

CQ Automotive Thick Film Chip Resistors

Thick film chip resistors for automotive electronics · test items per AEC-Q200

Features

- Automotive thick film chip resistors manufactured by KOME, for automotive applications
- Test items follow the AEC-Q200 test standard
- Anti-sulfuration
- Applications: cars, iPad, LED lamps, intelligent home appliances, medical equipment, industrial control devices and industrial supplies ⑤
- Compliant with the RoHS directive
- Meets the halogen-free requirement

CASE SIZES 0201 – 2512	POWER RATING 1/20W – 1W	RESISTANCE 0.01Ω – 10MΩ	OPERATING TEMP. -55°C ~ 155°C
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Part number

CQ Product code Automotive chip resistors	05 Type 0805	K TCR code Based on spec.	5 Total characters 103=10000=5	103 Resistance value 10KΩ	J Tolerance ±5%	T Packaging Tape & reel	LF Other Lead free
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Ordering example as given on the original sheet; each position is explained in the tables below.

Product code		TCR code ③		Resistance value		Tolerance ②																					
CQ	Automotive chip resistors	Code	TCR	E24	Significant figures + number of zeros	Code	Tolerance																				
<div>Type ①</div> <table><tr><th>Type</th><th>Size</th></tr><tr><td>CQ01</td><td>0201</td></tr><tr><td>CQ02</td><td>0402</td></tr><tr><td>CQ03</td><td>0603</td></tr><tr><td>CQ05</td><td>0805</td></tr><tr><td>CQ06</td><td>1206</td></tr><tr><td>CQ07</td><td>1210</td></tr><tr><td>CQ10</td><td>2010</td></tr><tr><td>CQ11</td><td>1812</td></tr><tr><td>CQ12</td><td>2512</td></tr></table>		Type	Size	CQ01	0201	CQ02	0402	CQ03	0603	CQ05	0805	CQ06	1206	CQ07	1210	CQ10	2010	CQ11	1812	CQ12	2512	W	±200	E96	No. of characters + significant figures + number of zeros	F	±1%
		Type	Size																								
		CQ01	0201																								
		CQ02	0402																								
		CQ03	0603																								
		CQ05	0805																								
		CQ06	1206																								
		CQ07	1210																								
		CQ10	2010																								
		CQ11	1812																								
CQ12	2512																										
L	±250	<div>Examples</div> <table><tr><td>E-24</td><td>1R0=1.0Ω, 103=10KΩ</td></tr><tr><td>E-96</td><td>5 1002=10KΩ</td></tr><tr><td>E-96</td><td>5 1003=100KΩ ④</td></tr></table> Letter R is the decimal point.		E-24	1R0=1.0Ω, 103=10KΩ	E-96	5 1002=10KΩ	E-96	5 1003=100KΩ ④	J	±5%																
E-24	1R0=1.0Ω, 103=10KΩ																										
E-96	5 1002=10KΩ																										
E-96	5 1003=100KΩ ④																										
B	±300	G	±2%																								
U	±400	0	Jumper																								
c	±50	<div>Packaging</div> <table><tr><td>T</td><td>Tape & reel</td></tr><tr><td>B</td><td>Bulk case</td></tr></table>		T	Tape & reel	B	Bulk case	<div>Other</div> <table><tr><td>LF</td><td>Lead free</td></tr></table>		LF	Lead free																
T	Tape & reel																										
B	Bulk case																										
LF	Lead free																										
K	Based on spec.																										
		<div>Total characters ④</div> No. of total characters (103=10000=5)																									

Marking

Normally, CQ01 and CQ02 resistors are marked as follows:

Normally, 0Ω CQ03, CQ05, CQ06, CQ07, CQ10 and CQ12 resistors are marked as follows:

±5% tolerance products (E-24 series): 3 characters. The 1st and 2nd characters are the significant figures of the resistance value; the last character is the power of ten.

±1% tolerance products (E-96 series): 4 characters. The 1st to 3rd characters are the significant figures of the resistance value; the last character is the power of ten. The letter “R” in the marking is the decimal point.



Illustration; not a photograph of a specific part.

	0 → 0Ω
	333 → 33KΩ
	2701 → 2.7KΩ

Standard E-96 values of CQ03, $\leq \pm 1\%$: 3-character marking

Because of the small size of the resistor body, standard E-96 values of CQ03 with $\leq \pm 1\%$ tolerance are marked with 3 characters that give the exact resistance value, using the multiplier code and the resistance value code below.

Multiplier code (for CQ03 $\leq \pm 1\%$ marking)

Code	A	B	C	D	E	F	G	H	X	Y	Z
Multiplier	10^0	10^1	10^2	10^3	10^4	10^5	10^6	10^7	10^{-1}	10^{-2}	10^{-3}

Standard E-96 series resistance value code (for CQ03 $\leq \pm 1\%$ marking)

Value	Code	Value	Code	Value	Code	Value	Code
100	01	178	25	316	49	562	73
102	02	182	26	324	50	576	74
105	03	187	27	332	51	590	75
107	04	191	28	340	52	604	76
110	05	196	29	348	53	619	77
113	06	200	30	357	54	634	78
115	07	205	31	365	55	649	79
118	08	210	32	374	56	665	80
121	09	215	33	383	57	681	81
124	10	221	34	392	58	698	82
127	11	226	35	402	59	715	83
130	12	232	36	412	60	732	84
133	13	237	37	422	61	750	85
137	14	243	38	432	62	768	86
140	15	249	39	442	63	787	87
143	16	255	40	453	64	806	88
147	17	261	41	464	65	825	89
150	18	267	42	475	66	845	90
154	19	274	43	487	67	866	91
158	20	280	44	499	68	887	92
162	21	287	45	511	69	909	93
165	22	294	46	523	70	931	94
169	23	301	47	536	71	953	95
174	24	309	48	549	72	976	96

The resistance values are marked as in the following examples:



1.96K Ω =196 $\times 10^1\Omega$ =29B



12.4 Ω =124 $\times 10^{-1}\Omega$ =10X

Standard E-24 values that are not in the E-96 series ($\leq \pm 1\%$), 0603 size: marked as for $\pm 5\%$ tolerance, but underlined.



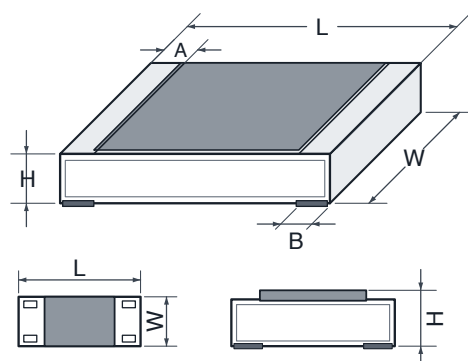
333=33K Ω



680=68 Ω

Dimensions

Type	Dimension (mm)				
	L	W	H	A	B
CQ01 (0201)	0.60 $\pm$ 0.03	0.30 $\pm$ 0.03	0.23 $\pm$ 0.03	0.12 $\pm$ 0.05	0.15 $\pm$ 0.05
CQ02 (0402)	1.00 $\pm$ 0.10	0.50 $\pm$ 0.05	0.35 $\pm$ 0.05	0.20 $\pm$ 0.10	0.25 $\pm$ 0.10
CQ03 (0603)	1.60 $\pm$ 0.10	0.80 $\pm$ 0.10	0.45 $\pm$ 0.10	0.30 $\pm$ 0.20	0.30 $\pm$ 0.20
CQ05 (0805)	2.00 $\pm$ 0.15	1.25 +0.15/-0.10	0.55 $\pm$ 0.10	0.40 $\pm$ 0.20	0.40 $\pm$ 0.20
CQ06 (1206)	3.10 $\pm$ 0.15	1.55 +0.15/-0.10	0.55 $\pm$ 0.10	0.45 $\pm$ 0.20	0.45 $\pm$ 0.20
CQ07 (1210)	3.10 $\pm$ 0.10	2.50 $\pm$ 0.15	0.55 $\pm$ 0.10	0.50 $\pm$ 0.25	0.50 $\pm$ 0.20
CQ10 (2010)	5.00 $\pm$ 0.10	2.50 $\pm$ 0.20	0.55 $\pm$ 0.10	0.60 $\pm$ 0.25	0.50 $\pm$ 0.20
CQ12 (2512)	6.35 $\pm$ 0.10	3.20 $\pm$ 0.20	0.55 $\pm$ 0.10	0.60 $\pm$ 0.25	0.50 $\pm$ 0.20



Resistance range

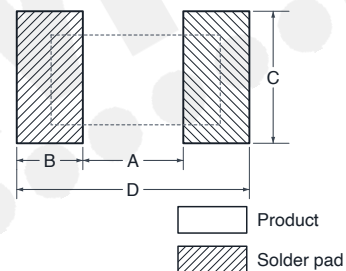
Type	Power rating	Resistance range			
		±0.5%	±1.0%	±2.0%	±5.0%
CQ01	1/20W	—	1Ω-10MΩ	1Ω-10MΩ	1Ω-10MΩ
CQ02	1/16W	1Ω-10MΩ	0.1Ω-10MΩ	0.1Ω-10MΩ	0.1Ω-10MΩ
CQ03	1/10W	1Ω-10MΩ	0.01Ω-10MΩ	0.01Ω-10MΩ	0.01Ω-10MΩ
CQ05	1/8W	1Ω-10MΩ	0.1Ω≤R<10MΩ	0.1Ω≤R<10MΩ	0.1Ω≤R<10MΩ
	1/4W	—	0.01Ω≤R<0.1Ω	0.01Ω≤R<0.1Ω	0.01Ω≤R<0.1Ω
CQ06	1/4W	1Ω-10MΩ	0.1Ω≤R<10MΩ	0.1Ω≤R<10MΩ	0.1Ω≤R<10MΩ
	1/3W	—	0.01Ω≤R<0.1Ω	0.01Ω≤R<0.1Ω	0.01Ω≤R<0.1Ω
CQ07	1/2W	1Ω-10MΩ	0.01Ω-10MΩ	0.01Ω-10MΩ	0.01Ω-10MΩ
CQ10	3/4W	1Ω-10MΩ	0.01Ω-10MΩ	0.01Ω-10MΩ	0.01Ω-10MΩ
CQ12	1W	1Ω-10MΩ	0.01Ω-10MΩ	0.01Ω-10MΩ	0.01Ω-10MΩ

Ratings

Type	Max. working voltage	Max. overload voltage	Dielectric withstanding voltage	Resistance value of jumper	Rated current of jumper	Max. overload current of jumper	Operating temperature
CQ01	25V	50V	/	<50mΩ	0.5A	1A	-55°C~155°C
CQ02	50V	100V	100V	<50mΩ	1A	2A	-55°C~155°C
CQ03	75V	150V	300V	<50mΩ	1A	2A	-55°C~155°C
CQ05	150V	300V	500V	<50mΩ	2A	5A	-55°C~155°C
CQ06	200V	400V	500V	<50mΩ	2A	10A	-55°C~155°C
CQ07	200V	500V	500V	<50mΩ	2A	10A	-55°C~155°C
CQ10	200V	500V	500V	<50mΩ	2A	10A	-55°C~155°C
CQ12	200V	500V	500V	<50mΩ	2A	10A	-55°C~155°C

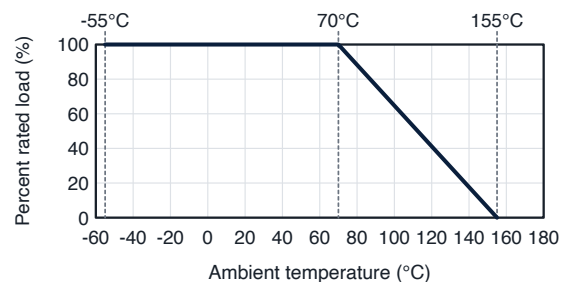
Recommended soldering pad

Type	Dimension (mm)			
	A	B	C	D
CQ01	0.3±0.05	0.35±0.05	0.4±0.05	1.0±0.05
CQ02	0.50±0.05	0.45±0.05	0.5±0.05	1.4±0.05
CQ03	0.8±0.05	0.65±0.05	0.8±0.05	2.1±0.05
CQ05	1.0±0.1	1.0±0.1	1.3±0.1	3.0±0.1
CQ06	2.0±0.1	1.1±0.1	1.6±0.1	4.2±0.1
CQ07	2.0±0.1	1.1±0.1	2.6±0.1	4.2±0.1
CQ10	3.6±0.1	1.3±0.1	2.6±0.1	6.2±0.1
CQ12	4.9±0.1	1.6±0.1	3.3±0.1	8.1±0.1



Derating curve

The power rating applies to continuous load at ambient temperatures from -55 to 155°C. It is constant from -55 to 70°C and derates to zero as the temperature rises from 70 to 155°C.



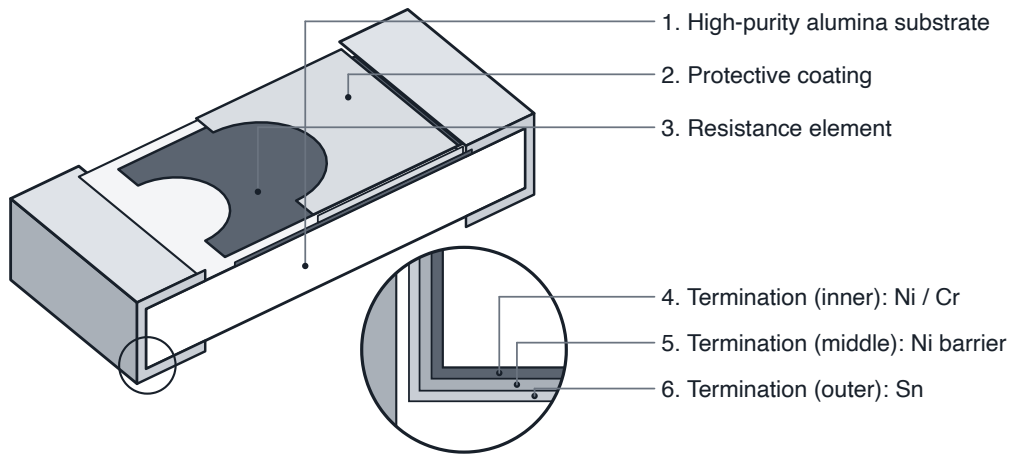
Voltage rating

Resistors shall have a rated direct-current (DC) continuous working voltage or an approximate sine-wave root-mean-square (RMS) alternating-current (AC) continuous working voltage at commercial-line frequency and waveform corresponding to the power rating, as determined from the following formula:

$$RCWV = \sqrt{P \times R} \quad \text{⑥}$$

where RCWV = rated continuous working voltage (V), P = power rating (W), R = nominal resistance (Ω). In no case shall the rated DC or RMS AC continuous working voltage be greater than the applicable maximum value. The overload voltage is 2.5 times RCWV or the max. overload voltage, whichever is lower.

Structure



Performance specification

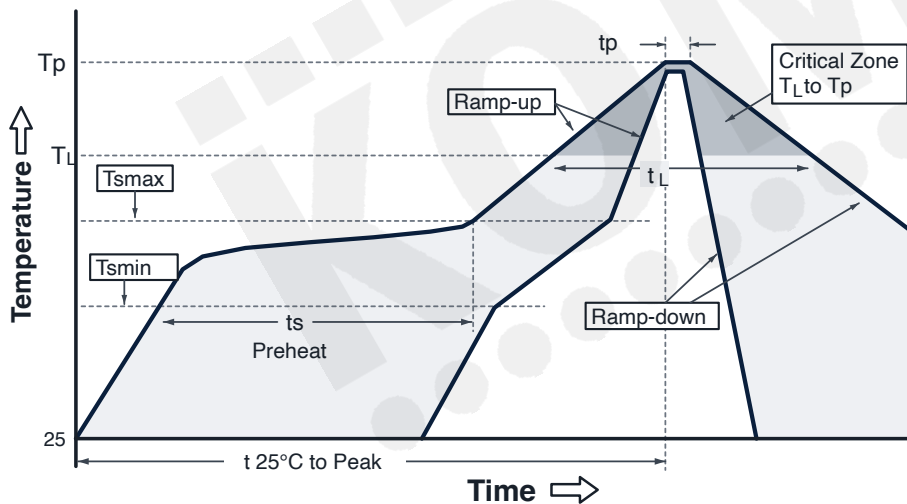
Characteristic	Limits	Ref. standards	Test methods
Operational life	$\pm 2\%$, $\pm 5\%$: $\pm(3.0\%+0.1\Omega)$ $\pm 0.5\%$, $\pm 1\%$: $\pm(1.0\%+0.1\Omega)$	MIL-STD-202 Method 108	125°C, at 36% of operating power, 1000 h (1.5 hours "ON", 0.5 hour "OFF"). Measurement at 24±4 hours after test conclusion.
	<100mΩ		Apply rated current for 0Ω.
Electrical characterization (TCR)	CQ01: 1Ω≤R≤10Ω: -100~+350PPM/°C >10Ω: ±200PPM/°C CQ02: 0.1Ω≤R<1Ω: ±800PPM/°C 1Ω≤R≤10Ω: ±200PPM/°C >10Ω: ±100PPM/°C CQ03: 0.01Ω≤R≤0.03Ω: ±1500PPM/°C 0.03Ω<R≤0.05Ω: ±1000PPM/°C 0.05Ω<R<1Ω: ±800PPM/°C 1Ω≤R≤10Ω: ±200PPM/°C >10Ω: ±100PPM/°C CQ05, CQ06, CQ07, CQ10, CQ12: 0.01Ω≤R≤0.015Ω: ±1500PPM/°C 0.015Ω<R≤0.03Ω: ±1000PPM/°C 0.03Ω<R<1Ω: ±800PPM/°C 1Ω≤R≤10Ω: ±200PPM/°C >10Ω: ±100PPM/°C	GB/T 5729 4.8 JIS-C-5201 4.8 IEC 60115-1 6.2	Natural resistance change per degree Celsius: $(R_2 - R_1) / (R_1(t_2 - t_1)) \times 10^6$ (PPM/°C) R ₁ : resistance value at room temperature (t ₁); R ₂ : resistance at test temperature (t ₂); t ₁ : +25°C or specified room temperature; t ₂ : test temperature (-55°C or 125°C).
Short-time overload	$\pm 0.5\%$, $\pm 1\%$: $\pm(1.0\%+0.05\Omega)$ $\pm 2\%$, $\pm 5\%$: $\pm(2.0\%+0.05\Omega)$	GB/T 5729 4.13 JIS-C-5201 4.13 IEC 60115-1 8.1.4.2	Permanent resistance change after applying 2.5 times RCWV or the max. overload voltage, whichever is less, for 5 seconds.
	<50mΩ		Apply max. overload current for 0Ω.
External visual	Marking complete, no mechanical damage	MIL-STD-883 Method 2009	Electrical test not required. Inspect device construction, marking and workmanship.
Physical dimension	See Dimensions ⑦	JESD22 MH Method JB-100 ⑦	Verify physical dimensions to the applicable device detail specification. Note: user and supplier specification. Electrical test not required.
Resistance to solvent	Marking complete, no mechanical damage	MIL-STD-202 Method 215	Note: add aqueous wash chemical – OKEM Clean or equivalent. Do not use banned solvents.
Terminal strength	Not broken	AEC-Q200-006	0201: 2N, 0402: 5N; others: 17.7N, 60±1 seconds.
High temperature exposure (storage)	$\pm(1.0\%+0.1\Omega)$ <100mΩ	MIL-STD-202 Method 108	1000 hrs at T=155°C, unpowered. Measurement at 24±4 hours after test conclusion.
Temperature cycling	$\pm(1.0\%+0.1\Omega)$ <100mΩ	JESD22 Method JA-104	1000 cycles (-55°C to +155°C). Measurement at 24±4 hours after test conclusion.
Biased humidity	$\pm 2\%$, $\pm 5\%$: $\pm(3.0\%+0.05\Omega)$ $\pm 0.5\%$, $\pm 1\%$: $\pm(1.0\%+0.05\Omega)$	MIL-STD-202 Method 103	1000 hours, 85°C, 85%RH. Note: specified conditions: 10% of operating power. Measurement at 24±4 hours after test conclusion.
	<100mΩ		Apply rated current for 0Ω.
Mechanical shock	$\pm(1.0\%+0.1\Omega)$	MIL-STD-202 Method 213	Half-sine wave, acceleration 100g's, three times each in the X, Y and Z directions, pulse width 6ms.

Characteristic	Limits	Ref. standards	Test methods
Vibration	$\pm(1.0\%+0.1\Omega)$	MIL-STD-202 Method 204	5g's for 20 min., 12 cycles each of 3 orientations. Note: use 8"x5" PCB. 031" thick ⑨, 7 secure points on one long side and 2 secure points at corners of opposite sides. Parts mounted within 2' ⑨ from any secure point. Test from 10-2000Hz.
ESD	$\pm(3.0\%+0.1\Omega)$	AEC-Q200-002	With the electrometer in direct contact with the discharge tip, verify the voltage setting at levels of $\pm 500V$, $\pm 1KV$, $\pm 2KV$, $\pm 4KV$, $\pm 8KV$. The electrometer reading shall be within $\pm 10\%$ for voltages from 500V to $\pm 800V$ ⑧.
Solderability	Coverage must be over 95%.	J-STD-020E ⑦	For both leaded and SMD parts. Electrical test not required. Magnification 50X. Conditions: a) Method B: 4 hrs at 155°C dry heat, then dip in a bath at 245°C, 5s. b) Method D: at 260°C, 30 $\pm$ 0.5s.
Flammability	No ignition of the tissue paper or scorching of the pinewood board	UL-94	V-0 or V-1 are acceptable. Electrical test not required.
Board flex	$\pm(1.0\%+0.05\Omega)$ <50m Ω	AEC-Q200-005	Bending 2mm (min) for 60+5 sec ⑦
Flame retardance	No flame	AEC-Q200-001	Only requested when voltage/power will increase the surface temperature to 350°C. Apply voltage from 9V to 32V. No flame; no explosion.
Resistance to soldering heat	$\pm(1.0\%+0.05\Omega)$ <50m Ω	MIL-STD-202 Method 210	Condition B, no pre-heat of samples. Dip the resistor into a solder bath at a temperature of 260°C $\pm$ 5°C and hold it for 10 $\pm$ 1 seconds.
Sulfuration test	$\pm(1.0\%+0.05\Omega)$	ASTM B-809-95	Sulfur (saturated vapor), temperature: 60 $\pm$ 2°C, humidity: 86 ~ 90%RH, 1000 h.

Soldering conditions

The profiles below are recommendations; please adjust them to the actual application.

Recommended reflow soldering profile (solder: Sn96.5 / Ag3 / Cu0.5)

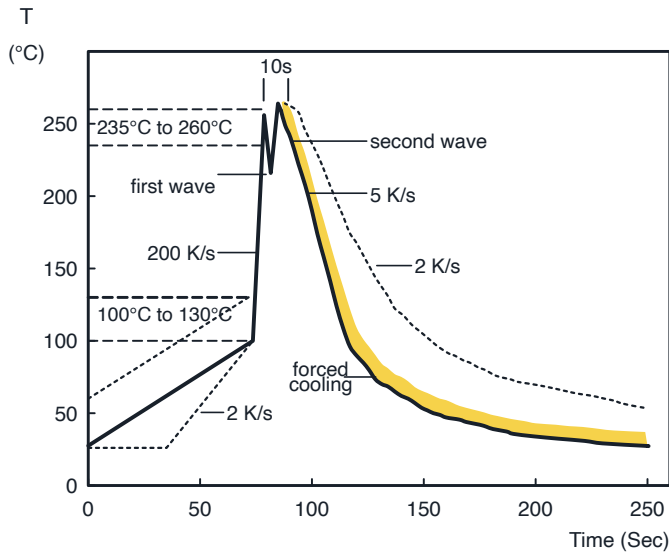


	Profile feature	Lead (Pb)-free solder
Preheat	Temperature min. (Ts _{min})	150°C
	Temperature max. (Ts _{max})	200°C
	Time (Ts _{min} to Ts _{max}) (ts)	60-120 seconds
Average ramp-up rate (Ts _{max} to Tp)		3°C/second max.
Time maintained above	Temperature (T _L)	217°C
	Time (t _L)	60-150 seconds
Peak temperature (Tp)		260°C
Time within +0/-5°C of actual peak temperature (tp)		10 seconds
Ramp-down rate		6°C/second max.
Time 25°C to peak temperature		8 minutes max.

Number of reflow cycles allowed: 2.

To avoid discoloration of the chip terminal electrodes, an N₂ reflow furnace is suggested.

Recommended wave soldering profile (applies to 0603 and larger sizes)

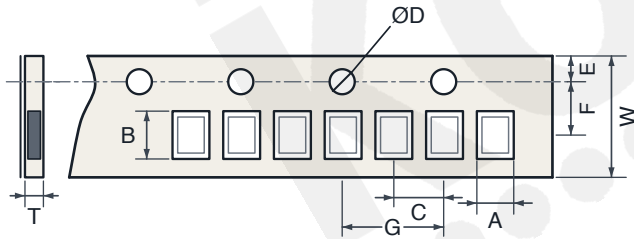


Packing

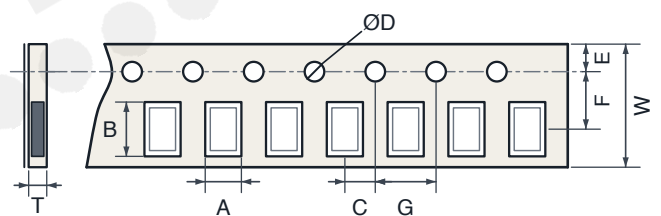
Paper taping (unit: mm) ⑩

Type	A	B	C	ΦD	E	F	G	W	T
CQ01	0.40±0.05	0.70±0.05	±0.05	+0.1/-0	±0.1	±0.05	±0.1	±0.2	0.42±0.1
CQ02	0.65±0.1	1.20±0.1	2.00	1.50	1.75	3.50	4.00	8.00	0.42±0.05

Type	A	B	C	ΦD	E	F	G	W	T
CQ03	±0.2	±0.2	±0.05	+0.1/-0	±0.1	±0.05	±0.1	±0.2	±0.1
CQ05	1.10	1.90	2.00	1.50	1.75	3.50	4.00	8.00	0.67
CQ06	1.65	2.40	2.00	1.50	1.75	3.50	4.00	8.00	0.81
CQ07	2.00	3.60	2.00	1.50	1.75	3.50	4.00	8.00	0.81
CQ07	2.80	3.50	2.00	1.50	1.75	3.50	4.00	8.00	0.75



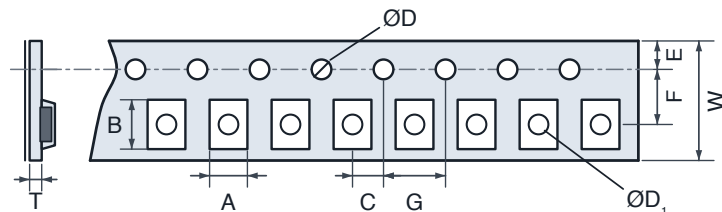
Paper taping, CQ01 and CQ02



Paper taping, CQ03 to CQ07

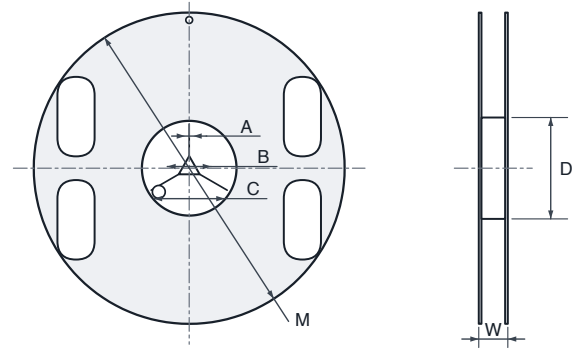
Plastic taping (unit: mm)

Type	A	B	C	ΦD	ΦD ₁	E	F	G	W	T
CQ10	±0.2	±0.2	±0.05	+0.1/-0	+0.25/-0	±0.1	±0.05	±0.1	±0.2	±0.1
CQ12	2.90	5.60	2.00	1.50	1.50	1.75	5.50	4.00	12.00	1.00
CQ12	3.50	6.70	2.00	1.50	1.50	1.75	5.50	4.00	12.00	1.00



Reel (unit: mm)

Type	Taping	Qty/reel	A	B	C	D	M	W
			±0.5	±0.5	±0.5	±1	±2	±1
CQ01	Paper	15,000pcs	2.0	13.0	21.0	60.0	178.0	10.0
CQ02	Paper	10,000pcs	2.0	13.0	21.0	60.0	178.0	10.0
CQ03	Paper	5,000pcs	2.0	13.0	21.0	60.0	178.0	10.0
CQ05	Paper	5,000pcs	2.0	13.0	21.0	60.0	178.0	10.0
CQ06	Paper	5,000pcs	2.0	13.0	21.0	60.0	178.0	10.0
CQ07	Paper	5,000pcs	2.0	13.0	21.0	60.0	178.0	10.0
CQ10	Embossed	4,000pcs	2.0	13.0	21.0	60.0	178.0	13.8
CQ12	Embossed	4,000pcs	2.0	13.0	21.0	60.0	178.0	13.8



Reel, front and side view

Notes on storage and use

- KOME recommends storing the products in a warehouse at a temperature between 15 and 35°C and a humidity between 25 and 75%RH. Even under these recommended storage conditions, the solderability of products stored for over 1 year will be degraded.
- Cartons must be placed in the direction indicated on the carton; otherwise the reel or wire will be deformed.
- The following storage conditions are inappropriate: a. storage in a high-electrostatic environment; b. storage in direct sunshine, rain, snow or condensation.
- This product is intended for automotive electronics ⑤. KOME will not be responsible for any damage, expense or loss caused by the use of this specification in any special environment. This series is suitable for the automotive electronics applications shown below; for other applications, please confirm with KOME whether they are applicable: a. control units for information, entertainment, navigation and audio; b. control units for comfort doors, windows and seats; c. control units for interior lighting.

Notes

- Part number: the ordering example shows the type as "05" (CQ05K5103JTLF), while the type table prints the codes with the prefix, "CQ01" to "CQ12". The type table also lists CQ11 (1812), for which no dimensions, resistance range, ratings, pad size, TCR, taping or reel data are given — subject to manufacturer confirmation.
- Tolerance codes are given only for ±1% (F), ±2% (G), ±5% (J) and jumper (0). The resistance range table and the test limits also cover ±0.5%, for which no code is given — subject to manufacturer confirmation.
- TCR codes W ±200, L ±250, B ±300, U ±400, c ±50 ("c" printed in lower case) and K based on spec. are printed without a unit; the TCR limits under Performance specification use -100~+350, ±100, ±200, ±800, ±1000 and ±1500 PPM/°C, so ±250, ±300, ±400 and ±50 do not appear there — subject to manufacturer confirmation.
- Total characters: the example is printed "(103=10000=5)". The E-96 example "5 1003=100KΩ" gives 5 characters, although 100KΩ (100000Ω) has 6 characters under this rule — subject to manufacturer confirmation.
- The scope lists general applications (iPad, LED lamps, home appliances, medical equipment, industrial control), whereas the notes state that the product is intended for automotive electronics and that other applications must be confirmed with KOME — subject to manufacturer confirmation.
- The formula is printed "RCWV = √P × R" with the radical bar detached from "P × R"; it is shown here as √(P × R) — subject to manufacturer confirmation.
- Performance specification: "Physical dimension" refers to "5.0 Dimension Standards" (on the original, dimensions are section 4 and section 5 is the resistance range); the reference standards are printed "JESD22 MH Method JB-100" and, for solderability, "J-STD-020E"; the board-flex time is printed "60+5sec" — subject to manufacturer confirmation.
- ESD: the test levels go up to ±8KV, but the electrometer tolerance is stated for voltages "from 500V to ≤800V" — subject to manufacturer confirmation.
- Vibration: the board thickness is printed "PCB. 031" thick" and the mounting distance "within 2'" (single prime) — subject to manufacturer confirmation.
- Paper taping: cavity B of CQ07 (1210) is printed 3.50, smaller than CQ06 (1206) 3.60 — subject to manufacturer confirmation.