

# FMH23N60ES

FUJI POWER MOSFET

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

## N-CHANNEL SILICON POWER MOSFET

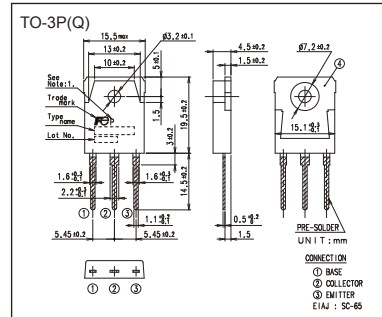
### Features

- 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

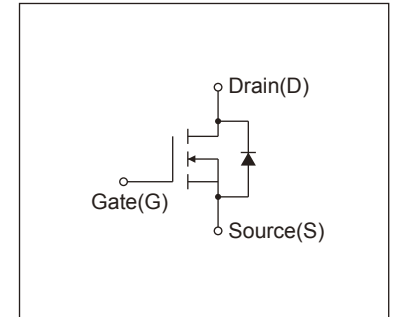
### Applications

- 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>	600	V	
	V <sub>DSSX</sub>	600	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>	1033.1	mJ	Note*2
Repetitive Maximum Avalanche Energy	E <sub>AR</sub>	40	mJ	Note*3
Peak Diode Recovery dV/dt	dV/dt	4.7	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
		400		T <sub>c</sub> =25°C
Operating and Storage Temperature range	T <sub>ch</sub>	150	°C	
	T <sub>stg</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	600	-	-	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> =600V, V <sub>GS</sub> =0V	-	-	25	μA
		V <sub>DS</sub> =480V, 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	-	0.24	0.28	Ω
Forward Transconductance	g <sub>fs</sub>	I <sub>D</sub> =11.5A, V <sub>DS</sub> =25V	9	18	-	S
Input Capacitance	C <sub>iss</sub>	V <sub>DS</sub> =25V	-	3500	5250	pF
Output Capacitance	C <sub>oss</sub>	V <sub>GS</sub> =0V	-	380	570	
Reverse Transfer Capacitance	C <sub>rss</sub>	f=1MHz	-	22	33	
Turn-On Time	td(on)	V <sub>cc</sub> =300V	-	45	68	ns
	tr	V <sub>GS</sub> =10V	-	34	51	
Turn-Off Time	td(off)	I <sub>D</sub> =11.5A	-	110	165	
	tf	R <sub>G</sub> =8.2Ω	-	16	24	
Total Gate Charge	Q <sub>G</sub>	V <sub>cc</sub> =300V	-	92	138	nC
Gate-Source Charge	Q <sub>GS</sub>	I <sub>D</sub> =23A	-	28	42	
Gate-Drain Charge	Q <sub>GD</sub>	V <sub>GS</sub> =10V	-	33	50	
Gate-Drain Crossover Charge	Q <sub>SW</sub>		-	11	17	
Avalanche Capability	I <sub>AV</sub>	L=1.56mH, 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	t <sub>rr</sub>	I <sub>F</sub> =23A, V <sub>GS</sub> =0V	-	0.92	-	μs
Reverse Recovery Charge	Q <sub>rr</sub>	-di/dt=100A/μs, T <sub>ch</sub> =25°C	-	14	-	μC

#### Thermal Characteristics

Description	Symbol	Test Conditions	min.	typ.	max.	Unit
Thermal resistance	R <sub>th(ch-c)</sub>	Channel to case			0.313	°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=18.9mH, V<sub>cc</sub>=60V, R<sub>G</sub>=50Ω  
E<sub>AS</sub> limited by maximum channel temperature and avalanche current.  
See to 'Avalanche Energy' graph.

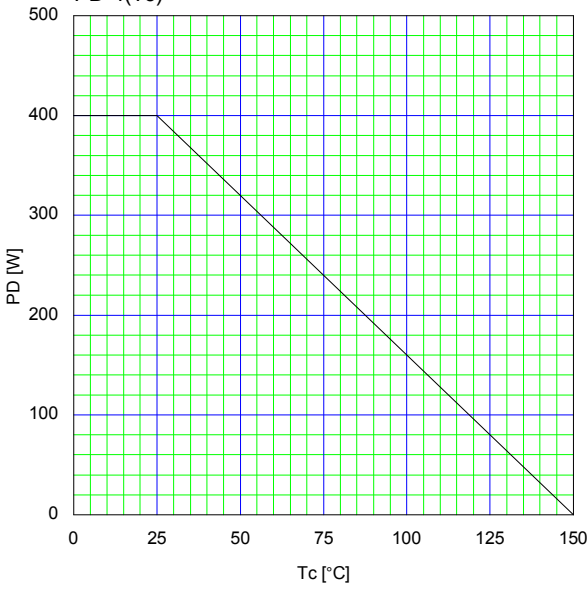
Note \*3 : Repetitive rating : Pulse width limited by maximum channel temperature.

See to the 'Transient Thermal Impedance' graph.

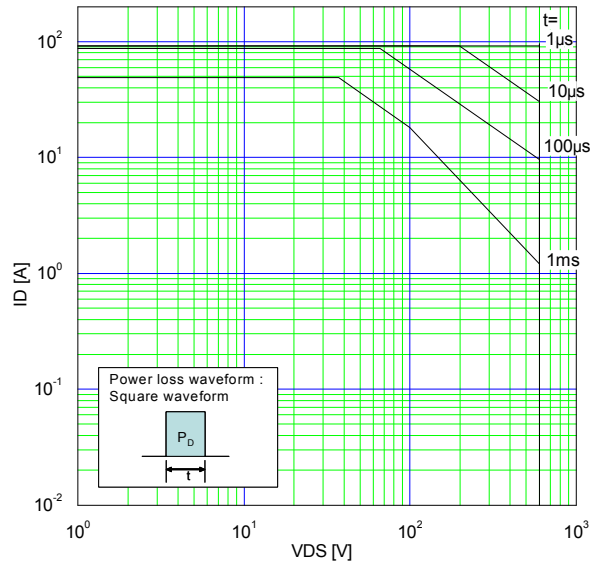
Note \*4 : I<sub>F</sub>≤I<sub>D</sub>, -di/dt=100A/μs, V<sub>cc</sub>≤BV<sub>DSS</sub>, T<sub>ch</sub>≤150°C.

Note \*5 : I<sub>F</sub>≤I<sub>D</sub>, dv/dt=4.7kV/μs, V<sub>cc</sub>≤BV<sub>DSS</sub>, T<sub>ch</sub>≤150°C.

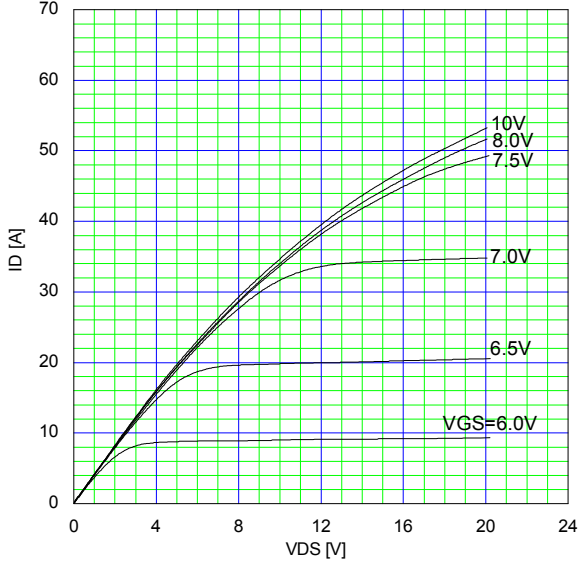
Allowable Power Dissipation  
 $PD=f(T_c)$



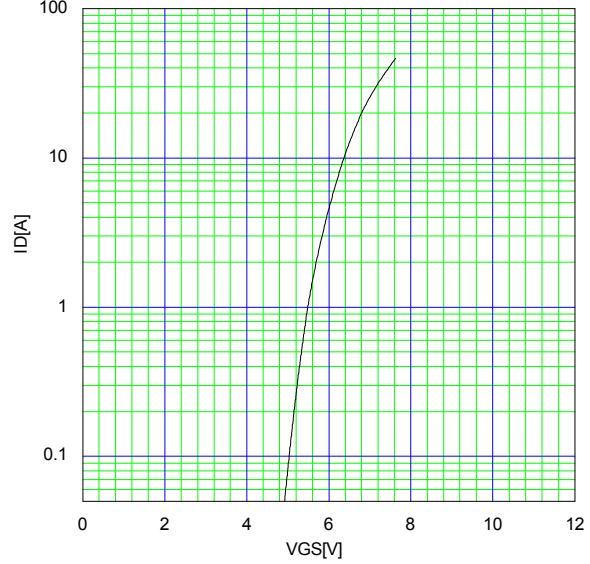
Safe Operating Area  
 $I_D=f(V_{DS}): Duty=0(\text{Single pulse}), T_c=25^\circ\text{C}$



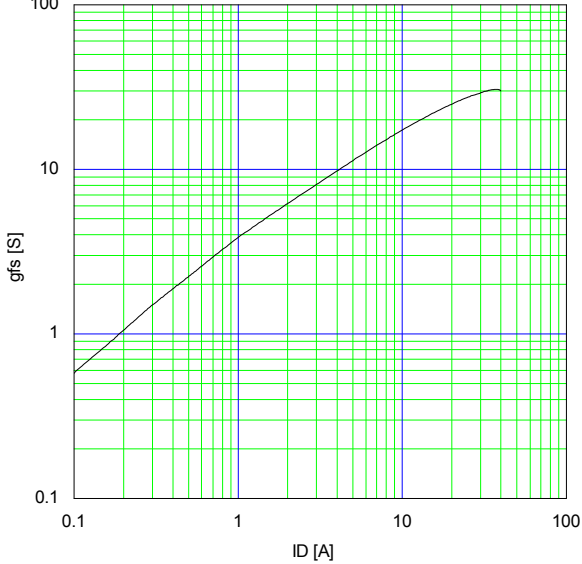
Typical Output Characteristics  
 $I_D=f(V_{DS}): 80\ \mu\text{s pulse test}, T_{ch}=25^\circ\text{C}$



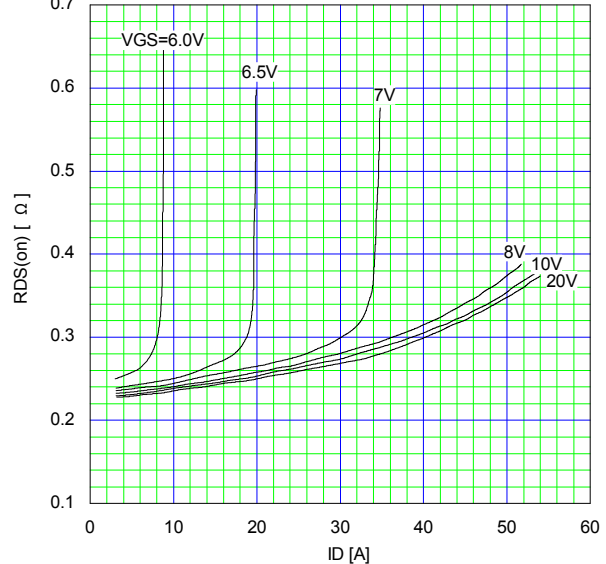
Typical Transfer Characteristic  
 $I_D=f(V_{GS}): 80\ \mu\text{s pulse test}, V_{DS}=25\text{V}, T_{ch}=25^\circ\text{C}$



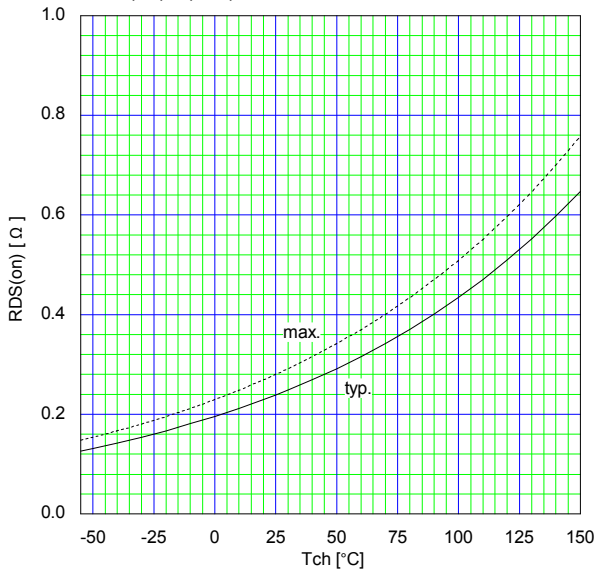
Typical Transconductance  
 $g_{fs}=f(I_D): 80\ \mu\text{s pulse test}, V_{DS}=25\text{V}, T_{ch}=25^\circ\text{C}$



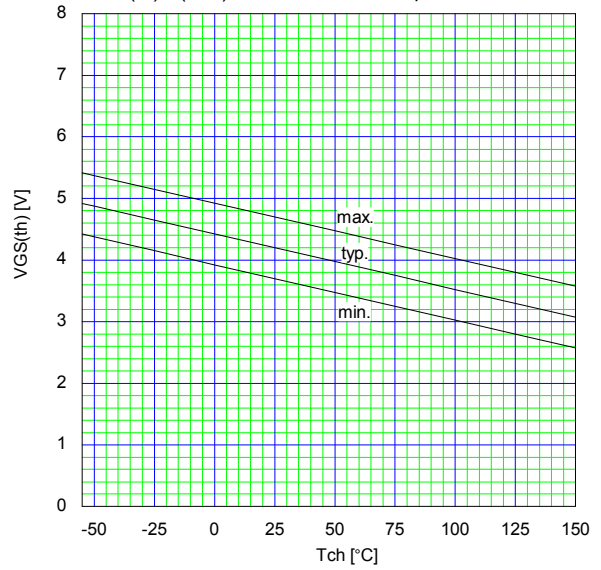
Typical Drain-Source on-state Resistance  
 $R_{DS(on)}=f(I_D): 80\ \mu\text{s pulse test}, T_{ch}=25^\circ\text{C}$



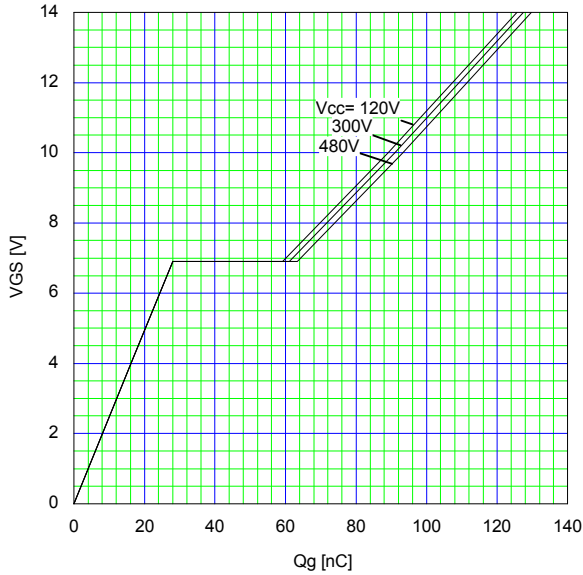
Drain-Source On-state Resistance  
 $R_{DS(on)}=f(T_{ch}):I_D=11.5A, V_{GS}=10V$



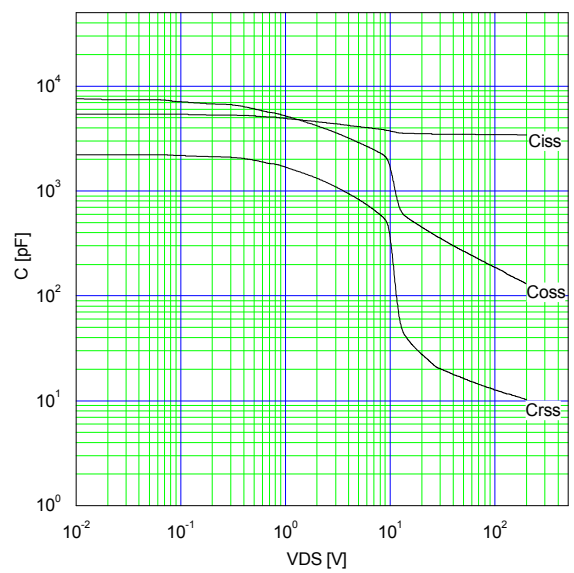
Gate Threshold Voltage vs.  $T_{ch}$   
 $V_{GS(th)}=f(T_{ch}):V_{DS}=V_{GS}, I_D=250\mu A$



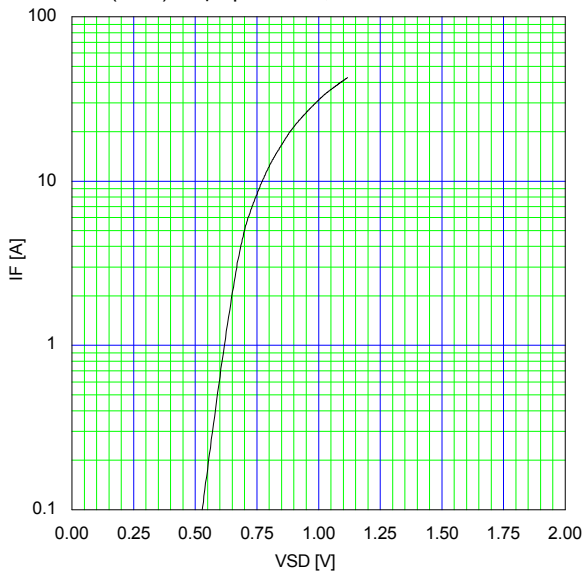
Typical Gate Charge Characteristics  
 $V_{GS}=f(Q_g):I_D=23A, T_{ch}=25\text{ }^\circ C$



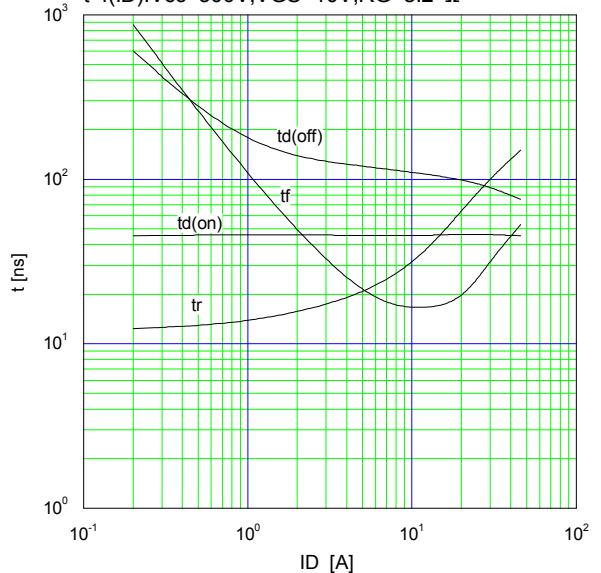
Typical Capacitance  
 $C=f(V_{DS}):V_{GS}=0V, f=1MHz$

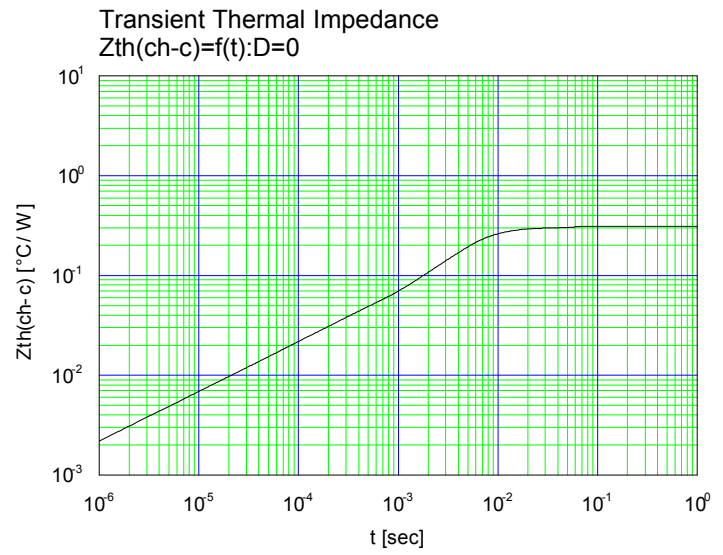
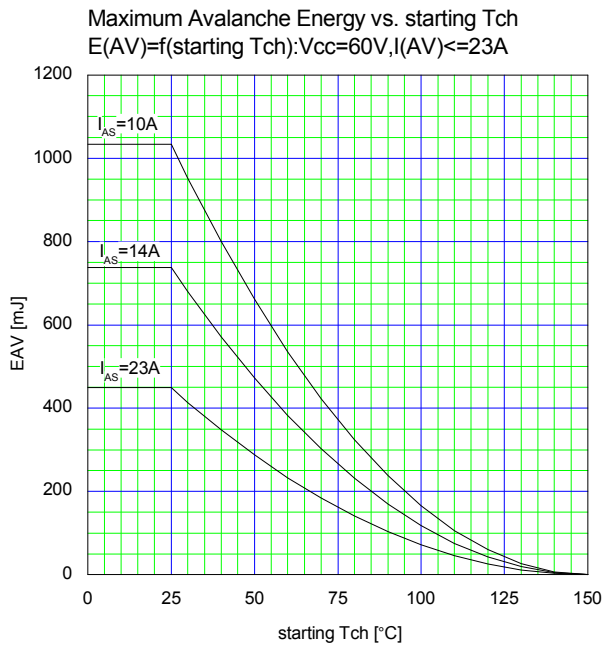


Typical Forward Characteristics of Reverse Diode  
 $I_F=f(V_{SD}):80\text{ }\mu s\text{ pulse test}, T_{ch}=25\text{ }^\circ C$



Typical Switching Characteristics vs.  $I_D$   
 $t=f(I_D):V_{CC}=300V, V_{GS}=10V, R_G=8.2\text{ }\Omega$





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