

# MN6153UC

## PLL LSI with Built-In Prescaler

### ■ Overview

The MN6153UC is a CMOS LSI for a phase-locked loop (PLL) frequency synthesizer with serial data input.

It consists of a two-coefficient prescaler, variable frequency divider, phase comparator, and charge pump.

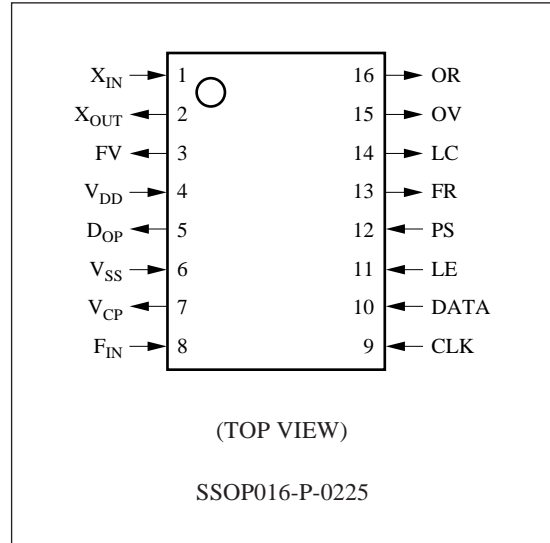
It offers high-speed operation on a low power supply voltage (1.0 to 1.4 V) and low power consumption (0.5 mW for  $V_{DD}=1.03$  V,  $F_{IN}=60$  MHz).

Other features include intermittent operation by the power save (PS) control signal and high-speed pull-in that rapidly corrects the phase differences occurring at the start of operation.

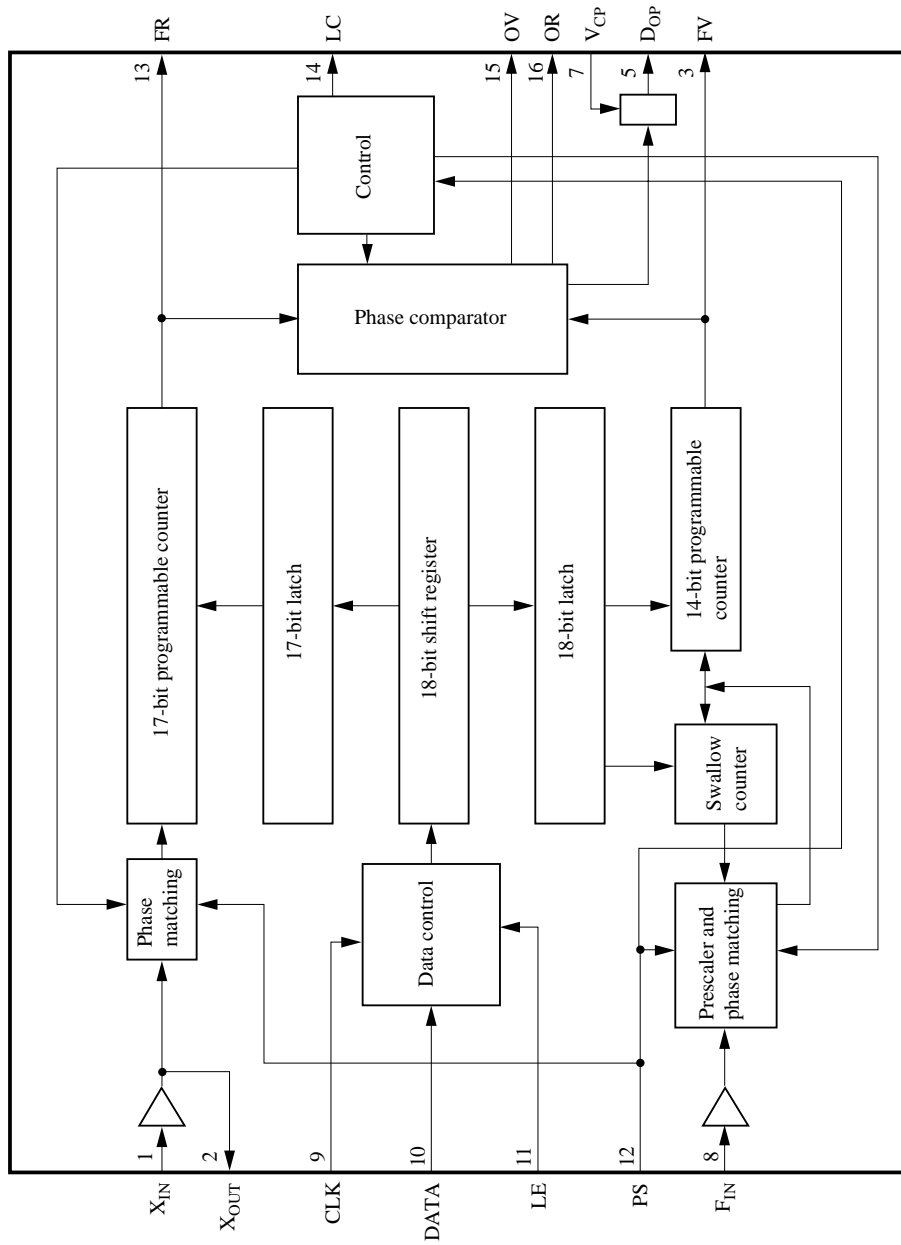
### ■ Features

- Low power supply voltage:  $V_{DD}=1.0$  to  $1.4$ V
- Low power consumption:  $0.5$ mW ( $V_{DD}=1.03$ V,  $F_{IN}=60$ MHz)
- High-speed operation:  $F_{IN}=60$ MHz ( $V_{DD}=1.03$ V)
- Frequency dividing ratios in reference frequency dividing stage: 5 to 131,071
- Frequency dividing ratios in comparator stage: 272 to 262,143
- Lock detector output pin
- Two types of phase comparator output
  - Internal charge pump output
  - Output for external charge pump
- Output monitor pins for both comparator and reference frequency dividing stages

### ■ Pin Assignment



■ Block Diagram



### ■ Pin Descriptions

Pin No.	Symbol	Function Description
1	$X_{IN}$	Crystal oscillator connection pins: $X_{IN}$ =Oscillator circuit input pin; $X_{OUT}$ =Oscillator circuit output pin.
2	$X_{OUT}$	
3	FV	Frequency divider output signal in comparator stage. Phase comparator input monitor.
4	$V_{DD}$	Power supply
5	$D_{OP}$	Low-pass filter connection pin. Use a passive filter.
6	$V_{SS}$	Ground
7	$V_{CP}$	Power supply pin for built-in charge pump
8	$F_{IN}$	Frequency divider input pin in comparator stage.
9	CLK	Shift register clock input pin. The chip latches data at the rising edge of the CLK signal.
10	DATA	Shift register data input pin. The final two bits in the data select the write latch: "11" for R-latch; "01" for N-latch.
11	LE	Load enable signal input pin. This is the latch-write-enable signal. It is at "H" level for write.
12	PS	Power save control signal input pin. "H" level input starts the frequency divider and places the chip in operational mode. "L" level input places the chip in standby mode, which saves power. The chip switches the internal charge pump output to the H-z state and the loop is opened.
13	FR	Reference frequency divider output signal. Phase comparator input monitor.
14	LC	Charge pump control signal output pin. When frequency divider operation is stopped, this pin is at "L" level, the internal charge pump output is in the high-impedance state, and the loop is opened.
15	OV	Phase comparator output pin for external charge pump. (OR provides N-channel open drain output.)
16	OR	

### ■ MN6153 Frequency Dividing Data Settings

The following formula shows frequency divider operation.

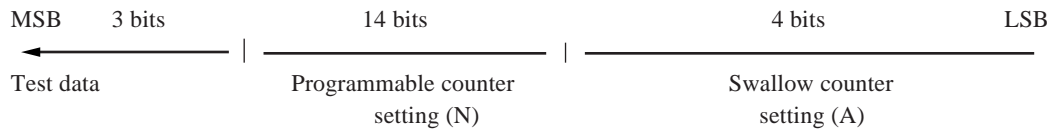
$$F_{IN} = \{ (16 \times N) + A \} \times (X_{IN} \div R)$$

where

- $F_{IN}$  : VCO output frequency
- $N$  : Setting for 14-bit programmable counter on comparator side
- $A$  : Setting for 4-bit swallow counter on comparator side
- $X_{IN}$  : Reference oscillator frequency
- $R$  : Setting for 17-bit programmable counter on reference side

Note that  $N$  should be greater than  $A$ .

#### ● N-Side Latch Data





### ■ Absolute Maximum Ratings

Parameter	Symbol	Rating	Unit
Power supply voltage	$V_{DD}$	- 0.3 to +3.0	V
Power supply voltage	$V_{CP}$	- 0.3 to +4.0	
Input pin voltage	$V_I$	$V_{SS} - 0.3$ to $V_{DD} + 0.3$	
Output pin voltage	$V_O$	$V_{SS} - 0.3$ to $V_{DD} + 0.3$	
Power dissipation	$P_D$	20	mW
Operating ambient temperature	$T_{opr}$	-10 to +60	°C
Storage temperature	$T_{stg}$	-55 to +125	

### ■ Operating Conditions

$V_{SS}=0V$ ,  $T_a=-10$  to  $+60^\circ C$

Parameter	Symbol	Test Conditions	min	typ	max	Unit
Power supply voltage	$V_{DD}$		1.0	1.1	1.4	V
Power supply voltage	$V_{CP}$		2.5	3.0	3.2	V

### ■ Electric Characteristics

$V_{CP}=2.5V$ ,  $T_a=-10$  to  $+60^\circ C$

Parameter	Symbol	Test Conditions	min	typ	max	Unit
Power supply pin	$V_{DD}$	$V_{DD}=1.03V$				
Power supply current	$I_{DD}$	$F_{IN}=100MHz$ , $X_{IN}=20MHz$ , PS="H"			0.5	mA
	$I_{Dstop}$	PS="L" (at power save operation)			2.0	$\mu A$

Input Pins CLK, DATA, LE, PS  $V_{DD}=1.0$  to  $1.4V$

"H" level input voltage	$V_{IH}$		$V_{DD} - 0.2$		$V_{DD}$	V
"L" level input voltage	$V_{IL}$		$V_{SS}$		0.2	
Input leakage current	$I_{LI}$				$\pm 1.0$	$\mu A$

Input Pin  $F_{IN}$   $V_{DD}=1.03$  to  $1.4V$

Input voltage	$V_{IN}$		0.4			$V_{p-p}$
Input current	$I_{IF}$	Pull-up resistor is present (PS="L")	-10		-100	$\mu A$
Input leakage current	$I_{LIF}$	$V_{IN}=0$ or $V_{DD}$ (PS="H")			$\pm 20$	$\mu A$
Maximum operating frequency	$F_{INMAX}$	$V_{IN}=0.4 V_{p-p}$	60			MHz
Minimum operating frequency	$F_{INMIN}$	$V_{IN}=0.4 V_{p-p}$			10	MHz

Input Pin  $X_{IN}$   $V_{DD}=1.0$  to  $1.4V$

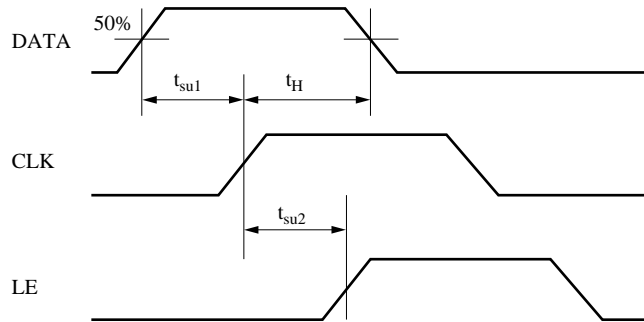
Input voltage	$V_{IN}$		0.4			$V_{p-p}$
Input current	$I_{IX}$	Pull-up resistor is present (PS="L")	-0.2		-1.5	mA
Input leakage current	$I_{LIX}$	$V_{IN}=0$ or $V_{DD}$			2.0	$\mu A$

■ Electrical Characteristics (continued)

$V_{CP}=2.5V$ ,  $T_a=-10$  to  $+60^{\circ}C$

Parameter	Symbol	Test Conditions	min	typ	max	Unit
Crystal Oscillator Pins $X_{IN}, X_{OUT}$ $V_{DD}=1.03$ to $1.4V$						
Crystal oscillator frequency	$f_{Xtal}$			12.8		MHz
Output Pins $FV, FR, LC, OV$ $V_{DD}=1.0$ to $1.4V$						
"H"level output voltage	$V_{OH}$	$I_{OH}=-60\mu A$	$V_{DD}-0.3$		$V_{DD}$	V
"L"level output voltage	$V_{OL}$	$I_{OL}=30\mu A$	$V_{SS}$		0.3	
Output Pin $X_{OUT}$ $V_{DD}=1.0$ to $1.4V$						
"H"level output voltage	$V_{XOH}$	$I_{XOH}=-100\mu A$	$V_{DD}-0.3$		$V_{DD}$	V
"L"level output voltage	$V_{XOL}$	$I_{XOL}=100\mu A$	$V_{SS}$		0.3	
Output Pin $D_{OP}$ $V_{DD}=1.0$ to $1.4V$						
"H"level output voltage	$I_{DOH}$	$V_{Dop}=V_{CP}-0.3V$	-250			$\mu A$
"L"level output voltage	$I_{DOL}$	$V_{Dop}=0.3V$	250			
Output leak current	$I_{LOH}$	$V_{Dop}=V_{CP}$			2.0	
Output leak current	$I_{LOL}$	$V_{Dop}=0.0V$			-2.0	
Output Pin $OR$ $V_{DD}=1.0$ to $1.4V$						
"L"level output voltage	$I_{ORL}$	$V_{OR}=0.3V$	45			$\mu A$
$V_{DD}=1.0$ to $1.4V$						
Setup time *1	$t_{su1}$		500			ns
	$t_{su2}$		500			ns
Hold time *1	$t_H$		500			ns

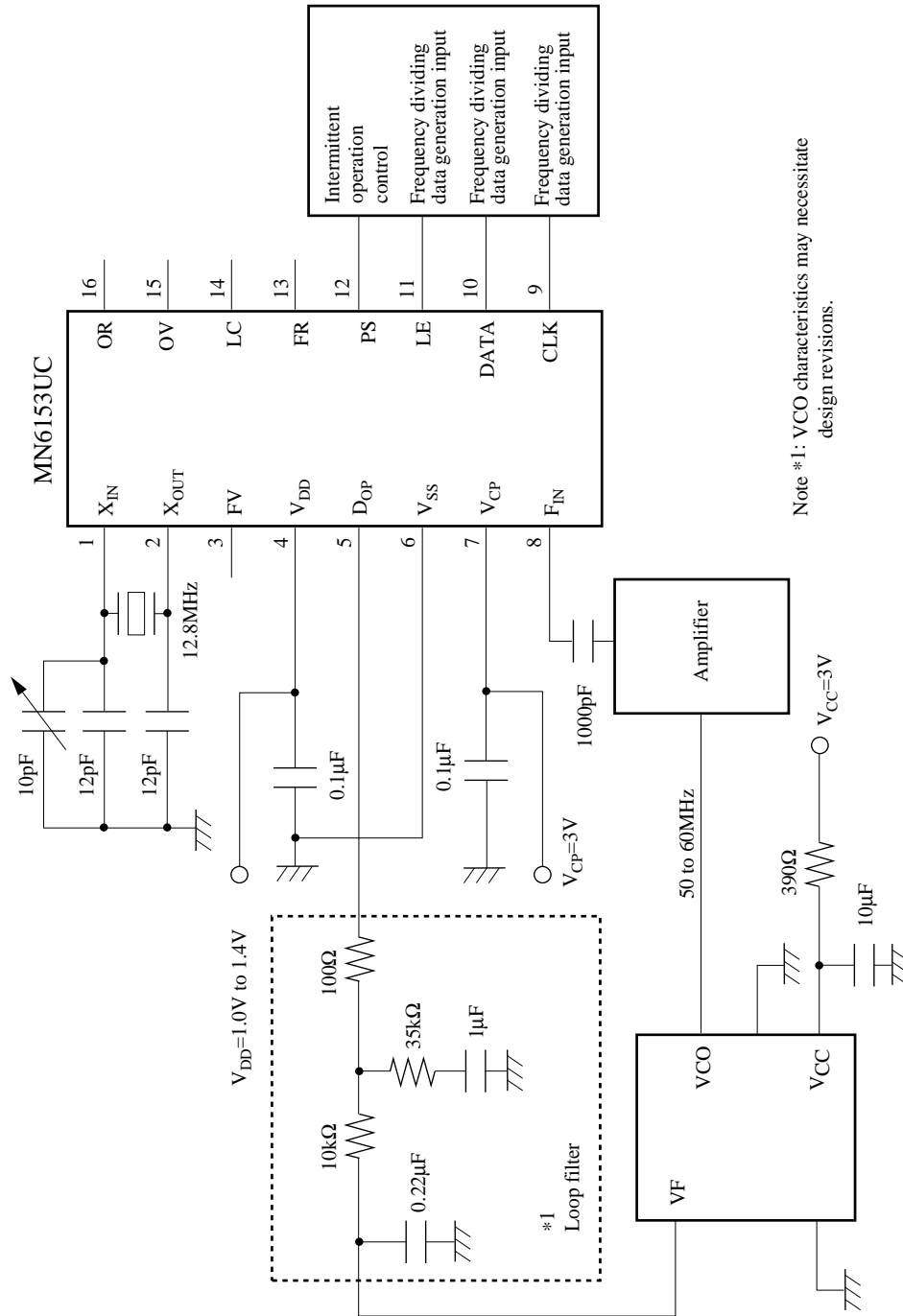
Note\*1: The following timing chart shows the setup and hold times.



Usage Note

Be particularly careful with this product as it is more sensitive on the static electricity damage than most of our other products.

■ Application Circuit Example





■ Package Dimensions (Unit: mm)

SSOP016-P-0225

