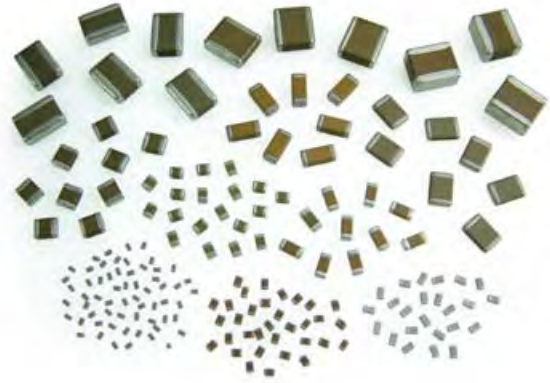


Non Magnetic Chip COG & X7R

This range of MLC chip capacitors that are completely non magnetic. They are designed to operate in non magnetic environments such as Magnetic Resonance Imaging (MRI) and Nuclear Magnetic Resonance (NMR) systems. Copper barrier terminations are available for soldering applications and palladium silver terminations for conductive epoxy. Consult the Sales Office if your specific requirements exceed our catalog maximums (size, cap. value, and voltage).



Capacitance and Voltage Selection

Size	0402		0504		0603		0805		1206		1210		1808		1812		1825		2221		2225	
Min cap.	OR3	121	OR5	121	OR3	121	OR5	121	2R0	121	5R0	121	5R0	151	100	151	150	471	270	471	270	471
Tmax inches: mm:	0.024 0.61		0.044 1.12		0.035 0.89		0.054 1.37		0.064 1.63		0.065 1.65		0.065 1.65		0.065 1.65		0.080 2.03		0.080 2.03		0.080 2.03	
Dielectric	COG	X7R	COG	X7R	COG	X7R	COG	X7R	COG	X7R	COG	X7R	COG	X7R	COG	X7R	COG	X7R	COG	X7R	COG	X7R
16V	470	562	561	393	271	273	122	124	272	334	562	474	562	684	103	125	223	185	183	155	223	225
25V	390	472	471	333	221	223	102	104	272	274	562	474	562	564	103	105	223	155	183	125	223	185
50V	330	472	391	333	181	223	821	104	222	274	472	474	472	394	682	824	223	155	183	125	223	185
100V	330	472	391	333	181	223	821	683	182	184	392	334	332	274	562	564	153	125	123	125	153	155
200V	180	222	221	153	101	103	391	333	102	104	222	184	182	184	392	334	103	824	822	684	123	105
250V	120	152	121	103	680	682	271	273	821	683	152	124	152	124	272	224	822	684	682	564	822	824
300V	•	•	•	•	•	•	181	153	471	473	102	823	102	823	222	154	472	474	472	394	682	474
400V	•	•	•	•	•	•	181	123	391	273	821	563	102	563	222	104	472	334	472	274	682	394
500V	•	•	•	•	•	•	181	103	391	223	821	563	102	563	222	104	472	334	472	274	682	334
600V	•	•	•	•	•	•	151	822	331	183	681	393	821	393	182	683	392	224	392	224	562	274
800V†	•	•	•	•	•	•	151	472	331	103	681	273	821	273	182	473	392	124	392	124	562	154
1kV	•	•	•	•	•	•	820	272	181	682	471	153	471	153	102	273	222	823	222	823	332	104
1.5kV	•	•	•	•	•	•	•	•	101	222	271	472	271	472	561	822	122	273	102	273	152	333
2kV	•	•	•	•	•	•	•	•	680	102	151	222	181	272	391	472	561	123	561	123	821	153
3kV	•	•	•	•	•	•	•	•	•	•	•	•	820	561	181	122	271	472	221	472	331	562
4kV	•	•	•	•	•	•	•	•	•	•	•	•	390	331	101	681	121	152	121	152	181	152
5kV	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	820	821	820	821	121	102

Note: Maximum capacitance values are shown above as 3 digit code: 2 significant figures followed by the no. of zeros e.g. 183 = 18,000pF. R denotes decimal e.g. 2R7 = 2.7pF.

- For characteristics of dielectrics M (COG) and C (X7R) see pages 4 & 6.
- For dimensions see page 12.
- For termination options see pages 3 & 15.
- For capacitance tolerances available see page 15.
- For ordering information see page 15.

Chip Ordering Information



Prefix	Case Size	Dielectric	Capacitance	Capacitance Tolerance	Voltage	Termination	Special Thickness	High Reliability Testing	Packaging	Marking	High Reliability Test Criteria
XX	1206	N	472	J	101	N	X050	H	T	M	HB

Capacitance Code

1st two digits are significant, third digit denotes number of zeros, R = decimal
Examples:

1R0	= 1.0pF
120	= 12pF
471	= 470pF
102	= 1,000pF
273	= 0.027μF
474	= 0.47μF
105	= 1.0μF

Special Thickness

None	Standard thickness as per Novacap catalog specifications
X	Denotes a special thickness other than standard. Specify in inches if required. (As shown above X = 0.050")

Packaging

None	Bulk
T	Tape & Reel
W	Waffle Pack

Marking

None	Unmarked
M	Marked *Marking not available on sizes ≤ 0603

High Reliability Testing

None	Standard product
H	High Reliability Testing
H	High Temp Screening

Hi-Reliability Testing Criteria

HB	MIL-PRF-55681 Group A
HV	MIL-PRF-49467 Group A
HS	MIL-PRF-123 Group A

Dielectric Codes

N	C0G/NP0	Ultra Stable
M	C0G/NP0	Ultra Stable Magnetic Free
F	C0G/NP0	High Temp. (up to 160°C)
D	C0G/NP0	High Temp. (up to 200°C)
K	R3L	Ultra Stable
R	R2D	Pulse Energy
Y	Y5V	General Purpose
Z	Z5U	General Purpose
B	X7R	Stable
C	X7R	Stable Magnetic Free
X	BX	MIL
S	X8R	High Temp. (up to 150°C)
E	Class II	High Temp. (up to 200°C)
G	Class II	High Temp. (up to 160°C)
W	X5R	Stable
RN	Lead free C0G/NP0	Ultra Stable
RB	Lead free X7R	Stable
BB	X7R BME	Stable
BW	X5R BME	Stable

Voltage Code

1st two digits are significant, third digit denotes number of zeros. For example:

160	= 16 Volts
101	= 100 Volts
501	= 500 Volts
102	= 1,000 Volts
502	= 5,000 Volts
103	= 10,000 Volts

Termination Codes

P	Palladium Silver	
PR	Palladium Silver*	
K	Solderable Palladium Silver*	
N	Nickel Barrier*	100% tin
Y	Nickel Barrier	90% tin, 10% lead
NG	Nickel Barrier Gold Flash*	
C	FlexiCap™/Nickel Barrier*	100% tin
D	FlexiCap™/Nickel Barrier	90% tin, 10% lead
B	Copper Barrier*	100% tin
E	Copper Barrier	90% tin, 10% lead
S	Silver*	

* Indicates RoHS terminations

Capacitance Tolerance Codes

Code	Tolerance	Dielectric										Positive VTC		
		C0G/NP0			R3L	R2D	Y5V Z5U	X7R	BX	X8R	Class II		X5R	
	* Not RF series	N	M	F/D	K	R	Y/Z	B	C	X	S	E/G	W	P
B	±0.10pF	•	•											
C	±0.25pF	•	•		•									
D	±0.50pF	•	•		•									
F	±1%	•	•	•										
G	±2%	•	•	•	•									
J	±5%	•	•	•	•	•		•*	•	•*	•	•		
K	±10%	•	•	•	•	•		•	•	•	•	•	•	•
M	±20%	•		•	•	•	•	•	•	•	•	•	•	•
Z	+80% -20%	•				•	•	•*						•
P	+100% -0%	•				•	•	•*						•

Prefix Definitions

None	Standard chip	
RF	Improved ESR Capacitor	p. 23
LS	Y ³ Certified Safety Capacitor	p. 42 - 43
ES	Y ² Certified Safety Capacitor	p. 42 - 43
ST	Stacked Capacitor Assembly	p. 48 - 53
SM	Stacked Hi-Rel Capacitor Assembly	p. 48 - 53
CR	Cap-Rack Capacitor Array	p. 54
RC	Bleed Resistor	p. 58 - 61

Technical Information

Novacap provides application notes throughout this catalog as a guide to chip selection and attachment methods. Refer to the Novacap Technical Brochure found at www.novacap.com for more details. This technical information includes the nature of capacitance, dielectric properties, electrical properties, classes of dielectrics, ferroelectric behavior, test standards, and high reliability test plans. Please do not hesitate to contact the sales office for any product or technical assistance.

Capacitor Size

Size availability is based primarily on capacitance values and voltage rating. Smaller units are generally less expensive. Because mass affects the thermal shock susceptibility of chip capacitors, size selection should consider the soldering method used to attach the chip to the board. Sizes 1812 and smaller can be wave, vapor phase, or reflow soldered. Larger units require reflow soldering.

Chip Selection

Multilayer capacitors (MLC) are categorized by dielectric performance with temperature. The Temperature Coefficient of Capacitance describes the variance of capacitance value with temperature. The choice of components is therefore largely determined by the temperature stability required of the device and the size necessary for the desired capacitance value and voltage rating.

Packaging

Units are available reeled, in waffle pack, or bulk packaged. Bar coded labels are standard for reeled and bulk packaging.

Primary Dielectric Types

COG/NP0:

Ultra stable Class I dielectric, with negligible dependence of capacitance on temperature, voltage, frequency, and time. Used in circuitry requiring very stable performance.

X7R:

Stable Class II dielectric, with predictable change in properties across a temperature range of -55°C to +125°C. Used as blocking, decoupling, bypassing, and frequency discriminating elements. This dielectric is ferroelectric and provides higher capacitance than Class I materials.

BX:

The military specification for ceramic chip capacitors (MIL-PRF-55681) defines a mid-K stable dielectric designated as BX. The BX specification has voltage temperature limits in addition to temperature limits of capacitance. The BX dielectric is limited to ±15% maximum change in capacitance between 25°C and -55°C or +125°C and also has a voltage restriction of +15% / -25% maximum change in capacitance between 25°C and -55°C or +125°C at rated voltage.

Z5U/Y5V:

General purpose Class III dielectrics with higher dielectric constant and greater variation of properties over temperature and voltage. Very high capacitance per volume is attainable for general purpose applications where stability over a wide temperature range is not critical.

Dielectric Termination Combinations

Dielectric	Code	Palladium Silver	Palladium Silver	Solderable Palladium Silver	Nickel Barrier 100% tin	Nickel Barrier 90/10% tin/lead	Nickel Barrier Gold flash	FlexiCap™/Nickel Barrier 100% tin	FlexiCap™/Nickel Barrier 90/10% tin/lead	Copper Barrier 100% tin	Copper Barrier 90/10% tin/lead	Solderable Silver
		RoHS	RoHS	RoHS	RoHS	RoHS	RoHS	RoHS	RoHS	RoHS	RoHS	RoHS
COG/NP0	N/RN	•	•	•	•	•	•	•	•			•
R3L	K	•	•	•	•	•	•	•	•			
X7R	B/RB	•	•	•	•	•	•	•	•			•
X7R BME	BB				•	•	•					
X5R BME	BW				•	•	•					
BX	X	•	•	•	•	•	•	•	•			•
Y5V	Y							•	•			
Z5U	Z							•	•			
COG/NP0 (Mag free)	M	•	•	•						•	•	
X7R (Mag free)	C	•	•	•						•	•	
X8R	S	•	•	•	•	•		•	•			•
COG/NP0 (160°C)	F	•	•	•	•	•		•	•			•
COG/NP0 (200°C)	D			•								•
Class II (160°C)	G	•	•	•	•	•		•	•			•
Class II (200°C)	E			•								•
Pulse Power	P	•	•	•								
R2D	R	•	•	•								

Termination Material

We recommend the following termination types:

Solder Attachment:

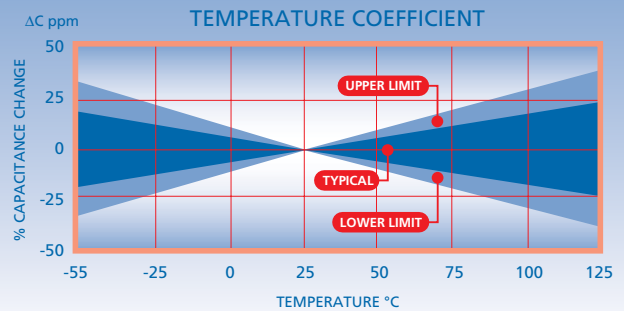
- N** Nickel Barrier, 100% matte tin plated - RoHS
 - C** FlexiCap™ with Nickel Barrier, 100% tin plated - RoHS
 - Y** Nickel Barrier, tin-lead plated
 - D** FlexiCap™ Nickel Barrier, tin-lead plated
 - B** Copper Barrier 100% matte tin plated - RoHS
 - E** Copper Barrier, tin-lead plated
 - K** Solderable Palladium Silver - RoHS (suitable for conductive epoxy attach)
 - S** Solderable Silver - RoHS
- Conductive Epoxy attachment:**
- P** Palladium Silver
 - PR** Palladium Silver - RoHS
 - NG** Nickel Barrier Gold Flash - RoHS (suitable for soldering attach)



Dielectric Characteristics

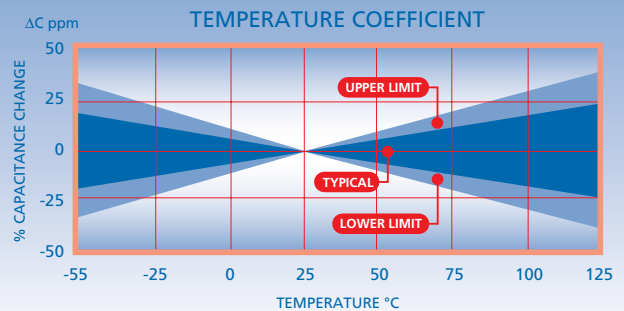
COG/NP0 (N) Ultra Stable and RoHS 2013 (RN) type

Operating temperature range:	-55°C to 125°C
Temperature coefficient:	0 ±30 ppm/°C
Dissipation factor:	0.1% max @ 25°C
Insulation resistance	@25°C: >100GΩ or >1000ΩF whichever is less @125°C: >10GΩ or >100ΩF whichever is less
Dielectric withstanding voltage	<200V: 250% 201-500V: 150% or 500V whichever is greater >500V: 120% or 750V whichever is greater
Ageing rate:	0% per decade
Test parameters:	1KHz, 1.0 ±0.2 VRMS, 25°C 1MHz for Capacitance ≤100pF



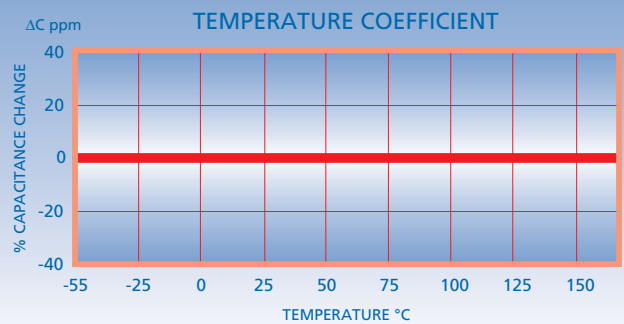
COG/NP0 (M) Ultra Stable Non Magnetic

Operating temperature range:	-55°C to 125°C
Temperature coefficient:	0 ±30 ppm/°C
Dissipation factor:	0.1% max @ 25°C
Insulation resistance	@25°C: >1000ΩF or >10000ΩF whichever is less @125°C: >100ΩF or >1000ΩF whichever is less
Dielectric withstanding voltage	<200V: 250% 201-500V: 150% or 500V whichever is greater >500V: 120% or 750V whichever is greater
Ageing rate:	0% per decade
Test parameters:	1KHz, 1.0 ±0.2 VRMS, 25°C 1MHz for Capacitance ≤100pF



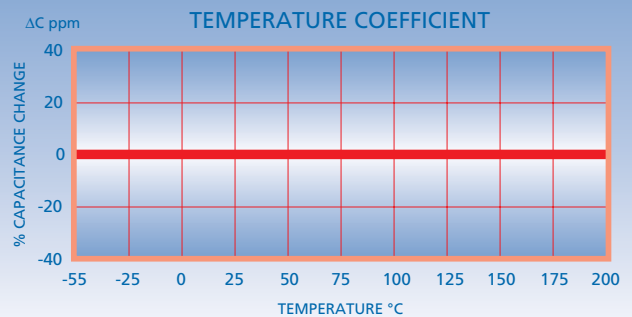
COG/NP0 (F) Ultra Stable High Temperature (up to 160°C)

Operating temperature range:	-55°C to 160°C
Temperature coefficient:	0 ±30 ppm/°C
Dissipation factor:	0.1% max @ 25°C
Insulation resistance	@25°C: >100GΩ or >1000ΩF whichever is less @160°C: >1GΩ or >10ΩF whichever is less
Dielectric withstanding voltage	<200V: 250% 201-500V: 150% or 500V whichever is greater >500V: 120% or 750V whichever is greater
Ageing rate:	0% per decade
Test parameters:	1KHz, 1.0 ±0.2 VRMS, 25°C 1MHz for Capacitance ≤100pF



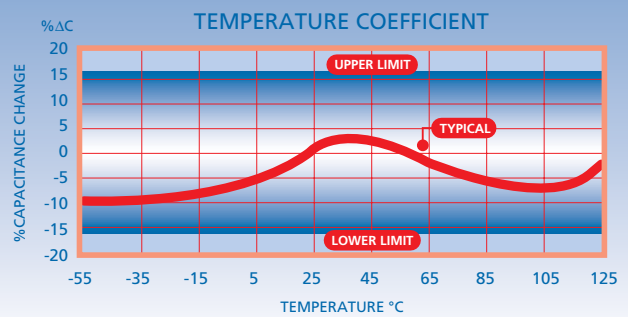
COG/NP0 (D) Ultra Stable High Temperature (up to 200°C)

Operating temperature range:	-55°C to 200°C
Temp. coefficient ≤200°C:	0 ±30 ppm/°C
Dissipation factor @ 25°C:	0.1% Max.
Insulation resistance	@25°C: >100GΩ or >1000ΩF whichever is less @200°C: >1GΩ or >10ΩF whichever is less
Dielectric withstanding voltage	<200V: 250% 201-500V: 150% or 500V whichever is greater >500V: 120% or 750V whichever is greater
Ageing rate:	0% per decade
Test parameters:	1KHz, 1.0 ±0.2 VRMS, 25°C 1MHz for capacitance ≤100pF



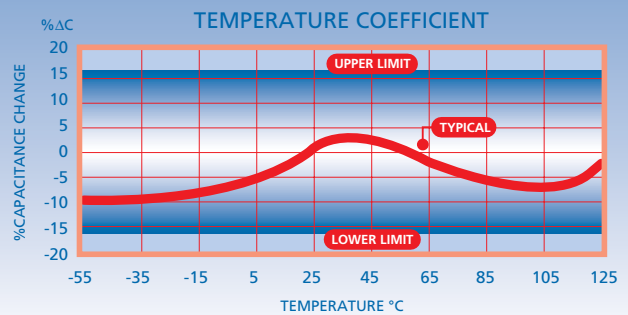
X7R (B) Stable and RoHS 2013 (RB) type

Operating temperature range:	-55°C to 125°C
Temperature coefficient :	±15% ΔC Max.
Dissipation factor	>25V rating: 2.5% max ≤25V rating: 3.5% max
Insulation resistance:	@25°C: >100GΩ or >1000ΩF whichever is less @125°C: >10GΩ or >100ΩF whichever is less
Dielectric withstanding voltage	≤200V: 250% 201-500V: 150% or 500V whichever is greater >500V: 120% or 750V whichever is greater
Ageing rate:	<2.0% per decade
Test parameters:	1KHz, 1.0 ±0.2 VRMS, 25°C



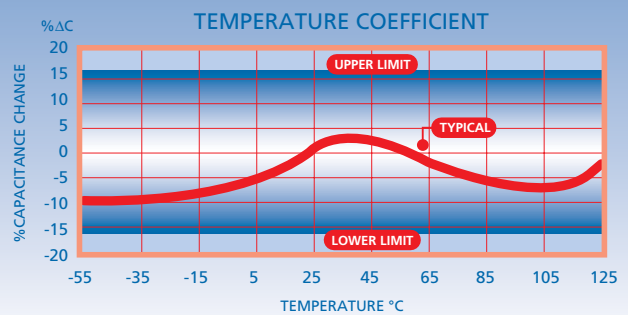
X7R (C) Stable Non Magnetic

Operating temperature range:	-55°C to 125°C
Temperature coefficient:	±15% ΔC Max.
Dissipation factor	>25V rating: 2.5% max ≤25V rating: 3.5% max
Insulation resistance:	@25°C: >100GΩ or >1000ΩF whichever is less @125°C: >10GΩ or >100ΩF whichever is less
Dielectric withstanding voltage	≤200V: 250% 201-500V: 150% or 500V whichever is greater >500V: 120% or 750V whichever is greater
Ageing rate:	<2.0% per decade
Test parameters:	1KHz, 1.0 ±0.2 VRMS, 25°C



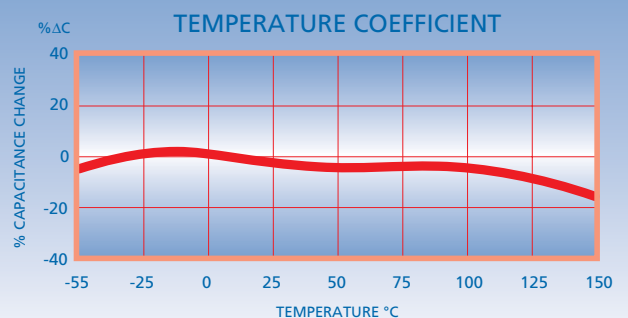
BX (X) Stable

Operating temperature range:	-55°C to 125°C
Temperature coefficient:	±15% ΔC Max.
Temp-voltage coefficient:	+15% -25% ΔC Max.
Dissipation factor	>25V rating: 2.5% max ≤25V rating: 3.5% max
Insulation resistance:	@25°C: >100GΩ or >1000ΩF whichever is less @125°C: >10GΩ or >100ΩF whichever is less
Dielectric withstanding voltage	≤200V: 250% 201-500V: 150% or 500V whichever is greater >500V: 120% or 750V whichever is greater
Ageing rate:	<2.0% per decade
Test parameters:	1KHz, 1.0 ±0.2 VRMS, 25°C



X8R (S) Stable

Operating temperature range:	-55°C to 150°C
Temp. coefficient ≤150°C:	±15% ΔC Max.
Dissipation factor	>25V rating: 2.5% max ≤25V rating: 3.5% max
Insulation resistance	@25°C: >100GΩ or >1000ΩF whichever is less @150°C: >10GΩ or >100ΩF whichever is less
Dielectric withstanding voltage	≤200V: 250% 201-500V: 150% or 500V whichever is greater >500V: 120% or 750V whichever is greater
Ageing rate:	<2.0% per decade
Test parameters:	1KHz, 1.0 ±0.2 VRMS, 25°C





Dimensions - inches (mm)

Size	Length (L)	Width (W)	Max. Thickness (T)*	Termination Band (MB)
0402	0.040 ± 0.004 (1.02 ± 0.102)	0.020 ± 0.004 (0.508 ± 0.102)	0.024 (0.610)	0.010 ± 0.006 (0.254 ± 0.152)
0504	0.050 ± 0.006 (1.27 ± 0.152)	0.040 ± 0.006 (1.02 ± 0.152)	0.044 (1.12)	0.014 ± 0.006 (0.356 ± 0.152)
RF0505	0.055 +0.015 -0.010 (1.4 +0.38 -0.25)	0.055 ± 0.015 (1.40 ± 0.381)	0.057 (1.45)	0.014 ± 0.006 (0.356 ± 0.152)
0603	0.060 ± 0.006 (1.52 ± 0.152)	0.030 ± 0.006 (0.762 ± 0.152)	0.035 (0.889)	0.014 ± 0.006 (0.356 ± 0.152)
0805	0.080 ± 0.008 (2.03 ± 0.203)	0.050 ± 0.008 (1.27 ± 0.203)	0.054 (1.37)	0.020 ± 0.010 (0.508 ± 0.254)
0907	0.090 ± 0.008 (2.29 ± 0.203)	0.070 ± 0.008 (1.78 ± 0.203)	0.060 (1.52)	0.020 ± 0.010 (0.508 ± 0.254)
1005	0.100 ± 0.008 (2.54 ± 0.203)	0.050 ± 0.008 (1.27 ± 0.203)	0.054 (1.37)	0.020 ± 0.010 (0.508 ± 0.254)
RF1111	0.110+0.025 -0.010 (2.79 +0.64 -0.25)	0.110 ± 0.015 (2.79 ± 0.381)	0.102 (2.59)	0.020 ± 0.010 (0.508 ± 0.254)
1206	0.125 ± 0.008 (3.18 ± 0.203)	0.060 ± 0.008 (1.52 ± 0.203)	0.064 (1.63)	0.020 ± 0.010 (0.508 ± 0.254)
1210	0.125 ± 0.008 (3.18 ± 0.203)	0.100 ± 0.008 (2.54 ± 0.203)	0.065 (1.65)	0.020 ± 0.010 (0.508 ± 0.254)
1515	0.150 ± 0.015 (3.81 ± 0.381)	0.150 ± 0.015 (3.81 ± 0.381)	0.130 (3.30)	0.030 ± 0.015 (0.762 ± 0.381)
1808	0.180 ± 0.012 (4.57 ± 0.305)	0.080 ± 0.008 (2.03 ± 0.203)	0.065 (1.65)	0.024 ± 0.014 (0.610 ± 0.356)
1812	0.180 ± 0.012 (4.57 ± 0.305)	0.125 ± 0.008 (3.18 ± 0.203)	0.065 (1.65)	0.024 ± 0.014 (0.610 ± 0.356)
1825	0.180 ± 0.012 (4.57 ± 0.305)	0.250 ± 0.015 (6.35 ± 0.381)	0.080 (2.03)	0.024 ± 0.014 (0.610 ± 0.356)
2020	0.200 ± 0.015 (5.08 ± 0.381)	0.200 ± 0.015 (5.08 ± 0.381)	0.180 (4.57)	0.024 ± 0.014 (0.610 ± 0.356)
2221	0.220 ± 0.015 (5.59 ± 0.381)	0.210 ± 0.015 (5.33 ± 0.381)	0.080 (2.03)	0.030 ± 0.015 (0.762 ± 0.381)
2225	0.220 ± 0.015 (5.59 ± 0.381)	0.250 ± 0.015 (6.35 ± 0.381)	0.080 (2.03)	0.030 ± 0.015 (0.762 ± 0.381)
2520	0.250 ± 0.015 (6.35 ± 0.381)	0.200 ± 0.015 (5.08 ± 0.381)	0.180 (4.57)	0.030 ± 0.015 (0.762 ± 0.381)
RF2525	0.230 +0.020 -0.012 (5.84 +0.51 -0.30)	0.250 ± 0.015 (6.35 ± 0.381)	0.165 (4.19)	0.030 ± 0.015 (0.762 ± 0.381)
3333	0.330 ± 0.017 (8.38 ± 0.432)	0.330 ± 0.017 (8.38 ± 0.432)	0.250 (6.35)	0.030 ± 0.015 (0.762 ± 0.381)
3530	0.350 ± 0.018 (8.89 ± 0.457)	0.300 ± 0.015 (7.62 ± 0.381)	0.250 (6.35)	0.030 ± 0.015 (0.762 ± 0.381)
4040	0.400 ± 0.020 (10.2 ± 0.508)	0.400 ± 0.020 (10.2 ± 0.508)	0.300 (7.62)	0.040 ± 0.020 (1.02 ± 0.508)
4540	0.450 ± 0.023 (11.4 ± 0.584)	0.400 ± 0.020 (10.2 ± 0.508)	0.300 (7.62)	0.040 ± 0.020 (1.02 ± 0.508)
5440	0.540 ± 0.027 (13.7 ± 0.686)	0.400 ± 0.020 (10.2 ± 0.508)	0.300 (7.62)	0.040 ± 0.020 (1.02 ± 0.508)
5550	0.550 ± 0.028 (14.0 ± 0.711)	0.500 ± 0.025 (12.7 ± 0.635)	0.300 (7.62)	0.040 ± 0.020 (1.02 ± 0.508)
6560	0.650 ± 0.033 (16.5 ± 0.838)	0.600 ± 0.030 (15.2 ± 0.762)	0.300 (7.62)	0.040 ± 0.020 (1.02 ± 0.508)
7565	0.750 ± 0.038 (19.1 ± 0.965)	0.650 ± 0.033 (16.5 ± 0.838)	0.300 (7.62)	0.040 ± 0.020 (1.02 ± 0.508)

* Non standard thicknesses are available - consult the sales office for details.