




# MK1574 Frame Rate Communications PLL

## Description

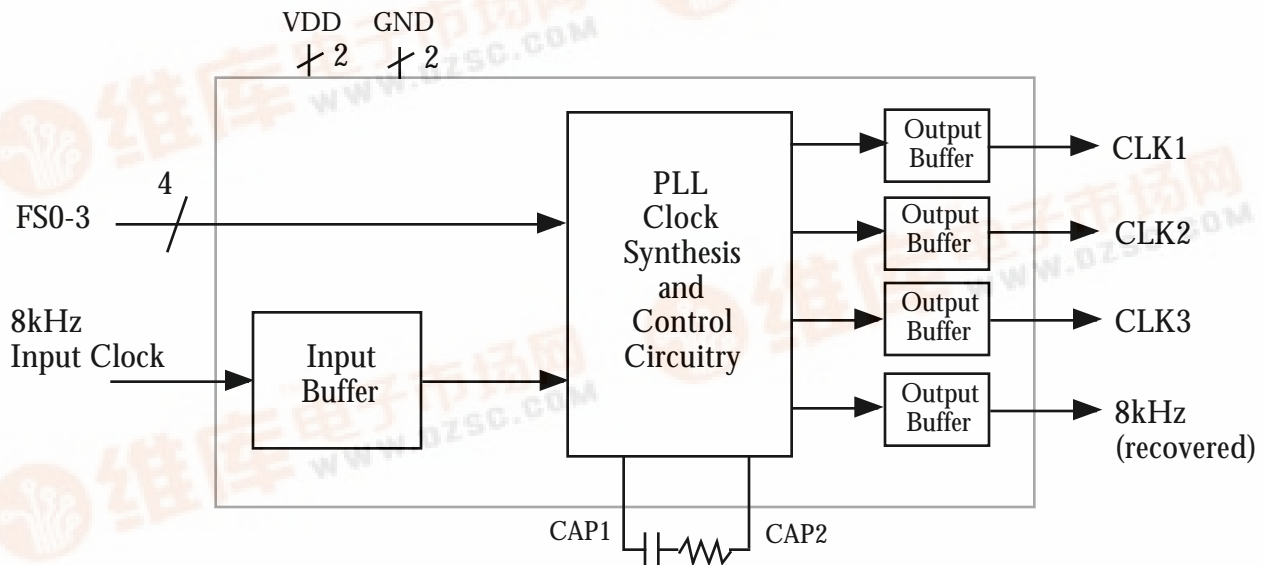
The MK1574-01 is a Phase-Locked Loop (PLL) based clock synthesizer, which accepts an 8 kHz clock input as a reference, and generates many popular communications frequencies. All outputs are frequency locked together and to the input. This allows for the generation of locked clocks to the 8 kHz backplane clock, simplifying clock generation and distribution in communications systems.

MicroClock can customize this device for any other different frequencies.

## Features

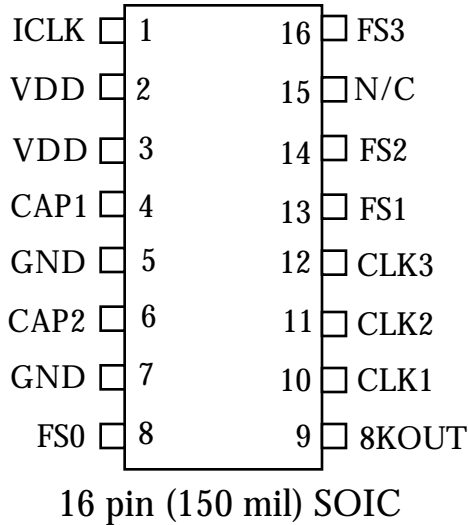
- Packaged in 16 pin narrow (150 mil) SOIC 
- Exact multiplications stored in the device eliminate the need for external dividers
- Accepts 8 kHz input clock
- Output clock rates include T1, E1, T2, E2
- 3.0V to 5.5V operation
- Available in commercial (0 to +70 C) or industrial (-40 to +85 C) temperature ranges
- For jitter attenuation, use the MK2049

## Block Diagram





## Pin Assignment



## Output Clocks Decoding Table MK1574-01 (MHz)

Decode FS3:0	Address (Hex)	ICLK pin 1	Multiplier On-chip	CLK 1 pin 10	CLK 2 pin 11	CLK 3 pin 12
0000	0	Reserved	Reserved	Reserved	Reserved	Reserved
0001	1	Reserved	Reserved	Reserved	Reserved	Reserved
0010	2	Reserved	Reserved	Reserved	Reserved	Reserved
0011	3	Reserved	Reserved	Reserved	Reserved	Reserved
0100	4	8.00kHz	2940	23.52	11.76	5.88
0101	5	8.00kHz	1960	15.68	7.84	3.92
0110	6	8.00kHz	2760	22.08	11.04	5.52
0111	7	8.00kHz	2640	21.12	10.56	5.28
1000	8	8.00kHz	1920	15.36	7.68	3.84
1001	9	8.00kHz	6480	51.84	25.92	12.96
1010	A	8.00kHz	2112	16.896	8.448	4.224
1011	B	8.00kHz	1578	12.624	6.312	3.156
1100	C	8.00kHz	8192	65.536	32.768	16.384
1101	D	8.00kHz	6176	49.408	24.704	12.352
1110	E	8.00kHz	1024	8.192	4.096	2.048
1111	F	8.00kHz	772	6.176	3.088	1.544

• 0 = connect directly to ground, 1 = connect directly to VDD.

## Pin Descriptions

Number	Name	Type	Description
1	ICLK	I	Input clock. Connect to an 8kHz clock input.
2	VDD	P	Connect to +3.3V or +5V.
3	VDD	P	Connect to +3.3V or +5V. Must be same voltage as pin 2.
4	CAP1	I	Connect a ceramic capacitor and a resistor in series between this pin and CAP2. Refer to page 4.
5	GND	P	Connect to ground.
6	CAP2	I	Connect a ceramic capacitor and a resistor in series between this pin and CAP1. Refer to page 4.
7	GND	P	Connect to ground.
8	FS0	I	Frequency Select 0. Determines CLK outputs per table above.
9	8KOUT	O	Recovered 8kHz output clock. Can be lower jitter, better duty cycle than input clock.
10	CLK1	O	Clock 1 determined by status of FS3:0 per table above.
11	CLK2	O	Clock 2 determined by status of FS3:0 per table above.
12	CLK3	O	Clock 3 determined by status of FS3:0 per table above.
13	FS1	I	Frequency Select 1. Determines CLK outputs per table above.
14	FS2	I	Frequency Select 2. Determines CLK outputs per table above.
15	N/C	-	No Connect. Nothing is connected to this pin.
16	FS3	I	Frequency Select 3. Determines CLK outputs per table above.

Type: I = Input, O = output, P = power supply connection



## External Components/Crystal Selection

The MK1574 requires a minimum number of external components for proper operation. An RC network (see Capacitor Selection on following page) should be connected between CAP1 and CAP2 as close to the chip as possible. A high quality ceramic capacitor is recommended. A decoupling capacitor of 0.1 $\mu$ F must be connected between VDD and GND pins (pins 2 and 3, 5 and 7) close to the chip, and 33 terminating resistors can be used on clock outputs with traces longer than 1 inch.

## Electrical Specifications

Parameter	Conditions	Minimum	Typical	Maximum	Units
<b>ABSOLUTE MAXIMUM RATINGS (Note 1)</b>					
Supply Voltage, VDD	Referenced to GND			7	V
Inputs and Clock Outputs		-0.5		VDD+0.5	V
Ambient Operating Temperature		0		70	°C
Soldering Temperature	Max of 10 seconds			250	°C
Storage Temperature		-65		150	°C
<b>DC CHARACTERISTICS (VDD = 5V unless noted)</b>					
Operating Voltage, VDD		3		5.5	V
Input High Voltage, VIH		2			V
Input Low Voltage, VIL				0.8	V
Output High Voltage	IOH=-4mA	VDD-0.4			V
Output High Voltage	IOH=-25mA	2.4			V
Output Low Voltage	IOL=25mA			0.4	V
Operating Supply Current, IDD	No Load, VDD=5.0V		15		mA
Short Circuit Current	Each output		±100		mA
Input Capacitance			7		pF
<b>AC CHARACTERISTICS (VDD = 5V unless noted)</b>					
Input Frequency			8.0000		kHz
Output Clock Rise Time	0.8 to 2.0V			1.5	ns
Output Clock Fall Time	2.0 to 0.8V			1.5	ns
Output Clock Duty Cycle, High Time	At VDD/2	40	49 to 51	60	%
Absolute Clock Period Jitter			1		ns
Actual mean frequency error versus target, note 2	Any clock selection		0	0	ppm

### Notes:

1. Stresses beyond those listed under Absolute Maximum Ratings could cause permanent damage to the device. Prolonged exposure to levels above the operating limits but below the Absolute Maximums may affect device reliability.
2. All multipliers as shown in the table on page two are exact, and are stored in ROM on the chip.



## Loop Bandwidth and Loop Filter Component Selection

The series-connected capacitor and resistor between CAP1 and CAP2 (pins 4 and 6) determine the dynamic characteristics of the phase-locked loop. The capacitor must have very low leakage, therefore a high quality ceramic capacitor is recommended. DO NOT use any type of polarized or electrolytic capacitor. The series connected capacitor and resistor between CAP1 and CAP2 (pins 4 and 6) determine the dynamic characteristics of the phase-locked loop. The capacitor must have very low leakage, therefore a high quality ceramic capacitor is recommended. DO NOT use any type of polarized or electrolytic capacitor. Ceramic capacitors should have C0G or NP0 dielectric. Avoid high-K dielectrics like Z5U and X7R; these and other ceramics which have piezoelectric properties allow mechanical vibration in the system to increase the output jitter because the mechanical energy is converted directly to voltage noise on the VCO input.

The values of the RC network determine the bandwidth of the PLL. The values of the loop filter components are calculated using the constants K1 and K2 from the table on page 5. The loop bandwidth is set by the capacitor C and the constant K1 using the formula

$$BW \text{ (Hz)} = \frac{K1}{\sqrt{C}} \quad \text{Equation 1}$$

The loop damping is set by the resistor R, the capacitor C, and the constant K2 using the formula

$$R = \frac{\zeta \cdot K2}{\sqrt{C}} \quad \text{Equation 2; } (\zeta) \text{ is the damping factor}$$

For example, to design the loop filter when generating 8.192 MHz from 8 kHz:

1. From the table on page 2, the address is E. The table on page 5 shows constants K1=0.0516 and K2=6.2.
2. A good value for the loop bandwidth is 1/20 the input frequency; where 8 kHz/20 = 400 Hz. Using Equation 1,

$$400 = \frac{0.0516}{\sqrt{C}}$$

Therefore, 
$$C = \left( \frac{0.0516}{400} \right)^2 = 16.6 \text{ nF (16 nF nearest standard value)}$$

3. A good value for the damping factor  $\zeta$  is 0.707. From Equation 2,

$$R = \frac{0.707 \cdot 6.2}{\sqrt{16E-9}} = 34.7 \text{ k (36 k nearest standard value)}$$

### Loop Filter Constants

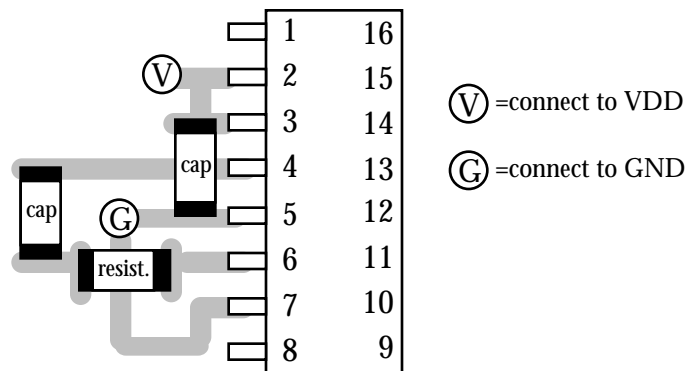
This table shows the constants K1 and K2 that are used with the equations on page 4 to calculate the external loop filter components.

**Loop Filter Constants for MK1574-01**

Decode Address		Loop Filter Constants	
FS3:0	(Hex)	K1	K2
0000	0	Reserved	Reserved
0001	1	Reserved	Reserved
0010	2	Reserved	Reserved
0011	3	Reserved	Reserved
0100	4	0.0430	7.4
0101	5	0.0527	6.0
0110	6	0.0444	7.2
0111	7	0.0454	7.0
1000	8	0.0533	6.0
1001	9	0.0410	7.8
1010	A	0.0508	6.3
1011	B	0.0587	5.4
1100	C	0.0365	8.7
1101	D	0.0420	7.6
1110	E	0.0516	6.2
1111	F	0.0594	5.4

### PC Board Layout

A proper board layout is critical to the successful use of the MK1574. In particular, the CAP1 and CAP2 pins are very sensitive to noise and leakage (CAP1 at pin 4 is the most sensitive). Traces must be as short as possible and the capacitor and resistor must be mounted next to the device as shown to the right. The capacitor connected between pins 3 and 5 is the power supply decoupling capacitor.



The high frequency output clocks on may benefit from a series 33 resistor connected close to the pin (not shown).

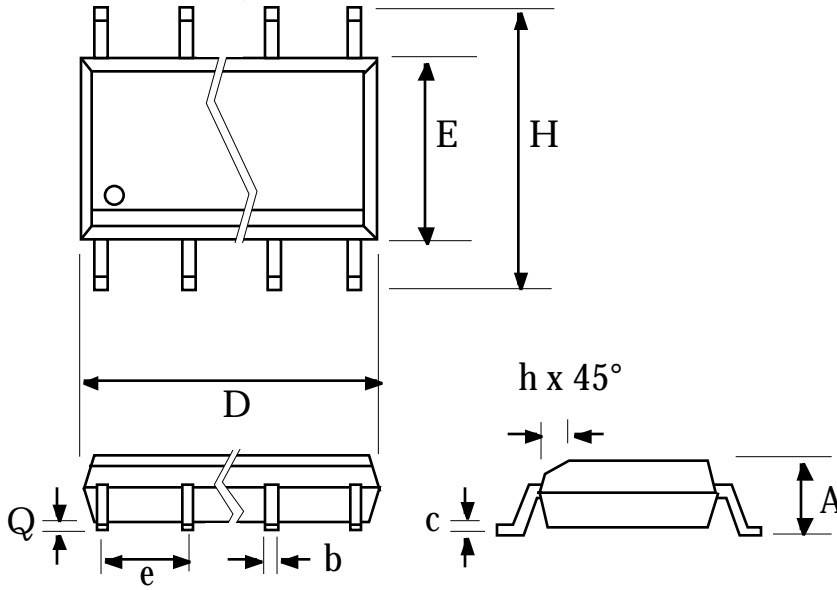
### Clock Multipliers/Accuracies

In the table on page 2 are the actual multipliers stored in the MK1574 ROM, which yield the exact values shown for the output clocks.



## Package Outline and Package Dimensions

16 pin SOIC narrow



Symbol	Inches		Millimeters	
	Min	Max	Min	Max
A	0.055	0.070	1.397	1.778
b	0.013	0.019	0.330	0.483
c	0.007	0.010	0.191	0.254
D	0.385	0.400	9.779	10.160
E	0.150	0.160	3.810	4.064
H	0.225	0.245	5.715	6.223
e	.050 BSC		1.27 BSC	
h		0.016		0.406
Q	0.004	0.01	0.102	0.254

## Ordering Information

Part/Order Number	Marking	Package	Temperature
MK1574-01S	MK1574-01S	16 pin narrow SOIC	0 to 70°C
MK1574-01STR	MK1574-01S	Add Tape & Reel	0 to 70°C
MK1574-01SI	MK1574-01S	16 pin narrow SOIC	-40 to +85°C
MK1574-01SITR	MK1574-01S	Add Tape & Reel	-40 to +85°C

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### CHANGE HISTORY

Version	Date first published	Comments
A	1/24/97	Original
B	2/3/98	Added I grade, revised filter equations, updated address.
C	2/23/98	Added Absolute Jitter value.
D	1/19/99	Added additional capacitor requirements.