# GM6603

**3.0A LOW DROPOUT PRECISION REGULATOR**

## Description

GM6603 series of positive adjustable and fixed regulators is designed to provide 3A output current with low dropout voltage performance.

On-chip trimming adjusts the reference voltage with an accuracy of ±2%. Besides the features mentioned, GM6603 works well in post regulators or micro-processor power supplies where low voltage operation and fast transient response are required. GM6603 includes over current protection and thermal shutdown protection as well.

GM6605 is available in TO-220 and surface-mount TO-252 and TO-263 packages.

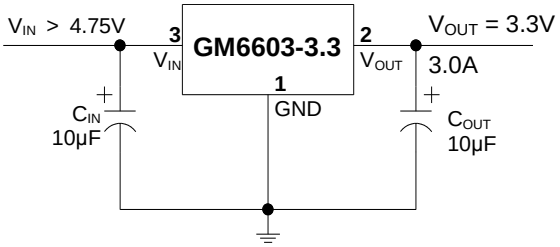
## Features

- **Adjustable or Fixed Output**
- **Output Current of 3.0A**
- **Low Dropout, 1.15V max at 3A Output Current**
- **0.04% Line Regulation**
- **0.2 % Load Regulation**
- **Current Limit Protection**
- **100% Thermal Limit Burn-In**
- **Fast Transient Response**

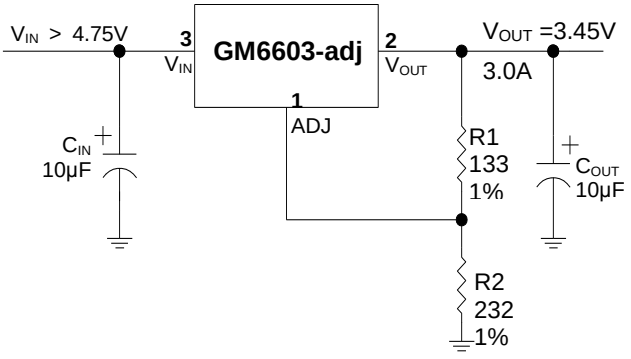
## Applications

- **Microprocessor Supply**
- **Post Regulators for Switching Supplies**
- **Telecommunication Systems**
- **Printer Supplies**
- **Motherboards**

## Typical Application Circuit




**Fixed Output Voltage Version**

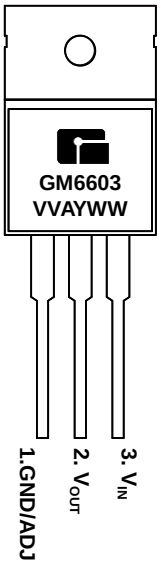



**Adjustable Output Voltage Version**

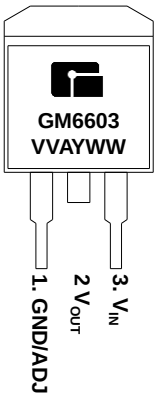
**Notes:**
1. $C_{IN}$ needed if device is far from filter capacitors
2. $C_{OUT}$ minimum value required for stability

## Marking Information and Pin Configurations (Top View) – Pb Free Product

TO 220




TO 263
($D^2$-PAK)



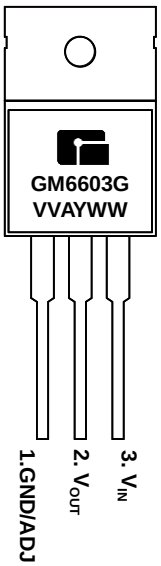

TO 252
(D-PAK)



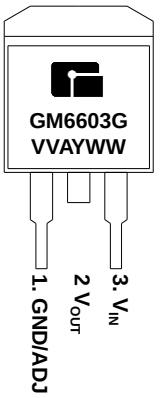

VV: Output Voltage Codes (05: 5.0V, …A: ADJ)
A: Assembly/Test Site Code
Y: Year
WW: Week

## Marking Information and Pin Configurations (Top View) – Green Product

TO 220




TO 263
($D^2$-PAK)




TO 252
(D-PAK)




G: Green Product
VV: Output Voltage Codes (05: 5.0V, …A: ADJ)
A: Assembly/Test Site Code
Y: Year
WW: Week

## Ordering Information – Pb Free Product

| Ordering Number | $V_{OUT}$ | Package | Shipping |
|---|---|---|---|
| GM6603-ATA3T | Adj | TO-263 | 50 Units/Tube |
| GM6603-ATA3R | | TO-263 | 800 Units / Reel |
| GM6603-ATB3T | | TO-220 | 50 Units/Tube |
| GM6603-ATC3T | | TO-252 | 80 Units/Tube |
| GM6603-ATC3R | | TO-252 | 2,500 Units / Reel |
| GM6603-1.8TA3T | 1.8V | TO-263 | 50 Units/Tube |
| GM6603-1.8TA3R | | TO-263 | 800 Units / Reel |
| GM6603-1.8TB3T | | TO-220 | 50 Units/Tube |
| GM6603-1.8TC3T | | TO-252 | 80 Units/Tube |
| GM6603-1.8TC3R | | TO-252 | 2,500 Units / Reel |
| GM6603-2.5TA3T | 2.5V | TO-263 | 50 Units/Tube |
| GM6603-2.5TA3R | | TO-263 | 800 Units / Reel |
| GM6603-2.5TB3T | | TO-220 | 50 Units/Tube |
| GM6603-2.5TC3T | | TO-252 | 80 Units/Tube |
| GM6603-2.5TC3R | | TO-252 | 2,500 Units / Reel |
| GM6603-3.3TA3T | 3.3V | TO-263 | 50 Units/Tube |
| GM6603-3.3TA3R | | TO-263 | 800 Units / Reel |
| GM6603-3.3TB3T | | TO-220 | 50 Units/Tube |
| GM6603-3.3TC3T | | TO-252 | 80 Units/Tube |
| GM6603-3.3TC3R | | TO-252 | 2,500 Units / Reel |
| GM6603-5.0TA3T | 5.0V | TO-263 | 50 Units/Tube |
| GM6603-5.0TA3R | | TO-263 | 800 Units / Reel |
| GM6603-5.0TB3T | | TO-220 | 50 Units/Tube |
| GM6603-5.0TC3T | | TO-252 | 80 Units/Tube |
| GM6603-5.0TC3R | | TO-252 | 2,500 Units / Reel |

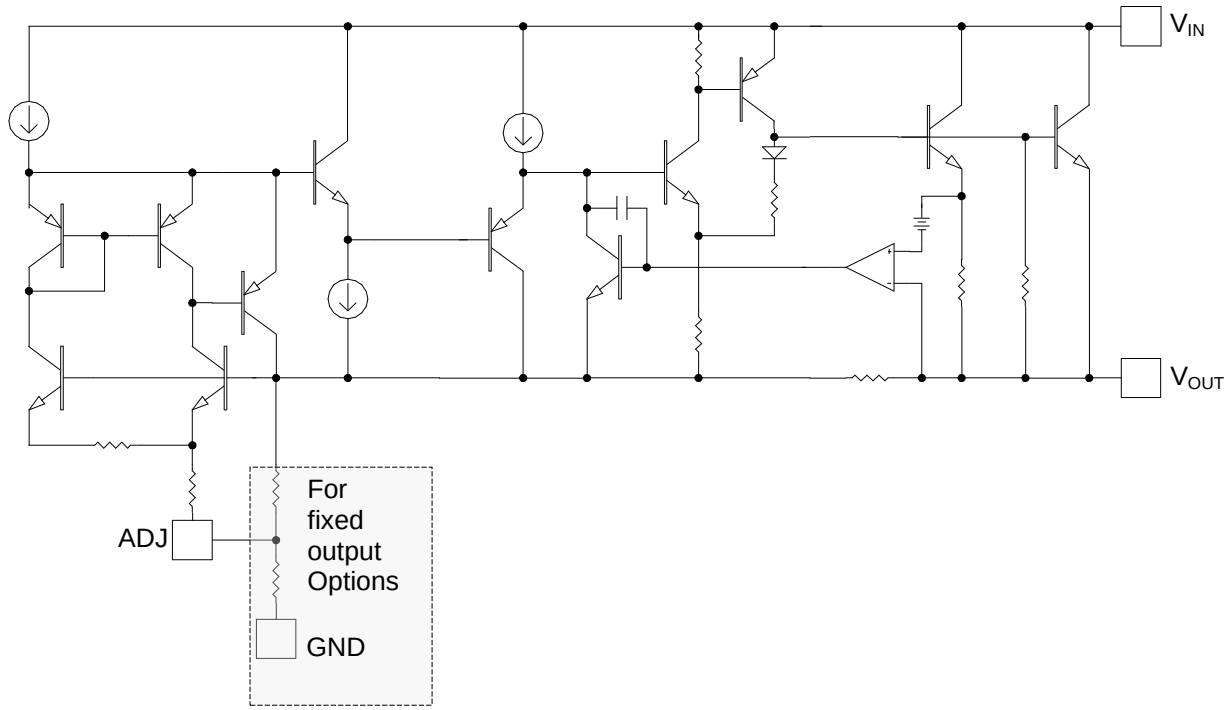
## Ordering Information – Green Product

| Ordering Number | $V_{OUT}$ | Package | Shipping |
|---|---|---|---|
| GM6603-ATA3TG | Adj | TO-263 | 50 Units/Tube |
| GM6603-ATA3RG | | TO-263 | 800 Units / Reel |
| GM6603-ATB3TG | | TO-220 | 50 Units/Tube |
| GM6603-ATC3TG | | TO-252 | 80 Units/Tube |
| GM6603-ATC3RG | | TO-252 | 2,500 Units / Reel |
| GM6603-1.8TA3TG | 1.8V | TO-263 | 50 Units/Tube |
| GM6603-1.8TA3RG | | TO-263 | 800 Units / Reel |
| GM6603-1.8TB3TG | | TO-220 | 50 Units/Tube |
| GM6603-1.8TC3TG | | TO-252 | 80 Units/Tube |
| GM6603-1.8TC3RG | | TO-252 | 2,500 Units / Reel |
| GM6603-2.5TA3TG | 2.5V | TO-263 | 50 Units/Tube |
| GM6603-2.5TA3RG | | TO-263 | 800 Units / Reel |
| GM6603-2.5TB3TG | | TO-220 | 50 Units/Tube |
| GM6603-2.5TC3TG | | TO-252 | 80 Units/Tube |
| GM6603-2.5TC3RG | | TO-252 | 2,500 Units / Reel |
| GM6603-3.3TA3TG | 3.3V | TO-263 | 50 Units/Tube |
| GM6603-3.3TA3RG | | TO-263 | 800 Units / Reel |
| GM6603-3.3TB3TG | | TO-220 | 50 Units/Tube |
| GM6603-3.3TC3TG | | TO-252 | 80 Units/Tube |
| GM6603-3.3TC3RG | | TO-252 | 2,500 Units / Reel |
| GM6603-5.0TA3TG | 5.0V | TO-263 | 50 Units/Tube |
| GM6603-5.0TA3RG | | TO-263 | 800 Units / Reel |
| GM6603-5.0TB3TG | | TO-220 | 50 Units/Tube |
| GM6603-5.0TC3TG | | TO-252 | 80 Units/Tube |
| GM6603-5.0TC3RG | | TO-252 | 2,500 Units / Reel |

## Absolute Maximum Ratings

| PARAMETER | SYMBOL | RATINGS | UNITS |
|---|---|---|---|
| Input Voltage | $V_I$ | 15 | V |
| Power Dissipation | $P_D$ | Internally Limited | W |
| Operating Junction Temperature | $T_J$ | - 40 to 125 | °C |
| Storage Temperature | $T_{stg}$ | - 60 to 150 | °C |
| Lead Temperature 1.6mm (1/6 inch) from case for 10 seconds | | 260 | °C |

## Block Diagram



## Electrical Characteristics ($T_j$ = 25°C, Inless otherwise noted)

| Parameter | | Symbol | Test Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| Reference Voltage | GM6603-A | $V_{REF}$ | $I_{OUT}$ = 10mA, $V_{IN}$ = 5.0V | 1.238 | 1.250 | 1.262 | V |
| | | | 10mA ≤ $I_{OUT}$ ≤ 3A, 1.5V ≤ $V_{IN}$ – $V_{OUT}$ ≤10V | 1.225 | 1.250 | 1.275 | |
| Output Voltage | GM6603-1.8 | $V_O$ | $I_{OUT}$ = 10mA, $V_{IN}$ = 3.3V | 1.782 | 1.800 | 1.818 | V |
| | | | 10mA ≤ $I_{OUT}$ ≤ 3A, 1.5V ≤ $V_{IN}$ – $V_{OUT}$ ≤10V | 1.764 | 1.800 | 1.836 | |
| | GM6603-2.5 | | $I_{OUT}$ = 10mA, $V_{IN}$ = 4V | 2.475 | 2.500 | 2.525 | |
| | | | 10mA ≤ $I_{OUT}$ ≤ 3A, 1.5V ≤ $V_{IN}$ – $V_{OUT}$ ≤10V | 2.460 | 2.500 | 2.540 | |
| | GM6603-3.3 | | $I_{OUT}$ = 10mA, $V_{IN}$ = 4.8V | 3.267 | 3.300 | 3.333 | |
| | | | 10mA ≤ $I_{OUT}$ ≤ 3A, 1.5V ≤ $V_{IN}$ – $V_{OUT}$ ≤10V | 3.247 | 3.300 | 3.353 | |
| | GM6603-5.0 | | $I_{OUT}$ = 10mA, $V_{IN}$ = 6.5V | 4.950 | 5.000 | 5.050 | |
| | | | 10mA ≤ $I_{OUT}$ ≤ 3A, 1.5V ≤ $V_{IN}$ – $V_{OUT}$ ≤10V | 4.920 | 5.000 | 5.080 | |
| Line Regulation | GM6603-A | $\Delta V_{OI}$ | $I_{OUT}$ = 10mA | | 0.04 | 0.20 | % |
| | GM6603-1.8 | | $I_{OUT}$ = 10mA, 3.3V ≤$V_{IN}$ ≤10V | | | | |
| | GM6603-2.5 | | $I_{OUT}$ = 10mA, 4V ≤$V_{IN}$ ≤10V | | | | |
| | GM6603-3.3 | | $I_{OUT}$ = 10mA, 4.8V ≤$V_{IN}$ ≤10V | | | | |
| | GM6603-5.0 | | $I_{OUT}$ = 10mA, 6.5V ≤$V_{IN}$ ≤10V | | | | |
| Load Regulation | GM6603-A | $\Delta V_{OL}$ | $V_{IN}$ –$V_{OUT}$ =1.5V, 10mA ≤ $I_{OUT}$ ≤ 3A | | 0.2 | 0.40 | % |
| | GM6603-1.8 | | $V_{IN}$ = 3.3V, 10mA ≤ $I_{OUT}$ ≤ 3A | | | | |
| | GM6603-2.5 | | $V_{IN}$ = 4.0V, 10mA ≤ $I_{OUT}$ ≤ 3A | | | | |
| | GM6603-3.3 | | $V_{IN}$ = 4.8V, 10mA ≤ $I_{OUT}$ ≤ 3A | | | | |
| | GM6603-5.0 | | $V_{IN}$ = 6.5V, 10mA ≤ $I_{OUT}$ ≤ 3A | | | | |
| Dropout Voltage | | $V_D$ | $I_{OUT}$ = 3A | | 1.15 | 1.3 | V |
| Current Limit | | $I_{CL}$ | $V_{IN}$ –$V_{OUT}$ =3V | 3 | 4.5 | | A |
| Minimum Load Current | | $I_{O(MIN)}$ | $V_{IN}$ = 5.0V | | 3 | 7 | mA |
| Quiescent Current | GM6603-1.8 | $I_Q$ | $V_{IN}$ = 3.3V, 10mA ≤ $I_{OUT}$ ≤ 3A | | 7 | 10 | mA |
| | GM6603-2.5 | | $V_{IN}$ = 4.0V, 10mA ≤ $I_{OUT}$ ≤ 3A | | | | |
| | GM6603-3.3 | | $V_{IN}$ = 4,8V, 10mA ≤ $I_{OUT}$ ≤ 3A | | | | |
| | GM6603-5.0 | | $V_{IN}$ = 6.5V, 10mA ≤ $I_{OUT}$ ≤ 3A | | | | |
| Adjust Pin Current | GM6603-A | $I_{ADJ}$ | $I_{OUT}$ = 10mA, 1.5V ≤$V_{IN}$ – $V_{OUT}$ ≤10V | | 40 | 90 | μA |
| Temperature Coefficient | | | $I_{OUT}$ = 10mA, $V_{IN}$ – $V_{OUT}$ = 1.5V | | 0.005 | | %/°C |
| Ripple Rejection | | $R_A$ | $I_{OUT}$ = 3A, $V_{IN}$ – $V_{OUT}$ = 1.5V | 60 | 80 | | dB |

## Application Information

GM6603 series linear regulators provide fixed and adjustable output voltages at currents up to 3.0A. These regulators are protected against over-current conditions and include thermal shutdown protection. The GM6603 has a composite PNP-NPN output transistor and require an output capacitor for stability.

A detailed procedure for selecting this capacitor is as below:

**Stability Considerations**

The circuit design used in the GM6603 series requires the use of an output capacitor as part of the device frequency compensation. The addition of 150µF aluminum electrolytic or a 22µF solid tantalum on the output will ensure stability for all operating conditions.

When the adjustment terminal is bypassed with a capacitor to improve the ripple rejection, the requirement for an output capacitor increases. The value of 22µF tantalum or 150µF aluminum covers all cases of bypassing the adjustment terminal. Without bypassing the adjustment terminal smaller capacitors can be used with equally good results.

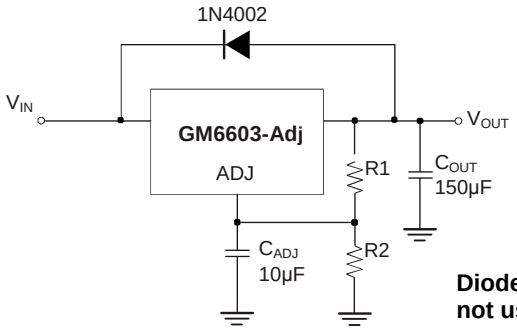
To ensure good transient response with heavy load current changes capacitor values on the order of 100µF are used in the output of many regulators. To further improve stability and transient response of these devices larger values of output capacitor can be used.

**Protection Diodes**

Unlike older regulators, the GM6603 family does not need any protection diodes between the adjustment pin and the output and from the output to the input to prevent over stressing the die. Internal resistors are limiting the internal current paths on the GM6603 adjustment pin, therefore even with capacitors on the adjustment pin no protection diode is needed to ensure device safety under short-circuit conditions.

Microsecond surge currents of 50A to 100A can be handled by the internal diode between the input and output pins of the device. In normal operations it is difficult to get those values of surge currents even with the use of large output capacitances. If high value output capacitors are used, such as 1000µF to 5000µF at the input pin, is instantaneously shorted to ground, damage can occur. A diode from output to input is recommended, when a crowbar circuit at the input of the GM6603 is used. Normal power supply cycling or even plugging and unplugging in the system will not generate current large enough to do any damage.

The adjustment pin can be driven on a transient basis ±25V, with respect to the output without any device degradation. As with any IC regulator, none the protection circuitry will be functional and the internal transistors will break down if the maximum input to output voltage differential is exceeded.




**Diodes between the input and output are not usually needed.**

**Ripple Rejection**

The ripple rejection values are measured with the adjustment pin bypassed. The impedance of the adjust pin capacitor at the ripple frequency should be less than the value of R1 (normally 100. to 120.) for a proper bypassing and ripple rejection approaching the values shown. The size of the required adjust pin capacitor is a function of the input ripple frequency. If R1=100. at 120Hz the adjust pin capacitor should be 25µF. At 10kHz only 0.22µF is needed. The ripple rejection will be a function of output voltage, in circuits without an adjust pin bypass capacitor. The output ripple will increase directly as a ratio of the output voltage to the reference voltage ($V_{OUT}$ / $V_{REF}$).

## Output Voltage Sensing

GM6603 series is a three-terminal regulator, so it cannot provide true remote load sensing. Load regulation is limited by the resistance of the conductors connecting the regulator to the load. For best results, GM6603 should be connected as shown 1n F1gure 2.

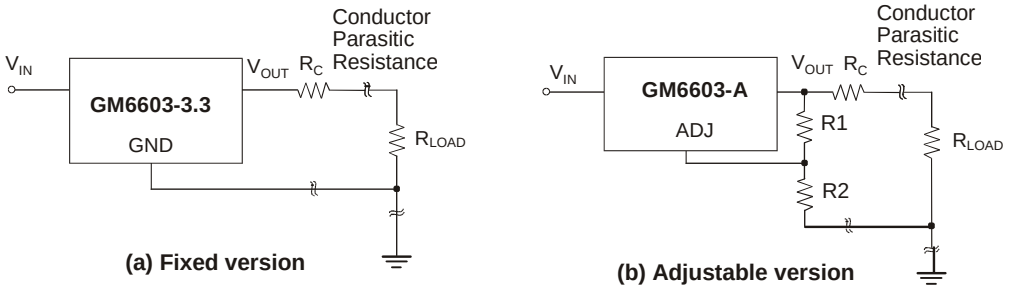



**Figure 1. Conductor Parasitic Resistance Effects are Minimized by this Grounding Scheme.**

### Calculating Power Dissipation and Heat Sink Requirements

GM6603 series include thermal shutdown and current limit circuitry to protect the devices. However, high power regulators normally operate at high junction temperatures so it is important to calculate the power dissipation and junction temperatures accurately to be sure to use an adequate heat sink. The case is connected to $V_{OUT}$ on GM6603, so electrical isolation may be required for some applicat1ons. Thermal compound should always be used with high current regulators like GM6603.

The thermal characteristics of an IC depend on four factors:

1. Maximum Ambient Temperature $T_A$ (°C)
2. Power Dissipation $P_D$ (Watts)
3. Maximum Junction Temperature $T_J$ (°C)
4. Thermal Resistance Junction to amb1ent $\theta_{JA}$

The relationship of these four factors is expressed by equation (1):

$$T_J = T_A + P_D \times \theta_{JA}$$

Maximum ambient temperature and power dissipation are determ1ned by the design while the maximum junction temperature and thermal resistance depend on the manufacturer and the package type.

The maximum power dissipation for a regulator is expressed by equation (2):

$$P_{D(MAX)} = (V_{IN(MAX)} - V_{OUT(MIN)}) \times I_{OUT(MIN)} + V_{IN(MIN)} \times I_Q$$

where:

$V_{IN(MAX)}$ is the maximum input voltage,
$V_{OUT(MIN)}$ is the minimum output voltage,
$I_{OUT(MAX)}$ is the maximum output current
$I_Q$ is the max1mum quiescent current at $I_{OUT(MAX)}$.

A heat sink effect1vely increases the surface area of the package to improve the flow of heat away from the IC into the air. Each material in the heat flow path between the IC and the environment has a thermal resistance. Like series electrical resistances, these resistance are summed to determine $\theta_{JA}$, the total thermal resistance between the junction and the air. This is expressed by equation (3):

$$\theta_{JA} = \theta_{JC} + \theta_{CS} + \theta_{SA}$$

where:

$\theta_{JC}$ is the thermal resistance of Junction to Case,
$\theta_{CS}$ is the thermal resistance of Case to Heat Sink,
$\theta_{SA}$ is the thermal resistance of Heat Sink to Ambient air.

The value for $\theta_{JA}$ is calculated using equation (3) and the result can be substituted in equation (1). The value for $\theta_{CS}$ is 3.5°C/W for a given package typed based on an average d1ie size. For a high current regulator such as GM6603, the majority of the heat is generated in the power transistor sect1on.

## Typical Performance Characteristics

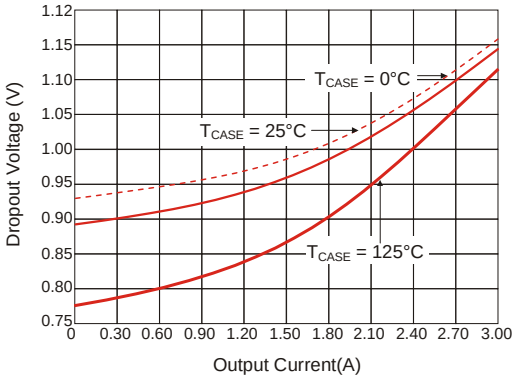



**Figure 1. Dropout Voltage vs. Output Current**

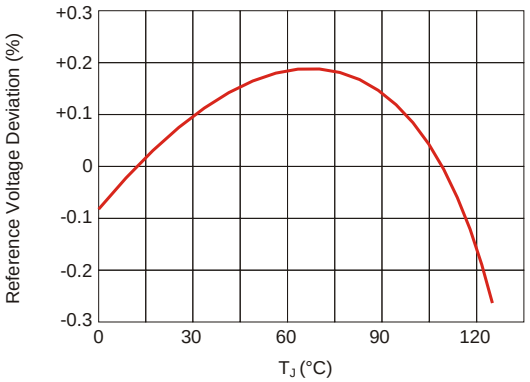



**Figure 2. Bandgap Reference Voltage Deviation Vs. Temperature**

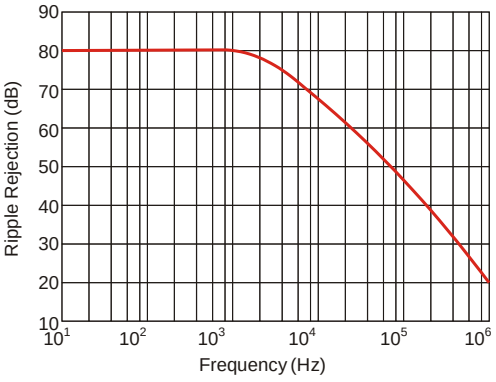



**Figure 3. Ripple Rejection vs. Frequency**

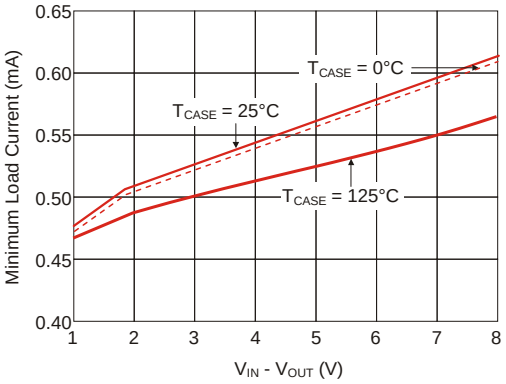
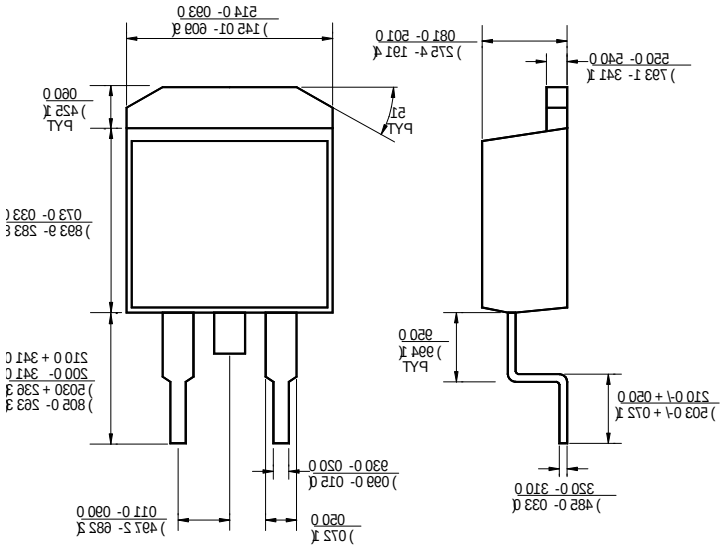
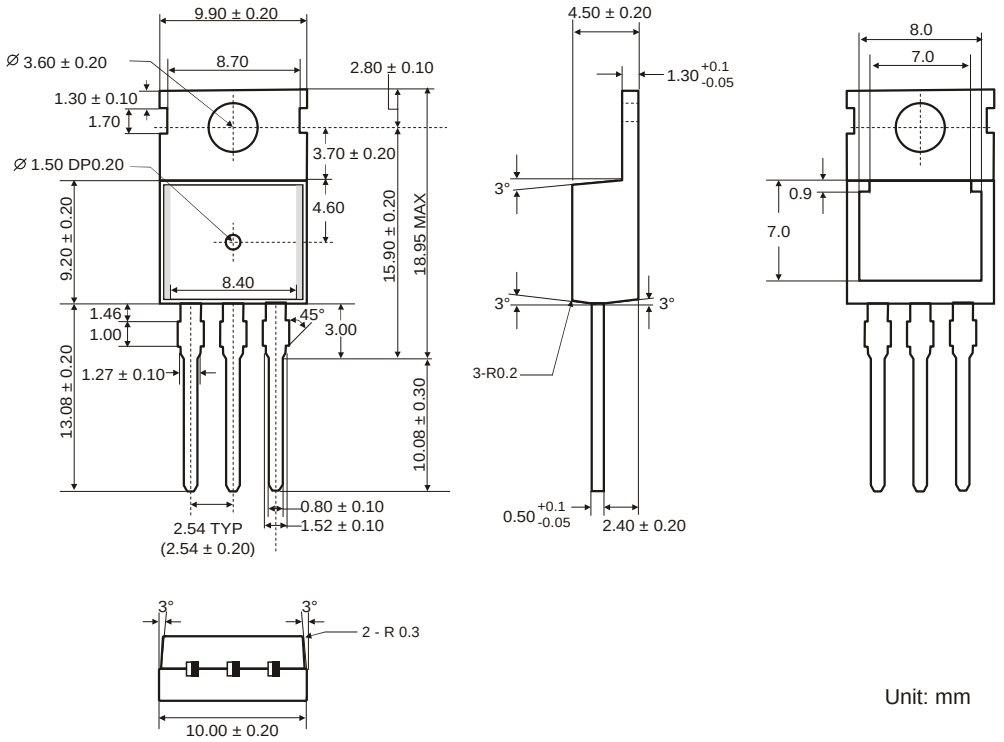



**Figure 4. Minimum Load Current vs. $V_{IN}$ - $V_{OUT}$**

## Package Outline Dimensions – TO263

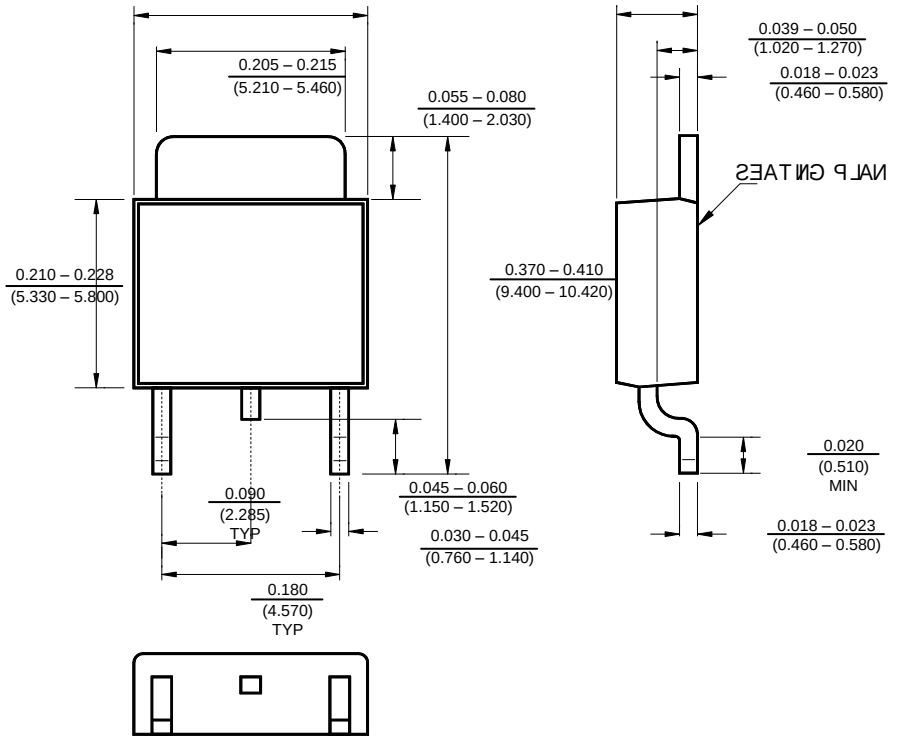


## Package Outline Dimensions – TO220




Unit: mm

## Package Outline Dimensions – TO252




Note:

**Pb-free products:**

- RoHS compliant and compatible with the current require-ments of IPC/JEDEC J-STD-020.
- Suitable for use in Pb-free soldering processes with 100% matte tin (Sn) plating.

**Green products:**

- Lead-free (RoHS compliant)
- Halogen free(Br or Cl does not exceed 900ppm by weight in homogeneous material and total of Br and Cl does not exceed 1500ppm by weight)

## Ordering Number

| GM | 6603 | - 1.8 | TA3 | T | G |
|---|---|---|---|---|---|
| APM Gamma Micro | Circuit Type | Output Voltages<br><br>A: ADJ<br>1.8: 1.8V<br>2.5: 2.5V<br>3.3: 3.3V<br>5.0: 5.0V | Package Type<br><br>TA3: TO263<br>TB3: TO220<br>TC3: TO252 | Shipping Type<br><br>T: Tube<br>R: Tape & Reel | <br><br>Blank: Pb-free<br>G:Green |

Note:

**Pb-free products:**

- RoHS compliant and compatible with the current require-ments of IPC/JEDEC J-STD-020.
- Suitable for use in Pb-free soldering processes with 100% matte tin (Sn) plating.

**Green products:**

- Lead-free (RoHS compliant)
- Halogen free(Br or Cl does not exceed 900ppm by weight in homogeneous material and total of Br and Cl does not exceed 1500ppm by weight)

Общество с ограниченной ответственностью «МосЧип» ИНН 7719860671 / КПП 771901001
Адрес: 105318, г.Москва, ул.Щербаковская д.3, офис 1107

**Данный компонент на территории Российской Федерации**

**Вы можете приобрести в компании MosChip.**

Для оперативного оформления запроса Вам необходимо перейти по данной ссылке:

http://moschip.ru/get-element

Вы можете разместить у нас заказ для любого Вашего проекта, будь то серийное производство или разработка единичного прибора.

В нашем ассортименте представлены ведущие мировые производители активных и пассивных электронных компонентов.

Нашей специализацией является поставка электронной компонентной базы двойного назначения, продукции таких производителей как XILINX, Intel (ex.ALTERA), Vicor, Microchip, Texas Instruments, Analog Devices, Mini-Circuits, Amphenol, Glenair.

Сотрудничество с глобальными дистрибьюторами электронных компонентов, предоставляет возможность заказывать и получать с международных складов практически любой перечень компонентов в оптимальные для Вас сроки.

На всех этапах разработки и производства наши партнеры могут получить квалифицированную поддержку опытных инженеров.

Система менеджмента качества компании отвечает требованиям в соответствии с ГОСТ Р ИСО 9001, ГОСТ РВ 0015-002 и ЭС РД 009

**Офис по работе с юридическими лицами:**

105318, г.Москва, ул.Щербаковская д.3, офис 1107, 1118, ДЦ «Щербаковский»

Телефон: +7 495 668-12-70 (многоканальный)

Факс: +7 495 668-12-70 (доб.304)

E-mail: info@moschip.ru

Skype отдела продаж:
moschip.ru
moschip.ru_4
moschip.ru_6
moschip.ru_9