

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.

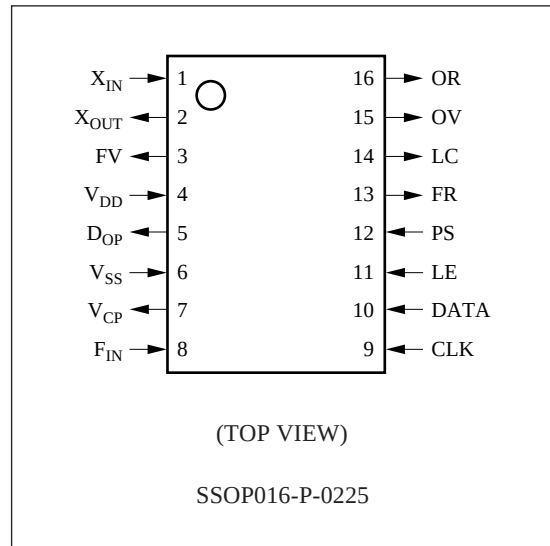
It offers high-speed operation on a low power supply voltage (1.0 to 1.4 V) and low power consumption (0.5 mW for $V_{DD}=1.03$ V, $F_{IN}=60$ MHz).

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.

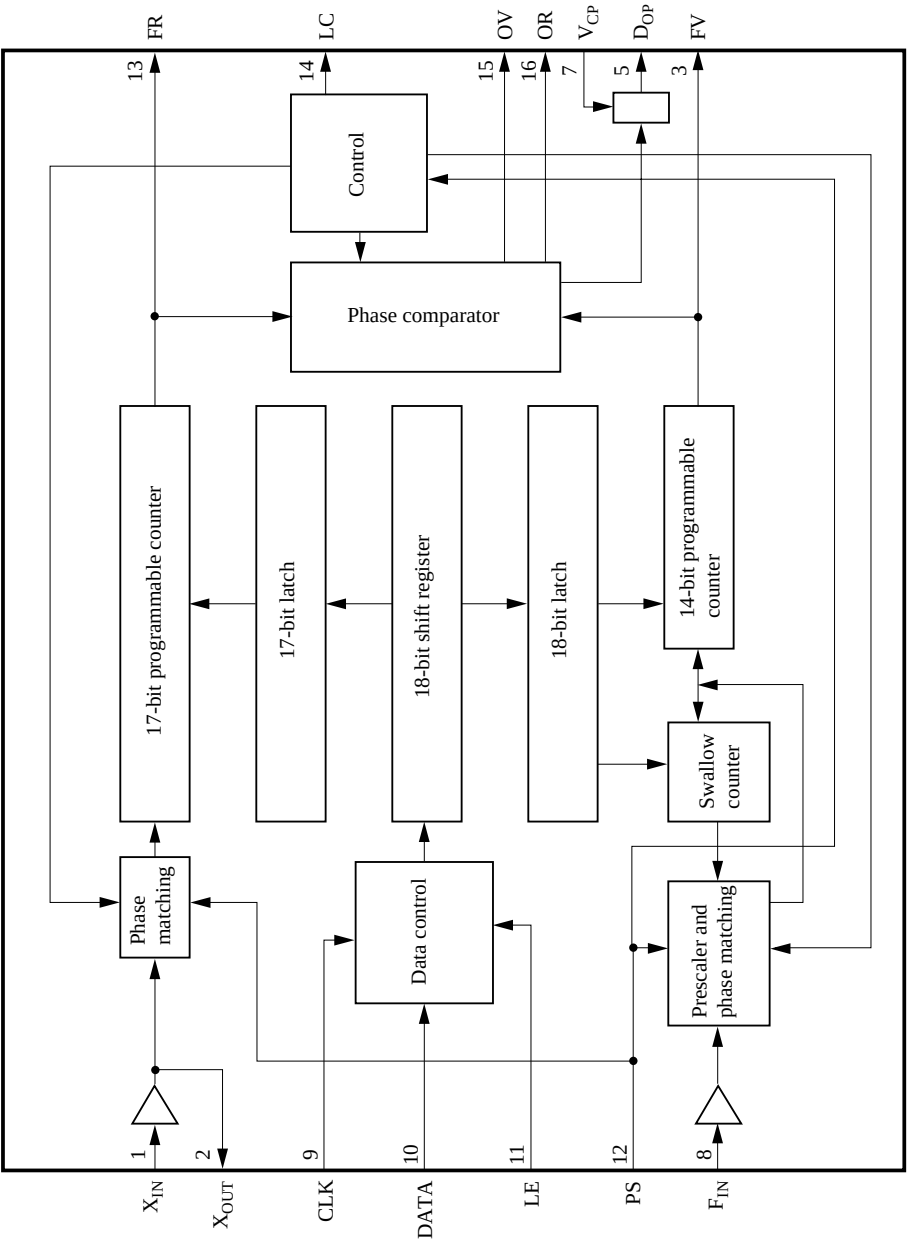
■ Features

- Low power supply voltage: $V_{DD}=1.0$ to 1.4 V
- Low power consumption: 0.5mW ($V_{DD}=V_{1.03V}$, $F_{IN}=60$ 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.

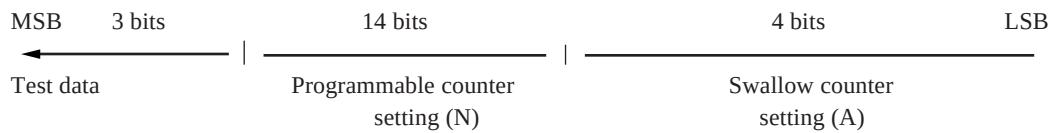
$$F_{IN} = \{ (16 \times N) + A \} \times (X_{IN} \div R)$$

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

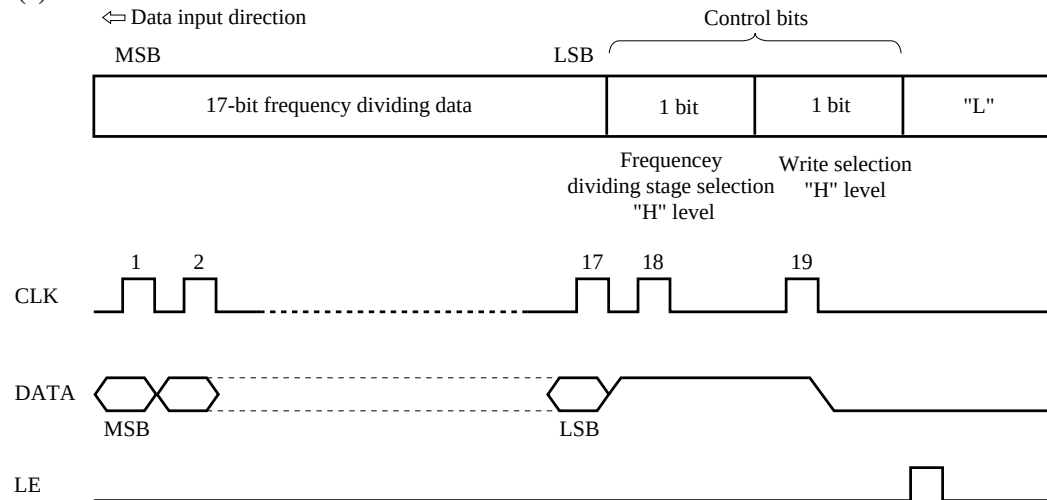


■ Note on Setting Frequency Dividing Data Input

1) Frequency dividing data input

(1) Reference side

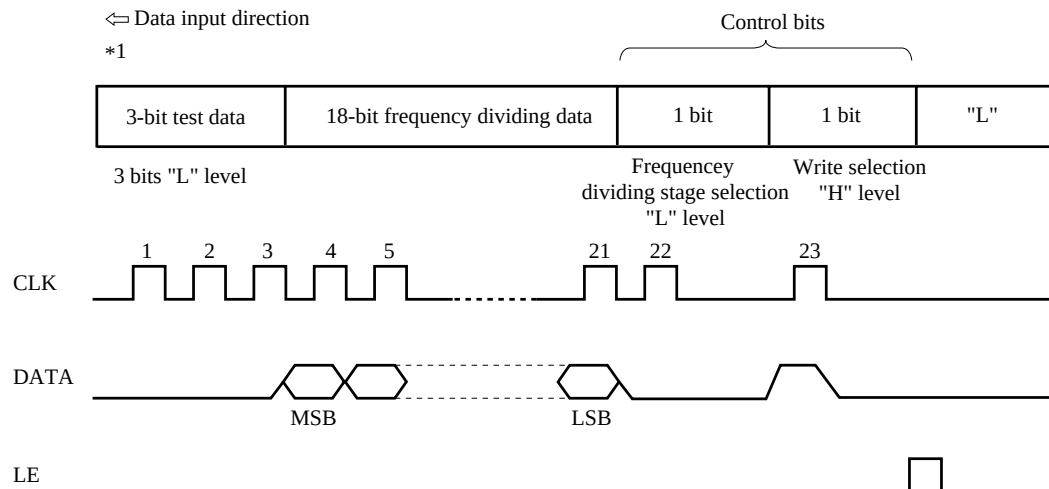
⇔ Data input direction



(2) Comparating side

⇔ Data input direction

*1



Notes

- *1: Preceding the input of the frequency dividing data for the comparing side, input test data consisting of three "L" level bits to produce normal operation. Never use any other pattern.
- When the power is first applied, internal operation remains in an unstable state until data is written. To eliminate the risk of excessive current consumption, keep the PS pin at "L" level.
- When the power is first applied, the data settings are indeterminate. Always write data to the chip before starting operation.
- Enter the data to fill the entire latch:
Reference side: 19 bits (17 bits for the frequency divider setting and 2 control bits)
Comparating side: 23 bits (3 bits for the test pattern, 18 bits for the frequency divider setting, and 2 control bits)
- Drive the LE pin at "L" level while writing the data.
- "H" level input from the LE pin causes the chip to read the data only when the CLK pin and the DATA pin are both at "L" level.
- Writes are possible when the PS pin is either "H" or "L" level.
- Input the data MSB first.
- The data are inputted at the rising edge of the CLK signal.

■ 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	μA

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}				± 1.0	μA

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	μA
Input leakage current	I_{LIF}	$V_{IN}=0$ or V_{DD} (PS="H")			± 20	μA
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 $1.4V$

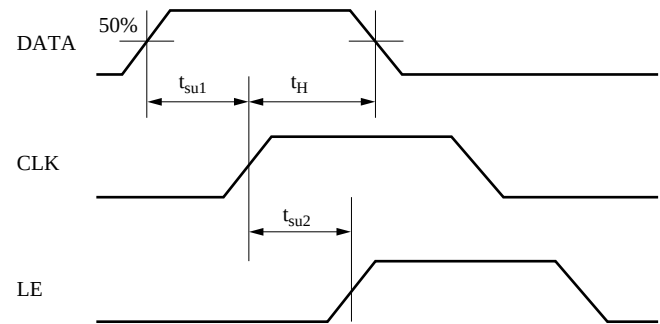
Input voltage	V_{IN}		0.4			V_{p-p}
Input current	I_{IX}	Pull-up resistor is present (PS="L")	- 0.2		-1.5	mA
Input leakage current	I_{LIX}	$V_{IN}=0$ or V_{DD}			2.0	μA

■ Electrical Characteristics (continued)

V_{CP}=2.5V, Ta=-10 to +60°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			μA
"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			μA
$V_{DD}=1.0$ to $1.4V$						
Setup time *1	t_{sul}		500			ns
	t_{su2}		500			ns
Hold time *1	t_H		500			ns

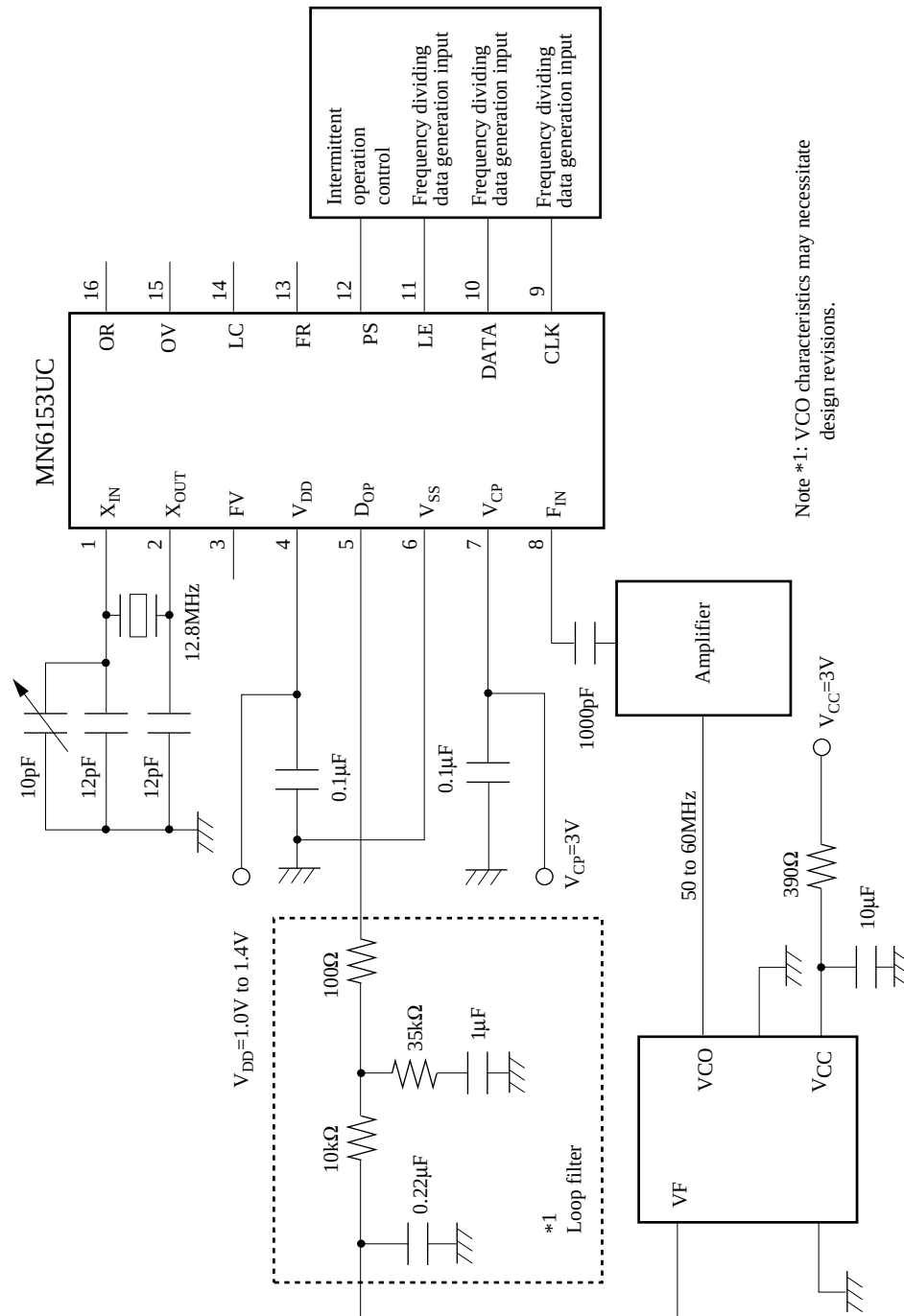
Note*1: The following timing chart shows the setup and hold times.



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



Note *1: VCO characteristics may necessitate design revisions.

■ Package Dimensions (Unit: mm)

SSOP016-P-0225

