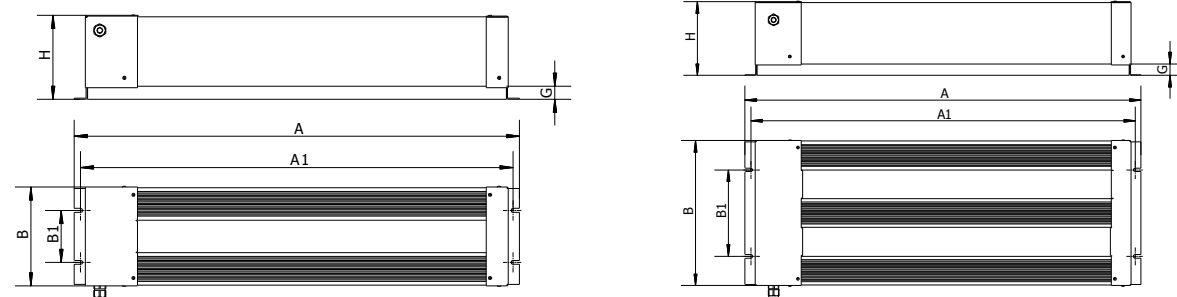


●产品介绍 Product Introduction:

LTRX 系列电阻器在传统铝壳电阻器两端加装不锈钢挡片, 进行密封, 并在两端加装支架对薄弱部分进行保护, 使其 IP 等级达到 IP54. LTRX Series resistors install the stainless steel plate on the aluminum shell resistors, and install the bracket mounting onto the end of the resistors for protection, and the IP grade achieve to IP54.

●技术参数 Technical Parameters:

- 1、 功率范围 Power range: 200W—3000W
- 2、 耐压 Withstand voltage: AC3000V/50HZ 5S
- 3、 额定功率 Rated Power: 200W-3000W
- 4、 IP 等级 IP Grade: IP33—IP54
- 5、 绝缘电阻 Insulation resistance: 线—地 1000VDC, 绝缘阻值 $\geq 100M\Omega$  When DC1000V between the cable and the earth, the insulation resistance  $\geq 100M\Omega$ .



●外形安装尺寸 Appearance Installation Size:

成型 Forming	功率 Power(w)	尺寸 Dimensions (mm)						配线 Cable (mm <sup>2</sup> )	引线长度(mm) Lead wire length
		A	A1	B	B1	G	H		
L001	200	268	253	64	30	20	54	2.5	500
	300	318	303	64	30	20	54	2.5	500
	400	368	353	64	30	20	54	4	500
	500	438	423	64	30	20	54	4	500
	600	503	488	64	30	20	54	4	500
L002	800	372	355	84	49	20	84	4	500
	1000	442	425	84	49	20	84	4	500
	1200	507	490	84	49	20	84	4	500
L003	1200	372	355	134	75	20	84	4	500
	1500	442	425	134	75	20	84	4	500
	1800	507	490	134	75	20	84	4	500
L004	1600	372	355	184	125	20	84	4	500
	2000	442	425	184	125	20	84	4	500
	2400	507	490	184	125	20	84	4	500
L005	2000	372	355	234	175	20	84	4	500
	2500	442	425	234	175	20	84	4	500
	3000	507	490	234	175	20	84	4	500

●料号规则 Part No. Regulation:

LTRX	2KW	-5%	0	L002	20R
产品名称 Product Name	功率 Power	精度 Tol.	特殊码 Special Code	成型 Forming	阻值 Ohm
多联体铝壳电阻器 Concatemer Aluminum Housed Resistors		±5%			20R=20Ω



●产品介绍 Product Introduction:

Crowbar 电阻器 Crowbar Resistors——低电压穿越技术 Low voltage ride through.

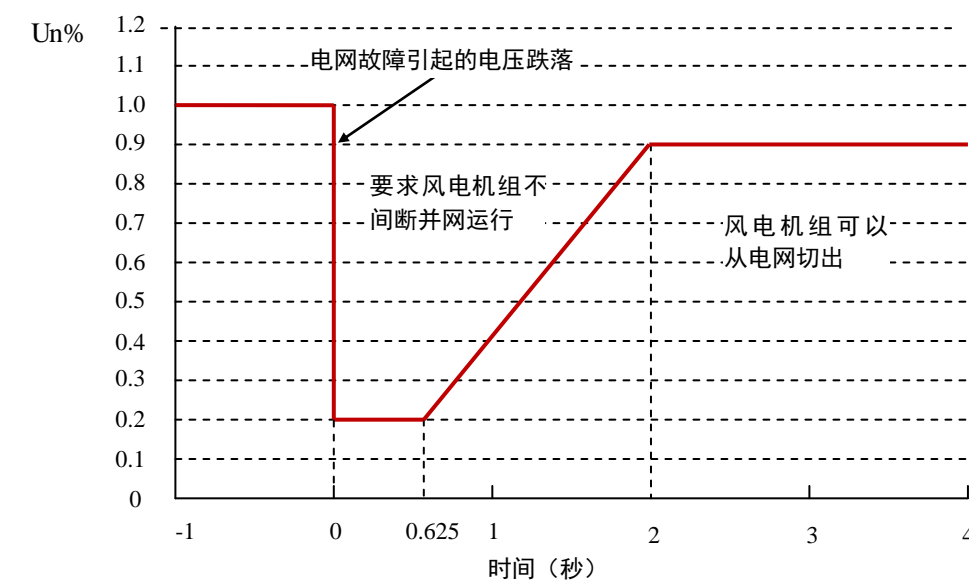
Crowbar 电阻主要应用于风力发电逆变器的低电压穿越技术中。它用在风力发电机转子侧, 用于旁路转子侧变流器。当电网发生低电压扰动时, 防止直流母线电压过高和转子电流过大。主要工作在故障状态阻尼定子磁链。Crowbar 电阻能在瞬间把巨大能量耗散掉。Crowbar resistor is mainly used in wind power inverter low voltage through technology. It used in the wind generator rotor side, used to bypass the rotor converter. When power grid leads to low voltage disturbance, prevent the DC bus voltage is too high and the rotor current is too large. The main work in fault state damping stator magnetic chain. Crowbar resistance can dissipate off the huge energy instantly.

●电阻的寿命评估 Life Time of Crowbar Resistor:

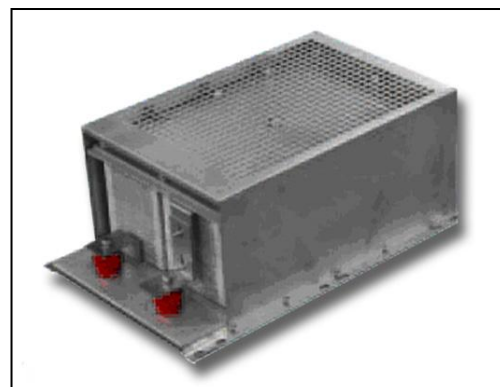
(以 1.5MW 风力发电机为例, 环境温度 < 60°C)  
(Take 1.5MW windmill generator for example, environmental temperature < 60°C)

200J	1 次/秒	Once/Second	
220KJ	1 次/30 分钟	Once/30 Minutes	350000 次 (20 年寿命) 350000 Times(20 Years)
640KJ	1 次/星期	Once/Week	1000 次 (20 年寿命) 1000 Times(20 Years)
1360KJ	1 次/月	Once/Month	250 次 (20 年寿命) 250 Times(20Years)

●风电机组低电压穿越要求 Wind turbine Low Voltage Ride Through Requirement:



● Crowbar 电阻器分类 Classification of the Crowbar Resistor :



栅格结构——自然风冷

Lattice Structural--Natural Wind Cooling

M: 电阻材料的质量 The quality of the resistors material.  
单位 Unit: kg

Q: 电阻材料吸收的能量 The energy of absorption of the resistors material.单位 Unit: kJ

C: 电阻材料的比热容 The specific heat capacity of the resistors material.单位 Unit: kJ/kg\*K

Δt: 电阻材料的温升 The temperature rise of the resistors material.单位 Unit: K

以 1.5MW 风力发电机为例:

1.5MW Wind turbine as an example:

电阻材料 Resistors material: SUS304

Q max.=1360KJ C=0.5kJ/kg\*K Δt=400K

M=1360/(0.5\*400)=6.8kg

电阻材料重量 The Weight of resistors material: 约 about 6.8kg

辅助材料重量 The weight of auxiliary material: 约 about 20kg

体积 Size: 500×450×150 (mm)

夹层结构——自然风冷

Sandwich Structural--Natural Wind Cooling

M: 电阻材料的质量 The quality of the resistors material 单位 Unit: kg

Q: 电阻材料吸收的能量 The energy of absorption of the resistors material.单位 Unit: kJ

C: 电阻材料的比热容 The specific heat capacity of the resistors material.单位 Unit: kJ/kg\*K

Δt: 电阻材料的温升 The temperature rise of the resistors material.单位 Unit: K

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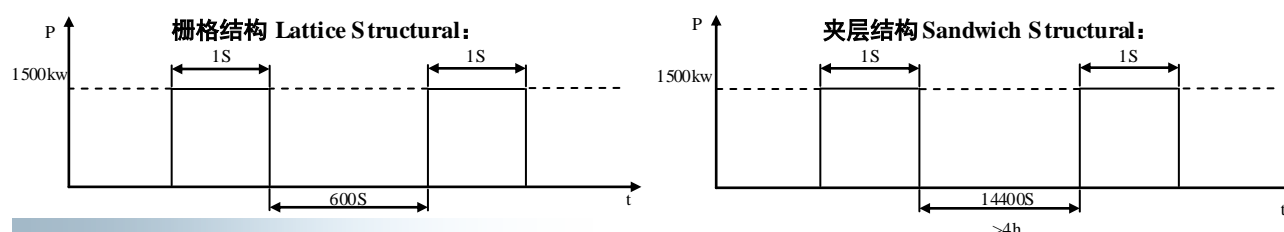
M=1360/(0.5\*400)=6.8kg

电阻材料重量 The Weight of resistors material: 约 about 6.8kg

辅助材料重量 The weight of auxiliary material: 约 about 20kg

体积 Size: 491×320×200 (mm)

● 工况比较 Working condition compare :



● 结构比较 Structural compare :

结构 Structural	重量 (kg) Wight	体积尺寸 (mm) Dimension	实际温升 (°C) Actual Temp.Rise	价格 Price
栅格结构 Lattice Structural	26	500×450×150	450	中 Middle
夹层结构 Sandwich Structural	28	491×320×200	200	低 Low

● 电阻材质比较 Resistor material comparison:

材质 Material	密度 Density (g/mm <sup>3</sup> )	电阻率 Resistivity (Ω*mm <sup>3</sup> /m)	热容 Heat capacity (J/g*k)	导热率 Thermal Conductivity (w/m <sup>2</sup> *°C)	温度特性 Temperature Coefficient (ppm/°C)
SUS304	0.008	0.68	0.5	13.2	<1400
SUS316	0.008	0.73	0.45	13.23	<900
SUS310	0.008	0.71	0.46	13.2	<600
Cr20Ni80	0.0084	4.09	0.441	60.5	<100
oCr25Al5	0.0071	1.42	0.496	46.5	<100

● 选型公式 Formula For Selection:

制动电阻器的阻值 Braking Resistance value:  $R=U_{2dc}/(K \times P)$

U<sub>2dc</sub>: 所选变频器制动回路的斩波电压值 The chopping voltage of the brake circuit of the transducer.

K: 所需的制动转矩倍数 Braking torque multiple (1.2-2.0)

P: 所选变频器的功率 The power of the transducer

制动电阻器的功率 The Power of the Braking resistors:  $P_r=P_0/\Delta K=P_1 \times (1-0.2) \times \eta / \Delta K$

P<sub>0</sub>: 电机的功率 The power of the Motor

ΔK: 制动电阻器短时工作允许过负荷倍数, 具体数值根据工况查图取值 Braking resistor allows multiple over load in short-term work, Specific numerical value according to the condition check chart

P<sub>1</sub>: 系统所需的平均制动功率 Average braking power

η: 传动效率, 传动的机械系统在制动时, 提供与效率相应的制动阻尼 Transmission efficiency, Drive mechanical system in braking, provide and efficiency corresponding brake damping.

0.2: 电动机的内阻消耗了 20% 的制动能量 Motor resistance consumes 20% braking energy.

ED 制动率以 100S 运行为一个周期, 制动时间所占比率根据制动电流 U<sub>dc</sub>/R 与制动率 ED 选择制动单元 Brake rate: 100s operation as a cycle, braking time percentage according to brake current U<sub>dc</sub>/R and the braking ratio ED to choose brake unit.

● 电阻器允许过负荷倍数 Resistors Overload multiple allowed:

