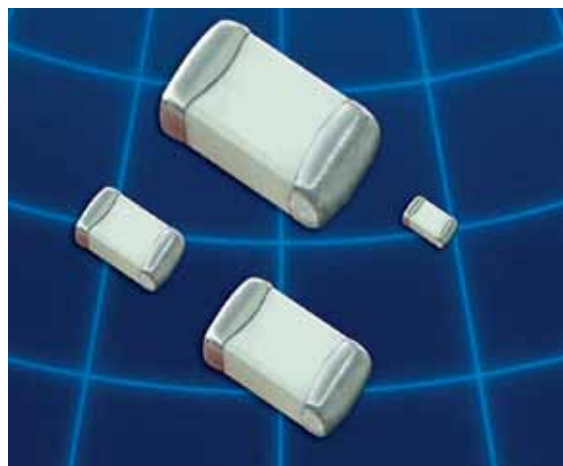


MULTI-LAYER HIGH-Q CAPACITORS



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

- The **S-Series** (R03S, 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.
- The **W-Series** (R05W) capacitors offer a large capacitance value in an ultra-small 0201 package size. These exhibit a X7R temperature characteristic.
- RoHS compliance is standard for all unleaded parts (see termination options box).

HOW TO ORDER

252 VOLTAGE (DC) 6R3 = 6.3 V 101 = 100 V 160 = 16 V 250 = 25 V 500 = 50 V 201 = 200 V 251 = 250 V 301 = 300 V 501 = 500 V 102 = 1000 V 152 = 1500 V 202 = 2000 V 252 = 2500 V 362 = 3600 V 502 = 5000 V 722 = 7200 V	S48 CASE SIZE R03 (01005) 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 = High Temp (175C) Ultra High Q NPO W = X7R	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.	V TERMINATION Nickel Barrier V = Ni/Sn (Green) T = Ni/SnPb G = Ni/Au (Green) Non-Mag* U = Cu/Sn (Green) C = Cu/SnPb Leaded (All Non-Mag)* 1 = Microstrip 2 = Axial Ribbon 3 = Axial Wire 4 = Radial Ribbon 5 = Radial Wire	4 PACKAGING S = Bulk W = Waffle Pack 01005 - 0603 Y = Paper 5" Reel T = Paper 7" Reel *R = Paper 13" Reel *J = Paper 5" Reel - Horizontally Oriented Electrodes *N = Paper 5" Reel - Vertically Oriented Electrodes *L = Paper 7" Reel - Horizontally Oriented Electrodes *V = Paper 7" Reel - Vertically Oriented Electrodes 0805 - 3838 Z = Embossed 5" Reel E = Embossed 7" Reel *U = Embossed 13" Reel *M = Embossed 5" Reel - Horizontally Oriented Electrodes *Q = Embossed 5" Reel - Vertically Oriented Electrodes *G = Embossed 7" Reel - Horizontally Oriented Electrodes *P = Embossed 7" Reel - Vertically Oriented Electrodes Tape specifications conform to EIA RS481
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Part Number written: **252S48E470KV4E**

MARKING
 3 = Cap Code & Tolerance
 4 = No Marking
 6 = EIA Code
 (Marking on 0805 and larger only)

"**" - Not available for all MLCC - Call factory for info.



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Low ESR / High-Q CAPACITOR SELECTION CHART

EIA Size Cap. Value		Miniature Size - Portable Electronics				RF Power Applications						
		01005 (R03S)		0201 (R05) NPO (R05L) X7R* (R05W)		0402 (R07S)	0603 (R14S)	0805 (R15S)	1111 (S42E)	2525 (S48E)	3838 (S58E)	
		Capacitance pF	Code	Voltage								
0.1	0R1											
0.2	0R2			16 V	25 V		50/200 V	250 V		500V	1000V	
0.3	0R3			16 V	25 V		50/200 V	250 V	250 V	500V	1000V	
0.4	0R4			16 V	25 V		50/200 V	250 V	250 V	500V	1000V	
0.5	0R5			16 V	25 V		50/200 V	250 V	250 V	500V	1000V	2500V
0.6	0R6			16 V	25 V		50/200 V	250 V	250 V	500V	1000V	2500V
0.7	0R7			16 V	25 V		50/200 V	250 V	250 V	500V	1000V	2500V
0.8	0R8			16 V	25 V		50/200 V	250 V	250 V	500V	1000V	2500V
0.9	0R9			16 V	25 V		50/200 V	250 V	250 V	500V	1000V	2500V
1.0	1R0			16 V	25 V		50/200 V	250 V	250 V	500V	1000V	2500V
1.1	1R1			16 V	25 V		50/200 V	250 V	250 V	500V	1000V	2500V
1.2	1R2			16 V	25 V		50/200 V	250 V	250 V	500V	1000V	2500V
1.3	1R3			16 V	25 V		50/200 V	250 V	250 V	500V	1000V	2500V
1.4	1R4			16 V	25 V		50/200 V	250 V	250 V	500V	1000V	2500V
1.5	1R5			16 V	25 V		50/200 V	250 V	250 V	500V	1000V	2500V
1.6	1R6			16 V	25 V		50/200 V	250 V	250 V	500V	1000V	2500V
1.7	1R7			16 V	25 V		50/200 V	250 V	250 V	500V	1000V	2500V
1.8	1R8			16 V	25 V		50/200 V	250 V	250 V	500V	1000V	2500V
1.9	1R9			16 V	25 V		50/200 V	250 V	250 V	500V	1000V	2500V
2.0	2R0			16 V	25 V		50/200 V	250 V	250 V	500V	1000V	2500V
2.1	2R1			16 V	25 V		50/200 V	250 V	250 V	500V	1000V	2500V
2.2	2R2			16 V	25 V		50/200 V	250 V	250 V	500V	1000V	2500V
2.4	2R4			16 V	25 V		50/200 V	250 V	250 V	500V	1000V	2500V
2.7	2R7			16 V	25 V		50 V	250 V	250 V	500V	1000V	2500V
3.0	3R0			16 V	25 V		50 V	250 V	250 V	500V	1000V	2500V
3.3	3R3			16 V	25 V		50 V	250 V	250 V	500V	1000V	2500V
3.6	3R6			16 V	25 V		50 V	250 V	250 V	500V	1000V	2500V
3.9	3R9			16 V	25 V		50 V	250 V	250 V	500V	1000V	2500V
4.3	4R3			16 V	25 V		50 V	250 V	250 V	500V	1000V	2500V
4.7	4R7			16 V	25 V		50 V	250 V	250 V	500V	1000V	2500V
5.1	5R1			16 V	25 V		50 V	250 V	250 V	500V	1000V	2500V
5.6	5R6			16 V	25 V		50 V	250 V	250 V	500V	1000V	2500V
6.2	6R2			16 V	25 V		50 V	250 V	250 V	500V	1000V	2500V
6.8	6R8			16 V	25 V		50 V	250 V	250 V	500V	1000V	2500V
7.5	7R5			16 V	25 V		50 V	250 V	250 V	500V	1000V	2500V
8.2	8R2			16 V	25 V		50 V	250 V	250 V	500V	1000V	2500V
9.1	9R1			16 V	25 V		50 V	250 V	250 V	500V	1000V	2500V
10	100			16 V	25 V		50 V	250 V	250 V	500V	1000V	2500V
11	110			16 V	25 V		50 V	250 V	250 V	500V	1000V	2500V
12	120			16 V	25 V		50 V	250 V	250 V	500V	1000V	2500V
13	130			16 V	25 V		50 V	250 V	250 V	500V	1000V	2500V
15	150			16 V	25 V		50 V	250 V	250 V	500V	1000V	2500V
16	160			16 V	25 V		50 V	250 V	250 V	500V	1000V	2500V
18	180				25 V		50 V	250 V	250 V	500V	1000V	2500V
20	200				25 V		50 V	250 V	250 V	500V	1000V	2500V
22	220				25 V		50 V	250 V	250 V	500V	1000V	2500V
24	240				25 V		50 V	250 V	250 V	500V	1000V	2500V
27	270				25 V		50 V	250 V	250 V	500V	1000V	2500V
30	300				25 V		50 V	250 V	250 V	500V	1000V	2500V
33	330				25 V		50 V	250 V	250 V	500V	1000V	2500V

* The R05W parts, which are X7R, can only be provided with "K" or "M" tolerance.

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			Miniature Size - Portable Electronics				RF Power Applications							
			01005 (R03S)	0201 (R05)		0402 (R07S)	0603 (R14S)	0805 (R15S)	1111 (S42E)	2525 (S48E)	3838 (S58E)			
				NPO (R05L)	X7R* (R05W)									
Capacitance pF Code		Tolerance	Voltage											
36	360	F G J K		25 V			250 V	250 V	500V	1000V	2500V	3600V	7200V	
39	390			25 V			250 V	250 V	500V	1000V	2500V	3600V	7200V	
43	430			25 V			250 V	250 V	500V	1000V	2500V	3600V	7200V	
47	470			25 V			250 V	250 V	500V	1000V	2500V	3600V	7200V	
51	510			25 V			250 V	250 V	500V	1000V	2500V	3600V	7200V	
56	560			25 V			250 V	250 V	500V	1000V	2500V	3600V	7200V	
62	620			25 V			250 V	250 V	500V	1000V	2500V	3600V	7200V	
68	680			25 V			250 V	250 V	500V	1000V	2500V	3600V	7200V	
75	750			25 V			250 V	250 V	500V	1000V	2500V	3600V	7200V	
82	820			25 V			250 V	250 V	500V	1000V	2500V	3600V	7200V	
91	910			25 V			250 V	250 V	500V	1000V	2500V	3600V	7200V	
100	101			25 V			250 V	250 V	500V	1000V	2500V	3600V	7200V	
110	111					16 V			250 V	300V	500V	2500V	3600V	7200V
120	121								250 V	300V	500V	2500V	3600V	7200V
130	131								250 V	300V	500V	2500V	3600V	7200V
150	151								250 V	300V	500V	2500V	3600V	7200V
160	161								250 V	300V	500V	2500V	3600V	7200V
180	181								250 V	300V	500V	2500V	3600V	7200V
200	201								250 V	300V	500V	2500V	3600V	
220	221					16 V			250 V	200V	500V	2500V	3600V	
240	241									200V	500V	2500V	3600V	
270	271									200V	500V	2500V	3600V	
300	301									200V	500V	1500V	2500V	
330	331									200V	500V	1500V	2500V	
360	361								200V	500V	1500V	2500V		
390	391								200V	500V	1500V	2500V		
430	431	G J K							200V	500V	1500V	2500V		
470	471				16 V				200V	500V	1500V	2500V		
510	511								100V	500V	1000V	2500V		
560	561								100V	500V	1000V	2500V		
620	621								100V	500V	1000V	2500V		
680	681				16 V				50V		1000V	2500V		
750	751								50V		1000V	2500V		
820	821				16 V				50V		1000V	2500V		
910	911								50V		1000V	1000V		
1000	102				10 V				50V		1000V	1000V		
1200	122										1000V	1000V		
1500	152										500V	1000V		
1800	182										500V	1000V		
2200	222				10 V						300V	1000V		
2700	272										300V	500V		
3300	332											500V		
3900	392											500V		
4700	472				10 V							500V		
5100	512										500V			
10000	103			6.3 V										

* The R05W parts, which are X7R, can only be provided with "K" and "M" tolerance.
Consult factory for Non-Standard values.



DIELECTRIC CHARACTERISTICS

NPO

X7R

TEMPERATURE COEFFICIENT:	0 ± 30ppm /°C, -55 to 125°C	± 15%, -55 to 125°C
QUALITY FACTOR / DF:	Q >1,000 @ 1 MHz, Typical 10,000	16VDC DF ≤ 3.5% @ 1 KHz, 25°C 10VDC DF ≤ 5.0% @ 1 KHz, 25°C
INSULATION RESISTANCE:	>10 GΩ @ 25°C, WVDC; 125°C IR is 10% of 25°C rating	>500 ΩF* or 10 GΩ* @ 25°C, WVDC; 125°C IR is 10% of 25°C rating * whichever is less
DIELECTRIC STRENGTH:	2.5 X WVDC Min., 25°C, 50 mA max	2.5 X WVDC Min., 25°C, 50 mA max
TEST PARAMETERS:	1MHz ±50kHz, 1.0±0.2 VRMS, 25°C	1KHz ±50Hz, 1.0±0.2 VRMS, 25°C
AVAILABLE CAPACITANCE:	Size 01005: 0.2 - 10 pF 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	100 - 10,000 pF

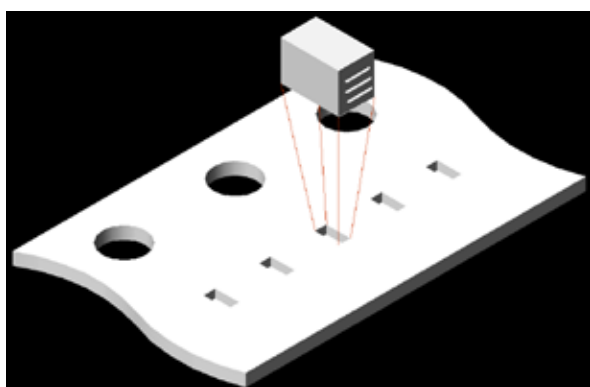
MECHANICAL & ENVIRONMENTAL CHARACTERISTICS

	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 Breakdown voltage: 2.5 x WVDC	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* exerted on axial leads soldered to each terminal. *0402 ≥ 2.0lbs, 0603 ≥ 2.0lbs (min.)
PCB DEFLECTION:	No mechanical damage. Capacitance change: 2% or 0.5pF Max	Glass epoxy PCB: 0.5 mm deflection
LIFE TEST:	No mechanical damage Capacitance change: ±3.0% or 0.3 pF Q>500 I.R. >1 G Ohms Breakdown voltage: 2.5 x WVDC	Applied voltage: 200% rated voltage, 50 mA max. 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 Breakdown voltage: 2.5 x WVDC	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 Breakdown voltage: 2.5 x WVDC	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. Breakdown voltage: 2.5 x WVDC	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 Breakdown voltage: 2.5 x WVDC	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

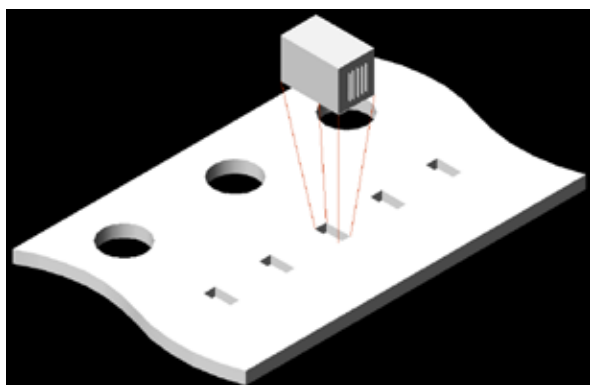


MECHANICAL CHARACTERISTICS

Size	Units	Length	Width	Thickness	End Band
01005	In	.016 ±.001	.008 ±.001	.008 ±.001	.006 Max.
(0402)	mm	(0.40 ±0.03)	(0.20 ±0.03)	(0.20 ±0.03)	(0.15 Max.)
0201	In	.024 ±.001	.012 ±.001	.012 ±.001	.008 Max.
(0603)	mm	(0.60 ±0.03)	(0.30 ±0.03)	(0.30 ±0.03)	(0.20 Max.)
0402	In	.040 ±.004	.020 ±.004	.020 ±.004	.010 ±.006
(1005)	mm	(1.02 ±0.1)	(0.51 ±0.1)	(0.51 ±0.1)	(0.25 ±.15)
0603	In	.062 ±.006	.032 ±.006	.030 +.005/-.003	.014 ±.006
(1608)	mm	(1.57 ±0.15)	(0.81 ±0.15)	(0.76 +.13-.08)	(0.35 ±.15)
0805	In	.080 ±.008	.050 ±.008	.040 ±.006	.020 ±.010
(2012)	mm	(2.03 ±0.20)	(1.27 ±0.20)	(1.02 ±.15)	(0.50 ±.25)



Horizontal Electrode Orientation



Vertical Electrode Orientation

E-SERIES TERMINATIONS AND LEADS

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:

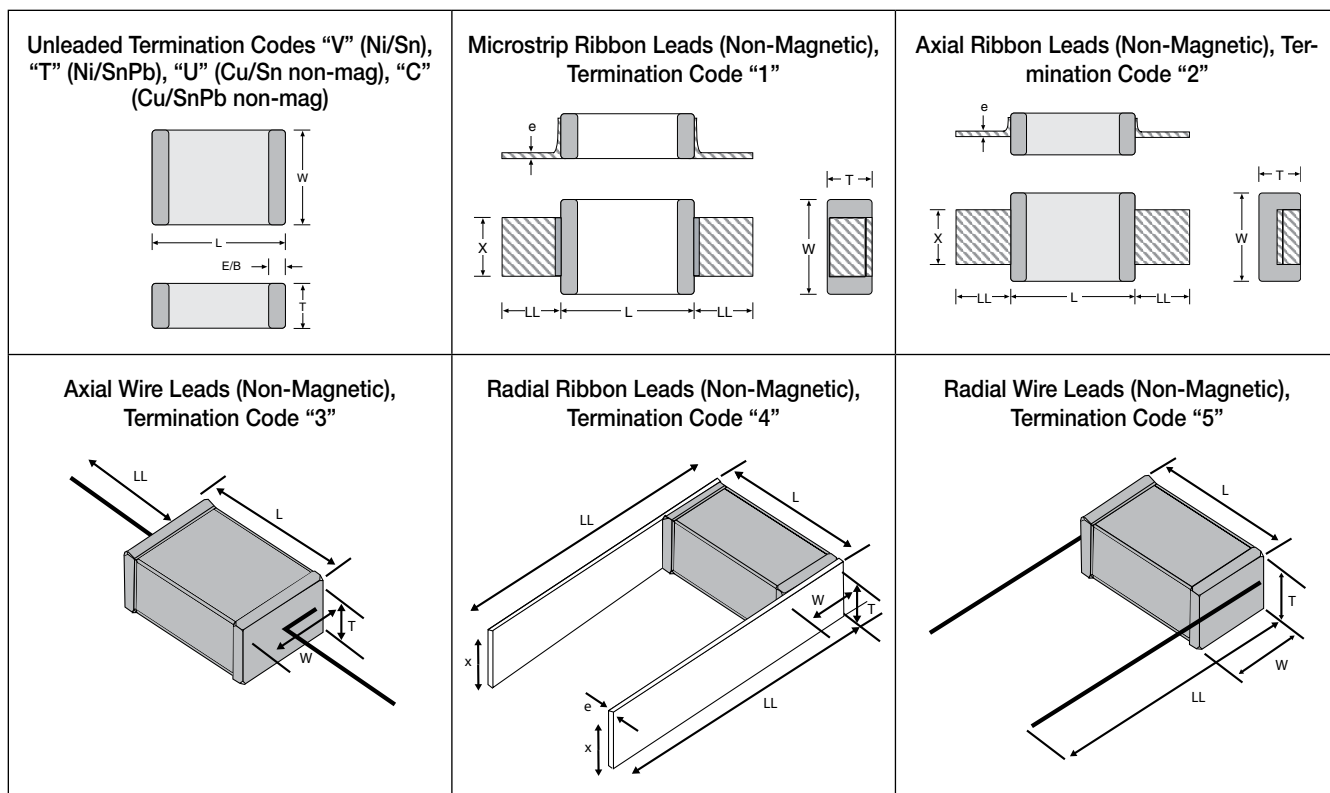
>1000 ΩF or >10 GΩ,
whichever is less
@ 25°C WVDC

TEMPERATURE COEFFICIENT:

0 ± 30ppm /°C, -55 to 125°C

DISSIPATION FACTOR (TYP):

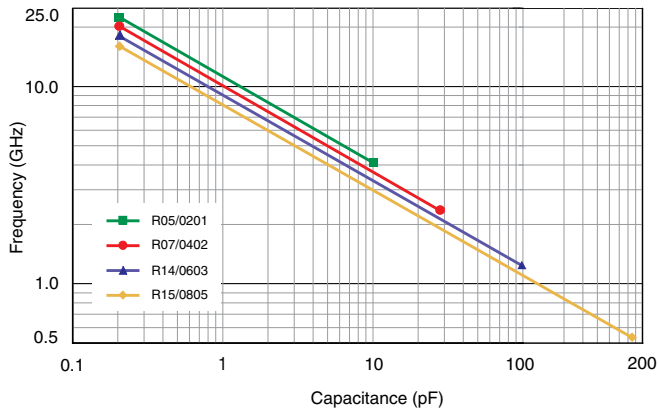
< 0.05% @ 1 MHz



Lead	Size	Units	L	Tol	W	Tol	T (max)	E/B (typ)	LL(min)	X	Tol	e	Tol
1	S42E	In	0.135	+/- .015	0.110	+/- .020	0.120	0.015	0.25	0.093	+/-0.005	0.004	+/- 0.001
		mm	3.43	+/- 0.38	2.79	+/- 0.51	3.05	0.38	6.35	2.36	+/- 0.13	0.102	+/- 0.025
	S48E	In	0.245	+/- 0.025	0.250	+/- 0.015	0.160	0.025	0.50	0.240	+/- 0.005	0.004	+/- 0.001
		mm	6.22	+/- 0.64	6.35	+/- 0.38	3.81	0.63	12.7	6.10	+/- 0.13	0.102	+/- 0.025
	S58E	In	0.38	+0.035 / - 0.010	0.38	+/- 0.010	0.170	0.04 MAX.	0.750	0.35	+/- 0.010	0.010	+/- 0.005
		mm	9.65	+0.89 / -0.25	9.65	+/- 0.25	4.32	1.02 MAX.	19.05	8.89	+/- 0.25	0.25	+/- 0.13
2	S42E	In	0.135	+/- .015	0.110	+/- .020	0.102	0.015	0.25	0.093	+/-0.005	0.004	+/- 0.001
		mm	3.43	+/- 0.38	2.79	+/- 0.51	2.59	0.38	6.35	2.36	+/- 0.13	0.102	+/- 0.025
	S48E	In	0.245	+/- 0.025	0.250	+/- 0.015	0.160	0.025	0.50	0.240	+/- 0.005	0.004	+/- 0.001
		mm	6.22	+/- 0.64	6.35	+/- 0.38	3.81	0.63	12.7	6.10	+/- 0.13	0.102	+/- 0.025
	S58E	In	0.38	+0.035 / - 0.010	0.38	+/- 0.010	0.170	0.04 MAX.	0.750	0.35	+/- 0.010	0.010	+/- 0.005
		mm	9.65	+0.89 / -0.25	9.65	+/- 0.25	4.32	1.02 MAX.	19.05	8.89	+/- 0.25	0.25	+/- 0.13
3	S42E S48E S58E	In	0.145	+/- .020	0.110	+/- .015	0.102		0.50	#26 AWG, .016 (.406) dia. nominal			
		mm	3.68	+/- 0.51	2.79	+/- 0.38	2.59		12.70				
4	S42E S48E S58E	In	0.135	+/- .015	0.110	+/- .015	0.102		0.25	0.093	+/-0.005	0.004	+/- 0.001
		mm	3.43	+/- 0.38	2.79	+/- 0.38	2.59		6.35	2.36	+/- 0.13	0.102	+/- 0.025
5	S42E S48E S58E	In	0.145	+/- .020	0.110	+/- .015	0.102		0.50	#26 AWG, .016 (.406) dia. nominal			
		mm	3.68	+/- 0.51	2.79	+/- 0.38	2.59		12.70				

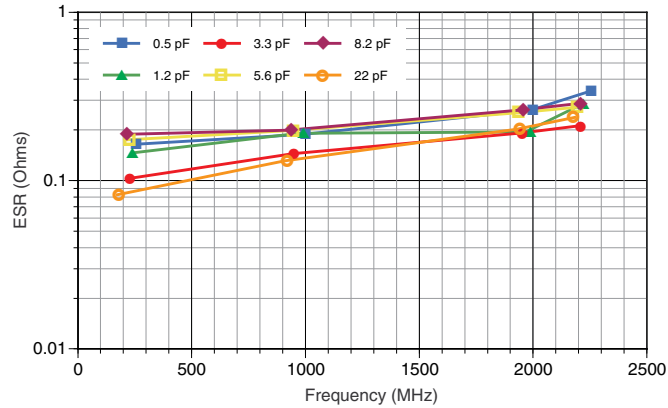
SERIES RESONANCE CHART

Typical Series Resonant Frequency (Series Mounted)

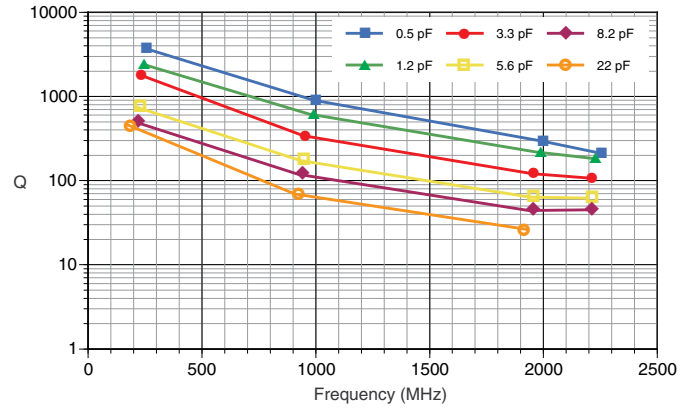


RF CHARACTERISTICS - L-SERIES

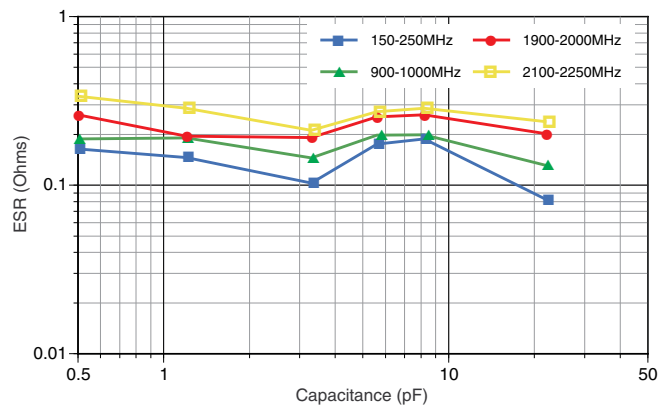
ESR vs Frequency: 0201/R05L



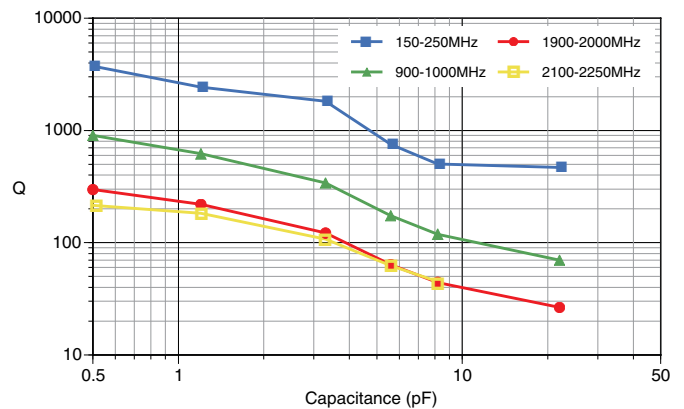
Q vs Frequency: 0201/R05L



ESR vs Capacitance: 0201/R05L

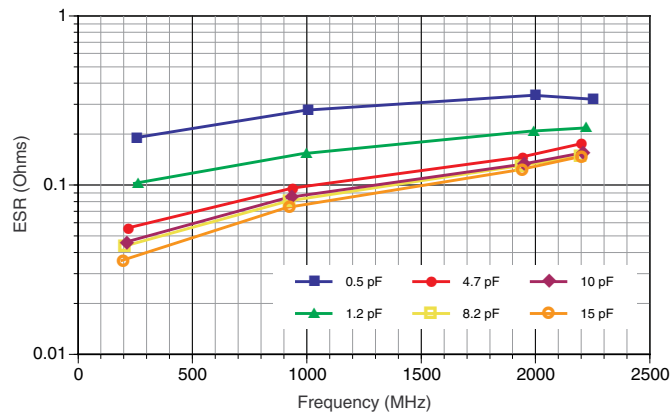


Q vs Capacitance: 0201/R05L

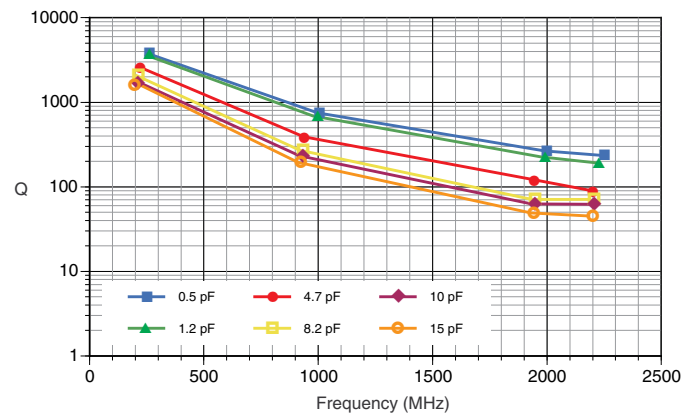


S-SERIES RF CHARACTERISTICS VERSUS FREQUENCY

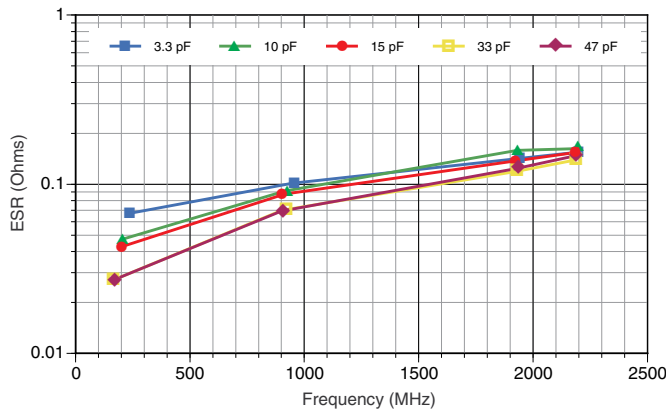
Equivalent Series Resistance: 0402/R07S



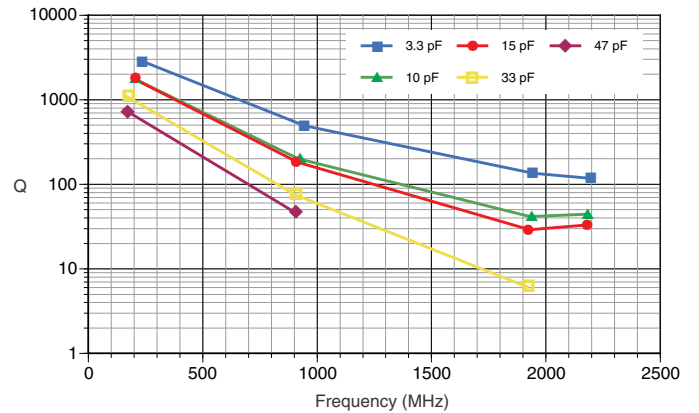
Q Factor: 0402/R07S



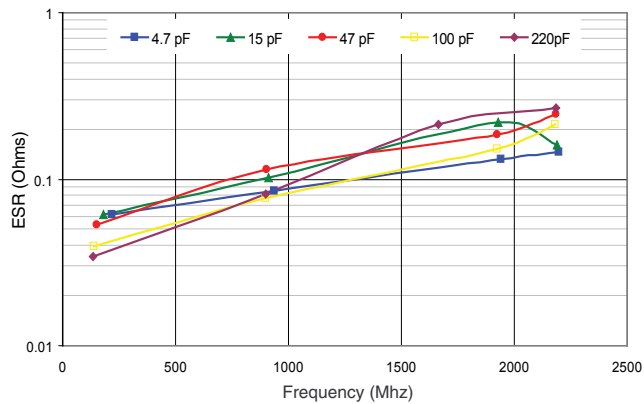
Equivalent Series Resistance: 0603/R14S



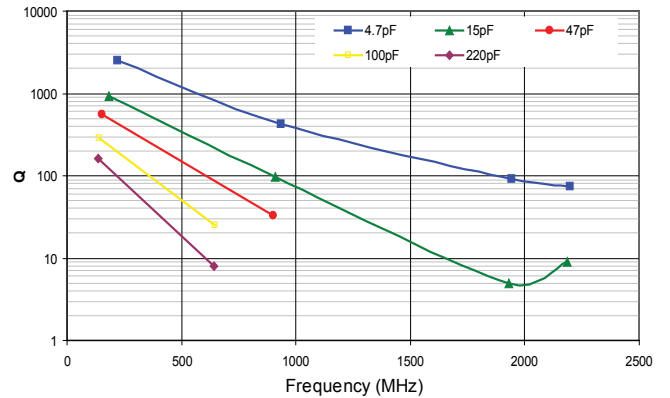
Q Factor: 0603/R14S



Equivalent Series Resistance: 0805/R15S



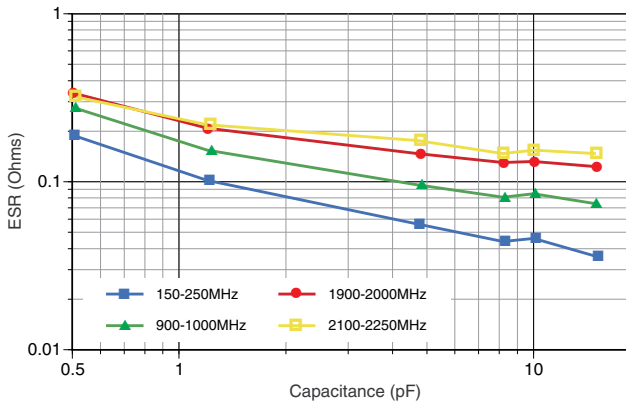
Q Factor: 0805/R15S



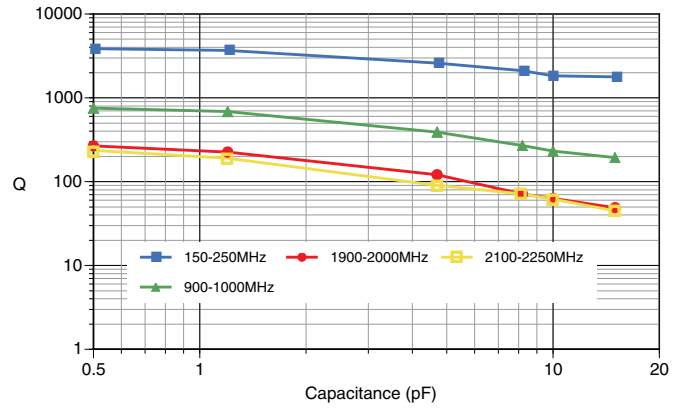
Measurements performed on a Boonton 34A Resonant Coaxial Line and represent typical capacitor performance.

S-SERIES RF CHARACTERISTICS VERSUS CAPACITANCE

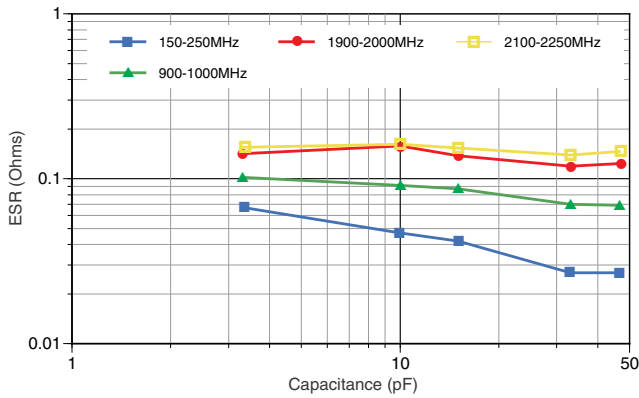
Equivalent Series Resistance: 0402/R07S



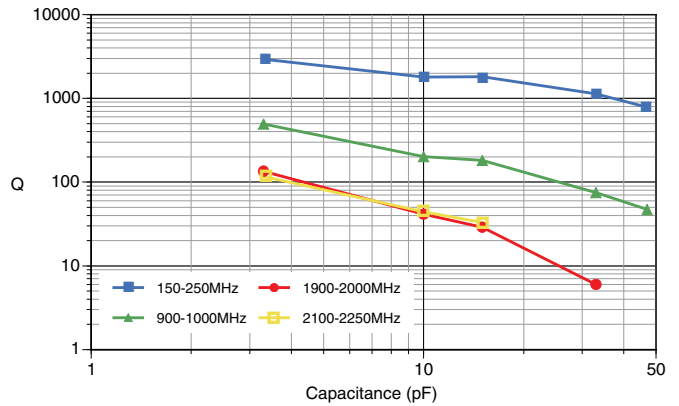
Q Factor: 0402/R07S



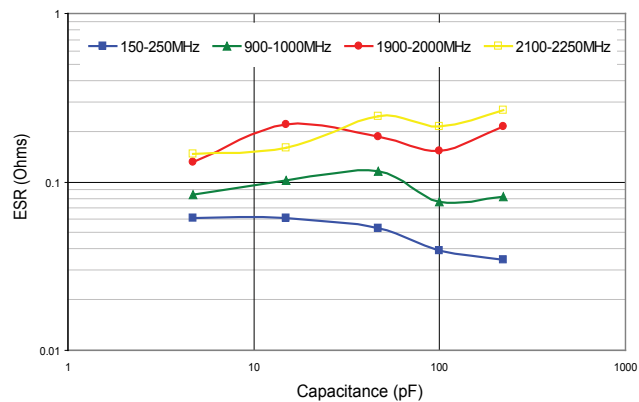
Equivalent Series Resistance: 0603/R14S



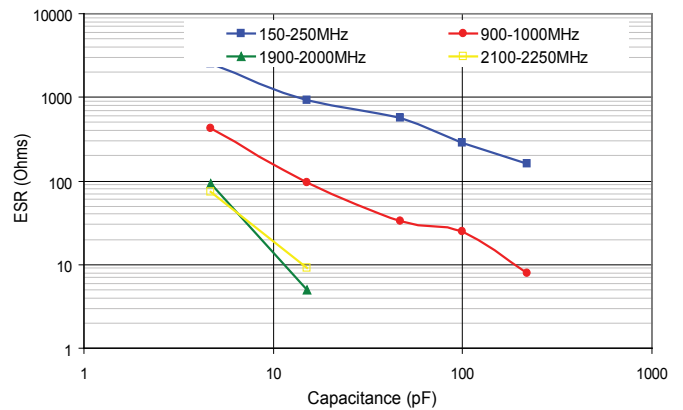
Q Factor: 0603/R14S



Equivalent Series Resistance: 0805/R15S



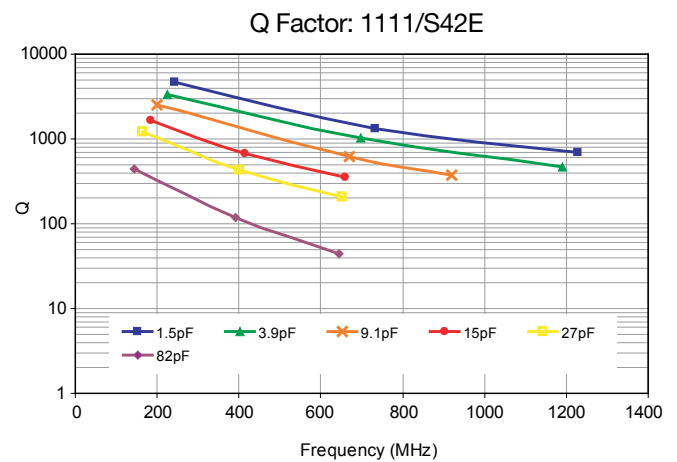
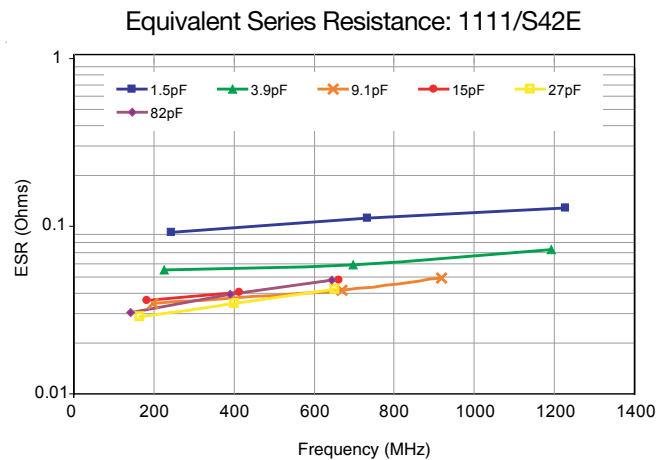
Q Factor: 0805/R15S



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

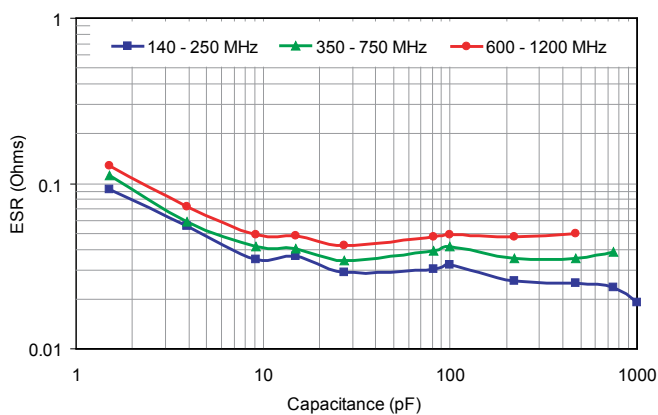


S42E SERIES RF CHARACTERISTICS VERSUS FREQUENCY

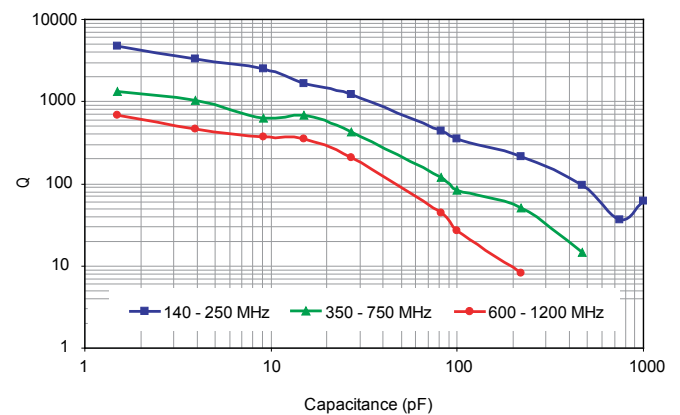


S42E SERIES RF CHARACTERISTICS VERSUS CAPACITANCE

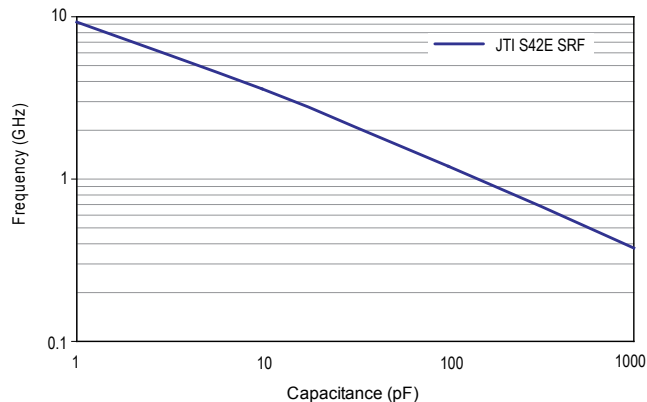
S42E Equivalent Series Resistance vs Capacitance, Typical



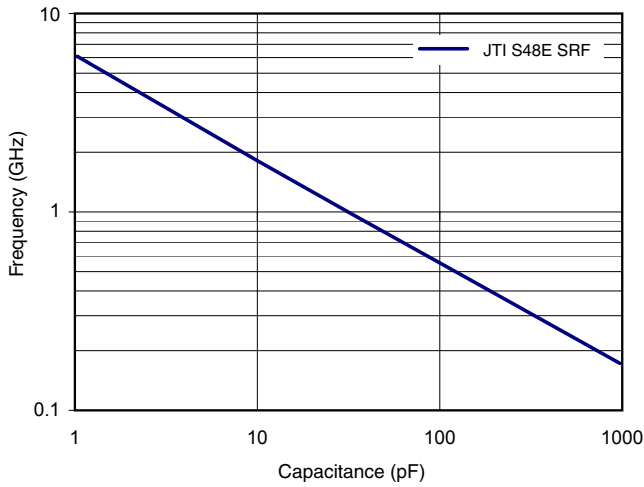
S42E Q vs. Capacitance, Typical



S42E SRF (Series Mount), Typical

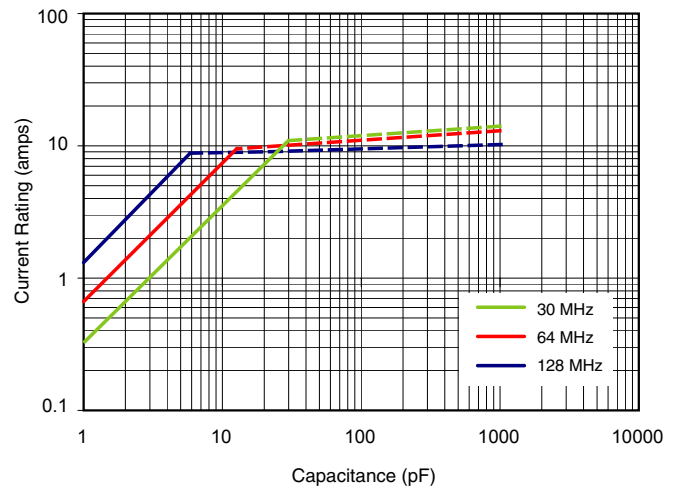


SRF (Shunt Mount), S48E, Typical (Preliminary)



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

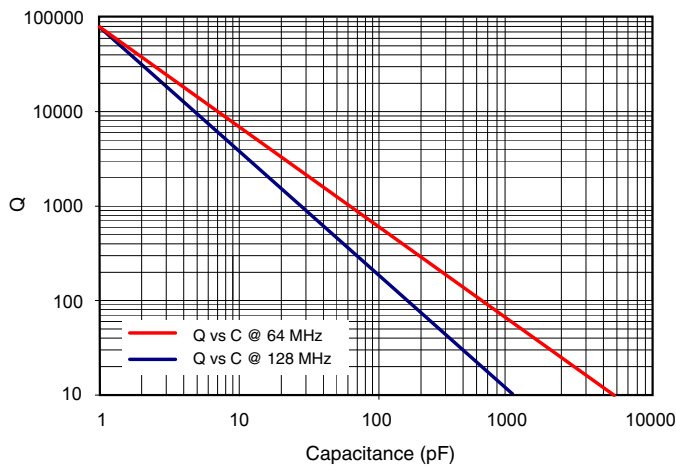
Current Rating vs. Capacitance, S48E, Typical (Preliminary)



Solid traces show voltage limited current (Vrms)

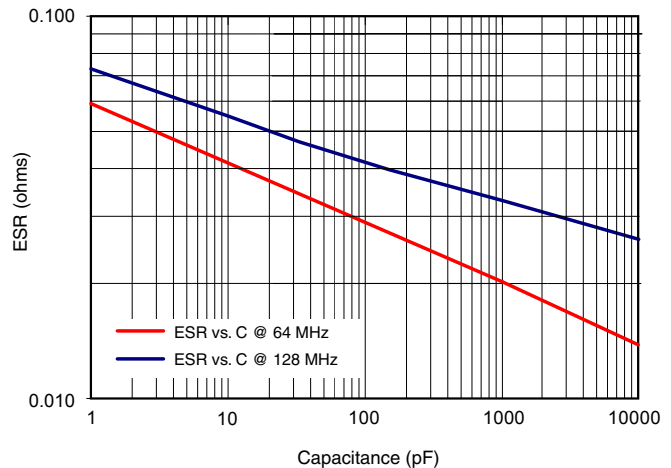
Dotted traces show power dissipation limited current (Based on 4 Watts Power Dissipation, and 125 degrees C case temp.)

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