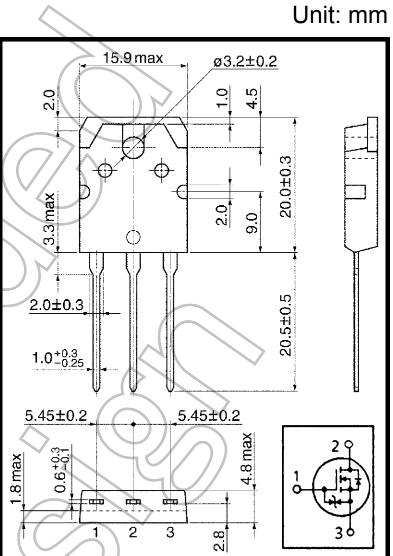
TOSHIBA Field Effect Transistor Silicon N Channel MOS Type (π−MOSIII)

2SK2968

DC−DC Converter, Relay Drive and Motor Drive Applications

- Low drain−source ON resistance : $R_{DS\ (ON)}$ = 1.05 Ω (typ.)
- High forward transfer admittance : $|Y_{fs}|$ = 7.6 S (typ.)
- Low leakage current : I_{DSS} = 100 μA (max) (V_{DS} = 720 V)
- Enhancement mode : V_{th} = 2.0 to 4.0 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.)

Absolute Maximum Ratings (Ta = 25°C)

Characteristics		Symbol	Rating	Unit
Drain−source voltage		V_{DSS}	900	V
Drain−gate voltage (R_{GS} = 20 kΩ)		V_{DGR}	900	V
Gate−source voltage		V_{GSS}	±30	V
Drain current	DC (Note 1)	I_D	10	A
	Pulse (Note 1)	I_{DP}	30	A
Drain power dissipation (Tc = 25°C)		P_D	150	W
Single pulse avalanche energy (Note 2)		E_{AS}	810	mJ
Avalanche current		I_{AR}	10	A
Repetitive avalanche energy (Note 3)		E_{AR}	15	mJ
Channel temperature		T_{ch}	150	°C
Storage temperature range		T_{stg}	−55 to 150	°C

Note: 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).

Thermal Characteristics

Characteristics	Symbol	Max	Unit
Thermal resistance, channel to case	$R_{th\ (ch-c)}$	0.833	°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.

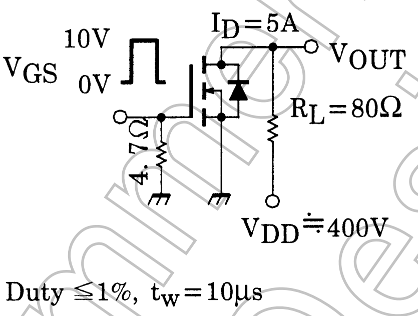
Note 2: V_{DD} = 90 V, T_{ch} = 25°C (initial), L = 14.9 mH, R_G = 25 Ω, I_{AR} = 10 A

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

This transistor is an electrostatic-sensitive device.
Please handle with caution.

Start of commercial production
2007-07

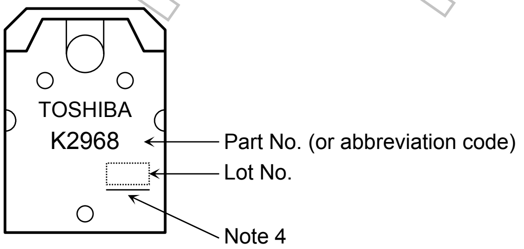
Electrical Characteristics (Ta = 25°C)

Characteristics		Symbol	Test Condition	Min	Typ.	Max	Unit
Gate leakage current		I_{GSS}	V_{GS} = ±30 V, V_{DS} = 0 V	—	—	±10	μA
Gate−source breakdown voltage		$V_{(BR)\ GSS}$	I_G = ±10 μA, V_{DS} = 0 V	±30	—	—	V
Drain cut−off current		I_{DSS}	V_{DS} = 720 V, V_{GS} = 0 V	—	—	100	μA
Drain−source breakdown voltage		$V_{(BR)\ DSS}$	I_D = 10 mA, V_{GS} = 0 V	900	—	—	V
Gate threshold voltage		V_{th}	V_{DS} = 10 V, I_D = 1 mA	2.0	—	4.0	V
Drain−source ON resistance		$R_{DS\ (ON)}$	V_{GS} = 10 V, I_D = 4 A	—	1.05	1.25	Ω
Forward transfer admittance		$\lvert Y_{fs} \rvert$	V_{DS} = 15 V, I_D = 4 A	3.5	7.6	—	S
Input capacitance		C_{iss}	V_{DS} = 25 V, V_{GS} = 0 V, f = 1 MHz	—	2150	—	pF
Reverse transfer capacitance		C_{rss}		—	35	—	
Output capacitance		C_{oss}		—	220	—	
Switching time	Rise time	t_r		—	25	—	ns
	Turn−on time	t_{on}		—	60	—	
	Fall time	t_f		—	25	—	
	Turn−off time	t_{off}		—	120	—	
Total gate charge (gate−source plus gate−drain)		Q_g	V_{DD} ≈ 400 V, V_{GS} = 10 V, I_D = 10 A	—	70	—	nC
Gate−source charge		Q_{gs}		—	37	—	
Gate−drain (“miller”) Charge		Q_{gd}		—	33	—	

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

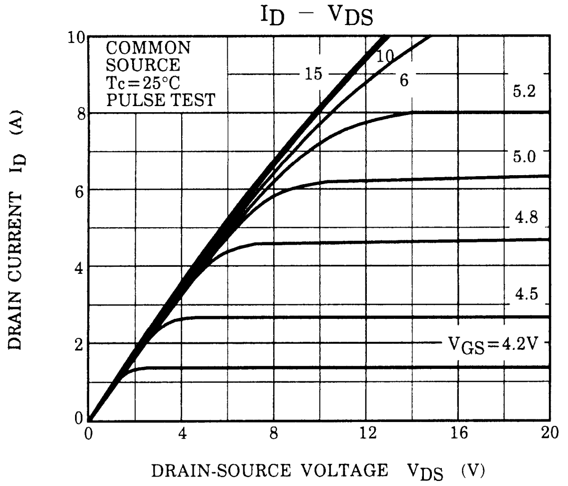
Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Continuous drain reverse current (Note 1)	I_{DR}	—	—	—	10	A
Pulse drain reverse current (Note 1)	I_{DRP}	—	—	—	30	A
Forward voltage (diode)	V_{DSF}	I_{DR} = 10 A, V_{GS} = 0 V	—	—	−1.9	V
Reverse recovery time	t_{rr}	I_{DR} = 10 A, V_{GS} = 0 V dI_{DR} / dt = 100 A / μs	—	1300	—	ns
Reverse recovery charge	Q_{rr}		—	14.5	—	μC

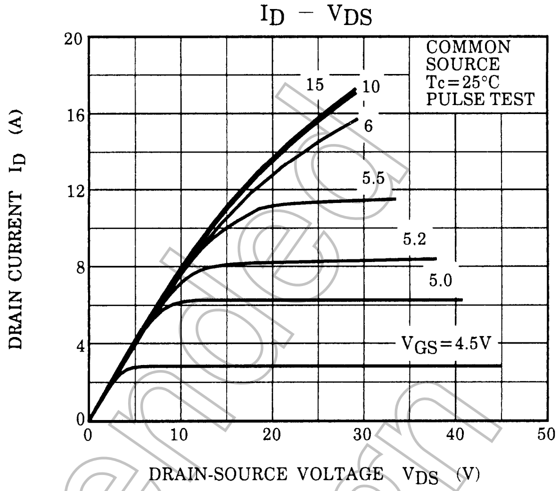
Marking

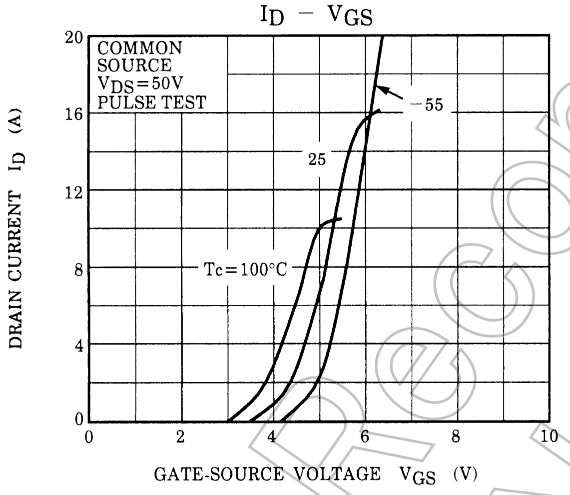


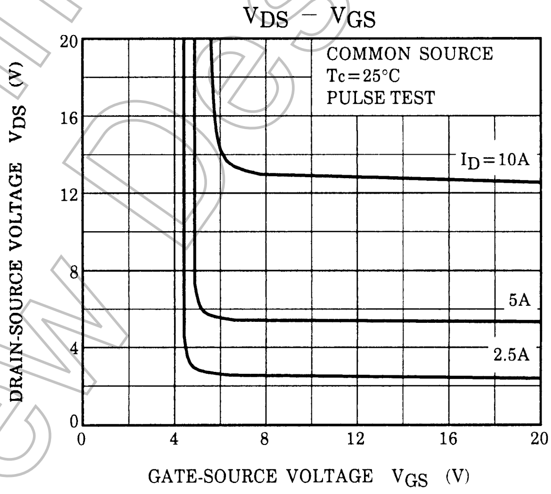
Note 4: A line under a Lot No. identifies the indication of product Labels.
Not underlined: [[Pb]]/INCLUDES > MCV
Underlined: [[G]]/RoHS COMPATIBLE or [[G]]/RoHS [[Pb]]

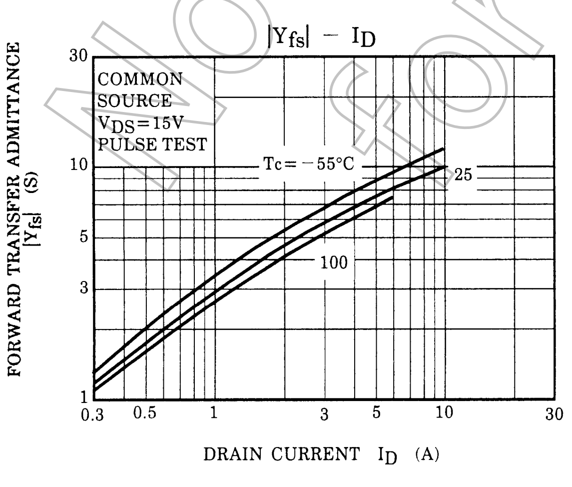
Please contact your TOSHIBA sales representative for details as to environmental matters such as the RoHS compatibility of Product. The RoHS is the Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

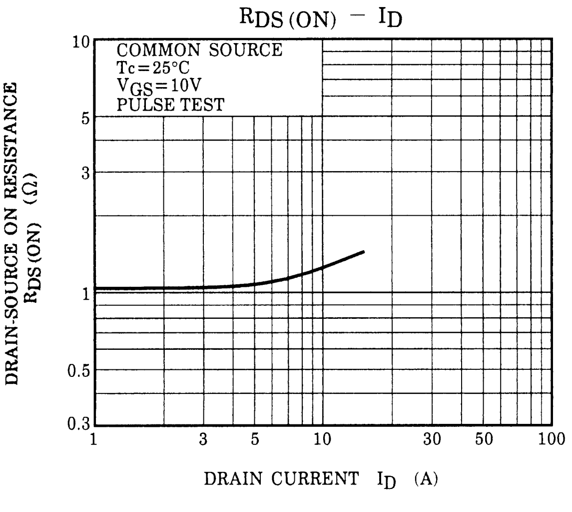

ID – VDS
COMMON SOURCE
Tc = 25°C
PULSE TEST
15
10
6
5.2
5.0
4.8
4.5
VGS = 4.2V
DRAIN CURRENT ID (A)
0
2
4
6
8
10
0
4
8
12
16
20
DRAIN-SOURCE VOLTAGE VDS (V)

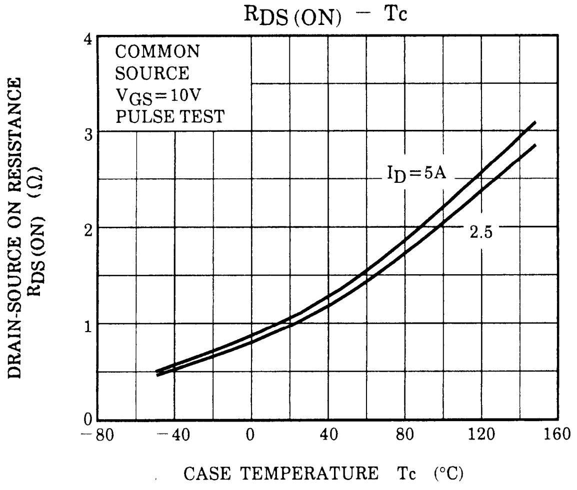

ID – VDS
COMMON SOURCE
Tc = 25°C
PULSE TEST
15
10
6
5.5
5.2
5.0
VGS = 4.5V
DRAIN CURRENT ID (A)
0
4
8
12
16
20
0
10
20
30
40
50
DRAIN-SOURCE VOLTAGE VDS (V)

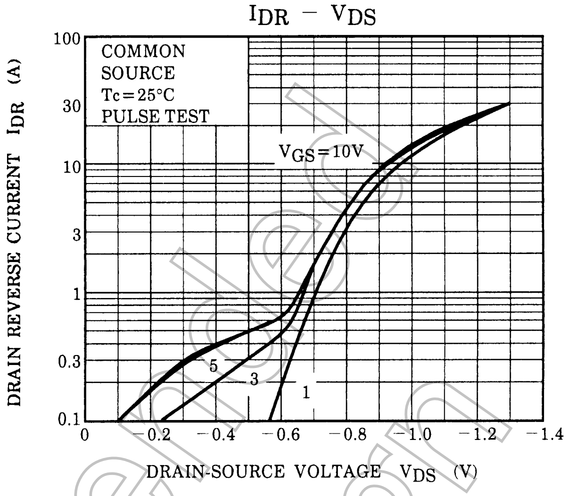

ID – VGS
COMMON SOURCE
VDS = 50V
PULSE TEST
−55
25
Tc = 100°C
DRAIN CURRENT ID (A)
0
4
8
12
16
20
0
2
4
6
8
10
GATE-SOURCE VOLTAGE VGS (V)

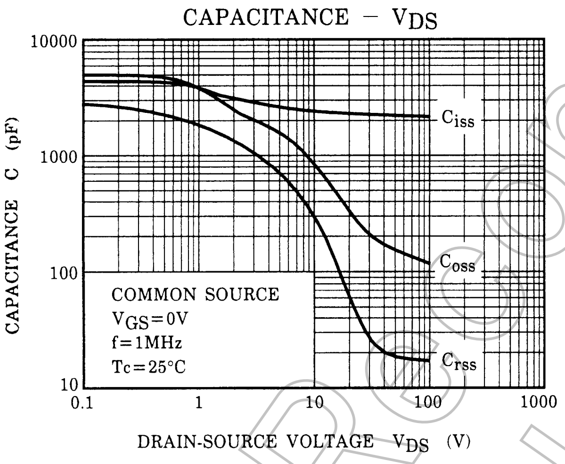

VDS – VGS
COMMON SOURCE
Tc = 25°C
PULSE TEST
ID = 10A
5A
2.5A
DRAIN-SOURCE VOLTAGE VDS (V)
0
4
8
12
16
20
0
4
8
12
16
20
GATE-SOURCE VOLTAGE VGS (V)

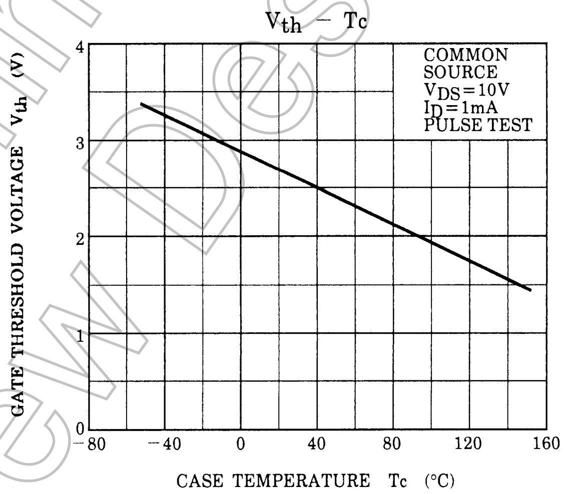

|Yfs| – ID
COMMON SOURCE
VDS = 15V
PULSE TEST
Tc = −55°C
25
100
FORWARD TRANSFER ADMITTANCE |Yfs| (S)
1
3
5
10
30
0.3
0.5
1
3
5
10
30
DRAIN CURRENT ID (A)

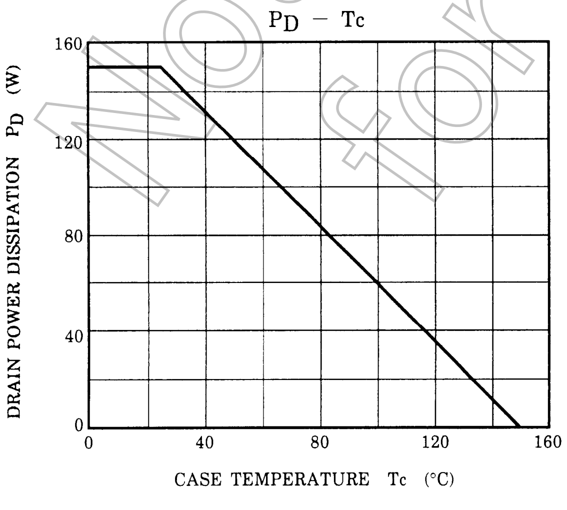

RDS (ON) – ID
COMMON SOURCE
Tc = 25°C
VGS = 10V
PULSE TEST
DRAIN-SOURCE ON RESISTANCE RDS (ON) (Ω)
0.3
0.5
1
3
5
10
1
3
5
10
30
50
100
DRAIN CURRENT ID (A)

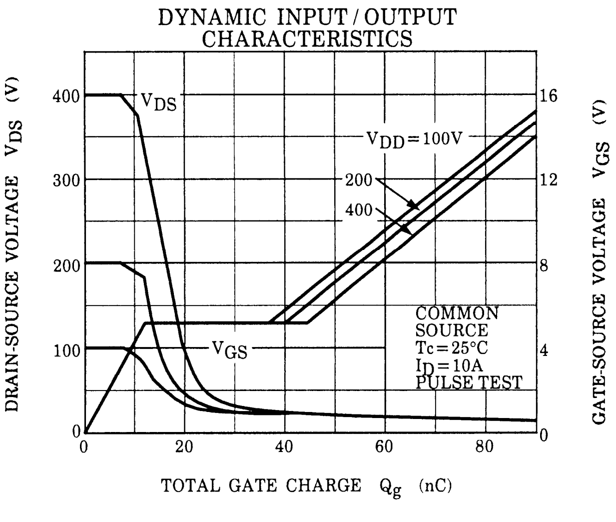

$R_{DS(ON)}$ – Tc
COMMON SOURCE
V_{GS} = 10V
PULSE TEST
I_D = 5A
2.5
DRAIN-SOURCE ON RESISTANCE $R_{DS(ON)}$ (Ω)
0
1
2
3
4
−80
−40
0
40
80
120
160
CASE TEMPERATURE Tc (°C)

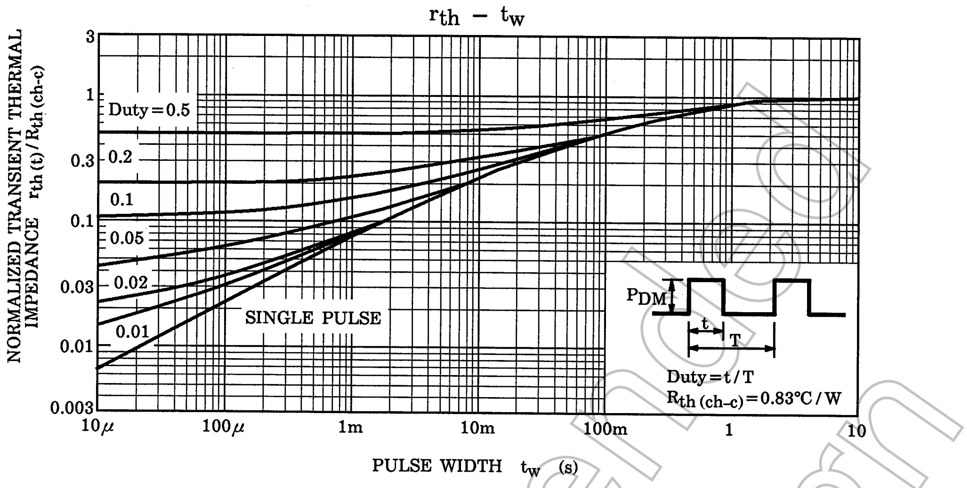

I_{DR} – V_{DS}
COMMON SOURCE
Tc = 25°C
PULSE TEST
V_{GS} = 10V
5
3
1
DRAIN REVERSE CURRENT I_{DR} (A)
0.1
0.3
1
3
10
30
100
0
−0.2
−0.4
−0.6
−0.8
−1.0
−1.2
−1.4
DRAIN-SOURCE VOLTAGE V_{DS} (V)

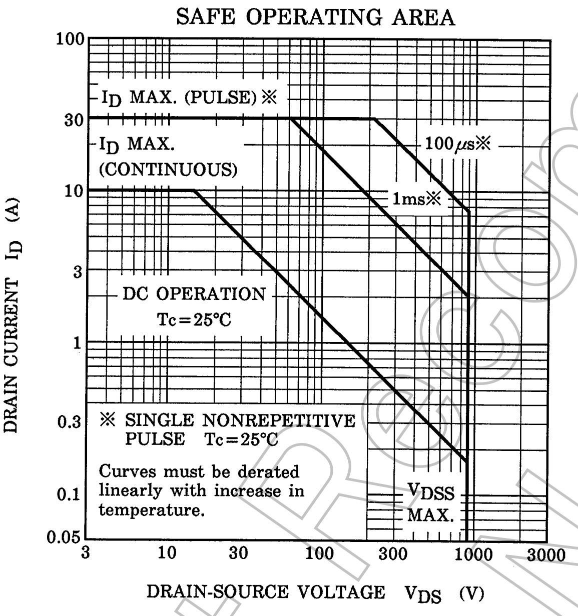

CAPACITANCE – V_{DS}
C_{iss}
C_{oss}
C_{rss}
COMMON SOURCE
V_{GS} = 0V
f = 1MHz
Tc = 25°C
CAPACITANCE C (pF)
10
100
1000
10000
0.1
1
10
100
1000
DRAIN-SOURCE VOLTAGE V_{DS} (V)

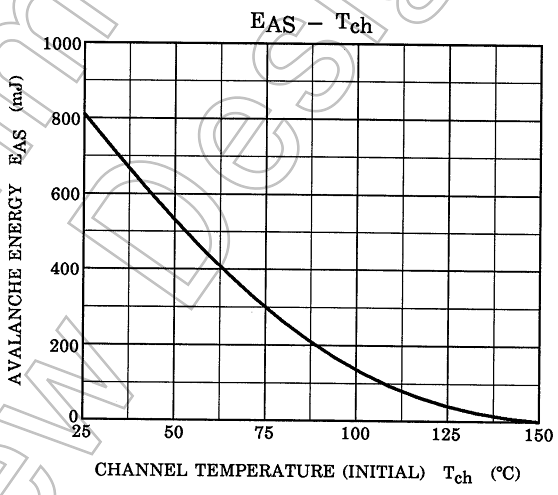

V_{th} – Tc
COMMON SOURCE
V_{DS} = 10V
I_D = 1mA
PULSE TEST
GATE THRESHOLD VOLTAGE V_{th} (V)
0
1
2
3
4
−80
−40
0
40
80
120
160
CASE TEMPERATURE Tc (°C)

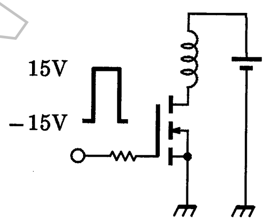

P_D – Tc
DRAIN POWER DISSIPATION P_D (W)
0
40
80
120
160
0
40
80
120
160
CASE TEMPERATURE Tc (°C)


DYNAMIC INPUT / OUTPUT CHARACTERISTICS
V_{DS}
V_{DD} = 100V
200
400
V_{GS}
COMMON SOURCE
Tc = 25°C
I_D = 10A
PULSE TEST
DRAIN-SOURCE VOLTAGE V_{DS} (V)
0
100
200
300
400
GATE-SOURCE VOLTAGE V_{GS} (V)
0
4
8
12
16
0
20
40
60
80
TOTAL GATE CHARGE Q_g (nC)

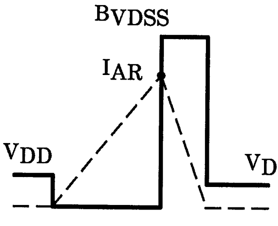








TEST CIRCUIT



WAVE FORM

$R_G = 25\ \Omega$
$V_{DD} = 90\ \text{V},\ L = 14.9\ \text{mH}$

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