HAT2028R/HAT2028RJ

Silicon N Channel Power MOS FET
High Speed Power Switching

HITACHI

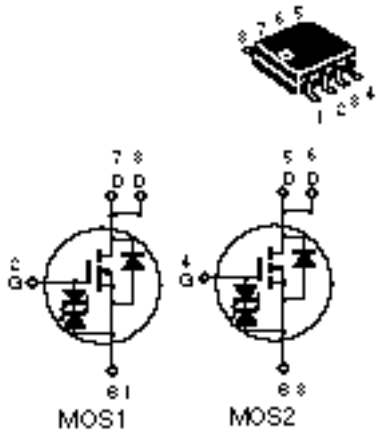
ADE-208-524C (Z)
4th. Edition
February 1999

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	4	A
Drain peak current		$I_{D(pulse)}$ Note1	32	A
Body-drain diode reverse drain current		I_{DR}	4	A
Avalanche current	HAT2028R	I_{AP} Note4	—	—
	HAT2028RJ		4	A
Avalanche energy	HAT2028R	E_{AR} Note4	—	—
	HAT2028RJ		1.37	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

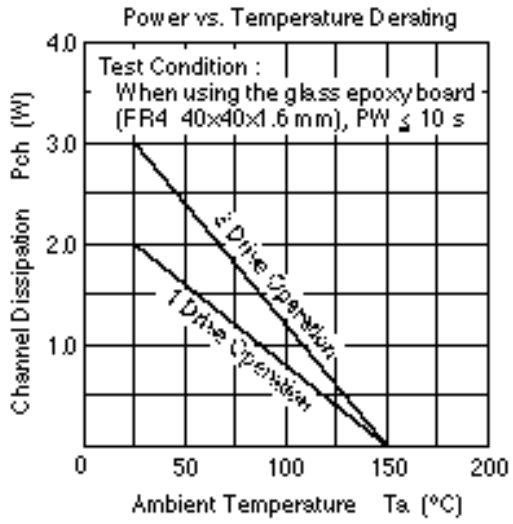
Note: 1. PW ≤ 10µs, duty cycle ≤ 1 %
2. 1 Drive operation ; When using the glass epoxy board (FR4 40 x 40 x 1.6 mm), PW ≤ 10s
3. 2 Drive operation ; When using the glass epoxy board (FR4 40 x 40 x 1.6 mm), PW ≤ 10s
4. Value at Tch=25°C, Rg ≥ 50Ω

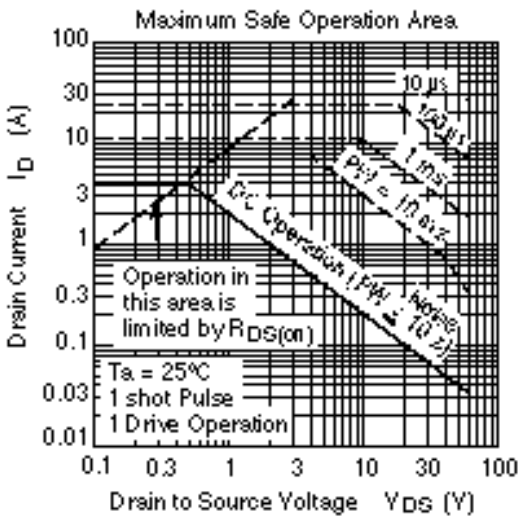
Electrical Characteristics (Ta = 25°C)

Item		Symbol	Min	Typ	Max	Unit	Test Conditions
Drain to source breakdown voltage		$V_{(BR)DSS}$	60	—	—	V	I_D = 10mA, V_{GS} = 0
Gate to source breakdown voltage		$V_{(BR)GSS}$	±20	—	—	V	I_G = ±100µA, V_{DS} = 0
Gate to source leak current		I_{GSS}	—	—	±10	µA	V_{GS} = ±16V, V_{DS} = 0
Zero gate voltage	HAT2028R	I_{DSS}	—	—	1	µA	V_{DS} = 60V, V_{GS} = 0
drain current	HAT2028RJ	I_{DSS}	—	—	0.1	µA	
Zero gate voltage	HAT2028R	I_{DSS}	—	—	—	µA	V_{DS} =48V, V_{GS} = 0
drain current	HAT2028RJ	I_{DSS}	—	—	10	µA	Ta=125°C
Gate to source cutoff voltage		$V_{GS(off)}$	1.3	—	2.3	V	V_{DS} = 10V, I_D = 1mA
Static drain to source on state resistance		$R_{DS(on)}$	—	0.08	0.1	Ω	I_D = 2A, V_{GS} = 10V Note5
		$R_{DS(on)}$	—	0.12	0.16	Ω	I_D = 2A, V_{GS} = 4V Note5
Forward transfer admittance		$\|y_{fs}\|$	3.3	5	—	S	I_D = 2A, V_{DS} = 10V Note5
Input capacitance		Ciss	—	280	—	pF	V_{DS} = 10V
Output capacitance		Coss	—	150	—	pF	V_{GS} = 0
Reverse transfer capacitance		Crss	—	55	—	pF	f = 1MHz
Turn-on delay time		$t_{d(on)}$	—	15	—	ns	V_{GS} =4V, I_D = 2A
Rise time		t_r	—	100	—	ns	V_{DD} ≈ 30V
Turn-off delay time		$t_{d(off)}$	—	35	—	ns	
Fall time		t_f	—	45	—	ns	
Body–drain diode forward voltage		V_{DF}	—	0.88	1.15	V	IF = 4A, V_{GS} = 0 Note5
Body–drain diode reverse recovery time		t_{rr}	—	40	—	ns	IF =4A, V_{GS} = 0 diF/ dt =50A/µs

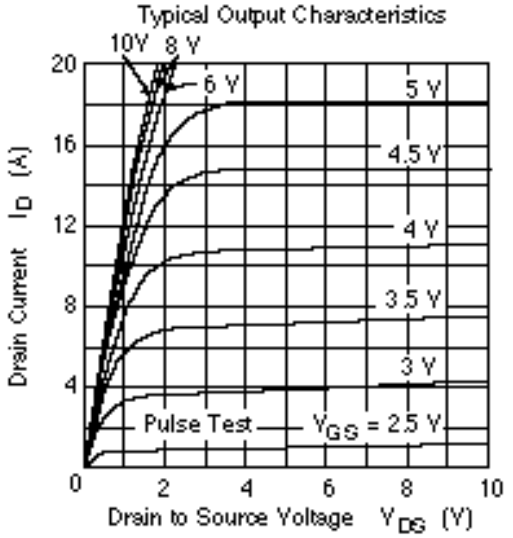
Note: 5. Pulse test

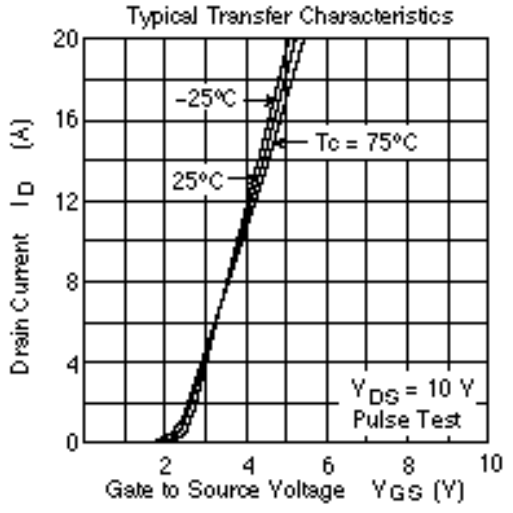
Main Characteristics



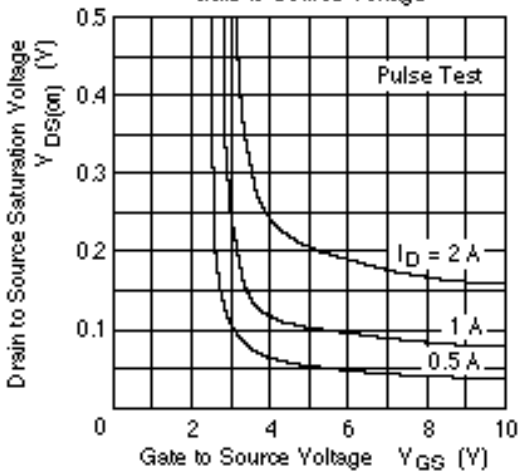


Note 6 :
When using the glass epoxy board
(FR4 40×40×1.6 mm)

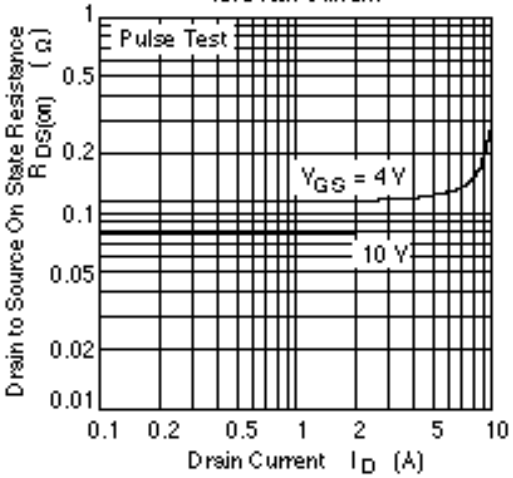




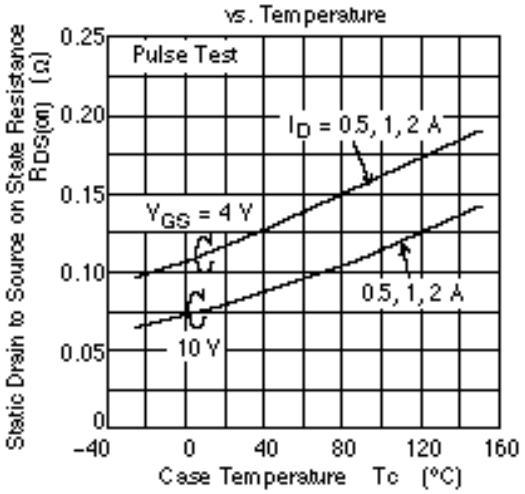
Drain to Source Saturation Voltage vs. Gate to Source Voltage



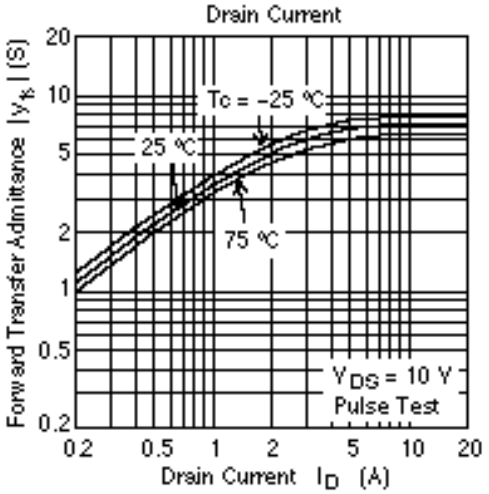
Static Drain to Source on State Resistance vs. Drain Current

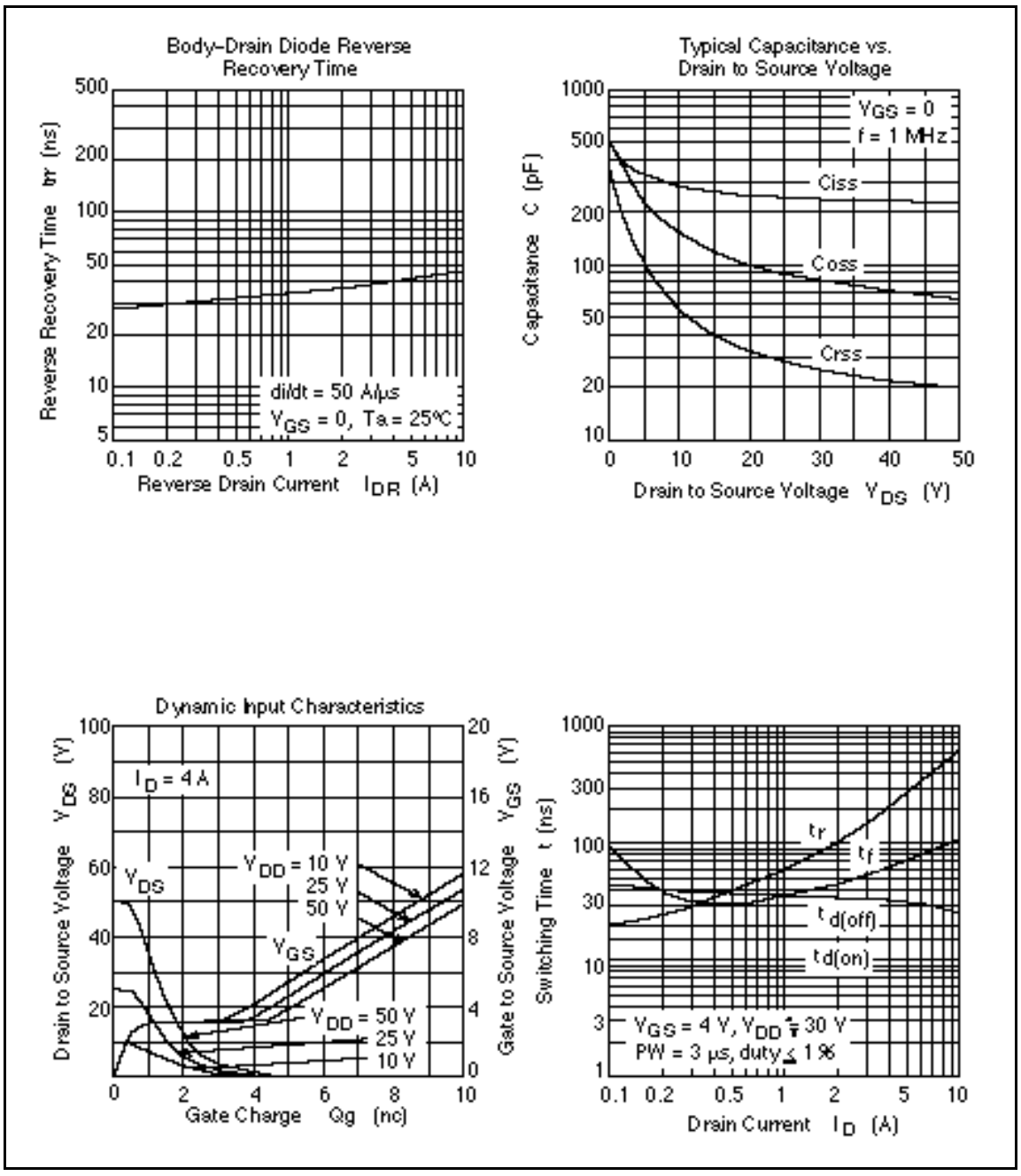


Static Drain to Source on State Resistance vs. Temperature

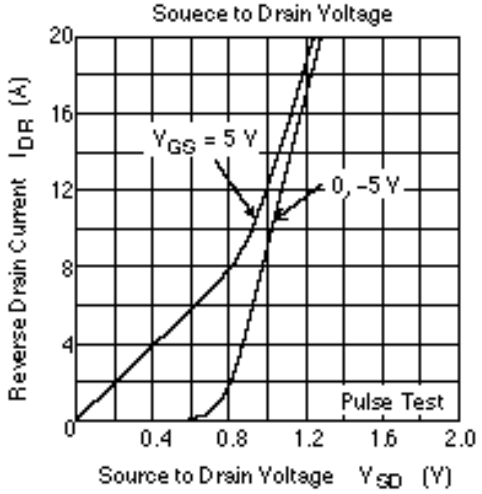


Forward Transfer Admittance vs. Drain Current

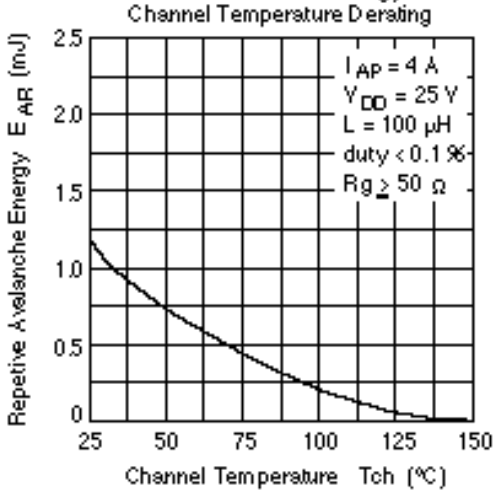



Body-Drain Diode Reverse Recovery Time
Reverse Recovery Time trr (ns)
500
200
100
50
20
10
5
di/dt = 50 A/µs
VGS = 0, Ta = 25°C
0.1 0.2 0.5 1 2 5 10
Reverse Drain Current IDR (A)
Typical Capacitance vs. Drain to Source Voltage
Capacitance C (pF)
1000
500
200
100
50
20
10
VGS = 0
f = 1 MHz
Ciss
Coss
Crss
0 10 20 30 40 50
Drain to Source Voltage VDS (V)
Dynamic Input Characteristics
Drain to Source Voltage VDS (V)
100
80
60
40
20
ID = 4 A
VDS
VDD = 10 V
25 V
50 V
VGS
VDD = 50 V
25 V
10 V
Gate to Source Voltage VGS (V)
20
16
12
8
4
0
0 2 4 6 8 10
Gate Charge Qg (nc)
Switching Time t (ns)
1000
300
100
30
10
3
1
tr
tf
td(off)
td(on)
VGS = 4 V, VDD ≒ 30 V
PW = 3 µs, duty ≦ 1 %
0.1 0.2 0.5 1 2 5 10
Drain Current ID (A)

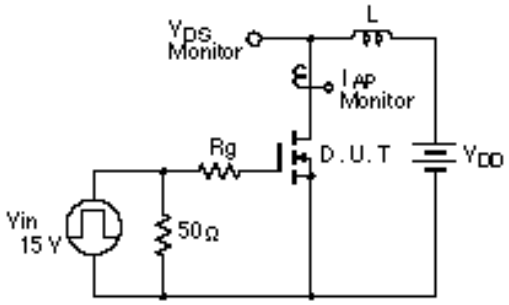
Reverse Drain Current vs. Souece to Drain Voltage



Maximun Avalanche Energy vs. Channel Temperature Derating

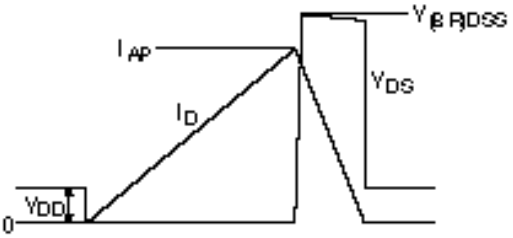


Avalanche Test Circuit

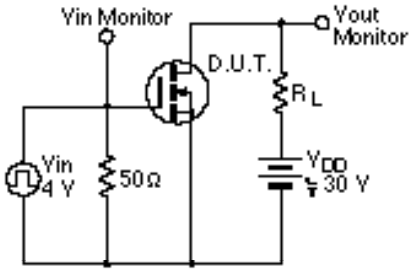


Avalanche Waveform

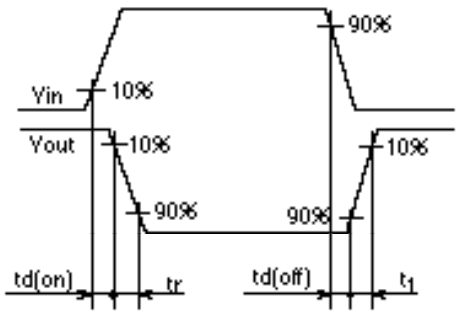
$$E_{AR} = \frac{1}{2} \cdot L \cdot I_{AP}^2 \cdot \frac{V_{DSS}}{V_{DSS} - V_{DD}}$$

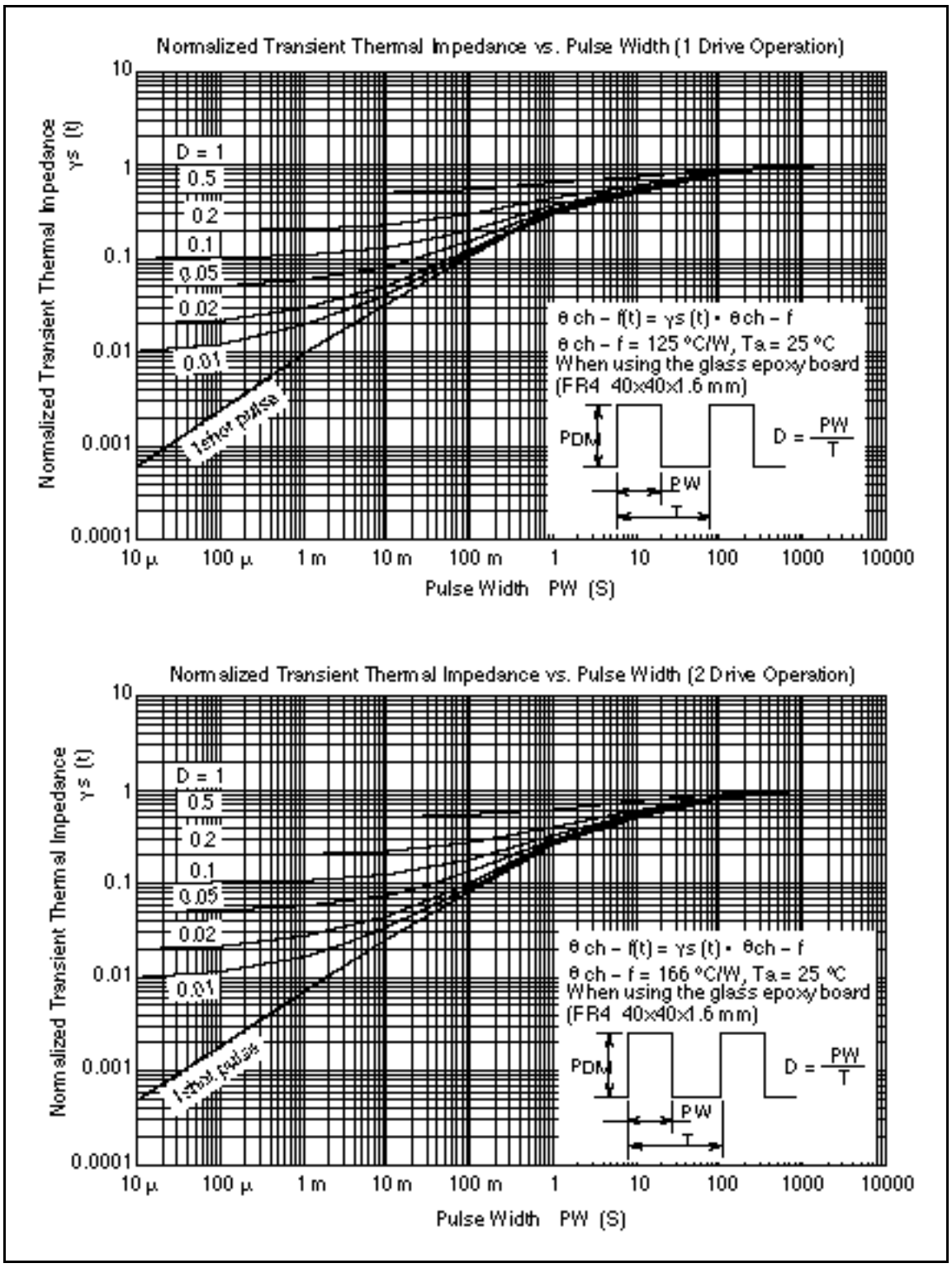


Switching Time Test Circuit



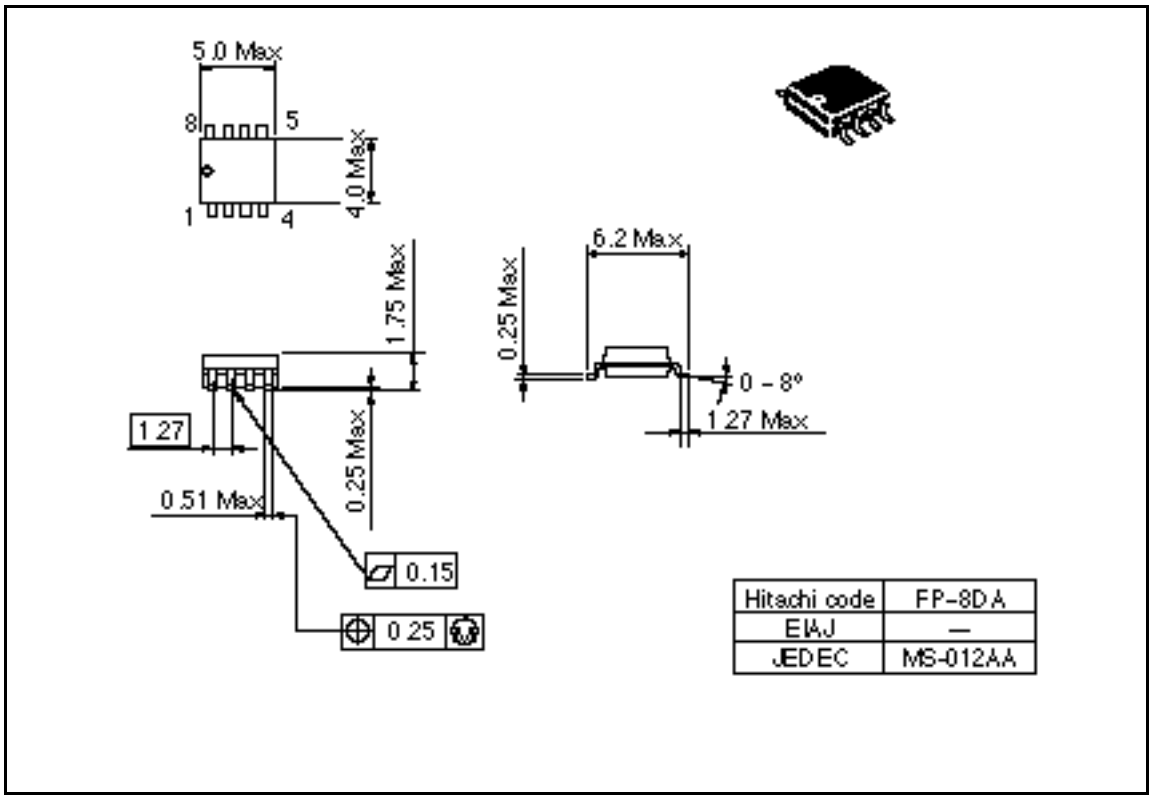
Switching Time Waveform




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
θch – f(t) = γs (t) • θch – f
θch – f = 125 °C/W, Ta = 25 °C
When using the glass epoxy board
(FR4 40×40×1.6 mm)
PDM
PW
T
D = 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
θch – f(t) = γs (t) • θch – f
θch – f = 166 °C/W, Ta = 25 °C
When using the glass epoxy board
(FR4 40×40×1.6 mm)
PDM
PW
T
D = 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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