GM66150 Series

1.5A ULTRA LOW DROPOUT VOLTAGE REGULATORS

Description

The GM66150 series of positive fixed and adjustable regulators is designed to provide up to 1.5A output with high current, high accuracy, and extremely low dropout voltage performance. These regulators feature 300 to 350mV (full load) dropout voltages, and very low ground current. Although designed for high current loads, these devices are also useful in lower current, extremely low dropout critical systems, where the minimal dropout voltage and ground current values are important characteristics.

TheGM66150 is fully protected against over current, reversed input polarity (or reversed battery connection), reversed lead insertion, over temperature operation, and transient voltage spikes (positive or negative).

Five lead fixed voltage versions feature logic level ON/OFF control and an error flag which signals whenever the output falls out of regulation.

For GM66151 and GM66152, the ENABLE pin may be tied to V_{IN} if it is not required for ON/OFF control. The GM66150 series is available in 3-pin and 5-pin TO-220 and surface mount SOT-223 and TO-263 packages.

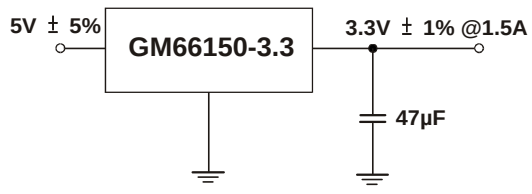
Features

- **Ultra Low Dropout Voltage of 350mV @ 1.5A with Low Ground Current**
- **Fixed and Adjustable Voltage Versions**
- **Output Current up to 1.5A**
- **Guaranteed 1% Accurate Tolerance**
- **Extremely Fast Transient Response**
- **Reverse-battery Protection**
- **"Load Dump" Protection**
- **Zero-Current shutdown mode(5-pin versions) Error flag signals output out-of-regulation (5-pin versions)**

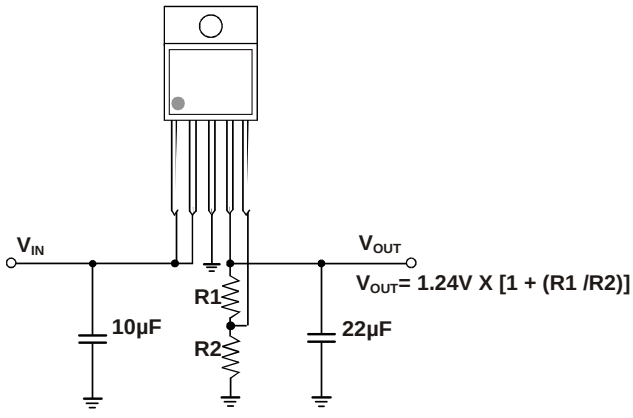
Application

- **High Efficiency Linear Regulators**
- **Post Regulators for Switching Supplies High Efficiency "Green" Computer Systems**
- **Battery Powered Equipment**
- **Automotive ElectronicS**

Typical Application Circuits



Fixed Voltage Version

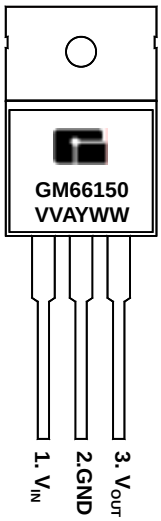


Adjustable Voltage Version

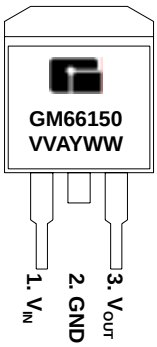
Marking Information and Pin Configurations (Top View)

GM66150 (Pb Free)

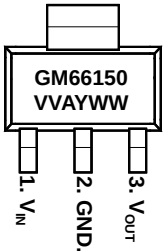
TO 220



TO 263 (D^2-PAK)

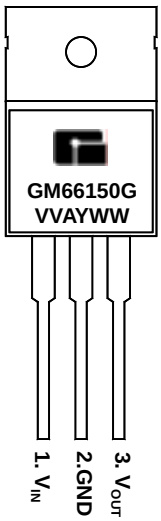


SOT223

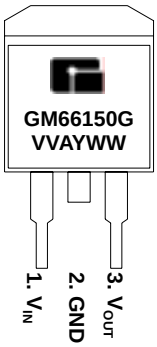


GM66150 (Green Product)

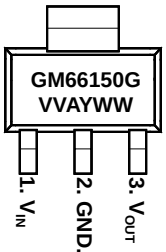
TO 220



TO 263 (D^2-PAK)



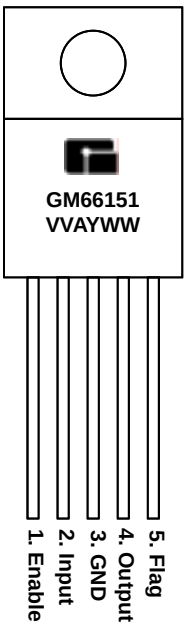
SOT223

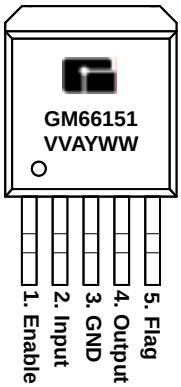


G: Green Product
VV: Voltage suffix (15 = 1.5V, 50 = 5.0V…A = Adj)
A: Assembly / Test site code
Y: Year
WW: Week

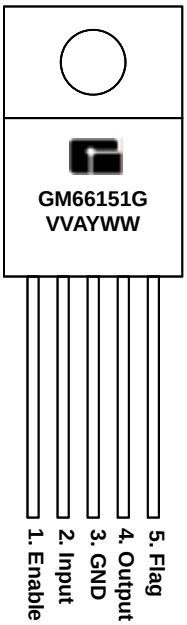
Marking Information and Pin Configurations (Top View)

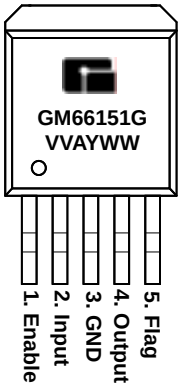
GM66151 (Pb Free)





GM66151 (Green Product)



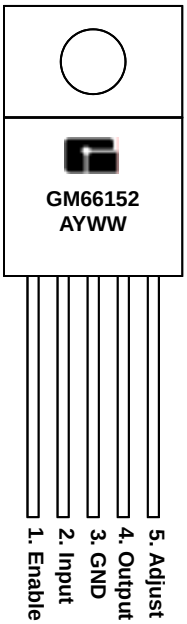


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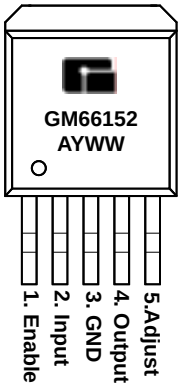
Marking Information and Pin Configurations (Top View)

GM66152 (Pb Free)

TO-220-5

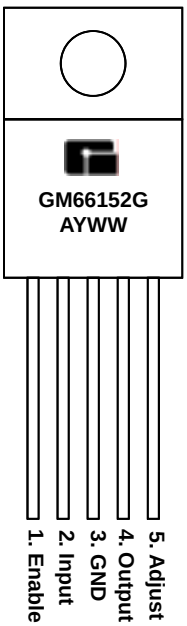


TO-263-5

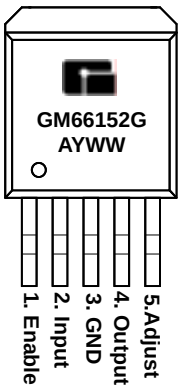


GM66152 (Green Product)

TO-220-5



TO-263-5

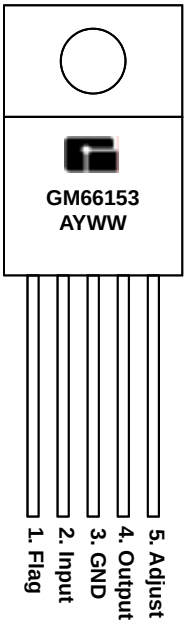


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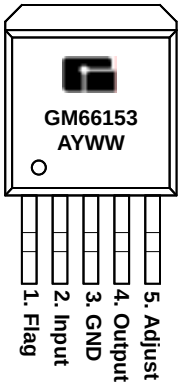
Marking Information and Pin Configurations (Top View)

GM66153 (Pb Free)

TO-220-5

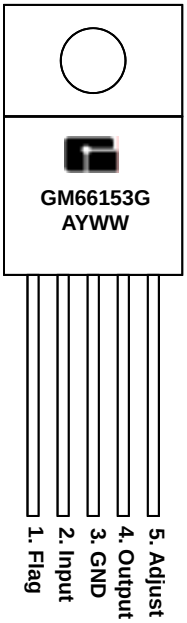


TO-263-5

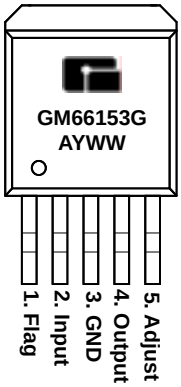


GM66153 (Green Product)

TO-220-5



TO-263-5



G: Green Product
A: Assembly / Test site code
Y: Year
WW: Week

Ordering Information – Pb Free

Ordering Number	Output Voltage	Package	Shipping
GM66150			
GM66150-1.5TA3T	1.5V	TO-263	50 Units/Tube
GM66150-1.5TA3R	1.5V	TO-263	800 Units / Reel
GM66150-1.5TB3T	1.5V	TO-220	50 Units/Tube
GM66150-1.5ST3T	1.5V	SOT-223	80 Units/Tube
GM66150-1.5ST3R	1.5V	SOT-223	2,500 Units / Tape & Reel
GM66150-1.8TA3T	1.8V	TO-263	50 Units/Tube
GM66150-1.8TA3R	1.8V	TO-263	800 Units / Reel
GM66150-1.8TB3T	1.8V	TO-220	50 Units/Tube
GM66150-1.8ST3T	1.8V	SOT-223	80 Units/Tube
GM66150-1.8ST3R	1.8V	SOT-223	2,500 Units / Tape & Reel
GM66150-2.5TA3T	2.5V	TO-263	50 Units/Tube
GM66150-2.5TA3R	2.5V	TO-263	800 Units / Reel
GM66150-2.5TB3T	2.5V	TO-220	50 Units/Tube
GM66150-2.5ST3T	2.5V	SOT-223	80 Units/Tube
GM66150-2.5ST3R	2.5V	SOT-223	2,500 Units / Tape & Reel
GM66150-3.0TA3T	3.0V	TO-263	50 Units/Tube
GM66150-3.0TA3R	3.0V	TO-263	800 Units / Reel
GM66150-3.0TB3T	3.0V	TO-220	50 Units/Tube
GM66150-3.0ST3T	3.0V	SOT-223	80 Units/Tube
GM66150-3.0ST3R	3.0V	SOT-223	2,500 Units / Tape & Reel
GM66150-3.3TA3T	3.3V	TO-263	50 Units/Tube
GM66150-3.3TA3R	3.3V	TO-263	800 Units / Reel
GM66150-3.3TB3T	3.3V	TO-220	50 Units/Tube
GM66150-3.3ST3T	3.3V	SOT-223	80 Units/Tube
GM66150-3.3ST3R	3.3V	SOT-223	2,500 Units / Tape & Reel
GM66150-5.0TA3T	5.0V	TO-263	50 Units/Tube
GM66150-5.0TA3R	5.0V	TO-263	800 Units / Reel
GM66150-5.0TB3T	5.0V	TO-220	50 Units/Tube
GM66150-5.0ST3T	5.0V	SOT-223	80 Units/Tube
GM66150-5.0ST3R	5.0V	SOT-223	2,500 Units / Tape & Reel
GM66150-12TA3T	12V	TO-263	50 Units/Tube
GM66150-12TA3R	12V	TO-263	800 Units / Reel
GM66150-12TB3T	12V	TO-220	50 Units/Tube

Ordering Information – Green Product

Ordering Number	Output Voltage	Package	Shipping
GM66150			
GM66150-1.5TA3TG	1.5V	TO-263	50 Units/Tube
GM66150-1.5TA3RG	1.5V	TO-263	800 Units / Reel
GM66150-1.5TB3TG	1.5V	TO-220	50 Units/Tube
GM66150-1.5ST3TG	1.5V	SOT-223	80 Units/Tube
GM66150-1.5ST3RG	1.5V	SOT-223	2,500 Units / Tape & Reel
GM66150-1.8TA3TG	1.8V	TO-263	50 Units/Tube
GM66150-1.8TA3RG	1.8V	TO-263	800 Units / Reel
GM66150-1.8TB3TG	1.8V	TO-220	50 Units/Tube
GM66150-1.8ST3TG	1.8V	SOT-223	80 Units/Tube
GM66150-1.8ST3RG	1.8V	SOT-223	2,500 Units / Tape & Reel
GM66150-2.5TA3TG	2.5V	TO-263	50 Units/Tube
GM66150-2.5TA3RG	2.5V	TO-263	800 Units / Reel
GM66150-2.5TB3TG	2.5V	TO-220	50 Units/Tube
GM66150-2.5ST3TG	2.5V	SOT-223	80 Units/Tube
GM66150-2.5ST3RG	2.5V	SOT-223	2,500 Units / Tape & Reel
GM66150-3.0TA3TG	3.0V	TO-263	50 Units/Tube
GM66150-3.0TA3RG	3.0V	TO-263	800 Units / Reel
GM66150-3.0TB3TG	3.0V	TO-220	50 Units/Tube
GM66150-3.0ST3TG	3.0V	SOT-223	80 Units/Tube
GM66150-3.0ST3RG	3.0V	SOT-223	2,500 Units / Tape & Reel
GM66150-3.3TA3TG	3.3V	TO-263	50 Units/Tube
GM66150-3.3TA3RG	3.3V	TO-263	800 Units / Reel
GM66150-3.3TB3TG	3.3V	TO-220	50 Units/Tube
GM66150-3.3ST3TG	3.3V	SOT-223	80 Units/Tube
GM66150-3.3ST3RG	3.3V	SOT-223	2,500 Units / Tape & Reel
GM66150-5.0TA3TG	5.0V	TO-263	50 Units/Tube
GM66150-5.0TA3RG	5.0V	TO-263	800 Units / Reel
GM66150-5.0TB3TG	5.0V	TO-220	50 Units/Tube
GM66150-5.0ST3TG	5.0V	SOT-223	80 Units/Tube
GM66150-5.0ST3RG	5.0V	SOT-223	2,500 Units / Tape & Reel
GM66150-12TA3TG	12V	TO-263	50 Units/Tube
GM66150-12TA3RG	12V	TO-263	800 Units / Reel
GM66150-12TB3TG	12V	TO-220	50 Units/Tube

Ordering Information – Pb Free

Ordering Number	Output Voltage	Package	Shipping
GM66151			
GM66151-1.5TA5T	1.5V	TO-263-5	50 Units/Tube
GM66151-1.5TA5R	1.5V	TO-263-5	800 Units / Reel
GM66151-1.5TB5T	1.5V	TO-220-5	50 Units/Tube
GM66151-1.8TA5T	1.8V	TO-263-5	50 Units/Tube
GM66151-1.8TA5R	1.8V	TO-263-5	800 Units / Reel
GM66151-1.8TB5T	1.8V	TO-220-5	50 Units/Tube
GM66151-2.5TA5T	2.5V	TO-263-5	50 Units/Tube
GM66151-2.5TA5R	2.5V	TO-263-5	800 Units / Reel
GM66151-2.5TB5T	2.5V	TO-220-5	50 Units/Tube
GM66151-3.0TA5T	3.0V	TO-263-5	50 Units/Tube
GM66151-3.0TA5R	3.0V	TO-263-5	800 Units / Reel
GM66151-3.0TB5T	3.0V	TO-220-5	50 Units/Tube
GM66151-3.3TA5T	3.3V	TO-263-5	50 Units/Tube
GM66151-3.3TA5R	3.3V	TO-263-5	800 Units / Reel
GM66151-3.3TB5T	3.3V	TO-220-5	50 Units/Tube
GM66151-5.0TA5T	5.0V	TO-263-5	50 Units/Tube
GM66151-5.0TA5R	5.0V	TO-263-5	800 Units / Reel
GM66151-5.0TB5T	5.0V	TO-220-5	50 Units/Tube
GM66151-12TA5T	12V	TO-263-5	50 Units/Tube
GM66151-12TA5R	12V	TO-263-5	800 Units / Reel
GM66151-12TB5T	12V	TO-220-5	50 Units/Tube

Ordering Information – Green Product

Ordering Number	Output Voltage	Package	Shipping
GM66151			
GM66151-1.5TA5TG	1.5V	TO-263-5	50 Units/Tube
GM66151-1.5TA5RG	1.5V	TO-263-5	800 Units / Reel
GM66151-1.5TB5TG	1.5V	TO-220-5	50 Units/Tube
GM66151-1.8TA5TG	1.8V	TO-263-5	50 Units/Tube
GM66151-1.8TA5RG	1.8V	TO-263-5	800 Units / Reel
GM66151-1.8TB5TG	1.8V	TO-220-5	50 Units/Tube
GM66151-2.5TA5TG	2.5V	TO-263-5	50 Units/Tube
GM66151-2.5TA5RG	2.5V	TO-263-5	800 Units / Reel
GM66151-2.5TB5TG	2.5V	TO-220-5	50 Units/Tube
GM66151-3.0TA5TG	3.0V	TO-263-5	50 Units/Tube
GM66151-3.0TA5RG	3.0V	TO-263-5	800 Units / Reel
GM66151-3.0TB5TG	3.0V	TO-220-5	50 Units/Tube
GM66151-3.3TA5TG	3.3V	TO-263-5	50 Units/Tube
GM66151-3.3TA5RG	3.3V	TO-263-5	800 Units / Reel
GM66151-3.3TB5TG	3.3V	TO-220-5	50 Units/Tube
GM66151-5.0TA5TG	5.0V	TO-263-5	50 Units/Tube
GM66151-5.0TA5RG	5.0V	TO-263-5	800 Units / Reel
GM66151-5.0TB5TG	5.0V	TO-220-5	50 Units/Tube
GM66151-12TA5TG	12V	TO-263-5	50 Units/Tube
GM66151-12TA5RG	12V	TO-263-5	800 Units / Reel
GM66151-12TB5TG	12V	TO-220-5	50 Units/Tube

Ordering Information – Pb Free

Ordering Number	Output Voltage	Package	Shipping
GM66152			
GM66152TA5T	Adj	TO-263-5	50 Units/Tube
GM66152TA5R	Adj	TO-263-5	800 Units / Reel
GM66152TB5T	Adj	TO-220-5	50 Units/Tube
GM66153			
GM66153TA5T	Adj	TO-263-5	50 Units/Tube
GM66153TA5R	Adj	TO-263-5	800 Units / Reel
GM66153TB5T	Adj	TO-220-5	50 Units/Tube

Ordering Information – Green Product

Ordering Number	Output Voltage	Package	Shipping
GM66152			
GM66152TA5TG	Adj	TO-263-5	50 Units/Tube
GM66152TA5RG	Adj	TO-263-5	800 Units / Reel
GM66152TB5TG	Adj	TO-220-5	50 Units/Tube
GM66153			
GM66153TA5TG	Adj	TO-263-5	50 Units/Tube
GM66153TA5RG	Adj	TO-263-5	800 Units / Reel
GM66153TB5TG	Adj	TO-220-5	50 Units/Tube

Absolute Maximum Ratings

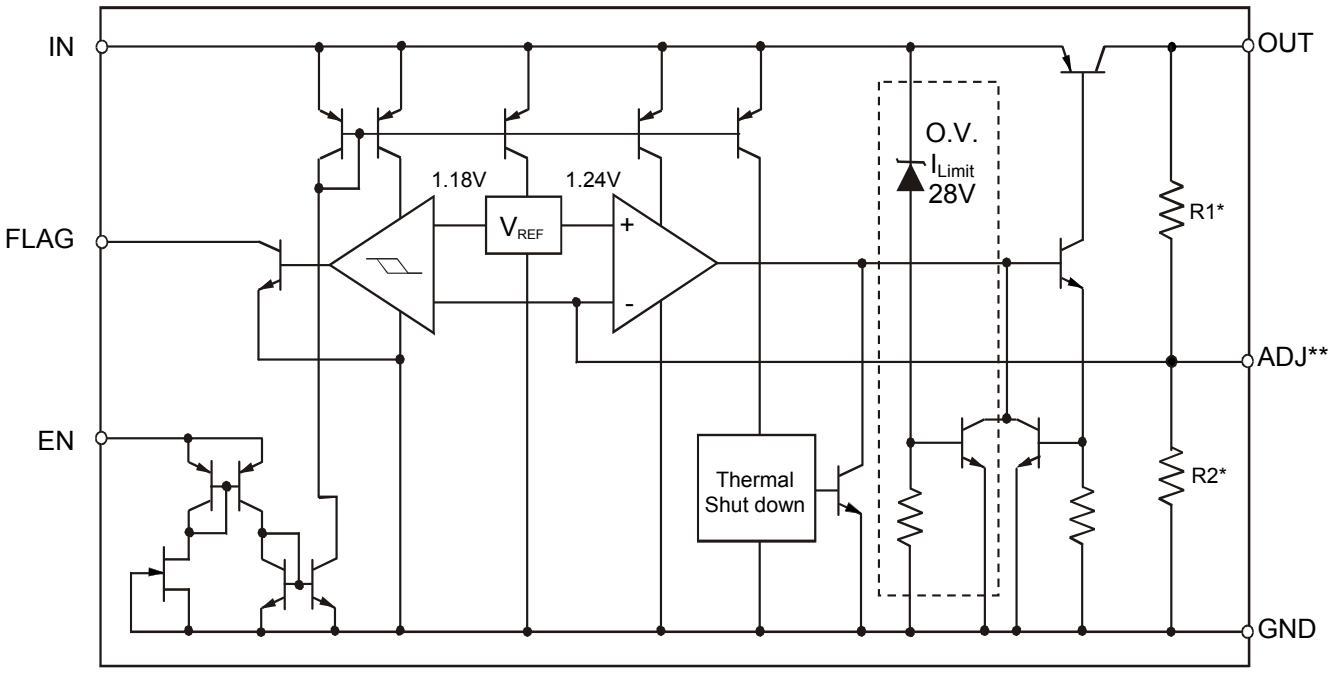
Parameter	Symbol	Value	Unit
Power Dissipation	P_D	Internally Limited	W
Input Power Supply Voltage (Note 1)	V_{IN}	-20 to +60	V
Storage Temperature Range	T_{STG}	- 65 to 150	℃
Lead Temperature (Soldering, 5 sec)		+ 260	℃

Note 1: Maximum positive supply voltage of 60V must be of limited duration (<100msec) and duty cycle (< 1%). The maximum continuous supply voltage is 26V.

Operating Ratings

Parameter	Symbol	Value	Unit
Maximum Operating Input Voltage	V_{IN}	26	V
Operating Junction Temperature	T_J	-40 to +125	℃

Block Diagram



* Feedback network in fixed versions only
** Adjustable version only

Electrical Characteristics:

(Unless otherwise specified: T_J = 25℃, Bold values are guaranteed across the full operating temperature range. Adjustable versions are programmed to 5.0V)

Parameter	Condition		Symbol	Min	Typ	Max	Unit
Output Voltage	I_O = 10mA		V_{OUT}	-1		1	%
	10mA ≤ I_O ≤ 1.5A, V_{OUT} + 1V ≤ V_{IN} ≤ 26V, (Note 2, 6)			**-2**		**2**	
Line Regulation	I_O = 10mA, V_{OUT} + 1V ≤ V_{IN} ≤ 26V		ΔV_{OI}		0.06	0.5	%
Load Regulation	V_{IN} = V_{OUT} + 5V, 10mA ≤ I_O ≤ 1.5A, (Note 6)		ΔV_{OL}		0.2	1.0	%
Output Temperature Coefficient	(Note 6)		$\Delta V_{OUT}/\Delta T$		20	100	ppm/℃
Dropout Voltage	ΔV_{OUT} = -1% (Note 3)	I_O = 100mA	V_{DO}		80	**200**	mV
		I_O = 750A			220		
		I_O = 1.5A			350	**600**	
Ground Current (Note 5)	I_O = 750mA, V_{IN} = V_{OUT} + 1V		I_{GND}		8	**20**	mA
	I_O = 1.5A				22		
Ground Pin Current at Dropout	V_{IN} = 0.5V less than specified V_{OUT}, I_O = 10mA		I_{GNDDO}		20		mA
Current Limit	GM66150, V_{OUT} = 0V, (Note 4)		I_{CL}		2.1	**3.5**	A
Output Noise Voltage	10Hz to 100kHz, I_L = 100mA	C_L = 10 μ F	e_n		400		μV_{RMS}
		C_L = 33 μ F			260		
Reference GM66152							
Reference Voltage			V_{REF}	1.228	1.240	1.252	V
				1.215		**1.265**	
	(Note 8)			**1.203**		**1.277**	
Adjust Pin Bias Current			I_{ADJB}		40	80	nA
						120	
V_{REF} Temperature Coefficient	(Note 7)		$\Delta V_{REF}/\Delta T$		20		ppm/℃
Adjust Pin Bias Current Temperature Coefficient					0.1		nA/℃

Electrical Characteristics (continued):

(Unless otherwise specified: T_J = 25℃, Bold values are guaranteed across the full operating temperature range. Adjustable versions are programmed to 5.0V)

Parameter		Condition	Symbol	Min	Typ	Max	Unit
Flag Output (Error Comparator) GM66151/GM66153							
Output Leakage Current		V_{OH} = 26V	I_{OLEAK}		0.01	1	µA
						2	
Output Low Voltage		Device set for 5V, V_{IN} = 4.5V I_{OL} = 250µA	V_{OL}		220	300	mV
						400	
Upper Threshold Voltage		Device set for 5V (Note 9)	V_{THU}	40	60		mV
				25			
Lower Threshold Voltage		Device set for 5V (Note 9)	V_{THL}		75	95	mV
						140	mV
Hysteresis		Device set for 5V (Note 9)	V_{HYS}		15		mV
Enable Input GM66151/GM66152							
Input Logic Voltage	Low (Off)					**0.8**	V
	High (On)			**2.4**			
Enable Pin Input Current		V_{EN} = 26V	I_{EN}		100	600	µA
						750	
		V_{EN} = 0.8V				2.5	
						5.0	
Regulator Output Current in Shutdown		(Note 10)	I_{OSD}		10		µA
						500	

Note 2: Full Load current (I_{FL}) is defined as 1.5A.

Note 3: Dropout voltage is defined as the input-to-output differential when the output voltage drops to 99% of its nominal value with V_{OUT} to V_{IN}

Note 4: V_{IN} = V_{OUT} (nominal) + 1V. For example, use V_{IN} = 4.3V for a 3.3V regulator or use 6V for a 5V regulator. Employ pulse testing procedures to minimize temperature rise.

Note 5: Ground pin current is the regulator quiescent current. The total current drawn from the source is the sum of the load current plus the ground pin current.

Note 6: Output voltage temperature coefficient is defined as the worst case voltage change divided by the total temperature range.

Note 7: Thermal regulation is defined as the change in output voltage at a time T after a change in power dissipation is applied, excluding load or line regulation effects. Specifications are for a 200mA load pulse at V_{IN} = 20V (a 4W pulse) for T = 10ms.

Note 8: $V_{REF} \le V_{OUT} \le (V_{IN}$ -1V), 2.3V $\le V_{IN} \le$ 26V, 10mA $\le$ IL $\le I_{FL}$, $T_J \le T_{J\,MAX}$.

Note 9: $V_{EN} \le$ 0.8V and $V_{IN} \le$ 26V, V_{OUT}=0

Note 10: When used in dual supply systems where the regulator load is returned to a negative supply, the output voltage must be diode clamped to ground.

Application Information

The GM66150 series is a high performance low-dropout voltage regulator suitable for all moderate to high current/voltage regulator applications. The 350mV dropout voltage at full load makes it especially valuable in battery powered systems and as high efficiency noise filters in “post-regulator” applications.

Unlike older NPN-pass transistor designs, dropout performance of the PNP output of these devices is limited merely by the low VCE saturation voltage. The GM66150 family of regulators is fully protected from damage due to fault conditions. Current limiting is provided. This limiting is linear; output current under overload conditions is constant.

Thermal shutdown disables the device when the die temperature exceeds the 125°C maximum safe operating temperature. Transient protection allows device survival even when the input voltage spikes between -20V and +60V. When the input voltage exceeds about 35V to 40V, the over voltage sensor temporarily disables the regulator.

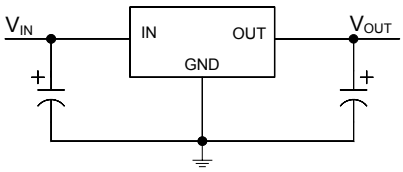


Figure 1.Linear regulators require only two capacitors for operation.

Thermal Design

Linear regulators are simple to use. The most complicated design parameters to consider are thermal characteristics. Thermal design requires the following application-specific parameters:

- Maximum ambient temperature, T_A
- Output Current, I_{OUT}
- Output Voltage, V_{OUT}
- Input Voltage, V_{IN}

First, we calculate the power dissipation of the regulator from these numbers and the device parameters from this datasheet.

$P_D = I_{OUT} X (1.01V_{IN} - V_{OUT})$, Where the ground current is approximated by 1% of I_{OUT}.

Then the heat sink thermal resistance is determined with this formula:

$$\theta_{SA} = \frac{T_{JMAX} - T_A}{P_D} - (\theta_{JC}+\theta_{CS}),$$ where $T_{JMAX} \leq 125°C$ and θ_{CS} is between 0 and 20°C/W

Capacitor Requirements

For stability and minimum output noise, a capacitor on the regulator output is necessary. The value of this capacitor is dependent upon the output current; lower currents allow smaller capacitors. GM66150 series are stable with the 10μF minimum capacitor values at full load. Where the regulator is powered from a source with a high AC impedance, a 0.1μF capacitor connected between Input and GND is recommended. This capacitor should have good characteristics to above 250kHz.

Application Information (continued)

Minimum Load Current

The GM66150 regulators are specified between finite loads. If the output current is too small, leakage currents dominate and the output voltage rises. The 5mA minimum load current swamps any expected leakage current across the operating temperature range.

Adjustable Regulator Design

The adjustable regulator versions, GM66152 and GM66153, allow programming the output voltage anywhere between 1.25V and the 26V maximum operating rating of the family. Two resistors are used. Resistors can be quite large, up to 1M., because of the very high input impedance and low bias current of the sense comparator: The resistor values are calculated by:

$$R1 = R2\left(\frac{V_{OUT}}{1.24} - 1\right)$$

Where is V_{OUT} the desired output voltage. Figure 2 shows component definition. Applications with widely varying load currents may scale the resistors to draw the minimum load current required for proper operation.

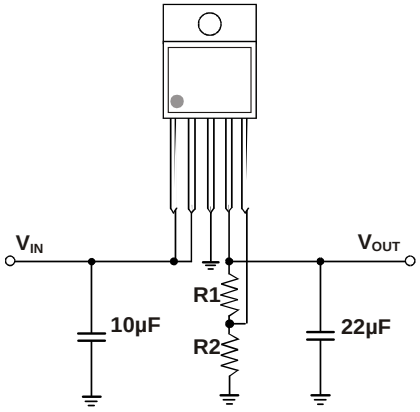


Figure 2. Adjustable Regulator with Resistors

Error Flag

GM66151 and GM66153 versions feature an Error Flag, which looks at the output voltage and signals an error condition when this voltage drops 5% below its expected value. The error flag is an open-collector output that pulls low under fault conditions. It may sink 10mA. Low output voltage signifies a number of possible problems, including an over-current fault (the device is in current limit) and low input voltage. The flag output is inoperative during over temperature shutdown conditions.

Enable Input

GM66151 and GM66152 versions feature an enable (EN) input that allows ON/OFF control of the device. Special design allows œzeroB current drain when the device is disabled#only microamperes of leakage current flows. The EN input has TTL/CMOS compatible thresholds for simple interfacing with logic, or may be directly tied to ≤ 30V. Enabling the regulator requires approximately 20µA.

Typical Characteristics (GM66150)

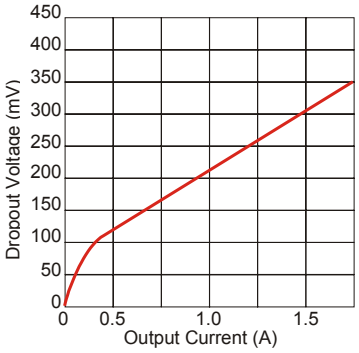


Figure 1. GM66150 Dropout Voltage vs. Output Current

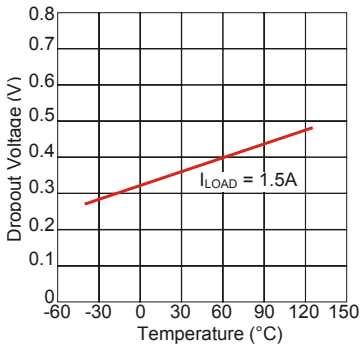


Figure 2. GM66150 Dropout Voltage vs. Temperature

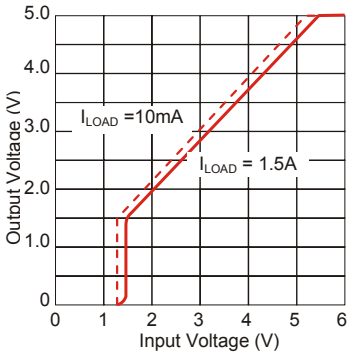


Figure 3. GM66150-5.0 Dropout Characteristics

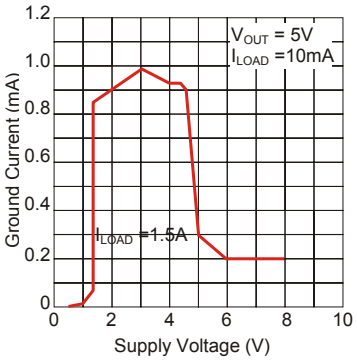


Figure 4. GM66150 Ground Current vs. Supply Voltage

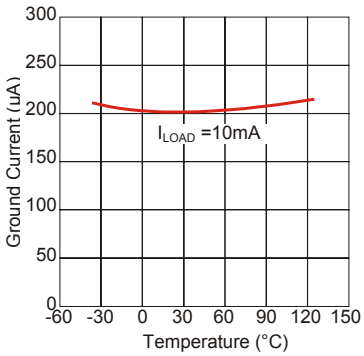


Figure 5. GM66150 Ground Current vs. Temperature

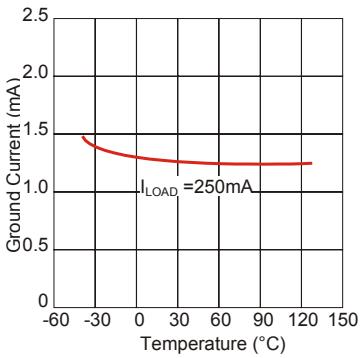


Figure 6. GM66150 Ground Current vs. Temperature

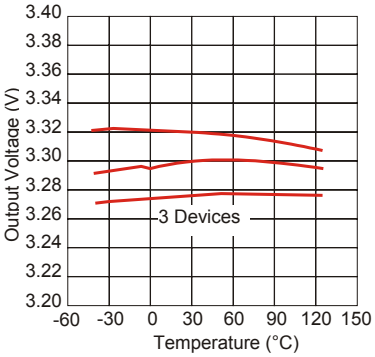


Figure 7. GM66150-3.3 Output Votlage vs. Temperature

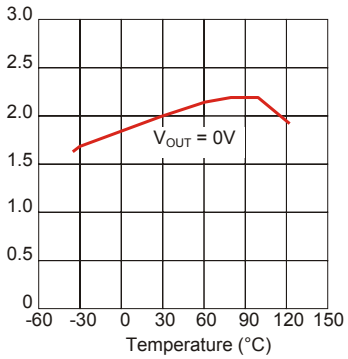


Figure 8. GM66150-3.3 Short Circuit Current vs. Temperature

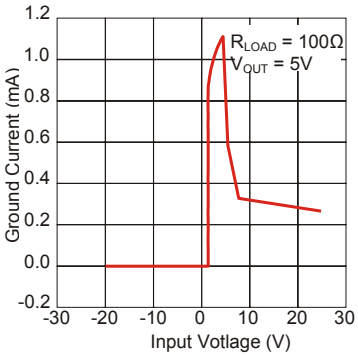
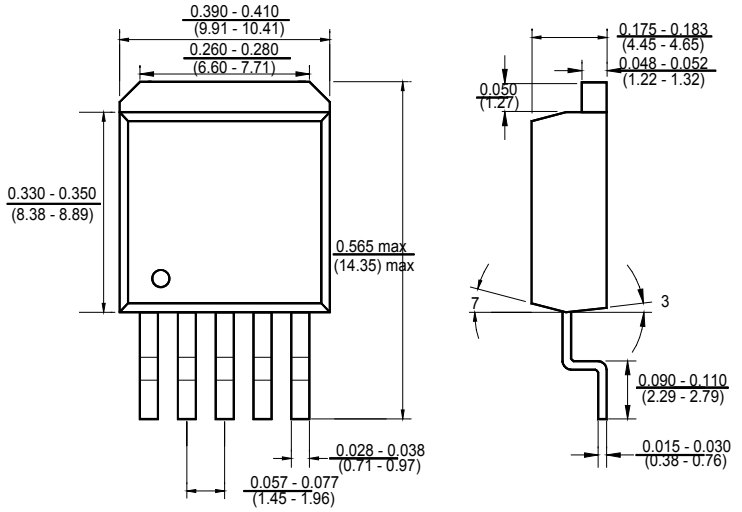
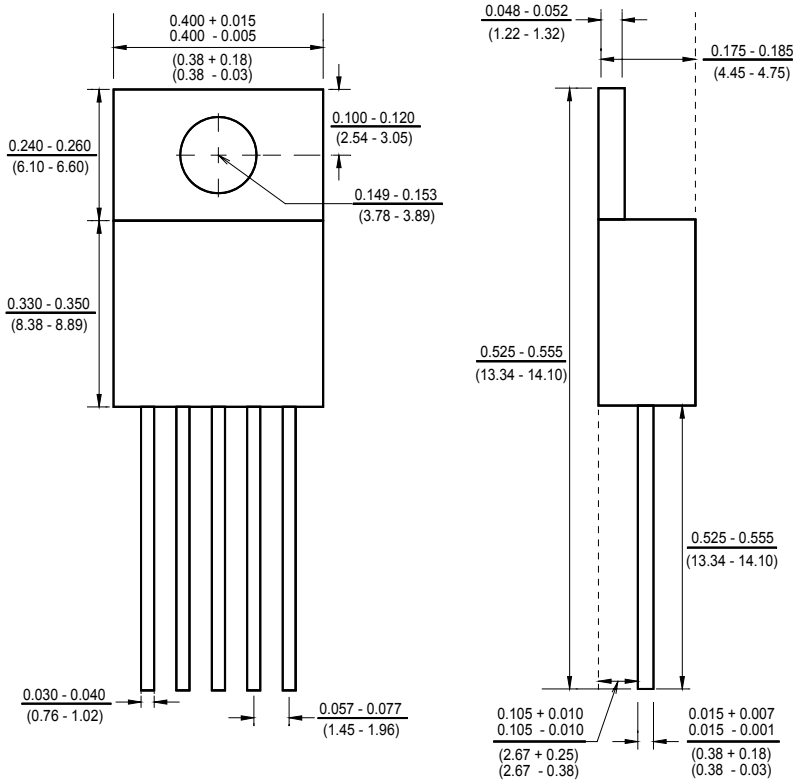


Figure 9. GM66150 Ground Current vs. Input Voltage

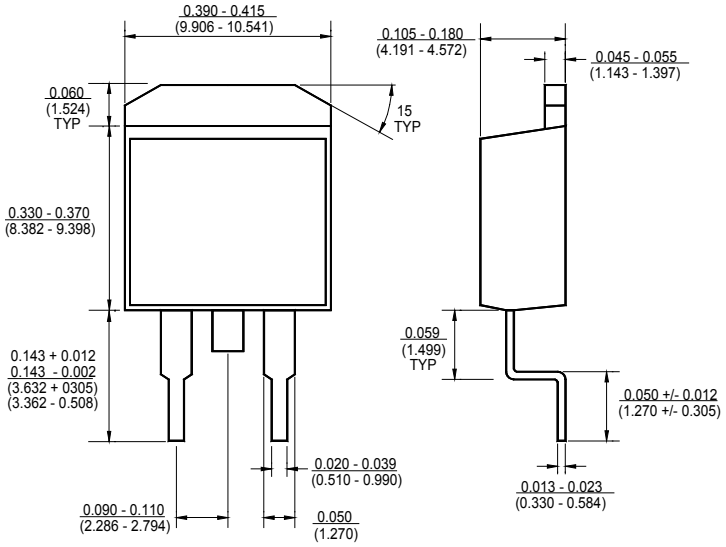
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Package Outline Dimensions – TO-220-5



Package Outline Dimensions – TO263



Ordering Number

GM	66150	-1.5	TA3	R	G
APM Gamma Micro	Circuit Type	Output Voltage 1.5 = 1.5V 1.8 = 1.8V 2.5 = 2.5V 3.0 = 3.0V 3.3 = 3.3V 5.0 = 5.0V 12 = 12.0V	Package Type TA3: TO263 TB3: TO220	Shipping Type R:Taping& Reel T: Tube	Blank: Pb-free G:Green

GM	66151	-1.5	TA5	R	G
APM Gamma Micro	Circuit Type	Output Voltage 1.5 = 1.5V 1.8 = 1.8V 2.5 = 2.5V 3.0 = 3.0V 3.3 = 3.3V 5.0 = 5.0V 12 = 12.0V	Package Type TA5: TO263-5 TB5: TO220-5	Shipping Type R:Taping& Reel T:Tube	Blank: Pb-free G:Green

GM	66152	-A	TA5	R	G
APM Gamma Micro	Circuit Type	Output Voltage Adj	Package Type TA3: TO263-5 TB3: TO220-5	Shipping Type R: Taping & Reel T: Tube	Blank: Pb-free G:Green

GM	66153	-A	TA5	R	G
APM Gamma Micro	Circuit Type	Output Voltage Adj	Package Type TA3: TO263-5 TB3: TO220-5	Shipping Type R: Taping & Reel T: Tube	Blank: Pb-free G:Green

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