

# FML20N50ES

## FUJI POWER MOSFET

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

## N-CHANNEL SILICON POWER MOSFET

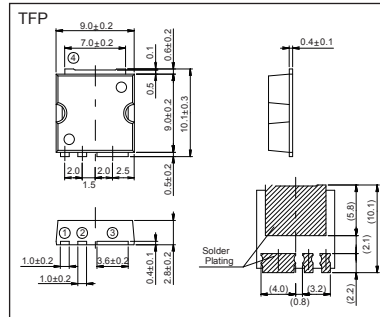
## ■ Features

- 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 ( $4.2 \pm 0.5V$ )
- High avalanche durability

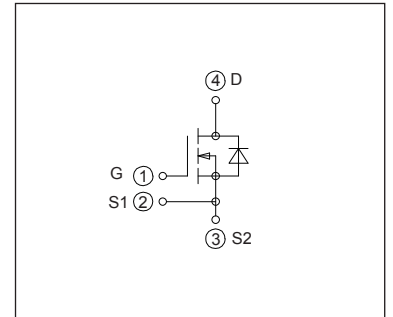
## ■ Applications

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

### ■ Outline Drawings [mm]



### ■ Equivalent circuit schematic



### ■ Maximum Ratings and Characteristics

● Absolute Maximum Ratings at Tc=25°C (unless otherwise specified)

| Description   | Symbol           | Characteristics | Unit  | Remarks                |
|---|------------------|-----------------|-------|------------------------|
| Drain-Source Voltage                                    | V <sub>DS</sub>  | 500             | V     |                        |
|   | V <sub>DSX</sub> | 500             | V     | V <sub>GS</sub> = -30V |
| Continuous Drain Current                                | I <sub>D</sub>   | ±20             | A     |                        |
| Pulsed Drain Current                                    | I <sub>DP</sub>  | ±80             | A     |                        |
| Gate-Source Voltage                                     | V <sub>GS</sub>  | ±30             | V     |                        |
| Repetitive and Non-Repetitive Maximum Avalanche Current | I <sub>AR</sub>  | 20              | A     | Note*1                 |
| Non-Repetitive Maximum Avalanche Energy                 | E <sub>AS</sub>  | 582.5           | mJ    | Note*2                 |
| Repetitive Maximum Avalanche Energy                     | E <sub>AR</sub>  | 9.5             | mJ    | Note*3                 |
| Peak Diode Recovery dV/dt                               |                  | 4.6             | kV/μs | Note*4                 |
| Peak Diode Recovery -di/dt                              | -di/dt           | 100             | A/μs  | Note*5                 |
| Maximum Power Dissipation                               | P <sub>D</sub>   | 2.16            | W     | Ta=25°C                |
|   |                  | 95              |       | Tc=25°C                |
| Operating and Storage Temperature range                 | T <sub>ch</sub>  | 150             | °C    |                        |
|   | T <sub>stg</sub> | -55 to + 150    | °C    |                        |
| Isolation Voltage                                       | V <sub>ISO</sub> | 2               | kVrms | t = 60sec, f = 60Hz    |

● Electrical Characteristics at Tc=25°C (unless otherwise specified)

| Description                      | Symbol               | Conditions  | min. | typ. | max.  | Unit |
|----------------------------------|----------------------|---|------|------|-------|------|
| Drain-Source Breakdown Voltage   | BV <sub>DSS</sub>    | I <sub>D</sub> =250μA, V <sub>GS</sub> =0V                      | 500  | -    | -     | V    |
| Gate Threshold Voltage           | V <sub>GS</sub> (th) | I <sub>D</sub> =250μA, V <sub>DS</sub> =V <sub>GS</sub>         | 3.7  | 4.2  | 4.7   | V    |
| Zero Gate Voltage Drain Current  | I <sub>DSS</sub>     | V <sub>DS</sub> =500V, V <sub>GS</sub> =0V                      | -    | -    | 25    | μA   |
|                                  |                      | V <sub>DS</sub> =400V, V <sub>GS</sub> =0V                      | -    | -    | 250   |      |
| Gate-Source Leakage Current      | I <sub>GSS</sub>     | V <sub>GS</sub> =±30V, V <sub>DS</sub> =0V                      | -    | 10   | 100   | nA   |
| Drain-Source On-State Resistance | R <sub>DS</sub> (on) | I <sub>D</sub> =10A, V <sub>GS</sub> =10V                       | -    | 0.27 | 0.31  | Ω    |
| Forward Transconductance         | g <sub>fs</sub>      | I <sub>D</sub> =10A, V <sub>DS</sub> =25V                       | 5    | 10   | -     | S    |
| Input Capacitance                | C <sub>iss</sub>     | V <sub>DS</sub> =25V  | -    | 2100 | 3150  | pF   |
| Output Capacitance               | C <sub>oss</sub>     | V <sub>GS</sub> =0V   | -    | 250  | 375   |      |
| Reverse Transfer Capacitance     | C <sub>rss</sub>     | f=1MHz  | -    | 15   | 22.5  |      |
| Turn-On Time                     | t <sub>d</sub> (on)  | V <sub>cc</sub> =300V   | -    | 40   | 60    | ns   |
|                                  | t <sub>r</sub>       | V <sub>GS</sub> =10V  | -    | 38   | 57    |      |
| Turn-Off Time                    | t <sub>d</sub> (off) | I <sub>D</sub> =10A   | -    | 85   | 127.5 |      |
|                                  | t <sub>f</sub>       | R <sub>GS</sub> =15Ω  | -    | 17   | 25.5  |      |
| Total Gate Charge                | Q <sub>G</sub>       | V <sub>cc</sub> =250V   | -    | 57   | 85.5  | nC   |
| Gate-Source Charge               | Q <sub>GS</sub>      | I <sub>D</sub> =20A   | -    | 21   | 31.5  |      |
| Gate-Drain Charge                | Q <sub>GD</sub>      | V <sub>GS</sub> =10V  | -    | 21   | 31.5  |      |
| Gate-Drain Crossover Charge      | Q <sub>SW</sub>      |   | -    | 10   | 15    |      |
| Avalanche Capability             | I <sub>AV</sub>      | L=1.07mH, T <sub>ch</sub> =25°C                                 | 20   | -    | -     | A    |
| Diode Forward On-Voltage         | V <sub>SD</sub>      | I <sub>F</sub> =20A, V <sub>GS</sub> =0V, T <sub>ch</sub> =25°C | -    | 0.90 | 1.35  | V    |
| Reverse Recovery Time            | t <sub>rr</sub>      | I <sub>F</sub> =20A, V <sub>GS</sub> =0V                        | -    | 0.5  | -     | μs   |
| Reverse Recovery Charge          | Q <sub>rr</sub>      | -di/dt=100A/μs, T <sub>ch</sub> =25°C                           | -    | 7.0  | -     | μC   |

### ● Thermal Characteristics

| Description        | Symbol                 | Test Conditions    | min. | typ. | max.  | Unit |
|--------------------|------------------------|--------------------|------|------|-------|------|
| Thermal resistance | R <sub>th</sub> (ch-c) | Channel to Case    |      |      | 1.320 | °C/W |
|                    | R <sub>th</sub> (ch-a) | Channel to Ambient |      |      | 58.0  | °C/W |

Note \*1 : Tch≤150°C.

Note \*2 : Stating Tch=25°C, I<sub>AS</sub>=8A, L=16.7mH, V<sub>cc</sub>=50V, R<sub>G</sub>=50Ω.

EAS limited by maximum channel temperature and avalanche current.  
See to 'Avalanche Energy' graph.

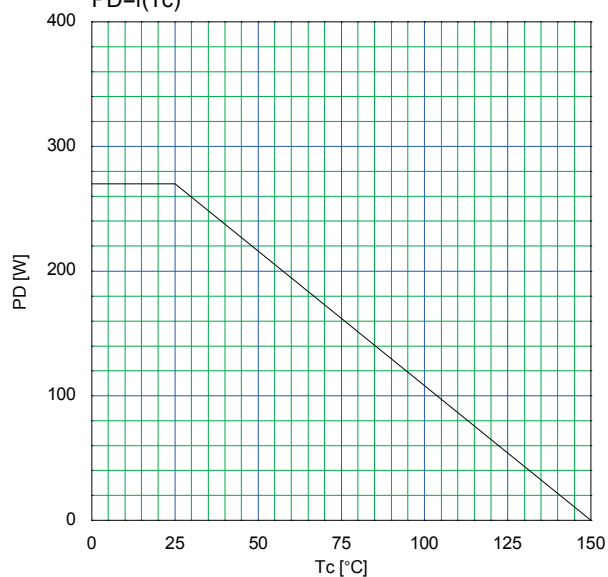
Note \*3 : Repetitive rating : Pulse width limited by maximum channel temperature.

See to the 'Transient Thermal impedance' graph.

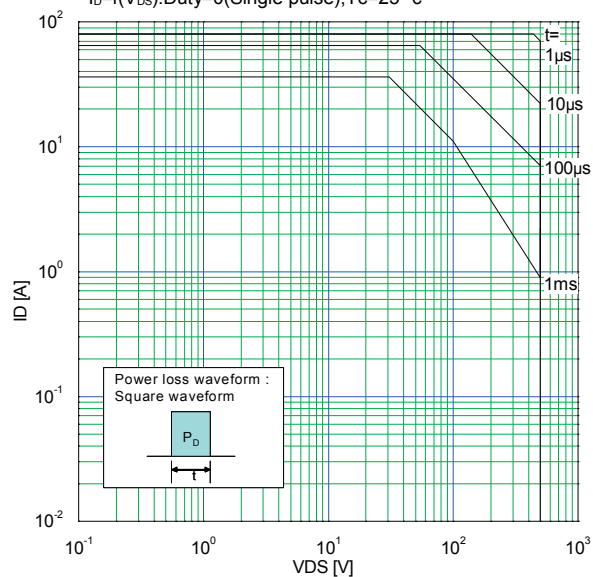
Note \*4 :  $I_F \leq I_D$ ,  $-di/dt = 100A/\mu s$ ,  $V_{CC} \leq BV_{DSS}$ ,  $T_{ch} \leq 150^\circ C$ .

Note \*5 :  $I_F \leq I_D$ ,  $dv/dt = 4.6 \text{ kV}/\mu\text{s}$ ,  $V_{CC} \leq BV_{DSS}$ ,  $T_{ch} \leq 150^\circ\text{C}$ .

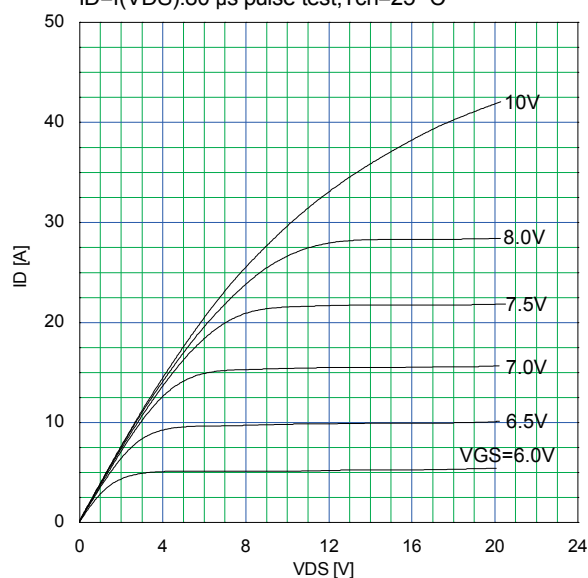
Allowable Power Dissipation  
 $P_D = f(T_c)$



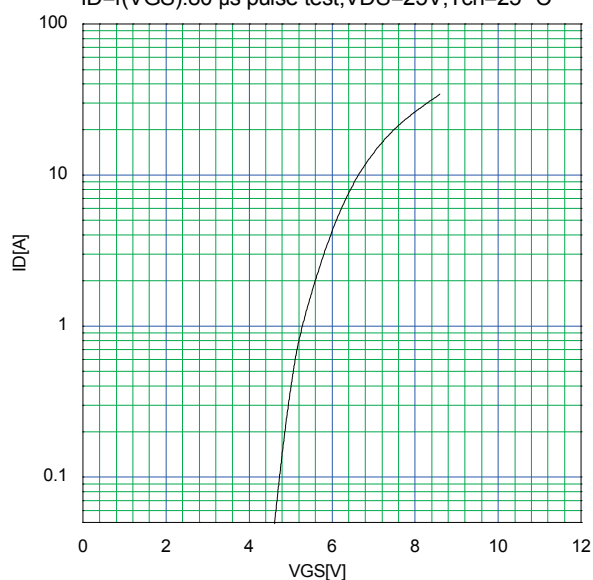
Safe Operating Area  
 $I_D = f(V_{DS})$ : Duty=0 (Single pulse),  $T_c = 25$  °C



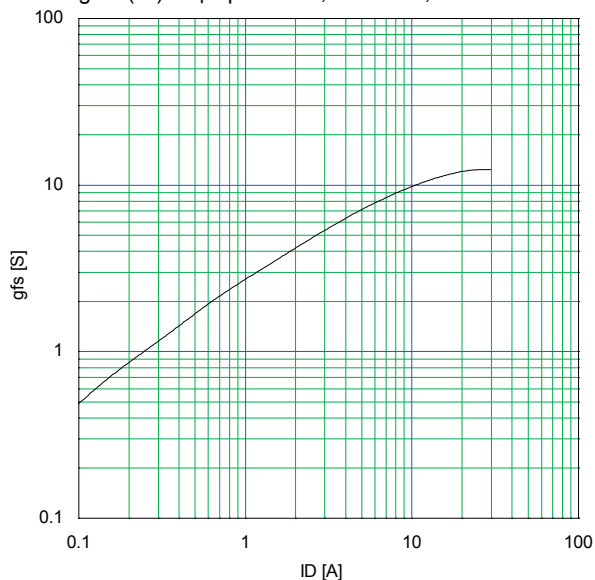
Typical Output Characteristics  
 $I_D = f(V_{DS})$ : 80 μs pulse test,  $T_{ch} = 25$  °C



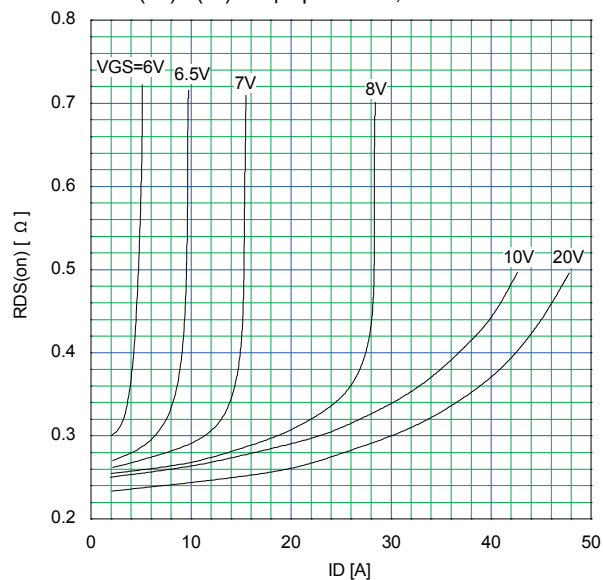
Typical Transfer Characteristic  
 $I_D = f(V_{GS})$ : 80 μs pulse test,  $V_{DS} = 25$  V,  $T_{ch} = 25$  °C



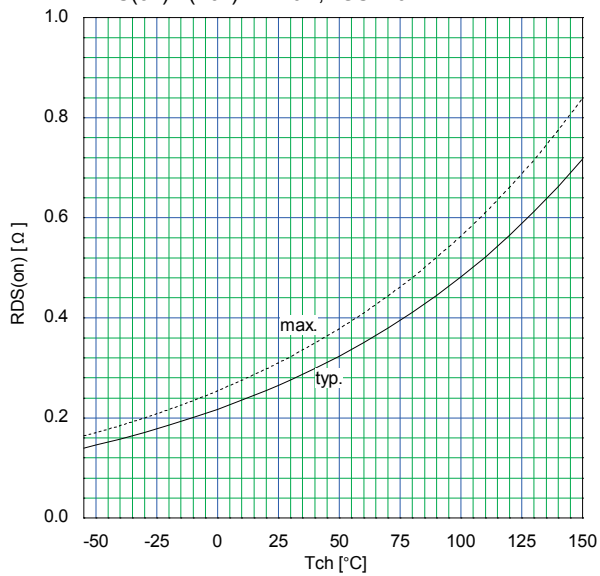
Typical Transconductance  
 $g_{fs} = f(I_D)$ : 80 μs pulse test,  $V_{DS} = 25$  V,  $T_{ch} = 25$  °C



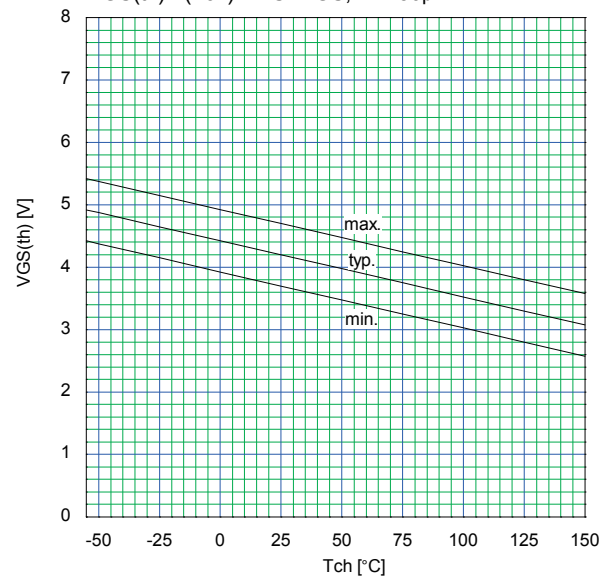
Typical Drain-Source on-state Resistance  
 $R_{DS(on)} = f(I_D)$ : 80 μs pulse test,  $T_{ch} = 25$  °C



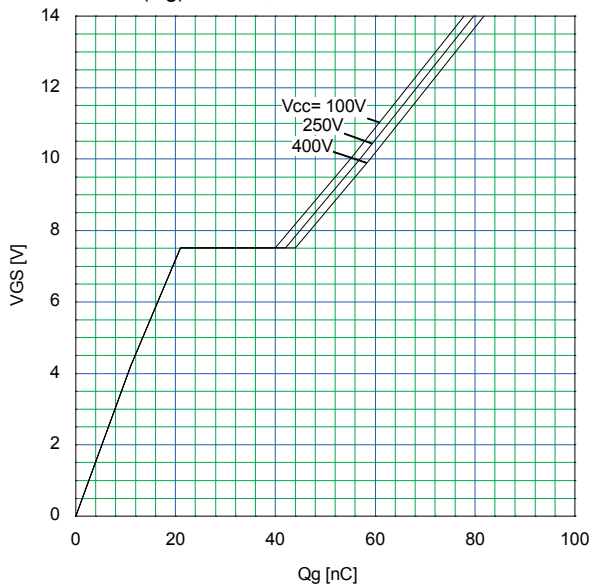
Drain-Source On-state Resistance  
 $R_{DS(on)} = f(T_{ch}): I_D = 10A, V_{GS} = 10V$



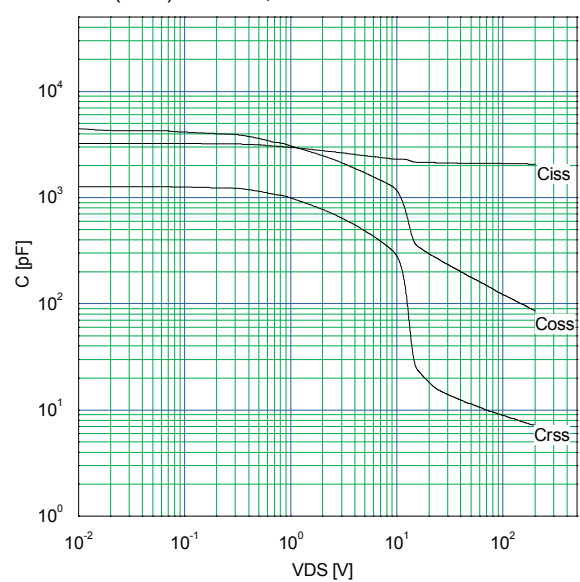
Gate Threshold Voltage vs.  $T_{ch}$   
 $V_{GS(th)} = f(T_{ch}): V_{DS} = V_{GS}, I_D = 250\mu A$



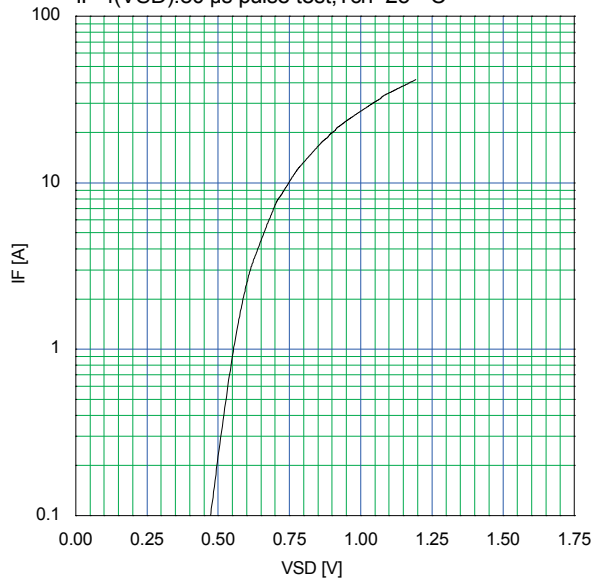
Typical Gate Charge Characteristics  
 $V_{GS} = f(Q_g): I_D = 20A, T_{ch} = 25^{\circ}C$



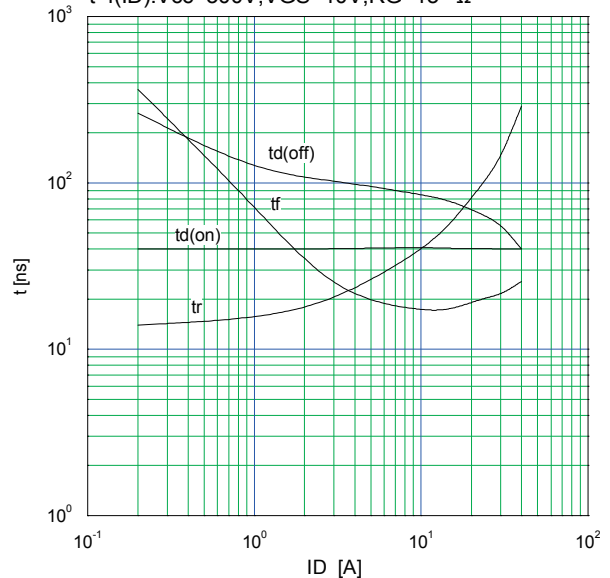
Typical Capacitance  
 $C = f(V_{DS}): V_{GS} = 0V, f = 1MHz$

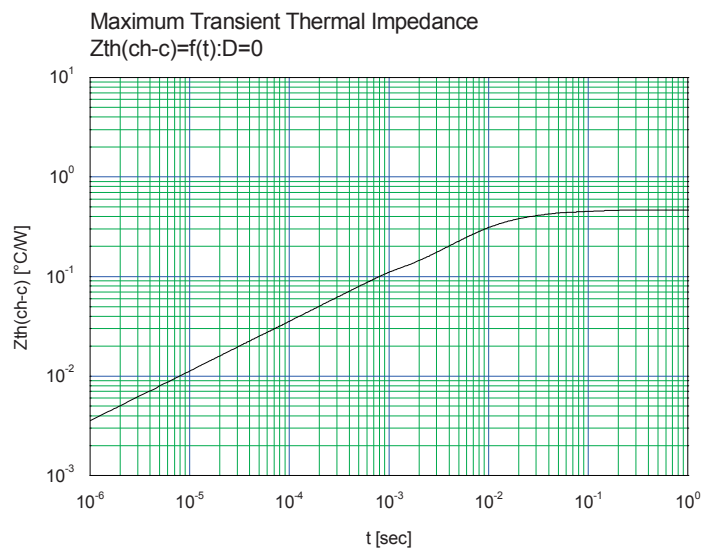
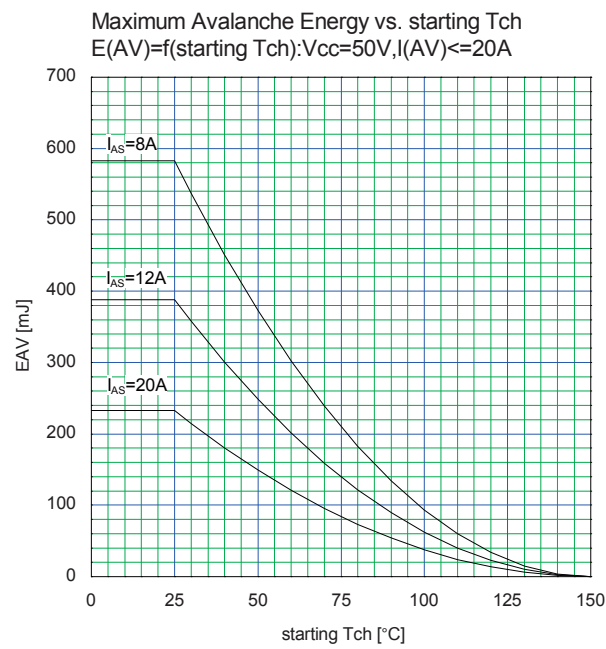


Typical Forward Characteristics of Reverse Diode  
 $I_F = f(V_{SD}): 80\mu s$  pulse test,  $T_{ch} = 25^{\circ}C$



Typical Switching Characteristics vs.  $I_D$   
 $t = f(I_D): V_{CC} = 300V, V_{GS} = 10V, R_G = 15\Omega$





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