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2SK1402, 2SK1402A

Silicon N-Channel MOS FET

HITACHI

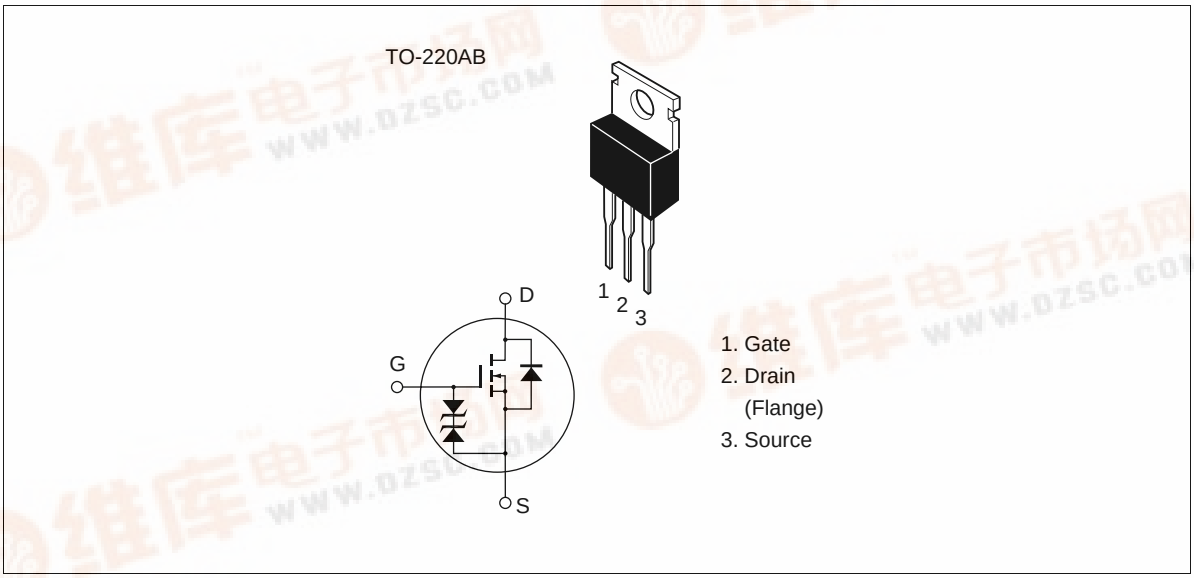
Application

High speed power switching

Features

- Low on-resistance
- High speed switching
- Low drive current
- No secondary breakdown
- Suitable for switching regulator and DC-DC converter

Outline



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Absolute Maximum Ratings (Ta = 25°C)

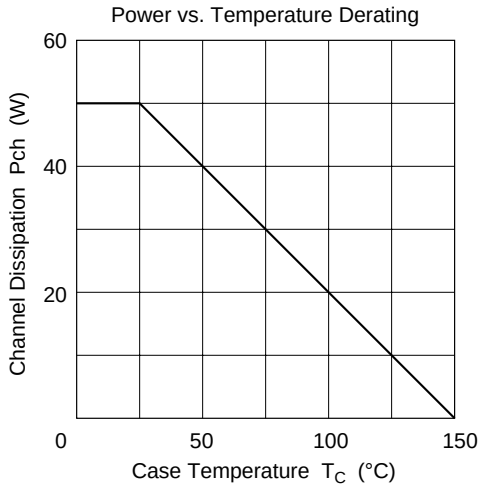
Item		Symbol	Ratings	Unit
Drain to source voltage	2SK1402	V_{DSS}	600	V
	2SK1402A		650	
Gate to source voltage		V_{GSS}	±30	V
Drain current		I_D	4	A
Drain peak current		$I_{D(pulse)}$*1	16	A
Body to drain diode reverse drain current		I_{DR}	4	A
Channel dissipation		Pch*2	50	W
Channel temperature		Tch	150	°C
Storage temperature		Tstg	–55 to +150	°C

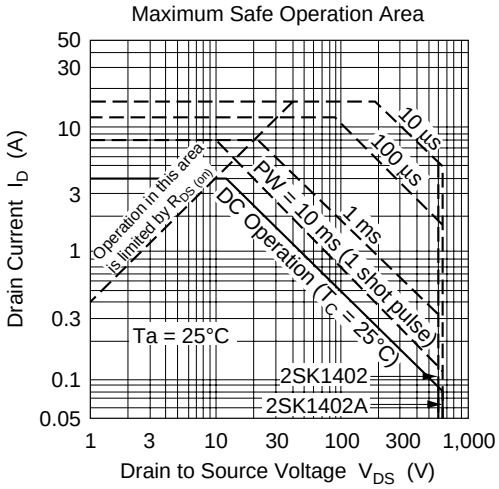
Notes: 1. PW ≤ 10 μs, duty cycle ≤ 1%
2. Value at T_C = 25°C

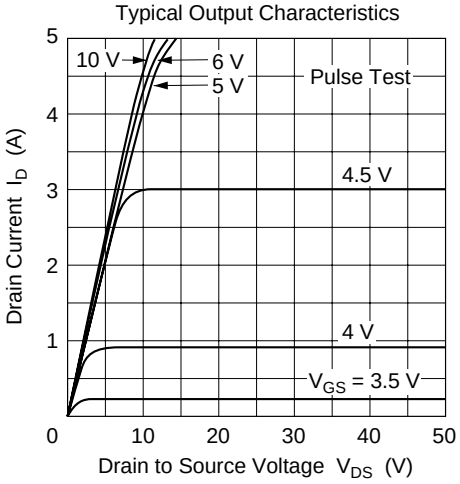
Electrical Characteristics (Ta = 25°C)

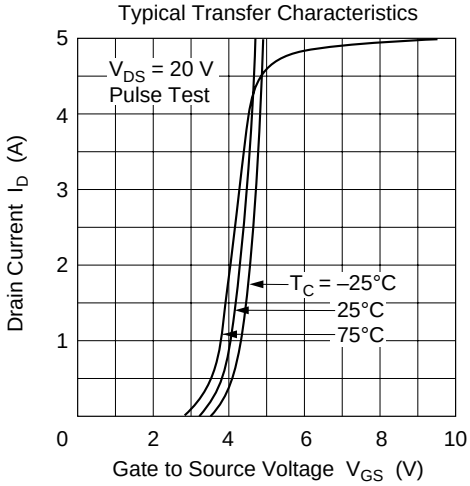
Item		Symbol	Min	Typ	Max	Unit	Test conditions
Drain to source	K1402	$V_{(BR)DSS}$	600	—	—	V	I_D = 10 mA, V_{GS} = 0
breakdown voltage	K1402A		650	—	—		
Gate to source breakdown voltage		$V_{(BR)GSS}$	±30	—	—	V	I_G = ±100 µA, V_{DS} = 0
Gate to source leak current		I_{GSS}	—	—	±10	µA	V_{GS} = ±25 V, V_{DS} = 0
Zero gate voltage	K1402	I_{DSS}	—	—	250	µA	V_{DS} = 500 V, V_{GS} = 0
drain current	K1402A						V_{DS} = 550 V, V_{GS} = 0
Gate to source cutoff voltage		$V_{GS(off)}$	2.0	—	3.0	V	I_D = 1 mA, V_{DS} = 10 V
Static drain to source	K1402	$R_{DS(on)}$	—	1.8	2.4	Ω	I_D = 2 A, V_{GS} = 10 V *[1]
on state resistance	K1402A		—	2.0	2.6		
Forward transfer admittance		|yfs|	2.2	3.5	—	S	I_D = 2 A, V_{DS} = 10 V *[1]
Input capacitance		Ciss	—	600	—	pF	V_{DS} = 10 V, V_{GS} = 0,
Output capacitance		Coss	—	140	—	pF	f = 1 MHz
Reverse transfer capacitance		Crss	—	25	—	pF	
Turn-on delay time		$t_{d(on)}$	—	8	—	ns	I_D = 2 A, V_{GS} = 10 V,
Rise time		t_r	—	30	—	ns	R_L = 15 Ω
Turn-off delay time		$t_{d(off)}$	—	60	—	ns	
Fall time		t_f	—	35	—	ns	
Body to drain diode forward voltage		V_{DF}	—	0.9	—	V	I_F = 4 A, V_{GS} = 0
Body to drain diode reverse recovery time		t_{rr}	—	300	—	ns	I_F = 4 A, V_{GS} = 0, di_F/dt = 100 A/µs

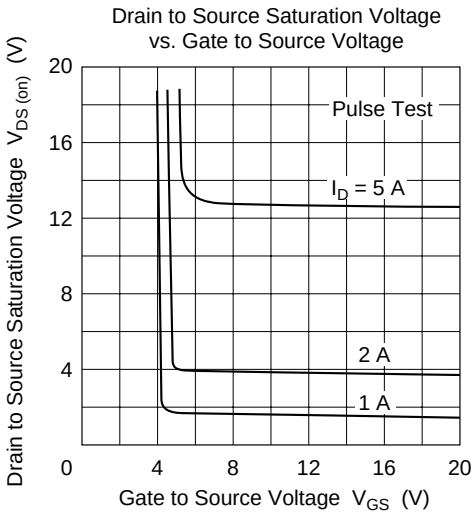
Note: 1. Pulse test

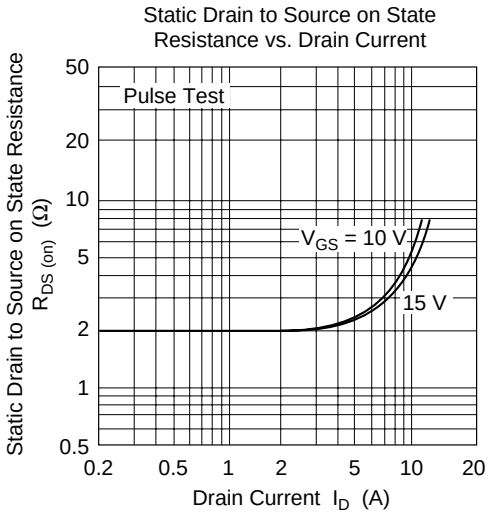

Power vs. Temperature Derating
Channel Dissipation Pch (W)
60
40
20
0
50
100
150
Case Temperature T_C (°C)

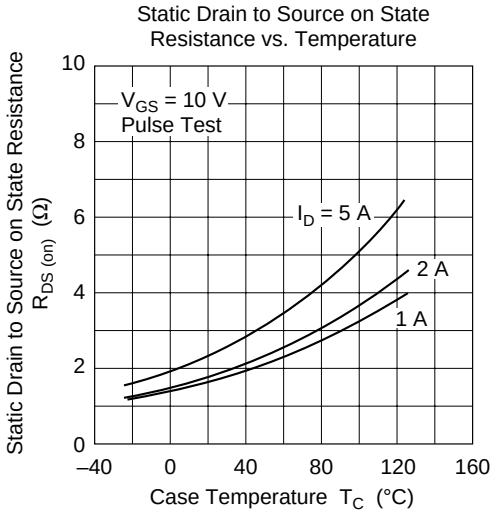

Maximum Safe Operation Area
Drain Current I_D (A)
50
30
10
3
1
0.3
0.1
0.05
1
3
10
30
100
300
1,000
Drain to Source Voltage V_{DS} (V)
10 μs
100 μs
PW = 10 ms
1 ms
DC Operation (T_C = 25°C)
(1 shot pulse)
Operation in this area is limited by $R_{DS(on)}$
Ta = 25°C
2SK1402
2SK1402A

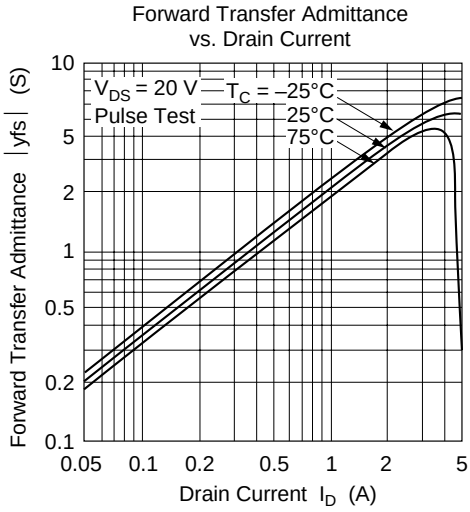

Typical Output Characteristics
Drain Current I_D (A)
5
4
3
2
1
0
10
20
30
40
50
Drain to Source Voltage V_{DS} (V)
10 V
6 V
5 V
Pulse Test
4.5 V
4 V
V_{GS} = 3.5 V

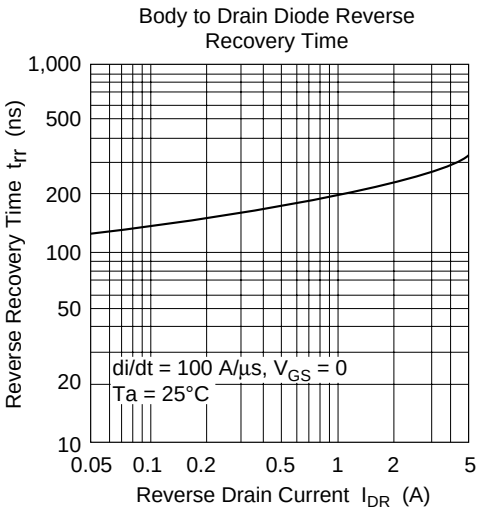

Typical Transfer Characteristics
Drain Current I_D (A)
5
4
3
2
1
0
2
4
6
8
10
Gate to Source Voltage V_{GS} (V)
V_{DS} = 20 V
Pulse Test
T_C = –25°C
25°C
75°C

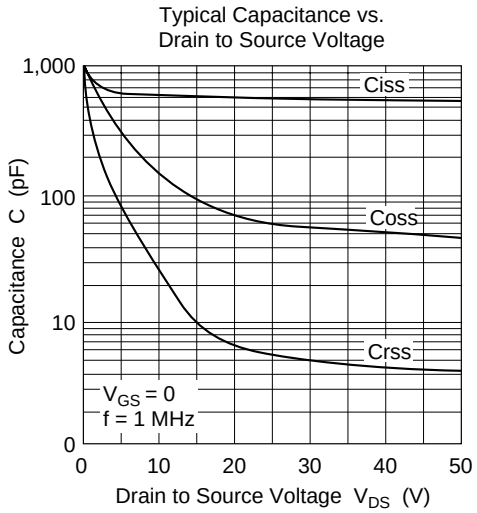

Drain to Source Saturation Voltage
vs. Gate to Source Voltage
Drain to Source Saturation Voltage $V_{DS (on)}$ (V)
Pulse Test
I_D = 5 A
2 A
1 A
Gate to Source Voltage V_{GS} (V)

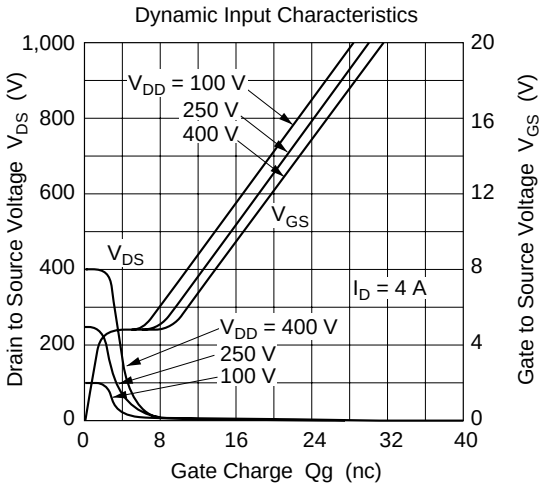

Static Drain to Source on State
Resistance vs. Drain Current
Static Drain to Source on State Resistance
$R_{DS (on)}$ (Ω)
Pulse Test
V_{GS} = 10 V
15 V
Drain Current I_D (A)

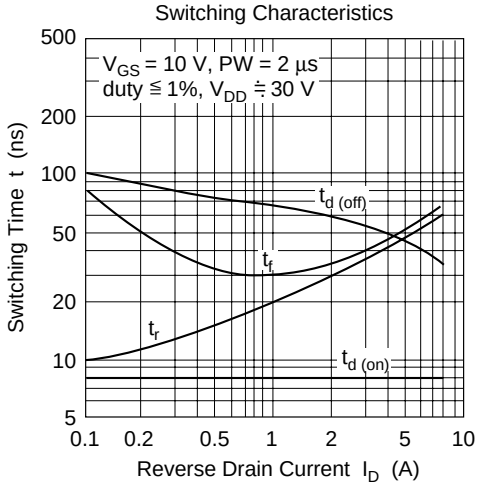

Static Drain to Source on State
Resistance vs. Temperature
Static Drain to Source on State Resistance
$R_{DS (on)}$ (Ω)
V_{GS} = 10 V
Pulse Test
I_D = 5 A
2 A
1 A
Case Temperature T_C (°C)


Forward Transfer Admittance
vs. Drain Current
Forward Transfer Admittance |yfs| (S)
V_{DS} = 20 V
Pulse Test
T_C = –25°C
25°C
75°C
Drain Current I_D (A)

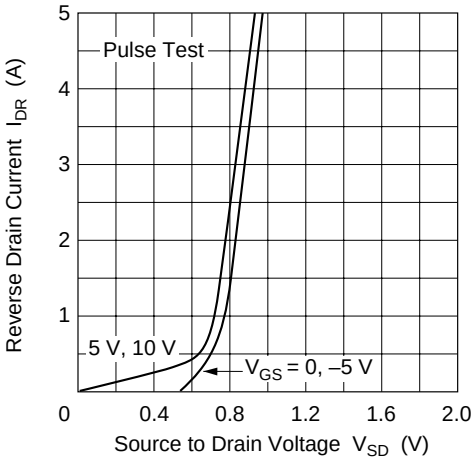

Body to Drain Diode Reverse Recovery Time
Reverse Recovery Time trr (ns)
1,000
500
200
100
50
20
10
di/dt = 100 A/µs, VGS = 0
Ta = 25°C
0.05 0.1 0.2 0.5 1 2 5
Reverse Drain Current IDR (A)


Typical Capacitance vs. Drain to Source Voltage
Capacitance C (pF)
1,000
100
10
0
Ciss
Coss
Crss
VGS = 0
f = 1 MHz
0 10 20 30 40 50
Drain to Source Voltage VDS (V)

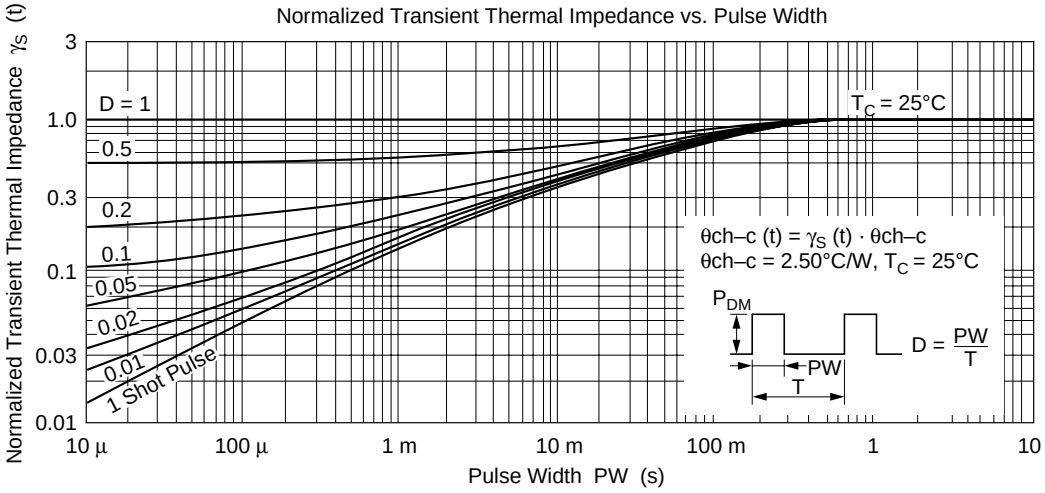

Dynamic Input Characteristics
Drain to Source Voltage VDS (V)
1,000
800
600
400
200
0
VDD = 100 V
250 V
400 V
VGS
VDS
ID = 4 A
VDD = 400 V
250 V
100 V
Gate to Source Voltage VGS (V)
20
16
12
8
4
0
0 8 16 24 32 40
Gate Charge Qg (nc)


Switching Characteristics
Switching Time t (ns)
500
200
100
50
20
10
5
VGS = 10 V, PW = 2 µs
duty ≦ 1%, VDD ≒ 30 V
td (off)
tf
tr
td (on)
0.1 0.2 0.5 1 2 5 10
Reverse Drain Current ID (A)

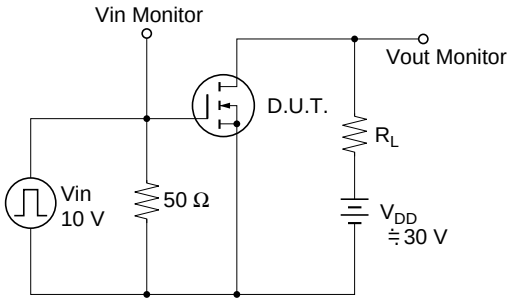
Reverse Drain Current vs.
Source to Drain Voltage



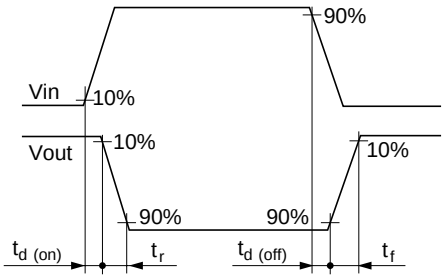
Normalized Transient Thermal Impedance vs. Pulse Width



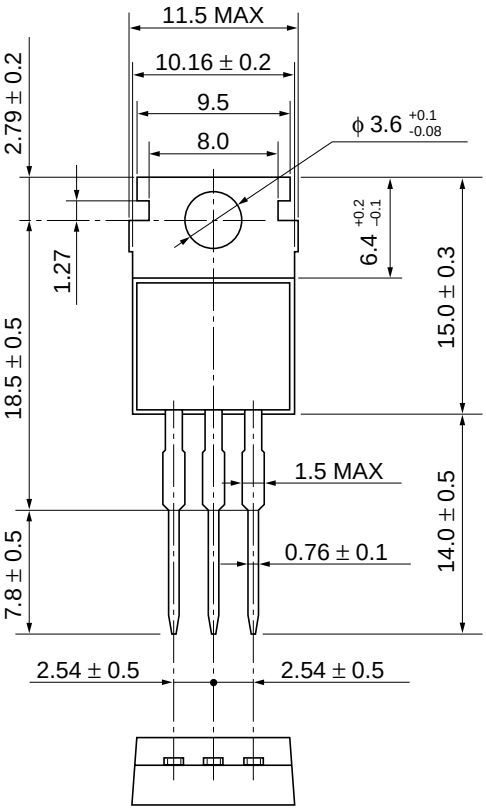
Switching Time Test Circuit

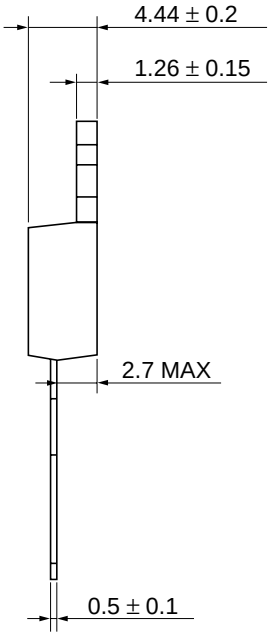


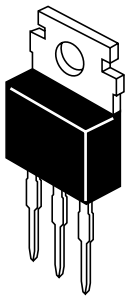
Waveforms



Unit: mm


11.5 MAX
10.16 ± 0.2
9.5
8.0
ϕ 3.6 +0.1 -0.08
2.79 ± 0.2
1.27
6.4 +0.2 -0.1
15.0 ± 0.3
18.5 ± 0.5
1.5 MAX
14.0 ± 0.5
0.76 ± 0.1
7.8 ± 0.5
2.54 ± 0.5
2.54 ± 0.5


4.44 ± 0.2
1.26 ± 0.15
2.7 MAX
0.5 ± 0.1



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