RBN40H65T1FPQ-A0

650V - 40A - IGBT
Power Switching

R07DS1379EJ0121
Rev.1.21
Oct.14.2021

Features

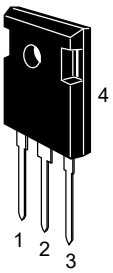
- Trench gate and thin wafer technology (G8H series)
- Built in fast recovery diode in one package
- Low collector to emitter saturation voltage
  $V_{CE(sat)}$ = 1.5 V typ. (at I_C = 40 A, V_{GE} = 15 V, Ta = 25°C)
- Quality grade: Standard
- High speed switching
- Non-specification for short circuit
- Applications: UPS, Welding, photovoltaic inverters, Power converter system

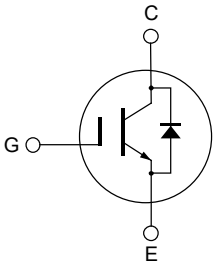
Key Performance

Type	V_{CES}	I_C	$V_{CE(sat)}$, T_C=25°C	I_F	T_j
RBN40H65T1FPQ-A0	650 V	40 A	1.5 V	30 A	175 °C

Outline

RENESAS Package code: PRSS0003ZH-A
(Package name: TO-247A)





1. Gate
2. Collector
3. Emitter
4. Collector

Absolute Maximum Ratings

(Tc = 25°C)

Item		Symbol	Ratings	Unit
Collector to emitter voltage		V_{CES}	650	V
Gate to emitter voltage		V_{GES}	±30	V
Collector current	Tc = 25 °C	I_C	80	A
	Tc = 100 °C	I_C	40	A
Collector peak current		$I_{C(peak)}$ Notes1	160	A
Diode forward current	Tc = 25 °C	I_F	60	A
	Tc = 100 °C	I_F	30	A
Diode forward peak current		$I_{F(peak)}$ Notes1	160	A
Collector power dissipation		P_C Notes 2	185	W
Junction temperature		T_j Notes2	175	°C
Storage temperature		T_{stg}	–55 to +150	°C

Note: Continuous heavy condition (e.g. high temperature/voltage/current or high variation of temperature) may affect a reliability even if it is within the absolute maximum ratings. Please consider derating condition for appropriate reliability in reference Renesas Semiconductor Reliability Handbook (Recommendation for Handling and Usage of Semiconductor Devices) and individual reliability data.

Notes: 1. PW ≤ 10 μs, duty cycle ≤ 1%
2. Please use this device in the thermal conditions which the junction temperature does not exceed 175 °C. Renesas IGBT Application Note is disclosed about reliability test and application condition up to 175 °C.

Thermal Resistance Characteristics

(Tc = 25°C)

Item	Symbol	Max. Value Notes3	Unit
Junction to case thermal resistance (IGBT)	$R_{th(j-c)}$	0.81	°C/W
Junction to case thermal resistance (Diode)	$R_{th(j-c)}$	0.97	°C/W

Notes: 3. Designed target value on Renesas measurement condition. (Not tested)

Electrical Characteristics

(Tc = 25°C)

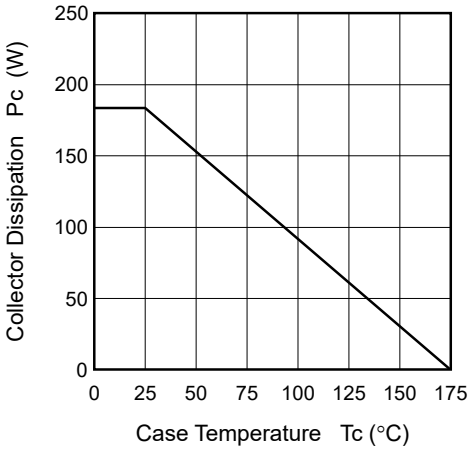
Item	Symbol	Min	Typ	Max	Unit	Test Conditions
Collector to emitter leakage current	I_{CES}	—	—	200	μA	V_{CE} = 650 V, V_{GE} = 0 V
Gate to emitter leakage current	I_{GES}	—	—	±1	μA	V_{GE} = ±30 V, V_{CE} = 0 V
Gate to emitter threshold voltage	$V_{GE(th)}$	4.1	—	5.9	V	V_{CE} = 10 V, I_C = 0.8 mA
Collector to emitter saturation voltage	$V_{CE(sat)}$	—	1.5	2.0	V	I_C = 40 A, V_{GE} = 15 V Notes4
Input capacitance	C_{ies}	—	775	—	pF	V_{CE} = 25 V
Output capacitance	C_{oes}	—	105	—	pF	V_{GE} = 0 V
Reverse transfer capacitance	C_{res}	—	10	—	pF	f = 1 MHz
Total gate charge	Q_g	—	28	—	nC	V_{GE} = 15 V
Gate to emitter charge	Q_{ge}	—	7	—	nC	V_{CE} = 400 V
Gate to collector charge	Q_{gc}	—	13	—	nC	I_C = 40 A
Turn-on delay time	$t_{d(on)}$	—	22	—	Ns	V_{CC} = 400 V
Rise time	t_r	—	19	—	ns	V_{GE} = +15 V/–5 V
Turn-off delay time	$t_{d(off)}$	—	96	—	ns	I_C = 40 A
Fall time	t_f	—	45	—	ns	R_g = 16 Ω
Turn-on loss energy	E_{on}	—	0.62	—	mJ	T_C = 25 °C
Turn-off loss energy	E_{off}	—	0.52	—	mJ	Inductive load Notes5
Total switching energy	E_{total}	—	1.14	—	mJ	
Turn-on delay time	$t_{d(on)}$	—	21	—	Ns	V_{CC} = 400 V
Rise time	t_r	—	20	—	ns	V_{GE} = +15 V/–5V
Turn-off delay time	$t_{d(off)}$	—	120	—	ns	I_C = 40 A
Fall time	t_f	—	60	—	ns	R_g = 16 Ω
Turn-on loss energy	E_{on}	—	0.98	—	mJ	T_C = 150 °C
Turn-off loss energy	E_{off}	—	0.88	—	mJ	Inductive load Notes5
Total switching energy	E_{total}	—	1.86	—	mJ	
Diode forward voltage	V_F	—	1.7	2.2	V	I_F = 30 A Notes4
Diode reverse recovery time	t_{rr}	—	55	—	ns	I_F = 30 A, d_{iF}/d_t = 300 A/μs
Diode reverse recovery charge	Q_{rr}	—	0.21	—	μC	
Diode peak reverse recovery current	I_{rr}	—	7	—	A	

Notes: 4. Pulse test

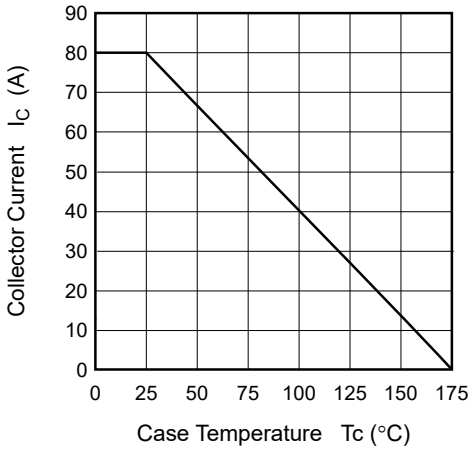
5. Switching time test circuit and waveform are shown below.

Main Characteristics

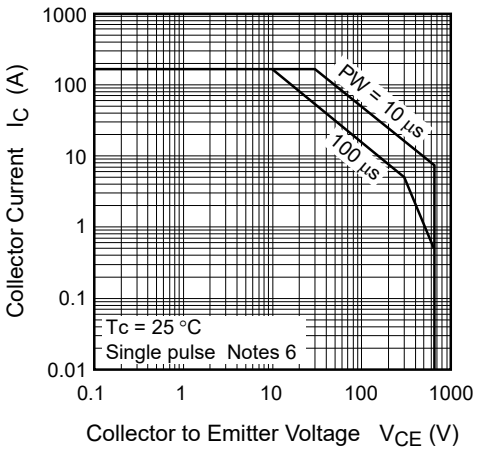
Collector Dissipation vs. Case Temperature



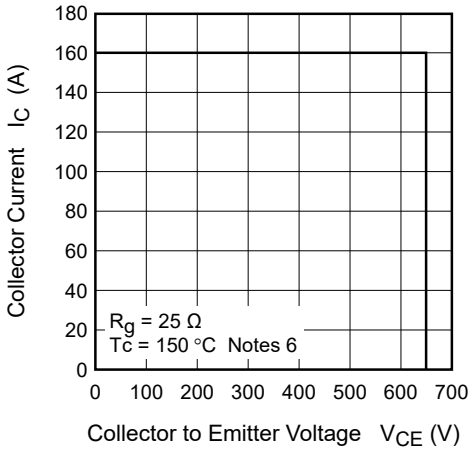
Maximum DC Collector Current vs. Case Temperature



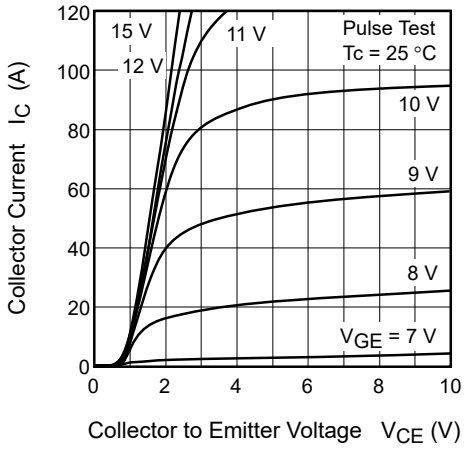
Forward Bias Safe Operating Area



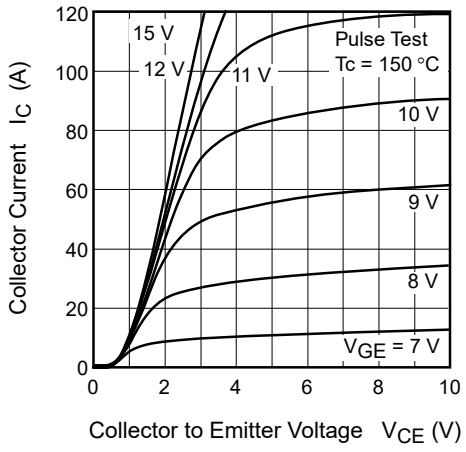
Reverse Bias Safe Operating Area



Typical Output Characteristics

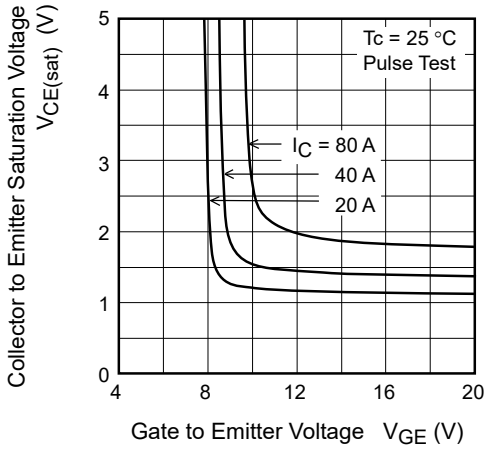


Typical Output Characteristics

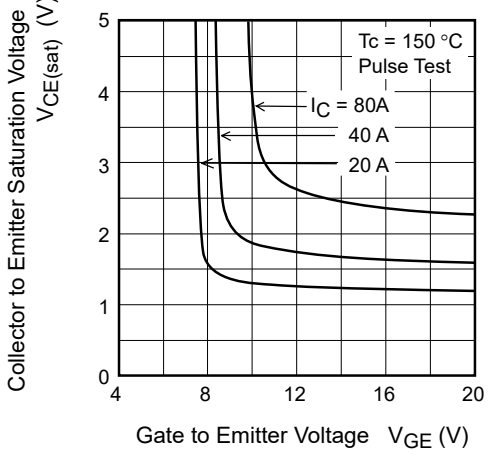


Notes: 6. Designed target value on Renesas measurement condition. (Not tested)
Renesas recommends that operating conditions are designed according to a document “Power MOS FET・IGBT Attention of Handling Semiconductor Devices”.

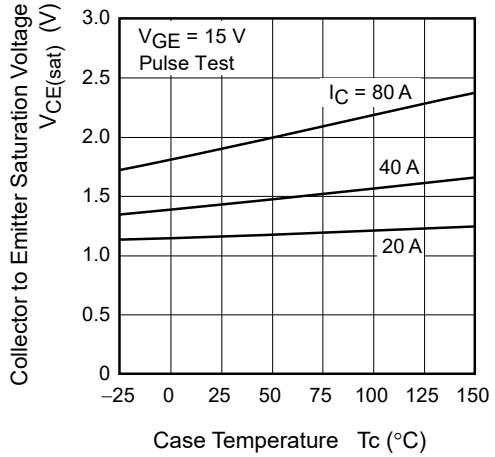
Collector to Emitter Saturation Voltage vs. Gate to Emitter Voltage (Typical)



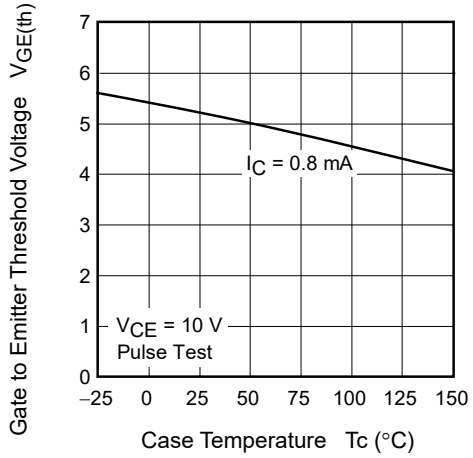
Collector to Emitter Saturation Voltage vs. Gate to Emitter Voltage (Typical)



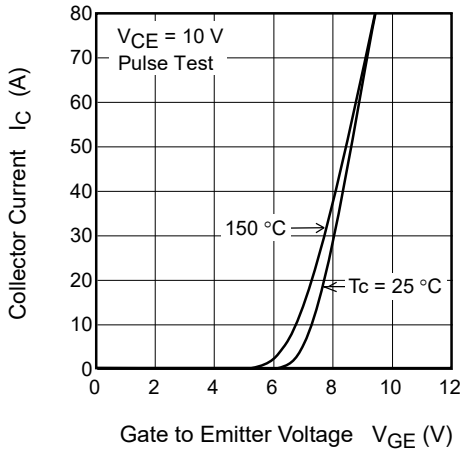
Collector to Emitter Saturation Voltage vs. Case Temperature (Typical)



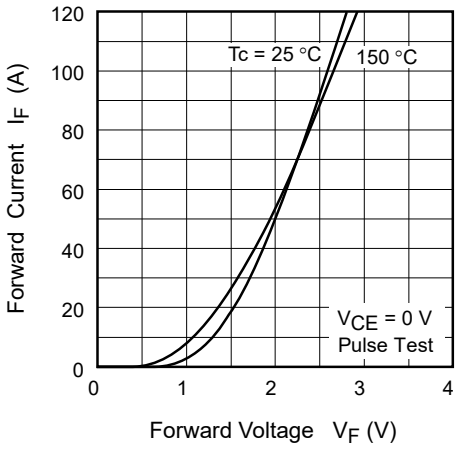
Gate to Emitter Threshold Voltage vs. Case Temperature (Typical)



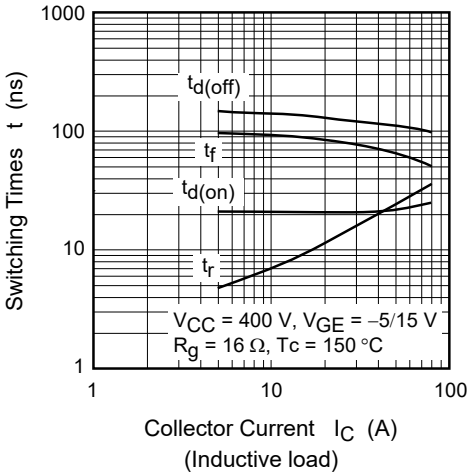
Typical Transfer Characteristics



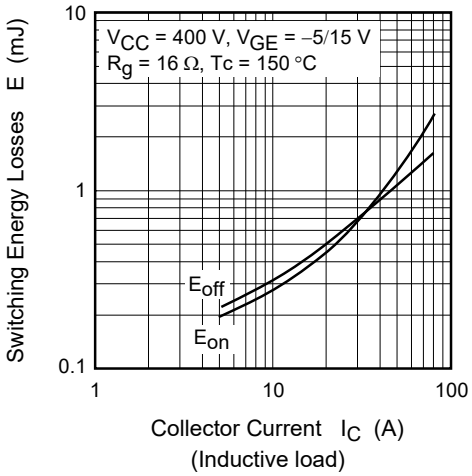
Diode Forward Current vs. Diode Forward Voltage (Typical)



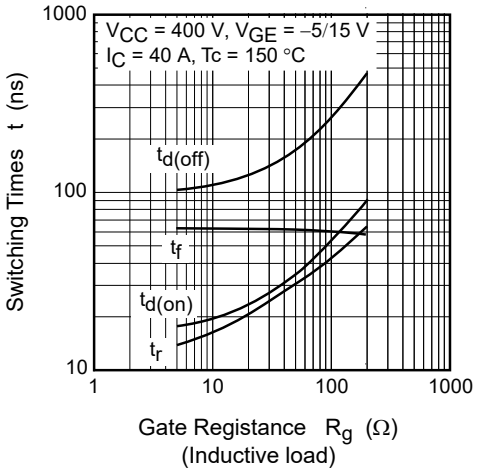
Switching Characteristics (Typical) (1)



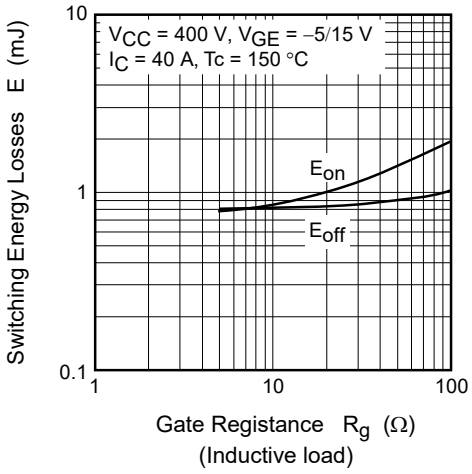
Switching Characteristics (Typical) (2)



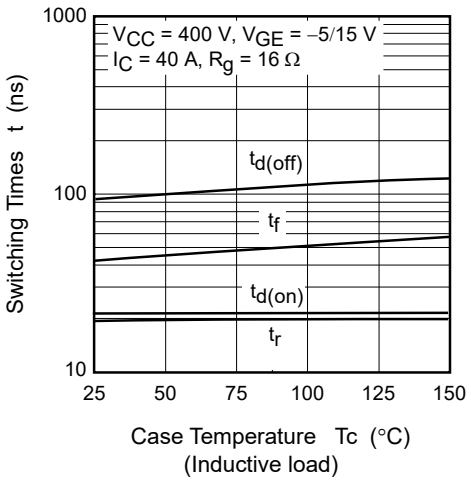
Switching Characteristics (Typical) (3)



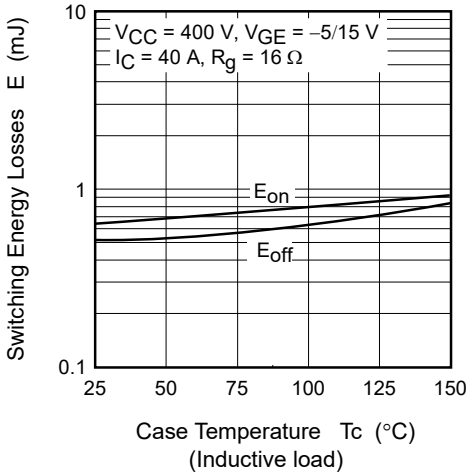
Switching Characteristics (Typical) (4)



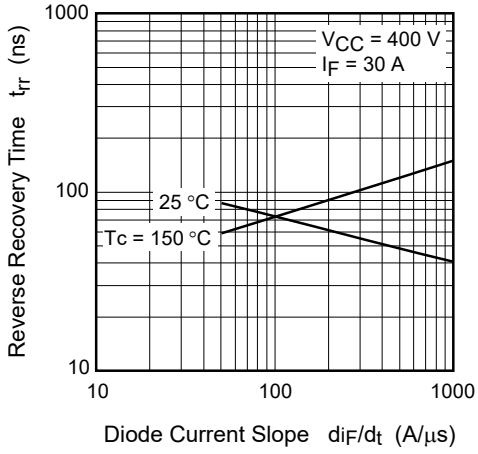
Switching Characteristics (Typical) (5)



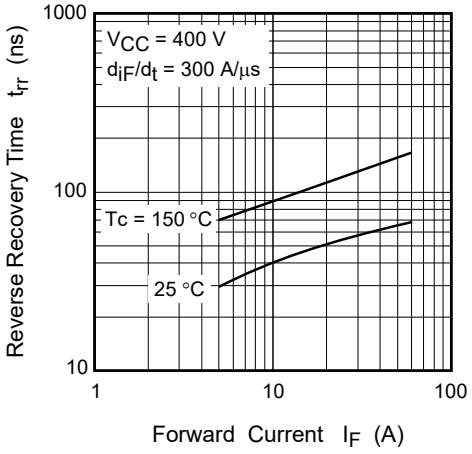
Switching Characteristics (Typical) (6)



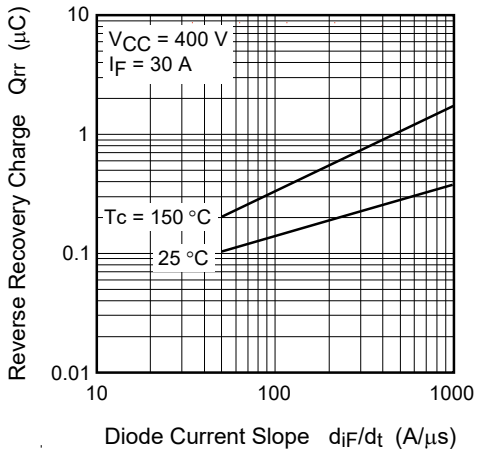
Reverse Recovery Time vs.
Diode Current Slope (Typical)



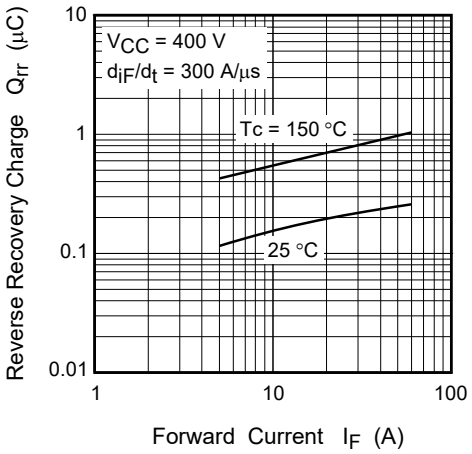
Reverse Recovery Time vs.
Forward Current (Typical)



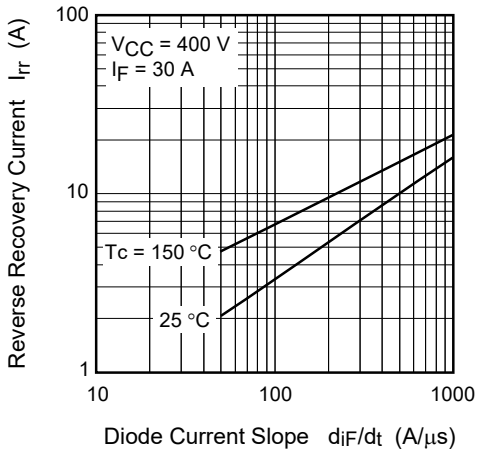
Reverse Recovery Charge vs.
Diode Current Slope (Typical)



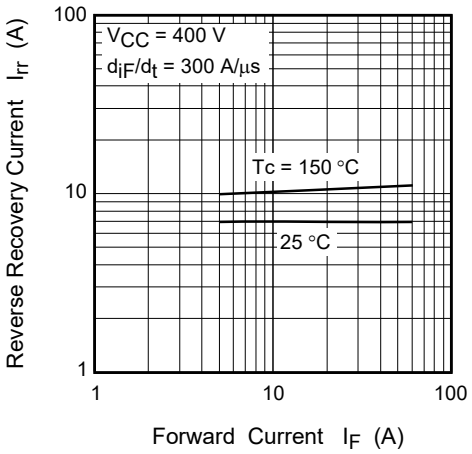
Reverse Recovery Charge vs.
Forward Current (Typical)



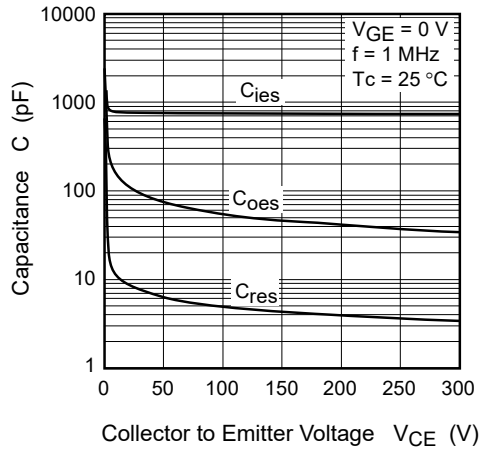
Reverse Recovery Current vs.
Diode Current Slope (Typical)



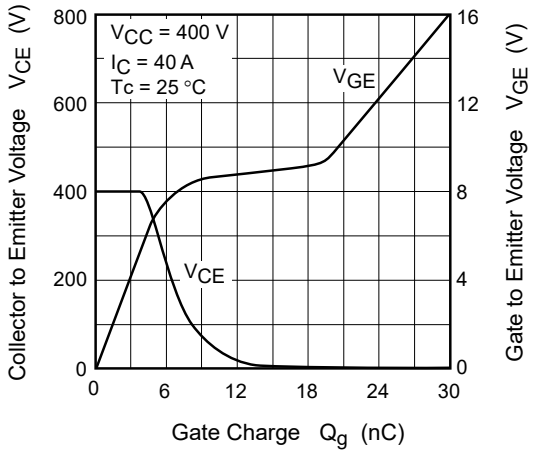
Reverse Recovery Current vs.
Forward Current (Typical)

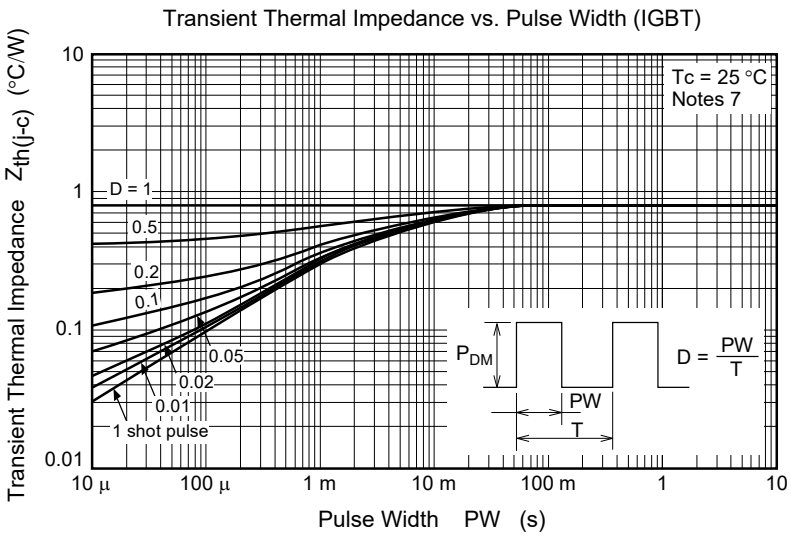


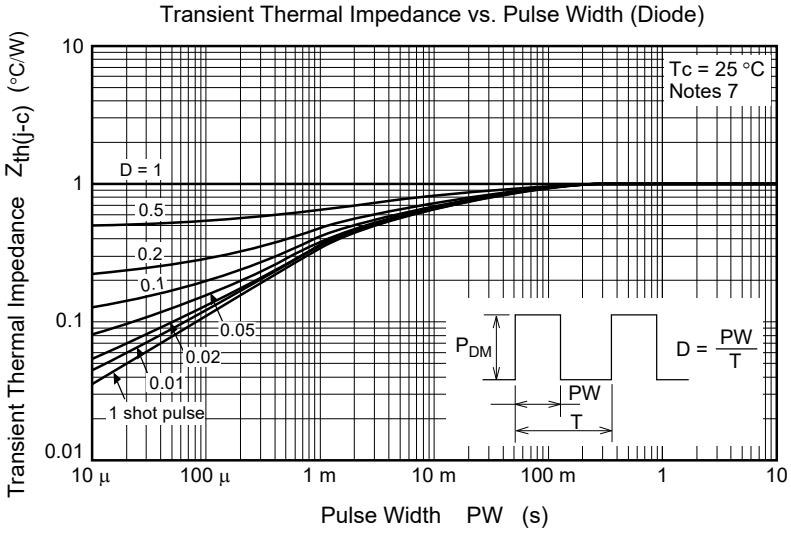
Typical Capacitance vs.
Collector to Emitter Voltage



Dynamic Input Characteristics (Typical)

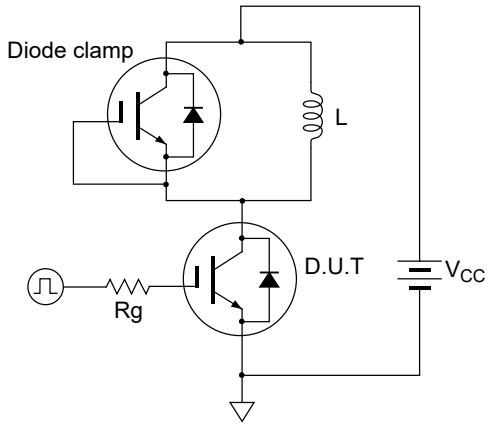




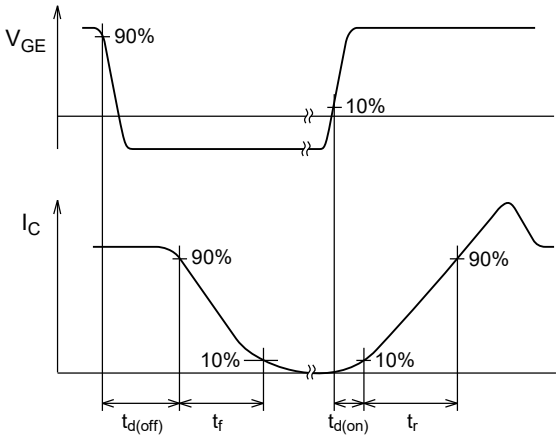


Notes: 7. Designed target value on Renesas measurement condition. (Not tested)

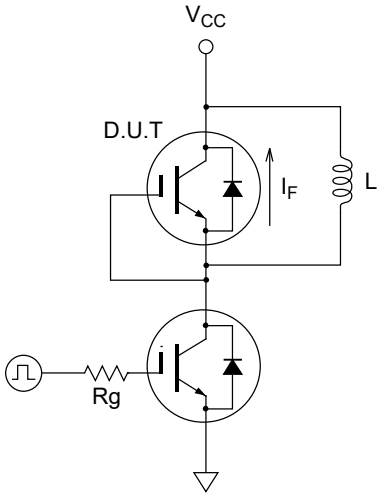
Switching Time Test Circuit



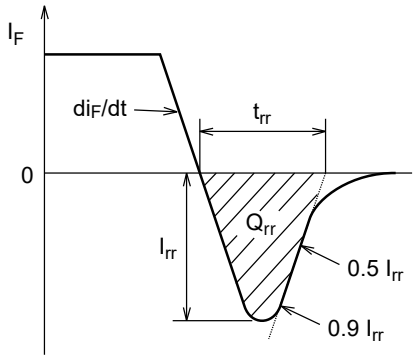
Waveform



Diode Reverse Recovery Time Test Circuit



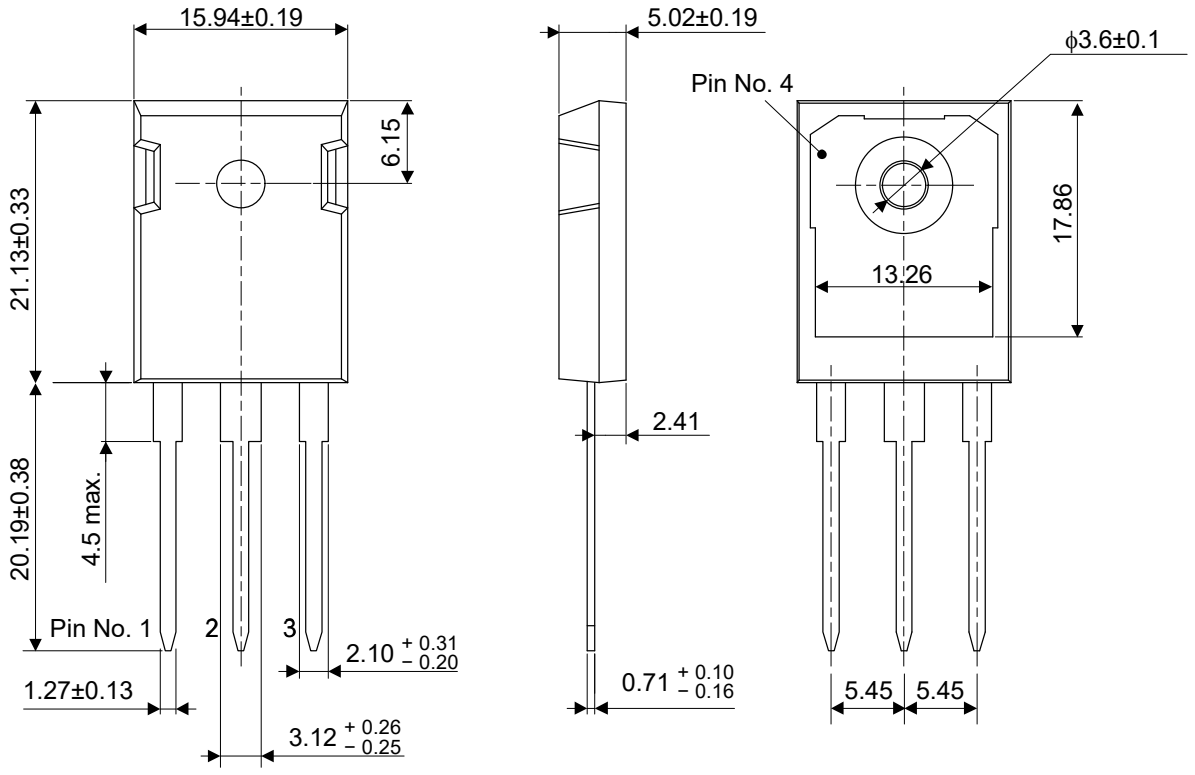
Waveform



Package Dimensions

JEDEC Package Code	RENESAS Code	Previous Code	MASS (Typ) [g]
TO-247AD	PRSS0003ZH-A	—	6.14

Unit: mm



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Ordering Information

Orderable Part Number	Quantity	Shipping Container
RBN40H65T1FPQ-A0#CB0	240 pcs	Box (Tube)

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