HAT2038R/HAT2038RJ

Silicon N Channel Power MOS FET
High Speed Power Switching

HITACHI

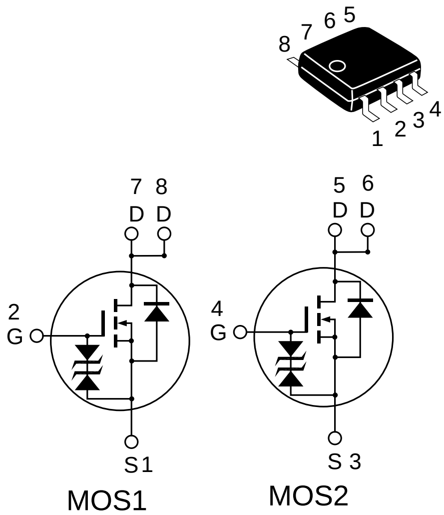
ADE-208-666C (Z)
4th. Edition
February 1999

Features

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

Outline

SOP–8



1, 3	Source
2, 4	Gate
5, 6, 7, 8	Drain

Hitachi semiconductor

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	5	A
Drain peak current		$I_{D(pulse)}$ Note1	40	A
Body-drain diode reverse drain current		I_{DR}	5	A
Avalanche current	HAT2038R	I_{AP} Note4	—	—
	HAT2038RJ		5	A
Avalanche energy	HAT2038R	E_{AR} Note4	—	—
	HAT2038RJ		2.14	mJ
Channel dissipation		Pch Note2	2	W
Channel dissipation		Pch Note3	3	W
Channel temperature		Tch	150	°C
Storage temperature		Tstg	– 55 to + 150	°C

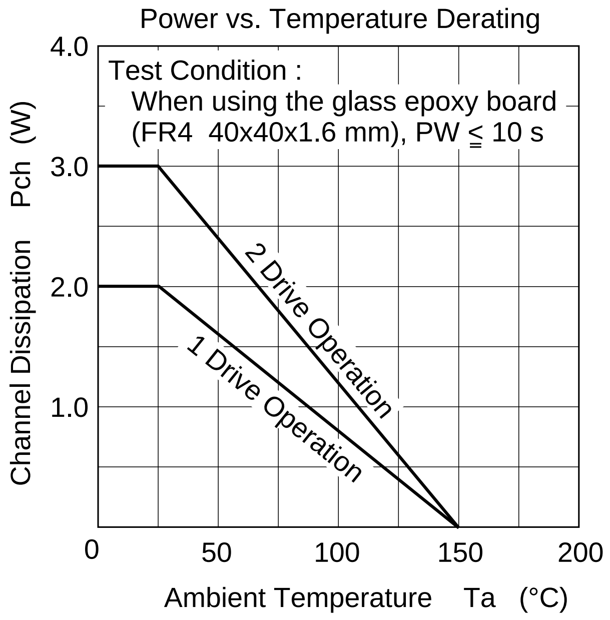
Note: 1. PW ≤ 10µs, duty cycle ≤ 1 %
2. 1 Drive operation : When using the glass epoxy board (FR4 40 x 40 x 1.6 mm), PW≤ 10s
3. 2 Drive operation : When using the glass epoxy board (FR4 40 x 40 x 1.6 mm), PW≤ 10s
4. Value at Tch=25°C, Rg≥50Ω

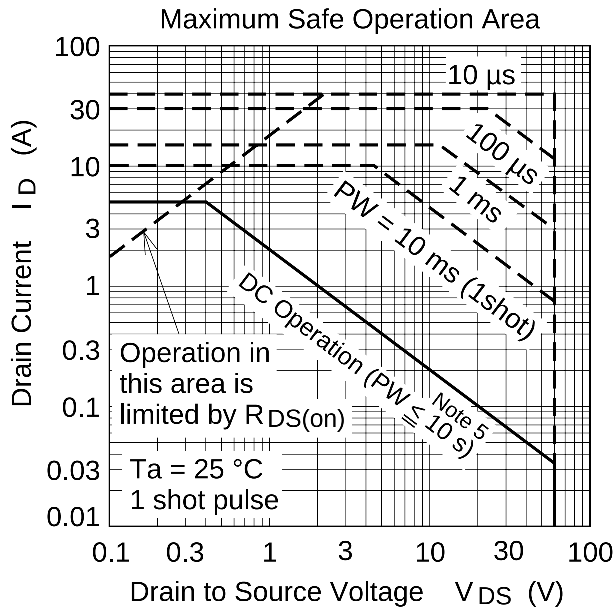
Electrical Characteristics (Ta = 25°C)

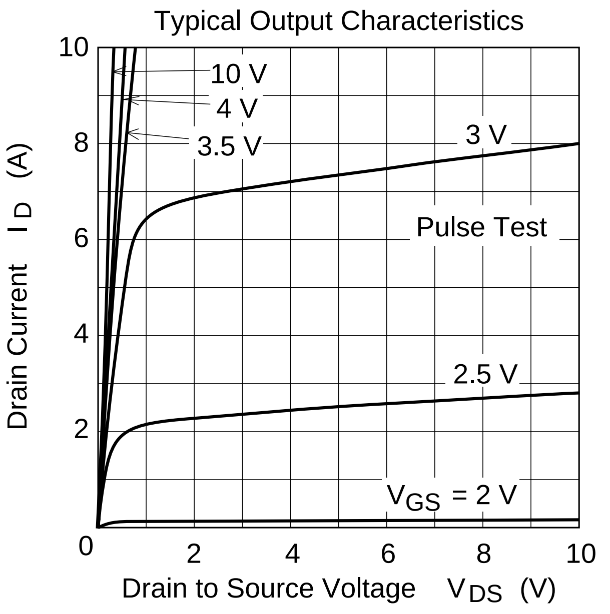
Item		Symbol	Min	Typ	Max	Unit	Test Conditions
Drain to source breakdown voltage		$V_{(BR)DSS}$	60	—	—	V	I_D = 10 mA, V_{GS} = 0
Gate to source breakdown voltage		$V_{(BR)GSS}$	± 20	—	—	V	I_G = ± 100 µA, V_{DS} = 0
Gate to source leak current		I_{GSS}	—	—	± 10	µA	V_{GS} = ± 16 V, V_{DS} = 0
Zero gate voltage	HAT2038R	I_{DSS}	—	—	1	µA	V_{DS} = 60 V, V_{GS} = 0
drain current	HAT2038RJ	I_{DSS}	—	—	0.1	µA	
Zero gate voltage	HAT2038R	I_{DSS}	—	—	—	µA	V_{DS} = 48 V, V_{GS} = 0
drain current	HAT2038RJ	I_{DSS}	—	—	10	µA	Ta = 125°C
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		$R_{DS(on)}$	—	0.043	0.058	Ω	I_D = 3 A, V_{GS} = 10 V Note5
resistance		$R_{DS(on)}$	—	0.056	0.084	Ω	I_D = 3 A, V_{GS} = 4 V Note5
Forward transfer admittance		$\|y_{fs}\|$	6	9	—	S	I_D = 3 A, V_{DS} = 10 V Note5
Input capacitance		Ciss	—	520	—	pF	V_{DS} = 10 V
Output capacitance		Coss	—	270	—	pF	V_{GS} = 0
Reverse transfer capacitance		Crss	—	100	—	pF	f = 1MHz
Turn-on delay time		$t_{d(on)}$	—	11	—	ns	V_{GS} =10 V, I_D = 3 A
Rise time		t_r	—	40	—	ns	V_{DD} ≅ 30 V
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	IF = 5 A, V_{GS} = 0 Note5
Body–drain diode reverse recovery time		t_{rr}	—	40	—	ns	IF = 5 A, V_{GS} = 0 diF/ dt = 50 A/µs

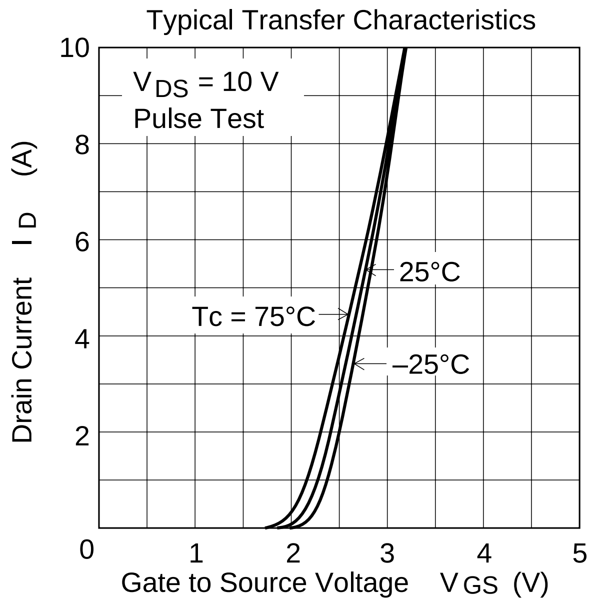
Note: 5. Pulse test

Main Characteristics

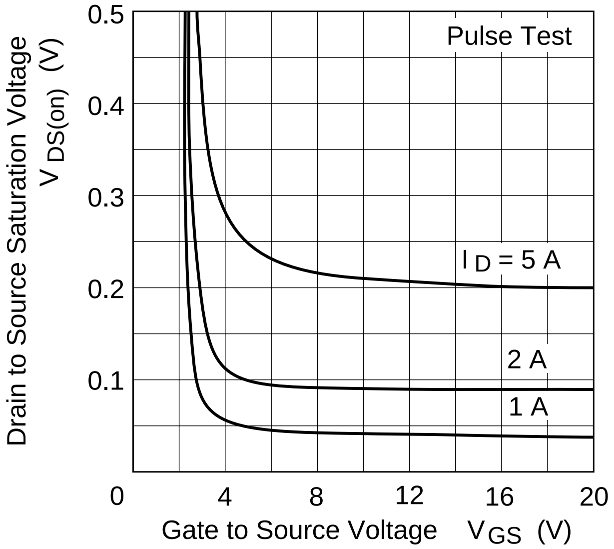




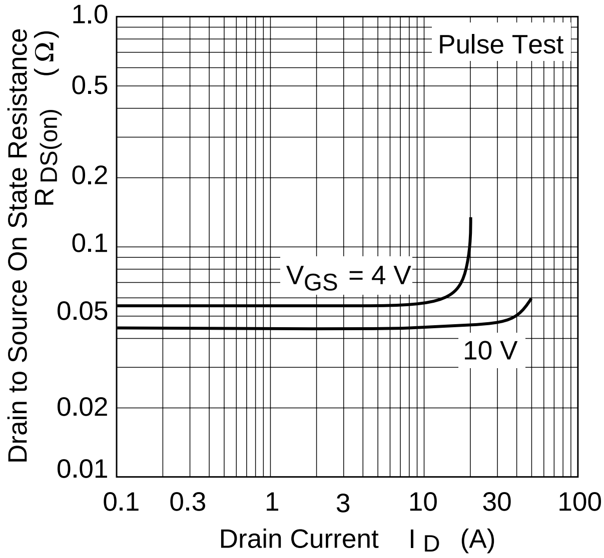




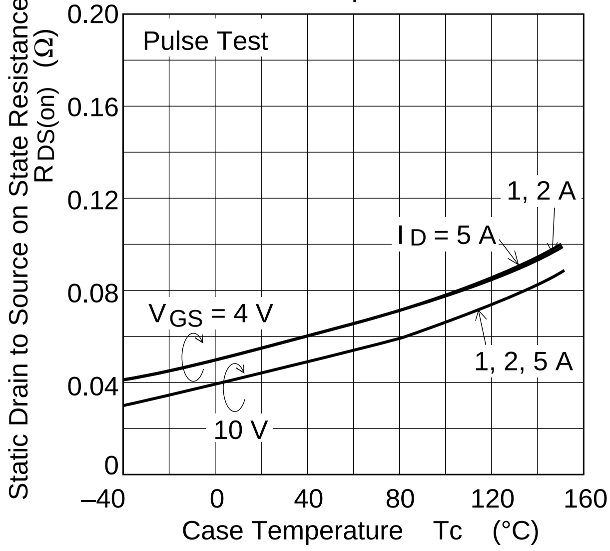
Drain to Source Saturation Voltage vs. Gate to Source Voltage



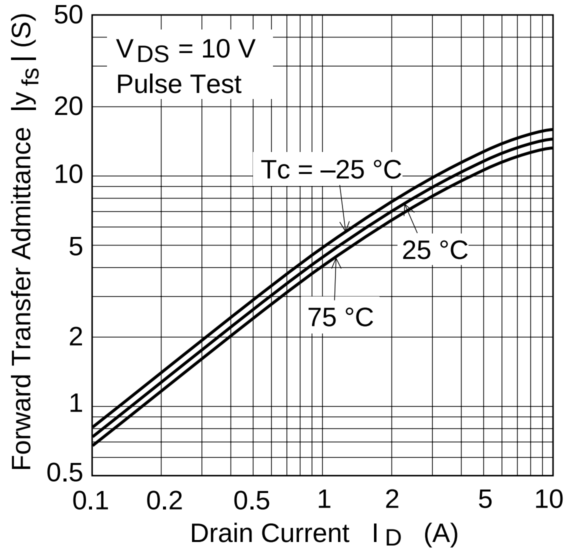
Static Drain to Source on State Resistance vs. Drain Current

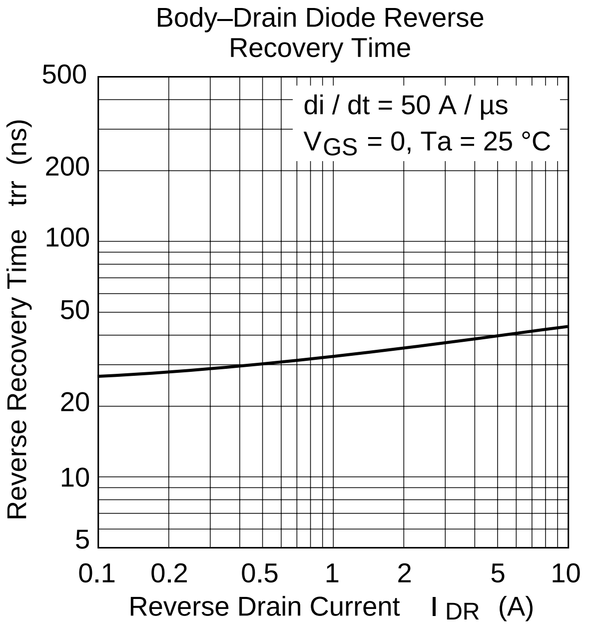


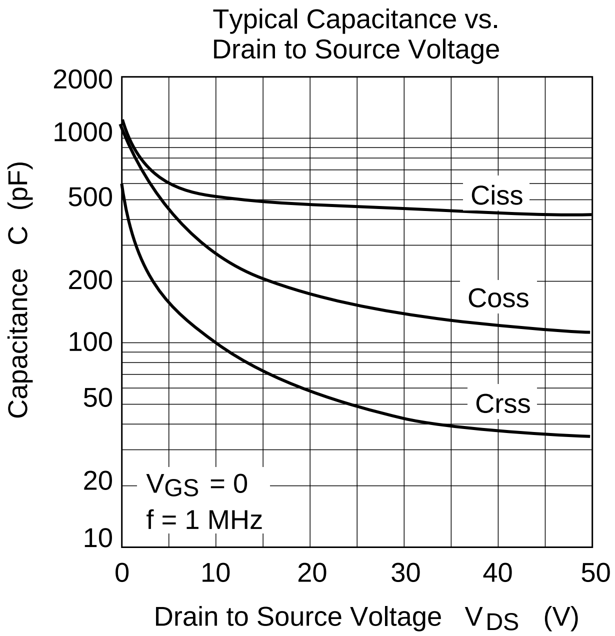
Static Drain to Source on State Resistance vs. Temperature

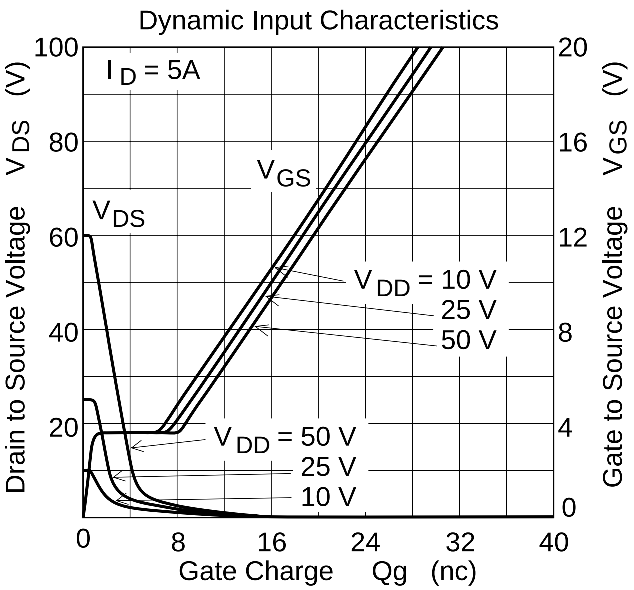


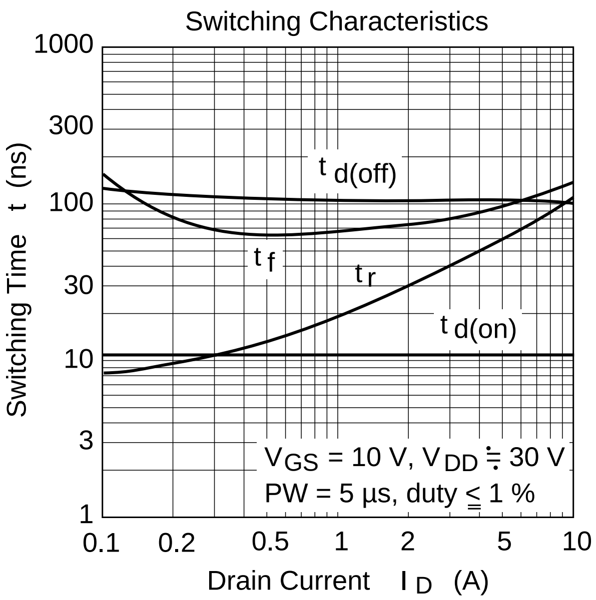
Forward Transfer Admittance vs. Drain Current



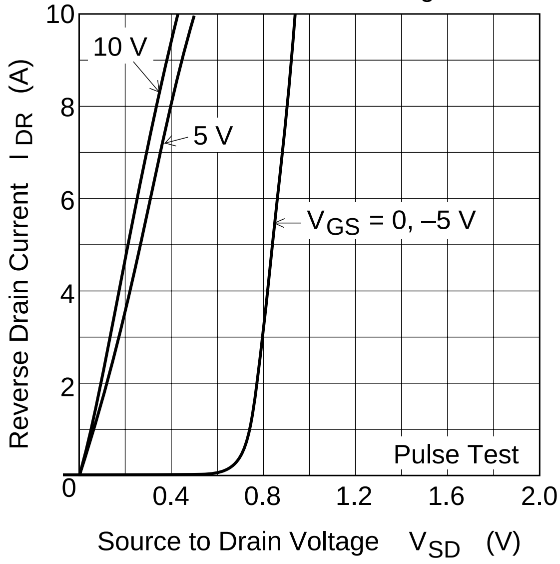

Body–Drain Diode Reverse
Recovery Time
di / dt = 50 A / µs
VGS = 0, Ta = 25 °C
Reverse Recovery Time trr (ns)
500
200
100
50
20
10
5
0.1
0.2
0.5
1
2
5
10
Reverse Drain Current I DR (A)


Typical Capacitance vs.
Drain to Source Voltage
Capacitance C (pF)
2000
1000
500
200
100
50
20
10
Ciss
Coss
Crss
VGS = 0
f = 1 MHz
0
10
20
30
40
50
Drain to Source Voltage VDS (V)

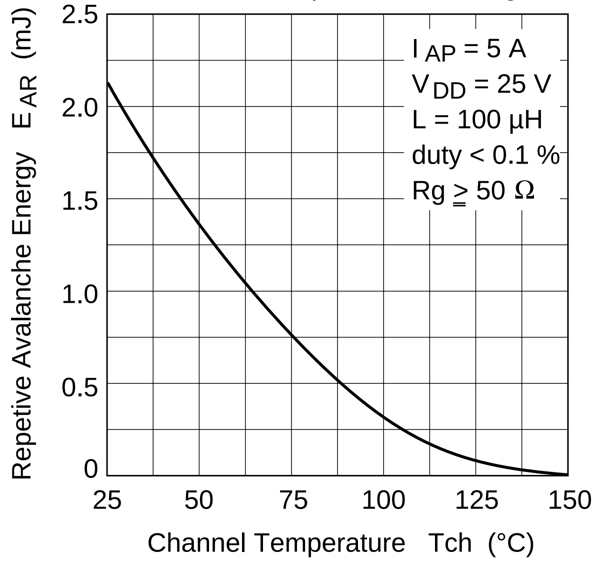

Dynamic Input Characteristics
I D = 5A
Drain to Source Voltage VDS (V)
Gate to Source Voltage VGS (V)
100
80
60
40
20
0
20
16
12
8
4
0
VGS
VDS
VDD = 10 V
25 V
50 V
VDD = 50 V
25 V
10 V
8
16
24
32
40
Gate Charge Qg (nc)


Switching Characteristics
Switching Time t (ns)
1000
300
100
30
10
3
1
t d(off)
t f
t r
t d(on)
VGS = 10 V, VDD ≒ 30 V
PW = 5 µs, duty ≦ 1 %
0.1
0.2
0.5
1
2
5
10
Drain Current I D (A)

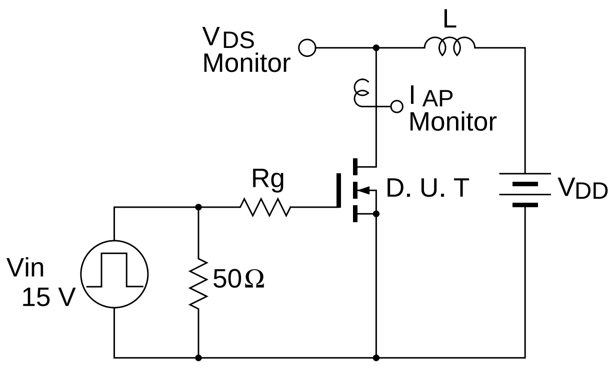
Reverse Drain Current vs.
Source to Drain Voltage



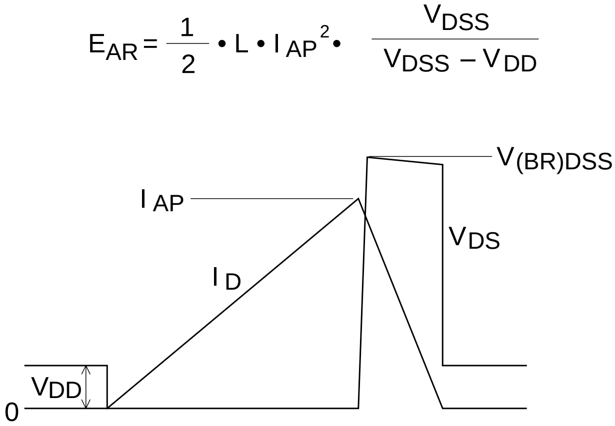
Maximun Avalanche Energy vs.
Channel Temperature Derating



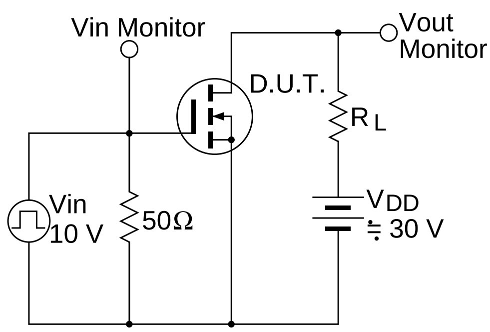
Avalanche Test Circuit



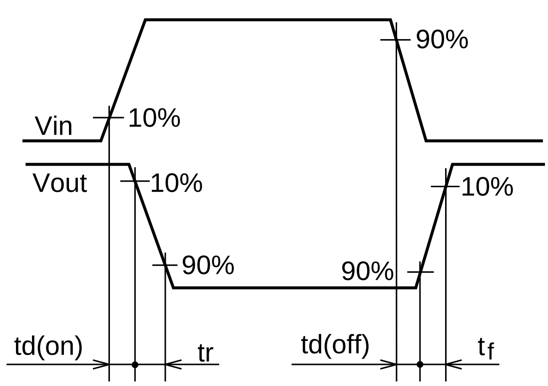
Avalanche Waveform

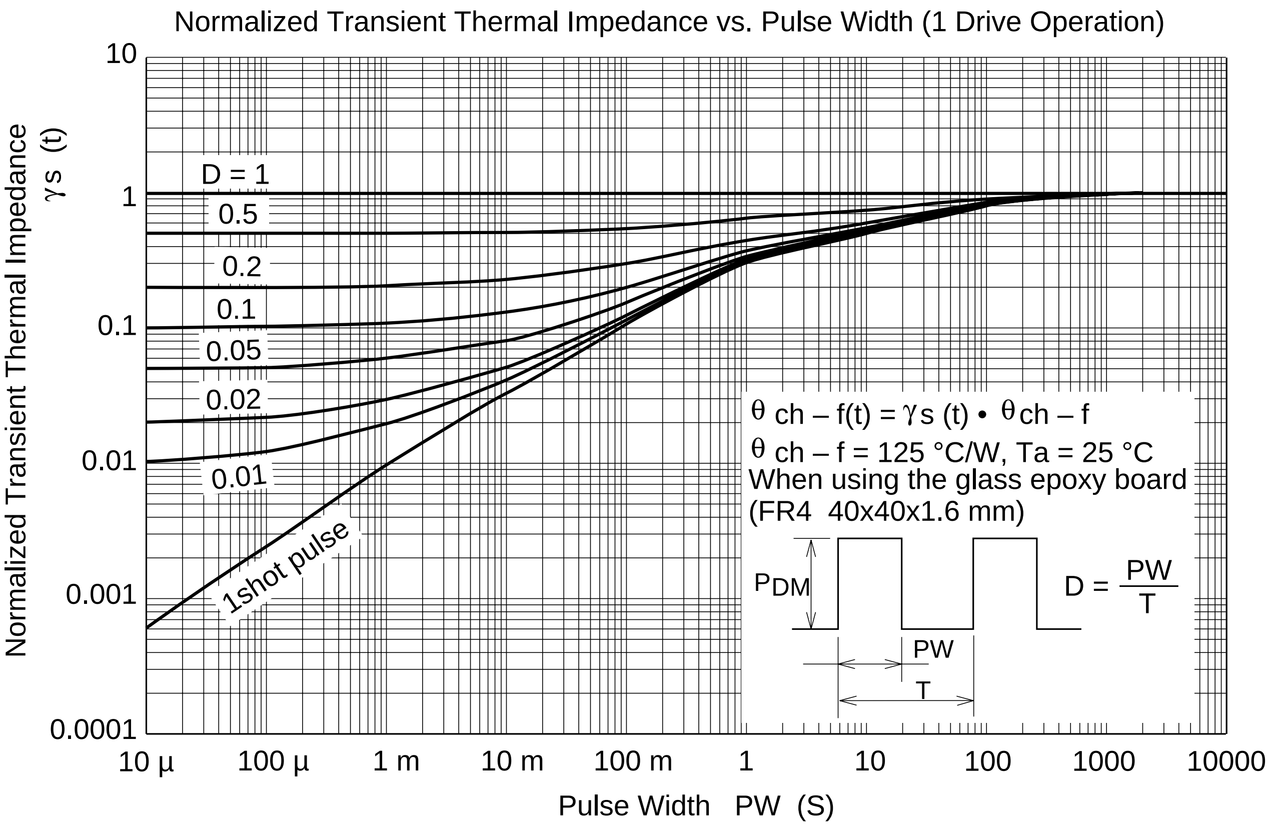


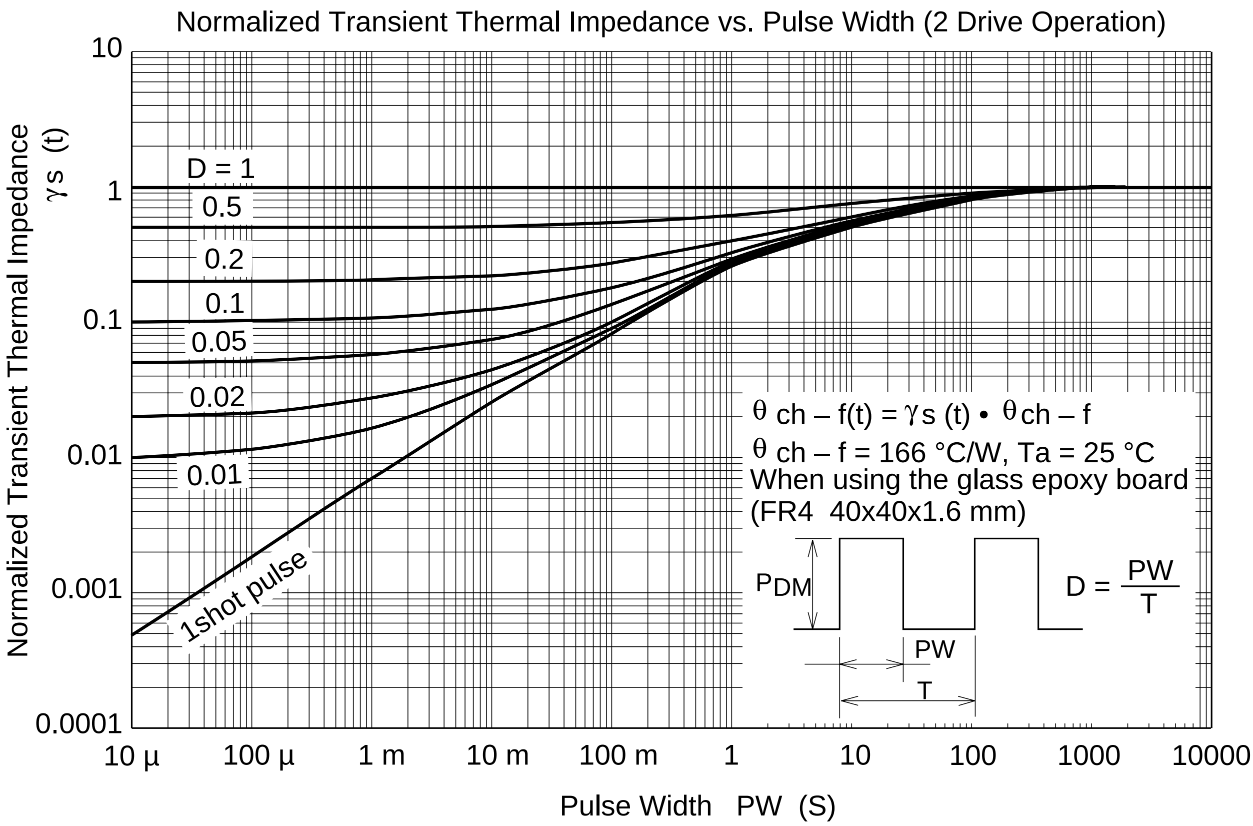
Switching Time Test Circuit



Switching Time Waveform

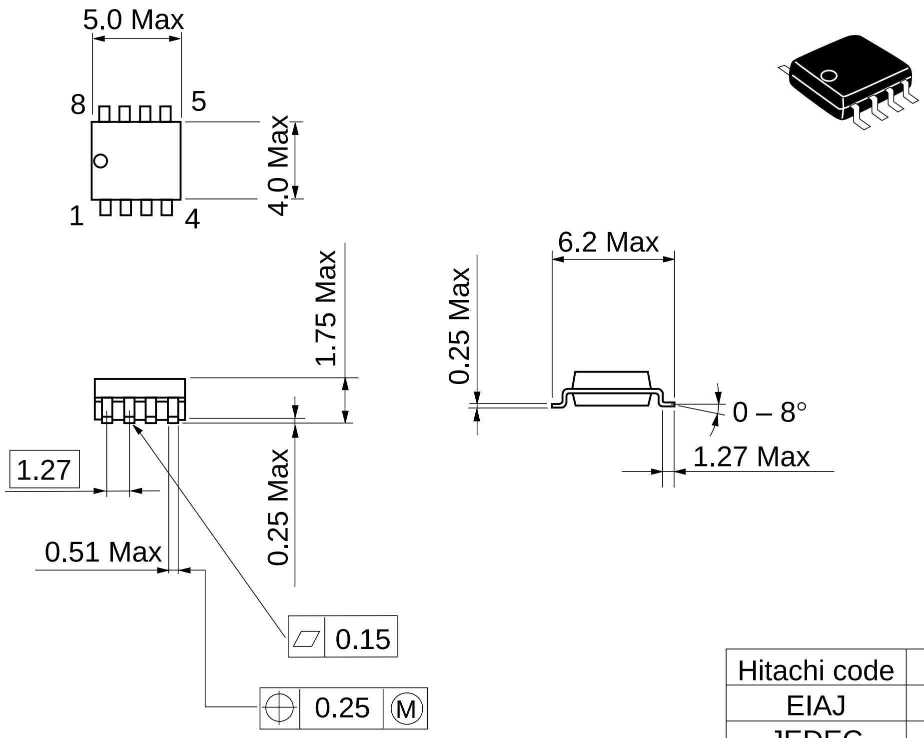



Normalized Transient Thermal Impedance vs. Pulse Width (1 Drive Operation)
Normalized Transient Thermal Impedance γs (t)
10
1
0.1
0.01
0.001
0.0001
D = 1
0.5
0.2
0.1
0.05
0.02
0.01
1shot pulse
θ ch – f(t) = γs (t) • θch – f
θ ch – f = 125 °C/W, Ta = 25 °C
When using the glass epoxy board
(FR4 40x40x1.6 mm)
PDM
D = PW/T
PW
T
10 µ
100 µ
1 m
10 m
100 m
1
10
100
1000
10000
Pulse Width PW (S)


Normalized Transient Thermal Impedance vs. Pulse Width (2 Drive Operation)
Normalized Transient Thermal Impedance γs (t)
10
1
0.1
0.01
0.001
0.0001
D = 1
0.5
0.2
0.1
0.05
0.02
0.01
1shot pulse
θ ch – f(t) = γs (t) • θch – f
θ ch – f = 166 °C/W, Ta = 25 °C
When using the glass epoxy board
(FR4 40x40x1.6 mm)
PDM
D = PW/T
PW
T
10 µ
100 µ
1 m
10 m
100 m
1
10
100
1000
10000
Pulse Width PW (S)

Package Dimensions

Unit: mm



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