

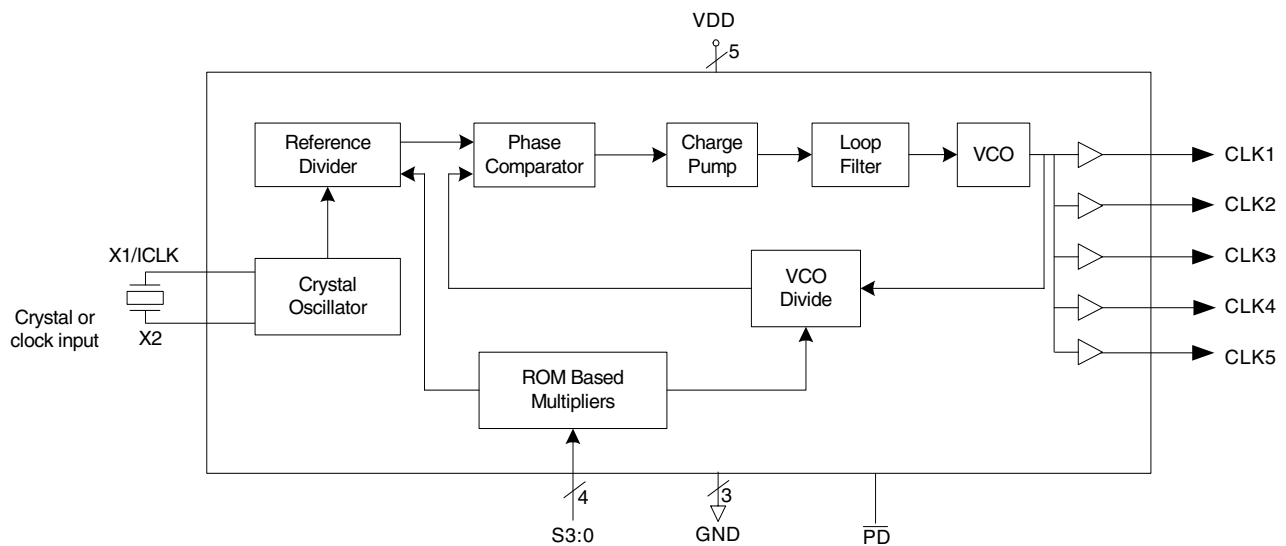
## Description

The ICS601-25 is a low-cost, low phase noise, high performance clock synthesizer for applications which require low phase noise, low jitter, and low skew fanout. It is IDT's lowest phase noise multiplier, and also the lowest CMOS part in the industry. Using IDT's patented analog and digital Phase Locked Loop (PLL) techniques, the chip accepts a 10-27 MHz crystal or clock input, and produces output clocks up to 156 MHz.

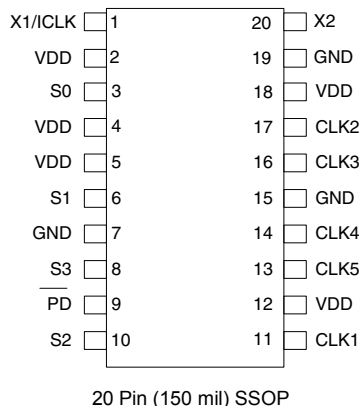
## Features

- Packaged in 20-pin SSOP
- Uses fundamental 10 - 27 MHz crystal or clock
- Output clocks up to 156 MHz
- Low phase noise: -132 dBc/Hz at 10 kHz
- Five low skew (<250 ps) outputs
- Low jitter - 18 ps one sigma at 125 MHz
- Full swing CMOS outputs with 25 mA drive capability at TTL levels
- Powerdown mode lowers power consumption
- Advanced, low power, sub-micron CMOS process
- Industrial temperature version available
- Pb (lead) free package
- Operating voltage of 3.3 V

## Block Diagram



## Pin Assignment



## Output Select Table

| S3 | S2 | S1 | S0 | Multiplier       |
|----|----|----|----|------------------|
| 0  | 0  | 0  | 0  | x1               |
| 0  | 0  | 0  | 1  | x2               |
| 0  | 0  | 1  | 0  | x3               |
| 0  | 0  | 1  | 1  | x4               |
| 0  | 1  | 0  | 0  | x5               |
| 0  | 1  | 0  | 1  | x6               |
| 0  | 1  | 1  | 0  | x8               |
| 0  | 1  | 1  | 1  | x16              |
| 1  | 0  | 0  | 0  | x7               |
| 1  | 0  | 0  | 1  | x9               |
| 1  | 0  | 1  | 0  | x10              |
| 1  | 0  | 1  | 1  | x11              |
| 1  | 1  | 0  | 0  | x12              |
| 1  | 1  | 0  | 1  | output tristates |
| 1  | 1  | 1  | 0  | x14              |
| 1  | 1  | 1  | 1  | x15              |

## Pin Descriptions

| Pin Number | Pin Name               | Pin Type | Pin Description  |
|------------|------------------------|----------|--|
| 1          | X1/ICLK                | XI       | Crystal or clock input. Connect to a 10-27 MHz fundamental parallel mode crystal or clock input.                   |
| 2          | VDD                    | Power    | Connect to +3.3 V.   |
| 3          | S0                     | Input    | Select pin 0. Internal pull-up.  |
| 4, 5       | VDD                    | Power    | Connect to +3.3 V.   |
| 6          | S1                     | Input    | Select pin 1. Internal pull-up.  |
| 7          | GND                    | Power    | Connect to ground.   |
| 8          | S3                     | Input    | Select pin 3. Internal pull-down.  |
| 9          | $\overline{\text{PD}}$ | Input    | Powerdown when held low. Internal pull-up.   |
| 10         | S2                     | Input    | Select pin 2. Internal pull-up.  |
| 11         | CLK1                   | Output   | Clock output.  |
| 12         | VDD                    | Power    | Connect to +3.3 V.   |
| 13         | CLK5                   | Output   | Clock output.  |
| 14         | CLK4                   | Output   | Clock output.  |
| 15         | GND                    | Power    | Connect to ground.   |
| 16         | CLK3                   | Output   | Clock output.  |
| 17         | CLK2                   | Output   | Clock output.  |
| 18         | VDD                    | Power    | Connect to +3.3 V.   |
| 19         | GND                    | Power    | Connect to ground.   |
| 20         | X2                     | XO       | Crystal connection. Connect to a 10-27 MHz fundamental parallel mode crystal or leave unconnected for clock input. |

## External Components

The ICS601-25 requires a minimum number of external components for proper operation. Decoupling capacitors of 0.01  $\mu\text{F}$  and 0.1  $\mu\text{F}$  should be connected between VDD and GND, as close to the part as possible. A 33 $\Omega$  series terminating resistor should be used on each clock output. The crystal must be connected as close to the chip as possible. The crystal should be fundamental mode, parallel resonant. Do not use third overtone. For exact tuning when using a crystal, capacitors should be connected from pins X1 to ground and X2 to ground. In general, the value of these capacitors is given by the following equation, where CL is the crystal load capacitance: Crystal caps (pF) = (CL-5) x 2. So for a crystal with 16 pF load capacitance, two 22 pF caps can be used. For any given board layout, ICS can measure the board capacitance and recommend the exact capacitance value to use.

## Absolute Maximum Ratings

Stresses above the ratings listed below can cause permanent damage to the ICS601-25. These ratings, which are standard values for IDT commercially rated parts, are stress ratings only. Functional operation of the device at these or any other conditions above those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods can affect product reliability. Electrical parameters are guaranteed only over the recommended operating temperature range.

| Item  | Rating              |
|---|---------------------|
| Supply Voltage, VDD                               | 7 V                 |
| All Inputs and Outputs                            | -0.5 V to VDD+0.5 V |
| Ambient Operating Temperature, Commercial version | 0 to +70 °C         |
| Ambient Operating Temperature, Industrial version | -40 to +85 °C       |
| Storage Temperature                               | -65 to +150 °C      |
| Junction Temperature                              | 125 °C              |
| Soldering Temperature                             | 260 °C              |

## Recommended Operation Conditions

| Parameter   | Min.  | Typ. | Max.  | Units |
|---|-------|------|-------|-------|
| Ambient Operating Temperature (commercial)        | 0     |      | +70   | °C    |
| Ambient Operating Temperature (industrial)        | -40   |      | +85   | °C    |
| Power Supply Voltage (measured in respect to GND) | +2.97 |      | +3.63 | V     |

## DC Electrical Characteristics

VDD=3.3 V  $\pm$ 10%, Ambient temperature -40 to +85°C

| Parameter          | Symbol          | Conditions       | Min.    | Typ. | Max.    | Units |
|--------------------|-----------------|------------------|---------|------|---------|-------|
| Operating Voltage  | VDD             |                  | 2.97    |      | 3.63    | V     |
| Input High Voltage | V <sub>IH</sub> | X1/ICLK pin only | VDD/2+1 |      |         | V     |
| Input Low Voltage  | V <sub>IL</sub> | X1/ICLK pin only |         |      | VDD/2-1 | V     |

## DC Electrical Characteristics (continued)

| Parameter                       | Symbol    | Conditions                       | Min.     | Typ.     | Max. | Units      |
|---------------------------------|-----------|----------------------------------|----------|----------|------|------------|
| Input High Voltage              | $V_{IH}$  |                                  | 2        |          | VDD  | V          |
| Input Low Voltage               | $V_{IL}$  |                                  |          |          | 0.8  | V          |
| Output High Voltage, CMOS level | $V_{OH}$  | $I_{OH} = -4$ mA                 | VDD-0.4  |          |      | V          |
| Output High Voltage             | $V_{OH}$  | $I_{OL} = -12$ mA                | 2.4      |          |      | V          |
| Output Low Voltage              | $V_{OL}$  | $I_{OL} = 12$ mA                 |          |          | 0.4  | V          |
| Operating Supply Current        | IDD       | No load, 125 MHz                 |          | 45       | 60   | mA         |
| Short Circuit Current           | $I_{OS}$  | Each output                      | $\pm 40$ | $\pm 60$ |      | mA         |
| Input Capacitance               |           | Select pins                      |          | 5        |      | pF         |
| Output Impedance                | $Z_{OUT}$ |                                  |          | 20       |      | $\Omega$   |
| On Chip Pull-up Resistor        | $R_{PU}$  | S2, S1, S0, $\overline{PD}$ pins |          | 510      |      | k $\Omega$ |
| On Chip Pull-down Resistor      | $R_{PD}$  | S3 pin                           |          | 240      |      | k $\Omega$ |

## AC Electrical Characteristics

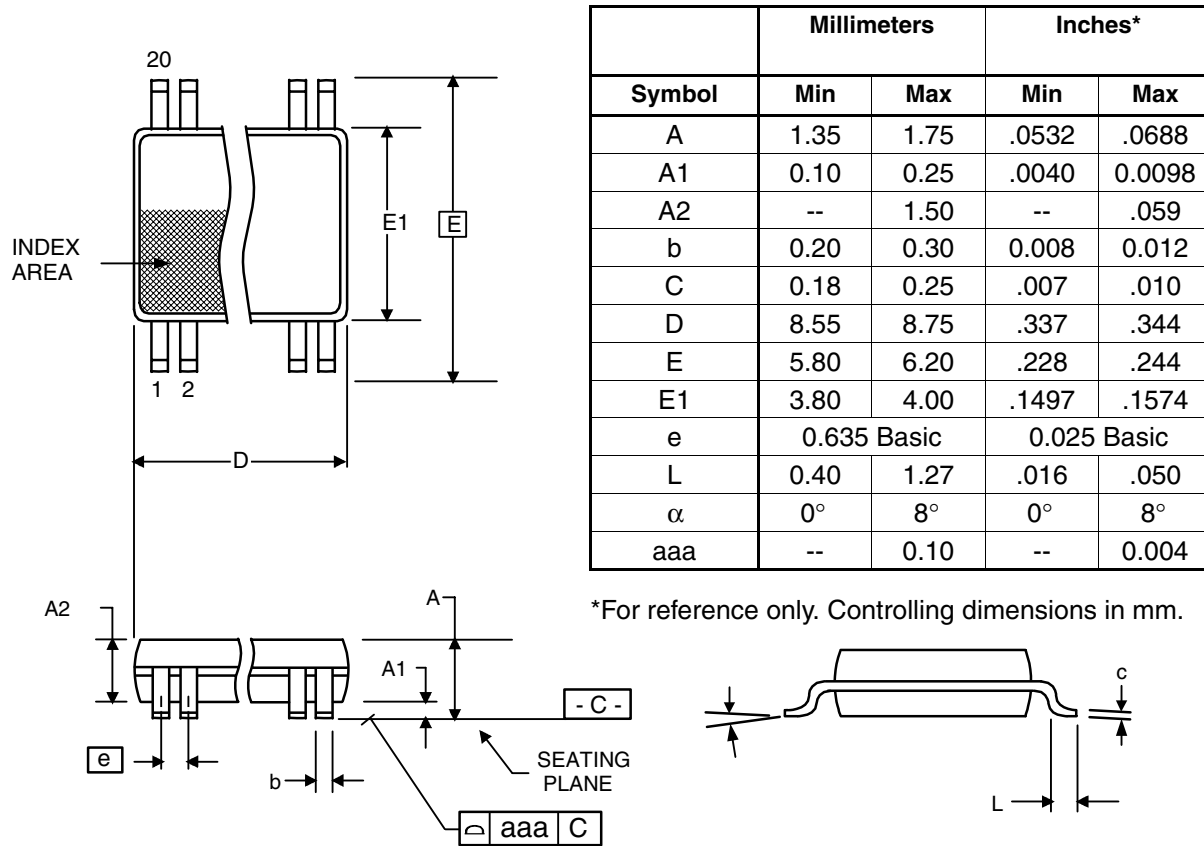
VDD = 3.3V  $\pm 10\%$ , Ambient Temperature -40 to +85° C

| Parameter                                      | Symbol   | Conditions               | Min. | Typ.     | Max.     | Units  |
|--|----------|--------------------------|------|----------|----------|--------|
| Input Frequency                                |          |                          | 10   |          | 27       | MHz    |
| Output Frequency                               |          | At 3.3V                  |      |          | 156      | MHz    |
| Output Rise Time                               | $t_{OR}$ | 0.8 to 2.0 V, Note 1     |      |          | 1.5      | ns     |
| Output Fall Time                               | $t_{OF}$ | 0.8 to 2.0 V, Note 1     |      |          | 1.5      | ns     |
| Output Clock Duty Cycle                        |          | At VDD/2, Note 1         | 45   | 50       | 55       | %      |
| Maximum Absolute jitter, short term, 125 MHz   |          | Note 1                   |      | $\pm 50$ | $\pm 75$ | ps     |
| Maximum jitter, one sigma, 125 MHz (x5)        |          | Note 1                   |      | 18       | 25       | ps     |
| Phase Noise, relative to carrier, 125 MHz (x5) |          | 100 Hz offset            | -90  | -95      |          | dBc/Hz |
| Phase Noise, relative to carrier, 125 MHz (x5) |          | 1 kHz                    | -115 | -120     |          | dBc/Hz |
| Phase Noise, relative to carrier, 125 MHz (x5) |          | 10 kHz offset            | -118 | -123     |          | dBc/Hz |
| Phase Noise, relative to carrier, 125 MHz (x5) |          | 100 kHz offset           | -115 | -120     |          | dBc/Hz |
| Output to Output Skew                          |          | 25M in, 125M out, Note 1 |      |          | 250      | ps     |

Note 1: Measured with 15 pF load

## Package Outline and Package Dimensions (20-pin SSOP, 150 Mil. Narrow Body)

Package dimensions are kept current with JEDEC Publication No. 95



## Ordering Information

| Part / Order Number | Marking    | Shipping Packaging | Package     | Temperature  |
|---------------------|------------|--------------------|-------------|--------------|
| 601R-25LF           | 601R-25LF  | Tubes              | 20-pin SSOP | 0 to +70° C  |
| 601R-25LFT          | 601R-25LF  | Tape and Reel      | 20-pin SSOP | 0 to +70° C  |
| 601R-25ILF          | 601R-25ILF | Tubes              | 20-pin SSOP | -40 to 85° C |
| 601R-25ILFT         | 601R-25ILF | Tape and Reel      | 20-pin SSOP | -40 to 85° C |

"LF" suffix to the part number are the Pb-Free configuration and are RoHS compliant.

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