Wr2 Surge resistors for PCB Mounting

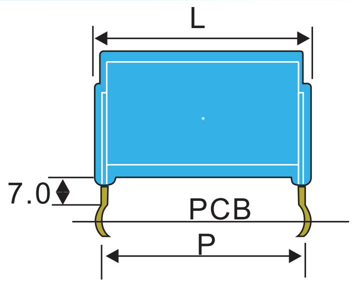
Features

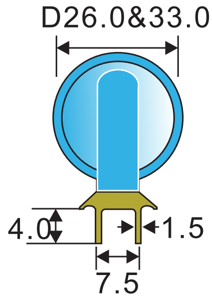
Ⅰ High Surge Energy Rating
Ⅱ 100%Cearmic Structure.
Ⅲ Desighed for PCB Withstand.
Ⅳ High Voltage Withstand.
Ⅴ Essentially Non-Inductive
Ⅵ Wide Resistivity Range
Ⅶ Coating Approved to U194 V-0.

Reference Standards

JISC 5201-1

Dimensions





For Wr Surge Resistors with Surge Energy Rating 2250 J - 10500 J:

RESISTOR TYPE	DIM. CODE	OVERALL DIMENSIONS			VOL. V	MAX. J	MAX. W	T.T.C. (t)	WT.	A/L	RESISTANCE RANGE	
		Do Max	Lo Max	Lp Pitch		@25°C	@25°C				MIN	MAX
UNITS		(mm)	(mm)	(mm)	(cm3)	(J)	(W)	(s)	(g)	(cm)	(Ohms)	(Ohms)
Wr2 2250	2420	26	24	20	9.0	2250	6.00	390	24.0	2. 3	4R7	3K3
Wr2 2850	2425	26	29	25	11.5	2850	6.50	435	28.0	1. 8	5R6	4K7
Wr2 3500	2431	26	35	32	14.0	3500	7.50	465	35.0	1. 5	6R8	5K6
Wr2 4200	2437	26	41	36	17.0	4200	8.50	490	40.0	1. 2	10R0	6K9
Wr2 5200	2446	26	50	46	21.0	5200	10.00	520	50.0	1. 0	10R0	6K9
Wr2 7000	3137	33	41	38	28.0	7000	12.00	605	66.0	2. 0	5R6	3K3
Wr2 8690	2146	33	50	46	35.0	8690	13.50	655	82.0	1. 6	6R8	5K6
Wr2 10500	3155	33	59	56	42.0	10500	15.50	680	100.0	1. 4	8R2	6K3

Ordering Information

Example:

Wr2	6.5	2250	K	4R7
(1)	(2)	(3)	(4)	(5)
Series Name	Power Rating	Joules	Tolerance	Resistace Value

1.Type:Wr2 SERIES
2.Power:2250=6W,2825=6.5W,3500=7.5W,4200=8.5W,5200=10W,7000=12W
3.Joules:2250=2250,2850=2850,3500=3500,4200=4200,5200=5200,7000=7000
4.Tolerance:K±10, M±20
5.Resistace Value:MIN:4R7 MAX:6K9

Applications And Ratings

The Maximum Working Voltage levels can be derived from the appropriate formulae illustrated in the tables below. Examples are shown at the foot of this page.
Waveforms are defined in the usual manner: 1.2 / 50 µs indicates a rise time to peak value in 1.2 µs and an exponential decay to half amplitude in a total time of 50 µs.

Wr2 2250

IMPULSE / WAVESHAPE	MAX. WORKING VOLTAGE (kV)
(50 Hz rms)	$1.9 \times (2.3R / t)^{0.3}$
(1.2 / 50 µs)	1.26R x (-1 + √ (1 + 26 / R)
(10 / 1000 µs)	0.0627R x (-1 + √ (1 + 526 / R)
(500 / 5000 µs)	0.0126R x (-1 + √ (1 + 2630 / R)

Wr2 2825

IMPULSE / WAVESHAPE	MAX. WORKING VOLTAGE (kV)
(50 Hz rms)	$2.4 \times (1.8R / t)^{0.3}$
(1.2 / 50 µs)	1.26R x (-1 + √ (1 + 33 / R)
(10 / 1000 µs)	0.0627R x (-1 + √ (1 + 658 / R)
(500 / 5000 µs)	0.0126R x (-1 + √ (1 + 3288 / R)

Wr2 3500

IMPULSE / WAVESHAPE	MAX. WORKING VOLTAGE (kV)
(50 Hz rms)	$2.9 \times (1.5R / t)^{0.3}$
(1.2 / 50 µs)	1.18R x (-1 + √ (1 + 41 / R)
(10 / 1000 µs)	0.0589R x (-1 + √ (1 + 815 / R)
(500 / 5000 µs)	0.0118R x (-1 + √ (1 + 4077 / R)

Wr2 4200

IMPULSE / WAVESHAPE	MAX. WORKING VOLTAGE (kV)
(50 Hz rms)	$3.5 \times (1.2R / t)^{0.3}$
(1.2 / 50 µs)	1.11R x (-1 + √ (1 + 49 / R)
(10 / 1000 µs)	0.0552R x (-1 + √ (1 + 973 / R)
(500 / 5000 µs)	0.0110R x (-1 + √ (1 + 4866 / R)

Wr2 5200

IMPULSE / WAVESHAPE	MAX. WORKING VOLTAGE (kV)
(50 Hz rms)	$4.4 \times (1.0R / t)^{0.3}$
(1.2 / 50 µs)	1.00R x (-1 + √ (1 + 61 / R)
(10 / 1000 µs)	0.0495R x (-1 + √ (1 + 1210 / R)
(500 / 5000 µs)	0.0100R x (-1 + √ (1 + 6050 / R)

Wr2 7000

IMPULSE / WAVESHAPE	MAX. WORKING VOLTAGE (kV)
(50 Hz rms)	$3.5 \times (2.0R / t)^{0.3}$
(1.2 / 50 µs)	1.84R x (-1 + √ (1 + 29 / R)
(10 / 1000 µs)	0.0920R x (-1 + √ (1 + 583 / R)
(500 / 5000 µs)	0.0184R x (-1 + √ (1 + 2917 / R)

Wr2 8690

IMPULSE / WAVESHAPE	MAX. WORKING VOLTAGE (kV)
(50 Hz rms)	$4.4 \times (1.6R / t)^{0.3}$
(1.2 / 50 µs)	1.65R x (-1 + √ (1 + 36 / R)
(10 / 1000 µs)	0.0826R x (-1 + √ (1 + 725 / R)
(500 / 5000 µs)	0.0165R x (-1 + √ (1 + 3626 / R)

Wr2 10500

IMPULSE / WAVESHAPE	MAX. WORKING VOLTAGE (kV)
(50 Hz rms)	5.2 x (1.4R / t) 0.3
(1.2 / 50 µs)	1.46R x (-1 + √ (1 + 43 / R)
(10 / 1000 µs)	0.0732R x (-1 + √ (1 + 867 / R)
(500 / 5000 µs)	0.0146R x (-1 + √ (1 + 4336 / R)

Worked example (50 Hz rms) :
Consider an Wr2 2825 Resistor with a Resistance Value of 100R0.
What is the maximum 50 Hz rms Working Voltage (kV) sustainable for an insertion time of 100 ms?
V working = 2.4 x (1.8R / t) 0.3 = 2.86 kV
(Note: R = Resistance Value in Ohms and t = 50 Hz Insertion time in ms)
Worked example (1.2 / 50 µs) :
Consider an Wr2 2825 Resistor with a Resistance Value of 100R0.
What is the maximum Working Voltage (kV) for a 1.2 / 50 µs waveform?
V working = 1.26R x (-1 + √(1 + 33 / R)) = 19.31 kV

THERMAL PARAMETERS

Heat generated by Wr2 Series Resistors is dissipated mainly by radiation and convection from the exposed surface areas. Within restricted domains, mathematical models may be employed to permit heat transfer estimations.

Symbols	ΔT= Temperature Rise (° C) Wa= Watts / Unit Exposed Surface Area (W.cm $^{-2}$) v= Volume / Disc (cm 3) cm= Specific Heat Capacity of Active Material = 2J. cm $^{-3}$. ° C $^{-1}$ Do= Disc Outside Diameter (cm) t= Resistor Thermal Time Constant (s)
Radiation and Convection	Wa = 0.00026 (ΔT) 1.4 (ΔT = 50 ° C to 175 ° C, Do = 10 mm to 151 mm, Ambient 25 ° C)
Thermal Conductivity	0.04 W / cm2. ° C / cm
Maximum Insertion Energy Ratings	For a Resistor initially at 25 ° C : 350 Joules / cm3 (Infrequently) For a Resistor initially at 25 ° C : 250 Joules / cm3 (Continuously)
Recommended Operating Temperatures	200 ° C (Infrequent Operation) 150 ° C (Continuous Operation)
Temperature Rise from Energy Injection	ΔT (° C) = Joules (per Resistor) / (v x cm) (Free Air)
Thermal Time Constant	t (s) = Max Joules @ 25 ° C / Max Watts @ 25 ° C
Full Cooling	≥ 4 t
De-rating for other ambient Temperatures (Ta ° C)	Multiply Max Joules @ 25 ° C & Max Watts @ 25 ° C by the ratio (150 - Ta) / 125
Repetitive Thermal Impulsing	Assuming that the Heat Transfer Coefficient α (W / cm 2 . ° C / cm) is constant over the operating temperature range, then the Peak temperature Rise (ΔTp) associated with repetitive impulsing can be estimated by way of reference to a classical geometric progression: If ΔTp (° C) = ΔT x (1 - (e - (t / t))n) / (1 - e - (t / t)) .... 1 Where ΔT is the Temperature Rise associated with each electrical impulse (° C) t is the Resistor Thermal Time Constant (s) t is the Repetition Rate (s) n is the number of impulses If the number of impulses (n) →∞(i.e.continuous duty),then equation 1 can be simplified thus: ΔTp (° C) = ΔT / (1 - e - (t / t)) 2

ELECTRICAL PARAMETERS

Resistance Values	E6 and E12 values are available as standard.
Resistance Tolerance	± 20% and ± 10% available as standard.
Resistivity Range - ϱ	10 Ohm cm to 5000 Ohm cm ϱ = R x A/L, where R = Resistance Value
Temperature Coefficient - TCR	-0.05% to -0.15% per ℃ Temperature Rise depending on Resistivity Value. TCR = 0.16 x e -(log ϱ / 1.4) - 0.135 (% / ℃ Temperature Rise)
Voltage Coefficient - VCR	-0.5% to -7.5% / kV / cm VCR = -0.62 x ϱ 0.22 (% / kV / cm) For p domain 10 to 5000 Ohm cm
Inductance	This is negligible (nH)and the Resistors may be described as non-inductive. In practice the inductance of connecting leads will be greater than that of the Resistors.
Maximum Working Voltages	The Maximum Working Voltage levels (V working) can be derived from the appropriate formulae for each Resistor Type. Waveforms are defined in the usual manner: 1.2/50 µs indicates a rise time to peak value in 1.2 µs and an exponential decay to half amplitude in a total time of 50 µs. **Worked example (50 Hz rms) :** Consider an WR2 2825 Resistor with a Resistance Value of 100R0. What is the maximum 50 Hz rms Working Voltage (kV) sustainable for an insertion time of 100 ms? V working = 2.4 x (1.8R / t) 0.3 = 2.86 kV (Note: R = Resistance Value in Ohms and t = 50 Hz Insertion time in ms) **Worked example (1.2 / 50 µs) :** Consider an Wr2 2825 Resistor with a Resistance Value of 100R0. What is the maximum Working Voltage (kV) for a 1.2/50 µs waveform? V working = 1.26R x (-1 + √(1 + 33/R)) = 19.31 kV

MECHANICAL PARAMETERS

Explanation of Dimension Code	Each Resistor Type is assigned a 4 digit code, the first 2 digits give the nominal Active Diameter (D) in mm and the last 2 digits give the nominal Active Length (L) of the Resistor in mm. From this information the Volume of Active Material (v) may be determined.
Construction	The Gold Plated Brass terminations are attached to the Copper metallised contact on the Resistor body opposing flat surfaces, with high melting point solder. This permits reliable short time operation at temperatures up to 200 ° C
Coating	The UL94 V-0 approved epoxy resin coating is applied by fluidised bed technique. The coating finish is hard, smooth and has good appearance to harmonise with other electronic components. If this range of Resistors experience surface temperatures regularly in excess of 150 ℃, the coating will tend to degrade slightly, becoming darker. Though unsightly, performance is not compromised. Whilst the coating can reduce the rate of moisture ingress, it is not impervious to liquids.
Terminations / Soldering	The Gold Plated Brass termination pins are1.5mm wide by 0.4mm thick with the spring pin format designed to ensure stability during PCB assembly. recommend , as a minimum, PCB mounting holes of 2.0mm Diameter. Soldering is permissible with mildly activated fluxed solders with liquidous properties less than 230 ° C.
Coefficient of Linear Expansion	In the range $+4 \times 10^{-6}$ to $+10 \times 10^{-6}$ per ° C depending on material Resistivity.