HITACHI

2SK974Ⓛ , 2SK974Ⓢ

Silicon N-Channel MOS FET

Application

High speed power switching

Features

- Low on-resistance
- High speed switching
- Low drive current
- 4 V gate drive device
  – Can be driven from 5 V source
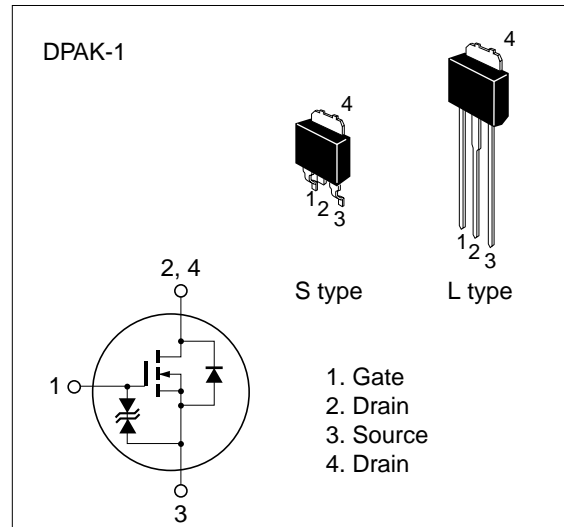- Suitable for motor drive, DC-DC converter, power switch and solenoid drive

DPAK-1

S type   L type

1. Gate
2. Drain
3. Source
4. Drain

Table 1   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	A
Drain peak current	$I_{D(peak)}$*	12	A
Body to drain diode reverse drain current	I_{DR}	3	A
Channel dissipation	Pch**	20	W
Channel temperature	Tch	150	°C
Storage temperature	Tstg	–55 to +150	°C

*   PW ≤ 10 µs, duty cycle ≤ 1 %
**   Value at T_C = 25 °C

Table 2 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 drain current	I_{DSS}	—	—	100	µA	V_{DS} = 50 V, V_{GS} = 0
Gate to source cutoff voltage	$V_{GS(off)}$	1.0	—	2.0	V	I_D = 1 mA, V_{DS} = 10 V
Static drain to source on state resistance	$R_{DS(on)}$	—	0.15	0.18	Ω	I_D = 2 A, V_{GS} = 10 V *
			0.20	0.25		I_D = 2 A, V_{GS} = 4 V *
Forward transfer admittance	$|y_{fs}|$	2.4	4.0	—	S	I_D = 2 A, V_{DS} = 10 V *
Input capacitance	Ciss	—	400	—	pF	V_{DS} = 10 V, V_{GS} = 0,
Output capacitance	Coss	—	230	—	pF	f = 1 MHz
Reverse transfer capacitance	Crss	—	60	—	pF	
Turn-on delay time	$t_{d(on)}$	—	5	—	ns	I_D = 2 A, V_{GS} = 10 V,
Rise time	t_r	—	25	—	ns	R_L = 15 Ω
Turn-off delay time	$t_{d(off)}$	—	180	—	ns	
Fall time	t_f	—	75	—	ns	
Body to drain diode forward voltage	V_{DF}	—	0.9	—	V	I_F = 3 A, V_{GS} = 0
Body to drain diode reverse recovery time	t_{rr}	—	85	—	ns	I_F = 3 A, V_{GS} = 0, di_F/dt = 50 A/µs

*   Pulse Test

Power vs. Temperature Derating

Channel Dissipation Pch (W) vs Case Temperature T_C (°C)

Maximum Safe Operation Area

Drain Current I_D (A) vs Drain to Source Voltage V_{DS} (V)

Operation in this area is limited by $R_{DS\,(on)}$

10 µs
100 µs
1 ms
PW = 10 ms (1 Shot)
DC Operation (T_C = 25°C)
Ta = 25°C

Typical Output Characteristics

Drain Current I_D (A) vs Drain to Source Voltage V_{DS} (V)

Pulse Test

10 V
5 V
4 V
3.5 V
3 V
2.5 V
V_{GS} = 2 V

Typical Transfer Characteristics

Drain Current I_D (A) vs Gate to Source Voltage V_{GS} (V)

V_{DS} = 10 V
Pulse Test

75°C
−25°C
T_C = 25°C

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Drain to Source Saturation Voltage vs. Gate to Source Voltage

Pulse Test

5 A

2 A

I_D = 1 A

Drain to Source Saturation Voltage $V_{DS\,(on)}$ (V)

Gate to Source Voltage V_{GS} (V)

Static Drain to Source on State Resistance vs. Drain Current

Pulse Test

V_{GS} = 4 V

10 V

Static Drain to Source on State Resistance $R_{DS\,(on)}$ (Ω)

Drain Current I_D (A)

Static Drain to Source on State Resistance vs. Temperature

Pulse Test

I_D = 5 A

1 A, 2 A

V_{GS} = 4 V

5 A

1 A, 2 A

V_{GS} = 10 V

Static Drain to Source on State Resistance $R_{DS\,(on)}$ (Ω)

Case Temperature T_C (°C)

Forward Transfer Admittance vs. Drain Current

V_{DS} = 10 V
Pulse Test
T_C = 25°C

−25°C

75°C

Forward Transfer Admittance $\left|\,yfs\,\right|$ (S)

Drain Current I_D (A)

Body to Drain Diode Reverse Recovery Time

di/dt = 50 A/μs, Ta = 25°C
$V_{GS} = 0$
Pulse Test

Reverse Recovery Time t_{rr} (ns)

Reverse Drain Current I_{DR} (A)

Typical Capacitance vs. Drain to Source Voltage

$V_{GS} = 0$
f = 1 MHz

Ciss
Coss
Crss

Capacitance C (pF)

Drain to Source Voltage V_{DS} (V)

Dynamic Input Characteristics

$V_{DD} = 50$ V
25 V
10 V

V_{DS}

$V_{DD} = 50$ V

V_{GS}

25 V
10 V

$I_D = 3$ A

Drain to Source Voltage V_{DS} (V)

Gate to Source Voltage V_{GS} (V)

Gate Charge Qg (nc)

Switching Characteristics

$t_{d (off)}$

t_f

$V_{GS} = 10$ V
PW = 2 μs, duty < 1 %

t_r

$t_{d (on)}$

Switching Time t (ns)

Drain Current I_D (A)

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Reverse Drain Current vs. Source to Drain Voltage

Pulse Test

10 V
15 V
5 V
$V_{GS} = 0, -5 V$

Reverse Drain Current I_{DR} (A)

Source to Drain Voltage V_{SD} (V)

Normalized Transient Thermal Impedance vs. Pulse Width

$T_C = 25°C$

D = 1
0.5
0.2
0.1
0.05
0.02
0.01
1 Shot Pulse

$\theta_{ch-c}(t) = \gamma_s(t) \cdot \theta_{ch-c}$
$\theta_{ch-c} = 6.25°C/W, T_C = 25°C$

P_{DM}

$D = \dfrac{PW}{T}$

PW
T

Normalized Transient Thermal Impedance γ_s (t)

Pulse Width PW (s)

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Switching Time Test Circuit

Wavewforms

Vin Monitor

Vout Monitor

D.U.T

R_L

50 Ω

Vin = 10 V

$V_{DD} \fallingdotseq 30$ V

Vin — 10 %

Vout — 10 %

90 %

90 %

90 %

10 %

t_d (on) t_r t_d (off) t_f