

Electronic Components for Automotive Applications



www.yageo.com

YAGEO
Phycomp

FERROXCUBE
A YAGEO COMPANY

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: 21 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

Table of contents

| | |
|---|----|
| Introduction..... | 3 |
| Applications..... | 4 |
| Component Solutions..... | 6 |
| Recommended Products..... | 8 |
| Comparison for Automotive Grade vs Commercial Grade | 12 |
| Product Information - Chip Resistors..... | 14 |
| Product Information - MLCCs..... | 16 |
| Product Information - Wireless Components..... | 18 |





Introduction

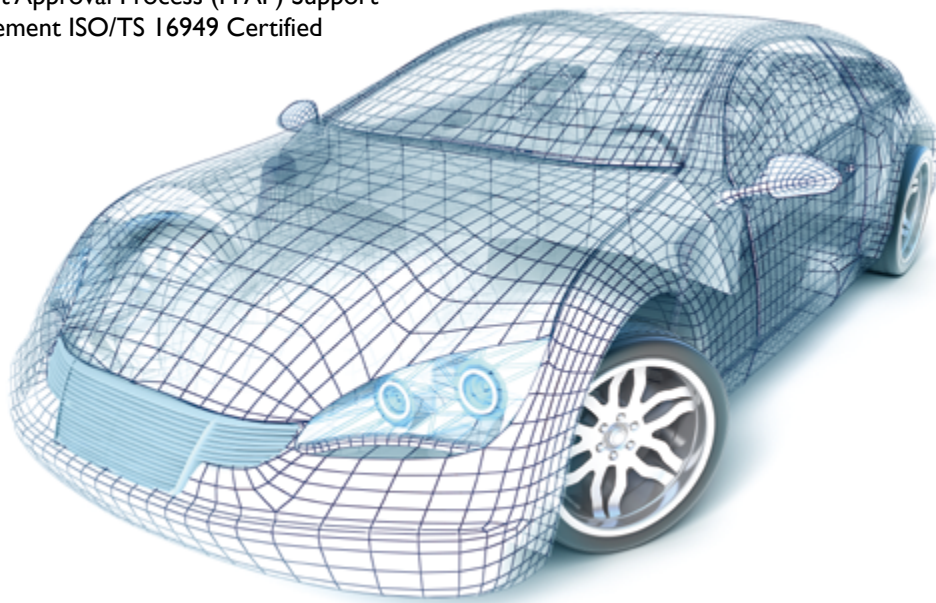
Gear Up for Automotive Applications

As the leading service provider of global passive components, Yageo is pleased to bring you this brochure to offer you a full range of products to fulfill your automotive application requirements. The brochure includes thick film automotive-grade chip resistors, automotive-grade MLCCs, antennas and other related products.

Compared to other applications, the requirements of the automotive industry for application and specification components are stricter, especially for things such as high reliability, resistance to high temperature and high humidity. Yageo's AC Series for the automotive industry is designed to fulfill customer expectations and demonstrate Yageo's commitment to the industry.

Requirements for Automotive Applications

- Narrow Specifications and Cpk Monitoring
- 100% AOI for Pattern Matching and Defect Detection
- AEC-Q200 Stress Test Qualified
- Production Part Approval Process (PPAP) Support
- Quality Management ISO/TS 16949 Certified



Convenience (Infotainment & Comfort)

- Electronic Toll Collection (ETC)
- Vehicle Information and Communication System (VICS)
- Bluetooth Communication
- GPS/Navigation
- Audio/Video
- Air Conditioner Control System
- PAS (Parking Assist System)
- Automatic Cruise Control

Environment (Emission Control)

- Electric Cars
- Hybrid
- Battery Management System (BMS)
- DC/DC Converter
- Electric Power Steering
- Fuel Control

Safety & Security (Body Control & Power System)

- Engine Control Unit (ECU)
- Power Seat Control
- Body & Motor Control for Power Windows, Doors and Mirrors
- Keyless Entry System
- Lighting Control
- Tire Pressure Monitoring System (TPMS)
- ABS, Airbag System



Applications

| Automotive Application Matrix | | | | | | | | | | |
|--|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|------------|-----------------|-----------------|-----------------------------------|
| Product Line | Chip Resistors | | | | | | | | MLCCs | Wireless Components |
| Size / Series | AC 0201~2512 | AA 0201~2512 | AT 0402~1206 | SR 0402~2512 | PT 0402~2512 | RL 0402~2512 | PA 2512 | PE 0402~2512 | AC 0402~1210 | ANT / BPF / LPF / BLN / DPX |
| Convenience (Infotainment & Comfort) | | | | | | | | | | |
| Electronic Toll Collection (ETC) | V | V | | | | | | | V | |
| Vehicle Information and communication System (VICS) | V | V | | | | | | | V | 2.4/5 GHz Chip Antenna |
| Bluetooth Communication | V | | | | | | | | V | Bluetooth Chip Antenna |
| GPS/Navigation | V | V | | | V | V | V | V | V | GPS/Glonass Chip & Patch Antennas |
| Audio/Video | V | | V | V | | | | | V | |
| Air Conditioner Control System | V | | V | | | | | | V | |
| PAS (Parking Assist System) | V | | | | | | | | V | |
| Automatic Cruise Control | V | | | | | | | | V | |
| Environment (Emission Control) | | | | | | | | | | |
| Battery Management System (BMS) | | | V | | V | V | V | V | V | |
| DC/DC Converter | | | V | | V | V | V | V | V | |
| Electric Power Steering | V | V | V | | | | | | V | |
| Fuel Control | V | V | | | | | | | V | |
| Safety & Security (Body Control & Power System) | | | | | | | | | | |
| Engine Control Unit (ECU) | V | V | V | V | V | V | V | V | V | |
| Power Seat Control | V | | | | | | | | V | |
| Body & Motor Control for Power Windows, Doors and Mirrors | V | V | | V | V | V | V | V | V | |
| Keyless Entry System | V | V | | | | | | | V | Short Range Chip Antennas |
| Lighting Control | V | | | V | | | | | V | |
| Tire Pressure Monitoring System (TPMS) | | | V | | V | V | V | V | V | Short Range Chip Antennas |
| ABS, Airbag System | V | V | V | | | | | | V | |

Component Solutions

HID Lighting

The main error amplifier and its external associated resistors and capacitors will determine where the peak of the power curve occurs as well as the shape of the frequency response of the ballast.

Yageo solution for HID lighting control

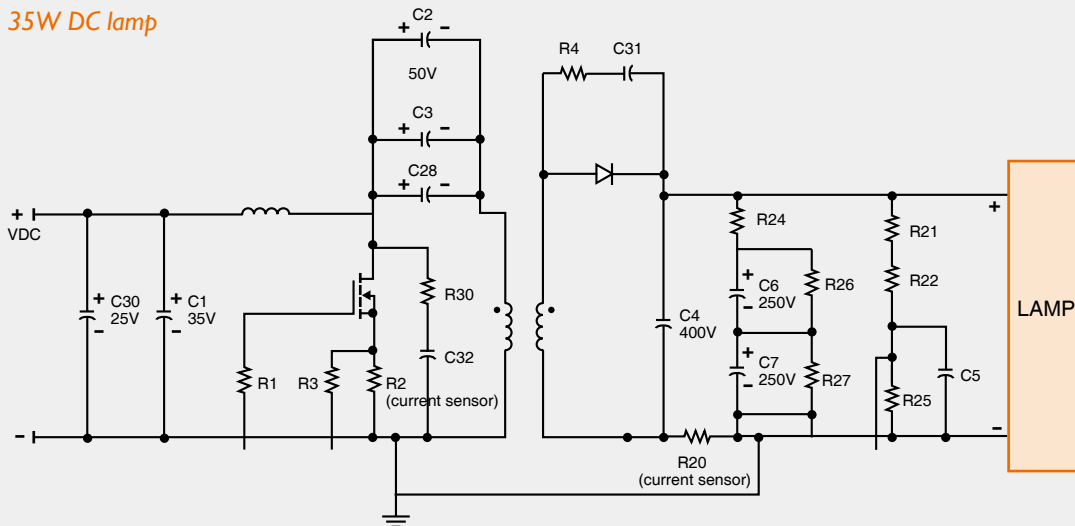
Resistors

AC series: AC0402~AC1206 (1Ω-1MΩ)
 AA series: AA0402~AA2512 (1Ω-10MΩ)
 PT series: PT0402~PT2512 (100mΩ-910mΩ)
 RL series: RL0603~RL2512 (10mΩ-910mΩ)

Capacitors

AC series: AC0402~AC1210 (10pF-2.2μF)

35W DC lamp



Interior Lighting Applications

Interior lighting applications include cluster or instrument backlighting, dome or map reading lights, courtesy lights at doors or in the trunk, and display backlighting.

Power supply for interior lighting applications

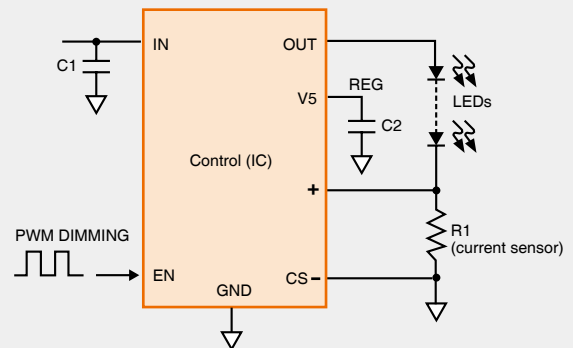
Yageo solution for interior lighting

Resistors

AA series: AA0402~AA2512 (1Ω-10MΩ)
 PA series: PA1206~PA2512 (1mΩ-100mΩ)
 PE series: PE0603~PE2512 (1mΩ-100mΩ)

Capacitors

AC series: AC0402~AC1210 (10pF-2.2μF)



Automotive Protected Circuit

The automotive electrical system makes up of large current electromotor, relay, solenoid, lighting and switch. So it is easy to engender the peak signal and noise.

Yageo solution for automotive protected circuit

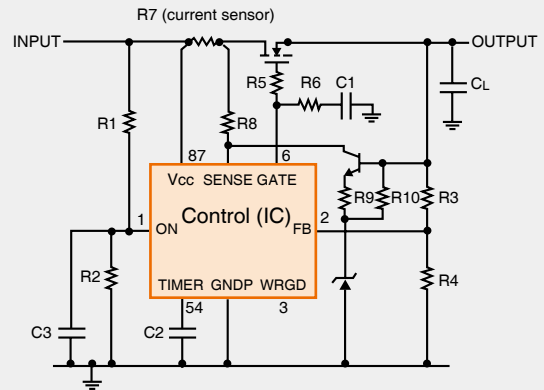
Resistors

AC series: AC0402~AC1206 (1Ω-1MΩ)
 AA series: AA0402~AA2512 (1Ω-10MΩ)
 AT series: AT0402~AT1206 (10Ω-1MΩ)
 RL series: RL0603~RL2512 (10mΩ-910mΩ)

Capacitors

AC series: AC0402~AC1210 (10pF-2.2μF)

Protected circuit



Automotive Current Mode PWM Control Circuit

- In order to prevent output leakage current from activating the power switch, the output should be shunted to ground with a resistor.
- Timing and bypass capacitors should be connected to GND pin in a single point ground.

Yageo solution for current mode control circuit

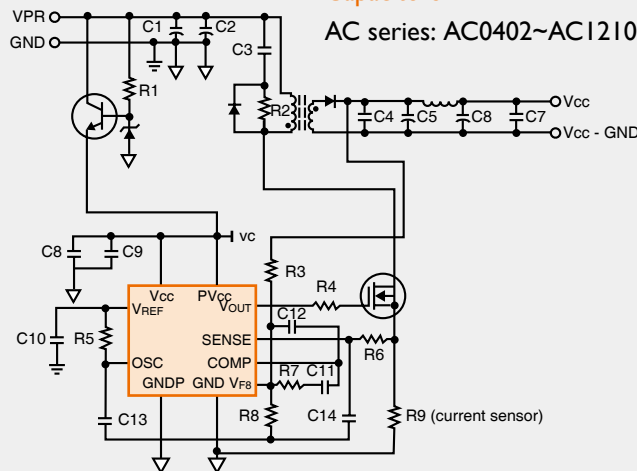
Resistors

AC series: AC0402~AC1206 (1Ω-1MΩ)
 AA series: AA0402~AA2512 (1Ω-10MΩ)
 AT series: AT0402~AT1206 (10Ω-1MΩ)
 PT series: PT0402~PT2512 (100mΩ-910mΩ)
 PE series: PE0603~PE2512 (1mΩ-100mΩ)

Capacitors

AC series: AC0402~AC1210 (10pF-2.2μF)

PWM control circuit



Recommended Products

Automotive Grade Chip Resistors: AC Series



Features

- EIA0201 to 2512 case sizes
- 100% AOI at screen printing
- Stable process control including narrow specifications and Cpk monitor
- 100% AOI after plating
- ESD withstands max. voltage of 2KV
- Humidity resistance of 1% (1,000 hours @ +85°C, 85% RH, applied 10% of operating power)
- Moisture sensitivity level: MSL I
- Soldering profiles according to J-STD-020D
- Halogen free epoxy
- RoHS compliant

Automotive Anti-Sulfurated Chip Resistors: AA Series



Features

- EIA0201 to 2512 case sizes
- Superior resistance against sulfur containing atmosphere (105°C 750hours)
- AEC-Q200-qualified
- Moisture sensitivity level: MSL I
- Soldering profiles according to J-STD-020D
- Halogen free epoxy
- RoHS compliant
- 100% AOI after plating

Automotive Thin Film Chip Resistors: AT Series



Features

- EIA0402 to 1206 case sizes
- Sulfur-resistant (ASTM B809-95 Standard)
- Higher pulse load performance, especially for higher ohmic values (> 33k ohm)
- AEC-Q200-qualified
- Moisture sensitivity level: MSL I
- Halogen free epoxy
- RoHS compliant
- 100% AOI after plating

Thick Film Low Ohmic Chip Resistors: RL / PT Series



Features

- Excellent performance at current sensing applications
- PT series: excellent T.C.R. and high rated power

Applications

- Current sensing
- Over current protection

Surge Chip Resistors: SR Series



Features

- EIA0402 to 2512 case sizes
- Low assembly costs
- Excellent performance at pulse loading
- High reliability and stability

Applications

- Circuits requiring high pulse
- Ideal for blocking surge voltage in power supplies

Current Sensors - low T. C. R. Chip Resistors: PR / PA / PE Series



Features

- Ultra-low resistance down to 0.0005 Ω
- Original trimless design significantly improves current detection, making them ideal for large current fast switching circuits

- Resistive element composed of a special alloy, resulting in a superior resistance-temperature coefficient
- The unique chip structure minimizes thermal stress during temperature cycling, resulting in greater reliability

Applications

- Ideal for a variety of applications, including current control circuits, over current protect circuits, and battery charge detection

Automotive Grade MLCCs: AC Series



Features

- EIA 0402 to 1812 & array 0508 to 0612 case sizes
- DC voltage ratings of 6.3V to 630V
- Capacitance offerings ranging from 10pF up to 1 μ F
- High thermal stability

- High ripple current capability
- Negligible capacitance change with respect to temperature from -55°C to +125°C
- Non-polar device, minimizing installation concerns

Recommended Products

GPS/Glonass Antennas



Features

- Support GPS & GLONASS system
- High radiation efficiency
- Pin-solder process
- Frequency: 1575/1602 MHz

Applications

- Navigation device
- Telematics box
- Fleet management

Cellular WWAN Antennas



Features

- Compact Size
- High radiation efficiency
- Multi-band coverage
- Reflow process compatible

Applications

- Global cellular network devices
- Telematics
- Cellular broadband access
- M2M module

Short Range Antennas



Features

- Compact size
- Omni-directional radiation
- Tape & reel automatic mounting
- Reflow process compatible

Applications

- Smart meter
- Industrial remote control
- ISM band equipment

2.4 GHz Bluetooth/WiFi Antennas



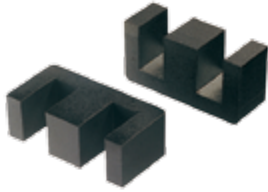
Features

- Compact size
- Omni-directional radiation
- Tape & reel automatic mounting
- Reflow process compatible

Applications

- 2.4 GHz WiFi device
- Bluetooth gadget
- ZigBee device
- ISM band equipment

E Cores



Features

- Materials: 3C90, 3C92, 3C94, 3C95, 3C96, 3C97, 3F35, 3F36
- Available in a wide variety of sizes

Applications

- Power converters
- Small signal applications
- EMI suppression

Toroids (Ring Cores)



Features

- Flame retardant in accordance with UL94V-2
- Materials: 3E27, 3E5, 3E6, 3E10, 3E12, 4A11

Applications

- EMC chokes for suppressing RF interference

PQ Cores



Features

- Materials: 3C90, 3C92, 3C94, 3C95, 3C96, 3C97, 3F35, 3F36
- Available in a wide variety of sizes

Applications

- General purpose transformers
- Power conversion

Custom Shapes



Features

- Standard materials
- Standard manufacturing process
- Design in support to optimize cost and reliability

Comparison for Automotive Grade vs Commercial Grade

Chip Resistors Automotive Grade vs Commercial Grade

| Items | Automotive Grade | Commercial Grade |
|--------------------------------------|---|----------------------------------|
| Documentation | PPAP with AEC-Q200 test report | Standard reliability test report |
| Qualification Criteria | AEC-Q200 | IEC 60115-8 / MIL-STD-202G |
| Process Control | a. 100% AOI at screen printing b. 100% AOI after plating c. Enlarge sampling size | Standard control |
| Dedicated Production Machines | Yes | No |

Chip Resistors Qualification Tests

| Qualification Tests | | AC Series | RC Series |
|----------------------------------|-------------------------------------|--|---|
| Life | | 1 000 hours at 125°C applied RCWV 1.5 hours on, 0.5 hours off | 1 000 hours at 70 ±5°C applied RCWV 1.5 hours on, 0.5 hours off, still air required |
| High temperature exposure | | 1 000 hours at maximum operating temperature depending on specification | 1 000 hours at maximum operating temperature depending on specification, unpowered |
| Moisture resistance | | Each temperature / humidity cycle is defined as 8 hours (method 106F), 3 cycles / 24 hours for 10d with 25°C / 65°C 95% R.H. | Each temperature / humidity cycle is defined as 8 hours (method 106F), 3 cycles / 24 hours for 10d with 25°C / 65°C 95% R.H. |
| Biased humidity | | 1 000 hours; + 85°C 85% R.H.; 10% of operating power Measured at 24 ±2 hours after test | On request |
| Thermal shock | | LCT / UCT, number of cycles required is 300 Maximum transfer time is 20 seconds | LCT / UCT, number of cycles required is 300 Maximum transfer time is 20 seconds |
| Solderability | Wetting | Electrical test not required. Magnification 50X Lead-free solder bath at 245 ±3°C Dipping time: 3 ±0.5 seconds | Electrical test not required. Magnification 50X Lead-free solder bath at 245 ±3°C Dipping time: 3 ±0.5 seconds |
| | Resistance to soldering heat | Lead-free solder, 260°C, 10 seconds immersion time | Lead-free solder, 260°C, 10 seconds immersion time |
| Short time overload | | 2.5 times RCWV or maximum overload voltage whichever is less for 5 seconds at room temperature | 2.5 times RCWV or maximum overload voltage whichever is less for 5 seconds at room temperature |

Note: Detailed tests and requirements, please refer to specific data sheets of Yageo automotive chip resistor series.



MLCC Automotive Grade vs Commercial Grade

| Item | Automotive Grade | Commercial Grade |
|------------------------------|--------------------------------|----------------------------------|
| Documentation | PPAP with AEC-Q200 test report | Standard reliability test report |
| Qualification Criteria | AEC-Q200 | IEC 60384 |
| Process Control | 100% AOI | Standard control |
| Dedicated Production Machine | Yes | No |

MLCC Qualification Tests

| Qualification Tests | AC Series | CC Series |
|-----------------------------|---|---|
| High Temperature Exposure | Unpowered; 1,000 hours at T = 150°C | N/A |
| Temperature Cycling | 1,000 cycles (-55°C to +125°C) Measurement at 24±2 hours after test conclusion | 5 cycles (-55°C to +125°C) Measurement at 24±2 hours after test conclusion |
| Thermal Shock | Rapid change of temperature test: NP0/X7R: -55 °C to +125 °C; 300 cycles 15 minutes at lower category temperature; 15 minutes at upper category temperature | N/A |
| Moisture Resistance | T = 24 hrs/per cycle; 10 continuous cycles unpowered | N/A |
| Biased Humidity | 1,000 hours at 85°C/85% R.H., with U _r | 500 hours at 40°C/95% R.H., with U _r |
| Mechanical Shock | Three shocks in each direction shall be applied along the three mutually perpendicular axes of the test specimen (18 shocks) | N/A |
| Vibration | 5 g's for 20 minutes, 12 cycles each of 3 orientations | N/A |
| ESD | Level Confirmed | N/A |
| Solderability (Steam Aging) | Guaranteed | N/A |
| Board Flex | Class 1: 3 mm, Class 2: 2 mm | 1 mm |
| Beam Load (Body Strength) | ≤ 0805 Thickness > 0.5mm: 20N Thickness ≤ 0.5mm: 8N ≥ 1206 Thickness > 1.25 mm: 54N Thickness ≤ 1.25 mm: 15N | N/A |

Product Information - Chip Resistors

| Electrical characteristics | | | | | | | | | | unit: mm | |
|----------------------------|--------------------------|--------------------------|------|------|------|---|---------------------------------|-----------------------|-----------------------------|----------|-----|
| Type | Power P ₇₀ | Operating Temp. range | MWV | RCOV | DWV | Resistance range & tolerance | | T. C. R. (ppm/°C) | Jumper criteria (unit:A) | | |
| AA0201 | 1/20W | -55°C to 125°C | 25V | 50V | 50V | E24 ±5% E24/E96 ±0.5%, ±1% | 1 Ω to 10 MΩ Jumper < 0.05Ω | 1Ω ≤ R ≤ 10Ω -100/350 | I _{Rated} | 0.5 | |
| AA0402 | 1/16W | -55°C to 155°C | 50V | 100V | 100V | | | 10Ω < R ≤ 10MΩ ±200 | I _{Max.} | 1.0 | |
| AA0603 | 1/10W | | 75V | 150V | 100V | | | I _{Rated} | 1.0 | | |
| AA0805 | 1/8W | | 150V | 300V | 300V | | | I _{Max.} | 2.0 | | |
| AA1206 | 1/4W | | 200V | 400V | 500V | | | I _{Rated} | 2.0 | | |
| AA1210 | 1/2W | | 200V | 500V | 500V | | | I _{Max.} | 10.0 | | |
| AA1218 | 1W | | 200V | 500V | 500V | | | I _{Rated} | 2.0 | | |
| AA2010 | 3/4W | | 200V | 500V | 500V | | | I _{Max.} | 10.0 | | |
| AA2512 | 1W | | 200V | 500V | 500V | | | I _{Rated} | 2.0 | | |
| | | | | | | | | | I _{Max.} | 10.0 | |
| AC0201 | 1/20W | -55°C to 125°C | 25V | 50V | 50V | E24 ±5% E24/E96 ±0.5%, ±1% | 1Ω ≤ R ≤ 10MΩ Jumper < 0.05Ω | 1Ω ≤ R ≤ 10Ω -100/350 | I _{Rated} | 0.5 | |
| AC0402 | 1/16W | -55°C to 155°C | 50V | 100V | 100V | | | 10Ω < R ≤ 10MΩ ±200 | I _{Max.} | 1.0 | |
| AC0603 | 1/10W | | 50V | 100V | 100V | | | I _{Rated} | 1.0 | | |
| AC0805 | 1/8W | | 150V | 300V | 300V | | | I _{Max.} | 2.0 | | |
| AC1206 | 1/4W | | 200V | 400V | 500V | | | I _{Rated} | 2.0 | | |
| AC1210 | 1/2W | | 200V | 500V | 500V | | | I _{Max.} | 10.0 | | |
| AC1218 | 1W | | 200V | 500V | 500V | | | I _{Rated} | 6.0 | | |
| AC2010 | 3/4W | | 200V | 500V | 500V | | | I _{Max.} | 10.0 | | |
| AC2512 | 1W | | 200V | 500V | 500V | | | I _{Rated} | 2.0 | | |
| | | | | | | | | | I _{Max.} | 10.0 | |
| AT0402 | 1/16W | -55°C to 155°C | 50V | 100V | 100V | E-24/E96 ±0.1%, ±0.25% ±0.5%, ±1% | 10~100KΩ | ±25 ±50 | --- | --- | |
| AT0603 | 1/10W | | 75V | 150V | 100V | | | | 10~300KΩ | --- | --- |
| AT0805 | 1/8W | | 150V | 300V | 300V | | | | 10~1MΩ | --- | --- |
| AT1206 | 1/4W | | 200V | 400V | 500V | | | | | --- | --- |



| Packing quantities | | | | | |
|--------------------|------------|------------------|----------|-------------------|-------------------|
| Size code | Tape width | 178mm / Ø7" reel | | 254mm / Ø10" reel | 330mm / Ø13" reel |
| | | Paper | Embossed | Paper | Paper |
| 0201 | 8mm | 10 000 | --- | --- | 50 000 |
| 0402 | 8mm | 10 000 | --- | 20 000 | 50 000 |
| 0603 | 8mm | 5 000 | --- | 10 000 | 20 000 |
| 0805 | 8mm | 5 000 | --- | 10 000 | 20 000 |
| 1206 | 8mm | 5 000 | --- | 10 000 | 20 000 |
| 1210 | 8mm | 5 000 | --- | --- | 20 000 |
| 1218 | 12mm | --- | 4 000 | --- | --- |
| 2010 | 12mm | --- | 4 000 | --- | --- |
| 2512 | 12mm | --- | 4 000 | --- | --- |

Explanation of ordering code

AC 0603JR - 07 100K L

Series name (code 1-2) ————

AC = Automotive grade chip resistors

Size code (code 3-6) ————

(inch / metric)

| | |
|-------------------|-------------------|
| 0201 = 0.6 × 0.3 | 1210 = 3.2 × 2.6 |
| 0402 = 1.0 × 0.5 | 1218 = 3.2 × 4.5 |
| 0603 = 1.6 × 0.8 | 2010 = 5.0 × 2.5 |
| 0805 = 2.0 × 1.25 | 2512 = 6.35 × 3.2 |
| 1206 = 3.2 × 1.6 | |

Tolerance (code 7) ————

D = ±0.5%
 F = ±1%
 J = ±5% (for jumper ordering)

Packing style (code 8) ————

R = Paper tape reel
 K = Embossed plastic tape reel

Default code (code 17)

Resistance (code 12-16)

0R = Jumper
 10R = 10Ω
 100R = 100Ω
 100K = 100KΩ

Taping reel (code 10-11)

07 = 7 inch Dia. reel
 10 = 10 inch Dia. reel
 13 = 13 inch Dia. reel

T. C. R. (code 9)

“—” = Based on spec.

Product Information - MLCCs

| Electrical Characteristics | | | | | |
|----------------------------|-----|----------------------|-------------------|---------------|------------|
| Type | TC | Operating Temp Range | Capacitance Range | Voltage Range | Tolerance |
| AC0402 | NPO | -55°C to 125°C | 0.47pF~220pF | 50V | ±5% |
| | X7R | -55°C to 125°C | 100pF~100nF | 10V~50V | ±10%, ±20% |
| AC0603 | NPO | -55°C to 125°C | 0.47pF~680pF | 50V~250V | ±5% |
| | X7R | -55°C to 125°C | 100pF~220nF | 10V~100V | ±10%, ±20% |
| AC0805 | NPO | -55°C to 125°C | 0.47pF~1nF | 50V~630V | ±5% |
| | X7R | -55°C to 125°C | 150pF~1µF | 10V~500V | ±10%, ±20% |
| AC1206 | NPO | -55°C to 125°C | 0.47pF~2.7nF | 50V~630V | ±5% |
| | X7R | -55°C to 125°C | 220pF~1µF | 6.3V~630V | ±10%, ±20% |
| AC1210 | NPO | -55°C to 125°C | 47pF~2.7nF | 50V~500V | ±5% |
| | X7R | -55°C to 125°C | 2.2nF~1µF | 6.3V~500V | ±10%, ±20% |
| AC1812 | X7R | -55°C to 125°C | 2.2nF~1µF | 50V~100V | ±10%, ±20% |
| AC0508 (Array) | NPO | -55°C to 125°C | 10pF~100pF | 50V | ±5%, ±10% |
| | X7R | -55°C to 125°C | 1.0nF~10nF | 16V~50V | ±10%, ±20% |
| AC0612 (Array) | NPO | -55°C to 125°C | 10pF~470pF | 50V | ±5%, ±10% |
| | X7R | -55°C to 125°C | 220pF~47nF | 16V~50V | ±10%, ±20% |

| Thickness classes and packing quantities | | | | | | |
|--|-------------------------------|------------|------------------|---------|-------------------|---------|
| Size code | Thickness classification (mm) | Tape width | 180mm / Ø7" reel | | 330mm / Ø13" reel | |
| | | | Paper | Blister | Paper | Blister |
| 0402 | 0.5 ±0.05 / ±0.15 / ±0.20 | 8 mm | 10 000 | --- | 50 000 | --- |
| 0603 | 0.8 ±0.1 / ±0.2 | | 4 000 | --- | 15 000 | --- |
| 0805 | 0.6 ±0.1 | | 4 000 | --- | 20 000 | --- |
| | 0.85 | | 4 000 | --- | 15 000 | --- |
| 1206 | 1.25 ±0.2 | | --- | 3 000 | --- | 10 000 |
| | 0.6 ±0.1 | | 4 000 | --- | 20 000 | --- |
| | 0.85 ±0.1 | | 4 000 | --- | 15 000 | --- |
| | 1.15 ±0.1 | | --- | 3 000 | --- | 10 000 |
| | 1.25 ±0.2 | | --- | 3 000 | --- | 10 000 |
| | 1.6 ±0.2 | | --- | 2 000 | --- | 10 000 |
| 1210 | 0.85 ±0.1 | | --- | 4 000 | --- | 10 000 |
| | 1.25 ±0.2 | | --- | 3 000 | --- | --- |
| | 1.6 | | --- | 2 000 | --- | --- |
| 1812 | 0.85 | | --- | 2 000 | --- | --- |
| | 1.15 | | --- | 1 000 | --- | --- |
| | 1.25 | | --- | 1 000 | --- | --- |
| | 1.6 | | --- | 1 000 | --- | --- |
| 0508 (Array) | 0.6 | | 4 000 | --- | --- | --- |
| | 0.8 | | --- | --- | --- | --- |
| 0612 (Array) | 0.6 | | 4 000 | --- | --- | --- |
| | 0.8 | --- | --- | --- | --- | |



| Dimensions | | | | | | | |
|------------|-------------------|---------------|----------------------|------------|--|--|--------------------------|
| | Inch-based | Metric | L₁ | W | L₂ / L₃ min | L₂ / L₃ max | L₄ min |
| | 0402 | 1005M | 1.0 ±0.05 | 0.5 ±0.05 | 0.15 | 0.30 | 0.40 |
| | 0603 | 1608M | 1.6 ±0.10 | 0.8 ±0.10 | 0.20 | 0.60 | 0.40 |
| | 0805 | 2012M | 2.0 ±0.20 | 1.25 ±0.20 | 0.25 | 0.75 | 0.55 |
| | 1206 | 3216M | 3.2 ±0.30 | 1.6 ±0.20 | 0.25 | 0.75 | 1.40 |
| | 1210 | 3225M | 3.2 ±0.30 | 2.5 ±0.20 | 0.25 | 0.75 | 1.40 |
| 1812 | 3245M | 4.5 ±0.40 | 3.2 ±0.30 | 0.25 | 0.75 | 2.20 | |
| | Inch-based | Metric | L | W | A | B | P |
| | 0508 (Array) | 1220M | 2.0 ±0.15 | 1.25 ±0.15 | 0.28 ±0.10 | 0.2 ±0.10 | 0.5 ±0.10 |
| | 0612 (Array) | 1632M | 3.2 ±0.15 | 1.6 ±0.15 | 0.4 ±0.10 | 0.3 ±0.20 | 0.8 ±0.10 |

| Explanation of ordering code | |
|--|--|
| AC 0402 KRX7R8BB102 | |
| <p>Series name (code 1-2) AC = Automotive grade capacitors</p> <p>Size code (code 3-6) 0402 0603 0805 1206 1210 1812 0508(Array) 0612(Array)</p> <p>Capacitance tolerance (code 7) J = ±5% K = ±10% M = ±20%</p> <p>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</p> <p>TC material (code 9-11) NP0 X7R</p> | <p>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 10¹ 2 = x 10² 3 = x 10³ 4 = x 10⁴ 5 = x 10⁵ 6 = x 10⁶ 7 = x 10⁷ X X R = Special capacitance (X X: capacitance before decimal point)</p> <p>Process code (code 14) N = NP0 B = X7R</p> <p>Termination (code 13) B = Ni-Barrier</p> <p>Rated voltage (code 12) 5 = 6.3 V A = 200 V 6 = 10 V B = 500 V 7 = 16 V Y = 250 V 8 = 25 V Z = 630 V 9 = 50 V 0 = 100 V</p> |

Product Information

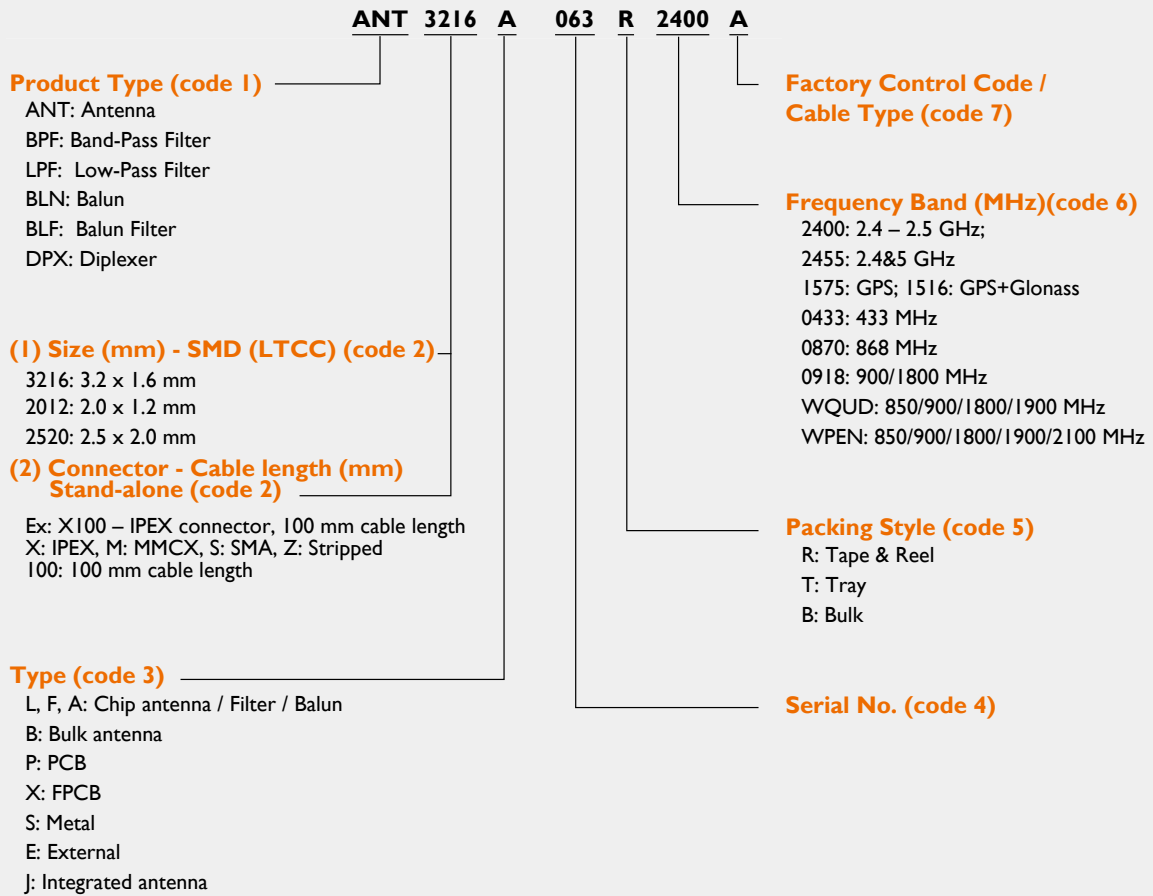
- Wireless Components

| Product Series | Part Number (new) | Part Number (old) | Frequency range (MHz) | Gain | Size (mm) | Assembly |
|--------------------|-------------------|-------------------|-----------------------|-----------------|---------------|-----------------------|
| Cellular WWAN | ANT2112A010B0918A | CAN4313284109181B | 824~960/ 1710~1990 | 0~1 dBi | 21*12*0.5 | SMD |
| | ANT3505B000TWPENA | CAN4313449009181B | 824~960 /1710~2170 | 2.9 dBi | 35*5*6 | SMD |
| | ANTX100P001BWPEN3 | - | 824~960/ 1710~2170 | 4.2 dBi | 50*20*0.55 | I-PEX dia 1.13, 100mm |
| 2.4 GHz | ANT1204F001R2400A | CAN4311059012451K | 2400~2500 | 6.66 dBi | 12*4*2 | SMD |
| | ANT3216LL00R2400A | CAN4311712002453K | 2400~2500 | 5 dBi | 3.2*1.6*1.3 | SMD |
| | ANT3216A063R2400A | CAN4311212632453K | 2400~2500 | 1.69 dBi | 3.2*1.6*0.5 | SMD |
| | ANT2012LL13R2400A | CAN4311714132454K | 2400~2500 | 2.72 dBi | 2.0*1.2*1 | SMD |
| | ANTX200P001B24003 | - | 2400~2500 | 4.8 dBi | 18.4*7.5*0.55 | I-PEX dia 1.13, 200mm |
| GPS | ANT1515B00BT1575A | CAN43134230B1581B | 1575 | 1.5 dBic | 15*15*4 | SMD |
| | ANT1818B00FT1575A | CAN43134240F1581B | 1575 | 4 dBic | 18*18*4 | Pin Solder |
| | ANT2525B00BT1575A | CAN43134250B1581B | 1575 | 5.5 dBic | 25*25*4 | SMD |
| GPS+Glonass | ANT1818B00BT1516A | CAN43134240B1561B | 1575 / 1602 | 1.89 / 2.59 dBi | 18*18*4 | SMD |
| | ANT1818B00DT1516A | CAN43134240D1561B | 1575 / 1602 | 2.65 / 2.79 dBi | 18*18*4 | Pin Solder |
| | ANT2525B00BT1516A | CAN43134250B1561B | 1575 / 1602 | 3.44 / 4.10 dBi | 25*25*4 | SMD |
| | ANT2525B00DT1516A | CAN43134250D1561B | 1575 / 1602 | 3.5 / 3.8 dBi | 25*25*4 | Pin Solder |
| Active GPS | ANT1212JB27B1575A | CAN4313322271581B | 1575 | 25 dB | 12*12*6.5 | Connector |
| | ANT1818JB30B1575A | CAN4313324301581B | 1575 | 25 dB | 18*18*7.1 | Connector |
| | ANT2525JB08B1575A | CAN4313325081581B | 1575 | 16 dB | 25*25*7.5 | Connector |
| | ANT1606JB12B1575A | CAN4313346121581B | 1575 | 20 dB | 20*6*6.4 | Connector |
| Active GPS+Glonass | ANT8010JLC1B1516A | CAN4313981C11561B | 1575 / 1602 | 20/20 dB | 22*6*1.9 | Connector |
| ISM Bands | ANT1204LL05R0915A | CAN4311759050911K | 915 | 3.32 | 12*4*1.6 | SMD |
| | ANT1204LL08R0870A | CAN4311759080871K | 870 | 0.5 | 12*4*1.6 | SMD |
| | ANT7020LL05R0870A | CAN4311772050872K | 870 | N/A | 7.0*2.0*0.7 | SMD |
| | ANT1204LL20R0433A | CAN4311759200431K | 433 | 0.83 | 12*4*1.2 | SMD |
| | ANT1204LL20R0315A | CAN4311759200311K | 315 | N/A | 12*4*1.2 | SMD |
| | ANT2405F001R0169A | CAN4311050010162K | 169 | N/A | 24*5*1.2 | SMD |
| SDARS | ANT2020B00FT2300A | CAN43134200F2301B | 2320~2345 | N/A | 20*20*4 | Pin Solder |
| FM | ANT2405F001R0098A | CAN4311050010882K | 88~108 | N/A | 24*5*1.6 | SMD |



Explanation of ordering code

Ordering example : **ANT3216A063R2400A**



YAGEO - A GLOBAL COMPANY

HQ

Taipei, Taiwan
Tel. +886 2 6629 9999
Fax. +886 2 6628 8886
Mail: sales_tw@yageo.com

China and ASIA

Suzhou, China

Tel. +86 512 6825 5568
Fax. +86 512 6825 5386
Mail: sales_sz@yageo.com

Qingdao, China

Tel. +86 532 8797 0533
Fax. +86 532 8797 0533
Mail: sales_qd@yageo.com

Dongguan, China

Tel. +86 769 8772 0275
Fax. +86 769 8791 0053
Mail: sales_dg@yageo.com

Tokyo, Japan

Tel. +81 3 6809 3972
Fax. +81 3 6809 3982
Mail: sales_yj@yageo.com

Seongnam, Korea

Tel. +82 31 712 4797
Fax. +82 31 712 5866
Mail: sales_yk@yageo.com

Singapore

Tel. +65 6244 7800
Fax. +65 6244 4943
Mail: sales_ysa@yageo.com

Kuala Lumpur, Malaysia

Tel. +60 3 8063 8864
Fax. +60 3 8063 7376
Mail: sales_ysa@yageo.com

Penang, Malaysia

Tel. +60 4 3973049
Fax. +60 4 3973050
Mail: sales_ysa@yageo.com

EUROPE

Munich, Germany

Tel. +49 8990 7784 380
Fax. +49 8990 7784 379
Mail: sales_je@yageo.com

Milan, Italy

Tel. +39 02 6129 1017
Fax. +39 02 6601 7490
Mail: sales_je@yageo.com

Roermond, Benelux

Tel. +31 475 385 555
Fax. +31 475 385 589
Mail: sales_je@yageo.com

Szombathely, Hungary

Tel. +36 94 517 702
Fax. +36 94 517 701
Mail: sales_je@yageo.com

Moscow, Russian Federation

Tel. +7 965 408 1811
Fax. +7 498 610 0707
Mail: sales_je@yageo.com

NORTH AMERICA

San Jose, U.S.A.

Tel. +1 408 240 6200
Fax. +1 408 240 6201
Mail: sales_ya@yageo.com

Mexico

Tel. +52 33 31330631
Fax. +1 408 240 6201
Mail: sales_ya@yageo.com

For a complete listing of all Yageo sales offices, distributors, and representatives, please visit "contact us" at www.yageo.com

© YAGEO Corporation

All rights are reserved. Reproduction in whole or in part is prohibited without the prior written consent of the copyright owner.

The information presented in this document does not form part of any quotation or contract, is believed to be accurate and reliable and may be changed without notice.

No liability will be accepted by the publisher for any consequence of its use. Publication thereof does not convey nor imply any license under patent or other industrial or intellectual property rights.