

# YAGEO Leded R Introduction

**Leded R PM Team**

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# Introduction

## Purpose

- To introduce Yageo's Leaded Resistors and their manufacturing process

## Objectives

- Provide a basic explanation of how leaded resistors are made
- Discuss the industrial target applications and part's features
- Provide an overview of resistors
- Explore Yageo's part number breakdowns and certificate information

## Content

- 24 pages

## Learning Time

- 15 minutes

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Welcome to the Yageo Leaded Resistors training module. This module will provide an overview of leaded resistors construction, overall product availability, targeted industrial applications and part's features.

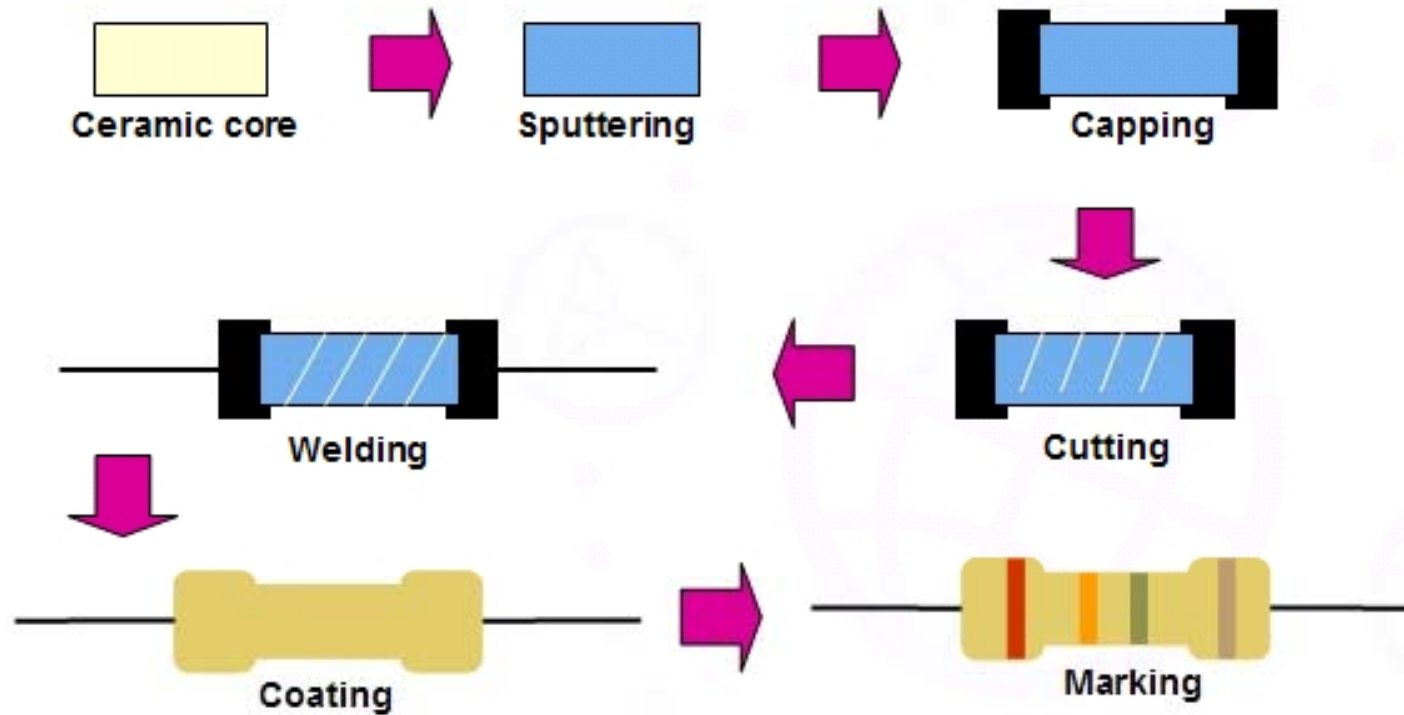
Additionally, explanations of Yageo's part numbering scheme and certification information will be presented

# Introduction to Leaded Resistors



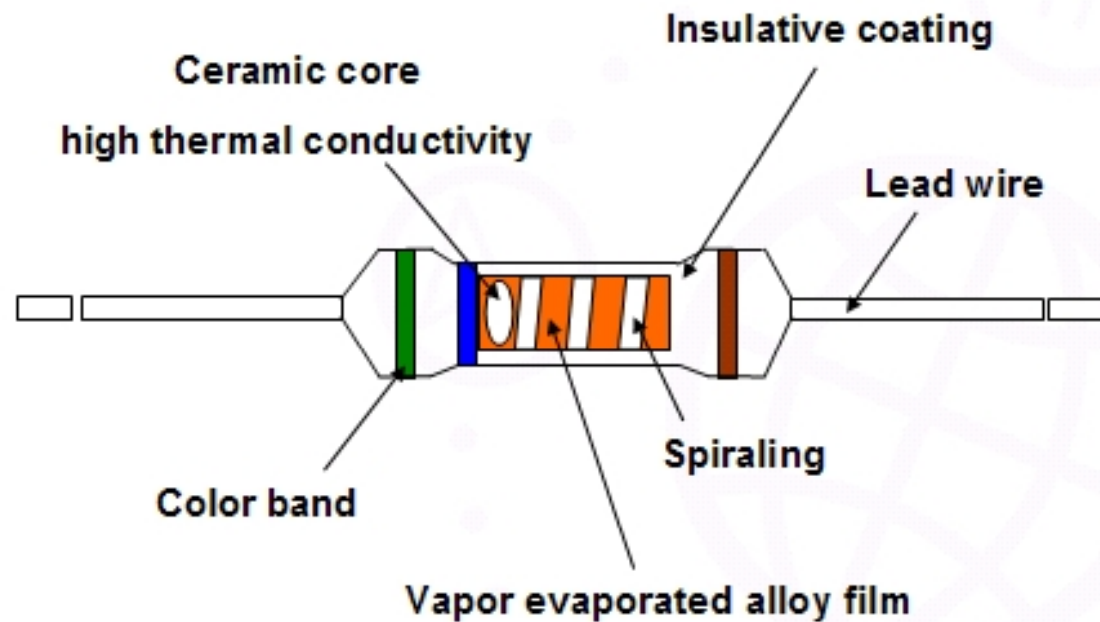
Leaded resistors are also called through-hole resistors, come in small, cylinder-like packages with axial wire leads (the wires come out the main axis of the cylinder). They are marked with either colored bands or numerically to determine their resistance. Some through-hole resistors are not cylindrical, but rectangular. These resistors are known as *power resistors* due to their ability to handle large power loads.

# Leaded Resistors Production Process – Film Resistors



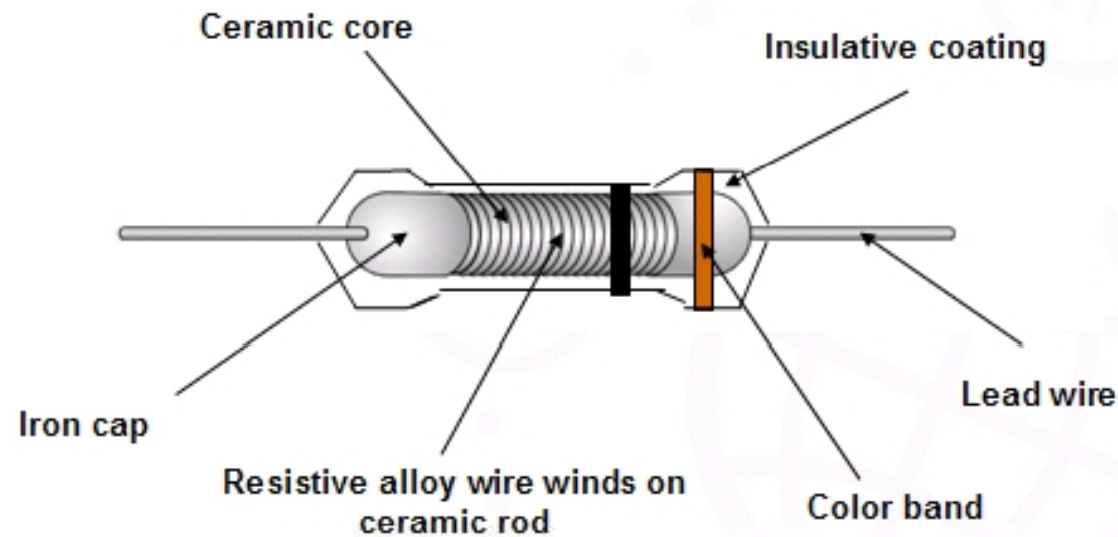
The first phase of forming a high stability, narrow tolerance leaded resistor is sputtering a layer of special resistant alloy onto a high grade ceramic.

## Construction - Film Resistors



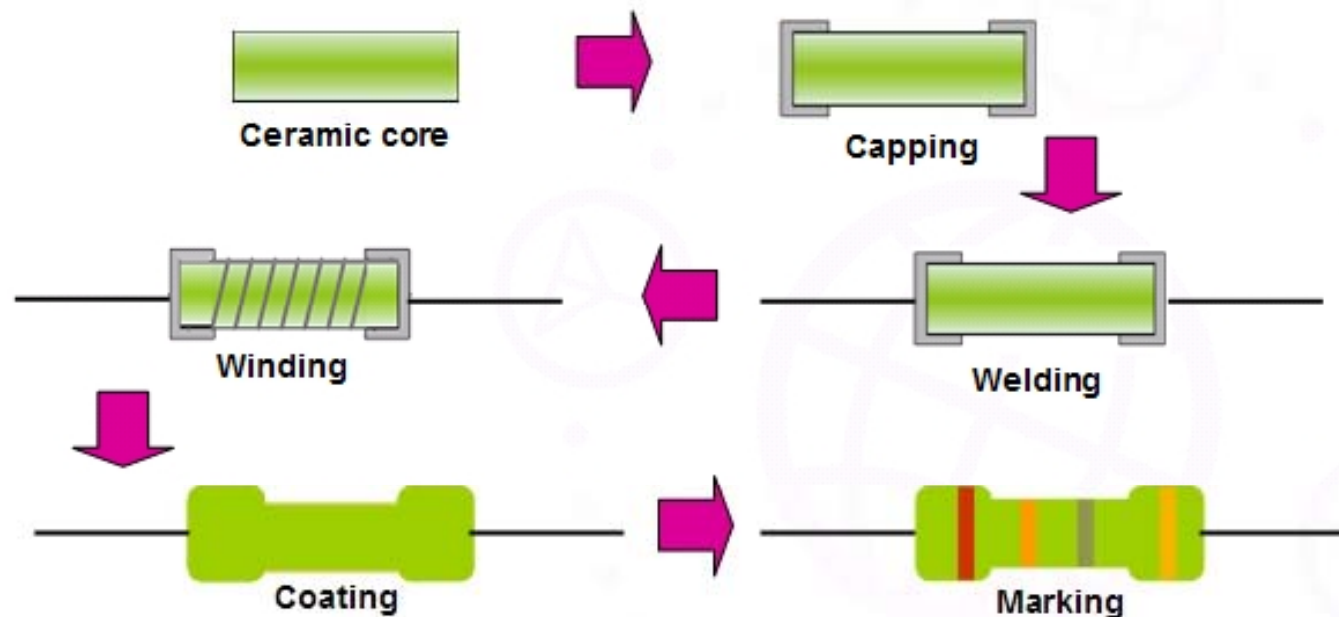
The resistance value is then achieved by cutting spirals into the vapor evaporated alloy film.

## Construction - Wirewound Resistors



In an entirely different process from film resistors (which are cut from a ceramic core), wirewound resistors are made by winding a wire around the ceramic core. The resistance value of a leaded wirewound is determined by the number of revolutions of the alloy wire around the ceramic core.

# Leaded Resistors Production Process – Wirewound Resistors



In the construction of wirewound resistors, high grade ceramic is capped with iron on each end and the terminals are welded to the caps. During the next production step, a special resistant wire is first welded to one cap and then wound around the ceramic core and finally welded to the other cap. The resistors are lacquered by using several layers of excellent high temperature resistant lacquer to isolate against environmental effects. Before the taping process, all resistors are checked to be certain they fall within tolerance.

## Product List

### Basic material:

- ▶ Metal film
- ▶ Carbon film
- ▶ Metal oxide film
- ▶ Pulse-Loading
- ▶ MELF
- ▶ Fuse
- ▶ Manganese copper wire
- ▶ Wirewound
- ▶ High voltage/ High ohmic
- ▶ High Temperature
- ▶ Cement
- ▶ Aluminum housed

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Leaded Resistors can be divided into different categories based on their materials – metal film/metal oxide film, carbon film, melf metal film/melf carbon film, pulse-loading, fuse, manganese copper wire, wirewound, high voltage/high ohmic, high temperature, cement and aluminum housed.



# Target Industries and Product Features

## ■ Application Industry

- ▶ Lighting
- ▶ Home appliances
- ▶ Automotive electronics
- ▶ Power supplies/chargers
- ▶ Industrial
- ▶ Alternative energy

## ■ Features of Yageo Leaded Resistors

- ▶ Miniature size
- ▶ Narrow tolerance
- ▶ Higher power ratings
- ▶ Higher working voltages
- ▶ Lower resistance ranges available
- ▶ Fuse safeguarding applications
- ▶ Biased humidity
- ▶ Anti-electrical arc and
- ▶ Anti-explosion safeguarding

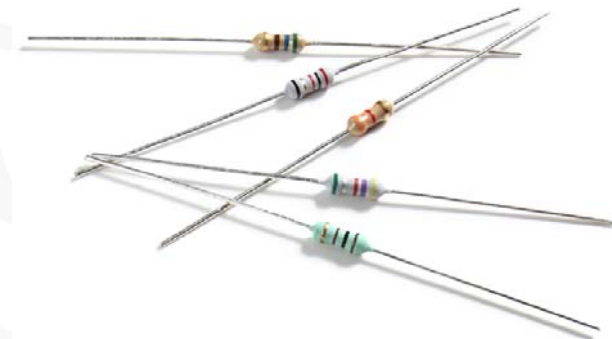
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Yageo leaded resistors can be applied in various markets such as lighting, home appliances, automotive electronics, power supplies/chargers, industrial and alternative energy because of their miniature size, narrow resistance tolerance, higher power ratings, fuse safeguarding applications, resistance to high temperature/humidity and higher working voltages.

## Carbon Film Resistors

Series	Description
CFR	General Type
FCR	Flame-Proof Type

- **Power Rating** : 1/6W ~ 3W
- **Tolerance** :  $\pm 2\%$ ,  $\pm 5\%$
- **Temp. Coefficient** :  $\pm 350\text{ppm}/^\circ\text{C}$  ~  $\pm 1500\text{ppm}/^\circ\text{C}$
- **Resistance Range** : 1  $\Omega$  ~ 10M  $\Omega$

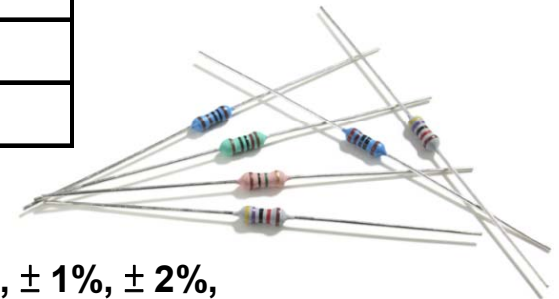


Yageo produces different carbon film resistors with power ratings from 1/6W to 3W, and resistance values between 1  $\Omega$  and 10M  $\Omega$ . They are available in sizes as small as 0204, and in flame-proof and non-inductive variations.

## Metal/Metal Oxide Film Resistors

Series	Description
MFR	General Type
MFP	Precision Type
FMF	Flame-Proof Type
FM0	Flame-Proof & Professional Type
FMP	Flame-Proof & High Power Type
HTM	HID Lamps Type
RSF	Metal Oxide Flame-Proof Type

- **Power Rating** : 1/6W ~ 5W
- **Tolerance** :  $\pm 0.02\%$ ,  $\pm 0.05\%$ ,  $\pm 0.1\%$ ,  $\pm 0.25\%$ ,  $\pm 0.5\%$ ,  $\pm 1\%$ ,  $\pm 2\%$ ,  
 $\pm 5\%$ ,  $\pm 10\%$
- **Temp. Coefficient** :  $\pm 5\text{ppm}/^\circ\text{C}$  ~  $\pm 300\text{ppm}/^\circ\text{C}$
- **Resistance Range** : 1  $\Omega$  ~ 10M  $\Omega$

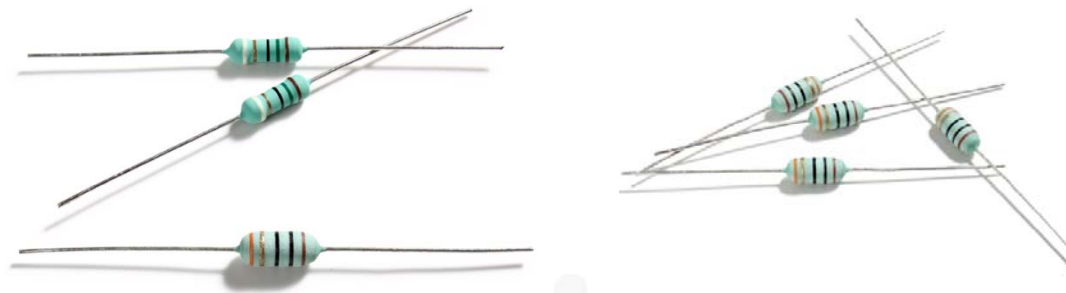


Yageo produces different metal/metal oxide film resistors with power ratings from 1/6W to 5W and resistance values between 1 $\Omega$  and 10M $\Omega$  with a very narrow tolerance and a considerably lower Temperature Coefficient of Resistance (TCR). They are available in sizes as small as 0204, and in flame-proof and non-inductive types. Ultra-miniature types reduce the required board space by more than 40% when compared to the general purpose series.

# Fusible Resistors

Series	Description
F AE	Anti-Explosion Fusible Type
F KN	Wirewound Flame-Proof Type
F RM	Metal Film Flame-Proof Type

- **Power Rating** : 1/4W ~ 7W
- **Tolerance** :  $\pm 1\%$  ,  $\pm 2\%$  ,  $\pm 5\%$   $\pm 10\%$
- **Temp. Coefficient** :  $\pm 200\text{ppm}/^\circ\text{C}$  ~  $\pm 350\text{ppm}/^\circ\text{C}$
- **Resistance Range** : 1  $\Omega$  ~ 10K  $\Omega$

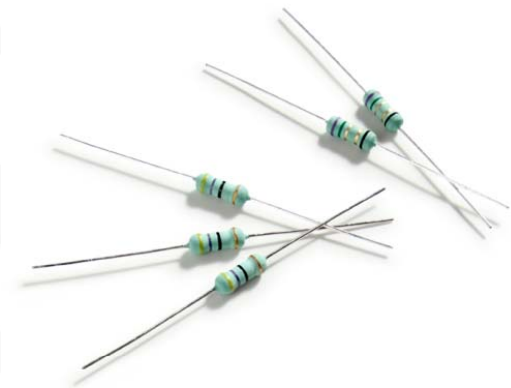


Yageo fusible resistors are available in metal film, wirewound, cement, thermal and anti-explosion types. Power ratings from 1/4W to 7W and resistance values between 1  $\Omega$  to 10K  $\Omega$  are available.

## Wirewound Resistors

Series	Description
KNP	Flame-Proof & General Type
NKN	Flame-Proof & Non Inductive Type
PNP	Flame-Proof & High Power Type

- **Power Rating** : 1/4W ~ 7W
- **Tolerance** :  $\pm 1\%$  ,  $\pm 5\%$
- **Temp. Coefficient** :  $\pm 100\text{ppm}/^\circ\text{C}$  ~  $\pm 350\text{ppm}/^\circ\text{C}$
- **Resistance Range** : 0.015  $\Omega$  ~ 7.5K  $\Omega$

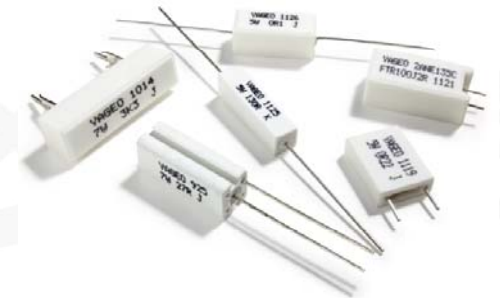


Yageo wirewound resistors are available in general wirewound, non-inductive, fusible, and cement types. Power ratings from 1/4W to 7W and resistance values between 0.015  $\Omega$  to 7.5K  $\Omega$  are available. Ultra-miniature type reduces the required board space by more than 40% when compared to the general series.

## Cement Resistors

Series	Description
SQP	Axial Lead Type
SLR	Metal Plate Radial Lead Type
PSP	Power Wirewound Axial Lead Type
PSM	Power Wirewound Vertical Lead Type

- **Power Rating** : 2W ~ 10W
- **Tolerance** :  $\pm 5\%$  ,  $\pm 10\%$
- **Temp. Coefficient** :  $\pm 250\text{ppm}/^\circ\text{C}$  ~  $\pm 400\text{ppm}/^\circ\text{C}$
- **Resistance Range** :  $0.015\ \Omega$  ~  $1\text{M}\ \Omega$



Yageo produces cement resistors in non-inductive, metal plate, fusible, wirewound, thermal, anti-explosion and anti-arc styles. Power ratings from 2W to 10W and resistance values between  $0.015\ \Omega$  to  $1\text{M}\ \Omega$  are available. These resistors come with axial, vertical, and radial lead types, and are all housed in a flame-proof ceramic case.

# Aluminum Housed Resistors

Series	Description
AHA	Power Wirewound Lug/Threaded Terminals

- **Power Rating** : 5W ~ 250W
- **Tolerance** :  $\pm 0.25\%$ ,  $\pm 0.5\%$ ,  $\pm 1\%$ ,  $\pm 5\%$ ,  $\pm 10\%$
- **Temp. Coefficient** :  $\pm 200\text{ppm}/^\circ\text{C}$
- **Resistance Range** :  $0.1 \Omega \sim 3\text{K} \Omega$



The AHA series is high power resistors housed in a very strong aluminum case. The sides of the aluminum case are corrugated for added strength. The resistors offer power ratings up to 250W, and are available in a tolerance as narrow as 0.25%.

## Zero Ohm Resistors

Series	Description
ZOR	Zero Ohm

- **Power Rating** : 1/6W , 1/4W
- **Max. Resistance** : 20 mΩ or less
- **Current Rating** : 2.5 AMPS at 70°C for 1/4W  
1.5 AMMS at 70°C for 1/6W



Yageo's Zero Ohm resistor - ZOR series provides power ratings of 1/4W and 1/6W, ideal for automatic insertion or cut and form.



# Metal Glazed Film Resistors (High Voltage, High Ohmic Type)

Series	Description
HHV	High Voltage & High Ohmic Type

- **Power Rating** : 1/4W ~ 3W
- **Tolerance** : ±1%, ±5%
- **Temp. Coefficient** : ±200ppm/°C
- **Resistance Range** : 100K Ω ~ 68M Ω

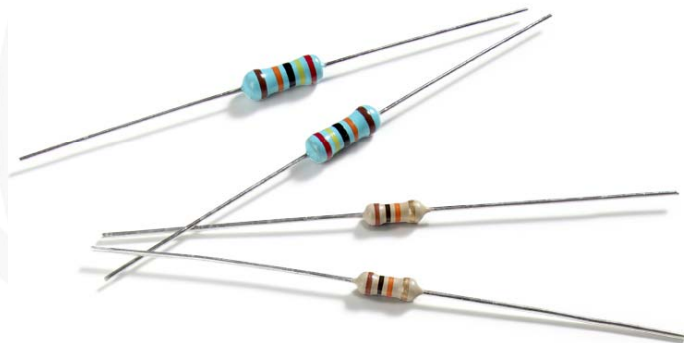


The Yageo HHV series resistors are made of metal glaze film, with tinned connecting leads of electrolytic copper welded to the end of caps. This series is also very humidity-resistant.

## High Temperature Resistors (Biased Humidity Type)

Series	Description
CFN	Carbon Film Withstanding up to 85°C/85RH

- **Power Rating** : 1/6W ~ 3W
- **Tolerance** : ±2% , ±5%
- **Temp. Coefficient** : ± 350ppm/°C ~ - 1500ppm/°C
- **Resistance Range** : 1 Ω ~ 10M Ω



The Yageo CFN high-temp and high humidity resistors are ideal for situations requiring reliability up to a temperature of 85°C and humidity up to 85RH. Its processes and controls ensure the product is impervious to moisture.

# Target Segments

Industry Segment	End Products	Target Series
Power Supply	Adapters, chargers ,UPS, converters, Inverter, Transformer, generator	HHV, RSF, LIR, CFR, PNP, FKN, MFR, MFP, SQP, FAE
Home Appliance	TV, Monitor, Printer, Scanner, Audio, Tuner, Refrigerator, white goods, meter	PNP, HHV, CFN, KNP, SQP
Charger Communications	Mobile Phone Station, Telephone Exchange, Charger, base station	FKN, PNP, MFP, FAE
Medical	Medical Equipment	MFP, HHV, PNP
Automotive	Car related industrial, Traffic Mark	AHA, PNP, MFP, MMF, HTM
Lighting	Lighting, Lamp, ballast	HTM, FAE, FMP, HHV, MMF

**This mapping table gives an overview of the product series which can be applied in specific industry segments and end products.**

## Application Guidelines

Application Classification	Series
High Voltage Circuit	HHV
High Precision Circuit	MFP, AHA
Current Sensing	PSP, PSM, SLR
Safety / Current Protector	FSP, FSM, FAE
High Stable Circuit	MFP, AHA, PNP
High Power Rating	AHA
HID Lamp / Biased Humidity	CFN, HTM

This mapping table provides a guidelines of the product series which can be used in specific applications.

# Part Number Breakdown

CFR    -25    J    T    -    52-    1K  
 (1)    (2)    (3)    (4)    (5)    (6)    (7)

(1)	(2)	(3)	(4)	(5)	(6)	(7)
Series Name	Power Rating	Tolerance	Packing Style	TCR	Forming Type	Resistance
CFR / CF0 / FCR / FC0	-05=φd=0.5mm    250 = 2.5W	P= ±0.02%	T = Tape/Box ( Ammo )	— = Base on Specs	26- = 26mm tape width	Example
MFR / MF0 / FMF / FM0	-06=φd=0.6mm    300 = 3W (0825)	A= ±0.05%	R = Tape Reel	A = +5ppm/°C	52- = 52.4mm tape width	0R1
MFP / MHP / RSF / FMP	-07=φd=0.7mm    3WS = 3W (0615)	B= ±0.1%	B = Bulk	B = +10ppm/°C	73- = 73mm tape width	1R
NCR / LIR	-08=φd=0.8mm    3WM = 3W (0718)	C= ±0.25%		C = ±15ppm/°C	91- = 91mm tape width	10R
ZOR / JPW / MCW	-10=φd=1.0mm    500 = 5W (0925)	D= ±0.5%		D = ±25ppm/°C	F = F Type for Bulk	100K
FRM / FKN / FSP / FSM	0204 = 0.4W    5WS = 5W (0925)	F= ±1%		E = ±50ppm/°C	FK = FK Type for Bulk	1M
FTR / FAE	0207 = 0.6W    5SS = 5SS (0718)	G= ±2%		F = ±100ppm/°C	FKK =FKK Type for Bulk	10M
KNP / NKN / PNP	-12 = 1/6W (0204)    700=7W	J= ±5%		G = ±200ppm/°C	FFK =FFK Type for Bulk	
PSP / PSM	-25 = 1/4W (0207)    7WS=7WS	K=±10%		H=±250ppm/°C	M = M Type for Bulk	
SQP / NSP / SQM / NSM	25S = 1/4W (0204)    900=9W	— = Base on Specs		I=±300ppm/°C	MB = MB Type for Bulk	
SOZ / NSZ / SLR / AAR	-50 = 1/2W (0309)    10A=10W			J=±30ppm/°C	MR = MR Type for Bulk	
AHP / AHA	50S = 1/2W (0207)    11A=11W				PN = PANAsert for Tape	
MMF / MMP / MCF / MCP	100 = 1W (0414)    20A=20W				AV =Avisert for Tape	
HHV / APR / ASR	1WS = 1W (0309)    10S=10WS				MT =M type for Tape	
HTR / HTM / CFN / MFN	200 = 2W (0615)    10B=100W				FT =F Type for Tape	
	2WS = 2W (0414)    25B=250W					

**Remark:** Suffix code is optional, represents specific specifications, required only when Wirewound resistor with special specification. Wirewound series including: KNP, NKN, PNP, FKN, etc.

**Exception:** Cement/Melf series without forming code: ex. SQP500JB-100R, MMF25SFRE10K  
 JPW series: without resistance value code. Ex. JPW-06-T-52-

This reference table shows Yageo's part number breakdown for the leaded resistors discussed in this module.

## RoHS/Certification Information

- ▶ ISO14001
- ▶ TS16949
- ▶ UL1412
- ▶ VDE
- ▶ RoHS+HF
- ▶ REACH
- ▶ PFOA+PFOS

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All YAGEO leaded resistors manufactured since 1/1/1996 are lead-free and are RoHS compliant. YAGEO factories, administration, and products have earned ISO14001, TS16949, UL1412, VDE, REACH, PFOA, and PFOS certification.

## Summary

- A resistor is primarily used to create and maintain a known safe current within electrical components
- Resistors can be made of many different materials and have different power ratings depending on their application
- Leaded resistors find use in industrial applications such as lighting, appliances, automotive electronics, chargers, and power supplies because of their miniature size, narrow resistance tolerance, high power ratings, fuse safeguarding applications, resistance to high temperatures/humidity, and higher working voltages
- Yageo has obtained several international industry certifications to ensure that they offer a quality product

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In summary, a resistor is primarily used to create and maintain a known safe current within electrical components. Resistors are made of several different materials and technologies to meet the various power ratings required by system designs. The quality and performance of these products are assured since Yageo has obtained several international industry certifications. Leaded resistors are used in various industrial applications such as lighting, appliances, automotive electronics, chargers, and power supplies.