

# 5V Step-Down Switching Regulator

## FEATURES

- Fixed 5V Output
- 2A On-Board Switch
- 100kHz Switching Frequency
- 2% Output Voltage Tolerance Over Temperature
- Greatly Improved Dynamic Behavior
- Available in Low Cost 5-Lead Package
- Only 9.5mA Quiescent Current
- Operates Up to 60V Input

## APPLICATIONS

- 5V Output Buck Converter
- Tapped Inductor Buck Converter with 4A Output at 5V
- Positive-to-Negative Converter

## DESCRIPTION

The LT1076-5 is a 2A fixed 5V output monolithic bipolar switching regulator which requires only a few external parts for normal operation. The power switch, all oscillator and control circuitry, all current limit components, and an output monitor are included on the chip. The topology is a classic positive “buck” configuration but several design innovations allow this device to be used as a positive-to-negative converter, a negative boost converter, and as a flyback converter. The switch output is specified to swing 40V below ground, allowing the LT1076-5 to drive a tapped inductor in the buck mode with output currents up to 4A.

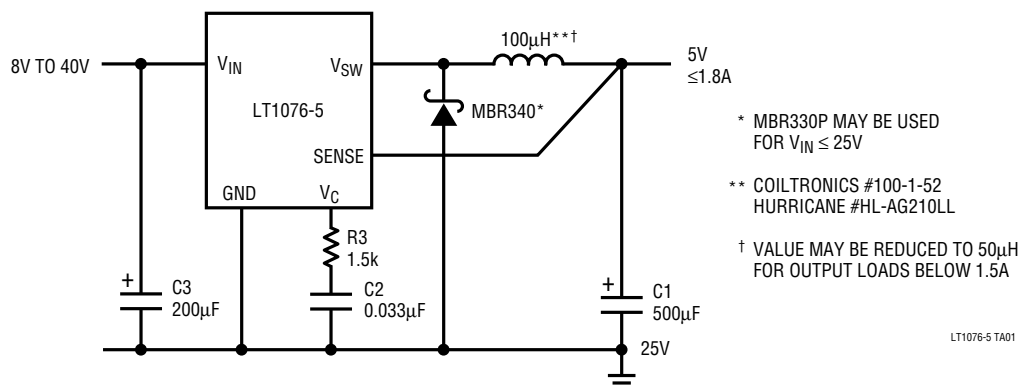
The LT1076-5 uses a true analog multiplier in the feedback loop. This makes the device respond nearly instantaneously to input voltage fluctuations and makes loop gain independent of input voltage. As a result, dynamic behavior of the regulator is significantly improved over previous designs.

On-chip pulse by pulse current limiting makes the LT1076-5 nearly bust-proof for output overloads or shorts. The input voltage range as a buck converter is 8V to 60V, but a self-boot feature allows input voltages as low as 5V in the inverting and boost configurations.

The LT1076-5 is available in a low cost 5-lead TO-220 package with frequency pre-set at 100kHz and current limit at 2.6A. See Application Note 44 for design details.

## TYPICAL APPLICATION

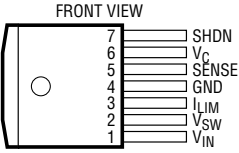
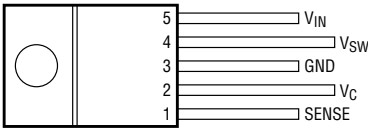
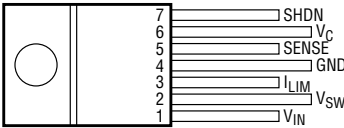
Basic Positive Buck Converter



## ABSOLUTE MAXIMUM RATINGS

Input Voltage	
LT1076-5 .....	45V
LT1076HV-5 .....	64V
Switch Voltage with Respect to Input Voltage	
LT1076-5 .....	64V
LT1076HV-5 .....	75V
Switch Voltage with Respect to Ground Pin ( $V_{SW}$ <b>Negative</b> )	
LT1076-5 (Note 5) .....	35V
LT1076HV-5 (Note 5) .....	45V
Sense Pin Voltage .....	-2V, 10V
Maximum Operating Ambient Temperature Range	
LT1076C-5, LT1076HVC-5 .....	0°C to 70°C
LT1076I-5, LT1076HVI-5 .....	-40°C to 85°C
Maximum Operating Junction Temperature Range	
LT1076C-5, LT1076HVC-5 .....	0°C to 125°C
LT1076I-5, LT1076HVI-5 .....	-40°C to 125°C
Maximum Storage Temperature .....	-65°C to 150°C
Lead Temperature (Soldering, 10 sec) .....	300°C

## PACKAGE/ORDER INFORMATION

 <p>R PACKAGE 7-LEAD PLASTIC DD <math>T_{JMAX} = 110^{\circ}\text{C}</math> <math>\theta</math> WILL VARY FROM APPROXIMATELY 30°C/W WITH 2.8IN<sup>2</sup> OF 1 OZ COPPER TO 70°C/W WITH 0.20IN<sup>2</sup> OF 1 OZ COPPER.</p>	<p>ORDER PART NUMBER</p> <p>LT1076CR-5</p>
 <p>T PACKAGE 5-LEAD TO-220 FOR STRAIGHT LEADS, ORDER FLOW 06 <math>T_{JMAX} = 110^{\circ}\text{C}</math>, <math>\theta_{JA} = 130^{\circ}\text{C/W}</math></p>	<p>LT1076CT-5 LT1076HVCT-5 LT1076IT-5 LT1076HVIT-5</p>
 <p>Y PACKAGE 7-LEAD TO-220 <math>T_{JMAX} = 110^{\circ}\text{C}</math>, <math>\theta_{JA} = 130^{\circ}\text{C/W}</math></p>	<p>LT1076CY-5</p>

Consult factory for Military grade parts.

## ELECTRICAL CHARACTERISTICS $T_J = 25^{\circ}\text{C}$ , $V_{IN} = 25\text{V}$ , unless otherwise noted.

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Switch "On" Voltage (Note 1)	$I_{SW} = 0.5\text{A}$	●		1.2	V
	$I_{SW} = 2\text{A}$	●		1.7	V
Switch "Off" Leakage	$V_{IN} = 25\text{V}$ , $V_{SW} = 0$			150	$\mu\text{A}$
	$V_{IN} = V_{MAX}$ , $V_{SW} = 0$ (Note 6)			250	$\mu\text{A}$
Supply Current (Note 2)	$V_{OUT} = 5.5\text{V}$ , $V_{IN} \leq 40\text{V}$	●	8.5	11	mA
	$40\text{V} < V_{IN} < 60\text{V}$	●	9.0	12	mA
	$V_{SHDN} = 0.1\text{V}$ (Device Shutdown) (Note 8)		140	300	$\mu\text{A}$
Minimum Supply Voltage	Normal Mode	●	7.3	8.0	V
	Start-Up Mode (Note 3)	●	3.5	4.8	V
Switch Current Limit (Note 4)	$I_{LIM} = \text{Open}$	●	2	2.6	A
	$R_{LIM} = 10\text{k}$ (Note 9)			1.8	A
	$R_{LIM} = 7\text{k}$ (Note 9)			1.2	A
Maximum Duty Cycle		●	85	90	%

**ELECTRICAL CHARACTERISTICS**  $T_J = 25^\circ\text{C}$ ,  $V_{IN} = 25\text{V}$ , unless otherwise noted.

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
Switching Frequency	$T_J \leq 125^\circ\text{C}$ $V_{OUT} = V_{SENSE} = 0\text{V}$ (Note 4)	●	90	100	110	kHz
			85		120	kHz
				20		kHz
Switching Frequency Line Regulation	$8\text{V} \leq V_{IN} \leq V_{MAX}$ (Note 7)	●		0.03	0.1	%/V
Error Amplifier Voltage Gain (Note 7)	$1\text{V} \leq V_C \leq 4\text{V}$			2000		V/V
Error Amplifier Transconductance (Note 7)			3700	5000	8000	$\mu\text{mho}$
Error Amplifier Source and Sink Current	Source ( $V_{SENSE} = 4.5\text{V}$ ) Sink ( $V_{SENSE} = 5.5\text{V}$ )		100	140	225	$\mu\text{A}$
			0.7	1.0	1.6	$\text{mA}$
Sense Pin Divider Resistance			3	5	8	$\text{k}\Omega$
Sense Voltage	$V_C = 2\text{V}$	●	4.85	5	5.15	V
Output Voltage Tolerance	$V_{OUT}$ (Nominal) = 5V All Conditions of Input Voltage, Output Voltage, Temperature and Load Current	●		$\pm 0.5$	$\pm 2$	%
				$\pm 1.0$	$\pm 3$	%
Output Voltage Line Regulation	$8\text{V} \leq V_{IN} \leq V_{MAX}$ (Note 6)	●		0.005	0.02	%/V
$V_C$ Voltage at 0% Duty Cycle	Over Temperature	●		1.5		V
				-4.0		$\text{mV}/^\circ\text{C}$
Multiplier Reference Voltage				24		V
Shutdown Pin Current	$V_{SHDN} = 5\text{V}$ $V_{SHDN} \leq V_{THRESHOLD} (\cong 2.5\text{V})$		5	10	20	$\mu\text{A}$
					50	$\mu\text{A}$
Shutdown Thresholds	Switch Duty Cycle = 0 Fully Shut Down		2.2	2.45	2.7	V
			0.1	0.30	0.5	V
Thermal Resistance Junction to Case					4	$^\circ\text{C}/\text{W}$

The ● denotes specifications which apply over the full operating temperature range.

**Note 1:** To calculate maximum switch “on” voltage at currents between low and high conditions, a linear interpolation may be used.

**Note 2:** A sense pin voltage ( $V_{SENSE}$ ) of 5.5V forces the  $V_C$  pin to its low clamp level and the switch duty cycle to zero. This approximates the zero load condition where duty cycle approaches zero.

**Note 3:** Total voltage from  $V_{IN}$  pin to ground pin must be  $\geq 8\text{V}$  after start-up for proper regulation. For  $T_A < 25^\circ\text{C}$ , limit = 5V.

**Note 4:** Switch frequency is internally scaled down when the sense pin voltage is less than 2.6V to avoid extremely short switch on times. During current limit testing,  $V_{SENSE}$  is adjusted to give a minimum switch on time of 1 $\mu\text{s}$ .

**Note 5:** Switch to input voltage limitation must also be observed.

**Note 6:**  $V_{MAX} = 40\text{V}$  for the LT1076-5 and 60V for the LT1076HV-5.

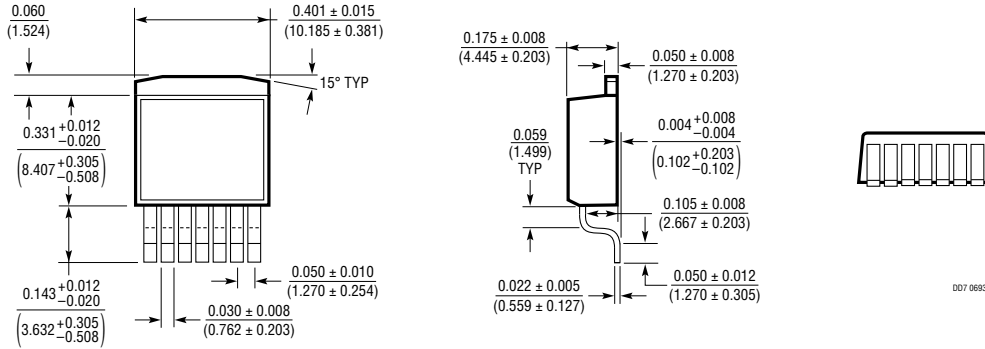
**Note 7:** Error amplifier voltage gain and transconductance are specified relative to the internal feedback node. To calculate gain and transconductance from the Sense pin (Output) to the  $V_C$  pin, multiply by 0.44.

**Note 8:** Does not include switch leakage.

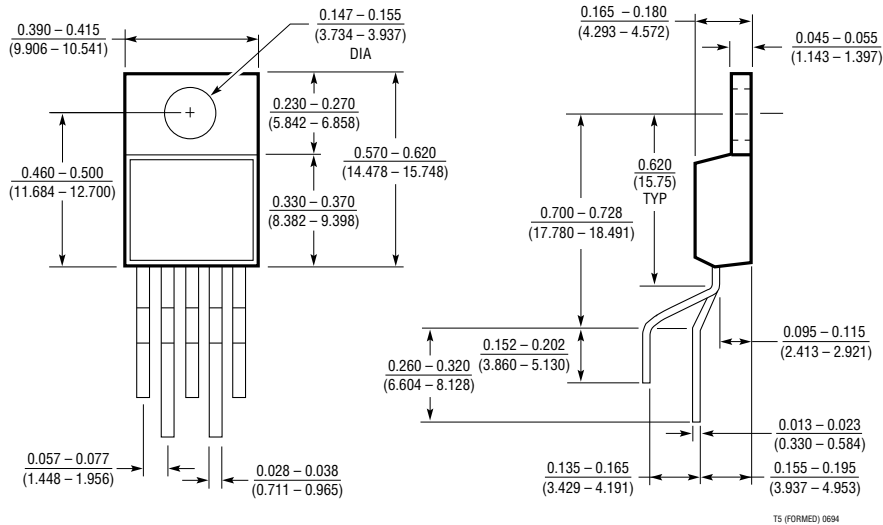
**Note 9:**  $I_{LIM} \approx \frac{R_{LIM} - 1\text{k}}{5\text{k}}$

**PACKAGE DESCRIPTION** Dimensions in inches (millimeters) unless otherwise noted.

**R Package, 7-Lead Plastic DD**



**T Package, 5-Lead TO-220**



**Y Package, 7-Lead TO-220**

