FailSafe™ PacketClock™ Global Communications Clock Generator

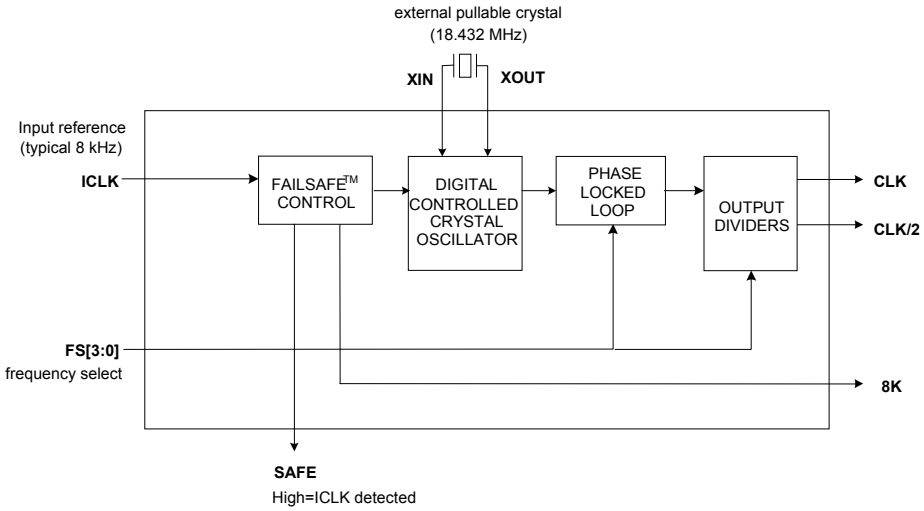
Features

- Fully integrated phase-locked loop (PLL)
- FailSafe™ output
- PLL driven by a crystal oscillator that is phase aligned with external reference
- Output frequencies selectable and/or programmed to standard communication frequencies
- Low-jitter, high-accuracy outputs
- Commercial and Industrial operation
- 3.3V ± 5% operation
- 16-lead TSSOP

Benefits

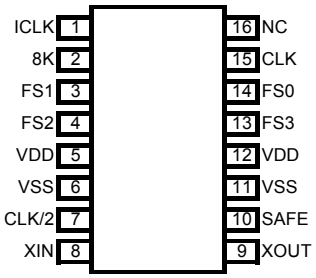
- Integrated high-performance PLL tailored for telecommunications frequency synthesis eliminates the need for external loop filter components
- When reference is in range, SAFE pin is driven high.
- When reference is off, DCXO maintains clock outputs. SAFE pin is low.
- DCXO maintains continuous operation should the input reference clock fail
- Glitch-free transition simplifies system design
- Selectable output clock rates include T1/DS1, E1, T3/DS3, E3, and OC-3.
- Works with commonly available, low-cost 18.432-MHz crystal
- Zero-ppm error for all output frequencies
- Performance guaranteed for applications that require an extended temperature range
- Compatible across industry standard design platforms
- Industry standard package with 6.4 x 5.0 mm^2 footprint and a height profile of just 1.1 mm.

Logic Block Diagram



Pin Configuration

CY26049-36
16-pin TSSOP
Top View



Pin Definitions

Pin Name	Pin Number	Pin Description
ICLK	1	**Reference Input Clock**; 8 kHz or 10 to 60 MHz.
8K	2	**Clock Output**; 8 kHz or high impedance in buffer mode.
FS1	3	**Frequency Select 1**; Determines CLK outputs per *Table 1*.
FS2	4	**Frequency Select 2**; Determines CLK outputs per *Table 1*.
VDD	5	**Voltage Supply;** 3.3V.
VSS	6	**Ground**
CLK/2	7	**Clock Output**; Frequency per *Table 1*.
XIN	8	**Pullable Crystal Input;** 18.432 MHz.
XOUT	9	**Pullable Crystal Output**; 18.432 MHz.
SAFE	10	**High = reference ICLK within range, Low = reference ICLK out of range**.
VSS	11	**Ground**
VDD	12	**Voltage Supply;** 3.3V.
FS3	13	**Frequency Select 3**; Determines CLK outputs per *Table 1*.
FS0	14	**Frequency Select 0**; Determines CLK outputs per *Table 1*.
CLK	15	**Clock Output**; Frequency per *Table 1*.
NC	16	**No Connect**

Selector Guide

Part Number	Input Frequency Range	Outputs	Output Frequencies
CY26049-36	8 kHz or 10 to 60 MHz Reference Input Crystal: 18.432-MHz pullable Crystal per Cypress Specification	3	8 kHz to 155.52 MHz Selectable (see *Table 1*)

Functional Description

CY26049 is a FailSafe frequency synthesizer with a reference clock input and three clock outputs. The device provides an optimum solution for applications where continuous operation is required in the event of a primary clock failure. The continuous, glitch-free operation is achieved by using a DCXO which serves as a primary clock source. The FailSafe control circuit synchronizes the DCXO with the reference as long as the reference is within the pull range of the crystal.

In the event of a reference clock failure the DCXO maintains the last frequency and phase information of the reference clock. The unique feature of the CY26049-36 is that the DCXO is in fact the primary clocking source. When the reference clock is restored, the DCXO automatically re-synchronizes to the reference. The status of the reference clock input, as detected by the CY26049-36, is reported by the SAFE pin.

In the buffer mode (FS3:FS0 = 1110 or 1111), the CY26049-36 can be used as a jitter attenuator. In this mode, extensive jitter on the input clock will be “filtered”, resulting in a low-jitter output clock.

Frequency Select Tables

Table 1. CY26049-36 Frequency Select–Output Decoding Table–External Mode (MHz except as noted)

ICLK	FS3	FS2	FS1	FS0	CLK/2	CLK	8K	Crystal
8 kHz	0	0	0	0	1.544	3.088	8 kHz	18.432
8 kHz	0	0	0	1	2.048	4.096	8 kHz	18.432
8 kHz	0	0	1	0	22.368	44.736	8 kHz	18.432
8 kHz	0	0	1	1	17.184	34.368	8 kHz	18.432
8 kHz	0	1	0	0	77.76	155.52	8 kHz	18.432
8 kHz	0	1	0	1	16.384	32.768	8 kHz	18.432
8 kHz	0	1	1	0	14.352	28.704	8 kHz	18.432
8 kHz	0	1	1	1	High Z[1]	High Z[1]	High Z[1]	18.432
8 kHz	1	0	0	0	18.528	37.056	8 kHz	18.432
8 kHz	1	0	0	1	12.352	24.704	8 kHz	18.432
8 kHz	1	0	1	0	7.68	15.36	8 kHz	18.432
8 kHz	1	0	1	1	High Z[1]	High Z[1]	High Z[1]	18.432
8 kHz	1	1	0	0	12.288	24.576	8 kHz	18.432
8 kHz	1	1	0	1	16.384	32.768	8 kHz	18.432

Table 2. CY26049-36 Frequency Select–Output Decoding Table–Buffer Mode

ICLK	FS3	FS2	FS1	FS0	CLK/2	CLK	8K	Crystal
20 to 60	1	1	1	0	ICLK/2	ICLK	High Z[1]	ICLK/2
10 to 30	1	1	1	1	2*ICLK	4*ICLK	High Z[1]	ICLK

Note:
1. High Z = high impedance.

Absolute Maximum Conditions

Supply Voltage (V_{DD}) .....–0.5 to +7.0V
DC Input Voltage .....–0.5V to V_{DD}+0.5
Storage Temperature (Non-Condensing) ....–55°C to +125°C
Junction Temperature ..... –40°C to +125°C
Data Retention @ Tj=125°C.....>10 years
Package Power Dissipation..... 350 mW
ESD (Human Body Model) MIL-STD-883..... 2000V
(Above which the useful life may be impaired. For user guidelines, not tested.

Recommended Pullable Crystal Specifications[2]

Parameter	Description	Comments	Min.	Typ.	Max.	Units
F_{NOM}	Nominal crystal frequency	Parallel resonance, fundamental mode, AT cut	–	18.432	–	MHz
C_{LNOM}	Nominal load capacitance		–	14	–	pF
R_1	Equivalent series resistance (ESR)	Fundamental mode	–	–	25	Ω
R_3/R_1	Ratio of third overtone mode ESR to fundamental mode ESR	Ratio used because typical R_1 values are much less than the maximum spec	3	–	–	
DL	Crystal drive level	No external series resistor assumed	–	0.5	2	mW
F_{3SEPHI}	Third overtone separation from 3*F_{NOM}	High side	400	–	–	ppm
F_{3SEPLO}	Third overtone separation from 3*F_{NOM}	Low side	–	–	–200	ppm
C_0	Crystal shunt capacitance		–	–	7	pF
C_0/C_1	Ratio of shunt to motional capacitance		180	–	250	
C_1	Crystal motional capacitance		14.4	18	21.6	fF

Recommended Operating Conditions

Parameter	Description	Min.	Typ.	Max.	Unit
V_{DD}	Operating Voltage	3.15	3.3	3.45	V
T_{AC}	Ambient Temperature (Commercial Temperature)	0	–	70	° C
T_{AI}	Ambient Temperature (Industrial Temperature)	–40	–	85	° C
C_{LOAD}	Max Output Load Capacitance	–	–	15	pF
t_{pu}	Power-up time for all V_{DD}s to reach minimum specified voltage (power ramps must be monotonic)	0.05	–	500	ms
$t_{ER(I)}$	8 kHz Input Edge Rate, 20% to 80% of V_{DD} = 3.3V	0.07	–	–	V/ns

DC Electrical Specifications (Commercial Temp: 0° to 70°C)

Parameter	Description	Test Conditions	Min.	Typ.	Max.	Unit
I_{OH}	Output High Current	V_{OH} = V_{DD} – 0.5, V_{DD} = 3.3V (source)	12	24	–	mA
I_{OL}	Output Low Current	V_{OL} = 0.5, V_{DD} = 3.3V (sink)	12	24	–	mA
V_{IH}	Input High Voltage	CMOS Levels	0.7	–	–	V_{DD}
V_{IL}	Input High Voltage	CMOS Levels	–	–	0.3	V_{DD}
I_{IH}	Input High Current	V_{IH}=V_{DD}	–	5	10	µA
I_{IL}	Input Low Current	V_{IL}=0V	–	5	10	µA
C_{IN}	Input Capacitance		–	–	7	pF
I_{OZ}	Output Leakage Current	High Z[1] output	–	± 5	–	µA
I_{DD}	Supply Current	C_{LOAD} = 15 pF, V_{DD} = 3.45V, FS [3:0] = 0100	–	–	45	mA
		C_{LOAD} = 15 pF, V_{DD} = 3.45V, FS [3:0] = 1101	–	–	30	mA

Note:
2. Ecliptek ECX-5761-18.432 M and ECX-5762-18.432 M meets these specifications.

DC Electrical Specifications (Industrial Temp: –40° to 85°C)

Parameter	Description	Test Conditions	Min.	Typ.	Max.	Unit
I_{OH}	Output High Current	$V_{OH} = V_{DD} – 0.5$, $V_{DD} = 3.3V$ (source)	10	20	–	mA
I_{OL}	Output Low Current	$V_{OL} = 0.5$, $V_{DD} = 3.3V$ (sink)	10	20	–	mA
V_{IH}	Input High Voltage	CMOS Levels	0.7	–	–	V_{DD}
V_{IL}	Input High Voltage	CMOS Levels	–	–	0.3	V_{DD}
I_{IH}	Input High Current	$V_{IH} = V_{DD}$	–	5	10	µA
I_{IL}	Input Low Current	$V_{IL} = 0V$	–	5	10	µA
C_{IN}	Input Capacitance		–	–	7	pF
I_{OZ}	Output Leakage Current	High Z[1] output	–	± 5	–	µA
I_{DD}	Supply Current	$C_{LOAD} = 15$ pF, $V_{DD} = 3.45V$, FS [3:0] = 0100	–	–	50	mA
		$C_{LOAD} = 15$ pF, $V_{DD} = 3.45V$, FS [3:0] = 1101	–	–	35	mA

AC Electrical Specifications (Commercial Temp: 0° to 70° C and Industrial Temp: –40° to 85°C)

Parameter	Description	Test Conditions	Min.	Typ.	Max.	Unit
f_{ICLK-E}	Frequency, Input Clock	Input Clock Frequency, External Mode	–	8.00	–	kHz
f_{ICLK-B}	Frequency, Input Clock	Input Clock Frequency, Buffer Mode	10	–	60	MHz
LR	FailSafe Lock Range[3]	Range of reference ICLK for Safe = High	–250	–	+250	ppm
DC = t_2/t_1	Output Duty Cycle	Duty Cycle defined in *Figure 1*, measured at 50% of V_{DD}	45	50	55	%
T_{PJIT1}	Clock Jitter; output > 5 MHz	Period Jitter, Peak to Peak, 10,000 periods	–	–	250	ps
		RMS Period Jitter, RMS	–	–	50	ps
T_{PJIT2}	Clock Jitter; output <5 MHz	Period Jitter, Peak to Peak, 10,000 periods	–	–	500	ps
		RMS Period Jitter, RMS	–	–	100	ps
t_6	PLL Lock Time	Time for PLL to lock within ± 150 ppm of target frequency	–	–	3	ms
t_{fs_lock}	Failsafe Lock Time	Time for PLL to lock to ICKL (outputs phase aligned with ICKL and Safe = High)	–	–	7	s
f_{error}	Frequency Synthesis Error	Actual mean frequency error vs. target	–	0	–	ppm
ER	Rising Edge Rate	Output Clock Edge Rate, Measured from 20% to 80% of V_{DD}, $C_{LOAD} = 15$ pF See *Figure 2*.	0.8	1.4	2	V/ns
EF	Falling Edge Rate	Output Clock Edge Rate, Measured from 20% to 80% of V_{DD}, $C_{LOAD} = 15$ pF See *Figure 2*.	0.8	1.4	2	V/ns

Voltage and Timing Definitions

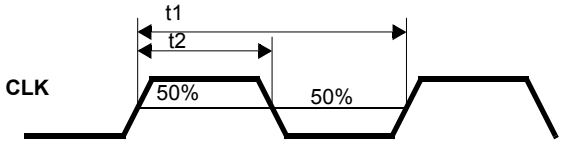


Figure 1. Duty Cycle Definition; DC = t2/t1

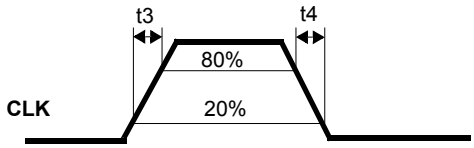
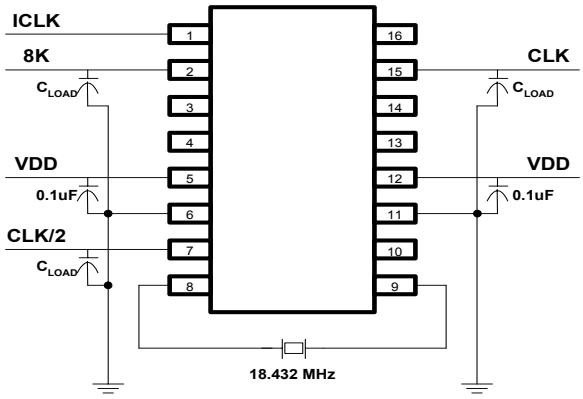


Figure 2. Rise and Fall Time Definitions: ER = 0.6 x VDD / t3, EF = 0.6 x VDD / t4

Note:
3. Dependent on crystals chosen and crystal specs.

Test Circuit

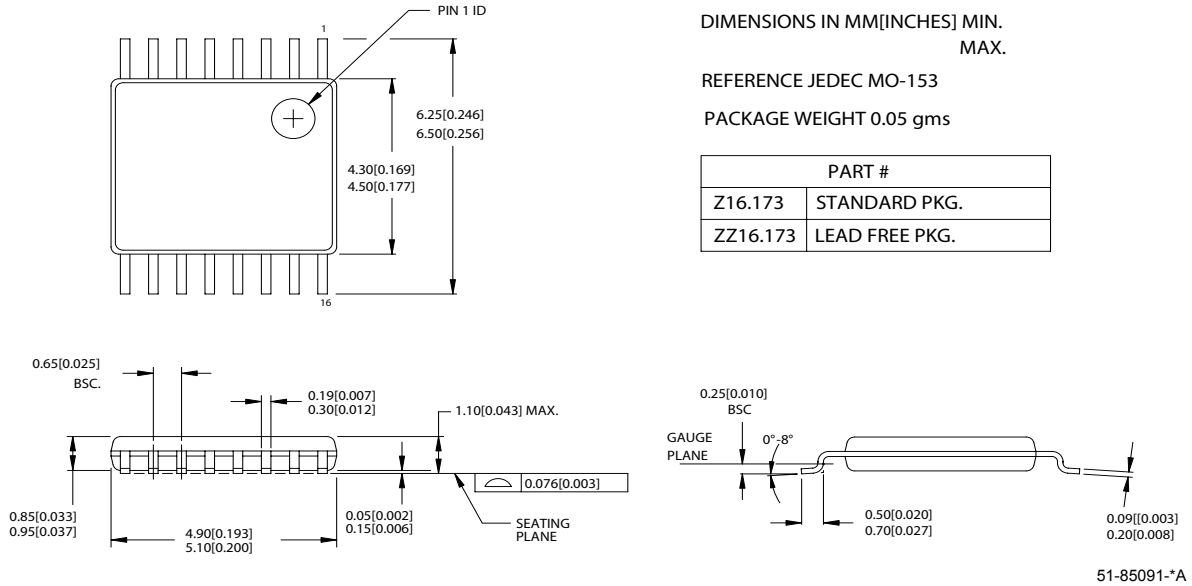


Ordering Information

Ordering Code	Package Type	Operating Temperature Range
CY26049ZC-36	16-lead TSSOP	Commercial 0 to 70°C
CY26049ZC-36T	16-lead TSSOP–Tape and Reel	Commercial 0 to 70°C
CY26049ZI-36	16-lead TSSOP	Industrial –40 to 85°C
CY26049ZI-36T	16-lead TSSOP–Tape and Reel	Industrial –40 to 85°C
Lead Free		
CY26049ZXC-36	16-lead TSSOP	Commercial 0 to 70°C
CY26049ZXC-36T	16-lead TSSOP–Tape and Reel	Commercial 0 to 70°C
CY26049ZXI-36	16-lead TSSOP	Industrial –40 to 85°C
CY26049ZXI-36T	16-lead TSSOP–Tape and Reel	Industrial –40 to 85°C

Package Diagram

16-lead TSSOP 4.40 MM Body Z16.173



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Document History Page

Document Title: CY26049-36 FailSafe™ PacketClock™ Global Communications Clock Generator Document Number: 38-07415				
REV.	**ECN NO.**	**Issue Date**	**Orig. of Change**	**Description of Change**
**	114749	08/08/02	CKN	New Data Sheet
*A	120067	01/06/03	CKN	Changed “FailSafe is a trademark of Silicon Graphics, Inc.” to read “FailSafe is a trademark of Cypress Semiconductor”
*B	128000	07/15/03	IJA	Changed Benefits to read “When reference is in range, SAFE pin is driven high” Changed first sentence to “CY26049 is a FailSafe frequency synthesizer with a reference clock input and three clock outputs” Changed title from “Failsafe™ PacketClock™ Global Communications Clocks” to “FailSafe™ PacketClock™ Global Communications Clock Generator” Changed definitions in Pin Description Table Replaced format for Absolute Maximum Conditions Replaced Recommended Pullable Crystal Specifications table Added t_{pu} to Recommended Operating Conditions Added I_{IH} and I_{IL} to DC Electrical Specifications Replaced AC Electrical Specifications from Cy26049-16 data sheet Changed Voltage and Timing Definitions to match CY2410 data sheet Moved Package Diagram to end of data sheet
*C	244412	See ECN	RGL	Spec. ($t_{ER(I)}$) Input Edge Rate in the Recommended Operating Conditions Table Added Lead Free Devices