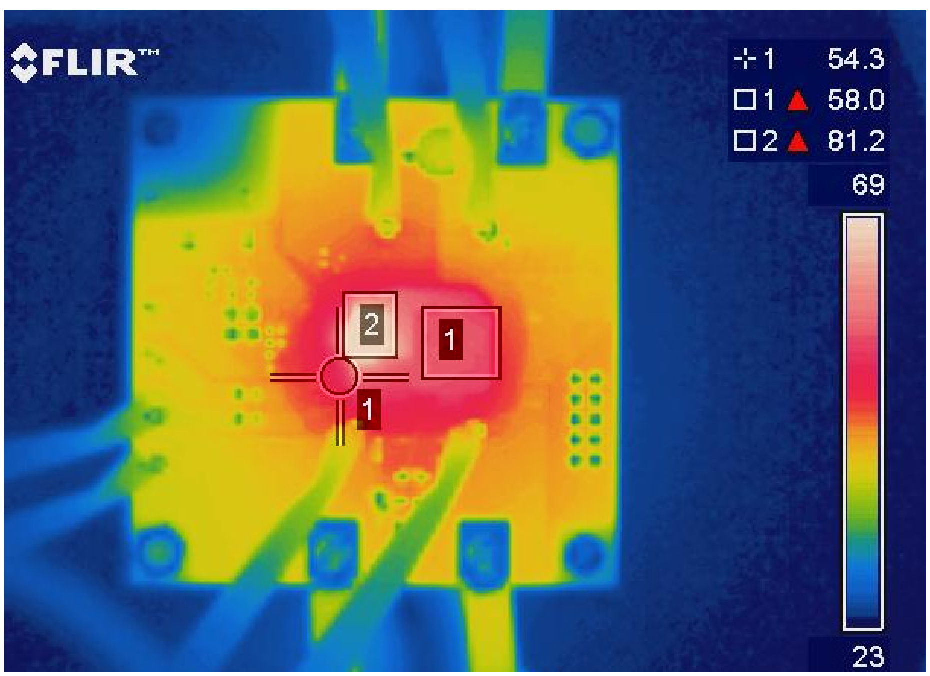



**Fig. 17: Thermal Image (IR3876: 81°C, Inductor: 58°C, PCB: 54°C)**

## TYPICAL OPERATING DATA

VIN = 12.6V, VCC = 5V, VOUT = 1.05V, Fs = 300kHz, IOUT = 0 ~ 12A, TA = 25°C, no airflow, unless otherwise specified

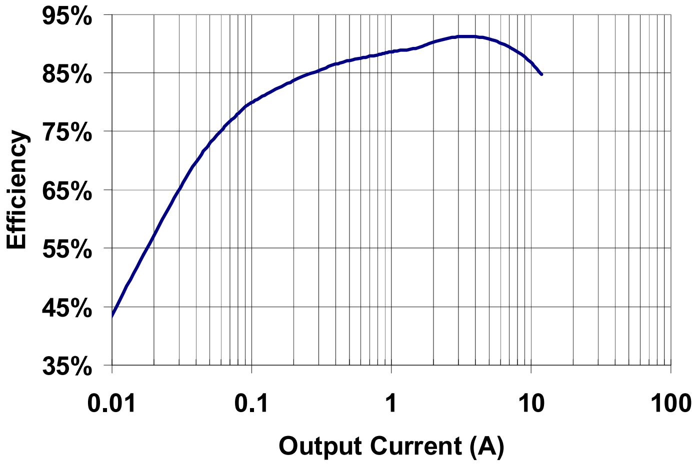



Fig. 18: Efficiency vs. Output Current

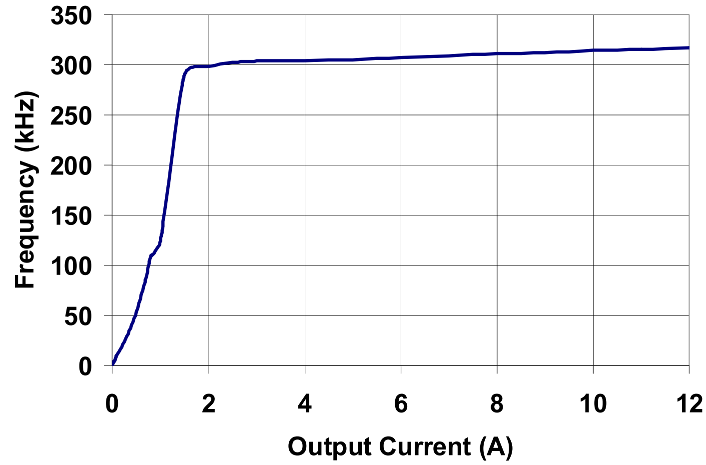



Fig. 19: Switching Frequency vs. Output Current

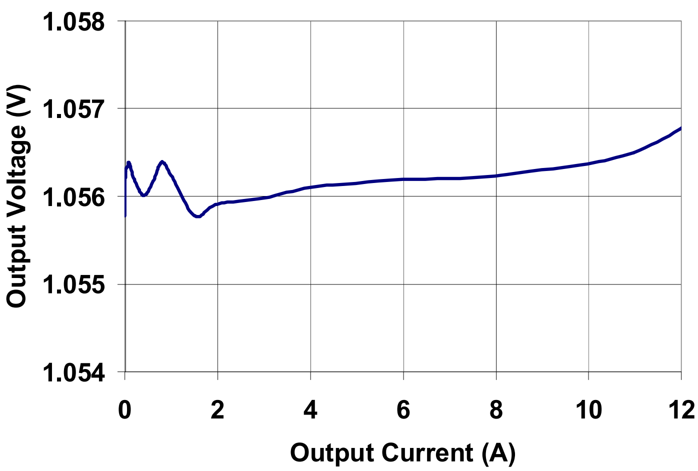



Fig. 20: Load Regulation

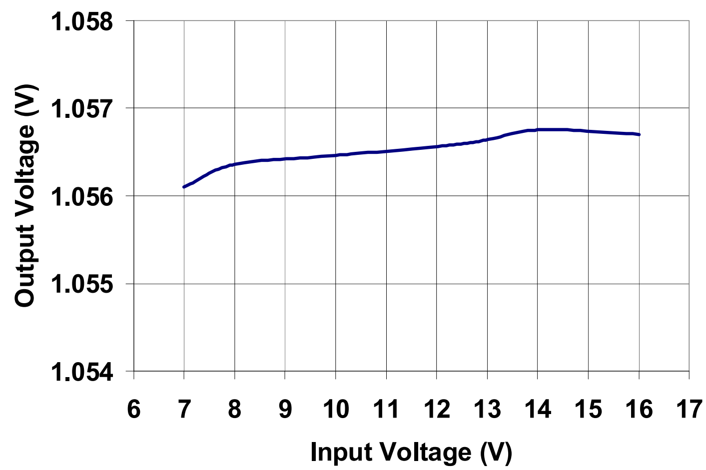


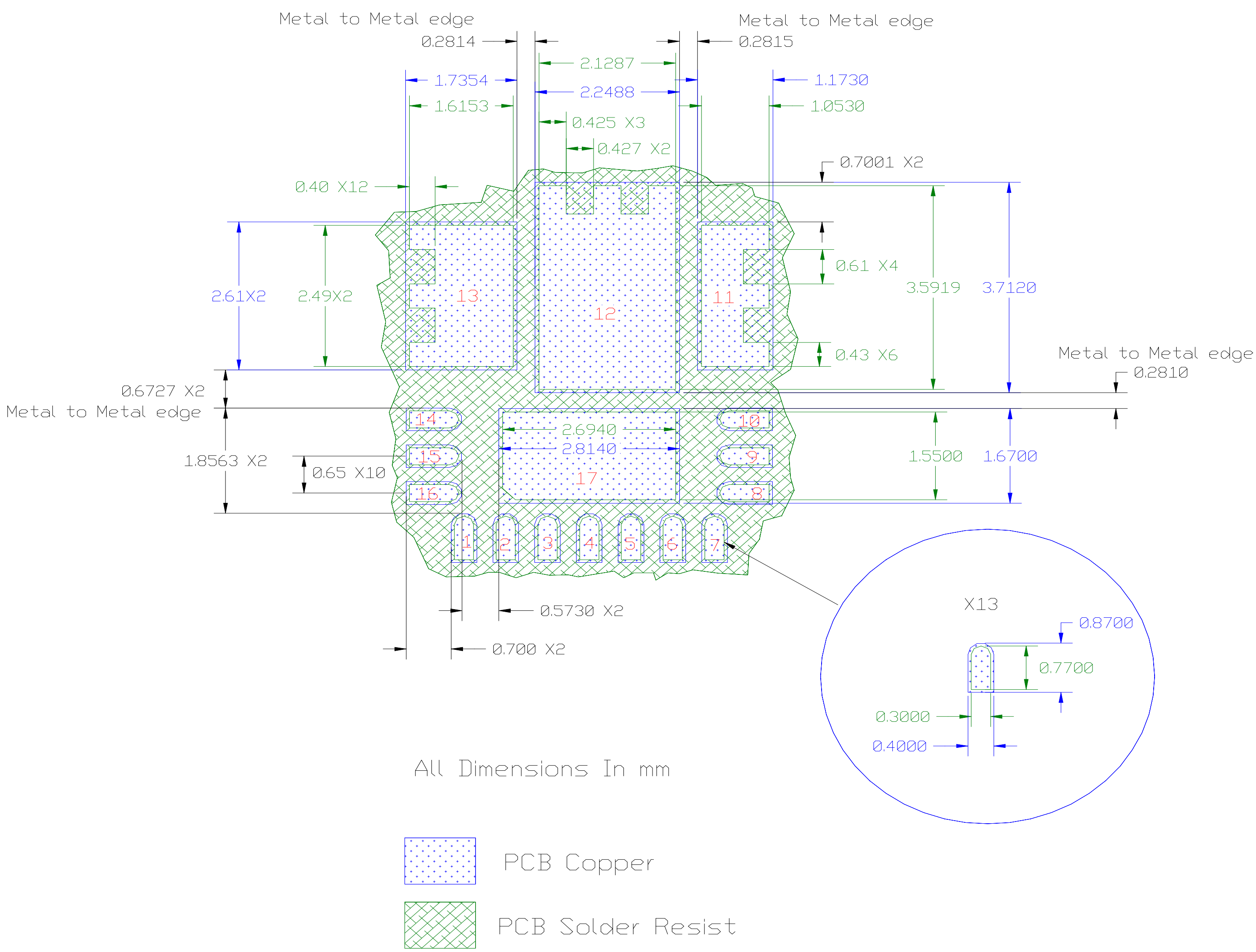

Fig. 21: Line Regulation at 12A Load

## 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.

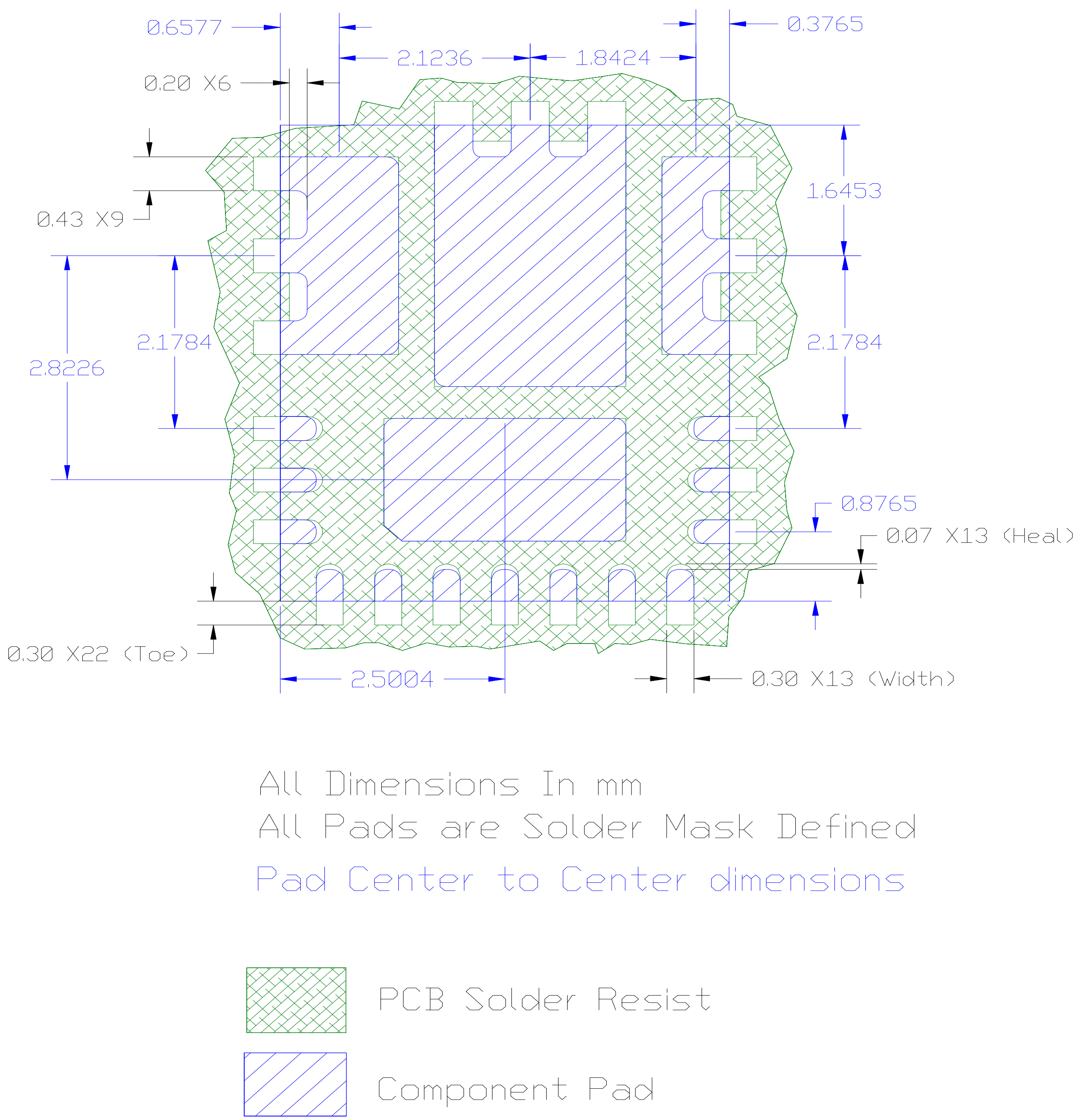


## Solder Resist

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.

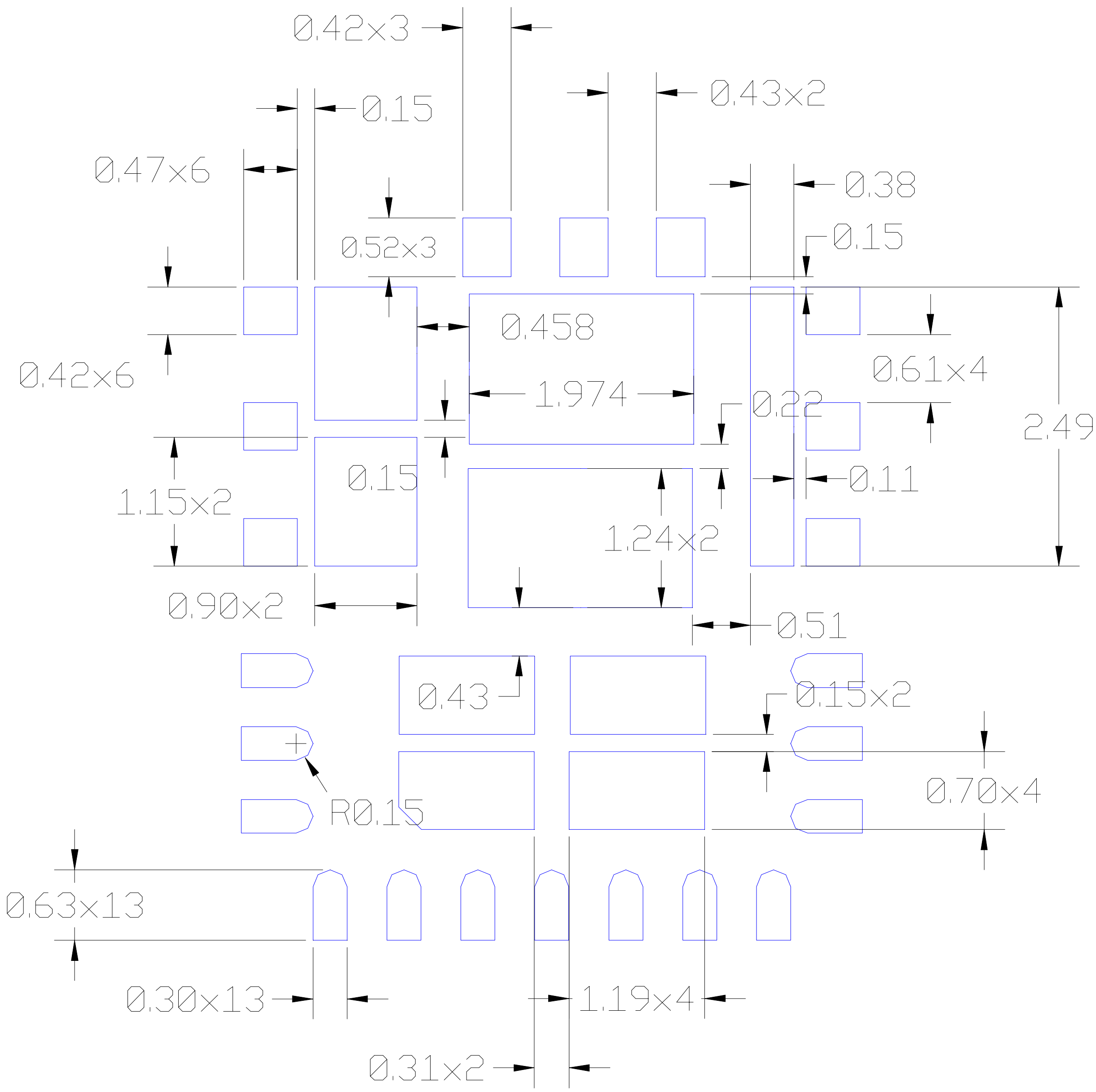
Ensure that the solder resist in between the lead lands and the pad land is ⩾ 0.15mm due to the high aspect ratio of the solder resist strip separating the lead lands from the pad land.



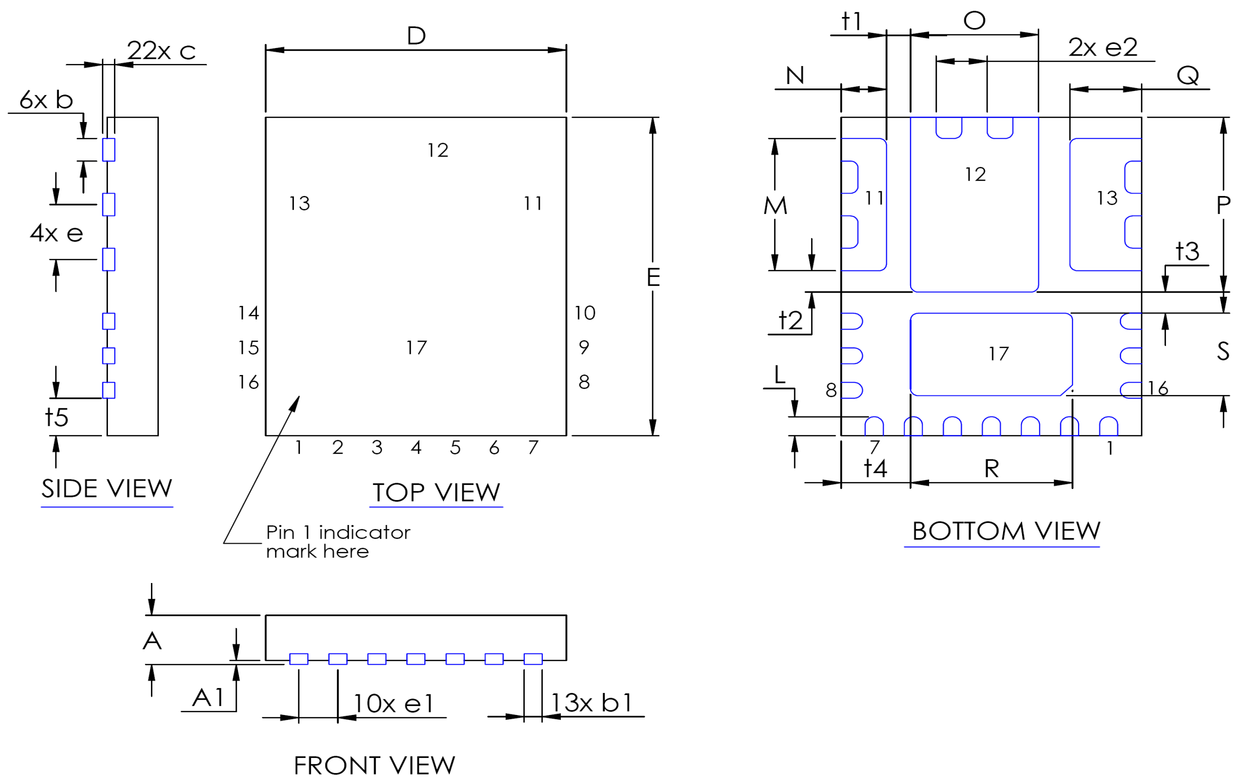
## Stencil Design

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.



| DIM | MILIMITERS | | INCHES | | DIM | MILIMITERS | | INCHES | |
|---|---|---|---|---|---|---|---|---|---|
| | MIN | MAX | MIN | MAX | | MIN | MAX | MIN | MAX |
| A | 0.800 | 1.000 | 0.0315 | 0.0394 | L | 0.350 | 0.450 | 0.0138 | 0.0177 |
| A1 | 0.000 | 0.050 | 0.0000 | 0.0020 | M | 2.441 | 2.541 | 0.0961 | 0.1000 |
| b | 0.375 | 0.475 | 0.1477 | 0.1871 | N | 0.703 | 0.803 | 0.0277 | 0.0316 |
| b1 | 0.250 | 0.350 | 0.0098 | 0.1379 | O | 2.079 | 2.179 | 0.0819 | 0.0858 |
| c | 0.203 REF. | | 0.008 REF. | | P | 3.242 | 3.342 | 0.1276 | 0.1316 |
| D | 5.000 BASIC | | 1.969 BASIC | | Q | 1.265 | 1.365 | 0.0498 | 0.0537 |
| E | 6.000 BASIC | | 2.362 BASIC | | R | 2.644 | 2.744 | 0.1041 | 0.1080 |
| e | 1.033 BASIC | | 0.0407 BASIC | | S | 1.500 | 1.600 | 0.0591 | 0.0630 |
| e1 | 0.650 BASIC | | 0.0256 BASIC | | t1, t2, t3 | 0.401 BASIC | | 0.016 BACIS | |
| e2 | 0.852 BASIC | | 0.0335 BASIC | | t4 | 1.153 BASIC | | 0.045 BASIC | |
| | | | | | t5 | 0.727 BASIC | | 0.0286 BASIC | |




**IR WORLD HEADQUARTERS:** 233 Kansas St., El Segundo, California 90245, USA Tel: (310) 252-7105
TAC Fax: (310) 252-7903
Visit us at www.irf.com for sales contact information
*Data and specifications subject to change without notice. 05/2012*