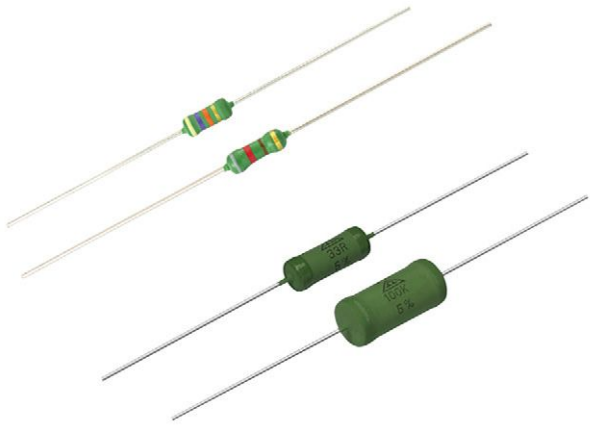
High Pulse Load, High Power Metal Oxide Leaded Resistors



FEATURES

- High power pulse withstanding capability (up to 1 kW)
- High power dissipation in small size (1 W / 0207 size to 4 W / 0922 size)
- WK2 and WR4 are AEC-Q200 qualified
- High temperature (up to 200 °C), heat resistant encapsulation
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

Pb-free

RoHS COMPLIANT

HALOGEN FREE

APPLICATIONS

- Automotive electronics
- Industrial electronics
- Power supplies

TECHNICAL SPECIFICATIONS

DESCRIPTION	WK2	WR4	WR5	WK8
Imperial size	0207	0414	0617	0922
Resistance range	0.22 Ω to 1 MΩ	0.33 Ω to 1 MΩ	0.22 Ω to 560 kΩ	0.22 Ω to 100 kΩ
Resistance tolerance	± 1 %, ± 2 %, ± 5 %	± 2 %, ± 5 %	± 2 %, ± 5 %	± 2 %, ± 5 %
Temperature coefficient	± 50 ppm/K, ± 100 ppm/K, ± 200 ppm/K	± 200 ppm/K	± 200 ppm/K	± 200 ppm/K
Rated dissipation, P_{70}	1 W	2 W	3 W	4 W
Operating voltage, $U_{max.}$ AC/DC (1)	500 V	500 V	750 V	750 V
Operating temperature range (2)	-55 °C to +200 °C			
Thermal resistance (R_{th})	≤ 140 K/W	≤ 100 K/W	≤ 70 K/W	≤ 60 K/W
Insulation voltage: 1 min; U_{ins}	> 500 V			
Failure rate	< 1 x 10^{-8}/h			
Max. resistance change for resistance range, ΔR max., after: load (1000 h, P_{70})	± (5 % R + 0.1 Ω)	± (5 % R + 0.1 Ω)	± (5 % R + 0.1 Ω)	± (2 % R + 0.1 Ω)

Notes

(1) Rated voltage $\sqrt{P \times R}$.

(2) For values < 10 Ω the upper limiting temperature is 155 °C. The power rating is correspondingly lower and can be calculated by R_{th}.
E.g. for WK8 - R_{th} is 60 K/W; to calculate power P for < 10R; $T_{ambient}$ = 25 °C
$P = T_{Upper\ Limiting} - T_{Ambiant}/R_{th} = (155 - 25) / 60 = 2.16$ W

AUTOMOTIVE QUALIFICATION

DESCRIPTION	WK2	WR4	WR5	WK8
Qualifications	AEC-Q200	AEC-Q200	-	-

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TEMPERATURE COEFFICIENT AND RESISTANCE RANGE

TYPE / SIZE	TCR	TOLERANCE	RESISTANCE	E-SERIES
WK2	± 50 ppm/K	± 1 %	4.7 Ω to 1 MΩ	E24; E96
	± 100 ppm/K	± 2 %	4.7 Ω to 1 MΩ	E24; E48
	± 100 ppm/K	± 5 %	4.7 Ω to 1 MΩ	E24
	± 200 ppm/K	± 5 %	0.22 Ω to 1 MΩ	E24
WR4	± 200 ppm/K	± 2 %	1 Ω to 1 MΩ	E24; E96
	± 200 ppm/K	± 5%	0.33 Ω to 1 MΩ	E24
WR5	± 200 ppm/K	± 2 %	1 Ω to 100 kΩ	E24; E96
	± 200 ppm/K	± 5 %	0.22 Ω to 560 kΩ	E24
WK8	± 200 ppm/K	± 2 %	1 Ω to 68 kΩ	E24; E48
	± 200 ppm/K	± 5 %	0.22 Ω to 100 kΩ	E24

PART NUMBER AND PRODUCT DESCRIPTION

Part Number: WK202070C1001FD500

W	K	2	0	2	0	7	0	C	1	0	0	1	F	D	5	0	0

TYPE / SIZE
WK2 = WK20207
WR4 = WR40414
WR5 = WR50617
WK8 = WK80922

VARIANT
0 = neutral

TCR
0 = standard (for WK8 only)
C = ± 50 ppm/K
B = ± 100 ppm/K
A = ± 200 ppm/K

RESISTANCE
3 digit value
1 digit multiplier
MULTIPLIER
7 = $*10^{-3}$
8 = $*10^{-2}$
9 = $*10^{-1}$
0 = $*10^{0}$
1 = $*10^{1}$
2 = $*10^{2}$
3 = $*10^{3}$
4 = $*10^{4}$
5 = $*10^{5}$
6 = $*10^{6}$

TOLERANCE (1)
F = ± 1 %
G = ± 2 %
J = ± 5 %

PACKAGING
22 = A2
25 = A5
D5 = R5
5C = AC
G1 = R1
41 = A1 G73
51 = A1 G77
FE = RE G73
GP = RP

SPECIAL
00 = standard

Product Description: WK2 50 1K0 1 % R5

WK2	50	1K0	1 %	R5
TYPE / SIZE	TCR	RESISTANCE VALUE	TOLERANCE	PACKAGING
WK2 **WR4** **WR5** **WK8**	± **50** ppm/K ± **100** ppm/K ± **200** ppm/K	**49K9** = 49.9 kΩ **50R1** = 50.1 Ω **1K0** = 1.0 kΩ	± **1 %** ± **2 %** ± **5 %**	**A2** **A5** **R5** **AC** **R1** **41** **51** **FE** **GP**

Note
(1) See temperature coefficient and resistance range table for selecting correct TCR and tolerance combination.

PACKAGING

TYPE / SIZE	CODE	QUANTITY	PACKAGING STYLE	WIDTH	PITCH	DIMENSION
WK2	A2	2000	Taped acc. to IEC 60286-1 fan-folded in a box	53 mm	5 mm	72 mm x 55 mm x 258 mm
	A5	5000			5 mm	75 mm x 114 mm x 260 mm
	R5	5000	Taped acc. to IEC 60286-1 on a reel	73 mm	5 mm	93 mm x 300 mm x 298 mm
WR4	A1	1000	Taped acc. to IEC 60286-1 fan-folded in a box		5 mm	95 mm x 57 mm x 260 mm
	RE	2500	Taped acc.to IEC 60286-1 on a reel		5 mm	105 mm x 315 mm x 305 mm
WR5	A1	1000	Taped acc. to IEC 60286-1 fan-folded in a box	77 mm	10 mm	155 mm x 110 mm x 410 mm
	RP	1500	Taped acc. to IEC 60286-1 on a reel			119 mm x 353 mm x 353 mm
WK8	AC	500	Taped acc. to IEC 60286-1 fan-folded in a box	77 mm	10 mm	120 mm x 118 mm x 412 mm
	R1	1000	Taped acc.to IEC 60286-1 on a reel			119 mm x 353 mm x 353 mm

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DESCRIPTION

Production is strictly controlled and follows an extensive set of instructions established for reproducibility. A homogeneous film of metal oxide is deposited on a high grade ceramic body and conditioned to achieve the desired temperature coefficient. Plated steel termination caps are firmly pressed on the metallized rods. Mostly, a special laser is used to achieve the target value by smoothly cutting a helical groove in the resistive layer without damaging the ceramics. Connecting wires of electrolytic copper plated with 100 % tin are welded to the termination caps. The resistor elements are covered by a green protective coating designed for electrical, mechanical and climatic protection. Four or five color code rings designate the resistance value and tolerance in accordance with **IEC 60062** [(1)]. WK2 and WR4 are color coded while WR5 and WK8 are print marked.

The result of the determined production is verified by an extensive testing procedure performed on 100 % of the individual resistors. Only accepted products are stuck directly on the adhesive tapes in accordance with **IEC 60286-1** [(1)].

MATERIALS

Vishay acknowledges the following systems for the regulation of hazardous substances:

- IEC 62474, Material Declaration for Products of and for the Electrotechnical Industry, with the list of declarable substances given therein
- The Global Automotive Declarable Substance List (GADSL) [(2)]
- The REACH regulation (1907/2006/EC) and the related list of substances with very high concern (SVHC) for its supply chain

The products do not contain any of the banned substances as per IEC 62474, GADSL, or the SVHC list, see www.vishay.com/how/leadfree.

Hence the products fully comply with the following directives:

- 2000/53/EC End-of-Life Vehicle Directive (ELV) and Annex II (ELV II)
- 2011/65/EU Restriction of the Use of Hazardous Substances Directive (RoHS) with amendment 2015/863/EU
- 2012/19/EU Waste Electrical and Electronic Equipment Directive (WEEE)

Vishay pursues the elimination of conflict minerals from its supply chain, see the Conflict Minerals Policy at www.vishay.com/doc?49037.

ASSEMBLY

The resistors are suitable for processing on automatic insertion equipment and cutting and bending machines. Excellent solderability is proven, even after extended storage. They are suitable for automatic soldering using wave or dipping.

The resistors are completely lead (Pb)-free, the pure tin plating provides compatibility with lead (Pb)-free and lead-containing soldering processes. The immunity of the plating against tin whisker growth, in compliance with IEC 60068-2-82, has been proven under extensive testing.

The encapsulation is resistant to cleaning solvent [(3)] specified in IEC 60115-1. The suitability of conformal coatings, potting compounds and their processes, if applied, shall be qualified by appropriate means to ensure the long-term stability of the whole system

APPROVALS

WK2 and WR4 are AEC-Q200 qualified which makes these products ideal to be used in automotive applications.

RELATED PRODUCTS

For a correlated range of Power Metal Film Resistors with small size-high rated dissipation see the PR series datasheet: www.vishay.com/doc?28729.

Notes

(1) The quoted IEC standards are also released as EN standards with the same number and identical contents.

(2) Global Automotive Declarable Substance List, see www.gadsl.org. All products comply with the IEC 62474, Material Declaration for Products of and for the Electrotechnical Industry.
CEFIC (European Chemical Industry Council), EECA (European Electronic Component Manufacturers Association), EICTA (European trade organization representing the information and communications technology and consumer electronics), see www.digitaleurope.org/SearchResults.aspx?Search=eicta.

(3) Other cleaning solvents with aggressive chemicals should be evaluated in actual cleaning process for their suitability.

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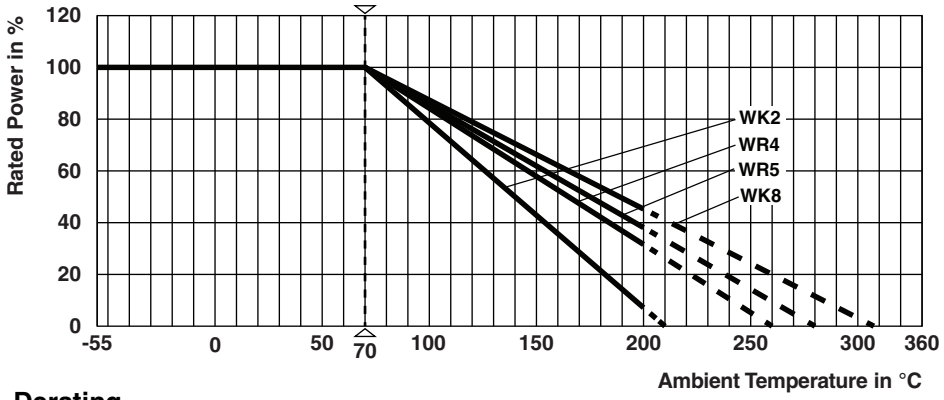
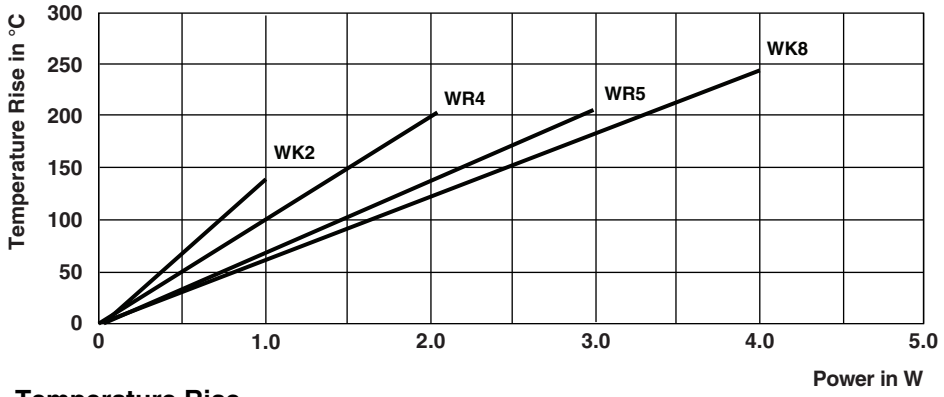
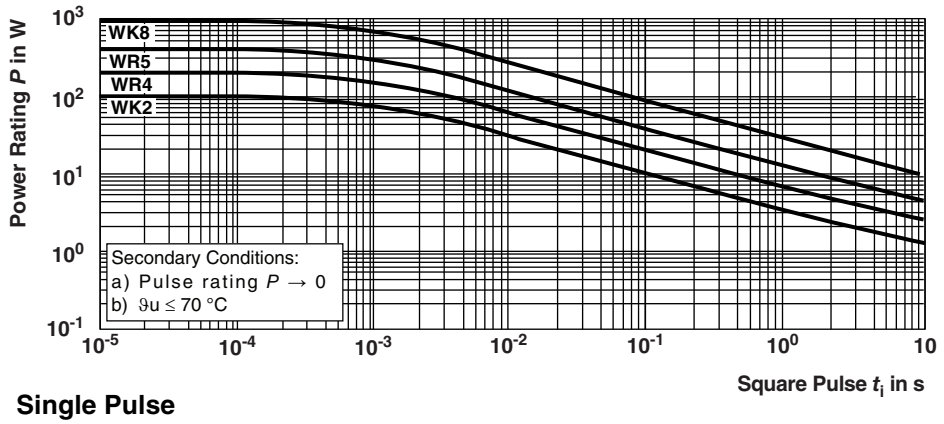
FUNCTIONAL PERFORMANCE



Derating



Temperature Rise



Single Pulse

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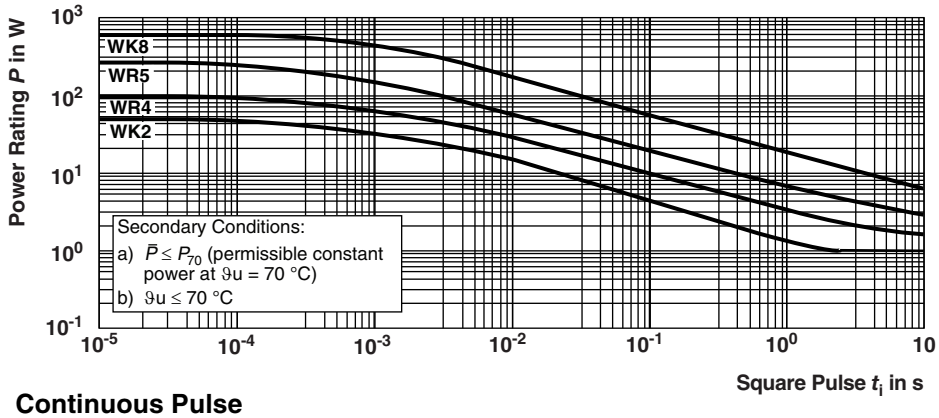
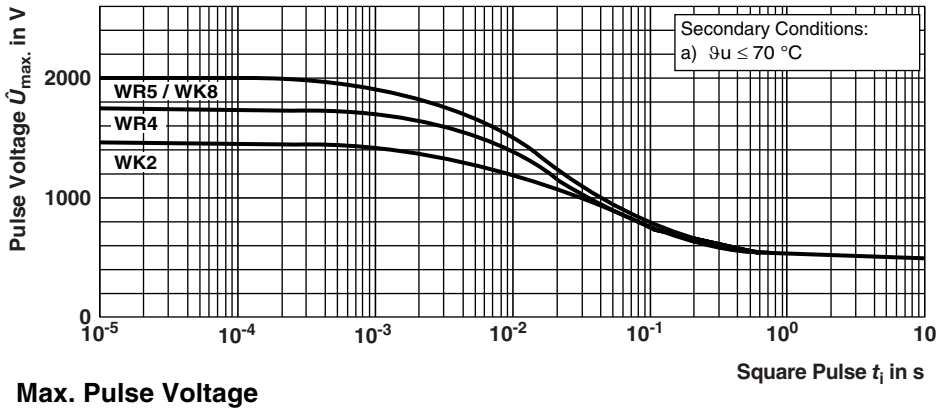
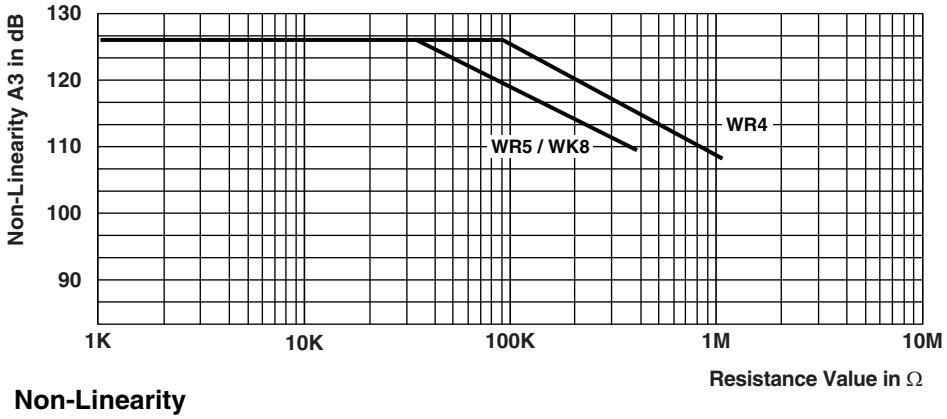


Continuous Pulse



Max. Pulse Voltage



Non-Linearity

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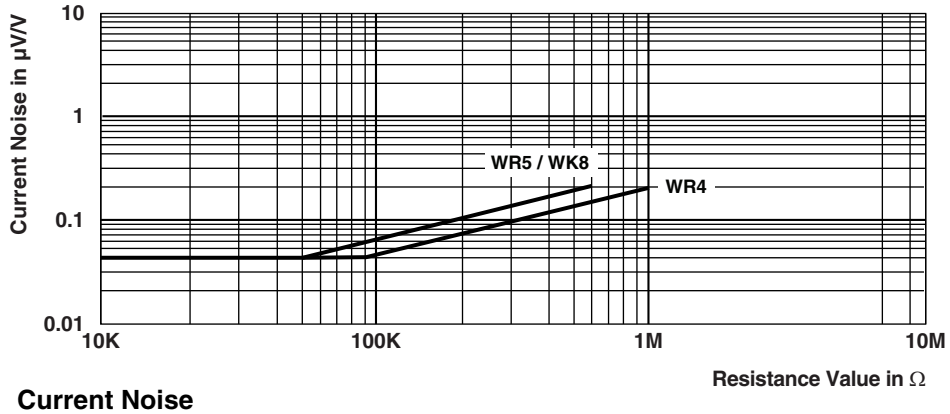

Current Noise

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TESTS PROCEDURES AND REQUIREMENTS

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

- EN 60115-1, generic specification (includes tests)

The test and requirements table contains only the most important tests. For the full test schedule refer to the documents listed above.

The tests are carried out in accordance with IEC 60068-2-xx test method and under standard atmospheric conditions in accordance with IEC 60068-1, 5.3.

Climatic category -40 / 200 / 56 (rated temperature range: lower category temperature, upper category temperature; damp heat, steady state, test duration: 56 days) is valid.

Unless otherwise specified the following values apply:

- Temperature: 15 °C to 35 °C
- Relative humidity: 45 % to 75 %
- Air pressure: 86 kPa to 106 kPa (860 mbar to 1060 mbar).

For performing some of the tests, the components are mounted on a test board in accordance with IEC 60115-1, 4.31.

In the Test Procedures and Requirements table, only the tests and requirements are listed with reference to the relevant clauses of IEC 60115-1 and IEC 60068-2-xx test methods. A short description of the test procedure is also given.

TEST PROCEDURES AND REQUIREMENTS

IEC 60115-1 CLAUSE	IEC 60068-2 TEST METHOD	TEST	PROCEDURE	REQUIREMENTS PERMISSIBLE CHANGE ($\Delta R_{max.}$)	
4.13	-	Short time overload	Room temperature; P = 6.25 x P_n; (voltage not more than 2 x limiting voltage); 5 s	± (0.25 % R + 0.05 Ω)	
4.16	21 (Ua_1) 21 (Ub) 21 (Uc)	Robustness of terminations	Tensile, bending, and torsion	No damage ± (0.25 % R + 0.05 Ω)	
4.18	20 (Tb)	Resistance to soldering heat	Unmounted components (260 ± 5) °C; (10 ± 1) s	± (0.25 % R + 0.05 Ω)	
4.19	14 (Na)	Rapid change of temperature	30 min at -55 °C and 30 min at +155 °C; 5 cycles	± (0.25 % R + 0.05 Ω)	
4.20	29 (Eb)	Bump	3 x 1500 bumps in three directions; 40 g	No damage ± (0.25 % R + 0.05 Ω)	
4.22	6 (Fc)	Vibration	Frequency 10 Hz to 500 Hz; displacement 1.5 mm or acceleration 10 g; 3 directions; total 6 h (3 x 2 h)	No damage ± (0.25 % R + 0.05 Ω)	
4.23		Climatic sequence:		$R_{ins\ min.}$: 1 GΩ ± (0.5 % R + 0.1 Ω)	
4.23.2	2 (Ba)	Dry heat	16 h; 155 °C		
4.23.3	30 (Db)	Damp heat, cyclic	24 h; 55 °C 90 % to 100 % RH; 1 cycle		
4.23.4	1 (Aa)	1st cycle, cold	2 h; -55 °C		
4.23.5	13 (M)	Low air pressure	2 h; 8.5 kPa 15 °C to 35 °C		
4.23.6	30 (Db)	Damp heat, remaining cyclic	5 days; 55 °C 95 % to 100 % RH; 5 cycles		
4.23.7	30 (Db)	DC load	apply rated power for 1 min		
4.24	78 (Cab)	Damp heat (steady state)	56 days; 40 °C; 90 % to 95 % RH; loaded with 0.01 P_{70} (steps: 0 V to 100 V)	± (1.5 % R + 0.1 Ω)	
4.25.1	-	Endurance (at 70 °C)	1000 h; loaded with P_{70} or $U_{max.}$; 1.5 h ON and 0.5 h OFF	**WK2, WR4, WR5**	≤ ± (5 % R + 0.1 Ω)
				WK8	≤ ± (2 % R + 0.1 Ω)
4.25.3	-	Endurance at 200 °C	1000 h; without load	**WK2, WR4**	≤ ± (5 % R + 0.1 Ω)
				WR5, WK8	≤ ± (1 % R + 0.1 Ω)

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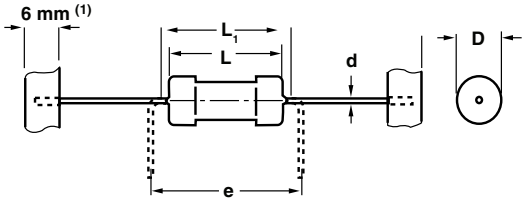
DIMENSIONS



DIMENSIONS - Leaded resistor types, mass and relevant physical dimensions						
TYPE	$D_{MAX.}$ (mm)	$L_{MAX.}$ (mm)	$L_{1\ MAX.}$ (mm)	d (mm)	e (2) (mm)	MASS (g)
WK2	2.5	6.5	8.0	0.58 ± 0.05	7.5	0.2
WR4	3.9	10.0	12.0	0.78 ± 0.05	15.0	0.7
WR5	6.0	16.5	20	0.78 ± 0.05	17.5	1.5
WK8	9.0	20.0	24.0	0.78 ± 0.05	22.5	3.5

Notes

(1) 9 mm for WR5/WK8.

(2) "e" depicts recommended pitch for mounting the resistor.

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