GAMMA MICROELECTRONICS

GM7110

1A STEP-DOWN VOLTAGE SWITCHING REGULATOR

Description

GM7110 of regulators provides all the active functions for a step- down (buck) switching regulator, and drives 1A load with excellent line and load regulation.

GM7110 is available in fixed output volt ages of 3.3V, 5V, 12V, 15V and a versatile Adjustable output version. These regulators are simple to use and require a minimum number of external components.

Features include internal frequency compensation and a fixed- frequency oscillator. GM7110 high-efficiency replacement for popular three-terminal linear regulators, and is requiring a smaller heat sink or even no heat sink.

GM7110 performs well with standard inductors from several manufacturers, and simplifying the design of switch-mode power supplies. GM7110 guarantees ±4% tolerance on output voltage within specified input voltages and output load conditions, and ±10% on the oscillator frequency.

External shutdown is included with 50 uA(typical) standby current. The output switch has cycle-by-cycle current limiting as well as thermal shutdown for full protection under fault conditions.

Features

- **3.3V, 5V, 12V, 15V and Adjustable output versions**
- **Adjustable version output voltage range 1.23V to 37V ±4% max over line and load conditions**
- **1A output current**
- **Requires Only 4 External Components**
- **High Efficiency**
- **TTL shutdown capability and low power standby mode**
- **Thermal shutdown, current limit protection**
- **Uses standard inductors**
- **52 kHz fixed frequency internal oscillator**

Application

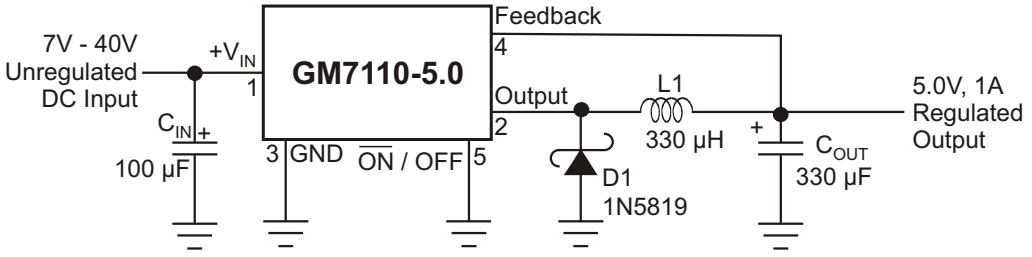
Pre-regulator for linear regulators

High-efficiency step-down buck regulator

On-card/ board switching regulators

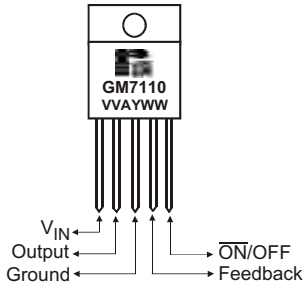
Positive to negative converter (buck-boost)

TYPICAL APPLICATION

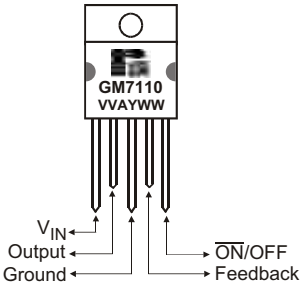


◆ MARKING INFORMATION & PIN CONFIGURATIONS

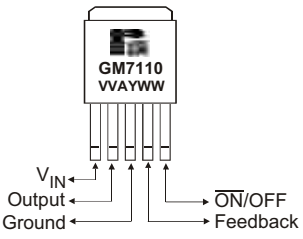
TO-220- 5



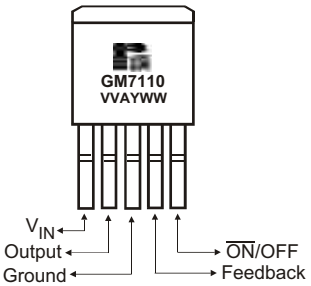
TO-220- 5B



TO-252-5 (DPAK)



TO-263-5(D^{2}PAK)



V V, VVV = Output Voltage (33=3.3V , 120=12V,A=Adj)
A = Assembly Location
Y = Year
W W = Weekly

◆ ORDERING INFORMATION

Ordering Number	Output Voltage	Package	Shipping
GM7110-ATB5T	Adj	TO-220-5	50 Units / Tube
GM7110-ATB5BT	Adj	TO-220-5B	50 Units / Tube
GM7110-ATA5R	Adj	TO-263-5	800 Units/ Tape & Reel
GM7110-ATA5T	Adj	TO-263-5	50 Units / Tube
GM7110-3.3TB5T	3.3	TO-220-5	50 Units / Tube
GM7110-3.3TB5BT	3.3	TO-220-5B	50 Units / Tube
GM7110-3.3TA5R	3.3	TO-263-5	800 Units/ Tape & Reel
GM7110-3.3TA5T	3.3	TO-263-5	50 Units / Tube
GM7110-5.0TB5T	5.0	TO-220-5	50 Units / Tube
GM7110-5.0TB5BT	5.0	TO-220-5B	50 Units / Tube
GM7110-5.0TA5R	5.0	TO-263-5	800 Units/ Tape & Reel
GM7110-5.0TA5T	5.0	TO-263-5	50 Units / Tube
GM7110-5.0TC5T	5.0	TO-252-5	80 Units/ Tube
GM7110-5.0TC5R	5.0	TO-252-5	2,500 Units/ Tape & Reel
GM7110-12TB5T	12	TO-220-5	50 Units / Tube
GM7110-12TB5BT	12	TO-220-5B	50 Units / Tube
GM7110-12TA5R	12	TO-263-5	800 Units/ Tape & Reel
GM7110-12TA5T	12	TO-263-5	50 Units / Tube
GM7110-15TB5T	15	TO-220-5	50 Units / Tube
GM7110-15TB5BT	15	TO-220-5B	50 Units / Tube
GM7110-15TA5R	15	TO-263-5	800 Units/ Tape & Reel
GM7110-15TA5T	15	TO-263-5	50 Units / Tube

* TB5B: Bent and Staggered Leads of TO-220 package

** For detail Ordering Number identification, please see last page.

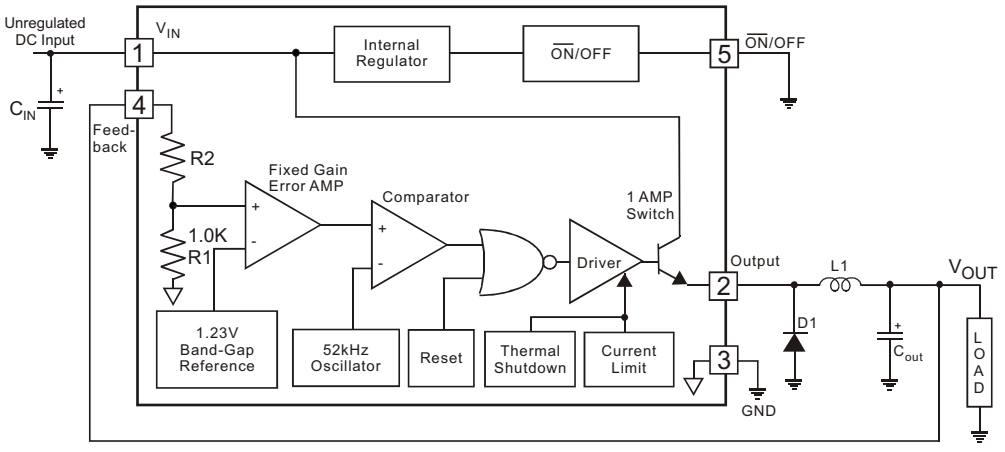
◆ ABSOLUTE MAXIMUM RATINGS

PARAMETER	VALUE	UNIT
Maximum Supply Voltage	45	V
$\overline{ON}$/OFF Pin Input Voltage	$-0.3 \le V \le V_{IN}$	V
Output Voltage to Ground (Steady State)	-1.0	V
Power Dissipation	Internally Limited	-
Storage Temperature Range	-65 to + 150	°C
Maximum Junction Temperature	+150	°C
Lead Temperature (Soldering, 10 sec.)	+260	°C

◆ RECOMMENDED OPERATING CONDITIONS

PARAMETER	VALUE	UNIT
Temperature Range	$-40 \le T_J \le 125$	°C
Supply Voltage	40	V

◆ BLOCK DIAGRAM



V_{OUT}
3.3V, R2 = 1.7K
5V, R2 = 3.1K
12V, R2 = 8.84K
15V, R2 = 11.3K
For ADJ. Version
R1 = Open, R2 = 0

◆ ELECTRICAL CHARACTERISTICS: GM7110-3.3

(Specifications with standard type face are for T_J = 25°C, and those with **boldface type** apply over full Operating Temperature Range)

Parameter	Conditions	Symbol	Min	Typ	Max	Unit
Output Voltage	V_{IN} = 12V, I_{LOAD} = 0.2A	V_{OUT}	3.234	3.3	3.366	V
Output Voltage	4.75V ≤ V_{IN} ≤ 40V, 0.2A ≤ I_{LOAD} ≤ 1A	V_{OUT}	3.168/**3.135**	3.3	3.432/**3.465**	V
Efficiency	V_{IN} = 12V, I_{LOAD} = 1A		-	75	-	%

◆ ELECTRICAL CHARACTERISTICS: GM7110-5.0

(Specifications with standard type face are for T_J = 25°C, and those with **boldface type** apply over full Operating Temperature Range)

Parameter	Conditions	Symbol	Min	Typ	Max	Unit
Output Voltage	V_{IN} = 12V, I_{LOAD} = 0.2A	V_{OUT}	4.900	5.0	5.100	V
Output Voltage	8V ≤ V_{IN} ≤ 40V, 0.2A ≤ I_{LOAD} ≤ 1A	V_{OUT}	4.800/**4.750**	5.0	5.200/**5.250**	V
Efficiency	V_{IN} = 12V, I_{LOAD} = 1A		-	77	-	%

◆ ELECTRICAL CHARACTERISTICS: GM7110-12

(Specifications with standard type face are for T_J = 25°C, and those with **boldface type** apply over full Operating Temperature Range)

Parameter	Conditions	Symbol	Min	Typ	Max	Unit
Output Voltage	V_{IN} = 25V, I_{LOAD} = 0.2A	V_{OUT}	11.76	12.0	12.24	V
Output Voltage	15V ≤ V_{IN} ≤ 40V, 0.2A ≤ I_{LOAD} ≤ 1A	V_{OUT}	11.52/**11.40**	12.0	12.48/**12.60**	V
Efficiency	V_{IN} = 15V, I_{LOAD} = 1A		-	88	-	%

◆ ELECTRICAL CHARACTERISTICS: GM7110-15

(Specifications with standard type face are for T_J = 25°C, and those with **boldface type** apply over full Operating Temperature Range)

Parameter	Conditions	Symbol	Min	Typ	Max	Unit
Feedback Voltage	V_{IN} = 30V, I_{LOAD} = 0.2A	V_{OUT}	14.70	15.0	15.30	V
Feedback Voltage	18V ≤ V_{IN} ≤ 40V, 0.2A ≤ I_{LOAD} ≤ 1A	V_{OUT}	14.40/**14.25**	15.0	15.60/**15.75**	V
Efficiency	V_{IN} = 18V, I_{LOAD} = 1A		-	88	-	%

◆ ELECTRICAL CHARACTERISTICS: GM7110-ADJ

(Specifications with standard type face are for T_J = 25°C, and those with **boldface type** apply over full Operating Temperature Range)

Parameter	Conditions	Symbol	Min	Typ	Max	Unit
Feedback Voltage	V_{IN} = 12V, I_{LOAD} = 0.2A, V_{OUT} = 5V	V_{OUT}	1.217	1.230	1.243	V
Feedback Voltage	8V ≤ V_{IN} ≤ 40V, 0.2A ≤ I_{LOAD} ≤ 1A V_{OUT} = 5V	V_{OUT}	1.193/**1.180**	1.230	1.267/**1.280**	V
Efficiency	V_{IN} = 12V, I_{LOAD} = 1.0A, V_{OUT}=5V		-	77	-	%

◆ ELECTRICAL CHARACTERISTICS: All Output Voltage Versions

(Specifications with standard type face are for T_J = 25°C, and those with **boldface type** apply over full Operating Temperature Range. Unless otherwise specified, V_{IN}= 12V for the 3.3V, 5.0V and ADJ version, V_{IN}= 25V for 12V version. and V_{IN}= 30V for 15V version. I_{LOAD} = 500 mA)

Parameter	Conditions	Symbol	Min	Typ	Max	Unit
Feedback Bias Current	V_{OUT} = 5V (Adjustable Version Only)	I_{FB}	-	50	100 / **500**	nA
Oscillator Frequency	(Note 11)	F_O	47 / **42**	52	58 / **63**	kHz
Saturation Voltage	I_{OUT} = 1A (Notes 4)	V_{SAT}	-	0.9	1.2 / **1.4**	V
Max Duty Cycle (ON)	(Note 5)	T_{DC}	93	98	-	%
Current Limit	(Note 4, 11)	I_{CL}	1.7 / **1.3**	2.2	3.0 / **3.2**	A
Output Leakage Current	(Notes 6, 7) Output = 0 V Output = -1V	I_{OL}	- -	- 7.5	2 30	mA
Quiescent Current	(Note 6)	I_Q	-	5	10	mA
Standby Quiescent Current	$\overline{ON}$/OFF Pin = 5V (OFF)	I_{STBY}	-	50	200	A
Thermal Resistance	TO-220 Package, Junction to Ambient (Note 8) TO-220 Package, Junction to Ambient (Note 8) TO-220,TO-263, Package, Junction to Case TO-252 Package, Junction to Case TO-263 Package, Junction to Ambient (Note 10)	JA JA JC JC JA	- - - - -	65 45 2 6 37	- - - -	°C/W
$\overline{ON}$/OFF Pin Logic Input Level	V_{OUT}=0V	V_{IH}	2.2 / **2.4**	1.4	-	V
	V_{OUT} = Nominal Output Voltage	V_{IL}	-	1.2	1.0 / **0.8**	V
$\overline{ON}$/OFF Pin Input Current	$\overline{ON}$/OFF Pin = 5V (OFF)	V_{IH}	-	12	30	A
	$\overline{ON}$/OFF Pin = 0V (ON)	I_{IL}	-	0	10	A

Note 1: Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indic ate conditions for which the device is intended to be functional, but do not guarantee specific performance limits. Guaranteed specifications and Test conditions are shown in Electrical Characteristics.

Note 2: All limits guaranteed at 25°C (standard type face) and over full operating temperature range (bold type face). All 25°C limits are 100% production tested. All limits over full operating temperature range are guaranteed via correlation using standard Statistics Quality Control methods.

Note 3: External components such as the catch diode, inductor, input and output capacitors can affect switching regulator system performance. When the GM7110 is used as shown in the Figure 2 test circuit, system performance will be as shown in system parameters section of Electrical Characteristics.

Note 4: Output pin sourcing current. No diode, inductor or capacitor connected to output.

Note 5: Feedback pin removed from output and connected to 0V.

Note 6: Feedback pin removed from output and connected to +12V for the Adjustable, 3.3V, and 5V versions, and +25V for the 12V and 15V versions, to force the output transistor OFF.

Note 7: V_{IN} = 40V

Note 8: Junction to ambient thermal resistance (no external heat sink) for the 5 lead TO-220 package mounted vertically, with ½ inch leads in a socket, or on a PC board with minimum copper area.

Note 9: Junction to ambient thermal resistance (no external heat sink) for the 5 lead TO-220 package mounted vertically, with ¼ inch leads soldered to a PC board containing approximately 4 square inches of copper area surrounding the leads.

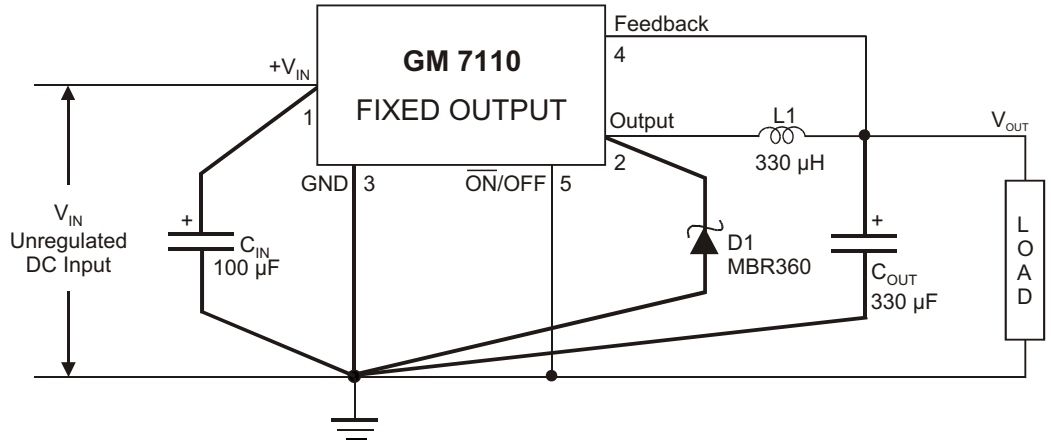
Note 10: If the TO-263 package is used, the thermal resistance can be reduced by increasing the PC board Copper area thermally connected to the package. Using 0.5 square inches of copper area, $_{JA}$ is 50°C//W, with 1 square inch of copper area, $_{JA}$ is 37°C/W, and with 1.6 or more square inches of copper area, $_{JA}$ is 32°C/W.

Note 11: The oscillator frequency reduces to approximately 11 kHz in the event of an output short or an Overload which causes the regulated output voltage to drop approximately 40% from the nominal output voltage. This self-protection feature lowers the Average power dissipation of Gm7110 By lowering the minimum duty cycle from 5% down to approximately 2%.

◆ TEST CIRCUIT AND LAYOUT GUIDELINES

Careful layout is important with any switching regulator. Rapidly switching currents associated with wiring inductance generate voltage transients, which can cause problems. To minimize inductance and ground loops, the lengths of the leads indicated by heavy lines in Figure 1 below should be kept as short as possible. Single-point grounding (as indicated in Figure 1) or ground plane construction should be used for best results. When using the Adjustable version, place the programming resistors as close as possible to GM7110, to keep the sensitive feedback wiring short.

Figure 1(a). Fixed Output Voltage Versions



C_{IN} - 100 µF, 75V, Aluminum Electrolytic

C_{OUT} - 330 µF, 25V, Aluminum Electrolytic

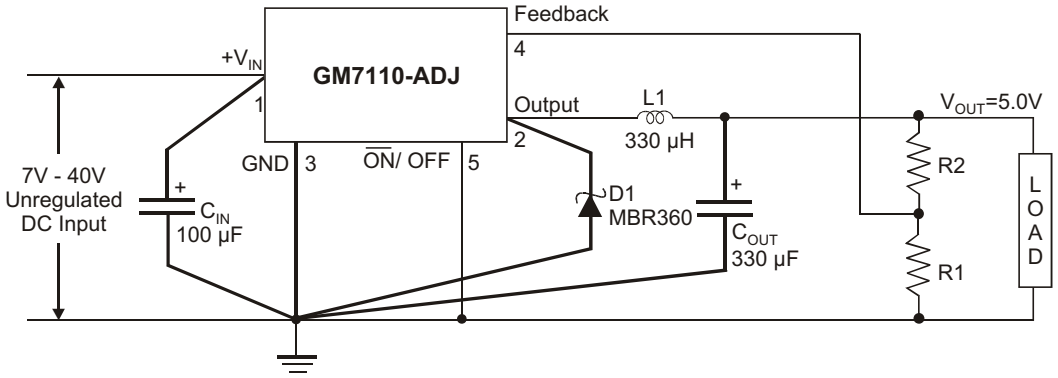
D1 - Schottky, MBR360

L1 - 330 µH, 3L Electronic Corp. TC-331M-1.0A- 5026

R1 - 2k, 0.1%

R2 - 6.12k, 0.1%

Figure 1(b).Adjustable Output Voltage Versions



$$V_{OUT} = V_{REF} \left(1 + \frac{R2}{R1} \right)$$

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

where V_{REF} = 1.23V, R1 between 1k and 5k.

◆ Typical Performance Characteristics

Figure 2. Switch Saturation Voltage

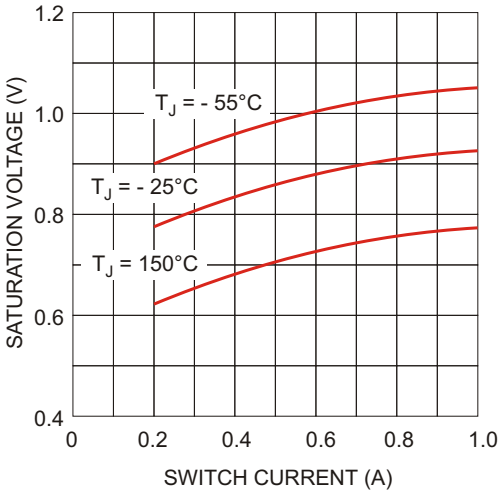
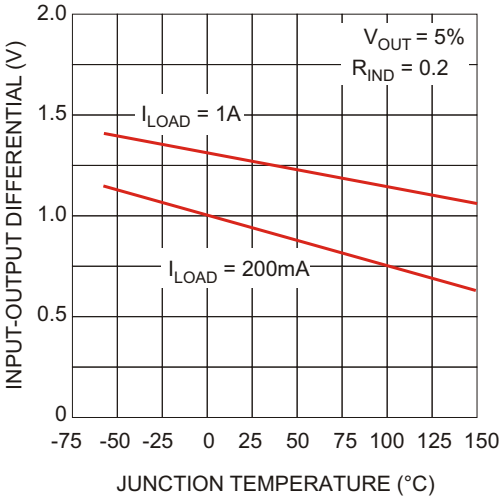


Figure 3. Dropout Voltage



◆ Typical Performance Characteristics

Figure 4. Quiescent Current

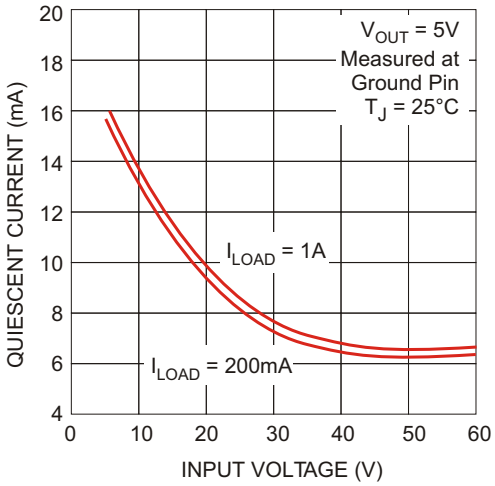


Figure 5. Maximum Power Dissipation(TO-263)

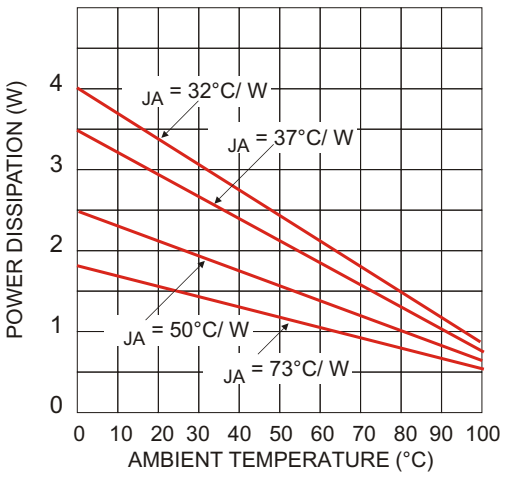


Figure 6. Minimum Operating Voltage

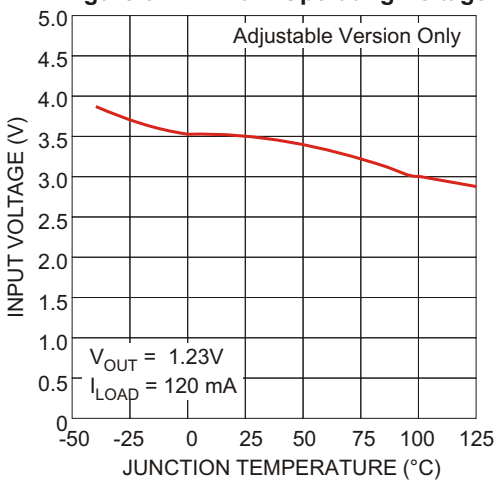
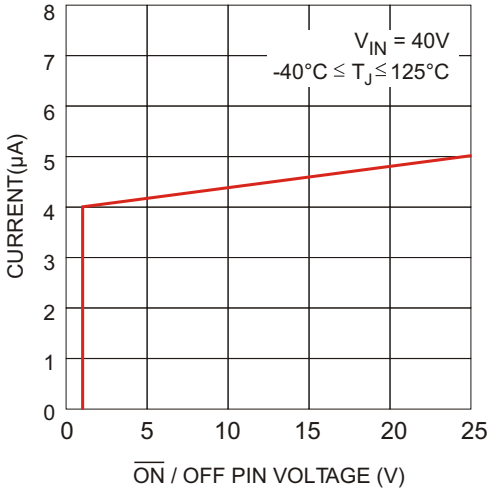
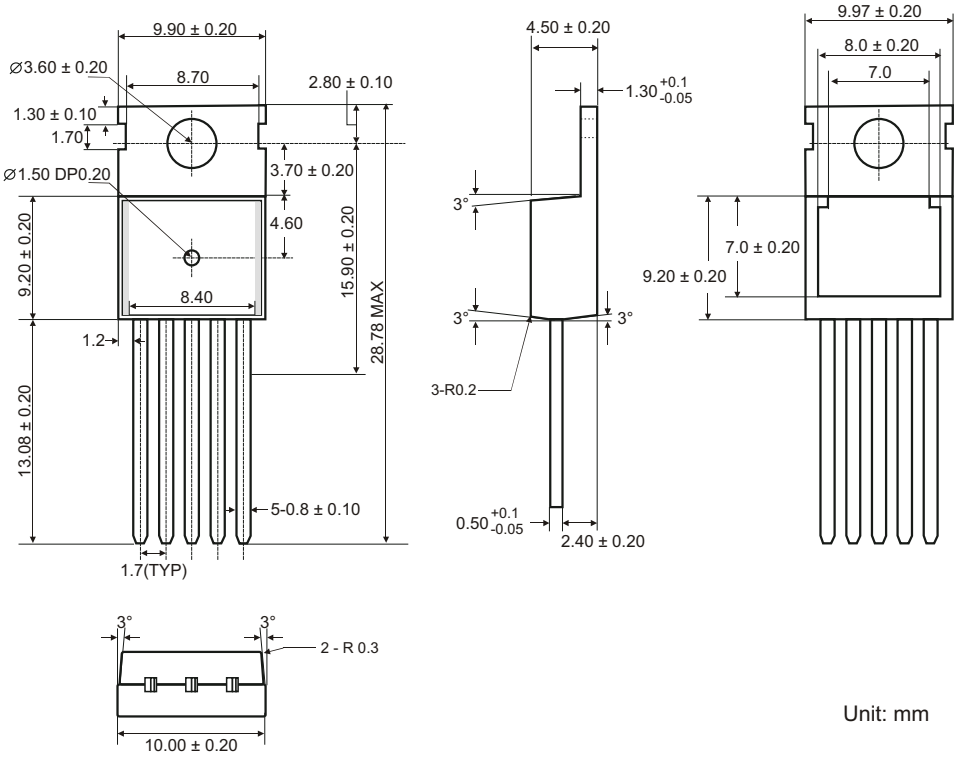


Figure 7. $\overline{ON}$ / OFF Pin Current (Sinking)

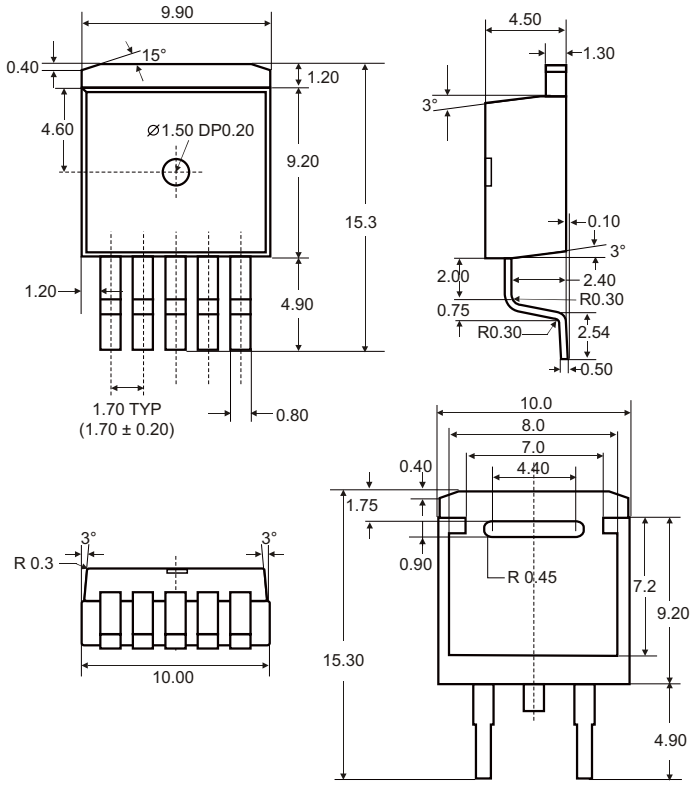


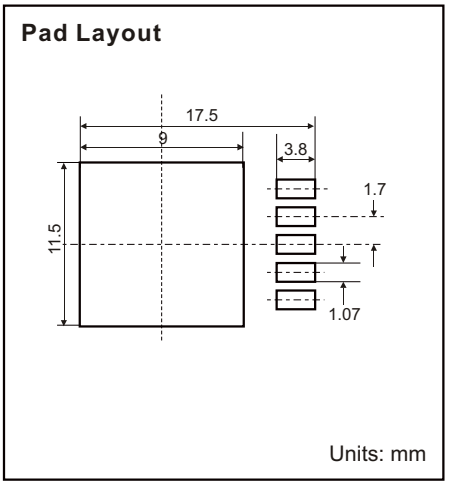
◆ TO-220-5 PACKAGE OUTLINE DIMENSIONS



Unit: mm

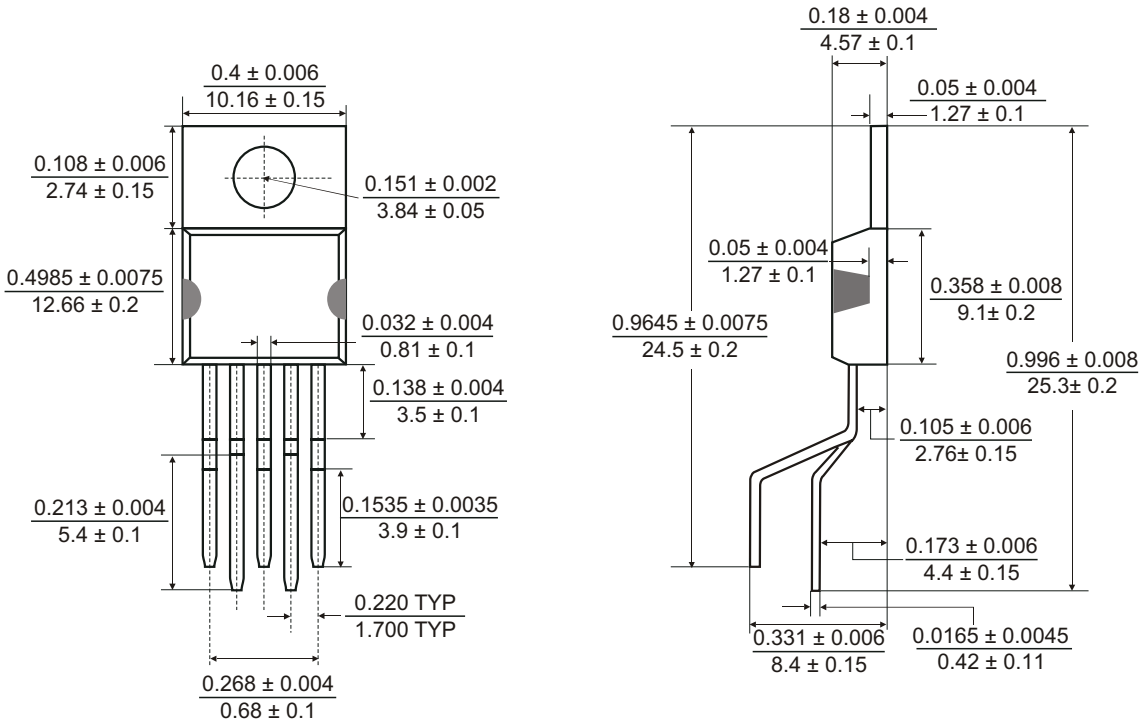
◆ TO-263-5 PACKAGE OUTLINE DIMENSIONS





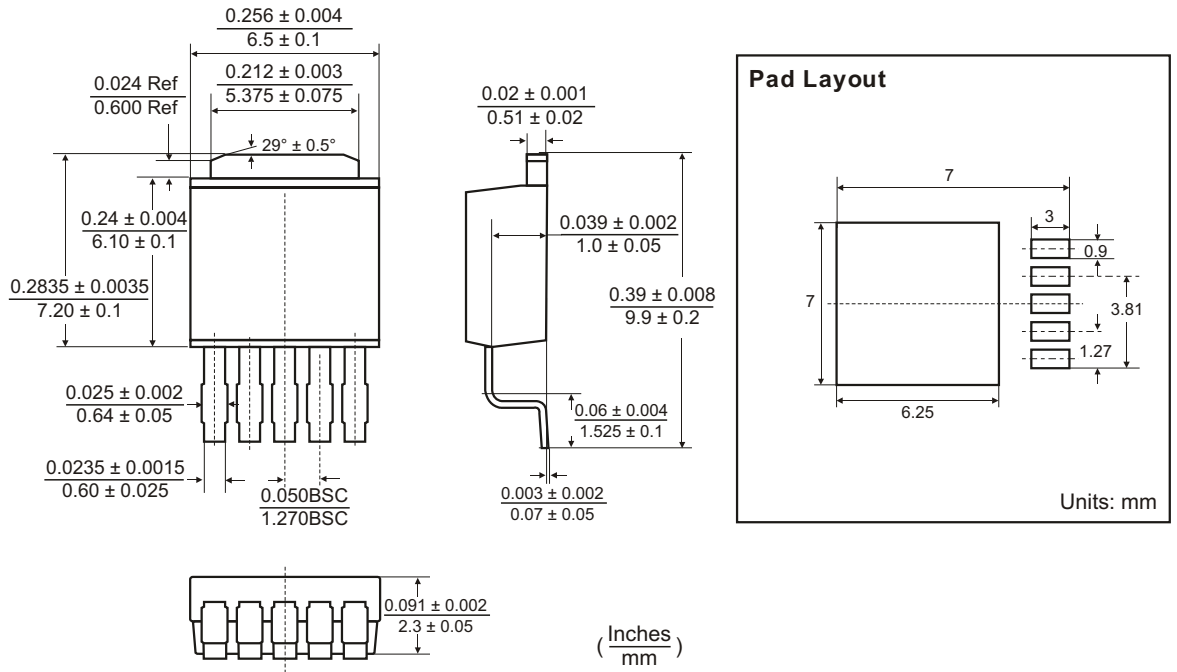
Unit: mm

◆ TO-220-5B PACKAGE OUTLINE DIMENSIONS



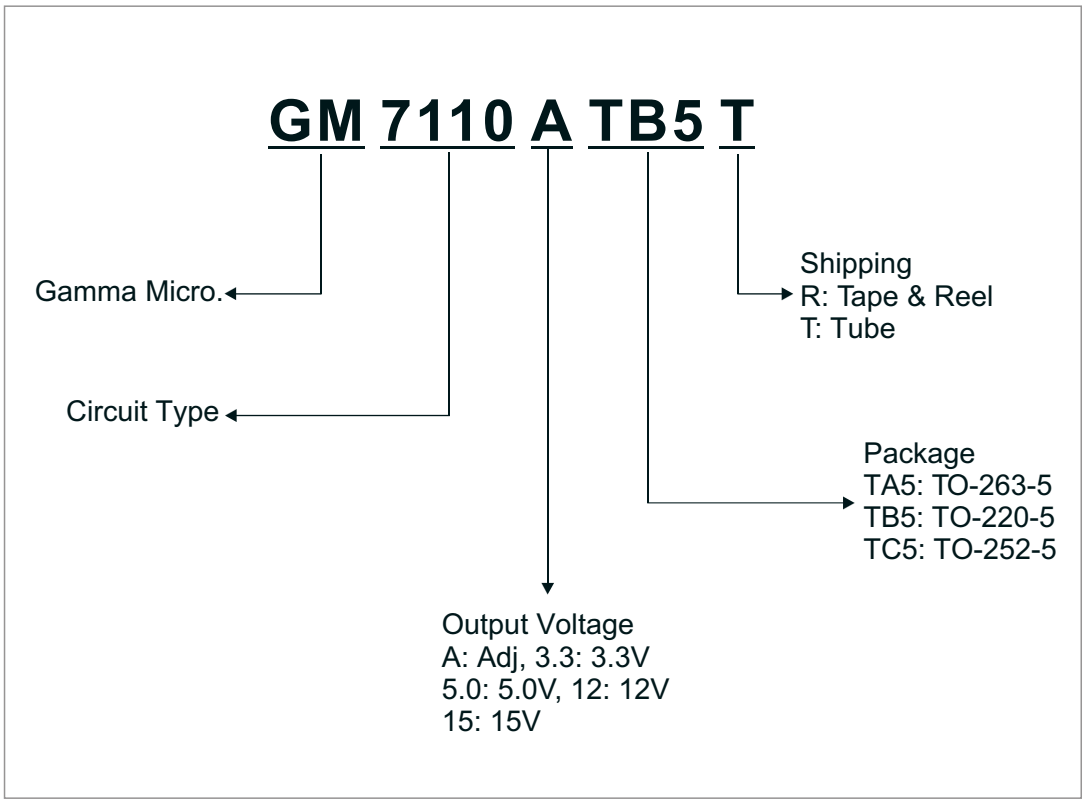
(Inches / mm)

◆ TO-252-5 PACKAGE OUTLINE DIMENSIONS



(Inches / mm)

◆ ORDERING NUMBER



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