

The logo consists of a stylized 'C' shape formed by multiple parallel red lines that fan out from the top left to the bottom right.

**CARDINAL
COMPONENTS**

2007

What sets a company apart?

A broad range of products, technical expertise, and commitment to quality control are key factors.

At Cardinal Components, Inc., we have been supplying the finest quartz crystals and oscillators to the electronic industries in North America, Europe, and Asia since 1986. Throughout our history we have enjoyed long relationships with many customers. They come back because they know that, no matter what the challenge, Cardinal will get the job done!

Certified ISO-9002, Cardinal is committed to providing the best quality products, technical support, and superior service to our customers. Our engineering staff can answer your questions, as well as provide design aid for both new and existing products. We offer flexible delivery programs, such as JIT and stocking for orders, so supply problems are eliminated. Cardinal's pricing and delivery lead times are the most competitive in the crystal components industry. Sales representatives, distributors, and a dedicated in-house sales department focus on providing a high level of service to meet your needs.

In order to better serve you, our web site **www.cardinalxtal.com** provides up-to-date information and data sheet retrieval on demand. Cardinal's web site is an easy way to access information about us, our products, and our engineering services, and to get on our mailing list for the latest information about new products.

The Cardinal difference is more than just our range of products or our technical capabilities. Steadfast, reliable performance that you can trust is what sets us apart.

E. Carl Fabend, President

Microprocessor Crystals

Surface Mount Crystals

Watch Crystals

Crystal Oscillators

Surface Mount Oscillators

TCXO

VCXO

VCTCXO



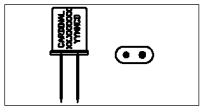
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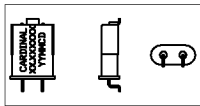


Short Form Guide • Parts Catalog

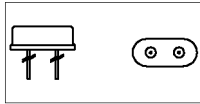
CRYSTAL SECTION



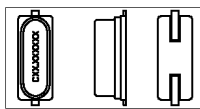
C49 10
Microprocessor Crystals
 HC-49, 1.8 - 150 MHz
 Low cost, Broad Frequency Range



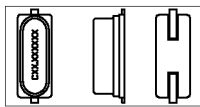
C49J 11
Surface Mount HC-49
 HC-49 Jacket SMD, 1.8 - 150 MHz
 Surface Mount, Low ESR



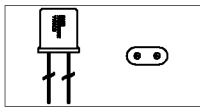
CLP, CLP3, CLP4, CLP5, CLP6 12
Low Profile Crystals
 HC-49S, 3.5-75 MHz
 Low Profile, 2-4 mm Height Options



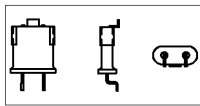
CSM1 13
Low Profile Surface Mount Crystals
 HC-49SMD, 3.5-75 MHz
 Surface Mount, Cost Effective



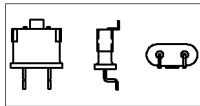
CSM4, CSM5 14
Low Profile Surface Mount Crystals
 HC-49SMD Short, 3.5-75.0 MHz
 2.5-3.2mm Low Profile, Surface Mount



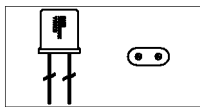
CM1, CM4, CM5 15
Ultra-Miniature Crystals
 UM1, UM4, UM5, 10.0-175 MHz
 Ultra Miniature, Tight Tolerance



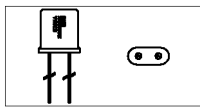
CM1J 16
Surface Mount UM-1
 UM1-SMD, 10.0-175 MHz
 Surface Mount



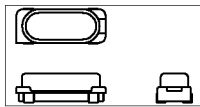
CM5J 17
Surface Mount UM-5
 UM5-SMD, 10.0-175 MHz
 Smaller than CM1J, Surface Mount



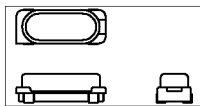
CX77 18
Ultra-Miniature Crystals
 77.760 MHz
 Fundamental Fixed Frequency



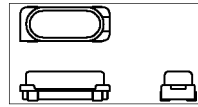
CX155 19
Ultra Miniature Crystals
 155.52 MHz
 Fundamental Fixed Frequency



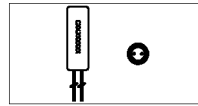
CX406 20
Surface Mount Crystal
 Fits MA 406, 3.5-75 MHz
 Surface Mount, Cost Effective



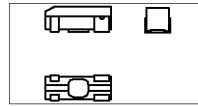
CX505 21
Surface Mount Crystal
 Fits MA505, 3.5-70 MHz
 Surface Mount, Cost Effective



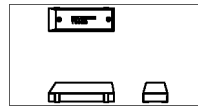
CX506 22
Surface Mount Crystal
 Fits MA506, 3.5-75 MHz
 Surface Mount, Cost Effective



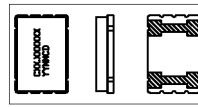
CMS8 23
Micro AT-Strip Crystals
 3x8 At-Strip, 3.5-64 MHz
 Micro AT-Strip, Small Foot Print



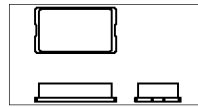
CPX 24
Plastic Surface Mount Crystals
 Plastic SMD, 3.5-70.0 MHz
 Surface Mount, High Temperature



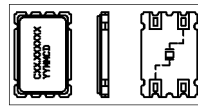
CPC 25
Plastic Surface Mount Crystals
 Plastic SMD, 3.5-70 MHz
 Low Cost, Thermoplastic



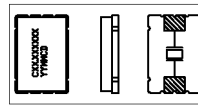
CX21 26
Low Profile Ceramic Surface Mount
 Ceramic SMD, 3.5-60 MHz
 Low Profile, 2.0 mm Height



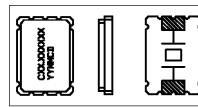
CX129 27
Low Profile Ceramic Surface Mount
 Ceramic SMD, 8-100 MHz
 Low Profile, 1.8 mm Height



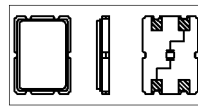
CX051 28
Ceramic Surface Mount
 Ceramic 5 x 7, 9.8-100 MHz
 1.3 mm Height, Industry Standard



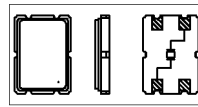
CX17A, CX17C 29
Ceramic Surface Mount Crystals
 Ceramic 5 x 7, 10-100 MHz
 Low Cost, Epoxy Sealed



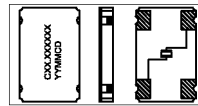
CX12A, CX12B, CX12C 30
Ceramic Surface Mount
 Ceramic 5 x 7, 9.8-100 MHz
 1.25 mm Height, 3 Footprint Options



CX5 31
Ceramic Surface Mount
 Ceramic 5 x 7, 9-150 MHz
 Low Drive Level, Tight Stability



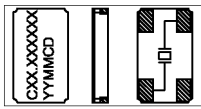
CX47 32
Ceramic Surface Mount
 Ceramic 5 x 7, 9-150 MHz
 Low Drive Level, Epoxy Sealed



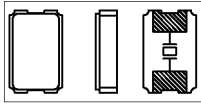
CX745 33
Ceramic Surface Mount Crystal
 Ceramic SMD, 10-72 MHz
 1 mm Height, Tight Stability



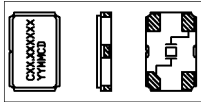
PARTS CATALOG



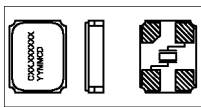
CX635A, CX635B -----34
Ceramic Surface Mount Crystals
 Ceramic SMD, 11-150 MHz
 Low Drive Level, Wide Frequency Range



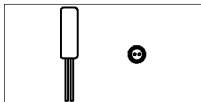
CX532 -----35
Ceramic Surface Mount Crystal
 Ceramic 3 x 5, 10-45 MHz
 Small Footprint, Fundamental to 45 MHz



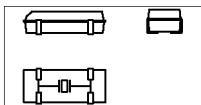
CX45 -----36
Ultra Miniature Surface Mount Crystal
 Ceramic 3 x 5, 10-45 MHz
 <1 mm Height, Low Drive Level



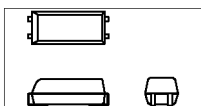
CX325 -----37
Ceramic Surface Mount Crystal
 20-55 MHz 3.2 x 2.5 mm.
 Smallest Package Dimensions



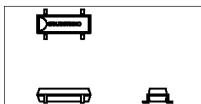
CTF6, CTF8 -----38
Tuning Fork Crystals
 Watch Crystals, 30-200 KHz
 Tuning Fork



CPFA, CPFB -----39
Plastic Tuning Fork Crystals
 SMD Watch Crystals, 32.768 KHz
 Plastic Tuning Fork, 2.5 mm Height



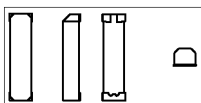
CPTA, CPTB -----40
Plastic Surface Mount Watch Crystals
 32.768 KHz, Plastic Surface Mount Watch,
 Two Different Pin Configurations



CPL -----41
Plastic Surface Mount Watch Crystals
 SMD Watch Crystals, 32.768 KHz
 Ultra Miniature, 2.0mm Height



CT5 -----42
Surface Mount Low Frequency Crystal
 SMD Watch Crystals, 32.768 KHz/76.8 KHz
 Plastic Surface Mount, 2.0mm Height

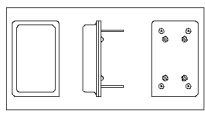


CT6 -----43
Surface Mount Low Frequency Crystal
 SMD Watch Crystals, 32.768 KHz/75 KHz
 Plastic Surface Mount, 1.5 mm Height

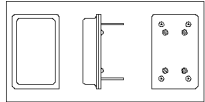


PARTS CATALOG

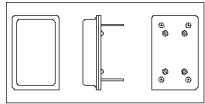
OSCILLATOR SECTION



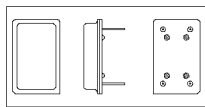
C11 -----47
Crystal Clock Oscillator
TTL Dip, 1-100 MHz
8 & 14 Pin Dip, Tri-stateable



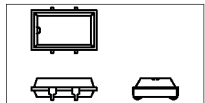
CTH11 -----48
Crystal Clock Oscillator
HC MOS/TTL, 1-70 MHz
8 & 14 Pin Dip, Tri-stateable



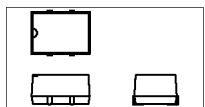
CH11 -----49
Crystal Clock Oscillator
50 pF, 1.8-100 MHz
8 & 14 Pin Dip, Tri-stateable



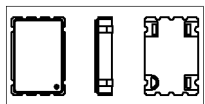
CDO -----50
Independent Dual Output Oscillators
Dual 14 Pin Dip, Standard & Custom Combo.,
Dual Output, Space Saving Design



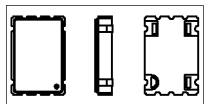
CPO -----51
Surface Mount Clock Oscillator
Plastic SMD, 1.5-70 MHz
Surface Mount Plastic, Tri-stateable



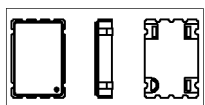
CPH -----52
Surface Mount Clock Oscillator
Plastic SMD, 70-125 MHz
Surface Mount Plastic, Tri-stateable



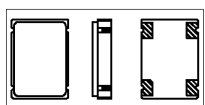
CC065S -----53
Surface Mount Clock Oscillator
5 x 7 Ceramic, 1.8 x 125 MHz
5V Surface Mount Ceramic, 10 LSTTL, 15 pF



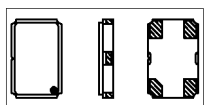
CC065H -----54
Surface Mount Clock Oscillator
5 x 7 Ceramic, 1.8 x 80 MHz
5V Surface Mount Ceramic, 10 LSTTL, 50 pF



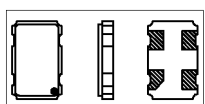
CC065L -----55
Surface Mount Clock Oscillator
5 x 7 Ceramic, 1.8-80MHz
3V Surface Mount Ceramic, 10 LSTTL, 15pF



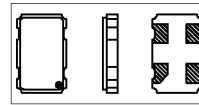
CC85 -----56
Surface Mount Clock Oscillator
5 x 7 Ceramic, 8-125 MHz
1.7 mm Height, Ceramic Surface Mount



CC045 -----57
Ceramic Surface Mount Oscillator
2.5-55 MHz
Ceramic Surface Mount, Small Outline

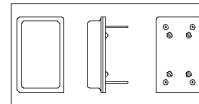


CC532 -----58
Surface Mount Clock Oscillator
3 x 5 Ceramic, 8.0-67 MHz
Ceramic Surface Mount, Small Outline

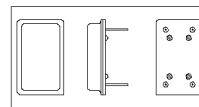


CC137 -----59
Ceramic Surface Mount Oscillator
1.5-100 MHz
Ceramic Surface Mount, Small Outline

ECL SECTION

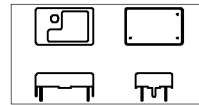


CECL -----61
ECL Oscillators 14 Pin Dip Compatible
Metal ECL, 30-250 MHz
ECL 14 Pin Dip, Various Pin Configurations

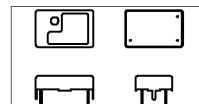


CECLP -----62
ECL Oscillators 14 Pin Dip Compatible
19.4 - 155.5 MHz
PECL

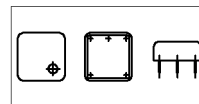
TCXO SECTION



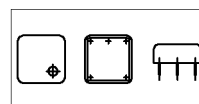
CTCX -----64
Thru-Hole TCXO
Metal TCXO, 4-25 MHz
Thru-hole TCXO, Stable Over Temperature



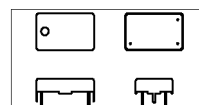
CC124 -----65
Thru Hole TCXO
Metal TCXO, 1-35 MHz
Thru hole TCXO, 4.5 mm Height



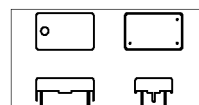
CC180 -----66
Thru Hole TCXO
Metal TCXO, 1-35 MHz
Thru hole TCXO, Sinewave Output



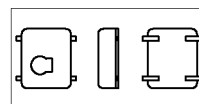
CC181 -----67
Thru Hole TCXO
Metal TCXO, 1-35 MHz
Thru-hole TCXO, Tight Stability



CC163 -----68
Thru Hole TCXO
Metal TCXO, 1-35 MHz
Thru hole TCXO, Sinewave Output



CC162 -----69
Thru Hole TCXO
1-35 MHz
Thru Hole, Tight Stability

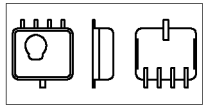


CTX4 -----70
Surface Mount TCXO
4 Pin SMD TCXO, 12-19.6 MHz
Surface Mount TCXO, 4 mm Height

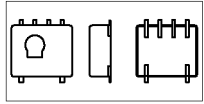


PARTS CATALOG

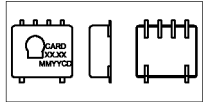
VCXO SECTION



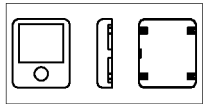
CTX5 -----71
Surface Mount TCXO
 5 Pin SMD TCXO, 12-19.6 MHz
 Surface Mount TCXO, Sine Wave



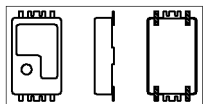
CTX6 -----72
Surface Mount TCXO
 6 Pin SMD TCXO, 12-19.6 MHz
 Surface Mount TCXO, 4 mm Height



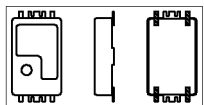
CC128 -----73
Surface Mount TCXO
 9.6 x 11.4, 1-35 MHz
 Surface Mount TCXO, 4.0 mm Height



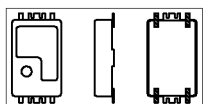
CT4S -----74
Surface Mount TCXO
 9.6 x 11.4, 9.6-32 MHz
 Surface Mount TCXO, 2.5 mm Height



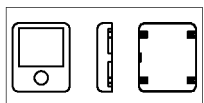
CTX8 -----75
Surface Mount TCXO
 11.7 x 18.3, 9.6-32 MHz
 Surface Mount TCXO, Sine Wave



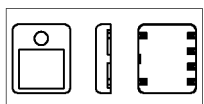
CC131 -----76
Surface Mount TCXO
 11.7 x 18.3, 1-35 MHz
 Surface Mount TCXO, Sine Wave



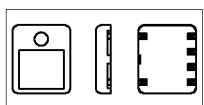
CC132 -----77
Surface Mount TCXO
 11.7 x 18.3, 1-35 MHz
 LSTTL/HCMOS



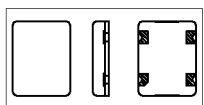
CT4T -----78
Surface Mount TCXO
 9.6 x 11.4, 9.6-32 MHz
 Surface Mount TCXO, 2.5 mm Height



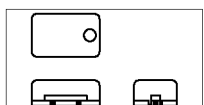
CT6S -----79
Surface Mount TCXO
 9.6 x 11.4, 9.6-32 MHz
 Surface Mount TCXO, Sine Wave



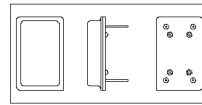
CT6T -----80
Surface Mount TCXO
 9.6 x 11.4, 9.6-32 MHz
 Surface Mount TCXO, 2.5 mm Height



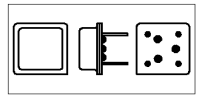
CT79 -----81
Surface Mount TCXO
 7 x 9, 12.6-19.8 MHz
 2 mm. Height



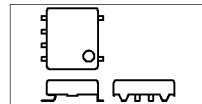
CC141 -----82
Surface Mount TCXO
 10-35 MHz
 Surface Mount TCXO, Sine Wave



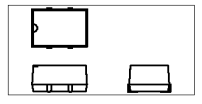
CVO1 -----84
Thru Hole VCXO
 14 Pin Dip VCXO, 1-150 MHz
 Wide Freq. Range VCXO, Exc. Pullability



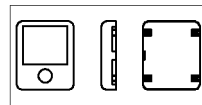
CVO4 -----85
Thru Hole VCXO
 8 Pin Dip VCXO, 1-40 MHz
 Wide Freq. Range VCXO, Exc. Pullability



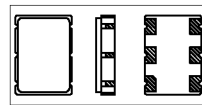
CC121 -----86
Surface Mount VCXO
 9.6 x 11.4, 8-120 MHz, 6 Pin



CC165 -----87
Surface Mount VCXO
 13.2 x 10.2, 8-30 MHz
 Plastic Package

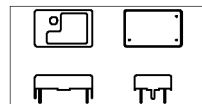


CC127 -----88
Surface Mount VCXO
 9.6 x 11.4, 9.6-32 MHz
 Surface Mount VCXO, Lead-less

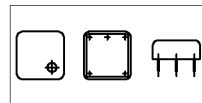


CC154 -----89
Ceramic Surface Mount VCXO
 Ceramic SMD VCXO, 8-36 MHz
 Surface Mount VCXO

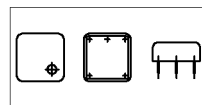
VC-TCXO SECTION



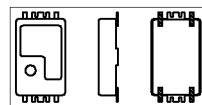
CC123 -----91
Thru Hole Mount VC-TCXO
 14 Pin Dip VCXO, 1-35 MHz
 Thru hole VCXO, 4.5 mm Height



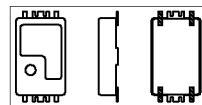
CC182 -----92
Thru Hole Mount TCXO
 20 x 20, 1-35 MHz
 Thru Hole TCXO, Sinewave



CC183 -----93
Thru Hole Mount VC-TCXO
 20 x 20, 1-35 MHz, Thru Hole VC-TCXO,
 TTL/CMOS



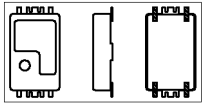
CTX8V -----94
Surface Mount VC-TCXO
 11.7 x 18.3, 9.6-32 MHz, Surface Mount VC-
 TCXO, Industry Standard Footprint



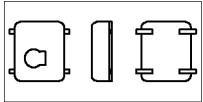
CC133 -----95
Surface Mount VC-TCXO
 11.7 x 18.3, 1-35 MHz
 Surface Mount VC-TCXO, Sine Wave



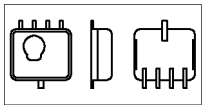
PARTS CATALOG



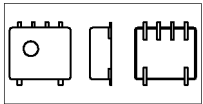
CC134 ----- 96
Surface Mount VC-TCXO
 11.7 x 18.3, 1-35 MHz
 Surface Mount VC-TCXO



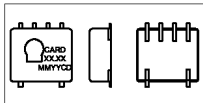
CTV4 ----- 97
Surface Mount VC-TCXO
 9.6 x 11.4, 12-19.68 MHz
 Surface Mount VC-TCXO, 4.0 mm Height



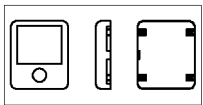
CTX5V ----- 98
Surface Mount VC-TCXO
 9.6 x 11.4, 12-19.68 MHz
 Surface Mount VC-TCXO, Sine Wave



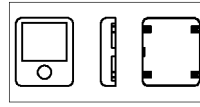
CTV6 ----- 99
Surface Mount VC-TCXO
 9.6 x 11.4, 12-19.68 MHz
 Surface Mount VC-TCXO, Sine Wave



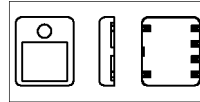
CC129 ----- 100
Surface Mount VC-TCXO
 9.6 x 11.4 x 4.0, 1-35 MHz
 Surface Mount VC-TCXO,



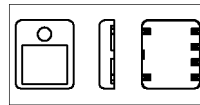
CT4V ----- 101
Surface Mount VC-TCXO
 9.6 x 11.4, 9.6-32 MHz
 Surface Mount VC-TCXO, Lead-less



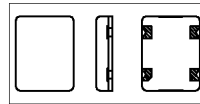
CT4TV ----- 102
Surface Mount VC-TCXO
 9.6 x 11.4, 9.6-32 MHz
 Surface Mount VC-TCXO, Lead-less



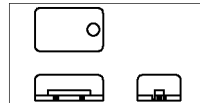
CT6V ----- 103
Surface Mount VC-TCXO
 9.6 x 11.4, 9.6-32 MHz
 Surface Mount VC-TCXO, Lead-less



CT6TV ----- 104
Surface Mount VC-TCXO
 9.6 x 11.4, 9.6-32 MHz
 Surface Mount VC-TCXO, Lead-less



CV79 ----- 105
Surface Mount VC-TCXO
 7 x 9, 12.6-19.8 MHz
 Surface Mount VC-TCXO, Lead-less



CC142 ----- 106
Surface Mount VC-TCXO
 10-35 MHz
 Surface Mount VC-TCXO, Sine Wave



CRYSTAL SECTION

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Microprocessor Crystals

Series **C49**

Cardinal provides the most comprehensive range of crystal components available. From standard microprocessors to custom-made crystals, Cardinal engineers and salespeople are dedicated to providing the best technical support and services possible.

Part Numbering Example: C49 X - A1 B2 C2 180 - 3.579545 D18 - 3

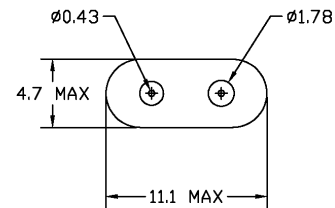
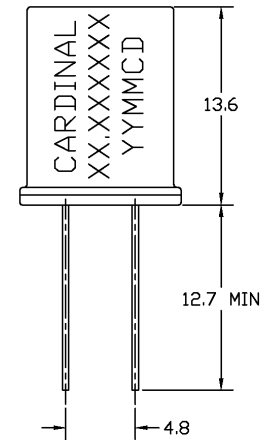
C49	X	A1*	C2	B2	180	3.579545	D18	- 3
SERIES	ADDED FEATURES	OPERATING TEMP.	TOLERANCE	STABILITY	RESISTANCE	FREQUENCY	LOAD CAP.	OVERTONE
C49	F = FORMED LEADS W = VINYL SLEEVING X = INSULATOR PAD Y = THIRD LEAD Z = TAPE AND REEL BLANK=BULK PACK	A0 = -10°C ~ +60°C A1 = -10°C ~ +70°C A2 = -40°C ~ +85°C A3 = -55°C ~ +125°C	C1 = ±100 C2 = ± 50 C3 = ± 30 C4 = ± 10	B1 = ±100 B2 = ± 50 B3 = ± 30 B4 = ± 10	SEE CHART BELOW		D16,18,20,ETC. DS = SERIES	BLANK: FUND. -3: 3rd OT -5: 5th OT -7: 7th OT -BT: BT Cut

*NOTE: The above ABC combinations cover basic specification options. We tailor our crystal specifications to meet customer requirements. Please contact our sales department if you don't see exactly what you need.

Specifications:

Frequency Range:	1.8432 ~ 150.000 MHz	
	Custom crystals available.	
Operating Temperature:	-10°C ~ + 70°C -40°C ~ + 85°C -55°C ~ +125°C	Standard
Frequency Stability:	±100 ppm ± 50 ppm ± 30 ppm ± 10 ppm	Standard
Frequency Tolerance: (at 25°C)	±100 ppm ± 50 ppm ± 30 ppm ± 10 ppm	Standard
Load Capacitance:	Standard 18 pF or series. Please specify your required load.	
Resistance:	Maximum resistance corresponds to frequency. See chart below.	
Standard:	Mode: Fundamental, 3rd, 5th, or 7th Overtone Shunt Capacitance: 7 pF Max Aging: ± 5 ppm/year Drive Level: 1.0 mW Max	
Optional Features:	Formed Leads Vinyl Sleeves Insulator Pads Third Lead Radial Tape and Reel (1K per Reel)	

C49



Resistance Chart: All resistances are maximum values.

EQUIVALENT SERIES RESISTANCE (ESR), MODE OF OPERATION (MODE), AND CUT					
Frequency MHz	ESR(Ω)	Mode/cut	Frequency MHz	ESR (Ω)	Mode/cut
1.8432~1.999	650 Max	Fund./AT	5.000~5.999	75 Max	Fund./AT
2.000~2.399	550 Max	Fund./AT	6.000~6.999	50 Max	Fund./AT
2.400~2.999	350 Max	Fund./AT	7.000~7.999	40 Max	Fund./AT
3.000~3.199	250 Max	Fund./AT	8.000~9.999	35 Max	Fund./AT
3.200~3.499	200 Max	Fund./AT	10.000~12.999	30 Max	Fund./AT
3.500~3.599	180 Max	Fund./AT	13.000~32.768	25 Max	Fund./AT
3.600~3.899	150 Max	Fund./AT	24.000~29.999	60 Max	3rd Overtone/AT
3.900~3.999	120 Max	Fund./AT	30.000~74.999	40 Max	3rd Overtone/AT
4.000~4.099	100 Max	Fund./AT	75.000~119.999	80 Max	5th Overtone/AT
4.100~4.999	80 Max	Fund/AT	120.000~150.000	100 Max	5th Overtone/AT

Note 1: Not all combinations of the above tolerances, stabilities, and temperature ranges are available. Consult the factory if your requirement is not standard.



Surface Mount HC-49

Series **C49J**

- Lower ESR than AT-Strip crystals
- SMD profile
- Grounded case better for EMI

Part Numbering Example: **C49J Z - A1 B2 C2 180 - 3.579545 D18 - 3**

C49J	Z	A1*	B2	C2	180	3.579545	D18	- 3
SERIES	ADDED FEATURES	OPERATING TEMP.	STABILITY	TOLERANCE	RESISTANCE	FREQUENCY	LOAD CAP.	OVERTONE
C49J	BLANK = BULK PACK Z = TAPE AND REEL	A0 = -10°C ~ +60°C A1 = -10°C ~ +70°C A2 = -40°C ~ +85°C A3 = -55°C ~ +125°C	B1 = ±100 B2 = ± 50 B3 = ± 30 B4 = ± 10	C1 = ±100 C2 = ± 50 C3 = ± 30 C4 = ± 10	SEE CHART BELOW		D16,18,20,ETC. DS = SERIES	BLANK: FUND. -3: 3rd OT -5: 5th OT -7: 7th OT -BT: BT Cut

*NOTE: The above ABC combinations cover basic specification options. We tailor our crystal specifications to meet customer requirements. Please contact our sales department if you don't see exactly what you need.

Specifications:

Frequency Range:	1.8432 ~ 150.000 MHz
Operating Temperature:	-10°C ~ + 70°C <i>Standard</i> -40°C ~ + 85°C -55°C ~ +125°C
Frequency Stability:	±100 ppm ± 50 ppm <i>Standard</i> ± 30 ppm ± 10 ppm
Frequency Tolerance: (at 25°C)	±100 ppm ± 50 ppm <i>Standard</i> ± 30 ppm ± 10 ppm
Load Capacitance:	Standard 18 pF or series. Please specify your required load.
Resistance:	Maximum resistance corresponds to frequency. See chart below.
Standard:	Mode: Fundamental, 3rd, 5th, or 7th Overtone Shunt Capacitance: 7 pF Max Aging: ± 5 ppm/year Drive Level: 1.0 mW Max
Optional Features:	Vinyl Sleeves Tape and Reel (1K per Reel)

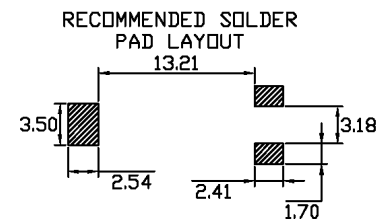
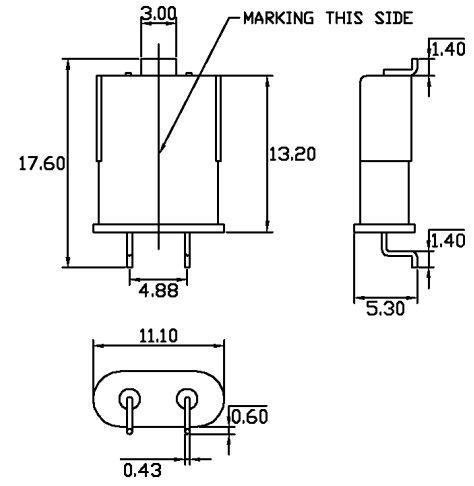
Note: Not all combinations of the above tolerances, stabilities, and temperature ranges are available. Consult the factory if your requirement is not standard.

Resistance Chart: All resistances are maximum values.

EQUIVALENT SERIES RESISTANCE (ESR), MODE OF OPERATION (MODE), AND CUT

Frequency MHz	ESR(Ω)	Mode/cut	Frequency MHz	ESR (Ω)	Mode/cut
1.8432~1.999	650 Max	Fund./AT	5.000~5.999	75 Max	Fund./AT
2.000~2.399	550 Max	Fund./AT	6.000~6.999	50 Max	Fund./AT
2.400~2.999	350 Max	Fund./AT	7.000~7.999	40 Max	Fund./AT
3.000~3.199	250 Max	Fund./AT	8.000~9.999	35 Max	Fund./AT
3.200~3.499	200 Max	Fund./AT	10.000~12.999	30 Max	Fund./AT
3.500~3.599	180 Max	Fund./AT	13.000~32.768	25 Max	Fund./AT
3.600~3.899	150 Max	Fund./AT	24.000~29.999	60 Max	3rd Overtone/AT
3.900~3.999	120 Max	Fund./AT	30.000~74.999	40 Max	3rd Overtone/AT
4.000~4.099	100 Max	Fund./AT	75.000~119.999	80 Max	5th Overtone/AT
4.100~4.999	80 Max	Fund/AT	120.000~150.000	100 Max	5th Overtone/AT

C49J



Low Profile Crystals

Cardinal "AT-Strip" low profile crystals come in a variety of heights and specifications to accommodate all of our customers' requirements.

Series

**CLP
CLP3
CLP4
CLP5
CLP6**

Part Numbering Example: CLP X - A1 B2 C2 200 - 3.579545 D18 - 3

CLP	X	A1*	B2	C2	200	3.579545	D18	- 3
SERIES	ADDED FEATURES	OPERATING TEMP.	STABILITY	TOLERANCE	RESISTANCE	FREQUENCY	LOAD CAP.	OVERTONE
CLP	F = FORMED LEADS	A0 = -10°C ~ +60°C	B1 = ±100	C1 = ±100	SEE CHART		D16,18,20,ETC.	BLANK: FUND.
CLP3	W = VINYL SLEEVING	A1 = -10°C ~ +70°C	B2 = ± 50	C2 = ± 50	BELOW		DS = SERIES	-3: 3rd OT
CLP4	X = INSULATOR PAD	A2 = -40°C ~ +85°C	B3 = ± 30	C3 = ± 30				-5: 5th OT
CLP5	Y = THIRD LEAD	A3 = -55°C ~ +125°C	B4 = ± 10	C4 = ± 10				-7: 7th OT
CLP6	Z = TAPE AND REEL							-BT: BT Cut
BLANK = BULK PACK								

**NOTE: The above ABC combinations cover basic specification options. We tailor our crystal specifications to meet customer requirements. Please contact our sales department if you don't see exactly what you need.*

Specifications:

Frequency Range:

3.579545 ~ 38.000 MHz	AT Cut Fundamental
25.000000 ~ 75.000 MHz	AT Cut 3rd Overtone
26.000000 ~ 42.000 MHz	BT Cut Fundamental

Operating Temperature:	-10°C ~ +70°C	Standard
	-40°C ~ +85°C	

Frequency Stability:	±100 ppm	
	± 50 ppm	Standard
	± 30 ppm	
	± 15 ppm	

Frequency Tolerance:	±100 ppm	
(at 25°C)	± 50 ppm	Standard
	± 30 ppm	
	± 10 ppm	

Load Capacitance: Standard 18 pF or series.
Please specify your required load.

Resistance: Maximum resistance corresponds to frequency.
See chart below.

Standard: Mode: Fundamental or 3rd Overtone
Shunt Capacitance: 7 pF Max
Aging: ± 5 ppm/year
Drive Level: 1.0 mW Max

Optional Features: Formed Leads
Vinyl Sleeves
Insulator Pads
Radial Tape and Reel

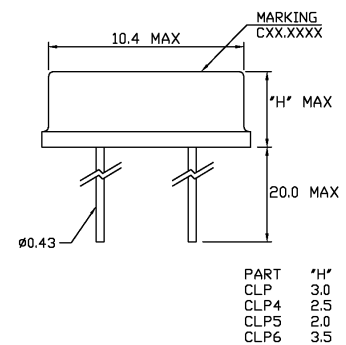
Note 1: Not all combinations of the above tolerances, stabilities, and temperature ranges are available. Consult the factory if your requirement is not standard.

Note 2: Heights of 3.5 mm (0.138) and 2.5 mm (0.098) are also available. Please consult factory if required.

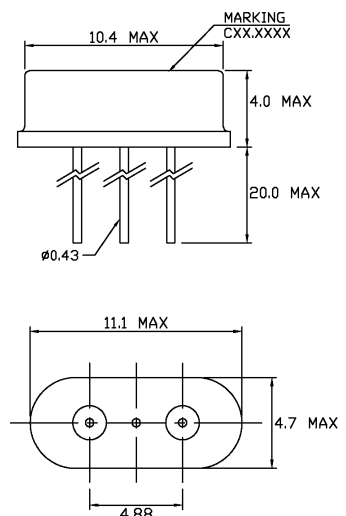
Resistance Chart: All resistances are maximum values.

EQUIVALENT SERIES RESISTANCE (ESR), MODE OF OPERATION (MODE), AND CUT					
Frequency MHz	ESR(Ω)	Mode/cut	Frequency MHz	ESR (Ω)	Mode/cut
3.579545-4.999	200 Max	Fund./AT	15.000-15.999	60 Max	Fund./AT
5.000-5.999	150 Max	Fund./AT	16.000-23.999	50 Max	Fund./AT
6.000-7.999	120 Max	Fund./AT	24.000-30.000	40 Max	Fund./AT
8.000-8.999	90 Max	Fund./AT	24.000-48.000	40 Max	Fund./BT
9.000-9.999	80 Max	Fund./AT	24.576-29.999	150 Max	3rd Overtone/AT
10.000-14.999	70 Max	Fund./AT	30.000-75.000	100 Max	3rd Overtone/AT

CLP



CLP3



Low Profile Surface Mount Crystals

Series CSM1

Cardinal "AT-Strip" surface mount crystals are among the most readily available on the market today. Many popular frequencies are kept in stock at our facility.

Part Numbering Example: CSM1 Z - A1 B2 C2 200 3.579545 D18 - 3

CSM1	Z	A1*	B2	C2	200	3.579545	D18	- 3
SERIES	ADDED FEATURES	OPERATING TEMP.	STABILITY	TOLERANCE	RESISTANCE	FREQUENCY	LOAD CAP.	OVERTONE
CSM1	BLANK = BULK PACK Z = TAPE AND REEL	A0 = -10°C ~ +60°C A1 = -10°C ~ +70°C A2 = -40°C ~ +85°C A3 = -55°C ~ +125°C	B1 = ±100 B2 = ± 50 B3 = ± 30 B4 = ± 10	C1 = ±100 C2 = ± 50 C3 = ± 30 C4 = ± 10	SEE CHART BELOW		D16,18,20,ETC. DS = SERIES	BLANK: FUND. -3: 3rd OT -5: 5th OT -7: 7th OT -BT: BT Cut

**NOTE: The above ABC combinations cover basic specification options. We tailor our crystal specifications to meet customer requirements. Please contact our sales department if you don't see exactly what you need.*

Specifications:

Frequency Range:

3.579545 ~ 38.000 MHz	AT Cut Fundamental
25.000000 ~ 75.000 MHz	AT Cut 3rd Overtone
26.000000 ~ 48.000 MHz	BT Cut Fundamental

Operating Temperature: -10°C ~ +70°C *Standard*
-40°C ~ +85°C

Frequency Stability: ±100 ppm
± 50 ppm *Standard*
± 30 ppm
± 15 ppm

Frequency Tolerance: ±100 ppm
(at 25°C) ± 50 ppm *Standard*
± 30 ppm
± 10 ppm

Load Capacitance: Standard 18 pF or series.
Please specify your required load.

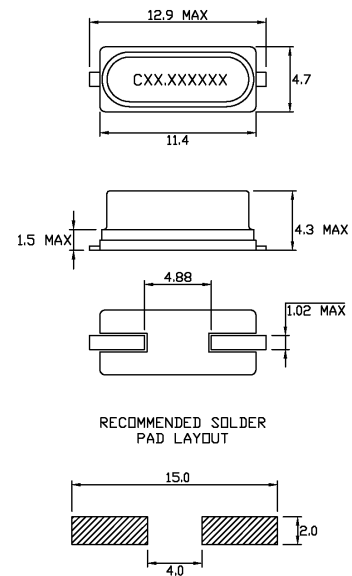
Resistance: Maximum resistance corresponds to frequency.
See chart below.

Standard: Mode: Fundamental or 3rd Overtone
Shunt Capacitance: 7 pF Max
Aging: ± 5 ppm/year
Drive Level: 1.0 mW Max

Optional Features: Tape and Reel (1K per Reel)

Note: Not all combinations of the above tolerances, stabilities, and temperature ranges are available. Consult the factory if your requirement is not standard.

CSM1



Resistance Chart: All resistances are maximum values.

EQUIVALENT SERIES RESISTANCE (ESR), MODE OF OPERATION (MODE), AND CUT					
Frequency MHz	ESR(Ω)	Mode/cut	Frequency MHz	ESR (Ω)	Mode/cut
3.579545~4.999	200 Max	Fund./AT	15.000~15.999	60 Max	Fund./AT
5.000~5.999	150 Max	Fund./AT	16.000~23.999	50 Max	Fund./AT
6.000~7.999	120 Max	Fund./AT	24.000~30.000	40 Max	Fund./AT
8.000~8.999	90 Max	Fund./AT	24.000~48.000	40 Max	Fund./BT
9.000~9.999	80 Max	Fund./AT	24.576~29.999	150 Max	3rd Overtone/AT
10.000~14.999	70 Max	Fund./AT	30.000~75.000	100 Max	3rd Overtone/AT



Low Profile Surface Mount Crystals

Series **CSM4**
CSM5

- 3.0 mm Maximum SMD profile
- Very cost competitive
- Fast delivery

Part Numbering Example: CSM4 Z - A1 B2 C2 200 - 3.579545 D18 - 3

CSM4	Z	A1*	B2	C2	200	3.579545	D18	- 3
SERIES	ADDED FEATURES	OPERATING TEMP.	STABILITY	TOLERANCE	RESISTANCE	FREQUENCY	LOAD CAP.	OVERTONE
CSM4	BLANK = BULK PACK	A0 = -10°C ~ +60°C	B1 = ±100	C1 = ±100	SEE CHART		D16,18,20,ETC.	BLANK: FUND.
CSM5	Z = TAPE AND REEL	A1 = -10°C ~ +70°C	B2 = ± 50	C2 = ± 50	BELOW		DS = SERIES	-3: 3rd OT
		A2 = -40°C ~ +85°C	B3 = ± 30	C3 = ± 30				-5: 5th OT
		A3 = -55°C ~ +125°C	B4 = ± 10	C4 = ± 10				-7: 7th OT
								-BT: BT Cut

*NOTE: The above ABC combinations cover basic specification options. We tailor our crystal specifications to meet customer requirements. Please contact our sales department if you don't see exactly what you need.

Specifications:

Frequency Range:

3.579545 ~ 38.000 MHz	AT Cut Fundamental
25.000000 ~ 75.000 MHz	AT Cut 3rd Overtone
26.000000 ~ 48.000 MHz	BT Cut Fundamental

Operating Temperature: -10°C ~ +70°C *Standard*
-40°C ~ +85°C

Frequency Stability: ±100 ppm
± 50 ppm *Standard*
± 30 ppm
± 15 ppm

Frequency Tolerance: ±100 ppm
(at 25°C) ±50 ppm *Standard*
±30 ppm
±10 ppm

Load Capacitance: Standard 18 pF or series.
Please specify your required load.

Resistance: Maximum resistance corresponds to frequency.
See chart below.

Standard: Mode: Fundamental or 3rd Overtone
Shunt Capacitance: 7 pF Max
Aging: ± 5 ppm/year
Drive Level: 1.0 mW Max

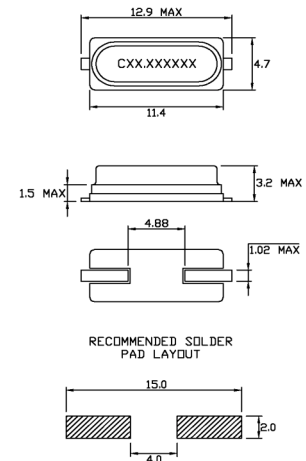
Optional Features: Tape and Reel (1K per Reel)

Note: Not all combinations of the above tolerances, stabilities, and temperature ranges are available. Consult the factory if your requirement is not standard.

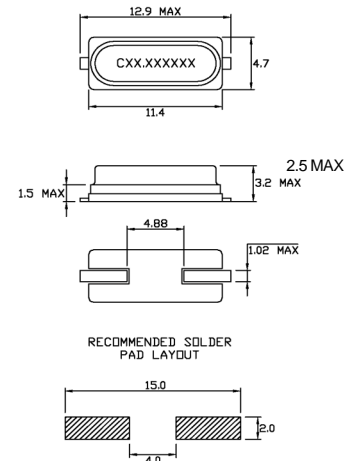
Resistance Chart: All resistances are maximum values.

EQUIVALENT SERIES RESISTANCE (ESR), MODE OF OPERATION (MODE), AND CUT					
Frequency MHz	ESR(Ω)	Mode/cut	Frequency MHz	ESR (Ω)	Mode/cut
3.579545~4.999	200 Max	Fund./AT	15.000~15.999	60 Max	Fund./AT
5.000~5.999	150 Max	Fund./AT	16.000~23.999	50 Max	Fund./AT
6.000~7.999	120 Max	Fund./AT	24.000~30.000	40 Max	Fund./AT
8.000~8.999	90 Max	Fund./AT	24.000~48.000	40 Max	Fund./BT
9.000~9.999	80 Max	Fund./AT	24.576~29.999	150 Max	3rd Overtone/AT
10.000~14.999	70 Max	Fund./AT	30.000~75.000	100 Max	3rd Overtone/AT

CSM4



CSM5



Ultra-Miniature Crystals

Cardinal's ultra-miniature crystals are a smaller alternative to the standard HC-49 package where applications require compact board space. They are perfect for applications requiring tight tolerances over wide temperature ranges.

Series
CM1
CM4
CM5

Part Numbering Example: CM1 Z - A1 - B2 - C2 50 - 7.0 D18 - 3

CM1	Z	A1*	B2	C2	50	7.0	D18	- 3
SERIES	ADDED FEATURES	OPERATING TEMP.	STABILITY	TOLERANCE	RESISTANCE	FREQUENCY	LOAD CAP.	OVERTONE
CM1	BLANK = BULK PACK	A0 = -10°C ~ +60°C	B1 = ±100	C1 = ±100	SEE CHART		D16,18,20,ETC.	BLANK: FUND.
CM4	Z = TAPE AND REEL	A1 = -10°C ~ +70°C	B2 = ± 50	C2 = ± 50	BELOW		DS = SERIES	-3: 3rd OT
CM5		A2 = -40°C ~ +85°C	B3 = ± 30	C3 = ± 30				-5: 5th OT
		A3 = -55°C ~ +125°C	B4 = ± 10	C4 = ± 10				-7: 7th OT
								-BT: BT Cut

**NOTE: The above ABC combinations cover basic specification options. We tailor our crystal specifications to meet customer requirements. Please contact our sales department if you don't see exactly what you need.*

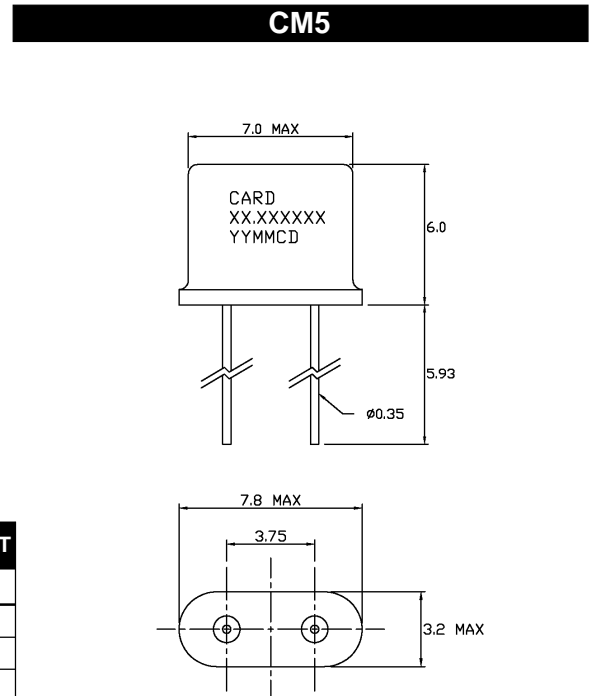
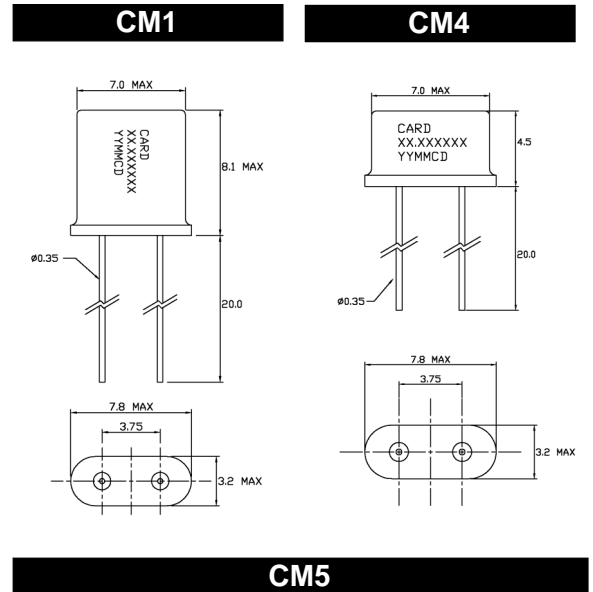
Specifications:

Frequency Range:	10.000 ~ 175.000 MHz
Operating Temperature:	-10°C ~ + 70°C <i>Standard</i> -40°C ~ + 85°C -55°C ~ + 125°C
Frequency Stability:	±100 ppm ± 50 ppm <i>Standard</i> ± 30 ppm ± 10 ppm
Frequency Tolerance: (at 25°C)	±100 ppm ± 50 ppm <i>Standard</i> ± 30 ppm ± 10 ppm
Load Capacitance:	Standard 18 pF or series. Please specify your required load.
Resistance:	Maximum resistance corresponds to frequency. See chart below.
Standard:	Mode: Fundamental, 3rd, 5th, or 7th Overtone Shunt Capacitance: 7 pF Max Aging: ± 5 ppm/year Drive Level: 1.0 mW Max
Optional Features:	Third lead Insulator pads Tape and Reel (1K per Reel)

Note 1: Not all combinations of the above tolerances, stabilities, and temperature ranges are available. Consult the factory if your requirement is not standard.

Resistance Chart: All resistances are maximum values.

EQUIVALENT SERIES RESISTANCE (ESR), MODE OF OPERATION (MODE), AND CUT					
CM1			CM4 & CM5		
Frequency MHz	ESR(Ω)	Mode	Frequency MHz	ESR (Ω)	Mode/cut
7.000~15.999	50 Max	Fund.	10.000~15.999	60 Max	Fundamental
16.000~40.000	40 Max	Fund.	16.000~40.000	50 Max	Fundamental
30.000~90.000	70 Max	Third OT	30.000~90.000	80 Max	Third Overtone
70.000~150.000	100 Max	Fifth OT	70.000~175.000	120 Max	Fifth Overtone



Surface Mount UM-1

Series **CM1J**

- *Smaller than C49J with the same characteristics*
- *SMD profile*
- *Grounded case better for EMI*

Part Numbering Example: CM1J - Z - A1 B2 C2 50 - 7.0 D18 - 3

CM1J	Z	A1*	B2	C2	50	7.0	D18	- 3
SERIES	ADDED FEATURES	OPERATING TEMP.	STABILITY	TOLERANCE	RESISTANCE	FREQUENCY	LOAD CAP.	OVERTONE
CM1J	BLANK = BULK PACK Z = TAPE AND REEL	A0 = -10°C ~ +60°C A1 = -10°C ~ +70°C A2 = -40°C ~ +85°C A3 = -55°C ~ +125°C	B1 = ±100 B2 = ± 50 B3 = ± 30 B4 = ± 10	C1 = ±100 C2 = ± 50 C3 = ± 30 C4 = ± 10	SEE CHART BELOW		D16,18,20,ETC. DS = SERIES	BLANK: FUND. -3: 3rd OT -5: 5th OT -7: 7th OT -BT: BT Cut

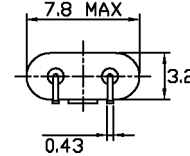
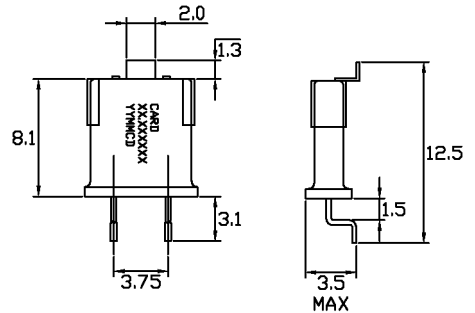
**NOTE: The above ABC combinations cover basic specification options. We tailor our crystal specifications to meet customer requirements. Please contact our sales department if you don't see exactly what you need.*

Specifications:

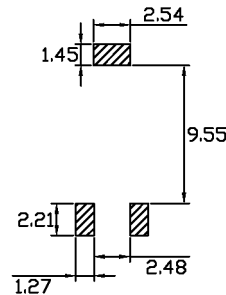
Frequency Range:	10.000 ~ 175.000 MHz
Operating Temperature:	-10°C ~ + 70°C <i>Standard</i> -40°C ~ + 85°C -55°C ~ +125°C
Frequency Stability:	± 100 ppm ± 50 ppm <i>Standard</i> ± 30 ppm ± 10 ppm
Frequency Tolerance: (at 25°C)	± 100 ppm ± 50 ppm <i>Standard</i> ± 30 ppm ± 10 ppm
Load Capacitance:	Standard 18 pF or series. Please specify your required load.
Resistance:	Maximum resistance corresponds to frequency. See below.
Standard:	Mode: Fundamental, 3rd, 5th, or 7th Overtone Shunt Capacitance: 7 pF Max Aging: ± 5 ppm/year Drive Level: 1.0 mW Max
Optional Features:	Tape and Reel (1K per Reel)

Note: Not all combinations of the above tolerances, stabilities, and temperature ranges are available. Consult the factory if your requirement is not standard.

CM1J



RECOMMENDED SOLDER PAD LAYOUT



Resistance Chart: All resistances are maximum values.

Frequency MHz	Equivalent Series Resistance (Ω)	Oscillation Mode / Cut
7.000~15.999	50 Max	Fundamental
16.000~40.000	40 Max	Fundamental
30.000~90.000	70 Max	Third Overtone
70.000~175.000	100 Max	Fifth Overtone



Surface Mount UM-5

Series **CM5J**

- *Smaller than CM1J with the same characteristics*
- *SMD profile*
- *Grounded case better for EMI*

Part Numbering Example: CM5J Z - A1 B2 C2 50 - 7.0 D18 - 3

CM5J	Z	A1*	B2	C2	50	7.0	D18	- 3
SERIES	ADDED FEATURES	OPERATING TEMP.	STABILITY	TOLERANCE	RESISTANCE	FREQUENCY	LOAD CAP.	OVERTONE
CM5J	BLANK = BULK PACK Z = TAPE AND REEL	A0 = -10°C ~ +60°C A1 = -10°C ~ +70°C A2 = -40°C ~ +85°C A3 = -55°C ~ +125°C	B1 = ±100 B2 = ± 50 B3 = ± 30 B4 = ± 10	C1 = ±100 C2 = ± 50 C3 = ± 30 C4 = ± 10	SEE CHART BELOW		D16,18,20,ETC. DS = SERIES	BLANK: FUND. -3: 3rd OT -5: 5th OT -7: 7th OT -BT: BT Cut

**NOTE: The above ABC combinations cover basic specification options. We tailor our crystal specifications to meet customer requirements. Please contact our sales department if you don't see exactly what you need.*

Specifications:

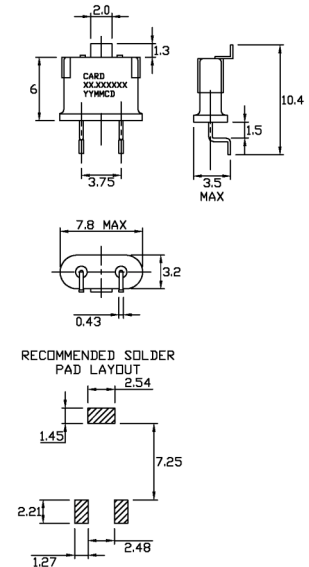
Frequency Range:	10.000 ~ 175.000 MHz
Operating Temperature:	-10°C ~ + 70°C <i>Standard</i> -40°C ~ + 85°C -55°C ~ +125°C
Frequency Stability:	± 100 ppm ± 50 ppm <i>Standard</i> ± 30 ppm ± 10 ppm
Frequency Tolerance: (at 25°C)	± 100 ppm ± 50 ppm <i>Standard</i> ± 30 ppm ± 10 ppm
Load Capacitance:	Standard 18 pF or series. Please specify your required load.
Resistance:	Maximum resistance corresponds to frequency. See chart below..
Standard:	Mode: Fundamental, 3rd, 5th, or 7th Overtone Shunt Capacitance: 7 pF Max Aging: ± 5 ppm/year Drive Level: 1.0 mW Max
Optional Features:	Tape and Reel (?? per Reel) Vinyl Sleeves

Note: Not all combinations of the above tolerances, stabilities, and temperature ranges are available. Consult the factory if your requirement is not standard.

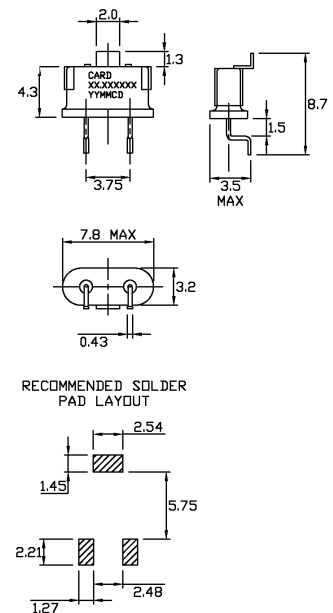
Resistance Chart: All resistances are maximum values.

EQUIVALENT SERIES RESISTANCE (ESR), MODE OF OPERATION (MODE), AND CUT		
Frequency MHz	Equivalent Series Resistance (Ω)	Oscillation Mode / Cut
7.000~15.999	60 Max	Fundamental
16.000~40.000	50 Max	Fundamental
30.000~90.000	80 Max	Third Overtone
70.000~175.000	120 Max	Fifth Overtone

CM5J



CM4J



Ultra-Miniature Crystals

Series **CX77**

Cardinal's ultra-miniature crystals are a smaller alternative to the standard HC-49 package where applications require compact board space. They are perfect for wireless applications like cellular, pagers, etc.

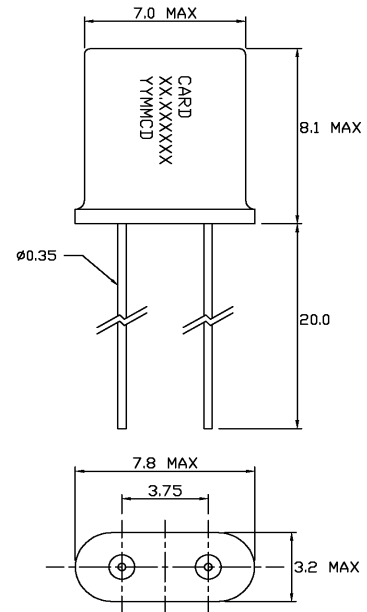
Part Numbering Example: CX77 Z - A1 - B2 - C2 35 - 77.76 DS

CX77	Z	A1*	B2	C2	35	77.76	DS
SERIES	ADDED FEATURES	OPERATING TEMP.	STABILITY	TOLERANCE	RESISTANCE	FREQUENCY	LOAD CAP.
CX77	BLANK = BULK PACK Z = TAPE AND REEL	A0 = -10°C ~ +60°C A1 = -10°C ~ +70°C A2 = -40°C ~ +85°C A3 = -55°C ~ +125°C	B1 = ±100 B2 = ± 50 B3 = ± 30 B4 = ± 10	C1 = ±100 C2 = ± 50 C3 = ± 30 C4 = ± 10			DS = SERIES

Specifications:

Frequency Range:	77.760 MHz (Fundamental)
Operating Temperature:	-0°C ~ +70°C Standard
Frequency Stability:	± 10 ppm Standard
Frequency Tolerance:	± 10 ppm Standard (at 25°C)
Load Capacitance:	Series Resonance
Resistance:	Maximum resistance 35 Ω.
Standard:	Mode: Fundamental Shunt Capacitance: 7 pF Max Aging: ± 5 ppm/year Drive Level: 1.0 mW Max
Optional Features:	Third lead Insulator pads

CX77



Ultra-Miniature Crystals

Cardinal's ultra-miniature crystals are a smaller alternative to the standard HC-49 package where applications require compact board space. They are perfect for wireless applications like cellular, pagers, etc.

Part Numbering Example: CX155 Z - A1 - B2 - C2 35 - 155.52 DS

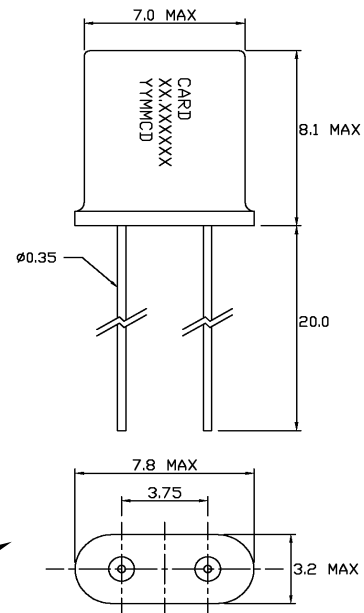
CX155	Z	A1*	B2	C2	35	155.52	DS
SERIES	ADDED FEATURES	OPERATING TEMP.	STABILITY	TOLERANCE	RESISTANCE	FREQUENCY	LOAD CAP.
CX155	BLANK = BULK PACK Z = TAPE AND REEL	A0 = -10°C ~ +60°C A1 = -10°C ~ +70°C A2 = -40°C ~ +85°C A3 = -55°C ~ +125°C	B1 = ±100 B2 = ± 50 B3 = ± 30 B4 = ± 10	C1 = ±100 C2 = ± 50 C3 = ± 30 C4 = ± 10			DS = SERIES

**NOTE: The above ABC combinations cover basic specification options. We tailor our crystal specifications to meet customer requirements. Please contact our sales department if you don't see exactly what you need.*

Specifications:

Frequency Range:	155.52 MHz	(Fundamental)
Operating Temperature:	-0°C ~ + 70°C	Standard
Frequency Stability:	± 10 ppm	Standard
Frequency Tolerance:	± 10 ppm	Standard (at 25°C)
Load Capacitance:	Series Resonance	
Resistance:	Maximum resistance 35	
Standard:	Mode: Fundamental Shunt Capacitance: 7 pF Max Aging: ± 5 ppm/year Drive Level: 1.0 mW Max	
Optional Features:	Third lead Insulator pads	

CX155



Surface Mount Crystal

Fits Epson MA406 footprint.

Series **CX406**

Part Numbering Example: CX406 Z - A1 B2 C2 200 3.579545 D18 - 3

CX406	Z	A1*	B2	C2	200	3.579545	D18	- 3
SERIES	ADDED FEATURES	OPERATING TEMP.	STABILITY	TOLERANCE	RESISTANCE	FREQUENCY	LOAD CAP.	OVERTONE
CX406	BLANK = BULK PACK Z = TAPE AND REEL	A0 = -10°C ~ +60°C A1 = -10°C ~ +70°C A2 = -40°C ~ +85°C A3 = -55°C ~ +125°C	B1 = ±100 B2 = ± 50 B3 = ± 30 B4 = ± 10	C1 = ±100 C2 = ± 50 C3 = ± 30 C4 = ± 10	SEE CHART BELOW		D16,18,20,ETC. DS = SERIES	BLANK: FUND. -3: 3rd OT -5: 5th OT -7: 7th OT -BT: BT Cut

*NOTE: The above ABC combinations cover basic specification options. We tailor our crystal specifications to meet customer requirements. Please contact our sales department if you don't see exactly what you need.

Specifications:

Frequency Range:

3.579545 ~ 38.000 MHz	AT Cut Fundamental
25.000000 ~ 75.000 MHz	AT Cut 3rd Overtone
26.000000 ~ 42.000 MHz	BT Cut Fundamental

Operating Temperature:	-10°C ~ +70°C	Standard
	-40°C ~ +85°C	

Frequency Stability:	±100 ppm	
	± 50 ppm	Standard
	± 30 ppm	
	± 15 ppm	

Frequency Tolerance:	±100 ppm	
(at 25°C)	± 50 ppm	Standard
	± 30 ppm	
	± 10 ppm	

Load Capacitance:	Standard 18 pF or series.
	Please specify your required load.

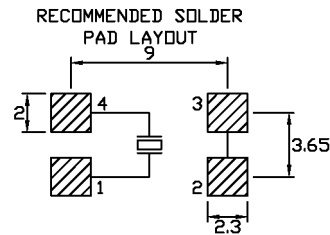
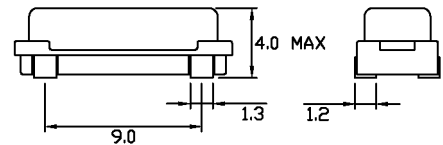
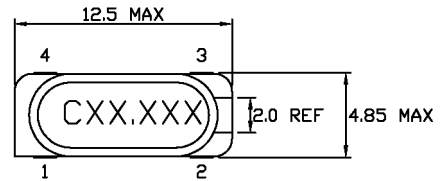
Resistance:	Maximum resistance corresponds to frequency.
	See chart below.

Standard:	Mode: Fundamental or 3rd Overtone
	Shunt Capacitance: 7 pF Max
	Aging: ± 5 ppm/year
	Drive Level: 1.0 mW Max

Optional Features:	Tape and Reel (1K per Reel)
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Note: Not all combinations of the above tolerances, stabilities, and temperature ranges are available. Consult the factory if your requirement is not standard.

CX406



Resistance Chart: All resistances are maximum values.

EQUIVALENT SERIES RESISTANCE (ESR), MODE OF OPERATION (MODE), AND CUT					
Frequency MHz	ESR(Ω)	Mode/cut	Frequency MHz	ESR (Ω)	Mode/cut
3.579545~4.999	200 Max	Fund./AT	15.000~15.999	60 Max	Fund./AT
5.000~5.999	150 Max	Fund./AT	16.000~23.999	50 Max	Fund./AT
6.000~7.999	120 Max	Fund./AT	24.000~30.000	40 Max	Fund./AT
8.000~8.999	90 Max	Fund./AT	24.000~48.000	40 Max	Fund./BT
9.000~9.999	80 Max	Fund./AT	24.576~29.999	150 Max	3rd Overtone/AT
10.000~14.999	70 Max	Fund./AT	30.000~75.000	100 Max	3rd Overtone/AT



Surface Mount Crystal

Fits Epson MA505 footprint.

Series **CX505**

Part Numbering Example: CX505 Z - A1 B2 C3 200 - 3.579545 D18 - 3

CX505	Z	A1*	B2	C2	200	3.579545	D18	- 3
SERIES	ADDED FEATURES	OPERATING TEMP.	STABILITY	TOLERANCE	RESISTANCE	FREQUENCY	LOAD CAP.	OVERTONE
CX505	BLANK = BULK PACK Z = TAPE AND REEL	A0 = -10°C ~ +60°C A1 = -10°C ~ +70°C A2 = -40°C ~ +85°C A3 = -55°C ~ +125°C	B1 = ±100 B2 = ± 50 B3 = ± 30 B4 = ± 10	C1 = ±100 C2 = ± 50 C3 = ± 30 C4 = ± 10	SEE CHART BELOW		D16,18,20,ETC. DS = SERIES	BLANK: FUND. -3: 3rd OT -5: 5th OT -7: 7th OT -BT: BT Cut

*NOTE: The above ABC combinations cover basic specification options. We tailor our crystal specifications to meet customer requirements. Please contact our sales department if you don't see exactly what you need.

Specifications:

Frequency Range:

3.579545 ~ 38.000 MHz	AT Cut Fundamental
25.000000 ~ 75.000 MHz	AT Cut 3rd Overtone
26.000000 ~ 42.000 MHz	BT Cut Fundamental

Operating Temperature:	-10°C ~ +70°C	Standard
	-40°C ~ +85°C	

Frequency Stability:	±100 ppm	
	± 50 ppm	Standard
	± 30 ppm	
	± 15 ppm	

Frequency Tolerance:	±100 ppm	
(at 25°C)	± 50 ppm	Standard
	± 30 ppm	
	± 10 ppm	

Load Capacitance:	Standard 18 pF or series.
	Please specify your required load.

Resistance:	Maximum resistance corresponds to frequency. See chart below.
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Standard:	Mode: Fundamental or 3rd Overtone Shunt Capacitance: 7 pF Max Aging: ± 5 ppm/year Drive Level: 1.0 mW Max
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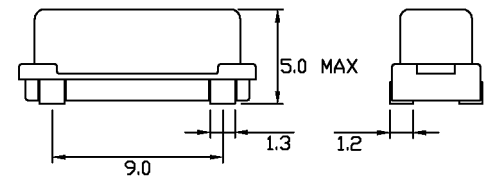
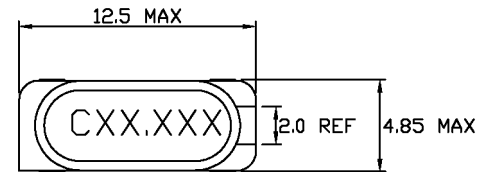
Optional Features:	Tape and Reel (1K per Reel)
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Note: Not all combinations of the above tolerances, stabilities, and temperature ranges are available. Consult the factory if your requirement is not standard.

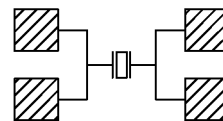
Resistance Chart: All resistances are maximum values.

EQUIVALENT SERIES RESISTANCE (ESR), MODE OF OPERATION (MODE), AND CUT					
Frequency MHz	ESR(Ω)	Mode/cut	Frequency MHz	ESR (Ω)	Mode/cut
3.579545~4.999	200 Max	Fund./AT	15.000~15.999	60 Max	Fund./AT
5.000~5.999	150 Max	Fund./AT	16.000~23.999	50 Max	Fund./AT
6.000~7.999	120 Max	Fund./AT	24.000~30.000	40 Max	Fund./AT
8.000~8.999	90 Max	Fund./AT	24.000~48.000	40 Max	Fund./BT
9.000~9.999	80 Max	Fund./AT	24.576~29.999	150 Max	3rd Overtone/AT
10.000~14.999	70 Max	Fund./AT	30.000~75.000	100 Max	3rd Overtone/AT

CX505



RECOMMENDED SOLDER PAD LAYOUT



Surface Mount Crystal

Fits Epson MA506 footprint.

Series **CX506**

Part Numbering Example: **CX506 Z - A1 B2 C2 200 - 3.579545 D18 - 3**

CX506	Z	A1*	B2	C2	200	3.579545	D18	- 3
SERIES	ADDED FEATURES	OPERATING TEMP.	STABILITY	TOLERANCE	RESISTANCE	FREQUENCY	LOAD CAP.	OVERTONE
CX506	BLANK = BULK PACK Z = TAPE AND REEL	A0 = -10°C ~ +60°C A1 = -10°C ~ +70°C A2 = -40°C ~ +85°C A3 = -55°C ~ +125°C	B1 = ±100 B2 = ± 50 B3 = ± 30 B4 = ± 10	C1 = ±100 C2 = ± 50 C3 = ± 30 C4 = ± 10	SEE CHART BELOW		D16,18,20,ETC. DS = SERIES	BLANK: FUND. -3: 3rd OT -5: 5th OT -7: 7th OT -BT: BT Cut

*NOTE: The above ABC combinations cover basic specification options. We tailor our crystal specifications to meet customer requirements. Please contact our sales department if you don't see exactly what you need.

Specifications:

Frequency Range:

3.579545 ~ 38.000 MHz	AT Cut Fundamental
25.000000 ~ 75.000 MHz	AT Cut 3rd Overtone
26.000000 ~ 42.000 MHz	BT Cut Fundamental

Operating Temperature:	-10°C ~ +70°C	Standard
	-40°C ~ +85°C	

Frequency Stability:	±100 ppm	
	± 50 ppm	Standard
	± 30 ppm	
	± 15 ppm	

Frequency Tolerance:	±100 ppm	
(at 25°C)	± 50 ppm	Standard
	± 30 ppm	
	± 10 ppm	

Load Capacitance:	Standard 18 pF or series.
	Please specify your required load.

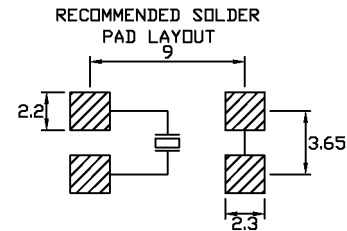
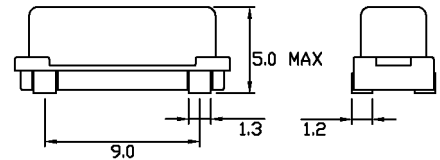
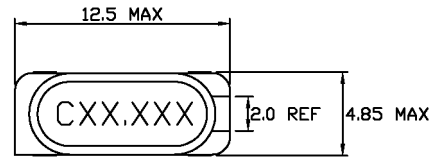
Resistance:	Maximum resistance corresponds to frequency.
	See chart below.

Standard:	Mode: Fundamental or 3rd Overtone
	Shunt Capacitance: 7 pF Max
	Aging: ± 5 ppm/year
	Drive Level: 1.0 mW Max

Optional Features:	Tape and Reel (1K per Reel)
---------------------------	-----------------------------

Note: Not all combinations of the above tolerances, stabilities, and temperature ranges are available. Consult the factory if your requirement is not standard.

CX506



Resistance Chart: All resistances are maximum values.

EQUIVALENT SERIES RESISTANCE (ESR), MODE OF OPERATION (MODE), AND CUT					
Frequency MHz	ESR(Ω)	Mode/cut	Frequency MHz	ESR (Ω)	Mode/cut
3.579545~4.999	200 Max	Fund./AT	15.000~15.999	60 Max	Fund./AT
5.000~5.999	150 Max	Fund./AT	16.000~23.999	50 Max	Fund./AT
6.000~7.999	120 Max	Fund./AT	24.000~30.000	40 Max	Fund./AT
8.000~8.999	90 Max	Fund./AT	24.000~48.000	40 Max	Fund./BT
9.000~9.999	80 Max	Fund./AT	24.576~29.999	150 Max	3rd Overtone/AT
10.000~14.999	70 Max	Fund./AT	30.000~75.000	100 Max	3rd Overtone/AT



Micro AT-Strip Crystals

Series **CMS8**

Cardinal micro crystals are small substitutes for the HC-49 package.
They are perfect for applications involving tight board density.

Part Numbering Example: CSM8 - Z - A1 B2 C2 150 - 3.579545 D18 - 3

CSM8	Z	A1*	B2	C2	150	3.579545	D18	- 3
SERIES	ADDED FEATURES	OPERATING TEMP.	STABILITY	TOLERANCE	RESISTANCE	FREQUENCY	LOAD CAP.	OVERTONE
CSM8	F = FORMED LEADS W = VINYL SLEEVING Z = TAPE AND REEL	A0 = -10°C ~ +60°C A1 = -10°C ~ +70°C A2 = -40°C ~ +85°C A3 = -55°C ~ +125°C	B1 = ±100 B2 = ± 50 B3 = ± 30 B4 = ± 10	C1 = ±100 C2 = ± 50 C3 = ± 30 C4 = ± 10	SEE CHART BELOW		D16,18,20,ETC. DS = SERIES	BLANK: FUND. -3: 3rd OT

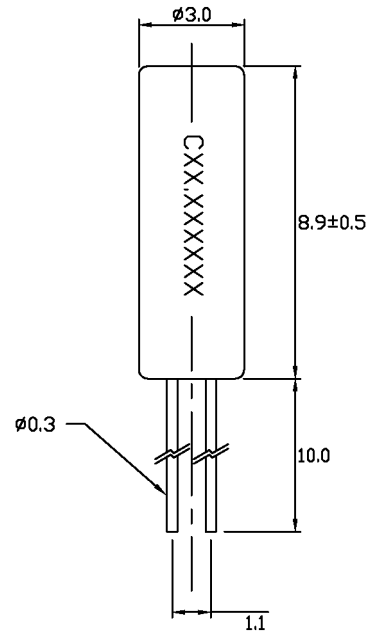
*NOTE: The above ABC combinations cover basic specification options. We tailor our crystal specifications to meet customer requirements. Please contact our sales department if you don't see exactly what you need.

Specifications:

Frequency Range:	3.579545 ~ 64.000 MHz
Operating Temperature:	-10°C ~ +60°C <i>Standard</i>
Frequency Stability:	± 100 ppm ± 50 ppm <i>Standard</i> ± 30 ppm
Frequency Tolerance: (at 25°C)	± 100 ppm ± 50 ppm <i>Standard</i> ± 30 ppm
Load Capacitance:	Standard 18 pF or series. Please specify your required load.
Resistance:	Maximum resistance corresponds to frequency. See chart below.
Standard:	Mode: Fundamental or 3rd Overtone Shunt Capacitance: 7 pF Max Aging: ± 5 ppm/year Drive Level: 1.0 mW Max
Optional Features:	Formed Leads Vinyl Sleeves

Note: Not all combinations of the above tolerances, stabilities, and temperature ranges are available. Consult the factory if your requirement is not standard.

CMS8



Resistance Chart: All resistances are maximum values.

CMS		
Frequency MHz	Mode of Operation	ESR (Ω)
3.579545 ~ 3.999999		200Ω
4.000000 ~ 4.999999		150Ω
5.000000 ~ 5.999999		120Ω
6.000000 ~ 6.999999		100Ω
7.000000 ~ 8.999999		80Ω
9.000000 ~ 12.999999		60Ω
13.000000 ~ 24.999999		50Ω
25.000000 ~ 42.000000	Fundamental	40Ω
25.000000 ~ 48.000000	Third Overtone	80Ω
48.000001 ~ 64.000000	Third Overtone	60Ω



Plastic Surface Mount Crystals

Series **CPX**

The Cardinal CPX series SMD crystal is made of durable thermoplastic. The wide frequency range and small size make it very versatile for many consumer electronic applications.

Part Numbering Example: CPX Z - A1 B2 C2 200 - 3.579545 D18 - 3

CPX	Z	A1*	B2	C2	200	3.579545	D18	- 3
SERIES	ADDED FEATURES	OPERATING TEMP.	STABILITY	TOLERANCE	RESISTANCE	FREQUENCY	LOAD CAP.	OVERTONE
CPX	BLANK = BULK PACK Z = TAPE AND REEL	A0 = -10°C ~ +60°C A1 = -10°C ~ +70°C A2 = -40°C ~ +85°C A3 = -55°C ~ +125°C	B1 = ±100 B2 = ± 50 B3 = ± 30 B4 = ± 10	C1 = ±100 C2 = ± 50 C3 = ± 30 C4 = ± 10	SEE CHART BELOW		D16,18,20,ETC. DS = SERIES	BLANK: FUND. -3: 3rd OT

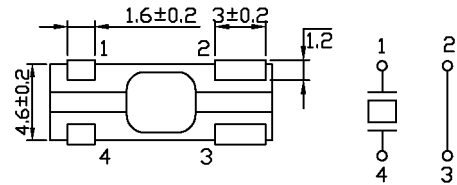
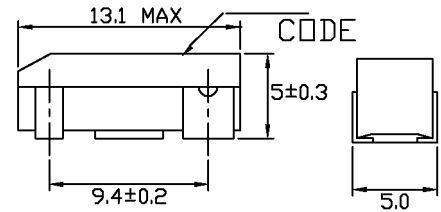
**NOTE: The above ABC combinations cover basic specification options. We tailor our crystal specifications to meet customer requirements. Please contact our sales department if you don't see exactly what you need.*

Specifications:

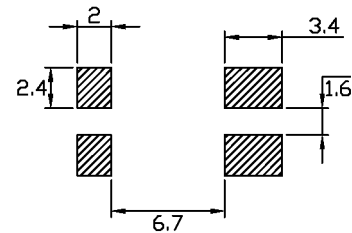
Frequency Range:	3.579545 ~ 70.000 MHz
Operating Temperature:	-10°C ~ +70°C <i>Standard</i> -40°C ~ +85°C
Frequency Stability:	±100 ppm ± 50 ppm <i>Standard</i> ± 30 ppm
Frequency Tolerance:	± 50 ppm <i>Standard</i> (at 25°C) ± 30 ppm
Load Capacitance:	Standard 18 pF or series. Please specify your required load.
Resistance:	Maximum resistance corresponds to frequency. See chart below.
Standard:	Mode: Fundamental or 3rd Overtone Shunt Capacitance: 7 pF Max Aging: ± 5 ppm/year Drive Level: 1.0 mW Max Packaging: Tape and Reel (1K per Reel)

Note: Not all combinations of the above tolerances, stabilities, and temperature ranges are available. Consult the factory if your requirement is not standard.

CPX



RECOMMENDED SOLDER PAD LAYOUT



Resistance Chart: All resistances are maximum values.

EQUIVALENT SERIES RESISTANCE (ESR), MODE OF OPERATION (MODE), AND CUT					
Frequency MHz	ESR(Ω)	Mode/cut	Frequency MHz	ESR (Ω)	Mode/cut
3.579545~4.999	200 Max	Fund./AT	10.000~14.999	70 Max	Fund./AT
5.000~5.999	150 Max	Fund./AT	15.000~15.999	60 Max	Fund./AT
6.000~7.999	120 Max	Fund./AT	16.000~30.000	50 Max	Fund./AT
8.000~8.999	90 Max	Fund./AT	30.000~49.999	80 Max	3rd Overtone/AT
9.000~9.999	80 Max	Fund./AT	50.000~70.000	80 Max	3rd Overtone/AT



Plastic Surface Mount Crystals

Series **CPC**

- Smaller package than CPX
- Cost effective

Part Numbering Example: CPC Z - A1 B2 C2 200 - 3.579545 D18 - 3

CPC	Z	A1*	B2	C2	200	3.579545	D18	- 3
SERIES	ADDED FEATURES	OPERATING TEMP.	STABILITY	TOLERANCE	RESISTANCE	FREQUENCY	LOAD CAP.	OVERTONE
CPC	BLANK = BULK PACK Z = TAPE AND REEL	A0 = -10°C ~ +60°C A1 = -10°C ~ +70°C A2 = -40°C ~ +85°C A3 = -55°C ~ +125°C	B1 = ±100 B2 = ± 50 B3 = ± 30 B4 = ± 10	C1 = ±100 C2 = ± 50 C3 = ± 30 C4 = ± 10	SEE CHART BELOW		D16,18,20,ETC. DS = SERIES	BLANK: FUND. -3: 3rd OT -5: 5th OT -7: 7th OT -BT: BT Cut

*NOTE: The above ABC combinations cover basic specification options. We tailor our crystal specifications to meet customer requirements. Please contact our sales department if you don't see exactly what you need.

Specifications:

Frequency Range:

3.500 ~ 30.000 MHz	AT-Cut Fundamental
30.000 ~ 70.000 MHz	3rd Overtone

Operating Temperature:	0°C ~ +70°C	Standard
	-40°C ~ +85°C	

Frequency Stability:	± 100 ppm	
	± 50 ppm	Standard

Frequency Tolerance:	± 50 ppm	Standard
	<i>(at 25°C)</i>	

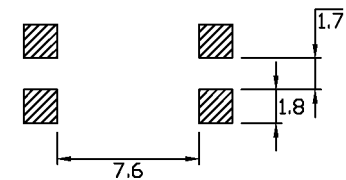
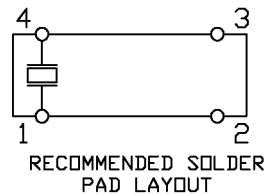
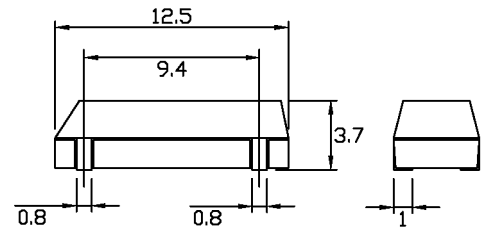
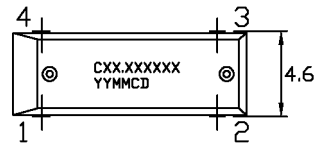
Load Capacitance:	Standard 18 pF or series.
	Please Specify your required load.

Resistance:	Maximum resistance corresponds to frequency.
	See chart below.

Standard:	Shunt Capacitance: 7 pF Max
	Aging: ± 5 ppm/year
	Drive Level: 1.0 mW Max
	Packaging: Tape and Reel

Note: Not all combinations of the above tolerances, stabilities, and temperature ranges are available. Consult the factory if your requirement is not standard.

CPC



Resistance Chart: All resistances are maximum values.

EQUIVALENT SERIES RESISTANCE (ESR), MODE OF OPERATION (MODE), AND CUT					
Frequency MHz	ESR(Ω)	Mode/cut	Frequency MHz	ESR(Ω)	Mode/cut
3.579545~4.999	200 Max	Fund./AT	10.000~14.999	70 Max	Fund./AT
5.000~5.999	150 Max	Fund./AT	15.000~15.999	60 Max	Fund./AT
6.000~7.999	120 Max	Fund./AT	16.000~30.000	50 Max	Fund./AT
8.000~8.999	90 Max	Fund./AT	30.000~49.999	80 Max	3rd Overtone/AT
9.000~9.999	80 Max	Fund./AT	50.000~70.000	80 Max	3rd Overtone/AT



Low Profile Ceramic Surface Mount Crystals

Series **CX21**

Cardinal "AT-Strip" ceramic surface mount crystals are among the most readily available on the market today. Many popular frequencies are kept in stock at our facility.

Part Numbering Example: CX21 Z - A1 B2 C2 200 - 3.579545 D18 - 3

CX21	Z	A1*	B2	C2	200	3.579545	D18	- 3
SERIES	ADDED FEATURES	OPERATING TEMP.	STABILITY	TOLERANCE	RESISTANCE	FREQUENCY	LOAD CAP.	OVERTONE
CX21	BLANK = BULK PACK Z = TAPE AND REEL	A0 = -10°C ~ +60°C A1 = -10°C ~ +70°C A2 = -40°C ~ +85°C A3 = -55°C ~ +125°C	B1 = ±100 B2 = ± 50 B3 = ± 30 B4 = ± 10	C1 = ±100 C2 = ± 50 C3 = ± 30 C4 = ± 10	SEE CHART BELOW		D16,18,20,ETC. DS = SERIES	BLANK: FUND. -3: 3rd OT -5: 5th OT -7: 7th OT -BT: BT Cut

**NOTE: The above ABC combinations cover basic specification options. We tailor our crystal specifications to meet customer requirements. Please contact our sales department if you don't see exactly what you need.*

Specifications:

Frequency Range:

3.579545 ~ 20.000 MHz	AT Cut Fundamental
20.000000 ~ 60.000 MHz	AT Cut 3rd Overtone

Operating Temperature: -10°C ~ +60°C *Standard*

Frequency Stability:

±100 ppm	
± 50 ppm	<i>Standard</i>
± 30 ppm	
± 15 ppm	

Frequency Tolerance:

±100 ppm	
(at 25°C) ± 50 ppm	<i>Standard</i>
± 30 ppm	
± 10 ppm	

Load Capacitance: Standard 18 pF
Please specify your required load.

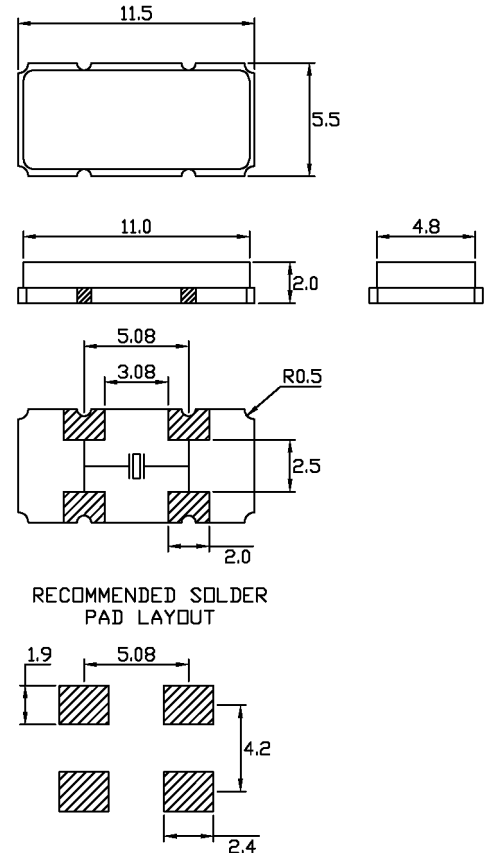
Resistance: Maximum resistance corresponds to frequency.
See chart below.

Standard: Mode: Fundamental or 3rd Overtone
Shunt Capacitance: 7 pF Max
Aging: ± 5 ppm/year
Drive Level: 1.0 mW Max

Optional Features: Tape and Reel (1K per Reel)

Note: Not all combinations of the above tolerances, stabilities, and temperature ranges are available. Consult the factory if your requirement is not standard.

CX21



Resistance Chart: All resistances are maximum

EQUIVALENT SERIES RESISTANCE (ESR), MODE OF OPERATION (MODE)		
Frequency MHz	ESR (Ω)	Oscillation Mode
3.5 ~ 3.999	200 Max	Fundamental
4.0 ~ 4.499	150 Max	Fundamental
4.5 ~ 6.999	100 Max	Fundamental
7.0 ~ 13.999	70 Max	Fundamental
14.0 ~ 20.000	50 Max	Fundamental
20.0 ~ 60.000	100 Max	3rd Overtone



Low Profile Ceramic Surface Mount Crystal

Series **CX129**

Cardinal "AT-Strip" low profile crystals come in a variety of heights and specifications to accommodate all of our customers' requirements.

Part Numbering Example: CX129 Z - A1 B2 C2 100 - 8.0 D18 - 3

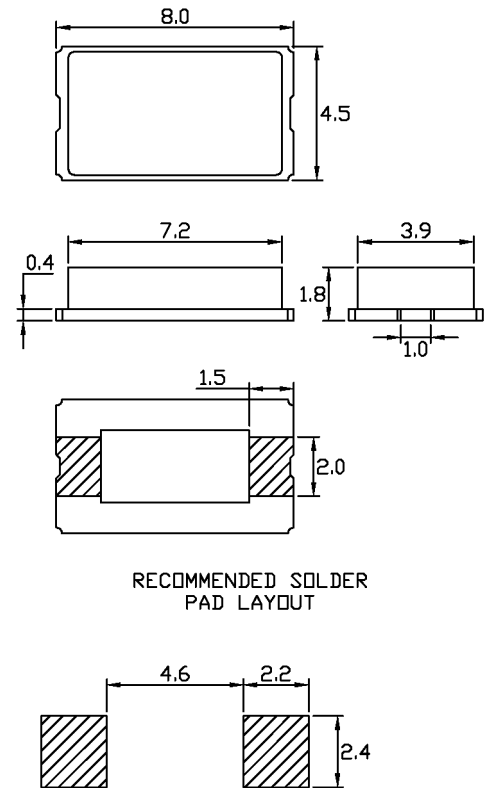
CX129	Z	A1*	B2	C2	100	8.0	D18	- 3
SERIES	ADDED FEATURES	OPERATING TEMP.	STABILITY	TOLERANCE	RESISTANCE	FREQUENCY	LOAD CAP.	OVERTONE
CX129	BLANK = BULK PACK Z = TAPE AND REEL	A0 = -10°C ~ +60°C A1 = -10°C ~ +70°C A2 = -40°C ~ +85°C A3 = -55°C ~ +125°C	B1 = ±100 B2 = ± 50 B3 = ± 30 B4 = ± 10	C1 = ±100 C2 = ± 50 C3 = ± 30 C4 = ± 10	SEE CHART BELOW		D16,18,20,ETC. DS = SERIES	BLANK: FUND. -3: 3rd OT -5: 5th OT -7: 7th OT -BT: BT Cut

*NOTE: The above ABC combinations cover basic specification options. We tailor our crystal specifications to meet customer requirements. Please contact our sales department if you don't see exactly what you need.

Specifications:

Frequency Range:	8.0 ~ 40.0 MHz	AT Cut Fundamental
	30.0 ~100.0 MHz	AT Cut 3rd Overtone
Operating Temperature:	-10°C ~ +60°C	Standard
Frequency Stability:	±100 ppm	
	± 50 ppm	Standard
	± 30 ppm	
	± 10 ppm	
Frequency Tolerance:	±100 ppm	
(at 25°C)	± 50 ppm	Standard
	± 30 ppm	
	± 10 ppm	
Load Capacitance:	Standard 18 pF or series. Please specify your required load.	
Resistance:	Maximum resistance corresponds to frequency. See chart below.	
Standard:	Mode: Fundamental or 3rd Overtone Shunt Capacitance: 7 pF Max Aging: ± 5 ppm/year Drive Level: 1.0 mW Max	
Optional Features:	Tape and Reel (1K per Reel)	

CX129



Resistance Chart: All resistances are maximum

EQUIVALENT SERIES RESISTANCE (ESR), MODE OF OPERATION (MODE)		
Frequency MHz	ESR (Ω)	Oscillation Mode
8.0 ~ 9.999	100	Fundamental
10.0 ~ 11.999	80	Fundamental
12.0 ~ 40.000	50	Fundamental
30.0 ~ 100.000	70	3rd Overtone



Ceramic CX051

Series **CX051**

Cardinal's CX051 at 1.3 mm max height is perfect for all PCMCIA applications such as multimedia, LAN adaptors, disk drives, and data collection. The tight tolerance option is available for telecommunications applications.

Part Numbering Example: CX051 Z - A1 - B2 - C2 60 - 9.8304 D16 - 3

CX051	Z	A1*	B2	C2	60	9.8304	D16	- 3
SERIES	ADDED FEATURES	OPERATING TEMP.	STABILITY	TOLERANCE	RESISTANCE	FREQUENCY	LOAD CAP.	OVERTONE
CX051	BLANK = BULK PACK Z = TAPE AND REEL	A0 = -10°C ~ +60°C A1 = -10°C ~ +70°C A2 = -40°C ~ +85°C A3 = -55°C ~ +125°C	B1 = ±100 B2 = ± 50 B3 = ± 30 B4 = ± 10	C1 = ±100 C2 = ± 50 C3 = ± 30 C4 = ± 10	SEE CHART BELOW		D16,18,20,ETC. DS = SERIES	BLANK: FUND. -3: 3rd OT -5: 5th OT -7: 7th OT -BT: BT Cut

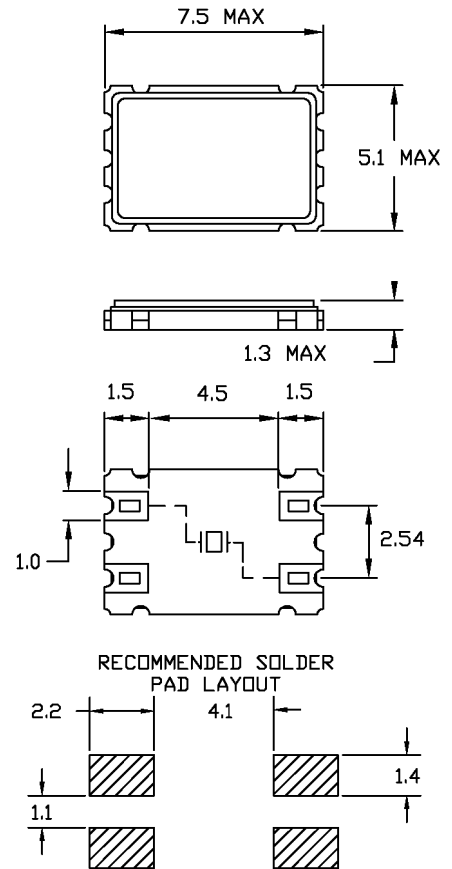
*NOTE: The above ABC combinations cover basic specification options. We tailor our crystal specifications to meet customer requirements. Please contact our sales department if you don't see exactly what you need.

Specifications:

Frequency Range:	9.8304 ~ 100.000 MHz
Operating Temperature:	-10°C ~ +60°C <i>Standard</i> -40°C ~ +85°C
Frequency Stability:	± 100 ppm ± 50 ppm <i>Standard</i> ± 10 ppm
Frequency Tolerance:	± 100 ppm (at 25°C) ± 50 ppm <i>Standard</i> ± 10 ppm
Load Capacitance:	Standard 16 pF or series. Other values are available.
Resistance:	Maximum resistance corresponds to frequency. See chart below.
Standard:	Mode: Fundamental, 3rd, or 5th Overtone Shunt Capacitance: 7 pF Max Aging: ± 5 ppm/year Drive Level: 100 µW Packaging: Tape and Reel (1K per Reel)

Note: Not all combinations of the above tolerances, stabilities, and temperature ranges are available. Consult the factory if your requirement is not standard.

CX051



Resistance Chart: All resistances are maximum values.

EQUIVALENT SERIES RESISTANCE (ESR), MODE OF OPERATION (MODE), AND CUT					
Frequency MHz	ESR(Ω)	Mode/cut	Frequency MHz	ESR (Ω)	Mode/cut
9.500~10.999	60 Max	Fund./AT	35.000~39.999	100 Max	3rd Overtone/AT
11.000~13.999	50 Max	Fund./AT	40.000~49.999	80 Max	3rd Overtone/AT
14.000~15.999	40 Max	Fund./AT	50.000~89.999	50 Max	3rd Overtone/AT
16.000~40.000	30 Max	Fund./AT	90.000~100.000	100 Max	5th Overtone/AT



Ceramic Surface Mount Crystals

Series **CX17A**
CX17C

The Cardinal CX17A and CX17C are epoxy sealed ceramic crystals. The advantages of short height (1.7 mm max), two different terminal patterns, and lower cost are combined in this popular Cardinal SMD crystal.

Part Numbering Example: CX17A Z - A1 B2 C2 60 - 10.0 D18 - 3

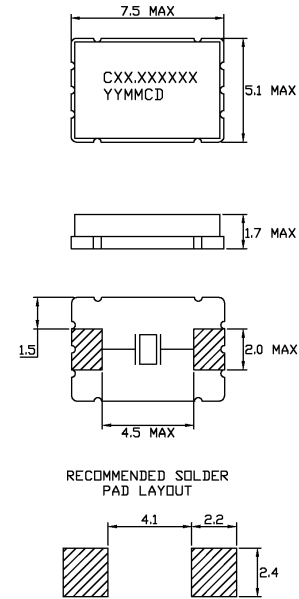
CX17A	Z	A1*	B2	C2	60	10.0	D18	- 3
SERIES	ADDED FEATURES	OPERATING TEMP.	STABILITY	TOLERANCE	RESISTANCE	FREQUENCY	LOAD CAP.	OVERTONE
CX17A	BLANK = BULK PACK	A0 = -10°C ~ +60°C	B1 = ±100	C1 = ±100	SEE CHART		D16,18,20,ETC.	BLANK: FUND.
CX17C	Z = TAPE AND REEL	A1 = -10°C ~ +70°C	B2 = ± 50	C2 = ± 50	BELOW		DS = SERIES	-3: 3rd OT
		A2 = -40°C ~ +85°C	B3 = ± 30	C3 = ± 30				-5: 5th OT
		A3 = -55°C ~ +125°C	B4 = ± 10	C4 = ± 10				-7: 7th OT
								-BT: BT Cut

*NOTE: The above ABC combinations cover basic specification options. We tailor our crystal specifications to meet customer requirements. Please contact our sales department if you don't see exactly what you need.

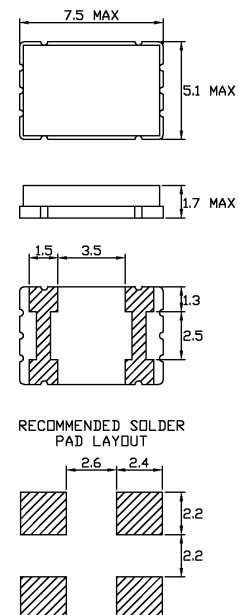
Specifications:

Frequency Range:	10.000 ~ 100.000 MHz
Operating Temperature:	-10°C ~ +60°C <i>Standard</i> -40°C ~ +85°C
Frequency Stability:	±100 ppm <i>Standard</i> ± 50 ppm
Frequency Tolerance:	± 50 ppm <i>Standard</i> (at 25°C)
Load Capacitance:	Standard 16 pF or series. Other values are available.
Resistance:	Maximum resistance corresponds to frequency. See chart below.
Standard:	Mode: Fundamental, 3rd, or 5th Overtone Shunt Capacitance: 7 pF Max Aging: ± 5 ppm/year Drive Level: 100 µW Packaging: Tape and Reel (1K per Reel)

CX17A



CX17C



Resistance Chart: All resistances are maximum values.

EQUIVALENT SERIES RESISTANCE (ESR), MODE OF OPERATION (MODE), AND CUT					
Frequency MHz	ESR(Ω)	Mode/cut	Frequency MHz	ESR (Ω)	Mode/cut
9.500~10.999	60 Max	Fund./AT	35.000~39.999	100 Max	3rd Overtone/AT
11.000~13.999	50 Max	Fund./AT	40.000~49.999	80 Max	3rd Overtone/AT
14.000~15.999	40 Max	Fund./AT	50.000~89.999	50 Max	3rd Overtone/AT
16.000~40.000	30 Max	Fund./AT	90.000~100.000	100 Max	5th Overtone/AT



Ceramic Surface Mount

- 1.25 mm height
- Three industry standard footprints
- Glass-sealed housing for high reliability
- Economic cost

Series
CX12A
CX12B
CX12C

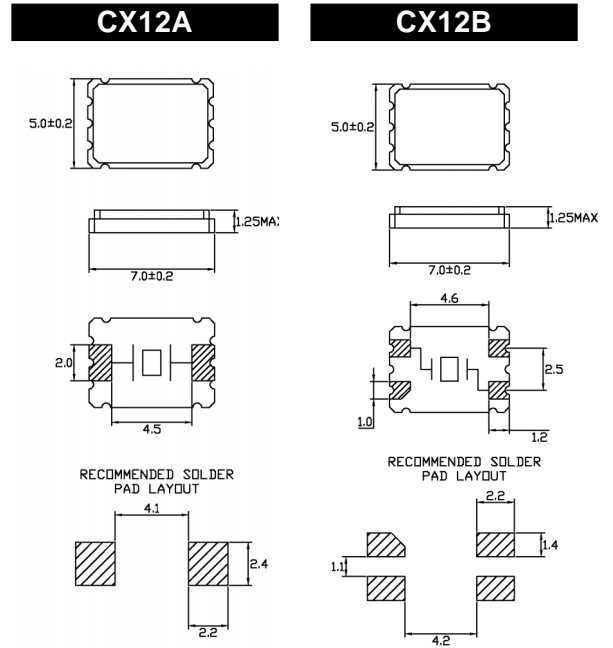
Part Numbering Example: CX12A Z - A1 B2 C2 60 - 9.83 D18 - 3

CX12A	Z	A1*	B2	C2	60	9.83	D18	- 3
SERIES	ADDED FEATURES	OPERATING TEMP.	STABILITY	TOLERANCE	RESISTANCE	FREQUENCY	LOAD CAP.	OVERTONE
CX12A	BLANK = BULK PACK Z = TAPE AND REEL	A0 = -10°C ~ +60°C A1 = -10°C ~ +70°C A2 = -40°C ~ +85°C A3 = -55°C ~ +125°C	B1 = ±100 B2 = ± 50 B3 = ± 30 B4 = ± 10	C1 = ±100 C2 = ± 50 C3 = ± 30 C4 = ± 10	SEE CHART BELOW		D16,18,20,ETC. DS = SERIES	BLANK: FUND. -3: 3rd OT -5: 5th OT -7: 7th OT -BT: BT Cut

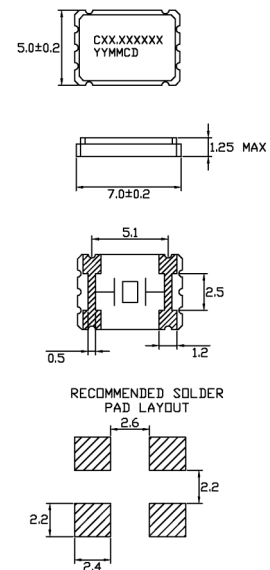
**NOTE: The above ABC combinations cover basic specification options. We tailor our crystal specifications to meet customer requirements. Please contact our sales department if you don't see exactly what you need.*

Specifications:

Frequency Range:	9.83 ~ 100.000 MHz
Operating Temperature:	-10°C ~ +60°C <i>Standard</i> -40°C ~ +85°C
Frequency Stability:	±100 ppm <i>Standard</i> ± 50 ppm
Frequency Tolerance:	± 50 ppm <i>Standard</i> (at 25°C)
Load Capacitance:	Standard 18 pF or series. Other values are available.
Resistance:	Maximum resistance corresponds to frequency. See chart below.
Standard:	Mode: Fundamental or 3rd Overtone Shunt Capacitance: 5 pF Max Aging: ± 5 ppm/year Drive Level: 0.1 mW Packaging: Tape and Reel (1K per Reel)



CX12C



Resistance Chart: All resistances are maximum values.

EQUIVALENT SERIES RESISTANCE (ESR), MODE OF OPERATION (MODE), AND CUT					
Frequency MHz	ESR(Ω)	Mode/cut	Frequency MHz	ESR (Ω)	Mode/cut
9.83~11.999	60 Max	Fund./AT	28.000~30.999	100 Max	3rd Overtone/AT
12.000~15.999	60 Max	Fund./AT	31.000~34.999	100 Max	3rd Overtone/AT
16.000~25.999	40 Max	Fund./AT	35.000~49.999	60 Max	3rd Overtone/AT
26.000~41.000	40 Max	Fund./AT	50.000~100.000	60 Max	3rd Overtone/AT



Ceramic Surface Mount

Series **CX5**

- Lowest maximum drive level available
- Widest frequency range
- Very tight stabilities

Part Numbering Example: CX5 Z - A1 - B2 - C2 60 - 10.0 D18 - 3

CX5	Z	A1*	B2	C2	60	10.0	D18	- 3
SERIES	ADDED FEATURES	OPERATING TEMP.	STABILITY	TOLERANCE	RESISTANCE	FREQUENCY	LOAD CAP.	OVERTONE
CX5	BLANK = BULK PACK Z = TAPE AND REEL	A0 = -10°C ~ +60°C A1 = -10°C ~ +70°C A2 = -40°C ~ +85°C A3 = -55°C ~ +125°C	B1 = ±100 B2 = ± 50 B3 = ± 30 B4 = ± 10	C1 = ±100 C2 = ± 50 C3 = ± 30 C4 = ± 10	SEE CHART BELOW		D16,18,20,ETC. DS = SERIES	BLANK: FUND. -3: 3rd OT -5: 5th OT -7: 7th OT -BT: BT Cut

**NOTE: The above ABC combinations cover basic specification options. We tailor our crystal specifications to meet customer requirements. Please contact our sales department if you don't see exactly what you need.*

Specifications:

Frequency Range:

9.000 ~ 40.320 MHz	AT-Cut Fundamental
40.000 ~ 90.000 MHz	3rd Overtone
90.000 ~ 150.000 MHz	5th Overtone

Operating Temperature:	0°C ~ +70°C	Standard
	-40°C ~ +85°C	

Frequency Stability:	± 50 ppm	Standard
	Stabilities from ± 5 ppm available.	

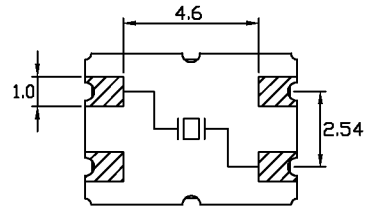
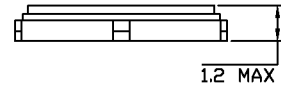
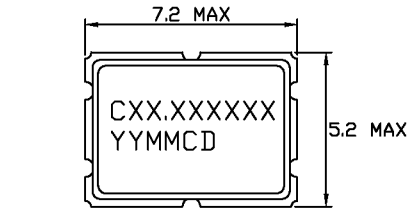
Frequency Tolerance:	± 50 ppm	Standard
(at 25°C)	Tolerances from ± 10 ppm available.	

Load Capacitance:	Parallel or series.	
	Please specify your required load.	

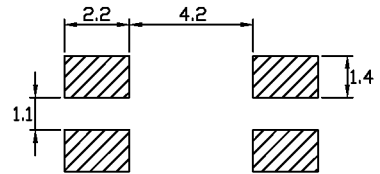
Resistance:	Maximum resistance corresponds to frequency. See chart below.	
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Standard:	Shunt Capacitance: 7 pF Max Aging: ± 3 ppm first year Drive Level: 50 µW Max Packaging: Tape and Reel (1K per Reel)	
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CX5



RECOMMENDED SOLDER PAD LAYOUT



Resistance Chart: All resistances are maximum values.

EQUIVALENT SERIES RESISTANCE (ESR), MODE OF OPERATION (MODE), AND CUT					
Frequency MHz	ESR(Ω)	Mode/cut	Frequency MHz	ESR (Ω)	Mode/cut
9.500~10.999	60 Max	Fund./AT	40.000~49.999	80 Max	3rd Overtone/AT
11.000~13.999	50 Max	Fund./AT	50.000~89.999	50 Max	3rd Overtone/AT
14.000~15.999	40 Max	Fund./AT	90.000~150.000	100 Max	5th Overtone/AT
16.000~39.999	30 Max	Fund./AT			



Ceramic Surface Mount

Series **CX47**

- Low maximum drive level
- Lower ESR than AT-Strip crystals
- Epoxy sealed

Part Numbering Example: **CX47 Z - A1 B2 C2 45 - 14.0 D18 - 3**

SERIES	ADDED FEATURES	OPERATING TEMP.	STABILITY	TOLERANCE	RESISTANCE	FREQUENCY	LOAD CAP.	OVERTONE
CX47	BLANK = BULK PACK Z = TAPE AND REEL	A0 = -10°C ~ +60°C A1 = -10°C ~ +70°C A2 = -40°C ~ +85°C A3 = -55°C ~ +125°C	B1 = ±100 B2 = ± 50 B3 = ± 30 B4 = ± 10	C1 = ±100 C2 = ± 50 C3 = ± 30 C4 = ± 10	SEE CHART BELOW	45 14.0	D16,18,20,ETC. DS = SERIES	BLANK: FUND. -3: 3rd OT -5: 5th OT -7: 7th OT -BT: BT Cut

**NOTE: The above ABC combinations cover basic specification options. We tailor our crystal specifications to meet customer requirements. Please contact our sales department if you don't see exactly what you need.*

Specifications:

Frequency Range:

9.000 ~ 40.320 MHz	AT-Cut Fundamental
40.000 ~ 90.000 MHz	3rd Overtone
90.000 ~ 150.000 MHz	5th Overtone

Operating Temperature:	0°C ~ +70°C	Standard
	-40°C ~ +85°C	

Frequency Stability:	± 100 ppm	BT-Cut
	± 50 ppm	Standard

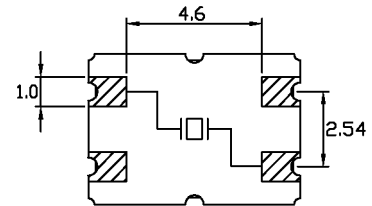
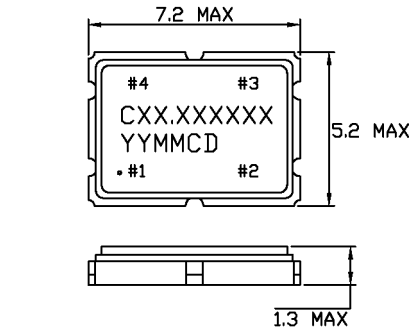
Frequency Tolerance:	± 50 ppm	Standard
	<i>(at 25°C)</i>	

Load Capacitance:	Parallel or series. Please specify your required load.	
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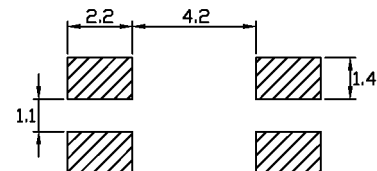
Resistance:	Maximum resistance corresponds to frequency. See chart below.	
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Standard:	Shunt Capacitance: 7 pF Max Aging: ± 5 ppm first year Drive Level: 100 µW Max Packaging: Tape and Reel (1K per Reel)	
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CX47



RECOMMENDED SOLDER PAD LAYOUT



Resistance Chart: All resistances are maximum values.

EQUIVALENT SERIES RESISTANCE (ESR), MODE OF OPERATION (MODE), AND CUT					
Frequency MHz	ESR(Ω)	Mode/cut	Frequency MHz	ESR (Ω)	Mode/cut
9.500~10.999	60 Max	Fund./AT	40.000~49.999	80 Max	3rd Overtone/AT
11.000~13.999	50 Max	Fund./AT	50.000~89.999	50 Max	3rd Overtone/AT
14.000~15.999	40 Max	Fund./AT	90.000~150.000	100 Max	5th Overtone/AT
16.000~39.999	30 Max	Fund./AT			



Ceramic Surface Mount Crystal

Series **CX745**

- Very low height
- Tight stability options

Part Numbering Example: **CX745 Z - A1 B2 C2 60 - 10.0 D18 - 3**

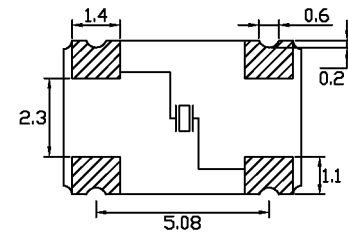
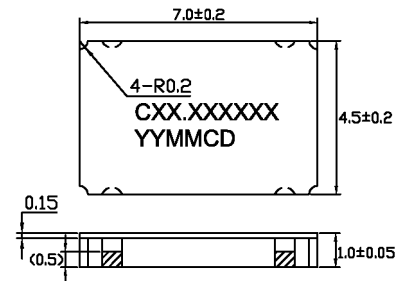
CX745	Z	A1*	B2	C2	60	10.0	D18	- 3
SERIES	ADDED FEATURES	OPERATING TEMP.	STABILITY	TOLERANCE	RESISTANCE	FREQUENCY	LOAD CAP.	OVERTONE
CX745	BLANK = BULK PACK Z = TAPE AND REEL	A0 = -10°C ~ +60°C A1 = -10°C ~ +70°C A2 = -40°C ~ +85°C A3 = -55°C ~ +125°C	B1 = ±100 B2 = ± 50 B3 = ± 30 B4 = ± 10	C1 = ±100 C2 = ± 50 C3 = ± 30 C4 = ± 10	SEE CHART BELOW		D16,18,20,ETC. DS = SERIES	BLANK: FUND. -3: 3rd OT -5: 5th OT -7: 7th OT -BT: BT Cut

**NOTE: The above ABC combinations cover basic specification options. We tailor our crystal specifications to meet customer requirements. Please contact our sales department if you don't see exactly what you need.*

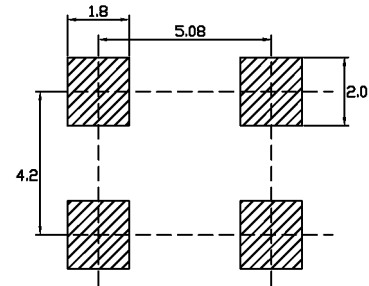
Specifications:

Frequency Range:	10.000 ~ 72.000 MHz
Operating Temperature:	-10°C ~ +70°C
Frequency Stability:	±50 ppm <i>Standard</i> ±30 ppm ±10 ppm ± 5 ppm
Frequency Tolerance: (at 25°C)	±50 ppm <i>Standard</i> ±30 ppm ±10 ppm
Load Capacitance:	Standard 18pF or series. Other values are available.
Resistance:	Maximum resistance corresponds to frequency.
Standard:	Mode: Fundamental or 3rd Overtone Shunt Capacitance: 7 pF Max Aging: ± 5 ppm/year Drive Level: 1.0 mW Max Packaging: Tape & Reel (1K per Reel)

CX745



RECOMMENDED SOLDER PAD LAYOUT



Resistance Chart: All resistances are maximum values.

EQUIVALENT SERIES RESISTANCE (ESR), MODE OF OPERATION (MODE), AND CUT					
Frequency MHz	ESR(Ω)	Mode/cut	Frequency MHz	ESR (Ω)	Mode/cut
10.0~10.999	60 Max	Fund./AT	35.000~39.999	100 Max	3rd Overtone/AT
11.000~13.999	50 Max	Fund./AT	40.000~49.999	80 Max	3rd Overtone/AT
14.000~15.999	40 Max	Fund./AT	50.000~89.999	50 Max	3rd Overtone/AT
16.000~40.000	30 Max	Fund./AT	90.000~150.000	100 Max	5th Overtone/AT



Ceramic Surface Mount Crystals

Series **CX635A**
CX635B

- Very low drive level
- Wide frequency range
- Tight stabilities and tolerances

Part Numbering Example: **CX635A Z - A1 B2 C2 50 - 11.0 D18 - 3**

CX635A	Z	A1*	B2	C2	50	11.0	D18	- 3
SERIES	ADDED FEATURES	OPERATING TEMP.	STABILITY	TOLERANCE	RESISTANCE	FREQUENCY	LOAD CAP.	OVERTONE
CX635A	BLANK = BULK PACK	A0 = -10°C ~ +60°C	B1 = ±100	C1 = ±100	SEE CHART		D16,18,20,ETC.	BLANK: FUND.
CX635B	Z = TAPE AND REEL	A1 = -10°C ~ +70°C	B2 = ± 50	C2 = ± 50	BELOW		DS = SERIES	-3: 3rd OT
		A2 = -40°C ~ +85°C	B3 = ± 30	C3 = ± 30				-5: 5th OT
		A3 = -55°C ~ +125°C	B4 = ± 10	C4 = ± 10				-7: 7th OT
								-BT: BT Cut

*NOTE: The above ABC combinations cover basic specification options. We tailor our crystal specifications to meet customer requirements. Please contact our sales department if you don't see exactly what you need.

Specifications:

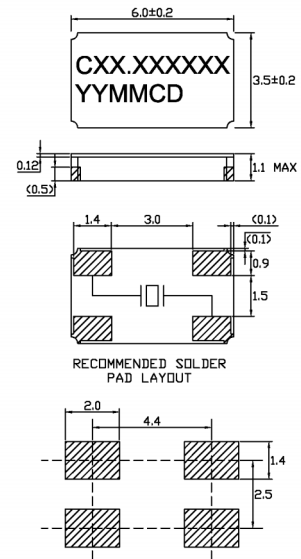
Frequency Range:	11.000 ~ 150.000 MHz
Operating Temperature:	-10°C ~ +70°C <i>Standard</i> -20°C ~ +70°C -40°C ~ +85°C
Frequency Stability:	±50 ppm <i>Standard</i> ±30 ppm ±10 ppm ± 5 ppm
Frequency Tolerance:	±50 ppm <i>Standard</i> (at 25°C) ±30 ppm ±10 ppm
Load Capacitance:	Standard 18pF or series. Other values are available.
Resistance:	Maximum resistance corresponds to frequency. See chart below.
Standard:	Mode: Fundamental, 3rd or 5th Overtone Shunt Capacitance: 7 pF Max Aging: ± 5 ppm/year Drive Level: 50 µW Packaging: Tape and Reel (1K per Reel)

Note: Not all combinations of the above tolerances, stabilities, and temperature ranges are available. Consult the factory if your requirement is not standard.

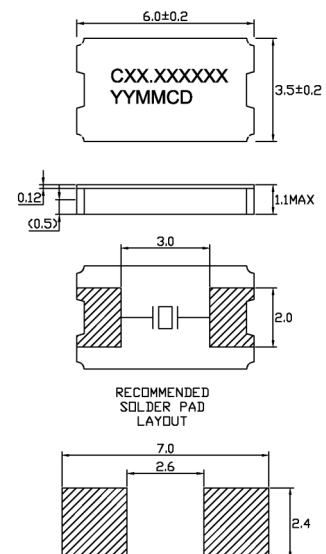
Resistance Chart: All resistances are maximum

EQUIVALENT SERIES RESISTANCE (ESR), MODE OF OPERATION (MODE)		
Frequency MHz	ESR (Ω)	Oscillation Mode
11.0 ~ 13.99	50	Fundamental
14.0 ~ 24.99	40	Fundamental
25.0 ~ 54.99	30	Fundamental
55.0 ~ 100.00	70	3rd Overtone
100.0 ~ 150.00	100	5th Overtone

CX635A



CX635B



Ceramic Surface Mount Crystal

• Small overall package dimensions

Series **CX532**

Part Numbering Example: **CX532 Z - A1 B2 C2 150 - 10.0 D16 - 3**

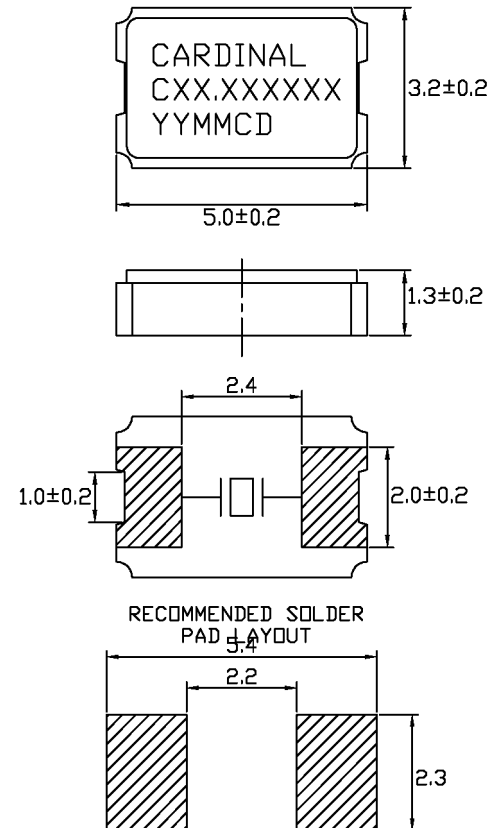
CX532	Z	A1*	B2	C2	150	10.0	D16	- 3
SERIES	ADDED FEATURES	OPERATING TEMP.	STABILITY	TOLERANCE	RESISTANCE	FREQUENCY	LOAD CAP.	OVERTONE
CX532	BLANK = BULK PACK Z = TAPE AND REEL	A0 = -10°C ~ +60°C A1 = -10°C ~ +70°C A2 = -40°C ~ +85°C A3 = -55°C ~ +125°C	B1 = ±100 B2 = ± 50 B3 = ± 30 B4 = ± 10	C1 = ±100 C2 = ± 50 C3 = ± 30 C4 = ± 10	SEE CHART BELOW	10.0	D16,18,20,ETC. DS = SERIES	BLANK: FUND. -3: 3rd OT -5: 5th OT -7: 7th OT -BT: BT Cut

**NOTE: The above ABC combinations cover basic specification options. We tailor our crystal specifications to meet customer requirements. Please contact our sales department if you don't see exactly what you need.*

Specifications:

Frequency Range:	10.000 ~ 45.000 MHz	(Fundamental)
Operating Temperature:	-10°C ~ +60°C	Standard
Frequency Stability:	±100 ppm ± 50 ppm ± 30 ppm	Standard
Frequency Tolerance: (at 25°C)	±100 ppm ± 50 ppm ± 30 ppm	Standard
Load Capacitance:	Standard 16, 18 pF or series. Other values are available.	
Resistance:	Maximum resistance corresponds to frequency. See chart below.	
Standard:	Mode: Fundamental or 3rd Overtone Shunt Capacitance: 7 pF Max Aging: ± 5 ppm/year Drive Level: 100 µW Max	
Option:	Packaging: Tape and Reel	

CX532



Resistance Chart: All resistances are maximum

EQUIVALENT SERIES RESISTANCE (ESR), MODE OF OPERATION (MODE)		
Frequency MHz	ESR (Ω)	Oscillation Mode
10.0 ~ 11.999	150	Fundamental
12.0 ~ 15.999	100	Fundamental
16.0 ~ 29.999	70	Fundamental
30.0 ~ 45.000	50	Fundamental



Ultra Miniature Surface Mount Crystals

Series **CX45**

- Very low height
- Very low drive level
- Small size excellent for next generation products

Part Numbering Example: **CX45 - Z - A1 B2 C2 100 - 10.0 D18 - 3**

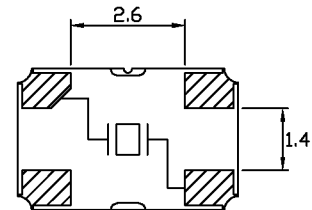
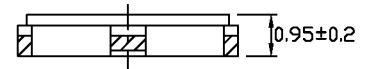
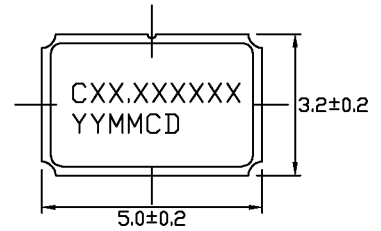
SERIES	ADDED FEATURES	OPERATING TEMP.	STABILITY	TOLERANCE	RESISTANCE	FREQUENCY	LOAD CAP.	OVERTONE
CX45	BLANK = BULK PACK Z = TAPE AND REEL	A0 = -10°C ~ +60°C A1 = -10°C ~ +70°C A2 = -40°C ~ +85°C A3 = -55°C ~ +125°C	B1 = ±100 B2 = ± 50 B3 = ± 30 B4 = ± 10	C1 = ±100 C2 = ± 50 C3 = ± 30 C4 = ± 10	SEE CHART BELOW	10.0	D16,18,20,ETC. DS = SERIES	BLANK: FUND. -3: 3rd OT -5: 5th OT -7: 7th OT -BT: BT Cut

**NOTE: The above ABC combinations cover basic specification options. We tailor our crystal specifications to meet customer requirements. Please contact our sales department if you don't see exactly what you need.*

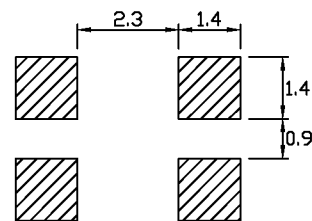
Specifications:

Frequency Range:	10.000 ~ 45.000 MHz	AT-Cut Fundamental
Operating Temperature:	-0°C ~ +60°C	Standard
	-40°C ~ +85°C	
Frequency Stability:	±100 ppm	AT-Cut
	± 50 ppm	Standard
	± 30 ppm	
	± 10 ppm	
Frequency Tolerance:	± 50 ppm	Standard
(at 25°C)		
Load Capacitance:	Please specify your required load.	
Resistance:	See chart below.	
Standard:	Shunt Capacitance: 7 pF Max	
	Aging: ± 5 ppm/year	
	Drive Level: 100 µW Max	
	Packaging: Tape and Reel	

CX45



RECOMMENDED SOLDER PAD LAYOUT



Resistance Chart: All resistances are maximum

EQUIVALENT SERIES RESISTANCE (ESR), MODE OF OPERATION (MODE)		
Frequency MHz	ESR (Ω)	Oscillation Mode
10.0 ~ 11.999	100	Fundamental
12.0 ~ 15.999	60	Fundamental
16.0 ~ 29.999	50	Fundamental
30.0 ~ 45.000	40	Fundamental



Ceramic Surface Mount Crystal

Series **CX325**

- *Smallest package dimensions available*
- *Wide fundamental mode*
- *Very low drive level*

Part Numbering Example: CX325 - Z - A1 B2 C2 100 - 20.0 D18

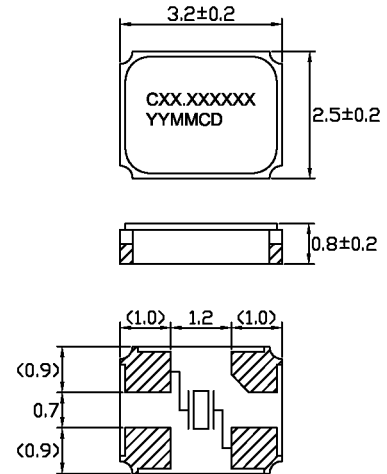
CX325	Z	A1*	B2	C2	100	20.0	D18
SERIES	ADDED FEATURES	OPERATING TEMP.	STABILITY	TOLERANCE	RESISTANCE	FREQUENCY	LOAD CAP.
CX325	BLANK = BULK PACK Z = TAPE AND REEL	A0 = -10°C ~ +60°C A1 = -10°C ~ +70°C A2 = -40°C ~ +85°C A3 = -55°C ~ +125°C	B1 = ±100 B2 = ± 50 B3 = ± 30 B4 = ± 10	C1 = ±100 C2 = ± 50 C3 = ± 30 C4 = ± 10	SEE CHART BELOW		D16,18,20,ETC. DS = SERIES

**NOTE: The above ABC combinations cover basic specification options. We tailor our crystal specifications to meet customer requirements. Please contact our sales department if you don't see exactly what you need.*

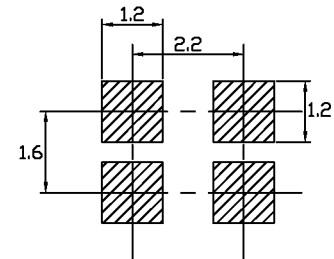
Specifications:

Frequency Range:	20.000 ~ 55.000 MHz	(Fundamental)
Operating Temperature:	-10°C ~ +60°C	
Frequency Stability:	± 30 ppm	
	± 50 ppm	Standard
	± 100 ppm	
Frequency Tolerance:	± 30 ppm	
(at 25°C)	± 50 ppm	Standard
	± 100 ppm	
Load Capacitance:	16 pF or series Other values are available	
Standard:	Mode: Fundamental Shunt Capacitance: 7 pF Max Aging: ± 5 ppm/year Drive Level: 10 µW (100 µW Max) Packaging: Tape and Reel	

CX325



RECOMMENDED SOLDER PAD LAYOUT



Resistance Chart: All resistances are maximum

EQUIVALENT SERIES RESISTANCE (ESR), MODE OF OPERATION (MODE)		
Frequency MHz	ESR (Ω)	Oscillation Mode
20.0 ~ 29.999	100	Fundamental
30.0 ~ 55.999	50	Fundamental



Tuning Fork Crystals

Cardinal's tuning fork crystals provide a cost-effective approach for time-management products.

Series **CTF6**
CTF8

Part Numbering Example: CTF6 F - A1 B2 C3 50 - 32.768K D12.5

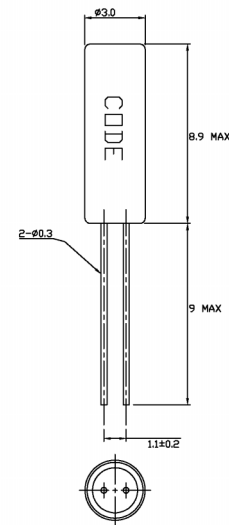
CTF6	F	A*	B3	C3	50	32.768K	D12.5
SERIES	ADDED FEATURES	OPERATING TEMP.	STABILITY	TOLERANCE	RESISTANCE	FREQUENCY	LOAD CAP.
CTF6	F = FORMED LEADS	A0 = -10°C ~ +60°C	B1 = ±100	C1 = ±100			D6 = 6.0 pF
CTF8	W = VINYL SLEEVING	A1 = -10°C ~ +70°C	B2 = ± 50	C2 = ± 50			D12.5 = 12.5 pF
	Z = TAPE AND REEL	A2 = -40°C ~ +85°C	B3 = ± 30	C3 = ± 30			
		A3 = -55°C ~ +125°C	B4 = ± 10	C4 = ± 10			

***NOTE:** The above ABC combinations cover basic specification options. We tailor our crystal specifications to meet customer requirements. Please contact our sales department if you don't see exactly what you need.

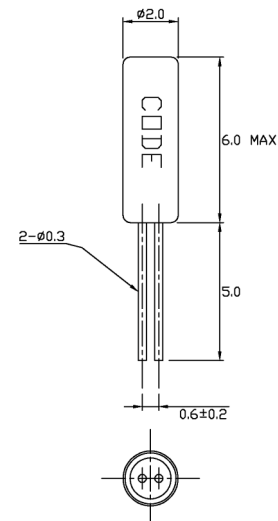
Specifications:

Frequency Range:	32.768 KHz	Standard
	30.000 ~ 200.000 KHz	Available
Operating Temperature:	-10°C ~ +60°C	Standard
Temperature Coefficient:	-(0.035 ± 0.008) ppm/°C ²	
Frequency Tolerance:	±30 ppm	Standard
	(at 25°C)	
Load Capacitance:	12.5 pF, 6.0 pF	
Resistance:	50,000Ω Max	
Standard:	Shunt Capacitance: 1.7 pF Max	
	Aging: ± 3 ppm Max first year	
	Drive Level: 1 μW Max	
Optional Features:	Formed Leads	
	Vinyl Sleeves	

CTF8



CTF6



Plastic Tuning Fork Crystals

Cardinal's CPF crystals offer real time frequency control in a sturdy thermoplastic encasement with a 2.5 mm height.

Series **CPFA**
CPFB

Part Numbering Example: CPFA Z - A1 B2 C5 - 32.768K D12.5

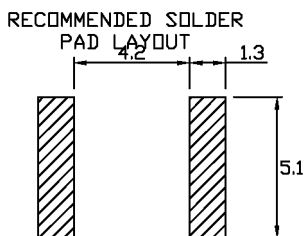
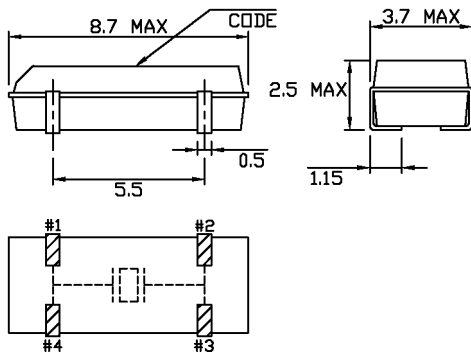
CPFA	Z	A2*	B5	C5	32.768	D12.5
SERIES	ADDED FEATURES	OPERATING TEMP.	STABILITY	TOLERANCE	FREQUENCY	LOAD CAP.
CPFA	BLANK = BULK PACK	A0 = -10°C ~ +60°C	B1 = ±100	C1 = ±100		D6 = 6.0 pF
CPFB	Z = TAPE AND REEL	A1 = -10°C ~ +70°C	B2 = ± 50	C2 = ± 50		D12.5 = 12.5 pF
		A2 = -40°C ~ +85°C	B3 = ± 30	C3 = ± 30		
		A3 = -55°C ~ +125°C	B4 = ± 10	C4 = ± 10		
			B5 = ± 20	C5 = ± 20		

*NOTE: The above ABC combinations cover basic specification options. We tailor our crystal specifications to meet customer requirements. Please contact our sales department if you don't see exactly what you need.

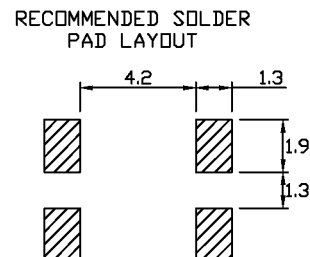
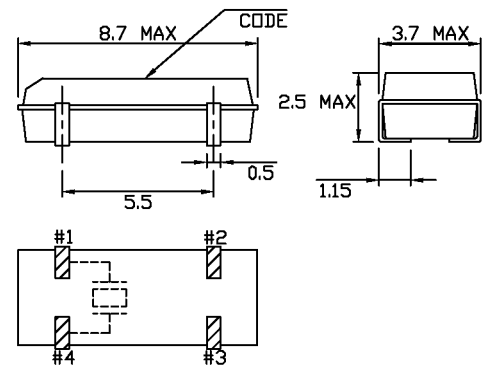
Specifications:

Frequency Range:	32.768 KHz
Operating Temperature:	-40°C ~ +85°C Standard
Temperature Coefficient:	-(0.035 ± 0.008) ppm/°C ²
Frequency Tolerance:	± 20 ppm (at 25°C)
Load Capacitance:	12.5 pF Typical
Shunt Capacitance:	1.35 pF Typical
Resistance:	50,000Ω Max
Drive Level:	1.0 μW Max
Aging:	± 3.0 ppm per year
Packaging:	Tape and Reel (3K per Reel)

CPFA



CPFB



Plastic Surface Mount Watch Crystals

Series **CPTA**
CPTB

- Extended operating temperature
- Two industry standard pin connections
- Uniform, stable performance

Part Numbering Example: CPTA Z - A1 B2 C5 - 32.768K D12.5

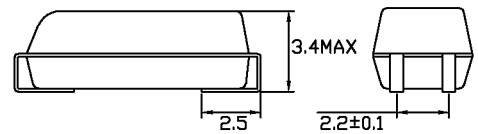
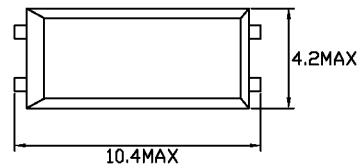
CPTA	Z	A1*	B2	C5	32.768K	D12.5
SERIES	ADDED FEATURES	OPERATING TEMP.	STABILITY	TOLERANCE	FREQUENCY	LOAD CAP.
CPTA CPTB	BLANK = BULK PACK Z = TAPE AND REEL	A0 = -10°C ~ +60°C A1 = -10°C ~ +70°C A2 = -40°C ~ +85°C A3 = -55°C ~ +125°C	B1 = ±100 B2 = ± 50 B3 = ± 30 B4 = ± 10	C1 = ±100 C2 = ± 50 C3 = ± 30 C4 = ± 10 C5 = ± 20		D12.5 pF

***NOTE:** The above ABC combinations cover basic specification options. We tailor our crystal specifications to meet customer requirements. Please contact our sales department if you don't see exactly what you need.

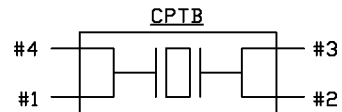
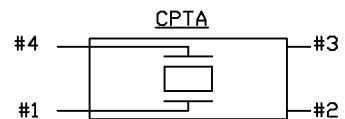
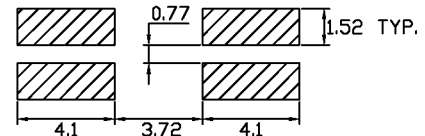
Specifications:

Frequency Range:	32.768 KHz Custom frequencies available.
Operating Temperature:	-40°C ~ +85°C <i>Standard</i>
Temperature Coefficient:	-(0.035 ± 0.008) ppm/°C ²
Frequency Tolerance:	± 20 ppm (at 25°C)
Load Capacitance:	12.5 pF Other values are available.
Shunt Capacitance:	1.35 pF <i>Typical</i>
Resistance:	50,000Ω Max
Standard:	Shunt Capacitance: 0.85 pF typ. Motional Capacitance: 2.0 fF typ. Aging: ± 3 ppm/year Max Drive Level: 1.0 μW Max Packaging: Tape & Reel (2K per Reel)

CPT



RECOMMENDED SOLDER PAD LAYOUT



Plastic Surface Mount Watch Crystal

Series **CPL**

- Ultra Miniature size
- 2.0 mm Max height
- Durable thermoplastic package

Part Numbering Example: CPL Z - A1 B2 C3 - 32.768K D12.5

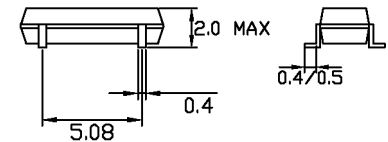
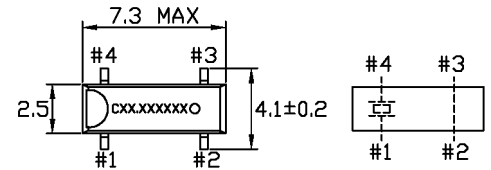
CPL	Z	A0*	B2	C3	32.768K	D12.5
SERIES	ADDED FEATURES	OPERATING TEMP.	STABILITY	TOLERANCE	FREQUENCY	LOAD CAP.
CPL	BLANK = BULK PACK Z = TAPE AND REEL	A0 = -10°C ~ +60°C A1 = -10°C ~ +70°C A2 = -40°C ~ +85°C A3 = -55°C ~ +125°C	B1 = ±100 B2 = ± 50 B3 = ± 30 B4 = ± 10 B5 = ± 20	C1 = ±100 C2 = ± 50 C3 = ± 30 C4 = ± 10 C5 = ± 20		D12.5 pF

**NOTE: The above ABC combinations cover basic specification options. We tailor our crystal specifications to meet customer requirements. Please contact our sales department if you don't see exactly what you need.*

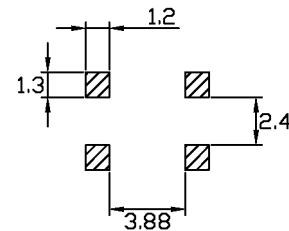
Specifications:

Frequency Range:	32.768 KHz
Operating Temperature:	-10°C ~ +60°C <i>Standard</i> -40°C ~ +85°C
Temperature Coefficient:	-(0.035 ± 0.008) ppm/°C ²
Frequency Tolerance:	± 20 ppm (at 25°C)
Load Capacitance:	12.5 pF
Resistance:	55,000Ω Max
Standard:	Shunt Capacitance: 1.0 pF typ. Motional Capacitance: 2.5 fF typ Aging: ± 3 ppm/year Max Drive Level: 1.0 μW Max Packaging: Tape & Reel (3K per Reel)

CPL



RECOMMENDED SOLDER PAD LAYOUT



Surface Mount Low Frequency Crystal

Series **CT5**

- Ultra thin plastic molded package
- High reliability and excellent shock and heat resistance
- Tight stability option

Part Numbering Example: CT5 Z - A1 B5 C5 - 32.768K D12.5

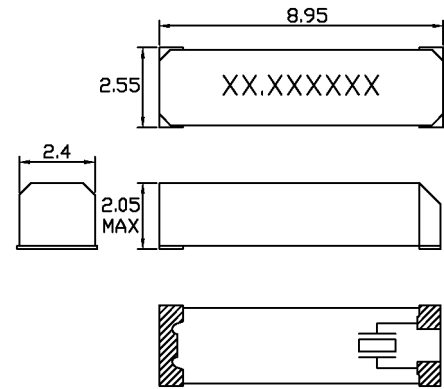
CT5	Z	A1*	B5	C5	76.800K	D12.5
SERIES	ADDED FEATURES	OPERATING TEMP.	STABILITY	TOLERANCE	FREQUENCY	LOAD CAP.
CT5	BLANK = BULK PACK Z = TAPE AND REEL	A0 = -10°C ~ +60°C A1 = -10°C ~ +70°C A2 = -40°C ~ +85°C A3 = -55°C ~ +125°C	B1 = ±100 B2 = ± 50 B3 = ± 30 B4 = ± 10 B5 = ± 20	C1 = ±100 C2 = ± 50 C3 = ± 30 C4 = ± 10 C5 = ± 20		D6 = 6.0 pF D12.5 = 12.5 pF

*NOTE: The above ABC combinations cover basic specification options. We tailor our crystal specifications to meet customer requirements. Please contact our sales department if you don't see exactly what you need.

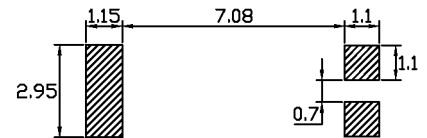
Specifications:

Frequency Range:	32.768 KHz 76.800 KHz
Operating Temperature:	-20°C ~ +70°C
Temperature Coefficient:	-(0.035 ± 0.008) ppm/°C ²
Frequency Tolerance: (at 25°C)	± 50 ppm ± 20 ppm <i>Standard</i> ± 10 ppm
Load Capacitance:	6 pF, 12.5 pF
Resistance:	50,000Ω Max
Standard:	Shunt Capacitance: 0.9 pF typ. Aging: ± 3 ppm/year Max Drive Level: 1.0 μW Max Packaging: Tape and Reel (3K per Reel)

CT5



RECOMMENDED SOLDER PAD LAYOUT



Surface Mount Low Frequency Crystal

Series **CT6**

- Very small package dimensions
- Extremely low drive level
- High reliability

Part Numbering Example: CT6 Z - A1 B5 C5 - 75.0K D7

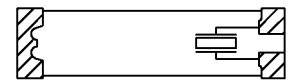
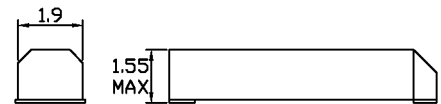
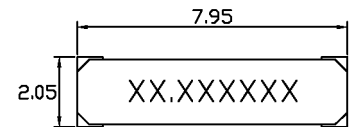
CT6	Z	A1*	B5	C5	75.0K	D7
SERIES	ADDED FEATURES	OPERATING TEMP.	STABILITY	TOLERANCE	FREQUENCY	LOAD CAP.
CT6	BLANK = BULK PACK Z = TAPE AND REEL	A0 = -10°C ~ +60°C A1 = -10°C ~ +70°C A2 = -40°C ~ +85°C A3 = -55°C ~ +125°C	B1 = ±100 B2 = ± 50 B3 = ± 30 B4 = ± 10 B5 = ± 20	C1 = ±100 C2 = ± 50 C3 = ± 30 C4 = ± 10 C5 = ± 20		D16,18,20,ETC. DS = SERIES

**NOTE: The above ABC combinations cover basic specification options. We tailor our crystal specifications to meet customer requirements. Please contact our sales department if you don't see exactly what you need.*

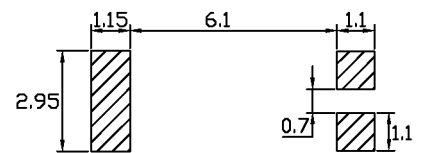
Specifications:

Frequency Range:	32.768 KHz 75.000 KHz
Operating Temperature:	-20°C ~ +70°C
Temperature Coefficient:	-(0.035 ± 0.008) ppm/°C ²
Frequency Tolerance:	± 20 ppm <i>Standard</i> (at 25°C) ± 10 ppm
Load Capacitance:	7 pF Other values are available.
Resistance:	55,000Ω Max
Standard:	Shunt Capacitance: 0.8 pF typ. Aging: ± 3 ppm/year Max Drive Level: 1.0 μW Max Packaging: Tape and Reel (3K per Reel)

CT6



RECOMMENDED SOLDER PAD LAYOUT





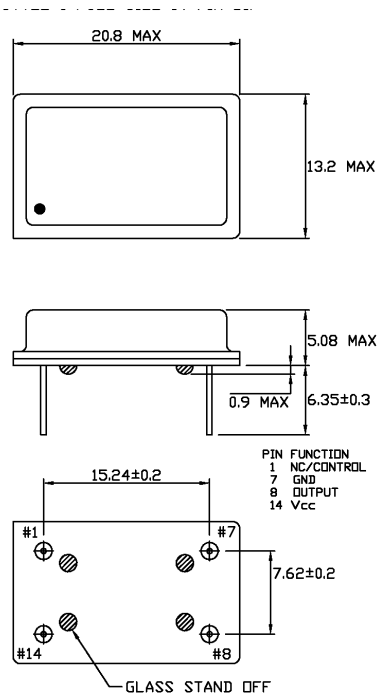
OSCILLATOR SECTION

C11	47	CC065H	54
CTH11	48	CC065L	55
CH11	49	CC85	56
CDO	50	CC045	57
CPO	51	CC532	58
CPH	52	CC137	59
CC065S	53		

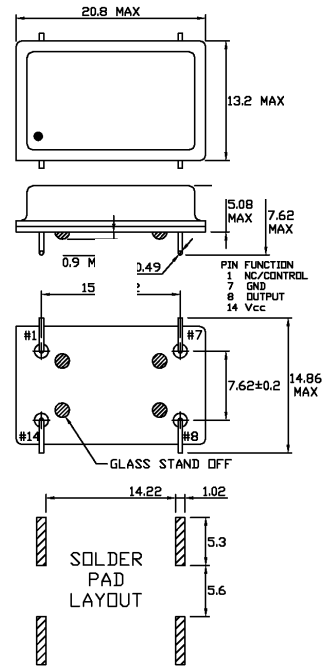


Dip Oscillator Package Dimensions

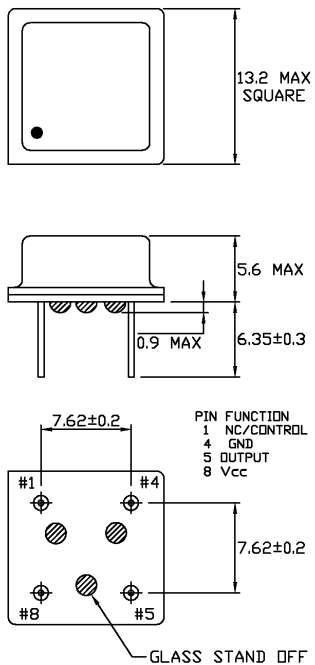
Style 1 Full Size 14 Pin Dip



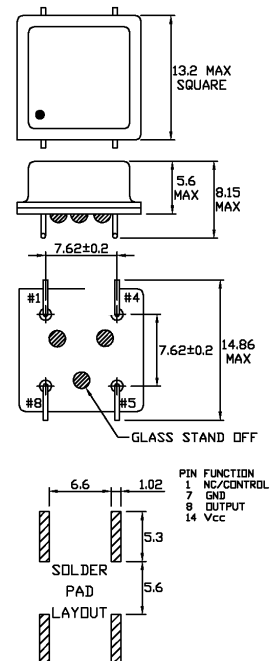
Style 3 Full Size 14 Pin Dip Gull Wing



Style 4 Half Size 8 Pin Dip



Style 6 Half Size 8 Pin Dip Gull Wing



Crystal Clock Oscillator

Series **C11**

- Gull wings optional
- Wide frequency range
- Optional tristate

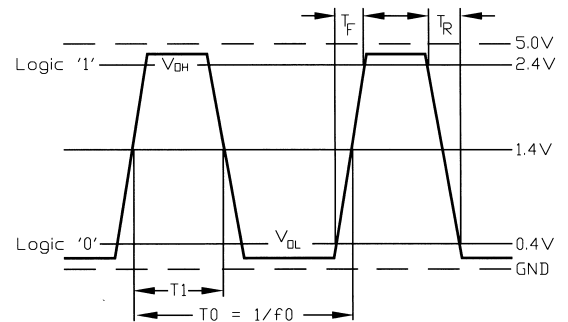
Part Numbering Example: C11 00 4 45 - A2 - 50.0 TS

C11	00	4	45	A2	50.0	TS
SERIES	STABILITY	PACKAGE STYLE	SYMMETRY	OPERATING TEMP.	FREQUENCY	
C11	00 = ±100 ppm 50 = ± 50 ppm 25 = ± 25 ppm 10 = ± 10 ppm	1 = Full Size 3 = Full Size, Gull Wing 4 = Half Size 6 = Half Size, Gull Wing	Blank = 40/60% 45 = 45/55%	Blank = 0°C ~ +70°C A2=-40°C ~ +85°C		Blank = No Connection TS = Tristate, pin 1

Specifications:

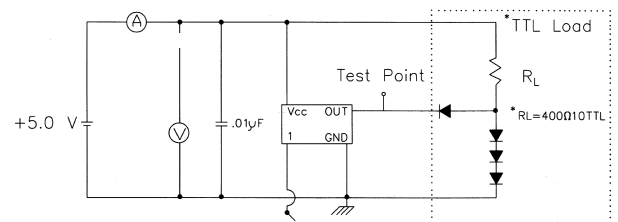
Frequency Range:	1.000 MHz to 100 MHz
Available Stability Options:	±100 ppm ±50 ppm ±25 ppm ±10 ppm
Output Series:	TTL
Input Voltage:	+5.0 VDC ±10%
Operating Temperature Range Options:	-10°C to +70°C -40°C to +85°C
Output Voltage:	1.000 to 24.999 MHz V _{OL} =0.4 V Max. V _{OH} =2.4 V. Min. 25.000 to 100.000 MHz V _{OL} =0.5 V Max. V _{OH} =2.4 V Min.
Output Load:	10 TTL
Maximum Input Current:	15 mA (1.000 to 7.999 MHz) 30 mA (8.000 to 24.999 MHz) 70 mA (25.000 to 69.999 MHz) 80 mA (70.000 to 100.000 MHz)
Maximum Rise/Fall Time:	10 ns (1.000 to 24.999 MHz) 5 ns (25.000 to 69.999 MHz) 4 ns (70.000 to 100.000 MHz)
Duty Cycle:	40/60% 45/55%
Max. Start-Up Time:	35 ms (1.000 to 3.999 MHz) 30 ms (4.000 to 7.999 MHz) 20 ms (8.000 to 19.999 MHz) 15 ms (20.000 to 100.000 MHz)
Tristate Input:	+0.40 VDC Max. to Disable +2.40 VDC Min. to Enable or Open to Enable
Storage Temperature:	-55°C to +125°C

OUTPUT WAVE FORM



$$\text{SYMMETRY} = \left(\frac{T_1}{T_0} \right) \times 100\%$$

TEST CIRCUIT



*Includes stray and probe capacitance (15pF TYP)



Crystal Clock Oscillator

Series **CTH11**

- Gull wings optional
- Optional tristate
- TTL and CMOS compatible

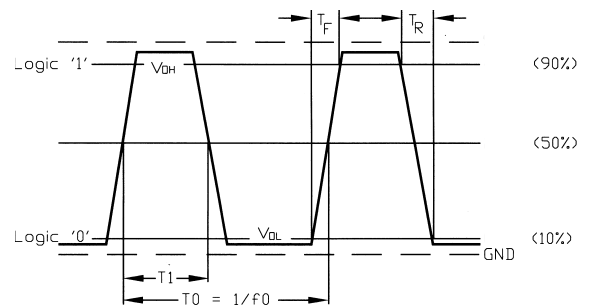
Part Numbering Example: CTH11 00 4 L 45 - A2 - 50.0 TS L

CTH11	00	4	L	45	A2	50.0	TS
SERIES	STABILITY	PACKAGE STYLE	VOLTAGE	SYMMETRY	OPERATING TEMP.	FREQUENCY	
CTH11	00 = ±100 ppm 50 = ± 50 ppm 25 = ± 25 ppm 10 = ± 10 ppm	1 = Full Size 3 = Full Size, Gull Wing 4 = Half Size 6 = Half Size, Gull Wing	Blank = 5V L = 3.3V	Blank = 40/60% 45 = 45/55%	Blank = 0°C ~ +70°C A2=-40°C ~ +85°C		Blank = No Connection TS = Tristate, pin 1

Specifications:

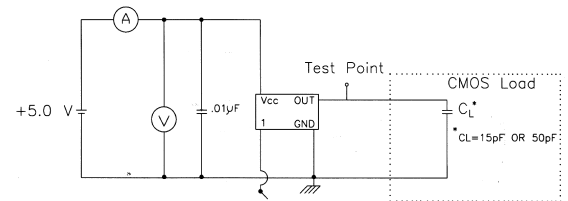
Frequency Range:	1.000 MHz to 70.000 MHz
Available Stability Options:	±100 ppm <i>Standard</i> ±50 ppm ±25 ppm ±10 ppm
Output Series:	TTL/CMOS
Input Voltage:	+5.0 VDC ±10% +3.3 VDC ±10%
Operating Temperature Range Options:	-10°C to +70°C
Output Voltage:	HCMOS $V_{OL} = 10\% V_{DD} V$ Max. HCMOS $V_{OH} = 90\% V_{DD} V$ Min.
Output Load:	10 LS TTL, 15 pF CMOS
Maximum Input Current:	20 mA (1.000 to 24.999 MHz) 35 mA (25.000 to 49.999 MHz) 50 mA (50.000 to 70.000 MHz)
Maximum Rise/Fall Time:	10 ns (1.000 to 23.999 MHz) 6 ns (24.000 to 70.000 MHz)
Duty Cycle:	40/60% <i>Standard</i> 45/55%
Max. Start-Up Time:	10 ms
Tristate Input:	@+5 VDC Input +0.80 VDC Max. to Disable +3.60 VDC Min. to Enable or Open to Enable @+3.3 VDC Input +0.80 VDC Max. to Disable +2.20 VDC Min. to Enable or open to Enable
Storage Temperature:	-55°C to +125°C

OUTPUT WAVE FORM



$$SYMMETRY = (T_1/T_0) \times 100\%$$

TEST CIRCUIT



* Includes stray and probe capacitance (15pF TYP)



Crystal Clock Oscillator

Series **CH11**

- 50 pf load capable
- 3.3 VDC input available
- TTL and CMOS compatible
- Optional tristate

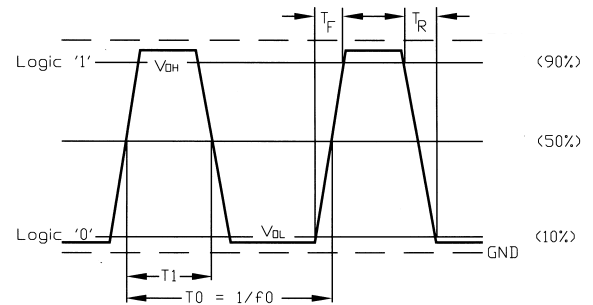
Part Numbering Example: CH11 00 4 L 45 - A2 - 50.0 TS

CTH11	00	4	L	45	A2	50.0	TS
SERIES	STABILITY	PACKAGE STYLE	VOLTAGE	SYMMETRY	OPERATING TEMP.	FREQUENCY	
CTH11	00 = ±100 ppm 50 = ± 50 ppm 25 = ± 25 ppm 10 = ± 10 ppm	1 = Full Size 3 = Full Size, Gull Wing 4 = Half Size 6 = Half Size, Gull Wing	Blank = 5V L = 3.3V	Blank = 40/60% 45 = 45/55%	Blank = 0°C ~ +70°C A2 = -40°C ~ +85°C		Blank = No Connection TS = Tristate, pin 1

Specifications:

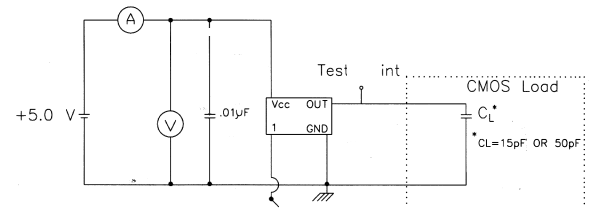
Frequency Range:	1.8432 MHz to 100.000 MHz
Available Stability Options:	±100 ppm <i>Standard</i> ±50 ppm ±25 ppm ±10 ppm
Output Series:	TTL/CMOS
Input Voltage:	+5.0 VDC ±10% <i>Standard</i> +3.3 VDC ±10%
Operating Temperature Range Options:	-10°C to +70°C <i>Standard</i> -40°C to +85°C
Output Voltage:	HCMOS $V_{OL} = 10\% V_{DD} V$ Max. HCMOS $V_{OH} = 90\% V_{DD} V$ Min.
Output Load:	10 TTL, 50 pf CMOS
Maximum Input Current:	25 mA (1.8432 to 24.999 MHz) 45 mA (25.000 to 49.999 MHz) 70 mA (50.000 to 69.999 MHz) 80 mA (70.000 to 100.000 MHz)
Maximum Rise/Fall Time:	7 ns
Duty Cycle:	40/60% <i>Standard</i> 45/55%
Max. Start-Up Time:	10 ms
Tristate Input:	@+5 VDC Input +0.80 VDC Max. to Disable +3.60 VDC Min. to Enable or Open to Enable @+3.3 VDC Input +0.80 VDC Max. to Disable +2.20 VDC Min. to Enable or open to Enable
Storage Temperature:	-55°C to +125°C

OUTPUT WAVE FORM

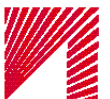


$$\text{SYMMETRY} = \left(\frac{T_1}{T_0} \right) \times 100\%$$

TEST CIRCUIT



* Includes stray and probe capacitance (15pF TYP)



Independent Dual Output Oscillators: HCMOS, TTL, or Compatible

Series **CDO**

Cardinal dual oscillators are built with two separate crystal blanks to obtain two independent frequencies from one component. It is perfect space-saving device for applications using two microprocessors running at different clock speeds.

Part Numbering Example: **CD0 00 1 45 A2 1.8432 / 24.0**

CDO	00	1	45	A2	1.8432 / 24.0
SERIES	STABILITY	PACKAGE STYLE	SYMMETRY	OPERATING TEMP.	FREQUENCY FREQUENCY
CD0	00 = ±100 ppm 50 = ± 50 ppm 25 = ± 25 ppm 10 = ± 10 ppm	1 = Full Size 3 = Full Size, Gull Wing	Blank = 40/60% 45 = 45/55%	Blank = 0°C ~ +70°C A2=-40°C ~ +85°C	

Specifications:

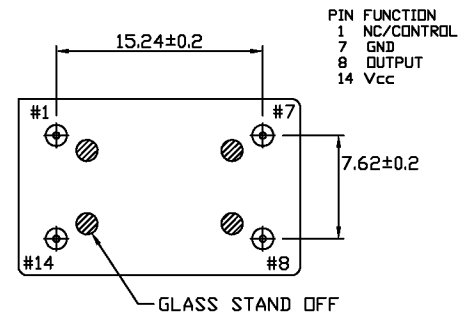
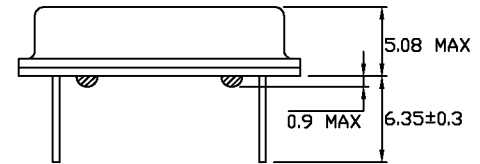
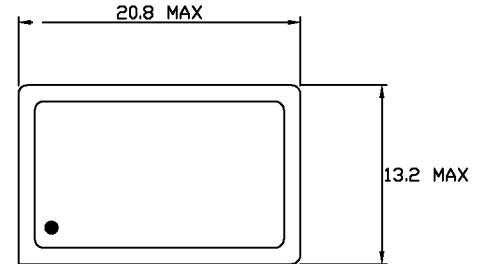
Frequency Range:	F ₁ = 8.0 MHz ~ 32.00 MHz F ₂ = 8.00 MHz ~ 50.00 MHz	
Frequency Stability:	±100 ppm ±50 ppm	Standard
Operating Temperature:	0°C ~ +70°C Standard	
Storage Temperature:	-55°C ~ +125°C	
Input Voltage:	+5.0 VDC ± 10%	
Input Current:	30 mA Max	
Output Voltage:	Output '0' Level +0.5V Max	Output '1' Level +4.5V Min
Symmetry:	40/60 % @ 1/2 VDD	
Rise/Fall Time:	10 ns Max	
Output Load:	10 LS TTL, 15 pF	
Packaging:	Style 1 Full Size. See Dip Package Dimensions Guide	

Popular Frequency Combinations in MHz:

1.8432 / 24.000
10.240 / 16.000
10.240 / 20.000
14.31818 / 16.000
14.31818 / 16.09824
14.31818 / 24.000
14.31818 / 48.000
16.000 / 20.000
16.257 / 16.872
25.175 / 28.321
25.175 / 28.322

CDO

STYLE 1 FULL SIZE 14 PIN DIP



Surface Mount Clock Oscillator

Series **CPO**

- Tristate capable
- TTL/HCMOS compatible

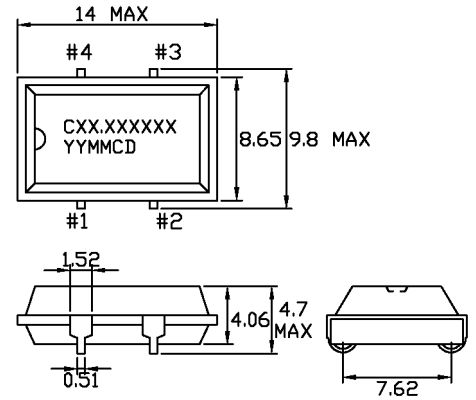
Part Numbering Example: CPO Z A2 B2 45 - 33.333 TS

CPO	Z	A2	B2	45	33.333	TS
SERIES	ADDED FEATURES	OPERATING TEMP.	STABILITY	SYMMETRY	FREQUENCY	TRI STATE
CPO	BLANK = BULK PACK Z = TAPE AND REEL	Blank = 0°C ~ +70°C A2 = -40°C ~ +85°C	Blank = ±100 ppm B2 = ± 50 ppm	Blank = 40/60% 45 = 45/55%		Tri State Standard

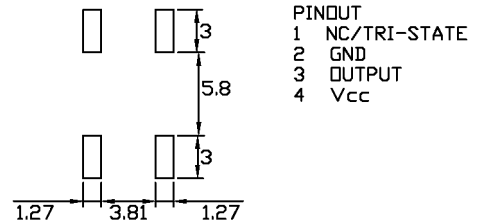
Specifications:

Frequency Range:	1.500 MHz to 70.000 MHz
Available Stability Options:	±100 ppm <i>Standard</i> ±50 ppm ±25 ppm
Output Series:	TTL/HCMOS
Input Voltage:	+5.0 VDC ±10%
Operating Temperature Range Options:	-10°C to +70°C <i>Standard</i> -40°C to +85°C
Output Voltage:	V _{OL} = 0.5 V Max. V _{OH} = 4.5 V Min.
Output Load:	10 TTL or 50 pf (1.500 to 49.999 MHz) 10 TTL or 30 pf (50.000 to 70.000 MHz)
Maximum Input Current:	23 mA (1.500 to 26.999 MHz) 30 mA (27.000 to 29.999 MHz) 35 mA (30.000 to 49.999 MHz) 45 mA (50.000 to 69.999 MHz)
Maximum Rise/Fall Time:	8 ns (1.500 to 49.999 MHz) 7 ns (50.000 to 70.000 MHz)
Duty Cycle:	40/60% 45/55%
Maximum Frequency Aging at +25°C:	±5 ppm/yr
Max. Start-Up Time:	10 ms
Tristate Input:	+0.80 VDC Max. to Disable +3.60 VDC Min. to Enable or open to Enable
Storage Temperature:	-55°C to +125°C
Package:	Tape and Reel (1K per Reel)

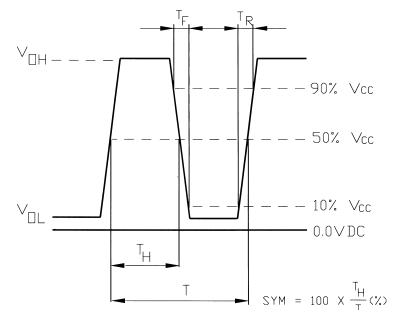
CPO



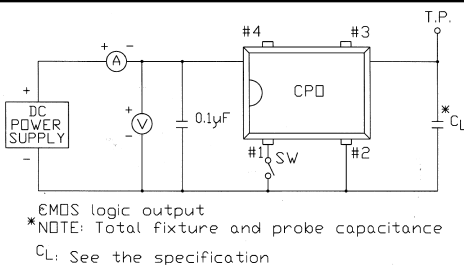
RECOMMENDED SOLDER PAD LAYOUT



OUTPUT WAVE FORM



TEST CIRCUIT



Surface Mount Clock Oscillator

Series **CPH**

- Two input voltage options
- Tristate capable

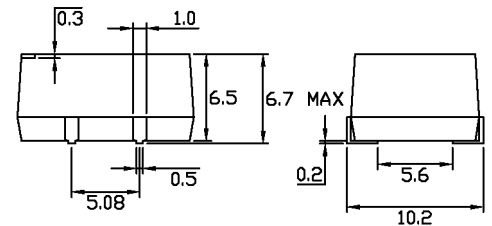
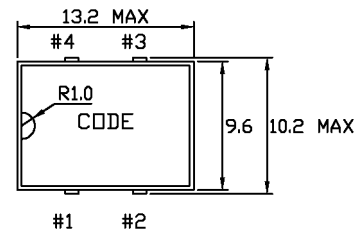
Part Numbering Example: CPH L Z - A2 B2 45 - 33.333 TS

CPH	L	Z	A2	B2	45	33.333	TS
SERIES	VOLTAGE	ADDED FEATURES	OPERATING TEMP.	STABILITY	SYMMETRY	FREQUENCY	TRI STATE
CPH	Blank = 5V L = 3.3V	BLANK = BULK PACK Z = TAPE AND REEL	Blank = 0°C ~ +70°C A2 = -40°C ~ +85°C	Blank = ±100 ppm B2 = ± 50 ppm BR = ± 25 ppm	Blank = 40/60% 45 = 45/55%		Tri State Standard

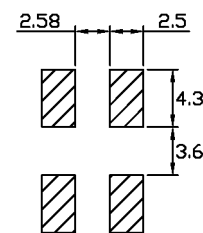
Specifications:

Frequency Range:	70.000 MHz to 125.000 MHz
Available Stability Options:	±100 ppm <i>Standard</i> ±50 ppm ±25 ppm
Output Series:	HCMOS
Input Voltage:	+5.0 VDC ±10% <i>Standard</i> +3.3 VDC ±10%
Operating Temperature Range Options:	-10°C to +70°C <i>Standard</i> -40°C to +85°C
Output Voltage:	HCMOS $V_{OL} = 10\% V_{DD} V$ Max. HCMOS $V_{OH} = 90\% V_{DD} V$ Min.
Output Load:	15pf
Maximum Input Current:	65 mA @ +5.0 VDC 30 mA @ +3.3 VDC
Maximum Rise/Fall Time:	3 ns
Duty Cycle:	40/60% 45/55%
Tristate Input:	@+5 VDC Input +0.80 VDC Max. to Disable +3.60 VDC Min. to Enable or open to Enable @3.3 VDC Input +0.80 VDC Max. to Disable +2.20 VDC Min. to Enable or open to Enable
Storage Temperature:	-55°C to +125°C
Packaging:	Tape and Reel (1K per Reel)

CPH



RECOMMENDED SOLDER PAD LAYOUT



- PINOUT
- 1 NC/TRI-STATE
 - 2 GND
 - 3 OUTPUT
 - 4 Vcc



Surface Mount Clock Oscillator

Series **CC065S**

- *Tristate capable*
- *1.7 mm height*

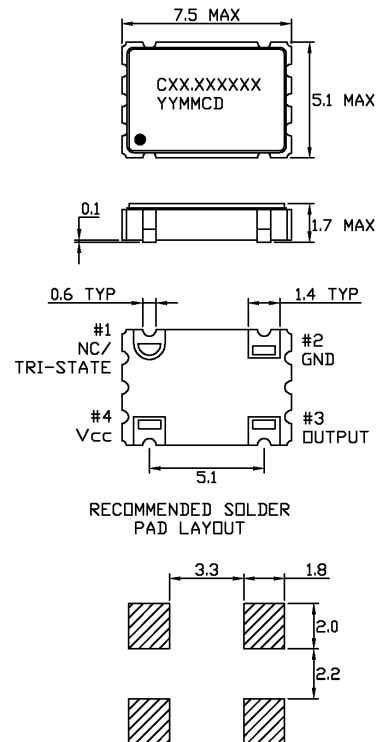
Part Numbering Example: CC065S Z - A2 B2 45 - 33.333 TS

CC065S	Z	A2	B2	45	33.333	TS
SERIES	ADDED FEATURES	OPERATING TEMP.	STABILITY	SYMMETRY	FREQUENCY	TRI STATE
CC065S	BLANK = BULK PACK Z = TAPE AND REEL	Blank = 0°C ~ +70°C A2 = -40°C ~ +85°C	Blank = ±100 ppm B2 = ± 50 ppm	Blank = 40/60% 45 = 45/55%		Tri State Standard

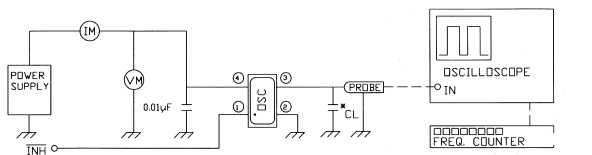
Specifications:

Frequency Range:	1.8432 MHz to 125.000 MHz
Available Stability Options:	±100 ppm <i>Standard</i> ±50 ppm
Output Series:	HCMOS
Input Voltage:	+5.0 VDC ±10%
Operating Temperature Range Options:	-10°C to +70°C <i>Standard</i> -40°C to +85°C
Output Voltage:	V _{OL} = 0.5 V Max. V _{OH} = 4.5 V Min.
Output Load:	10 LS TTL, 15 pf CMOS
Maximum Input Current:	25 mA (1.8432 to 31.999 MHz) 35 mA (32.000 to 70.000 MHz)
Maximum Rise/Fall Time:	10 ns
Duty Cycle:	40/60% 45/55%
Max. Start-Up Time:	10 ms
Tristate Input:	+0.80 VDC Max. to Disable +3.60 VDC Min. to Enable or open to Enable
Storage Temperature:	-55°C to +125°C
Packaging:	Tape and Reel (1K per Reel)

CC065S

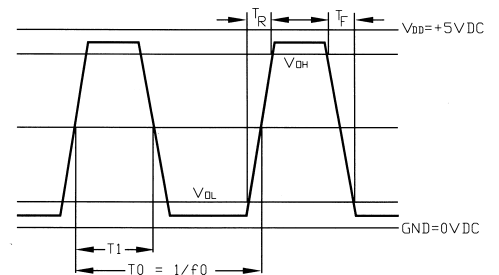


TEST CIRCUIT

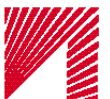


* CL=15pF or 50pF : Total Fixture And Probe Capacitance

OUTPUT WAVE FORM



$$\text{SYMMETRY} = \left(\frac{T_1}{T_0} \right) \times 100\%$$



Surface Mount Clock Oscillator

Series **CC065H**

- *Tristate capable*
- *1.7 mm height*
- *50 pf load compatible*

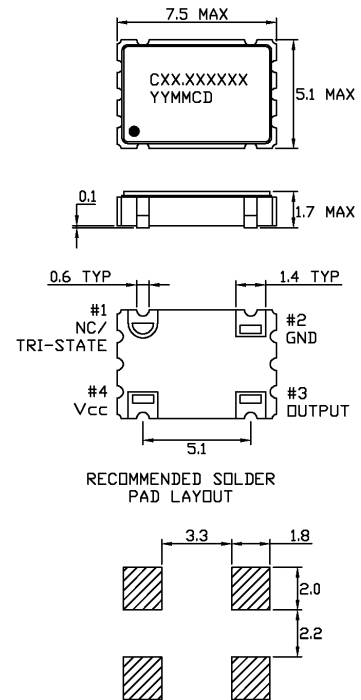
Part Numbering Example: **CC065H Z - A2 B2 45 - 33.333 TS**

CC065H	Z	A2	B2	45	33.333	TS
SERIES	ADDED FEATURES	OPERATING TEMP.	STABILITY	SYMMETRY	FREQUENCY	TRI STATE
CC065H	BLANK = BULK PACK Z = TAPE AND REEL	Blank = 0°C ~ +70°C A2 = -40°C ~ +85°C	Blank = ±100 ppm B2 = ± 50 ppm	Blank = 40/60% 45 = 45/55%		Tri State Standard

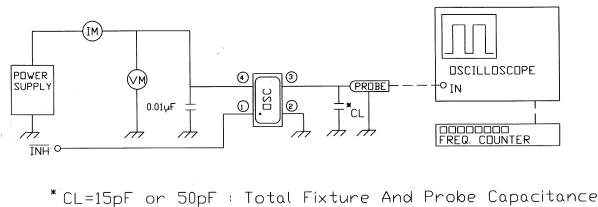
Specifications:

Frequency Range:	1.8432 MHz to 80.000 MHz
Available Stability Options:	±100 ppm <i>Standard</i> ±50 ppm
Output Series:	LSTTL / HCMOS
Input Voltage:	+5.0 VDC ±10%
Operating Temperature Range Options:	-10°C to +70°C <i>Standard</i> -40°C to +85°C
Output Voltage:	V _{OL} = 0.5 V Max. V _{OH} = 4.5 V Min.
Output Load:	10 TTL, 50 pf CMOS
Maximum Input Current:	27 mA (1.8432 to 31.999 MHz) 45 mA (32.000 to 49.999 MHz) 75 mA (50.000 to 80.000 MHz)
Maximum Rise/Fall Time:	7 ns
Duty Cycle:	40/60% <i>Standard</i> 45/55%
Max. Start-Up Time:	10 ms
Tristate Input:	+0.80 VDC Max. to Disable +3.60 VDC Min. to Enable or open to Enable
Storage Temperature:	-55°C to +125°C
Packaging:	Tape and Reel (1K per Reel)

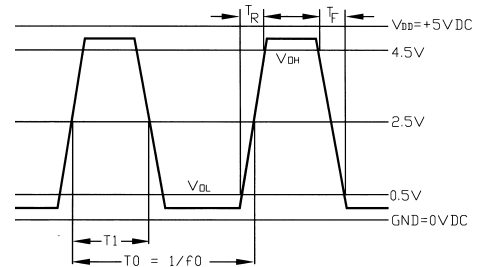
CC065H



TEST CIRCUIT



OUTPUT WAVE FORM



$$\text{SYMMETRY} = \left(\frac{T_1}{T_0} \right) \times 100\%$$



Surface Mount Clock Oscillator

Series **CC065L**

- 1.7 mm height
- 3.3 VDC operation
- TTL State Capable

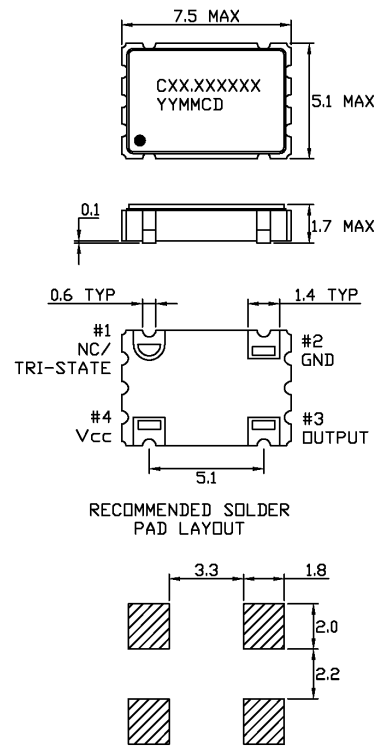
Part Numbering Example: CC065L Z - A2 B2 45 - 33.333 TS

CC065L	Z	A2	B2	45	33.333	TS
SERIES	ADDED FEATURES	OPERATING TEMP.	STABILITY	SYMMETRY	FREQUENCY	TRI STATE
CC065L	BLANK = BULK PACK Z = TAPE AND REEL	Blank = 0°C ~ +70°C A2 = -40°C ~ +85°C	Blank = ±100 ppm B2 = ± 50 ppm	Blank = 40/60% 45 = 45/55%		Tri State Standard

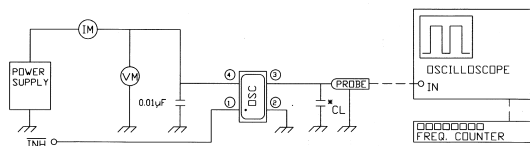
Specifications:

Frequency Range:	1.8432 MHz to 80.000 MHz
Available Stability Options:	±100 ppm <i>Standard</i> ±50 ppm
Output Series:	HCMOS
Input Voltage:	+3.3 VDC ±10%
Operating Temperature Range Options:	-10°C to +70°C -40°C to +85°C
Output Voltage:	V _{OL} = .33 V Max. V _{OH} = 2.97 V Min.
Output Load:	10 LS TTL, 15 pf CMOS
Maximum Input Current:	25 mA (1.8432 to 31.999 MHz) 40 mA (32.000 to 80.000 MHz)
Maximum Rise/Fall Time:	7 ns
Duty Cycle:	40/60% 45/55%
Max. Start-Up Time:	10 ms
Tristate Input:	+0.80 VDC Max. to Disable +2.20 VDC Min. to Enable or open to Enable
Storage Temperature:	-55°C to +125°C
Packaging:	Tape and Reel (1K per Reel)

CC065L

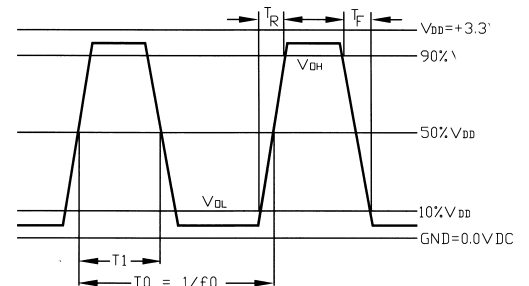


TEST CIRCUIT

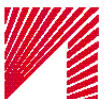


* CL=15pF or 50pF : Total Fixture And Probe Capacitance

OUTPUT WAVE FORM



$$\text{SYMMETRY} = \left(\frac{T_F}{T_R} \right) \times 100\%$$



Surface Mount Clock Oscillator

Series **CC85**

- 1.7 mm height
- High frequency range
- Tight stability available

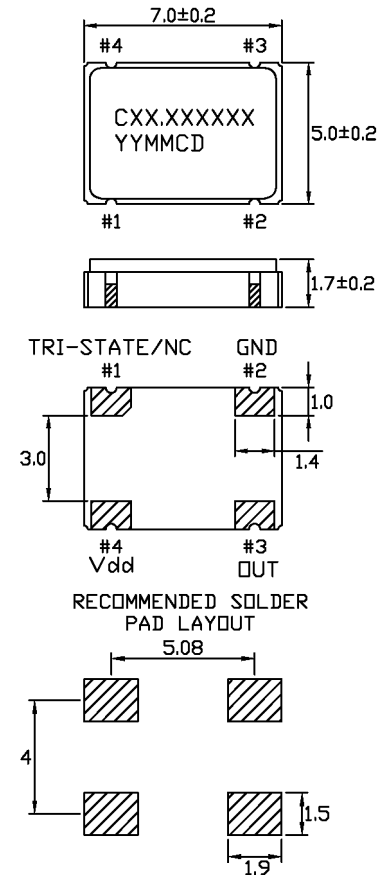
Part Numbering Example: CC85 L Z - A2 B2 45 - 83.333 TS

CC85	L	Z	A2	B2	45	83.333	TS
SERIES	VOLTAGE	ADDED FEATURES	OPERATING TEMP.	STABILITY	SYMMETRY	FREQUENCY	TRI STATE
CC85	Blank = 5V L = 3.3V	BLANK = BULK PACK Z = TAPE AND REEL	Blank = 0°C ~ +70°C A2 = -40°C ~ +85°C	Blank = ±100 ppm B2 = ± 50 ppm BR = ± 25 ppm	Blank = 40/60% 45 = 45/55%		Tri State Standard

Specifications:

Frequency Range:	8.000 MHz to 125.000 MHz
Available Stability Options:	±100 ppm <i>Standard</i> ±50 ppm ±25 ppm
Output Series:	HCMOS
Input Voltage:	+5.0 VDC ±10% <i>Standard</i> +3.3 VDC ±10%
Operating Temperature Range Options:	-10°C to +70°C <i>Standard</i> -40°C to +85°C
Output Voltage:	HCMOS $V_{OL} = 10\% V_{DD} V \text{ Max.}$ HCMOS $V_{OH} = 90\% V_{DD} V \text{ Min.}$
Output Load:	15 pf
Maximum Input Current:	65 mA @ +5.0 VDC 30 mA @ +3.3 VDC
Maximum Rise/Fall Time:	3 ns
Duty Cycle:	40/60% 45/55%
Tristate Input:	+5 VDC Input +0.80 VDC Max. to Disable +3.60 VDC Min. to Enable or Open to Enable +3.3 VDC Input +0.80 VDC Max. to Disable +2.20 VDC Min. to Enable or open to Enable
Storage Temperature:	-55°C to +125°C
Packaging:	Tape and Reel (1K per Reel)

CC85



Ceramic Surface Mount Oscillator

Series **CC045**

- 5.0 x 3.2 x 0.95 (L x W x H)
- Tristate capable

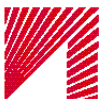
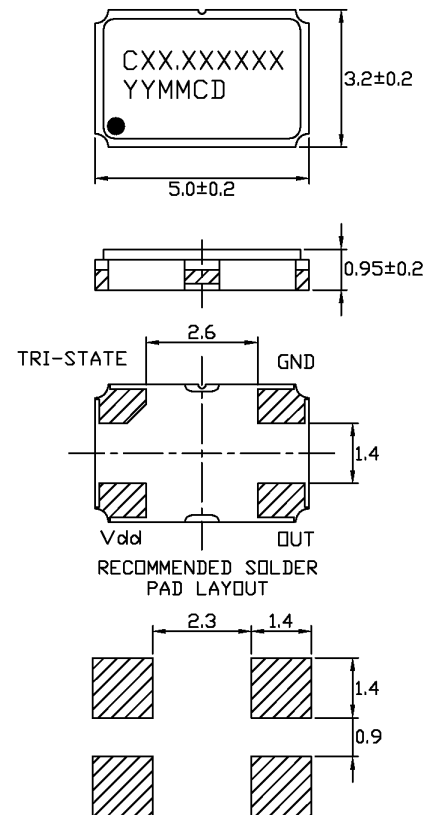
Part Numbering Example: CC045 L Z - A2 B2 45 - 33.333 TS

CC045	L	Z	A2	B2	45	33.333	TS
SERIES	VOLTAGE	ADDED FEATURES	OPERATING TEMP.	STABILITY	SYMMETRY	FREQUENCY	TRI STATE
CC045	Blank = 5V L = 3.3V E = 3.0V	BLANK = BULK PACK Z = TAPE AND REEL	Blank = 0°C ~ +70°C	Blank = ±100 ppm B2 = ± 50 ppm	Blank = 40/60% 45 = 45/55%		Tri State Standard

Specifications:

Frequency Range:	2.500 MHz to 55.000 MHz
Available Stability Options:	±100 ppm ±50 ppm
Output Series:	HCMOS
Input Voltage:	+5.0 VDC ±10% +3.3 VDC ±10% +3.0 VDC ±10%
Operating Temperature Range Options:	0°C to +70°C
Output Voltage:	HCMOS $V_{OL} = 10\% V_{DD} V$ Max. HCMOS $V_{OH} = 90\% V_{DD} V$ Min.
Output Load:	15 pf
Maximum Input Current:	50 mA
Maximum Rise/Fall Time:	6 ns
Duty Cycle:	40/60% 45/55%
Tristate Input:	+5 VDC Input +0.80 VDC Max. to Disable +3.60 VDC Min. to Enable or open to Enable +3.3 VDC & 3.0 VDC Input +0.80 VDC Max. to Disable +2.20 VDC Min. to Enable or open to Enable
Storage Temperature:	-55°C to +125°C
Packaging:	Tape and Reel (1K per Reel)

CC045



Surface Mount Clock Oscillator

Series **CC532**

- 5.0 x 3.2 x 1.0 mm (L x W x H)
- Low power consumption
- Tight stability available
- Tristate capable

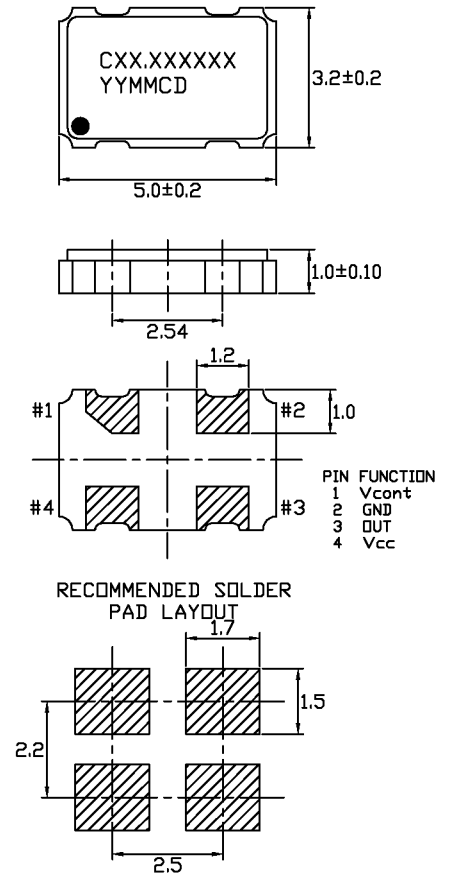
Part Numbering Example: CC532 L Z - A B2 45 - 33.333 TS

CC532	L	Z	A	B2	45	33.333	TS
SERIES	VOLTAGE	ADDED FEATURES	OPERATING TEMP.	STABILITY	SYMMETRY	FREQUENCY	TRI STATE
CC532	Blank = 5V L = 3.3V E = 3.0V	BLANK = BULK PACK Z = TAPE AND REEL	Blank = 0°C ~ +70°C A1=-10°C ~ +70°C	Blank = ±100 ppm B2 = ± 50 ppm	Blank = 40/60% 45 = 45/55%		Tri State Standard

Specifications:

Frequency Range:	8.00 MHz to 67.000 MHz
Available Stability Options:	±100 ppm <i>Standard</i> ±50 ppm
Output Series:	HCMOS
Input Voltage:	+5.0 VDC ±10% <i>Standard</i> +3.3 VDC ±10% +3.0 VDC ±10%
Operating Temperature Range Options:	-10°C to +70°C
Output Voltage:	HCMOS $V_{OL} = 10\% V_{DD} V$ Max. HCMOS $V_{OH} = 90\% V_{DD} V$ Min.
Output Load:	15 pf
Maximum Rise/Fall Time:	10 ns
Duty Cycle:	40/60% 45/55%
Tristate Input:	+5 VDC Input +0.80 VDC Max. to Disable +3.60 VDC Min. to Enable or open to Enable +3.3 VDC Input +0.80 VDC Max. to Disable +2.20 VDC Min. to Enable or open to Enable
Storage Temperature:	-40°C to +85°C
Packaging:	Tape and Reel (1K per Reel)

CC532



Ceramic Surface Mount Oscillator

Series **CC137**

- 5.0 x 3.2 x 0.95 (L x W x H)
- Small size

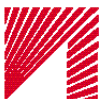
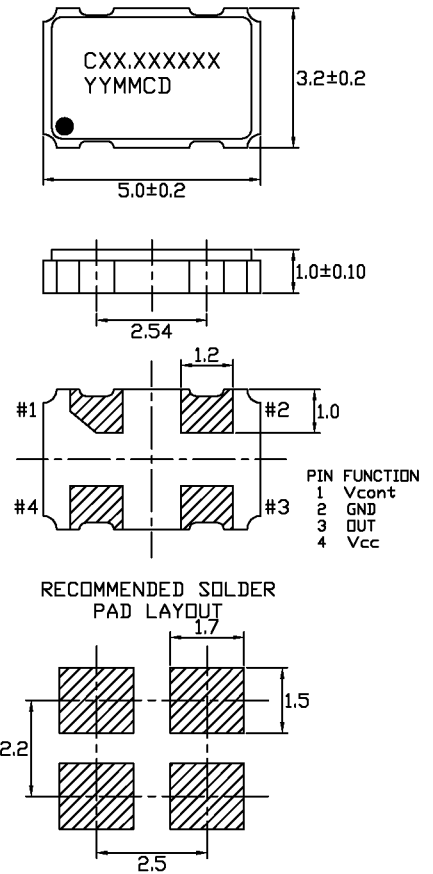
Part Numbering Example: CC137 L Z - A0 B2 45 - 33.333 TS

CC137	L	Z	A0	B2	45	33.333	TS
SERIES	VOLTAGE	ADDED FEATURES	OPERATING TEMP.	STABILITY	SYMMETRY	FREQUENCY	TRI STATE
CC137	Blank = 5V L = 3.3V	BLANK = BULK PACK Z = TAPE AND REEL	A0=-10°C ~+60°C	Blank = ±100 ppm B2 = ± 50 ppm B3 = ± 30 ppm	Blank = 40/60% 45 = 45/55%		Tri State Standard

Specifications:

Frequency Range:	1.500 MHz to 100 MHz
Available Stability Options:	±100 ppm ±50 ppm ±30 ppm
Output Series:	TTL/HCMOS
Input Voltage:	+5.0 VDC ±10% +3.3 VDC ±10%
Operating Temperature Range Options:	-10°C to +60°C
Output Voltage:	TTL $V_{OL} = 0.4$ V Max. TTL $V_{OH} = 2.4$ V Min. HCMOS $V_{OL} = 10\%$ V_{DD} V Max. HCMOS $V_{OH} = 90\%$ V_{DD} V Min.
Output Load:	10 TTL, 15 pf CMOS @+5 VDC 5 TTL, 15 pf CMOS @+3.3 VDC
Maximum Input Current:	20 mA
Maximum Rise/Fall Time:	10 nsec
Duty Cycle:	40/60% 45/55%
Storage Temperature:	-40°C to +85°C
Packaging:	Tape and Reel (1K per Reel)

CC137



ECL SECTION

CECL	61
CECLP	62



ECL Oscillators 14 Pin Dip Compatible

Series **CECL**

Cardinal ECL oscillators offer high frequencies, fast speed, and a multitude of pin configurations to fit your exact specifications.

Part Numbering Example: CECL -B2 - 150.0 B

CECL

SERIES

CECL

B2

STABILITY

Blank = ±100 ppm
B2 = ± 50 ppm

150.0

FREQUENCY

B

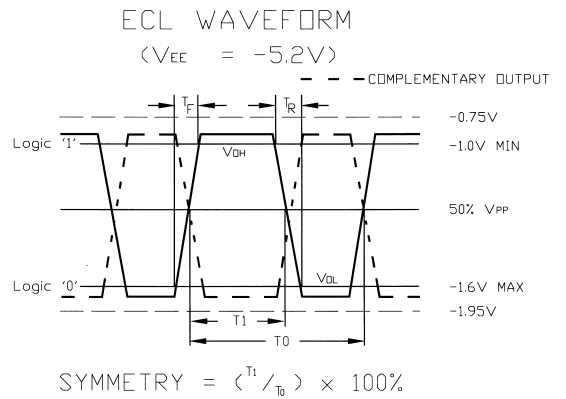
PIN CONFIGURATION

see chart below

Specifications:

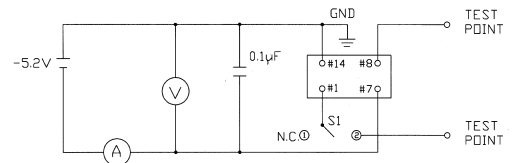
Frequency Range:	30.000 MHz to 250.000 MHz
Available Stability Options:	±100 ppm <i>Standard</i> ±50 ppm
Input Voltage:	VEE = -5.2V ± 5% VCC = 0V VCC = +5.2V ± 5% VEE = 0V
Output Voltage:	For -5.2V Operation '0' Logic Level: -1.95 V Min -1.6 V Max '1' Logic Level: -1.00 V Min -0.75 V Max For +5.2V Operation '0' Logic Level: +3.05 V Min +3.42 V Max '1' Logic Level: +4.00 V Min +4.45 V Max
Operating Temperature	-10°C to +70°C
Range Options:	
Output Load:	5 ECL GATES
Maximum Input Current:	< 170.000000 MHz 40 mA ≥ 170.000000 MHz 50 mA
Maximum Rise/Fall Time:	< 170.000000 MHz 2.0 ns Max ≥ 170.000000 MHz 1.5 ns Max
Duty Cycle:	40/60%
Storage Temperature:	-55°C to +125°C

OUTPUT WAVE FORM

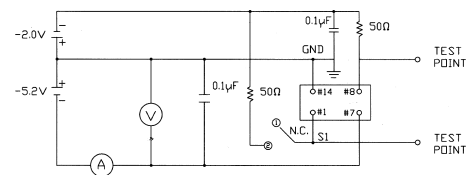


TEST CIRCUIT

ECL TEST CIRCUIT (with pull down resistors)



ECL TEST CIRCUIT (without pull down resistors)



Pin Configurations

PIN	A	B	C	D	E	F	G
1	N.C.	N.C.	N.C.	ECL Comp. Out	ECL Comp. Out	ECL Comp. Out	Case Gnd N.C.
7	V _{EE} (Case Gnd)	V _{CC} (Case Gnd)	V _{EE}	V _{EE}	V _{EE} (Case Gnd)	V _{CC} (Case Gnd)	V _{EE}
8	ECL Output	ECL Output	ECL Output	ECL Output	ECL Output	ECL Output	ECL Output
14	V _{CC}	V _{EE}	V _{CC} (Case Gnd)	V _{CC} (Case Gnd)	V _{CC}	V _{EE}	V _{CC}



PECL Oscillators 14Pin Dip Compatible

Series **CECLP**

Cardinal PECL oscillators offer high frequencies, fast speed, and a multitude of pin configurations to fit your exact specifications.

Part Numbering Example: CECLP 1 -B2 - 150.0

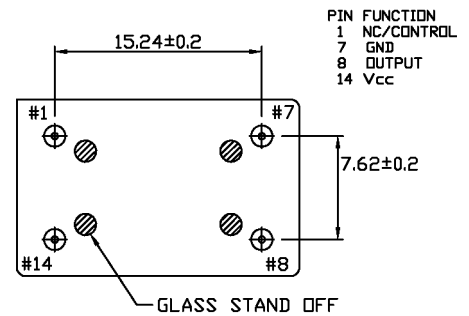
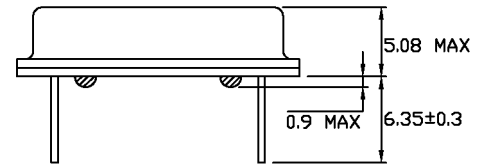
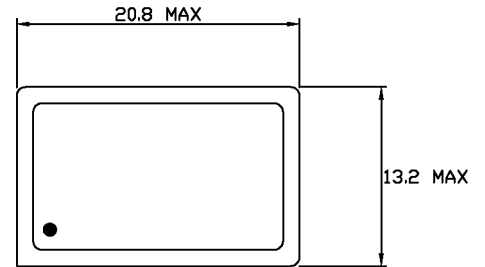
CECLP	1	B2	150.0
SERIES	PACKAGE STYLE	STABILITY	FREQUENCY
CECLP	1 = Full Size 3 = Full Size, Gull Wing	Blank = ±100 ppm B2 = ± 50 ppm	

Specifications:

Frequency Range:	19.44 MHz to 155.52 MHz	
Available Stability Options:	±100 ppm <i>Standard</i> ±50 ppm	
Input Voltage:	VCC = +5.0V ± 5% VEE = 0V	
Output Voltage:	Output '0' Level Vcc -1.60V Max	Output '1' Level Vcc -1.02V Min
Operating Temperature Range Options:	-10°C to +70°C	
Output Load:	50 Ohm to Vcc-2V (All outputs require termination)	
Maximum Input Current:	60 mA	
Maximum Rise/Fall Time:	2.0 ns Max	
Duty Cycle:	40/60%	
Storage Temperature:	-55°C to +125°C	

CECLP

STYLE 1 FULL SIZE 14 PIN DIP



TCXO SECTION

CTCX	64	CT4S	74
CC124	65	CTX8	75
CC180	66	CC131	76
CC181	67	CC132	77
CC163	68	CT4T	78
CC162	69	CT6S	79
CTX4	70	CT6T	80
CTX5	71	CT79	81
CTX6	72	CC141	82
CC128	73		



Thru Hole TCXO

Series **CTCX**

- Tight frequency
- Stability over temperature with excellent aging

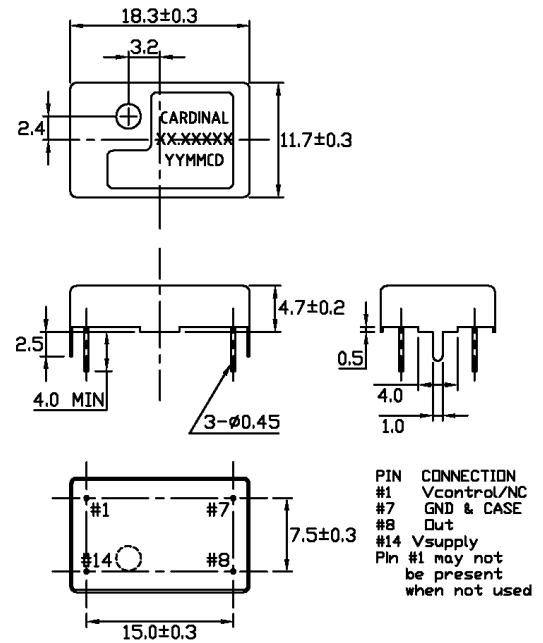
Part Numbering Example: CTCX - A3 B3 - 15.360

CTCX	A3	B3	15.360
SERIES	OPERATING TEMP.	STABILITY	FREQUENCY
CTCX	A1=-10°C~+50°C A2=-10°C~+60°C A3=-30°C~+75°C A4=-40°C~+75°C	B1 = ±5.0 ppm B2 = ±3.0 ppm B3 = ±2.5 ppm	

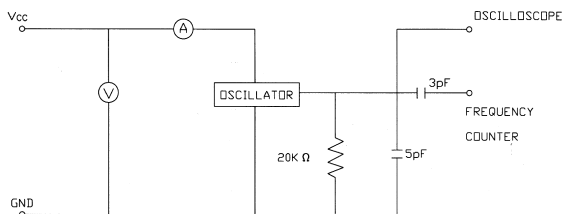
Specifications:

Frequency Range:	4.000 MHz to 25.000 MHz
Available Stability Options:	±5.0 ppm ±2.5 ppm <i>Standard</i> ±3.0 ppm
Output Series:	Clipped Sine
Input Voltage:	+5.0 VDC ±5%
Operating Temperature Range Options:	-30°C to +75°C <i>Standard</i> -10°C to +60°C
Output Voltage:	1.0 Volt Peak to Peak Minimum
Frequency Trim Range With Externally Adjustable Trimmer:	±3.0 ppm Minimum
Output Load:	10K OHM Parallel with 10 pf
Maximum Input Current:	2.0 mA
Maximum Frequency Aging at +25°C:	±1 ppm/yr
Freq. Stability Vs. Change of Input Voltage of ±5%:	±0.5 ppm
Storage Temperature	-40°C to +85°C

CTCX



TEST CIRCUIT



Thru Hole TCXO

- 4.5 mm height
- Tight stability availability

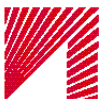
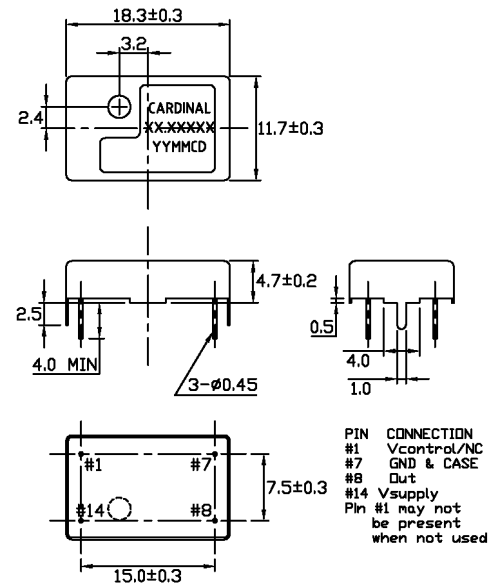
Part Numbering Example: CC124 L - A2 B2 45 - 22.5792

CC124	L	A2	B2	45	22.5792
SERIES	VOLTAGE	OPERATING TEMP.	STABILITY	SYMMETRY	FREQUENCY
CC124	Blank = 5V L = 3.3V	A2 = -10°C ~+60°C A3 = -30°C ~+75°C A5 = -20°C ~+70°C A9 = 0°C ~+50°C AA = -10°C ~+70°C AB = -30°C ~+70°C AC = -30°C ~+60°C AE = -40°C ~+80°C	B1 = ±5.0 ppm B2 = ±3.0 ppm B3 = ±2.5 ppm B4 = ±2.0 ppm B5 = ±1.5 ppm B9 = ±4.0 ppm BB = ±4.5 ppm BF = ±3.5 ppm	Blank = 40/60% 45 = 45/55%	

Specifications:

Frequency Range:	1.000 MHz to 35.000 MHz
Available Stability Options:	±5.0 ppm ±4.5 ppm ±4.0 ppm ±3.5 ppm ±3.0 ppm ±2.5 ppm ±2.0 ppm ±1.5 ppm
Output Series:	TTL/CMOS
Input Voltage:	+5.0 VDC ±5%
Operating Temperature Range Options:	0°C to +50°C -10°C to +60°C -10°C to +70°C -20°C to +70°C -30°C to +60°C -30°C to +70°C -30°C to +75°C -40°C to +80°C
Output Voltage:	TTL V _{OL} = 0.4 V Max. TTL V _{OH} = 2.4 V Min. HCMOS V _{OL} = 10%V _{DD} V Max. HCMOS V _{OH} = 90%V _{DD} V Min.
Frequency Trim Range With Externally Adjustable Trimmer:	±3.0 ppm Minimum
Output Load:	10 LS TTL, 15 pf CMOS
Maximum Input Current:	20 mA
Maximum Rise/Fall Time:	10 ns
Duty Cycle:	40/60% 45/55%
Maximum Frequency Aging at +25°C:	±1 ppm/yr
Storage Temperature:	-40°C to +80°C

CC124



Thru Hole TCXO

- 8.0 mm height
- Tight stability availability
- Sinewave output

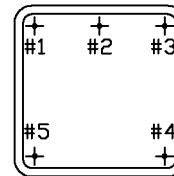
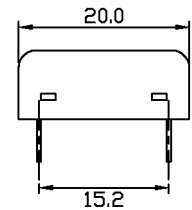
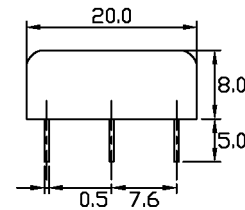
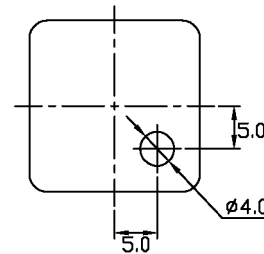
Part Numbering Example: CC180 L - A2 B2 - 22.5792

CC180	L	A2	B2	22.5792
SERIES	VOLTAGE	OPERATING TEMP.	STABILITY	FREQUENCY
CC180	Blank = 5V L = 3.3V	A2 = -10°C ~+60°C A3 = -30°C ~+75°C A5 = -20°C ~+70°C A9 = 0°C ~+50°C AA = -10°C ~+70°C AB = -30°C ~+70°C AC = -30°C ~+60°C AE = -40°C ~+80°C	B1 = ±5.0 ppm B2 = ±3.0 ppm B3 = ±2.5 ppm B4 = ±2.0 ppm B5 = ±1.5 ppm B9 = ±4.0 ppm BB = ±4.5 ppm BF = ±3.5 ppm	

Specifications:

Frequency Range:	1.000 MHz to 35.000 MHz
Available Stability Options:	±5.0 ppm ±4.5 ppm ±4.0 ppm ±3.5 ppm ±3.0 ppm ±2.5 ppm ±2.0 ppm ±1.5 ppm
Output Series:	Clipped Sine
Input Voltage:	+5.0 VDC ±5%
Operating Temperature Range Options:	0°C to +50°C -10°C to +60°C -10°C to +70°C -20°C to +70°C -30°C to +60°C -30°C to +70°C -30°C to +75°C -40°C to +80°C
Output Voltage:	1.0 Volt Peak to Peak Minimum
Frequency Trim Range With Externally Adjustable Trimmer:	±3.0 ppm Minimum
Output Load:	20K OHM Parallel with 5 pf
Maximum Input Current:	3 mA
Maximum Frequency Aging at +25°C:	±1 ppm/yr
Storage Temperature:	-40°C to +80°C

CC180



PIN	FUNCTION
1	V _{CC}
2	OUTPUT
3	V _{control} /GND
4	GND
5	GND



Thru Hole TCXO

- 8.0 mm height
- Tight stability availability
- TTL/HCMOS output

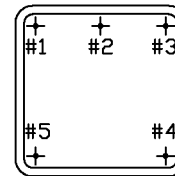
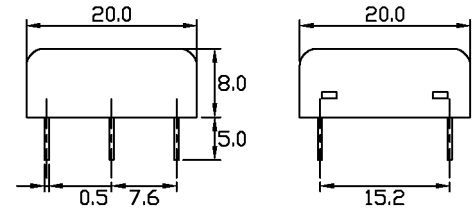
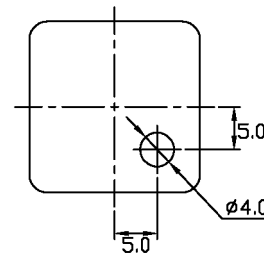
Part Numbering Example: **CC181 L - A2 B2 45 - 22.5792**

CC181	L	A2	B2	45	22.5792
SERIES	VOLTAGE	OPERATING TEMP.	STABILITY	SYMMETRY	FREQUENCY
CC181	Blank = 5V L = 3.3V	A2 = -10°C ~+60°C A3 = -30°C ~+75°C A5 = -20°C ~+70°C A9 = 0°C ~+50°C AA = -10°C ~+70°C AC = -30°C ~+60°C AE = -40°C ~+80°C	B1 = ±5.0 ppm B2 = ±3.0 ppm B3 = ±2.5 ppm B4 = ±2.0 ppm B5 = ±1.5 ppm B9 = ±4.0 ppm BB = ±4.5 ppm BF = ±3.5 ppm	Blank = 40/60% 45 = 45/55%	

Specifications:

Frequency Range:	1.000 MHz to 35.000 MHz
Available Stability Options:	±5.0 ppm ±4.5 ppm ±4.0 ppm ±3.5 ppm ±3.0 ppm ±2.5 ppm ±2.0 ppm ±1.5 ppm
Output Series:	TTL/CMOS
Input Voltage:	+5.0 VDC ±5%
Operating Temperature Range Options:	0°C to +50°C -10°C to +60°C -10°C to +70°C -20°C to +70°C -30°C to +60°C -30°C to +70°C -30°C to +75°C -40°C to +80°C
Output Voltage:	TTL $V_{OL} = 0.4$ V Max. TTL $V_{OH} = 2.4$ V Min. HCMOS $V_{OL} = 10\%V_{DD}$ V Max. HCMOS $V_{OH} = 90\%V_{DD}$ V Min.
Frequency Trim Range With Externally Adjustable Trimmer:	±3.0 ppm Minimum
Output Load:	10 LS TTL, 15 pf CMOS
Maximum Input Current:	20 mA
Maximum Rise/Fall Time:	10 ns
Duty Cycle:	40/60% 45/55%
Maximum Frequency Aging at +25°C:	±1 ppm/yr
Storage Temperature:	-40°C to +80°C
Packaging:	Tape and Reel (1K per Reel)

CC181



PIN	FUNCTION
1	V _{CC}
2	OUTPUT
3	V _{control} /GND
4	GND
5	GND



Thru Hole TCXO

- 8.5 mm height
- Tight stability availability
- Sinewave output

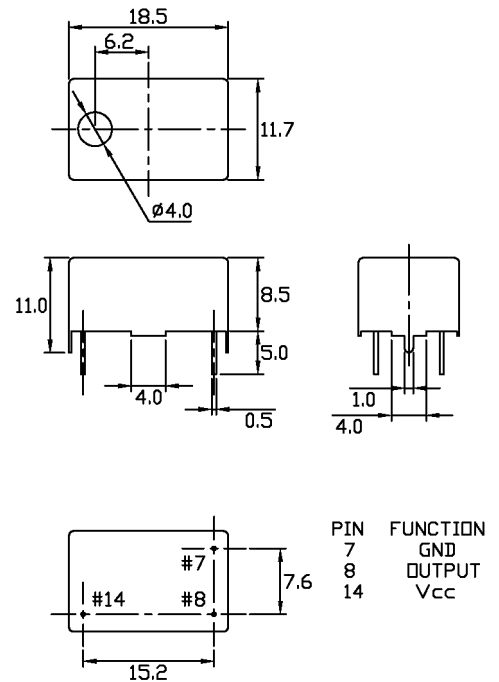
Part Numbering Example: **CC163 - A2 B2 - 22.5792**

CC163	A2	B2	22.5792
SERIES	OPERATING TEMP.	STABILITY	FREQUENCY
CC163	A2 = -10°C ~+60°C	B1 = ±5.0 ppm	
	A3 = -30°C ~+75°C	B2 = ±3.0 ppm	
	A5 = -20°C ~+70°C	B3 = ±2.5 ppm	
	A9 = 0°C ~+50°C	B4 = ±2.0 ppm	
	AA = -10°C ~+70°C	B5 = ±1.5 ppm	
	AB = -30°C ~+70°C	B9 = ±4.0 ppm	
	AC = -30°C ~+60°C	BB = ±4.5 ppm	
	AE = -40°C ~+80°C	BF = ±3.5 ppm	

Specifications:

Frequency Range:	1.000 MHz to 35.000 MHz
Available Stability Options:	±5.0 ppm ±4.5 ppm ±4.0 ppm ±3.5 ppm ±3.0 ppm ±2.5 ppm ±2.0 ppm ±1.5 ppm
Output Series:	Clipped Sine
Input Voltage:	+5.0 VDC ±5%
Operating Temperature Range Options:	0°C to +50°C -10°C to +60°C -10°C to +70°C -20°C to +70°C -30°C to +60°C -30°C to +70°C -30°C to +75°C -40°C to +80°C
Output Voltage:	1.0 Volt Peak to Peak Minimum
Frequency Trim Range With Externally Adjustable Trimmer:	±3.0 ppm Minimum
Output Load:	20K OHM Parallel with 5 pf
Maximum Input Current:	3 mA
Maximum Frequency Aging at +25°C:	±1 ppm/yr
Storage Temperature:	-40°C to +80°C

CC163



Thru Hole TCXO

- 8.5 mm height
- Tight stability availability
- TTL/HCMOS

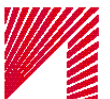
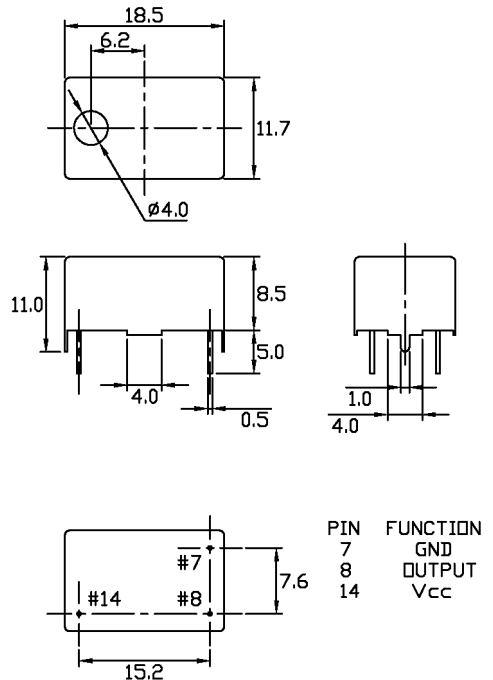
Part Numbering Example: CC162 - A2 B2 45 - 22.5792

CC162	A2	B2	45	22.5792
SERIES	OPERATING TEMP.	STABILITY	SYMMETRY	FREQUENCY
CC162	A2 = -10°C ~+60°C A3 = -30°C ~+75°C A5 = -20°C ~+70°C A9 = 0°C ~+50°C AA = -10°C ~+70°C AC = -30°C ~+60°C AE = -40°C ~+80°C	B1 = ±5.0 ppm B2 = ±3.0 ppm B3 = ±2.5 ppm B4 = ±2.0 ppm B5 = ±1.5 ppm B9 = ±4.0 ppm BB = ±4.5 ppm BF = ±3.5 ppm	Blank = 40/60% 45 = 45/55%	

Specifications:

Frequency Range:	1.000 MHz to 35.000 MHz
Available Stability Options:	±5.0 ppm ±4.5 ppm ±4.0 ppm ±3.5 ppm ±3.0 ppm ±2.5 ppm ±2.0 ppm ±1.5 ppm
Output Series:	TTL/CMOS
Input Voltage:	+5.0 VDC ±5%
Operating Temperature Range Options:	0°C to +50°C -10°C to +60°C -10°C to +70°C -20°C to +70°C -30°C to +60°C -30°C to +70°C -30°C to +75°C -40°C to +80°C
Output Voltage:	TTL $V_{OL} = 0.4$ V Max. TTL $V_{OH} = 2.4$ V Min. HCMOS $V_{OL} = 10\%V_{DD}$ V Max. HCMOS $V_{OH} = 90\%V_{DD}$ V Min.
Frequency Trim Range With Externally Adjustable Trimmer:	±3.0 ppm Minimum
Output Load:	10 LS TTL, 15 pf CMOS
Maximum Input Current:	20 mA
Maximum Rise/Fall Time:	10 ns
Duty Cycle:	40/60% 45/55%
Maximum Frequency Aging at +25°C:	±1 ppm/yr
Storage Temperature:	-40°C to +80°C

CC162



Surface Mount TCXO

Series **CTX5**

Cardinal's CTX5 oscillator is the latest in surface mount technology for TCXO's. It is capable of withstanding high temperature IR reflow applications.

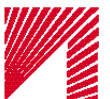
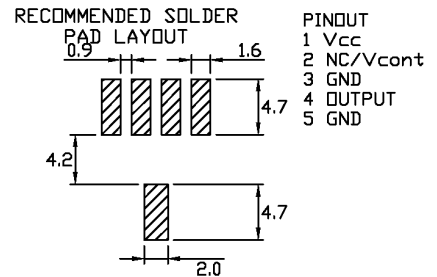
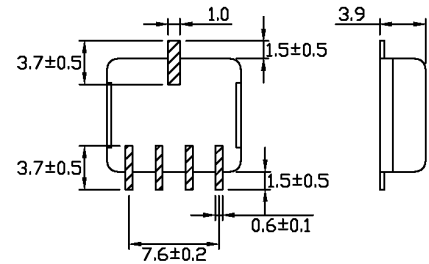
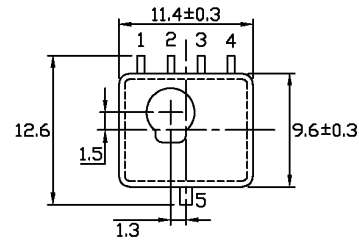
Part Numbering Example: CTX5 L Z - A3 B3 - 15.360

CTX5	L	Z	A3	B3	15.360
SERIES	VOLTAGE	PACKAGING OPTIONS	OPERATING TEMP.	STABILITY	FREQUENCY
CTX5	Blank = 5V B = 4.0V C = 3.7V L = 3.3V E = 3.0V	Z = Tape and Reel	A1=-10°C ~ +50°C A2=-10°C ~ +60°C A3=-30°C ~ +75°C A4=-40°C ~ +75°C	B3 = ±2.5 ppm	

Specifications:

Frequency Range:	12.000 MHz to 19.680 MHz
Available Stability Options:	±2.5 ppm
Output Series:	Clipped Sine
Input Voltage:	+5.0 VDC ± 5% <i>Standard</i> +4.0 VDC ± 5% +3.7 VDC ± 5% +3.3 VDC ± 5% +3.0 VDC ± 5%
Operating Temperature Range Options:	-30°C to +75°C <i>Standard</i>
Output Voltage:	1.0 Volt Peak to Peak Minimum
Frequency Trim Range With Externally Adjustable Trimmer:	±3.0 ppm Minimum
Output Load:	10K OHM Parallel with 5 pf
Maximum Input Current:	2.0 mA
Maximum Frequency Aging at +25°C:	±1.0 ppm/yr
Freq. Stability Vs. Change of Input Voltage of ±5%:	±0.3 ppm
Packaging:	Tape and Reel (1K per Reel)

CTX5



Surface Mount TCXO

Series **CTX6**

- 4.0 mm max height
- Various input supply voltage options

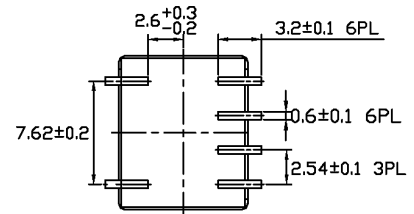
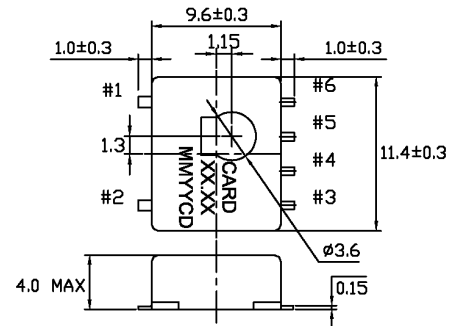
Part Numbering Example: CTX6 L Z - A3 B3 - 15.360

CTX6	L	Z	A3	B3	15.360
SERIES	VOLTAGE	PACKAGING OPTIONS	OPERATING TEMP.	STABILITY	FREQUENCY
CTX6	Blank = 5V B = 4.0V C = 3.7V L = 3.3V E = 3.0V	Z = Tape and Reel	A1=-10°C ~ +50°C A2=-10°C ~ +60°C A3=-30°C ~ +75°C A4=-40°C ~ +75°C	B3 = ±2.5 ppm	

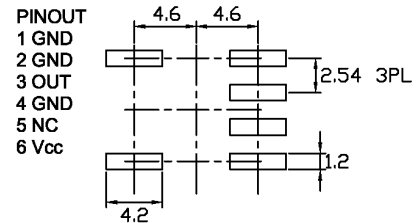
Specifications:

Frequency Range:	12.000 MHz to 19.680 MHz
Available Stability Options:	±2.5 ppm
Output Series:	Clipped Sine
Input Voltage:	+5.0 VDC ±5% +4.0 VDC ±5% +3.7 VDC ±5% +3.3 VDC ±5% +3.0 VDC ±5%
Operating Temperature Range Options:	-30°C to +75°C
Output Voltage:	1.0 Volt Peak to Peak Minimum
Frequency Trim Range With Externally Adjustable Trimmer:	±3.0 ppm Minimum
Output Load:	10K OHM Parallel with 15 pf
Maximum Input Current:	2.0 mA
Maximum Frequency Aging at +25°C:	±1 ppm/yr
Freq. Stability Vs. Change of Input Voltage of ±5%:	±0.3 ppm
Packaging:	Tape and Reel (1K per Reel)

CTX6



RECOMMENDED SOLDER PAD LAYOUT



Surface Mount TCXO

Series **CC128**

- 4.0 mm height
- Tight stability availability
- TTL/HCMOS

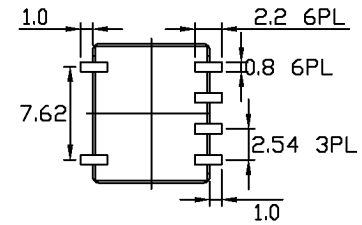
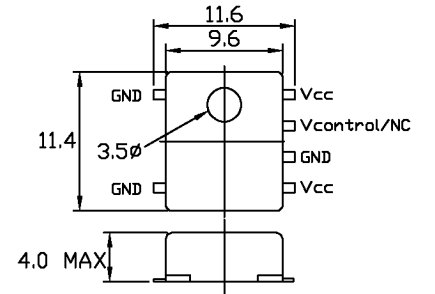
Part Numbering Example: CC128 L Z - A2 B2 45 - 22.5792

CC128	L	Z	A2	B2	45	22.5792
SERIES	VOLTAGE	PACKAGING OPTIONS	OPERATING TEMP.	STABILITY	SYMMETRY	FREQUENCY
CC128	Blank = 5V L = 3.3V	Blank = Bulk Z = Tape and Reel	A2 = -10°C ~+60°C A3 = -30°C ~+75°C A5 = -20°C ~+70°C A9 = 0°C ~+50°C AA = -10°C ~+70°C AB = -30°C ~+70°C AC = -30°C ~+60°C AE = -40°C ~+80°C	B1 = ±5.0 ppm B2 = ±3.0 ppm B3 = ±2.5 ppm B4 = ±2.0 ppm B5 = ±1.5 ppm B9 = ±4.0 ppm BB = ±4.5 ppm BF = ±3.5 ppm	Blank = 40/60% 45 = 45/55%	

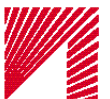
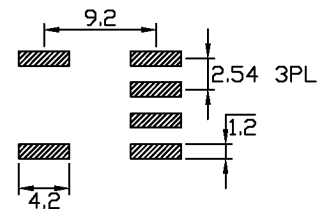
Specifications:

Frequency Range:	1.000 MHz to 35.000 MHz
Available Stability Options:	±5.0 ppm ±4.5 ppm ±4.0 ppm ±3.5 ppm ±3.0 ppm ±2.5 ppm ±2.0 ppm ±1.5 ppm
Output Series:	TTL/CMOS
Input Voltage:	+5.0 VDC ±5%
Operating Temperature Range Options:	0°C to +50°C -10°C to +60°C -10°C to +70°C -20°C to +70°C -30°C to +60°C -30°C to +70°C -30°C to +75°C -40°C to +80°C
Output Voltage:	TTL $V_{OL} = 0.4$ V Max. TTL $V_{OH} = 2.4$ V Min. HCMOS $V_{OL} = 10\%V_{DD}$ V Max. HCMOS $V_{OH} = 90\%V_{DD}$ V Min.
Frequency Trim Range With Externally Adjustable Trimmer:	±3.0 ppm Minimum
Output Load:	10 LS TTL, 15 pf CMOS
Maximum Input Current:	20 mA
Maximum Rise/Fall Time:	10 ns
Duty Cycle:	40/60% 45/55%
Maximum Frequency Aging at +25°C:	± 1 ppm/yr
Storage Temperature:	-40°C to +80°C
Packaging:	Tape and Reel (1K per Reel)

CC128



RECOMMENDED SOLDER PAD LAYOUT



Surface Mount TCXO

Series **CT4S**

- Industry standard footprint
- 2.5 mm max. height
- Low power consumption

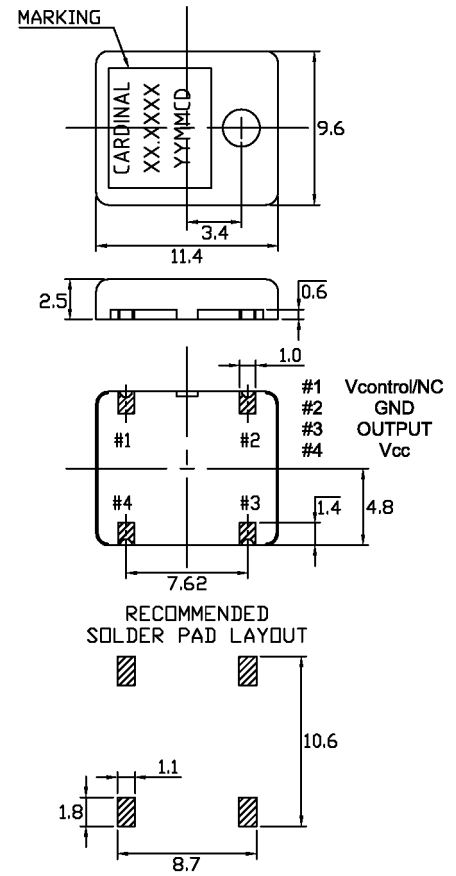
Part Numbering Example: **CT4S L Z - A3 B3 - 15.360**

CT4S	L	Z	A3	B3	15.360
SERIES	VOLTAGE	PACKAGING OPTIONS	OPERATING TEMP.	STABILITY	FREQUENCY
CT4S	Blank = 5V L = 3.3V E = 3.0V	Z = Tape and Reel	A1 = -10°C ~+50°C A2 = -10°C ~+60°C A3 = -30°C ~+75°C A4 = 40°C ~+75°C	B3 = ±2.5 ppm B5 = ±1.5 ppm	

Specifications:

Frequency Range:	9.600 MHz to 32.000 MHz
Available Stability Options:	±2.5 ppm ±1.5 ppm
Output Series:	Clipped Sine
Input Voltage:	+5.0 VDC ±5% +3.3 VDC ±5% +3.0 VDC ±5%
Operating Temperature Range Options:	-30°C to +75°C -20°C to +70°C
Output Voltage:	1.0 Volt Peak to Peak Minimum (+5 VDC Input) 0.8 VOLT Peak to Peak Minimum (+3 VDC Input)
Frequency Trim Range With Externally Adjustable Trimmer:	±3.0 ppm Minimum
Output Load:	10K OHM Parallel with 10 pf
Maximum Input Current:	2.0 mA (9.600 to 19.999 MHz) 3.0 mA (20.000 to 32.000 MHz)
Maximum Frequency Aging at +25°C:	±1 ppm/yr
Freq. Stability Vs. Change of Input Voltage of ±5%:	±0.3 ppm
Storage Temperature:	-40°C to +85°C
Packaging:	Tape and Reel (1K per Reel)

CT4S



Surface Mount TCXO

• Industry standard footprint

Series **CTX8**

Part Numbering Example: CTX8 Z - A3 B3 - 15.360

CTX8

SERIES

CTX8

Z

PACKAGING OPTIONS

Z = Tape and Reel

A3

OPERATING TEMP.

A1=-10°C ~ +50°C
A2=-10°C ~ +60°C
A3=-30°C ~ +75°C
A4=-40°C ~ +75°C

B3

STABILITY

B1 = ±5.0 ppm
B2 = ±3.0 ppm
B3 = ±2.5 ppm

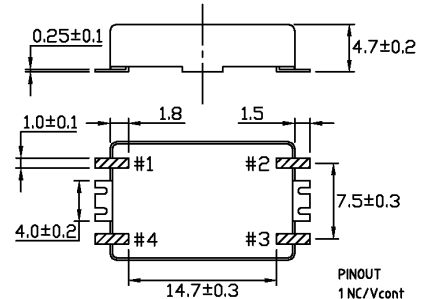
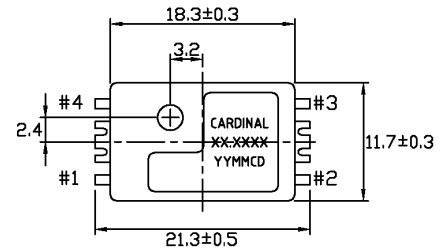
15.360

FREQUENCY

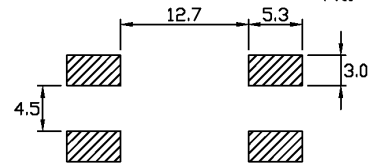
Specifications:

Frequency Range:	9.600 MHz to 32.000 MHz
Available Stability Options:	±5.0 ppm ±3.0 ppm ±2.5 ppm
Output Series:	Clipped Sine
Input Voltage:	+5.0 VDC ±5%
Operating Temperature Range Options:	-10°C to +50°C -10°C to +60°C -30°C to +75°C -40°C to +75°C
Output Voltage:	1.0 Volt Peak to Peak Minimum
Frequency Trim Range With Externally Adjustable Trimmer:	± 3.0 ppm Minimum
Output Load:	10K OHM Parallel with 10 pf
Maximum Input Current:	2.0 mA
Maximum Frequency Aging at +25°C:	±1 ppm/yr
Freq. Stability Vs. Change of Input Voltage of ±5%:	±0.3 ppm
Packaging:	Tape and Reel (1K per Reel)

CTX8



RECOMMENDED SOLDER PAD LAYOUT



PINOUT
1 NC/Vcont
2 GND&CASE
3 OUTPUT
4 Vcc



Surface Mount TCXO

Series **CC131**

- 4.5 mm height
- Tight stability availability
- Sinewave output

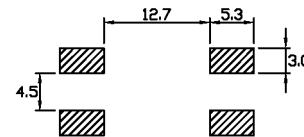
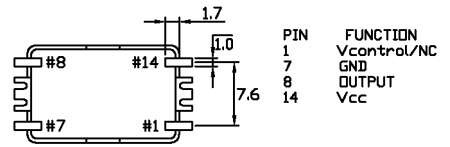
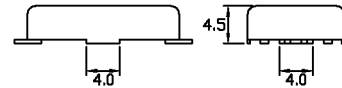
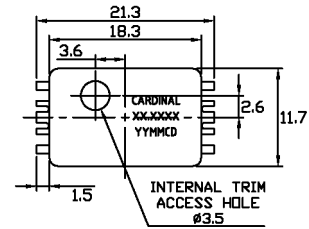
Part Numbering Example: **CC131 L Z - A2 B2 - 22.5792**

CC131	L	Z	A2	B2	22.5792
SERIES	VOLTAGE	PACKAGING OPTIONS	OPERATING TEMP.	STABILITY	FREQUENCY
CC131	Blank = 5V	Blank = Bulk Z = Tape and Reel	A2 = -10°C ~+60°C A3 = -30°C ~+75°C A5 = -20°C ~+70°C A9 = 0°C ~+50°C AA = -10°C ~+70°C AB = -30°C ~+70°C AC = -30°C ~+60°C AE = -40°C ~+80°C	B1 = ±5.0 ppm B2 = ±3.0 ppm B3 = ±2.5 ppm B4 = ±2.0 ppm B5 = ±1.5 ppm B9 = ±4.0 ppm BB = ±4.5 ppm BF = ±3.5 ppm	

Specifications:

Frequency Range:	1.000 MHz to 35.000 MHz
Available Stability Options:	±5.0 ppm ±4.5 ppm ±4.0 ppm ±3.5 ppm ±3.0 ppm ±2.5 ppm ±2.0 ppm ±1.5 ppm
Output Series:	Clipped Sine
Input Voltage:	+5.0 VDC ±5%
Operating Temperature Range Options:	0°C to +50°C -10°C to +60°C -10°C to +70°C -20°C to +70°C -30°C to +60°C -30°C to +70°C -30°C to +75°C -40°C to +80°C
Output Voltage:	1.0 Volt Peak to Peak Minimum
Frequency Trim Range With Externally Adjustable Trimmer:	±3.0 ppm Minimum
Output Load:	20K OHM Parallel with 5 pf
Maximum Input Current:	3 mA
Maximum Frequency Aging at +25°C:	±1 ppm/yr
Storage Temperature:	-40°C to +80°C
Packaging:	Tape and Reel (1K per Reel)

CC131



Surface Mount TCXO

Series **CC132**

- 4.5 mm height
- Tight stability availability
- TTL/HCMOS

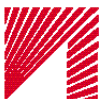
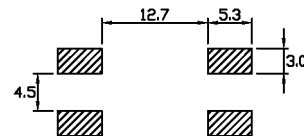
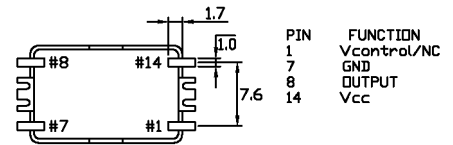
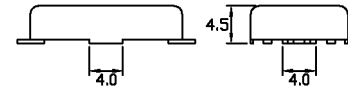
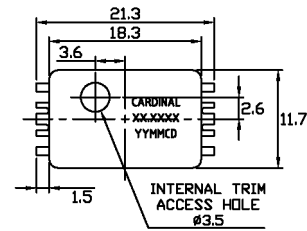
Part Numbering Example: **CC132 L Z - A2 B2 45 - 22.5792**

CC132	L	Z	A2	B2	45	22.5792
SERIES	VOLTAGE	PACKAGING OPTIONS	OPERATING TEMP.	STABILITY	SYMMETRY	FREQUENCY
CC132	Blank = 5V	Blank = Bulk Z = Tape and Reel	A2 = -10°C ~+60°C A3 = -30°C ~+75°C A5 = -20°C ~+70°C A9 = 0°C ~+50°C AA = -10°C ~+70°C AC = -30°C ~+60°C AE = -40°C ~+80°C	B1 = ±5.0 ppm B2 = ±3.0 ppm B3 = ±2.5 ppm B4 = ±2.0 ppm B5 = ±1.5 ppm B9 = ±4.0 ppm BB = ±4.5 ppm BF = ±3.5 ppm	Blank = 40/60% 45 = 45/55%	

Specifications:

Frequency Range:	1.000 MHz to 35.000 MHz
Available Stability Options:	±5.0 ppm ±4.5 ppm ±4.0 ppm ±3.5 ppm ±3.0 ppm ±2.5 ppm ±2.0 ppm ±1.5 ppm
Output Series:	TTL/CMOS
Input Voltage:	+5.0 VDC ±5%
Operating Temperature Range Options:	0°C to +50°C -10°C to +60°C -10°C to +70°C -20°C to +70°C -30°C to +60°C -30°C to +70°C -30°C to +75°C -40°C to +80°C
Output Voltage:	TTL $V_{OL} = 0.4$ V Max. TTL $V_{OH} = 2.4$ V Min. HCMOS $V_{OL} = 10\%V_{DD}$ V Max. HCMOS $V_{OH} = 90\%V_{DD}$ V Min.
Frequency Trim Range With Externally Adjustable Trimmer:	±3.0 ppm Minimum
Output Load:	10 LS TTL, 15 pf CMOS
Maximum Input Current:	20 mA
Maximum Rise/Fall Time:	10 ns
Duty Cycle:	40/60% 45/55%
Maximum Frequency Aging at +25°C:	±1 ppm/yr
Storage Temperature:	-40°C to +80°C
Packaging:	Tape and Reel (1K per Reel)

CC132



Surface Mount TCXO

Series **CT4T**

- TTL/CMOS compatibility
- Industry standard footprint
- 2.5 mm max. height
- Low power consumption

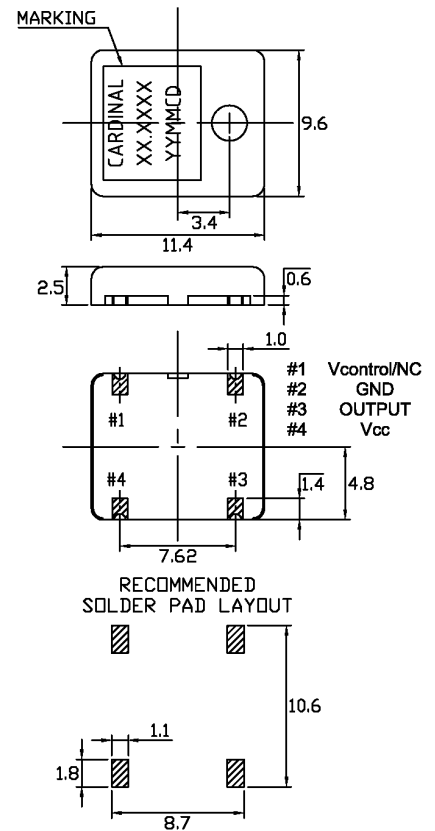
Part Numbering Example: **CT4T L Z - A3 B3 - 15.360**

CT4T	L	Z	A3	B3	15.360
SERIES	VOLTAGE	PACKAGING OPTIONS	OPERATING TEMP.	STABILITY	FREQUENCY
CT4T	Blank = 5V L = 3.3V E = 3.0V	Z = Tape and Reel	A1 = -10°C ~+50°C A2 = -10°C ~+60°C A3 = -30°C ~+75°C A4 = -40°C ~+75°C	B3 = ±2.5 ppm	

Specifications:

Frequency Range:	9.600 MHz to 32.000 MHz
Available Stability Options:	±2.5 ppm
Output Series:	TTL/CMOS
Input Voltage:	+3.0 VDC ±5%
Operating Temperature Range Options:	-30°C to +75°C
Output Voltage:	V _{OL} = 0.4 Max. V _{OH} = 2.4 V Min.
Frequency Trim Range With Externally Adjustable Trimmer:	± 3.0 ppm Minimum
Output Load:	5 TTL/CMOS
Maximum Input Current:	15.0 mA
Maximum Frequency Aging at +25°C:	±1 ppm/yr
Freq. stability Vs. Change of Input Voltage of ±5%:	±0.3 ppm
Storage Temperature:	-40°C to +85°C
Packaging:	Tape and Reel (1K per Reel)

CT4T



Surface Mount TCXO

Series **CT6S**

- Industry standard footprint
- 2.5 mm max. height
- Low power consumption

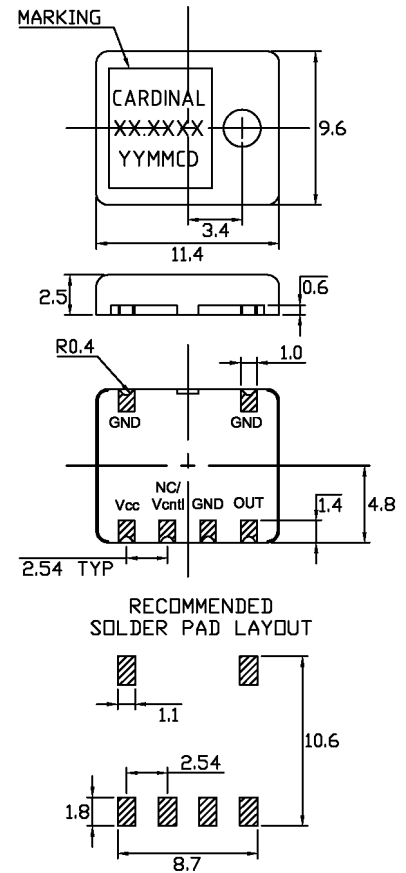
Part Numbering Example: **CT6S L Z - A3 B3 - 15.360**

CT6S	L	Z	A3	B3	15.360
SERIES	VOLTAGE	PACKAGING OPTIONS	OPERATING TEMP.	STABILITY	FREQUENCY
CT6S	Blank = 5V L = 3.3V E = 3.0V	Z = Tape and Reel	A1 = -10°C ~+50°C A2 = -10°C ~+60°C A3 = -30°C ~+75°C A4 = -40°C ~+75°C	B3 = ±2.5 ppm B5 = ±1.5 ppm	

Specifications:

Frequency Range:	9.600 MHz to 32.000 MHz
Available Stability Options:	±2.5 ppm ±1.5 ppm
Output Series:	Clipped Sine
Input Voltage:	+5.0 VDC ±5% +3.0 VDC ±5%
Operating Temperature Range Options:	-30°C to +75°C -20°C to +70°C
Output Voltage:	1.0 Volt Peak to Peak Minimum (+5 VDC Input) 0.8 Volt Peak to Peak Minimum (+3 VDC Input)
Frequency Trim Range With Externally Adjustable Trimmer:	±3.0 ppm Minimum
Output Load:	10K OHM Parallel with 10 pf
Maximum Input Current:	2.0 mA (9.600 to 19.999 MHz) 3.0 mA (20.000 to 32.000 MHz)
Maximum Frequency Aging at +25°C:	±1 ppm/yr
Freq. Stability Vs. Change of Input Voltage of ±5%:	±0.3 ppm
Storage Temperature:	-40°C to +85°C
Packaging:	Tape and Reel (1K per Reel)

CT6S



Surface Mount TCXO

Series **CT6T**

- TTL/CMOS compatibility
- Industry standard footprint
- 2.5 mm max. height
- Low power consumption

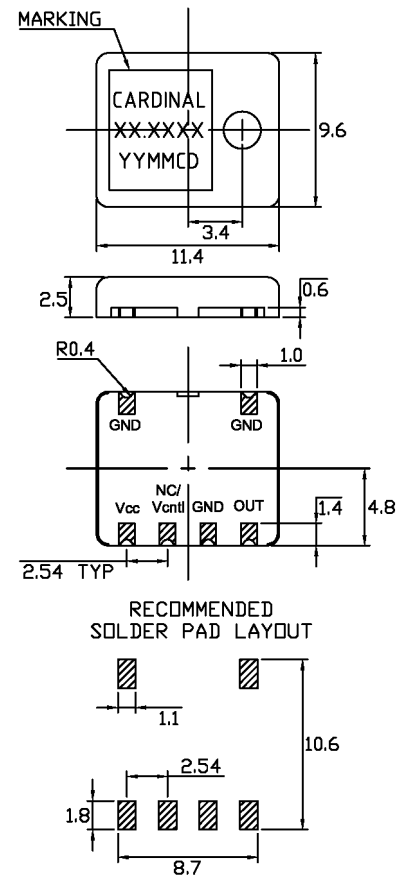
Part Numbering Example: CT6T L - A3 B3 - 15.360

CT6T	L	A3	B3	15.360
SERIES	VOLTAGE	OPERATING TEMP.	STABILITY	FREQUENCY
CT6T	Blank = 5.0V L = 3.3V E = 3.0V	A1=-10°C ~ +50°C A2=-10°C ~ +60°C A3=-30°C ~ +75°C A4=-40°C ~ +75°C	B3 = ±2.5 ppm	

Specifications:

Frequency Range:	9.600 MHz to 32.000 MHz
Available Stability Options:	±2.5 ppm
Output Series:	TTL/CMOS
Input Voltage:	+3.0 VDC ±5%
Operating Temperature Range Options:	-30°C to +75°C
Output Voltage:	V _{OL} = 0.4 Max. V _{OH} = 2.4 V Min.
Frequency Trim Range With Externally Adjustable Trimmer:	±3.0 ppm Minimum
Output Load:	5 TTL/CMOS
Maximum Input Current:	15 mA
Duty Cycle:	40/60% 45/55%
Maximum Frequency Aging at +25°C:	±1 ppm/yr
Freq. stability Vs. Change of Input Voltage of ±5%:	±0.3 ppm
Storage Temperature:	-40°C to +85°C
Packaging:	Tape and Reel (1K per Reel)

CT6T



Surface Mount TCXO

Series **CT79**

- Small overall package size
- 2.0 mm height
- Eutectic reflow soldering possible

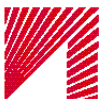
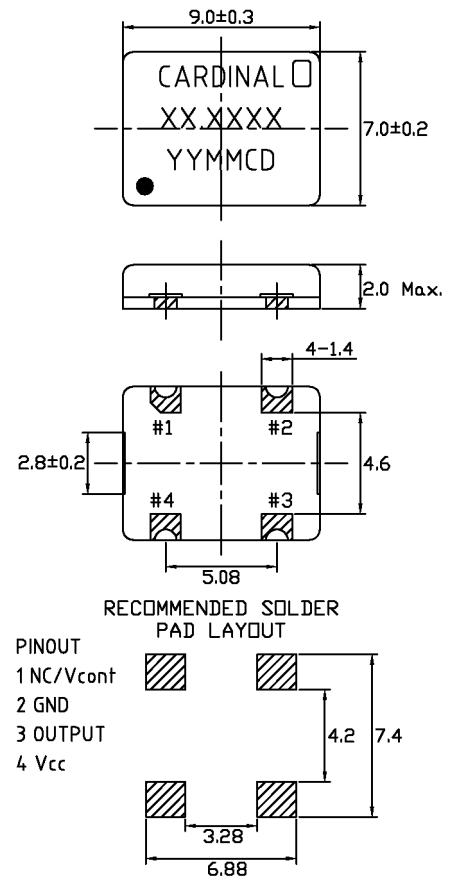
Part Numbering Example: CT79 L Z - A3 B3 - 15.360

CT79	L	Z	A3	B3	15.360
SERIES	VOLTAGE	PACKAGING OPTIONS	OPERATING TEMP.	STABILITY	FREQUENCY
CT79	L = 3.3V E = 3.0V	Z = Tape and Reel	A5 = -20°C ~+75°C	B3 = ±2.5 ppm	

Specifications:

Frequency Range:	12.600 MHz to 19.800 MHz
Available Stability Options:	±2.5 ppm
Output Series:	Clipped Sine
Input Voltage:	+3.0 VDC ± 5%
Operating Temperature	-20°C to +70°C
Range Options:	
Output Voltage:	0.8 Volt Peak to Peak Minimum
Output Load:	10K OHM Parallel with 10 pf
Maximum Input Current:	2.0 mA
Maximum Frequency	±1 ppm/yr
Aging at +25°C:	
Freq. stability Vs. Change of Input Voltage of ±5%:	±0.3 ppm
Storage Temperature:	-40°C to +85°C
Packaging:	Tape and Reel (1K per Reel)

CT79



Surface Mount TCXO

Series **CC141**

- 5 mm height
- Tight stability available
- Sinewave output

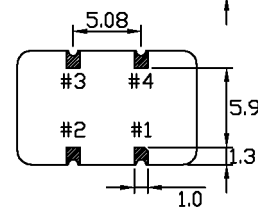
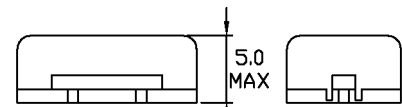
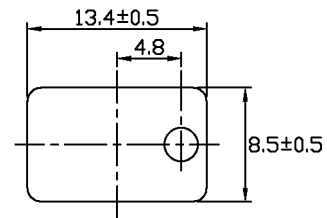
Part Numbering Example: **CC141 L Z - A2 B2 - 22.5792**

CC141	L	Z	A2	B2	22.5792
SERIES	VOLTAGE	PACKAGING OPTIONS	OPERATING TEMP.	STABILITY	FREQUENCY
CC141	Blank = 5V L = 3.3V	Blank = Bulk Z = Tape and Reel	A2 = -10°C ~+60°C A3 = -30°C ~+75°C A5 = -20°C ~+70°C A9 = 0°C ~+50°C AA = -10°C ~+70°C AB = -30°C ~+70°C AC = -30°C ~+60°C	B1 = ±5.0 ppm B2 = ±3.0 ppm B3 = ±2.5 ppm B4 = ±2.0 ppm B5 = ±1.5 ppm B9 = ±4.0 ppm BB = ±4.5 ppm BF = ±3.5 ppm	

Specifications:

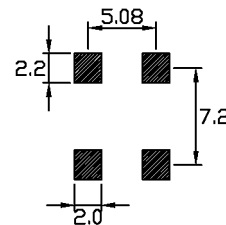
Frequency Range:	10.000 MHz to 35.000 MHz
Available Stability Options:	±5.0 ppm ±4.5 ppm ±4.0 ppm ±3.5 ppm ±3.0 ppm ±2.5 ppm ±2.0 ppm ±1.5 ppm
Output Series:	Clipped Sine
Input Voltage:	+5.0 VDC ±5% +3.3 VDC ±5%
Operating Temperature Range Options:	0°C to +50°C -10°C to +60°C -10°C to +70°C -20°C to +70°C -30°C to +60°C -30°C to +70°C -30°C to +75°C -40°C to +80°C
Output Voltage:	1.0 Volt Peak to Peak Minimum
Frequency Trim Range With Externally Adjustable Trimmer:	±3.0 ppm Minimum
Output Load:	10K OHM Parallel with 10 pf
Maximum Input Current:	3.0 mA
Maximum Frequency Aging at +25°C:	±1 ppm/yr
Storage Temperature:	-40°C to +80°C
Packaging:	Tape and Reel (1K per Reel)

CC141



PIN	FUNCTION
1	NC/Vcontrol
2	GND
3	OUTPUT
4	Vcc

RECOMMENDED SOLDER PAD LAYOUT



VCXO SECTION

CV01	84
CV04	85
CC121	86
CC165	87
CC127	88
CC154	89



Thru Hole VCXO

- Wide frequency range
- Extended temperature range and tight symmetry available
- Broad range of pullability

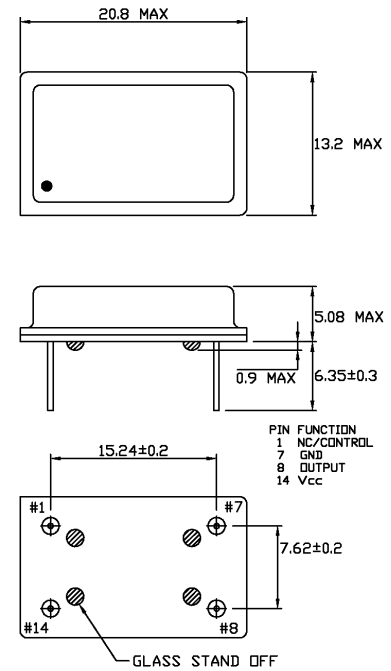
Part Numbering Example: CV01 L - A3 B3 - 15.360 A P

CV01	L	A3	B3	15.360	A	P
SERIES	VOLTAGE	OPERATING TEMP.	STABILITY	FREQUENCY	TUNING RANGE	LINEARITY
CV01	Blank = 5.0V L = 3.3V	A1=-10°C ~ +50°C A2=-10°C ~ +60°C A3=-30°C ~ +75°C A4=-40°C ~ +75°C	B6 = ±100 ppm BP = ±50 ppm BR = ±25 ppm		A = ±50 ppm B = ±100 ppm C = ±150 ppm D = ±200 ppm E = ±250 ppm F = ±300 ppm G = ±350 ppm	Blank = ±20% Q = ±15% P = ±10%

Specifications:

Frequency Range:	1.000 MHz to 150.000 MHz
Available Stability Options:	±100 ppm ±50 ppm ±25 ppm
Output Series:	TTL/HCMOS
Input Voltage:	+5.0 VDC ±5% +3.3 VDC ±5%
Frequency Tuning Range:	±50 ppm ±100 ppm ±150 ppm ±200 ppm ±250 ppm ±300 ppm ±350 ppm
External Control Voltage:	+2.5 VDC ±2.0 VDC (5V) +1.5 VDC ±1.0 VDC (3.3V)
Linearity:	±20% Max. ±15% Max. ±10% Max.
Polarity of Freq. Slope:	Positive
Output Voltage:	TTL VOL=0.4 V Max. TTL VOH=2.4 V Min. HCMOS VOL=10%VDD V Max. HCMOS VOH=90%VDD V Min.
Operating Temperature Range Options:	-0°C to +70°C -40°C to +85°C
Output Load:	10 TTL 15 pf HCMOS
Maximum Input Current:	20 mA (1.000 to 20.000 MHz) 40 mA (20.010 to 50.000 MHz) 50 mA (50.010 to 160.000 MHz)
Maximum Rise/Fall Time:	10 ns
Duty Cycle:	40/60% 45/55%
Max Start-Up Time:	10 ms
Storage Temperature:	-55°C to +125°C

CV01



Thru Hole VCXO

- Half-size dip package
- Tight symmetry option

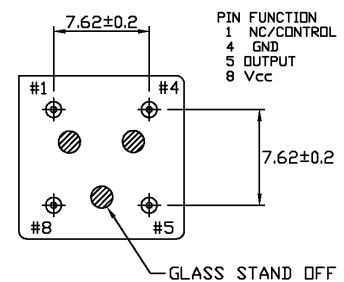
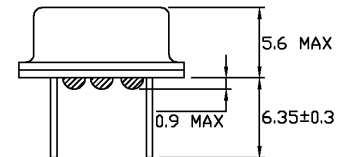
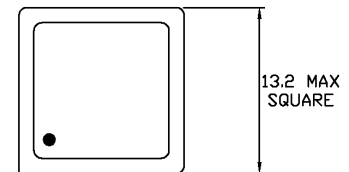
Part Numbering Example: CV04 L - A3 B3 - 15.360 A P

CV04	L	A3	B3	15.360	A	P
SERIES	VOLTAGE	OPERATING TEMP.	STABILITY	FREQUENCY	TUNING RANGE	LINEARITY
CV04	Blank = 5.0V L = 3.3V	A1=-10°C ~ +50°C A2=-10°C ~ +60°C A3=-30°C ~ +75°C A4=-40°C ~ +75°C	BC = ±100 ppm BP = ±50 ppm BR = ±25 ppm		A = ±50 ppm B = ±100 ppm C = ±150 ppm D = ±200 ppm E = ±250 ppm F = ±300 ppm G = ±350 ppm	Blank = ±20% Q = ±15% P = ±10%

Specifications:

Frequency Range:	1.000 MHz to 40.000 MHz
Available Stability Options:	±100 ppm ±50 ppm ±25 ppm
Output Series:	TTL/HCMOS
Input Voltage:	+5.0 VDC ±5% +3.3 VDC ±5%
Frequency Tuning Range:	±50 ppm Min. ±100 ppm Min. ±150 ppm Min. ±200 ppm Min. ±250 ppm Min. ±300 ppm Min. ±350 ppm Min.
External Control Voltage:	+2.5 VDC ±2.0 VDC (5V) +1.5 VDC ±1.0 VDC (3.3V)
Linearity:	±20% Max. ±15% Max. ±10% Max.
Polarity of Freq. Slope:	Positive
Output Voltage:	TTL V _{OL} =0.4 V Max. TTL V _{OH} =2.4 V Min. HCMOS V _{OL} =10%V _{DD} V Max. HCMOS V _{OH} =90%V _{DD} V Min.
Operating Temperature Range Options:	-0°C to +70°C -40°C to +85°C
Output Load:	10 TTL 15 pf HCMOS
Maximum Input Current:	20 mA (1.000 to 20.000 MHz) 40 mA (20.010 to 50.000 MHz) 50 mA (50.010 to 160.000 MHz)
Maximum Rise/Fall Time:	10 ns
Duty Cycle:	40/60% 45/55%
Max Start-Up Time:	10 ms
Storage Temperature:	-55°C to +125°C

CV04



Surface Mount VCXO

Series **CC121**

- 4.0 mm Max. height
- Various input supply voltage options

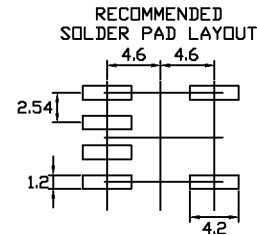
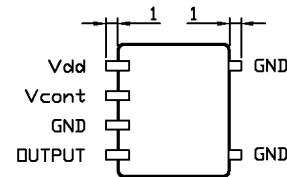
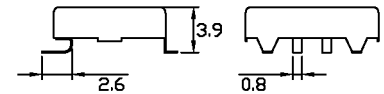
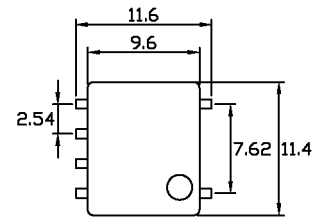
Part Numbering Example: CC121 L Z - A2 BP 45 - 22.5792 A

CC121	L	Z	A2	BP	45	22.5792	A
SERIES	VOLTAGE	PACKAGING OPTIONS	OPERATING TEMP.	STABILITY	SYMMETRY	FREQUENCY	PULL RANGE
CC121	Blank = 5V L = 3.3V	Blank = Bulk Z = Tape and Reel	A2 = -10°C ~+60°C A5 = -20°C ~+70°C	B7 = ±30 ppm BD = ±20 ppm BP = ±50 ppm	Blank = 40/60% 45 = 45/55%		A = ±50 ppm H = ±30 ppm

Specifications:

Frequency Range:	8.000 MHz to 120.000 MHz
Available Stability Options:	±50 ppm ±30 ppm ±20 ppm
Output Series:	TTL/HCMOS
Input Voltage:	+5.0 VDC ±5% +3.3 VDC ±5%
Frequency Tuning Range:	±50 ppm Min. ±30 ppm Min.
External Control Voltage:	+2.5 VDC ± 2.0 VDC @ 5 V INPUT +1.5 VDC ± 1.0 VDC @ 3.3 V INPUT
Output Voltage:	TTL $V_{OL}=0.4$ V Max. TTL $V_{OH}=2.4$ V Min. HCMOS $V_{OL}=10\%V_{DD}$ V Max. HCMOS $V_{OH}=90\%V_{DD}$ V Min.
Operating Temperature Range Options:	-10°C to +60°C -20°C to +70°C
Output Load:	10 LS TTL, 15 pf @ +5 VDC 5 LS TTL, 15 pf @ +3.3 VDC
Maximum Input Current:	30 mA
Duty Cycle:	40/60% 45/55%
Storage Temperature:	-40°C to +85°C
Packaging:	Tape and Reel (1K per Reel)

CC121



Surface Mount VCXO

• Plastic package

Series **CC165**

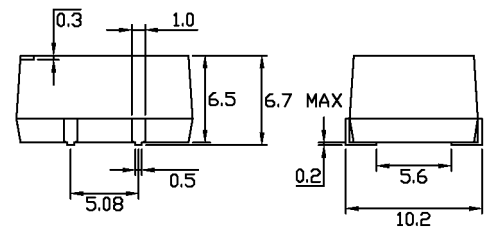
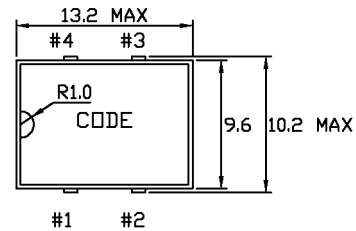
Part Numbering Example: CC165 L Z - A6 BP 45 - 22.5792 A

CC165	L	Z	A6	BP	45	22.5792	A
SERIES	VOLTAGE	PACKAGING OPTIONS	OPERATING TEMP.	STABILITY	SYMMETRY	FREQUENCY	PULL RANGE
CC165	Blank = 5V L = 3.3V	Blank = Bulk Z = Tape and Reel	A6 = -0°C ~+70°C	B7 = ±30 ppm BD = ±20 ppm BP = ±50 ppm	Blank = 40/60% 45 = 45/55%		H = ±80 ppm B = ±100 ppm

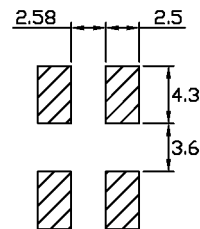
Specifications:

Frequency Range:	8.000 MHz to 30.000 MHz
Available Stability Options:	±50 ppm
Output Series:	TTL/HCMOS
Input Voltage:	+5.0 VDC ±5% +3.3 VDC ±5%
Frequency Tuning Range:	±80 ppm Min. (3.3Vdc) ±100 ppm Min.(5.0Vdc)
External Control Voltage:	+2.5 VDC ± 2.0 VDC @ 5 V INPUT +1.5 VDC ± 1.0 VDC @ 3.3 V INPUT
Output Voltage:	HCMOS $V_{OL}=10\%V_{DD}$ V Max. HCMOS $V_{OH}=90\%V_{DD}$ V Min.
Operating Temperature Range Options:	-0°C to +60°C
Output Load:	15 pf @ +5 VDC 15 pf @ +3.3 VDC
Maximum Input Current:	30 mA
Duty Cycle:	40/60% 45/55%
Storage Temperature:	-50°C to +125°C
Packaging:	Tape and Reel (1K per Reel)

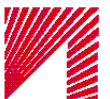
CC165



RECOMMENDED SOLDER PAD LAYOUT



- PINOUT
- 1 NC/TRI-STATE
 - 2 GND
 - 3 OUTPUT
 - 4 Vcc



Surface Mount VCXO

• Various stability options

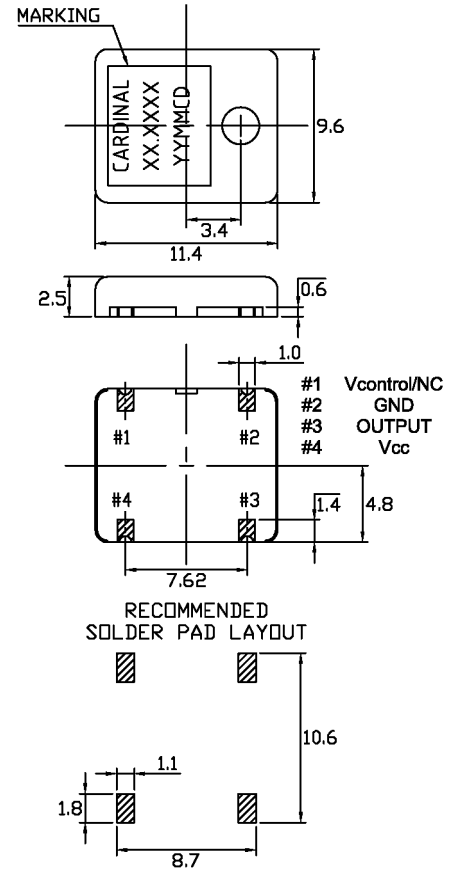
Part Numbering Example: **CC127 L Z - A2 B2 45 - 22.5792 A P**

CC127	L	Z	A2	B2	45	22.5792	A	P
SERIES	VOLTAGE	PACKAGING OPTIONS	OPERATING TEMP.	STABILITY	SYMMETRY	FREQUENCY	PULL RANGE	LINEARITY
CC127	Blank = 5V L = 3.3V	Blank = Bulk Z = Tape and Reel	A2 = -10°C ~ +60°C A5 = -20°C ~ +70°C A6 = 0°C ~ +70°C A7 = -40°C ~ +85°C A9 = 0°C ~ +50°C AA = -10°C ~ +70°C AF = 0°C ~ +60°C	B7 = ±30 ppm BC = ±15 ppm BD = ±20 ppm BE = ±10 ppm BP = ±50 ppm	Blank = 40/60% 45 = 45/55%	22.5792	A = ±50 ppm H = ±30 ppm K = ±20 ppm L = ±10 ppm	Blank = ±20% Q = ±15% P = ±10%

Specifications:

Frequency Range:	9.600 MHz to 32.000 MHz
Available Stability Options:	±50 ppm ±30 ppm ±20 ppm ±15 ppm ±10 ppm
Output Series:	HCMOS/TTL
Input Voltage:	+5.0 VDC ±5%
Frequency Tuning Range:	±10 ppm Min. ±30 ppm Min. ±50 ppm Min. ±15 ppm Min. ±20 ppm Min.
External Control Voltage:	+2.5 VDC, ±2.0 VDC
Linearity:	±20% ±15% ±10%
Output Voltage:	TTL $V_{OL}=0.4$ V Max. TTL $V_{OH}=2.4$ V Min. HCMOS $V_{OL}=10\%V_{DD}$ V Max. HCMOS $V_{OH}=90\%V_{DD}$ V Min.
Operating Temperature	0°C to +70°C -10°C to +70°C -20°C to +70°C -40°C to +85°C
Output Load:	10 LS TTL, 15 pf HCMOS
Maximum Input Current:	80 mA
Maximum Rise/Fall Time:	10 ns
Duty Cycle:	40/60% 45/55%
Max. Start-Up Time:	10 ms
Storage Temperature:	-40°C to +85°C
Packaging:	Tape and Reel (1K per Reel)

CC127



Ceramic Surface Mount VCXO

Series **CC154**

- 4.0 mm max. height
- Tri-State Control

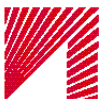
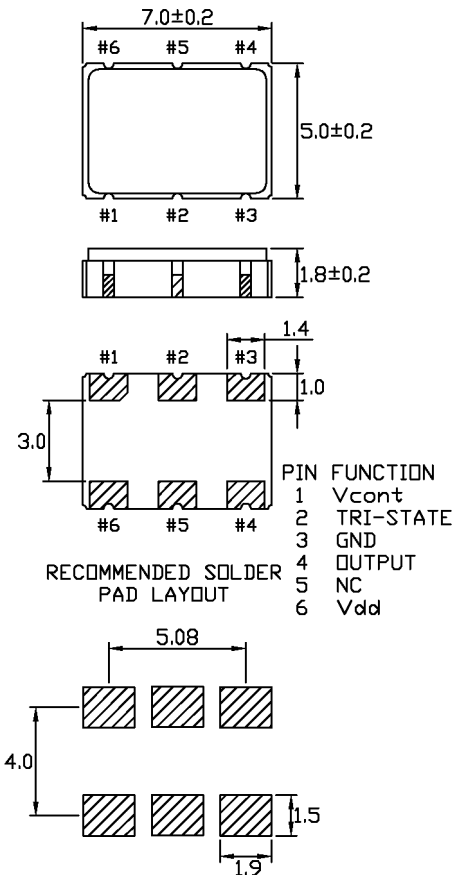
Part Numbering Example: CC154 L Z - A6 BP 45 - 22.5792 TS B

CC154	L	Z	A6	BP	45	22.5792	TS	B
SERIES	VOLTAGE	PACKAGING OPTIONS	OPERATING TEMP.	STABILITY	SYMMETRY	FREQUENCY	TRI-STATE	PULL RANGE
CC154	Blank = 5V L = 3.3V	Blank = Bulk Z = Tape and Reel	A6 = 0°C ~ +70°C	BP = ±50 ppm	Blank = 40/60% 45 = 45/55%	22.5792	TS = Tri-State	B = ±100 ppm N = ±80 ppm

Specifications:

Frequency Range:	8.000 MHz to 36.000 MHz
Available Stability Options:	±50 ppm
Output Series:	HCMOS
Input Voltage:	+5.0 VDC ±5% +3.3 VDC ±5%
Frequency Tuning Range:	±100 ppm @ 5.0V ±80 ppm @ 3.3VDC ±50 ppm ±15 ppm ±20 ppm
External Control Voltage:	+2.5 VDC, ±2.0 VDC @ 5V input +1.65 VDC, ±1.0 VDC @ 3.3V input
Tristate Input:	@+5 VDC Input +0.80 VDC Max. to Disable +3.60 VDC Min. to Enable or open to Enable @3.3 VDC & 3.0 VDC Input +0.80 VDC Max. to Disable +2.20 VDC Min. to Enable or open to Enable
Output Voltage:	HCMOS $V_{OL}=10\%V_{DD}$ V Max. HCMOS $V_{OH}=90\%V_{DD}$ V Min.
Operating Temperature	0°C to +70°C
Output Load:	15 pf
Maximum Input Current:	30 mA
Maximum Rise/Fall Time:	8 ns
Duty Cycle:	40/60% 45/55%
Storage Temperature:	-40°C to +85°C
Packaging:	Tape and Reel (1K per Reel)

CC154



VC-TCXO

SECTION

CC123	91	CTV6	99
CC182	92	CC129	100
CC183	93	CT4V	101
CTX8V	94	CT4TV	102
CC133	95	CT6V	103
CC134	96	CT6TV	104
CTV4	97	CV79	105
CTX5V	98	CC142	106



Thru Hole Mount VC-TCXO

Series **CC123**

- 4.5 mm height
- Tight stability available
- TTL/HCMOS output

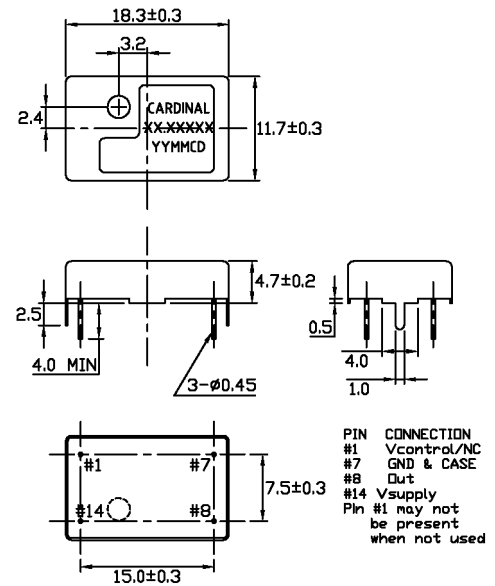
Part Numbering Example: CC123 L - A1 B2 45 - 22.5792 M

CC123	L	A1	B2	45	22.5792	M
SERIES	VOLTAGE	OPERATING TEMP.	STABILITY	SYMMETRY	FREQUENCY	PULL RANGE
CC123	Blank = 5V L = 3.3V	A2 = -10°C ~+60°C A3 = -30°C ~+75°C A5 = -20°C ~+70°C A9 = 0°C ~+50°C AA = -10°C ~+70°C AB = -30°C ~+70°C AC = -30°C ~+60°C AE = -40°C ~+80°C	B1 = ±5.0 ppm B2 = ±3.0 ppm B3 = ±2.5 ppm B4 = ±2.0 ppm B5 = ±1.5 ppm B9 = ±4.0 ppm BB = ±4.5 ppm BF = ±3.5 ppm	Blank = 40/60% 45 = 45/55%		L = ±10 ppm M = ±5 ppm

Specifications:

Frequency Range:	1.000 MHz to 35.000 MHz
Available Stability Options:	±1.5 ppm ±2.0 ppm ±2.5 ppm ±3.0 ppm ±3.5 ppm ±4.0 ppm ±4.5 ppm ±5.0 ppm
Output Series:	TTL/CMOS
Input Voltage:	+5.0 VDC ±5%
Operating Temperature Range Options:	0°C to +50°C -10°C to +60°C -10°C to +70°C -20°C to +70°C -30°C to +60°C -30°C to +70°C -30°C to +75°C -40°C to +80°C
Frequency Tuning Range:	±5 ppm Min. ±10 ppm Min.
External Control Voltage:	+2.5 VDC, ± 2.0 VDC
Output Voltage:	TTL $V_{OL}=0.4$ V Max. TTL $V_{OH}=2.4$ V Min. HCMOS $V_{OL}=10\%V_{DD}$ V Max. HCMOS $V_{OH}=90\%V_{DD}$ V Min.
Frequency Trim Range With Externally Adjustable Trimmer:	±3.0 ppm Minimum
Output Load:	10 LS TTL, 15 pf CMOS
Maximum Input Current:	20 mA
Maximum Rise/Fall Time:	10 ns
Duty Cycle:	40/60%
Maximum Frequency Aging at +25°C:	±1 ppm/yr
Storage Temperature:	-40°C to +80°C

CC123



Thru Hole Mount TCXO

- 8.0 mm height
- Tight stability available
- Sinewave output

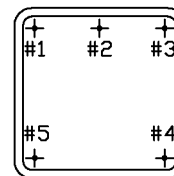
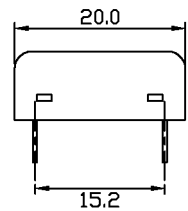
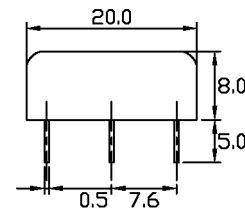
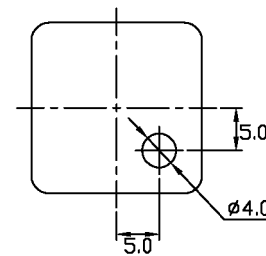
Part Numbering Example: **CC182 L - A2 B2 - 22.5792**

CC182	L	A2	B2	22.5792
SERIES	VOLTAGE	OPERATING TEMP.	STABILITY	FREQUENCY
CC182	Blank = 5V L = 3.3V	A2 = -10°C ~+60°C A3 = -30°C ~+75°C A5 = -20°C ~+70°C A9 = 0°C ~+50°C AA = -10°C ~+70°C AB = -30°C ~+70°C AC = -30°C ~+60°C AE = -40°C ~+80°C	B1 = ±5.0 ppm B2 = ±3.0 ppm B3 = ±2.5 ppm B4 = ±2.0 ppm B8 = ±1.0 ppm B9 = ±4.0 ppm BB = ±4.5 ppm BF = ±3.5 ppm	

Specifications:

Frequency Range:	1.000 MHz to 35.000 MHz
Available Stability Options:	±1.5 ppm ±2.0 ppm ±2.5 ppm ±3.0 ppm ±3.5 ppm ±4.0 ppm ±4.5 ppm ±5.0 ppm
Output Series:	Clipped Sine
Input Voltage:	+5.0 VDC ±5%
Operating Temperature Range Options:	0°C to +50°C -10°C to +60°C -10°C to +70°C -20°C to +70°C -30°C to +60°C -30°C to +70°C -30°C to +75°C -40°C to +80°C
Frequency Tuning Range:	±5 ppm Min. ±10 ppm Min.
External Control Voltage:	+2.5 VDC, ±2.0 VDC
Output Voltage:	1.0 Volt Peak to Peak Minimum
Frequency Trim Range With Externally Adjustable Trimmer:	±3.0 ppm Minimum
Output Load:	20K OHM Parallel with 5 pf
Maximum Input Current:	3 mA
Maximum Frequency Aging at +25°C:	±1 ppm/yr
Storage Temperature:	-40°C to +80°C

CC182



PIN	FUNCTION
1	V _{CC}
2	OUTPUT
3	V _{control} /GND
4	GND
5	GND



Thru Hole Mount VC-TCXO

Series **CC183**

- 8.0 mm height
- Tight stability available
- HCMOS/LS TTL

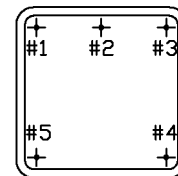
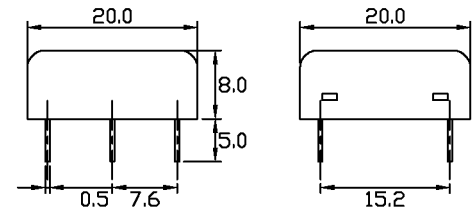
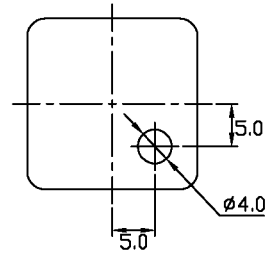
Part Numbering Example: **CC183 L - A2 B2 45 - 22.5792 M**

CC183	L	A2	B2	45	22.5792	M
SERIES	VOLTAGE	OPERATING TEMP.	STABILITY	SYMMETRY	FREQUENCY	PULL RANGE
CC183	Blank = 5V L = 3.3V	A2 = -10°C ~+60°C A3 = -30°C ~+75°C A5 = -20°C ~+70°C A9 = 0°C ~+50°C AA = -10°C ~+70°C AC = -30°C ~+60°C AE = -40°C ~+80°C	B1 = ±5.0 ppm B2 = ±3.0 ppm B3 = ±2.5 ppm B4 = ±2.0 ppm B5 = ±1.5 ppm B9 = ±4.0 ppm BB = ±4.5 ppm BF = ±3.5 ppm	Blank = 40/60% 45 = 45/55%		L = ±10 ppm M = ±5 ppm

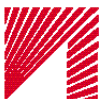
Specifications:

Frequency Range:	1.000 MHz to 35.000 MHz
Available Stability Options:	±1.5 ppm ±2.0 ppm ±2.5 ppm ±3.0 ppm ±3.5 ppm ±4.0 ppm ±4.5 ppm ±5.0 ppm
Output Series:	TTL/CMOS
Input Voltage:	+5.0 VDC ±5%
Operating Temperature Range Options:	0°C to +50°C -10°C to +60°C -10°C to +70°C -20°C to +70°C -30°C to +60°C -30°C to +70°C -30°C to +75°C -40°C to +80°C
Frequency Tuning Range:	±5 ppm Min. ±10 ppm Min.
External Control Voltage:	+2.5 VDC, ± 2.0 VDC
Output Voltage:	TTL $V_{OL}=0.4$ V Max. TTL $V_{OH}=2.4$ V Min. HCMOS $V_{OL}=10\%V_{DD}$ V Max. HCMOS $V_{OH}=90\%V_{DD}$ V Min.
Frequency Trim Range With Externally Adjustable Trimmer:	±3.0 ppm Minimum
Output Load:	10 LS TTL, 15 pf CMOS
Maximum Input Current:	20 mA
Maximum Rise/Fall Time:	10 ns
Duty Cycle:	40/60% 45/55%
Maximum Frequency Aging at +25°C:	±1 ppm/yr
Storage Temperature:	-40°C to +80°C

CC183



PIN	FUNCTION
1	V _{CC}
2	OUTPUT
3	V _{control} /GND
4	GND
5	GND



Surface Mount VC-TCXO

• Industry standard footprint

Series **CTX8V**

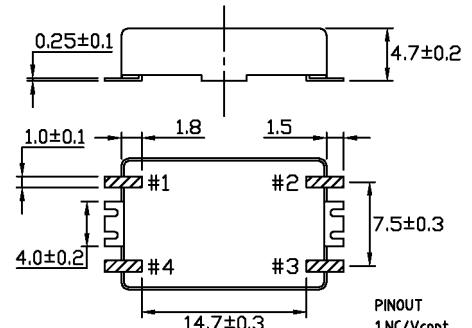
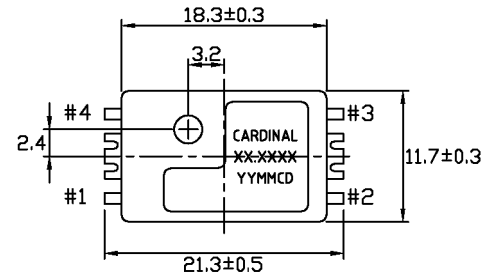
Part Numbering Example: CTX8V Z - A3 B3 - 15.360

CTX8V	Z	A3	B3	15.360
SERIES	PACKAGING OPTIONS	OPERATING TEMP.	STABILITY	FREQUENCY
CTX8V	Z = Tape and Reel	A1=-10°C ~ +50°C A2=-10°C ~ +60°C A3=-30°C ~ +75°C A4=-40°C ~ +75°C	B1 = ±5.0 ppm B2 = ±3.0 ppm B3 = ±2.5 ppm	

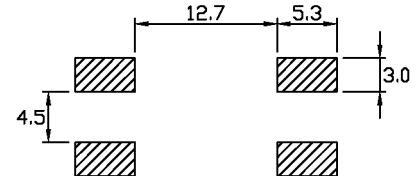
Specifications:

Frequency Range:	9.600 MHz to 32.000 MHz
Available Stability Options:	±5.0 ppm ±3.0 ppm ±2.5 ppm
Output Series:	Clipped Sine
Input Voltage:	+5.0 VDC ±5%
Operating Temperature Range Options:	-10°C to +50°C -10°C to +60°C -30°C to +75°C -40°C to +75°C
Frequency Tuning Range:	±8.0 ppm to ±15 ppm
External Control Voltage:	+2.5 VDC, ±2.0 VDC
Output Voltage:	1.0 Volt Peak to Peak Minimum
Frequency Trim Range With Externally Adjustable Trimmer:	±3.0 ppm Minimum
Output Load:	10K OHM Parallel with 10 pf
Maximum Input Current:	2.0 mA
Maximum Frequency Aging at +25°C:	±1 ppm/yr
Freq. Stability Vs. Change of Input Voltage of ±5%:	±0.3 ppm Max.
Storage Temperature:	-40°C to +85°C
Packaging:	Tape and Reel (1K per Reel)

CTX8V



RECOMMENDED SOLDER PAD LAYOUT



PINOUT
1 NC/Vcont
2 GND&CASE
3 OUTPUT
4 Vcc



Surface Mount VC-TCXO

Series **CC133**

- 4.5 mm height
- Tight stability available
- Sinewave output

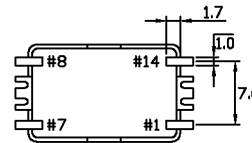
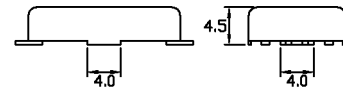
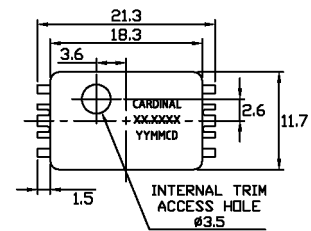
Part Numbering Example: CC133 L Z - A1 B2 - 22.5792 M

CC133	L	Z	A1	B2	22.5792	M
SERIES	VOLTAGE	PACKAGING OPTIONS	OPERATING TEMP.	STABILITY	FREQUENCY	PULL RANGE
CC133	Blank = 5V L = 3.3V	Blank = Bulk Z = Tape and Reel	A2 = -10°C ~+60°C A3 = -30°C ~+75°C A5 = -20°C ~+70°C A9 = 0°C ~+50°C AA = -10°C ~+70°C AB = -30°C ~+70°C AC = -30°C ~+60°C AE = -40°C ~+80°C	B1 = ±5.0 ppm B2 = ±3.0 ppm B3 = ±2.5 ppm B4 = ±2.0 ppm B5 = ±1.5 ppm B9 = ±4.0 ppm BB = ±4.5 ppm BF = ±3.5 ppm		L = ±10 ppm M = ±5 ppm

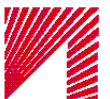
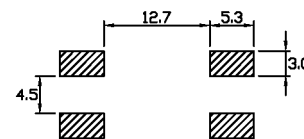
Specifications:

Frequency Range:	1.000 MHz to 35.000 MHz
Available Stability Options:	±1.5 ppm ±2.0 ppm ±2.5 ppm ±3.0 ppm ±3.5 ppm ±4.0 ppm ±4.5 ppm ±5.0 ppm
Output Series:	Clipped Sine
Input Voltage:	+5.0 VDC ±5%
Operating Temperature Range Options:	0°C to +50°C -10°C to +60°C -10°C to +70°C -20°C to +70°C -30°C to +60°C -30°C to +70°C -30°C to +75°C -40°C to +80°C
Frequency Tuning Range:	±5 ppm Min. ±10 ppm Min.
External Control Voltage:	+2.5 VDC, ±2.0 VDC
Output Voltage:	1.0 Volt Peak To Peak Minimum
Frequency Trim Range With Externally Adjustable Trimmer:	±3.0 ppm Minimum
Output Load:	20K OHM Parallel with 5 pf
Maximum Input Current:	3 mA
Maximum Frequency Aging at +25°C:	±1 ppm/yr
Storage Temperature:	-40°C to +80°C
Packaging:	Tape and Reel (1K per Reel)

CC133



PIN	FUNCTION
1	V _{control} /NC
7	GND
8	OUTPUT
14	V _{cc}



Surface Mount VC-TCXO

Series **CC134**

- 4.5 mm height
- Tight stability available
- HCMOS/TTL

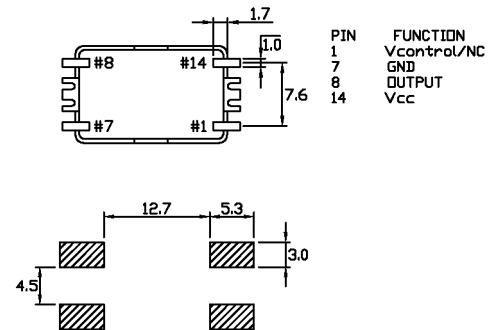
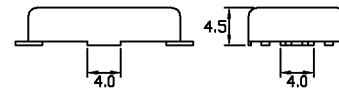
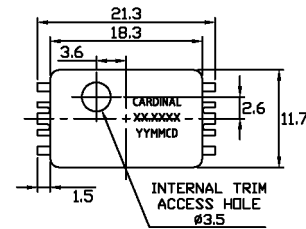
Part Numbering Example: CC134 L Z - A2 B2 45 - 22.5792 M

CC134	L	Z	A2	B2	45	22.5792	M
SERIES	VOLTAGE	PACKAGING OPTIONS	OPERATING TEMP.	STABILITY	SYMMETRY	FREQUENCY	PULL RANGE
CC134	Blank = 5V L = 3.3V	Blank = Bulk Z = Tape and Reel	A2 = -10°C ~+60°C A3 = -30°C ~+75°C A5 = -20°C ~+70°C A9 = 0°C ~+50°C AA = -10°C ~+70°C AC = -30°C ~+60°C AE = -40°C ~+80°C	B1 = ±5.0 ppm B2 = ±3.0 ppm B3 = ±2.5 ppm B4 = ±2.0 ppm B5 = ±1.5 ppm B9 = ±4.0 ppm BB = ±4.5 ppm BF = ±3.5 ppm	Blank = 40/60% 45 = 45/55%		L = ±10 ppm M = ±5 ppm

Specifications:

Frequency Range:	1.000 MHz to 35.000 MHz
Available Stability Options:	±1.5 ppm ±2.0 ppm ±2.5 ppm ±3.0 ppm ±4.0 ppm ±4.5 ppm ±5.0 ppm
Output Series:	TTL/CMOS
Input Voltage:	+5.0 VDC ±5%
Operating Temperature Range Options:	-20°C to +70°C -30°C to +60°C -30°C to +70°C -30°C to +75°C -40°C to +80°C
Frequency Tuning Range:	±5 ppm Min. ±10 ppm Min.
External Control Voltage:	+2.5 VDC, ±2.0 VDC
Output Voltage:	TTL $V_{OL}=0.4$ V Max. TTL $V_{OH}=2.4$ V Min. HCMOS $V_{OL}=10\%V_{DD}$ V Max. HCMOS $V_{OH}=90\%V_{DD}$ V Min.
Frequency Trim Range With Externally Adjustable Trimmer:	±3.0 ppm Minimum
Output Load:	10 LS TTL, 15 pf CMOS
Maximum Input Current:	20 mA
Maximum Rise/Fall Time:	10 ns
Duty Cycle:	40/60% 45/55%
Maximum Frequency Aging at +25°C:	±1 ppm/yr
Storage Temperature:	-40°C to +85°C
Packaging:	Tape and Reel (1K per Reel)

CC134



Surface Mount VC-TCXO

Series **CTV4**

- 4.0 mm max height
- Eutectic reflow soldering possible

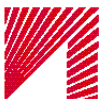
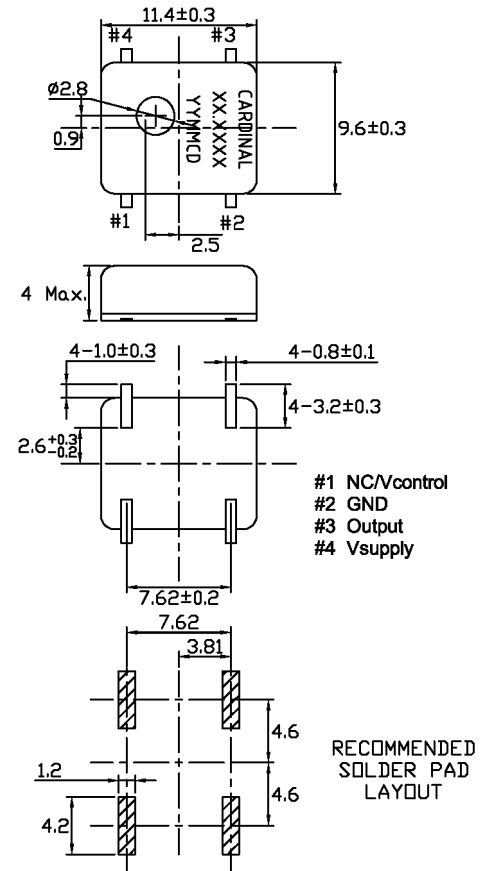
Part Numbering Example: CTV4 L Z - A3 B3 - 15.360

CTV4	L	Z	A3	B3	15.360
SERIES	VOLTAGE	PACKAGING OPTIONS	OPERATING TEMP.	STABILITY	FREQUENCY
CTV4	Blank = 5V L = 3.3V E = 3.0V B = 4.0V C = 3.7V	Z = Tape and Reel	A1 = -10°C ~+50°C A2 = -10°C ~+60°C A3 = -30°C ~+75°C A4 = -40°C ~+75°C	B3 = ±2.5 ppm	

Specifications:

Frequency Range:	12.000 MHz to 19.680 MHz
Available Stability Options:	±2.5 ppm
Output Series:	Clipped Sine
Input Voltage:	+5.0 VDC ± 5% <i>Standard</i> +4.0 VDC ± 5% +3.7 VDC ± 5% +3.3 VDC ± 5% <i>Standard</i> +3.0 VDC ± 5%
Operating Temperature Range Options:	-30°C to +75°C <i>Standard</i>
Frequency Tuning Range:	±4.0 ppm Min.
External Control Voltage:	+2.5 VDC, ±2.0 VDC (5V Supply) +1.5 VDC, ±1.0 VDC (3V Supply)
Polarity Of Freq. Slope:	Positive
Output Voltage:	1.0 Volt Peak to Peak Minimum
Frequency Trim Range With Externally Control Voltage:	±3.0 ppm Minimum
Output Load:	10K OHM Parallel with 10 pf
Maximum Input Current:	2.0 mA
Maximum Frequency Aging at +25°C:	±1 ppm/yr
Freq. Stability Vs. Change of Input Voltage of ±5%:	±0.3 ppm
Storage Temperature:	-40°C to +85°C
Packaging:	Tape and Reel (1K per Reel)

CTV4



Surface Mount VC-TCXO

Series **CTX5V**

Cardinal's CTX5 oscillator is the latest in surface mount technology for VC-TCXO's. It is capable of withstanding high temperature IR reflow applications.

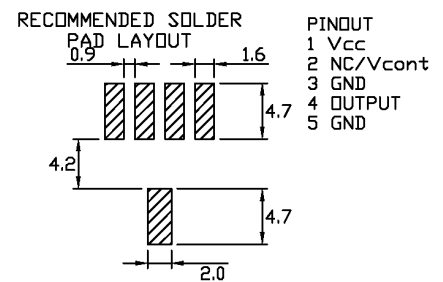
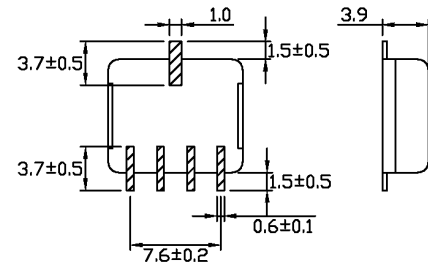
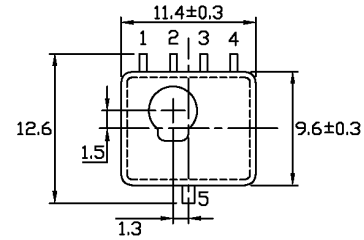
Part Numbering Example: CTX5V L Z - A3 B3 - 15.360

CTX5V	L	Z	A3	B3	15.360
SERIES	VOLTAGE	PACKAGING OPTIONS	OPERATING TEMP.	STABILITY	FREQUENCY
CTX5V	Blank = 5V L = 3.3V E = 3.0V B = 4.0V C = 3.7V	Z = Tape and Reel	A1 = -10°C ~+50°C A2 = -10°C ~+60°C A3 = -30°C ~+75°C A4 = -40°C ~+75°C	B3 = ±2.5 ppm	

Specifications:

Frequency Range:	12.000 MHz to 19.680 MHz
Available Stability Options:	±2.5 ppm
Output Series:	Clipped Sine
Input Voltage:	+5.0 VDC ± 5% <i>Standard</i> +4.0 VDC ± 5% +3.7 VDC ± 5% +3.3 VDC ± 5% <i>Standard</i> +3.0 VDC ± 5%
Operating Temperature Range Options:	-30°C to +75°C <i>Standard</i>
Frequency Tuning Range:	±4.0 ppm Min.
External Control Voltage:	+2.5 VDC, ±2.0 VDC (5V Supply) +1.5 VDC, ±1.0 VDC (3V Supply)
Polarity Of Freq. Slope:	Positive
Output Voltage:	1.0 Volt Peak to Peak Minimum
Frequency Trim Range With Externally Control Voltage:	±3.0 ppm Minimum
Output Load:	10K OHM Parallel with 10 pf
Maximum Input Current:	2.0 mA
Maximum Frequency Aging at +25°C:	±1 ppm/yr
Freq. Stability Vs. Change of Input Voltage of ±5%:	±0.3 ppm
Storage Temperature:	-40°C to +85°C
Packaging:	Tape and Reel (1K per Reel)

CTX5V



Surface Mount VC-TCXO

Series **CTV6**

- 4.0 mm Max height
- Various input supply voltage options

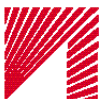
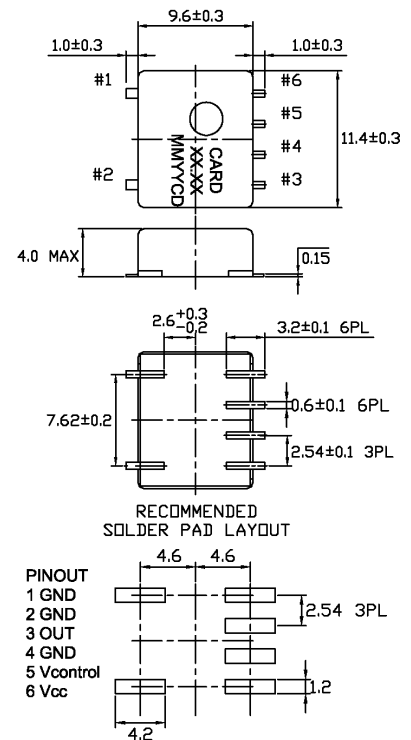
Part Numbering Example: CTV6 L Z - A3 B3 - 15.360

CTV6	L	Z	A3	B3	15.360
SERIES	VOLTAGE	PACKAGING OPTIONS	OPERATING TEMP.	STABILITY	FREQUENCY
CTV6	Blank = 5V L = 3.3V E = 3.0V B = 4.0V C = 3.7V	Z = Tape and Reel	A1 = -10°C ~+50°C A2 = -10°C ~+60°C A3 = -30°C ~+75°C A4 = -40°C ~+75°C	B3 = ±2.5 ppm	

Specifications:

Frequency Range:	12.000 MHz to 19.680 MHz
Available Stability Options:	±2.5 ppm
Output Series:	Clipped Sine
Input Voltage:	+5.0 VDC ±5% +4.0 VDC ±5% +3.7 VDC ±5% +3.3 VDC ±5% +3.0 VDC ±5%
Operating Temperature Range Options:	-30°C to +75°C
Frequency Tuning Range:	±4.0 ppm Min.
External Control Voltage:	+05 V to VDC -0.5V
Polarity Of Freq. Slope:	Positive
Output Voltage:	1.0 Volt Peak to Peak Minimum
Frequency Trim Range With Externally Adjustable Trimmer:	±3.0 ppm Minimum
Output Load:	10K OHM Parallel with 15 pf
Maximum Input Current:	2.0 mA
Maximum Frequency Aging at +25°C:	±1.0 ppm/yr
Freq. Stability Vs. Change of Input Voltage of ±5%:	±0.3 ppm
Storage Temperature:	-40°C to +85°C
Packaging:	Tape and Reel (1K per Reel)

CTV6



Surface Mount VC-TCXO

Series **CC129**

- 4.0 mm height
- Tight stability available
- TTL/HCMOS output

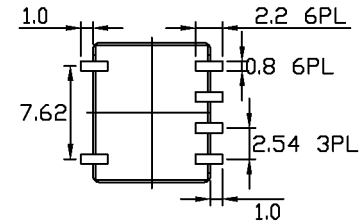
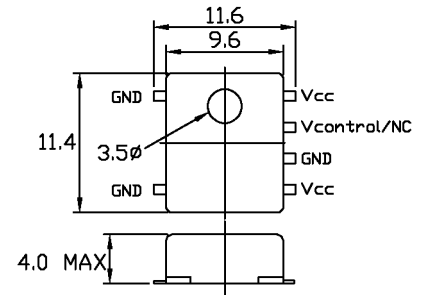
Part Numbering Example: CC129 L Z - A2 B2 45 - 22.5792 M

CC129	L	Z	A2	B2	45	22.5792	M
SERIES	VOLTAGE	PACKAGING OPTIONS	OPERATING TEMP.	STABILITY	SYMMETRY	FREQUENCY	PULL RANGE
CC129	Blank = 5V L = 3.3V	Blank = Bulk Z = Tape and Reel	A2 = -10°C ~+60°C A3 = -30°C ~+75°C A5 = -20°C ~+70°C A9 = 0°C ~+50°C AA = -10°C ~+70°C AB = -30°C ~+70°C AC = -30°C ~+60°C AE = -40°C ~+80°C	B1 = ±5.0 ppm B2 = ±3.0 ppm B3 = ±2.5 ppm B4 = ±2.0 ppm B5 = ±1.5 ppm B9 = ±4.0 ppm BB = ±4.5 ppm BF = ±3.5 ppm	Blank = 40/60% 45 = 45/55%		L = ±10 ppm M = ±5 ppm

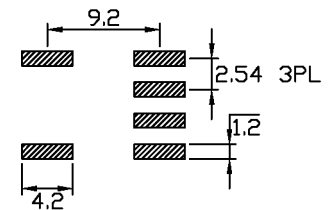
Specifications:

Frequency Range:	1.000 MHz to 35.000 MHz
Available Stability Options:	±1.5 ppm ±2.0 ppm ±2.5 ppm ±3.0 ppm ±3.5 ppm ±4.0 ppm ±4.5 ppm ±5.0 ppm
Output Series:	TTL/CMOS
Input Voltage:	+5.0 VDC ±5%
Operating Temperature Range Options:	0°C to +50°C -10°C to +60°C -10°C to +70°C -20°C to +70°C -30°C to +60°C -30°C to +70°C -30°C to +75°C -40°C to +80°C
Frequency Tuning Range:	±5 ppm Min. ±10 ppm Min.
External Control Voltage:	+2.5 VDC, ± 2.0 VDC
Output Voltage:	TTL $V_{OL}=0.4$ V Max. TTL $V_{OH}=2.4$ V Min. HCMOS $V_{OL}=10\%V_{DD}$ V Max. HCMOS $V_{OH}=90\%V_{DD}$ V Min.
Frequency Trim Range With Externally Adjustable Trimmer:	±3.0 ppm Minimum
Output Load:	10 LS TTL, 15 pf CMOS
Maximum Input Current:	20 mA
Maximum Rise/Fall Time:	10 ns
Duty Cycle:	40/60% 45/55%
Maximum Frequency Aging at +25°C:	±1 ppm/yr
Storage Temperature:	-40°C to +80°C
Packaging:	Tape and Reel (1K per Reel)

CC129



RECOMMENDED SOLDER PAD LAYOUT



Surface Mount VC-TCXO

Series **CT4V**

- 2.5 mm height
- Industry standard footprint
- Low power consumption

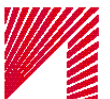
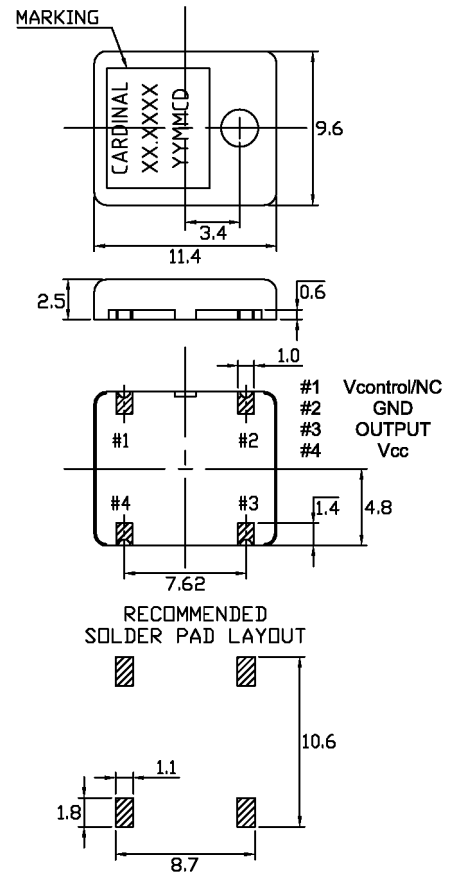
Part Numbering Example: **CT4V L Z - A3 B3 - 15.360 M**

CT4V	L	Z	A3	B3	15.360	M
SERIES	VOLTAGE	PACKAGING OPTIONS	OPERATING TEMP.	STABILITY	FREQUENCY	PULL RANGE
CT4V	Blank = 5V L = 3.3V E = 3.0V	Z = Tape and Reel	A1 = -10°C ~+50°C A2 = -10°C ~+60°C A3 = -30°C ~+75°C A4 = -40°C ~+75°C	B3 = ±2.5 ppm		L = ±10 ppm M = ±5 ppm

Specifications:

Frequency Range:	9.600 MHz to 32.000 MHz
Available Stability Options:	±2.5 ppm
Output Series:	Clipped Sine
Input Voltage:	+5.0 VDC ±5% +3.0 VDC ±5%
Operating Temperature Range Options:	-30°C to +75°C
Frequency Tuning Range:	±5.0 ppm to ±15 ppm
External Control Voltage:	+2.5 VDC, ± 2.0 VDC @ 5 V Input +1.5 VDC, ± 1.0 VDC @ 3 V Input
Output Voltage:	1.0 Volt Peak to Peak Minimum (+5 VDC Input) 0.8 Volt Peak to Peak Minimum (+3 VDC Input)
Frequency Trim Range With Externally Adjustable Trimmer:	±3.0 ppm Minimum
Output Load:	10K OHM Parallel with 10 pf
Maximum Input Current:	2.0 mA (9.600 to 19.999 MHz) 3.0 mA (20.000 to 32.000 MHz)
Maximum Frequency Aging at 25°C:	± 1 ppm/yr
Freq. Stability Vs. Change of Input Voltage of ±5%:	± 0.3 ppm
Storage Temperature:	-40°C to +85°C
Packaging:	Tape and Reel (1K per Reel)

CT4V



Surface Mount VC-TCXO

Series **CT4TV**

- 2.5 mm height
- Industry standard footprint
- Low power consumption

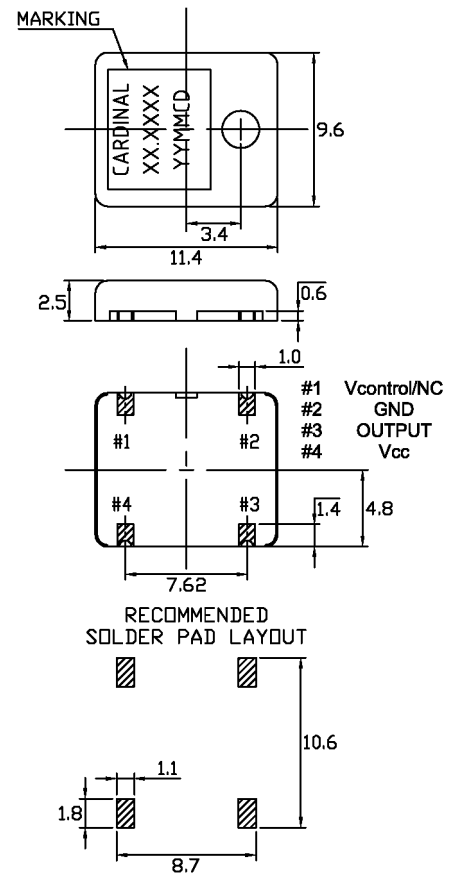
Part Numbering Example: **CT4TV L - A3 B3 - 15.360 M**

CT4TV	L	A3	B3	15.360	M
SERIES	VOLTAGE	OPERATING TEMP.	STABILITY	FREQUENCY	PULL RANGE
CT4TV	Blank = 5.0V L = 3.3V E = 3.0V	A1=-10°C ~ +50°C A2=-10°C ~ +60°C A3=-30°C ~ +75°C A4=-40°C ~ +75°C	B3 = ±2.5 ppm		L = ±10 ppm M = ±5 ppm

Specifications:

Frequency Range:	9.600 MHz to 32.000 MHz
Available Stability Options:	±2.5 ppm
Output Series:	TTL/CMOS
Input Voltage:	+3.0 VDC 5%
Operating Temperature	-30°C to +75°C
Range Options:	
Frequency Tuning Range:	±5 ppm to ±15 ppm
External Control Voltage:	+1.5 VDC, ±1.0 VDC
Output Voltage:	TTL $V_{OL}=0.4$ V Max. TTL $V_{OH}=2.4$ V Min. HCMOS $V_{OL}=10\%V_{DD}$ V Max. HCMOS $V_{OH}=90\%V_{DD}$ V Min.
Frequency Trim Range With Externally Adjustable Trimmer:	±3.0 ppm Minimum
Output Load:	5 LS TTL/CMOS 15 pF CMOS
Maximum Input Current:	15 mA
Maximum Rise/Fall Time:	10 ns
Duty Cycle:	40/60% 45/55%
Maximum Frequency Aging at +25°C	± 1 ppm/yr
Freq. Stability Vs. Change of Input Voltage of ± 5%:	± 0.3 ppm
Storage Temperature:	-40°C to +85°C
Packaging:	Tape and Reel (1K per Reel)

CT4TV



Surface Mount VC-TCXO

Series **CT6V**

- 2.5 mm height
- Industry standard footprint
- Low power consumption

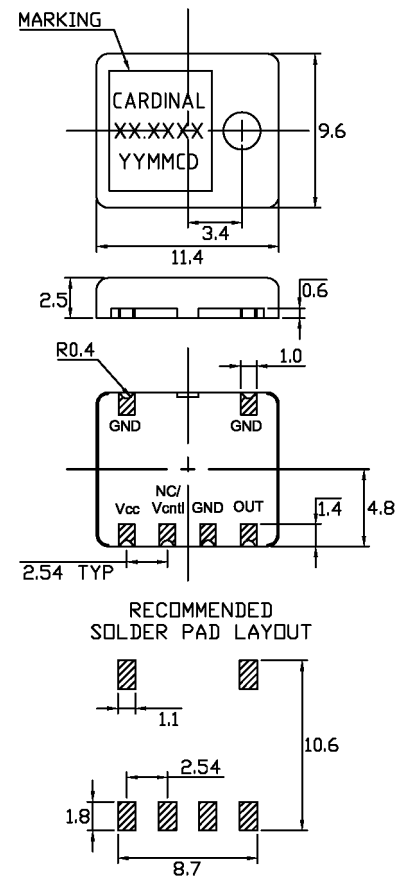
Part Numbering Example: CT6V L - A3 B3 - 15.360 M

CT6V	L	A3	B3	15.360	M
SERIES	VOLTAGE	OPERATING TEMP.	STABILITY	FREQUENCY	PULL RANGE
CT6V	Blank = 5.0V L = 3.3V E = 3.0V	A1=-10°C ~ +50°C A2=-10°C ~ +60°C A3=-30°C ~ +75°C A4=-40°C ~ +75°C	B3 = ±2.5 ppm		L = ±10 ppm M = ±5 ppm

Specifications:

Frequency Range:	9.600 MHz to 32.000 MHz
Available Stability Options:	±2.5 ppm
Output Series:	Clipped Sine
Input Voltage:	+5.0 VDC ±5% +3.0 VDC ±5%
Operating Temperature Range Options:	-30°C to +75°C
Frequency Tuning Range:	±5.0 ppm to ±15 ppm
External Control Voltage:	+2.5 VDC, ±2.0 VDC @ 5 V Input +1.5 VDC, ±1.0 VDC @ 3 V Input
Output Voltage:	1.0 Volt Peak to Peak Minimum (+5 VDC Input) 0.8 Volt Peak to Peak Minimum (+3 VDC Input)
Frequency Trim Range With Externally Adjustable Trimmer:	±3.0 ppm Minimum
Output Load:	10K OHM Parallel with 10 pf
Maximum Input Current:	2.0 mA (9.600 to 19.999 MHz) 3.0 mA (20.000 to 32.000 MHz)
Maximum Frequency Aging at 25°C:	±1 ppm/yr
Freq. Stability Vs. Change of Input Voltage of ±5%:	±0.3 ppm Max.
Storage Temperature:	-40°C to +85°C
Packaging:	Tape and Reel (1K per Reel)

CT6V



Surface Mount VC-TCXO

Series **CT6TV**

- 2.5 mm height
- Industry standard footprint
- Low power consumption

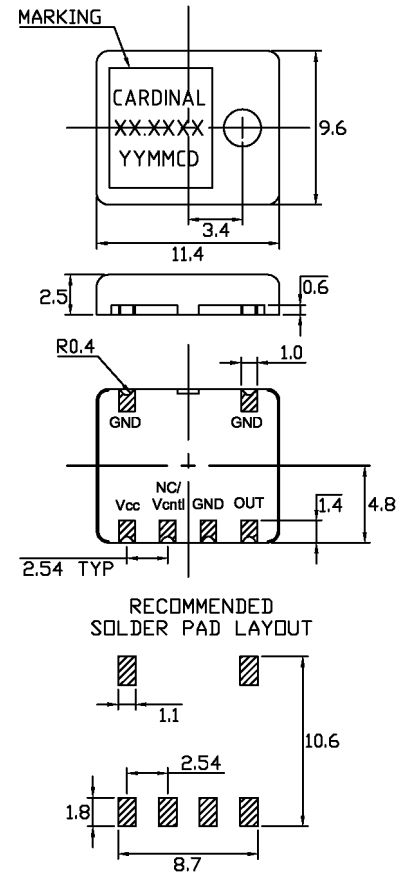
Part Numbering Example: **CT6TV L - A3 B3 - 15.360 M**

CT6TV	L	A3	B3	15.360	M
SERIES	VOLTAGE	OPERATING TEMP.	STABILITY	FREQUENCY	PULL RANGE
CT6TV	Blank = 5.0V L = 3.3V E = 3.0V	A1=-10°C ~ +50°C A2=-10°C ~ +60°C A3=-30°C ~ +75°C A4=-40°C ~ +75°C	B3 = ±2.5 ppm		L = ±10 ppm M = ±5 ppm

Specifications:

Frequency Range:	9.600 MHz to 32.000 MHz
Available Stability Options:	±2.5 ppm
Output Series:	TTL/CMOS
Input Voltage:	+3.0 VDC ±5%
Operating Temperature	-30°C to +75°C
Range Options:	
Frequency Tuning Range:	±5 ppm to ±15 ppm
External Control Voltage:	+1.5 VDC, ±1.0 VDC
Output Voltage:	TTL $V_{OL}=0.4$ V Max. TTL $V_{OH}=2.4$ V Min. HCMOS $V_{OL}=10\%V_{DD}$ V Max. HCMOS $V_{OH}=90\%V_{DD}$ V Min.
Frequency Trim Range With Externally Adjustable Trimmer:	±3.0 ppm Minimum
Output Load:	5 LS TTL/CMOS 15 pF CMOS
Maximum Input Current:	15 mA
Maximum Rise/Fall Time:	10 ns
Duty Cycle:	40/60% 45/55%
Maximum Frequency Aging at +25°C:	± 1 ppm/yr
Freq. Stability Vs. Change of Input Voltage of ± 5%:	± 0.3 ppm
Storage Temperature:	-40°C to +85°C
Packaging:	Tape and Reel (1K per Reel)

CT6TV

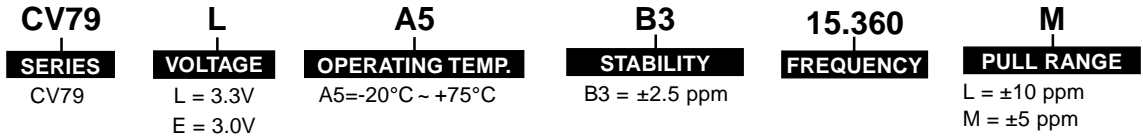


Surface Mount VC-TCXO

Series **CV79**

- 2.0 mm height
- Leadless package
- Small overall size

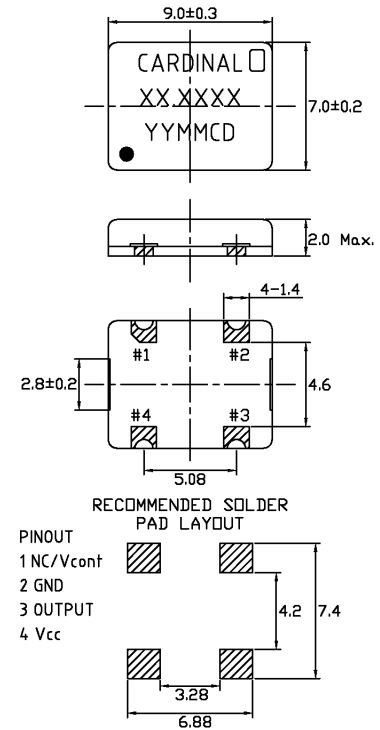
Part Numbering Example: CV79 L - A5 B3 - 15.360



Specifications:

Frequency Range:	12.600 MHz to 19.800 MHz
Available Stability Options:	±2.5 ppm
Output Series:	Clipped Sine
Input Voltage:	+3.0 VDC ±5%
Operating Temperature	-20°C to +70°C
Range Options:	
Frequency Tuning Range:	±9 ppm to ±15 ppm
External Control Voltage:	+1.5 VDC, ±1.0 VDC
External Control Voltage:	Positive
Output Voltage:	0.8 Volt Peak to Peak Minimum
Output Load:	10K OHM Parallel with 10 pf
Maximum Input Current:	2.0 mA
Maximum Frequency	±1 ppm/yr
Aging at +25°C	
Freq. Stability Vs. Change of Input Voltage of ± 5%:	±0.3 ppm Max.
Storage Temperature:	-40°C to +85°C
Packaging:	Tape and Reel (1K per Reel)

CV79



Surface Mount VC-TCXO

Series **CC142**

- 5 mm height
- Tight stability available
- Sinewave output

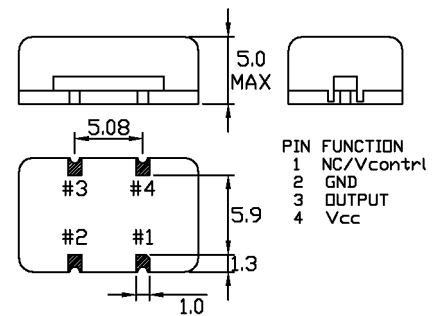
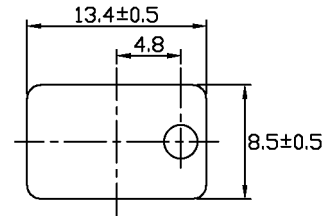
Part Numbering Example: CC142 L Z - A2 B2 - 22.5792

CC142	L	Z	A2	B2	22.5792	M
SERIES	VOLTAGE	PACKAGING OPTIONS	OPERATING TEMP.	STABILITY	FREQUENCY	PULL RANGE
CC142	Blank = 5V L = 3.3V	Blank = Bulk Z = Tape and Reel	A2 = -10°C ~+60°C A3 = -30°C ~+75°C A5 = -20°C ~+70°C A9 = 0°C ~+50°C AA = -10°C ~+70°C AB = -30°C ~+70°C AC = -30°C ~+60°C	B1 = ±5.0 ppm B2 = ±3.0 ppm B3 = ±2.5 ppm B4 = ±2.0 ppm B5 = ±1.5 ppm B9 = ±4.0 ppm BB = ±4.5 ppm BF = ±3.5 ppm		L = ±10 ppm M = ±5 ppm

Specifications:

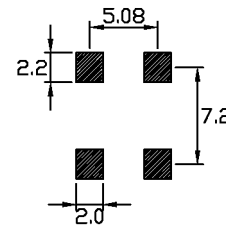
Frequency Range:	10.0 MHz to 35.000 MHz
Available Stability Options:	±1.5 ppm ±2.0 ppm ±2.5 ppm ±3.0 ppm ±3.5 ppm ±4.0 ppm ±4.5 ppm ±5.0 ppm
Output Series:	Clipped Sine
Input Voltage:	+5.0 VDC ±5% +3.3 VDC ±5%
Operating Temperature Range Options:	0°C to +50°C -10°C to +60°C -10°C to +70°C -20°C to +70°C -30°C to +60°C -30°C to +70°C -30°C to +75°C -40°C to +80°C
Frequency Tuning Range:	±5 ppm Min. ±10 ppm Min.
External Control Voltage:	+2.5 VDC, ±2.0 VDC@ 5 V input +1.5 VDC, ±1.0 VDC@ 3.3 V input
Output Voltage:	1.0 Volt Peak to Peak Minimum
Frequency Trim Range With Externally Adjustable Trimmer:	±3.0 ppm Minimum
Output Load:	20K OHM Parallel with 5 pf
Maximum Input Current:	3 mA
Maximum Frequency Aging at +25°C:	±1 ppm/yr
Storage Temperature:	-40°C to +80°C
Packaging:	Tape and Reel (1K per Reel)

CC142



PIN	FUNCTION
1	NC/Vcontrol
2	GND
3	OUTPUT
4	Vcc

RECOMMENDED SOLDER PAD LAYOUT



Principles of Quartz Crystal Operation

QUARTZ PRINCIPLES OF OPERATION

Quartz crystal units serve as the controlling element of oscillator circuits by converting mechanical vibrations to electrical current at a specific frequency. This is accomplished by means of the “Piezoelectric” effect. Piezoelectricity is electricity created by pressure. In a piezoelectric material, the application of mechanical pressure along one axis will result in the creation of an electrical charge along an axis at right angles to the first. In some materials, the obverse piezoelectric effect is found, which means that the imposition of an electric field on the ends of an axis will result in a mechanical deflection along an axis at right angles to the first. Quartz is uniquely suited, in terms of mechanical, electrical, and chemical properties, for the manufacture of frequency control devices. Quartz crystal units that oscillate within certain frequency and temperature ranges have been developed over the years.

The most practical raw material for quartz crystals is crystalline silicon dioxide, SiO_2 . This results from its mechanical and chemical stability, together with a favorable piezoelectric constant. The small frictional losses in the material guarantee the manufacture of electromechanical oscillators of very high quality factors.

In nature, silicon dioxide is found in different forms, one of which is quartz. Even though 14% of the earth’s surface consists of silicon dioxide, quartz of suitable size and necessary purity is seldom found. As a result, cultured quartz has been developed. Cultured quartz is achieved from hot saturated solutions of silicon dioxide, in large steel autoclaves at a temperature of some 400°C and a pressure of $1,000 \text{ Kgs/cm}^2$. The axial growth of the crystal is controlled by previously cut seeds planted in the autoclaves. The growth rate can be as much as 2.5 mm per day . In order to achieve a pure crystal, a controlled slow rate of growth is preferred. The yield of quartz crystals from cultured quartz is higher than when grown quartz is used.

Temperature coefficient has to do with the frequency stability of a quartz blank with respect to changes in temperature, which is a function of quartz, the mode of vibration, and the type of cut. The frequency-temperature curve generalized for high frequency AT crystals, known as the frequency deviation (in PPM) at a specified temperature range (in $^\circ\text{C}$), the family of curves can be used to define maximum allowable deviation (in minutes) around the center for cutting the blank.

Of the various elements, the “AT” cut has become the most popular, because it is available at relatively high frequencies, exhibits excellent frequency vs temperature stability, and is widely available at reasonable cost.

Fundamental vs. Overtone is of concern primarily when specifying the “AT” cut crystal unit. These units increase in

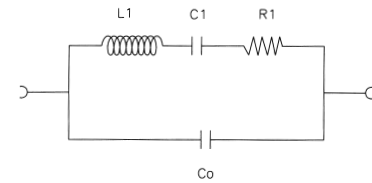
frequency as the thickness of the resonator plate is diminished. At some point, typically around 30 MHz , the plate becomes too thin for efficient processing. As the “AT” will resonate at odd integer multiples of the fundamental frequency, it is necessary to specify the desired order of overtone when ordering higher frequency crystals.

Drive level is the amount of power dissipated by the crystal. Drive level is usually specified in terms of micro or milliwatts, with a typical value being 100 microwatts .

“**Series**” resonant crystals are intended for use in circuits containing no reactive components in the oscillator feedback loop. “**Parallel**” resonant crystals are intended for use in circuits containing reactive components (usually capacitors) in the oscillator feedback loop. Such circuits depend on the combination of the reactive components and the crystal to accomplish the phase shift necessary to start and maintain oscillation at the specified frequency.

Pullability refers to the change in frequency of a crystal unit, either from the natural resonant frequency (F_R) to a load resonant frequency (F_L), or from one load resonant frequency to another. The amount of pullability exhibited by a given crystal unit at a given value of load capacitance is a function of the shunt capacitance (C_0) and the motional capacitance (C_1) of the crystal unit.

The **equivalent circuit** of a quartz crystal is useful in explaining how a crystal will perform.



C_0 is the shunt or static capacitance of a crystal. This parameter equals the sum of the capacitance measured from pin to pin including the electrode and mounting structure.

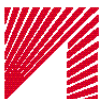
L_1 , C_1 , and R_1 are the motional arm of the crystal.

L_1 , motional inductance, is determined by the mechanical mass of quartz in motion. Thompson’s formula relates the L_1 and the C_1 specifications.

$$L_1 = \frac{1}{4\pi^2 f^2 C_1}$$

C_1 is the motional capacitance of the crystal. This parameter is determined by the stiffness of the quartz (constant), the area of the electrode, and the thickness and shape of the quartz wafer.

R_1 stands for the equivalent series resistance (ESR) of a crystal. It is a function of the mechanical losses during vibration. Low resistance is a sign that little mechanical loss is occurring. The lower the resistance, the more easily the crystal will oscillate.



Principles of Quartz Crystal Operation

Three main components of crystal specifications are:

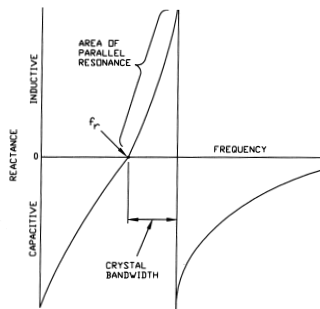
- Calibration at room temperature
- Stability over the temperature range
- Aging

Calibration at room temperature is a measurement of the accuracy of the frequency at +25°C. Crystal frequencies are adjusted within the stated tolerance by changing the mass of the electrode. Lower frequencies are less sensitive to mass change and are therefore easier to hold tighter tolerances. Tolerance and stability are measured in parts per million (ppm).

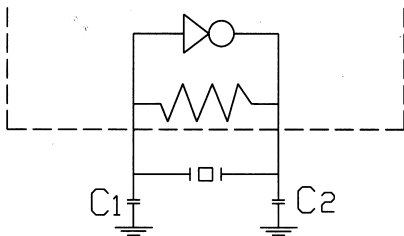
The angle at which the quartz bar is cut determines the **stability** over the temperature range. A very popular cut is the “AT” cut. The accuracy of the cut determines how tight the shifts in ppm will be over a temperature range.

Aging is defined as the change in frequency over time. Two factors affect this specification: contamination and stress. See the section on aging.

Load capacity is the dynamic capacity of the total circuit measured or computed across the crystal terminals. In a parallel circuit the load capacity should be selected to operate the crystal at a stable point on the fr-fa reactance curve (as close to fr as possible).



Below is an example of an oscillator circuit in which the crystal is expected to run in its parallel mode. If a series crystal is put into this circuit, the frequency would be high by approximately 0.02%.



Load capacitance (C_L), which is specified in picofarads (pF), can be calculated by the following formula:

$$C_L = \frac{C_1 * C_2}{C_1 + C_2} + C_{stray}$$

C_{stray} includes pin to pin, input and output capacitance of the oscillator stage at the C_1 and C_2 pins plus any additional parasitics. It is usually assumed C_{stray} equals 5 pF.

If C_1 and C_2 each equal 22 pF, then $C_L = 16$ pF.

If the oscillator stage is configured with a phase shift presented to the crystal exactly equal to 0° or multiples of 360° , then the crystal will operate at series resonance (f_r). The crystal's load capacity must be specified “Series Resonance.”

The Quality Factor (Q) Value of a crystal unit is a measure of the units relative quality, or efficiency of oscillation. The maximum attainable stability of a crystal unit is dependent on the “Q” value. The separation between the series and parallel frequencies is called bandwidth. The smaller the bandwidth, the higher the “Q” value, and the steeper the slope of the reactance. Changes in the reactance of external circuit components have less effect (less “pullability”) on a high “Q” crystal; therefore such a part is more stable.

The U.S. military specifications (MIL-C-3098) for crystals define the **equivalent resistance** as follows:

For crystal units designed to operate at series resonance, equivalent resistance is the equivalent ohmic resistance of the unit when operating in the specified crystal impedance meter adjusted for the rated drive level and tuned to the specified crystal unit frequency.

For crystal units designed to operate at parallel or antiresonance, equivalent resistance is the equivalent ohmic resistance of the unit and a series load capacitor of the specified load value, when operating in the specified crystal impedance meter adjusted for rated drive level and tuned to the specified crystal unit frequency.

Operating **drive level** is the power dissipated internally in the crystal blank. It is very important to carefully determine and select a drive level that is consistent with reliable start up and the desired performance of the crystal once oscillating. If the drive level is too low (generally less than 100 microwatts), starting of oscillation may not occur. However, drive level that is too high (generally greater than 1 milliwatt) will cause frequency shifts, poor long-term frequency aging, and frequency perturbations over the operating temperature.

Aging is a general term used to describe the gradual

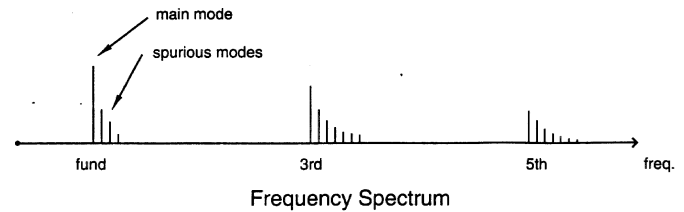


Principles of Quartz Crystal Operation

- f_s = Series Resonant Frequency = $\frac{1}{2\pi\sqrt{L_1C_1}}$
- f_a = Antiresonant Frequency = $\frac{1}{2\pi}\sqrt{\frac{1}{L_1C_1} + \frac{1}{L_1C_0}}$
- ΔF = Change in Frequency = $\frac{f_s C_1}{2(C_0 + C_L)}$
- C_1 = Motional capacitance = $\frac{2(C_0 + C_1)\Delta F}{f_s}$
- L_1 = Motional Inductance = $\frac{1}{4\pi^2 f_s^2 C_1}$
- R_1 = Series Resonant Resistance
- r = Capacitance Ratio = $\frac{C_0}{C_1}$
- Q = Quality Factor = $\frac{1}{2\pi f_s R_1 C_1}$
- R_a = Antiresonant Resistance
- C_0 = Crystal Shunt Capacitance
- C_L = Load Capacitance

deterioration of the operating characteristics of a crystal unit over time. Many factors contribute to this deterioration, such as internal contamination, excessive drive level, wire fatigue, frictional wear, and surface erosion of the crystal blank. Cleanliness of the manufacturing process and of the quartz blank can greatly reduce aging by contamination. The most rapid aging occurs within the first year. If aging rates of a crystal must be low, the crystal can be pre-aged by temperature-cycling or by high-temperature burn-in for an extended period of time.

All quartz crystals have multiple vibrational modes. **Spurious modes** refer to those that are unwanted and can be a problem if the response is as strong as the main mode. When the oscillator runs on the spur instead of the main mode, the frequency output is changed. Spurious modes should be specified as either a resistance ratio to the main mode or dB suppression. A resistance ratio of 1.5 or 2.0 to 1 is sufficient to avoid mode hopping. A -3dB to -6dB is an approximate equivalent for a specification in terms of dB.



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ABSOLUTE MAXIMUM RATING

Maximum rated voltage value assuring the normal operation of a crystal oscillator. Exceeding this value may result in a decrease in the reliability of a crystal oscillator.

AGING

The systematic change in frequency with time due to internal changes in the crystal and/or oscillator. Aging is often expressed as a maximum value in parts per million per year (ppm/yr). The rate of aging is typically greatest during the first 30 to 60 days, after which time the aging rate decreases. The following factors affect crystal aging: adsorption and desorption of contamination on the surfaces of the quartz, stress relief of the mounting and bonding structures, material outgassing, and seal integrity.

CALIBRATION ACCURACY (SEE FREQUENCY TOLERANCE)

CAPACITIVE RATIO

In applications (i.e. VCXO) where variations in the crystal parallel resonant frequency are desired, the capacitive ratio (r) may be specified. The capacitive ratio equation is shown below. This ratio is an indicator of the change in a parallel load resonant frequency as a direct result of a given change in crystal load capacitance. Because the value of this ratio has physical limitations when it is realized in a quartz crystal design, please consult Cardinal Components engineering department for product specifications.

$$r = \frac{C_0}{C_1}$$

CENTER FREQUENCY

The specified reference frequency of the crystal, typically specified in megahertz (MHz) or kilohertz (kHz).

CRYSTAL EQUIVALENT CIRCUIT

A crystal device consists of a quartz resonator with metal plating. This plating, located on both sides of the crystal and is connected to insulated leads on the crystal package. The device exhibits a piezoelectric response between the two crystal electrodes.

DRIVE LEVEL

A function of the driving or excitation current flowing through the crystal. The Drive Level is the amount of power dissipation in the crystal, expressed in microwatts or milliwatts. Maximum power is the most power the device can dissipate while still maintaining operation with all electrical parameters guaranteed. Drive level should be maintained at the minimum levels necessary to initiate proper start-up and assure steady oscillation. Excessive drive level can cause poor aging characteristics and crystal damage.

DUTY CYCLE

The measure of output waveform uniformity. This term, also referred to as symmetry, is a measurement of the time that the output waveform is in a logic high state, compared to the logic low state, expressed as a percentage (%). This parameter is measured at a specific voltage threshold or at a percentage of the output waveform amplitude.

EQUIVALENT SERIES RESISTANCE (ESR)

The resistive element, measured in ohms, of a crystal device. The motional inductance (L_1) and motional capacitance (C_1) are of equal ohmic value but are exactly opposite in phase. The net result is that they cancel one another and only a resistance remains in the series leg of the above equivalent circuit. The ESR measurement is made only at the series resonant frequency (F_s), not at some predetermined parallel resonant frequency (F_L). Crystal resistance measured at some parallel load resonant frequency is often called the "effective" resistance.

FANOUT

Number of IC gates which can be connected to the output of a crystal oscillator.



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FREQUENCY STABILITY

The amount of frequency deviation from the ambient temperature frequency over the operating temperature range. This deviation is associated with a set of operating conditions, including operating temperature range, load capacitance, and drive level. This parameter is specified with a maximum and minimum frequency deviation, expressed in percent (%) or parts per million (ppm). The frequency stability is determined by the type of quartz cut and the angle of the quartz cut. Some of the secondary factors include mode of operation, drive level, load capacitance, and mechanical design.

Frequency stability includes frequency drifts over the operating temperature, input voltage changes, output load variations and the effects of long-term aging. The most standard stabilities are specified as ± 100 ppm, and ± 50 ppm. Cardinal Components oscillators can also be specified with ± 25 ppm and ± 10 ppm stabilities.

FREQUENCY TOLERANCE

The amount of frequency deviation from a specified center frequency at ambient temperature of 25°C. This parameter is specified with a maximum and minimum frequency deviation, expressed in percent (%) or parts per million (ppm). This deviation is associated with a set of operating conditions including load capacitance and drive level.

INPUT CURRENT

The amount of current consumption by an oscillator from the power supply, typically specified in milliamps (mA).

LOGIC COMPATIBILITY

In the past, CMOS, TTL, and ECL oscillators were only capable of driving output loads of the same logic family. With the introduction of HCMOS logic, dual compatible oscillators are manufactured that can drive two logic families. Most Cardinal Components oscillators are capable of driving both HCMOS and TTL loads. The dual compatible oscillator's output waveform voltages are derived from HCMOS logic. The logic output exceeds the minimum voltage level requirements of TTL, and with the higher output current capability of HCMOS, these dual compatible oscillators can drive both logic families. Be aware that oscillators not specifically designed for both families cannot be used to drive other logic families, i.e., TTL cannot drive HCMOS or ECL logic. Cardinal Components also offers oscillators that drive TTL and ECL logic exclusively.

NOMINAL FREQUENCY

The specified "name plate frequency" of a crystal or oscillator.

MODE OF OPERATION

The Mode of Operation of a quartz device is one of the factors that will determine the frequency of oscillation. For "AT" cut quartz crystals, overtone modes are at odd frequency harmonics. For example, a crystal may operate at its fundamental frequency of 10 MHz, or at odd harmonics of approximately 30 MHz (Third Overtone), 50 MHz (Fifth Overtone) and 70 MHz (Seventh Overtone).

MOTIONAL CAPACITANCE (C₁) AND MOTIONAL INDUCTANCE (L₁)

The motional capacitance and inductance are designated by C_1 and L_1 . For a "Series" resonant crystal, the value of C_1 resonates with the value of L_1 at a frequency (F_s).

$$F_s = \frac{1}{2\pi \sqrt{L_1 C_1}}$$

Typically, L_1 is not mentioned when working with most crystals. Due to this absolute equation, it is only necessary to specify one motional component or the other. The industry standard is to specify a proper value of C_1 only. The actual value of C_1 has physical limitations when it is realized in a quartz crystal design. These constraints include the mode of operation, the quartz cut, the mechanical design, and the nominal frequency of the crystal.

OPERATING TEMPERATURE RANGE

The maximum and minimum temperatures that the crystal device can be exposed to during oscillation. Over this temperature range, all of the specified device operating parameters are guaranteed.

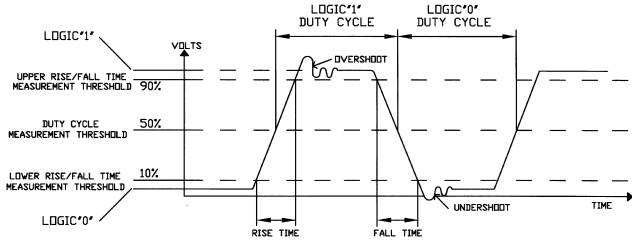


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OUTPUT VOLTAGE LEVELS

In digital logic, voltage levels are referred to in terms of logic “0” and logic “1”. These levels vary depending on the type of output logic required for the application.

TTL	$V_{OL} = \text{Logic "0"} = 0.4V \text{ Max}$
	$V_{OH} = \text{Logic "1"} = 2.4V \text{ Max}$
HCMOS	$V_{OL} = \text{Logic "0"} = 0.5V \text{ Max}$
	$V_{OH} = \text{Logic "1"} = 4.5V \text{ Max}$
ECL	$V_{OL} = \text{Logic "0"} = -1.95V \text{ Min} / -1.60V \text{ Max}$
	$V_{OH} = \text{Logic "1"} = -1.00V \text{ Min} / -0.75V \text{ Max}$



OVERSHOOT/UNDERSHOOT

This effect is commonly called ringing. The output voltage can exceed the steady state plateau of either the logic “0” state or the logic “1” state for a period of time. This ringing will decrease in amplitude until the steady state plateau is reached. The ringing is caused by an unmatched impedance load presented to the oscillator output. It becomes more pronounced as the rise/fall times decrease and the output frequency increases. Proper output loading and good R.F./Microwave transmission line techniques must be used to prevent ringing on the waveform.

PULLABILITY

Pullability refers to the change in the parallel load resonant frequency as a function of change in crystal load capacitance. The equation below is used to calculate the frequency difference, expressed in ppm, between two parallel load resonant frequencies [F_{CL1} and F_{CL2}] as a direct result of a given change in crystal load capacitance [C_{L1} and C_{L2}]. Because there are several methods to express crystal pullability, please consult Cardinal Components engineering department for product specifications.

$$\frac{\Delta F}{F} = \frac{F_{CL1} - F_{CL2}}{F_{CL1}}$$

QUARTZ CRYSTAL

Synthetic quartz is composed of silicon and oxygen (silicon dioxide) and is cultured in autoclaves under high pressure and temperature. Quartz exhibits piezoelectric properties that generate an electrical potential when pressure is applied on the surfaces of the crystal. Conversely, when an electrical potential is applied to the surfaces of a crystal, mechanical deformation or vibration is generated. These vibrations occur at a frequency determined by the crystal design and oscillator circuit. Under proper conditions, quartz is used to stabilize the frequency of an oscillator circuit.

QUARTZ CRYSTAL OSCILLATOR

A timing device that consists of a crystal and an oscillator circuit, providing an output waveform at a specified reference frequency.

RISE AND FALL TIMES

Rise time is the amount of time, measured in nanoseconds that it takes to go from the logic “0” state to the logic “1” state. The fall time is the transition time from logic “1” state to logic “0” state. The time is measured at the 10% and the 90% points of the voltage transition.

SERIES VS. PARALLEL LOAD RESONANCE

A crystal can be used in an oscillator circuit to operate in either of two resonant modes: Series Resonance or Parallel Load Resonance (also known as antiresonance). The crystals used in these two types of modes are physically the same crystal, but calibrated to slightly different frequencies.

When a crystal is placed into an oscillator circuit, they oscillate together at a tuned frequency. This frequency is dependent upon the crystal design and the amount of Load Capacitance, if any, the oscillator circuit presents to the crystal. Specified in picofarads (pF), Load Capacitance is comprised of a combination of the circuit’s discrete load capacitance, stray board ca-



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capacitance, and capacitance from semiconductor Miller effects. When an oscillator circuit presents some amount of load capacitance to a crystal, the crystal is termed “Parallel Load Resonant,” and a value of Load Capacitance must be specified. If the circuit does not exhibit any capacitive loading, the crystal is termed “Series Resonant”, and no value of Load Capacitance is specified. The “Parallel Load Resonant” operating frequency of a quartz crystal is based on the equation below:

$$F_L = F_s \left(\frac{C_1}{2(C_0 + C_L)} + 1 \right)$$

Where: F_s = Series Resonant Frequency (MHz)
 F_L = Parallel Load Resonant Frequency (MHz)
 C_L = Crystal Load Capacitance (pF)
 C_0 = Crystal Shunt Capacitance (pF)
 C_1 = Crystal Motional Capacitance (pF)

SHUNT CAPACITANCE (C0)

The static capacitance between the crystal terminals. Measured in picofarads (pF), shunt capacitance is present whether the device is oscillating or not (unrelated to the piezoelectric effect of the quartz). Shunt capacitance is derived from the dielectric of the quartz, the area of the crystal electrodes, and the capacitance presented by the crystal holder.

START-UP TIME

The specified time from oscillator power-up to the time the oscillator reaches steady state oscillation.

STORAGE TEMPERATURE RANGE

The minimum and maximum temperatures that the device can be stored or exposed to when in a nonoscillation state. After exposing or storing the device at the minimum or maximum temperatures for a length of time, all of the operating specifications are guaranteed over the specified Operating Temperature Range.

SUPPLY VOLTAGE

The DC input voltage necessary for oscillator operation, specified in volts.

SYMMETRY

Symmetry is defined as the ratio of amount of time the voltage is in the logic “1” state compared to the time in the logic “0” state. The measurements are taken at the 50% points of the voltage transition between the two logic states.

The time period of one cycle of the waveform is calculated first as below.

$$\frac{1}{\text{Frequency in Hz}} = \text{Time period in seconds}$$

Next, the time period of the logic “1” state is measured from the 50% point of the waveform’s positive voltage transition to the 50% point of the waveform’s negative voltage transition, then compared to the total waveform period. The calculation for symmetry is shown below:

$$\frac{\text{Logic “1” time in seconds}}{\text{Period of one cycle}} \times 100 = \% \text{ Symmetry}$$

For the % symmetry of the logic “0” state, subtract the logic “1” symmetry from 100%. For example, 40/60% means that the waveform is in its logic “1” state 40% and in the logic “0” state 60% of the total waveform time period.

TRI-STATE

An oscillator with the tri-state feature allows the output to be placed into a high impedance state with no output oscillation present. This feature is activated by the application of a logic control voltage to pin 1 of the oscillator.

TYPE/ANGLE OF QUARTZ CUT

The type and angle of a quartz cut affects the crystal device operating parameters, the most significant being frequency stability over temperature. The frequency stability is dependent upon the plane or the angle of the crystal element in relation to the crystalline axes of the crystal. The plane or angle is referred to as the crystal “cut”. A common type of thickness shear crystal fabricated from Y bar quartz is the “AT” cut. The frequency stability and operating temperature range required by the customer determine the angle of cut utilized.

