

High Q Capacitors - Q(MS) & U ranges

The "Q(MS)" and "U" ranges offers a very stable High Q material system that provides excellent, low loss, performance in systems below 3GHz. Optimised for lowest possible ESR, this range of high frequency capacitors is suitable for many applications where economical, high performance is required.

Available in 0402 to 3640 case sizes (0603 & 0805 case sizes only available in the "U" range) with various termination options including FlexiCap™.

CapCad™ capacitor modelling software is now available and has been developed with an easy to use and readily accessible comparison tool for choosing the best MLCC to suit the customer's needs. Please consult the Knowles website to launch the software.

Operating Temperature

-55°C to +125°C

Temperature Coefficient (Typical)

0 ± 30 ppm/°C (COG/NP0)

Insulation resistance

MS range: >100GΩ at +25°C; >10GΩ +125°C

U range: 100GΩ or 1000s (whichever is the least)

Q Factor

>2000 @ 1MHz



0603 S-parameter downloads are available from:

<http://www.knowlescapacitors.com/syfer/en/products/mlc-capacitors/ultra-low-esr-capacitors> and the Syfer MVP page on

the Modelithics website. Please visit the Syfer MVP page for more

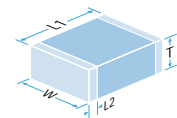
information at: <http://www.modelithics.com/mvp/syfer>

Minimum/maximum capacitance values - Q(MS) & U ranges - High Q capacitors

Chip Size	0402*	0603†	0505	0805†	1206	1111	1210	1812	2220	2225	4040
Min Cap	0.1pF	0.1pF	0.2pF	0.2pF	0.5pF	0.3pF	0.3pF	1.0pF	2.0pF	-	-
50V _{63V}	33pF	-	330pF	-	2.2nF	-	-	-	-	-	-
100V	22pF	-	220pF	-	1.5nF	3.3nF	3.3nF	6.8nF	15nF	-	-
150V	22pF	-	180pF	-	1.2nF	2.7nF	2.7nF	4.7nF	12nF	-	-
200V _{250V}	22pF	100pF	150pF	240pF	1.0nF	2.2nF	2.2nF	3.9nF	10nF	6.2 - 10nF	16 - 27nF
300V	-	-	100pF	-	680pF	1.5nF	1.5nF	3.3nF	6.8nF	-	-
500V	-	-	-	-	330pF	820pF	820pF	2.2nF	4.7nF	5.1 - 5.6nF	13 - 15nF
630V	-	-	-	-	150pF	390pF	390pF	1.0nF	2.2nF	3.6 - 4.7nF	11 - 12nF
1000V	-	Below 1pF capacitance values are available in 0.1pF steps ~ above 1pF capacitance values are available in E24 series values.		-	82pF	220pF	220pF	680pF	1.5nF	1.1 - 3.3nF	5.6 - 10nF
2000V	-			-	18pF	68pF	68pF	150pF	470pF	510pF - 1.0nF	1.6 - 5.1nF
3000V	-			-	-	-	-	68pF	150pF	1.0 - 470pF	910pF - 1.5nF
4000V	-			-	-	-	-	-	-	-	620 - 820pF
5000V	-			-	-	-	-	-	-	-	360 - 560pF
6000V	-			-	-	-	-	-	-	-	160 - 330pF
7000/7200V	-			-	-	-	-	-	-	-	1.0 - 150pF
Tape quantities	7" reel 10000	7" reel 4000	7" reel 2500	7" reel 3000	7" reel 2500	7" reel 1000	7" reel 2000	7" reel 500 13" reel 2000	7" reel 500 13" reel 2000	7" reel 500 13" reel 2000	13" reel only
	13" reel quantities available on request										

*0402 size and other values (inc. values < than 0.3pF) and taping quantities may be available on request, consult the Sales Office.

†0603 and 0805 sizes only available in the "U" range and not Q(MS)

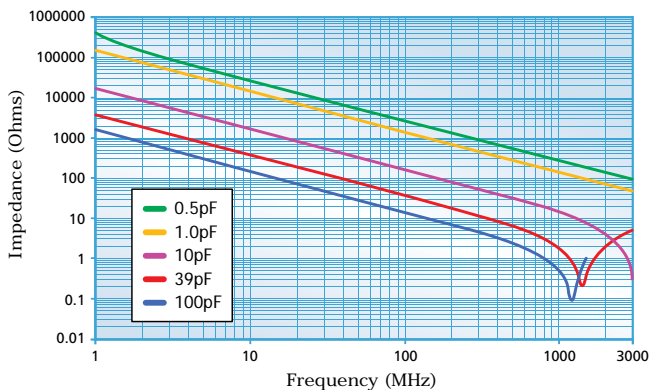


Dimensions

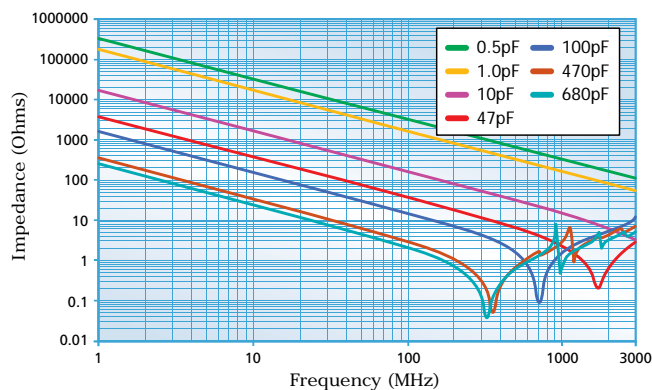
Range	Case Size	Length (L1) mm ~ inches	Width (W) mm ~ inches	Max. Thickness (T) mm ~ inches	Termination Band (L2) mm ~ inches	
					Min	Max
MS	0402	1.0 ± 0.10 ~ 0.04 ± 0.006	0.50 ± 0.10 ~ 0.02 ± 0.003	0.60 ~ 0.031	0.10 ~ 0.004	0.40 ~ 0.015
U	0603	1.6 ± 0.2 ~ 0.063 ± 0.008	0.8 ± 0.2 ~ 0.032 ± 0.008	0.80 ~ 0.032	0.10 ~ 0.004	0.40 ~ 0.016
MS	0505	1.4 +0.35 -0.25 ~ 0.055 +0.014 -0.01	1.4 ± 0.25 ~ 0.055 ± 0.01	1.27 ~ 0.05	0.13 ~ 0.005	0.5 ~ 0.02
U	0805	2.0 ± 0.3 ~ 0.079 ± 0.012	1.25 ± 0.20 ~ 0.049 ± 0.008	1.3 ~ 0.051	0.13 ~ 0.005	0.75 ~ 0.03
MS	1206	3.2 ± 0.3 ~ 0.126 ± 0.012	1.6 ± 0.20 ~ 0.063 ± 0.008	1.6 ~ 0.063	0.25 ~ 0.01	0.75 ~ 0.03
MS	1111	2.79 +0.51 -0.25 ~ 0.11 +0.02 -0.01	2.79 ± 0.38 ~ 0.113 ± 0.015	1.78 ~ 0.07	0.13 ~ 0.005	0.63 ~ 0.025
MS	1210	3.2 ± 0.3 ~ 0.126 ± 0.012	2.5 ± 0.3 ~ 0.10 ± 0.012	2.0 ~ 0.08	0.25 ~ 0.01	0.75 ~ 0.03
MS	1812	4.5 ± 0.35 ~ 0.18 ± 0.014	3.2 ± 0.3 ~ 0.126 ± 0.012	2.5 ~ 0.10	0.25 ~ 0.01	1.0 ~ 0.04
MS	2220	5.7 ± 0.40 ~ 0.225 ± 0.016	5.0 ± 0.40 ~ 0.197 ± 0.016	4.2 ~ 0.16	0.25 ~ 0.01	1.0 ~ 0.04
MS	2225	5.7 ± 0.40 ~ 0.225 ± 0.016	6.30 ± 0.40 ~ 0.252 ± 0.016	4.2 ~ 0.165	0.381 ~ 0.01	1.143 ~ 0.045
MS	4040	10.2 ± 0.508 ~ 0.400 ± 0.020	10.2 ± 0.508 ~ 0.400 ± 0.020	7.62 ~ 0.30	0.50 ~ 0.02	1.50 ~ 0.06

High Q Capacitors - Q(MS) & U ranges

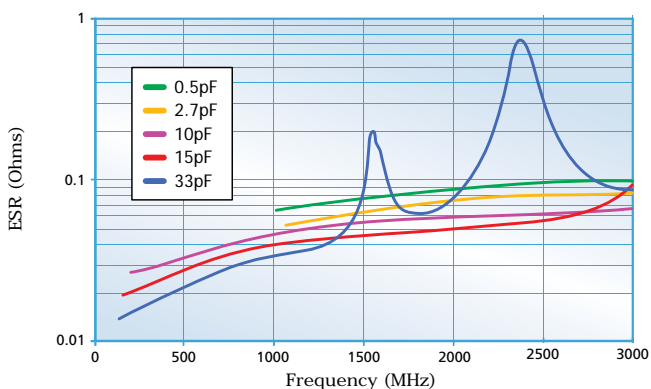
Q(MS) Series - Impedance vs. Frequency - Case size 0505



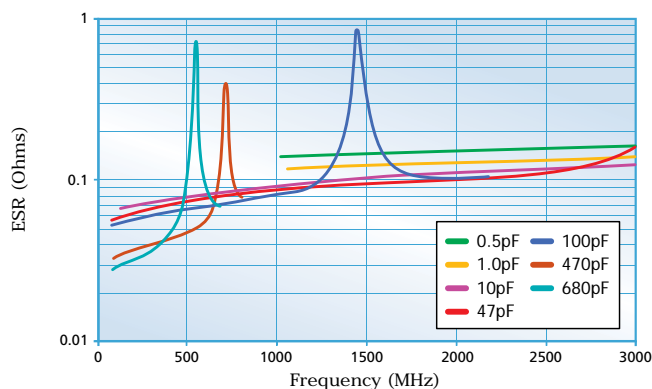
Q(MS) Series - Impedance vs. Frequency - Case size 1111



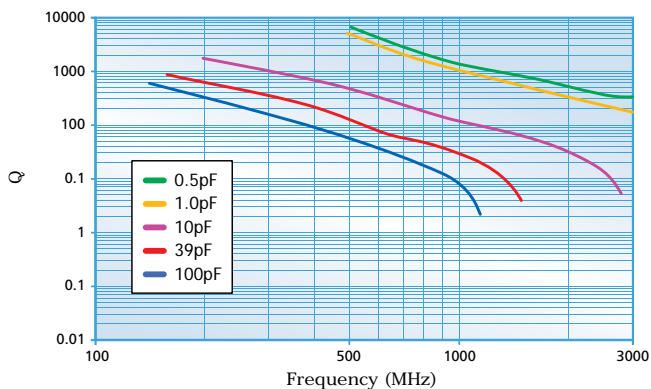
Q(MS) Series - ESR vs. Frequency - Case size 0505



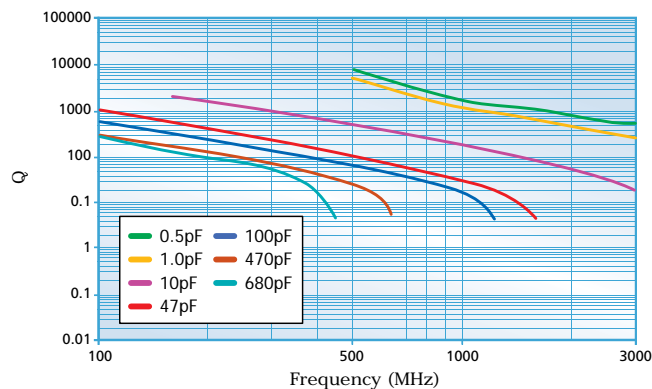
Q(MS) Series - ESR vs. Frequency - Case size 1111



Q(MS) Series Q vs. Frequency - Case size 0505



Q(MS) Series Q vs. Frequency - Case size 1111

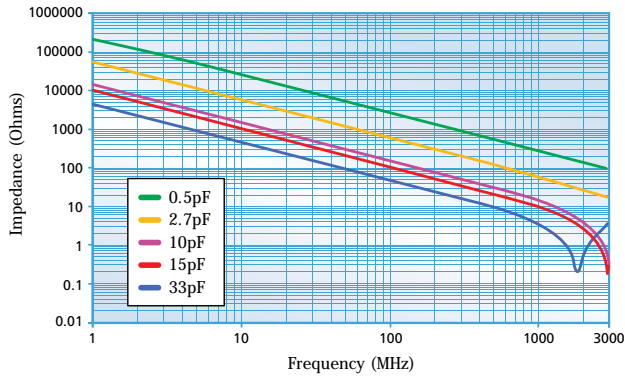


All performance curves are based on measurements taken with Boonton 34A resonant tube, Agilent E4991A impedance analyser and Agilent 16197A test fixture. Different test methods or fixtures may give different results. Data is typical and is supplied for indication only.

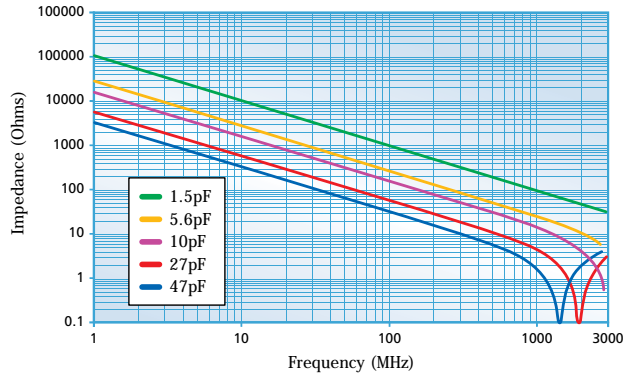
High Q Capacitors - Q(MS) & U ranges



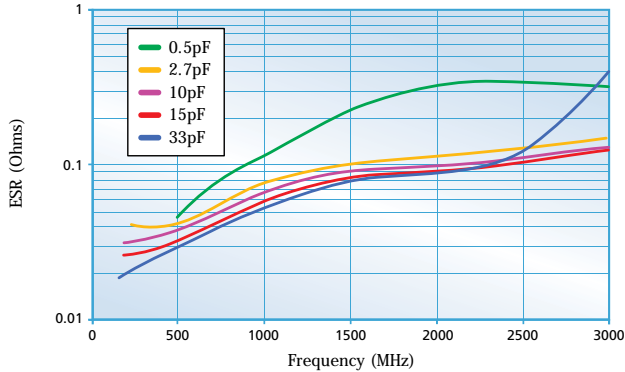
U Series - Impedance vs. Frequency - Case size 0603



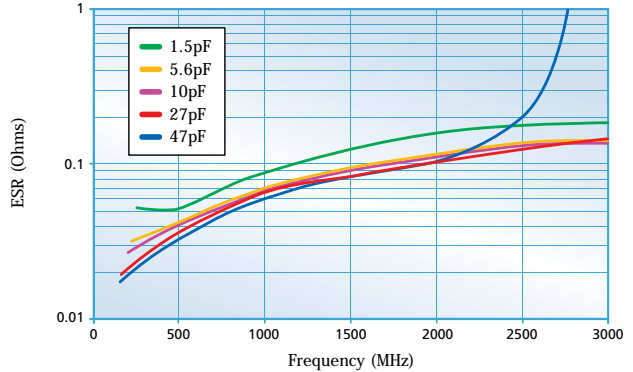
U Series - Impedance vs. Frequency - Case size 0805



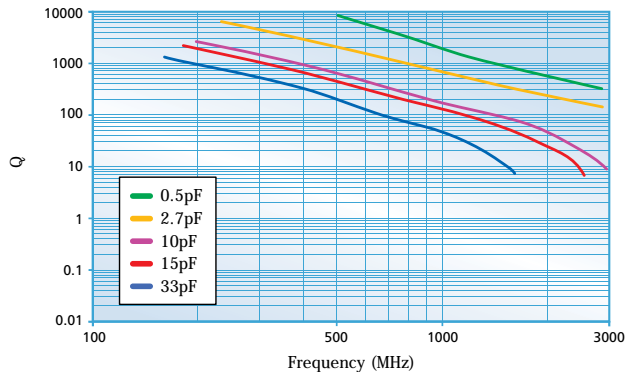
U Series - ESR vs. Frequency - Case size 0603



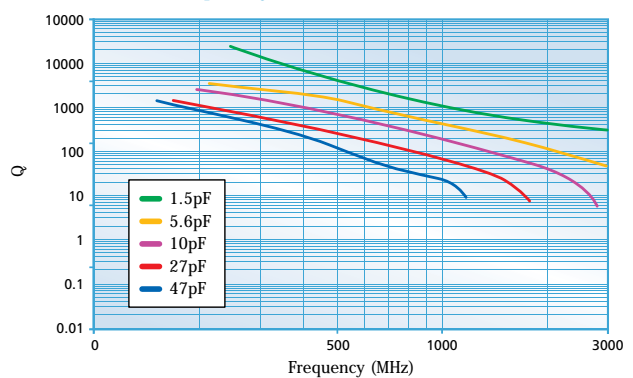
U Series - ESR vs. Frequency - Case size 0805



U Series Q vs. Frequency - Case size 0603



U Series Q vs. Frequency - Case size 0805



Note: All performance curves are based on measurements taken with Boonton 34A resonant tube, Agilent E4991A impedance analyser and Agilent 16197A test fixture. Different test methods or fixtures may give different results. Data is typical and is supplied for indication only.

*0402 size and other values (inc. values < than 0.3pF) and taping quantities may be available on request, consult the Sales Office.

†0603 and 0805 sizes only available in the "U" range and not Q(MS).

Ordering information - High Q capacitors - MS(Q) and U ranges

0805	J	250	4P70	B	U	T
Chip size	Termination	Voltage	Capacitance in picofarads (pF)	Capacitance tolerance	Dielectric	Packaging
0402* 0603† 0505 0805† 1206 1111 1210 1812 2220 2225 3640	J = Nickel barrier (100% matte tin plating). RoHS compliant. Lead free. A = Nickel barrier (Tin/lead plating with min. 10% lead). Not RoHS compliant.	050 = 50V 063 = 63V 100 = 100V 150 = 150V 200 = 200V 250 = 250V 300 = 300V 500 = 500V 630 = 630V 1K0 = 1kV 2K0 = 2kV 3K0 = 3kV	<1.0pF: Insert a P for the decimal point as the first character. eg. P300 = 0.3pF Values in 0.1pF steps ≥1.0pF & <10pF: Insert a P for the decimal point as the second character. eg. 8P20 = 8.2pF Values are E24 series ≥10pF: First digit is 0. Second and third digits are significant figures of capacitance code. Fourth digit is number of zeros. eg. 0101 = 100pF Values are E24 series	<4.7pF H = ±0.05pF B = ±0.1pF C = ±0.25pF D = ±0.5pF <10pF B = ±0.1pF C = ±0.25pF D = ±0.5pF ≥10pF F = ±1% G = ±2% J = ±5% K = ±10%	Q = High Q version of COG/NPO U = High Q version of COG/NPO	T = 178mm (7") reel R = 330mm (13") reel B = Bulk pack - tubs or trays

High Q Capacitors, High Temperature - H range

The Ultra-low ESR "H" range offers a very stable, X8G High Q material system that provides excellent low loss performance. Optimised for lowest possible ESR, the electrode system provides low metal losses resulting in flatter performance curves and reduced losses at higher frequencies.

An extended operating temperature range of -55°C to +150°C accommodates modern high density micro electronics requirements.

This range of high frequency capacitors is suitable for many applications where economical, high performance is required.

Operating Temperature

-55°C to +150°C (EIA X8G)

Temperature Coefficient (Typical)

0 ± 30 ppm/°C (EIA X8G)

Insulation resistance

Time constant (Ri xCr) (whichever is the least)

100GΩ or 1000s

Q Factor

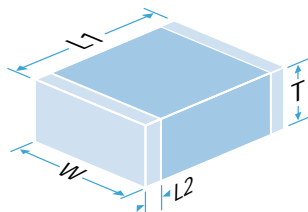
>2000 @ 1MHz



Minimum/maximum capacitance values - Ultra-low ESR capacitors - H range

Chip Size		0402	0603	0805
Min Cap		0.1pF	0.1pF	0.2pF
Max Cap	250V	22pF	100pF	240pF
Tape quantities		7" reel - 10,000	7" reel - 4,000	7" reel - 3,000
		13" reel - 15,000	13" reel - 16,000	13" reel - 12,000

Note: Below 1pF capacitance values are available in 0.1pF steps. Above 1pF capacitance values are available in E24 series values.



Dimensions

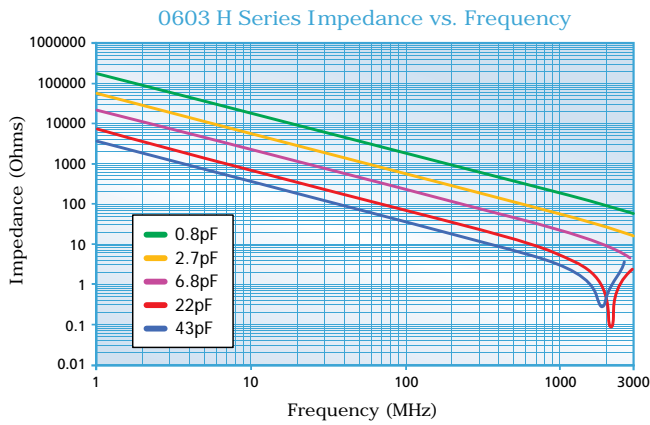
Size	Length (L1) mm ~ inches	Width (W) mm ~ inches	Max. Thickness (T) mm ~ inches	Termination Band (L2) mm ~ inches	
				min	max
0402	1.0 ± 0.10 ~ 0.04 ± 0.004	0.5 ± 0.1 ~ 0.02 ± 0.004	0.60 ~ 0.24	0.10 ~ 0.004	0.40 ~ 0.016
0603	1.6 ± 0.2 ~ 0.063 ± 0.008	0.8 ± 0.2 ~ 0.032 ± 0.008	0.80 ~ 0.032	0.10 ~ 0.004	0.40 ~ 0.016
0805	2.0 ± 0.3 ~ 0.079 ± 0.012	1.25 ± 0.20 ~ 0.049 ± 0.008	1.3 ~ 0.051	0.13 ~ 0.005	0.75 ~ 0.03

Ordering information - Ultra-low ESR capacitors - H range

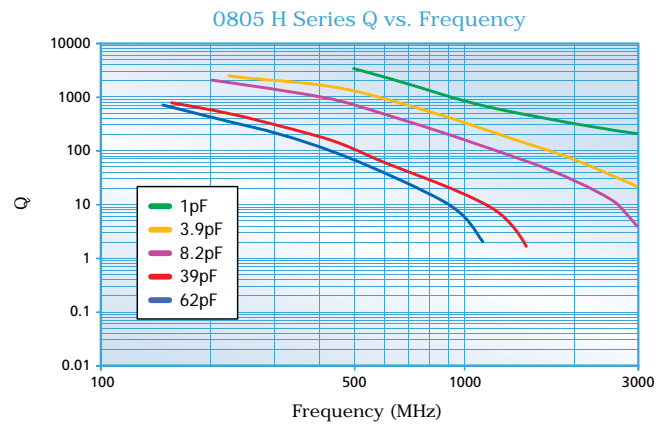
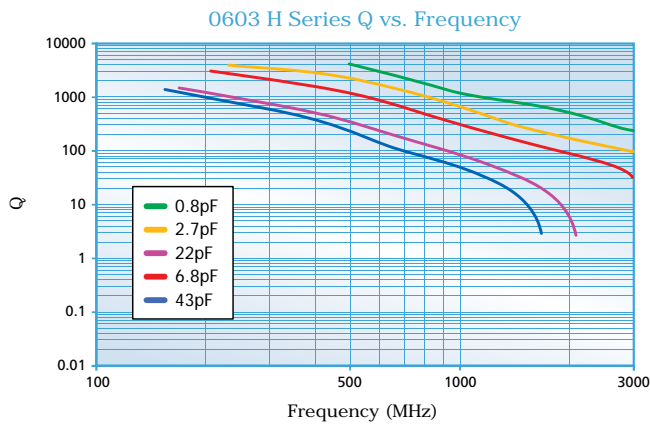
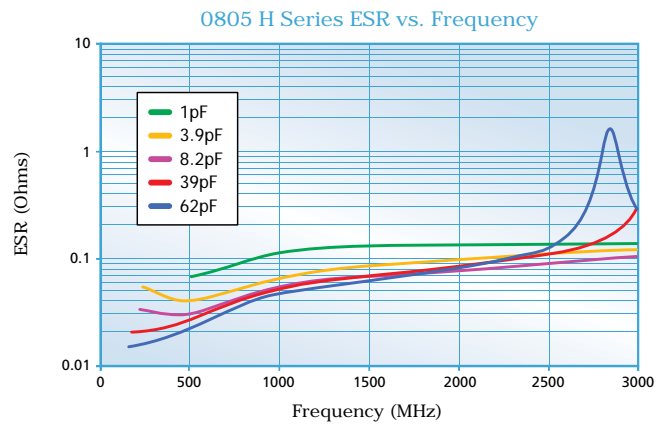
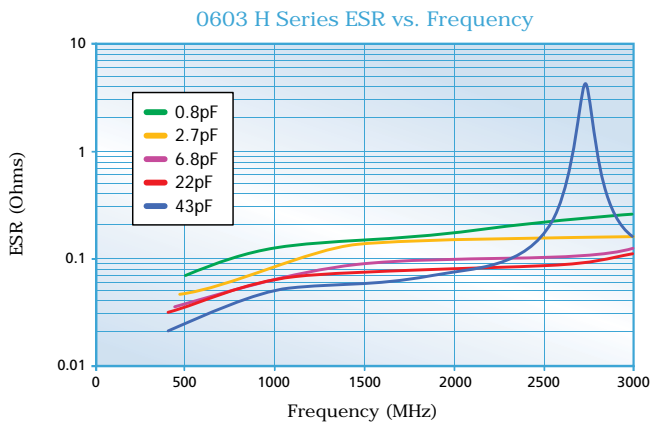
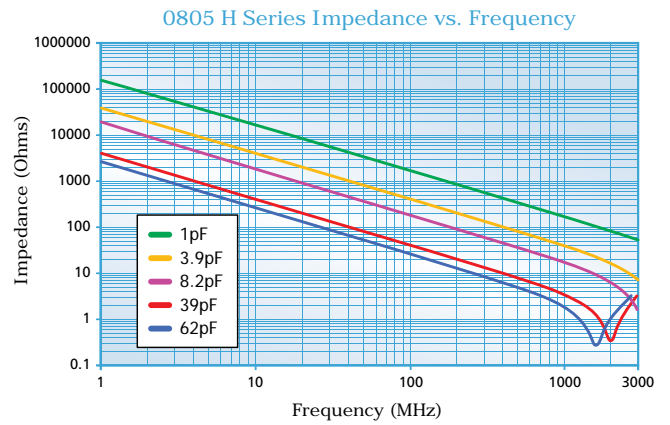
0805	J	250	0101	J	H	T
Chip size	Termination	Voltage	Capacitance in picofarads (pF)	Capacitance tolerance	Dielectric	Packaging
0402 0603 0805	J = Nickel barrier (100% matte tin plating). RoHS compliant. Lead free.	250 = 250V	<1.0pF: Insert a P for the decimal point as the first character. eg. P300 = 0.3pF Values in 0.1pF steps ≥1.0pF & <10pF: Insert a P for the decimal point as the second character. eg. 8P20 = 8.2pF Values are E24 series ≥10pF: First digit is 0. Second and third digits are significant figures of capacitance code. Fourth digit is number of zeros. eg. 0101 = 100pF Values are E24 series	<4.7pF H = ±0.05pF B = ±0.1pF C = ±0.25pF D = ±0.5pF <10pF B = ±0.1pF C = ±0.25pF D = ±0.5pF ≥10pF F = ±1% G = ±2% J = ±5% K = ±10%	H = Ultra-low ESR High Frequency "H" range	T = 178mm (7") reel R = 330mm (13") reel B = Bulk pack - tubs or trays

High Q Capacitors, High Temperature - H range

Typical performance - 0603 chip size



Typical performance - 0805 chip size



High Q Capacitors, High Power RF - Surface Mount & Ribbon Leaded

A range of ultra-low loss High Q ceramic capacitors with COG/NPO characteristics suitable for high power applications where minimal power loss and very low self heating is demanded.

Capacitance values

1pF to 27nF (High Q)

Chip sizes

2225 and 4040

Operating temperature

-55°C to +125°C

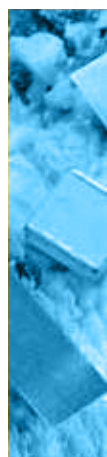
High Q low ESR dielectrics

(other options available)

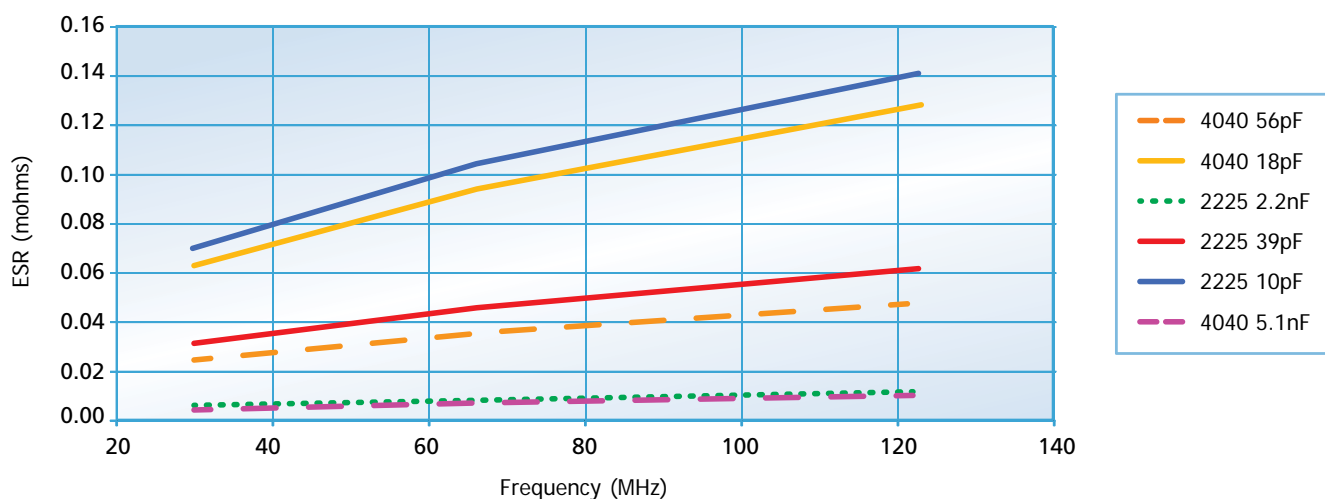
Insulation Resistance (IR)

100GΩ min @ 100 Vdc or 1000s (whichever is the less)

DWV up to 8400Vdc



Typical ESR vs Frequency



ESR Measurement

All ESR figures are measured using a VNA and 2m copper resonant tube and extrapolating to 30MHz by ratio. Measured data can be supplied on request. Measurement of ESR can vary with test method and components should only be compared when tested back-to-back on the same equipment under controlled conditions.

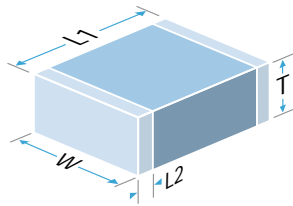
High Power RF capacitors - minimum/maximum capacitance values

Chip size	Case size 25 - 2225		Case size 40 - 4040	
	Min.	Max.	Min.	Max.
200V	6.2nF	10nF	16nF	27nF
500V	5.1nF	5.6nF	13nF	15nF
630V	3.6nF	4.7nF	11nF	12nF
1kV	1.1nF	3.3nF	5.6nF	10nF
2kV	510pF	1.0nF	1.6nF	5.1nF
3kV	110pF	470pF	910pF	1.5nF
3.6kV	1pF	47pF*/100pF	-	-
4kV	-	-	620pF	820pF
5kV	-	-	360pF	560pF
6kV	-	-	160pF	330pF
7.0kV/7.2kV	-	-	1pF	56pF** / 150pF

Note: *2225 - 47pF max. for dual rated @2.5kVac 30MHz **4040 - 56pF max. for dual rated @5kVac 30MHz.

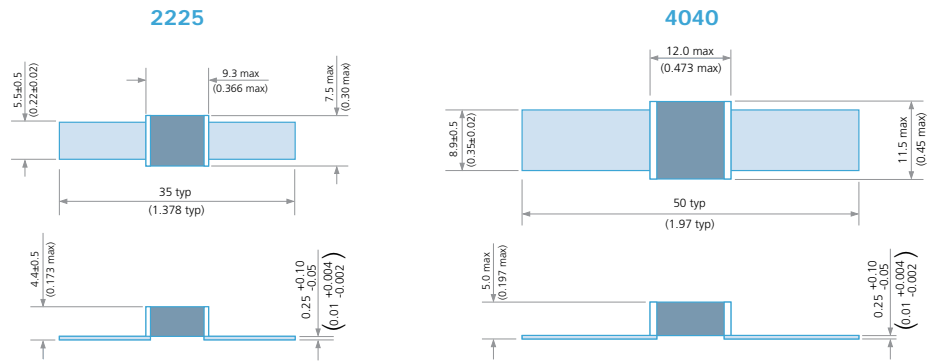
High Q Capacitors, High Power RF - Surface Mount & Ribbon Leded

Surface Mount



Plating finish:
Tin over Ni.

Ribbon Leded Silver plated copper ribbon attached with HMP solder - (MP greater than 260°C)



Range dimensions - Surface Mount High Power RF capacitors

Chip size	Length (L1) mm/inches	Width (W) mm/inches	Max. Thickness (T) mm/inches	Termination Band L2 mm/inches	
				min	max
2225	5.7 ± 0.04 0.225 ± 0.016	6.3 ± 0.4 0.25 ± 0.016	4.2 0.16	0.25 0.01	1.0 0.04
4040	10.2 ± 0.5 0.402 ± 0.020	10.2 ± 0.5 0.402 ± 0.020	4.2 0.16	0.5 0.02	1.5 0.06

Ordering information - Surface Mount High Power RF capacitors

4040	J	7K0	0470	J	Q	B	AF7
Chip size	Termination	Voltage	Capacitance in picofarads (pF)	Capacitance tolerance	Dielectric	Packing	Variant Code
2225 4040	J = Nickel barrier (100% matte tin plating). RoHS compliant. Lead free.	200 = 200V 500 = 500V 630 = 630V 1K0 = 1kV 2K0 = 2kV 3K0 = 3kV 3K6 = 3.6kV 4K0 = 4kV 5K0 = 5kV 6K0 = 6kV 7K0 = 7kV/ 7.2kV	<10pF Insert a P for the decimal point, eg 2P20 = 2.2pF. >10pF. 1st digit is 0. 2nd and 3rd digits are significant figures of capacitance code. The 4th digit is number of 0's following eg. 0470 = 47pF 0512 = 5100pF	<10pF B = ±0.10pF C = ±0.25pF D = ±0.50pF ≥10pF G = ±2% J = ±5% K = ±10% M = ±20%	Q = High Q version of COG/NPO	B = Bulk packed	AF7 = Standard Variant for High Power applications

Ordering information - Ribbon Leded High Power RF capacitors

4040	B	7K0	0470	G	Q	B	Lead options	Variant code
Chip size	Coating	Voltage	Capacitance in picofarads (pF)	Capacitance tolerance	Dielectric	Packing	R	W001
2225 4040	B = Uncoated V = Coated with modified silicone lacquer	200 = 200V 500 = 500V 630 = 630V 1K0 = 1kV 2K0 = 2kV 3K0 = 3kV 3K6 = 3.6kV 4K0 = 4kV 5K0 = 5kV 6K0 = 6kV 7K0 = 7kV/ 7.2kV	<10pF Insert a P for the decimal point, eg 2P20 = 2.2pF. >10pF. 1st digit is 0. 2nd and 3rd digits are significant figures of capacitance code. The 4th digit is number of 0's following eg. 0470 = 47pF 0512 = 5100pF	<10pF B = ±0.10pF C = ±0.25pF D = ±0.50pF ≥10pF G = ±2% J = ±5% K = ±10% M = ±20%	Q = High Q version of COG/NPO	B = Bulk packed	R = Ribbon Leded	W001 = Standard Variant W**1 = Marked

Note: For non-magnetic see page 69.