



The DNA of tech.™

# EMERGING MARKET OF CHARGING INFRASTRUCTURE

The global electric vehicle charging infrastructure market size was valued at **USD 19.26 billion** in 2021 and is expected to expand at a compound annual growth rate (CAGR) of 30.6% from 2022 to 2030. The rising levels of carbon emissions and other harmful gases stemming from transportation have triggered the necessity of adopting electric vehicles.

**Growth rate:** CAGR of 33.4% from 2021 to 2028

**Market size value in 2021:** USD 19.26 billion

**Revenue forecast in 2028:** USD 144.97 billion

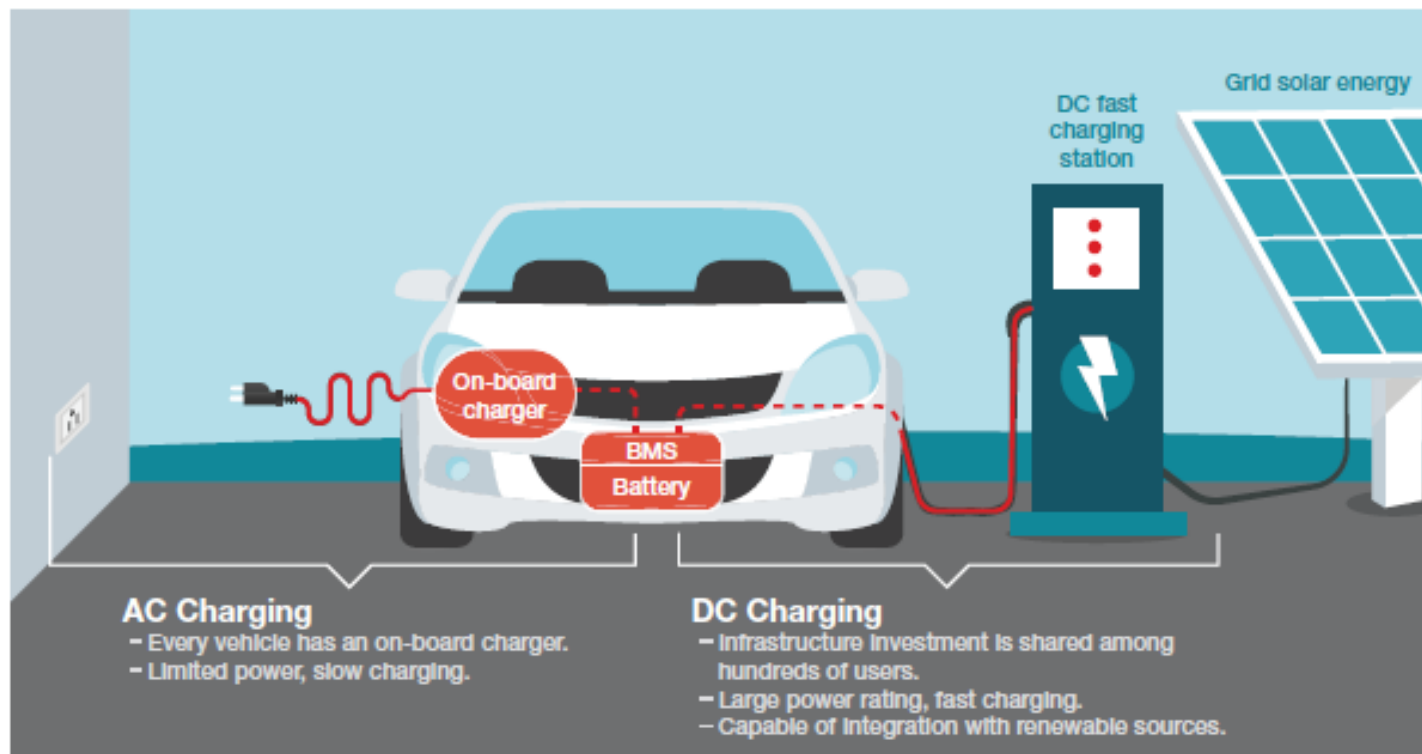
[Electric Vehicle Charging Infrastructure Market Report,2030 \(grandviewresearch.com\)](https://www.grandviewresearch.com/industry-analysis/Electric-Vehicle-Charging-Infrastructure-Market-Report-2030)

# Business as the fuel for EV charging infrastructure growth

- As more electric vehicles roam in Europe, we'll naturally see an increase in charging stations options all around the continent.
  - At independent petrol and service stations when on the move.
  - Before or after shopping.
- EV drivers are plugging their EVs:
  - When on the move, using fast and ultra-fast chargers.
  - While they shop.
  - While at home or the office.
  - The moment of the charging event makes all the difference here. EV drivers will shop where they can charge their batteries.

**Vishay is taking on the challenge of a decade – with our wide range of products  
we are the center to support developing EV charging infrastructures**

# Introduction



EVSE type	Power supply	Charger power	Approximate charging time for a 24 kWh battery
AC charging station: Level 1 residential	120/230 VAC and 12 A to 16 A (single phase)	~1.44 kW to ~1.92 kW	~17 hours
AC charging station: Level 2 commercial	208/~240 VAC and 15 A to ~80 A (single/split phase)	~3.1 kW to ~19.2 kW	~8 hours
DC charging station: Level 3 fast chargers	300 to 600 VDC and max 400 A (poly phase)	From 120 kW up to 240 kW	~ 30 minutes

# Components

## Filter and Resonant Inductors



- Common Mode Choke: [ihcm-2321aa-10.pdf](http://ihcm-2321aa-10.pdf) ([vishay.com](http://vishay.com))

- ✓ SMD
- ✓ Pick and Place
- ✓ Low Profile
- ✓ Reflow soldering
- ✓ 155°C

STANDARD ELECTRICAL SPECIFICATIONS						
PART NUMBER	L <sub>0</sub> INDUCTANCE ± 30 % AT 100 kHz, 0.25 V, 0 A (μH)	COMMON MODE IMPEDANCE AT 10 MHz, TYP. (Ω)	DC RESISTANCE MAX. (Ω)	HEAT RATING CURRENT TYPICAL (EST.) (A <sub>DC</sub> ) <sup>(1)</sup>	SATURATION CURRENT AT 25 °C TYP. (A <sub>DC</sub> ) <sup>(2)</sup>	LEAKAGE MAX. (μH)
IHCM2321AAEG900N10	90	380	0.0015	31	35	2.5
IHCM2321AAEG121N10	120	480	0.0018	25	28	3.5
IHCM2321AAEG251N10	250	850	0.0050	14	19	7.5
IHCM2321AAEG301N10	300	900	0.0070	10	17	8.0
IHCM2321AAEG481N10	480	1200	0.0125	8	13	14.0

- Edge Wound Inductor: [ihdm-1008bc-30.pdf](http://ihdm-1008bc-30.pdf) ([vishay.com](http://vishay.com))

- ✓ Customization possible
- ✓ Soft Saturation
- ✓ Different Terminals
- ✓ 180°C

STANDARD ELECTRICAL SPECIFICATIONS								
L <sub>0</sub> INDUCTANCE ± 20 % AT 100 kHz, 0.25 V, 0 A (μH)	DCR AT 25 °C TYP. (mΩ)	DCR AT 25 °C MAX. (mΩ)	HEAT RATING CURRENT DC TYP. (1) (A)	SATURATION CURRENT DC TYP. (2) (A)	SATURATION CURRENT DC TYP. (3) (A)	SRF TYP. (MHZ)	DIMENSION A ± 0.016 [0.4]	DIMENSION B ± 0.020 [0.5]
1.2	0.25	0.30	80	110	150	90	0.126 [3.2]	0.543 [13.8]
2.2	0.35	0.40	70	75	110	45	0.098 [2.5]	0.571 [14.5]
3.3	0.63	0.70	50	60	90	25	0.079 [2.0]	0.591 [15.0]
4.7	0.86	0.95	45	50	70	15	0.071 [1.8]	0.598 [15.2]
6.8	1.00	1.15	40	45	60	10	0.063 [1.6]	0.606 [15.4]
8.2	1.35	1.50	35	35	50	9	0.055 [1.4]	0.614 [15.6]
10	1.70	2.00	30	30	45	8	0.043 [1.1]	0.626 [15.9]



# Components

## Filter Capacitors Film Technology

High stability grade film capacitor for RFI suppression for long lasting service under severe ambient conditions of heat and humidity.

### F340X2 305VAC

- Capacitance Range up to 20 $\mu$ F

### F340X1 480VAC

- AEC-Q200 Qualified (under release)
- Max. Application Voltage: 530Vac

### F340Y2 305VAC

- AEC-Q200 Qualified
- Maximum operation temperature: 125°C

IEC 60384-14 ed. 4 AMD1: High Robustness under High Humidity – Grade IIIB

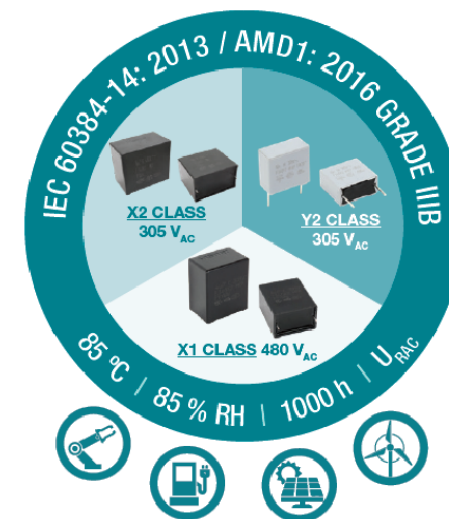
- THB: 85°C / 85% R.H. / 1000h at VRAC

Full compliance and certified by external labs with Grade IIIB for EMI Capacitors.

[f340x1\\_480vac.pdf \(vishay.com\)](#)

[f340y2\\_305vac.pdf \(vishay.com\)](#)

[f340x2\\_305vac.pdf \(vishay.com\)](#)



# Components

## Filter Capacitors Ceramic Technology



- **Leaded Single Disc:** Mainly used for Y1 applications (Line and GND):

[vy1series.pdf](http://vy1series.pdf) ([vishay.com](http://vishay.com))

Features	Did You Know?	Our Advantages
<ul style="list-style-type: none"> <li>✓ Complying with IEC60384-14</li> <li>✓ VY1: X1/Y1 with 470pF - 4.7nF</li> <li>✓ VY2: X1/Y2 with 10pF - 10nF</li> <li>✓ Widest Product Portfolio</li> </ul>	<ul style="list-style-type: none"> <li>✓ The 440L series and the VY1*C series have the highest humidity robustness grade (IIIB) available at IEC60384-14 (Annex I)</li> </ul>	<ul style="list-style-type: none"> <li>✓ VY1*C: 10kV and 85/85/1000h</li> <li>✓ Service and Flexibility</li> <li>✓ New Product Launches</li> </ul>

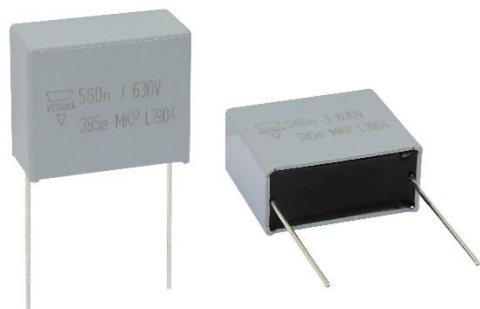
- **SMD:**

[smdy1.pdf](http://smdy1.pdf) ([vishay.com](http://vishay.com))

Features	Did You Know?	Our Advantages
<ul style="list-style-type: none"> <li>✓ X1/Y1 with 470pF – 4700pF</li> <li>✓ Reflow soldering</li> <li>✓ Humidity class IIB (IEC60384-14 Annex I)</li> <li>✓ Y1: 1500 V<sub>DC</sub> (IEC60384-14 Annex H)</li> </ul>	<ul style="list-style-type: none"> <li>✓ Humidity robustness grade IIB is the second highest grade defined by IEC60384-14 and is tested by running the capacitor under rated voltage for 500 hours at 85 °C and 85% r.h.</li> </ul>	<ul style="list-style-type: none"> <li>✓ Industry first 500 V<sub>AC</sub> and 1500 V<sub>DC</sub> Y1 safety cap in SMD</li> <li>✓ Highest capacitance (up to 4700 pF)</li> <li>✓ Humidity class IIB</li> <li>✓ MSL2a</li> </ul>

# Components

## Resonant Capacitors: MKP385 and MKP385e series



AEC-Q200 Qualified

High Robustness under High Humidity  $60^{\circ}\text{C} / 93\% \text{RH} / 56\text{days at } V_{\text{NDC}}$

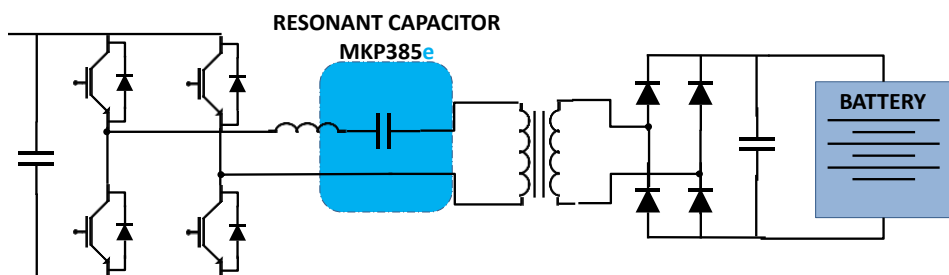
High Capacitance and Voltage range

Very Low ESR for very high Ripple current Capabilities

Very High Frequency Operation

Maximum operation temperature up to  $125^{\circ}\text{C}^*$

For Industrial applications, MMKP383 Double Metalized also available.

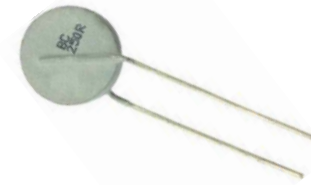


MKP385e	
$U_{\text{RDC}}$ (V)	CAPACITANCE ( $\mu\text{F}$ )
400	0.047 min.
	15 max.
630	0.027 min.
	15 max.
850	0.01 min.
	4.7 max.
1000	0.018 min.
	3.3 max.
1250	0.0082 min.
	2.7 max.
1600	0.0039 min.
	1.20 max.
2000	0.001 min.
	0.68 max.
2500	0.001 min.
	0.39 max.

# Components

## Thermistors

- **[PTCEL](#)**: Radial leaded ceramic PTC for inrush current limitation (ICL) and Energy Load-Dump; Can handle high direct voltage up to 1.2 kV and 2 kV energy-limited peak voltages; Self protecting in case of overload or circuit failure and no risk of overheating
- **[NTCALUG](#)**: NTC assembly for surface temperature measurement; Many versions and custom options available; High insulation voltage
- **[NTCLE213](#) / [NTCLE203...SB0](#)**: Epoxy coated NTC thermistor with tinned nickel radial leads (low heat conductivity); Highly resistant to thermal shocks
- **[PTCSL03](#)**: Mini radial leaded ceramic PTC thermistor for over-temperature protection e.g. in the charging plug

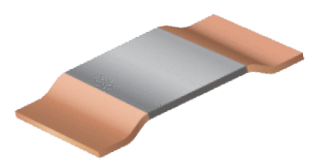




# Components

## Shunt resistors

WSLP3921

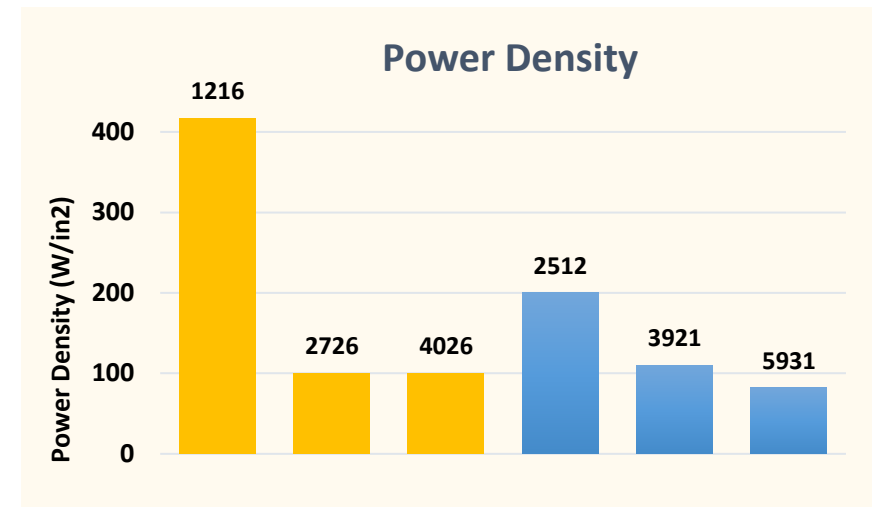


9W 0.1 mΩ to 1.5 mΩ  
5W 2 mΩ to 4 mΩ

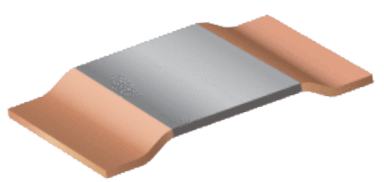
WSLF2512



6W 0.3 mΩ , 0.5 mΩ  
5W 1 mΩ to 2 mΩ  
4 W 3 mΩ  
3W 4 mΩ

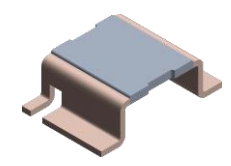


WSLP5931



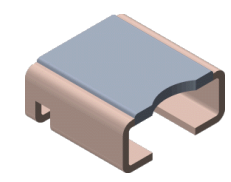
15W 0.1 mΩ  
10W 0.2 mΩ to 1 mΩ  
8 W 2 mΩ  
7W 3 mΩ

WSLP4026



7W 0.2 mΩ to 1 mΩ  
5W 1.3 mΩ to 5 mΩ

WSLP2726

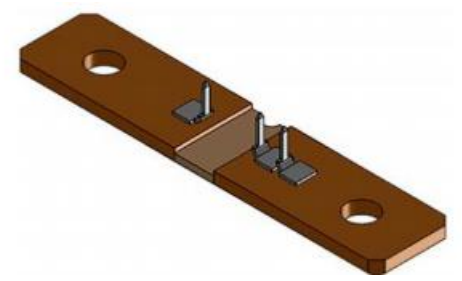


7W 0.2 mΩ to 1 mΩ  
5W 1.3 mΩ to 5 mΩ

WSK1216



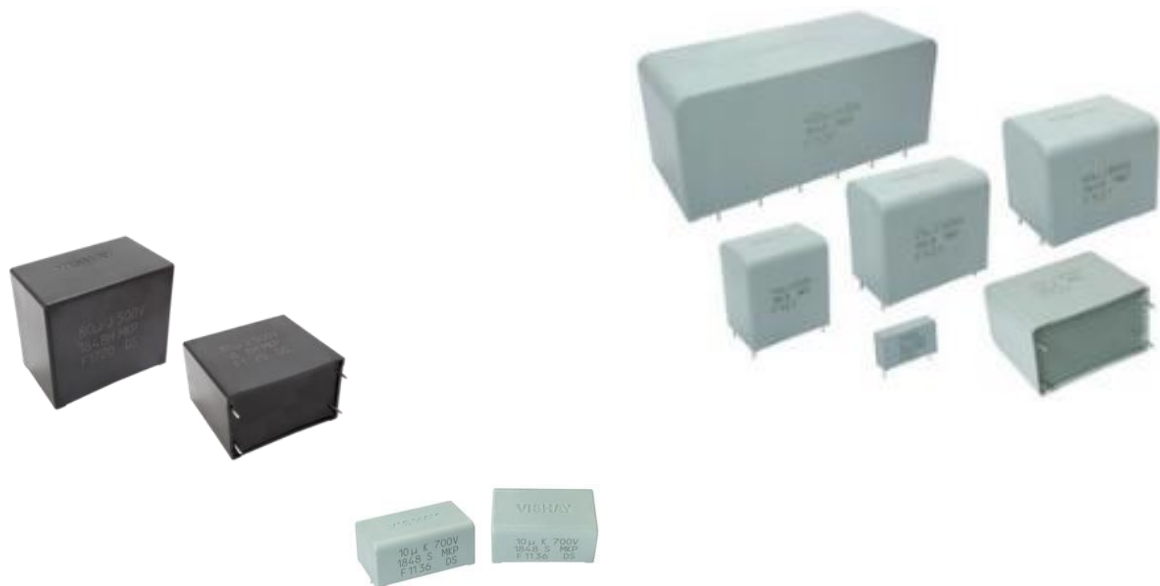
8W 0.2 mΩ, 0.3 mΩ  
5W 0.5 mΩ  
3W 1 mΩ



WSBS8518..

# Components

## DC-Link Capacitors: MKP1848- Family



Rated capacitance range: 1μF to 500μF  
 Rated DC Voltage: 450VDC to 1200VDC  
 High Ripple Current Capabilities up to 54A @ 85°C / 10kHz  
 Low ESR down to 1,3mΩ

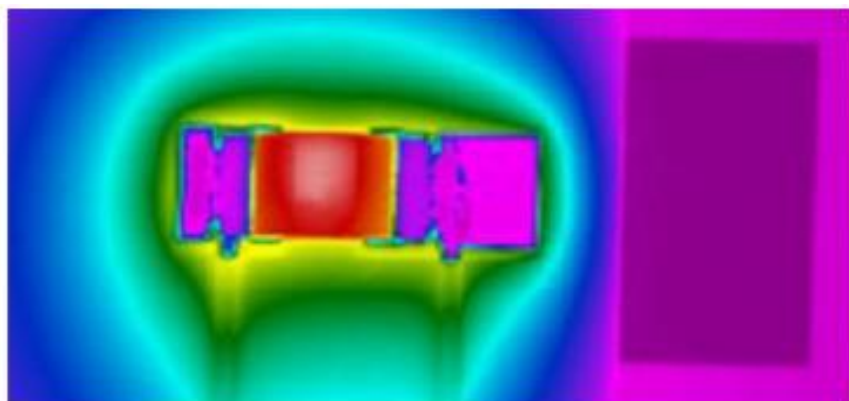
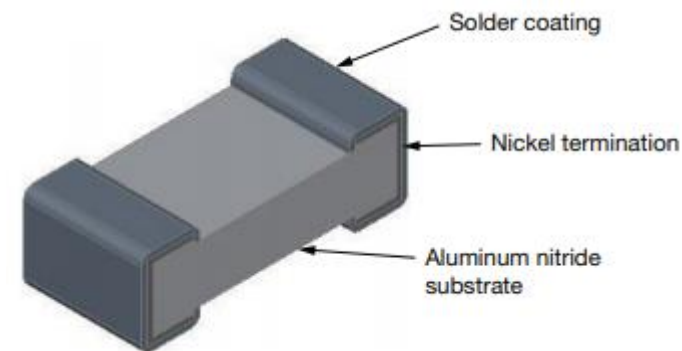
- **MKP1848 (Standard)**
  - AEC-Q200 Qualified
- **MKP1848H**
  - High Robustness under High Humidity
- **MKP1848Se**
  - AEC-Q200 & Low Profile
- **MKP1848C**
  - Industrial Compact

DC VOLTAGE RATINGS						
U <sub>NDC</sub> at 85 °C	450 V	700 V	800 V	900 V	1100 V	1200 V
U <sub>OPDC</sub> at 70 °C	500 V	800 V	900 V	1100 V	1350 V	1500 V
U <sub>OPDC</sub> at 105 °C	300 V	500 V	570 V	650 V	800 V	850 V

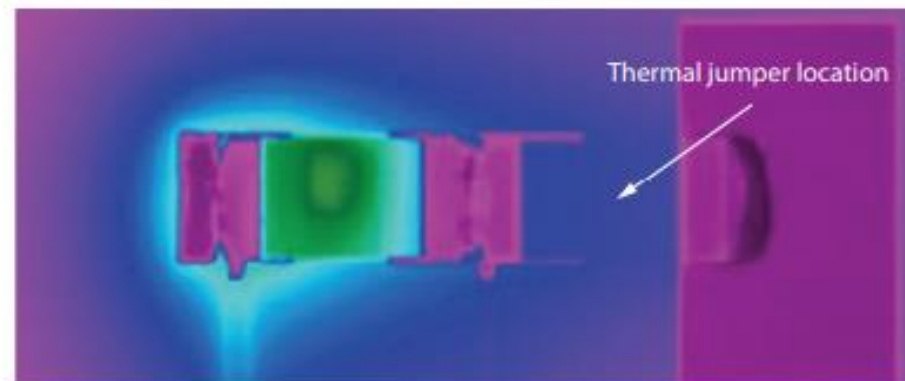
# Components

## Thermal Jumper [thjp.pdf \(vishay.com\)](http://thjp.pdf(vishay.com))

- Passive Cooling ⇔ Isolated heat Transfer



Ceramic Resistor Chip Without Thermal Jumper (149.8 °C)



Ceramic Chip Resistor With Thermal Jumper (95.5 °C)

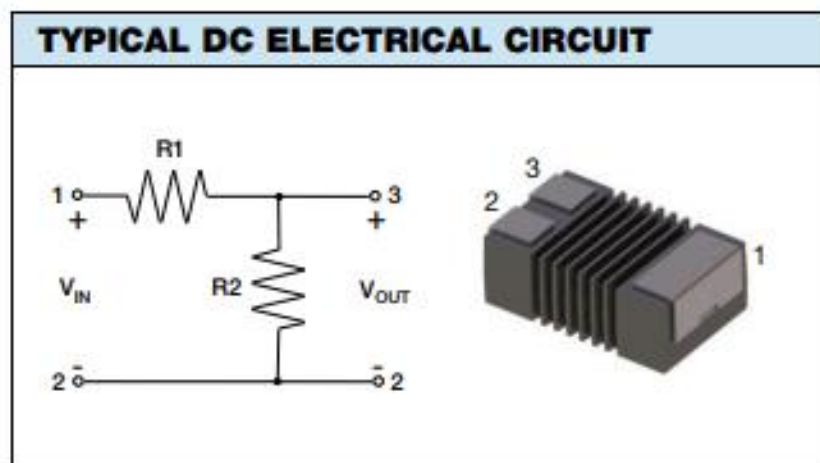
TYPICAL CHARACTERISTICS						
CASE SIZE	0603	0612	0805	1206	1225	2512
Thermal resistance (°C/W), $T_R$	14	4	13	15	4	15
Thermal conductance (mW/°C), $T_C$	70	259	77	65	259	65
Capacitance (pF)	0.07	0.26	0.15	0.07	0.26	0.07
Dielectric withstanding voltage $kV_{AC}$ , RMS (60 Hz)	> 1.5	> 1.5	> 1.5	> 1.5	> 1.5	> 1.5

# CDMM

## Integrated precision voltage divider

- <https://www.vishay.com/docs/68041/cdmm.pdf>

STANDARD ELECTRICAL SPECIFICATIONS								
GLOBAL MODEL	CASE SIZE	POWER RATING $P_{70\text{ }^\circ\text{C}}$ W	MAXIMUM WORKING VOLTAGE <sup>(1)</sup> V	RESISTANCE RANGE $R_1$ <sup>(2)</sup> $\Omega$	TOLERANCE <sup>(3)</sup> $R_1$ $\pm \%$	RATIO RANGE <sup>(4)</sup> $(R_1 + R_2) / R_2$	RATIO TOL. $\pm \%$	TCR TRACKING (-55 °C to +155 °C) $\pm \text{ppm}/^\circ\text{C}$
CDMM	4527	1.5	1500	500K to 50M	0.5, 1, 2, 5, 10	100:1 to 500:1	0.5, 1, 2, 5	10 - 50



# HRHA

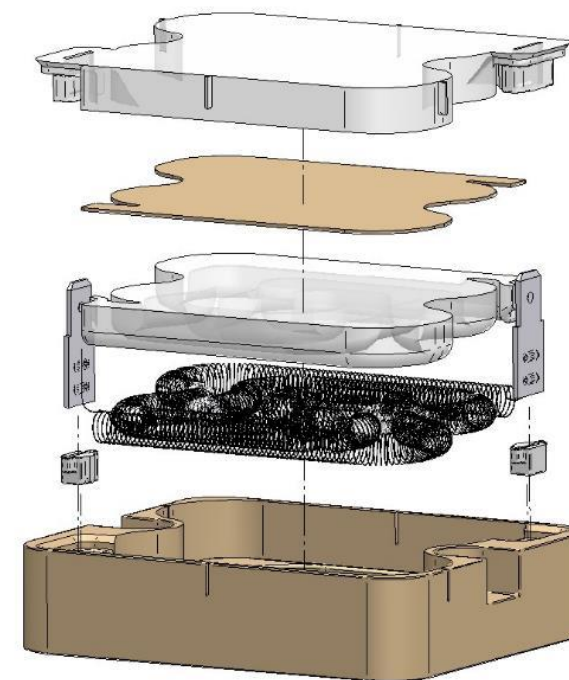


## Hybrid Wire-Wound Resistor <https://www.vishay.com/docs/32594/hrha.pdf>

GENERAL CHARACTERISTICS	
Dielectric base	Ceramic
Resistive circuit	Hybrid wirewound
Terminals	Stainless steel
Ohmic values	E24 (other on request)
Maximum operating voltage between terminals (by design)	1000 V <sub>DC</sub>
Dielectric voltage	3000 V <sub>RMS</sub> (higher on request), 50 Hz, 1 min

GLOBAL MODEL	POWER RATING ON STAINLESS STEEL <sup>(1)</sup> W
HRHA	90

ENERGY	
Energy mode at 30 °C room temperature	Stainless steel (6 mm thickness)
Refer to Fig. 2 for bottom case temperature vs. pulse number	PULSE – DURATION – WAIT <sup>(1)</sup>
Continuous cycle - short circuit wave (refer to Fig. 3)	9000 J - 1.8 s - 100 s
Continuous cycle - RC discharge wave (refer to Fig. 4)	1850 J - 0.74 s - 30 s





**Thank you.**