Automotive IGBT Power Module

QMFS820R08PNF 750V / 820A

Preliminary Data Sheet

Confidential, Shared Under NDA

Rev. 1.0

Features

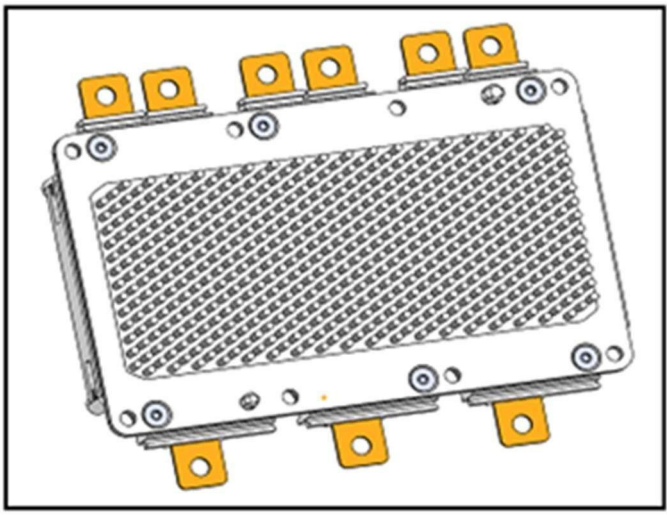
- High Current density
- Low V_{CEsat} and Switching Losses
- Low Inductive Design

Benefits

- Higher system efficiency
- Reduced cooling requirements
- Low conduction losses over temperature

Applications

- Automotive Applications
- Motor Drive



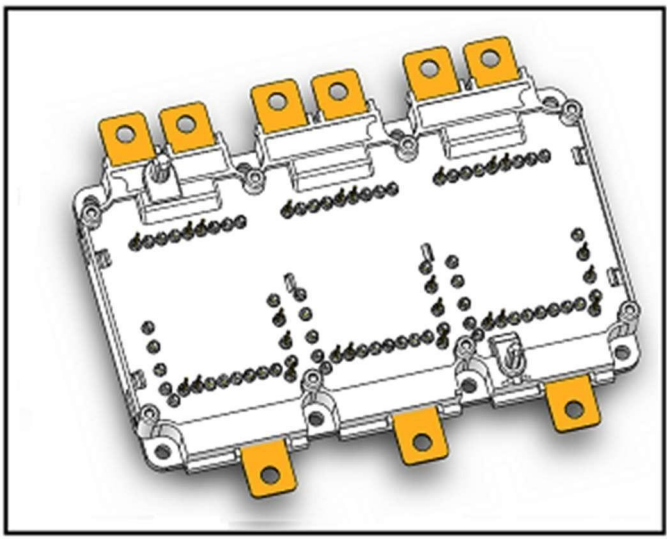


Table 1 Key Performance and Package Parameters

Type	V_{CES}	I_C (T_F = 75℃)	$V_{CE\ sat}$ (T_j = 25℃, Ic = 450A, V_{GE} = 15V)	T_{vjmax}	Package
-	750V	450A	1.15V	175	HD1

Absolute Maximum ratings

Table 2 Absolute Maximum ratings (Tj= 25℃)

Parameter	Symbol	Ratings	Unit
Collector-emitter voltage	V_{CES}	750	V
Gate-emitter peak voltage	V_{GE}	±20	V
Implemented collector current	I_{CN}	820	A
Continuous DC collector current (T_F = 75°C)	I_C	450	A
Repetitive peak collector current	I_{CRM}	1640	A
Maximum Junction Temperature	T_{vjmax}	-40 to +175	°C
Storage Temperature	T_{stg}	-40 to +125	°C

Electrical characteristics

Table 3 Thermal resistance (ΔV/Δt=10L/min,T_F=75℃)

Parameter	Symbol	Min	Typ.	Max	Unit
Thermal resistance, junction – cooling fluid, IGBT	R_{thJF}	-	0.12	-	℃/W
Thermal resistance, junction – cooling fluid, Diode	R_{thJF}	-	0.18	-	℃/W

*1 Limited by maximum temperature allowed

Table 4 Static characteristics (Tvj=25°C, unless otherwisespecified)

Parameter	Symbol	Min	Typ.	Max	Unit	Conditions
Gate-Emitter Leakage Current	I_{GES}	-	-	±400	nA	V_{CE} = 0 V V_{GE} = 20 V
Collector-Emitter Breakdown Voltage	BV_{CES}	750	-	-	V	V_{GS} = 0V
Zero Gate Voltage Collector Current	I_{CES}	-	-	1	mA	V_{DS} = 750V V_{GS} = 0V
Zero Gate Voltage Collector Current	I_{CES}	-	3	-	mA	V_{DS} = 750V V_{GS} = 0V T_{vj} = 150 °C
Gate-emitter threshold voltage	$V_{GE(th)}$	4.9	5.7	6.5	V	I_C = 9.6 mA V_{CE} = V_{GE}
Collector-emitter saturation voltage	$V_{CE(sat)}$*1	-	1.15	-	V	I_C = 450A V_{GE} = 15V T_{vj} = 25 °C
		-	1.4	-	V	I_C = 820A V_{GE} = 15V T_{vj} = 25 °C
		-	1.19	-	V	I_C = 450A V_{GE} = 15V T_{vj} = 150 °C
		-	1.56	-	V	I_C = 820A V_{GE} = 15V T_{vj} = 150 °C
Internal gate resistor	R_{Gint}		1.3		Ω	T_{vj} = 25 °C

Table 5 Dynamic characteristics (Tvj=25°C)

Parameter	Symbol	Min	Typ.	Max	Unit	Conditions
Input Capacitance	C_{ies}	-	70	-	nF	V_{CE} = 50 V V_{GE} = 0 V f= 100kHz
Output Capacitance	C_{oss}	-	1.8	-	nF	
Reverse Transfer Capacitance	C_{rss}	-	0.32	-	nF	
Gate charge total	Q_g	-	3.7	-	μC	V_{GE} = -8/15 V V_{CE} = 400 V

Table 6 IGBT Switching Characteristic, Inductive Load

Parameter	Symbol	Min	Typ.	Max	Unit	Conditions
Turn-On Delay Time	$t_{d(on)}$	-	0.22	-	µs	V_{CC} = 400V I_C = 450 A d_i/d_t = 6400 A/µs d_v/d_t =3200 V/µs V_{GE} = -8V / 15 V T_{vj} =25°C Rgon = 0.8 Ω Rgoff = 1.8 Ω
Rise Time	t_r	-	0.06	-	µs	
Turn-Off Delay Time	$t_{d(off)}$	-	0.95	-	µs	
Fall Time	t_f	-	0.08	-	µs	
Turn-on switching loss	E_{on}	-	11.5	-	mJ	
Turn-off switching loss	E_{off}	-	19	-	mJ	
Total switching loss	E_{ts}	-	30.5	-	mJ	
Turn-On Delay Time	$t_{d(on)}$	-	0.23	-	µs	V_{CC} = 400V I_C = 450 A d_i/d_t = 5000 A/µs d_v/d_t =2400 V/µs V_{GE} = -8V / 15 V T_{vj} = 150°C Rgon = 0.8 Ω Rgoff = 1.8 Ω
Rise Time	t_r	-	0.06	-	µs	
Turn-Off Delay Time	$t_{d(off)}$	-	1.1	-	µs	
Fall Time	t_f	-	0.08	-	µs	
Turn-on switching loss	E_{on}	-	15	-	mJ	
Turn-off switching loss	E_{off}	-	29	-	mJ	
Total switching loss	E_{ts}	-	44	-	mJ	

Table 7 Diode Recovery characteristics

Parameter	Symbol	Min	Typ.	Max	Unit	Conditions
Forward Voltage	V_{SD}*1	-	1.39	-	V	I_F = 450 A T_{vj} = 25°C
		-	1.7	-	V	I_F = 820 A T_{vj} = 25°C
		-	1.35	-	V	I_F = 450 A T_{vj} = 150°C
		-	1.73	-	V	I_F = 820 A T_{vj} = 150°C
Recovery time	t_{rr}	-	0.11	-	μs	I_F = 450 A V_R = 400 V T_{vj} = 25°C
Peak reverse recovery current	I_{RM}	-	250	-	A	
Recovered charge	Q_{rr}	-	19.5	-	μC	
Reverse recovery energy	E_{rec}	-	7	-	mJ	I_F = 450 A V_R = 400 V T_{vj} = 150°C
Recovery time	t_{rr}	-	0.22	-	μs	
Peak reverse recovery current	I_{RM}	-	350	-	A	
Recovered charge	Q_{rr}	-	40	-	μC	
Reverse recovery energy	E_{rec}	-	14	-	mJ	

Note： (*1)Indicates it is measured at the auxiliary busbar terminal.

Table 8 NTC-Thermistor

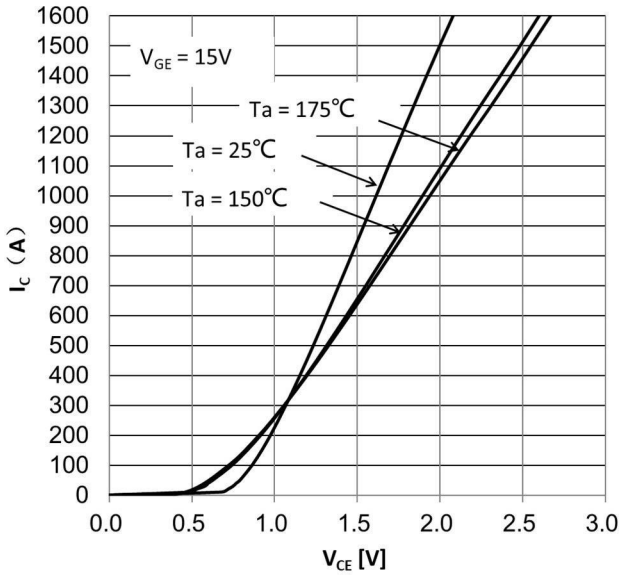
Parameter	Symbol	Min	Typ.	Max	Unit	Conditions
Rated resistance	R_{25}	-	5	-	kΩ	T_C = 25°C
Deviation of R100	$\Delta R/R$	-10	-	10	%	T_C = 100°C, R_{100} = 493 Ω
B-value	$B_{25/50}$	-	3375	-	K	$R_2 = R_{25}$ exp [$B_{25/50}$(1/T_2 1/(298,15K))]

Table 9 Module

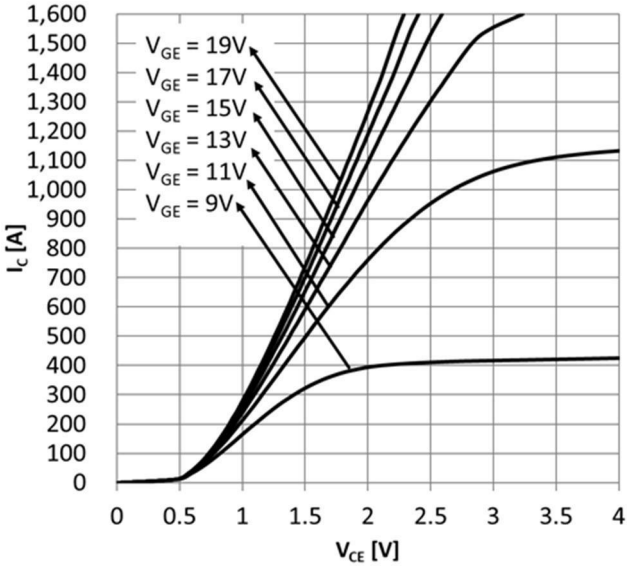
Parameter	Symbol	Value	Unit	Conditions
Isolation test voltage	V_{ISOL}	4.2	kV	RMS, f = 0 Hz, t = 1 sec
Material of module baseplate		Cu+Ni		
Internal isolation		Al_2O_3		basic insulation
Creepage distance	d_{Creep}	9.0 9.0	mm	terminal to heatsink terminal to terminal
Clearance	d_{Clear}	4.5 4.5	mm	terminal to heatsink terminal to terminal
Comperative tracking index	*CTI*	>200		
Stray inductance module	L_s	8	nH	
Internal transistor resistance	R_{ml}	0.75	mΩ	
I²t - value	I²t	15 000	A^2 s	V_R = 0 V, Tp = 10 ms, T_{vj} = 175° C

Characteristics Diagrams

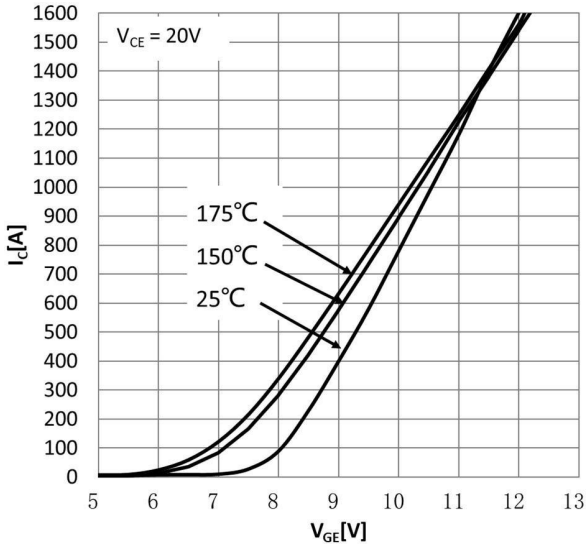
Typical Output Characteristics IGBT
Ic = f (V_{CE}) V_{GE} = 15 V



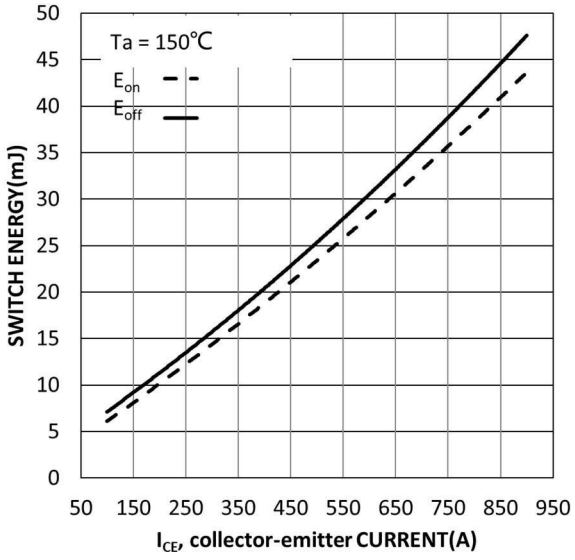
Typical Output Characteristics IGBT
Tvj=150℃



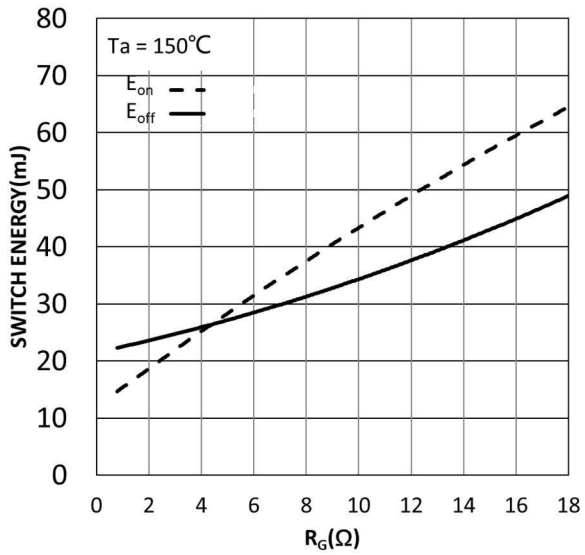
Typical transfer Characteristics IGBT
Ic = f (V_{CE}) V_{CE} = 20 V



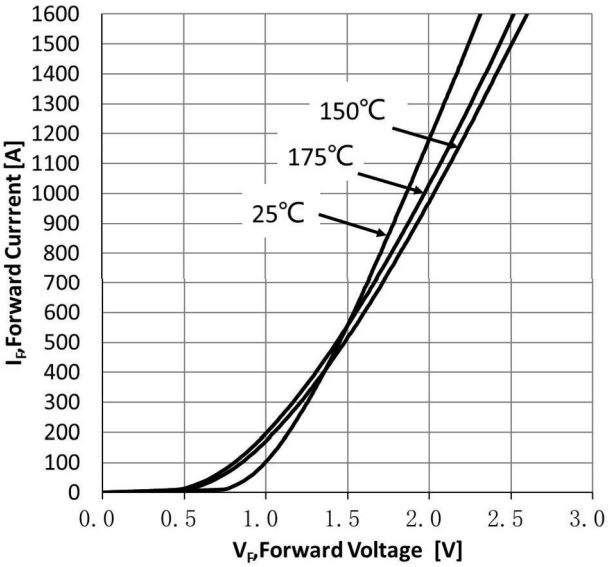
switching losses IGBT,Inverter (typical)
E_{on} = f (I_C), E_{off} = f (I_C),
V_{GE} = +15 V / -8 V, R_{Gon} = 0.8 Ω, R_{Goff} = 1.8 Ω, V_{CE} = 400 V



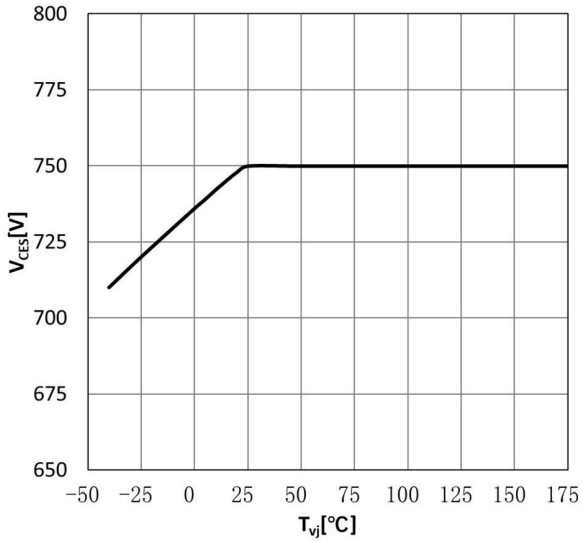
switching losses IGBT,Inverter (typical)
E_{on} = f (R_G), E_{off} = f (R_G),
V_{GE} = +15V / -8V, I_C = 450 A, V_{CE} = 400 V



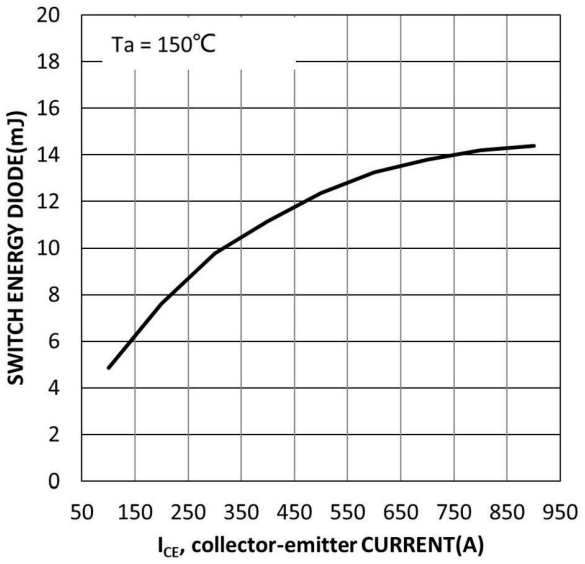
Typical forward characteristic of Diode



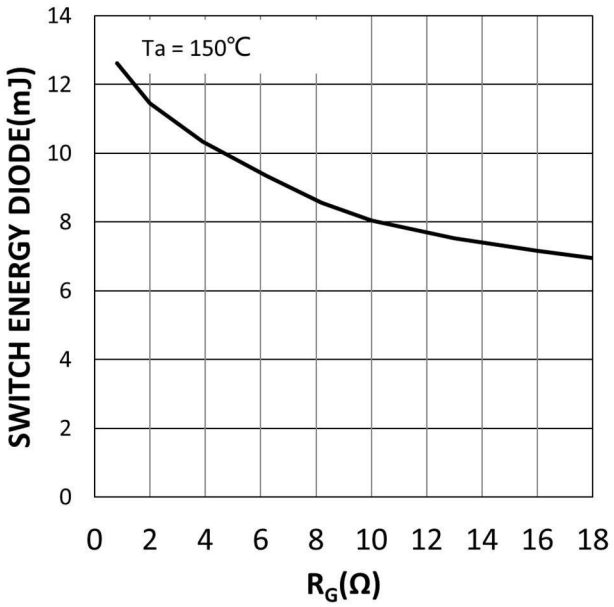
maximum allowed collector-emitter voltage
I_{CES} = 1 mA for Tvj ⩽25°C; I_{CES} = 30 mA for Tvj > 25°C



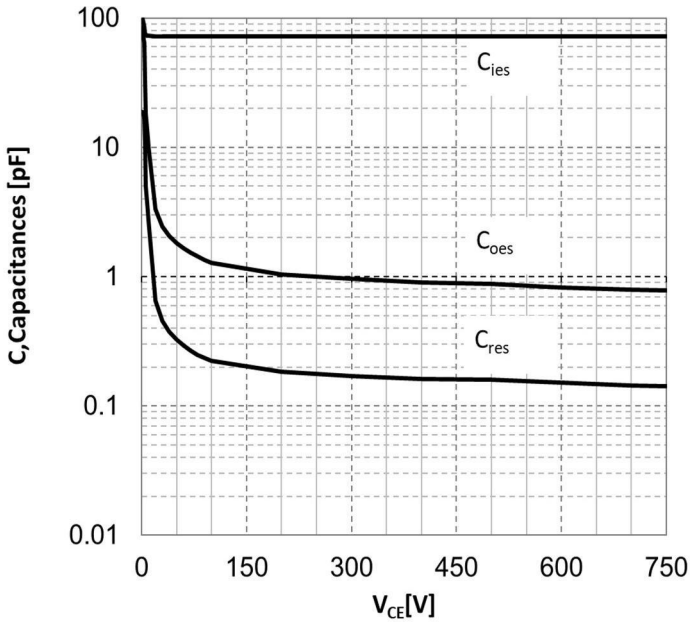
switching losses Diode, Inverter (typical)
E_{rec} = f (I_F),
R_{Gon} = 0.8 Ω , V_F = 400 V



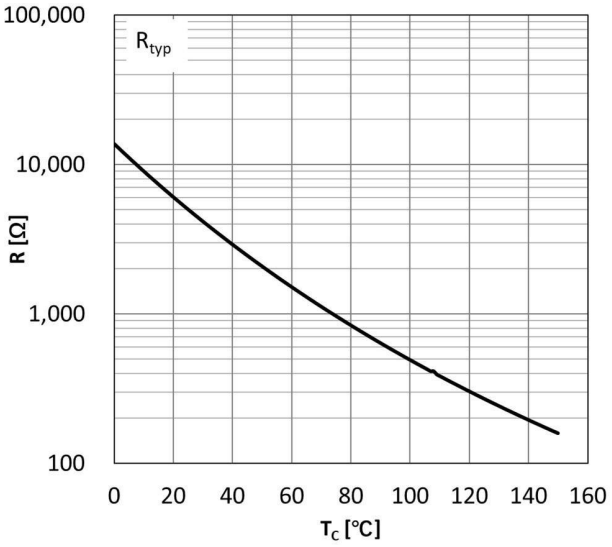
switching losses Diode, Inverter (typical)
E_{rec} = f (R_G),
I_F = 450 A, V_F = 400 V



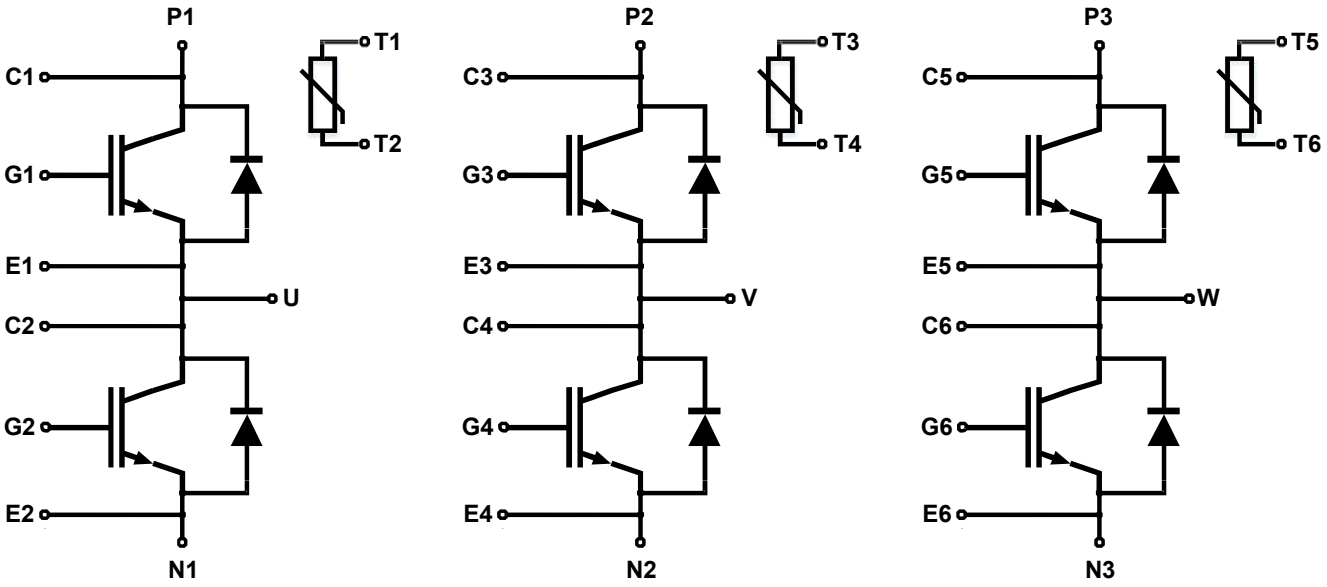
Capacity characteristic
C = f(V_{CE}) , V_{GE} = 0 V, Tvj = 25°C, f = 100KHz



NTC-Thermistor-temperature characteristic (typical)



Circuit diagram



Package Outlines