

# Model 356C

## Advanced PLL HCMOS VCXO

### Features

- Ceramic Surface Mount Package
- Low Phase Jitter Performance, 600fs Typical
- Advanced PLL Design w/ Low Fundamental Crystal
- Frequency Range 10 – 250MHz \*
- +2.5V or +3.3V Operation
- Output Enable Standard
- Tape and Reel Packaging, EIA-418

### Applications

- Broadcast Video Systems
- Storage Area Networking
- Broadband Access
- Phase-Locked Loop
- Networking Equipment
- Ethernet/GbE/SyncE
- Fiber Channel
- Test and Measurement



Part Dimensions:  
7.0 × 5.0 × 1.85mm • 174.2mg

#### Standard Frequencies

- 25.00MHz	- 100.00MHz	- 155.52MHz
- 50.00MHz	- 122.88MHz	- 156.25MHz
- 74.25MHz	- 125.00MHz	- 200.00MHz
- 77.76MHz	- 148.50MHz	- 250.00MHz

\* See Page 7 for additional developed frequencies.  
Check with factory for availability of frequencies not listed.

### Description

CTS Model 356C is a low cost, high performance PLL voltage controlled oscillator supporting HCMOS output. Employing the latest IC technology, M356C has excellent stability and low phase jitter performance.

### Ordering Information

Model	Output Type	Frequency Code [MHz]	Absolute Pull Range	Frequency Stability	Temperature Range	Supply Voltage	Packaging
356	C	XXX or XXXX	B	3	I	3	T
	Code    Output		Code    APR		Code    Temp. Range		Code    Packing
	C        HCMOS		B        ±50ppm		C        -20°C to +70°C		T        1k pcs./reel
					I        -40°C to +85°C		
		Code    Frequency		Code    Stability		Code    Voltage	
		Product Frequency Code <sup>1</sup>		5        ±25ppm <sup>2</sup>		2        +2.5Vdc	
				4        ±30ppm		3        +3.3Vdc	
				3        ±50ppm			

Notes:

- 1] Refer to document 016-1454-0, Frequency Code Tables.  
3-digits for frequencies <100MHz, 4-digits for frequencies 100MHz or greater.
- 2] Check factory availability when paired with "I" temperature code.

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

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## Electrical Specifications

### Operating Conditions

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Maximum Supply Voltage	$V_{CC}$	-	-0.5	-	4.0	V
Maximum Control Voltage	$V_C$	$V_{CC} = +2.5V$	-0.5	-	3.0	V
		$V_{CC} = +3.3V$	-0.5	-	3.8	V
Supply Voltage	$V_{CC}$	$\pm 5\%$	2.375	2.5	2.625	V
			3.135	3.3	3.465	
Supply Current	$I_{CC}$	Maximum Load	-	20	65	mA
Operating Temperature	$T_A$	-	-20	+25	+70	°C
			-40	-	+85	
Storage Temperature	$T_{STG}$	-	-55	-	+125	°C

### Frequency Stability

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Frequency Range	$f_O$	-		10 - 250		MHz
Frequency Stability [Note 1]	$\Delta f/f_O$	-		25, 30 or 50		$\pm$ ppm
Absolute Pull Range [Note 2]	APR	-	50	-	-	$\pm$ ppm
Aging	$\Delta f/f_{25}$	First Year @ +25°C, nominal $V_{CC}$	-3	-	3	ppm

1.] Inclusive of initial tolerance at time of shipment, changes in supply voltage, load, temperature and 1st year aging.

2.] Minimum guaranteed frequency shift from  $f_O$  over variations in temperature, aging, power supply and load.

### Output Parameters

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Output Type	-	-		HCMOS		-
Output Load	$C_L$	-	-	-	15	pF
Output Voltage Levels	$V_{OH}$	CMOS Load	$0.9V_{CC}$	-	-	V
	$V_{OL}$		-	-	$0.1V_{CC}$	
Output Duty Cycle	SYM	@ 50% Level	45	-	55	%
Rise and Fall Time	$T_R, T_F$	@ 20%/80% Levels, $C_L = 15pF$	-	5	10	ns
Start Up Time	$T_S$	Application of $V_{CC}$	-	3	5	ms
<b>Enable Function [Tri-State]</b>						
Enable Input Voltage	$V_{IH}$	Pin 2 Logic '1', Output Enabled	$0.7V_{CC}$	-	-	V
Disable Input Voltage	$V_{IL}$	Pin 2 Logic '0', Output Disabled	-	-	$0.3V_{CC}$	V
Disable Current	$I_{IL}$	Pin 2 Logic '0', Output Disabled	-	16	22	mA
Enable Time	$T_{PLZ}$	Pin 2 Logic '1', Output Enabled	-	-	200	ns
Phase Jitter, RMS	$t_{jrms}$	Bandwidth 12 kHz - 20 MHz	-	600	<1000	fs
Period Jitter, RMS	$p_{jrms}$	-	-	3.0	-	ps
Period Jitter, pk-pk	$p_{jpk-pk}$	-	-	30	-	ps

## Electrical Specifications

### Control Voltage

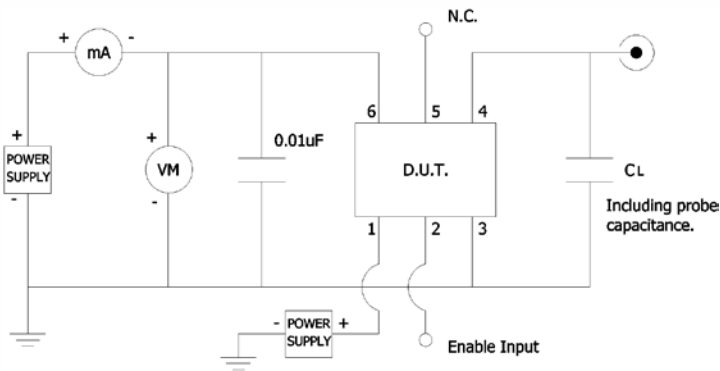
PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Control Voltage	$V_C$	$V_{CC} = 2.5V$	0.2	1.25	2.3	V
		$V_{CC} = 3.3V$	0.3	1.65	3.0	
Frequency Deviation	$\Delta f/f_0$	$V_C = 0.2V$		-60 to -180		ppm
		$V_C = 2.3V$		60 to 180		
		$V_C = 0.3V$		-60 to -180		ppm
		$V_C = 3.0V$		60 to 180		
Linearity	L	Best Straight Line Fit	-	-	$\pm 15$	%
Gain Transfer	$K_V$	Pull Sensitivity; @ +1.25V, +25°C	-	80	260	ppm/V
		Pull Sensitivity; @ +1.65V, +25°C				
Input Impedance	$Z_{Vc}$	-	1	-	-	MOhms
Modulation Roll-off	-	@ -3dB	10	-	-	kHz
Transfer Function	-	-		Positive		-

### Enable Truth Table

Pin 2	Pin 4
Logic '1'	Output
Open	Output
Logic '0'	High Imp.

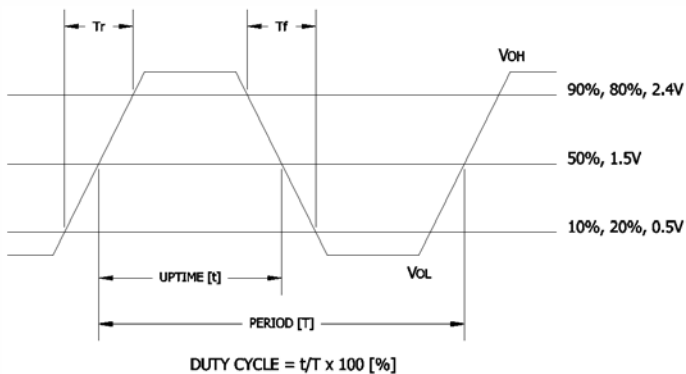
### Test Circuit

HCMOS



### Output Waveform

HCMOS



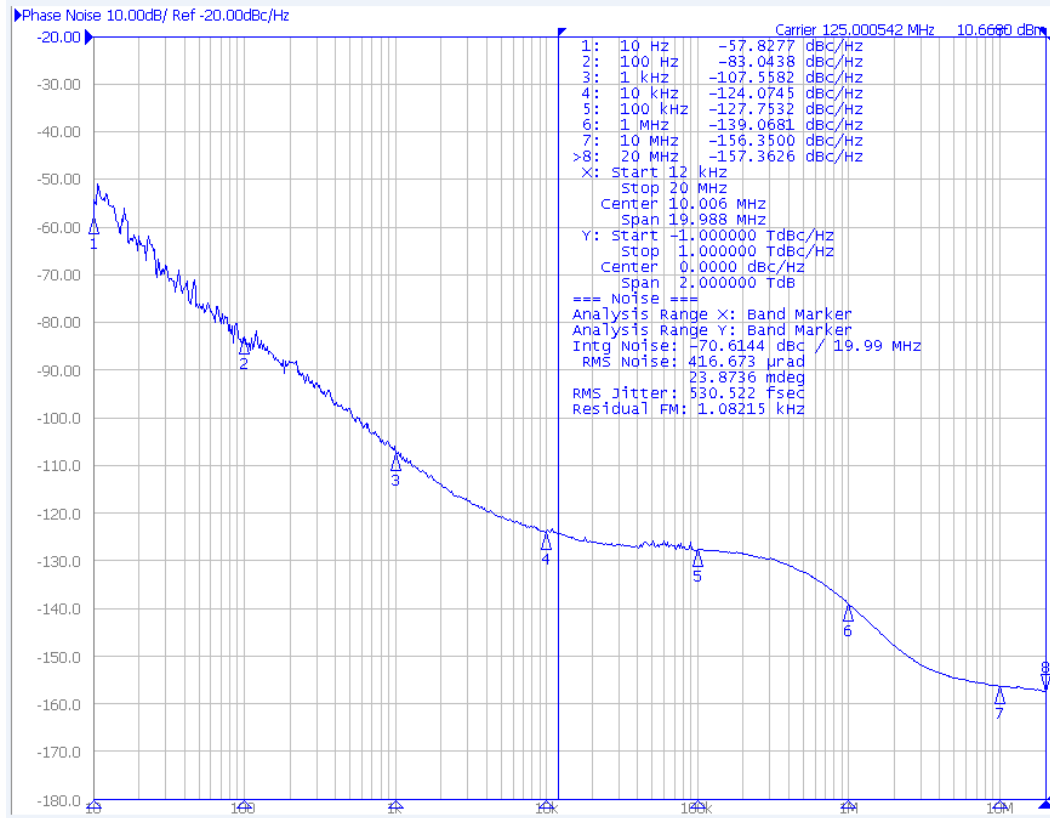


## Electrical Specifications

### Performance Data

#### Phase Noise [typical]

125MHz, HCMOS,  $V_{CC} = +3.3V$ ,  $V_C = +1.65V$ ,  $T_A = +25^\circ C$



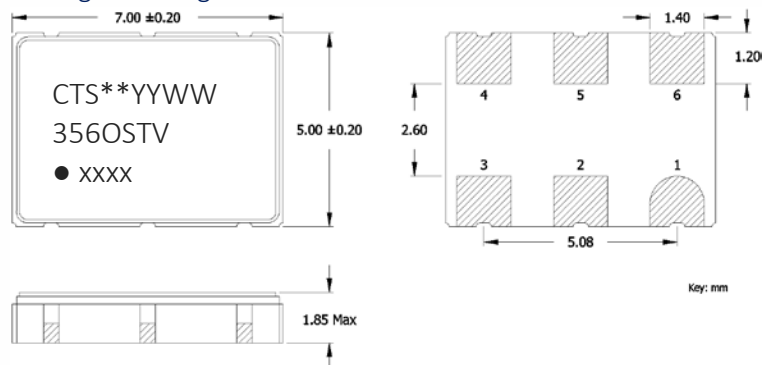
#### Phase Noise Tabulated

125MHz, HCMOS,  $V_{CC} = +3.3V$ ,  $V_C = +1.65V$ ,  $T_A = +25^\circ C$

PARAMETER	SYMBOL	CONDITIONS	TYP	UNIT
<b>HCMOS @ 125.00MHz</b>				
Phase Noise		Single Side Band		
		@ 10Hz	-57.8277	
		@ 100Hz	-83.0438	
		@ 1kHz	-107.5582	
	-	@ 10kHz	-124.0745	dBc/Hz
		@ 100kHz	-127.7532	
		@ 1MHz	-139.0681	
		@ 10MHz	-156.3500	
	@ 20MHz	-157.3626		
Phase Jitter, RMS	tjrms	Integration Bandwidth 12kHz - 20MHz	530.5330	fs

## Mechanical Specifications

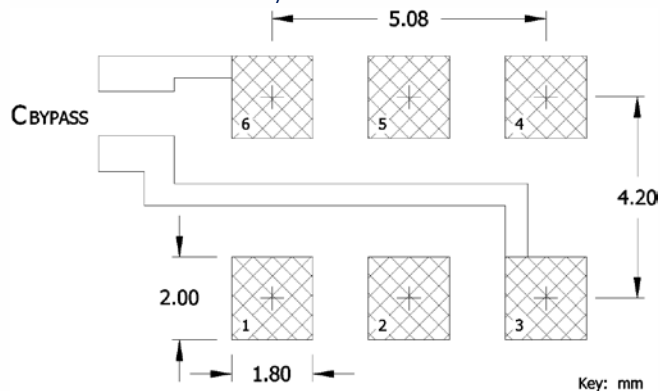
### Package Drawing



### Marking Information

1. \*\* – Manufacturing Site Code.
2. YYWW – Date Code; YY = year, WW = week.
3. O – Output Type; C = HCMOS.
4. ST – Frequency Stability/Temperature Code. [Refer to Ordering Information]
5. V – Voltage Code; 3 = 3.3V, 2 = 2.5V.
6. xxxx – Frequency Code.  
3-digits, frequencies below 100MHz  
4-digits, frequencies 100MHz or greater  
[See document 016-1454-0, Frequency Code Tables.]

### Recommended Pad Layout



### Notes

1. JEDEC termination code (e4). Barrier-plating is nickel [Ni] with gold [Au] flash plate.
2. Reflow conditions per JEDEC J-STD-020; +260°C maximum, 20 seconds.
3. MSL = 1.

### Pin Assignments

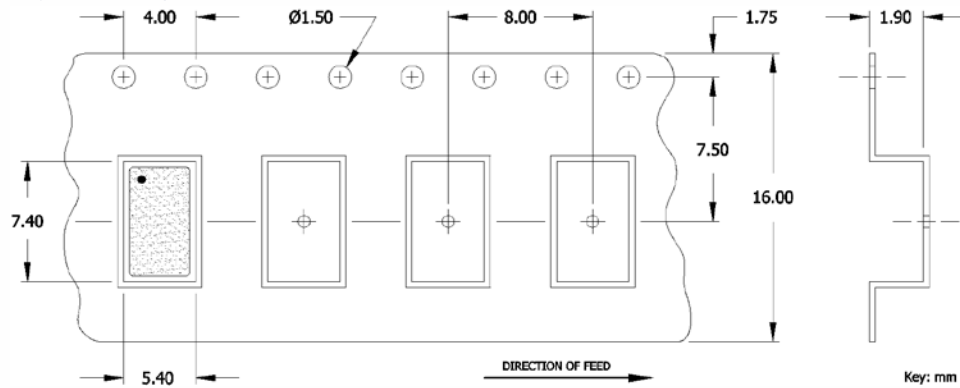
Pin	Symbol	Function
1	V <sub>C</sub>	Voltage Control
2	EOH	Enable [tri-state]
3	GND	Circuit & Package Ground
4	Output	RF Output
5	N.C.	No Connect
6	V <sub>CC</sub>	Supply Voltage

Table I - Date Code

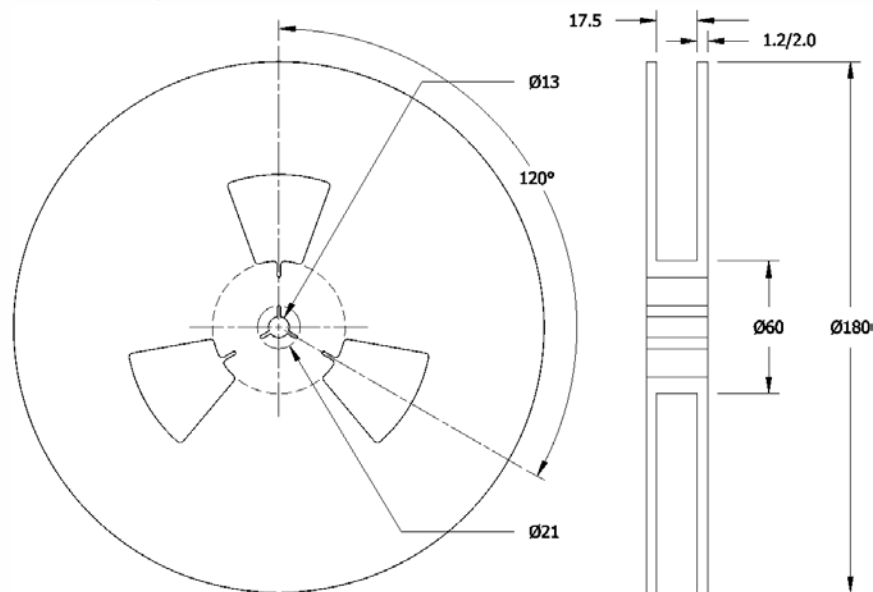
YEAR		MONTH														
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC			
2001	2005	2009	2013	2017	A	B	C	D	E	F	G	H	J	K	L	M
2002	2006	2010	2014	2018	N	P	Q	R	S	T	U	V	W	X	Y	Z
2003	2007	2011	2015	2019	a	b	c	d	e	f	g	h	j	k	l	m
2004	2008	2012	2016	2020	n	p	q	r	s	t	u	v	w	x	y	z

### Packaging - Tape and Reel

#### Tape Drawing



#### Reel Drawing



#### Notes

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



## Addendum

### Additional Developed Frequencies – MHz

FREQUENCY	FREQUENCY CODE	FREQUENCY	FREQUENCY CODE	FREQUENCY	FREQUENCY CODE	FREQUENCY	FREQUENCY CODE
27.000000	270	62.500000	625	106.250000	1062	156.253906	156A
38.840000	38D	74.175800	74A	132.000000	1320	160.000000	1600
38.880000	388	76.800000	768	144.500000	1445	184.320000	1843
43.350000	433	86.700000	867	148.351648	148B		
45.000000	450	87.351542	873	150.000000	1500		
54.000000	540	92.160000	921	153.600000	1536		

### Frequency Codes for Cover Page Table – MHz

FREQUENCY	FREQUENCY CODE	FREQUENCY	FREQUENCY CODE	FREQUENCY	FREQUENCY CODE
25.000000	250	122.880000	1228	200.000000	2000
50.000000	500	125.000000	1250	250.000000	2500
74.250000	742	148.500000	1485		
77.760000	777	155.520000	1555		
100.000000	1000	156.250000	1562		