30V, 2.5A Monolithic Buck Converter with CC/CV Control

FEATURES

- 2.5A continuous output current capability
- 10V to 30V wide operating input range with input Over Voltage Protection
- Integrated 30V, 80mΩ high side and 30V, 39mΩ low side power MOSFET switches
- Up to 93% efficiency
- CV Mode control (Constant voltage). Cycle-by-Cycle Current Limiting
- Configurable Line Drop Compensation with resistor
- Internal Soft-Start limits the inrush current at turn-on
- Internal compensation to save external components
- Stable with Low ESR Ceramic Output Capacitors
- Configurable Switching Frequency with resistor
- Over-Temperature Protection
- MOSFETs from working at high current ,high input voltage condition
- Fixed Soft start time
- Under-Input Voltage Lockout.
- SOP8 Package

GENERAL DESCRIPTION

DP3115B integrates a high efficiency synchronous step-down switching regulator, which includes a 30V, 80mΩ high side P-MOS and a 30V, 39mΩ low side N-MOS to provide 2.5A continuous load current over 10V to 30V wide operating input voltage with 38V input over voltage protection. Conductance Peak current mode control provides fast transient responses and cycle-by-cycle current limiting.

DP3115B has configurable line drop compensation, configurable charging current limit. A simple Power system with few external components is possible with DP3115B.

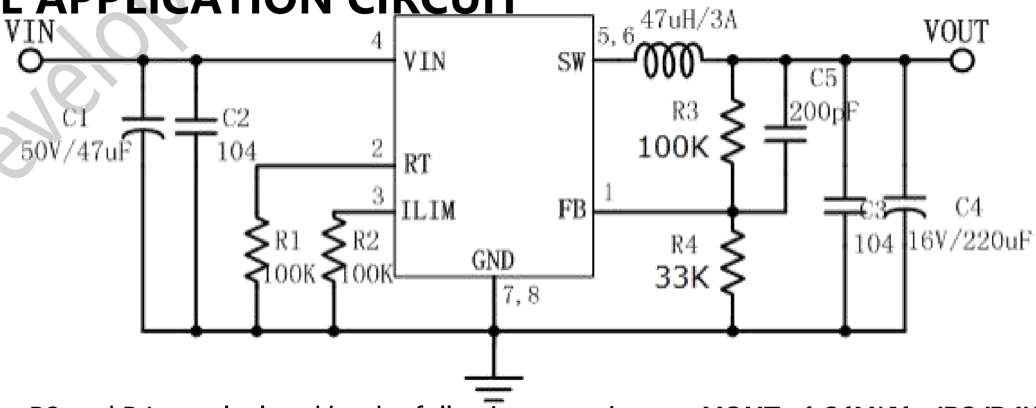
APPLICATIONS

- USB car charger
- Portable charging device
- General purpose USB charger
- General purpose DC-DC conversion

ORDERING INFORMATION

Part Number	Description
DP3115B	SOP8 halogen free 4000pcs/reel

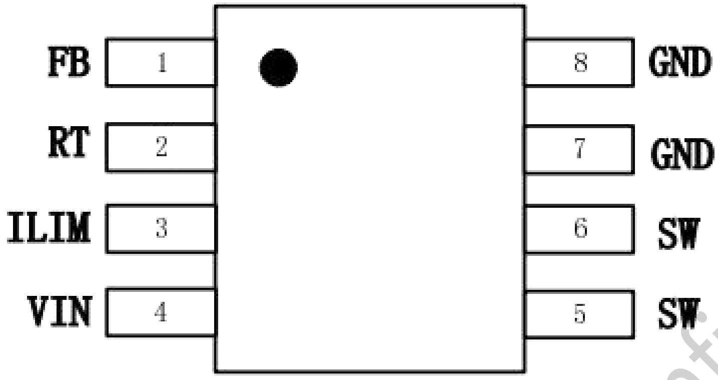
TYPICAL APPLICATION CIRCUIT



VOUT is set by R3 and R4, calculated by the following equation : **VOUT=1.21V*[1+(R3/R4)]**
The stability of power system can be enhanced when using C5.

PRODUCT DESCRIPTION

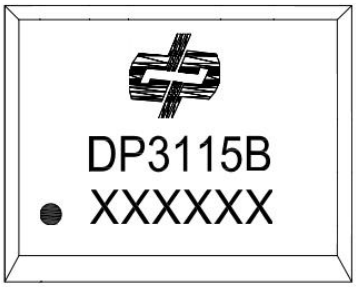
➢ Pin Configuration



➢ Pin Description

Number	Pin Name	Description
1	FB	Feedback Input PIN. FB senses the output voltage. Connect FB with a resistor divider connected between the output and ground. FB is a sensitive node. Keep FB away from SW. It is better to connect a 200pF ceramic capacitor between FB pin and VOUT.
2	RT	Resistor to set scillation frequency.Connect to GND. Keep RT away from SW
3	ILIM	Resistor to set Ipeak of inductance. Connect to GND. Keep ILIM away from SW
4	VIN	Power Input PIN. Vin supplies the power to the IC. Supply Vin with a 10V to 30V power source. Bypass Vin to GND with a large capacitor and at least another 0.1uF ceramic capacitor to eliminate noise on the input to the IC. Put the capacitors close to Vin and GND pins.
5,6	SW	Power Switching pin. Connect this pin to the switching node of inductor.
7,8	GND	GROUND

➢ Marking Information



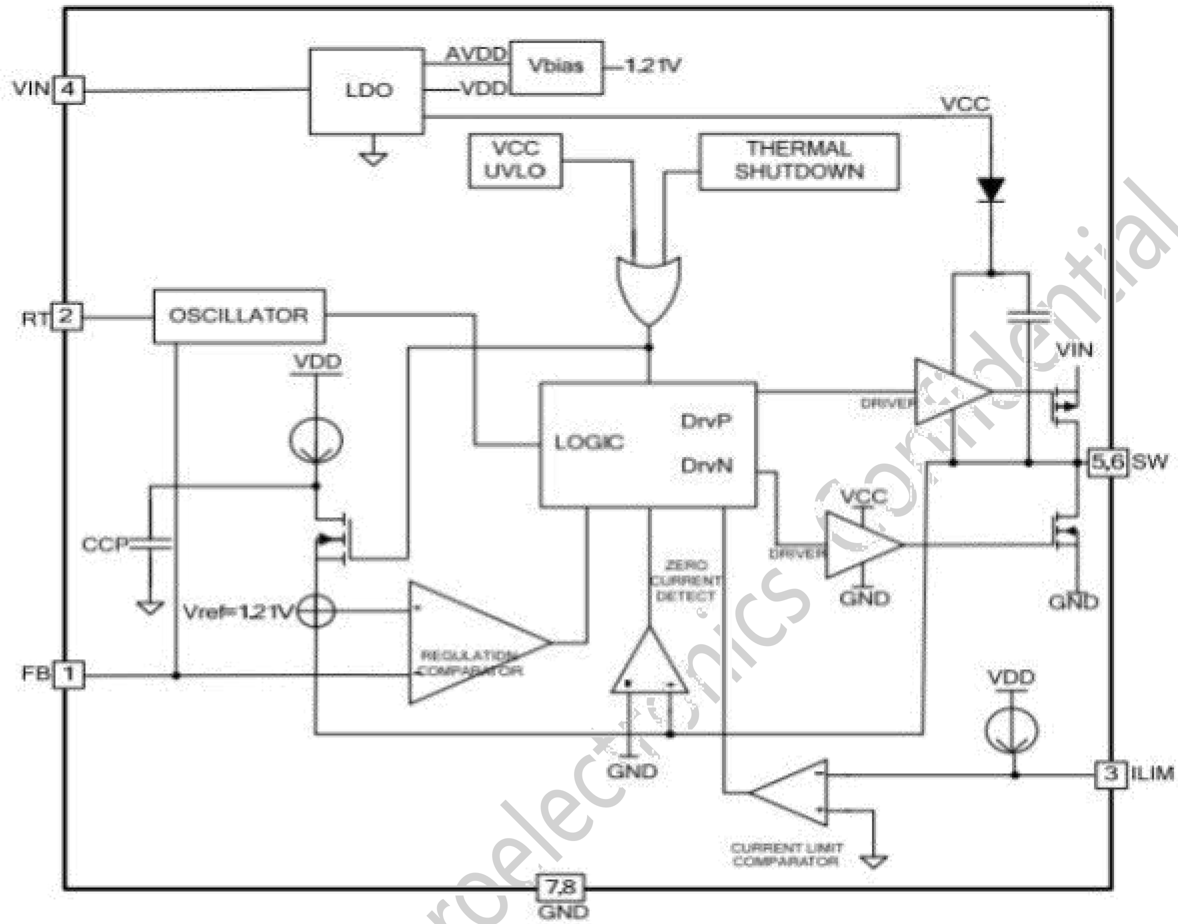
DP3115Bfor product name:

XXXXXX The first X represents the last year,2014 is 4;The second X represents the month,inA-L 12 letters;The third and fourth X on behalf of the date,01-31said;The last two X represents the wafer batch code

➢ Absolute Maximum Ratings (Note 1)

	PARAMETER	MIN	MAX	Unit
Input Voltages	VIN to GND	-0.3	30	V
	VRT to GND	-0.3	6	V
	VILIM to GND	-0.3	6	V
	VFB to GND	-0.3	6	V
	VSW to GND	-0.3	VIN+1	V

BLOCK DIAGRAM



HANDLING RATINGS

PARAMETER	DEFINITION	MIN	MAX	Unit
TST	Storage Temperature Range	-65	150	℃
TJ	Junction Temperature		150	℃
TL	Lead Temperature		260	℃

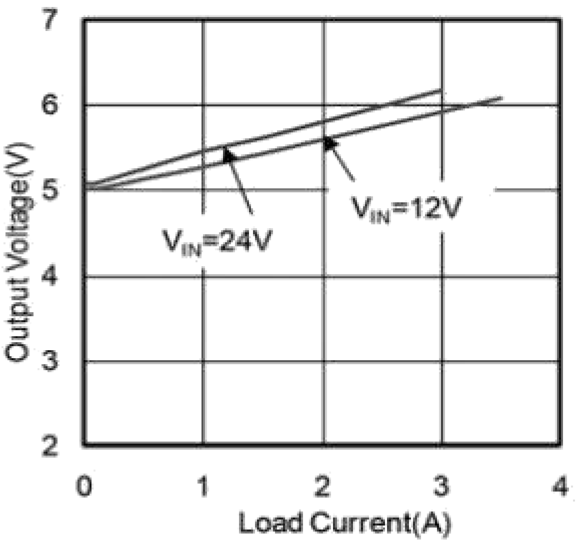
ELECTRICAL CHARACTERISTICS **(Typical at Vin = 12V, TJ=25°C, unless otherwise noted.)**

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Input Voltage	VIN		10		30	V
No-load current	ICC	ILOAD=0A	0	0.5	2	mA
Stand By current	IST		0	0.2	1	mA
Input UVLO	Vuvlo			6.8	8	V
Input UVLO hysteresis voltage	ΔVuvlo		0.2	0.6	1	V
Voltage of FB	VFB		1.188	1.21	1.236	V
Input current of FB	IFB				0.5	uA
operating frequency range	FOSC		80		500	KHZ
		RT=100K	80	120	150	
Max duty cycle	DC				100	%
RDSON of P-MOS	RPFET			80		mΩ
RDSON of N-MOS	RNFET			39		mΩ
Over- Temperature Protection	TSD			150		C
Over-Temperature Protection hysteresis	△ TSD			30		C

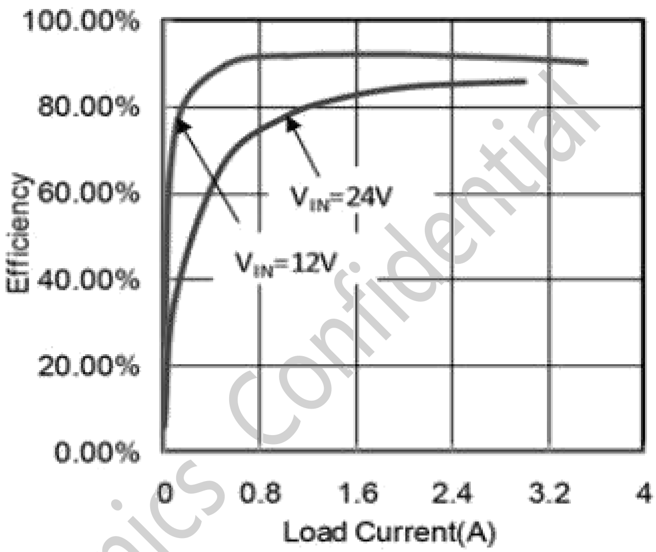
TYPICAL CHARACTERISTICS

Test Condition：TA = 25C，VIN=12V，CIN=100uF，COUT=470uF，L=47uH,unless otherwise noted.

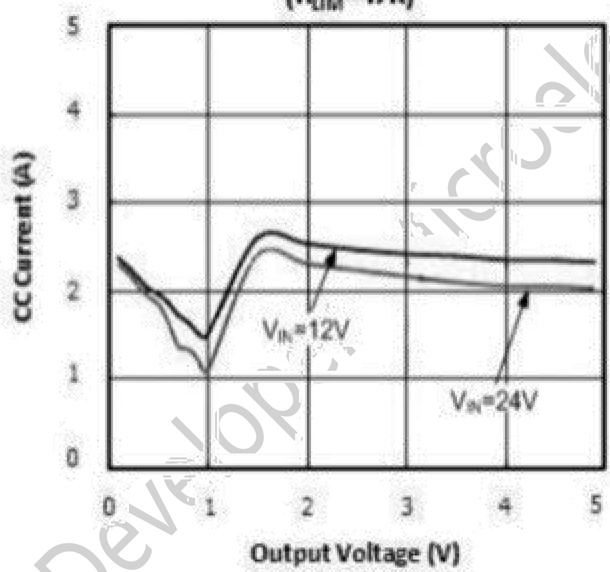
Output Voltage vs Load Current（with Cable Compensation）



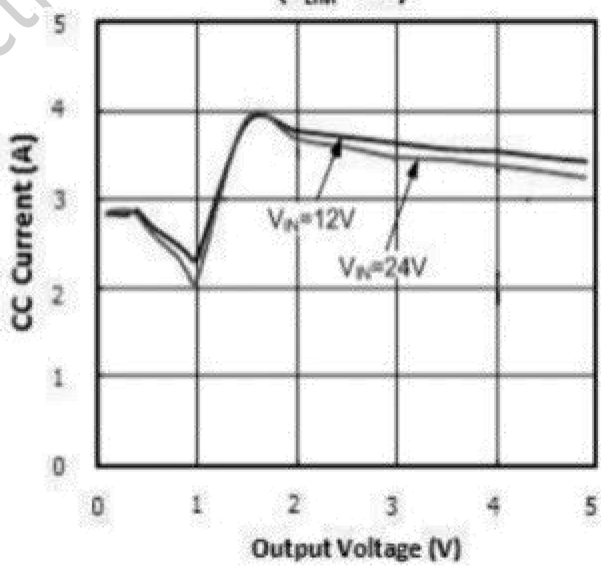
Efficiency vs Load Current



CC Current vs Output Voltage (R_{LIM}=47K)



CC Current vs Output Voltage (R_{LIM}=68K)



OPERATION DESCRIPTION

- **Overview**

DP3115B works at a constant frequency mode. The output Voltage is set by VFB which is divided by R3 and R4.DP3115B adjusts the drop-down current of FB by monitoring the Ipeak of inductance and VFB to stabilize the output voltage.

At normal operation mode, DP3115B controls and drives the internal P-MOS and N-MOS to on and off by internal oscillator. When P-MOS is ON,N-MOS is OFF.

- **Thermal Shutdown**

The internal thermal-shutdown circuitry forces the device to stop switching if the junction temperature exceeds 150°C typically.

- **Inductance peak current limiting**

DP3115B Limit the P-MOS peak current to limit input power, DP3115B detect the peak current of P-MOS at toff of every cycle, if higher than the set limit DP3115B will shut down the P-MOS. When the temperature rise up, the RDSON of P-MOS will become larger.
The Ipeak of DP3115B Actual tested on a DP3115B demo board

RILIM	56K	62K	68K	75K	90K	100K	110K	120K	130K
Type Ipeak	2.0A	2.2A	2.6A	3.0A	3.1A	3.2A	3.4A	3.5A	3.6A

Ipeak(A)≈0.5 ·RDSON ·RILIM(KΩ)

- **Oscillation frequency**

The oscillation frequency of DP3115B is set by a resistor connected between RT and GND. This resistor should be placed as close as possible to the DP3115B.The output current of RT is 12uA. If RT value is smaller, the oscillation frequency of DP3115B will be higher.
The frequency of DP3115B Actual tested on a DP3115B demo board

RT	20KΩ	27KΩ	36KΩ	47KΩ	62KΩ	75KΩ	100KΩ
Type Freq	500KHz	400KHz	300KHz	240KHz	190KHz	160KHz	120KHz

- **Output Shutdown voltage**

DP3115B will shutdown the output if the output voltage is lower than about 2V when the output load is too heavy.

- **Setting Output Voltage**

The output voltage is set by FB voltage, which is divided by resistor (R3 & R4) from output node to Ground. That resistor with 1% or higher accuracy is preferred. The output voltage value is set by equation as below. Suggest R3/R4=3. 16:
R3 = R4*[(VOUT / VREF) – 1]

Vref is the internal reference voltage of DP3115B, 1.21V.

- **Line drop compensation**

If USB cable is too long or resistance value is high, the voltage of charging device end will be dropped a lot. If the voltage across the load input terminals is too low, it will affect charging time. So recommend to adjust the output voltage of charger to compensate this voltage drop. DP3115B has an excellent configurable line drop compensation function. The compensation value of line drop can be programmed by the down feedback resistor R4 . The value can be roughly calculated by equation as below:
ΔVOUT(V)=3*R4(KΩ)*IOUT(A)/1000

- **Inductor selection**

An inductor is required to supply constant current to the load while being driven by the switched input voltage. The common value of the inductance is between 4.7uH to 47uH. A larger value inductor will result in less current ripple and lower output voltage ripple. However, the larger value inductor will have larger physical size, higher DC resistance, and/or lower saturation current. A good rule to calculate the inductance is to allow the peak-to-peak ripple current in the inductor to be approximately 25% of the maximum load current. At the same time, it is needed to make sure that the peak inductor current is below the inductor saturation current.

The inductance value can be calculated by:

$$L=\frac{V_{OUT}}{f_s\times\Delta I_L}\left(1-\frac{V_{OUT}}{V_{IN}}\right)$$

Where VOUT is the output voltage, VIN is the input voltage, fs is the switching frequency, and ΔL is the peak-to-peak inductor ripple current.

The choice of which style inductor to use mainly depends on the price vs. size requirements and any EMI constraints.

- **Input capacitors selection**

The input current to the step-down converter is discontinuous, therefore a capacitor is required to supply the AC current to the converter. It is recommend to use low ESR capacitors to optimize the performance. Ceramic capacitor is preferred, but tantalum or low-ESR electrolytic capacitors may also meet the requirements. It is better to choose X5R or X7R dielectrics when using ceramic capacitors.

Since the input capacitor (CIN) absorbs the input switching current, a good ripple current rating is required for the capacitor. The RMS current in the input capacitor can be estimated by:

$$I_{CIN}=I_{load}\times\sqrt{\frac{V_{OUT}}{V_{IN}}\times\left(1-\frac{V_{OUT}}{V_{IN}}\right)}$$

The worst-case condition occurs at VIN = 2× VOUT, where:

$$I_{CIN}=\frac{I_{load}}{2}$$

For simplification, choose the input capacitor whose RMS current rating is greater than half of the maximum load current. When electrolytic or tantalum capacitors are used, a small, high quality ceramic capacitor, i.e. 0.1μF, should be placed as close to the IC as possible. When ceramic capacitors are used, make sure that they have enough capacitance to maintain voltage ripple at input. The input voltage ripple caused by capacitance can be estimated by:

$$\Delta V_{IN}=\frac{I_{load}}{f_s\times C_{IN}}\times\frac{V_{OUT}}{V_{IN}}\times\left(1-\frac{V_{OUT}}{V_{IN}}\right)$$

CIN is the input capacitance.

- **Output capacitors selection**

The output capacitor (COUT) is required to maintain the DC output voltage. Ceramic, tantalum, or low ESR electrolytic capacitors are recommended.

Low ESR capacitors are preferred to keep the output voltage ripple low. The output voltage ripple can be estimated by:

Where L is the inductor value, RESR is the equivalent series resistance (ESR) value of the output capacitor and COUT is the output capacitance value. In the case of ceramic capacitors, the impedance at the switching frequency is dominated by the capacitance. The output voltage ripple is mainly determined by the capacitance. For simplification, the output voltage ripple can be estimated by:

In the case of tantalum or electrolytic capacitors, the ESR dominates the impedance at the switching frequency. For simplification, the output ripple can be approximated to:

The characteristics of the output capacitor also affect the stability of the regulation system. The DP3115B can be optimized for a wide range of capacitance and ESR values.

- **PCB Layout**

PCB layout is a critical portion of good power supply design. The following guidelines will help users design a PCB with the best power conversion efficiency, thermal performance, and minimized EMI.

1. The feedback network, resistor R3 and R4 , should be kept close to FB pin. Vout sense path should stay away from noisy nodes, such as SW signals and preferably through a layer on the other side of shielding layer.

2. The input bypass capacitor C1 and C2 must be placed as close as possible to the VIN pin and ground. Grounding for both the input and output capacitors should consist of localized top side planes that connect to the GND pin and PAD. It is a good practice to place a ceramic cap near the VIN pin to reduce the high frequency injection current.

3. The inducor L should be placed close to the SW pin to reduce magnetic and electrostatic noise.

4. The output capacitor, COUT should be placed close to the junction of L. The L, and COUT trace should be as short as possible to reduce conducted and radiated noise and increase overall efficiency.

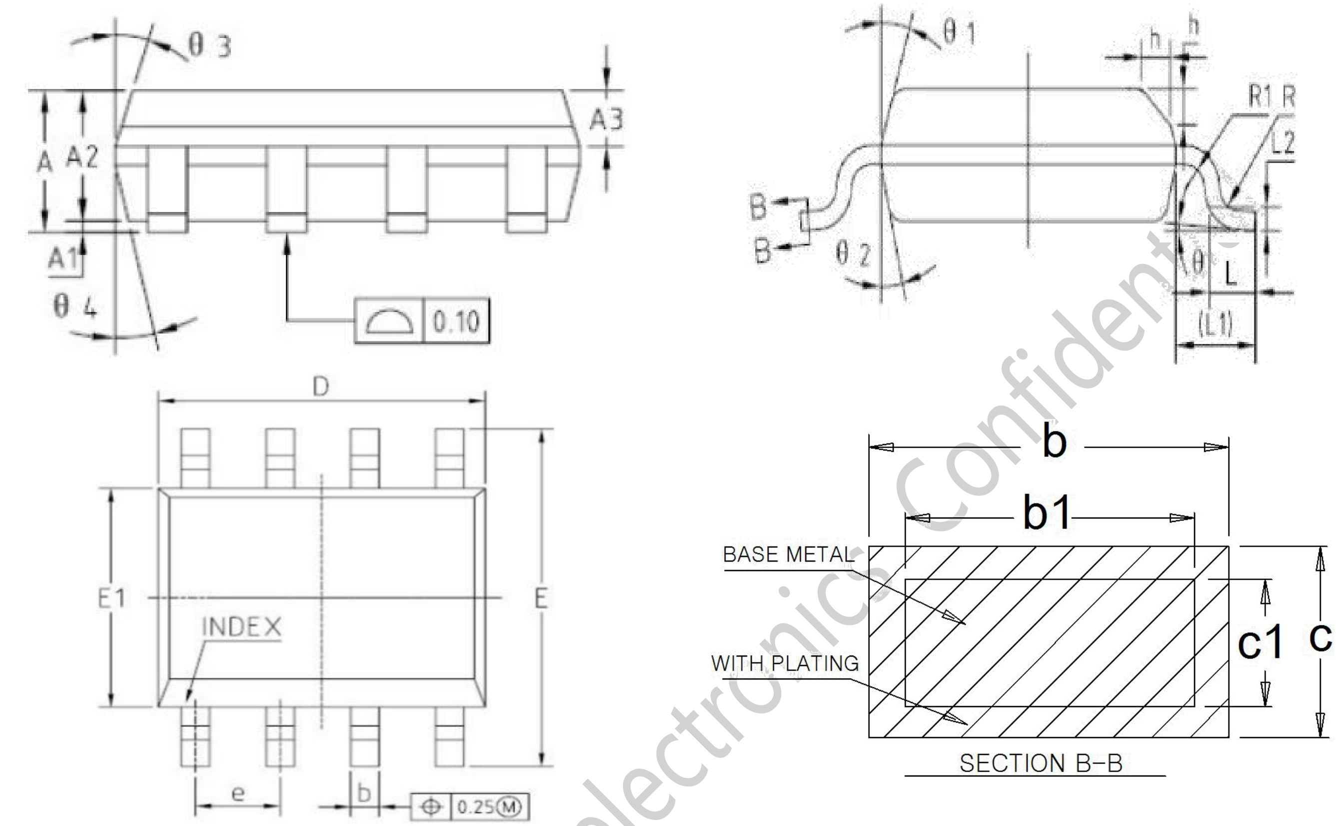
5. The ground connection for C1 , C2 and C3 , C4 should be as small as possible and connect to system ground plane at only one spot (preferably at the COUT ground point) to minimize injecting noise into system ground plane.

6. Place R1 and R2 as close as possible to the chip and stay away from noisy nodes such as SW, BST.

7. Large GND Copper Pour near IC is recommended to minimize the heat of DP3115B.

PACKAGE DIMENSION

SOP8



Symbol	Dimensions in Millimeters		
	Min	Nom	Max
A	1.45	1.55	1.65
A1	0.10	0.15	0.20
A2	1.353	1.40	1.453
A3	0.55	0.60	0.65
b	0.38	-	0.51
b1	0.37	0.42	0.47
c	0.17	-	0.25
c1	0.17	0.20	0.23
D	4.85	4.90	4.95
E	5.85	6.00	6.15
E1	3.85	3.90	3.95
e	1.245	1.27	1.295
L	0.45	0.60	0.75
L1	-	1.050REF	-
L2	-	0.250BSC	-
Θ1-Θ4	12° REF		
h	0.40REF		
R	0.15° REF		
R1	0.15° REF		

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