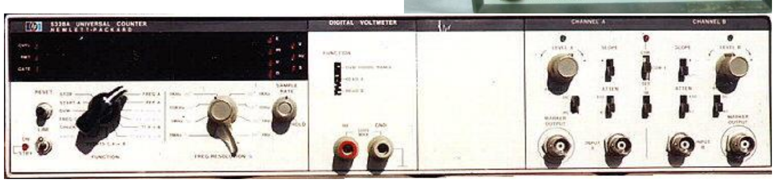
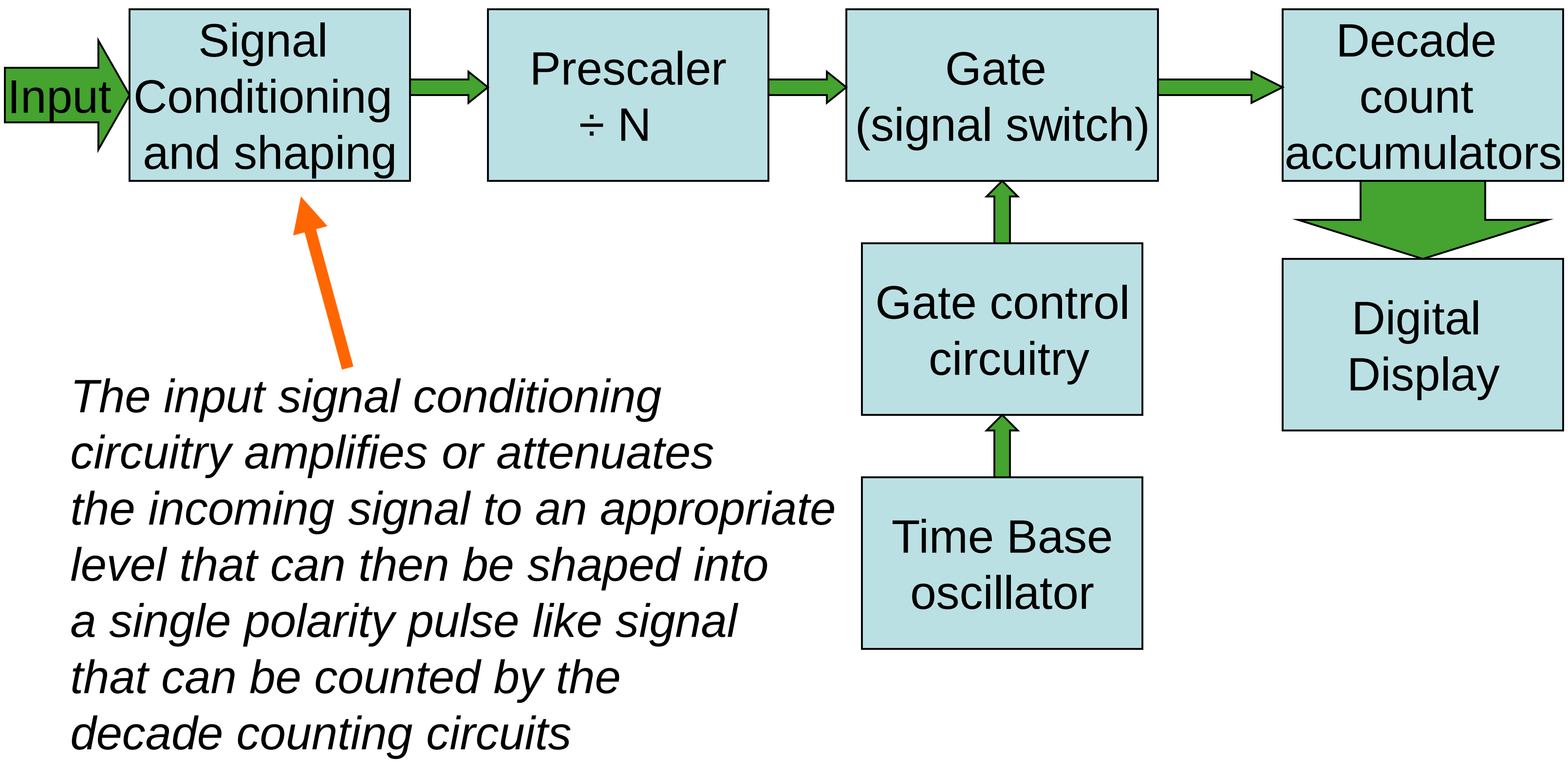
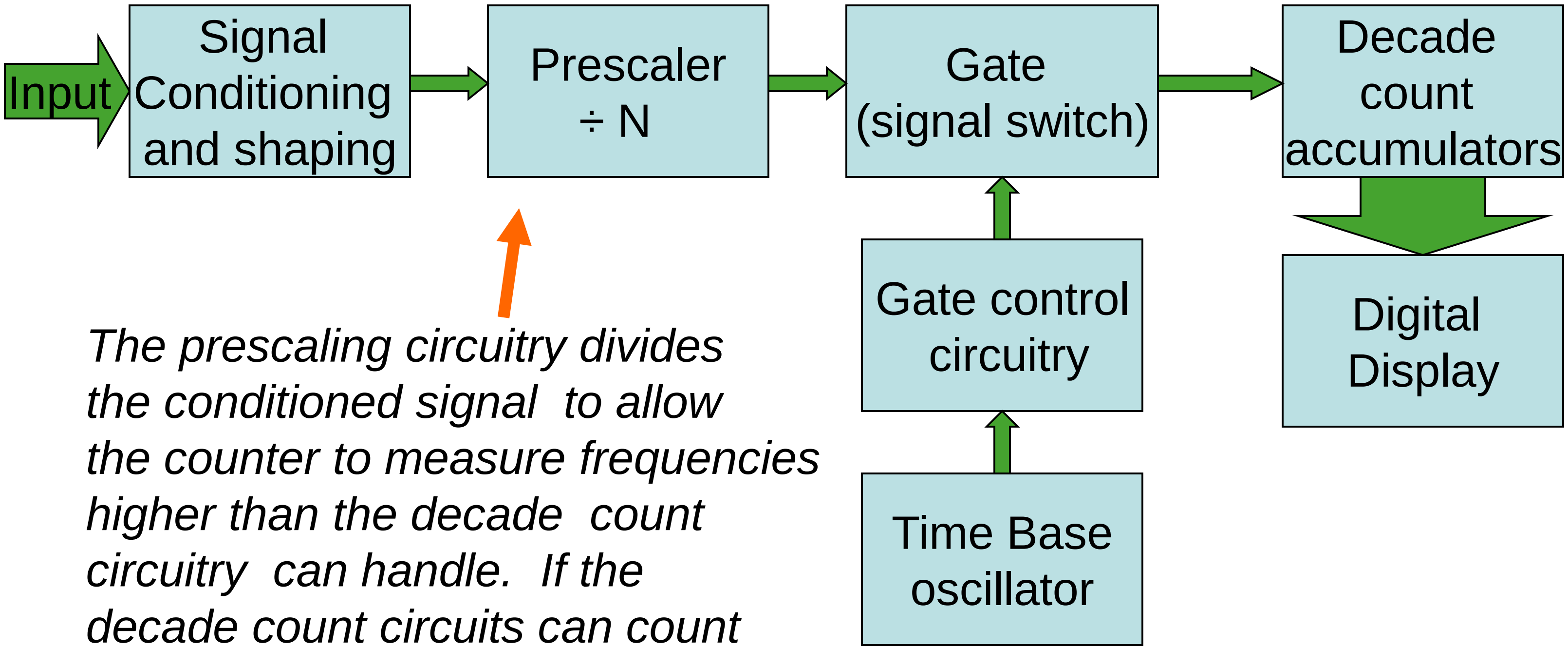
Frequency Counters



Frequency Counter Block Diagram

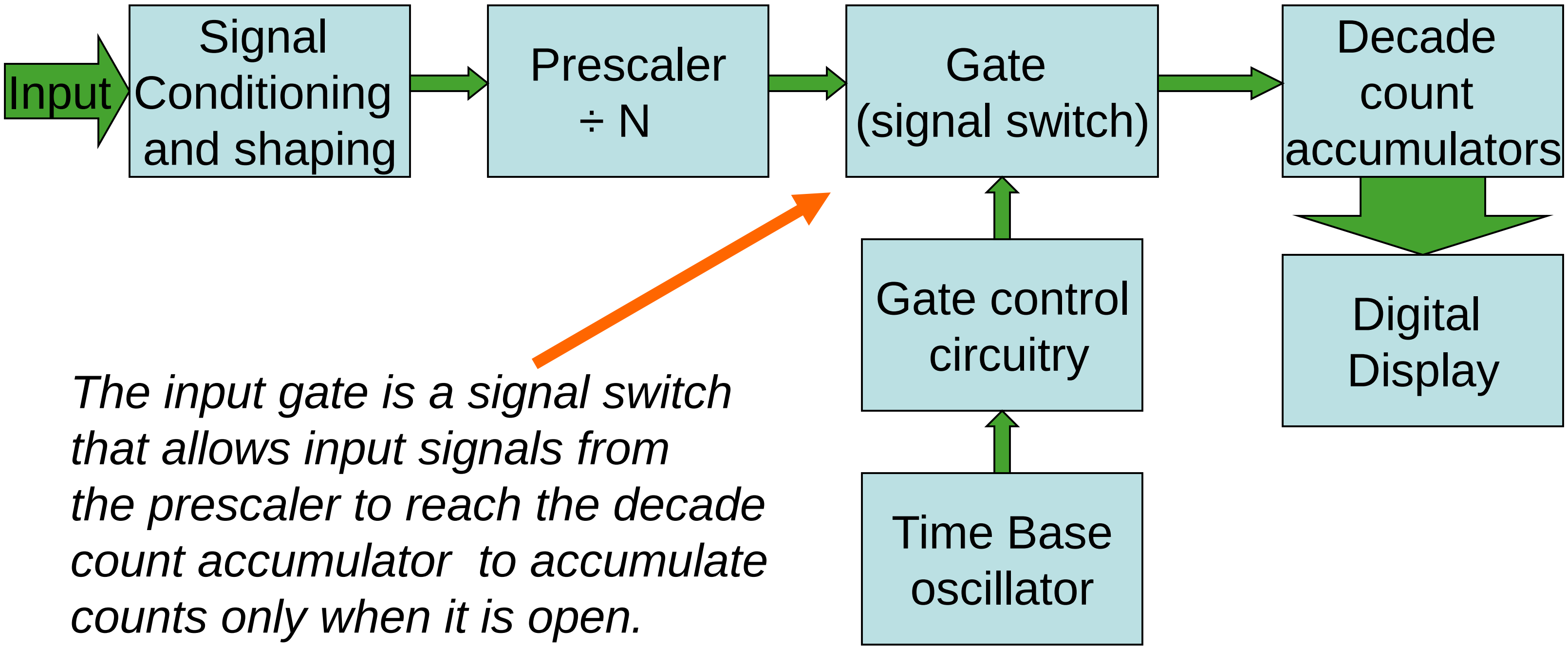


Frequency Counter Block Diagram



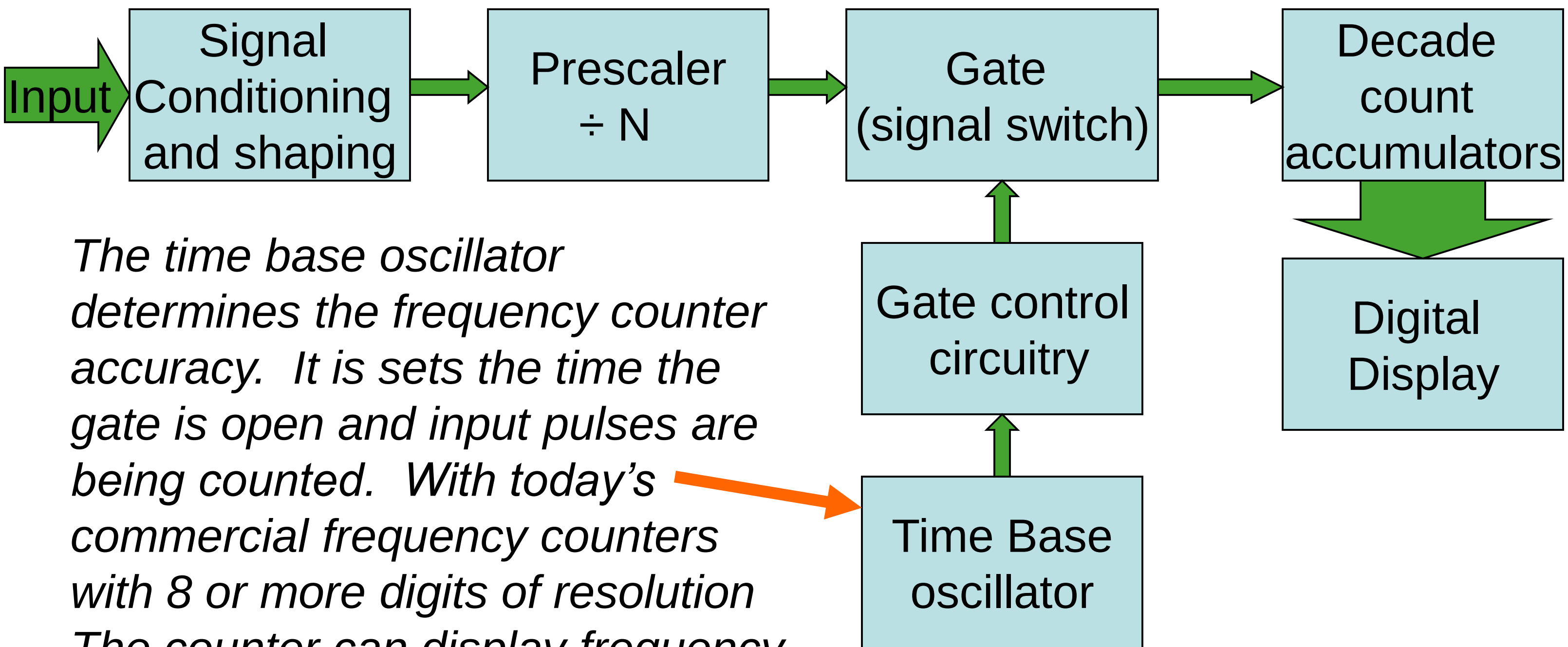
The prescaling circuitry divides the conditioned signal to allow the counter to measure frequencies higher than the decade count circuitry can handle. If the decade count circuits can count to 100 MHz then a ÷10 prescaler will extend the range to 1,000 MHz. For a given gate time of 1 second the ÷10 prescaler will reduce the resolution to 10 Hz instead of 1 Hz

Frequency Counter Block Diagram



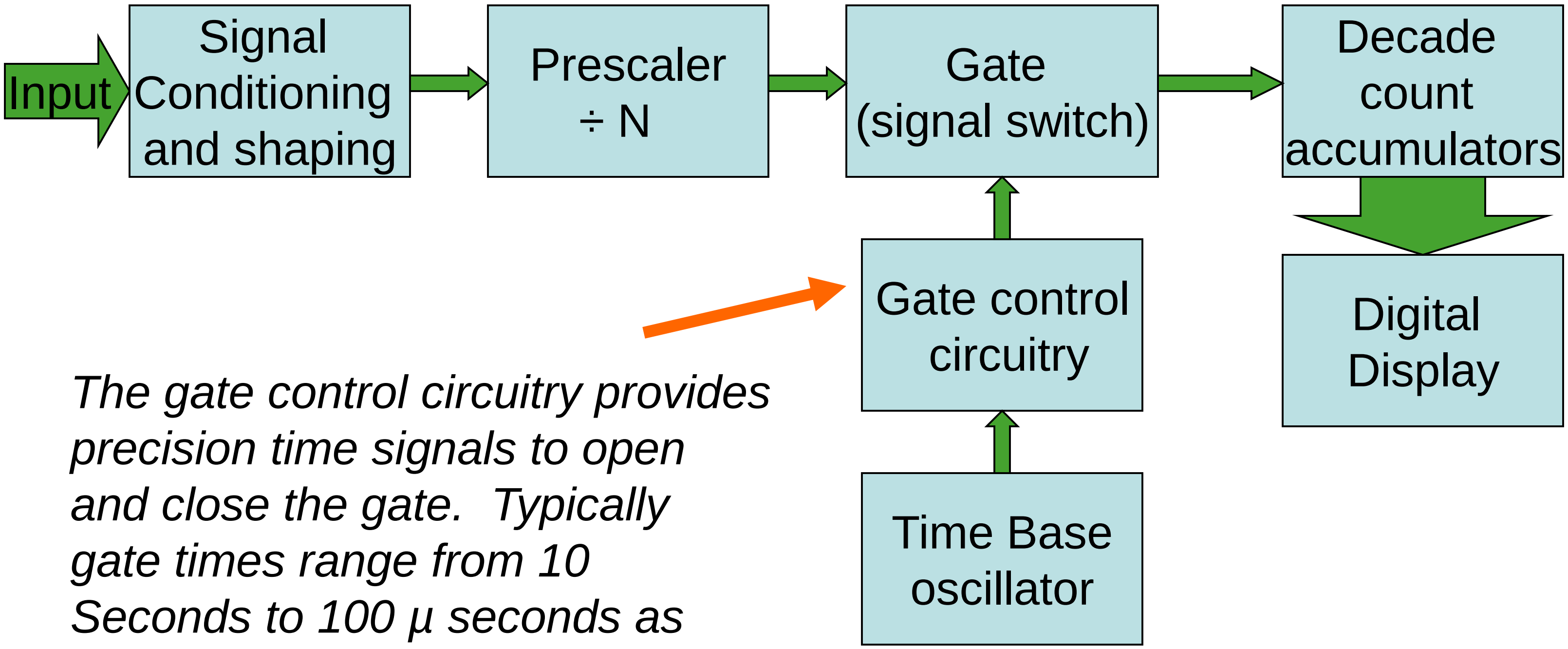
The input gate is a signal switch that allows input signals from the prescaler to reach the decade count accumulator to accumulate counts only when it is open. When the gate is closed the input signal is not counted

Frequency Counter Block Diagram



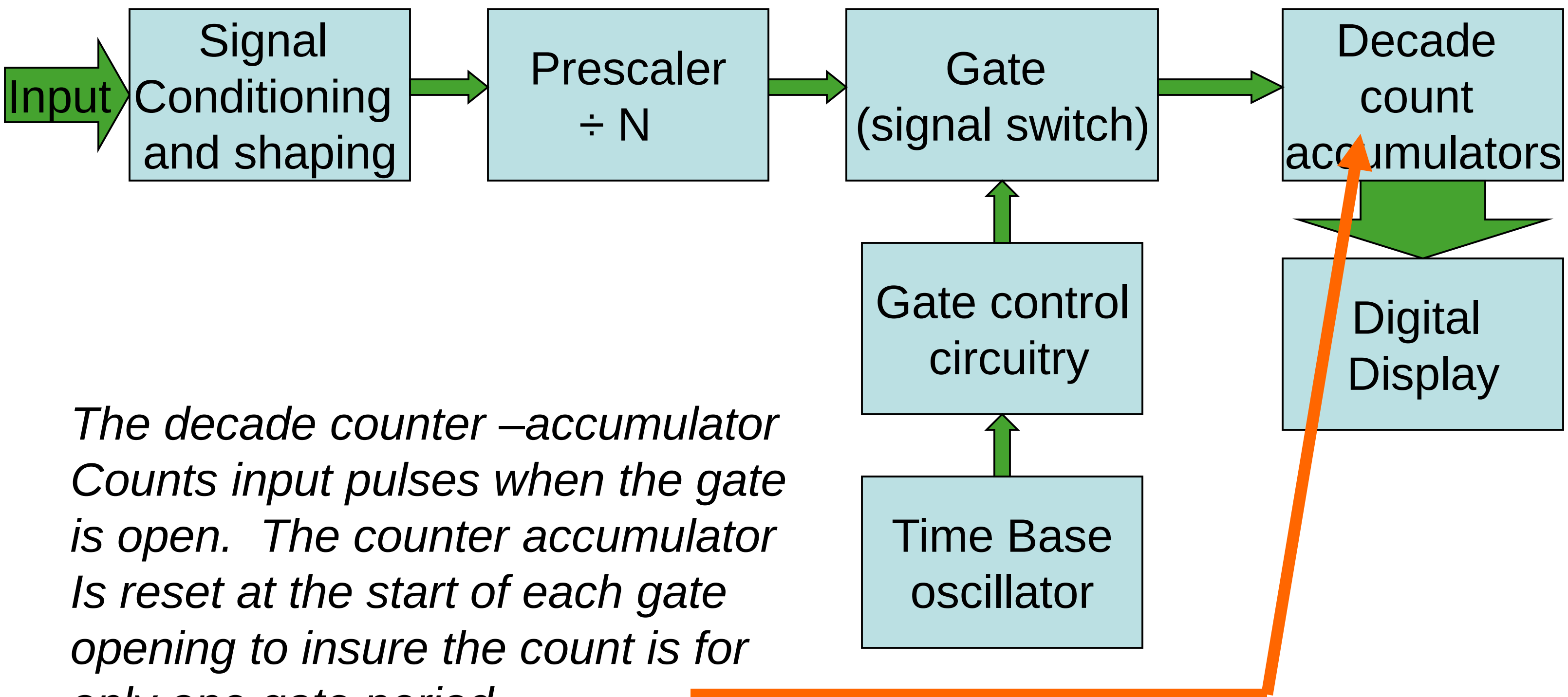
The time base oscillator determines the frequency counter accuracy. It is sets the time the gate is open and input pulses are being counted. With today's commercial frequency counters with 8 or more digits of resolution The counter can display frequency with more digits than the accuracy of the time base can support (resolution exceeds accuracy)

Frequency Counter Block Diagram



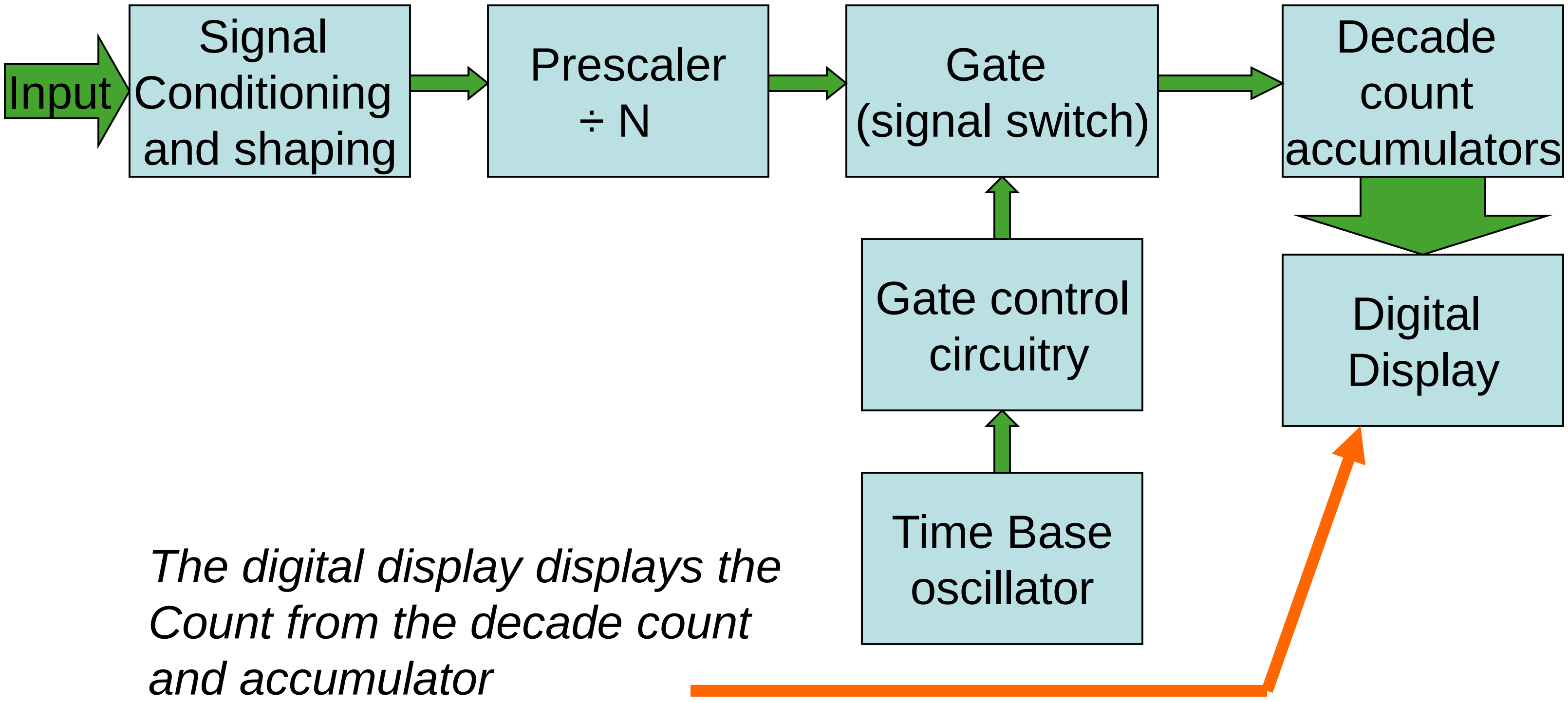
The gate control circuitry provides precision time signals to open and close the gate. Typically gate times range from 10 Seconds to 100 µ seconds as well as a signal to reset the decade accumulator to 0 for the next count

Frequency Counter Block Diagram



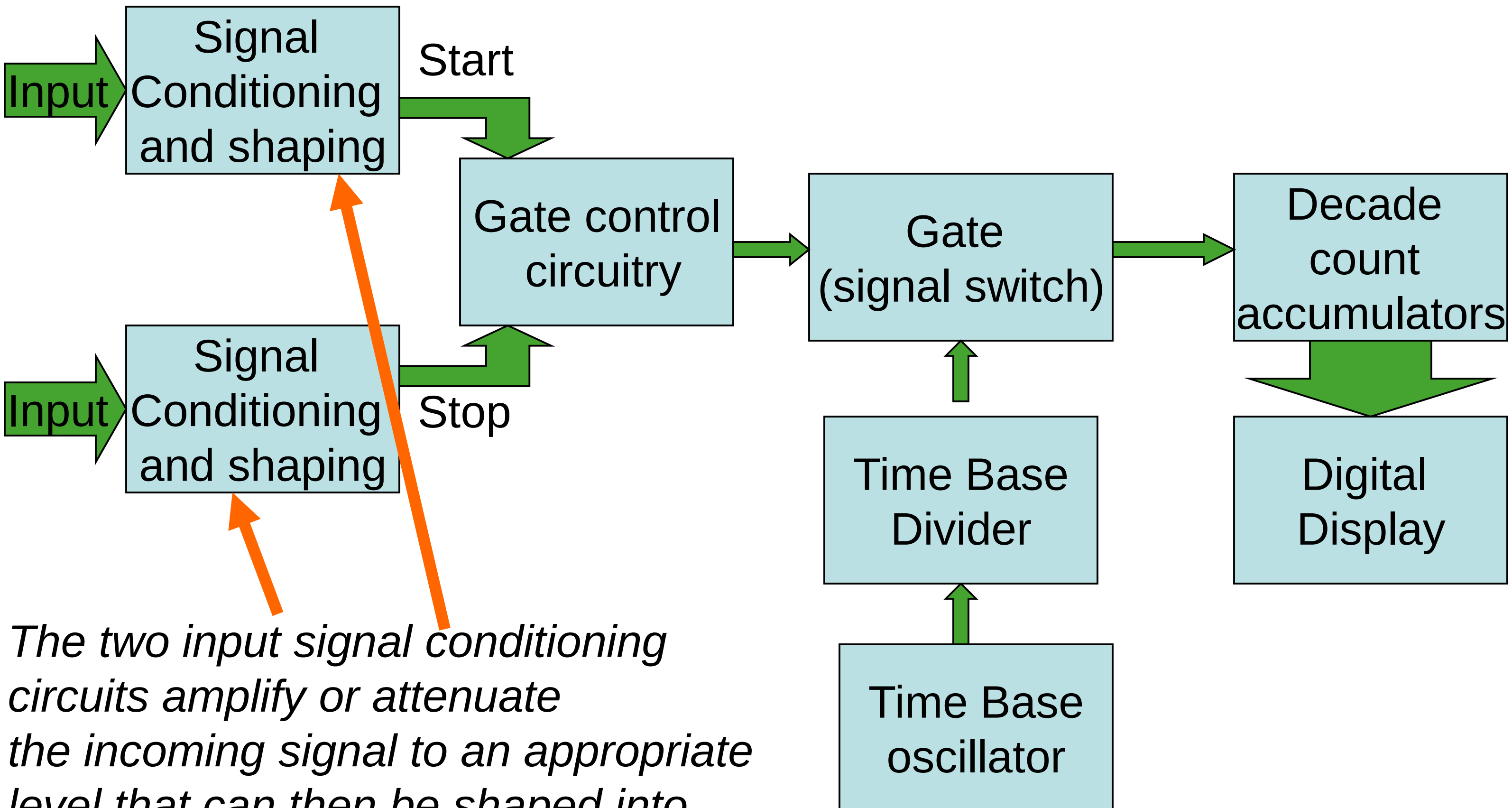
The decade counter –accumulator Counts input pulses when the gate is open. The counter accumulator Is reset at the start of each gate opening to insure the count is for only one gate period.

Frequency Counter Block Diagram



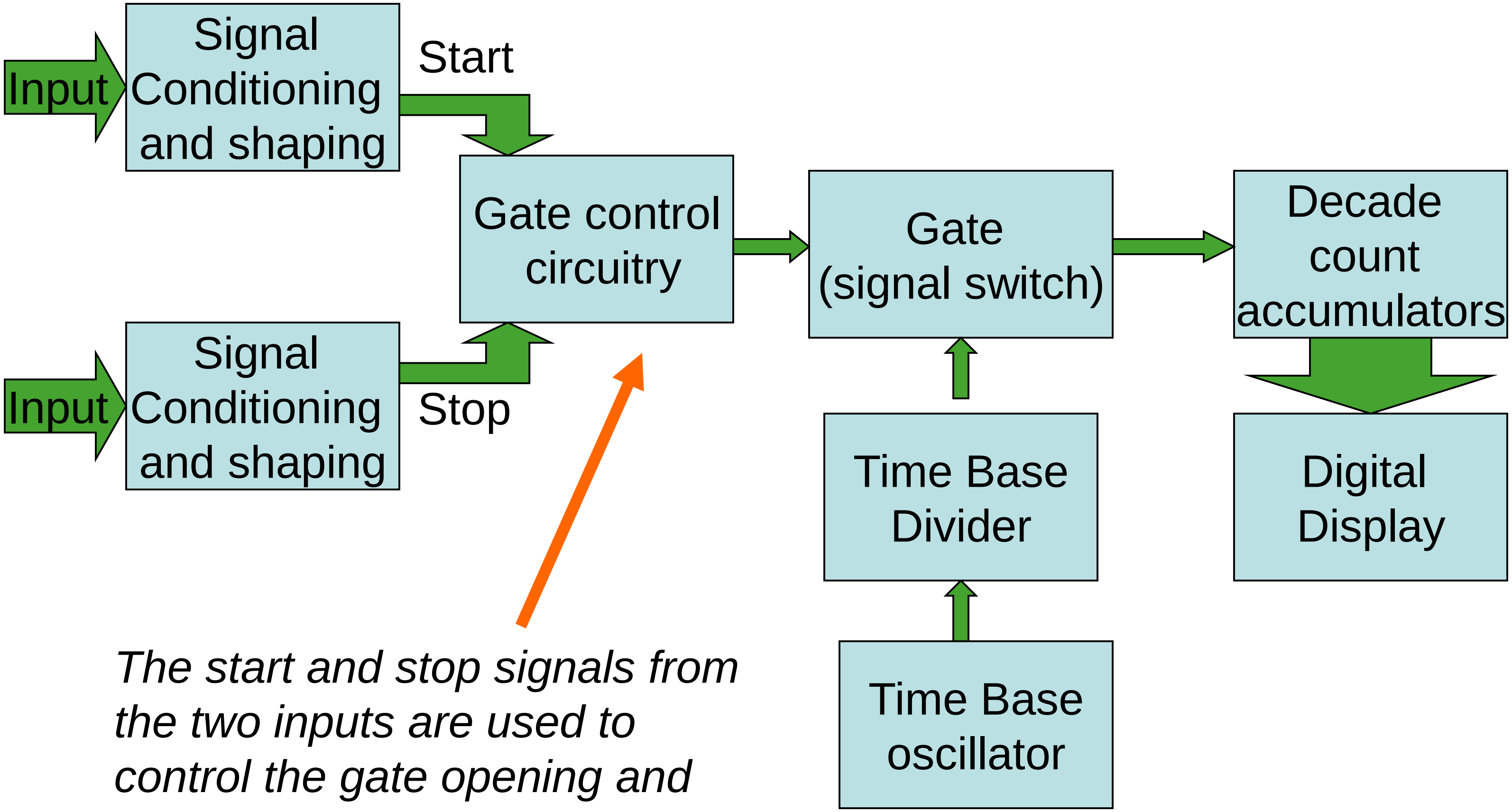
The digital display displays the Count from the decade count and accumulator

Time Interval Counters



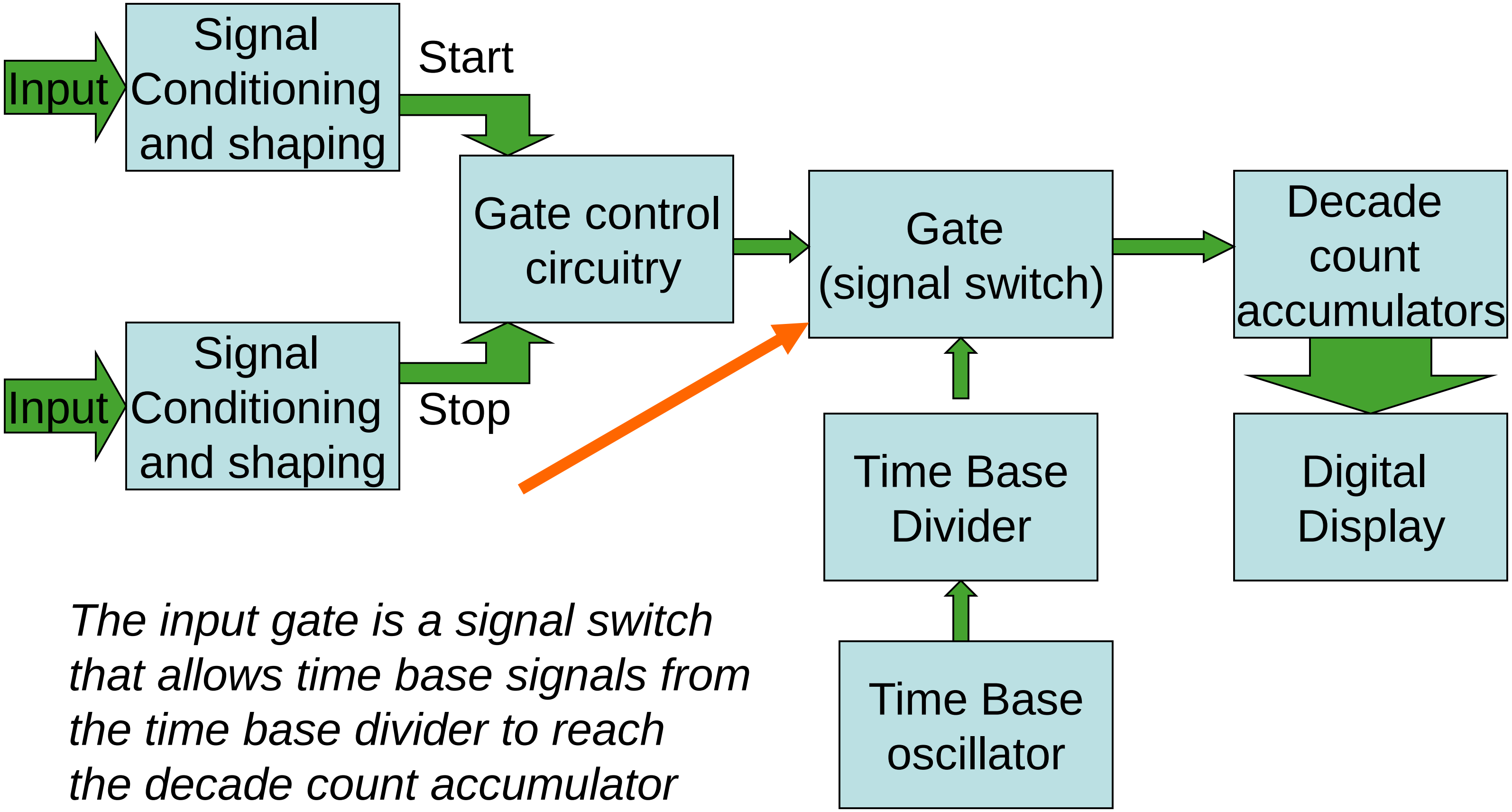
The two input signal conditioning circuits amplify or attenuate the incoming signal to an appropriate level that can then be shaped into a signal that can be used to control the gate opening (start counting) and closing (stop counting)

Time Interval Counters



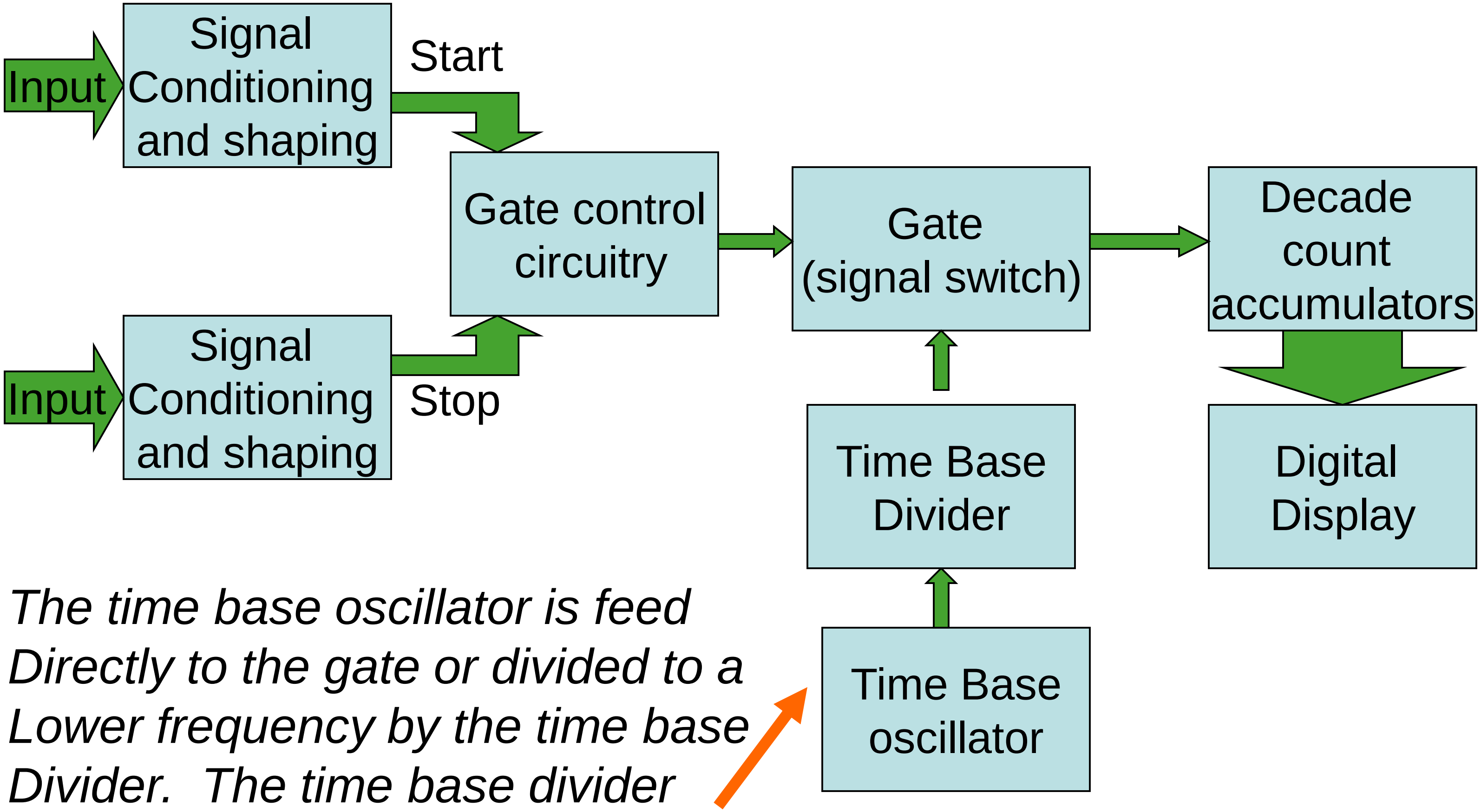
The start and stop signals from the two inputs are used to control the gate opening and closing

Time Interval Counters



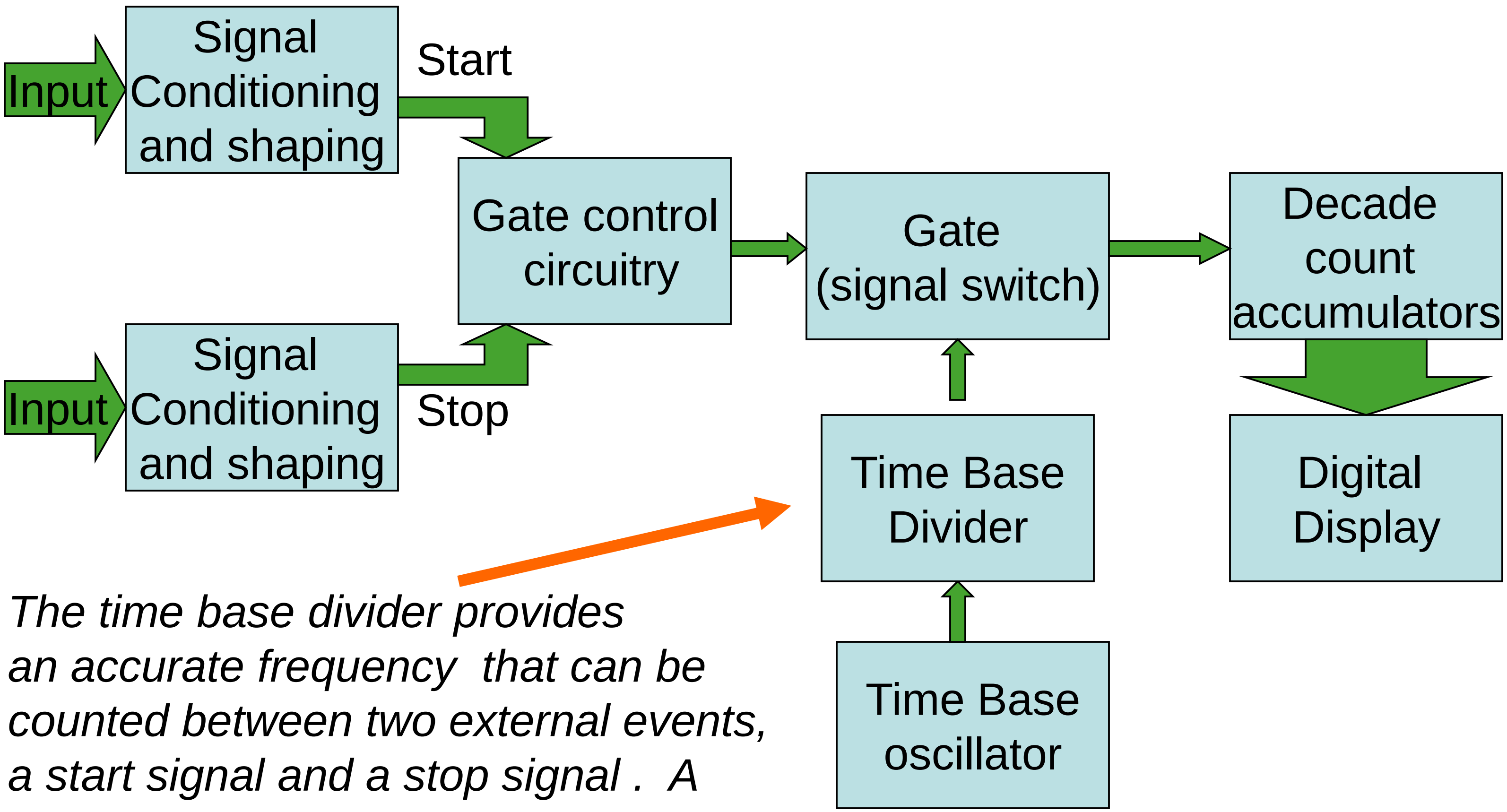
The input gate is a signal switch that allows time base signals from the time base divider to reach the decade count accumulator to accumulate between separate start and stop signals

Time Interval Counters



The time base oscillator is feed Directly to the gate or divided to a Lower frequency by the time base Divider. The time base divider frequency sets the resolution of The time interval measurement

Time Interval Counters



The time base divider provides an accurate frequency that can be counted between two external events, a start signal and a stop signal . A 10 MHz time base will allow 100 nS resolution timing measurements, and when divided to 100 Hz will provide 10 mS resolution

Accuracy of frequency measurements

Time base accuracy	Error at 14 MHz	Error at 144 MHz	Error at 220 MHz	Error at 445 MHz	Error at 1296 MHz
1 pt 10^6 **1 ppm**	14 Hz	144 Hz	220 Hz	445 Hz	1,296 Hz
1 pt 10^7 **0.1 ppm**	1.4 Hz	14.4 Hz	22.0 Hz	44.5 Hz	129.6 Hz
1 pt 10^8 **0.01 ppm**	.14 Hz	1.44 Hz	2.20 Hz	4.45 Hz	12.96 Hz
1 pt 10^9 **0.001 ppm**	.014 Hz	.144 Hz	.220 Hz	.445 Hz	1.296 Hz

Time Base Error Contribution to Frequency and Time Meas.

T/B Accuracy	Type of Oscillator
1 pt 10^6	Generic Crystal Oscillator Error of ~one second every 11 days
1 pt 10^7	Temperature Compensated Crystal Error of one second every 115 days
1 pt 10^8 to 1 pt 10^9	Ovenized crystal oscillator Error of one second every 3 years
1 pt 10^10	Precision proportional controlled special cut crystal oscillators Error of one second every 300 years
1 pt 10^11	GPS Locked Oscillators Error of one second every 3,000 years
1 pt 10^13	Rubidium and Cesium Based Oscillators Error of one second every 300,000 years

Available Standard Frequencies

WWV	2.5, 5, 10, 15, and 20 MHz transmissions from NBS Subject to path changes that can effect accuracy
WWVB	60 KHz transmission from NBS Bolder Colorado Ground wave reception for most of the US, better than WWV
CMU	7335 KHz from Canada
GPS Locked Oscillators	Surplus devices like the HP Z3801 are available at reasonable cost ($300-$400)
Loran C	Going away in a few years, but still in use by many
Rubidium Oscillators	Almost an absolute standard, calibration needed
Cesium Beam Clocks	Absolute standard, no calibration needed. Also called Atomic Clocks

Summary

- Frequency counters are useful for measuring transmitter frequencies.
- Frequency Counter accuracy is dependent on time base accuracy.
- Frequency Counter time bases need periodic calibration.
- Do not adjust your radio oscillator unless you know the Frequency Counter being used is accurate.
- Most Frequency Counters do not like high power, use an attenuator or antenna to couple to the radio under test.