



## BUF420AW

### HIGH VOLTAGE FAST-SWITCHING NPN POWER TRANSISTOR

- STMicroelectronics PREFERRED SALESTYPE
- HIGH VOLTAGE CAPABILITY
- VERY HIGH SWITCHING SPEED
- MINIMUM LOT-TO-LOT SPREAD FOR RELIABLE OPERATION
- LOW BASE-DRIVE REQUIREMENTS

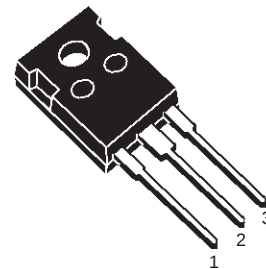
#### APPLICATIONS:

- SWITCH MODE POWER SUPPLIES
- MOTOR CONTROL

#### DESCRIPTION

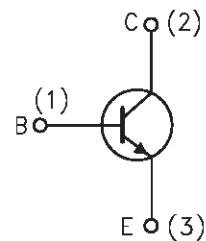
The BUF420AW is manufactured using High Voltage Multi Epitaxial Planar technology for high switching speeds and high voltage capacity. It uses a Cellular Emitter structure with planar edge termination to enhance switching speeds while maintaining a wide RBSOA.

The BUF series is designed for use in high-frequency power supplies and motor control applications.



TO-247

#### INTERNAL SCHEMATIC DIAGRAM



#### ABSOLUTE MAXIMUM RATINGS

| Symbol    | Parameter                                      | Value      | Unit       |
|-----------|------------------------------------------------|------------|------------|
| $V_{CEV}$ | Collector-Emitter Voltage ( $V_{BE} = -1.5V$ ) | 1000       | V          |
| $V_{CEO}$ | Collector-Emitter Voltage ( $I_B = 0$ )        | 450        | V          |
| $V_{EBO}$ | Emitter-Base Voltage ( $I_C = 0$ )             | 7          | V          |
| $I_C$     | Collector Current                              | 30         | A          |
| $I_{CM}$  | Collector Peak Current ( $t_p < 5$ ms)         | 60         | A          |
| $I_B$     | Base Current                                   | 6          | A          |
| $I_{BM}$  | Base Peak Current ( $t_p < 5$ ms)              | 9          | A          |
| $P_{tot}$ | Total Dissipation at $T_c = 25^\circ C$        | 200        | W          |
| $T_{stg}$ | Storage Temperature                            | -65 to 150 | $^\circ C$ |
| $T_j$     | Max. Operating Junction Temperature            | 150        | $^\circ C$ |

**THERMAL DATA**

|                       |                                  |     |      |      |
|-----------------------|----------------------------------|-----|------|------|
| R <sub>thj-case</sub> | Thermal Resistance Junction-Case | Max | 0.63 | °C/W |
|-----------------------|----------------------------------|-----|------|------|

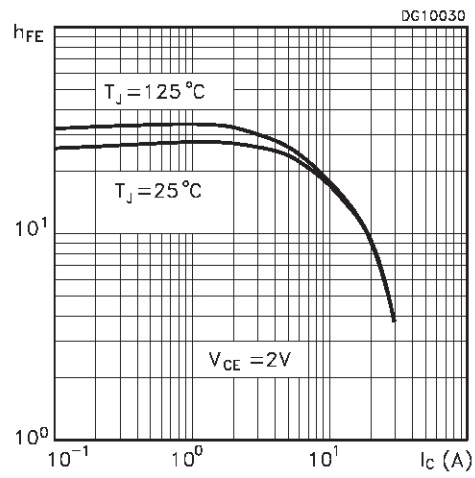
**ELECTRICAL CHARACTERISTICS** (T<sub>case</sub> = 25 °C unless otherwise specified)

| Symbol                                             | Parameter                                                      | Test Conditions                                                                                                                                                                                                                    | Min.      | Typ.                | Max.             | Unit                 |
|----------------------------------------------------|----------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|---------------------|------------------|----------------------|
| I <sub>CER</sub>                                   | Collector Cut-off Current (R <sub>BE</sub> = 5 Ω)              | V <sub>CE</sub> = 1000 V<br>V <sub>CE</sub> = 1000 V T <sub>C</sub> = 100 °C                                                                                                                                                       |           |                     | 0.2<br>1         | mA<br>mA             |
| I <sub>CEV</sub>                                   | Collector Cut-off Current (V <sub>BE</sub> = -1.5V)            | V <sub>CE</sub> = 1000 V<br>V <sub>CE</sub> = 1000 V T <sub>C</sub> = 100 °C                                                                                                                                                       |           |                     | 0.2<br>1         | mA<br>mA             |
| I <sub>EBO</sub>                                   | Emitter Cut-off Current (I <sub>C</sub> = 0)                   | V <sub>EB</sub> = 5 V                                                                                                                                                                                                              |           |                     | 1                | mA                   |
| V <sub>CEO(sus)*</sub>                             | Collector-Emitter Sustaining Voltage (I <sub>B</sub> = 0)      | I <sub>C</sub> = 200 mA L = 25 mH                                                                                                                                                                                                  | 450       |                     |                  | V                    |
| V <sub>EBO</sub>                                   | Emitter Base Voltage (I <sub>C</sub> = 0)                      | I <sub>E</sub> = 50 mA                                                                                                                                                                                                             | 7         |                     |                  | V                    |
| V <sub>CE(sat)*</sub>                              | Collector-Emitter Saturation Voltage                           | I <sub>C</sub> = 10 A I <sub>B</sub> = 1 A<br>I <sub>C</sub> = 10 A I <sub>B</sub> = 1 A T <sub>C</sub> = 100°C<br>I <sub>C</sub> = 20 A I <sub>B</sub> = 4 A<br>I <sub>C</sub> = 20 A I <sub>B</sub> = 4 A T <sub>C</sub> = 100°C |           | 0.8<br>0.5          | 2.8<br>2         | V<br>V<br>V<br>V     |
| V <sub>BE(sat)*</sub>                              | Base-Emitter Saturation Voltage                                | I <sub>C</sub> = 10 A I <sub>B</sub> = 1 A<br>I <sub>C</sub> = 10 A I <sub>B</sub> = 1 A T <sub>C</sub> = 100°C<br>I <sub>C</sub> = 20 A I <sub>B</sub> = 4 A<br>I <sub>C</sub> = 20 A I <sub>B</sub> = 4 A T <sub>C</sub> = 100°C |           | 0.9<br>1.1          | 1.5<br>1.5       | V<br>V<br>V<br>V     |
| di <sub>C</sub> /dt                                | Rate of rise on-state Collector Current                        | V <sub>CC</sub> = 300 V R <sub>C</sub> = 0 t <sub>p</sub> = 3 μs<br>I <sub>B1</sub> = 1.5 A T <sub>C</sub> = 25°C<br>I <sub>B1</sub> = 1.5 A T <sub>C</sub> = 100°C<br>I <sub>B1</sub> = 6 A T <sub>C</sub> = 100°C                | 70<br>150 | 100                 |                  | A/μs<br>A/μs<br>A/μs |
| V <sub>CE(3μs)</sub>                               | Collector-Emitter Dynamic Voltage                              | V <sub>CC</sub> = 300 V R <sub>C</sub> = 60 Ω<br>I <sub>B1</sub> = 1.5 A T <sub>C</sub> = 25°C<br>I <sub>B1</sub> = 1.5 A T <sub>C</sub> = 100°C                                                                                   |           | 2.1                 | 8                | V<br>V               |
| V <sub>CE(5μs)</sub>                               | Collector-Emitter Dynamic Voltage                              | V <sub>CC</sub> = 300 V R <sub>C</sub> = 60 Ω<br>I <sub>B1</sub> = 1.5 A T <sub>C</sub> = 25°C<br>I <sub>B1</sub> = 1.5 A T <sub>C</sub> = 100°C                                                                                   |           | 1.1                 | 4                | V<br>V               |
| t <sub>s</sub><br>t <sub>f</sub><br>t <sub>c</sub> | INDUCTIVE LOAD<br>Storage Time<br>Fall Time<br>Cross Over Time | I <sub>C</sub> = 10 A V <sub>CC</sub> = 50 V<br>V <sub>BB</sub> = - 5 V R <sub>BB</sub> = 0.6 Ω<br>V <sub>clamp</sub> = 400 V I <sub>B1</sub> = 1 A<br>L = 0.25 mH                                                                 |           | 1<br>0.05<br>0.08   |                  | μs<br>μs<br>μs       |
| t <sub>s</sub><br>t <sub>f</sub><br>t <sub>c</sub> | INDUCTIVE LOAD<br>Storage Time<br>Fall Time<br>Cross Over Time | I <sub>C</sub> = 10 A V <sub>CC</sub> = 50 V<br>V <sub>BB</sub> = - 5 V R <sub>BB</sub> = 0.6 Ω<br>V <sub>clamp</sub> = 400 V I <sub>B1</sub> = 1 A<br>L = 0.25 mH T <sub>C</sub> = 100°C                                          |           |                     | 2<br>0.1<br>0.18 | μs<br>μs<br>μs       |
| V <sub>CEW</sub>                                   | Maximum Collector Emitter Voltage without Snubber              | I <sub>C</sub> = 10 A V <sub>CC</sub> = 50 V<br>V <sub>BB</sub> = - 5 V R <sub>BB</sub> = 0.6 Ω<br>I <sub>B1</sub> = 1 A L = 0.25 mH<br>T <sub>C</sub> = 125°C                                                                     | 500       |                     |                  | V                    |
| t <sub>s</sub><br>t <sub>f</sub><br>t <sub>c</sub> | INDUCTIVE LOAD<br>Storage Time<br>Fall Time<br>Cross Over Time | I <sub>C</sub> = 10 A V <sub>CC</sub> = 50 V<br>V <sub>BB</sub> = 0 R <sub>BB</sub> = 0.15 Ω<br>V <sub>clamp</sub> = 400 V I <sub>B1</sub> = 1 A<br>L = 0.25 mH                                                                    |           | 1.5<br>0.04<br>0.07 |                  | μs<br>μs<br>μs       |

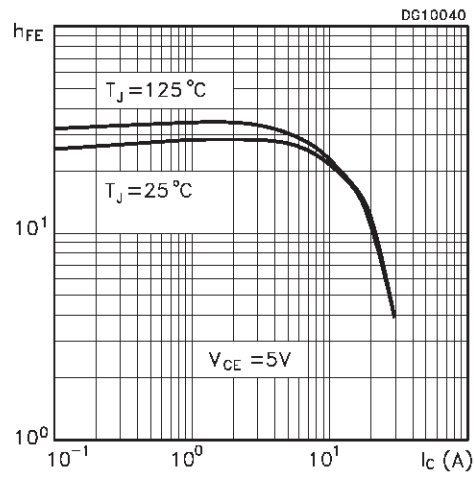
**ELECTRICAL CHARACTERISTICS** (continued)

| Symbol                  | Parameter                                                      | Test Conditions                                                                                                 |                                                                                                               | Min. | Typ.                | Max.               | Unit                                            |
|-------------------------|----------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|------|---------------------|--------------------|-------------------------------------------------|
| $t_s$<br>$t_f$<br>$t_c$ | INDUCTIVE LOAD<br>Storage Time<br>Fall Time<br>Cross Over Time | $I_C = 10\text{ A}$<br>$V_{BB} = 0$<br>$V_{clamp} = 400\text{ V}$<br>$L = 0.25\text{ mH}$                       | $V_{CC} = 50\text{ V}$<br>$R_{BB} = 0.15\text{ }\Omega$<br>$I_{B1} = 1\text{ A}$<br>$T_C = 100^\circ\text{C}$ |      |                     | 3<br>0.15<br>0.25  | $\mu\text{s}$<br>$\mu\text{s}$<br>$\mu\text{s}$ |
| $V_{CEW}$               | Maximum Collector<br>Emitter Voltage<br>without Snubber        | $I_C = 10\text{ A}$<br>$V_{BB} = 0$<br>$I_{B1} = 1\text{ A}$<br>$T_C = 125^\circ\text{C}$                       | $V_{CC} = 50\text{ V}$<br>$R_{BB} = 0.15\text{ }\Omega$<br>$L = 0.25\text{ mH}$                               | 500  |                     |                    | V                                               |
| $t_s$<br>$t_f$<br>$t_c$ | INDUCTIVE LOAD<br>Storage Time<br>Fall Time<br>Cross Over Time | $I_C = 20\text{ A}$<br>$V_{BB} = -5\text{ V}$<br>$V_{clamp} = 400\text{ V}$<br>$L = 0.12\text{ mH}$             | $V_{CC} = 50\text{ V}$<br>$R_{BB} = 0.6\text{ }\Omega$<br>$I_{B1} = 4\text{ A}$                               |      | 2.2<br>0.06<br>0.12 |                    | $\mu\text{s}$<br>$\mu\text{s}$<br>$\mu\text{s}$ |
| $t_s$<br>$t_f$<br>$t_c$ | INDUCTIVE LOAD<br>Storage Time<br>Fall Time<br>Cross Over Time | $I_C = 20\text{ A}$<br>$V_{BB} = -5\text{ V}$<br>$V_{clamp} = 400\text{ V}$<br>$L = 0.12\text{ mH}$             | $V_{CC} = 50\text{ V}$<br>$R_{BB} = 0.6\text{ }\Omega$<br>$I_{B1} = 4\text{ A}$<br>$T_C = 125^\circ\text{C}$  |      |                     | 3.5<br>0.12<br>0.3 | $\mu\text{s}$<br>$\mu\text{s}$<br>$\mu\text{s}$ |
| $V_{CEW}$               | Maximum Collector<br>Emitter Voltage<br>without Snubber        | $I_{C\text{Woff}} = 30\text{ A}$<br>$V_{BB} = -5\text{ V}$<br>$L = 0.12\text{ mH}$<br>$T_C = 125^\circ\text{C}$ | $V_{CC} = 50\text{ V}$<br>$R_{BB} = 0.6\text{ }\Omega$<br>$I_{B1} = 6\text{ A}$                               | 400  |                     |                    | V                                               |

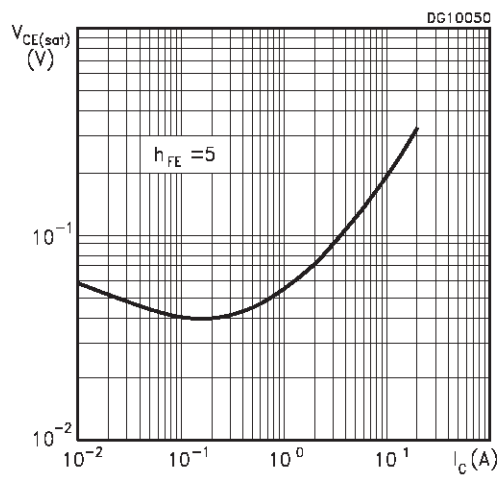
DC Current Gain



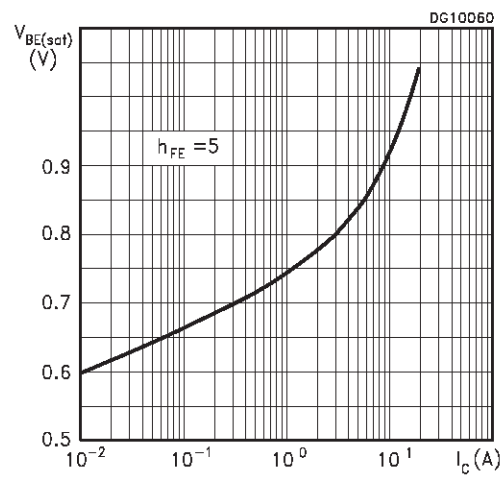
DC Current Gain



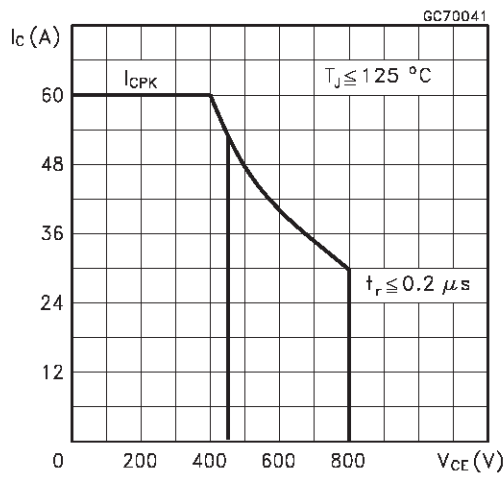
Collector Emitter Saturation Voltage



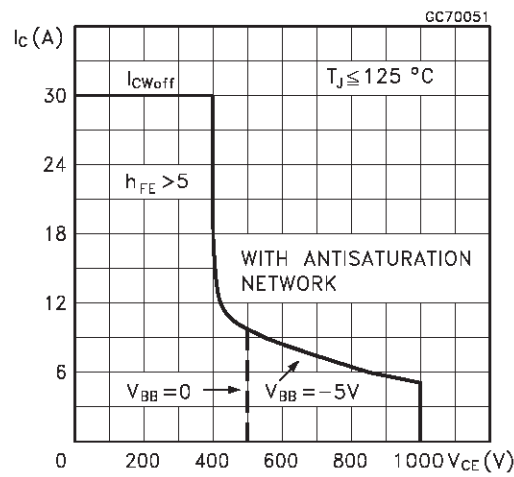
Base Emitter Saturation Voltage



Forward Biased Safe Operating Area



Reverse Biased Safe Operating Area



Storage Time Versus Pulse Time.

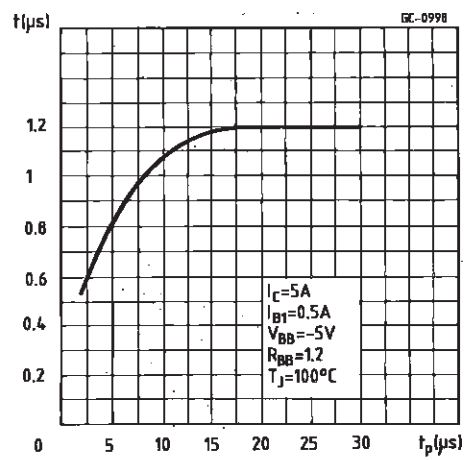
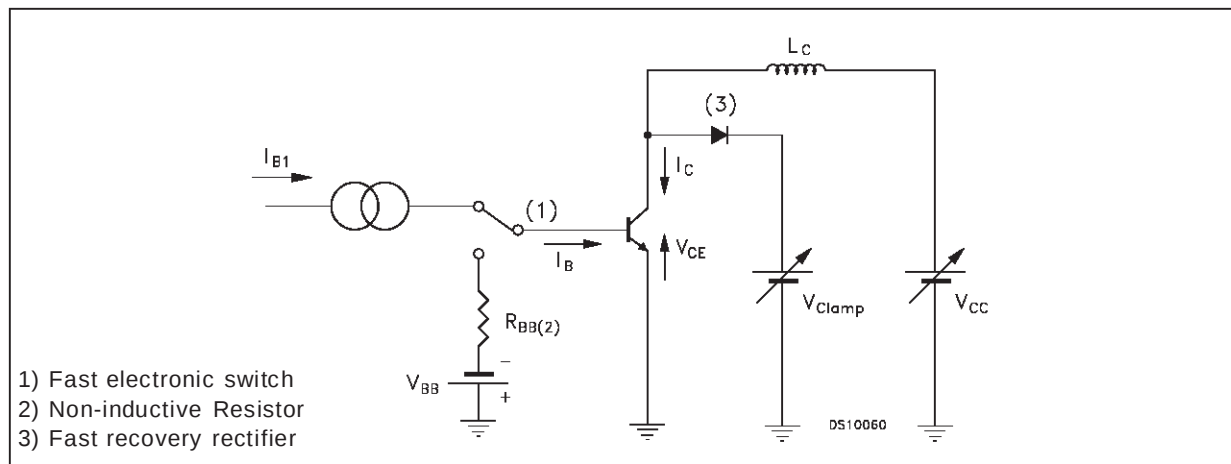
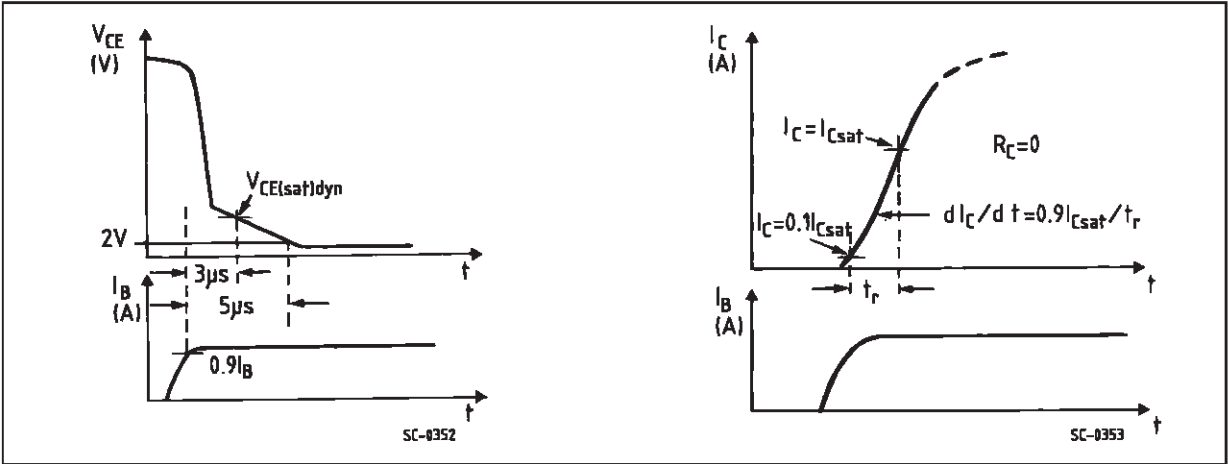


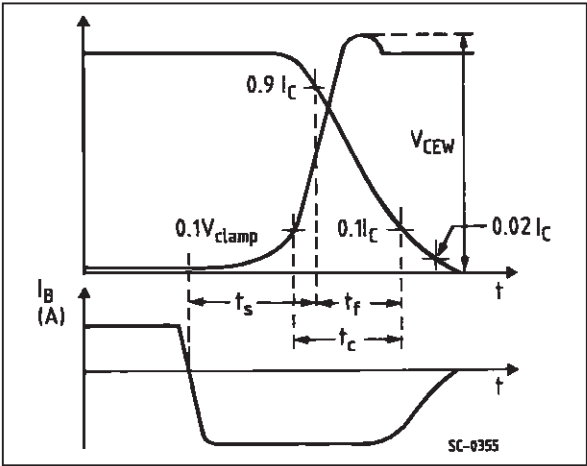
Figure 1: Inductive Load Switching Test Circuit.



Turn-on Switching Test Waveforms.

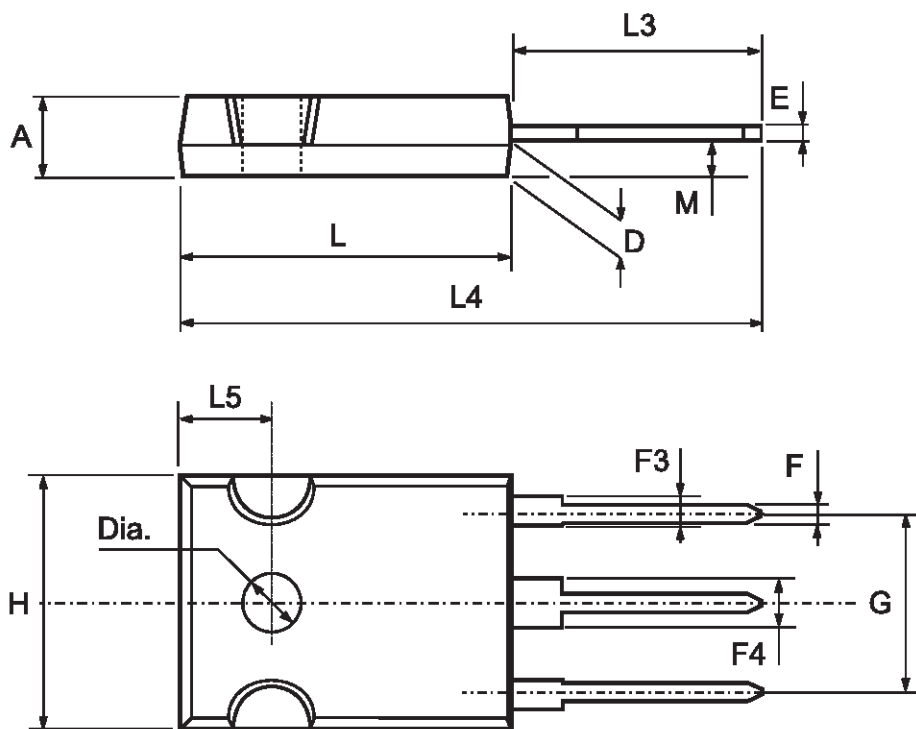


Turn-off Switching Test Waveforms (inductive load).



TO-247 MECHANICAL DATA

| DIM. | mm   |      |      | inch  |       |       |
|------|------|------|------|-------|-------|-------|
|      | MIN. | TYP. | MAX. | MIN.  | TYP.  | MAX.  |
| A    | 4.7  |      | 5.3  | 0.185 |       | 0.209 |
| D    | 2.2  |      | 2.6  | 0.087 |       | 0.102 |
| E    | 0.4  |      | 0.8  | 0.016 |       | 0.031 |
| F    | 1    |      | 1.4  | 0.039 |       | 0.055 |
| F3   | 2    |      | 2.4  | 0.079 |       | 0.094 |
| F4   | 3    |      | 3.4  | 0.118 |       | 0.134 |
| G    |      | 10.9 |      |       | 0.429 |       |
| H    | 15.3 |      | 15.9 | 0.602 |       | 0.626 |
| L    | 19.7 |      | 20.3 | 0.776 |       | 0.779 |
| L3   | 14.2 |      | 14.8 | 0.559 |       | 0.582 |
| L4   |      | 34.6 |      |       | 1.362 |       |
| L5   |      | 5.5  |      |       | 0.217 |       |
| M    | 2    |      | 3    | 0.079 |       | 0.118 |



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