

# FMI20N50E

FUJI POWER MOSFET

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

## N-CHANNEL SILICON POWER MOSFET

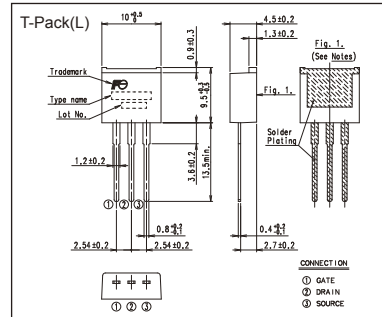
### ■ Features

- 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                                    | $V_{DS}$  | 500             | V           |                  |
|   | $V_{DSX}$ | 500             | V           | $V_{GS} = -30V$  |
| Continuous Drain Current                                | $I_D$     | $\pm 20$        | A           |                  |
| Pulsed Drain Current                                    | $I_{DP}$  | $\pm 80$        | A           |                  |
| Gate-Source Voltage                                     | $V_{GS}$  | $\pm 30$        | V           |                  |
| Repetitive and Non-Repetitive Maximum Avalanche Current | $I_{AR}$  | 20              | A           | Note*1           |
| Non-Repetitive Maximum Avalanche Energy                 | $E_{AS}$  | 582.5           | mJ          | Note*2           |
| Repetitive Maximum Avalanche Energy                     | $E_{AR}$  | 27              | mJ          | Note*3           |
| Peak Diode Recovery $dV/dt$                             | $dV/dt$   | 7.4             | 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   | $BV_{DSS}$   | $I_D=250\mu A, V_{GS}=0V$               | 500  | -    | -     | 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  | $I_{DSS}$    | $V_{DS}=500V, V_{GS}=0V$                | -    | -    | 25    | $\mu A$  |
|                                  |              | $V_{DS}=400V, V_{GS}=0V$                | -    | -    | 250   |          |
| Gate-Source Leakage Current      | $I_{GSS}$    | $V_{GS}=\pm 30V, V_{DS}=0V$             | -    | 10   | 100   | nA       |
| Drain-Source On-State Resistance | $R_{DS(on)}$ | $I_D=10A, V_{GS}=10V$                   | -    | 0.27 | 0.31  | $\Omega$ |
| Forward Transconductance         | $g_{fs}$     | $I_D=10A, V_{DS}=25V$                   | 11   | 22   | -     | S        |
| Input Capacitance                | $C_{iss}$    | $V_{DS}=25V$                            | -    | 2650 | 3980  | pF       |
| Output Capacitance               | $C_{oss}$    | $V_{GS}=0V$                             | -    | 250  | 375   |          |
| Reverse Transfer Capacitance     | $C_{rss}$    | $f=1MHz$                                | -    | 19   | 28.5  |          |
| Turn-On Time                     | $t_{d(on)}$  | $V_{cc}=300V$                           | -    | 22   | 33    | ns       |
|                                  | $t_r$        | $V_{GS}=10V$                            | -    | 11   | 16.5  |          |
| Turn-Off Time                    | $t_{d(off)}$ | $I_D=10A$                               | -    | 120  | 180   |          |
|                                  | $t_f$        | $R_{GS}=10\Omega$                       | -    | 21   | 31.5  |          |
| Total Gate Charge                | $Q_G$        | $V_{cc}=250V$                           | -    | 77   | 115.5 | nC       |
| Gate-Source Charge               | $Q_{GS}$     | $I_D=20A$                               | -    | 17   | 25.5  |          |
| Gate-Drain Charge                | $Q_{GD}$     | $V_{GS}=10V$                            | -    | 22   | 33    |          |
| Avalanche Capability             | $I_{AV}$     | $L=1.07mH, T_{ch}=25^\circ C$           | 20   | -    | -     | A        |
| Diode Forward On-Voltage         | $V_{SD}$     | $I_F=20A, V_{GS}=0V, T_{ch}=25^\circ C$ | -    | 0.90 | 1.35  | V        |
| Reverse Recovery Time            | $t_{rr}$     | $I_F=20A, V_{GS}=0V$                    | -    | 0.5  | -     | $\mu s$  |
| Reverse Recovery Charge          | $Q_{rr}$     | $-di/dt=100A/\mu s, T_{ch}=25^\circ C$  | -    | 7    | -     | $\mu C$  |

#### ● 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  | $^\circ C/W$ |

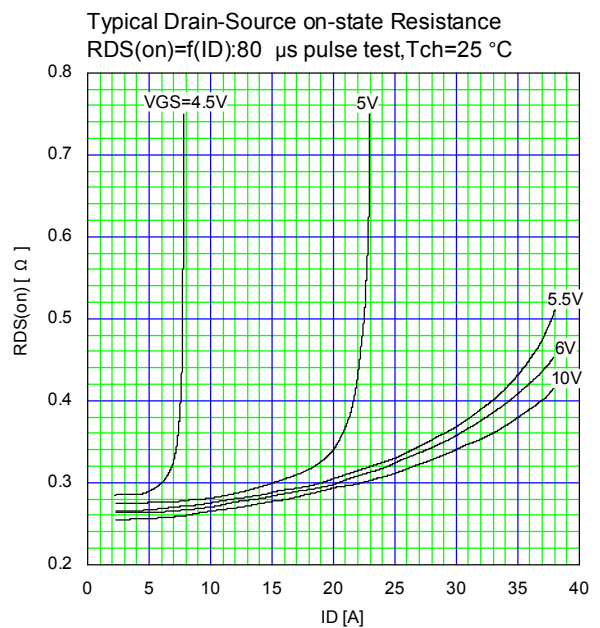
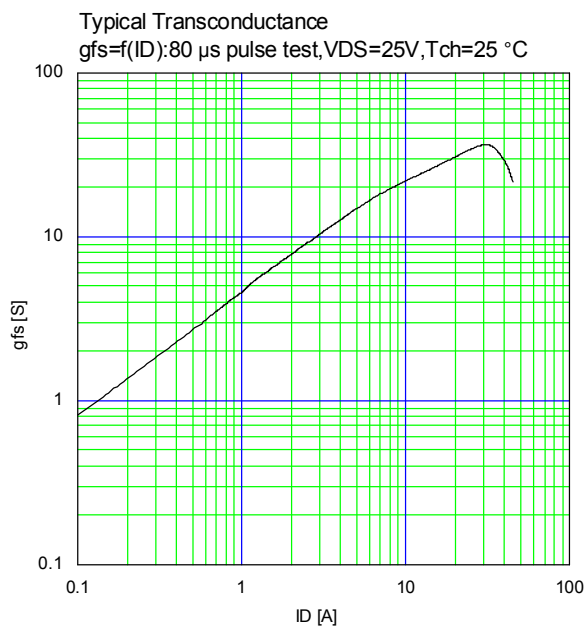
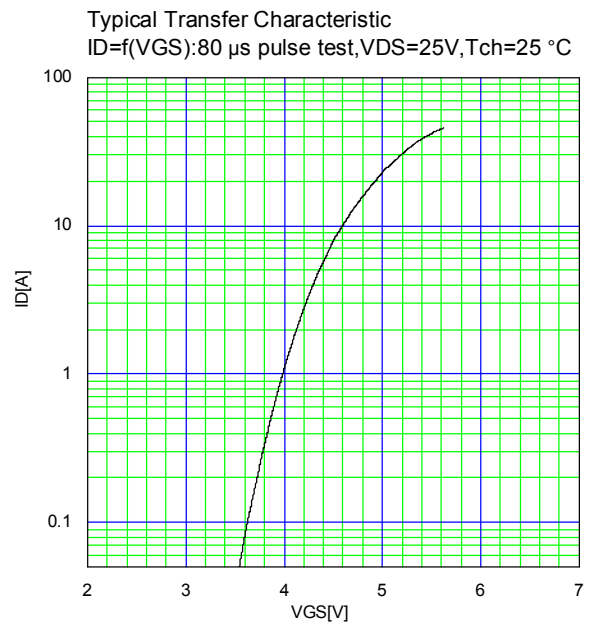
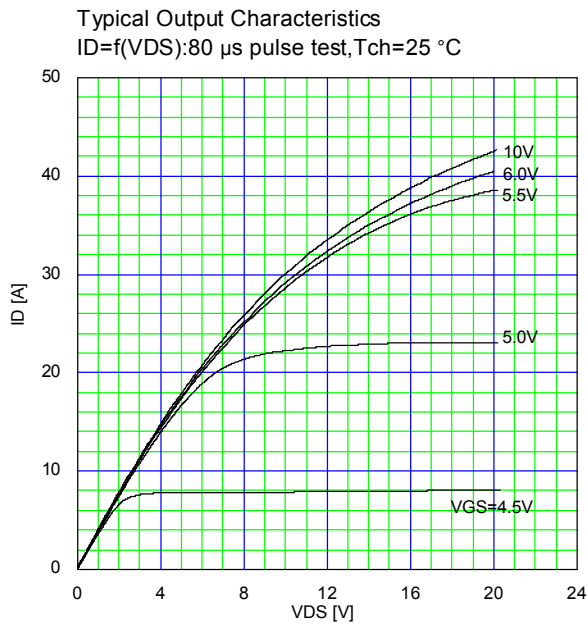
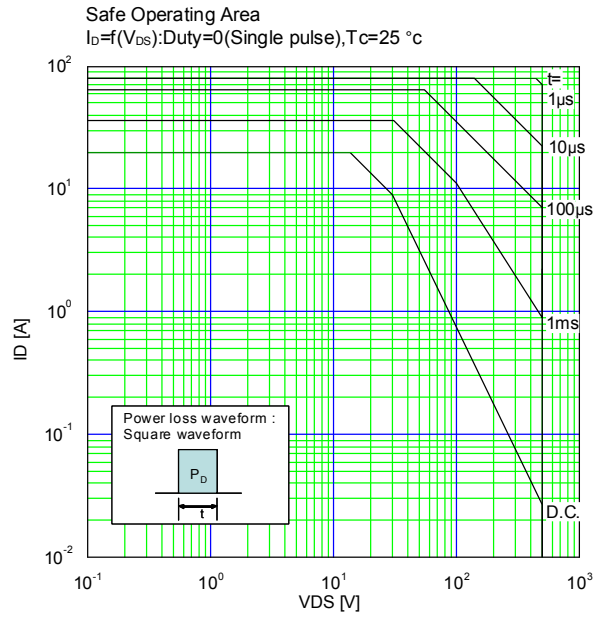
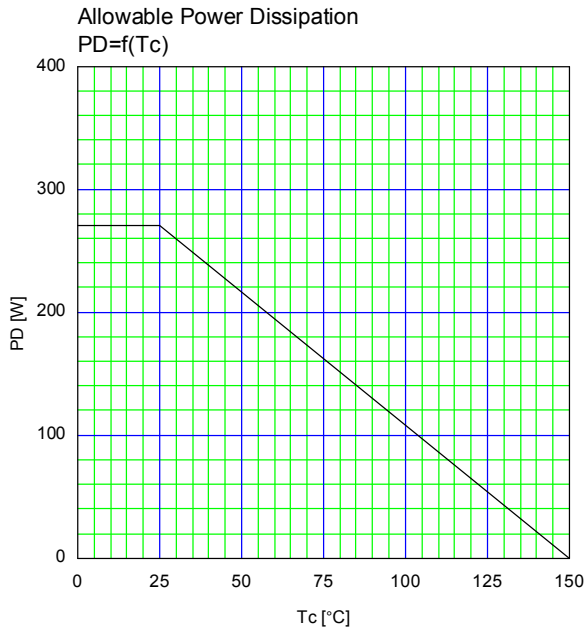
Note \*1 :  $T_{ch} \leq 150^\circ C$

Note \*2 : Stating  $T_{ch}=25^\circ C, I_{AS}=8A, L=16.7mH, V_{cc}=50V, R_G=50\Omega$   
 $E_{AS}$  limited by maximum channel temperature and avalanche current.  
 See to 'Avalanche Energy' graph.

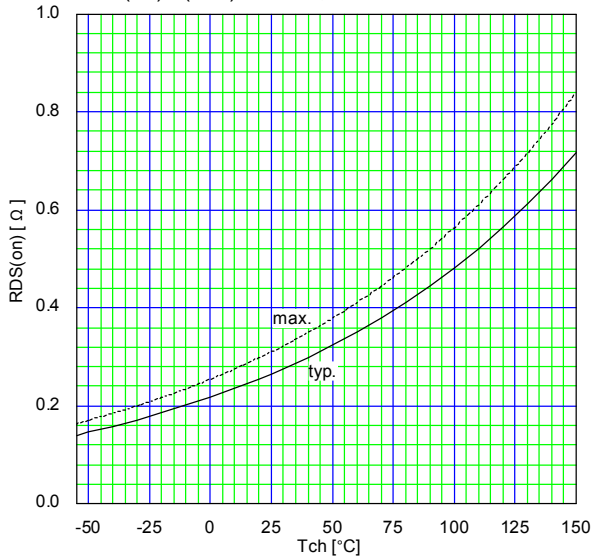
Note \*3 : Repetitive rating : Pulse width limited by maximum channel temperature.  
 See to the 'Transient Thermal Impedance' graph.

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

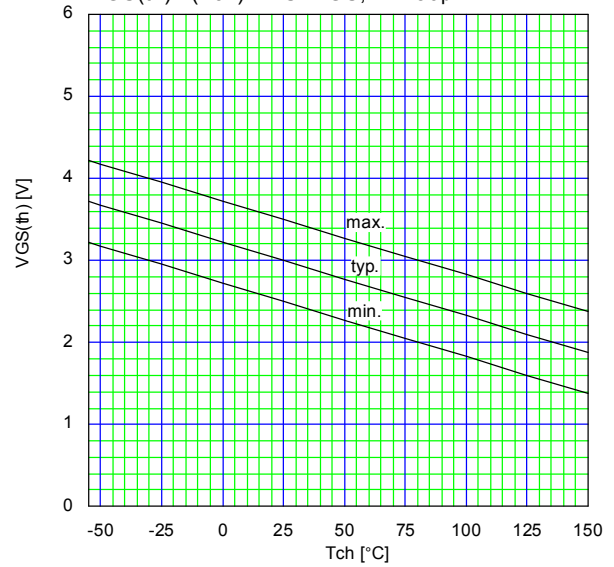
Note \*5 :  $I_F \leq I_D, dv/dt=7.4kV/\mu s, V_{cc} \leq BV_{DSS}, T_{ch} \leq 150^\circ C$ .



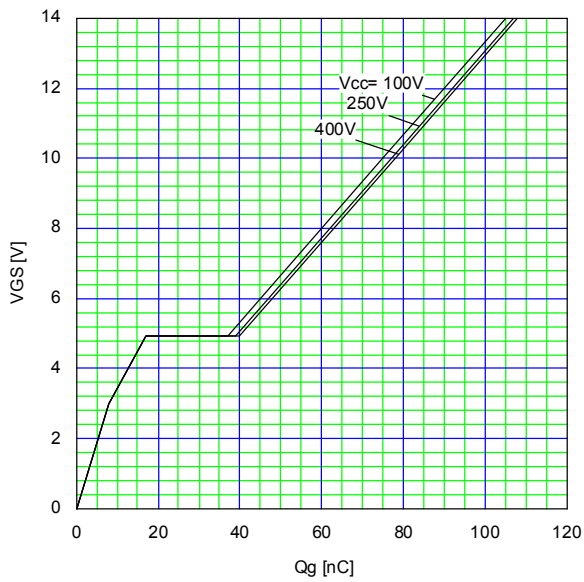
Drain-Source On-state Resistance  
 $R_{DS(on)} = f(T_{ch}) : I_D = 10A, V_{GS} = 10V$



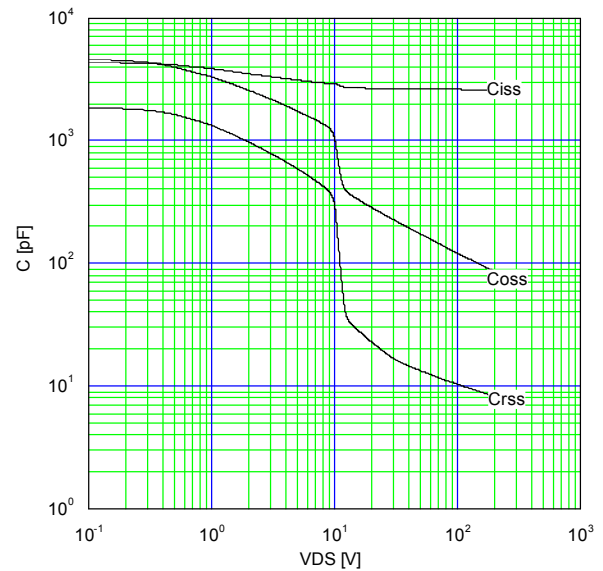
Gate Threshold Voltage vs. T<sub>ch</sub>  
 $V_{GS(th)} = f(T_{ch}) : V_{DS} = V_{GS}, I_D = 250\mu A$



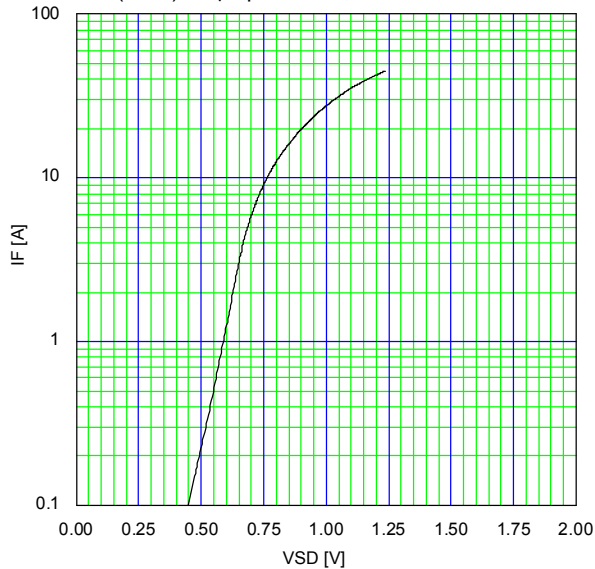
Typical Gate Charge Characteristics  
 $V_{GS} = f(Q_g) : I_D = 20A, T_{ch} = 25\text{ °C}$



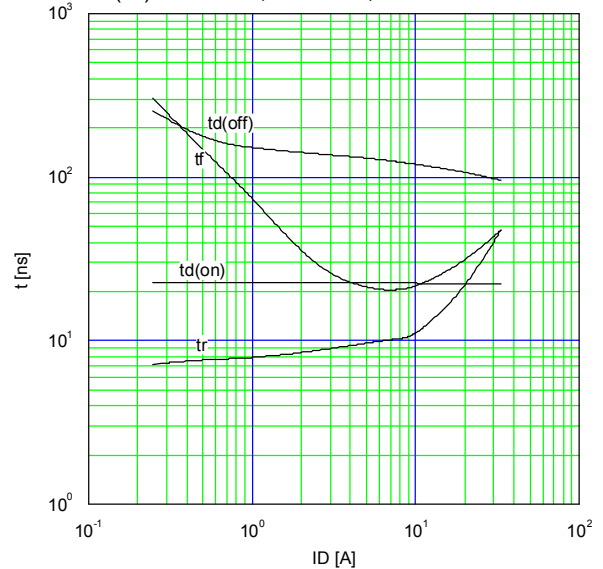
Typical Capacitance  
 $C = f(V_{DS}) : V_{GS} = 0V, f = 1MHz$

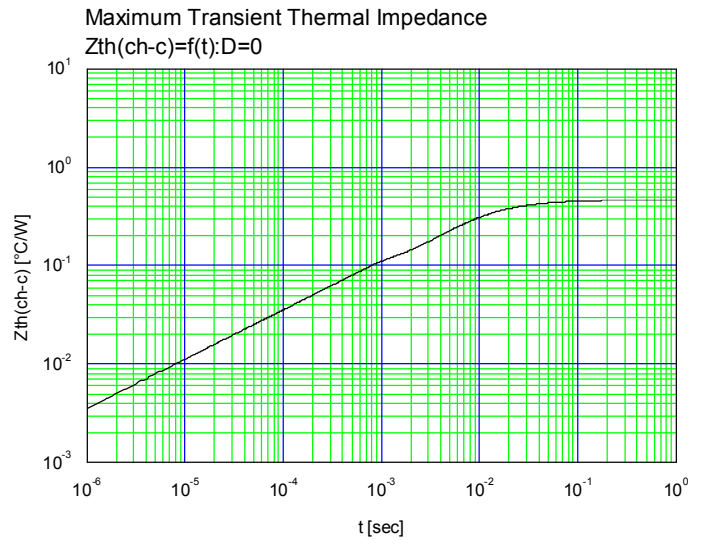
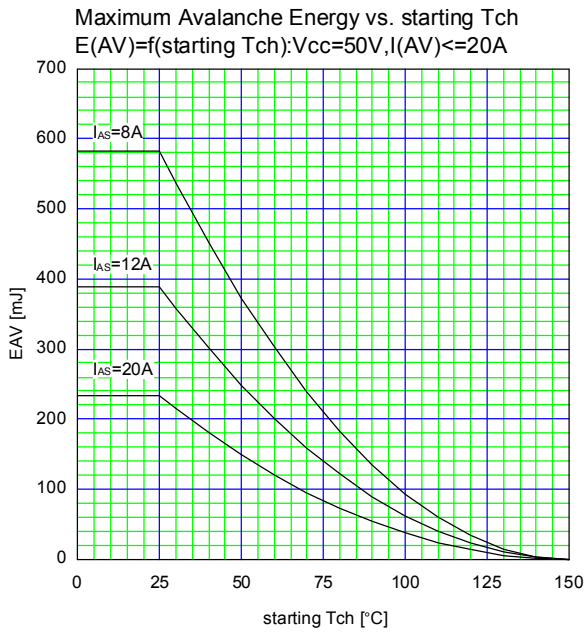


Typical Forward Characteristics of Reverse Diode  
 $I_F = f(V_{SD}) : 80\text{ }\mu s\text{ pulse test}, T_{ch} = 25\text{ °C}$



Typical Switching Characteristics vs. I<sub>D</sub>  
 $t = f(I_D) : V_{cc} = 300V, V_{GS} = 10V, R_G = 10\text{ }\Omega$





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