

# N0609N

## N-channel MOSFET

60 V, 120 A, 3.0 mΩ

R07DS1294EJ0100

Rev.1.00

2019.9.30

### Features

- Low on-state resistance :  $R_{DS(on)} = 3.0 \text{ m}\Omega$  max. (  $V_{GS} = 10 \text{ V}$ ,  $I_D = 60 \text{ A}$  )
- Low  $C_{iss}$  :  $C_{iss} = 11300 \text{ pF}$  typ. (  $V_{DS} = 25 \text{ V}$  )
- High current :  $I_{D(DC)} = \pm 120 \text{ A}$
- RoHS Compliant
- Quality Grade : Standard
- Applications : For high current switching

### Ordering Information

| Orderable Part Number | Package                            | Packing                  |
|-----------------------|------------------------------------|--------------------------|
| N0609N-S19-AY         | TO-220AB, Pb-free <sup>Note1</sup> | 50 pcs / Magazine (Tube) |

Note: 1. Pb-free means that this product does not contain lead in the external electrode.

### Absolute Maximum Ratings ( $T_A = 25^\circ\text{C}$ )

| Item                                                 | Symbol         | Ratings    | Unit             |
|------------------------------------------------------|----------------|------------|------------------|
| Drain to Source Voltage ( $V_{GS} = 0 \text{ V}$ )   | $V_{DSS}$      | 60         | V                |
| Gate to Source Voltage ( $V_{DS} = 0 \text{ V}$ )    | $V_{GSS}$      | $\pm 20$   | V                |
| Drain Current (DC) ( $T_C = 25^\circ\text{C}$ )      | $I_{D(DC)}$    | $\pm 120$  | A                |
| Drain Current (pulse) <sup>Note2</sup>               | $I_{D(pulse)}$ | $\pm 480$  | A                |
| Total Power Dissipation ( $T_C = 25^\circ\text{C}$ ) | $P_{T1}$       | 282        | W                |
| Total Power Dissipation ( $T_A = 25^\circ\text{C}$ ) | $P_{T2}$       | 1.8        | W                |
| Channel Temperature                                  | $T_{ch}$       | 150        | $^\circ\text{C}$ |
| Storage Temperature                                  | $T_{stg}$      | -55 to 150 | $^\circ\text{C}$ |
| Single Avalanche Current <sup>Note3</sup>            | $I_{AS}$       | 65         | A                |
| Single Avalanche Energy <sup>Note3</sup>             | $E_{AS}$       | 420        | mJ               |

Note: Continuous heavy condition (e.g. high temperature/voltage/current or high variation of temperature) may affect a reliability even if it is within the absolute maximum ratings. Please consider derating condition for appropriate reliability in reference Renesas Semiconductor Reliability Handbook (Recommendation for Handling and Usage of Semiconductor Devices) and individual reliability data.

Notes: 2.  $PW \leq 10 \mu\text{s}$ , Duty Cycle  $\leq 1\%$

3. Starting  $T_{ch} = 25^\circ\text{C}$ ,  $V_{DD} = 30 \text{ V}$ ,  $R_G = 25 \Omega$ ,  $V_{GS} = 20 \rightarrow 0 \text{ V}$ ,  $L = 100 \mu\text{H}$

### Thermal Resistance

| Item                                  | Symbol         | Max. Value <sup>Note4</sup> | Unit               |
|---------------------------------------|----------------|-----------------------------|--------------------|
| Channel to Case Thermal Resistance    | $R_{th(ch-C)}$ | 0.44                        | $^\circ\text{C/W}$ |
| Channel to Ambient Thermal Resistance | $R_{th(ch-A)}$ | 69.3                        | $^\circ\text{C/W}$ |

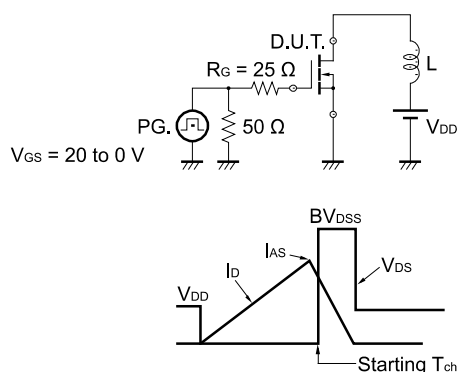
Notes: 4. This data is the designed target maximum value on Renesas's measurement condition. (Not tested)

Electrical Characteristics ( $T_A = 25^\circ\text{C}$ )

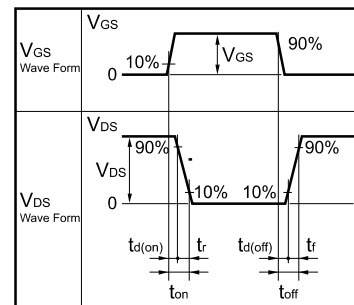
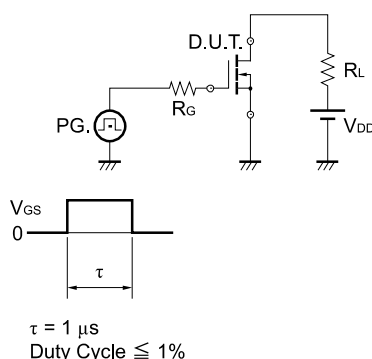
| Item                                                 | Symbol        | Min. | Typ.  | Max.      | Unit             | Test Conditions                                                                             |
|------------------------------------------------------|---------------|------|-------|-----------|------------------|---------------------------------------------------------------------------------------------|
| Zero Gate Voltage Drain Current                      | $I_{DSS}$     |      |       | 1         | $\mu\text{A}$    | $V_{DS} = 60\text{ V}$ , $V_{GS} = 0\text{ V}$                                              |
| Gate Leakage Current                                 | $I_{GSS}$     |      |       | $\pm 100$ | nA               | $V_{GS} = \pm 20\text{ V}$ , $V_{DS} = 0\text{ V}$                                          |
| Gate to Source Cut-off Voltage                       | $V_{GS(off)}$ | 2.0  |       | 4.0       | V                | $V_{DS} = 10\text{ V}$ , $I_D = 1\text{ mA}$                                                |
| Forward Transfer Admittance <sup>Note5</sup>         | $ y_{fs} $    |      | 78    |           | S                | $V_{DS} = 10\text{ V}$ , $I_D = 60\text{ A}$                                                |
| Drain to Source On-state Resistance <sup>Note5</sup> | $R_{DS(on)}$  |      | 2.5   | 3.0       | $\text{m}\Omega$ | $V_{GS} = 10\text{ V}$ , $I_D = 60\text{ A}$                                                |
| Input Capacitance                                    | $C_{iss}$     |      | 11300 |           | pF               | $V_{DS} = 25\text{ V}$<br>$V_{GS} = 0\text{ V}$<br>$f = 1\text{ MHz}$                       |
| Output Capacitance                                   | $C_{oss}$     |      | 800   |           | pF               |                                                                                             |
| Reverse Transfer Capacitance                         | $C_{rss}$     |      | 480   |           | pF               |                                                                                             |
| Turn-on Delay Time                                   | $t_{d(on)}$   |      | 40    |           | ns               | $V_{DD} = 30\text{ V}$ , $I_D = 60\text{ A}$<br>$V_{GS} = 10\text{ V}$<br>$R_G = 0\ \Omega$ |
| Rise Time                                            | $t_r$         |      | 15    |           | ns               |                                                                                             |
| Turn-off Delay Time                                  | $t_{d(off)}$  |      | 140   |           | ns               |                                                                                             |
| Fall Time                                            | $t_f$         |      | 16    |           | ns               |                                                                                             |
| Total Gate Charge                                    | $Q_G$         |      | 210   |           | nC               | $V_{DD} = 48\text{ V}$<br>$V_{GS} = 10\text{ V}$<br>$I_D = 120\text{ A}$                    |
| Gate to Source Charge                                | $Q_{GS}$      |      | 45    |           | nC               |                                                                                             |
| Gate to Drain Charge                                 | $Q_{GD}$      |      | 70    |           | nC               |                                                                                             |
| Body Diode Forward Voltage <sup>Note5</sup>          | $V_{F(S-D)}$  |      |       | 1.5       | V                | $I_F = 120\text{ A}$ , $V_{GS} = 0\text{ V}$                                                |
| Reverse Recovery Time                                | $t_{rr}$      |      | 53    |           | ns               | $I_F = 90\text{ A}$ , $V_{GS} = 0\text{ V}$<br>$di/dt = 100\text{ A}/\mu\text{s}$           |
| Reverse Recovery Charge                              | $Q_{rr}$      |      | 47    |           | nC               |                                                                                             |

Notes: 5. Pulsed test

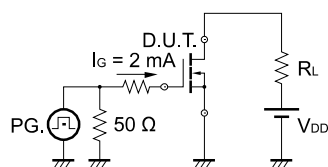
## TEST CIRCUIT 1 AVALANCHE CAPABILITY

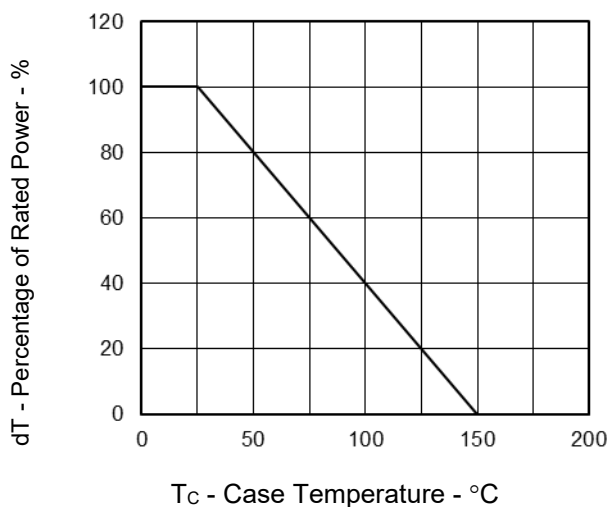
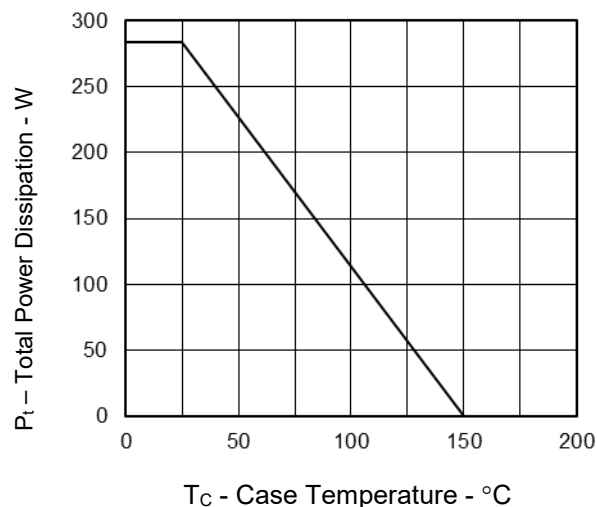


## TEST CIRCUIT 2 SWITCHING TIME

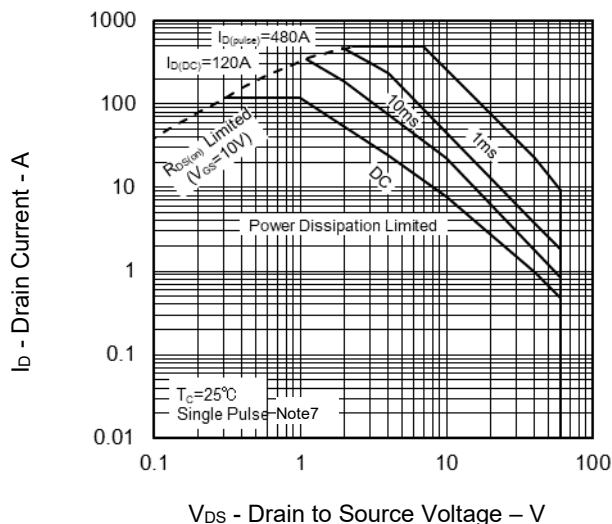


## TEST CIRCUIT 3 GATE CHARGE

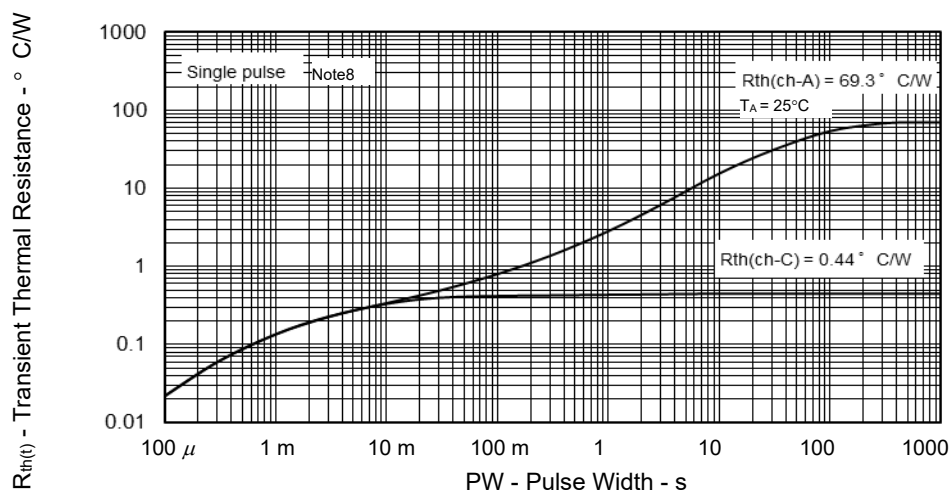


Typical Characteristics Note6DERATING FACTOR OF FORWARD BIAS  
SAFE OPERATING AREATOTAL POWER DISSIPATION vs.  
CASE TEMPERATURE

FORWARD BIAS SAFE OPERATING AREA



TRANSIENT THERMAL RESISTANCE vs. PULSE WIDTH

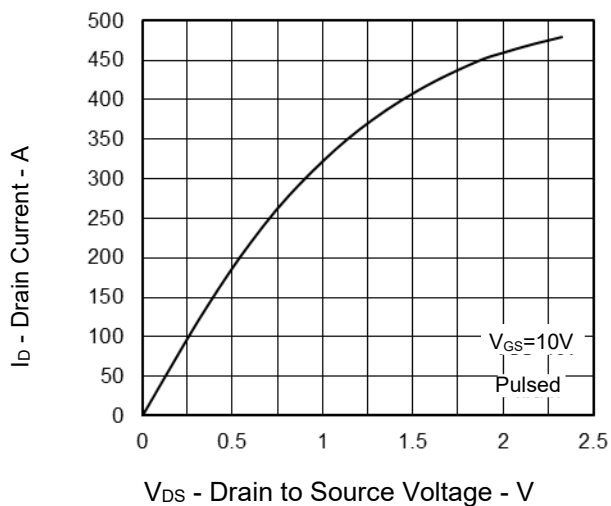


Notes: 6. Designed target value on Renesas measurement condition. ( $T_C = 25^{\circ}\text{C}$ , unless otherwise specified)

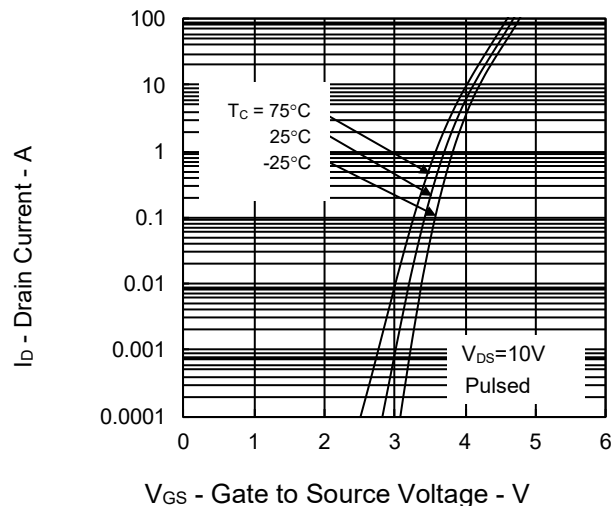
7. This data is the designed value on Renesas's measurement condition. Renesas recommends that operating conditions are designed according to a document "Power MOSFET/IGBT Attention of Handling Semiconductor Devices (R07ZZ0010)".

8. This data is the designed target maximum value on Renesas's measurement condition.

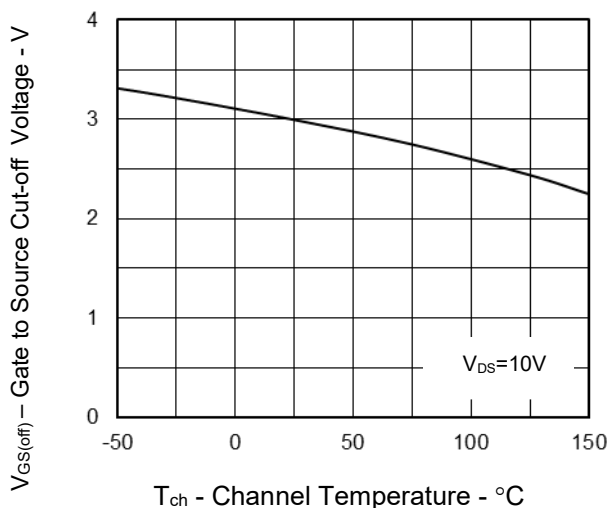
DRAIN CURRENT vs. DRAIN TO SOURCE VOLTAGE



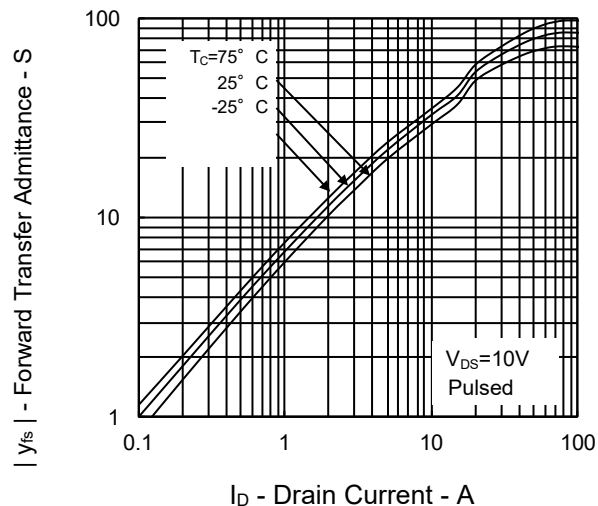
FORWARD TRANSFER CHARACTERISTICS



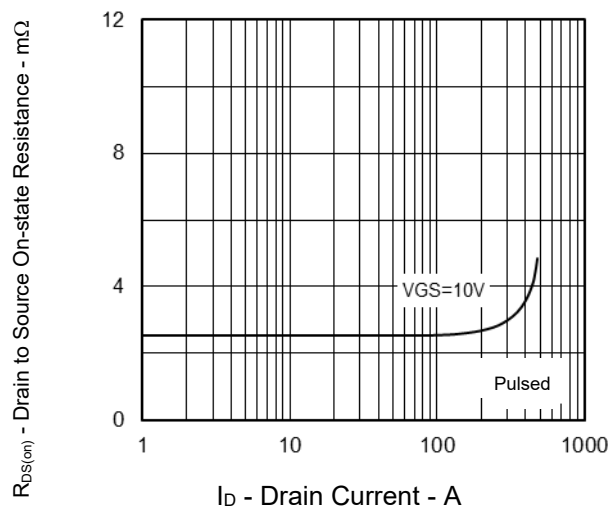
GATE TO SOURCE THRESHOLD VOLTAGE vs. CHANNEL TEMPERATURE



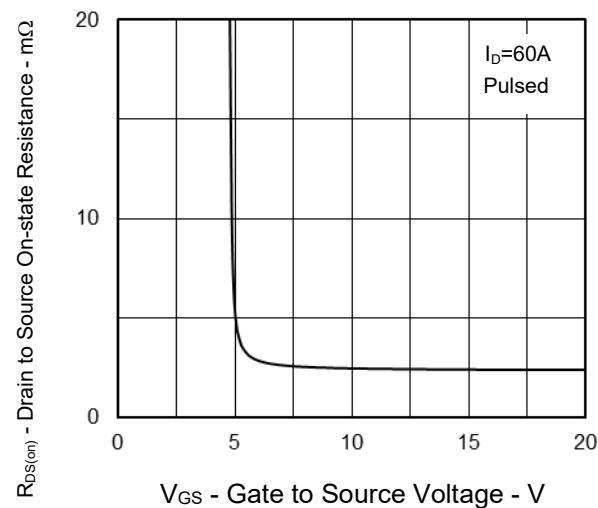
FORWARD TRANSFER ADMITTANCE vs. DRAIN CURRENT



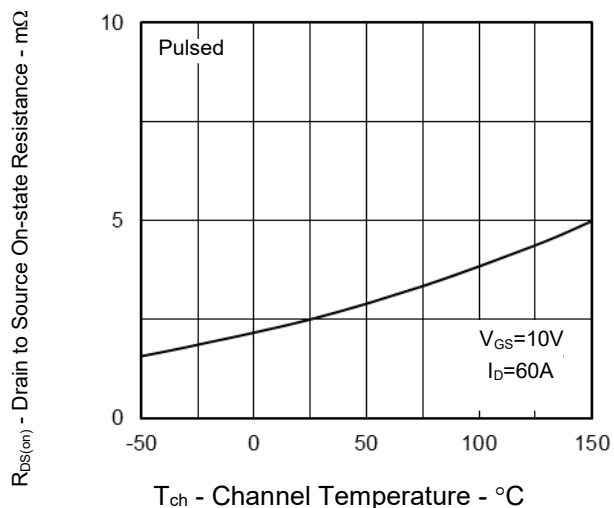
DRAIN TO SOURCE ON-STATE RESISTANCE vs. DRAIN CURRENT



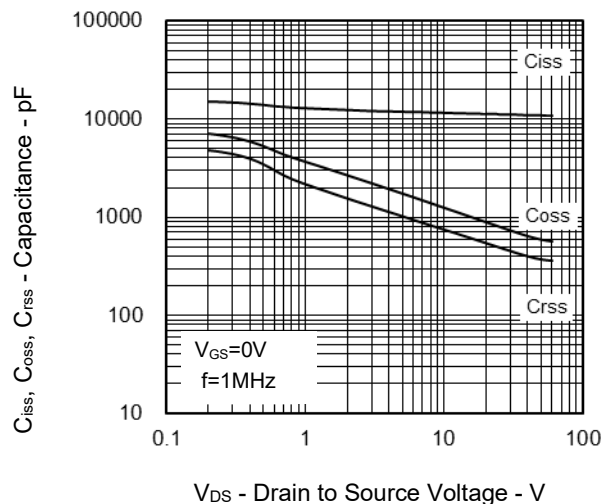
DRAIN TO SOURCE ON-STATE RESISTANCE vs. GATE TO SOURCE VOLTAGE



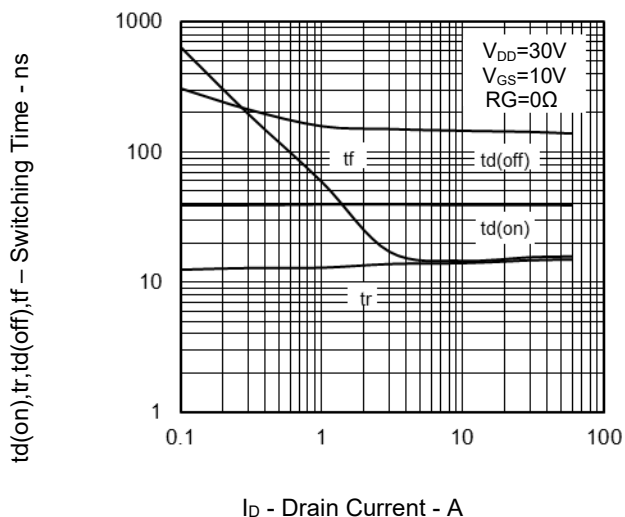
### DRAIN TO SOURCE ON-STATE RESISTANCE vs. CHANNEL TEMPERATURE



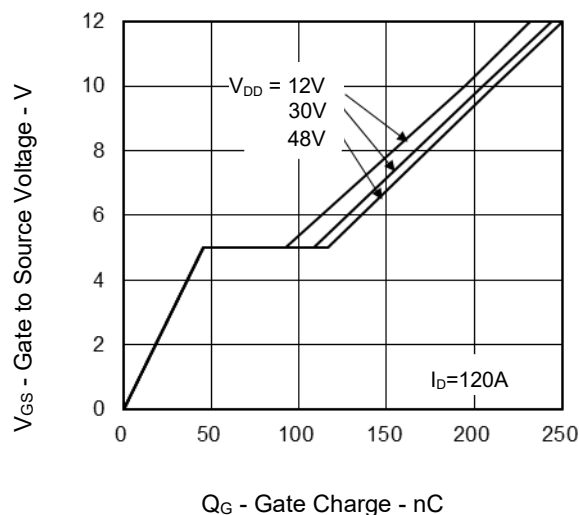
### CAPACITANCE vs. DRAIN TO SOURCE VOLTAGE



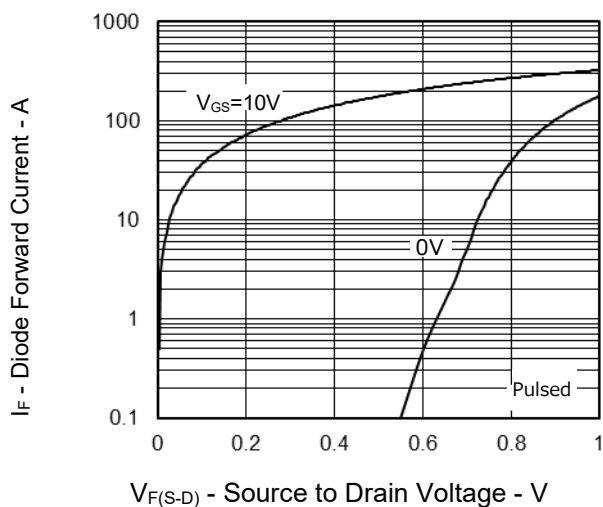
### SWITCHING CHARACTERISTICS



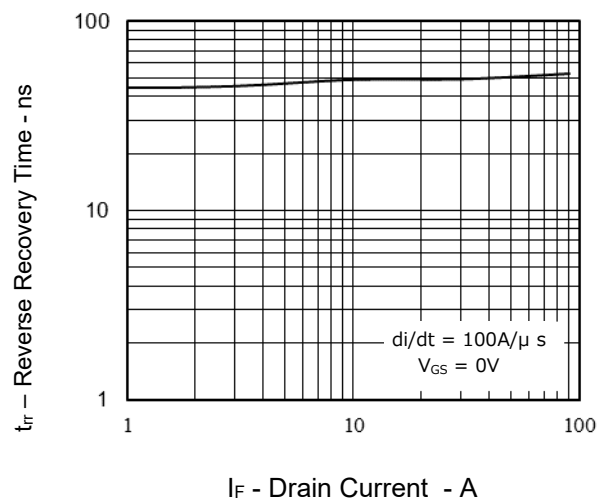
### DYNAMIC INPUT CHARACTERISTICS



### SOURCE TO DRAIN DIODE FORWARD VOLTAGE



### REVERSE RECOVERY TIME vs. DRAIN CURRENT





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