# 150mA LOAD SWITCH FEATURING COMPLEMENTARY BIPOLAR TRANSISTORS



## Description

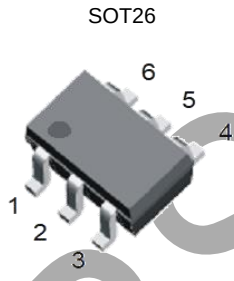
DIODES™ LMN150B01 is best suited for applications where the load needs to be turned on and off using control circuits like micro-controllers, comparators etc., particularly at a point of load. It features a discrete PNP pass transistor with stable $V_{CE(sat)}$ which does not depend on the input voltage and can support maximum continuous current of 150mA up to +125°C (see Fig. 1). It also contains a discrete NPN that can be used as a control. The component devices can be used as a part of a circuit or as standalone discrete devices.

## Features

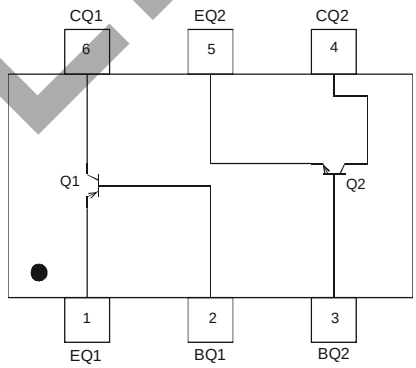
- Epitaxial Planar Die Construction
- Ideally Suited for Automated Assembly Processes
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**
- **For automotive applications requiring specific change control (i.e. parts qualified to AEC-Q100/101/104/200, PPAP capable, and manufactured in IATF 16949 certified facilities), please contact us or your local Diodes representative. https://www.diodes.com/quality/product-definitions/**

## Mechanical Data

- Package: SOT26
- Package Material: Molded Plastic. "Green Molding" Compound. UL Flammability Classification Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020
- Terminal Connections: See Diagram
- Terminals: Finish - Matte Tin Annealed over Copper Leadframe. Solderable per MIL- STD -202, Method 208 e3
- Weight: 0.016 grams (Approximate)




Top View



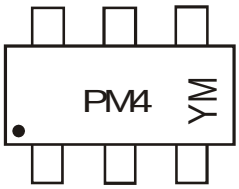

Schematic and Pin Configuration

## Ordering Information (Note 4)

| Part Number | Marking Code | Package | Packing | |
|---|---|---|---|---|
| | | | Qty. | Carrier |
| LBN150B01-7 | PM4 | SOT26 | 3000 | Tape & Reel |

Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
2. See https://www.diodes.com/quality/lead-free/ for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.
4. For packaging details, go to our website at https://www.diodes.com/design/support/packaging/diodes-packaging/.

## Marking Information




PM4 = Product Type Marking Code
YM = Date Code Marking
Y = Year (ex: K = 2023)
M = Month (ex: 9 = September)

Date Code Key

| Year | 2006 | …. | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Code | T | …. | K | L | M | N | O | P | R | S | T | U |

| Month | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Code | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | O | N | D |

## Maximum Ratings, Total Device (@$T_A$ = +25°C, unless otherwise specified.)

| Characteristic | Symbol | Value | Unit |
|---|---|---|---|
| Output Current | $I_{out}$ | 150 | mA |

## Thermal Characteristics (@$T_A$ = +25°C, unless otherwise specified.)

| Characteristic | Symbol | Value | Unit |
|---|---|---|---|
| Power Dissipation (Note 5) | $P_D$ | 300 | mW |
| Power Derating Factor above +120°C | $P_{der}$ | 2.33 | mW/°C |
| Thermal Resistance, Junction to Ambient Air (Note 5)<br>(Equivalent to One Heated Junction of PNP Transistor) | $R_{\theta JA}$ | 417 | °C/W |
| Junction Operation and Storage Temperature Range | $T_J$, $T_{STG}$ | -55 to +150 | °C |

Note: 5. Device mounted on FR-4 PCB, 1 inch x 0.85 inch x 0.062 inch; pad layout as shown on Page 9.

## Maximum Ratings: Discrete PNP Transistor (Q1) (@$T_A$ = +25°C, unless otherwise specified.)

| Characteristic | Symbol | Value | Unit |
|---|---|---|---|
| Collector-Base Voltage | $V_{CBO}$ | -40 | V |
| Collector-Emitter Voltage | $V_{CEO}$ | -40 | V |
| Emitter-Base Voltage | $V_{EBO}$ | -6 | V |
| Output Current - Continuous (Note 6) | $I_C$ | -200 | mA |

## Maximum Ratings: Discrete NPN Transistor (Q2) (@$T_A$ = +25°C, unless otherwise specified.)

| Characteristic | Symbol | Value | Unit |
|---|---|---|---|
| Collector-Base Voltage | $V_{CBO}$ | 60 | V |
| Collector-Emitter Voltage | $V_{CEO}$ | 40 | V |
| Emitter-Base Voltage | $V_{EBO}$ | 6 | V |
| Output Current - continuous (Note 6) | $I_C$ | 200 | mA |

Note: 6. Short duration pulse test used to minimize self-heating effect.

## Electrical Characteristics: Discrete PNP Transistor (Q1) (@$T_A$ = +25°C, unless otherwise specified.)

| Characteristic | Symbol | Min | Max | Unit | Test Condition |
|---|---|---|---|---|---|
| **OFF CHARACTERISTICS (Note 6)** | | | | | |
| Collector-Base Breakdown Voltage | $V_{CBO}$ | -40 | — | V | $I_C$ = -10µA, $I_E$ = 0 |
| Collector-Emitter Breakdown Voltage | $V_{CEO}$ | -40 | — | V | $I_C$ = -1.0mA, $I_B$ = 0 |
| Emitter-Base Breakdown Voltage | $V_{EBO}$ | -6 | — | V | $I_E$ = -10µA, $I_C$ = 0 |
| Collector Cutoff Current | $I_{CEX}$ | — | -50 | nA | $V_{CE}$ = -30V, $V_{EB(off)}$ = -3.0V |
| Base Cutoff Current | $I_{BL}$ | — | -50 | nA | $V_{CE}$ = -30V, $V_{EB(off)}$ = -3.0V |
| Collector-Base Cut Off Current | $I_{CBO}$ | — | -50 | nA | $V_{CB}$ = -30V, $I_E$ = 0 |
| Collector-Emitter Cut Off Current | $I_{CEO}$ | — | -50 | nA | $V_{CE}$ = -30V, $I_B$ = 0 |
| Emitter-Base Cut Off Current | $I_{EBO}$ | — | -50 | nA | $V_{EB}$ = -5V, $I_C$ = 0 |
| **ON CHARACTERISTICS (Note 6)** | | | | | |
| DC Current Gain | $h_{FE}$ | 105 | — | — | $V_{CE}$ = -1V, $I_C$ = -100µA |
| | | 110 | — | — | $V_{CE}$ = -1V, $I_C$ = -1mA |
| | | 120 | — | — | $V_{CE}$ = -1V, $I_C$ = -10mA |
| | | 90 | — | — | $V_{CE}$ = -1V, $I_C$ = -50mA |
| | | 32 | — | — | $V_{CE}$ = -1V, $I_C$ = -100mA |
| | | 10 | — | — | $V_{CE}$ = -1V, $I_C$ = -200mA |
| Collector-Emitter Saturation Voltage | $V_{CE(sat)}$ | — | -0.08 | V | $I_C$ = - 10 mA, $I_B$ = -1mA |
| | | — | -0.15 | | $I_C$ = -50mA, $I_B$ = -5mA |
| | | — | -0.5 | | $I_C$ = -200mA, $I_B$ = -20mA |
| Equivalent On-Resistance | $R_{CE(sat)}$ | — | 2.5 | Ω | $I_C$ = -200mA, $I_B$ = -20mA |
| Base-Emitter Turn-on Voltage | $V_{BE(on)}$ | – | -0.92 | V | $V_{CE}$ = -5V, $I_C$ = -200mA |
| Base-Emitter Saturation Voltage | $V_{BE(sat)}$ | — | -0.95 | V | $I_C$ = -10mA, $I_B$ = -1mA |
| | | — | -1.1 | | $I_C$ = -50mA, $I_B$ = -5mA |
| **SMALL SIGNAL CHARACTERISTICS** | | | | | |
| Output Capacitance | $C_{obo}$ | — | 4 | pF | $V_{CB}$ = -5.0V, f = 1.0MHz, $I_E$ = 0 |
| Input Capacitance | $C_{ibo}$ | — | 8 | pF | $V_{EB}$ = -5.0V, f = 1.0MHz, $I_C$ = 0 |
| Input Impedance | $h_{IE}$ | 2 | 12 | kΩ | $V_{CE}$ = 1.0V, Ic = 10mA, f = 1.0kHz |
| Voltage Feedback Ratio | $h_{RE}$ | 0.1 | 10 | x 10E-4 | |
| Small Signal Current Gain | $h_{FE}$ | 100 | 400 | — | |
| Output Admittance | $h_{OE}$ | 3 | 60 | µS | |
| Current Gain-Bandwidth Product | $f_T$ | 250 | — | MHz | $V_{CE}$ = - 20V, $I_C$ = -10mA, f = 100MHz |
| Noise Figure | NF | — | 4 | dB | $V_{CE}$ = - 5V, Ic = -100µA, $R_s$ = 1Ω<br>f = 1kHz |
| **SWITCHING CHARACTERISTICS** | | | | | |
| Delay Time | $t_d$ | — | 35 | ns | $V_{CC}$ = -3.0V, $I_C$ = -10mA |
| Rise Time | $t_r$ | — | 35 | ns | $V_{BE(off)}$ = 0.5V, $I_{B1}$ = -1.0mA |
| Storage Time | $t_s$ | — | 225 | ns | $V_{CC}$ = -3.0V, $I_C$ = -10mA |
| Fall Time | $t_f$ | — | 75 | ns | $I_{B1}$ = $I_{B2}$ = -1.0mA |

Note: 6. Short duration pulse test used to minimize self-heating effect.

## Electrical Characteristics: Discrete NPN Transistor (Q2) (@$T_A$ = +25°C, unless otherwise specified.)

| Characteristic | Symbol | Min | Max | Unit | Test Condition |
|---|---|---|---|---|---|
| **OFF CHARACTERISTICS (Note 6)** | | | | | |
| Collector-Base Breakdown Voltage | $V_{CBO}$ | 60 | — | V | $I_C$ = 10µA, $I_E$ = 0 |
| Collector-Emitter Breakdown Voltage | $V_{CEO}$ | 40 | — | V | $I_C$ = 1.0mA, $I_B$ = 0 |
| Emitter-Base Breakdown Voltage | $V_{EBO}$ | 6 | — | V | $I_E$ = 10µA, $I_C$ = 0 |
| Collector Cutoff Current | $I_{CEX}$ | — | 50 | nA | $V_{CE}$ = 30V, $V_{EB(off)}$ = 3.0V |
| Base Cutoff Current | $I_{BL}$ | — | 50 | nA | $V_{CE}$ = 30V, $V_{EB(off)}$ = 3.0V |
| Collector-Base Cut Off Current | $I_{CBO}$ | — | 50 | nA | $V_{CB}$ = 30V, $I_E$ = 0 |
| Collector-Emitter Cut Off Current | $I_{CEO}$ | — | 50 | nA | $V_{CE}$ = 30V, $I_B$ = 0 |
| Emitter-Base Cut Off Current | $I_{EBO}$ | — | 50 | nA | $V_{EB}$ = 5V, $I_C$ = 0 |
| **ON CHARACTERISTICS (Note 6)** | | | | | |
| DC Current Gain | $h_{FE}$ | 150 | — | — | $V_{CE}$ = 1V, $I_C$ = 100µA |
| | | 170 | — | — | $V_{CE}$ = 1V, $I_C$ = 1mA |
| | | 160 | — | — | $V_{CE}$ = 1V, $I_C$ = 10mA |
| | | 70 | — | — | $V_{CE}$ = 1V, $I_C$ = 50mA |
| | | 30 | — | — | $V_{CE}$ = 1V, $I_C$ = 100mA |
| | | 12 | — | — | $V_{CE}$ = 1V, $I_C$ = 200mA |
| Collector-Emitter Saturation Voltage | $V_{CE(sat)}$ | — | 0.08 | V | $I_C$ = 10mA, $I_B$ = 1mA |
| | | — | 0.16 | | $I_C$ = 50mA, $I_B$ = 5mA |
| | | — | 0.36 | | $I_C$ = 200mA, $I_B$ = 20mA |
| Equivalent On-Resistance | $R_{CE(sat)}$ | — | 1.8 | Ω | $I_C$ = 200mA, $I_B$ = 20mA |
| Base-Emitter Turn-on Voltage | $V_{BE(on)}$ | – | 0.98 | V | $V_{CE}$ = 5V, $I_C$ = 200mA |
| Base-Emitter Saturation Voltage | $V_{BE(sat)}$ | — | 0.95 | V | $I_C$ = 10mA, $I_B$ = 1mA |
| | | — | 1.1 | | $I_C$ = 50mA, $I_B$ = 5mA |
| **SMALL SIGNAL CHARACTERISTICS** | | | | | |
| Output Capacitance | $C_{obo}$ | — | 4 | pF | $V_{CB}$ = 5.0V, f = 1.0MHz, $I_E$ = 0 |
| Input Capacitance | $C_{ibo}$ | — | 8 | pF | $V_{EB}$ = 5.0V, f = 1.0MHz, $I_C$ = 0 |
| Input Impedance | $h_{IE}$ | 2 | 12 | kΩ | $V_{CE}$ = 1.0V, $I_C$ = 10mA, f = 1.0kHz |
| Voltage Feedback Ratio | $h_{RE}$ | 0.1 | 10 | x 10E-4 | |
| Small Signal Current Gain | $h_{FE}$ | 100 | 400 | — | |
| Output Admittance | $h_{OE}$ | 3 | 60 | µS | |
| Current Gain-Bandwidth Product | $f_T$ | 250 | — | MHz | $V_{CE}$ = 20V, $I_C$ = 0mA, f = 100MHz |
| Noise Figure | NF | — | 4 | dB | $V_{CE}$ = 5V, $I_C$ = 100µA, $R_S$ = 1Ω<br>f = 1kHz |
| **SWITCHING CHARACTERISTICS** | | | | | |
| Delay Time | $t_d$ | — | 35 | ns | $V_{CC}$ = -3.0V, $I_C$ = 10mA, |
| Rise Time | $t_r$ | — | 35 | ns | $V_{BE(off)}$ = 0.5V, $I_{B1}$ = 1.0mA |

Note: 6. Short duration pulse test used to minimize self-heating effect.

## Typical Characteristics

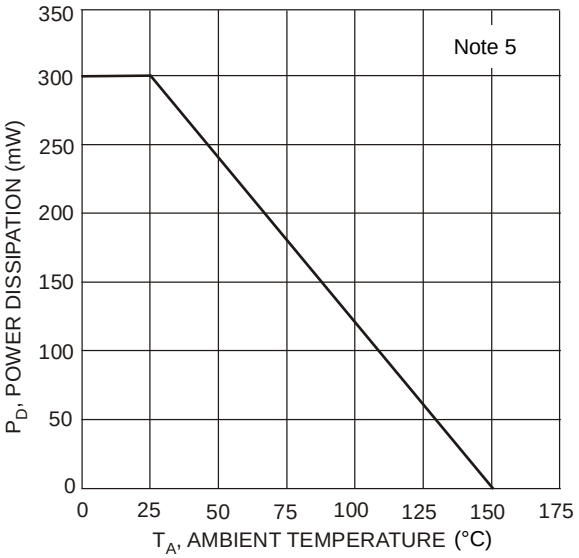



Fig. 1 Max Power Dissipation vs Ambient Temperature

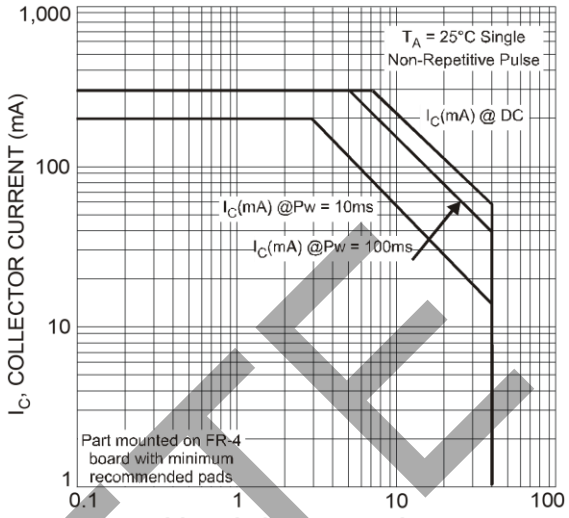



Fig. 2 Safe Operating Area

## Characteristics of NPN Transistor (Q2):

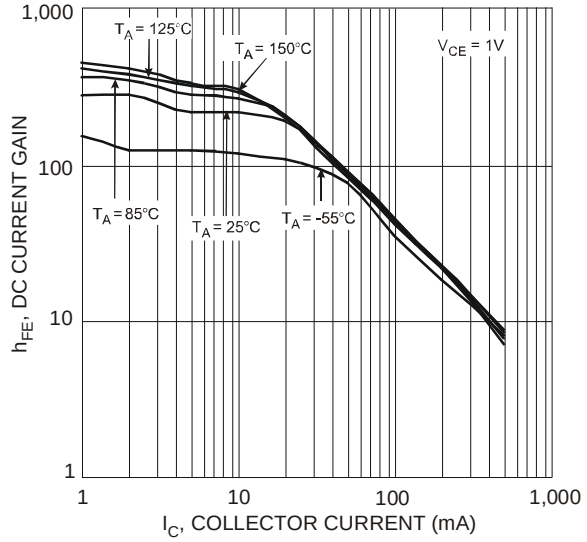



Fig. 3 Typical DC Current Gain vs. Collector Current

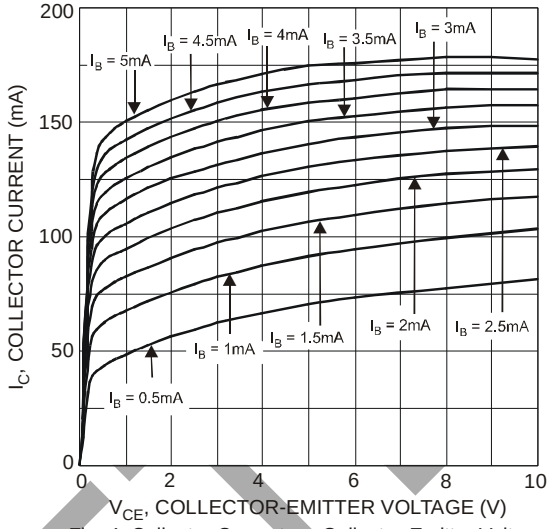



Fig. 4 Collector Current vs. Collector-Emitter Voltage

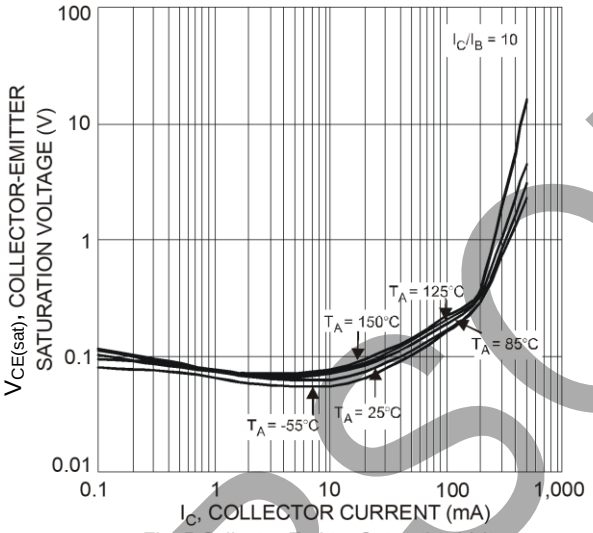



Fig. 5 Collector-Emitter Saturation Voltage vs. Collector Current

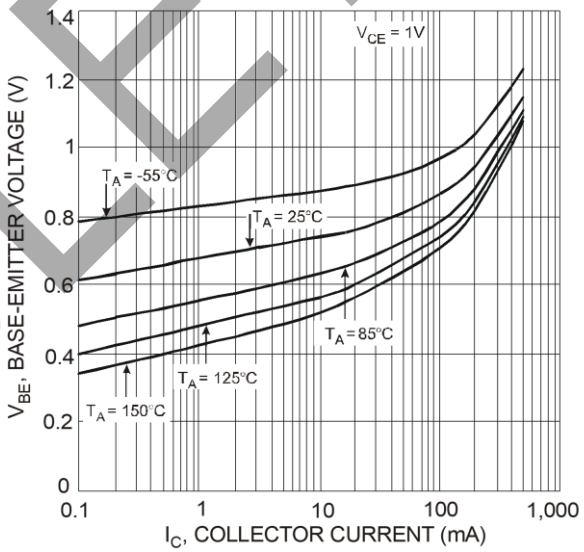



Fig. 6 Base-Emitter Turn-on Voltage vs. Collector Current

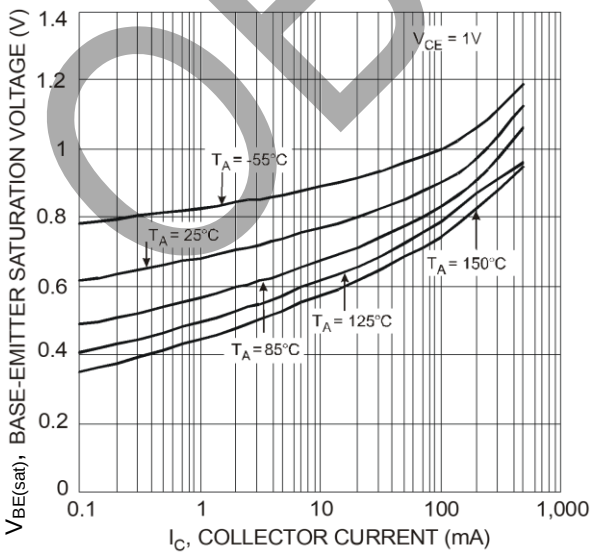



Fig. 7 Base-Emitter Saturation Voltage vs. Collector Current

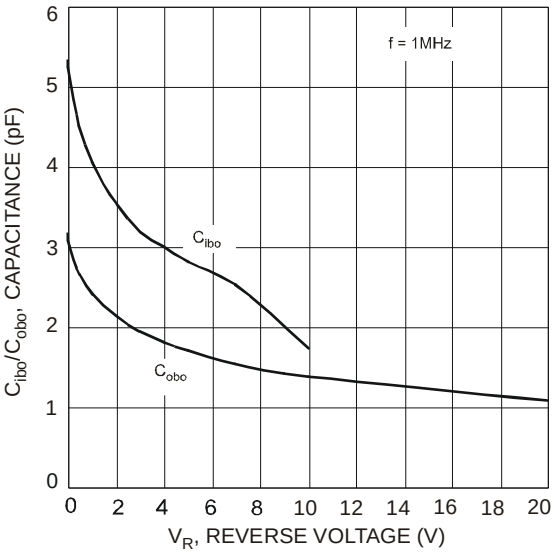



Fig. 8 Typical Capacitance Characteristics

## Characteristics of PNP Transistor (Q1):

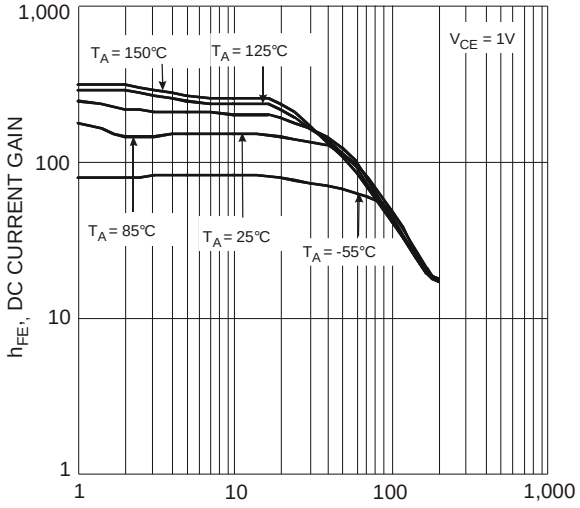



Fig. 9 Typical DC Current Gain vs. Collector Current

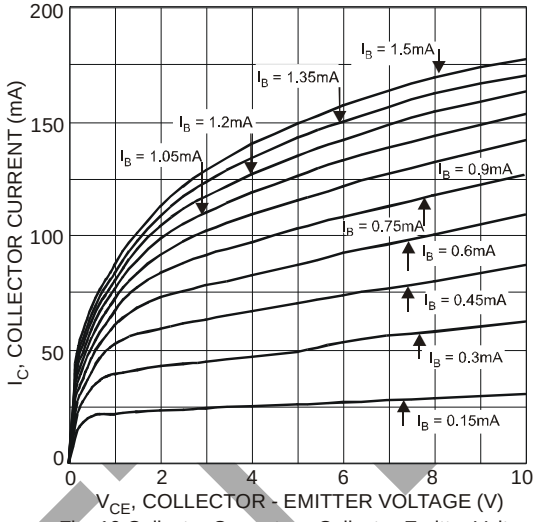



Fig. 10 Collector Current vs. Collector-Emitter Voltage

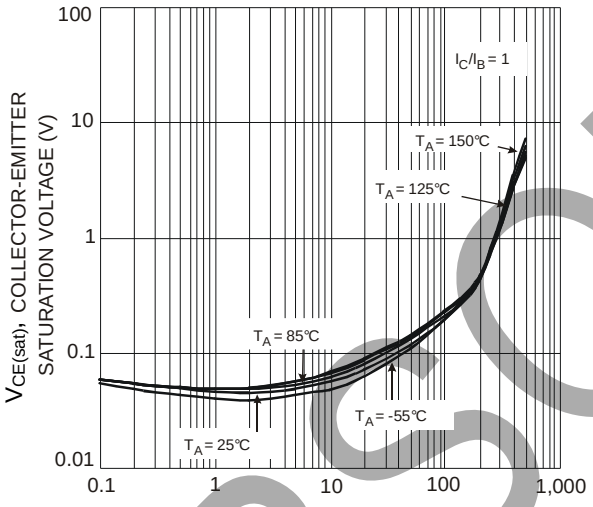



Fig. 11 Collector-Emitter Saturation Voltage vs. Collector Current

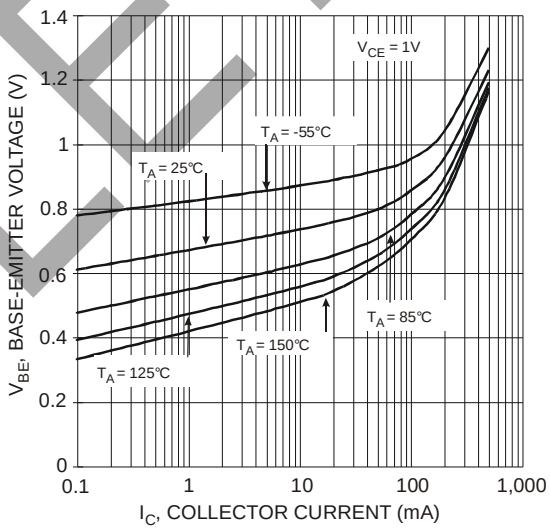



Fig. 12 Base-Emitter Turn-On Voltage vs. Collector Current

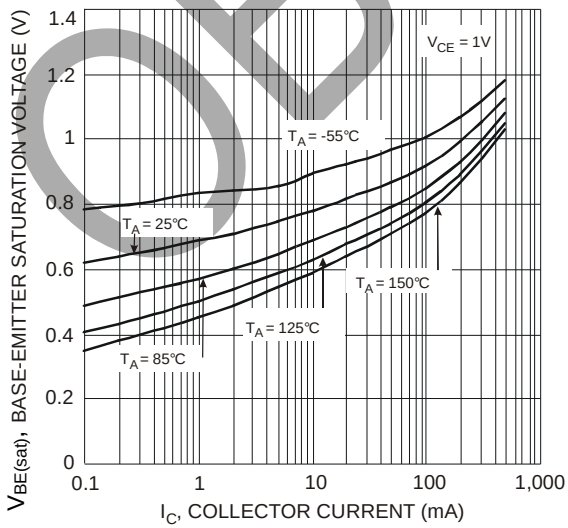



Fig. 13 Base-Emitter Saturation Voltage vs. Collector Current

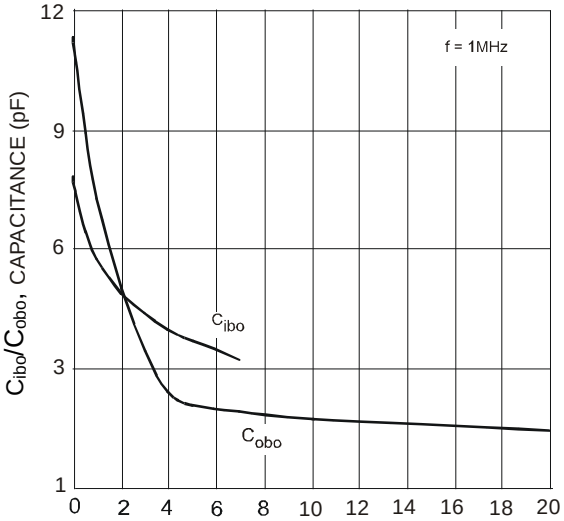
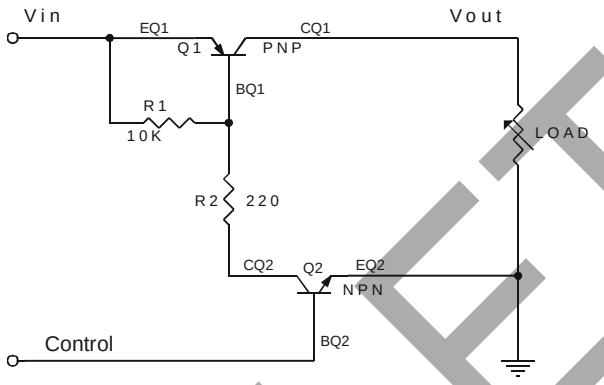



Fig. 14 Typical Capacitance Characteristics

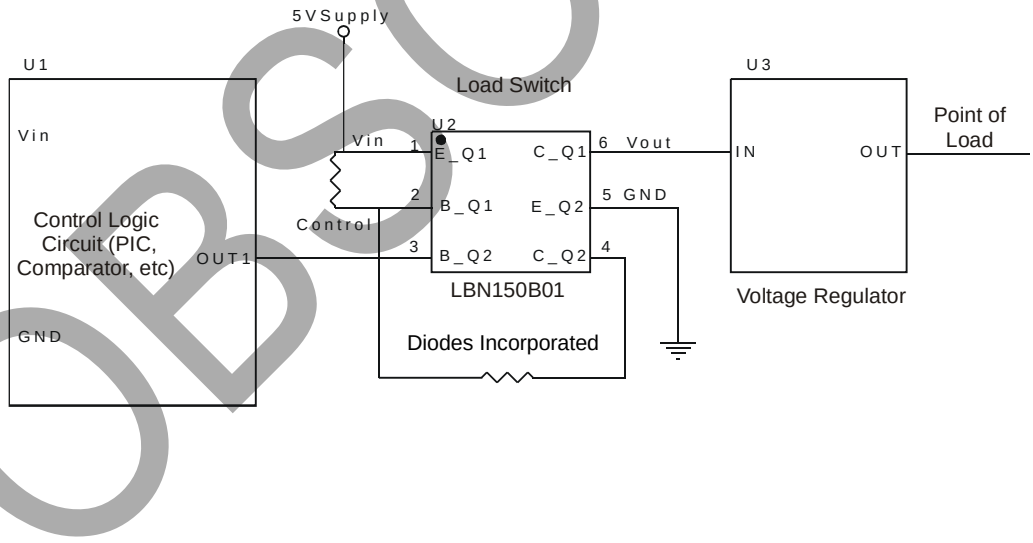
## Application Details

PNP Transistor and NPN Transistor integrated as one in LBN150B01 can be used as a discrete entity for general purpose applications or as a part of a circuit to function as a Load Switch. When it is used as the latter as shown in Example Circuit Schematic, various input voltage sources can be used as long as they do not exceed the maximum rating of the device. These devices are designed to deliver continuous output load current up to maximum of 150mA. The use of the NPN as a switch eliminates the need for higher current required to overcome the gate charge in the event an N-MOSFET is used. Care must be taken for higher levels of dissipation while designing for higher load conditions. These devices provide power on demand and also consume less space. It mainly helps in optimizing power usage, thereby conserving battery life in a controlled load system like portable battery powered applications. (Please see Figure below for one example of typical application circuit used in conjunction with a voltage regulator as a part of power management system).




Example Circuit Schematic

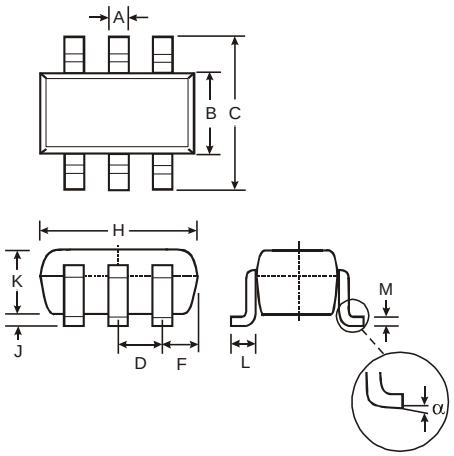
## Typical Application Circuit



## Package Outline Dimensions

Please see http://www.diodes.com/package-outlines.html for the latest version.

**SOT26**

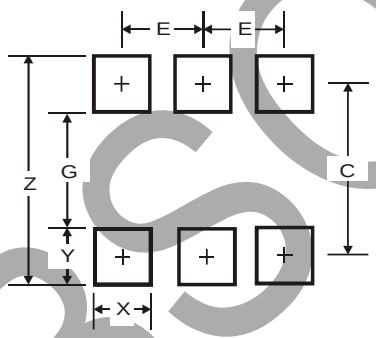



| SOT26 | | | |
|---|---|---|---|
| **Dim** | **Min** | **Max** | **Typ** |
| **A** | 0.35 | 0.50 | 0.38 |
| **B** | 1.50 | 1.70 | 1.60 |
| **C** | 2.70 | 3.00 | 2.80 |
| **D** | — | — | 0.95 |
| **F** | — | — | 0.55 |
| **H** | 2.90 | 3.10 | 3.00 |
| **J** | 0.013 | 0.10 | 0.05 |
| **K** | 1.00 | 1.30 | 1.10 |
| **L** | 0.35 | 0.55 | 0.40 |
| **M** | 0.10 | 0.20 | 0.15 |
| **α** | 0° | 8° | — |
| **All Dimensions in mm** | | | |

## Suggested Pad Layout

Please see http://www.diodes.com/package-outlines.html for the latest version.

**SOT26**




| Dimensions | Value (in mm) |
|---|---|
| Z | 3.20 |
| G | 1.60 |
| X | 0.55 |
| Y | 0.80 |
| C | 2.40 |
| E | 0.95 |

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