



1A Low Drop-out Positive Voltage Regulators

Features

- Low dropout voltage (500mV at 1A load)
- Voltage reference accuracy of 1%
- Low ground current
- Maximum quiescent current in shutdown of 1 μ A
(APU1207M-3, APU1208M-3)
- Fast transient response
- Current limit and thermal shutdown
- Error flag signal for "output out of regulation"
(APU1207M-3, APU1208M-3)
- RoHS-compliant, halogen-free package

Applications

- Supplying 2.5V output from 3.3V input for the new generation of ICs
- Computer motherboard and add-on cards
- High efficiency post-regulator in switched-mode power supplies (SMPS)

Description

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

Along with the low dropout voltage of less than 0.5V, other features of this family of parts are micro-power shutdown capability and output UVLO detection where the Flag pin is switched low when the output falls below 5% of its nominal point.

Typical Application

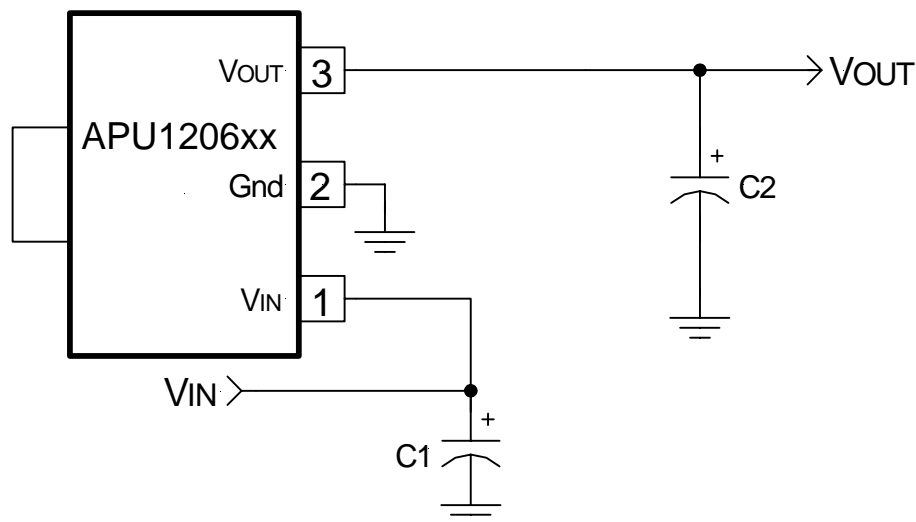


Figure 1 - Typical application for the APU1206XX in a 3-pin SOT-223 package.

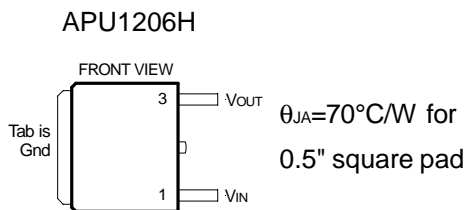


Ordering Information

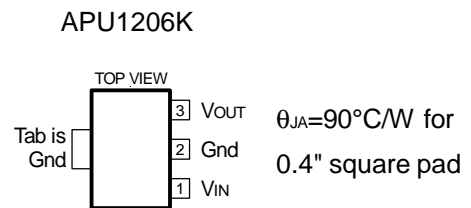
T _J (°C)	2-PIN TO-252 (H)	3-PIN SOT-223 (K)	8-PIN PLASTIC SOIC (M)	OUTPUT VOLTAGE	PIN FUNCTIONS
0 to 125	APU1206H-18-HF-3TR	APU1206K-18-HF-3TR	NA	1.8V	V _{IN} , V _{OUT} , Gnd
0 to 125	APU1206H-25-HF-3TR	APU1206K-25-HF-3TR	NA	2.5V	V _{IN} , V _{OUT} , Gnd
0 to 125	APU1206H-33-HF-3TR	APU1206K-33-HF-3TR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

Pin Configuration

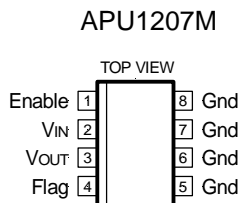
2-PIN PLASTIC TO-252 (D-Pak)



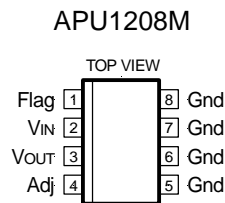
3-PIN PLASTIC SOT-223



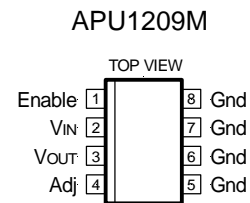
8-PIN PLASTIC SOIC



$\theta_{JA}=55^{\circ}\text{C/W}$
for 1" square pad



$\theta_{JA}=55^{\circ}\text{C/W}$
for 1" square pad



$\theta_{JA}=55^{\circ}\text{C/W}$
for 1" square pad

THIS PRODUCT IS SENSITIVE TO ELECTROSTATIC DISCHARGE, PLEASE HANDLE WITH CAUTION.

USE OF THIS PRODUCT AS A CRITICAL COMPONENT IN LIFE SUPPORT OR OTHER SIMILAR SYSTEMS IS NOT AUTHORIZED.

APEC DOES NOT ASSUME ANY LIABILITY ARISING OUT OF THE APPLICATION OR USE OF ANY PRODUCT OR CIRCUIT DESCRIBED HEREIN; NEITHER DOES IT CONVEY ANY LICENSE UNDER ITS PATENT RIGHTS, NOR THE RIGHTS OF OTHERS.

APEC RESERVES THE RIGHT TO MAKE CHANGES WITHOUT FURTHER NOTICE TO ANY PRODUCTS HEREIN TO IMPROVE RELIABILITY, FUNCTION OR DESIGN.



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

Electrical Specifications

Unless otherwise indicated, these specifications apply for $C_{IN}=C_{OUT}=10\mu F$, $V_{IN}=V_O+1V$, $V_{OUT}=V_{FB}$ (for adjustable version only), and $T_A=25^\circ C$. Typical values refer to $T_A=25^\circ C$. 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	$I_O=10mA$, $T_A=25^\circ C$ (Note 4)	-1 -1.3		1 1.3	%
Line Regulation	ΔV_I	$V_O + 1V < V_{IN} < 10$		0.5	1	%
Load Regulation (Note 1)	ΔV_L	$10mA < I_O < 1A$ $1mA < I_O < 150mA$		0.5	0.7 0.5	%
Output Voltage Temp Coef.	$\Delta V_{O(T)}$			20	100	ppm/°C
Dropout Voltage (Note 2)	$\Delta V_{I(O)}$	$I_O=100mA$ (Note 4) $I_O=500mA$ (Note 4) $I_O=1000mA$ (Note 4)		100 300 500	200 400 650	mV
Ground Current (Note 3)	I_Q	$V_{IN}=V_O + 1V$ for all conditions: $I_O=100mA$ (Note 4) $I_O=500mA$ (Note 4) $I_O=1000mA$ (Note 4)			3 15 50	mA
Current Limit	I_{CL}	$V_O=5\%$ below regulation point	1.1	1.4		A
Minimum Input Voltage	$V_{IN(min)}$			2.1	2.3	V
APU1208, APU1209						
Adjust Pin Current	I_{ADJ}	$V_{IN}=2.5V$, $V_O=V_{ADJ}$ (Note 4)			0.1	μA
Minimum Load Current	$I_{O(min)}$		1			mA
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 junction temperatures from 0 to +125°C.



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 ensure 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 capacitor of at least 2.2 μ F 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 requires the use of an output capacitor as part of the frequency compensation in order to make the regulator stable. A capacitor of at least 2.2 μ F and ESR in the range of 0.5 to 2 Ω will ensure the stability of the system.

Typical Applications

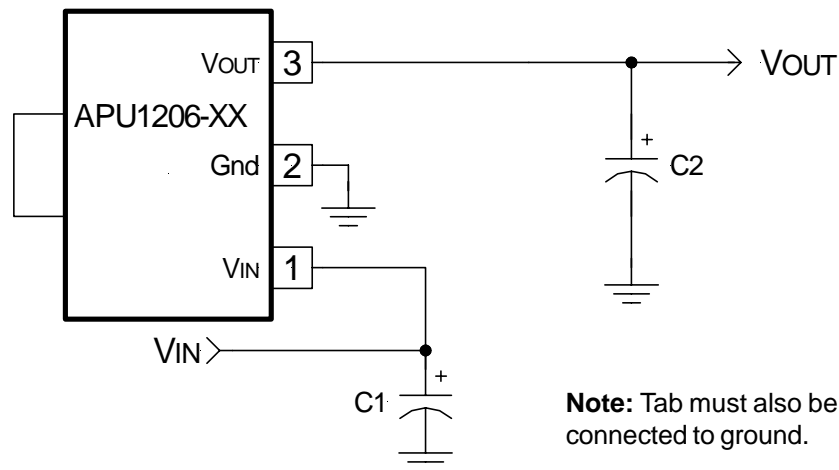


Figure 2 - Typical application of APU1206.

Ref Desig	Description	Qty	Part #	Manuf
C1	Capacitor	1	10 μ F, Tantalum	AVX
C2	Capacitor	1	10 μ F, Tantalum	AVX



Typical Applications

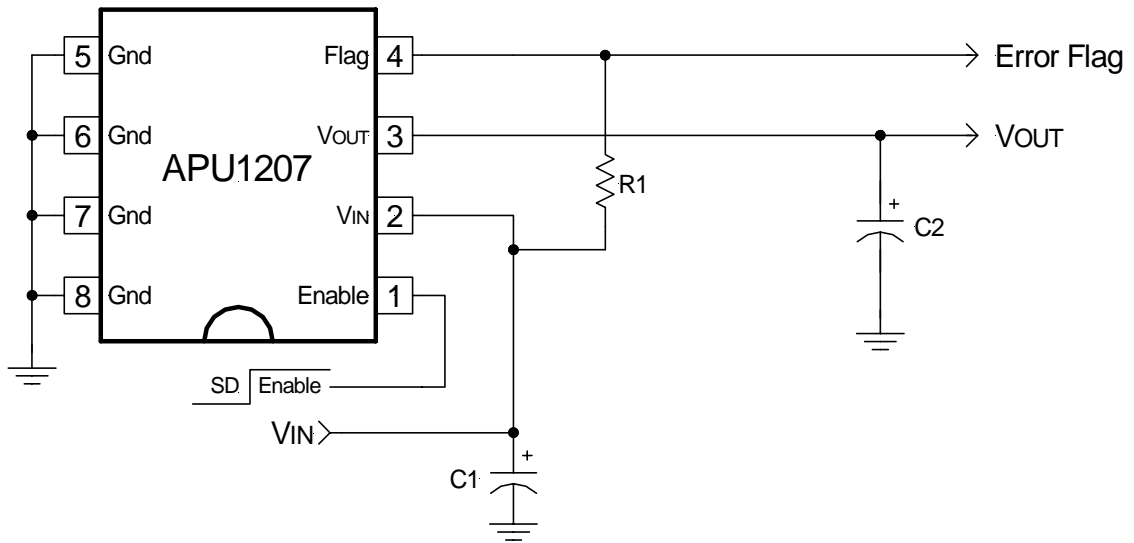


Figure 3 - Typical application of APU1207.

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

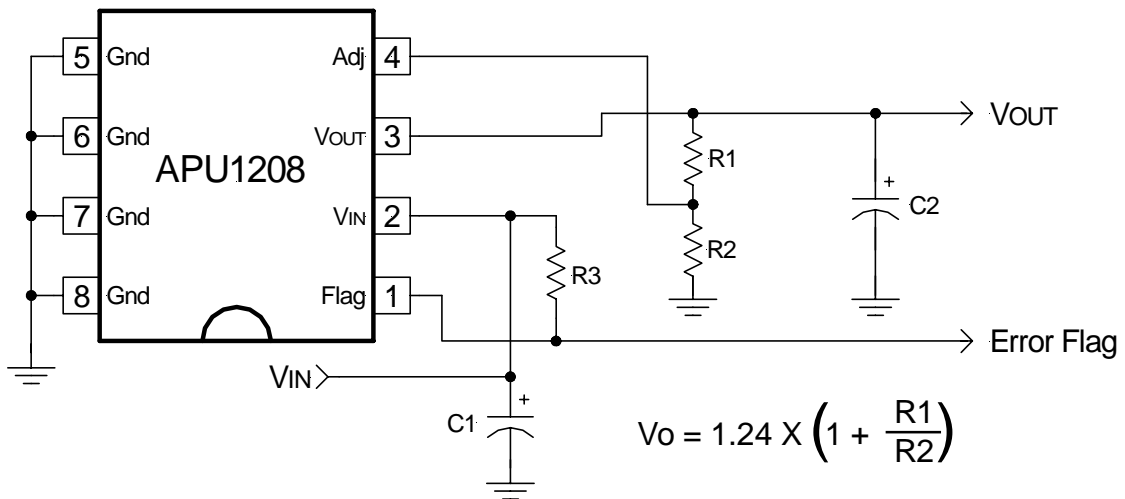


Figure 4 - Typical application of APU1208 in 3.3V to 2.5V regulator.

Ref Desig	Description	Qty	Part #	Manuf
C1	Capacitor	1	10μF, Tantalum	AVX
C2	Capacitor	1	10μF, Tantalum	AVX
R1	Resistor	1	127Ω, 1%	
R2	Resistor	1	124Ω, 1%	
R3	Resistor	1	10kΩ, 5%	



Typical Applications

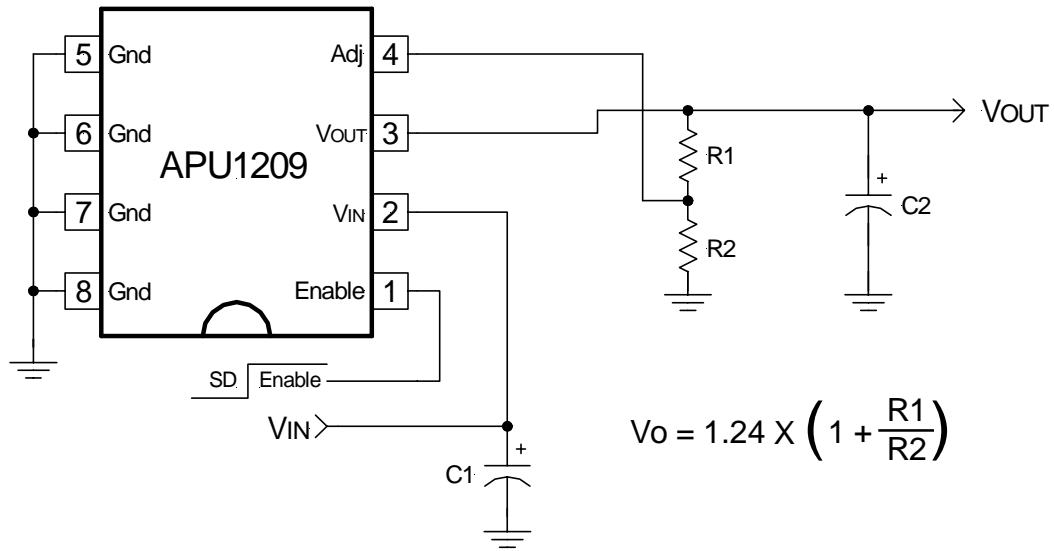


Figure 5 - Typical application of APU1209 in 3.3V to 2.5V regulator.

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 Ω , 1%	
R2	Resistor	1	124 Ω , 1%	



Electrical Characteristics

APU1209 Line Regulation from 5mA to 100mA

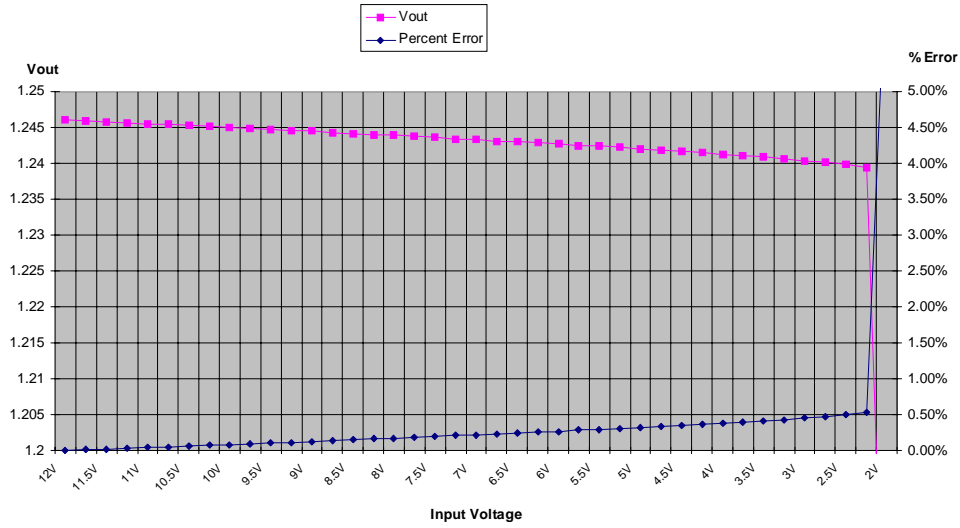


Figure 6

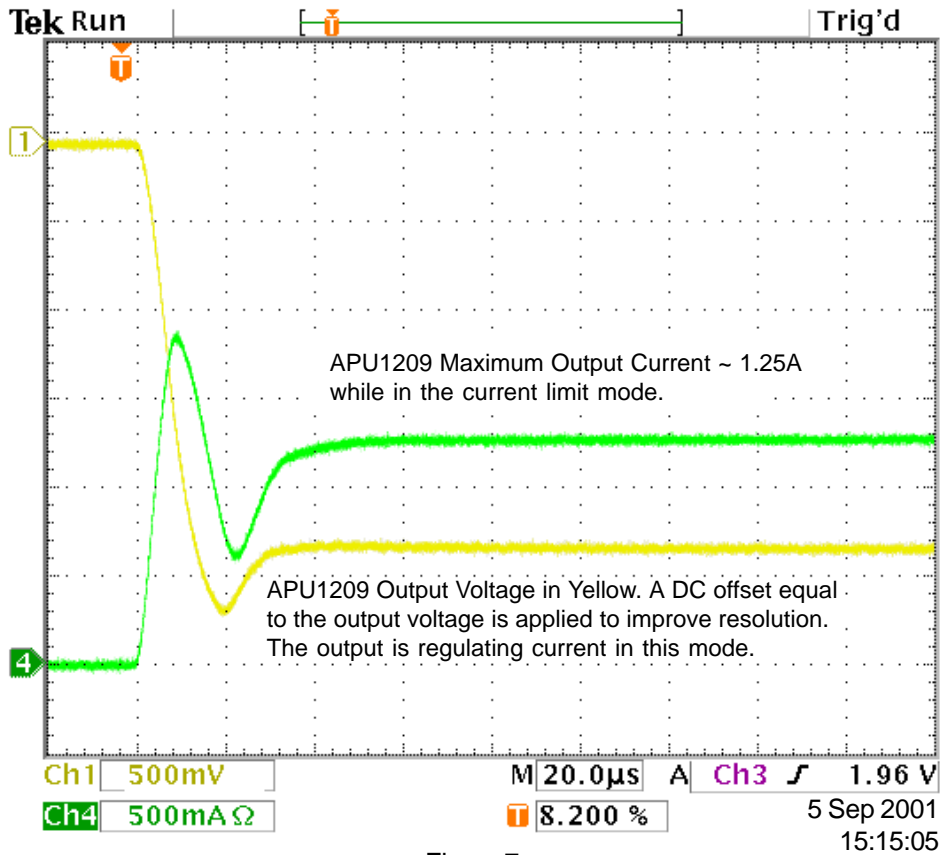


Figure 7



Electrical Characteristics (cont.)

APU1209 Voltage Drop-out Variation with Ambient Temperature
with various load currents

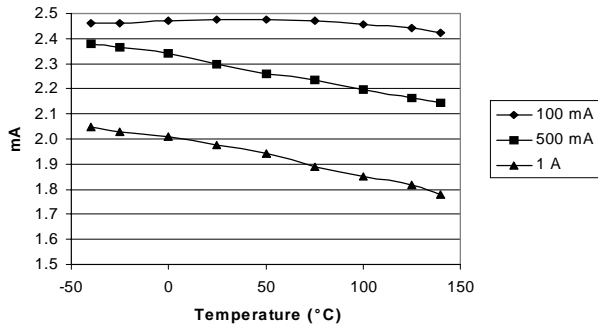


Figure 8

APU1209 Vout Variation with Ambient Temperature
with Vin at 3.5V and 12V

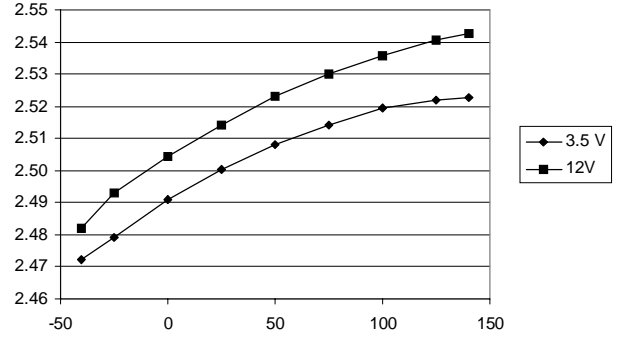


Figure 9

APU1209 Ground Current Variation with Ambient Temperature

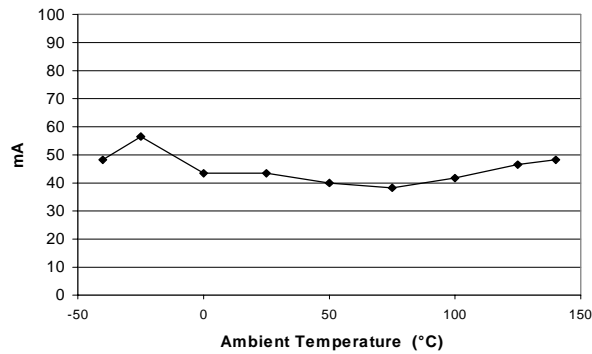
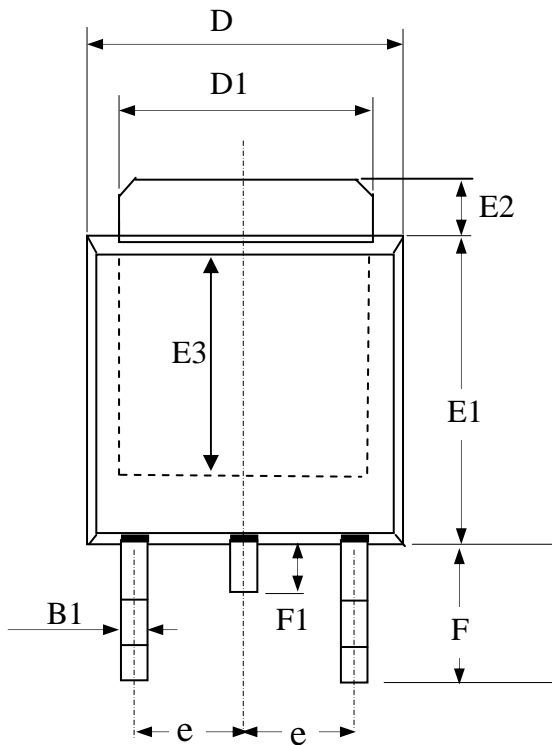


Figure 10

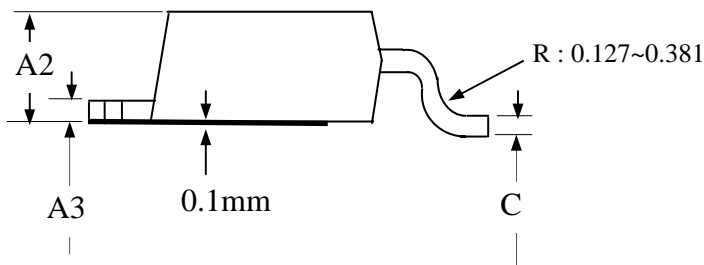


Package Dimensions: TO-252

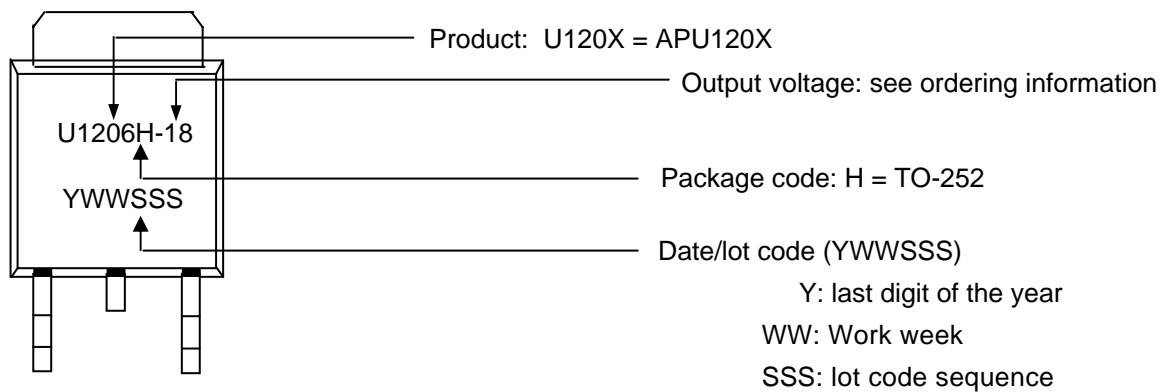


SYMBOLS	Millimeters		
	MIN	NOM	MAX
A2	1.80	2.30	2.80
A3	0.40	0.50	0.60
B1	0.40	0.70	1.00
D	6.00	6.50	7.00
D1	4.80	5.35	5.90
E3	3.50	4.00	4.50
F	2.20	2.63	3.05
F1	0.5	0.85	1.20
E1	5.10	5.70	6.30
E2	0.50	1.10	1.80
e	--	2.30	--
C	0.35	0.50	0.65

1. All dimensions are in millimeters.
2. Dimensions do not include mold protrusions.

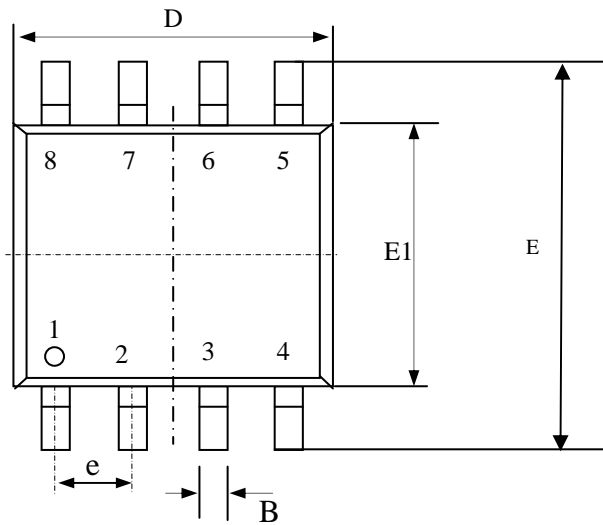


Part Marking

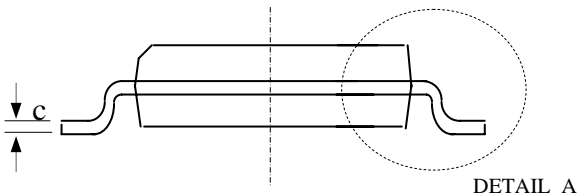
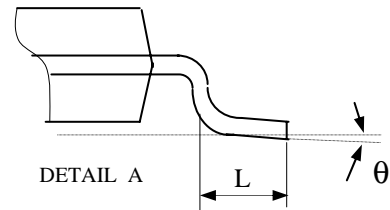
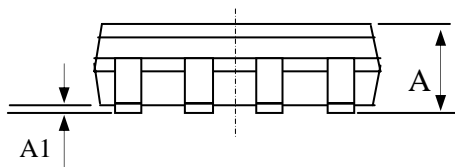




Package Dimensions: SO-8

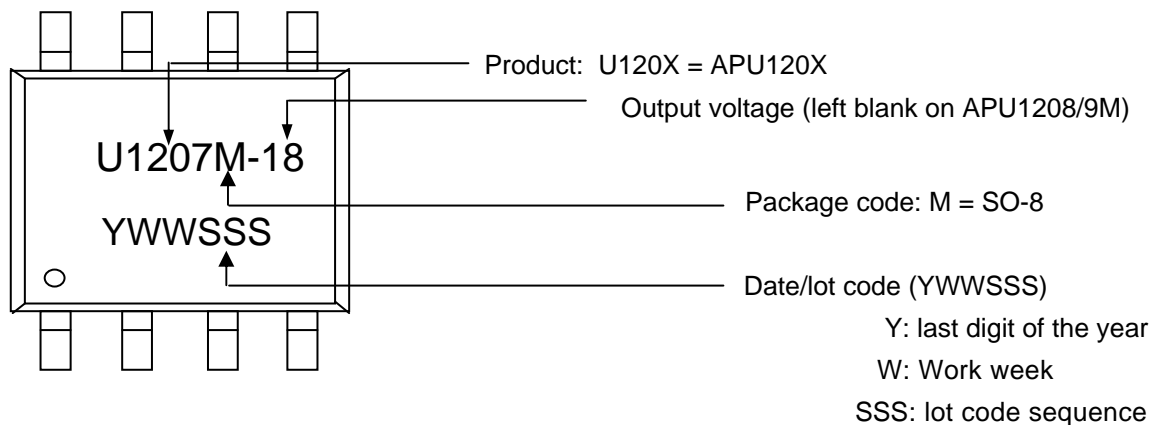


SYMBOLS	Millimeters		
	MIN	NOM	MAX
A	1.35	1.55	1.75
A1	0.10	0.18	0.25
B	0.33	0.41	0.51
C	0.19	0.22	0.25
D	4.80	4.90	5.00
E1	3.80	3.90	4.00
E	5.80	6.15	6.50
L	0.38	0.71	1.27
θ	0	4.00	8.00
e	1.27 TYP		



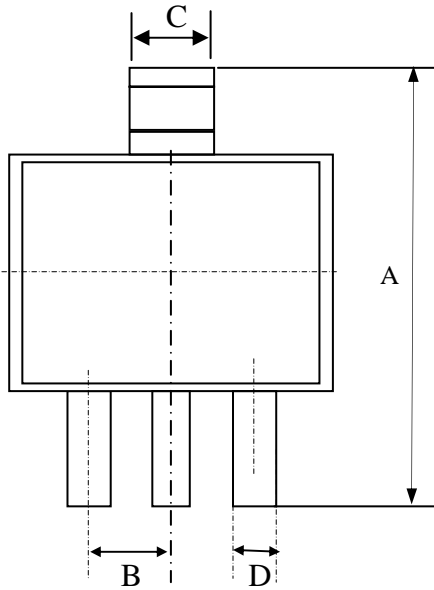
1. All dimension are in millimeters.
2. Dimensions do not include mold protrusions.

Part Marking

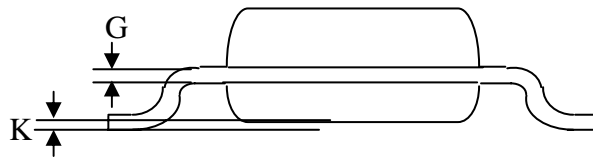
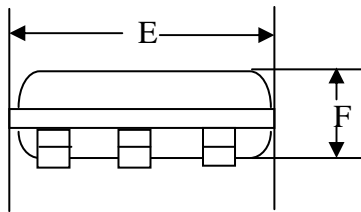




Package Dimensions: SOT-223



SYMBOLS	Millimeters		
	MIN	NOM	MAX
A	6.70	7.00	7.30
B	---	2.3	---
C	2.90	3.00	3.10
D	0.60	0.70	0.80
G	0.25	0.30	0.35
E	6.30	6.50	6.70
F	1.40	1.60	1.80
K	0.02	0.06	0.10



1. All dimension are in millimeters.
2. Dimensions do not include mold protrusions.

Part Marking

