SM802121

ClockWorks™ 10GbE (156.25MHz), Ultra-Low Jitter, LVPECL Frequency Synthesizer

General Description

The SM802121 is a member of the ClockWorks™ family of devices from Micrel and provides an extremely low-noise timing solution for 10GbE Ethernet clock signals. It is based upon a unique patented RotaryWave® architecture that provides very-low phase noise.

The device operates from a 2.5V or 3.3V power supply and synthesizes an LVPECL output clock at 156.25MHz. The SM802121 accepts a 25MHz crystal or LVCMOS reference clock.

Data sheets and support documentation can be found on Micrel's web site at: www.micrel.com.

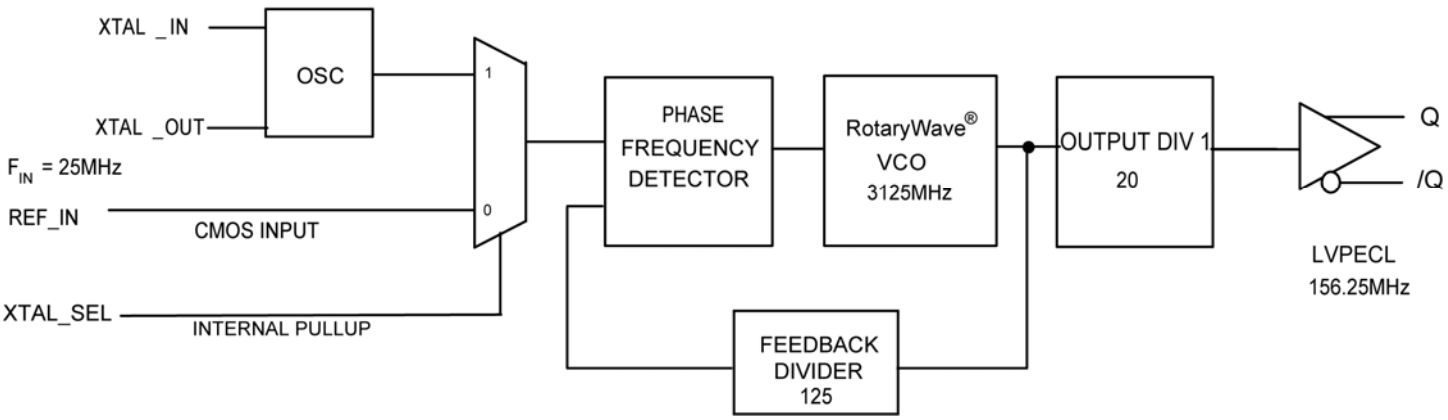
Features

- Generates one LVPECL clock outputs at 156.25MHz
- 2.5V or 3.3V operating range
- Typical phase jitter @ 156.25MHz (1.875MHz to 20MHz): 110fs
- Industrial temperature range
- Green, RoHS-, and PFOS- compliant
- Available in 24-pin 4mm × 4mm QFN package

Applications

- 10 Gigabit Ethernet

Block Diagram



ClockWorks is a trademark of Micrel, Inc
RotaryWave is a registered trademark of Multigig, Inc.

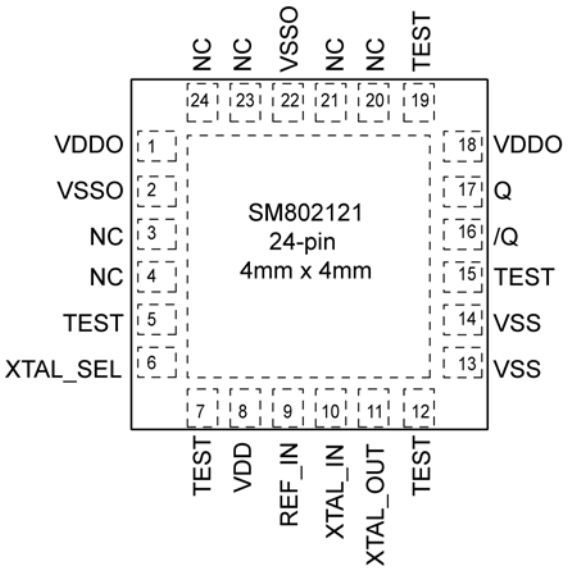
Ordering Information[1]

Part Number	Marking	Shipping	Temperature Range	Package
SM802121UMG	802121	Tube	–40°C to +85°C	24-Pin QFN
SM802121UMGTR	802121	Tape and Reel	–40°C to +85°C	24-Pin QFN

Note:

1. Devices are Green, RoHS-, and PFOS- compliant.

Pin Configuration



24-Pin QFN
(Top View)

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Pin Description

Pin Number	Pin Name	Pin Type	Pin Level	Pin Function
16, 17	/Q, Q	O, (DIF)	LVPECL	Differential Clock Output 156.25MHz.
1, 18	VDDO	PWR		Power Supply for Output.
2, 22	VSSO	PWR		Power Supply Ground for Output.
6	XTAL_SEL	I, (SE)	LVCMOS	Selects PLL Input Reference Source (0 = REF_IN, 1 = XTAL, 45KΩ pull-up).
3, 4, 20, 21, 23, 24	NC			No Connect. Do not connect anything to these pins.
5, 7, 12, 15, 19	TEST			Factory Test Pins. Do not connect anything to these pins.
8	VDD	PWR		Core Power Supply.
13, 14	VSS (Exposed Pad)	PWR		Core Power Supply Ground. The exposed pad must be connected to the VSS ground plane.
9	REF_IN	I, (SE)	LVCMOS	Reference Clock Input.
10	XIN	I, (SE)	crystal	Crystal Reference Input. No load caps needed. (See Fig. 5)
11	XOUT	O, (SE)	crystal	Crystal Reference Output. No load caps needed. (See Fig. 5)

Application Information

Input Reference

When operating with a crystal input reference, do not apply a switching signal to REF_IN.

Crystal Layout

Keep the layers under the crystal as open as possible and do not place switching signals or noisy supplies under the crystal.

Crystal load capacitance is built inside the die so no external capacitance is needed. See the *Selecting a quartz crystal for the Clockworks Flex I Family of Precision Synthesizers* application note for further details.

Contact Micrel's HBW applications group if you need assistance on selecting a suitable crystal for your application at hbwhelp@micrel.com

Truth Table

XTAL_SEL	INPUT
0	REF_IN
1	XTAL

Absolute Maximum Ratings[1]

Supply Voltage (V_{DD}, V_{DDO}) ..... +4.6V
Input Voltage (V_{IN}) ..... –0.50V to V_{DD} + 0.5V
Lead Temperature (soldering, 20s) ..... 260°C
Case Temperature ..... 115°C
Storage Temperature (T_s) ..... –65°C to +150°C

Operating Ratings[2]

Supply Voltage (V_{DD}, V_{DDO}) ..... +2.375V to +3.465V
Ambient Temperature (T_A) ..... –40°C to +85°C
Junction Thermal Resistance[3]
QFN (θ_{JA})
Still-Air ..... 50°C/W
QFN (ψ_{JB})
Junction-to-Board ..... 30°C/W

DC Electrical Characteristics[4]

V_{DD} = V_{DDO} = 3.3V ±5% or 2.5V ±5%

V_{DD} = 3.3V ±5%, V_{DDO}= 3.3V ±5% or 2.5V ±5%

T_A = –40°C to +85°C.

Symbol	Parameter	Condition	Min.	Typ.	Max.	Units
V_{DD}, V_{DDO}	2.5V Operating Voltage		2.375	2.5	2.625	V
V_{DD}, V_{DDO}	3.3V Operating Voltage		3.135	3.3	3.465	V
I_{DD}	Supply Current V_{DD} + V_{DDO}	XTAL_SEL = 0; REF_IN source, outputs open		78	100	mA
I_{DD}	Supply Current V_{DD} + V_{DDO}	XTAL_SEL = 1; CRYSTAL source, outputs open		88	114	mA

LVPECL DC Electrical Characteristics[4]

V_{DD} = V_{DDO}= 3.3V ±5% or 2.5V ±5%

V_{DD} = 3.3V ±5%, V_{DDO} = 3.3V ±5% or 2.5V ±5%

T_A = –40°C to +85°C. R_L = 50Ω to V_{DDO} – 2V

Symbol	Parameter	Condition	Min.	Typ.	Max.	Units
V_{OH}	Output High Voltage		V_{DDO} – 1.145	V_{DDO} – 0.97	V_{DDO} – 0.845	V
V_{OL}	Output Low Voltage		V_{DDO} – 1.945	V_{DDO} – 1.77	V_{DDO} – 1.645	V
V_{SWING}	Output Voltage Swing		0.6	0.8	1.0	V

Notes:

1. Permanent device damage may occur if absolute maximum ratings are exceeded. This is a stress rating only and functional operation is not implied at conditions other than those detailed in the operational sections of this data sheet. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.
2. The data sheet limits are not guaranteed if the device is operated beyond the operating ratings.
3. Package thermal resistance assumes exposed pad is soldered (or equivalent) to the devices most negative potential on the PCB.
4. The circuit is designed to meet the AC and DC specifications shown in the above table(s) after thermal equilibrium has been established.

LVCMOS (XTAL_SEL) DC Electrical Characteristics[4]

V_{DD} = 3.3V ±5%, or 2.5V ±5%, T_A = –40°C to +85°C.

Symbol	Parameter	Condition	Min.	Typ.	Max.	Units
V_{IH}	Input High Voltage		2		V_{DD} + 0.3	V
V_{IL}	Input Low Voltage		–0.3		0.8	V
I_{IH}	Input High Current	V_{DD} = V_{IN} = 3.465V			5	µA
I_{IL}	Input Low Current	V_{DD} = 3.465V, V_{IN} = 0V	–150			µA

REF_IN DC Electrical Characteristics[4]

V_{DD} = 3.3V ±5%, or 2.5V ±5%, T_A = –40°C to +85°C.

Symbol	Parameter	Condition	Min.	Typ.	Max.	Units
V_{IH}	Input High Voltage		1.1		V_{DD} + 0.3	V
V_{IL}	Input Low Voltage		–0.3		0.6	V
I_{IN}	Input Current	XTAL_SEL = V_{IL}, V_{IN} = 0V to V_{DD}	–5		5	µA
		XTAL_SEL = V_{IH}, V_{IN} = V_{DD}		20		µA

Crystal Characteristics

Parameter	Condition	Min.	Typ.	Max.	Units
Mode of Oscillation	10pF Load	**Fundamental, Parallel Resonant**			
Frequency			25		MHz
Equivalent Series Resistance (ESR)				50	Ω
Shunt Capacitor (C0)			1	5	pF
Correlation Drive Level			10	100	uW

AC Electrical Characteristics[4, 5]

V_{DD} = V_{DDO} = 3.3V ±5% or 2.5V ±5%

V_{DD} = 3.3V ±5%, V_{DDO}= 3.3V ±5% or 2.5V ±5%

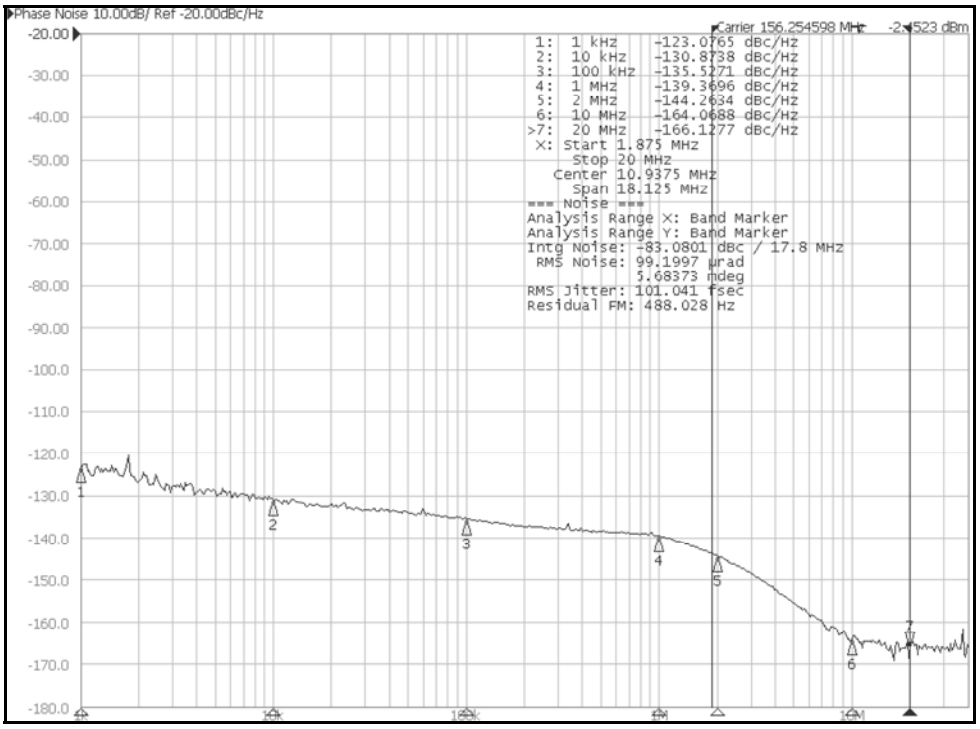
T_A = –40°C to +85°C. R_L = 50Ω to V_{DDO} – 2V

Symbol	Parameter	Condition	Min.	Typ.	Max.	Units
F_{OUT}	Output Frequency			156.25		MHz
F_{REF}	Reference Input Frequency			25		MHz
T_R/T_F	LVPECL Output Rise/Fall Time	20% – 80%	80	175	350	ps
ODC	Output Duty Cycle		48	50	52	%
T_{LOCK}	PLL Lock Time				20	ms
$T_{jit}(\varnothing)$	RMS Phase Jitter[6]	156.25MHz Integration Range (1.875MHz – 20MHz) Integration Range (12kHz – 20MHz)		110 250		fs
	Spurious Noise Components	6.25MHz		–75		dBc

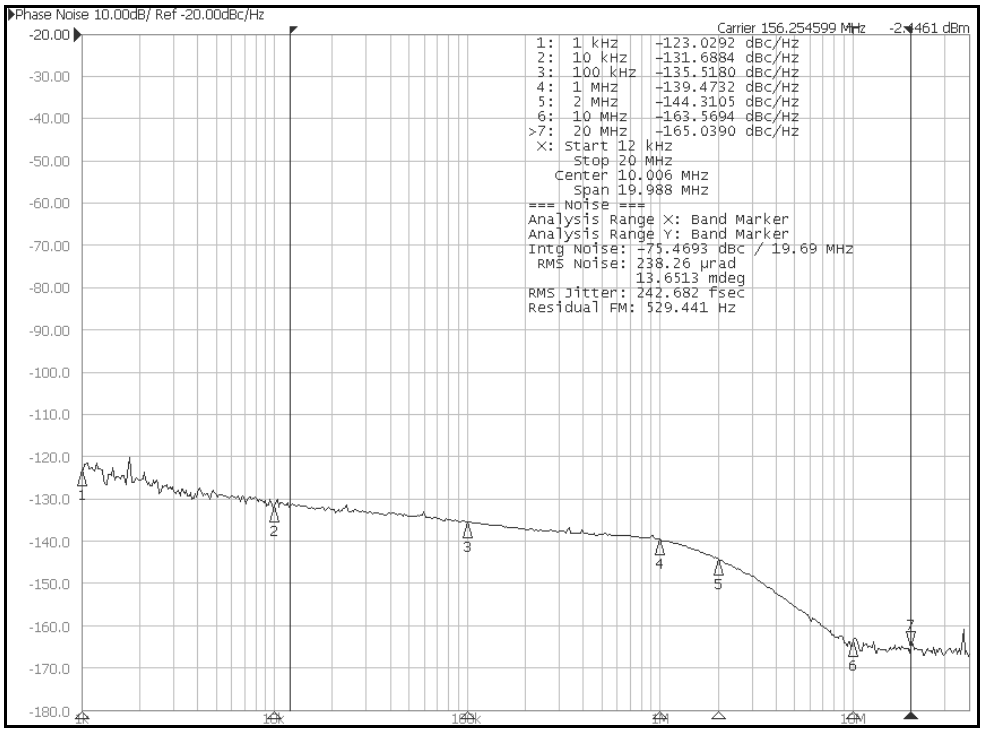
Notes:

5. All phase-noise measurements were taken with an Agilent 5052B phase-noise system.
6. Measured using a 25MHz crystal as the input reference source. If using an external reference input, use a low phase noise source. With an external reference, the phase noise will follow the input source phase noise up to about 1MHz offset.

Phase Noise Plots (XTAL Source)



Phase Noise Plot: 156.25MHz, 1.875MHz – 20MHz 101fS



Phase Noise Plot: 156.25MHz, 12kHz – 20MHz 243fS

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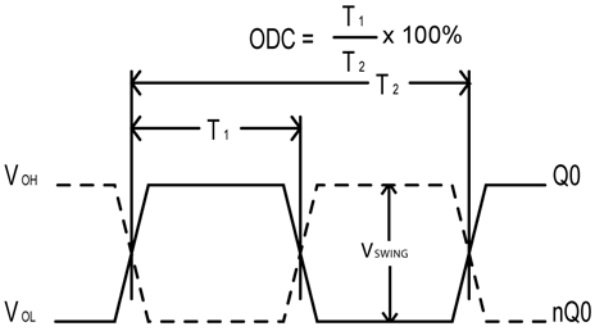


Figure 1. Duty Cycle Timing

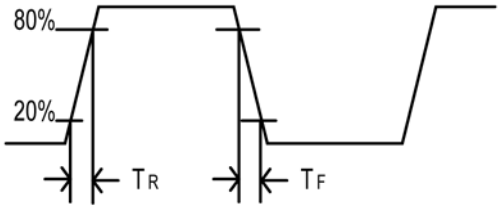


Figure 2. All Outputs Rise/Fall Time

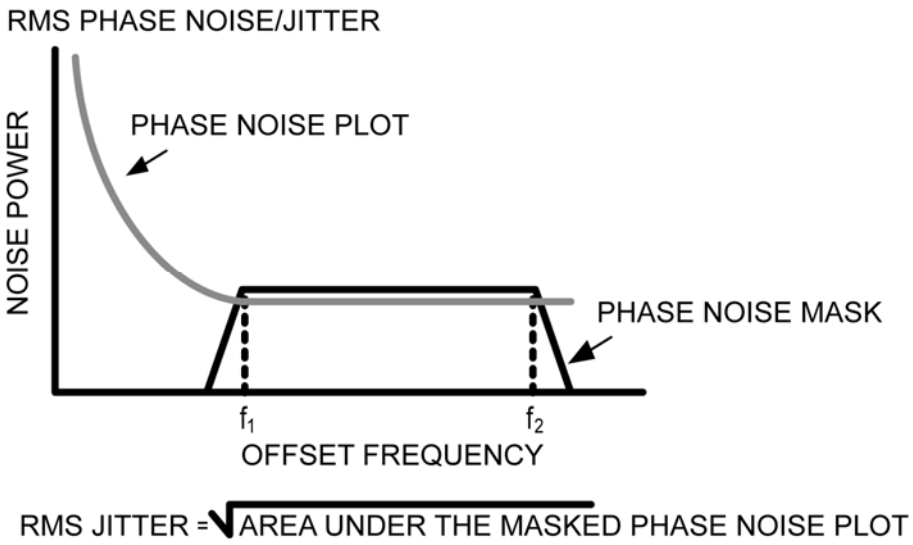


Figure 3. RMS Phase/Noise Jitter

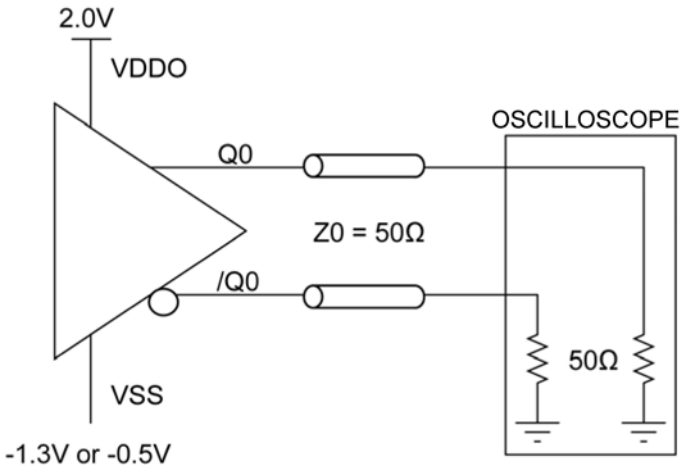


Figure 4. LVPECL Output Load and Test Circuit

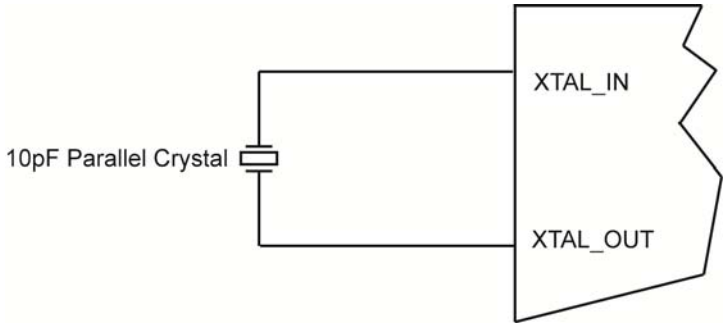
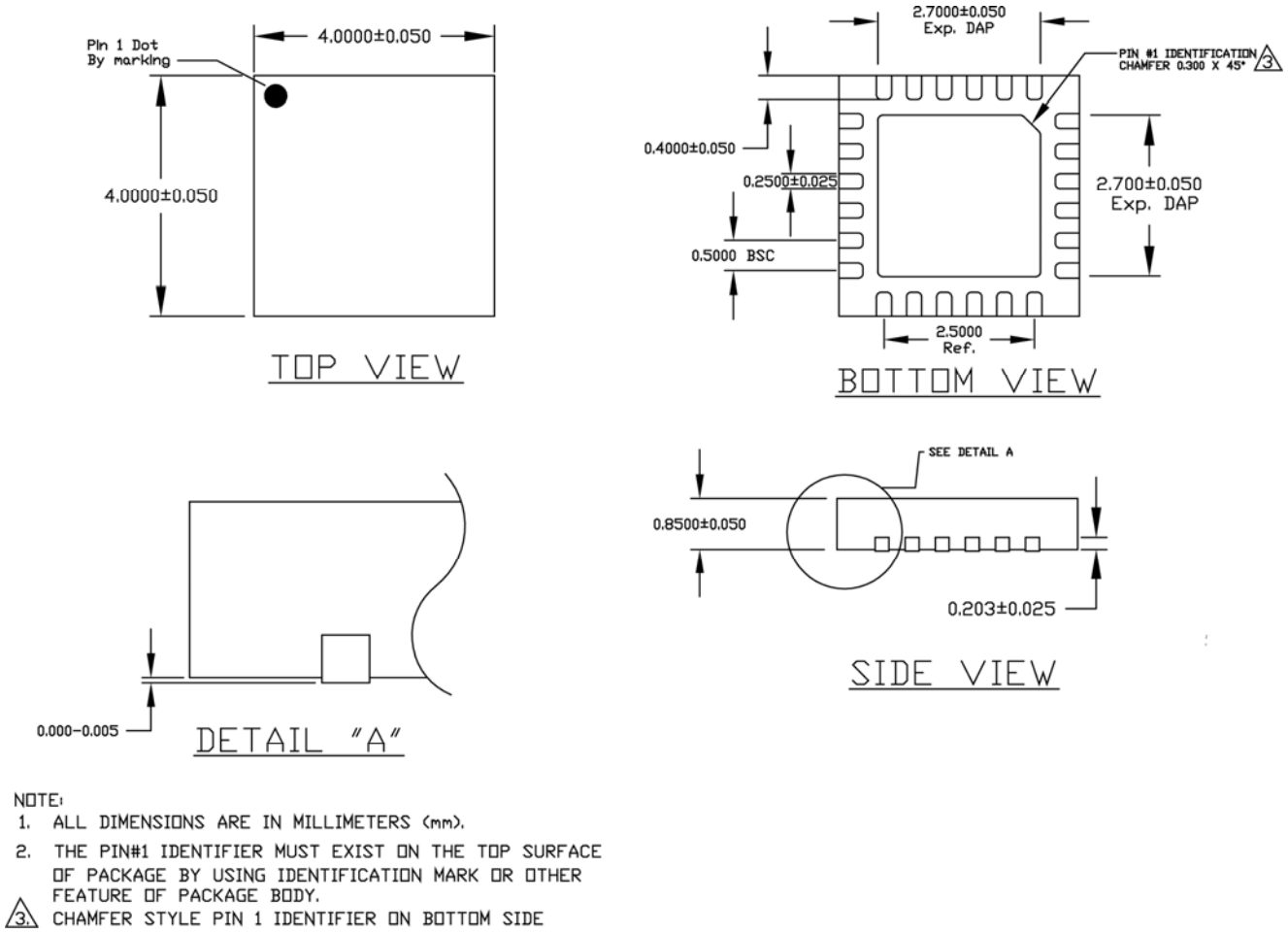


Figure 5. Crystal Input Interface

Package Information



NOTE:
1. ALL DIMENSIONS ARE IN MILLIMETERS (mm).
2. THE PIN#1 IDENTIFIER MUST EXIST ON THE TOP SURFACE OF PACKAGE BY USING IDENTIFICATION MARK OR OTHER FEATURE OF PACKAGE BODY.
3. CHAMFER STYLE PIN 1 IDENTIFIER ON BOTTOM SIDE

24-Pin Package Type

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