3A HIGH OUTPUT CURRENT LDO REGULATOR

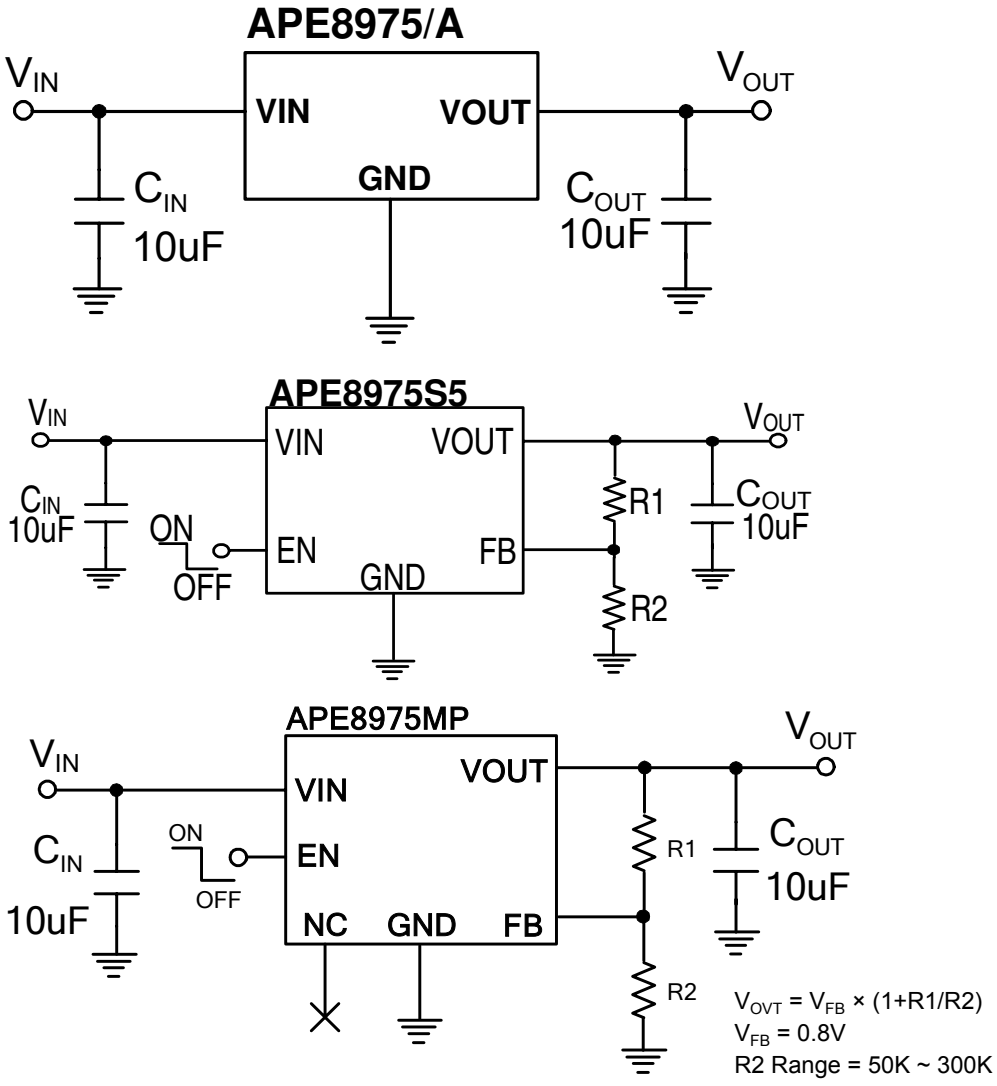
FEATURES

- **Input Voltage：2.6V to 5.5V**
- **Adjustable Output (ESOP-8 & TO-263-5LOnly) and Fixed Output Voltage for 1.5V, 1.8V, 2.5V and 3.3V**
- **Dropout Voltage is 380mV at 3A Output Current**
- **Guaranteed 3A Output Current**
- **Low Quiescent Current is 200μA (typ.)**
- **Fast Transient Response**
- **Current Limit and Thermal Shutdown Protection**
- **Short Circuit Current Fold-back**
- **Available in the TO-220, SOT-223, TO-252, TO-263 and TO-263-5L and ESOP-8 Pb-Free packages**
- **Halogen Free Product**

DESCRIPTION

The APE8975/A is a low noise, high output current, low quiescent current and low dropout linear regulator. The Device includes pass element, error amplifier, band-gap, current-limit and thermal shutdown circuitry. The output current is up to 3A. The characteristics of low dropout voltage and less quiescent current make it good for some critical current application, for example, some battery powered devices. The typical quiescent current is approximately 200 μ A. There are 1.5V, 1.8V, 2.5V, 3.3V fixed output voltage and adjustable output versions (ESOP-8 & TO-263-5L Only). Built-in current-limit, Short current protection and thermal-shutdown functions prevent any fault condition from IC damage.

TYPICAL APPLICATION



ABSOLUTE MAXIMUM RATINGS (at T_A=25°C)

Input Voltage (V_{IN})	GND - 0.3V to 6V
Output Voltage (V_{UOT})	GND - 0.3V to V_{IN} + 0.3V
EN Pin Voltage (V_{EN})	GND - 0.3V to 6V
FB Pin Voltage (V_{FB})	GND - 0.3V to 6V
Power Dissipation (P_D)	Internally Limited
Storage Temperature Range (T_{ST})	-40°C To 150°C
Operating Temperature Range (T_{OP})	-40°C To + 85°C
Junction Temperature Range (T_J)	-40°C To + 125°C
Thermal Resistance from Junction to case (R_{thjc})	
SOT-223	15°C/W
ESOP-8	15°C/W
TO-263	3.5°C/W
TO-252	10°C/W
TO-220	3.5°C/W
Thermal Resistance from Junction to ambient (R_{thja})	
SOT-223	75°C/W
ESOP-8	40°C/W
TO-263	25°C/W
TO-252	45°C/W
TO-220	25°C/W

Note: R_{thja} is measured with the PCB copper area of approximately 1in^2 (Multi-layer).
That need connect to tap or exposed pad (ESOP-8 only) pin.

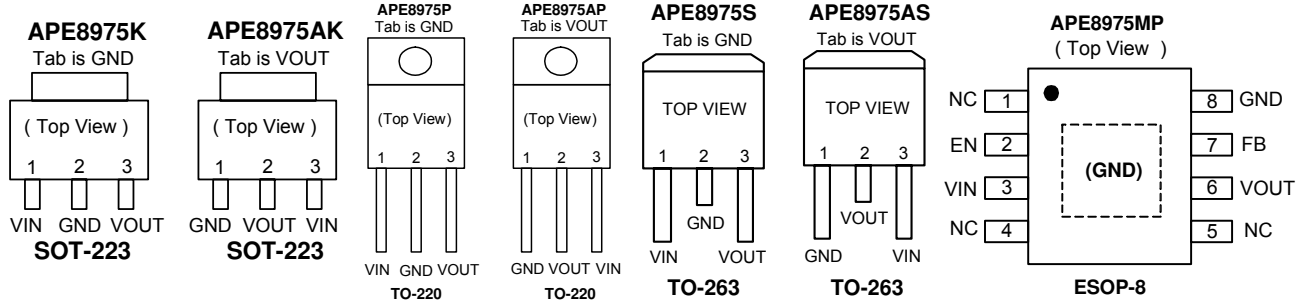
ORDERING/PACKAGE INFORMATION

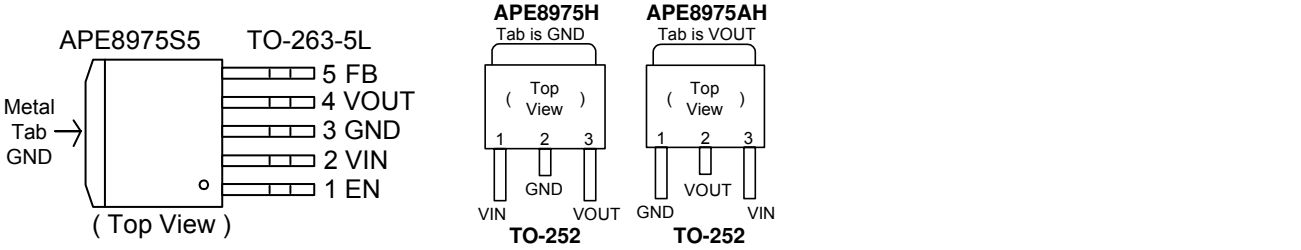
Fixed Version

APE8975 X X - XX - HF
Halogen Free
Pin Define: Refer Pin Assignment
Package: K : SOT-223, H : TO-252, P : TO-220, S : TO-263
Output voltage: 15 : 1.5V, 18 : 1.8V, 25 : 2.5V, 33 : 3.3V

ADJ Version

APE8975X - HF
Halogen Free
Package: MP : ESOP-8, S5 : TO-263-5L





ELECTRICAL SPECIFICATIONS

(V_{IN} = 5V, T_A = 25°C (unless otherwise noted))

Parameter	SYM	TEST CONDITION		MIN	TYP	MAX	UNITS
Input Voltage	V_{IN}	I_{OUT}=30mA **(Note1)**		2.6	-	5.5	V
Output Voltage Accuracy	ΔV_{OUT}	I_{OUT}=1mA **(Note1)**		-2	-	2	%
Feedback Voltage (ESOP-8 Only)	V_{FB}	I_{OUT} = 1mA		0.784	0.8	0.816	V
FB Input Leakage Current (ESOP-8 Only)	I_{FB}	V_{FB}=0.8V		-100	-	100	nA
Quiescent Current	I_Q	I_{OUT} =0mA, V_{IN}=5V		-	200	300	μA
Shutdown Current	I_{STB}	For TO-263-5L and ESOP-8 Only		-	2	5	uA
Dropout Voltage	V_{DROP}	I_{OUT}=3A	V_{OUT}=1.50V	-	1.2	1.5	V
			V_{OUT}=1.80V	-	0.9	1.2	
			V_{OUT}=2.50V	-	0.57	0.7	
			V_{OUT}=3.30V	-	0.38	0.6	
Current Limit **(Note 2)**	I_{LIMIT}			3.3	4	-	A
Short Circuit Current	I_{short}	Output Voltage < 0.25 x V_{OUT}		-	1	-	A
Load Regulation **(Note 3)**	ΔV_{LOAD}	I_{OUT} =10m~3A		-	15	30	mV
Enable Input Threshold	V_{ENH}	Regulator Enable		2	-	-	V
	V_{ENL}	Regulator Shutdown		-	-	0.6	
Enable Pin Current	I_{ENH}	V_{EN}=V_{IN}		-	0.003	0.1	μA
	I_{ENL}	V_{EN}=0V		-	2	4	
Ripple Rejection	PSRR	C_{IN}=10uF,C_O=10uF, I_{OUT} =10mA	F=120Hz	-	65	-	dB
			F=1KHz	-	55	-	
Temperature Shutdown	TS			-	140	-	°C
Temperature Shutdown Hysterisis	TSH			-	30	-	°C

Note1. Minimum V_{IN} voltage is defined by output adds a dropout voltage.

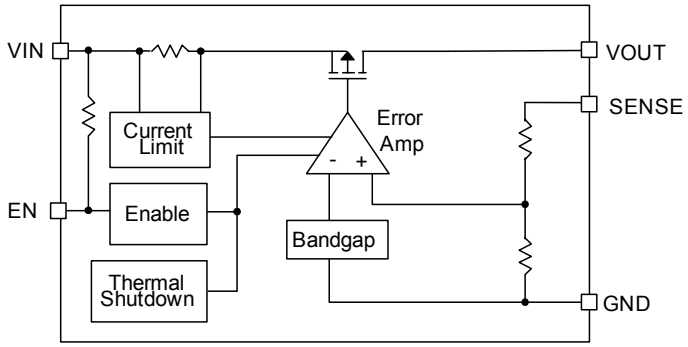
Note2. Current limit is measured at constant junction temperature by using pulsed testing with a low ON time.

Note3. Regulation is measured at constant junction temperature by using pulsed testing with a low ON time.

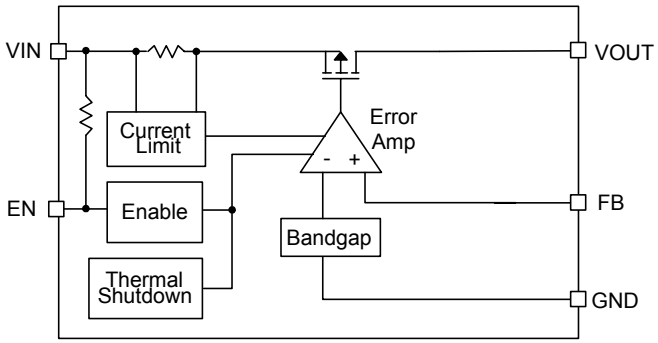
PIN DESCRIPTIONS

PIN SYMBOL	PIN DESCRIPTION
FB	Feedback Pin
EN	Enable Pin Input
VIN	Input Voltage
VOUT	Output Voltage
GND	Ground Pin
NC	No Connect Pin

BLOCK DIAGRAM



Fixed Version



Adjustable Version

FUNCTION DESCRIPTIONS

A minimum of 10μF capacitor must be connected from V_{OUT} to ground to insure stability. Typically a large storage capacitor is connected from V_{IN} to ground to ensure that the input voltage does not sag below the minimum dropout voltage during the load transient response. This pin must always be dropout voltage higher than V_{OUT} in order for the device to regulate properly.

Enable Function

The APE8975/A (TO263-5L and SOP-8L-EP only) features an LDO regulator enable/disable function. To assure the LDO regulator will switch on; the EN turn on control level must be greater than 2.0 volts. The LDO regulator will go into the shutdown mode when the voltage on the EN pin falls below 0.6 volts. If the enable function is not needed in a specific application, it can be floating.

FB Function (ESOP-8 & TO-263-5L only)

The output is an adjustable version, the FB voltage is 0.8V. The output voltage can be set by outside resistances. The output voltage, V_{OUT}, is then given by the

$$V_{OUT} = 0.8 \times (1 + R1/R2)$$

For the reasons of reducing power dissipation and loop stability, R2 is recommending to choose 50K~300KΩ.

APPLICATION INFORMATION

Like any low-dropout regulator, the APE8975/A requires input and output decoupling capacitors. The device is specifically designed for portable applications requiring minimum board space and smallest components. These capacitors must be correctly selected for good performance (see Capacitor Characteristics Section). Please note that linear regulators with a low dropout voltage have high internal loop gains which require care in guarding against oscillation caused by insufficient decoupling capacitance.

Capacitor Selection

Normally, use a 10µF capacitor on the input and a 10µF capacitor on the output of the APE8975/A. Larger input capacitor values and lower ESR (X5R, X7R) provide better supply-noise rejection and transient response. A higher- value output capacitor may be necessary if large, fast transients are anticipated and the device is located several inches from the power source.

Input-Output (Dropout) Voltage

A regulator's minimum input-to-output voltage differential (dropout voltage) determines the lowest usable supply voltage. In battery-powered systems, this determines the useful end-of-life battery voltage. Because the device uses a PMOS, its dropout voltage is a function of drain-to source on-resistance, $R_{DS\ (ON)}$, multiplied by the load current:

$$V_{DROPOUT} = V_{IN} - V_{OUT} = R_{DS\ (ON)} \times I_{OUT}$$

Current Limit and Short-Circuit Protection

The APE8975/A used a current sense-resistor to monitor the output current. A portion of the PMOS output transistor's current is mirrored to a resistor such that the voltage across this resistor is proportional to the output current. Once the output current exceeds limit threshold, AX6639/A would be protected with a limited output current. Further more, when the output is short to ground, the output current would be folded-back to a less limit.

Thermal Considerations

The APE8975/A series can deliver a current of up to 3A over the full operating junction temperature range. However, the maximum output current must be dated at higher ambient temperature to ensure the junction temperature does not exceed 125° C. With all possible conditions, the junction temperature must be within the range specified under operating conditions. Power dissipation can be calculated based on the output current and the voltage drop across regulator.

$$P_D = (V_{IN} - V_{OUT})\ I_{OUT}$$

The final operating junction temperature for any set of conditions can be estimated by the following thermal equation :

$$P_{D\ (MAX)} = (T_{J\ (MAX)} - T_A) / \theta_{JA}$$

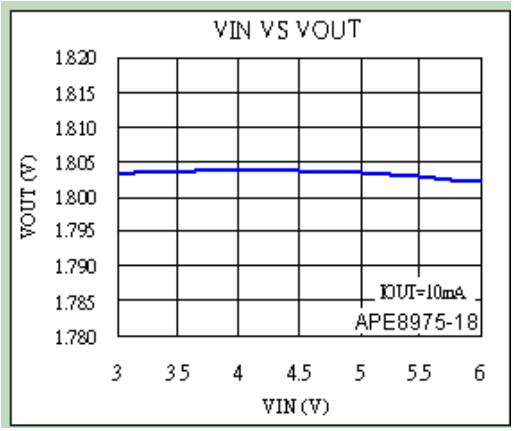
Where $T_{J\ (MAX)}$ is the maximum junction temperature of the die (125°C) and T_A is the maximum ambient temperature. The junction to ambient thermal resistance (θ_{JA}) for SOT-223 package at recommended minimum footprint is 75°C/W that is connect 1 in^2 PCB copper area to tap pin.

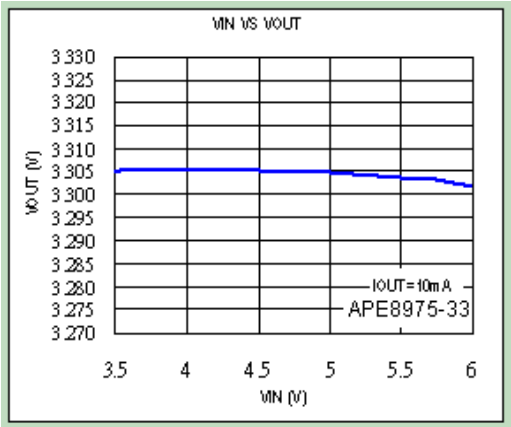
APPLICATION INFORMATION

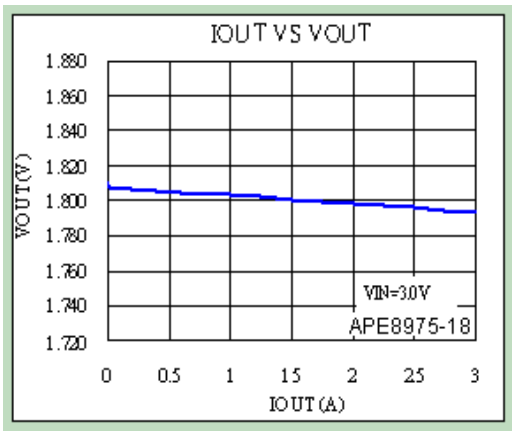
PCB Layout

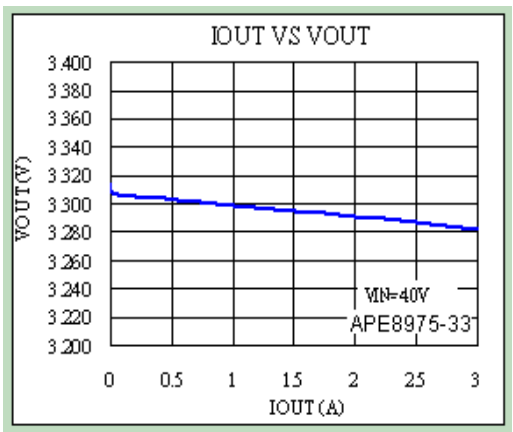
An input capacitance of ≧10μF is required between the APE8975/A input pin and ground (the amount of the capacitance may be increased without limit), this capacitor must be located a distance of not more than 1cm from the input and return to a clean analog ground. Input capacitor can filter out the input voltage spike caused by the surge current due to the inductive effect of the package pin and the printed circuit board's routing wire. Otherwise, the actual voltage at the VIN pin may exceed the absolute maximum rating. The output capacitor also must be located a distance of not more than 1cm from output to a clean analog ground. Because it can filter out the output spike caused by the surge current due to the inductive effect of the package pin and the printed circuit board's routing wire.

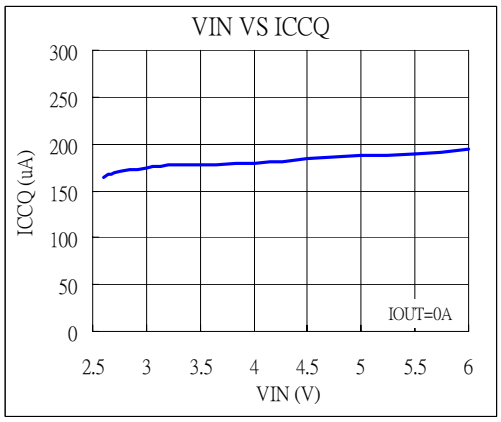
TYPICAL PERFORMANCE CHARACTERISTICS

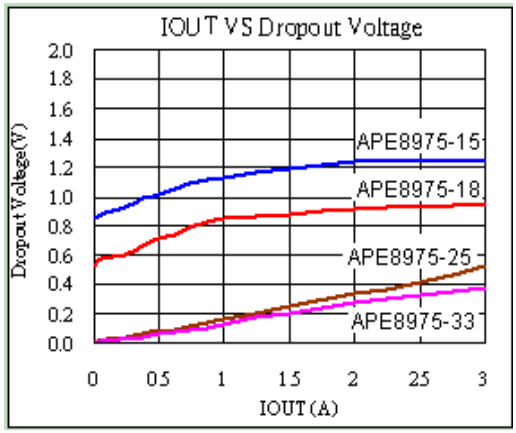












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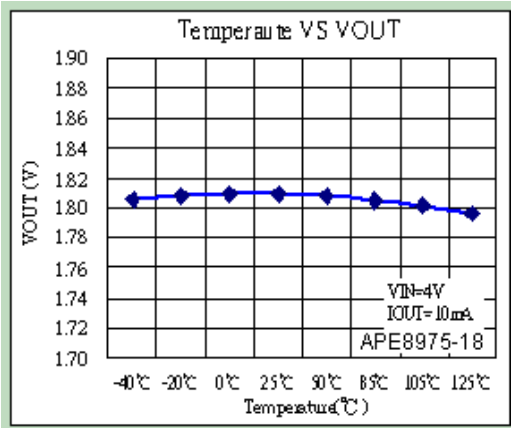
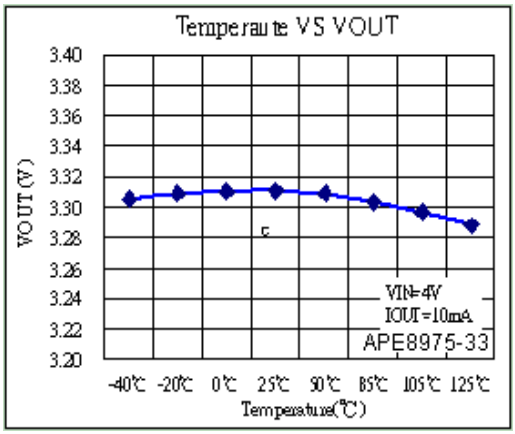
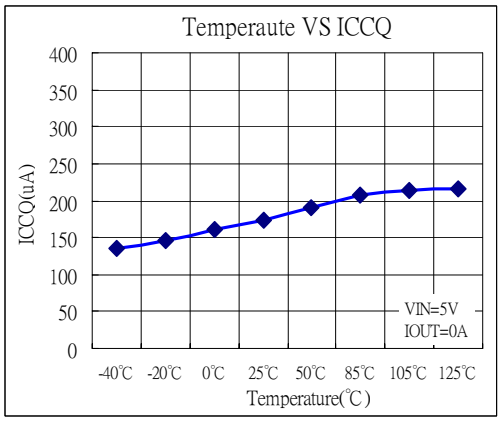
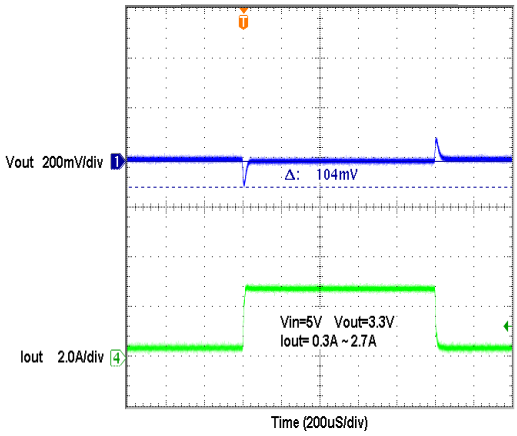


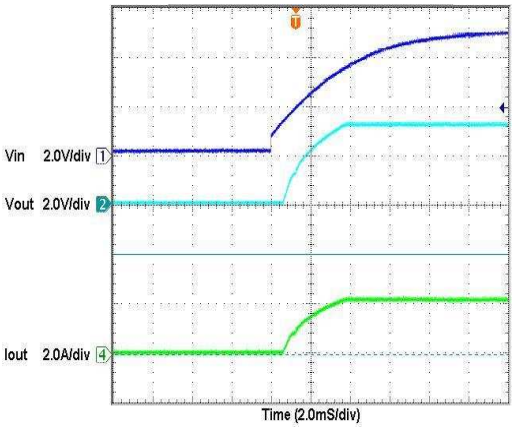




Load Transient

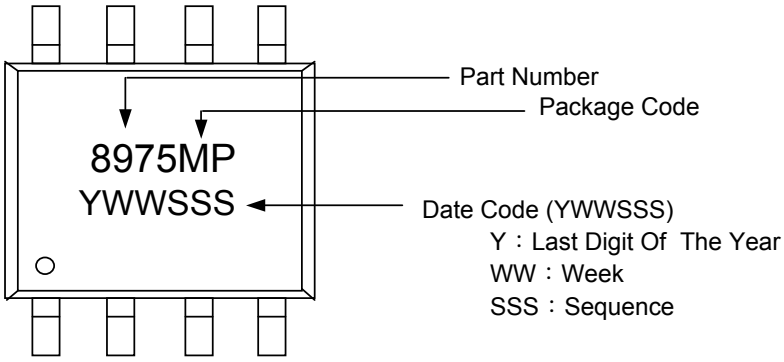


Power-ON (V_{IN}=5V, V_{OUT}=3.3V, I_{OUT}=2A)

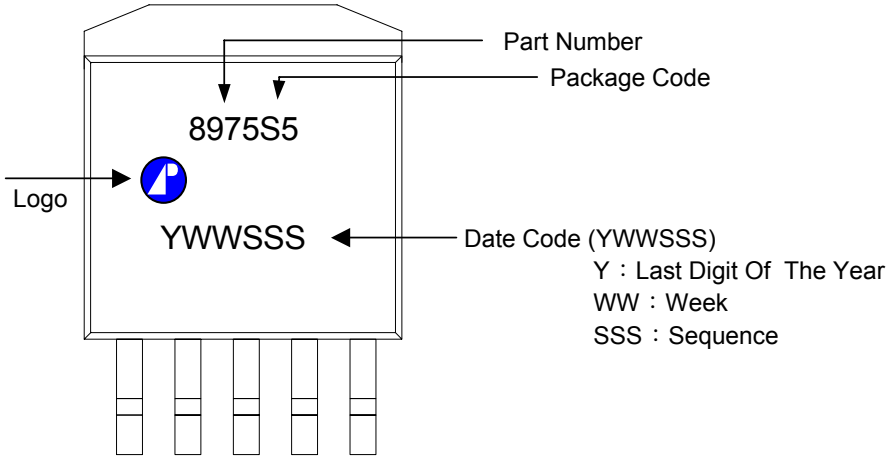


MARKING INFORMATION

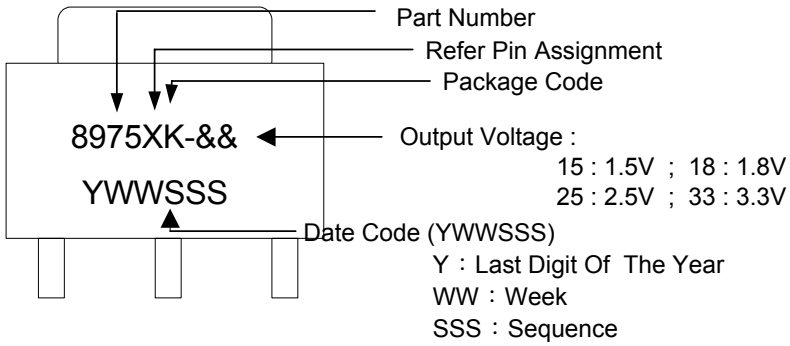
ESOP-8



TO-263-5L

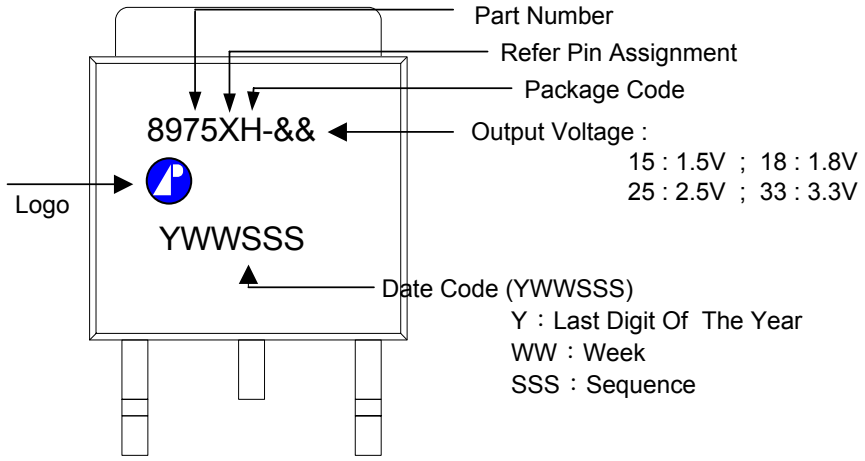


SOT-223



MARKING INFORMATION

TO-252



TO-220