

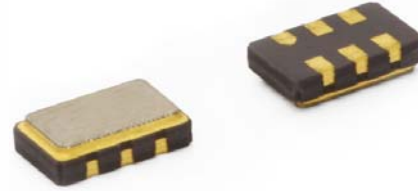


Model 653

Very Low Jitter LVPECL or LVDS Clock

Features

- Ceramic Surface Mount Package
- Very Low Phase Jitter Performance, 500fs Maximum
- Fundamental or 3rd Overtone Crystal Design
- Frequency Range 10 – 320MHz *
- +2.5V or +3.3V Operation
- Output Enable Standard
- Tape and Reel Packaging, EIA-418



Part Dimensions:
5.0 × 3.2 × 1.2mm • 62.00mg

Applications

- SerDes
- Storage Area Networking
- Broadband Access
- SONET/SDH/DWDM
- PON
- Ethernet/GbE/SyncE
- Fiber Channel
- Test and Measurement

Standard Frequencies

- | | |
|-------------|---------------|
| - 25.00MHz | - 161.1328MHz |
| - 50.00MHz | - 187.50MHz |
| - 100.00MHz | - 200.00MHz |
| - 125.00MHz | - 212.50MHz |
| - 155.52MHz | - 250.00MHz |
| - 156.25MHz | - 312.50MHz |

* Check with factory for availability.

Description

CTS Model 653 is a low cost, high performance clock oscillator supporting differential LVPECL or LVDS outputs. Employing the latest IC technology, M653 has excellent stability and very low jitter/phase noise performance.

Ordering Information

Model	Output Type	Frequency Code [MHz]	Frequency Stability	Temperature Range	Supply Voltage	Packaging																																										
653	P	XXX or XXXX	3	I	3	T																																										
<table><tr><th>Code</th><th>Output</th></tr><tr><td>P</td><td>LVPECL - Pin 1 Enable</td></tr><tr><td>L</td><td>LVDS - Pin 1 Enable</td></tr><tr><td>E</td><td>LVPECL - Pin 2 Enable</td></tr><tr><td>V</td><td>LVDS - Pin 2 Enable</td></tr></table>		Code	Output	P	LVPECL - Pin 1 Enable	L	LVDS - Pin 1 Enable	E	LVPECL - Pin 2 Enable	V	LVDS - Pin 2 Enable	<table><tr><th>Code</th><th>Frequency</th></tr><tr><td colspan="2">Product Frequency Code ¹</td></tr></table>	Code	Frequency	Product Frequency Code ¹		<table><tr><th>Code</th><th>Stability</th></tr><tr><td>6</td><td>±20ppm²</td></tr><tr><td>5</td><td>±25ppm</td></tr><tr><td>3</td><td>±50ppm</td></tr><tr><td>2</td><td>±100ppm</td></tr></table>	Code	Stability	6	±20ppm ²	5	±25ppm	3	±50ppm	2	±100ppm	<table><tr><th>Code</th><th>Temp. Range</th></tr><tr><td>A</td><td>-10°C to +60°C</td></tr><tr><td>C</td><td>-20°C to +70°C</td></tr><tr><td>I</td><td>-40°C to +85°C</td></tr></table>	Code	Temp. Range	A	-10°C to +60°C	C	-20°C to +70°C	I	-40°C to +85°C	<table><tr><th>Code</th><th>Voltage</th></tr><tr><td>2</td><td>+2.5Vdc</td></tr><tr><td>3</td><td>+3.3Vdc</td></tr></table>	Code	Voltage	2	+2.5Vdc	3	+3.3Vdc	<table><tr><th>Code</th><th>Packing</th></tr><tr><td>T</td><td>1k pcs./reel</td></tr></table>	Code	Packing	T	1k pcs./reel
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Notes:

- 1] Refer to document 016-1454-0, Frequency Code Tables. 3-digits for frequencies <100MHz, 4-digits for frequencies 100MHz or greater.
- 2] Consult factory for availability of 6I Stability/Temperature combination.

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

Electrical Specifications

Operating Conditions

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Maximum Supply Voltage	V_{CC}	-	-0.5	-	5.0	V
Supply Voltage	V_{CC}	$\pm 5\%$	2.375 3.135	2.5 3.3	2.625 3.465	V
Supply Current						
LVPECL	I_{CC}	Maximum Load	-	55	88	mA
LVDS			-	45	66	
Operating Temperature	T_A	-	-20 -40	+25	+70 +85	$^{\circ}\text{C}$
Storage Temperature	T_{STG}	-	-40	-	+125	$^{\circ}\text{C}$

Frequency Stability

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Frequency Range						
LVPECL	f_0	-		10 - 320		MHz
LVDS				10 - 320		
Frequency Stability [Note 1]	$\Delta f/f_0$	-		20, 25, 50 or 100		$\pm\text{ppm}$
Aging	$\Delta f/f_{25}$	First Year @ +25 $^{\circ}\text{C}$, 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.

Output Parameters

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Output Type	-	-		LVPECL		-
Output Load	R_L	Terminated to $V_{CC} - 2.0\text{V}$	-	50	-	Ohms
Output Voltage Levels	V_{OH}	PECL Load, -20 $^{\circ}\text{C}$ to +70 $^{\circ}\text{C}$	$V_{CC} - 1.025$	-	$V_{CC} - 0.880$	V
	V_{OL}		$V_{CC} - 1.810$	-	$V_{CC} - 1.620$	
	V_{OH}	PECL Load, -40 $^{\circ}\text{C}$ to +85 $^{\circ}\text{C}$	$V_{CC} - 1.085$	-	$V_{CC} - 0.880$	V
	V_{OL}		$V_{CC} - 1.830$	-	$V_{CC} - 1.555$	
Output Duty Cycle	SYM	@ $V_{CC} - 1.3\text{V}$	45	-	55	%
Rise and Fall Time	T_R, T_F	@ 20%/80% Levels, $R_L = 50\text{ Ohms}$	-	0.3	0.7	ns
Output Type	-	-		LVDS		-
Output Load	R_L	Between Outputs	-	100	-	Ohms
Output Voltage Levels	V_{OH}	LVDS Load	-	1.43	1.60	V
	V_{OL}		0.90	1.10	-	
Output Duty Cycle	SYM	@ 1.25V	45	-	55	%
Differential Output Voltage	V_{OD}	$R_L = 100\text{ Ohms}$	247	330	454	mV
Offset Voltage	V_{OS}	LVDS Load	1.125	1.25	1.375	V
Rise and Fall Time	T_R, T_F	@ 20%/80% Levels, $R_L = 100\text{ Ohms}$	-	0.4	0.7	ns

Electrical Specifications

Output Parameters

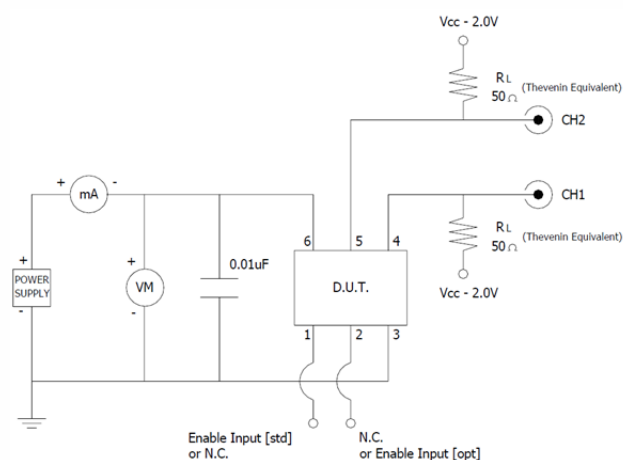
PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Start Up Time	T_S	Application of V_{CC}	-	2	5	ms
Enable Function [Standby]						
Enable Input Voltage	V_{IH}	Pin 1 or 2 Logic '1', Output Enabled	$0.7V_{CC}$	-	-	V
Disable Input Voltage	V_{IL}	Pin 1 or 2 Logic '0', Output Disabled	-	-	$0.3V_{CC}$	V
Disable Time	T_{PLZ}	Pin 1 or 2 Logic '0', Output Disabled	-	-	200	ns
Enable Time	T_{PLZ}	Pin 1 or 2 Logic '1', Output Enabled	-	-	2	ms
Phase Jitter, RMS	t_{jrms}	Bandwidth 12 kHz - 20 MHz	-	300	500	fs
Period Jitter, pk-pk	p_{jpk-pk}	-	-	2.6	-	ps
Period Jitter, RMS	p_{jrms}	-	-	25	-	ps

Enable Truth Table

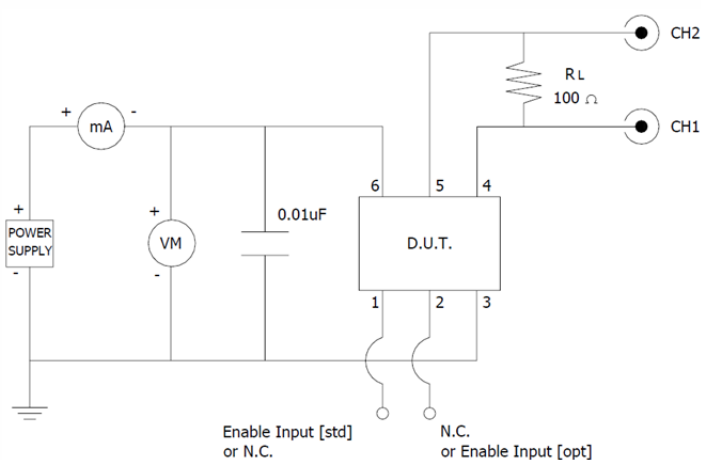
Pin 1 or Pin 2	Pin 4 & Pin 5
Logic '1'	Output
Open	Output
Logic '0'	High Imp.

Test Circuit

LVPECL

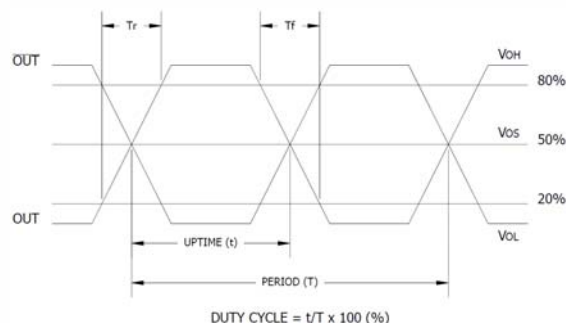


LVDS



Output Waveform

LVPECL or LVDS

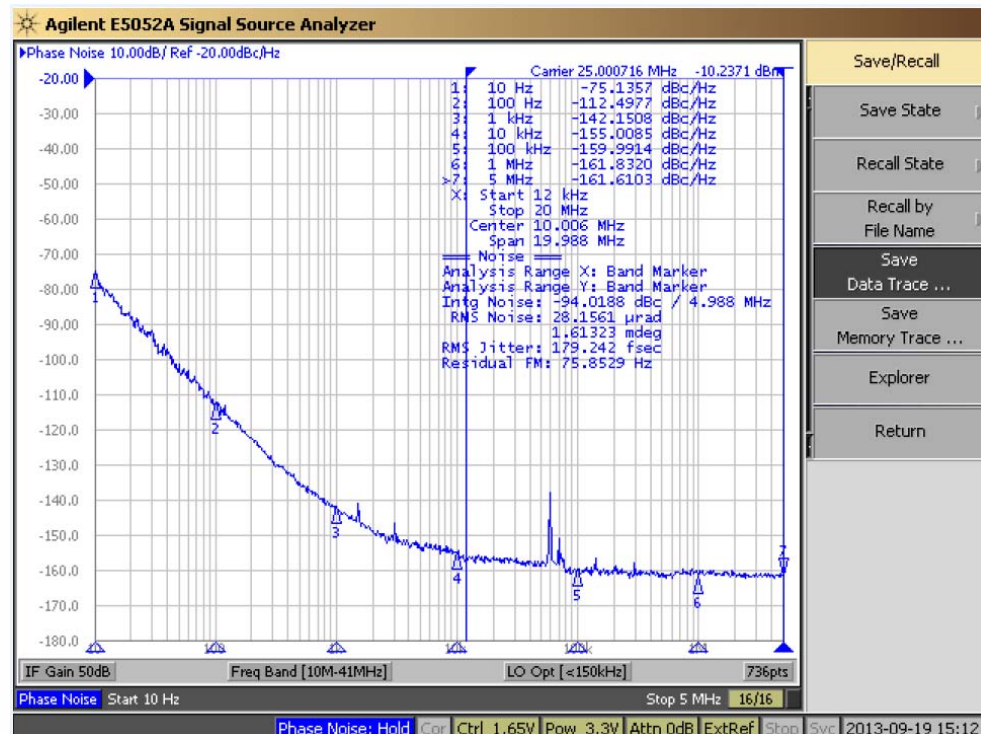


Electrical Specifications

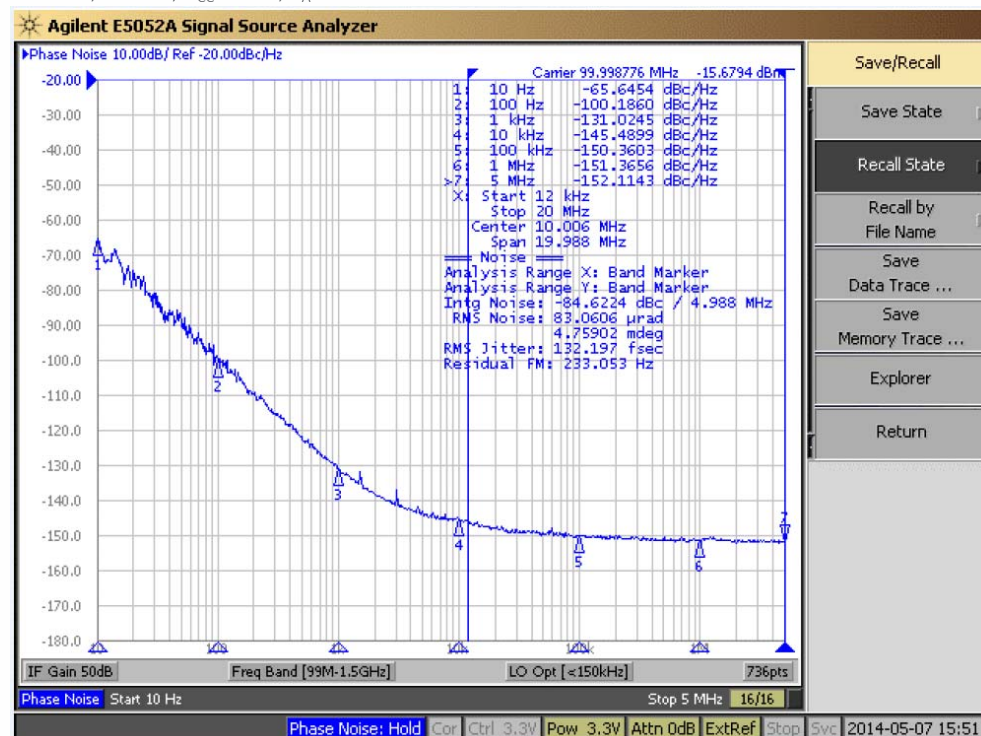
Performance Data

Phase Noise [typical]

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



100MHz, LVPECL, $V_{CC} = 3.3V$, $T_A = +25^\circ C$

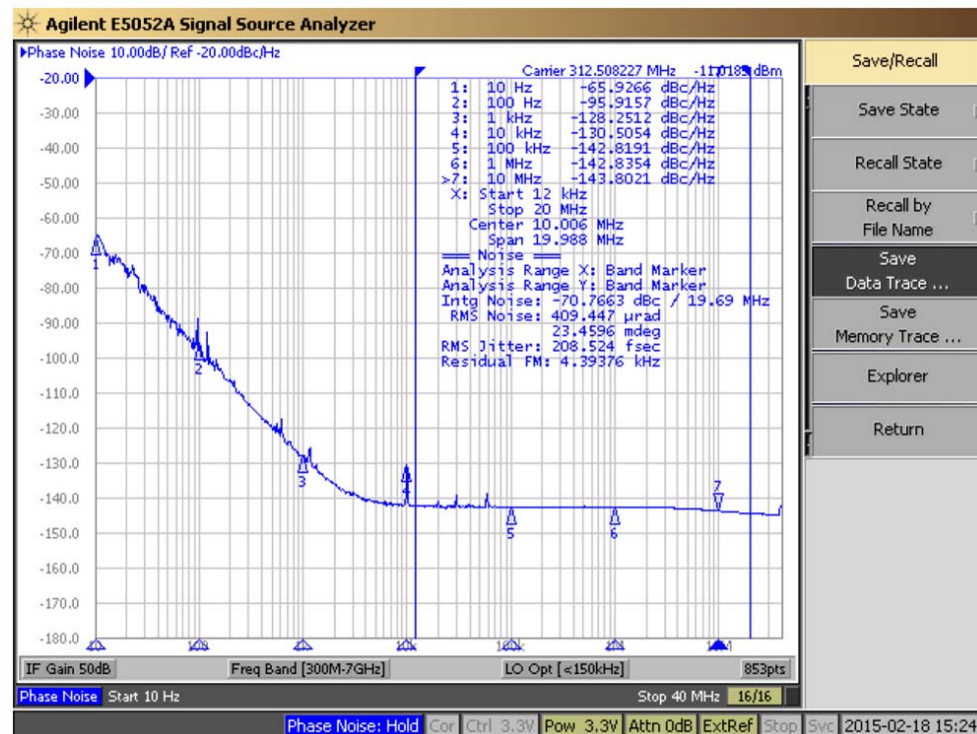


Electrical Specifications

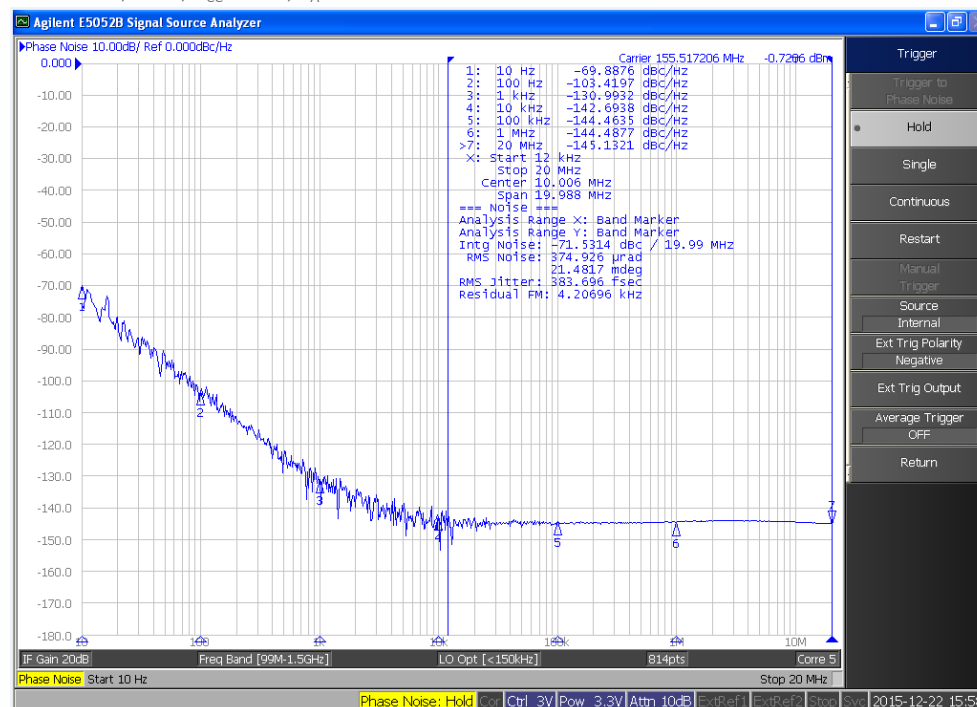
Performance Data

Phase Noise [typical]

312.50MHz, LVPECL, $V_{CC} = 3.3V$, $T_A = +25^{\circ}C$



155.52MHz, LVDS, $V_{CC} = 3.3V$, $T_A = +25^{\circ}C$





Electrical Specifications

Phase Noise Tabulated

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

PARAMETER	SYMBOL	CONDITIONS	TYP	UNIT
LVPECL @ 25.00MHz				
Phase Noise	Single Side Band			
	@ 10Hz		-75.14	
	@ 100Hz		-112.50	
	@ 1kHz		-142.15	
	@ 10kHz		-155.01	dBc/Hz
	@ 100kHz		-159.99	
	@ 1MHz		-161.83	
	@ 5MHz		-161.61	
Phase Jitter, RMS	tjrms	Integration Bandwidth 12kHz - 20MHz	179.24	fs

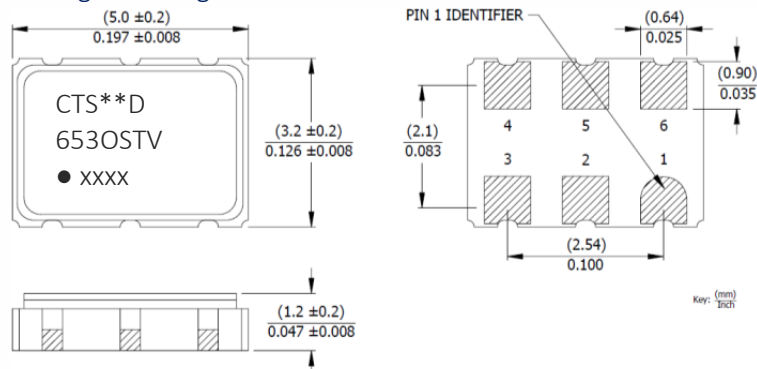
PARAMETER	SYMBOL	CONDITIONS	TYP	UNIT
LVPECL @ 312.20MHz				
Phase Noise	Single Side Band			
	@ 10Hz		-65.93	
	@ 100Hz		-95.92	
	@ 1kHz		-128.25	
	@ 10kHz		-130.51	dBc/Hz
	@ 100kHz		-142.82	
	@ 1MHz		-142.84	
	@ 10MHz		-143.80	
Phase Jitter, RMS	tjrms	Integration Bandwidth 12kHz - 20MHz	208.52	fs

PARAMETER	SYMBOL	CONDITIONS	TYP	UNIT
LVPECL @ 100.00MHz				
Phase Noise	Single Side Band			
	@ 10Hz		-65.65	
	@ 100Hz		-100.19	
	@ 1kHz		-131.02	
	@ 10kHz		-145.49	dBc/Hz
	@ 100kHz		-150.36	
	@ 1MHz		-151.37	
	@ 5MHz		-152.11	
Phase Jitter, RMS	tjrms	Integration Bandwidth 12kHz - 20MHz	132.20	fs

PARAMETER	SYMBOL	CONDITIONS	TYP	UNIT
LVDS @ 155.52MHz				
Phase Noise	Single Side Band			
	@ 10Hz		-69.89	
	@ 100Hz		-103.42	
	@ 1kHz		-130.99	
	@ 10kHz		-142.69	dBc/Hz
	@ 100kHz		-144.46	
	@ 1MHz		-144.49	
	@ 20MHz		-145.13	
Phase Jitter, RMS	tjrms	Integration Bandwidth 12kHz - 20MHz	383.70	fs

Mechanical Specifications

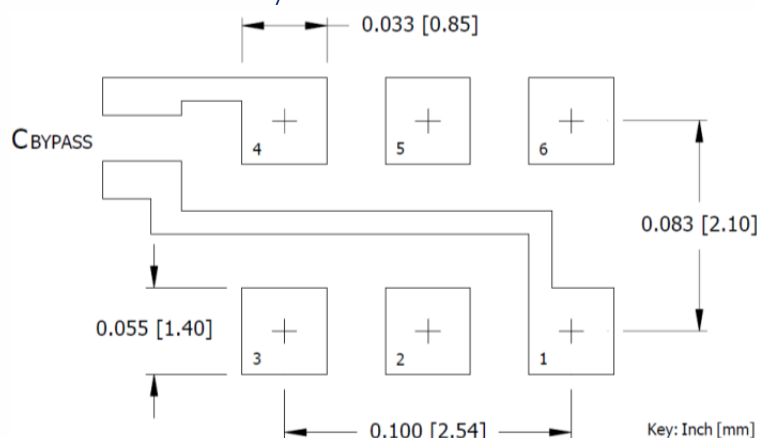
Package Drawing



Marking Information

1. ** - Manufacturing Site Code.
2. D - Date Code. See Table I for codes.
3. O - Output Type; P or E = LVPECL, L or V = LVDS. [Refer to Ordering Information]
4. V - Voltage Code; 3 = 3.3V, 2 = 2.5V.
5. 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

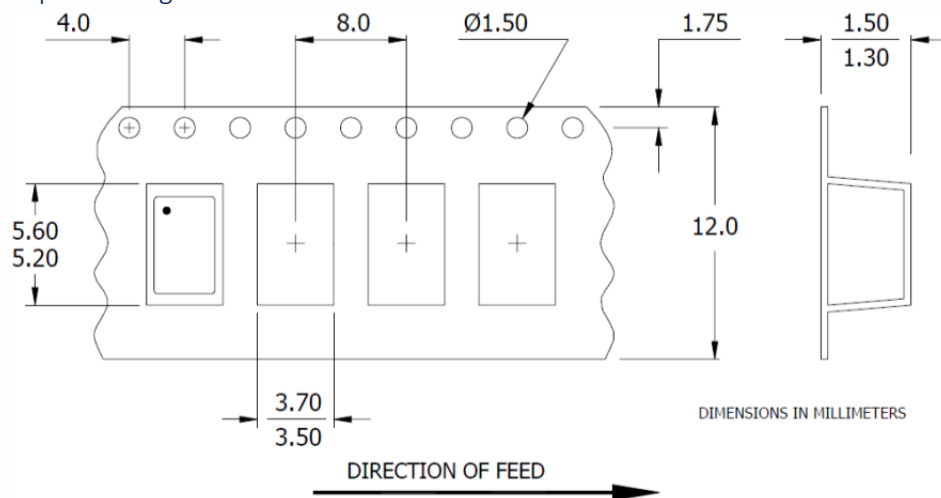
Pin	Symbol	Function
1	EOH or N.C.	Enable [std] or No Connect
2	N.C. or EOH	No Connect or Enable [opt]
3	GND	Circuit & Package Ground
4	Output	RF Output
5	Output	Complimentary RF Output
6	V _{CC}	Supply Voltage

Table I - Date Code

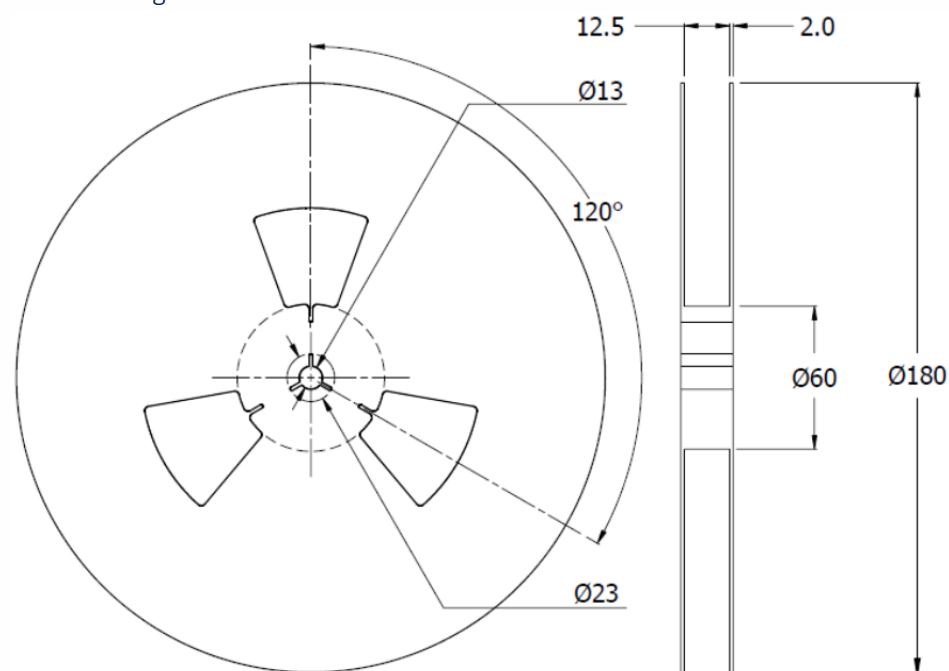
YEAR					MONTH											
2001	2002	2003	2004	2005	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2006	2007	2008	2009	2010	A	B	C	D	E	F	G	H	J	K	L	M
2011	2012	2013	2014	2015	N	P	Q	R	S	T	U	V	W	X	Y	Z
2016	2017	2018	2019	2020	a	b	c	d	e	f	g	h	j	k	l	m
					n	p	q	r	s	t	u	v	w	x	y	z

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.