



Fixed Resistors

Product Data Short Form



Belief in Technology

TT electronics plc is a global electronics company. Within its electronic components group are multiple manufacturing facilities for fixed resistors and dedicated engineering teams providing custom solutions.

Welwyn Components, IRC and BI Technologies are three market leading companies within this group, each with a 70-year track record of resistive component innovation.

TT electronics offers the full spectrum of resistor technologies and a broad standard product range, in addition to providing custom engineered solutions.

Medical Application

A manufacturer of portable automatic external defibrillators (AEDs) needed a compact high voltage resistor for use in the charge regulation circuit. Standard products from other sources were proving unreliable under conditions of sustained high humidity and high voltage loading. The precision and stability with time and temperature were critical as they directly impact the tight error budget for delivered energy dosage. TT electronics engineers solved this problem with a planar resistor with optimised thick-film element design and a high integrity epoxy coating and supported the customer through their rigorous approval process.

Other innovations in this area include pulse withstanding chip resistors for monitor circuit protection and a 200J energy dump resistor based on reinforced wirewound technology to enable daily self-test diagnostic cycles.



Aerospace Application

A designer working on an anti-ice aircraft surface heating system had to meet stringent safety requirements in the event of failure of a heating circuit. The failure mode to be mitigated was an "always on" condition, and this called for a single shot disconnection switch. TT electronics engineers were contacted to help identify a solution, but nothing was available off the shelf. A set of potential solutions was proposed and the preferred option was a combination of self-switching resistive heater and thermal fuse. This was developed from concept into a fully qualified component within the required timescale. The compact format of the design also contributed significantly to the customer's mass reduction target.



Consumer Application

Safety is becoming increasingly important in consumer products and a key aspect is protection against fire by the use of fusing line input resistors. With one component it is possible to reduce inrush current, protect against power line surges and give flameproof circuit opening under fault conditions. One company working in this area had a further need for fusing to be inaudible and invisible to the consumer.

TT electronics devised a solution using a wirewound resistor with impact absorbing coating which contains the fused element without fragmenting. Other innovations include the offer of UL1412 recognised fusing resistors.



Industrial Application

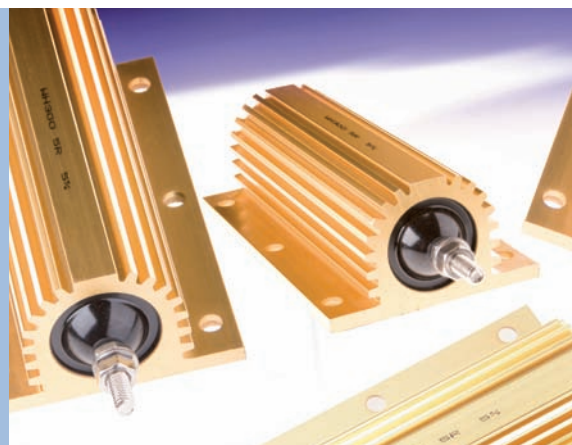
High-end industrial circuit breakers need to give reliable long-term performance under harsh conditions. In particular, transient surges caused by switching of inductive loads present a challenge. When a designer of industrial circuit breakers needed to modernise a design to SMT format, a through-hole wirewound protection resistor was proving hard to replace without filling a very large area with chip resistors. TT electronics developed a solution whereby an axial part is leadformed and packed in blister tape. The resulting "Z-form" component can be picked, placed and reflowed as an SMT part.



Using the Short Form

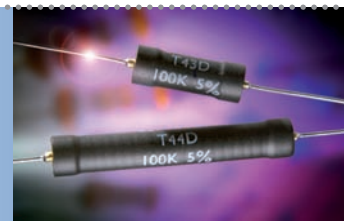
1. Choose the right technology - page 3
Find the best resistor technology for the set of features your design needs
2. Choose the right product series - pages 3 & 4
Use the SMT and Through Hole selector guides to identify a series which has the required ratings, precision and value range
3. Choose the right product type - pages 5 to 16
Refer to product tables to select the correct size and link to further data

Or, if you know the product series, use the Quick Find index.



Quick Find

Series	Page	Series	Page	Series	Page	Series	Page
1600/1900	9	HR	7	PCR	13	TD4	15
2500	5	HTCR	10	PFC	15	ULR	6
3810	6	HVC	7	PFC-HF	15	ULW	14
4500	6	HVP	7	PFC-HT	15	VRW	8
4530	6	LHVC	7	PFC-A	13	W20	11
4800	12	LOB	5	PFC-D	13	W30	9
ASC	16	L RCS	5	PHVD	7	WA80Z	11
BCS	5	LRF	5	PHVP	8	WA84F	14
BHPR	9	LRF3W	5	PLO	6	WBC	14
BPC	9	LRZ	15	PR	13	WCCHB/WCDH	11
BPR	10	MAR	12	PTCR	15	WCR	16
CAR	12	MFP	10	PTS	15	WDBR	11
CC	8	MFR	15	PWC	9	WH	12
CHP	8	MFR4P	16	PWRL	6	WHPC	12
CR	14	MF-S	10	RC	13	WHVL	8
CRT	16	MH	7	RCP	13	WL4	15
DSC	9	MHP	10	SC3	10	WMO-S	12
EMC	14	OAR	5	SMHP	10	WNCR	16
F	6	OARS	5	SOT143	13	WP-S	9
FCR	14	OLV	5	SOT23	13	WPYP	8
FM	14	PCF	13	SQM	11	WRM	14
GC	7	PCFH	13	SQP	11	WSM	12
GCR	16	PCFP	13	T	8		



Through-hole & Off-PCB Products	Power (W)					LEV (V)				TCR (ppm/°C)					Tol. (%)			Value (Ω)																	Category	Series			
	0.01	0.1	1	10	100	10	100	1000	10K	100K	≤5	10 - 15	25	50	≥100	≤0.1	0.25-0.5	1 - 2	≥5	R001	R01	R1	1R	10R	100R	1K	10K	100K	1M	10M	100M	1G	10G	100G					
Thick Film																																							
Ultra-high ohmic																																						Hv	3810
HV SIL resistor																																						Hv	4500
HV SIL divider																																						Hv	4530
TO227 power																																						Hp	BHPR
Power SIL																																						Hp	BPC
Robust power SIL																																						Hp	BPR
HV axial																																						Hv	F
Compact HV axial																																						Hv	GC
Compact HV SIL																																						Hv	HVP
TO-126, 220, 247																																						Hp	MHP
Precision SIL div.																																						Hv	PHVD
Precision SIL res.																																						Hv	PHVP
Ultra-HV axial																																						Hv	T
¼ – 1W HV axial																																						Hv	VRW
Steel power res.																																						Hp	WDBR
Precision HV axial																																						Hv	WHVL
Metal Film																																							
Low value																																						Cs	2500
High precision																																						Pr	CAR
UL1412 inrush																																						Fu	EMC
Fusible film																																						Fu	FM
Ultra precision																																						Pr	MAR
Small flameproof																																						Hp	MFP
Professional film																																						Hr	MFR
0.6W 0207 film																																						Gp	MFR4P
Flameproof film																																						Hp	MF-S
High voltage film																																						Hv	MH
Semi-precision																																						Pr	PR
Precision																																						Pr	RC
Power precision																																						Pr	RCP
Nickel film sensor																																						Ts	TD4
Metal Oxide																																							
Ceramic box vert.																																						Hp	SQM 1of2
Ceramic box hor.																																						Hp	SQP 1of2
Flameproof coat																																						Hp	WMO-S
Carbon Comp																																							
Moulded axial																																						Sg	CC
Wirewound																																							
Vitreous tubular																																						Hp	1600
Low val. hor. box																																						Cs	PLO
Low val. vert. box																																						Cs	PWRL
Ceramic box vert.																																						Hp	SQM 2of2
Ceramic box hor.																																						Hp	SQP 2of2
UL1412 inrush																																						Fu	ULW
Vitreous axial																																						Hp	W20
Flameproof pulse																																						Sg	W30
Flameproof fusing																																						Fu	WA84F
Low profile Al case																																						Hp	WCCHB...
Al clad power																																						Hp	WH
Flameproof coat																																						Sg	WP-S
Capacitor mount																																						Hv	WPYP
Metal Alloy																																							
Low value axial																																						Cs	LOB
Low value open																																						Cs	OAR
Wire shunt																																						Cs	OLV
0207 & wire links																																						Zo	WL4
Metal Foil																																							
Ultra precision																																						Pr	4800

Cs: Current Sense

Fu: Fusible

Gp: General Purpose

Hp: High Power

Hr: High Reliability

Hv: High Value / Voltage

Pr: Precision

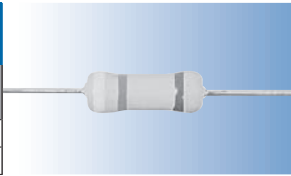
Sg: Surge / Pulse

Ts: Temperature Sensor

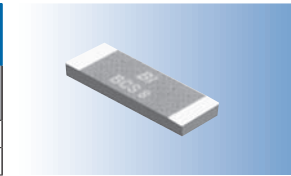
Zo: Zero-ohm Jumper

Current Sense

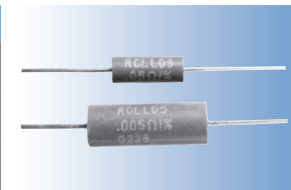
2500 Series				Low Value Metal Film Resistors		
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, dia
2504	2	R025 - 1R0	1, 2, 5, 10	-	+370	14.5 x 5.3
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/2500.PDF						



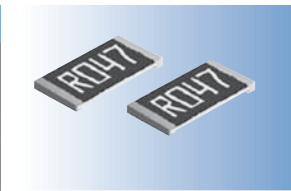
BCS Series				8W Current Sense Metal Alloy Resistors		
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, h, t
BCS8	8	R0005 - R01	1, 5	-	50	12.8, 6.4, 2.5
Datasheet - http://www.bitechnologies.com/pdfs/BCS.PDF						



LOB Series				Low Resistance Metal Element Resistors		
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, Dia
LOB-1	1	0.005 - 0.1	1 - 5	-	-	9.9, 3.6
LOB-1	1	0.005 - 0.1	1 - 5	-	-	9.9, 3.6
LOB-1	1	0.005 - 0.1	1 - 5	-	-	9.9, 3.6
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/LOB.PDF						



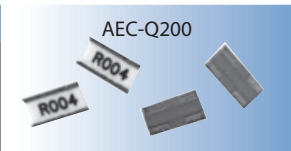
LRCS Series				Small Size Low Value Chip Resistor		
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim. (mm) l, w, h
0402	0.063	R05 - 1R0	1, 5	-	200 - 400	1, 0.5, 0.32
0603	0.1	R02 - 1R0	1, 5	-	200 - 600	1.6, 0.8, 0.45
0805	0.125, 0.25	R02 - 1R0	1, 5	-	200 - 600	2, 1.25, 0.55
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/LRCS.pdf						



LR (F) Series				Low Value Flat Chip Resistor		
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, w, h
1206	0.5	0R003 - 1R	1, 2, 5	-	±100	3.2, 1.63, .8
2010	1.0	0R003 - 1R	1, 2, 5	-	±100	5.23, 2.64, .8
2512	1.5/2.0	0R003 - 1R	1, 2, 5	-	±100	6.5, 3.25, .8
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/LRC-LRF.PDF						



LRF3W Series				Low Range 3 Watt SMT Chip Resistor		
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, w, h
LRF3W	3	0R003 - 1R	to ±1%	50	±100	3.25, 6.5, 0.9
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/LRF3W.PDF						



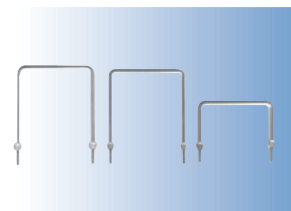
OAR Series				Open Air Sense Resistors		
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, w, h
OAR-1	1	0R005 - 0.10	1, 5	-	to ±20	11.43, 1.65, 8.26
OAR-2	3	0R005 - 0.10	1, 5	-	to ±20	15.24, 1.65, 28.58
OAR-3	5	0R005 - 0.05	1, 5	-	to ±20	20.32, 1.65, 28.58
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/OAR.PDF						



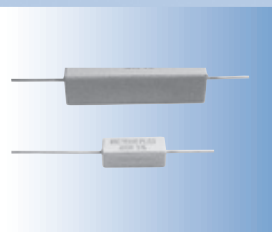
OARS / OARS-XP Series				Surface Mount Sense Resistors		
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, w, h
OARS1	2	0R003 to 0R050	1	-	±20	11.18, 3.175, 3.05
OARSXP	4	0R001 to 0R025	1, 5	-	±20	12, 6.4, 4.6
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/OARS.PDF						



OLV Series				Alloy Wire Shunt Resistors		
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Pitch, h
OLV1	1	R005 - R025	5	-	200	11.4, 7.6
OLV2	2	R005 - R05	5	-	200	12.7, 14.6
OLV3	3	R005 - 0R1	5	-	200	15.2, 22.6
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/OLV.PDF						



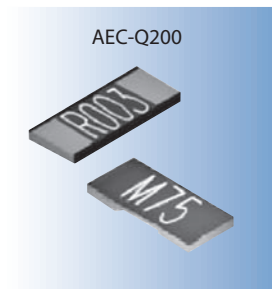
PLO Series Low Resistance Power Wirewound Resistors						
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, w, h
PLO-3	3	R005 - R18	1, 2, 3, 5, 10	-	30 - 500	22.4, 7.87, 7.87
PLO-5	5	R005 - R18	1, 2, 3, 5, 10	-	30 - 500	22.4, 9.65, 8.89
PLO-7	7	R01 - R18	1, 2, 3, 5, 10	-	30 - 500	35.3, 9.65, 8.89
PLO-10	10	R01 - R18	1, 2, 3, 5, 10	-	30 - 500	47.8, 9.65, 8.89
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/PLO.PDF						



PWRL Series Low Resistance Stand-up Power Wirewound Resistors						
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, w, h
PWRL	3, 5, 7, 10	OR01 - OR18	1, 2, 3, 5, 10	-	50 - 500	25.4, 12 (3W)
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/PWRL.PDF						

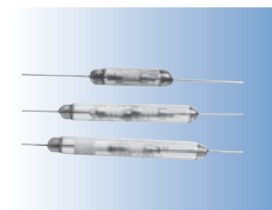


ULR Series Metal Strip Current Sense Resistors Surface Mount						
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, w, h
ULR1S	1	R001 - R01	1, 5	-	50	3.2, 1.6, 0.6
ULR1	1.0	R0005 - R015	1, 5	-	50, 75, 100, 150	6.4, 3.2, 1.4
ULR15S	1.5	R001 - R01	1, 5	-	50	5.1, 2.5, 0.6
ULR2	2.0	R0005 - R01	1, 5	-	50	6.4, 3.2, 1.4
ULR25	2.5	R0035 - R006	1, 5	-	50	6.4, 3.2, 1.4
ULR3	3.0	R0005 - R003	1, 5	-	50, 75, 100	6.4, 3.2, 1.4
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/ULR.PDF						

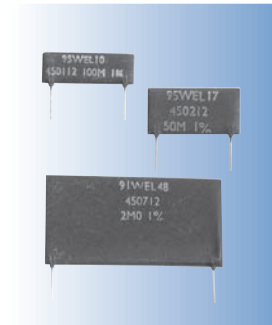


High Value / Voltage

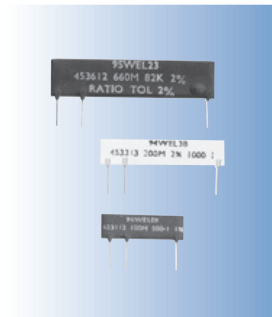
3810 Series Ultra-High Value Precision Resistors						
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, dia
3810	-	100M - 1T	10, 20	500	-500 to -3500	25, 6
3811	-	100M - 1T	1, 2, 5, 10	1000	-500 to -3500	42.9, 6
3812	-	1T - 100T	2, 5, 10	1000	-500 to -3500	48, 6
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/3810.PDF						



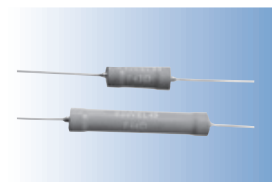
4500 Series High Voltage Planar Resistors						
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, w, h
4501	1	20K - 500M	1, 2, 5	10000	100, 150	25.7, 2, 9
4502	1.7	36K - 750M	1, 2, 5	10000	100, 150	25.7, 2, 13
4503	2	36K - 750M	1, 2, 5	15000	100, 150	38.7, 2, 9
4504	3	62K - 1G	1, 2, 5	15000	100, 150	38.7, 2, 13
4505	2.8	51K - 1G	1, 2, 5	20000	100, 150	51.2, 2, 9
4506	3.6	82K - 1G	1, 2, 5	20000	100, 150	51.2, 2, 13
4507	4.5	180K - 1.5G	1, 2, 5	20000	100, 150	51.2, 2, 25.7
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/4500.PDF						



4530 Series High Voltage Planar Dividers						
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, w, h
4531	1.0	20K - 130M	1, 2, 5	6500	100	25.7, 2, 9
4532	1.7	36K - 250M	1, 2, 5	6500	100	25.7, 2, 13
4533	2.0	36K - 250M	1, 2, 5	10000	100	38.7, 2, 9
4534	3.0	62K - 450M	1, 2, 5	10000	100	38.7, 2, 13
4535	2.8	51K - 370M	1, 2, 5	15000	100	51.2, 2, 9
4536	3.6	82K - 660M	1, 2, 5	15000	100	51.2, 2, 13
4537	4.5	180K - 1.4G	1, 2, 5	15000	100	51.2, 2, 25.7
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/4530.PDF						



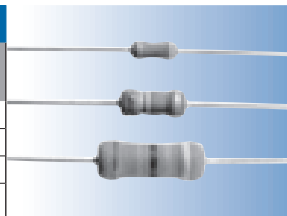
F Series High Voltage Thick Film Resistors						
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, Dia
F43	0.7	2M - 100G	2, 5, 10	4000	-2000	25.4, 8.4
F44	1.3	2M - 150G	2, 5, 10	14000	-2000	50.8, 8.4
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/F.PDF						



GC Series High Value Thick Film Resistors

Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, dia
GC55	0.25	47K - 1G	1, 2, 5	1700	100	6.2, 2.5
GC65	0.5	47K - 1G	1, 2, 5	3500	100	9, 3.6
GC70	1.0	47K - 1G	1, 2, 5	10000	100	14.5, 5.3

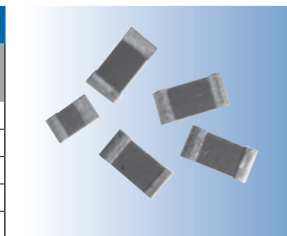
Datasheet - <http://www.welwyn-tt.com/pdf/datasheet/GC.PDF>



HR Series High Value Surface Mount Resistors

Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, w, h
0503	-	10M - 20G	10	50	0 to -2500	1.25, .63, .5
0805	-	100M - 50G	10	100	0 to -2000	2, 1.25, .6
1005	-	100M - 50G	10	150	0 to -1500	2.5, 1.25, .7
1206	-	100M - 50G	10	200	0 to -1000	3.2, 1.6, .7

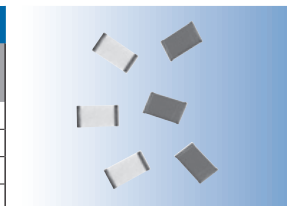
Datasheet - <http://www.welwyn-tt.com/pdf/datasheet/HR.PDF>



HVC Series High Voltage Chip Resistors

Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, w, h
1206	0.3	10K - 100M	10, 5, 2, 1	1000	100	3.2±0.4, 1.6±0.2, 0.7
2010	0.5	10K - 100M	10, 5, 2, 1	2000	100	5.1±0.3, 2.5±0.2, 0.8
2512	1	10K - 100M	10, 5, 2, 1	3000	100	6.5±0.3, 3.2±0.2, 0.8

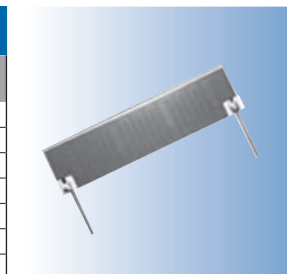
Datasheet - <http://www.welwyn-tt.com/pdf/datasheet/HVC.PDF>



HVP Series High Voltage Planar resistors

Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim. (mm) l, w, h
HVP04	0.4	1K - 250M	1, 5	2000	100	10.2, 6.4, 2
HVP06	0.6	1K5 - 500M	1, 5	5000	100	12.7, 6.4, 2
HVP08	0.8	2K - 500M	1, 5	7500	100	19.1, 6.4, 2
HVP10	1	3K - 500M	1, 5	10,000	100	25.4, 6.4, 2
HVP15	1.5	4K - 750M	1, 5	15,000	100	38.1, 6.4, 2
HVP20	2	5K - 1G	1, 5	20,000	100	50.8, 6.4, 2

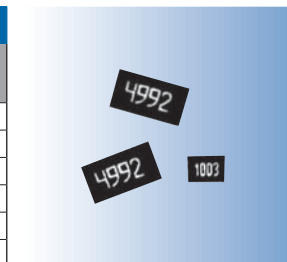
Datasheet - <http://www.welwyn-tt.com/pdf/datasheet/HVP.pdf>



LHVC Series Lower Range High Voltage Chip

Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim. (mm) l, w, h
0603	0.1	100K - 10M	1, 5	200	200	1.6, 0.8, 0.45
0805	0.125	100K - 10M	1, 5	400	200	2, 1.3, 0.55
1206	0.25	100K - 10M	1, 5	500	200	3.1, 1.6, 0.55
2010	0.5	50K - 10M	1, 5	1600	200	5, 2.5, 0.55
2512	1	50K - 10M	1, 5	2000	200	6.4, 3.2, 0.55

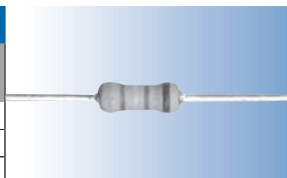
Datasheet - <http://www.welwyn-tt.com/pdf/datasheet/LHVC.pdf>



MH Series High Voltage Metal Film Resistors

Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, dia
MH25	0.25	100K - 10M	1, 2, 5	1600	100	6.2, 2.3
MH37	0.5	100K - 1M	1, 2, 5	3500	100	9, 3.7

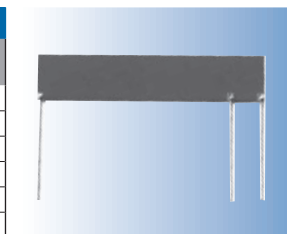
Datasheet - <http://www.welwyn-tt.com/pdf/datasheet/MH.PDF>



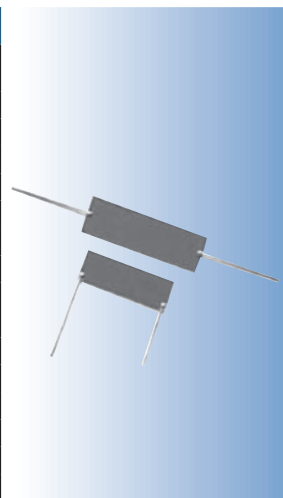
PHVD Series Precision High Voltage Divider

Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim. (mm) l, h, w
PHVD10	0.75	1K - 7G	0.1, 0.25, 0.5, 1	10,000	25, 50	25.4, 7.6, 2.5
PHVD15	1.5	1K - 10G		15,000		38.1, 12.7, 2.5
PHVD20	2.5	1K - 20G		20,000		50.8, 15.2, 2.5
PHVD30	3.5	1K - 30G		30,000		76.2, 15.2, 2.5
PHVD40	4.5	1K - 40G		40,000		101.6, 15.2, 2.5

Datasheet - <http://www.welwyn-tt.com/pdf/datasheet/PHVD.PDF>



PHVP Series				Precision High Voltage Planar Resistor		
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim. (mm) l, h, w
PHVP5	1	1K – 3G	0.1, 0.25, 0.5, 1	5000	15, 25, 50	12.7, 5.1, 2
PHVP7	0.8	1K – 1G		7000		20.3, 3.8, 2
PHVP7B	1	1K – 2G5		7000		20.3, 5.1, 2.5
PHVP10	1	1K – 1G5		10,000		25.4, 3.8, 2
PHVP10B	1.3	1K – 3G5		10,000		25.4, 5.1, 2.5
PHVP10C	2	1K – 7G		10,000		25.4, 7.6, 2.5
PHVP15	1.5	1K – 4G		15,000		38.1, 3.8, 2
PHVP15B	2	1K – 5G		15,000		38.1, 5.1, 2.5
PHVP15C	3	1K – 10G		15,000		38.1, 12.7, 2.5
PHVP20	2	1K – 7G		20,000		50.8, 5.1, 2
PHVP20B	3	1K – 10G		20,000		50.8, 6.4, 2.5
PHVP20C	4.5	1K – 20G		20,000		50.8, 15.2, 2.5
PHVP30	6.5	1K – 30G		30,000		76.2, 15.2, 3
PHVP40	9	1K – 40G		40,000		101.6, 15.2, 3
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/PHVPPDF						



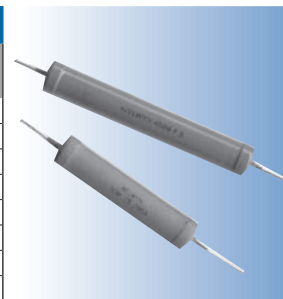
T Series High Voltage Precision Thick Film Resistors						
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, dia
T43	1.5	10K - 10G	1, 2, 5	4000	25, 50, 100	25.4, 8.4
T44	3.5	10K - 50G	1, 2, 5	14000	25, 50, 100	50.8, 8.4
T48	10	33K - 50G	1, 2, 5	50000	25, 50, 100	150, 8.4
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/T.PDF						



VRW Series High Voltage Thick Film Resistors						
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) L, D
VRW25	0.25	100K to 30M	1, 2, 5	1600	200	6.2, 2.5
VRW37	0.5	100K to 10M	1, 2, 5	3500	200	9.0, 3.7
VRW68	1	100K – 68M	1, 2, 5	10000	200	15.5, 5
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/VRW.PDF						



WHVL Series			Precision Low Inductance High Voltage Resistors			
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim. (mm) l, dia
WHVL2	2.9	1K – 100G	0.1, 0.25, 0.5, 1	11,000	15, 25, 50	27, 8
WHVL3	3.8	1K – 100G		14,000		37, 8
WHVL5	5.6	1K – 100G		22,000		52, 8
WHVL7	7.5	1K – 100G		33,000		77, 8
WHVL10	10	1K – 100G		45,000		102, 8.3
WHVL12	12	1K – 100G		54,000		122, 8.5
WHVL15	15	1K – 100G		67,000		152, 8.5
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/WHVL.PDF						

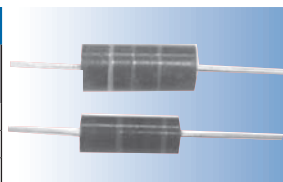


WPYP Series Capacitor Mount Balance/ Bleed Resistor						
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim. (mm) Pitch
WPYP8	10	1R0 – 82K	1, 2, 5	685	100	22
WPYP10	13	1R0 – 120K	1, 2, 5	940	100	31.8
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/WPYP.pdf						

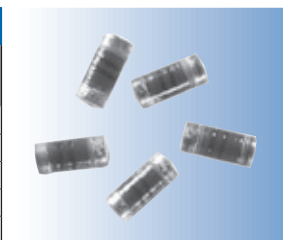


Surge / Pulse

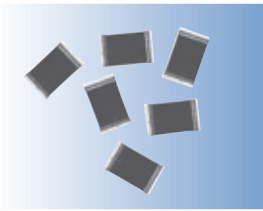
CC Series Carbon Composition Resistors						
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim. (mm) l, dia
CC1	1	100R – 50K	10, 20	-	1000	15, 6
CC2	2	100R – 10K	10, 20	-	1000	18, 8
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/CC.pdf						



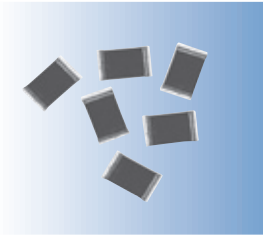
CHP Series Metal Glaze™ Surface Mount Power Resistors						
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, dia
CHP1/8	0.25	0R1 – 1M	1, 2, 5	200	50, 100	3.25, 1.45
CHP1/2	0.5	0R1 – 350K	1, 2, 5	300	50, 100	5.08, 2.01
CHP1	1	0R1 – 2M2	1, 2, 5	350	50, 100	6.38, 2.10
CHP2	1.33	0R1 – 2M2	1, 2, 5	500	50, 100	9.32, 2.67
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/CHP.PDF						



DSC Series						Double Sided Chip
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, w, h
1206	0.33	1R0 - 4M7	0.5, 1, 2, 5	200	100 - 200	3.2, 1.6, 0.7
2010	0.75	1R0 - 4M7	0.5, 1, 2, 5	400	100 - 200	5.1, 2.5, 0.8
2512	1.5	1R0 - 4M7	0.5, 1, 2, 5	500	100 - 200	6.5, 3.2, 0.8
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/DSC.PDF						



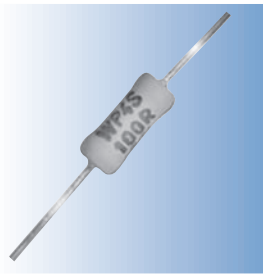
PWC Series						Pulse Withstanding Chip Resistors
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, w, h
0805	0.125	1R0 - 10M	0.5, 1, 2, 5	150	100 - 200	2.0, 1.25, 2.0
1206	0.33	1R0 - 10M	0.5, 1, 2, 5	200	100 - 200	3.2, 1.6, 0.7
2010	0.75	1R0 - 10M	0.5, 1, 2, 5	400	100 - 200	5.1, 2.5, 0.8
2512	1.5	1R0 - 10M	0.5, 1, 2, 5	500	100 - 200	6.5, 3.2, 0.8
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/PWC.PDF						



W30 Series						Flameproof Wirewound Resistor
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, dia
W31	3	R01 - 10K	<R1: 5 ≥R1: 1, 2, 5	500	100 - 1000	13, 5.6
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/W30.PDF						

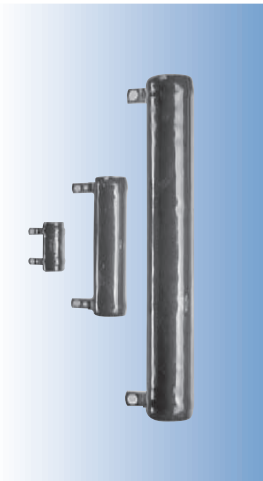


WP-S Series						Compact Flameproof Power Wirewound Resistors
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, dia
WP1S	1	R068 to 430R	<20r: 5 ≥20R: 1,2,5	50	<1R: 350 ≥1R: 200	6.2, 2.8
WP2S	2	R05 to 900R	<20r: 5 ≥20R: 1,2,5	50	<1R: 350 ≥1R: 200	9.0, 3.6
WP25S	2.5	R05 to 900R	<20r: 5 ≥20R: 1,2,5	75	<1R: 350 ≥1R: 200	12.5, 4.5
WP3S	3	R01 to 2K2	<20r: 5 ≥20R: 1,2,5	100	<1R: 350 ≥1R: 200	14.5, 5.2
WP4S	4	R01 to 10K	<R10:5 ≥R10: 1,2,5	100	<1R: 350 ≥1R: 200	13, 5.6
WP5S	5	R015 to 6K8	<20r:5 ≥20R: 1,2,5	150	<1R: 350 ≥1R: 200	16.5, 7.0
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/WP-S.PDF						



High Power

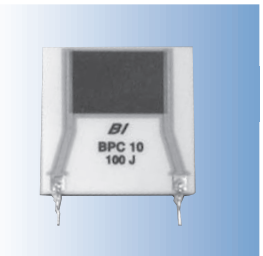
1600/1900 Series						Tubular Vitreous Enamelled Wirewound Resistors
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, dia
1601	11	1 - 15K	1, 2, 5, 10	250	75 - 200	33, 17.5
1905	16	1 - 30K	1, 2, 5, 10	450	75 - 200	56.1, 14.5
1600	16.5	1 - 56K	1, 2, 5, 10	600	75 - 200	61.5, 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
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/1600-1900.PDF						



BHPR Series						TO-227 High Power Single/Dual Resistors
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, w, h
BHPR	150, 200, 250, 300, 550, 600	OR1 - 1K0	1, 5	-	100	38, 25, 11.8
Datasheet - http://www.bitechnologies.com/pdfs/BHPR.PDF						



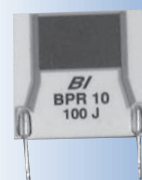
BPC Series						Planar Power Resistors
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, h, t
BPC3	3	OR1 - 200K	1, 2, 5, 10	500	100	10.2, 27.7, 2.5
PBC5	5	OR1 - 200K	1, 2, 5, 10	500	100	12.7, 27.7, 2.5
BPC7	7.5	OR1 - 200K	1, 2, 5, 10	500	100	19.1, 27.7, 2.5
BPC10	10	OR1 - 200K	1, 2, 5, 10	500	100	25.4, 27.7, 2.5
Datasheet - http://www.bitechnologies.com/pdfs/BPC.PDF						



BPR Series

Vibration-proof Planar Power Resistors

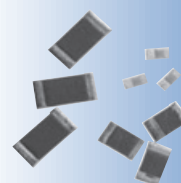
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, h, t
BPR3	3	0R1 - 200K	1, 2, 5	500	100	12.7, 17, 6.1
PBR5	5	0R1 - 200K	1, 2, 5	500	100	12.7, 27.2, 6.1
BPR7	7	0R1 - 200K	1, 2, 5	500	100	25.4, 20.8, 6.1
BPR10	10	0R1 - 200K	1, 2, 5	500	100	25.4, 27.2, 6.1
BPR20	20	0R1 - 200K	1, 2, 5	500	100	50.8, 27.2, 6.1
BPR30	30	0R1 - 200K	1, 2, 5	500	100	53.3, 37.3, 6.1
BPR40	40	0R1 - 200K	1, 2, 5	500	100	53.3, 50.0, 6.1
BPR50	50	0R1 - 200K	1, 2, 5	500	100	53.3, 57.7, 6.1

Datasheet - <http://www.bitechnologies.com/pdfs/BPR.PDF>

HTCR Series

High Temperature Chip Resistors

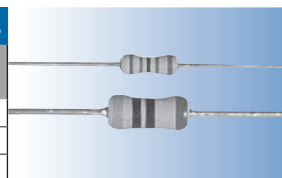
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, h, t
0805	0.125	1R0 - 10M	1, 5	150	100 - 200	2, 1.3, 0.5
1206	0.25	1R0 - 10M	1, 5	200	100 - 200	3.2, 1.6, 0.5
2010	0.625	1R0 - 10M	1, 5	400	100 - 200	5, 2.5, 0.65
2512	1	1R0 - 10M	1, 5	500	100 - 200	6.3, 3.2, 0.65

Datasheet - <http://www.welwyn-tt.com/pdf/datasheet/HTCR.PDF>

MFP Series

Flameproof Power Metal Film Resistors

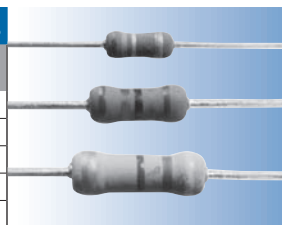
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, dia
MFP1	1	0R1 - 1M	1, 2, 5	350	100, 200, 300	6.2, 2.5
MFP2	2	1R0 - 1M	1, 2, 5	350	100	10, 4

Datasheet - <http://www.welwyn-tt.com/pdf/datasheet/MFP.PDF>

MF-S Series

Power Metal Film Resistors

Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, dia
MF1/2S	0.5	0R1 - 1M	1, 2, 5, 10	350	150 - 350	6.2, 2.5
MF1S	1.0	0R1 - 1M	1, 2, 5, 10	350	150 - 350	9, 3.6
MF2S	2.0	0R1 - 470K	1, 2, 5, 10	350	150 - 350	12.5, 4.2
MF3S	3.0	0R1 - 470K	1, 2, 5, 10	350	150 - 350	14.5, 5.3

Datasheet - <http://www.welwyn-tt.com/pdf/datasheet/MF-S.PDF>

MHP Family

Heatsink Mount Packaged Power Resistors

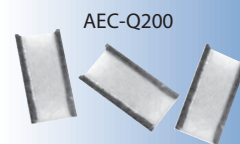
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Package
MHP20S	20	R01 - 51K	1, 5	-	50 - 250	TO-126
MHP20	20	R01 - 51K	1, 5	500	50 - 250	TO-220
MHP35	35	R01 - 51K	1, 5	500	50 - 250	TO-220
MHP50	50	R01 - 51K	1, 5	500	50 - 250	TO-220
MHP100	100	R01 - 51K	1, 5	700	50 - 250	TO-247
MHP140	140	R01 - 51K	1, 5	700	50 - 250	TO-247

Datasheets - <http://www.bitechnologies.com/power/index.htm>

SC3 Series

High Power Chip Resistor

Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, w, h
SC3	3	1R0 - 10K	1, 2, 5	50	100	3.25, 6.5,

Datasheet - <http://www.welwyn-tt.com/pdf/datasheet/SC3.PDF>

SMHP Series

TO-263 Packaged Power Resistors

Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, w, h
SMHP	20	R01 - 51K	1, 5	500	50 - 250	10.3, 10.1, 4.5

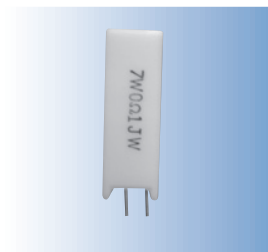
Datasheet - <http://www.bitechnologies.com/pdfs/SMHP.PDF>

SQM Series

Ceramic Case Pluggable Resistor

Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim. (mm) h, w, d
SQM2	2	0R1 – 33K	5	150	350, 400	20, 11.5, 7.5
SQM3	3	0R1 – 56K	5	300	350, 400	25, 12.5, 8.5
SQM5	5	0R1 – 100K	5	350	350, 400	25, 12.5, 9
SQM7	7	0R1 – 200K	5	500	350, 400	38, 12.5, 9
SQM10	10	0R1 – 200K	5	750	350, 400	50, 12.5, 9

Datasheet - <http://www.welwyn-tt.com/pdf/datasheet/SQM.pdf>

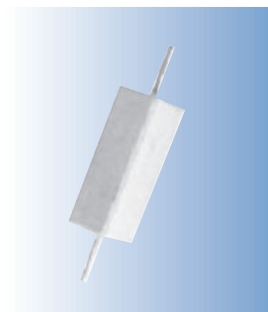


SQP Series

Ceramic Case Resistors - Wirewound / Metal Oxide

Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, w, h
SQP2	2	0R1-47K	5	150	WW types, <0R68, 1700ppm; ≥0R68, 200ppm; MO types all values 350ppm	18, 7, 7
SQP3	3	0R1-47K	5	300		22, 8, 8
SQP5	5	0R1 - 47K	5	350		22, 10, 10
SQP7	7	0R1 - 47K	5	500		35, 10, 10
SQP10	10	0R1 - 68K	5	750		48, 10, 10
SQP15	15	0R1 - 68k	5	1000		48, 13, 13
SQP20	20	0R1-100K	5	1000		60, 14.5, 14.5

Datasheet - <http://www.welwyn-tt.com/pdf/datasheet/SQP.PDF>



W20 Series

Vitreous Enamelled Wirewound Resistors

Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, dia
W21	3.0	0R1 - 10K	1, 2, 5	100	+75 to 200	12.7, 5.6
W215	5.0	0R1 - 15K	1, 2, 5	160	+75 to 200	22, 7
W22	7.0	0R1 - 22K	1, 2, 5	200	+75 to 200	22, 8
W23	10.5	0R15 - 60K	1, 2, 5	500	+75 to 200	38, 8
W24	14.0	0R2 - 100K	1, 2, 5	750	+75 to 200	53.5, 8

Datasheet - <http://www.welwyn-tt.com/pdf/datasheet/W20.PDF>

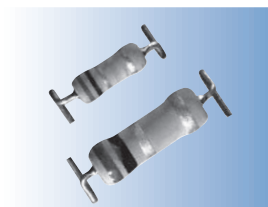


WA80Z Series

Cement Coated Surface Mount Wirewound Resistors

Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, w, h
WA83Z	2	0.05 - 900R	<0R1:5,10	50	<1R: 350 1R: 200	13.4±0.2, 3.6, 6.2
WA84Z	3	0.01 - 2K2	≥0R1:1,2,5,10	100	<1R: 350 1R: 200	18.7±0.2, 5.2, 7.0
WA85Z	5	0.015 - 6K8	1, 2, 5, 10	150	<1R: 350 1R: 200	18.7, 7.0, 7.9

Datasheet - <http://www.welwyn-tt.com/pdf/datasheet/WA80Z.PDF>

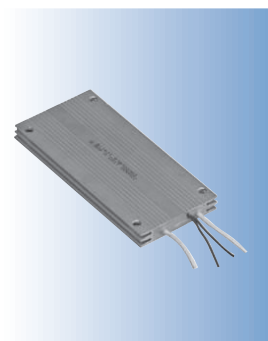


WCCHB / WCDH Series

Low Profile Aluminium Housed Wirewound Resistors

Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, w, h
WCDH600	600	2R2 - 200R	5, 10	-	100	102, 68, 12.5
WCCHB110	650	2R2 - 200R	5, 10	-	100	110, 76, 15
WCDH900	900	3R3 - 250R	5, 10	-	100	145, 68, 12.5
WCCHB166	950	3R3 - 250R	5, 10	-	100	166, 76, 15
WCDH1300	1300	3R3 - 300R	5, 10	-	100	195, 68, 12.5
WCCHB216	1400	3R3 - 300R	5, 10	-	100	216, 76, 15
WCCHB270	1600	4R7 - 390R	5, 10	-	100	270, 76, 15
WCCHB320	1800	5R1 - 470R	5, 10	-	100	320, 76, 15

Datasheet - <http://www.welwyn-tt.com/pdf/datasheet/WCCHB.PDF>



WDBR Series

Ultra Low Profile Dynamic Braking Resistors

Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, w
WDBR1/2	300	22R - 100R	10	-	+500 - +600	31.9, 28.1
WDBR1	700	12R - 150R	10	-	+500 - +600	49.3, 35.9
WDBR2	780	12R - 150R	10	-	+500 - +600	61, 40.6
WDBR3	900	12R - 150R	10	-	+500 - +600	102, 70
WDBR5	1000	12R - 150R	10	-	+500 - +600	122, 70
WDBR7	1490	47R - 150R	10	-	+500 - +600	152, 102

Datasheet - <http://www.welwyn-tt.com/pdf/datasheet/WDBR.PDF>

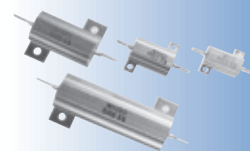


WH Series Aluminium Housed Wirewound Resistors

Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, w, h
WH5	10	0R01 - 10K	1, 2, 5, 10	150	50, 100	30, 17, 9
WH10	15	0R01 - 20K	1, 2, 5, 10	250	50, 100	36.5, 21, 11
WH25	25	0R01 - 44K	1, 2, 5, 10	500	50, 100	51, 28, 15
WH50	50	0R015 - 120K	1, 2, 5, 10	1250	50, 100	72.5, 30, 16
WH100	100	0R01 - 70K	1, 2, 5, 10	1900	25, 100	88, 47.5, 24.1
WH200	200	0R01 - 50K	1, 2, 5, 10	1900	25, 100	146, 72.5, 41.8
WH300	300	0R01 - 68K	1, 2, 5, 10	2500	25, 100	184, 72.5, 41.8

Datasheet - <http://www.welwyn-tt.com/pdf/datasheet/WH.PDF>

CECC 40203-006



WHPC Series High Power Chip

Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim. (mm) l, w, h
1206	0.5	1R - 10M	1, 5	200	100 - 200	3.1, 1.6, 0.55
0612	0.5	1R - 1M	1, 5	200	100 - 400	1.6, 3.2, 0.55
2010	1	1R - 10M	1, 5	200	100 - 200	5, 2.5, 0.55
1020	1	1R - 1M	1, 5	200	100 - 400	2.5, 5, 0.55
1218	1	1R - 1M	1, 5	200	100 - 400	3.1, 4.6, 0.55
1225	1.5	1R - 1M	1, 5	200	100 - 400	3.1, 6.3, 0.55

Datasheet - <http://www.welwyn-tt.com/pdf/datasheet/WHPC.pdf>



WMO-S Series Flameproof Metal Oxide Resistors

Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, dia
WMO1/2S	0.5	10R - 100K	5	250	350	7.5, 3
WMO1S	1.0	10R - 120K	5	350	350	10, 4.5
WMO1S	1.0	10R - 150K	5	350	350	10, 4.5
WMO3S	3.0	10R - 150K	5	350	350	16, 5.5
WMO5S	5.0	10R - 180K	5	500	350	26, 8.5
WMO7S	7	20R - 150K	5	750	350	32, 8.5

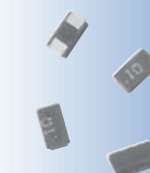
Datasheet - <http://www.welwyn-tt.com/pdf/datasheet/WMO-S.PDF>



WSM Series Moulded Surface Mount Wirewound Resistors

Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, w, h
WSM1	1	0R01 - 1K	1, 2, 5, 10	100	20 - 100	7.9, 7, 3.94
WSM2	2	0R01 - 2K	1, 2, 5, 10	100	20 - 100	12, 10.5, 5.5
WSM3	3	0R01 - 3K	1, 2, 5, 10	100	20 - 200	18, 16, 6.5

Datasheet - <http://www.welwyn-tt.com/pdf/datasheet/WSM.PDF>



Precision

4800 Series Ultra Precision Bulk Metal Foil Resistors

Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, w, h
4802/12/32	0.5	1R0 to 100K	0.005, 0.01	200	5	8.9, 10.2, 3.8, 7.5, 8, 2.5
4804	1	0R5 to 200k	0.02, 0.05	350	5	9.7 5.4 9.7
4805	1.5	33R0 to 300K	0.01, 0.25, 0.5, 1	500	5	22.6, 13.2, 3.8

Datasheet - <http://www.welwyn-tt.com/pdf/datasheet/4800.PDF>



CAR Series Ultra Precision Metal Film Resistors

Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, dia
CAR5	0.25	10R0 - 3M	0.01, 0.02,	250	5, 10,	7.2, 2.5
CAR6	0.33	10R0 - 5M	0.05, 0.1,	350	15, 25,	10, 3.7
CAR7	0.5	10R0 - 10M	1.0	500	50	15.5, 5.5

Datasheet - <http://www.welwyn-tt.com/pdf/datasheet/CAR.PDF>



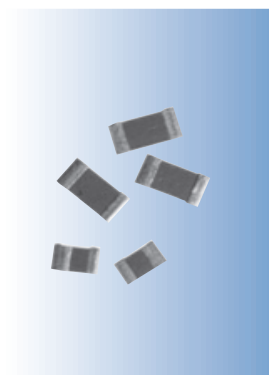
MAR 40/42 Series Ultra Precision Metal Film Resistors

Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, w, h
MAR 40	0.3	20R0 - 400K	0.005, 0.01	250	2, 5	7.75, 3.3, 8.64
MAR 42			0.02, 0.05			8.25, 3.3, 8.64

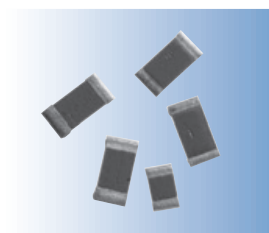
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/MAR_40-42.PDF



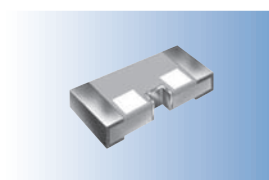
PCF Series				Precision Surface Mount Resistor		
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, w, h
0201	0.031	50R - 33K	0.5, 1	15	25, 50	0.6, 0.3, 0.26
0402	0.063	10R - 205K	0.01 - 0.5	25	5 - 50	1, 0.5, 0.4
0603	0.063	2R - 1M	0.01 - 0.5	50	5 - 50	1.6, 0.8, 0.55
0805	0.1	1R - 2M	0.01 - 0.5	100	5 - 50	2, 1.3, 0.65
1206	0.125	1R - 2M5	0.01 - 0.5	150	5 - 50	3.2, 1.6, 0.65
1210	0.2	1R - 2M5	0.01 - 0.5	150	5 - 50	3.2, 2.6, 0.5
2010	0.25	1R - 3M	0.01 - 0.5	150	5 - 50	4.9, 2.4, 0.65
2512	0.5	1R - 3M	0.01 - 0.5	150	5 - 50	6.3, 3.1, 0.65
High Power (PCFH), Extended High Power (PCFX) and Passivated (PCFP) versions available						
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/PCF.pdf						



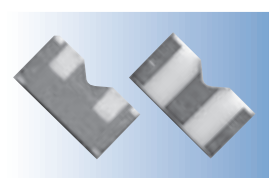
PCR Series				Precision Thick Film Surface Mount Resistors		
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, w, h
0805	0.1	10R - 1M	0.1 - 1	100	50	2, 1.25, .6
1005	0.125	10R - 1M	0.1 - 1	150	50	2.5, 1.25, .7
1206	0.25	10R - 1M	0.1 - 1	200	50	3.2, 1.6, .7
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/PCR.PDF						



PFC-A Series				TaNFilm® Precision Chip Attenuator	
Type	Power (watts)	Atten, Range (dB)	impedance (ohms)	Tolerance (dB)	Dim.(mm) l, w, h
1206	0.125	1 -20	50, 75	0.3	3.2, 1.6 0.6
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/PFC-A.pdf					



PFC-D Series				Precision 1206 Resistive Dividers		
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, w, t
PFC-D	0.25	10R - 200K	0.05, 0.1, 0.5, 1	100	25, 50, 100	3.2, 1.6, 0.6
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/PFC-DIVIDER.PDF						



PR Series				Precision Metal Film Resistors		
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, dia
PR4	0.25	100R - 1M	0.1, 0.25,	250	15, 25, 50	6.2, 2.5
PR5	0.5	100R - 1M	0.5, 1	350	15, 25, 50	9, 3.6
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/PR.PDF						



RC Series				Precision Metal Film Resistors		
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, dia
RC55	0.25	1R - 4M	0.05, 0.1, 0.25, 0.5	350	5, 10, 15, 25, 50, 100	7.2, 2.5
RC65	0.5	1R - 4M		350		10, 3.7
RC70	1.0	1R - 10M		500		15.5, 5.5
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/RC.PDF						



RCP Series				Precision Metal Film Resistors		
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, dia
RC55P	0.5	1R - 4M	0.05, 0.1, 0.25, 0.5	350	5, 10, 15, 25, 50, 100	7.2, 2.5
RC65P	1.0	1R - 4M		500		10, 3.7
RC70P	1.5	1R - 10M		500		15.5, 5.5
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/RCP.PDF						



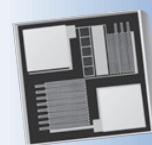
SOT143 Series				4 Pin SMT Package		
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, w, h
SOT	0.25	10R - 100K	0.05	100	Track ±5	2.9, 1.3, 1
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/SOT143.pdf						



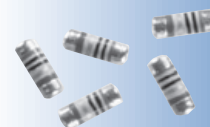
SOT23 Series				Surface Mount Divider Network		
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, w, h
SOT	0.25	10R - 200K	0.05	100	Track ±5	2.9, 1.3, 1
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/SOT23.pdf						



TaNSil® Wire Bondable Silicon Chip Resistors						
WBC Series	Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)
	0202	0.25	10R - 100K	to 0.05	100	±25
	0303	0.25	10R - 100K	to 0.05	100	Track 2
Dim.(mm) l, w, h						
0.51, 0.51						
0.76, 0.76						
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/WBC.PDF						

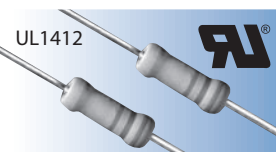


WRM Series						Mini Melf Resistors
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, dia
0102	0.2	R22 - 2M21	0.1, 0.25, 0.5, 1, 2, 5	150	15, 25, 50	2.2, 1.1
0204	0.25	R22 - 5M1		200	5, 15, 25, 50	3.6, 1.4
0207	0.4	R16 - 10M		250	25, 50	6, 2.2
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/WRM.PDF						

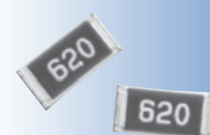


Fusible

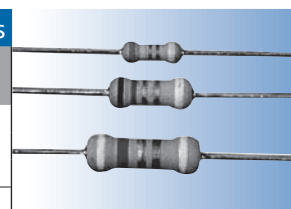
Pulse Withstanding Fusible Flameproof Metal Film Resistors						
EMC Series	Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)
	EMC2	2	4R7 - 68R	10, 20	-	100
Dim.(mm) l, dia						
10, 4						
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/EMC.PDF						



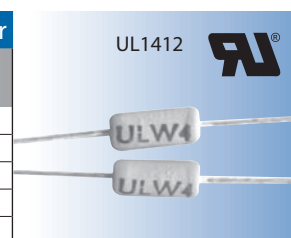
Fusing Surface Mount Resistors						
FCR Series	Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)
	0603	0.063	5R6 - 33R	±5	-	±500
	0805	0.1	10R - 82R	±5	-	±500
	1206	0.125	10R - 82R	±5	-	±500
	1210	0.25	10R - 300R	±5	-	±500
	2010	0.5	10R - 100R	±5	-	±500
Dim.(mm) l, w, h						
1.6, 0.8, 0.7						
2, 1.3, 0.7						
3.2, 1.6, 0.7						
3.2, 2.6, 0.70						
5, 2.5, 0.71						
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/FCR.PDF						



Fusible Metal Film Resistors						
FM Series	Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)
	FM1/4	0.25	0R1 - 10K	5	250	250
	FM1/2	0.5	0R1 - 27K	5	350	250
	FM1	1	0R2 - 1K5	5	350	250
Dim.(mm) l, dia						
6.2, 2.3						
9, 3.4						
12.5, 4.2						
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/FM.PDF						



UL1412 Wirewound Mains Input Resistor						
ULW Series	Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)
	ULW2	2	22R - 100R	5	-	200
	ULW3	3	10R - 100R	5	-	200
	ULW4	4	10R	5	-	200
	ULW5	5	4R7 - 100R	5	-	200
Dim. (mm) l, dia						
9, 3.6						
14.5, 5.2						
13, 5.6						
16.5, 7.2						
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/ULW.pdf						



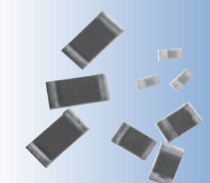
Fusible Wirewound Resistors						
WA84F Series	Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)
	WA84F	1.6	0R2 - 30R	5	100	100 - 350
Dim.(mm) l, dia						
14.5, 5.2						
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/WA84F.PDF						



High Reliability

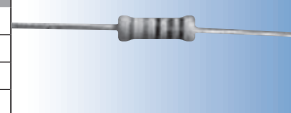
Surface Mount Resistors						
CR Series	Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)
	0503	0.063	1R - 10M	0.1 - 5	50	100
	0805	0.125	1R - 100M	0.1 - 5	100	100
	1005	0.125	1R - 100M	0.1 - 5	150	100
	1206	0.25	1R - 100M	0.1 - 5	200	100
	2010	0.5	1 - 1M	0.1 - 5	400	100
	2512	1.0	1 - 1M	0.1 - 5	500	100
Dim.(mm) l, w, h						
1.25, .63, .5						
2, 1.25, .6						
2.5, 1.25, .7						
3.2, 1.6, .7						
5.1, 2.5, .7						
6.5, 3.2, .7						
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/CR.PDF						

CECC 40401-003/004/008



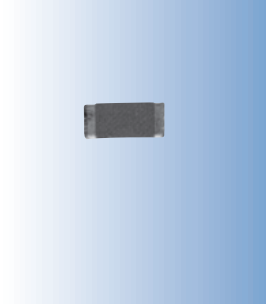
MFR Series						Metal Film Resistors
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, dia
MFR3	0.4	1R0 - 1M	1	200	50	3.5, 1.8
MFR4	0.5	1R0 - 1M	0.5, 1	350	50	6.2, 2.5
MFR5	0.75	1R0 - 1M	0.5,	350	100 - 150	9, 3.6
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/MFR.PDF						

CECC 40101-019/803



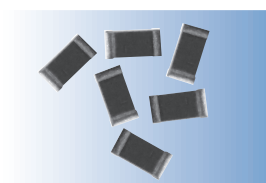
PFC Series						TaNFilm® Precision Chip Resistors
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, w, h
0402	0.05	50R - 30K	0.1 - 5	75	25 - 100	1, 0.5, 0.3
0603	0.1	5R - 100K	0.02 - 5	75	10 - 100	1.6, 0.8, 0.5
0805	0.25	5R - 267K	0.02 - 5	100	10 - 100	2.1, 1.3, 0.5
1206	0.33	5R - 1M	0.02 - 5	200	10 - 100	3.2, 1.6, 0.6
1505	0.35	5R - 1M	0.02 - 5	100	25 - 100	3.9, 1.3, 0.6
2010	0.8	5R - 1M	0.02 - 5	175	25 - 100	5.2, 2.6, 0.6
2512	1	5R - 1M	0.02 - 5	200	25 - 100	6.5, 3.1, 0.6
High Temperature (PFC-HT) and High Frequency (PFC-HF) versions available						
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/PFC.pdf						
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/PFC-HT.pdf						
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/PFC-HF.pdf						

MIL-PRF-55342

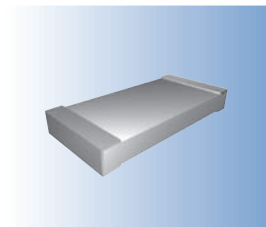


Temperature Sense

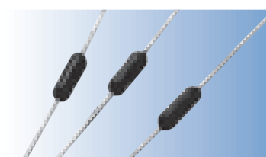
PTCR Series						PTC Thermistor Chip
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim (mm) l, w, h
0805	0.1	10R - 400R	2, 5, 10	100	2200 - 3500	2, 1.25, 0.6
1206	0.2	10R - 800R	2, 5, 10	200	2200 - 3500	3.2, 1.6, 0.7
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/PTCR.PDF						



PTS Series						Platinum Film Temperature Sensors
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, w, t
0603	-	1K0	0.12, 0.24	-	+3850	1.6, 0.8, 0.5
0805	-	100R & 1K0	0.12, 0.24	-	+3850	2.1, 1.3, 0.5
1206	-	100R & 1K0	0.12, 0.24	-	+3850	3.2, 1.6, 0.6
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/RTD.PDF						



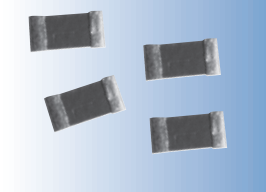
TD4 Series						Nickel Film Temperature Sensor
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, dia
TD4	-	20R - 1K	1.0, 2.0, 4.0	-	6000	7.2, 2.5
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/TD4.PDF						



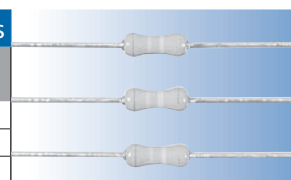
Zero-Ohm Jumper

LRZ Series						High Current Jumper Chip
Type	Current (amps)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, w, t
0805	15	0.003 max	-	-	-	2.0, 1.25, 0.61
1206	20	0.003 max	-	-	-	3.2, 1.25, 0.61
2010	30	0.003 max	-	-	-	5.23, 2.64, 0.74
2512	35	0.003 max	-	-	-	6.5, 3.25, 0.74
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/LRZ.pdf						

AEC-Q200

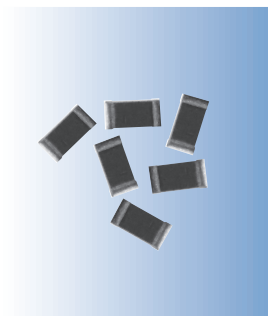


WL4 Series						Jumper Resistors
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, dia
WL4	-	0.012 max	-	-	-	6.2, 2.3
WLT	Wire link taped, 0.6 / 0.7 / 0.8mm dia x 52mm					
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/WL4.PDF						

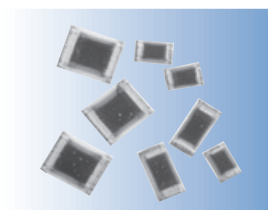


General Purpose

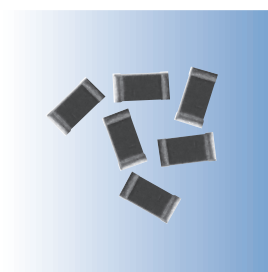
ASC Series						Anti Sulphur Chip Resistors
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, w, h
0402	0.063	1R0 - 10M	1	50	100 - 200	1, 0.5, 0.35
0603	0.1	1R0 - 10M	1	50	100 - 200	1.6, 0.8, 0.45
0805	0.125	1R0 - 10M	1	150	100 - 200	2, 1.25, 0.5
1206	0.25	1R0 - 10M	1	200	100 - 200	3.1, 1.55, 0.55
1210	0.33	1R0 - 10M	1	200	100 - 200	3.2, 2.6, 0.55
2010	0.625	1R0 - 10M	1	200	100 - 200	5, 2.5, 0.55
2512	1	1R0 - 10M	1	250	100 - 200	6.35, 3.2, 0.55
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/ASC.PDF						



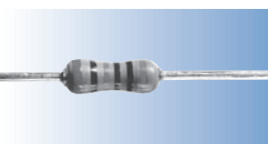
CRT Series						Trimmable Surface Mount Resistors
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, w, h
0805	0.1	10R - 1M	±20	100	250	2, 1.25, .5
1206	0.125	10R - 1M	±20	200	250	3.2, 1.6, .55
1210	0.25	10R - 1M	±20	200	250	3.2, 2.6, .55
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/CRT.PDF						



GCR Series						Glueable Chip Resistors
Type	Current (amps)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, w, h
0805	0.125	1R0 - 10M	1, 5	150	100 - 200	2, 1.3, 0.5
1206	0.25	1R0 - 10M	1, 5	200	100 - 200	3.2, 1.6, 0.5
2010	0.625	1R0 - 10M	1, 5	400	100 - 200	5, 2.5, 0.65
2512	1	1R0 - 10M	1, 5	500	100 - 200	6.3, 3.2, 0.65
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/GCR.PDF						



MFR4P Series						Metal Film Resistors
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, dia
MFR4P	0.6	R22 - 1M	1, 2, 5,	250	50	6.2, 2.5
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/MFR4P.PDF						



WCR Series						General Purpose Surface Mounted Resistors
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, w, h
0201	0.05	10R - 1M	1	25	250	0.6, 0.3, 0.23
0402	0.1	10R - 1M	1	50	100	1, .5, .35
0603	0.063	1R - 10M	1	50	100	1.6, .8, .5
0805	0.125	1R - 10M	1	150	100	2, 1.25, .5
1206	0.25	1R - 10M	1	200	100	3.2, 1.6, .55
1210	0.25	1R - 10M	1	200	100	3.2, 2.6, 0.55
2010	0.5	1R - 10M	1	200	200	5, 2.5, .56
2512	1.0	1R - 10M	1	200	200	6.3, 3.2, .56
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/WCR.PDF						



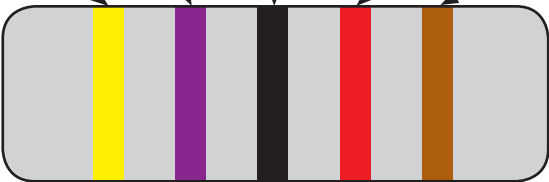
WNCR Series						Resistor Array
Type	Power (watts)	Res. Range (ohms)	Tolerance %	Max Volts	TCR (ppm/°C)	Dim.(mm) l, w, h
WNCR	0.063	10 - 1M	±5	50	±200	3.2, 1.6, .45
Datasheet - http://www.welwyn-tt.com/pdf/datasheet/WNCR.PDF						



Colour Code for Band-marked Resistors

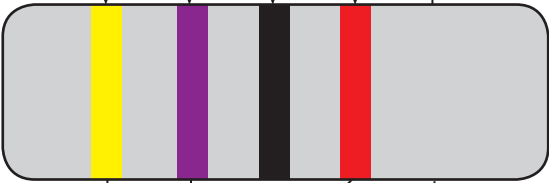
		Value 1	Value 2	Value 3	Multiplier	Tolerance	
Silver					x 0.01	10%	K
Gold					x 0.1	5%	J
Black		0	0	0	x 1		
Brown		1	1	1	x 10	1%	F
Red		2	2	2	x 100	2%	G
Orange		3	3	3	x 1K		
Yellow		4	4	4	x 10K		
Green		5	5	5	x 100K	0.5%	D
Blue		6	6	6	x 1M	0.25%	C
Violet		7	7	7	x 10M	0.1%	B
Grey		8	8	8	x 100M	0.05%	A
White		9	9	9	x 1G		
Blank						20%	M

Example 1
5-Band Marking
E24/E96 values



4 7 0 x100 1% = 47K 1%
E.g. MFR4 E96

Example 2
4-Band Marking
E24/E96 values
without tolerance



4 7 0 x100 = 47K
E.g. WRM0204 E96

Example 3
4-Band Marking
E24 values

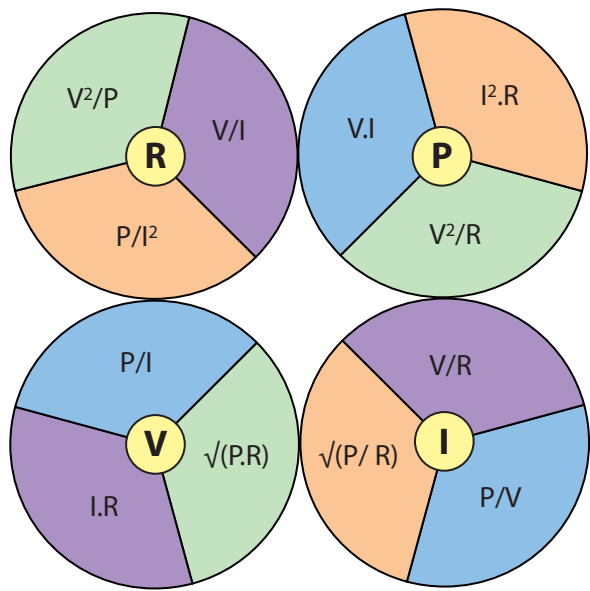


8 2 x1K 5% = 82K 5%
E.g. WMO3S E24

Further Technical Information

Application Notes for current sense, circuit protection, pulse and overload ratings, energy metering, lighting, medical, automotive, high voltage design and more	http://www.welwyn-tt.com/literature.asp
Parametric Search for selection of products by parameters, package, technology and application	http://www.welwyn-tt.com/products/resistors/resistors.asp
Calculation Tools for pulse loading, temperature derating, critical resistance, capacitor bleed and more	http://www.welwyn-tt.com/products/resistors/calculation-tools.asp
Product Compliance Matrix for RoHS and REACH SVHC status, termination finish, obsolescence data, SnPb availability and more	http://www.welwyn-tt.com/downloads/pbfree/rohs-compliance-matrix.pdf
Tin Whisker Report test report on tin whisker qualification of Pb-free finishes	http://www.welwyn-tt.com/downloads/pbfree/sn-whisker-report.pdf

Common Formulae



R is resistance value (ohms) **P** is power dissipated (watts)
V is voltage dropped (volts) **I** is current flowing (amps)
E.g. $R = V / I$

Terms and Definitions

Ambient Temperature	The temperature which would be adopted by the body of the resistor under application conditions except with negligible power dissipation in the resistor.
Critical Resistance	The resistance value at which application of the LEV causes dissipation of the full rated power.
Isolation Voltage (Voltage Proof)	The maximum continuous voltage which may be applied between the resistor and a conductor in contact with its insulated body.
LEV (Max Volts)	The maximum continuous voltage which may be applied across a resistor whose ohmic value is greater than the critical resistance.
Overload	Power dissipation which exceeds the power rating for durations exceeding 0.1s.
Power Rating	The maximum continuous power that may be dissipated by a resistor whose ohmic value is less than the critical resistance and at a defined maximum ambient temperature.
Pulse (Surge)	Power dissipation which exceeds the power rating for durations less than 0.1s.
Series	A set of components with the same basic design features and performance and usually a range of sizes and ratings.
TCR	Temperature Coefficient of Resistance; the maximum magnitude of reversible ohmic value change per degree centigrade due to deviation in body temperature from a reference normally of 20°C.
Tolerance	The maximum allowable magnitude of deviation from nominal ohmic value measured at delivery and at room temperature.
Type	An individual member of a series with specified size and rating.
VCR	Voltage Coefficient of Resistance; the maximum reversible reduction in ohmic value per volt due to an increase in applied voltage.

Preferred Values

E192		E96		E24		E12		E6			
1	3.16	1	1	1	1	1	1	1	1	97	
1.01	3.2	1.02	1.1	1.2	1.5	2	2	98			
1.02	3.24	1.05	1.2	1.5	2.2	3	3	99			
1.04	3.28	1.07	1.3	1.8	3.3	4	4	100			
1.05	3.32	1.1	1.5	2.2	4.7	5	5	101			
1.06	3.36	1.13	1.6	2.7	6.8	6	6	102			
1.07	3.4	1.15	1.8	3.3	10 etc...	7	7	103			
1.09	3.44	1.18	2	3.9		8	8	104			
1.1	3.48	1.21	2.2	4.7		9	9	105			
1.11	3.52	1.24	2.4	5.6		10	10	106			
1.13	3.57	1.27	2.7	6.8		11	11	107			
1.14	3.61	1.3	3	8.2		12	12	108			
1.15	3.65	1.33	3.3	10 etc...		13	13	109			
1.17	3.7	1.37	3.6			14	14	110			
1.18	3.74	1.4	3.9			15	15	111			
1.2	3.79	1.43	4.3			16	16	112			
1.21	3.83	1.47	4.7			17	17	113			
1.23	3.88	1.5	5.1			18	18	114			
1.24	3.92	1.54	5.6			19	19	115			
1.26	3.97	1.58	6.2			20	20	116			
1.27	4.02	1.62	6.8			21	21	117			
1.29	4.07	1.65	7.5			22	22	118			
1.3	4.12	1.69	8.2			23	23	119			
1.32	4.17	1.74	9.1			24	24	120			
1.33	4.22	1.78	10 etc...			25	25	121			
1.35	4.27	1.82				26	26	122			
1.37	4.32	1.87				27	27	123			
1.38	4.37	1.91				28	28	124			
1.4	4.42	1.96				29	29	125			
1.42	4.48	2				30	30	126			
1.43	4.53	2.05				31	31	127			
1.45	4.59	2.1				32	32	128			
1.47	4.64	2.15				33	33	129			
1.49	4.7	2.21				34	34	130			
1.5	4.75	2.26				35	35	131			
1.52	4.81	2.32				36	36	132			
1.54	4.87	2.37				37	37	133			
1.56	4.93	2.43				38	38	134			
1.58	4.99	2.49				39	39	135			
1.6	5.05	2.55				40	40	136			
1.62	5.11	2.61				41	41	137			
1.64	5.17	2.67				42	42	138			
1.65	5.23	2.74				43	43	139			
1.67	5.3	2.8				44	44	140			
1.69	5.36	2.87				45	45	141			
1.72	5.42	2.94				46	46	142			
1.74	5.49	3.01				47	47	143			
1.76	5.56	3.09				48	48	144			
1.78	5.62	3.16				49	49	145			
1.8	5.69	3.24				50	50	146			
1.82	5.76	3.32				51	51	147			
1.84	5.83	3.4				52	52	148			
1.87	5.9	3.48				53	53	149			
1.89	5.97	3.57				54	54	150			
1.91	6.04	3.65				55	55	151			
1.93	6.12	3.74				56	56	152			
1.96	6.19	3.83				57	57	153			
1.98	6.26	3.92				58	58	154			
2	6.34	4.02				59	59	155			
2.03	6.42	4.12				60	60	156			
2.05	6.49	4.22				61	61	157			
2.08	6.57	4.32				62	62	158			
2.1	6.65	4.42				63	63	159			
2.13	6.73	4.53				64	64	160			
2.15	6.81	4.64				65	65	161			
2.18	6.9	4.75				66	66	162			
2.21	6.98	4.87				67	67	163			
2.23	7.06	4.99				68	68	164			
2.26	7.15	5.11				69	69	165			
2.29	7.23	5.23				70	70	166			
2.32	7.32	5.36				71	71	167			
2.34	7.41	5.49				72	72	168			
2.37	7.5	5.62				73	73	169			
2.4	7.59	5.76				74	74	170			
2.43	7.68	5.9				75	75	171			
2.46	7.77	6.04				76	76	172			
2.49	7.87	6.19				77	77	173			
2.52	7.96	6.34				78	78	174			
2.55	8.06	6.49				79	79	175			
2.58	8.16	6.65				80	80	176			
2.61	8.25	6.81				81	81	177			
2.64	8.35	6.98				82	82	178			
2.67	8.45	7.15				83	83	179			
2.71	8.56	7.32				84	84	180			
2.74	8.66	7.5				85	85	181			
2.77	8.76	7.68				86	86	182			
2.8	8.87	7.87				87	87	183			
2.84	8.98	8.06				88	88	184			
2.87	9.09	8.25				89	89	185			
2.91	9.2	8.45				90	90	186			
2.94	9.31	8.66				91	91	187			
2.98	9.42	8.87				92	92	188			
3.01	9.53	9.09				93	93	189			
3.05	9.65	9.31				94	94	190			
3.09	9.76	9.53				95	95	191			
3.12	9.88	9.76				96	96	192			
10 etc...		10 etc...									



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