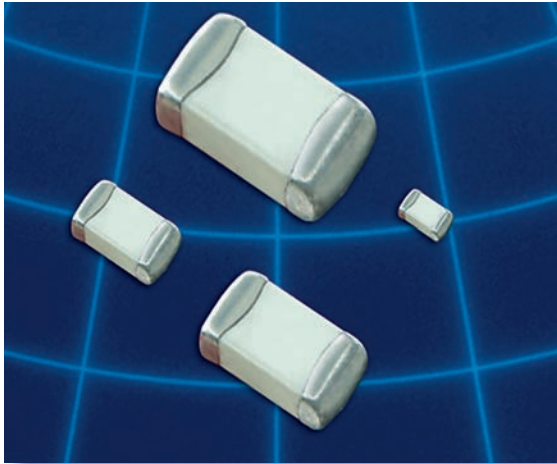


MULTI-LAYER HIGH-Q CAPACITORS



These lines of multilayer capacitors have been developed for High-Q and microwave applications.

- The **S-Series** (R07S, R14S, R15S) capacitors give an ultra-high Q performance, and exhibit NP0 temperature characteristics.
- The **L-Series** (R05L) capacitors give mid-high Q performance, and exhibit NP0 temperature characteristics.
- The **E-Series** (S42E, S48E, S58E) capacitors give excellent high-Q performance from HF to Microwave frequencies. Typical uses are high voltage, high current applications. They are offered in chip (Ni barrier or Non-Magnetic Pt.-Ag) or in Non-Magnetic leaded form.
- RoHS compliance is standard for all unleaded parts (see termination options box).

HOW TO ORDER

252 WVDC² 250 = 25 V 201 = 200 V 251 = 250 V 501 = 500 V 102 = 1000 V 152 = 1500 V 252 = 2500 V 362 = 3600 V 722 = 7200 V	S48 CASE SIZE R05 (0201) R07 (0402) R14 (0603) R15 (0805) S42 (1111) S48 (2525) S58 (3838)	E CAPACITANCE (pF) 1st two digits are significant; third digit denotes number of zeros, R = decimal. 100 = 10 pF 101 = 100 pF DIELECTRIC S = Ultra High Q NPO L = High Q NPO E = Ultra High Q NPO, High Voltage, High Power, T ¹ = High Temp (175C) Ultra High Q NPO	470 TOLERANCE A = ± 0.05 pF B = ± 0.10 pF C = ± 0.25 pF D = ± 0.50 pF F = ± 1 % G = ± 2% J = ± 5% K = ± 10% For tolerance availability, see chart.	K TERMINATION Nickel Barrier V = Ni/Sn (Green) T = Ni/SnPb G = Ni/Au (Green) Non-Mag¹ U = Cu/Sn (Green) C = Cu/SnPb Leaded (All Non-Mag)¹ 1 = Microstrip 2 = Axial Ribbon 3 = Axial Wire 4 = Radial Ribbon 5 = Radial Wire	V MARKING 3 = Cap Code & Tolerance 4 = No Marking 6 = EIA Code (Marking option is only available on 0805 and larger case sizes)	4 PACKAGING S = Bulk W = Waffle Pack 0201 - 0603 Y = Paper 5" Reel T = Paper 7" Reel R ¹ = Paper 13" Reel J ¹ = Paper 5" Reel - Horizontally Oriented Electrodes N ¹ = Paper 5" Reel - Vertically Oriented Electrodes L ¹ = Paper 7" Reel - Horizontally Oriented Electrodes V ¹ = Paper 7" Reel - Vertically Oriented Electrodes 0805 - 3838 Z = Embossed 5" Reel E = Embossed 7" Reel U ¹ = Embossed 13" Reel M ¹ = Embossed 5" Reel - Horizontally Oriented Electrodes Q ¹ = Embossed 5" Reel - Vertically Oriented Electrodes G ¹ = Embossed 7" Reel - Horizontally Oriented Electrodes P ¹ = Embossed 7" Reel - Vertically Oriented Electrodes Tape specifications conform to EIA RS481	E
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Part Number written: **252S48E470KV4E**




¹ - Not available for all MLCC - Call factory for info.
² - WVDC - Working Voltage DC.

Low ESR / High-Q CAPACITOR SELECTION CHART

Cap. Value		EIA Size		RF Power Applications									
				0201 (R05)		0402	0603	0805	0805	1111	2525	3838	
				NPO (R05L)	NPO (R05G)	(R07S)	(R14S)	(R15S)	(R15G)	(S42E)	(S48E)	(S58E)	
Capacitance pF	Code												
0.1	0R1												
0.2	0R2			25 V	25 V	200 V	250 V			500V	1500V		
0.3	0R3			25 V	25 V	200 V	250 V	250 V	1000V	500V	1500V		
0.4	0R4			25 V	25 V	200 V	250 V	250 V	1000V	500V	1500V		
0.5	0R5			25 V	25 V	200 V	250 V	250 V	1000V	500V	1500V	2500V	
0.6	0R6			25 V	25 V	200 V	250 V	250 V	1000V	500V	1500V	2500V	3600V
0.7	0R7			25 V	25 V	200 V	250 V	250 V	1000V	500V	1500V	2500V	3600V
0.8	0R8			25 V	25 V	200 V	250 V	250 V	1000V	500V	1500V	2500V	3600V
0.9	0R9			25 V	25 V	200 V	250 V	250 V	1000V	500V	1500V	2500V	3600V
1.0	1R0			25 V	25 V	200 V	250 V	250 V	1000V	500V	1500V	2500V	3600V
1.1	1R1			25 V	25 V	200 V	250 V	250 V	1000V	500V	1500V	2500V	3600V
1.2	1R2	A		25 V	25 V	200 V	250 V	250 V	1000V	500V	1500V	2500V	3600V
1.3	1R3	B		25 V	25 V	200 V	250 V	250 V	1000V	500V	1500V	2500V	3600V
1.4	1R4	C		25 V	25 V	200 V	250 V	250 V	1000V	500V	1500V	2500V	3600V
1.5	1R5	D		25 V	25 V	200 V	250 V	250 V	1000V	500V	1500V	2500V	3600V
1.6	1R6			25 V	25 V	200 V	250 V	250 V	1000V	500V	1500V	2500V	3600V
1.7	1R7			25 V	25 V	200 V	250 V	250 V	1000V	500V	1500V	2500V	3600V
1.8	1R8			25 V	25 V	200 V	250 V	250 V	1000V	500V	1500V	2500V	3600V
1.9	1R9			25 V	25 V	200 V	250 V	250 V	1000V	500V	1500V	2500V	3600V
2.0	2R0			25 V	25 V	200 V	250 V	250 V	1000V	500V	1500V	2500V	3600V
2.1	2R1			25 V	25 V	200 V	250 V	250 V	1000V	500V	1500V	2500V	3600V
2.2	2R2			25 V	25 V	200 V	250 V	250 V	1000V	500V	1500V	2500V	3600V
2.4	2R4			25 V	25 V	200 V	250 V	250 V	1000V	500V	1500V	2500V	3600V
2.7	2R7			25 V	25 V	200 V	250 V	250 V	1000V	500V	1500V	2500V	3600V
3.0	3R0			25 V	25 V	200 V	250 V	250 V	1000V	500V	1500V	2500V	3600V
3.3	3R3			25 V	25 V	200 V	250 V	250 V	1000V	500V	1500V	2500V	3600V
3.6	3R6			25 V	25 V	200 V	250 V	250 V	1000V	500V	1500V	2500V	3600V
3.9	3R9			25 V	25 V	200 V	250 V	250 V	1000V	500V	1500V	2500V	3600V
4.3	4R3			25 V	25 V	200 V	250 V	250 V	1000V	500V	1500V	2500V	3600V
4.7	4R7			25 V	25 V	200 V	250 V	250 V	1000V	500V	1500V	2500V	3600V
5.1	5R1	A**		25 V	25 V	200 V	250 V	250 V	1000V	500V	1500V	2500V	3600V
5.6	5R6	B		25 V	25 V	200 V	250 V	250 V	1000V	500V	1500V	2500V	3600V
6.2	6R2	C		25 V	25 V	200 V	250 V	250 V	1000V	500V	1500V	2500V	3600V
6.8	6R8	D		25 V	25 V	200 V	250 V	250 V	1000V	500V	1500V	2500V	3600V
7.5	7R5			25 V	25 V	200 V	250 V	250 V	1000V	500V	1500V	2500V	3600V
8.2	8R2			25 V	25 V	200 V	250 V	250 V	1000V	500V	1500V	2500V	3600V
9.1	9R1			25 V	25 V	200 V	250 V	250 V	1000V	500V	1500V	2500V	3600V
10	100			25 V	25 V	200 V	250 V	250 V	1000V	500V	1500V	2500V	3600V
11	110			25 V	25 V	200 V	250 V	250 V	1000V	500V	1500V	2500V	3600V
12	120			25 V	25 V	200 V	250 V	250 V	1000V	500V	1500V	2500V	3600V
13	130			25 V	25 V	200 V	250 V	250 V	1000V	500V	1500V	2500V	3600V
15	150			25 V	25 V	200 V	250 V	250 V	1000V	500V	1500V	2500V	3600V
16	160			25 V	25 V	200 V	250 V	250 V	1000V	500V	1500V	2500V	3600V
18	180			25 V	25 V	200 V	250 V	250 V	1000V	500V	1500V	2500V	3600V
20	200			25 V		200 V	250 V	250 V	1000V	500V	1500V	2500V	3600V
22	220			25 V		200 V	250 V	250 V	1000V	500V	1500V	2500V	3600V
24	240			25 V		200 V	250 V	250 V	1000V	500V	1500V	2500V	3600V
27	270			25 V		200 V	250 V	250 V	1000V	500V	1500V	2500V	3600V
30	300			25 V		200 V	250 V	250 V	1000V	500V	1500V	2500V	3600V
33	330			25 V		200 V	250 V	250 V	1000V	500V	1500V	2500V	3600V

Consult factory for Non-Standard values.

**A tolerance only available for R07S (0402) and R14S(0603) caps



Low ESR / HIGH-Q CAPACITOR SELECTION CHART

EIA Size Cap. Value			RF Power Applications										
			0201 (R05)		0402 (R07S)	0603 (R14S)	0805 (R15S)	0805 (R15G)	1111 (S42E)	2525 (S48E)	3838 (S58E)		
			NPO (R05L)	NPO (R05G)									
Capacitance pF Code		Tolerance											
36	360	F G J K	25 V			250 V	250 V	1000V	500V	1500V	2500V	3600V	7200V
39	390		25 V			250 V	250 V	1000V	500V	1500V	2500V	3600V	7200V
43	430		25 V			250 V	250 V	1000V	500V	1500V	2500V	3600V	7200V
47	470		25 V			250 V	250 V	1000V	500V	1500V	2500V	3600V	7200V
51	510		25 V			250 V	250 V	1000V	500V	1500V	2500V	3600V	7200V
56	560		25 V			250 V	250 V	1000V	500V	1500V	2500V	3600V	7200V
62	620		25 V			250 V	250 V	1000V	500V	1500V	2500V	3600V	7200V
68	680		25 V			250 V	250 V	1000V	500V	1500V	2500V	3600V	7200V
75	750		25 V			250 V	250 V	1000V	500V	1500V	2500V	3600V	7200V
82	820		25 V			250 V	250 V	1000V	500V	1500V	2500V	3600V	7200V
91	910		25 V			250 V	250 V	1000V	500V	1500V	2500V	3600V	7200V
100	101		25 V			250 V	250 V	1000V	500V	1500V	2500V	3600V	7200V
110	111						250 V		300V	1500V	2500V	3600V	7200V
120	121						250 V		300V	1000V	2500V	3600V	7200V
130	131						250 V		300V	1000V	2500V	3600V	7200V
150	151						250 V		300V	1000V	2500V	3600V	7200V
160	161						250 V		300V	1000V	2500V	3600V	7200V
180	181						250 V		300V	1000V	2500V	3600V	7200V
200	201						250 V		300V	1000V	2500V	3600V	
220	221						250 V		200V	1000V	2500V	3600V	
240	241								200V	1000V	2500V	3600V	
270	271								200V	1000V	2500V	3600V	
300	301							200V	1000V	1500V	3600V		
330	331							200V	1000V	1500V	3600V		
360	361							200V	1000V	1500V	3600V		
390	391							200V	500V	1500V	3600V		
430	431	G J K						200V	500V	1500V	2500V		
470	471							200V	500V	1500V	2500V		
510	511							100V	500V	1000V	2500V		
560	561							100V	500V	1000V	2500V		
620	621							100V	500V	1000V	2500V		
680	681							50V		1000V	2500V		
750	751							50V		1000V	2500V		
820	821							50V		1000V	2500V		
910	911							50V		1000V	1000V		
1000	102							50V		1000V	1000V		
1200	122									1000V	1000V		
1500	152									500V	1000V		
1800	182									500V	1000V		
2200	222									300V	1000V		
2700	272									300V	500V		
3300	332										500V		
3900	392										500V		
4700	472										500V		
5100	512									500V			
10000	103												

Consult factory for Non-Standard values.



DIELECTRIC CHARACTERISTICS

NPO

TEMPERATURE COEFFICIENT:	0 ± 30ppm /°C, -55 to 125°C
QUALITY FACTOR / DF:	Q >1,000 @ 1KHz (C>1,000pF), Typical 10,000 (C<1,000 pF)
INSULATION RESISTANCE:	>100 GΩ @ 25°C, WVDC ¹ ; 125°C IR is 10% of 25°C rating
DIELECTRIC STRENGTH:	500 V ≤ 2.5 X WVDC ¹ Min., 25°C, 50 mA max 1000 V ≤ 1.5 X WVDC ¹ Min., 25°C, 50 mA max > 1500 = 1 X WVDC ¹ Min., 25°C, 50 mA max
TEST PARAMETERS::	1MHz ±50kHz, 1.0±0.2 VRMS, 25°C
AVAILABLE CAPACITANCE:	
Size 0201:	0.2 - 100 pF
Size 0402:	0.2 - 33 pF
Size 0603:	0.2 - 100 pF
Size 0805:	0.3 - 220 pF
Size 1111:	0.2 - 1000 pF
Size 2525:	1.0 - 2700 pF
Size 3838:	1.0 - 5100 pF

MECHANICAL & ENVIRONMENTAL CHARACTERISTICS

	SPECIFICATION	TEST PARAMETERS
SOLDERABILITY:	Solder coverage ≥ 90% of metalized areas No termination degradation	Preheat chip to 120°-150°C for 60 sec., dip terminals in rosin flux then dip in Sn62 solder @ 240°±5°C for 5±1 sec
RESISTANCE TO SOLDERING HEAT:	No mechanical damage Capacitance change: ±2.5% or 0.25pF Q>500 I.R. >10 G Ohms DWV ² : 2.5 x WVDC ¹	Preheat device to 80°-100°C for 60 sec. followed by 150°-180°C for 60 sec. Dip in 260°±5°C solder for 10±1 sec. Measure after 24±2 hour cooling period
TERMINAL ADHESION:	Termination should not pull off. Ceramic should remain undamaged.	Linear pull force ³ exerted on axial leads soldered to each terminal.
PCB DEFLECTION:	No mechanical damage. Capacitance change: 2% or 0.5pF Max	Glass epoxy PCB: 0.5 mm deflection
LIFE TEST:	MIL-STD-202, Method 108I No mechanical damage Capacitance change: ±3.0% or 0.3 pF Q>500 I.R. >1 G Ohms DWV ² : 2.5 x WVDC ¹	Applied voltage: 200% of WVDC ¹ for capacitors rated at 500 volts DC or less. 100% of WVDC ¹ for capacitors rated at 1250 volts DC or less. Temperature: 125°±3°C Test time: 1000+48-0 hours
THERMAL CYCLE:	No mechanical damage. Capacitance change: ±2.5% or 0.25pF Q>2000 I.R. >10 G Ohms DWV ² : 2.5 x WVDC ¹	5 cycles of: 30±3 minutes @ -55°+0/-3°C, 2-3 min. @ 25°C, 30±3 min. @ +125°+3/-0°C, 2-3 min. @ 25°C Measure after 24±2 hour cooling period
HUMIDITY, STEADY STATE:	No mechanical damage. Capacitance change: ±5.0% or 0.50pF max. Q>300 I.R. ≥ 1 G-Ohm DWV ² : 2.5 x WVDC ¹	Relative humidity: 90-95% Temperature: 40°±2°C Test time: 500 +12/-0 Hours Measure after 24±2 hour cooling period
HUMIDITY, LOW VOLTAGE:	No mechanical damage. Capacitance change: ±5.0% or 0.50pF max. Q>300 I.R. = 1 G-Ohm min. DWV ² : 2.5 x WVDC ¹	Applied voltage: 1.5 VDC, 50 mA max. Relative humidity: 85±2% Temperature: 40°±2°C Test time: 240 +12/-0 Hours Measure after 24±2 hour cooling period
VIBRATION:	No mechanical damage. Capacitance change: ±2.5% or 0.25pF Q>1000 I.R. ≥ 10 G-Ohm DWV ² : 2.5 x WVDC ¹	Cycle performed for 2 hours in each of three perpendicular directions Frequency range 10Hz to 55 Hz to 10 Hz traversed in 1 minute. Harmonic motion amplitude: 1.5mm

¹ - WVDC - Working Voltage DC.

² - DWV - Dielectric Withstanding Voltage.

³ - 0402 ≥ 2.0lbs, 0603 ≥ 4.0lbs (min).

⁴ - Whichever is less.

MECHANICAL CHARACTERISTICS

Size	Units	Length	Width	Thickness	End Band
EIA 0201	In	.024 ±.001	.012 ±.001	.012 ±.001	.008 Max.
Metric (0603)	mm	(0.60 ±0.03)	(0.30 ±0.03)	(0.30 ±0.03)	(0.20 Max.)
EIA 0402	In	.040 ±.004	.020 ±.004	.020 ±.004	.010 ±.006
Metric (1005)	mm	(1.02 ±0.1)	(0.51 ±0.1)	(0.51 ±0.1)	(0.25 ±.15)
EIA 0603	In	.062 ±.006	.032 ±.006	.030 +.005/-.003	.014 ±.006
Metric (1608)	mm	(1.57 ±0.15)	(0.81 ±0.15)	(0.76 +.13-.08)	(0.35 ±.15)
EIA 0805	In	.080 ±.008	.050 ±.008	.040 ±.006	.020 ±.010
Metric (2012)	mm	(2.03 ±0.20)	(1.27 ±0.20)	(1.02 ±.15)	(0.50 ±.25)

HORIZONTAL AND VERTICAL ORIENTED CAPACITORS

Horizontal Electrode Orientation



Vertical Electrode Orientation



APPLICATIONS & FEATURES

Size: EIA 0201, 0402
Performance: SRF's up to 20 GHz, Ultra High Q, Tight tolerance, Ultralow ESR
Termination: Ni/Au, Ni/Sn, Ni/SnPb
Applications: High Frequency Wireless Communications, Portable Wireless Products, Battery Powered Products
RoHS Compliant

BENEFITS OF USING ORIENTED CAPACITORS

- Consistent Orientation - Improved repeatability of production circuits.
- Consistent Orientation - More consistent filter performance.
- Vertical Orientation - The elimination of parallel frequencies.
- Vertical Orientation - Lower inductance for a given capacitor.
- Horizontal Orientation - Lower coupling between adjacent capacitors.



E-SERIES TERMINATIONS AND LEADS

CHIP DIMENSIONS

Termination	Size	Units	L	Tol	W	Tol	T	E / B	Tol
V, T U, C	S42E	In	0.110	+0.020 -0.010	0.110	+/- .015	0.102 Max.	0.015 Typ.	+/- 0.008
		mm	2.79	+0.51 -0.25	2.79	+/- 0.38	2.59 Max.	0.38 Typ.	+/- 0.20
	S48E	In	0.230	+0.025 -0.010	0.250	+/- .015	0.150 Max.	0.025 Typ.	
		mm	5.84	+0.63 -0.25	6.35	+/- 0.38	3.81 Max.	0.63 Typ.	
	S58E	In	0.380	+0.015 -0.010	0.380	+/- .010	0.170 Max.	0.025 Typ.	
		mm	9.65	+0.38 -0.25	9.65	+/- 0.25	4.32 Max.	0.63 Typ.	

For all E-Series Models:

OPERATING TEMP. : -55 to +125°C
INSULATION RESISTANCE: >10G Ω @ 25°C
TEMPERATURE COEFFICIENT: $0 \pm 30\text{ppm}/^\circ\text{C}$, -55 to 125°C
DISSIPATION FACTOR (TYP): < 0.05% @ 1 MHz

Drawings not to scale



Lead	Size	LL(min)	X	Tol	e	e-Tol
1	S42E	0.25	0.093	+/-0.005	0.004	+/- 0.002
		6.40	2.36	+/- 0.13	0.102	+/- 0.051
	S48E	0.394	0.217	+/- 0.02	0.009	- 0.0019/+ 0.0031
		10.0	5.5	+/- 0.50	0.220	- 0.050/+ 0.080
	S58E	0.748	0.35	+/- 0.02	0.010	- 0.0019/+ 0.0039
		19.00	8.90	+/- 0.50	0.250	- 0.050/+ 0.100
2	S42E	0.25	0.093	+/-0.005	0.004	+/- 0.002
		6.40	2.36	+/- 0.13	0.102	+/- 0.051
	S48E	0.394	0.217	+/- 0.02	0.009	- 0.0019/+ 0.0031
		10.00	5.50	+/- 0.50	0.220	- 0.050/+ 0.080
	S58E	0.748	0.35	+/- 0.02	0.010	- 0.0019/+ 0.0039
		19.00	8.90	+/- 0.50	0.25	- 0.050/+ 0.100
3	S42E	0.25	0.020in (0.511) diameter wire			
		6.40				
	S48E	0.394				
		10.00				
	S58E	0.748				
		19.00				

Lead	Size	LL(min)	X	Tol	e	e-Tol
4	S42E	0.352	0.093	+/-0.005	0.004	+/- 0.002
		8.90	2.36	+/- 0.13	0.102	+/- 0.051
	S48E	0.501	0.217	+/- 0.02	0.009	- 0.0019/+ 0.0031
		12.70	5.50	+/- 0.50	0.220	- 0.050/+ 0.080
	S58E	0.886	0.35	+/- 0.02	0.010	- 0.0019/+ 0.0039
		22.50	8.90	+/- 0.50	0.25	- 0.050/+ 0.100
5	S42E	0.25	0.020in (0.511) diameter wire			
		6.40				
	S48E	0.394				
		10.00				
	S58E	0.748				
		19.00				

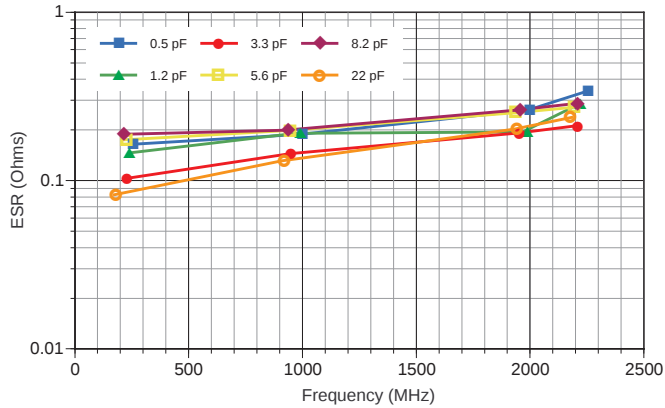
SERIES RESONANCE CHART

Typical Series Resonant Frequency (Series Mounted)



RF CHARACTERISTICS - L-SERIES

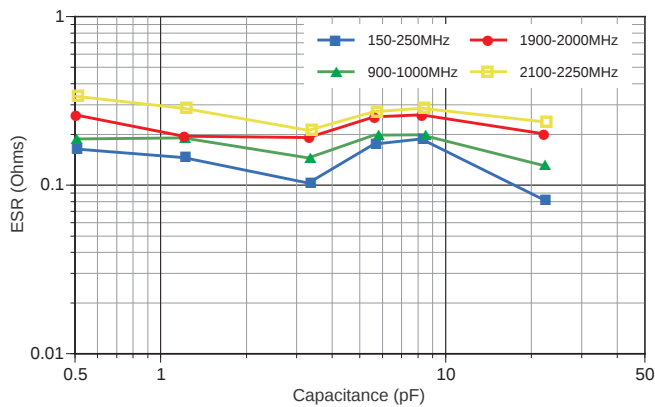
ESR vs Frequency: 0201/R05L



Q vs Frequency: 0201/R05L



ESR vs Capacitance: 0201/R05L

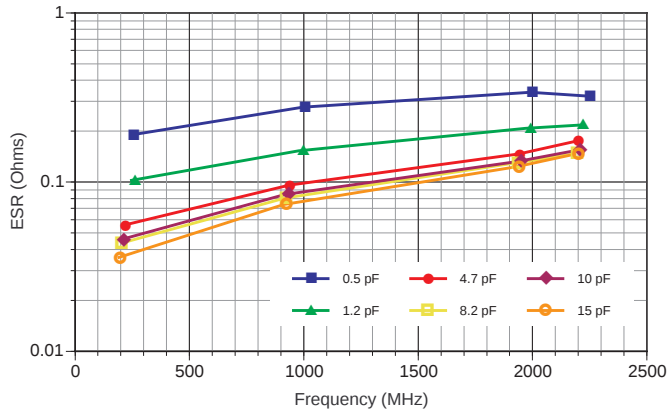


Q vs Capacitance: 0201/R05L

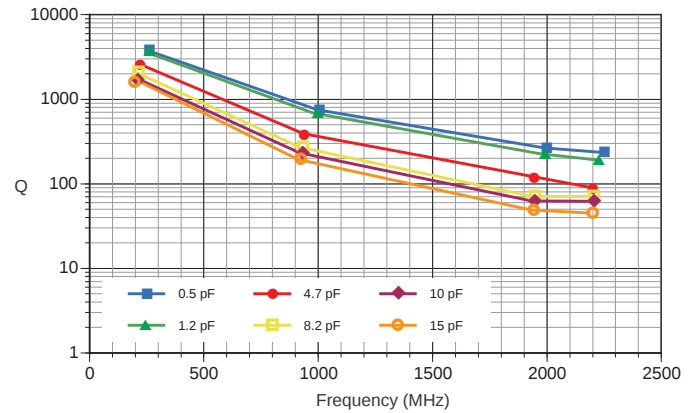


S-SERIES RF CHARACTERISTICS VERSUS FREQUENCY

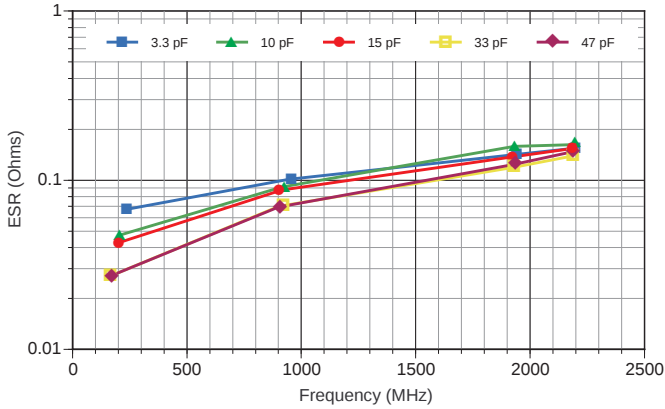
Equivalent Series Resistance: 0402/R07S



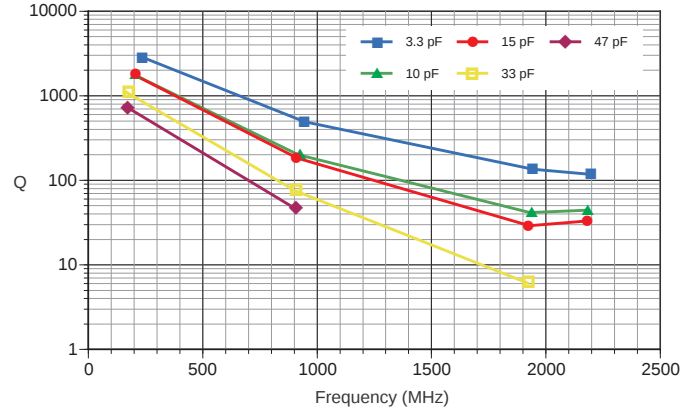
Q Factor: 0402/R07S



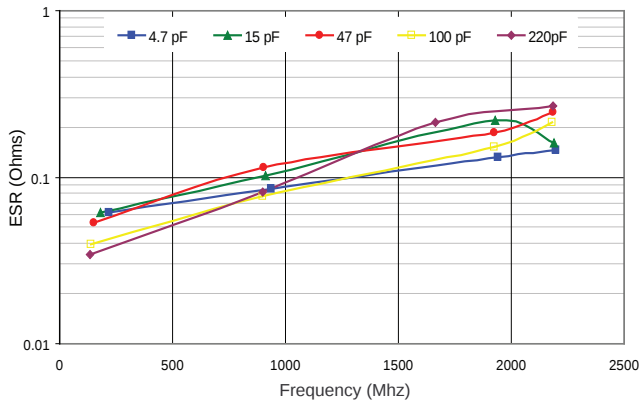
Equivalent Series Resistance: 0603/R14S



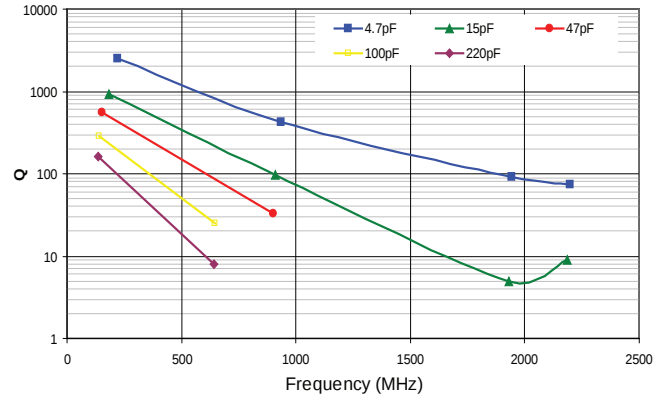
Q Factor: 0603/R14S



Equivalent Series Resistance: 0805/R15S



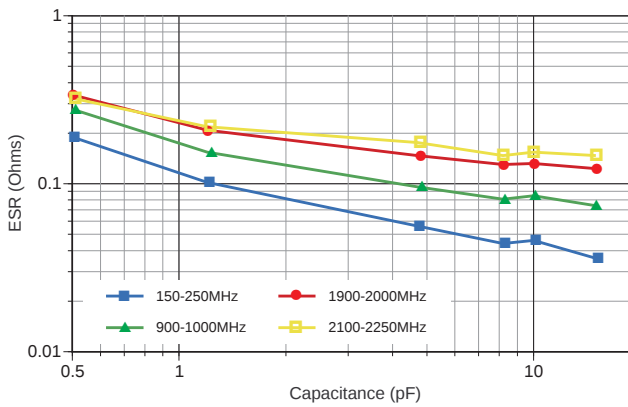
Q Factor: 0805/R15S



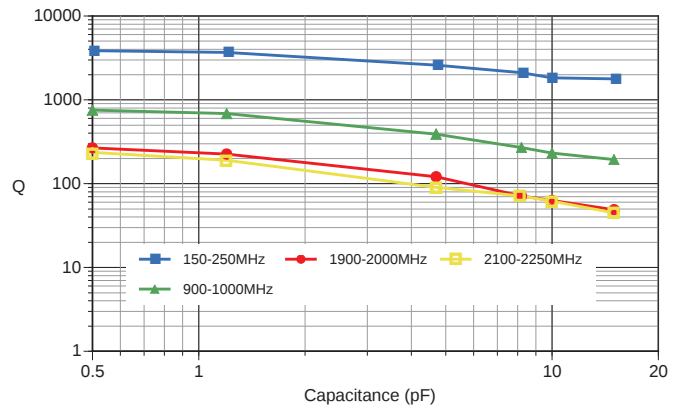
Measurements performed on a Boonton 34A Resonant Coaxial Line and represent typical capacitor performance.

S-SERIES RF CHARACTERISTICS VERSUS CAPACITANCE

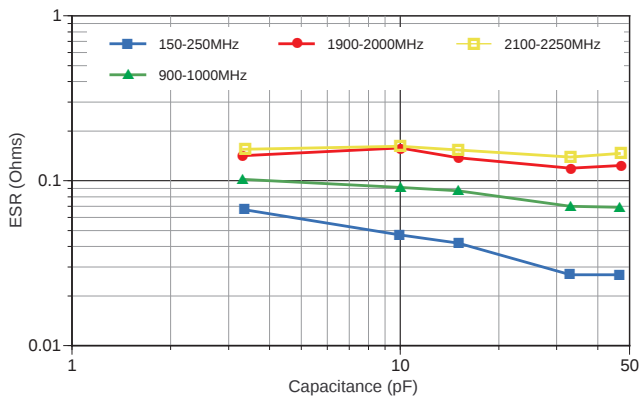
Equivalent Series Resistance: 0402/R07S



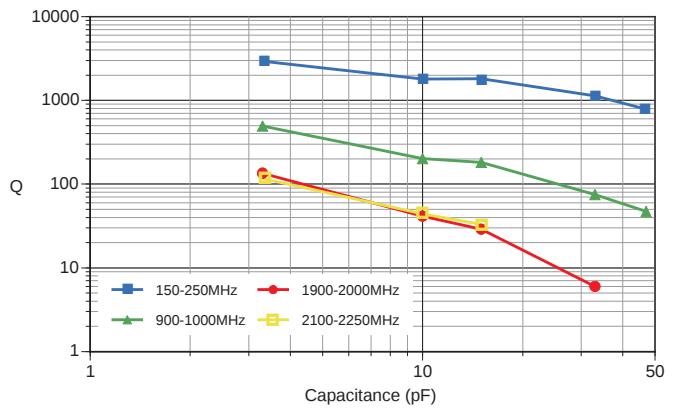
Q Factor: 0402/R07S



Equivalent Series Resistance: 0603/R14S



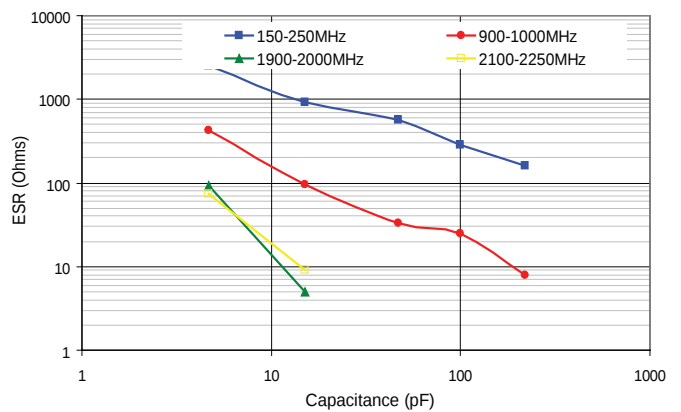
Q Factor: 0603/R14S



Equivalent Series Resistance: 0805/R15S



Q Factor: 0805/R15S



Measurements performed on a Boonton 34A Resonant Coaxial Line and represent typical capacitor performance.

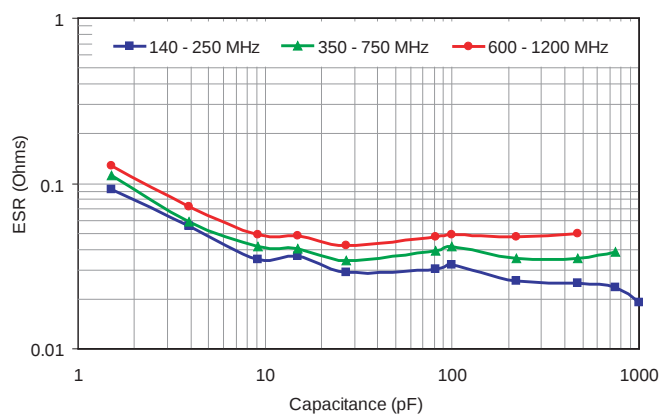


S42E SERIES RF CHARACTERISTICS VERSUS FREQUENCY

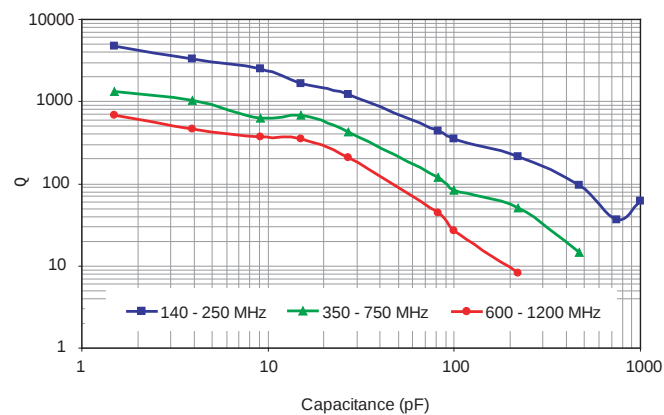


S42E SERIES RF CHARACTERISTICS VERSUS CAPACITANCE

S42E Equivalent Series Resistance vs Capacitance, Typical



S42E Q vs. Capacitance, Typical



S42E SRF (Series Mount), Typical

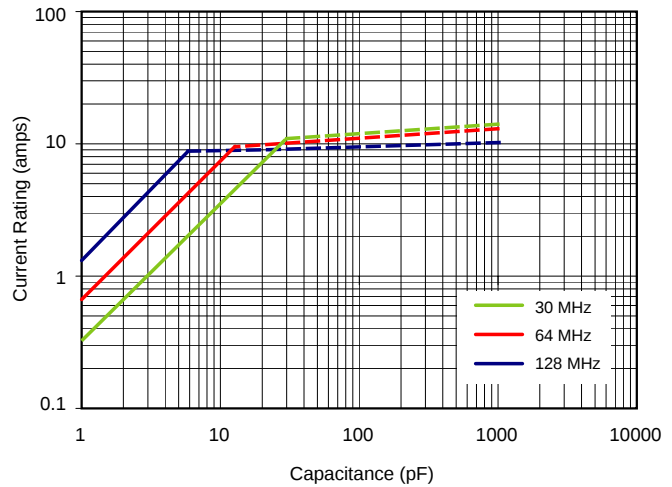


SRF (Shunt Mount), S48E, Typical (Preliminary)



As measured on a 8720C VNA, using a Shunt-Through fixture, and using the S11 magnitude dip to determine the SRF

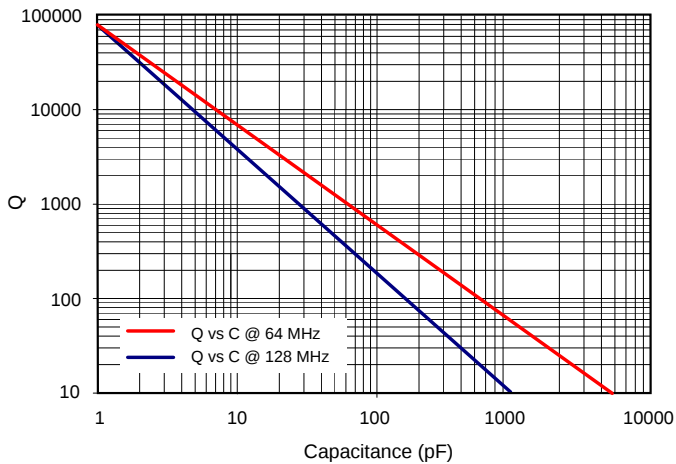
Current Rating vs. Capacitance, S48E, Typical (Preliminary)



Solid traces show voltage limited current (Vrms)

Dotted traces show power dissipation limited current (Based on 4 Watts Power Dissipation, and 125 degrees C case temp.)

S48E Q vs. Capacitance, Typical (Preliminary)



As measured on a 4287A LCR meter, using a 16092A fixture

S48E ESR vs. Capacitance, Typical (Preliminary)



As measured on a 4287A LCR meter, using a 16092A fixture

JTI S48E GRAPHICAL DATA



*Actual data from Boonton 34A resonant line.

JTI S58E GRAPHICAL DATA



*Actual data from Boonton 34A resonant line.



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