

TOSHIBA Field Effect Transistor Silicon N Channel MOS Type ( $\pi$ -MOS $\text{VII}$ )

# TK15A50D

## Switching Regulator Applications

- Low drain-source ON-resistance:  $R_{DS(ON)} = 0.24 \, \Omega$  (typ.)
- High forward transfer admittance:  $|Y_{fs}| = 7.0 \, S$  (typ.)
- Low leakage current:  $I_{DSS} = 10 \, \mu A$  (max) ( $V_{DS} = 500 \, V$ )
- Enhancement mode:  $V_{th} = 2.0$  to  $4.0 \, V$  ( $V_{DS} = 10 \, V$ ,  $I_D = 1 \, mA$ )

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

| Characteristics                                      |                | Symbol    | Rating     | Unit             |
|------------------------------------------------------|----------------|-----------|------------|------------------|
| Drain-source voltage                                 |                | $V_{DSS}$ | 500        | V                |
| Gate-source voltage                                  |                | $V_{GSS}$ | $\pm 30$   | V                |
| Drain current                                        | DC (Note 1)    | $I_D$     | 15         | A                |
|                                                      | Pulse (Note 1) | $I_{DP}$  | 60         |                  |
| Drain power dissipation ( $T_c = 25^\circ\text{C}$ ) |                | $P_D$     | 50         | W                |
| Single pulse avalanche energy<br>(Note 2)            |                | $E_{AS}$  | 542        | mJ               |
| Avalanche current                                    |                | $I_{AR}$  | 15         | A                |
| Repetitive avalanche energy (Note 3)                 |                | $E_{AR}$  | 5.0        | mJ               |
| Channel temperature                                  |                | $T_{ch}$  | 150        | $^\circ\text{C}$ |
| Storage temperature range                            |                | $T_{stg}$ | -55 to 150 | $^\circ\text{C}$ |

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

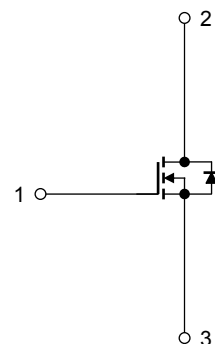
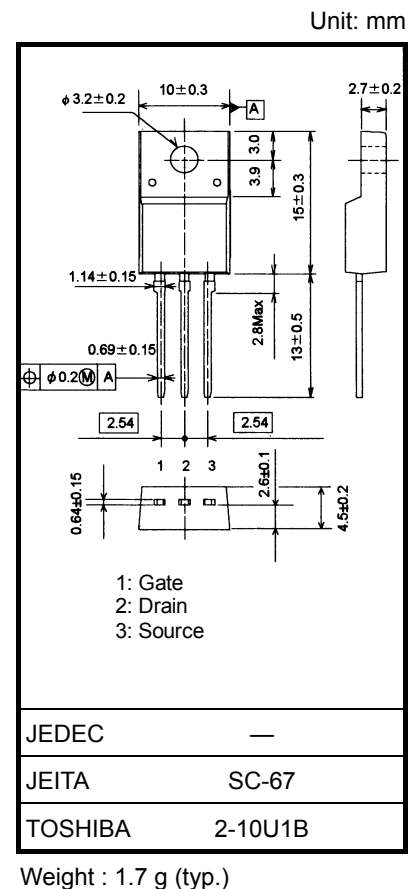
| Characteristics                        | Symbol         | Max  | Unit |
|----------------------------------------|----------------|------|------|
| Thermal resistance, channel to case    | $R_{th(ch-c)}$ | 2.5  | °C/W |
| Thermal resistance, channel to ambient | $R_{th(ch-a)}$ | 62.5 | °C/W |

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

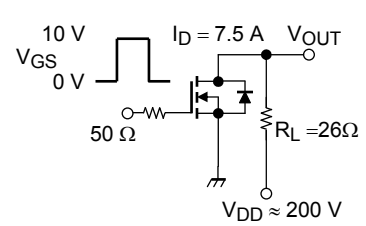
Note 2:  $V_{DD} = 90\text{ V}$ ,  $T_{ch} = 25^\circ\text{C}$  (initial),  $L = 4.1\text{ mH}$ ,  $R_G = 25\ \Omega$ ,  $I_{AR} = 15\text{ A}$

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

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



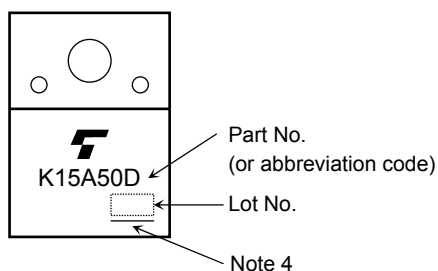
## Electrical Characteristics (Ta = 25°C)

| Characteristics                |               | Symbol        | Test Condition                                                                                                                                                                                            | Min | Typ. | Max     | Unit          |
|--------------------------------|---------------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|------|---------|---------------|
| Gate leakage current           |               | $I_{GSS}$     | $V_{GS} = \pm 30 \text{ V}, V_{DS} = 0 \text{ V}$                                                                                                                                                         | —   | —    | $\pm 1$ | $\mu\text{A}$ |
| Drain cut-off current          |               | $I_{DSS}$     | $V_{DS} = 500 \text{ V}, V_{GS} = 0 \text{ V}$                                                                                                                                                            | —   | —    | 10      | $\mu\text{A}$ |
| Drain-source breakdown voltage |               | $V_{(BR)DSS}$ | $I_D = 10 \text{ mA}, V_{GS} = 0 \text{ V}$                                                                                                                                                               | 500 | —    | —       | V             |
| Gate threshold voltage         |               | $V_{th}$      | $V_{DS} = 10 \text{ V}, I_D = 1 \text{ mA}$                                                                                                                                                               | 2.0 | —    | 4.0     | V             |
| Drain-source ON-resistance     |               | $R_{DS(ON)}$  | $V_{GS} = 10 \text{ V}, I_D = 7.5 \text{ A}$                                                                                                                                                              | —   | 0.24 | 0.3     | $\Omega$      |
| Forward transfer admittance    |               | $ Y_{fs} $    | $V_{DS} = 10 \text{ V}, I_D = 7.5 \text{ A}$                                                                                                                                                              | 2.0 | 7.0  | —       | S             |
| Input capacitance              |               | $C_{iss}$     | $V_{DS} = 25 \text{ V}, V_{GS} = 0 \text{ V}, f = 1 \text{ MHz}$                                                                                                                                          | —   | 2300 | —       | pF            |
| Reverse transfer capacitance   |               | $C_{rss}$     |                                                                                                                                                                                                           | —   | 10   | —       |               |
| Output capacitance             |               | $C_{oss}$     |                                                                                                                                                                                                           | —   | 250  | —       |               |
| Switching time                 | Rise time     | $t_r$         | <br>$V_{GS} = 10 \text{ V}, I_D = 7.5 \text{ A}, V_{DD} \approx 200 \text{ V}$<br>$Duty \leq 1\%, t_w = 10 \mu\text{s}$ | —   | 50   | —       | ns            |
|                                | Turn-on time  | $t_{on}$      |                                                                                                                                                                                                           | —   | 100  | —       |               |
|                                | Fall time     | $t_f$         |                                                                                                                                                                                                           | —   | 25   | —       |               |
|                                | Turn-off time | $t_{off}$     |                                                                                                                                                                                                           | —   | 140  | —       |               |
| Total gate charge              |               | $Q_g$         | $V_{DD} \approx 400 \text{ V}, V_{GS} = 10 \text{ V}, I_D = 15 \text{ A}$                                                                                                                                 | —   | 40   | —       | nC            |
| Gate-source charge             |               | $Q_{gs}$      |                                                                                                                                                                                                           | —   | 25   | —       |               |
| Gate-drain charge              |               | $Q_{gd}$      |                                                                                                                                                                                                           | —   | 15   | —       |               |

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

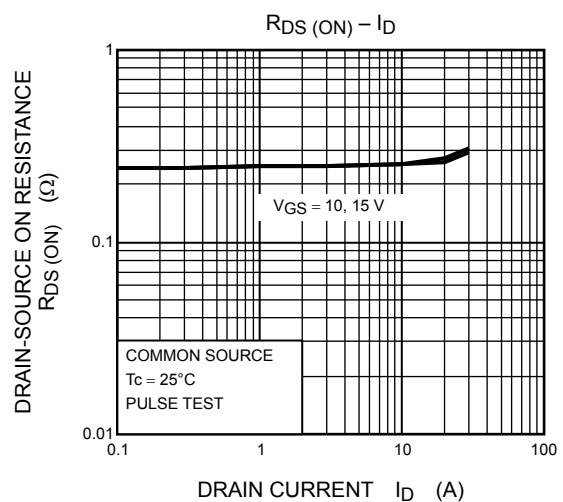
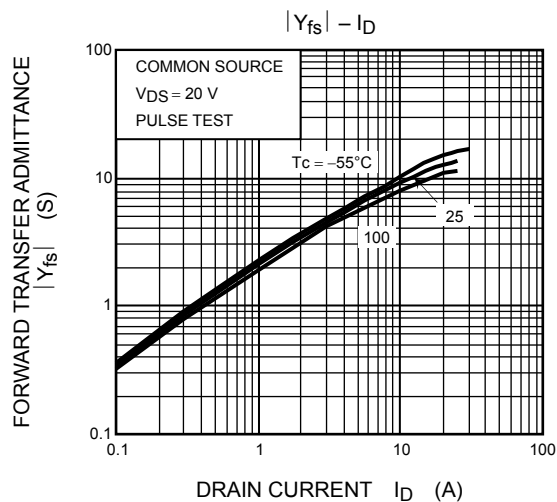
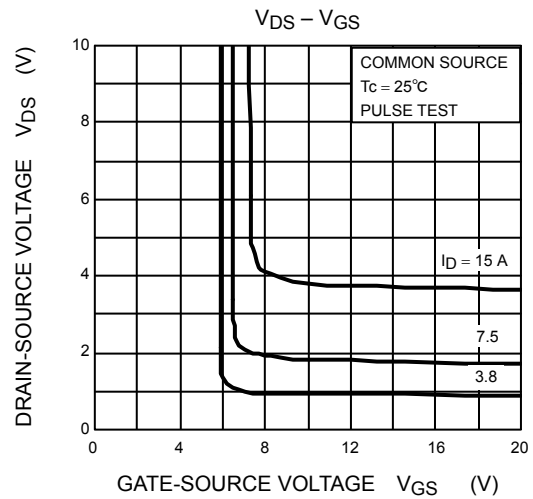
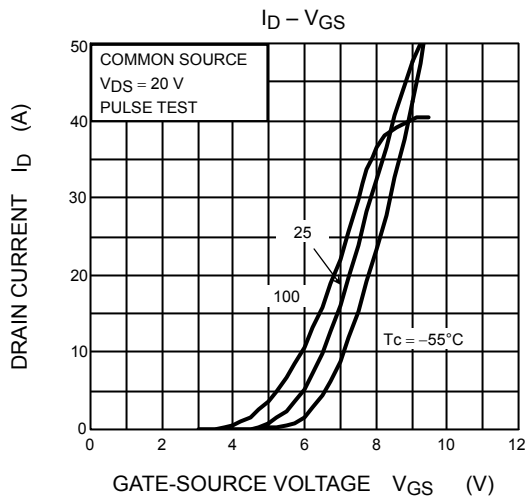
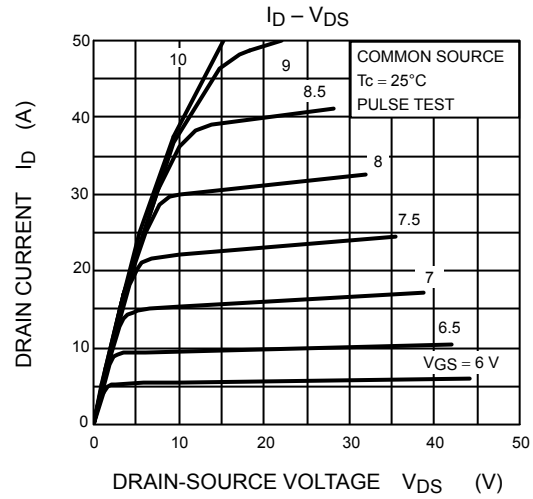
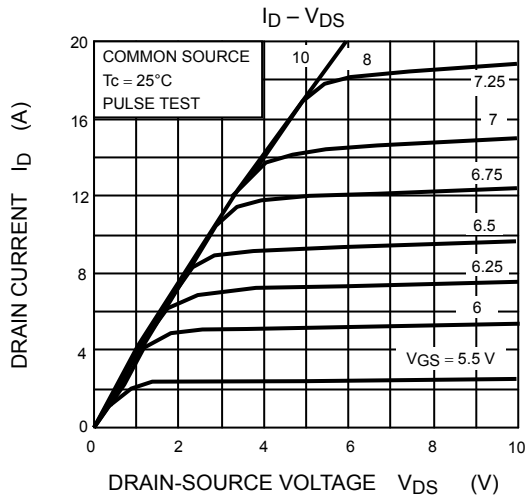
| Characteristics                              | Symbol    | Test Condition                                 | Min | Typ. | Max  | Unit          |
|----------------------------------------------|-----------|------------------------------------------------|-----|------|------|---------------|
| Continuous drain reverse current<br>(Note 1) | $I_{DR}$  | —                                              | —   | —    | 15   | A             |
| Pulse drain reverse current<br>(Note 1)      | $I_{DRP}$ | —                                              | —   | —    | 60   | A             |
| Forward voltage (diode)                      | $V_{DSF}$ | $I_{DR} = 15 \text{ A}, V_{GS} = 0 \text{ V}$  | —   | —    | -1.7 | V             |
| Reverse recovery time                        | $t_{rr}$  | $I_{DR} = 15 \text{ A}, V_{GS} = 0 \text{ V},$ | —   | 1600 | —    | ns            |
| Reverse recovery charge                      | $Q_{rr}$  | $dI_{DR}/dt = 100 \text{ A}/\mu\text{s}$       | —   | 20   | —    | $\mu\text{C}$ |

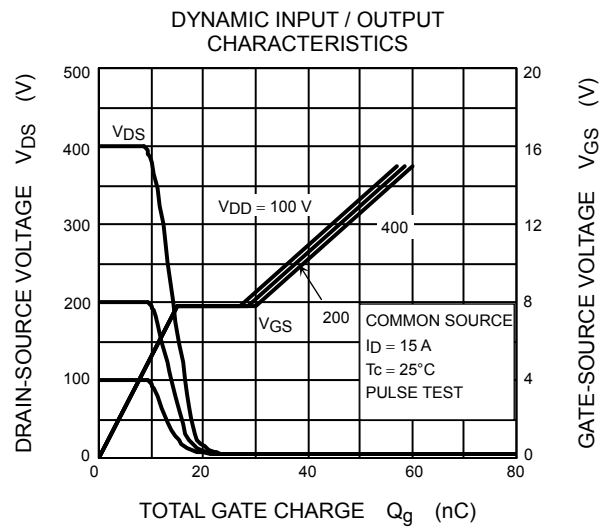
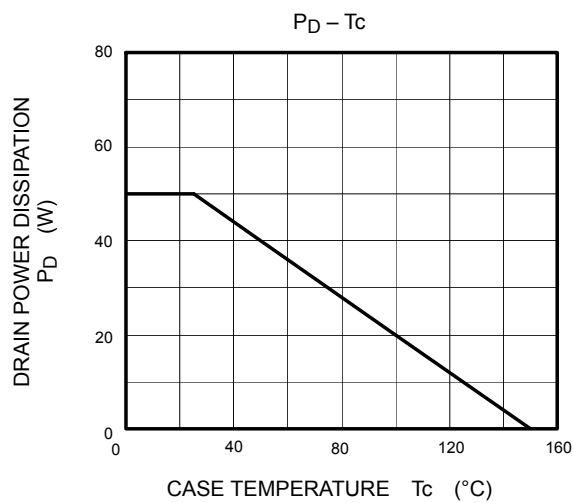
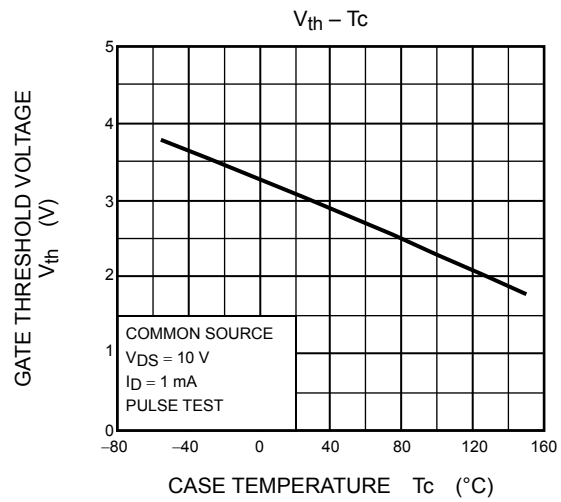
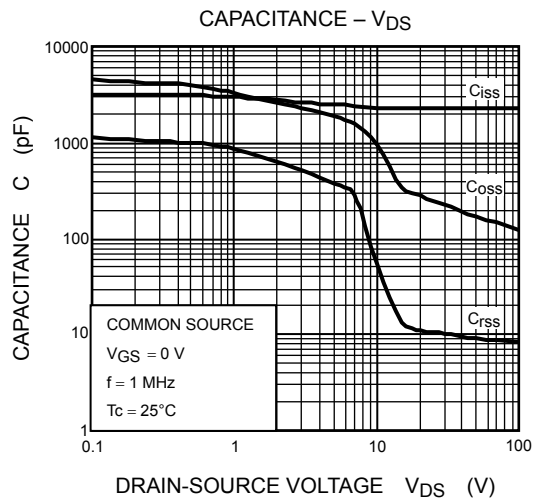
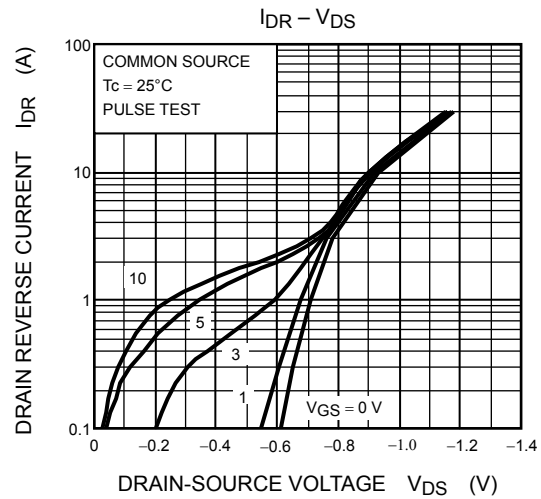
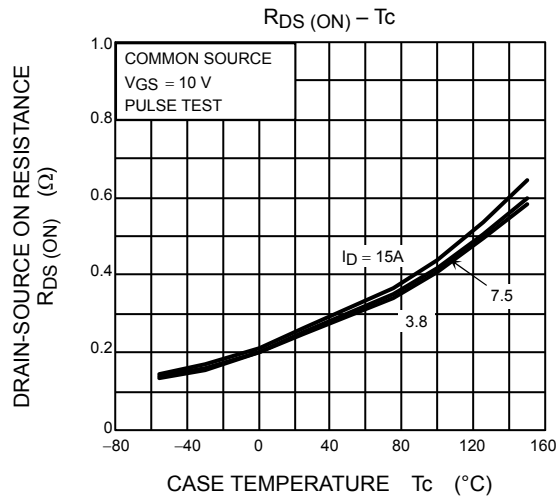
## Marking

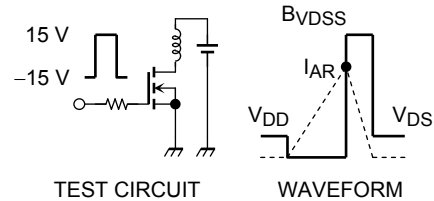
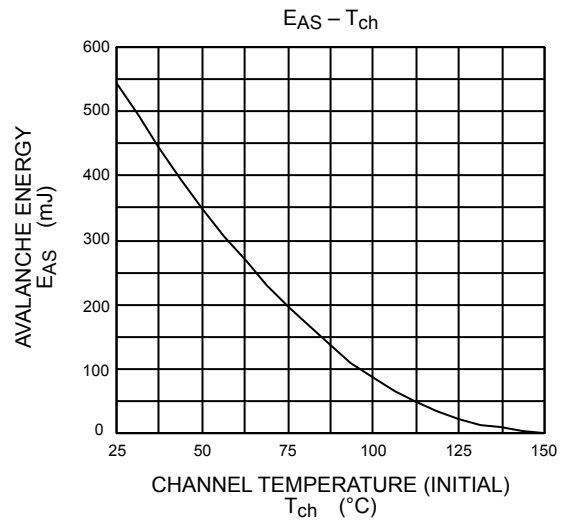
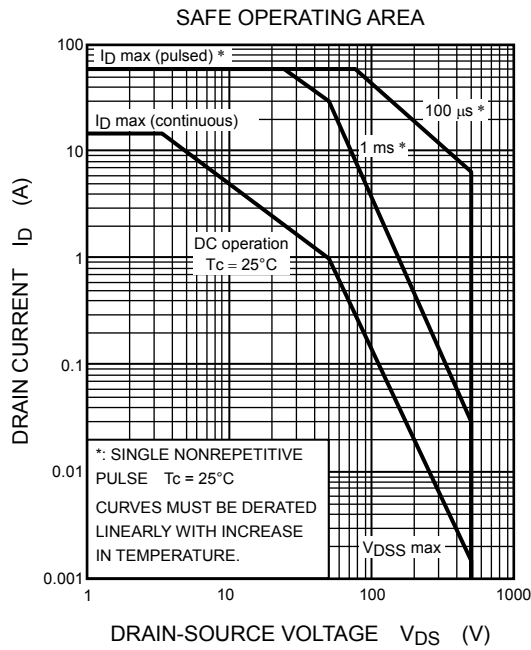
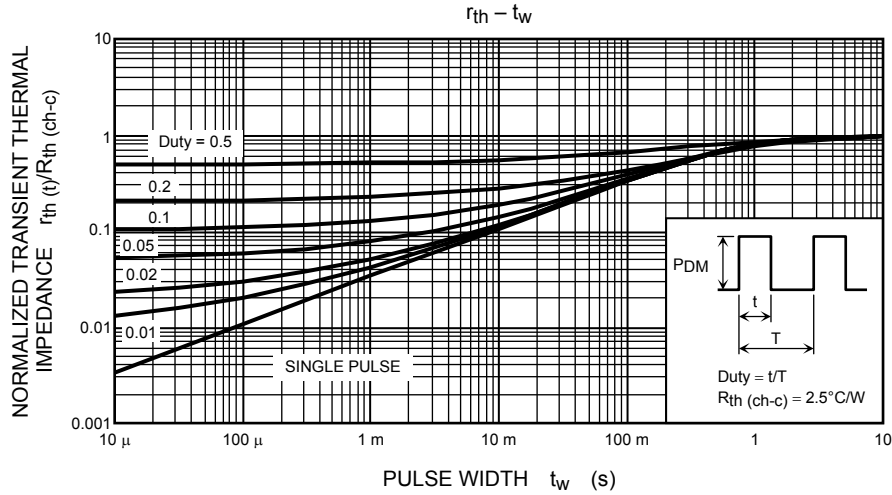


Note 4 : A line under a Lot No. identifies the indication of product Labels  
[[G]]/RoHS COMPATIBLE or [[G]]/RoHS [[Pb]]

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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.







$$R_G = 25 \, \Omega$$

$$V_{DD} = 90 \, \text{V}, L = 4.1 \, \text{mH}$$

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

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