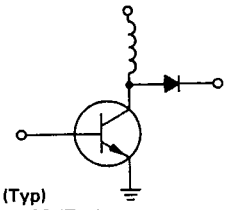
MOTOROLA
**SEMICONDUCTOR**
TECHNICAL DATA

# BUS47
# BUS47A

## SWITCHMODE II▲ SERIES
## NPN SILICON POWER TRANSISTORS

The BUS 47 and BUS 47A transistors are designed for high-voltage, high-speed, power switching in inductive circuits where fall time is critical. They are particularly suited for line-operated switch-mode applications such as:

- Switching Regulators
- Inverters
- Solenoid and Relay Drivers
- Motor Controls
- Deflection Circuits



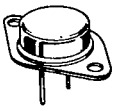
Fast Turn-Off Times
60 ns Inductive Fall Time—25°C (Typ)
120 ns Inductive Crossover Time—25°C (Typ)

Operating Temperature Range −65 to +200°C
100°C Performance Specified for:
Reverse-Biased SOA with Inductive Loads
Switching Times with Inductive Loads
Saturation Voltages
Leakage Currents (125°C)

**9 AMPERES**
**NPN SILICON**
**POWER TRANSISTORS**
**400 AND 450 VOLTS (BVCEO)**
**150 WATTS**
**850 – 1000 V (BVCES)**

**Designer's Data for "Worst Case" Conditions**

The Designers▲ Data Sheet permits the design of most circuits entirely from the information presented. Limit data – representing device characteristics boundaries – are given to facilitate "worst case" design.



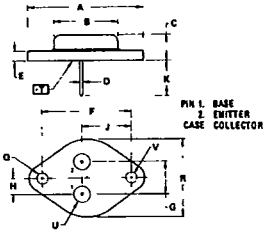
### MAXIMUM RATINGS

| Rating | Symbol | BUS 47 | BUS 47A | Unit |
|---|---|---|---|---|
| Collector-Emitter Voltage | $V_{CEO(sus)}$ | 450 | 450 | Vdc |
| Collector-Emitter Voltage | $V_{CEV}$ | 850 | 1000 | Vdc |
| Emitter Base Voltage | $V_{EB}$ | 7 | | Vdc |
| Collector Current – Continuous<br>– Peak (1)<br>– Overload | $I_C$<br>$I_{CM}$<br>$I_{OI}$ | 9<br>18<br>36 | | Adc |
| Base Current – Continuous<br>– Peak (1) | $I_B$<br>$I_{BM}$ | 5<br>10 | | Adc |
| Total Power Dissipation – $T_C$ = 25°C<br>– $T_C$ = 100°C<br>Derate above 25°C | $P_D$ | 150<br>85.5<br>0.86 | | Watts<br><br>W/°C |
| Operating and Storage Junction Temperature Range | $T_J$, $T_{stg}$ | −65 to +200 | | °C |

### THERMAL CHARACTERISTICS

| Characteristic | Symbol | Max | Unit |
|---|---|---|---|
| Thermal Resistance, Junction to Case | $R_{\theta JC}$ | 1.17 | °C/W |
| Maximum Lead Temperature for Soldering Purposes: 1/8" from Case for 5 Seconds | $T_L$ | 275 | °C |

(1) Pulse Test: Pulse Width = 5 ms, Duty Cycle ≤ 10%.




NOTES
1. DIMENSIONS Q AND V ARE DATUMS
2. T IS SEATING PLANE AND DATUM
3. POSITIONAL TOLERANCE FOR MOUNTING HOLE Q
⌀ 0.13 (0.005) M T V M
FOR LEADS
⌀ 0.13 (0.005) M T V M Q M
4. DIMENSIONS AND TOLERANCES PER ANSI Y14.5, 1973.

| DIM | MILLIMETERS MIN | MILLIMETERS MAX | INCHES MIN | INCHES MAX |
|---|---|---|---|---|
| A | – | 39.37 | – | 1.550 |
| B | – | 21.08 | – | 0.830 |
| C | 8.35 | 7.87 | 0.250 | 0.300 |
| D | 0.97 | 1.09 | 0.038 | 0.043 |
| E | 1.45 | 1.78 | 0.055 | 0.070 |
| F | 30.15 BSC | | 1.187 BSC | |
| G | 10.92 BSC | | 0.430 BSC | |
| H | 5.46 BSC | | 0.215 BSC | |
| J | 16.89 BSC | | 0.665 BSC | |
| K | 11.18 | 12.19 | 0.440 | 0.480 |
| Q | 3.81 | 4.19 | 0.150 | 0.165 |
| R | – | 26.67 | – | 1.050 |
| U | 4.83 | 5.33 | 0.190 | 0.210 |
| V | 3.81 | 4.19 | 0.150 | 0.165 |

CASE 1-05 TO-3 TYPE

3

**BUS47, BUS47A**

T-33-13

**ELECTRICAL CHARACTERISTICS** ($T_C$ = 25°C unless otherwise noted)

| Characteristic | | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| **OFF CHARACTERISTICS (1)** | | | | | | |
| Collector-Emitter Sustaining Voltage (Table 1) ($I_C$ = 200 mA, $I_B$ = 0) L = 25 mH | BUS47<br>BUS47A | $V_{CEO(sus)}$ | 400<br>450 | – | – | Vdc |
| Collector Cutoff Current ($V_{CEV}$ = Rated Value, $V_{BE(off)}$ = 1.5 Vdc)<br>($V_{CEV}$ = Rated Value, $V_{BE(off)}$ = 1.5 Vdc, $T_C$ = 125°C) | | $I_{CEV}$ | –<br>– | –<br>– | 0.15<br>1.5 | mAdc |
| Collector Cutoff Current ($V_{CE}$ = Rated $V_{CEV}$, $R_{BE}$ = 10 Ω) | $T_C$ = 25°C<br>$T_C$ = 125°C | $I_{CER}$ | – | – | 0.4<br>3.0 | mAdc |
| Emitter Cutoff Current ($V_{EB}$ = 5 Vdc, $I_C$ = 0) | | $I_{EBO}$ | – | – | 0.1 | mAdc |
| Emitter-base breakdown Voltage ($I_E$ = 50 mA - $I_C$ = 0) | | $B_{VEBO}$ | 7.0 | – | – | Vdc |
| **SECOND BREAKDOWN** | | | | | | |
| Second Breakdown Collector Current with Base Forward Biased | | $I_{S/b}$ | See Figure 12 | | | |
| Clamped Inductive SOA with Base Reverse Biased | | RBSOA | See Figure 13 | | | |
| **ON CHARACTERISTICS (1)** | | | | | | |
| DC Current Gain ($I_C$ = 6 Adc, $V_{CE}$ = 5 Vdc)<br>($I_C$ = 5 Adc, $V_{CE}$ = 5 V) | BUS47<br>BUS47A | $h_{FE}$ | 7 | – | – | |
| Collector-Emitter Saturation Voltage ($I_C$ = 6 Adc, $I_B$ = 1.2 Adc)<br>($I_C$ = 9 Adc, $I_B$ = 1.8 Adc)<br>($I_C$ = 6 Adc, $I_B$ = 1.2 Adc, $T_C$ = 100°C)<br>($I_C$ = 5 Adc, $I_B$ = 1 Adc)<br>($I_C$ = 8 Adc, $I_B$ = 1.6 Adc)<br>($I_C$ = 5 Adc, $I_B$ = 1 Adc, $T_C$ = 100°C) | BUS47<br><br><br>BUS47A<br><br> | $V_{CE(sat)}$ | –<br>–<br>–<br>–<br>–<br>– | –<br>–<br>–<br>–<br>–<br>– | 1.5<br>5.0<br>2.5<br>1.5<br>5.0<br>2.5 | Vdc |
| Base-Emitter Saturation Voltage ($I_C$ = 6 Adc, $I_B$ = 1.2 Adc)<br>($I_C$ = 6 Adc, $I_B$ = 1.2 Adc, $T_C$ = 100°C)<br>($I_C$ = 5 Adc, $I_B$ = 1 Adc)<br>($I_C$ = 5 Adc, $I_B$ = 1 Adc, $T_C$ = 100°C) | BUS47<br><br>BUS47A<br> | $V_{BE(sat)}$ | –<br>–<br>–<br>– | –<br>–<br>–<br>– | 1.6<br>1.6<br>1.6<br>1.6 | Vdc |
| **DYNAMIC CHARACTERISTICS** | | | | | | |
| Output Capacitance ($V_{CB}$ = 10 Vdc, $I_E$ = 0, $f_{test}$ = 100 Khz) | | $C_{ob}$ | – | – | 300 | pF |
| **SWITCHING CHARACTERISTICS** | | | | | | |
| **Resistive Load (Table 1)** | | | | | | |
| Delay Time | ($V_{CC}$ = 250 Vdc, $I_C$ = 6 A, $I_{B1}$ = 1.2 A, $t_p$ = 30 μs, Duty Cycle ≤ 2%, $V_{BE(off)}$ = 5 V) | $t_d$ | – | 0.05 | 0.2 | μs |
| Rise Time | | $t_r$ | – | 0.5 | 0.8 | |
| Storage Time | | $t_s$ | – | 1 | 2.0 | |
| Fall Time | | $t_f$ | – | 0.2 | 0.4 | |
| **Inductive Load, Clamped (Table 1)** | | | | | | |
| Storage Time | ($I_{C(pk)}$ = 6 A, $I_{B1}$ = 1.2 A, $V_{BE(off)}$ = 5 V, $V_{CE(cl)}$ = 250 V) BUS47 | ($T_C$ = 25°C) $t_{sv}$ | – | 0.9 | – | μs |
| Fall Time | | $t_{fi}$ | – | 0.06 | – | |
| Storage Time | | ($T_C$ = 100°C) $t_{sv}$ | – | 1.0 | 2.5 | |
| Crossover Time | $I_{C(pk)}$ = 5 A BUS47A | $t_c$ | – | 0.2 | 0.5 | |
| Fall Time | $I_{B1}$ = 1 A | $t_{fi}$ | – | 0.1 | 0.3 | |

(1) Pulse Test: PW = 300 μs, Duty Cycle ≤ 2%.