

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).
- Automotive versions (AEC-Q200) of R05L, R07S, R14S, R15S, and S42E series are available on request

HOW TO ORDER

252	S48	E	470	K	V	4	E	-AEC
<p>WVDC² 250 = 25 V 500 = 50V 201 = 200 V 251 = 250 V 501 = 500 V 102 = 1000 V 152 = 1500 V 252 = 2500 V 362 = 3600 V 722 = 7200 V</p>	<p>CASE SIZE R05 (0201) R07 (0402) R14 (0603) R15 (0805) S42 (1111) S48 (2525) S58 (3838)</p>	<p>CAPACITANCE (pF) 1st two digits are significant; third digit denotes number of zeros, R = decimal. 100 = 10 pF 101 = 100 pF</p>	<p>TOLERANCE < 10pF A = ± 0.05 pF B = ± 0.10 pF C = ± 0.25 pF D = ± 0.50 pF</p> <p>≥ 10pF F = ±1 % G = ±2% J = ±5% K = ± 10%</p> <p>For tolerance availability, see chart.</p>	<p>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</p>	<p>PACKAGING S = Bulk W = Waffle Pack 0201 - 0603 Y = Paper 5" Reel T = Paper 7" Reel R¹ = Paper 13" Reel J¹ = Paper 5" Reel - Horizontally Oriented Electrodes N¹ = Paper 5" Reel - Vertically Oriented Electrodes L¹ = Paper 7" Reel - Horizontally Oriented Electrodes V¹ = Paper 7" Reel - Vertically Oriented Electrodes 0805 - 3838 Z = Embossed 5" Reel E = Embossed 7" Reel U¹ = Embossed 13" Reel M¹ = Embossed 5" Reel - Horizontally Oriented Electrodes Q¹ = Embossed 5" Reel - Vertically Oriented Electrodes G¹ = Embossed 7" Reel - Horizontally Oriented Electrodes P¹ = Embossed 7" Reel - Vertically Oriented Electrodes Tape specifications conform to EIA RS481</p>	<p>QUALIFICATION AEC-Q200 qualification ³ (optional)</p>		
<p>Part Number written: 252S48E470KV4E</p>		<p>DIELECTRIC S = Ultra High Q NP0 L = High Q NP0 E = Ultra High Q NP0, High Voltage, High Power G = Fully Oriented, Ultra High-Q NP0</p>	<p>MARKING 3 = Cap Code & Tolerance 4 = No Marking 6 = EIA Code (Marking option is only available on 0805 and larger case sizes)</p>					



¹ - Not available for all MLCC - Call factory for info.

² - WVDC - Working Voltage DC.

³ - Qualification required for automotive application, Not available for all series - Call factory for info.



LOW ESR / HIGH-Q CAPACITOR SELECTION CHART

EIA Size Cap. Value		RF Power Applications																			
		0201 (R05)		0402	0603	0805	0805	1111	2525	3838											
		NPO (R05L)	NPO (R05G)	(R07S)	(R14S)	(R15S)	(R15L)	(S42E)	(S48E)	(S58E)											
Capacitance pF	Code																				
0.1	0R1	A	25/50 V	25 V	50/250 V	250 V															
0.2	0R2	A	25/50 V	25 V	50/250 V	250 V			500V	1500V											
0.3	0R3	A	25/50 V	25 V	50/250 V	250 V	250V		500V	1500V											
0.4	0R4	A	25/50 V	25 V	50/250 V	250 V	250V		500V	1500V											
0.5	0R5	A	25/50 V	25 V	50/250 V	250 V	250V		500V	1500V	3600V										
0.6	0R6	A	25/50 V	25 V	50/250 V	250 V	250V		500V	1500V	3600V	3600V	7200V								
0.7	0R7	A	25/50 V	25 V	50/250 V	250 V	250V		500V	1500V	3600V	3600V	7200V								
0.8	0R8	A	25/50 V	25 V	50/250 V	250 V	250V		500V	1500V	3600V	3600V	7200V								
0.9	0R9	A	25/50 V	25 V	50/250 V	250 V	250V		500V	1500V	3600V	3600V	7200V								
1.0	1R0	A	25/50 V	25 V	50/250 V	250 V	250V		500V	1500V	3600V	3600V	7200V								
1.1	1R1	A	25/50 V	25 V	50/250 V	250 V	250V		500V	1500V	3600V	3600V	7200V								
1.2	1R2	A	25/50 V	25 V	50/250 V	250 V	250V		500V	1500V	3600V	3600V	7200V								
1.3	1R3	A	25/50 V	25 V	50/250 V	250 V	250V		500V	1500V	3600V	3600V	7200V								
1.4	1R4	B	25/50 V	25 V	50/250 V	250 V	250V		500V	1500V	3600V	3600V	7200V								
1.5	1R5	B	25/50 V	25 V	50/250 V	250 V	250V		500V	1500V	3600V	3600V	7200V								
1.6	1R6	C	25/50 V	25 V	50/250 V	250 V	250V		500V	1500V	3600V	3600V	7200V								
1.7	1R7	C	25/50 V	25 V	50/250 V	250 V	250V		500V	1500V	3600V	3600V	7200V								
1.8	1R8	D	25/50 V	25 V	50/250 V	250 V	250V		500V	1500V	3600V	3600V	7200V								
1.9	1R9	D	25/50 V	25 V	50/250 V	250 V	250V		500V	1500V	3600V	3600V	7200V								
2.0	2R0		25/50 V	25 V	50/250 V	250 V	250V		500V	1500V	3600V	3600V	7200V								
2.1	2R1		25/50 V	25 V	50/250 V	250 V	250V		500V	1500V	3600V	3600V	7200V								
2.2	2R2		25/50 V	25 V	50/250 V	250 V	250V		500V	1500V	3600V	3600V	7200V								
2.4	2R4		25/50 V	25 V	50/250 V	250 V	250V		500V	1500V	3600V	3600V	7200V								
2.7	2R7		25/50 V	25 V	50/250 V	250 V	250V		500V	1500V	3600V	3600V	7200V								
3.0	3R0		25/50 V	25 V	50/250 V	250 V	250V		500V	1500V	3600V	3600V	7200V								
3.3	3R3		25/50 V	25 V	50/250 V	250 V	250V		500V	1500V	3600V	3600V	7200V								
3.6	3R6		25/50 V	25 V	50/200 V	250 V	250V		500V	1500V	3600V	3600V	7200V								
3.9	3R9		25/50 V	25 V	50/200 V	250 V	250V		500V	1500V	3600V	3600V	7200V								
4.3	4R3		25/50 V	25 V	50/200 V	250 V	250V		500V	1500V	3600V	3600V	7200V								
4.7	4R7		25/50 V	25 V	50/200 V	250 V	250V		500V	1500V	3600V	3600V	7200V								
5.1	5R1	A**	25/50 V	25 V	50/200 V	250 V	250V		500V	1500V	3600V	3600V	7200V								
5.6	5R6	A**	25/50 V	25 V	50/200 V	250 V	250V		500V	1500V	3600V	3600V	7200V								
6.2	6R2	B	25/50 V	25 V	50/200 V	250 V	250V		500V	1500V	3600V	3600V	7200V								
6.8	6R8	B	25/50 V	25 V	50/200 V	250 V	250V		500V	1500V	3600V	3600V	7200V								
7.5	7R5	C	25/50 V	25 V	50/200 V	250 V	250V		500V	1500V	3600V	3600V	7200V								
8.2	8R2	C	25/50 V	25 V	50/200 V	250 V	250V		500V	1500V	3600V	3600V	7200V								
9.1	9R1	D	25/50 V	25 V	50/200 V	250 V	250V		500V	1500V	3600V	3600V	7200V								
10	100		25/50 V	25 V	50/200 V	250 V	250V		500V	1500V	3600V	3600V	7200V								
11	110		25/50 V	25 V	50/200 V	250 V	250V		500V	1500V	3600V	3600V	7200V								
12	120		25/50 V	25 V	50/200 V	250 V	250V		500V	1500V	3600V	3600V	7200V								
13	130	F	25/50 V	25 V	50/200 V	250 V	250V		500V	1500V	3600V	3600V	7200V								
15	150	F	25/50 V	25 V	50/200 V	250 V	250V		500V	1500V	3600V	3600V	7200V								
16	160	G	25/50 V	25 V	50/200 V	250 V	250V		500V	1500V	3600V	3600V	7200V								
18	180	G	25/50 V	25 V	50/200 V	250 V	250V		500V	1500V	3600V	3600V	7200V								
20	200	J	25/50 V		50/200 V	250 V	250V		500V	1500V	3600V	3600V	7200V								
22	220	J	25/50 V		50/200 V	250 V	250V		500V	1500V	3600V	3600V	7200V								
24	240	K	25/50 V		50/200 V	250 V	250V		500V	1500V	3600V	3600V	7200V								
27	270	K	25/50 V		50/200 V	250 V	250V		500V	1500V	3600V	3600V	7200V								
30	300		25/50 V		50/200 V	250 V	250V		500V	1500V	3600V	3600V	7200V								
33	330		25/50 V		50/200 V	250 V	250V		500V	1500V	3600V	3600V	7200V								

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	0603	0805	0805	1111	2525	3838		
			NPO (R05L)	NPO (R05G)	(R07S)	(R14S)	(R15S)	(R15L)	(S42E)	(S48E)	(S58E)		
Capacitance pF	Code	Tolerance											
36	360	F	25/50 V			250 V	250 V		500V	1500V	3600V	3600V	7200V
39	390		25/50 V			250 V	250 V		500V	1500V	3600V	3600V	7200V
43	430		25/50 V			250 V	250 V		500V	1500V	3600V	3600V	7200V
47	470		25/50 V			250 V	250 V		500V	1500V	3600V	3600V	7200V
51	510		25/50 V			250 V	250 V		500V	1500V	3600V	3600V	7200V
56	560		25/50 V			250 V	250 V		500V	1500V	3600V	3600V	7200V
62	620		25/50 V			250 V	250 V		500V	1500V	3600V	3600V	7200V
68	680		25/50 V			250 V	250 V		500V	1500V	3600V	3600V	7200V
75	750		25/50 V			250 V	250 V		500V	1500V	3600V	3600V	7200V
82	820		25/50 V			250 V	250 V		500V	1500V	3600V	3600V	7200V
91	910		25/50 V			250 V	250 V		500V	1500V	3600V	3600V	7200V
100	101		25/50 V			250 V	250 V		500V	1500V	3600V	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							500V	200V	600V	2500V	3600V	
270	271							500V	200V	600V	2500V	3600V	
300	301							500V	200V	600V	1500V	3600V	
330	331							500V	200V	600V	1500V	3600V	
360	361							500V	200V	600V	1500V	3600V	
390	391							500V	200V	500V	1500V	3600V	
430	431							500V	200V	500V	1500V	2500V	
470	471							500V	200V	500V	1500V	2500V	
510	511							100V	200V	500V	1000V	2500V	
560	561							100V	200V	500V	1000V	2500V	
620	621							100V	200V	500V	1000V	2500V	
680	681							50V	200V		1000V	2500V	
750	751							50V	200V		1000V	2500V	
820	821	G						50V	200V		1000V	2500V	
910	911								50V	200V		1000V	1000V
1000	102								50V	200V		1000V	1000V
1200	122								50V			1000V	1000V
1500	152								50V			500V	1000V
1800	182								50V			500V	1000V
2200	222								50V			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 150°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	
TEST PARAMETERS:	1MHz ± 50kHz, 1.0 ± 0.2VRMS for capacitance values ≤ 1,000pF 1kHz ± 50Hz, 1.0 ± 0.2VRMS for capacitance values > 1,000pF	
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	
AVAILABLE CAPACITANCE:		
Size 0201:	0.2 - 100 pF	Size 1111: 0.2 - 1000 pF
Size 0402:	0.2 - 33 pF	Size 2525: 1.0 - 2700 pF
Size 0603:	0.2 - 100 pF	Size 3838: 1.0 - 5100 pF
Size 0805:	0.3 - 220 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: 5% or 0.5pF whichever is greater.	Glass epoxy PCB: 2 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).

AEC-Q200: Qualification required for automotive application - Not available for all series - Call factory for info.

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/-0.03	.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, 0805, 1111
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

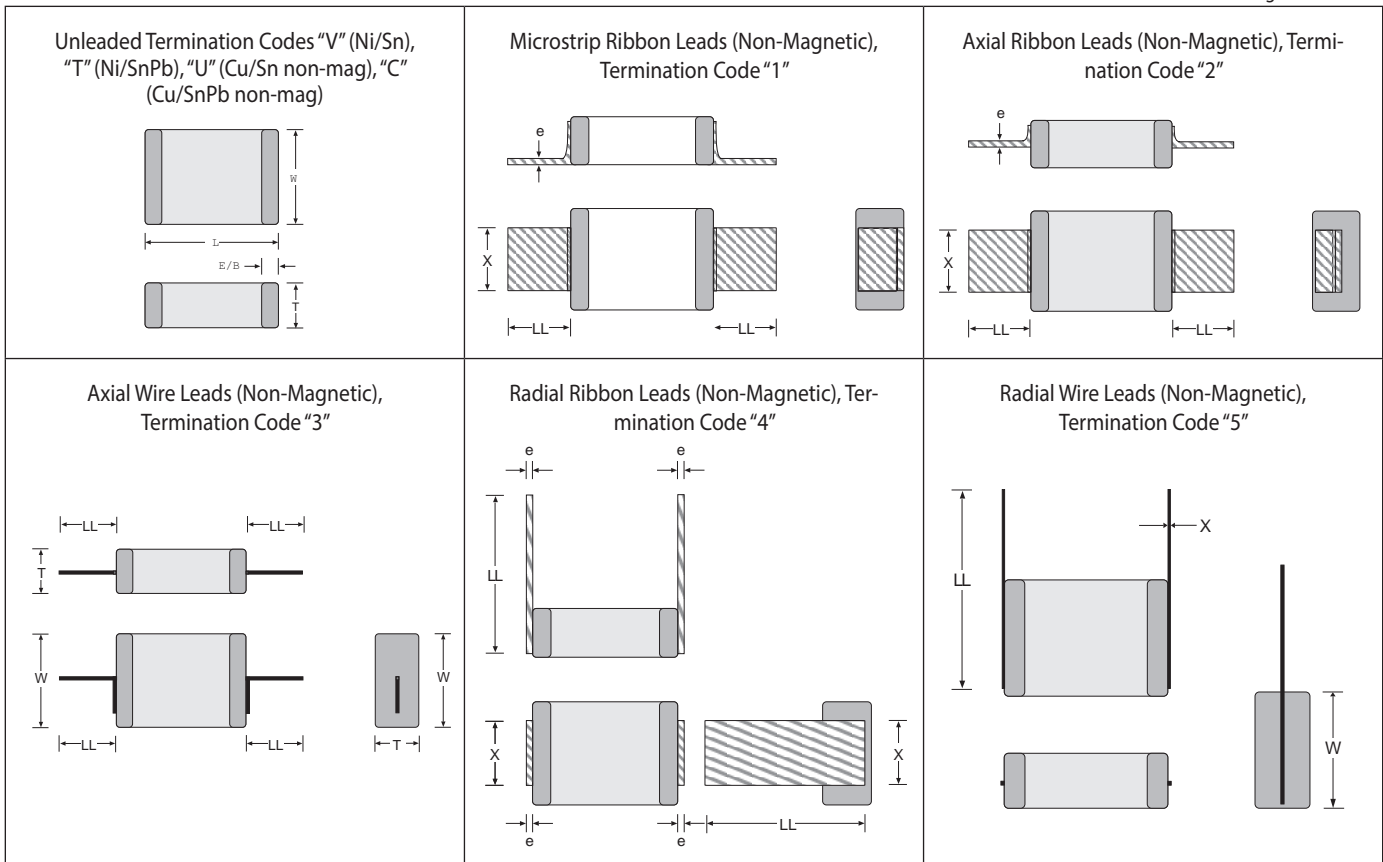
CHIP DIMENSIONS

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 ± 30ppm /°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					

Resonant Frequency : 0201/R05L



The Series Resonant Frequency is highly dependent on the substrate, pad dimensions, and measurement method. The above chart is for reference only.

0201 R05L Q factor



0201 R05L Equivalent Series Resistance (ESR)



0201 R05L Max Current



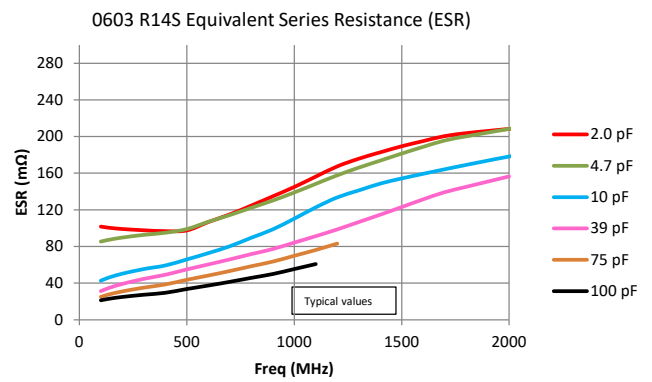
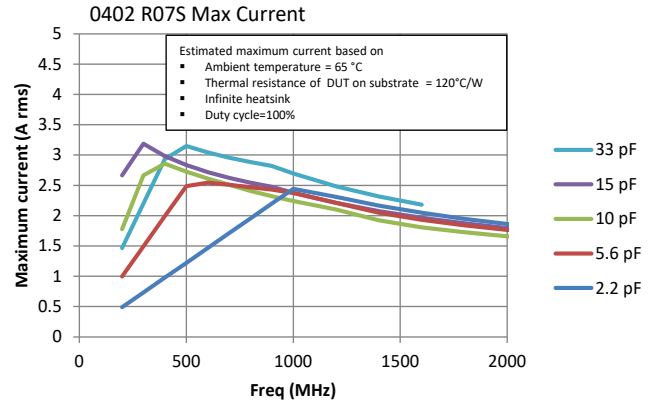
0402 R07S Series Resonant frequency



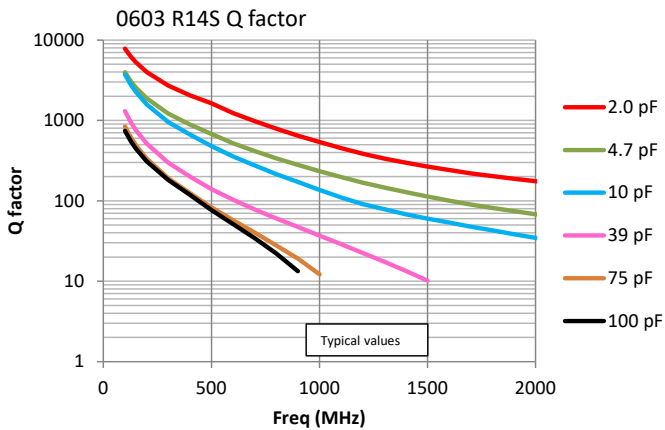
The Series Resonant Frequency is highly dependent on the substrate, pad dimensions, and measurement method. The above chart is for reference only.

0402 R07S Equivalent Series Resistance (ESR)





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