

## Standard Thick Film Chip Resistors



### FEATURES

- Stability  $\Delta R/R = 1\%$  for 1000 h at 70 °C
- 2 mm pitch packaging option for 0603 size
- Pure tin solder contacts on Ni barrier layer provides compatibility with lead (Pb)-free and lead containing soldering processes
- Metal glaze on high quality ceramic
- AEC-Q200 qualified
- Material categorization: For definitions of compliance please see [www.vishay.com/doc?99912](http://www.vishay.com/doc?99912)



**RoHS**  
COMPLIANT  
HALOGEN  
**FREE**

### STANDARD ELECTRICAL SPECIFICATIONS

| MODEL        | SIZE |          | RATED DISSIPATION<br>$P_{70^\circ\text{C}}$<br>W | LIMITING ELEMENT VOLTAGE<br>$U_{\text{max. AC/DC}}$ | TEMPERATURE COEFFICIENT<br>ppm/K | TOLERANCE<br>%     | RESISTANCE RANGE<br>$\Omega$ | SERIES          |
|--------------|------|----------|--------------------------------------------------|-----------------------------------------------------|----------------------------------|--------------------|------------------------------|-----------------|
|              | INCH | METRIC   |                                                  |                                                     |                                  |                    |                              |                 |
| D10/CRCW0402 | 0402 | RR 1005M | 0.063                                            | 50                                                  | $\pm 100$<br>$\pm 200$           | $\pm 1$<br>$\pm 5$ | 1R0 to 10M                   | E24; E96<br>E24 |
|              |      |          |                                                  |                                                     |                                  |                    |                              |                 |
| D11/CRCW0603 | 0603 | RR 1608M | 0.10                                             | 75                                                  | $\pm 100$<br>$\pm 200$           | $\pm 1$<br>$\pm 5$ | 1R0 to 10M                   | E24; E96<br>E24 |
|              |      |          |                                                  |                                                     |                                  |                    |                              |                 |
| D12/CRCW0805 | 0805 | RR 2012M | 0.125                                            | 150                                                 | $\pm 100$<br>$\pm 200$           | $\pm 1$<br>$\pm 5$ | 1R0 to 10M                   | E24; E96<br>E24 |
|              |      |          |                                                  |                                                     |                                  |                    |                              |                 |
| D25/CRCW1206 | 1206 | RR 3216M | 0.25                                             | 200                                                 | $\pm 100$<br>$\pm 200$           | $\pm 1$<br>$\pm 5$ | 1R0 to 10M                   | E24; E96<br>E24 |
|              |      |          |                                                  |                                                     |                                  |                    |                              |                 |
| CRCW1210     | 1210 | RR 3225M | 0.5                                              | 200                                                 | $\pm 100$<br>$\pm 200$           | $\pm 1$<br>$\pm 5$ | 1R0 to 10M                   | E24; E96<br>E24 |
|              |      |          |                                                  |                                                     |                                  |                    |                              |                 |
| CRCW1218     | 1218 | RR 3246M | 1.0                                              | 200                                                 | $\pm 100$<br>$\pm 200$           | $\pm 1$<br>$\pm 5$ | 1R0 to 2M2                   | E24; E96<br>E24 |
|              |      |          |                                                  |                                                     |                                  |                    |                              |                 |
| CRCW2010     | 2010 | RR 5025M | 0.75                                             | 400                                                 | $\pm 100$<br>$\pm 200$           | $\pm 1$<br>$\pm 5$ | 1R0 to 10M                   | E24; E96<br>E24 |
|              |      |          |                                                  |                                                     |                                  |                    |                              |                 |
| CRCW2512     | 2512 | RR 6332M | 1.0                                              | 500                                                 | $\pm 100$<br>$\pm 200$           | $\pm 1$<br>$\pm 5$ | 1R0 to 10M                   | E24; E96<br>E24 |
|              |      |          |                                                  |                                                     |                                  |                    |                              |                 |

#### Notes

- These resistors do not feature a limited lifetime when operated within the permissible limits. However, resistance value drift increasing over operating time may result in exceeding a limit acceptable to the specific application, thereby establishing a functional lifetime.
- Marking: See data sheet "Surface Mount Resistor Marking" (document number 20020).
- Power rating depends on the max. temperature at the solder point, the component placement density and the substrate material.

# **TECHNICAL SPECIFICATIONS**

| PARAMETER                                    | UNIT     | D10/<br>CRCW0402       | D11/<br>CRCW0603 | D12/<br>CRCW0805 | D25/<br>CRCW1206 | CRCW1210 | CRCW1218 | CRCW2010 | CRCW2512 |
|----------------------------------------------|----------|------------------------|------------------|------------------|------------------|----------|----------|----------|----------|
| Rated dissipation $P_{70}$ <sup>(1)</sup>    | W        | 0.063                  | 0.1              | 0.125            | 0.25             | 0.5      | 1.0      | 0.75     | 1.0      |
| Limiting element voltage<br>$U_{max. AC/DC}$ | V        | 50                     | 75               | 150              | 200              | 200      | 200      | 400      | 500      |
| Insulation voltage<br>$U_{ins}$ (1 min)      | V        | > 75                   | > 100            | > 200            | > 300            | > 300    | > 300    | > 300    | > 300    |
| Insulation resistance                        | $\Omega$ | > $10^9$               |                  |                  |                  |          |          |          |          |
| Category temperature range                   | °C       | - 55 to + 155          |                  |                  |                  |          |          |          |          |
| Failure rate                                 | $h^{-1}$ | < $0.1 \times 10^{-9}$ |                  |                  |                  |          |          |          |          |
| Weight                                       | mg       | 0.65                   | 2                | 5.5              | 10               | 16       | 29.5     | 25.5     | 40.5     |

## **Note**

<sup>(1)</sup> The power dissipation on the resistor generates a temperature rise against the local ambient, depending on the heat flow support of the printed-circuit board (thermal resistance). The rated dissipation applies only if the permitted film temperature of 155 °C is not exceeded.

# **PART NUMBER AND PRODUCT DESCRIPTION**

Part Number: CRCW0603562RFKEC

C R C W 0 6 0 3 5 6 2 R F K E C

| MODEL                                                                                        | VALUE                                                       | TOLERANCE                                        | TCR                                                      | PACKAGING                                                 | SPECIAL        |
|----------------------------------------------------------------------------------------------|-------------------------------------------------------------|--------------------------------------------------|----------------------------------------------------------|-----------------------------------------------------------|----------------|
| CRCW0402<br>CRCW0603<br>CRCW0805<br>CRCW1206<br>CRCW1210<br>CRCW1218<br>CRCW2010<br>CRCW2512 | R = Decimal<br>K = Thousand<br>M = Million<br>0000 = Jumper | F = $\pm 1.0\%$<br>J = $\pm 5.0\%$<br>Z = Jumper | K = $\pm 100$ ppm/K<br>N = $\pm 200$ ppm/K<br>0 = Jumper | EA, EB,<br>EC, ED,<br>EE, EF,<br>EG, EH,<br>EI, EL,<br>EK | Up to 2 digits |

Product Description: D11/CRCW0603 100 562R 1 % ET6 e3

| D11/CRCW0603                                                                                                 | 100                                | 562R                                                                                                  | 1 %                    | ET6                                                                               | e3                                  |
|--------------------------------------------------------------------------------------------------------------|------------------------------------|-------------------------------------------------------------------------------------------------------|------------------------|-----------------------------------------------------------------------------------|-------------------------------------|
| MODEL                                                                                                        | TCR                                | RESISTANCE VALUE                                                                                      | TOLERANCE              | PACKAGING                                                                         | LEAD (Pb)-FREE                      |
| D10/CRCW0402<br>D11/CRCW0603<br>D12/CRCW0805<br>D25/CRCW1206<br>CRCW1210<br>CRCW1218<br>CRCW2010<br>CRCW2512 | $\pm 200$ ppm/K<br>$\pm 100$ ppm/K | 10R = 10 $\Omega$<br>562R = 562 $\Omega$<br>10K = 10 k $\Omega$<br>1M0 = 1 M $\Omega$<br>0R0 = Jumper | $\pm 5\%$<br>$\pm 1\%$ | ET1, ET2,<br>ET3, ET4,<br>ET5, ET6,<br>ET7, ET8,<br>ET9, EF4,<br>E02, E67,<br>E82 | e3 = Pure tin<br>termination finish |

| PACKAGING |          |          |                                                |       |       |               |
|-----------|----------|----------|------------------------------------------------|-------|-------|---------------|
| MODEL     | CODE     | QUANTITY | CARRIER TAPE                                   | WIDTH | PITCH | REEL DIAMETER |
| CRCW0402  | ED = ET7 | 10 000   | Paper tape acc.<br>to IEC 60068-3<br>Type I    | 8 mm  | 2 mm  | 180 mm/7"     |
|           | EE = EF4 | 50 000   |                                                |       |       | 330 mm/13"    |
| CRCW0603  | EI = ET2 | 5000     |                                                | 8 mm  | 2 mm  | 180 mm/7"     |
|           | ED = ET3 | 10 000   |                                                |       |       | 180 mm/7"     |
|           | EL = ET4 | 20 000   |                                                | 8 mm  | 4 mm  | 285 mm/11.25" |
|           | EE = ET8 | 50 000   |                                                |       |       | 330 mm/13"    |
|           | EA = ET1 | 5000     |                                                |       |       | 180 mm/7"     |
|           | EB = ET5 | 10 000   |                                                |       |       | 285 mm/11.25" |
|           | EC = ET6 | 20 000   |                                                |       |       | 330 mm/13"    |
| CRCW0805  | EA = ET1 | 5000     |                                                | 8 mm  | 4 mm  | 180 mm/7"     |
|           | EB = ET5 | 10 000   |                                                |       |       | 285 mm/11.25" |
|           | EC = ET6 | 20 000   |                                                |       |       | 330 mm/13"    |
| CRCW1206  | EA = ET1 | 5000     |                                                | 8 mm  | 4 mm  | 180 mm/7"     |
|           | EB = ET5 | 10 000   |                                                |       |       | 285 mm/11.25" |
|           | EC = ET6 | 20 000   |                                                |       |       | 330 mm/13"    |
| CRCW1210  | EA = ET1 | 5000     |                                                | 8 mm  | 4 mm  | 180 mm/7"     |
|           | EB = ET5 | 10 000   |                                                |       |       | 285 mm/11.25" |
|           | EC = ET6 | 20 000   |                                                |       |       | 330 mm/13"    |
| CRCW1218  | EK = ET9 | 4000     | Blister tape acc.<br>to IEC 60068-3<br>Type II | 12 mm | 4 mm  | 180 mm/7"     |
| CRCW2010  | EF = E02 | 4000     |                                                | 12 mm | 4 mm  | 180 mm/7"     |
| CRCW2512  | EG = E67 | 2000     |                                                | 12 mm | 8 mm  | 180 mm/7"     |
|           | EH = E82 | 4000     |                                                |       | 4 mm  |               |

## DIMENSIONS



| SIZE |        | DIMENSIONS in millimeters              |             |             |                                       |           | SOLDER PAD DIMENSIONS in millimeters |     |     |                |     |     |
|------|--------|----------------------------------------|-------------|-------------|---------------------------------------|-----------|--------------------------------------|-----|-----|----------------|-----|-----|
|      |        |                                        |             |             |                                       |           | REFLOW SOLDERING                     |     |     | WAVE SOLDERING |     |     |
| INCH | METRIC | L                                      | W           | H           | T1                                    | T2        | a                                    | b   | l   | a              | b   | l   |
| 0402 | 1005   | 1.0 ± 0.05                             | 0.5 ± 0.05  | 0.35 ± 0.05 | 0.25 ± 0.05                           | 0.2 ± 0.1 | 0.4                                  | 0.6 | 0.5 |                |     |     |
| 0603 | 1608   | 1.55 <sup>+0.10</sup> <sub>-0.05</sub> | 0.85 ± 0.1  | 0.45 ± 0.05 | 0.3 ± 0.2                             | 0.3 ± 0.2 | 0.5                                  | 0.9 | 1.0 | 0.9            | 0.9 | 1.0 |
| 0805 | 2012   | 2.0 <sup>+0.20</sup> <sub>-0.10</sub>  | 1.25 ± 0.15 | 0.45 ± 0.05 | 0.3 <sup>+0.20</sup> <sub>-0.10</sub> | 0.3 ± 0.2 | 0.7                                  | 1.3 | 1.2 | 0.9            | 1.3 | 1.3 |
| 1206 | 3216   | 3.2 <sup>+0.10</sup> <sub>-0.20</sub>  | 1.6 ± 0.15  | 0.55 ± 0.05 | 0.45 ± 0.2                            | 0.4 ± 0.2 | 0.9                                  | 1.7 | 2.0 | 1.1            | 1.7 | 2.3 |
| 1210 | 3225   | 3.2 ± 0.2                              | 2.5 ± 0.2   | 0.55 ± 0.05 | 0.45 ± 0.2                            | 0.4 ± 0.2 | 0.9                                  | 2.5 | 2.0 | 1.1            | 2.5 | 2.2 |
| 1218 | 3246   | 3.2 <sup>+0.10</sup> <sub>-0.20</sub>  | 4.6 ± 0.15  | 0.55 ± 0.05 | 0.45 ± 0.2                            | 0.4 ± 0.2 | 1.05                                 | 4.9 | 1.9 | 1.25           | 4.8 | 1.9 |
| 2010 | 5025   | 5.0 ± 0.15                             | 2.5 ± 0.15  | 0.6 ± 0.1   | 0.6 ± 0.2                             | 0.6 ± 0.2 | 1.0                                  | 2.5 | 3.9 | 1.2            | 2.5 | 3.9 |
| 2512 | 6332   | 6.3 ± 0.2                              | 3.15 ± 0.15 | 0.6 ± 0.1   | 0.6 ± 0.2                             | 0.6 ± 0.2 | 1.0                                  | 3.2 | 5.2 | 1.2            | 3.2 | 5.2 |

## FUNCTIONAL PERFORMANCE

## Single Pulse



Maximum pulse load, single pulse; applicable if  $\bar{P} \rightarrow 0$  and  $n < 1000$  and  $\bar{U} \leq \bar{U}_{max}$ ; for permissible resistance change equivalent to 8000 h operation

## Continuous Pulse



Maximum pulse load, continuous pulses; applicable if  $\bar{P} \leq P(9_{amb})$  and  $\bar{U} \leq \bar{U}_{max}$ ; for permissible resistance change equivalent to 8000 h operation



Maximum pulse voltage, single and continuous pulses; applicable if  $\bar{P} \leq \bar{P}_{max}$ ; for permissible resistance change equivalent to 8000 h operation

**Derating**


| TEST PROCEDURES AND REQUIREMENTS |                                  |                                       |                                                                                                                     |                                                                                        |                                                                |
|----------------------------------|----------------------------------|---------------------------------------|---------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|----------------------------------------------------------------|
| EN<br>60115-1<br>CLAUSE          | IEC<br>60068-2<br>TEST<br>METHOD | TEST                                  | PROCEDURE                                                                                                           | REQUIREMENTS<br>PERMISSIBLE CHANGE ( $\Delta R$ )                                      |                                                                |
|                                  |                                  |                                       |                                                                                                                     | SIZE 0402 to 2512                                                                      |                                                                |
|                                  |                                  |                                       |                                                                                                                     | STABILITY<br>CLASS 1<br>OR BETTER                                                      | STABILITY<br>CLASS 2<br>OR BETTER                              |
|                                  |                                  |                                       | Stability for product types:                                                                                        | 1 $\Omega$ to 10 M $\Omega$                                                            |                                                                |
|                                  |                                  |                                       | D/CRCW e3                                                                                                           |                                                                                        |                                                                |
| 4.5                              | -                                | Resistance                            | -                                                                                                                   | $\pm 1 \%$                                                                             | $\pm 5 \%$                                                     |
| 4.7                              | -                                | Voltage proof                         | $U = 1.4 \times U_{\text{ins}}$ ; 60 s                                                                              | No flashover or breakdown                                                              |                                                                |
| 4.13                             | -                                | Short time overload                   | $U = 2.5 \times \sqrt{P_{70} \times R}$<br>$\leq 2 \times U_{\text{max.}}$ ;<br>duration: Acc. to style             | $\pm (0.25 \% R + 0.05 \Omega)$                                                        | $\pm (0.5 \% R + 0.05 \Omega)$                                 |
| 4.17.2                           | 58 (Td)                          | Solderability                         | Solder bath method;<br>Sn60Pb40<br>non activated flux;<br>(235 $\pm$ 5) $^{\circ}\text{C}$<br>(2 $\pm$ 0.2) s       | Good tinning ( $\geq 95 \%$ covered)<br>no visible damage                              |                                                                |
|                                  |                                  |                                       | Solder bath method;<br>Sn96.5Ag3Cu0.5<br>non-activated flux;<br>(245 $\pm$ 5) $^{\circ}\text{C}$<br>(3 $\pm$ 0.3) s | Good tinning ( $\geq 95 \%$ covered)<br>no visible damage                              |                                                                |
| 4.8.4.2                          | -                                | Temperature<br>coefficient            | (20/- 55/20) $^{\circ}\text{C}$ and<br>(20/125/20) $^{\circ}\text{C}$                                               | $\pm 100 \text{ ppm/K}$                                                                | $\pm 200 \text{ ppm/K}$                                        |
| 4.32                             | 21 (Uu <sub>3</sub> )            | Shear<br>(adhesion)                   | RR 1608 and smaller: 9 N<br>RR 2012 and larger: 45 N                                                                | No visible damage                                                                      |                                                                |
| 4.33                             | 21 (Uu <sub>1</sub> )            | Substrate bending                     | Depth 2 mm;<br>3 times                                                                                              | No visible damage, no open circuit in bent position<br>$\pm (0.25 \% R + 0.05 \Omega)$ |                                                                |
| 4.19                             | 14 (Na)                          | Rapid change of<br>temperature        | 30 min. at - 55 $^{\circ}\text{C}$ ;<br>30 min. at 125 $^{\circ}\text{C}$<br><br>5 cycles<br><br>1000 cycles        | $\pm (0.25 \% R + 0.05 \Omega)$<br>$\pm (1 \% R + 0.05 \Omega)$                        | $\pm (0.5 \% R + 0.05 \Omega)$<br>$\pm (1 \% R + 0.05 \Omega)$ |
| 4.23                             | -                                | Climatic sequence:                    | -                                                                                                                   | $\pm (1 \% R + 0.05 \Omega)$                                                           | $\pm (2 \% R + 0.1 \Omega)$                                    |
| 4.23.2                           | 2 (Ba)                           | Dry heat                              | 125 $^{\circ}\text{C}$ ; 16 h                                                                                       |                                                                                        |                                                                |
| 4.23.3                           | 30 (Db)                          | Damp heat, cyclic                     | 55 $^{\circ}\text{C}$ ; $\geq 90 \%$ RH;<br>24 h; 1 cycle                                                           |                                                                                        |                                                                |
| 4.23.4                           | 1 (Aa)                           | Cold                                  | - 55 $^{\circ}\text{C}$ ; 2 h                                                                                       |                                                                                        |                                                                |
| 4.23.5                           | 13 (M)                           | Low air pressure                      | 1 kPa; (25 $\pm$ 10) $^{\circ}\text{C}$ ; 1 h                                                                       |                                                                                        |                                                                |
| 4.23.6                           | 30 (Db)                          | Damp heat, cyclic                     | 55 $^{\circ}\text{C}$ ; $\geq 90 \%$ RH;<br>24 h; 5 cycles                                                          |                                                                                        |                                                                |
| 4.23.7                           | -                                | DC load                               | $U = \sqrt{P_{70} \times R}$                                                                                        |                                                                                        |                                                                |
| 4.25.1                           | -                                | Endurance<br>at 70 $^{\circ}\text{C}$ | $U = \sqrt{P_{70} \times R} \leq U_{\text{max.}}$ ;<br>1.5 h on; 0.5 h off;                                         |                                                                                        |                                                                |
|                                  |                                  |                                       | 70 $^{\circ}\text{C}$ ; 1000 h                                                                                      | $\pm (1 \% R + 0.05 \Omega)$                                                           | $\pm (2 \% R + 0.1 \Omega)$                                    |
|                                  |                                  |                                       | 70 $^{\circ}\text{C}$ ; 8000 h                                                                                      | $\pm (2 \% R + 0.1 \Omega)$                                                            | $\pm (4 \% R + 0.1 \Omega)$                                    |

| TEST PROCEDURES AND REQUIREMENTS |                                  |                                                                  |                                                                                                              |                                                   |                                    |
|----------------------------------|----------------------------------|------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|---------------------------------------------------|------------------------------------|
| EN<br>60115-1<br>CLAUSE          | IEC<br>60068-2<br>TEST<br>METHOD | TEST                                                             | PROCEDURE                                                                                                    | REQUIREMENTS<br>PERMISSIBLE CHANGE ( $\Delta R$ ) |                                    |
|                                  |                                  |                                                                  |                                                                                                              | SIZE 0402 to 2512                                 |                                    |
|                                  |                                  |                                                                  |                                                                                                              | STABILITY<br>CLASS 1<br>OR BETTER                 | STABILITY<br>CLASS 2<br>OR BETTER  |
|                                  |                                  |                                                                  | Stability for product types:                                                                                 | 1 $\Omega$ to 10 M $\Omega$                       |                                    |
|                                  |                                  |                                                                  | D/CRCW e3                                                                                                    |                                                   |                                    |
| 4.18.2                           | 58 (Td)                          | Resistance to soldering heat                                     | Solder bath method<br>(260 $\pm$ 5) $^{\circ}$ C;<br>(10 $\pm$ 1) s                                          | $\pm$ (0.25 % $R$ + 0.05 $\Omega$ )               | $\pm$ (0.5 % $R$ + 0.05 $\Omega$ ) |
| 4.35                             | -                                | Flamability,<br>needle flame test                                | IEC 60695-11-5;<br>10 s                                                                                      | No burning after 30 s                             |                                    |
| 4.24                             | 78 (Cab)                         | Damp heat,<br>steady state                                       | (40 $\pm$ 2) $^{\circ}$ C;<br>(93 $\pm$ 3) % RH;<br>56 days                                                  | $\pm$ (1 % $R$ + 0.05 $\Omega$ )                  |                                    |
| 4.25.3                           | -                                | Endurance at<br>upper category<br>temperature                    | 155 $^{\circ}$ C, 1000 h                                                                                     | $\pm$ (1 % $R$ + 0.05 $\Omega$ )                  | $\pm$ (2 % $R$ + 0.1 $\Omega$ )    |
| 4.40                             | -                                | Electrostatic<br>discharge<br>(human body model)                 | IEC 61340-3-1;<br>3 pos. + 3 neg.<br>discharges;<br>ESD voltage acc. to size                                 | $\pm$ (1 % $R$ + 0.05 $\Omega$ )                  |                                    |
| 4.29                             | 45 (XA)                          | Component solvent<br>resistance                                  | Isopropyl alcohol;<br>50 $^{\circ}$ C; method 2                                                              | No visible damage                                 |                                    |
| 4.30                             | 45 (XA)                          | Solvent resistance<br>of marking                                 | Isopropyl alcohol;<br>50 $^{\circ}$ C; method 1,<br>toothbrush                                               | Marking legible,<br>no visible damage             |                                    |
| 4.22                             | 6 (Fc)                           | Vibration, endurance<br>by sweeping                              | f = 10 Hz to 2000 Hz;<br>x, y, z $\leq$ 1.5 mm;<br>A $\leq$ 200 m/s <sup>2</sup> ;<br>10 sweeps per axis     | $\pm$ (0.25 % $R$ + 0.05 $\Omega$ )               | $\pm$ (0.5 % $R$ + 0.05 $\Omega$ ) |
| 4.37                             | -                                | Periodic electric<br>overload                                    | $U = \sqrt{15 \times P_{70} \times R}$<br>$\leq 2 \times U_{\max.}$ ;<br>0.1 s on; 2.5 s off;<br>1000 cycles | $\pm$ (1 % $R$ + 0.05 $\Omega$ )                  |                                    |
| 4.27                             | -                                | Single pulse high<br>voltage overload,<br>10 $\mu$ s/700 $\mu$ s | $\hat{U} = 10 \times \sqrt{P_{70} \times R}$<br>$\leq 2 \times U_{\max.}$ ;<br>10 pulses                     | $\pm$ (1 % $R$ + 0.05 $\Omega$ )                  |                                    |

All tests are carried out in accordance with the following specifications:

- EN 60115-1, generic specification
- EN 140400, sectional specification
- EN 140401-802, detail specification
- IEC 60068-2-x, environmental test procedures

Packaging of components is done in paper or blister tapes according to IEC 60286-3.



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