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## 400mA Output Voltage Adjustable High Speed LDO Regulators ME6221 Series

### General Description

The ME6221 series are highly accurate, low noise, LDO Voltage Regulators. The output voltage can be set via the external resistor. On chip trimming adjusts the reference/output voltage to within  $\pm 2\%$  accuracy. Internal protection features consist of output current limiting, safe operating area compensation, and thermal shutdown. The current limiter's feedback circuit also operates as a short protect for the output current limiter and the output pin. The CE function allows the output of regulator to be turned off, resulting in greatly reduced power consumption. The ME6221 series can operate with up to 18V input.

### Features

- Maximum Output Current: 400mA
- Voltage Setting via External Resistor: 1.25V~5.0V
- Dropout Voltage: 125mV@  $I_{OUT} = 100\text{mA}$  ( $V_{out} = 3.3\text{V}$ )
- Operating Voltage Range: 2.8V~18V
- Highly Accuracy:  $\pm 2\%$
- Standby Current: 45uA (TYP.)
- Line Regulation: 30mV (TYP.)
- Temperature Stability  $\leq 0.5\%$
- Thermal Shutdown Protection: 165°C

### Applications

- Consumer and Industrial Equipment Point of Regulation
- Switching Power Supply Post Regulation
- Hard Drive Controllers
- Battery Chargers

### Package

- 5-pin SOT23-5

Typical Application Circuit

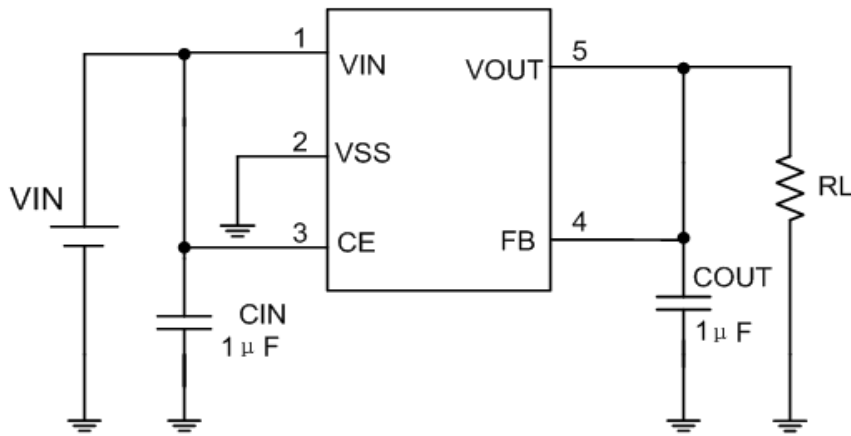


Fig.1  $V_{OUT} = 1.25V$

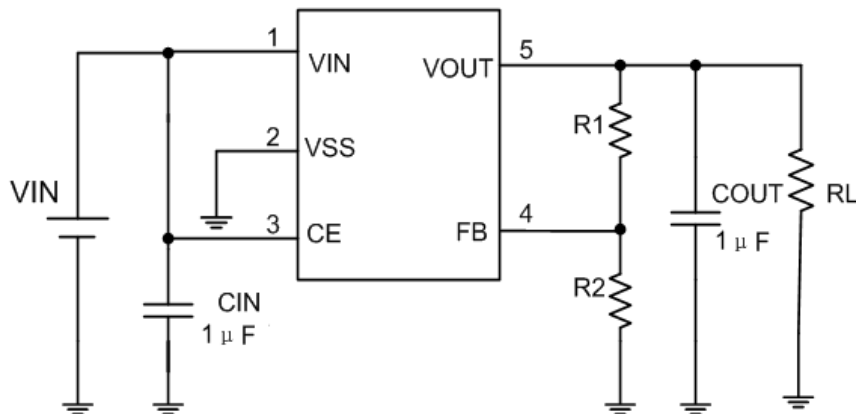
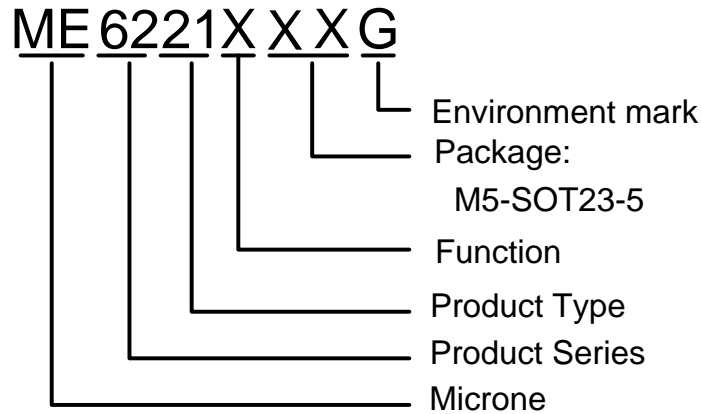


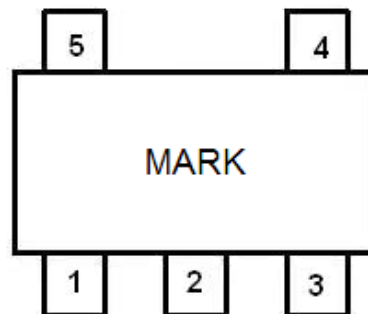
Fig.2  $V_{OUT} = 1.25 \times \left( 1 + \frac{R_1}{R_2} \right)$

## Selection Guide



| product series | product description                                    |
|----------------|--|
| ME6221CM5G     | $V_{FB} = 1.25V$ ,<br>the output voltage is adjustable |

## Pin Configuration

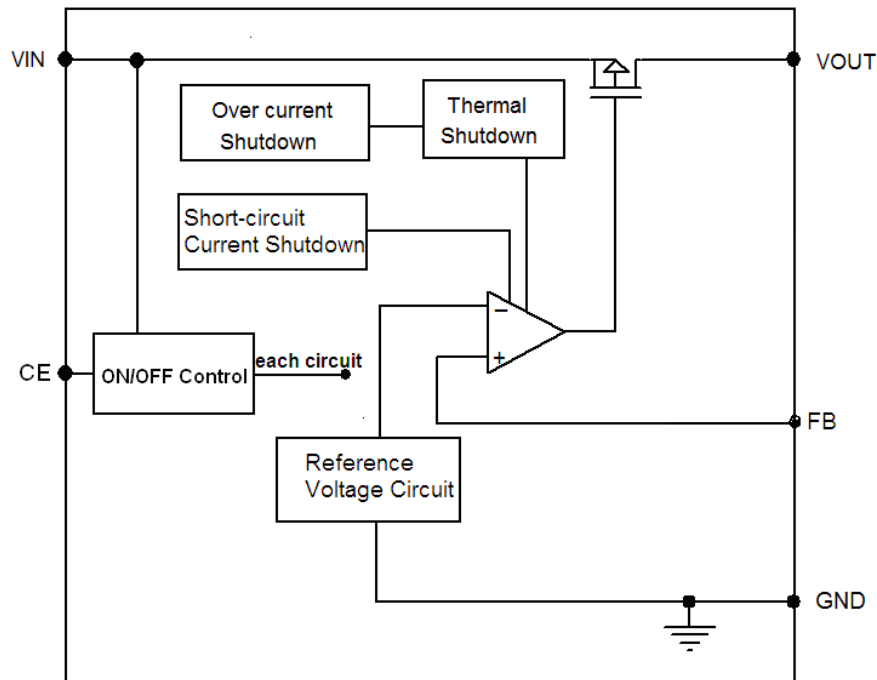


SOT23-5

## Pin Assignment

| Pin Number | Pin Name  | Functions           |
|------------|-----------|---------------------|
| SOT23-5    |           |                     |
| 1          | $V_{IN}$  | Power Input Voltage |
| 2          | $V_{SS}$  | Ground              |
| 3          | CE        | ON / OFF Control    |
| 4          | FB        | Feedback Voltage    |
| 5          | $V_{OUT}$ | Output Voltage      |

## Block Diagram



## Absolute Maximum Ratings

| Parameter                   | Symbol           | Ratings                        | Units       |
|-----------------------------|------------------|--------------------------------|-------------|
| Input Voltage               | $V_{IN}$         | 18                             | V           |
| Output Current              | $I_{OUT}$        | 500                            | mA          |
| Output Voltage              | $V_{OUT}$        | $V_{SS}-0.3 \sim 8.0$          | V           |
| CE Pin Voltage              | $V_{CE}$         | $V_{SS}-0.3 \sim V_{IN} + 0.3$ | V           |
| FB Pin Voltage              | $V_{FB}$         | $V_{SS}-0.3 \sim V_{IN} + 0.3$ | V           |
| Power Dissipation           | SOT23-5<br>$P_D$ | 300                            | mW          |
| Operating Temperature Range | $T_{OPR}$        | $-40 \sim +150$                | $^{\circ}C$ |
| Storage Temperature Range   | $T_{STG}$        | $-55 \sim +150$                | $^{\circ}C$ |
| Lead Temperature            |                  | $260^{\circ}C, 4sec$           |             |

## Electrical Characteristics

( $V_{IN}=V_{OUT}+1$ ,  $V_{CE}=V_{IN}$ ,  $V_{OUT}=V_{FB}$ ,  $C_{IN}=C_{OUT}=1\mu F$ ,  $T_a=25^{\circ}C$ , unless otherwise noted)

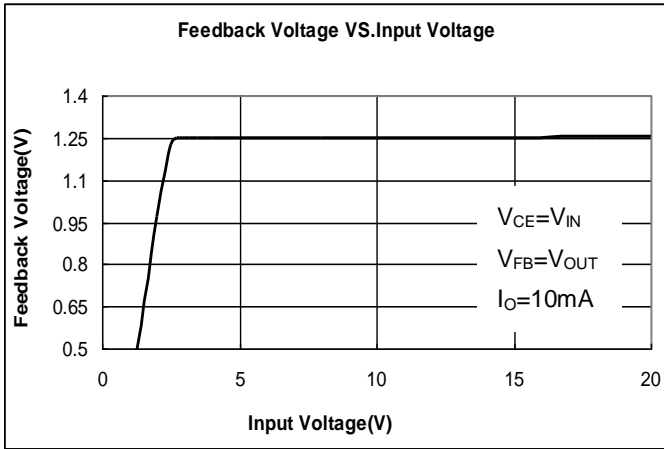
| Parameter                      | Symbol                   | Conditions   | Min.   | Typ.                     | Max.   | Units       |
|--------------------------------|--------------------------|--|--------|--------------------------|--------|-------------|
| Output Voltage                 | $V_{OUT(E)}$<br>(Note 2) | $I_{OUT}=30mA$ ,   | X 0.98 | $V_{OUT(T)}$<br>(Note 1) | X 1.02 | V           |
| Output Voltage Range           | $V_{ROUT}$               | $V_{IN}=V_{OUT(T)}+1V$ , $V_{CE}=V_{IN}$<br>Using test circuit 2 | 1.25   |                          | 5.0    | V           |
| Maximum Output Current         | $I_{OUTMAX}$             | $V_{IN}=V_{OUT}+1V$ (Note1)                                      |        | 400                      | 550    | mA          |
| Load Regulation                | $\Delta V_{OUT}$         | $1mA \leq I_{OUT} \leq 100mA$                                    |        | 4                        | 10     | mV          |
| Dropout Voltage (Note 1)       | $V_{DIF1}$               | $I_{OUT}=100mA$  |        | 125                      | 140    | mV          |
|                                | $V_{DIF2}$               | $I_{OUT}=200mA$  |        | 250                      | 270    | mV          |
| Supply Current                 | $I_{SS}$                 | $V_{IN}=3V$ , $V_{CE}=V_{IN}$                                    |        | 45                       | 60     | $\mu A$     |
| Stand-by Current               | $I_{CEL}$                | $V_{IN}=3V$ , $V_{CE}=0V$  |        | 0                        | 1      | $\mu A$     |
| Line Regulation<br>(Note 1)    | $\Delta V_{OUT}$         | $I_{OUT}=30mA$<br>$V_{OUT}+1V \leq V_{IN} \leq 18V$              |        | 4                        | 15     | mV          |
| CE "High" Voltage              | $V_{CEH}$                | $RL=1.0K\Omega$  | 1.3    |                          | 18     | V           |
| CE "Low" Voltage               | $V_{CEL}$                | $RL=1.0K\Omega$  | 0      |                          | 0.7    | V           |
| CE "High" Current              | $I_{SH}$                 | $V_{CE}=7V$  | -0.1   |                          | 0.1    | $\mu A$     |
| CE "Low" Current               | $I_{SL}$                 | $V_{CE}=0V$  | -0.1   |                          | 0.1    | $\mu A$     |
| Short-circuit Current          | $I_{SHORT}$              | $V_{OUT}=0V$   |        | 70                       |        | mA          |
| Thermal Shutdown<br>Protection | $T_{sd}$                 | $I_{OUT}=1mA$ ,  |        | 165                      |        | $^{\circ}C$ |
| Over Current Protection        | $I_{limit}$              |  |        | 600                      |        | mA          |

### Note :

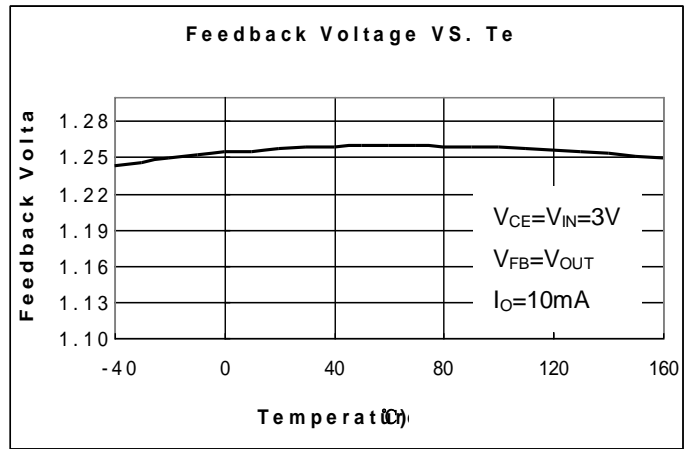
- $V_{OUT(T)}$  : Output Voltage less than 1.8V, the input Voltage should be 2.8V at least, and the others fulfil the rule of  $V_{in}=V_{out}+1$ .
- $V_{OUT(E)}$  : Effective Output Voltage ( i.e. The output voltage when " $V_{OUT(T)}+1.0V$ " is provided at the Vin pin while maintaining a certain  $I_{OUT}$  value.)
- $V_{DIF}$ :  $V_{IN1}-V_{OUT(E)}$   
 $V_{IN1}$  : The input voltage when  $V_{OUT(E)}$  appears as input voltage is gradually decreased.  
 $V_{OUT(E)}$  : A voltage equal to 98% of the output voltage whenever an amply stabilized  $I_{OUT}$  ( $V_{OUT(T)}+1.0V$ ) is input.

## Type Characteristics

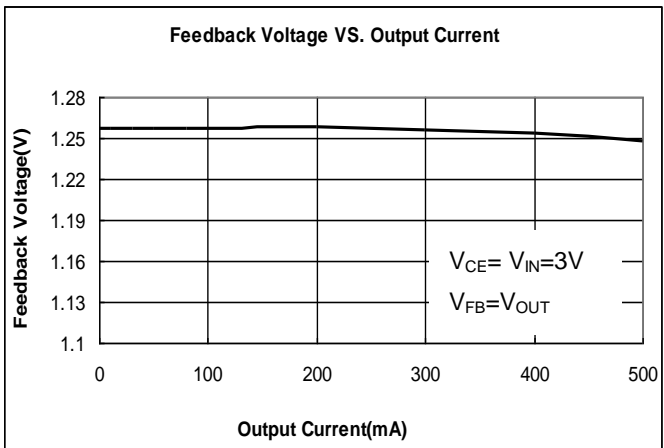
(1) Feedback Voltage VS. Input Voltage



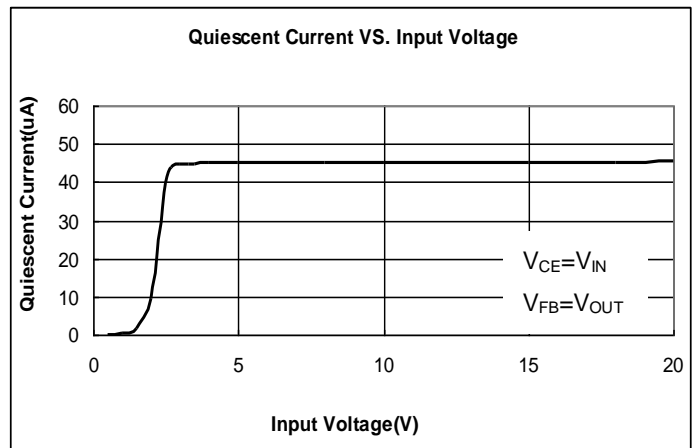
(2) Feedback Voltage VS. Temperature



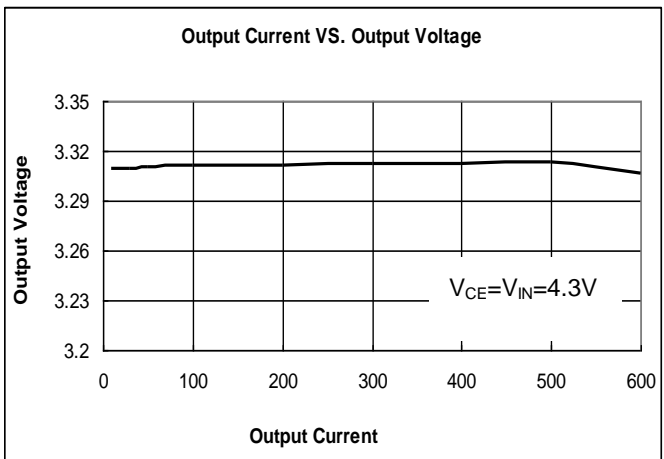
(3) Feedback Voltage VS. Output Current



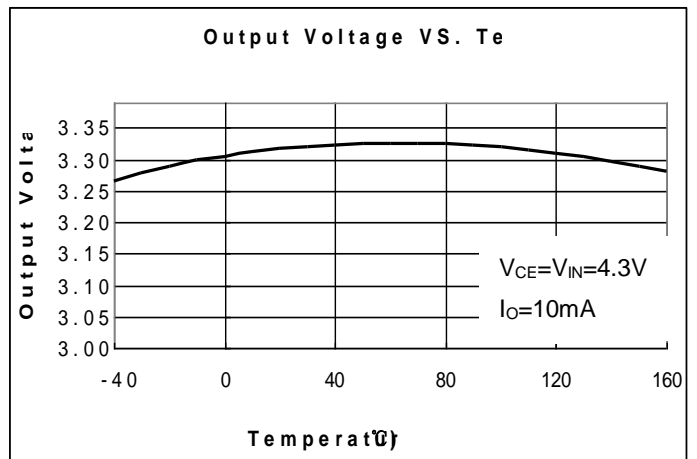
(4) Quiescent Current VS. Input Voltage



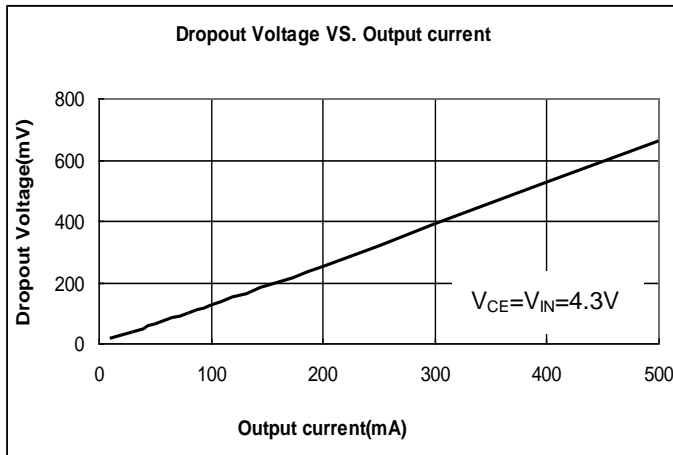
(5) Output Voltage VS. Output Current  
( $V_{IN}=V_{OUT}+1V$ ,  $V_{OUT}=3.3V$ )



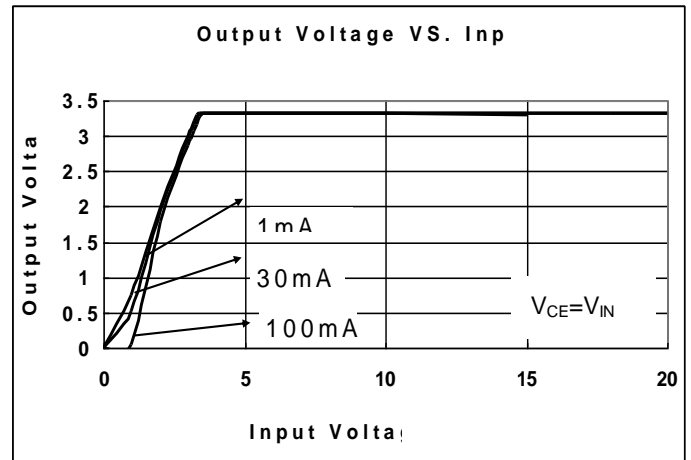
(6) Output Voltage VS. Temperature  
( $V_{IN}=V_{OUT}+1V$ ,  $V_{OUT}=3.3V$ ,  $I_{OUT}=10mA$ )



(7) Dropout Voltage VS. Output Current  
( $V_{IN}=V_{OUT}+1V, V_{OUT}=3.3V$ )



(8) Output Voltage VS. Input Voltage  
( $V_{OUT}=3.3V$ )



## Applications Information

### 1. Setting the Output Voltage

ME6221 series output voltage can be set via a external resistor. AS the internal reference is 1.25V (Typical), the external voltage can optionally set between 1.25V and 5.0V by connecting a extra resistor between the Vout and  $V_{FB}$  pins and a resistor between the  $V_{FB}$  and  $V_{SS}$  pins.

The output voltage is calculated as below:

$$V_{OUT} = 1.25 \times \left( 1 + \frac{R_1}{R_2} \right)$$

**Table 1:** Resistor selection for output voltage setting (e.g.)

| $V_o$ (V) | R1 (K $\Omega$ ) | R2 (K $\Omega$ ) |
|-----------|------------------|------------------|
| 1.8       | 53               | 120              |
| 2.5       | 120              | 120              |
| 3.0       | 168              | 120              |
| 3.3       | 197              | 120              |
| 3.6       | 225              | 120              |
| 5.0       | 360              | 120              |

**Caution:** The value of R2 is more than 100K in the best.

## 2. Input Bypass Capacitor

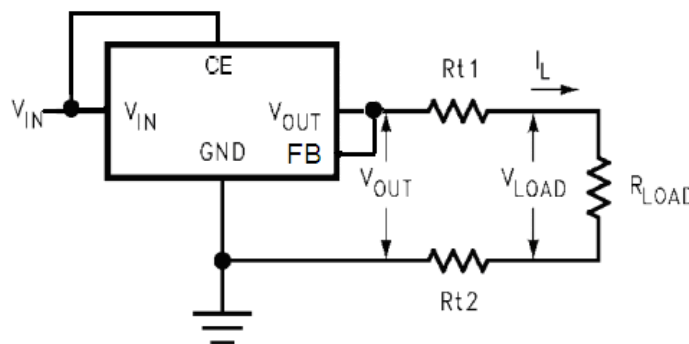
An input capacitor is recommended. A 1uF or more tantalum on the input is a suitable input bypassing for almost all applications.

## 3. Output Capacitor

The output capacitor is critical in maintaining regulator stability, and must meet the required conditions for both minimum amount of capacitance and ESR (Equivalent Series Resistance). The output capacitance required by the ME6221 is 2.2μF or more, if a tantalum capacitor is used. Any increase of the output capacitance will merely improve the loop stability and transient response. The ESR of the output capacitor should be less than 1Ω.

## 4. Load Regulation

The ME6221 regulates the voltage that appears between its output and adjust pins. In some cases, line resistances can introduce errors to the voltage across the load. To obtain the best load regulation, a few precautions are needed. Figure 1, shows a typical application. The  $R_{t1}$  and  $R_{t2}$  are the line resistances. It is obvious that the  $V_{LOAD}$  is less than the  $V_{OUT}$  by the sum of the voltage drops along the line resistances. In this case, the load regulation seen at the  $R_{LOAD}$  would be degraded from the datasheet specification. To improve this, the load should be tied directly to the output terminal on the positive side and directly tied to the ground terminal on the negative side.



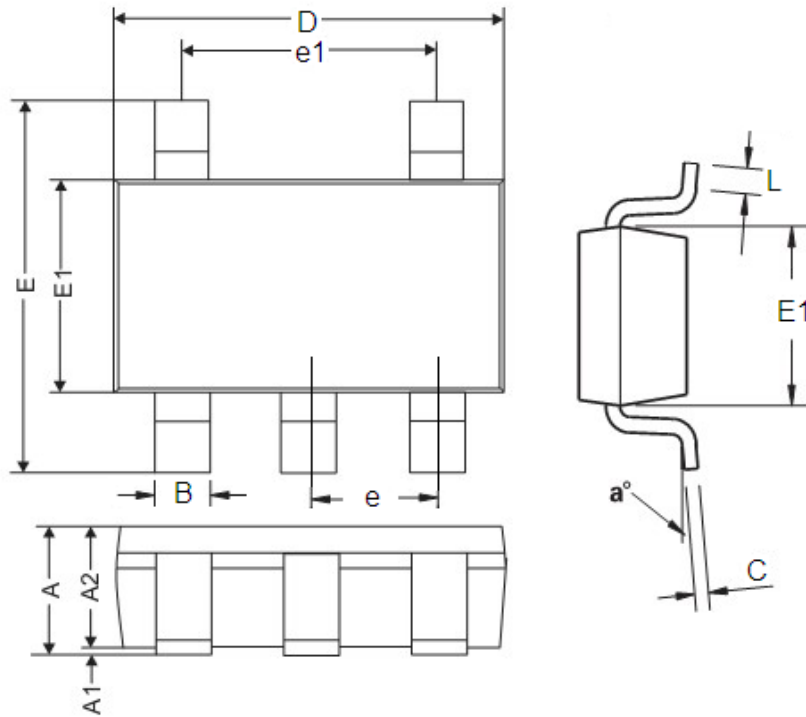
$$V_{LOAD} = V_{OUT} - I_L (R_{t1} + R_{t2})$$

**Fig.3** Typical Application



## Packaging Information

- Packaging Type: SOT23-5



| DIM | Millimeters |      | Inches    |        |
|-----|-------------|------|-----------|--------|
|     | Min         | Max  | Min       | Max    |
| A   | 0.9         | 1.45 | 0.0354    | 0.0570 |
| A1  | 0           | 0.15 | 0         | 0.0059 |
| A2  | 0.9         | 1.3  | 0.0354    | 0.0511 |
| B   | 0.2         | 0.5  | 0.0078    | 0.0196 |
| C   | 0.09        | 0.26 | 0.0035    | 0.0102 |
| D   | 2.7         | 3.10 | 0.1062    | 0.1220 |
| E   | 2.2         | 3.2  | 0.0866    | 0.1181 |
| E1  | 1.30        | 1.80 | 0.0511    | 0.0708 |
| e   | 0.95REF     |      | 0.0374REF |        |
| e1  | 1.90REF     |      | 0.0748REF |        |
| L   | 0.10        | 0.60 | 0.0039    | 0.0236 |
| a°  | 0°          | 30°  | 0°        | 30°    |

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