

Complementary Silicon High-Power Transistors

... for general-purpose power amplifier and switching applications.

- 25 A Collector Current
- Low Leakage Current — $I_{CEO} = 1.0 \text{ mA}$ @ 30 and 60 V
- Excellent DC Gain — $h_{FE} = 40 \text{ Typ}$ @ 15 A
- High Current Gain Bandwidth Product — $|h_{fe}| = 3.0 \text{ min}$ @ $I_C = 1.0 \text{ A}$, $f = 1.0 \text{ MHz}$

MAXIMUM RATINGS

Rating	Symbol	TIP35A TIP36A	TIP35B TIP36B	TIP35C TIP36C	Unit
Collector-Emitter Voltage	V_{CEO}	60 V	80 V	100 V	Vdc
Collector-Base Voltage	V_{CB}	60 V	80 V	100 V	Vdc
Emitter-Base Voltage	V_{EB}	5.0			Vdc
Collector Current — Continuous Peak (1)	I_C	25 40			Adc
Base Current — Continuous	I_B	5.0			Adc
Total Power Dissipation @ $T_C = 25^\circ\text{C}$ Derate above 25°C	P_D	125 1.0			Watts W/ $^\circ\text{C}$
Operating and Storage Junction Temperature Range	T_J, T_{stg}	-65 to +150			$^\circ\text{C}$
Unclamped Inductive Load	E_{SB}	90			mJ

THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.0	$^\circ\text{C/W}$
Junction-To-Free-Air Thermal Resistance	$R_{\theta JA}$	35.7	$^\circ\text{C/W}$

(1) Pulse Test: Pulse Width = 10 ms, Duty Cycle $\leq 10\%$.

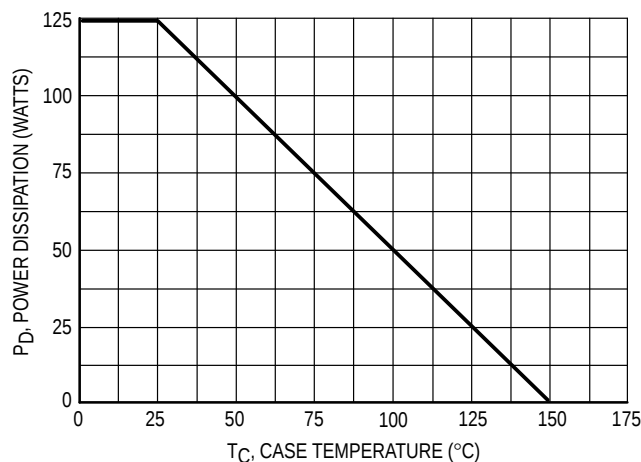


Figure 1. Power Derating

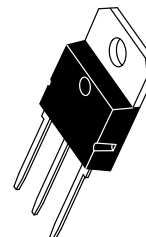
Preferred devices are Motorola recommended choices for future use and best overall value.

REV 1

NPN
TIP35A
TIP35B*
TIP35C*
PNP
TIP36A
TIP36B*
TIP36C*

*Motorola Preferred Device

**25 AMPERE
COMPLEMENTARY
SILICON
POWER TRANSISTORS
60-100 VOLTS
125 WATTS**



**CASE 340D-02
TO-218AC**



MOTOROLA

TIP35A TIP35B TIP35C TIP36A TIP36B TIP36C

ELECTRICAL CHARACTERISTICS ($T_C = 25^\circ\text{C}$ unless otherwise noted)

Characteristic	Symbol	Min	Max	Unit
OFF CHARACTERISTICS				
Collector–Emitter Sustaining Voltage (1) ($I_C = 30\text{ mA}$, $I_B = 0$)	$V_{CEO(sus)}$	60 80 100	—	Vdc
Collector–Emitter Cutoff Current ($V_{CE} = 30\text{ V}$, $I_B = 0$) ($V_{CE} = 60\text{ V}$, $I_B = 0$)	I_{CEO}	— —	1.0 1.0	mA
Collector–Emitter Cutoff Current ($V_{CE} = \text{Rated } V_{CEO}$, $V_{EB} = 0$)	I_{CES}	—	0.7	mA
Emitter–Base Cutoff Current ($V_{EB} = 5.0\text{ V}$, $I_C = 0$)	I_{EBO}	—	1.0	mA

ON CHARACTERISTICS (1)

DC Current Gain ($I_C = 1.5\text{ A}$, $V_{CE} = 4.0\text{ V}$) ($I_C = 15\text{ A}$, $V_{CE} = 4.0\text{ V}$)	h_{FE}	25 15	— 75	—
Collector–Emitter Saturation Voltage ($I_C = 15\text{ A}$, $I_B = 1.5\text{ A}$) ($I_C = 25\text{ A}$, $I_B = 5.0\text{ A}$)	$V_{CE(sat)}$	— —	1.8 4.0	Vdc
Base–Emitter On Voltage ($I_C = 15\text{ A}$, $V_{CE} = 4.0\text{ V}$) ($I_C = 25\text{ A}$, $V_{CE} = 4.0\text{ V}$)	$V_{BE(on)}$	— —	2.0 4.0	Vdc

DYNAMIC CHARACTERISTICS

Small–Signal Current Gain ($I_C = 1.0\text{ A}$, $V_{CE} = 10\text{ V}$, $f = 1.0\text{ kHz}$)	h_{fe}	25	—	—
Current–Gain — Bandwidth Product ($I_C = 1.0\text{ A}$, $V_{CE} = 10\text{ V}$, $f = 1.0\text{ MHz}$)	f_T	3.0	—	MHz

(1) Pulse Test: Pulse Width = 300 μs , Duty Cycle $\leq 2.0\%$.

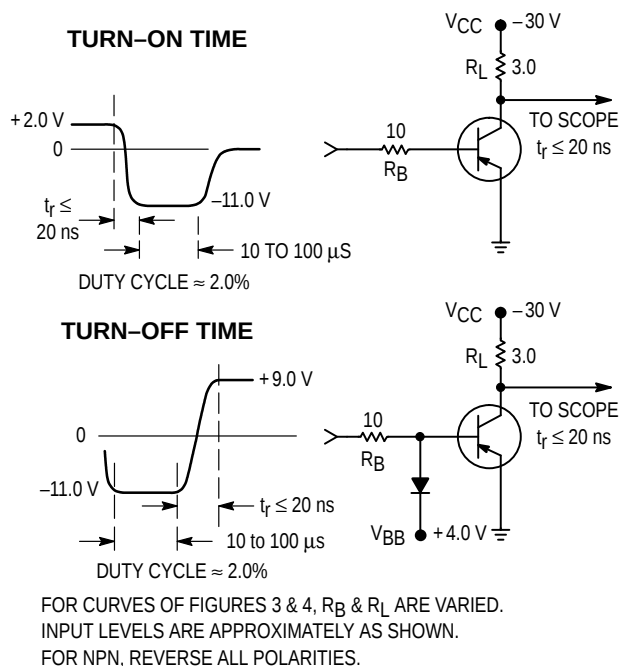


Figure 2. Switching Time Equivalent Test Circuits

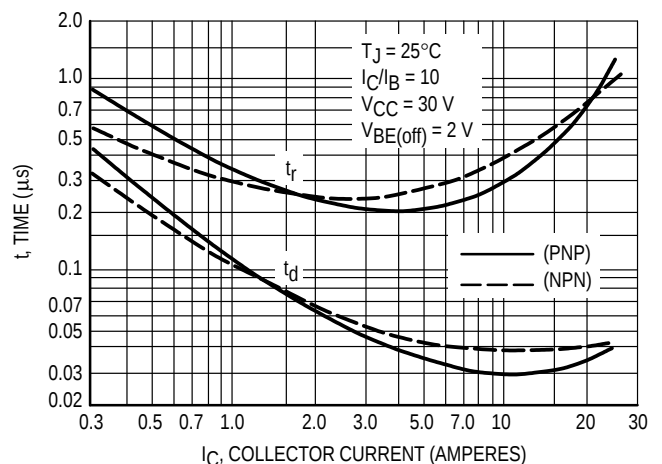


Figure 3. Turn–On Time

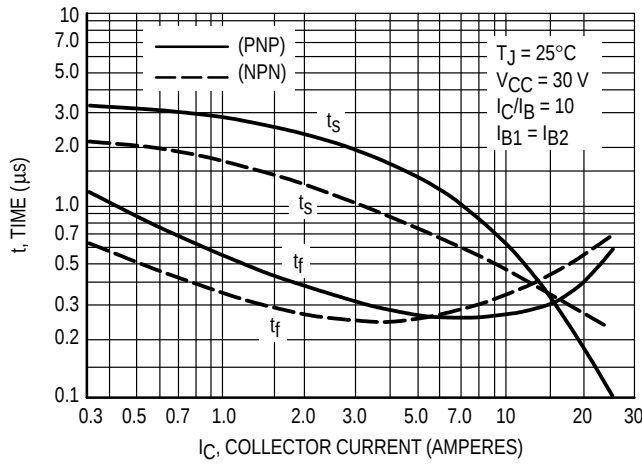


Figure 4. Turn-Off Time

FORWARD BIAS

There are two limitations on the power handling ability of a transistor: average junction temperature and second breakdown. Safe operating area curves indicate $I_C - V_{CE}$ limits of the transistor that must be observed for reliable operation; i.e., the transistor must not be subjected to greater dissipation than the curves indicate.

The data of Figure 6 is based on $T_C = 25^\circ C$; $T_{J(pk)}$ is variable depending on power level. Second breakdown pulse limits are valid for duty cycles to 10% but must be derated when $T_C \geq 25^\circ C$. Second breakdown limitations do not derate the same as thermal limitations.

REVERSE BIAS

For inductive loads, high voltage and high current must be sustained simultaneously during turn-off, in most cases, with the base to emitter junction reverse biased. Under these conditions the collector voltage must be held to a safe level at or below a specific value of collector current. This can be accomplished by several means such as active clamping, RC snubbing, load line shaping, etc. The safe level for these devices is specified as Reverse Bias Safe Operating Area and represents the voltage-current conditions during reverse biased turn-off. This rating is verified under clamped conditions so that the device is never subjected to an avalanche mode. Figure 7 gives RBSOA characteristics.

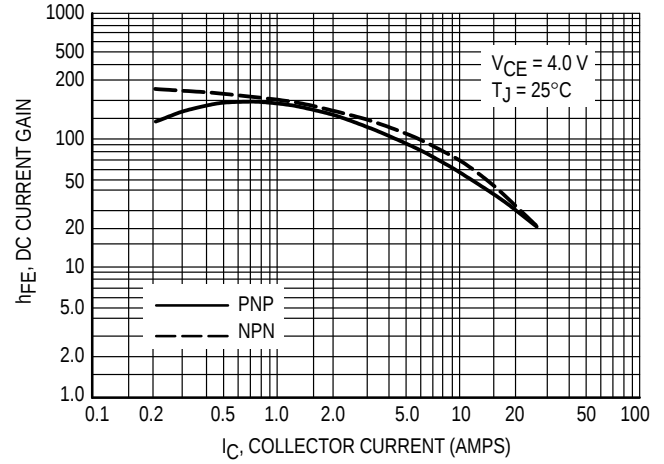


Figure 5. DC Current Gain

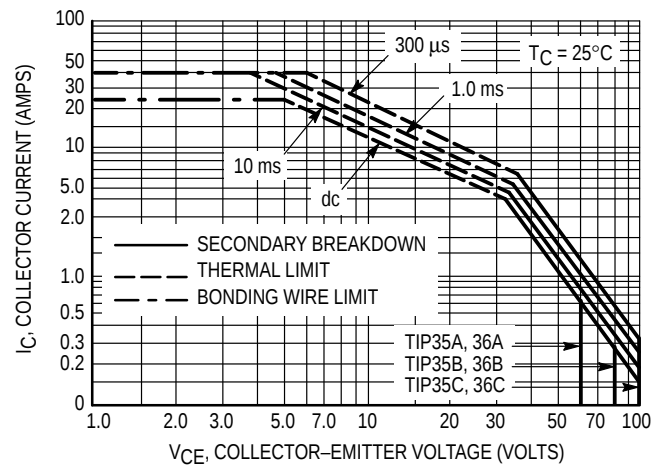


Figure 6. Maximum Rated Forward Bias Safe Operating Area

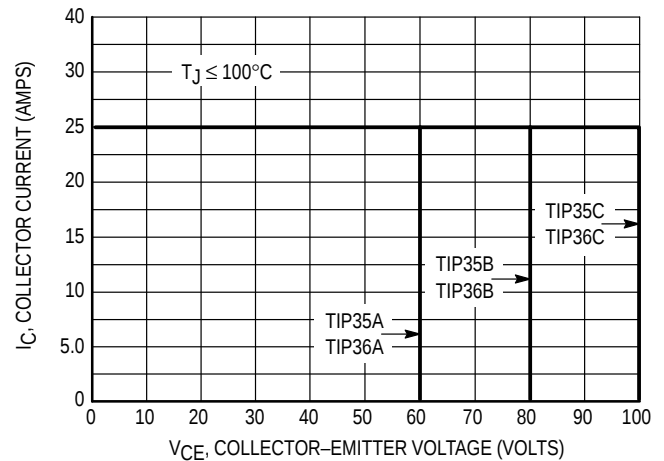
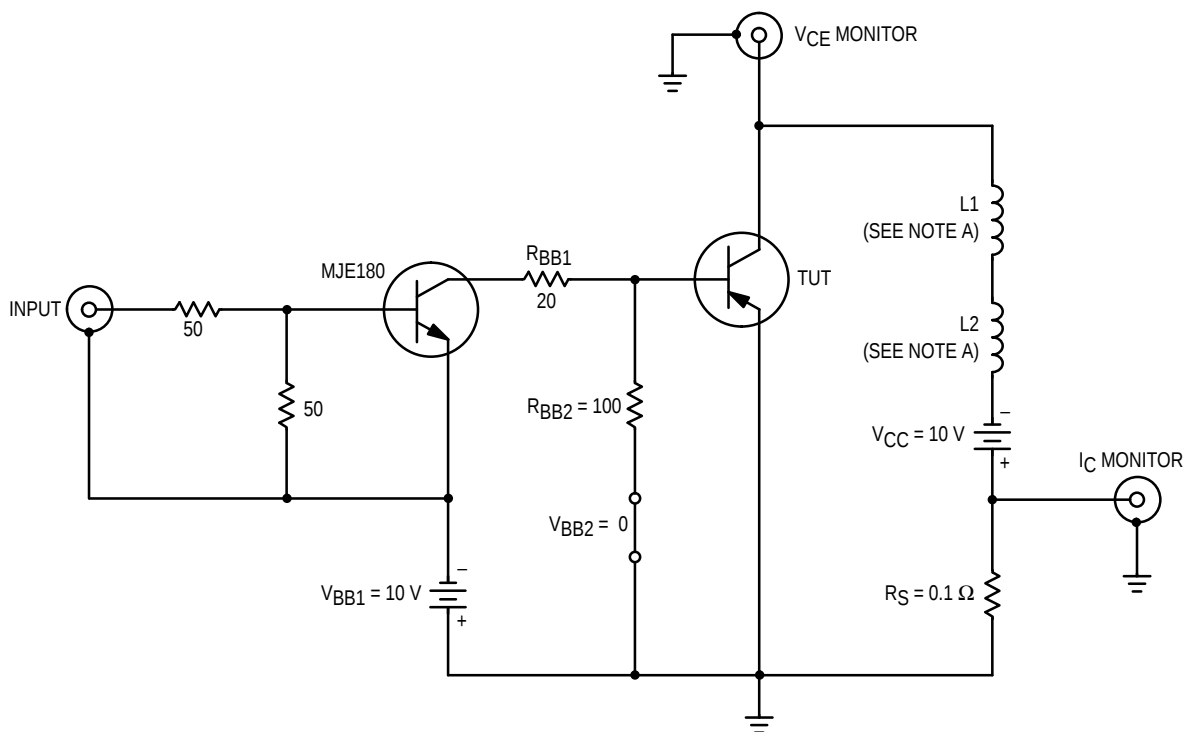
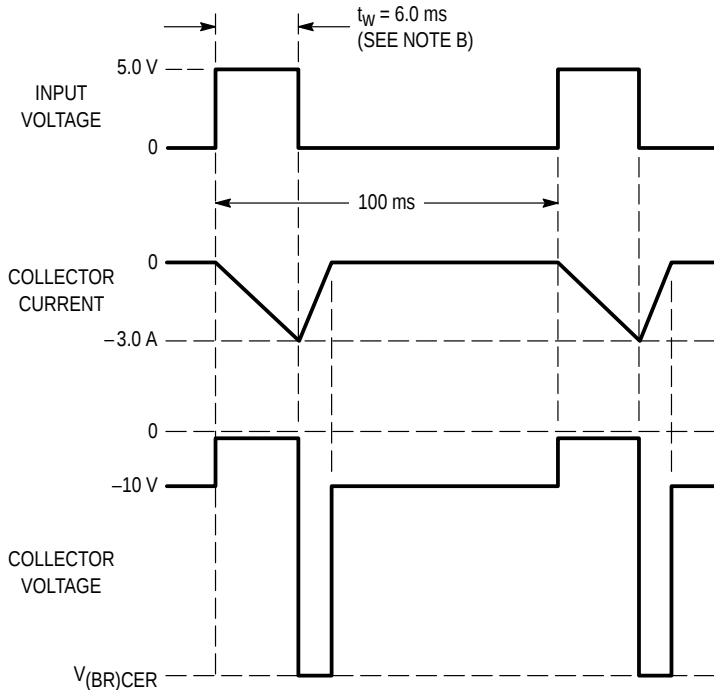


Figure 7. Maximum Rated Forward Bias Safe Operating Area

TEST CIRCUIT



VOLTAGE AND CURRENT WAVEFORMS

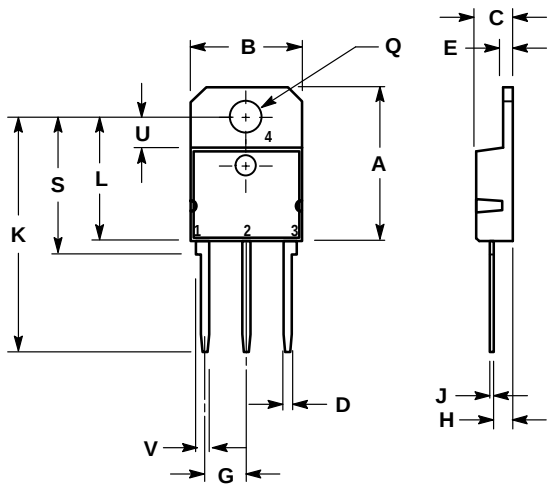


NOTES:

- A. L1 and L2 are 10 mH, 0.11 Ω , Chicago Standard Transformer Corporation C-2688, or equivalent.
- B. Input pulse width is increased until $I_{CM} = -3.0$ A.
- C. For NPN, reverse all polarities.

Figure 8. Inductive Load Switching

TIP35A TIP35B TIP35C TIP36A TIP36B TIP36C
PACKAGE DIMENSIONS



- NOTES:
 1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. CONTROLLING DIMENSION: MILLIMETER.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	—	20.35	—	0.801
B	14.70	15.20	0.579	0.598
C	4.70	4.90	0.185	0.193
D	1.10	1.30	0.043	0.051
E	1.17	1.37	0.046	0.054
G	5.40	5.55	0.213	0.219
H	2.00	3.00	0.079	0.118
J	0.50	0.78	0.020	0.031
K	31.00 REF		1.220 REF	
L	—	16.20	—	0.638
Q	4.00	4.10	0.158	0.161
S	17.80	18.20	0.701	0.717
U	4.00 REF		0.157 REF	
V	1.75 REF		0.069	

- STYLE 1:
 PIN 1. BASE
 2. COLLECTOR
 3. EMITTER
 4. COLLECTOR

**CASE 340D-02
 ISSUE B**

Motorola reserves the right to make changes without further notice to any products herein. Motorola makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does Motorola assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation consequential or incidental damages. "Typical" parameters which may be provided in Motorola data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. Motorola does not convey any license under its patent rights nor the rights of others. Motorola products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the Motorola product could create a situation where personal injury or death may occur. Should Buyer purchase or use Motorola products for any such unintended or unauthorized application, Buyer shall indemnify and hold Motorola and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that Motorola was negligent regarding the design or manufacture of the part. Motorola and  are registered trademarks of Motorola, Inc. Motorola, Inc. is an Equal Opportunity/Affirmative Action Employer.

How to reach us:

USA/EUROPE/Locations Not Listed: Motorola Literature Distribution;
P.O. Box 20912; Phoenix, Arizona 85036. 1-800-441-2447 or 602-303-5454

MFAX: RMFAX0@email.sps.mot.com – TOUCHTONE 602-244-6609
INTERNET: <http://Design-NET.com>

JAPAN: Nippon Motorola Ltd.; Tatsumi-SPD-JLDC, 6F Seibu-Butsuryu-Center,
3-14-2 Tatsumi Koto-Ku, Tokyo 135, Japan. 03-81-3521-8315

ASIA/PACIFIC: Motorola Semiconductors H.K. Ltd.; 8B Tai Ping Industrial Park,
51 Ting Kok Road, Tai Po, N.T., Hong Kong. 852-26629298

**MOTOROLA****TIP35/D**