

**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)**

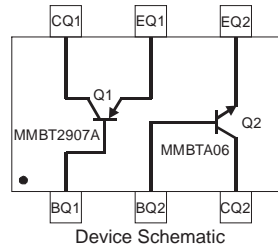
Sub-Component P/N	Reference	Device Type
MMBT2907A_DIE	Q1	PNP Transistor
MMBTA06_DIE	Q2	NPN Transistor



Top View

**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)



Device Schematic

**Maximum Ratings: Total Device** @ $T_A = 25^\circ\text{C}$  unless otherwise specified

Characteristic	Symbol	Value	Unit
Operating and Storage Junction Temperature Range	$V_{EBO}$	-55 to +150	$^\circ\text{C}$

**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	$^\circ\text{C/W}$

**Maximum Ratings: Sub-Component Devices** @ $T_A = 25^\circ\text{C}$  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](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>.

**Electrical Characteristics: PNP (MMBT2907A) Transistor (Q1)** @ $T_A = 25^\circ\text{C}$  unless otherwise specified

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

**Electrical Characteristics: NPN (MMBTA06) Transistor (Q2)** @ $T_A = 25^\circ\text{C}$  unless otherwise specified

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

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

**Typical Characteristics** @ $T_A = 25^\circ\text{C}$  unless otherwise specified

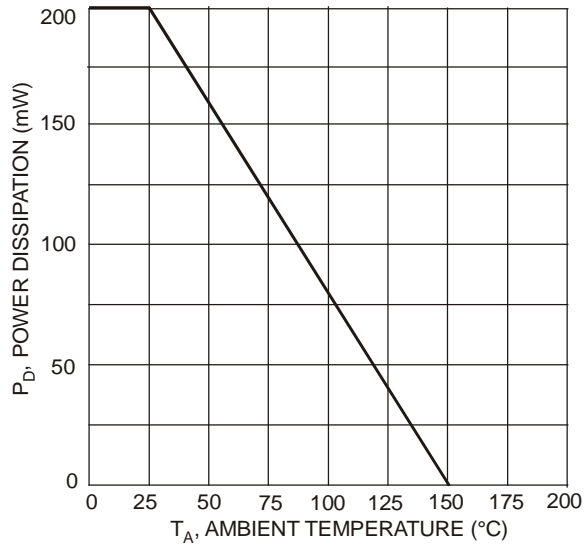


Fig. 1 Power Derating Curve

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

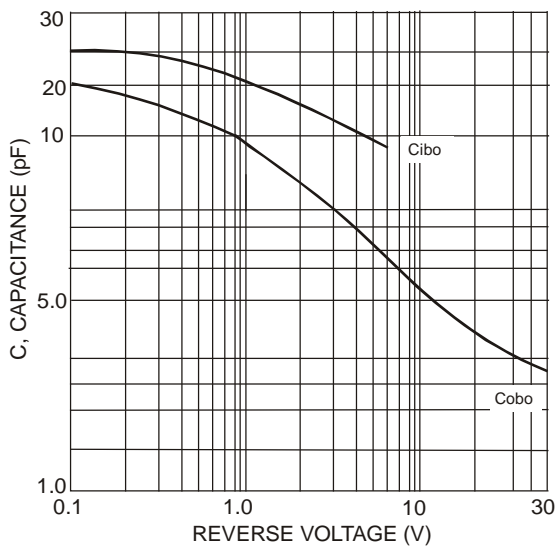


Fig. 2 Typical Capacitance

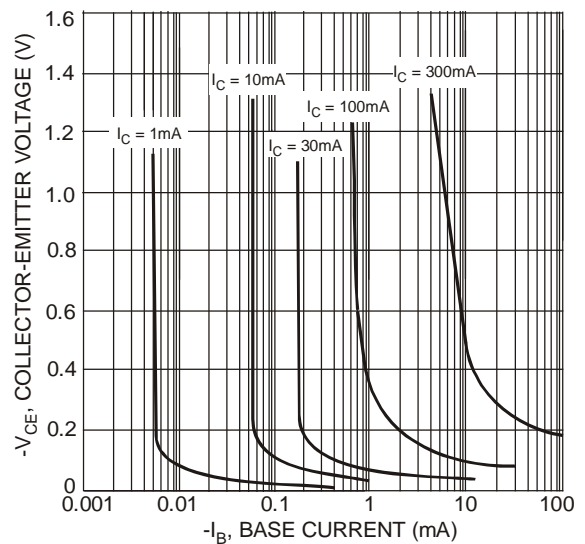


Fig. 3 Typical Collector Saturation Region

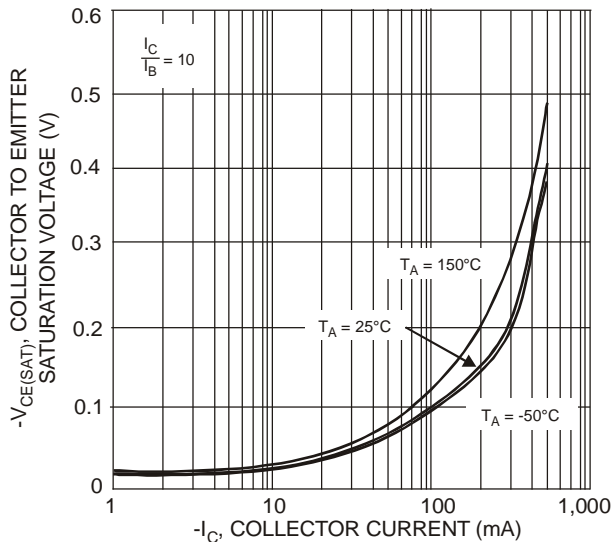


Fig. 4 Collector Emitter Saturation Voltage vs. Collector Current

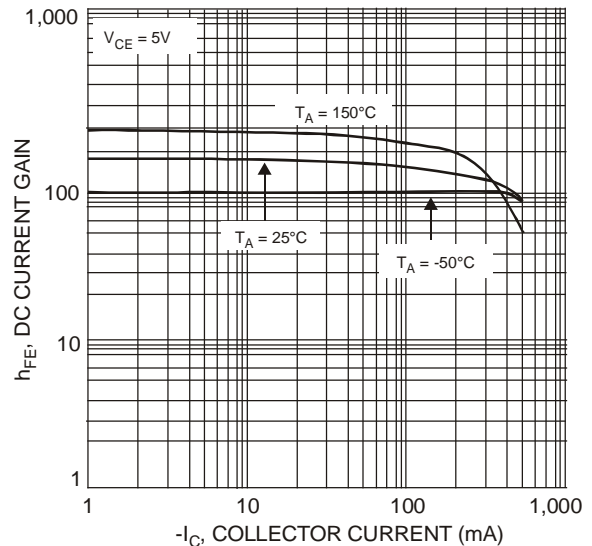


Fig. 5 Typical DC Current Gain vs. Collector Current

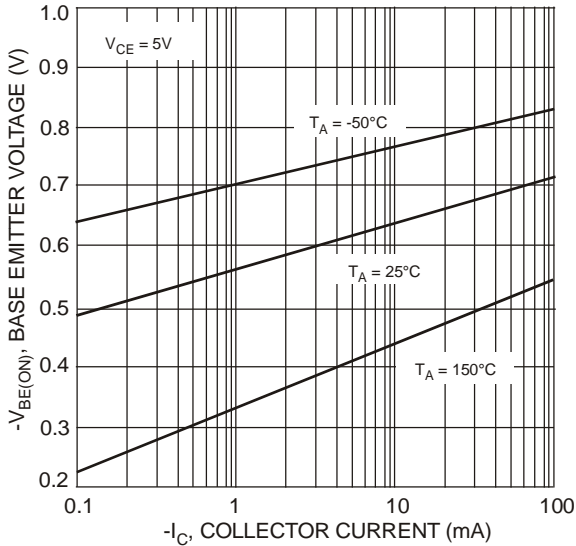


Fig. 6 Typical Base Emitter Voltage vs. Collector Current

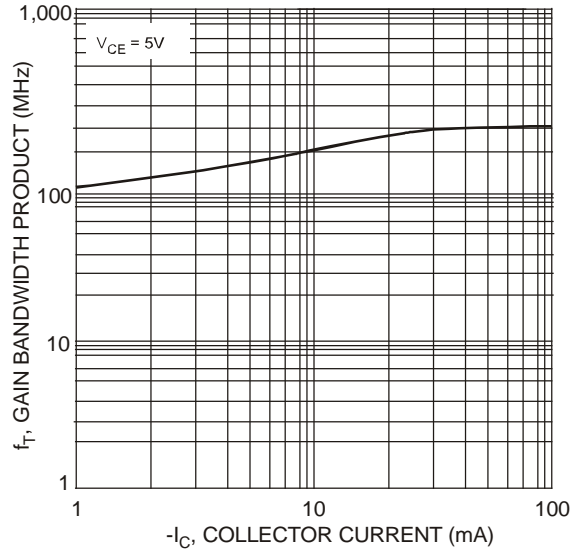


Fig. 7 Typical Gain Bandwidth Product vs. Collector Current

**NPN (MMBTA06) Transistor (Q2) Plots**

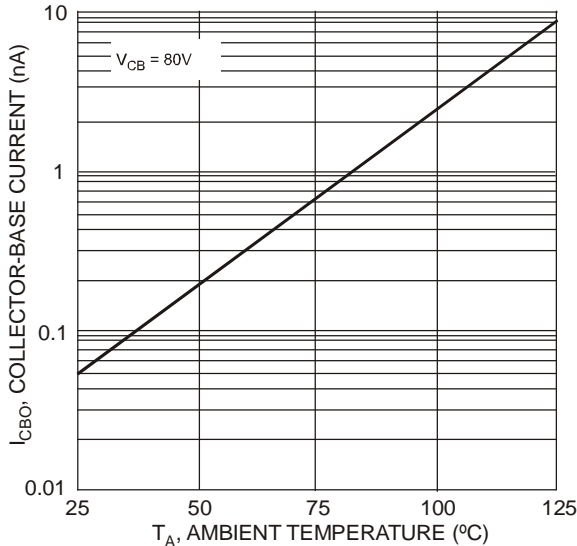


Fig. 8 Typical Collector-Cutoff Current vs. Ambient Temperature

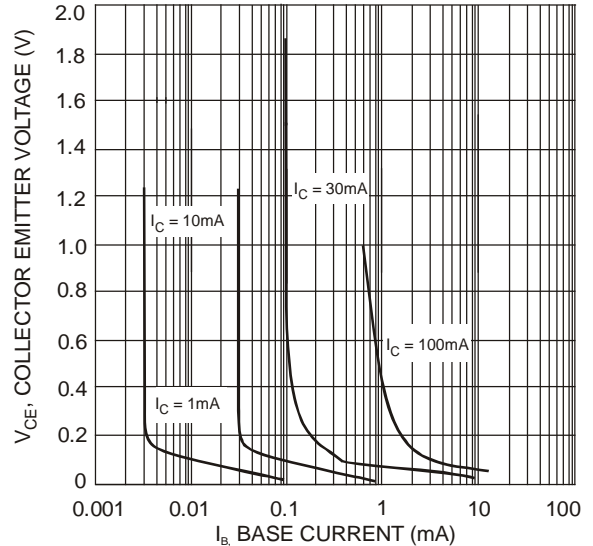


Fig. 9 Typical Collector Saturation Region

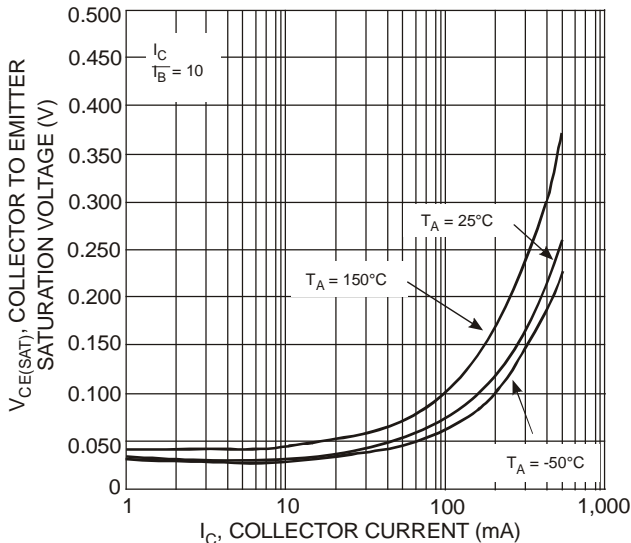


Fig. 10 Typical Collector Emitter Saturation Voltage vs. Collector Current

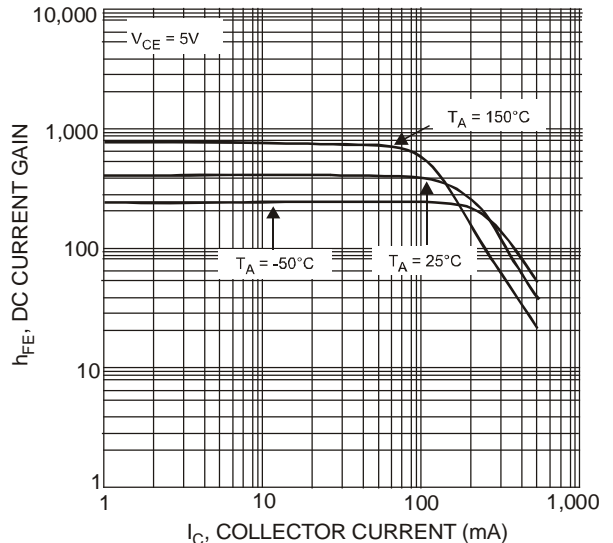


Fig. 11 Typical DC Current Gain vs. Collector Current

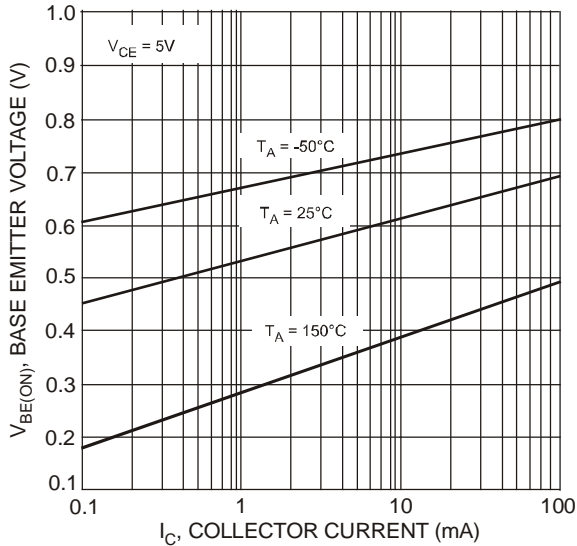


Fig. 12 Typical Base Emitter Voltage vs. Collector Current

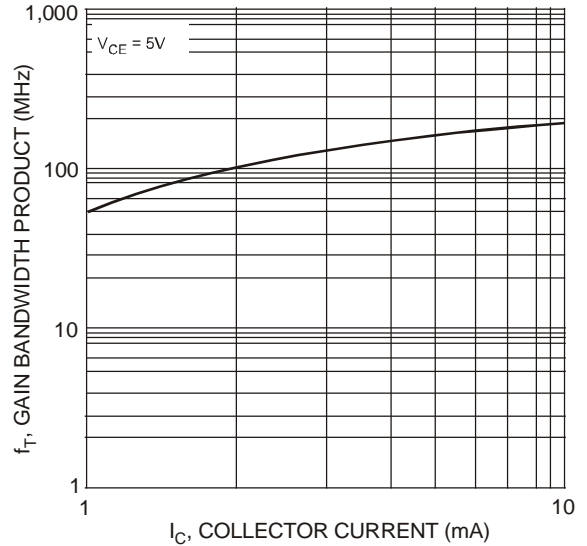
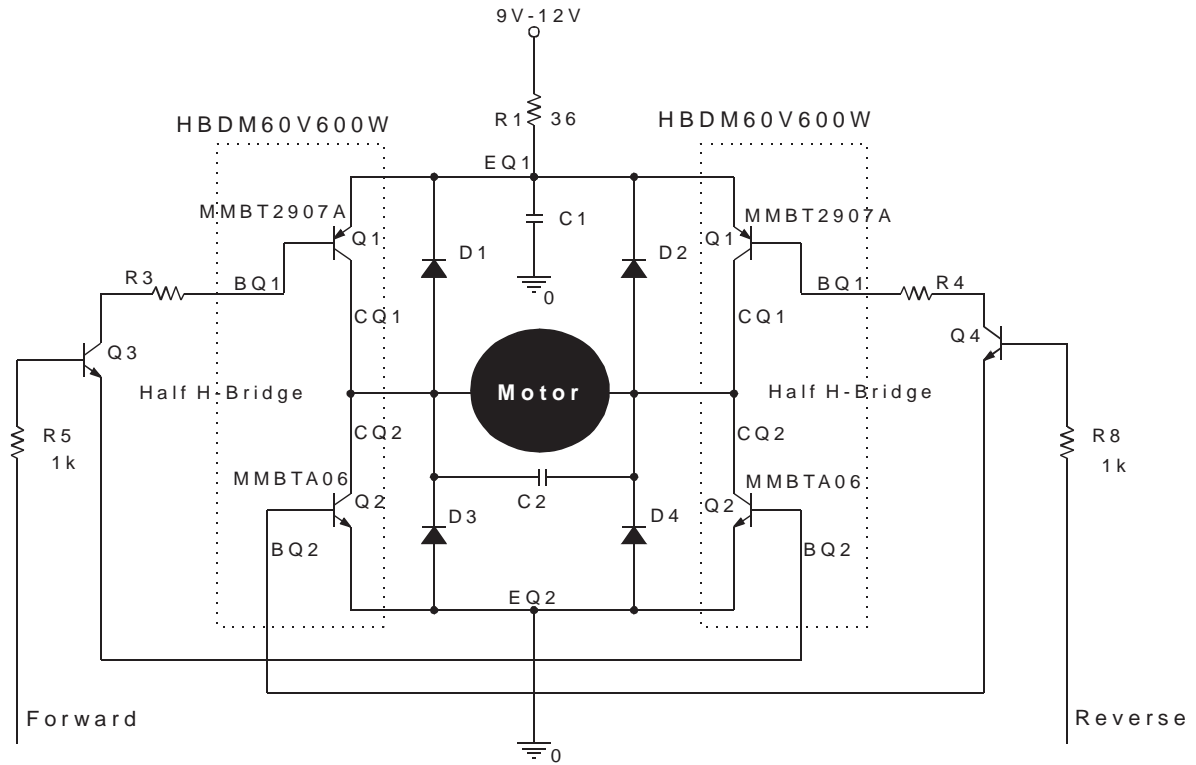


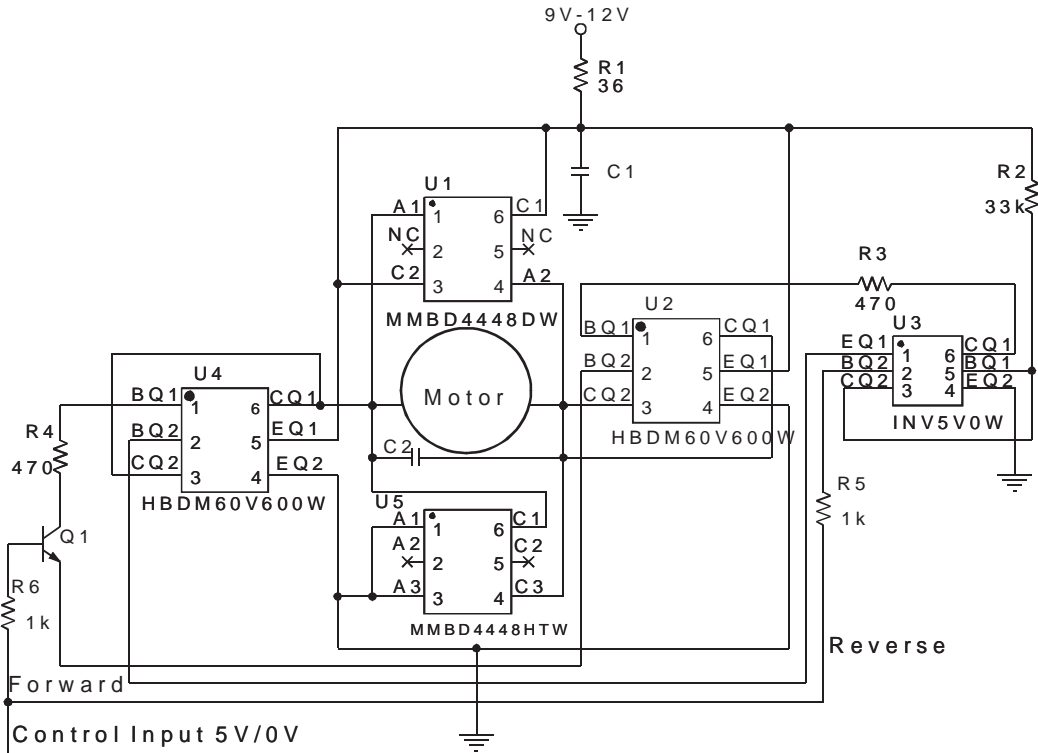
Fig. 13 Typical Gain Bandwidth Product vs. Collector Current

**Current Schematic along with Application Example:**



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

**Application Example Schematic: (with Package Pinouts)**

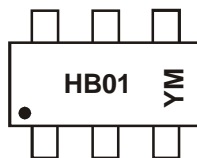


**Ordering Information** (Note 5)

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>.

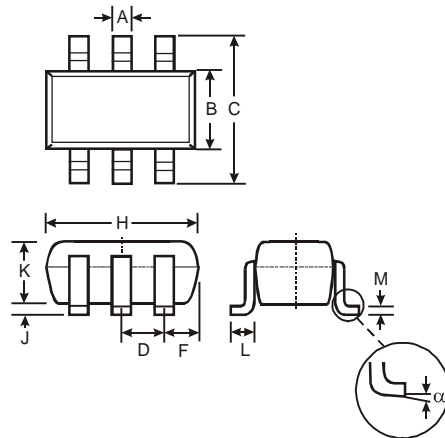
**Marking Information**



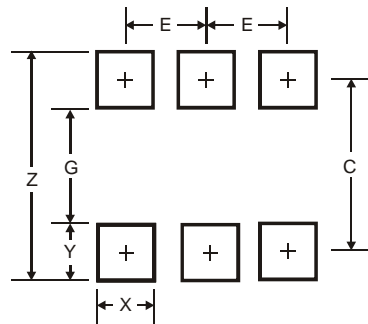
HB01 = Product Type Marking Code  
 YM = Date Code Marking  
 Y = Year (ex: T = 2006)  
 M = Month (ex: 9 = September)

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

**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
$\alpha$	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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