AP1086

1.5A LOW DROPOUT POSITIVE ADJUSTABLE OR FIXED-MODE REGULATOR

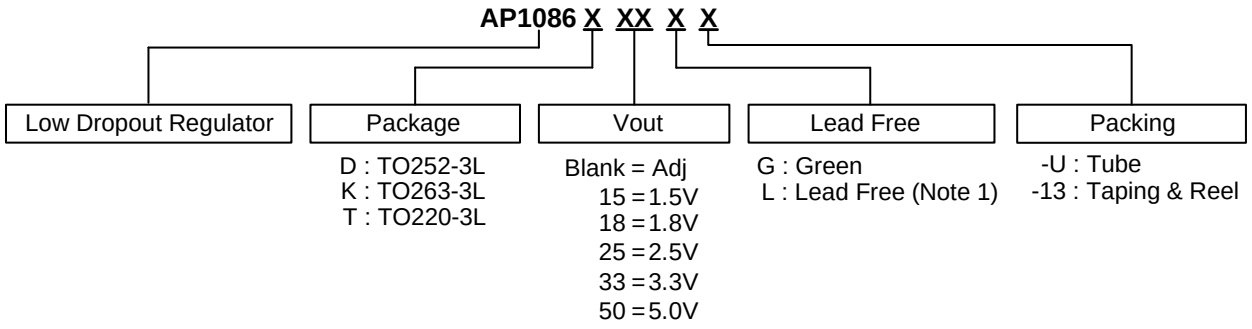
Features

- 3-Terminal Adjustable or Fixed 1.5V, 1.8V, 2.5V,3.3V, 5.0V
- 1.4V Maximum Dropout at Full Load Current
- Fast Transient Response
- Built-in Thermal Shutdown
- Output Current Limiting
- Lead Free Packages: TO252-3L, TO263-3L, and TO220-3L
- TO252-3L: Available in “Green” Molding Compound (No Br, Sb)
- Lead Free Finish/ RoHS Compliant (Note 2)

General Description

AP1086 is a low dropout positive adjustable or fixed-mode regulator with 1.5A output current capability. The product is specifically designed to provide well-regulated supply for low voltage IC applications such as high-speed bus termination and low current 3.3V logic supply. AP1086 is also well suited for other applications such as VGA cards. AP1086 is guaranteed to have lower than 1.4V dropout at full load current making it ideal to provide well-regulated outputs of 1.25V to 5.0V with 4.7 to 12V input supply by different output voltage.

Ordering Information



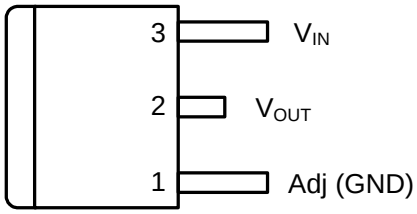
Device	Package Code	Packaging (Note 3)	Tube/Bulk		13” Tape and Reel	
			Quantity	Part Number Suffix	Quantity	Part Number Suffix
AP1086D	D	TO252-3L	80	-U	2500/Tape & Reel	-13
AP1086K	K	TO263-3L	50	-U	800/Tape & Reel	-13
AP1086T	T	TO220-3L	50	-U	NA	NA

Notes: 1. TO263-3L and TO220-3L are available in “Lead Free” products only.
2. EU Directive 2002/95/EC (RoHS). All applicable RoHS exemptions applied, see *EU Directive 2002/95/EC Annex Notes.*
3. Pad layout as shown on Diodes Inc. suggested pad layout document AP02001, which can be found on our website at http://www.diodes.com/datasheets/ap02001.pdf.

Pin Assignments

(1) TO263-3L

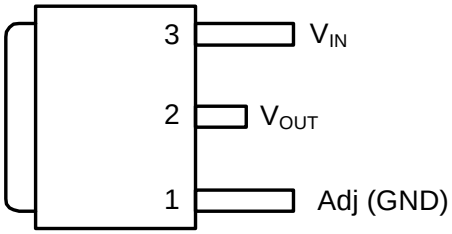
(Top View)



Tab is V_{OUT}

(2) TO252-3L

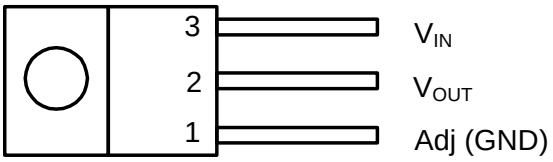
(Top View)



Tab is V_{OUT}

(3) TO220-3L

(Top View)

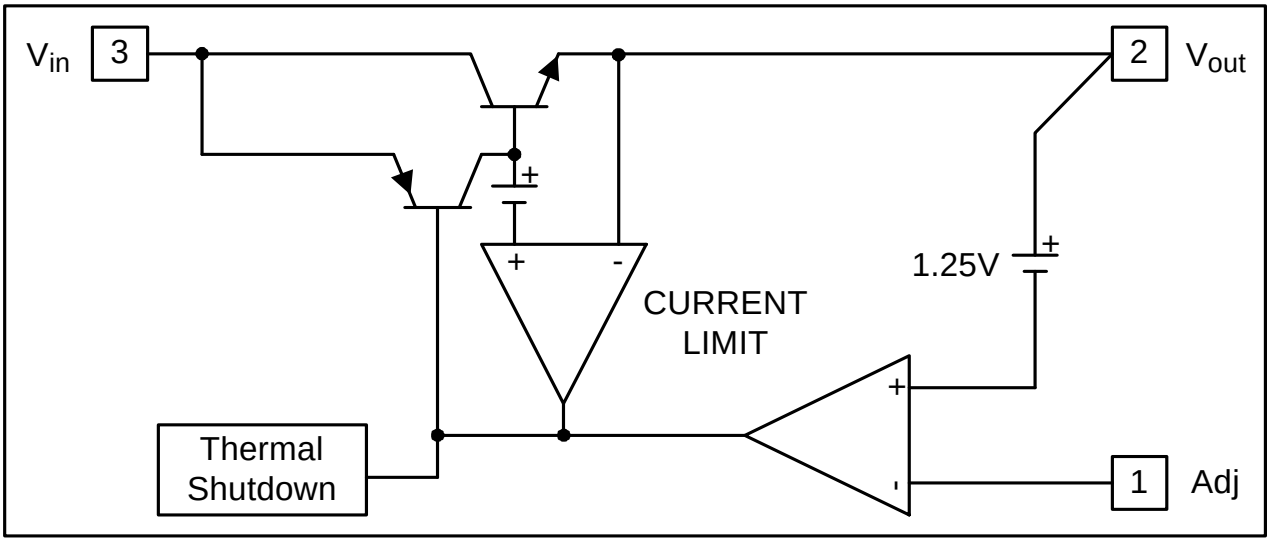


Tab is V_{OUT}

Pin Descriptions

Pin Name	I/O	Pin #	Function
Adj (GND)		1	Adjustable (Ground only for fixed mode)
V_{OUT}	O	2	The output of the regulator. A minimum of 10uF capacitor must be connected from this pin to ground to insure stability.
V_{IN}	I	3	The input pin of 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 dropout voltage during the load transient response. This pin must always be 1.4V higher than Vout in order for the device to regulate properly.

Block Diagram



Absolute Maximum Ratings

Symbol	Parameter	Rating	Unit
Vin	DC Supply Voltage	-0.3 to 12	V
P_D	Power Dissipation	Internally Limited	
T_{ST}	Storage Temperature	-65 to +150	°C
T_{OP}	Operating Junction Temperature Range	0 to +150	°C

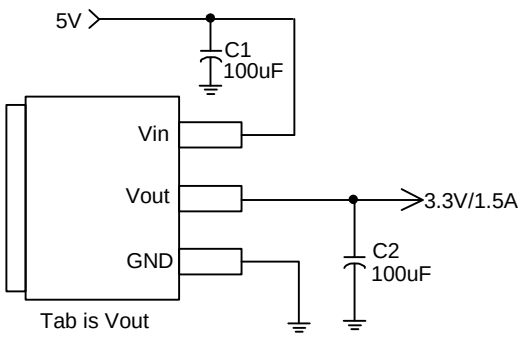
Electrical Characteristics (Under Operating Conditions)

Parameter	Conditions		Min	Typ.	Max	Unit
Reference Voltage	AP1086-Adj	T_A = 25°C, (V_{IN}-V_{OUT})= 1.5V,I_O = 10mA	1.225	1.250	1.275	V
Output Voltage	AP1086-1.5	I_{OUT} = 10mA, T_A = 25°C, 3V≦V_{IN}≦12V	1.470	1.500	1.530	V
	AP1086-1.8	I_{OUT} = 10mA, T_A = 25°C, 3.3V≦V_{IN}≦12V	1.764	1.800	1.836	V
	AP1086-2.5	I_{OUT} = 10mA, T_A = 25°C, 4V≦V_{IN}≦12V	2.450	2.500	2.550	V
	AP1086-3.3	I_{OUT} = 10mA, T_A = 25°C, 4.8V≦V_{IN}≦12V	3.235	3.300	3.365	V
	AP1086-5.0	I_{OUT} = 10mA, T_A = 25°C, 6.5V≦V_{IN}≦12V	4.900	5.000	5.100	V
Line Regulation	AP1086-XXX	I_O = 10mA, V_{OUT}+1.5V<V_{IN}<12V	-	-	0.2	%
Load Regulation	AP1086-Adj	V_{IN} = 3.3V, 0mA<Io<1.5A, T_A = 25°C (Note 4, 5)	-	-	1	%
	AP1086-1.5	V_{IN} = 3V, 0mA<Io<1.5A, T_A = 25°C (Note 4, 5)	-	12	15	mV
	AP1086-1.8	V_{IN} = 3.3V, 0mA<Io<1.5A, T_A = 25°C (Note 4, 5)	-	15	18	mV
	AP1086-2.5	V_{IN} = 4V, 0mA<Io<1.5A, T_A = 25°C (Note 4, 5)	-	20	25	mV
	AP1086-3.3	V_{IN} = 5V, 0≦I_{OUT}≦1.5A, T_A = 25°C, T_J = 25°C (Note 4, 5)	-	26	33	mV
	AP1086-5.0	V_{IN} = 8V, 0≦I_{OUT}≦1.5A, T_A = 25°C, T_J = 25°C (Note 4, 5)	-	40	50	mV
Dropout Voltage (V_{IN}-V_{OUT})	AP1086-Adj/-2.5 /-3.3/-3.6/-5.0	I_{OUT} = 1.5A, ΔV_{OUT} = 1%V_{OUT}	-	1.3	1.4	V
Current Limit	AP1086-Adj/-2.5 /-3.3/-3.6/-5.0	(V_{IN}-V_{OUT}) = 5V	1. 6	-	-	A
Minimum Load Current (Note 6)	AP1086-XXX	0°C≦T_J≦125°C	-	5	10	mA
Thermal Regulation	T_A = 25°C, 30ms pulse		-	0.008	0.04	%/W
Ripple Rejection	f = 120Hz,C_{OUT} = 25uF Tantalum, I_{OUT} = 1.5A					
	AP1086-XXX	V_{IN} = V_{OUT}+3V	-	60	70	dB
RMS Noise (% of V_{OUT})	10Hz ≤ f ≤ 10KHz		-	0.003	-	%
Temperature Stability	I_O = 10mA		-	0.5	-	%
θ_{JA} Thermal Resistance Junction-to-Ambient (No heat sink; No air flow)	TO252-3L TO263-3L TO220-3L		-	101 83 86	-	°C/W
θ_{JC} Thermal Resistance Junction-to-Case	TO252-3L: Control Circuitry/Power Transistor TO263-3L: Control Circuitry/Power Transistor TO220-3L: Control Circuitry/Power Transistor		-	15 0.65/2.7 0.65/2.7	-	°C/W

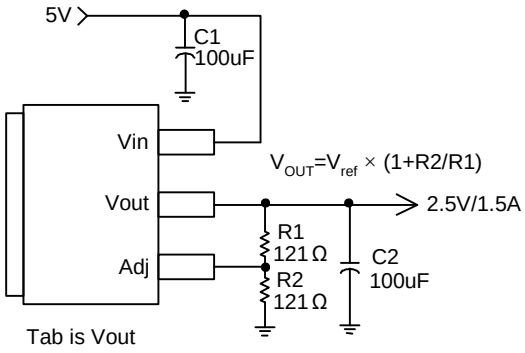
Notes: 4. See thermal regulation specifications for changes in output voltage due to heating effects. Line and load regulation are measured at a constant junction temperature by low duty cycle pulse testing. Load regulation is measured at the output lead = 1/18" from the package.
5. Line and load regulation are guaranteed up to the maximum power dissipation of 15W. Power dissipation is determined by the difference in input and output and the output current. Guaranteed maximum power dissipation will not be available over the full input/output range.
6. Quiescent current is defined as the minimum output current required in maintaining regulation. At 12V input/output differential the device is guaranteed to regulate if the output current is greater than 10mA.

Typical Application

5V to 3.3V Fixed Mode Regulator



Adjustable Regulator



Note: $V_o = V_{REF} * (1+\frac{R_2}{R_1})$

Functional Description

Introduction
The AP1086 adjustable or fixed-mode Low Dropout (LDO) regulator is a 3 terminal device which can easily be programmed by internal mask change to any voltages within the range of 1.25V to Vin-1.4V. The AP1086 only needs 1.4V differential between Vin and Vout to maintain output regulation. In addition, the output voltage tolerances are also extremely tight and they include the transient response as part of the specification. For example, Intel VRE specification calls for a total of +/- 100mV including initial tolerance, load regulation and 0 to 1.5A load step.
The AP1086 is specifically designed to meet the fast current transient needs as well as providing an accurate initial voltage, reducing the overall system cost with the need for fewer output capacitors.

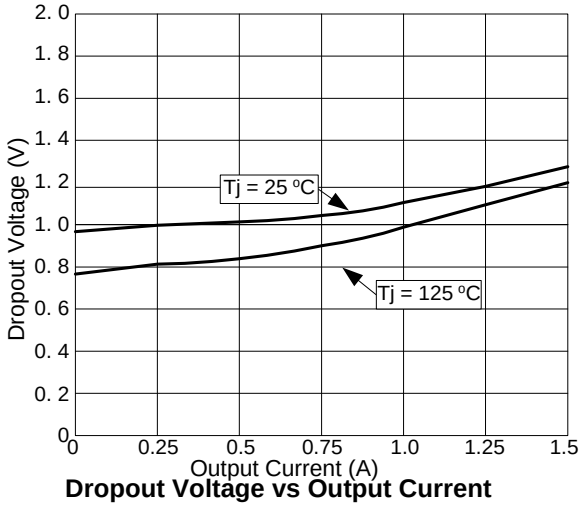
Load Regulation
Since the AP1086 is only a 3 terminal device, it is not possible to provide true remote sensing of the output voltage at the load. But it can supply good load regulation by internal feedback bypass the external loss such as adjustable mode.

Stability
The AP1086 requires the use of an output capacitor as part of the frequency compensation in order to make the regulator stable. For most applications a minimum of 10uF aluminum electrolytic capacitor insures both stability and good transient response.

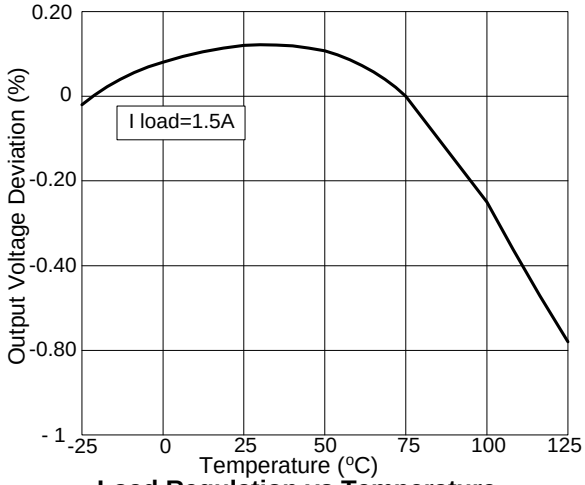
Thermal Design
The AP1086 incorporates an internal thermal shutdown that protects the device when the junction temperature exceeds the maximum allowable junction temperature. Although this device can operate with junction temperatures in the range of 150°C, it is recommended that the selected heat sink be chosen such that during maximum continuous load operation the junction temperature is kept below the temperature.

Layout Consideration
The output capacitors must be located as close to the Vout terminal of the device as possible. It is recommended to use a section of a layer of the PC board as a plane to connect the Vout pin to the output capacitors to prevent any high frequency oscillation that may result due to excessive trace inductance.

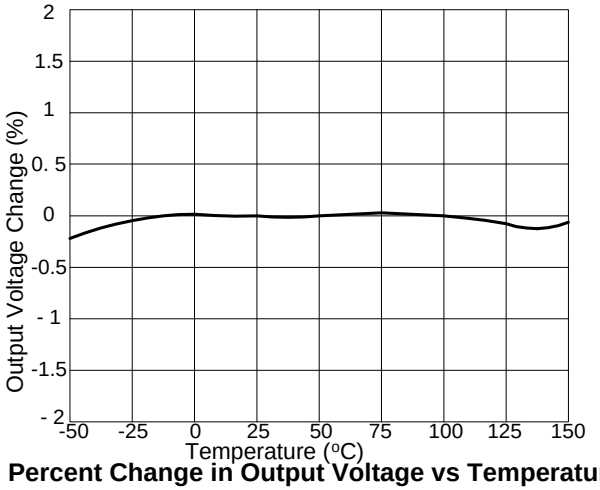
Typical Performance Characteristics



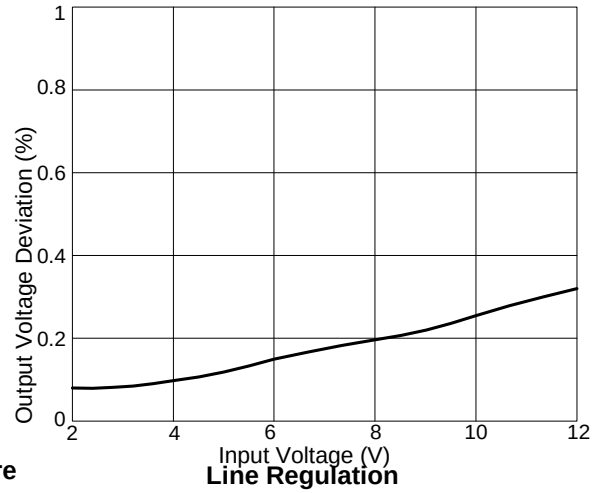
Dropout Voltage vs Output Current



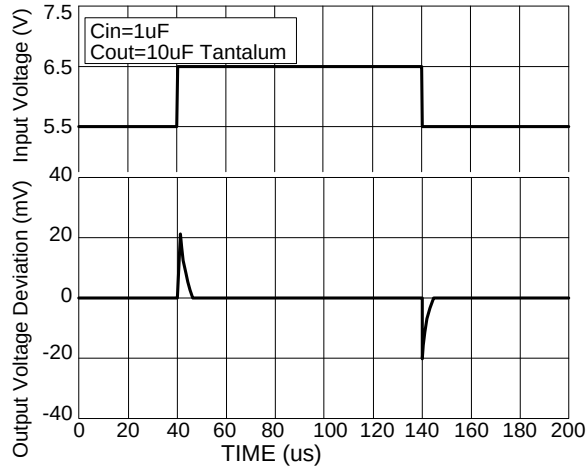
Load Regulation vs Temperature



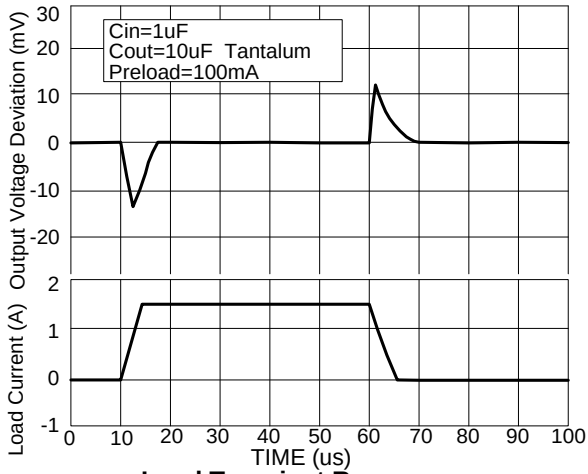
Percent Change in Output Voltage vs Temperature



Line Regulation



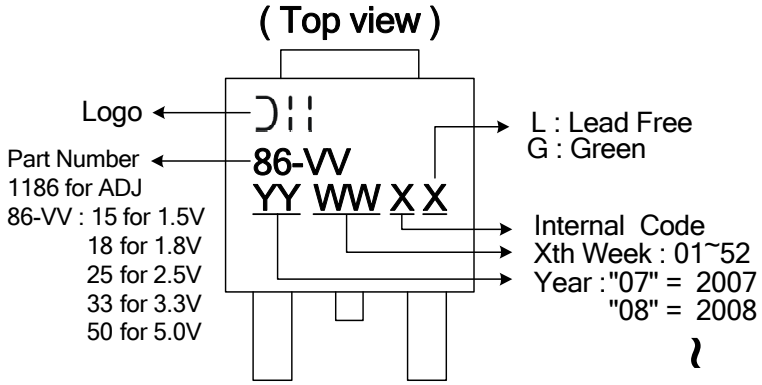
Line Transient Response



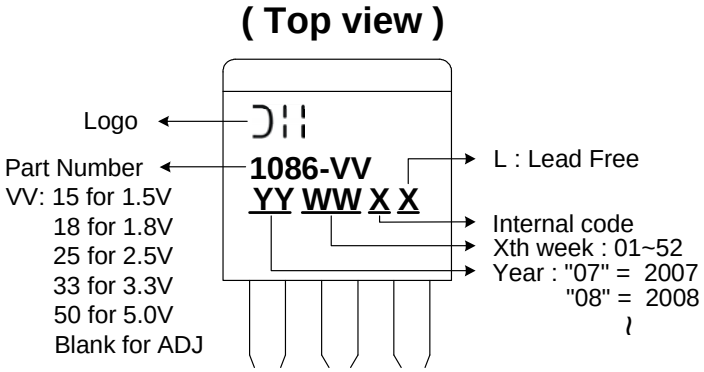
Load Transient Response

Marking Information

(1) TO252-3L

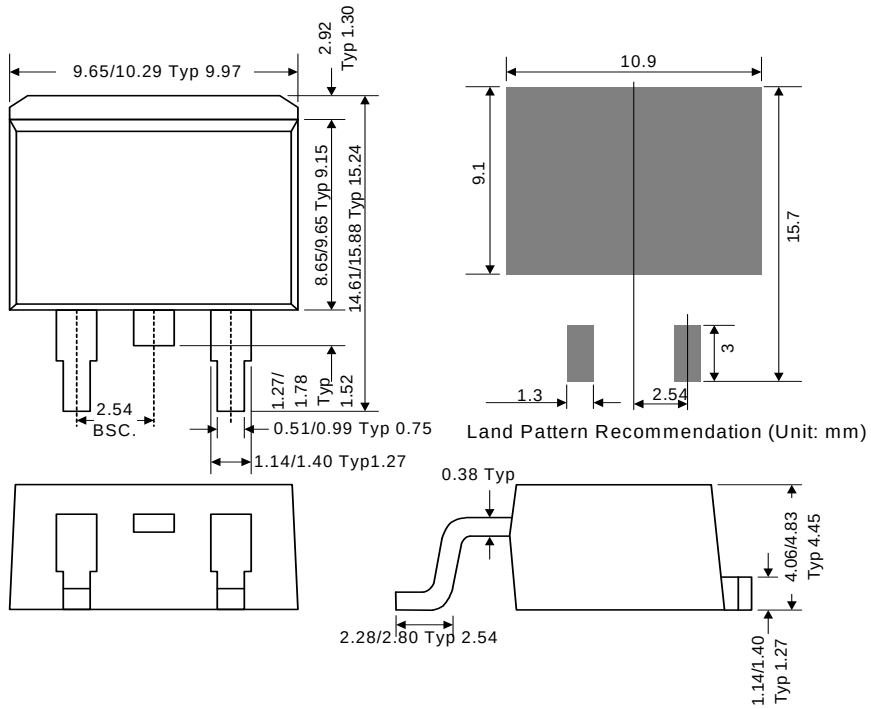


(2) TO220-3L and TO263-3L

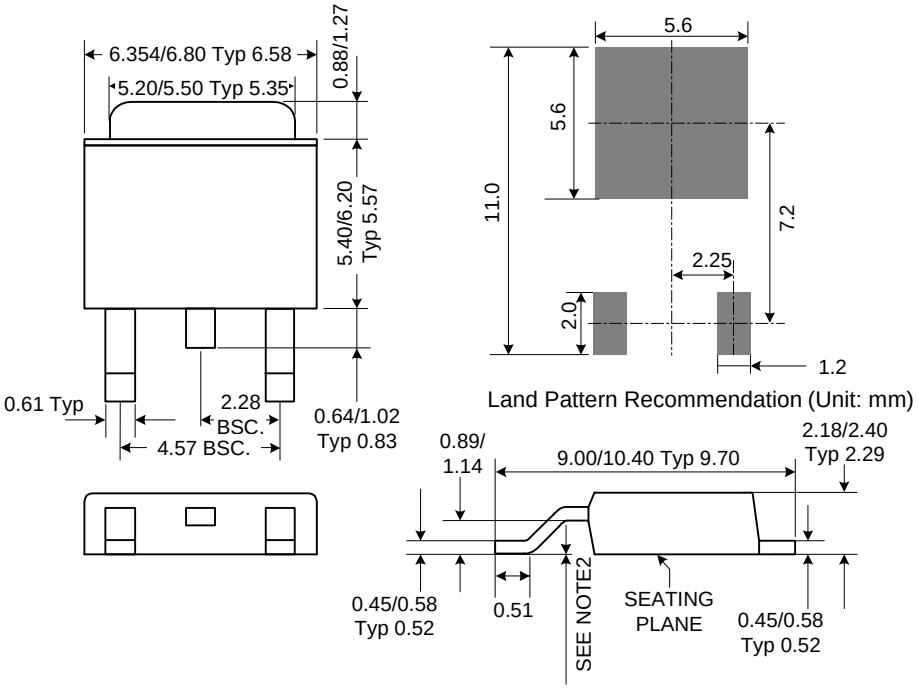


Package Information

(1) TO263-3L



(2) TO252-3L



Package Information (Continued)

(3) TO220-3L