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# **BCT2021**

## **70dB, 300mA, Fast Response Linear Regulators**

### **GENERAL DESCRIPTION**

The BCT2021 series are low power, High PSRR , Fast Response CMOS linear voltage regulators. The BCT2021 is optimized for wide variety of applications by supporting an input voltage range from 1.6V to 6V. This device features an internal soft-start to lower the inrush current which provides a controlled voltage to the load and minimizes the input voltage drop during start up.

Other features include a shutdown mode, current limit, Foldback current Limit and thermal shutdown protection.

The BCT2021 is available in Green SOT23-3 SOT23-5, SC70-5 and UTDFN1x1-4L packages. It operates over an ambient temperature range of -40°C to +85°C.

### **FEATURES**

- Excellent Load and Line Transient Response
- High PSRR(70dB at 1KHz)
- 300mA Output Current
- 35μA Ground Current at no Load
- 1.6V to 6V Input Voltage Range
- Fixed Output Voltage 1.0V, 1.2V, 1.8V, 2.5V, 2.8V, 3.0V, 3.3V
- Thermal-Overload Protection
- Quick\_discharge Function
- Undervoltage Lockout Function
- Output Current Limit
- Foldback Current Limit
- Soft start time 130us
- Available in Green SOT23-3 , SOT23-5 , SC70-5, UTDFN1x1-4L Packages

### **APPLICATIONS**

Cellular Telephones  
Cordless Telephones  
PCMCIA Cards  
Modems  
MP3 Player  
Hand-Held Instruments  
Portable/Battery-Powered Equipment

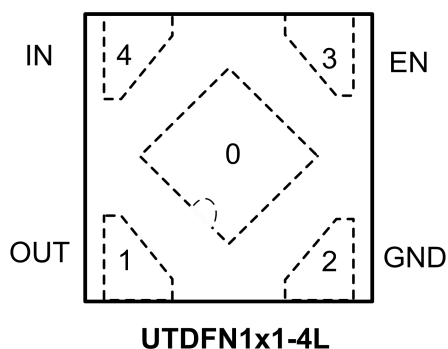
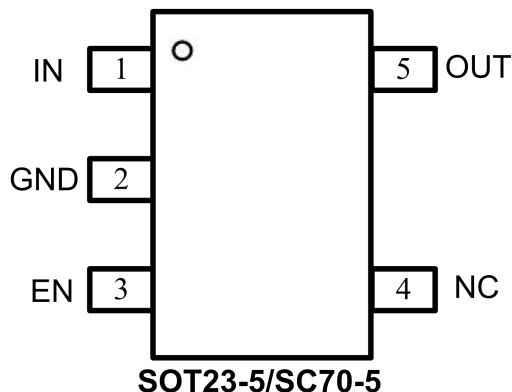
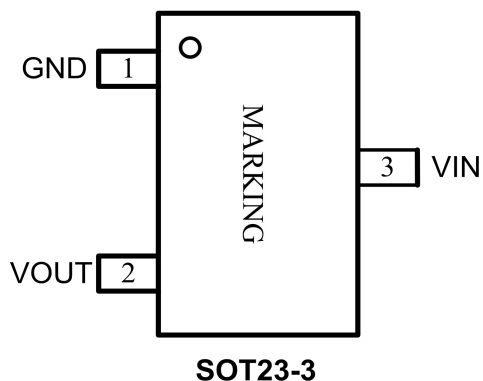
## ORDERING INFORMATION

| Order Number    | V <sub>OUT</sub> (V) | Package Type | Temperature Range | Marking | QTY/Reel |
|-----------------|----------------------|--------------|-------------------|---------|----------|
| BCT2021EUK10-TR | 1.0                  | SOT23-5      | -40°C to +85°C    | b0XX    | 3000     |
| BCT2021EUK12-TR | 1.2                  | SOT23-5      | -40°C to +85°C    | b2XX    | 3000     |
| BCT2021EUK18-TR | 1.8                  | SOT23-5      | -40°C to +85°C    | bKXX    | 3000     |
| BCT2021EUK25-TR | 2.5                  | SOT23-5      | -40°C to +85°C    | b5XX    | 3000     |
| BCT2021EUK28-TR | 2.8                  | SOT23-5      | -40°C to +85°C    | bKXX    | 3000     |
| BCT2021EUK30-TR | 3.0                  | SOT23-5      | -40°C to +85°C    | b0XX    | 3000     |
| BCT2021EUK33-TR | 3.3                  | SOT23-5      | -40°C to +85°C    | b3XX    | 3000     |
| BCT2021EUR10-TR | 1.0                  | SOT23-3      | -40°C to +85°C    | b0XX    | 3000     |
| BCT2021EUR12-TR | 1.2                  | SOT23-3      | -40°C to +85°C    | b2XX    | 3000     |
| BCT2021EUR18-TR | 1.8                  | SOT23-3      | -40°C to +85°C    | bKXX    | 3000     |
| BCT2021EUR25-TR | 2.5                  | SOT23-3      | -40°C to +85°C    | b5XX    | 3000     |
| BCT2021EUR28-TR | 2.8                  | SOT23-3      | -40°C to +85°C    | bKXX    | 3000     |
| BCT2021EUR30-TR | 3.0                  | SOT23-3      | -40°C to +85°C    | b0XX    | 3000     |
| BCT2021EUR33-TR | 3.3                  | SOT23-3      | -40°C to +85°C    | b3XX    | 3000     |
| BCT2021EXK10-TR | 1.0                  | SC70-5       | -40°C to +85°C    | b0XX    | 3000     |
| BCT2021EXK12-TR | 1.2                  | SC70-5       | -40°C to +85°C    | b2XX    | 3000     |
| BCT2021EXK18-TR | 1.8                  | SC70-5       | -40°C to +85°C    | bKXX    | 3000     |
| BCT2021EXK25-TR | 2.5                  | SC70-5       | -40°C to +85°C    | b5XX    | 3000     |
| BCT2021EXK28-TR | 2.8                  | SC70-5       | -40°C to +85°C    | bKXX    | 3000     |
| BCT2021EXK30-TR | 3.0                  | SC70-5       | -40°C to +85°C    | b0XX    | 3000     |
| BCT2021EXK33-TR | 3.3                  | SC70-5       | -40°C to +85°C    | b3XX    | 3000     |
| BCT2021ELS10-TR | 1.0                  | UTDFN1x1-4L  | -40°C to +85°C    | b0X     | 10000    |
| BCT2021ELS12-TR | 1.2                  | UTDFN1x1-4L  | -40°C to +85°C    | b2X     | 10000    |
| BCT2021ELS18-TR | 1.8                  | UTDFN1x1-4L  | -40°C to +85°C    | bKX     | 10000    |
| BCT2021ELS25-TR | 2.5                  | UTDFN1x1-4L  | -40°C to +85°C    | b5X     | 10000    |
| BCT2021ELS28-TR | 2.8                  | UTDFN1x1-4L  | -40°C to +85°C    | bKX     | 10000    |
| BCT2021ELS30-TR | 3.0                  | UTDFN1x1-4L  | -40°C to +85°C    | b0X     | 10000    |
| BCT2021ELS33-TR | 3.3                  | UTDFN1x1-4L  | -40°C to +85°C    | b3X     | 10000    |

Note: "b" in Marking is product short code for BCT2021.

"XX" or "X" in Marking will be appeared as the batch code.

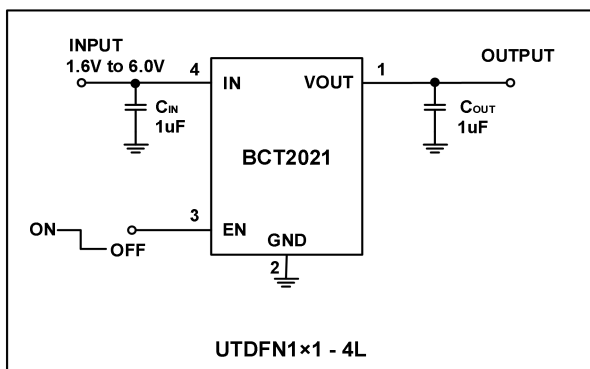
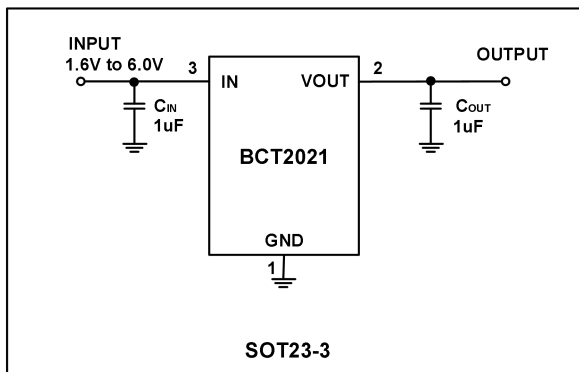
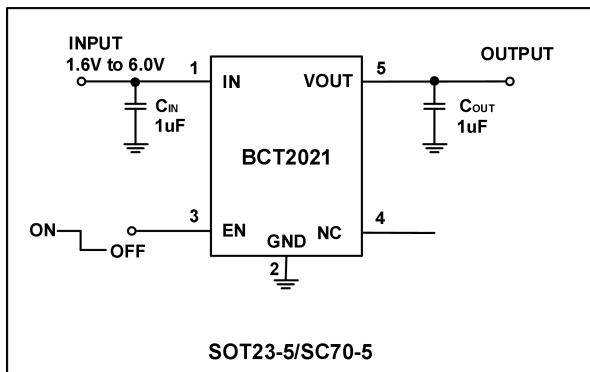
#### PIN CONFIGURATION (TOP VIEW)



#### PIN DESCRIPTION

| PIN     |                   |             | NAME        | FUNCTION                           |
|---------|-------------------|-------------|-------------|------------------------------------|
| SOT23-3 | SOT23-5<br>SC70-5 | UTDFN1x1-4L |             |                                    |
| 1       | 2                 | 2           | GND         | Ground.                            |
| 2       | 5                 | 1           | OUT         | Regulator Output.                  |
| 3       | 1                 | 4           | IN          | Input of Supply Voltage.           |
| -       | 3                 | 3           | EN          | Enable Control Input. Active high. |
| -       | 4                 | -           | NC          | No Connection                      |
| -       | -                 | 0           | Exposed Pad | Leave floating or tie to GND.      |

#### TYPICAL APPLICATION CIRCUIT





# BCT2021

## 70dB PSRR, 300mA

### Fast Response Linear Regulators

#### ABSOLUTE MAXIMUM RATINGS

|                                           |                |
|-------------------------------------------|----------------|
| VIN, EN, VOUT to GND.....                 | -0.3V to 6.0V  |
| Output Short-Circuit Duration.....        | Infinite       |
| Package Thermal Resistance                |                |
| SOT23-3, $\theta_{JA}$ .....              | 300°C/W        |
| SOT23-5, $\theta_{JA}$ .....              | 260°C/W        |
| SC70-5, $\theta_{JA}$ .....               | 330°C/W        |
| UTDFN1x1-4L, $\theta_{JA}$ .....          | 280°C/W        |
| Junction Temperature.....                 | 150°C          |
| Operating Temperature Range.....          | -40°C to +85°C |
| Storage Temperature Range.....            | -65°C to 150°C |
| Lead Temperature (Soldering, 10 sec)..... | 260°C          |
| ESD Susceptibility                        |                |
| HBM.....                                  | 4000V          |

#### RECOMMENDED OPERATING CONDITIONS

|                                   |                |
|-----------------------------------|----------------|
| Operating Voltage Range.....      | 1.6V to 6V     |
| Operating Temperature Range ..... | -40°C to +85°C |

#### OVERSTRESS CAUTION

Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

#### ESD SENSITIVITY CAUTION

This integrated circuit can be damaged by ESD if you don't pay attention to ESD protection. Broadchip recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

#### DISCLAIMER

Broadchip reserves the right to make any change in circuit design, specification or other related things if necessary without notice at any time. Please contact Broadchip sales office to get the latest datasheet.

## ELECTRICAL CHARACTERISTICS

( $V_{IN} = V_{OUT(NOMINAL)} + 1V$ , unless otherwise specified, Typical values are at = 25°C.)

| PARAMETER                              | SYM               | CONDITIONS                                   | MIN              | TYP  | MAX  | UNITS |
|----------------------------------------|-------------------|----------------------------------------------|------------------|------|------|-------|
| Input Voltage                          | $V_{IN}$          |                                              | 1.6              |      | 6.0  | V     |
| Output Voltage Accuracy <sup>(1)</sup> |                   | $I_{OUT}=30mA$                               | -2.0             |      | 2.0  | %     |
| Maximum Output Current                 |                   |                                              |                  | 300  |      | mA    |
| Current Limit                          | $I_{LIM}$         |                                              | 350              | 500  |      | mA    |
| Foldback Current Limit                 | $I_{short}$       | $V_{out}=0V$                                 |                  | 250  |      | mA    |
| Ground Pin Current                     | $I_Q$             | No load, $EN = V_{IN}$                       |                  | 35   | 60   | uA    |
| Dropout Voltage <sup>(2)</sup>         | $V_{DROP}$        | $I_{OUT}=300mA$                              | $V_{OUT} = 1.0V$ | 1050 | 1200 | mV    |
|                                        |                   |                                              | $V_{OUT} = 1.2V$ | 850  | 1000 |       |
|                                        |                   |                                              | $V_{OUT} = 1.5V$ | 720  | 850  |       |
|                                        |                   |                                              | $V_{OUT} = 1.8V$ | 550  | 700  |       |
|                                        |                   |                                              | $V_{OUT} = 2.5V$ | 380  | 530  |       |
|                                        |                   |                                              | $V_{OUT} = 3.0V$ | 350  | 500  |       |
|                                        |                   |                                              | $V_{OUT} = 3.3V$ | 330  | 450  |       |
| Line Regulation                        | $\Delta V_{LNR}$  | $V_{IN}=V_{OUT}+1V$ to 6V,<br>$I_{OUT}=30mA$ |                  |      | 0.12 | %/V   |
| Load Regulation                        | $\Delta V_{LDR}$  | $I_{OUT}=1mA$ to 300mA                       |                  | 20   |      | mV    |
| Power Supply Rejection Ratio           | PSRR              | $f=100Hz$ , $I_{LOAD}=30mA$                  |                  | 73   |      | dB    |
|                                        |                   | $f=1KHz$ , $I_{LOAD}=30mA$                   |                  | 70   |      | dB    |
| Undervoltage lockout                   | $V_{UVLO}$        | $V_{IN}$ rising                              | 0.66             | 0.82 | 0.98 | V     |
|                                        | $V_{UVLO\_HYST}$  | $V_{IN}$ falling                             |                  | 60   |      | mV    |
| Start-up time                          |                   |                                              |                  | 130  |      | us    |
| <b>SHUTDWON</b>                        |                   |                                              |                  |      |      |       |
| EN Input Threshold                     | $V_{IH}$          | $1.8V \leq V_{IN} \leq 6V$                   | 1.4              |      |      | V     |
|                                        | $V_{IL}$          | $1.8V \leq V_{IN} \leq 6V$                   |                  |      | 0.4  |       |
| EN Input Bias Current                  | $I_{IN}$          | $V_{EN}=3V$                                  |                  | 1    |      | uA    |
| Shutdown Supply Current                | $I_{Q(SHDN)}$     | $EN=0V$                                      |                  | 0    | 1    | uA    |
| <b>THERMAL PROTECTION</b>              |                   |                                              |                  |      |      |       |
| Thermal Shutdown Temperature           | $T_{SHDN}$        |                                              |                  | 150  |      | °C    |
| Thermal Shutdown Hysteresis            | $\Delta T_{SHDN}$ |                                              |                  | 30   |      | °C    |

NOTE:

1.  $V_{IN} = V_{OUT(NOMINAL)} + \text{Dropout or } 1.6V$ , whichever is greater.

2. The dropout voltage is defined as  $V_{IN} - V_{OUT}$ , when  $V_{OUT}$  is 100mV below the value of  $V_{OUT}$ .

REV1.7

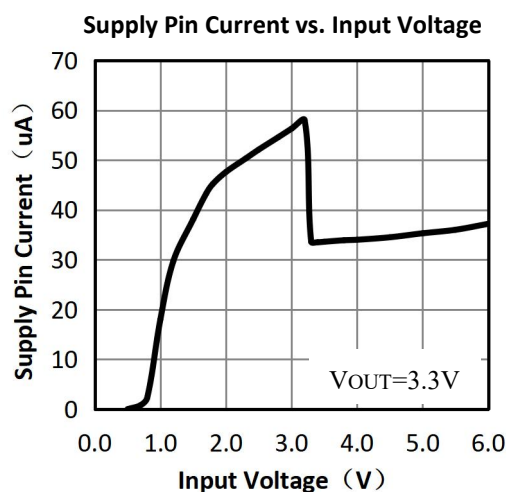
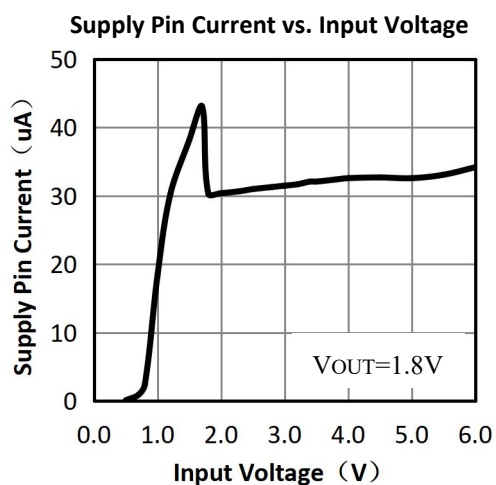
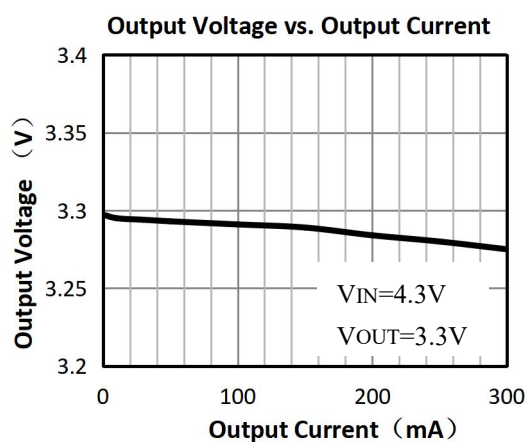
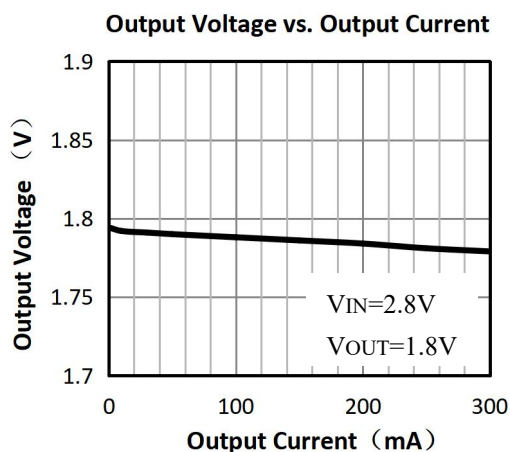
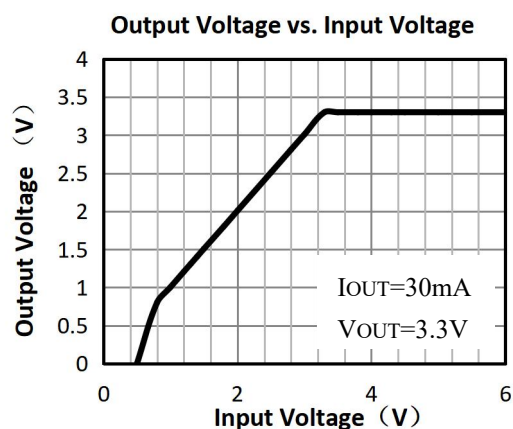
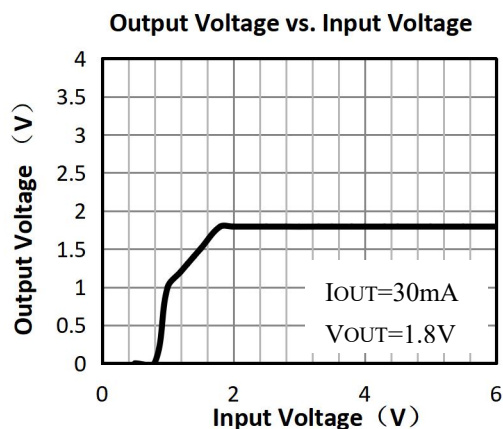
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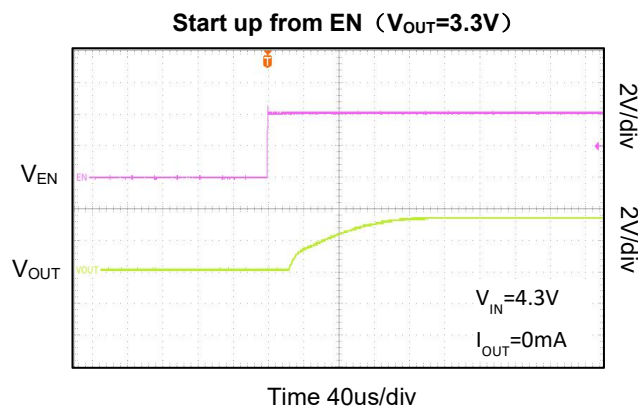
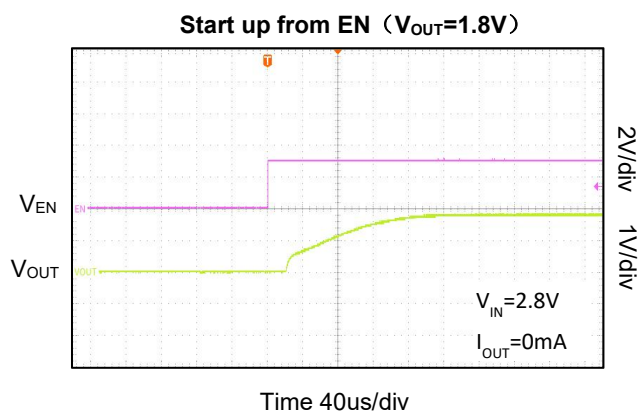
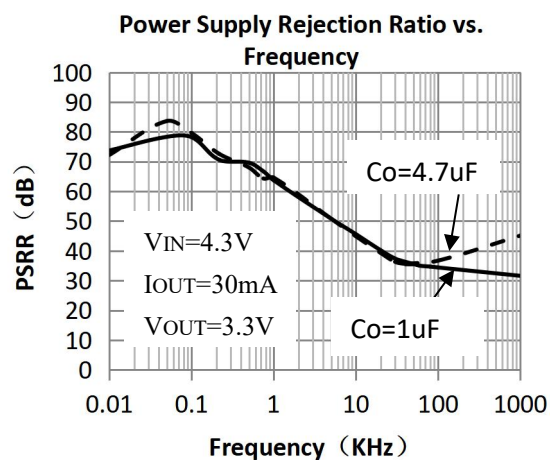
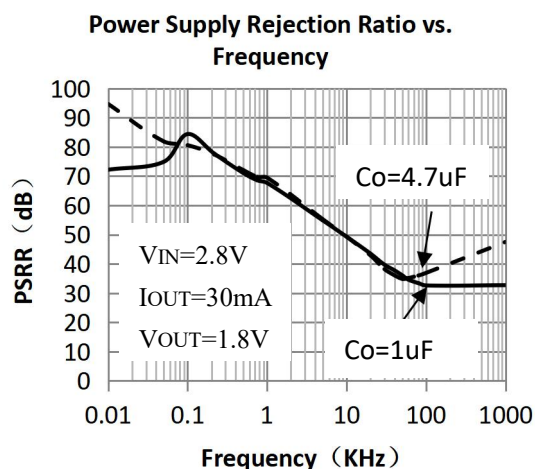
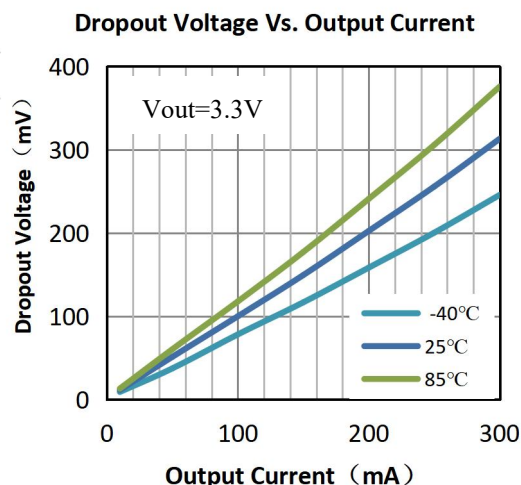
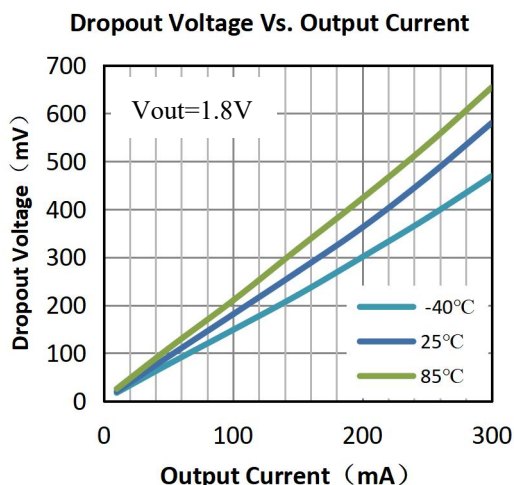
## TYPICAL PERFORMANCE CHARACTERISTICS

$V_{EN} = V_{IN}$ ,  $C_{IN} = 1\mu F$ ,  $C_{OUT} = 1\mu F$ ,  $T_A = +25^\circ C$ , unless otherwise noted.



## TYPICAL PERFORMANCE CHARACTERISTICS (continued)

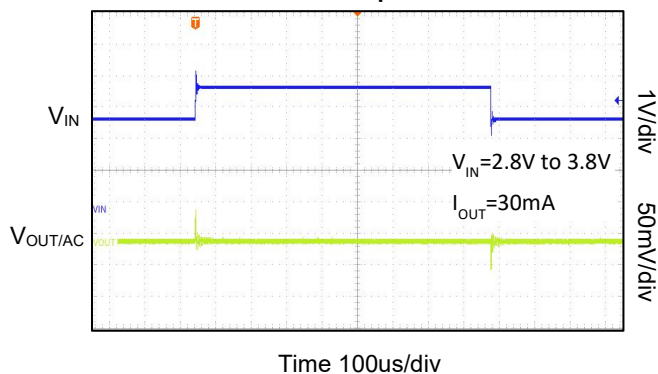
$V_{EN} = V_{IN}$ ,  $C_{IN} = 1\mu F$ ,  $C_{OUT} = 1\mu F$ ,  $T_A = +25^\circ C$ , unless otherwise noted



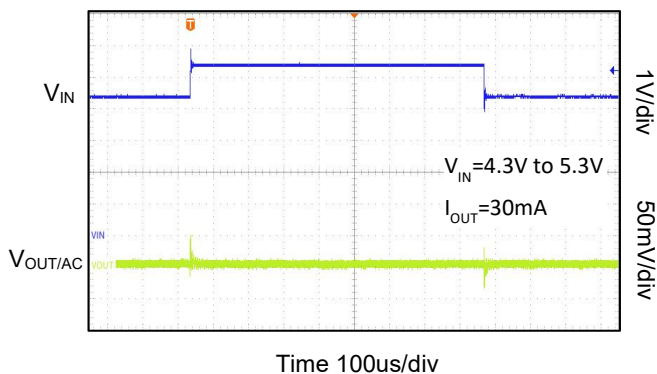
## TYPICAL PERFORMANCE CHARACTERISTICS (continued)

$V_{EN} = V_{IN}$ ,  $C_{IN} = 1\mu F$ ,  $C_{OUT} = 1\mu F$ ,  $T_A = +25^\circ C$ , unless otherwise noted.

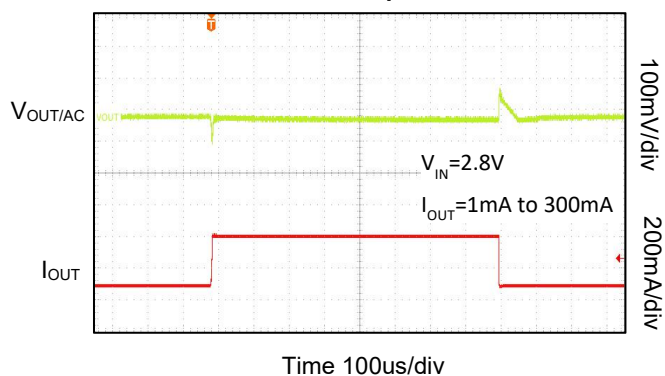
**Line Transient Response ( $V_{OUT}=1.8V$ )**



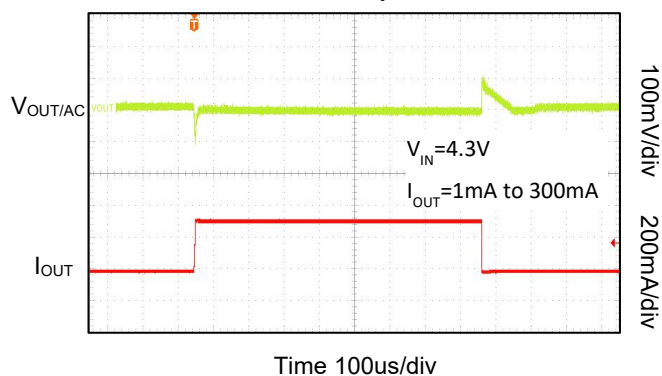
**Line Transient Response ( $V_{OUT}=3.3V$ )**



**Load Transient Response ( $V_{OUT}=1.8V$ )**



**Load Transient Response ( $V_{OUT}=3.3V$ )**



## Input and Output Capacitor Requirements

The external input and output capacitors of BCT2021 series must be properly selected for stability and performance. Use a 1μF or larger input capacitor and place it close to the IC's VIN and GND pins. Any output capacitor meeting the minimum 1mΩ ESR (Equivalent Series Resistance) and effective capacitance between 1μF and 22μF requirement may be used. Place the output capacitor close to the IC's VOUT and GND pins. Increasing capacitance and decreasing ESR can improve the circuit's PSRR and line transient response.

## Thermal Considerations

Thermal protection limits power dissipation in BCT2021. When the operation junction temperature exceeds 150°C, the OTP circuit starts the thermal shutdown function turn the pass element off. The pass element turns on again after the junction temperature cools by 30°C.

For continue operation, do not exceed absolute maximum operation junction temperature 150°C. The power dissipation definition in device is:

$$P_D = (V_{IN} - V_{OUT}) \times I_{OUT} + V_{IN} \times I_Q$$

The maximum power dissipation depends on the thermal resistance of IC package, PCB layout, the rate of surroundings airflow and temperature difference between junction to ambient. The maximum power dissipation can be calculated by following formula:

$$P_D(\text{MAX}) = (T_J(\text{MAX}) - T_A) / \theta_{JA}$$

Where  $T_J(\text{MAX})$  is the maximum operation junction temperature 150°C,  $T_A$  is the ambient temperature and the  $\theta_{JA}$  is the junction to ambient thermal resistance. For recommended operating conditions specification of BCT2021, where  $T_J(\text{MAX})$  is the maximum junction temperature of the die (150°C) and  $T_A$  is the maximum ambient temperature. The junction to ambient thermal resistance ( $\theta_{JA}$  is layout dependent) for SOT23-5 package is 260°C/W, on standard JEDEC 51-3 thermal test board. The maximum power dissipation at  $T_A = 25^\circ\text{C}$  can be calculated by following formula:

$$P_D(\text{MAX}) = (150^\circ\text{C} - 25^\circ\text{C}) / 260^\circ\text{C/W} = 0.48\text{W (SOT23-5)}$$

The maximum power dissipation depends on operating ambient temperature for fixed  $T_J(\text{MAX})$  and thermal resistance  $\theta_{JA}$ . It is also useful to calculate the junction of temperature of the BCT2021 under a set of specific conditions. In this example let the Input voltage  $V_{IN} = 3.3\text{V}$ , the output current  $I_O = 300\text{mA}$  and the case temperature  $T_A = 40^\circ\text{C}$  measured by a thermal couple during operation. The power dissipation for the  $V_O = 2.8\text{V}$  of the BCT2021 can be calculated as:

$$P_D = (3.3\text{V} - 2.8\text{V}) \times 300\text{mA} + 3.3\text{V} \times 35\mu\text{A} \approx 0.15\text{W}$$

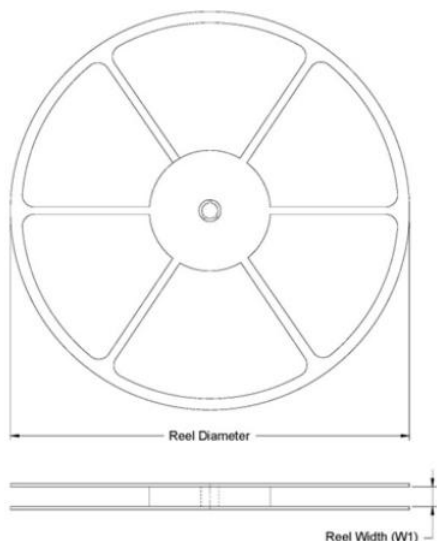
And the junction temperature,  $T_J$ , can be calculated as follows:

$$\begin{aligned} T_J &= T_A + P_D \times \theta_{JA} = 40^\circ\text{C} + 0.15\text{W} \times 260^\circ\text{C/W} \\ &= 40^\circ\text{C} + 39^\circ\text{C} = 79^\circ\text{C} < T_{J(\text{MAX})} = 150^\circ\text{C} \end{aligned}$$

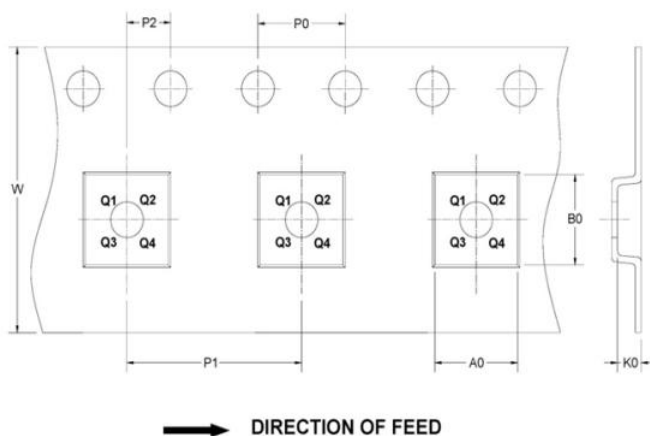
For this operating condition,  $T_J$  is lower than the absolute maximum operating junction temperature  $150^\circ\text{C}$ , so it is safe to use the BCT2021 in this configuration.

## TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



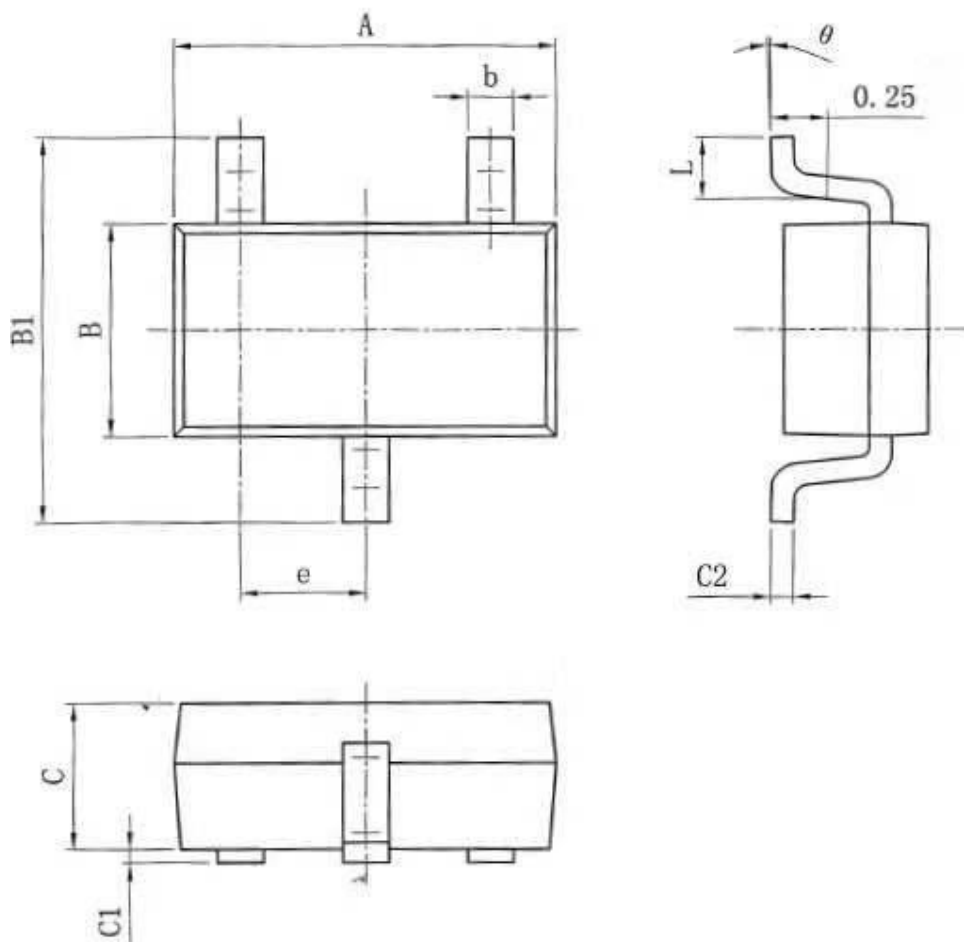
## KEY PARAMETER LIST OF TAPE AND REEL

| Device Name     | Package Type | Reel Diameter | Unit: mm      |      |      |      |    |    |    |   | Pin 1 Quadrant | Reel Q'ty |
|-----------------|--------------|---------------|---------------|------|------|------|----|----|----|---|----------------|-----------|
|                 |              |               | Reel Width W1 | A0   | B0   | K0   | P0 | P1 | P2 | W |                |           |
| BCT2021EUKXX-TR | SOT23-5      | 7"            | 9             | 3.25 | 3.3  | 1.38 | 4  | 4  | 2  | 8 | Q3             | 3000      |
| BCT2021ELSXX-TR | UTDFN1x1-4L  | 7"            | 9.5           | 1.16 | 1.16 | 0.5  | 4  | 2  | 2  | 8 | Q1             | 10000     |

Note: "XX" will be appeared as the Vout, XX=(10 / 12 / 18 / 25 / 28 / 30 / 33).

#### Package Outline Dimensions

SOT23-3

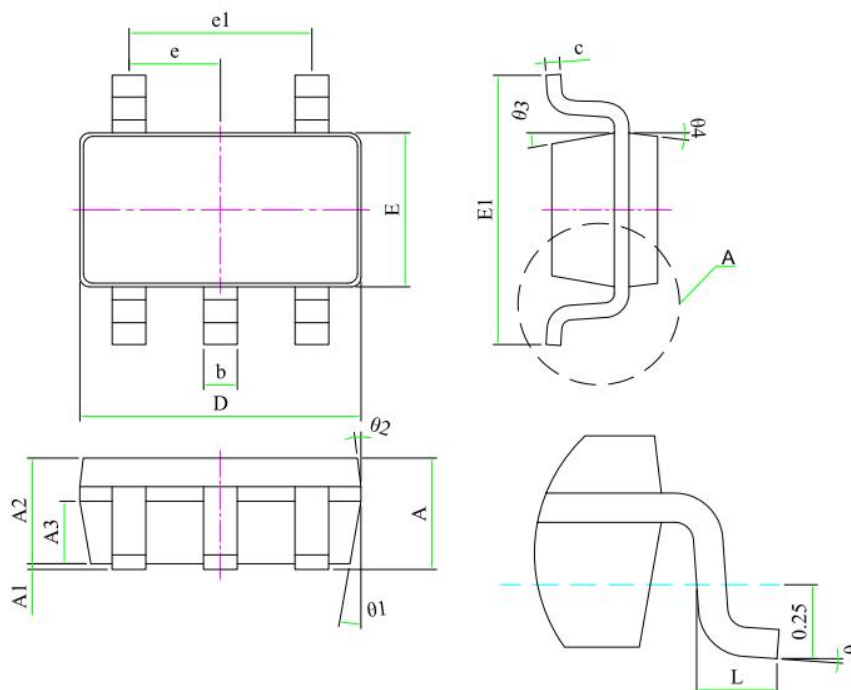


| Symbol | Dimensions In Millimeters |      |
|--------|---------------------------|------|
|        | Min                       | Max  |
| A      | 2.82                      | 3.02 |
| e      | 0.95(BSC)                 |      |
| b      | 0.28                      | 0.45 |
| B      | 1.50                      | 1.70 |
| B1     | 2.75                      | 3.05 |
| C      | 1.05                      | 1.15 |
| C1     | 0.03                      | 0.15 |
| C2     | 0.12                      | 0.23 |
| L      | 0.35                      | 0.55 |
| θ      | 0°                        | 8°   |

#### SOT23-3 Surface Mount Package

#### Package Outline Dimensions

SOT23-5

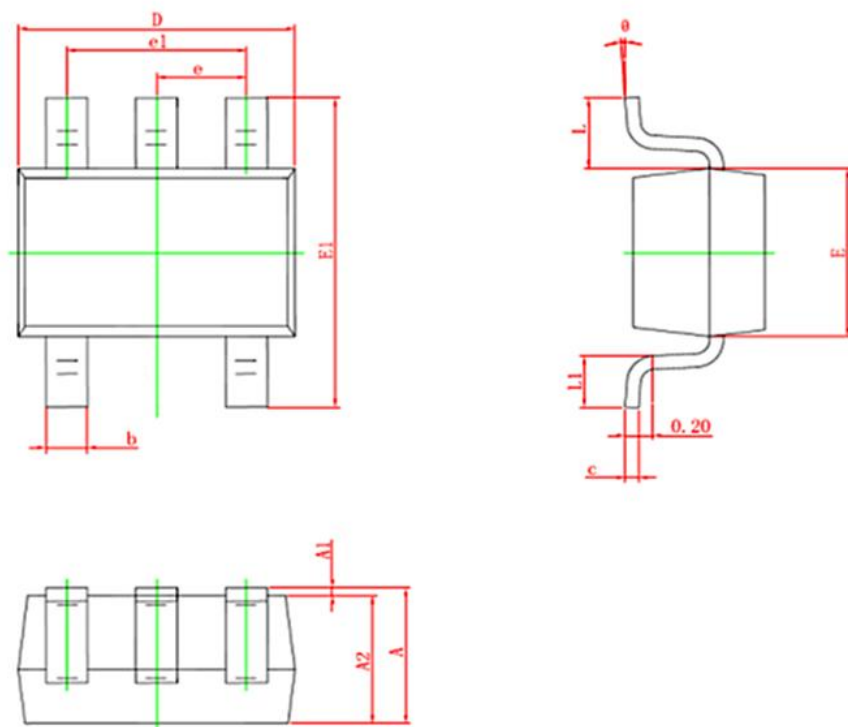


| Symbol | Dimensions In Millimeters |      |      |
|--------|---------------------------|------|------|
|        | Min                       | Nom  | Max  |
| A      | 1.05                      | 1.15 | 1.25 |
| A1     | 0.00                      | 0.05 | 0.10 |
| A2     | 1.05                      | 1.10 | 1.15 |
| A3     | 0.60                      | 0.65 | 0.70 |
| D      | 2.82                      | 2.92 | 3.02 |
| E      | 1.50                      | 1.60 | 1.70 |
| E1     | 2.65                      | 2.80 | 2.95 |
| L      | 0.30                      | 0.45 | 0.60 |
| b      | 0.28                      | 0.35 | 0.42 |
| c      | 0.10                      | 0.15 | 0.20 |
| e      | 0.95 (BSC)                |      |      |
| e1     | 1.80                      | 1.90 | 2.00 |
| θ      | 0°                        | —    | 8°   |
| θ1     | 10°                       | —    | 14°  |
| θ2     | 8°                        | —    | 12°  |
| θ3     | 10°                       | —    | 14°  |
| θ4     | 8°                        | —    | 12°  |

SOT23-5 Surface Mount Package

#### Package Outline Dimensions

##### SC70-5

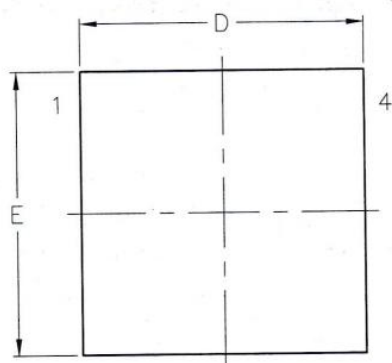


| Symbol | Dimensions In Millimeters |       |
|--------|---------------------------|-------|
|        | Min.                      | Max.  |
| A      | 0.900                     | 1.100 |
| A1     | 0.000                     | 0.100 |
| A2     | 0.900                     | 1.000 |
| b      | 0.150                     | 0.350 |
| c      | 0.110                     | 0.175 |
| D      | 2.000                     | 2.200 |
| E      | 1.150                     | 1.350 |
| E1     | 2.150                     | 2.450 |
| e      | 0.650 TYP.                |       |
| e1     | 1.200                     | 1.400 |
| L      | 0.525 REF.                |       |
| L1     | 0.260                     | 0.460 |
| θ      | 0°                        | 8°    |

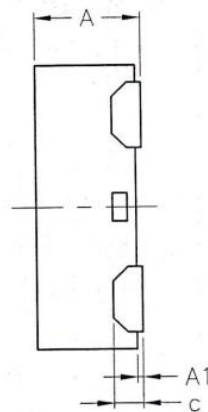
SC70-5 Surface Mount Package

## Package Outline Dimensions

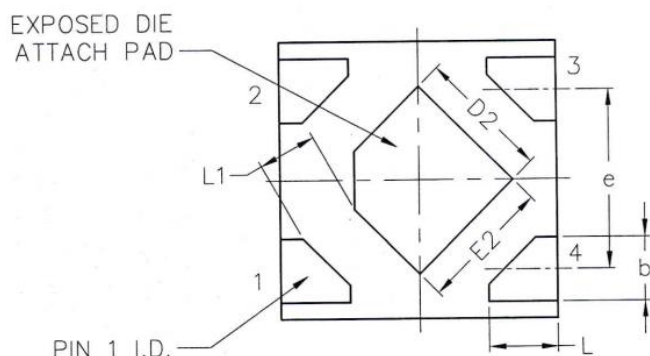
UTDFN1x1-4L



TOP VIEW



SIDE VIEW



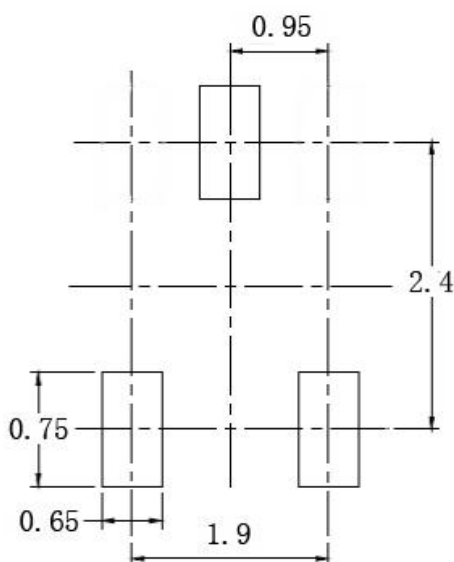
BOTTOM VIEW

| Symbol | Dimensions In Millimeters |       |       |
|--------|---------------------------|-------|-------|
|        | Min                       | Nom   | Max   |
| A      | 0.320                     | 0.370 | 0.410 |
| A1     | 0.000                     | 0.020 | 0.050 |
| A2     | 0.102 REF                 |       |       |
| D      | 0.950                     | 1.000 | 1.050 |
| D2     | 0.430                     | 0.480 | 0.530 |
| e      | 0.650 BSC                 |       |       |
| E      | 0.950                     | 1.000 | 1.050 |
| E2     | 0.430                     | 0.480 | 0.530 |
| L      | 0.200                     | 0.250 | 0.300 |
| L1     | 0.205 REF                 |       |       |

UTDFN1x1-4L Surface Mount Package

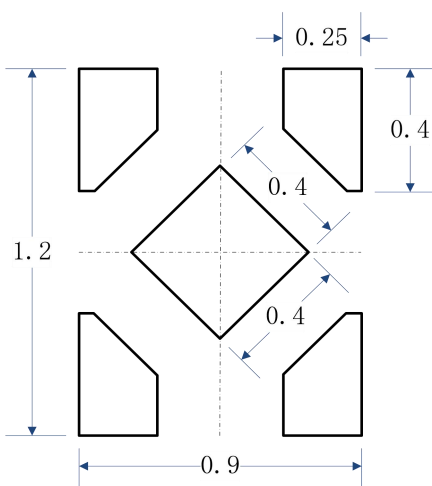
## LAND PATTERN DATA

SOT23-3



RECOMMENDED PCB LAYOUT PATTERN (Unit: mm)

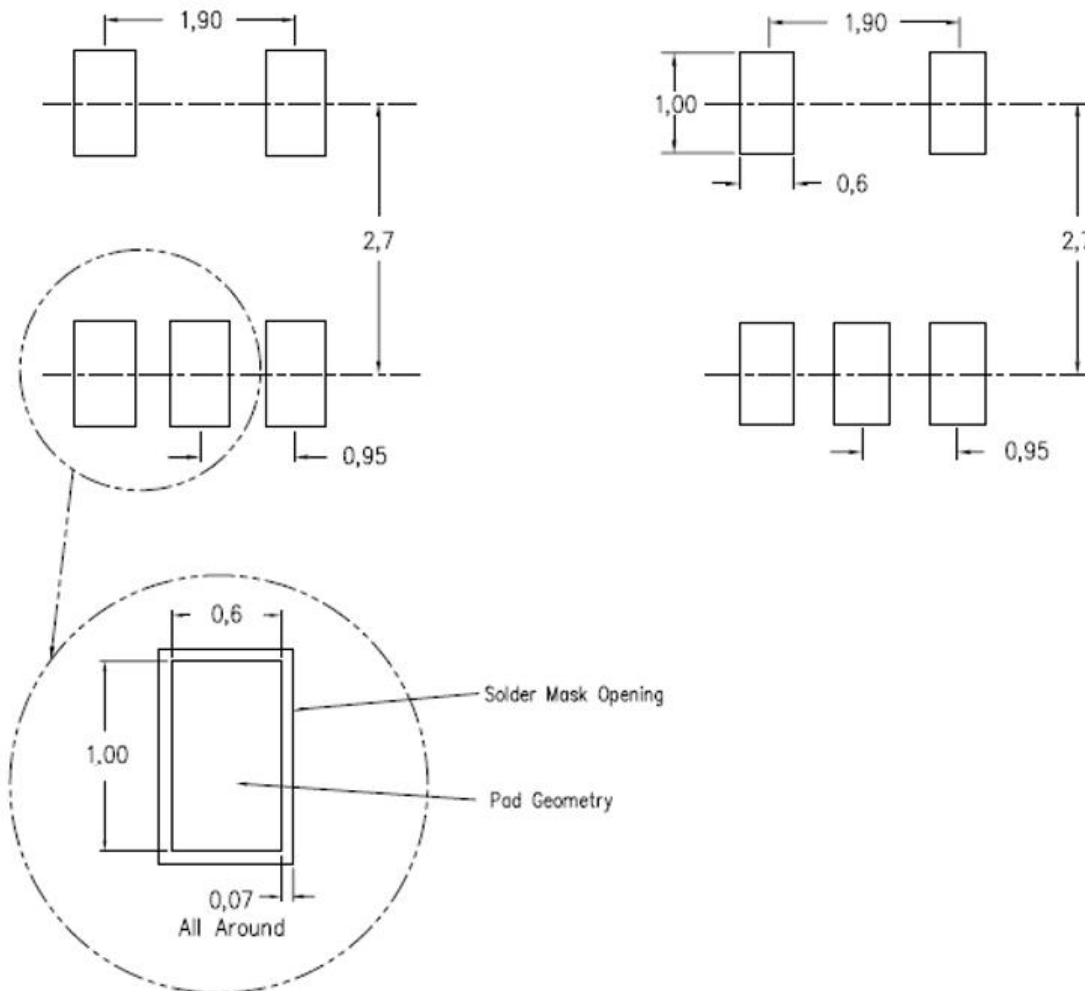
UTDFN1x1-4L



RECOMMENDED PCB LAYOUT PATTERN (Unit: mm)

## LAND PATTERN DATA

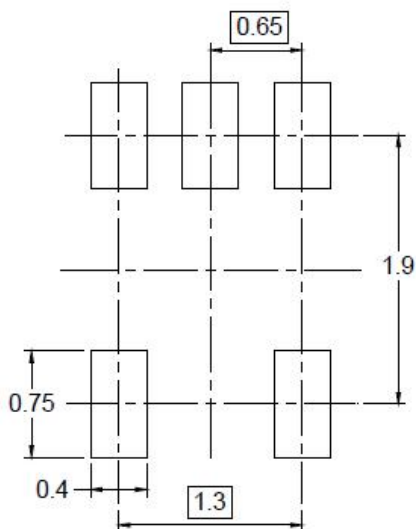
### SOT23-5



### RECOMMENDED PCB LAYOUT PATTERN (Unit: mm)

## LAND PATTERN DATA

SC70-5



**RECOMMENDED PCB LAYOUT PATTERN** (Unit: mm)