

FMI13N60ES

FUJI POWER MOSFET

Super FAP-E^{3S} series

N-CHANNEL SILICON POWER MOSFET

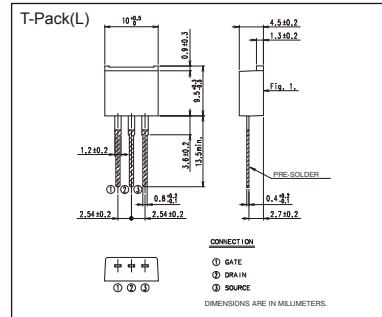
■ Features

- 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

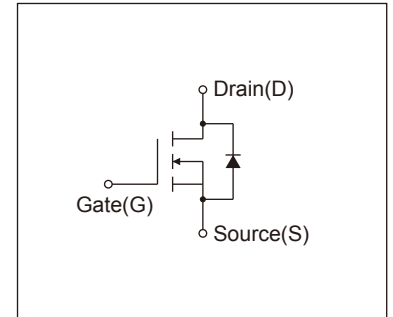
■ Applications

- 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}	600	V	
	V_{DSX}	600	V	$V_{GS} = -30V$
Continuous Drain Current	I_D	± 13	A	
Pulsed Drain Current	I_{DP}	± 52	A	
Gate-Source Voltage	V_{GS}	± 30	V	
Repetitive and Non-Repetitive Maximum Avalanche Current	I_{AR}	13	A	Note*1
Non-Repetitive Maximum Avalanche Energy	E_{AS}	471.5	mJ	Note*2
Repetitive Maximum Avalanche Energy	E_{AR}	22.5	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_D	1.67	W	$T_a=25^\circ\text{C}$
		225		$T_c=25^\circ\text{C}$
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_{DSS}	$I_D=250\mu\text{A}$, $V_{GS}=0V$	600	-	-	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}	$V_{DS}=600V$, $V_{GS}=0V$	-	-	25	μA
		$V_{DS}=480V$, $V_{GS}=0V$	-	-	250	
Gate-Source Leakage Current	I_{GSS}	$V_{GS}=\pm 30V$, $V_{DS}=0V$	-	10	100	nA
Drain-Source On-State Resistance	$R_{DS(on)}$	$I_D=6.5A$, $V_{GS}=10V$	-	0.50	0.58	Ω
Forward Transconductance	g_{fs}	$I_D=6.5A$, $V_{DS}=25V$	5	10	-	S
Input Capacitance	C_{iss}	$V_{DS}=25V$	-	1700	2550	pF
Output Capacitance	C_{oss}	$V_{GS}=0V$	-	190	285	
Reverse Transfer Capacitance	C_{rss}	$f=1\text{MHz}$	-	10	15	
Turn-On Time	$t_{d(on)}$	$V_{cc}=300V$	-	38	57	ns
	t_r	$V_{GS}=10V$	-	24	36	
Turn-Off Time	$t_{d(off)}$	$I_D=6.5A$	-	86	129	
	t_f	$R_G=18\Omega$	-	16	24	
Total Gate Charge	Q_G	$V_{cc}=300V$	-	48	72	nC
Gate-Source Charge	Q_{GS}	$I_D=13A$	-	16	24	
Gate-Drain Charge	Q_{GD}	$V_{GS}=10V$	-	16	24	
Gate-Drain Crossover Charge	Q_{SW}		-	7	10.5	
Avalanche Capability	I_{AV}	$L=2.36\text{mH}$, $T_{ch}=25^\circ\text{C}$	13	-	-	A
Diode Forward On-Voltage	V_{SD}	$I_F=13A$, $V_{GS}=0V$, $T_{ch}=25^\circ\text{C}$	-	0.90	1.08	V
Reverse Recovery Time	t_{rr}	$I_F=13A$, $V_{GS}=0V$	-	0.7	-	μs
Reverse Recovery Charge	Q_{rr}	$-di/dt=100A/\mu\text{s}$, $T_{ch}=25^\circ\text{C}$	-	8	-	μC

● 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			75.0	$^\circ\text{C/W}$

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

Note *2 : Stating $T_{ch}=25^\circ\text{C}$, $I_{AS}=6A$, $L=24.0\text{mH}$, $V_{cc}=60V$, $R_G=50\Omega$

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

See to 'Avalanche Energy' graph.

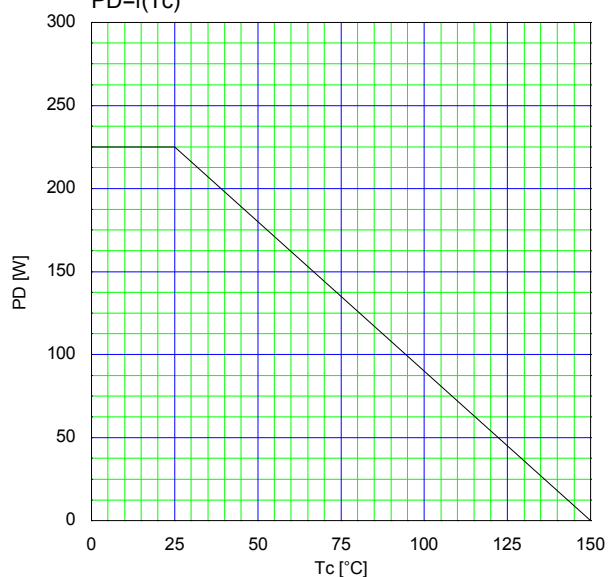
Note *3 : Repetitive rating : Pulse width limited by maximum channel temperature.

See to the 'Transient Thermal Impedance' graph.

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

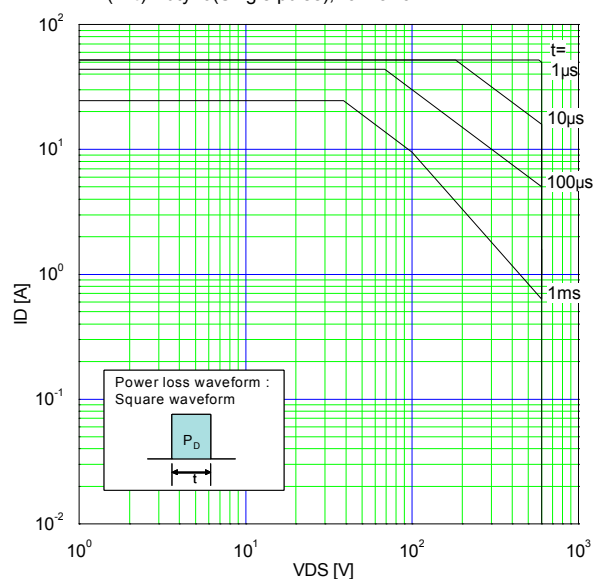
Note *5 : $I_F \leq I_D$, $dv/dt=4.7kV/\mu\text{s}$, $V_{cc} \leq BV_{DSS}$, $T_{ch} \leq 150^\circ\text{C}$.

Allowable Power Dissipation
 $P_D = f(T_c)$

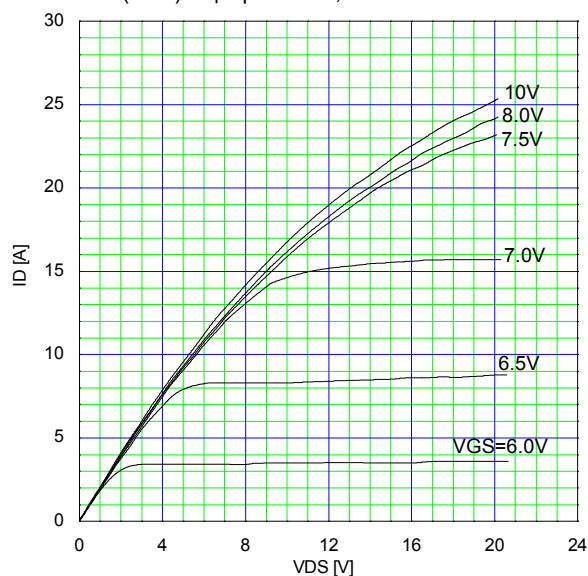


Safe Operating Area

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

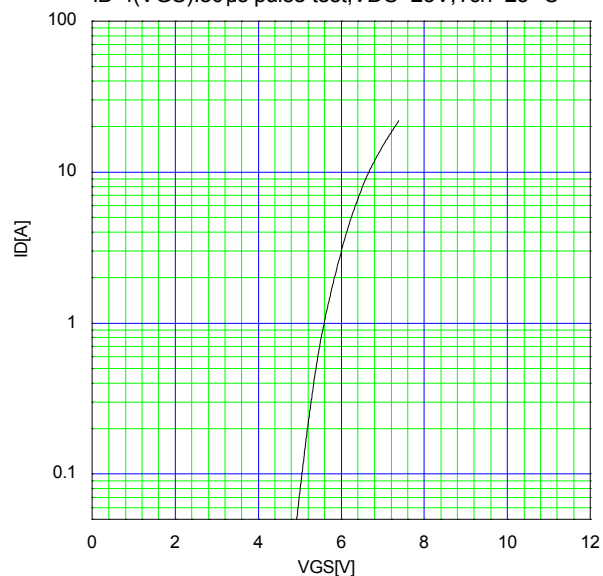


Typical Output Characteristics
 $I_D = f(V_{DS})$: 80 μs pulse test, $T_{ch} = 25^\circ\text{C}$

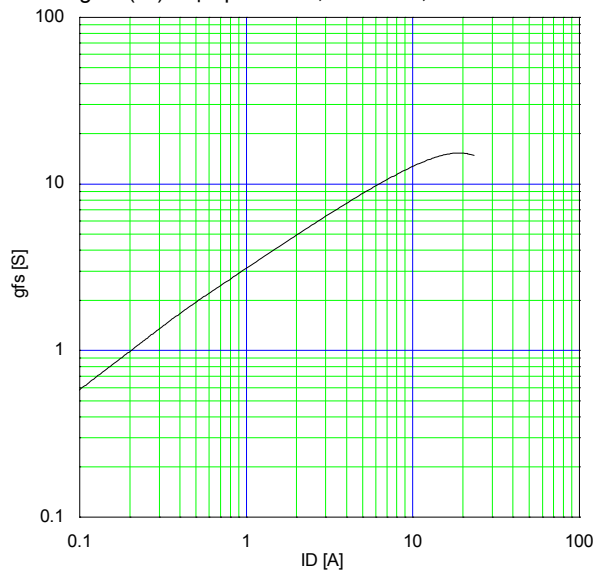


Typical Transfer Characteristic

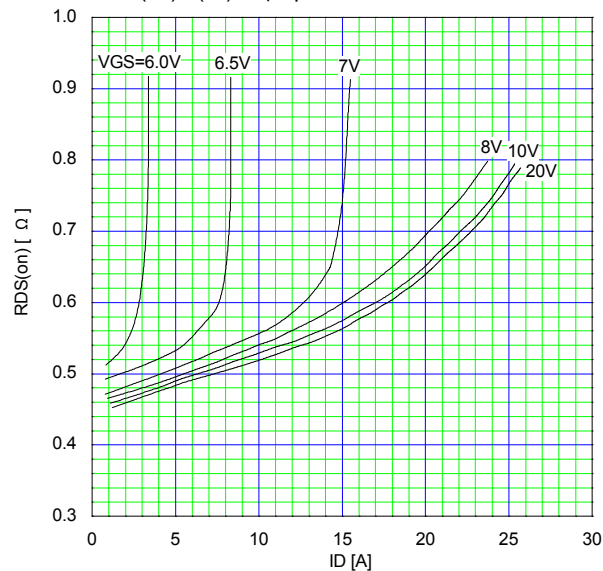
$I_D = f(V_{GS})$: 80 μs pulse test, $V_{DS} = 25\text{V}$, $T_{ch} = 25^\circ\text{C}$



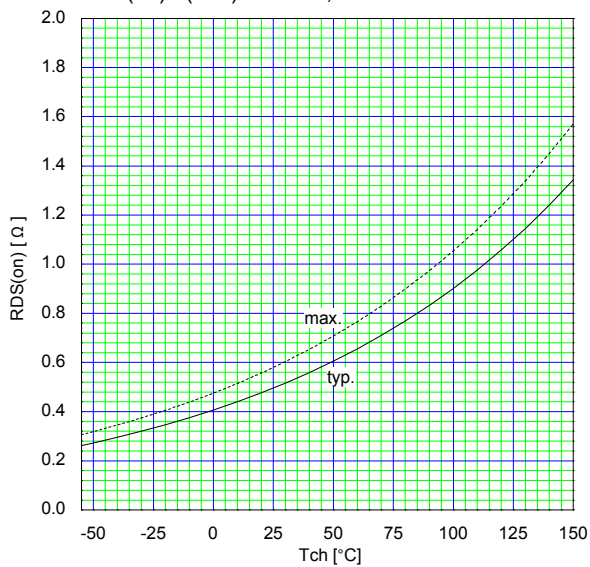
Typical Transconductance
 $g_{fs} = f(I_D)$: 80 μs pulse test, $V_{DS} = 25\text{V}$, $T_{ch} = 25^\circ\text{C}$



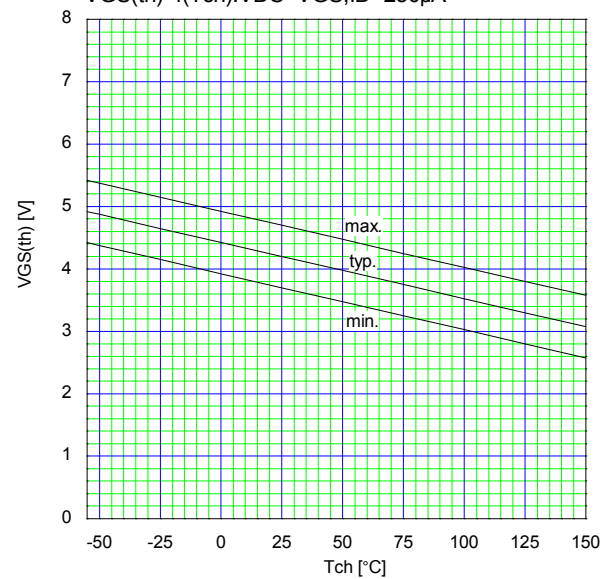
Typical Drain-Source on-state Resistance
 $R_{DS(on)} = f(I_D)$: 80 μs pulse test, $T_{ch} = 25^\circ\text{C}$



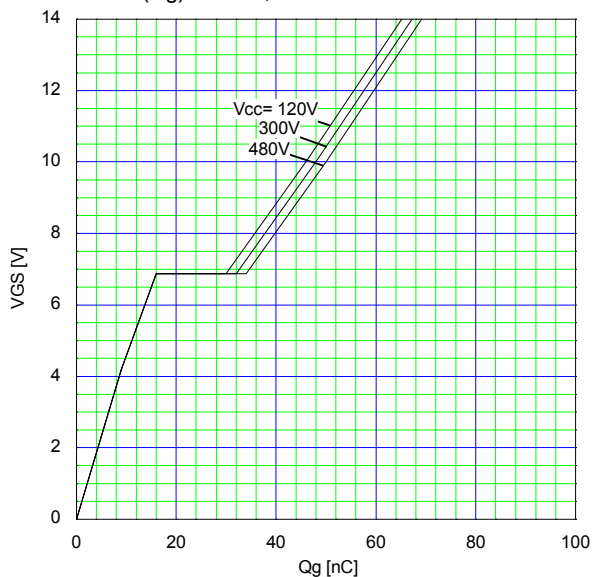
Drain-Source On-state Resistance
 $R_{DS(on)} = f(T_{ch}): I_D = 6.5A, V_{GS} = 10V$



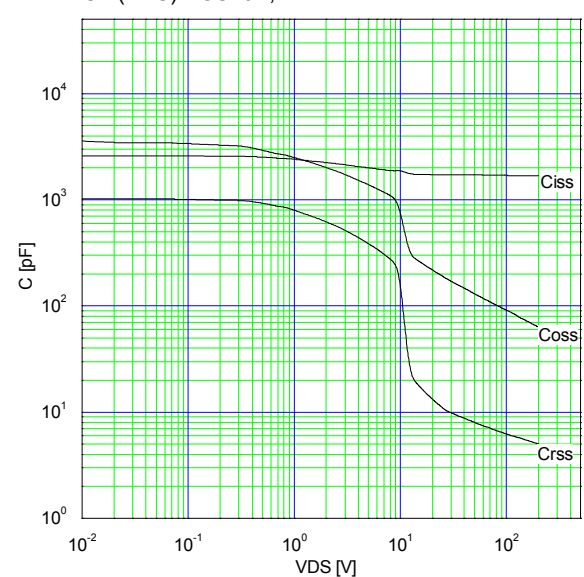
Gate Threshold Voltage vs. T_{ch}
 $V_{GS(th)} = f(T_{ch}): V_{DS} = V_{GS}, I_D = 250\mu A$



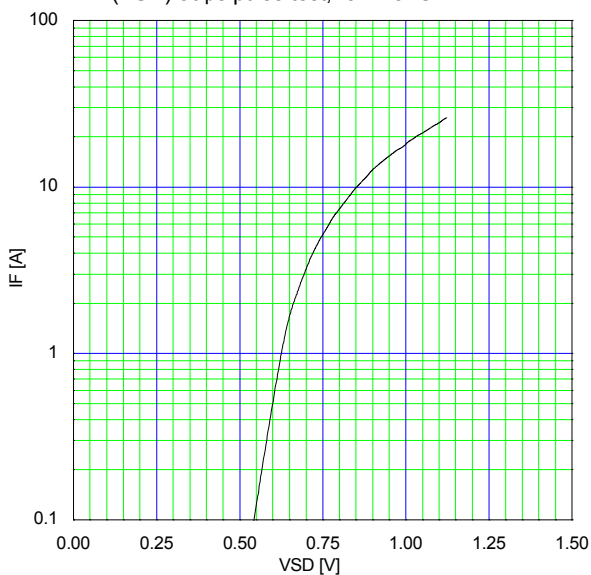
Typical Gate Charge Characteristics
 $V_{GS} = f(Q_g): I_D = 13A, T_{ch} = 25^\circ C$



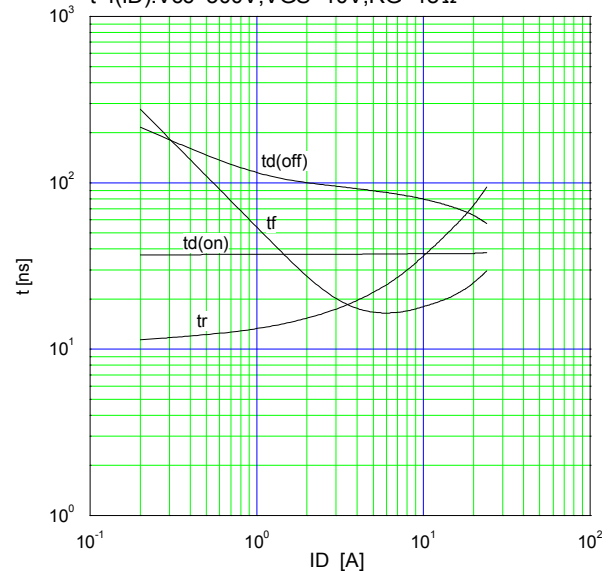
Typical Capacitance
 $C = f(V_{DS}): V_{GS} = 0V, f = 1MHz$

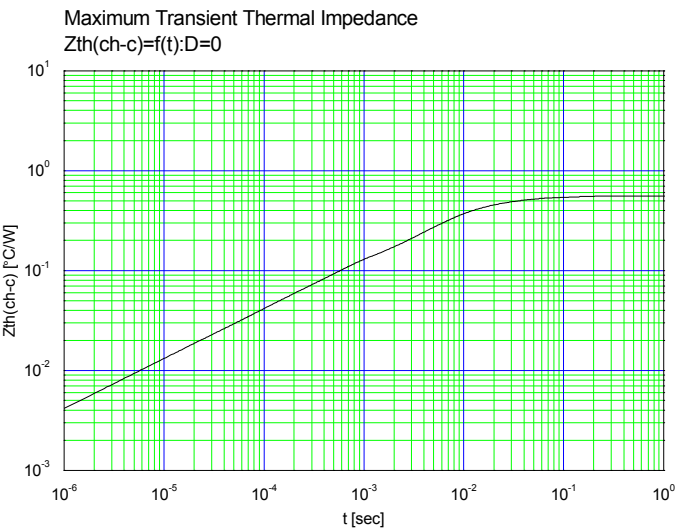
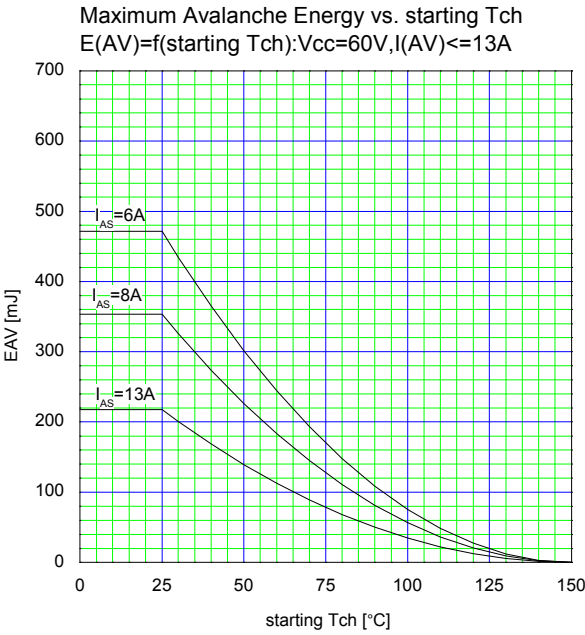


Typical Forward Characteristics of Reverse Diode
 $I_F = f(V_{SD}): 80\mu s \text{ pulse test}, T_{ch} = 25^\circ C$



Typical Switching Characteristics vs. I_D
 $t = f(I_D): V_{CC} = 300V, V_{GS} = 10V, R_G = 18\Omega$





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