

# FMR21N50ES

FUJI POWER MOSFET

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

## N-CHANNEL SILICON POWER MOSFET

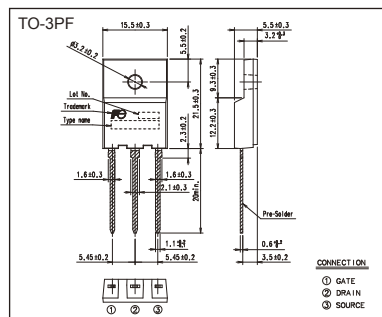
### ■ Features

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

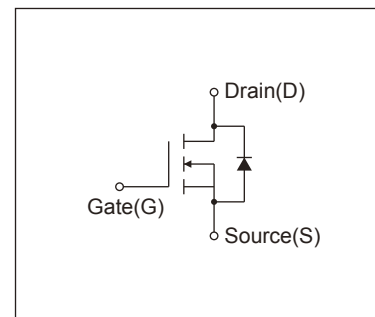
### ■ Applications

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

### ■ Outline Drawings [mm]



### ■ Equivalent circuit schematic



### ■ Maximum Ratings and Characteristics

#### ● Absolute Maximum Ratings at $T_c=25^\circ\text{C}$ (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	$I_D$	$\pm 21$	A	
Pulsed Drain Current	$I_{DP}$	$\pm 84$	A	
Gate-Source Voltage	$V_{GS}$	$\pm 30$	V	
Repetitive and Non-Repetitive Maximum Avalanche Current	$I_{AR}$	21	A	Note*1
Non-Repetitive Maximum Avalanche Energy	$E_{AS}$	714.5	mJ	Note*2
Repetitive Maximum Avalanche Energy	$E_{AR}$	13.5	mJ	Note*3
Peak Diode Recovery $dV/dt$	$dV/dt$	5.7	kV/ $\mu\text{s}$	Note*4
Peak Diode Recovery $-di/dt$	$-di/dt$	100	A/ $\mu\text{s}$	Note*5
Maximum Power Dissipation	$P_D$	3.13	W	$T_a=25^\circ\text{C}$
		135		$T_c=25^\circ\text{C}$
Operating and Storage Temperature range	$T_{ch}$	150	$^\circ\text{C}$	
	$T_{stg}$	-55 to + 150	$^\circ\text{C}$	
Isolation Voltage	$V_{ISO}$	2	kVrms	$t = 60\text{sec}, f = 60\text{Hz}$

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

Description	Symbol	Conditions	min.	typ.	max.	Unit
Drain-Source Breakdown Voltage	$BV_{DSS}$	$I_D=250\mu\text{A}, V_{GS}=0V$	500	-	-	V
Gate Threshold Voltage	$V_{GS(th)}$	$I_D=250\mu\text{A}, V_{DS}=V_{GS}$	3.7	4.2	4.7	V
Zero Gate Voltage Drain Current	$I_{DSS}$	$V_{DS}=500V, V_{GS}=0V$	-	-	25	$\mu\text{A}$
		$V_{DS}=400V, V_{GS}=0V$	-	-	250	
Gate-Source Leakage Current	$I_{GSS}$	$V_{GS}=\pm 30V, V_{DS}=0V$	-	10	100	nA
Drain-Source On-State Resistance	$R_{DS(on)}$	$I_D=10.5A, V_{GS}=10V$	-	0.23	0.27	$\Omega$
Forward Transconductance	$g_{fs}$	$I_D=10.5A, V_{DS}=25V$	7.5	15	-	S
Input Capacitance	$C_{iss}$	$V_{DS}=25V$	-	2450	3675	pF
Output Capacitance	$C_{oss}$	$V_{GS}=0V$	-	320	480	
Reverse Transfer Capacitance	$C_{rss}$	$f=1\text{MHz}$	-	19	28.5	
Turn-On Time	$t_d(on)$	$V_{cc}=300V$	-	41	61.5	ns
	$t_r$	$V_{GS}=10V$	-	33	49.5	
Turn-Off Time	$t_d(off)$	$I_D=10.5A$	-	90	135	
	$t_f$	$R_{GS}=10\Omega$	-	16	24	
Total Gate Charge	$Q_G$	$V_{cc}=250V$	-	68	102	nC
Gate-Source Charge	$Q_{GS}$	$I_D=21A$	-	23	34.5	
Gate-Drain Charge	$Q_{GD}$	$V_{GS}=10V$	-	26	39	
Gate-Drain Crossover Charge	$Q_{SW}$		-	10	15	
Avalanche Capability	$I_{AV}$	$L=1.27\text{mH}, T_{ch}=25^\circ\text{C}$	21	-	-	A
Diode Forward On-Voltage	$V_{SD}$	$I_F=21A, V_{GS}=0V, T_{ch}=25^\circ\text{C}$	-	0.90	1.35	V
Reverse Recovery Time	$t_{rr}$	$I_F=21A, V_{GS}=0V$	-	0.45	-	$\mu\text{s}$
Reverse Recovery Charge	$Q_{rr}$	$-di/dt=100A/\mu\text{s}, T_{ch}=25^\circ\text{C}$	-	7.2	-	$\mu\text{C}$

### ● Thermal Characteristics

Description	Symbol	Test Conditions	min.	typ.	max.	Unit
Thermal resistance	$R_{th(ch-c)}$	Channel to Case			0.930	$^\circ\text{C/W}$
	$R_{th(ch-a)}$	Channel to Ambient			40.0	$^\circ\text{C/W}$

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

Note \*2 : Stating  $T_{ch}=25^\circ\text{C}$ ,  $I_{AS}=9A$ ,  $L=16.2\text{mH}$ ,  $V_{cc}=50V$ ,  $R_G=50\Omega$ .

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

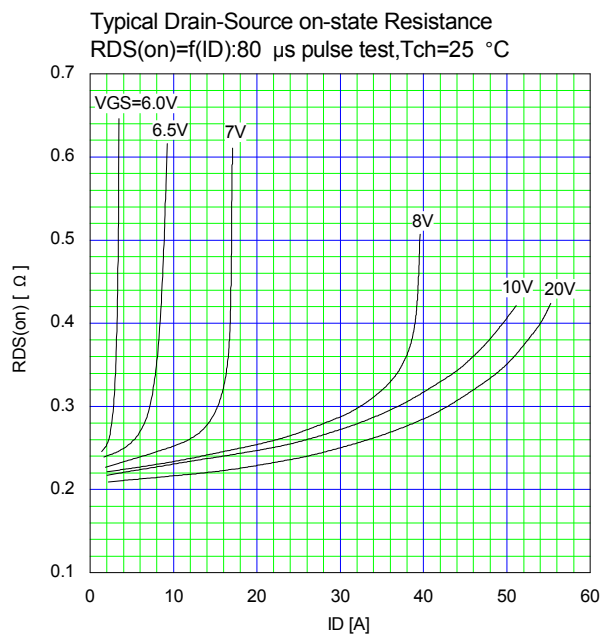
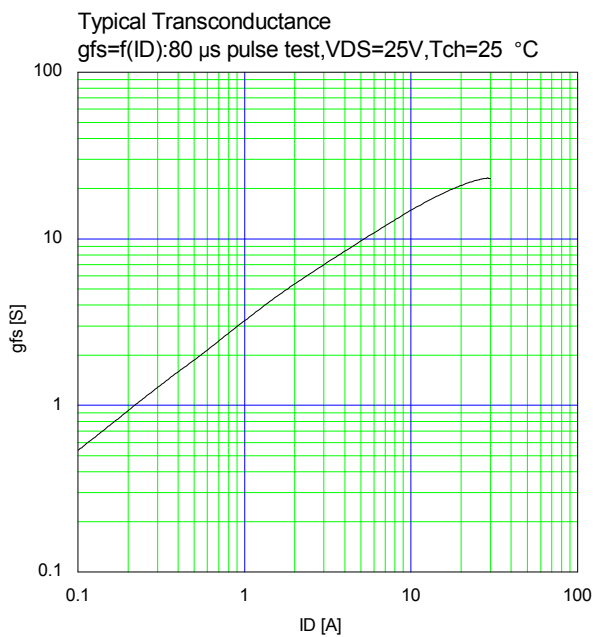
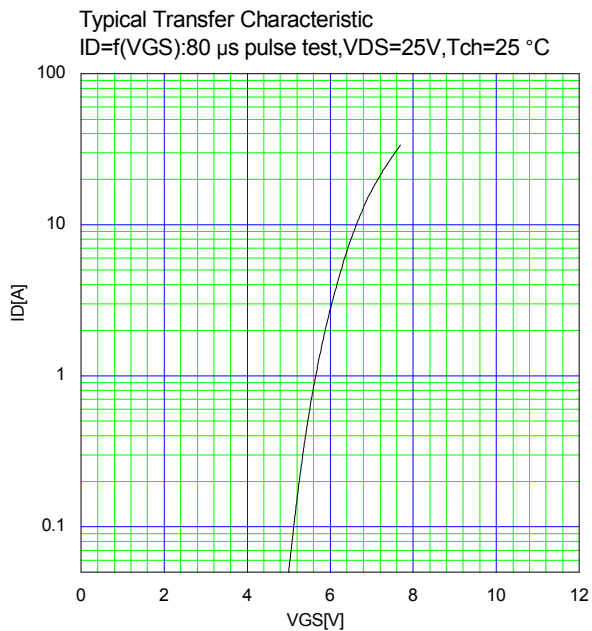
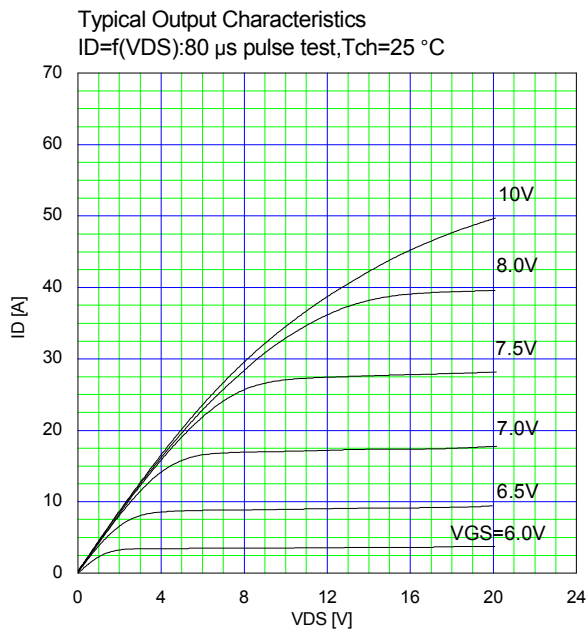
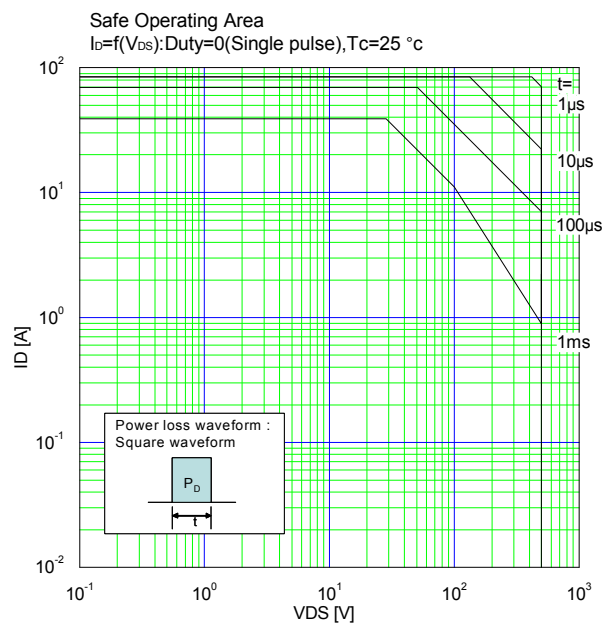
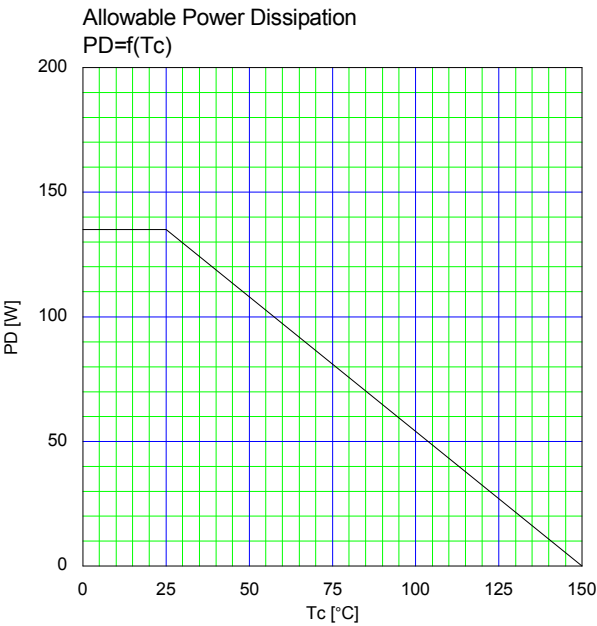
See to 'Avalanche Energy' graph.

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

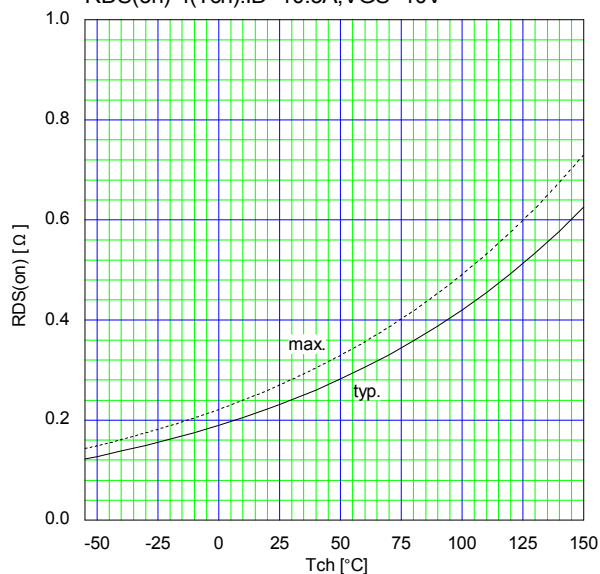
See to the 'Transient Thermal impedance' graph.

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

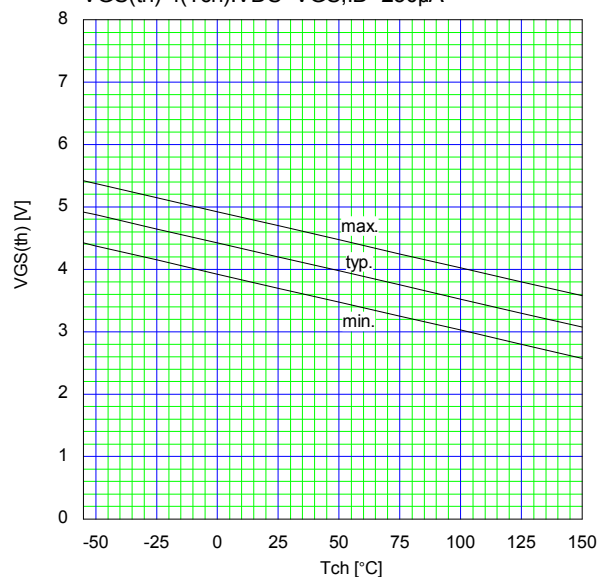
Note \*5 :  $I_{FS}=I_D$ ,  $dv/dt=5.7kV/\mu\text{s}$ ,  $V_{ccs}BV_{oss}$ ,  $T_{ch} \leq 150^\circ\text{C}$ .



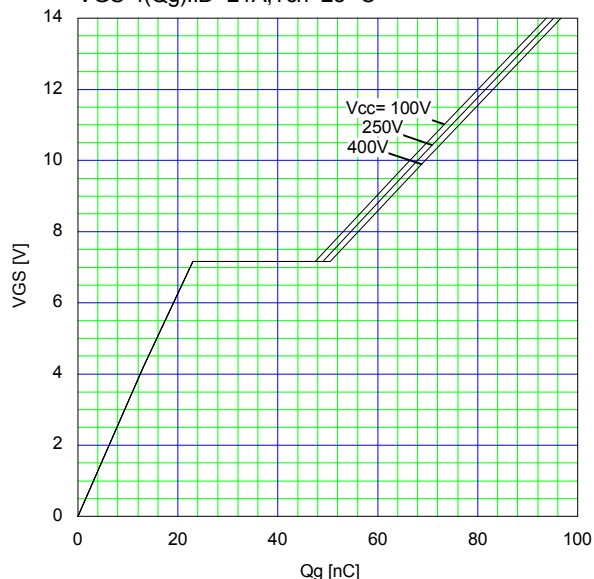
Drain-Source On-state Resistance  
 $R_{DS(on)} = f(T_{ch}) : I_D = 10.5A, V_{GS} = 10V$



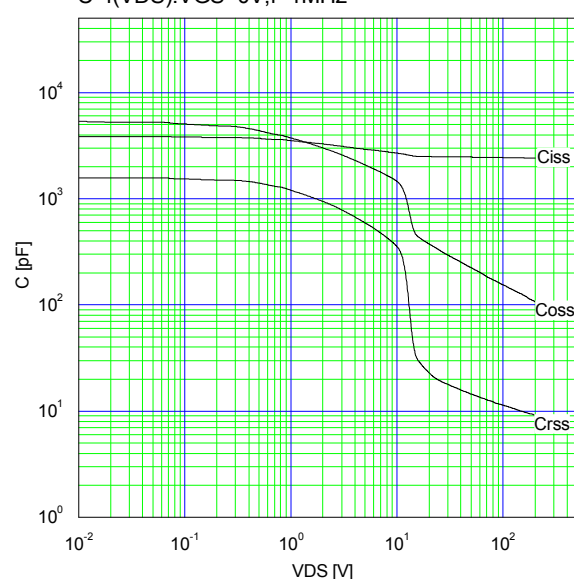
Gate Threshold Voltage vs.  $T_{ch}$   
 $V_{GS(th)} = f(T_{ch}) : V_{DS} = V_{GS}, I_D = 250\mu A$



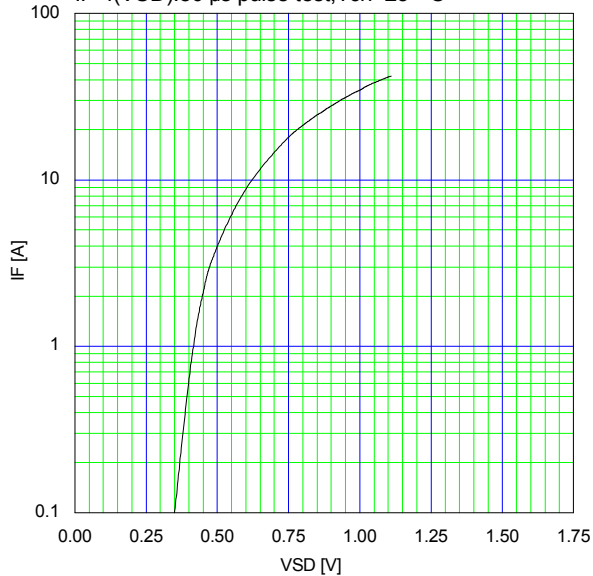
Typical Gate Charge Characteristics  
 $V_{GS} = f(Q_g) : I_D = 21A, T_{ch} = 25^{\circ}C$



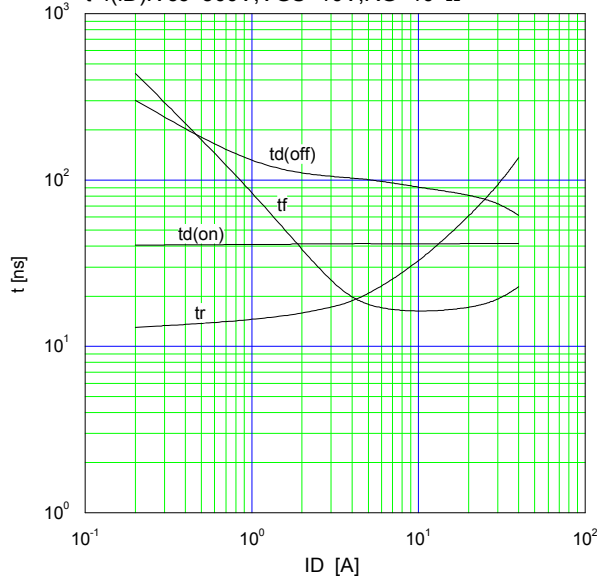
Typical Capacitance  
 $C = f(V_{DS}) : V_{GS} = 0V, f = 1MHz$

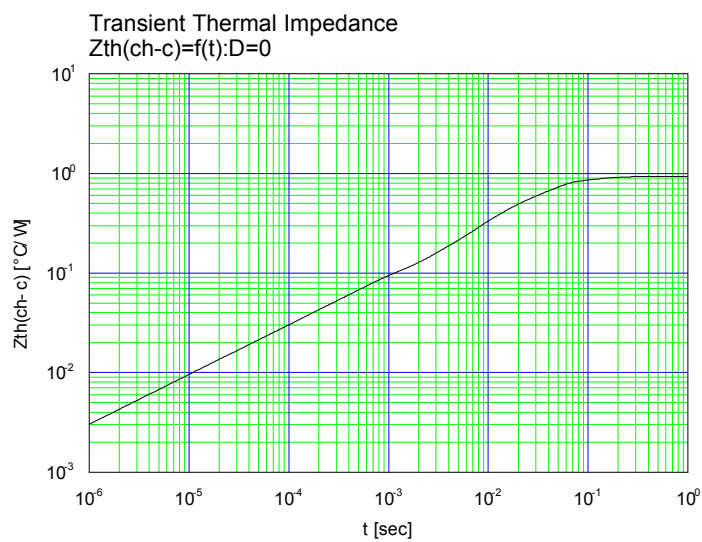
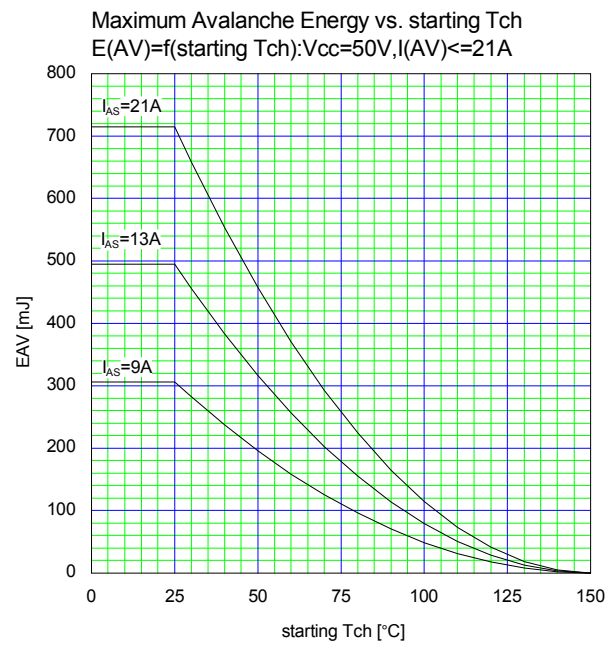


Typical Forward Characteristics of Reverse Diode  
 $I_F = f(V_{SD}) : 80\mu s \text{ pulse test}, T_{ch} = 25^{\circ}C$



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





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