

|                     |       |
|---------------------|-------|
| $V_{DSS}$           | 500V  |
| $R_{DS(on)}$ (Max.) | 0.52Ω |
| $I_D$               | -13A  |
| $P_D$               | 40W   |

### ●Features

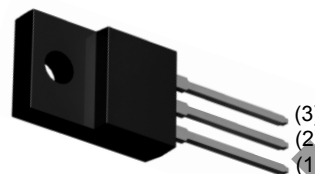
- 1) Low on-resistance.
- 2) Fast switching speed.
- 3) Gate-source voltage ( $V_{GSS}$ ) guaranteed to be  $\pm 30V$ .
- 4) Drive circuits can be simple.
- 5) Parallel use is easy.
- 6) Pb-free lead plating ; RoHS compliant

### ●Application

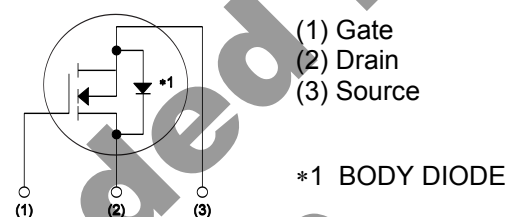
Switching Power Supply

### ●Outline

TO-220FM



### ●Inner circuit



### ●Packaging specifications

|      |                           |           |
|------|---------------------------|-----------|
| Type | Packaging                 | Bulk      |
|      | Reel size (mm)            | -         |
|      | Tape width (mm)           | -         |
|      | Basic ordering unit (pcs) | 500       |
|      | Taping code               | -         |
|      | Marking                   | ZDX130N50 |

### ●Absolute maximum ratings( $T_a = 25^\circ C$ )

| Parameter                                   | Symbol             | Value       | Unit       |
|---------------------------------------------|--------------------|-------------|------------|
| Drain - Source voltage                      | $V_{DSS}$          | 500         | V          |
| Continuous drain current $T_c = 25^\circ C$ | $I_D^{*1}$         | $\pm 13$    | A          |
| Pulsed drain current                        | $I_{D,pulse}^{*2}$ | $\pm 39$    | A          |
| Gate - Source voltage                       | $V_{GSS}$          | $\pm 30$    | V          |
| Power dissipation ( $T_c = 25^\circ C$ )    | $P_D$              | 40          | W          |
| Junction temperature                        | $T_j$              | 150         | $^\circ C$ |
| Range of storage temperature                | $T_{stg}$          | -55 to +150 | $^\circ C$ |

## ●Thermal resistance

| Parameter                              | Symbol     | Values |      |       | Unit |
|----------------------------------------|------------|--------|------|-------|------|
|                                        |            | Min.   | Typ. | Max.  |      |
| Thermal resistance, junction - ambient | $R_{thJA}$ | -      | -    | 3.125 | °C/W |

●Electrical characteristics( $T_a = 25^\circ\text{C}$ )

| Parameter                                   | Symbol            | Conditions                      | Values |      |           | Unit     |
|---------------------------------------------|-------------------|---------------------------------|--------|------|-----------|----------|
|                                             |                   |                                 | Min.   | Typ. | Max.      |          |
| Drain - Source breakdown voltage            | $V_{(BR)DSS}$     | $V_{GS} = 0V, I_D = 1mA$        | 500    | -    | -         | V        |
| Zero gate voltage drain current             | $I_{DSS}$         | $V_{DS} = 500V, V_{GS} = 0V$    | -      | -    | 100       | $\mu A$  |
| Gate - Source leakage current               | $I_{GSS}$         | $V_{GS} = \pm 30V, V_{DS} = 0V$ | -      | -    | $\pm 100$ | nA       |
| Gate threshold voltage                      | $V_{GS(th)}$      | $V_{DS} = 10V, I_D = 1mA$       | 2.5    | -    | 4.5       | V        |
| Static drain - source on - state resistance | $R_{DS(on)}^{*3}$ | $V_{GS} = 10V, I_D = 6.5A$      | -      | 0.4  | 0.52      | $\Omega$ |

●Electrical characteristics( $T_a = 25^\circ\text{C}$ )

| Parameter                    | Symbol            | Conditions                                        | Values |      |      | Unit |
|------------------------------|-------------------|---------------------------------------------------|--------|------|------|------|
|                              |                   |                                                   | Min.   | Typ. | Max. |      |
| Transconductance             | $g_{fs}^{*3}$     | $V_{DS} = 10\text{V}, I_D = 6\text{A}$            | 2.0    | 8.5  | -    | S    |
| Input capacitance            | $C_{iss}$         | $V_{GS} = 0\text{V}$                              | -      | 2180 | -    | pF   |
| Output capacitance           | $C_{oss}$         | $V_{DS} = 25\text{V}$                             | -      | 200  | -    |      |
| Reverse transfer capacitance | $C_{rss}$         | $f = 1\text{MHz}$                                 | -      | 60   | -    |      |
| Turn - on delay time         | $t_{d(on)}^{*3}$  | $V_{DD} \approx 250\text{V}, V_{GS} = 10\text{V}$ | -      | 30   | -    | ns   |
| Rise time                    | $t_r^{*3}$        | $I_D = 5\text{A}$                                 | -      | 25   | -    |      |
| Turn - off delay time        | $t_{d(off)}^{*3}$ | $R_L = 50\Omega$                                  | -      | 43   | -    |      |
| Fall time                    | $t_f^{*3}$        | $R_G = 10\Omega$                                  | -      | 15   | -    |      |

●Gate Charge characteristics( $T_a = 25^\circ\text{C}$ )

| Parameter            | Symbol          | Conditions                                    | Values |      |      | Unit |
|----------------------|-----------------|-----------------------------------------------|--------|------|------|------|
|                      |                 |                                               | Min.   | Typ. | Max. |      |
| Total gate charge    | $Q_g^{*3}$      | $V_{DD} \approx 250\text{V}$                  | -      | 40   | -    | nC   |
| Gate - Source charge | $Q_{gs}^{*3}$   | $I_D = 5\text{A}$                             | -      | 11.5 | -    |      |
| Gate - Drain charge  | $Q_{gd}^{*3}$   | $V_{GS} = 10\text{V}$                         | -      | 12.5 | -    |      |
| Gate plateau voltage | $V_{(plateau)}$ | $V_{DD} \approx 250\text{V}, I_D = 5\text{A}$ | -      | 5.5  | -    | V    |

\*1 Limited only by maximum temperature allowed.

\*2  $P_w \leq 10\mu\text{s}$ , Duty cycle  $\leq 1\%$

\*3 Pulsed

**●Body diode electrical characteristics (Source-Drain)( $T_a = 25^\circ\text{C}$ )**

| Parameter                                    | Symbol        | Conditions                             | Values |      |      | Unit |
|----------------------------------------------|---------------|----------------------------------------|--------|------|------|------|
|                                              |               |                                        | Min.   | Typ. | Max. |      |
| Inverse diode continuous,<br>forward current | $I_S^{*1}$    | $T_c = 25^\circ\text{C}$               | -      | -    | 13   | A    |
| Inverse diode direct current,<br>pulsed      | $I_{SM}^{*2}$ |                                        | -      | -    | 39   | A    |
| Forward voltage                              | $V_{SD}^{*3}$ | $V_{GS} = 0\text{V}, I_S = 13\text{A}$ | -      | -    | 1.7  | V    |

Not Recommended for  
New Designs

●Electrical characteristic curves

Fig.1 Power Dissipation Derating Curve

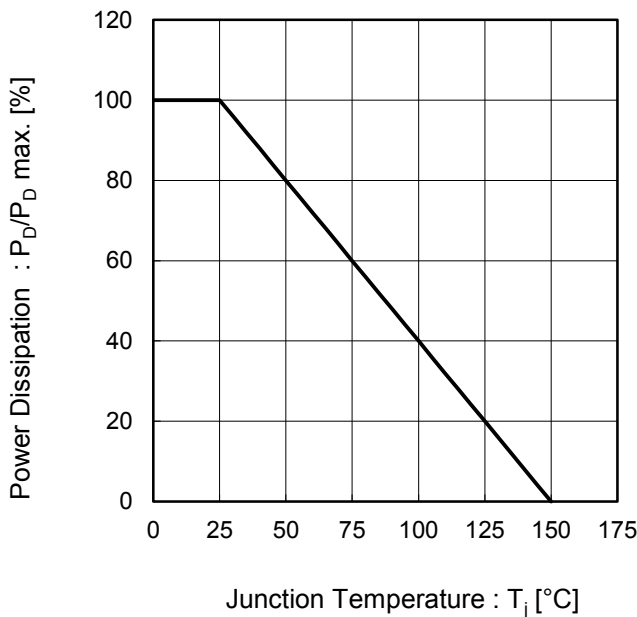


Fig.2 Maximum Safe Operating Area

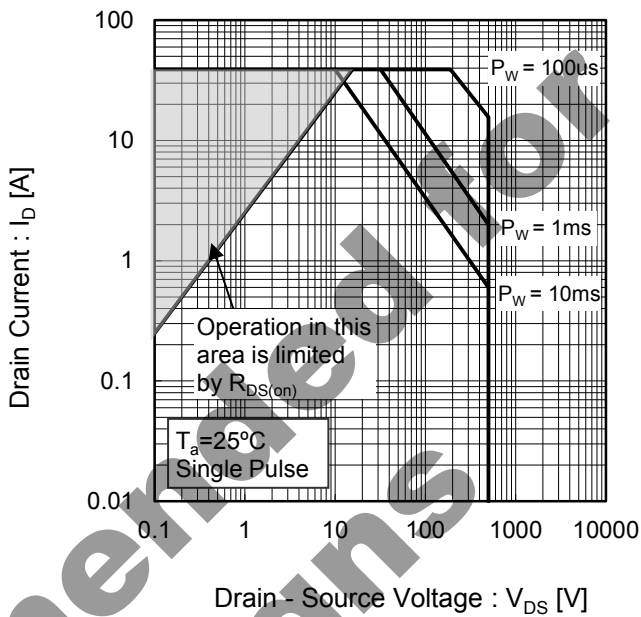
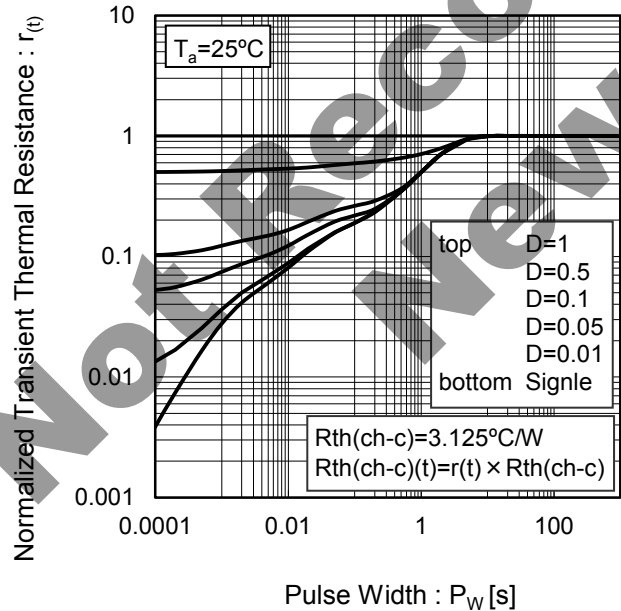


Fig.3 Normalized Transient Thermal Resistance vs. Pulse Width



●Electrical characteristic curves

Fig.4 Typical Output Characteristics(I)

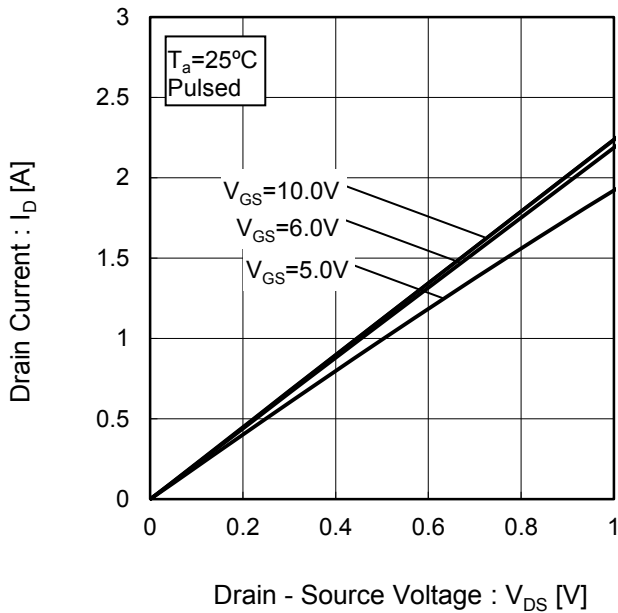


Fig.5 Typical Output Characteristics(II)

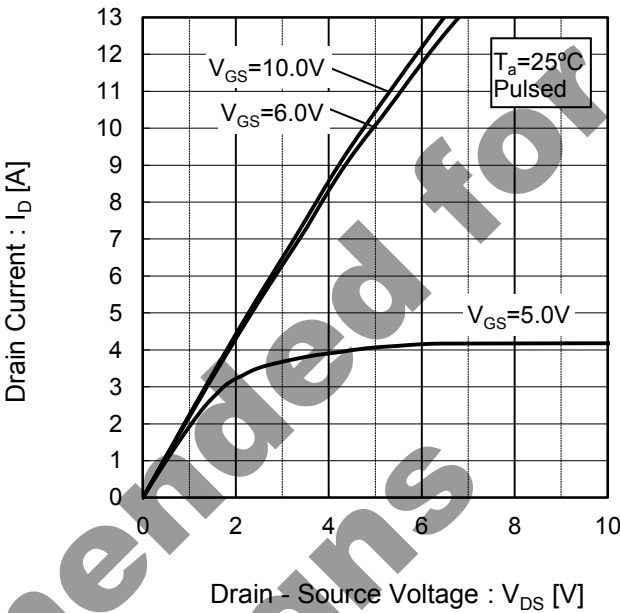


Fig.6 Breakdown Voltage vs. Channel Temperature

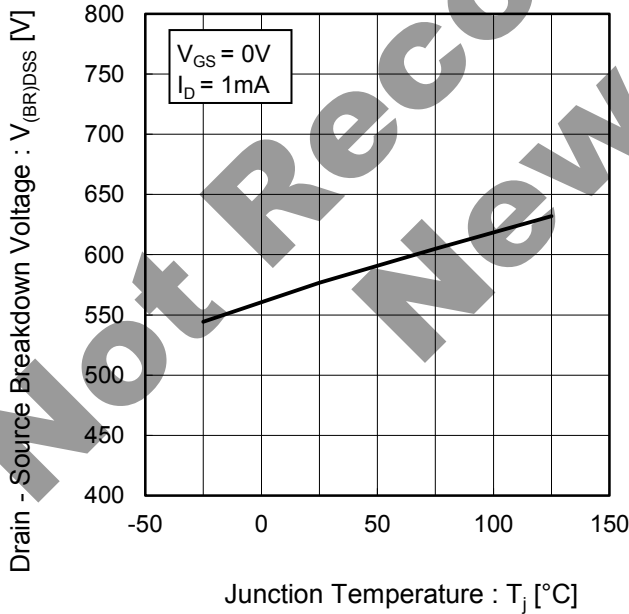
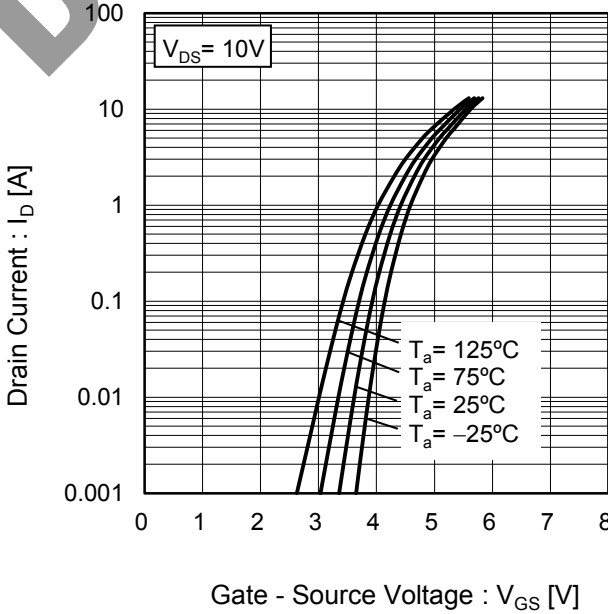


Fig.7 Typical Transfer Characteristics



●Electrical characteristic curves

Fig.8 Gate Threshold Voltage vs. Channel Temperature

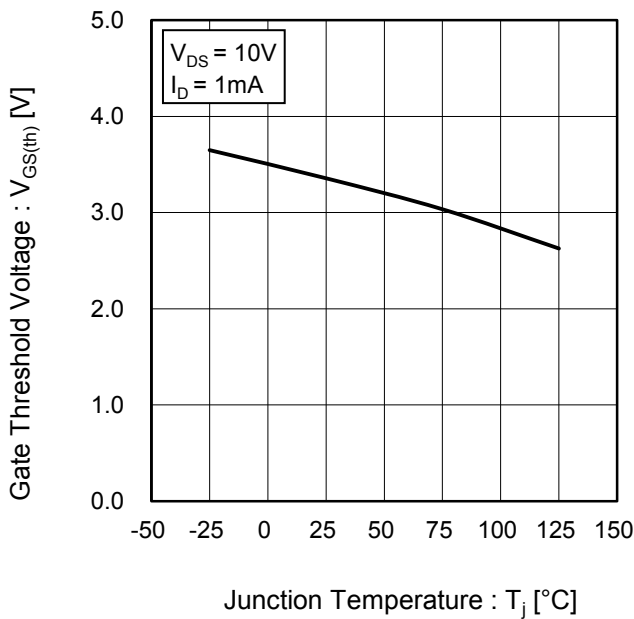


Fig.9 Transconductance vs. Drain Current

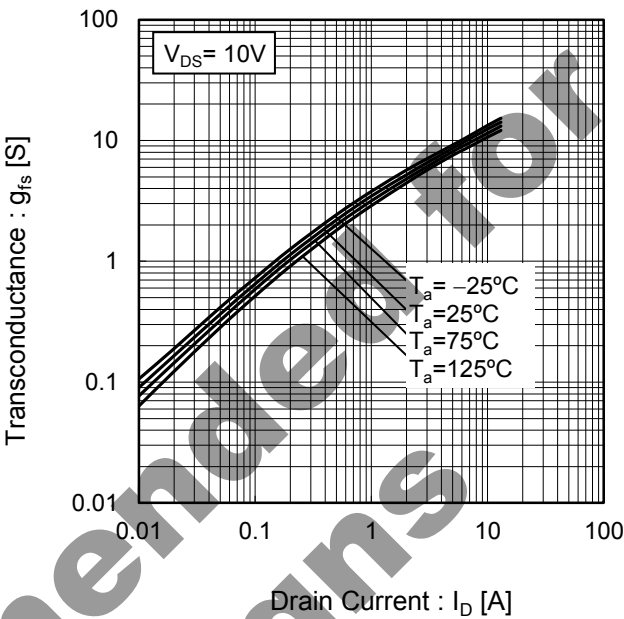
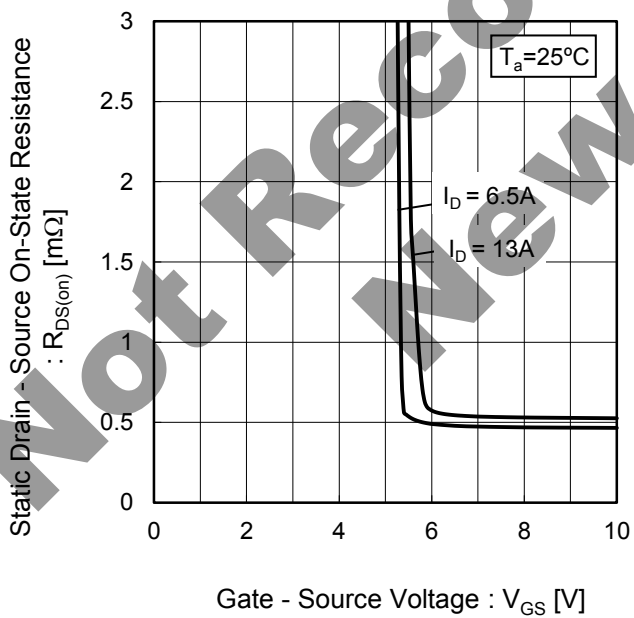


Fig.10 Static Drain - Source On - State Resistance vs. Gate Source Voltage



●Electrical characteristic curves

Fig.11 Static Drain - Source On - State Resistance vs. Drain Current(II)

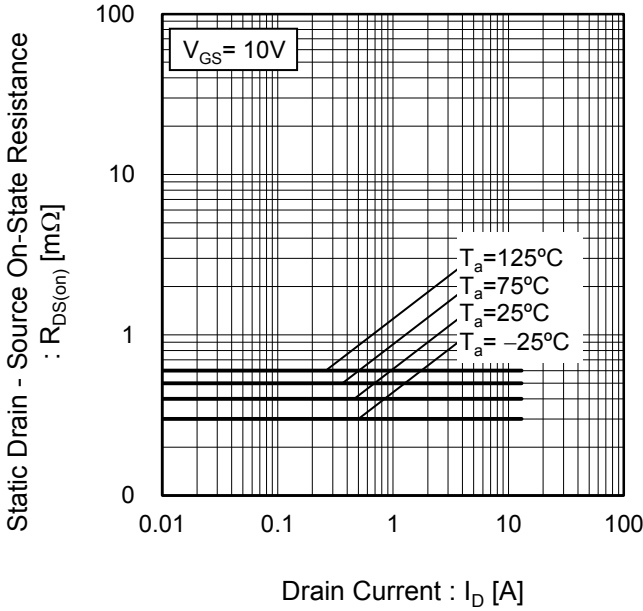
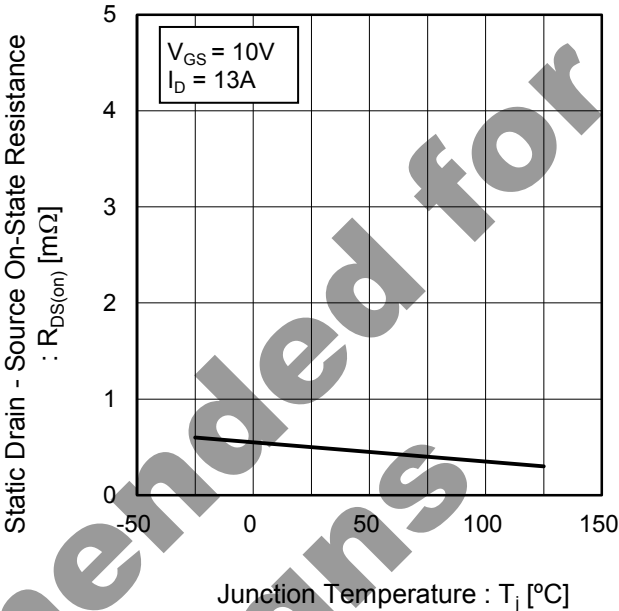


Fig.12 Static Drain - Source On - State Resistance vs. Junction Temperature





●Electrical characteristic curves

Fig.13 Typical Capacitance vs. Drain - Source Voltage

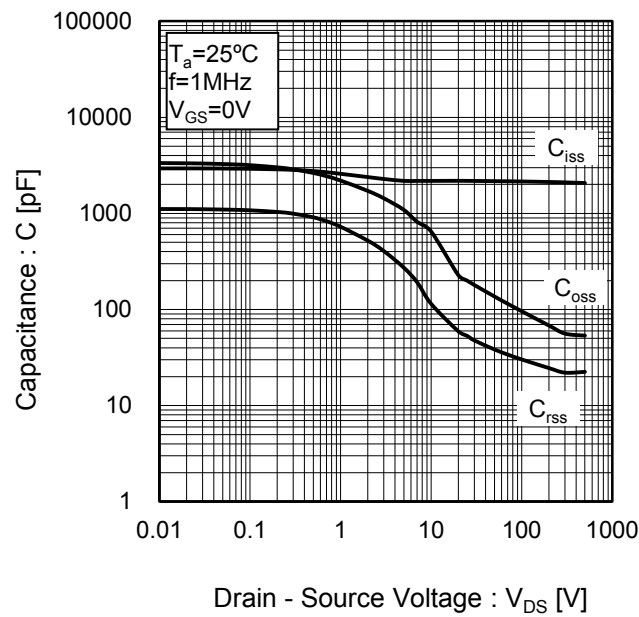


Fig.14 Switching Characteristics

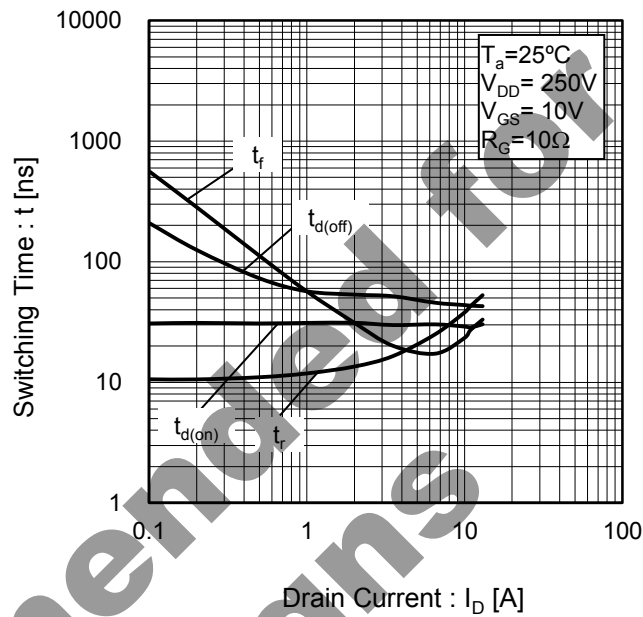


Fig.15 Dynamic Input Characteristics

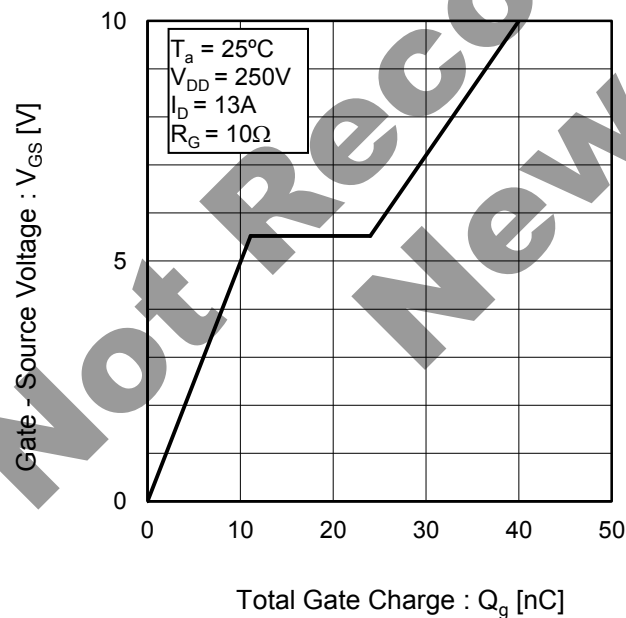
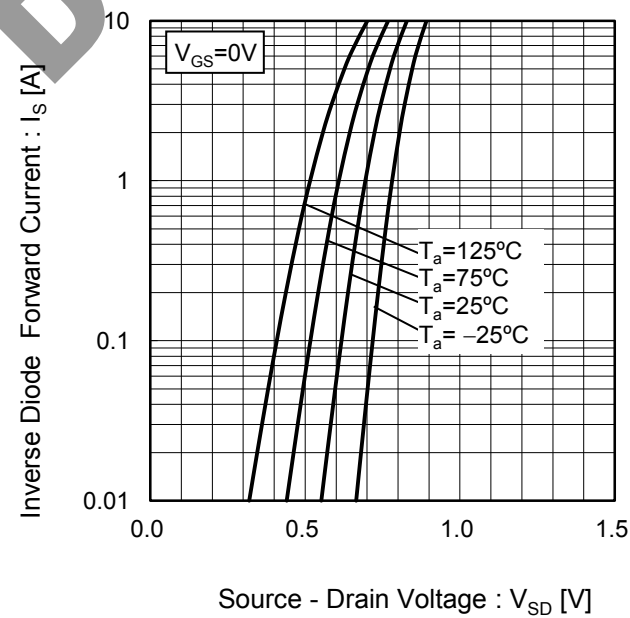


Fig.16 Inverse Diode Forward Current vs. Source - Drain Voltage



●Measurement circuits

Fig.1-1 Switching Time Measurement Circuit

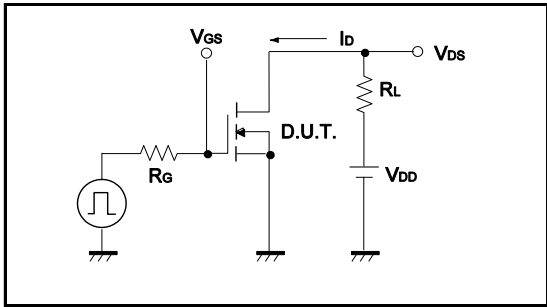


Fig.1-2 Switching Waveforms

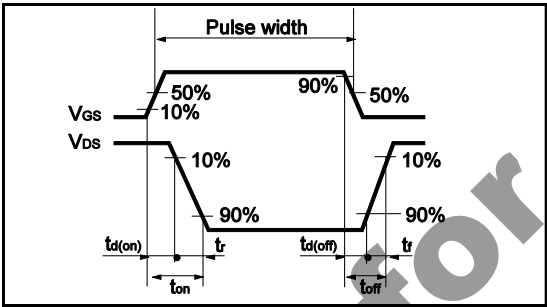


Fig.2-1 Gate Charge Measurement Circuit

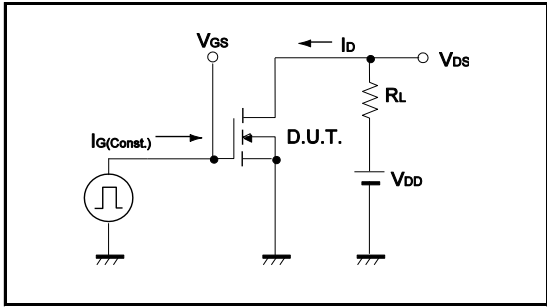
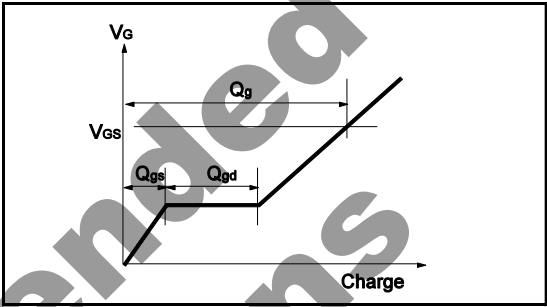
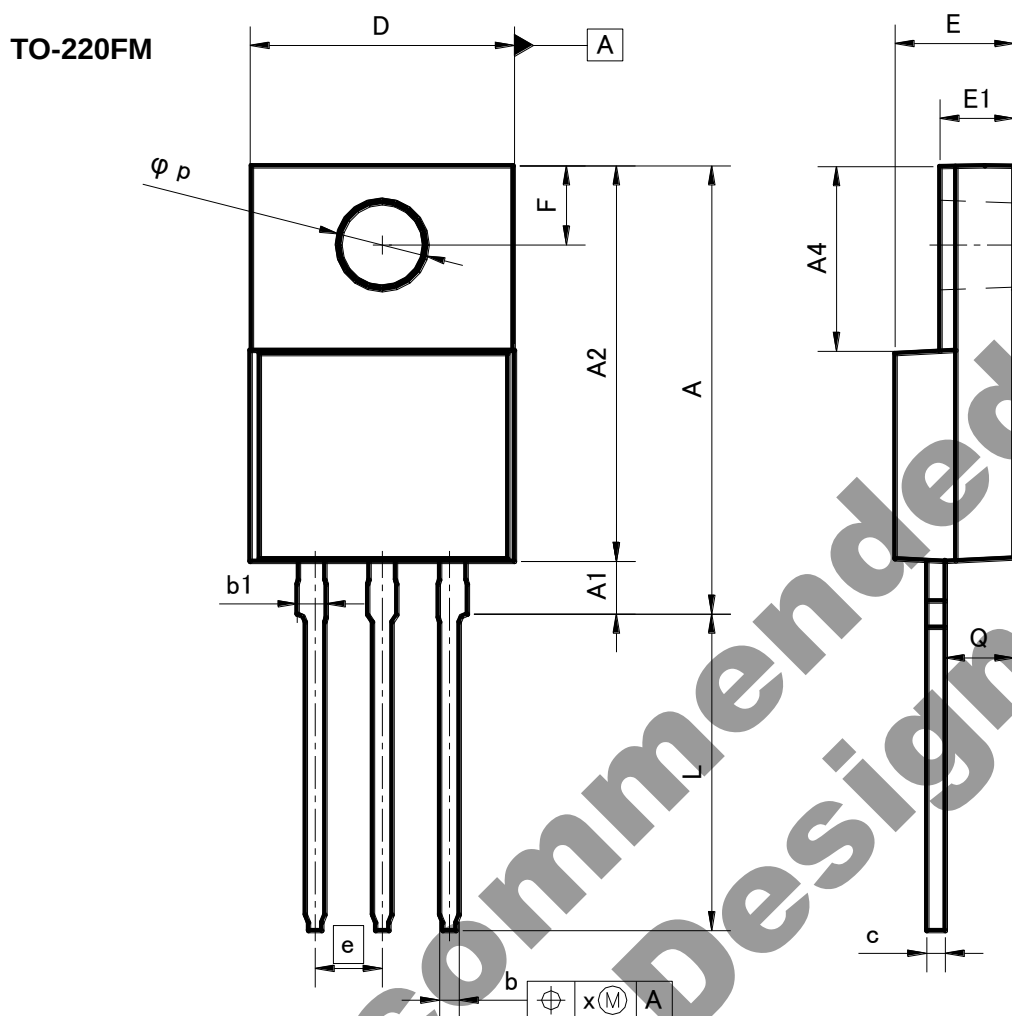


Fig.2-2 Gate Charge Waveform



## ●Dimensions (Unit : mm)



| DIM | MILIMETERS |       | INCHES |       |
|-----|------------|-------|--------|-------|
|     | MIN        | MAX   | MIN    | MAX   |
| A   | 16.60      | 17.60 | 0.654  | 0.693 |
| A1  | 1.80       | 2.20  | 0.071  | 0.087 |
| A2  | 14.80      | 15.40 | 0.583  | 0.606 |
| A4  | 6.80       | 7.20  | 0.268  | 0.283 |
| b   | 0.70       | 0.85  | 0.028  | 0.033 |
| b1  | 1.10       | 1.50  | 0.043  | 0.059 |
| c   | 0.70       | 0.85  | 0.028  | 0.033 |
| D   | 9.90       | 10.30 | 0.39   | 0.406 |
| E   | 4.40       | 4.80  | 0.173  | 0.189 |
| e   | 2.54       |       | 0.10   |       |
| E1  | 2.70       | 3.00  | 0.106  | 0.118 |
| F   | 2.80       | 3.20  | 0.11   | 0.126 |
| L   | 11.50      | 12.50 | 0.453  | 0.492 |
| p   | 3.00       | 3.40  | 0.118  | 0.134 |
| Q   | 2.10       | 3.10  | 0.083  | 0.122 |
| x   | —          | 0.381 | —      | 0.015 |

Dimension in mm/inches

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