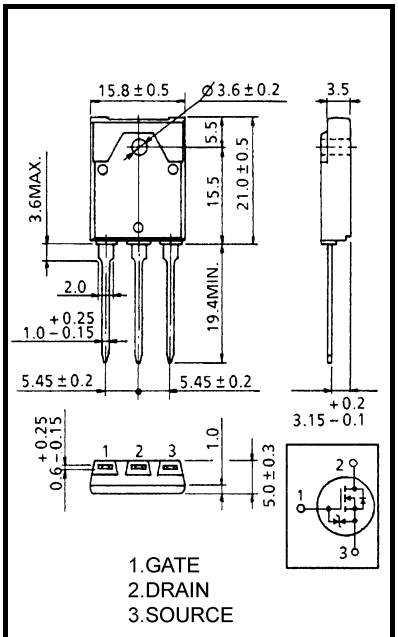
TOSHIBA Field Effect Transistor Silicon N Channel MOS Type (π–MOSV)

# 2SK2916

DC−DC Converter, Relay Drive and Motor Drive Applications

- Low drain–source ON resistance : $R_{DS\ (ON)}$ = 0.35 Ω (typ.)
- High forward transfer admittance : $|Y_{fs}|$ = 11 S (typ.)
- Low leakage current : $I_{DSS}$ = 100 μA (max) ($V_{DS}$ = 500 V)
- Enhancement mode : $V_{th}$ = 2.0~4.0 V ($V_{DS}$ = 10 V, $I_D$ = 1 mA)

Unit: mm




| | |
|---|---|
| JEDEC | — |
| JEITA | — |
| TOSHIBA | 2-16F1B |

Weight: 5.8 g (typ.)

## Absolute Maximum Ratings (Ta = 25°C)

| Characteristics | | Symbol | Rating | Unit |
|---|---|---|---|---|
| Drain–source voltage | | $V_{DSS}$ | 500 | V |
| Drain–gate voltage ($R_{GS}$ = 20 kΩ) | | $V_{DGR}$ | 500 | V |
| Gate–source voltage | | $V_{GSS}$ | ±30 | V |
| Drain current | DC (Note 1) | $I_D$ | 14 | A |
| | Pulse (Note 1) | $I_{DP}$ | 56 | A |
| Drain power dissipation (Tc = 25°C) | | $P_D$ | 80 | W |
| Single pulse avalanche energy (Note 2) | | $E_{AS}$ | 795 | mJ |
| Avalanche current | | $I_{AR}$ | 14 | A |
| Repetitive avalanche energy (Note 3) | | $E_{AR}$ | 8 | mJ |
| Channel temperature | | $T_{ch}$ | 150 | °C |
| Storage temperature range | | $T_{stg}$ | −55~150 | °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 | $R_{th\ (ch–c)}$ | 1.56 | °C / W |
| Thermal resistance, channel to ambient | $R_{th\ (ch–a)}$ | 41.6 | °C / W |

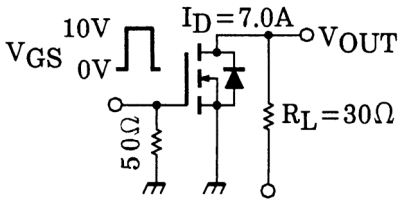
Note 1: Ensure that the channel temperature does not exceed 150°C.

Note 2: $V_{DD}$ = 90 V, starting $T_{ch}$ = 25°C, L = 6.9 mH, $R_G$ = 25 Ω, $I_{AR}$ = 14 A

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

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

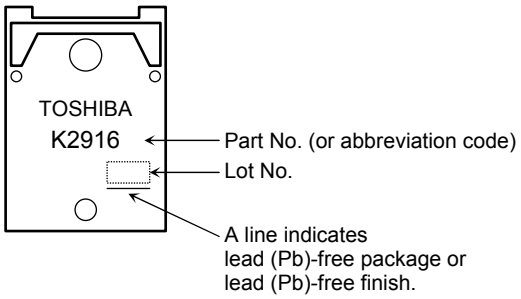
## Electrical Characteristics (Ta = 25°C)

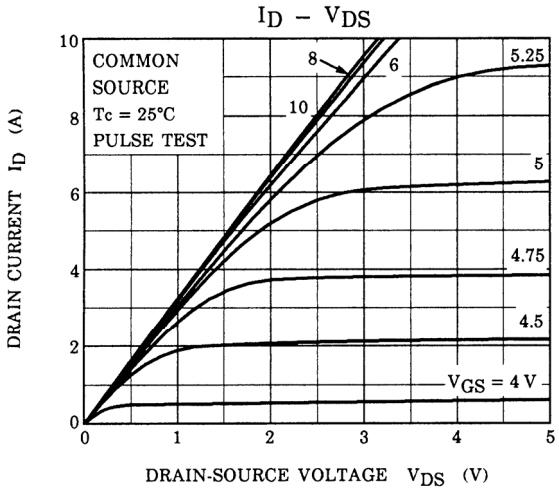
| Characteristics | | Symbol | Test Condition | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|---|
| Gate leakage current | | $I_{GSS}$ | $V_{GS}$ = ±25 V, $V_{DS}$ = 0 V | — | — | ±10 | μA |
| Gate−source breakdown voltage | | $V_{(BR)\ GSS}$ | $I_G$ = ±10 μA, $V_{DS}$ = 0 V | ±30 | — | — | V |
| Drain cut−off current | | $I_{DSS}$ | $V_{DS}$ = 500 V, $V_{GS}$ = 0 V | — | — | 100 | μA |
| Drain−source breakdown voltage | | $V_{(BR)\ DSS}$ | $I_D$ = 10 mA, $V_{GS}$ = 0 V | 500 | — | — | 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, $I_D$ = 7.0 A | — | 0.35 | 0.4 | Ω |
| Forward transfer admittance | | $\|Y_{fs}\|$ | $V_{DS}$ = 10 V, $I_D$ = 7.0 A | 6 | 11 | — | S |
| Input capacitance | | $C_{iss}$ | $V_{DS}$ = 10 V, $V_{GS}$ = 0 V, f = 1 MHz | — | 2600 | — | pF |
| Reverse transfer capacitance | | $C_{rss}$ | | — | 280 | — | |
| Output capacitance | | $C_{oss}$ | | — | 880 | — | |
| Switching time | Rise time | $t_r$ |  | — | 50 | — | ns |
| | Turn−on time | $t_{on}$ | | — | 85 | — | |
| | Fall time | $t_f$ | | — | 65 | — | |
| | Turn−off time | $t_{off}$ | | — | 260 | — | |
| Total gate charge (gate−source plus gate−drain) | | $Q_g$ | $V_{DD}$ ≈ 400 V, $V_{GS}$ = 10 V, $I_D$ = 14 A | — | 58 | — | nC |
| Gate−source charge | | $Q_{gs}$ | | — | 36 | — | |
| Gate−drain (“miller”) Charge | | $Q_{gd}$ | | — | 22 | — | |

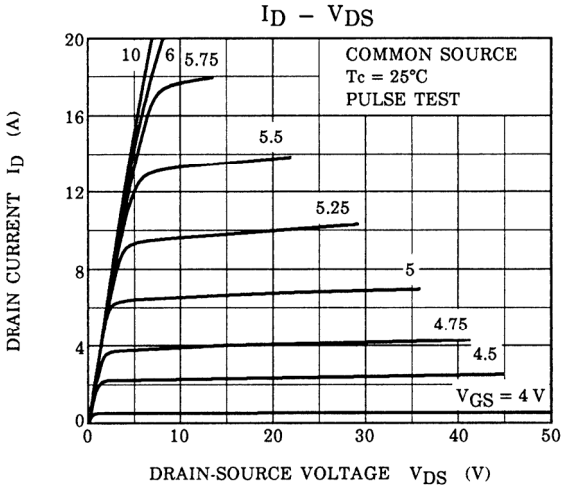
## Source−Drain Ratings and Characteristics (Ta = 25°C)

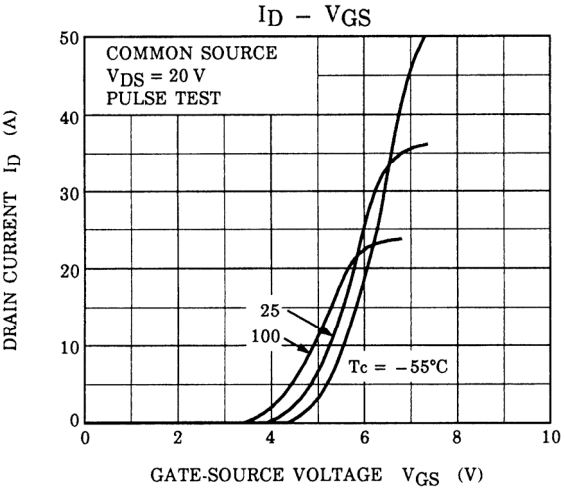
| Characteristics | Symbol | Test Condition | Min | Typ. | Max | Unit |
|---|---|---|---|---|---|---|
| Continuous drain reverse current (Note 1) | $I_{DR}$ | — | — | — | 14 | A |
| Pulse drain reverse current (Note 1) | $I_{DRP}$ | — | — | — | 56 | A |
| Forward voltage (diode) | $V_{DSF}$ | $I_{DR}$ = 14 A, $V_{GS}$ = 0 V | — | — | −1.7 | V |
| Reverse recovery time | $t_{rr}$ | $I_{DR}$ = 14 A, $V_{GS}$ = 0 V<br>$dI_{DR}$ / dt = 100 A / μs | — | 400 | — | ns |
| Reverse recovery charge | $Q_{rr}$ | | — | 4.3 | — | μC |

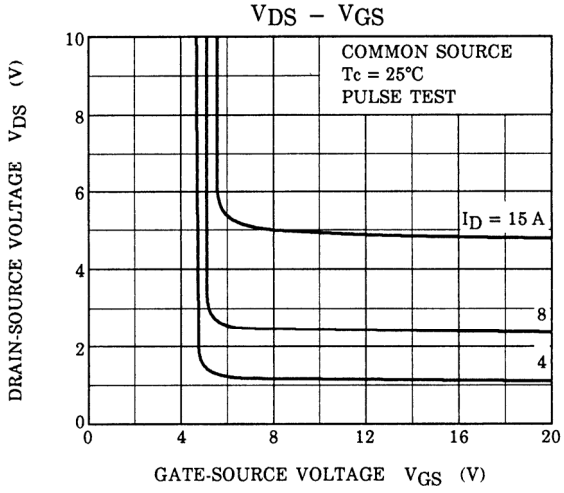
## Marking

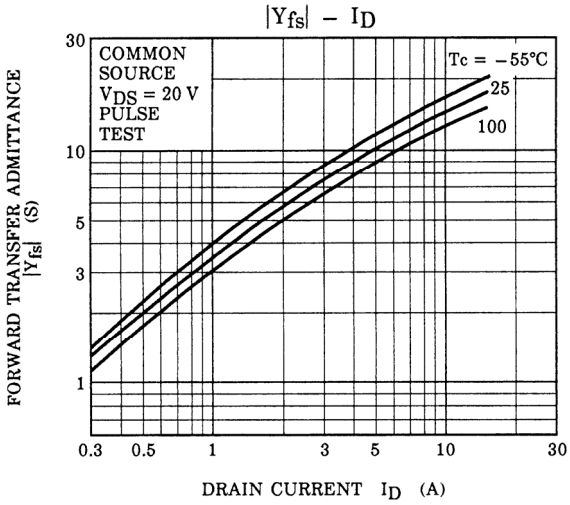


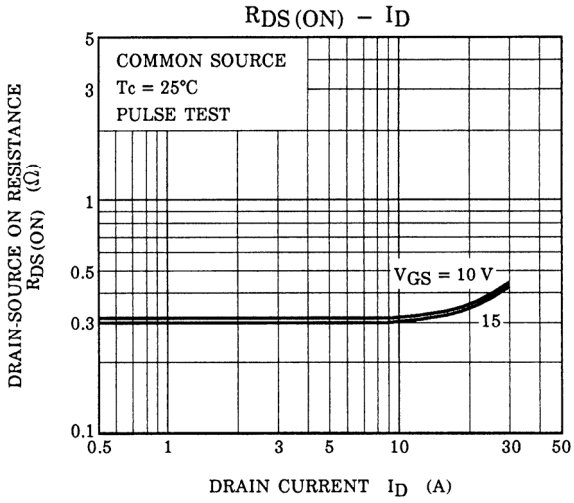

$I_D$ – $V_{DS}$
COMMON SOURCE
Tc = 25°C
PULSE TEST
8
6
10
5.25
5
4.75
4.5
$V_{GS}$ = 4 V
DRAIN CURRENT $I_D$ (A)
DRAIN-SOURCE VOLTAGE $V_{DS}$ (V)


$I_D$ – $V_{DS}$
COMMON SOURCE
Tc = 25°C
PULSE TEST
10
6
5.75
5.5
5.25
5
4.75
4.5
$V_{GS}$ = 4 V
DRAIN CURRENT $I_D$ (A)
DRAIN-SOURCE VOLTAGE $V_{DS}$ (V)

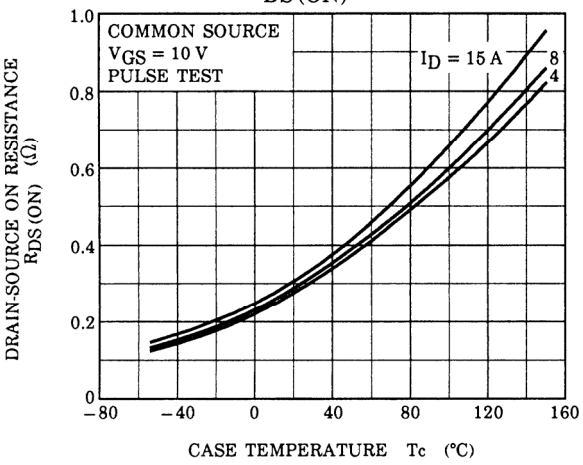

$I_D$ – $V_{GS}$
COMMON SOURCE
$V_{DS}$ = 20 V
PULSE TEST
25
100
Tc = −55°C
DRAIN CURRENT $I_D$ (A)
GATE-SOURCE VOLTAGE $V_{GS}$ (V)


$V_{DS}$ – $V_{GS}$
COMMON SOURCE
Tc = 25°C
PULSE TEST
$I_D$ = 15 A
8
4
DRAIN-SOURCE VOLTAGE $V_{DS}$ (V)
GATE-SOURCE VOLTAGE $V_{GS}$ (V)

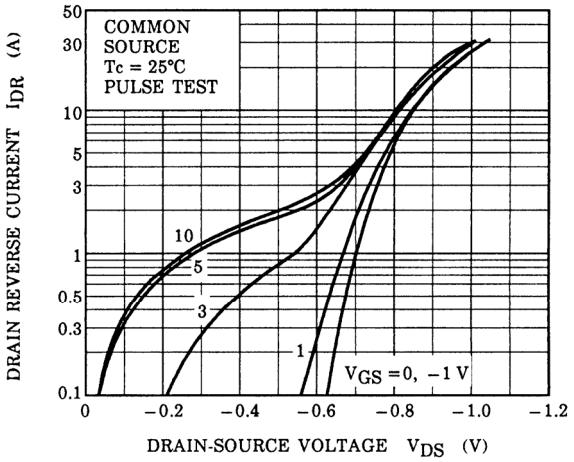

$|Y_{fs}|$ – $I_D$
COMMON SOURCE
$V_{DS}$ = 20 V
PULSE TEST
Tc = −55°C
25
100
FORWARD TRANSFER ADMITTANCE $|Y_{fs}|$ (S)
DRAIN CURRENT $I_D$ (A)


$R_{DS(ON)}$ – $I_D$
COMMON SOURCE
Tc = 25°C
PULSE TEST
$V_{GS}$ = 10 V
15
DRAIN-SOURCE ON RESISTANCE $R_{DS(ON)}$ (Ω)
DRAIN CURRENT $I_D$ (A)

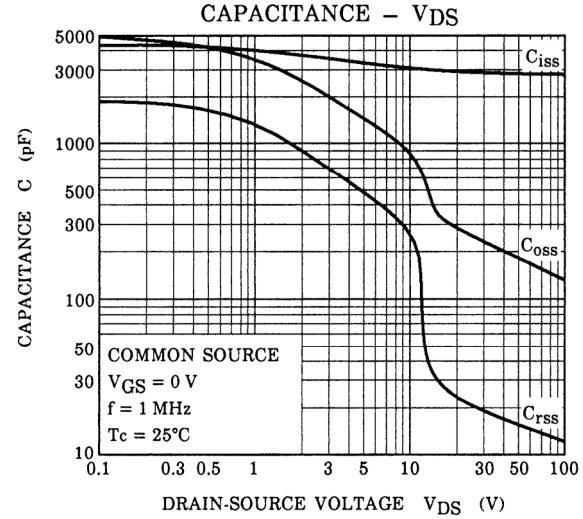
$R_{DS\,(ON)}$ – Tc



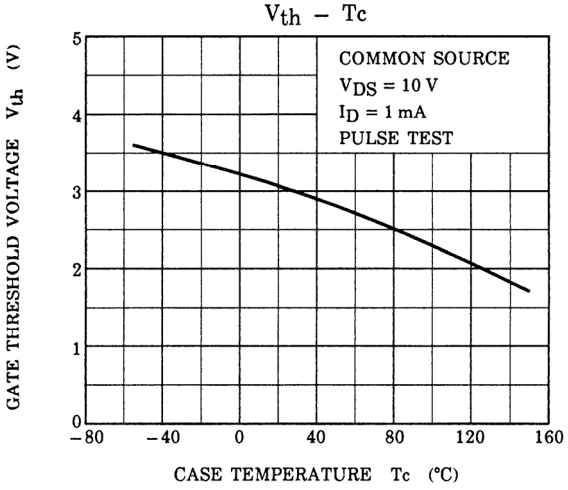

$I_{DR}$ – $V_{DS}$



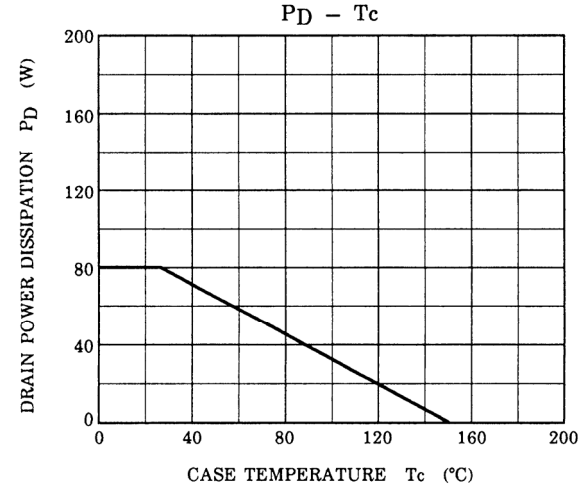

CAPACITANCE – $V_{DS}$



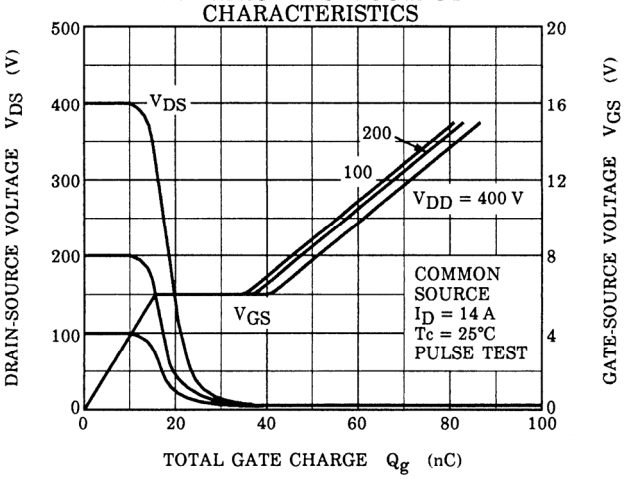

$V_{th}$ – Tc

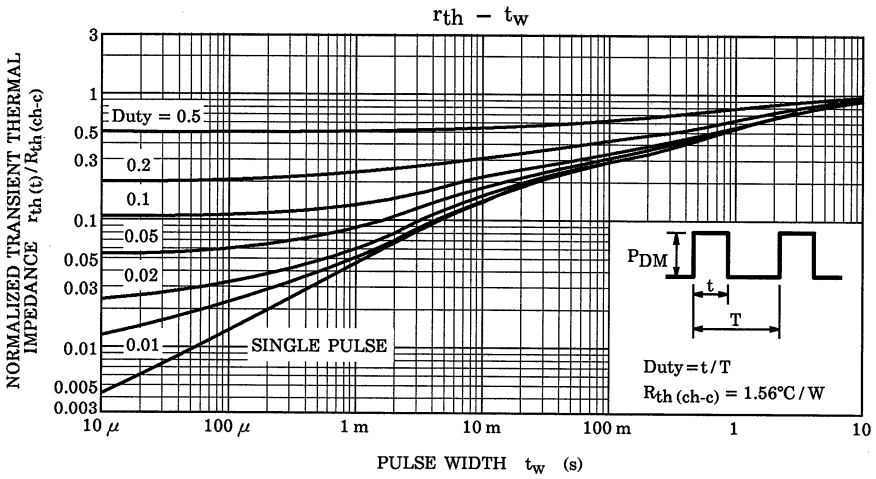


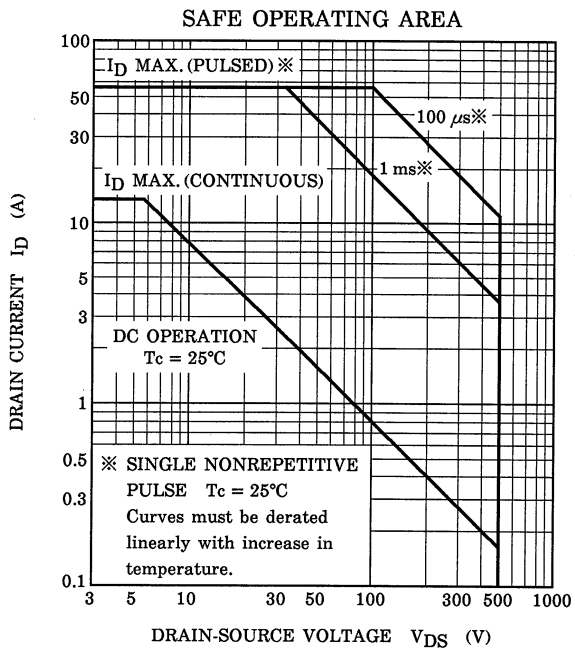

$P_D$ – Tc

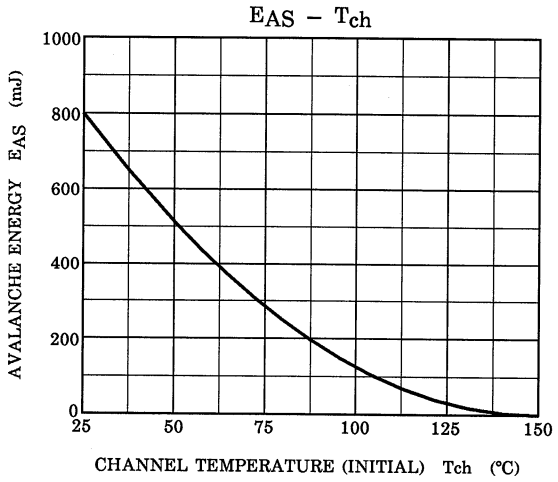


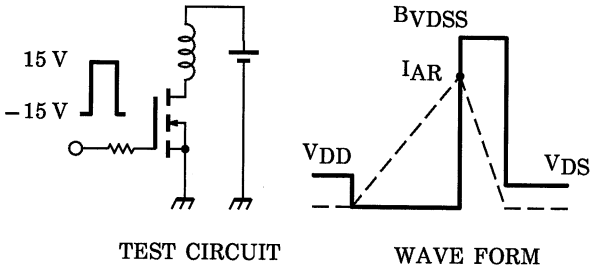

DYNAMIC INPUT / OUTPUT CHARACTERISTICS






$R_G = 25\ \Omega$
$V_{DD} = 90$ V, L = 6.9 mH

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

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20070701-EN

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