

# TK5A45DA

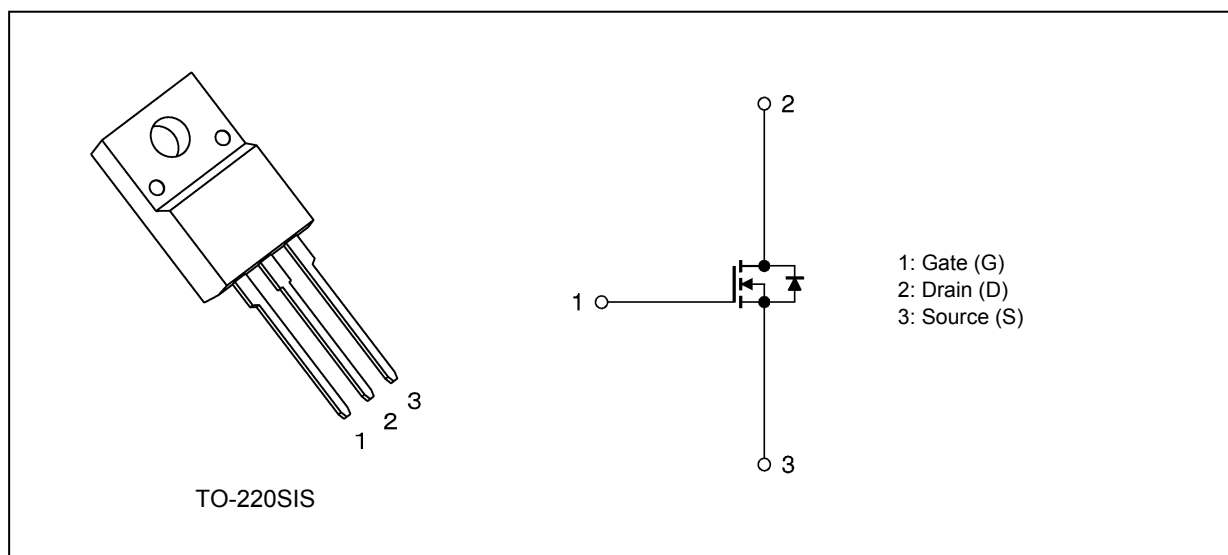
## 1. Applications

- Switching Voltage Regulators

## 2. Features

- (1) Low drain-source on-resistance:  $R_{DS(ON)} = 1.52 \Omega$  (typ.)
- (2) High forward transfer admittance:  $|Y_{fs}| = 1.5 S$  (typ.)
- (3) Low leakage current:  $I_{DSS} = 10 \mu A$  (max) ( $V_{DS} = 450 V$ )
- (4) Enhancement mode:  $V_{th} = 2.4$  to  $4.4 V$  ( $V_{DS} = 10 V, I_D = 1 mA$ )

## 3. Packaging and Internal Circuit



## 4. Absolute Maximum Ratings (Note) ( $T_a = 25^\circ C$ unless otherwise specified)

| Characteristics               | Symbol                       | Rating     | Unit       |
|-------------------------------|------------------------------|------------|------------|
| Drain-source voltage          | $V_{DSS}$                    | 450        | V          |
| Gate-source voltage           | $V_{GSS}$                    | $\pm 30$   |            |
| Drain current (DC)            | (Note 1) $I_D$               | 4.5        | A          |
| Drain current (pulsed)        | (Note 1) $I_{DP}$            | 18         |            |
| Power dissipation             | ( $T_c = 25^\circ C$ ) $P_D$ | 30         | W          |
| Single-pulse avalanche energy | (Note 2) $E_{AS}$            | 122        | mJ         |
| Avalanche current             | $I_{AR}$                     | 4.5        | A          |
| Repetitive avalanche energy   | (Note 3) $E_{AR}$            | 3.0        | mJ         |
| Channel temperature           | $T_{ch}$                     | 150        | $^\circ C$ |
| Storage temperature           | $T_{stg}$                    | -55 to 150 |            |

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).

Start of commercial production  
2009-11

**5. Thermal Characteristics**

| Characteristics                       | Symbol         | Max  | Unit |
|---------------------------------------|----------------|------|------|
| Channel-to-case thermal resistance    | $R_{th(ch-c)}$ | 4.17 | °C/W |
| Channel-to-ambient thermal resistance | $R_{th(ch-a)}$ | 62.5 |      |

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),  $L = 10\text{ mH}$ ,  $R_G = 25\ \Omega$ ,  $I_{AR} = 4.5\text{ A}$

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

Note: This transistor is sensitive to electrostatic discharge and should be handled with care.

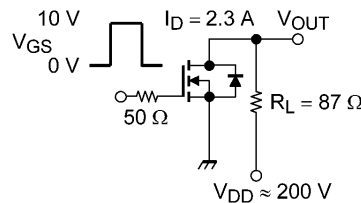
**6. Electrical Characteristics**

**6.1. Static Characteristics ( $T_a = 25^\circ\text{C}$  unless otherwise specified)**

| 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          | $I_{DSS}$     | $V_{DS} = 450\text{ V}, V_{GS} = 0\text{ V}$    | —   | —    | 10      |               |
| Drain-source breakdown voltage | $V_{(BR)DSS}$ | $I_D = 10\text{ mA}, V_{GS} = 0\text{ V}$       | 450 | —    | —       | V             |
| Gate threshold voltage         | $V_{th}$      | $V_{DS} = 10\text{ V}, I_D = 1\text{ mA}$       | 2.4 | —    | 4.4     |               |
| Drain-source on-resistance     | $R_{DS(ON)}$  | $V_{GS} = 10\text{ V}, I_D = 2.3\text{ A}$      | —   | 1.52 | 1.75    | $\Omega$      |
| Forward transfer admittance    | $ Y_{fs} $    | $V_{DS} = 10\text{ V}, I_D = 2.3\text{ A}$      | 0.4 | 1.5  | —       | S             |

**6.2. Dynamic Characteristics ( $T_a = 25^\circ\text{C}$  unless otherwise specified)**

| Characteristics                | Symbol    | Test Condition  | Min | Typ. | Max | Unit          |
|--------------------------------|-----------|---|-----|------|-----|---------------|
| Input capacitance              | $C_{iss}$ | $V_{DS} = 25\text{ V}, V_{GS} = 0\text{ V}, f = 1\text{ MHz}$ | —   | 380  | —   | $\mu\text{F}$ |
| Reverse transfer capacitance   | $C_{rss}$ |   | —   | 2.5  | —   |               |
| Output capacitance             | $C_{oss}$ |   | —   | 45   | —   |               |
| Switching time (rise time)     | $t_r$     | See Figure 6.2.1.   | —   | 18   | —   | ns            |
| Switching time (turn-on time)  | $t_{on}$  |   | —   | 40   | —   |               |
| Switching time (fall time)     | $t_f$     |   | —   | 7    | —   |               |
| Switching time (turn-off time) | $t_{off}$ |   | —   | 55   | —   |               |



Duty  $\leq 1\%$ ,  $t_w = 10\ \mu\text{s}$

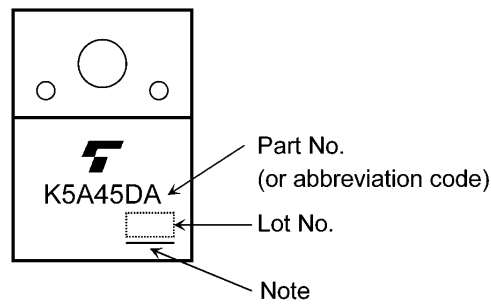
**Fig. 6.2.1 Switching Time Test Circuit**

**6.3. Gate Charge Characteristics ( $T_a = 25^\circ\text{C}$  unless otherwise specified)**

| Characteristics                                 | Symbol   | Test Condition  | Min | Typ. | Max | Unit |
|---|----------|---|-----|------|-----|------|
| Total gate charge (gate-source plus gate-drain) | $Q_g$    | $V_{DD} \approx 360\text{ V}, V_{GS} = 10\text{ V}, I_D = 4.5\text{ A}$ | —   | 9    | —   | nC   |
| Gate-source charge                              | $Q_{gs}$ |   | —   | 5    | —   |      |
| Gate-drain charge                               | $Q_{gd}$ |   | —   | 4    | —   |      |

**6.4. Source-Drain Characteristics ( $T_a = 25^\circ\text{C}$  unless otherwise specified)**

| Characteristics                         | Symbol    | Test Condition   | Min | Typ. | Max  | Unit |
|---|-----------|--|-----|------|------|------|
| Reverse drain current (DC) (Note 1)     | $I_{DR}$  | —  | —   | —    | 4.5  | A    |
| Reverse drain current (pulsed) (Note 1) | $I_{DRP}$ | —  | —   | —    | 18   |      |
| Diode forward voltage                   | $V_{DSF}$ | $I_{DR1} = 4.5\text{ A}, V_{GS} = 0\text{ V}$  | —   | —    | -1.7 | V    |
| Reverse recovery time                   | $t_{rr}$  | $I_{DR} = 4.5\text{ A}, V_{GS} = 0\text{ V}$<br>$-di_{DR}/dt = 100\text{ A}/\mu\text{s}$ | —   | 1000 | —    | ns   |
| Reverse recovery charge                 | $Q_{rr}$  |  | —   | 5.5  | —    | nC   |

**7. Marking (Note)****Fig. 7.1 Marking**

Note: A line under a Lot No. identifies the indication of product Labels.

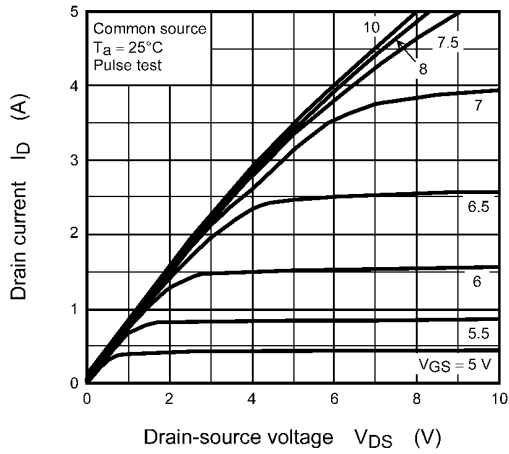
Not underlined: [[Pb]]/INCLUDES > MCV

Underlined: [[G]]/RoHS COMPATIBLE or [[G]]/RoHS [[Pb]]

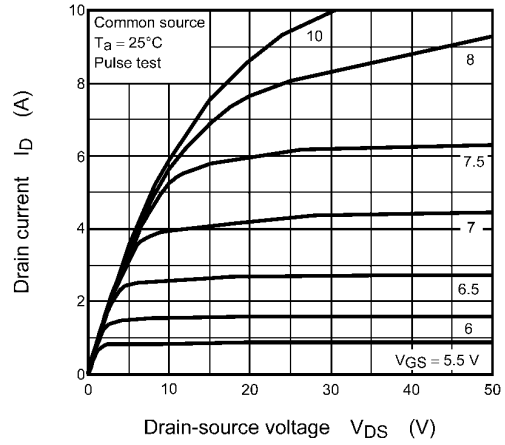
Please contact your TOSHIBA sales representative for details as to environmental matters such as the RoHS compatibility of Product.

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.

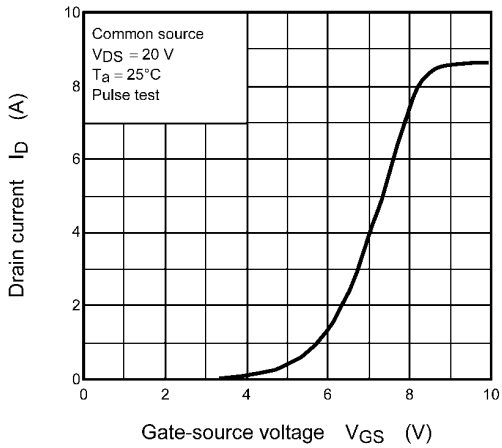
**8. Characteristics Curves (Note)**



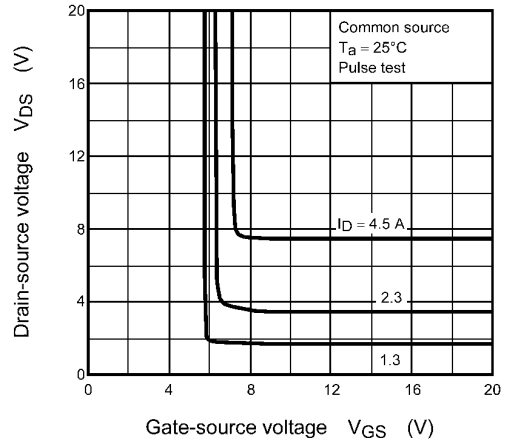
**Fig. 8.1  $I_D - V_{DS}$**



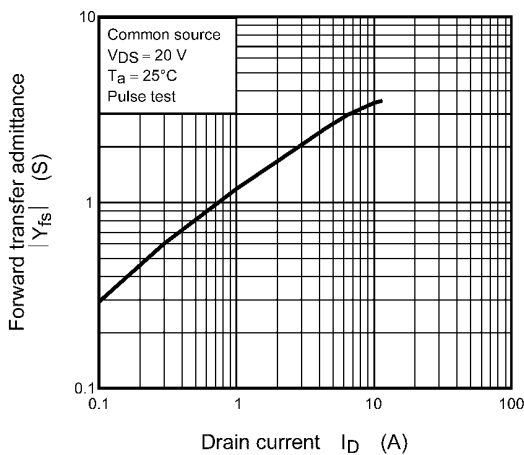
**Fig. 8.2  $I_D - V_{DS}$**



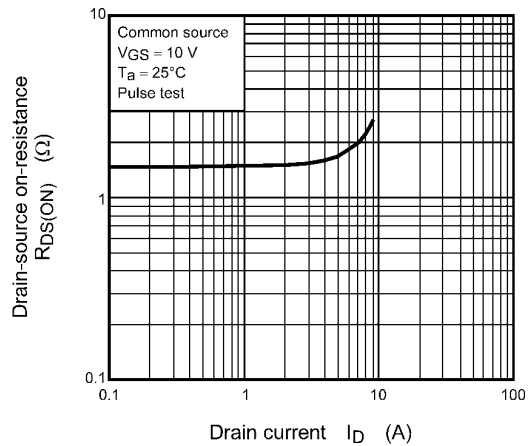
**Fig. 8.3  $I_D - V_{GS}$**



**Fig. 8.4  $V_{DS} - V_{GS}$**



**Fig. 8.5  $|Y_{fs}| - I_D$**



**Fig. 8.6  $R_{DS(ON)} - I_D$**

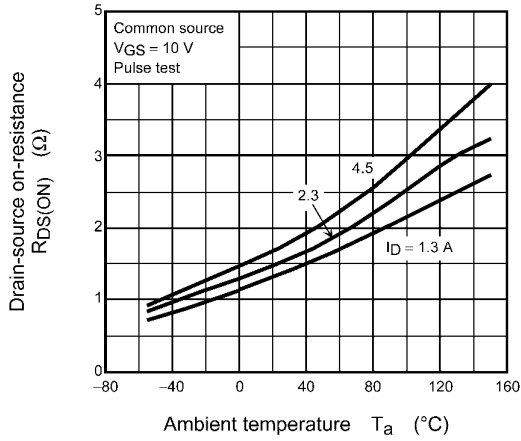


Fig. 8.7  $R_{DS(ON)} - T_a$

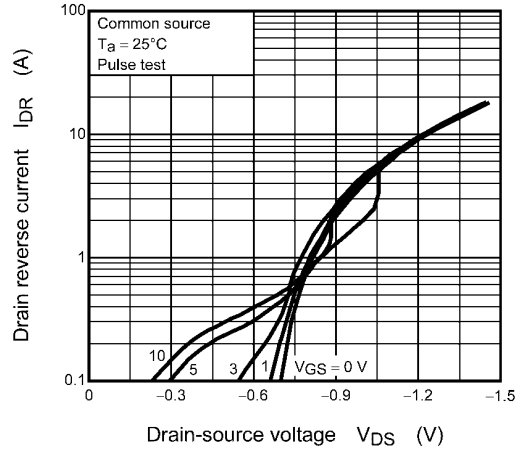


Fig. 8.8  $I_{DR} - V_{DS}$

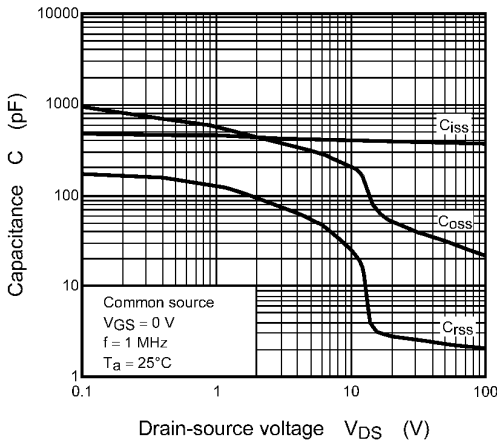


Fig. 8.9 C -  $V_{DS}$

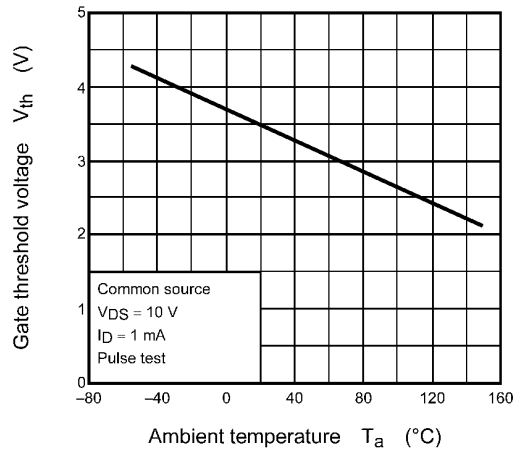


Fig. 8.10  $V_{th} - T_a$

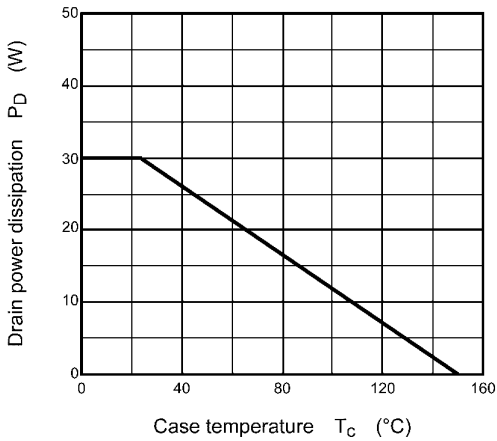


Fig. 8.11  $P_D - T_c$   
(Guaranteed Maximum)

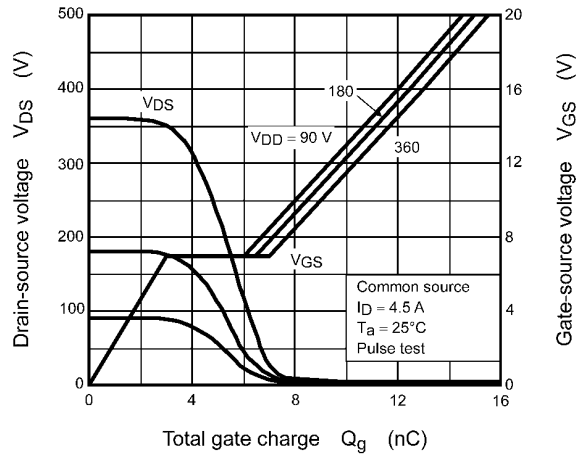
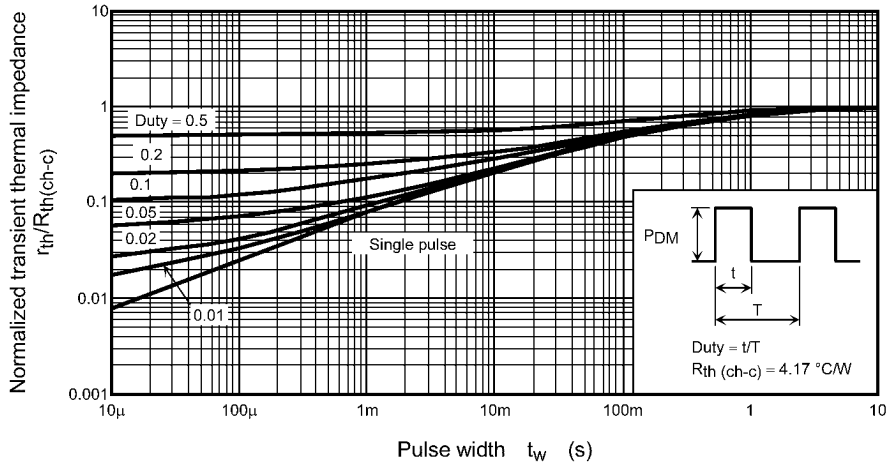
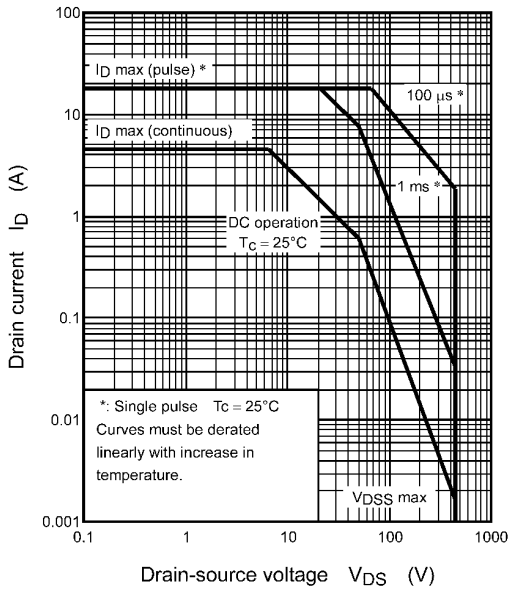


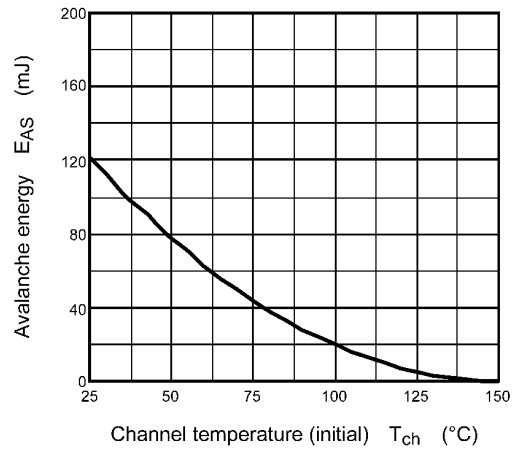
Fig. 8.12 Dynamic Input/Output Characteristics



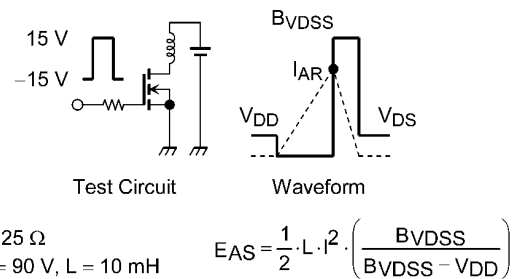
**Fig. 8.13**  $r_{th}/R_{th(ch-c)} - t_w$   
(Guaranteed Maximum)



**Fig. 8.14** Safe Operating Area  
(Guaranteed Maximum)



**Fig. 8.15**  $E_{AS} - T_{ch}$   
(Guaranteed Maximum)



**Fig. 8.16** Test Circuit/Waveform

Note: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.



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