

## N-Channel Enhancement Mode Power MOSFET

# MTBA5N10FP

|                                                                  |                     |
|------------------------------------------------------------------|---------------------|
| <b>BV<sub>DSS</sub></b>                                          | <b>100V</b>         |
| <b>I<sub>D</sub></b>                                             | <b>10A</b>          |
| <b>R<sub>DS(ON)</sub>@V<sub>GS</sub>=10V, I<sub>D</sub>=10A</b>  | <b>151 mΩ (typ)</b> |
| <b>R<sub>DS(ON)</sub>@V<sub>GS</sub>=4.5V, I<sub>D</sub>=10A</b> | <b>165 mΩ (typ)</b> |

## Description

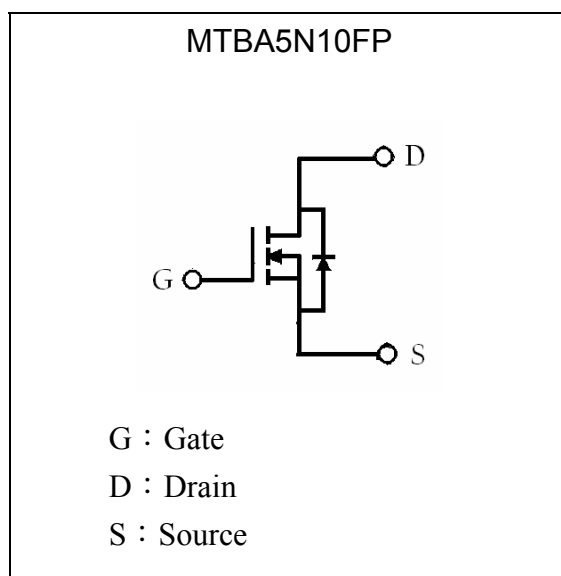
The MTBA5N10FP is a N-channel enhancement-mode MOSFET, providing the designer with the best combination of fast switching, ruggedized device design, low on-resistance and cost effectiveness.

The TO-220FP package is universally preferred for all commercial-industrial applications

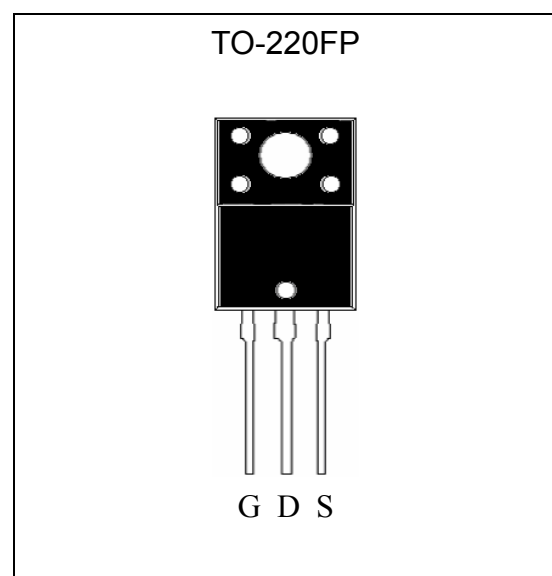
## Features

- Low On Resistance
- Simple Drive Requirement
- Low Gate Charge
- Fast Switching Characteristic
- Insulating package, front/back side insulating voltage=2500V(AC)
- RoHS compliant package

## Symbol



## Outline



**Absolute Maximum Ratings** ( $T_C=25^{\circ}\text{C}$ )

| Parameter                                                                                      |                                | Symbol                            | Limits   | Unit |
|------------------------------------------------------------------------------------------------|--------------------------------|-----------------------------------|----------|------|
| Drain-Source Voltage (Note 1)                                                                  |                                | V <sub>DS</sub>                   | 100      | V    |
| Gate-Source Voltage                                                                            |                                | V <sub>GS</sub>                   | ±20      |      |
| Continuous Drain Current @T <sub>C</sub> =25°C, V <sub>GS</sub> =10V (Note 1)                  |                                | I <sub>D</sub>                    | 10       | A    |
| Continuous Drain Current @T <sub>C</sub> =100°C, V <sub>GS</sub> =10V (Note 1)                 |                                |                                   | 6.3      |      |
| Continuous Drain Current @T <sub>A</sub> =25°C, V <sub>GS</sub> =10V (Note 2)                  |                                | I <sub>DSM</sub>                  | 2.5      |      |
| Continuous Drain Current @T <sub>A</sub> =70°C, V <sub>GS</sub> =10V (Note 2)                  |                                |                                   | 2        |      |
| Pulsed Drain Current @ V <sub>GS</sub> =10V (Note 3)                                           |                                | I <sub>DM</sub>                   | 20       |      |
| Avalanche Current (Note 3)                                                                     |                                | I <sub>AS</sub>                   | 10       |      |
| Single Pulse Avalanche Energy @ L=0.2mH, I <sub>D</sub> =10Amps, V <sub>DD</sub> =25V (Note 2) |                                | E <sub>AS</sub>                   | 10       | mJ   |
| Repetitive Avalanche Energy (Note 3)                                                           |                                | E <sub>AR</sub>                   | 3        |      |
| Power Dissipation                                                                              | T <sub>C</sub> =25°C (Note 1)  | P <sub>D</sub>                    | 31       | W    |
|                                                                                                | T <sub>C</sub> =100°C (Note 1) |                                   | 12       |      |
|                                                                                                | T <sub>A</sub> =25°C (Note 2)  | P <sub>DSM</sub>                  | 2        |      |
|                                                                                                | T <sub>A</sub> =70°C (Note 2)  |                                   | 1.3      |      |
| Maximum Temperature for Soldering @ Lead at 0.063 in(1.6mm) from case for 10 seconds           |                                | T <sub>L</sub>                    | 300      | °C   |
| Maximum Temperature for Soldering @ Package Body for 10 seconds                                |                                | T <sub>PKG</sub>                  | 260      |      |
| Operating Junction and Storage Temperature                                                     |                                | T <sub>j</sub> , T <sub>stg</sub> | -55~+150 |      |

\*Drain current limited by maximum junction temperature

**Thermal Data**

| Parameter                                             | Symbol          | Value | Unit                        |
|-------------------------------------------------------|-----------------|-------|-----------------------------|
| Thermal Resistance, Junction-to-case, max             | $R_{\theta JC}$ | 4     | $^{\circ}\text{C}/\text{W}$ |
| Thermal Resistance, Junction-to-ambient, max (Note 2) | $R_{\theta JA}$ | 62.5  | $^{\circ}\text{C}/\text{W}$ |

- Note : 1. The power dissipation  $P_D$  is based on  $T_{J(MAX)}=150^{\circ}\text{C}$ , using junction-to-case thermal resistance, and is more useful in setting the upper dissipation limit for cases where additional heatsinking is used.
2. The value of  $R_{\theta JA}$  is measured with the device mounted on 1 in<sup>2</sup> FR-4 board with 2 oz. copper, in a still air environment with  $T_A=25^{\circ}\text{C}$ . The power dissipation  $P_{DSM}$  is based on  $R_{\theta JA}$  and the maximum allowed junction temperature of  $150^{\circ}\text{C}$ . The value in any given application depends on the user's specific board design, and the maximum temperature of  $175^{\circ}\text{C}$  may be used if the PCB allows it.
3. Repetitive rating, pulse width limited by junction temperature  $T_{J(MAX)}=150^{\circ}\text{C}$ . Ratings are based on low frequency and low duty cycles to keep initial  $T_J=25^{\circ}\text{C}$ .

**Characteristics (Tj=25°C, unless otherwise specified)**

| Symbol                              | Min. | Typ. | Max. | Unit | Test Conditions                                                                     |
|-------------------------------------|------|------|------|------|-------------------------------------------------------------------------------------|
| Static                              |      |      |      |      |                                                                                     |
| BV <sub>DSS</sub>                   | 100  | -    | -    | V    | V <sub>GS</sub> =0V, I <sub>D</sub> =250μA                                          |
| ΔBV <sub>DSS</sub> /ΔT <sub>j</sub> | -    | 0.08 | -    | V/°C | Reference to 25°C, I <sub>D</sub> =250μA                                            |
| V <sub>GS(th)</sub>                 | 1    | 1.5  | 2.5  | V    | V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> =250μA                           |
| *G <sub>FS</sub>                    | -    | 13   | -    | S    | V <sub>DS</sub> =5V, I <sub>D</sub> =10A                                            |
| I <sub>GSS</sub>                    | -    | -    | ±100 | nA   | V <sub>GS</sub> =±20V                                                               |
| I <sub>DSS</sub>                    | -    | -    | 1    | μA   | V <sub>DS</sub> =80V, V <sub>GS</sub> =0V                                           |
| I <sub>DSS</sub>                    | -    | -    | 10   |      | V <sub>DS</sub> =80V, V <sub>GS</sub> =0V, T <sub>j</sub> =125°C                    |
| *R <sub>DS(ON)</sub>                | -    | 151  | 180  | mΩ   | V <sub>GS</sub> =10V, I <sub>D</sub> =10A                                           |
|                                     | -    | 165  | 200  |      | V <sub>GS</sub> =4.5V, I <sub>D</sub> =10A                                          |
| Dynamic                             |      |      |      |      |                                                                                     |
| *Q <sub>g</sub>                     | -    | 8.4  | -    | nC   | V <sub>DD</sub> =80V, I <sub>D</sub> =10A, V <sub>GS</sub> =10V                     |
| *Q <sub>gs</sub>                    | -    | 1.0  | -    |      |                                                                                     |
| *Q <sub>gd</sub>                    | -    | 2.8  | -    |      |                                                                                     |
| *t <sub>d(ON)</sub>                 | -    | 4    | -    | ns   | V <sub>DD</sub> =50V, I <sub>D</sub> =10A, V <sub>GS</sub> =10V, R <sub>G</sub> =6Ω |
| *tr                                 | -    | 3    | -    |      |                                                                                     |
| *t <sub>d(OFF)</sub>                | -    | 9    | -    |      |                                                                                     |
| *tf                                 | -    | 4    | -    |      |                                                                                     |
| C <sub>iss</sub>                    | -    | 303  | -    | pF   | V <sub>GS</sub> =0V, V <sub>DS</sub> =25V, f=1MHz                                   |
| C <sub>oss</sub>                    | -    | 35   | -    |      |                                                                                     |
| C <sub>rss</sub>                    | -    | 15   | -    |      |                                                                                     |
| Source-Drain Diode                  |      |      |      |      |                                                                                     |
| *I <sub>S</sub>                     | -    | -    | 10   | A    |                                                                                     |
| *I <sub>SM</sub>                    | -    | -    | 20   |      |                                                                                     |
| *V <sub>SD</sub>                    | -    | 0.9  | 1.3  | V    | I <sub>S</sub> =10A, V <sub>GS</sub> =0V                                            |
| *trr                                | -    | 60   | -    | ns   | V <sub>GS</sub> =0, I <sub>F</sub> =10A, dI/dt=100A/μs                              |
| *Qrr                                | -    | 95   | -    | nC   |                                                                                     |

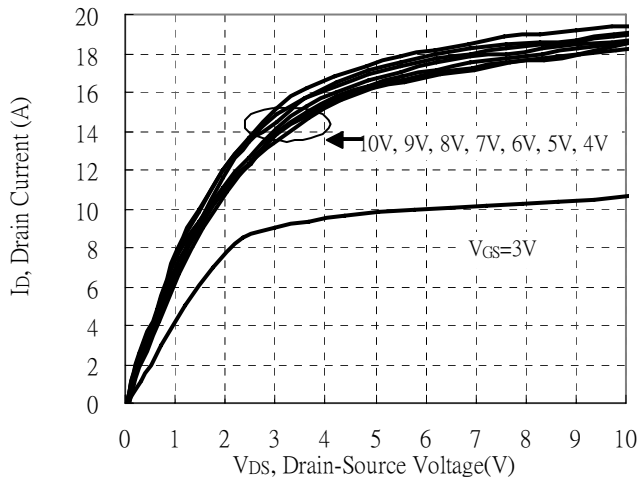
\*Pulse Test : Pulse Width ≤300μs, Duty Cycle≤2%

**Ordering Information**

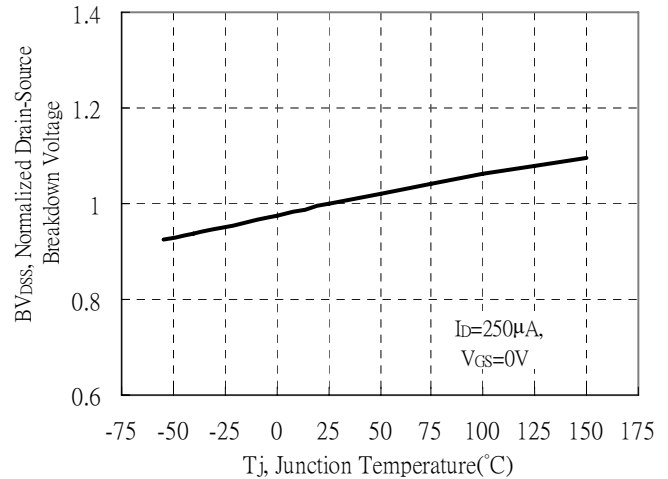
| Device            | Package                      | Shipping                                    |
|-------------------|------------------------------|---------------------------------------------|
| MTBA5N10FP-0-UB-S | TO-220FP<br>(RoHS compliant) | 50 pcs/tube, 20 tubes/box, 4 boxes / carton |

## Typical Characteristics

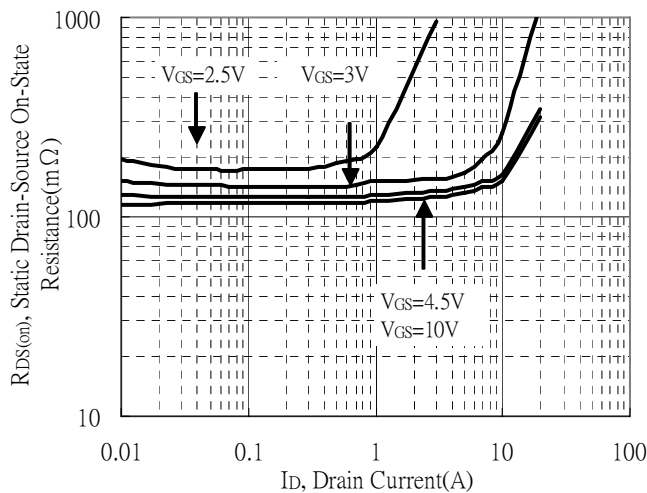
Typical Output Characteristics



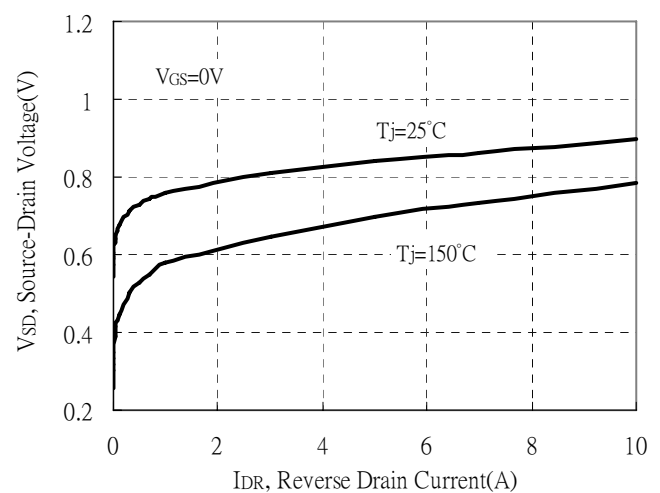
Breakdown Voltage vs Ambient Temperature



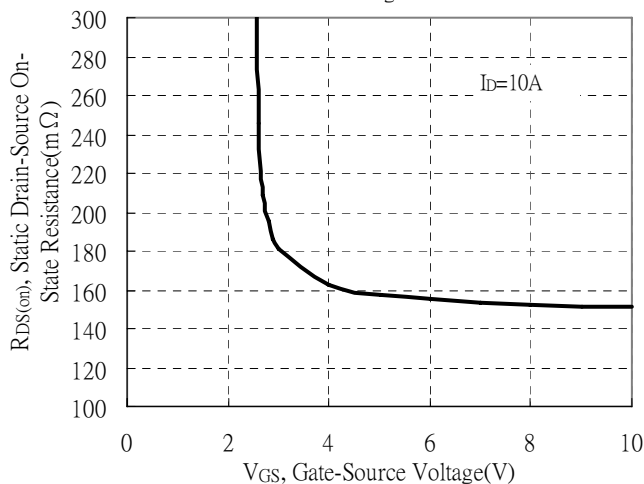
Static Drain-Source On-State resistance vs Drain Current



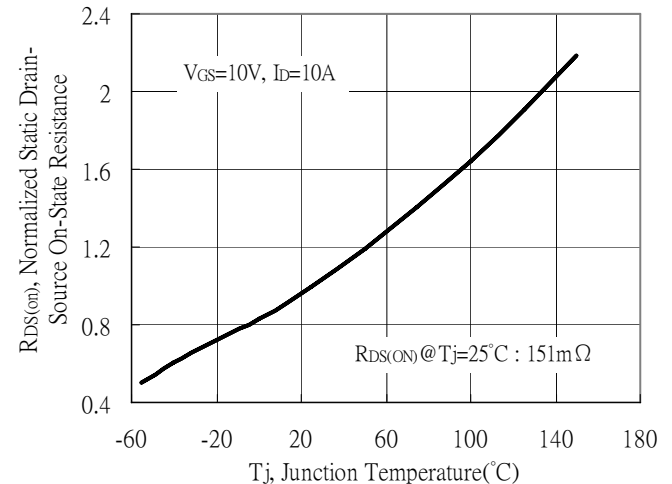
Reverse Drain Current vs Source-Drain Voltage



Static Drain-Source On-State Resistance vs Gate-Source Voltage

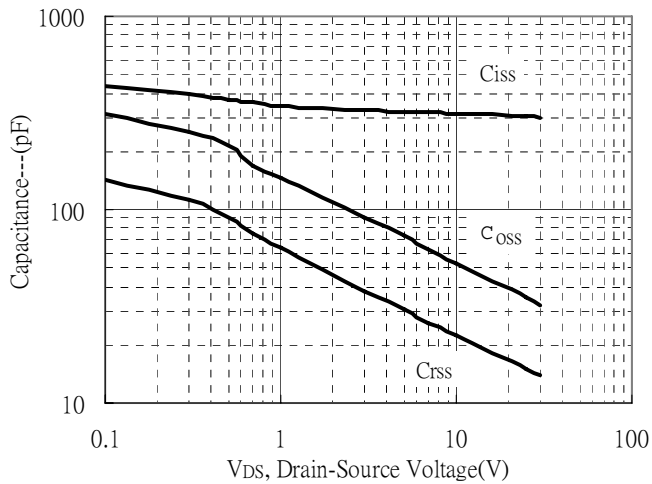


Drain-Source On-State Resistance vs Junction Temperature

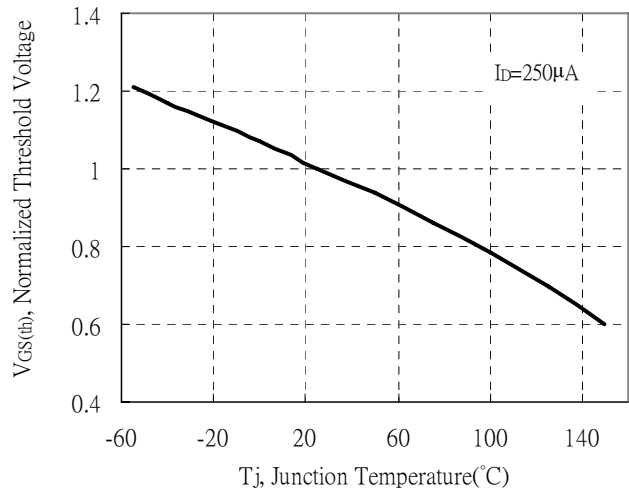


## Typical Characteristics(Cont.)

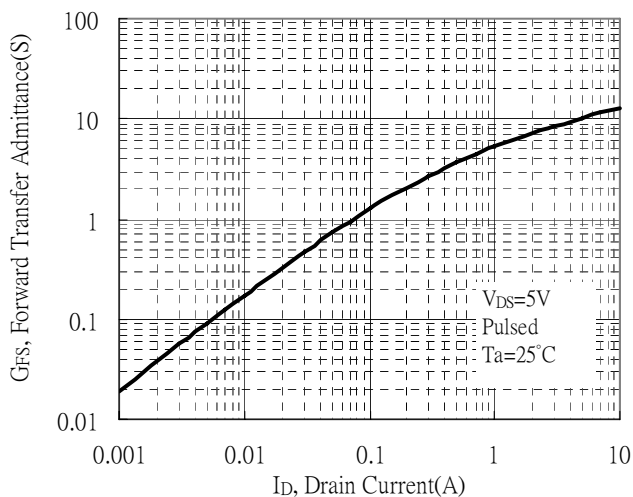
Capacitance vs Drain-to-Source Voltage



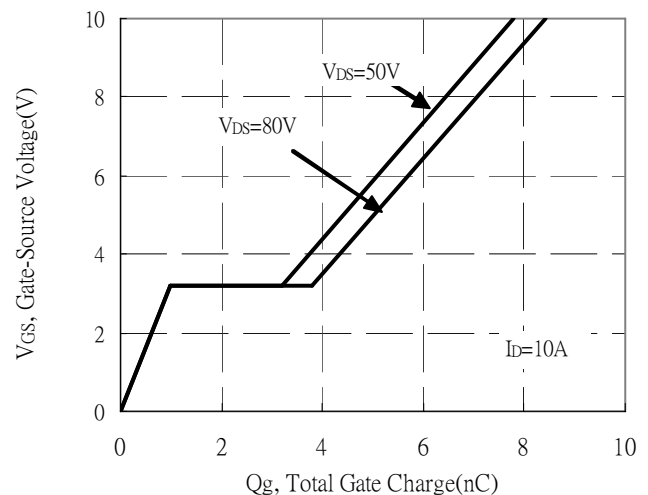
Threshold Voltage vs Junction Temperature



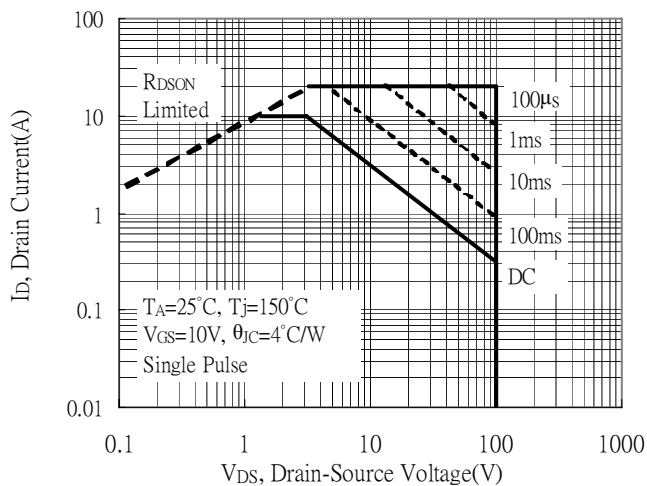
Forward Transfer Admittance vs Drain Current



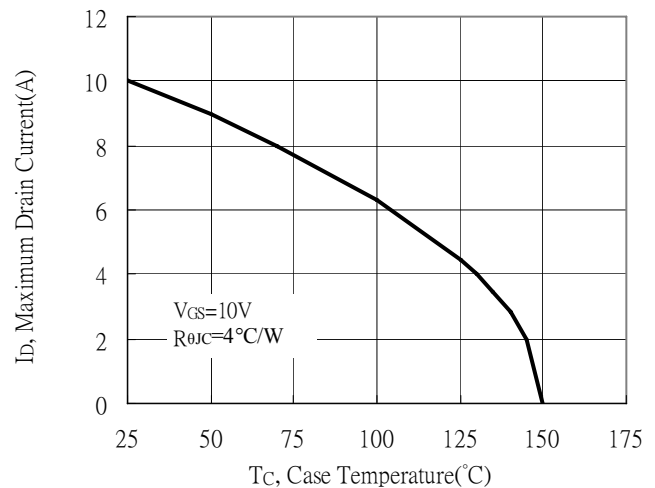
Gate Charge Characteristics



Maximum Safe Operating Area

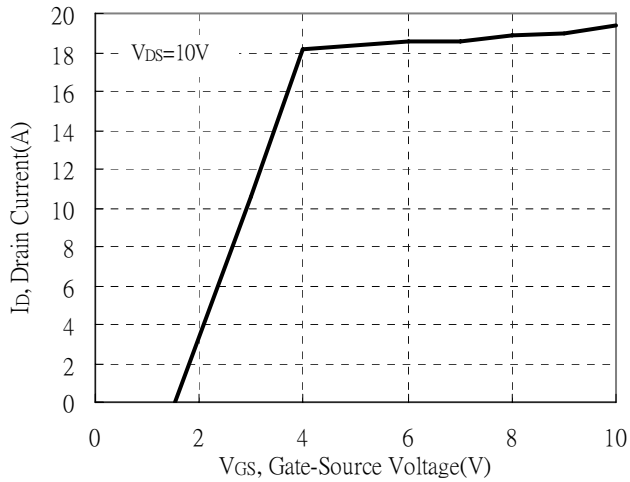


Maximum Drain Current vs Case Temperature

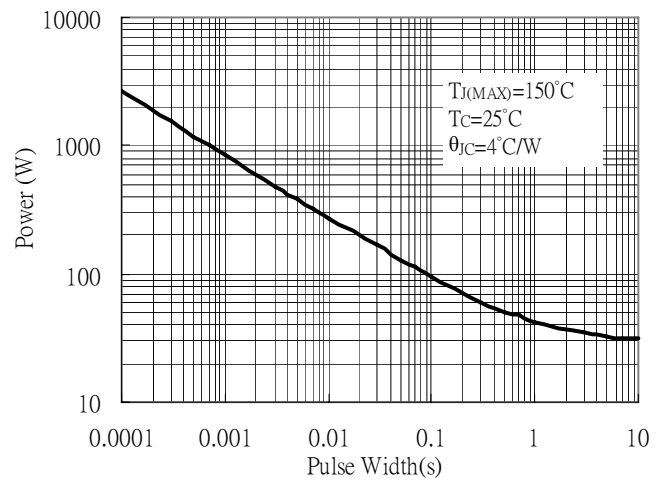


## Typical Characteristics(Cont.)

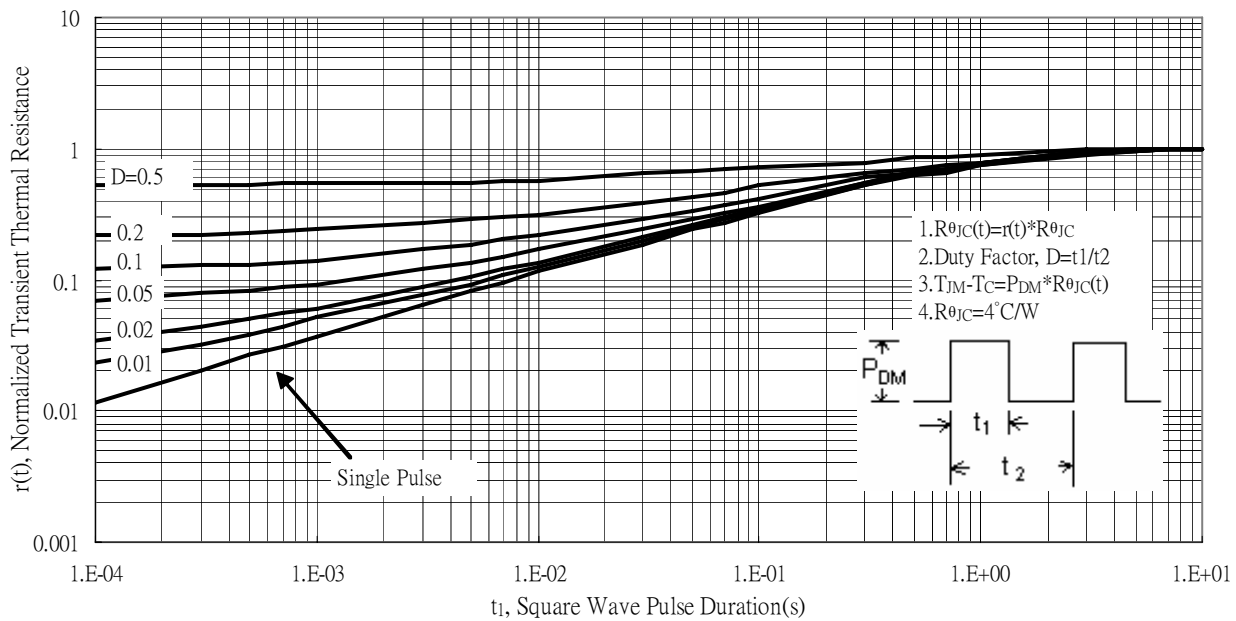
Typical Transfer Characteristics



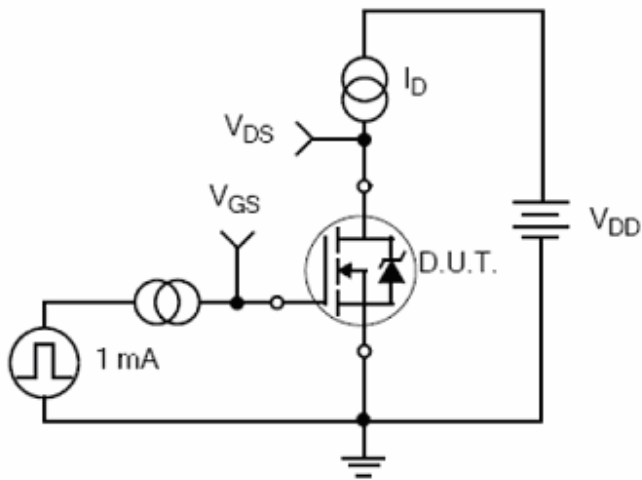
Single Pulse Power Rating, Junction to Case



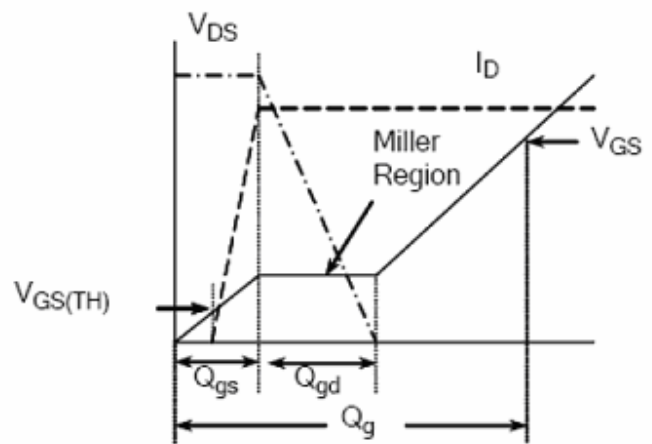
Transient Thermal Response Curves



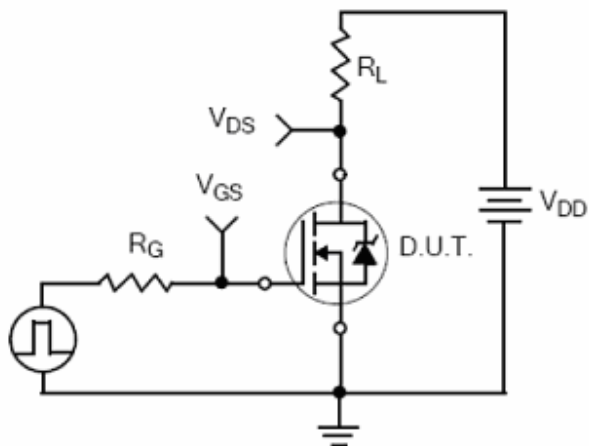
## Test Circuit and Waveforms



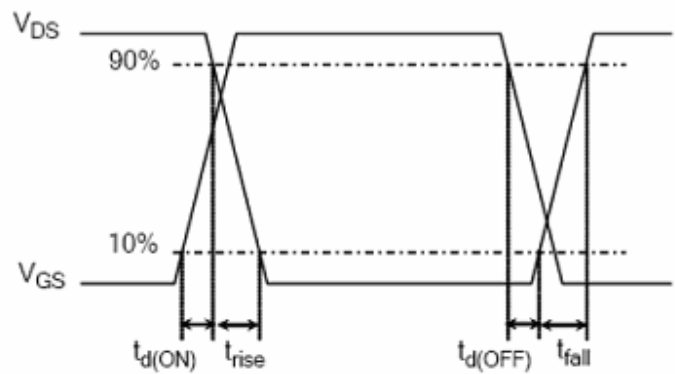
Gate Charge Test Circuit



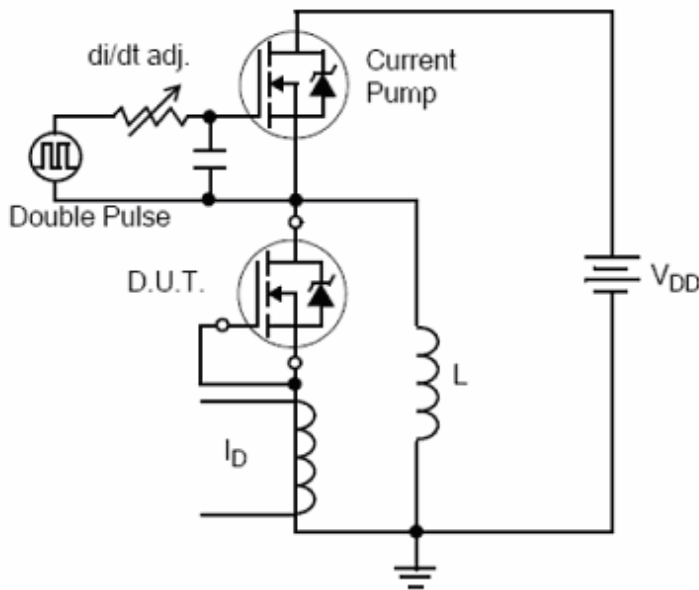
Gate Charge Waveform



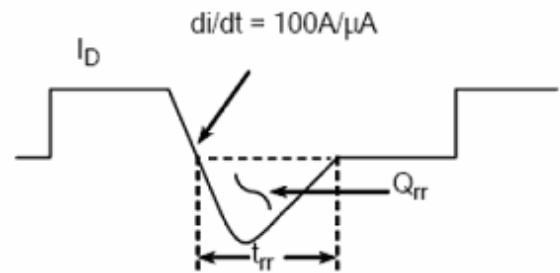
Resistive Switching Test Circuit



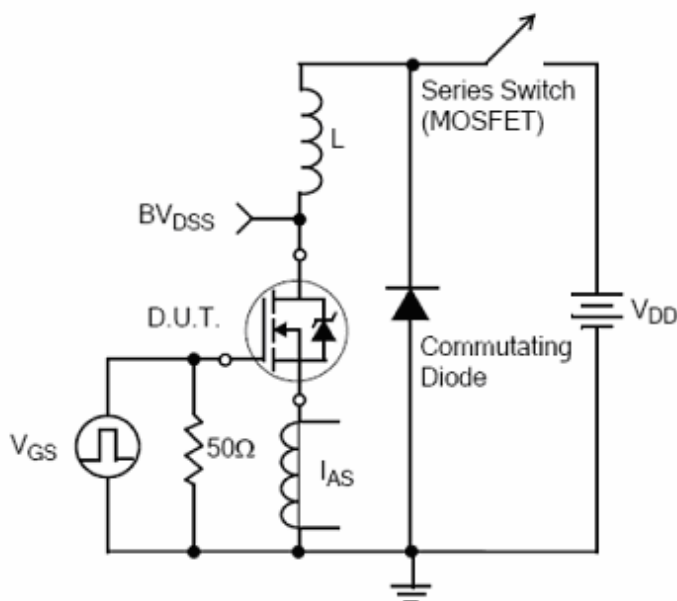
Resistive Switching Waveforms

**Test Circuit and Waveforms(Cont.)**


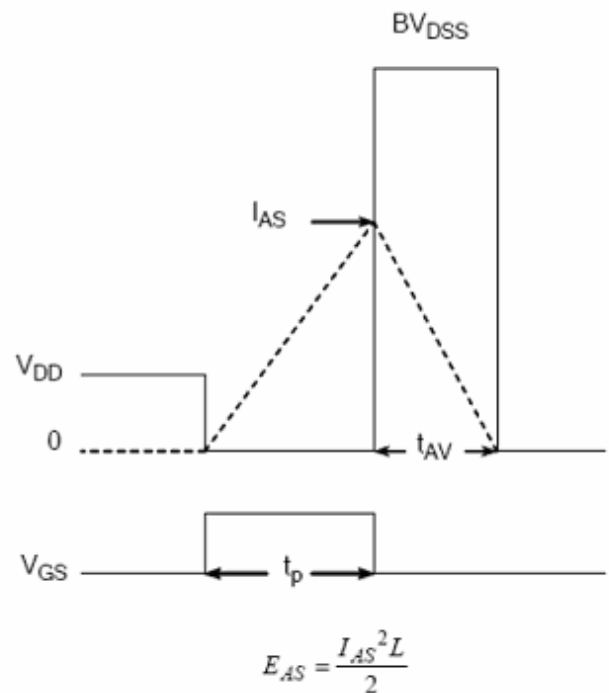
Diode Reverse Recovery Test Circuit



Diode Reverse Recovery Waveform



Unclamped Inductive Switching Test Circuit

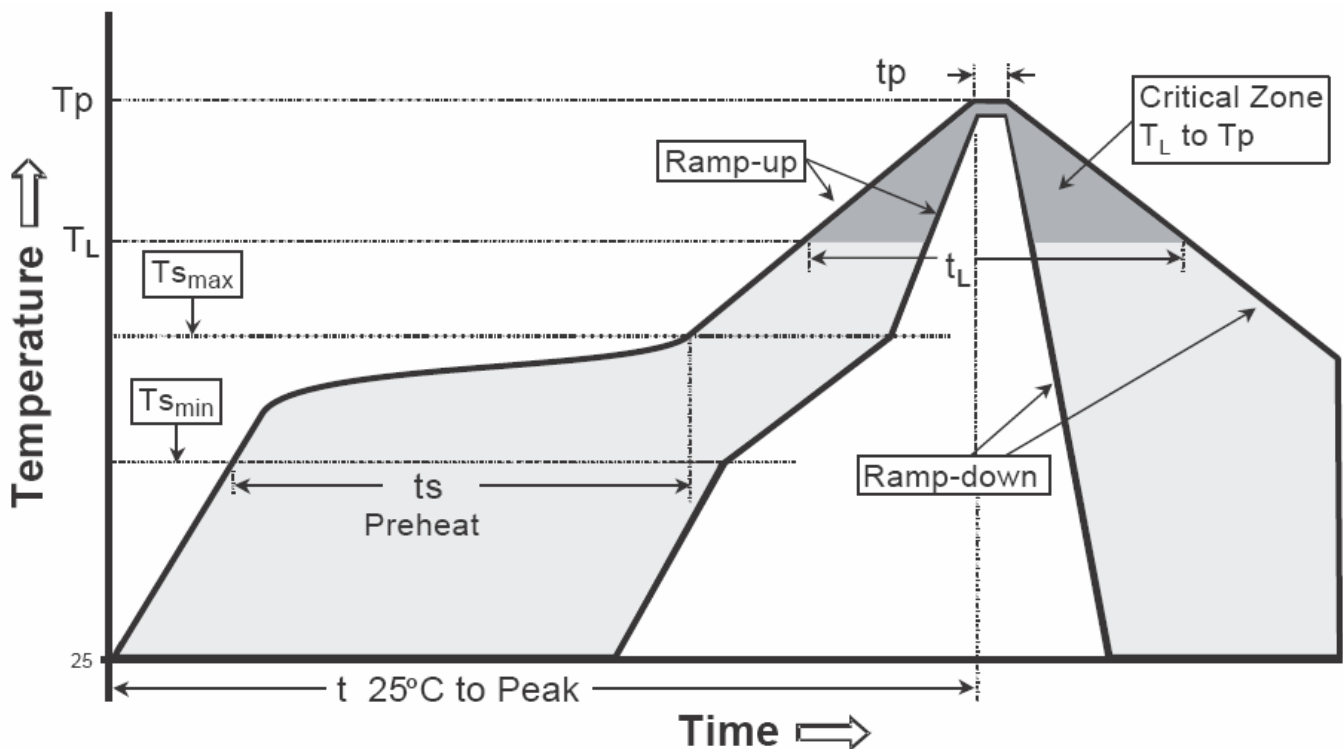


Unclamped Inductive Switching Waveforms

### Recommended wave soldering condition

|                 |                  |                 |
|-----------------|------------------|-----------------|
| Product         | Peak Temperature | Soldering Time  |
| Pb-free devices | 260 +0/-5 °C     | 5 +1/-1 seconds |

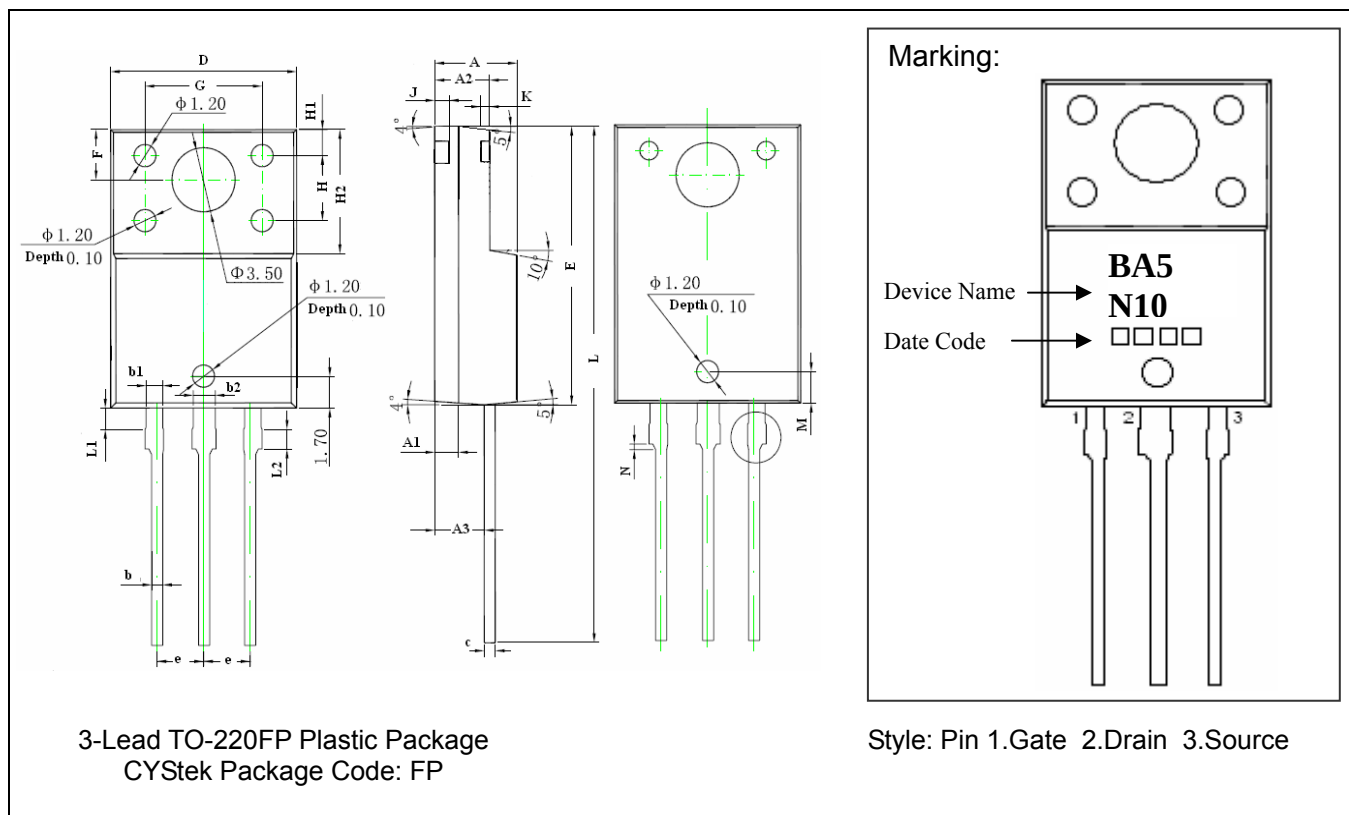
### Recommended temperature profile for IR reflow



| Profile feature                                     | Sn-Pb eutectic Assembly | Pb-free Assembly |
|-----------------------------------------------------|-------------------------|------------------|
| Average ramp-up rate ( $T_{smax}$ to $T_p$ )        | 3°C/second max.         | 3°C/second max.  |
| Preheat                                             |                         |                  |
| -Temperature Min( $T_{smin}$ )                      | 100°C                   | 150°C            |
| -Temperature Max( $T_{smax}$ )                      | 150°C                   | 200°C            |
| -Time( $t_{smin}$ to $t_{smax}$ )                   | 60-120 seconds          | 60-180 seconds   |
| Time maintained above:                              |                         |                  |
| -Temperature ( $T_L$ )                              | 183°C                   | 217°C            |
| - Time ( $t_L$ )                                    | 60-150 seconds          | 60-150 seconds   |
| Peak Temperature( $T_p$ )                           | 240 +0/-5 °C            | 260 +0/-5 °C     |
| Time within 5°C of actual peak temperature( $t_p$ ) | 10-30 seconds           | 20-40 seconds    |
| Ramp down rate                                      | 6°C/second max.         | 6°C/second max.  |
| Time 25 °C to peak temperature                      | 6 minutes max.          | 8 minutes max.   |

Note : All temperatures refer to topside of the package, measured on the package body surface.

## TO-220FP Dimension



\*Typical

| DIM | Inches    |       | Millimeters |       | DIM | Inches    |       | Millimeters |       |
|-----|-----------|-------|-------------|-------|-----|-----------|-------|-------------|-------|
|     | Min.      | Max.  | Min.        | Max.  |     | Min.      | Max.  | Min.        | Max.  |
| A   | 0.171     | 0.183 | 4.35        | 4.65  | G   | 0.246     | 0.258 | 6.25        | 6.55  |
| A1  | 0.051 REF |       | 1.300 REF   |       | H   | 0.138 REF |       | 3.50 REF    |       |
| A2  | 0.112     | 0.124 | 2.85        | 3.15  | H1  | 0.055 REF |       | 1.40 REF    |       |
| A3  | 0.102     | 0.110 | 2.60        | 2.80  | H2  | 0.256     | 0.272 | 6.50        | 6.90  |
| b   | 0.020     | 0.030 | 0.50        | 0.75  | J   | 0.031 REF |       | 0.80 REF    |       |
| b1  | 0.031     | 0.041 | 0.80        | 1.05  | K   | 0.020     |       | 0.50 REF    |       |
| b2  | 0.047 REF |       | 1.20 REF    |       | L   | 1.102     | 1.118 | 28.00       | 28.40 |
| c   | 0.020     | 0.030 | 0.500       | 0.750 | L1  | 0.043     | 0.051 | 1.10        | 1.30  |
| D   | 0.396     | 0.404 | 10.06       | 10.26 | L2  | 0.036     | 0.043 | 0.92        | 1.08  |
| E   | 0.583     | 0.598 | 14.80       | 15.20 | M   | 0.067 REF |       | 1.70 REF    |       |
| e   | 0.100 *   |       | 2.54*       |       | N   | 0.012 REF |       | 0.30 REF    |       |
| F   | 0.106 REF |       | 2.70 REF    |       |     |           |       |             |       |

Notes: 1.Controlling dimension: millimeters.

2.Maximum lead thickness includes lead finish thickness, and minimum lead thickness is the minimum thickness of base material.

3.If there is any question with packing specification or packing method, please contact your local CYStek sales office.

### Material:

- Lead: Pure tin plated.
- Mold Compound: Epoxy resin family, flammability solid burning class: UL94V-0.

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