Hongda Capacitors®
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High Q Multilayer Ceramic Capacitors - MQ Series

Features:

1. Low equivalent series resistance
2. Equivalent series inductance
3. High self-resonant frequency
4. High Q value, low noise
5. High-density ceramic structure
6. Ultra-high stability

Application:

Microwave / RF / IF amplifiers, Mixers, Oscillators, Low noise amplifiers, Ffilter networks, Timing circuits,

Bypassing in delay circuits, Coupling, Tuning, Feedback, Impedance matching and DC blocking

How to order

MQ	20	0603	NPO	2E	101	J	N	8	B
Type	Series	Dimension	Temperature characteristics (coefficient)	Rated voltage	Nominal capacitance	Capacitance tolerance	Terminal form	Thickness code	Package type
Table 1	Table 2	Table 3	Table 4	Table 5	Table 6	Table 7	Table 8	Table 9	Table 10

Table 1 product type		Table 2 product type	
MQ	High Q Multilayer Ceramic Capacitors	10	Applied to occasions with high reliability requirements, product sizes (0505, 1111, 2525, 3838, etc.)
		20	Applied to occasions with high reliability requirements, product sizes (0402, 0603, 0805, etc.)
		30	With very low ESR, suitable for consumer electronics applications, product sizes (0402, 0603, 0805, etc.)

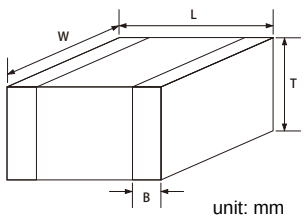
Table 3 Dimension Code (mm)								
Figure	Dimension code	0402	0505	1111	0603	0805	2525	3838
 unit: mm	L	1.00±0.15	1.40±0.64	$2.79^{+0.89}_{-0.51}$	1.60±0.15	2.00 ±0.20	$5.84^{+0.51}_{-0.25}$	$9.65^{+0.38}_{-0.25}$
	W	0.50±0.10	1.40±0.38	2.79±0.51	0.81±0.15	1.25±0.20	6.50±0.25	9.85±0.30
	Tmin	/	0.51	0.76	/	/	/	/
	Tmax	0.55	1.45	2.59	0.90	1.30	4.19	4.32
	B	0.15～0.35	$0.25^{+0.25}_{-0.13}$	$0.38^{+0.50}_{-0.25}$	0.35 ±0.15	0.50±0.25	1.0max	1.2max

Table 4 Temperature characteristics (coefficients)		
Temperature characteristic (coefficient)	The capacity is allowed to change	Temperature range
M7G	100±30ppm/℃	-55℃~125℃
C0G	0±30ppm/℃	-55℃~125℃
X7R	±15%	-55℃~125℃

Table 5 Rated voltage					
1H	50V	2H	500V	3E	2500V
2A	100V	2J	600V	3F	3000V
2C	150V	2K	800V	3V	3600V
2D	200V	3A	1000V	3H	5000V
2E	250V	3C	1500V	3L	7200V
2F	300V	3D	2000V		

Table 6 Nominal Capacitance
The three-digit standard method is adopted, the first two digits represent the effective value of the capacitance, and the third digit represents the number of 0s after the effective value, and the unit is pF, for example 106=10,000,000pF（10μF）

Table 7 Allowable deviation of capacitance	
B ±0.1pF	C_R＜10pF
C ±0.25pF	
D ±0.5pF	
F ±1%	C_R≥10pF
G ±2%	
J ±5%	
K ±10%	
M ±20%	

Table 8 Terminal form	
Terminal code	Terminal type
N	Base Metallization - Nickel - Pure Tin
D	Base Metallization - Nickel - Gold
TN	Base Metallization - Copper - Tin
MS	Microstrip (for 1111, 2525, 3838 sizes)
MN	Nonmagnetic Microstrip (for 1111, 2525, 3838 sizes)

Table 9 Thickness codes		
Thickness codes	Standard thickness（mm）	Thickness Tolerance (mm)
8	0.80	±0.15
A	0.60	±0.15
B	0.50	±0.10
C	0.85	±0.15
D	1.00	±0.10
F	1.25	±0.20
H	1.60	±0.20
I	2.00	±0.20
M	2.30	±0.20
L	3.20	±0.40
N	3.80	±0.50

Table 10 Package type		
B-Bulk	R-T&R	C-Case

10 Series M7G Capacity Table

0505																	
U_R(V) Code	C_R (pF)	Tolerance	Rated DC working voltage（V）		U_R(V) Code	C_R (pF)	Tolerance	Rated DC working voltage（V）		U_R(V) Code	C_R (pF)	Tolerance	Rated DC working voltage（V）	
0R1	0.1	B	150	Ex-tended voltage 250	2R2	2.2	B、C、D	150	Ex-tended voltage 250	160	16	F、G、J、K、M	150	Ex-tended voltage 250
0R2	0.2				2R4	2.4				180	18			
0R3	0.3	B、C			2R7	2.7				200	20			
0R4	0.4				3R0	3.0				220	22			
0R5	0.5	B、C、D			3R3	3.3				240	24			
0R6	0.6				3R6	3.6				270	27			
0R7	0.7				3R9	3.9				300	30			
0R8	0.8				4R3	4.3				330	33			
0R9	0.9				4R7	4.7				360	36			
1R0	1.0	B、C、D			5R1	5.1				390	39			
1R1	1.1				5R6	5.6				430	43			
1R2	1.2				6R2	6.2				470	47			
1R3	1.3				6R8	6.8				510	51			
1R4	1.4				7R5	7.5				560	56			
1R5	1.5				8R2	8.2				620	62			Ex-tended voltage 200
1R6	1.6				9R1	9.1				680	68			
1R7	1.7				100	10	F、G、J、K、M			750	75			
1R8	1.8				110	11				820	82			
1R9	1.9				120	12				910	91			
2R0	2.0				130	13				101	100			
2R1	2.1				150	15								

1111																	
0R1	0.1	B	500	Ex-tended voltage 1500	4R7	4.7	B、C、D	500	Ex-tended voltage 1500	750	75	F、G、J、K、M	500	Ex-tended voltage 1500
0R2	0.2				5R1	5.1				820	82			
0R3	0.3	B、C			5R6	5.6				910	91			
0R4	0.4				6R2	6.2				101	100			
0R5	0.5	B、C、D			6R8	6.8				111	110		300	Ex-tended voltage 1000
0R6	0.6				7R5	7.5				121	120			
0R7	0.7				8R2	8.2				131	130			
0R8	0.8				9R1	9.1				151	150			
0R9	0.9				100	10	F、G、J、K、M			161	160			
1R0	1.0	B、C、D			110	11				181	180		200	Ex-tended voltage 600
1R1	1.1				120	12				201	200			
1R2	1.2				130	13				221	220			
1R3	1.3				150	15				241	240			
1R4	1.4				160	16				271	270			
1R5	1.5				180	18				301	300			
1R6	1.6				200	20				331	330			
1R7	1.7				220	22				361	360			
1R8	1.8				240	24				391	390			
1R9	1.9				270	27				431	430			
2R0	2.0				300	30				471	470			Ex-tended voltage 300
2R1	2.1				330	33				511	510		100	
2R2	2.2				360	36				561	560			
2R4	2.4				390	39				621	620			
2R7	2.7				430	43				681	680		50	
3R0	3.0				470	47				751	750			
3R3	3.3				510	51				821	820			
3R6	3.6				560	56				911	910			
3R9	3.9				620	62				102	1000			
4R3	4.3				680	68								

10 Series M7G Capacity Table

2525																	
U_R(V) Code	C_R (pF)	Tolerance	Rated DC working voltage（V）		U_R(V) Code	C_R (pF)	Tolerance	Rated DC working voltage（V）		U_R(V) Code	C_R (pF)	Tolerance	Rated DC working voltage（V）	
1R0	1.0	B、C、D	2500	Extended voltage 3600	100	10	B、C、J、K、M	2500	Extended voltage 3600	151	150	F、G、J、K、M	2500	3000
1R1	1.1				110	11				161	160			
1R2	1.2				120	12	F、G、J、K、M			181	180			
1R3	1.3				130	13				201	200			
1R4	1.4				150	15				221	220			
1R5	1.5				160	16				241	240			
1R6	1.6				180	18				271	270			
1R7	1.7				200	20				301	300		1500	2000
1R8	1.8				220	22				331	330			
1R9	1.9				240	24				361	360			
2R0	2.0				270	27				391	390			
2R1	2.1				300	30				431	430			
2R2	2.2				330	33				471	470			
2R4	2.4				360	36				511	510		1000	Extended voltage 1500
2R7	2.7				390	39				561	560			
3R0	3.0				430	43				621	620			
3R3	3.3				470	47				681	680			
3R6	3.6				510	51				751	750			
3R9	3.9				560	56				821	820			
4R3	4.3				620	62				911	910			
4R7	4.7				680	68				102	1000			
5R1	5.1				750	75				112	1100			
5R6	5.6				820	82				122	1200			
6R2	6.2				910	91				152	1500		500	Extended voltage 800
6R8	6.8	B、C、J、K、M			101	100				182	1800			
7R5	7.5				111	110			Extended voltage 3000	222	2200		300	Extended voltage 500
8R2	8.2				121	120				272	2700			
9R1	9.1				131	130								

3838														
1R0	1.0	B、C、D	3600	Extended voltage 7200	120	12	C、J、K、M	3600	Extended voltage 7200	221	220	F、G、J、K、M	3600	
1R1	1.1				130	13				241	240			
1R2	1.2				150	15	F、G、J、K、M			271	270			
1R3	1.3				160	16				301	300			
1R4	1.4				180	18				331	330			
1R5	1.5				200	20				361	360			
1R6	1.6				220	22				391	390			
1R7	1.7				240	24				431	430		2500	
1R8	1.8				270	27				471	470			
1R9	1.9				300	30				511	500			
2R0	2.0				330	33				561	560			
2R1	2.1				360	36				621	620			
2R2	2.2				390	39				681	680			
2R4	2.4				430	43				751	750			
2R7	2.7				470	47				821	820		1000	
3R0	3.0				510	51				911	910			
3R3	3.3				560	56				102	1000			
3R6	3.6				620	62				112	1100			
3R9	3.9				680	68				122	1200			
4R3	4.3				750	75				152	1500			
4R7	4.7				820	82				182	1800			
5R1	5.1				910	91				222	2200			
5R6	5.6				101	100				272	2700		500	
6R2	6.2				111	110			Extended voltage 5000	302	3000			
6R8	6.8	B、C、J、K、M			121	120				332	3300			
7R5	7.5				131	130				392	3900			
8R2	8.2				151	150				472	4700			
9R1	9.1				161	160				512	5100			
100	10	C、J、K、M			181	180								
110	11				201	200								

20，30 Series NPO Capacity Table

0402											
U_R(V) Code	C_R (pF)	Tolerance	Rated DC working voltage（V）	U_R(V) Code	C_R (pF)	Tolerance	Rated DC working voltage（V）	U_R(V) Code	C_R (pF)	Tolerance	Rated DC working voltage（V）
0R1	0.1	B	200	2R0	2.0	B、C、D	200	9R1	9.1	B、C、D	200
0R2	0.2			2R2	2.2			100	10	F、G、J	
0R3	0.3	B、C		2R4	2.4			110	11		
0R4	0.4			2R7	2.7			120	12		
0R5	0.5			3R0	3.0			150	15		
0R6	0.6			3R3	3.3			180	18		
0R7	0.7			3R6	3.6			200	20		
0R8	0.8			3R9	3.9			220	22		
0R9	0.9	B、C、D		4R3	4.3			240	24		
1R0	1.0			4R7	4.7			270	27		
1R1	1.1			5R1	5.1			300	30		50
1R2	1.2			5R6	5.6			330	33		
1R3	1.3			6R2	6.2			360	36		
1R5	1.5			6R8	6.8			390	39		
1R6	1.6			7R5	7.5			430	43		
1R8	1.8			8R2	8.2			470	47		
0603											
0R1	0.1	B	250	2R7	2.7	B、C、D	250	200	20	F、G、J	250
0R2	0.2			3R0	3.0			220	22		
0R3	0.3	B、C		3R3	3.3			240	24		
0R4	0.4			3R6	3.6			270	27		
0R5	0.5			3R9	3.9			300	30		
0R6	0.6			4R3	4.3			330	33		
0R7	0.7			4R7	4.7			360	36		
0R8	0.8			5R1	5.1			390	39		
0R9	0.9	B、C、D		5R6	5.6			430	43		
1R0	1.0			6R2	6.2			470	47		
1R1	1.1			6R8	6.8			510	51		
1R2	1.2			7R5	7.5			560	56		
1R3	1.3			8R2	8.2			620	62		
1R5	1.5			9R1	9.1			680	68		
1R6	1.6			100	10	F、G、J		750	75		
1R8	1.8			110	11			820	82		
2R0	2.0			120	12			910	91		
2R2	2.2			150	15			101	100		
2R4	2.4			180	18						
0805											
0R1	0.1	B	250	3R3	3.3	B、C、D	250	300	30	F、G、J、K、M	250
0R2	0.2			3R6	3.6			330	33		
0R3	0.3	B、C		3R9	3.9			360	36		
0R4	0.4			4R3	4.3			390	39		
0R5	0.5			4R7	4.7			430	43		
0R6	0.6			5R1	5.1			470	47		
0R7	0.7			5R6	5.6			510	51		
0R8	0.8			6R2	6.2			560	56		
0R9	0.9			6R8	6.8			620	62		
1R0	1.0	B、C、D		7R5	7.5			680	68		
1R1	1.1			8R2	8.2			750	75		
1R2	1.2			9R1	9.1			820	82		
1R3	1.3			100	10	F、G、J、K、M		910	91		
1R5	1.5			110	11			101	100		
1R6	1.6			120	12			111	110		
1R8	1.8			150	15			121	120		
2R0	2.0			180	18			151	150		
2R2	2.2			200	20			181	180		
2R4	2.4			220	22			201	200		
2R7	2.7			240	24			221	220		
3R0	3.0			270	27			241	240		

20 Series X7R Capacity Table

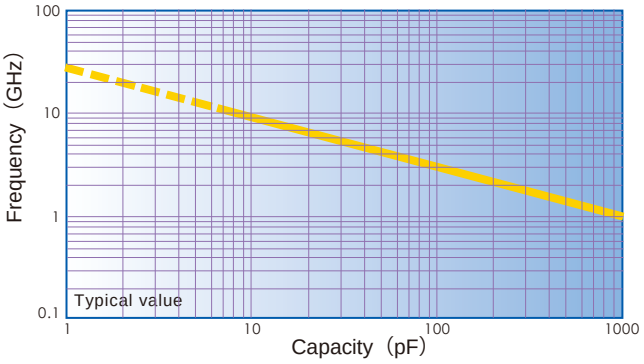
1111											
U_R(V) Code	C_R (pF)	Tolerance	Rated DC working voltage（V）	U_R(V) Code	C_R (pF)	Tolerance	Rated DC working voltage（V）	U_R(V) Code	C_R (pF)	Tolerance	Rated DC working voltage（V）
502	5200	K、M	50/100	183	18000	K、M	50/100	503	50000	K、M	50/100
562	5600			203	20000			563	56000		
682	6800			223	22000			683	68000		
822	8200			273	27000			823	82000		
103	10000			333	33000			104	100000		
123	12000			393	39000						
153	15000			473	47000						

Normal temperature electrical performance indicators and test conditions

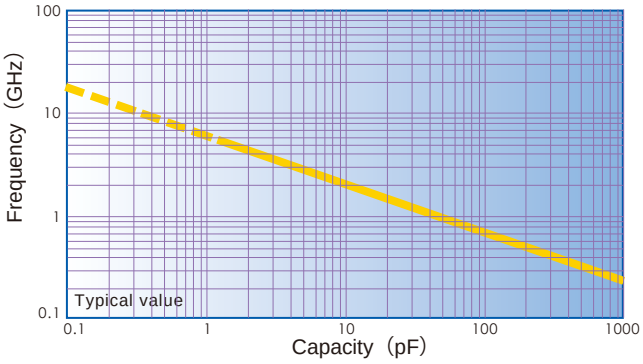
Item	Test conditions (25°C ±2°C)	Performance
Capacitance	Test frequency: C_R ≤ 1000pF, 1MHz±10% C_R > 1000pF, 1kHz±10% Test voltage: 1.0Vrms±0.2Vrms	Capacitance is within the specified range
Loss tangent tanδ		M7G features: tanδ ≤ 1×10^{-4} Exemption below 5pF NPO Features: 0505：C_R≤ 100pF， tanδ ≤ 1×10^{-4} 1111：C_R≤ 200pF， tanδ ≤ 1×10^{-4} other specifications: tanδ ≤ 5×10^{-4} Exemption below 5pF X7R features: tanδ ≤ 250×10^{-4} Exemption below 5pF
Insulation resistance Ri	Test voltage: rated voltage U_R Test time: 2min±5s	M7G features 0505: C_R ≤ 100pF 1111: C_R ≤ 470pF R_i≥ 10^6MΩ other specifications: R_i≥ 10^5MΩ
Withstand voltage	U_R >1250V, 1.2U_R； 500V<U_R ≤ 1250V, 1.5U_R； U_R ≤ 500V， 2.5U_R, 5s±1s, Inrush current ≤ 50mA	No breakdown, arcing and visible damage

Self-resonant frequency parameter diagram

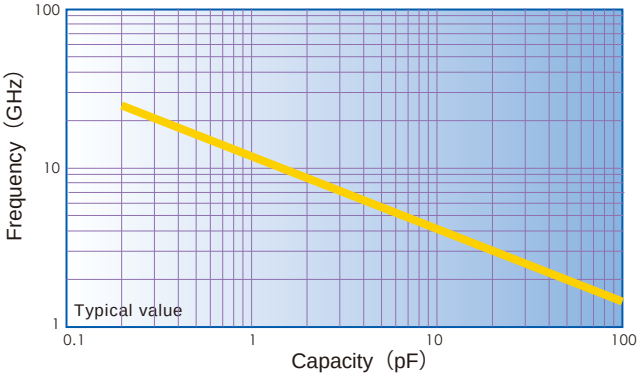
10 series size 0505



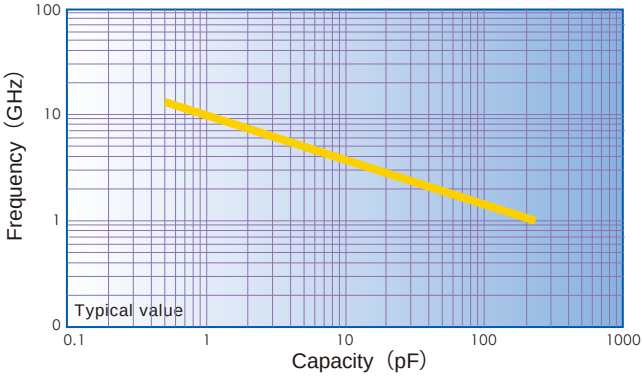
10 series size 1111



20 series size 0603

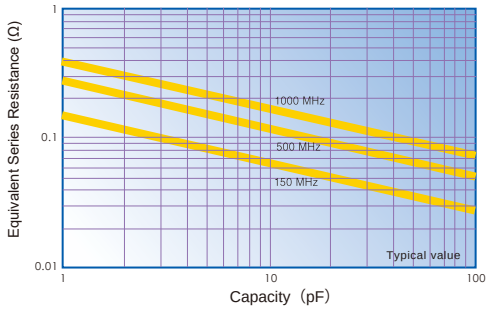


20 series size 0805

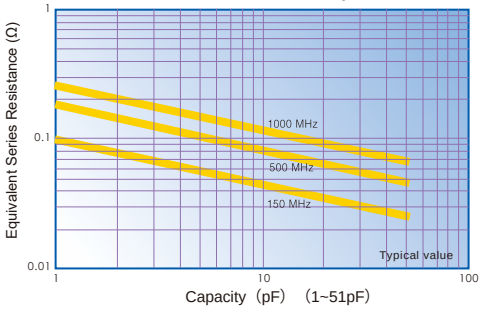


Equivalent series resistance parameter

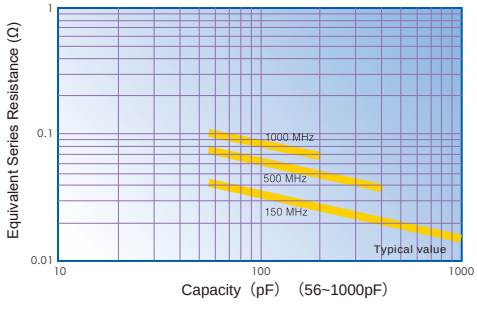
10 series size 0505



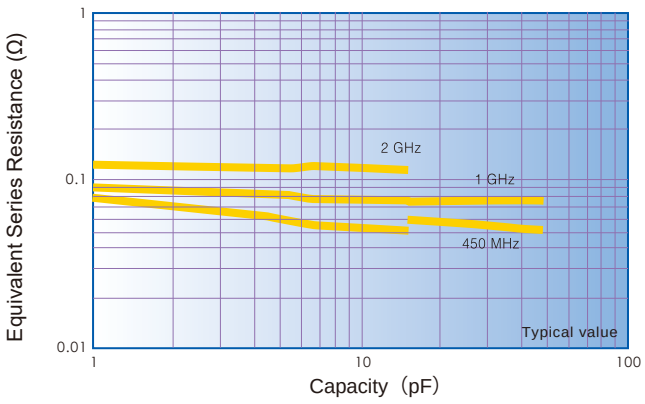
10 series size 1111（1~51pF）



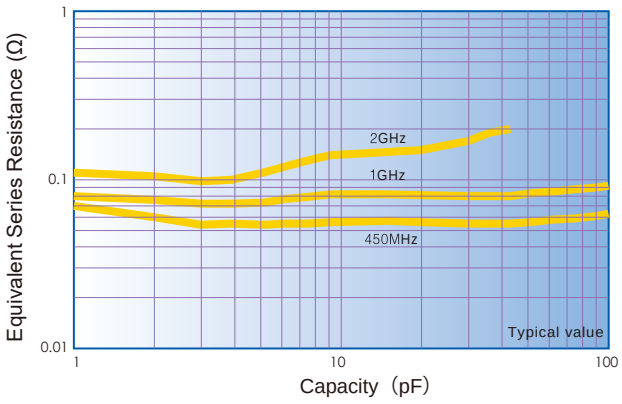
10 series size 1111（56~1000pF）



20 series size 0603

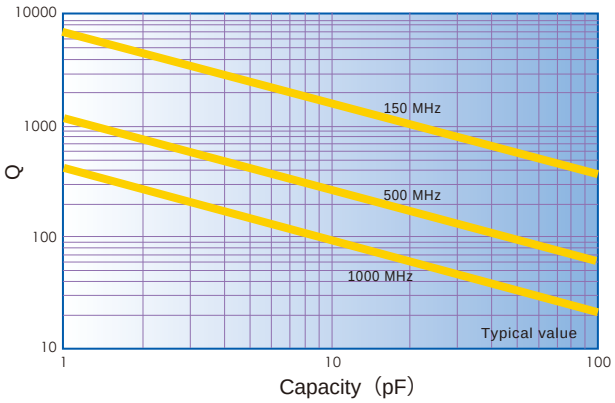


20 series size 0805

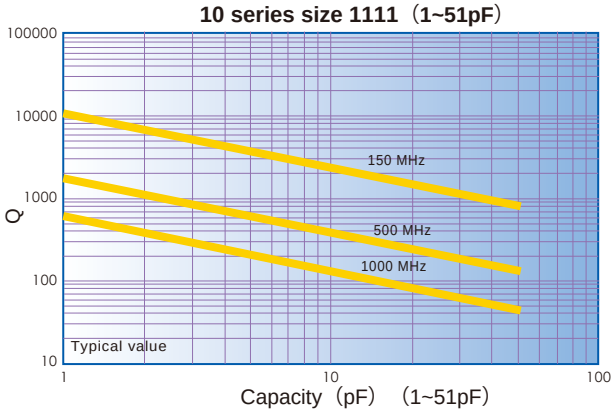


Q value parameter table

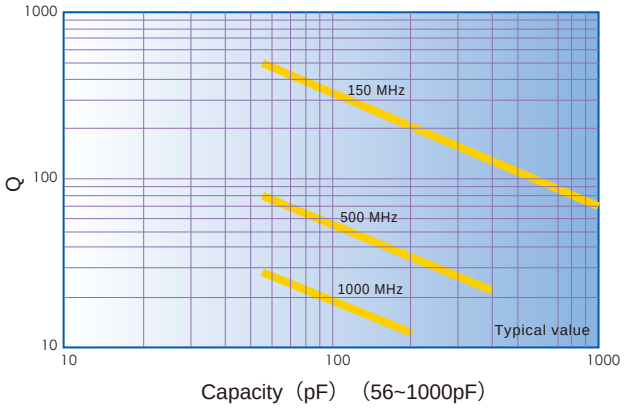
10 series size 0505



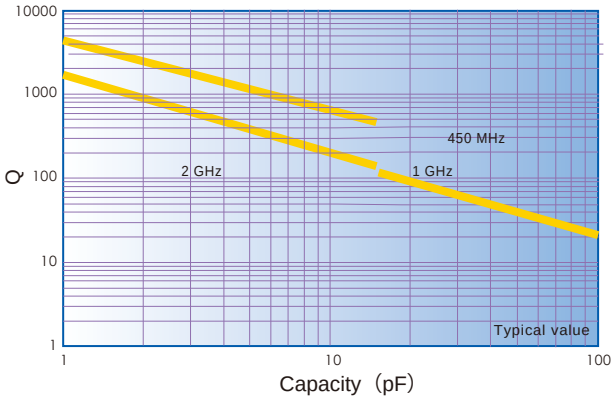
10 series size 1111（1~51pF）



10 series size 1111（56~1000pF）



20 series size 0603



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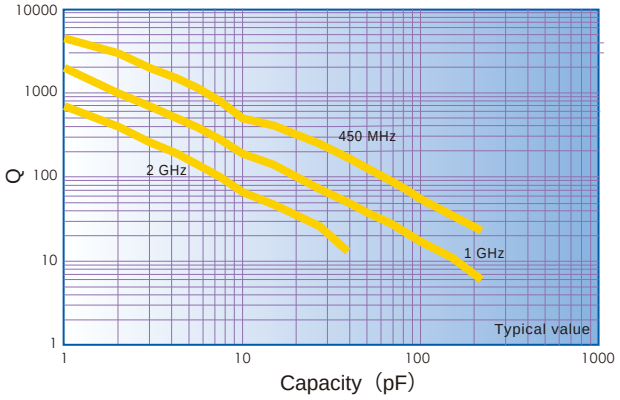
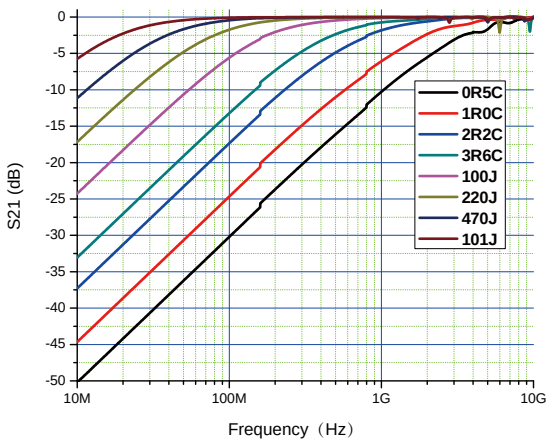


S21 parameter map

20 series size 0603



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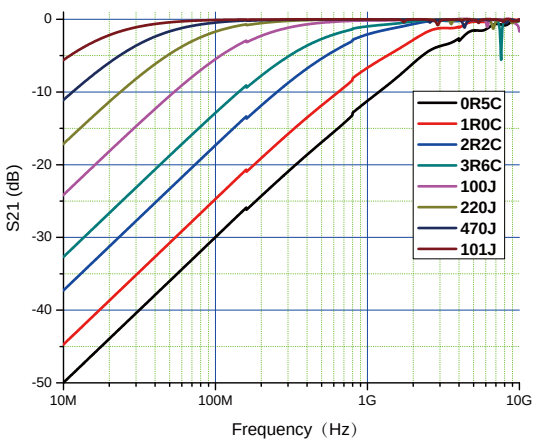

1. The selection of capacitors should pay attention to the following parameters

High-Q multilayer ceramic capacitors are a kind of ceramic capacitors. Compared with conventional multilayer ceramic capacitors, in addition to capacity, loss tangent, insulation resistance, in addition to rated voltage, series resonant frequency and ESR should also be considered.

1. Nominal capacity::

Refers to the capacitance value determined by the capacitor design and usually marked on the capacitor. The actual capacity of the capacitor often has a certain difference from the nominal capacity deviation, the qualified product capacity is within the allowable deviation range, but in circuits that require precise capacity such as impedance matching and band-pass filters, it is necessary to pay attention to the accuracy of the selected capacitor.

2. Loss tangent, quality factor, ESR:

The loss tangent is the active power of the capacitor divided by the reactive power of the capacitor under the sinusoidal voltage of the specified frequency, and it has an inverse relationship with the quality factor.

$$\tan\delta = \frac{1}{Q} = \frac{I \times ESR}{I \times X_C} = \frac{ESR}{X_C}$$

3. Insulation resistance:

Insulation resistance is a measure of the insulation performance of dielectric materials, usually in megohms, and consists of two parts, namely bulk resistance and surface resistance.

Parts are connected in parallel to form the insulation resistance of the capacitor.

The insulation resistance of capacitors is easily reduced due to welding, moisture, salt and many environmental pollutants, so special attention should be paid to the cleaning of the capacitor surface. Eliminate foreign matter.

4. Temperature characteristic (coefficient):

Temperature coefficient: Applicable only to Class 1 ceramic capacitors, it refers to the rate of change of capacitance with temperature measured within a specified temperature range. usually used expressed in ppm/°C.

Temperature characteristics: Applicable only to Class 2 and Class 3 ceramic capacitors, it refers to the electric current that occurs within a given temperature range that does not exceed the class temperature range.Maximum reversible change in capacity. Temperature characteristics are usually expressed as a percentage of capacitance at a reference temperature of 25°C.

The temperature coefficient of a capacitor is used to describe the maximum change in capacitance within a specific temperature range. Class 1 ceramic capacitors mainly use this parameter to express show.

The temperature coefficient is expressed in parts per million (ppm) of capacity change when the temperature changes by 1°C. Because the capacitance indicated by the capacitor manufacturer is in. It is measured at a reference temperature of 25°C, so when the temperature of the circuit deviates from 25°C, the temperature coefficient of capacitance needs to be considered.

5. Rated voltage:

The maximum DC voltage or AC effective voltage that can be continuously applied to a capacitor at any temperature between the upper and lower category temperatures.

The maximum DC voltage and AC effective voltage of general microwave capacitors follow the following formula:

$$Urms=0.707 \times U_{DC}$$

6. Series resonant frequency:

Series resonance means that the voltage and current of the studied series circuit part reach the same phase, so that the studied circuit presents a purely resistive characteristic.

In the case of constant terminal voltage, the maximum current will appear in the studied circuit, and the active power consumed in the circuit will also be the maximum, and the corresponding frequency is series resonant frequency.

2. Notes on application of high-Q multilayer ceramic capacitors

The application fields of high-Q multilayer ceramic capacitors determine the content that should be paid attention to in use.

For the field of high-power applications, we must pay attention to thermal design issues. Temperature is an important indicator that affects the reliability of electronic equipment applications, while affecting capacitance

The conditions for the application temperature of the capacitor are mainly the ambient temperature, the thermal resistance of the installation environment, and the self-heating of the capacitor. The ambient temperature is the overall design consideration of the circuit board. The application of capacitors mainly considers the thermal resistance of the installation environment and the self-heating of the capacitor, and the self-heating needs to consider the ESR and the actual passed

Alternating current.

a. The heat generated by the capacitor is mainly dissipated from the terminal electrode to the conductor material on the circuit board, so the thermal resistance and capacitance of the capacitor installation environment

It is related to the welding material selected for capacitor welding, the type and shape of the conductor material on the circuit board, and the thermal resistance of the capacitor installation environment should be as small as possible during the design stage;

b. In the layout of the capacitor, attention should be paid to the overall thermal balance and the total amount of thermal load. The evaluation of the temperature rise caused by the heating of the capacitor is consistent with that of the transistor.

The evaluation method is similar, and the heat of other heat-generating devices on the circuit board and the heat of the capacitor together constitute the overall heat load of the circuit board. In addition to evaluating the overall heat load, the heat balance problem should also be evaluated.

c. In the same state of AC current passing through the capacitor, the smaller the ESR of the capacitor, the smaller the heat generated, and the lower the temperature rise caused, so you should try to choose a low ESR if conditions permit. the capacitor.

d. The larger the size of the capacitor, the greater the power it can carry, so in the application, it should be noted that the use of a capacitor with a larger size can provide higher reliability redundancy.

e. The assembly of high-Q multilayer ceramic capacitors needs to pay attention to the control of solder joints like ordinary capacitors. Too large solder joints and too small solder joints are easy to reduce

Reliability of use of capacitors.

For the application of high-Q multilayer ceramic capacitors, the frequency used, the maximum voltage applied, the maximum current passed, and the heat dissipation method should be considered in the design stage.

When these conditions are determined, the ESR can be determined by consulting the information of the alternative capacitor, so as to estimate the temperature rise of the capacitor and the impedance at the operating frequency point,

This is beneficial to the overall performance guarantee and reliability of the equipment.