

# FMP16N50E

FUJI POWER MOSFET

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

## N-CHANNEL SILICON POWER MOSFET

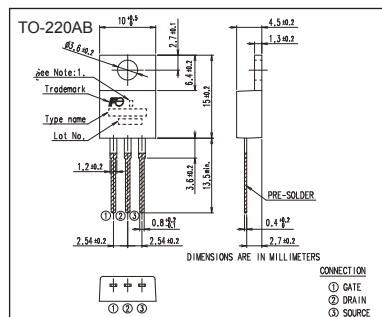
### ■ Features

- 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

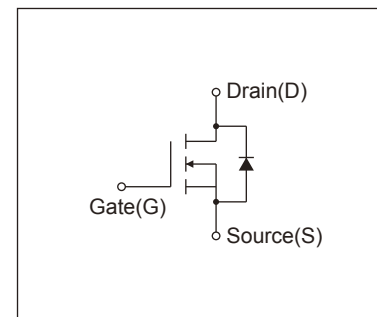
### ■ Applications

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

### ■ Outline Drawings [mm]



### ■ Equivalent circuit schematic



### ■ Maximum Ratings and Characteristics

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

| Description                                             | Symbol    | Characteristics | Unit              | Remarks                |
|---------------------------------------------------------|-----------|-----------------|-------------------|------------------------|
| Drain-Source Voltage                                    | $V_{DS}$  | 500             | V                 |                        |
|                                                         | $V_{DSX}$ | 500             | 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                 | $E_{AS}$  | 485             | mJ                | Note*2                 |
| Repetitive Maximum Avalanche Energy                     | $E_{AR}$  | 8               | mJ                | Note*3                 |
| Peak Diode Recovery $dV/dt$                             | $dV/dt$   | 7.8             | kV/ $\mu\text{s}$ | Note*4                 |
| Peak Diode Recovery $-di/dt$                            | $-di/dt$  | 100             | A/ $\mu\text{s}$  | Note*5                 |
| Maximum Power Dissipation                               | $P_D$     | 2.02            | W                 | $T_a=25^\circ\text{C}$ |
|                                                         |           | 225             | W                 | $T_c=25^\circ\text{C}$ |
| Operating and Storage Temperature range                 | $T_{ch}$  | 150             | $^\circ\text{C}$  |                        |
|                                                         | $T_{stg}$ | -55 to +150     | $^\circ\text{C}$  |                        |

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

| Description                      | Symbol       | Conditions                                               | min. | typ. | max. | Unit          |
|----------------------------------|--------------|----------------------------------------------------------|------|------|------|---------------|
| Drain-Source Breakdown Voltage   | $BV_{DS}$    | $I_D=250\mu\text{A}$ , $V_{GS}=0V$                       | 500  | -    | -    | V             |
| Gate Threshold Voltage           | $V_{GS(th)}$ | $I_D=250\mu\text{A}$ , $V_{DS}=V_{GS}$                   | 2.5  | 3.0  | 3.5  | V             |
| Zero Gate Voltage Drain Current  | $I_{DSS}$    | $V_{DS}=500V$ , $V_{GS}=0V$ , $T_{ch}=25^\circ\text{C}$  | -    | -    | 25   | $\mu\text{A}$ |
|                                  |              | $V_{DS}=400V$ , $V_{GS}=0V$ , $T_{ch}=125^\circ\text{C}$ | -    | -    | 250  | $\mu\text{A}$ |
| Gate-Source Leakage Current      | $I_{GSS}$    | $V_{GS}=\pm 30V$ , $V_{DS}=0V$                           | -    | 10   | 100  | nA            |
| Drain-Source On-State Resistance | $R_{DS(on)}$ | $I_D=8A$ , $V_{GS}=10V$                                  | -    | 0.33 | 0.38 | $\Omega$      |
| Forward Transconductance         | $g_{fs}$     | $I_D=8A$ , $V_{DS}=25V$                                  | 8.5  | 17   | -    | S             |
| Input Capacitance                | $C_{iss}$    | $V_{DS}=25V$                                             | -    | 2150 | 3225 | pF            |
| Output Capacitance               | $C_{oss}$    | $V_{GS}=0V$                                              | -    | 210  | 315  | pF            |
| Reverse Transfer Capacitance     | $C_{rss}$    | $f=1\text{MHz}$                                          | -    | 16   | 24   | pF            |
| Turn-On Time                     | $t_{d(on)}$  | $V_{cc}=300V$                                            | -    | 21   | 31.5 | ns            |
|                                  | $t_r$        | $V_{GS}=10V$                                             | -    | 9    | 13.5 | ns            |
| Turn-Off Time                    | $t_{d(off)}$ | $I_D=8A$                                                 | -    | 100  | 150  | ns            |
|                                  | $t_f$        | $R_{GS}=10\Omega$                                        | -    | 16   | 24   | ns            |
| Total Gate Charge                | $Q_G$        | $V_{cc}=250V$                                            | -    | 60   | 90   | nC            |
| Gate-Source Charge               | $Q_{GS}$     | $I_D=16A$                                                | -    | 17   | 25.5 | nC            |
| Gate-Drain Charge                | $Q_{GD}$     | $V_{GS}=10V$                                             | -    | 18   | 27   | nC            |
| Avalanche Capability             | $I_{AV}$     | $L=1.52\text{mH}$ , $T_{ch}=25^\circ\text{C}$            | 16   | -    | -    | A             |
| Diode Forward On-Voltage         | $V_{SD}$     | $I_F=16A$ , $V_{GS}=0V$ , $T_{ch}=25^\circ\text{C}$      | -    | 0.90 | 1.08 | V             |
| Reverse Recovery Time            | $t_{rr}$     | $I_F=16A$ , $V_{GS}=0V$                                  | -    | 0.46 | -    | $\mu\text{s}$ |
| Reverse Recovery Charge          | $Q_{rr}$     | $-di/dt=100A/\mu\text{s}$ , $T_{ch}=25^\circ\text{C}$    | -    | 6.0  | -    | $\mu\text{C}$ |

#### ● Thermal Characteristics

| Description        | Symbol         | Test Conditions    | min. | typ. | max.  | Unit               |
|--------------------|----------------|--------------------|------|------|-------|--------------------|
| Thermal resistance | $R_{th(ch-c)}$ | Channel to Case    |      |      | 0.560 | $^\circ\text{C/W}$ |
|                    | $R_{th(ch-a)}$ | Channel to Ambient |      |      | 62.0  | $^\circ\text{C/W}$ |

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

Note \*2 : Stating  $T_{ch}=25^\circ\text{C}$ ,  $I_{AS}=7A$ ,  $L=18.1\text{mH}$ ,  $V_{cc}=50V$ ,  $R_G=50\Omega$

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

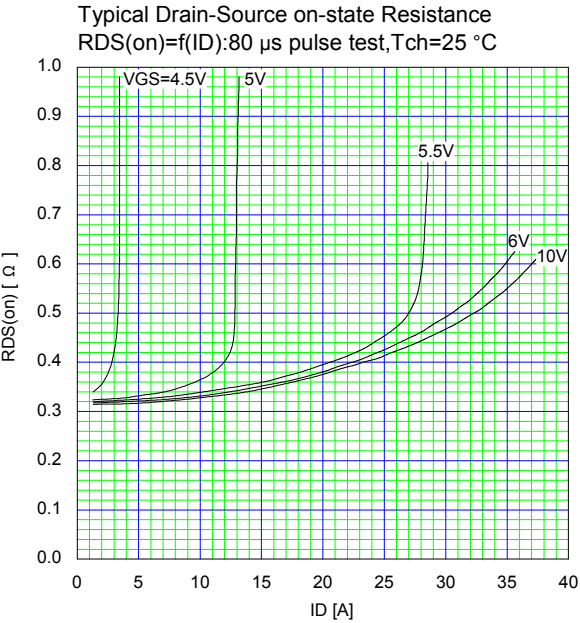
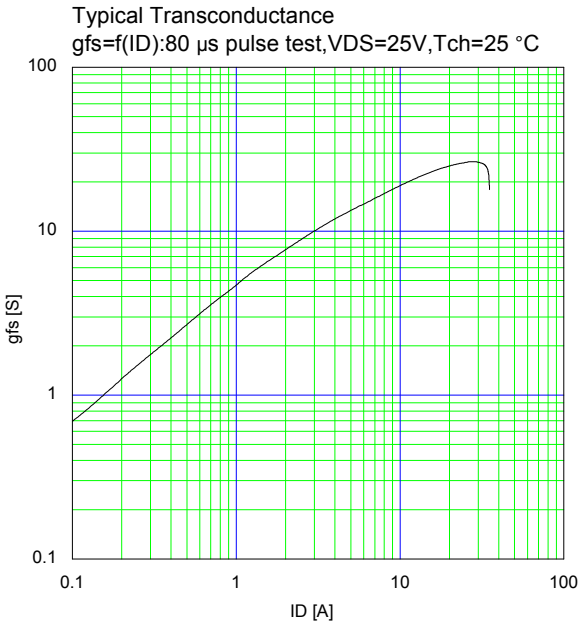
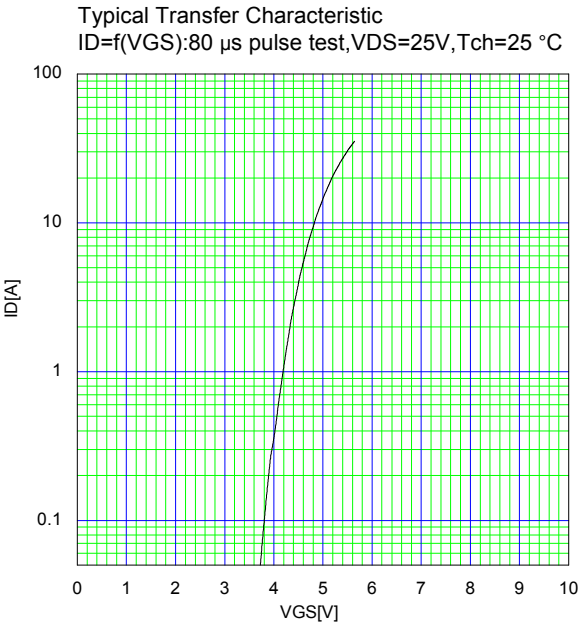
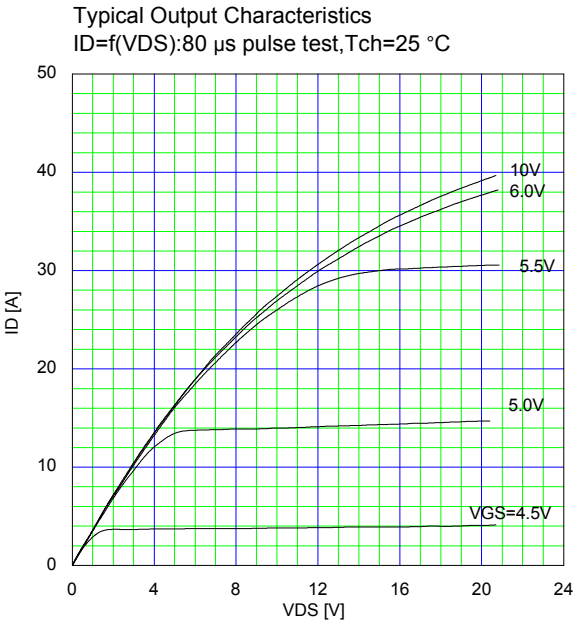
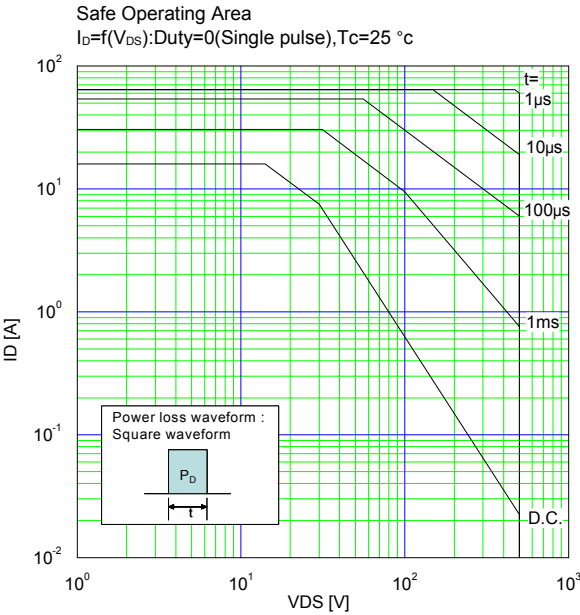
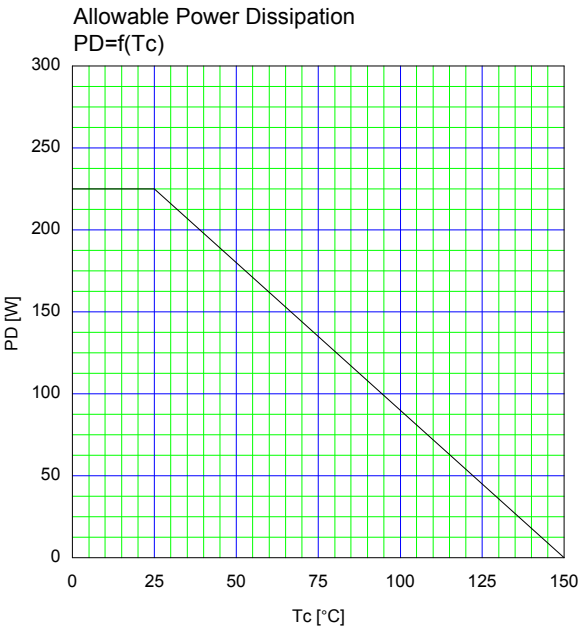
See to 'Avalanche Energy' graph.

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

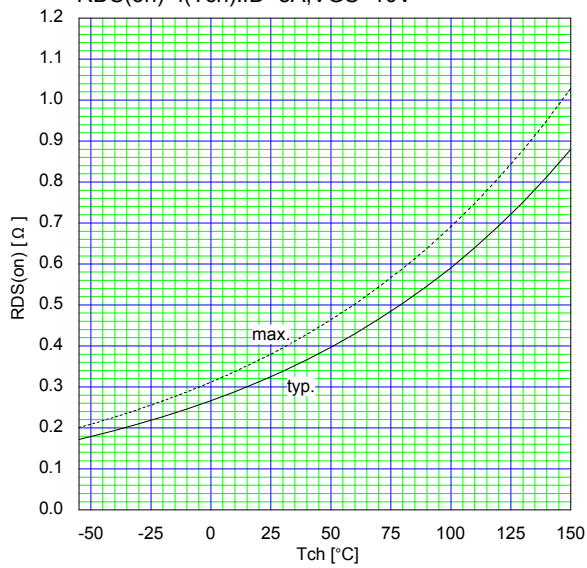
See to the 'Transient Thermal Impedance' graph.

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

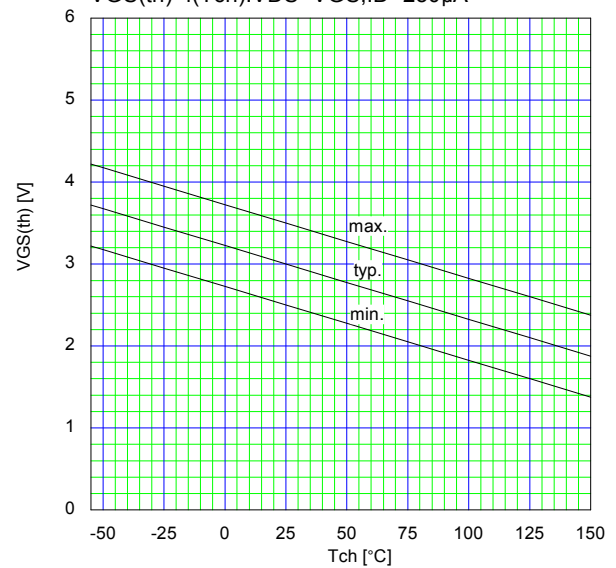
Note \*5 :  $I_{FS}=I_D$ ,  $dv/dt=7.8kV/\mu\text{s}$ ,  $V_{cc} \leq BV_{DSS}$ ,  $T_{ch} \leq 150^\circ\text{C}$ .



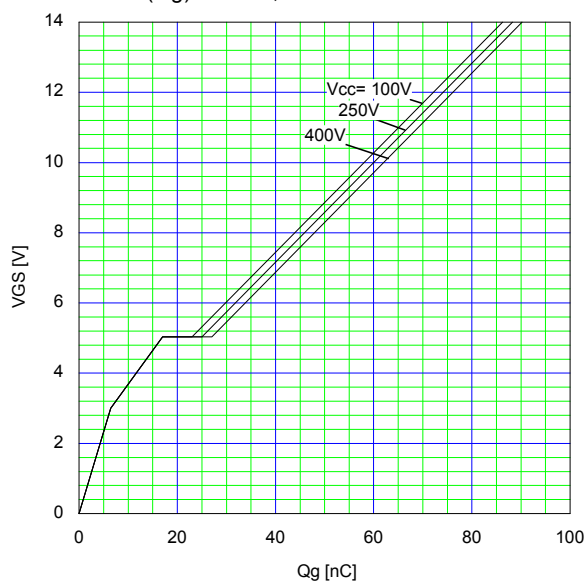
Drain-Source On-state Resistance  
 $R_{DS(on)} = f(T_{ch})$ :  $I_D = 8A, V_{GS} = 10V$



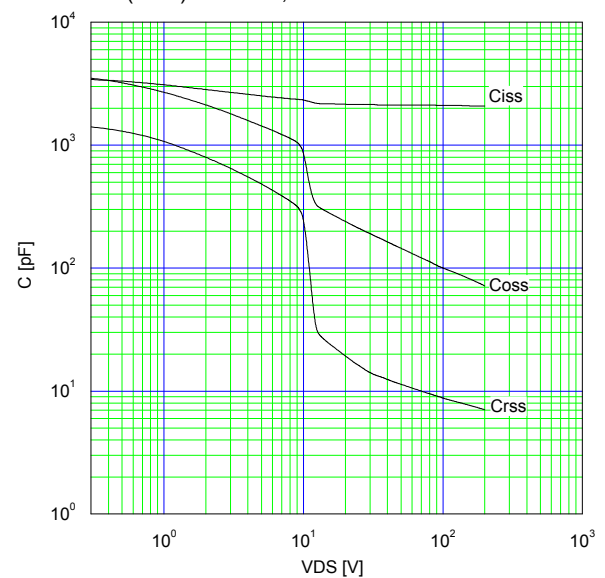
Gate Threshold Voltage vs.  $T_{ch}$   
 $V_{GS(th)} = f(T_{ch})$ :  $V_{DS} = V_{GS}, I_D = 250\mu A$



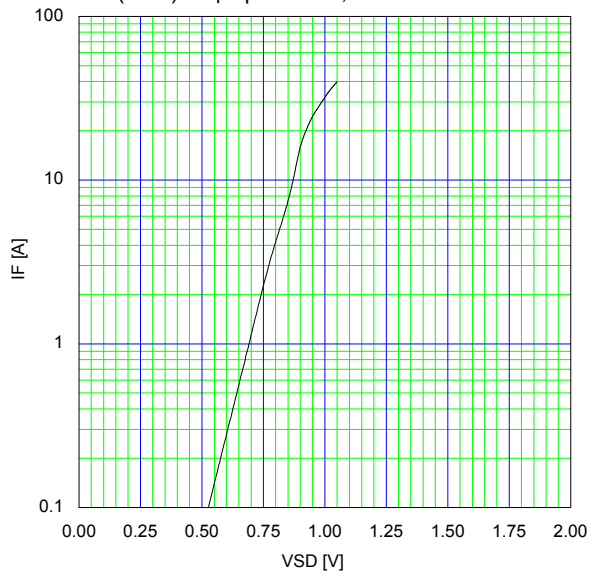
Typical Gate Charge Characteristics  
 $V_{GS} = f(Q_g)$ :  $I_D = 16A, T_{ch} = 25^{\circ}C$



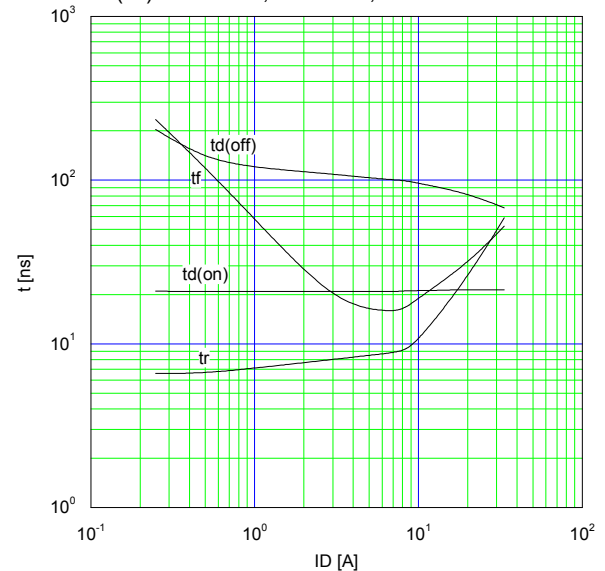
Typical Capacitance  
 $C = f(V_{DS})$ :  $V_{GS} = 0V, f = 1MHz$

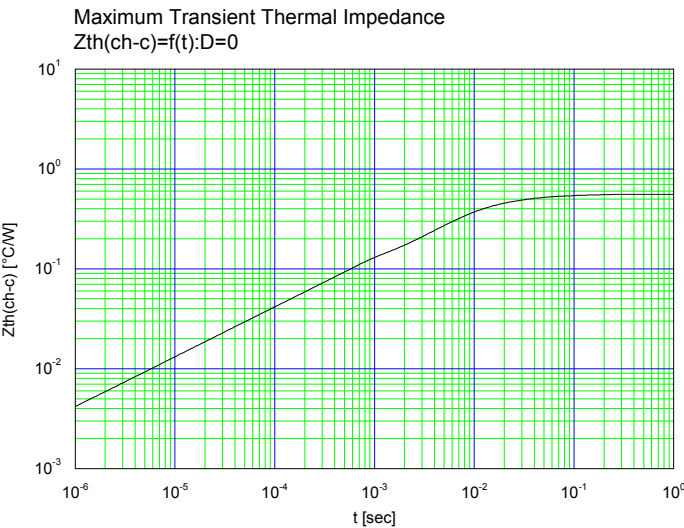
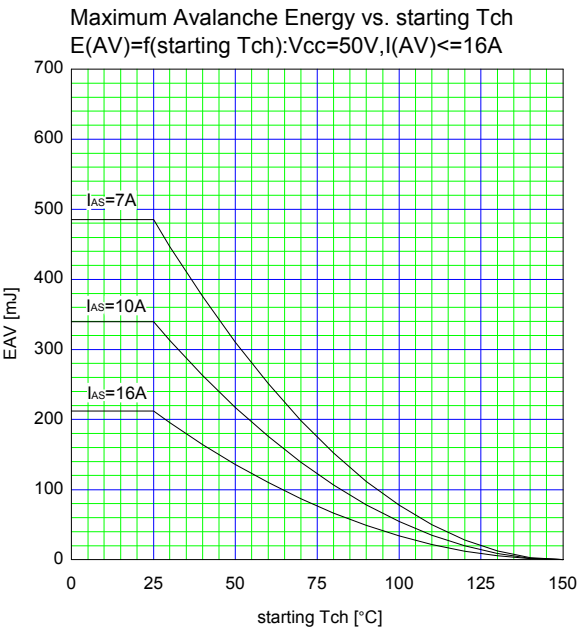


Typical Forward Characteristics of Reverse Diode  
 $I_F = f(V_{SD})$ : 80  $\mu s$  pulse test,  $T_{ch} = 25^{\circ}C$



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





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