

# HAT1038R/HAT1038RJ

Silicon P Channel Power MOS FET  
High Speed Power Switching

## HITACHI

ADE-208-663C (Z)

4th. Edition

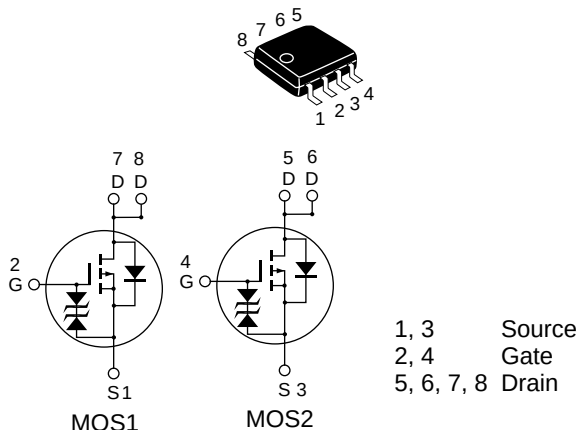
February 1999

### Features

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

### Outline

SOP-8



Absolute Maximum Ratings (Ta = 25°C)

| Item                                   |           | Symbol                          | Ratings       | Unit |
|----------------------------------------|-----------|---------------------------------|---------------|------|
| Drain to source voltage                |           | $V_{DSS}$                       | − 60          | V    |
| Gate to source voltage                 |           | $V_{GSS}$                       | ± 20          | V    |
| Drain current                          |           | $I_D$                           | − 3.5         | A    |
| Drain peak current                     |           | $I_{D(pulse)}$ <sup>Note1</sup> | − 28          | A    |
| Body-drain diode reverse drain current |           | $I_{DR}$                        | − 3.5         | A    |
| Avalanche current                      | HAT1038R  | $I_{AP}$ <sup>Note4</sup>       | —             | —    |
|                                        | HAT1038RJ |                                 | − 3.5         | A    |
| Avalanche energy                       | HAT1038R  | $E_{AR}$ <sup>Note4</sup>       | —             | —    |
|                                        | HAT1038RJ |                                 | 1.05          | mJ   |
| Channel dissipation                    |           | $P_{ch}$ <sup>Note2</sup>       | 2             | W    |
| Channel dissipation                    |           | $P_{ch}$ <sup>Note3</sup>       | 3             | W    |
| Channel temperature                    |           | $T_{ch}$                        | 150           | °C   |
| Storage temperature                    |           | $T_{stg}$                       | − 55 to + 150 | °C   |

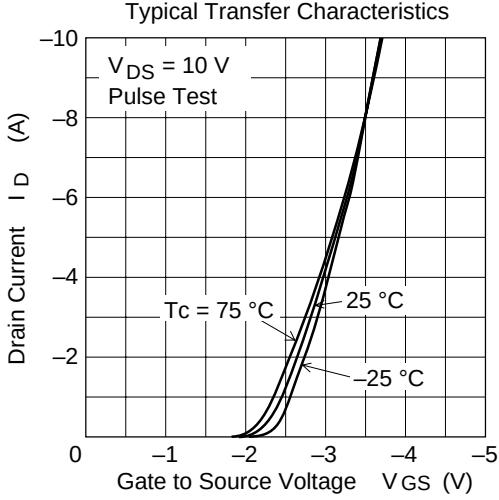
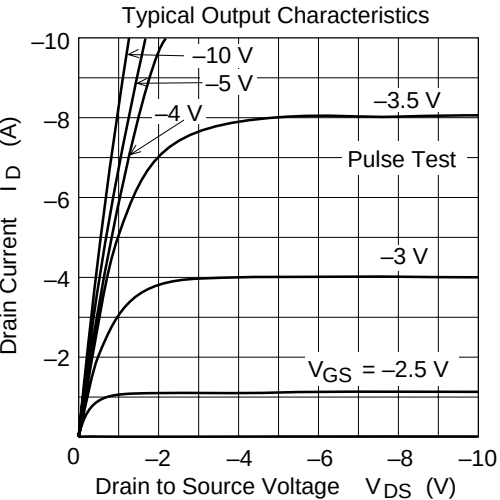
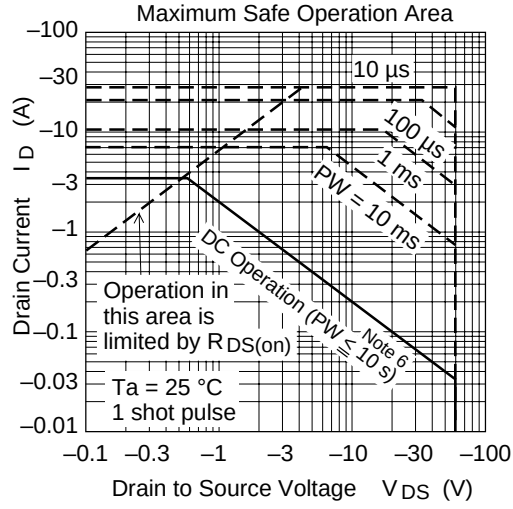
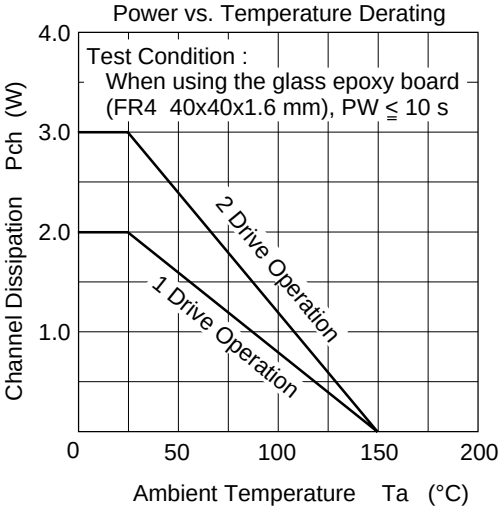
- Note:
- 1.  $PW \leq 10 \mu s$ , duty cycle  $\leq 1 \%$
  - 2. 1 Drive operation : When using the glass epoxy board (FR4 40 x 40 x 1.6 mm),  $PW \leq 10 s$
  - 3. 2 Drive operation : When using the glass epoxy board (FR4 40 x 40 x 1.6 mm),  $PW \leq 10 s$
  - 4. Value at  $T_{ch} = 25^{\circ}C$ ,  $R_g \geq 50 \Omega$

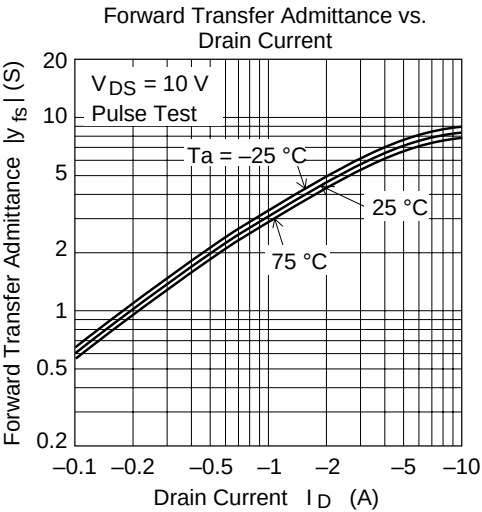
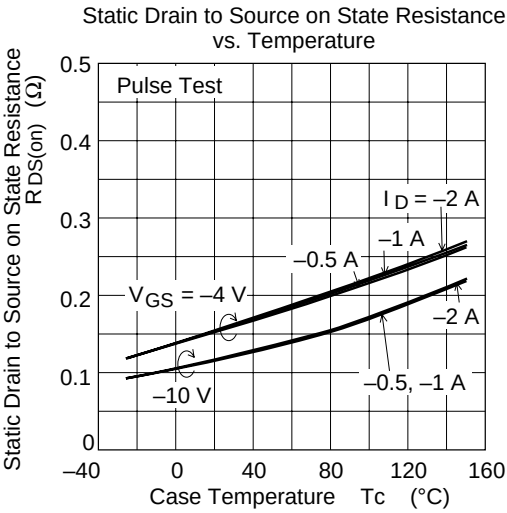
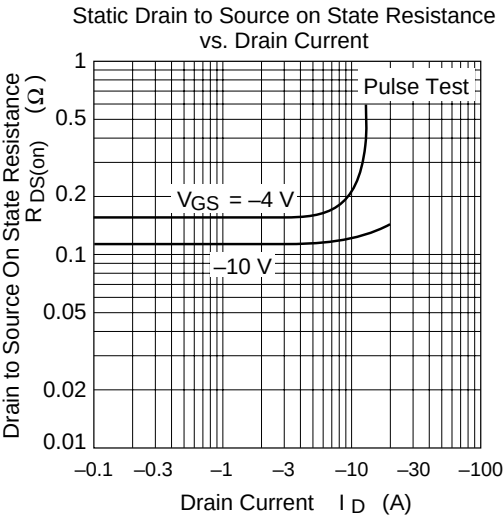
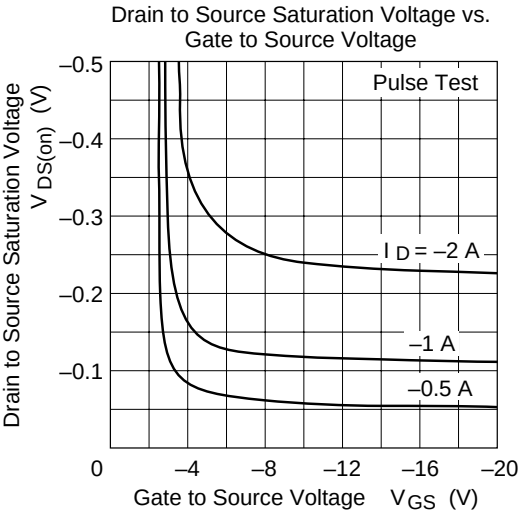
## Electrical Characteristics (Ta = 25°C)

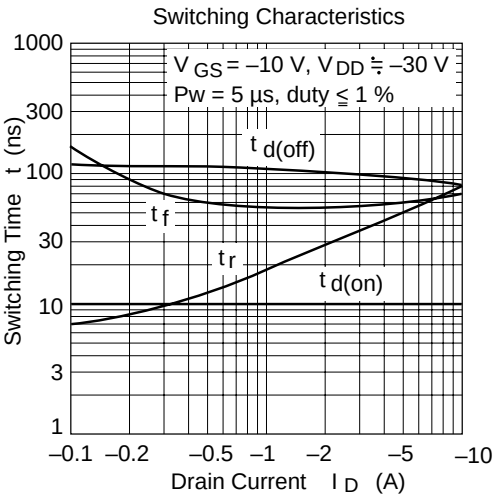
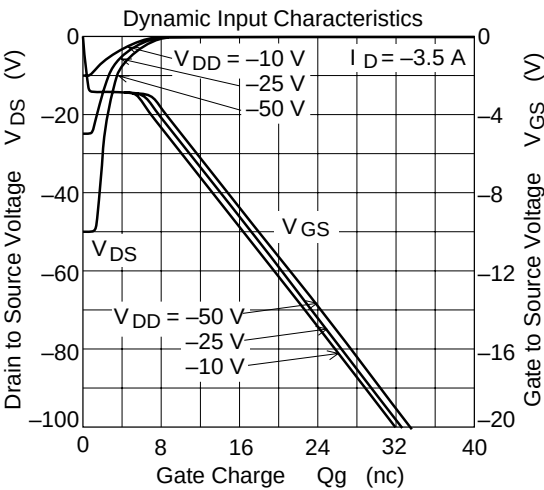
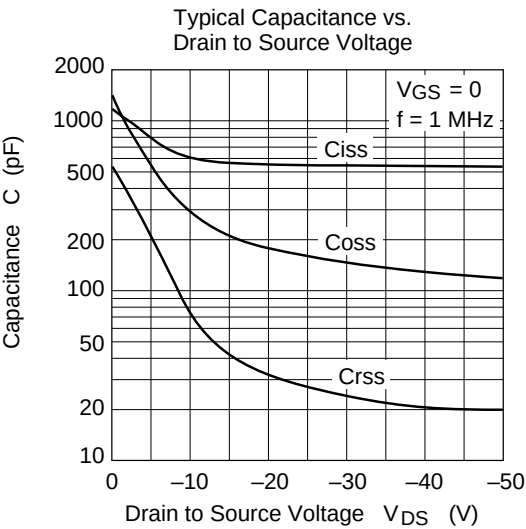
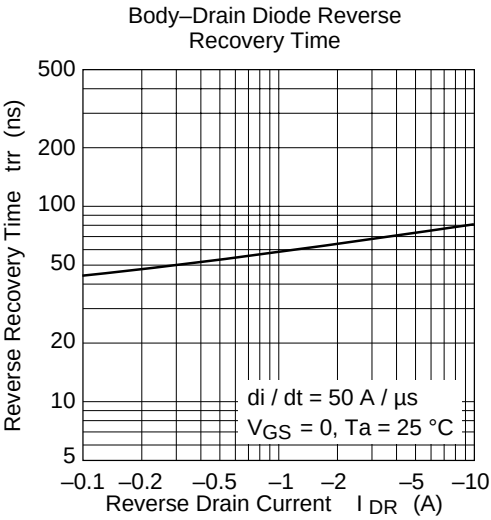
| Item                                   |           | Symbol        | Min      | Typ    | Max      | Unit          | Test Conditions                                                            |
|----------------------------------------|-----------|---------------|----------|--------|----------|---------------|----------------------------------------------------------------------------|
| Drain to source breakdown voltage      |           | $V_{(BR)DSS}$ | - 60     | —      | —        | V             | $I_D = -10 \text{ mA}$ , $V_{GS} = 0$                                      |
| Gate to source breakdown voltage       |           | $V_{(BR)GSS}$ | $\pm 20$ | —      | —        | V             | $I_G = \pm 100 \text{ }\mu\text{A}$ , $V_{DS} = 0$                         |
| Gate to source leak current            |           | $I_{GSS}$     | —        | —      | $\pm 10$ | $\mu\text{A}$ | $V_{GS} = \pm 16 \text{ V}$ , $V_{DS} = 0$                                 |
| Zero gate voltage                      | HAT1038R  | $I_{DSS}$     | —        | —      | - 1      | $\mu\text{A}$ | $V_{DS} = -60 \text{ V}$ , $V_{GS} = 0$                                    |
| drain current                          | HAT1038RJ | $I_{DSS}$     | —        | —      | - 0.1    | $\mu\text{A}$ |                                                                            |
| Zero gate voltage                      | HAT1038R  | $I_{DSS}$     | —        | —      | —        | $\mu\text{A}$ | $V_{DS} = -48 \text{ V}$ , $V_{GS} = 0$                                    |
| drain current                          | HAT1038RJ | $I_{DSS}$     | —        | —      | -10      | $\mu\text{A}$ | Ta=125°C                                                                   |
| Gate to source cutoff voltage          |           | $V_{GS(off)}$ | - 1.2    | —      | - 2.2    | V             | $V_{DS} = -10 \text{ V}$ , $I_D = -1 \text{ mA}$                           |
| Static drain to source on state        |           | $R_{DS(on)}$  | —        | 0.12   | 0.15     | $\Omega$      | $I_D = -2 \text{ A}$ , $V_{GS} = -10 \text{ V}$ <sup>Note5</sup>           |
| resistance                             |           | $R_{DS(on)}$  | —        | 0.16   | 0.23     | $\Omega$      | $I_D = -2 \text{ A}$ , $V_{GS} = -4 \text{ V}$ <sup>Note5</sup>            |
| Forward transfer admittance            |           | $ y_{fs} $    | 3        | 4.5    | —        | S             | $I_D = -2 \text{ A}$ , $V_{DS} = -10 \text{ V}$ <sup>Note5</sup>           |
| Input capacitance                      |           | $C_{iss}$     | —        | 600    | —        | pF            | $V_{DS} = -10 \text{ V}$                                                   |
| Output capacitance                     |           | $C_{oss}$     | —        | 290    | —        | pF            | $V_{GS} = 0$                                                               |
| Reverse transfer capacitance           |           | $C_{rss}$     | —        | 75     | —        | pF            | $f = 1\text{MHz}$                                                          |
| Turn-on delay time                     |           | $t_{d(on)}$   | —        | 11     | —        | ns            | $V_{GS} = -10 \text{ V}$ , $I_D = -2 \text{ A}$                            |
| Rise time                              |           | $t_r$         | —        | 30     | —        | ns            | $V_{DD} \cong -30 \text{ V}$                                               |
| Turn-off delay time                    |           | $t_{d(off)}$  | —        | 100    | —        | ns            |                                                                            |
| Fall time                              |           | $t_f$         | —        | 55     | —        | ns            |                                                                            |
| Body-drain diode forward voltage       |           | $V_{DF}$      | —        | - 0.98 | - 1.28   | V             | $I_F = -3.5 \text{ A}$ , $V_{GS} = 0$ <sup>Note5</sup>                     |
| Body-drain diode reverse recovery time |           | $t_{rr}$      | —        | 70     | —        | ns            | $I_F = -3.5 \text{ A}$ , $V_{GS} = 0$<br>$diF/dt = 50\text{A}/\mu\text{s}$ |

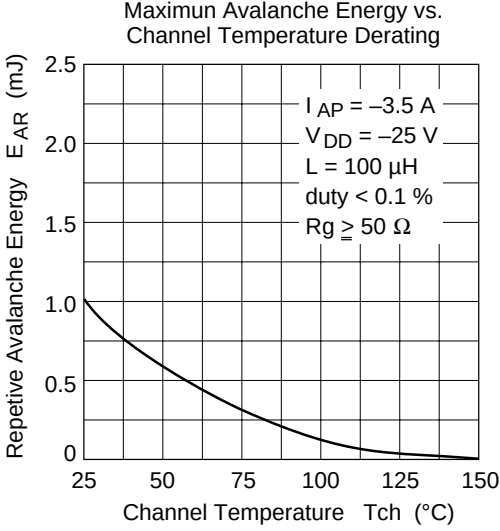
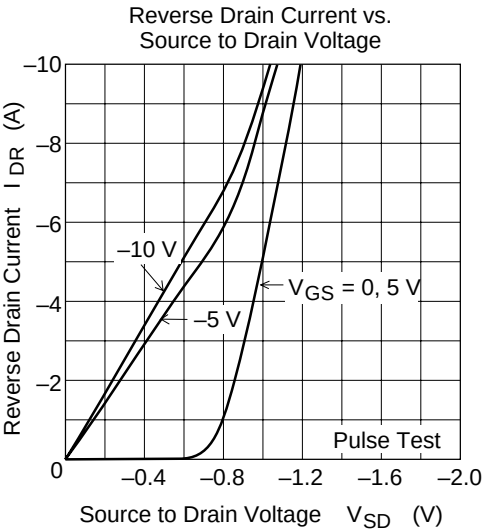
Note: 5. Pulse test

Main Characteristics

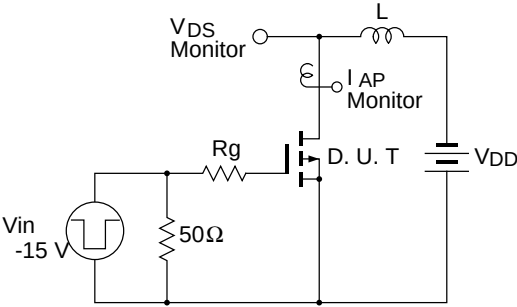






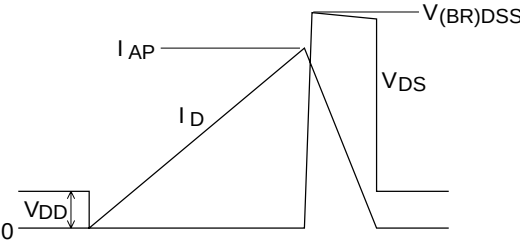


Avalanche Test Circuit

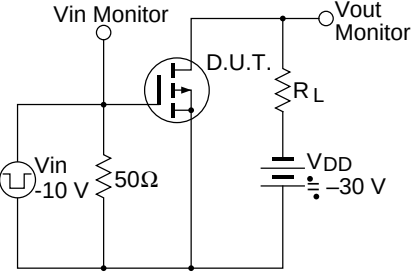


Avalanche Waveform

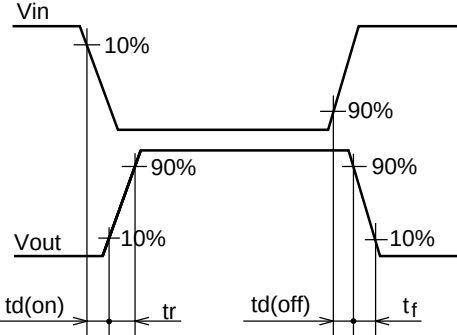
$$E_{AR} = \frac{1}{2} \cdot L \cdot I_{AP}^2 \cdot \frac{V_{DSS}}{V_{DSS} - V_{DD}}$$

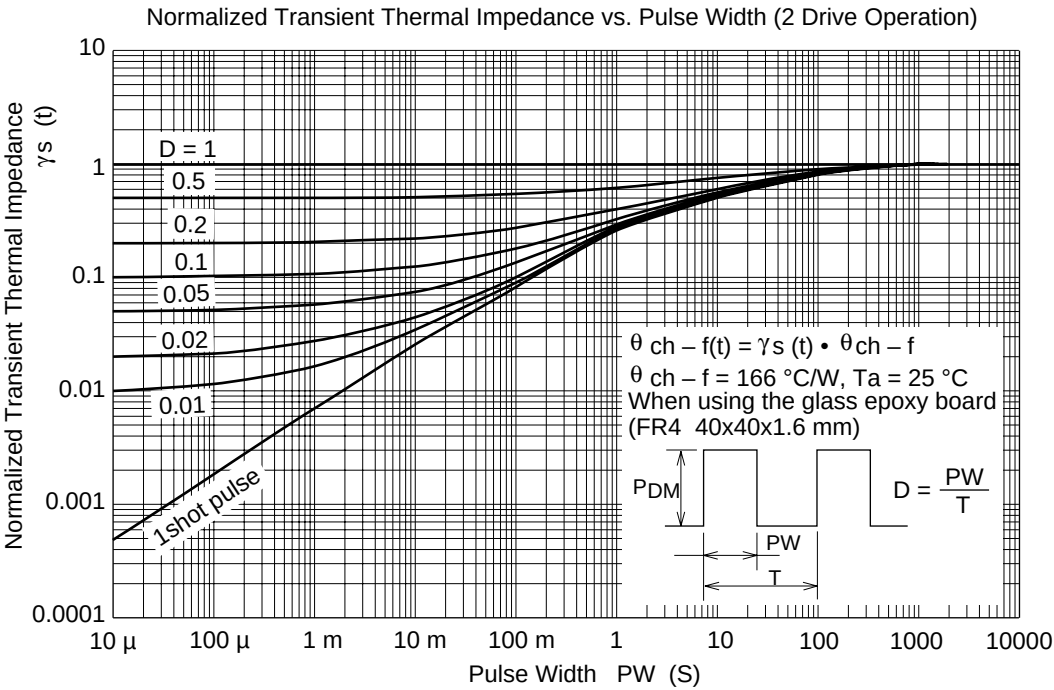
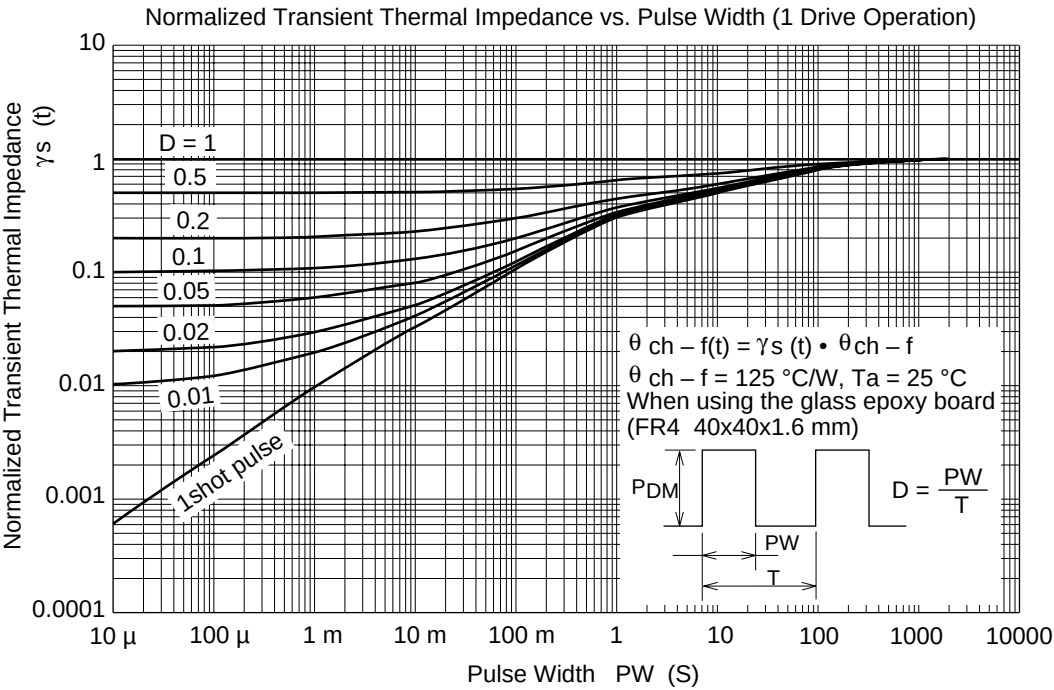


Switching Time Test Circuit



Switching Time Waveform

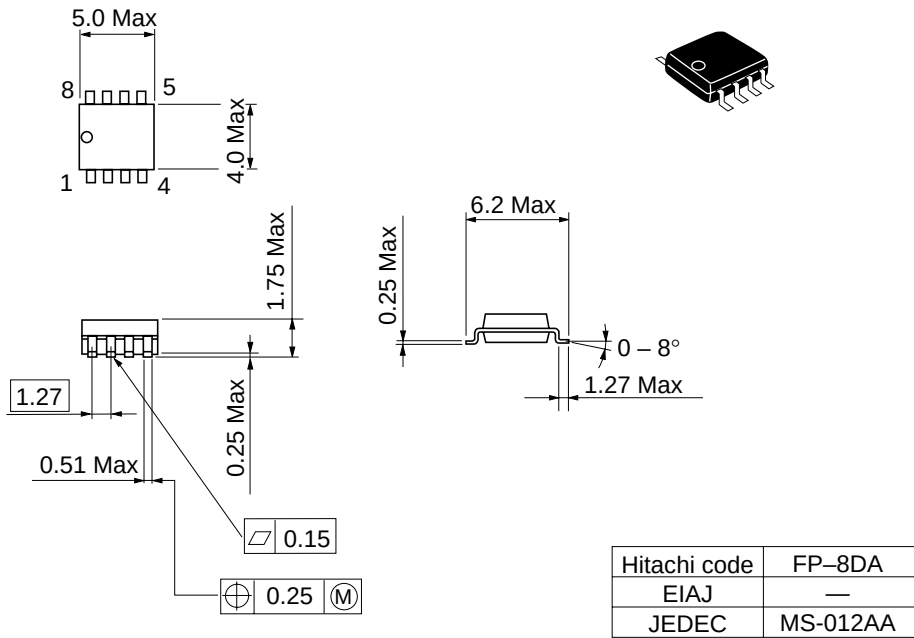






Package Dimensions

Unit: mm



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