# AMC7110/1/3/4

## WHITE/BLUE LED DRIVER FOR LI-ION BATTERY APPLICATION

### DESCRIPTION

The AMC7110 series is member of ADDM North Star White/Blue LED driver family. No external component is required. Especially good for use Li-ion battery powered LCD display's backlight white LEDs. The special circuit design provides over 90% efficiency in low noise.

Target end applications are color LCD display, such as mobile phone with color display, smart phone, PDA, etc.

### APPLICATIONS

- Small Size Color LCD Backlights
- Mobile Phone, Smart Phone Keypad Backlights

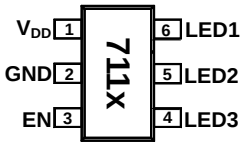
### FEATURES

- **LED sink current 20mA and 15mA**
- **Individual current sink circuit for all LEDs outputs to prevent short / open circuit on LEDs.**
- **PTC LED current for luminosity compensation.**
- **3 channels (SOT-26), 4 channels (MSOP-8) available.**
- **90% efficiency**
- **Supply voltage range 2.7V ~ 6V**
- **0.1uA standby current**
- **2KV HBM ESD protection**
- **Advanced Bi-CMOS process.**

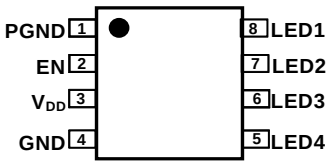
### OPTIONS

| Device Name | LED Sink Current | Channel Number |
|---|---|---|
| AMC7110 | 20mA | 3 |
| AMC7111 | 20mA | 4 |
| AMC7113 | 15mA | 3 |
| AMC7114 | 15mA | 4 |

### PACKAGE PIN OUT

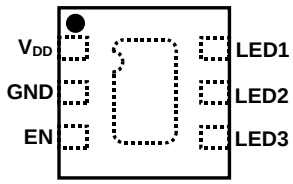



**AMC7110 / AMC7113**
**SOT-26**

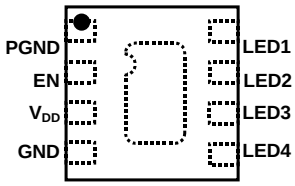



**AMC7111 / AMC7114**
**MSOP-8**

**AMC7110**
**TSOT-26**

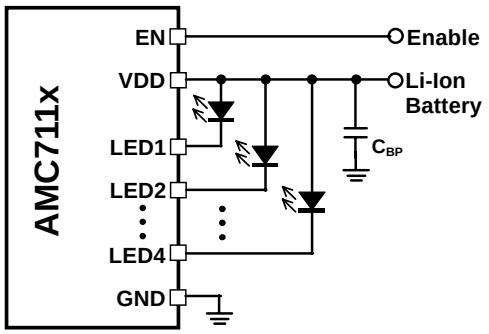



**AMC7110**
**QFN 2mmx2mm**




**AMC7111**
**QFN 2mmx2mm**

### TYPICAL APPLICATION CIRCUIT




### ORDER INFORMATION

| $I_{LED}$ (mA) | DB SOT-26 6-pin | DN MSOP-8 8-pin | DJ TSOT-26 6-pin | W QFN 2x2 6-pin | W QFN 2x2 8-pin |
|---|---|---|---|---|---|
| 18 ~ 22 | AMC7110DBF | AMC7111DNF | AMC7110DJ | AMC7110WF | AMC7111WF |
| 19 ~ 21 | AMC7110ADBF | AMC7111ADNF | - | - | - |
| 13.5 ~ 16.5 | AMC7113DBF | AMC7114DNF | - | - | - |

Note: Surface-mount packages is available in Tape & Reel. Append "T" to part number (i.e., AMC7111DNFT).
The letter "F" is marked for lead free process.

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## ABSOLUTE MAXIMUM RATINGS (Note)

| | |
|---|---|
| Input Voltage, $V_{DD}$ | -0.3V to 7V |
| Output Voltage, $V_{LEDn}$ | -0.3V to 7V |
| Voltage at all other pins | -0.3V to 5.5V |
| Maximum Junction Temperature, $T_J$ | 150°C |
| Storage Temperature Range | -40°C to 150°C |
| Lead Temperature (soldering, 10 seconds) | 260°C |

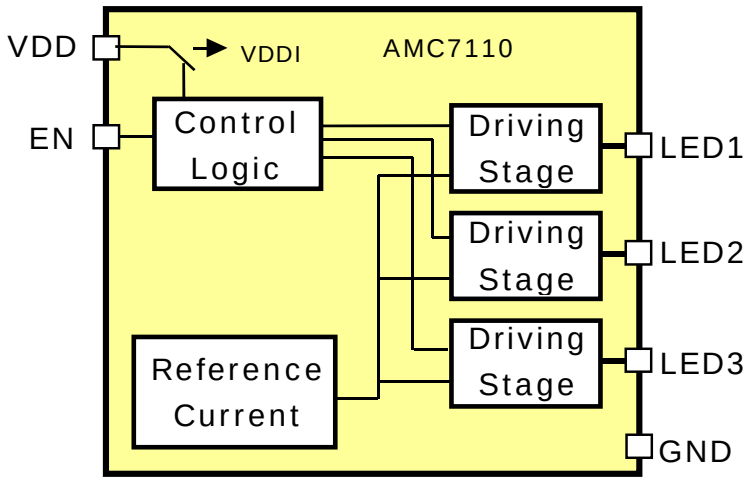
Note:
Exceeding these ratings could cause damage to the device. All voltages are with respect to Ground.
Currents are positive into, negative out of the specified terminal.

## POWER DISSIPATION TABLE

| Package | $\theta_{JA}$ ( °C/W ) | Derating factor ( mW/°C ) $T_A \geqq 25$°C | $T_A \leqq 25$°C Power rating (mW) | $T_A$=70°C Power rating (mW) | $T_A$= 85°C Power rating (mW) |
|---|---|---|---|---|---|
| DB | 220 | 4.5 | 568 | 363 | 295 |
| DJ | 220 | 4.5 | 568 | 363 | 295 |
| DN | 180 | 5.56 | 695 | 444 | 361 |
| W | 76.5 | 13.1 | 1634 | 1045 | 849 |

Note :
Junction Temperature Calculation: $T_J = T_A + (P_D \times \theta_{JA})$.
$P_D$: Power Dissipation, $T_A$: Ambient temperature, $\theta_{JA}$: Thermal Resistance-Junction to Ambient
The $\theta_{JA}$ numbers are guidelines for the thermal performance of the device/PC-board system.
All of the above assume no ambient airflow.

## BLOCK DIAGRAM



## PIN DESCRIPTION

| Pin Name | Pin Function |
|---|---|
| LED1 ~ LED3/4 | Output pins; connect to LED's cathode. |
| EN | Enable control pin. Pulling this pin high will enable the device. Pulling this pin to GND will disable the device. |
| $V_{DD}$ | Power supply |
| GND | Ground |
| PGND | Power ground |

## RECOMMENDED OPERATING CONDITIONS

| Parameter | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| Supply Voltage | $V_{DD}$ | 2.7 | | 6 | V |
| Output Sink current | $I_{LED}$ | | | 25 | mA |
| Operating free-air temperature range | Ta | -40 | | +85 | ℃ |

## ELECTRICAL CHARACTERISTICS

$V_{DD}$=3.7V, $T_A$=25°C, No Load, Input: $V_{IH}$=3.3V, $V_{IL}$=GND. (Unless otherwise noted)

| Parameter | Symbol | Condition | | Min | Typ | Max | Unit | Apply Pin |
|---|---|---|---|---|---|---|---|---|
| "Low" Input Voltage | $V_{IL}$ | | | | | 0.4 | V | EN |
| "High" Input Voltage | $V_{IH}$ | | | 1.7 | | | V | |
| "Low" Input Current | $I_{IL}$ | | | -5.0 | | +5.0 | µA | |
| "High" Input Current | $I_{IH}$ | | | -5.0 | | +5.0 | µA | |
| LED Dropout Voltage | $V_{LEDL}$ | AMC7110/1 | Note | | 75 | 90 | mV | LEDn |
| | | AMC7113/4 | Note | | 60 | 75 | | |
| LED Sink Current | $I_{LED}$ | AMC7110A<br>AMC7111A | $V_{DD}$=2.7V~6V<br>$V_{LEDn}$=0.15~3V | 19 | 20 | 21 | mA | |
| | | AMC7110/1 | $V_{LEDn}$=0.15~3V | 18 | 20 | 22 | | |
| | | | $V_{DD}$=2.7V~6V<br>$V_{LEDn}$=0.15~3V | 17 | 20 | 23 | | |
| | | AMC7113/4 | | 13.5 | 15 | 16.5 | | |
| LED Sink Current Deviation | $\triangle I_{LEDn}$ | AMC7110A | | | | ±3 | % | |
| | | | | | | ±5 | | |
| Supply Current | $I_{DD}$ | | | | 400 | 800 | uA | $V_{DD}$ |
| Standby Supply Current | $I_{DDSTBY}$ | | | | 0.1 | | uA | |

Note: LED Dropout Voltage: 90% × $I_{LEDn}$ @ $V_{LEDn}$=150mV

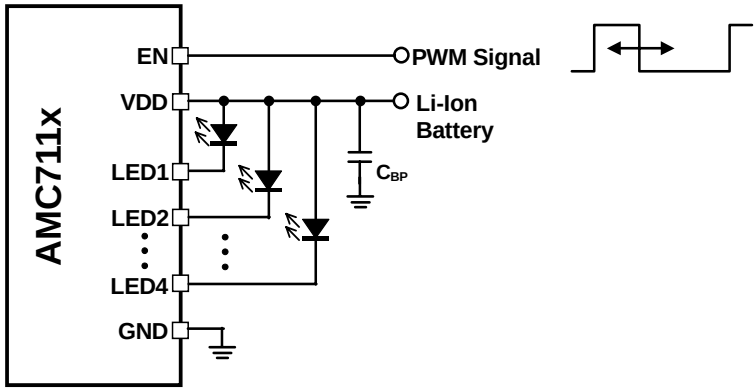
## APPLICATION INFORMATION

### Enable

The EN pin enables and disables the device. Pulling the EN pin high will enable the device beginning sink current on LED pins. Pulling the EN pin to ground will shutdown the device reducing the $I_{DD}$ current to typical 0.1uA. This pin should not be left floating and need to be terminated.

### LED Brightness Control

The LED sink current was fixed at 20mA or 15mA. Apply PWM signal to EN pin and control the duty that could control the LED brightness from 0% to maximum.




### Supply Voltage and Li-ion battery low warning

AMC711X works with supply voltage range from 2.7V to 6V. The white/blue LED forward voltage is in the range of 2.9V to 3.5V at 20mA current. The supply voltage range and LED forward voltage (Vf) should be set to fully ultilize Li-ion battery energy. For example, the maximum white LED forward voltage limit at 3.2V (@ 20mA) when Li-ion battery discharg reaches 3.275V( normally around 1% ~ 3% power left in the battery). When Li-ion battery voltage is lower than the presetted low level, the LED current(brightness) will start to decrease.

### Efficiency

The ACR (Advanced Current Regulator) architecture offers ultra low output dropout that significantly improves the efficiency compared to Inductive Boost type or Capacitor Charge Pump type LED driver. The system efficiency, defined as the ratio between the LEDs power and the input supplied power, is:

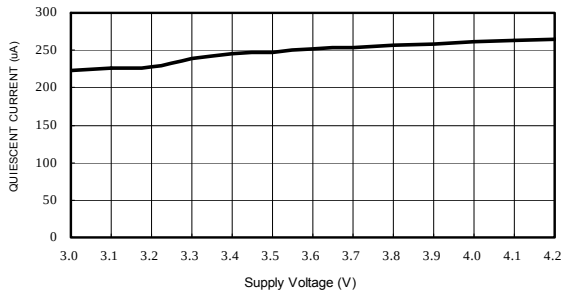
$$\text{Efficiency} = (Vf1 \times I_{LED}1 + Vf2 \times I_{LED}2 + Vf3 \times I_{LED}3 + Vf4 \times I_{LED}4) / (V_{DD} \times I_{DD})$$

Where, Vf is the forward voltage of LED.

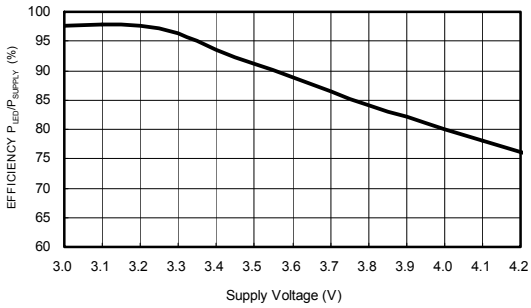
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## CHARACTERIZATION CURVES

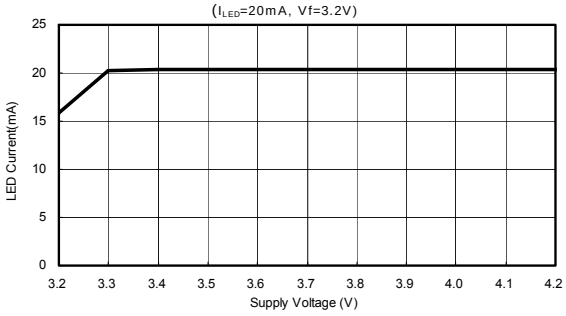
QUIESCENT CURRENT vs. SUPPLY VOLTAGE
( 4 LEDs, Vf=3.2V at 20mA/LED)



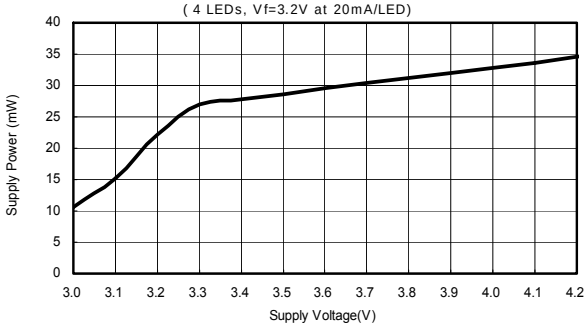

EFFICIENCY vs. SUPPLY VOLTAGE
( 4 LEDs, Vf=3.2V at 20mA/LED)



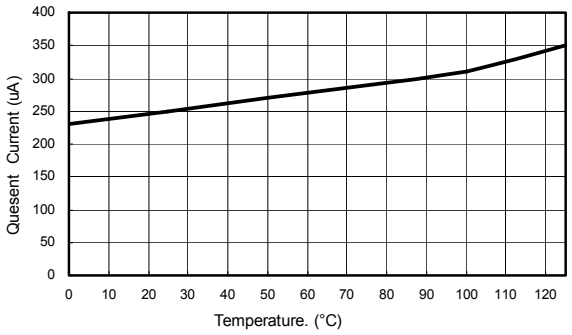

$I_{LED}$ vs. SUPPLY VOLTAGE
($I_{LED}$=20mA, Vf=3.2V)

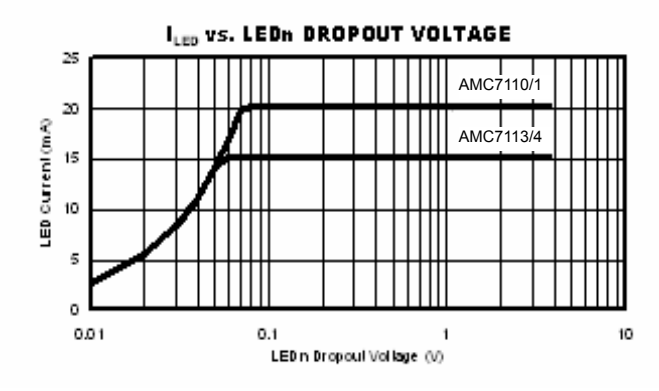



POWER IN vs. SUPPLY VOLTAGE
( 4 LEDs, Vf=3.2V at 20mA/LED)

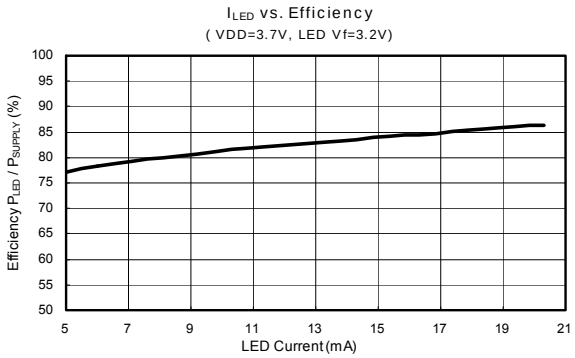


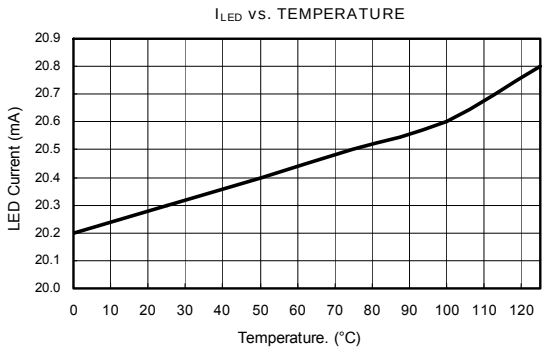

QUIESCENT CURRENT vs TEMPERATURE



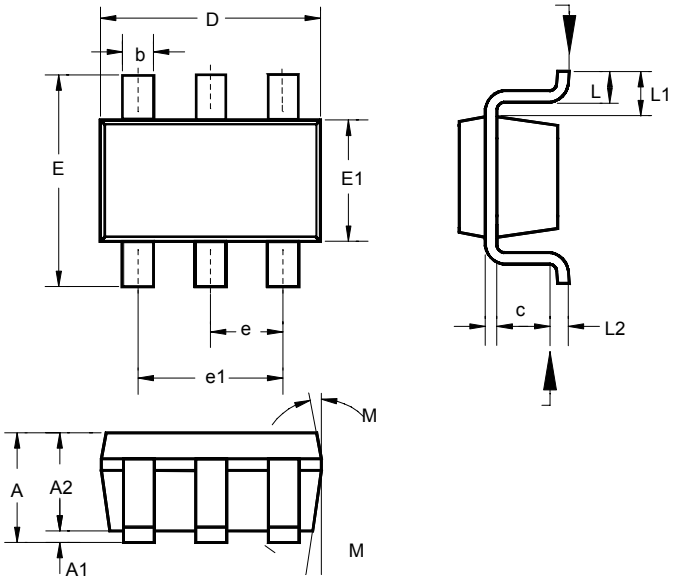

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$I_{LED}$ vs. Efficiency
( VDD=3.7V, LED Vf=3.2V)
Efficiency $P_{LED}$ / $P_{SUPPLY}$ (%)
100
95
90
85
80
75
70
65
60
55
50
5
7
9
11
13
15
17
19
21
LED Current (mA)


$I_{LED}$ vs. TEMPERATURE
LED Current (mA)
20.9
20.8
20.7
20.6
20.5
20.4
20.3
20.2
20.1
20.0
0
10
20
30
40
50
60
70
80
90
100
110
120
Temperature. (°C)

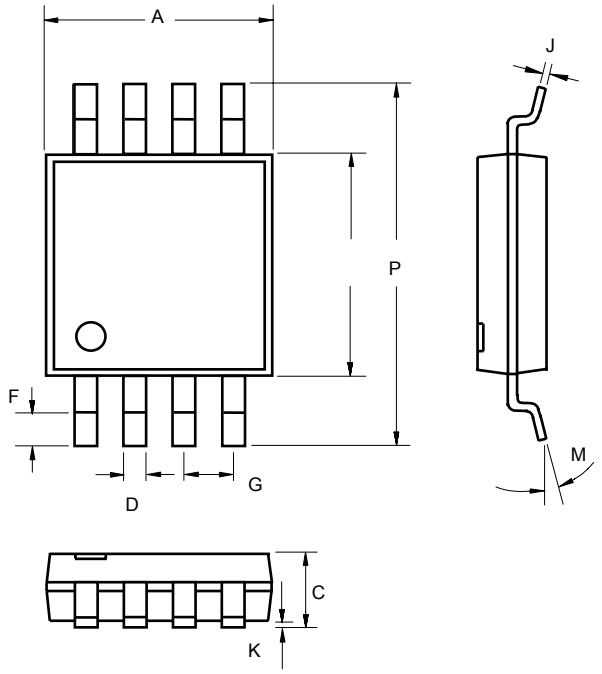
## PACKAGE

### Surface Mount SOT-26 (DB)



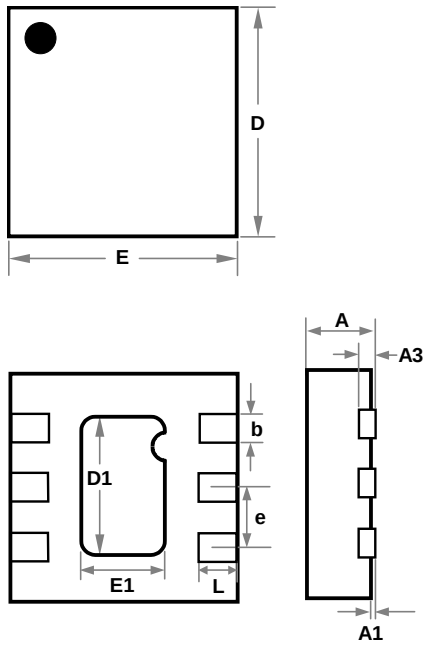

| | INCHES | | | MILLIMETERS | | |
|---|---|---|---|---|---|---|
| | MIN | TYP | MAX | MIN | TYP | MAX |
| A | - | - | 0.057 | - | - | 1.45 |
| A1 | - | - | 0.006 | - | - | 0.15 |
| A2 | 0.035 | 0.045 | 0.051 | 0.90 | 1.15 | 1.30 |
| b | 0.012 | - | 0.020 | 0.30 | - | 0.50 |
| c | 0.003 | - | 0.009 | 0.08 | - | 0.22 |
| D | 0.114 BSC | | | 2.90 BSC | | |
| E | 0.110 BSC | | | 2.80 BSC | | |
| E1 | 0.063`BSC | | | 1.60 BSC | | |
| e | 0.037 BSC | | | 0.95 BSC | | |
| e1 | 0.075BSC | | | 1.90 BSC | | |
| L | 0.012 | 0.018 | 0.024 | 0.30 | 0.45 | 0.60 |
| L1 | 0.024 REF | | | 0.60 REF | | |
| L2 | 0.010 BSC | | | 0.25 BSC | | |
| °M | 5° | 10° | 15° | 5° | 10° | 15° |

### 8-Pin Plastic MSOP (DN)




| | INCHES | | | MILLIMETERS | | |
|---|---|---|---|---|---|---|
| | MIN | TYP | MAX | MIN | TYP | MAX |
| A | 0.114 | 0.118 | 0.122 | 2.90 | 3.00 | 3.10 |
| B | 0.114 | 0.118 | 0.122 | 2.90 | 3.00 | 3.10 |
| C | | 0.040 | 0.044 | | 1.02 | 1.12 |
| D | | 0.012 | | | 0.30 | |
| F | 0.016 | 0.021 | 0.031 | 0.40 | 0.53 | 0.80 |
| G | - | 0.026 | - | - | 0.65 | - |
| J | | 0.006 | | | 0.15 | |
| K | 0.000 | - | 0.006 | 0.00 | - | 0.15 |
| M | 0º | - | 8º | 0º | - | 8º |
| P | 0.185 | 0.193 | 0.201 | 4.70 | 4.90 | 5.10 |

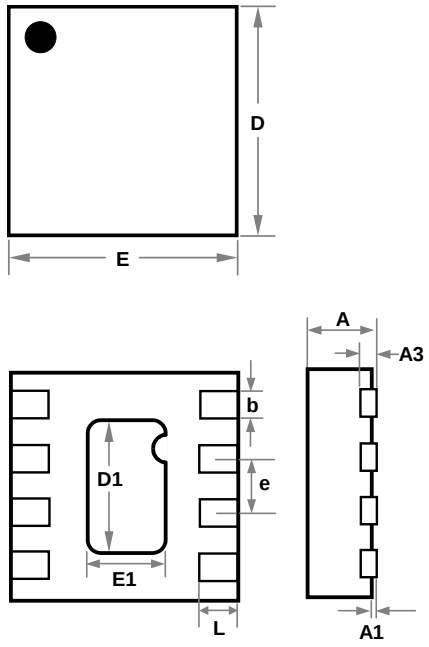
## 6-Pin QFN 2mm×2mm




| SYMBOLS | MIN. | TYP. | MAX. |
|---|---|---|---|
| A | 0.800 | 0.850 | 0.900 |
| A1 | 0.000 | - | 0.050 |
| A3 | - | 0.203 | - |
| b | 0.200 | 0.250 | 0.300 |
| D | 1.950 | 2.000 | 2.050 |
| D1 | 1.350 | 1.400 | 1.450 |
| E | 1.950 | 2.000 | 2.050 |
| E1 | 0.750 | 0.800 | 0.850 |
| e | | 0.650 | |
| L | 0.300 | 0.350 | 0.400 |

UNIT: MILLIMETERS

## 8-Pin QFN 2mm×2mm

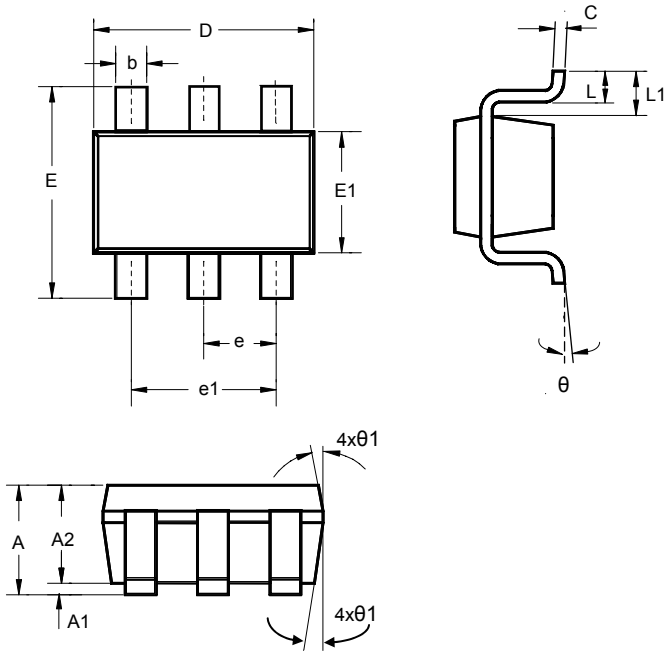



| SYMBOLS | MIN. | TYP. | MAX. |
|---|---|---|---|
| A | 0.800 | 0.850 | 0.900 |
| A1 | 0.000 | - | 0.050 |
| A3 | - | 0.203 | - |
| b | 0.200 | 0.250 | 0.300 |
| D | 1.950 | 2.000 | 2.050 |
| D1 | 1.150 | 1.200 | 1.250 |
| E | 1.950 | 2.000 | 2.050 |
| E1 | 0.550 | 0.600 | 0.650 |
| e | - | 0.500 | - |
| L | 0.300 | 0.350 | 0.400 |

UNIT: MILLIMETERS

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## Surface Mount TSOT-26




| SYMBOLS | MILLIMETERS | | |
|---|---|---|---|
| | MIN | TYP | MAX |
| A | --- | --- | 1.00 |
| A1 | 0.00 | 0.05 | 0.10 |
| A2 | 0.84 | 0.87 | 0.90 |
| b | 0.35 | 0.40 | 0.50 |
| C | 0.10 | 0.125 | 0.15 |
| D | 2.70 | 2.90 | 3.10 |
| E | 2.60 | 2.80 | 3.00 |
| E1 | 1.40 | 1.60 | 1.80 |
| e | --- | 0.95 | --- |
| e1 | --- | 1.90 | --- |
| L | 0.30 | 0.40 | 0.60 |
| L1 | 0.5 | 0.6 | 0.7 |
| θ | 0° | 4° | 8° |
| θ1 | 4° | 10° | 12° |

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