

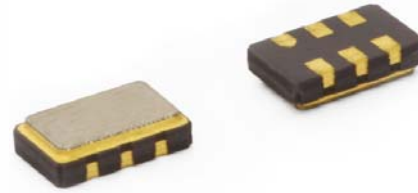


Model 655

Ultra Low Jitter LVPECL or LVDS Clock

Features

- Ceramic Surface Mount Package
- Ultra Low Phase Jitter Performance, 100fs Typical
- Fundamental or 3rd Overtone Crystal Design
- Frequency Range 80 – 170MHz *
- +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, 100fs Maximum

- 125.00MHz	- 156.25MHz
- 155.52MHz	- 161.1328MHz

* Check with factory for availability.

Description

CTS Model 655 is a low cost, high performance clock oscillator supporting differential LVPECL or LVDS outputs. Employing the latest IC technology, M655 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																																										
655	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 Code¹</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	-		80 - 170		MHz
LVDS				80 - 170		
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

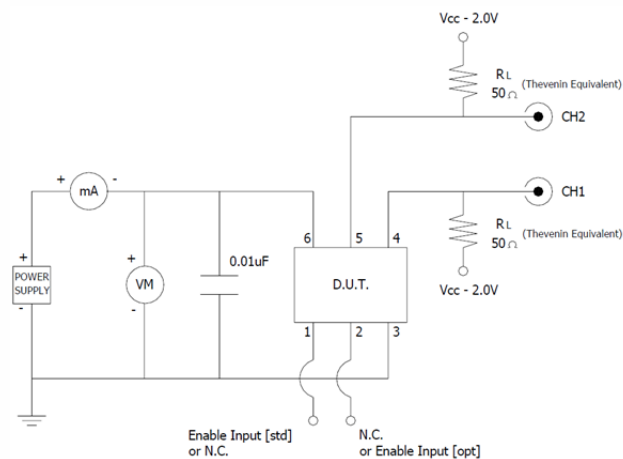
PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Start Up Time	T _S	Application of V _{CC}	-	2	5	ms
Enable Function [Standby]						
Enable Input Voltage	V _{IH}	Pin 1 or 2 Logic '1', Output Enabled	0.7V _{CC}	-	-	V
Disable Input Voltage	V _{IL}	Pin 1 or 2 Logic '0', Output Disabled	-	-	0.3V _{CC}	V
Disable 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	tj _{rms}	80 - 124.9MHz, Bandwidth 12 kHz - 20 MHz	-	-	200	fs
		125 - 170MHz, Bandwidth 12 kHz - 20 MHz	-	-	100	
Period Jitter, pk-pk	pj _{pk-pk}	-	-	2.6	-	ps
Period Jitter, RMS	pj _{rms}	-	-	25	-	ps

Enable Truth Table

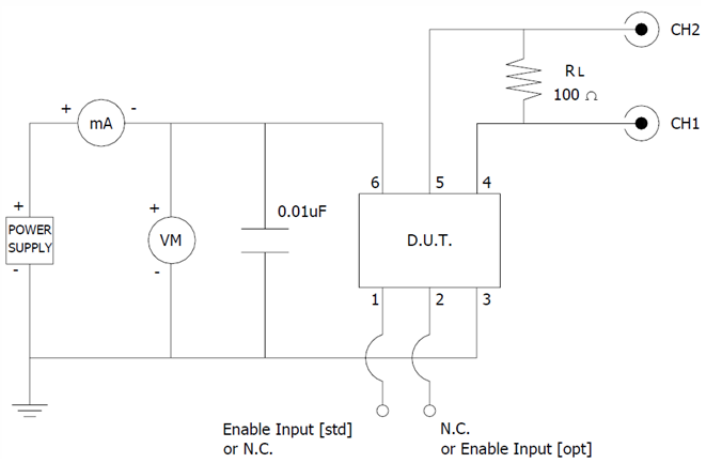
Pin 1 or Pin 2	Pin 4 & Pin 5
Logic '1'	Output
Open	Output
Logic '0'	High Imp.

Test Circuit

LVPECL

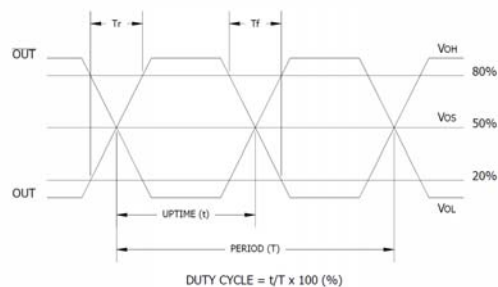


LVDS



Output Waveform

LVPECL or LVDS

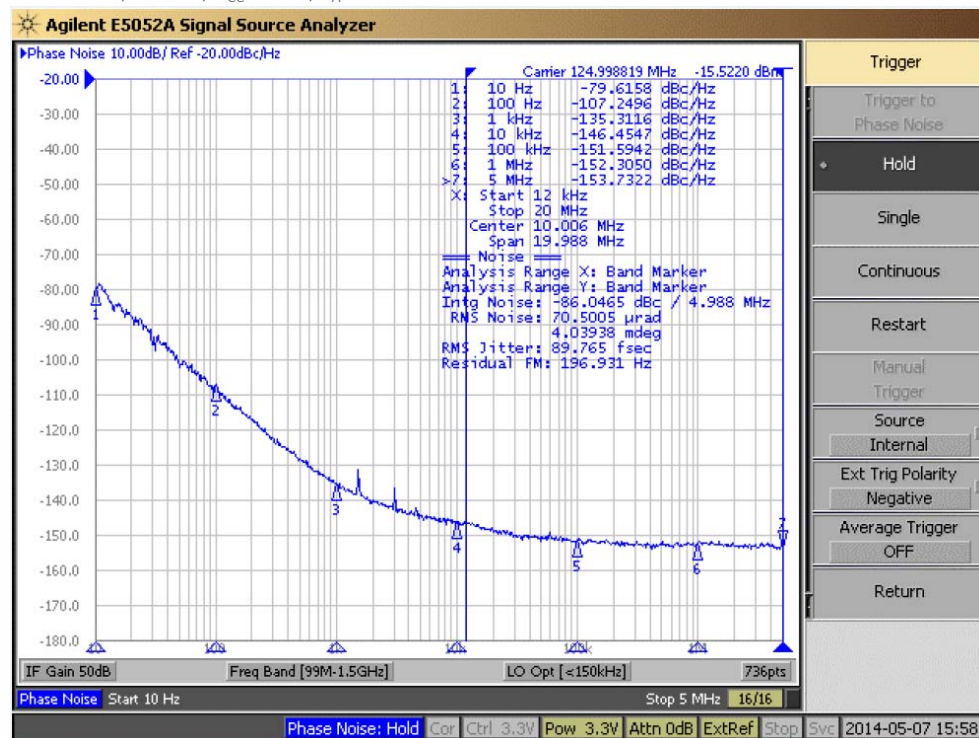


Electrical Specifications

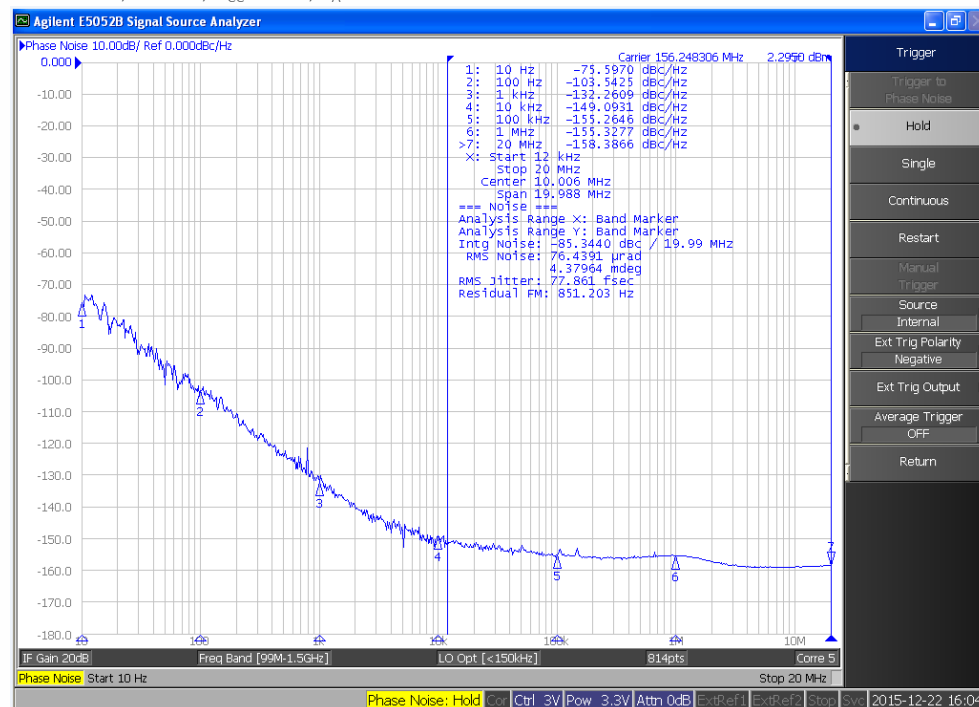
Performance Data

Phase Noise [typical]

125.00MHz, LVPECL, $V_{CC} = 3.3V$, $T_A = +25^\circ C$



156.25MHz, LVPECL, $V_{CC} = 3.3V$, $T_A = +25^\circ C$

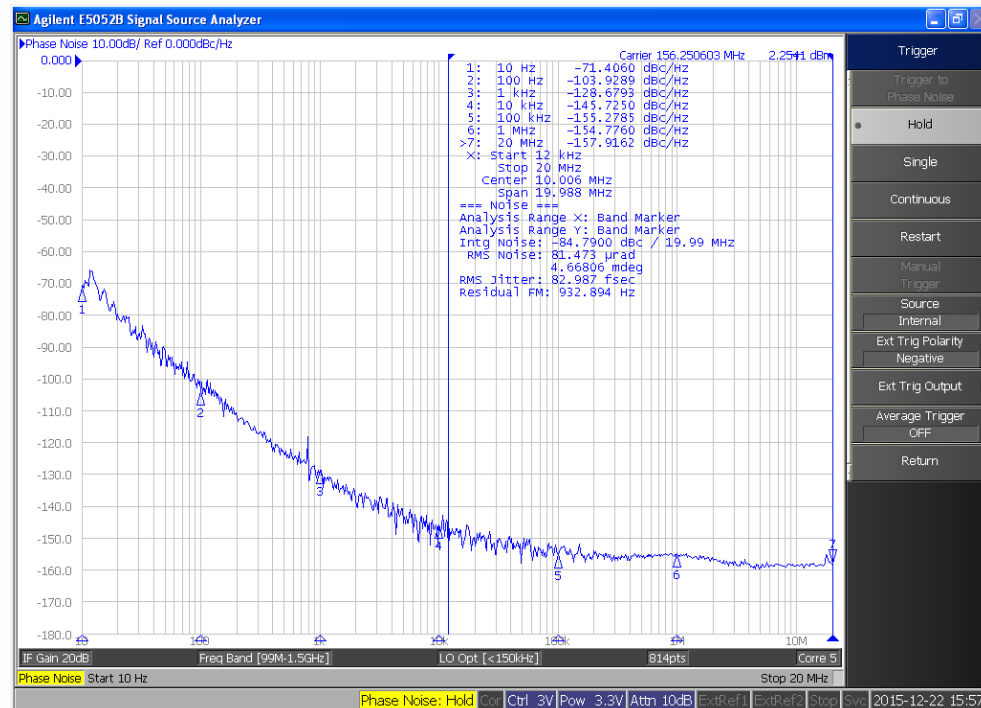


Electrical Specifications

Performance Data

Phase Noise [typical]

156.25MHz, LVDS, $V_{CC} = 3.3V$, $T_A = +25^\circ C$



Phase Noise Tabulated

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

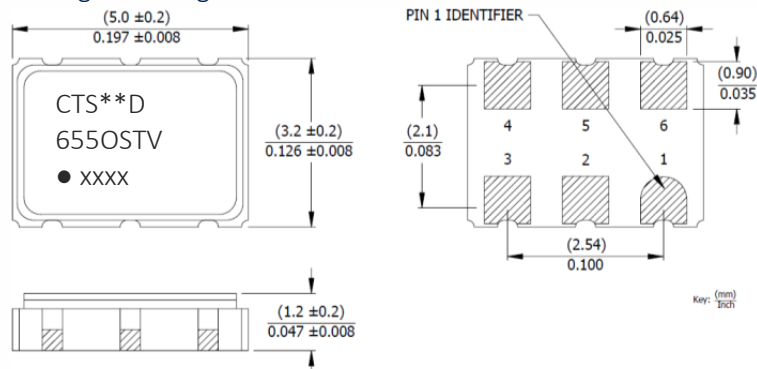
PARAMETER	SYMBOL	CONDITIONS	TYP	UNIT
LVPECL @ 125.00MHz				
Phase Noise	Single Side Band			
	@ 10Hz		-79.62	
	@ 100Hz		-107.25	
	@ 1kHz		-135.31	dBc/Hz
	@ 10kHz		-146.45	
	@ 100kHz		-151.59	
	@ 1MHz		-152.31	
	@ 5MHz		-153.73	
Phase Jitter, RMS	tjrms	Integration Bandwidth 12kHz - 20MHz	89.77	fs

PARAMETER	SYMBOL	CONDITIONS	TYP	UNIT
LVDS @ 156.25MHz				
Phase Noise	Single Side Band			
	@ 10Hz		-71.41	
	@ 100Hz		-103.93	
	@ 1kHz		-128.68	dBc/Hz
	@ 10kHz		-145.73	
	@ 100kHz		-155.28	
	@ 1MHz		-154.78	
	@ 20MHz		-157.92	
Phase Jitter, RMS	tjrms	Integration Bandwidth 12kHz - 20MHz	82.99	fs

PARAMETER	SYMBOL	CONDITIONS	TYP	UNIT
LVPECL @ 156.25MHz				
Phase Noise	Single Side Band			
	@ 10Hz		-75.60	
	@ 100Hz		-103.54	
	@ 1kHz		-132.26	dBc/Hz
	@ 10kHz		-149.09	
	@ 100kHz		-155.26	
	@ 1MHz		-155.33	
	@ 20MHz		-158.39	
Phase Jitter, RMS	tjrms	Integration Bandwidth 12kHz - 20MHz	77.86	fs

Mechanical Specifications

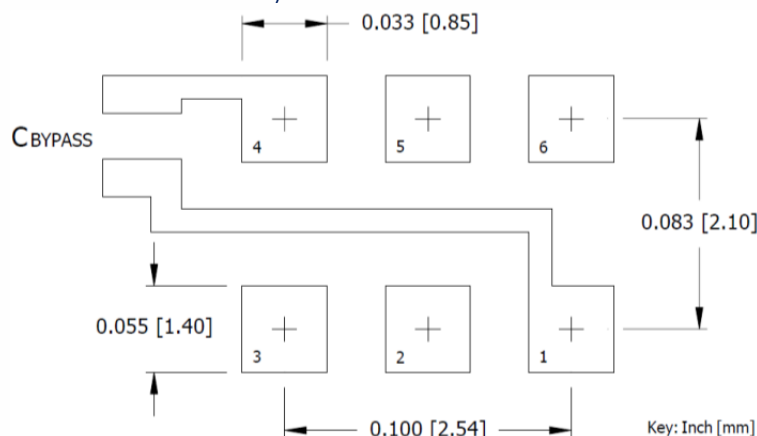
Package Drawing



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.
 3. ST - Frequency Stability/Temperature Code. [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

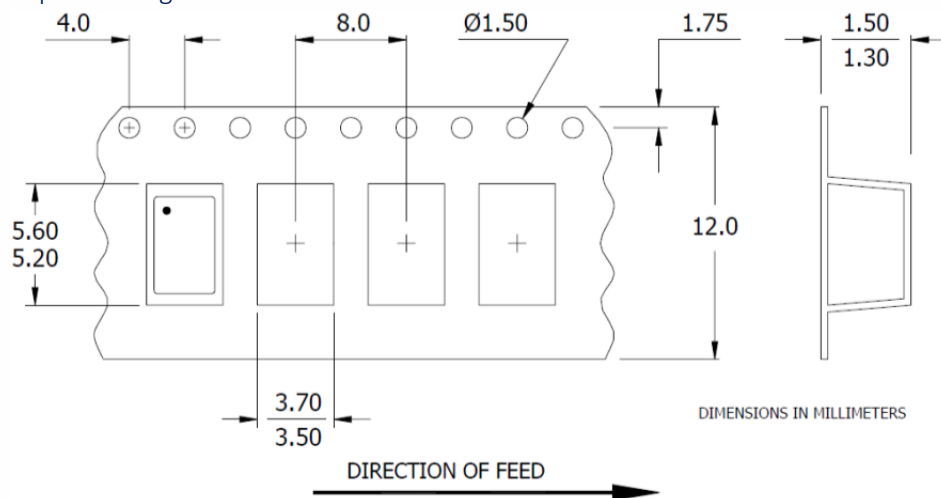
Pin	Symbol	Function
1	EOH or N.C.	Enable [std] or No Connect
2	N.C. or EOH	No Connect or Enable [opt]
3	GND	Circuit & Package Ground
4	Output	RF Output
5	Output	Complimentary RF Output
6	V _{CC}	Supply Voltage

Table I - Date Code

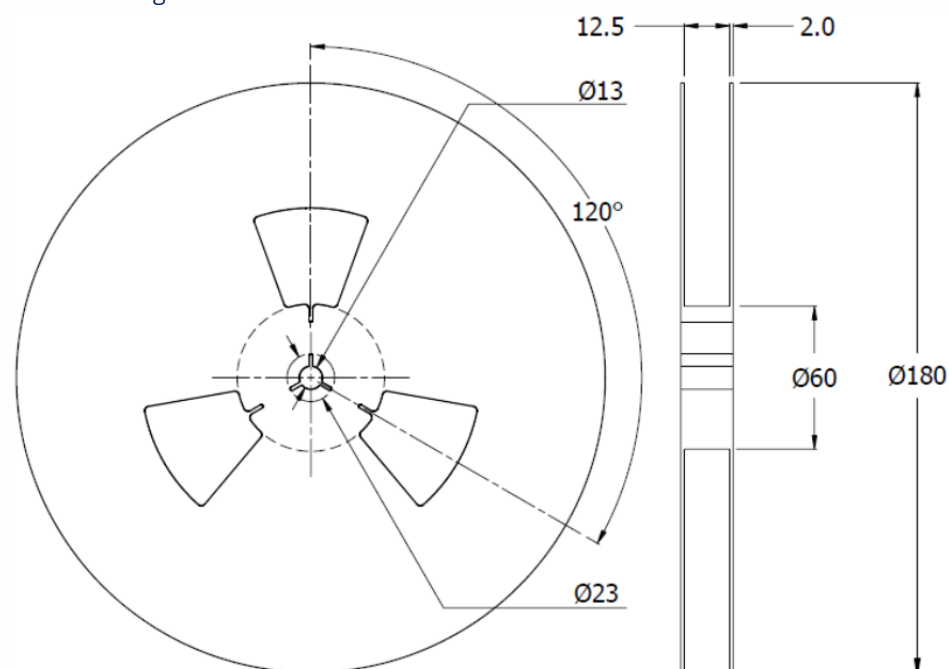
YEAR					MONTH											
2001	2002	2003	2004	2005	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2006	2007	2008	2009	2010	A	B	C	D	E	F	G	H	J	K	L	M
2011	2012	2013	2014	2015	N	P	Q	R	S	T	U	V	W	X	Y	Z
2016	2017	2018	2019	2020	a	b	c	d	e	f	g	h	j	k	l	m
					n	p	q	r	s	t	u	v	w	x	y	z

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.