Multilayer ceramic capacitors

Array, X7R

Series/Type: **Array**

Date: February 2009

The following products presented in this data sheet are being withdrawn.

Substitute Products: See www.epcos.com/withdrawal_mlcc

Ordering Code	Substitute Product	Date of Withdrawal	Deadline Last Orders	Last Shipments
B37831R9102M021		2009-06-26	2010-06-30	2010-12-31
B37831R9102M023		2009-06-26	2010-06-30	2010-12-31
B37831R9103M021		2009-06-26	2010-06-30	2010-12-31

Ordering Code	Substitute Product	Date of Withdrawal	Deadline Last Orders	Last Shipments
B37831R9103M023		2009-06-26	2010-06-30	2010-12-31
B37831R9223M021		2009-06-26	2010-06-30	2010-12-31
B37831R9223M023		2009-06-26	2010-06-30	2010-12-31
B37831R9333M021		2009-06-26	2010-06-30	2010-12-31
B37831R9333M023		2009-06-26	2010-06-30	2010-12-31
B37941R0102M041		2009-06-26	2010-06-30	2010-12-31
B37941R0102M043		2009-06-26	2010-06-30	2010-12-31
B37941R0222M041		2009-06-26	2010-06-30	2010-12-31
B37941R0222M043		2009-06-26	2010-06-30	2010-12-31
B37941R0472M041		2009-06-26	2010-06-30	2010-12-31
B37941R0472M043		2009-06-26	2010-06-30	2010-12-31
B37941R0103M041		2009-06-26	2010-06-30	2010-12-31
B37941R0103M043		2009-06-26	2010-06-30	2010-12-31
B37941R5102M041		2009-06-26	2010-06-30	2010-12-31
B37941R5102M043		2009-06-26	2010-06-30	2010-12-31
B37872R5472M043		2009-06-26	2010-06-30	2010-12-31
B37872R5103M041		2009-06-26	2010-06-30	2010-12-31
B37872R5103M043		2009-06-26	2010-06-30	2010-12-31
B37872R5223M041		2009-06-26	2010-06-30	2010-12-31
B37872R5223M043		2009-06-26	2010-06-30	2010-12-31
B37872R5102M041		2009-06-26	2010-06-30	2010-12-31
B37872R5102M043		2009-06-26	2010-06-30	2010-12-31
B37872R5222M041		2009-06-26	2010-06-30	2010-12-31
B37872R5222M043		2009-06-26	2010-06-30	2010-12-31
B37872R5472M041		2009-06-26	2010-06-30	2010-12-31

For further information please contact your nearest EPCOS sales office, which will also support you in selecting a suitable substitute. The addresses of our worldwide sales network are presented at www.epcos.com/sales.

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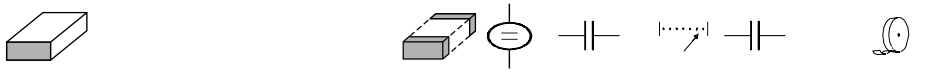
X7R

Ordering code system



B37831	R	0	101	K	0	2	1

Type and size

Chip size (inch/mm)	Temperature characteristic X7R
0405/1012	B37831
0508/1220	B37941
0612/1632	B37872

Internal coding
"R" indicates array capacitor

Rated voltage
9 (Code) ≙ 16 VDC
0 (Code) ≙ 25 VDC
5 (Code) ≙ 50 VDC

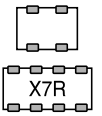
Capacitance, coded (example)
100 ≙ $10 \cdot 10^0$ pF = 10 pF
101 ≙ $10 \cdot 10^1$ pF = 100 pF
220 ≙ $22 \cdot 10^0$ pF = 22 pF

Capacitance tolerance
K ≙ **±10%**
M ≙ **±20% (standard for X7R)**

Internal coding: 0
or decimal place for cap. value <10 pF

2 ≙ 2-fold array
4 ≙ 4-fold array

Packaging
1 ≙ cardboard tape, 180-mm reel
3 ≙ cardboard tape, 330-mm reel



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Features
- Reduction of mounting time and mounting costs
- Space saving on the PCB
- Based on AEC-Q200 Rev-C

Applications
- Suitable for electronic circuits with parallel line layout
- Decoupling
- Coupling
- Blocking
- Interference suppression

Termination
- Nickel barrier terminations (Ni) for lead-free soldering

Options
- Alternative capacitance values and tolerances available on request

Delivery mode
- Cardboard and blister tape, 180-mm and 330-mm reel available

Electrical data

Temperature characteristic			X7R	
Max. relative capacitance change	within −55 ... +125 °C	ΔC/C	±15	%
Climatic category	(IEC 60068-1)		55/125/56	
Standard			EIA	
Dielectric			Class 2	
Rated voltage[1)]		V_R	16, 25, 50	VDC
Test voltage		V_{test}	$2.5 \cdot V_R$/5 s	VDC
Capacitance range		C_R	1 nF ... 33 nF	
Dissipation factor	(limit value)	tan δ	$< 25 \cdot 10^{-3}$	
	(limit value)	tan δ	$< 35 \cdot 10^{-3}$ for 16 V	
Insulation resistance[2)]	(at +25 °C)	R_{ins}	$> 10^5$	MΩ
Insulation resistance[2)]	(at +125 °C)	R_{ins}	$> 10^4$	MΩ
Time constant[2)]	(at +25 °C)	τ	> 1000	s
Time constant[2)]	(at +125 °C)	τ	> 100	s
Operating temperature range		T_{op}	−55 ... +125	°C
Ageing[3)]			yes	

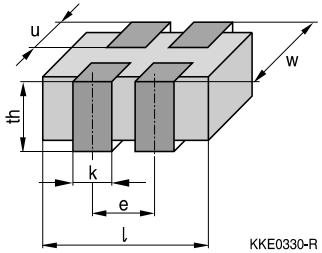
1) Note: No operation on AC line.
2) For C_R >10 nF the time constant $\tau = C \cdot R_{ins}$ is given.
3) Refer to chapter "General technical information", "Ageing".

Capacitance tolerances

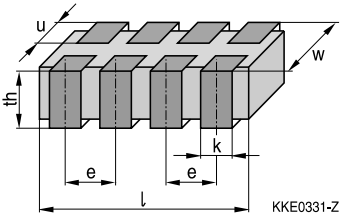
Code letter	K	M (standard)
Tolerance	±10%	±20%

Dimensional drawing

2-fold array (case size 0405)



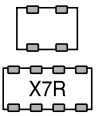
4-fold array (case sizes 0508 and 0612)



Dimensions (mm)

		2-fold array	4-fold array	
Case size	(inch)	0405	0508	0612
	(mm)	1012	1220	1632
l		1.37 ±0.15	2.00 ±0.20	3.20 ±0.20
w		1.00 +0/−0.15	1.25 ±0.15	1.60 ±0.20
th		0.70 max.	0.85 ±0.10	0.85 ±0.10
k		0.36 ±0.10	0.30 ±0.10	0.40 ±0.15
e		0.64	0.50 ±0.10	0.80 ±0.15
u		0.20 ±0.10	0.20 +0.30/−0.10	0.20 +0.30/−0.10

Tolerances to CECC 32101-801



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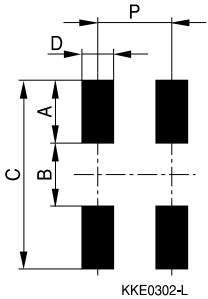
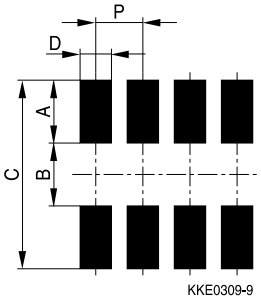
Recommended solder pad

2-fold array (case size 0405)



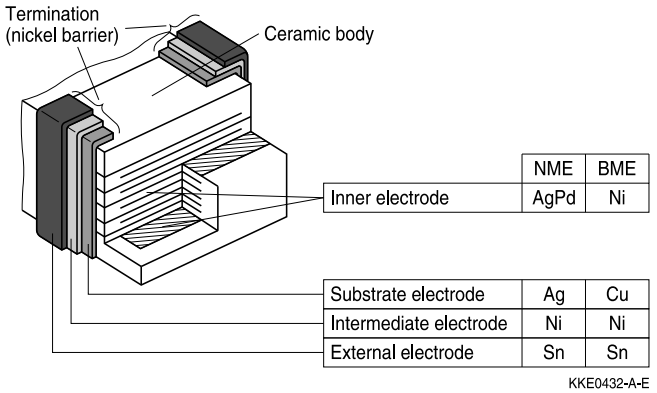
4-fold array (case sizes 0508 and 0612)

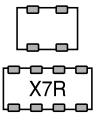


Recommended dimensions (mm) for reflow soldering

Case size	(inch/mm)	Type	A	B	C	D	P
	0405/1012	2-fold array	0.50 ... 0.55	0.45 ... 0.50	1.45 ... 1.60	0.30 ... 0.35	0.64 ±0.10
	0508/1220	4-fold array	0.50 ... 0.70	0.60 ... 0.70	1.60 ... 2.10	0.25 ... 0.35	0.50 ±0.005
	0612/1632	4-fold array	0.70 ... 0.90	0.80 ... 1.00	2.20 ... 2.80	0.30 ... 0.40	0.80 ±0.005

Termination





Multilayer ceramic capacitors

X7R

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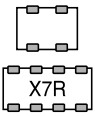
Product range for array capacitors, X7R

	2-fold arrays	4-fold arrays		
Size **inch (l x w)** mm (l x w)	**0405** 1012	**0508** 1220		**0612** 1632
Type	B37831R	B37941R		B37872R
$C_R \setminus V_R$ (VDC)	16	25	50	50
1.0 nF				
2.2 nF				
4.7 nF				
10 nF				
22 nF				
33 nF				



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Ordering codes and packing for X7R, 16 VDC, nickel barrier terminations

		Chip thickness	Cardboard tape, ∅180-mm reel	Cardboard tape, ∅330-mm reel
			* ≙ 1	* ≙ 3
C_R	Ordering code	mm	pcs./reel	pcs./reel
Case size 0405, 16 VDC, 2-fold arrays				
1.0 nF	B37831R9102M02*	0.6 ±0.1	5000	20000
10 nF	B37831R9103M02*	0.6 ±0.1	5000	20000
22 nF	B37831R9223M02*	0.6 ±0.1	5000	20000
33 nF	B37831R9333M02*	0.6 ±0.1	5000	20000

Ordering codes and packing for X7R, 25 VDC, nickel barrier terminations

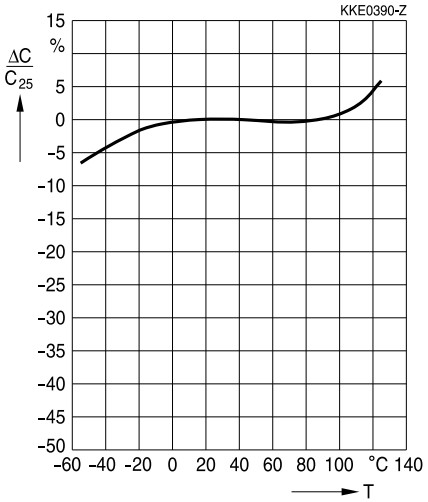
		Chip thickness	Cardboard tape, ∅180-mm reel	Cardboard tape, ∅330-mm reel
			* ≙ 1	* ≙ 3
C_R	Ordering code	mm	pcs./reel	pcs./reel
Case size 0508, 25 VDC, 4-fold arrays				
1.0 nF	B37941R0102M04*	0.85 ±0.1	4000	16000
2.2 nF	B37941R0222M04*	0.85 ±0.1	4000	16000
4.7 nF	B37941R0472M04*	0.85 ±0.1	4000	16000
10 nF	B37941R0103M04*	0.85 ±0.1	4000	16000

Ordering codes and packing for X7R, 50 VDC, nickel barrier terminations

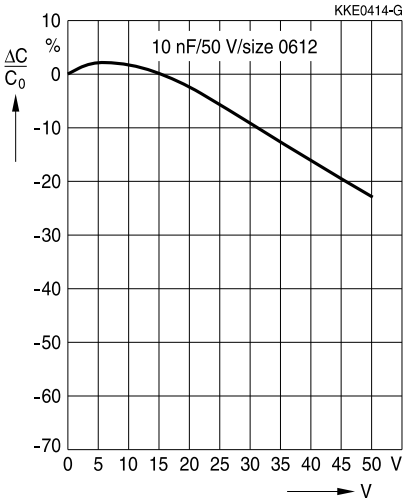
		Chip thickness	Cardboard tape, ∅180-mm reel	Cardboard tape, ∅330-mm reel
			* ≙ 1	* ≙ 3
C_R	Ordering code	mm	pcs./reel	pcs./reel
Case size 0508, 50 VDC, 4-fold arrays				
1.0 nF	B37941R5102M04*	0.85 ±0.1	4000	16000
Case size 0612, 50 VDC, 4-fold arrays				
1.0 nF	B37872R5102M04*	0.85 ±0.1	4000	16000
2.2 nF	B37872R5222M04*	0.85 ±0.1	4000	16000
4.7 nF	B37872R5472M04*	0.85 ±0.1	4000	16000
10 nF	B37872R5103M04*	0.85 ±0.1	4000	16000
22 nF	B37872R5223M04*	0.85 ±0.1	4000	16000

Typical characteristics[1)]

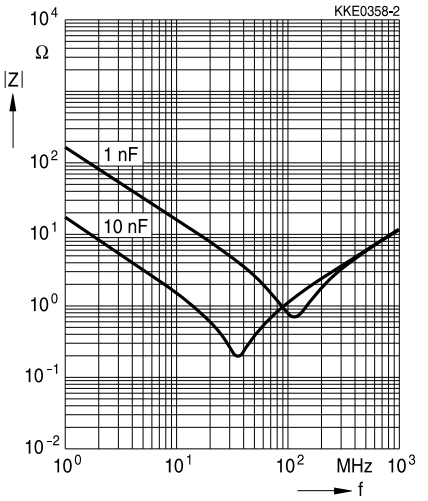
Capacitance change $\Delta C/C_{25}$ versus temperature T



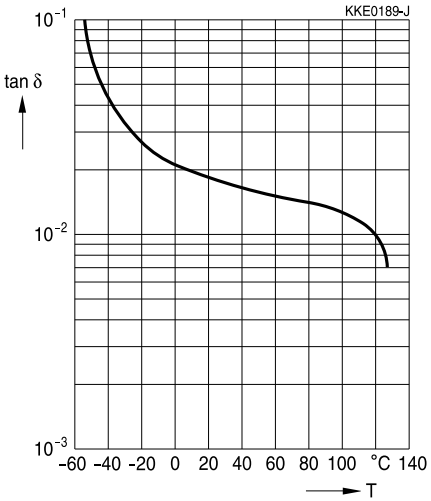
Capacitance change $\Delta C/C_0$ versus superimposed DC voltage V



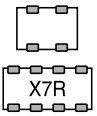
Impedance |Z| versus frequency f



Dissipation factor tan δ versus temperature T



1) For more detailed information on frequency behavior and characteristics see www.epcos.com/mlcc_impedance.



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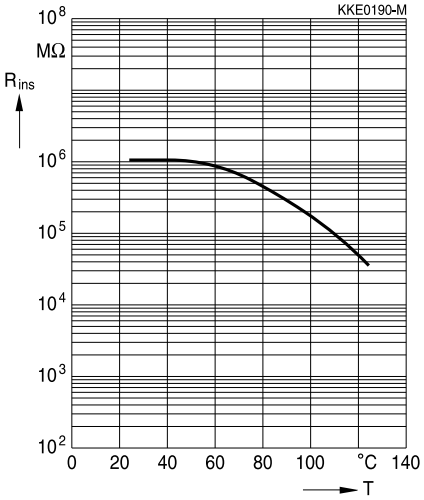
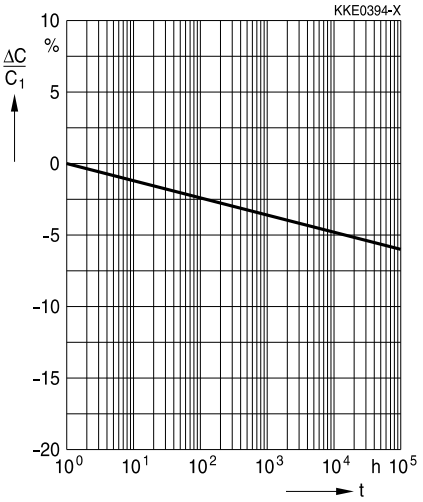
Typical characteristics[1)]

Insulation resistance R_{ins} versus temperature T



Capacitance change $\Delta C/C_1$ versus time t



1) For more detailed information on frequency behavior and characteristics see www.epcos.com/mlcc_impedance.

Cautions and warnings

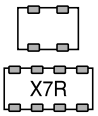
How to select ceramic capacitors

Remember the following when selecting ceramic capacitors:

1. Ceramic capacitors that must fulfill high quality requirements must be qualified based on AEC-Q200 Rev-C.
2. When ceramic capacitors are used at the connection to a battery or power supply (e.g. clamp 15 or 30 in an automobile) or for safety-relevant applications, two single ceramic capacitors should be connected in series. Alternatively a ceramic capacitor with integrated series circuits should be used in order to reduce the possibility of a short circuit caused by a fracture. The MLSC from EPCOS contains such a series circuit in a single component.
3. The use of multilayer varistors (MLVs) is recommended for ESD protection (see chapter “Effects on mechanical, thermal and electrical stress”, section 1.4).
4. Additional stress factors such as continuous operating voltage or application-specific derating must be taken into account in the selection of components (refer to chapter “Reliability”).

Recommendations for the circuit board design

1. Components with an optimized geometrical design are preferable where permitted by the application.
2. Use at least FR4 circuit board material.
3. Geometrically optimized circuit boards are preferable, especially those that cannot be deformed.
4. Ceramic capacitors should be placed with a sufficient minimum distance from the edge of a circuit board. High bending forces may be exerted there when boards are separated and during further processing of a board (e.g. when incorporating it in a housing).
5. Ceramic capacitors should always be placed parallel to the possible bending axis of a circuit board.
6. Screw connections should not be used to fix a board or connect several boards. Components should not be placed near screw holes. If screw connections are unavoidable, they should be cushioned, for instance using rubber pads.



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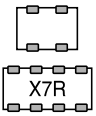
Recommendations for processing

1. Ensure correct positioning of a ceramic capacitor on the solder pad.
2. Be careful when using casting, injection-molded and molding compounds and cleaning agents. They can damage a capacitor.
3. Support a circuit board and reduce placement forces.
4. Do not straighten a board (manually) if it is distorted by soldering.
5. Separate boards with a peripheral saw, or preferably with a milling head (no dicing or breaking).
6. Be careful when subsequently placing heavy or leaded components (e.g. transformers or snap-in components) because of the danger of bending and fracture.
7. When testing, transporting, packing or inserting a board, avoid any deformation of it so that components are not damaged.
8. Avoid excessive force when plugging a connector into a device soldered onto a board.
9. Only mount ceramic capacitors using the soldering process (reflow or wave) that is permissible for them (see chapter “Soldering directions”).
10. When soldering, select the softest solder profile possible (heating time, peak temperature, cooling time) to avoid thermal stress and damage.
11. Ensure the correct solder meniscus height and solder quantity.
12. Ensure correct dosing of the cement.
13. Ceramic capacitors with external silver-palladium terminations are intended for conductive adhesion - they are not suited for lead-free soldering processes.

This listing does not claim to be complete, but merely reflects the experience of EPCOS AG.

Symbols and terms

Symbol	English	German
A	Area	Fläche
C	Capacitance	Kapazität
C_0	Initial (original) capacitance	Anfangskapazität
C_1	Capacitance value after one hour's use	Kapazitätswert nach einer Stunde
C_R	Rated capacitance	Nennkapazität
C_{20}	Capacitance at 20 °C	Kapazität bei 20 °C
C_{25}	Capacitance at 25 °C	Kapazität bei 25 °C
ΔC	Capacitance change	Kapazitätsänderung
D	Bending displacement	Durchbiegung
E_a	Activation energy	Aktivierungsenergie
ESR	Equivalent series resistance	Ersatzserienwiderstand
F	Force	Kraft
f	Frequency	Frequenz
f_{meas}	Measuring frequency	Messfrequenz
f_{res}	Self-resonant frequency	Eigenresonanzfrequenz
I_{test}	Test current	Prüfstrom
k	Ageing constant	Alterungskonstante
L	Inductance	Induktivität
N	Quantity (integer values)	Anzahl (ganzzahliger Wert)
P_{loss}	Power dissipation or loss	Verlustleistung
Q_{el}	Electrical charge	Elektrische Ladung
Q	Quality	Güte
R_{ins}	Insulation resistance	Isolationswiderstand
R_P	Parallel resistance	Parallelwiderstand
R_S	Series resistance (circuit resistance)	Serienwiderstand
S_V	Rate of rise of a voltage pulse	Flankensteilheit eines Spannungsimpulses
T	Temperature	Temperatur
T_{meas}	Measuring temperature	Messtemperatur
T_{op}	Operating temperature	Betriebstemperatur
T_{ref}	Reference temperature	Bezugstemperatur
T_{test}	Test temperature	Prüftemperatur
t	Time	Zeit
t_r	Rise time of a voltage pulse	Anstiegszeit eines Spannungsimpulses
t_{test}	Test duration	Prüfdauer
tan δ	Dissipation factor	Verlustfaktor



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Symbol	English	German
V	Voltage	Spannung
V_0	Initial (original) voltage (basic voltage level)	Anfangsspannung (Spannungsgrundpegel)
V_{meas}	Measuring voltage	Messspannung
V_R	Rated voltage	Nennspannung
V_S	Amplitude of a voltage pulse	Hub des Spannungsimpulses
V_{RMS}	Measuring (root-mean-square or effective) AC voltage	Effektivspannung
V_{test}	Test voltage	Prüfspannung
|Z|	Magnitude of impedance (AC resistance)	Betrag der Impedanz (Wechselstromwiderstand)
α	Temperature coefficient	Temperaturkoeffizient
ε_0	Absolute dielectric constant	Absolute Dielektrizitätskonstante
ε_r	Relative dielectric constant	Relative Dielektrizitätskonstante
λ	Failure rate	Ausfallrate
τ	Time constant	Zeitkonstante

Abbreviations / Notes

Symbol	English	German
e	Lead spacing (in mm)	Rastermaß (in mm)
SMD	Surface-mounted devices	Oberflächenmontierbares Bauelement
*	To be replaced by a number in ordering codes, type designations etc.	Platzhalter für Zahl im Bestellnummern-code oder für die Typenbezeichnung.
+	To be replaced by a letter.	Platzhalter für einen Buchstaben.
	All dimensions are given in mm.	Alle Maße sind in mm angegeben.
	The commas used in numerical values denote decimal points.	Verwendete Kommas in Zahlenwerten bezeichnen Dezimalpunkte.

Important notes

The following applies to all products named in this publication:

1. Some parts of this publication contain **statements about the suitability of our products for certain areas of application**. These statements are based on our knowledge of typical requirements that are often placed on our products in the areas of application concerned. We nevertheless expressly point out **that such statements cannot be regarded as binding statements about the suitability of our products for a particular customer application**. As a rule, EPCOS is either unfamiliar with individual customer applications or less familiar with them than the customers themselves. For these reasons, it is always ultimately incumbent on the customer to check and decide whether an EPCOS product with the properties described in the product specification is suitable for use in a particular customer application.
2. We also point out that **in individual cases, a malfunction of electronic components or failure before the end of their usual service life cannot be completely ruled out in the current state of the art, even if they are operated as specified**. In customer applications requiring a very high level of operational safety and especially in customer applications in which the malfunction or failure of an electronic component could endanger human life or health (e.g. in accident prevention or lifesaving systems), it must therefore be ensured by means of suitable design of the customer application or other action taken by the customer (e.g. installation of protective circuitry or redundancy) that no injury or damage is sustained by third parties in the event of malfunction or failure of an electronic component.
3. **The warnings, cautions and product-specific notes must be observed.**
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