

FML16N60ES

FUJI POWER MOSFET

Super FAP-E³ series

N-CHANNEL SILICON POWER MOSFET

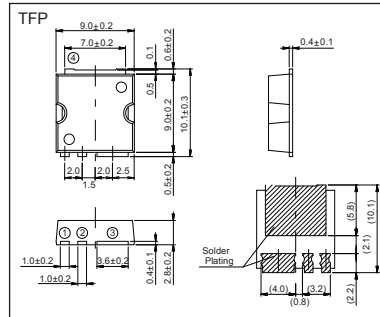
Features

- 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

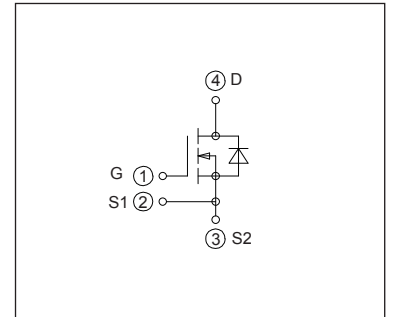
Applications

- 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	± 16	A	
Pulsed Drain Current	I_{DP}	± 64	A	
Gate-Source Voltage	V_{GS}	± 30	V	
Repetitive and Non-Repetitive Maximum Avalanche Current	I_{AR}	16	A	Note*1
Non-Repetitive Maximum Avalanche Energy	E_{AS}	554.8	mJ	Note*2
Repetitive Maximum Avalanche Energy	E_{AR}	27	mJ	Note*3
Peak Diode Recovery dV/dt	dV/dt	3.8	kV/ μs	Note*4
Peak Diode Recovery $-di/dt$	$-di/dt$	100	A/ μs	Note*5
Maximum Power Dissipation	P_D	1.44	W	$T_a=25^\circ\text{C}$
		270	W	$T_c=25^\circ\text{C}$
Operating and Storage Temperature range	T_{ch}	150	$^\circ\text{C}$	
	T_{slg}	-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}	$V_{DS}=600V$, $V_{GS}=0V$, $T_{ch}=25^\circ\text{C}$	-	-	25	μA
		$V_{DS}=480V$, $V_{GS}=0V$, $T_{ch}=125^\circ\text{C}$	-	-	250	
Gate-Source Leakage Current	I_{GSS}	$V_{GS}=\pm 30V$, $V_{DS}=0V$	-	10	100	nA
Drain-Source On-State Resistance	$R_{DS(on)}$	$I_D=8A$, $V_{GS}=10V$	-	0.40	0.47	Ω
Forward Transconductance	g_s	$I_D=8A$, $V_{DS}=25V$	5	10	-	S
Input Capacitance	C_{iss}	$V_{DS}=25V$	-	2100	3150	pF
Output Capacitance	C_{oss}	$V_{GS}=0V$	-	230	345	pF
Reverse Transfer Capacitance	C_{rss}	$f=1\text{MHz}$	-	13	19.5	pF
Turn-On Time	$t_d(on)$	$V_{cc}=300V$	-	43	64.5	ns
	t_r	$V_{GS}=10V$	-	41	61.5	
Turn-Off Time	$t_d(off)$	$I_D=8A$	-	94	141	
	t_f	$R_G=18\Omega$	-	20	30	
Total Gate Charge	Q_G	$V_{cc}=300V$	-	56	114	nC
Gate-Source Charge	Q_{GS}	$I_D=16A$	-	20	25.5	
Drain-Source Crossover Charge	Q_{SW}	$V_{GS}=10V$	-	21	33	
Gate-Drain Charge	Q_{GD}		-	9.5	14.5	
Avalanche Capability	I_{AV}	$L=1.74\text{mH}$, $T_{ch}=25^\circ\text{C}$	16	-	-	A
Diode Forward On-Voltage	V_{SD}	$I_F=16A$, $V_{GS}=0V$, $T_{ch}=25^\circ\text{C}$	-	0.90	1.08	V
Reverse Recovery Time	t_{rr}	$I_F=16A$, $V_{GS}=0V$	-	0.7	-	μs
Reverse Recovery Charge	Q_{rr}	$-di/dt=100A/\mu\text{s}$, $T_{ch}=25^\circ\text{C}$	-	9	-	μC

Thermal Characteristics

Description	Symbol	Test Conditions	min.	typ.	max.	Unit
Thermal resistance	$R_{th(ch-c)}$	Channel to case			0.46	$^\circ\text{C/W}$
	$R_{th(ch-a)}$	Channel to Ambient			87	$^\circ\text{C/W}$
	$R_{th(ch-a)}$	Channel to Ambient Note*6			52	$^\circ\text{C/W}$

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

Note *2 : $T_{ch}=25^\circ\text{C}$, $I_{AS}=5A$, $L=33.8\text{mH}$, $V_{cc}=50V$, $R_G=10\Omega$,

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

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

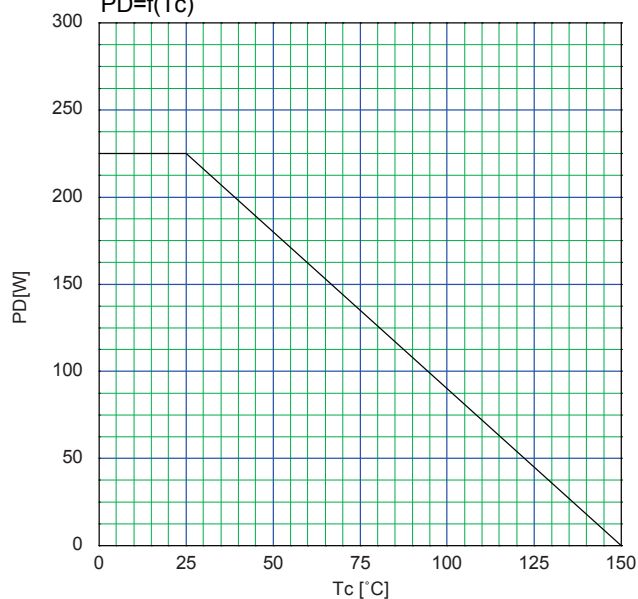
Note *4 : $I_F=I_D$, $-di/dt=100A/\mu\text{s}$, $V_{cc}=BV_{DSS}$, $T_{ch}=150^\circ\text{C}$.

Note *5 : $I_F=I_D$, $dv/dt=6.3kV/\mu\text{s}$, $V_{cc}=BV_{DSS}$, $T_{ch}=150^\circ\text{C}$.

Note *6 : Surface mounted on 1000mm², $t=1.6\text{mm}$ FR-4 PCB (Drain pad area : 500mm²)

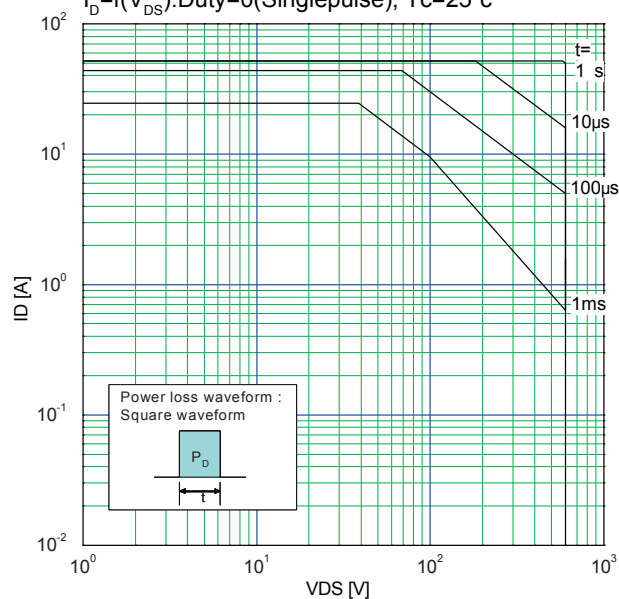
Allowable Power Dissipation

$P_D = f(T_c)$



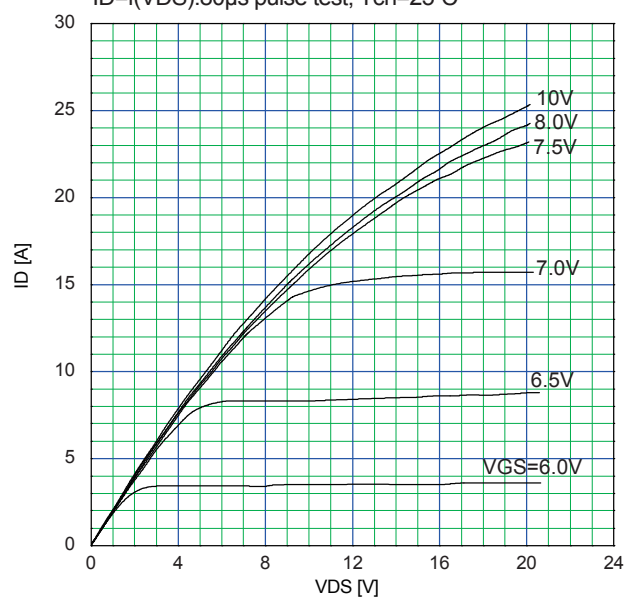
Safe Operating Area

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



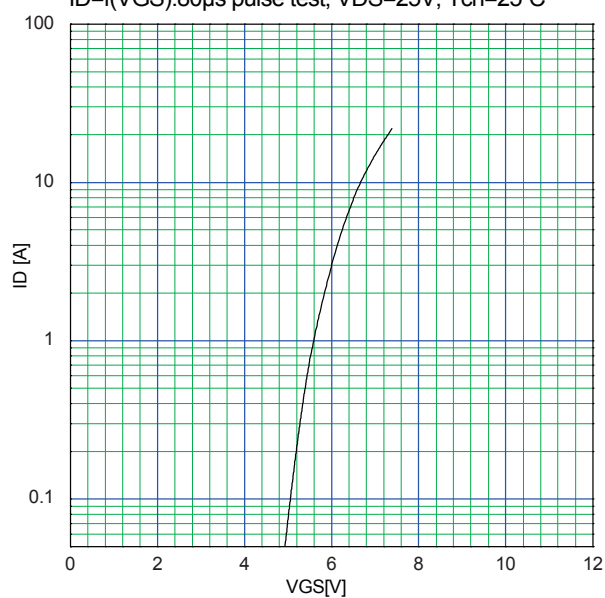
Typical Output Characteristics

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



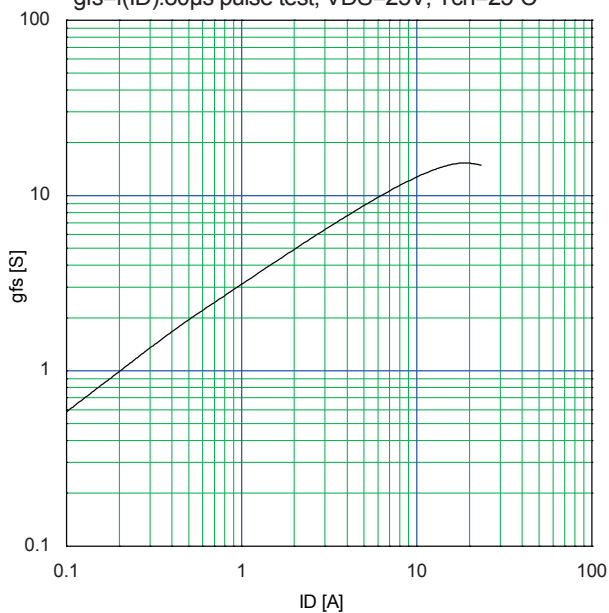
Typical Transfer Characteristic

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



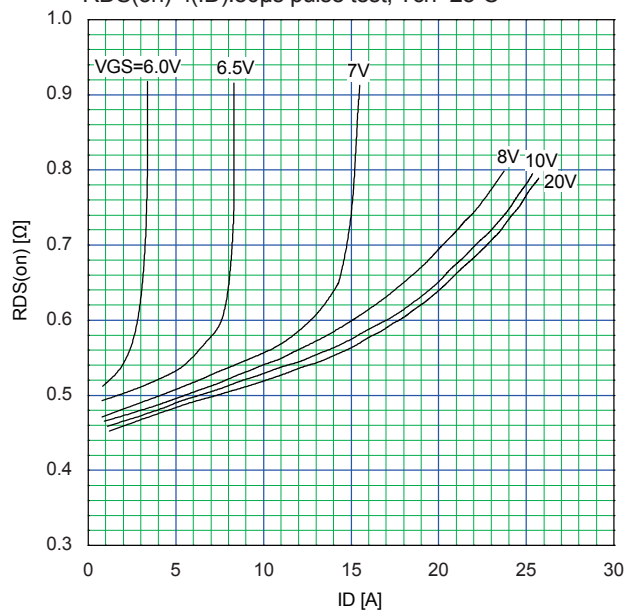
Typical Transconductance

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

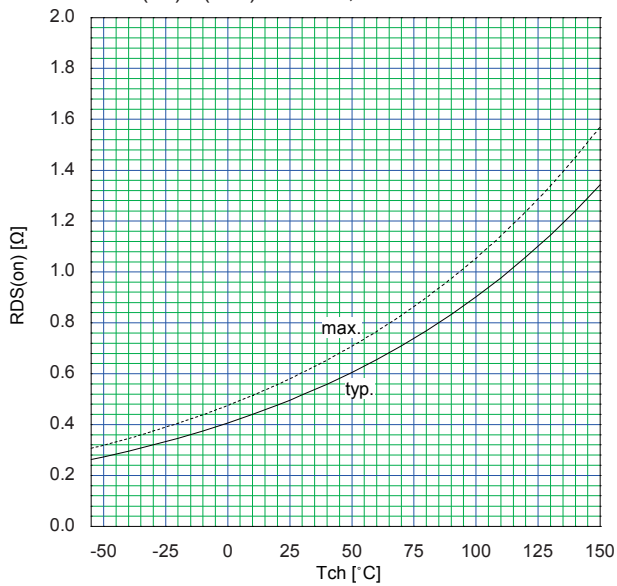


Typical Drain-Source on-state Resistance

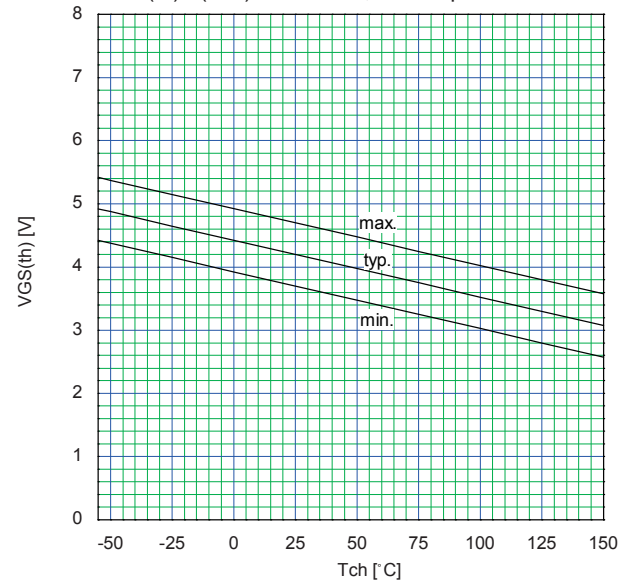
$R_{DS(on)} = f(I_D): 80\mu\text{s pulse test}, T_{ch}=25^\circ\text{C}$



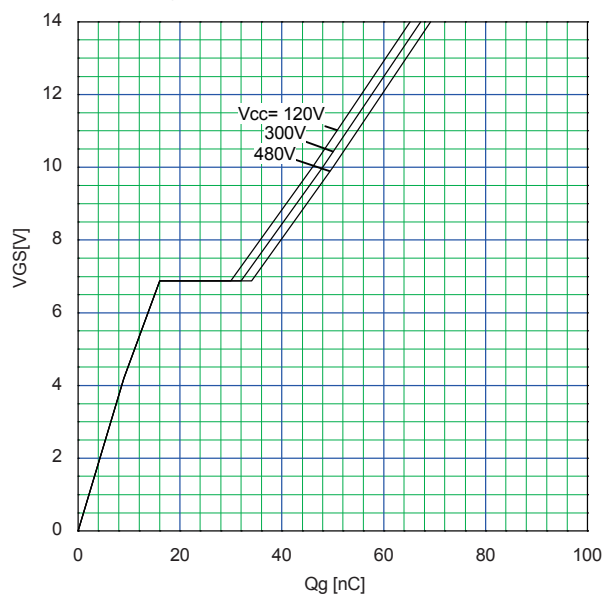
Drain-Source On-state Resistance
 $R_{DS(on)} = f(T_{ch}): I_D = 6.5A, V_{GS} = 10V$



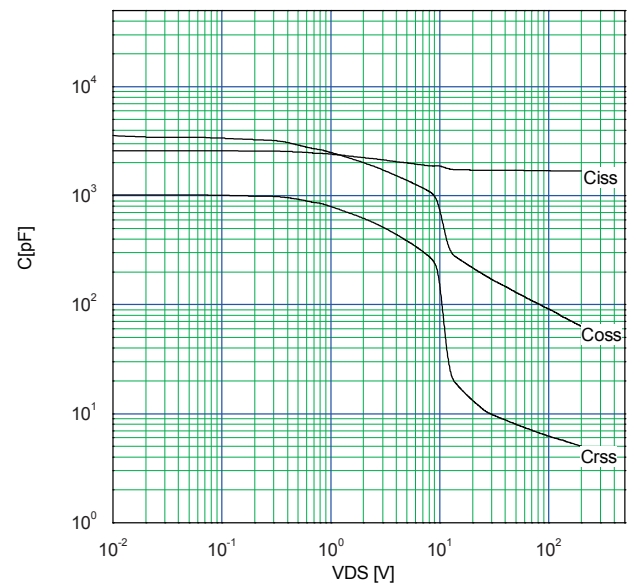
Gate Threshold Voltage vs. T_{ch}
 $V_{GS(th)} = f(T_{ch}): V_{DS} = V_{GS}, I_D = 250\mu A$



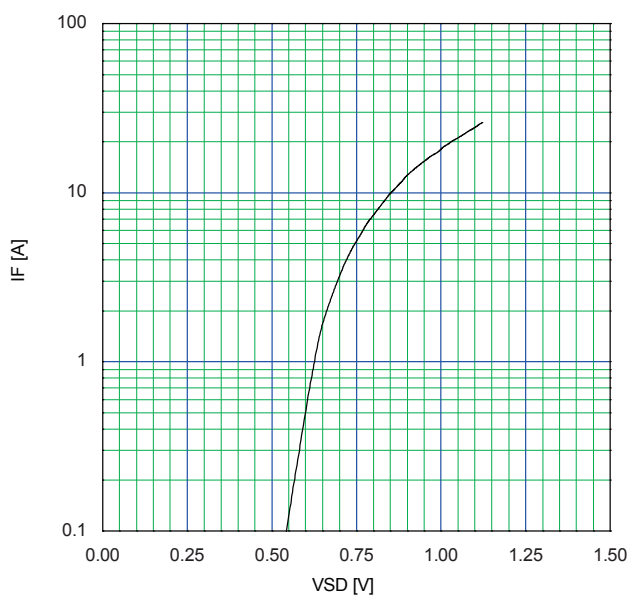
Typical Gate Charge Characteristics
 $V_{GS} = f(Q_g): I_D = 13A, T_{ch} = 25^{\circ}C$



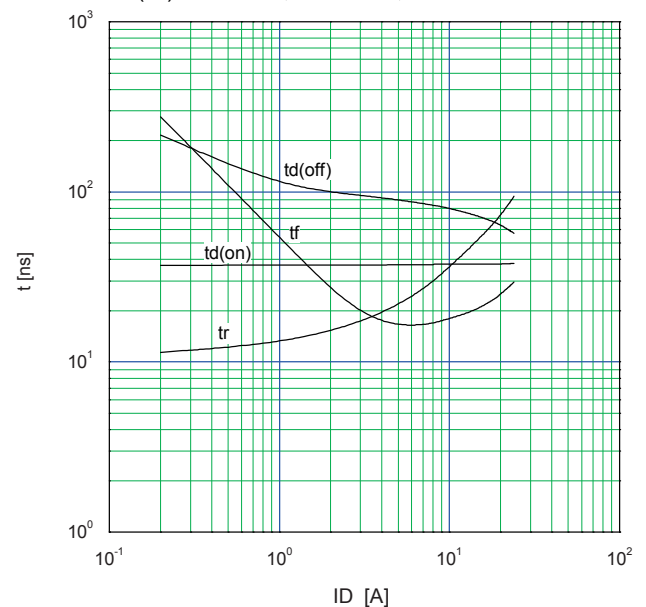
Typical Capacitance
 $C = f(V_{DS}): V_{GS} = 0V, f = 1MHz$

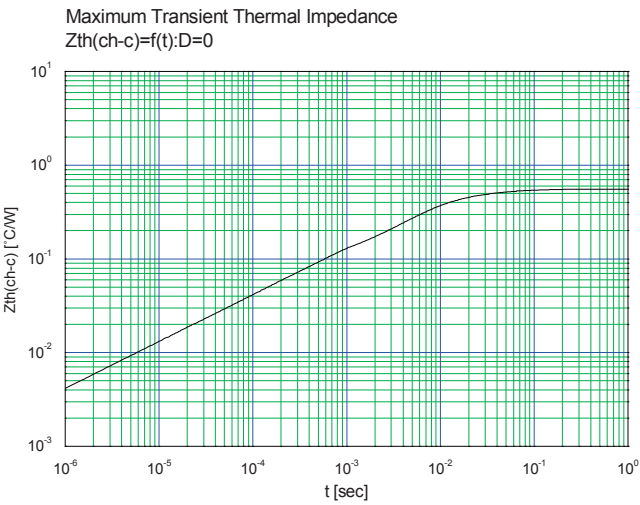
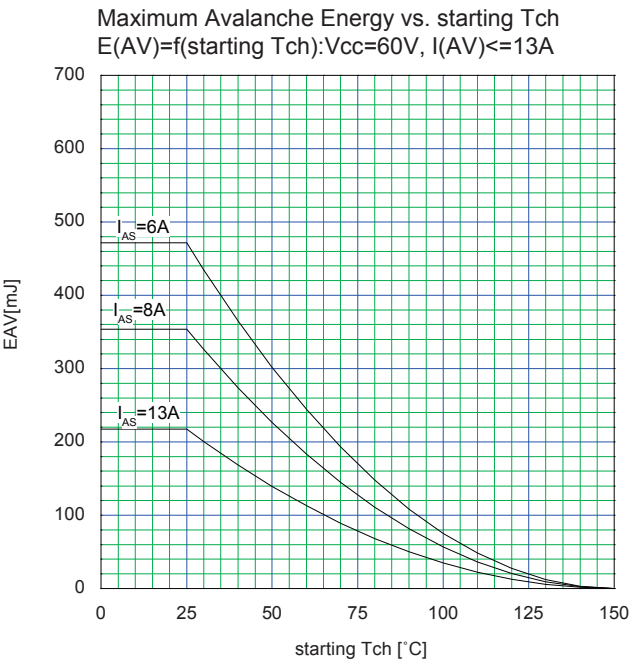


Typical Forward Characteristics of Reverse Diode
 $I_F = f(V_{SD}): 80\mu s$ pulse test, $T_{ch} = 25^{\circ}C$



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





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