# COMPLEX TRANSISTOR ARRAY FOR BIPOLAR TRANSISTOR HALF H-BRIDGE MOTOR/ACTUATOR DRIVER

## Features

- Epitaxial Planar Die Construction
- **Lead Free By Design/RoHS Compliant (Note 1)**
- **"Green" Device (Note 2)**

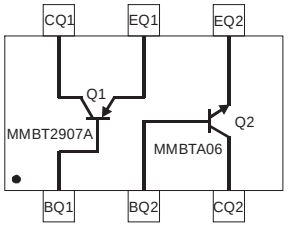
| Sub-Component P/N | Reference | Device Type |
|---|---|---|
| MMBT2907A_DIE | Q1 | PNP Transistor |
| MMBTA06_DIE | Q2 | NPN Transistor |

## Mechanical Data

- Case: SOT-363
- Case Material: Molded Plastic, “Green” Molding Compound. UL Flammability Classification Rating 94V-0
- Moisture Sensitivity: Level 1 per J-STD-020D
- Terminal Connections: See Schematic & Pin Configuration
- Terminals: Finish - Matte Tin annealed over Alloy 42 leadframe. Solderable per MIL-STD-202, Method 208
- Marking Information: See Page 6
- Ordering Information: See Page 6
- Weight: 0.016 grams (approximate)



Top View




Device Schematic

## Maximum Ratings: Total Device @$T_A$ = 25°C unless otherwise specified

| Characteristic | Symbol | Value | Unit |
|---|---|---|---|
| Operating and Storage Junction Temperature Range | $V_{EBO}$ | -55 to +150 | °C |

## Thermal Characteristics: Total Device

| Characteristic | Symbol | Value | Unit |
|---|---|---|---|
| Power Dissipation (Note 3) | $P_D$ | 200 | mW |
| Thermal Resistance, Junction to Ambient Air (Note 3) | $R_{\theta JA}$ | 625 | °C/W |

## Maximum Ratings: Sub-Component Devices @$T_A$ = 25°C unless otherwise specified

| Characteristic | Symbol | Q1-PNP Transistor (MMBT2907A) | Q2-NPN Transistor (MMBTA06) | Unit |
|---|---|---|---|---|
| Collector-Base Voltage | $V_{CBO}$ | -60 | 80 | V |
| Collector-Emitter Voltage | $V_{CEO}$ | -60 | 65 | V |
| Emitter-Base Voltage | $V_{EBO}$ | -5.5 | 6 | V |
| Collector Current - Continuous (Note 3) | $I_C$ | -600 | 500 | mA |

Notes:
1. No purposefully added lead.
2. Diodes Inc.'s "Green" policy can be found on our website at http://www.diodes.com/products/lead_free/index.php.
3. Device mounted on FR-4 PCB, 1 inch x 0.85 inch x 0.062 inch; pad layout as shown on page 7 or on Diodes Inc. suggested pad layout document AP02001, which can be found on our website at http://www.diodes.com/datasheets/ap02001.pdf.


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## Electrical Characteristics: PNP (MMBT2907A) Transistor (Q1) @$T_A$ = 25°C unless otherwise specified

| Characteristic | Symbol | Min | Max | Unit | Test Condition |
|---|---|---|---|---|---|
| **OFF CHARACTERISTICS (Note 4)** | | | | | |
| Collector-Base Breakdown Voltage | $V_{(BR)CBO}$ | -60 | — | V | $I_C$ = -10μA, $I_E$ = 0 |
| Collector-Emitter Breakdown Voltage | $V_{(BR)CEO}$ | -60 | — | V | $I_C$ = -10mA, $I_B$ = 0 |
| Emitter-Base Breakdown Voltage | $V_{(BR)EBO}$ | -5.5 | — | V | $I_E$ = -10μA, $I_C$ = 0 |
| Collector Cutoff Current | $I_{CBO}$ | — | -10 | nA | $V_{CB}$ = -50V, $I_E$ = 0 |
| Collector Cutoff Current | $I_{CEX}$ | — | -50 | nA | $V_{CE}$ = -30V, $V_{EB(OFF)}$ = -0.5V |
| Base Cutoff Current | $I_{BL}$ | — | -50 | nA | $V_{CE}$ = -30V, $V_{EB(OFF)}$ = -0.5V |
| **ON CHARACTERISTICS (Note 4)** | | | | | |
| DC Current Gain | $h_{FE}$ | 100<br>100<br>100<br>100<br>50 | —<br>—<br>—<br>300<br>— | —<br>—<br>—<br>—<br>— | $I_C$ = -100μA, $V_{CE}$ = -10V<br>$I_C$ = -1.0mA, $V_{CE}$ = -10V<br>$I_C$ = -10mA, $V_{CE}$ = -10V<br>$I_C$ = -150mA, $V_{CE}$ = -10V<br>$I_C$ = -500mA, $V_{CE}$ = -10V |
| Collector-Emitter Saturation Voltage | $V_{CE(SAT)}$ | — | -0.3<br>-0.5 | V | $I_C$ = -150mA, $I_B$ = -15mA<br>$I_C$ = -500mA, $I_B$ = -50mA |
| Base-Emitter Saturation Voltage | $V_{BE(SAT)}$ | — | -0.95<br>-1.3 | V | $I_C$ = -150mA, $I_B$ = -15mA<br>$I_C$ = -500mA, $I_B$ = -50mA |
| **SMALL SIGNAL CHARACTERISTICS** | | | | | |
| Current Gain-Bandwidth Product | $f_T$ | 100 | — | MHz | $V_{CE}$ = -2.0V, $I_C$ = -10mA, f = 100MHz |
| **SWITCHING CHARACTERISTICS** | | | | | |
| Turn-On Time | $t_{on}$ | — | 45 | ns | $V_{CE}$ = -30V, $I_C$ = -150mA, $I_{B1}$ = -15mA |
| Delay Time | $t_d$ | — | 10 | ns | |
| Rise Time | $t_r$ | — | 40 | ns | |
| Turn-Off Time | $t_{off}$ | — | 100 | ns | $V_{CC}$ = -6.0V, $I_C$ = -150mA, $I_{B1}$ = $I_{B2}$ = -15mA |
| Storage Time | $t_s$ | — | 80 | ns | |
| Fall Time | $t_r$ | — | 30 | ns | |

## Electrical Characteristics: NPN (MMBTA06) Transistor (Q2) @$T_A$ = 25°C unless otherwise specified

| Characteristic | Symbol | Min | Typ | Max | Unit | Test Condition |
|---|---|---|---|---|---|---|
| **OFF CHARACTERISTICS (Note 4)** | | | | | | |
| Collector-Base Breakdown Voltage | $V_{(BR)CBO}$ | 80 | — | — | V | $I_C$ = 100μA, $I_E$ = 0 |
| Collector-Emitter Breakdown Voltage | $V_{(BR)CEO}$ | 65 | — | — | V | $I_C$ = 1mA, $I_B$ = 0 |
| Emitter-Base Breakdown Voltage | $V_{(BR)EBO}$ | 6 | — | — | V | $I_E$ = 100μA, $I_C$ = 0 |
| Collector-Base Cutoff Current | $I_{CBO}$ | — | — | 100 | nA | $V_{CB}$ = 80V, $I_E$ = 0 |
| Collector Cutoff Current | $I_{CES}$ | — | — | 100 | nA | $V_{CE}$ = 90V, $V_{BE}$ = 0 |
| Emitter-Base Cutoff Current | $I_{EBO}$ | — | — | 100 | nA | $V_{EB}$ = 5V, $I_C$ = 0 |
| **ON CHARACTERISTICS (Note 4)** | | | | | | |
| DC Current Gain | $h_{FE}$ | 250 | — | — | — | $V_{CE}$ = 1V, $I_C$ = 10mA |
| | | 100 | — | — | — | $V_{CE}$ = 1V, $I_C$ = 100mA |
| Collector-Emitter Saturation Voltage | $V_{CE(SAT)}$ | — | 0.2 | 0.4 | V | $I_C$ = 100mA, $I_B$ = 10mA |
| Base-Emitter Turn-on Voltage | $V_{BE(ON)}$ | 0.7 | 0.75 | 0.8 | V | $V_{CE}$ = 1V, $I_C$ = 100mA |
| Base-Emitter Saturation Voltage | $V_{BE(SAT)}$ | — | — | 0.95 | V | $I_C$ = 100mA, $I_B$ = 5mA |
| **SMALL SIGNAL CHARACTERISTICS** | | | | | | |
| Current Gain-Bandwidth Product | $f_T$ | 100 | — | — | MHz | $V_{CE}$ = 20V, $I_C$ = 10mA, f = 100MHz |

Notes: 4. Short duration pulse test used to minimize self-heating effect.


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## Typical Characteristics @$T_A$ = 25°C unless otherwise specified

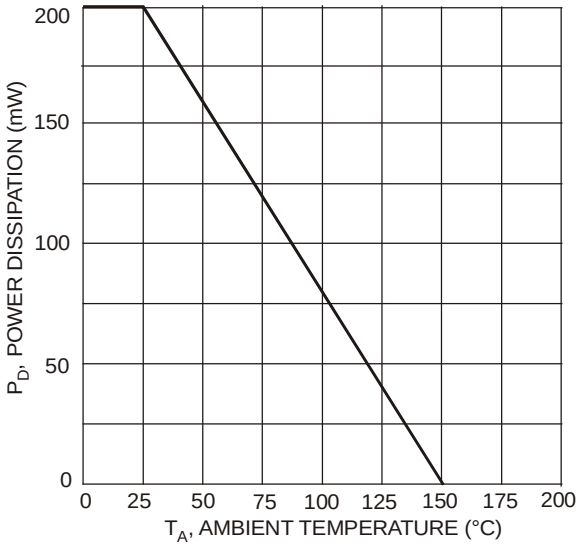



Fig. 1 Power Derating Curve

## PNP (MMBT2907A) Transistor (Q1) Plots:

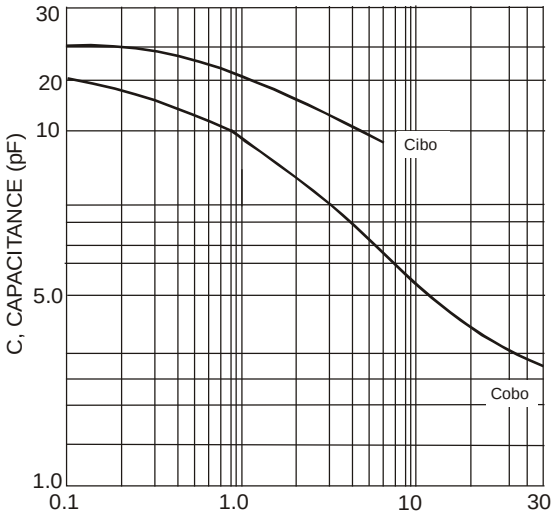



Fig. 2 Typical Capacitance

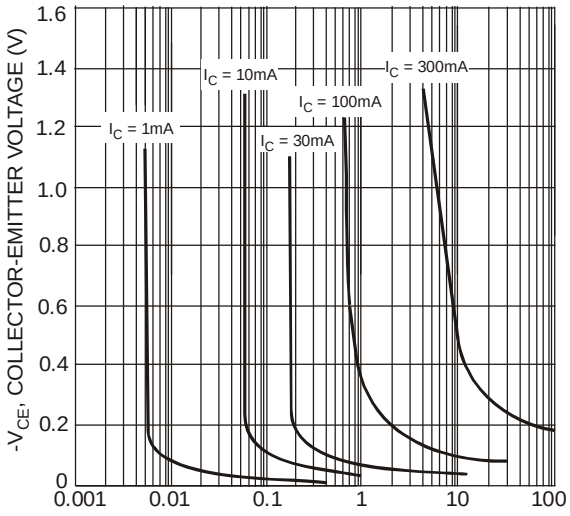



Fig. 3 Typical Collector Saturation Region

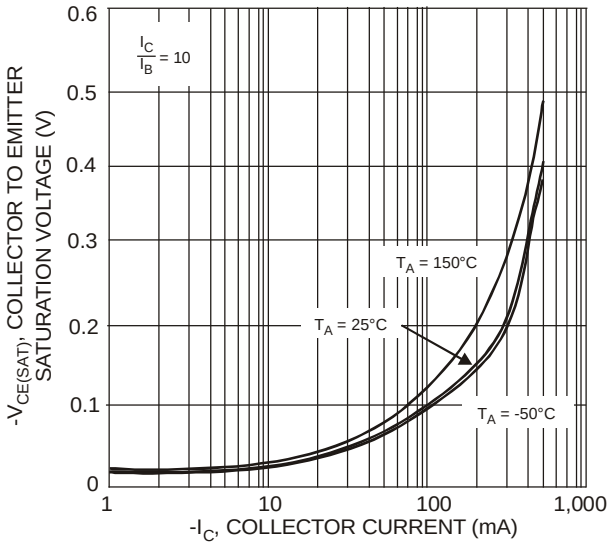



Fig. 4 Collector Emitter Saturation Voltage vs. Collector Current

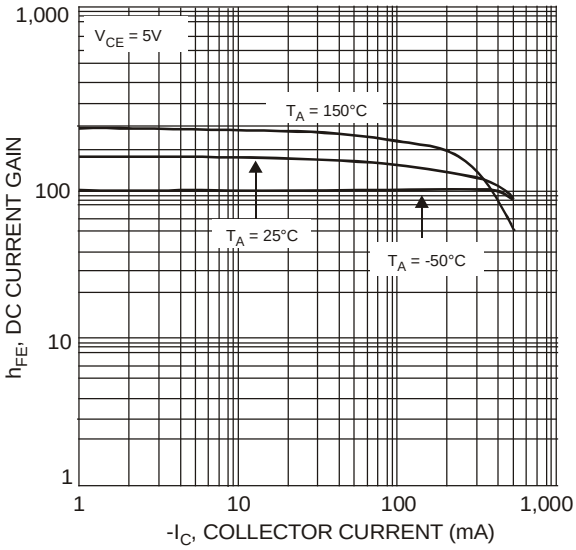



Fig. 5 Typical DC Current Gain vs. Collector Current


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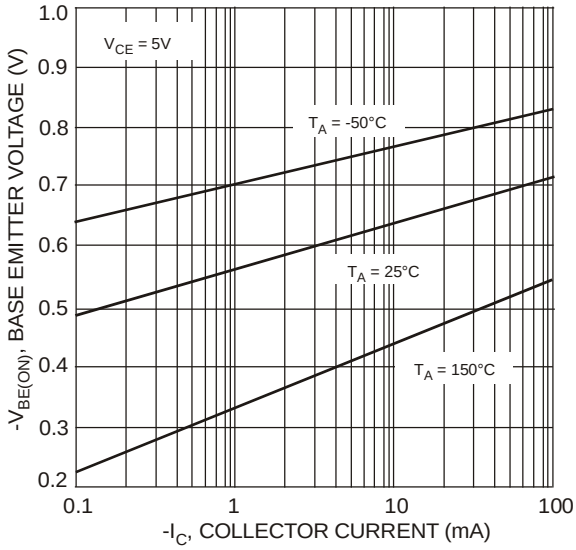



Fig. 6 Typical Base Emitter Voltage vs. Collector Current

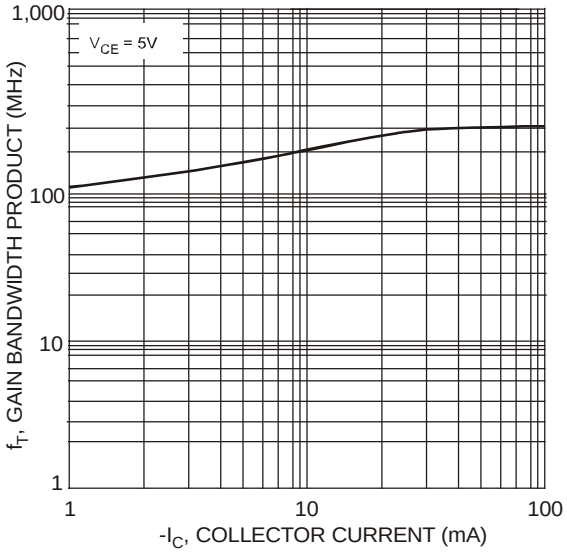



Fig. 7 Typical Gain Bandwidth Product vs. Collector Current

## NPN (MMBTA06) Transistor (Q2) Plots

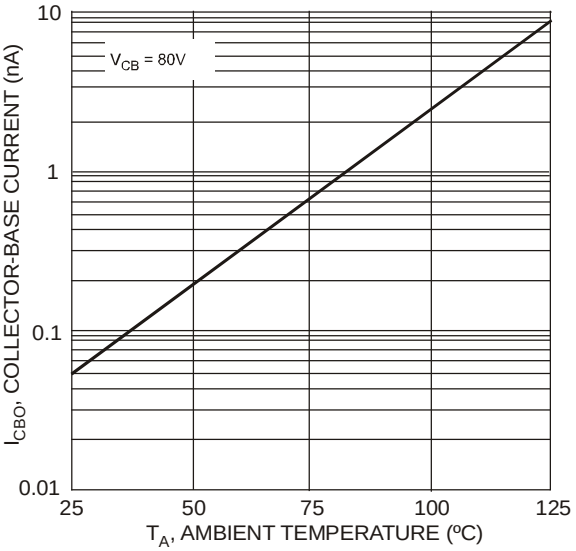



Fig. 8 Typical Collector-Cutoff Current vs. Ambient Temperature

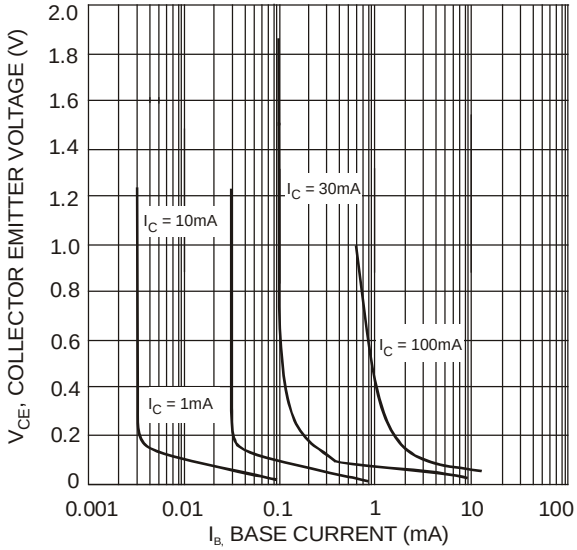



Fig. 9 Typical Collector Saturation Region

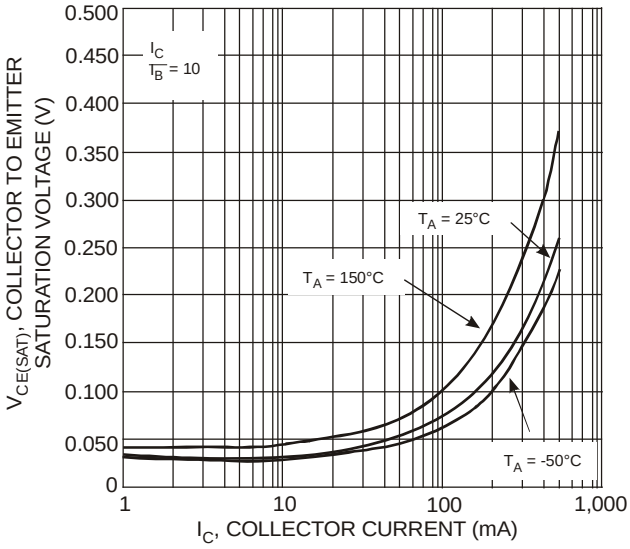



Fig. 10 Typical Collector Emitter Saturation Voltage vs. Collector Current

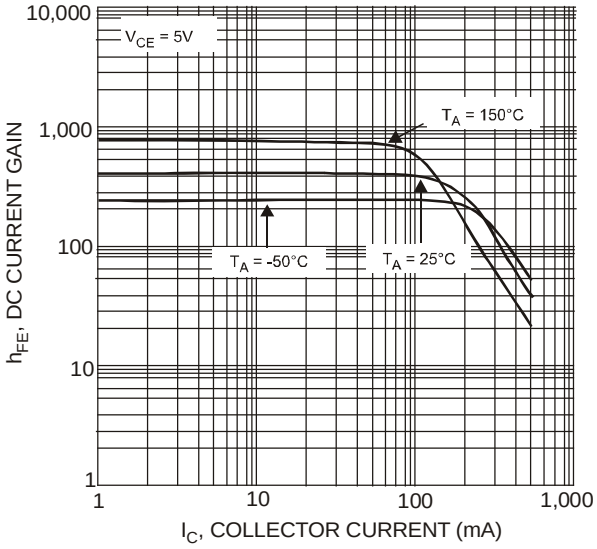



Fig. 11 Typical DC Current Gain vs. Collector Current


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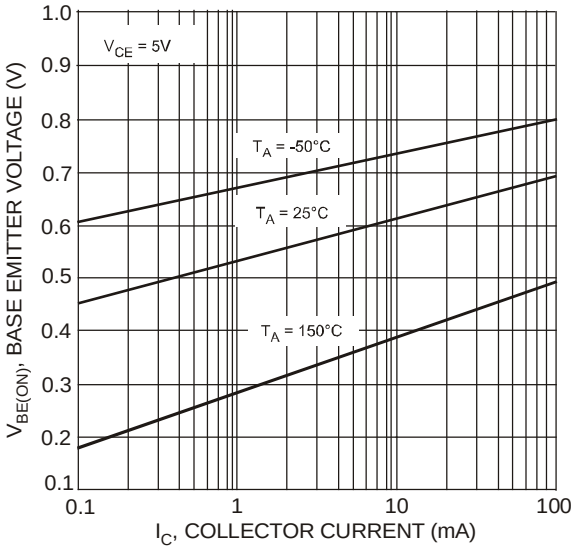



Fig. 12 Typical Base Emitter Voltage vs. Collector Current

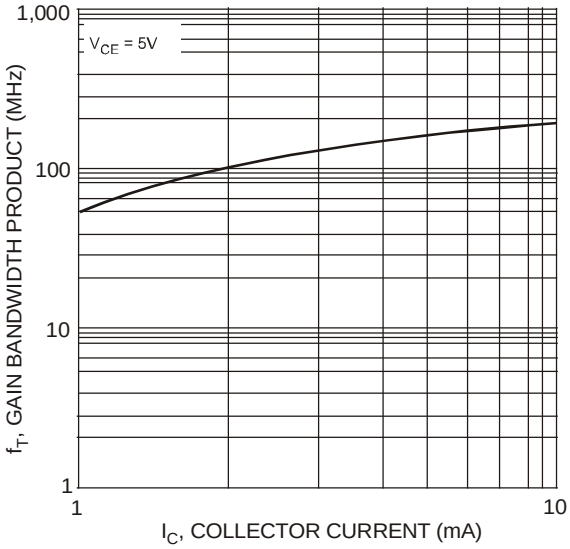
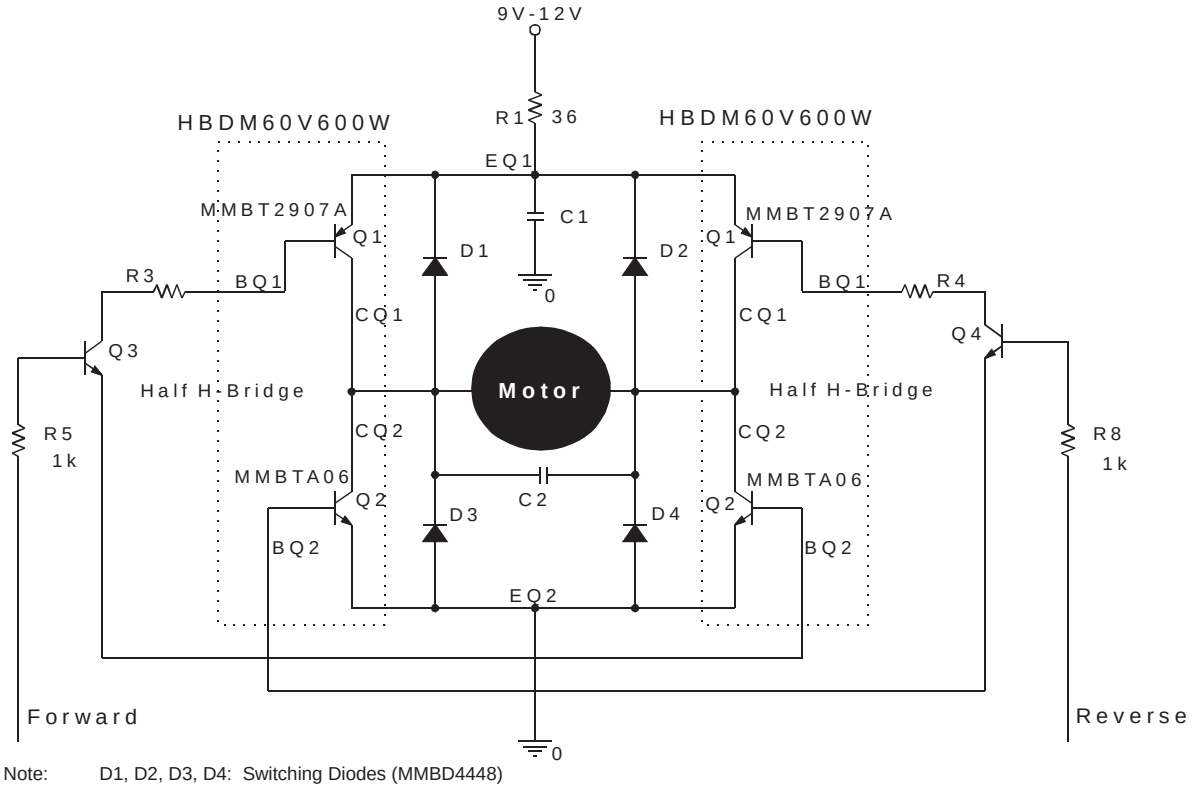



Fig. 13 Typical Gain Bandwidth Product vs. Collector Current

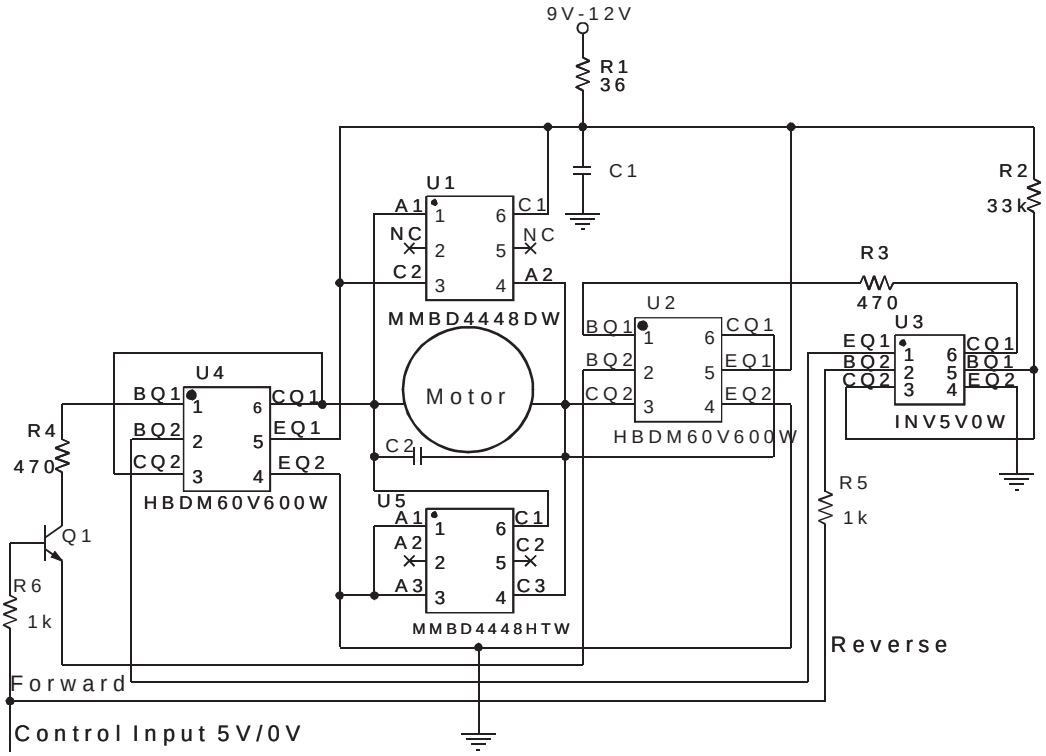
## Current Schematic along with Application Example:




Note: D1, D2, D3, D4: Switching Diodes (MMBD4448)
Q3, Q4: NPN Transistors (MMBTA06)


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## Application Example Schematic: (with Package Pinouts)

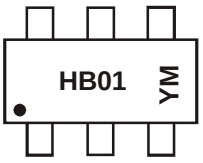



## Ordering Information (Note 5)

| Part Number | Case | Packaging |
|---|---|---|
| HBDM60V600W-7 | SOT-363 | 3000/Tape & Reel |

Notes: 5. For packaging details, go to our website at http://www.diodes.com/datasheets/ap02007.pdf.

## Marking Information




HB01 = Product Type Marking Code
YM = Date Code Marking
Y = Year (ex: T = 2006)
M = Month (ex: 9 = September)

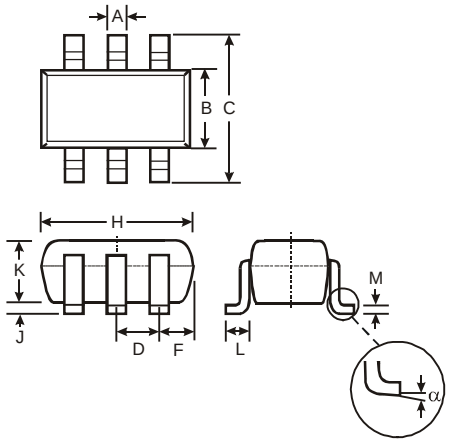
Date Code Key

| Year | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 |
|---|---|---|---|---|---|---|---|---|---|---|
| Code | T | U | V | W | X | Y | Z | A | B | C |

| 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 |

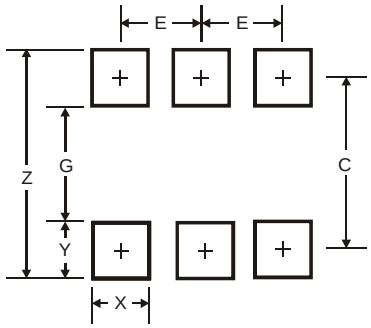

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## Package Outline Dimensions




| SOT-363 | | |
|---|---|---|
| **Dim** | **Min** | **Max** |
| **A** | 0.10 | 0.30 |
| **B** | 1.15 | 1.35 |
| **C** | 2.00 | 2.20 |
| **D** | 0.65 Typ | |
| **F** | 0.40 | 0.45 |
| **H** | 1.80 | 2.20 |
| **J** | 0 | 0.10 |
| **K** | 0.90 | 1.00 |
| **L** | 0.25 | 0.40 |
| **M** | 0.10 | 0.22 |
| **α** | 0° | 8° |
| **All Dimensions in mm** | | |

## Suggested Pad Layout




| Dimensions | Value (in mm) |
|---|---|
| **Z** | 2.5 |
| **G** | 1.3 |
| **X** | 0.42 |
| **Y** | 0.6 |
| **C** | 1.9 |
| **E** | 0.65 |

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