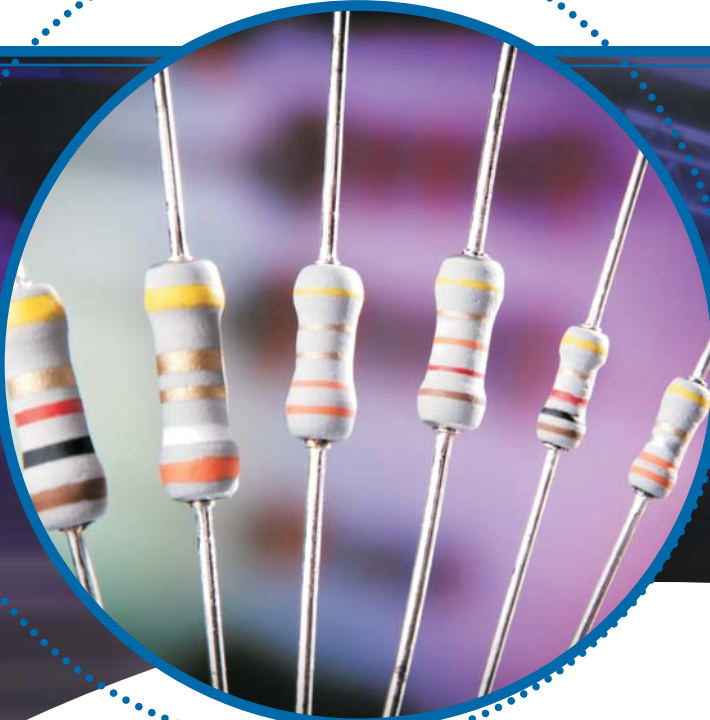


Resistors for Lighting Applications



Increasing safety standards and the growing trend towards more efficient lighting methods have greatly increased the complexity of lighting circuits and placed new stresses upon components.

In a market where customers demand low prices, small physical size, plus the latest safety standards, designers are faced with a difficult task.

TT electronics has worked closely with lighting designers and manufacturers to make this task easier. TT electronics can provide not only standard Metal Film/Oxide and Wirewound resistors, for general non-critical circuitry, but

also fusible resistors for circuit protection and pulse withstand resistors capable of withstanding the high surges present during tube start up or strike. TT electronics can also design and manufacture custom resistors to meet specific circuit requirements.

Applications are not limited to fluorescent light ballast circuits, TT electronics can provide resistors for use in any lighting application. Some of the more common applications are detailed below.

- High Intensity Discharge
- Mercury Vapour
- Metal Halide
- High Pressure Sodium
- Low Pressure Sodium

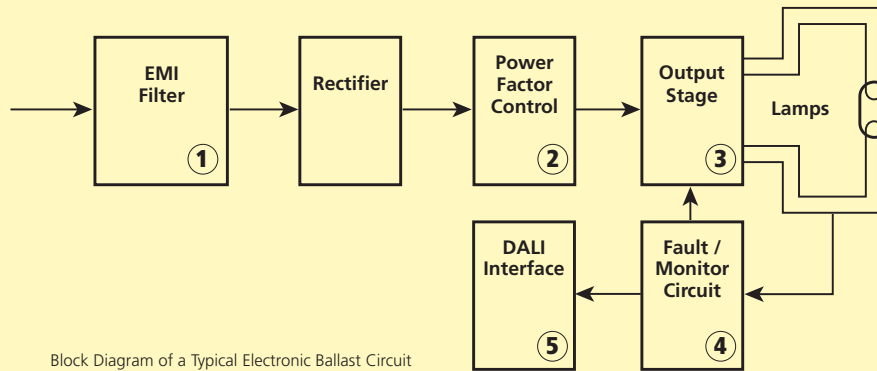
Resistors selected and designed to customer specifications
Available technologies include:

- Metal Film
- Metal Oxide
- Wirewound
- Surface Mount
- Custom Leadforming



A subsidiary of TT electronics plc

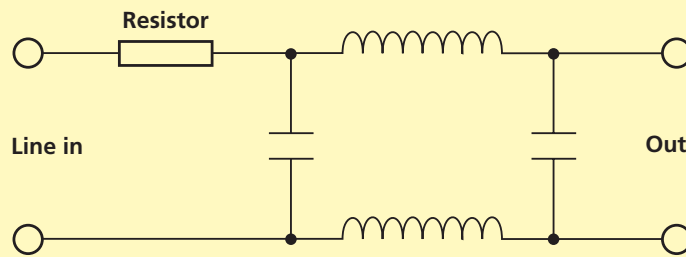
Typical Electronic Ballast Circuit



Block Diagram of a Typical Electronic Ballast Circuit

1. EMI Filter

Ballasts have an inrush current during the initial start-up several times greater than their normal operating current and in general electronic ballasts have a higher inrush current than electromagnetic or hybrid ballasts. Inrush current limiting resistors are designed to withstand these surges but to fuse safely should a fault occur, for example if a capacitor were to go short resulting in a mains short circuit. Typical parts used are WPS, WFF and EMC Series in axial form and the FCR Series in surface mount form.

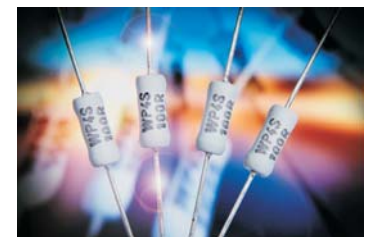


EMI Filter (example)

Power Wirewound Resistors

WP-S Series

- Flameproof protection
- Excellent pulse withstand performance



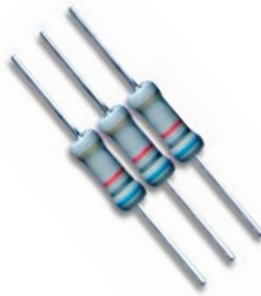
Electrical Data

	WP1S	WP2S	WP25S	WP3S	WP4S	WP5S	WP7S
Power rating at 25°C watts	1	2	2.5	3	4	5	7
5s overload rating at 25°C watts	5	10	12.5	15	20	25	35
Short pulse performance	Available on request						
Resistance range ohms	R068 to 430R	R05 to 900R	R05 to 900R	R01 to 2K2	R01 to 10K	R015 to 6K8	R15 to 10K
Limiting element voltage volts	50	50	75	100	100	150	150
TCR ppm/°C	<1R: 350 =1R: 200						
Isolation voltage volts	250			350	500		700
Resistance tolerance %	<20R: 5 ≥20R: 1, 2, 5				<R10: 5 ≥ R10: 1,2, 5	<20R: 5 ≥20R: 1, 2, 5	
Standard values	E24 preferred						
Thermal impedance °C/watt	140	110	90	82	62	54	35
Ambient temp range °C	-55 to +155						

Pulse Withstanding Fusible Flameproof Metal Film Resistors EMC Series

- UL1412 recognised*
- Failsafe 240V mains fusing
- Good Pulse handling capability
- Small size for power rating
- UL94-V0 flameproof protection

* Values 22R and above. UL file number E234469



Electrical Data

		EMC2
Power rating at 70°C	watts	2
Resistance range	ohms	4R7-68R
TCR (25 to 75°C)	ppm/°C	100
Isolation voltage	volts	500
Resistance tolerance	%	10, 20
Standard values		E12
Thermal impedance	°C/watt	82
Ambient temperature range	°C	-55 to +155

Fast Fusible Metal Film Resistors WFF Series

- Low power fusing
- Predictable fusing characteristics
- Flameproof protection



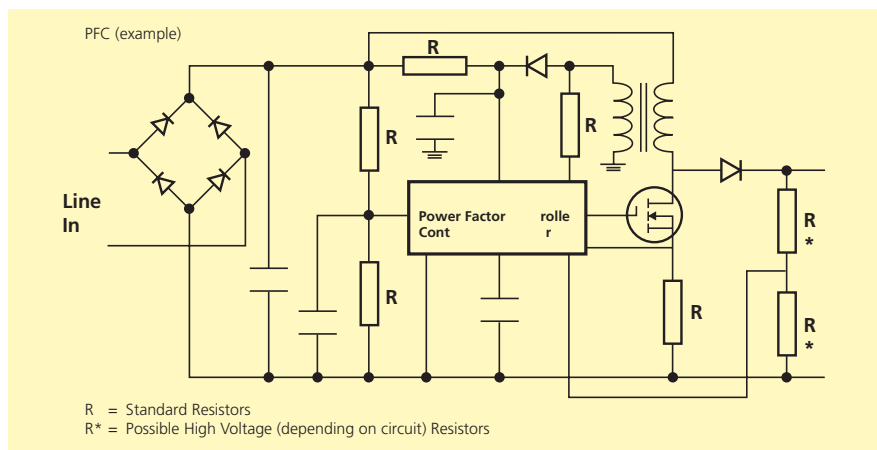
Electrical Data

		WFF1/4	WFF1/2	WFF1
Power rating at 70°C	watts	0.25	0.5	1
Resistance range	ohms	0R1-10K	0R10-27K	0R2-1K5
Limiting element voltage	volts	250	350	350
TCR	ppm/°C	250		
Resistance tolerance	%	5		
Standard values		E24 preferred		
Thermal impedance	°C/watt	150	120	100
Ambient temperature range	°C	-55 to 155		

2. Power Factor Control

As a general rule, electronic ballasts use a large reservoir capacitor associated with the bridge rectifier; this results in a low power factor, poor waveshape and harmonic distortion. In order to meet the EN61000 family of standards, designers usually incorporate active or passive circuits to improve the power factor. These circuits contain general purpose parts such as the axial MFP series and surface mount types such as the WCR and PCF series.

The MOSFET source resistor (current sense) would be from the LR family, which has enhanced pulse performance.



Flameproof Power Metal Film Resistors MFP Series

- Smallest size for power rating
- Resistance range 0.1 ohms to 1M ohms
- Flameproof protection



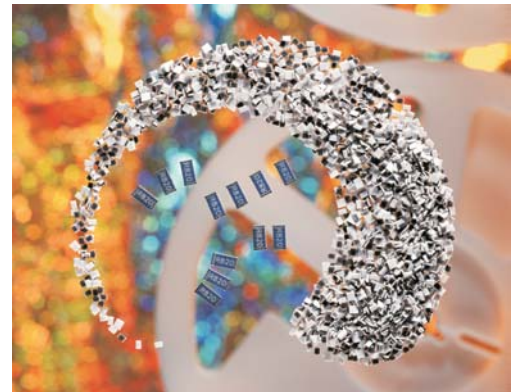
Electrical Data

		MFP1	MFP2
Power rating at 70°C	watts	<1 Ω: 0.7 ≥1Ω:1.0	2
Resistance range	ohms	0R1 – 1M	1R0 – 1M
Limiting element voltage	volts	350	
TCR	ppm/°C	<1 Ω:300 1 Ω – 9.1 Ω: 200 ≥10 Ω:50	100
Resistance tolerance	%	1, 2, 5	
Standard values		E24 preferred	
Thermal impedance	°C/watt	120	82
Ambient temperature range	°C	-55 to 155	

Precision Surface Mount Resistor

PCF Series

- Wide ohmic range – 10 ohms to 2M ohms
- Tolerance down to 0.05% (available on request)
- TCR to 5ppm/°C



Electrical Data

Type	TCR (ppm/°C)	Power (watts)	Working Voltage (volts)	Overload Voltage (volts max)	Ohmic Value Range		
					0.5%	0.1%	0.05%
PCF0402	100	1/16	25	50	10R-97R6		
PCF0402	25	1/16	25	50	100R-100K	100R-100K	
PCF0603	50	1/16	75	150	10R-97R6		
PCF0603	25	1/16	75	150	100R-360K	100R-332K	
PCF0805	50	1/10	100	200	10R-97R6		
PCF0805	25	1/10	100	200	100R-1M0	100R-1M0*	
PCF0805	10	1/10	100	200	100R-100K	100R-100K	100R-100K
PCF0805	5	1/10	100	200	100R-100K	100R-100K	100R-100K
PCF1206	50	1/8	150	300	10R-49R9		
PCF1206	25	1/8	150	300	10R-1M0	10R-1M0	
PCF1206	10	1/8	150	300	100R-249K	100R-249K	100R-200K
PCF1206	5	1/8	150	300	100R-249K	100R-249K	100R-200K
PCF1210	25	1/4	200	400	51R-2M0	51R-2M0	
PCF1210	10	1/4	200	400	100R-330K	100R-330K	
PCF1210	5	1/4	200	400	100R-200K	100R-200K	

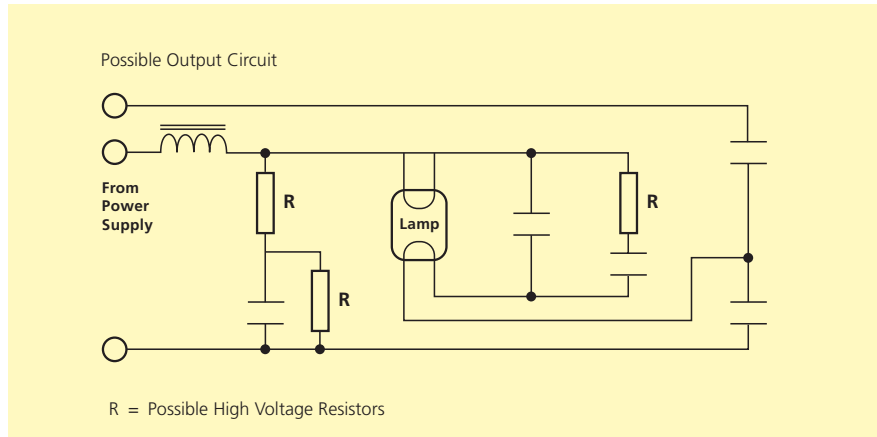
* 10R – 97R6 is available upon request

3 & 4. Output/Fault Monitoring

The output and fault/monitoring stages of the ballast can subject components to high electrical stresses; for example a typical fluorescent tube has a strike voltage of 1kV or more, depending on size and operating frequency.

In these conditions a standard resistor is unlikely to be suitable. Welwyn can offer high duty / high voltage types (VRW series), cement coated wirewound resistors with excellent pulse handling properties (SQP series), as well as specially designed pulse withstanding resistors suitable for these applications.

We can also supply surface mount parts with these high performance properties; High Voltage Chip (HVC series), Pulse Withstanding Chip (PWC series).



Electrical Data

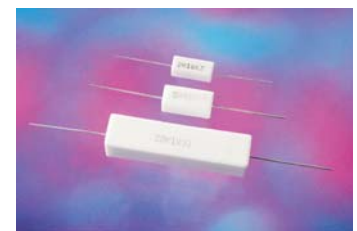
High Voltage Thick Film Resistors VRW Series

- VRW37 meets the requirements of BS/EN/IEC 60065
- High working voltage to 3.5kV in compact size
- High ohmic range to 30M
- High pulse load capacity
- Robust flameproof coating material
- RoHS compliant

		VRW25	VRW37
Power rating @70°C	watts	0.25	0.5
Resistance range	ohms	100K to 30M	100K to 10M
Limiting element voltage	Volts or ac peak	1600	3500
Isolation voltage	volts	700	
TCR	ppm/°C	200	
Resistance tolerance	%	1, 2, 5	
Standard values		E24 and E96 preferred	
Thermal impedance	°C/watt	140	112
Ambient temperature range	°C	-55 to +155	

General Purpose Ceramic Case Resistors – Wirewound / Metal Oxide SQP Series

- 2 watts to 20 watts*
- High overload capability
- RoHS compliant
- Resistance 0R1 to 100K
- Flameproof case



Electrical Data

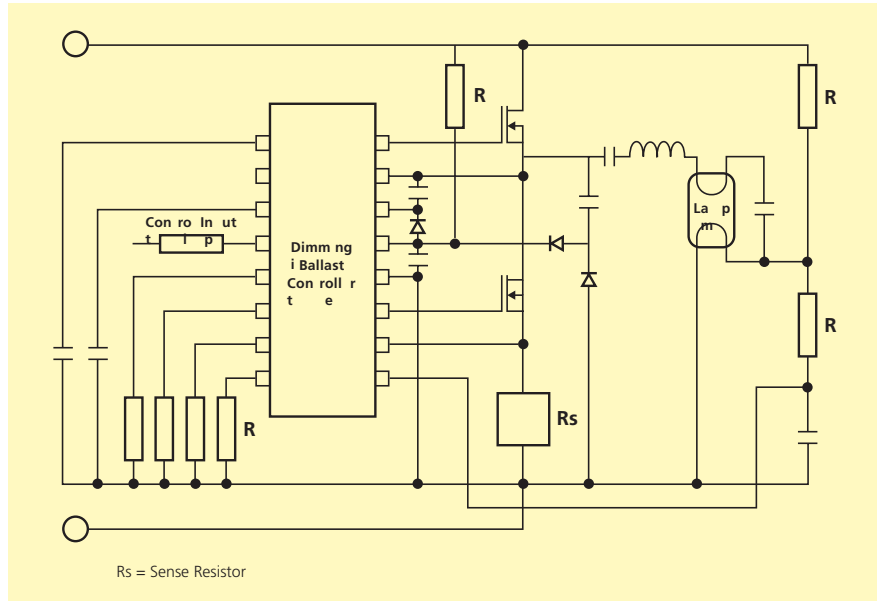
	SQP2	SQP3	SQP5	SQP7/7S	SQP10	SQP15	SQP20	
Power rating at 70°C	watts	2	3	5	7	10	15	20
Resistance range	Wirewound	0.1R-50R	0.1R-100R	0.1R-100R	0.1R-100R	0.1R-200R	0.1R-200R	0.1R-500R
	Metal Oxide (ohms)	51R-47K	110R-47K	110R-47K	110R-47K	220R-68K	220R-68K	510R-100K
Limiting element voltage	Volts dc or ac peak	150	300	350	500 (7S-350)	750	1000	1000
Thermal impedance	°C/watt	50	45	30	28	23	16	13
Isolation voltage	volts	1000						
TCR	ppm/°C	WW types, <0R68, 1700ppm; ≥0R68, 200ppm: MO types all values 350ppm						
Resistance tolerance	%	5 (J)						
Standard values		E24 preferred						
Ambient temperature range	°C	-55 to +155°C						

* Other styles (radial / pluggable); sizes, and 30, 40, 50, W types are available to special order.

5. Other Applications

Welwyn can also provide resistors for specialised lighting applications, such as the increasingly popular energy saving lamps, high intensity discharge (HID) lamps for automotive use, emergency lighting packs and dimmable fluorescent lighting, an example of the latter is shown here. Dimming ballasts use not only general purpose axial and surface mount resistors as seen in other forms of ballast, but require low value current sense resistors to provide feedback signals for pre-heat, ignition, dimming and fault currents.

Welwyn can offer low value current sense resistors with enhanced pulse performance for surface mount applications (LR series). For lower current, surface mount pulse applications, the DSC (double sided chip) should be selected.



Low Value Flat Chip Resistor

LRC/LRF Series

- Standard 2512, 2010 and 1206 sizes
- Resistance values down to 0.003 Ohms
- Leach resistant tin-plated copper wrap-around termination
- Low inductance – less than 0.2nH
- Standard EIA Tape – 1206 = 8mm, 2010 or 2512 = 12mm

Lead Form Capability

Resistors can be supplied with various pre-formed leads

The standard options are:

- Radial
- Lancelot
- Hairpin
- Lancelot in Tape
- Z-Form
- Goalpost
- Straight Cut
- Shoulder Form

Electrical Data

		LR1206	LR2010	LR2512	LR1225
Power rating at 70°C	watts	0.5	1.0	1.5/2.0*	2.0
Resistance range	ohms	0R010 to 1R	0R003 to 1R	0R003 to 1R	0R003 to 0R10
Limiting element voltage	volts	200	200	200	200
TCR	ppm/°C	±100 (Content factory for value below 0.050 ohms)			
Resistance tolerance	%	1, 2, 5			
Temperature rise at rated power	°C	40	80	90	80
Pad and trace area for max power rating @ 70°C	mm²	30	30	100	200

* 2 watts with total solder pad and trace size of 300 mm²

Welwyn Components Ltd has over 70 years experience in designing and manufacturing resistive parts.

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