< HVMOSFET MODULE >

FMF800DC-66BEW

HIGH POWER SWITCHING USE
INSULATED TYPE 2nd gen. HVMOSFET (High Voltage Metal Oxide Semiconductor Field Effect Transistor) Modules

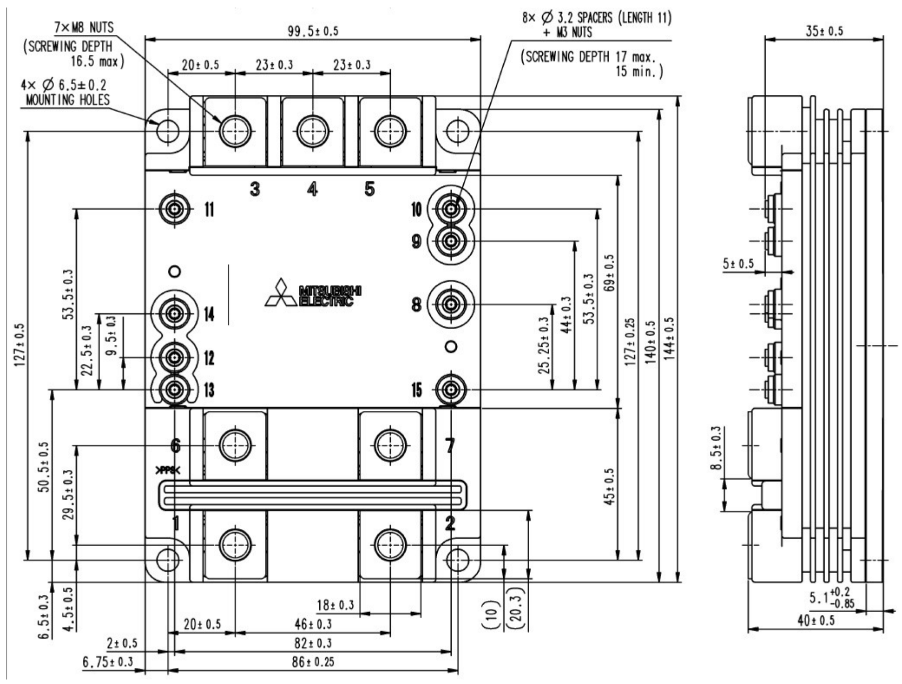
FMF800DC-66BEW

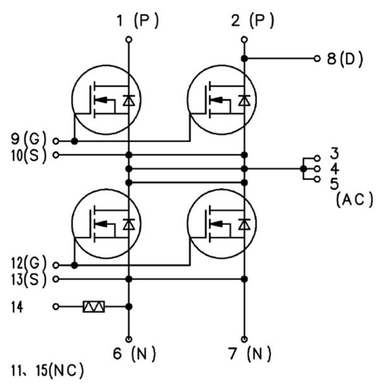
- I_D 800A
- V_{DSX} 3300V
- 2-element in a Pack
- Insulated Type
- SiC SBD embedded MOSFET

APPLICATION

Traction drives, High Reliability Converters / Inverters, DC choppers

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





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	NC
12	G(N)
13	S(N)
14	NTC
15	NC

MAXIMUM RATINGS

Item	Symbol	Condition		Ratings	Unit
Drain-Source voltage, specified gate-source voltage	V_{DSX}	V_{GS} = -7 V	T_j = -40~175 °C	3300	V
Gate-Source voltage	V_{GSS}	V_{DS} = 0 V	T_j = -40~175 °C	±20	V
Drain current	I_D	V_{GS} = 17 V , T_c = 87 °C , AC terminal output current (Note 1)		800	A
Drain current	I_{DP}	Non repetitive pulse	T_j = T_{op}	1600	A
Reverse drain current (FWD forward current)	I_S	V_{GS} = -7 V , T_c = 85 °C , AC terminal output current(Note 1)(Note 2)		800	A
Reverse drain current (FWD forward current)	I_{SP}	Non repetitive pulse(Note 2)	T_j = T_{op}	1600	A
Total power dissipation	P_{tot}	T_c = 25 °C , MOSFET part(Note 3)		6650	W
Isolation voltage	V_{isol}	Charge part to the baseplate RMS sinusoidal, 60Hz 1min		6000	V_{rms}
Partial discharge charge	Q_{pd}	Charged part to the baseplate RMS sinusoidal, 60 Hz 1min V1 = 3500 V, V2 = 2600 V(acc. to IEC 61287-1)		10	pC
Junction temperature	T_j	Maximum temperature range in off-state or on-state(non-switching)		-40~175	°C
Case temperature	T_c	Maximum case temperature range in on-state		-40~150	°C
Storage temperature	T_{stg}	Maximum case temperature range in off-state		-50~175	°C
Operating junction temperature	T_{jop}	Maximum junction temperature range for switching operation		-40~175	°C
Short-circuit withstand pulse duration	t_{pSC}	V_{DD} = 2500 V , V_{GS} = +17 / -7 V , L_s = 40 nH , V_{GS}50%-V_{GS}50%	T_j = T_{op}	1.7	μs
Short circuit energy	E_{SC}	V_{DD} = 2500 V , F(t)weibull=1%	T_j = T_{op}	35	J
Non-repetitive surge forward current	I_{FSM}	t_p = 10ms, F(t)weibull=1%, Half sinewave	T_j = 175 °C	5.9	kA
I2t value	I^2t	t_p = 10ms, F(t)weibull=1%, Half sinewave	T_j = 175 °C	180	kA^2s

ELECTRICAL CHARACTERISTICS

Item	Symbol	Condition		Limits Min.	Typ.	Max.	Unit
Gate-source leakage current	I_{GSS}	V_{DS} = 0 V , V_{GS} = V_{GSS}	T_j = 25 °C	-2.0	-	2.0	μA
Drain-source cut-off current	I_{DSX}	V_{DS} = V_{DSX} , V_{GS} = -7 V	T_j = 25 °C	-	0.003	-	mA
			T_j = 150 °C	-	0.050	-	mA
			T_j = 175 °C	-	0.080	3.0	mA
Gate-source threshold voltage	$V_{GS(th)}$	V_{DS} = 10 V , I_D = 80mA	T_j = 25 °C	1.60	2.10	2.60	V
			T_j = 150 °C	-	1.50	-	V
			T_j = 175 °C	0.90	1.45	1.90	V
Drain-source on resistance	$r_{DS(on)}$	V_{DS} = $V_{DS(on)}$, V_{GS} = 17 V , P-side(Terminal 8-10)	T_j = 25 °C	-	2.00	-	mΩ
			T_j = 150 °C	-	4.31	-	mΩ
			T_j = 175 °C	-	5.00	6.06	mΩ
		V_{DS} = $V_{DS(on)}$, V_{GS} = 17 V , N-side(Terminal 10-13),(Note 5)	T_j = 25 °C	-	2.25	-	mΩ
			T_j = 150 °C	-	4.63	-	mΩ
			T_j = 175 °C	-	5.38	6.44	mΩ
Drain-source on-state voltage	$V_{DS(on)}$	I_D = 800 A , V_{GS} = 17 V , P-side(Terminal 8-10)(Note 4)	T_j = 25 °C	-	1.60	-	V
			T_j = 150 °C	-	3.45	-	V
			T_j = 175 °C	-	4.00	4.85	V
		I_D = 800 A , V_{GS} = 17 V , N-side(Terminal 10-13),(Note 4))(Note 5)	T_j = 25 °C	-	1.80	-	V
			T_j = 150 °C	-	3.70	-	V
			T_j = 175 °C	-	4.30	5.15	V

ELECTRICAL CHARACTERISTICS (continuation)

Item	Symbol	Condition		Limits Min.	Limits Typ.	Limits Max.	Unit
Source-drain voltage	$V_{SD(on)}$	I_S = 800 A , V_{GS} = 17 V , P-side(Terminal 8-10)(Note 4)	T_j = 25 °C	-	1.45	-	V
			T_j = 150 °C	-	3.25	-	V
			T_j = 175 °C	-	3.80	4.40	V
		I_S = 800 A , V_{GS} = 17 V , N-side(Terminal 10-13),(Note 4))(Note 5)	T_j = 25 °C	-	1.65	-	V
			T_j = 150 °C	-	3.50	-	V
			T_j = 175 °C	-	4.10	4.70	V
Source-drain voltage	V_{SD}	I_S = 800 A , V_{GS} = 0 V , P-side(Terminal 8-10)(Note 4)	T_j = 25 °C	-	2.00	-	V
			T_j = 150 °C	-	3.85	-	V
			T_j = 175 °C	-	4.35	5.00	V
		I_S = 800 A , V_{GS} = 0 V , N-side(Terminal 10-13),(Note 4))(Note 5)	T_j = 25 °C	-	2.20	-	V
			T_j = 150 °C	-	4.10	-	V
			T_j = 175 °C	-	4.65	5.30	V
Source-drain voltage	$V_{SD(off)}$	I_S = 800 A , V_{GS} = -7 V , P-side(Terminal 8-10)(Note 4)	T_j = 25 °C	-	2.00	-	V
			T_j = 150 °C	-	3.85	-	V
			T_j = 175 °C	-	4.35	5.00	V
		I_S = 800 A , V_{GS} = -7 V , N-side(Terminal 10-13),(Note 4))(Note 5)	T_j = 25 °C	-	2.20	-	V
			T_j = 150 °C	-	4.10	-	V
			T_j = 175 °C	-	4.65	5.30	V
Input capacitance	C_{iss}	V_{DS} = 10 V , V_{GS} = 0 V , f = 100kHz , 1/2 module	T_j = 25 °C	-	110	-	nF
Output capacitance	C_{oss}	V_{DS} = 10 V , V_{GS} = 0 V , f = 100kHz , 1/2 module	T_j = 25 °C	-	70	-	nF
Reverse transfer capacitance	C_{rss}	V_{DS} = 10 V , V_{GS} = 0 V , f = 100kHz , 1/2 module	T_j = 25 °C	-	2.7	-	nF
Gate charge	Q_G	V_{DD} = 1800 V , I_D = 800 A , V_{GS} = +17 / -7 V , 1/2 module	T_j = 25 °C	-	3.3	-	μC
Turn-on delay time	$t_{d(on)}$	V_{DD} = 1800 V , I_D = 800 A , V_{GS} = +17 / -7 V , L_s = 40 nH	T_j = 175 °C	-	-	0.50	μs
Rise time	t_r	V_{DD} = 1800 V , I_D = 800 A , V_{GS} = +17 / -7 V , L_s = 40 nH	T_j = 175 °C	-	-	0.30	μs
Turn-on (switching) energy per pulse 10% integral	$E_{on(10\%)}$	V_{DD} = 1800 V , I_D = 800 A , V_{GS} = +17 / -7 V , L_s = 40 nH $R_{G(on)}$ = 1.5 Ω , $R_{G(off)}$ = 1.5 Ω , Inductive load	T_j = 25 °C	-	0.26	-	J
			T_j = 150 °C	-	0.22	-	J
			T_j = 175 °C	-	0.22	-	J
Turn-on (switching) energy per pulse	E_{on}	V_{DD} = 1800 V , I_D = 800 A , V_{GS} = +17 / -7 V , L_s = 40 nH $R_{G(on)}$ = 1.5 Ω , $R_{G(off)}$ = 1.5 Ω , Inductive load	T_j = 25 °C	-	0.27	-	J
			T_j = 150 °C	-	0.23	-	J
			T_j = 175 °C	-	0.23	-	J
Total capacitive charge	Q_C	V_{DD} = 1800 V , I_D = 800 A , V_{GS} = +17 / -7 V , L_s = 40 nH $R_{G(on)}$ = 1.5 Ω , $R_{G(off)}$ = 1.5 Ω , Inductive load	T_j = 25 °C	-	10.7	-	μC
			T_j = 150 °C	-	12.5	-	μC
			T_j = 175 °C	-	12.5	-	μC
Diode turn-off energy (per pulse)	$E_{off\_Diode(10\%)}$	V_{DD} = 1800 V , I_D = 800 A , V_{GS} = +17 / -7 V , L_s = 40 nH $R_{G(on)}$ = 1.5 Ω , $R_{G(off)}$ = 1.5 Ω , Inductive load	T_j = 25 °C	-	0.004	-	J
			T_j = 150 °C	-	0.005	-	J
			T_j = 175 °C	-	0.005	-	J
Diode switching off energy of diode	E_{off_Diode}	V_{DD} = 1800 V , I_D = 800 A , V_{GS} = +17 / -7 V , L_s = 40 nH $R_{G(on)}$ = 1.5 Ω , $R_{G(off)}$ = 1.5 Ω , Inductive load	T_j = 25 °C	-	0.004	-	J
			T_j = 150 °C	-	0.006	-	J
			T_j = 175 °C	-	0.006	-	J
Turn-off delay time	$t_{d(off)}$	V_{DD} = 1800 V , I_D = 800 A , V_{GS} = +17 / -7 V , L_s = 40 nH	T_j = 175 °C	-	-	0.94	μs
Fall time	t_f	V_{DD} = 1800 V , I_D = 800 A , V_{GS} = +17 / -7 V , L_s = 40 nH	T_j = 175 °C	-	-	0.40	μs
Turn-off (switching) energy per pulse 10% integral	$E_{off(10\%)}$	V_{DD} = 1800 V , I_D = 800 A , V_{GS} = +17 / -7 V , L_s = 40 nH $R_{G(on)}$ = 1.5 Ω , $R_{G(off)}$ = 1.5 Ω , Inductive load	T_j = 25 °C	-	0.10	-	J
			T_j = 150 °C	-	0.11	-	J
			T_j = 175 °C	-	0.11	-	J
Turn-off (switching) energy per pulse	E_{off}	V_{DD} = 1800 V , I_D = 800 A , V_{GS} = +17 / -7 V , L_s = 40 nH $R_{G(on)}$ = 1.5 Ω , $R_{G(off)}$ = 1.5 Ω , Inductive load	T_j = 25 °C	-	0.10	-	J
			T_j = 150 °C	-	0.11	-	J
			T_j = 175 °C	-	0.11	-	J

THERMAL CHARACTERISTICS

Item	Symbol	Conditions	Limits			Unit
			Min.	Typ.	Max.	
Thermal resistance junction to case	$R_{th(j-c)}$	Junction to Case, MOSFET + embeded SBD part, 1/2 module	-	-	22.5	K/kW
Contact thermal resistance case to heatsink	$R_{th(c-s)}$	Case to heat sink, λ_{grease} = 1W/m·K, $D_{(c-s)}$ = 70μm, 1/2 module	-	22.5	-	K/kW

MECHANICAL CHARACTERISTICS

Item	Symbol	Conditions	Limits			Unit
			Min.	Typ.	Max.	
Mounting torque	M_t	Main terminal screw M8 This is the case when installing the product on the bus bar	7.0	-	22.0	N·m
Mounting torque	M_t	Mounting screw M6	3.0	-	6.0	N·m
Mounting torque	M_t	Auxiliary terminals screw M3	0.4	-	0.8	N·m
Mass	m	-	-	0.8	-	kg
Comparative tracking index	CTI	-	600	-	-	-
Clearance distance in air	d_a	Between main terminal	8.0	-	-	mm
Creepage distance along surface	d_s	-	32.0	-	-	mm
Internal inductance, D-S	$L_{P\,DS}$	Between DC+ and DC-(terminal1,2-6,7)	-	15	-	nH
	$L_{P\,DS}$	Between DC+ and AC (terminal1,2-3,4,5)	-	43	-	nH
	$L_{P\,DS}$	Between AC and DC-(terminal3,4,5-6,7)	-	43	-	nH
Internal lead resistance, DD'-SS'	$R_{DD'+SS'}$	T_C=25°C, Between DC+ and DC-(terminal1,2-6,7)	-	0.46	-	mΩ
	$R_{DD'+SS'}$	T_C=25°C, Between DC+ and AC(terminal1,2-3,4,5)	-	0.22	-	mΩ
	$R_{DD'+SS'}$	T_C=25°C,Between AC and DC-(terminal3,4,5-6,7)	-	0.33	-	mΩ
Zero-power resistance	R_{25}	T_C=25°C	4.65	5.00	5.35	kΩ
B-constant	$B_{(25/50)}$	Approximate by equation,(Note 6)	-	3375	-	K

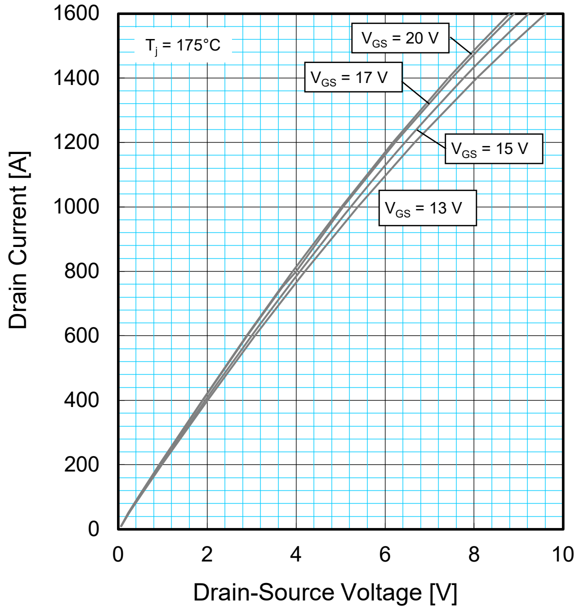
Note 1. Control Case Temperature (Tc) so that the junction temperature (T_j) does not exceed the maximum rating.
Note 2. The symbols represent characteristics of the anti-parallel, source to drain free-wheel diode (FWDi).
Note 3. Junction temperature (Tj) should not exceed Tjmax rating.
Note 4. Pulse width and repetition rate should be such as to cause negligible temperature rise.
Note 5. N-side characteristic value includes wiring resistance between P-side source potential and N-side drain potential.
(P-side characteristic value corresponds to chip characteristics).
Note 6. $B_{(25/50)} = \ln\left(\frac{R_{25}}{R_{50}}\right) / \left(\frac{1}{T_{25}} - \frac{1}{T_{50}}\right)$

R_{25}: resistance at absolute temperature T_{25} [K]; T_{25} = 25[ºC] + 273.15 = 298.15[K]
R_{50}: resistance at absolute temperature T_{50} [K]; T_{50} = 50[ºC] + 273.15 = 323.15[K]

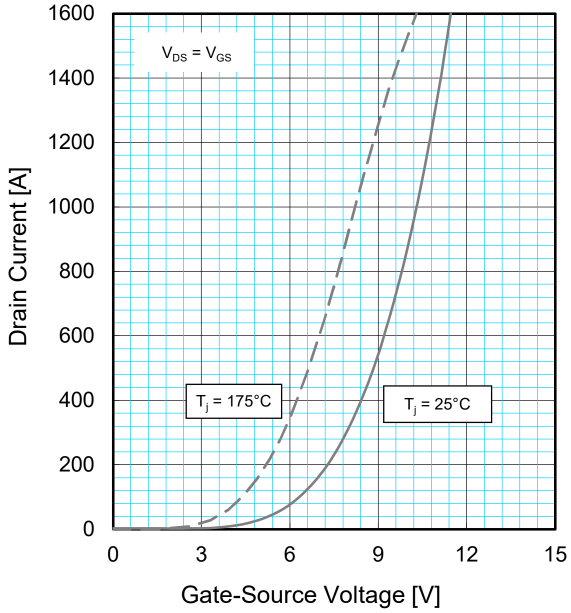
Products falling under the subject item No. 2 (41) 3 of Appended Table 1 of the Export Trade Control Order.

PERFPRMANCE CURVES

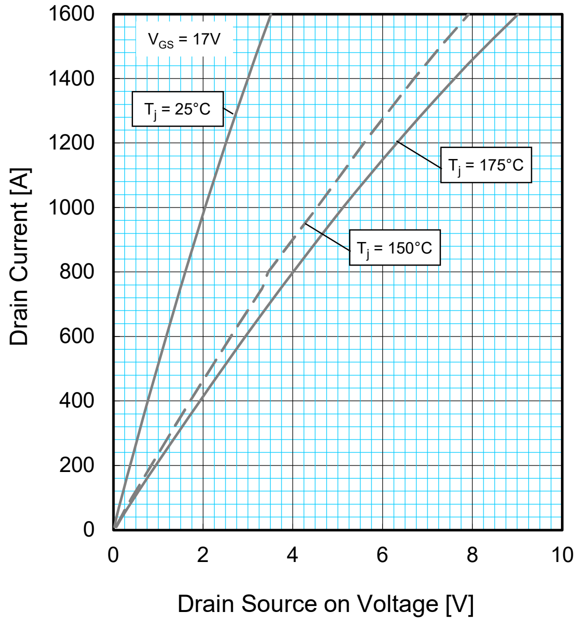
OUTPUT CHARACTERISTICS (TYPICAL)



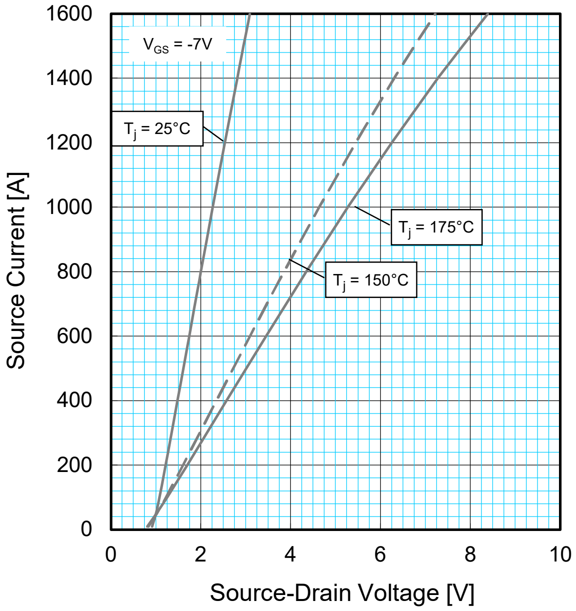
TRANSFER CHARACTERISTICS (TYPICAL)



DRAIN-SOURCE ON VOLTAGE CHARACTERISTICS (TYPICAL)

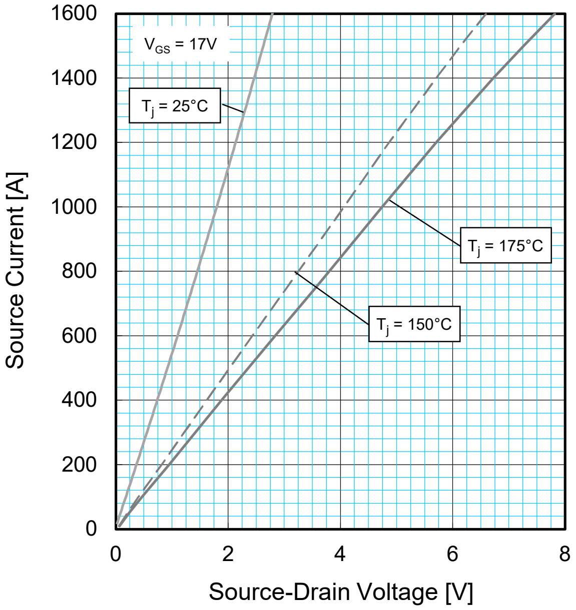


FREE-WHEEL DIODE FORWARD CHARACTERISTICS (TYPICAL)

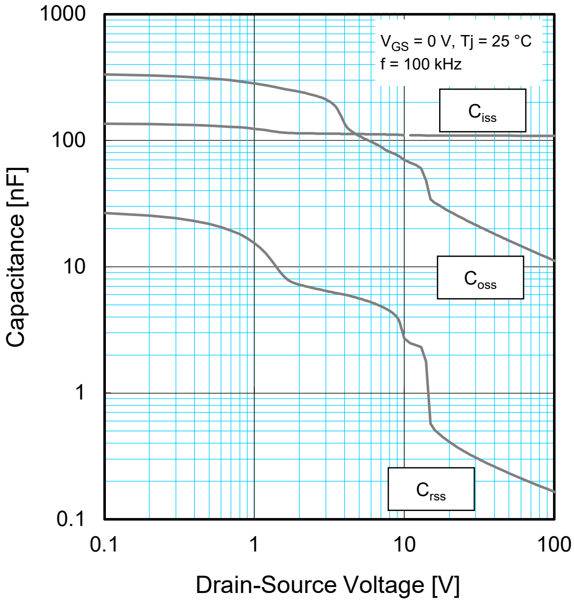


PERFORMANCE CURVES

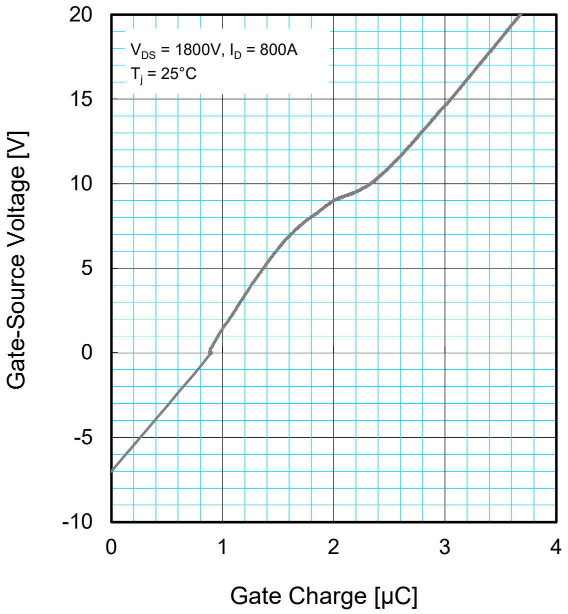
FREE-WHEEL DIODE FORWARD CHARACTERISTICS (TYPICAL)



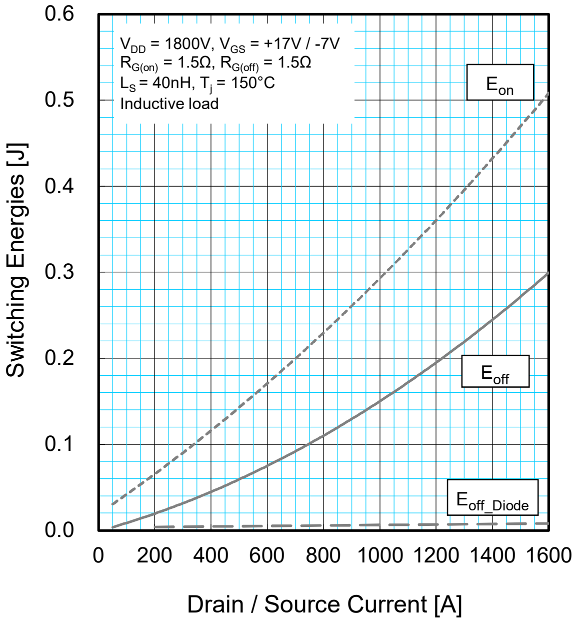
CAPACITANCE CHARACTERISTICS (TYPICAL)



GATE CHARGE CHARACTERISTICS (TYPICAL)

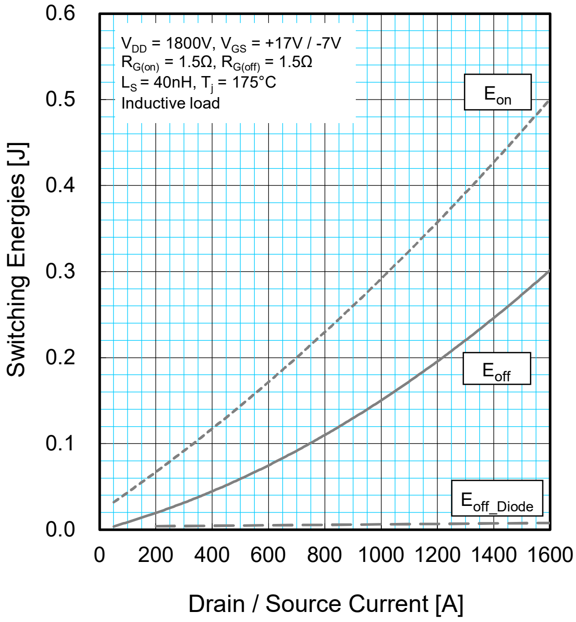


HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)

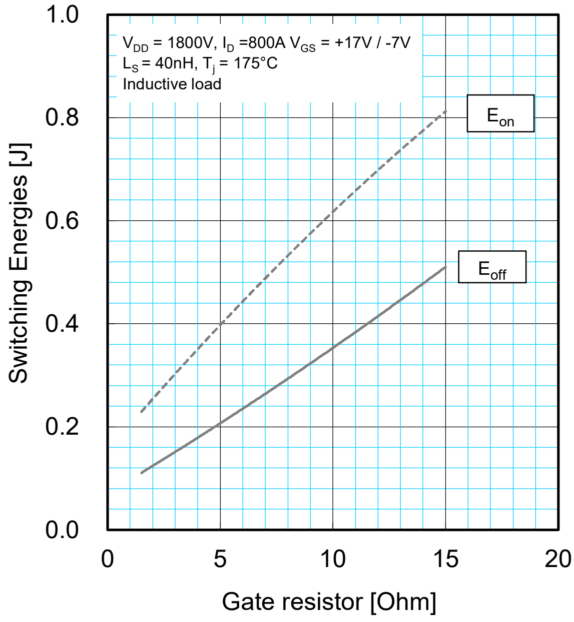


PERFORMANCE CURVES

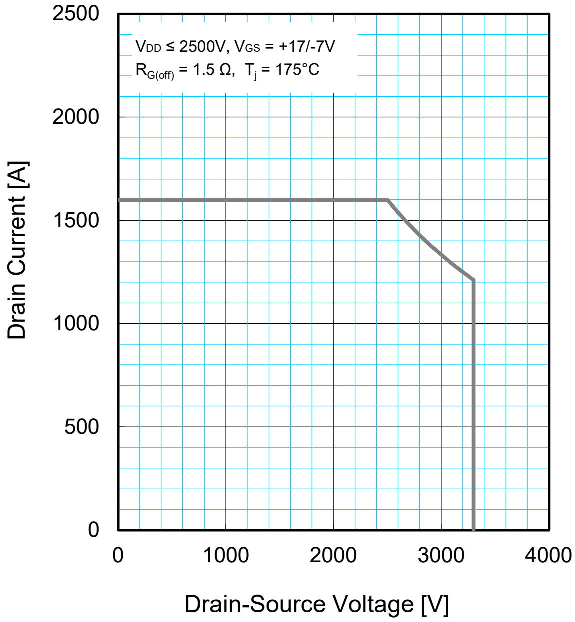
HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



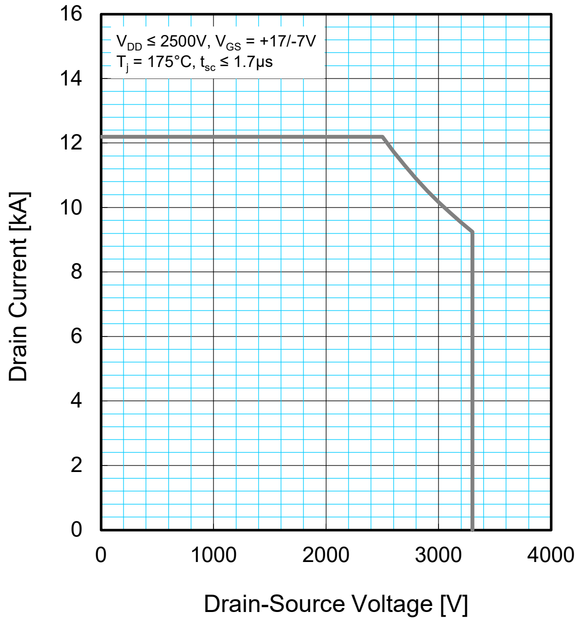
HALF-BRIDGE SWITCHING ENERGY CHARACTERISTICS (TYPICAL)



REVERSE BIAS SAFE OPERATING AREA (RBSOA)

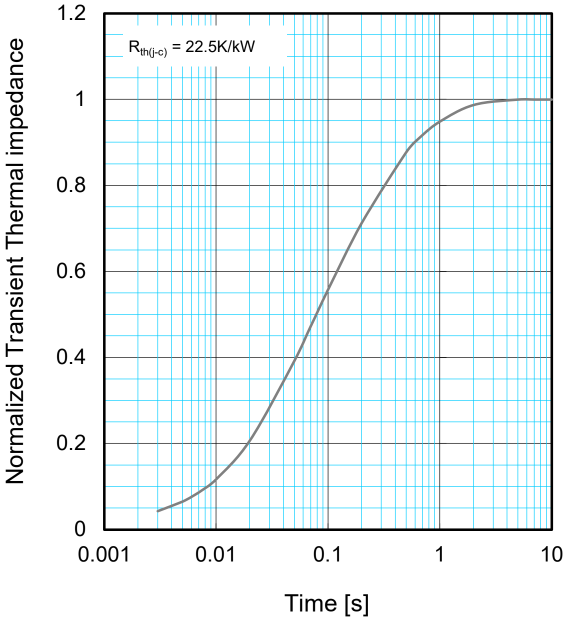


SHORT CIRCUIT SAFE OPERATING AREA (SCSOA)



PERFORMANCE CURVES

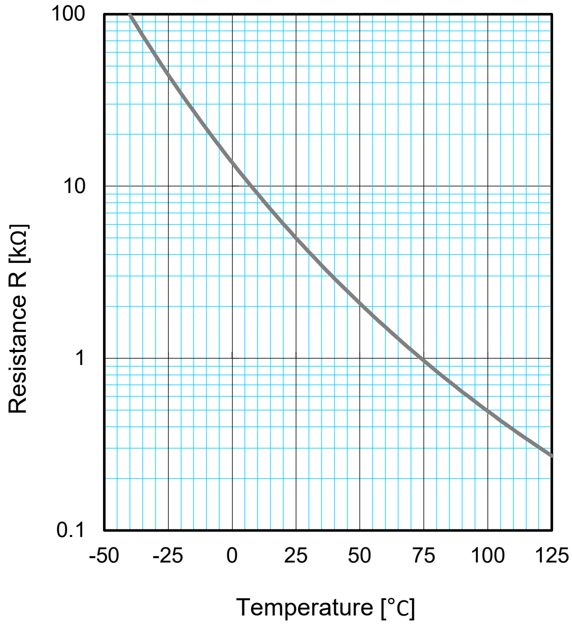
TRANSIENT THERMAL IMPEDANCE CHARACTERISTICS



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

	1	2	3	4
R_i / R_{th} :	0.0078	0.1975	0.3553	0.4393
τ_i [sec.] :	0.0001	0.7324	0.0381	0.1698

NTC THERMISTOR TEMPERATURE CHARACTERISTICS (TYPICAL)



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