Features

- Low collector to emitter saturation voltage
  \( V_{CE(sat)} = 1.8 \text{ V typ.} \) at \( I_C = 40 \text{ A}, V_{GE} = 15 \text{ V}, T_a = 25^\circ \text{C} \)
- Built in fast recovery diode in one package
- Trench gate and thin wafer technology (G7H series)
- High speed switching
  \( t_r = 45 \text{ ns typ.} \) at \( V_{CC} = 400 \text{ V}, V_{GE} = 15 \text{ V}, I_C = 40 \text{ A}, R_g = 10 \Omega, T_a = 25^\circ \text{C}, \) inductive load
- Operation frequency \( 20kHz \leq f < 100kHz \)
- Not guarantee short circuit withstand time

Outline

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

Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Ratings</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collector to emitter voltage / diode reverse voltage</td>
<td>( V_{CES} / V_R )</td>
<td>650</td>
<td>V</td>
</tr>
<tr>
<td>Gate to emitter voltage</td>
<td>( V_{GES} )</td>
<td>( \pm 30 )</td>
<td>V</td>
</tr>
<tr>
<td>Collector current</td>
<td>( T_c = 25^\circ \text{C} ) ( I_C )</td>
<td>80</td>
<td>A</td>
</tr>
<tr>
<td>Collector current</td>
<td>( T_c = 100^\circ \text{C} ) ( I_C )</td>
<td>40</td>
<td>A</td>
</tr>
<tr>
<td>Collector peak current</td>
<td>( I_{C(peak)} ) Note1</td>
<td>300</td>
<td>A</td>
</tr>
<tr>
<td>Collector to emitter diode forward current</td>
<td>( T_c = 25^\circ \text{C} ) ( I_{DF} )</td>
<td>30</td>
<td>A</td>
</tr>
<tr>
<td>Collector to emitter diode forward peak current</td>
<td>( T_c = 100^\circ \text{C} ) ( I_{DF} )</td>
<td>15</td>
<td>A</td>
</tr>
<tr>
<td>Collector dissipation</td>
<td>( P_C )</td>
<td>340.9</td>
<td>W</td>
</tr>
<tr>
<td>Junction to case thermal impedance (IGBT)</td>
<td>( \theta_{jc} )</td>
<td>0.44</td>
<td>°C/W</td>
</tr>
<tr>
<td>Junction to case thermal resistance (Diode)</td>
<td>( \theta_{jcd} )</td>
<td>1.33</td>
<td>°C/W</td>
</tr>
<tr>
<td>Junction temperature</td>
<td>( T_{J} ) Note2</td>
<td>175</td>
<td>°C</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>( T_{stg} )</td>
<td>–55 to +150</td>
<td>°C</td>
</tr>
</tbody>
</table>

Notes:
1. \( PW \leq 10 \mu s, \) duty cycle \( \leq 1\% \)
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.
## Electrical Characteristics

\( (Ta = 25\, ^\circ C) \)

<table>
<thead>
<tr>
<th>Item</th>
<th>Symbol</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
<th>Test Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zero gate voltage collector current</td>
<td>( I_{CES} / I_R )</td>
<td>—</td>
<td>—</td>
<td>100</td>
<td>( \mu A )</td>
<td>( V_{GE} = 650 , V, , V_{GE} = 0 )</td>
</tr>
<tr>
<td>Gate to emitter leak current</td>
<td>( I_{GES} )</td>
<td>—</td>
<td>—</td>
<td>±1</td>
<td>( \mu A )</td>
<td>( V_{GE} = \pm 30 , V, , V_{CE} = 0 )</td>
</tr>
<tr>
<td>Gate to emitter cutoff voltage</td>
<td>( V_{GE(off)} )</td>
<td>4.0</td>
<td>—</td>
<td>7.0</td>
<td>( V )</td>
<td>( V_{CE} = 10V, , I_C = 1.33 , mA )</td>
</tr>
<tr>
<td>Collector to emitter saturation voltage</td>
<td>( V_{CE(sat)} )</td>
<td>—</td>
<td>1.8</td>
<td>2.4</td>
<td>( V )</td>
<td>( I_C = 40 , A, , V_{GE} = 15V ) Note3</td>
</tr>
<tr>
<td>Input capacitance</td>
<td>( C_{ies} )</td>
<td>—</td>
<td>—</td>
<td>3000</td>
<td>( pF )</td>
<td>( V_{GE} = 25 , V )</td>
</tr>
<tr>
<td>Output capacitance</td>
<td>( C_{oes} )</td>
<td>—</td>
<td>92</td>
<td>—</td>
<td>( pF )</td>
<td>( V_{GE} = 0 )</td>
</tr>
<tr>
<td>Reverses transfer capacitance</td>
<td>( C_{res} )</td>
<td>—</td>
<td>55</td>
<td>—</td>
<td>( pF )</td>
<td>( f = 1 , MHz )</td>
</tr>
<tr>
<td>Total gate charge</td>
<td>( Q_g )</td>
<td>—</td>
<td>138</td>
<td>—</td>
<td>( nC )</td>
<td>( V_{GE} = 15 , V )</td>
</tr>
<tr>
<td>Gate to emitter charge</td>
<td>( Q_{ge} )</td>
<td>—</td>
<td>22</td>
<td>—</td>
<td>( nC )</td>
<td>( V_{CE} = 400 , V )</td>
</tr>
<tr>
<td>Gate to collector charge</td>
<td>( Q_{gc} )</td>
<td>—</td>
<td>57</td>
<td>—</td>
<td>( nC )</td>
<td>( I_C = 40 , A )</td>
</tr>
<tr>
<td>Turn-on delay time</td>
<td>( t_{d(on)} )</td>
<td>—</td>
<td>45</td>
<td>—</td>
<td>( ns )</td>
<td>( V_{CC} = 400 , V )</td>
</tr>
<tr>
<td>Rise time</td>
<td>( t_r )</td>
<td>—</td>
<td>30</td>
<td>—</td>
<td>( ns )</td>
<td>( V_{GE} = 15 , V )</td>
</tr>
<tr>
<td>Turn-off delay time</td>
<td>( t_{d(off)} )</td>
<td>—</td>
<td>170</td>
<td>—</td>
<td>( ns )</td>
<td>( I_C = 40 , A )</td>
</tr>
<tr>
<td>Fall time</td>
<td>( t_f )</td>
<td>—</td>
<td>45</td>
<td>—</td>
<td>( ns )</td>
<td>( R_g = 10 , \Omega )</td>
</tr>
<tr>
<td>Turn-on loss energy</td>
<td>( E_{on} )</td>
<td>—</td>
<td>0.45</td>
<td>—</td>
<td>( mJ )</td>
<td>( T_C = 25 , ^\circ C ) Inductive load Note4</td>
</tr>
<tr>
<td>Turn-off loss energy</td>
<td>( E_{off} )</td>
<td>—</td>
<td>0.55</td>
<td>—</td>
<td>( mJ )</td>
<td></td>
</tr>
<tr>
<td>Total switching energy</td>
<td>( E_{total} )</td>
<td>—</td>
<td>1.00</td>
<td>—</td>
<td>( mJ )</td>
<td></td>
</tr>
<tr>
<td>Turn-on delay time</td>
<td>( t_{d(on)} )</td>
<td>—</td>
<td>45</td>
<td>—</td>
<td>( ns )</td>
<td>( V_{CC} = 400 , V )</td>
</tr>
<tr>
<td>Rise time</td>
<td>( t_r )</td>
<td>—</td>
<td>30</td>
<td>—</td>
<td>( ns )</td>
<td>( V_{GE} = 15 , V )</td>
</tr>
<tr>
<td>Turn-off delay time</td>
<td>( t_{d(off)} )</td>
<td>—</td>
<td>185</td>
<td>—</td>
<td>( ns )</td>
<td>( I_C = 40 , A )</td>
</tr>
<tr>
<td>Fall time</td>
<td>( t_f )</td>
<td>—</td>
<td>50</td>
<td>—</td>
<td>( ns )</td>
<td>( R_g = 10 , \Omega )</td>
</tr>
<tr>
<td>Turn-on loss energy</td>
<td>( E_{on} )</td>
<td>—</td>
<td>0.57</td>
<td>—</td>
<td>( mJ )</td>
<td>( T_C = 150 , ^\circ C ) Inductive load Note4</td>
</tr>
<tr>
<td>Turn-off loss energy</td>
<td>( E_{off} )</td>
<td>—</td>
<td>0.63</td>
<td>—</td>
<td>( mJ )</td>
<td></td>
</tr>
<tr>
<td>Total switching energy</td>
<td>( E_{total} )</td>
<td>—</td>
<td>1.20</td>
<td>—</td>
<td>( mJ )</td>
<td></td>
</tr>
</tbody>
</table>

\[ \text{FRD forward voltage} \quad V_F \quad — \quad 1.7 \quad 2.2 \quad V \quad I_F = 15 \, A \text{ Note3} \]

\[ \text{FRD reverse recovery time} \quad t_r \quad — \quad 100 \quad — \quad ns \quad I_F = 15 \, A, \, \text{dir/dt} = 300 \, A/\mu s \]

Notes:
3. Pulse test
4. Switching time test circuit and waveform are shown below.
Main Characteristics

Collector Dissipation vs. Case Temperature

Maximum Safe Operation Area

Maximum DC Collector Current vs. Case Temperature

Typical Transfer Characteristics

Typical Output Characteristics

Typical Output Characteristics
Switching Characteristics (Typical) (1)

- Collector Current $I_C$ (A) (Inductive load)
- Gate Resistance $R_g$ ($\Omega$) (Inductive load)

Switching Characteristics (Typical) (2)

- Switching Energy Losses $E$ (mJ)

Switching Characteristics (Typical) (3)

- Switching Times $t$ (ns)

Switching Characteristics (Typical) (4)

- Eon
- Eoff

Switching Characteristics (Typical) (5)

- Switching Times $t$ (ns)

Switching Characteristics (Typical) (6)

- Switching Energy Losses $E$ (mJ)
Normalized Transient Thermal Impedance vs. Pulse Width (IGBT)

\[ \theta_j - c(t) = \gamma_s(t) \cdot \theta_j - c \]

\[ \theta_j - c = 0.44^\circ C/W, T_c = 25^\circ C \]

Normalized Transient Thermal Impedance vs. Pulse Width (Diode)

\[ \theta_j - c(t) = \gamma_s(t) \cdot \theta_j - c \]

\[ \theta_j - c = 1.33^\circ C/W, T_c = 25^\circ C \]
Switching Time Test Circuit

Diode Reverse Recovery Time Test Circuit

Waveform

Diode clamp

RJU6054TDPP

D.U.T

L

VCC

Rg

tr

diF/dt

0.9 Iff

VGE

90%

10%

Irr

td(off)

tr

td(on)

tr

VCC

D.U.T

L

Rg

Iff

0

0.5 Iff

0.9 Iff
# Package Dimensions

<table>
<thead>
<tr>
<th>Package Name</th>
<th>JEITA Package Code</th>
<th>RENESAS Code</th>
<th>Previous Code</th>
<th>MASS [Typ.]</th>
<th>Unit: mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>TO-247A</td>
<td>—</td>
<td>PPS50032Y/A</td>
<td>—</td>
<td>6.14g</td>
<td></td>
</tr>
</tbody>
</table>

![Package Dimensions Diagram]

## Ordering Information

<table>
<thead>
<tr>
<th>Orderable Part Number</th>
<th>Quantity</th>
<th>Shipping Container</th>
</tr>
</thead>
<tbody>
<tr>
<td>RJH65T46DPQ-A0#T0</td>
<td>240 pcs</td>
<td>Box (Tube)</td>
</tr>
</tbody>
</table>

RJH65T46DPQ-A0

May 18, 2015

REnesas

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