

Description

GM7130HV series is designed to provide all the active function for a step-down (buck) switching regulator, and drives a maximum load current as high as 3A line and load regulations. GM7130HV is available in fixed output voltages of 3.3V, 5V, 12V and a versatile Adjustable output version.

These regulators are simple to use and require minimum number of external components. The features include internal frequency compensation and a fixed-frequency oscillator.

The GM7130HV is high-efficiency replacements for popular three-terminal linear regulators, and is requiring a smaller heat sink or even no need heat sink.

GM7130HV performs well with standard inductors from most of manufacturers, and simplifying the design of switch-mode power supplies. External shutdown is included with 80 μ A (typical) standby current. The output switch has cycle-by-cycle current limiting as well as thermal shutdown for full protection under fault conditions.

GM7130HV operates at a switching frequency of 52 kHz which allowing smaller size filter components than what would be needed with lower frequency switching regulators.

GM7130HV series are available in a standard 5-lead TO-220, TO220B and TO263 packages.

Features

- ◆ 3.3V, 5V, 12V and Adjustable output versions
- ◆ Adjustable version output voltage range 1.23V to 57V
- ◆ V_{OUT} accuracy is up to $\pm 2\%$ under specified input voltage the output load conditions
- ◆ Input voltage range up to 60V
- ◆ Requires only 4 external components with High efficiency
- ◆ TTL shutdown capability, low power standby mode
- ◆ Built-in thermal shutdown, current limit protection
- ◆ Uses standard inductors
- ◆ 52 kHz fixed frequency internal oscillator

Application

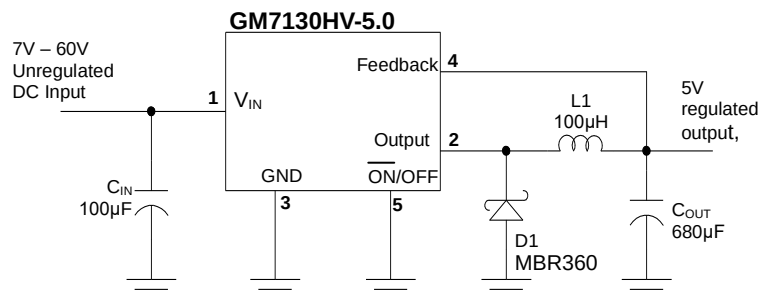
Pre-regulator for linear regulators

On-card/board switching regulators

High-efficiency step-down buck regulator

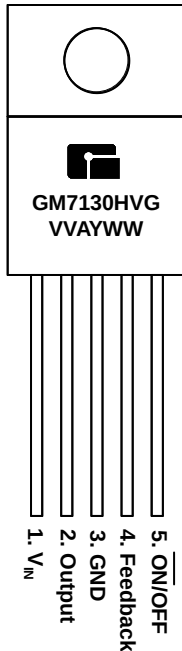
Positive to negative converter (buck-boost)

Typical Application Circuits

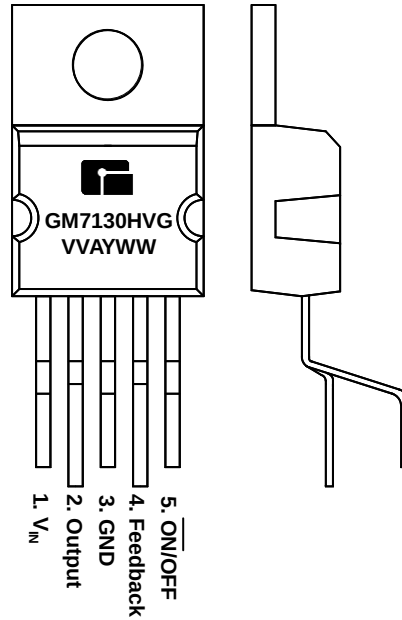


Marking Information and Pin Configurations (Top View)

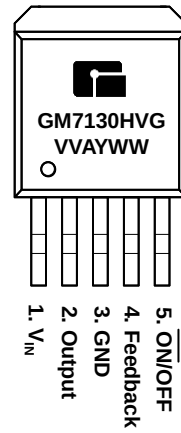
TO-220-5



TO-220B-5



TO-263-5



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

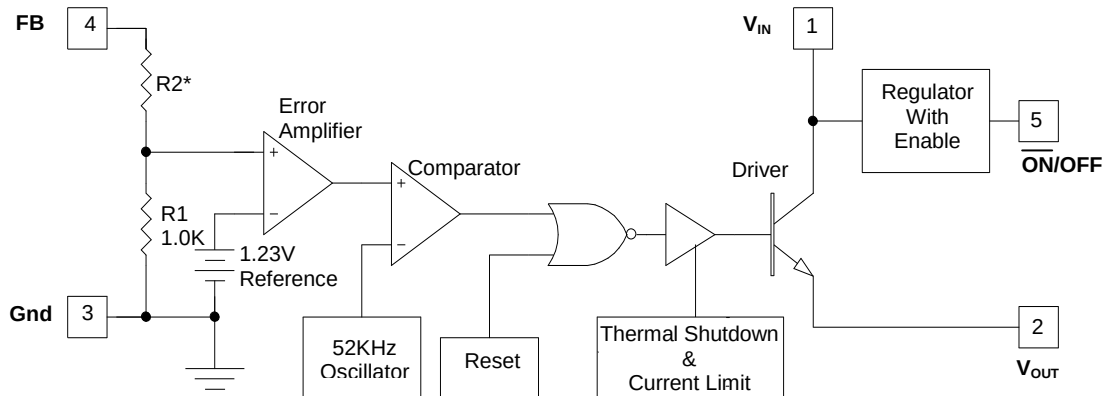
Ordering Information

Ordering Number	Output Voltage	Package	Shipping
GM7130HV-ATA5TG	Adj	TO-263-5	50 Units / Tube
GM7130HV-ATA5RG		TO-263-5	800 Units / Reel
GM7130HV-ATB5TG		TO-220-5	50 Units / Tube
GM7130HV-ATB5BTG		TO-220-5B	50 Units / Tube
GM7130HV-3.3TA5TG	3.3	TO-263-5	50 Units / Tube
GM7130HV-3.3TA5RG		TO-263-5	800 Units / Reel
GM7130HV-3.3TB5TG		TO-220-5	50 Units / Tube
GM7130HV-3.3TB5BTG		TO-220-5B	50 Units / Tube
GM7130HV-5.0TA5TG	5.0	TO-263-5	50 Units / Tube
GM7130HV-5.0TA5RG		TO-263-5	800 Units / Reel
GM7130HV-5.0TB5TG		TO-220-5	50 Units / Tube
GM7130HV-5.0TB5BTG		TO-220-5B	50 Units / Tube
GM7130HV-12TA5TG	12	TO-263-5	50 Units / Tube
GM7130HV-12TA5RG		TO-263-5	800 Units / Reel
GM7130HV-12TB5TG		TO-220-5	50 Units / Tube
GM7130HV-12TB5BTG		TO-220-5B	50 Units / Tube

Absolute Maximum Ratings (Note 1)

Rating	Value	Unit
Maximum Supply Voltage	63	V
$\overline{\text{ON/OFF}}$ Pin Input Voltage	$-0.3 + V_{\text{IN}} + 0.3$	V
Feedback Pin Voltage	$-0.3 + V_{\text{IN}} + 0.3$	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
Operating Temperature Range	- 40 to 125	°C
Minimum EDS Rating (Note 2)	2	kV
Lead Temperature (Soldering, 10 sec)	+ 260	°C

Block Diagram



$V_{\text{OUT}} = 3.3\text{V}$, $R2 = 1.7\text{K}$
 $V_{\text{OUT}} = 5.0\text{V}$, $R2 = 3.1\text{K}$
 $V_{\text{OUT}} = 12\text{V}$, $R2 = 8.84\text{K}$
 $V_{\text{OUT}} = \text{ADJ}$, $R1 = \text{OPEN}$, $R2 = 0\Omega$

Electrical Characteristics: GM7130HV-ADJ

(Specifications with standard type face are for $T_J = 25^\circ\text{C}$, and those with **bold face** type apply over full Operating Temperature range)

Parameter	Condition (Note 3)	Symbol	Min	Typ	Max	Unit
Feedback Voltage	V _{IN} = 12V, I _{LOAD} = 0.5A, V _{OUT} = 5V, Circuit of Fig 2.	V _{OUT}	1.217	1.230	1.243	V
	8.0V ≤ V _{IN} ≤ 60V, 0.5A ≤ I _{LOAD} ≤ 3A, V _{OUT} = 5V, Circuit of Fig 2.		1.193		1.267	
			1.180		1.280	
Efficiency	V _{IN} =12V, I _{LOAD} =3.0A, V _{OUT} = 5V	η		77		%

Electrical Characteristics: GM7130HV-3.3

(Specifications with standard type face are for $T = 25^\circ\text{C}$, and those with bold face type apply over full Operating Temperature range)

Parameter	Condition (Note 3)	Symbol	Min	Typ	Max	Unit
Output Voltage	V _{IN} = 12V, I _{LOAD} = 0.5A, Circuit of Fig 2.	V _{OUT}	3.234	3.300	3.366	V
	6V ≤ V _{IN} ≤ 60V, 0.5A ≤ I _{LOAD} ≤ 3A, Circuit of Fig 2		3.168		3.432	
			3.135		3.465	
Efficiency	V _{IN} =12V, I _{LOAD} =3.0A	η		75		%

Electrical Characteristics: GM7130HV-5.0

(Specifications with standard type face are for $T = 25^\circ\text{C}$, and those with bold face type apply over full Operating Temperature range)

Parameter	Condition (Note 3)	Symbol	Min	Typ	Max	Unit
Output Voltage	V _{IN} = 12V, I _{LOAD} = 0.5A, Circuit of Fig 2.	V _{OUT}	4.900	5.000	5.100	V
	8V ≤ V _{IN} ≤ 60V, 0.5A ≤ I _{LOAD} ≤ 3A, Circuit of Fig 2.		4.800		5.200	
			4.750		5.250	
Efficiency	V _{IN} =12V, I _{LOAD} =3.0A	η		77		%

Electrical Characteristics: GM7130HV-12

(Specifications with standard type face are for $T = 25^\circ\text{C}$, and those with bold face type apply over full Operating Temperature range)

Parameter	Condition (Note 3)	Symbol	Min	Typ	Max	Unit
Output Voltage	V _{IN} = 25V, I _{LOAD} = 0.5A, Circuit of Fig 2.	V _{OUT}	11.76	12.00	12.24	V
	15V ≤ V _{IN} ≤ 60V, 0.5A ≤ I _{LOAD} ≤ 3A, Circuit of Fig 2.		11.52		12.48	
			11.40		12.60	
Efficiency	V _{IN} =15V, I _{LOAD} =3.0A	η		88		%

Electrical Characteristics: All Output Voltage Versions

(Specifications with standard type face are for $T_J = 25^\circ\text{C}$, and those with bold face type apply over full Operating Temperature range. Unless otherwise specified, $V_{IN} = 12\text{V}$ for 3.3V, 5.0V and Adj version, $V_{IN} = 25\text{V}$ for 12V version, $I_{LOAD} = 500\text{mA}$)

Parameter	Condition	Symbol	Min	Typ	Max	Unit
Feedback Bias Current	$V_{OUT} = 5\text{V}$ (Adjustable Version Only)	I_b	-	50	100 500	nA
Oscillator Frequency	(Note 8)	f_o	47 42	52	58 63	kHz
Saturation Voltage	$I_{OUT} = 3\text{A}$ (Notes 4)	V_{SAT}	-	1.4	1.8 2.0	V
Max Duty Cycle (ON)	(Note 5)	DC	93	98	-	%
Current Limit	Peak Current (Notes 4, 8)	I_{CL}	4.2 3.5	5.8	6.9 7.5	A
Output Leakage Current	Output = 0V (Notes 6, 7)	I_L		7.5	2	mA
	Output = -0.75V (Notes 6, 7)		-		30	
Quiescent Current	(Note 6)	I_Q	-	5	10	mA
Standby Quiescent Current	$\overline{\text{ON/OFF}} = 5\text{V}$ (OFF)	I_{STBY}	-	50	200	μA
$\overline{\text{ON/OFF}}$ Pin Logic Input Level	Low (ON)	V_{IH}	-	1.2	1.0 0.8	V
	High (OFF)	V_{IL}	2.2 2.4	1.4	-	
$\overline{\text{ON/OFF}}$ Pin Input Current	$V_{LOGIC} = 2.5\text{V}$ (OFF)	I_H		12	30	μA
	$V_{LOGIC} = 0.5\text{V}$ (ON)	I_L		0	10	

Note 1: Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional but do not guarantee specific performance limits. For guaranteed specifications and test conditions, see the Electrical Characteristics.

Note 2: All limits guaranteed at room temperature (standard type face) and at temperature extremes (bold type face).

Note 3: External components such as the catch diode, inductor, input and output capacitors can affect switching regulator system performance. When the GM7130HV 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: $V_{IN} = 40\text{V}$ (60V for high voltage version).

Note 8: 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 protections feature lowers the average power dissipation of the IC by lowering the minimum duty cycle from 5% down to approximately

Test Circuit and Layout Guidelines

Careful layout is important with any switching regulators. 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 & 2 below should be kept as short as possible. Single point grounding (as indicated) or ground plane construction should be used for best results. When using the Adjustable version, place the programming resistors as close as possible to GM7130HV, to keep the sensitive feedback wiring short.

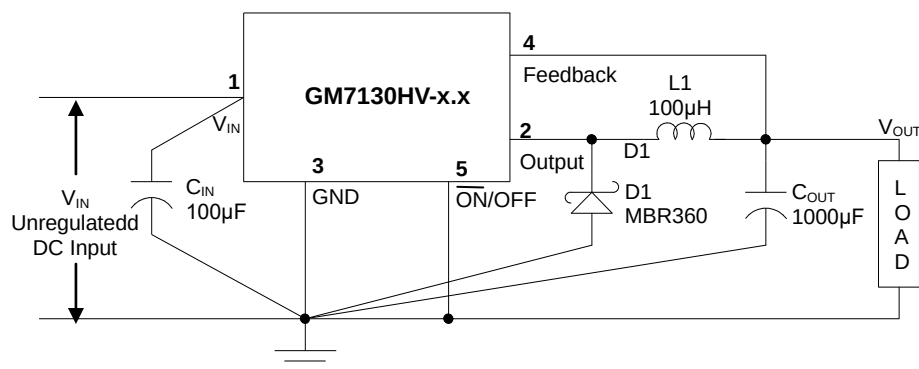


Figure 1 Fixed Output Voltage Versions

$C_{IN} = 100\mu F$, 75V, Aluminum Electrolytic
 $C_{OUT} = 1000\mu F$, 25V, Aluminum Electrolytic
 D1 = Schottky, MBR360
 $L1 = 100\mu H$

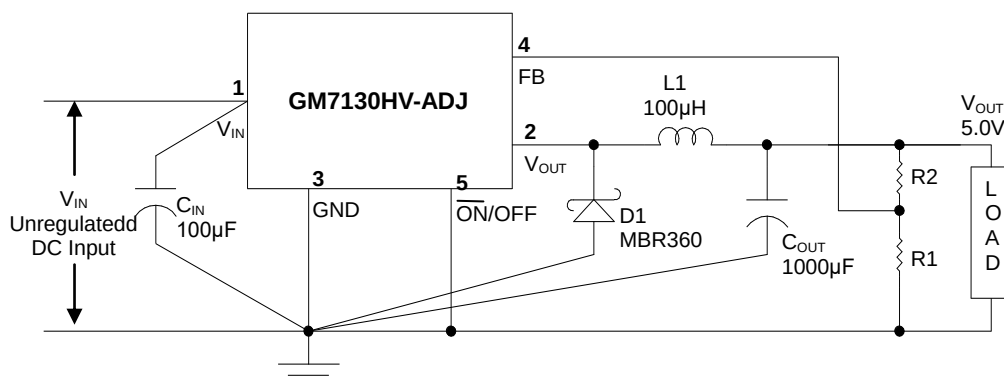


Figure 2 Adjustable Output Voltage Versions

$C_{IN} = 100\mu F$, 75V, Aluminum Electrolytic
 $C_{OUT} = 1000\mu F$, 25V, Aluminum Electrolytic
 D1 = Schottky
 $L1 = 100\mu H$

$$V_{OUT} = V_{REF} (1 + R2/R1)$$

where $V_{REF} = 1.23V$ and $R1$ is between 1K to 5K

Application Hints

Input Capacitors (C_{IN})

The regulator input pin must be by-passed with at least a 100 μ F electrolytic capacitor to maintain stability. The capacitor's leads must be kept short, and located near GM1730HV. If the operating temperature range includes temperature below -25°C, the input capacitor value may need to be larger. With most electrolytic capacitors, the capacitance value decreases and the ESR increase with lower temperature and age. It is suggested to parallel a ceramic or solid tantalum capacitor to increase the stability at cold temperature. It should be used for best results. When using the Adjustable version, place the programming resistors as close as possible to GM7130HV, to keep the sensitive feedback wiring short.

Inductor Selection

All switching regulators have two basic modes of operation: continuous and discontinuous. The difference between the two types relates to the inductor current, whether it is flowing continuously, or if it drops to zero for a period of time in the normal switching cycle. Each mode has distinctively different operating characteristics, which can affect the regulator performance and requirements. The GM7130HV can be used for both continuous and discontinuous modes of operation.

Inductors are available in different styles such as pot core, toriod, E-frame, bobbin core, etc., as well as different core materials, such as ferrites and powdered iron. The least expensive, the bobbin core type, consists of wire wrapped on a ferrite rod core. This type of construction makes for an inexpensive inductor, but since the magnetic flux is not completely contained within the core, it generates more electromagnetic interference (EMI). This EMI can cause problems in sensitive circuits, or can give incorrect scope readings because of induced voltages in the scope probe.

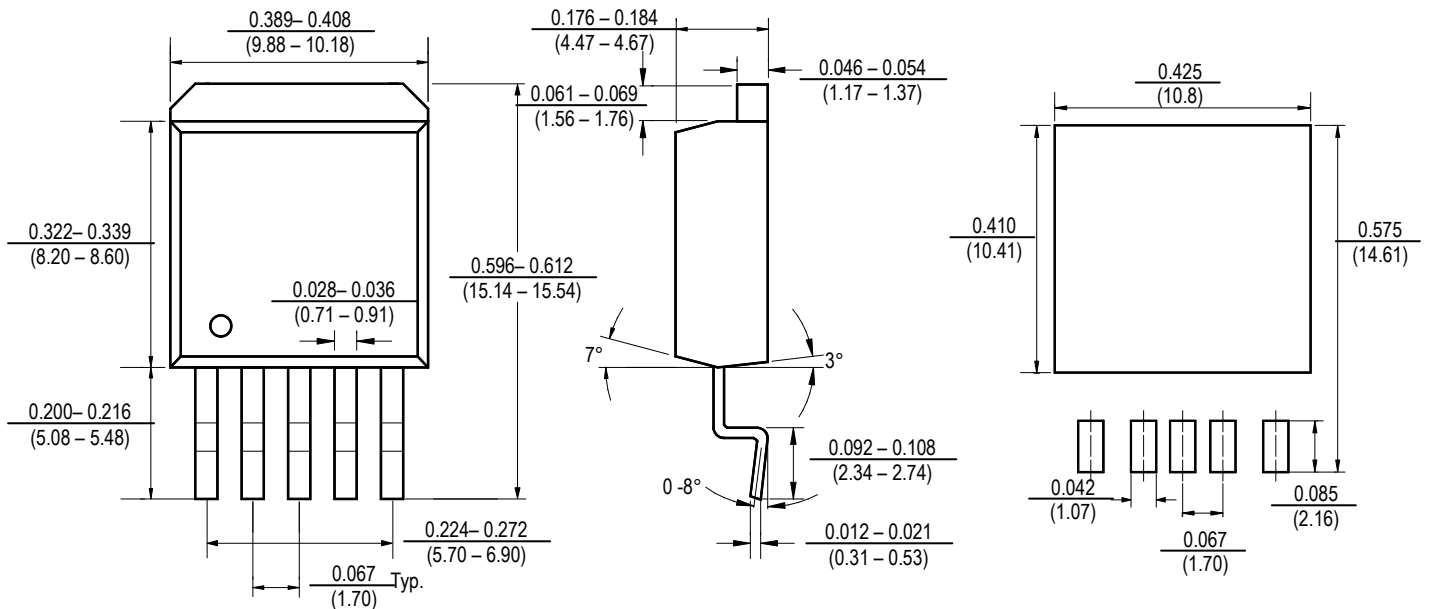
An inductor should not be operated beyond its maximum rated current because it may saturate. When an inductor begins to saturate, the inductance decreases rapidly and the inductor begins to look mainly a resistor (the DC resistance of the winding). This will cause the switch current to rise very rapidly. Different inductor types have different saturation characteristics, and this should be kept in mind when selecting an inductor. The inductor manufacturer's data sheets include current and energy limits to avoid inductor saturation.

Catch Diode

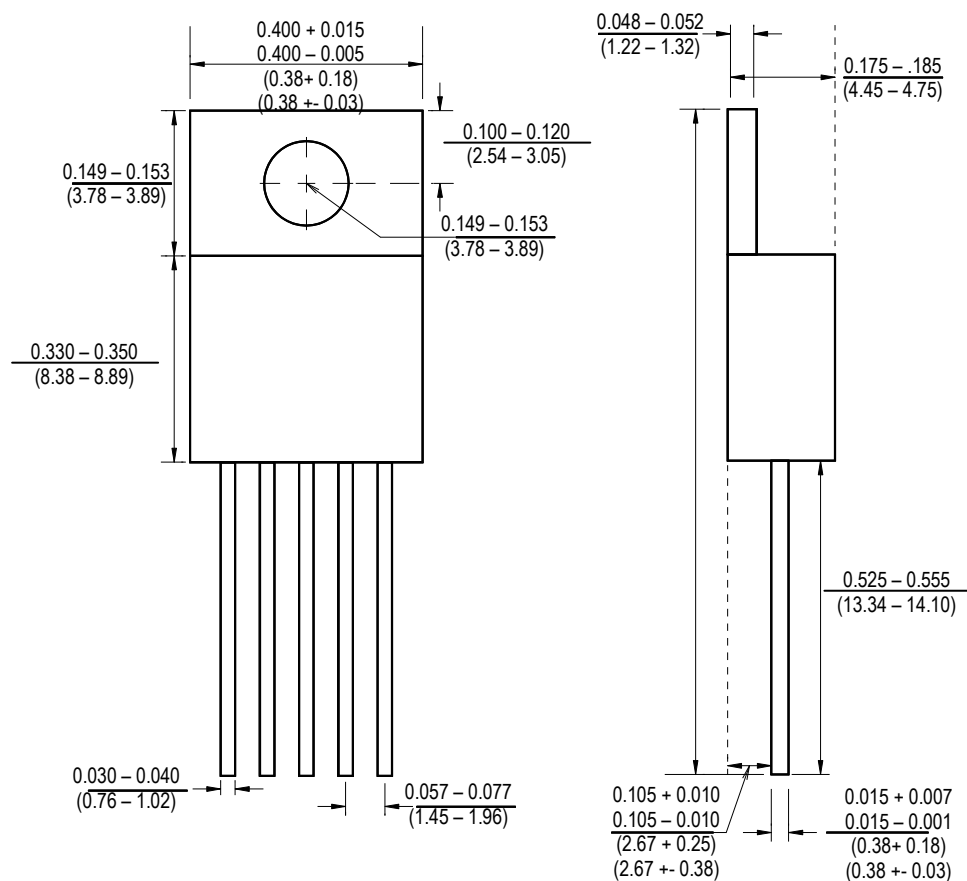
As the catch diode is to provide a return path for the inductor current when the switch is off. The diode must be located close to GM7130HV by short leads and short printed circuit trace.

The catch diode current rating must be at least 1.2 times greater than the maximum load current. Also, if the power supply design must withstand a continuous output short, the diode should have a current rating equal to the maximum current limit of GM7130HV. The reverse voltage rating of this diode should be at least 1.25 times the maximum input voltage

Package Outline Dimensions – TO-263-5



Package Outline Dimensions – TO-220-5



Ordering Number

<u>GM</u>	<u>7130HV</u>	<u>A</u>	<u>TA5</u>	<u>R</u>	<u>G</u>
APM Gamma Micro	Circuit Type	Output Voltage A: Adj 3.3 = 3.3V 5.0 = 5.0V 12 = 12.0V	Package Type TA5: TO263-5 TB5: TO-220-5 TB5B: TO-220B-5	Shipping Type R:Taping & Reel T:Tube	Blank: Pb-free 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)