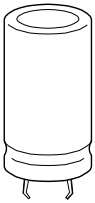
Aluminum electrolytic capacitors

Snap-in capacitors

Series/Type: **B41505**

Date: November 2012

Long-life grade capacitors



Applications
- Professional power supplies

Features
- Long useful life
- High reliability
- Outstanding ripple current capability
- Low ESR
- Capacitors with all insulation versions pass the needle flame test according to IEC 60695-11-5 for all flame exposure times up to 120 s
- RoHS-compatible

Construction
- Charge/discharge-proof, polar
- Aluminum case, fully insulated with PVC
- Snap-in solder pins to hold component in place on PC-board
- Minus pole marking on case surface
- Minus pole not insulated from case
- Overload protection by safety vent on the base

Terminals
- Standard version with 2 terminals, 2 lengths available: 6.3 and 4.5 mm
- 3 terminals to ensure correct insertion: length 4.5 mm

Specifications and characteristics in brief

Rated voltage V_R	10 ... 100 V DC	
Surge voltage V_S	1.15 · V_R	
Rated capacitance C_R	560 ... 33000 µF	
Capacitance tolerance	±20% ≙ M	
Dissipation factor tan δ (20 °C, 100 Hz)	V_R = 10 V DC: tan δ ≤ 0.20 V_R = 16 V DC: tan δ ≤ 0.15 V_R = 25 V DC: tan δ ≤ 0.11 V_R = 35 V DC: tan δ ≤ 0.10 V_R = 50 V DC: tan δ ≤ 0.08 V_R = 63 ... 100 V DC: tan δ ≤ 0.06	
Leakage current I_{leak} (5 min, 20 °C)	$I_{leak} \leq 0.3\ \mu A \cdot \left(\frac{C_R}{\mu F} \cdot \frac{V_R}{V}\right)^{0.7} + 4\ \mu A$	
Self-inductance ESL	Approx. 20 nH	
Useful life[1)] 105 °C; V_R; $I_{AC,R}$ 85 °C; V_R; $I_{AC,max}$ 40 °C; V_R; 2.1 · $I_{AC,R}$	 > 5000 h > 12000 h > 25000 h	Requirements: ΔC/C ≤ ±45% of initial value tan δ ≤ 3 times initial specified limit I_{leak} ≤ initial specified limit
Load life test 105 °C; V_R; $I_{AC,R}$	4000 h	Post test requirements: ΔC/C ≤ ±20% of initial value tan δ ≤ 2 times initial specified limit I_{leak} ≤ initial specified limit
Voltage endurance test 105 °C; V_R	2000 h	Post test requirements: ΔC/C ≤ ±15% of initial value tan δ ≤ 1.3 times initial specified limit I_{leak} ≤ initial specified limit
Vibration resistance test	To IEC 60068-2-6, test Fc: Frequency range 10 Hz ... 55 Hz, displacement amplitude 0.35 mm, acceleration max. 5 *g*, duration 3 × 2 h. Capacitor mounted by its body which is rigidly clamped to the work surface.	
Characteristics at low temperature	Max. impedance ratio at 100 Hz	
	V_R	10 ... 100 V
	$Z_{-25\,°C} / Z_{20\,°C}$	2
	$Z_{-40\,°C} / Z_{20\,°C}$	3
IEC climatic category	To IEC 60068-1: 40/105/56 (−40 °C/+105 °C/56 days damp heat test)	
Sectional specification	IEC 60384-4	

1) Refer to chapter "General technical information, 5 Useful life" on how to interpret useful life.

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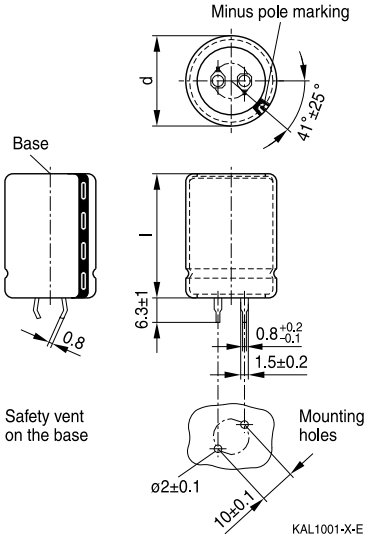
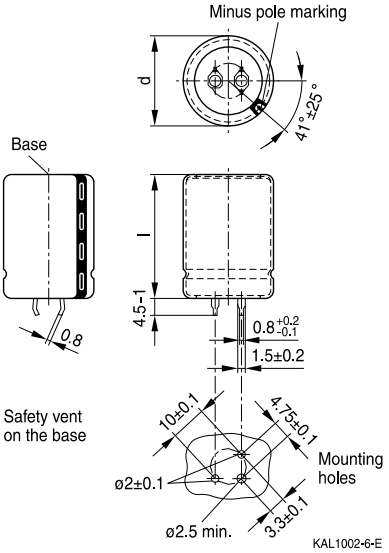
Dimensional drawings

Snap-in capacitors with standard insulation (PVC)



Snap-in terminals, length (6.3 ±1) mm.
Also available in a shorter version with a length of (4.5 −1) mm.

Dimensions (mm)		Approx. weight (g)	Packing units (pcs.)
d +1	l ±2		
22	25	9	160
22	30	12	160
22	35	15	160
22	40	18	160
25	25	13	130
25	30	17	130
25	35	19	130
25	40	22	130



Snap-in capacitors are also available with 3 terminals (length (4.5 −1) mm).

Dimensions (mm)		Approx. weight (g)	Packing units (pcs.)
d +1	l ±2		
30	25	17	80
30	30	23	80
30	35	29	80
30	40	36	80
30	45	41	80
30	50	46	80
35	35	36	60
35	40	41	60
35	45	56	60
35	50	70	60

Ordering codes for terminal styles and insulation features

Identification in 3rd block of ordering code

Snap-in capacitors	
Terminal version	Insulation version
	PVC
Standard terminals 6.3 mm	M000
Short terminals 4.5 mm	M007
3 terminals 4.5 mm	M002

Ordering examples:

B41505A5109M007 } snap-in capacitor with short terminals
B41505A5109M002 } snap-in capacitor with 3 terminals

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Overview of available types

V_R (V DC)	10	16	25	35	50	63	80	100
	Case dimensions d × l (mm)							
C_R (µF)								
560								25 × 25
680								22 × 35
1000						22 × 25	25 × 25	25 × 35 30 × 30
1200							30 × 25	
1500						22 × 35	25 × 35	30 × 40
2200				22 × 25	22 × 35	25 × 35 30 × 30	30 × 35	30 × 50
3300				22 × 30 25 × 25	25 × 35	30 × 40	35 × 35	35 × 50
4700			22 × 30 25 × 25	22 × 40	30 × 35	35 × 35	35 × 45	
6800	22 × 25	22 × 30	25 × 30	25 × 40	30 × 50	35 × 50		
10000	22 × 30	25 × 30	25 × 40	30 × 40	35 × 45			
15000	22 × 40	25 × 40	30 × 40	35 × 40				
18000				35 × 45				
22000	30 × 35	30 × 40						
33000	30 × 45							

The capacitance and voltage ratings listed above are available in different cases upon request. Other voltage and capacitance ratings are also available upon request.

Technical data and ordering codes

C_R 100 Hz 20 °C µF	Case dimensions d × l mm	ESR_{typ} 100 Hz 20 °C mΩ	Z_{max} 10 kHz 20 °C mΩ	$I_{AC,max}$ 100 Hz 60 °C A	$I_{AC,max}$ 100 Hz 85 °C A	$I_{AC,R}$ [1] 100 Hz 105 °C A	Ordering code (composition see below)
V_R = 10 V DC							
6800	22 × 25	74	78	3.6	2.8	1.4	B41505A3688M00#
10000	22 × 30	53	56	4.6	3.6	1.8	B41505A3109M00#
15000	22 × 40	37	39	5.9	4.6	2.3	B41505A3159M00#
22000	30 × 35	26	28	7.7	6.0	3.0	B41505A3229M00#
33000	30 × 45	19	20	10.2	7.8	3.9	B41505A3339M00#
V_R = 16 V DC							
6800	22 × 30	46	49	4.6	3.6	1.8	B41505A4688M00#
10000	25 × 30	34	36	5.6	4.4	2.2	B41505A4109M00#
15000	25 × 40	24	26	7.1	5.6	2.8	B41505A4159M00#
22000	30 × 40	17	18	9.4	7.0	3.5	B41505A4229M00#
V_R = 25 V DC							
4700	22 × 30	53	57	4.1	3.2	1.6	B41505A5478M00#
4700	25 × 25	53	57	4.1	3.2	1.6	B41505F5478M00#
6800	25 × 30	41	43	4.8	3.8	1.9	B41505A5688M00#
10000	25 × 40	30	32	6.4	5.0	2.5	B41505A5109M00#
15000	30 × 40	22	23	8.2	6.4	3.2	B41505A5159M00#
V_R = 35 V DC							
2200	22 × 25	85	90	2.8	2.2	1.1	B41505A7228M00#
3300	22 × 30	56	60	3.8	3.0	1.5	B41505A7338M00#
3300	25 × 25	56	60	3.8	3.0	1.5	B41505F7338M00#
4700	22 × 40	45	48	4.8	3.8	1.9	B41505A7478M00#
6800	25 × 40	35	37	5.9	4.6	2.3	B41505A7688M00#
10000	30 × 40	26	28	7.4	5.8	2.9	B41505A7109M00#
15000	35 × 40	19	20	9.4	7.6	3.8	B41505A7159M00#
18000	35 × 45	17	18	11.1	8.6	4.3	B41505A7189M00#
V_R = 50 V DC							
2200	22 × 35	85	90	3.6	2.8	1.4	B41505A6228M00#
3300	25 × 35	56	60	4.6	3.6	1.8	B41505A6338M00#
4700	30 × 35	42	45	5.6	4.4	2.2	B41505A6478M00#
6800	30 × 50	33	35	7.4	5.8	2.9	B41505A6688M00#
10000	35 × 45	25	26	9.4	7.2	3.6	B41505A6109M00#

Composition of ordering code

= Terminal style

0 = snap-in standard terminals (6.3 mm)
2 = snap-in 3 terminals (4.5 mm)
7 = snap-in short terminals (4.5 mm)

1) 120-Hz conversion factor of ripple current: I_{AC} (120 Hz) = 1.03 · I_{AC} (100 Hz)

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Technical data and ordering codes

C_R 100 Hz 20 °C µF	Case dimensions d × l mm	ESR_{typ} 100 Hz 20 °C mΩ	Z_{max} 10 kHz 20 °C mΩ	$I_{AC,max}$ 100 Hz 60 °C A	$I_{AC,max}$ 100 Hz 85 °C A	$I_{AC,R}$ [2] 100 Hz 105 °C A	Ordering code (composition see below)
V_R = 63 V DC							
1000	22 × 25	149	159	2.6	2.0	1.0	B41505A8108M00#
1500	22 × 35	100	106	3.6	2.8	1.4	B41505A8158M00#
2200	25 × 35	68	72	4.3	3.4	1.7	B41505A8228M00#
2200	30 × 30	80	85	4.6	3.6	1.8	B41505F8228M00#
3300	30 × 40	53	56	5.9	4.6	2.3	B41505A8338M00#
4700	35 × 35	42	45	6.9	5.4	2.7	B41505A8478M00#
6800	35 × 50	29	31	9.4	7.2	3.6	B41505A8688M00#
V_R = 80 V DC							
1000	25 × 25	125	133	3.3	2.6	1.3	B41505A0108M00#
1200	30 × 25	104	110	3.8	3.0	1.5	B41505A0128M00#
1500	25 × 35	83	89	4.6	3.6	1.8	B41505A0158M00#
2200	30 × 35	56	60	5.1	4.0	2.0	B41505A0228M00#
3300	35 × 35	45	48	7.1	5.6	2.8	B41505A0338M00#
4700	35 × 45	32	34	8.5	6.8	3.4	B41505A0478M00#
V_R = 100 V DC							
560	25 × 25	178	190	2.6	2.0	1.0	B41505A9567M00#
680	22 × 35	146	156	3.1	2.4	1.2	B41505A9687M00#
1000	25 × 35	100	106	3.6	2.8	1.4	B41505A9108M00#
1000	30 × 30	100	106	3.8	3.0	1.5	B41505F9108M00#
1500	30 × 40	66	70	4.8	3.8	1.9	B41505A9158M00#
2200	30 × 50	56	60	5.9	4.6	2.3	B41505A9228M00#
3300	35 × 50	38	40	7.7	6.0	3.0	B41505A9338M00#

Composition of ordering code

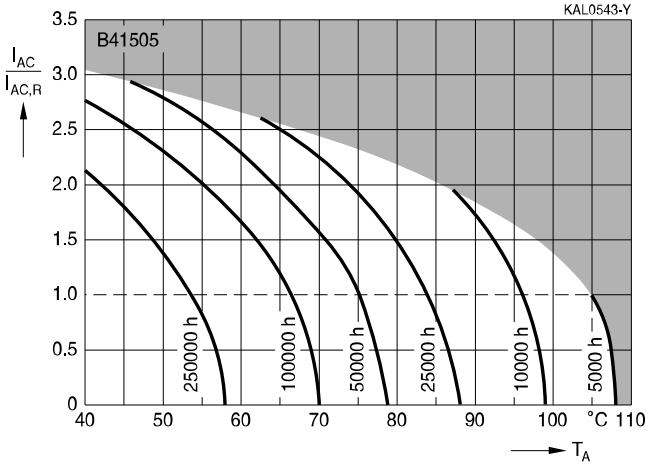
= Terminal style

0 = snap-in standard terminals (6.3 mm)
2 = snap-in 3 terminals (4.5 mm)
7 = snap-in short terminals (4.5 mm)

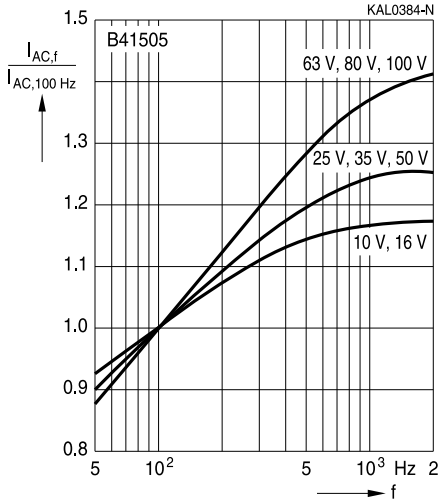
2) 120-Hz conversion factor of ripple current: I_{AC} (120 Hz) = 1.03 · I_{AC} (100 Hz)

Useful life[1)]

depending on ambient temperature T_A under ripple current operating conditions

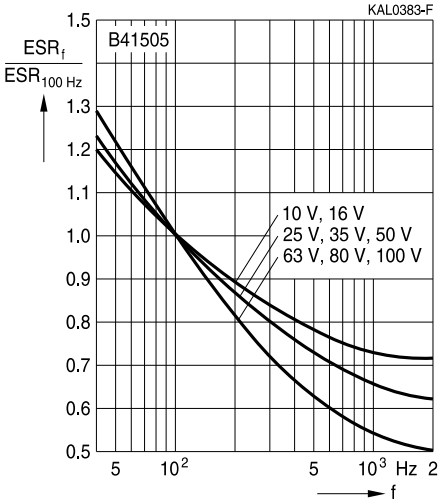


Frequency factor of permissible ripple current I_{AC} versus frequency f



Frequency characteristic of ESR

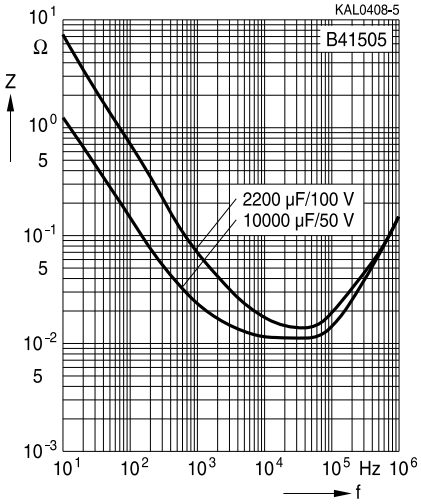
Typical behavior



1) Refer to chapter "General technical information, 5 Useful life" on how to interpret useful life.

Impedance Z versus frequency f

Typical behavior at 20 °C



Cautions and warnings

Personal safety

The electrolytes used by EPCOS have been optimized both with a view to the intended application and with regard to health and environmental compatibility. They do not contain any solvents that are detrimental to health, e.g. dimethyl formamide (DMF) or dimethyl acetamide (DMAC).
Furthermore, some of the high-voltage electrolytes used by EPCOS are self-extinguishing.

As far as possible, EPCOS does not use any dangerous chemicals or compounds to produce operating electrolytes. However, in exceptional cases, such materials must be used in order to achieve specific physical and electrical properties because no alternative materials are currently known. However, the amount of dangerous materials used in our products is limited to an absolute minimum.

Materials and chemicals used in EPCOS aluminum electrolytic capacitors are continuously adapted in compliance with the EPCOS Corporate Environmental Policy and the latest EU regulations and guidelines such as RoHS, REACH/SVHC, GADSL, and ELV.

MDS (Material Data Sheets) are available on the EPCOS website for all types listed in the data book. MDS for customer specific capacitors are available upon request.
MSDS (Material Safety Data Sheets) are available for all of our electrolytes upon request.

Nevertheless, the following rules should be observed when handling aluminum electrolytic capacitors: No electrolyte should come into contact with eyes or skin. If electrolyte does come into contact with the skin, wash the affected areas immediately with running water. If the eyes are affected, rinse them for 10 minutes with plenty of water. If symptoms persist, seek medical treatment. Avoid inhaling electrolyte vapor or mists. Workplaces and other affected areas should be well ventilated. Clothing that has been contaminated by electrolyte must be changed and rinsed in water.

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Product safety

The table below summarizes the safety instructions that must be observed without fail. A detailed description can be found in the relevant sections of chapter "General technical information".

Topic	Safety information	Reference chapter "General technical information"
Polarity	Make sure that polar capacitors are connected with the right polarity.	1 "Basic construction of aluminum electrolytic capacitors"
Reverse voltage	Voltages polarity classes should be prevented by connecting a diode.	3.1.6 "Reverse voltage"
Mounting position of screw-terminal capacitors	Do not mount the capacitor with the terminals (safety vent) upside down.	11.1. "Mounting positions of capacitors with screw terminals"
Robustness of terminals	The following maximum tightening torques must not be exceeded when connecting screw terminals: M5: 2.5 Nm M6: 4.0 Nm	11.3 "Mounting torques"
Mounting of single-ended capacitors	The internal structure of single-ended capacitors might be damaged if excessive force is applied to the lead wires. Avoid any compressive, tensile or flexural stress. Do not move the capacitor after soldering to PC board. Do not pick up the PC board by the soldered capacitor. Do not insert the capacitor on the PC board with a hole space different to the lead space specified.	11.4 "Mounting considerations for single-ended capacitors"
Soldering	Do not exceed the specified time or temperature limits during soldering.	11.5 "Soldering"
Soldering, cleaning agents	Do not allow halogenated hydrocarbons to come into contact with aluminum electrolytic capacitors.	11.6 "Cleaning agents"
Upper category temperature	Do not exceed the upper category temperature.	7.2 "Maximum permissible operating temperature"
Passive flammability	Avoid external energy, such as fire or electricity.	8.1 "Passive flammability"

Topic	Safety information	Reference chapter "General technical information"
Active flammability	Avoid overload of the capacitors.	8.2 "Active flammability"
Maintenance	Make periodic inspections of the capacitors. Before the inspection, make sure that the power supply is turned off and carefully discharge the electricity of the capacitors. Do not apply any mechanical stress to the capacitor terminals.	10 "Maintenance"
Storage	Do not store capacitors at high temperatures or high humidity. Capacitors should be stored at +5 to +35 °C and a relative humidity of ≤ 75%.	7.3 Storage conditions
		Reference chapter "Capacitors with screw terminals"
Breakdown strength of insulating sleeves	Do not damage the insulating sleeve, especially when ring clips are used for mounting.	"Screw terminals – accessories"

Symbols and terms

Symbol	English	German
C	Capacitance	Kapazität
C_R	Rated capacitance	Nennkapazität
C_S	Series capacitance	Serienkapazität
$C_{S,T}$	Series capacitance at temperature T	Serienkapazität bei Temperatur T
C_f	Capacitance at frequency f	Kapazität bei Frequenz f
d	Case diameter, nominal dimension	Gehäusedurchmesser, Nennmaß
d_{max}	Maximum case diameter	Maximaler Gehäusedurchmesser
ESL	Self-inductance	Eigeninduktivität
ESR	Equivalent series resistance	Ersatzserienwiderstand
ESR_f	Equivalent series resistance at frequency f	Ersatzserienwiderstand bei Frequenz f
ESR_T	Equivalent series resistance at temperature T	Ersatzserienwiderstand bei Temperatur T
f	Frequency	Frequenz
I	Current	Strom
I_{AC}	Alternating current (ripple current)	Wechselstrom
$I_{AC,rms}$	Root-mean-square value of alternating current	Wechselstrom, Effektivwert
$I_{AC,f}$	Ripple current at frequency f	Wechselstrom bei Frequenz f
$I_{AC,max}$	Maximum permissible ripple current	Maximal zulässiger Wechselstrom
$I_{AC,R}$	Rated ripple current	Nennwechselstrom
$I_{AC,R}$ (B)	Rated ripple current for base cooling	Nennwechselstromstrom für Bodenkühlung
I_{leak}	Leakage current	Reststrom
$I_{leak,op}$	Operating leakage current	Betriebsreststrom
l	Case length, nominal dimension	Gehäuselänge, Nennmaß
l_{max}	Maximum case length (without terminals and mounting stud)	Maximale Gehäuselänge (ohne Anschlüsse und Gewindebolzen)
R	Resistance	Widerstand
R_{ins}	Insulation resistance	Isolationswiderstand
R_{symm}	Balancing resistance	Symmetrierwiderstand
T	Temperature	Temperatur
ΔT	Temperature difference	Temperaturdifferenz
T_A	Ambient temperature	Umgebungstemperatur
T_C	Case temperature	Gehäusetemperatur
T_B	Capacitor base temperature	Temperatur des Becherbodens
t	Time	Zeit
Δt	Period	Zeitraum
t_b	Service life (operating hours)	Brauchbarkeitsdauer (Betriebszeit)

Symbol	English	German
V	Voltage	Spannung
V_F	Forming voltage	Formierspannung
V_{op}	Operating voltage	Betriebsspannung
V_R	Rated voltage, DC voltage	Nennspannung, Gleichspannung
V_S	Surge voltage	Spitzenspannung
X_C	Capacitive reactance	Kapazitiver Blindwiderstand
X_L	Inductive reactance	Induktiver Blindwiderstand
Z	Impedance	Scheinwiderstand
Z_T	Impedance at temperature T	Scheinwiderstand bei Temperatur T
tan δ	Dissipation factor	Verlustfaktor
λ	Failure rate	Ausfallrate
ε_0	Absolute permittivity	Elektrische Feldkonstante
ε_r	Relative permittivity	Dielektrizitätszahl
ω	Angular velocity; $2 \cdot \pi \cdot f$	Kreisfrequenz; $2 \cdot \pi \cdot f$

Note

All dimensions are given in mm.

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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