



1A VERY LOW DROPOUT POSITIVE FIXED AND ADJUSTABLE REGULATORS

FEATURES

- Low Dropout Voltage (500mV at 1A)
- 1% Voltage Reference Accuracy
- Low Ground Current
- 1µA Maximum Quiescent Current in Shutdown (APU1207, APU1208)
- Fast Transient Response
- Current Limit and Thermal Shutdown
- Error Flag Signal for Output out of Regulation (APU1207, APU1208)
- RoHS Compliant

APPLICATIONS

- 2.5V Supply from 3.3V Input for the new generation of Logic ICs
- Computer Mother Board, Add-On Cards
- High Efficiency Post Regulator in Switch Mode Power Supply (SMPS)

DESCRIPTION

The APU1206 family of devices are ultra low dropout 1A regulators using PNP transistor as the pass element. These products are ideal when a single input supply is only available and the dropout voltage is less than 1V, exceeding the minimum dropout characteristics of NPN/PNP hybrid regulators. One common application of these regulators is where input is 3.3V and a 2.5V output is needed.

Besides the low dropout of less than 0.5V, other features of the family of the parts are: micro-power shut-down capability and output UVLO detection where Flag pin is switched low when output is below 5% of its nominal point.

TYPICAL APPLICATION

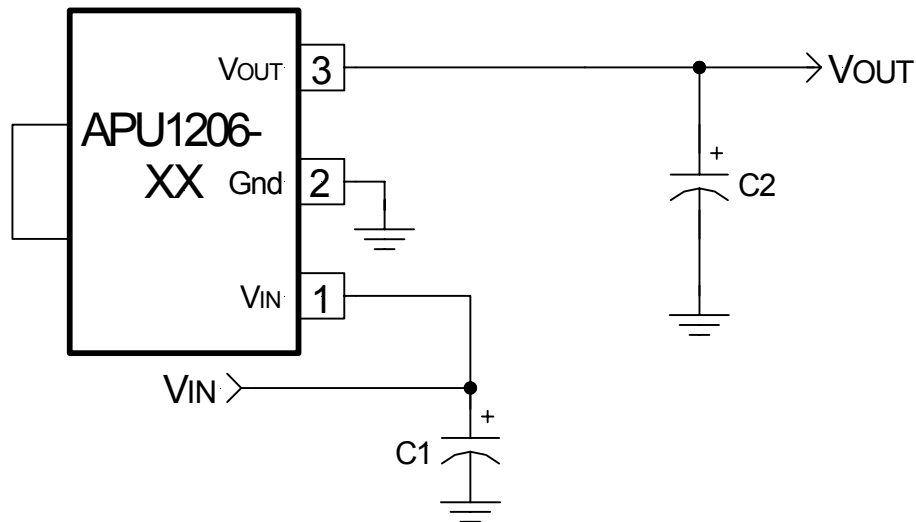


Figure 1 - Typical application of the 1206-XX in a 3-Pin SOT-223 package.



PACKAGE ORDER INFORMATION

Basic Part

| T _J (°C) | 2-PIN TO-252(H) | 3-PIN SOT-223(K) | 8-PIN PLASTIC SOIC(M) | VOLTAGE | PIN FUNCTIONS |
|---------------------|--------------------|---------------------|--------------------------|---------|--|
| 0 To 125 | APU1206H-18 | APU1206K-18 | NA | 1.8V | V _{IN} , V _{OUT} , Gnd |
| 0 To 125 | APU1206H-25 | APU1206K-25 | NA | 2.5V | V _{IN} , V _{OUT} , Gnd |
| 0 To 125 | APU1206H-33 | APU1206K-33 | NA | 3.3V | V _{IN} , V _{OUT} , Gnd |
| 0 To 125 | NA | NA | APU1207M-18 | 1.8V | V _{IN} , V _{OUT} , Gnd, Enable, Flag |
| 0 To 125 | NA | NA | APU1207M-25 | 2.5V | V _{IN} , V _{OUT} , Gnd, Enable, Flag |
| 0 To 125 | NA | NA | APU1207M-33 | 3.3V | V _{IN} , V _{OUT} , Gnd, Enable, Flag |
| 0 To 125 | NA | NA | APU1208M | Adj | V _{IN} , V _{OUT} , Gnd, Flag, Adj |
| 0 To 125 | NA | NA | APU1209M | Adj | V _{IN} , V _{OUT} , Gnd, Enable, Adj |



ABSOLUTE MAXIMUM RATINGS

| | |
|--|----------------|
| Input Voltage (V_{IN}) | 10V |
| Enable Input Voltage | 10V |
| Storage Temperature Range | -65°C To 150°C |
| Operating Junction Temperature Range | 0°C To 135°C |

PACKAGE INFORMATION

| 2-PIN PLASTIC TO-252 (D-Pak) | | 3-PIN PLASTIC SOT-223 (K) | |
|--|--|--|--|
| <p>APU1206</p> <p>FRONT VIEW</p> <p>Tab is Gnd</p> <p>$\theta_{JA}=70^{\circ}\text{C/W}$ for 0.5" Sq pad</p> | | <p>APU1206</p> <p>TOP VIEW</p> <p>Tab is Gnd</p> <p>$\theta_{JA}=90^{\circ}\text{C/W}$ for 0.4" Sq pad</p> | |
| 8-PIN PLASTIC SOIC (M) | | | |
| <p>APU1207</p> <p>TOP VIEW</p> <p>$\theta_{JA}=55^{\circ}\text{C/W}$ for 1" Sq pad</p> | | <p>APU1208</p> <p>TOP VIEW</p> <p>$\theta_{JA}=55^{\circ}\text{C/W}$ for 1" Sq pad</p> | |
| <p>APU1209</p> <p>TOP VIEW</p> <p>$\theta_{JA}=55^{\circ}\text{C/W}$ for 1" Sq pad</p> | | | |

ELECTRICAL SPECIFICATIONS

Unless otherwise specified, these specifications apply over $C_{IN}=C_{OUT}=10\mu\text{F}$, $V_{IN}=V_O+1\text{V}$, $V_{OUT}=V_{FB}$ (For adjustable version only), and $T_A=25^{\circ}\text{C}$. Typical values refer to $T_A=25^{\circ}\text{C}$. Low duty cycle pulse testing is used which keeps junction and case temperatures equal to the ambient temperature.

| PARAMETER | SYM | TEST CONDITION | MIN | TYP | MAX | UNITS |
|--|----------------------|--|------------|-------------------|-------------------|---------------|
| Initial Voltage Accuracy (see Table 1 for nominal values) | V_O | $I_O=10\text{mA}$, $T_A=25$ (Note 4) | -1 -1.3 | | 1 1.3 | % |
| Line Regulation | ΔV_I | $V_O + 1\text{V} < V_{IN} < 10$ | | 0.5 | 1 | % |
| Load Regulation (Note 1) | ΔV_L | $10\text{mA} < I_O < 1\text{A}$ $1\text{mA} < I_O < 150\text{mA}$ | | 0.5 | 0.7 0.5 | % |
| Output Voltage Temp Coef. | $\Delta V_{O(T)}$ | | | 20 | 100 | ppm/ |
| Dropout Voltage (Note 2) | $\Delta V_{I(O)}$ | $I_O=100\text{mA}$ (Note 4) $I_O=500\text{mA}$ (Note 4) $I_O=1000\text{mA}$ (Note 4) | | 100 300 500 | 200 400 650 | mV |
| Ground Current (Note 3) | I_G | $V_{IN}=V_O + 1$ for all conditions: $I_O=100\text{mA}$ (Note 4) $I_O=500\text{mA}$ (Note 4) $I_O=1000\text{mA}$ (Note 4) | | | 3 15 50 | mA |
| Current Limit | I_{CL} | $V_O=5\%$ Below Regulation Point | 1.1 | 1.4 | | A |
| Minimum Input Voltage | $V_{IN(\text{min})}$ | | | 2.1 | 2.3 | V |
| APU1208, APU1209 | | | | | | |
| Adjust Pin Current | I_{ADJ} | $V_{IN}=2.5\text{V}$, $V_O=V_{ADJ}$ (Note 4) | | | 0.1 | μA |
| Minimum Load Current | $I_{O(\text{min})}$ | | 1 | | | mA |



| PARAMETER | SYM | TEST CONDITION | MIN | TYP | MAX | UNITS |
|--------------------------------|--------------|-------------------------------------|-----|------------|-----|---------|
| APU1207, APU1209 | | | | | | |
| Ground Current - SD Activated | $I_{Q(SD)}$ | Enable=Open | | 0.01 | 1 | μA |
| Enable Pin Input LO Voltage | $V_{EN(L)}$ | Regulator OFF (Note 4) | | | 0.8 | V |
| Enable Pin Input HI Voltage | $V_{EN(L)}$ | Regulator ON (Note 4) | 2 | | | V |
| Enable Pin Input LO Current | | $V_{EN(L)}=0V$ to 0.8V (Note 4) | | 0.1 | 2 | μA |
| Enable Pin Input HI Current | | $V_{EN(L)}=2V$ to V_{in} (Note 4) | | 100 | 600 | μA |
| APU1207, APU1208 | | | | | | |
| Flag Output Threshold Voltage | $V_{TH(FG)}$ | | | 5 | | % V_o |
| Flag Output Hysteresis Voltage | V_{HYS} | Output Ramping Up | | 0.8 | | % V_o |
| Flag Output Saturation Voltage | $V_{F(SAT)}$ | $I_o=5mA$ $I_o=500\mu A$ | | 400 230 | | mV |

Note 1: Low duty cycle pulse testing with Kelvin connections is required in order to maintain accurate data.

Note 2: Dropout voltage is defined as the minimum differential voltage between V_{IN} and V_{OUT} required to maintain regulation at V_{OUT} . It is measured when the output voltage drops 1% below its nominal value.

Note 3: Ground current is the regulator quiescent current plus the pass transistor current. The total current from the supply is the sum of the load current plus the ground pin current.

Note 4: The specification applies for the junction temperature of 0 to +125.

PIN DESCRIPTIONS

| PIN SYMBOL | PIN DESCRIPTION |
|------------------------------|--|
| V_{IN} (All devices) | The input pin of the regulator. Typically a large storage capacitor is connected from this pin to ground to insure that the input voltage does not sag below the minimum drop out voltage during the load transient response. This pin must always be 0.6V higher than V_{OUT} in order for the device to regulate properly. |
| V_{OUT} (All devices) | The output of the regulator. A minimum of 2.2 μF capacitor must be connected from this pin to ground. |
| Gnd (All devices) | Ground pin. This pin must be connected to the lowest potential in the system and all other pins must be at higher potential with respect to this pin. |
| Enable (APU1207, APU1209) | Enable pin. A low signal or left open on this pin shuts down the output. This pin must be tied HI or to V_{IN} for normal operation. |
| Flag (APU1207, APU1208) | An open collector output that switches low when the output voltage drops about 4% below its expected regulated voltage. |
| Adj (APU1208, APU1209) | A resistor divider from this pin to the V_{OUT} pin and ground sets the output voltage. |

APPLICATION INFORMATION

Stability

The APU120X series of regulators require the use of an output capacitor as part of the frequency compensation in order to make the regulator stable. A minimum of 2.2 μF capacitance and the ESR in the range of 0.5 to 2 Ω insures the stability of the system.

| Part Number | Output Voltage |
|-------------|----------------|
| APU1206-18 | 1.8V |
| APU1206-25 | 2.5V |
| APU1206-33 | 3.3V |
| APU1207-18 | 1.8V |
| APU1207-25 | 2.5V |
| APU1207-33 | 3.3V |
| APU1208 | 1.24V |
| APU1209 | 1.24V |

Table 1 - Output voltage vs. part number.



TYPICAL APPLICATION

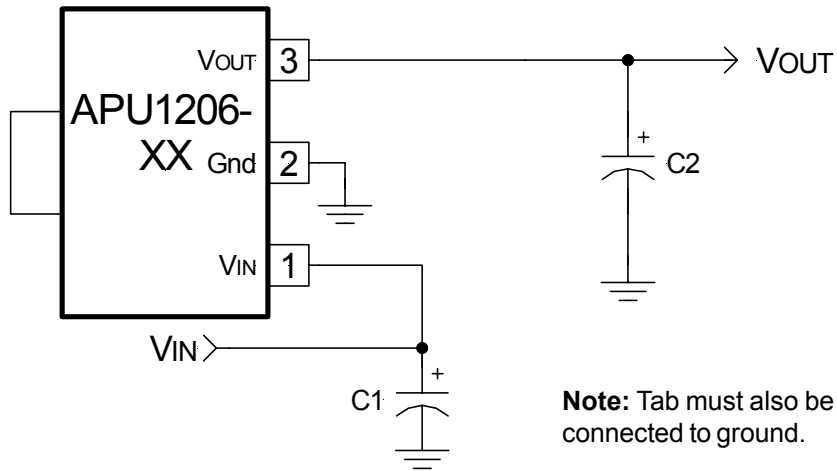


Figure 2 - Typical application of APU1206.

| Ref Desig | Description | Qty | Part # | Manuf |
|-----------|-------------|-----|----------------|-------|
| C1 | Capacitor | 1 | 10µF, Tantalum | AVX |
| C2 | Capacitor | 1 | 10µF, Tantalum | AVX |

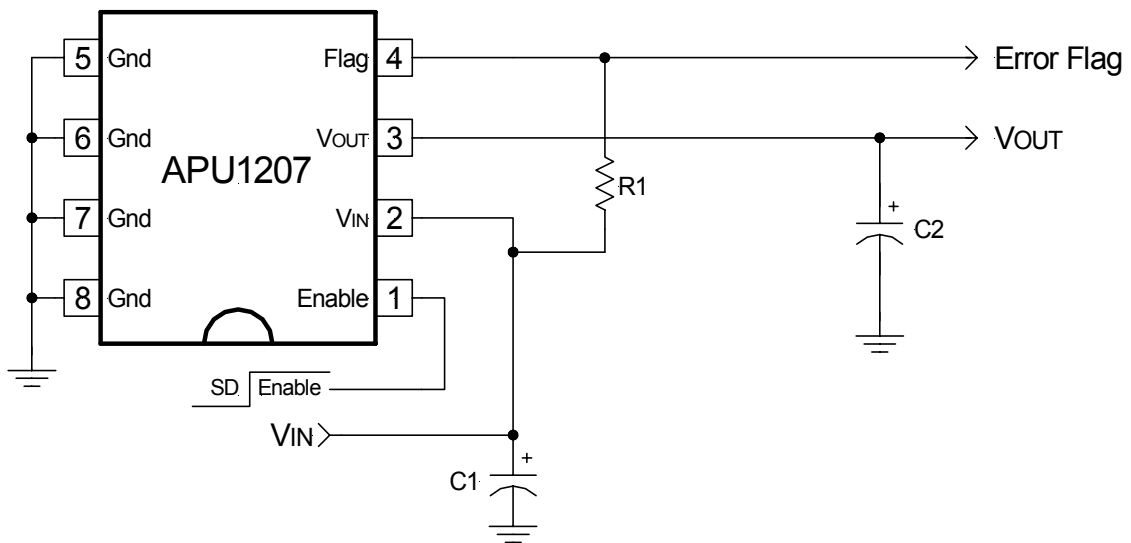


Figure 3 - Typical application of APU1207.

| Ref Desig | Description | Qty | Part # | Manuf |
|-----------|-------------|-----|----------------|-----------|
| C1 | Capacitor | 1 | 10µF, Tantalum | AVX |
| C2 | Capacitor | 1 | 10µF, Tantalum | AVX |
| R1 | Resistor | 1 | 10K ,5% | Panasonic |



TYPICAL APPLICATION

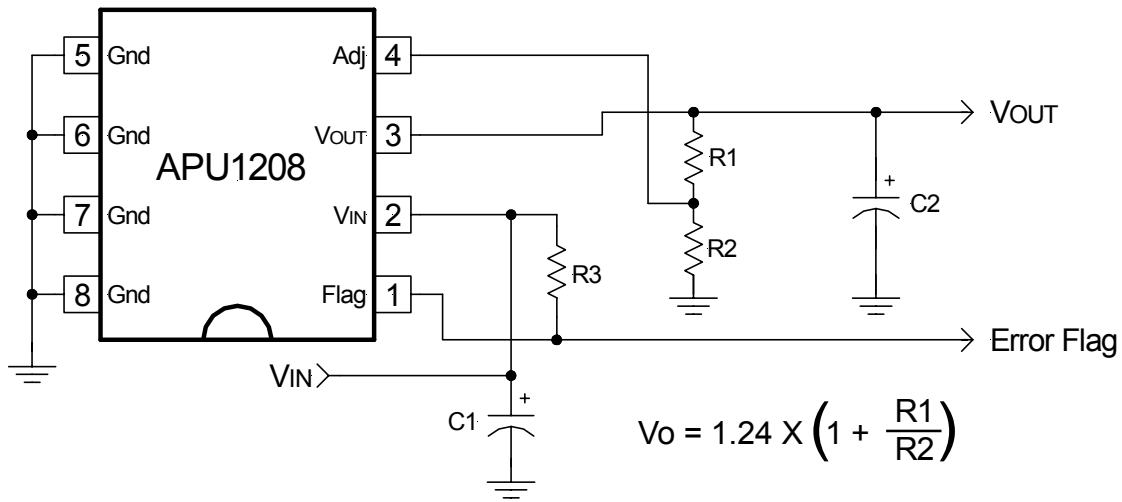


Figure 4 - Typical application of APU1208 in 3.3V to 2.5V regulator.

| Ref Desig | Description | Qty | Part # | Manuf |
|-----------|-------------|-----|----------------------|-------|
| C1 | Capacitor | 1 | 10 μ F, Tantalum | AVX |
| C2 | Capacitor | 1 | 10 μ F, Tantalum | AVX |
| R1 | Resistor | 1 | 127 , 1% | |
| R2 | Resistor | 1 | 124 , 1% | |
| R3 | Resistor | 1 | 10K , 5% | |

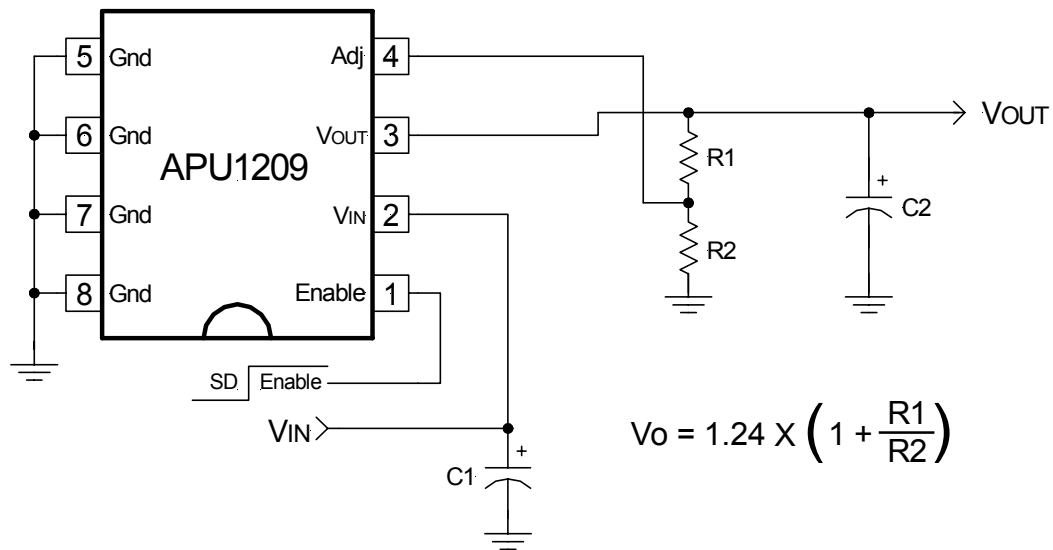

TYPICAL APPLICATION


Figure 5 - Typical application of APU1209 in 3.3V to 2.5V regulator.

| Ref Desig | Description | Qty | Part # | Manuf |
|-----------|-------------|-----|----------------------|-------|
| C1 | Capacitor | 1 | 10 μ F, Tantalum | AVX |
| C2 | Capacitor | 1 | 10 μ F, Tantalum | AVX |
| R1 | Resistor | 1 | 127 , 1% | |
| R2 | Resistor | 1 | 124 , 1% | |



CHARACTERISTICS

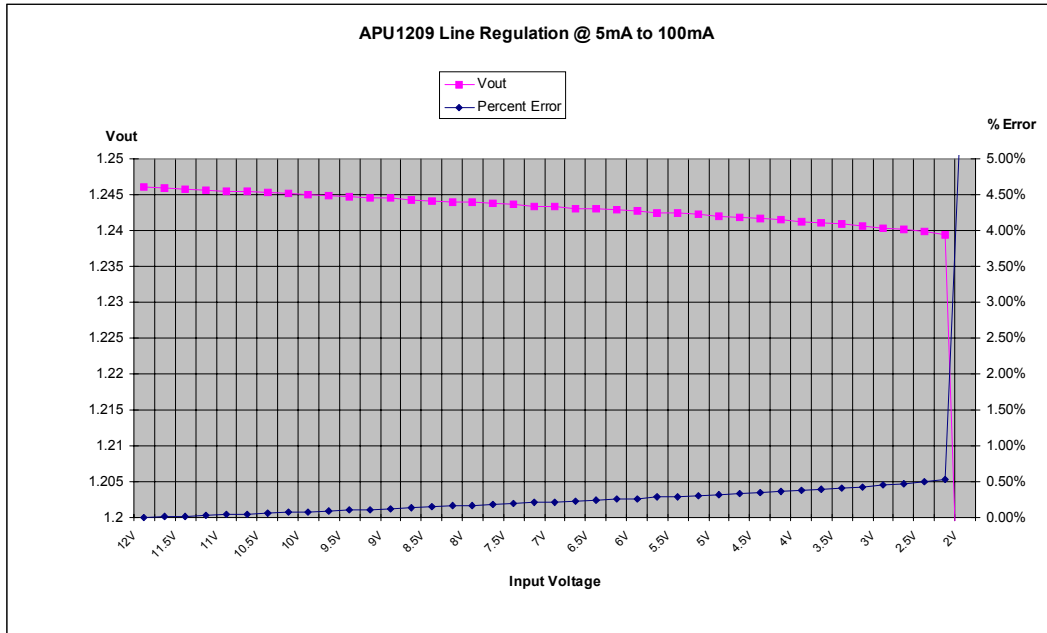


Figure 6

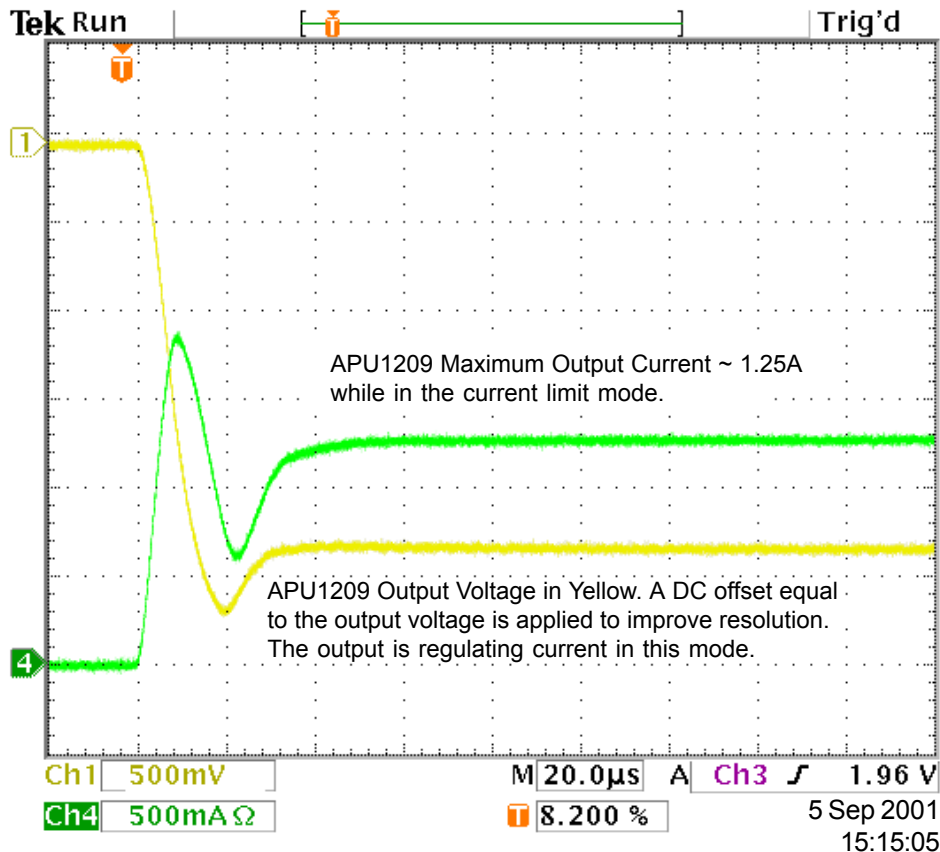


Figure 7



CHARACTERISTICS

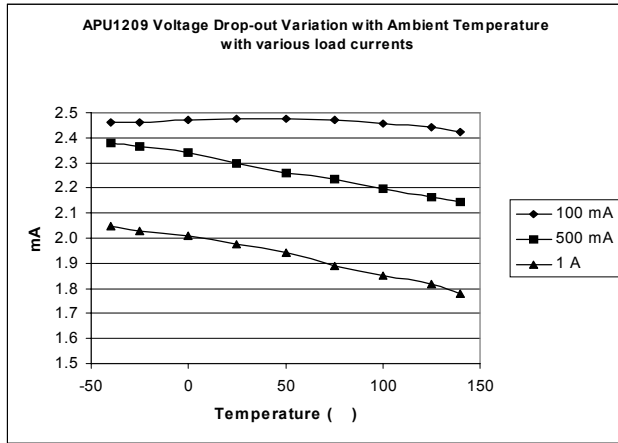


Figure 8

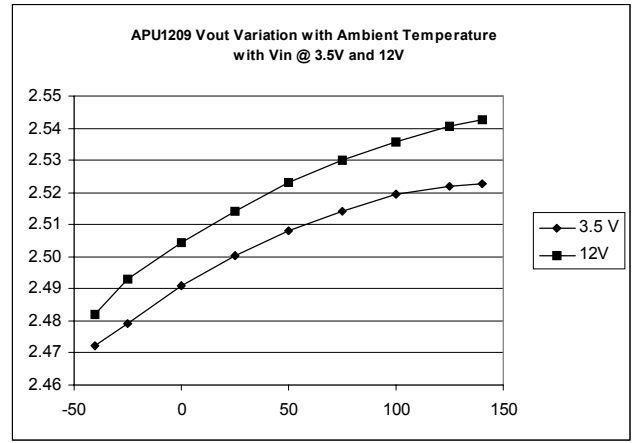


Figure 9

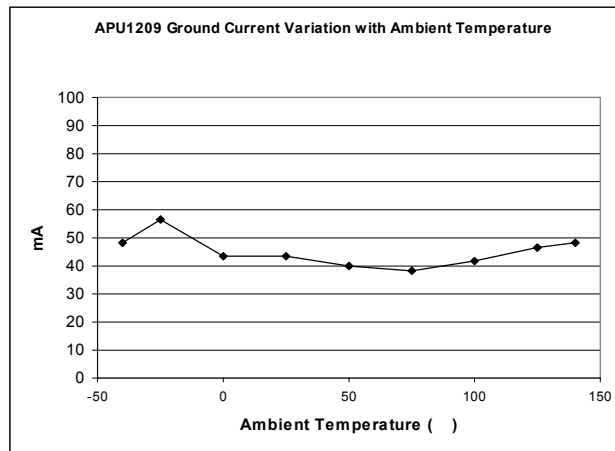


Figure 10