



## SM840002

### ClockWorks™ Dual 10-Gigabit/Gigabit Ethernet 62.5MHz, 125MHz, or 156.25MHz, Ultra-Low Jitter LVCMOS Clock Frequency Synthesizer

#### General Description

The SM840002 is a dual 10-Gigabit Ethernet and Gigabit Ethernet, 62.5MHz, 125MHz, or 156.25MHz LVCMOS clock frequency synthesizer and a member of the ClockWorks™ family of devices from Micrel. It provides a low-noise timing solution for high-speed, high-accuracy synthesis of clock signals. It includes a patented RotaryWave® architecture that provides a very stable clock with very-low noise.

Power supplies of either 2.5V or 3.3V are supported, with superior jitter and phase-noise performance. The device synthesizes a 62.5MHz, 125MHz, or 156.25MHz, low-noise LVCMOS output pair for Ethernet applications. The crystal reference frequency is 25MHz.

The SM840002 is an excellent replacement for IDT FemtoClocks®, with improved waveform integrity, and jitter.

Data sheets and support documentation can be found on Micrel's web site at: [www.micrel.com](http://www.micrel.com).

#### Features

- Generates two LVCMOS outputs
- Operating supply modes:
  - Core/Output
  - 3.3V/3.3V, 2.5V/2.5V
- Typical phase jitter @156.25MHz~64 fs (1.875MHz – 20MHz)
- Crystal frequency: 25MHz
- 62.5MHz, 125MHz, or 156.25MHz output frequency
- Output Skew: 12ps (maximum)
- Phase Noise @ 156.25MHz:
  - 1KHz: –126dBc/Hz
  - 10KHz: –130dBc/Hz
  - 100KHz: –126dBc/Hz
  - 1MHz: –139dBc/Hz
  - 10MHz: –165dBc/Hz
  - 20MHz: –166dBc/Hz
- Temperature range: –40°C to +75°C
- Green-, RoHS-, and PFOS-compliant
- Available in 16-pin TSSOP

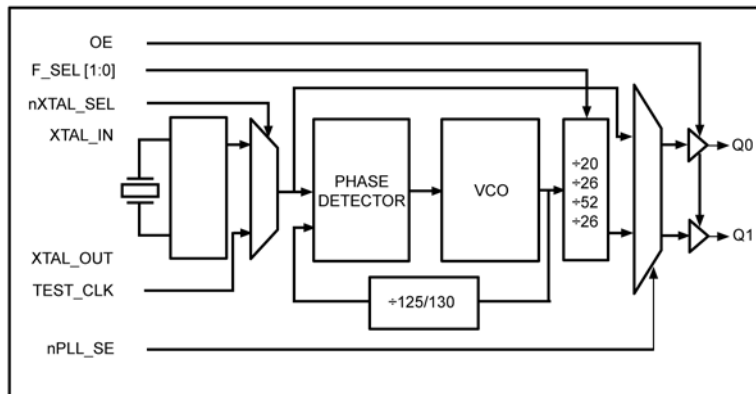
#### Applications

- Gigabit Ethernet
- 10-Gigabit Ethernet

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RotaryWave is a registered trademark of Multigig, Inc.  
FemtoClocks is a registered trademark of IDT, Inc.

Micrel Inc. • 2180 Fortune Drive • San Jose, CA 95131 • USA • tel +1 (408) 944-0800 • fax + 1 (408) 474-1000 • <http://www.micrel.com>

## Block Diagram



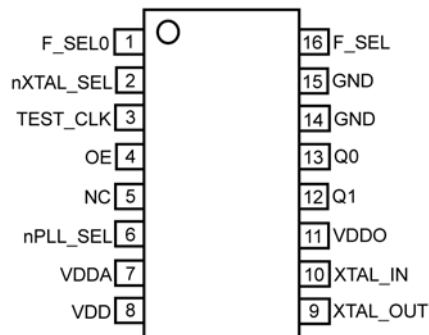
## Ordering Information<sup>(1)</sup>

Part Number	Package Type	Operating Range	Package Marking
SM840002KA	K-16	-40°C to +75°C	840002
SM840002KA TR <sup>(2)</sup>	K-16	-40°C to +75°C	840002

**Notes:**

1. Devices are Green-, RoHS-, and PFOS-compliant.
2. Tape and Reel.

## Pin Configuration



**16-Pin TSSOP (K-16)**

## Pin Description

Pin Number	Pin Name	Type	Level	Pin Function
1	F_SEL0	I	Pull-Up	Frequency Select Pin. LVCMOS interface levels.
2	nXTAL_SEL	I	Pull-Down	Selects between XTAL and TEST_CLK Reference Input. When HIGH, selects TEST_CLK. When LOW, selects XTAL inputs. LVCMOS interface levels.
3	TEST_CLK	I	Pull-Down	Single-Ended LVCMOS Clock Input.
4	OE	I	Pull-Up	Output Enable. When HIGH, the outputs are active. When LOW, the outputs are in a high impedance state. LVCMOS interface levels.
5	NC			No Connect.
6	nPLL_SEL	I	Pull-Down	Selects between the VCO reference and the VCO Output. When LOW, the output is driven from the VCO output. When HIGH, the PLL is bypassed.
7	V <sub>DDA</sub>	P		2.5V or 3.3V Output Power Supply. No filter resistor needed.
8	V <sub>DD</sub>	P		2.5V or 3.3V Output Power Supply.
9	XTAL_OUT	O	12pF Crystal	Crystal Reference Output, no load caps needed.
10	XTAL_IN	I	12pF Crystal	Crystal Reference Input, no load caps needed.
11	V <sub>DDO</sub>	P		2.5V or 3.3V Output Power Supply.
12	Q1	O	LVCMOS	Single-Ended Output Clock.
13	Q0	O	LVCMOS	Single-Ended Output Clock.
14	GND	P		Ground.
15	GND	P		Ground.
16	F_SEL1	I	Pull-up	Frequency Select Pin. LVCMOS interface levels.

## Configuring the SM840002

Xtal Frequency (MHz)	F_SEL1	F_SEL0	M Divider	N Divider	Output Frequency (MHz)
25	0	0	125	20	156.25
25	0	1	130	26	125
25	1	0	130	52	62.5
25	1	1	130	26	125

**Absolute Maximum Ratings<sup>(1)</sup>**

Supply Voltage ( $V_{DD}$ )	+4.6V
Input Voltage ( $V_{IN}$ )	-0.50V to $V_{DD}+0.5V$
Output Voltage ( $V_{OUT}$ )	-0.50V to $V_{DD}+0.5V$
Lead Temperature (soldering, 20sec.)	260°C
Storage Temperature ( $T_s$ )	-65°C to +150°C

**Operating Ratings<sup>(2)</sup>**

Supply Voltage ( $V_{DDO}$ )	+2.375V to +3.465V
Supply Voltage ( $V_{DD}, V_{DDA}$ )	+2.375V to +3.465V
Ambient Temperature ( $T_A$ )	-40°C to +75°C
Junction Thermal Resistance	
TSSOP ( $\theta_{JA}$ )(Still Air)	127°C/W

**DC Electrical Characteristics<sup>(3)</sup>**

$V_{DDA} = V_{DD} = 2.5V \pm 5\%$ ,  $V_{DDO} = 2.5V \pm 5\%$ ,  $T_A = -40^\circ\text{C}$  to  $+75^\circ\text{C}$ , unless noted.

Symbol	Parameter	Condition	Min.	Typ.	Max.	Units
$V_{DD}$	Core Supply Voltage		2.375	2.50	2.625	V
$V_{DDA}$	Analog Supply Voltage		2.375	2.50	2.625	V
$V_{DDO}$	Output Supply Voltage		2.375	2.50	2.625	V
$I_{DD}$	Core Supply Current			0.1	1	mA
$I_{DDA}$	Analog Supply Current			48	55	mA
$I_{DDO}$	Output Supply Current	No Load		15	23	mA

$V_{DDA} = V_{DD} = 3.3V \pm 5\%$ ,  $V_{DDO} = 3.3V \pm 5\%$ ,  $T_A = -40^\circ\text{C}$  to  $+75^\circ\text{C}$ , unless noted.

Symbol	Parameter	Condition	Min.	Typ.	Max.	Units
$V_{DD}$	Core Supply Voltage		3.135	3.30	3.465	V
$V_{DDA}$	Analog Supply Voltage		3.135	3.30	3.465	V
$V_{DDO}$	Output Supply Voltage		3.135	3.30	3.465	V
$I_{DD}$	Core Supply Current			0.1	1	
$I_{DDA}$	Analog Supply Current			49	55	mA
$I_{DDO}$	Power Supply Current	No Load		25	32	mA

**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. The circuit is designed to meet the DC specifications shown in the above table after thermal equilibrium has been established.

## LVC MOS DC Electrical Characteristics<sup>(3)</sup>

$V_{DDA} = V_{DD} = 2.5V$  or  $3.3V \pm 5\%$ ,  $V_{DDO} = 2.5V$  or  $3.3V \pm 5\%$ ,  $T_A = -40^\circ C$  to  $+75^\circ C$ , unless noted.

Symbol	Parameter	Condition	Min.	Typ.	Max.	Units
$V_{IH}$	Input HIGH Voltage		2		$V_{DD} + 0.3$	V
$V_{IL}$	Input LOW Voltage		-0.30		0.80	V
$I_{IH}$	Input HIGH Current	OE, F_SEL0, F_SEL1	$V_{DD} = V_{IN} = 3.465V$ or 2.625V		5	$\mu A$
		nPLL_SEL, MR, nXTAL_SEL, TEST_CLK	$V_{DD} = V_{IN} = 3.465V$ or 2.625V		150	$\mu A$
$I_{IL}$	Input LOW Current	OE, F_SEL0, F_SEL1	$V_{DD} = 3.465V$ or 2.625V $V_{IN} = 0V$	-150		$\mu A$
		nPLL_SEL, MR, nXTAL_SEL, TEST_CLK	$V_{DD} = 3.465V$ or 2.625V $V_{IN} = 0V$	-5		$\mu A$
$V_{OH}$	Output HIGH Voltage <sup>(4)</sup>		$V_{DDO} = 3.3V \pm 5\%$	2.6		V
			$V_{DDO} = 2.5V \pm 5\%$	1.8		V
$V_{OL}$	Output LOW Voltage <sup>(4)</sup>		$V_{DDO} = 3.3V \pm 5\%$ or $2.5V \pm 5\%$		0.5	V

## AC Electrical Characteristics<sup>(5)</sup>

$V_{DDA} = V_{DD} = 2.5V$  or  $3.3V \pm 5\%$ ,  $V_{DDO} = 2.5V$  or  $3.3V \pm 5\%$ ,  $T_A = -40^\circ C$  to  $+75^\circ C$ , unless noted.

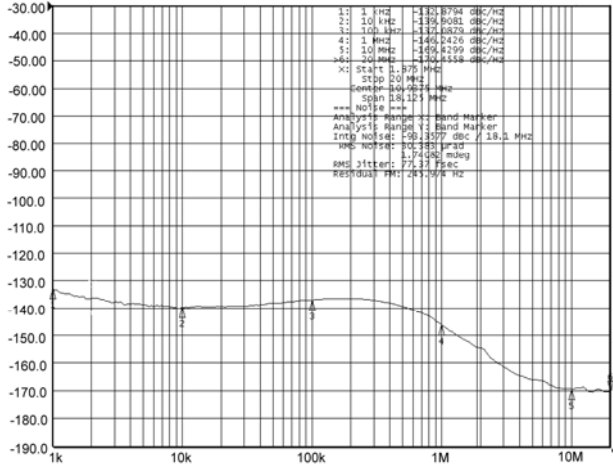
Symbol	Parameter	Condition	Min.	Typ.	Max.	Units
$F_{OUT}$	Output Frequency	F_SEL[1:0] = 00		156.25		MHz
$F_{OUT}$	Output Frequency	F_SEL[1:0] = 01		125		MHz
$F_{OUT}$	Output Frequency	F_SEL[1:0] = 10		62.5		MHz
$F_{OUT}$	Output Frequency	F_SEL[1:0] = 11		125		MHz
$t_{SKEW}$	Output Skew <sup>(6)</sup>				12	ps
$t_{JITTER}$	RMS Phase Jitter	156.25MHz		0.064		ps
$t_{JITTER}$	RMS Phase Jitter	125MHz		0.065		ps
$t_{JITTER}$	RMS Phase Jitter	62.5MHz		0.077		ps
$t_R/t_F$	Output Rise/ Fall Time	20% to 80%	100		350	ps
$O_{DC}$	Output Duty Cycle		48	50	52	%

### Notes:

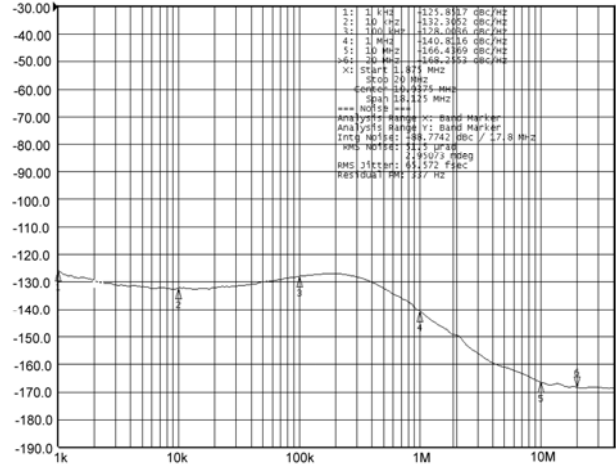
- Outputs terminated with  $50\Omega$  to  $V_{DD}/2$ . See Parameters measurements 3.3V load test circuit.
- The circuit is designed to meet the AC specifications shown in the above table(s) after thermal equilibrium has been established.
- Defined as skew between outputs at the same supply voltage and with equal load conditions; Measured at the output differential crossing points.

### Crystal Characteristics

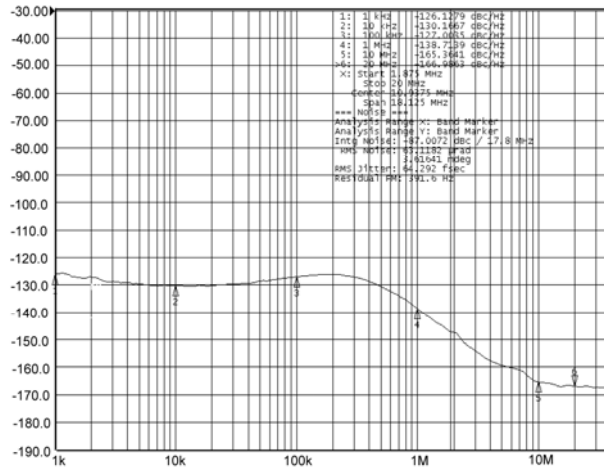
Parameter	Condition	Min.	Typ.	Max.	Units
Mode of Oscillation	12pF Load	Fundamental, Parallel Resonant			
Frequency			25		MHz
Equivalent Series Resistance (ESR)				50	$\Omega$
Shunt Capacitor, C0			3	7	pF
Correlation Drive Level			100	300	$\mu$ W



Phase Noise Plot: 62.5MHz @ 3.3V



Phase Noise Plot: 125MHz @ 3.3V



Phase Noise Plot: 156.25MHz @ 3.3V

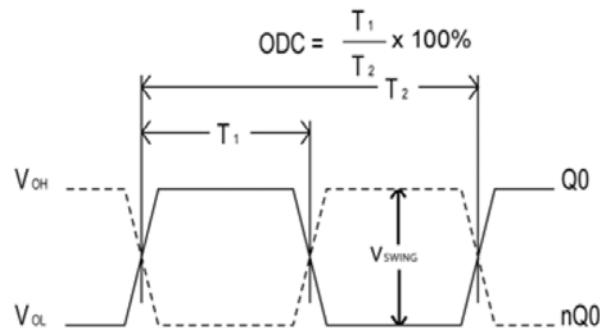


Figure 1. Duty Cycle Timing

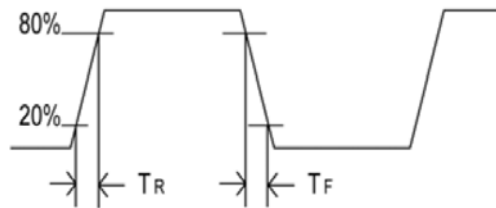


Figure 2. All Outputs Rise/Fall Time

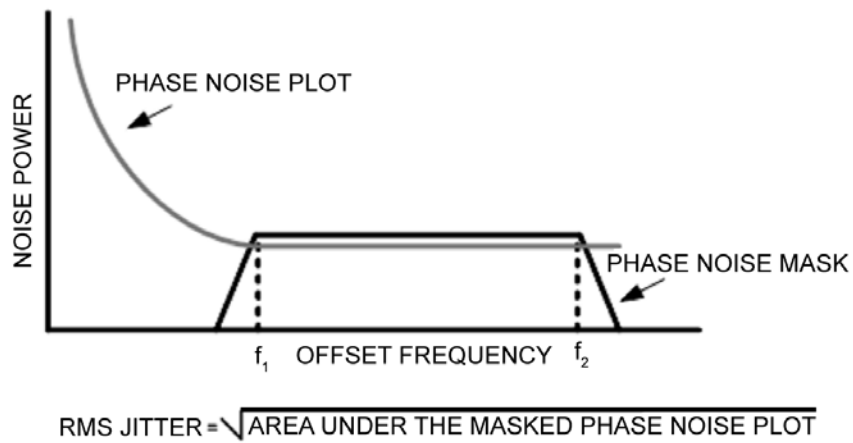


Figure 3. RMS Phase Noise/Jitter

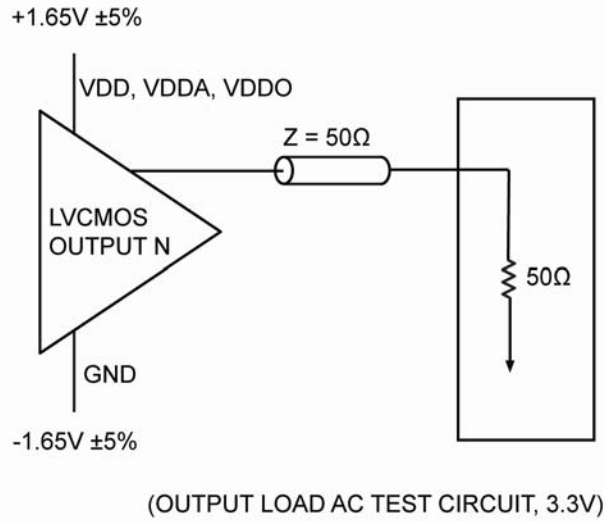


Figure 4. LVC MOS Output Load and Test Circuit

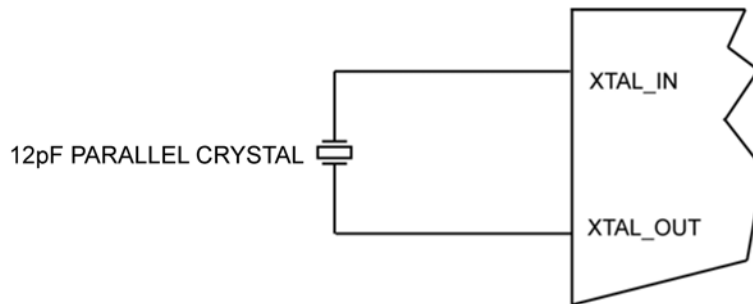
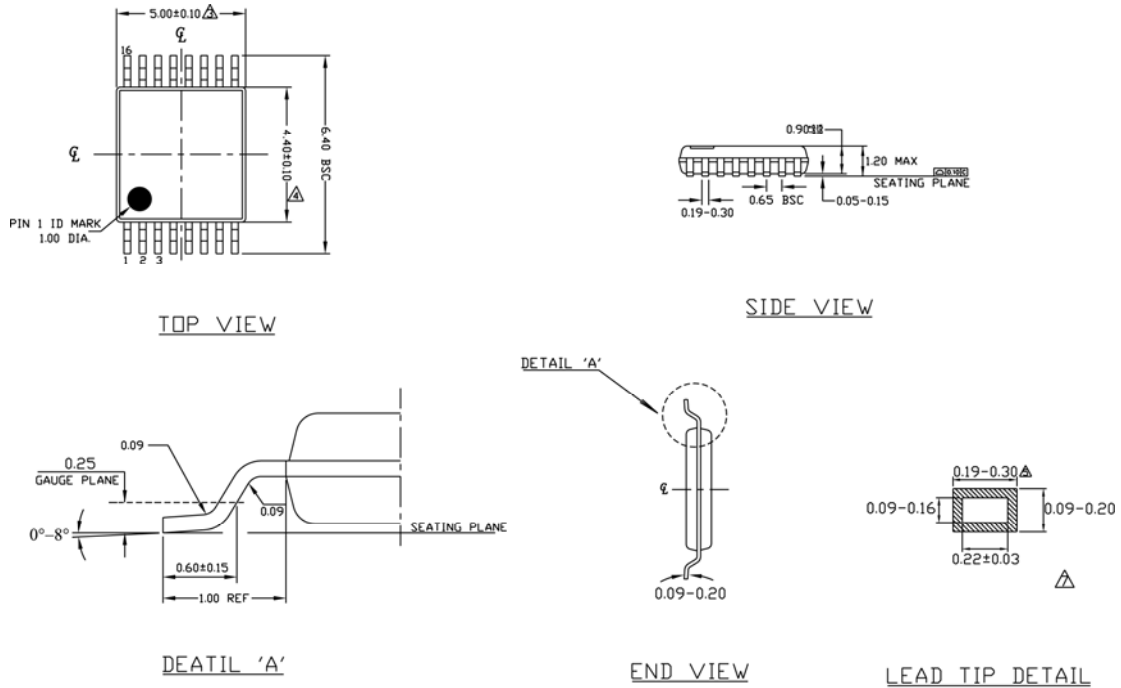


Figure 5. Crystal Input Interface



Package Information



Notes

1. ALL DIMENSIONS ARE IN MILLIMETERS (ANGLES IN DEGREES).
2. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M-1994.
- △ DIMENSION DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS.
- △ DIMENSION DOES NOT INCLUDE INTERNAL FLASH OR PROTRUSION.
- △ DIMENSION DOES NOT INCLUDE DAMBAR PROTRUSION.
- △ CROSS SECTION TO BE DETERMINED AT 0.10 TO 0.25MM FROM THE LEAD TIP.

16-Pin TSSOP (K-16)

MICREL, INC. 2180 FORTUNE DRIVE SAN JOSE, CA 95131 USA  
 TEL +1 (408) 944-0800 FAX +1 (408) 474-1000 WEB <http://www.micrel.com>

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