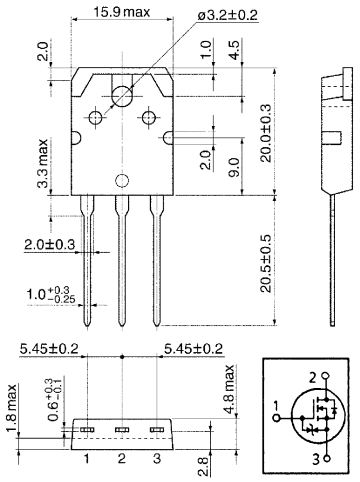
TOSHIBA Field Effect Transistor Silicon N-Channel MOS Type (U-MOSIII)

2SK3940

Switching Regulator, DC/DC Converter Applications
Motor Drive Applications

- Low drain-source ON-resistance: $R_{DS\ (ON)}$ = 5.6 mΩ (typ.)
- High forward transfer admittance: $|Y_{fs}|$ = 90 S (typ.)
- Low leakage current: I_{DSS} = 100 μA (V_{DS} = 75 V)
- Enhancement-mode: V_{th} = 3.0 to 5.0 V (V_{DS} = 10 V, I_D = 1 mA)

Unit: mm



1. GATE
2. DRAIN (HEAT SINK)
3. SOURCE

JEDEC	—
JEITA	—
TOSHIBA	2-16C1B

Weight: 4.6 g (typ.)

Maximum Ratings (Ta = 25°C)

Characteristic		Symbol	Rating	Unit
Drain-source voltage		V_{DSS}	75	V
Drain-gate voltage (R_{GS} = 20 kΩ)		V_{DGR}	75	V
Gate-source voltage		V_{GSS}	±20	V
Drain current	DC (Note 1)	I_D	70	A
	Pulse (Note 1)	I_{DP}	280	
Drain power dissipation (Tc = 25°C)		P_D	150	W
Single-pulse avalanche energy (Note 2)		E_{AS}	444	mJ
Avalanche current		I_{AR}	70	A
Repetitive avalanche energy (Note 3)		E_{AR}	15	mJ
Channel temperature		T_{ch}	175	°C
Storage temperature range		T_{stg}	−55~175	°C

Thermal Characteristics

Characteristic	Symbol	Max	Unit
Thermal resistance, channel to case	$R_{th\ (ch-c)}$	1.0	°C/W
Thermal resistance, channel to ambient	$R_{th\ (ch-a)}$	50	°C/W

Note 1: Ensure that the channel temperature does not exceed 150°C.

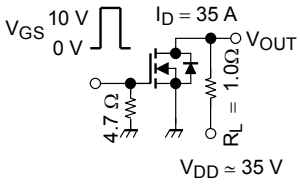
Note 2: V_{DD} = 25 V, T_{ch} = 25°C (initial), L = 135 μH, I_{AR} = 70 A, R_G = 25 Ω

Note 3: Repetitive rating: pulse width limited by maximum channel temperature

Note 4: The definition of maximum rating condition for both channel temperature and storage temperature range is derived from AEC-Q101.

This transistor is an electrostatic-sensitive device. Handle with care.

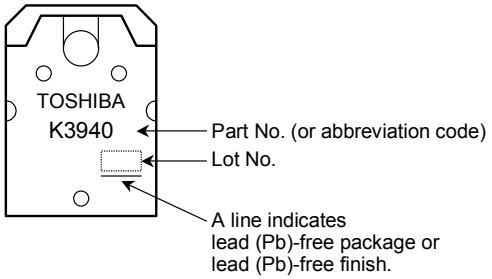
Electrical Characteristics (Ta = 25°C)

Characteristic		Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current		I_{GSS}	V_{GS} = ±16 V, V_{DS} = 0 V	—	—	±10	μA
Drain cutoff current		I_{DSS}	V_{DS} = 75 V, V_{GS} = 0 V	—	—	100	μA
Drain-source breakdown voltage		$V_{(BR)\ DSS}$	I_D = 10 mA, V_{GS} = 0 V	75	—	—	V
		$V_{(BR)\ DSX}$	I_D = 10 mA, V_{GS} = −20 V	45	—	—	V
Gate threshold voltage		V_{th}	V_{DS} = 10 V, I_D = 1 mA	3.0	—	5.0	V
Drain-source ON-resistance		$R_{DS\ (ON)}$	V_{GS} = 10 V, I_D = 35 A	—	5.6	7.0	mΩ
Forward transfer admittance		$\|Y_{fs}\|$	V_{DS} = 10 V, I_D = 35 A	45	90	—	S
Input capacitance		C_{iss}	V_{DS} = 10 V, V_{GS} = 0 V, f = 1 MHz	—	12500	—	pF
Reverse transfer capacitance		C_{rss}		—	510	—	
Output capacitance		C_{oss}		—	970	—	
Switching time	Rise time	t_r		—	20	—	ns
	Turn-on time	t_{on}		—	50	—	
	Fall time	t_f		—	30	—	
	Turn-off time	t_{off}	Duty ≦ 1%, t_w = 10 μs	—	160	—	
Total gate charge (gate-source plus gate-drain)		Q_g	V_{DD} ≃ 60 V, V_{GS} = 10 V, I_D = 70 A	—	200	—	nC
Gate-source charge		Q_{gs}		—	60	—	
Gate-drain (“Miller”) charge		Q_{gd}		—	85	—	

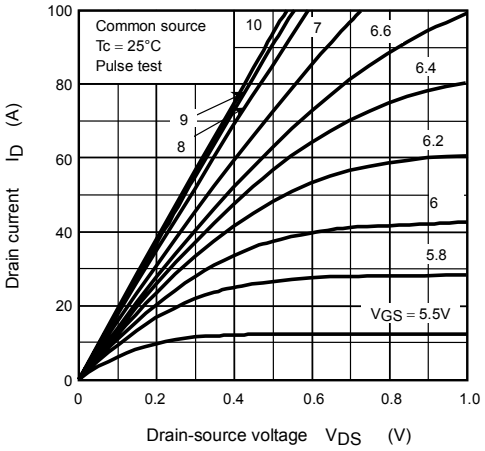
Source-Drain Ratings and Characteristics (Ta = 25°C)

Characteristic	Symbol	Test Condition	Min	Typ.	Max	Unit
Continuous drain reverse current (Note 1)	I_{DR}	—	—	—	70	A
Pulse drain reverse current (Note 1)	I_{DRP}	—	—	—	280	A
Forward voltage (diode)	V_{DSF}	I_{DR} = 70 A, V_{GS} = 0 V	—	—	−1.5	V
Reverse recovery time	t_{rr}	I_{DR} = 70 A, V_{GS} = 0 V, dI_{DR}/dt = 50 A/μs	—	75	—	ns
Reverse recovery charge	Q_{rr}		—	110	—	nC

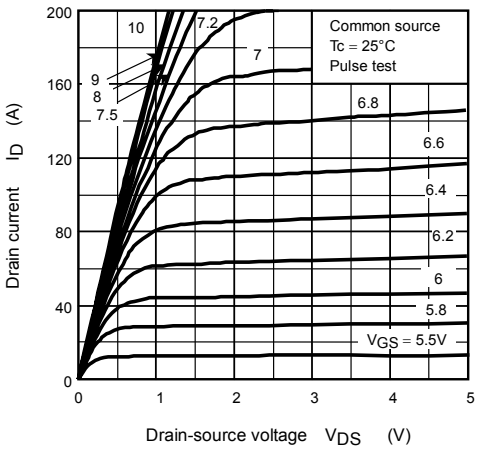
Marking



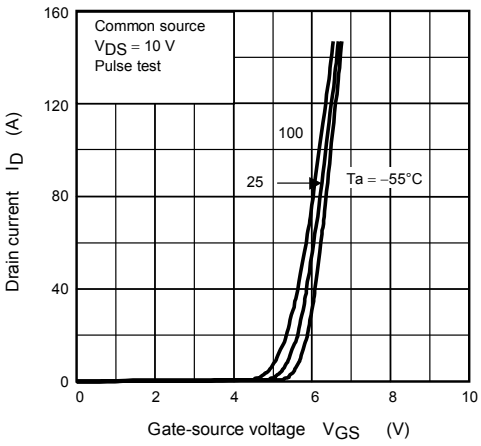
$I_D - V_{DS}$



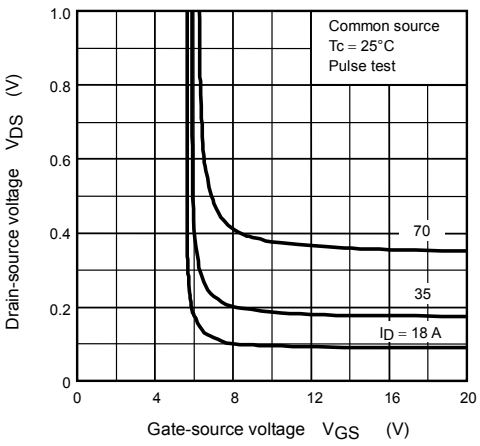
$I_D - V_{DS}$



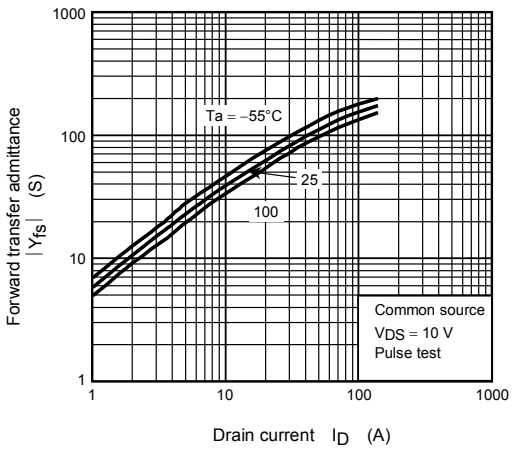
$I_D - V_{GS}$



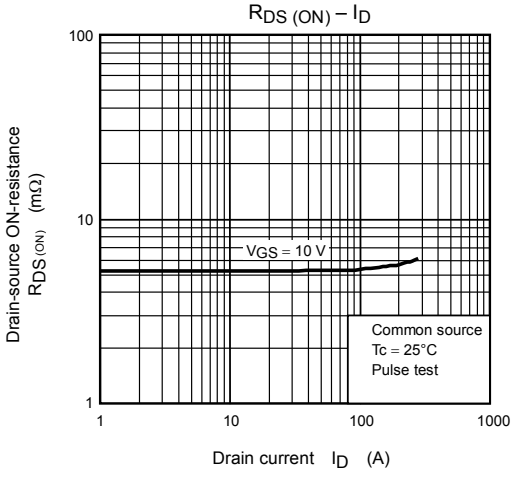
$V_{DS} - V_{GS}$



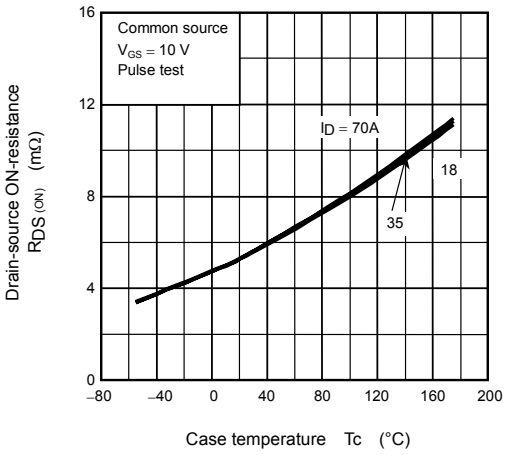
$|Y_{fs}| - I_D$



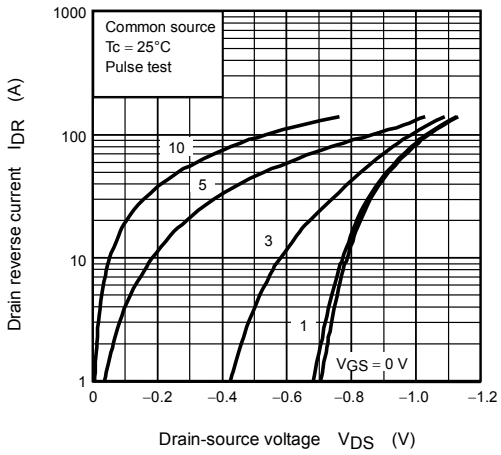
$R_{DS\ (ON)} - I_D$



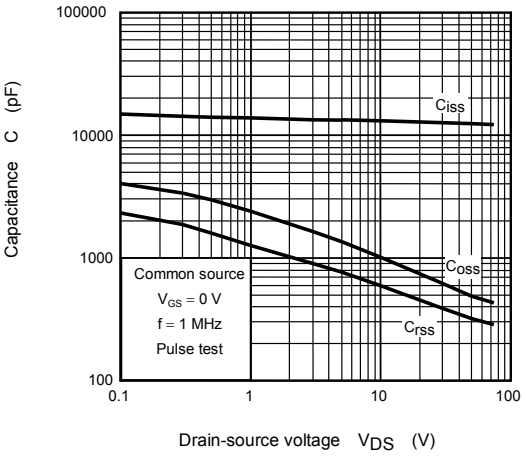
$R_{DS\ (ON)}$ – Tc



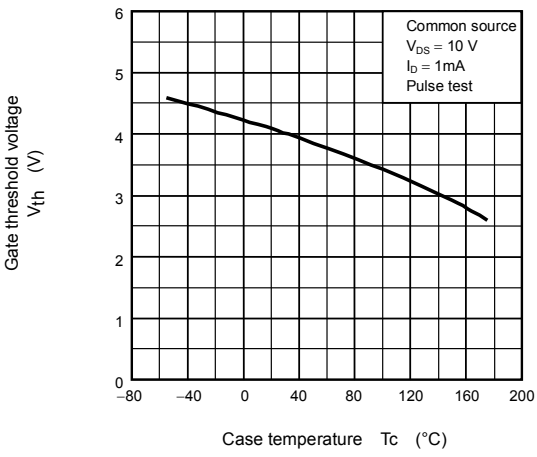
I_{DR} – V_{DS}



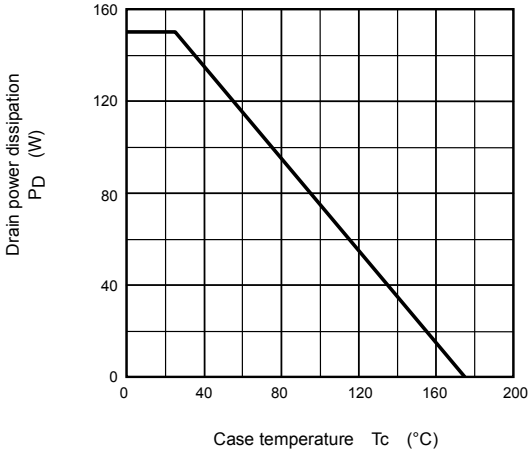
Capacitance – V_{DS}



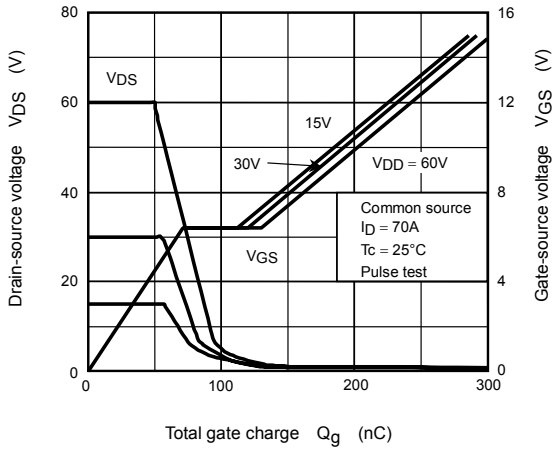
V_{th} – Tc



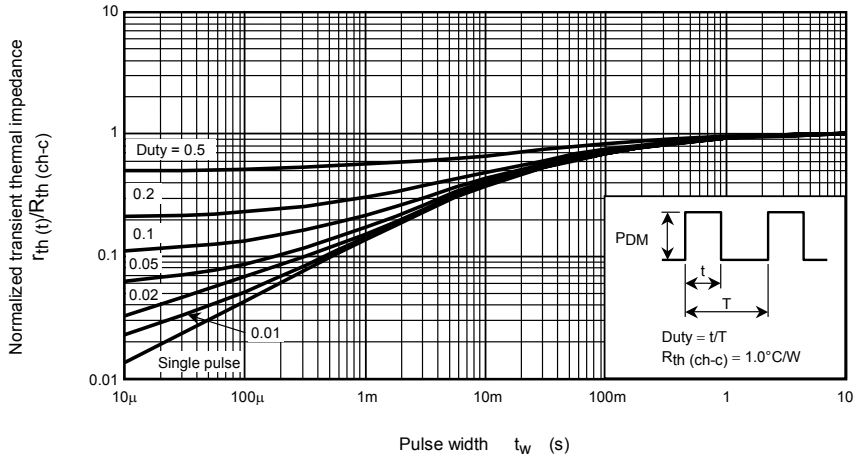
P_D – Tc



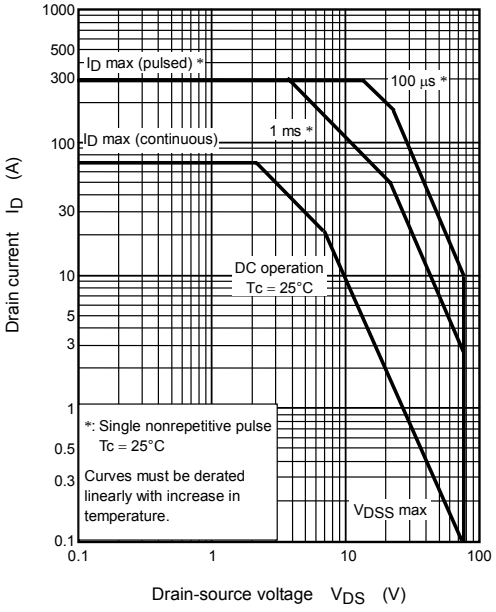
Dynamic input / output characteristics



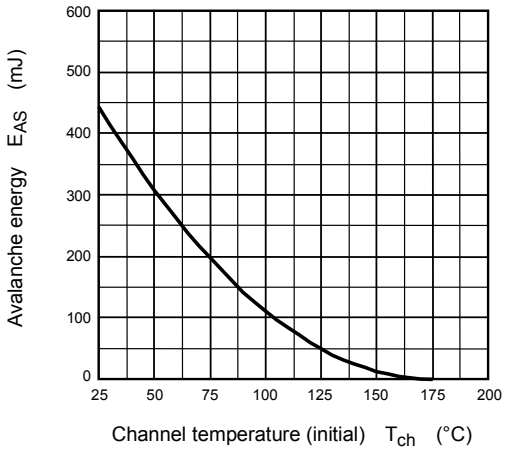
$r_{th} - t_w$

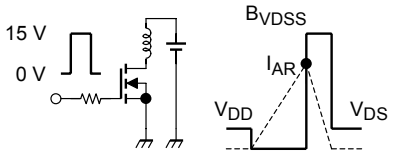


Safe operating area



$E_{AS} - T_{ch}$





Test circuit Waveform

$R_G = 25\ \Omega$
$V_{DD} = 25$ V, L = 135 μH

$$E_{AS} = \frac{1}{2} \cdot L \cdot I^2 \cdot \left(\frac{B_{VDSS}}{B_{VDSS} - V_{DD}} \right)$$

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