

# FMH23N50ES

FUJI POWER MOSFET

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

## N-CHANNEL SILICON POWER MOSFET

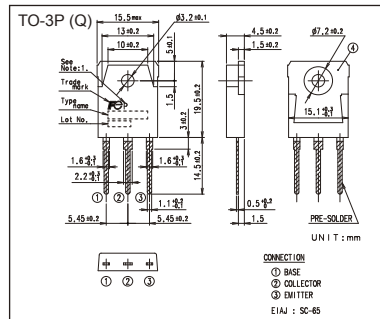
### Features

- Maintains both low power loss and low noise
- Lower R<sub>DS(on)</sub> characteristic
- More controllable switching dv/dt by gate resistance
- Smaller V<sub>GS</sub> ringing waveform during switching
- Narrow band of the gate threshold voltage (4.2±0.5V)
- High avalanche durability

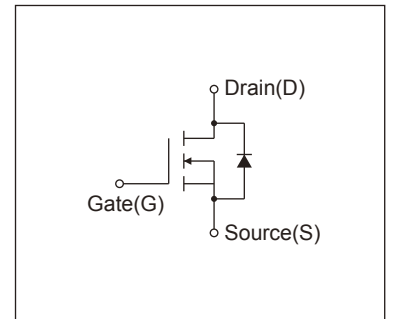
### Applications

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

### Outline Drawings [mm]



### Equivalent circuit schematic



### Maximum Ratings and Characteristics

#### Absolute Maximum Ratings at T<sub>c</sub>=25°C (unless otherwise specified)

Description	Symbol	Characteristics	Unit	Remarks
Drain-Source Voltage	V <sub>DS</sub>	500	V	
	V <sub>DSSX</sub>	500	V	V <sub>GS</sub> = -30V
Continuous Drain Current	I <sub>D</sub>	±23	A	
Pulsed Drain Current	I <sub>DP</sub>	±92	A	
Gate-Source Voltage	V <sub>GS</sub>	±30	V	
Repetitive and Non-Repetitive Maximum Avalanche Current	I <sub>AR</sub>	23	A	Note*1
Non-Repetitive Maximum Avalanche Energy	E <sub>AS</sub>	767.3	mJ	Note*2
Repetitive Maximum Avalanche Energy	E <sub>AR</sub>	31.5	mJ	Note*3
Peak Diode Recovery dv/dt	dV/dt	5.4	kV/μs	Note*4
Peak Diode Recovery -di/dt	-di/dt	100	A/μs	Note*5
Maximum Power Dissipation	P <sub>D</sub>	2.50	W	T <sub>a</sub> =25°C
		315		T <sub>c</sub> =25°C
Operating and Storage Temperature range	T <sub>ch</sub>	150	°C	
	T <sub>slg</sub>	-55 to +150	°C	

#### Electrical Characteristics at T<sub>c</sub>=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(th)</sub>	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(on)</sub>	I <sub>D</sub> =11.5A, V <sub>GS</sub> =10V	-	0.209	0.245	Ω
Forward Transconductance	g <sub>fs</sub>	I <sub>D</sub> =11.5A, V <sub>DS</sub> =25V	8.5	17	-	S
Input Capacitance	C <sub>iss</sub>	V <sub>DS</sub> =25V	-	2700	4050	pF
Output Capacitance	C <sub>oss</sub>	V <sub>GS</sub> =0V	-	330	495	
Reverse Transfer Capacitance	C <sub>rss</sub>	f=1MHz	-	20	30	
Turn-On Time	td(on)	V <sub>cc</sub> =300V	-	42	63	ns
	tr	V <sub>GS</sub> =10V	-	36	54	
Turn-Off Time	td(off)	I <sub>D</sub> =11.5A	-	94	141	
	tf	R <sub>GS</sub> =10Ω	-	17	25.5	
Total Gate Charge	Q <sub>G</sub>	V <sub>cc</sub> =250V	-	73	109.5	nC
Gate-Source Charge	Q <sub>GS</sub>	I <sub>D</sub> =23A	-	24	36	
Gate-Drain Charge	Q <sub>GD</sub>	V <sub>GS</sub> =10V	-	27	40.5	
Gate-Drain Crossover Charge	Q <sub>SW</sub>		-	10	15	
Avalanche Capability	I <sub>AV</sub>	L=1.16mH, T <sub>ch</sub> =25°C	23	-	-	A
Diode Forward On-Voltage	V <sub>SD</sub>	I <sub>F</sub> =23A, V <sub>GS</sub> =0V, T <sub>ch</sub> =25°C	-	0.90	1.35	V
Reverse Recovery Time	trr	I <sub>F</sub> =23A, 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	-	8.0	-	μC

#### Thermal Characteristics

Description	Symbol	Test Conditions	min.	typ.	max.	Unit
Thermal resistance	R <sub>th(ch-c)</sub>	Channel to Case			0.40	°C/W
	R <sub>th(ch-a)</sub>	Channel to Ambient			50.0	°C/W

Note \*1 : T<sub>ch</sub>≤150°C.

Note \*2 : Stating T<sub>ch</sub>=25°C, I<sub>AS</sub>=10A, L=14.1mH, V<sub>cc</sub>=50V, R<sub>G</sub>=50Ω.

E<sub>AS</sub> limited by maximum channel temperature and avalanche current. See to 'Avalanche Energy' graph.

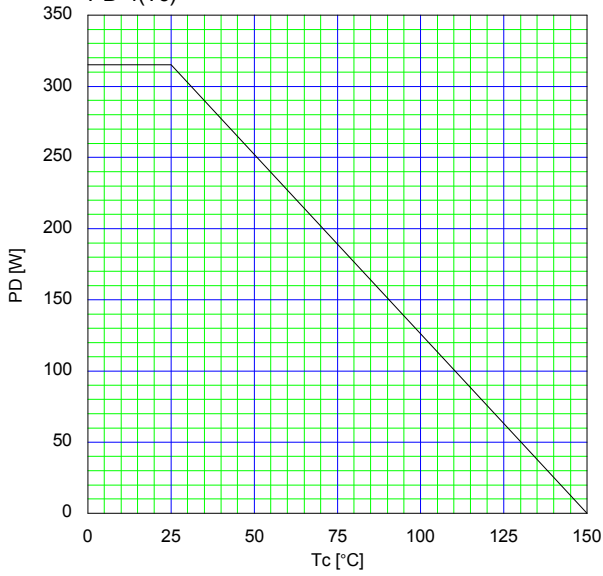
Note \*3 : Repetitive rating : Pulse width limited by maximum channel temperature.

See to the 'Transient Thermal impedance' graph.

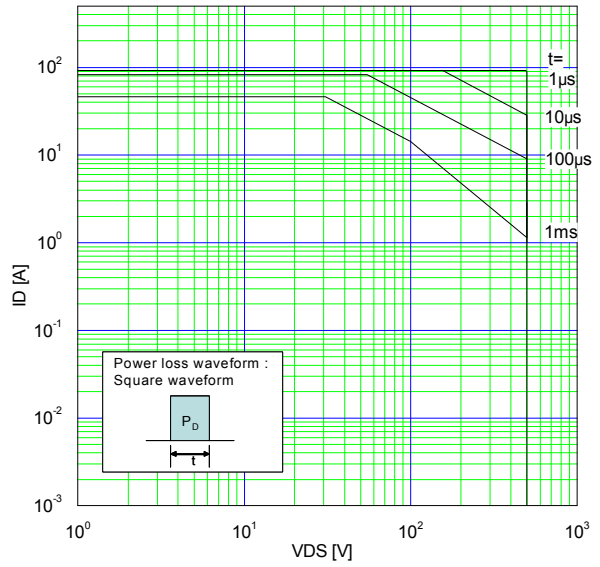
Note \*4 : I<sub>F</sub>≤I<sub>D</sub>, -di/dt=100A/μs, V<sub>cc</sub>≤BV<sub>DSS</sub>, T<sub>ch</sub>≤150°C.

Note \*5 : I<sub>F</sub>≤I<sub>D</sub>, dv/dt=5.4kV/μs, V<sub>cc</sub>≤BV<sub>DSS</sub>, T<sub>ch</sub>≤150°C.

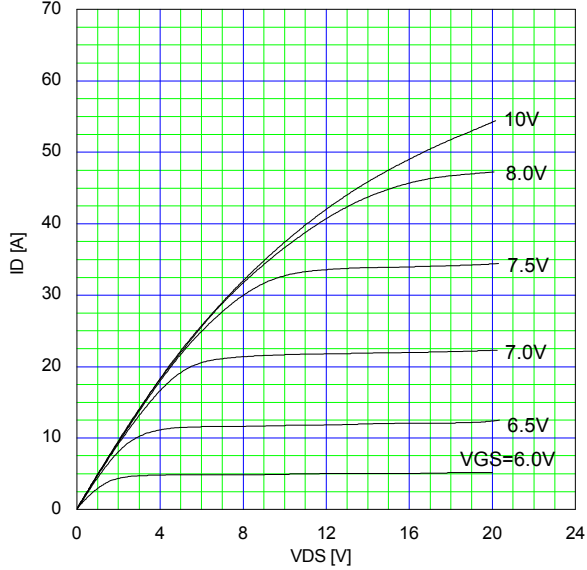
Allowable Power Dissipation  
 $P_D = f(T_c)$



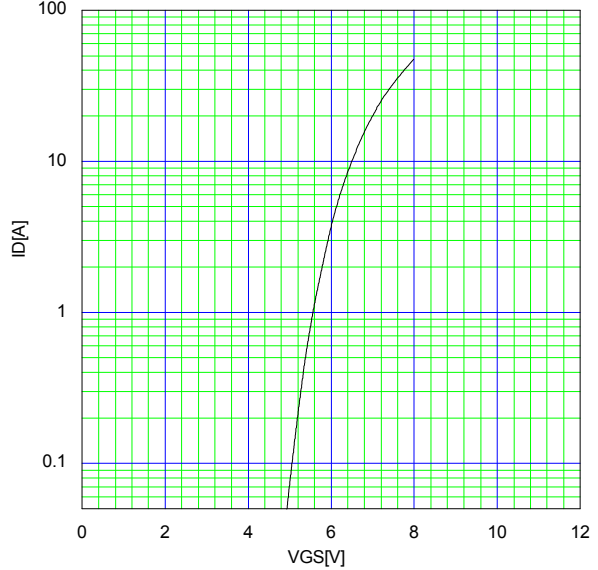
Safe Operating Area  
 $I_D = f(V_{DS}): \text{Duty}=0 (\text{Single pulse}), T_c=25^\circ\text{C}$



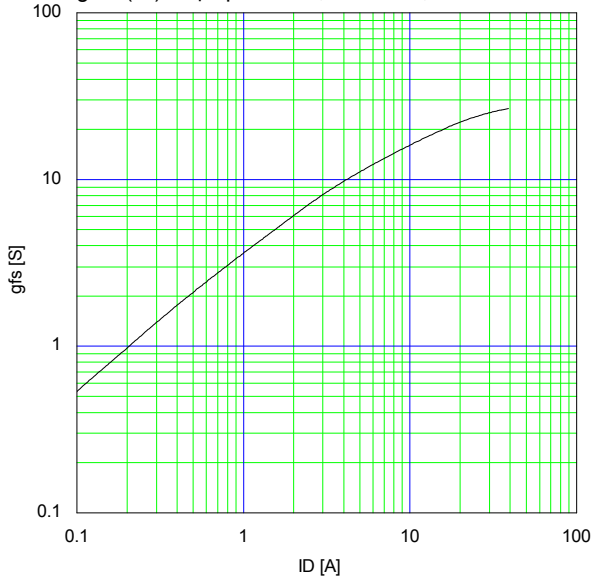
Typical Output Characteristics  
 $I_D = f(V_{DS}): 80\ \mu\text{s pulse test}, T_{ch}=25^\circ\text{C}$



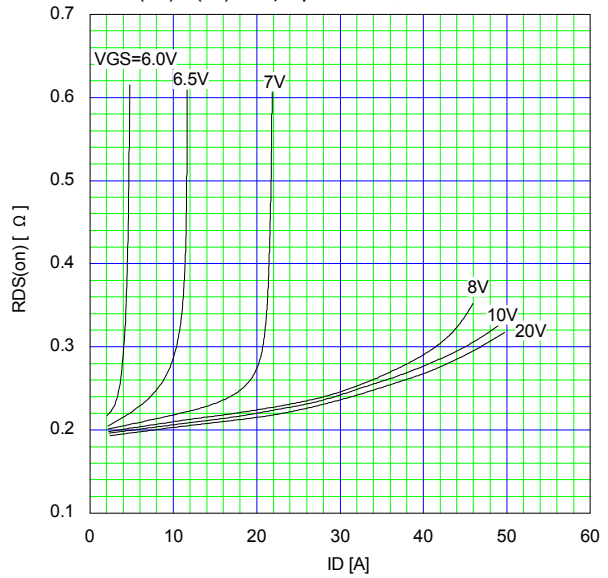
Typical Transfer Characteristic  
 $I_D = f(V_{GS}): 80\ \mu\text{s pulse test}, V_{DS}=25\text{V}, T_{ch}=25^\circ\text{C}$



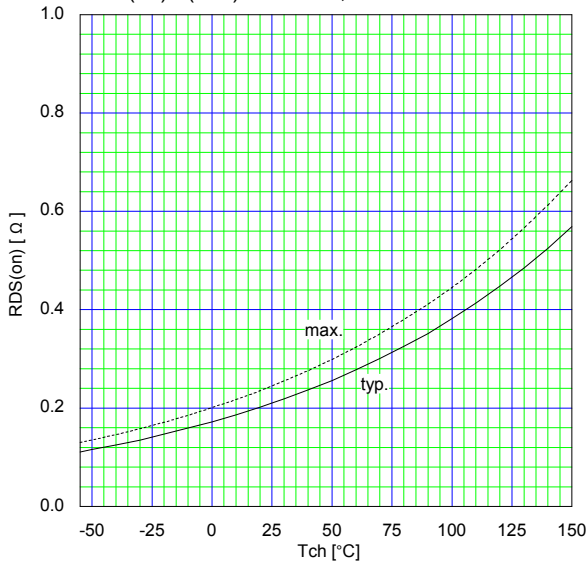
Typical Transconductance  
 $g_{fs} = f(I_D): 80\ \mu\text{s pulse test}, V_{DS}=25\text{V}, T_{ch}=25^\circ\text{C}$



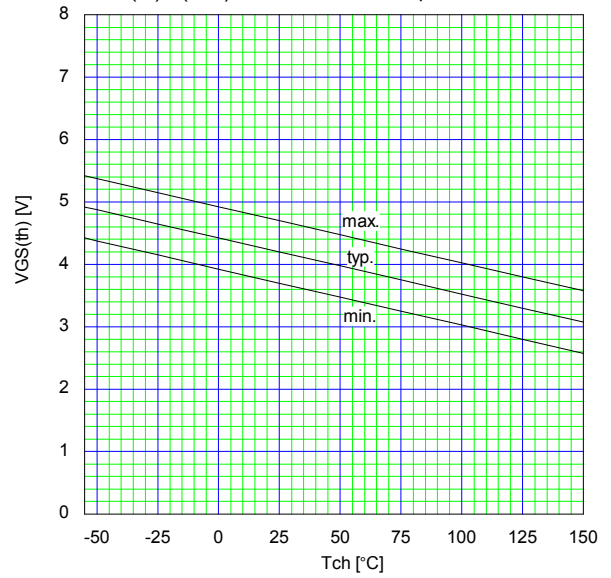
Typical Drain-Source on-state Resistance  
 $R_{DS(on)} = f(I_D): 80\ \mu\text{s pulse test}, T_{ch}=25^\circ\text{C}$



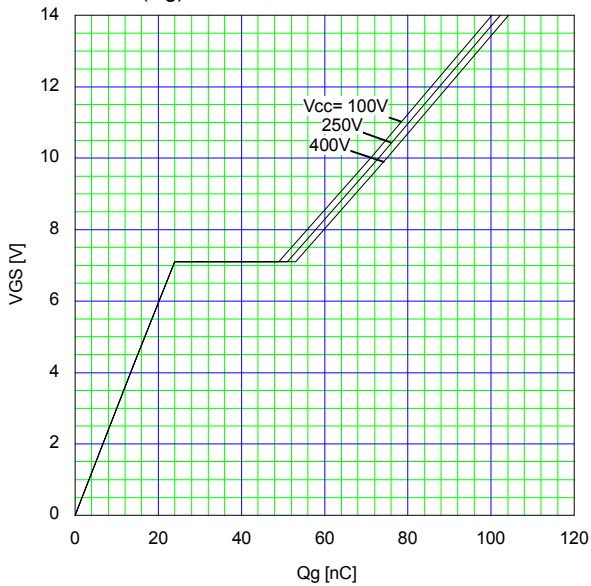
Drain-Source On-state Resistance  
 $R_{DS(on)}=f(T_{ch}):I_D=11.5A, V_{GS}=10V$



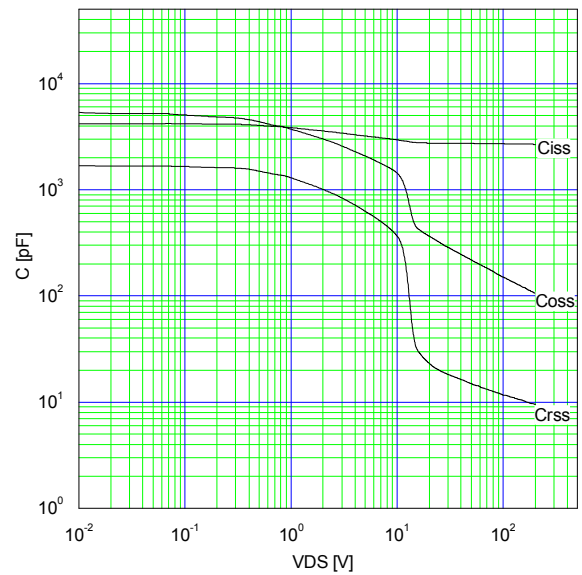
Gate Threshold Voltage vs. T<sub>ch</sub>  
 $V_{GS(th)}=f(T_{ch}):V_{DS}=V_{GS}, I_D=250\mu A$



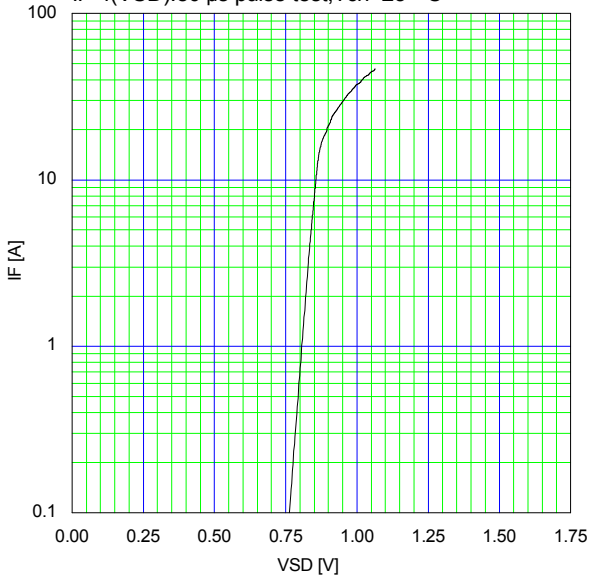
Typical Gate Charge Characteristics  
 $V_{GS}=f(Q_g):I_D=23A, T_{ch}=25\text{ }^\circ\text{C}$



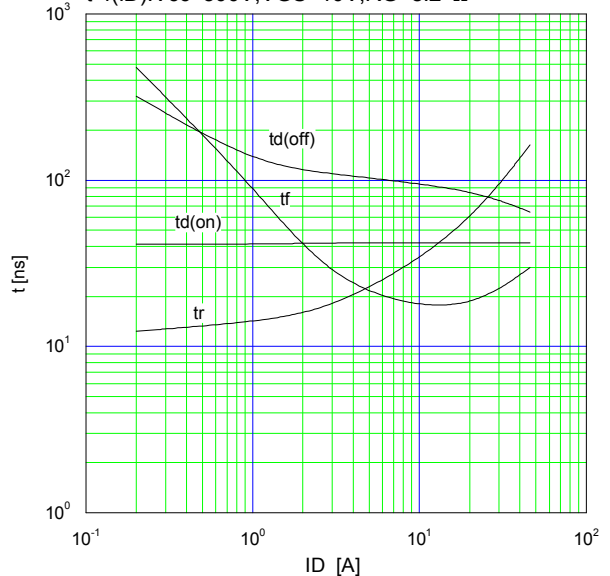
Typical Capacitance  
 $C=f(V_{DS}):V_{GS}=0V, f=1\text{MHz}$



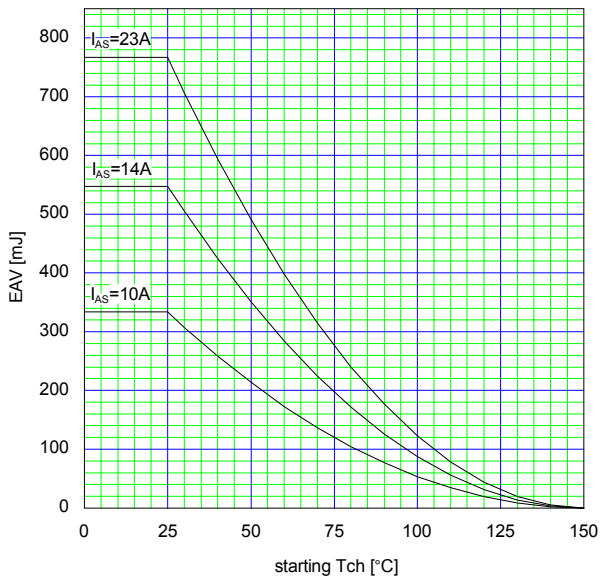
Typical Forward Characteristics of Reverse Diode  
 $I_F=f(V_{SD}):80\text{ }\mu\text{s pulse test}, T_{ch}=25\text{ }^\circ\text{C}$



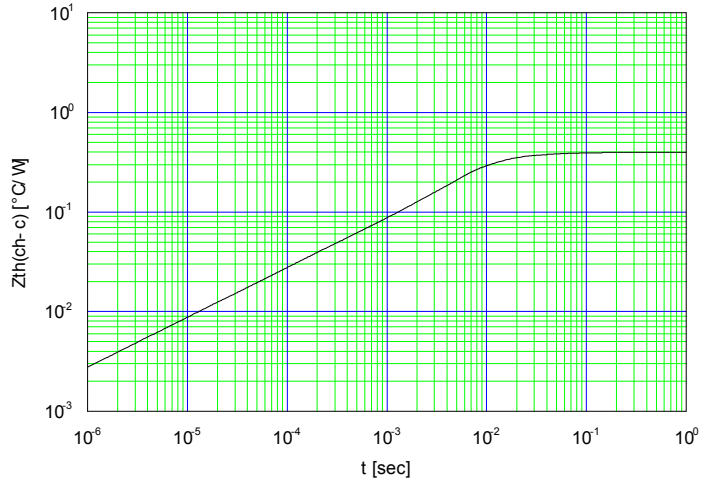
Typical Switching Characteristics vs. I<sub>D</sub>  
 $t=f(I_D):V_{cc}=300V, V_{GS}=10V, R_G=8.2\text{ }\Omega$



Maximum Avalanche Energy vs. starting Tch  
 $E(AV)=f(\text{starting Tch}):V_{CC}=50V, I(AV)\leq 23A$



Maximum Transient Thermal Impedance  
 $Z_{th(ch-c)}=f(t):D=0$



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