



< HVMOSFET MODULE >

FMF750DC-66A-1

HIGH POWER SWITCHING USE

INSULATED TYPE

HVMOSFET (High Voltage Metal Oxide Semiconductor Field Effect Transistor) Module

FMF750DC-66A-1

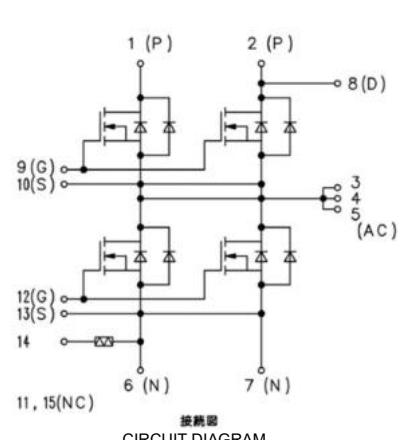
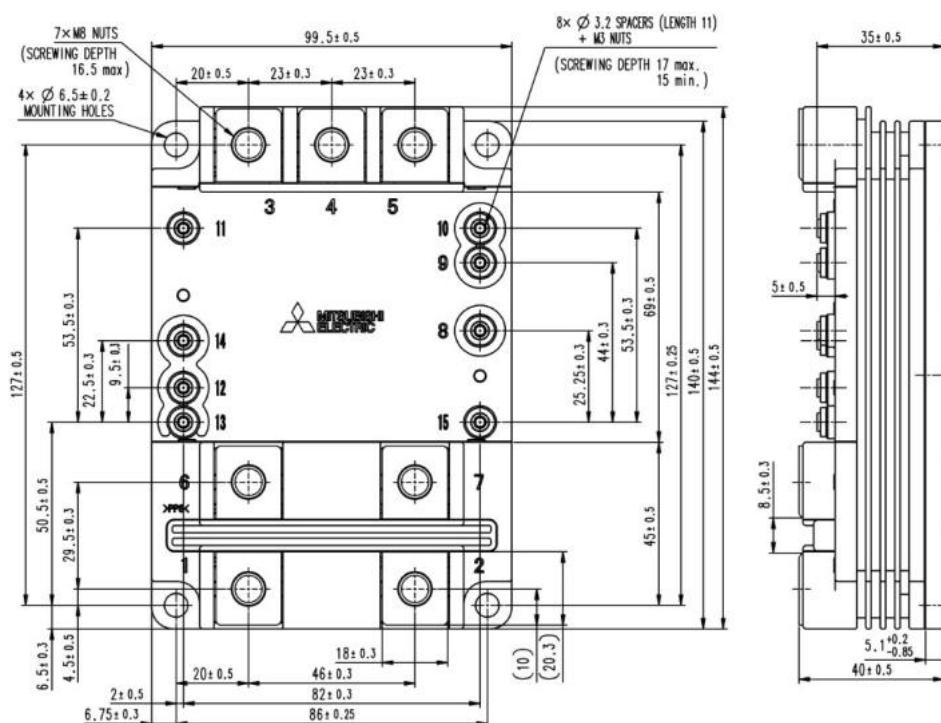
- I_D 750A
- V_{DSX} 3300V
- 2-element in a Pack
- Insulated Type
- SiC MOSFET
- JBS(Junction Barrier Schottky)

APPLICATION

Traction drives, High Reliability Converters / Inverters, DC choppers

OUTLINE DRAWING & CIRCUIT DIAGRAM

Dimensions in mm



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

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MAXIMUM RATINGS

Symbol	Item	Conditions	Ratings	Unit
V_{DSX}	Drain-source voltage	$V_{GS} = -5V, T_j = -40 \sim 175^\circ C$	3300	V
V_{GSS}	Gate-source voltage	$V_{DS} = 0V, T_j = 25^\circ C$	± 20	V
I_D	Drain current	DC, $V_{GS} = +17V, T_c = 55^\circ C$	750	A
		Pulse (Note 1)	1500	A
I_S	Source current (Note 2)	DC, $V_{GS} = -5V$	750	A
		Pulse (Note 1)	1500	A
P_{tot}	Maximum power dissipation (Note 3)	$T_c = 25^\circ C$, 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, $f = 60Hz, Q_{PD} \leq 10 pC, T_j = 25^\circ C$	2600	V
T_j	Channel temperature	—	$-40 \sim +175$	°C
T_{op}	Operating channel temperature	—	$-40 \sim +175$	°C
T_{stg}	Storage temperature	—	$-40 \sim +175$	°C
t_{sc}	Short circuit capability (Maximum pulse width)	$T_j = 175^\circ C, V_{DD} = 2500V, V_{GS} = +17V / -5V$ $R_{G(on)} = 2.0\Omega, R_{G(off)} = 0.9\Omega, L_s = 60nH$	4	μs

ELECTRICAL CHARACTERISTICS

Symbol	Item	Conditions	Limits			Unit
			Min	Typ	Max	
I_{GSS}	Gate leakage current	$V_{GS} = V_{GSS}, V_{DS} = 0V, T_j = 25^\circ C$	-2.0	—	2.0	μA
I_{DSX}	Drain-source cut-off current	$V_{DS} = V_{DSX}, V_{GS} = -5V$	$T_j = 25^\circ C$	—	2.5	mA
			$T_j = 150^\circ C$	—	—	
			$T_j = 175^\circ C$	—	3.0	
$V_{GS(th)}$	Gate-source threshold voltage	$V_{DS} = 10V, I_c = 75mA$	$T_j = 25^\circ C$	—	2.10	V
			$T_j = 150^\circ C$	—	1.40	
			$T_j = 175^\circ C$	—	1.30	
$r_{DS(on)}$	Drain-source resistance	$V_{DS} = V_{DS(on)}$ $V_{GS} = 17V$	$T_j = 25^\circ C$	—	2.35	mΩ
			$T_j = 150^\circ C$	—	4.55	
			$T_j = 175^\circ C$	—	5.20	
$V_{DS(on)}$	Drain-source on voltage	$V_{GS} = 17V, I_D = 750A$	$T_j = 25^\circ C$	—	1.75	V
			$T_j = 150^\circ C$	—	3.40	
			$T_j = 175^\circ C$	—	3.90	
C_{iss}	Input capacitance	$V_{DS} = 10V, V_{GS} = 0V, f = 100kHz, T_j = 25^\circ C$	—	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	$V_{DD} = 1800V$ $I_D = 750A$	$T_j = 150^\circ C$	—	0.80	μs
			$T_j = 175^\circ C$	—	0.75	
t_r	Rise time	$V_{GS} = +17V / -5V$ $R_{G(on)} = 2.0\Omega$	$T_j = 150^\circ C$	—	0.51	μs
			$T_j = 175^\circ C$	—	0.46	
E_{on}	Turn-on switching energy per pulse	$L_s = 60nH$ Inductive load	$T_j = 150^\circ C$	—	0.60	J
			$T_j = 175^\circ C$	—	0.60	
$t_{d(off)}$	Turn-off delay time	$V_{DD} = 1800V$ $I_D = 750A$	$T_j = 150^\circ C$	—	0.95	μs
			$T_j = 175^\circ C$	—	1.00	
t_f	Turn-off fall time	$V_{GS} = +17V / -5V$ $R_{G(off)} = 0.9\Omega$	$T_j = 150^\circ C$	—	0.18	μs
			$T_j = 175^\circ C$	—	0.18	
E_{off}	Turn-off switching energy per pulse	$L_s = 60nH$ Inductive load	$T_j = 150^\circ C$	—	0.25	J
			$T_j = 175^\circ C$	—	0.25	
V_{SD}	Source-drain voltage	$I_S = 750A$ $V_{GS} = 0V$	$T_j = 25^\circ C$	—	2.50	V
			$T_j = 150^\circ C$	—	3.35	
			$T_j = 175^\circ C$	—	3.50	
V_{SD}	Source-drain voltage	$I_S = 750A$ $V_{GS} = +17V$	$T_j = 25^\circ C$	—	1.20	V
			$T_j = 150^\circ C$	—	2.10	
			$T_j = 175^\circ C$	—	2.40	

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ELECTRICAL CHARACTERISTICS (continuation)

Symbol	Item	Conditions	Limits			Unit	
			Min	Typ	Max		
I_{F5M}	Surge forward current	$V_R = 0V$, $t_p = 10$ ms, $T_j = 150$ °C start	—	—	—	kA	
I^2t	Surge current load integral		—	—	—	kA ² s	
Q_c	Total capacitive charge (Note 2)	$V_{DD} = 1800V$, $I_D = 750A$ $di/dt \approx 1700 A/\mu s$, $L_s = 60nH$	$T_j = 150$ °C	—	30	μC	
			$T_j = 175$ °C	—	40		
	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, $\lambda_{grease} = 1W/m \cdot K$, $D_{(c-s)} = 100\mu m$, 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-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	—	
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_{jopmax} rating.

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

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

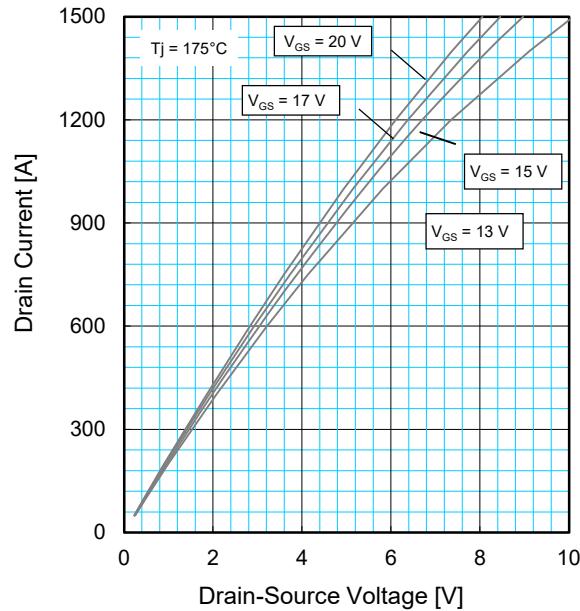
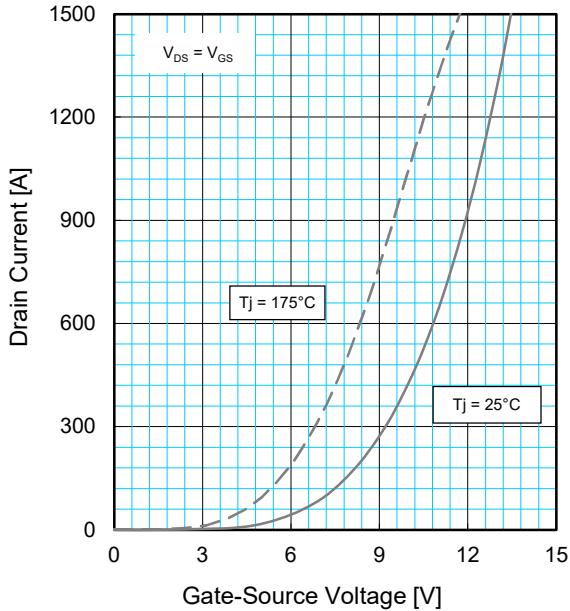
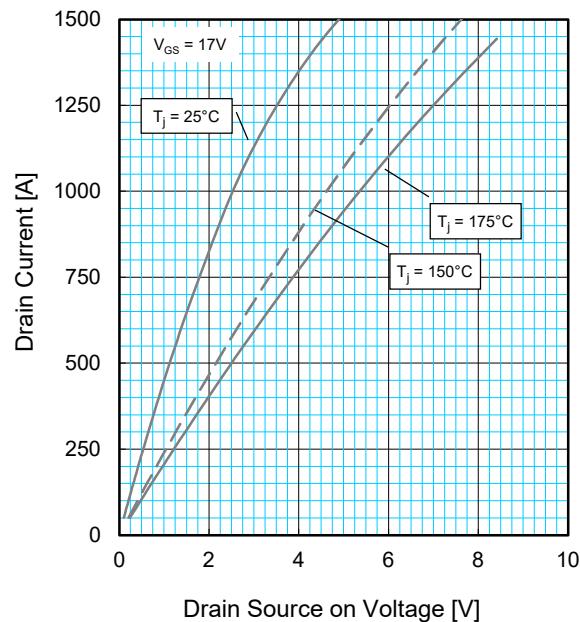
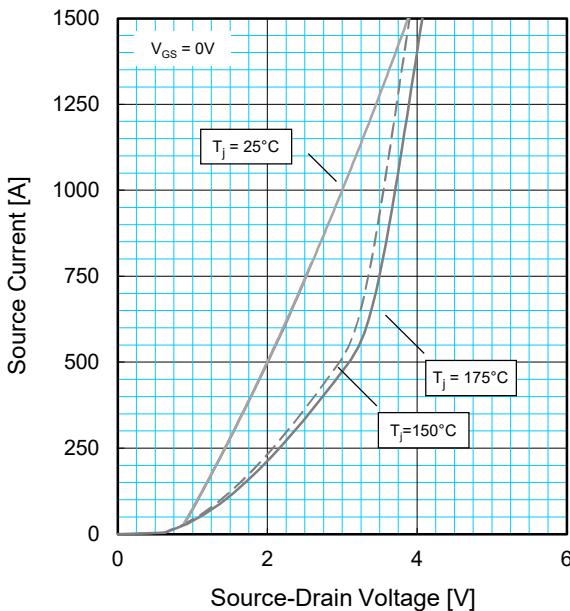
4.
$$B_{(25/50)} = \ln\left(\frac{R_{25}}{R_{50}}\right) / \left(\frac{1}{T_{25}} - \frac{1}{T_{50}}\right)$$

 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_{50} [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)**

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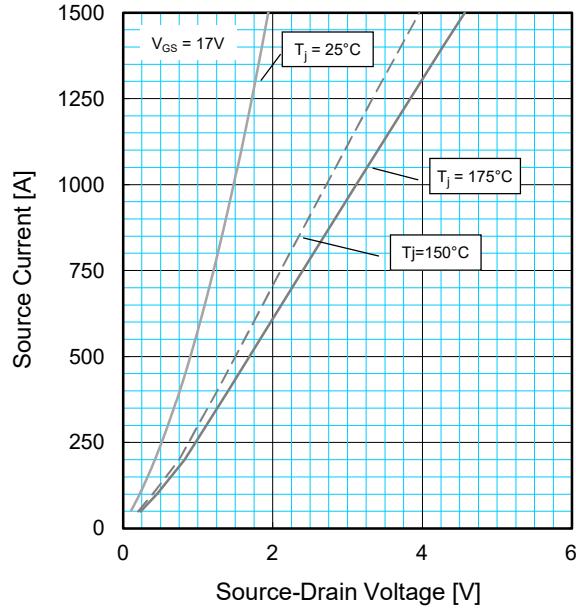
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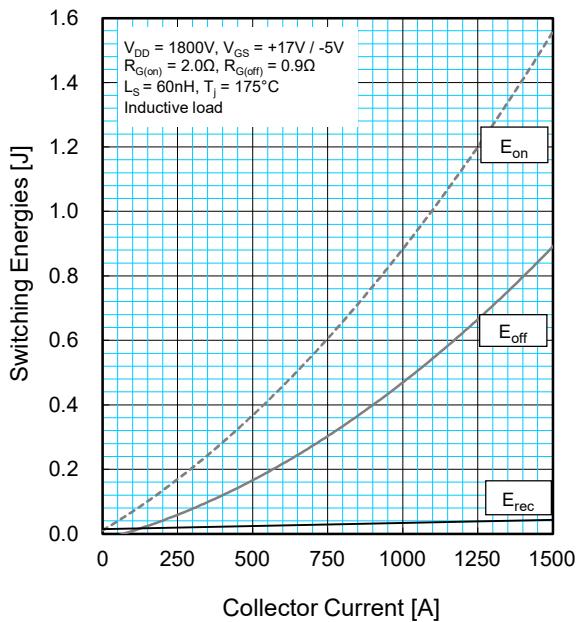
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PERFORMANCE CURVES

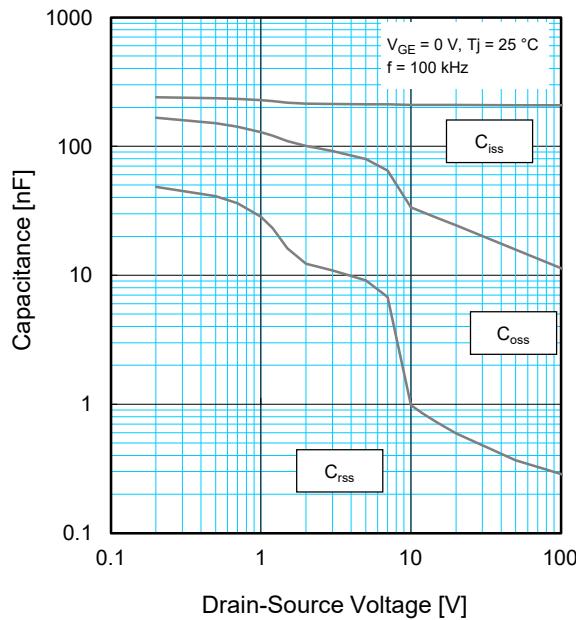
FREE-WHEEL DIODE FORWARD CHARACTERISTICS (TYPICAL)



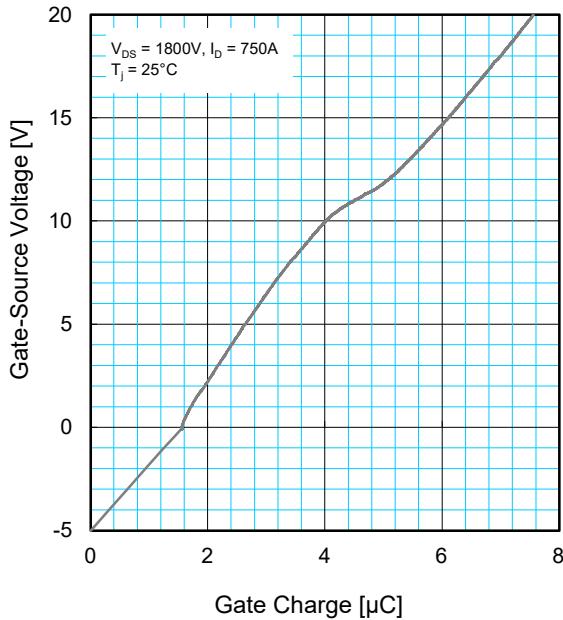
HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)

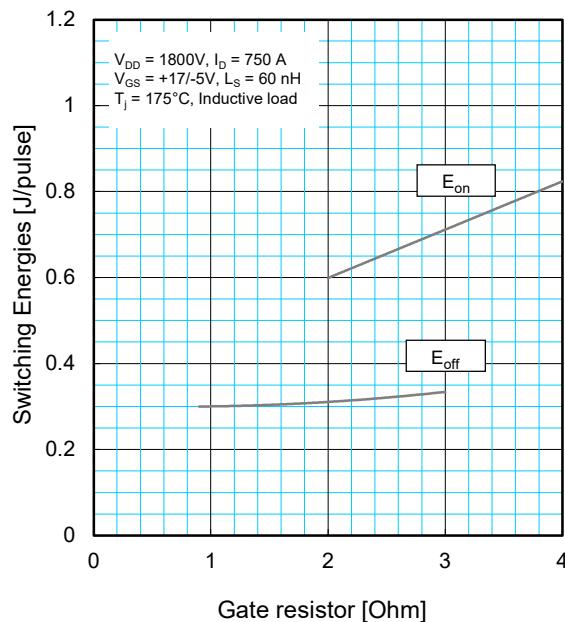
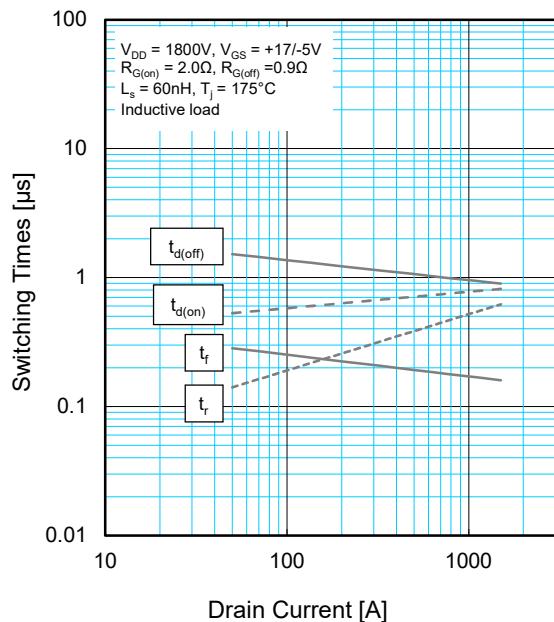
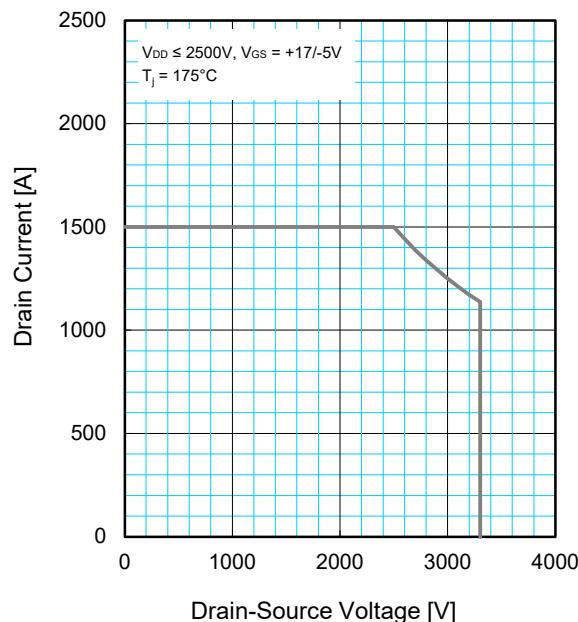
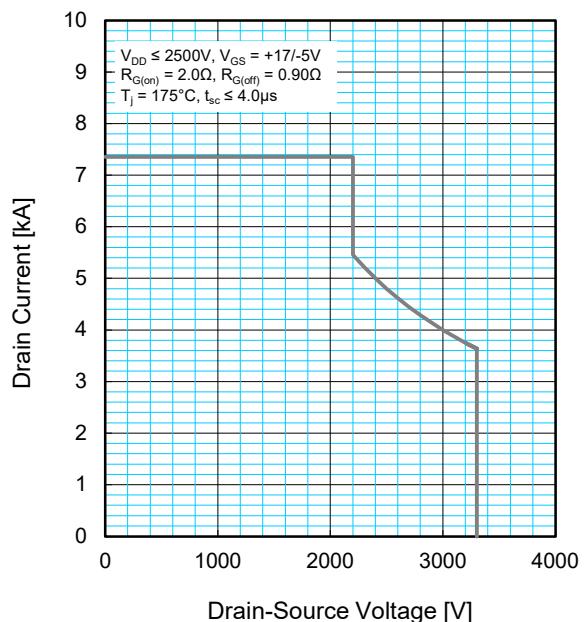


CAPACITANCE CHARACTERISTICS (TYPICAL)



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)**

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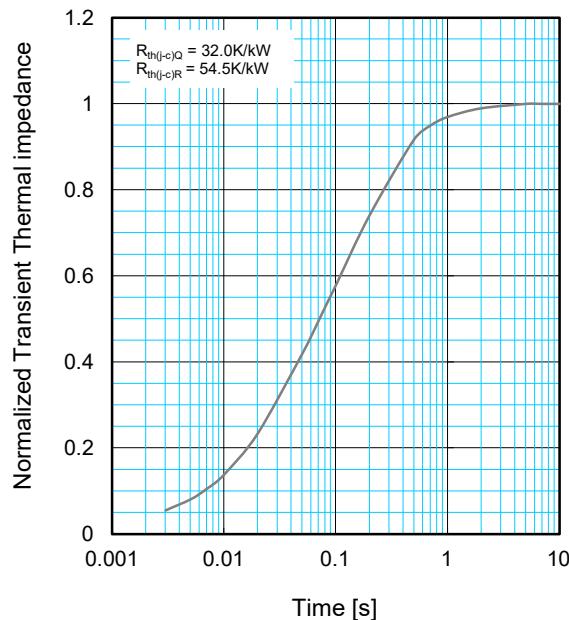
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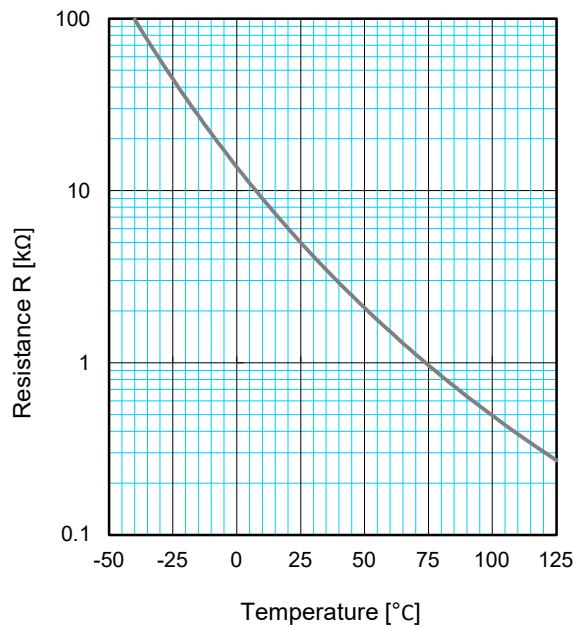
TRANSIENT THERMAL IMPEDANCE
CHARACTERISTICS



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

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

NTC THERMISTOR
TEMPERATURE CHARACTERISTICS
(TYPICAL)



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