



# Fixed Resistors

High Power Capabilities



Belief in Technology

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# High Power Products

The growth in power electronic solutions in the energy and transportation sectors is generating continued demand for passive as well as active component development.

Resistive components perform a number of critical functions in high power systems, including dynamic braking, overvoltage protection and heating. TT electronics is able to address these needs, not only with a large portfolio of power resistors, but also with dedicated engineering teams providing custom solutions. This brochure highlights some of these applications and gives guidance to designers on the selection of technologies and products suitable for their own applications. Further support is available from TT electronics' Fixed Resistor applications engineering team.







## Renewable Energy Applications

Renewable energy applications provide many challenging roles for high power resistors which are employed throughout the systems from generation to distribution.

With the growth in wind power generation there is an ever increasing need for power resistors to fulfill the various demanding applications in the turbine systems e.g. inrush current limiting and electronic braking.

TT electronics supplies Series Resistors for switching on double fed systems and load dumping of excess power in off grid systems.

Other applications addressed by TT electronics products include:

### Output Regulation

Regulation of the power output from wind turbines which is necessary to prevent the turbine becoming overloaded in high winds.

### Power Conversion

Power conversion systems, which allow the generator to operate at variable speed, frequency and voltage while supplying power at constant frequency and voltage to the MV transformer.

### Monitor & Control

Monitoring of electrical and mechanical data from wind turbines, voltage sense resistors for the output of the voltage inverter stage, motor control for Solar PV tracking systems.

In addition to the range of standard power resistors, TT electronics also offers custom designed resistors in all major resistor technologies.



## Traction Applications

### Motor start and speed control resistors

Traditionally power resistors have been used for motor control functions in some applications, such as mining locomotives, where they provide simple, robust and reliable solutions.

### Dynamic braking

As energy efficiency becomes increasingly important in modern transportation systems there is pressure to harvest and reuse energies where possible. Traction systems using electricity for acceleration purposes are ideally suited to adopt regenerative braking, where the electric motors become generators driven by the motion of the trains, and feed the resultant electricity back to the network where it can be used to power other systems or nearby trains. In some situations it is necessary to dissipate the generated electricity via resistors located at the trackside or onboard, providing effective and passive, non-wearing resistive brakes which convert the energy to heat. TT electronics has a wide range of dynamic braking resistors.

### Crowbar resistors

Traction power supply circuits employ crowbar resistors to handle the effects of transients and longer-term over-voltage conditions. In the case of transient over-voltages the soft crowbar resistor is used to dissipate pulsed energy and for higher energies or longer-term over-voltages the hard crowbar resistor is employed to convert the energy to heat.

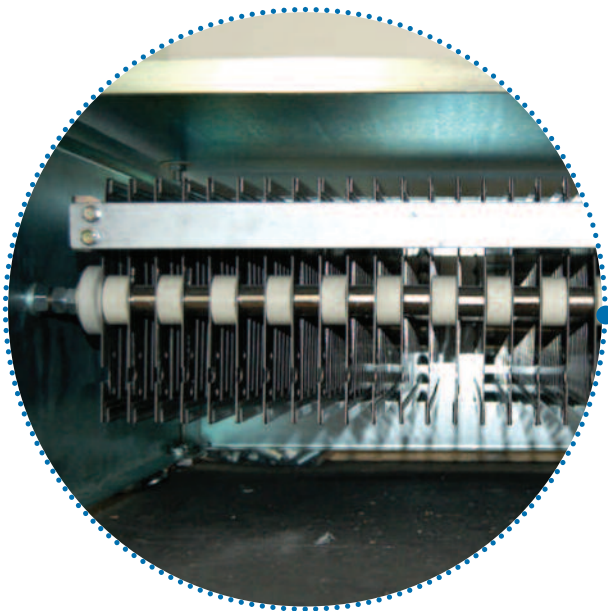
### Inrush current limit resistors

In order to electrically decouple the power supply from the drives it is common for traction systems to employ filter circuits to prevent surges and other transients getting back into the supply. In addition to inductors and capacitors it is usual to employ resistors to limit the current during charging and discharging cycles.

### Snubber resistors

Motor drive circuits employing high frequency electronic switching devices can produce potentially damaging transient voltages and back EMFs which need to be filtered out. Low inductance resistors are used, in conjunction with capacitors, to produce snubber circuits for use in the electric motor drives to remove these voltages.

# Customised Braking Resistors and Heating Products



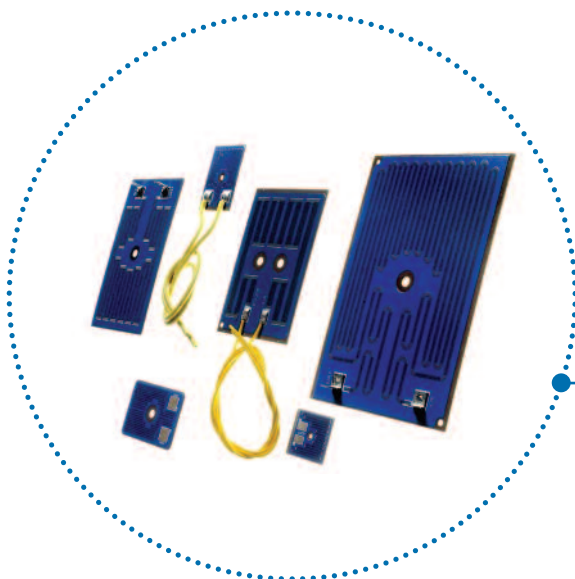
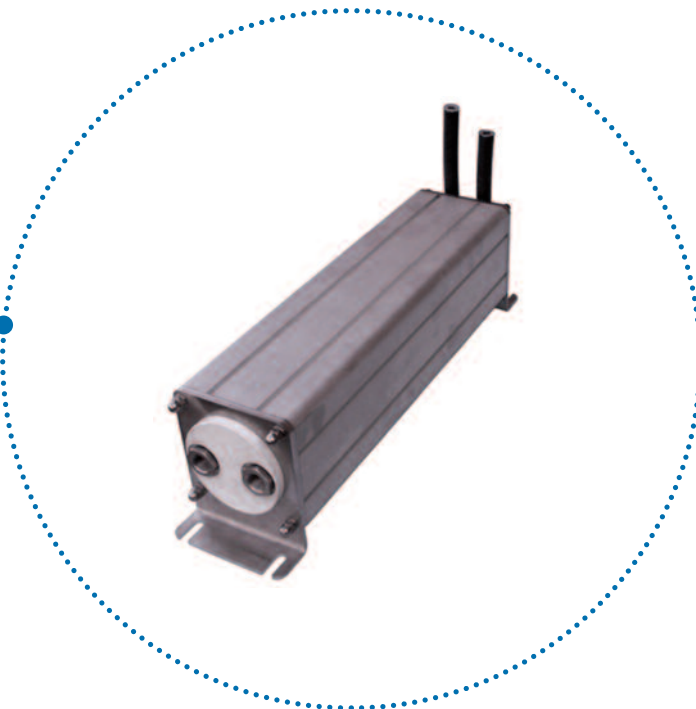
## WPCG Grid Resistors

Power (continuous)	Up to 3 kW
Overload (5s/120s)	Up to 270 kW
Thermal Capacity	94 to 164 J/K
Current Carrying (per sheet)	12A to 250A
Resistance Range (per sheet)	8mΩ to 2,4Ω

## WHB / WHHB

Extruded Aluminium housing  
Water cooled wirewound resistor

Power Range	1.5 kW – 100 kW
Dielectric Strength	Up to 20 kV AC
Working Voltage	Up to 2500VAC; 3500VDC
Insulation Resistance	>2000 Mohm



## Custom Heaters & Braking Resistors

TT electronics can supply customised Braking Resistors and Heating Solutions for most applications. Please contact our Global Applications Engineering Team with your requirements.

- Thick film heaters on steel in tubular and planar formats
- Design & test service, including UL recognition if required
- Anotherm® Insulated Aluminium planar power substrates.

# Technology and Product Sector Guide

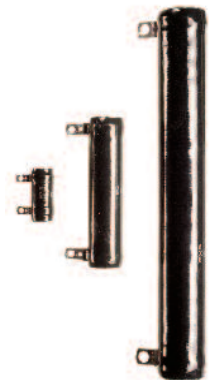
TT electronics offers a complete range of resistors manufactured with all the major technologies within its Fixed Resistors Business Unit. The high power resistors presented here are aimed at a range of applications from conventional industrial traction through to green-tech renewable energy systems. Our Applications Engineers are experts in tailoring resistor performance to meet the needs of the most demanding specifications, whatever your requirements.

Technology	Thick Film	Thick Film On Steel	Metal Film	Anotherm	Wirewound
Low Values	Good	Poor	Fair	Fair	Excellent
High Values	Excellent	Poor	Good	Poor	Poor
Tolerance	Good	Poor	Excellent	Fair	Fair
TCR	Fair	Poor	Excellent	Poor	Good
Power Rating	Good	Excellent	Fair	Good	Excellent
Voltage Rating	Excellent	Fair	Fair	Fair	Poor
Stability	Fair	Fair	Good	Fair	Fair
Overload	Good	Excellent	Fair	Fair	Good
Surge	Good	Good	Poor	Fair	Good
High Temp.	Good	Excellent	Fair	Good	Good

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# Product Capabilities

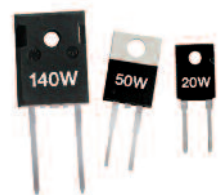
1600/1900 Series Tubular Vitreous Enamelled Wirewound Resistors						
Type	Power (watts)	Res. Range (ohms)	Tolerance (%)	Max Volts	TCR (ppm/°C)	Dim L, diam (mm)
1601	11	1 - 15k	1, 2, 5, 10	250	75 - 200	33, 17.5
1905	16	1 - 30k	1, 2, 5, 10	450	75 - 200	56.1, 14.5
1600	16.5	1 - 56k	1, 2, 5, 10	600	75 - 200	64.5, 14.5
1602	17	1 - 43k	1, 2, 5, 10	500	75 - 200	51, 17.5
1906	22	1 - 50k	1, 2, 5, 10	700	75 - 200	64.3, 17.5
1603	25	1 - 83k	1, 2, 5, 10	850	75 - 200	74.5, 17.5
1604	35	1 - 100k	1, 2, 5, 10	1300	75 - 200	102, 17.5
1605	47	1 - 100k	1, 2, 5, 10	1100	75 - 150	89.5, 24
1908	54	1 - 100k	1, 2, 5, 10	1200	75 - 150	102, 24
1607	76	1 - 100k	1, 2, 5, 10	1300	75 - 150	102, 32
1606	91	1 - 160k	1, 2, 5, 10	2100	75 - 150	166, 24
1608	115	1 - 180k	1, 2, 5, 10	2100	75 - 150	152, 32
1609	165	1 - 250k	1, 2, 5, 10	3000	75 - 150	216, 32



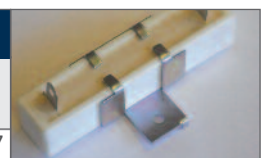
BHPR Series TO227 Low Inductance Chassis Mount Resistors						
Type	Power (watts)	Res. Range (ohms)	Tolerance (%)	Max Volts	TCR (ppm/°C)	Dim. L, W, H (mm)
BHPR 150	150	OR1 - 1K0	1, 5	-	100	38, 25, 11.8
BHPR 200	200	OR1 - 1K0	1, 5	-	100	38, 25, 11.8
BHPR 250	250	OR1 - 1K0	1, 5	-	100	38, 25, 11.8
BHPR 300	300	OR1 - 1K0	1, 5	-	100	38, 25, 11.8
BHPR 550	550	OR1 - 1K0	1, 5	-	100	38, 25, 11.8
BHPR 600	600	OR1 - 1K0	1, 5	-	100	38, 25, 11.8





MHP Series Heatsink Mount Packaged Power Resistors						
Type	Power (watts)	Res. Range (ohms)	Tolerance (%)	Max Volts	TCR (ppm/°C)	Dim. L, W, H (mm)
MHP 50	50	R01 - 51k	1, 5	500	50 - 250	TO-220
MHP 100	100	R01 - 51k	1, 5	700	50 - 250	TO-247
MHP 140	140	R01 - 51k	1, 5	700	50 - 250	TO-247

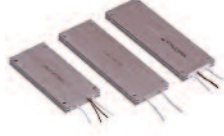


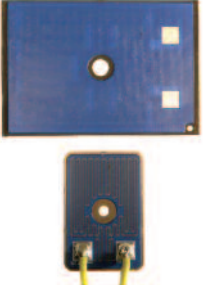
PW General Purpose Radial Terminal Resistors						
Type	Power (watts)	Res. Range (ohms)	Tolerance (%)	Max Volts	TCR (ppm/°C)	Dim. L, W, H (mm)
PW-50E	60	OR08 - 1K8	5, 10	2√PR	150	92.1, 12.7, 12.7




PWHW Automotive Dropping Resistors							
Type	Power (watts)	Res. Range (ohms)	Tolerance (%)	Max Volts	TCR (ppm/°C)	Dim. L, W, H (mm)	
PWHW 115	115	0R10 - 100R	5	2√PR	150	80.0, 36.8, 15.8	

WCCHB Series Low Profile Aluminium Housed Wirewound Resistors							
Type	Power (watts)	Res. Range (ohms)	Tolerance (%)	Max Volts	TCR (ppm/°C)	Dim. L, W, H (mm)	
WCCHB 110	650	2R2 - 200R	5, 10		100	110, 76, 15	
WCCHB 166	950	3R3 - 250R	5, 10		100	166, 76, 15	
WCCHB 216	1400	3R3 - 300R	5, 10		100	216, 76, 15	
WCCHB 270	1600	4R7 - 390R	5, 10		100	270, 76, 15	
WCCHB 320	1800	5R1 - 470R	5, 10		100	320, 76, 15	

WCDH Series Low Profile Aluminium Housed Wirewound Resistors							
Type	Power (watts)	Res. Range (ohms)	Tolerance (%)	Max Volts	TCR (ppm/°C)	Dim. L, W, H (mm)	
WCDH 600	600	2R2 - 200R	5, 10		100	102, 68, 12.5	
WCDH 900	900	3R3 - 250R	5, 10		100	145, 68, 12.5	
WCDH 1300	1300	3R3 - 300R	5, 10		100	195, 68, 12.5	

WDBR Series Ultra Low Profile High Power Resistors							
Type	Power (watts)	Res. Range (ohms)	Tolerance (%)	Max Volts	TCR (ppm/°C)	Dim. L, W, H (mm)	
WDBR 1/2	300	22R - 100R	10	-	+600	31.9, 28.1	
WDBR 1	700	12R - 150R	10	-	+600	49.3, 35.9	
WDBR 2	780	12R - 150R	10	-	+600	61.0, 40.6	
WDBR 3	900	12R - 150R	10	-	+600	102.0, 70.0	
WDBR 5	1000	12R - 150R	10	-	+600	122.0, 70.0	
WDBR 7	1490	47R - 150R	10	-	+600	152.0, 102.0	

WH Series Aluminium Housed Chassis Mount Resistors							
Type	Power (watts)	Res. Range (ohms)	Tolerance (%)	Max Volts	TCR (ppm/°C)	Dim. L, W, H (mm)	
WH 50	50	0R015 - 120K	1, 2, 5, 10	1250	50, 100	72.5, 30, 16	
WH 100	100	0R01 - 70K	1, 2, 5, 10	1900	25, 100	88, 47.5, 24.1	
WH 200	200	0R01 - 50K	1, 2, 5, 10	1900	25, 100	146, 72.5, 41.8	
WH 300	300	0R01 - 68K	1, 2, 5, 10	2500	25, 100	184, 72.5, 41.8	



# Global Sales Offices

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## North America

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