LT1076-5
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- and 7-Lead Packages
- 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 LT®1076-5 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 burst-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- and 7-lead TO-220 packages with frequency pre-set at 100kHz and current limit at 2.6A. See Application Note 44 for design details.

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TYPICAL APPLICATION

Basic Positive Buck Converter

- MBR330P MAY BE USED FOR VIN ≤ 25V
- COILTRONICS #100-1-52
- HURRICANE #HL-AG210LL
- VALUE MAY BE REDUCED TO 50μH FOR OUTPUT LOADS BELOW 1.5A

Downloaded from Arrow.com.
**LT1076-5**

### ABSOLUTE MAXIMUM RATINGS (Note 1)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>LT1076-5</th>
<th>LT1076HV-5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Voltage</td>
<td>45V</td>
<td>64V</td>
</tr>
<tr>
<td>Switch Voltage with Respect to Input Voltage</td>
<td>64V</td>
<td>75V</td>
</tr>
<tr>
<td>Switch Voltage with Respect to Ground Pin (V_{SW} Negative)</td>
<td>35V</td>
<td>45V</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SYMBOL CONDITIONS</th>
<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
<th>UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>V_{SENSE}</td>
<td></td>
<td></td>
<td></td>
<td>V</td>
</tr>
</tbody>
</table>

### SYMBOL CONDITIONS

- **V_{IN}**: Input Voltage
- **V_{SW}**: Switch Voltage
- **GND**: Ground Pin
- **VC**: Control Pin
- **V_{SENSE}**: Sense Pin Voltage

### ORDER PART NUMBER

- **LT1076CQ-5**: 5-Lead Plastic DIP, 
- **LT1076CR-5**: 5-Lead Plastic DIP, 
- **LT1076CT-5**: 7-Lead Plastic DIP, 
- **LT1076HVCT-5**: 7-Lead Plastic DIP, 
- **LT1076IT-5**: 7-Lead Plastic DIP, 
- **LT1076HVIT-5**: 7-Lead Plastic DIP, 
- **LT1076CT7-5**: 7-Lead Plastic DIP, 
- **LT1076HVCT7-5**: 7-Lead Plastic DIP, 
- **LT1076IT7-5**: 7-Lead Plastic DIP, 
- **LT1076HVIT7-5**: 7-Lead Plastic DIP, 
- **LT1076C-5**: 5-Lead Plastic TO-220, 
- **LT1076HVC-5**: 5-Lead Plastic TO-220, 
- **LT1076I-5**: 5-Lead Plastic TO-220, 
- **LT1076HVI-5**: 5-Lead Plastic TO-220, 
- **LT1076CT7-5**: 7-Lead Plastic TO-220, 
- **LT1076HVCT7-5**: 7-Lead Plastic TO-220, 
- **LT1076IT7-5**: 7-Lead Plastic TO-220, 
- **LT1076HVIT7-5**: 7-Lead Plastic TO-220, 

### ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at T_{J} = 25°C. V_{IN} = 25V, unless otherwise noted.

<table>
<thead>
<tr>
<th>SYMBOL CONDITIONS</th>
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<th>MAX</th>
<th>UNITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switch “On” Voltage (Note 2)</td>
<td>0.5A</td>
<td></td>
<td>1.2</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>2A</td>
<td>1.7</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Switch “Off” Leakage</td>
<td>150</td>
<td></td>
<td></td>
<td>μA</td>
</tr>
<tr>
<td></td>
<td>250</td>
<td></td>
<td></td>
<td>μA</td>
</tr>
</tbody>
</table>

### ORDER OPTIONS

- Tape and Reel: Add #TR
- Lead Free: Add #PBF
- Lead Free Tape and Reel: Add #TRPBF

Consult LTC Marketing for parts specified with wider operating temperature ranges. *The temperature grade is identified by a label on the shipping container.
# Electrical Characteristics

The **denotes the specifications which apply over the full operating temperature range, otherwise specifications are at T\(_J\) = 25°C. V\(_{IN}\) = 25V, unless otherwise noted.**

## SYMBOL CONDITIONS

<table>
<thead>
<tr>
<th>SYMBOL</th>
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<th>MIN</th>
<th>TYP</th>
<th>MAX</th>
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</tr>
</thead>
</table>
| Supply Current (Note 3)       | V\(_{OUT}\) = 5.5V, V\(_{IN}\) ≤ 40V  
                             | 40V < V\(_{IN}\) < 60V  
                             | V\(_{SHDN}\) = 0.1V (Device Shutdown) (Note 9)  | 8.5  | 11   | mA    |
| Minimum Supply Voltage        | Normal Mode                                                                | 7.3  | 8.0  | 7.3  | V      |
|                               | Start-Up Mode (Note 4)                                                    | 3.5  | 4.8  | 3.5  | V      |
| Switch Current Limit (Note 5) | I\(_{LIM}\) = Open  
                             | R\(_{LIM}\) = 10k (Note 10)                                               | 2    | 2.6  | 3.2  | A      |
|                               | R\(_{LIM}\) = 7k (Note 10)                                                | 1.8  | 1.8  | 1.8  | A      |
| Maximum Duty Cycle            |                                                                           | 85   | 90   | 85   | %      |
| Switching Frequency           | T\(_J\) ≤ 125°C  
                             | V\(_{OUT}\) = V\(_{SENSE}\) = 0V (Note 5)                                  | 90   | 100  | 110  | kHz    |
|                               |                                                                           | 85   | 120  | 20   | kHz    |
| Switching Frequency Line Regulation | 8V ≤ V\(_{IN}\) ≤ V\(_{MAX}\) (Note 8)  
                                            | V\(_{OUT}\) = V\(_{SENSE}\) = 0V (Note 5)                                  | 0.03 | 0.1  | %/V   |
| Error Amplifier Voltage Gain  | 1V ≤ V\(_{C}\) ≤ 4V                                                       | 2000 |      |      | V/V    |
| (Note 8)                      | Error Amplifier Transconductance (Note 8)                                  | 3700 | 5000 | 8000 | μmho   |
| Error Amplifier Source and Sink Current | Source (V\(_{SENSE}\) = 4.5V)  
                             | Sink (V\(_{SENSE}\) = 5.5V)                                              | 100  | 140  | 225  | μA    |
| Sense Pin Divider Resistance  | V\(_{C}\) = 2V                                                             | 3    | 5    | 8    | kΩ     |
| Sense Voltage                 | V\(_{C}\) = 2V                                                             | 4.85 | 5    | 5.15 | V      |
| Output Voltage Tolerance      | V\(_{OUT}\) (Nominal) = 5V  
                             | All Conditions of Input Voltage, Output Voltage, Temperature and Load Current | ±0.5 | ±2   | %     |
|                               |                                                                           | ±1.0 | ±3   | %     |
| Output Voltage Line Regulation | 8V ≤ V\(_{IN}\) ≤ V\(_{MAX}\) (Note 7)  
                                            | V\(_{OUT}\) = V\(_{SENSE}\) = 0V (Note 5)                                  | 0.005| 0.02 | %/V   |
| VC Voltage at 0% Duty Cycle   | V\(_{OUT}\) = V\(_{SENSE}\) = 0V (Note 5)                                  | 1.5  | ±4.0 | %     |
| Multiplier Reference Voltage  | V\(_{SHDN}\) = 5V                                                         | 24   |      |      | V      |
| Shutdown Pin Current          | V\(_{SHDN}\) = 6V                                                         | 5    | 10   | 20   | μA    |
|                               | V\(_{SHDN}\) ≤ V\(_{THRESHOLD}\) (≈ 2.5V)                                  | 5    | 10   | 20   | μA    |
| 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    |      |      | °C/W   |

**Note 1:** Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to any Absolute Maximum Rating condition for extended periods may affect device reliability and lifetime.

**Note 2:** To calculate maximum switch “on” voltage at currents between low and high conditions, a linear interpolation may be used.

**Note 3:** A sense pin voltage (V\(_{SENSE}\)) of 5.5V forces the VC 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 4:** Total voltage from V\(_{OUT}\) pin to ground pin must be ≥ 8V after start-up for proper regulation. For T\(_A\) < 25°C, limit = 5V.

**Note 5:** 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 1ms.

**Note 6:** Switch to input voltage limitation must also be observed.

**Note 7:** V\(_{MAX}\) = 40V for the LT1076-5 and 60V for the LT1076HV-5.

**Note 8:** 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 9:** Does not include switch leakage.

**Note 10:** \[ \text{LIM} = \frac{\text{R}_{LIM} - 1k}{5k} \]
LT1076-5

PACKAGE DESCRIPTION

Q Package
5-Lead Plastic DD Pak

(Reference LTC DWG # 05-08-1461)

BOTTOM VIEW OF DD PAK
HATCHED AREA IS SOLDER PLATED
COPPER HEAT SINK

NOTE:
1. DIMENSIONS IN INCH/(MILLIMETER)
2. DRAWING NOT TO SCALE

RECOMMENDED SOLDER PAD LAYOUT
RECOMMENDED SOLDER PAD LAYOUT
FOR THICKER SOLDER PASTE APPLICATIONS
RECOMMENDED SOLDER PAD LAYOUT

NOTE:
1. DIMENSIONS IN INCH/(MILLIMETER)
2. DRAWING NOT TO SCALE

BOTTOM VIEW OF DD PAK
HATCHED AREA IS SOLDER PLATED
COPPER HEAT SINK

R Package
7-Lead Plastic DD Pak
(Reference LTC DWG # 05-08-1462)
T Package
5-Lead Plastic TO-220 (Standard)
(Reference LTC DWG # 05-08-1421)

SEATING PLANE

* MEASURED AT THE SEATING PLANE

packages and footnotes:

LT1076-5
6
10765fc
PACKAGE DESCRIPTION
T5 (TO-220) 0801
.028 – .038
(0.711 – 0.965)
.067
(1.70) .135 – .165
(3.429 – 4.191)
.700 – .728
(17.78 – 18.491)
.152 – .202
(3.861 – 5.131)
.135 – .165
(3.429 – 4.191)
.013 – .023
(0.330 – 0.584)
.095 – .115
(2.413 – 2.921)
.155 – .195*
(3.937 – 4.953)
.152 – .202
(3.861 – 5.131)
.095 – .115
(2.413 – 2.921)
.155 – .195*
(3.937 – 4.953)
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## RELATED PARTS

<table>
<thead>
<tr>
<th>PART NUMBER</th>
<th>DESCRIPTION</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>LT1074/HV</td>
<td>4.4A (I&lt;sub&gt;OUT&lt;/sub&gt;), 100kHz High Efficiency</td>
<td>( \text{VIN: 7.3V to 45V/64V, V}<em>{\text{OUT(MIN)}}: 2.21V, I_D: 8.5mA, I</em>{\text{SHDN}}: 10\mu A, \text{DD5/7, TO-2205/7} )</td>
</tr>
<tr>
<td></td>
<td>Step-Down DC/DC Converter</td>
<td></td>
</tr>
<tr>
<td>LT3430</td>
<td>60V, 2.75A (I&lt;sub&gt;OUT&lt;/sub&gt;), 200kHz High</td>
<td>( \text{VIN: 5.5V to 60V, V}<em>{\text{OUT(MIN)}}: 1.20V, I_D: 2.5mA, I</em>{\text{SHDN}}: 25\mu A, \text{TSSOP16E} )</td>
</tr>
<tr>
<td></td>
<td>Efficiency Step-Down DC/DC Converter</td>
<td></td>
</tr>
<tr>
<td>LT1956</td>
<td>60V, 1.2A (I&lt;sub&gt;OUT&lt;/sub&gt;), 500kHz High</td>
<td>( \text{VIN: 5.5V to 60V, V}<em>{\text{OUT(MIN)}}: 1.20V, I_D: 2.5mA, I</em>{\text{SHDN}}: 25\mu A, \text{TSSOP16E} )</td>
</tr>
<tr>
<td></td>
<td>Efficiency Step-Down DC/DC Converter</td>
<td></td>
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