

# FrelTec GmbH

Mathildenstr. 10A  
82319 Starnberg  
Germany

## Cement Fixed Resistors

### SPECIFICATION

### Part Number

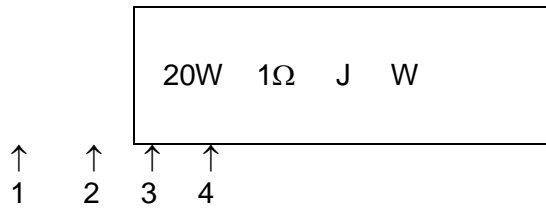
060	WC	05*	W*	----	J*	0	P05*
Type	Version / Type	Wattage	production type	Value	Tolerance	Special Feature:	Packing Type
060 : Cement Fixed Resistors	WX WC WA W1 (Axial Leaded)	01: 1W	W = Wire Wound type	First three digits are the significant figures of the resistance	F: ±1%	0 = Standard product	To be defined by sales
	MX MA MB MT (Radial Leaded)	02: 2W	P = Power film type	The last digit is the multiplier which denotes the number of zero following	J: ±5%	I = Non- Inductive	
	VA VB (Terminal type)	03: 3W			K: ±10%		
	1A 2A ZC C1 ZD (Terminal type)	04: 4W					
	FTR (Thermal Fusible Resistor	05: 5W					
	PFAS (Power Flat Alloy)	06: 6W					
		07: 7W					
		10: 10W					
		11: 11W					
		15: 15W					
		17: 17W					
		20: 20W					
		25: 25W					
		30: 30W					
		40: 40W					

## Cement Fixed

## Resistors

### Marking

Example:



Code description and regulation:

1. Wattage Rating
2. Nominal Resistance Value
3. Resistance Tolerance. J:  $\pm 5\%$   
K:  $\pm 10\%$

4. Pattern:

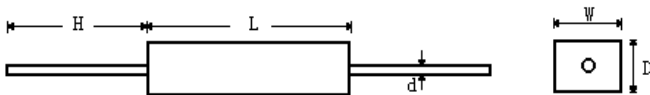
M: Power film

W: Wire wound

Color of marking: Black Ink

### Rating and Dimension:

#### 060WX:

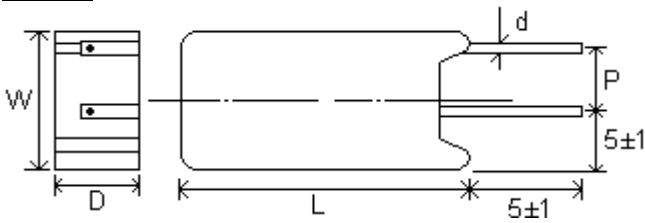


Type	Dimension(mm)					Resistance Range	
	W $\pm 1$	D $\pm 1$	L $\pm 1$	H	d $\pm 0,05$	Wire Wound	Power Film
060 WX 1W	6	6	13,5	25 $\pm 3$	0,65	0,1 $\Omega$ ~20 $\Omega$	21 $\Omega$ ~100K $\Omega$
060 WX 2W	7	7	18	28 $\pm 5$	0,70	0,1 $\Omega$ ~27 $\Omega$	28 $\Omega$ ~120K $\Omega$
060 WX 3W	8	8	22	32 $\pm 5$	0,70	0,1 $\Omega$ ~39 $\Omega$	40 $\Omega$ ~150K $\Omega$
060 WX 5W	10	9	22	35 $\pm 5$	0,75	0,1 $\Omega$ ~47 $\Omega$	48 $\Omega$ ~150K $\Omega$
060 WX 7W	10	9	35	35 $\pm 5$	0,75	0,1 $\Omega$ ~680 $\Omega$	681 $\Omega$ ~200K $\Omega$
060 WX 10W	10	9	49	35 $\pm 5$	0,75	0,1 $\Omega$ ~910 $\Omega$	911 $\Omega$ ~200K $\Omega$
060 WX 15W	12,5	11,5	49	35 $\pm 5$	0,75	1 $\Omega$ ~1K $\Omega$	1,1K $\Omega$ ~200K $\Omega$
060 WX 20W	14,5	13,5	60	35 $\pm 5$	0,75	2 $\Omega$ ~1,2K $\Omega$	1,3K $\Omega$ ~200K $\Omega$
060 WX 25W	14,5	13,5	64	35 $\pm 5$	0,75	2 $\Omega$ ~1,2K $\Omega$	1,3K $\Omega$ ~200K $\Omega$

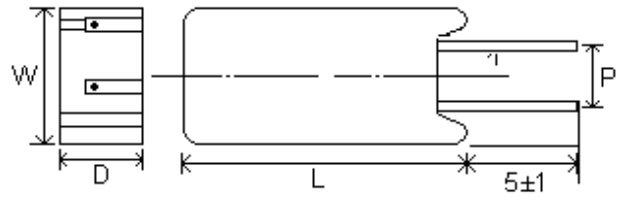
## Cement Fixed

## Resistors

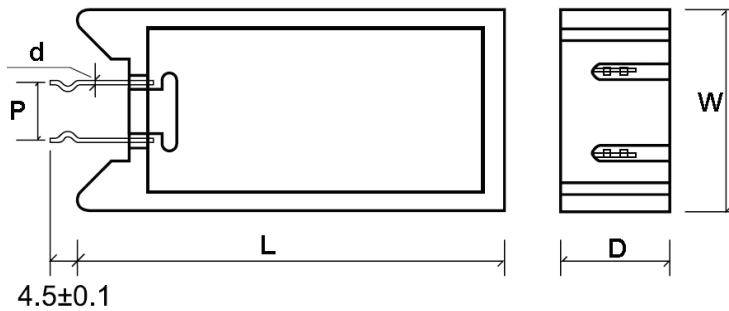
### 060M:



MX : Lead not centered



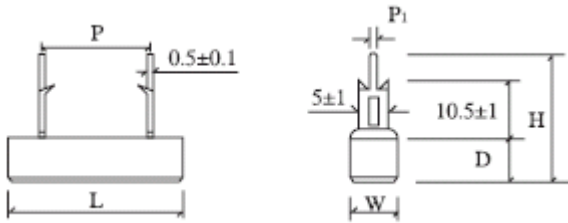
MA, MB : Lead centered



MT

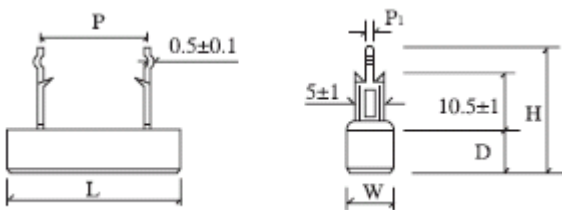
Type	Dimension(mm)					Resistance Range	
	W±1	D	L±1	P±1	d±0.05	Wire Wound	Power Film
060 MX 2W	11,5	7,5±1	20	5	0.70	0,1Ω-27Ω	28Ω-120KΩ
060 MX 3W	12,5	8,5±1	25	5	0.70	0,1Ω-39Ω	40Ω-150KΩ
060 MX 5W	13,0	9±1	25	5	0.75	0,1Ω-47Ω	48Ω-150KΩ
060 MX 7W	13,0	9±1	39	5	0.75	0,1Ω-680Ω	681Ω-200KΩ
060 MX 10W	13,0	9±1	50	5	0.75	0,1Ω-910Ω	911Ω-200KΩ
060 MA 5W	13,0	9±1	25	7.5	0.80	0,1Ω-47Ω	48Ω-100KΩ
060 MA 10W	13,0	12±1	35	7.5	0.80	0,1Ω-560Ω	561Ω-100KΩ
060 MB 7W	13,0	9±1	39	5	0.80	0,1Ω-680Ω	681Ω-200KΩ
060 MT 15W	20,0	13±0.5	38	7.5	0.50	0,1Ω-560Ω	561Ω-200KΩ
060 MT 20W	20,0	13±0.5	45	7.5	0.40	0,1Ω-560Ω	561Ω-200KΩ

### 060VA:



Type	Dimension(mm)						Resistance Range	
	W±1	D±1	L±1	P±1	P1±0,2	H±1	Wire Wound	Power Film
060 VA 3W	10	9	22	9,5	1,3	25	0,1Ω-47Ω	48Ω-150KΩ
060 VA 5W	10	9	27/25	15/9,5	1,3	25	0,1Ω-120Ω	121Ω-200KΩ
060 VA 7W	10	9	35	22	1,3	25	0,1Ω-560Ω	561Ω-200KΩ
060 VA 10W	10	9	48	35/32	1,3	25	1Ω-820Ω	821Ω-200KΩ
060 VA 15W	12,5	11,5	48	32	1,5	24	1Ω-1KΩ	1,1KΩ-200KΩ
060 VA 20W	12,5	13,5	63	42	1,5	26	1Ω-1,2KΩ	1,3KΩ-200KΩ

### 060VB:

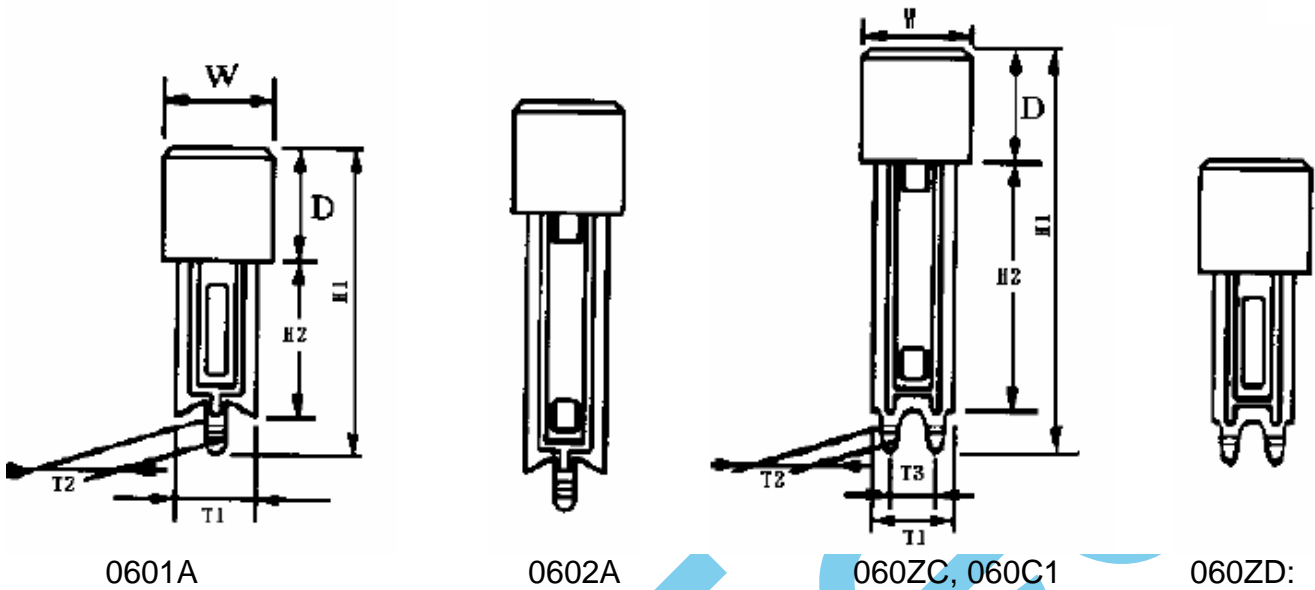


Type	Dimension(mm)						Resistance Range	
	W±1	D±1	L±1	P±1	P1±0.2	H±1	Wire Wound	Power Film
060 VB 3W	10	9	22	9,5	1,3	25	0,1Ω-47Ω	48Ω-150KΩ
060 VB 5W	10	9	27/25	15/9,5	1,3	25	0,1Ω-120Ω	121Ω-200KΩ
060 VB 7W	10	9	35	22	1,3	25	0,1Ω-560Ω	561Ω-200KΩ
060 VB 10W	10	9	48	35/32	1,3	25	1Ω-820Ω	821Ω-200KΩ
060 VB 15W	12,5	11,5	48	32	1,5	27,5	1Ω-1KΩ	1,1KΩ-200KΩ
060 VB 20W	12,5	13,5	63	42	1,5	29,5	1Ω-1,2KΩ	1,3KΩ-200KΩ

## Cement Fixed

## Resistors

**0601A, 0602A, 060ZC, 060C1, 060ZD:**



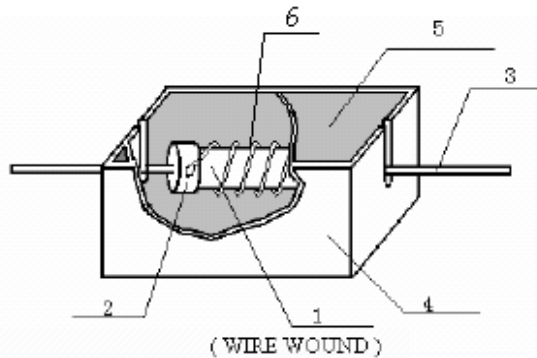
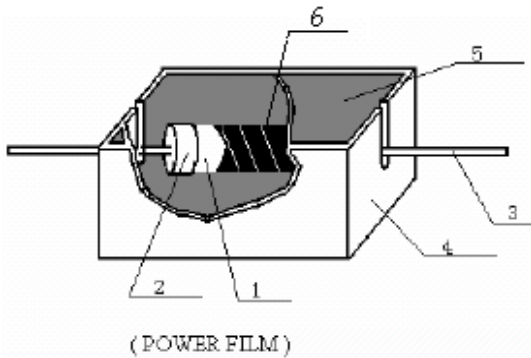
0601A:

	Type	Dimension(mm)								Resistance Range			
		W±1	D±1	L	P±1,5	T1±1	T2±0,2	T3±0,5	H1 <sup>+2</sup> <sub>1</sub>	H2 <sup>+2</sup> <sub>1</sub>	Wire Wound	Power Film	
0601A	3W	10	9	22±1	9,5	7	1,6	-	24	10	0,1Ω~47Ω	48Ω~150KΩ	
	5W	10	9	25/27±1	9,5/1,5	7	1,6	-	24	10	0,1Ω~120Ω	121Ω~200KΩ	
	7W	10	9	35±1	22	7	1,6	-	24	10	0,1Ω~560Ω	561Ω~200KΩ	
	10W	10	9	48±1,5	32/35	7	1,6	-	24	10	1Ω~820Ω	821Ω~200KΩ	
	15W	12,5	11,5	48±1,5	32	10	3	-	35	15	1Ω~1KΩ	1,1KΩ~200KΩ	
	20W	12,5	13,5	63±1,5	42	10	3	-	35	15	2Ω~1,2KΩ	1,3KΩ~200KΩ	
0602A	3W	10	9	22±1	9,5	7	1,6	-	39	25	0,1Ω~47Ω	48Ω~150KΩ	
	5W	10	9	27±1	15	7	1,6	-	39	25	0,1Ω~120Ω	121Ω~200KΩ	
	7W	10	9	35±1	22	7	1,6	-	39	25	0,1Ω~560Ω	561Ω~200KΩ	
	10W	10	9	48±1,5	32/35	7	1,6	-	39	25	1Ω~820Ω	821Ω~200KΩ	
	15W	12,5	11,5	48±1,5	32	10	3	-	47	30	1Ω~1KΩ	1,1KΩ~200KΩ	
	20W	12,5	13,5	63±1,5	42	10	3	-	47	30	2Ω~1,2KΩ	1,3KΩ~200KΩ	
060ZC	3W	10	9	22±1	9,5	7	1,5	3,5	36	22	0,1Ω~47Ω	48Ω~150KΩ	
	5W	10	9	27±1	15	7	1,5	3,5	36	22	0,1Ω~120Ω	121Ω~200KΩ	
	7W	10	9	35±1	22	7	1,5	3,5	36	32	0,1Ω~560Ω	561Ω~200KΩ	
	10W	10	9	48±1,5	32/35	7	1,5	3,5	36	22	1Ω~820Ω	821Ω~200KΩ	
	15W	12,5	11,5	48±1,5	32	10	2	5	47	30	1Ω~1KΩ	1,1KΩ~200KΩ	
	20W	12,5	13,5	63±1,5	42	10	2	5	47	30	2Ω~1,2KΩ	1,3KΩ~200KΩ	
060C1	5W	10	9	27±1	15	7	1,3	3,5	39	24	0,1Ω~120Ω	121Ω~200KΩ	
	7W	10	9	35±1	22	7	1,3	3,5	39	24	0,1Ω~560Ω	561Ω~200KΩ	
060ZD	3W	10	9	22±1	9,5	7	1,3	3,5	24	10	0,1Ω~47Ω	48Ω~150KΩ	
	5W	10	9	27±1	15	7	1,3	3,5	24	10	0,1Ω~120Ω	121Ω~200KΩ	
	7W	10	9	35±1	22	7	1,3	3,5	24	10	0,1Ω~560Ω	561Ω~200KΩ	
	10W	10	9	48±1,5	32/35	7	1,3	3,5	24	10	1Ω~820Ω	821Ω~200KΩ	

## Cement Fixed Construction:

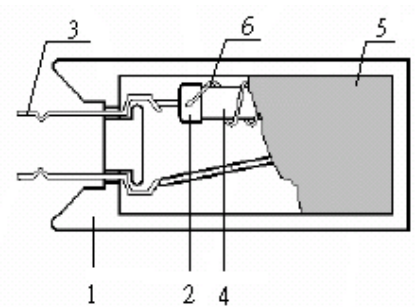
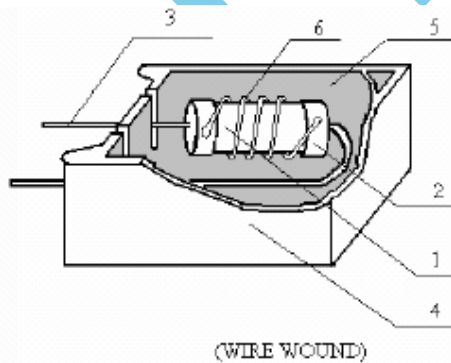
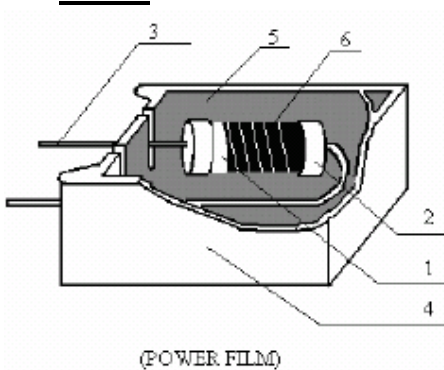
## Resistors

### 060WX:



No.	Name	material generic name
1	Body	Al <sub>2</sub> O <sub>3</sub>
2	Cap	Tin plated iron
3	Lead	Copper Wire
4	Ceramic Case	Al <sub>2</sub> O <sub>3</sub> CaO
5	Filling Materials	SiO <sub>2</sub>
6	Resistance element	Power film: Metal Oxide Film
		Wire-wound: NiCr alloys or CuNi alloys

### 060M:

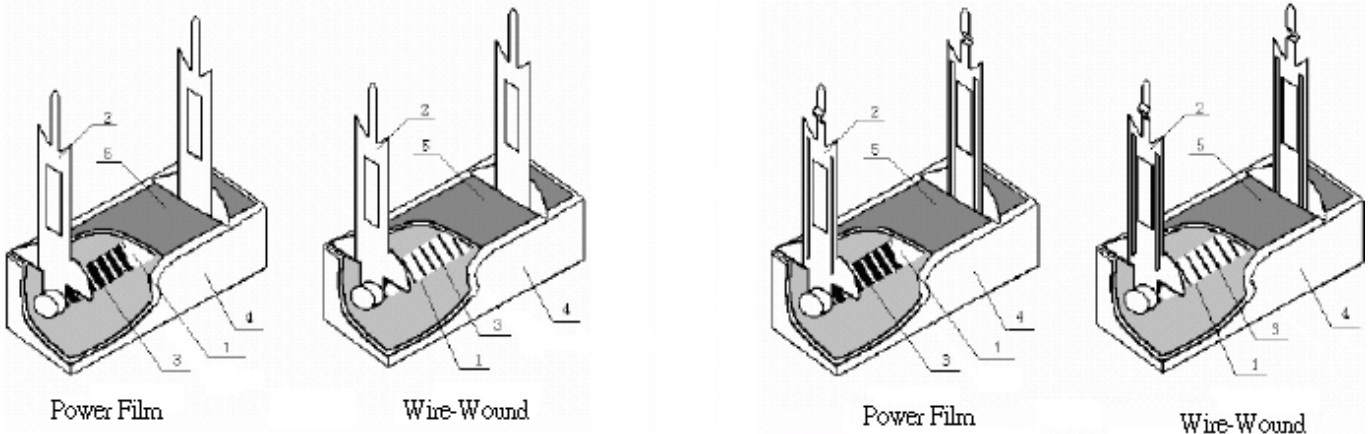


No.	Name	Material Generic Name
1	Body	Al <sub>2</sub> O <sub>3</sub>
2	Cap	Tin plated iron
3	Lead	Copper wire
	Terminal type	Tin plated iron
4	Ceramic case	Al <sub>2</sub> O <sub>3</sub> CaO
5	Filling materials	SiO <sub>2</sub>
6	Resistance element	Power film: Metal Oxide Film
		Wire-wound: NiCr alloys or CuNi alloys

## Cement Fixed

## Resistors

### 060V:

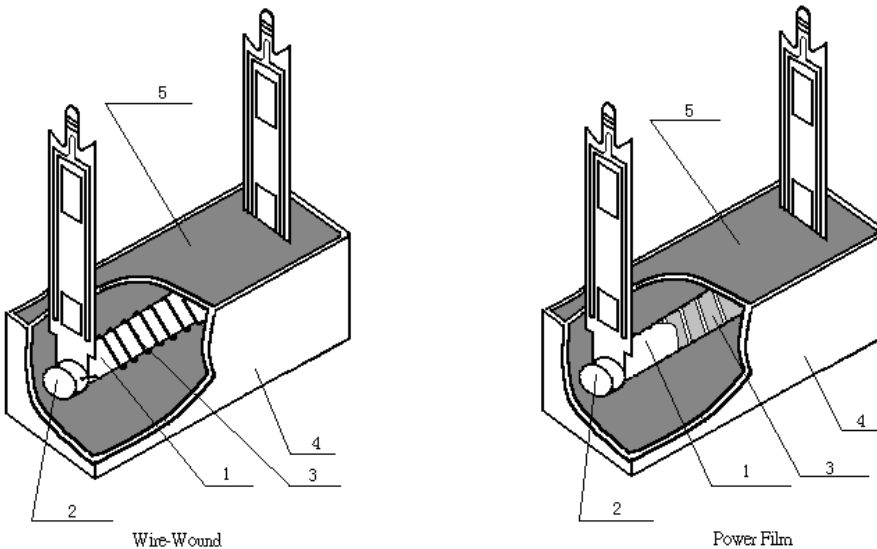


060VA

060VB

No.	Name	Material Generic Name
1	Body	Al <sub>2</sub> O <sub>3</sub>
2	Terminal lug	Tin plated iron
3	Resistor element	Power: Metal Oxide Film
		Wire-wound: NiCr alloys or CuNi alloys
4	Ceramic case	Al <sub>2</sub> O <sub>3</sub> CaO
5	Filling materials	SiO <sub>2</sub>

### 0601A, 0602A, 060ZC, 060C1, 060ZD:



Wire-Wound

Power Film

No.	Name	Material Generic Name
1	Body	Al <sub>2</sub> O <sub>3</sub>
2	Cap	Tin plated iron
3	Resistor element	Power: Metal Oxide Film
		Wire-wound: NiCr alloys or CuNi alloys
4	Ceramic case	Al <sub>2</sub> O <sub>3</sub> CaO
5	Filling materials	SiO <sub>2</sub>



**Storage Conditions:**

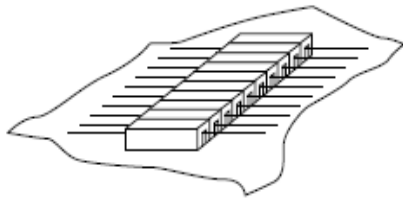
The performance of these products, including the solderability, is guaranteed for one year from the date of production, provided that they remain packed as they were when delivered and stored at a temperature of  $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$  and a relative humidity of  $60\%RH \pm 15\%RH$ . Store / transport cartons in the correct direction, which is indicated on a carton as a symbol. Otherwise bent leads may occur due to excessive stress applied when dropping of a carton. Even within the above guarantee periods, do not store these products in the following conditions. Otherwise, their electrical performance and/or solderability may be deteriorated, and the packaging materials (e.g. taping materials) may be deformed or deteriorated, resulting in mounting failures.

1. In salty air or in air with a high concentration of corrosive gas, such as  $\text{Cl}_2$ ,  $\text{H}_2\text{S}$ ,  $\text{NH}_3$ ,  $\text{SO}_2$ , or  $\text{NO}_2$
2. In direct sunlight

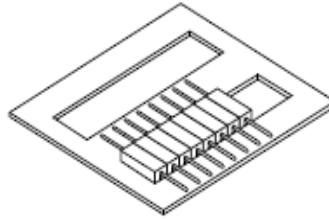
FrelTec

### (1) Type A Packing

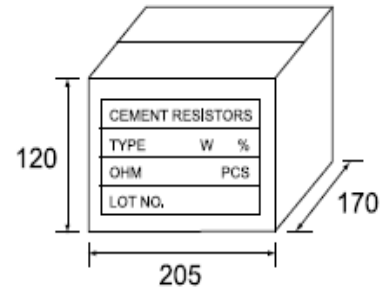
Dimension (mm)



Type-A1 plastic bag

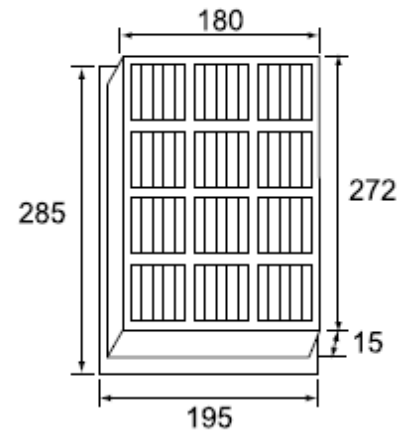
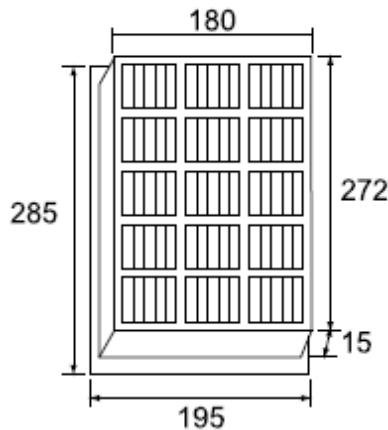
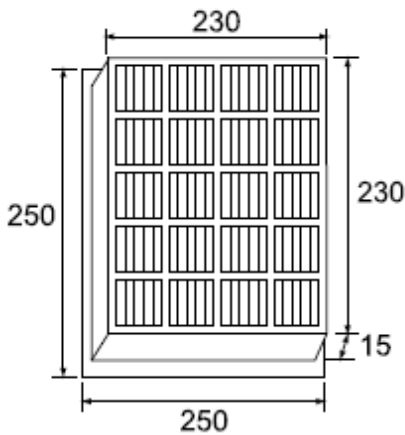


Type-A2 paper tray

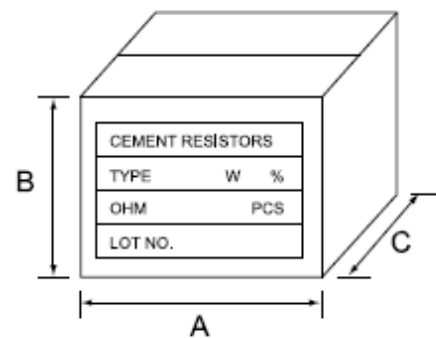


Inner box

### (2) Type B Packing (Plastic Case)



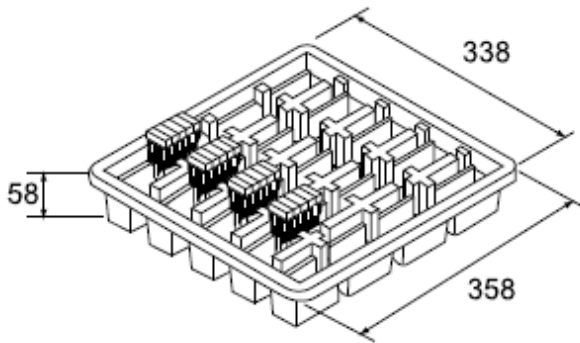
Dimension of Plastic Case (mm)			
Type	A	B	C
Type - B1	260	105	260
Type - B2	300	100	210
Type - B3	300	100	210



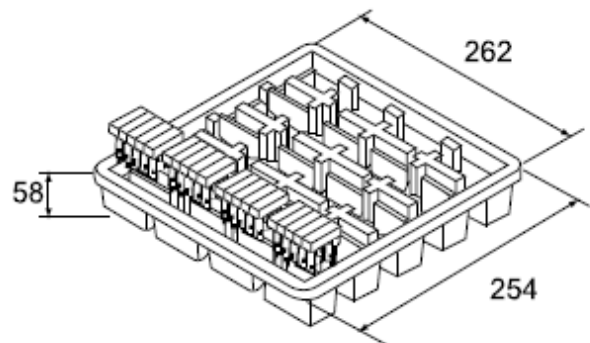
Inner Box of Plastic Case

### (3) Type C Packing (Pulp Case)

Dimension (mm)



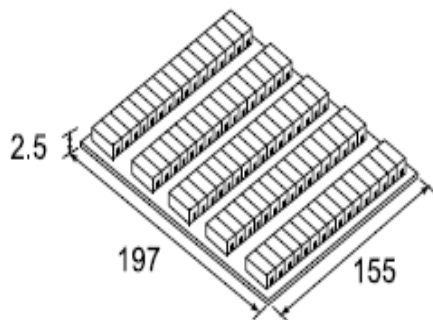
Type-C1 (5W)



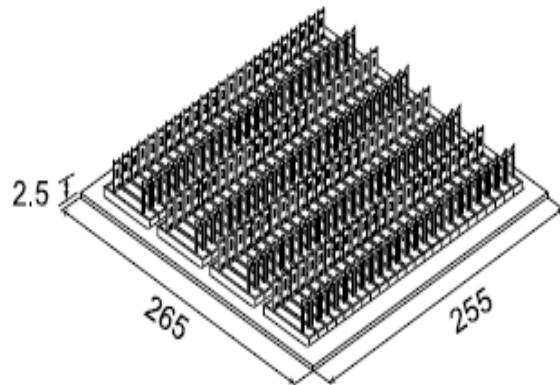
Type-C2 (7W)

### (4) Type D Packing (Paper Sheet)

Dimension (mm)



Type-D (5W) Axial M-Type



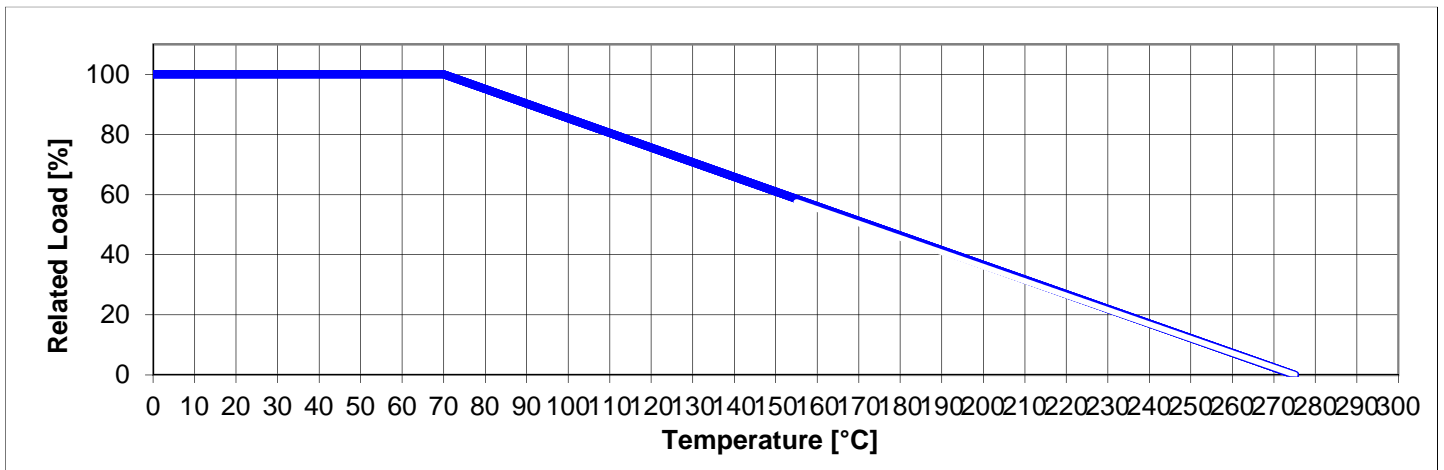
Type-D (10W, 15W, 20W) Terminal Type

## Specification

Type	Rated Power at 70°C	Max. Working Voltage	Max. Overload Voltage	Dielectric Withstand ing Voltage	Resistance Tolerance %	T.C.R (PPM/°C)	Wire-wound Resistance Range	Power Film Resistance Range	Operating Temp. Range
060-WC	5W	250 V	500 V	300 V	± 5	≥20Ω	1Ω-200Ω	201Ω-100kΩ	-55°C -- +155°C
060-WX	5W	500 V	1.000 V	1.000 V		± 350	0,1Ω-47Ω	48Ω-100kΩ	
060-WX	10W	500 V	1.000 V	1.000 V		<20Ω	0,1Ω-910Ω	911Ω-200kΩ	
060-MX	5W	500 V	1.000 V	1.000 V		± 400	0,1Ω-100Ω	48Ω-100kΩ	

### Power rating:

Resistors shall have a power rating based on continuous full load operation at an ambient temperature of 70 °C. For temperature in excess of 70 °C, the load shall be derated as shown in the figure below.



### Voltage rating:

The resistor shall have a DC continuous working voltage or a rms AC continuous working voltage at commercial-line frequency and wave form corresponding to the power rating, as determined from the following:

E= Rated voltage [V]

P= Power rating [W]

R= Nominal resistance [Ω]

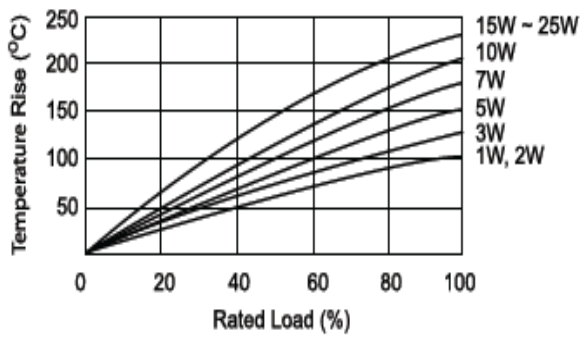
$$E = \sqrt{R \cdot P}$$

## Cement Fixed

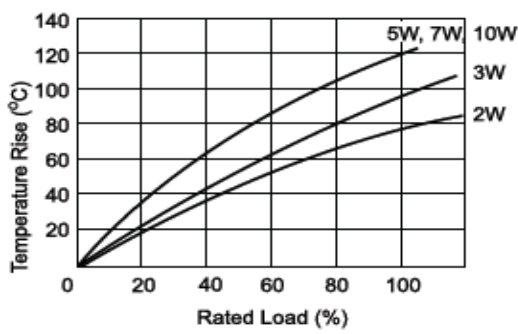
## Resistors

Heat rise chart:

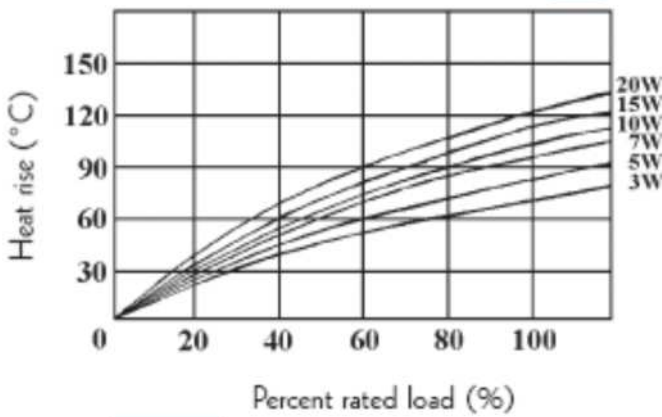
060WX:



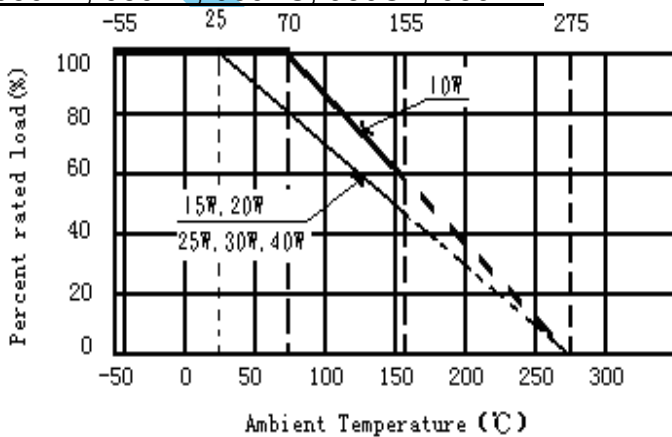
060M:



060V:



0601A, 0602A, 060ZC, 060C1, 060ZD:



Cement Fixed  
Characteristics

## Resistors

Characteristics	Limits	Test Methods (JIS C 5201 and JIS-C-5202)
DC. resistance	Must be within the specified tolerance	The limit of error of measuring apparatus shall not exceed allowable range or 5% of resistance tolerance (Sub-clause 4.5)
Dielectric withstanding voltage	No evidence of flashover mechanical damage, arcing or insulation break down	Resistors shall be clamped in the trough of a 90° metallic V-block shall be tested at AC potential respectively specified in the above list for 60 +10/-0 sec. For cement fixed resistors the testing voltage is 1000V (Sub-clause 4.7)
Temperature coefficient	$\geq 20 \Omega \pm 350 \text{ PPM}/^\circ\text{C}$ Max. $< 20 \Omega \pm 400 \text{ PPM}/^\circ\text{C}$	Natural resistance change per temp. degree centigrade. $\frac{R_2 - R_1}{R_1(t_2 - t_1)} \cdot 10^6 \text{ (PPM}/^\circ\text{C)}$ R1: Resistance value at room temperature (t1) R2: Resistance value at room temp. plus 100°C (t2) Test pattern: room temp. (T <sub>1</sub> ), room temp. +100°C(T <sub>2</sub> ) (Sub-clause 4.8)
Short time overload	Resistance change rate is $\pm (5 \% + 0,05\Omega)$ Max. with no evidence of mechanical damage	Permanent resistance change after the application of a potential of 2,5 times RCWV for 5 seconds. (Sub-clause 4.13)
Terminal strength	No evidence of mechanical damage.	<b>Direct load:</b> Resistance to a 2,5 kg direct load for 10 sec. in the direction of the longitudinal axis of the terminal leads. <b>Twist test :</b> Terminal leads shall be bent through 90 ° at a point of about 6mm from the body of the resistor and shall be rotated through 360° about the original axis of the bent terminal in alternating direction for a total of 3 rotations. (Sub-clause 4.16)
Solderability	95 % coverage Min.	The area covered with a new, smooth clean, shiny and continuous surface free from concentrated pinholes. Test temp. of solder : 245°C $\pm$ 3°C Dwell time in solder : 2 ~ 3 sec (Sub-clause 4.17)
Soldering reference	Electrical characteristics shall be satisfied. Without distinct deformation in appearance. 95 % coverage Min.	The leads immersed into solder bath to 3.2 to 4.8 mm from the body. Permanent resistance change shall be checked. <b>Wave soldering condition:</b> (2 cycles Max.) Pre-heat : 100 ~ 120°C, 30 $\pm$ 5 sec. Suggestion solder temp.: 235~255°C, 10s. (Max.) Peak temp.: 260°C <b>Hand soldering condition:</b> Hand Soldering bit temp. : 380 $\pm$ 10°C

# FrelTec

## Cement Fixed

## Resistors

		Dwell time in solder : 3 +1/-0 sec.															
Resistance to soldering heat	Resistance change rate is $\pm (1\% + 0,05\Omega)$ Max. with no evidence of mechanical damage.	Permanent resistance change when leads immersed to 2,0-2,5mm from the body in $260^{\circ}\text{C}\pm 5^{\circ}\text{C}$ solder for $10\pm 1$ seconds. (Sub-clause 4.18)															
Temperature cycling	Resistance change rate is $\pm (2\% + 0,05\Omega)$ Max. with no evidence of mechanical damage.	Resistance change after continuous 5 cycles for duty shown below:															
		<table border="1"> <thead> <tr> <th>Step</th> <th>Temperature</th> <th>Time</th> </tr> </thead> <tbody> <tr> <td>1</td> <td><math>-55^{\circ}\text{C} \pm 3^{\circ}\text{C}</math></td> <td>30 min</td> </tr> <tr> <td>2</td> <td>Room temp.</td> <td>10~15 min</td> </tr> <tr> <td>3</td> <td><math>+155^{\circ}\text{C}\pm 2^{\circ}\text{C}</math></td> <td>30 min</td> </tr> <tr> <td>4</td> <td>Room temp.</td> <td>10~15 min</td> </tr> </tbody> </table>	Step	Temperature	Time	1	$-55^{\circ}\text{C} \pm 3^{\circ}\text{C}$	30 min	2	Room temp.	10~15 min	3	$+155^{\circ}\text{C}\pm 2^{\circ}\text{C}$	30 min	4	Room temp.	10~15 min
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		2	Room temp.	10~15 min													
3	$+155^{\circ}\text{C}\pm 2^{\circ}\text{C}$	30 min															
4	Room temp.	10~15 min															
(Sub-clause 4.19)																	
Vibration		Resistance change rate is $\pm (1\% + 0,05\Omega)$ Max. 55Hz, 3 planes 2hrs each Total amplitude = 1,5mm (Sub-clause 4.22)															
Load life in humidity	<table border="1"> <thead> <tr> <th>Resistance value</th> <th><math>\Delta R/R</math></th> </tr> </thead> <tbody> <tr> <td>Wire-wound</td> <td><math>\pm 5\%</math></td> </tr> <tr> <td>Power film : <math>&lt; 100\text{K}\Omega</math></td> <td><math>\pm 5\%</math></td> </tr> <tr> <td><math>\geq 100\text{K}\Omega</math></td> <td><math>\pm 10\%</math></td> </tr> </tbody> </table>	Resistance value	$\Delta R/R$	Wire-wound	$\pm 5\%$	Power film : $< 100\text{K}\Omega$	$\pm 5\%$	$\geq 100\text{K}\Omega$	$\pm 10\%$	Resistance change after 1.000 hours operating at RCWV with duty cycle of (1,5 hours "on", 0,5 hour "off") in a humidity test chamber controlled at $40^{\circ}\text{C} \pm 2^{\circ}\text{C}$ and 90 to 95 % relative humidity (Sub-clause 7.9)							
	Resistance value	$\Delta R/R$															
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	Resistance value	$\Delta R/R$															
Wire-wound	$\pm 5\%$																
Power film : $< 100\text{K}\Omega$	$\pm 5\%$																
$\geq 100\text{K}\Omega$	$\pm 10\%$																
Resistance to solvent	No deterioration of protective coatings and markings	Specimens shall be immersed in a bath of Isopropyl alcohol completely for 3 minutes with ultrasonic (Sub-clause 4.29, 4.30)															
Humidity (Steady state)	Resistance change rate is: $\pm(5\%+0.05\Omega)$ Max. With no evidence of mechanical damage.	Temporary resistance change after 240 hours exposure in a humidity test chamber controlled at $40\pm 2^{\circ}\text{C}$ and 90~95%RH relative humidity (Sub-clause 4.24)															

**For this part: It does not use the materials that include the substances specified in RoHS, the detail refer to the part of prohibition or exclusion items in RoHS (2011/65/EC).**

Cadmium and cadmium compounds (permissive content < 100 ppm)

Lead and lead compounds (permissive content < 1000 ppm)

Exemption specified:

Lead contained in the glass of electrical and electronic components.

The glass material (which lead inside) used in resistive elements.

Mercury and its mercury compounds (permissive content < 1000 ppm)

Hexavalent chromium compounds (permissive content < 1000 ppm)

Polybrominated biphenyls (PBB) (permissive content < 1000 ppm)

Polybrominated diphenylethers (PBDE) (permissive content < 1000 ppm)

This product is complies to EU PAHs directive, EU PFOS directive, EU REACH directive and Halogen free.

FrelTec



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