

AME7730

100mA Regulated Charge Pump

■ General Description

The AME7730 is a charge pump voltage doublers that delivers a regulated output. No external inductor is required for operation. Using three small capacitors, the AME7730 can deliver up to 100mA to the voltage regulated output. The AME7730 features very low output ripple and high efficiency over a large portion of its load range making this device ideal for battery-powered applications. Furthermore, the combination of few external components and small package size keeps the total converter board area to a minimum in space restricted applications.

The AME7730 contains a thermal management circuit to protect the device under continuous output short circuit conditions.

The AME7730 is available in SOT-26 / TSOT-26 package and is rated from -40°C to 85°C.

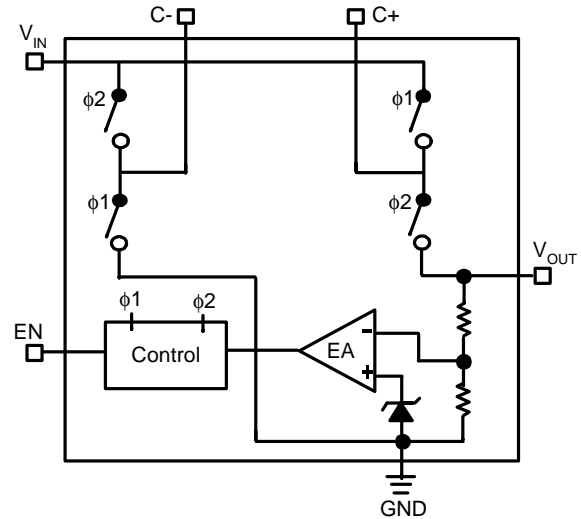
■ Features

- Input Voltage Range: 2.7V to 5V
- Accurate to with $\pm 4\%$
- Output Current: 100mA with $V_{IN} \geq 3.0V$
50mA with $V_{IN} \geq 2.7V$
- 1MHz Switching Frequency
- Shutdown Mode $< 1\mu A$
- Short Circuit Protection
- Over Temperature Protection
- All AME's Lead Free Product Meet RoHS Standards

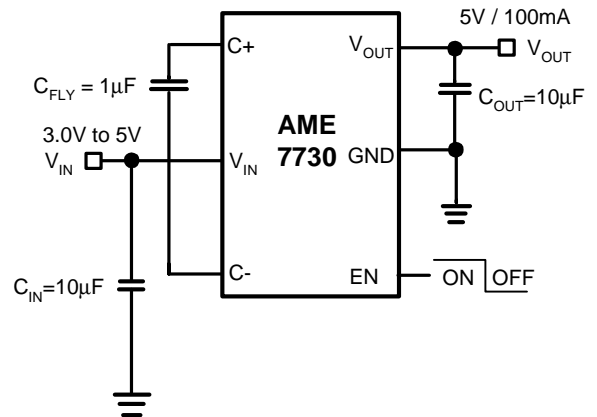
■ Applications

- Cellular Phones
- Digital Cameras
- PDAs LCD displays
- LED / Display Back Light Driver
- LEDs for Camera Flash

■ Functional Block Diagram

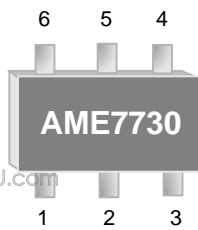


■ Typical Application



■ Pin Configuration

SOT-26 / TSOT-26
Front View



AME7730AEEY

1. OUT
2. GND
3. EN
4. C-
5. IN
6. C+

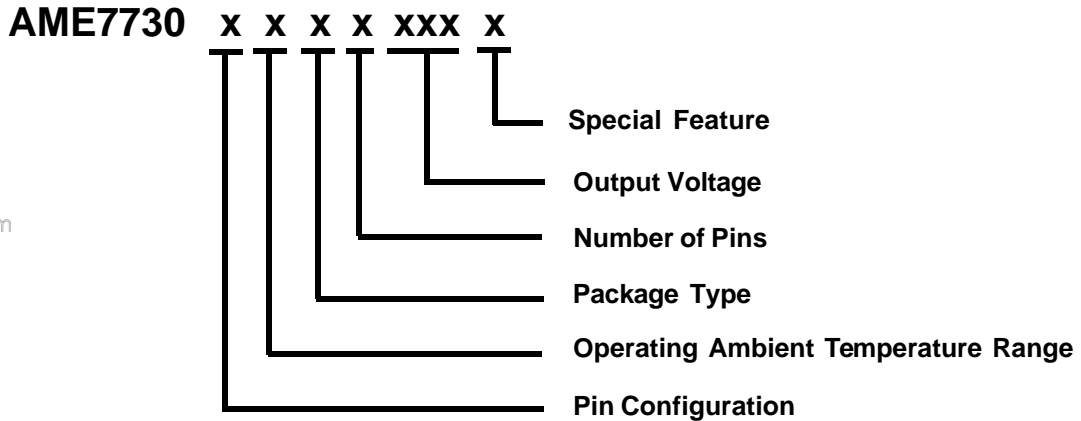
* Die Attach:
Conductive Epoxy

■ Pin Description

| Pin Number | Pin Name | Description |
|------------|----------|---|
| 1 | OUT | Regulator Output Pin. V_{OUT} should be bypassed with a 10 μ F low ESR ceramic capacitor |
| 2 | GND | Ground Pin Connection |
| 3 | EN | Enable Input. Active Low disable the regulator |
| 4 | C- | Pump Capacitor Negative Terminal |
| 5 | IN | Input Supply Pin. V_{IN} should be bypassed with a 10 μ F low ESR ceramic capacitor |
| 6 | C+ | Pump Capacitor Positive Terminal |



Ordering Information



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| Pin Configuration | Operating Ambient Temperature Range | Package Type | Number of Pins | Output Voltage | Special Feature |
|---|-------------------------------------|--------------|----------------|----------------|--|
| A 1. OUT (SOT-26) 2. GND (TSOT-26) 3. EN 4. C- 5. IN 6. C+ | E: -40°C to 85°C | E: SOT-2X | Y: 6 | 500: V = 5V | Z: Lead free Y: Lead free & Low profile |

Ordering Information

| Part Number | Marking* | Output Voltage | Package | Operating Ambient Temperature Range |
|-----------------|----------|----------------|---------|-------------------------------------|
| AME7730AEEY500Y | BCAww | 5V | TSOT-26 | - 40°C to 85°C |
| AME7730AEEY500Z | BCAww | 5V | SOT-26 | - 40°C to 85°C |

Note: ww represents date code and pls refer Date Code Rule on Package Dimension.

* A line on top of the first letter represents lead free plating such as BCA

Please consult AME sales office or authorized Rep./Distributor for the availability of output voltage and package type.



■ Absolute Maximum Ratings

| Parameter | Maximum | Unit |
|---------------------------------------|------------------------|------|
| Input Voltage, Output Voltage, C-, C+ | -0.3 to 5.5 | V |
| EN | -0.3 to $V_{IN} + 0.3$ | |
| ESD Classification | B* | |

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Note : Caution: Stress above the listed in absolute maximum ratings may cause permanent damage to the device.
* HBM B: 2000V ~ 3999V

■ Recommended Operating Conditions

| Parameter | Symbol | Rating | Unit |
|----------------------------|-----------|-------------|------|
| Ambient Temperature Range | T_A | - 40 to 85 | °C |
| Junction Temperature Range | T_J | - 40 to 125 | °C |
| Storage Temperature Range | T_{STG} | - 65 to 150 | °C |

■ Thermal Information

| Parameter | Package | Die Attach | Symbol | Maximum | Unit |
|---|-------------------|------------------|---------------|---------|------|
| Thermal Resistance* (Junction to Case) | SOT-26 TSOT-26 | Conductive Epoxy | θ_{JC} | 81 | °C/W |
| Thermal Resistance (Junction to Ambient) | | | θ_{JA} | 260 | |
| Internal Power Dissipation | | | P_D | 400 | mW |
| Solder Iron (10 Sec)** | | | | 350 | °C |

* Measure θ_{JC} on center of molding compound if IC has no tab.

** MIL-STD-202G 210F

■ Electrical Characteristics

$V_{IN} = V_{EN} = 3V$, $C_{pump} = 1\mu F$, $C_{IN} = 10\mu F$, $C_{OUT} = 10\mu F$, Typical values are at $T_A = 25^\circ C$, unless otherwise noted.

| Parameter | Symbol | Test Conditions | Min | Typ | Max | Units |
|-----------------------------|--------------|--|-----|------|-----|------------|
| Input Voltage | V_{IN} | $V_{OUT} = 5.0V$ | 2.7 | | 5 | V |
| Output Voltage | V_{OUT} | $I_{OUT} \leq 50mA$, $2.7V < V_{IN} < 5V$ | 4.8 | 5 | 5.2 | V |
| | | $I_{OUT} \leq 100mA$, $3.0V < V_{IN} < 5V$ | 4.8 | 5 | 5.2 | |
| Quiescent Current | I_Q | $2.7V < V_{IN} < 5V$, $I_{OUT} = 0mA$, $V_{EN} = V_{IN}$ | | 60 | 100 | μA |
| Shutdown Current | I_{SHDN} | $2.7V < V_{IN} < 3.6V$, $I_{OUT} = 0mA$, $V_{EN} = 0$ | | 0.01 | 1 | μA |
| | | $3.6V < V_{IN} < 5V$, $I_{OUT} = 0mA$, $V_{EN} = 0$ | | | 2.5 | |
| Short Circuit Current Limit | I_{SC} | $V_{IN} = V_{EN} = 3V$, $V_{OUT} = GND$ | | 300 | | mA |
| Ripple Voltage ¹ | V_{RIPPLE} | $V_{IN} = 2.7V$, $I_{OUT} = 50mA$, $V_{OUT} = 5V$ | | 25 | | mVp-p |
| | | $V_{IN} = 3V$, $I_{OUT} = 100mA$, $V_{OUT} = 5V$ | | 30 | | |
| Efficiency | η | $V_{IN} = 2.7V$, $I_{OUT} = 50mA$, $V_{OUT} = 5V$ | | 90 | | % |
| Frequency | f_{OSC} | Oscillator Free Running | | 1.0 | | MHz |
| EN Input Threshold High | V_{EH} | | 1.3 | | | V |
| EN Input Threshold Low | V_{EL} | | | | 0.6 | V |
| EN Input Current | I_{EN} | $V_{EN} = V_{IN}$, $V_{EN} = GND$ | | | 0.1 | μA |
| Over Temperature Shutdown | OTS | | | 160 | | $^\circ C$ |
| Over Temperature Hysteresis | OTH | | | 20 | | $^\circ C$ |

Note 1: Effective series resistance (ESR) of capacitors is $< 0.1\Omega$.



AME7730

100mA Regulated Chrg Pump

■ Detailed Description

The AME7730 uses charge pump voltage doubler structure to boost an input voltage to a regulated output voltage. Regulation is achieved by detecting the charge pump output voltage through an internal resistor divider network. A charge pump circuit is enabled when the divided output voltage below a preset trip point controlled by an internal comparator.

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■ Short Circuit and Thermal Protection

The AME7730 has a thermal protection and shutdown circuit that continuously monitors the IC junction temperature. If the thermal protection circuit senses the die temperature exceeding approximately 160°C, the thermal shutdown will disable the charge pump switching cycle operation, the thermal limit system has 20°C of system hysteresis before the charge pump can reset. Once the over current event is removed from the output and the junction temperature drops below 140°C, the charge pump will become active again. The thermal protection system will cycle on and off if an output short circuit condition persists. This will allow the AME7730 to operate indefinitely a short circuit condition with out damage to the device.

■ Shutdown Mode

A control pin EN on the regulator can be used to place the device into an energy-saving shutdown mode. In this mode, the output is disconnected from the input as long as V_{IN} is greater than or equal to minimum V_{IN} and input quiescent current is reduced to 1µA maximum.

■ Capacitor Selection

For minimum output voltage ripple, the output capacitor C_{OUT} should be a ceramic, surface-mount type. Tantalum capacitors generally have a higher Effective Series Resistance (ESR) and may contribute to higher output voltage ripple. Leaded capacitors also increase ripple due to the higher inductance of the package itself. To achieve best operation with low input voltage and high load current, the input and pump capacitors (C_{IN} , C_{PUMP} respectively) should also be surface-mount ceramic types. In all cases, X7R or X5R dielectric are recommended.

With high loads or higher input voltage, a smaller 0.1µF pump capacitor (C_{PUMP}) and smaller 1µF input and output capacitor (C_{IN} and C_{OUT} respectively) can be used. To minimize output voltage ripple, increase the output capacitor C_{OUT} to 10µF or larger.

■ Efficiency

The efficiency of the charge pump regulator depends on the applied input voltage, the load current, and the internal operation mode of the device.

The approximate efficiency is given by:

$$\text{Efficiency (\%)} = V_{OUT} / 2V_{IN} \cdot 100 \%$$

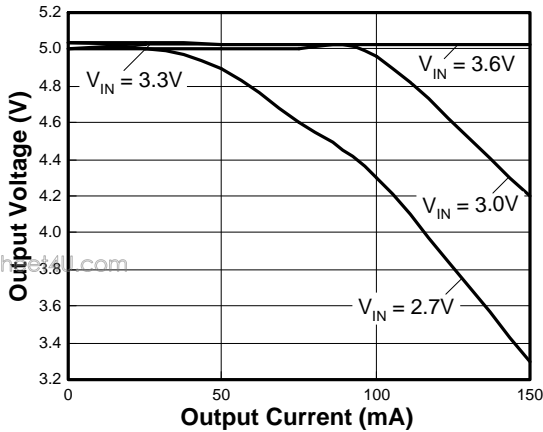
■ Layout

Large ripple currents flow in the V_{IN} and V_{OUT} traces. To minimize both input and output ripple, keep the capacitors as close as possible to the regulator using short, direct circuit traces.

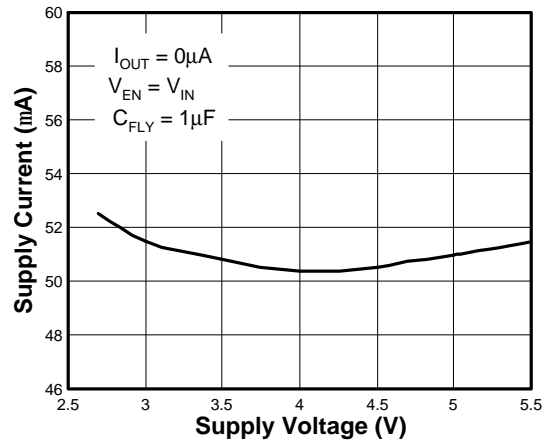
The trace lengths from the input and output capacitors have been kept as short as possible. A star ground system has been implemented, with GND pin as the center of the star. No ground plane is provided in other layers as this will provide capacitive coupling for noise spikes.



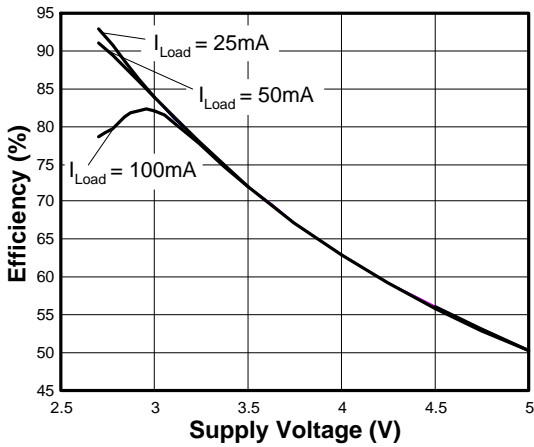
Output Voltage vs. Output Current



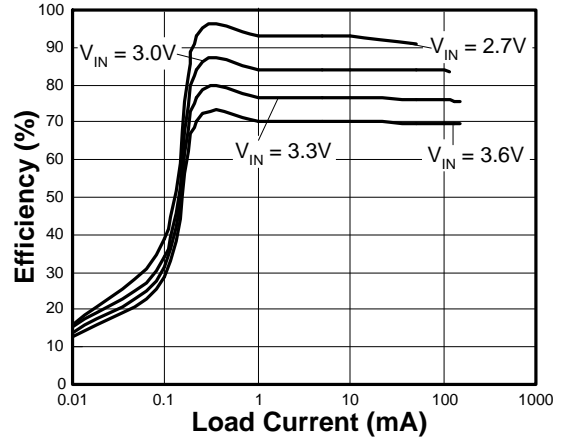
Supply Current vs. Supply Voltage



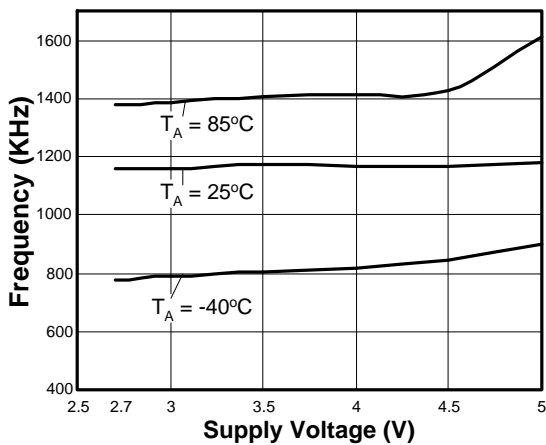
Efficiency vs. Supply Voltage



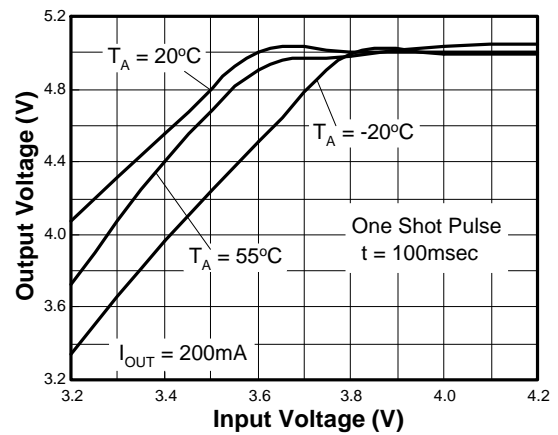
Efficiency vs. Load Current



Oscillator Frequency vs. Supply Voltage

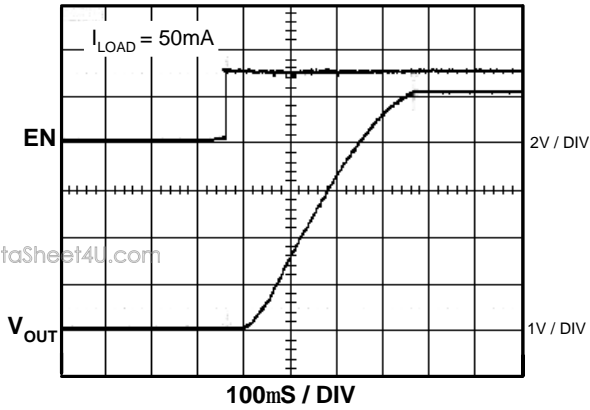


Output Voltage vs. Input Voltage

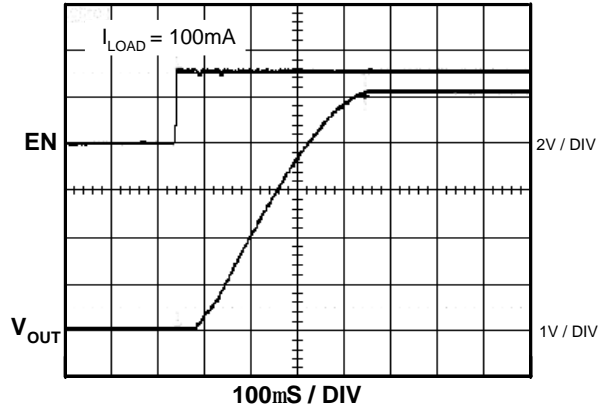




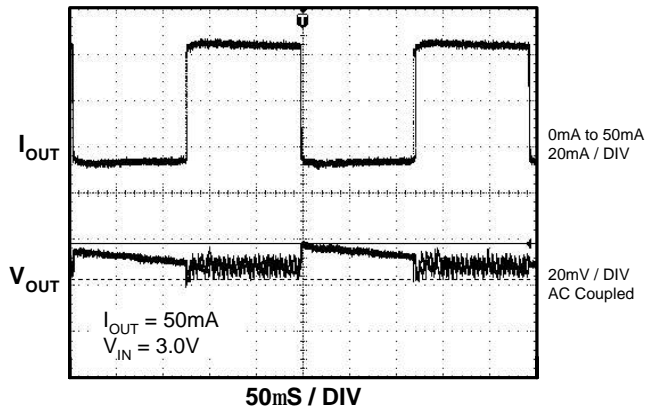
Startup Time



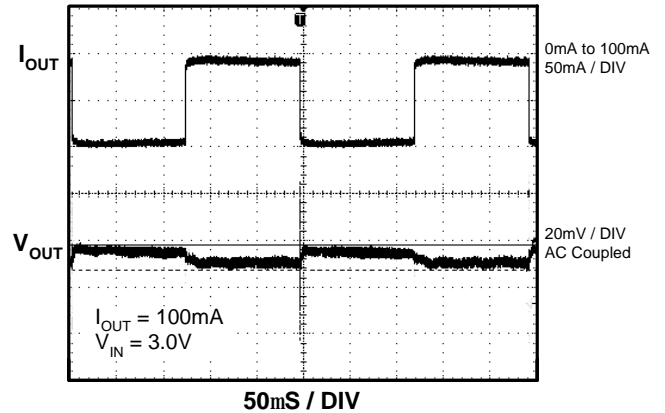
Startup Time



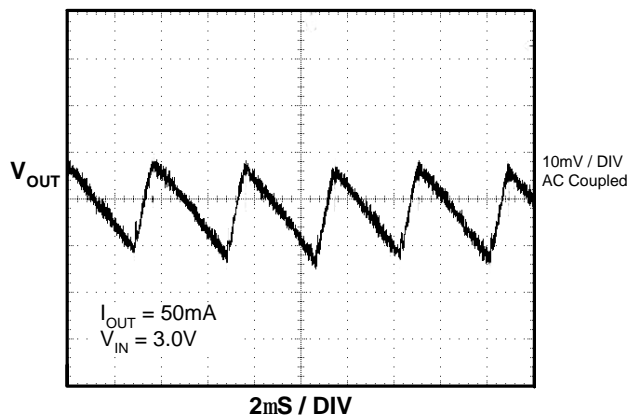
Load Transient Response



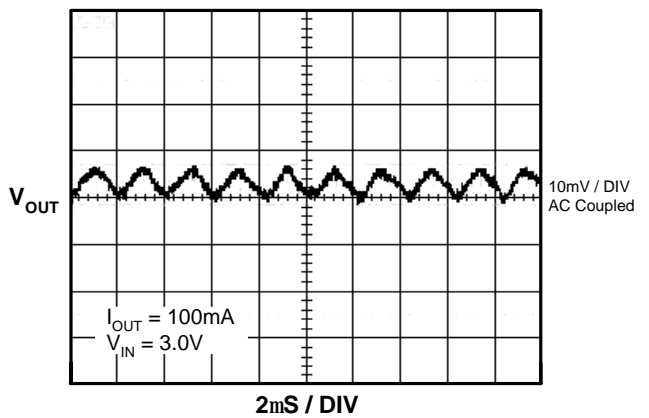
Load Transient Response



Output Ripple



Output Ripple





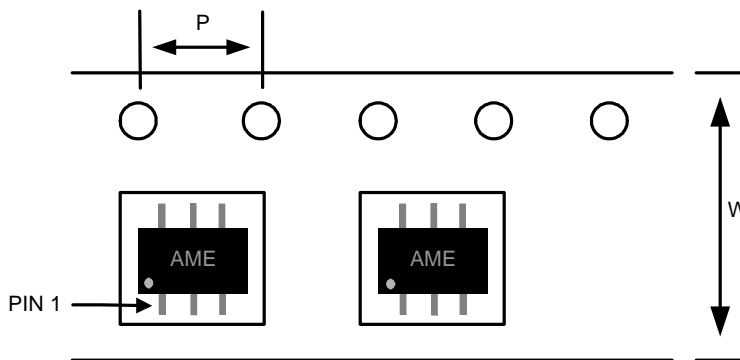
■ Date Code Rule

| Marking | | | Date Code | | Year |
|---------|----------|----------|-----------|----------|------|
| A | A | A | W | W | xxx0 |
| A | A | A | W | <u>W</u> | xxx1 |
| A | A | A | <u>W</u> | W | xxx2 |
| A | A | A | <u>W</u> | <u>W</u> | xxx3 |
| A | A | <u>A</u> | W | W | xxx4 |
| A | A | <u>A</u> | W | <u>W</u> | xxx5 |
| A | A | <u>A</u> | <u>W</u> | W | xxx6 |
| A | A | <u>A</u> | <u>W</u> | <u>W</u> | xxx7 |
| A | <u>A</u> | A | W | W | xxx8 |
| A | <u>A</u> | A | W | <u>W</u> | xxx9 |

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■ Tape and Reel Dimension

SOT-26



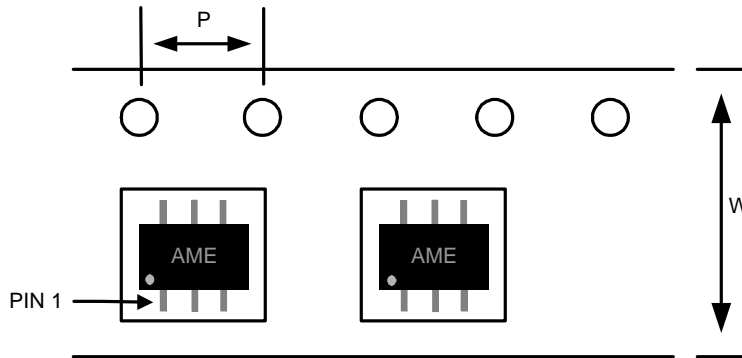
Carrier Tape, Number of Components Per Reel and Reel Size

| Package | Carrier Width (W) | Pitch (P) | Part Per Full Reel | Reel Size |
|---------|-------------------|------------|--------------------|-----------|
| SOT-26 | 8.0±0.1 mm | 4.0±0.1 mm | 3000pcs | 180±1 mm |



■ Tape and Reel Dimension

TSOT-26



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Carrier Tape, Number of Components Per Reel and Reel Size

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| TSOT-26 | 8.0±0.1 mm | 4.0±0.1 mm | 3000pcs | 180±1 mm |

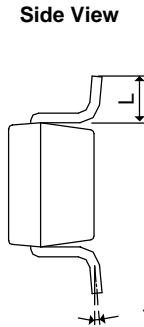
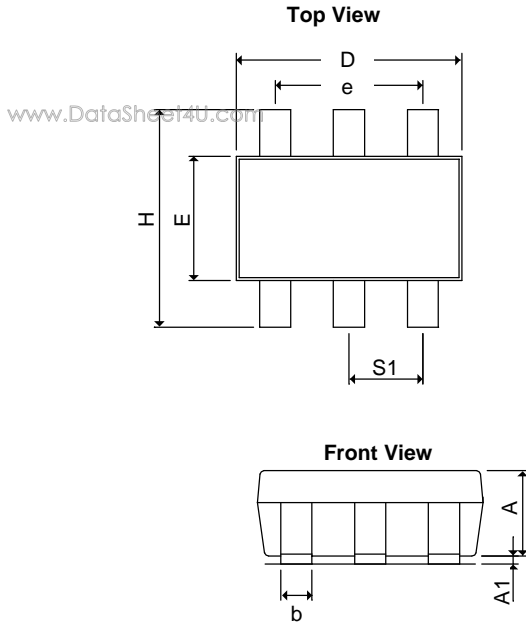


AME7730

100mA Regulated Charge Pump

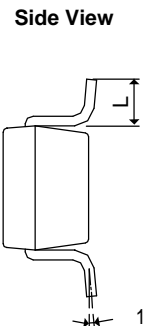
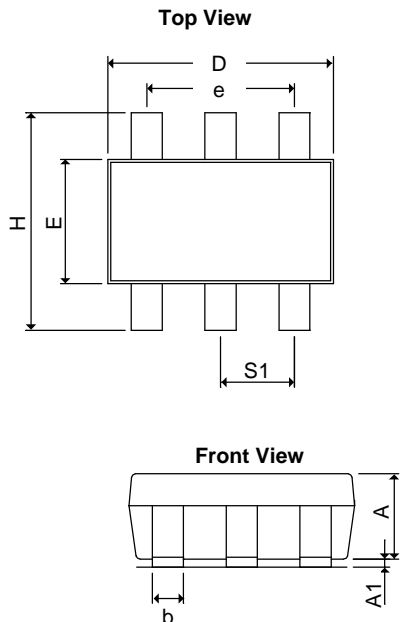
■ Package Dimension

SOT-26



| SYMBOLS | MILLIMETERS | | INCHES | |
|----------------|-------------|------|------------|---------|
| | MIN | MAX | MIN | MAX |
| A | 1.20REF | | 0.0472REF | |
| A ₁ | 0.00 | 0.15 | 0.0000 | 0.0059 |
| b | 0.30 | 0.55 | 0.0118 | 0.0217 |
| D | 2.70 | 3.10 | 0.1063 | 0.1220 |
| E | 1.40 | 1.80 | 0.0551 | 0.0709 |
| e | 1.90 BSC | | 0.0748 BSC | |
| H | 2.60 | 3.00 | 0.10236 | 0.11811 |
| L | 0.37REF | | 0.0146REF | |
| q1 | 0° | 10° | 0° | 10° |
| S ₁ | 0.95REF | | 0.0374REF | |

TSOT-26



| SYMBOLS | MILLIMETERS | | INCHES | |
|------------------|-------------|------|-------------|---------|
| | MIN | MAX | MIN | MAX |
| A+A ₁ | 0.90 | 1.25 | 0.0354 | 0.0492 |
| b | 0.30 | 0.50 | 0.0118 | 0.0197 |
| D | 2.70 | 3.10 | 0.1063 | 0.1220 |
| E | 1.40 | 1.80 | 0.0551 | 0.0709 |
| e | 1.90 BSC | | 0.07480 BSC | |
| H | 2.40 | 3.00 | 0.09449 | 0.11811 |
| L | 0.35BSC | | 0.0138BSC | |
| q1 | 0° | 10° | 0° | 10° |
| S ₁ | 0.95BSC | | 0.0374BSC | |



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