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## Flexible Ultra-Low Jitter Clock Synthesizer

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### Features

- 115 fs at 156.25 MHz (1.875 MHz to 20 MHz)
- 265 fs at 156.25 MHz (12 kHz to 20 MHz)
- On-Chip Power Supply Regulation for Excellent Board-Level Power Supply Noise Immunity
- Generates up to 8 Combinations of Differential or 16 Single-Ended Clock Outputs
  - LVPECL, LVDS, HCSL, LVCMOS (SE or Diff)
- Selectable Input:
  - Crystal: 11.4 MHz to 27 MHz
  - Reference Input: 11.4 MHz to 80 MHz
- No External Crystal Oscillator Capacitors Required
- 2.5V or 3.3V Operating Power Supply
- Available in Industrial Temperature Range
- Available in Green, RoHS, and PFOS Compliant QFN Packages:
  - 44-pin, 7 mm × 7 mm
  - 32-pin, 5 mm × 5 mm
  - 24-pin, 4 mm × 4 mm
  - 16-pin, 3 mm × 3.5 mm

### Applications

- 1/10/40/100 Gigabit Ethernet (GbE)
- SONET/SDH
- PCI Express
- CPRI/OBSAI – Wireless Base Station
- Fibre Channel
- SAS/SATA
- DIMM

### General Description

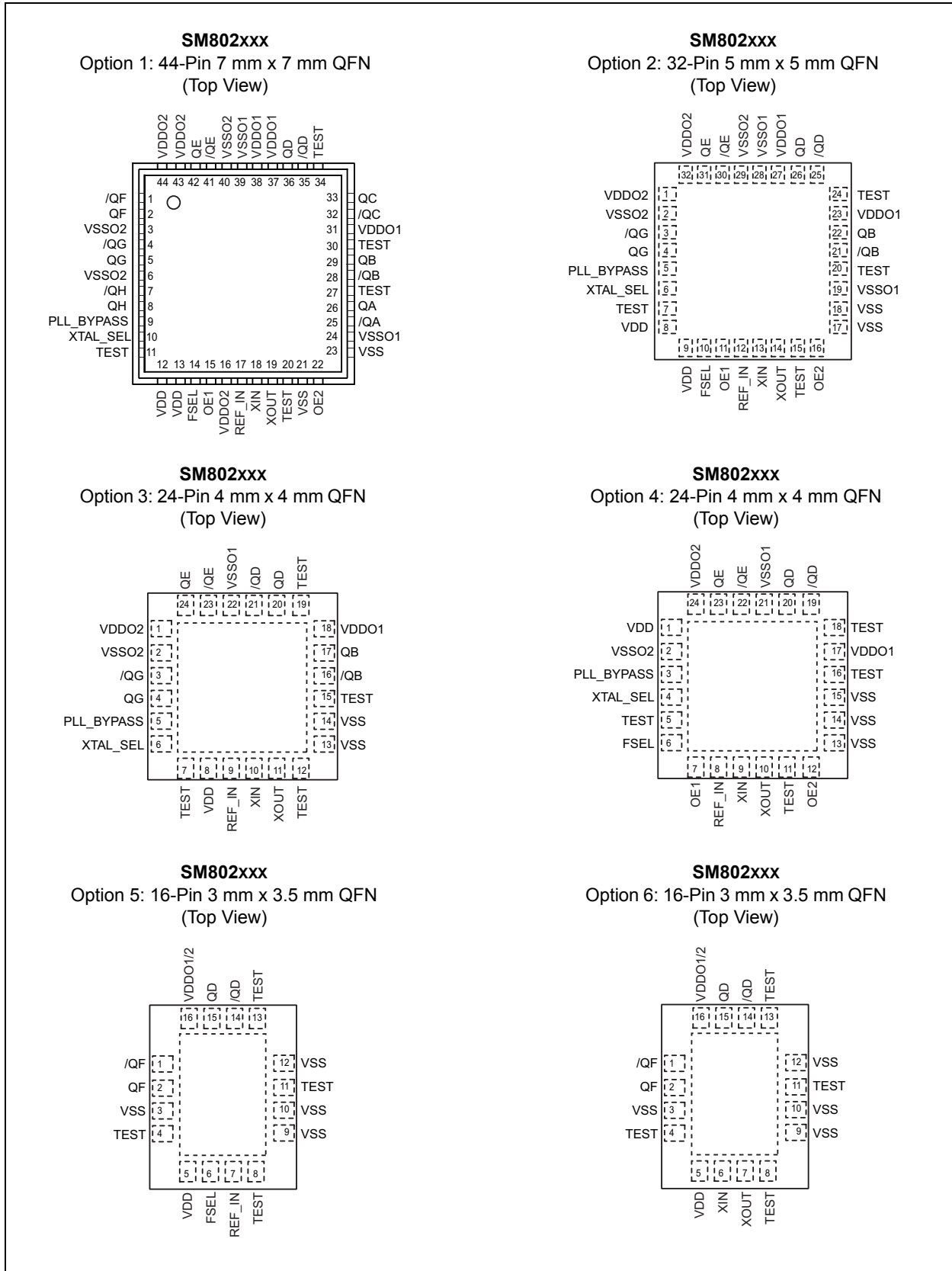
The SM802xxx series is a member of the ClockWorks® family of devices from Microchip and provide an extremely low-noise timing solution for applications such as (1-100) Gigabit Ethernet, SONET, wireless base station, satellite communication, Fibre Channel, SAS/SATA, and PCIe. It is based upon a unique PLL architecture that provides less than 250 fs phase jitter.

The devices operate from a 2.5V or 3.3V power supply and synthesize up to 8 different combinations (LVPECL, LVDS, HCSL) of differential or 16 single-ended output clocks. The devices accept an external reference clock or crystal input.

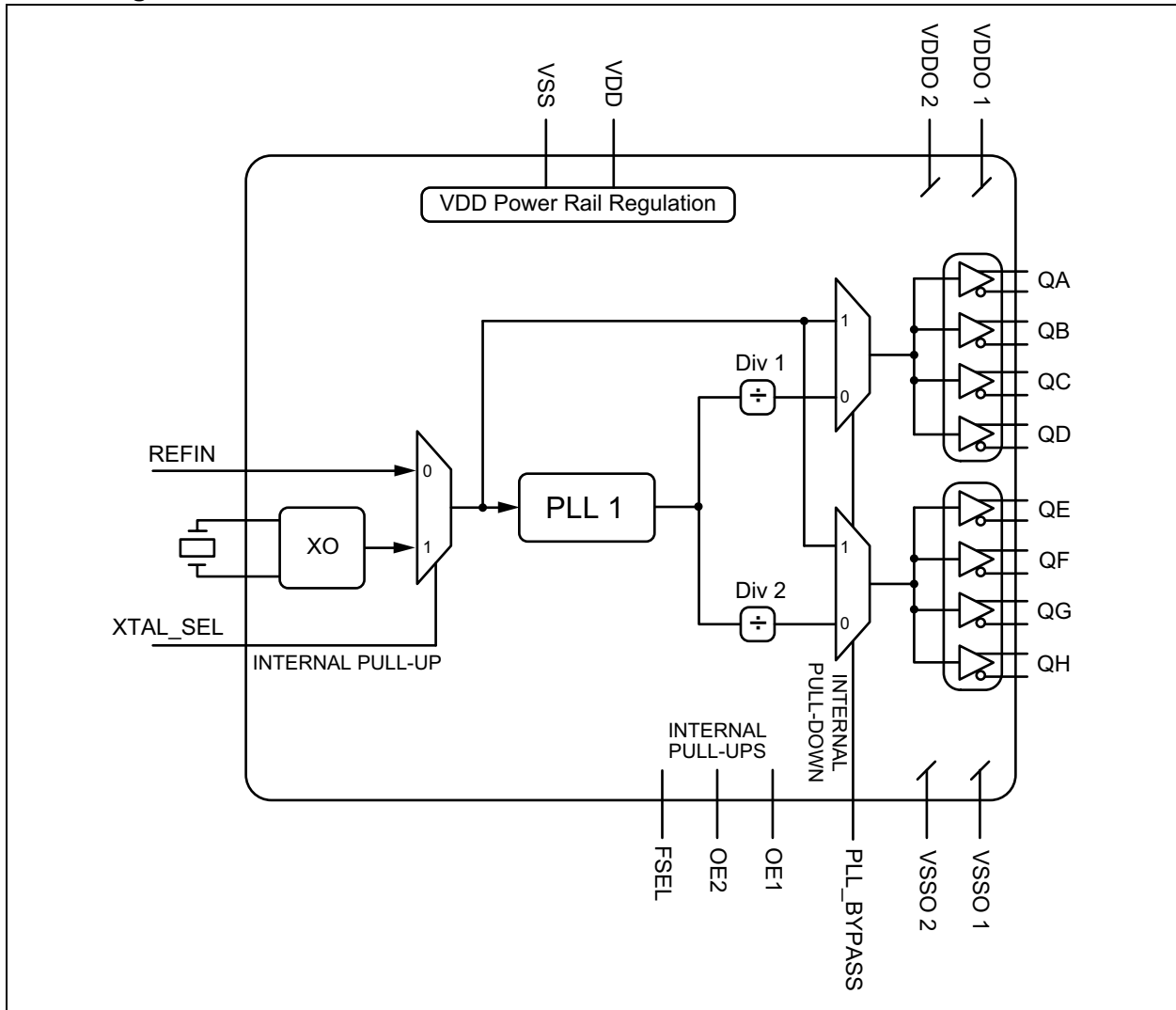
The SM802xxx series is fully programmable and a web tool is available to configure a part for samples at the [ClockWorks Configurator](#) tool.

# SM802XXX

## Package Types



## Block Diagram



# SM802XXX

## 1.0 ELECTRICAL CHARACTERISTICS

### Absolute Maximum Ratings †

Supply Voltage ( $V_{DD}$ , $V_{DDO1/2}$ ).....	+4.6V
Input Voltage ( $V_{IN}$ ).....	-0.5V to $V_{DD} + 0.5V$

### Operating Ratings ††

Supply Voltage ( $V_{DD}$ , $V_{DDO1/2}$ ).....	+2.375V to +3.465V
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† **Notice:** Exceeding the absolute maximum ratings may damage the device.

†† **Notice:** The data sheet limits are not guaranteed if the device is operated beyond the operating ratings.

### DC ELECTRICAL CHARACTERISTICS (Note 1)

Electrical Characteristics: $V_{DD} = V_{DDO1/2} = 3.3V \pm 5\%$ or $2.5V \pm 5\%$ ; $V_{DD} = 3.3V \pm 5\%$ , $V_{DDO1/2} = 3.3V \pm 5\%$ or $2.5V \pm 5\%$ ; $T_A = -40^\circ C$ to $+85^\circ C$ .						
Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
3.3V Operating Voltage	$V_{DD}$ , $V_{DDO1/2}$	3.135	3.3	3.465	V	$V_{DDO1} = V_{DDO2}$
2.5V Operating Voltage		2.375	2.5	2.625		
Total Supply Current, $V_{DD} + V_{DDO}$	$I_{DD}$	—	275	345	mA	8 LVPECL, 312.5 MHz (44-pin QFN) Outputs open
		—	150	185		4 HCSL (PCIe), 100 MHz (32-pin or 24-pin QFN) Outputs $50\Omega$ to $V_{SS}$
		—	70	90		2 LVCMOS, 125 MHz (16-pin QFN) Outputs open

**Note 1:** The circuit is designed to meet the AC and DC specifications shown in the Electrical Characteristics tables after thermal equilibrium has been established.

### LVCMOS INPUTS (OE1, OE2, PLL\_BYPASS, XTAL\_SEL, FSEL) DC ELECTRICAL CHARACTERISTICS (Note 1)

Electrical Characteristics: $V_{DD} = 3.3V \pm 5\%$ or $2.5V \pm 5\%$ ; $T_A = -40^\circ C$ to $+85^\circ C$ .						
Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Input High Voltage	$V_{IH}$	2	—	$V_{DD} + 0.3$	V	—
Input Low Voltage	$V_{IL}$	-0.3	—	0.8	V	—
Input High Current	$I_{IH}$	—	—	150	$\mu A$	$V_{DD} = V_{IN} = 3.465V$
Input Low Current	$I_{IL}$	-150	—	—	$\mu A$	$V_{DD} = 3.465V$ , $V_{IN} = 0V$

**Note 1:** The circuit is designed to meet the AC and DC specifications shown in the Electrical Characteristics tables after thermal equilibrium has been established.

## LVDS OUTPUT DC ELECTRICAL CHARACTERISTICS (Note 1)

**Electrical Characteristics:**  $V_{DD} = V_{DDO1/2} = 3.3V \pm 5\%$  or  $2.5V \pm 5\%$ ;  $V_{DD} = 3.3V \pm 5\%$ ,  $V_{DDO1/2} = 3.3V \pm 5\%$  or  $2.5V \pm 5\%$ ;  $T_A = -40^\circ C$  to  $+85^\circ C$ .  $R_L = 100\Omega$  across Q1 and /Q1.

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Differential Output Voltage	$V_{OD}$	275	350	475	mV	Figure 5-8
$V_{OD}$ Magnitude Change	$\Delta V_{OD}$	—	—	40	mV	—
Offset Voltage	$V_{OS}$	1.15	1.25	1.50	V	—
$V_{OS}$ Magnitude Change	$\Delta V_{OS}$	—	—	50	mV	—

**Note 1:** The circuit is designed to meet the AC and DC specifications shown in the Electrical Characteristics tables after thermal equilibrium has been established.

## HCSL OUTPUT DC ELECTRICAL CHARACTERISTICS (Note 1)

**Electrical Characteristics:**  $V_{DD} = V_{DDO1/2} = 3.3V \pm 5\%$  or  $2.5V \pm 5\%$ ;  $V_{DD} = 3.3V \pm 5\%$ ,  $V_{DDO1/2} = 3.3V \pm 5\%$  or  $2.5V \pm 5\%$ ;  $T_A = -40^\circ C$  to  $+85^\circ C$ .  $R_L = 50\Omega$  to  $V_{SS}$ .

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Output High Voltage	$V_{OH}$	660	700	850	mV	—
Output Low Voltage	$V_{OL}$	-150	0	27	mV	—
Output Voltage Swing	$V_{SWING}$	250	350	550	mV	—

**Note 1:** The circuit is designed to meet the AC and DC specifications shown in the Electrical Characteristics tables after thermal equilibrium has been established.

## LVPECL OUTPUT DC ELECTRICAL CHARACTERISTICS (Note 1)

**Electrical Characteristics:**  $V_{DD} = V_{DDO1/2} = 3.3V \pm 5\%$  or  $2.5V \pm 5\%$ ;  $V_{DD} = 3.3V \pm 5\%$ ,  $V_{DDO1/2} = 3.3V \pm 5\%$  or  $2.5V \pm 5\%$ ;  $T_A = -40^\circ C$  to  $+85^\circ C$ .  $R_L = 50\Omega$  to  $V_{DDO} - 2V$ .

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

**Note 1:** The circuit is designed to meet the AC and DC specifications shown in the Electrical Characteristics tables after thermal equilibrium has been established.

## LVC MOS OUTPUT DC ELECTRICAL CHARACTERISTICS (Note 1)

**Electrical Characteristics:**  $V_{DD} = V_{DDO1/2} = 3.3V \pm 5\%$  or  $2.5V \pm 5\%$ ;  $V_{DD} = 3.3V \pm 5\%$ ,  $V_{DDO1/2} = 3.3V \pm 5\%$  or  $2.5V \pm 5\%$ ;  $T_A = -40^\circ C$  to  $+85^\circ C$ .  $R_L = 50\Omega$  to  $V_{DDO}/2$ .

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Output High Voltage	$V_{OH}$	$V_{DDO} - 0.7$	—	—	V	Figure 5-9
Output Low Voltage	$V_{OL}$	—	—	0.6	V	Figure 5-9

**Note 1:** The circuit is designed to meet the AC and DC specifications shown in the Electrical Characteristics tables after thermal equilibrium has been established.

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## REF\_IN DC ELECTRICAL CHARACTERISTICS (Note 1)

Electrical Characteristics: $V_{DD} = 3.3V \pm 5\%$ or $2.5V \pm 5\%$ ; $T_A = -40^\circ C$ to $+85^\circ C$ .						
Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Input High Voltage	$V_{IH}$	1.1	—	$V_{DD} + 0.3$	V	—
Input Low Voltage	$V_{IL}$	-0.3	—	0.6	V	—
Input Current	$I_{IN}$	-5	—	5	$\mu A$	XTAL_SEL = $V_{IL}$ , $V_{IN} = 0V$ to $V_{DD}$
		—	20	—	$\mu A$	XTAL_SEL = $V_{IH}$ , $V_{IN} = V_{DD}$

**Note 1:** The circuit is designed to meet the AC and DC specifications shown in the Electrical Characteristics tables after thermal equilibrium has been established.

## CRYSTAL CHARACTERISTICS

Electrical Characteristics: $V_{DD} = 3.3V \pm 5\%$ or $2.5V \pm 5\%$ ; $T_A = -40^\circ C$ to $+85^\circ C$ .						
Parameter	Min.	Typ.	Max.	Units	Conditions	
Mode of Oscillation	Fundamental, parallel resonant			—	10 pF load capacitance	
Frequency	11.4	—	27	MHz	—	
Equivalent Series Resistance (ESR)	—	—	30	$\Omega$	—	
Shunt Capacitance, $C_0$	—	2	5	pF	—	
Correlation Drive Level	—	10	100	$\mu W$	—	

## LVPECL AC ELECTRICAL CHARACTERISTICS (Note 1, Note 2, Note 3, Note 4)

Electrical Characteristics: $V_{DDA} = V_{DD} = 3.3V \pm 5\%$ or $2.5V \pm 5\%$ , $V_{DDO} = 2.5V$ or $3.3V \pm 5\%$ , $T_A = -40^\circ C$ to $+85^\circ C$ , unless otherwise noted.						
Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Output Frequency	$F_{OUT}$	11	—	840	MHz	—
LVPECL Output Rise/Fall Time	$t_r/t_f$	80	175	350	ps	20% - 80%
Output Duty Cycle	ODC	48	50	52	%	< 350 MHz
		45	50	55	%	$\geq 350$ MHz
Output-to-Output Skew	$T_{SKEW}$	—	—	45	ps	Note 5
PLL Lock Time	$T_{LOCK}$	—	—	20	ms	—
RMS Phase Jitter @ 156.25 MHz	$T_{jit}(\emptyset)$	—	265	—	fs	Integration Range (12 kHz to 20 MHz)
		—	115	—	fs	Integration Range (1.875 MHz to 20 MHz)

- Note 1:** The circuit is designed to meet the AC and DC specifications shown in the Electrical Characteristics tables after thermal equilibrium has been established.
- 2:** See Figure 5-6 through Figure 5-9 for load test circuit examples.
- 3:** All phase noise measurements were taken with an Agilent 5052B phase noise system.
- 4:** Output load is  $50\Omega$  to  $V_{DD} - 2V$ .
- 5:** Defined as skew between outputs at the same supply voltage and with equal load conditions; Measured at the output differential crossing points.

## LVDS AC ELECTRICAL CHARACTERISTICS (Note 1, Note 2, Note 3, Note 4)

**Electrical Characteristics:**  $V_{DDA} = V_{DD} = 3.3V \pm 5\%$  or  $2.5V \pm 5\%$ ,  $V_{DDO} = 2.5V$  or  $3.3V \pm 5\%$ ,  $T_A = -40^\circ C$  to  $+85^\circ C$ , unless otherwise noted.

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Output Frequency	$F_{OUT}$	11.4	—	840	MHz	—
LVDS Output Rise/Fall Time	$t_r/t_f$	100	160	400	ps	20% - 80%
Output Duty Cycle	ODC	48	50	52	%	< 350 MHz
		45	50	55	%	$\geq$ 350 MHz
Output-to-Output Skew	$T_{SKEW}$	—	—	45	ps	Note 5
PLL Lock Time	$T_{LOCK}$	—	—	20	ms	—
RMS Phase Jitter @ 156.25 MHz	$T_{jit}(\emptyset)$	—	110	—	fs	Integration Range (1.875 MHz to 20 MHz)

- Note 1:** The circuit is designed to meet the AC and DC specifications shown in the Electrical Characteristics tables after thermal equilibrium has been established.
- 2:** See Figure 5-6 through Figure 5-9 for load test circuit examples.
- 3:** All phase noise measurements were taken with an Agilent 5052B phase noise system.
- 4:** Outputs terminated 100 $\Omega$  between Q and /Q. All unused outputs must be terminated.
- 5:** Defined as skew between outputs at the same supply voltage and with equal load conditions; Measured at the output differential crossing points.

## HCSL AC ELECTRICAL CHARACTERISTICS (Note 1, Note 2, Note 3, Note 4)

**Electrical Characteristics:**  $V_{DDA} = V_{DD} = 3.3V \pm 5\%$  or  $2.5V \pm 5\%$ ,  $V_{DDO} = 2.5V$  or  $3.3V \pm 5\%$ ,  $T_A = -40^\circ C$  to  $+85^\circ C$ , unless otherwise noted.

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Output Frequency	$F_{OUT}$	11.4	—	840	MHz	—
Output Rise/Fall Time	$t_r/t_f$	150	300	450	ps	20% - 80%
Output Duty Cycle	ODC	48	50	52	%	< 350 MHz
		45	50	55	%	$\geq$ 350 MHz
Output-to-Output Skew	$T_{SKEW}$	—	—	50	ps	Note 5
PLL Lock Time	$T_{LOCK}$	—	—	20	ms	—
RMS Phase Jitter @ 100 MHz	$T_{jit}(\emptyset)$	—	265	—	fs	Integration Range (12 kHz to 20 MHz)
		—	115	—	fs	Integration Range (1.875 MHz to 20 MHz)

- Note 1:** The circuit is designed to meet the AC and DC specifications shown in the Electrical Characteristics tables after thermal equilibrium has been established.
- 2:** See Figure 5-6 through Figure 5-9 for load test circuit examples.
- 3:** All phase noise measurements were taken with an Agilent 5052B phase noise system.
- 4:** Output load is 50 $\Omega$  to  $V_{DD} / 2$ .
- 5:** Defined as skew between outputs at the same supply voltage and with equal load conditions; Measured at the output differential crossing points.

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## LVCMOS AC ELECTRICAL CHARACTERISTICS (Note 1, Note 2, Note 3, Note 4)

**Electrical Characteristics:**  $V_{DDA} = V_{DD} = 3.3V \pm 5\%$  or  $2.5V \pm 5\%$ ,  $V_{DDO} = 2.5V$  or  $3.3V \pm 5\%$ ,  $T_A = -40^{\circ}C$  to  $+85^{\circ}C$ , unless otherwise noted.

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions
Output Frequency	$F_{OUT}$	11.4	—	250	MHz	—
REF_IN Frequency	$F_{REF}$	11	—	80	MHz	—
Output Rise/Fall Time	$t_r/t_f$	100	—	500	ps	20% - 80%
Output Duty Cycle	ODC	45	50	55	%	—
Output-to-Output Skew	$T_{SKEW}$	—	—	60	ps	Note 5
PLL Lock Time	$T_{LOCK}$	—	—	20	ms	—
RMS Phase Jitter @ 125 MHz	$T_{jit(\emptyset)}$	—	115	—	fs	Integration Range (1.875 MHz to 20 MHz)

**Note 1:** The circuit is designed to meet the AC and DC specifications shown in the Electrical Characteristics tables after thermal equilibrium has been established.

**2:** See Figure 5-6 through Figure 5-9 for load test circuit examples.

**3:** All phase noise measurements were taken with an Agilent 5052B phase noise system.

**4:** Output load is  $50\Omega$  to  $V_{DD} / 2$ .

**5:** Defined as skew between outputs at the same supply voltage and with equal load conditions; Measured at the output differential crossing points.



## TEMPERATURE SPECIFICATIONS

Parameters	Sym.	Min.	Typ.	Max.	Units	Conditions
<b>Temperature Ranges</b>						
Ambient Temperature Range	$T_A$	-40	—	+85	°C	—
Lead Temperature	—	—	—	+260	°C	Soldering, 20s
Case Temperature	—	—	—	+115	°C	—
Storage Temperature Range	$T_S$	-65	—	+150	°C	—
<b>Package Thermal Resistances (Note 1)</b>						
Junction Thermal Resistance, 7 x 7 QFN-44Ld	$\theta_{JA}$	—	24	—	°C/W	—
Junction Thermal Resistance, 5 x 5 QFN-32Ld	$\theta_{JA}$	—	34	—	°C/W	—
Junction Thermal Resistance, 4 x 4 QFN-24Ld	$\theta_{JA}$	—	50	—	°C/W	—
Junction Thermal Resistance, 3 x 3.5 QFN-16Ld	$\theta_{JA}$	—	60	—	°C/W	—

**Note 1:** Package thermal resistance assumes the exposed pad is soldered (or equivalent) to the device's most negative potential on the PCB.

# SM802XXX

## 2.0 PIN DESCRIPTIONS

The descriptions of the pins are listed in [Table 2-1](#).

**TABLE 2-1: PIN FUNCTION TABLE**

Pin Numbers by Package Option						Pin Name	Pin Type	Pin Level	Pin Function	
#1 44-pin	#2 32-pin	#3 24-pin	#4 24-pin	#5 16-pin	#6 16-pin					
18	13	10	9	—	6	XIN	I,O (SE)	—	Crystal connections.	
19	14	11	10	—	7	XOUT				
17	12	9	8	7	—	REF_IN	I, (SE)	LVC MOS	Reference clock input.	
14	10	—	6	6	—	FSEL	I, (SE)	LVC MOS	Frequency Select, divides output frequencies by 2. 0 = FREQ, 1 = FREQ/2, 45 kΩ pull-up	
10	6	6	4	—	—	XTAL SEL	I, (SE)	LVC MOS	XTAL Select, selects between XTAL and REF_IN 0 = REF_IN, 1 = XTAL, 45 kΩ pull-up	
9	5	5	3	—	—	PLL BYPASS	I, (SE)	LVC MOS	Bypasses the PLL and switches the XTAL or REF_IN frequency to all outputs 0 = PLL mode, 1 = Bypass mode, 45 kΩ pull-down	
25	—	—	—	—	—	/QA	O	Various	Clock Outputs from Bank 1 Each output can be programmed to its own logic type: LVPECL, LVDS, HCSL, or LVC MOS ( <a href="#">Note 1</a> )	
26	—	—	—	—	—	QA				
28	21	16	—	—	—	/QB	O	Various		
29	22	17	—	—	—	QB				
32	—	—	—	—	—	/QC	O	Various		
33	—	—	—	—	—	QC				
35	25	20	19	14	14	/QD	O	Various		
36	26	21	20	15	15	QD				
41	30	23	22	—	—	/QE	O	Various		
42	31	24	23	—	—	QE				
1	—	—	—	1	1	/QF	O	Various	Clock Outputs from Bank 2 Each output can be programmed to its own logic type: LVPECL, LVDS, HCSL, or LVC MOS ( <a href="#">Note 1</a> )	
2	—	—	—	2	2	QF				
4	3	3	—	—	—	/QG	O	Various		
5	4	4	—	—	—	QG				
7	—	—	—	—	—	/QH	O	Various		
8	—	—	—	—	—	QH				
31	23	18	17	16	16	V <sub>DDO1</sub>	PWR	—		Power Supply for the outputs on Bank 1.
37	27	—	—	—	—					
38	—	—	—	—	—					
16	1	1	24	16	16	V <sub>DDO2</sub>	PWR	—		Power Supply for the outputs on Bank 2.
43	32	—	—	—	—					
44	—	—	—	—	—					
24	19	22	21	—	—	V <sub>SSO1</sub>	PWR	—	Power Supply Ground for the outputs on Bank 1.	
39	28	—	—	—	—					

**TABLE 2-1: PIN FUNCTION TABLE (CONTINUED)**

Pin Numbers by Package Option						Pin Name	Pin Type	Pin Level	Pin Function
#1 44-pin	#2 32-pin	#3 24-pin	#4 24-pin	#5 16-pin	#6 16-pin				
3	2	2	2	—	—	V <sub>SSO2</sub>	PWR	—	Power Supply Ground for the outputs on Bank 2.
6	29	—	—	—	—				
40	—	—	—	—	—				
11	7	7	5	4	4	TEST	—	—	Used for production test. Do not connect anything to these pins.
20	15	12	11	8	8				
27	20	15	16	11	11				
30	24	19	18	13	13				
34	—	—	—	—	—				
12	8	8	1	5	5	V <sub>DD</sub>	PWR	—	Core power supply.
13	9	—	—	—	—	V <sub>SS</sub>	PWR	—	Core power supply ground.
21	17	13	13	3	3				
23	18	14	14	9	9				
—	—	—	15	10	10				
—	—	—	—	12	12				
—	—	—	—	—	—	EPAD	—	—	The exposed pad must be connected to the V <sub>SS</sub> ground plane.
15	11	—	7	—	—	OE1	I, (SE)	LVC MOS	Output Enable 1, OUT1–8 disables to tri-state, 0 = Disabled, 1 = Enabled, 45 kΩ pull-up
22	16	—	12	—	—	OE2	I, (SE)	LVC MOS	Output Enable 2, OUT9–16 disables to tri-state, 0 = Disabled, 1 = Enabled, 45 kΩ pull-up

**Note 1:** In the case of LVC MOS, an output pair can provide two single-ended LVC MOS outputs.

**TABLE 2-2: TRUTH TABLE**

Control Pin	Internal Resistor (Note 1)	0 Level (Low)	1 Level (High)
OE1	Pull-Up	Outputs QA~QD disabled to Hi Z (Tri-State)	Outputs QA~QD enabled
OE2	Pull-Up	Outputs QE~QH disabled to Hi Z (Tri-State)	Outputs QE~QH enabled
XTAL_SEL	Pull-Up	External reference clock input is selected	Crystal is selected
FSEL; (Note 2)	Pull-Up	Output = Target Frequency x2 or /2	Output = Target Frequency
PLL_BYPASS	Pull-Down	PLL frequency is connected to outputs	PLL is bypassed, Crystal or Ref-in is connected to outputs

**Note 1:** The internal resistor sets the default logic level on the control pin when the pin is left open. Pull up will set default logic 1 and pull down will set default logic 0. When the pin is not available on a specific configuration, the level will be the default logic level.

- 2:** The FSEL pin behavior can be programmed between two types:
- At FSEL=0 (low), the output frequency changes to multiply by 2.
  - At FSEL=1 (high), the output frequency changes to divide by 2.
- The FSEL function affects all outputs the same way, all outputs change when the FSEL pin level changes.

## 3.0 PHASE NOISE PLOTS

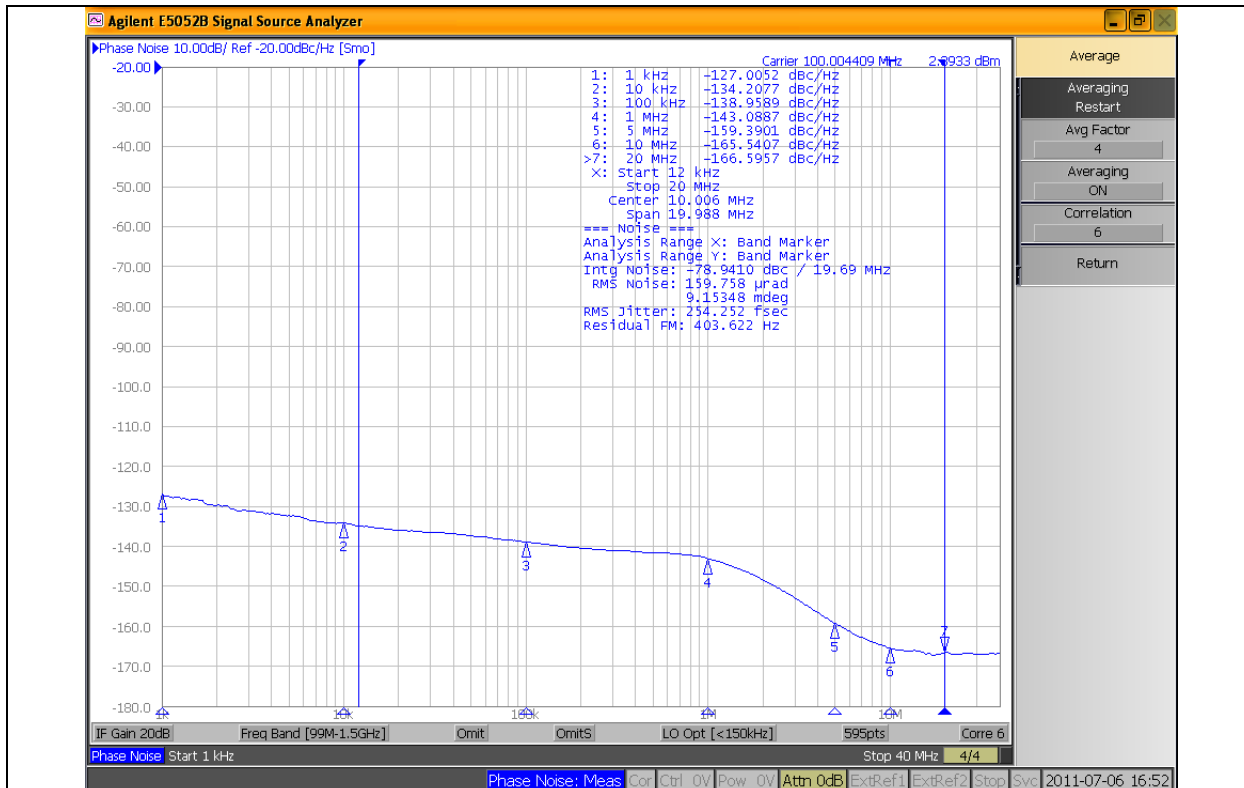


FIGURE 3-1: 100 MHz HCSL, 254  $f_{s_{RMS}}$  for 12 kHz to 20 MHz Integration Range.

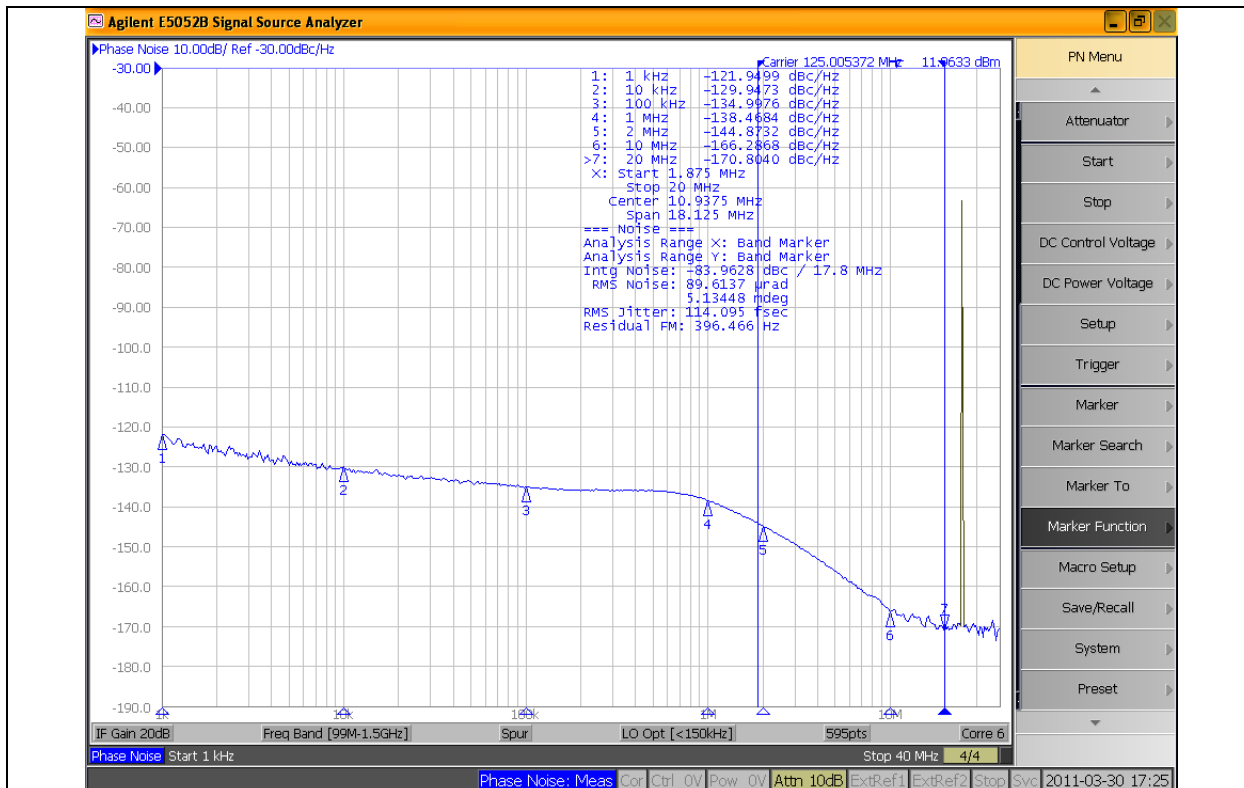
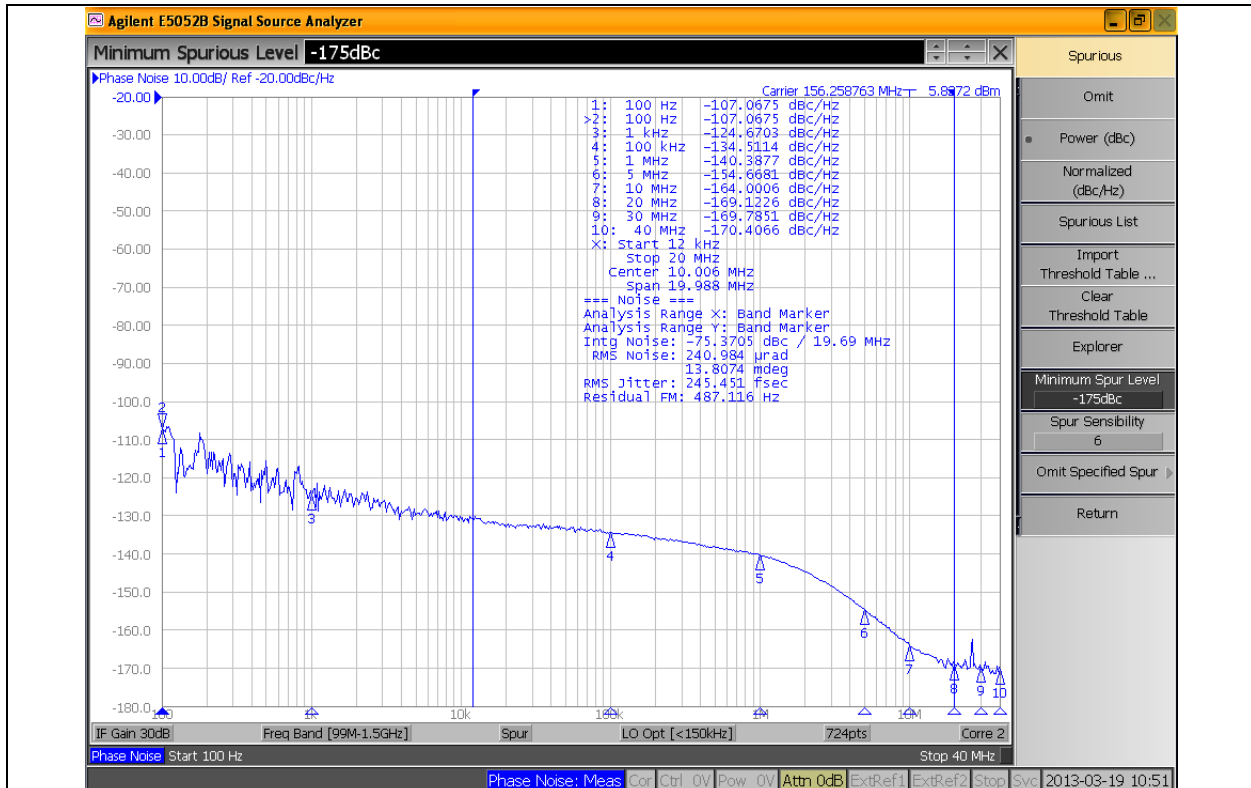
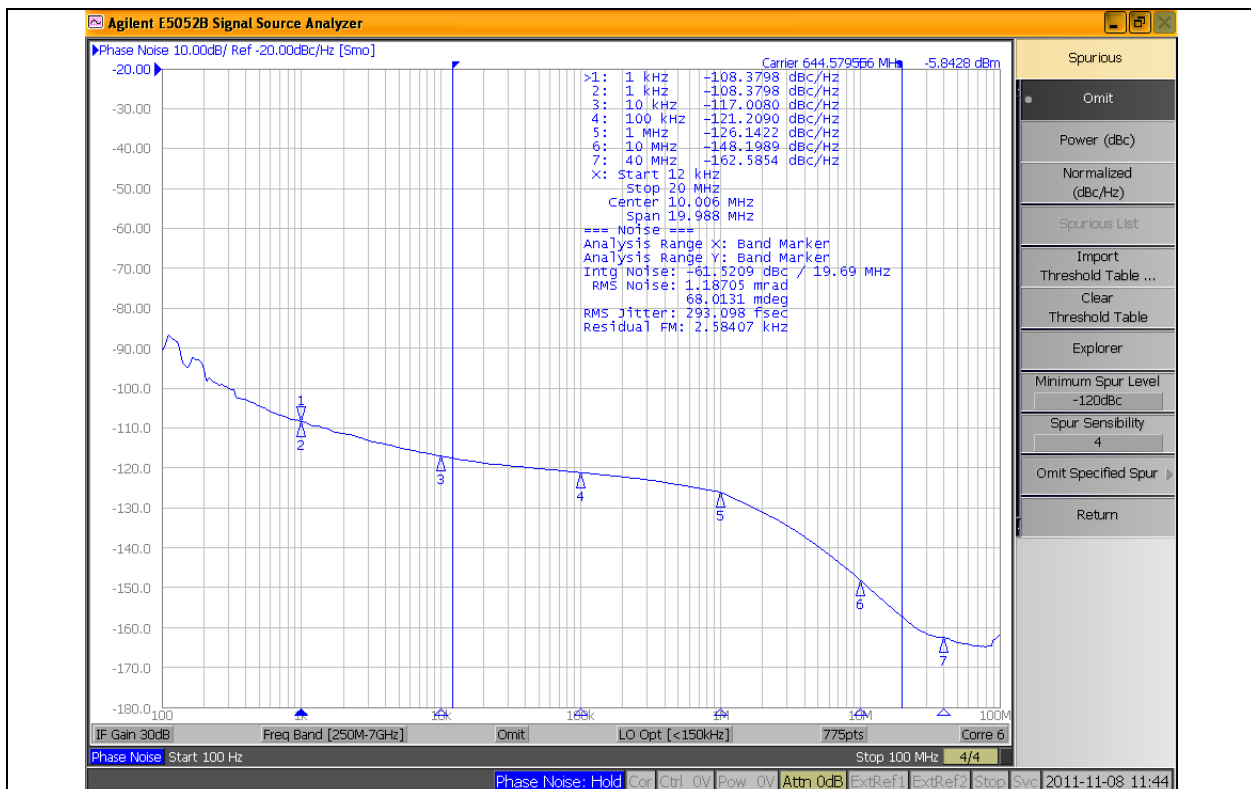


FIGURE 3-2: 125 MHz LVCMOS, 114  $f_{s_{RMS}}$  for 1.875 MHz to 20 MHz Integration Range.



**FIGURE 3-3:** 156.25 MHz LVPECL,  $245f_{RMS}$  for 12 kHz to 20 MHz Integration Range.



**FIGURE 3-4:** 644.53125 MHz LVDS,  $293f_{RMS}$  for 12 kHz to 20 MHz Integration Range.

# SM802XXX

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## 4.0 APPLICATION INFORMATION

### 4.1 Input Reference

When operating with a crystal input reference, do not apply a switching signal to REF\_IN.

### 4.2 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 Microchip application note ANTC207 for further details.

### 4.3 Power Supply Decoupling

Place the smallest value decoupling capacitor (4.7 nF above) between the  $V_{DD}$  and  $V_{SS}$  pins, as close as possible to those pins and at the same side of the PCB as the IC. The shorter the physical path from  $V_{DD}$  to capacitor and back from capacitor to  $V_{SS}$ , the more effective the decoupling. Use one 4.7 nF capacitor for each  $V_{DD}$  pin on the SM802xxx.

The impedance value of the ferrite bead (FB) needs to be between  $80\Omega$  and  $240\Omega$  with a saturation current  $\geq 150$  mA.

The  $V_{DDO1}$  and  $V_{DDO2}$  pins connect directly to the  $V_{DD}$  plane. All  $V_{DD}$  pins on the SM802xxx connect to  $V_{DD}$  after the power supply filter.

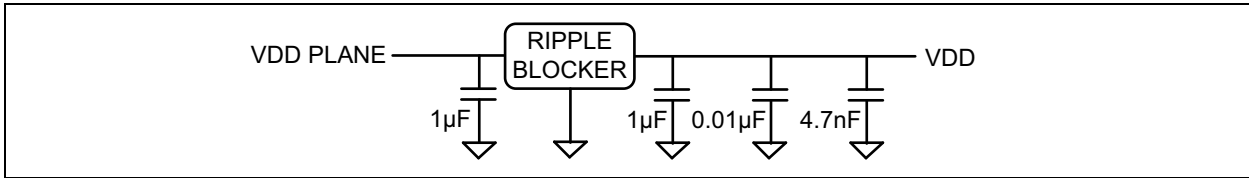
### 4.4 Output Traces

Design the traces for the output signals according to the output logic requirements. If LVCMOS is unterminated, add a  $30\Omega$  resistor in series with the output, as close as possible to the output pin, and start a  $50\Omega$  trace on the other side of the resistor.

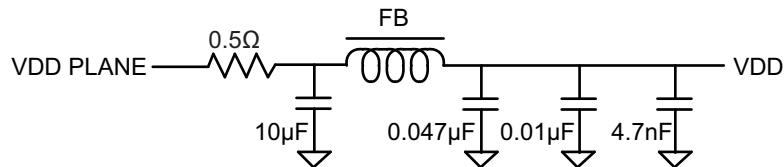
For differential traces, you can either use a differential design or two separate  $50\Omega$  traces. For EMI reasons, it is better to use a differential design.

LVDS can be AC-coupled or DC-coupled to its termination.

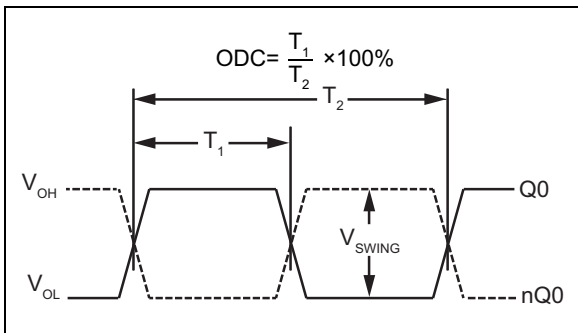
## 5.0 POWER SUPPLY FILTERING RECOMMENDATIONS



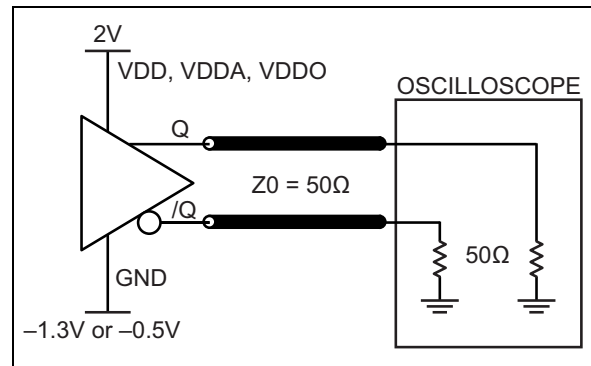
**FIGURE 5-1:** Preferred Filter, Using the MIC94300 or MIC94310 Ripple Blocker.



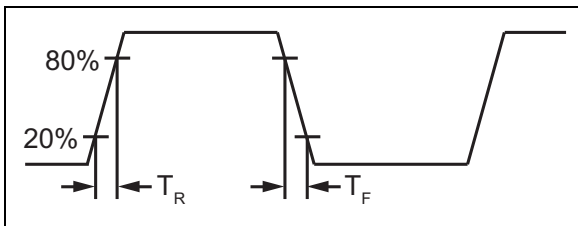
**FIGURE 5-2:** Alternative, Traditional Filter, Using a Ferrite Bead.



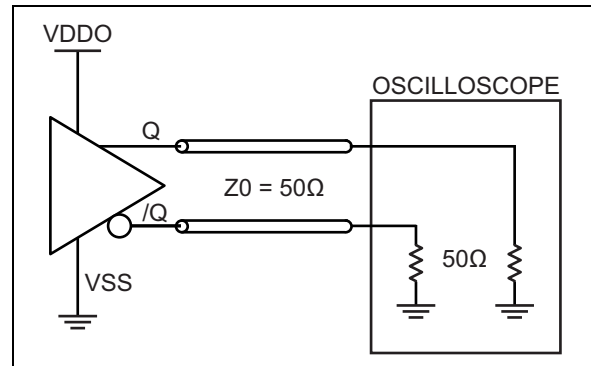
**FIGURE 5-3:** Duty Cycle Timing.



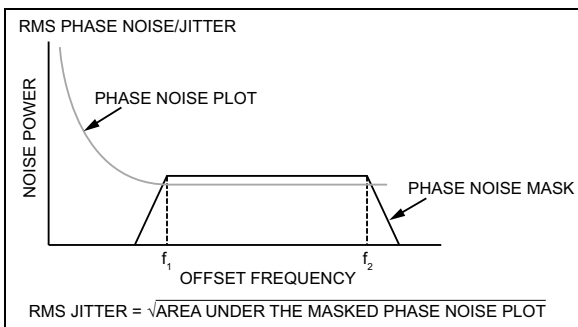
**FIGURE 5-6:** LVPECL Output Load and Test Circuit.



**FIGURE 5-4:** All Outputs Rise/Fall Time.

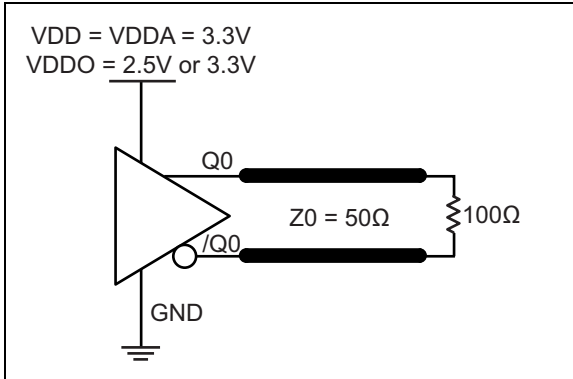


**FIGURE 5-7:** HCSL Output Load and Test Circuit.

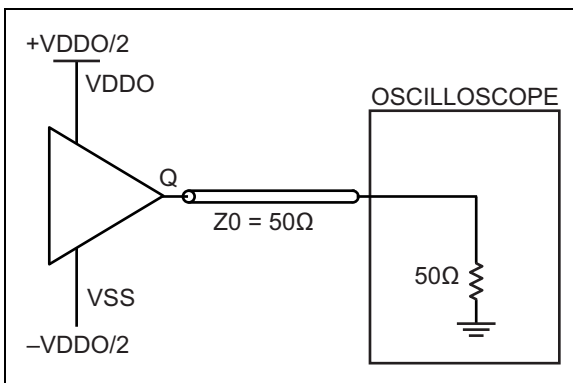


**FIGURE 5-5:** RMS Phase/Noise/Jitter.

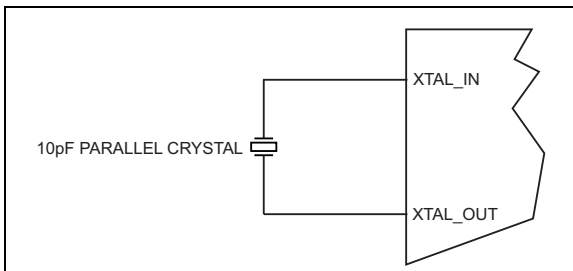
# SM802XXX



**FIGURE 5-8:** LVDS Output Load and Test Circuit.



**FIGURE 5-9:** LVCMOS Output Load and Test Circuit.

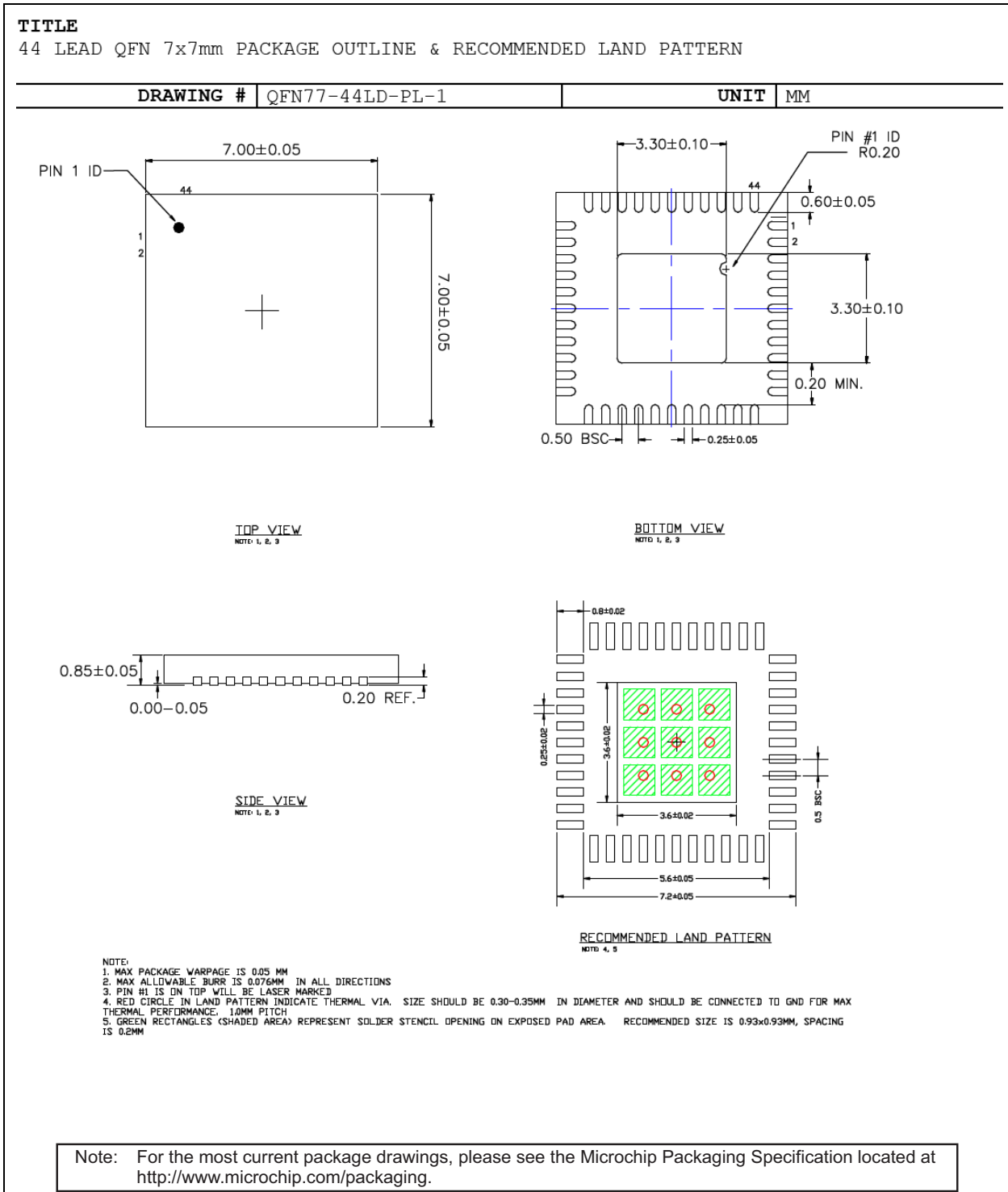


**FIGURE 5-10:** Crystal Input Interface.



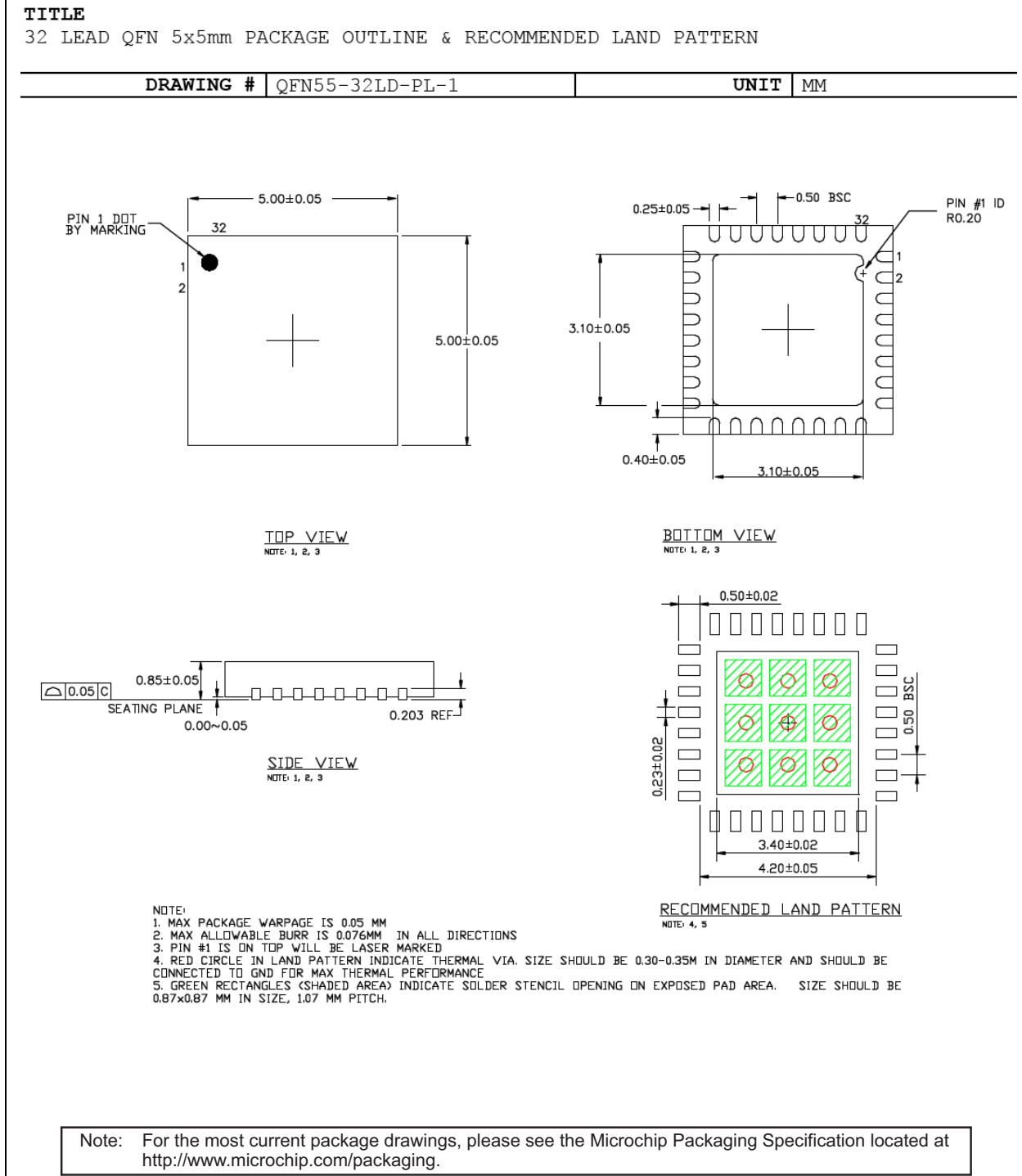
## 6.0 PACKAGING INFORMATION

### 44-Lead QFN Package Outline and Recommended Land Pattern



# SM802XXX

## 32-Lead QFN Package Outline and Recommended Land Pattern

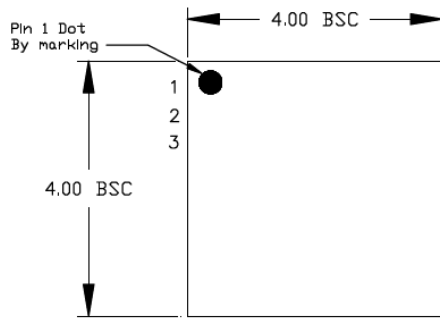


## 24-Lead QFN Package Outline and Recommended Land Pattern

**TITLE**

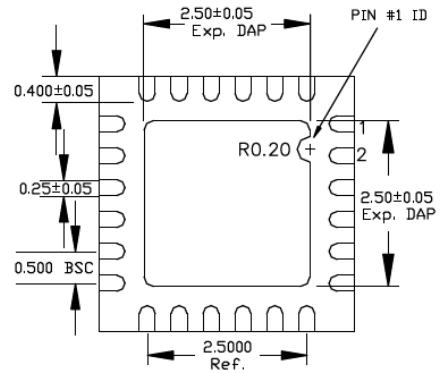
24 LEAD QFN 4x4mm PACKAGE OUTLINE & RECOMMENDED LAND PATTERN

DRAWING #	QFN44-24LD-PL-1	UNIT	MM
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TOP VIEW

NOTE: 1, 2, 3



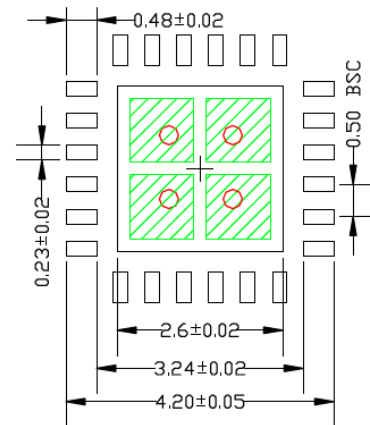
BOTTOM VIEW

NOTE: 1, 2, 3



SIDE VIEW

NOTE: 1, 2, 3



RECOMMENDED LAND PATTERN

NOTE: 4, 5

**NOTE:**

1. MAX PACKAGE WARPAGE IS 0.05 MM
2. MAX ALLOWABLE BURR IS 0.076MM IN ALL DIRECTIONS
3. PIN #1 IS ON TOP WILL BE LASER MARKED
4. RED CIRCLE IN LAND PATTERN INDICATE THERMAL VIA. SIZE SHOULD BE 0.30-0.35M IN DIAMETER AND SHOULD BE CONNECTED TO GND FOR MAX THERMAL PERFORMANCE
5. GREEN RECTANGLES (SHADED AREA) INDICATE SOLDER STENCIL OPENING ON EXPOSED PAD AREA. SIZE SHOULD BE 1.00x1.00 MM IN SIZE, 1.20 MM PITCH.

Note: For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>.

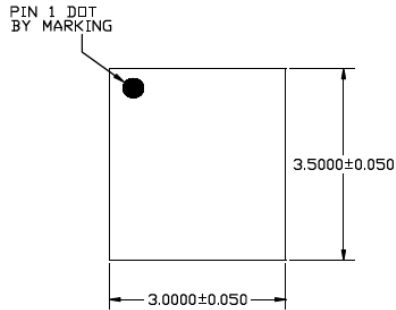
# SM802XXX

## 16-Lead QFN Package Outline and Recommended Land Pattern

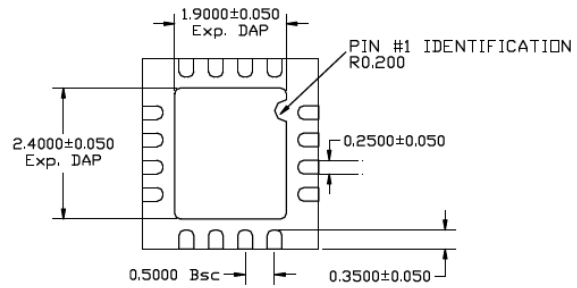
**TITLE**

16 LEAD QFN 3.0x3.5mm PACKAGE OUTLINE & RECOMMENDED LAND PATTERN

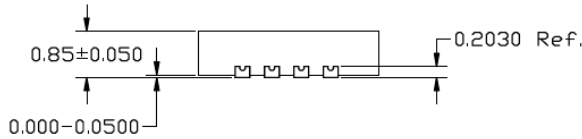
DRAWING #	QFN3035-16LD-PL-1	UNIT	MM
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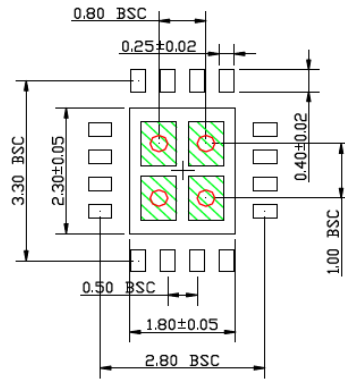
**TOP VIEW**  
NOTE: 1, 2, 3



**BOTTOM VIEW**  
NOTE: 1, 2, 3



**SIDE VIEW**  
NOTE: 1, 2, 3



**RECOMMENDED LAND PATTERN**  
NOTE: 4, 5

**NOTE:**

1. MAX PACKAGE WARPAGE IS 0.05 MM
2. MAX ALLOWABLE BURR IS 0.076MM IN ALL DIRECTIONS
3. PIN #1 IS ON TOP WILL BE LASER MARKED
4. RED CIRCLE IN LAND PATTERN REPRESENT THERMAL VIA. RECOMMENDED DIAMETER IS 0.30 - 0.35 MM AND SHOULD BE CONNECTED TO GND FOR MAX THERMAL PERFORMANCE
5. GREEN RECTANGLES (SHADED AREA) REPRESENT SOLDER STENCIL OPENING ON EXPOSED PAD AREA. SIZE SHOULD BE 0.80x0.60 MM, 0.20 MM SPACING.

Note: For the most current package drawings, please see the Microchip Packaging Specification located at <http://www.microchip.com/packaging>.

## APPENDIX A: REVISION HISTORY

### Revision A (March 2019)

- Converted Micrel document SM802xxx to Microchip data sheet DS20006176A.
- Minor text changes throughout.
- Updated the Crystal and Reference Input frequency ranges in the [Features](#) section and in [Crystal Characteristics](#) table.
- Updated ESR value in [Crystal Characteristics](#) table.
- Updated the 12 kHz to 20 MHz Phase Jitter to 265 fs in the [Features](#) and in [LVPECL AC Electrical Characteristics \(Note 1, Note 2, Note 3, Note 4\)](#).
- Updated Output Frequency minimum and typical Phase Jitter in [LVDS AC Electrical Characteristics \(Note 1, Note 2, Note 3, Note 4\)](#), [HCSL AC Electrical Characteristics \(Note 1, Note 2, Note 3, Note 4\)](#), and [LVCMOS AC Electrical Characteristics \(Note 1, Note 2, Note 3, Note 4\)](#).
- Corrected the impedance values for using a ferrite bead in [Power Supply Decoupling](#) section.

# SM802XXX

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NOTES:

## PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, contact your local Microchip representative or sales office.

<u>PART NO.</u>	X	X	X	-	X	<b>Examples:</b>			
Device	Voltage Option	Package Type	Temperature		Special Processing				
<b>Device:</b>	SM802xxx:	Flexible Ultra-Low Jitter Clock Synthesizer				a) SM802xxxUMG: Flexible Ultra-Low Jitter Clock Synthesizer, 2.5V/3.3V Voltage Option, QFN Package, -40°C to +85°C Temperature Range, Tray			
<b>Voltage Option:</b>	U	=	2.5V/3.3V		b) SM802xxxUMG-TR: Flexible Ultra-Low Jitter Clock Synthesizer, 2.5V/3.3V Voltage Option, QFN Package, -40°C to +85°C Temperature Range, Tape & Reel				
<b>Package Type:</b>	M	=	44-, 32-, 24-, or 16-QFN; see the <a href="#">Package Options Table (Note 1)</a> .						
<b>Temperature:</b>	G	=	-40°C to +85°C (NiPdAu Lead Free)						
<b>Special Processing:</b>	Blank	=	Tray						
	TR	=	Tape and Reel						
<b>Package Options Table (Note 1)</b>									
Package Option	QFN Package	# of Outputs	XTAL	REF_IN	XTAL_SEL	FSEL	OE1 OE2	PLL BYPASS	
#1	44-Pin 7x7	8 Diff.	Yes	Yes	Yes	Yes	Yes	Yes	
#2	32-Pin 5x5	4 Diff.	Yes	Yes	Yes	Yes	Yes	Yes	
#3	24-Pin 4x4	4 Diff.	Yes	Yes	Yes	No	No	Yes	
#4	24-Pin 4x4	2 Diff.	Yes	Yes	Yes	Yes	Yes	Yes	
#5	16-Pin 3x3.5	2 Diff.	No	Yes	No	Yes	No	No	
#6	16-Pin 3x3.5	2 Diff.	Yes	No	No	No	No	No	
<b>Note 1:</b> Use the web tool at <a href="http://clockworks.microchip.com/micrel/">http://clockworks.microchip.com/micrel/</a> to determine the desired configuration.									

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NOTES:



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