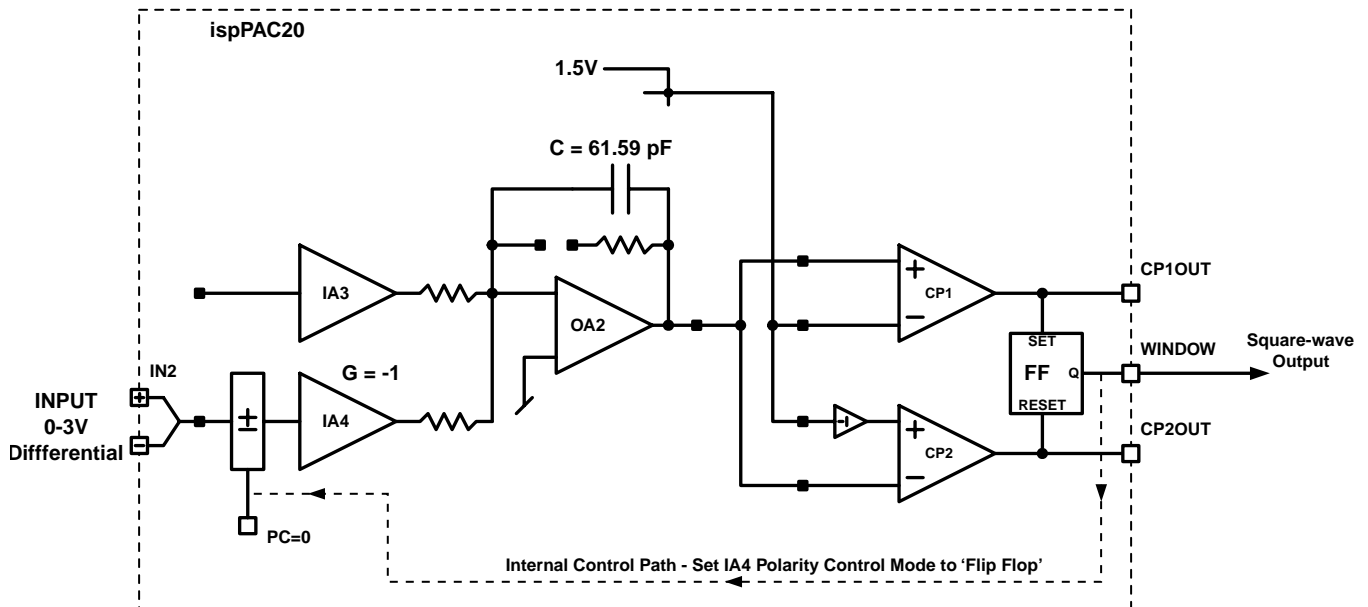


Voltage-controlled oscillators (VCOs) are key functions in many applications. They are used to frequency modulate analog signals for transmission in high-noise environments. Another, even more common, place in which VCOs are found are in phase-locked loops. A few examples of applications in which Phase-locked loops are used include frequency synthesizers, RF communications systems, fiber-optic data transmission and the 'clock-multipliers' used to generate GHz clocks in microprocessors.

The ispPAC20 can be used to implement VCOs that operate at low to moderate frequencies (1kHz -100kHz). Because the gains, time constants and reference voltages in ispPAC devices are both consistent on a unit-to-unit basis and over environmental conditions such as power supply voltage and temperature, it is straightforward to use the ispPAC20 as the basis for a stable VCO circuit. The schematic of Figure 1 shows how to use an ispPAC20 to implement this function.

Figure 1. Voltage-Controlled Oscillator Using ispPAC20



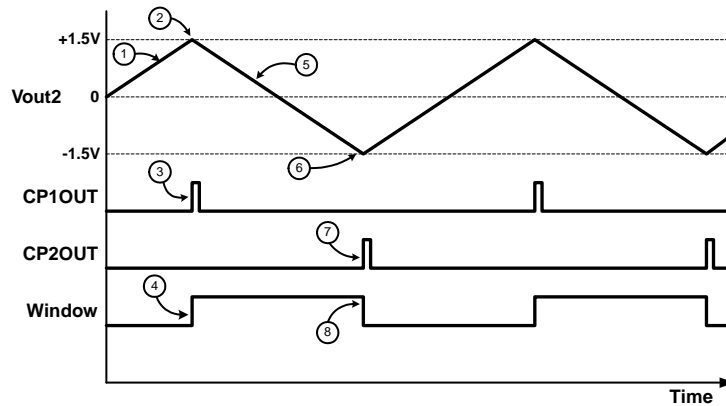
To successfully implement this circuit, there are several options on the ispPAC20 that must be set correctly. They are:

- 1) The feedback link on OA2 must be OPEN
- 2) The WINDOW output must be set to Flip-Flop mode instead of the XOR mode.
- 3) IA4's polarity control should be set to 'Flip-Flop' mode

The operation of this circuit can be understood by following the events that occur in it through a single cycle of oscillation. These events and the associated voltage waveforms are illustrated in Figure 2.

This circuit operates by integrating the voltage applied to the IN3 input. This results in a ramp whose slew rate is proportional to the voltage. For proper operation, the differential voltage applied to IN3 must be greater than zero. Referring to Figure 2, the Vout2 ramps in a positive direction (1) until it reaches a specified threshold (VL) of +1.5V (2). At this point, CP1 turns ON (3) and sets the output flip-flop, bringing the WINDOW output line high (4). Because the polarity control of the integrator (PC pin) is controlled by the WINDOW output, this changes the direction of inte-

Figure 2. Voltage Waveforms in VCO

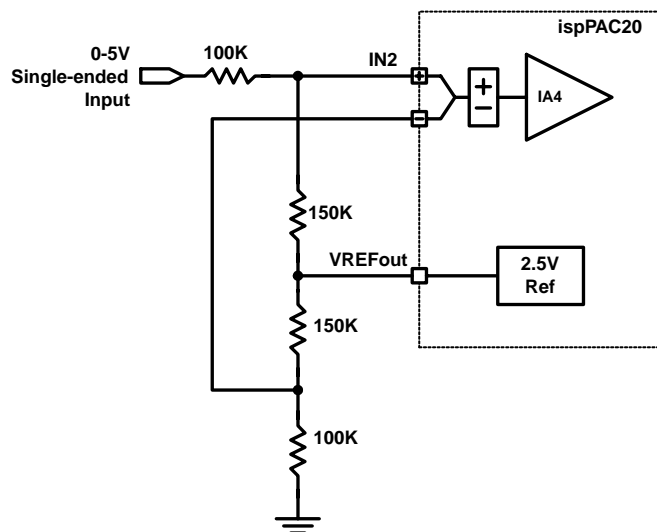


gration, and Vout2 ramps in a negative direction (5). When Vout2 falls below the negative threshold of -1.5V (6), comparator CP2 turns ON (7), and resets the output flip-flop (8). At this point Vout2 begins to ramp in a positive direction and the cycle repeats.

When using the gain, capacitor and threshold settings shown in Figure 1, this circuit can provide frequencies ranging from about 1kHz to 30kHz. Note that for this circuit to operate correctly, the input voltage must be positive. It is also possible to get better low-frequency performance by using the 3V reference instead of the 1.5V one shown. This results in the integrator having to slew twice the voltage. It is also possible to increase the operating frequency range by reducing the capacitor value or increasing the gain value. Although this circuit can oscillate at frequencies exceeding 300kHz, at operating frequencies much beyond 100kHz the comparator delay becomes a significant fraction of the oscillator's cycle time and can significantly decrease the linearity.

Because many systems operate with single-ended signals, it is often convenient to have a VCO that accepts a single-ended control voltage. The input circuit shown in Figure 3 will convert a 0 to 5 Volt single-ended input signal into a 0 to +3V differential signal to drive the VCO. In this case, 0V corresponds to the lowest frequency, while 5V corresponds to the full-scale maximum frequency.

Figure 3. Circuit to Accept 0-5V Single-ended Control Voltage



Technical Support Assistance

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