



DW8523A

2ch High-Brightness Buck converter LED Driver IC

Ver. 1.5
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1. General Description

The DW8523A is a high efficiency step down converter for LED driver IC which provide a solution for LED lighting of flat panel luminance and general DC voltage LED applications

The DW8523A built in high side LED current sensing circuit and protection circuit same as TSD, LED open, LED short and ambient temperature protection. And DW8523A is integrated MCU interface circuit for faults detection. In these fault, MCU interface pin voltage pull down. And DW8523A can adjust LED current by external analog signal. DW8523A can transfer external analog adjust signal to PWM logic signal. Practically, LED current is adjusted by PWM logic signal and analog dimming signal simultaneously. Thus DW8523A can prevent LED current flicker when LED current is low by analog dimming. And frequency of the PWM frequency is determined by external capacitor. The DW8523A are well suited for applications requiring a wide input voltage range. The high side current sensing and an integrated current-setting circuitry minimize the number of external components while delivering an LED current with +/-2.5% accuracy. A hysteretic control algorithm ensures excellent input supply rejection and fast response during load transient and PWM dimming. The DW8523A feature a 10% inductor current ripple. These devices operate up to 2MHz switching frequency. Thus allowing for small component size.

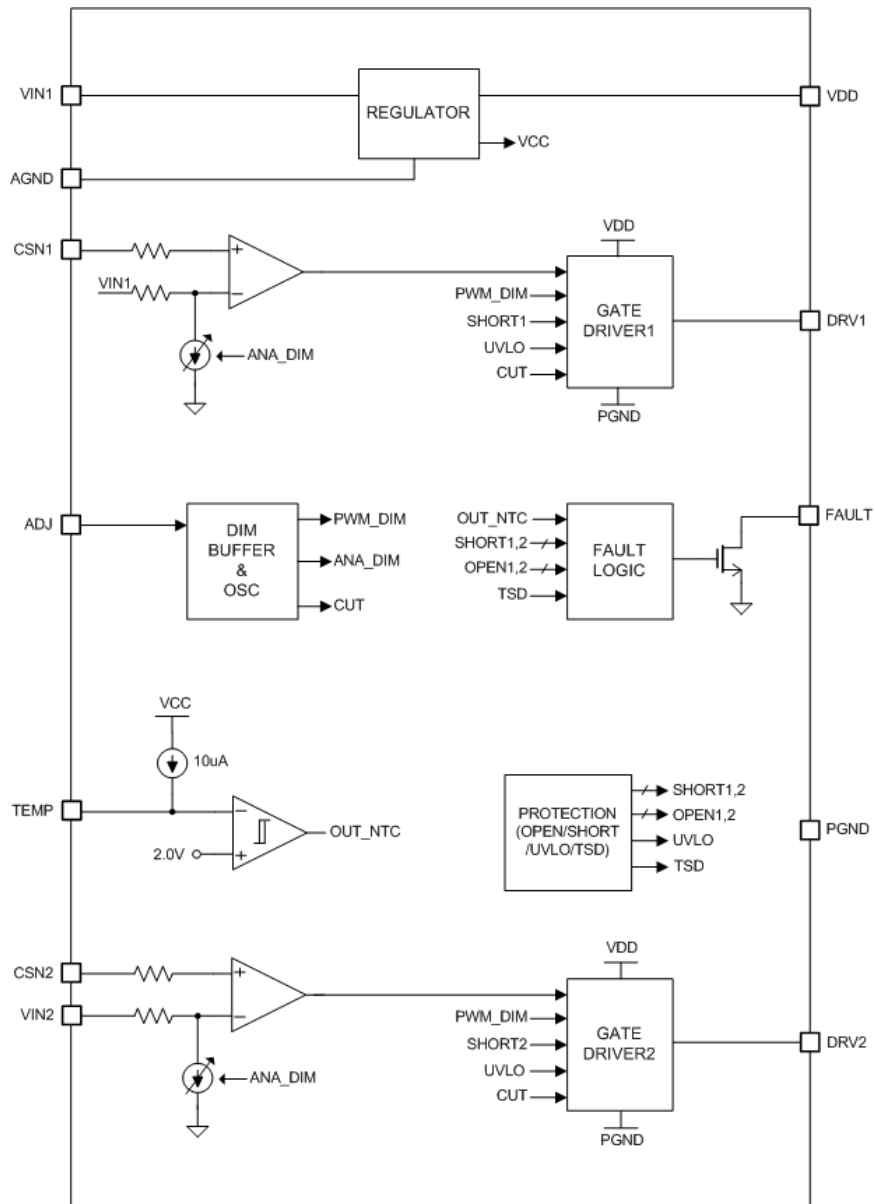
■ Features

- 6.5V to 60V Input voltage range
- 2-Channel hysteretic buck control
- +/-2.5% LED current accuracy
- Up to 95 % efficiency (VIN=34.5V, VLED=30V, ILED=400mA 2channel)
- Analog and PWM dimming simultaneously
- Various Fault detection
(LED open/short, Temperature, TSD)
- Protection function with external NTC
- Up to 2MHz switching frequency
- Wide temperature range : -40 to 125°C
- Over temperature derating (30%)
- SOIC-16L Package

■ Applications

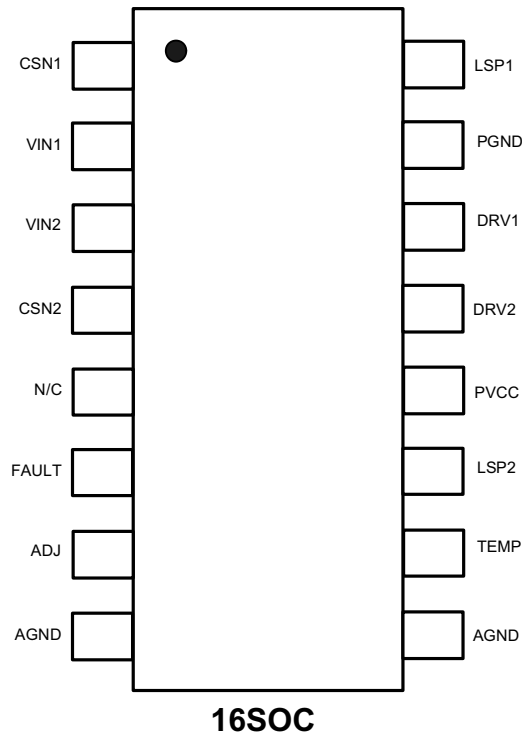
- Flat panel LED lighting
- LED down light
- Architectural lighting

2. Block Diagram



3. Pin Information

■ Pin Placement



■ Pin Description

| No. | Pin Name | Description | Note |
|-----|----------|------------------------------------|------|
| 1 | CSN1 | Channel 1 current sense input | |
| 2 | VIN1 | Supply voltage1 | |
| 3 | VIN2 | Supply voltage2 | |
| 4 | CSN2 | Channel 2 current sense input | |
| 5 | N/C | No connector | |
| 6 | Fault | Fault pin for interface MCU | |
| 7 | ADJ | Analog dimming & PWM dimming input | |
| 8 | AGND | Analog power Ground | |
| 9 | AGND | Analog power Ground | |
| 10 | TEMP | Temperature sense input | |
| 11 | LSP2 | Ch2 LED short sense | |
| 12 | PVCC | Power VCC | |
| 13 | DRV2 | Ch2 gate drive output | |
| 14 | DRV1 | Ch1 gate drive output | |
| 15 | PGND | Power ground | |
| 16 | LSP1 | Ch1 LED short sense | |

4. Absolute Maximum Ratings

| Symbol | Parameter | Ratings |
|-------------------|---|--------------|
| VIN1, VIN2 | Supply voltage between VIN1, VIN2 to GND | 72V |
| CSN1, CSN2 | Supply voltage between CSN1, CSN2 to GND | 72V |
| CSN1, CSN2 to VIN | Maximum voltage between VIN to CSN1, CSN2 | 0.3V |
| DRV1, DRV2 | DRV1, DRV2 pin voltage | 6.8V |
| VCC | External FET driving voltage | 6.8V |
| TEMP | Supply voltage between TEMP to GND | 6.8V |
| ADJ | Supply voltage between ADJ to GND | 6.8V |
| FAULT | Supply voltage between FAULT to GND | 6.8V |
| LSP1, LSP2 | Supply voltage between LSP1, LSP2 to GND | 6.8V |
| T _J | Junction operating temperature | -40 ~ +125°C |
| T _{STG} | Storage temperature | -55 ~ +150°C |
| P _d | Power dissipation | 82°C/W |

■ Absolute Maximum Ratings

Use of the IC in excess of absolute maximum ratings such as the applied voltage or operating temperature range (T_J) may result in IC damage. Assumptions should not be made regarding the state of the IC (short mode or open mode) when such damage is suffered. The implementation of a physical safety measure such as a fuse should be considered when use of the IC in a special mode when the absolute maximum ratings may be exceeded is anticipated.

5. Recommended Operating Condition

| Symbol | Parameter | Min. | Typ. | Max. | Unit |
|------------------------|-------------------------------|-------------|------|-------------|------|
| VIN1, VIN2 | Positive power supply voltage | 6.5 | | 60 | V |
| CSN1, CSN2 | Current sensing voltage | VIN - 0.25V | | VIN + 0.25V | V |
| ADJ, LSP1, LSP2, FAULT | Input voltage | | | VCC | V |

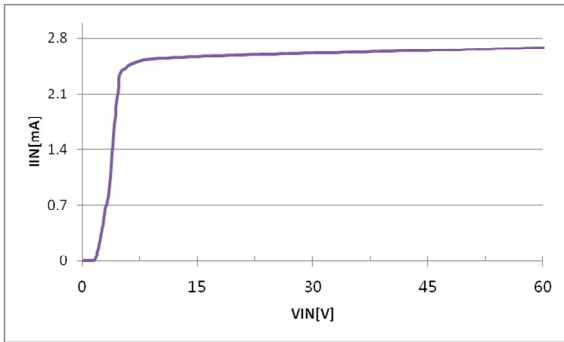
6. Electrical Specification

($V_{IN}=35V$, $C_{VCC}=1\mu F$, $R_{CSN} = 1\Omega$, connected between VIN and CSN, Typical value at $T_A=T_J=+25^\circ C$, unless other less)

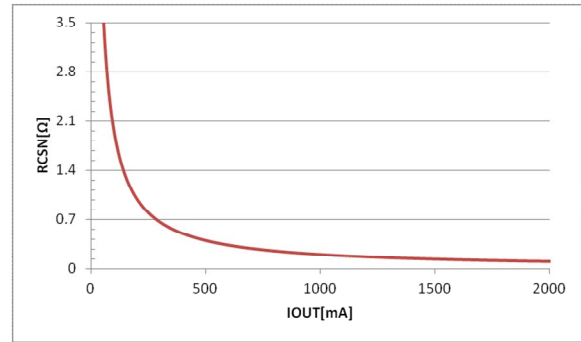
| Characteristic | Symbol | Condition | Min | Typ | Max | Unit |
|---|---------------|---------------------------------|---------|-------|------|------|
| Overall | | | | | | |
| Input voltage | Vin | | 6.5 | | 60 | V |
| Under voltage lockout | UVLO | VIN rising | | 6.25 | | V |
| Under voltage lockout hysteresis | Δ UVLO | Hysteresis UVLO | | 0.52 | | V |
| Quiescent current | Iq | VIN=60V, V(ADJ)<V(CDIMM) | | 3 | 4 | mA |
| Current sense comparator | | | | | | |
| CSN voltage threshold | Vcsn | | 195 | 200 | 205 | mV |
| CSN threshold hysteresis | CSNhys | Vin-Vcsn=200mV | | 5 | | % |
| Current CSN input current | | | | 0.1 | 1 | uA |
| Gate driver | | | | | | |
| Source current | Isource | VDD=5V,VDRV=2.5V | | 0.67 | | A |
| Sink current | Isink | VDD=5V,VDRV=2.5V | | 0.78 | | A |
| Gate driver output voltage high | | IDRV=10mA | Vcc-0.5 | | | V |
| Gate driver output voltage low | | IDRV=-10mA | | | 0.5 | V |
| VDD Regulator | | | | | | |
| Regulator | Vcc | IVDD=0.1mA~10mA VIN=6.5V~60V | 4.8 | | 5.2 | V |
| Analog to PWM dimming | | | | | | |
| ADJ Input voltage dimming range | VADJ | | 0.26 | | 2.3 | V |
| 100% duty ADJ range | VADJ_100 | | 2.17 | 2.275 | 2.38 | V |
| Dimming cut-off voltage | VADJ_PD | | 0.25 | 0.275 | 0.3 | V |
| Protection | | | | | | |
| Short LED protection threshold voltage | VLSP_TH | | 2.2 | 2.3 | 2.4 | V |
| Open fault detection delay time | Topen | | | 80 | | us |
| Over temperature protection threshold voltage | VOTP_TH | | 1.8 | 2.0 | 2.2 | V |
| NTC source current | ITEMP | V(TEMP)=2.0 | 29.6 | 31.6 | 33.6 | uA |
| Thermal derating | The_derating | | | 30 | | % |
| Open drain output voltage | Vtemp_TH | Isink=3mA | | | 0.4 | V |
| Thermal shut down | Temp_D | Temperature rising | | 150 | | °C |
| Thermal hysteresis | Temp_HYS | | | 20 | | °C |

7. Typical Operating Characteristics

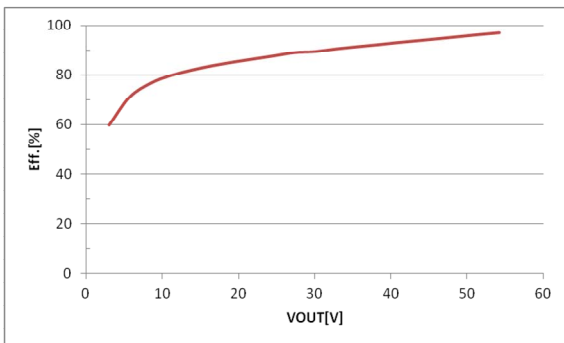
($V_{IN}=35V$, $C_{VCC}=1\mu F$, $R_{CSN} = 1\Omega$, connected between VIN and CSN, Typical value at $T_A=T_J=+25^\circ C$, unless other less)



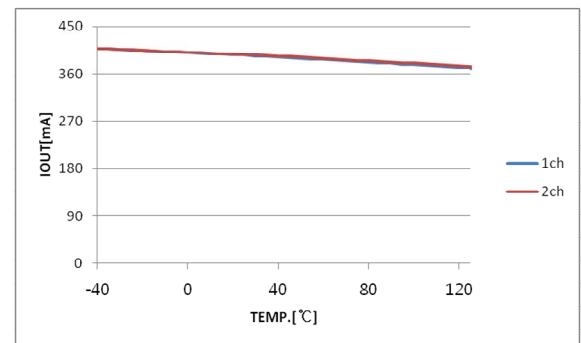
Quiescent vs. VIN (ADJ=5V)



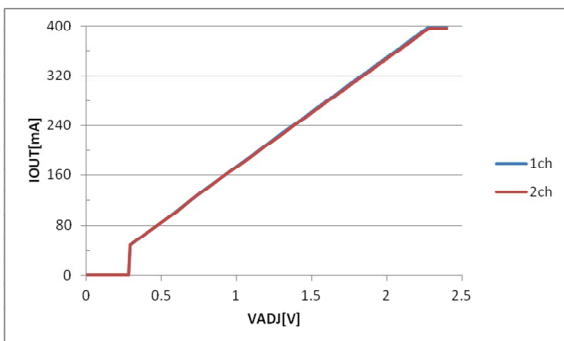
I_{OUT} vs. R_{CSN}



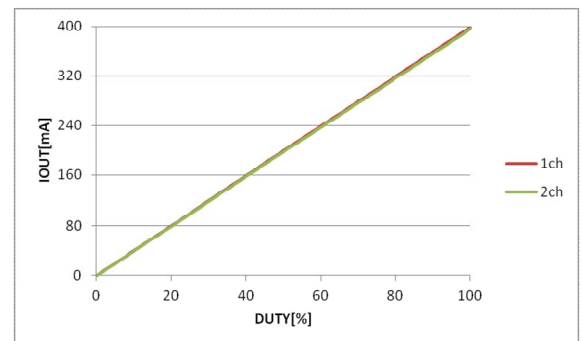
Efficiency vs. LED($V_{IN} = 60V$)



I_{OUT} vs. Temperature

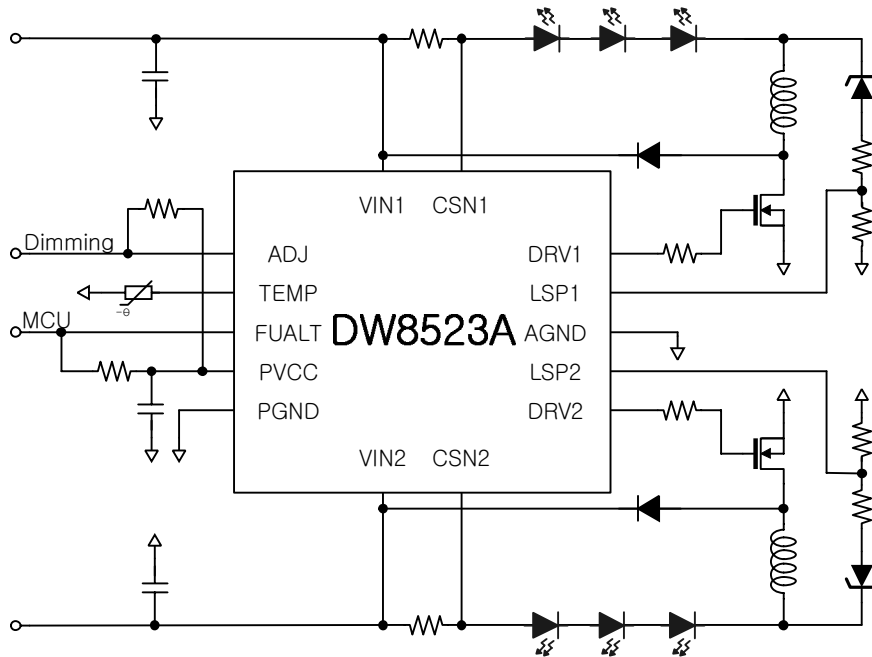


Analog Dimming



PWM Dimming(300hz)

8. Typical Application Circuit



9. Detailed Descriptions

The DW8523A are 2ch step down constant current HB LED drivers, This device operate form a +6.5V to +60V input voltage range. A high-side current sense resistor sets the LED current and a dedicated PWM dimming input enables pulsed LED dimming over a wide range of brightness levels. And Analog voltage dimming input enable LED dimming. Specially, feature of DW8523A contain the analog dimming to PWM dimming conversion. So, this device operates PWM dimming by analog dimming signal.

A high side current sensing scheme and an on board current setting circuitry minimize the number of external components while delivering LED current with +/- 2.5% accuracy, using a 1% sense resistor.

1) Under-Voltage Lockout (UVLO)

The DW8523A includes a UVLO with 500mV hysteresis. The external MOSFET turns off when VIN falls below 5.5V.

2) Dimming

DW8523A analog and PWM dimming can be input via the ADJ. LED dimming is achieved by applying a PWM signal at ADJ. A logic level below at ADJ force the DW8523A output low, thus turning off the LED current. To turn the LED current on, the logic level at ADJ must be greater than 2.275V. LED dimming is achieved by applying a Analog signal at ADJ. Analog dimming range is 0.275V to 2.275V. And DW8523A can to convert Analog to PWM, so LED current is adjusted by analog dimming signal.

3) Thermal LED Current Derating

The DW8523A include a thermal LED current derating feature that reduces the output current when the tempera ture of the LED string exceed a specified temperature point. These devices enter thermal derating mode when the voltage drop on the NTC thermistor, thermally attached to the LEDs and electrically conned by between NTC to ground. Drops below the internal 2V threshold limit and these device include thermal derating

feature that reduces the output current when the temperature of the silicon into PKG exceed a about 155°C. Ana hysteresis temperature is about 20°C.

4) Selecting Rsense to Set LED Current

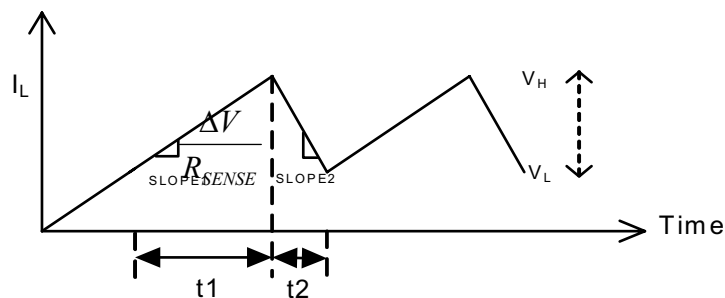
The LED current is programmed with a current-sense resistor connected between IN and CS. Use the following equation to calculate the value of this resistor

$$R_{sense} = \frac{0.2}{I_{LED}}$$

The value (0.2V) is the sense voltage RMS voltage. (See the Electrical Characteristics table for values).

5) Current-Regulator Operation

The current regulation topology of DW8523A is hysteric Buck converter. DW8523A regulate the LED current using a comparator with hysteresis. As the current through the inductor ramps up and the voltage threshold, external MOSFET turn off. The external MOSFET turns on again when the inductor current ramps down through the freewheeling diode until the voltage across the sense resistor equals the lower threshold voltage. Use the following equation to determine the operating frequency.



$$T = t1 + t2 = \frac{\Delta V \cdot L}{(V_{IN} - N \cdot V_{LED}) \cdot R_{SENSE}} + \frac{\Delta V \cdot L}{N \cdot V_{LED} \cdot R_{SENSE}}$$

$$f_{SW} = \frac{1}{T} = \frac{(V_{IN} - N \cdot V_{LED}) \cdot N \cdot V_{LED} \cdot R_{SENSE}}{V_{IN} \cdot \Delta V \cdot L}$$

$$\Delta V = V_H - V_L$$

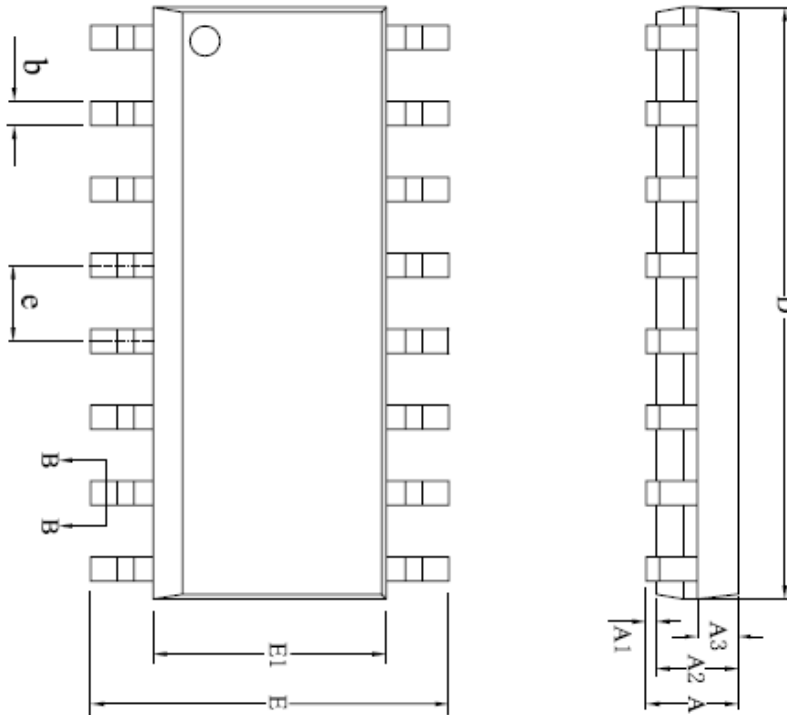
6) LED Short / LED Open Protection

The DW8523A include LED Short/LED Open detection and Protection function. These devices detect at LSP when LED is shorted. This case, LSP voltage rises from 0V up to 5V. Threshold voltage of LED Short Protection is 2.3V. In case LED short, LSP pin voltage is up to 2.3V, so these devices LED short detect, and Fault pin voltage full down to 0V, turn off external MOSFET. Thus, DW8523A can protect LED string. These devices can detect when LED is opened. In this case Fault pin voltage is pulled down.

10. Package Dimension

Package Dimension (6mm X 9.9mm X 1.75mm 16L SOIC)

- Package Name : 16-SOC,
- Package Size : 6mm * 9.9mm, Thickness : 1.75mm
- Pin Pitch : 1.27mm



| SYMBOL | MILLIMETER | | |
|------------------|------------|------|-------|
| | MIN | NOM | MAX |
| A | — | — | 1.75 |
| A1 | 0.10 | — | 0.25 |
| A2 | 1.35 | 1.40 | 1.45 |
| A3 | 0.60 | 0.65 | 0.70 |
| b | 0.39 | — | 0.48 |
| b1 | 0.38 | 0.41 | 0.43 |
| c | 0.21 | — | 0.26 |
| c1 | 0.19 | 0.20 | 0.21 |
| D | 9.70 | 9.90 | 10.10 |
| E | 5.80 | 6.00 | 6.20 |
| E1 | 3.70 | 3.90 | 4.10 |
| e | 1.27BSC | | |
| L | 0.50 | — | 0.80 |
| L1 | 1.05BSC | | |
| θ | 0 | — | 8° |
| L/P载体尺寸 (mil) | 75*75 | | |
| | 90*110 | | |
| | 90*180 | | |