XR81101

# Universal Clock - High Frequency LVCMOS Clock Synthesizer

A New Direction in Mixed-Signal

## General Description

The XR81101-AA02 is a clock synthesizer operating at a 3.3V/2.5V supply with Integer divider, using a 25MHz parallel resonant crystal reference input provides a 125MHz LVCMOS output. The device is optimized for use with a 25MHz crystal (or system clock) and generates a 125MHz output clock for GE applications. The LVCMOS output has very low phase noise jitter of sub 150fs, while consuming extremely low power.

The application diagram below shows a typical synthesizer configuration with any standard crystal oscillating in fundamental mode. Internal load capacitors are optionally available to minimize/eliminate external crystal loads. A system clock can also be used to overdrive the oscillator for a synchronous timing system.

The typical phase noise plot below shows the jitter integrated over the 1.875MHz to 20MHz range that is widely used in WAN systems. These clock devices show a very good high frequency noise floor below -150dB.

The XR81101 is a family of Universal Clock synthesizer devices in TSSOP-8 packages. The devices generate ANY frequency in the range of 10MHz to 200MHz by utilizing a highly flexible delta sigma modulator and a wide ranging VCO. These devices can be used with standard crystals or external system clock to support a wide variety of applications. This family of products has an extremely low power PLL block with core power consumption 40% less than the equivalent devices from competition. By second sourcing several of the existing sockets, these devices provides a very compelling power efficiency value benefit across all market segments.

Other clock multiplier and/or driver configurations are possible in this clock family and can be requested from the factory

### FEATURES

- XR81101-AA02: Factory configured
- One LVCMOS output
- Crystal oscillator interface which can also be overdriven using a single-ended reference clock
- Output frequency: 125MHz
- Crystal/input frequency: 25MHz, parallel resonant crystal
- RMS phase jitter @ 125MHz, 1.875MHz - 20MHz: < 150fs
- Full 3.3V or 2.5V operating supply
- -40°C to 85°C ambient operating temperature
- Lead-free (RoHS 6) package

### APPLICATIONS

- Gigabit Ethernet
- Low-jitter Clock Generation
- Synchronized clock systems

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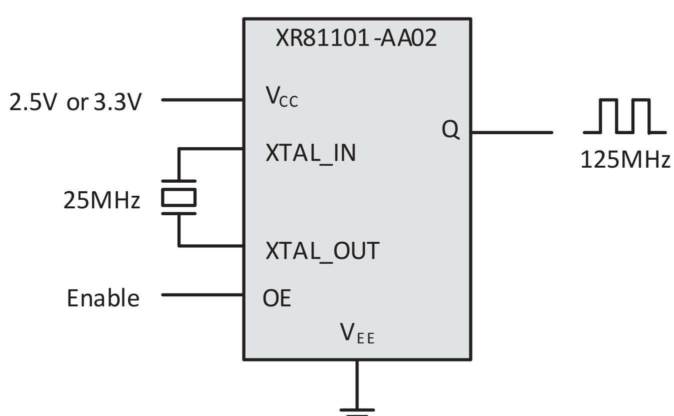
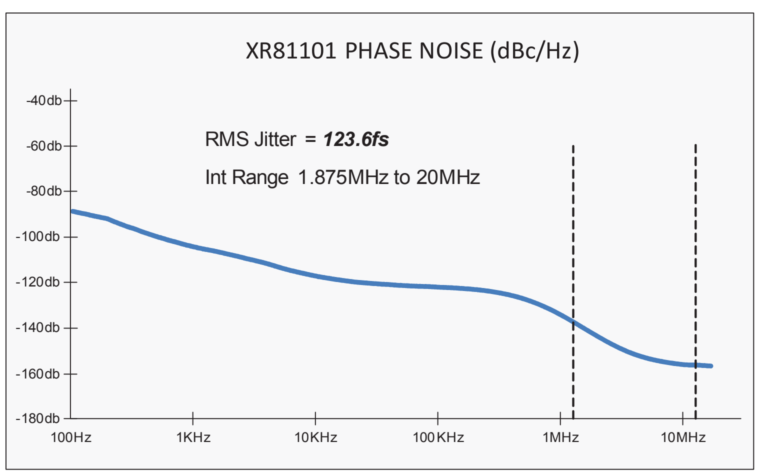
## Typical Application



## Absolute Maximum Ratings

Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to any Maximum Rating condition for extended periods may affect device reliability and lifetime.

Supply Voltage..........................................................+4.2V

Input Voltage......................................-0.5V to VCC + 0.5V

Output Voltage...................................-0.5V to VCC + 0.5V

Reference Frequency/Input Crystal.........10MHz to 60MHz

Storage Temperature................................-55°C to +125°C

Lead Temperature (Soldering, 10 sec).....................300°C

ESD Rating (HBM - Human Body Model)....................2kV

## Operating Conditions

Operating Temperature Range.....................-40°C to +85°C

## Electrical Characteristics

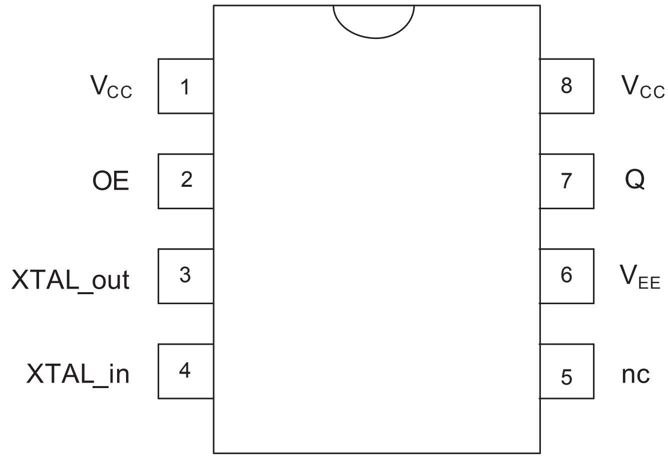
Unless otherwise noted: $T_A$ = -40°C to +85°C, $V_{CC}$ = 3.3V±5% or 2.5V±5%, $V_{EE}$ = 0V

| Symbol | Parameter | Conditions | * | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|---|
| 3.3V Power Supply DC Characteristics | | | | | | | |
| $V_{CC}$ | Power Supply Voltage | | • | 3.135 | 3.3 | 3.465 | V |
| $I_{EE}$ | Power Supply Current | 125MHz with output unloaded. | | | 24 | | mA |
| 2.5V Power Supply DC Characteristics | | | | | | | |
| $V_{CC}$ | Power Supply Voltage | | • | 2.375 | 2.5 | 2.625 | V |
| $I_{EE}$ | Power Supply Current | 125MHz with the output unloaded. | | | 21 | | mA |
| LVCMOS/LVTTL DC Characteristics | | | | | | | |

| Symbol | Parameter | Conditions | * | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|---|
| $V_{IH}$ | Input High Voltage | $V_{CC}$ = 3.465V | • | 2.42 | | $V_{CC}$ + 0.3 | V |
| | | $V_{CC}$ = 2.625V | • | 1.83 | | $V_{CC}$ + 0.3 | V |
| $V_{IL}$ | Input Low Voltage | $V_{CC}$ = 3.465V | • | -0.3 | | 1.03 | V |
| | | $V_{CC}$ = 2.625V | • | -0.3 | | 0.785 | V |
| $I_{IH}$ | Input High Current (OE, FSEL[1:0]) | $V_{IN}$ = $V_{CC}$ = 3.465V or 2.625V | • | | | 15 | µA |
| $I_{IL}$ | Input Low Current (OE, FSEL[1:0]) | $V_{IN}$ = 0V, $V_{CC}$ = 3.465V or 2.625V | • | -10 | | | µA |
| LVCMOS DC Characteristics | | | | | | | |
| $V_{OH}$ | Output High Voltage | Output unloaded | • | 0.8 x $V_{CC}$ | | | V |
| $V_{OL}$ | Output Low Voltage | Output unloaded | • | | | 0.1 x $V_{CC}$ | V |
| Crystal Characteristics | | | | | | | |
| $X_{Mode}$ | Mode of Oscillations | | | Fundamental | | | |
| $X_f$ | Frequency | | | | 25 | | MHz |
| ESR | Equivalent Series Resistance | | | | | 50 | Ω |
| $C_S$ | Shunt Capacitance | | | | | 7 | pF |
| AC Characteristics | | | | | | | |
| $f_{OUT}$ | Output Frequency | | | | 125 | | MHz |
| $t_{jit}(\phi)$ | RMS Phase Jitter | 125MHz (Int. Range 1.875MHz-20MHz) | | | 0.15 | | pS |
| $t_{jit}(cc)$ | Cycle-to-Cycle Jitter | Using 25MHz, 18pF resonant crystal | • | | | 10 | pS |
| $t_R/t_F$ | Output Rise/Fall Time | 20% to 80% | • | 100 | | 550 | pS |
| Odc | Output Duty Cycle | | • | 48 | | 52 | % |

* Limits applying over the full operating temperature range are denoted by a "•".

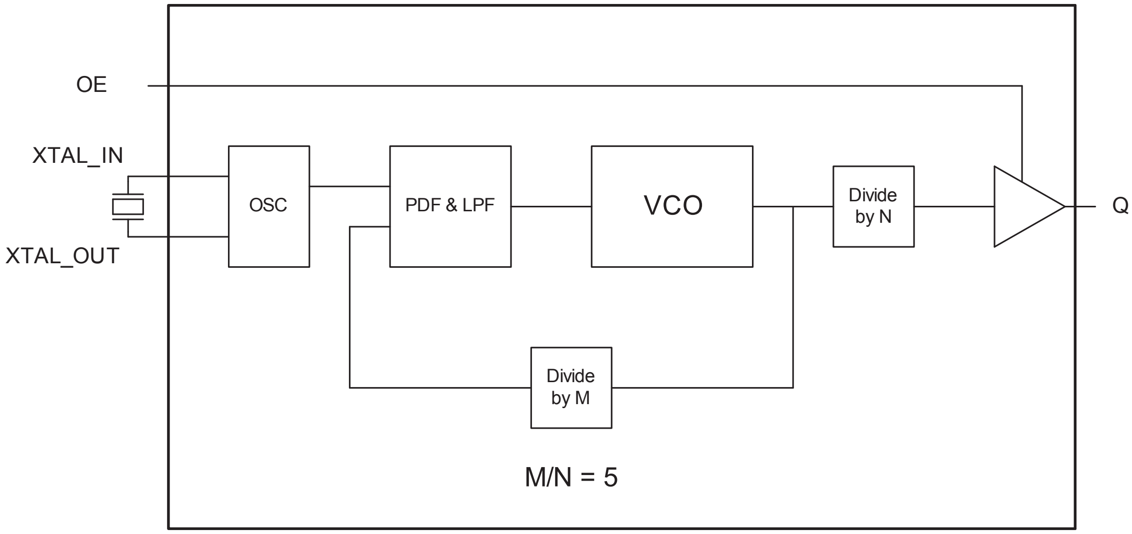
## Pin Configuration




## Pin Assignments

| Pin No. | Pin Name | Type | Description |
|---|---|---|---|
| 1 | $V_{CC}$ | Supply | Power supply pin. |
| 2 | OE | Input<br>(900KΩ pull-up) | Output enable pin - LVCMOS/LVTTL active high input. Outputs are enabled when OE = high. Outputs are disabled when OE = low. |
| 3 | XTAL_OUT | Output | Crystal oscillator output. |
| 4 | XTAL_IN | Input | Crystal oscillator input. |
| 5 | nc | No Connect | Unused, do not connect. |
| 6 | $V_{EE}$ | Supply | Negative supply pin. |
| 7 | Q | Output | LVCMOS output. |
| 8 | $V_{CC}$ | Supply | Power supply pin. |

## Functional Block Diagram




## Typical Performance Characteristics

Figure 1 shows a typical phase noise performance plots for a 125MHz clock output. The data was taken using the industry standard Agilent E5052B phase noise instrument. The integration range is 1.875MHz to 20MHz.

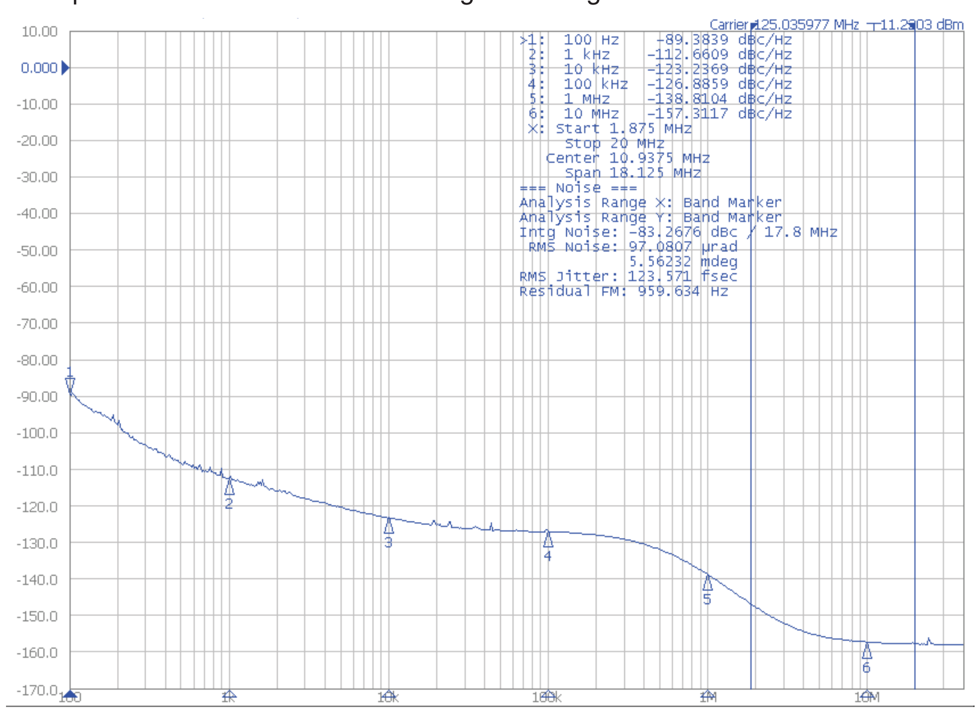



**Figure 1: 125MHz Operation, Typical Phase Noise at 3.3V**

## Application Information

### Termination for LVCMOS Outputs

The termination schemes shown in Figure 2 and Figure 3 are typical for LVCMOS outputs. A split supply approach can be used utilizing the scope's internal 50Ω impedance, as shown in Figure 4.

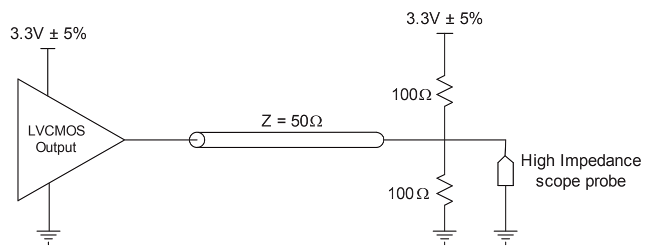



**Figure 2: XR81101 3.3V LVCMOS Output Termination**

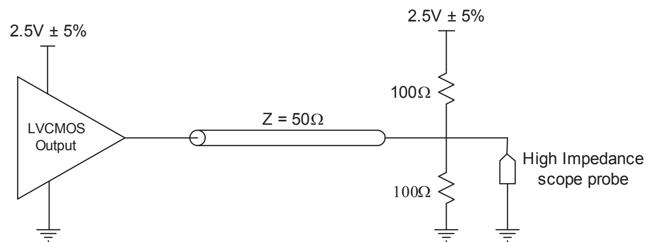



**Figure 3: XR81101 2.5V LVCMOS Output Termination**

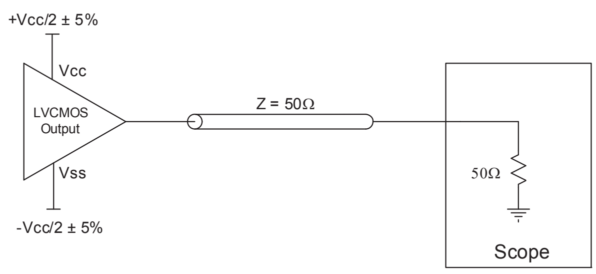



**Figure 4: XR81101 Split Supply LVCMOS Output Termination**

### Output Signal Timing Definitions

The following diagrams clarify the common definitions of the AC timing measurements.

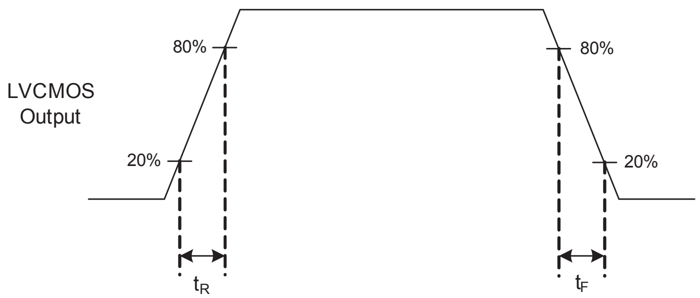
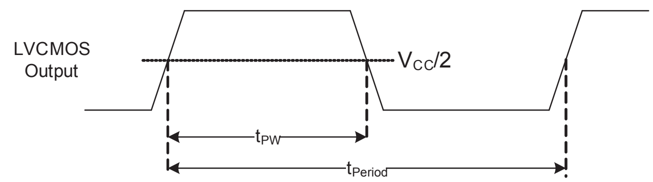



**Figure 5: Cycle-to-Cycle Jitter**

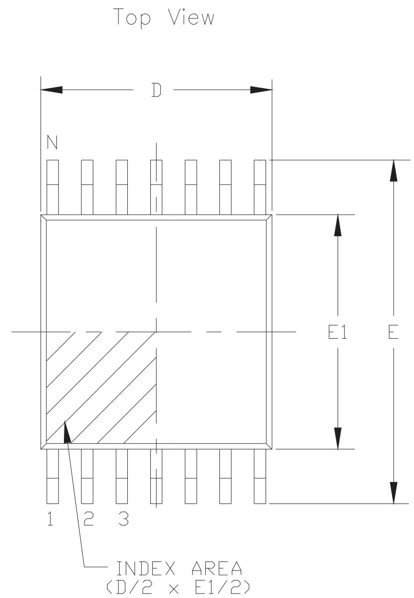


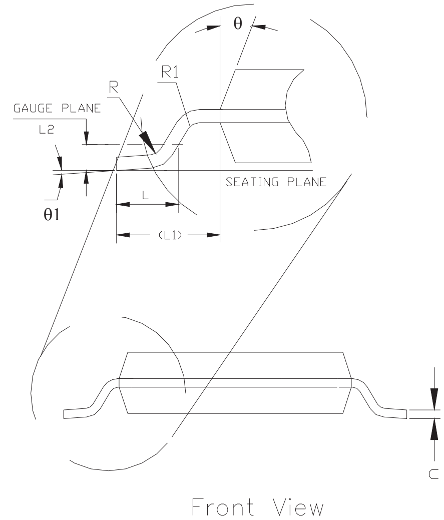

$$Odc = \frac{t_{PW}}{t_{Period}} \times 100\%$$

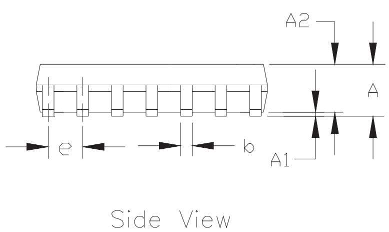
**Figure 6: Output Rise/Fall Time**

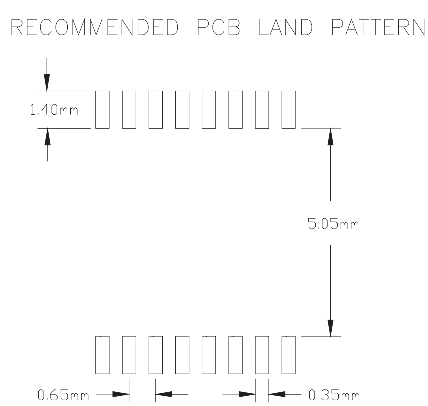
## Mechanical Dimensions

8-Pin TSSOP




| 8-Pin TSSOP JEDEC MO-153 Variation AA | | | | | | |
|---|---|---|---|---|---|---|
| SYMBOLS | DIMENSIONS IN MM (Control Unit) | | | DIMENSIONS IN INCH (Reference Unit) | | |
| | MIN | NOM | MAX | MIN | NOM | MAX |
| A | — | — | 1.10 | — | — | 0.043 |
| A1 | 0.05 | — | 0.15 | 0.002 | — | 0.006 |
| A2 | 0.85 | 0.90 | 0.95 | 0.033 | 0.035 | 0.037 |
| b | 0.19 | — | 0.30 | 0.007 | — | 0.012 |
| c | 0.09 | — | 0.20 | 0.004 | — | 0.008 |
| E | 6.40 BSC | | | 0.252 BSC | | |
| E1 | 4.30 | 4.40 | 4.50 | 0.169 | 0.173 | 0.177 |
| e | 0.65 BSC | | | 0.026 BSC | | |
| L | 0.50 | 0.60 | 0.75 | 0.020 | 0.024 | 0.030 |
| L1 | 1.00 REF | | | 0.039 REF | | |
| L2 | 0.25 BSC | | | 0.010 BSC | | |
| R | 0.09 | — | — | 0.035 | — | — |
| R1 | 0.09 | — | — | 0.035 | — | — |
| θ | 12° REF | | | 12° REF | | |
| θ1 | 0° | — | 8° | 0° | — | 8° |
| D | 2.90 | 3.00 | 3.10 | 0.114 | 0.118 | 0.122 |
| N | 8 | | | 8 | | |

Note: The side, top and landing pattern drawings are general to TSSOP packaging but the table is specific to the 8pin TSSOP.

## Ordering Information

| Part Number | Package | Green | Operating Temperature Range | Shipping Packaging | Marking |
|---|---|---|---|---|---|
| XR81101-AA02-F | 8-pin TSSOP | Yes | -40°C to +85°C | Tube | T01 |
| XR81101-AA02TR-F | 8-pin TSSOP | Yes | -40°C to +85°C | Tape & Reel | T01 |
| XR81101EVB | Eval Board | N/A | N/A | N/A | N/A |

## Revision History

| Revision | Date | Description |
|---|---|---|
| 1A | April 2014 | Initial release. [ECN1416-07 I 04/18/2014] |

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