

Model 633

Very Low Jitter LVPECL or LVDS Clock



Part Dimensions:
3.2 × 2.5 × 1.0mm • 25.00mg

Features

- Ceramic Surface Mount Package
- Very Low Phase Jitter Performance, 500fs Maximum
- Fundamental or 3rd Overtone Crystal Design
- Frequency Range 10 – 220MHz *
- +2.5V or +3.3V Operation [+1.8V LVDS only]
- Output Enable Standard
- Tape and Reel Packaging, EIA-418

Applications

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

Standard Frequencies

| | | |
|--------------|---------------|---------------|
| - 25.00MHz | - 125.00MHz | - 161.1328MHz |
| - 50.00MHz | - 148.3516MHz | - 187.50MHz |
| - 74.1758MHz | - 150.00MHz | - 200.00MHz |
| - 74.25MHz | - 155.52MHz | - 212.50MHz |
| - 100.00MHz | - 156.25MHz | |

* See Page 9 for additional developed frequencies.
Check with factory for availability of frequencies not listed.

Description

CTS Model 633 is a low cost, high performance clock oscillator supporting differential LVPECL or LVDS outputs. Employing the latest IC technology, M633 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 |
|-------|-------------|----------------------|---------------------|-------------------|----------------|-----------|
| 633 | P | XXX or XXXX | 3 | I | 3 | T |

| Code | Output |
|------|-----------------------|
| P | LVPECL - Pin 1 Enable |
| L | LVDS - Pin 1 Enable |
| E | LVPECL - Pin 2 Enable |
| V | LVDS - Pin 2 Enable |

| Code | Stability |
|------|---------------------|
| 6 | ±20ppm ² |
| 5 | ±25ppm |
| 4 | ±30ppm |
| 3 | ±50ppm |
| 2 | ±100ppm |

| Code | Temp. Range |
|------|------------------------------|
| A | -10°C to +60°C |
| C | -20°C to +70°C |
| I | -40°C to +85°C |
| G | -40°C to +105°C ³ |

| Code | Voltage |
|------|----------------------|
| M | +1.8Vdc ⁴ |
| 2 | +2.5Vdc |
| 3 | +3.3Vdc |

| Code | Frequency |
|------|-------------------------------------|
| | Product Frequency Code ¹ |

| Code | Packing |
|------|--------------|
| T | 1k 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] Check factory for availability. Temperature codes A and C only.
- 3] Check factory for availability. Stability codes 2 and 3 only.
- 4] LVDS output only. Consult factory for availability.

**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 | - | 4.0 | V |
| Supply Voltage [Note 1] | V_{CC} | $\pm 5\%$ | 1.710 | 1.8 | 1.890 | V |
| | | | 3.135 | 3.3 | 3.465 | |
| Supply Current | | | | | | |
| LVPECL | I_{CC} | $V_{CC} = +2.5V$ or $+3.3V$ @ Maximum Load | - | 55 | 88 | mA |
| LVDS | | | - | 45 | 66 | |
| LVDS | | | $V_{CC} = +1.8$ @ Maximum Load | - | 7 | |
| Operating Temperature | T_A | - | -20 | | +70 | °C |
| | | | -40 | +25 | +85 | |
| | | | -40 | | +105 | |
| Storage Temperature | T_{STG} | - | -40 | - | +125 | °C |

Frequency Stability

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNIT |
|---------------------------------|-------------------|--------------------------------------|------------------|-----------------------|-----|-----------|
| Frequency Range | | | | | | |
| LVPECL | f_O | $V_{CC} = +2.5V$ or $+3.3V$ | | 10 - 220 | | MHz |
| LVDS | | | 10 - 220 | | | |
| LVDS | | | $V_{CC} = +1.8V$ | 20 - 220 | | |
| Frequency Stability [Note 2] | $\Delta f/f_O$ | - | | 20, 25, 30, 50 or 100 | | \pm ppm |
| Aging | $\Delta f/f_{25}$ | First Year @ +25°C, nominal V_{CC} | -3 | - | 3 | ppm |

1.] LVDS output only for +1.8V option.

2.] 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 $V_{CC} - 2.0V$ | - | 50 | - | Ohms |
| Output Voltage Levels | V_{OH} | PECL Load, -20°C to +70°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°C to +85°C | $V_{CC} - 1.085$ | - | $V_{CC} - 0.880$ | V |
| | V_{OL} | | $V_{CC} - 1.830$ | - | $V_{CC} - 1.555$ | |
| Output Duty Cycle | SYM | @ $V_{CC} - 1.3V$ | 45 | - | 55 | % |
| Rise and Fall Time | T_{R}, T_F | @ 20%/80% Levels, $R_L = 50$ 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} | $R_L = 100$ 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, $R_L = 100$ Ohms | - | 0.4 | 0.7 | ns |

Electrical Specifications

Output Parameters

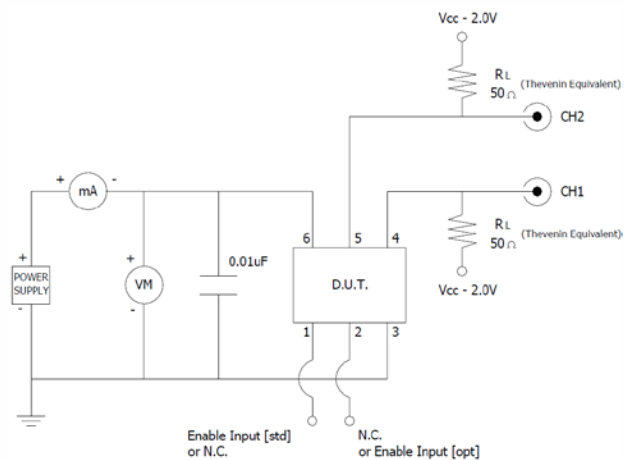
| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNIT |
|----------------------------------|------------|--|-------------|-----|-------------|------|
| Start Up Time | T_S | Application of V_{CC} | - | 2 | 5 | ms |
| Enable Function [Standby] | | | | | | |
| Enable Input Voltage | V_{IH} | Pin 1 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} | 40MHz - 220MHz, Bandwidth 12kHz to 20MHz | - | 300 | 500 | fs |
| | | 10MHz - 39.999MHz, Bandwidth 12kHz to 5MHz | - | 500 | <1 | ps |

Enable Truth Table

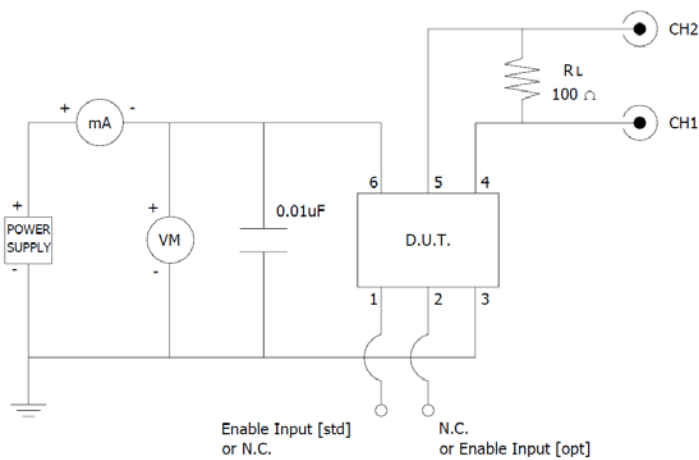
| Pin 1 or Pin 2 | Pin 4 & Pin 5 |
|----------------|---------------|
| Logic '1' | Output |
| Open | Output |
| Logic '0' | High Imp. |

Test Circuit

LVPECL

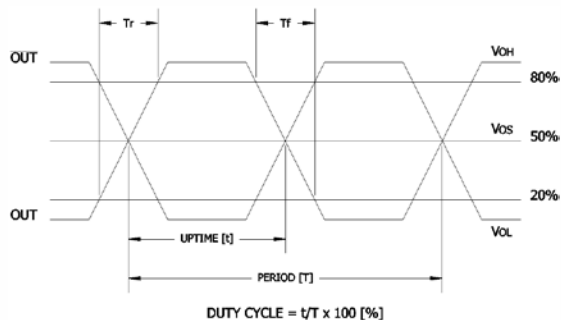


LVDS



Output Waveform

LVPECL or LVDS

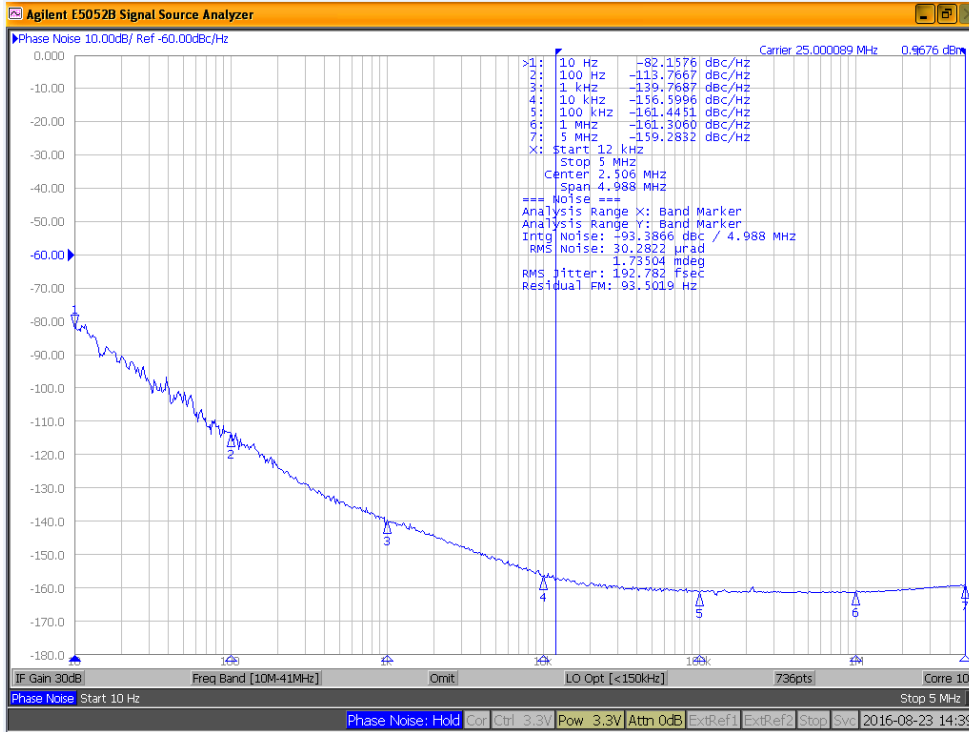


Electrical Specifications

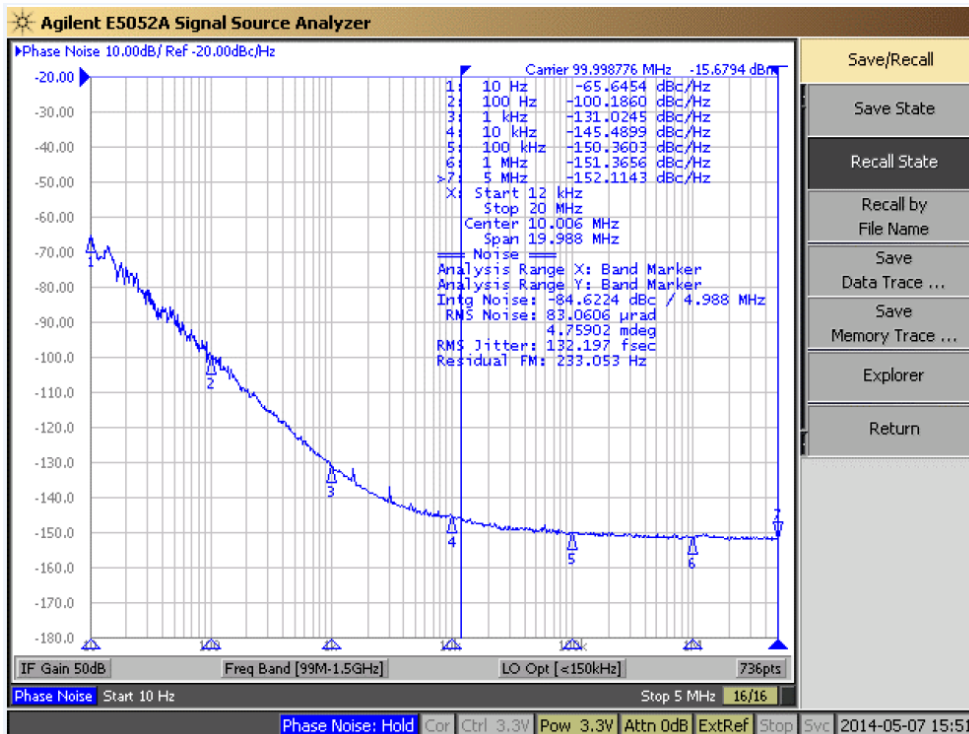
Performance Data

Phase Noise [typical]

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



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

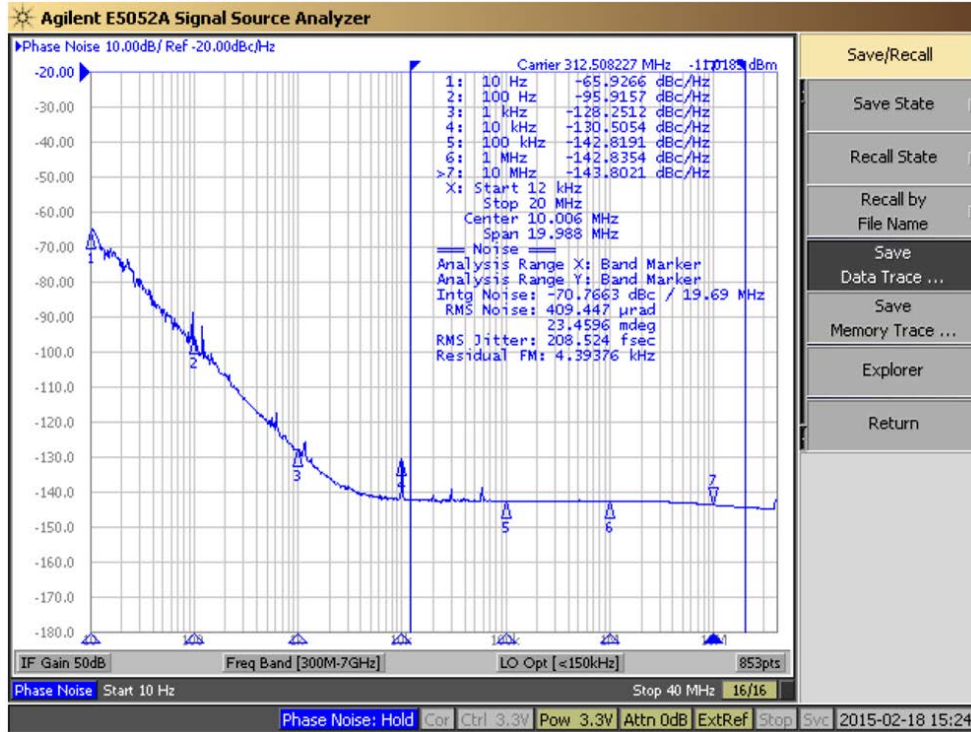


Electrical Specifications

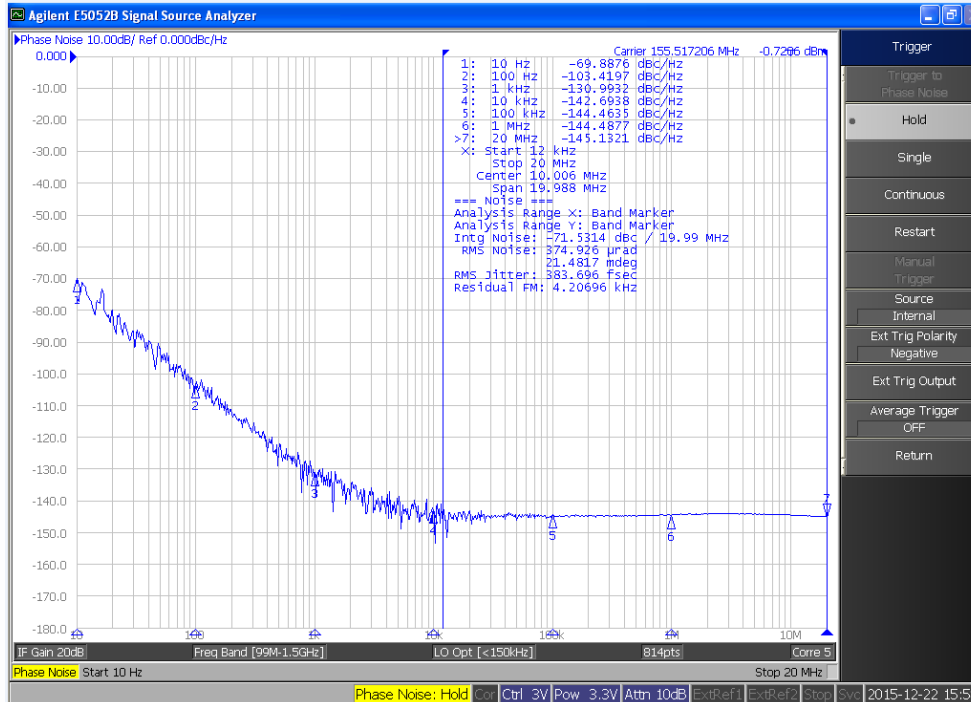
Performance Data

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 | -82.16 | |
| | | @ 100Hz | -113.77 | |
| | | @ 1kHz | -139.77 | |
| | - | @ 10kHz | -156.60 | dBc/Hz |
| | | @ 100kHz | -161.45 | |
| | | @ 1MHz | -161.31 | |
| | @ 5MHz | -159.28 | | |
| Phase Jitter, RMS | tjrms | Integration Bandwidth 12kHz - 20MHz | 192.78 | fs |

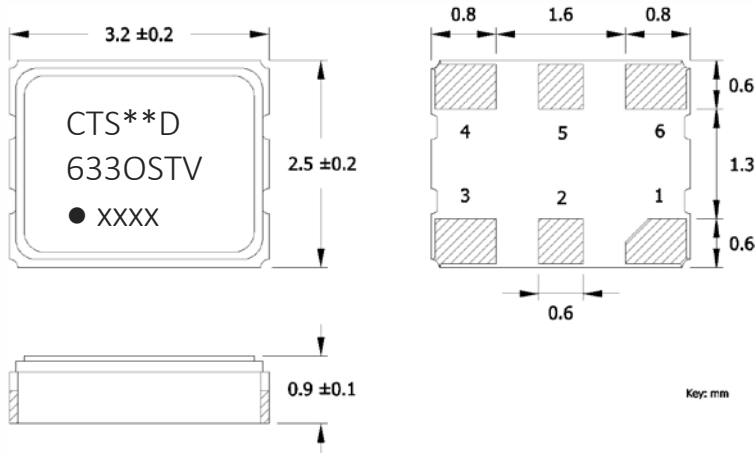
| PARAMETER | SYMBOL | CONDITIONS | TYP | UNIT |
|---------------------------|---------|-------------------------------------|---------|--------|
| LVPECL @ 312.20MHz | | | | |
| Phase Noise | | Single Side Band | | |
| | | @ 10Hz | -65.93 | |
| | | @ 100Hz | -95.92 | |
| | | @ 1kHz | -128.25 | |
| | - | @ 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 |

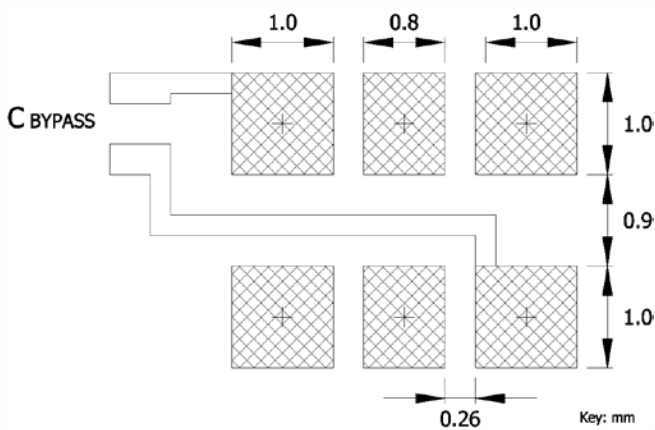
| PARAMETER | SYMBOL | CONDITIONS | TYP | UNIT |
|--------------------------|---------|-------------------------------------|---------|--------|
| LVDS @ 155.52MHz | | | | |
| Phase Noise | | Single Side Band | | |
| | | @ 10Hz | -69.89 | |
| | | @ 100Hz | -103.42 | |
| | | @ 1kHz | -130.99 | |
| | - | @ 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



Recommended Pad Layout



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 | | | | | | | | | | | | | | |
|------|------|-------|------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|---|---|---|
| | | 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 |

Marking Information

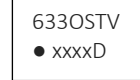
Option 1 [3 lines, 7 characters maximum per line]

- ** - Manufacturing Site Code.
 - D - Date Code. See Table I for codes.
 - O - Output Type; P or E = LVPECL, L or V = LVDS.
 - ST - Frequency Stability/Temperature Code. [Refer to Ordering Information]
 - V - Voltage Code; 3 = 3.3V, 2 = 2.5V.
 - xxxx - Frequency Code.
3-digits, frequencies below 100MHz
4-digits, frequencies 100MHz or greater
- [See document 016-1454-0, Frequency Code Tables.]



Option 2 [2 lines, 7 characters maximum per line]

- O - Output Type; P or E = LVPECL, L or V = LVDS.
 - ST - Frequency Stability/Temperature Code. [Refer to Ordering Information]
 - V - Voltage Code; 3 = 3.3V, 2 = 2.5V.
 - xxxx - Frequency Code.
3-digits, frequencies below 100MHz
4-digits, frequencies 100MHz or greater
- [See document 016-1454-0, Frequency Code Tables.]
- D - Date Code. See Table I for codes.
- [Note: Manufacturing site code must appear on reel and carton labels.]

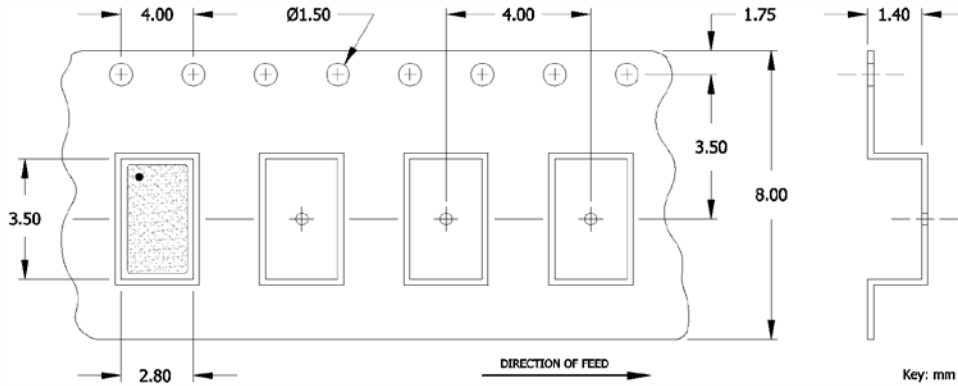


Notes

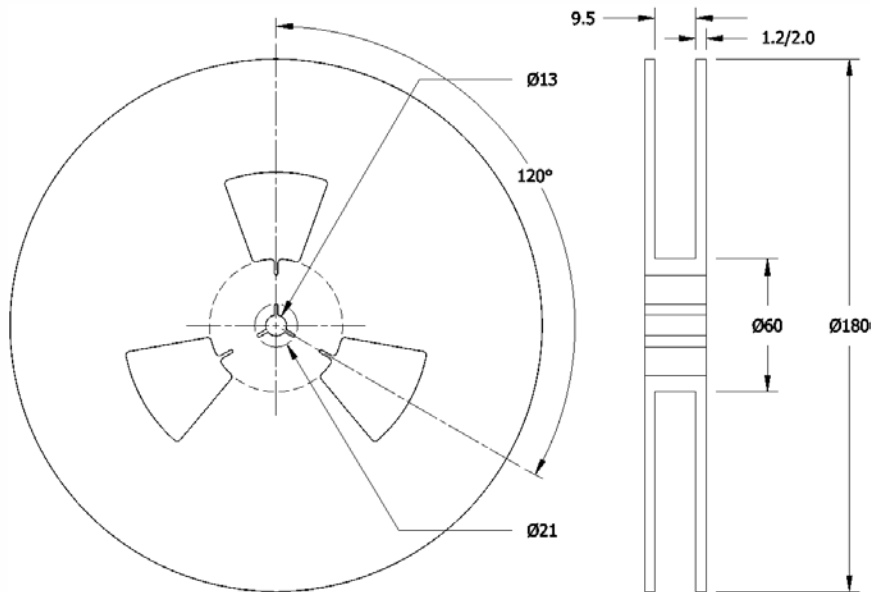
- JEDEC termination code (e4). Barrier-plating is nickel [Ni] with gold [Au] flash plate.
- Reflow conditions per JEDEC J-STD-020; +260°C maximum, 20 seconds.
- MSL = 1.

Packaging - Tape and Reel

Tape Drawing



Reel Drawing



Notes

1. Device quantity is 1k pieces minimum or 3k pieces maximum 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 |
|------------|----------------|------------|----------------|-----------|----------------|-----------|----------------|
| 10.000000 | 100 | 153.600000 | 1536 | | | | |
| 19.440000 | 194 | 156.253906 | 156A | | | | |
| 27.000000 | 270 | 167.372800 | 167A | | | | |
| 40.000000 | 400 | 173.370800 | 1733 | | | | |
| 44.736000 | 447 | 175.000000 | 1750 | | | | |
| 80.000000 | 800 | 178.500000 | 1785 | | | | |
| 120.000000 | 1200 | 180.000000 | 1800 | | | | |
| 133.000000 | 1330 | 184.320000 | 1843 | | | | |
| 148.351600 | 148A | | | | | | |
| 148.500000 | 1485 | | | | | | |

Frequency Codes for Cover Page Table – MHz

| FREQUENCY | FREQUENCY CODE | FREQUENCY | FREQUENCY CODE | FREQUENCY | FREQUENCY CODE | FREQUENCY | FREQUENCY CODE |
|-----------|----------------|------------|----------------|------------|----------------|------------|----------------|
| 25.000000 | 250 | 100.000000 | 1000 | 156.250000 | 1562 | 212.500000 | 2125 |
| 50.000000 | 500 | 125.000000 | 1250 | 161.132800 | 1611 | | |
| 74.175800 | 74A | 150.000000 | 1500 | 187.500000 | 1875 | | |
| 74.250000 | 742 | 155.520000 | 1555 | 200.000000 | 2000 | | |

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