



## 2N60K-MT

Power MOSFET

### 2A, 600V N-CHANNEL POWER MOSFET

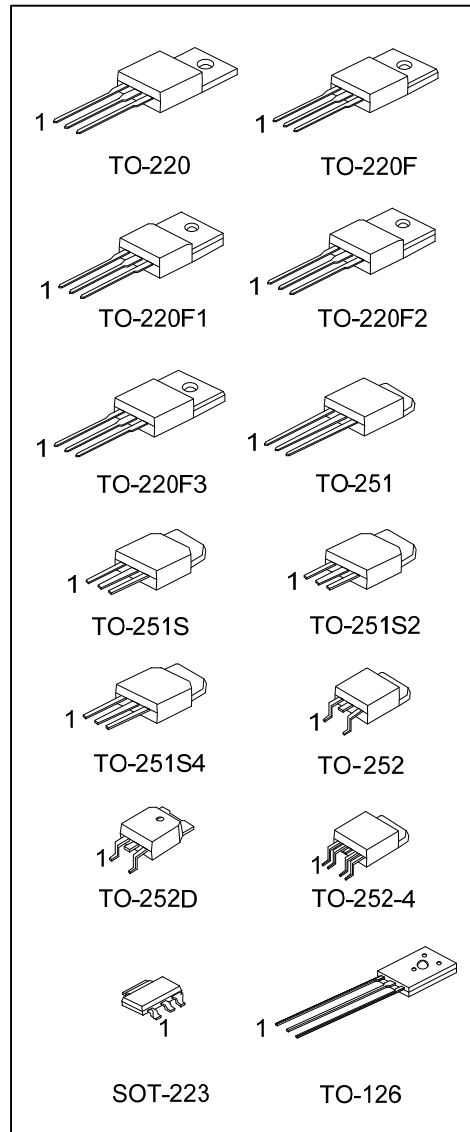
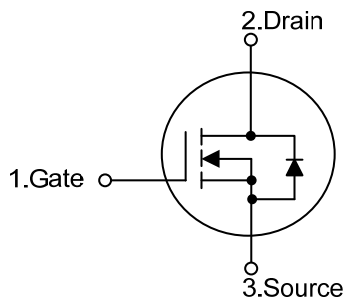
#### DESCRIPTION

The UTC **2N60K-MT** is a high voltage power MOSFET and is designed to have better characteristics, such as fast switching time, low gate charge, low on-state resistance and have a high rugged avalanche characteristics. This power MOSFET is usually used at high speed switching applications in power supplies, PWM motor controls, high efficient DC to DC converters and bridge circuits.

#### FEATURES

- \*  $R_{DS(ON)} < 5.0\Omega$  @  $V_{GS} = 10V, I_D = 1A$
- \* Fast switching capability
- \* Avalanche energy specified
- \* Improved dv/dt capability, high ruggedness

#### SYMBOL



### ORDERING INFORMATION

Ordering Number		Package	Pin Assignment					Packing
Lead Free	Halogen Free		1	2	3	4	5	
2N60KL-AA3-T	2N60KG-AA3-T	SOT-223	G	D	S	-	-	Tape Reel
2N60KL-TA3-T	2N60KG-TA3-T	TO-220	G	D	S	-	-	Tube
2N60KL-TF3-T	2N60KG-TF3-T	TO-220F	G	D	S	-	-	Tube
2N60KL-TF1-T	2N60KG-TF1-T	TO-220F1	G	D	S	-	-	Tube
2N60KL-TF2-T	2N60KG-TF2-T	TO-220F2	G	D	S	-	-	Tube
2N60KL-TF3T-T	2N60KG-TF3T-T	TO-220F3	G	D	S	-	-	Tube
2N60KL-TM3-T	2N60KG-TM3-T	TO-251	G	D	S	-	-	Tube
2N60KL-TMS-T	2N60KG-TMS-T	TO-251S	G	D	S	-	-	Tube
2N60KL-TMS2-T	2N60KG-TMS2-T	TO-251S2	G	D	S	-	-	Tube
2N60KL-TMS4-T	2N60KG-TMS4-T	TO-251S4	G	D	S	-	-	Tube
2N60KL-TN3-R	2N60KG-TN3-R	TO-252	G	D	S	-	-	Tape Reel
2N60KL-TN4-R	2N60KG-TN4-R	TO-252-4	S1	G1	D	S2	G2	Tape Reel
2N60KL-TND-R	2N60KG-TND-R	TO-252D	G	D	S	-	-	Tape Reel
2N60KL-T60-K	2N60KG-T60-K	TO-126	G	D	S	-	-	Bulk

Note: Pin Assignment: G: Gate D: Drain S: Source

	<p>(1) T: Tube, R: Tape Reel                  (2) AA3: SOT-223, TA3: TO-220, TF3: TO-220F, TF1: TO-220F1, TF2: TO-220F2, TF3T: TO-220F3, TM3: TO-251, TMS: TO-251S, TN3: TO-252, TND: TO-252D, T60: TO-126                  (3) G: Halogen Free and Lead Free, L: Lead Free</p>
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### MARKING

PACKAGE	MARKING
SOT-223	
TO-220 TO-220F TO-220F1 TO-220F2 TO-220F3 TO-251	TO-251S TO-251S2 TO-251S4 TO-252 TO-252-4 TO-252D
TO-126	

■ ABSOLUTE MAXIMUM RATINGS (T<sub>C</sub>=25°C, unless otherwise specified)

PARAMETER		SYMBOL	RATINGS	UNIT		
Drain-Source Voltage		V <sub>DSS</sub>	600	V		
Gate-Source Voltage		V <sub>GSS</sub>	±30	V		
Avalanche Current (Note 2)		I <sub>AR</sub>	2.0	A		
Drain Current	Continuous	I <sub>D</sub>	2.0	A		
	Pulsed (Note 2)	I <sub>DM</sub>	8.0	A		
Avalanche Energy	Single Pulsed (Note 3)	E <sub>AS</sub>	85	mJ		
	Repetitive (Note 2)	E <sub>AR</sub>	4.5	mJ		
Peak Diode Recovery dv/dt (Note 4)		dv/dt	4.5	V/ns		
Power Dissipation	SOT-223	P <sub>D</sub>	1	W		
	TO-220		54	W		
	TO-220F/TO-220F1 TO-220F3		21	W		
	TO-220F2		23	W		
	TO-251/TO-251S TO-251S2/TO-251S4 TO-252/TO-252-4 TO-252D		44	W		
	TO-126		40	W		
	Junction Temperature		T <sub>J</sub>	+150	°C	
	Operating Temperature		T <sub>OPR</sub>	-55 ~ +150	°C	
Storage Temperature		T <sub>STG</sub>	-55 ~ +150	°C		

Notes: 1. Absolute maximum ratings are those values beyond which the device could be permanently damaged.

Absolute maximum ratings are stress ratings only and functional device operation is not implied.

2. Repetitive Rating : Pulse width limited by T<sub>J</sub>

3. L=42.5mH, I<sub>AS</sub>=2.0A, V<sub>DD</sub>=50V, R<sub>G</sub>=25 Ω, Starting T<sub>J</sub> = 25°C

4. I<sub>SD</sub> ≤ 2.4A, di/dt ≤ 200A/μs, V<sub>DD</sub> ≤ BV<sub>DSS</sub>, Starting T<sub>J</sub> = 25°C

■ THERMAL DATA

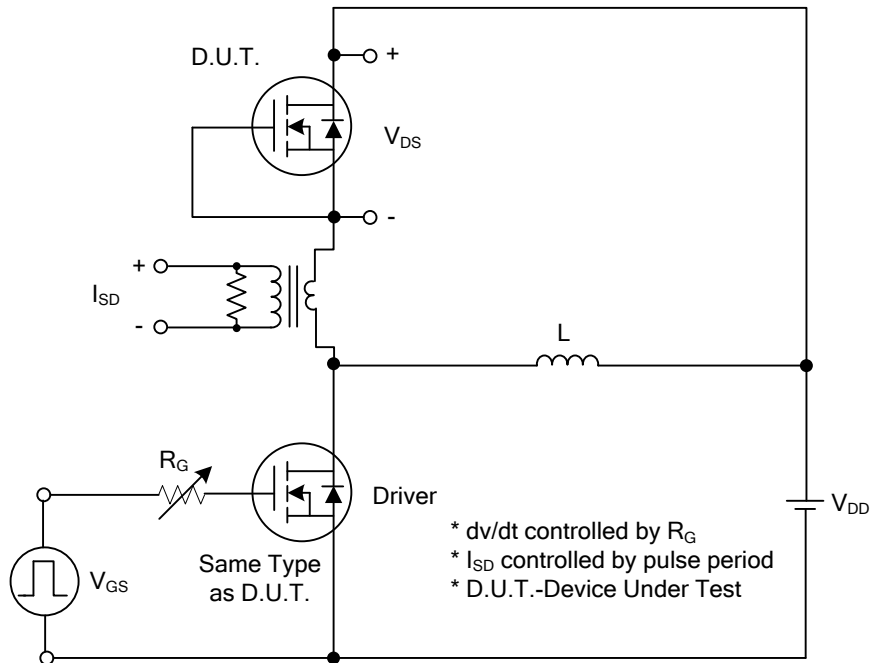
PARAMETER		SYMBOL	RATINGS	UNIT		
Junction to Ambient	SOT-223	θ <sub>JA</sub>	150	°C/W		
	TO-220/TO-220F TO-220F1/TO-220F2 TO-220F3		62.5	°C/W		
	TO-251/TO-251S TO-251S2/TO-251S4 TO-252/TO-252-4 TO-252D		100	°C/W		
	TO-126		89	°C/W		
	Junction to Case		SOT-223	θ <sub>JC</sub>	14	°C/W
			TO-220		2.32	°C/W
			TO-220F/TO-220F1 TO-220F3		5.95	°C/W
TO-220F2		5.43	°C/W			
TO-251/TO-251S TO-251S2/TO-251S4 TO-252/TO-252-4 TO-252D		2.87	°C/W			
TO-126		3.12	°C/W			

■ ELECTRICAL CHARACTERISTICS (T<sub>C</sub>=25°C, unless otherwise specified)

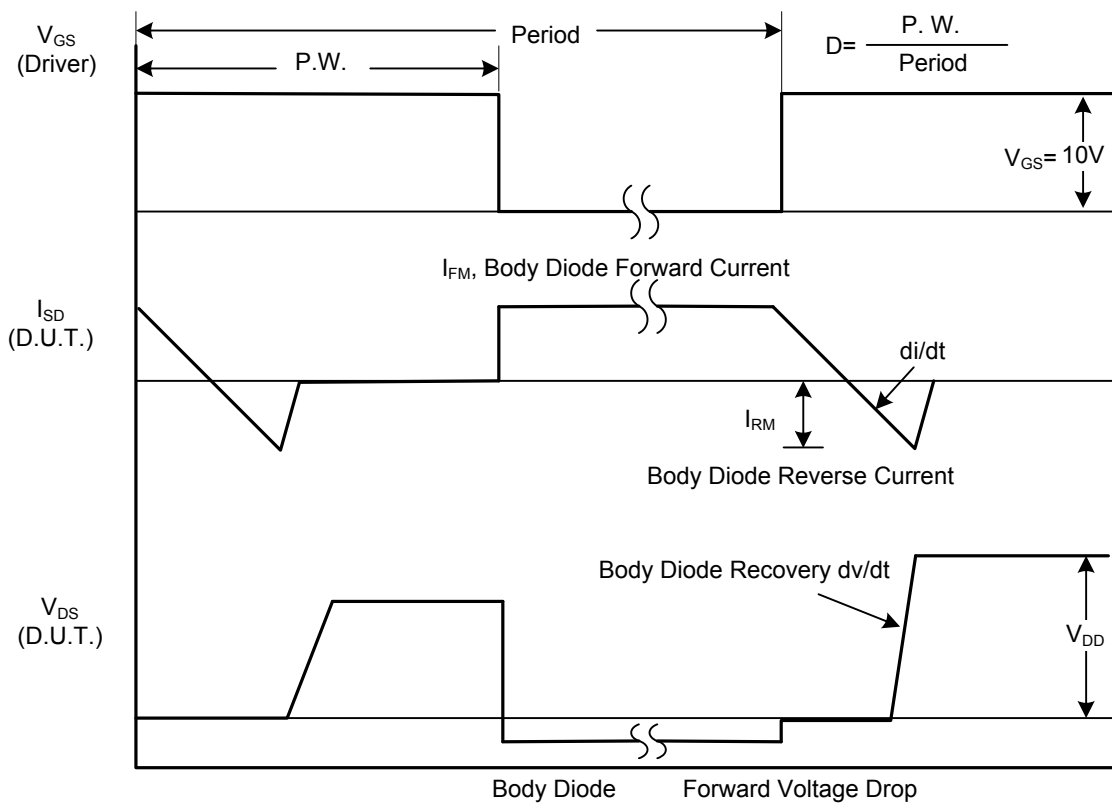
PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
<b>OFF CHARACTERISTICS</b>						
Drain-Source Breakdown Voltage	BV <sub>DSS</sub>	V <sub>GS</sub> = 0V, I <sub>D</sub> = 250μA	600			V
Drain-Source Leakage Current	I <sub>DSS</sub>	V <sub>DS</sub> = 600V, V <sub>GS</sub> = 0V			10	μA
		V <sub>DS</sub> = 480V, T <sub>C</sub> = 125°C			100	μA
Gate-Source Leakage Current	Forward	I <sub>GSS</sub>			100	nA
	Reverse					
					-100	nA
Breakdown Voltage Temperature Coefficient	ΔBV <sub>DSS</sub> /ΔT <sub>J</sub>	I <sub>D</sub> =250μA, Referenced to 25°C		0.4		V/°C
<b>ON CHARACTERISTICS</b>						
Gate Threshold Voltage	V <sub>GS(TH)</sub>	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 250μA	2.0		4.0	V
Static Drain-Source On-State Resistance	R <sub>DS(ON)</sub>	V <sub>GS</sub> = 10V, I <sub>D</sub> = 1A		3.9	5.0	Ω
<b>DYNAMIC CHARACTERISTICS</b>						
Input Capacitance	C <sub>ISS</sub>	V <sub>DS</sub> = 25V, V <sub>GS</sub> = 0V, f = 1MHz		210	290	pF
Output Capacitance	C <sub>OSS</sub>			31	43	pF
Reverse Transfer Capacitance	C <sub>RSS</sub>			4.5	6	pF
<b>SWITCHING CHARACTERISTICS</b>						
Total Gate Charge	Q <sub>G</sub>	V <sub>DS</sub> =50V, V <sub>GS</sub> =1.0V, I <sub>D</sub> =1.3A (Note 1, 2)		11	13	nC
Gate-Source Charge	Q <sub>GS</sub>			4.4		nC
Gate-Drain Charge	Q <sub>GD</sub>			1.3		nC
Turn-On Delay Time	t <sub>D(ON)</sub>	V <sub>DD</sub> = 30V, I <sub>D</sub> = 0.5A, R <sub>G</sub> = 25Ω (Note 1, 2)		40	60	ns
Turn-On Rise Time	t <sub>R</sub>			30	45	ns
Turn-Off Delay Time	t <sub>D(OFF)</sub>			52	60	ns
Turn-Off Fall Time	t <sub>F</sub>			20	35	ns
<b>DRAIN-SOURCE DIODE CHARACTERISTICS</b>						
Continuous Drain-Source Current	I <sub>SD</sub>				2.0	A
Pulsed Drain-Source Current	I <sub>SM</sub>				8.0	A
Drain-Source Diode Forward Voltage	V <sub>SD</sub>	V <sub>GS</sub> = 0 V, I <sub>SD</sub> = 2.0 A			1.4	V

Notes: 1. Pulse Test: Pulse width ≤ 300μs, Duty cycle ≤ 2%  
 2. Essentially independent of operating temperature

■ TEST CIRCUITS AND WAVEFORMS

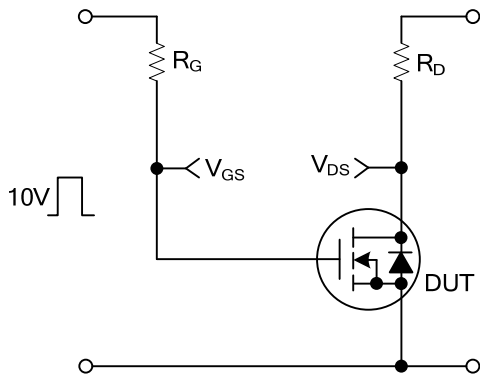


Peak Diode Recovery dv/dt Test Circuit

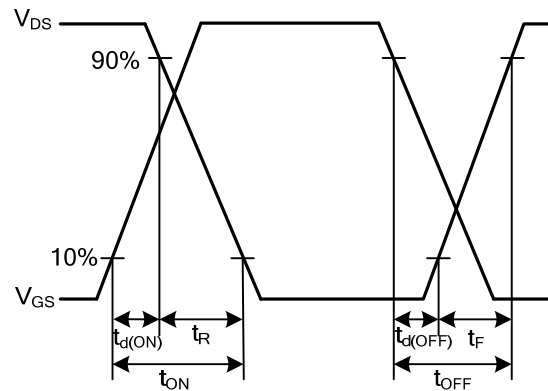


Peak Diode Recovery dv/dt Waveforms

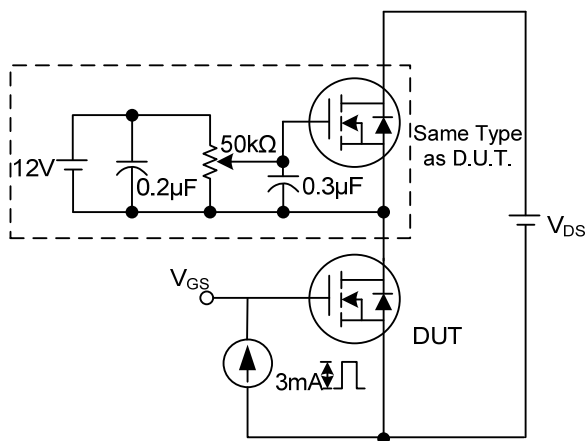
## TEST CIRCUITS AND WAVEFORMS (Cont.)



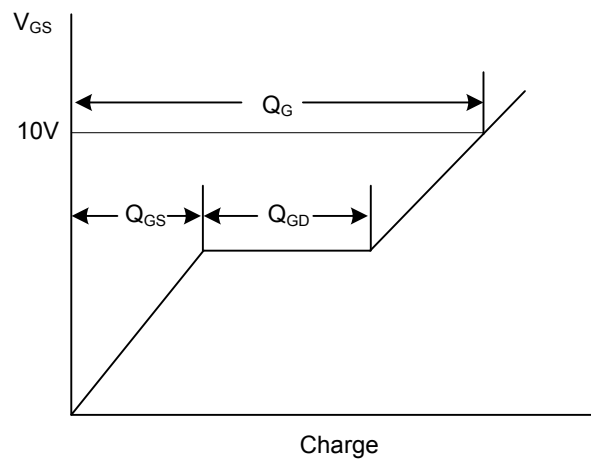
**Switching Test Circuit**



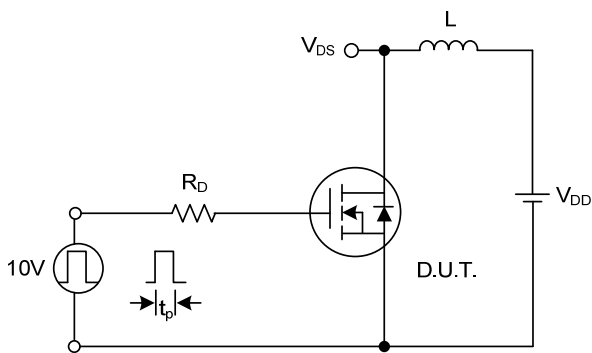
**Switching Waveforms**



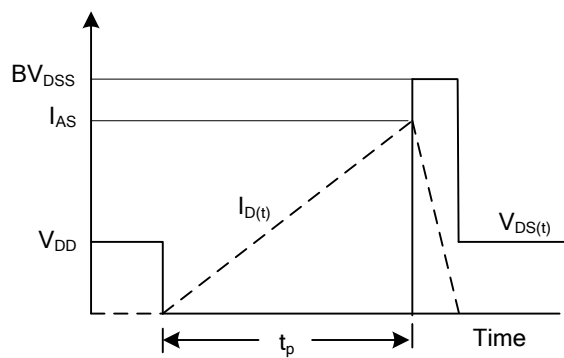
**Gate Charge Test Circuit**



**Gate Charge Waveform**

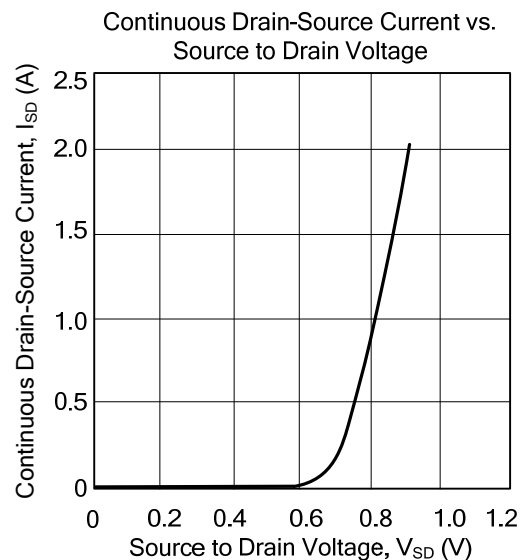
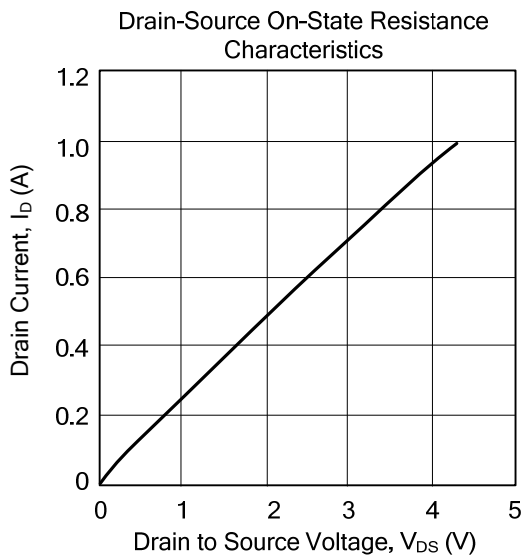
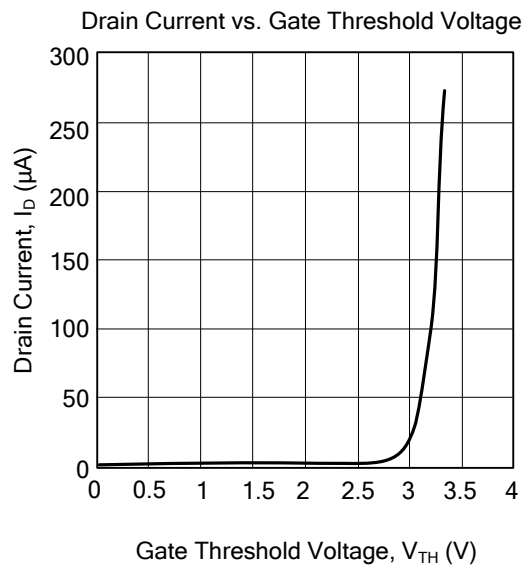
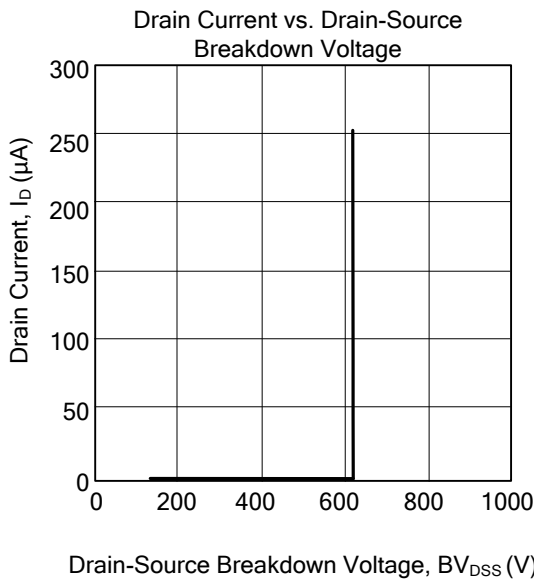


**Unclamped Inductive Switching Test Circuit**



**Unclamped Inductive Switching Waveforms**

## ■ TYPICAL CHARACTERISTICS



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