

Model 535

High Stability Clipped Sine TCXO



Part Dimensions:
5.0 × 3.2 × 2.0mm

Features

- Fundamental Crystal Design
- Frequency Range 10 – 50MHz *
- Operating Voltage +3.3V
- Frequency Stability, Overall $\pm 4.6\text{ppm}$ [-40°C to +85°C]
- Operating Temperature Range to -40°C to +105°C
- Voltage Control Option for Frequency Tuning [VCTCXO]
- Enable Function Option Available
- Tape and Reel Packaging, EIA-481

Standard Frequencies – see Page 7 for common frequencies.
* Check with factory for availability of frequencies not listed.

Applications

- 5G, 4G, LTE
- Femtocells, RRU, BBU
- Military Radio [Manpack]
- Inflight Entertainment
- Autonomous Technologies
- Synchronous Ethernet
- IP Networking
- Medical Imaging
- Stratum 3
- IEEE 1588 Timing
- Wireless Communication
- Test and Measurement

Description

CTS Model 535 is a high performance Temperature Compensated Crystal Oscillator [TCXO] suitable for applications requiring tight stability, Stratum 3 performance and more. Employing IC technology with Clipped Sine output and analog temperature compensation engine; coupled with a fundamental quartz crystal M535 has excellent stability and low jitter/phase noise performance.

Ordering Information

Model	Output Enable	Supply Voltage	Frequency Code [MHz]	Frequency Stability ²	Temperature Range	Frequency Tuning	Packaging																																								
535		L	XXX	X2	I	T	5																																								
	<table border="1"> <thead> <tr> <th>Code</th> <th>Function</th> </tr> </thead> <tbody> <tr> <td>Blank</td> <td>No Enable</td> </tr> <tr> <td>E</td> <td>Enable, Pin 3</td> </tr> </tbody> </table>	Code	Function	Blank	No Enable	E	Enable, Pin 3	<table border="1"> <thead> <tr> <th>Code</th> <th>Voltage</th> </tr> </thead> <tbody> <tr> <td>L</td> <td>+3.3Vdc</td> </tr> </tbody> </table>	Code	Voltage	L	+3.3Vdc	<table border="1"> <thead> <tr> <th>Code</th> <th>Frequency</th> </tr> </thead> <tbody> <tr> <td colspan="2">Product Frequency Code¹</td> </tr> </tbody> </table>	Code	Frequency	Product Frequency Code ¹		<table border="1"> <thead> <tr> <th>Code</th> <th>Stability</th> </tr> </thead> <tbody> <tr> <td>01</td> <td>$\pm 0.10\text{ppm}$</td> </tr> <tr> <td>X2</td> <td>$\pm 0.28\text{ppm}$</td> </tr> <tr> <td>05</td> <td>$\pm 0.50\text{ppm}$</td> </tr> </tbody> </table>	Code	Stability	01	$\pm 0.10\text{ppm}$	X2	$\pm 0.28\text{ppm}$	05	$\pm 0.50\text{ppm}$	<table border="1"> <thead> <tr> <th>Code</th> <th>Temp. Range</th> </tr> </thead> <tbody> <tr> <td>C</td> <td>-10°C to +70°C</td> </tr> <tr> <td>I</td> <td>-40°C to +85°C</td> </tr> <tr> <td>G</td> <td>-40°C to +105°C³</td> </tr> </tbody> </table>	Code	Temp. Range	C	-10°C to +70°C	I	-40°C to +85°C	G	-40°C to +105°C ³	<table border="1"> <thead> <tr> <th>Code</th> <th>Frequency Deviation</th> </tr> </thead> <tbody> <tr> <td>T</td> <td>TCXO [No Voltage Control]</td> </tr> <tr> <td>A</td> <td>$\pm 5\text{ppm} - \pm 10\text{ppm}$ [VCTCXO]</td> </tr> </tbody> </table>	Code	Frequency Deviation	T	TCXO [No Voltage Control]	A	$\pm 5\text{ppm} - \pm 10\text{ppm}$ [VCTCXO]	<table border="1"> <thead> <tr> <th>Code</th> <th>Packing</th> </tr> </thead> <tbody> <tr> <td>5</td> <td>500 pcs./reel</td> </tr> </tbody> </table>	Code	Packing	5	500 pcs./reel
Code	Function																																														
Blank	No Enable																																														
E	Enable, Pin 3																																														
Code	Voltage																																														
L	+3.3Vdc																																														
Code	Frequency																																														
Product Frequency Code ¹																																															
Code	Stability																																														
01	$\pm 0.10\text{ppm}$																																														
X2	$\pm 0.28\text{ppm}$																																														
05	$\pm 0.50\text{ppm}$																																														
Code	Temp. Range																																														
C	-10°C to +70°C																																														
I	-40°C to +85°C																																														
G	-40°C to +105°C ³																																														
Code	Frequency Deviation																																														
T	TCXO [No Voltage Control]																																														
A	$\pm 5\text{ppm} - \pm 10\text{ppm}$ [VCTCXO]																																														
Code	Packing																																														
5	500 pcs./reel																																														

Notes:

- 1] Refer to document 016-1454-0, Frequency Code Tables. 3-digits for frequencies <100MHz, 4-digits for frequencies 100MHz or greater.
- 2] Frequency vs. Temperature only.
- 3] Available with stability code X2 and 05 only.

**Not all performance combinations and frequencies may be available.
Contact your local CTS Representative or CTS Customer Service for availability.**

This product is specified for use only in standard commercial applications. Supplier disclaims all express and implied warranties and liability in connection with any use of this product in any non-commercial applications or in any application that may expose the product to conditions that are outside of the tolerances provided in its specification.



Electrical Specifications

Operating Conditions

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Maximum Supply Voltage	V_{CC}	-	-0.5	-	4.6	V
Maximum Control Voltage	V_C	-	-0.3	-	V_{CC}	V
Supply Voltage	V_{CC}	$\pm 5\%$	3.14	3.3	3.47	V
Supply Current	I_{CC}	-	-	-	10	mA
Output Load	$R_L//C_L$	-	10k Ohm//10pF		-	-
Operating Temperature	T_A	-	-10	+25	+70	°C
			-40		+105	
Storage Temperature	T_{STG}	-	-55	-	+125	°C

Frequency Stability

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Frequency Range	f_0	Frequency stability ± 0.10 ppm	10 - 40		-	MHz
		Frequency stability ± 0.28 ppm or ± 0.50 ppm	10 - 50			
Frequency Stability		-10°C to +70°C & -40°C to +85°C				
Overall Frequency Stability		Ref. f_0 , 20 Years Aging, ± 0.28 ppm over -40°C to +85°C	-4.6	-	4.6	ppm
Initial Calibration	$\Delta f/f_0$	Initial Calibration @ +25°C, At Time of Shipment	-0.9	-	0.9	ppm
Temperature Only		$[f_{max} - f_{min}]/2$, Over Temperature Range	0.10, 0.28, 0.50			\pm ppm
Voltage Coefficient	$\Delta f/f_{25}$	Supply Voltage, $\pm 5\%$	-0.2	-	0.2	ppm
Load Coefficient		Load, $\pm 10\%$	-0.2	-	0.2	ppm
Aging	$\Delta f/f_{25}$	First Year @ +25°C, nominal V_{CC} and V_C	-1.0	-	1.0	ppm
		20 Years @ +25°C, nominal V_{CC} and V_C	-3.0	-	3.0	ppm
Frequency Stability		-40°C to +105°C				
Overall Frequency Stability		Ref. f_0 , 20 Years Aging, ± 0.28 ppm over -40°C to +105°C	-4.7	-	4.7	ppm
Initial Calibration	$\Delta f/f_0$	Initial Calibration @ +25°C, At Time of Shipment	-0.9	-	0.9	ppm
Temperature Only		$[f_{max} - f_{min}]/2$, Over Temperature Range	0.28, 0.5			\pm ppm
Voltage Coefficient	$\Delta f/f_{25}$	Supply Voltage, $\pm 5\%$	-0.2	-	0.2	ppm
Load Coefficient		Load, $\pm 10\%$	-0.2	-	0.2	ppm
Aging	$\Delta f/f_{25}$	First Year @ +25°C, nominal V_{CC} and V_C	-1.0	-	1.0	ppm
		20 Years @ +25°C, nominal V_{CC} and V_C	-3.0	-	3.0	ppm

Electrical Specifications

Output Parameters

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Output Type	-	DC Coupled		Clipped Sine		-
Output Voltage Levels	V_O	-	0.8	-	-	V_{p-p}
Start Up Time	T_S	Application of V_{CC}	-	2	5	ms
Enable Function						
Enable Input Voltage	V_{IH}	Pin 3 Logic '1', Output Enabled	$0.8V_{CC}$	-	-	V
Disable Input Voltage	V_{IL}	Pin 3 Logic '0', Output Disabled	-	-	$0.2V_{CC}$	V
Disabled Current	I_{STB}	Pin 3 Logic '0', Output Disabled	-	-	3.5	mA
Enable Time	T_{PLZ}	Pin 3 Logic '1'	-	-	5	ms
Phase Noise	-	See Typical Plots	-	-	-	-

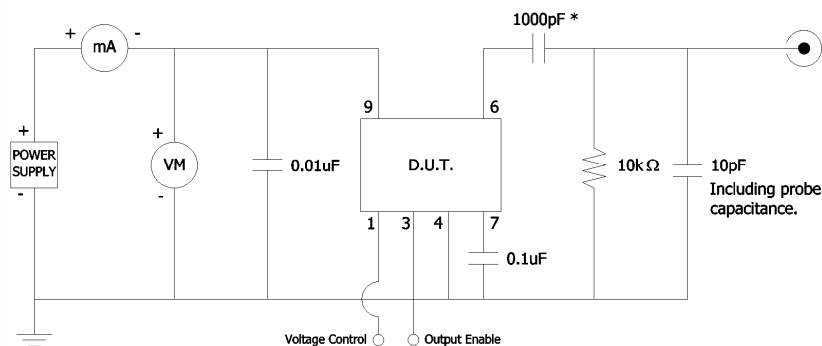
Control Voltage

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Control Voltage	V_C	$V_{CC} = +3.3V$	0.0	1.65	3.3	V
Frequency Tuning [VCTCXO Only]	$\Delta f/f_0$	Specified V_C Range		± 5 to ± 10		ppm
Input Impedance	Z_{Vc}	-	100	-	-	kOhms
Linearity	L	Best Straight Line Fit	-	± 5	± 10	%
Transfer Function	-	-		Positive		-

Test Circuit

Clipped Sine

* DC-Cut Capacitor: Add 1000pF capacitor between the TCXO output and input of load.

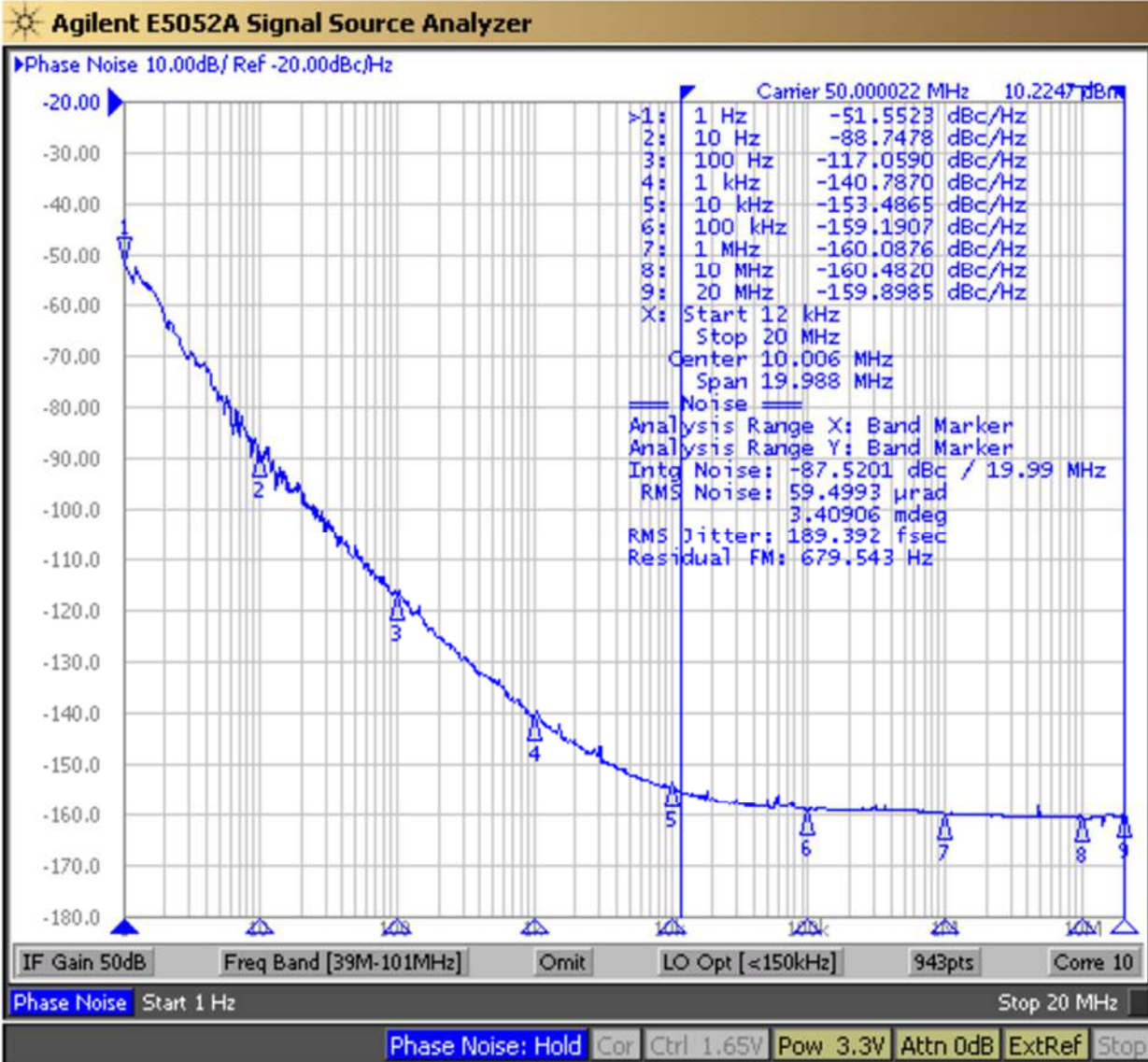


Electrical Specifications

Performance Data

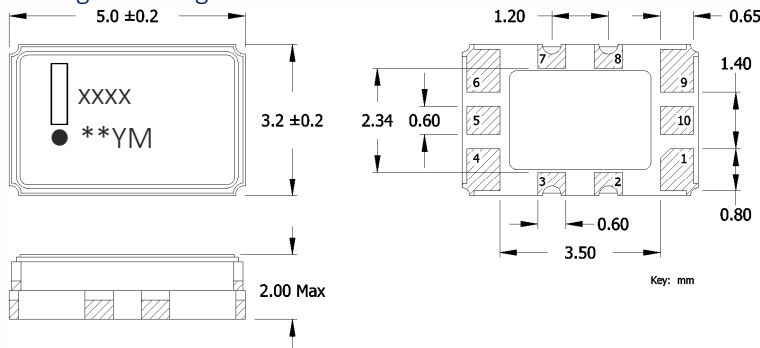
Phase Noise [typical]

50MHz, $V_{CC} = +3.3V$, $T_A = +25^\circ C$

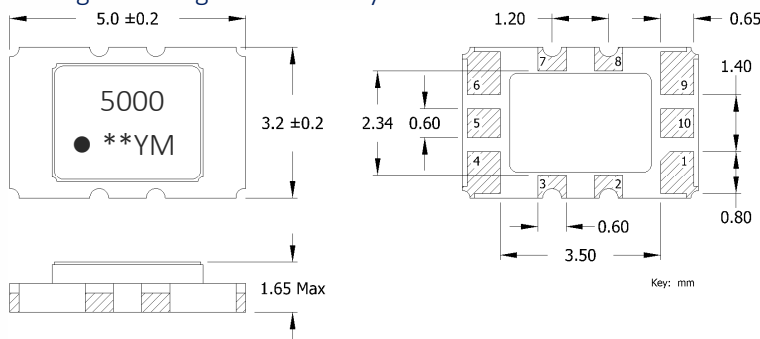


Mechanical Specifications

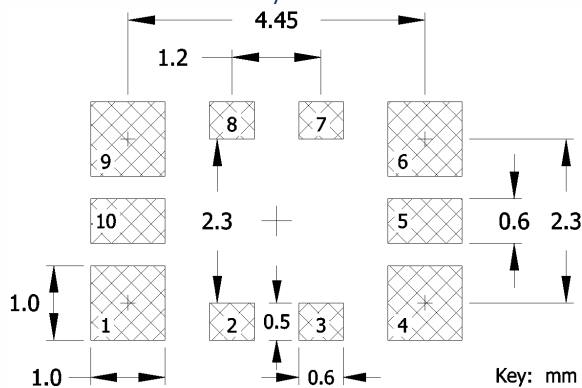
Package Drawing



Package Drawing – 50MHz Only



Recommended Pad Layout



Pin Assignment Notes

- Do not connect to Pin 1, if Voltage Control function is not used [TCXO].
- Do not connect to Pin 3, if Output Enable function is not used.
- Add 0.1µF capacitor between Pin 7 and ground.
- DC-Cut Capacitor Required. Add 1000pF capacitor between TCXO output and input of load.

Table I - Month Code

MONTH	1	2	3	4	5	6	7	8	9	10	11	12
MONTH CODE	1	2	3	4	5	6	7	8	9	X	Y	Z

Marking Information

- xxxx – Frequency Code, 4-digits. See Page 7.
- – Pin 1 Identifier.
- ** – Manufacturing Site Code.
- YM – Date Code; Y – year [last digit], M – month. [See Table I for month codes.]
- – Area for Crystal Lot Code or Date Code. [Not provided for 50MHz.]

Notes

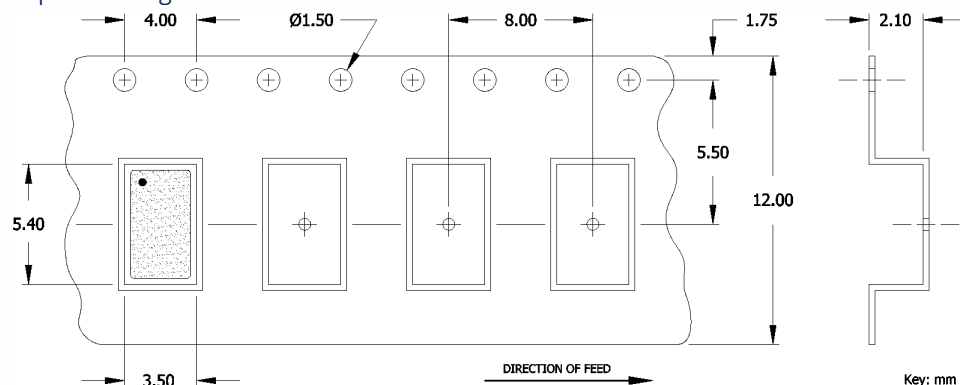
- DO NOT make connections to non-labeled pins or castellations as they may have internal connections used in the manufacturing process.
- JEDEC termination code (e4). Barrier-plating is nickel [Ni] with gold [Au] flash plate.
- Reflow conditions per JEDEC J-STD-020; +260°C maximum, 10 seconds.
- MSL = 1.

Pin Assignments

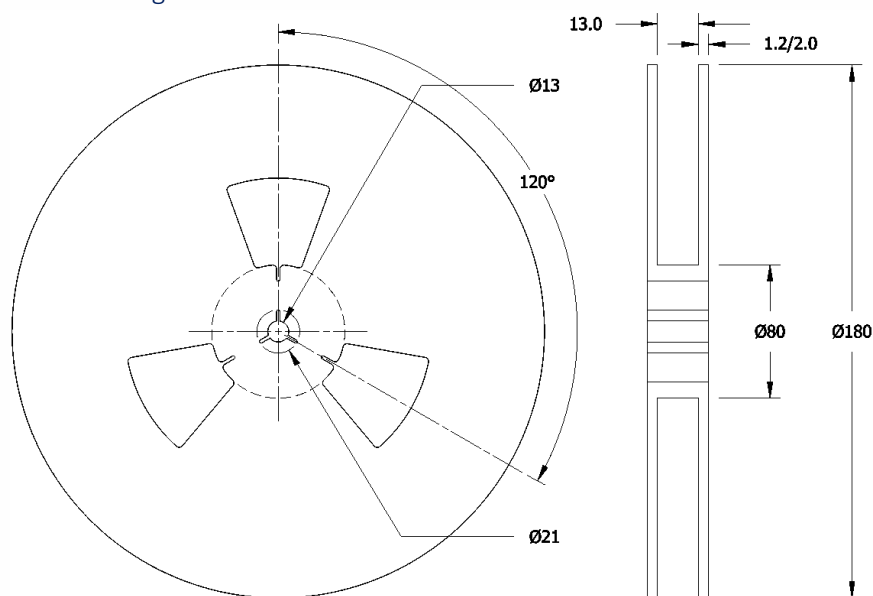
Pin	Symbol	Function
1	Vc	Voltage Control Note 1
2	-	Do Not Connect
3	EOH	Enable, Pin 3 [Optional] Note 2
4	GND	Circuit & Package
5	-	Do Not Connect
6	Output	Clipped Sine
7	-	Vcfilter
8	-	Do Not Connect
9	V _{CC}	Supply Voltage
10	-	Do Not Connect

Packaging - Tape and Reel

Tape Drawing



Reel Drawing



Notes

1. Device quantity is 500 pieces maximum per 180mm reel.
2. Complete CTS part number, frequency value and date code information must appear on reel and carton labels.



Addendum

Available Frequencies for Stability $\pm 0.50\text{ppm}$ – MHz

FREQUENCY	ORDERING CODE	MARKING CODE	FREQUENCY	ORDERING CODE	MARKING CODE	FREQUENCY	ORDERING CODE	MARKING CODE
10.000000	100	1000	38.880000	388	3888			
19.200000	192	1920	40.000000	400	4000			
20.000000	200	2000						
25.000000	250	2500						
38.400000	384	3840						

Available Frequencies for Stability $\pm 0.28\text{ppm}$ – MHz

FREQUENCY	ORDERING CODE	MARKING CODE	FREQUENCY	ORDERING CODE	MARKING CODE	FREQUENCY	ORDERING CODE	MARKING CODE
10.000000	100	1000	38.880000	388	3888			
19.200000	192	1920	40.000000	400	4000			
20.000000	200	2000						
25.000000	250	2500						
38.400000	384	3840						

Available Frequencies for Stability $\pm 0.10\text{ppm}$ – MHz

FREQUENCY	ORDERING CODE	MARKING CODE	FREQUENCY	ORDERING CODE	MARKING CODE	FREQUENCY	ORDERING CODE	MARKING CODE
10.000000	100	1000						
20.000000	200	2000						
25.000000	250	2500						