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April 1st, 2010
Renesas Electronics Corporation

Issued by: Renesas Electronics Corporation (<http://www.renesas.com>)

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MOS FIELD EFFECT TRANSISTOR

N0301N

N-CHANNEL MOS FIELD EFFECT TRANSISTOR FOR SWITCHING

DESCRIPTION

The N0301N is a switching device which can be driven directly by a 4.0 V power source.

The N0301N features a low on-state resistance and excellent switching characteristics, and is suitable for applications such as power switch of portable machine and so on.

FEATURES

- 4.0 V drive available
- Low on-state resistance
 - $R_{DS(on)1} = 36 \text{ m}\Omega \text{ MAX. (} V_{GS} = 10 \text{ V, } I_D = 2.25 \text{ A)}$
 - $R_{DS(on)2} = 50 \text{ m}\Omega \text{ MAX. (} V_{GS} = 4.5 \text{ V, } I_D = 2.25 \text{ A)}$
 - $R_{DS(on)3} = 130 \text{ m}\Omega \text{ MAX. (} V_{GS} = 4.0 \text{ V, } I_D = 2.25 \text{ A)}$
- Built-in gate protection diode

ORDERING INFORMATION

| PART NUMBER | LEAD PLATING | PACKING | PACKAGE |
|--------------|---------------|------------------|---------|
| N0301N-T1-AT | Pure Sn (Tin) | Tape 3000 p/reel | SOT-23F |

Marking: XU

ABSOLUTE MAXIMUM RATINGS ($T_A = 25^\circ\text{C}$)

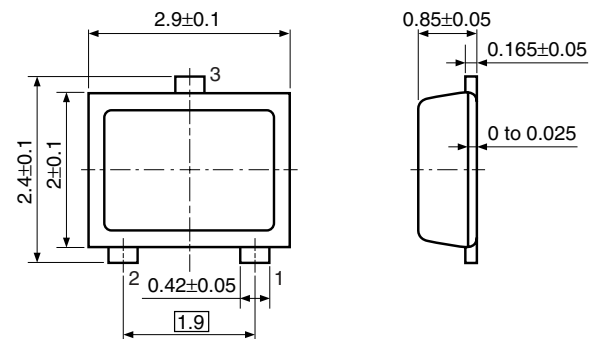
| | | | |
|---|----------------|-------------|------------------|
| Drain to Source Voltage ($V_{GS} = 0 \text{ V}$) | V_{DSS} | 30 | V |
| Gate to Source Voltage ($V_{DS} = 0 \text{ V}$) | V_{GSS} | ± 20 | V |
| Drain Current (DC) ($T_A = 25^\circ\text{C}$) | $I_{D(DC)}$ | ± 4.5 | A |
| Drain Current (pulse) ^{Note1} | $I_{D(pulse)}$ | ± 18 | A |
| Total Power Dissipation ($T_A = 25^\circ\text{C}$) | P_{T1} | 0.2 | W |
| Total Power Dissipation ($T_A = 25^\circ\text{C}$) ^{Note2} | P_{T2} | 1.3 | W |
| Channel Temperature | T_{ch} | 150 | $^\circ\text{C}$ |
| Storage Temperature | T_{stg} | -55 to +150 | $^\circ\text{C}$ |

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

2. Mounted on FR-4 board of 50 mm \times 50 mm \times 1.6 mm, copper foil 100%, $t \leq 5 \text{ sec}$.

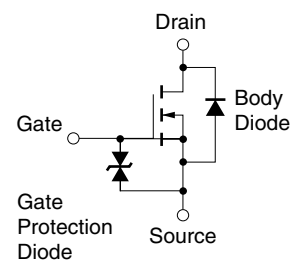
Remark The diode connected between the gate and source of the transistor serves as a protector against ESD. When this device actually used, an additional protection circuit is externally required if a voltage exceeding the rated voltage may be applied to this device.

PACKAGE DRAWING (Unit: mm)



1: Source
2: Gate
3: Drain

EQUIVALENT CIRCUIT



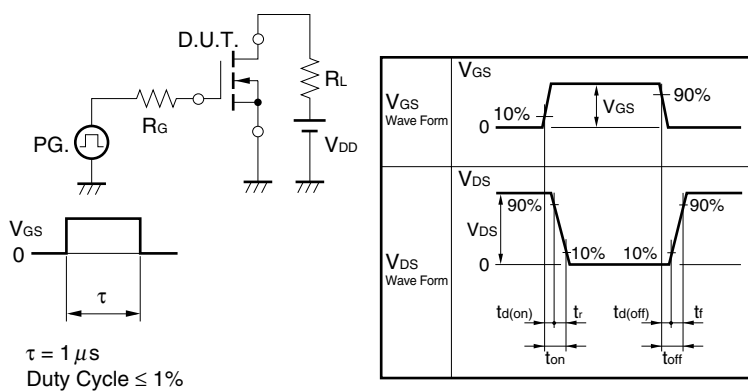
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ELECTRICAL CHARACTERISTICS (Ta = 25°C)

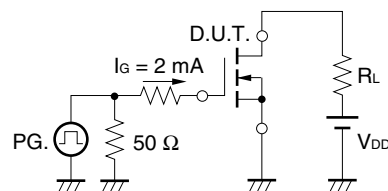
| CHARACTERISTICS | SYMBOL | TEST CONDITIONS | MIN. | TYP. | MAX. | UNIT |
|---|---------------|---|------|------|----------|---------------|
| Zero Gate Voltage Drain Current | I_{DSS} | $V_{DS} = 30\text{ V}, V_{GS} = 0\text{ V}$ | | | 10 | μA |
| Gate Leakage Current | I_{GSS} | $V_{GS} = \pm 16\text{ V}, V_{DS} = 0\text{ V}$ | | | ± 10 | μA |
| Gate to Source Cut-off Voltage | $V_{GS(off)}$ | $V_{DS} = 10\text{ V}, I_D = 1.0\text{ mA}$ | 1.0 | | 2.5 | V |
| Forward Transfer Admittance ^{Note} | $ y_{fs} $ | $V_{DS} = 10\text{ V}, I_D = 2.25\text{ A}$ | 2.0 | | | S |
| Drain to Source On-state Resistance ^{Note} | $R_{DS(on)1}$ | $V_{GS} = 10\text{ V}, I_D = 2.25\text{ A}$ | | 29 | 36 | m Ω |
| | $R_{DS(on)2}$ | $V_{GS} = 4.5\text{ V}, I_D = 2.25\text{ A}$ | | 36 | 50 | m Ω |
| | $R_{DS(on)3}$ | $V_{GS} = 4.0\text{ V}, I_D = 2.25\text{ A}$ | | 40 | 130 | m Ω |
| Input Capacitance | C_{iss} | $V_{DS} = 10\text{ V},$ $V_{GS} = 0\text{ V},$ $f = 1.0\text{ MHz}$ | | 400 | | pF |
| Output Capacitance | C_{oss} | $V_{GS} = 0\text{ V},$ $f = 1.0\text{ MHz}$ | | 80 | | pF |
| Reverse Transfer Capacitance | C_{rss} | $f = 1.0\text{ MHz}$ | | 50 | | pF |
| Turn-on Delay Time | $t_{d(on)}$ | $V_{DD} = 15\text{ V}, I_D = 2.25\text{ A},$ $V_{GS} = 10\text{ V},$ $R_G = 10\ \Omega$ | | 6 | | ns |
| Rise Time | t_r | $V_{GS} = 10\text{ V},$ $R_G = 10\ \Omega$ | | 4 | | ns |
| Turn-off Delay Time | $t_{d(off)}$ | $R_G = 10\ \Omega$ | | 23 | | ns |
| Fall Time | t_f | $R_G = 10\ \Omega$ | | 4 | | ns |
| Total Gate Charge | Q_G | $V_{DD} = 24\text{ V},$ $V_{GS} = 10\text{ V},$ $I_D = 4.5\text{ A}$ | | 10 | | nC |
| Gate to Source Charge | Q_{GS} | $V_{GS} = 10\text{ V},$ $I_D = 4.5\text{ A}$ | | 1.5 | | nC |
| Gate to Drain Charge | Q_{GD} | $I_D = 4.5\text{ A}$ | | 2.5 | | nC |
| Body Diode Forward Voltage ^{Note} | $V_{F(S-D)}$ | $I_F = 4.5\text{ A}, V_{GS} = 0\text{ V}$ | | 0.84 | | V |
| Reverse Recovery Time | T_{rr} | $I_F = 4.5\text{ A}, V_{GS} = 0\text{ V},$ $di/dt = 50\text{ A}/\mu\text{s}$ | | 20 | | ns |
| Reverse Recovery Charge | Q_{rr} | $di/dt = 50\text{ A}/\mu\text{s}$ | | 7 | | nC |

Note Pulsed

TEST CIRCUIT 1 SWITCHING TIME

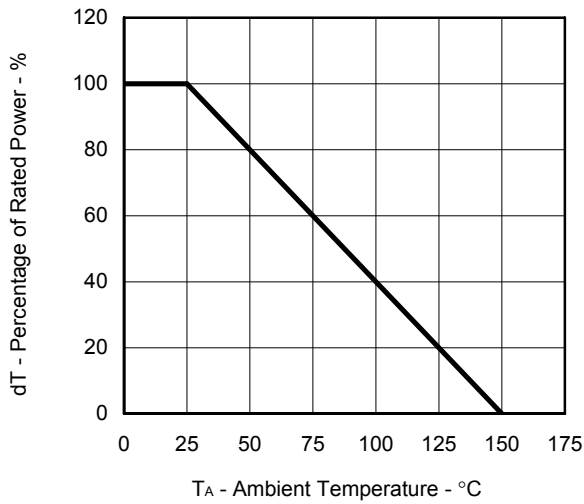


TEST CIRCUIT 2 GATE CHARGE

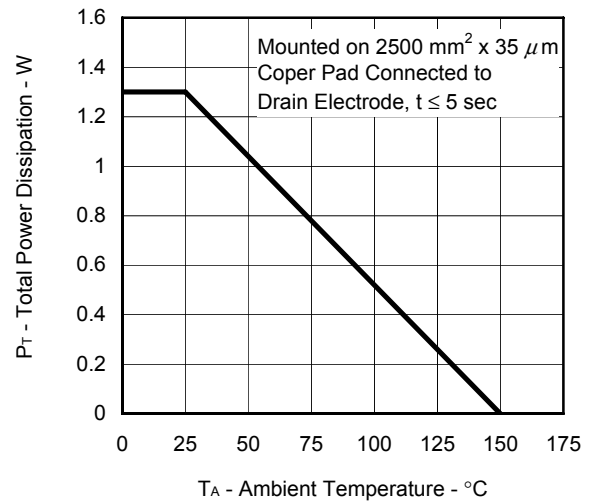


TYPICAL CHARACTERISTICS (T_A = 25°C)

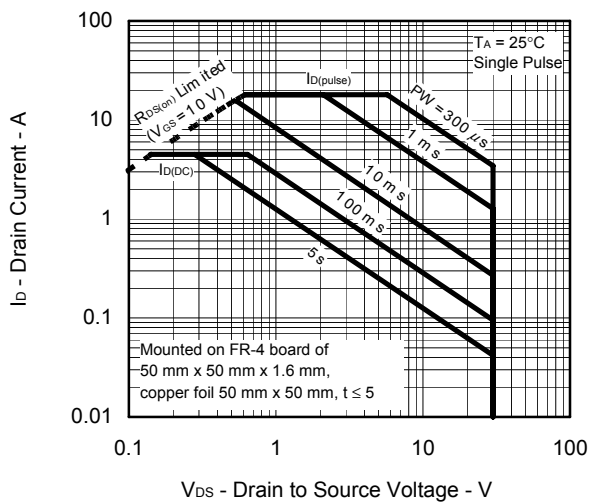
DERATING FACTOR OF FORWARD BIAS SAFE OPERATING AREA



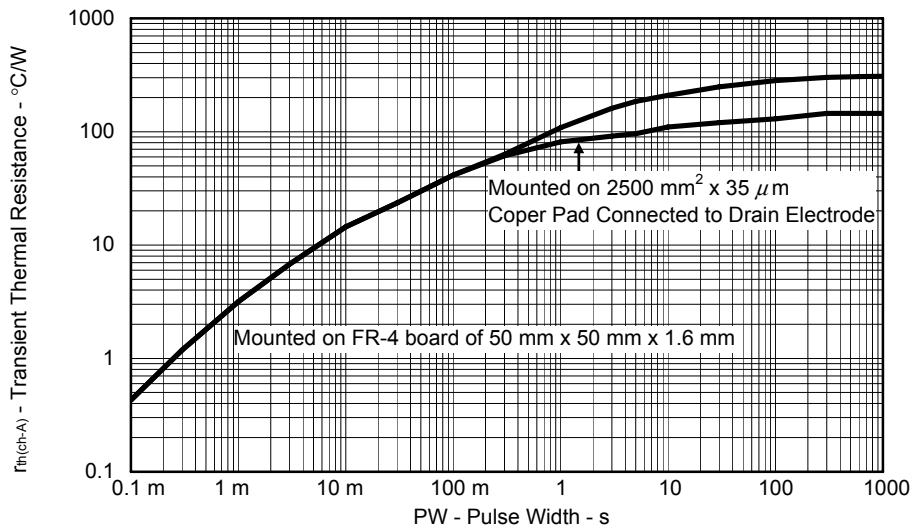
TOTAL POWER DISSIPATION vs. CASE TEMPERATURE



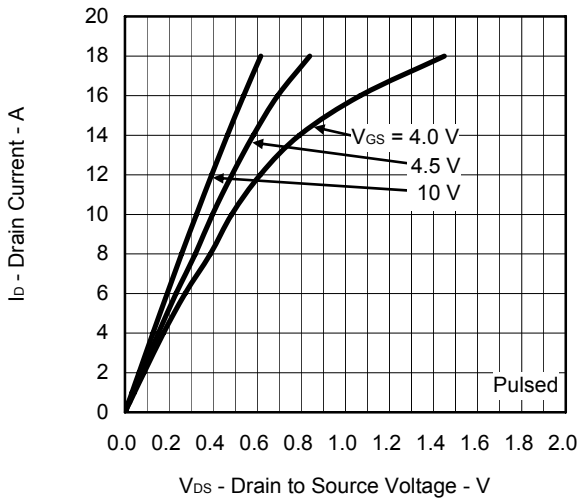
FORWARD BIAS SAFE OPERATING AREA



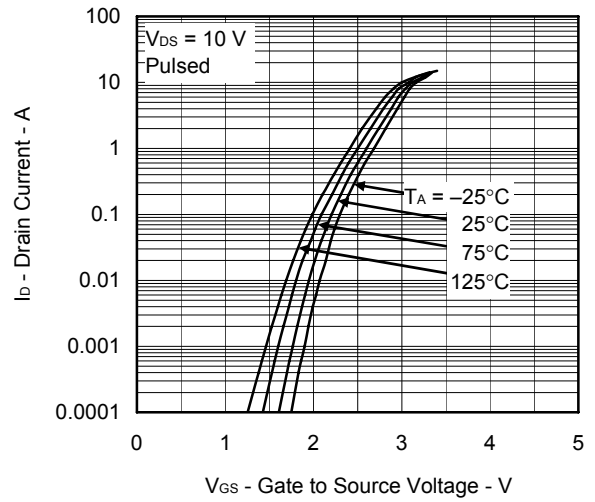
TRANSIENT THERMAL RESISTANCE vs. PULSE WIDTH



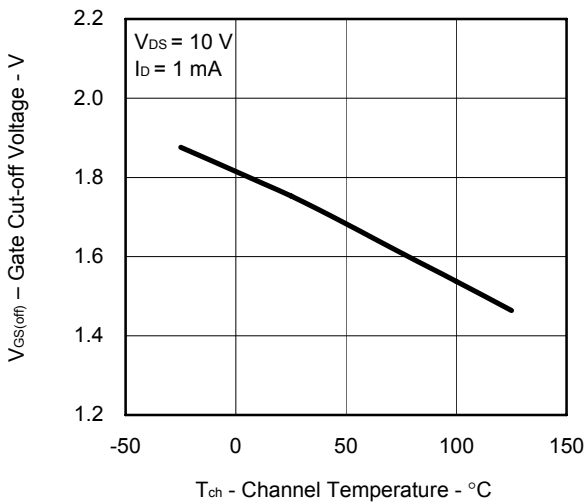
DRAIN CURRENT vs. DRAIN TO SOURCE VOLTAGE



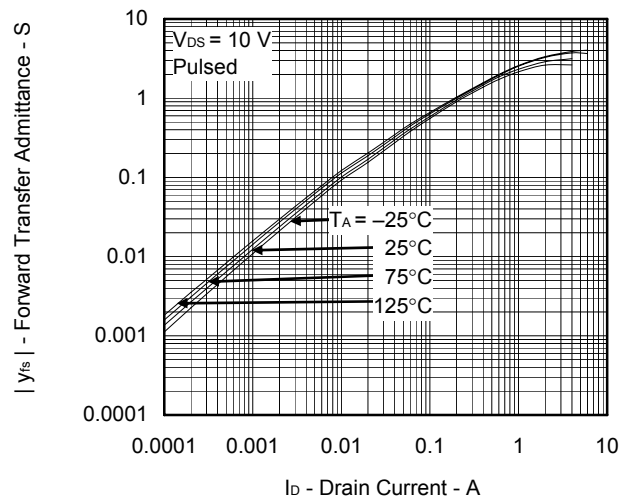
FORWARD TRANSFER CHARACTERISTICS



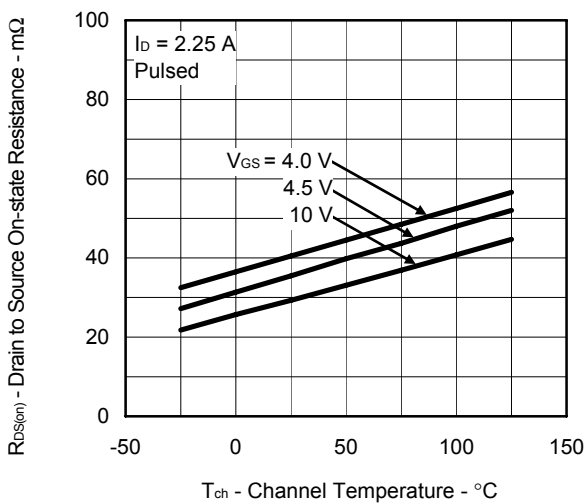
GATE CUT-OFF VOLTAGE vs. CHANNEL TEMPERATURE



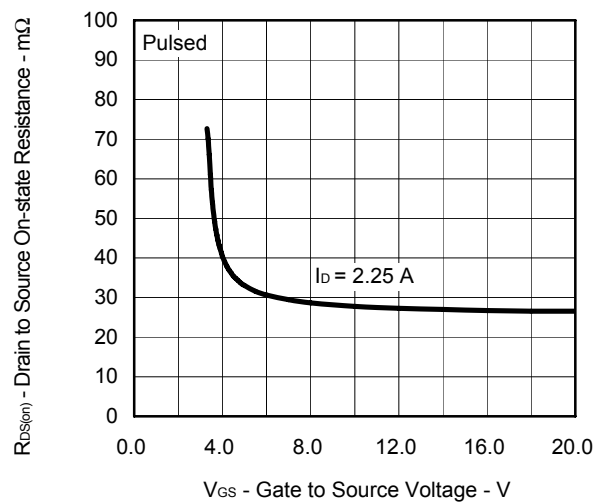
FORWARD TRANSFER ADMITTANCE vs. DRAIN CURRENT



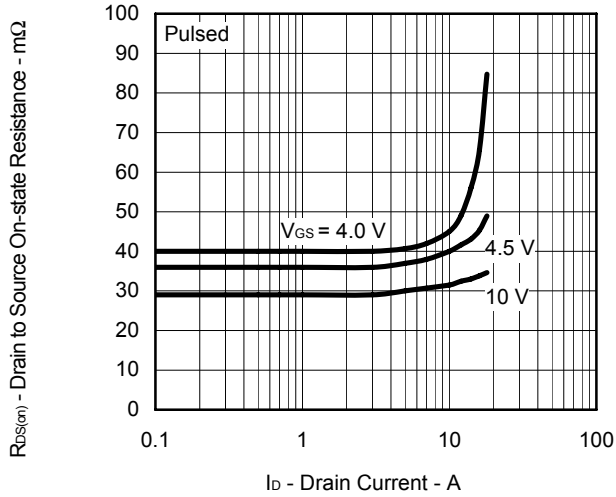
DRAIN TO SOURCE ON-STATE RESISTANCE vs. CHANNEL TEMPERATURE



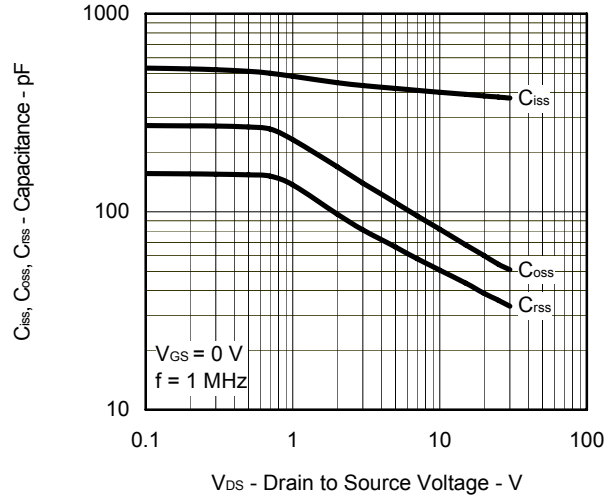
DRAIN TO SOURCE ON-STATE RESISTANCE vs. GATE TO SOURCE VOLTAGE



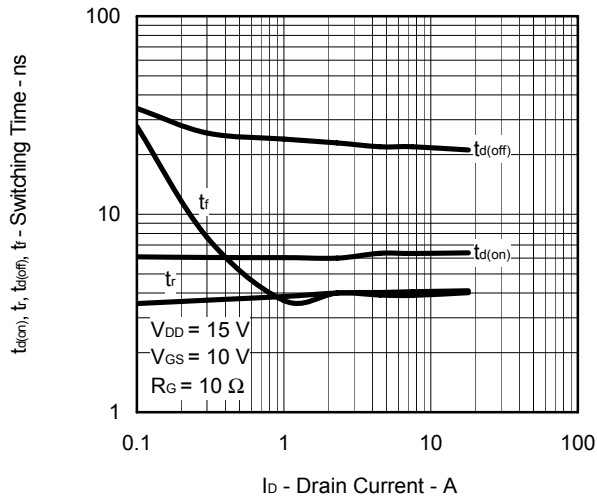
DRAIN TO SOURCE ON-STATE RESISTANCE vs. DRAIN CURRENT



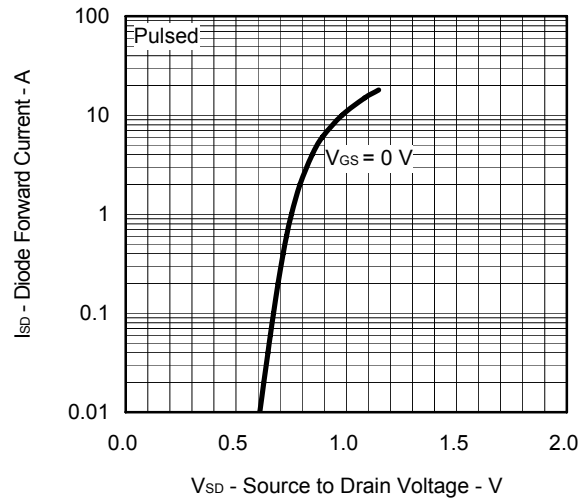
CAPACITANCE vs. DRAIN TO SOURCE VOLTAGE



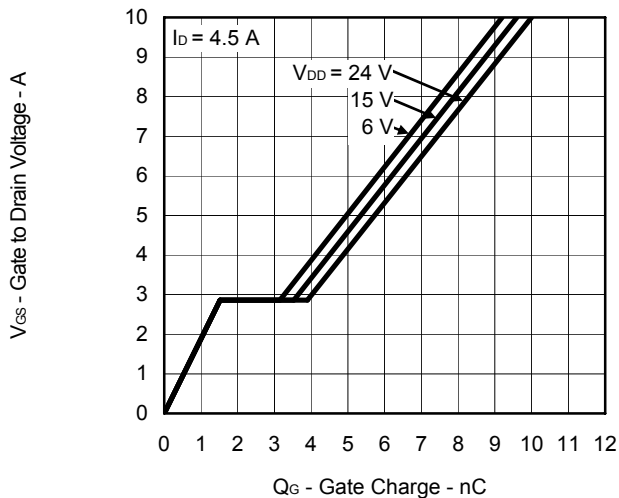
SWITCHING CHARACTERISTICS



SOURCE TO DRAIN DIODE FORWARD VOLTAGE



DYNAMIC INPUT/OUTPUT CHARACTERISTICS



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