

# FMV13N60ES

FUJI POWER MOSFET

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

N-CHANNEL SILICON POWER MOSFET

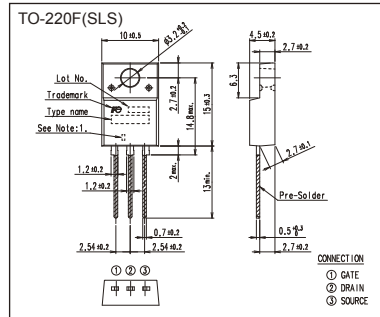
### ■ Features

- 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

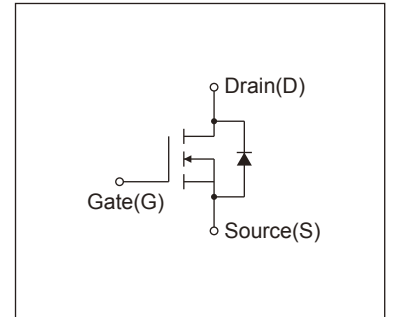
### ■ Applications

- 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>	±13	A	
Pulsed Drain Current	I <sub>DP</sub>	±52	A	
Gate-Source Voltage	V <sub>GS</sub>	±30	V	
Repetitive and Non-Repetitive Maximum Avalanche Current	I <sub>AR</sub>	13	A	Note*1
Non-Repetitive Maximum Avalanche Energy	E <sub>AS</sub>	471.5	mJ	Note*2
Repetitive Maximum Avalanche Energy	E <sub>AR</sub>	8	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>	2.16	W	T <sub>a</sub> =25°C
		80		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	
Isolation Voltage	V <sub>ISO</sub>	2	kVrms	t = 60sec, f = 60Hz

#### ● 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</sub> (th)	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</sub> (on)	I <sub>D</sub> =6.5A, V <sub>GS</sub> =10V	-	0.50	0.58	Ω
Forward Transconductance	g <sub>fs</sub>	I <sub>D</sub> =6.5A, V <sub>DS</sub> =25V	5	10	-	S
Input Capacitance	C <sub>iss</sub>	V <sub>DS</sub> =25V	-	1700	2550	pF
Output Capacitance	C <sub>oss</sub>	V <sub>GS</sub> =0V	-	190	285	
Reverse Transfer Capacitance	C <sub>rss</sub>	f=1MHz	-	10	15	ns
Turn-On Time	td(on)	V <sub>cc</sub> =300V	-	38	57	
	tr	V <sub>GS</sub> =10V	-	24	36	
Turn-Off Time	td(off)	I <sub>D</sub> =6.5A	-	86	129	
	tf	R <sub>G</sub> =18Ω	-	16	24	
Total Gate Charge	Q <sub>G</sub>	V <sub>cc</sub> =300V	-	48	72	nC
Gate-Source Charge	Q <sub>GS</sub>	I <sub>D</sub> =13A	-	16	24	
Gate-Drain Charge	Q <sub>GD</sub>	V <sub>GS</sub> =10V	-	16	24	
Gate-Drain Crossover Charge	Q <sub>SW</sub>		-	7	10.5	
Avalanche Capability	I <sub>AV</sub>	L=2.36mH, T <sub>ch</sub> =25°C	13	-	-	A
Diode Forward On-Voltage	V <sub>SD</sub>	I <sub>F</sub> =13A, V <sub>GS</sub> =0V, T <sub>ch</sub> =25°C	-	0.90	1.08	V
Reverse Recovery Time	t <sub>rr</sub>	I <sub>F</sub> =13A, V <sub>GS</sub> =0V	-	0.7	-	μS
Reverse Recovery Charge	Q <sub>rr</sub>	-di/dt=100A/μs, T <sub>ch</sub> =25°C	-	8	-	μC

#### ● Thermal Characteristics

Description	Symbol	Test Conditions	min.	typ.	max.	Unit
Thermal resistance	R <sub>th</sub> (ch-c)	Channel to case			1.560	°C/W
	R <sub>th</sub> (ch-a)	Channel to ambient			58.0	°C/W

Note \*1 : T<sub>ch</sub>≤150°C

Note \*2 : Stating T<sub>ch</sub>=25°C, I<sub>AS</sub>=6A, L=24.0mH, 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.

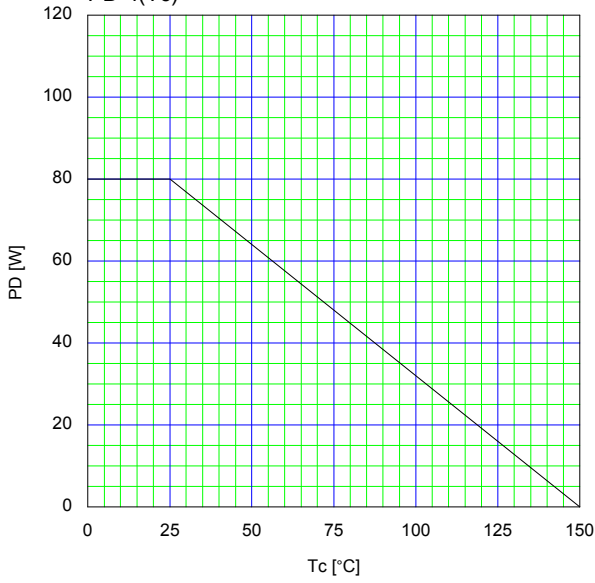
Note \*3 : Repetitive rating : Pulse width limited by maximum channel temperature.

See to the 'Transient Thermal Impedance' graph.

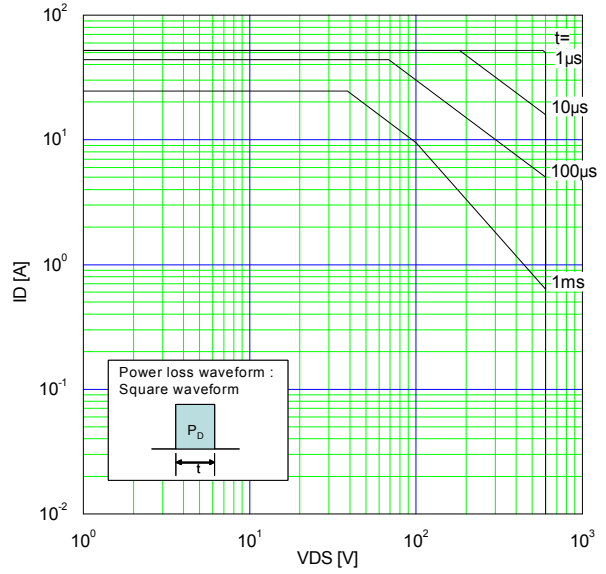
Note \*4 : I<sub>F</sub>≤I<sub>D</sub>, -di/dt=100A/μs, V<sub>cc</sub>≤BV<sub>DSS</sub>, T<sub>ch</sub>≤150°C.

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.

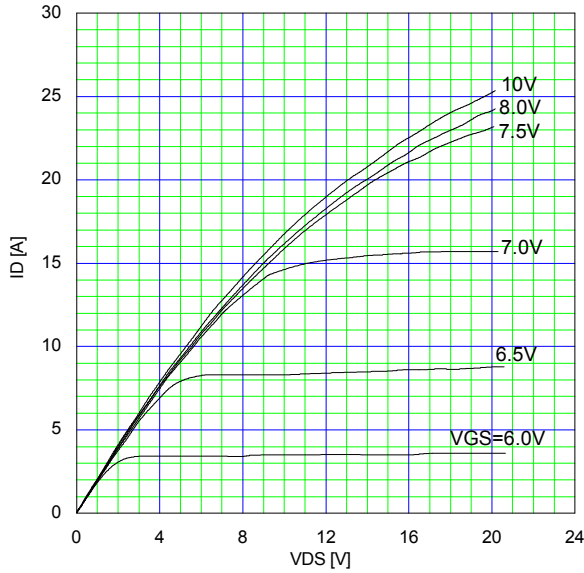
Allowable Power Dissipation  
 $P_D = f(T_c)$



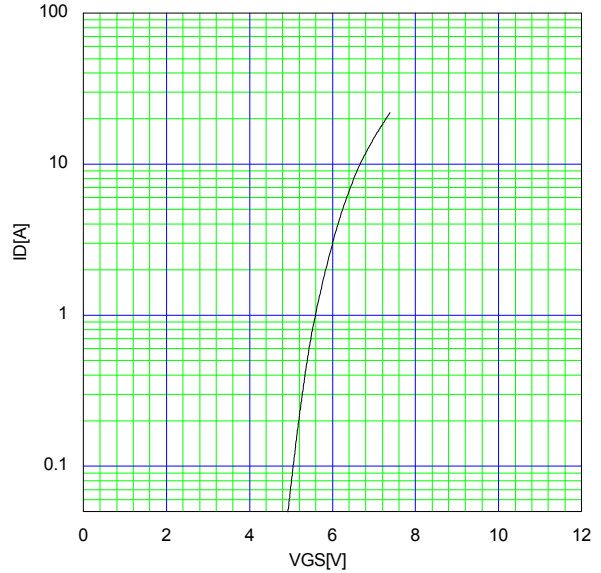
Safe Operating Area  
 $I_D = f(V_{DS})$ : Duty=0 (Single pulse),  $T_c = 25^\circ\text{C}$



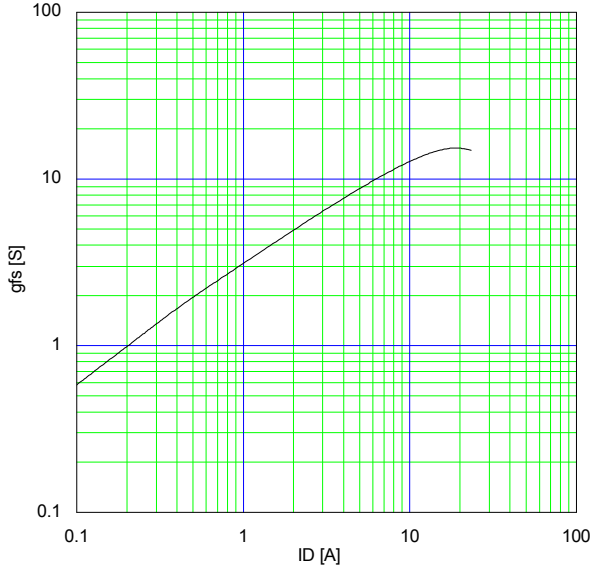
Typical Output Characteristics  
 $I_D = f(V_{DS})$ : 80 μs pulse test,  $T_{ch} = 25^\circ\text{C}$



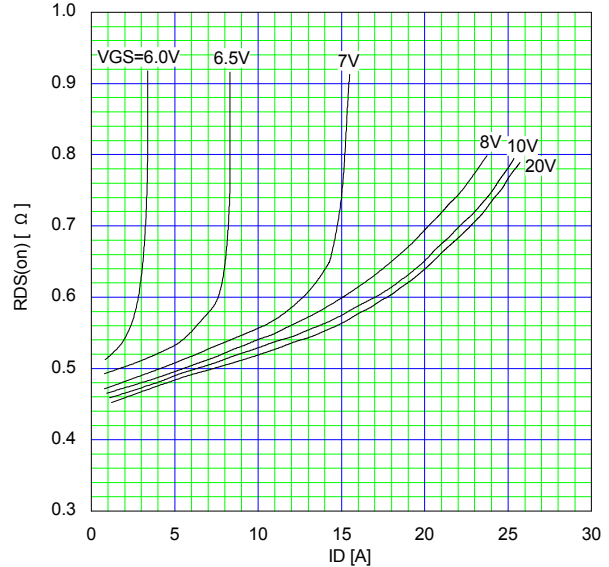
Typical Transfer Characteristic  
 $I_D = f(V_{GS})$ : 80 μs pulse test,  $V_{DS} = 25\text{V}$ ,  $T_{ch} = 25^\circ\text{C}$



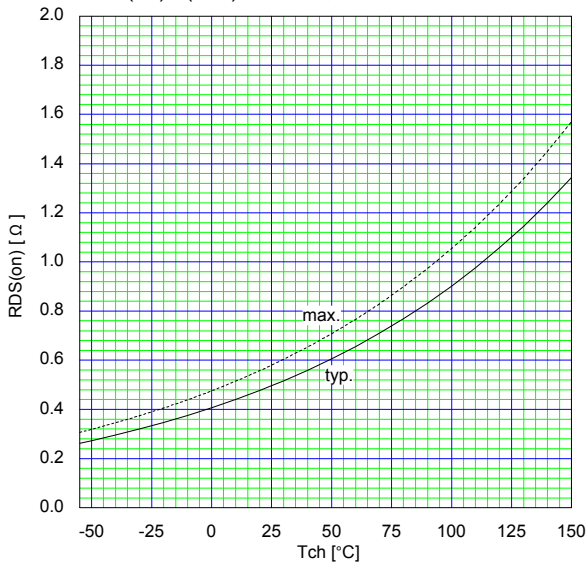
Typical Transconductance  
 $g_{fs} = f(I_D)$ : 80 μs pulse test,  $V_{DS} = 25\text{V}$ ,  $T_{ch} = 25^\circ\text{C}$



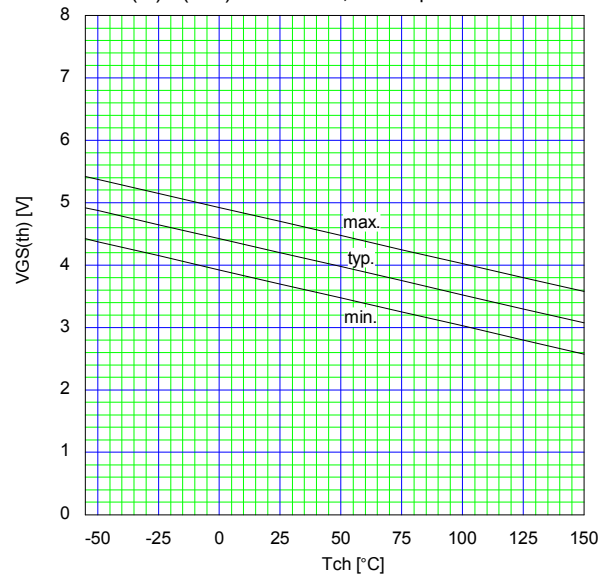
Typical Drain-Source on-state Resistance  
 $R_{DS(on)} = f(I_D)$ : 80 μs pulse test,  $T_{ch} = 25^\circ\text{C}$



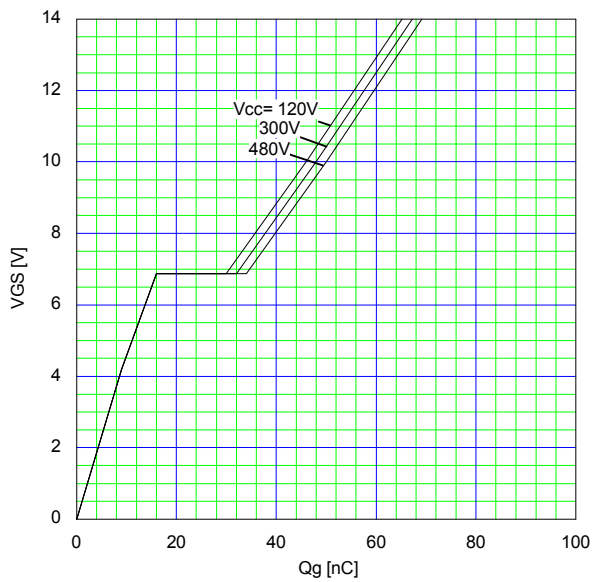
Drain-Source On-state Resistance  
 $R_{DS(on)}=f(T_{ch}):I_D=6.5A, V_{GS}=10V$



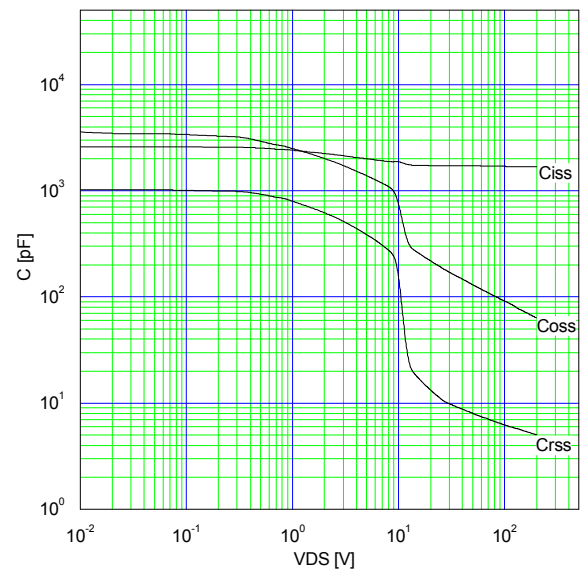
Gate Threshold Voltage vs. T<sub>ch</sub>  
 $V_{GS(th)}=f(T_{ch}):V_{DS}=V_{GS}, I_D=250\mu A$



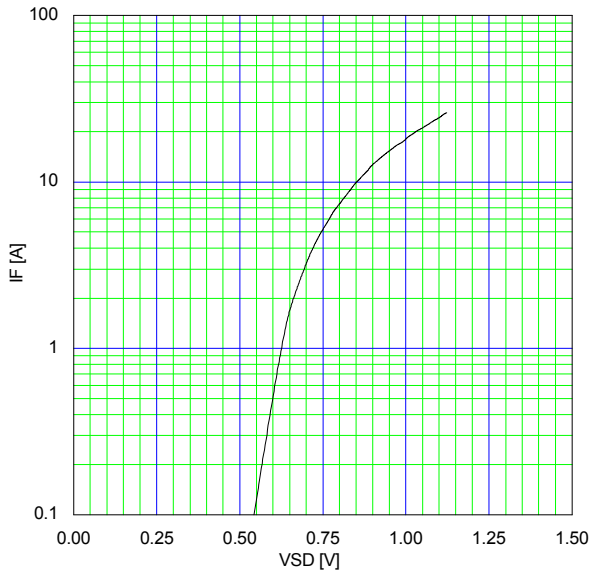
Typical Gate Charge Characteristics  
 $V_{GS}=f(Q_g):I_D=13A, T_{ch}=25^\circ C$



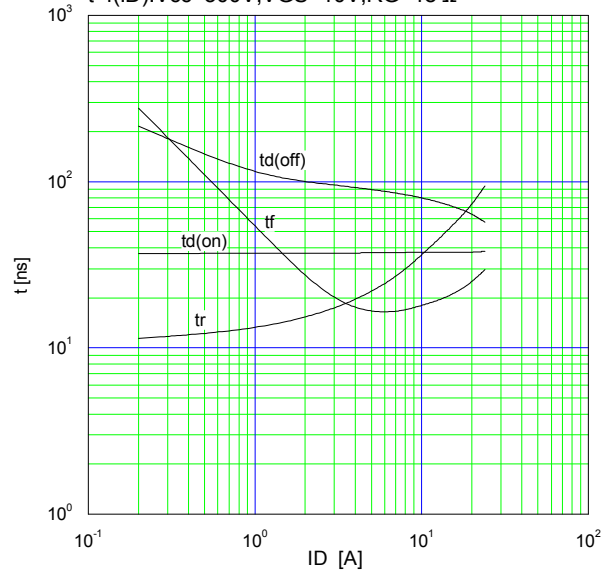
Typical Capacitance  
 $C=f(V_{DS}):V_{GS}=0V, f=1MHz$



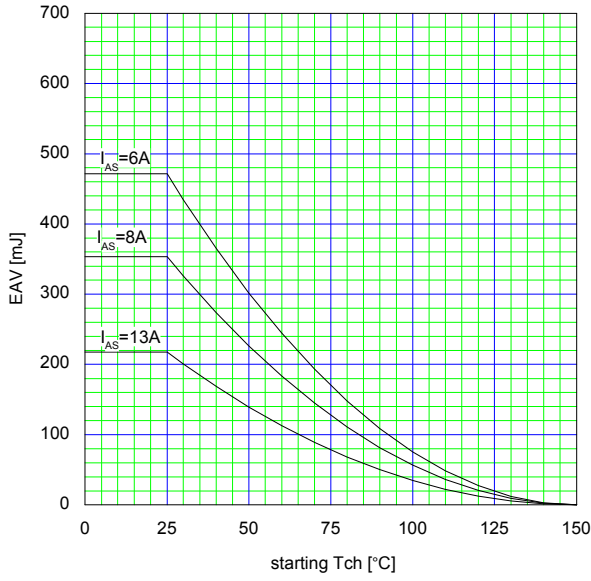
Typical Forward Characteristics of Reverse Diode  
 $I_F=f(V_{SD}):80\mu s \text{ pulse test}, T_{ch}=25^\circ C$



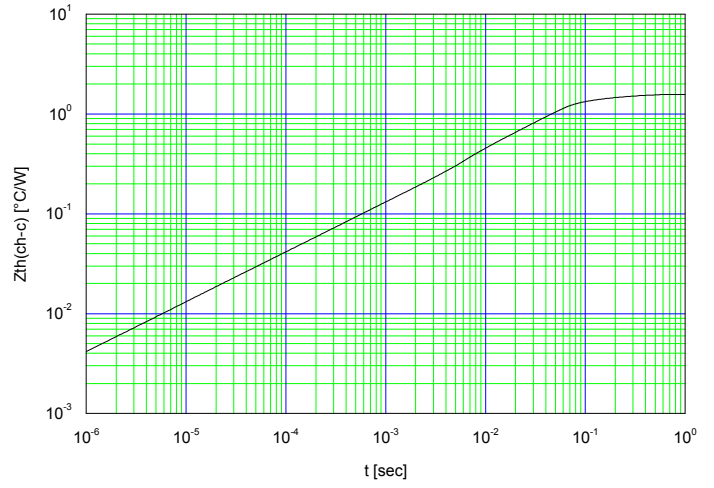
Typical Switching Characteristics vs. I<sub>D</sub>  
 $t=f(I_D):V_{cc}=300V, V_{GS}=10V, R_G=18\Omega$



Maximum Avalanche Energy vs. starting Tch  
 $E(AV)=f(\text{starting Tch}):V_{cc}=60V, I(AV)\leq 13A$



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



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