LMX5080

LMX5080 PLLatinum 2.7 GHz Low Power Dual Modulus Prescaler for RF Personal Communications

Literature Number: SNOS419

National Semiconductor

PRELIMINARY
April 1999

LMX5080
PLLatinum™ 2.7 GHz Low Power Dual Modulus Prescaler for RF Personal Communications

General Description

The LMX5080 integrated dual modulus prescaler, is designed to be used in a synthesized local oscillator for 2.5 GHz wireless transceivers. It is fabricated using National's 0.5µ ABiCV silicon BiCMOS process. The LMX5080 contains three dual modulus prescalers. Either a 128/130, 256/158 or a 512/514 prescaler can be selected for up to 2.7 Gz RF input frequencies. The prescaler inputs can be driven either differentially, or single ended with the use of a coupling capacitor on one of the inputs to ground. The LMX5080 CMOS output is optimized to generate very stable, low switching noise output signals. The LMX5080 prescaler can be used in conjunction with a low frequency Phase Lock Loop to form a frequency synthesizer suitable for UHF transceivers. Supply voltage can range from 2.7V to 5.5V. The LMX5080 features low current consumption; typically 7.0 mA at 5V V_{CC}

The LMX5080 is available in a 8-pin Small Outline (SOP) surface mount plastic package.

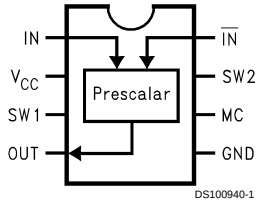
Features

- 2.7V to 5.5V operation
- Low current consumption: 7 mA (typ) @ 5V
- −40˚C to +85˚C low noise CMOS output
- Selectable dual modulus prescaler
  - 128/130
  - 256/258
  - 512/514
- 8-pin small package outline (SOP)

Applications

- 2.5 GHz wireless communications systems (ISM)
- Direct Broadcast Satellite systems (DBS)
- Cable TV tuners (CATV)

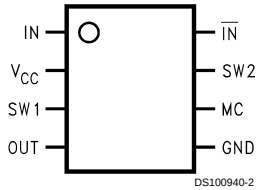
Functional Block Diagram



PLLatinum™ is a trademark of National Semiconductor Corporation.

Connection Diagram

Small Outline Package (SOP)



NS Package Number M08A
Order Number LMX5080M, LMX5080MX

Pin Descriptions

Pin No.	Pin Name	I/O	Description
1	IN	I	RF small signal prescaler input. Small signal input from the voltage controlled oscillator
2	V_{CC}	—	Power Supply voltage input may range from 2.7V to 5.5V. Bypass capacitors should be placed as close as possible to this pin and be connected directly to the ground plane.
3	SW1	I	Divide Ratio Control. CMOS logic input. Pin functionality is described in the Modulus Control Truth Table.
4	OUT	O	Prescaler Output. CMOS level output for connection to low frequency PLL input.
5	GND	—	Ground for analog and digital signals.
6	MC	I	Modulus Control Input. High impedance CMOS logic input. Pin functionality is described in the Modulus Control Truth Table.
7	SW2	I	Divide Ratio Control. High impedance CMOS logic input. Pin functionality is described in the Modulus Control Truth Table.
8	$\overline{IN}$	I	RF small signal prescaler complementary input. In single-ended mode, a bypass capacitor should be placed as close as possible to this pin and be connected directly to the ground plane. The IN and $\overline{IN}$ can be driven differentially when the bypass capacitor is omitted.

Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/ Distributors for availability and specifications.

Parameter	Symbol	Value Min	Typ	Max	Units
Power Supply Voltage	V_{CC}	−0.3		6.5	V
Voltage on any pin with GND=0V	V_i	−0.3		V_{CC}+0.3	V
Storage Temperature Range	T_S	−65		+1.50	˚C
Lead Temp. (solder 4 sec)	T_L			+2.60	˚C

Recommended Operating Conditions (Note 1)

Parameter	Symbol	Value Min	Typ	Max	Units
Power Supply Voltage	V_{CC}	2.7		5.5	V
Operating Temperature	T_A	−40		+85	˚C

Note 1: "Absolute Maximum Ratings" indicate limits beyond which damage to the device may occur. Recommended Operating Conditions indicate conditions for which the device is intended to be functional, but do not guarantee specific performance limits. Electrical Characteristics document specific minimum and/or maximum performance values at specified test conditions and are guaranteed. Typ or Typical values are for informational purposes only which are based on design parameters or device characterization and are not guaranteed.

Note 2: This device is a high performance RF integrated circuit and is ESD sensitive. Handling and assembly of this device should only be done on ESD-free workstations.

Electrical Characteristics

(V_{CC} = 5.0V, T_A = −40˚C to +85˚C except as specified) (Note 1)

Symbol	Parameter	Condition	Value Min	Typ	Max	Units
I_{CC}	Power Supply Current			7		mA
V_{OH}	Output Amplitude	Z_L = 100 kΩ//10 pF V_{CC} = 2.7V to 5.5V	0.9 x V_{CC}			V
V_{OL}					0.1 x V_{CC}	V
f_{in}	Input Frequency	AC coupled. V_{CC} = 2.7V to 5.5V	100		2700	MHz
Pf_{in}	Operational Input Signal Amplitude	V_{CC} = 2.7V to 5.5V	−15		+4	dBm
f_{out}	Output Frequency		0.1		25	MHz
V_{IH}	High-level Input Voltage (MC, SW1, SW2)		0.7 x V_{CC}			V
V_{IL}	Low-level Input Voltage (MC, SW1, SW2)				0.3 x V_{CC}	V
I_{IH}	High-level Input Current (MC, SW1, SW2)	V_{IH} = 0.7 x V_{CC}		±1		uA
I_{IL}	Low-level Input Current (MC, SW1, SW2)	V_{IL} = 0.3 x V_{CC}		±1		uA
t_{Set}	Modulus Control Set-up time. (Note 3)	SW1=H, SW2=H f_{in} = 2.7 GHz		15	20	ns
IM	Input/Output Intermodulation (Note 4)	−10 dBm / 50Ω AC coupled signal delivered to input. V_{CC}=2.7V to 5.5V. MC=0, MC=1. Fin=2.3 GHz to 2.5 GHz.		−35	−30	dBc

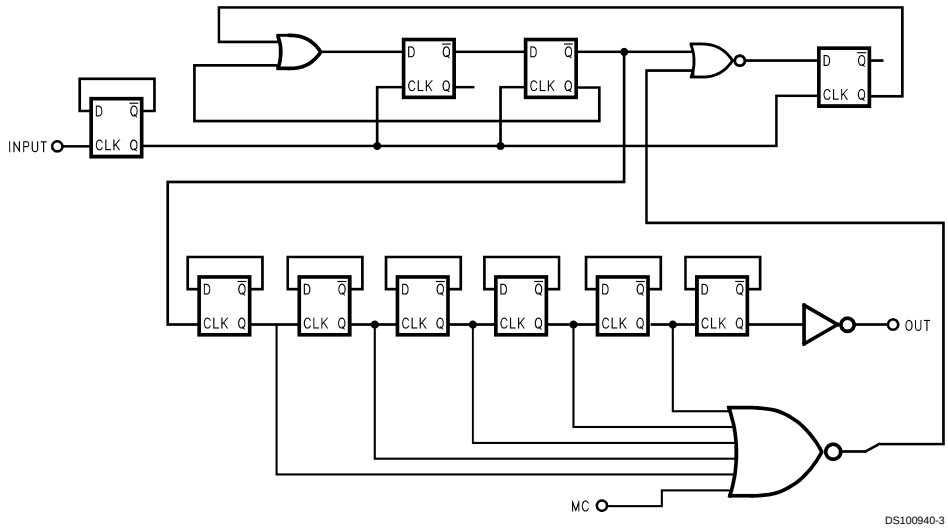
Note 3: See Timing Diagram.

Note 4: Guaranteed by design and characterization, not tested. Output frequency measured at input.

Functional Description

The basic phase-lock-loop (PLL) configuration using an external prescaler consists of a high-stability crystal reference oscillator, a prescaler such as the National Semiconductor LMX5080, a low frequency synthesizer, a voltage controlled oscillator (VCO), and a loop filter. The frequency synthesizer typically includes programmable reference [R] and feedback [N] frequency dividers, a phase detector, as well as a charge pump. The MC signal is fed back to the prescaler from either the low frequency synthesizer, or a controller to set the prescaler divide ratio to N or N+2. The prescaler output frequency is established by dividing the VCO signal down via the prescaler modulus. The RF inputs to the prescalar consist of the Fin and /Fin input pins which are complementary inputs to a differential pair amplifier. This configuration can operate to 2 GHz with an input sensitivity of −15 dBm.

Block Diagram



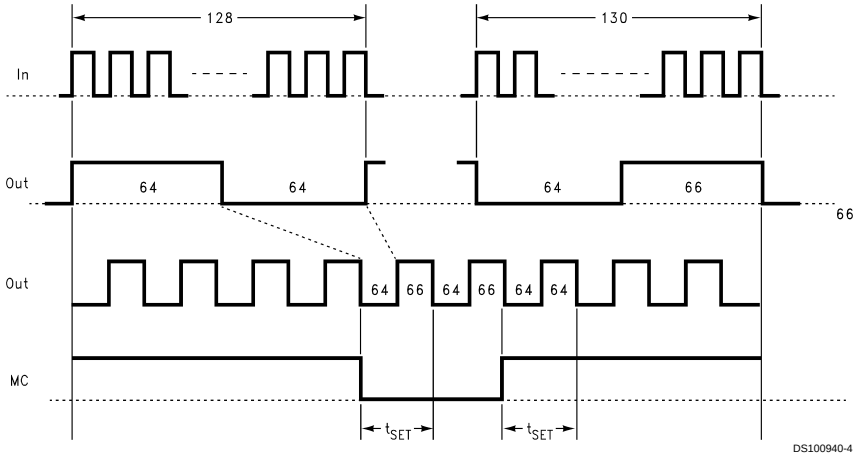
DS100940-3

Modulus Control Truth Table

SW1	SW2	MC	Divide Ratio
H	H	H	1/128
H	H	L	1/130
H	L	H	1/256
L	H	H	1/256
H	L	L	1/258
L	H	L	1/258
L	L	H	1/512
L	L	L	1/514

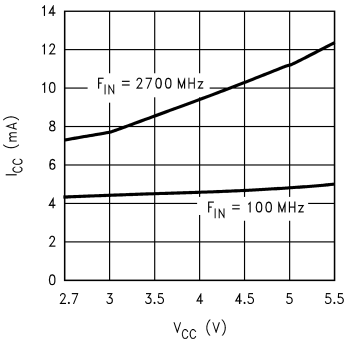
Note: SW1, SW2, MC: H = 0.7 x V_{CC}, L = 0.3 x V_{CC}.

Timing Diagram



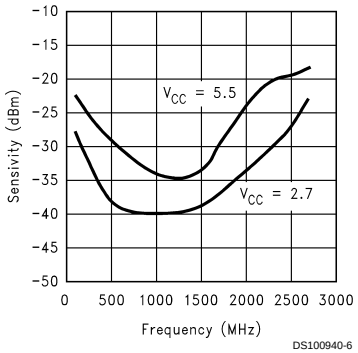
Typical Performance Characteristics

I_{CC} vs V_{CC}
N = 1/128, T_A = 25˚C



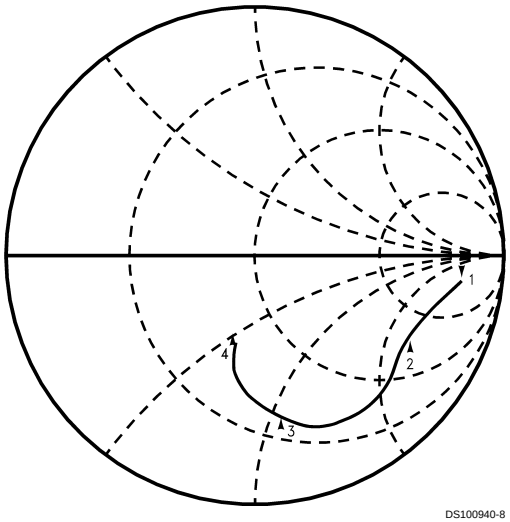
DS100940-7

RF Input Sensitivity vs Frequency



DS100940-6

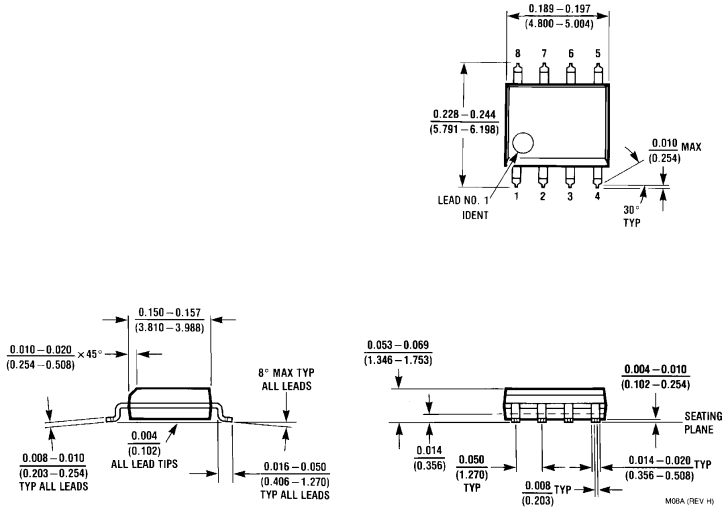
Input Impedance (S11) vs Frequency
V_{CC} = 2.7V to 5.5V, f_{in} = 100 MHz to 2.7 GHz



DS100940-8

Marker 1 = 100 MHz, Real = 364, I_{mag} = −253
Marker 2 = 1 GHz, Real = 104, I_{mag} = −136
Marker 3 = 2 GHz, Real = 26, I_{mag} = −53
Marker 4 = 2.7 GHz, Real = 36, I_{mag} = −23

Physical Dimensions inches (millimeters) unless otherwise noted



8 Lead (0.150" Wide) Molded Small Outline Package, JEDEC
Order Number LMX5080M
For Tape and Reel
Order Number LMX5080MX
NS Package Number M08A

LIFE SUPPORT POLICY

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

National Semiconductor Corporation
Americas
Tel: 1-800-272-9959
Fax: 1-800-737-7018
Email: support@nsc.com

www.national.com

National Semiconductor Europe
Fax: +49 (0) 1 80-530 85 86
Email: europe.support@nsc.com
Deutsch Tel: +49 (0) 1 80-530 85 85
English Tel: +49 (0) 1 80-532 78 32
Français Tel: +49 (0) 1 80-532 93 58
Italiano Tel: +49 (0) 1 80-534 16 80

National Semiconductor Asia Pacific Customer Response Group
Tel: 65-2544466
Fax: 65-2504466
Email: sea.support@nsc.com

National Semiconductor Japan Ltd.
Tel: 81-3-5639-7560
Fax: 81-3-5639-7507

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products		**Applications**	
Audio	www.ti.com/audio	Communications and Telecom	www.ti.com/communications
Amplifiers	amplifier.ti.com	Computers and Peripherals	www.ti.com/computers
Data Converters	dataconverter.ti.com	Consumer Electronics	www.ti.com/consumer-apps
DLP® Products	www.dlp.com	Energy and Lighting	www.ti.com/energy
DSP	dsp.ti.com	Industrial	www.ti.com/industrial
Clocks and Timers	www.ti.com/clocks	Medical	www.ti.com/medical
Interface	interface.ti.com	Security	www.ti.com/security
Logic	logic.ti.com	Space, Avionics and Defense	www.ti.com/space-avionics-defense
Power Mgmt	power.ti.com	Transportation and Automotive	www.ti.com/automotive
Microcontrollers	microcontroller.ti.com	Video and Imaging	www.ti.com/video
RFID	www.ti-rfid.com		
OMAP Mobile Processors	www.ti.com/omap		
Wireless Connectivity	www.ti.com/wirelessconnectivity		
	TI E2E Community Home Page		e2e.ti.com

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265