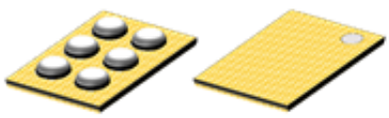
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# LD57100

Datasheet

## 1 A ultra low-dropout LDO with bias



Flip Chip6 (0.8x1.2 mm)

| Product status link |
| --- |
| LD57100 |

## Features

- Input voltage from $V_{OUT}$ to 5.5 V
- Input bias supply pin from 3.0 V to 5.5 V
- Ultra low-dropout voltage (40 mV typ. at 1 A load)
- Low ground current (35 µA typ. at no load)
- Output voltage tolerance: ±1% all over temperature range, ±0.5% at 25 °C
- 1 A guaranteed output current
- 50 mV output voltage step available from 0.4 V to 1.8 V
- 100 mV output voltage step available from 1.9 V to 3.6 V
- Adjustable version from 0.5 V to 3.0 V
- Logic-controlled electronic shutdown
- Internal current limit
- Thermal shutdown
- Output active discharge function
- Available in Flip Chip6 (0.8x1.2 mm) package
- Temperature range: -40 °C to 85 °C

## Applications

- Smartphones
- Cameras
- Low voltage, low noise post regulation

## Description

The LD57100 is a high accuracy voltage regulator, which provides 1 A of current. It is equipped with an NMOS pass transistor, whose gate is biased by a dedicated pin, thus allowing the ultra-low drop performance even at very low input voltages.

It is available in Flip Chip6 (0.8x1.2 mm), maximizing the space saving. This device is stabilized with a small ceramic capacitor on the output. The ultra low drop, low quiescent current and short-circuit protection make the LD57100 suitable for low power battery-operated applications.

An enable logic control function puts the LD57100 in shutdown mode allowing a total current consumption lower than 0.1 µA. Thermal protection is also included.

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# 1 Diagrams

Figure 1. **Block diagram fixed version**

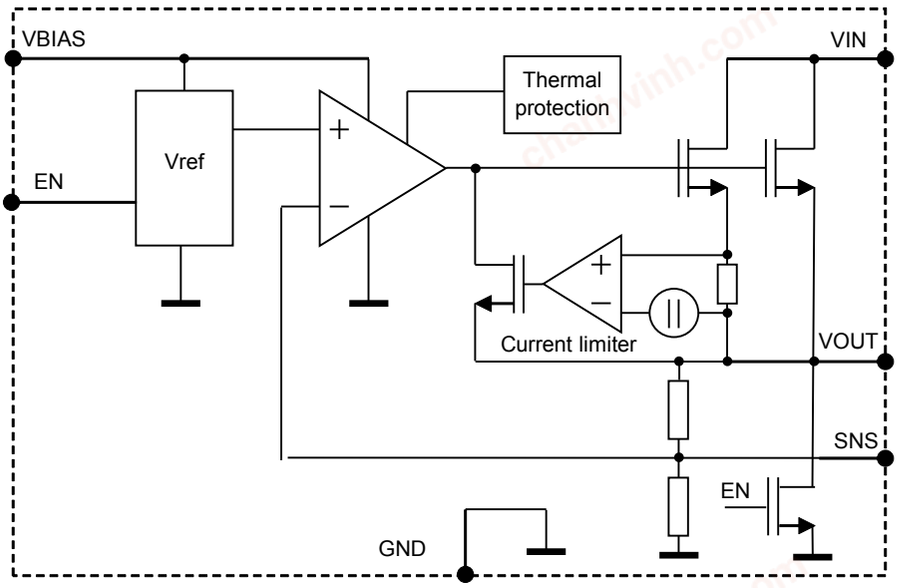
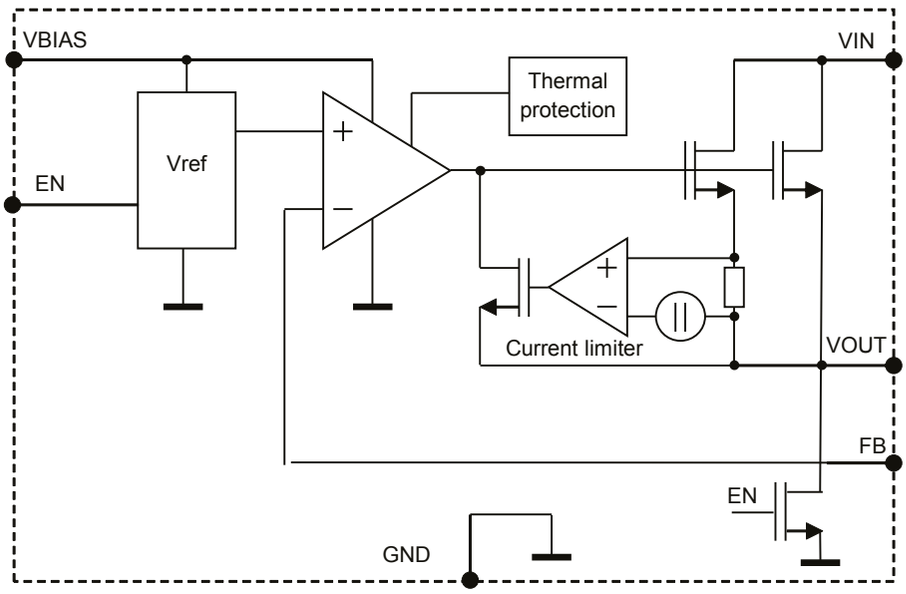



Figure 2. **Block diagram adjustable version**



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## 2 Pin configuration

Figure 3. **Pin connection (top view)**

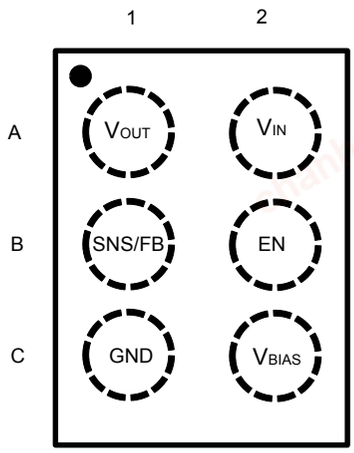



Table 1. **Pin description**

| Pin # | Symbol | Functions |
|---|---|---|
| A1 | $V_{OUT}$ | Output voltage |
| A2 | $V_{IN}$ | Input voltage |
| B1 | SNS / FB | Output voltage sense pin in fixed version. Connect to the load with a separate PCB track.<br>Feedback pin in adjustable version. Connect to the resistor divider central node |
| B2 | EN | Enable pin logic input: low = shutdown, high = active |
| C1 | GND | Common ground |
| C2 | $V_{BIAS}$ | Bias supply input |

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# 3 Typical application circuits

Figure 4. **Typical application for fixed version**

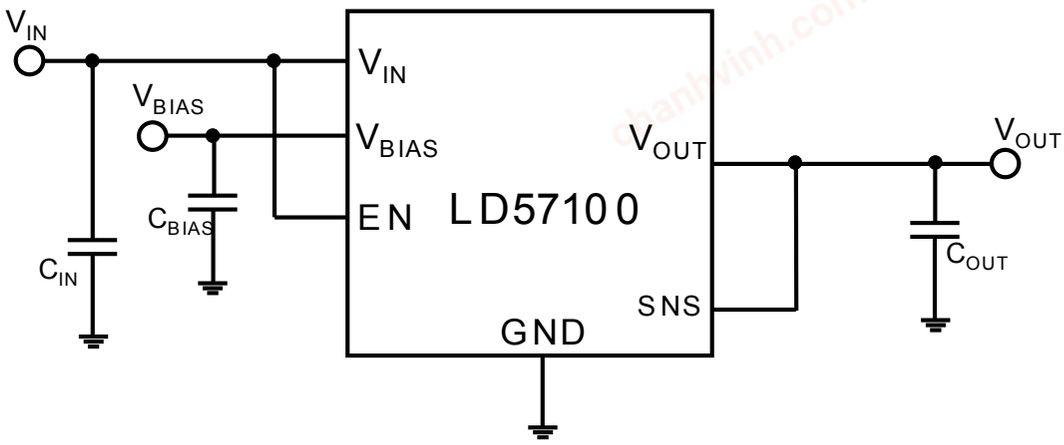



Figure 5. **Typical application for adjustable version**

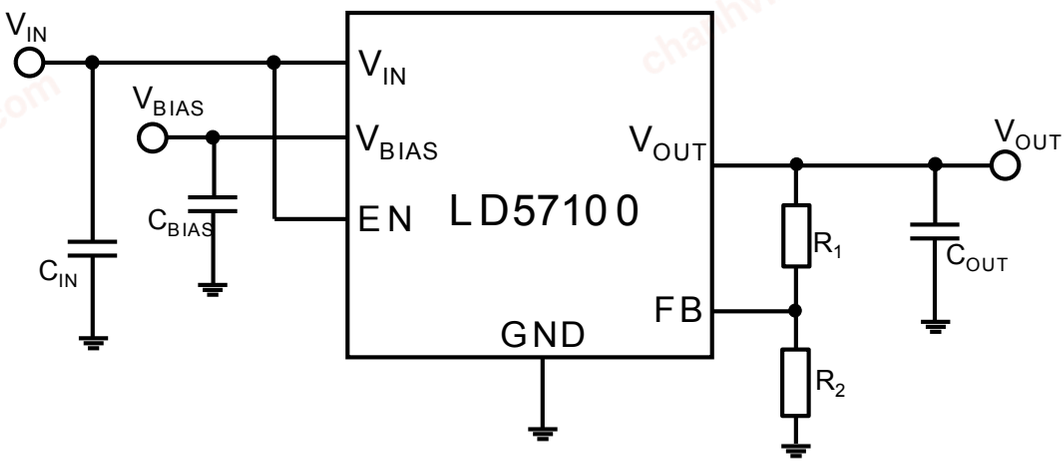



Table 2. **Typical application components**

| Symbol | Value | Description | Note |
|---|---|---|---|
| $C_{IN}$ | 1 µF | Input capacitor | Ceramic type |
| $C_{BIAS}$ | 4.7 µF | Control logic bypass capacitor | Ceramic type |
| $C_{OUT}$ | 10 µF | Output capacitor | Ceramic type |
| $R_1$ | | Output voltage side resistor | See Section 6.4 VOUT setting (adjustable version) |
| $R_2$ | | Ground side resistor | <500 kΩ max. |

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# 4 Absolute maximum ratings

**Table 3. Absolute maximum ratings**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $V_{IN}$, $V_{BIAS}$ | Input voltage | -0.3 to 7 | V |
| $V_{OUT}$, $V_{FB}$, $V_{SNS}$ | Output voltage | -0.3 to $V_{IN}$ + 0.3 | V |
| $V_{EN}$ | Enable input voltage | -0.3 to 7 | V |
| $I_{OUT}$ | Output current | Internally limited (see $I_{SC}$ in Table 6. Electrical characteristics) | A |
| $T_{STG}$ | Storage temperature range | - 40 to 150 | °C |

*Note: Absolute maximum ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not implied. All values are referred to GND.*

**Table 4. Thermal data**

| Symbol | Parameter | Value | Unit |
|---|---|---|---|
| $R_{thJA}$ | Thermal resistance junction-ambient(1) | 60 | °C/W |

1. *We considered the STD JEDEC board 4 layers (2s2p) 101.5 x114.5 mm with a top copper plane of 4x4 mm.*

**Table 5. ESD performance**

| Symbol | Parameter | Test conditions | Value | Unit |
|---|---|---|---|---|
| ESD | ESD protection voltage | HBM | 2 | kV |
| | | CDM | 500 | V |

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# 5 Electrical characteristics

$V_{BIAS}$ = 3.0 V or $V_{OUT}$ + 1.6 V (whichever is greater); $V_{IN}$ = $V_{OUT(NOM)}$ + 0.3 V; $I_{OUT}$ = 1 mA; $C_{IN}$ = 4.7 µF, $C_{OUT}$ = 10 µF; $C_{BIAS}$ = 1 µF, $V_{EN}$ = 1 V; typical values are at $T_J$ = 25 °C; min./max. values are at -40 °C ≤ $T_J$ ≤ 85 °C, unless otherwise specified.

**Table 6. Electrical characteristics**

| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{IN}$ | Operating input voltage | | $V_{OUT}$ + $V_{DROP}$ | | 5.5 | V |
| $V_{BIAS}$ | Operating bias voltage | | ($V_{OUT}$ + 1.60) ≥ 3.0 | | 5.5 | V |
| $V_{UVLO}$ | Bias undervoltage lockout | $V_{BIAS}$ rising<br>$T_J$ = 25 °C | 1.45 | 1.6 | 1.75 | V |
| | | Hysteresis<br>$T_J$ = 25 °C | 0.15 | 0.2 | 0.25 | V |
| $V_{REF}$ | Reference voltage for adjustable devices | $T_J$ = 25 °C; | | 0.5 | | V |
| $V_{OUT}$ | Output voltage accuracy | All versions, as per conditions above | | ± 0.5 | | % |
| | | $V_{OUT(NOM)}$ + 0.3 V ≤ $V_{IN}$ ≤ $V_{OUT(NOM)}$ + 1.0 V;<br>3.0 V or $V_{OUT(NOM)}$ + 1.6 V (whichever is greater) ≤ $V_{BIAS}$ ≤ 5.5 V;<br>$I_{OUT}$ = 1 mA to 1 A;<br>-40 °C ≤ $T_J$ ≤ 85 °C | -1.0 | | +1.0 | % |
| $\Delta V_{OUT-IN}$ | $V_{IN}$ static regulation | $V_{OUT(NOM)}$ + 0.3 V ≤ $V_{IN}$ ≤ 5.0 V,<br>$T_J$ = 25 °C | | 0.01 | 0.1 | % / V |
| $\Delta V_{OUT-BIAS}$ | $V_{BIAS}$ line regulation | 3.0 V or $V_{OUT(NOM)}$ + 1.6 V (whichever is greater) ≤ $V_{BIAS}$ ≤ 5.5 V,<br>$T_J$ = 25 °C | | 0.01 | 0.1 | % / V |
| $\Delta V_{OUT-LOAD}$ | Static load regulation | $I_{OUT}$ = 1 mA to 1 A, $T_J$ = 25 °C | | 1.0 | 2.0 | mV |
| $V_{DROP}$ | Dropout voltage | $I_{OUT}$ = 1 A; $V_{OUT}$ = 97% of $V_{OUT(NOM)}$ | | 40 | 80 | mV |
| $V_{DROP-BIAS}$ | Bias dropout voltage (1) | $V_{BIAS}$=$V_{IN}$; $I_{OUT}$ = 1 A; $V_{OUT}$ = 97% of $V_{OUT(NOM)}$ | | 1.05 | 1.5 | V |
| $I_{LIM}$ | Output current limit | $V_{OUT}$ = 90% $V_{OUT(NOM)}$ | 1.5 | 2 | 2.6 | A |
| | | $V_{OUT}$ = 90% $V_{OUT(NOM)}$ , −30 °C ≤ $T_J$ ≤ 85 °C | 1.55 | 2 | 2.6 | |
| $I_{FB}$, $I_{SNS}$ | FB/SNS pin operating current | | | 0.1 | 0.5 | µA |
| $I_{BIAS}$ | VBIAS operating current | $V_{BIAS}$ = 3.0 V, $I_{OUT}$ = 0 mA | | 35 | 50 | µA |
| $I_{Standby-BIAS}$ | $V_{BIAS}$ standby current | $V_{BIAS}$ input current in OFF mode: $V_{EN}$ = GND | | 0.1 | 1 | µA |
| $I_{Standby-IN}$ | $V_{IN}$ standby current | $V_{IN}$ input current in OFF mode: $V_{EN}$ = GND | | 0.1 | 1 | µA |
| $V_{EN}$ | Enable input logic low | | | | 0.4 | V |
| | Enable input logic high | | 0.9 | | | |

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| Symbol | Parameter | Test conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $I_{EN}$ | Enable pin input current | $V_{EN}$ = $V_{BIAS}$ = 5.5 V | | 0.2 | 1 | µA |
| $T_{ON}$ | Turn-on time | From assertion of $V_{EN}$ to $V_{OUT}$ = 98% $V_{OUT(NOM)}$, $V_{OUT(NOM)}$ = 1.0 V | | 160 | | µs |
| $SVR_{IN-ADJ}$ | $V_{IN}$ supply voltage rejection (adj version) | $V_{IN}$ = $V_{OUT(NOM)}$+ 0.5 V +/- $V_{RIPPLE}$<br>$V_{RIPPLE}$ = 0.2 V; freq=1 kHz<br>$I_{OUT}$ = 10 mA; $V_{OUT(NOM)}$ = 1.0 V | | 70 | | dB |
| $SVR_{BIAS-ADJ}$ | $V_{BIAS}$ supply voltage rejection (adj version) | $V_{BIAS}$ = 3.0 V +/- $V_{RIPPLE}$,<br>$V_{RIPPLE}$ = 0.2 V; freq=1 kHz;<br>$V_{IN}$ = $V_{OUT(NOM)}$+ 0.5 V<br>$I_{OUT}$ = 10 mA; $V_{OUT(NOM)}$ = 1.0 V | | 85 | | dB |
| $e_{N-ADJ}$ | Output noise voltage (adj version) | $V_{IN}$ = $V_{OUT(NOM)}$+ 0.5 V; $V_{OUT(NOM)}$ = 1.0 V;<br>10 Hz to 100 kHz, $I_{OUT}$ = 1 mA | | 35 x $V_{OUT}$ / $V_{REF}$ | | $µV_{RMS}$ |
| $SVR_{IN-FIX}$ | VIN supply voltage rejection (adj version) | $V_{IN}$ = $V_{OUT(NOM)}$+ 0.5 V +/- $V_{RIPPLE}$<br>$V_{RIPPLE}$ = 0.2 V; freq=1 kHz<br>$I_{OUT}$ = 10 mA; $V_{OUT(NOM)}$ = 1.8 V | | 75 | | dB |
| $SVR_{BIAS-FIX}$ | $V_{BIAS}$ supply voltage rejection (fixed versions) | $V_{BIAS}$ = 4.0 V +/- $V_{RIPPLE}$<br>$V_{RIPPLE}$ = 0.2 V; freq=1 kHz;<br>$V_{IN}$ = $V_{OUT(NOM)}$+ 0.5 V<br>$I_{OUT}$ = 10 mA; $V_{OUT(NOM)}$ = 1.8 V | | 85 | | dB |
| $e_{N-FIX}$ | Output noise voltage (fixed versions) | $V_{IN}$ = $V_{OUT(NOM)}$+ 0.5 V; $V_{OUT(NOM)}$ = 1.0 V;<br>10 Hz to 100 kHz, $I_{OUT}$ = 1 mA | | 27 | | $µV_{RMS}$ |
| $R_{ON}$ | Output voltage discharge MOSFET | | | 150 | | Ω |
| $T_{SHDN}$ | Thermal shutdown | | | 160 | | °C |
| | Hysteresis | | | 20 | | |

1. *Not applicable to fixed versions with $V_{OUT(NOM)}$ < 2.0 V.*

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# 6 Application information

## 6.1 $V_{BIAS}$ pin voltage requirements

The bias input is the supply of the internal driving and control circuitry. In order to assure a proper biasing of the N-channel power element, the bias pin must have a minimum voltage of 3.0 V and be 1.6 V (typically) higher than the output. If $V_{IN}$ supply voltage meets these requirements then the bias pin can be tied to $V_{IN}$.

## 6.2 Output discharge function

The LD57100 integrates a MOSFET connected between $V_{OUT}$ and GND. This transistor is activated when the EN pin goes to low logic level and has the function to quickly discharge the output capacitor when the device is disabled by the user.

## 6.3 Short-circuit and current limitation

The LD57100 is protected against short-circuit on the output. The load current is limited to the maximum value of $I_{LIM}$ when $V_{OUT}$ is equal to 90% of its nominal value.

## 6.4 $V_{OUT}$ setting (adjustable version)

In the LD57100 adjustable version, the desired output voltage is set according to the formula below:

$$V_{OUT} = V_{REF} \times \left(1 + \frac{R_1}{R_2}\right) \quad (1)$$

where $R_2$ cannot be higher than 500 kΩ.

Please, refer to Figure 5. Typical application for adjustable version for $R_1$ and $R_2$ connections.

## 6.5 Thermal protection

Thermal protection works when the junction temperature reaches 160 °C typical. At this point, the output of the IC shuts down. As soon as the junction temperature falls below the thermal hysteresis value, the device starts working again.

In order to calculate the maximum power that the device can dissipate, keeping the junction temperature below the maximum operating value, the following formula is used:

$$P_{DMAX} = \left(85 - T_{AMB}\right) / R_{thJA} \quad (2)$$

## 6.6 Input and output capacitors

The LD57100 requires external capacitors to assure the regulator control loop stability.

Any good quality ceramic capacitor can be used, however the X5R and the X7R are suggested since they guarantee a very stable combination of capacitance and ESR all over the temperature range.

It is recommended to place the input/output capacitors as close as possible to the relative pins. The LD57100 requires a $V_{IN}$ capacitor with a minimum value of 1 µF and a $V_{BIAS}$ capacitor of 100 nF minimum. These capacitors must be placed as close as possible to the input pins of the device and returned to a clean analog ground.

The control loop is designed to be stable with any good quality output ceramic capacitor (such as: X5R/X7R types) with a minimum value of 1.0 µF and equivalent series resistance in the [3 – 300 mΩ] range. It is important to highlight that the output capacitor must maintain its capacitance and ESR in the stable region over the full operating temperature, load and input voltage ranges, to assure stability. Therefore, capacitance and ESR variations must be taken into account in the design phase to be sure that the device works in the expected stability region.

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# 7 Typical characteristics

$C_{IN}$ = 1 µF; $C_{OUT}$ = 10 µF, $T_J$ = 25 °C unless otherwise specified.

**Figure 6. $V_{IN}$ drop vs temperature**

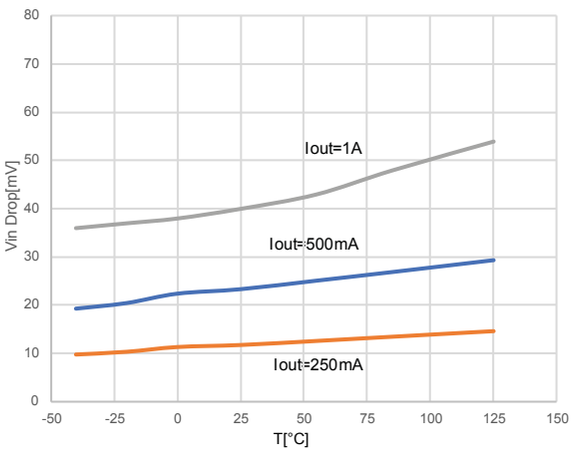



**Figure 7. UVLO vs temperature**

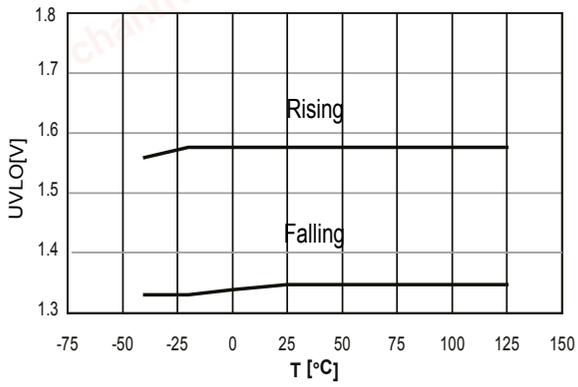



**Figure 8. $V_{OUT}$ vs temperature ($V_{BIAS}$@3 V, $V_{IN}$@$V_{OUT}$ +0.3 V@1 mA)**

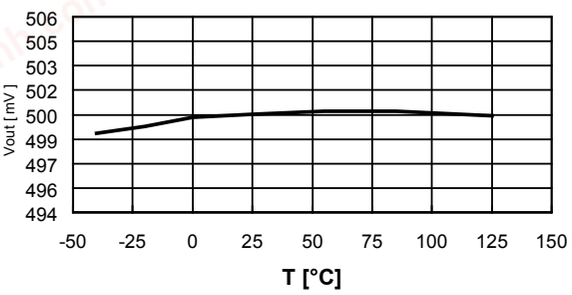



**Figure 9. $V_{OUT}$ vs temperature ($V_{BIAS}$@3 V, $V_{IN}$@$V_{OUT}$ +0.3 V@1 A)**

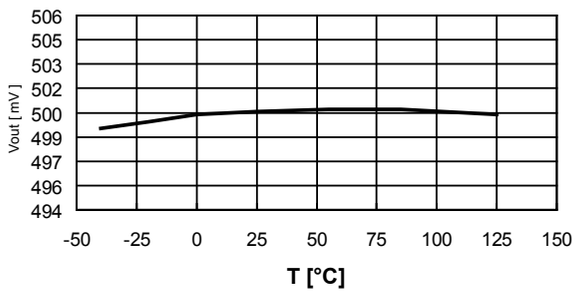



**Figure 10. $V_{in_line}$ vs temp. ($V_{OUT(NOM)}$ + 0.3 V ≤ $V_{IN}$ ≤ 5.0 V)**

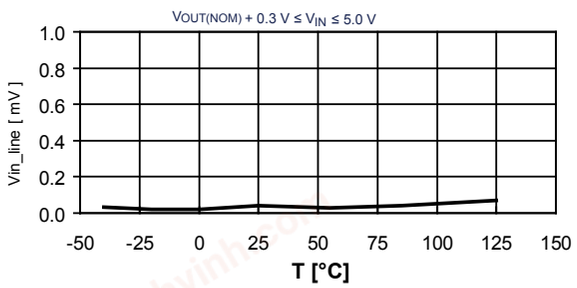
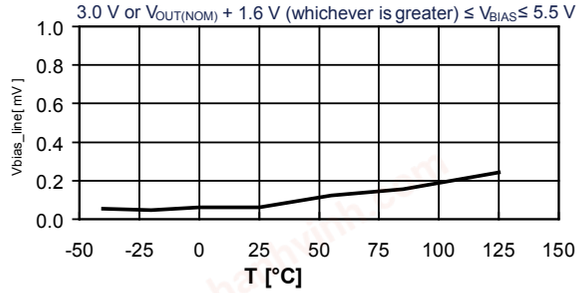



**Figure 11. $V_{BIAS_line}$ vs temp. (3.0 V or $V_{OUT(NOM)}$ + 1.6 V, whichever is greater, ≤ $V_{BIAS}$ ≤ 5.5 V)**



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Figure 12. Load vs temperature

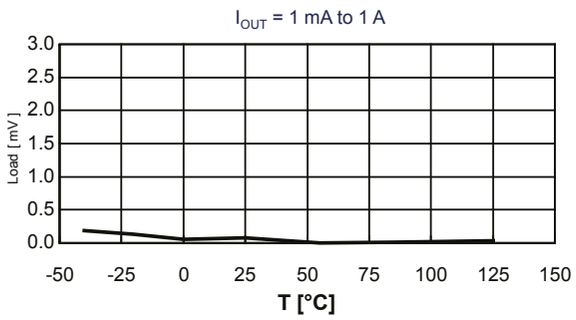



Figure 13. $I_{SENSE}$ vs temperature

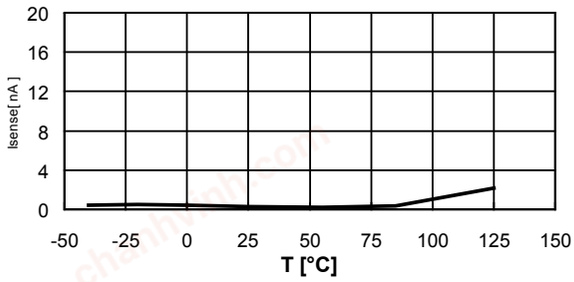



Figure 14. $I_{BIAS}$ vs temperature

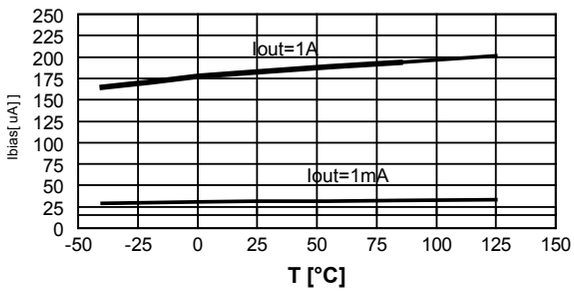



Figure 15. Enable high vs temperature ($V_{BIAS}$ min.)

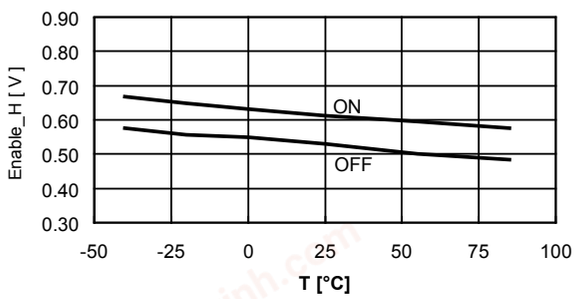



Figure 16. $I_{ENABLE}$ vs temperature

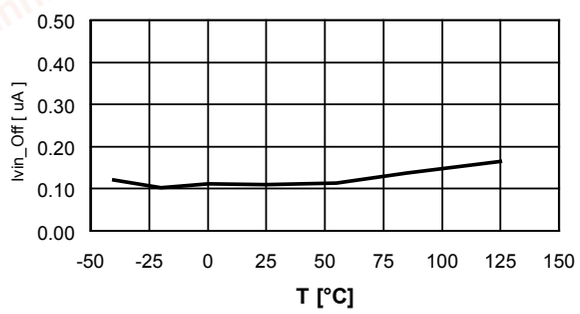
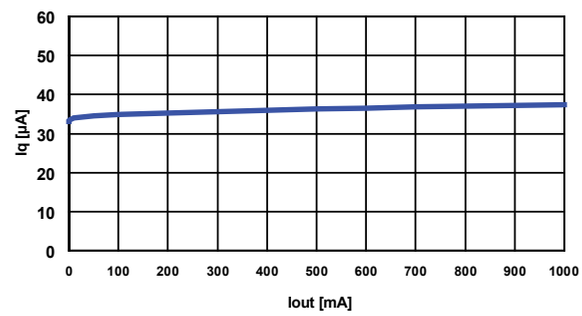



Figure 17. Ground pin current vs load current



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$V_{OUT}$ = 0.5 V, $C_{IN}$ = 4.7 µF, $C_{OUT}$ = 10 µF, $C_{BIAS}$ = 1 µF, $t_{rise/fall}$ = 5 µs

**Figure 18. Input voltage turn-on ($V_{IN}$= from 0 V to 0.8 V, $V_{BIAS}$=3 V, $V_{EN}$=0.8 V, $I_{OUT}$=1 A)**

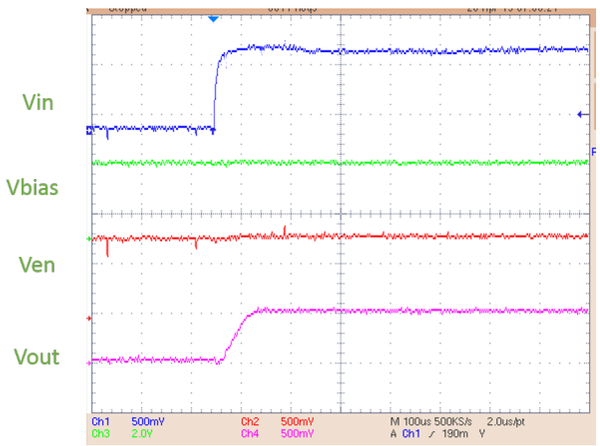



**Figure 19. Load transient ($V_{IN}$=0.8 V, $V_{BIAS}$=3 V, $V_{EN}$=1 V, $I_{OUT}$ from 1 mA to 1 A)**

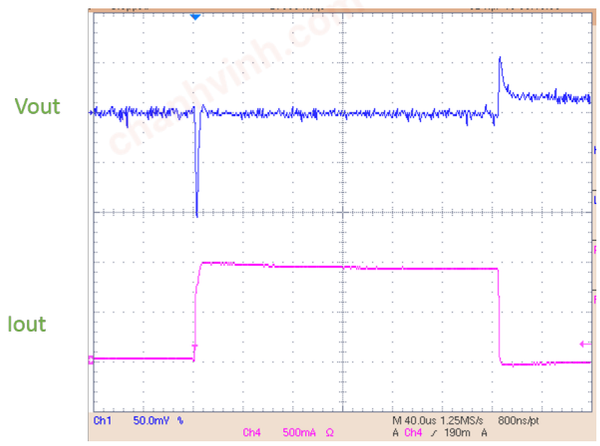



**Figure 20. Line transient vs input voltage ($V_{IN}$= from 0.8 V to 1.08 V, $V_{BIAS}$=3 V, $V_{EN}$=1 V, $I_{OUT}$ 100 mA)**

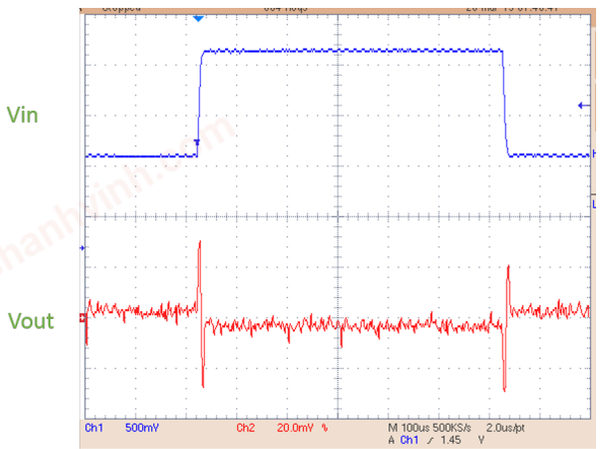



**Figure 21. Line transient vs BIAS voltage ($V_{IN}$=0.8 V to 1.08 V, $V_{BIAS}$= from 2.8 to 3.8 V, $V_{EN}$=1 V, $I_{OUT}$=100 mA)**

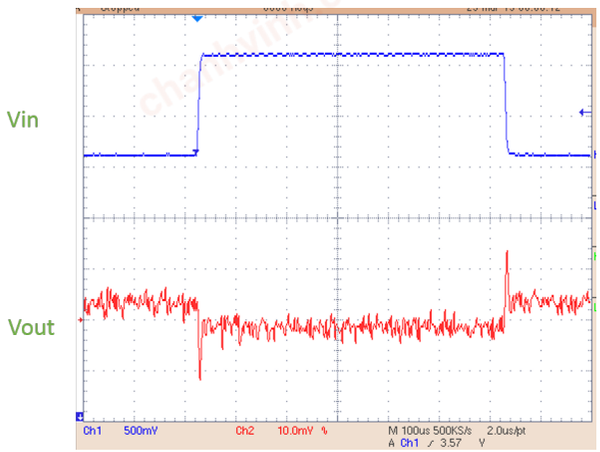



**Figure 22. $V_{BIAS}$ PSRR vs frequency**

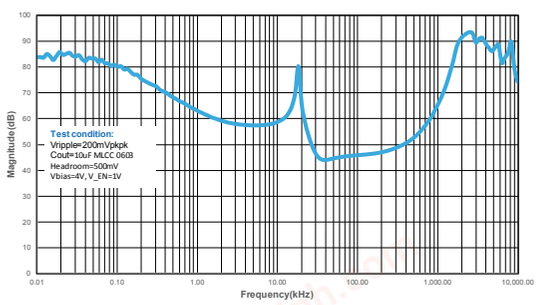
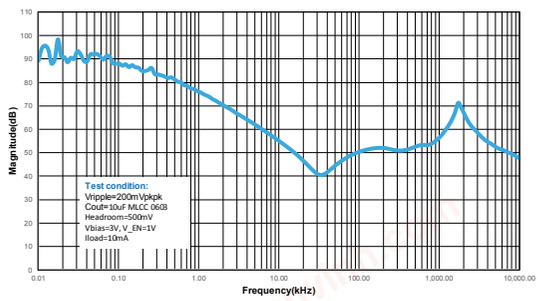



**Figure 23. $V_{IN}$ PSRR vs frequency**



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**Figure 24. Output voltage spectral noise density vs frequency ($V_{OUT}$= 1 V adj.)**

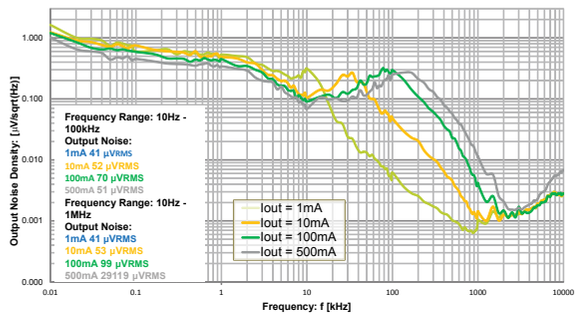



**Figure 25. Output voltage spectral noise density vs frequency**

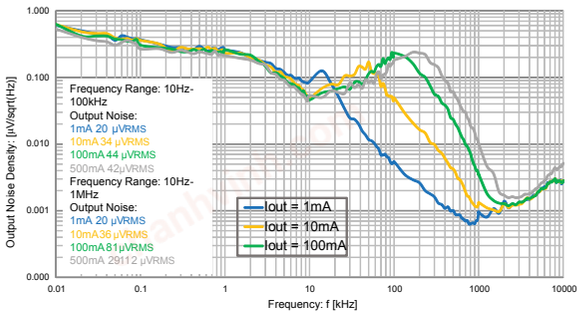
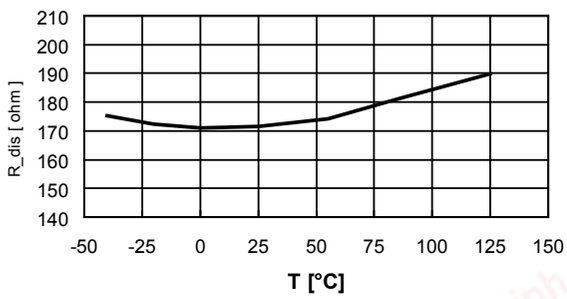



**Figure 26. Discharge_RMOS vs temperature**



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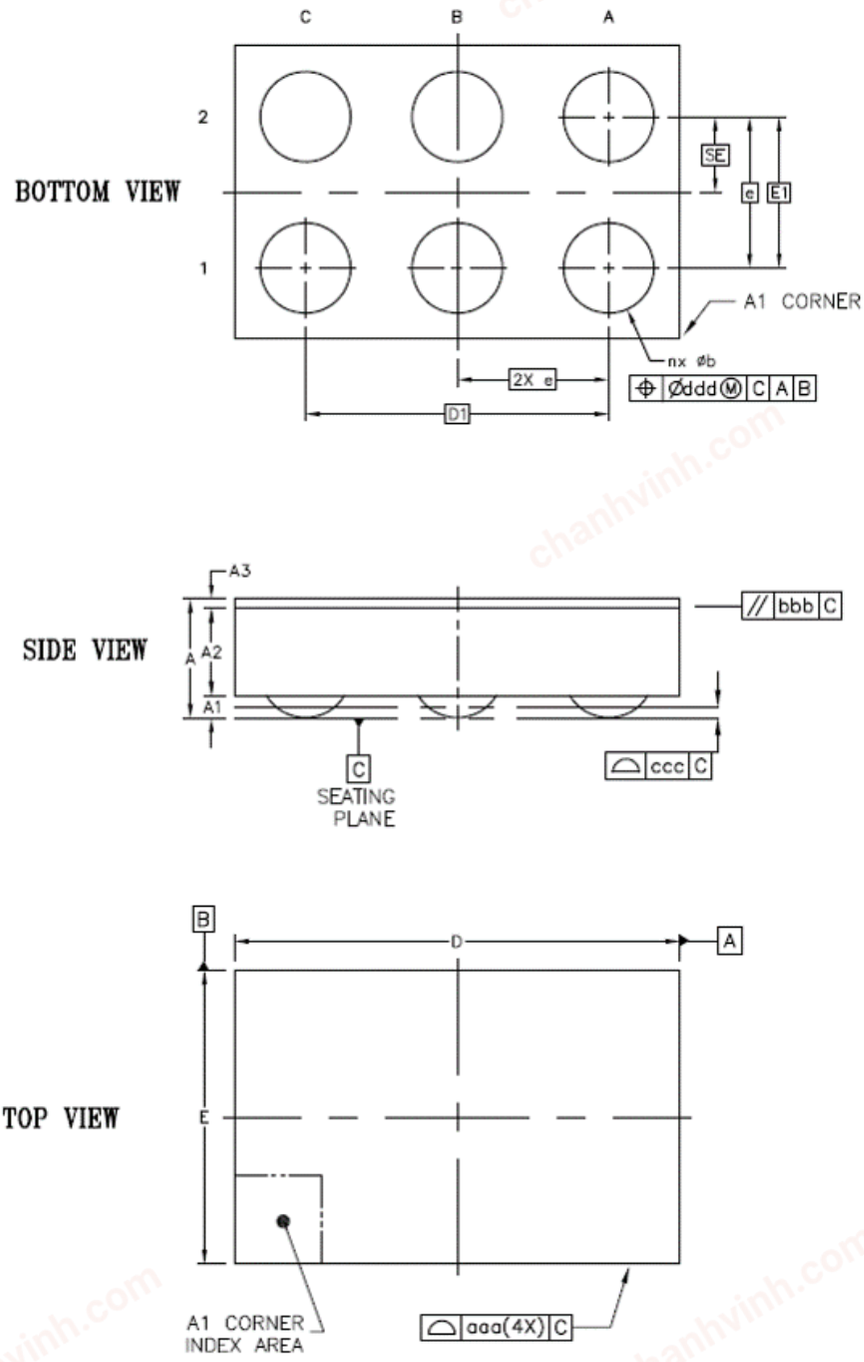


# 8 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK packages, depending on their level of environmental compliance. ECOPACK specifications, grade definitions and product status are available at: www.st.com. ECOPACK is an ST trademark.

## 8.1 Flip Chip6 (0.8x1.2 mm) package information

**Figure 27. Flip Chip6 (0.8x1.2 mm) package outline**



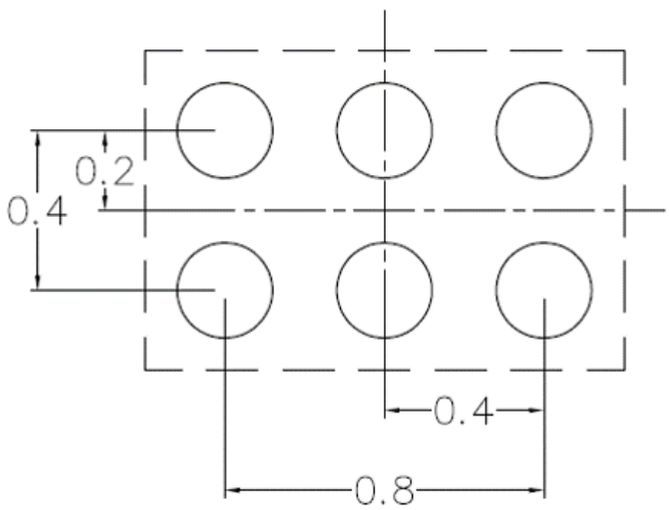
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Table 7. **Flip Chip6 (0.8x1.2 mm) package mechanical data**

| Symbol | Milimeters | | |
|---|---|---|---|
| | Min. | Typ. | Max. |
| A | 0.277 | 0.315 | 0.361 |
| A1 | 0.045 | 0.060 | 0.075 |
| A2 | 0.205 | 0.230 | 0.255 |
| A3 | 0.022 | 0.025 | 0.028 |
| b | 0.210 | 0.240 | 0.270 |
| D | 1.155 | 1.175 | 1.195 |
| E | 0.755 | 0.775 | 0.795 |
| D1 | 0.8 BSC | | |
| E1 | 0.4 BSC | | |
| e | 0.4 BSC | | |
| SE | 0.2 BSC | | |
| aaa | 0.03 | | |
| bbb | 0.06 | | |
| ccc | 0.03 | | |
| ddd | 0.015 | | |

Figure 28. **Flip Chip6 (0.8x1.2 mm) recommended footprint**

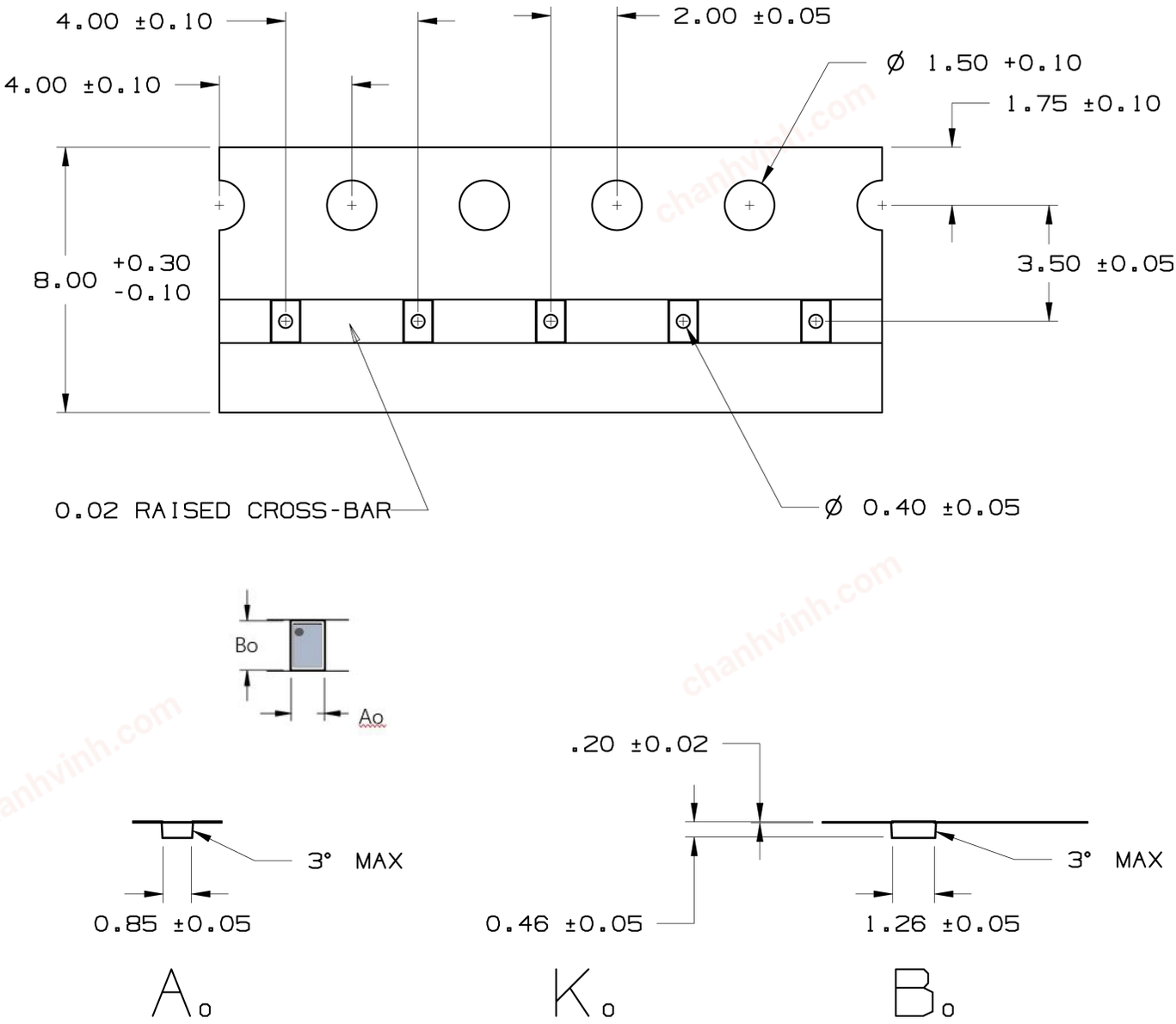


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## 8.2 Flip Chip6 (0.8x1.2 mm) packing information

Figure 29. **Flip Chip6 (0.8x1.2 mm) carrier tape outline**



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# 9 Ordering information

Table 8. **Order codes**

| Order code | $V_{OUT}$ | Marking |
|---|---|---|
| LD57100J100R | 1.00 V | JB |
| LD57100J105R | 1.05 V | JC |
| LD57100J800R | 0.8 V | JF |
| LD57100J110R | 1.10 V | JD |
| LD57100JR | Adjustable | JA |

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## Revision history

Table 9. **Document revision history**

| Date | Version | Changes |
|---|---|---|
| 30-Oct-2019 | 1 | Initial release. |
| 20-Dec-2019 | 2 | Updated Figure 2. Block diagram adjustable version, Figure 22. $V_{BIAS}$ PSRR vs frequency and Figure 23. $V_{IN}$ PSRR vs frequency .<br>Updated Table 3. Absolute maximum ratings and Table 6. Electrical characteristics. |
| 20-Jan-2020 | 3 | Updated Table 6. Electrical characteristics and Table 8. Order codes. |

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