



# XTMF50N05D

## 500V N-Channel MOSFET

### Product Description

|                   |      |          |
|-------------------|------|----------|
| $BV_{DSS}$        | 500  | V        |
| $I_D$             | 5    | A        |
| $R_{DS(ON),Typ.}$ | 1.55 | $\Omega$ |

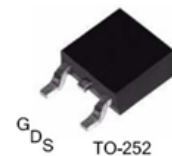
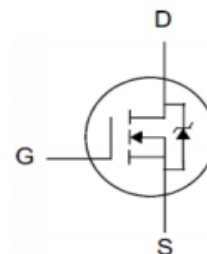
### General Features

- Advanced Planar Process
- $R_{DS(ON),typ.}=1.55\Omega@V_{GS}=10V$
- Low Gate Charge Minimize Switching Loss
- Rugged Poly silicon Gate Structure

### Applications

- BLDC Motor Driver
- Electric Welder
- High Efficiency SMPS

### 封装 Package



| Device     | Package | Marking    |
|------------|---------|------------|
| XTMF50N05D | TO-252  | XTMF50N05D |

### Absolute Maximum Ratings $T_j=25^{\circ}\text{C}$

| Symbol             | Parameter                                                                                                        | Value      | Unit                  |
|--------------------|------------------------------------------------------------------------------------------------------------------|------------|-----------------------|
| $V_{DSS}$          | Drain-to-Source Voltage                                                                                          | 500        | V                     |
| $V_{GSS}$          | Gate-to-Source Voltage                                                                                           | $\pm 30$   |                       |
| $I_D$              | Continuous Drain Current                                                                                         | 5          | A                     |
| $I_{DM}$           | Pulsed Drain Current at $V_{GS}=10V$                                                                             | 15         |                       |
| $E_{AS}$           | Single Pulse Avalanche Energy                                                                                    | 80         | mJ                    |
| $P_D$              | Power Dissipation                                                                                                | 45         | W                     |
|                    | Derating Factor above $25^{\circ}\text{C}$                                                                       | 0.36       | W/ $^{\circ}\text{C}$ |
| $T_L$<br>$T_{PAK}$ | Maximum Temperature for Soldering Leads at 0.063in (1.6mm) from Case for 10 seconds, Package Body for 10 seconds | 300<br>260 | $^{\circ}\text{C}$    |
| $T_J$ & $T_{STG}$  | Operating and Storage Temperature Range                                                                          | -55 to 150 |                       |



Caution: Stresses greater than those listed in the “Absolute Maximum Ratings” may cause permanent damage to the device.

## Thermal Characteristics

| Symbol          | Parameter                               | Value | Unit                 |
|-----------------|-----------------------------------------|-------|----------------------|
| $R_{\theta JC}$ | Thermal Resistance, Junction-to-Case    | 2.8   | $^{\circ}\text{C/W}$ |
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient | 62.5  | $^{\circ}\text{C/W}$ |

## Electrical Characteristics $T_j=25^{\circ}\text{C}$

### OFF Characteristics

| Symbol     | Parameter                         | Min | Typ | Max  | Unit    | Test Condition                                    |
|------------|-----------------------------------|-----|-----|------|---------|---------------------------------------------------|
| $BV_{DSS}$ | Drain-to-Source Breakdown Voltage | 500 | -   | -    | V       | $V_{GS}=0V, I_D=250\mu A$                         |
| $I_{DSS}$  | Drain-to-Source Leakage Current   | -   | -   | 1    | $\mu A$ | $V_{DS}=500V, V_{GS}=0V$                          |
|            |                                   | -   | -   | 100  |         | $V_{DS}=400V, V_{GS}=0V, T_j=125^{\circ}\text{C}$ |
| $I_{GSS}$  | Gate-to-Source Leakage Current    | -   | -   | +100 | nA      | $V_{GS}=+30V, V_{DS}=0V$                          |
|            |                                   | -   | -   | -100 |         | $V_{GS}=-30V, V_{DS}=0V$                          |

### ON Characteristics

| Symbol       | Parameter                            | Min | Typ | Max  | Unit     | Test Condition                |
|--------------|--------------------------------------|-----|-----|------|----------|-------------------------------|
| $R_{DS(ON)}$ | Static Drain-to-Source On-Resistance | -   | -   | 1.55 | $\Omega$ | $V_{GS}=10V, I_D=2.5A$        |
| $V_{GS(TH)}$ | Gate Threshold Voltage               | 2.5 | -   | 4.5  | V        | $V_{DS}=V_{GS}, I_D=250\mu A$ |



## Dynamic Characteristics

| Symbol    | Parameter                     | Min | Typ | Max | Unit | Test Condition                                    |
|-----------|-------------------------------|-----|-----|-----|------|---------------------------------------------------|
| $C_{iss}$ | Input Capacitance             | -   | 528 | -   | nF   | $V_{GS}=0V$ ,<br>$V_{DS}=25V$ ,<br>$f=1.0MHz$     |
| $C_{rss}$ | Reverse Transfer Capacitance  | -   | 4   | -   |      |                                                   |
| $C_{oss}$ | Output Capacitance            | -   | 52  | -   |      |                                                   |
| $Q_g$     | Total Gate Charge             | -   | 13  | -   | nC   | $V_{DD}=400V$ ,<br>$I_D=5A$ , $V_{GS}=0$ to $10V$ |
| $Q_{gs}$  | Gate-to-Source Charge         | -   | 3   | -   |      |                                                   |
| $Q_{gd}$  | Gate-to-Drain (Miller) Charge | -   | 6.2 | -   |      |                                                   |

## Resistive Switching Characteristics

| Symbol       | Parameter           | Min | Typ | Max | Unit | Test Condition                                                  |
|--------------|---------------------|-----|-----|-----|------|-----------------------------------------------------------------|
| $t_{d(ON)}$  | Turn-on Delay Time  | -   | 14  | -   | nS   | $V_{DD}=250V$ ,<br>$I_D=5A$ ,<br>$V_{GS}=10V$<br>$R_g=25\Omega$ |
| $t_{rise}$   | Rise Time           | -   | 15  | -   |      |                                                                 |
| $t_{d(OFF)}$ | Turn-Off Delay Time | -   | 29  | -   |      |                                                                 |
| $t_{fall}$   | Fall Time           | -   | 12  | -   |      |                                                                 |

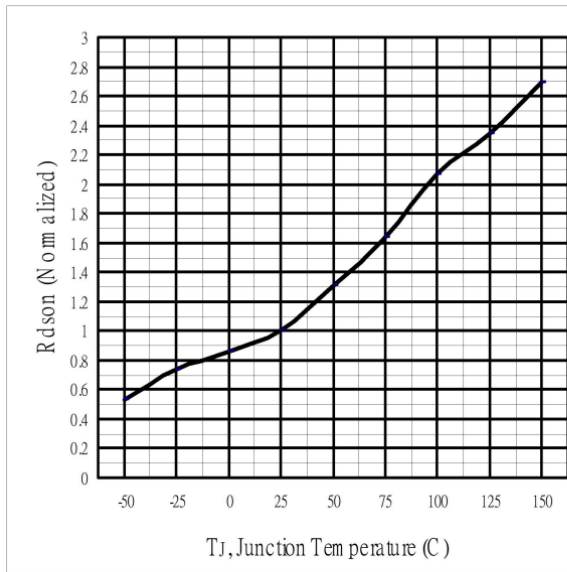
## Source-Drain Body Diode Characteristics

| Symbol   | Parameter                                | Min | Typ | Max | Unit | Test Condition                                 |
|----------|------------------------------------------|-----|-----|-----|------|------------------------------------------------|
| $I_{SD}$ | Continuous Source Current <sup>[1]</sup> | -   | -   | 5   | A    | Integral PN-diode in MOSFET                    |
| $I_{SM}$ | Pulsed Source Current <sup>[1]</sup>     | -   | -   | 15  |      |                                                |
| $V_{SD}$ | Diode Forward Voltage                    | -   | -   | 1.5 | V    | $I_S=5A$ , $V_{GS}=0V$                         |
| $t_{rr}$ | Reverse Recovery Time                    | -   | 213 | -   | ns   | $V_{GS}=0V$ $I_F=5A$ ,<br>$di_F/dt=100A/\mu s$ |

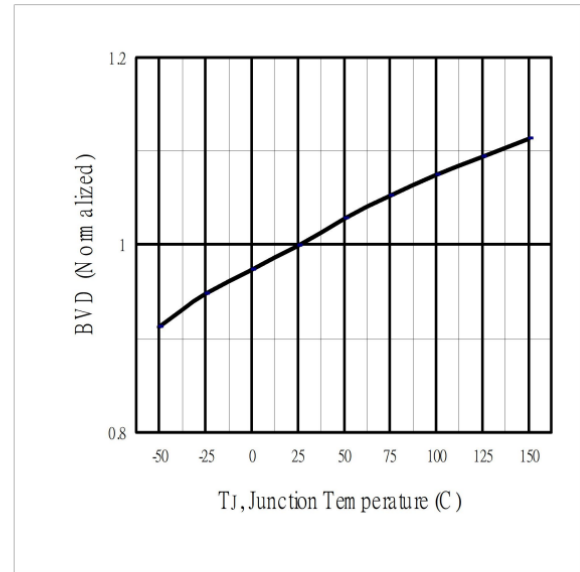
[1] Pulse width $\leq 380\mu s$ ; duty cycle $\leq 2\%$



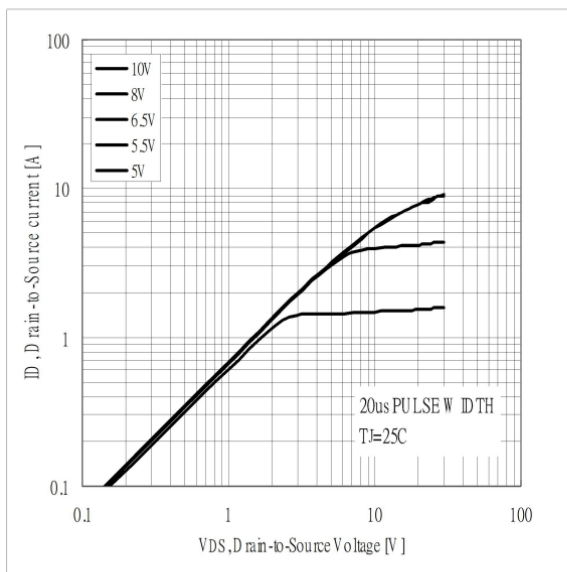
## Typical Characteristics



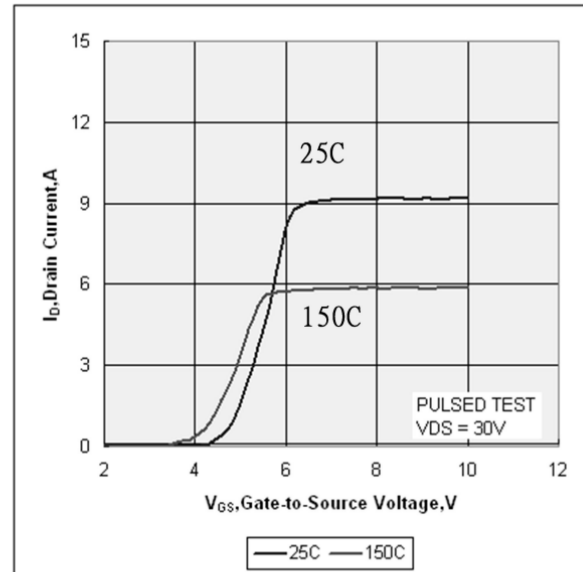
**Fig 1. On-Resistance Variation with vs. Temperature**



**Fig 2. Breakdown Voltage Variation vs. Temperature**



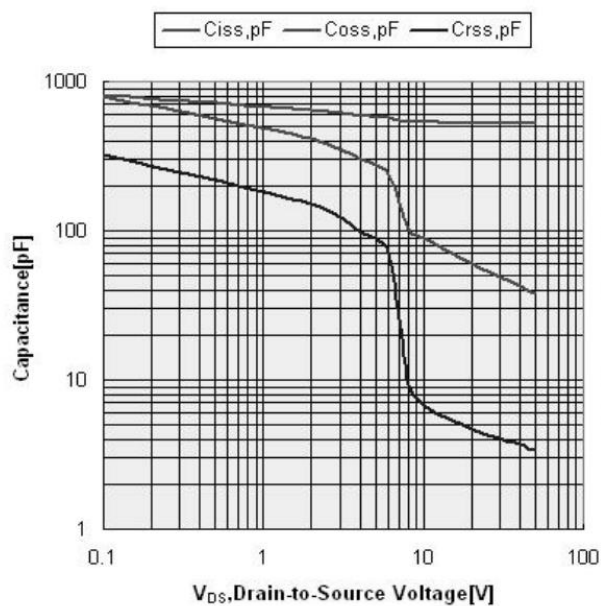
**Fig 3. Typical Output Characteristics**



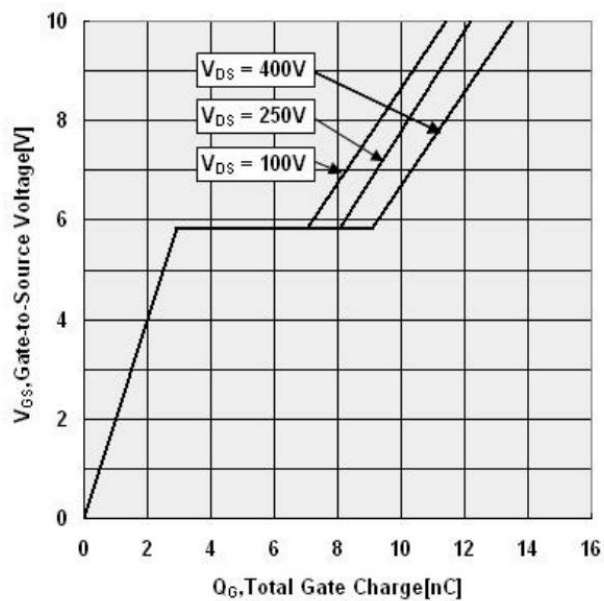
**Fig 4. Typical Transfer Characteristics**



## Typical Characteristics(Cont.)



**Fig 5. Typical Capacitance Vs. Drain-to-Source Voltage**



**Fig 6. Typical Gate Charge Vs. Gate-to-Source Voltage**



D.U.T.

$V_{DS}$

$V_{GS}$

$R_G$

Driver

Same Type as D.U.T.

$L$

$V_{DD}$

- \*  $dv/dt$  controlled by  $R_G$
- \*  $I_{SD}$  controlled by pulse period
- \* D.U.T.-Device Under Test

The diagram illustrates the switching behavior of a MOSFET's body diode. The top trace,  $V_{GS}$  (Driver), is a square wave with pulse width (P.W.) and period (Period). The duty cycle is given by  $D = \frac{P.W.}{Period}$ . The middle trace,  $I_{SD}$  (D.U.T.), shows the source-drain current. During the MOSFET's on-time, it carries the forward current  $I_{FM}$ . When the MOSFET turns off, the current reverses to  $I_{RM}$  (Body Diode Reverse Current) as the inductor's energy is transferred to the diode. The bottom trace,  $V_{DS}$  (D.U.T.), shows the drain-source voltage. During the MOSFET's on-time, it is at a low level. When the MOSFET turns off, the voltage rises to  $V_{DD}$  (Body Diode Recovery  $dV/dt$ ). The diagram also indicates the Body Diode Forward Voltage Drop and the Body Diode Recovery  $dV/dt$ .

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## Test Circuits and Waveforms (Cont.)

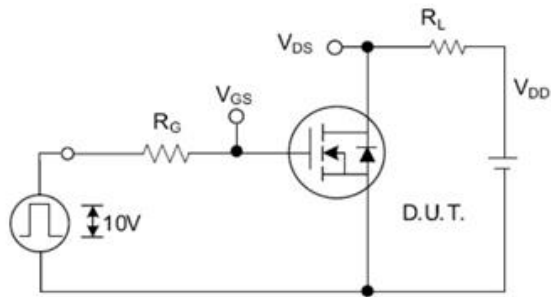


Fig. 2.1 Switching Test Circuit

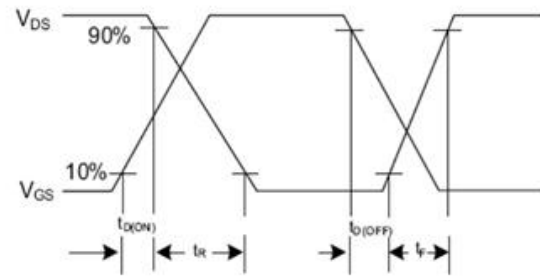


Fig. 2.2 Switching Waveforms

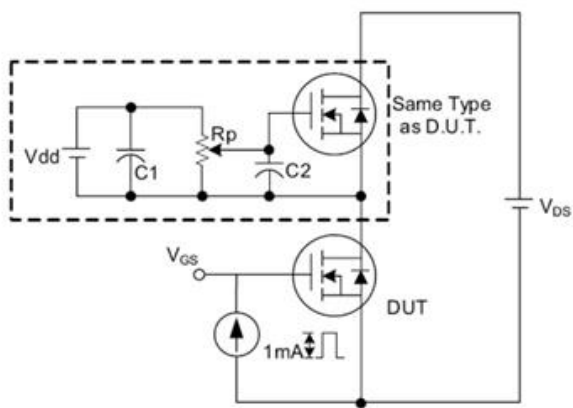


Fig. 3.1 Gate Charge Test Circuit

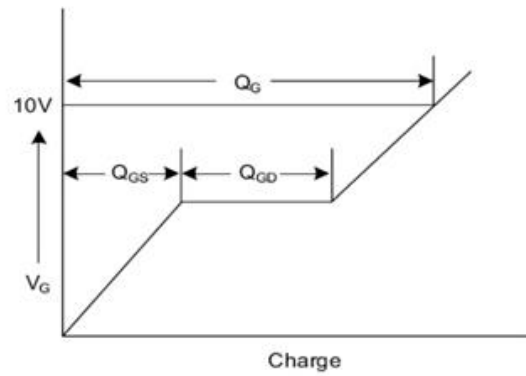


Fig. 3.2 Gate Charge Waveform

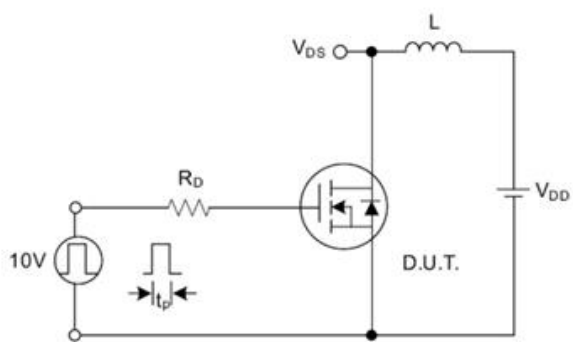


Fig. 4.1 Unclamped Inductive Switching Test Circuit

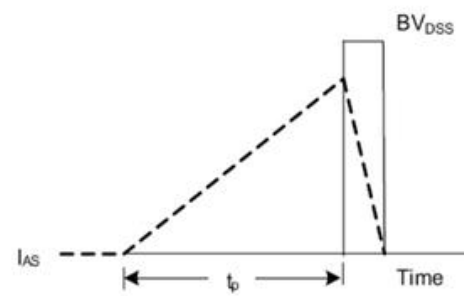


Fig. 4.2 Unclamped Inductive Switching Waveforms