ESMT												EMP8734

# Fast Ultra High-PSRR, Low-Noise, 300mA CMOS Linear Regulator

## General Description

The EMP8734 features ultra-high power supply rejection ratio, low output voltage noise, low dropout voltage, low quiescent current and fast transient response. It guarantees delivery of 300mA output current and supports preset output voltages ranging from 0.8V to 4.5V with 0.05V increment.

Based on its low quiescent current consumption and its less than 1μA shutdown mode of logical operation, the EMP8734 is ideal for battery-powered applications. The high power supply rejection ratio of the EMP8734 holds well for low input voltages typically encountered in battery-operated systems. The regulator is stable with small ceramic capacitive loads (1μF typical). The EMP8734 is available in miniature SOT-23-5, TDFN-6, SOT-353(SC-70-5) and SOT-343(SC-82-4) packages.

## Features

- 300mA guaranteed output current
- 62dB typical PSRR at 1kHz
- 110μV RMS output voltage noise (10Hz to 100kHz)
- 290mV typical dropout at 300mA
- 57μA typical quiescent current
- Less than 1μA typical shutdown mode
- Fast line and load transient response
- 2.2V to 5.5V input range
- Auto-discharge during chip disable
- 80μs typical turn-on time
- Stable with small ceramic output capacitors
- Over temperature and over current protection
- ±2% output voltage tolerance

## Applications

- Wireless handsets
- PCMCIA cards
- DSP core power
- Hand-held instruments
- Battery-powered systems
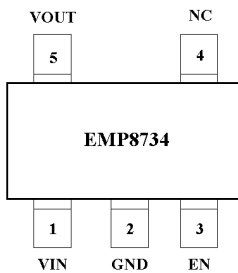- Portable information appliances

## Typical Application
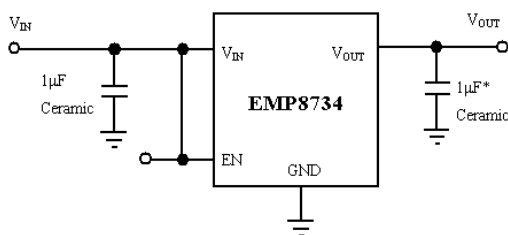


*Use 2.2μF for $V_{OUT} \leq$ 1.2V

## CONNECTION DIAGRAM (Top View)
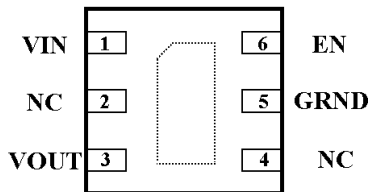
## ORDER INFORMATION

### SOT-23-5



EMP8734-XXVF05GRR

XX      Output voltage

VF05    SOT-23-5 Package

GRR    RoHS & Halogen free

       Rating: -40 to 85°C

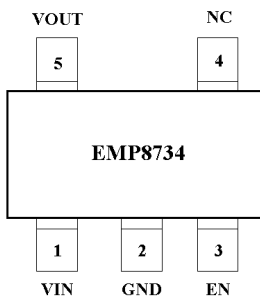        Package in Tape & Reel

### TDFN-6



EMP8734-XXFE06NRR

XX      Output voltage

FE06    TDFN-6 Package

NRR     RoHS & Halogen free

       Rating: -40 to 85°C

       Package in Tape & Reel

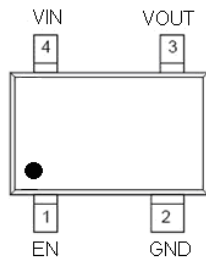### SOT-353 (SC-70-5)



EMP8734-XXVI05NRR

XX      Output voltage

VI05    SOT-353 Package

NRR     RoHS & Halogen free

       Rating: -40 to 85°C
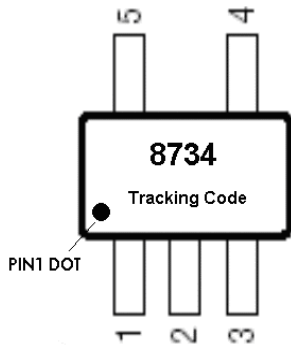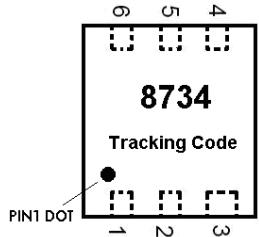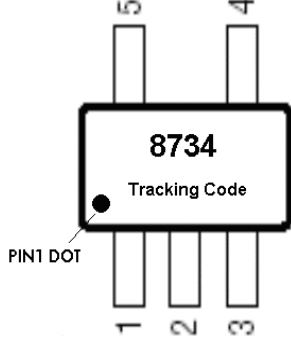
        Package in Tape & Reel

### SOT-343 (SC-82-4)
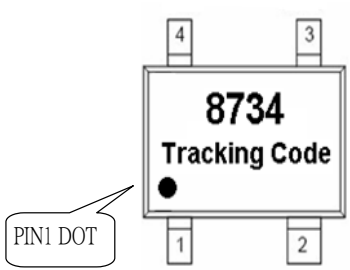


EMP8734-XXVJ04NRR

XX      Output voltage

VJ04    SOT-343 Package

NRR     RoHS & Halogen free

       Rating: -40 to 85°C

       Package in Tape & Reel

## Pin Functions

| Name | SOT-23-5 | TDFN-6 | SOT-353 | SOT-343 | Function |
|------|----------|--------|---------|---------|----------|
| VIN | 1 | 1 | 1 | 4 | **Supply Voltage Input**<br>Require a minimum input capacitor of close to 1μF to ensure stability and sufficient decoupling from the ground pin. |
| GND | 2 | 5 | 2 | 2 | **Ground Pin** |
| EN | 3 | 6 | 3 | 1 | **Enable Input**<br>Enable the regulator by pulling the EN pin High. To keep the regulator on during normal operation, connect the EN pin to VIN. The EN pin must not exceed VIN under all operating conditions. |
| NC | 4 | 2/4 | 4 | N/A | **No Connection** |
| VOUT | 5 | 3 | 5 | 3 | **Output Voltage Feedback** |

## Order, Mark & Packing Information

| Package | Marking | Vout | Product ID | Packing |
|---------|---------|------|-----------|---------|
| SOT-23-5 | 8734 Tracking Code PIN1 DOT | 1.0 | EMP8734-10VF05GRR | 3K units Tape & Reel |
| | | 1.2 | EMP8734-12VF05GRR | 3K units Tape & Reel |
| | | 1.5 | EMP8734-15VF05GRR | 3K units Tape & Reel |
| | | 1.8 | EMP8734-18VF05GRR | 3K units Tape & Reel |
| | | 2.5 | EMP8734-25VF05GRR | 3K units Tape & Reel |
| | | 2.8 | EMP8734-28VF05GRR | 3K units Tape & Reel |
| | | 3.0 | EMP8734-30VF05GRR | 3K units Tape & Reel |
| | | 3.3 | EMP8734-33VF05GRR | 3K units Tape & Reel |
| TDFN-6 | 8734 Tracking Code PIN1 DOT | 1.2 | EMP8734-12FE06NRR | 3K units Tape & Reel |
| | | 1.8 | EMP8734-18FE06NRR | 3K units Tape & Reel |
| | | 2.5 | EMP8734-25FE06NRR | 3K units Tape & Reel |
| | | 3.0 | EMP8734-30FE06NRR | 3K units Tape & Reel |
| | | 3.3 | EMP8734-33FE06NRR | 3K units Tape & Reel |
| SOT-353 (SC-70-5) | 8734 Tracking Code PIN1 DOT | 1.2 | EMP8734-12VI05NRR | 3K units Tape & Reel |
| | | 1.3 | EMP8734-13VI05NRR | 3K units Tape & Reel |
| | | 1.8 | EMP8734-18VI05NRR | 3K units Tape & Reel |
| | | 2.5 | EMP8734-25VI05NRR | 3K units Tape & Reel |
| | | 2.8 | EMP8734-28VI05NRR | 3K units Tape & Reel |
| | | 3.3 | EMP8734-33VI05NRR | 3K units Tape & Reel |

| Package | Marking | Vout | Product ID | Packing |
|---------|---------|------|------------|---------|
| SOT-343 (SC-82-4) |  | 1.2 | EMP8734-12VJ04NRR | 3K units Tape & Reel |
| | | 1.5 | EMP8734-15VJ04NRR | |
| | | 1.8 | EMP8734-18VJ04NRR | |
| | | 2.5 | EMP8734-25VJ04NRR | |
| | | 2.8 | EMP8734-28VJ04NRR | |
| | | 3.0 | EMP8734-30VJ04NRR | |
| | | 3.3 | EMP8734-33VJ04NRR | |

## Absolute Maximum Ratings (Notes 1, 2)

| | | | |
|---|---|---|---|
| VIN, VOUT, VEN | -0.3V to 6.5V | Thermal Resistance ($\theta_{JA}$) | |
| Storage Temperature Range | -65°C to160°C | SOT-23-5 | 250°C/W |
| Junction Temperature ($T_J$) | 150°C | SOT-343/SOT-353 | 333°C/W |
| Lead Temperature (10 sec.) | 240°C | TDFN-6 | 165°C/W |
| ESD Rating | | **Operating Ratings** (Note 1, 2) | |
| Human Body Model | 2kV | Temperature Range | -40°C to 85°C |
| MM | 200V | Supply Voltage | 2.2V to 5.5V |

## Electrical Characteristics

Unless otherwise specified, all limits guaranteed for $V_{IN} = V_{OUT} +1V$ (Note 3), $V_{EN}=V_{IN}$, $C_{IN} = C_{OUT} = 2.2\mu F$, $T_A = 25°C$.
**Boldface** limits apply for the operating temperature extremes: -40°C and 85°C.

| Symbol | Parameter | Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| $V_{OUT}$ | Output Voltage | | **0.8** | | **4.5** | V |
| $V_{IN}$ | Input Voltage | $V_{OUT} \geqq 1.2V$ | **2.2** | | **5.5** | V |
| | | $V_{OUT} < 1.2V$ | **2.5** | | **5.5** | V |
| $\Delta V_{OTL}$ | Output Voltage Tolerance (Note 3) | $V_{OUT} \geqq 1.8V$ ,$I_{OUT}$ = 10mA | -2 | | +2 | % of $V_{OUT (NOM)}$ |
| | | $V_{OUT} \geqq 1.8V$ ,$I_{OUT}$ = 10mA | **-3** | | **+3** | |
| | | $V_{OUT} < 1.8V$ ,$I_{OUT}$ = 10mA | -35 | | 35 | mV |
| | | $V_{OUT} < 1.8V$ ,$I_{OUT}$ = 10mA | **-50** | | **50** | |
| $I_{OUT}$ | Maximum Output Current | Average DC Current Rating | **300** | | | mA |
| $I_{LIMIT}$ | Output Current Limit | | **300** | 450 | | mA |
| $I_Q$ | Supply Current | $I_{OUT}$ = 0mA | | 57 | | µA |
| | | $I_{OUT}$ = 300mA | | 130 | | |
| | Shutdown Supply Current | $V_{OUT}$ = 0V, EN = GND | | 0.001 | 1 | |
| $V_{DO}$ | Dropout Voltage (Note4) | $I_{OUT}$ = 100mA | | 90 | | mV |
| | | $I_{OUT}$ = 300mA | | 290 | | |
| $\Delta V_{OUT}$ | Line Regulation | $I_{OUT}$ = 1mA, ($V_{OUT}$ + 1V) ≤ $V_{IN}$ ≤ 5.5V (Note 3) | -0.1 | 0.01 | 0.1 | %/V |
| | Load Regulation | 1mA ≤ $I_{OUT}$ ≤ 300mA | | 0.0008 | | %/mA |
| $e_n$ | Output Voltage Noise | $V_{OUT}$=2.5V, $I_{OUT}$ = 10mA, 10Hz ≤ f ≤ 100kHz | | 110 | | $\mu V_{RMS}$ |
| $T_{SD}$ | Thermal Shutdown Temperature | | | 165 | | °C |
| | Thermal Shutdown Hysteresis | | | 35 | | |
| $V_{EN}$ | EN Input Threshold | $V_{IH}$, ($V_{OUT}$ + 1V) ≤ $V_{IN}$ ≤ 5.5V (Note 3) | 1.2 | | | V |
| | | $V_{IL}$, ($V_{OUT}$ + 1V) ≤ $V_{IN}$ ≤ 5.5V (Note 3) | | | 0.4 | |
| $I_{EN}$ | EN Input Bias Current | EN = GND or VIN | | 0.1 | 100 | nA |
| $T_{ON}$ | Turn-On Time | $V_{OUT}$ at 95% of Final Value | | 80 | | µs |
| $T_{OFF}$ | Turn-Off Time | $I_{OUT}$=0mA (Note 5) | | 2.4 | | ms |

**Note 1:** Absolute Maximum ratings indicate limits beyond which damage may occur. Electrical specifications do not apply when operating the device outside of its rated operating conditions.

**Note 2:** All voltages are with respect to the potential at the ground pin.

**Note 3:** Condition does not apply to input voltages below 2.2V since this is the minimum input operating voltage.

**Note 4:** Dropout voltage is measured by reducing $V_{IN}$ until $V_{OUT}$ drops 100mV from its nominal value at $V_{IN}$ -$V_{OUT}$ = 1V. Dropout voltage does not apply to the regulator versions with $V_{OUT}$ less than 2.2V.

**Note 5:** Turn-off time is time measured between the enable input just decreasing below $V_{IL}$ and the output voltage just decreasing to 10% of its nominal value.

**Note 6:** Maximum Power dissipation for the device is calculated using the following equations:

$$P_D = \frac{T_{J(MAX)} - T_A}{\theta_{JA}}$$

where $T_{J(MAX)}$ is the maximum junction temperature, $T_A$ is the ambient temperature, and $\theta_{JA}$ is the junction-to-ambient thermal resistance. E.g. for the SOT-23-5 package $\theta_{JA}$ = 250°C/W, $T_{J(MAX)}$ = 150°C and using $T_A$ = 25°C, the maximum power dissipation is found to be 500mW. The derating factor (-1/$\theta_{JA}$) = -4mW/°C, thus below 25°C the power dissipation figure can be increased by 4mW per degree, and similarity decreased by this factor for temperatures above 25°C.
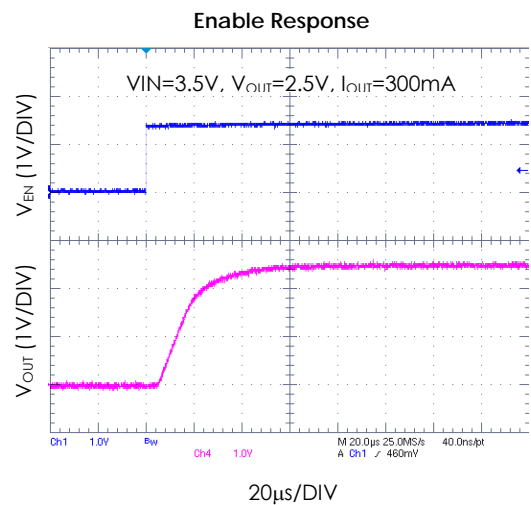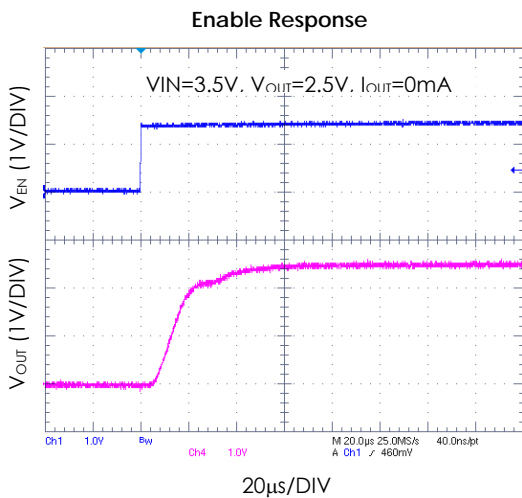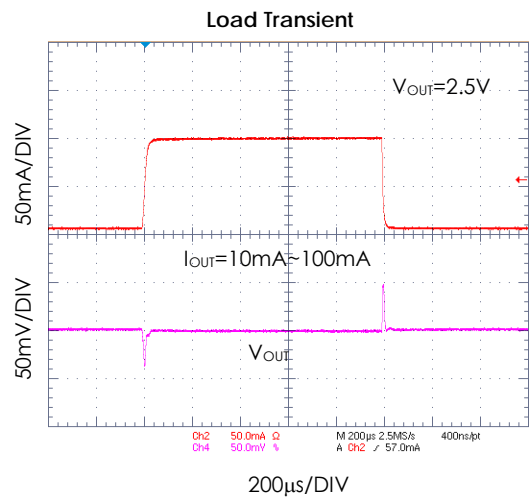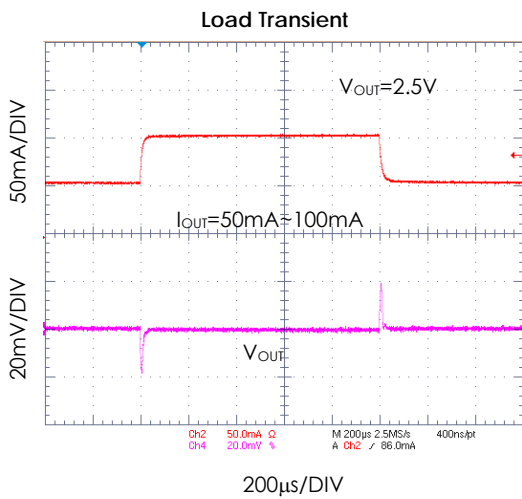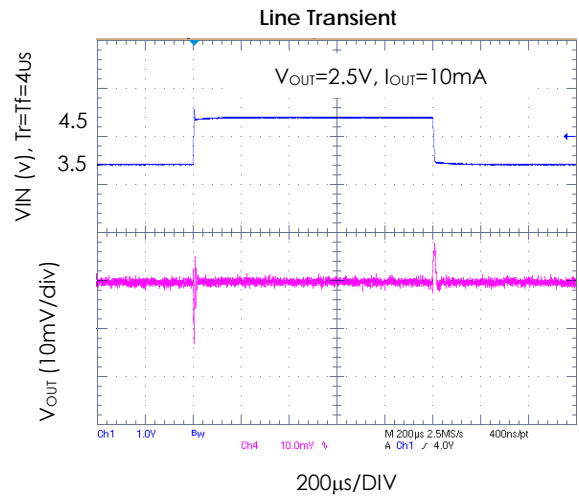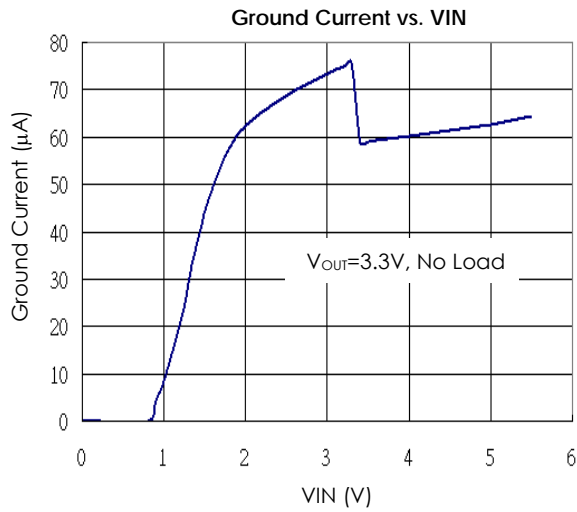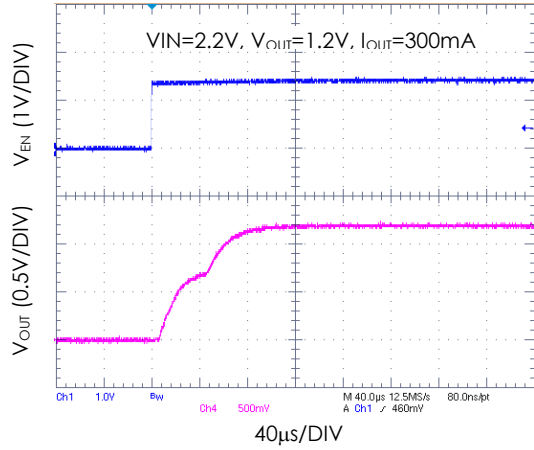
## Functional Block Diagram
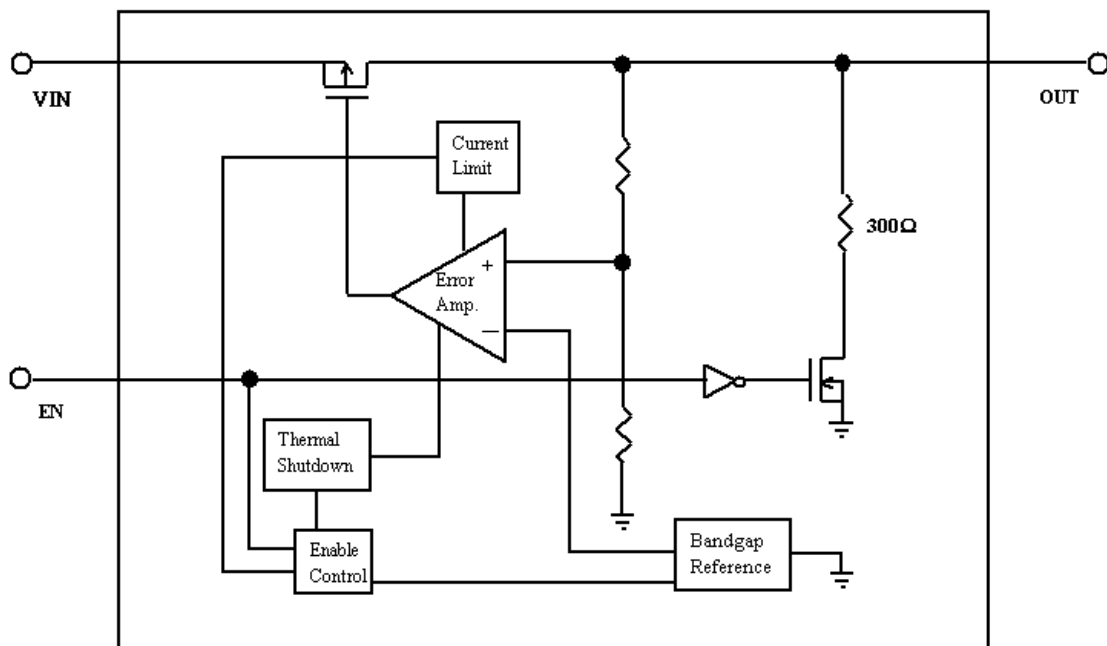
## Typical Performance Characteristics

Unless otherwise specified, VIN = $V_{OUT\,(NOM)}$ + 1V, $V_{EN}=V_{IN}$, $C_{IN}$ = $C_{OUT}$ = 2.2µF, $T_A$ = 25°C.



**PSRR vs. Frequency**
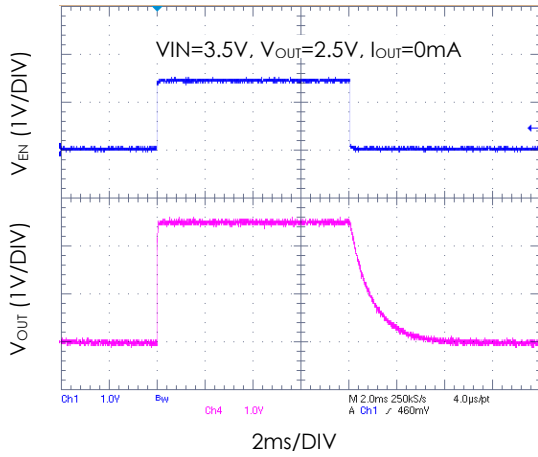VIN=5V, $V_{OUT}$=3.3V
10mA / 50mA / 100mA / 150mA / 300mA



**PSRR vs. Frequency**
VIN=4.3V, $V_{OUT}$=3.3V
10mA / 50mA / 100mA / 150mA / 300mA



**PSRR vs. Frequency**
VIN=3.3V, $V_{OUT}$=1.8V
10mA / 50mA / 100mA / 150mA / 300mA



**PSRR vs. Frequency**
VIN=2.5V, $V_{OUT}$=0.8V
10mA / 50mA / 100mA / 150mA / 300mA



**Dropout Voltage vs. Load Current**
$V_{OUT}$=2.5V
$V_{OUT}$=3.3V



**Ground Current vs. Load Current**
VIN=2.8V, $V_{OUT}$=1.8V
$T_A$=-40°C
$T_A$=25°C
$T_A$=85°C

## Typical Performance Characteristics

Unless otherwise specified, VIN = $V_{OUT (NOM)}$ + 1V, $V_{EN}=V_{IN}$, $C_{IN}$ = $C_{OUT}$ = 2.2µF, $T_A$ = 25°C. (Continued)



Ground Current vs. VIN

$V_{OUT}$=3.3V, No Load



Line Transient

$V_{OUT}$=2.5V, $I_{OUT}$=10mA

200µs/DIV



Load Transient

$V_{OUT}$=2.5V

$I_{OUT}$=50mA~100mA

$V_{OUT}$

200µs/DIV



Load Transient

$V_{OUT}$=2.5V

$I_{OUT}$=10mA~100mA

$V_{OUT}$

200µs/DIV



Enable Response

VIN=3.5V, $V_{OUT}$=2.5V, $I_{OUT}$=0mA

20µs/DIV



Enable Response

VIN=3.5V, $V_{OUT}$=2.5V, $I_{OUT}$=300mA

20µs/DIV
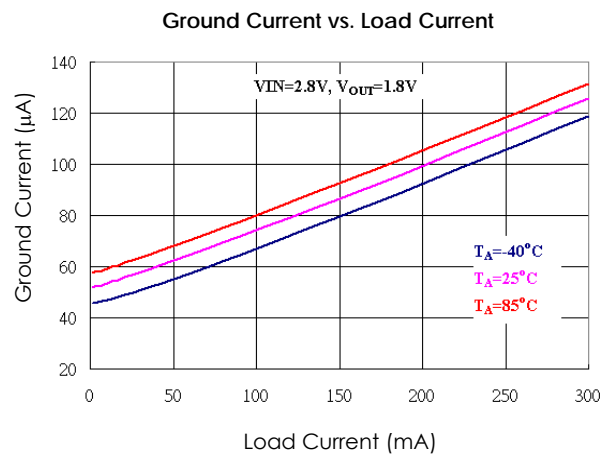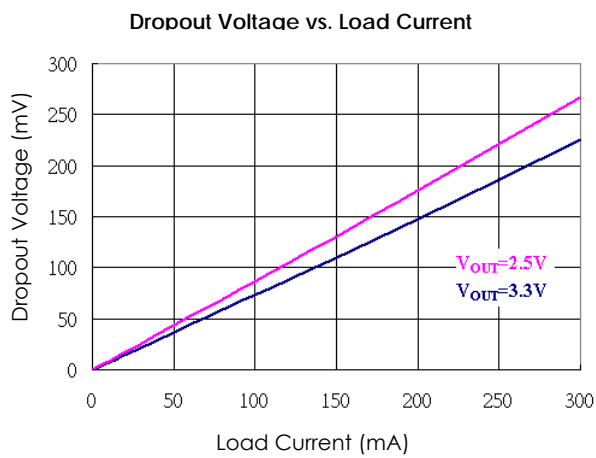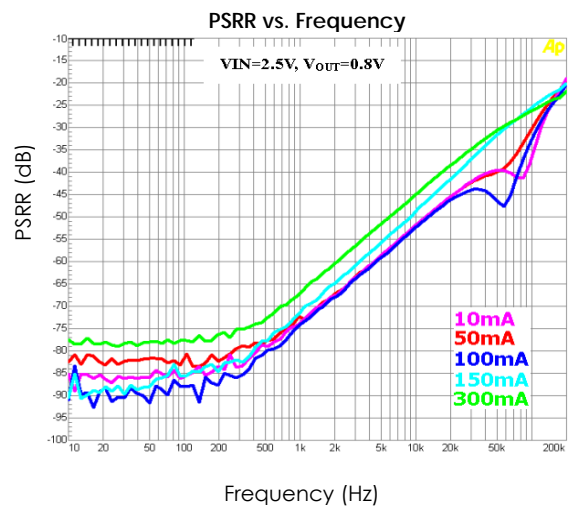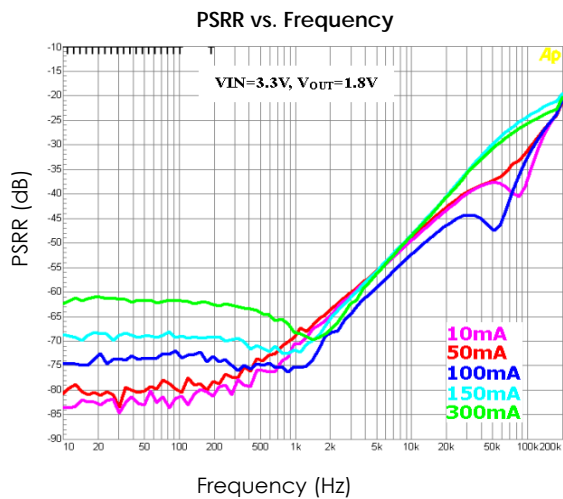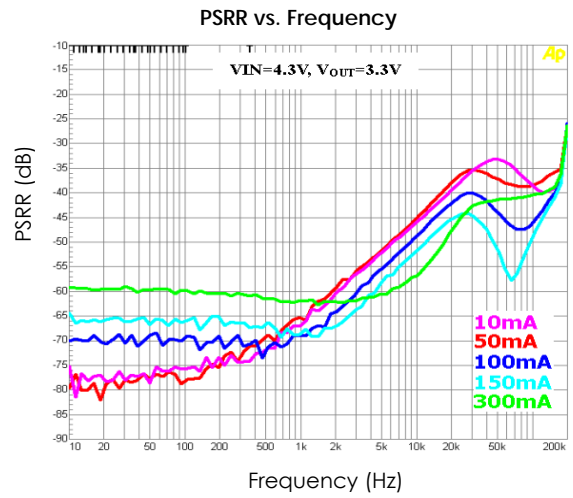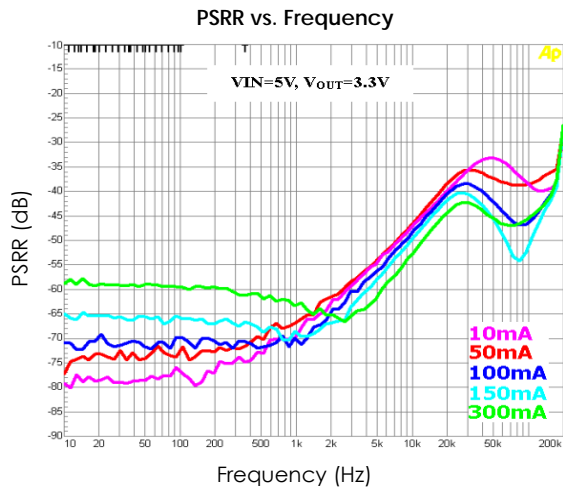
## Typical Performance Characteristics

Unless otherwise specified, VIN = $V_{OUT\,(NOM)}$ + 1V, $V_{EN}$=$V_{IN}$, $C_{IN}$ = $C_{OUT}$ = 2.2μF, $T_A$ = 25°C. (Continued)

**Enable Response**

VIN=2.2V, $V_{OUT}$=1.2V, $I_{OUT}$=0mA

40μs/DIV

**Enable Response**

VIN=2.2V, $V_{OUT}$=1.2V, $I_{OUT}$=300mA

40μs/DIV

**Disable Response**

VIN=3.5V, $V_{OUT}$=2.5V, $I_{OUT}$=0mA

2ms/DIV

**Disable Response**

VIN=2.2V, $V_{OUT}$=1.2V, $I_{OUT}$=0mA

2ms/DIV
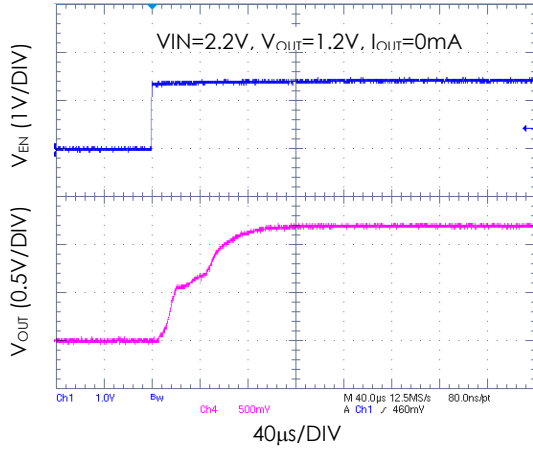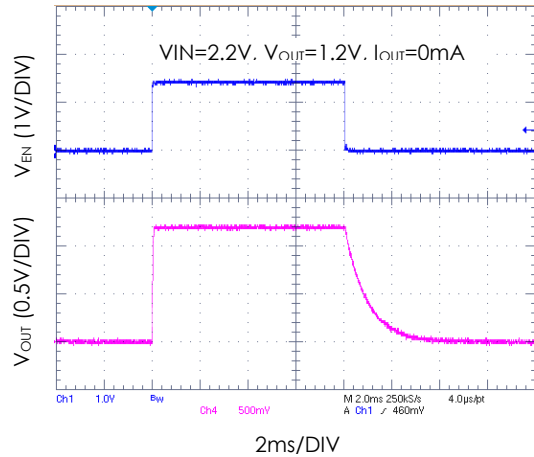
**Power Derating (SOT-25)**
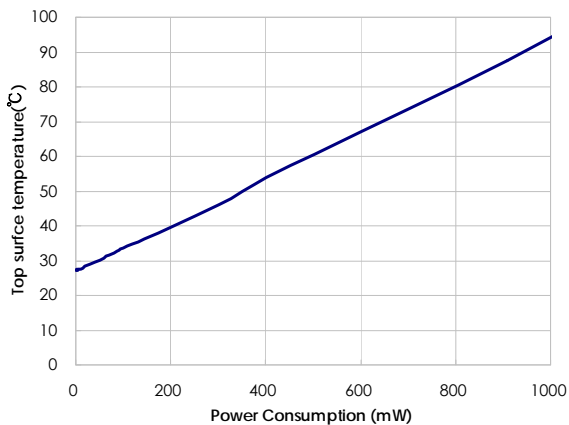
**Package Outline Drawing**
**SOT-23-5**
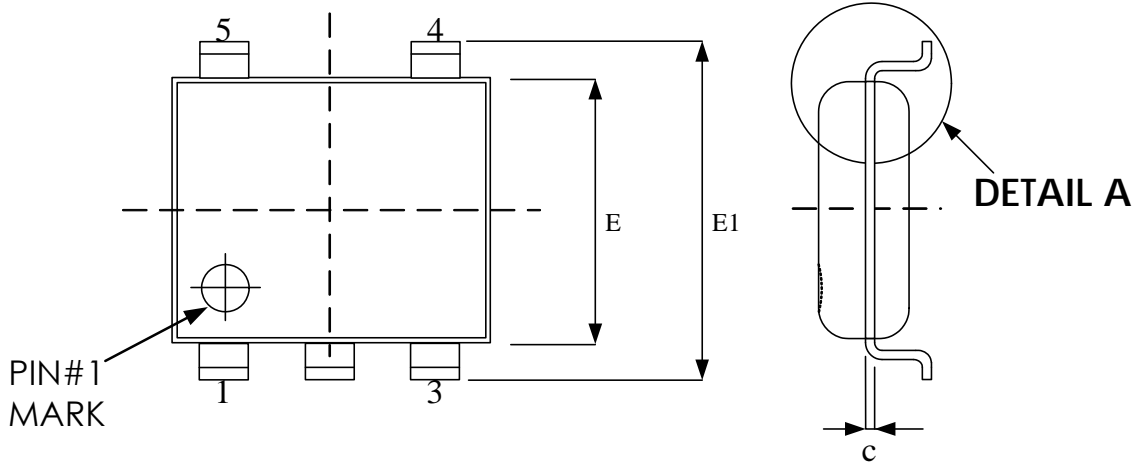


**TOP VIEW**
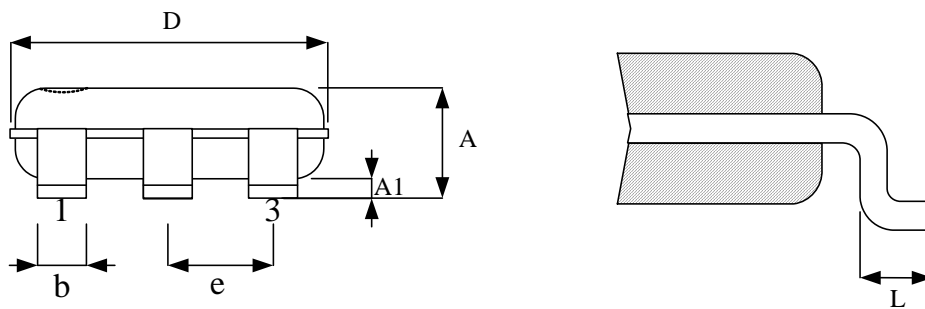


**SIDE VIEW**

**DETAIL A**

| Symbol | Dimension in mm | |
|--------|------|------|
|        | Min. | Max. |
| A      | 0.90 | 1.45 |
| A1     | 0.00 | 0.15 |
| b      | 0.30 | 0.50 |
| c      | 0.08 | 0.25 |
| D      | 2.70 | 3.10 |
| E      | 1.40 | 1.80 |
| E1     | 2.60 | 3.00 |
| e      | 0.95 BSC | |
| L      | 0.30 | 0.60 |

**Package Outline Drawing**
TDFN-6
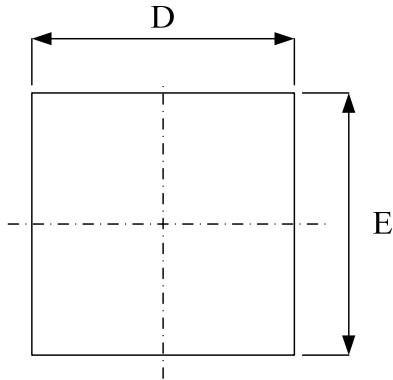


TOP VIEW
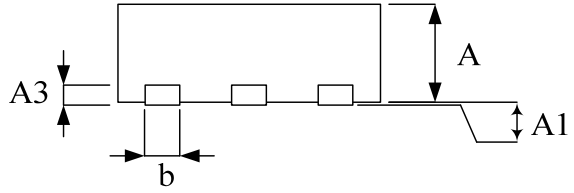
SIDE VIEW
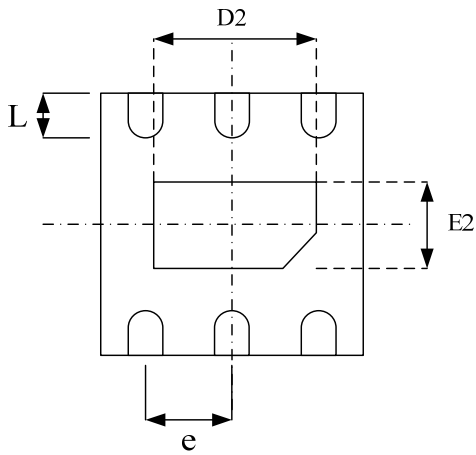
BOTTOM VIEW

| Symbol | Dimension in mm | |
| --- | --- | --- |
| | Min | Max |
| A | 0.70 | 0.80 |
| A1 | 0.00 | 0.05 |
| A3 | 0.18 | 0.25 |
| b | 0.25 | 0.35 |
| D | 1.95 | 2.05 |
| E | 1.95 | 2.05 |
| e | 0.65 BSC | |
| L | 0.20 | 0.45 |

Exposed pad

| Symbol | Dimension in mm | |
| --- | --- | --- |
| | Min | Max |
| D2 | 1.35 | 1.45 |
| E2 | 0.55 | 0.65 |

# ESMT                                                    *EMP8734*

**Package Outline Drawing**
**SC70**



TOP VIEW

DETAIL A

SIDE VIEW
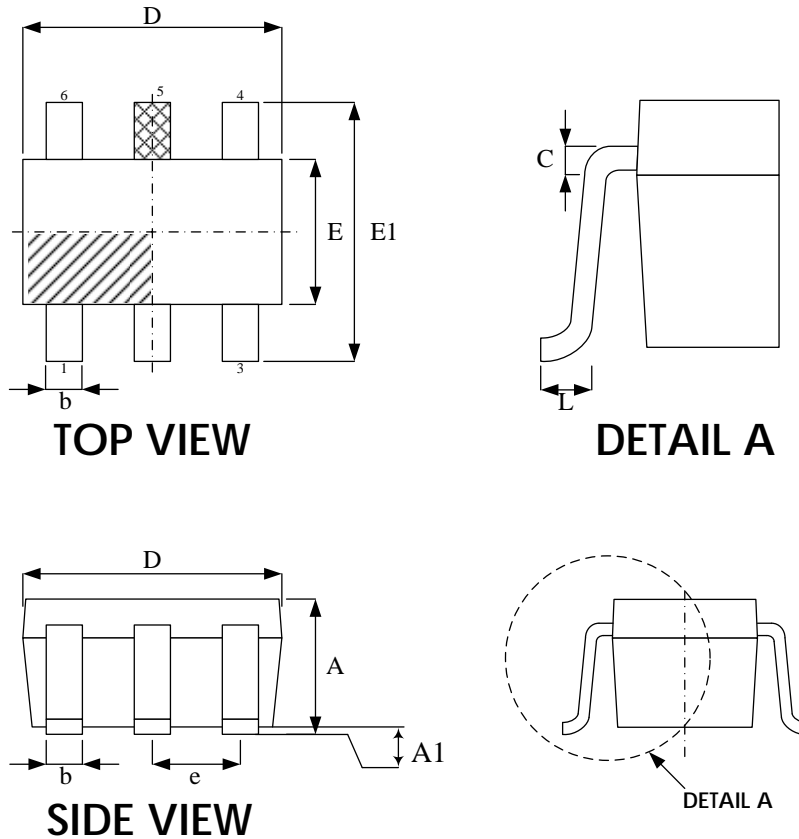
| Symbol | Dimension in mm | |
|--------|-------|-------|
|        | Min.  | Max.  |
| A      | 0.80  | 1.10  |
| A1     | 0.00  | 0.10  |
| b      | 0.15  | 0.30  |
| c      | 0.08  | 0.22  |
| D      | 1.85  | 2.15  |
| E      | 1.10  | 1.40  |
| E1     | 1.80  | 2.40  |
| e      | 0.65 BSC | |
| L      | 0.26  | 0.46  |

＊ This drawing includes SC70 5&6 lead.
For 5 lead packages, the No.5 was removed.

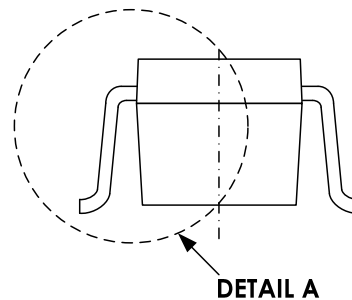**Package Outline Drawing**
SOT-343 (SC-82-4)
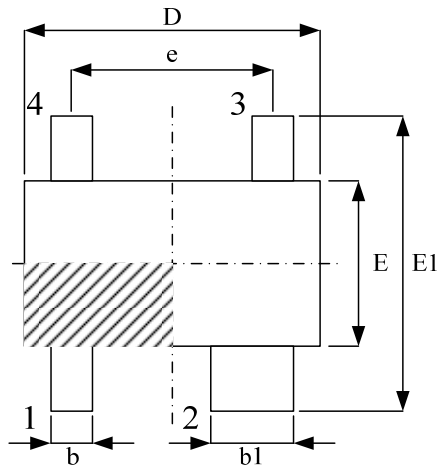
**TOP VIEW**
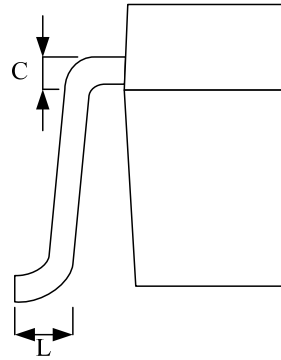
**DETAIL A**
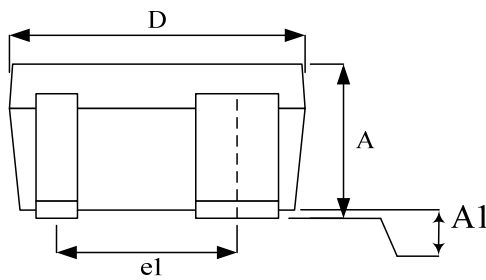
**BOTTOM VIEW**

**SIDE VIEW**

DETAIL A

| Symbol | Dimension in mm | |
|--------|------|------|
| | Min. | Max. |
| A | 0.80 | 1.10 |
| A1 | 0.00 | 0.10 |
| b | 0.15 | 0.30 |
| b1 | 0.30 | 0.60 |
| c | 0.08 | 0.22 |
| D | 1.85 | 2.15 |
| E | 1.10 | 1.40 |
| E1 | 1.80 | 2.40 |
| e | 1.30 BSC | |
| e1 | 1.1875 BSC | |
| L | 0.26 | 0.46 |

## Revision History

| Revision | Date | Description |
|---|---|---|
| 2.0 | 2009.05.08 | EMP transferred from version 1.3 |
| 2.1 | 2009.06.23 | 1. Delete FBP-6 & SOT-343 package (page 2)<br>2. Delete FBP-6 & SOT-343 order information (page 3)<br>3. Add order information SOT-23-5 Vout 1.2V、1.3V(page 3)<br>4. Add SOT-353 package type (page 2)<br>5. Add order information SOT-353 Vout 1.2V~3.3V (page 3)<br>6. Delete FBP-6 & SOT-343 outline drawing (page 10~13)<br>7. Add SOT-353 outline drawing (page 10~13) |
| 2.2 | 2010.01.13 | 1. Delete/Add some content in general description part (page 1)<br>2. Delete SOT-23-5 NRR package (page 2)<br>3. SC70-5 revised as SC-70-5 (page 2)<br>4. Add SOT-343 connection diagram & order information (page 2)<br>5. Add order, mark & packing information of SOT-343 (page 4)<br>6. SOT-343/SOT353 (page 5)<br>7. Add outline drawing of SOT-343 (page 13) |
| 2.3 | 2011.03.18 | Add D marking for SOT353 package in page12 |
| 2.4 | 2011.08.16 | 1.  Modify Output Voltage Tolerance (page 5)<br>2.  Added Vout=1.0V voltage option |
| 2.5 | 2011.09.06 | 1. Add Vout=3.0V and 3.3V voltage option for TDFN-6 package<br>2. Change outline spec for SOT23-5/TDFN-6/SC70-5/SC82-4 |
| 2.6 | 2012.04.02 | 1.Revise IC marking for SC-82-4 package (page 4)<br>2.Revise output voltage tolerance spec for Vout<1.8V option (page 5)<br>3.Revise package outline drawing (page 10-13)<br>4.Add Vout=1.2V voltage option for TDFN-6 package (page 3)<br>5.Add Vout=2.8V voltage option for SOT-353 package (page 3)<br>6. Add Vout=1.5/2.5/3V voltage option for SOT-343 package (page 4) |
| 2.7 | 2012.12.04 | 1.Modify MOQ for TDFN-6 package (page 3)<br>2. Add Vout=1.8V voltage option for TDFN-6 package (page 3)<br>3. Modify outline drawing of SOT23-5 and SC70-5 package (page 10/12) |
| 2.8 | 2013.03.07 | 1. Modify outline drawing of SOT-343 package (add b1 mark) |
| 2.9 | 2014.05.06 | 1. Updated the top surface temperature vs. power consumption curve. |

## Important Notice