To our customers,

# Old Company Name in Catalogs and Other Documents

On April 1st, 2010, NEC Electronics Corporation merged with Renesas Technology Corporation, and Renesas Electronics Corporation took over all the business of both companies. Therefore, although the old company name remains in this document, it is a valid Renesas Electronics document. We appreciate your understanding.

Renesas Electronics website: http://www.renesas.com

April 1st, 2010
Renesas Electronics Corporation

Issued by: Renesas Electronics Corporation (http://www.renesas.com)

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# HAT2038R, HAT2038RJ

## Silicon N Channel Power MOS FET
## High Speed Power Switching

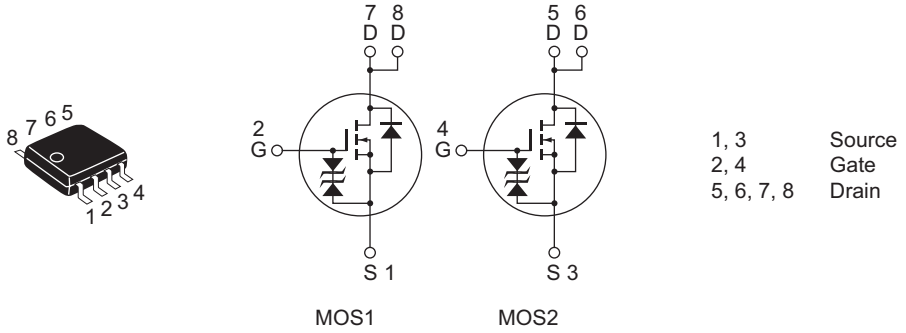
REJ03G1167-0600
Rev.6.00
Aug 25, 2009

### Features

- For Automotive Application (at Type Code "J")
- Low on-resistance
- Capable of 4 V gate drive
- High density mounting

### Outline

RENESAS Package code: PRSP0008DD-D
(Package name: SOP-8 <FP-8DAV> )




### Absolute Maximum Ratings

(Ta = 25°C)

| Item | | Symbol | Value | Unit |
|---|---|---|---|---|
| Drain to source voltage | | $V_{DSS}$ | 60 | V |
| Gate to source voltage | | $V_{GSS}$ | ±20 | V |
| Drain current | | $I_D$ | 5 | A |
| Drain peak current | | $I_{D\ (pulse)}$ Note 1 | 40 | A |
| Body-drain diode reverse drain current | | $I_{DR}$ | 5 | A |
| Avalanche current | HAT2038R | $I_{AP}$ Note 4 | — | — |
| | HAT2038RJ | | 5 | A |
| Avalanche energy | HAT2038R | $E_{AR}$ Note 4 | — | — |
| | HAT2038RJ | | 2.14 | mJ |
| Channel dissipation | | Pch Note 2 | 2 | W |
| Channel dissipation | | Pch Note 3 | 3 | W |
| Channel temperature | | Tch | 150 | °C |
| Storage temperature | | Tstg | –55 to +150 | °C |

Notes: 1. PW ≤ 10 μs, duty cycle ≤ 1%
2. 1 Drive operation: When using the glass epoxy board (FR4 40 × 40 × 1.6 mm), PW ≤ 10 s
3. 2 Drive operation: When using the glass epoxy board (FR4 40 × 40 × 1.6 mm), PW ≤ 10 s
4. Value at Tch = 25°C, Rg ≥ 50 Ω

## Electrical Characteristics

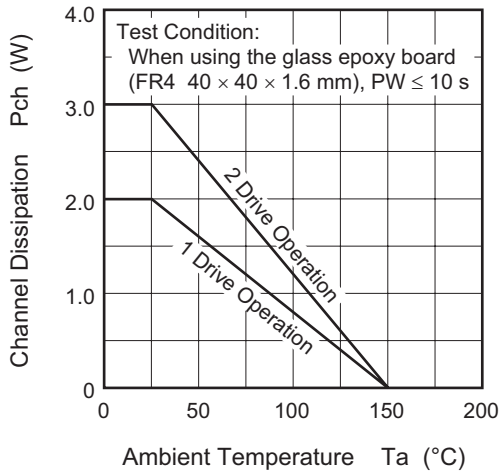
(Ta = 25°C)

| Item | | Symbol | Min | Typ | Max | Unit | Test Conditions |
|---|---|---|---|---|---|---|---|
| Drain to source breakdown voltage | | $V_{(BR)\ DSS}$ | 60 | — | — | V | $I_D$ = 10 mA, $V_{GS}$ = 0 |
| Gate to source breakdown voltage | | $V_{(BR)\ GSS}$ | ±20 | — | — | V | $I_G$ = ±100 μA, $V_{DS}$ = 0 |
| Gate to source leak current | | $I_{GSS}$ | — | — | ±10 | μA | $V_{GS}$ = ±16 V, $V_{DS}$ = 0 |
| Zero gate voltage drain current | HAT2038R | $I_{DSS}$ | — | — | 1 | μA | $V_{DS}$ = 60 V, $V_{GS}$ = 0 |
| | HAT2038RJ | $I_{DSS}$ | — | — | 0.1 | μA | |
| Zero gate voltage drain current | HAT2038R | $I_{DSS}$ | — | — | — | μA | $V_{DS}$ = 48 V, $V_{GS}$ = 0<br>Ta = 125°C |
| | HAT2038RJ | $I_{DSS}$ | — | — | 10 | μA | |
| Gate to source cutoff voltage | | $V_{GS\ (off)}$ | 1.2 | — | 2.2 | V | $V_{DS}$ = 10 V, $I_D$ = 1 mA |
| Static drain to source on state resistance | | $R_{DS\ (on)}$ | — | 0.043 | 0.058 | Ω | $I_D$ = 3 A, $V_{GS}$ = 10 V Note 5 |
| | | $R_{DS\ (on)}$ | — | 0.056 | 0.084 | Ω | $I_D$ = 3 A, $V_{GS}$ = 4 V Note 5 |
| Forward transfer admittance | | $\|y_{fs}\|$ | 6 | 9 | — | S | $I_D$ = 3 A, $V_{DS}$ = 10 V Note 5 |
| Input capacitance | | Ciss | — | 520 | — | pF | $V_{DS}$ = 10 V<br>$V_{GS}$ = 0<br>f = 1 MHz |
| Output capacitance | | Coss | — | 270 | — | pF | |
| Reverse transfer capacitance | | Crss | — | 100 | — | pF | |
| Turn-on delay time | | $t_{d\ (on)}$ | — | 11 | — | ns | $V_{GS}$ = 10 V, $I_D$ = 3 A,<br>$V_{DD}$ ≅ 30 V |
| Rise time | | $t_r$ | — | 40 | — | ns | |
| Turn-off delay time | | $t_{d\ (off)}$ | — | 110 | — | ns | |
| Fall time | | $t_f$ | — | 80 | — | ns | |
| Body-drain diode forward voltage | | $V_{DF}$ | — | 0.84 | 1.1 | V | $I_F$ = 5 A, $V_{GS}$ = 0 Note 5 |
| Body-drain diode reverse recovery time | | $t_{rr}$ | — | 40 | — | ns | $I_F$ = 5 A, $V_{GS}$ = 0<br>$di_F/dt$ = 50 A/μs |

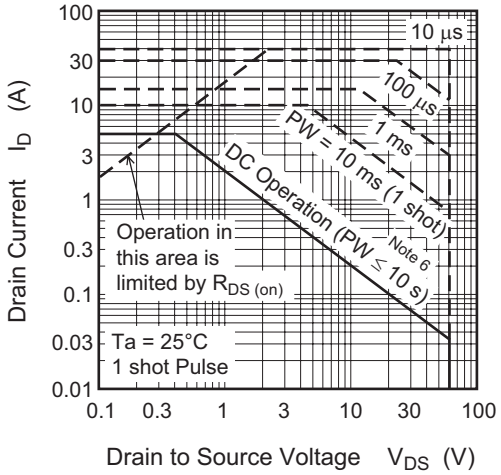
Note: 5. Pulse test

## Main Characteristics

Power vs. Temperature Derating

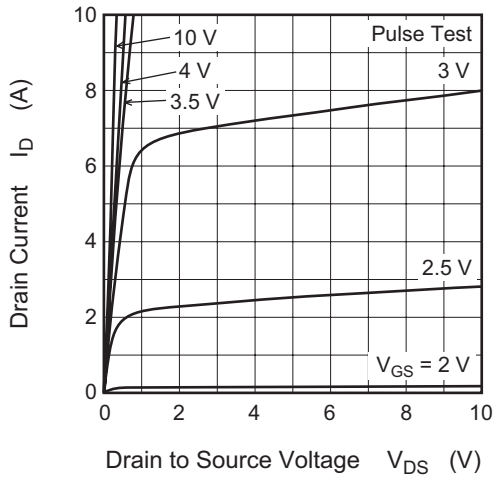



Maximum Safe Operation Area

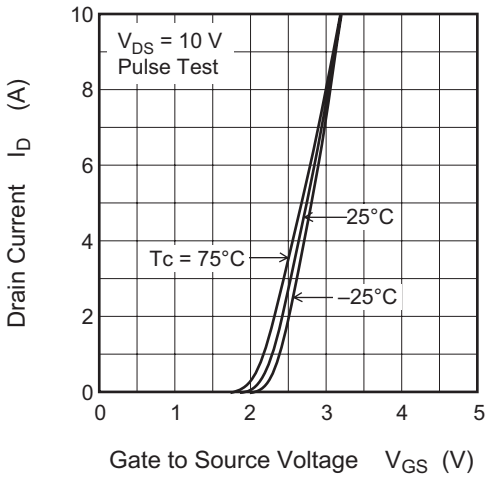



Note 6:
When using the glass epoxy board
(FR4 40 × 40 × 1.6 mm)

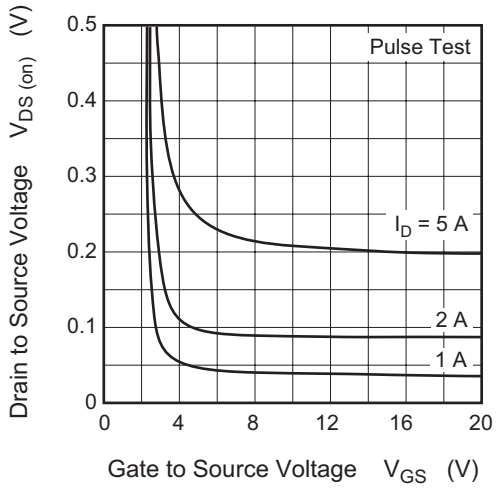
Typical Output Characteristics



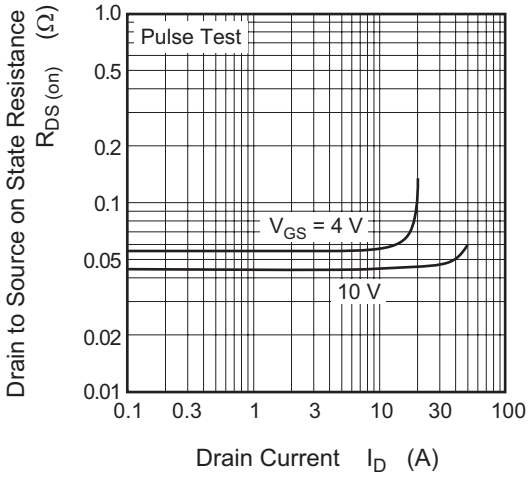

Typical Transfer Characteristics



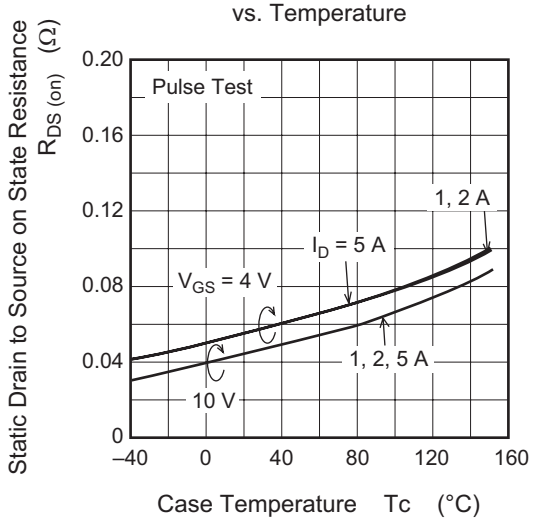

Drain to Source Saturation Voltage vs.
Gate to Source Voltage



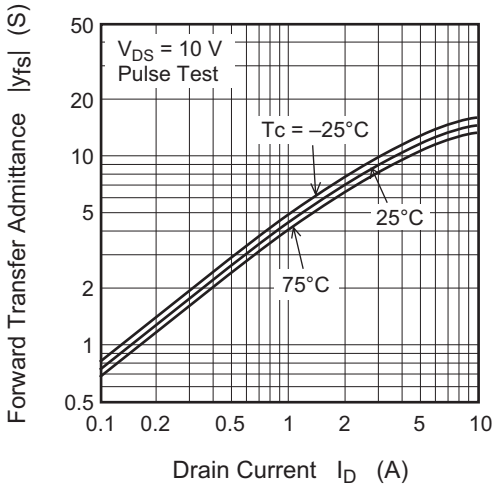

Static Drain to Source on State Resistance
vs. Drain Current



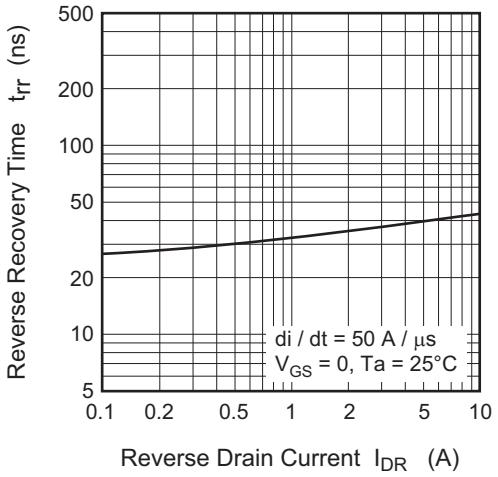
Static Drain to Source on State Resistance vs. Temperature



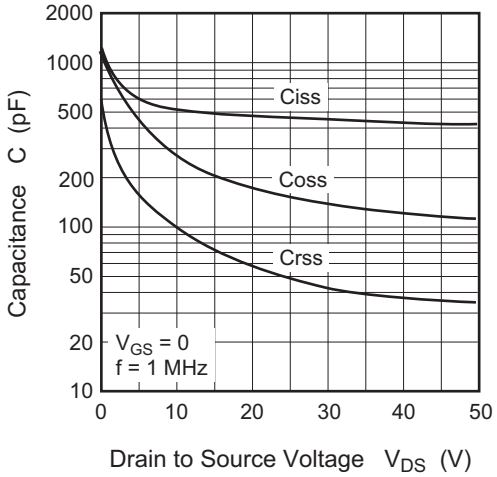

Forward Transfer Admittance vs. Drain Current



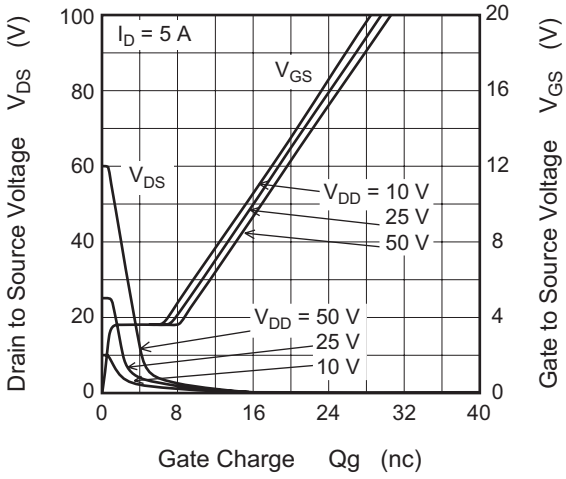

Body-Drain Diode Reverse Recovery Time



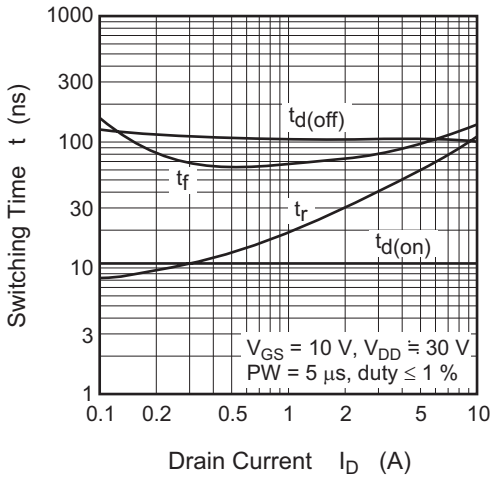

Typical Capacitance vs. Drain to Source Voltage



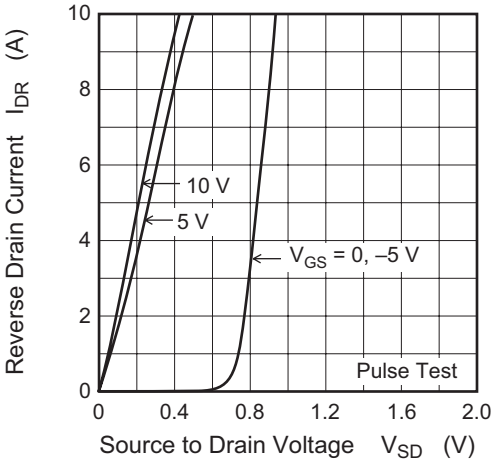

Dynamic Input Characteristics



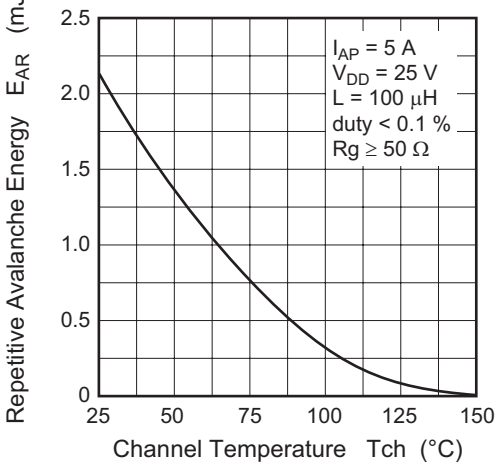

Switching Characteristics



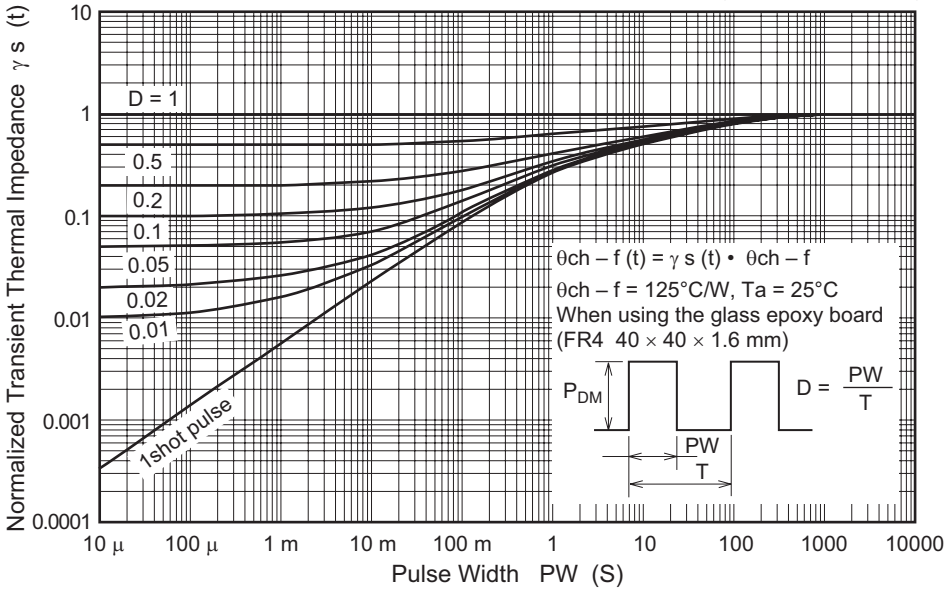
Reverse Drain Current vs. Source to Drain Voltage



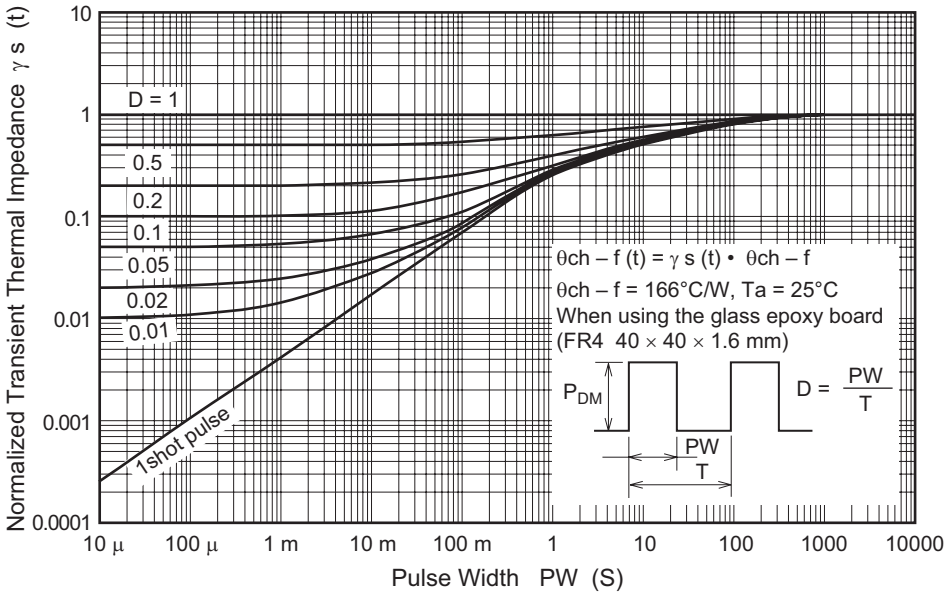

Maximum Avalanche Energy vs. Channel Temperature Derating



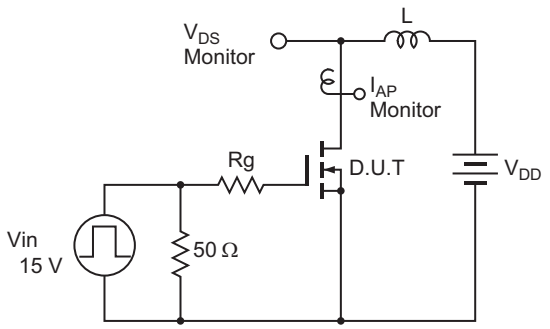

Normalized Transient Thermal Impedance vs. Pulse Width (1 Drive Operation)




Normalized Transient Thermal Impedance vs. Pulse Width (2 Drive Operation)

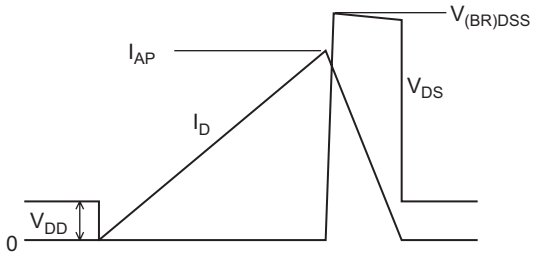


Avalanche Test Circuit

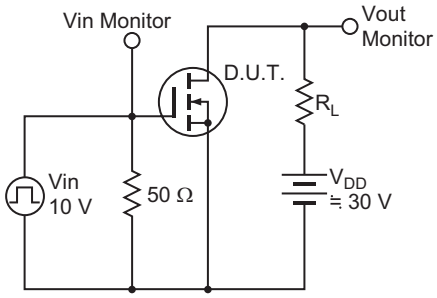



Avalanche Waveform

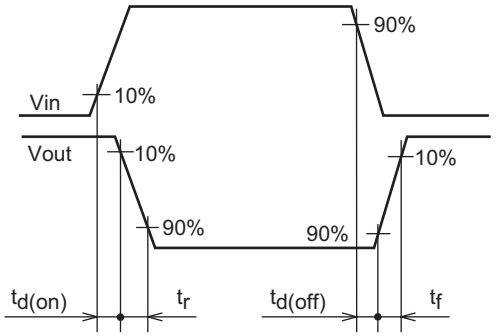
$$E_{AR} = \frac{1}{2} \cdot L \cdot I_{AP}^2 \cdot \frac{V_{DSS}}{V_{DSS} - V_{DD}}$$




Switching Time Test Circuit

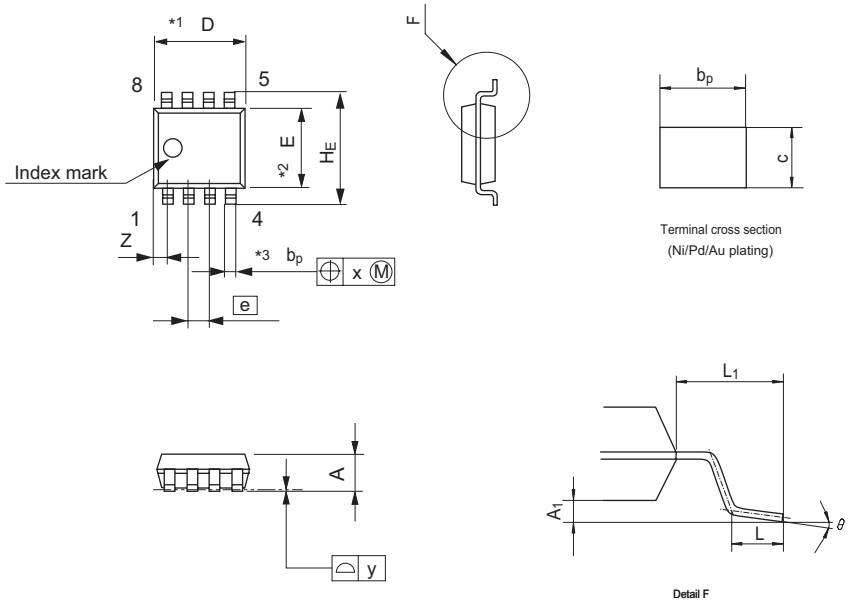



Switching Time Waveform



## Package Dimensions

| Package Name | JEITA Package Code | RENESAS Code | Previous Code | MASS[Typ.] |
|---|---|---|---|---|
| SOP-8 | P-SOP8-3.95 × 4.9-1.27 | PRSP0008DD-D | FP-8DAV | 0.085g |




NOTE)
1. DIMENSIONS "*1(Nom)" AND "*2" DO NOT INCLUDE MOLD FLASH.
2. DIMENSION "*3" DOES NOT INCLUDE TRIM OFFSET.

| Reference Symbol | Dimension in Millimeters | | |
|---|---|---|---|
| | Min | Nom | Max |
| D | — | 4.90 | 5.3 |
| E | — | 3.95 | — |
| $A_2$ | — | — | — |
| $A_1$ | 0.10 | 0.14 | 0.25 |
| A | — | — | 1.75 |
| $b_p$ | 0.34 | 0.40 | 0.46 |
| $b_1$ | — | — | — |
| c | 0.15 | 0.20 | 0.25 |
| $c_1$ | — | — | — |
| θ | 0° | — | 8° |
| $H_E$ | 5.80 | 6.10 | 6.20 |
| e | — | 1.27 | — |
| x | — | — | 0.25 |
| y | — | — | 0.1 |
| Z | — | — | 0.75 |
| L | 0.40 | 0.60 | 1.27 |
| $L_1$ | — | 1.08 | — |

## Ordering Information

| Part Name | Quantity | Shipping Container |
|---|---|---|
| HAT2038R-EL-E | 2500 pcs | Taping |
| HAT2038RJ-EL-E | 2500 pcs | Taping |

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