# RJM0603JSC

## Silicon N/P Channel Power MOS FET (6 in 1 Type)
## High Speed Power Switching

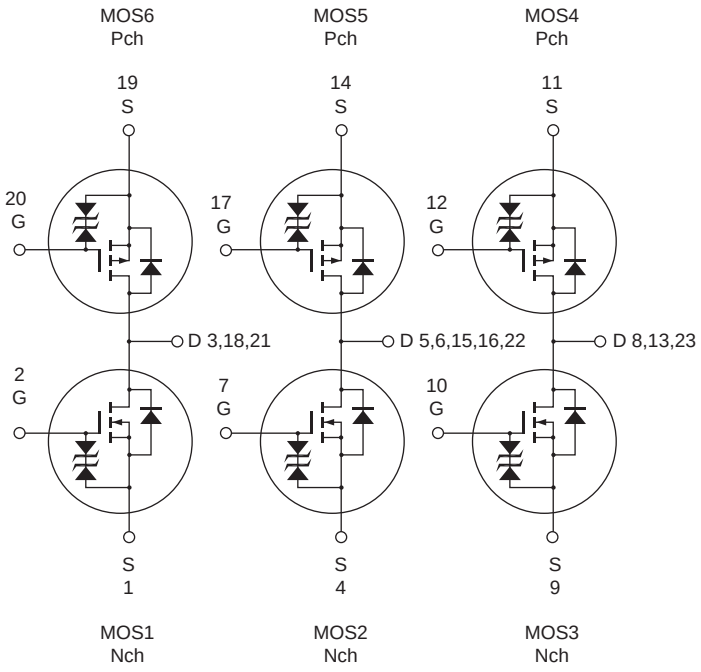
R07DS0339EJ0501
Rev.5.01
Jul 22, 2011

### Features

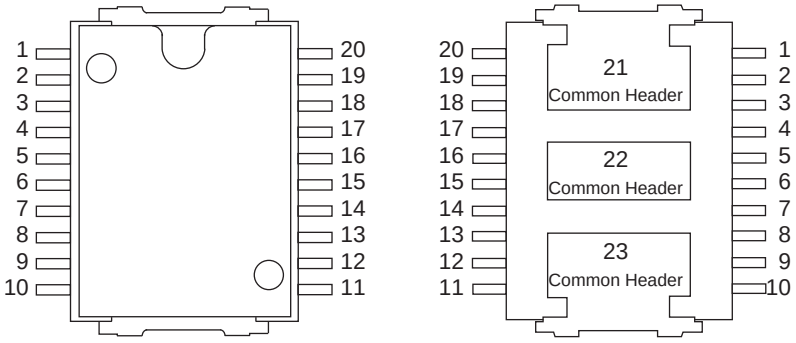
- For Automotive applications
- AEC-Q101 compliant
- N/P Channel MOS FET (6 in 1 Type). High density mounting
- Low on-resistance
- Capable of 4.5 V gate drive

### Outline

RENESAS Package Code: PRSP0020DF-A
(Package Name: HSOP-20)

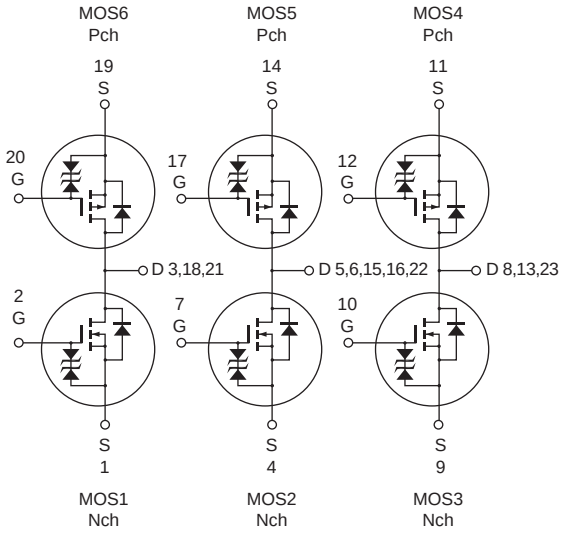


## Pin Arrangement




(Top View) (Bottom View)

| No. | | |
|---|---|---|
| 1 | MOS1 | Source |
| 2 | MOS1 | Gate |
| 3, 18 | MOS1, 6 | Drain |
| 4 | MOS2 | Source |
| 5, 6, 15, 16 | MOS2, 5 | Drain |
| 7 | MOS2 | Gate |
| 8, 13 | MOS3, 4 | Drain |
| 9 | MOS3 | Source |
| 10 | MOS3 | Gate |
| 11 | MOS4 | Source |
| 12 | MOS4 | Gate |
| 14 | MOS5 | Source |
| 17 | MOS5 | Gate |
| 19 | MOS6 | Source |
| 20 | MOS6 | Gate |
| 21 | MOS1, 6 | Drain (Header) |
| 22 | MOS2, 5 | Drain (Header) |
| 23 | MOS3, 4 | Drain (Header) |




## Absolute Maximum Ratings

(Ta = 25°C)

| Item | Symbol | Value | | Unit |
|---|---|---|---|---|
| | | MOS1, 2, 3 (Nch) | MOS4, 5, 6 (Pch) | |
| Drain to source voltage | $V_{DSS}$ | 60 | –60 | V |
| Gate to source voltage | $V_{GSS}$ | +20 / –5 | –20 / +5 | V |
| Drain current | $I_D$ | 20 | –20 | A |
| Drain peak current | $I_D$ (pulse) Note1 | 80 | –80 | A |
| Channel dissipation | Pch Note2 | 54 | 54 | W |
| Avalanche current | $I_{AP}$ Note3 | 20 | 20 | A |
| Avalanche energy | $E_{AR}$ Note3 | 34 | 34 | mJ |
| Channel temperature | Tch Note4 | 175 | 175 | °C |
| Storage temperature | Tstg | –55 to +150 | –55 to +150 | °C |

Notes: 1. PW ≤ 10μs duty cycle ≤ 1%
2. 1 Drive Operation ; Value at Tc = 25°C
3. Value at Tch = 25°C, Rg ≥ 50 Ω
4. AEC-Q101 compliant

## Thermal Impedance Characteristics

- Channel to case thermal impedance θch-c: 2.78°C/W

## Electrical Characteristics

### • MOS1, MOS2, MOS3 (N Channel)

(Ta = 25°C)

| Item | Symbol | Min | Typ | Max | Unit | Test Conditions |
|---|---|---|---|---|---|---|
| Zero gate voltage drain current | $I_{DSS}$ | — | — | 10 | μA | $V_{DS}$ = 60 V, $V_{GS}$ = 0 |
| Gate to source leak current | $I_{GSS}$ | — | — | ±10 | μA | $V_{GS}$ = +20 V / –5 V, $V_{DS}$ = 0 |
| Gate to source cutoff voltage | $V_{GS(off)}$ | 1.0 | — | 2.5 | V | $V_{DS}$ = 10 V, $I_D$ = 1 mA |
| Static drain to source on state resistance | $R_{DS(on)}$ | — | 16 | 20 | mΩ | $I_D$ = 10 A, $V_{GS}$ = 10 V Note5 |
| | | — | 21 | 32 | mΩ | $I_D$ = 10 A, $V_{GS}$ = 4.5 V Note5 |
| Input capacitance | Ciss | — | 2600 | — | pF | $V_{DS}$ = 10V, $V_{GS}$ = 0, f = 1 MHz |
| Output capacitance | Coss | — | 290 | — | pF | |
| Reverse transfer capacitance | Crss | — | 140 | — | pF | |
| Total gate charge | Qg | — | 43 | — | nC | $V_{DD}$ = 25 V, $V_{GS}$ = 10 V, $I_D$ = 20 A |
| Gate to source charge | Qgs | — | 6.2 | — | nC | |
| Gate to drain charge | Qgd | — | 7.2 | — | nC | |
| Turn-on delay time | $t_{d(on)}$ | — | 13 | — | ns | $V_{GS}$ = 10 V, $I_D$ = 10 A, $V_{DD}$ ≅ 30 V, $R_L$ = 3 Ω, $R_G$ = 4.7 Ω |
| Rise time | $t_r$ | — | 6 | — | ns | |
| Turn-off delay time | $t_{d(off)}$ | — | 65 | — | ns | |
| Fall time | $t_f$ | — | 4.5 | — | ns | |
| Body-drain diode forward voltage | $V_{DF}$ | — | 0.91 | 1.18 | V | $I_F$ = 20 A, $V_{GS}$ = 0 Note5 |
| Body-drain diode reverse recovery time | $t_{rr}$ | — | 35 | — | ns | $I_F$ = 20 A, $V_{GS}$ = 0, $di_F/dt$ = 100 A/μs |

Note: 5. Pulse test

### • MOS4, MOS5, MOS6 (P Channel)

(Ta = 25°C)

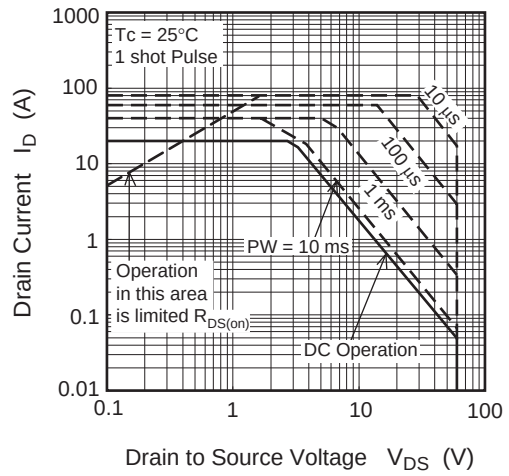
| Item | Symbol | Min | Typ | Max | Unit | Test Conditions |
|---|---|---|---|---|---|---|
| Zero gate voltage drain current | $I_{DSS}$ | — | — | –10 | μA | $V_{DS}$ = –60 V, $V_{GS}$ = 0 |
| Gate to source leak current | $I_{GSS}$ | — | — | ±10 | μA | $V_{GS}$ = –20 V / +5 V, $V_{DS}$ = 0 |
| Gate to source cutoff voltage | $V_{GS(off)}$ | –1.0 | — | –2.5 | V | $V_{DS}$ = –10 V, $I_D$ = –1 mA |
| Static drain to source on state resistance | $R_{DS(on)}$ | — | 32 | 40 | mΩ | $I_D$ = –10 A, $V_{GS}$ = –10 V Note6 |
| | | — | 42 | 64 | mΩ | $I_D$ = –10 A, $V_{GS}$ = –4.5 V Note6 |
| Input capacitance | Ciss | — | 2600 | — | pF | $V_{DS}$ = –10 V, $V_{GS}$ = 0, f = 1 MHz |
| Output capacitance | Coss | — | 330 | — | pF | |
| Reverse transfer capacitance | Crss | — | 240 | — | pF | |
| Total gate charge | Qg | — | 53 | — | nC | $V_{DD}$ = –25 V, $V_{GS}$ = –10 V, $I_D$ = –20 A |
| Gate to source charge | Qgs | — | 8.8 | — | nC | |
| Gate to drain charge | Qgd | — | 13 | — | nC | |
| Turn-on delay time | $t_{d(on)}$ | — | 22 | — | ns | $V_{GS}$ = –10 V, $I_D$= –10 A, $V_{DD}$ ≅ –30 V, $R_L$ = 3 Ω, $R_G$ = 4.7 Ω |
| Rise time | $t_r$ | — | 17 | — | ns | |
| Turn-off delay time | $t_{d(off)}$ | — | 100 | — | ns | |
| Fall time | $t_f$ | — | 20 | — | ns | |
| Body-drain diode forward voltage | $V_{DF}$ | — | –0.95 | –1.24 | V | $I_F$ = –20 A, $V_{GS}$ = 0 Note6 |
| Body-drain diode reverse recovery time | $t_{rr}$ | — | 50 | — | ns | $I_F$ = –20 A, $V_{GS}$ = 0, $di_F/dt$ = 100 A/μs |

Note: 6. Pulse test

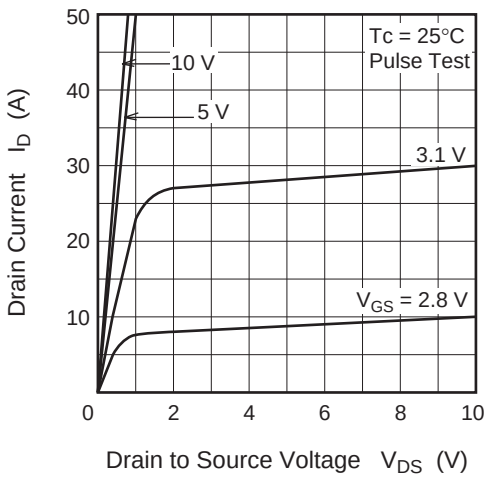
## Main Characteristics

• **MOS1, MOS2, MOS3 (N Channel)**

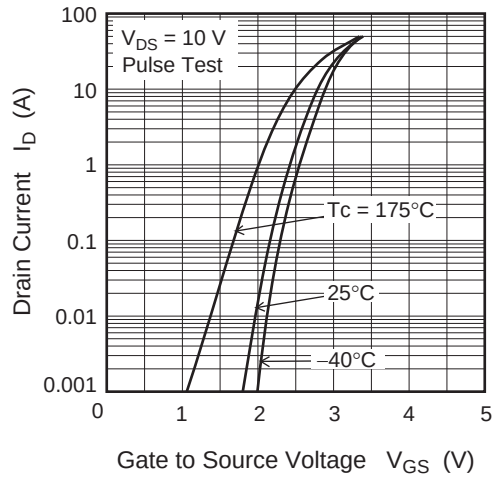
Maximum Safe Operation Area



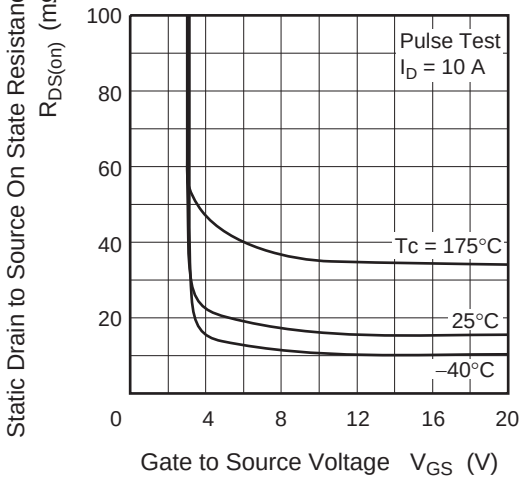

Typical Output Characteristics



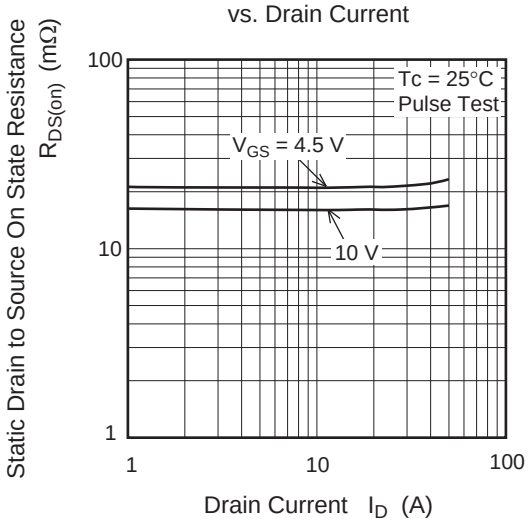

Typical Transfer Characteristics



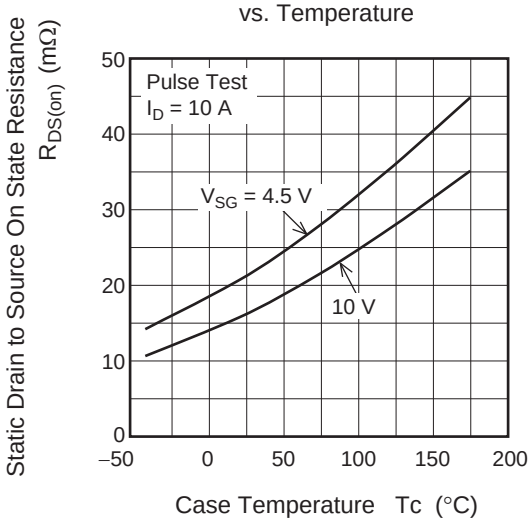

Static Drain to Source On State Resistance vs. Gate to Source Voltage




Static Drain to Source State On Resistance vs. Drain Current

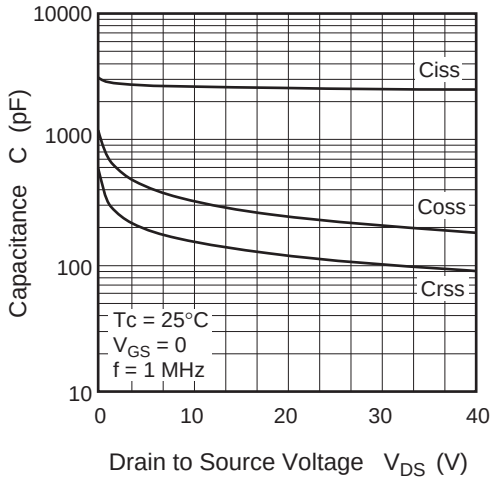



Static Drain to Source on State Resistance vs. Temperature

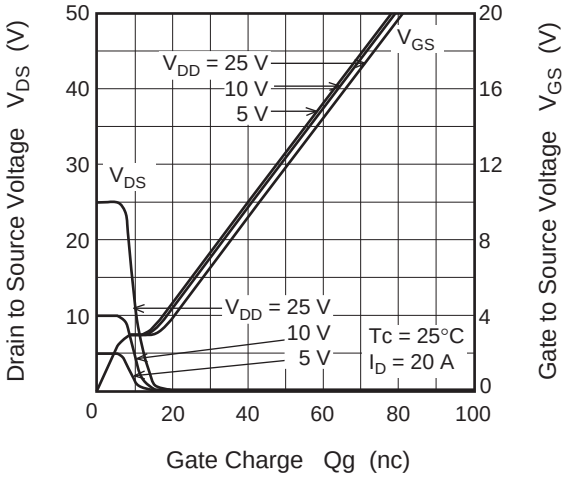


## • MOS1, MOS2, MOS3 (N Channel)

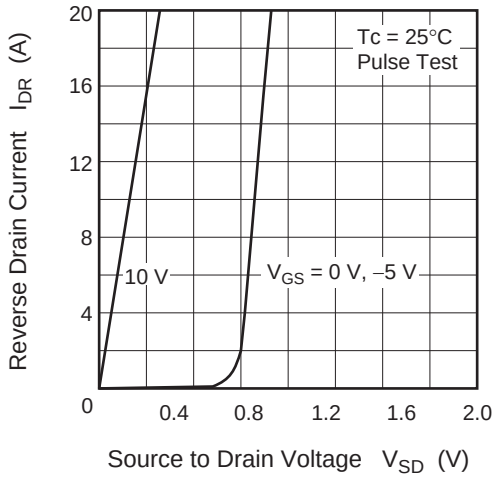
Typical Capacitance vs.
Drain to Source Voltage



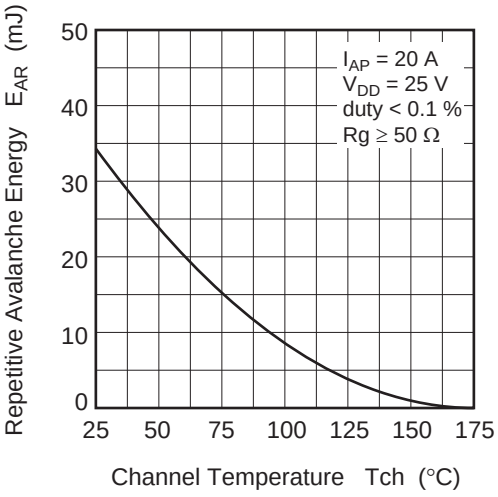

Dynamic Input Characteristics



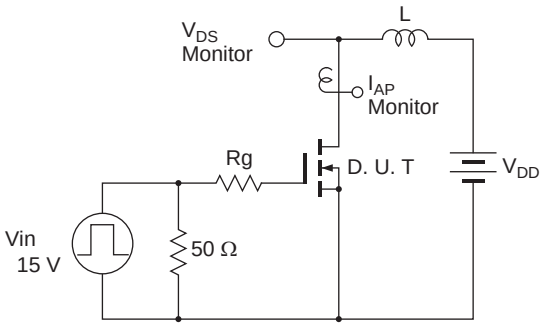

Reverse Drain Current vs.
Source to Drain Voltage




Avalanche Energy vs.
Channel Temperature Derating

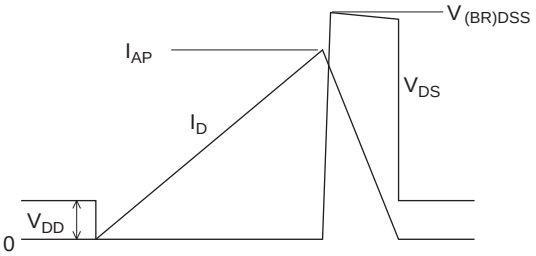



Avalanche Test Circuit



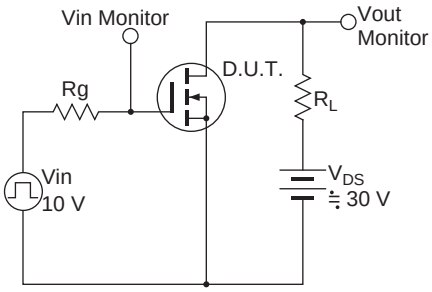

Avalanche Waveform

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

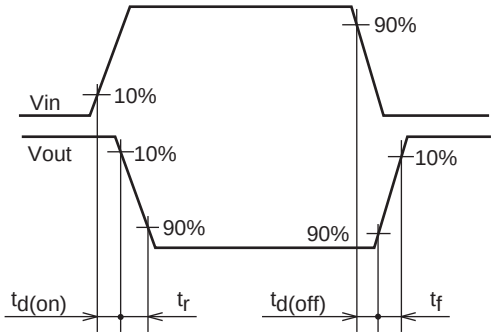


• **MOS1, MOS2, MOS3 (N Channel)**

Switching Time Test Circuit

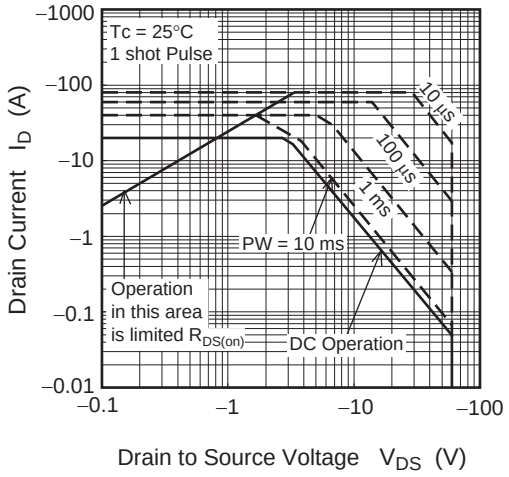



Switching Time Waveform

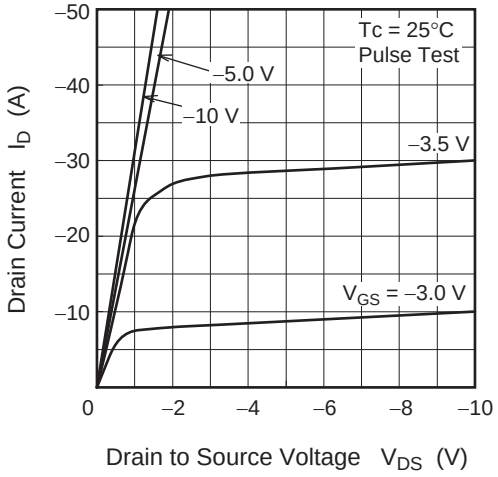


## • MOS4, MOS5, MOS6 (P Channel)

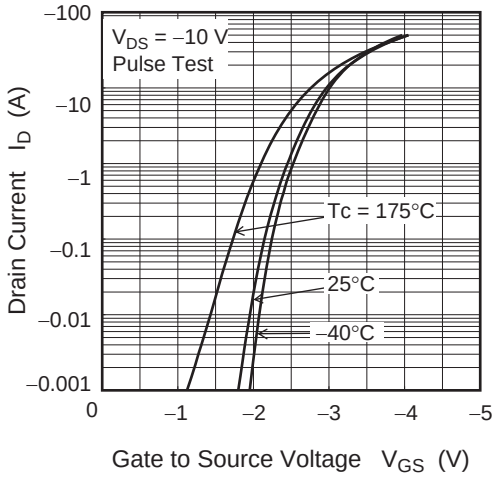
Maximum Safe Operation Area



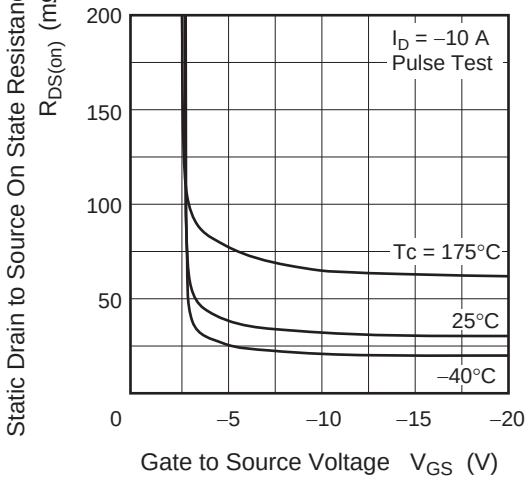

Typical Output Characteristics



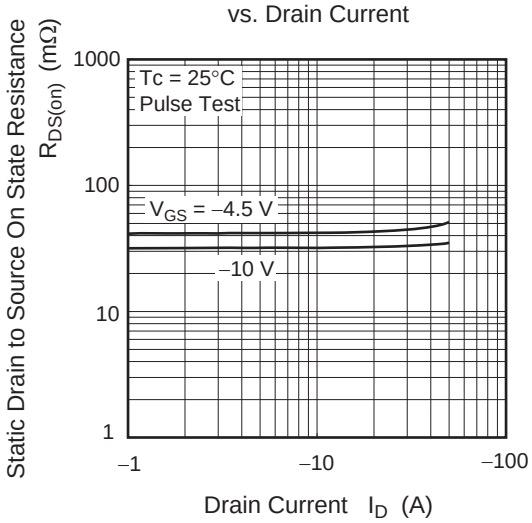

Typical Transfer Characteristics



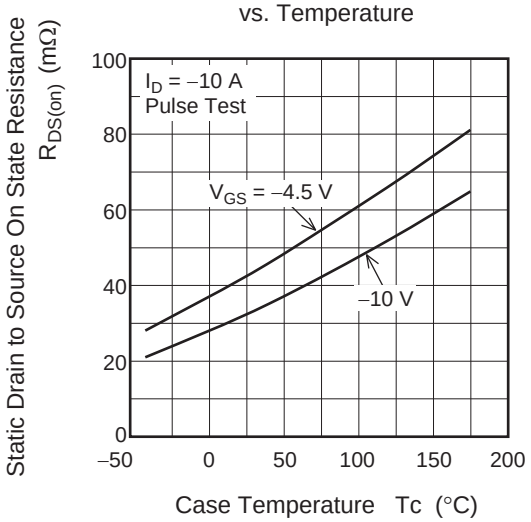

Static Drain to Source On State Resistance vs. Gate to Source Voltage




Static Drain to Source On State Resistance vs. Drain Current

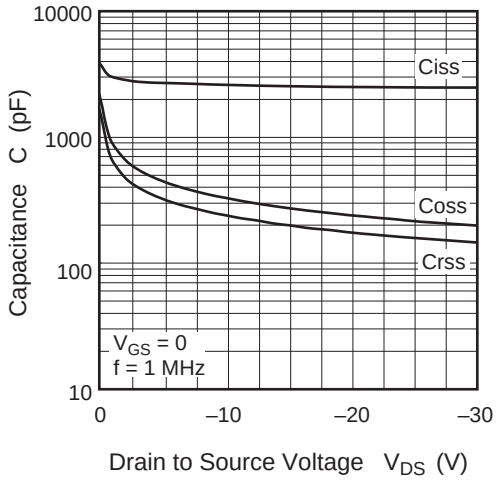



Static Drain to Source on State Resistance vs. Temperature

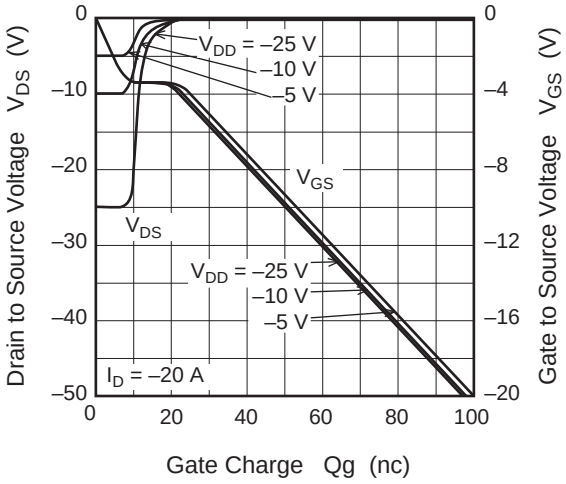


## • MOS4, MOS5, MOS6 (P Channel)

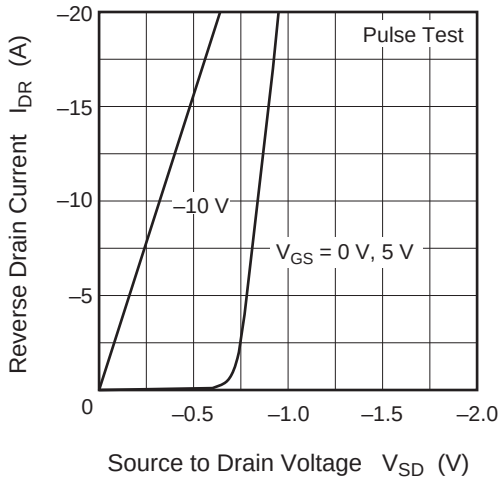
Typical Capacitance vs. Drain to Source Voltage



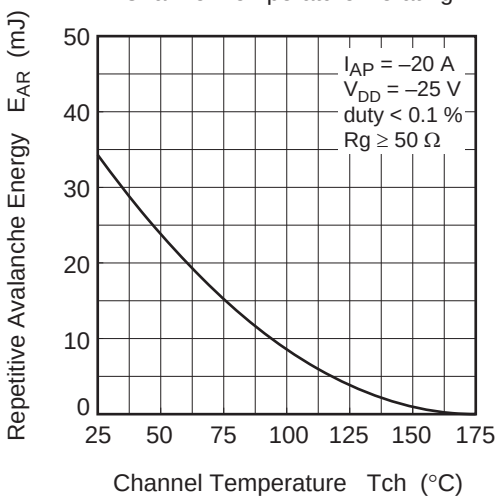

Dynamic Input Characteristics



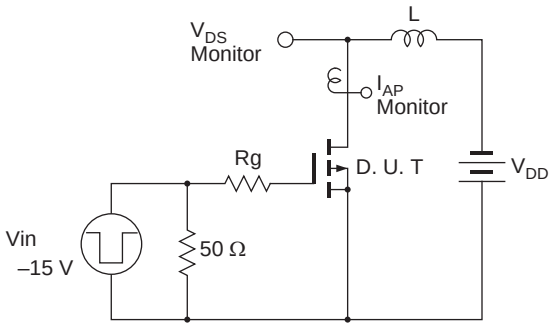

Reverse Drain Current vs. Source to Drain Voltage




Avalanche Energy vs. Channel Temperature Derating

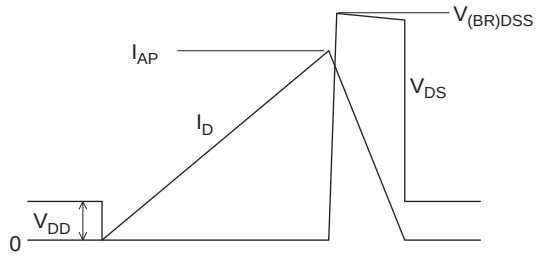



Avalanche Test Circuit



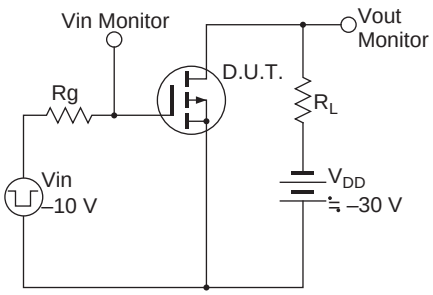

Avalanche Waveform

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

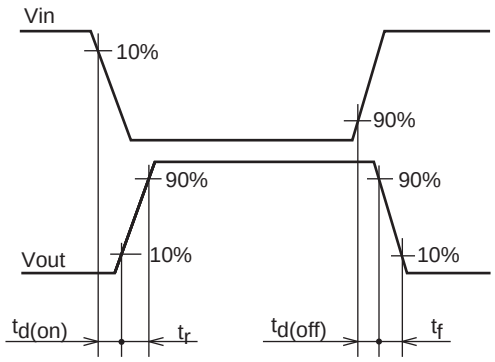


• **MOS4, MOS5, MOS6 (P Channel)**

Switching Time Test Circuit

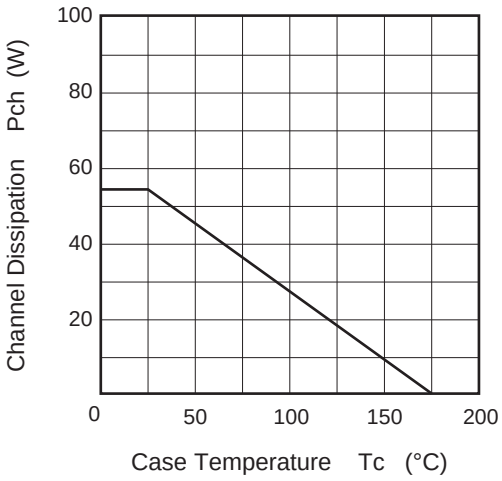



Switching Time Waveform

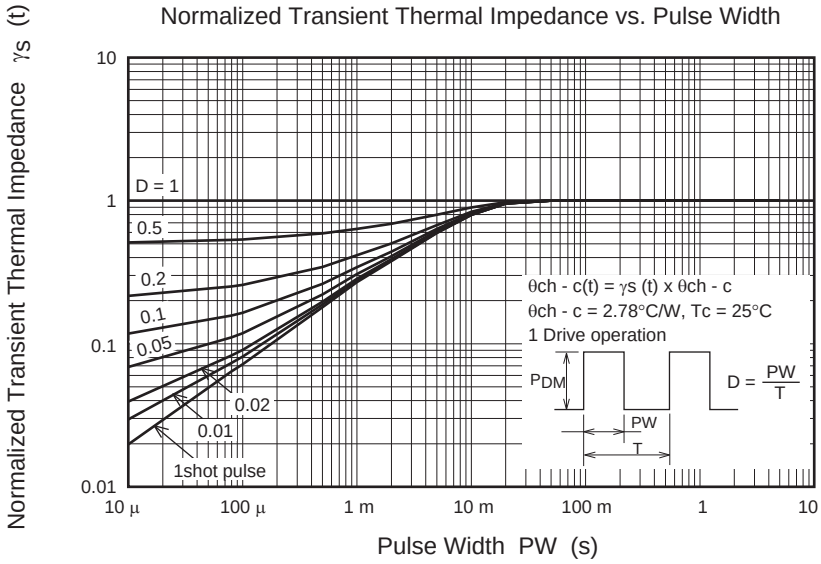


## • Common

Power vs. Temperature Derating

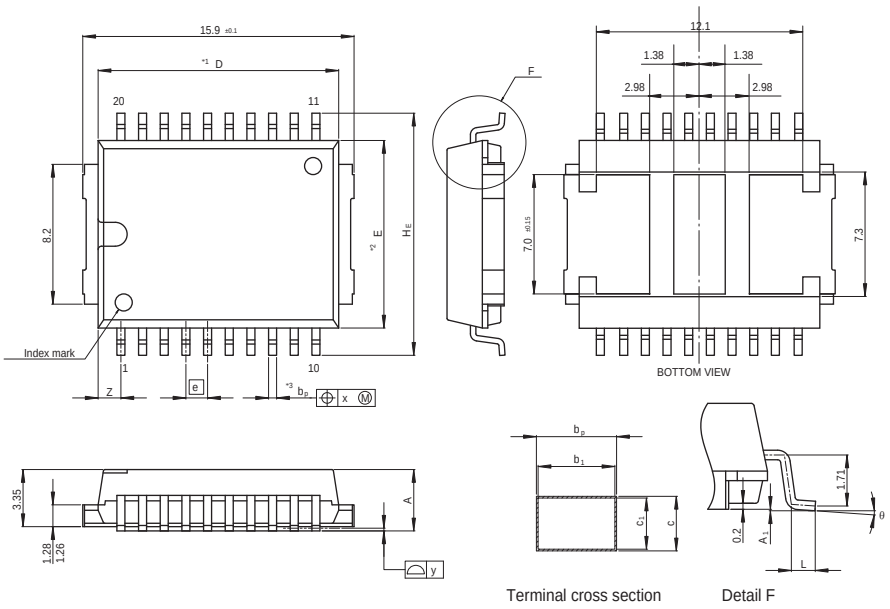



Normalized Transient Thermal Impedance vs. Pulse Width



## Package Dimensions

| JEITA Package Code | RENESAS Code | Previous Code | MASS[Typ.] |
|---|---|---|---|
| P-HSOP20-11x14.1-1.27 | PRSP0020DF-A | — | 2.0g |




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

| Reference Symbol | Dimension in Millimeters | | |
|---|---|---|---|
| | Min | Nom | Max |
| D | 13.95 | 14.1 | 14.25 |
| E | 10.9 | 11.0 | 11.1 |
| $A_2$ | — | — | — |
| $A_1$ | 0.01 | 0.05 | 0.10 |
| A | — | — | 3.6 |
| $b_p$ | 0.40 | 0.47 | 0.53 |
| $b_1$ | — | 0.45 | — |
| c | 0.28 | 0.32 | 0.37 |
| $c_1$ | — | 0.30 | — |
| θ | 0° | — | 8° |
| $H_E$ | 14.0 | 14.2 | 14.4 |
| e | — | 1.27 | — |
| x | — | — | 0.25 |
| y | — | — | 0.1 |
| Z | — | — | 1.8 |
| L | 0.65 | 0.8 | 0.95 |
| $L_1$ | — | — | — |

## Ordering Information

| Orderable Part Number | Quantity | Shipping Container |
|---|---|---|
| RJM0603JSC-00-12 | 700 pcs | Tray |

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