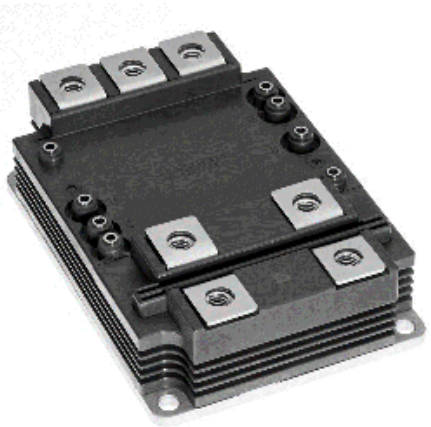
MITSUBISHI ELECTRIC

< HVMOSFET MODULE >

FMF185DC-66A

HIGH POWER SWITCHING USE
INSULATED TYPE 1st gen. HVMOSFET (High Voltage Metal Oxide Semiconductor Field Effect Transistor) Modules

FMF185DC-66A

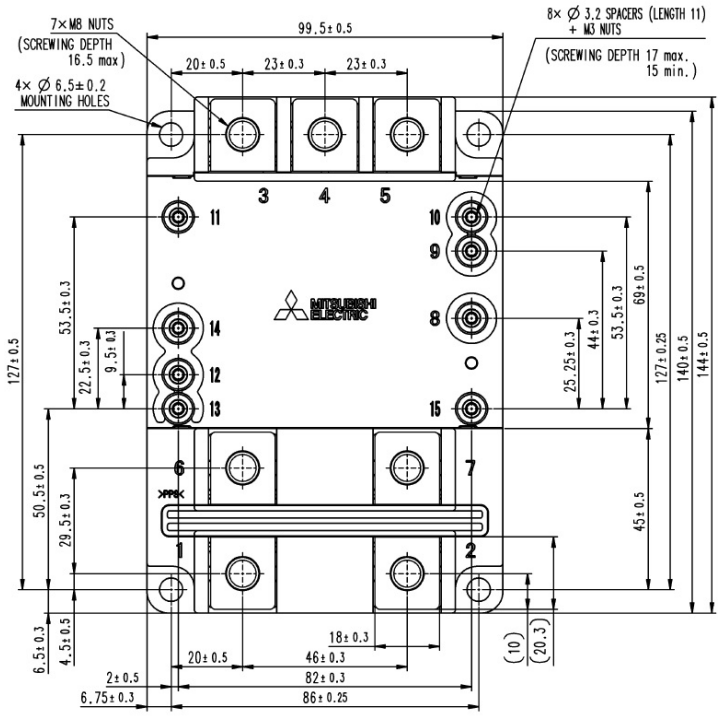


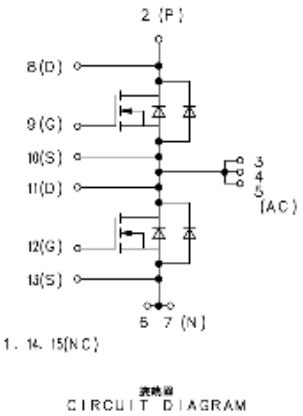
- I_D 185A
- V_{DSX} 3300V
- 2-element in a Pack
- Insulated Type
- SiC MOSFET
- JBS(Junction Barrier Schottky)

APPLICATION

Traction drives, High Reliability Converters / Inverters, DC choppers

OUTLINE DRAWING & CIRCUIT DIAGRAM **Dimensions in mm**





No.	Terminals
1	NC
2	DC+, D(P)
3, 4, 5	AC, S(P), D(N)
6, 7	DC-, S(N)
8	D(P)
9	G(P)
10	S(P)
11	D(N) / S(P)
12	G(N)
13	S(N)
14, 15	NC

Note 1. Terminal 1 is not connected to the circuit, but must be shorted to terminal 2 when using the module.

MAXIMUM RATINGS (Tj=25 °C, unless otherwise specified)

Symbol	Item	Conditions	Ratings	Unit
V_{DSX}	Drain-source voltage	V_{GS} = -5V	3300	V
V_{GSS}	Gate-source voltage	V_{DS} = 0V	±20	V
I_D	Drain current	DC (Note 1)	185	A
I_{DM}		Pulse (Note 2)	370	A
I_S	Source current (Note 3)	DC (Note 1)	185	A
I_{SM}		Pulse (Note 2)	370	A
P_{tot}	Maximum power dissipation (Note 4)	T_c = 25°C, MOSFET part	1150	W
V_{iso}	Isolation voltage	RMS, sinusoidal, f = 60Hz, t = 1 min., T_j = 25°C	6000	V
V_e	Partial discharge extinction voltage	RMS, sinusoidal, f = 60Hz, Q_{PD} ≤ 10 pC., T_j = 25°C	2600	V
T_j	Channel temperature	—	−40 ~ +175	°C
T_{op}	Operating channel temperature	—	−40 ~ +175	°C
T_{stg}	Storage temperature	—	−40 ~ +175	°C

ELECTRICAL CHARACTERISTICS (Tj=25 °C, unless otherwise specified)

Symbol	Item	Conditions		Limits			Unit
				Min	Typ	Max	
I_{GSS}	Gate leakage current	V_{GS} = V_{GSS}, V_{DS} = 0 V, T_j = 25°C		-0.5	—	0.5	μA
I_{DSX}	Drain-source cut-off current	V_{DS} = V_{DSX}, V_{GS} = −5 V	T_j = 25°C	—	—	0.7	mA
			T_j = 150°C	—	—	—	
			T_j = 175°C	—	0.8	—	
$V_{GS(th)}$	Gate-source threshold voltage	V_{DS} = 10V, I_C = 18.5mA	T_j = 25°C	—	2.1	—	V
$r_{DS(on)}$	Drain-source resistance	V_{DS} = $V_{DS(on)}$ V_{GS} = 17V	T_j = 25°C	—	9.5	—	mΩ
			T_j = 150°C	—	—	—	
			T_j = 175°C	—	21.1	—	
$V_{DS(on)}$	Drain-source on voltage	V_{GS} = 17V, I_D = 185A	T_j = 25°C	—	1.75	—	V
			T_j = 150°C	—	—	—	
			T_j = 175°C	—	3.90	—	
C_{iss}	Input capacitance	V_{DS} = 10V, V_{GS} = 0V, f = 100kHz, T_j = 25°C		—	52.5	—	nF
C_{oss}	Output capacitance			—	8.5	—	nF
C_{rss}	Reverse transfer capacitance			—	0.2	—	nF
Q_G	Total gate charge	V_{DD} = 1800V, I_D = 185A, V_{GS} = +17V / -5V		—	1.68	—	μC
$t_{d(on)}$	Turn-on delay time	V_{DD} = 1800V, I_D = 185A V_{GS} = +17V / -5V $R_{G(on)}$ = 2.0 Ω, L_s = 60 nH Inductive load	T_j = 175°C	—	—	1.2	μs
t_r	Rise time		T_j = 175°C	—	—	0.72	μs
$E_{on(10\%)}$	Turn-on switching energy per pulse		T_j = 150°C	—	—	—	mJ
			T_j = 175°C	—	130	—	
$t_{d(off)}$	Turn-off delay time	V_{DD} = 1800V I_D = 185 A V_{GS} = +17 V / -5V $R_{G(off)}$ = 2.0 Ω L_s = 60 nH Inductive load	T_j = 150°C	—	—	—	μs
			T_j = 175°C	—	0.90	—	
t_f	Fall time		T_j = 150°C	—	—	—	μs
			T_j = 175°C	—	0.24	—	
$E_{off(10\%)}$	Turn-off switching energy per pulse		T_j = 150°C	—	—	—	mJ
			T_j = 175°C	—	45	—	

ELECTRICAL CHARACTERISTICS

Symbol	Item	Conditions		Limits			Unit
				Min	Typ	Max	
V_{SD}	Source-drain voltage (Note 3)	I_S = 185 A, V_{GS} = 0 V	T_j = 25°C	—	2.50	—	V
			T_j = 150°C	—	—	—	
			T_j = 175°C	—	3.50	—	
V_{SD}	Source-drain voltage (Note 3)	I_S = 185 A, V_{GS} = +17 V	T_j = 25°C	—	1.20	—	V
			T_j = 150°C	—	—	—	
			T_j = 175°C	—	2.40	—	
$Q_{C(10\%)}$	Total capacitive charge (Note 3)	V_{DD} = 1800V, I_D = 185A, V_{GS} = +17V / -5V, $R_{G(on)}$ = 2.0 Ω, L_s = 60 nH, Inductive load	T_j = 150°C	—	—	—	μC
			T_j = 175°C	—	10	—	
$E_{off\_diode(10\%)}$	Diode turn-off energy per pulse (Note 3)		T_j = 150°C	—	—	—	mJ
			T_j = 175°C	—	7.5	—	

THERMAL CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min	Typ	Max	
$R_{th(j-c)Q}$	Thermal resistance	Junction to Case, MOSFET part,1/2 module	—	—	128.0	K/kW
$R_{th(j-c)D}$		Junction to Case, FWDi part,1/2 module	—	—	218.0	K/kW
$R_{th(c-s)}$	Contact thermal resistance	Case to heat sink, λ_{grease} = 1W/m·K, $D_{(c-s)}$ = 100μm, 1/2 module	—	90.0	—	K/kW

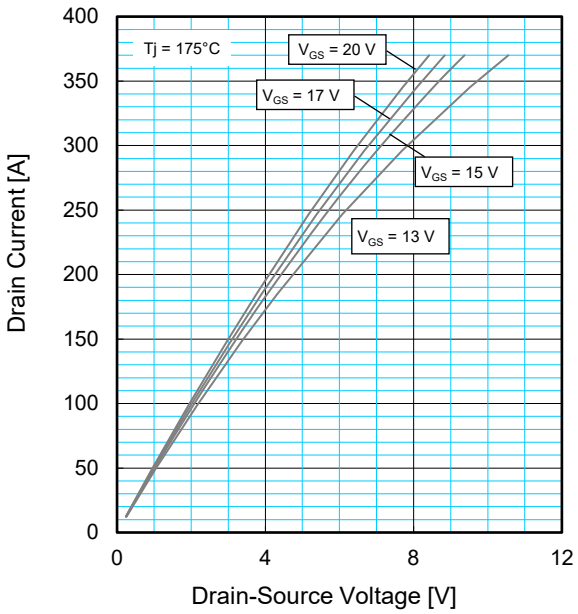
MECHANICAL CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min	Typ	Max	
M_t	Mounting torque	Main terminals screw M8 (Note 5)	7.0	—	14.0	N·m
M_s		Mounting screw M6	3.0	—	6.0	N·m
M_t		Auxiliary terminals screw M3	0.4	—	0.6	N·m
m	Mass	-	—	0.80	—	kg
CTI	Comparative tracking index	-	600	—	—	—
d_a	Clearance	Between terminals and baseplate	19.2	—	—	mm
d_s	Creepage distance	-	32	—	—	mm
$L_{P\ P-N}$	Parasitic stray inductance	Between terminal 2 and terminal 6,7	—	30.0	—	nH
$L_{p\ s-ss}$	Internal inductance	Between Auxiliary terminals (terminal 10-11)	—	—	—	nH
		Between Auxiliary terminals and DC- (terminal 13-6,7)	—	—	—	
$R_{DD'+SS'}$	Internal lead resistance	Between DC+ and DC- (terminal 2-6,7)	—	—	—	mΩ
		Between DC+ and AC (terminal 2-3,4,5)	—	0.66	—	
		Between AC and DC- (terminal 3,4,5-6,7)	—	0.83	—	

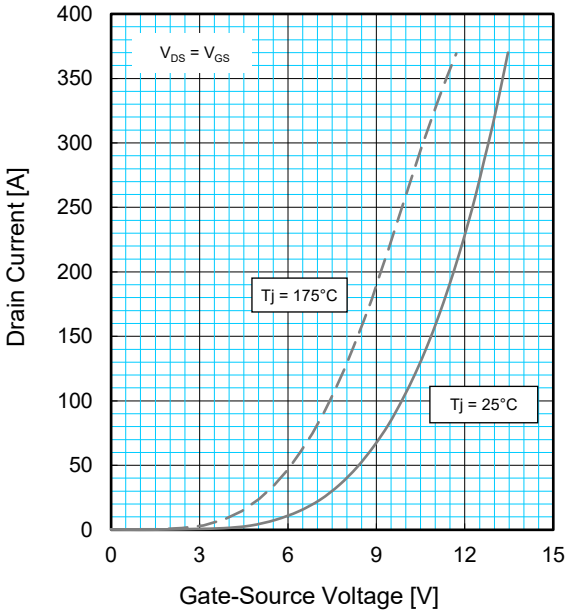
Note1. The energization time is a short time in which the internal electrode does not generate heat.
Note 2. Pulse width and repetition rate should be such that junction temperature (T_j) does not exceed T_{jmax} rating.
Note 3. The symbols represent characteristics of the anti-parallel, source to drain free-wheel diode (FWD_i).
Note 4. Junction temperature (T_j) should not exceed T_{jmax} rating.
Note 5. This is the case when installing the product on the bus bar

PERFORMANCE CURVES

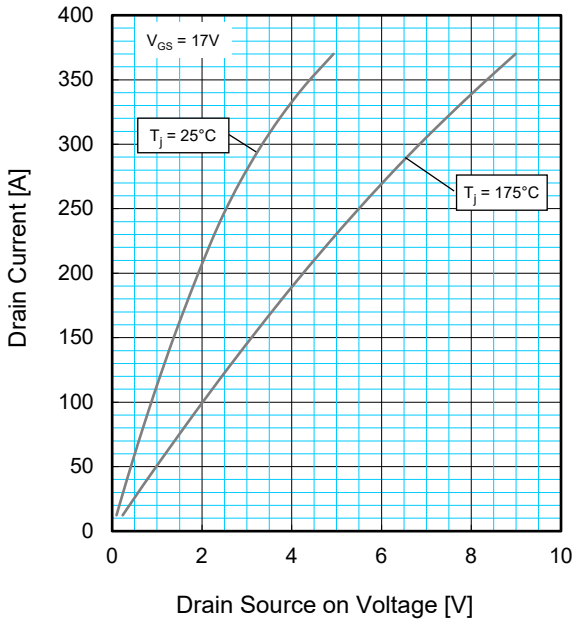
OUTPUT CHARACTERISTICS (TYPICAL)



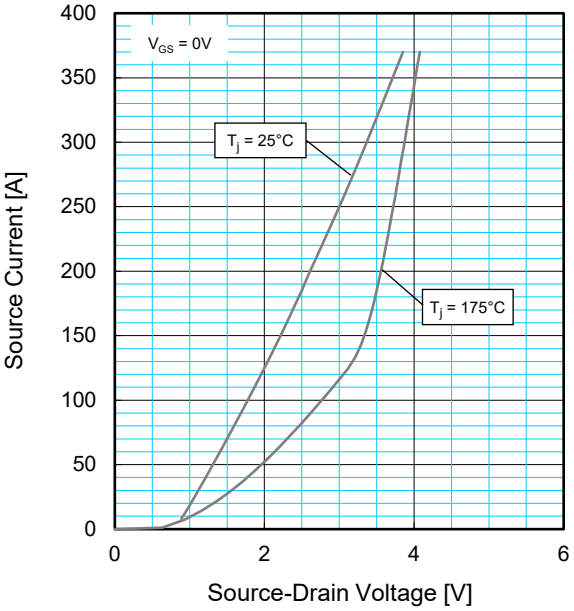
TRANSFER CHARACTERISTICS (TYPICAL)



DRAIN-SOURCE ON VOLTAGE CHARACTERISTICS (TYPICAL)

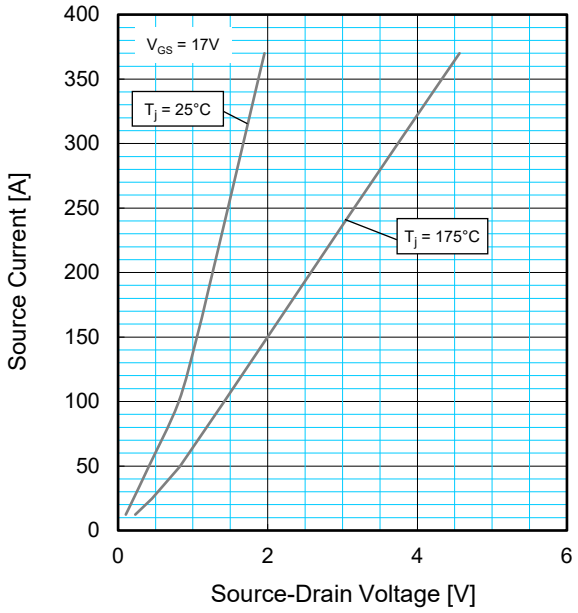


FREE-WHEEL DIODE FORWARD CHARACTERISTICS (TYPICAL)

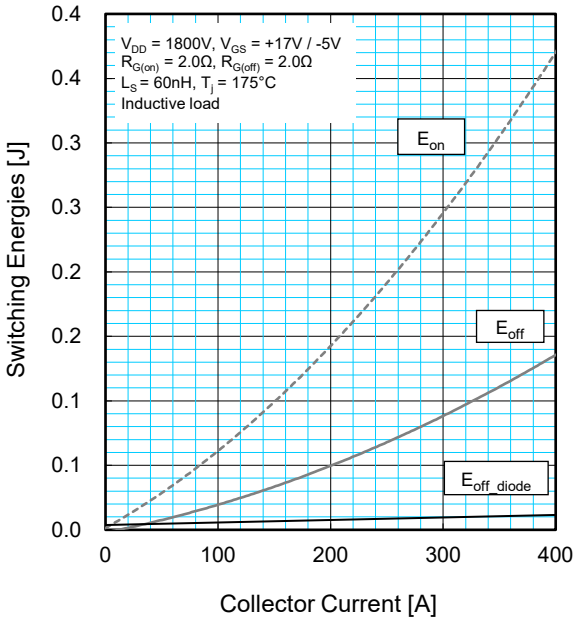


PERFORMANCE CURVES

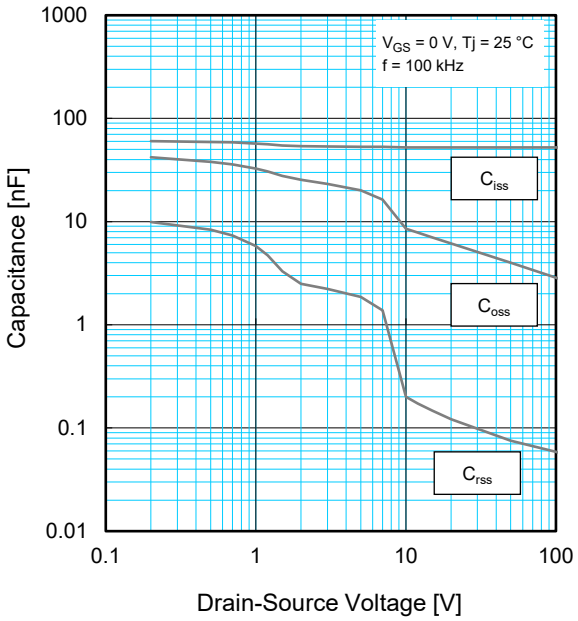
FREE-WHEEL DIODE FORWARD CHARACTERISTICS (TYPICAL)



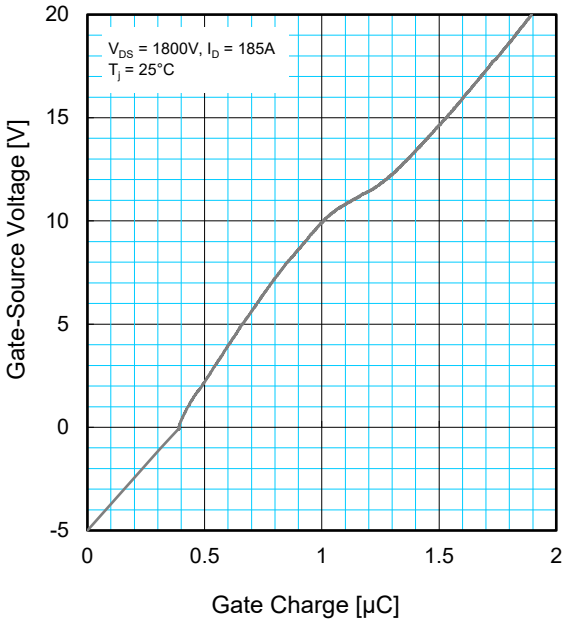
HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



CAPACITANCE CHARACTERISTICS (TYPICAL)

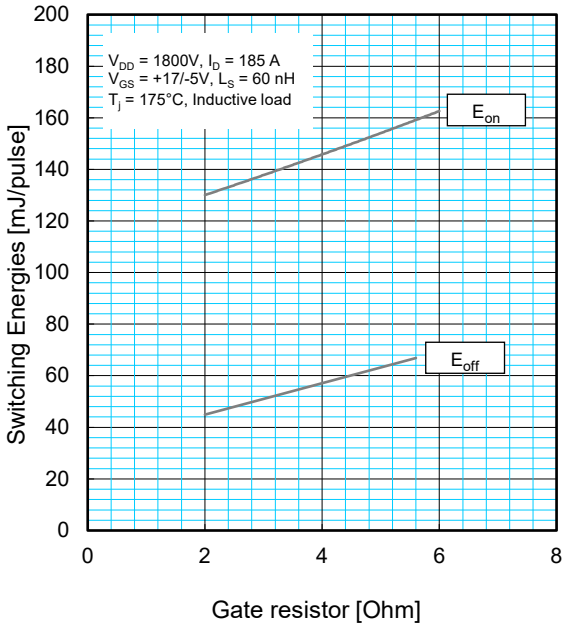


GATE CHARGE CHARACTERISTICS (TYPICAL)

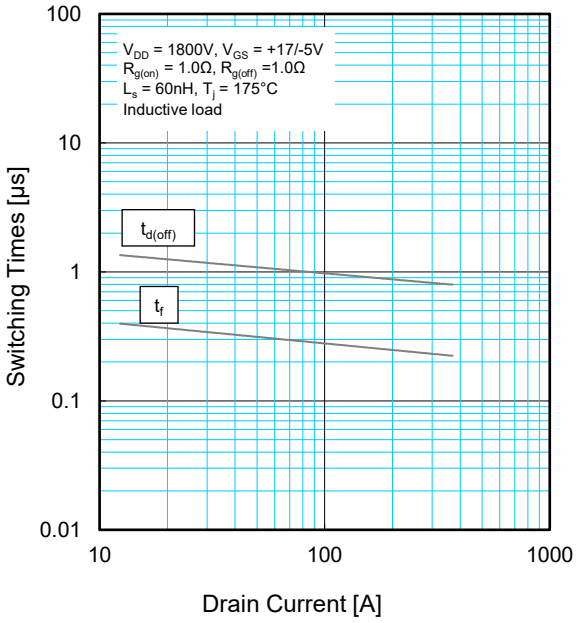


PERFORMANCE CURVES

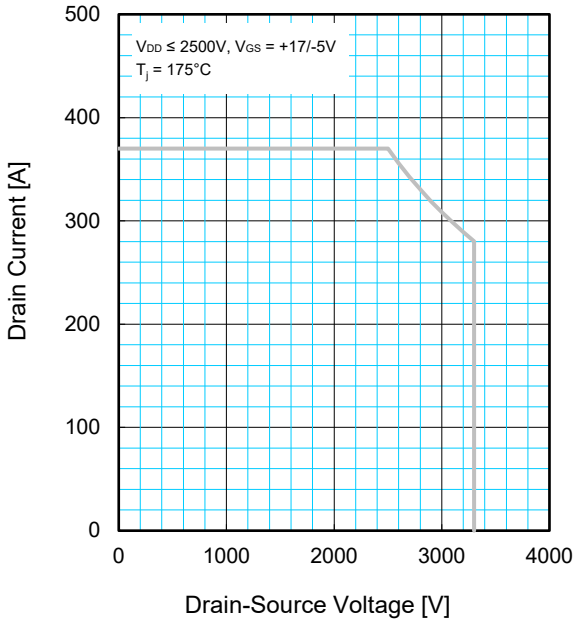
HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



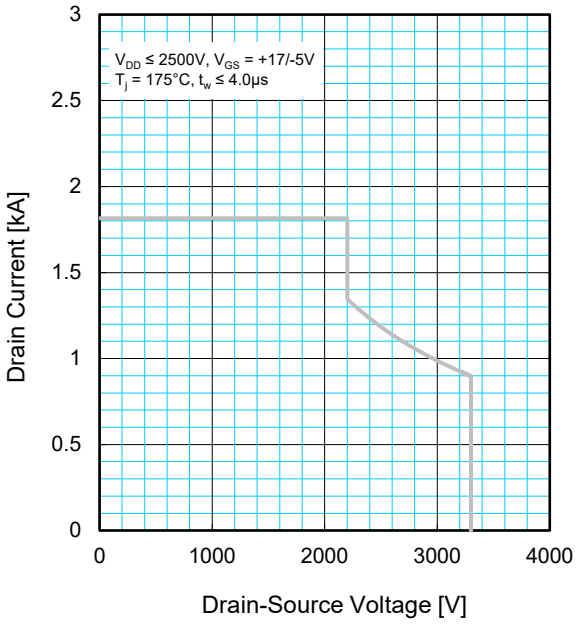
HALF-BRIDGE SWITCHING TIME CHARACTERISTICS (TYPICAL)



REVERSE BIAS SAFE OPERATING AREA (RBSOA)

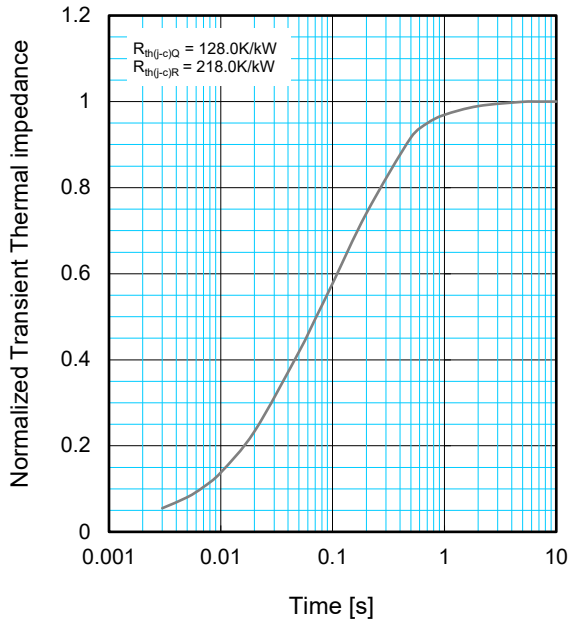


SHORT CIRCUIT SAFE OPERATING AREA (SCSOA)



PERFORMANCE CURVES

TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS



$$Z_{th(j-c)}(t) = \sum_{i=1}^{n} R_i \left\{ 1 - exp\left(-\frac{t}{\tau_i} \right) \right\}$$

	1	2	3	4
R_i / R_{th} :	0.0145	0.3107	0.5977	0.0772
τ_i [sec.] :	0.0001	0.0291	0.1797	1.0024

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