MITSUBISHI ELECTRIC

< HVMOSFET MODULE >

FMF750DC-66A-1

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

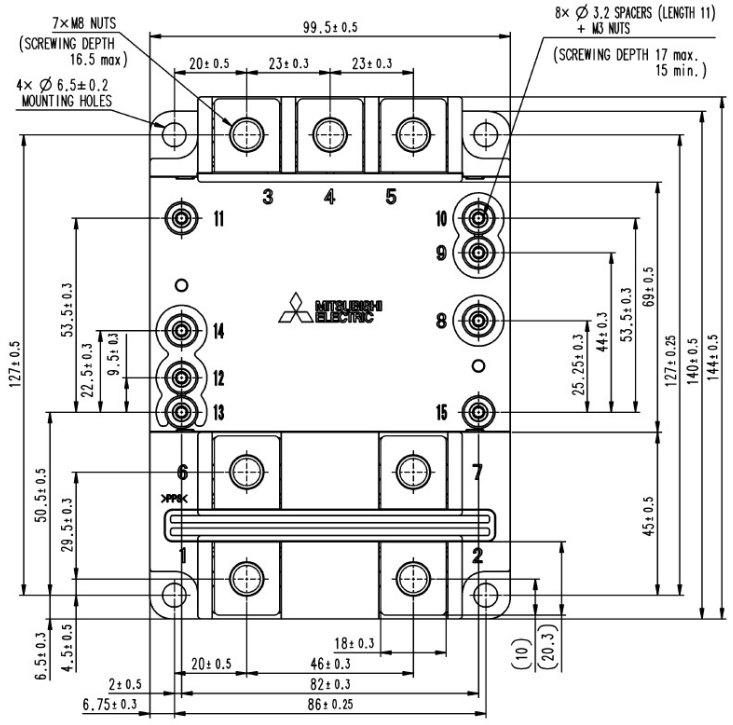
FMF750DC-66A-1

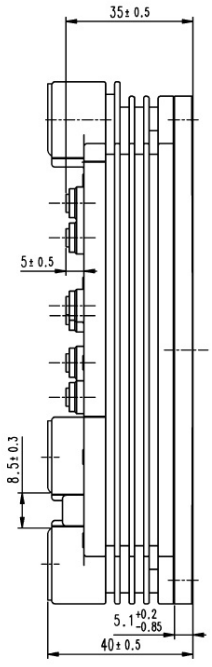
- I_D.....750A
- V_{DSX}.....3300V
- 2-element in a Pack
- Insulated Type
- SiC MOSFET
- JBS(Junction Barrier Schottky)

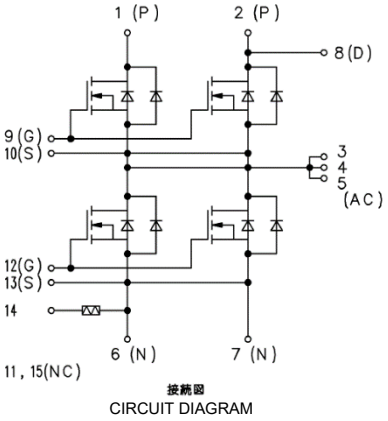
APPLICATION

Traction drives, High Reliability Converters / Inverters, DC choppers

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







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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)
12	G(N)
13	S(N)
14	NTC Thermistor
11, 15	NC

MAXIMUM RATINGS

Symbol	Item	Conditions	Ratings	Unit
V_{DSX}	Drain-source voltage	V_{GS} = -5V, T_j = -40 ~ 175°C	3300	V
V_{GSS}	Gate-source voltage	V_{DS} = 0V, T_j = 25°C	±20	V
I_D	Drain current	DC, V_{GS} = +17V, T_c = 55°C	750	A
I_{DM}		Pulse (Note 1)	1500	A
I_S	Source current (Note 2)	DC, V_{GS} = -5V	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 = 60Hz, t = 1 min.	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
t_{sc}	Short circuit capability (Maximum pulse width)	T_j = 175°C, V_{DD} = 2500V, V_{GS} = +17V / -5V $R_{G(on)}$ = 2.0Ω, $R_{G(off)}$ = 0.9Ω, L_S = 60nH	4	µs

ELECTRICAL CHARACTERISTICS

Symbol	Item	Conditions		Limits Min	Limits Typ	Limits Max	Unit
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} = 10V, I_C = 75mA	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} = 17V	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} = 17V, I_D = 750A	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} = 10V, V_{GS} = 0V, f = 100kHz, T_j = 25°C		—	209	—	nF
C_{oss}	Output capacitance			—	34.0	—	nF
C_{rss}	Reverse transfer capacitance			—	0.8	—	nF
Q_G	Total gate charge	V_{DD} = 1800V, I_D = 750A, V_{GS} = +17V / -5V		—	6.7	—	µC
$t_{d(on)}$	Turn-on delay time	V_{DD} = 1800V I_D = 750A V_{GS} = +17V / -5V $R_{G(on)}$ = 2.0Ω L_s = 60nH 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} = 1800V I_D = 750A V_{GS} = +17 V / -5V $R_{G(off)}$ = 0.9Ω L_s = 60nH 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	—	
V_{SD}	Source-drain voltage	I_S = 750 A V_{GS} = 0 V	T_j = 25°C	—	2.50	—	V
			T_j = 150°C	—	3.35	—	
			T_j = 175°C	—	3.50	—	
V_{SD}	Source-drain voltage	I_S = 750 A V_{GS} = +17 V	T_j = 25°C	—	1.20	—	V
			T_j = 150°C	—	2.10	—	
			T_j = 175°C	—	2.40	—	

ELECTRICAL CHARACTERISTICS (continuation)

Symbol	Item	Conditions		Limits			Unit
				Min	Typ	Max	
I_{FSM}	Surge forward current	V_R = 0V, t_p = 10 ms, T_j = 150 °C start		—	—	—	kA
I^2t	Surge current load integral			—	—	—	kA^2s
Q_C	Total capacitive charge (Note 2)	V_{DD} = 1800V, I_D = 750A, di_S/dt ≈ 1700 A/μs, L_s = 60nH	T_j = 150°C	—	30	—	μC
			T_j = 175°C	—	40	—	
E_{off_diode}	Diode turn-off energy per pulse		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, λ_{grease} = 1W/m·K, $D_{(c-s)}$ = 100μm, 1/2 module	—	22.5	—	K/kW

NTC THERMISTOR PART

Symbol	Item	Conditions	Limits			Unit
			Min	Typ	Max	
R_{25}	Zero-power resistance	T_c=25°C	—	5.00	—	kΩ
$B_{(25/50)}$	B-constant (Note 4)	Approximate by equation	—	3375	—	K

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	—	0.8	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
$L_{P\ P\text{-}N}$	Parasitic stray inductance	Between terminal 1, 2 and terminal 6,7	—	14.0	—	nH
$L_{p\ s\text{-}ss}$	Internal inductance	Between Auxiliary terminals (terminal 10-11)	—	3.0	—	nH
		Between Auxiliary terminals and DC- (terminal 13-6,7)	—	5.0	—	
$R_{DD'+SS'}$	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	—	

Note1. Pulse width and repetition rate should be such that junction temperature (T_j) does not exceed T_{jopmax} rating.

2. The symbols represent characteristics of the anti-parallel, source to drain free-wheel diode (FWD_i).

3. Junction temperature (T_j) should not exceed T_{jmax} rating.

4. $B_{(25/50)} = \ln\left(\frac{R_{25}}{R_{50}}\right) / \left(\frac{1}{T_{25}} - \frac{1}{T_{50}}\right)$

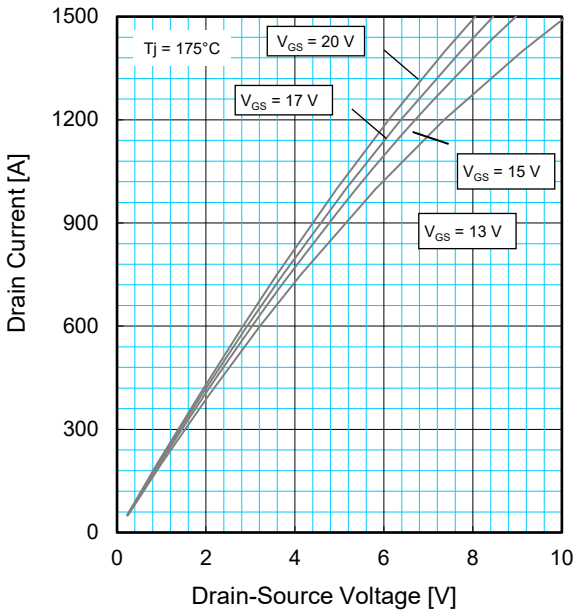
   R_{25}: resistance at absolute temperature T_{25} [K]; T_{25} = 25[°C] + 273.15 = 298.15[K]

   R_{50}: resistance at absolute temperature T_{25} [K]; T_{50} = 50[°C] + 273.15 = 323.15[K]

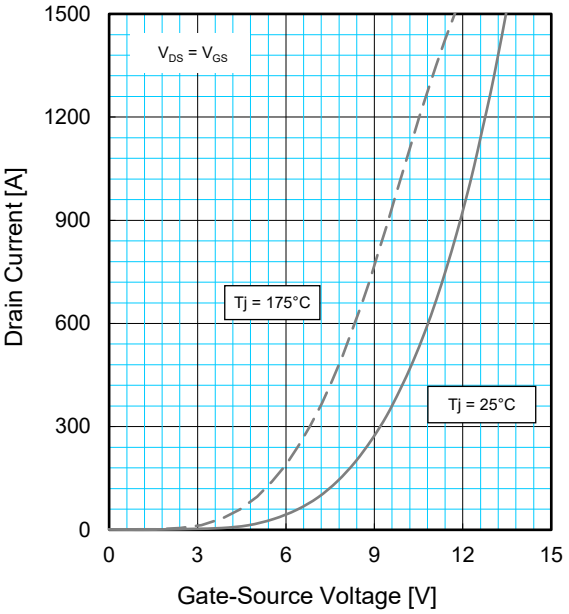
5. This is the case when installing the product on the bus-bar.

PERFORMANCE CURVES

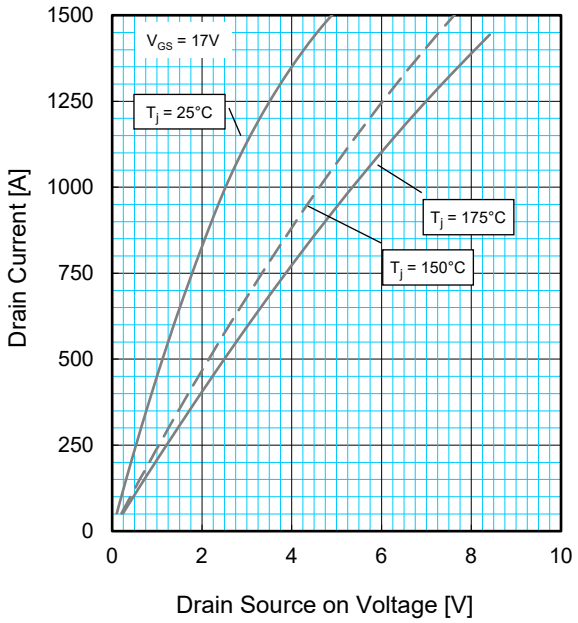
OUTPUT CHARACTERISTICS (TYPICAL)



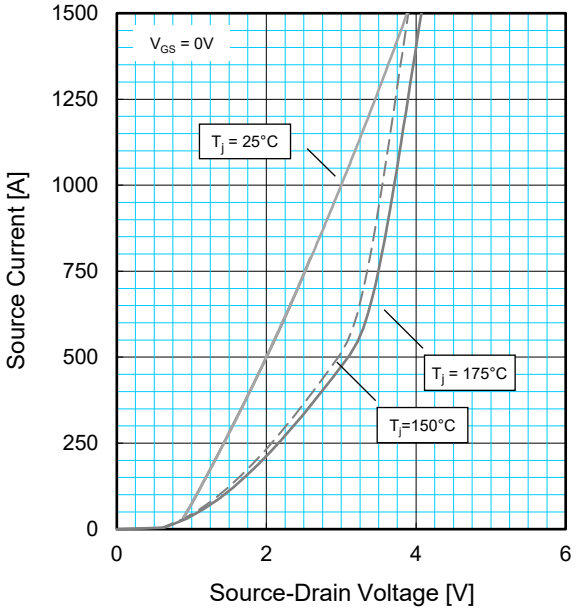
TRANSFER CHARACTERISTICS (TYPICAL)



DRAIN-SOURCE ON VOLTAGE CHARACTERISTICS (TYPICAL)

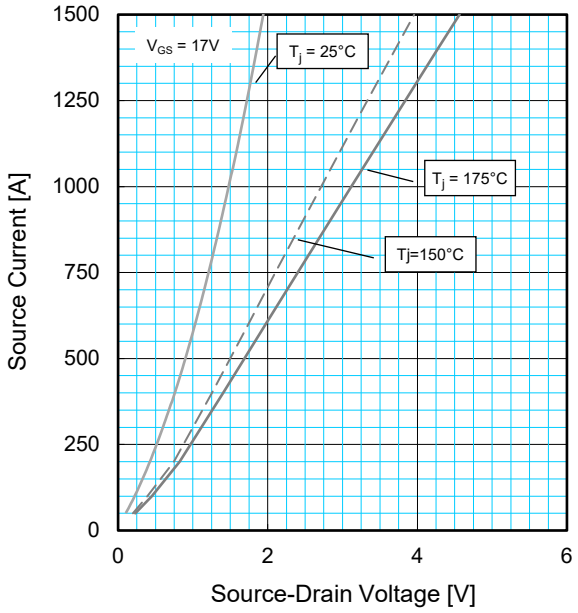


FREE-WHEEL DIODE FORWARD CHARACTERISTICS (TYPICAL)

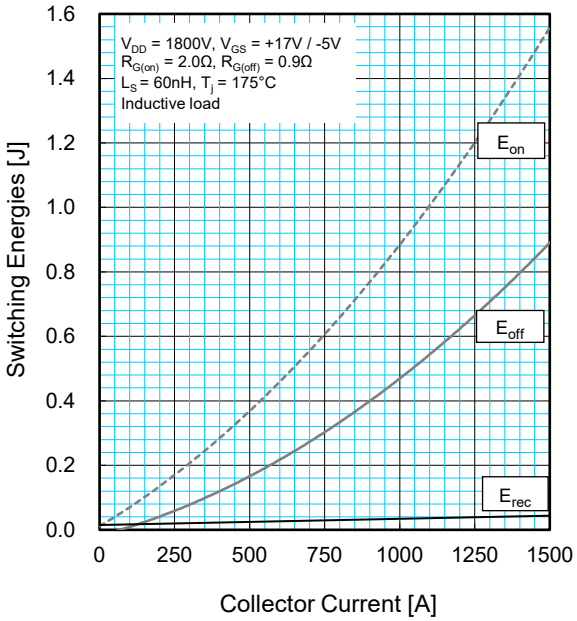


PERFORMANCE CURVES

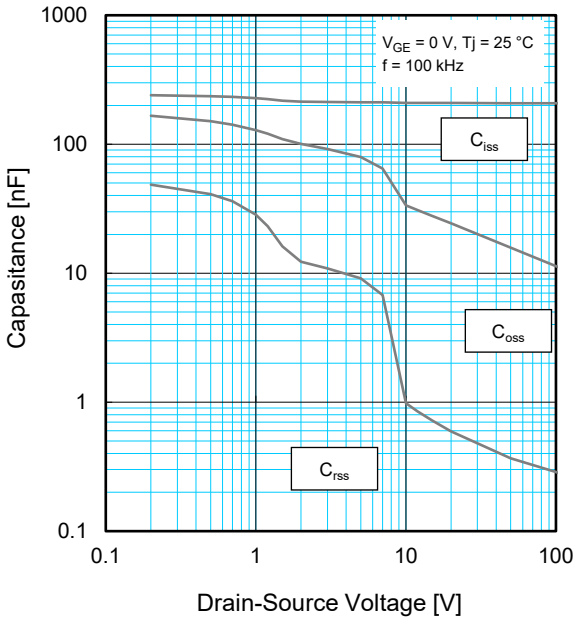
FREE-WHEEL DIODE FORWARD CHARACTERISTICS (TYPICAL)



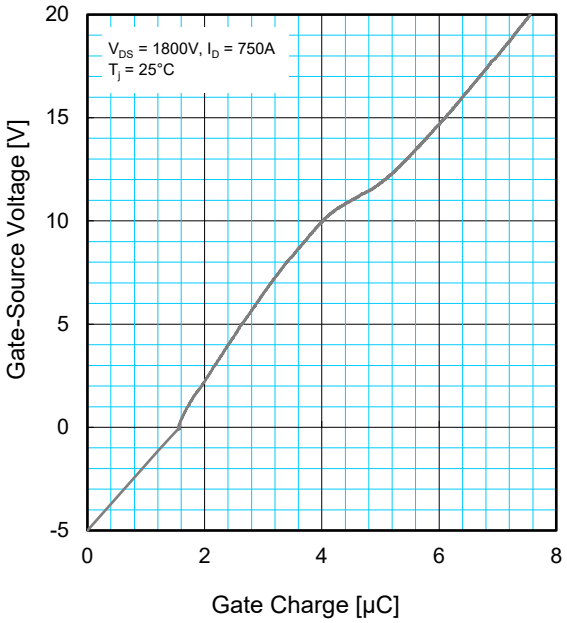
HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



CAPACITANCE CHARACTERISTICS (TYPICAL)

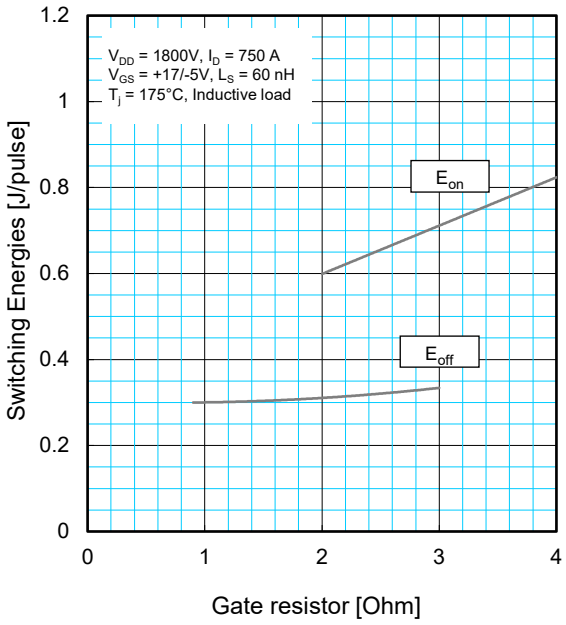


GATE CHARGE CHARACTERISTICS (TYPICAL)

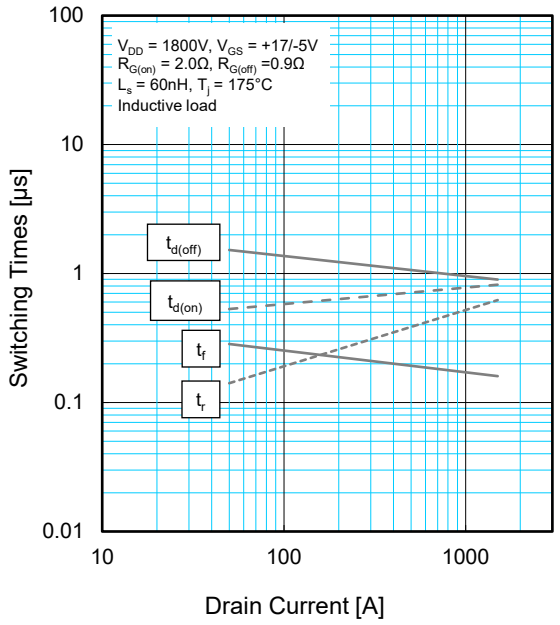


PERFORMANCE CURVES

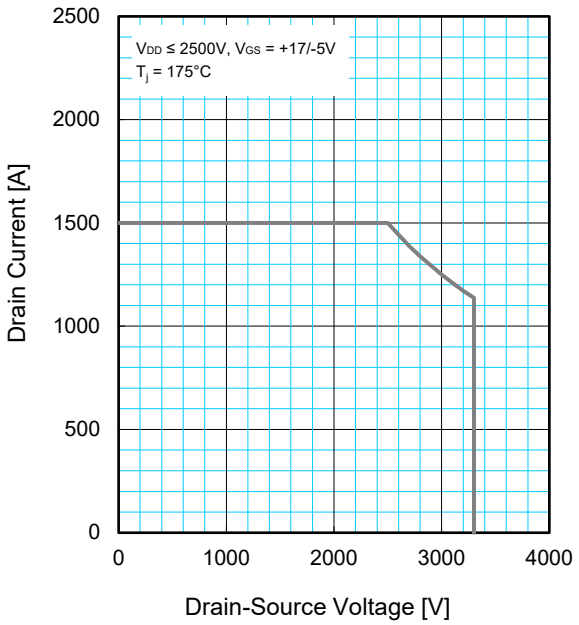
HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



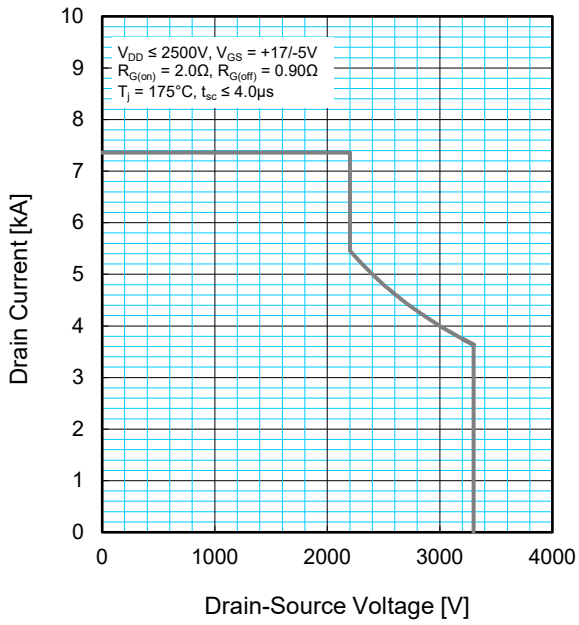
HALF-BRIDGE SWITCHING TIME CHARACTERISTICS (TYPICAL)



REVERSE BIAS SAFE OPERATING AREA (RBSOA)

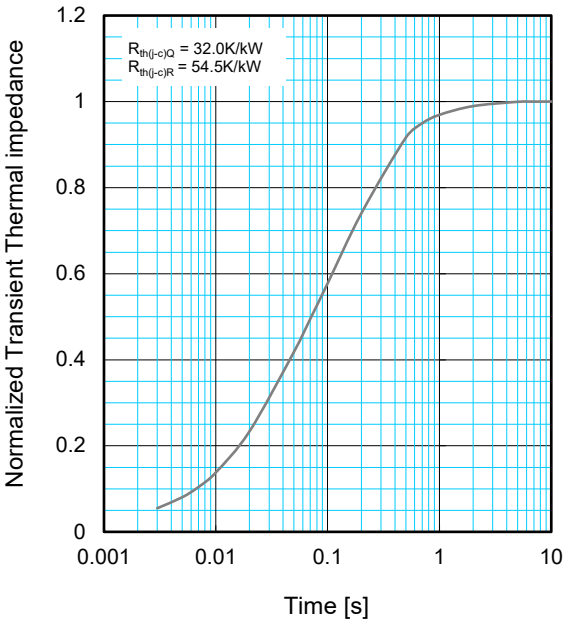


SHORT CIRCUIT SAFE OPERATING AREA (SCSOA)



PERFORMANCE CURVES

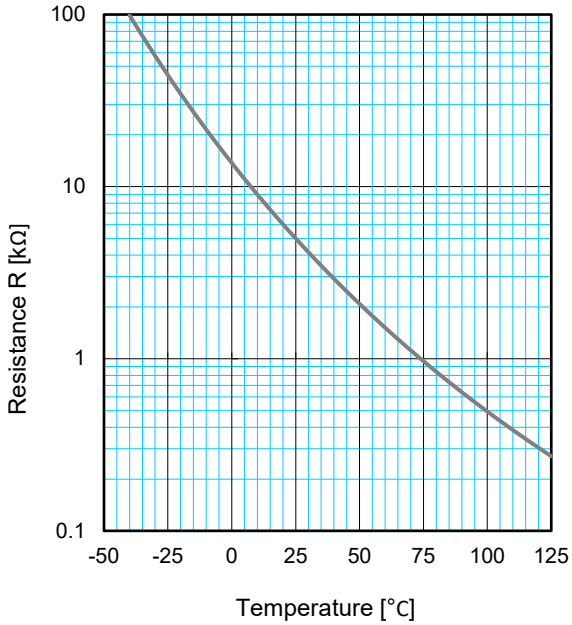
TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS



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

	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

NTC THERMISTOR TEMPERATURE CHARACTERISTICS (TYPICAL)



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