MITSUBISHI ELECTRIC

< HVMOSFET MODULE >

FMF750DC-66A

HIGH POWER SWITCHING USE
INSULATED TYPE HVMOSFET (High Voltage Metal Oxide Semiconductor Field Effect Transistor) Module

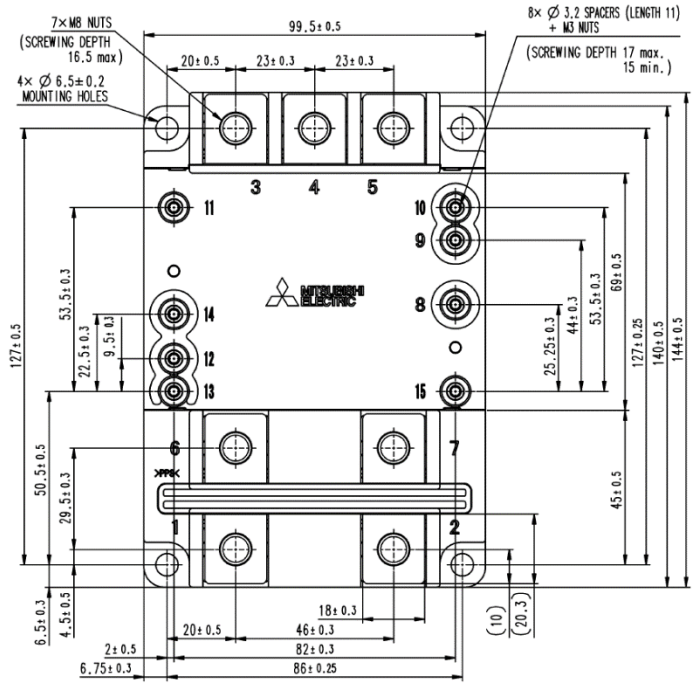
FMF750DC-66A

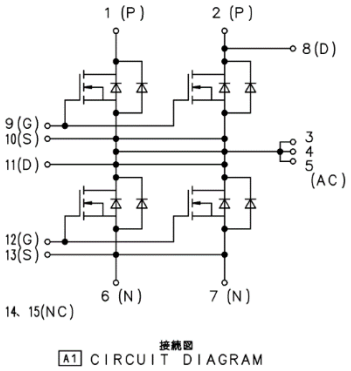
- I_D ..... 750 A
- V_{DSX} ..... 3300 V
- 2-element in a Pack
- Insulated Type
- SiC MOSFET
- JBS (Junction Barrier Schottky)

APPLICATION

Traction drives, High Reliability Converters / Inverters, DC choppers

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





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A1 CIRCUIT DIAGRAM

No.	Terminals
1, 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

MAXIMUM RATINGS

Symbol	Item	Conditions	Ratings	Unit
V_{DSX}	Drain-source voltage	V_{GS} = -5 V, T_j = -40 ~ 175 °C	3300	V
V_{GSS}	Gate-source voltage	V_{DS} = 0 V, T_j = 25 °C	±20	V
I_D	Drain current	DC, V_{GS} = +17 V, T_c = 55 °C	750	A
I_{DM}		Pulse (Note 1)	1500	A
I_S	Source current (Note 2)	DC, V_{GS} = -5 V	750	A
I_{SM}		Pulse (Note 1)	1500	A
P_{tot}	Maximum power dissipation (Note 3)	T_c = 25 °C, MOSFET part	4650	W
V_{isol}	Isolation voltage	RMS, sinusoidal, f = 60 Hz, t = 1 min.	6000	V
V_e	Partial discharge extinction voltage	RMS, sinusoidal, f = 60 Hz, Q_{PD} ≤ 10 pC T_j = 25 °C	2600	V
T_j	Channel temperature	—	−40 ~ +175	°C
T_{jop}	Operating channel temperature	—	−40 ~ +175	°C
T_{stg}	Storage temperature	—	−40 ~ +175	°C
t_{sc}	Short circuit capability (Maximum pulse width)	T_j = 175 °C, V_{DD} = 2500 V, V_{GS} = +17/-5 V $R_{G(on)}$ = 2.0 Ω, $R_{G(off)}$ = 0.9 Ω, L_S = 60 nH	4	µs

ELECTRICAL CHARACTERISTICS

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		-2.0	—	2.0	µA
I_{DSX}	Drain-source cut-off current	V_{DS} = V_{DSX}, V_{GS} = −5 V	T_j = 25 °C	—	—	2.5	mA
			T_j = 150 °C	—	—	—	
			T_j = 175 °C	—	3.0	—	
$V_{GS(th)}$	Gate-source threshold voltage	V_{DS} = 10 V, I_C = 75 mA	T_j = 25 °C	—	2.10	—	V
			T_j = 150 °C	—	1.40	—	
			T_j = 175 °C	—	1.30	—	
$r_{DS(on)}$	Drain-source resistance	V_{DS} = $V_{DS(on)}$ V_{GS} = 17 V	T_j = 25 °C	—	2.35	—	mΩ
			T_j = 150 °C	—	4.55	—	
			T_j = 175 °C	—	5.20	—	
$V_{DS(on)}$	Drain-source on voltage	V_{GS} = 17 V I_D = 750 A (Note 4)	T_j = 25 °C	—	1.75	—	V
			T_j = 150 °C	—	3.40	—	
			T_j = 175 °C	—	3.90	—	
C_{iss}	Input capacitance	V_{DS} = 10 V, V_{GS} = 0 V f = 100 kHz, T_j = 25 °C		—	209	—	nF
C_{oss}	Output capacitance			—	34	—	nF
C_{rss}	Reverse transfer capacitance			—	0.8	—	nF
Q_G	Total gate charge	V_{DD} = 1800 V, I_D = 750 A, V_{GS} = +17/-5 V		—	6.7	—	µC
$t_{d(on)}$	Turn-on delay time	V_{DD} = 1800 V I_D = 750 A V_{GS} = +17/-5 V $R_{G(on)}$ = 2.0 Ω L_s = 60 nH Inductive load	T_j = 150 °C	—	0.80	—	µs
			T_j = 175 °C	—	0.75	—	
t_r	Rise time		T_j = 150 °C	—	0.51	—	µs
			T_j = 175 °C	—	0.46	—	
E_{on}	Turn-on switching energy per pulse		T_j = 150 °C	—	0.60	—	J
			T_j = 175 °C	—	0.60	—	
$t_{d(off)}$	Turn-off delay time	V_{DD} = 1800 V I_D = 750 A V_{GS} = +17/-5 V $R_{G(off)}$ = 0.9 Ω L_s = 60 nH Inductive load	T_j = 150 °C	—	0.95	—	µs
			T_j = 175 °C	—	1.00	—	
t_f	Turn-off fall time		T_j = 150 °C	—	0.18	—	µs
			T_j = 175 °C	—	0.18	—	
E_{off}	Turn-off switching energy per pulse		T_j = 150 °C	—	0.25	—	J
			T_j = 175 °C	—	0.25	—	

ELECTRICAL CHARACTERISTICS

Symbol	Item	Conditions		Limits			Unit
				Min	Typ	Max	
V_{SD}	Source-drain voltage (Note 2)	V_{GS} = 0 V, I_S = 750 A (Note 4)	T_j = 25 °C	—	2.50	—	V
			T_j = 150 °C	—	3.35	—	
			T_j = 175 °C	—	3.50	—	
V_{SD}	Source-drain voltage (Note 2)	V_{GS} = +17 V, I_S = 750 A (Note 4)	T_j = 25 °C	—	1.20	—	V
			T_j = 150 °C	—	2.10	—	
			T_j = 175 °C	—	2.40	—	
I_{FSM}	Surge forward current (Note 2)	V_{SD} = 0 V, t_p = 10 ms, T_j = 150 °C start		—	—	—	kA
I^2t	Surge current load integral (Note 2)			—	—	—	kA^2s
Q_C	Total capacitive charge (Note 2)	V_{DD} = 1800 V, I_D = 750 A, $di_S/dt \approx$ 1700 A/μs, L_s = 60 nH	T_j = 150 °C	—	30	—	μC
			T_j = 175 °C	—	40	—	
E_{off_diode}	Diode turn-off energy per pulse (Note 2)		T_j = 150 °C	—	0.02	—	J
			T_j = 175 °C	—	0.03	—	

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	—	—	32.0	K/kW
$R_{th(j-c)D}$		Junction to Case, FWDi part, 1/2 module	—	—	54.5	K/kW
$R_{th(c-s)}$	Contact thermal resistance	Case to heat sink, 1/2 module, λ_{grease} = 1 W/m·K, $D_{(c-s)}$ = 100 μm	—	22.5	—	K/kW

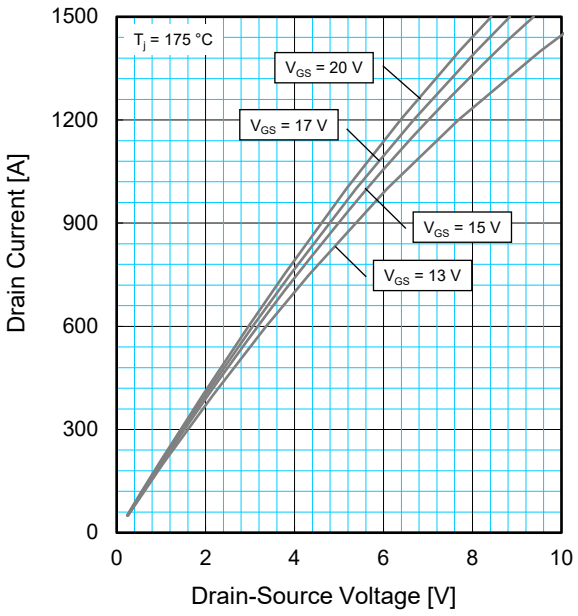
MECHANICAL CHARACTERISTICS

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	Between terminals and baseplate	32.0	—	—	mm
$L_{P\ P-N}$	Parasitic stray inductance	Between terminal 1,2 and terminal 6,7	—	14.0	—	nH
$L_{p\ s-ss}$	Internal inductance	Between Auxiliary terminals (terminal 10-11)	—	3.0	—	nH
		Between Auxiliary terminals and DC- (terminal 13-6,7)	—	5.0	—	nH
$R_{DD'+SS'}$	Internal lead resistance	Between DC+ and DC- (terminal 1,2-6,7)	—	0.46	—	mΩ
		Between DC+ and AC (terminal 1,2-3,4,5)	—	0.22	—	
		Between AC and DC- (terminal 3,4,5-6,7)	—	0.33	—	

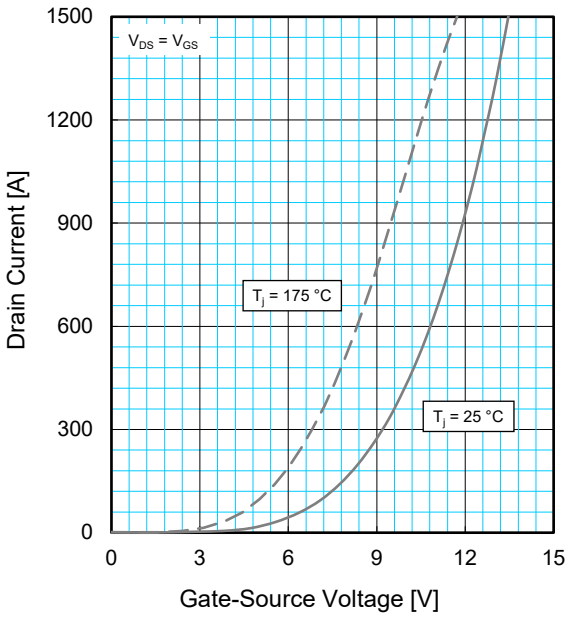
Note 1. Pulse width and repetition rate should be such that junction temperature (T_j) does not exceed T_{j_max} rating.
Note 2. The symbols represent characteristics of the anti-parallel, source to drain free-wheel diode (FWD_i).
Note 3. Junction temperature (T_j) should not exceed T_{j_max} rating.
Note 4. Pulse width and repetition rate should be such as to cause negligible temperature rise.
Note 5. This is the case when installing the product on the bus bar.

PERFPRMANCE CURVES

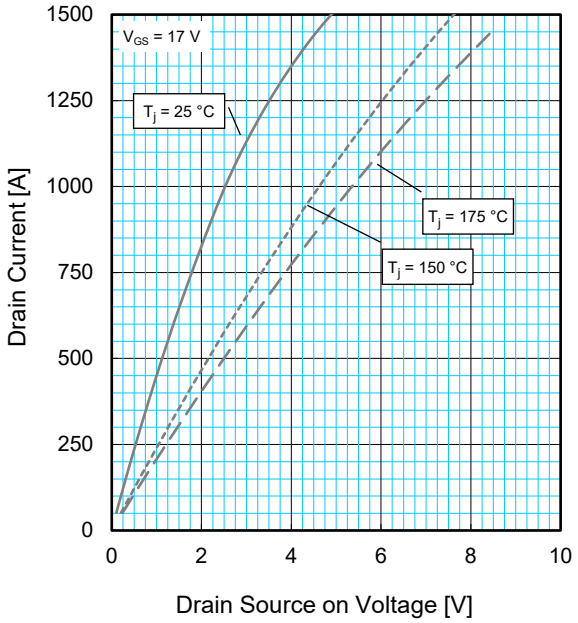
OUTPUT CHARACTERISTICS (TYPICAL)



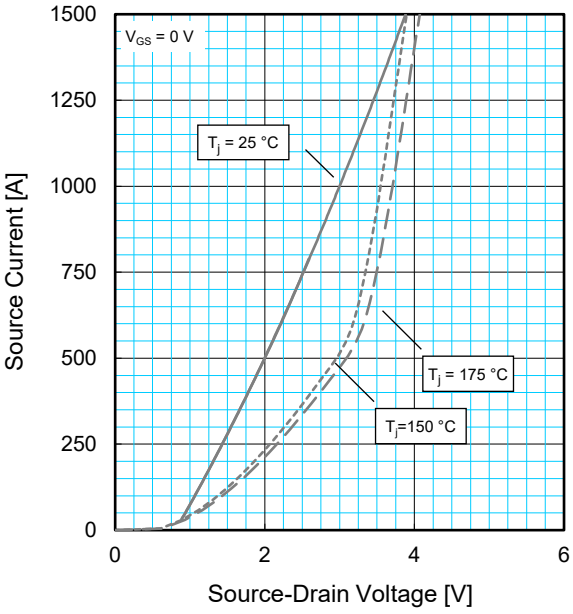
TRANSFER CHARACTERISTICS (TYPICAL)



DRAIN-SOURCE ON VOLTAGE CHARACTERISTICS (TYPICAL)

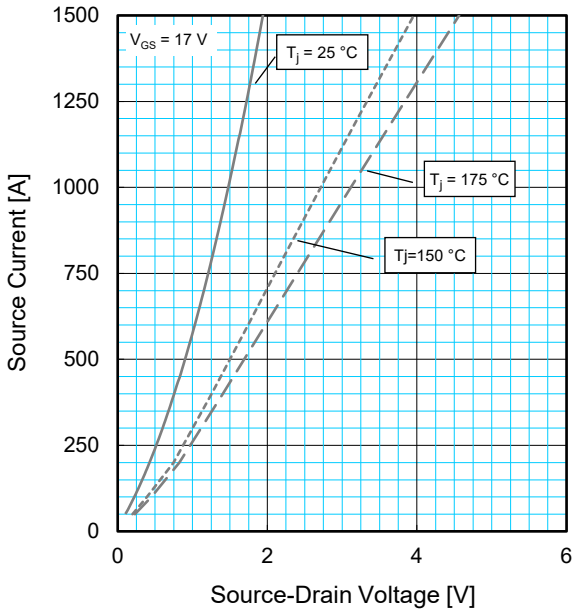


FREE-WHEEL DIODE FORWARD CHARACTERISTICS (TYPICAL)

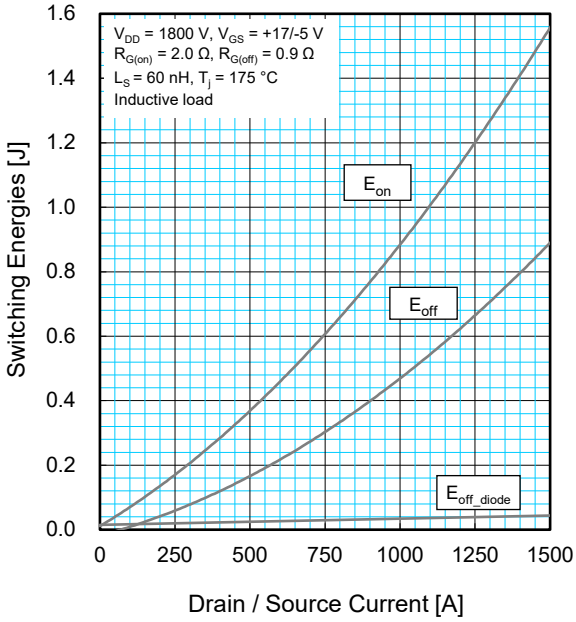


PERFORMANCE CURVES

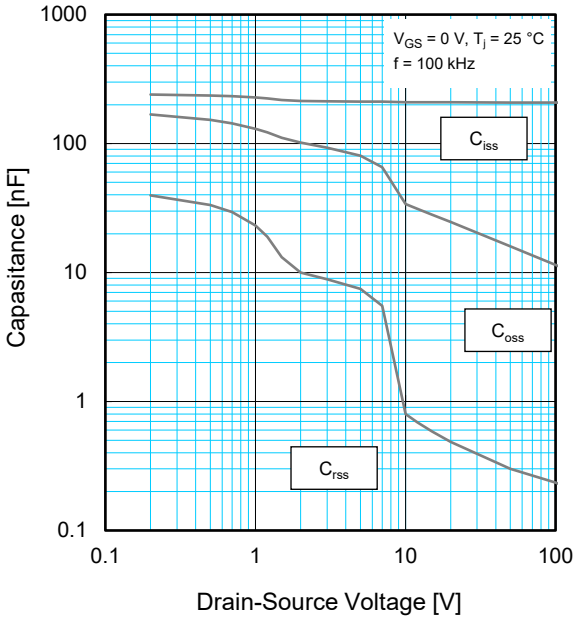
FREE-WHEEL DIODE FORWARD CHARACTERISTICS (TYPICAL)



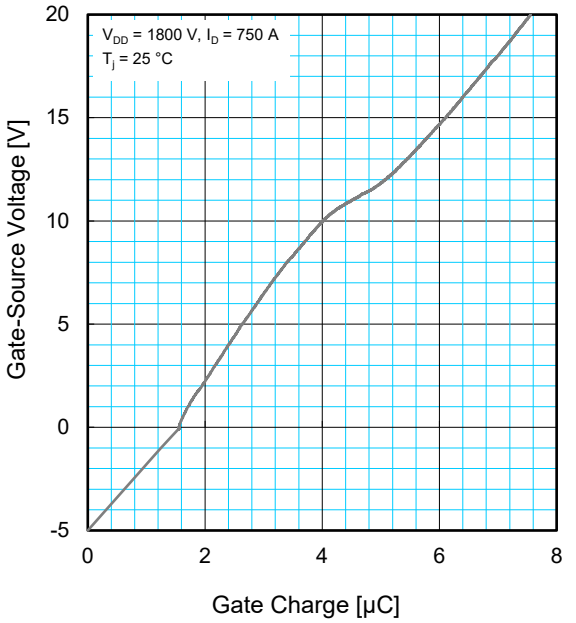
HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



CAPACITANCE CHARACTERISTICS (TYPICAL)

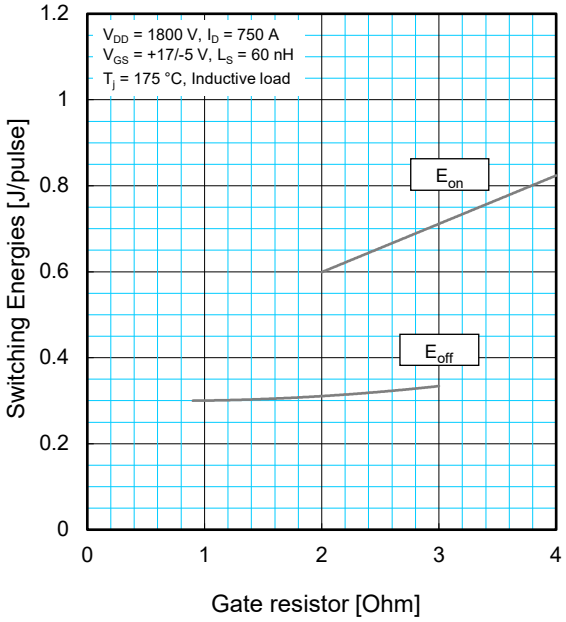


GATE CHARGE CHARACTERISTICS (TYPICAL)

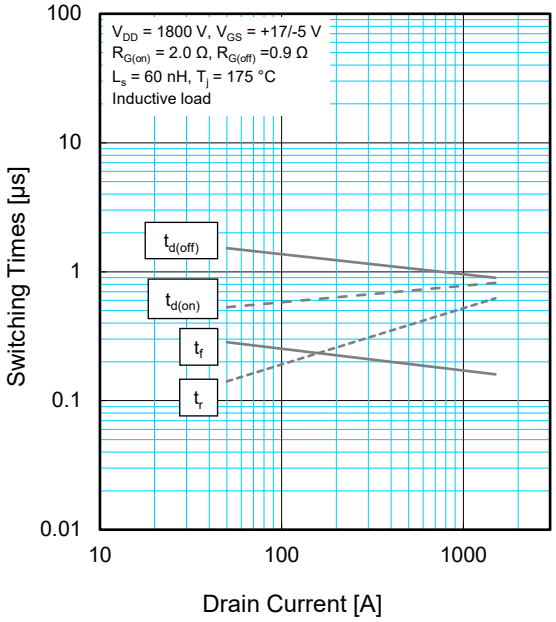


PERFORMANCE CURVES

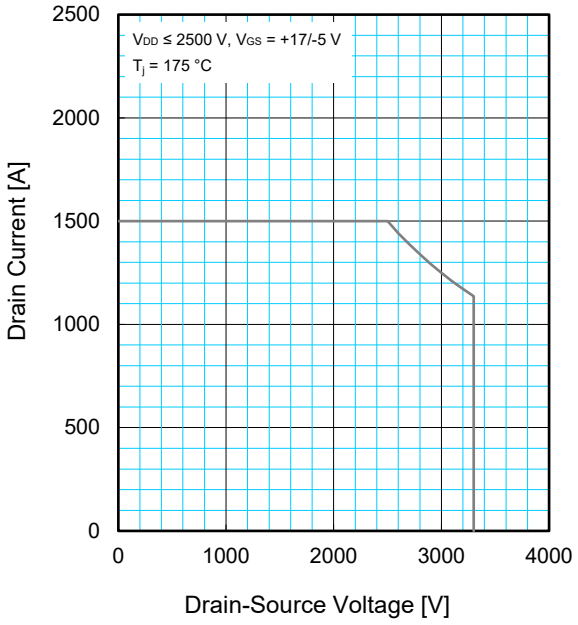
HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



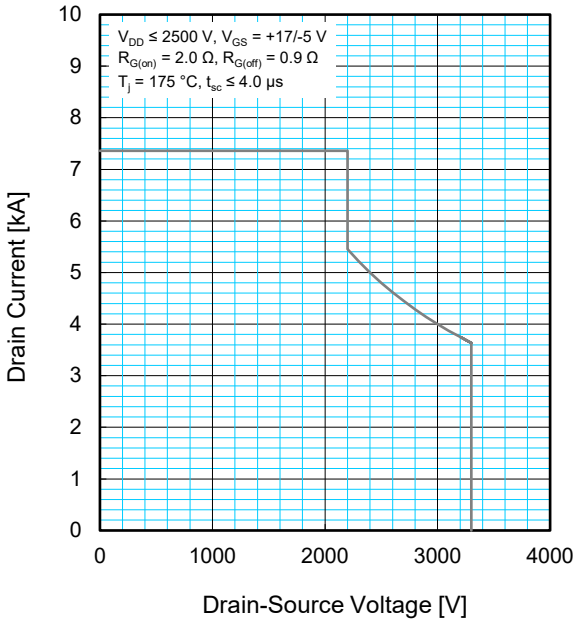
HALF-BRIDGE SWITCHING TIME CHARACTERISTICS (TYPICAL)



REVERSE BIAS SAFE OPERATING AREA (RBSOA)

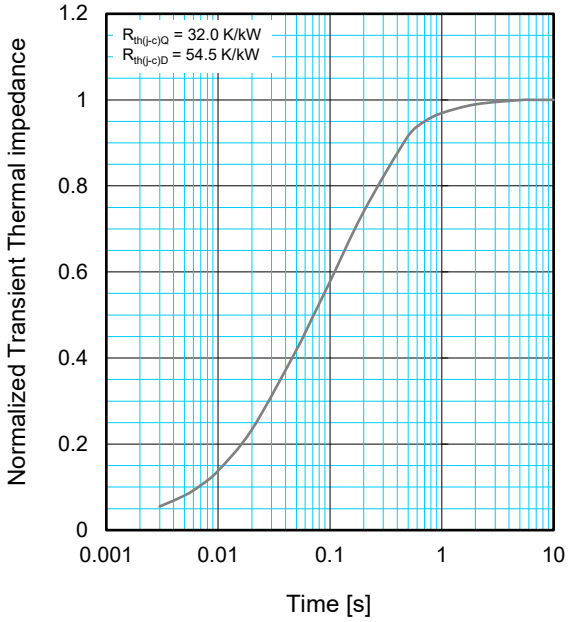


SHORT CIRCUIT SAFE OPERATING AREA (SCSOA)



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
$R_i / R_{th(j-c)}$	0.0145	0.3107	0.5977	0.0772
τ_i [s]	0.0001	0.0291	0.1797	1.0024

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