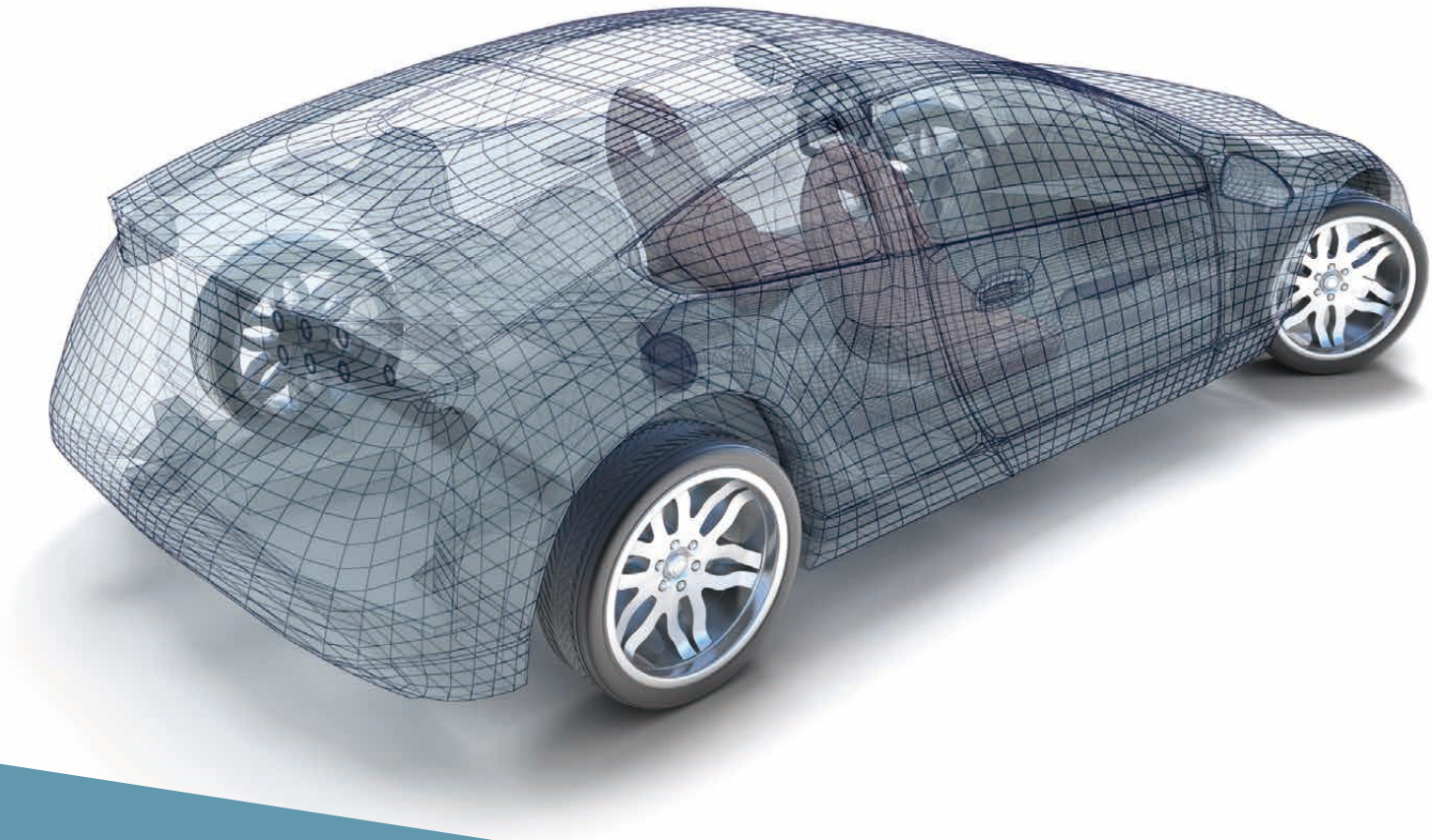
Innovative Service Around the Globe YAGEO



Automotive

Application Selection Guide

www.yageo.com

About Yageo

Founded in 1977, the Yageo Corporation has become a world-class provider of passive component services with capabilities on a global scale, including production and sales facilities in Asia, Europe and the Americas.

Yageo currently ranks as the world No.1 in chip-resistors, No. 3 in MLCCs and No. 4 in ferrite products, with a strong global presence: 23 sales offices in 15 countries, 9 production sites, 8 JIT logistic hubs, and 2 R&D centers worldwide. Ferroxcube and Vitrohm, who produce ferrites and leaded resistors, are also a part of the Yageo group.

We support our customers with extensive literature including datasheets, brochures and application notes, which are also available electronically on our website at: www.yageo.com

Content

Automotive

Automotive

Introduction

The ever increasing presence of electronics in the automotive environment requires a wide diversity of passive components possessing advanced product characteristics and superior reliability.

Not only are established systems like engine control, power steering, transmission, climate control, lighting, and ABS undergoing monumental changes, but relatively new systems, such as car-to-car communications, driver assistance, self-steering, and self-parking are experiencing similar transformations which call for a greater number of resistors and capacitors. Deeper integration within the automotive environment necessitates pushing the performance of passive components to the limit.

Armed with this knowledge, Yageo has made a new series of automotive-qualified MLCC and R Chip components available to the market for use in current designs and as a precursor for future trends.

The new MLCC and R Chip are fully designed to meet the following criteria:

- AEC-Q200 qualified
- Full PPAP available
- Capable of performing under the most demanding of conditions
- Mass production under TS 16949 certification

Yageo has introduced the AC Automotive Series of MLCC capacitors in two temperature characteristics, NPO and X7R. The special product design, specifically selected raw materials, and dedicated mass production environment give the AC Automotive series excellent long term reliability and improved mechanical properties. As a discrete part or within an array, this new series covers the products required within infotainment and comfort and convenience applications.

For the majority of automotive applications, the workhorse solution has been the standard AC series of R Chip Thick Film technology, available in 0201 to 2512 case sizes.

Only a specially designed solution manufactured using selected materials can meet the needs of harsh environmental conditions in safety systems where sulfur may be a challenge. Yageo has the ultimate solution, the AA R Chip series.

High precision resistors working under humid conditions must meet unsurpassed reliability standards. R Chip Thin Film AT products from Yageo are the perfect choice for circuitry in power steering, instrument clusters, ECU, and ABS.

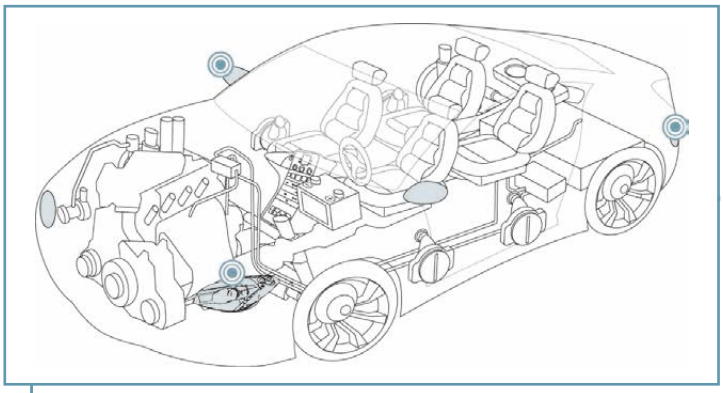
The third consideration in designing specialized solutions is derived from the automotive industry's constant need to increase the availability of circuitry and functions without increasing size. Traditionally, power dissipation had to be sacrificed to achieve miniaturization; Yageo's response is double and triple power resistors that enable small sizes without abandoning product performance.

Although SMD resistors dominate the PCB, leaded resistors are still essential components in various part of the electronic assembly due to the combination of reliability, power dissipation and stability. Flame proof (FMP Series) and precision metal film (MFP series) resistors are used in infotainment and comfort and convenience design. Yageo also introduces the AHA series for aluminum housed resistors which are applied in automotive signal lights.

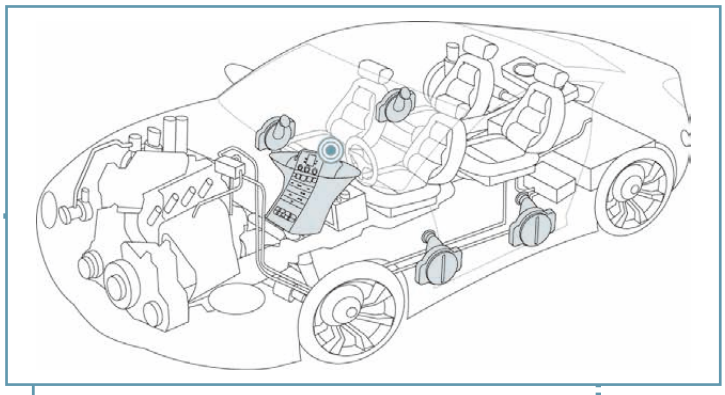
In addition to the resistors and capacitors, Yageo ceramic patch/chip antennas and PCB antennas bring wireless connectivity to infotainment and telematic systems which enrich drivers' experiences and enhance safety while driving.

The same knowledge and expertise which has helped Yageo develop its highly reliable components are also applied in assisting design engineers develop superior RoHS and REACH compliant solutions. By offering highly competitive and reliable solutions, Yageo realizes tomorrow's passive components for the automotive application.

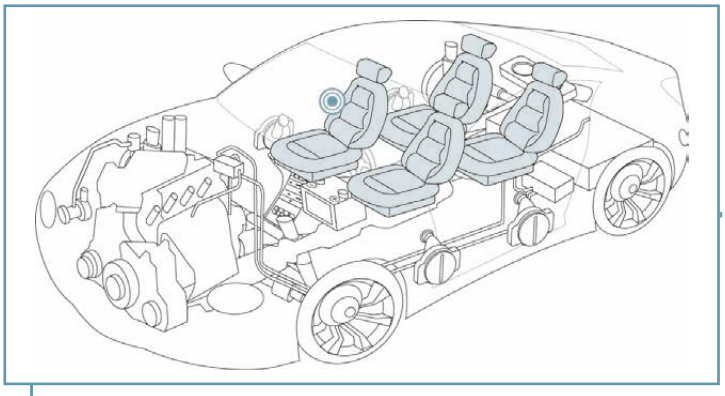
Automotive Electronics



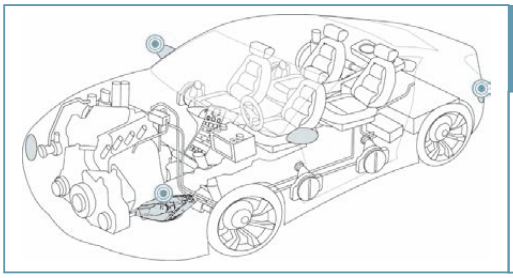
Lighting



Infotainment



Comfort & Convenience



Lighting

• Chip Resistors

AC Series

Automotive grade thick film chip resistor

Feature

- AEC-Q200 compliant
- Highly reliable electrode construction
- Compatible with all soldering processes
- Highly stable in auto-placement surface mounting applications

• Chip Resistors

AT Series

Automotive grade sulfur resistance thin film high precision high stability chip resistor

Feature

- Superior resistance against sulfur-containing environments
- AEC-Q200 compliant
- High precision & stability
- Low TCR
- Low electrical noise
- Advanced sputtering technology

• Chip Resistors

PA Series

Automotive grade metal current sensor, low TCR chip resistor

Feature

- Excellent current sensing performance
- High power rating for large current detection
- Accurate power control
- Reduce power consumption
- Low thermal EMF
- AEC-Q200 compliant
- Low TCR

• Chip Resistors

PE Series

Automotive grade metal current sensor, low TCR chip resistor

Feature

- Excellent current sensing performance
- High power rating for large current detection
- Accurate power control
- Reduce power consumption
- Low thermal EMF
- AEC-Q200 compliant
- Low TCR

• MLCC

AC Series

Automotive

Feature

- AEC-Q200 compliant and PPAP ready
- ISO/TS16949 certified
- Board Flex≧2mm
- 100% AOI
- High reliability

• MLCC

CS Series

Soft termination

Feature

- Good Resistance to Bending
- Good Resistance to Mechanical Vibration
- Good Resistance to Thermal Shock

• MLCC

CC-HCV Series

High CV

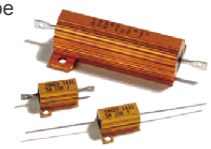
Feature

- High capacitance and high voltage
- Higher energy density
- High reliability with no polarity
- RoHS-compliant & halogen-free

• Through Hole

AHA/AHP Series

Wirewound resistors, high power, aluminum housed, heatsink type



Feature

- High power rating (up to 50W)
- Wirewound (max. resistance up to 33Kohm)
- Heatsink mounted
- Reduced size
- Corrision-resistant aluminum case for severe environments
- Excellent surge performance
- Fully lead-free compliance with no RoHS exemptions (7C-1)

• Through Hole

AHB Series

Wirewound resistors, high power, aluminum housed, heatsink type

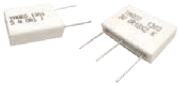
Feature

- High power rating (up to 500W)
- Wirewound (max. resistance up to 82Kohm)
- Heatsink mounted
- Reduced size
- Corrision-resistant aluminum case for severe environments
- Excellent surge performance
- Fully lead-free compliance with no RoHS exemptions (7C-1)

• Through Hole

SLR Series

Cement resistors, low ohmic, metal plate



Feature

- High power rating
- Low resistance (to 10mR)
- Double power available
- Flameproof cement case
- Excellent surge performance
- Vertical terminal
- Fully lead-free compliance with no RoHS exemptions (7C-1)

• Through Hole

JPW Series

Jumper, tinned-copper wire

Feature

- High quality tinned-copper
- High reliability
- Forming type available
- Fully lead-free compliance with no RoHS exemptions (7C-1)

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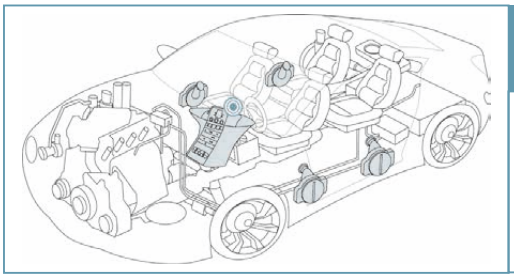


Infotainment

• Chip Resistors

AC Series

Automotive grade thick film chip resistor

Feature

- AEC-Q200 compliant
- Highly reliable electrode construction
- Compatible with all soldering processes
- Highly stable in auto-placement surface mounting applications

• Chip Resistors

AT Series

Automotive grade sulfur resistance thin film high precision high stability chip resistor

Feature

- Superior resistance against sulfur-containing environments
- AEC-Q200 compliant
- High precision & stability
- Low TCR
- Low electrical noise
- Advanced sputtering technology

• Chip Resistors

PA Series

Automotive grade metal current sensor, low TCR chip resistor

Feature

- Excellent current sensing performance
- High power rating for large current detection
- Accurate power control
- Reduce power consumption
- Low thermal EMF
- AEC-Q200 compliant
- Low TCR

• MLCC

AC Series

Automotive

Feature

- AEC-Q200 compliant and PPAP ready
- ISO/TS16949 certified
- Board Flex≧2mm
- 100% AOI
- High reliability

• MLCC

CC-HC Series

High Capacitance

Feature

- High capacitance
- Very Low ESR and ESL
- Low self heating
- High reliability with no polarity
- RoHS-compliant & halogen-free

• MLCC

CC-HCV Series

High CV

Feature

- High capacitance and high voltage
- Higher energy density
- High reliability with no polarity
- RoHS-compliant & halogen-free

• Wireless

GNSS Antenna

Ceramic Patch Antenna

Feature

- High efficiency
- High accuracy
- Operating temperature: -40°C~105°C
- RoHS-compliant & halogen-free

• Wireless

GNSS Antenna

Active Antenna

Feature

- Flexible cable length and connector type
- High gain
- Operating temperature: -30°C~85°C
- RoHS-compliant & halogen-free

• Wireless

WLAN/BT/ISM Antenna

Chip Antenna

Feature

- Compact size, small clearance
- SMD type antenna
- Operating temperature: -40°C-105°C
- RoHS-compliant & halogen-free

• Wireless

WWAN Antenna

Chip Antenna

Feature

- Compact size, small clearance
- SMD type antenna
- Operating temperature: -40°C-105°C
- RoHS-compliant & halogen-free

• Through Hole

MFP Series

Metal film resistors, precision

Feature

- High precision & stability
- Narrow tolerance
- Low TCR
- Low electrical noise
- AEC-Q200 compliant
- Fully lead-free compliance with no RoHS exemptions (7C-1)

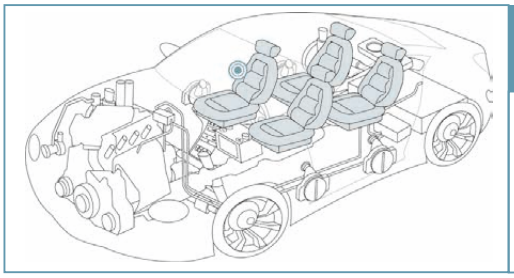
• Through Hole

MFR Series

Metal film resistors

Feature

- Wide resistance range
- High reliability
- High quality
- AEC-Q200 compliant
- Fully lead-free compliance with no RoHS exemptions (7C-1)



Comfort & Convenience

• Chip Resistors

AC Series

Automotive grade thick film chip resistor

Feature

- AEC-Q200 compliant
- Highly reliable electrode construction
- Compatible with all soldering processes
- Highly stable in auto-placement surface mounting applications

• Chip Resistors

AT Series

Automotive grade sulfur resistance thin film high precision high stability chip resistor

Feature

- Superior resistance against sulfur-containing environments
- AEC-Q200 compliant
- High precision & stability
- Low TCR
- Low electrical noise
- Advanced sputtering technology

• Chip Resistors

PA Series

Automotive grade metal current sensor, low TCR chip resistor

Feature

- Excellent current sensing performance
- High power rating for large current detection
- Accurate power control
- Reduce power consumption
- Low thermal EMF
- AEC-Q200 compliant
- Low TCR

• Chip Resistors

PE Series

Automotive grade metal current sensor, low TCR chip resistor

Feature

- Excellent current sensing performance
- High power rating for large current detection
- Accurate power control
- Reduce power consumption
- Low thermal EMF
- AEC-Q200 compliant
- Low TCR

• MLCC

AC Series

Automotive

Feature

- AEC-Q200 compliant and PPAP ready
- ISO/TS16949 certified
- Board Flex≧2mm
- 100% AOI
- High reliability

• MLCC

CC-HC Series

High Capacitance

Feature

- High capacitance
- Very Low ESR and ESL
- Low self heating
- High reliability with no polarity
- RoHS-compliant & halogen-free

• MLCC

CC-HCV Series

High CV

Feature

- High capacitance and high voltage
- Higher energy density
- High reliability with no polarity
- RoHS-compliant & halogen-free

• MLCC

CC-Class I and Class II (>=0201) Series

General purpose

Feature

- Suitable for all general purpose
- Low ESR and self-heating
- Stable capacitance and low impedance over wide frequency range
- High reliability with no polarity
- RoHS-complaint & halogen-free

• Wireless

X2Y Series

X2Y

Feature

- Excellent performance on EMI suppression or decoupling
- Ultra-low equivalent series inductance (ESL)
- Provides differential & common mode filtering with a single device

• Through Hole

MFP Series

Metal film resistors, precision

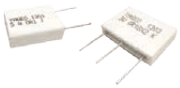
Feature

- High precision & stability
- Narrow tolerance
- Low TCR
- Low electrical noise
- AEC-Q200 compliant
- Fully lead-free compliance with no RoHS exemptions (7C-1)

• Through Hole

SLR Series

Cement resistors, low ohmic, metal plate



Feature

- High power rating
- Low resistance (to 10mR)
- Double power available
- Flameproof cement case
- Excellent surge performance
- Vertical terminal
- Fully lead-free compliance with no RoHS exemptions (7C-1)

• Through Hole

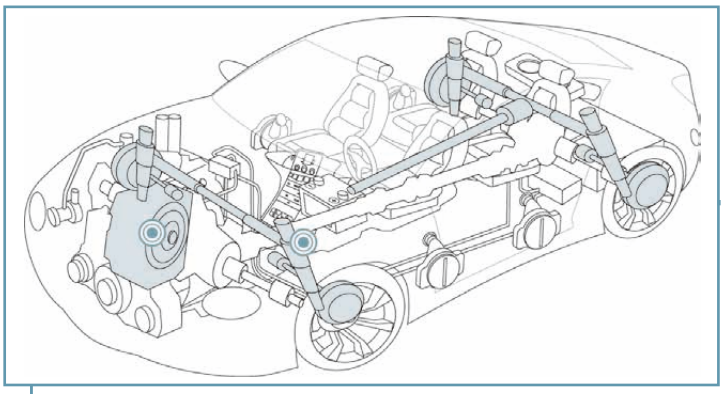
KNP Series

Wirewound resistors, flameproof

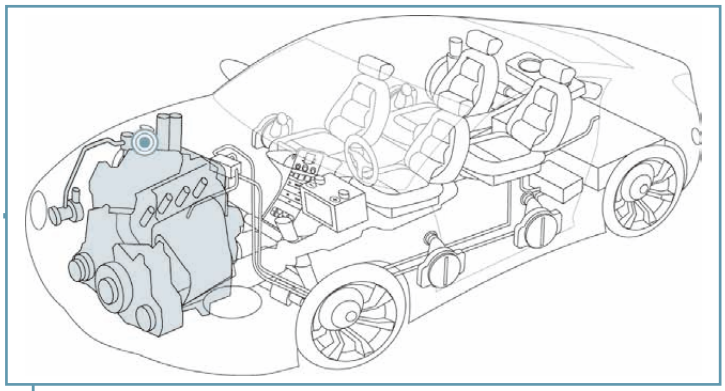
Feature

- High reliability
- Flameproof silicone coated
- Excellent surge performance
- Fully lead-free compliance with no RoHS exemptions (7C-1)

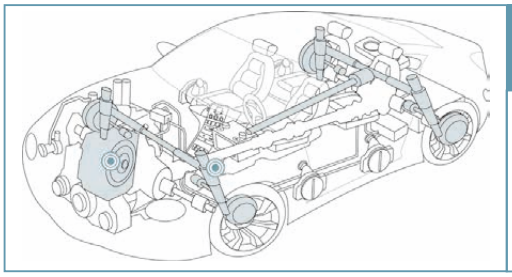
Powertrain & Safety



Steering & Transmissions



Engine Control Units



Steering & Transmissions

• Chip Resistors

AC Series

Automotive grade thick film chip resistor

Feature

- AEC-Q200 compliant
- Highly reliable electrode construction
- Compatible with all soldering processes
- Highly stable in auto-placement surface mounting applications

• Chip Resistors

AT Series

Automotive grade sulfur resistance thin film high precision high stability chip resistor

Feature

- Superior resistance against sulfur-containing environments
- AEC-Q200 compliant
- High precision & stability
- Low TCR
- Low electrical noise
- Advanced sputtering technology

• Chip Resistors

PA Series

Automotive grade metal current sensor, low TCR chip resistor

Feature

- Excellent current sensing performance
- High power rating for large current detection
- Accurate power control
- Reduce power consumption
- Low thermal EMF
- AEC-Q200 compliant
- Low TCR

• Chip Resistors

PE Series

Automotive grade metal current sensor, low TCR chip resistor

Feature

- Excellent current sensing performance
- High power rating for large current detection
- Accurate power control
- Reduce power consumption
- Low thermal EMF
- AEC-Q200 compliant
- Low TCR

• Wireless

X2Y Series

X2Y

Feature

- Excellent performance on EMI suppression or decoupling
- Ultra-low equivalent series inductance (ESL)
- Provides differential & common mode filtering with a single device

Check Products Datasheets
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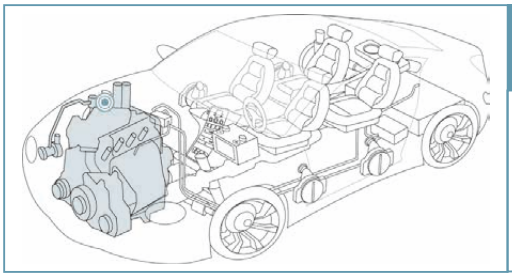

Engine Control Units

• Chip Resistors

AA Series

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X2Y Series

X2Y

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- Ultra-low equivalent series inductance (ESL)
- Provides differential & common mode filtering with a single device

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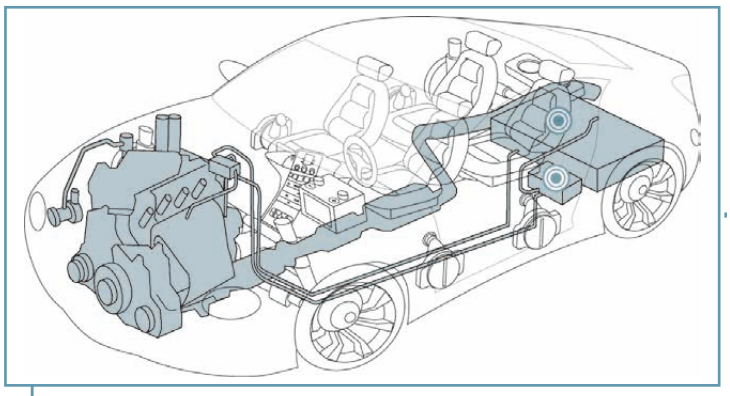
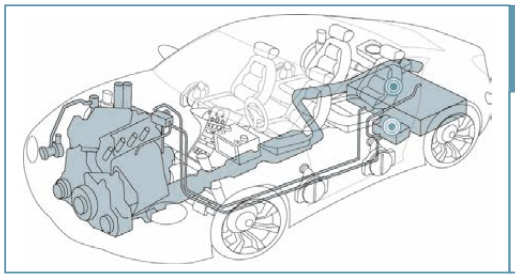
Electric Vehicles



Batteries & Chargers



Automotive | Electric Vehicles

Batteries & Chargers

• Chip Resistors

AA Series

Automotive grade sulfur resistant thick film chip resistor

Feature

- Superior resistance against sulfur-containing environments
- AEC-Q200 compliant
- Highly reliable electrode construction
- Compatible with all soldering processes
- Highly stable in auto-placement surface mounting applications

• Chip Resistors

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• Chip Resistors

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Automotive grade metal current sensor, low TCR chip resistor

Feature

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- High power rating for large current detection
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- Reduce power consumption
- Low thermal EMF
- AEC-Q200 compliant
- Low TCR

• Chip Resistors

PE Series

Automotive grade metal current sensor, low TCR chip resistor

Feature

- Excellent current sensing performance
- High power rating for large current detection
- Accurate power control
- Reduce power consumption
- Low thermal EMF
- AEC-Q200 compliant
- Low TCR

• Chip Resistors

SR Series

Surge Chip resistor

Feature

- Excellent pulse loading performance
- High stability & reliability
- Narrow tolerance to 0.5%
- Excellent ESD withstand performance
- AEC-Q200 compliant

• Chip Resistors

AC Series

Automotive grade thick film chip resistor

Feature

- AEC-Q200 compliant
- Highly reliable electrode construction
- Compatible with all soldering processes
- Highly stable in auto-placement surface mounting applications

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Chip Resistors
Ordering information - Global part number

Global part number - Single resistor [2]

Ordering example: RC0402JR-0710RL

RC 0402 J R — 07 10R L

Series name (code 1-2)
- RC = Thick film general
- RE = Thick film precision
- AC = Thick film automotive grade
- AA = Thick film anti-FOS automotive grade
- AF = Thick film anti-FOS
- SR = Thick film anti-surge
- RV = Thick film high voltage
- TR = Thick film trimmable
- AR = Thick film NiAu termination
- RT = Thin film high precision
- AT = Thin film high precision automotive grade
- RL/PT = Thick film low ohmic
- PA/PE/PS/PU = Metal current sensor
- UE = ESD suppressor[3]
- VRS = Multilayer chip varistor[3]

Size code (code 3-6)
(inch / metric)
- 0075 = 0.3x 0.15
- 0100 = 0.4 x 0.2
- 0201 = 0.6 x 0.3
- 0402 = 1.0 x 0.5
- 0603 = 1.6 x 0.8
- 0612 = 1.6 x 3.2
- 0805 = 2.0 x 1.25
- 0815 = 2.15 x 3.75
- 0830 = 2.0 x 7.5
- 1206 = 3.2 x 1.6
- 1210 = 3.2 x 2.6
- 1218 = 3.2 x 4.5
- 2010 = 5.0 x 2.5
- 2512 = 6.35 x 3.2

Tolerance (code 7)
- L = ±0.01%
- W = ±0.05%
- B = ±0.1%
- C = ±0.25%
- D = ±0.5%
- F = ±1%
- G = ±2%
- J = ±5% (for Thick Film Jumper ordering)
- K = ±10% (for TR = 0/-10%)
- M = ±20% (for TR = 0/-20%)
- N = ±30% (for TR = 0/-30%)
- "—" for RL/PT Jumper ordering

Default code[1] **(code 17)**

Resistance (code 12-16)
- 0R = Jumper
- 0U5 = 0.0005Ω
- 0R1 = 0.1Ω
- 1R = 1Ω
- 10R = 10Ω
- 100R = 100Ω
- 1K = 1 000Ω
- 1M = 1 000 000Ω
- 100M = 100 000 000Ω

Taping reel (code 10-11)
- 07 = 7 inch Dia. reel
- 13 = 13 inch Dia. reel
- 7N = 7 inch,ESD safe reel
- 7W = 7 in Dia. reel 2 x standard quantity
- 7T = 3 x standard power
- 47 = 4 x standard power
- 57 = 5 x standard power

T. C. R. (code 9)
- A = ±5 ppm/°C
- B = ±10 ppm/°C
- C = ±15 ppm/°C
- D = ±25 ppm/°C
- E = ±50 ppm/°C
- M = ±75 ppm/°C
- F = ±100 ppm/°C
- L = ±150 ppm/°C
- G = ±200 ppm/°C
- I = ±300 ppm/°C
- J = ±350 ppm/°C
- K = ±400 ppm/°C
- Q = ± 700 ppm/°C
- "—" = Based on spec (for thick film)

Packing style (code 8)
- R = Paper tape reel
- K = Embossed plastic tape reel
- S = ESD safe reel

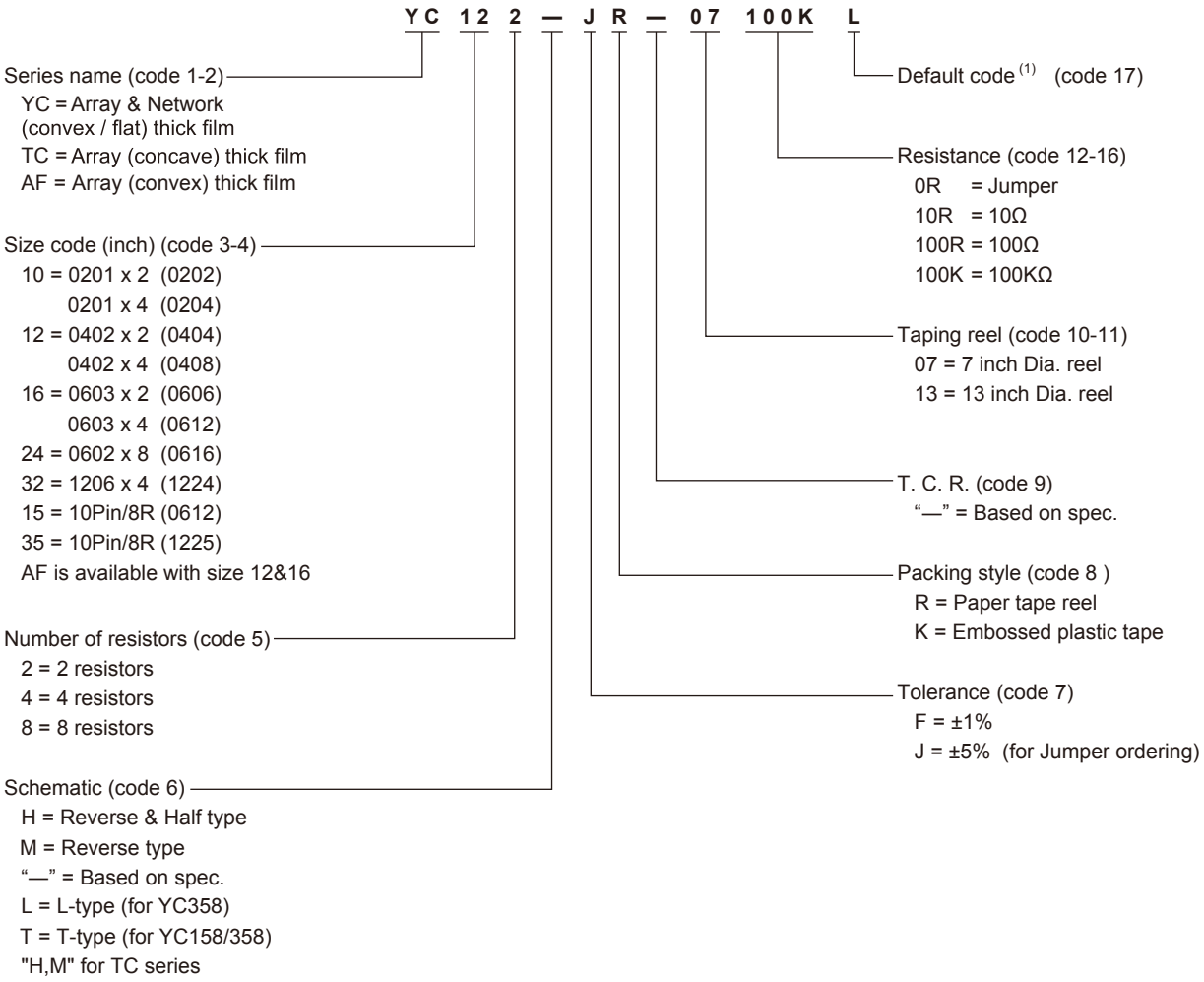
Note: 1. System default code for ordering only. Please refer to series datasheets for different default codes
2. Global Part Number is the preferred clear text code for ordering Yageo and Phycomp branded products.
3. Please refer to UE/VRS series datacheets for coding details.

Chip Resistors

Ordering information - Global part number - Arrays

Global part number - Arrays

Ordering example: YC122-JR-07100KL



Note: 1. System default code for ordering only. Please refer to series datasheets for different default codes

MLCC
Ordering information - Global part number

Global part number

Ordering example: CC0201KRX7R8BB102

C C 0 2 0 1 K R X 7 R 8 B B 1 0 2

Series name (code 1-2)
- CA = 4 x Capacitors array
- CC = Multilayer chip capacitors
- CL = Low inductance capacitors
- CQ = High frequency capacitors
- SC = Safety certification capacitors
- AC = Automotive grade capacitors
- CS = Soft termination capacitors

Size code (code 3-6)
- 0100
- 0201
- 0402
- 0603
- 0805
- 1206
- 1210
- 1808
- 1812
- 2220
- 0306
- 0508
- 0612

Capacitance tolerance (code 7)
- A = ±0.05 pF (CQ series only)
- B = ±0.1 pF
- C = ±0.25 pF
- D = ±0.5 pF
- F = ±1%
- G = ±2%
- J = ±5%
- K = ±10%
- M = ±20%
- Z = -20% to +80%

Packing style (code 8)
- R = Paper / PE tape reel Ø7 inch
- P = Paper / PE tape reel Ø13 inch
- K = Embossed plastic tape reel Ø7 inch
- F = Embossed plastic tape reel Ø13 inch
- C = Bulk case

TC material (code 9-11)
- NPO
- X5R
- X7R
- Y5V

Rated voltage (code 12)
- 5 = 6.3 V
- 6 = 10 V
- 7 = 16 V
- 8 = 25 V
- G = 35 V
- 9 = 50 V
- 0 = 100 V
- A = 200 V
- Y = 250 V
- B = 500 V
- Z = 630 V
- C = 1 kV
- D = 2 kV
- E = 3 kV
- T = X2 / Y3 for TUV / UL
- W = X1 / Y2 for TUV / UL
- U = X1 for UL (X7R, 1812)

Termination (code 13)
- B = Ni-Barrier

Process code (code 14)
- N = NP0
- B = Class 2 product

Capacitance value (code 15-17)
- 102 = 1 000 pF
- (2 significant digits+number of zeros; the 3rd digit signifies the multiplying factor, and letter R is decimal point)
- 0 = x 1
- 1 = x 10^1
- 2 = x 10^2
- 3 = x 10^3
- 4 = x 10^4
- 5 = x 10^5
- 6 = x 10^6
- 7 = x 10^7
- X X R = Special capacitance
- (X X: capacitance before decimal point)

Wireless
Ordering information - Global part number

Explanation of ordering code - New

Ordering example : ANT3216A063R2400A

ANT 3216 A 063 R 2400 A

Product Type (code 1)
ANT: Antenna
BPF: Band-Pass Filter
LPF: Low-Pass Filter
BLN: Balun
BLF: Balun Filter
DPX: Diplexer

(1) Size (mm) - SMD (LTCC) (code 2)
3216: 3.2 x 1.6 mm
2012: 2.0 x 1.2 mm
2520: 2.5 x 2.0 mm

(2) Connector - Cable length (mm) Stand-alone (code 2)
Ex: X100 – IPEX connector, 100 mm cable length
X: IPEX, M: MMCX, S: SMA, Z: Stripped
100: 100 mm cable length

Type (code 3)
L, F, A: Chip antenna / Filter / Balun
B: Bulk antenna
P: PCB
X: FPCB
S: Metal
E: External
J: Integrated antenna

Serial No. (code 4)

Packing Style (code 5)
R: Tape & Reel
T: Tray
B: Bulk

Frequency Band (MHz)(code 6)
2400: 2.4 – 2.5 GHz;
2455: 2.4&5 GHz
1575: GPS; 1516: GPS+Glonass
0433: 433 MHz
0870: 868 MHz
0918: 900/1800 MHz
WQUD: 850/900/1800/1900 MHz
WPEN: 850/900/1800/1900/2100 MHz

Factory Control Code / Cable Type (code 7)

Through Hole

Ordering information - Global part number

MFR	-12	F	T	F	52-	100R

Code 1 - 3
Series Name
See Index

Code 4 - 6
Power Rating

-05 = ød0.5mm
-06 = ød0.6mm
-07 = ød0.7mm
-08 = ød0.8mm
-10 = ød1.0mm
-14 = ød1.4mm
-12 = 1/6W
-25 = 1/4W
25S = 1/4WS
-50 = 1/2W
50S = 1/2WS
100 = 1W
1WS = 1WS
200 = 2W
2WS = 2WS
204 = 0.4W
207 = 0.6W
300 = 3W
3WS = 3WS
3WM = 3WM
400 = 4W
500 = 5W
5WS = 5WS
5SS = 5WSS
700 = 7W
7WS = 7WS
10A = 10W
20A = 20W
30A = 30W
40A = 40W
50A = 50W
10S = 10WS
15A = 15W
25A = 25W
10B = 100W
25B = 250W

Code 7
Tolerance

P = ±0.02 %
A = ±0.05 %
B = ±0.1 %
C = ±0.25%
D = ±0.5 %
F = ±1 %
G = ±2 %
J = ±5 %
K = ±10 %
- = Base on Spec.

Code 8
Packing Style

T = Tape/Box
R = Tape/Reel
B = Bulk

Code 9
Temperature Coefficient of Resistance

- = Base on Spec.
A = ±5 ppm/°C
B = ±10 ppm/°C
C = ±15 ppm/°C
S = ± 20ppm/°C
D = ±25 ppm/°C
E = ±50 ppm/°C
F = ±100 ppm/°C
G = ±200 ppm/°C
H = ±250 ppm/°C
I = ±300 ppm/°C
J = ±350 ppm/°C

Code 10 - 12
Forming Type

26- = 26mm
52- = 52.4mm
73- = 73mm
81- = 81mm
91- = 91mm
F = F Type
FK = FK Type
FKK = FKK Type
FFK = F-form Kink
M = M-Type Forming
M-formMBV/flat
MT = MT Type Forming
MR = MR Type
AV = AVIsert
PN = PANAsert

Code 13 - 17
Resistance Value

0R1 = 0.1
100R = 100
10K = 10,000
10M = 10,000,000

EXCEPTION:

• Cement series:

<Code 8>: Special packing style code
B: Bulk with wirewound or metal oxide sub-assembly for resistance value
W: Bulk with ceramic based wirewound sub-assembly for resistance value
M: Bulk with metal oxide sub-assembly for resistance value
F: Bulk with Fiberglass based wirewound sub-assembly for resistance value

<Code 10-12>: Without forming code

Example: **SQP500JB-10R**

• JPW series:

<Code 13-17>: without resistance value code

Example: **JPW-06-T-52-**

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