

June 1997
Preliminary

CMOS LSI
PLL FREQUENCY SYNTHESIZERS

PRODUCT DESCRIPTION

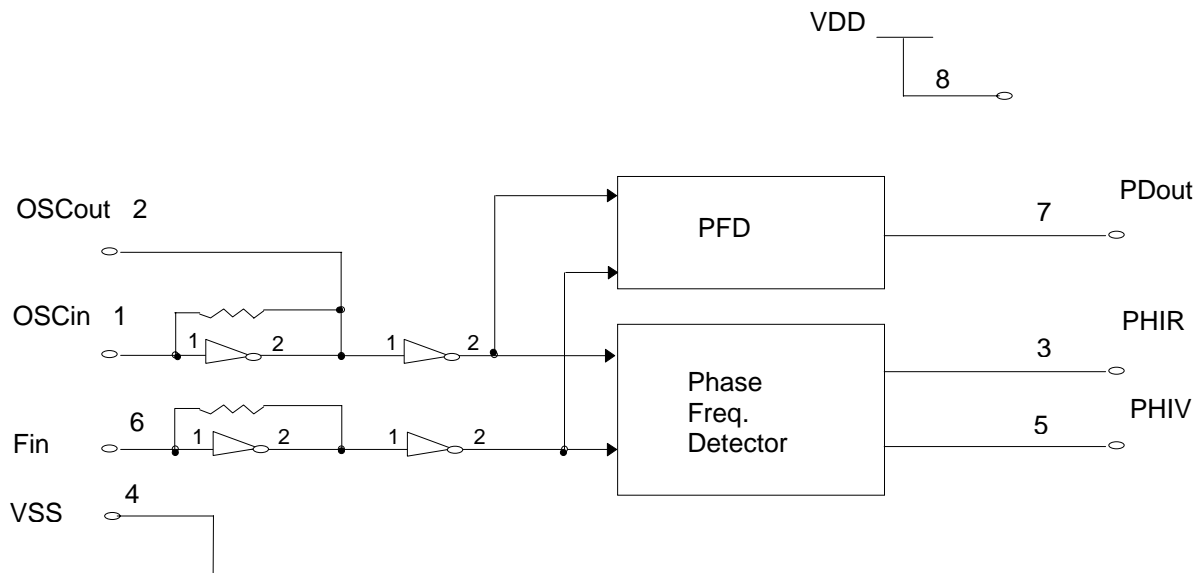
The IMI4347 is a member of a family of phaselock loop synthesizer ICs from International Microcircuits. This is a phase-frequency detector intended for use with high reference frequencies. Compatible with sinewave, ECL, TTL, and CMOS input waveforms makes the IMI4347 extremely versatile in wideband PLL applications.

The IMI4347 is a Type IV phase frequency detector which has eliminated by design the inherent dead zone which causes crossover distortion at the critical center lock point. The IMI circuitry enables consistent low noise loop designs using the simple single ended charge pump output. Differential charge pump outputs are also provided for those who require a more sophisticated differential active loop filter design.

PRODUCT FEATURES

- >40 MHz typical input frequency
- Low power consumption CMOS
- -163 dBc/Hz total phase noise floor
- No dead zone, by design
- High gain differential outputs
- 380 μ A Current Mode Charge Pump
- Unambiguous PLL acquisition
- Zero degree phase difference at lock
- ECL compatible inputs when AC coupled
- Sinewave inputs when AC coupled
- TTL, CMOS inputs can be DC coupled
- On- or off-chip reference oscillator operation
- Small 8 pin SOP package for SMT available
- 3-volt and 5-volt characterizations

BLOCK DIAGRAM



MAXIMUM RATINGS

| | |
|------------------------------|-----------------|
| Voltage Relative to VSS: | -0.3V to 7V |
| Voltage Relative to VDD | 0.3V |
| Storage Temperature: | -65°C to 150°C |
| Ambient Temperature: | -40° C to 85° C |
| Recommended Operating Range: | 4.5-5.5V |

This device contains circuitry to protect the inputs against damage due to high static voltages or electric field; however, precaution should be taken to avoid application for any voltage higher than the maximum rated voltages to this circuit. For proper operation, V_{in} and V_{out} should be constrained to the range:

$$V_{ss} < (V_{in} \text{ or } V_{out}) < V_{DD}$$

Unused inputs must always be tied to an appropriate logic voltage level (either VSS or VDD).

PIN DESCRIPTIONS

| <u>PIN NO.</u> | <u>NAME</u> | <u>DESCRIPTION</u> |
|----------------|-------------|---|
| 1 | OSCin | This input is self biased and is designed to be AC coupled for low level sinewave signals. |
| 2 | OS Cout | Reference signal output can be used in conjunction with OSCin to form an internal crystal oscillator. |
| 6 | Fin | This input is intended to be AC coupled for low level sinewave signals. DC coupling can be used for CMOS logic level input signals. |
| 4 | VSS | Circuit ground. |
| 8 | VDD | Circuit positive power supply. |
| 3 | PHIR | Phase detector output. This signal goes LOW when the feedback frequency is too low. |
| 5 | PHIV | Phase detector output. This signal goes LOW when the feedback frequency is too high. |
| 7 | Pdout | Single-ended charge pump output, usually used with passive loop filters. This signal operates according to the following: <ul style="list-style-type: none">■ Frequency $f_v > f_r$ at the phase detector: negative pulses.■ Frequency $f_v < f_r$ at the phase detector: positive pulses.■ Frequency $f_v = f_r$ at the phase detector: high-impedance state. |

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PLL OPERATING CHARACTERISTICS

VDD = 5 VOLTS

| Characteristics | | Symbol | | -40°C | | 0°C | | 25°C | | | 70°C | | 85°C | | Unit | Conditions |
|-----------------|---------------------|------------|--------|-------|------|------|------|------|------|------|------|-----|------|--------|------------|-----------------|
| | | | | Min | Max | Min | Max | Min | Typ | Max | Min | Max | Min | Max | | |
| Dynamic | Operating Frequency | fin, Sine | - | 50 | - | - | - | - | 50 | - | 40 | - | 40 | MHz | | |
| | Frequency | fosc, Sine | - | 50 | - | - | - | - | 50 | - | 40 | - | 40 | MHz | | |
| | Phase Noise Floor | PDNF | | | | | | -160 | | | | | | dBc/Hz | | |
| | Pin Capacitance | Cin | | - | 10 | | | - | 6 | 10 | | | - | 10 | pF | |
| | Capacitance | Cout | | - | 10 | | | - | 6 | 10 | | | - | 10 | pF | |
| Static | Input Voltages | VIL | | 1 | 1.5 | - | 1.5 | - | 2.75 | 1.5 | - | 1.5 | - | 1.5 | Vdc | |
| | Voltages | VIH | | 3.5 | - | 3.5 | - | 3.5 | 2.75 | - | 3.5 | - | 3.5 | - | | |
| | Output Voltages | VOL | | - | 0.05 | - | 0.05 | - | 0.0 | 0.05 | - | .05 | - | 0.05 | Vdc | |
| | Voltages | VOH | | 4.95 | - | 4.95 | - | 4.95 | 5.0 | - | 4.95 | - | 4.95 | - | | |
| | Output Current | IOL | Logic | 2.4 | - | | | 2.0 | 2.8 | - | | | 1.6 | - | | |
| | | | OSCout | 1.2 | - | | | 1.0 | 1.4 | - | | | 0.8 | - | mA | VOL = 0.40 |
| | | IOH | Logic | -2.4 | - | | | -2.0 | -2.8 | - | | | -1.6 | - | mA | VOH = 4.0 |
| | | | OSCout | -1.2 | - | | | -1.0 | -1.4 | - | | | -0.8 | - | mA | VOH = 4.0 |
| | Charge Pump | Icp | | | | | | 380 | | | | | | µA | Vdd = 5V | |
| | Supply Currents | IDD | | - | 10 | - | 10 | - | 7 | 10 | - | 10 | - | 10 | mA | fosc=fin-10 MHz |
| ISB | | | - | 150 | | | - | 40 | 150 | | | - | 150 | µA | fosc=fin=0 | |

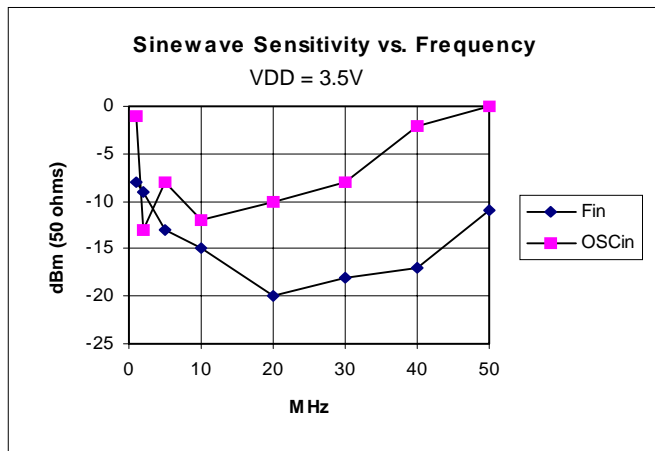
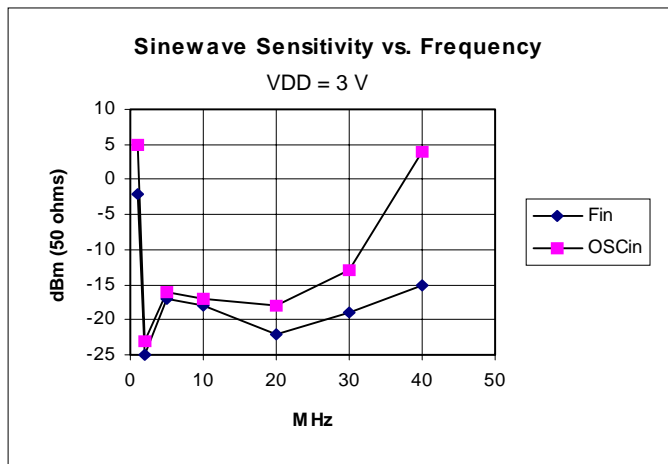
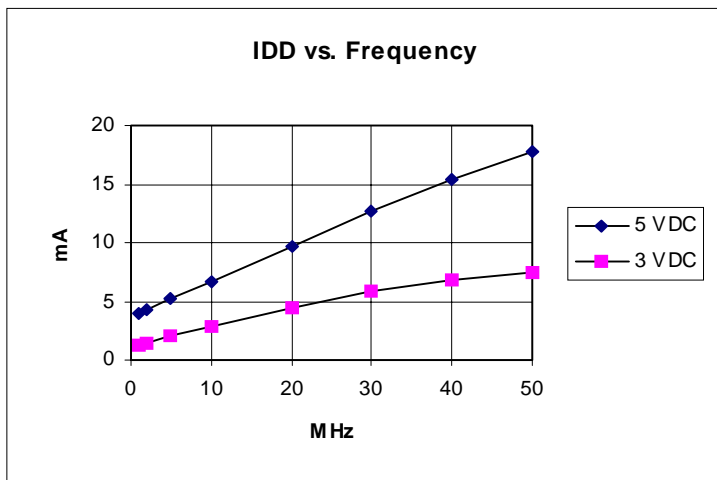
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| PLL OPERATING CHARACTERISTICS | | | | | | | | | | | | | | | | | |
|-------------------------------|---------------------|--------|--------|-------|------|------|------|------|------|------|------|------|------|------|--------|-----------------|------------|
| VDD = 3 VOLTS | | | | | | | | | | | | | | | | | |
| Characteristics | | Symbol | | -40°C | | 0°C | | 25°C | | | 70°C | | 85°C | | Unit | Conditions | |
| | | | | Min | Max | Min | Max | Min | Typ | Max | Min | Max | Min | Max | | | |
| Dynamic | Operating Frequency | fin, | Sine | - | 40 | - | - | 30 | - | 40 | - | - | - | 40 | MHz | | |
| | Frequency | fosc | Sine | - | 40 | - | - | 30 | - | 40 | - | - | - | 40 | MHz | | |
| | Phase Noise Floor | PDNF | | | | | | | -155 | | | | | | dBc/Hz | | |
| | Pin | Cin | | | - | 10 | | | - | 6 | 10 | | | - | 10 | pF | |
| | Capacitance | Cout | | | - | 10 | | | - | 6 | 10 | | | - | 10 | pF | |
| Static | Input Voltages | VIL | | - | 0.9 | - | 1.5 | - | 1.35 | 0.9 | - | 1.5 | - | 0.9 | Vdc | | |
| | Voltages | VIH | | 2.1 | - | - | - | 2.1 | 1.65 | - | | | 2.1 | - | | | |
| | Output Voltages | VOL | | - | 0.05 | - | 0.05 | - | 0.0 | 0.05 | - | 0.05 | - | 0.05 | Vdc | | |
| | Voltages | VOH | | 2.95 | - | 2.95 | - | 2.95 | 3.0 | - | 2.95 | - | 2.95 | - | | | |
| | Output Current | IOL | Logic | | 1.6 | - | | | 1.4 | 2.0 | - | | | 0.8 | - | | |
| | | | OSCout | | 0.8 | - | | | 0.7 | 1.0 | - | | | 0.4 | - | mA | VOL = 0.30 |
| | | IOH | Logic | | -1.6 | - | | | -1.4 | -2.0 | - | | | -0.8 | - | mA | VOH = 2.4 |
| | | | OSCout | | -1.6 | - | | | -0.7 | -1.0 | - | | | -0.4 | - | mA | VOL = 2.4 |
| | Charge Pump | Icp | | | | | | 240 | | | | | | | µA | Vdd = 3V | |
| Supply Currents | IDD | | | - | 5 | - | 5 | - | 3 | 5 | - | 5 | - | 5 | mA | fosc=fin-10 MHz | |
| | ISB | | | - | 150 | | | - | 40 | 150 | | | - | 150 | µA | fosc=fin=0 | |

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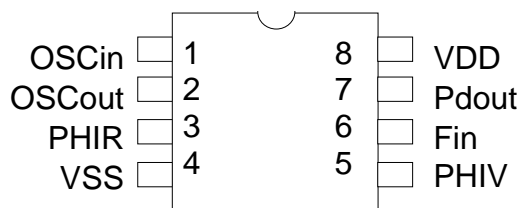
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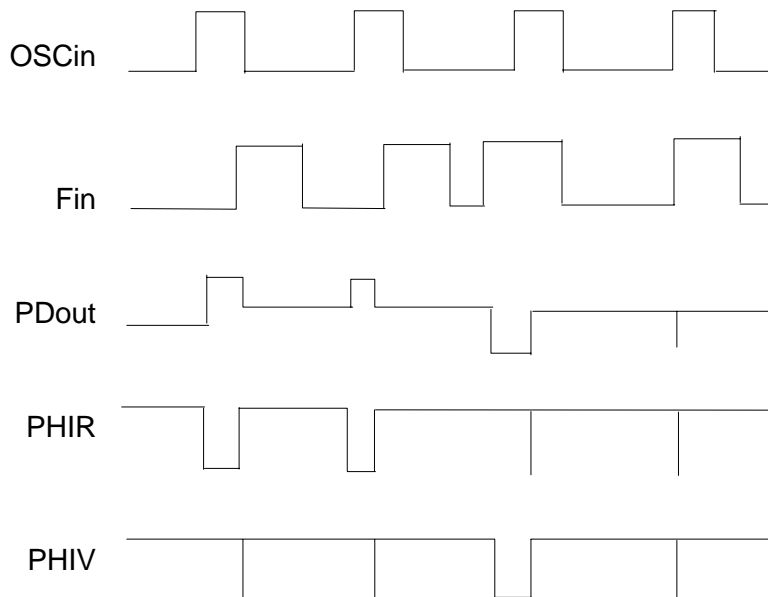
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CONNECTION DIAGRAM



PHASE DETECTOR OUTPUT WAVEFORMS

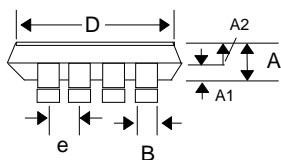
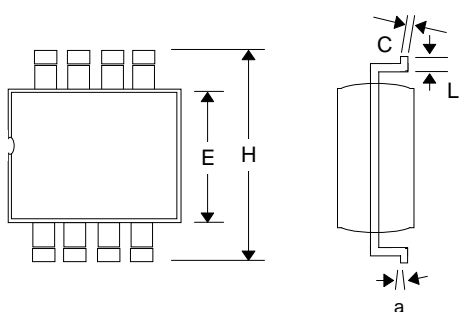


Note: The Pdout state is equal to either VDD or VSS when active. When not active, the output is high impedance and the voltage at that pin is determined by the low pass filter capacitor.

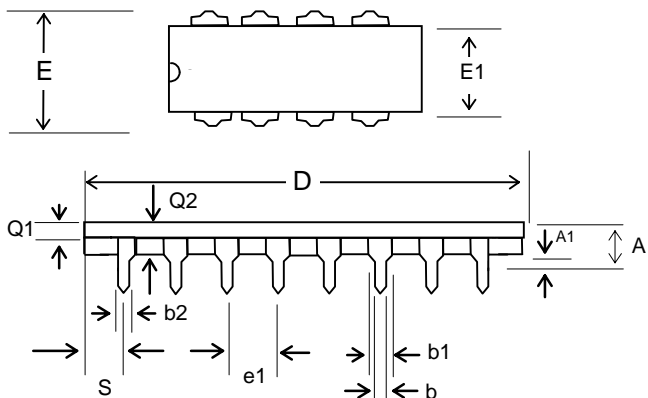
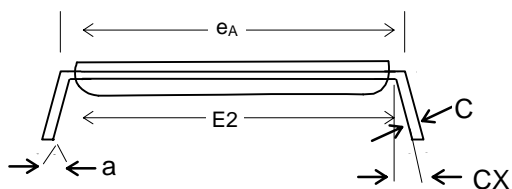
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PACKAGE DRAWING AND DIMENSIONS



SOP PACKAGE



P-DIP Package

8-PIN SOP DIMENSIONS

| SYMBOL | INCHES | | | MILLIMETERS | | |
|----------------|-----------|-------|--------|-------------|------|------|
| | MIN | NOM | MAX | MIN | NOM | MAX |
| A | - | 0.080 | - | - | 2.03 | - |
| A ₁ | 0.0020 | 0.009 | 0.0015 | 0.060 | 0.22 | 0.38 |
| A ₂ | 0.090 | 0.092 | 0.111 | 2.29 | 2.34 | 2.39 |
| B | 0.014 | .016 | .018 | 0.35 | .040 | 0.45 |
| C | - | .008 | - | - | .20 | - |
| D | 0.205 | 0.207 | 0.210 | 5.15 | 5.25 | 5.35 |
| E | 0.205 | 0.210 | 0.213 | 5.20 | 5.30 | 5.40 |
| e | 0.050 BSC | | | 1.27 BSC | | |
| H | 0.303 | 0.310 | 0.318 | 7.70 | 8.00 | 8.10 |
| a | | | | | | |
| L | 0.020 | 0.025 | 0.031 | 0.5 | 0.65 | 0.8 |

8-PIN PLASTIC DIP DIMENSIONS

| SYMBOL | INCHES | | | MILLIMETERS | | |
|----------------|----------|------|------|-------------|------|------|
| | MIN | NOM | MAX | MIN | NOM | MAX |
| A | - | - | .170 | - | - | 4.32 |
| A ₁ | .015 | - | - | .38 | - | - |
| b | .016 | .018 | .020 | .41 | .46 | .52 |
| b ₁ | .055 | .060 | .065 | 1.40 | 1.52 | 1.65 |
| b ₂ | .030 | .039 | .045 | .76 | .99 | 1.14 |
| C | .008 | .010 | .012 | .20 | .25 | .30 |
| D | .360 | .365 | .380 | 9.14 | 9.27 | 9.65 |
| E | .300 | - | .325 | 7.62 | - | 8.26 |
| E ₁ | .250 | .252 | .260 | 6.10 | 6.40 | 6.60 |
| e ₁ | .100 BSC | | | 2.54 BSC | | |
| e _A | .300 BSC | | | 7.62 BSC | | |
| CX | 0° | | 15° | 0° | | 15° |
| Q ₁ | .055 | .060 | .065 | 1.40 | 1.52 | 1.65 |
| Q ₂ | - | .130 | - | - | 3.30 | - |
| S | .027 | .032 | .037 | .69 | .81 | .94 |

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| ORDERING INFORMATION | | |
|-----------------------------|---------------------|-----------------------------|
| Part Number | Package Type | Production Flow |
| IMI4347xPB | 8 PIN Plastic DIP | Industrial, -40°C to + 85°C |
| IMI4347xYB | 8 PIN SOP | Industrial, -40°C to + 85°C |

NOTE: The "x" following the IMI Device Number denotes the device revision. The ordering part number is formed by a combination of device number, device revision, package style, and screening as shown below.

Marking: Example: FS4347x
Date Code
Lot #

IMI4347xPB

