

# FMI16N60E

FUJI POWER MOSFET

## Super FAP-E<sup>3</sup> series

## N-CHANNEL SILICON POWER MOSFET

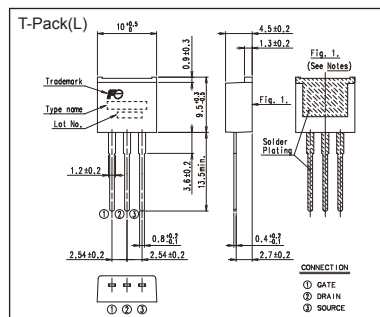
### ■ Features

Maintains both low power loss and low noise  
Lower  $R_{DS(on)}$  characteristic  
More controllable switching  $dv/dt$  by gate resistance  
Smaller  $V_{GS}$  ringing waveform during switching  
Narrow band of the gate threshold voltage ( $3.0 \pm 0.5V$ )  
High avalanche durability

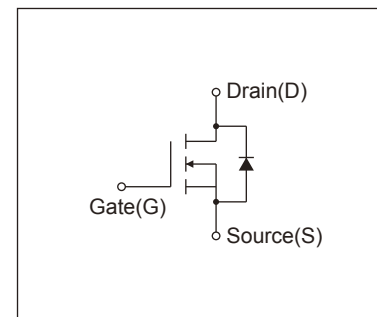
### ■ Applications

Switching regulators  
UPS (Uninterruptible Power Supply)  
DC-DC converters

### ■ Outline Drawings [mm]



### ■ Equivalent circuit schematic



### ■ Maximum Ratings and Characteristics

#### ● Absolute Maximum Ratings at $T_c=25^\circ C$ (unless otherwise specified)

| Description                                             | Symbol    | Characteristics | Unit        | Remarks          |
|---------------------------------------------------------|-----------|-----------------|-------------|------------------|
| Drain-Source Voltage                                    | $V_{DS}$  | 600             | V           |                  |
|                                                         | $V_{DSX}$ | 600             | V           | $V_{GS} = -30V$  |
| Continuous Drain Current                                | $I_D$     | $\pm 16$        | A           |                  |
| Pulsed Drain Current                                    | $I_{DP}$  | $\pm 64$        | A           |                  |
| Gate-Source Voltage                                     | $V_{GS}$  | $\pm 30$        | V           |                  |
| Repetitive and Non-Repetitive Maximum Avalanche Current | $I_{AR}$  | 16              | A           | Note*1           |
| Non-Repetitive Maximum Avalanche Energy                 | $E_{AS}$  | 554.8           | mJ          | Note*2           |
| Repetitive Maximum Avalanche Energy                     | $E_{AR}$  | 27              | mJ          | Note*3           |
| Peak Diode Recovery $dV/dt$                             | $dV/dt$   | 5.2             | kV/ $\mu s$ | Note*4           |
| Peak Diode Recovery $-di/dt$                            | $-di/dt$  | 100             | A/ $\mu s$  | Note*5           |
| Maximum Power Dissipation                               | $P_D$     | 2.16            | W           | $T_a=25^\circ C$ |
|                                                         |           | 270             |             | $T_c=25^\circ C$ |
| Operating and Storage Temperature range                 | $T_{ch}$  | 150             | $^\circ C$  |                  |
|                                                         | $T_{stg}$ | -55 to + 150    | $^\circ C$  |                  |

#### ● Electrical Characteristics at $T_c=25^\circ C$ (unless otherwise specified)

| Description                      | Symbol       | Conditions                                   | min. | typ. | max. | Unit     |
|----------------------------------|--------------|----------------------------------------------|------|------|------|----------|
| Drain-Source Breakdown Voltage   | $BV_{DSS}$   | $I_D=250\mu A, V_{GS}=0V$                    | 600  | -    | -    | V        |
| Gate Threshold Voltage           | $V_{GS(th)}$ | $I_D=250\mu A, V_{DS}=V_{GS}$                | 2.5  | 3.0  | 3.5  | V        |
| Zero Gate Voltage Drain Current  | $I_{DSS}$    | $V_{DS}=600V, V_{GS}=0V, T_{ch}=25^\circ C$  | -    | -    | 25   | $\mu A$  |
|                                  |              | $V_{DS}=480V, V_{GS}=0V, T_{ch}=125^\circ C$ | -    | -    | 250  |          |
| Gate-Source Leakage Current      | $I_{GSS}$    | $V_{GS}=\pm 30V, V_{DS}=0V$                  | -    | 10   | 100  | nA       |
| Drain-Source On-State Resistance | $R_{DS(on)}$ | $I_D=8A, V_{GS}=10V$                         | -    | 0.40 | 0.47 | $\Omega$ |
| Forward Transconductance         | $g_{fs}$     | $I_D=8A, V_{DS}=25V$                         | 10   | 20   | -    | S        |
| Input Capacitance                | $C_{iss}$    | $V_{DS}=25V$                                 | -    | 2650 | 3980 | pF       |
| Output Capacitance               | $C_{oss}$    | $V_{GS}=0V$                                  | -    | 230  | 345  |          |
| Reverse Transfer Capacitance     | $C_{rss}$    | $f=1MHz$                                     | -    | 17   | 25.5 |          |
| Turn-On Time                     | $t_{d(on)}$  | $V_{cc}=300V$                                | -    | 22   | 33   | ns       |
|                                  | $t_r$        | $V_{GS}=10V$                                 | -    | 10   | 15   |          |
| Turn-Off Time                    | $t_{d(off)}$ | $I_D=8A$                                     | -    | 120  | 180  |          |
|                                  | $t_f$        | $R_{GS}=10\Omega$                            | -    | 20   | 30   |          |
| Total Gate Charge                | $Q_G$        | $V_{cc}=300V$                                | -    | 76   | 114  | nC       |
| Gate-Source Charge               | $Q_{GS}$     | $I_D=16A$                                    | -    | 17   | 25.5 |          |
| Gate-Drain Charge                | $Q_{GD}$     | $V_{GS}=10V$                                 | -    | 22   | 33   |          |
| Avalanche Capability             | $I_{AV}$     | $L=1.74mH, T_{ch}=25^\circ C$                | 16   | -    | -    | A        |
| Diode Forward On-Voltage         | $V_{SD}$     | $I_F=16A, V_{GS}=0V, T_{ch}=25^\circ C$      | -    | 0.90 | 1.35 | V        |
| Reverse Recovery Time            | $t_{rr}$     | $I_F=16A, V_{GS}=0V$                         | -    | 0.7  | -    | $\mu s$  |
| Reverse Recovery Charge          | $Q_{rr}$     | $-di/dt=100A/\mu s, T_{ch}=25^\circ C$       | -    | 9    | -    | $\mu C$  |

### ● Thermal Characteristics

| Description        | Symbol         | Test Conditions    | min. | typ. | max.  | Unit         |
|--------------------|----------------|--------------------|------|------|-------|--------------|
| Thermal resistance | $R_{th(ch-c)}$ | Channel to case    |      |      | 0.460 | $^\circ C/W$ |
|                    | $R_{th(ch-a)}$ | Channel to ambient |      |      | 62.0  | $^\circ C/W$ |

Note \*1 :  $T_{ch} \leq 150^\circ C$

Note \*2 : Stating  $T_{ch}=25^\circ C, I_{AS}=7A, L=20.8mH, V_{cc}=60V, R_G=50\Omega$

$E_{AS}$  limited by maximum channel temperature and avalanche current.

See to 'Avalanche Energy' graph.

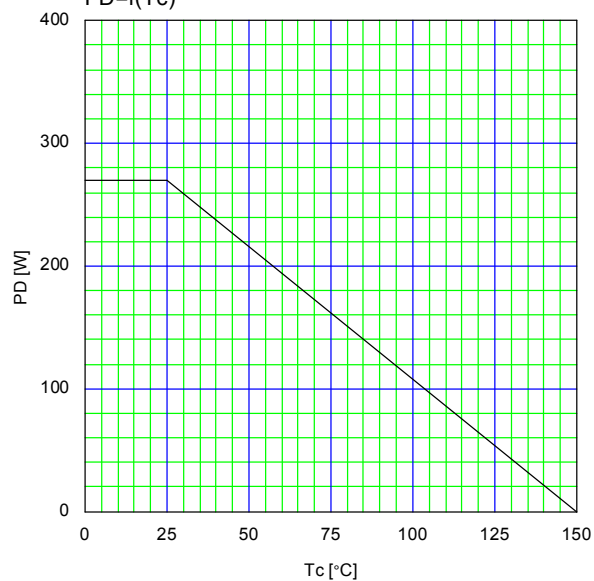
Note \*3 : Repetitive rating : Pulse width limited by maximum channel temperature.

See to the 'Transient Thermal impedance' graph.

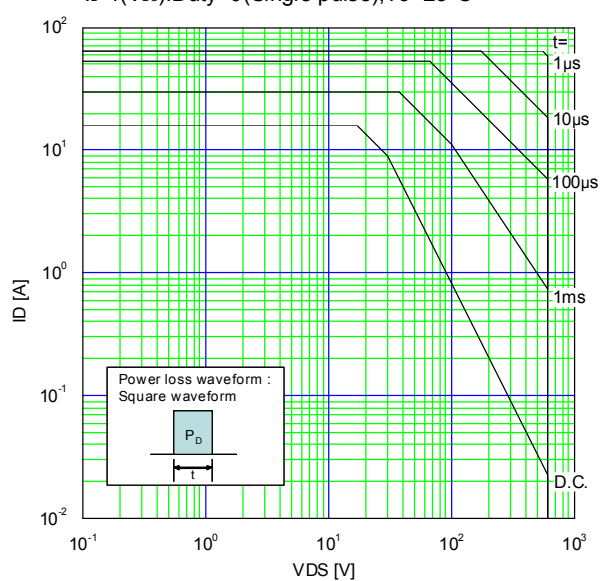
Note \*4 :  $I_F \leq I_D, -di/dt=100A/\mu s, V_{cc} \leq BV_{DSS}, T_{ch} \leq 150^\circ C$ .

Note \*5 :  $I_F \leq I_D, dv/dt=5.2kV/\mu s, V_{cc} \leq BV_{DSS}, T_{ch} \leq 150^\circ C$ .

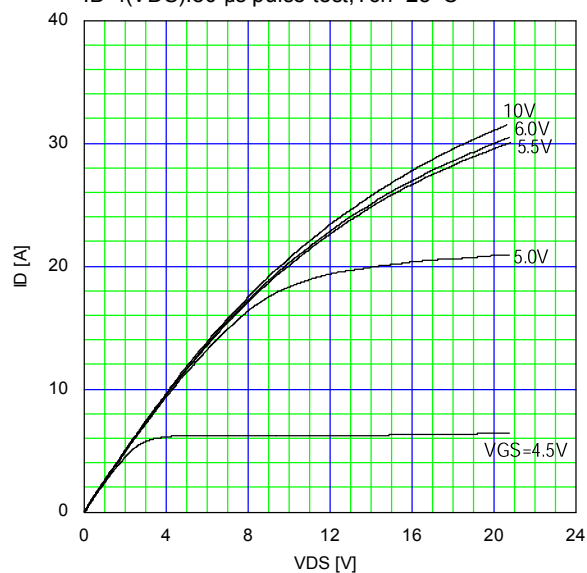
Allowable Power Dissipation  
 $P_D = f(T_c)$



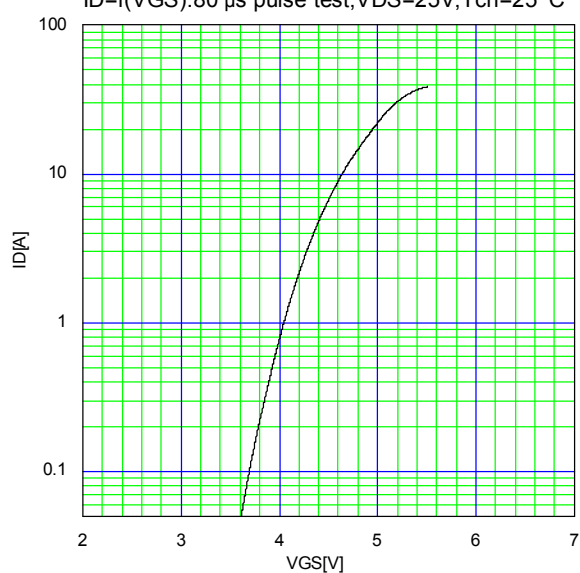
Safe Operating Area  
 $I_D = f(V_{DS})$ : Duty=0 (Single pulse),  $T_c = 25^\circ\text{C}$



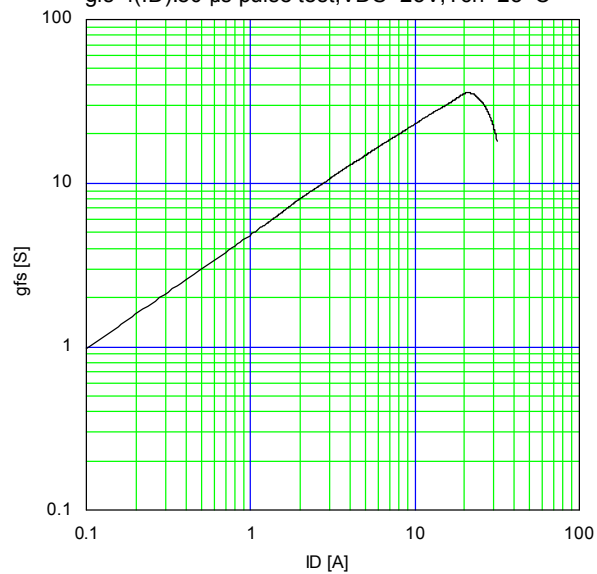
Typical Output Characteristics  
 $I_D = f(V_{DS})$ : 80 μs pulse test,  $T_{ch} = 25^\circ\text{C}$



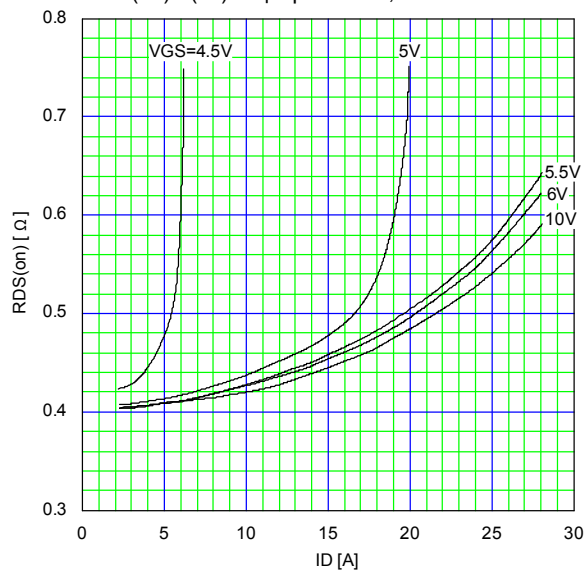
Typical Transfer Characteristic  
 $I_D = f(V_{GS})$ : 80 μs pulse test,  $V_{DS} = 25\text{V}$ ,  $T_{ch} = 25^\circ\text{C}$



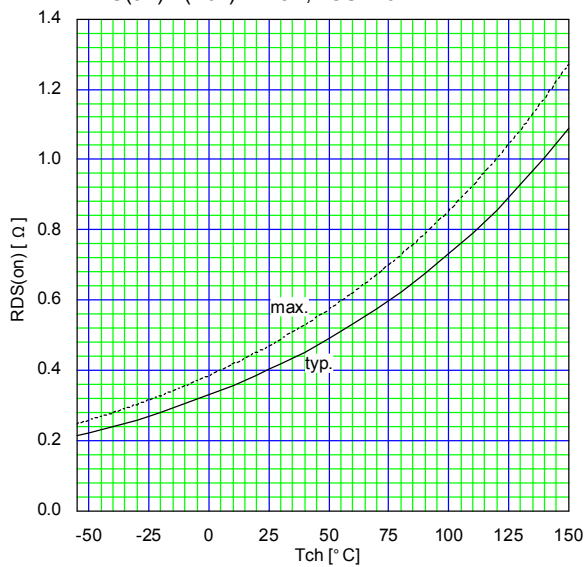
Typical Transconductance  
 $g_{fs} = f(I_D)$ : 80 μs pulse test,  $V_{DS} = 25\text{V}$ ,  $T_{ch} = 25^\circ\text{C}$



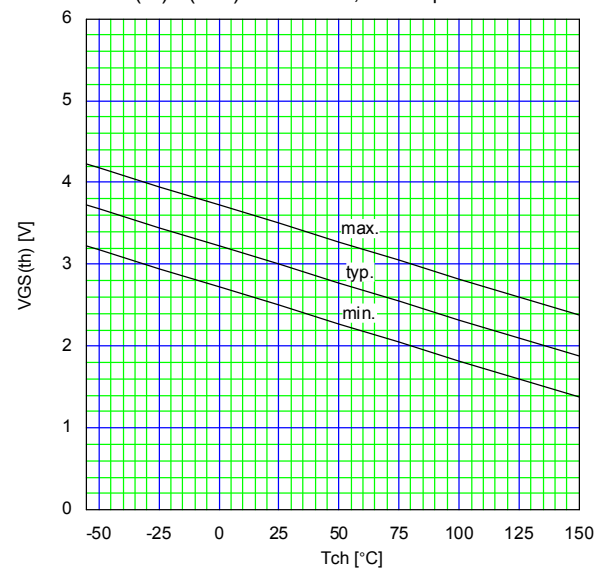
Typical Drain-Source on-state Resistance  
 $R_{DS(on)} = f(I_D)$ : 80 μs pulse test,  $T_{ch} = 25^\circ\text{C}$



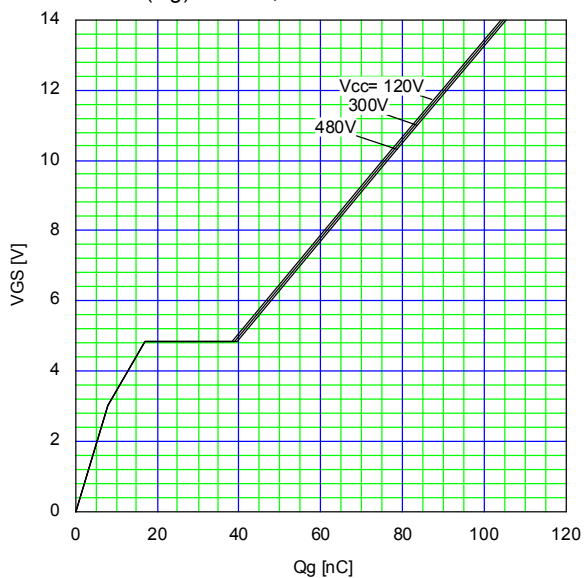
Drain-Source On-state Resistance  
 $R_{DS(on)} = f(T_{ch})$ :  $I_D = 8A, V_{GS} = 10V$



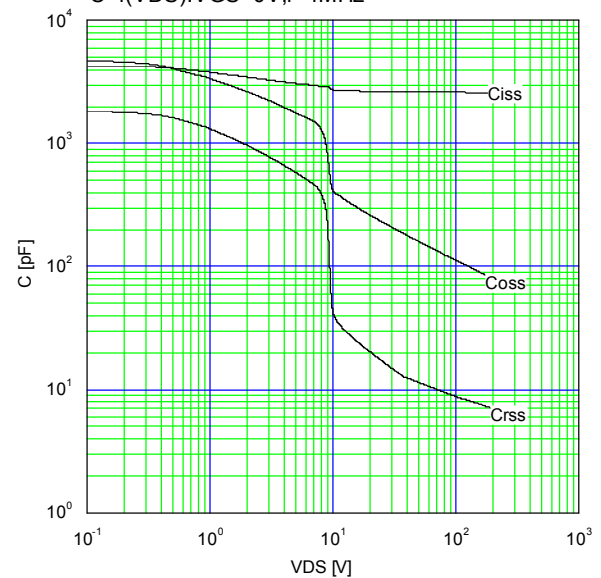
Gate Threshold Voltage vs.  $T_{ch}$   
 $V_{GS(th)} = f(T_{ch})$ :  $V_{DS} = V_{GS}, I_D = 250\mu A$



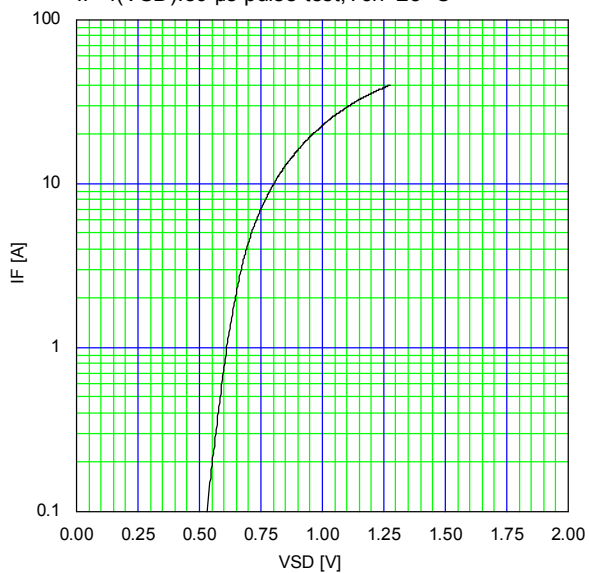
Typical Gate Charge Characteristics  
 $V_{GS} = f(Q_g)$ :  $I_D = 16A, T_{ch} = 25^\circ C$



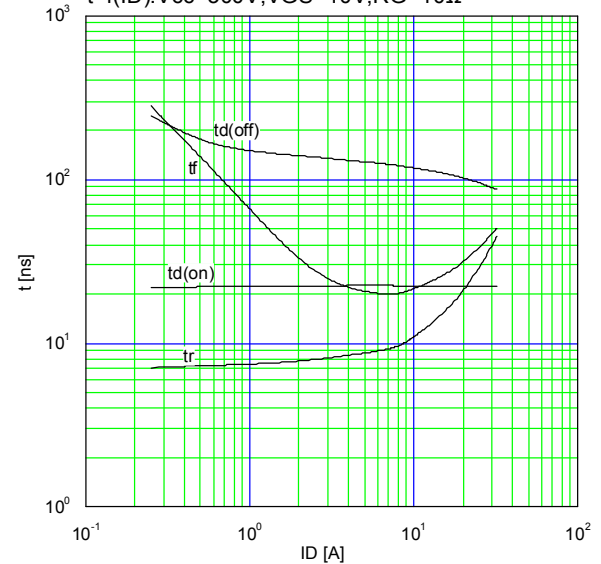
Typical Capacitance  
 $C = f(V_{DS})$ :  $V_{GS} = 0V, f = 1MHz$

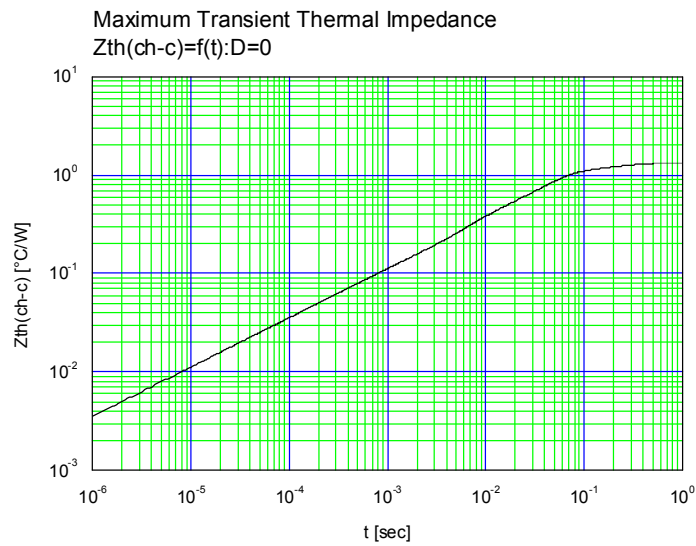
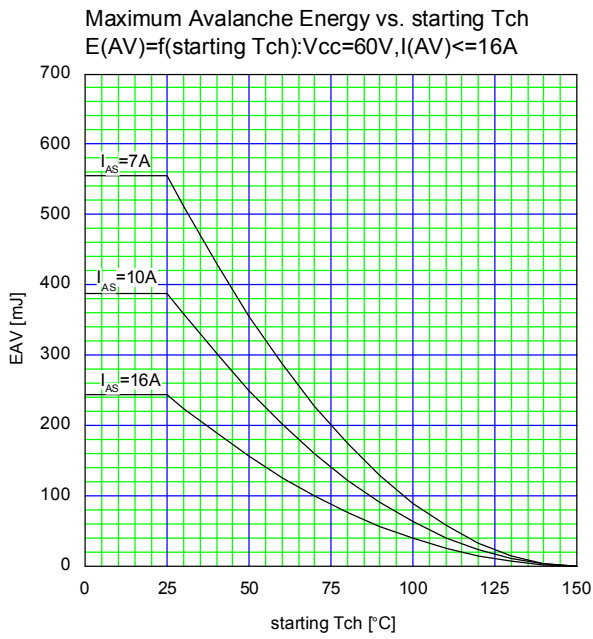


Typical Forward Characteristics of Reverse Diode  
 $I_F = f(V_{SD})$ : 80 μs pulse test,  $T_{ch} = 25^\circ C$



Typical Switching Characteristics vs.  $I_D$   
 $t = f(I_D)$ :  $V_{CC} = 300V, V_{GS} = 10V, R_G = 10\Omega$





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|                                                                             |                                                       |
|-----------------------------------------------------------------------------|-------------------------------------------------------|
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|                                |                        |                             |
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