



NMOS LSI

# LM7001/7001M — Direct PLL Frequency Synthesizers

## OVERVIEW

The LM7001 and LM7001M are direct PLL frequency synthesizers that provide accurate reference frequencies for long-wave and medium-wave AM and FM tuners. They incorporate a 24-bit shift register and latch, programmable divider, reference divider and phase detector charge pump.

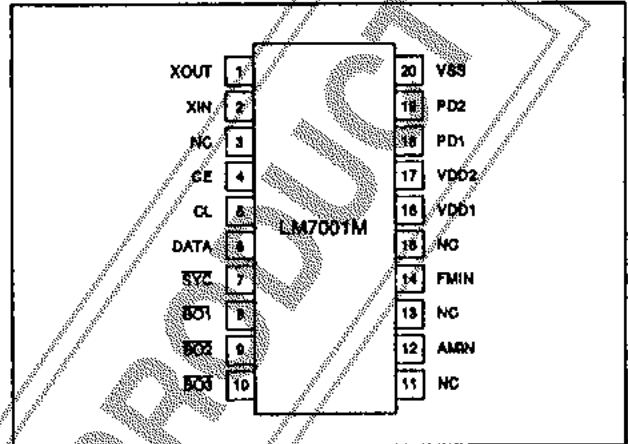
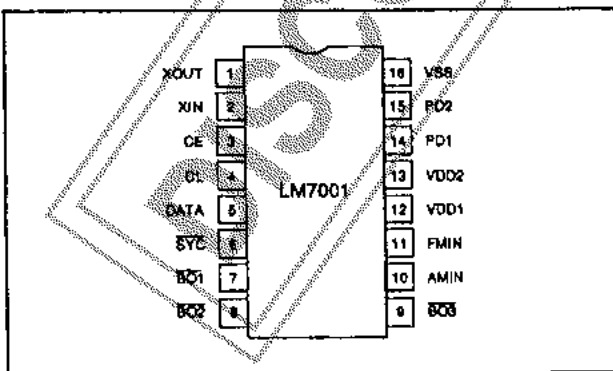
The LM7001 and LM7001M feature an AM frequency range of 500 kHz to 10 MHz and FM ranges of 5 to 30 MHz and 45 to 130 MHz. Seven software-selectable reference frequencies are available in the range 1 to 100 kHz. A 400 kHz microcontroller clock output and an 8 Hz real-time clock output are also provided.

The LM7001 and LM7001M operate from a 5 V supply and are available in 16-pin DIPs and 20-pin MFPs, respectively.

## FEATURES

- High-speed AM/FM programmable divider
- Seven software-selectable reference frequencies in the range 1 to 100 kHz
- Three on-chip, open-drain bandswitching output drivers
- 400 kHz clock output for microcontroller system clock
- 8 Hz timebase output for real-time clock
- Three-wire serial control
- 5 V supply
- 16-pin DIP (LM7001) and 20-pin MFP (LM7001M)

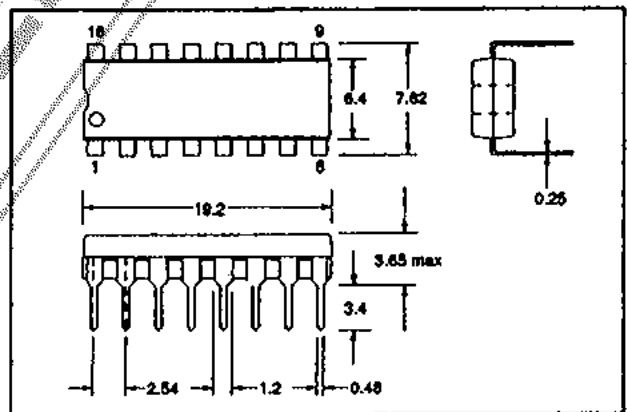
## PINOUTS



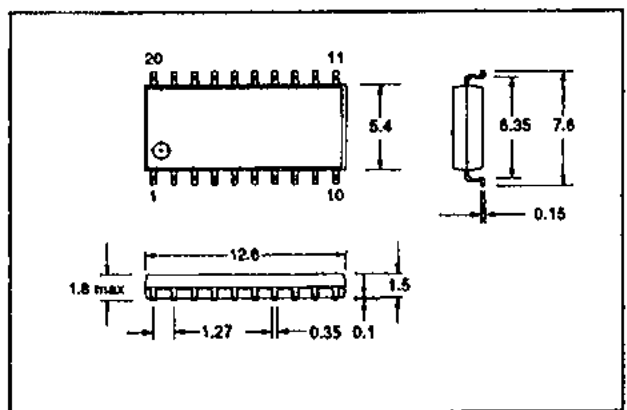
## PACKAGE DIMENSIONS

Unit: mm

3006B-DIP16



3036B-MFP20

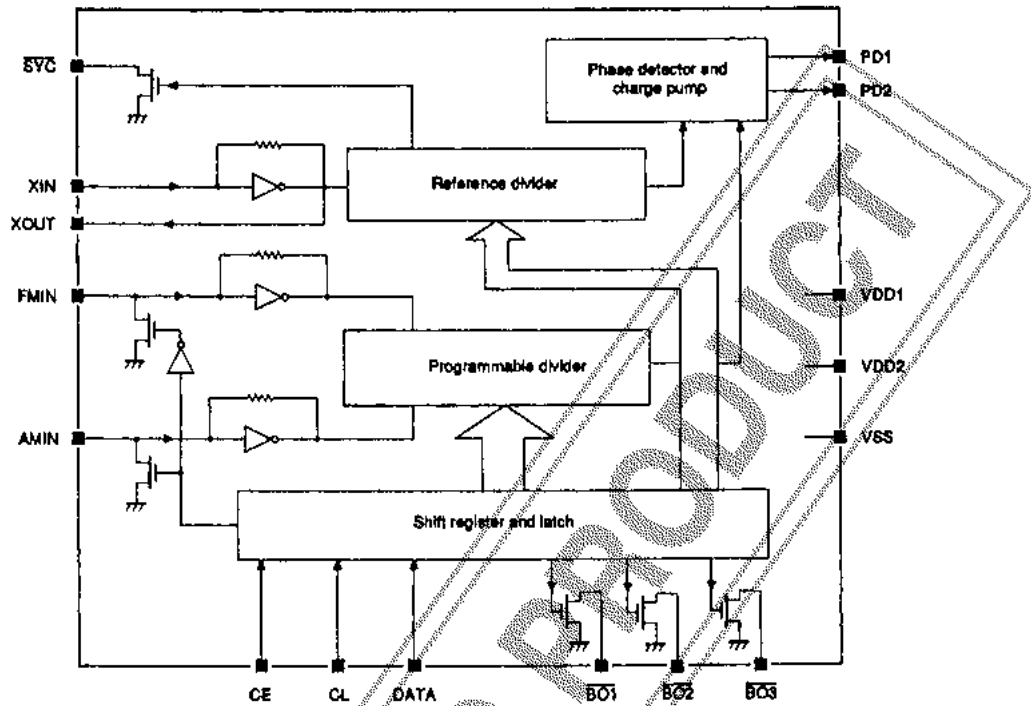


Specifications and information herein are subject to change without notice.

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**BLOCK DIAGRAM**



**PIN DESCRIPTION**

Number		Name	Description
LM7001	LM7001M		
1	1	XOUT	7.2 MHz crystal oscillator output
2	2	XIN	7.2 MHz crystal oscillator input
-	3	NC	No connection
3	4	CE	Chip enable
4	5	CL	Clock input
5	6	DATA	Serial data input
6	7	SYC	400 kHz controller clock output
7	8	BO1	Bandswitching output 1. Can be used for an 8 Hz timebase output
8	9	BO2	Bandswitching output 2
9	10	BO3	Bandswitching output 3
-	11	NC	No connection
10	12	AMIN	AM local oscillator input
-	13	NC	No connection
11	14	FMIN	FM local oscillator input
-	15	NC	No connection
12	16	VDD1	5 V supply
13	17	VDD2	5 V backup supply

LM7001, LM7001M

Number		Name	Description
LM7001	LM7001M		
14	18	PD1	Phase detector charge pump output 1
15	19	PD2	Phase detector charge pump output 2
16	20	VSS	Ground

**SPECIFICATIONS**

**Absolute Maximum Ratings**

Parameter	Symbol	Rating	Unit
Supply voltage range	$V_{DD}$ max	-0.3 to 7.0	V
Logic-level input voltage range	$V_{IH1}$ max	-0.3 to 7.0	V
Analog input voltage range	$V_{IH2}$ max	-0.3 to $V_{DD} + 0.3$	V
$\overline{SYC}$ output voltage range	$V_{OUT1}$ max	-0.3 to 7.0	V
$\overline{BO1}$ , $\overline{BO2}$ and $\overline{BO3}$ output voltage range	$V_{OUT2}$ max	-0.3 to 13	V
PD1, PD2 and XOUT output voltage range	$V_{OUT3}$ max	-0.3 to $V_{DD} + 0.3$	V
$\overline{BO1}$ , $\overline{BO2}$ and $\overline{BO3}$ output current range	$I_{OUT}$ max	0 to 3	mA
Power dissipation	$P_D$	300	mW
Operating temperature range	$T_{OPG}$	-40 to 85	deg. C
Storage temperature range	$T_{STG}$	-55 to 125	deg. C

**Recommended Operating Conditions**

$T_a = 25$  deg. C

Parameter	Symbol	Rating	Unit
Supply voltage	$V_{DD1}$	5	V
	$V_{DD2}$	5	V
Supply voltage range	$V_{DD1}$	4.5 to 6.5	V
	$V_{DD2}$	3.5 to 6.5	V

**Electrical Characteristics**

$T_a = -40$  to  $85$  deg. C

Parameter	Symbol	Condition	Rating			Unit
			min	typ	max	
CE, CL, DATA HIGH-level input voltage	$V_{IH}$		2.2	-	6.5	V
CE, CL, DATA LOW-level input voltage	$V_{IL}$		0	-	0.7	V
$\overline{SYC}$ output voltage	$V_{OUT1}$		0	-	6.5	V
$\overline{BO1}$ , $\overline{BO2}$ and $\overline{BO3}$ output voltage	$V_{OUT2}$		0	-	13	V
XIN input frequency	$f_{IN1}$	Sine wave, capacitive coupling	1.0	7.2	8.0	MHz

LM7001, LM7001M

Parameter	Symbol	Condition	Rating			Unit
			min	typ	max	
FMIN input frequency	$f_{IN2}$	Sine wave, capacitive coupling, S = 1. See notes 1 and 5.	45	–	130	MHz
		Sine wave, capacitive coupling, S = 1. See notes 2 and 5.	5	–	30	MHz
AMIN input frequency	$f_{IN3}$	Sine wave, capacitive coupling, S = 0	0.5	–	10	MHz
Crystal oscillator frequency	$f_{XTAL}$	Crystal impedance $\leq 30 \Omega$	5.0	7.2	8.0	MHz
XIN input voltage	$V_{IN1}$	Sine wave, capacitive coupling	0.5	–	1.5	V
FMIN input voltage	$V_{IN2}$	Sine wave, capacitive coupling	0.1	–	1.5	V
AMIN input voltage	$V_{IN3}$	Sine wave, capacitive coupling	0.1	–	1.5	V
XIN internal feedback resistance	$R_{F1}$		–	1.0	–	M $\Omega$
FMIN internal feedback resistance	$R_{F2}$		–	500	–	k $\Omega$
AMIN internal feedback resistance	$R_{F3}$		–	500	–	k $\Omega$
CE, CL, DATA HIGH-level input current	$I_{IH}$	$V_{IN} = 6.5 \text{ V}$	–	–	5.0	$\mu\text{A}$
CE, CL, DATA LOW-level input current	$I_{IL}$	$V_{IN} = 0 \text{ V}$	–	–	5.0	$\mu\text{A}$
FMIN, AMIN LOW-level output voltage	$V_{OL1}$	$I_{OUT} = 0.5 \text{ mA}$	–	–	3.5	V
SYC LOW-level output voltage	$V_{OL2}$	$I_{OUT} = 0.1 \text{ mA}$ . See note 3.	0.02	–	0.3	V
$\overline{BO1}$ to $\overline{BO3}$ LOW-level output voltage	$V_{OL3}$	$I_{OUT} = 2.0 \text{ mA}$	–	–	1.0	V
SYC output leakage current	$I_{OFF1}$	$V_{OUT} = 6.5 \text{ V}$	–	–	5.0	$\mu\text{A}$
$\overline{BO1}$ to $\overline{BO3}$ output leakage current	$I_{OFF2}$	$V_{OUT} = 13 \text{ V}$	–	–	3.0	$\mu\text{A}$
PD1 to PD2 HIGH-level output voltage	$V_{OH}$	$I_{OUT} = -0.1 \text{ mA}$	$0.5V_{DD}$	–	–	V
PD1 to PD2 LOW-level output voltage	$V_{OL4}$	$I_{OUT} = 0.1 \text{ mA}$	–	–	0.3	V
PD1 to PD2 HIGH-level leakage current	$I_{OFFH}$	$V_{OUT} = V_{DD}$	–	0.01	10.0	nA
PD1 to PD2 LOW-level leakage current	$I_{OFFL}$	$V_{OUT} = 0 \text{ V}$	–	0.01	10.0	nA
Supply current	$I_{DD1}$	See note 4.	–	25	40	mA
	$I_{DD2}$	PLL inhibited	–	2.0	3.5	mA
FMIN input capacitance	$C_{IN}$		1	2	3	pF

Notes

- $f_{ref} = 25, 50$  or  $100 \text{ kHz}$
- $f_{ref} \neq 25, 50$  or  $100 \text{ kHz}$
- $V_{DD} = 3.5$  to  $6.5 \text{ V}$
- $f_{IN2} = 130 \text{ MHz}$ ,  $V_{IN2} = 100 \text{ mV}$ . XIN and XOUT are connected to a  $7.2 \text{ MHz}$  crystal. All other input pins are connected to  $V_{SS}$  and all output pins are open.
- S is the divider select bit in the serial data input string.

**FUNCTIONAL DESCRIPTION**

**Input Data Format**

The LM7001 and LM7001M are controlled from a three-wire serial bus, which comprises chip-enable, clock and serial data inputs. The 24-bit serial data input comprises 14 divider select bits (D0 to D13), two test

control bits (T0 and T1), three bandswitching output control bits (B0 to B2), one timebase control bit (TB), three reference frequency select bits (R0 to R2) and one divider select bit (S) as shown in figure 2.

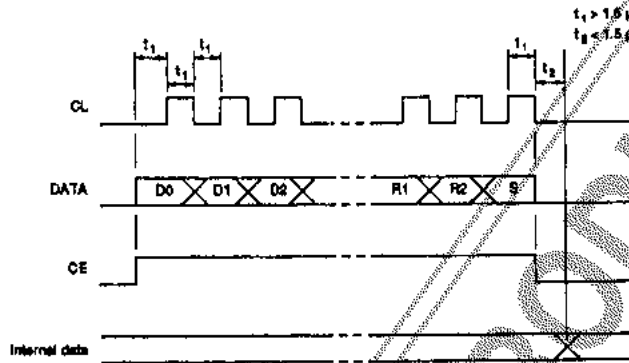


Figure 1. Input waveform diagram



Figure 2. Input data format

**Divider Ratio Select**

Bits D0 to D13 select the FMIN divider ratio. Bits D4 to D13 select the AMIN divider ratio as shown in figure

3. The S bit selects the FMIN divide function when set to 1, and AMIN, when cleared to 0.

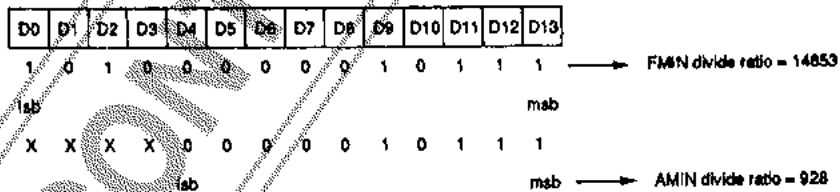


Figure 3. Divider ratio select

**Test Control**

Bits T0 and T1 should be cleared to 0 for normal operation.

**Bandswitching and Timebase Control**

Bits B0 to B2 and bit TB select the state of the bandswitching outputs  $\overline{BO1}$  to  $\overline{BO3}$  as shown in table 1.

Table 1. Bandswitching output select

Input				Output		
B0	B1	B2	TB	$\overline{BO1}$	$\overline{BO2}$	$\overline{BO3}$
0	0	0	0	See note 1.		
0	0	1	0	0	0	1
0	1	0	0	0	1	0
0	1	1	0	0	1	1
1	0	0	0	1	0	0
1	0	1	0	1	0	1
1	1	0	0	1	1	0
1	1	1	0	1	1	1
0	0	0	1	TB	See note 2.	
×	1	0	1	TB	1	0
×	0	1	1	TB	0	1
×	1	1	1	TB	1	1
1	0	0	1	TB	0	0

## Notes

1. Bits R0, R1 and R2 select the state of  $\overline{BO1}$ ,  $\overline{BO2}$  and  $\overline{BO3}$  as shown in table 2.
2. Bits R0, R1 and R2 select the state of  $\overline{BO2}$  and  $\overline{BO3}$  as shown in table 2.
3. The timebase frequency is 8 Hz when TB is set to 1.
4. × = don't care

## Reference Frequency Select

Bits R0 to R2 select the reference frequency as shown in table 2. In addition, bits R0 to R2 select the bandswitching outputs  $\overline{BO1}$  to  $\overline{BO3}$  when bits B0 to B2 are all 0.

Table 2. Reference frequency select

R0	R1	R2	$f_{ref}$ (kHz)	$\overline{BO1}$	$\overline{BO2}$	$\overline{BO3}$
0	0	0	100	1	1	0
0	0	1	50	1	1	0
0	1	0	25	1	1	0
0	1	1	5	0	0	1
1	0	0	10	1	0	1
1	0	1	9	1	0	1
1	1	0	1	0	1	1
1	1	1	5	0	0	1

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