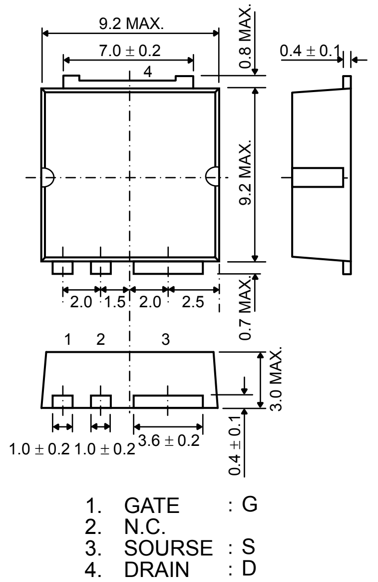
TOSHIBA Field Effect Transistor Silicon N Channel MOS Type (U-MOSⅣ)

TK80X04K3

Switching Regulator, DC-DC Converter Applications
Motor Drive Applications

- Low drain-source ON-resistance: $R_{DS\ (ON)}$ = 2.7 mΩ (typ.)
- High forward transfer admittance: $|Y_{fs}|$ = 150 S (typ.)
- Low leakage current: I_{DSS} = 10 μA (max) (V_{DS} = 40 V)
- Enhancement mode: V_{th} = 3.0 to 4.0 V (V_{DS} = 10 V, I_D = 1 mA)

Unit: mm



JEDEC	―
JEITA	SC-97
TOSHIBA	2-9F1C

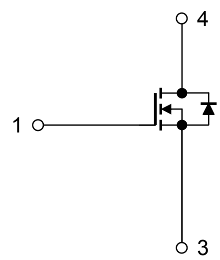
Weight: 0.74 g (typ.)

Absolute Maximum Ratings (Ta = 25°C)

Characteristics		Symbol	Rating	Unit
Drain-source voltage		V_{DSS}	40	V
Drain-gate voltage (R_{GS} = 20 kΩ)		V_{DGR}	40	V
Gate-source voltage		V_{GSS}	±20	V
Drain current	DC (Note 1)	I_D	80	A
	Pulse (Note 1)	I_{DP}	320	
Drain power dissipation (Tc = 25°C)		P_D	125	W
Single pulse avalanche energy (Note 2)		E_{AS}	123	mJ
Avalanche current		I_{AR}	80	A
Repetitive avalanche energy (Note 3)		E_{AR}	12.5	mJ
Channel temperature (Note 4)		T_{ch}	175	°C
Storage temperature range (Note 4)		T_{stg}	−55 to 175	°C

Thermal Characteristics

Characteristics	Symbol	Max	Unit
Thermal resistance, channel to case	$R_{th\ (ch-c)}$	1.2	°C/W



Note 1: Ensure that the channel temperature does not exceed 175°C.

Note 2: V_{DD} = 25 V, T_{ch} = 25°C (initial), L = 20 μH, I_{AR} = 80 A, R_G = 25 Ω

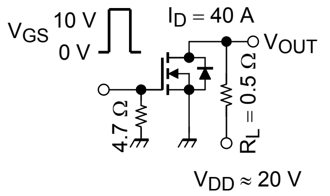
Note 3: Repetitive rating: pulse width limited by maximum channel temperature

Note 4: The definitions of the absolute maximum channel temperature and storage temperatures are based on AEC-Q101.

Note 5: Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings.
Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook (“Handling Precautions”/“Derating Concept and Methods”) and individual reliability data (i.e. reliability test report and estimated failure rate, etc).

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

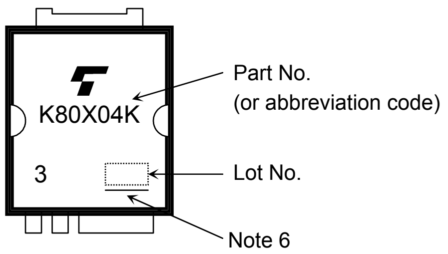
Electrical Characteristics (Ta = 25°C)

Characteristics		Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current		I_{GSS}	V_{GS} = ±20 V, V_{DS} = 0 V	—	—	±10	μA
Drain cut-off current		I_{DSS}	V_{DS} = 40 V, V_{GS} = 0 V	—	—	10	μA
Drain-source breakdown voltage		$V_{(BR)\ DSS}$	I_D = 10 mA, V_{GS} = 0 V	40	—	—	V
		$V_{(BR)\ DSX}$	I_D = 10 mA, V_{GS} = −20 V	20	—	—	V
Gate threshold voltage		V_{th}	V_{DS} = 10 V, I_D = 1 mA	3.0	—	4.0	V
Drain-source ON-resistance		$R_{DS\ (ON)}$	V_{GS} = 10 V, I_D = 40 A	—	2.7	3.5	mΩ
Forward transfer admittance		$\lvert Y_{fs} \rvert$	V_{DS} = 10 V, I_D = 40 A	75	150	—	S
Input capacitance		C_{iss}	V_{DS} = 10 V, V_{GS} = 0 V, f = 1 MHz	—	4600	—	pF
Reverse transfer capacitance		C_{rss}		—	850	—	
Output capacitance		C_{oss}		—	1150	—	
Switching time	Rise time	t_r		—	28	—	ns
	Turn-on time	t_{on}		—	60	—	
	Fall time	t_f		—	35	—	
	Turn-off time	t_{off}	Duty ≤ 1%, t_w = 10 μs	—	90	—	
Total gate charge (gate-source plus gate-drain)		Q_g	V_{DD} ≈ 32 V, V_{GS} = 10 V, I_D = 80 A	—	100	—	nC
Gate-source charge		Q_{gs}		—	60	—	
Gate-drain ("miller") charge		Q_{gd}		—	40	—	

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

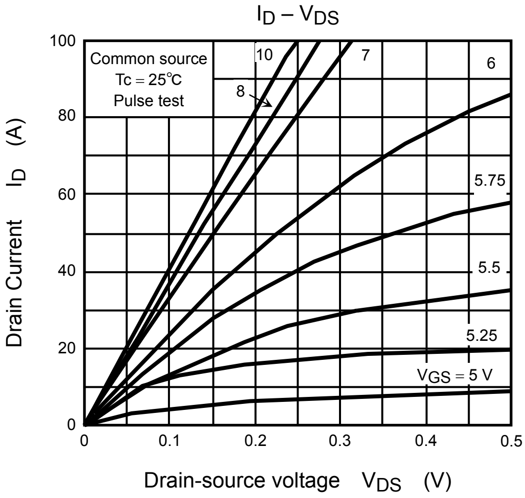
Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Continuous drain reverse current (Note 1)	I_{DR}	—	—	—	80	A
Pulse drain reverse current (Note 1)	I_{DRP}	—	—	—	320	A
Forward voltage (diode)	V_{DSF}	I_{DR} = 80 A, V_{GS} = 0 V	—	—	−1.5	V
Reverse recovery time	t_{rr}	I_{DR} = 80 A, V_{GS} = 0 V, dI_{DR}/dt = 30 A/μs	—	80	—	ns
Reverse recovery charge	Q_{rr}		—	60	—	nC

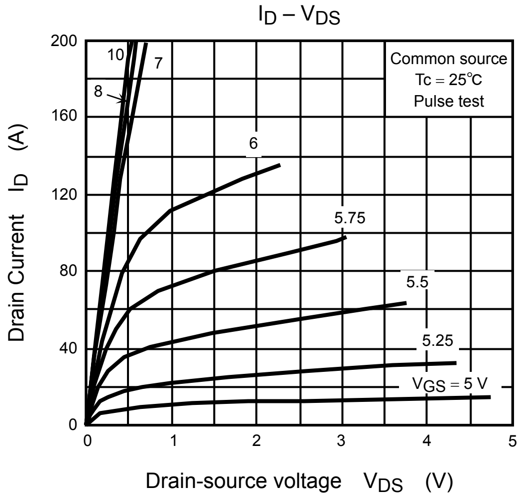
Marking

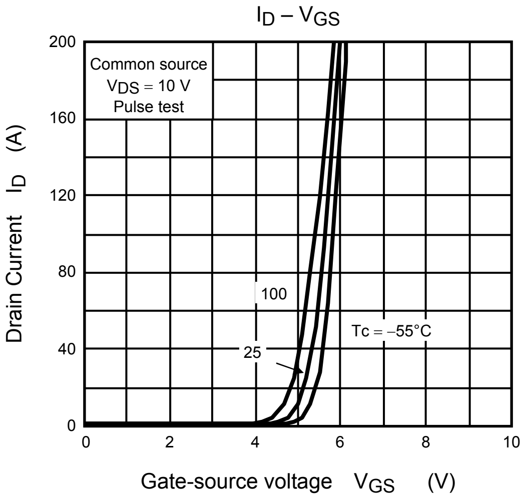


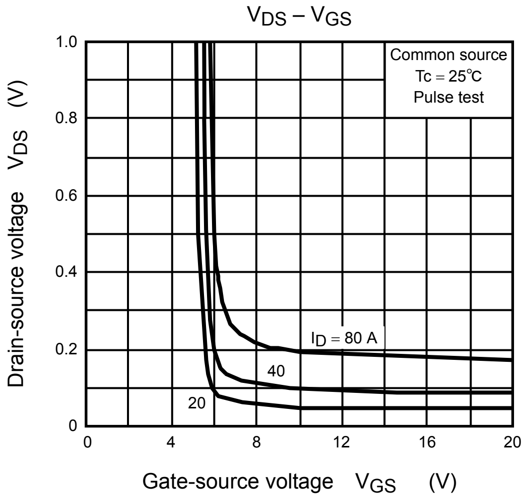
Note 6: A line under a Lot No. identifies the indication of product Labels [[G]]/RoHS COMPATIBLE or [[G]]/RoHS [[Pb]]

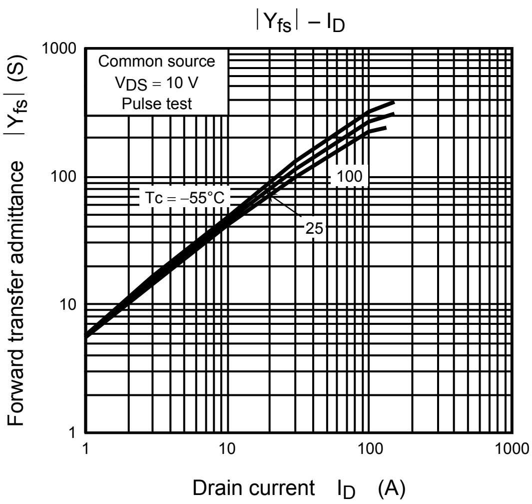
Please contact your TOSHIBA sales representative for details as to environmental matters such as the RoHS compatibility of Product. The RoHS is Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment

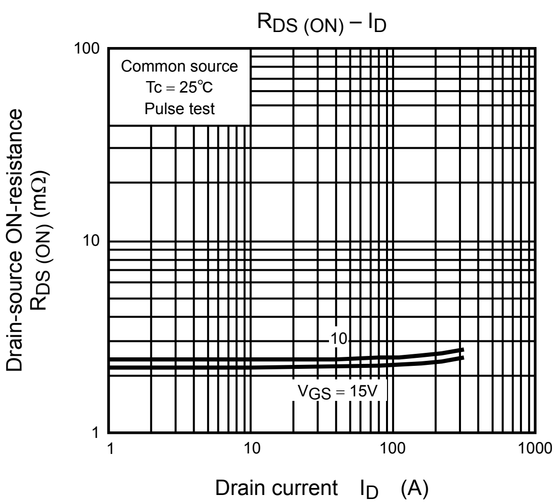

ID – VDS
Common source
Tc = 25°C
Pulse test
10
8
7
6
5.75
5.5
5.25
VGS = 5 V
Drain Current ID (A)
Drain-source voltage VDS (V)

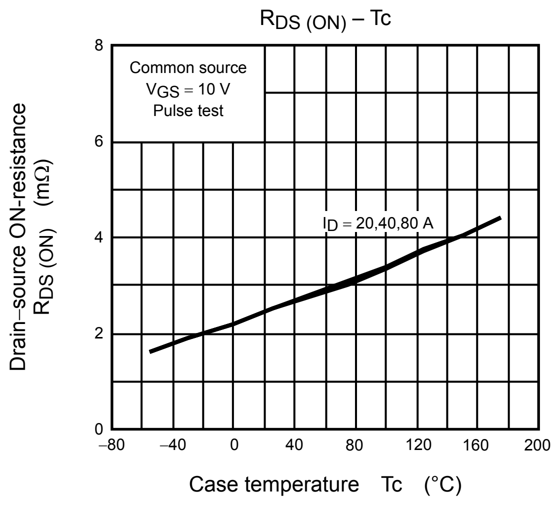

ID – VDS
Common source
Tc = 25°C
Pulse test
10
8
7
6
5.75
5.5
5.25
VGS = 5 V
Drain Current ID (A)
Drain-source voltage VDS (V)

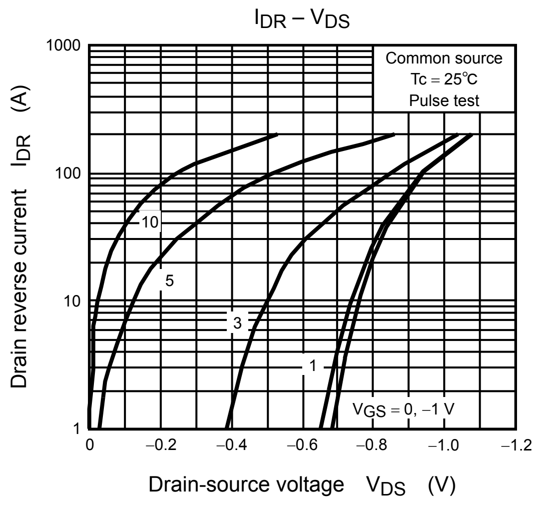

ID – VGS
Common source
VDS = 10 V
Pulse test
100
25
Tc = −55°C
Drain Current ID (A)
Gate-source voltage VGS (V)

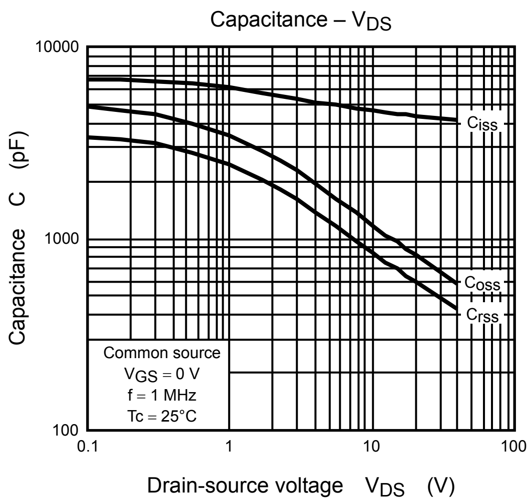

VDS – VGS
Common source
Tc = 25°C
Pulse test
ID = 80 A
40
20
Drain-source voltage VDS (V)
Gate-source voltage VGS (V)

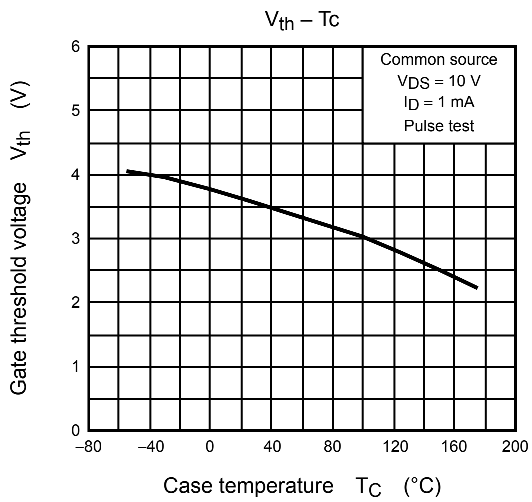

|Yfs| – ID
Common source
VDS = 10 V
Pulse test
Tc = −55°C
100
25
Forward transfer admittance |Yfs| (S)
Drain current ID (A)

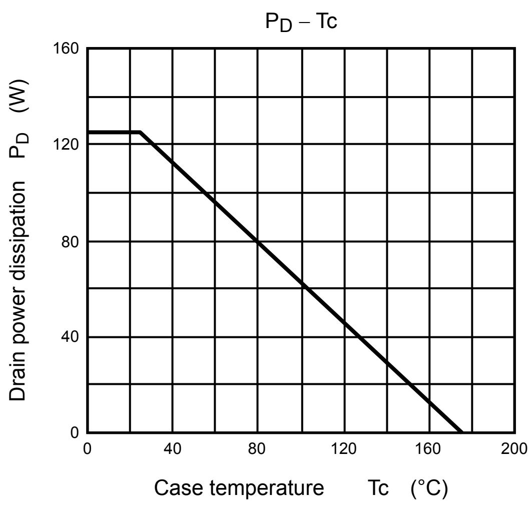

RDS (ON) – ID
Common source
Tc = 25°C
Pulse test
10
VGS = 15V
Drain-source ON-resistance RDS (ON) (mΩ)
Drain current ID (A)

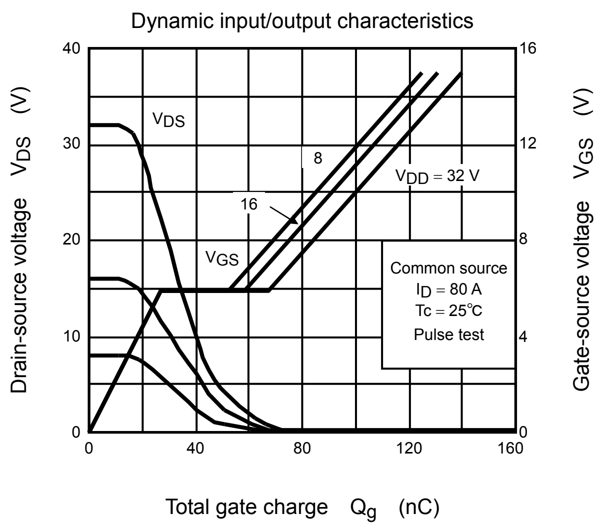

R$_{DS (ON)}$ – Tc
Common source
V$_{GS}$ = 10 V
Pulse test
I$_D$ = 20,40,80 A
Drain–source ON-resistance R$_{DS (ON)}$ (mΩ)
Case temperature Tc (°C)


I$_{DR}$ – V$_{DS}$
Common source
Tc = 25°C
Pulse test
10
5
3
1
V$_{GS}$ = 0, –1 V
Drain reverse current I$_{DR}$ (A)
Drain-source voltage V$_{DS}$ (V)

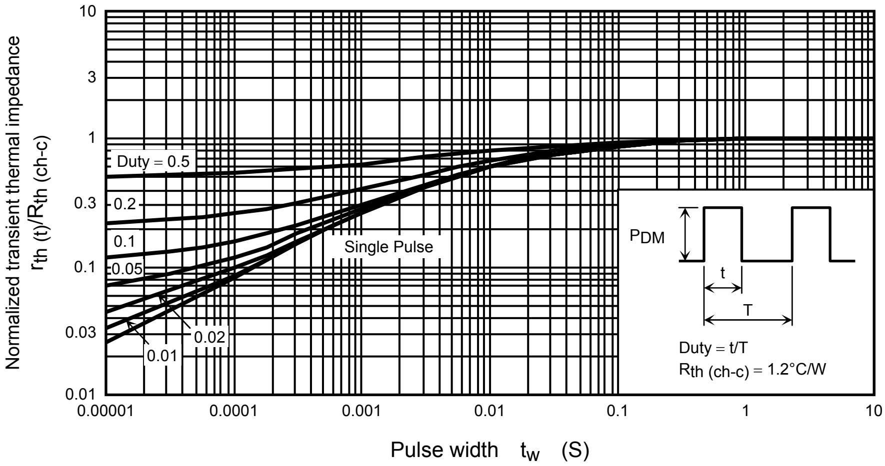

Capacitance – V$_{DS}$
C$_{iss}$
C$_{oss}$
C$_{rss}$
Common source
V$_{GS}$ = 0 V
f = 1 MHz
Tc = 25°C
Capacitance C (pF)
Drain-source voltage V$_{DS}$ (V)


V$_{th}$ – Tc
Common source
V$_{DS}$ = 10 V
I$_D$ = 1 mA
Pulse test
Gate threshold voltage V$_{th}$ (V)
Case temperature T$_C$ (°C)

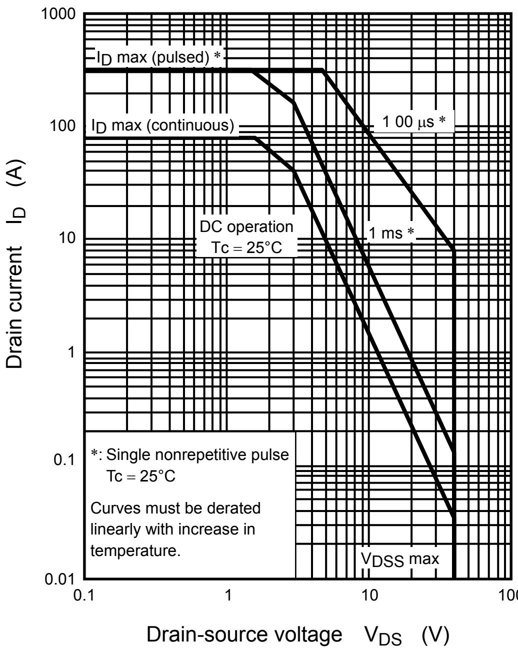

P$_D$ – Tc
Drain power dissipation P$_D$ (W)
Case temperature Tc (°C)


Dynamic input/output characteristics
V$_{DS}$
8
16
V$_{DD}$ = 32 V
V$_{GS}$
Common source
I$_D$ = 80 A
Tc = 25°C
Pulse test
Drain-source voltage V$_{DS}$ (V)
Gate-source voltage V$_{GS}$ (V)
Total gate charge Q$_g$ (nC)

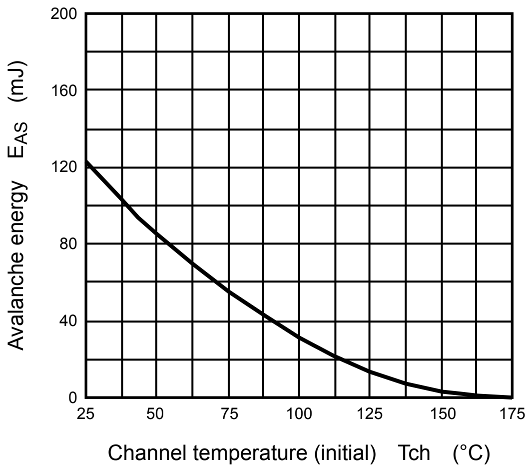
$r_{th} – t_w$

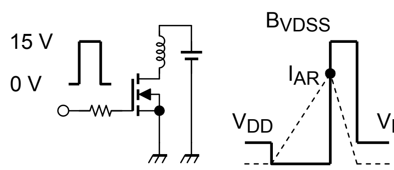


Safe operating area



$E_{AS} – T_{ch}$





Test circuit   Wave form

$R_G = 25\ \Omega$
$V_{DD} = 25\ V,\ L = 20\ \mu H$

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

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