

Commercial Chip - C0G 16Vdc to 10kVdc

A range of commercial MLC chip capacitors in Ultra stable EIA Class I C0G, or NP0, dielectric. C0G chips are used in precision circuitry requiring Class I stability and exhibit linear temperature coefficient, low loss and stable electrical properties with time, voltage and frequency.

Designed for surface mount application with nickel barrier terminations making them suitable for solder wave and reflow solder board attachment as well as vapor phase attachment for part sizes 2225 or smaller. Silver-palladium terminations are also available for hybrid use with conductive epoxy.

Standard EIA case sizes and available C/V values are listed below - special sizes, thicknesses and other voltage ratings are available; please contact the sales office for information.

Capacitance and voltage selection for popular chip sizes

Size	0402	0504	0603	0805	1005	1206	1210	1515	1808	1812	1825			
Min cap.	0R3	0R5	0R3	0R5	0R5	3R0	5R0	3R0	5R0	5R0	100	100	150	150
Tmax inches: mm:	0.024 0.61	0.044 1.12	0.035 0.89	0.054 1.37	0.054 1.37	0.064 1.63	0.065 1.63	0.130 3.02	0.065 1.63	0.080* 2.03	0.065 1.63	0.100* 2.54	0.080 2.03	0.140* 3.56
16V	271	222	152	562	822	153	273	473	393	393	563	563	104	104
25V	221	182	122	472	682	123	273	393	333	333	563	563	104	104
50V	181	152	102	392	562	123	223	333	223	273	393	393	104	104
100V	181	152	102	392	562	103	183	333	153	223	273	393	683	823
200V	101	821	561	182	272	562	103	223	103	153	183	273	473	683
250V	560	561	331	152	222	392	822	223	682	103	153	223	393	563
300V	•	•	•	821	122	272	472	153	472	562	103	153	223	473
400V	•	•	•	821	122	182	472	103	472	472	103	123	223	333
500V	•	•	•	821	122	182	472	822	472	472	103	123	223	273
600V	•	•	•	681	102	152	392	682	392	472	822	103	183	183
800V†	•	•	•	681	102	152	392	682	392	472	822	103	183	183
1kV†	•	•	•	471	391	102	222	562	222	332	472	822	103	153
1.5kV†	•	•	•	•	•	561	122	392	122	182	272	472	562	103
2kV†	•	•	•	•	•	391	821	272	821	122	182	272	272	562
3kV†	•	•	•	•	•	•	•	122	391	471	821	122	122	222
4kV†	•	•	•	•	•	•	•	681	221	271	471	821	681	122
5kV†	•	•	•	•	•	•	•	•	•	•	•	•	391	821
6kV†	•	•	•	•	•	•	•	•	•	•	•	•	•	•
7kV†	•	•	•	•	•	•	•	•	•	•	•	•	•	•
8kV†	•	•	•	•	•	•	•	•	•	•	•	•	•	•
9kV†	•	•	•	•	•	•	•	•	•	•	•	•	•	•
10kV†	•	•	•	•	•	•	•	•	•	•	•	•	•	•

† Units rated above 800V may require conformal coating to preclude arcing over chip surface

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- For dielectric characteristics see page 4.
- 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.

Note: Maximum capacitance values are shown below 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.



Capacitance and voltage selection for popular chip sizes

	2020	2221	2225		2520	3333	3530	4040	4540	5440	5550	6560	7565	Size
	270	270	270	270	390	390	390	390	390	390	390	560	101	Min cap.
	0.180 4.57	0.080 2.03	0.080 2.03	0.150* 3.81	0.180 4.57	0.250 6.35	0.250 6.35	0.300 7.62	0.300 7.62	0.300 7.62	0.300 7.62	0.300 7.62	0.300 7.62	inches mm Tmax
	683	104	124	124	104	184	184	334	334	394	394	684	824	16V
	683	104	124	124	104	184	184	334	334	394	394	684	824	25V
	683	104	124	124	104	154	184	274	334	394	394	684	824	50V
	563	683	823	104	823	124	154	224	274	274	274	474	564	100V
	563	473	563	823	683	104	124	184	224	274	274	474	564	200V
	473	393	473	683	563	104	124	184	204	224	224	394	474	250V
	393	223	273	563	473	823	104	154	184	224	224	394	474	300V
	333	223	273	393	393	563	823	124	154	184	184	334	394	400V
	273	223	273	333	393	473	683	104	124	154	184	274	334	500V
	153	183	273	273	223	393	393	823	823	104	154	224	274	600V
	153	183	273	273	183	333	333	563	683	823	124	184	224	800V [†]
	103	103	153	223	123	273	273	563	563	683	104	154	184	1kV [†]
	822	562	822	153	103	183	223	393	393	393	563	823	124	1.5kV [†]
	472	272	392	822	562	153	153	273	333	333	473	683	104	2kV [†]
	222	122	182	332	272	822	103	183	223	223	333	473	683	3kV [†]
	122	681	102	182	152	332	562	123	123	123	183	273	393	4kV [†]
	821	391	561	122	102	222	332	682	822	822	123	183	223	5kV [†]
	•	•	•	•	•	182	182	392	392	472	562	103	123	6kV [†]
	•	•	•	•	•	•	122	272	272	332	472	682	822	7kV [†]
	•	•	•	•	•	•	102	222	222	272	332	562	682	8kV [†]
	•	•	•	•	•	•	821	152	182	182	272	392	472	9kV [†]
	•	•	•	•	•	•	681	122	152	152	222	332	392	10kV [†]

* Denotes non standard chip thickness.

Order code needs to have an 'X' inserted together with the dimension in inches e.g. X080 where dimension is 0.080"

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 and 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
HK	MIL-PRF-38534 Class K
HS	MIL-PRF-123 Group A

Dielectric Codes

N	COG/NP0	Ultra Stable
M	COG/NP0	Ultra Stable Magnetic Free
F	COG/NP0	High Temp. (up to 160°C)
D	COG/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
P	Positive VTC	Pulse Power
RN	NP0	RoHS 2013 ≤ 200V
RB	X7R	RoHS 2013 ≤ 200V

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

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

Capacitance Tolerance Codes

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

Technical Summary

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 $\pm 15\%$ 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	•	•	•	•	•	•	•	•	•	•	•
X5R	W	•	•	•	•	•	•	•	•	•	•	•
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
- S** Solderable Silver - RoHS

Conductive Epoxy attachment:

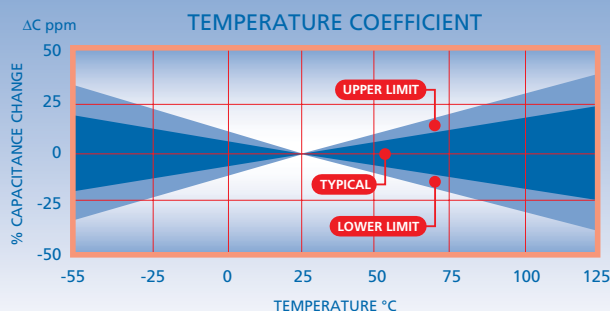
- P** Palladium Silver
- PR** Palladium Silver - RoHS
- NG** Nickel Barrier Gold Flash, also suitable for soldering attachment - RoHS



Dielectric Characteristics

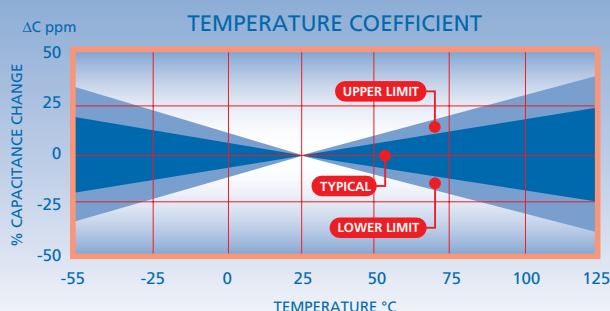
C0G/NP0 (N) Ultra Stable and RoHS 2013 (RN) type

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



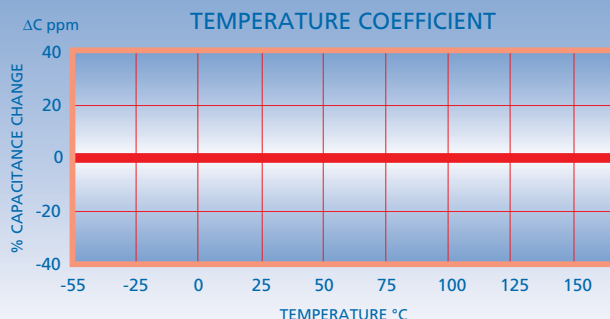
C0G/NP0 (M) Ultra Stable Non Magnetic

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



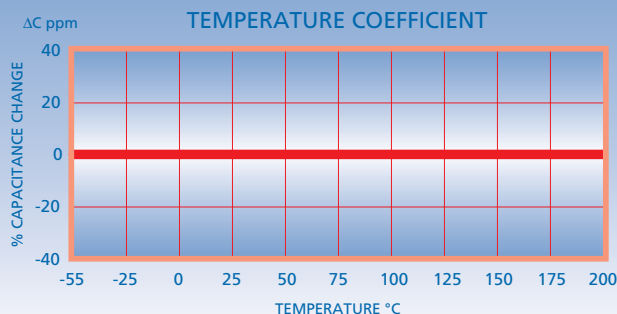
C0G/NP0 (F) Ultra Stable High Temperature (up to 160°C)

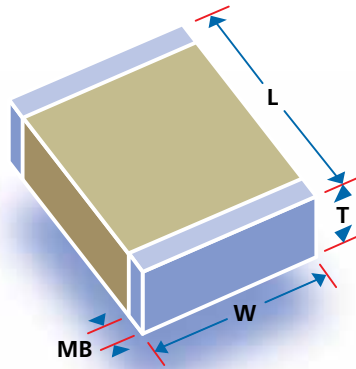
Operating temperature range:	-55°C to 160°C
Temperature coefficient:	0 ±30 ppm/°C
Dissipation factor:	0.1% max @ 25°C
Insulation resistance	@25°C: >100GΩ or >1000ΩF whichever is less @160°C: >1GΩ or >10ΩF whichever is less
Dielectric withstanding voltage	≤200V: 250% 201-500V: 150% or 500V whichever is 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



C0G/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





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.