RSPP2512FW1

FPM1 PIM
1200V 25A, IGBT Module

Raonsemi

Electrical Features
- Trench Field Stop IGBT
- Very low $V_{CE(sat)}$
- Extremely low switching losses

Mechanical Features
- Very Low Thermal Resistance with DBC Substrate
- High power density
- Compact design
- Isolation Rating of 2500 Vrms/1 min

Typical Applications
- Auxiliary inverters
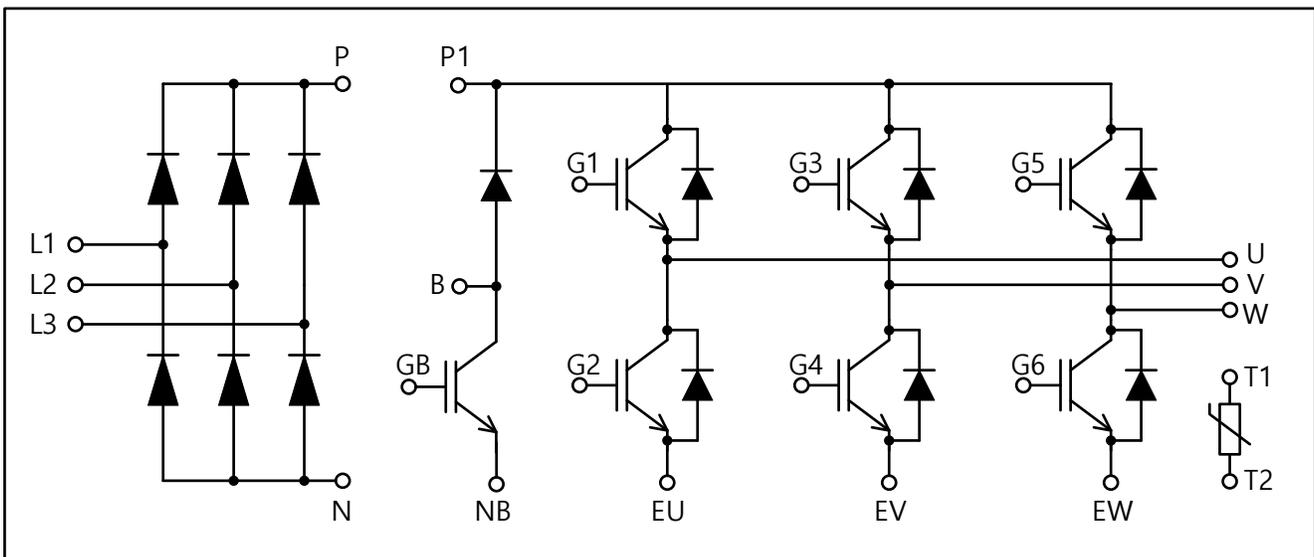- Air-conditioner
- Motor drives

Figure 1. Internal Circuit

RSPP2512FW1

ABSOLUTE MAXIMUM RATINGS (T_j = 25°C unless otherwise noted)

Symbol	Parameter	Conditions	Rating	Unit
IGBT, INVERTER				
V_{CES}	Collector-Emitter Voltage		1200	V
V_{GES}	Gate-Emitter Voltage		±20	V
I_C	DC Collector Current	T_C=100°C, T_j≤175°C	25	A
I_{CRM}	Repetitive Peak Collector Current	Under 1ms Pulse Width	50	A
Diode, INVERTER				
V_{RRM}	Repetitive Peak Reverse Voltage		1200	V
I_F	DC Forward Current		25	A
I_{FRM}	Repetitive Peak Forward Current	Under 1ms Pulse Width	50	A
I^2t	I^2t Value	t_p=10ms, T_j=150°C	98	A^2s
IGBT, Brake-Chopper				
V_{CES}	Collector-Emitter Voltage		1200	V
V_{GES}	Gate-Emitter Voltage		±20	V
I_C	DC Collector Current	T_C=100°C, T_j≤175°C	25	A
I_{CRM}	Repetitive Peak Collector Current	Under 1ms Pulse Width	50	A
Diode, Brake-Chopper				
V_{RRM}	Repetitive Peak Reverse Voltage		1200	V
I_F	DC Forward Current		10	A
I_{FRM}	Repetitive Peak Forward Current	Under 1ms Pulse Width	20	A
I^2t	I^2t Value	V_R=0V, t_p=10ms, T_j=150°C	18	A^2s
Diode, Rectifier				
V_{RRM}	Repetitive Peak Reverse Voltage		1600	V
I_{FRMSM}	Maximum RMS Forward Current per Chip	T_C=100°C	25	A
I_{RMSM}	Maximum RMS Forward Current at Rectifier Output	T_C=100°C	25	A
I_{FSM}	Surge Forward Current	t_p=10ms, T_j=150°C	210	A
I^2t	I^2t Value	t_p=10ms, T_j=150°C	220	A^2s

ELECTRICAL CHARACTERISTICS (T_j = 25°C unless otherwise specified.)

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
IGBT, INVERTER							
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	I_C=25A, V_{GE}=15V	T_j=25°C		1.60	1.9	V
			T_j=125°C		1.75		
			T_j=175°C		1.83		
V_{GEth}	Gate Threshold Voltage	I_C=250uA, V_{CE}=V_{GE}		5.0	5.8	6.6	V
I_{CES}	Collector-Emitter Cut-off Current	V_{CE}=1200V, V_{GE}=0V				2.0	uA
I_{GES}	Gate Leakage Current	V_{CE}=0V, V_{GE}=20V				100	nA
Q_G	Total Gate Charge	V_{GE}=±15V, V_{CE}=600V			0.126		uC
R_{Gint}	Internal Gate Resistance				0		Ω
C_{ies}	Input Capacitance	V_{CE}=30V, V_{GE}=0V, f=1.0MHz			2345		pF
C_{oes}	Output Capacitance				70		
C_{res}	Reverse Transfer Capacitance				10.7		

IGBT, INVERTER (Continued)

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
t_{don}	Turn-on Delay Time	V_{CE}=600V, I_C=25A, V_{GE}=0/15V, R_{G_ON}=6Ω, R_{G_OFF}=6Ω	T_J=25℃		36		ns
			T_J=125℃		36		
			T_J=175℃		37		
t_r	Rise Time	V_{CE}=600V, I_C=25A, V_{GE}=0/15V, R_{G_ON}=6Ω, R_{G_OFF}=6Ω	T_J=25℃		16		ns
			T_J=125℃		18		
			T_J=175℃		19		
t_{doff}	Turn-off Delay Time	V_{CE}=600V, I_C=25A, V_{GE}=0/15V, R_{G_ON}=6Ω, R_{G_OFF}=6Ω	T_J=25℃		163		ns
			T_J=125℃		196		
			T_J=175℃		217		
t_f	Fall Time	V_{CE}=600V, I_C=25A, V_{GE}=0/15V, R_{G_ON}=6Ω, R_{G_OFF}=6Ω	T_J=25℃		152		ns
			T_J=125℃		259		
			T_J=175℃		323		
E_{on}	Turn-on Energy Loss per Pulse	V_{CE}=600V, I_C=25A, V_{GE}=0/15V, R_{G_ON}=6Ω, R_{G_OFF}=6Ω	T_J=25℃		1.06		mJ
			T_J=125℃		1.41		
			T_J=175℃		1.76		
E_{off}	Turn-off Energy Loss per Pulse	V_{CE}=600V, I_C=25A, V_{GE}=0/15V, R_{G_ON}=6Ω, R_{G_OFF}=6Ω	T_J=25℃		1.49		mJ
			T_J=125℃		2.22		
			T_J=175℃		2.65		
I_{SC}	Short-circuit Current	V_{CC}=600V, V_{GE}≤15V, V_{CEmax}≤1200V, T_j=150℃ t_p≤10us			74		A
R_{thJC}	Thermal Resistance, Junction to Case	Per IGBT			1.5		℃/W
T_{jop}	Temperature under Switching Conditions			-40		175	℃

Diode, INVERTER

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_F	Forward Voltage	I_F=25A, V_{GE}=0V	T_J=25℃		1.80	2.1	V
			T_J=125℃		1.95		
			T_J=175℃		1.96		
I_{RM}	Peak Reverse Recovery Current	V_R=600V, I_F=25A, V_{GE}=0V, R_G=6Ω	T_J=25℃		40.7		A
			T_J=125℃		43.0		
			T_J=175℃		42.9		
t_{rr}	Reverse Recovery Time	V_R=600V, I_F=25A, V_{GE}=0V, R_G=6Ω	T_J=25℃		202		ns
			T_J=125℃		322		
			T_J=175℃		412		
Q_r	Recovered Charge	V_R=600V, I_F=25A, V_{GE}=0V, R_G=6Ω	T_J=25℃		2.02		uC
			T_J=125℃		2.95		
			T_J=175℃		3.89		
E_{rec}	Reverse Recovery Energy	V_R=600V, I_F=25A, V_{GE}=0V, R_G=6Ω	T_J=25℃		0.43		mJ
			T_J=125℃		0.58		
			T_J=175℃		0.75		
R_{thJC}	Thermal Resistance, Junction to Case	Per Diode			2.0		℃/W
T_{jop}	Temperature under Switching Conditions			-40		175	℃

ELECTRICAL CHARACTERISTICS (Tj = 25°C unless otherwise specified.) (continued)

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
IGBT, Brake-Chopper							
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	I_C=25A, V_{GE}=15V	T_j=25°C		1.60	1.9	V
			T_j=125°C		1.75		
			T_j=175°C		1.83		
V_{GEth}	Gate Threshold Voltage	I_C=250uA, V_{CE}=V_{GE}		5.0	5.8	6.6	V
I_{CES}	Collector-Emitter Cut-off Current	VCE=1200V, VGE=0V				2.0	uA
I_{GES}	Gate Leakage Current	V_{CE}=0V, V_{GE}=20V				100	nA
Q_G	Total Gate Charge	V_{GE}=±15V, V_{CE}=600V			0.126		uC
R_{Gint}	Internal Gate Resistance				0		Ω
C_{ies}	Input Capacitance	V_{CE}=30V, V_{GE}=0V, f=1.0MHz			2345		pF
C_{oes}	Output Capacitance				70		
C_{res}	Reverse Transfer Capacitance				10.7		
t_{don}	Turn-on Delay Time	V_{CE}=600V, I_C=25A, V_{GE}=0/15V, R_{G_ON}=10Ω, R_{G_OFF}=10Ω	T_j=25°C		76		ns
			T_j=125°C		77		
			T_j=175°C		78		
t_r	Rise Time	V_{CE}=600V, I_C=25A, V_{GE}=0/15V, R_{G_ON}=10Ω, R_{G_OFF}=10Ω	T_j=25°C		41		ns
			T_j=125°C		49		
			T_j=175°C		53		
t_{doff}	Turn-off Delay Time	V_{CE}=600V, I_C=25A, V_{GE}=0/15V, R_{G_ON}=10Ω, R_{G_OFF}=10Ω	T_j=25°C		177		ns
			T_j=125°C		209		
			T_j=175°C		224		
t_f	Fall Time	V_{CE}=600V, I_C=25A, V_{GE}=0/15V, R_{G_ON}=10Ω, R_{G_OFF}=10Ω	T_j=25°C		149		ns
			T_j=125°C		245		
			T_j=175°C		303		
E_{on}	Turn-on Energy Loss per Pulse	V_{CE}=600V, I_C=25A, V_{GE}=0/15V, R_{G_ON}=10Ω, R_{G_OFF}=10Ω	T_j=25°C		1.82		mJ
			T_j=125°C		2.28		
			T_j=175°C		2.56		
E_{off}	Turn-off Energy Loss per Pulse	V_{CE}=600V, I_C=25A, V_{GE}=0/15V, R_{G_ON}=10Ω, R_{G_OFF}=10Ω	T_j=25°C		1.53		mJ
			T_j=125°C		2.22		
			T_j=175°C		2.57		
I_{SC}	Short-circuit Current	V_{CC}=600V, V_{GE}≤15V, V_{CEmax}≤1200V, T_j=150°C t_p≤10us			74		A
R_{thJC}	Thermal Resistance, Junction to Case	Per IGBT			1.5		°C/W
T_{jop}	Temperature under Switching Conditions			-40		175	°C

ELECTRICAL CHARACTERISTICS (Tj = 25°C unless otherwise specified.) (continued)

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
Diode, Brake-Chopper							
V_F	Forward Voltage	I_F=10A, V_{GE}=0V	T_j=25℃		1.80	2.1	V
			T_j=125℃		1.91		
			T_j=175℃		1.89		
I_{RM}	Peak Reverse Recovery Current	V_R=600V, I_F=10A, V_{GE}=0V, R_G=10Ω	T_j=25℃		11.24		A
			T_j=125℃		10.61		
			T_j=175℃		10.97		
t_{rr}	Reverse Recovery Time	V_R=600V, I_F=10A, V_{GE}=0V, R_G=10Ω	T_j=25℃		173		ns
			T_j=125℃		264		
			T_j=175℃		360		
Q_r	Recovered Charge	V_R=600V, I_F=10A, V_{GE}=0V, R_G=10Ω	T_j=25℃		0.636		uC
			T_j=125℃		0.997		
			T_j=175℃		1.325		
E_{rec}	Reverse Recovery Energy	V_R=600V, I_F=10A, V_{GE}=0V, R_G=10Ω	T_j=25℃		0.171		mJ
			T_j=125℃		0.226		
			T_j=175℃		0.271		
R_{thJC}	Thermal Resistance, Junction to Case	Per Diode			2.3		℃/W
T_{jop}	Temperature under Switching Conditions			-40		175	℃

Diode, Rectifier

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_F	Forward Voltage	I_F=10A, T_j=150℃		1.1		V
I_r	Reverse Current	V_R=1600V, T_j=150℃		1		mA
R_{thJC}	Thermal Resistance, Junction to Case	Per Diode		1.5		℃/W
T_{jop}	Temperature under Switching Conditions		-40		175	℃

NTC-Thermistor

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
R_{25}	Rated Resistance	T_{NTC}=25°C	4.85	5	5.15	kΩ
ΔR/R	Deviation of R100	T_C=100°C, R_{100}=490Ω	-5		5	%
P_{25}	Power Dissipation	T_{NTC}=25°C			60	mW
$B_{25/50}$	B-constant	R_2=R_{25}exp[$B_{25/50}$(1/T_2-1/(298.15K))]		3375		K
$B_{25/80}$	B-constant	R_2=R_{25}exp[$B_{25/80}$(1/T_2-1/(298.15K))]		3425		K
$B_{25/100}$	B-constant	R_2=R_{25}exp[$B_{25/100}$(1/T_2-1/(298.15K))]		3443		K

Package

Symbol	Parameter	Conditions	Rating	Unit
V$_{ISO}$	Isolation Test Voltage	RMS, f=50Hz, t=1min	2500	V
d$_{creep}$	Creepage Distance	Terminal to Heatsink	11.5	mm
		Terminal to Terminal	6.3	mm
d$_{clear}$	Clearance	Terminal to Heatsink	10.0	mm
		Terminal to Terminal	5.0	mm
CTI	Comparative Tracking Index		>200	-

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
T$_{stg}$	Storage Temperature		-40		125	℃
G	Weight			22		g
F	Mounting Force per Clamp		20		50	N

CHARACTERISTICS DIAGRAMS

Output characteristic (typical), IGBT, Inverter $I_C=f(V_{CE})$ $V_{GE}=15V$	**Output characteristic (typical), IGBT, Inverter** $I_C=f(V_{CE})$ $T_j=175°C$
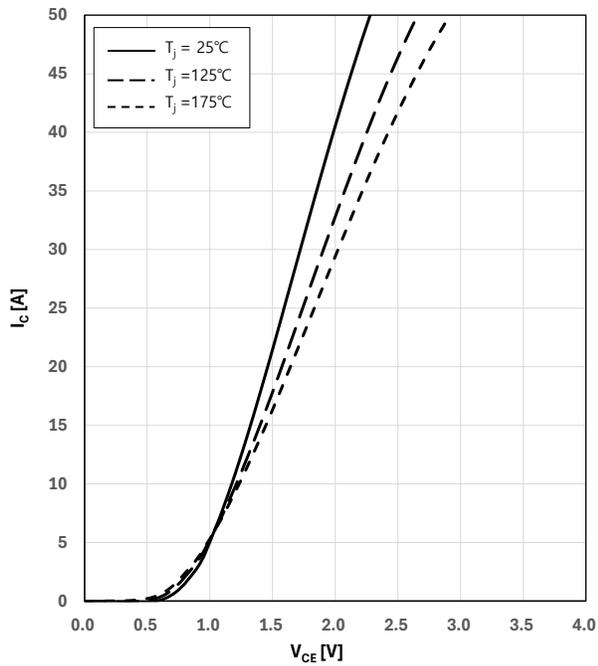
Output characteristic (typical), IGBT, Inverter. $I_C=f(V_{CE})$, $V_{GE}=15V$. Legend: $T_j = 25°C$, $T_j =125°C$, $T_j =175°C$.

Output characteristic (typical), IGBT, Inverter. $I_C=f(V_{CE})$, $T_j=175°C$. Legend: $V_{GE} = 19V$, $V_{GE} = 17V$, $V_{GE} = 15V$, $V_{GE} = 13V$, $V_{GE} = 11V$, $V_{GE} = 9 V$.
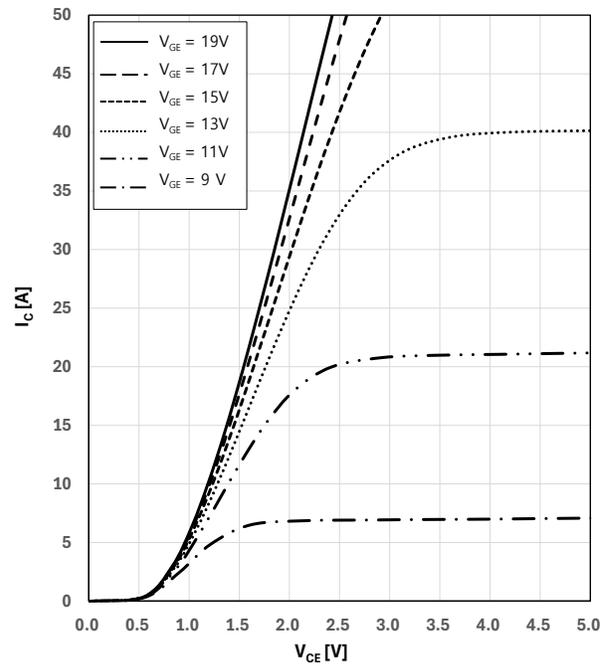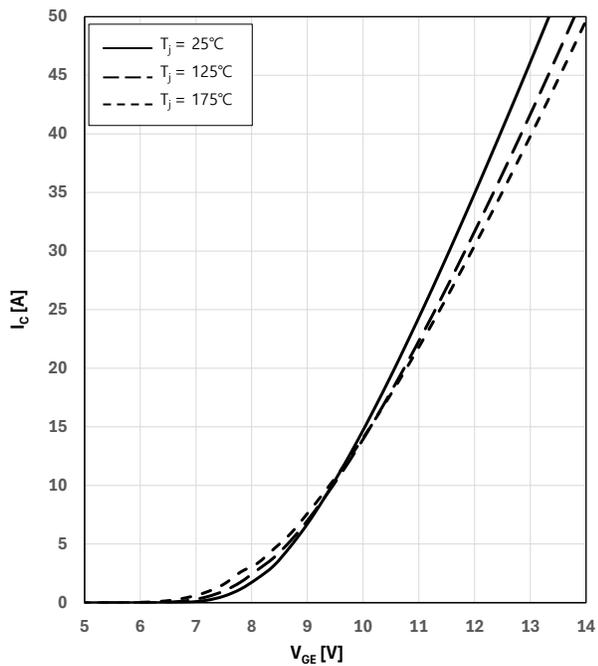
Transfer characteristic (typical), IGBT, Inverter $I_C=f(V_{GE})$ $V_{CE}=20V$	**Switching losses (typical), IGBT, Inverter** $E=f(I_C)$ $R_{Goff}=6Ω$, $R_{Gon}=6Ω$, $V_{CE}=600V$, $V_{GE}=±15V$

Transfer characteristic (typical), IGBT, Inverter. $I_C=f(V_{GE})$, $V_{CE}=20V$. Legend: $T_j = 25°C$, $T_j = 125°C$, $T_j = 175°C$.

Switching losses (typical), IGBT, Inverter. $E=f(I_C)$. Legend: $E_{on}, T_j = 125°C$, $E_{on}, T_j = 175°C$, $E_{off}, T_j = 125°C$, $E_{off}, T_j = 175°C$.
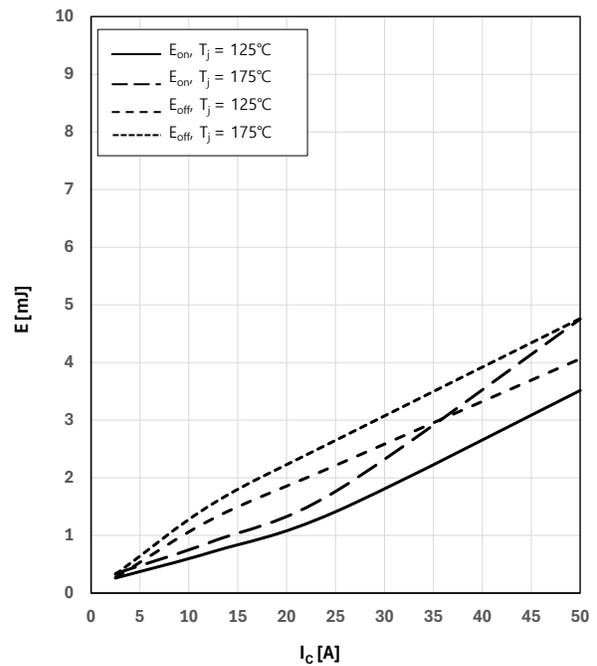
Switching losses (typical), IGBT, Inverter
E=f(R_G)
I_C=25A, V_{CE}=600V, V_{GE}=±15V

Legend:
- E_{on}, T_j = 125℃
- E_{on}, T_j = 175℃
- E_{off}, T_j = 125℃
- E_{off}, T_j = 175℃
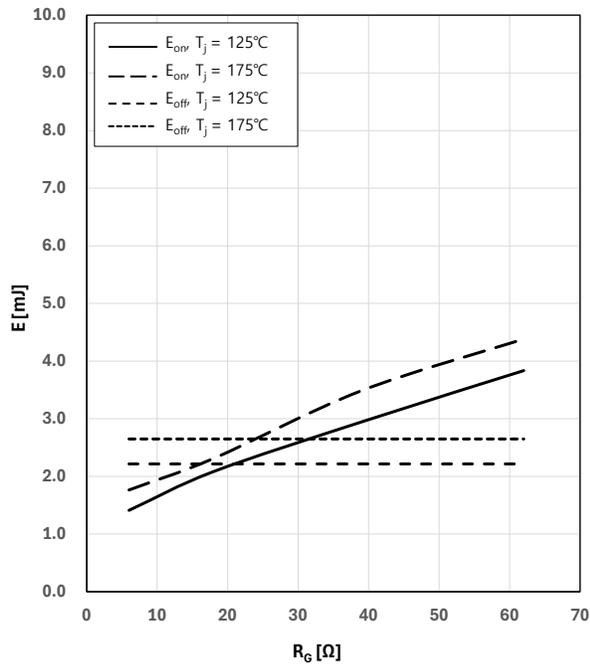
Switching times (typical), IGBT, Inverter
t=f(I_C)
R_{Goff}=6Ω, R_{Gon}=6Ω, V_{CE}=600V, V_{GE}=±15V, T_j=175°C

Legend:
- tdon
- tr
- tdoff
- tf
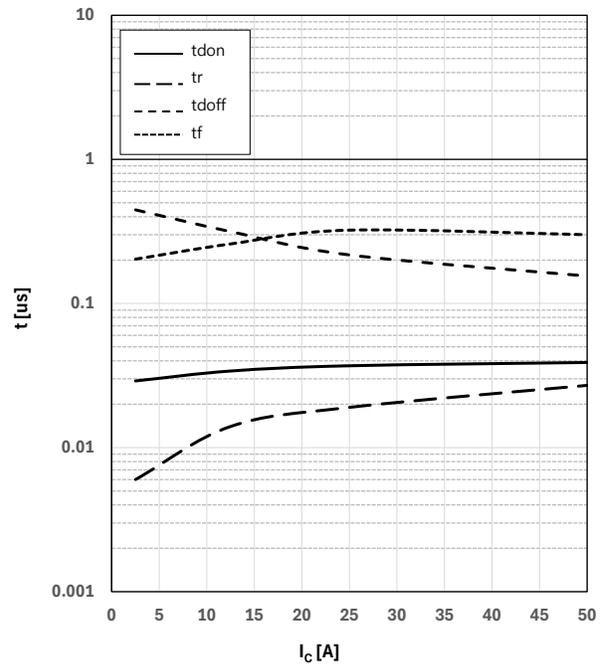
Switching times (typical), IGBT, Inverter
t=f(R_G)
I_C=25A, V_{CE}=600V, V_{GE}=±15V, T_j=175°C

Legend:
- tdon
- tr
- tdoff
- tf
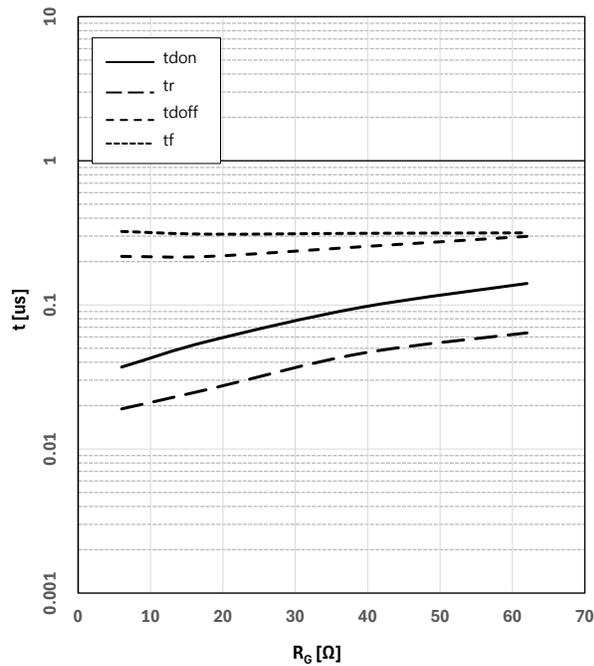
dv/dt (typical), IGBT, Inverter
dv/dt=f(R_G)
I_C=25A, V_{CE}=600V, V_{GE}=±15V, T_j=25°C

Legend:
- dv/dt-on at 0.1*I_c
- dv/dt-off at I_c
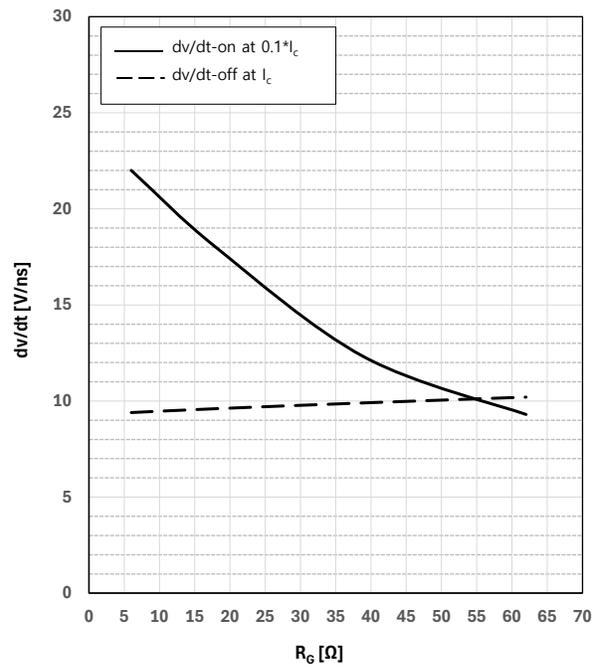
Gate charge characteristic (typical), IGBT, Inverter
$V_{GE}=f(Q_G)$
$T_j=25°C$, $I_C=25A$
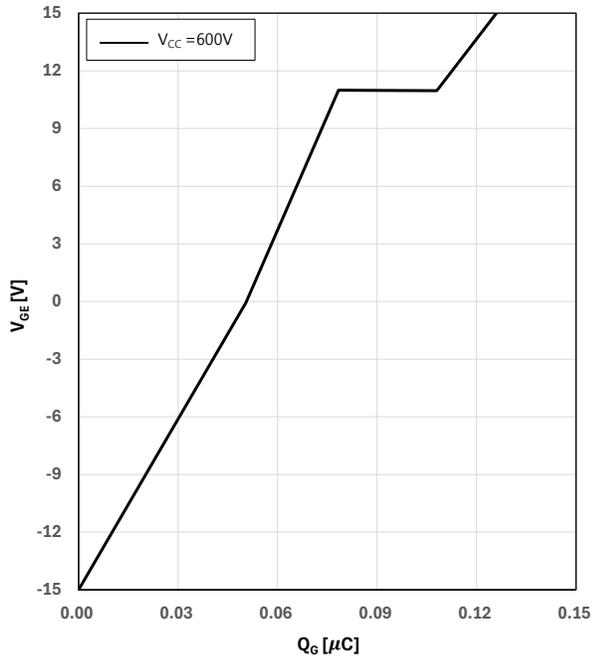
Reverse bias safe operating area (RBSOA), IGBT, Inverter
$I_C=f(V_{CE})$
$R_{Goff}=6Ω$, $V_{GE}=±15V$, $T_j=175°C$
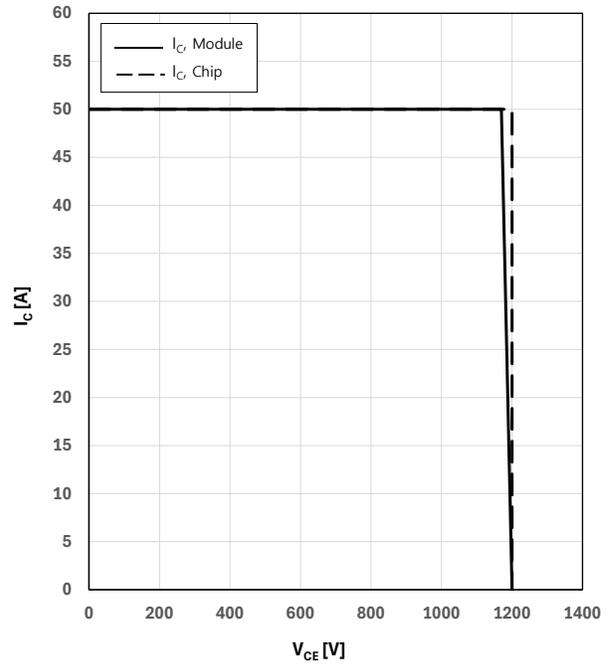
Capacity characteristic (typical), IGBT, Inverter
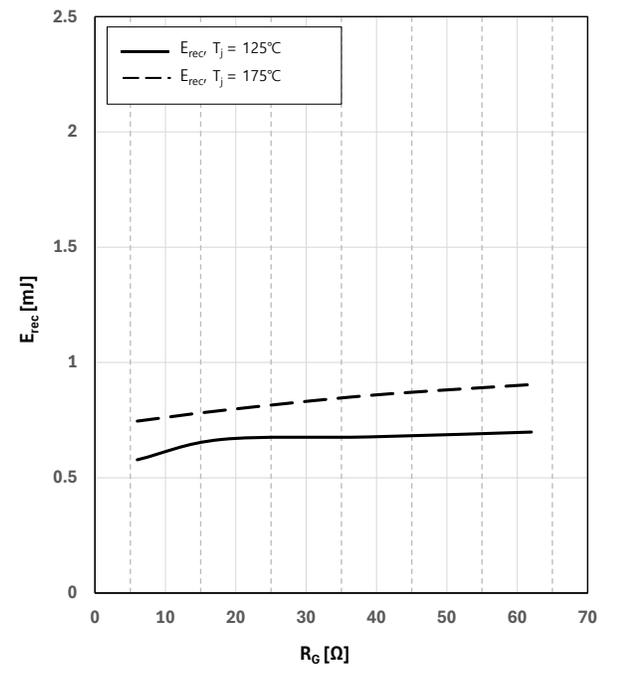$C=f(V_{CE})$
f=100kHz, $T_j=25°C$, $V_{GE}=0V$
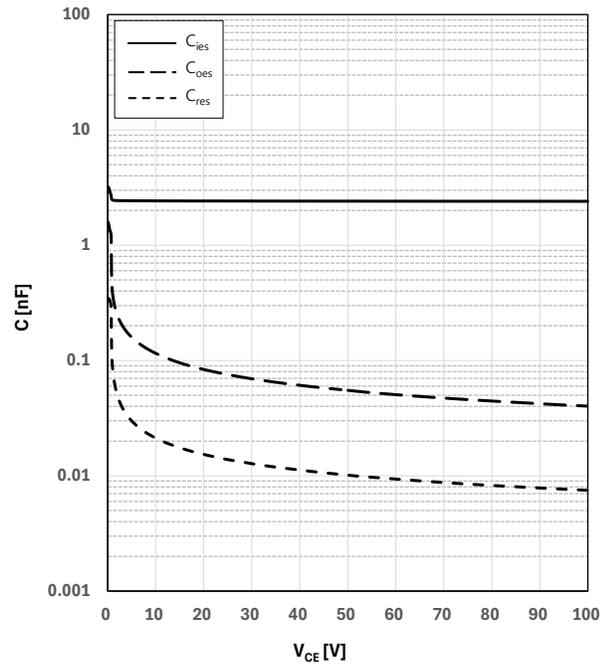
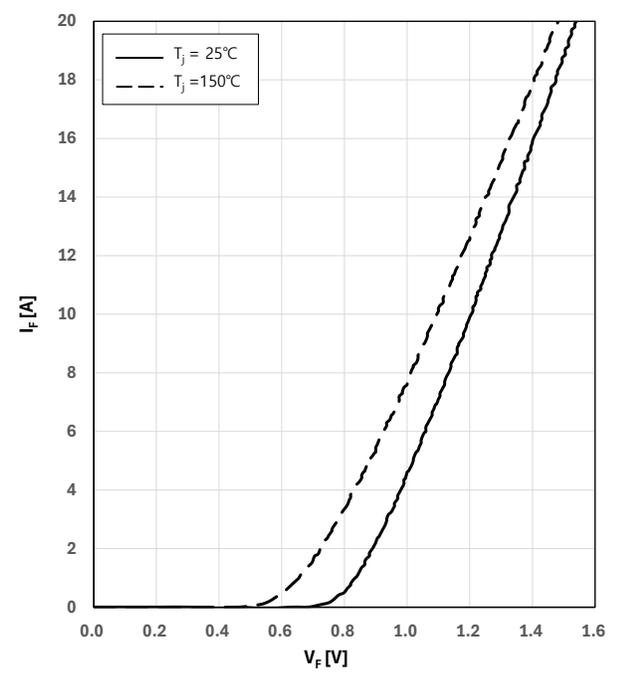**Forward characteristic (typical), Diode, Inverter**
$I_F = f(V_F)$
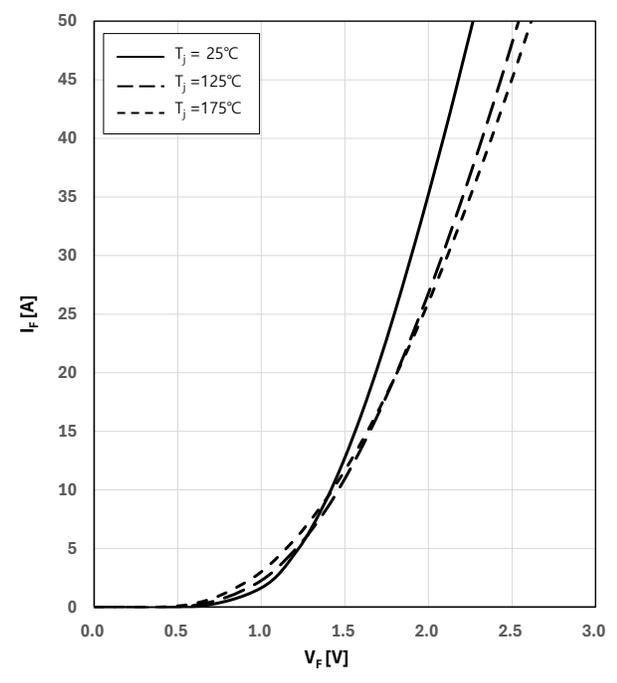
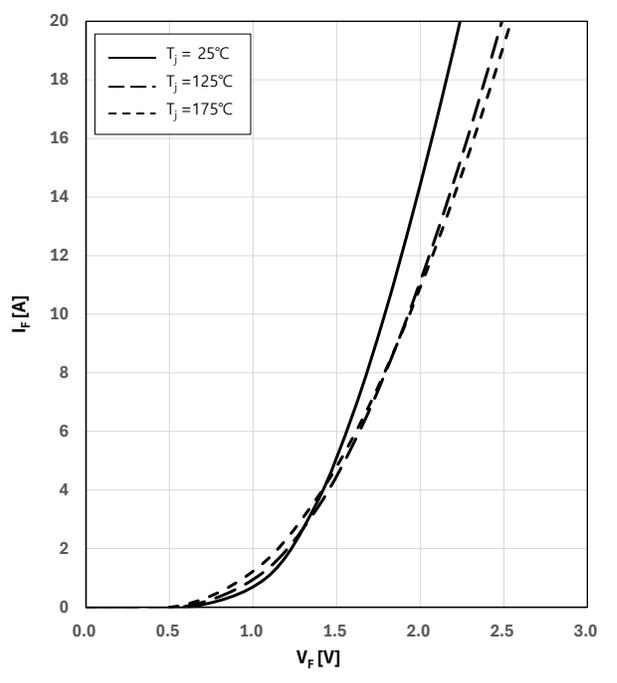**Switching losses (typical), Diode, Inverter**
$E_{rec} = f(I_F)$
$R_{Gon} = 6\Omega$, $V_{CE} = 600V$
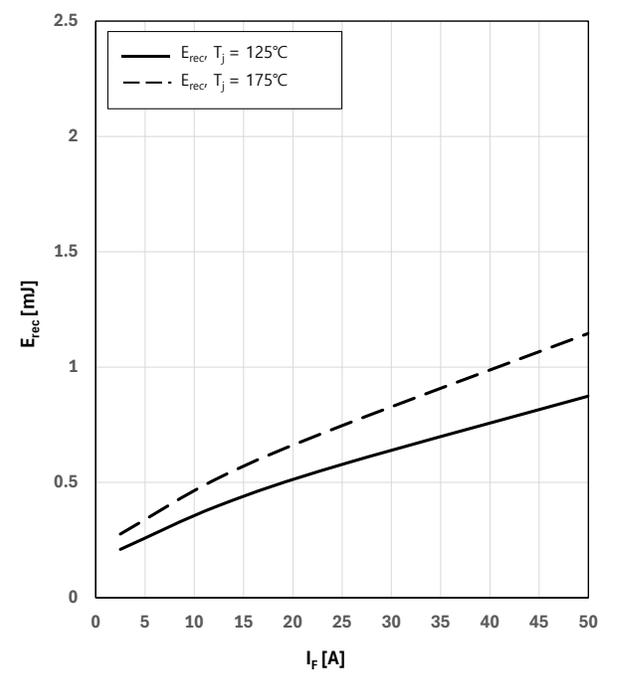
Switching losses (typical), Diode, Inverter
$E_{rec} = f(R_G)$
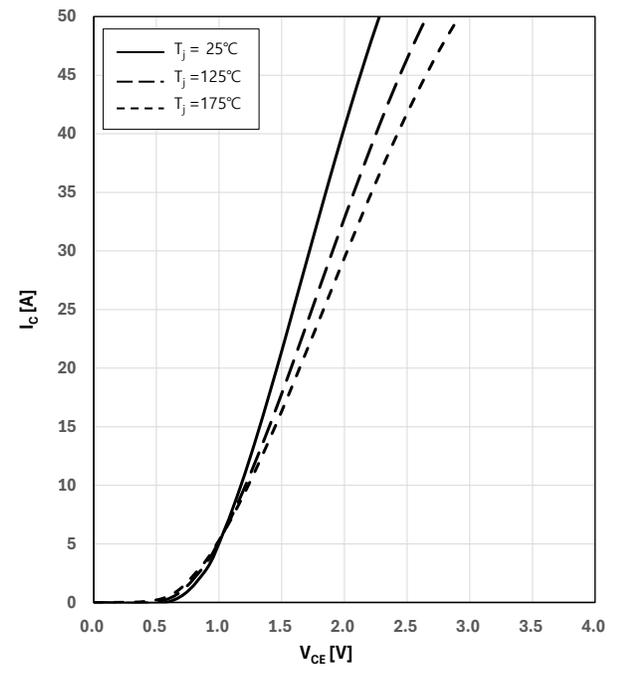$V_{CE} = 600V$, $I_F = 25A$

Forward characteristic (typical), Diode, Rectifier
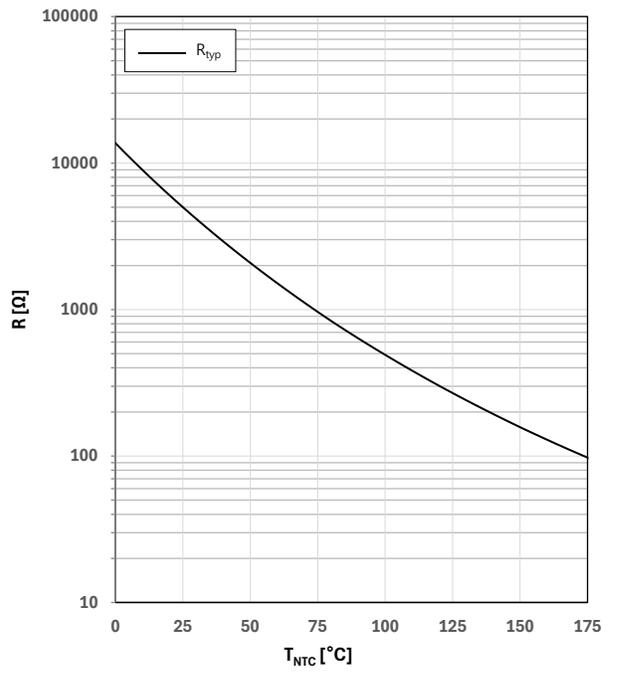$I_F=f(V_F)$

Forward characteristic (typical), Diode, Brake-Chopper
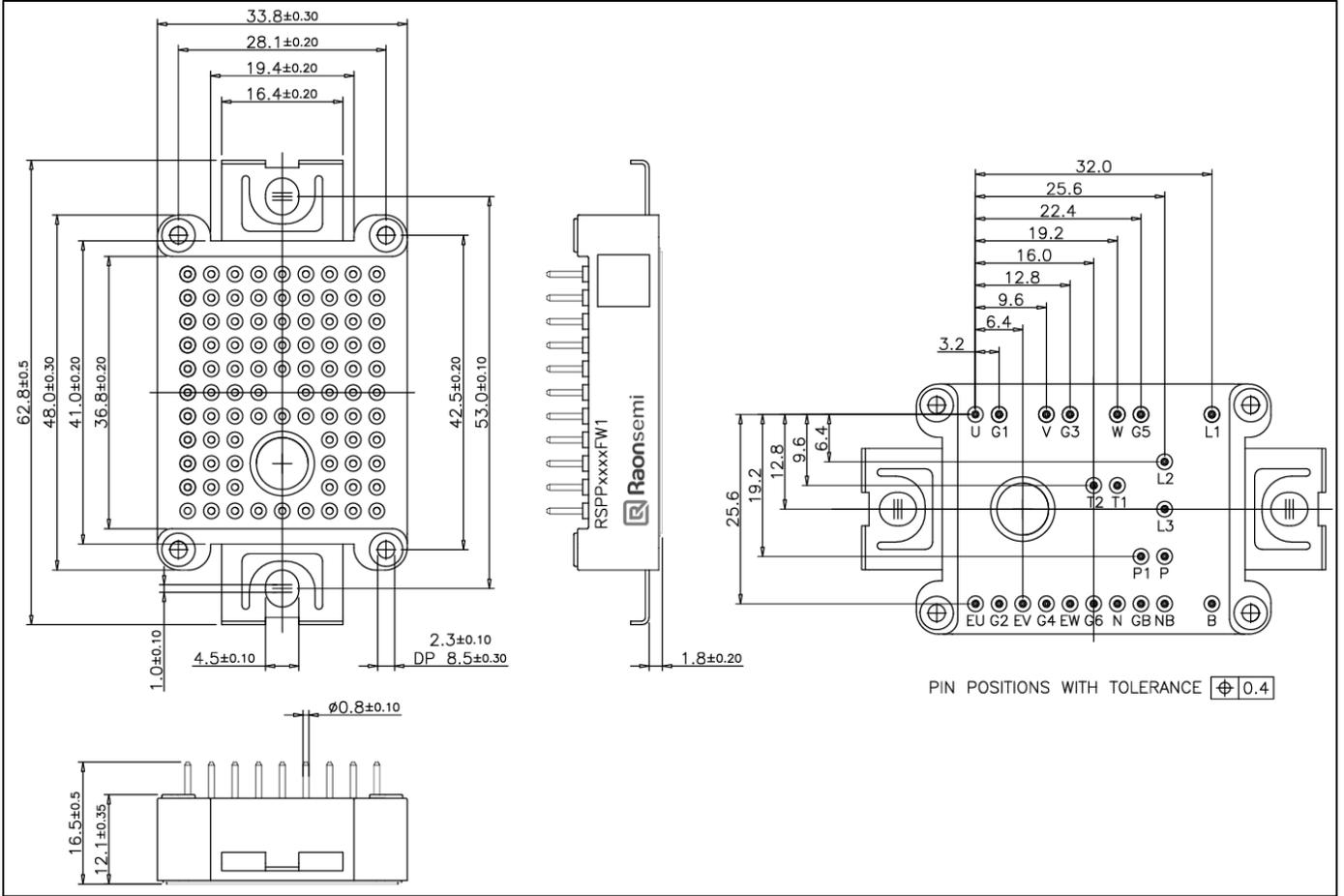$I_F=f(V_F)$

Output characteristic (typical), IGBT, Brake-Chopper
$I_C=f(V_{CE})$
$V_{GE}=15V$

Temperature characteristic (typical), NTC-Thermistor
$R=f(T_{NTC})$

PACKAGE DIMENSIONS

PIN POSITIONS WITH TOLERANCE ⊕ 0.4

Disclaimer

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