

**600mA ULDO REGULATOR WITH ENABLE****AP2318****General Description**

The AP2318 is a series of ultra low dropout regulators optimized for low voltage applications where transient response and minimum input voltage are critical.

The AP2318 provides current limit and thermal shutdown. Its circuit includes a trimmed bandgap reference to assure output voltage accuracy to be within  $\pm 1\%$ . On-chip thermal shutdown provides protection against any combination of overload and ambient temperatures that would create excessive junction temperatures.

The AP2318 has both fixed and adjustable versions. The 1.3V fixed versions integrate the corresponding resistor divider. The adjustable version can set the output voltage through two external resistors.

The AP2318 is available in the standard DFN-3 $\times$ 3-8 and SOIC-8 packages.

**Features**

- Wide Operating Voltage Ranges: 2.5V to 12V
- Output Voltage Accuracy:  $\pm 1\%$
- On-chip Thermal Shutdown
- ESD: Human Body Model 3kV  
Machine Model 600V
- Operating Junction Temperature:  $-40^{\circ}\text{C}$  to  $125^{\circ}\text{C}$

**Applications**

- Notebook
- USB Device
- Add-on Card
- DVD Player
- PC Motherboard

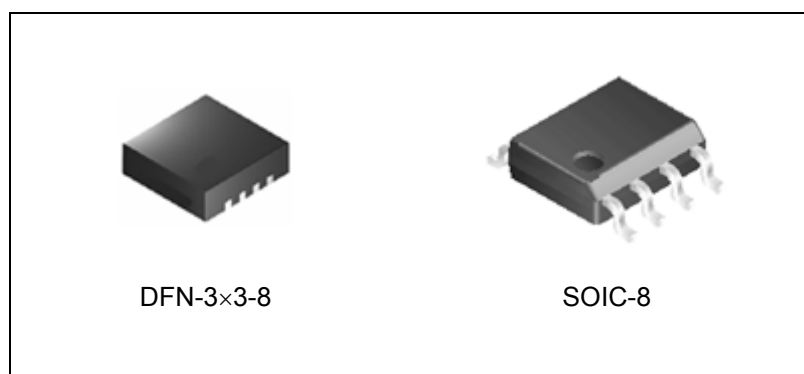


Figure 1. Package Types of AP2318

**600mA ULDO REGULATOR WITH ENABLE**

**AP2318**

**Pin Configuration**

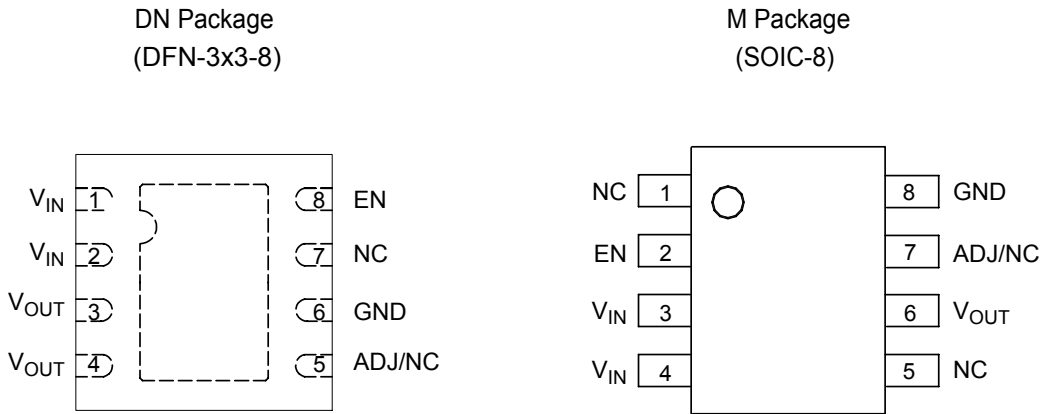


Figure 2. Pin Configuration of AP2318 (Top View)

**Functional Block Diagram**

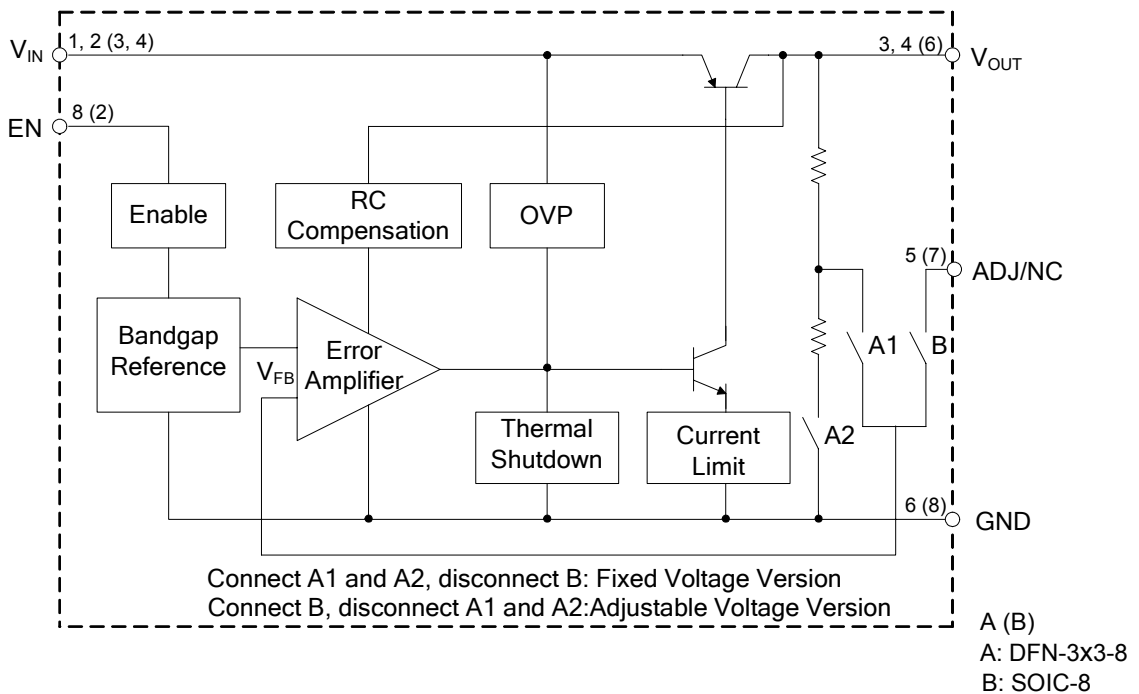


Figure 3. Functional Block Diagram of AP2318



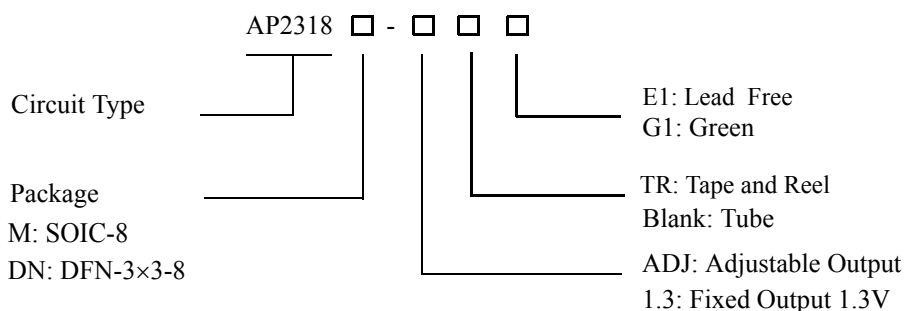
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**Pin Description**

| Pin Number |        | Pin Name         | Function                     |
|------------|--------|------------------|------------------------------|
| DFN-3×3-8  | SOIC-8 |                  |                              |
| 1, 2       | 3, 4   | V <sub>IN</sub>  | Input Voltage                |
| 3, 4       | 6      | V <sub>OUT</sub> | Output Voltage               |
| 5          | 7      | ADJ/NC           | Adjust Voltage/No Connection |
| 6          | 8      | GND              | Ground                       |
| 7          | 1, 5   | NC               | No connection                |
| 8          | 2      | EN               | On/Off control               |

**Ordering Information**



| Package   | Temperature Range | Part Number      |                  | Marking ID  |             | Packing Type |
|-----------|-------------------|------------------|------------------|-------------|-------------|--------------|
|           |                   | Lead Free        | Green            | Lead Free   | Green       |              |
| SOIC-8    | -40 to 125°C      | AP2318M-ADJE1    | AP2318M-ADJG1    | 2318M-ADJE1 | 2318M-ADJG1 | Tube         |
|           |                   | AP2318M-ADJTRE1  | AP2318M-ADJTRG1  | 2318M-ADJE1 | 2318M-ADJG1 | Tape & Reel  |
|           |                   | AP2318M-1.3E1    | AP2318M-1.3G1    | 2318M-1.3E1 | 2318M-1.3G1 | Tube         |
|           |                   | AP2318M-1.3TRE1  | AP2318M-1.3TRG1  | 2318M-1.3E1 | 2318M-1.3G1 | Tape & Reel  |
| DFN-3×3-8 | -40 to 125°C      | AP2318DN-ADJTRE1 | AP2318DN-ADJTRG1 | F9E         | B9E         | Tape & Reel  |
|           |                   | AP2318DN-1.3TRE1 | AP2318DN-1.3TRG1 | F9B         | B9B         | Tape & Reel  |

BCD Semiconductor's Pb-free products, as designated with "E1" suffix in the part number, are RoHS compliant. Products with "G1" suffix are available in green packages.

**600mA ULDO REGULATOR WITH ENABLE****AP2318****Absolute Maximum Ratings (Note 1)**

| Parameter                           | Symbol        | Value      | Unit |      |
|-------------------------------------|---------------|------------|------|------|
| Input Voltage                       | $V_{IN}$      | 15         | V    |      |
| Operating Junction Temperature      | $T_J$         | 150        | °C   |      |
| Storage Temperature Range           | $T_{STG}$     | -65 to 150 | °C   |      |
| Lead Temperature (Soldering, 10sec) | $T_{LEAD}$    | 260        | °C   |      |
| Thermal Resistance (Note 2)         | $\theta_{JA}$ | SOIC-8     | 135  | °C/W |
|                                     |               | DFN-3×3-8  | 120  |      |
| ESD (Human Body Model)              | ESD           | 3000       | V    |      |
| ESD (Machine Model)                 | ESD           | 600        | V    |      |

Note 1: Stresses greater than 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 under "Recommended Operating Conditions" is not implied. Exposure to "Absolute Maximum Ratings" for extended periods may affect device reliability.

Note 2: Absolute maximum ratings indicate limits beyond which damage to the component may occur. Electrical specifications do not apply when operating the device outside of its operating ratings. The maximum allowable power dissipation is a function of the maximum junction temperature,  $T_J(\max)$ , the junction-to-ambient thermal resistance,  $\theta_{JA}$ , and the ambient temperature,  $T_A$ . The maximum allowable power dissipation at any ambient temperature is calculated using:  $P_D(\max) = (T_J(\max) - T_A) / \theta_{JA}$ . Exceeding the maximum allowable power dissipation will result in excessive die temperature, and the regulator will go into thermal shutdown.

**Recommended Operating Conditions**

| Parameter                            | Symbol   | Min | Max | Unit |
|--------------------------------------|----------|-----|-----|------|
| Input Voltage                        | $V_{IN}$ | 2.5 | 12  | V    |
| Enable Voltage                       | $V_{EN}$ |     | 12  | V    |
| Operating Junction Temperature Range | $T_J$    | -40 | 125 | °C   |



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**Electrical Characteristics**

Operating Conditions:  $2.5V \leq V_{IN} \leq 12V$ ,  $C_{IN} = 1\mu F$ ,  $C_{OUT} = 2.2\mu F$ ,  $T_J = 25^\circ C$ , unless otherwise specified. ( $P \leq$  Maximum Power Dissipation). Limits appearing in **Boldface** type apply over the entire junction temperature range for operation of  $-40^\circ C$  to  $125^\circ C$ .

| Parameter                              | Symbol          | Conditions   | Min                   | Typ                   | Max                   | Unit         |
|--|-----------------|--|-----------------------|-----------------------|-----------------------|--------------|
| Reference Voltage                      | $V_{REF}$       | AP2318-ADJ $I_{OUT} = 10mA$ , $V_{IN} - V_{OUT} = 2V$ , $T_J = 25^\circ C$<br>$10mA \leq I_{OUT} \leq 600mA$ , $V_{OUT} + 2V \leq V_{IN} \leq 12V$ | 0.792<br><b>0.784</b> | 0.800<br><b>0.800</b> | 0.808<br><b>0.816</b> | V            |
| Output Voltage                         | $V_{OUT}$       | $I_{OUT} = 10mA$ , $V_{IN} = 2.5V$ , $T_J = 25^\circ C$<br>$10mA \leq I_{OUT} \leq 600mA$ , $2.5V \leq V_{IN} \leq 12V$                            | -1%<br><b>-2%</b>     |                       | 1%<br><b>2%</b>       | V            |
| Maximum Output Current                 | $I_{OUT(max)}$  | $V_{IN} - V_{OUT} = 2V$  | 0.85                  | 1.2                   |                       | A            |
| Line Regulation                        | $V_{RLINE}$     | AP2318-ADJ<br>$I_{OUT} = 10mA$ , $V_{OUT} + 2V \leq V_{IN} \leq 12V$   |                       | 0.05                  | <b>0.2</b>            | %/V          |
|  |                 | $I_{OUT} = 10mA$ , $2.5V \leq V_{IN} \leq 12V$   |                       | 1                     | <b>6</b>              | mV           |
| Load Regulation                        | $V_{RLOAD}$     | AP2318-ADJ<br>$V_{IN} = V_{OUT} + 2V$ , $10mA \leq I_{OUT} \leq 600mA$   |                       | 0.2                   | <b>0.4</b>            | %            |
|  |                 | $V_{IN} = 2.5V$ , $10mA \leq I_{OUT} \leq 600mA$   |                       | 1                     | <b>10</b>             | mV           |
| Dropout Voltage                        | $V_{DROP}$      | $\Delta V_{OUT} (\Delta V_{REF}) = 1%$ , $I_{OUT} = 600mA$   |                       | 0.35                  |                       | V            |
| Adjust Pin Current                     | $I_{ADJ}$       |  |                       | 0.05                  | <b>1</b>              | $\mu A$      |
| Minimum Load Current                   | $I_{LOAD(min)}$ | $V_{OUT} + 2V \leq V_{IN} \leq 12V$ (ADJ only)   |                       | <b>1.7</b>            | <b>5</b>              | mA           |
| Quiescent Current                      | $I_Q$           | $V_{IN} = V_{OUT} + 2V$ , $I_{OUT} = 0mA$  |                       | 250                   |                       | $\mu A$      |
| RMS Output Noise (% of $V_{OUT}$ )     | $V_{NOI}$       | $T_A = 25^\circ C$ , $10Hz \leq f \leq 20kHz$  |                       | 0.003                 |                       | %            |
| Thermal Shutdown Temperature           |                 |  |                       | 150                   |                       | $^\circ C$   |
| Thermal Shutdown Hysteresis            |                 |  |                       | 25                    |                       | $^\circ C$   |
| Enable Input Voltage                   | $V_{EN}$        | Enable logic low   |                       |                       | <b>0.8</b>            | V            |
|  |                 | Enable logic high  | 2.25                  |                       |                       |              |
| Enable Input Current                   | $I_{EN}$        | $V_{EN} = 2.25V$   |                       | 5                     | 15                    | $\mu A$      |
|  |                 | $V_{EN} = 0.8V$  |                       |                       | 4                     | $\mu A$      |
| Thermal Resistance, (Junction to Case) | $\theta_{JC}$   | DFN-3x3-8  |                       | 15                    |                       | $^\circ C/W$ |
|  |                 | SOIC-8   |                       | 24                    |                       |              |



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Typical Performance Characteristics

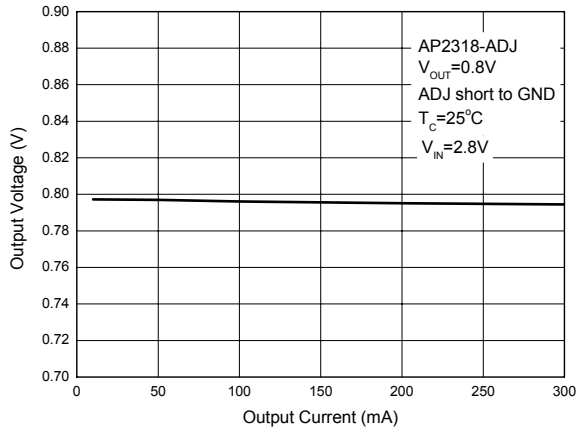


Figure 4. Output Voltage vs. Output Current (Conditions:  $V_{OUT}=0.8V$ , ADJ Short to GND)

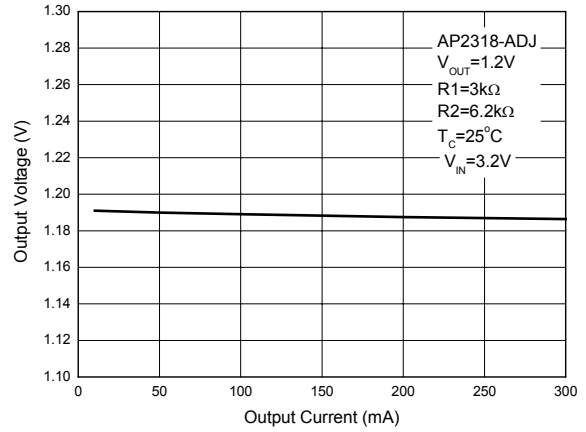


Figure 5. Output Voltage vs. Output Current (Conditions:  $V_{OUT}=1.2V$ ,  $R1=3k\Omega$ ,  $R2=6.2k\Omega$ )

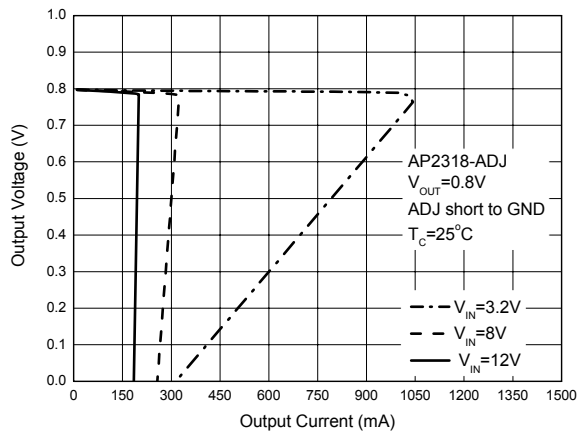


Figure 6. Output Voltage vs. Output Current (Conditions:  $V_{OUT}=0.8V$ , ADJ Short to GND)

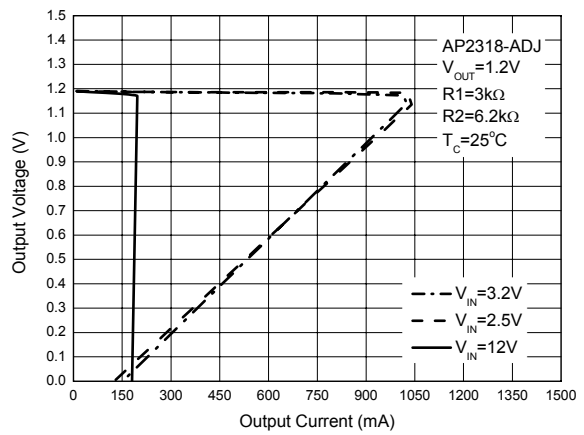


Figure 7. Output Voltage vs. Output Current (Conditions:  $V_{OUT}=1.2V$ ,  $R1=3k\Omega$ ,  $R2=6.2k\Omega$ )



Typical Performance Characteristics (Continued)

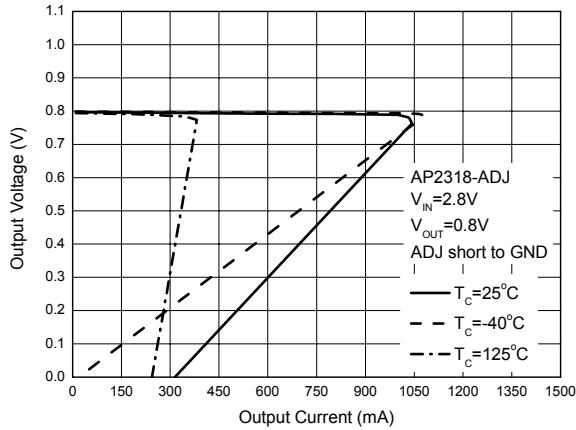


Figure 8. Output Voltage vs. Output Current (Conditions:  $V_{OUT}=0.8V$ , ADJ Short to GND)

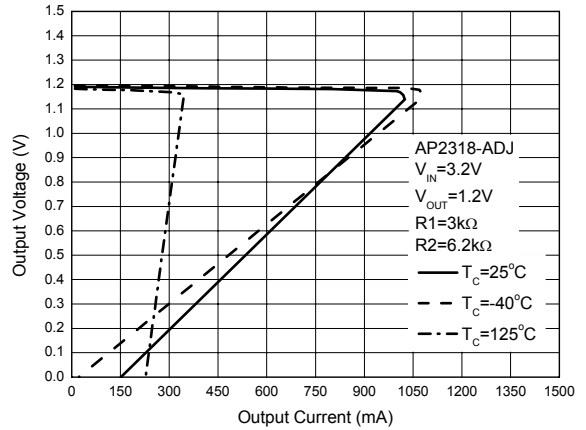


Figure 9. Output Voltage vs. Output Current (Conditions:  $V_{OUT}=1.2V$ ,  $R1=3k\Omega$ ,  $R2=6.2k\Omega$ )

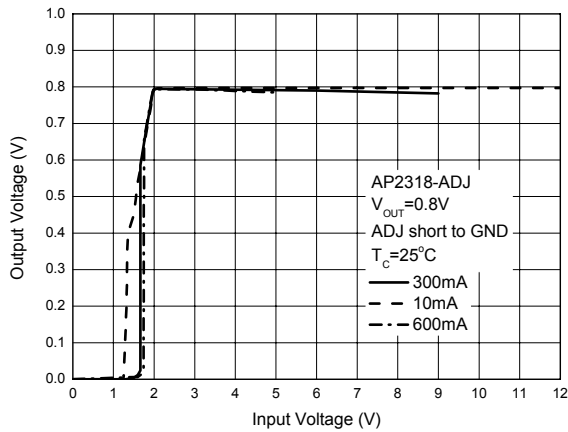


Figure 10. Output Voltage vs. Input Voltage (Conditions:  $V_{OUT}=0.8V$ , ADJ Short to GND)

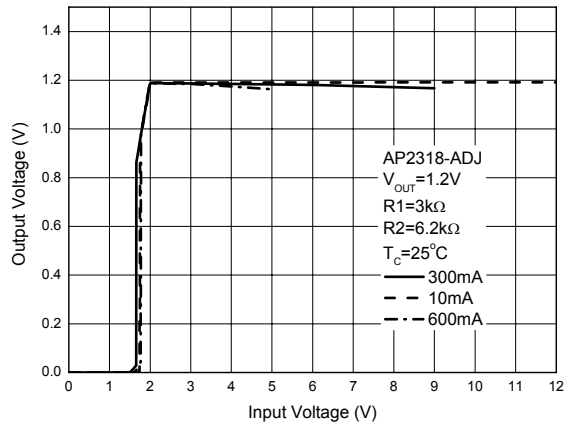


Figure 11. Output Voltage vs. Input Voltage (Conditions:  $V_{OUT}=1.2V$ ,  $R1=3k\Omega$ ,  $R2=6.2k\Omega$ )



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**Typical Performance Characteristics (Continued)**

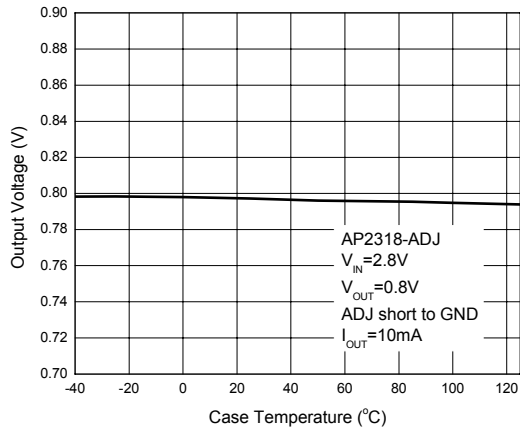


Figure 12. Output Voltage vs. Case Temperature (Conditions:  $V_{OUT}=0.8V$ , ADJ Short to GND)

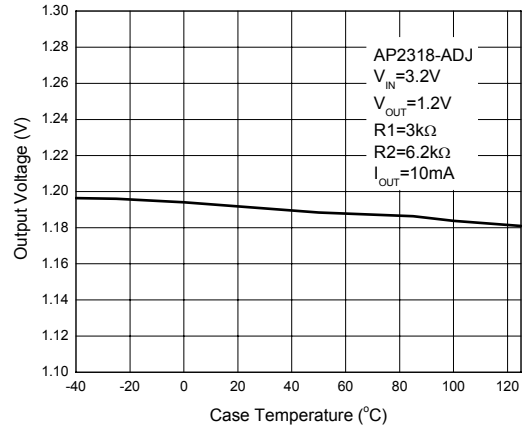


Figure 13. Output Voltage vs. Case Temperature (Conditions:  $V_{OUT}=1.2V$ ,  $R1=3k\Omega$ ,  $R2=6.2k\Omega$ )

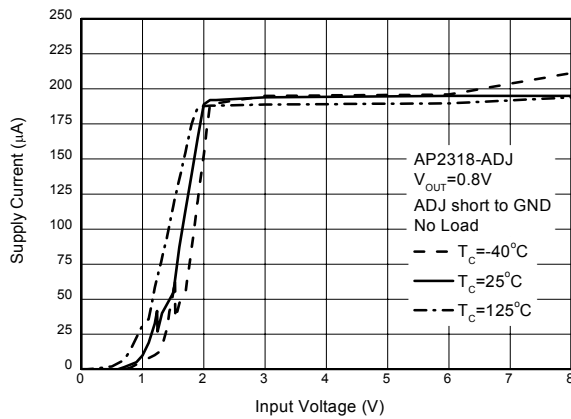


Figure 14. Supply Current vs. Input Voltage (Conditions:  $V_{OUT}=0.8V$ , ADJ Short to GND)

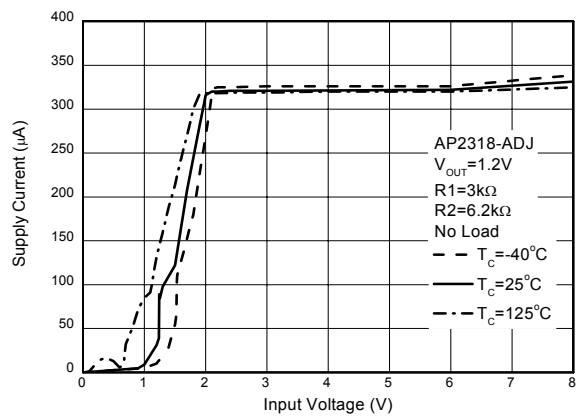


Figure 15. Supply Current vs. Input Voltage (Conditions:  $V_{OUT}=1.2V$ ,  $R1=3k\Omega$ ,  $R2=6.2k\Omega$ )





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Typical Performance Characteristics (Continued)

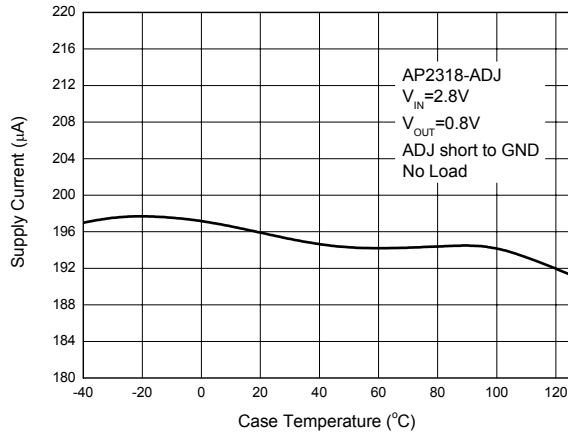


Figure 16. Supply Current vs. Case Temperature (Conditions:  $V_{OUT}=0.8V$ , ADJ Short to GND)

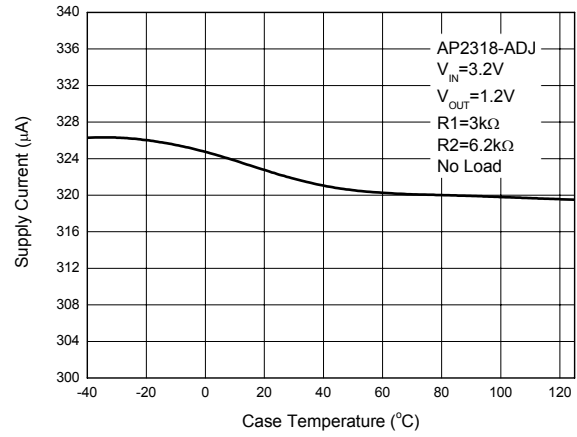


Figure 17. Supply current vs. Case Temperature (Conditions:  $V_{OUT}=1.2V$ ,  $R1=3k\Omega$ ,  $R2=6.2k\Omega$ )

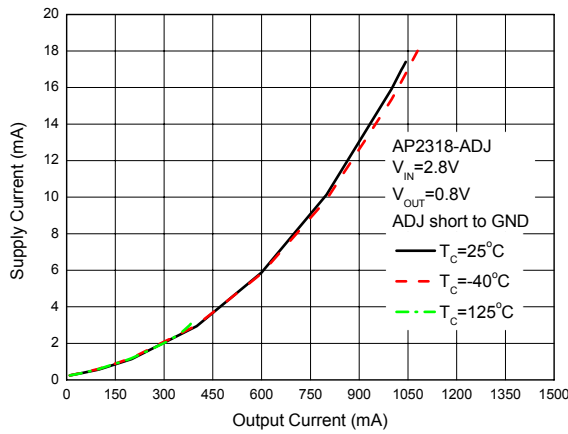


Figure 18. Supply Current vs. Output Current (Conditions:  $V_{OUT}=0.8V$ , ADJ Short to GND)

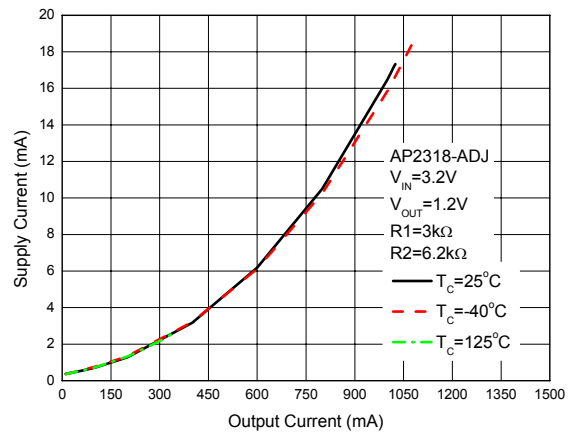


Figure 19. Supply Current vs. Output Current (Conditions:  $V_{OUT}=1.2V$ ,  $R1=3k\Omega$ ,  $R2=6.2k\Omega$ )



600mA ULDO REGULATOR WITH ENABLE

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Typical Performance Characteristics (Continued)

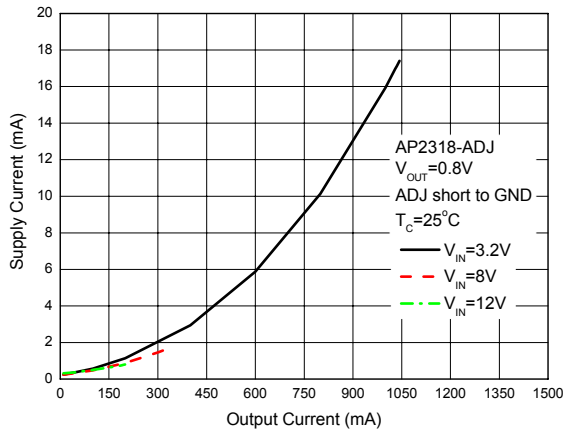


Figure 20. Supply Current vs. Output Current  
(Conditions:  $V_{OUT}=0.8V$ , ADJ Short to GND)

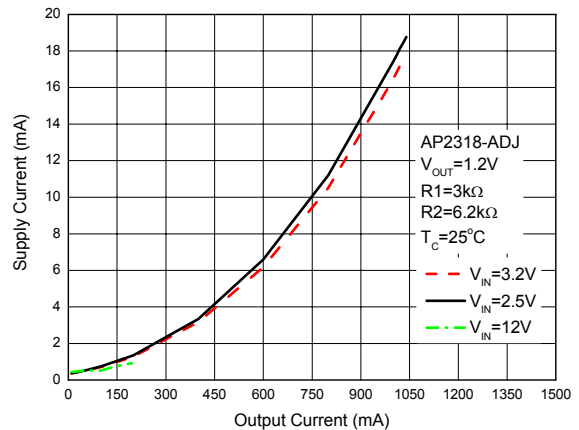


Figure 21. Supply Current vs. Output Current  
(Conditions:  $V_{OUT}=1.2V$ ,  $R1=3k\Omega$ ,  $R2=6.2k\Omega$ )

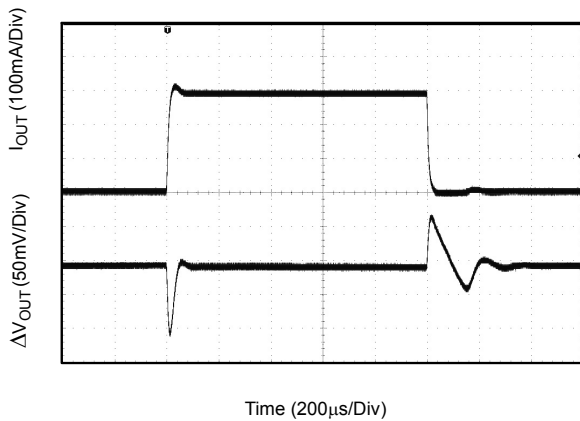


Figure 22. Load Transient Response  
(Conditions:  $V_{IN}=2.5V$ ,  $V_{OUT}=1.3V$ ,  $I_{OUT}=1mA$  to  $300mA$ ,  $C_{IN}=1\mu F$ ,  $C_{OUT}=2.2\mu F$ )

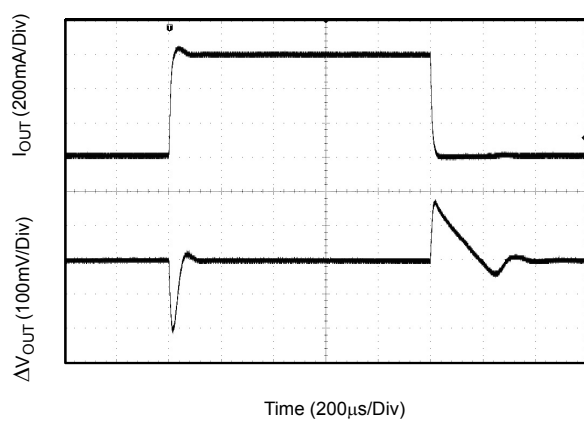


Figure 23. Load Transient Response  
(Conditions:  $V_{IN}=2.5V$ ,  $V_{OUT}=1.8V$ ,  $I_{OUT}=1mA$  to  $600mA$ ,  $C_{IN}=1\mu F$ ,  $C_{OUT}=2.2\mu F$ )

Typical Performance Characteristics (Continued)



Figure 24. Line Transient Response

(Conditions:  $V_{IN}=2.5V$  to  $5V$ ,  $V_{OUT}=0.8V$ ,  $I_{OUT}=10mA$ ,  $C_{IN}=0\mu F$ ,  $C_{OUT}=2.2\mu F$ )



Figure 25. Line Transient Response

(Conditions:  $V_{IN}=2.5V$  to  $10V$ ,  $V_{OUT}=0.8V$ ,  $I_{OUT}=10mA$ ,  $C_{IN}=0\mu F$ ,  $C_{OUT}=2.2\mu F$ )

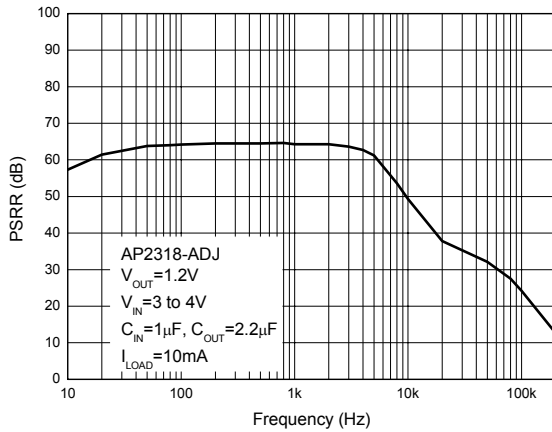


Figure 26. PSRR vs. Frequency

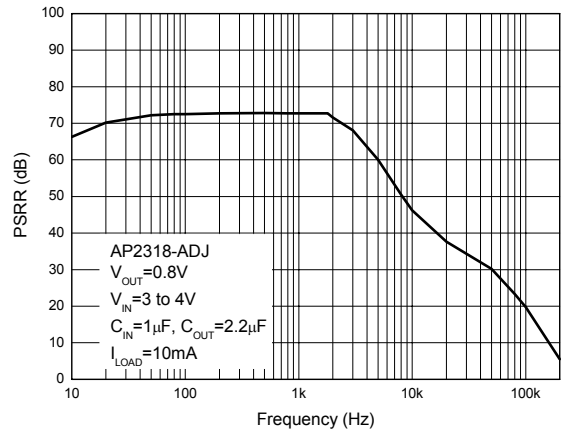


Figure 27. PSRR vs. Frequency



Typical Performance Characteristics (Continued)

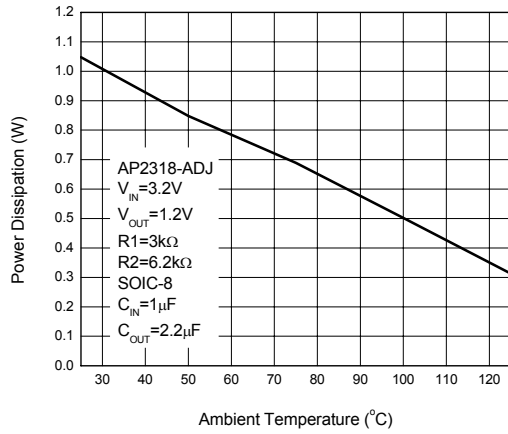


Figure 28. Power Dissipation vs. Ambient Temperature (Conditions:  $V_{OUT}=1.2V$ ,  $R1=3k\Omega$ ,  $R2=6.2k\Omega$ )

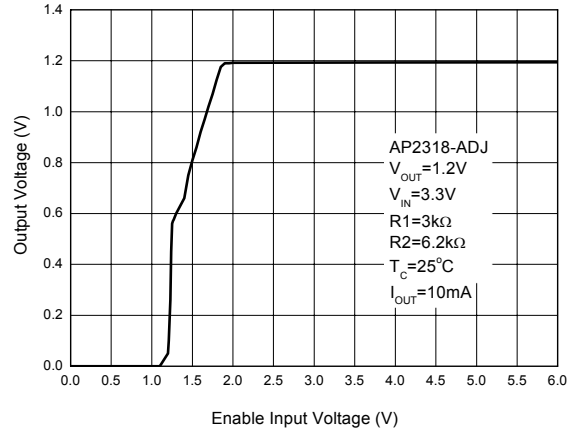


Figure 29. Output Voltage vs. Enable Input Voltage (Conditions:  $V_{OUT}=1.2V$ ,  $R1=3k\Omega$ ,  $R2=6.2k\Omega$ )

**Typical Applications**

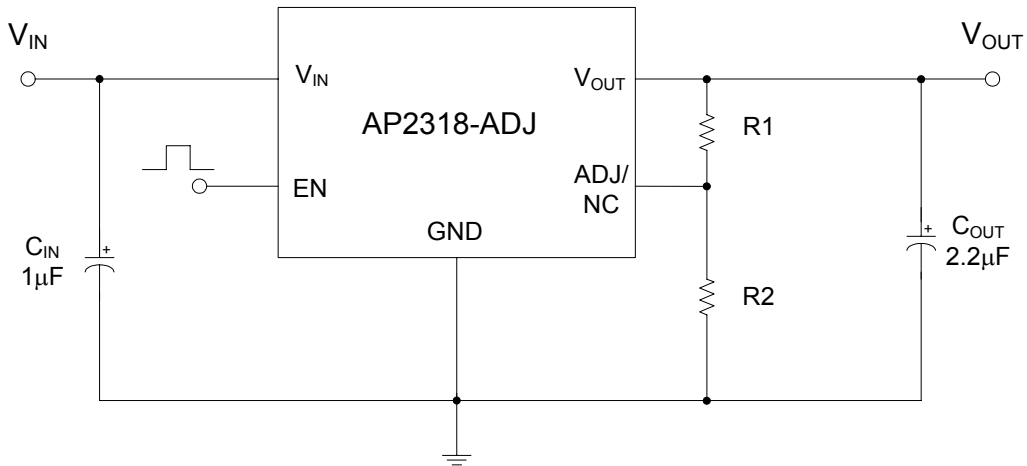


Figure 30. Typical Applications of AP2318 ADJ Version,  $V_{OUT}=0.8*(R1+R2)/R2$

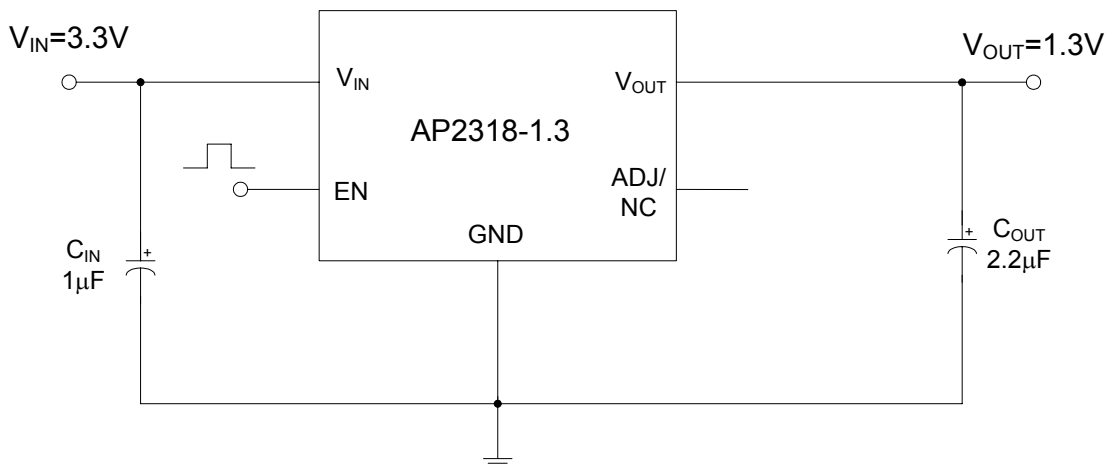


Figure 31. Typical Applications of AP2318 Fixed 1.3V Version,  $V_{OUT}=1.3V$



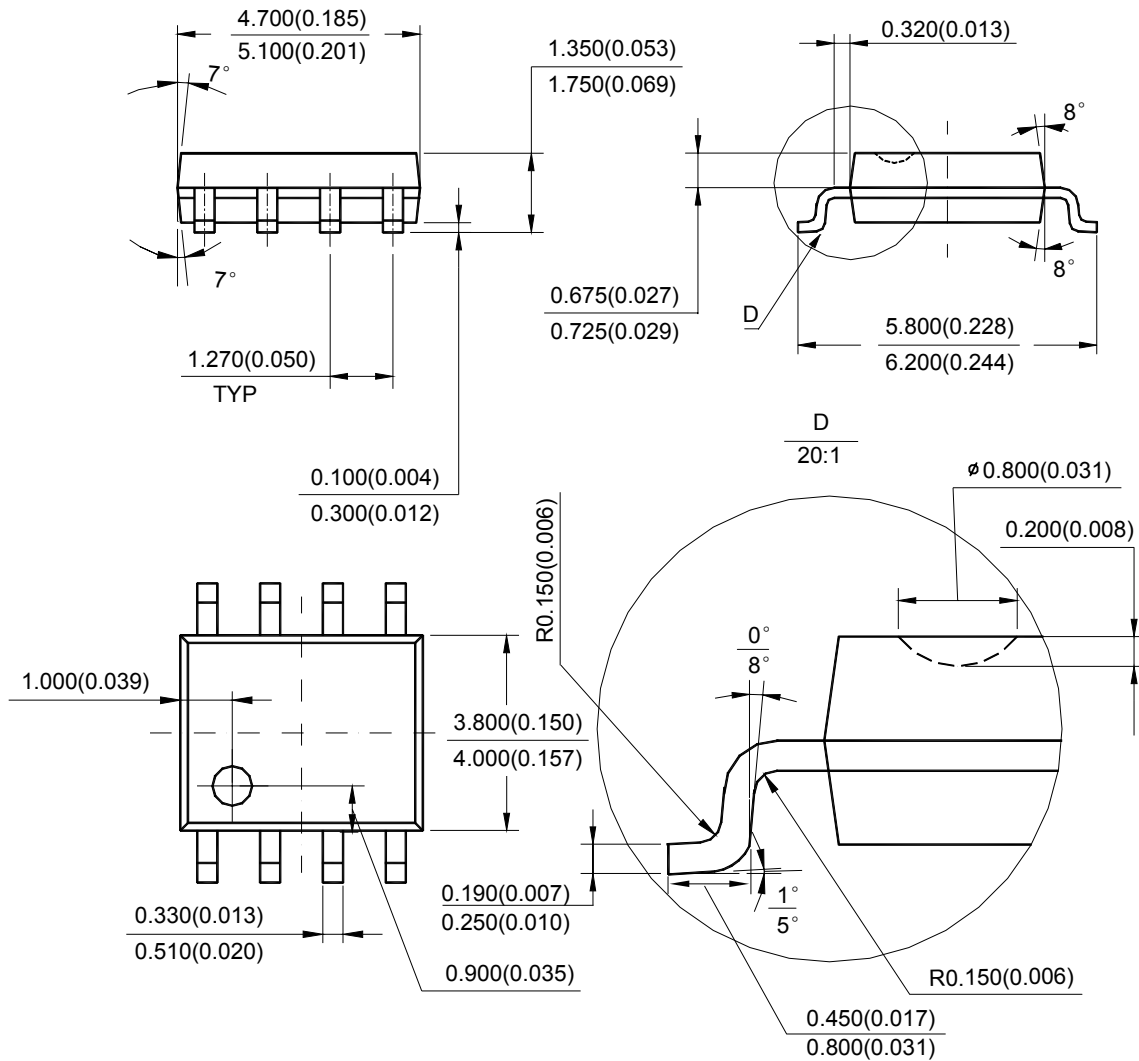
**600mA ULDO REGULATOR WITH ENABLE**

**AP2318**

**Mechanical Dimensions**

**SOIC-8**

**Unit: mm(inch)**



Note: Eject hole, oriented hole and mold mark is optional.



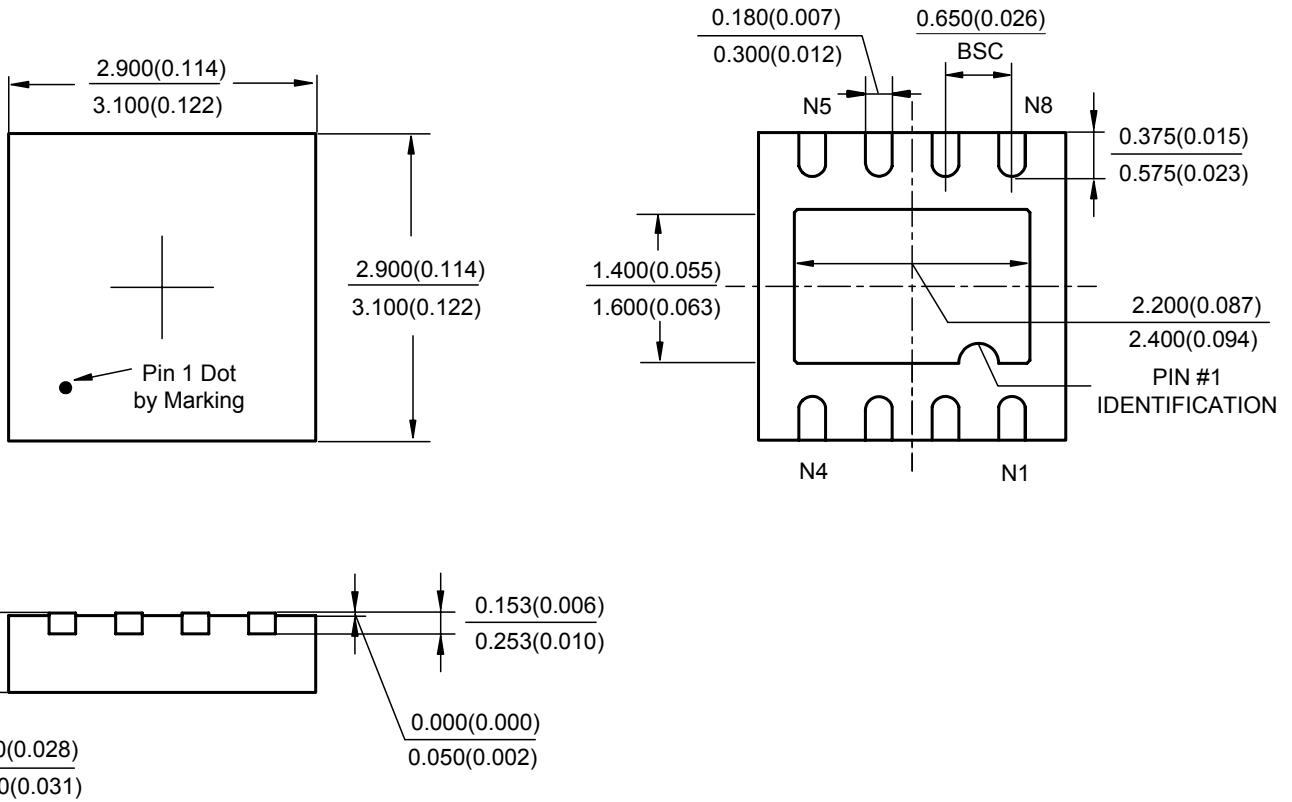
**600mA ULDO REGULATOR WITH ENABLE**

**AP2318**

**Mechanical Dimensions (Continued)**

**DFN-3x3-8**

**Unit: mm(inch)**





## **BCD Semiconductor Manufacturing Limited**

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