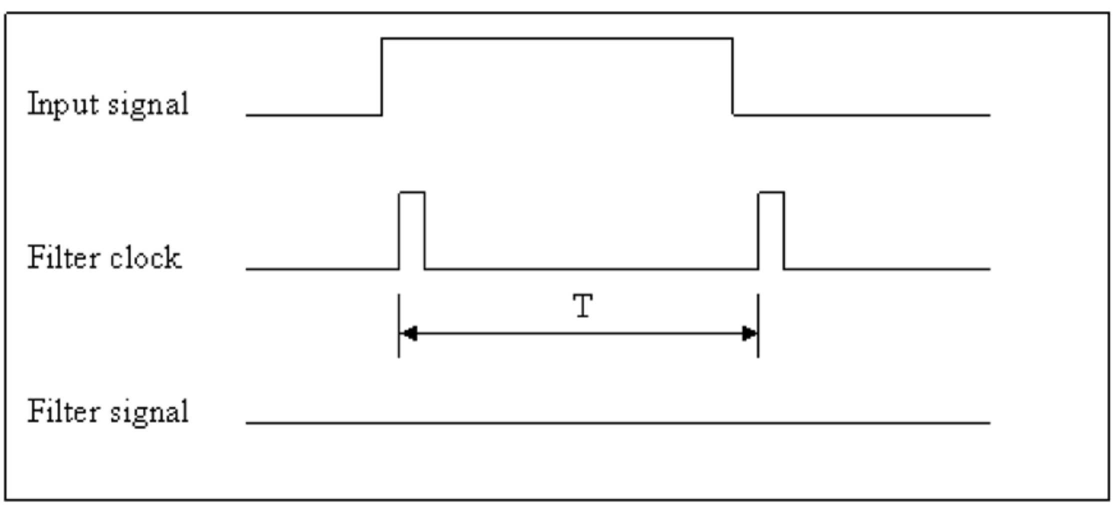
Digital Low Pass Filter

The 8080 has three independent 2nd-order digital noise filters, LP0, LP1 & LP2, to remove noises as follows:

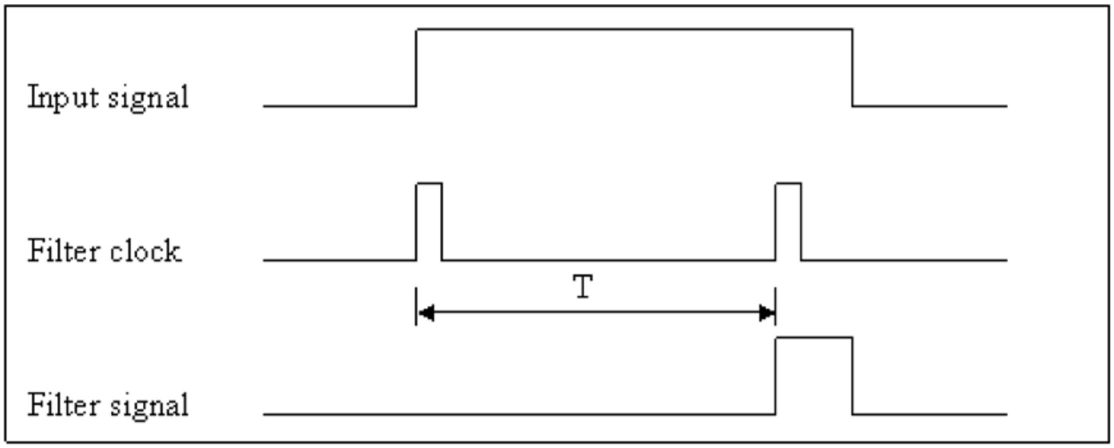
Channel	Low Pass Filter
A0	Low Pass Filter 0
B0	Low Pass Filter 0
A1	Low Pass Filter 1
B1	Low Pass Filter 1
A2	Low Pass Filter 2
B2	Low Pass Filter 2
A3	Low Pass Filter 2
B3	Low Pass Filter 2

The Low Pass Filter can be either disabled or programmable from 2 μS to 65535 μS.
The Low Pass Filter will apply to all working modes, counter or frequency.
These 3 Low Pass Filters are disabled status in the default shipping. User defined program can be
used to issue a command to enable or disable the filters.
Assume that the filter clock of the Low Pass Filter is set to T, this clock is used to sample the input signal.
If one of the adjacent 2 samples is low, then the input signal will be removed as follows:



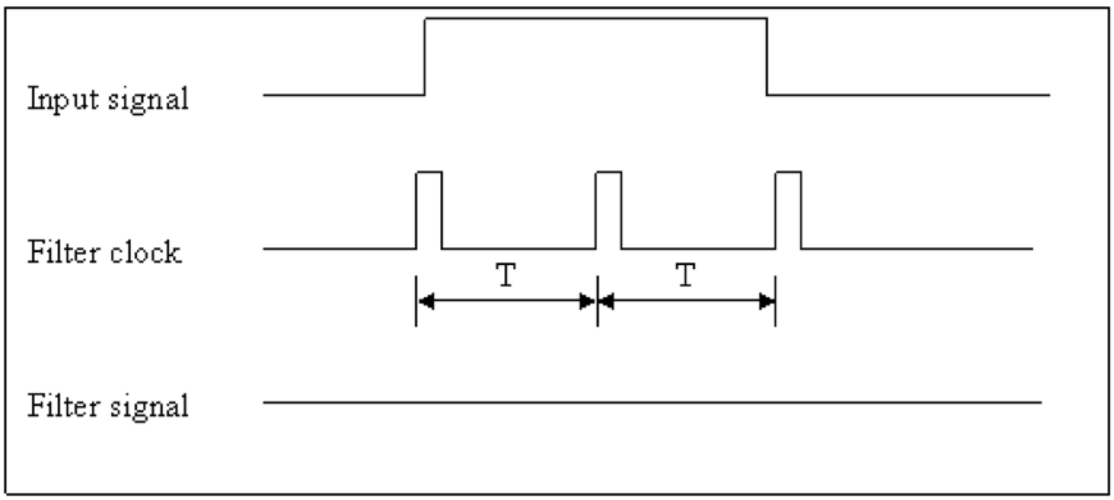
If the high width of the input signal is shorter then T, it will be filtered.

If the adjacent 2 samples are all HIGH, the input signal can pass as indicated below:



Note: the filter signal is shorter than the original input signal.

If the input signal is shorter than 2T, it may be filtered in the following manner:



The relationship between the input signal and the filter signal is as follows:
if (2T<input signal) , it will pass
if (T<=input signal<=2T) , it may be filtered or passed
if (input signal <T) , it will be filtered

The software driver, 'i8080_SetLowPassUs (int Slot, int Channel, unsigned int Us)', provides an parameter, Us which can be used to set the Low Pass Filter as follows:

if Us=1 and 2T =1μS then T = 0.5μS and signal<=0.5μS will be removed
if Us=2 and 2T= 2μS then T = 1 μS and signal<=1μS will be removed
if Us=N, N from 1 to 0x7fff and 2T = N μS then signal<=(N/2) μS will be removed

The Low Pass Filter range can be configured from 1μS to 32767μS. The high width of the signal < (Us/2) will be removed.

For example, if you use a function generator as signal source, the 500Hz signal & 50/50 duty cycle
will generate a 1000µS high & 1000µS low as follows:

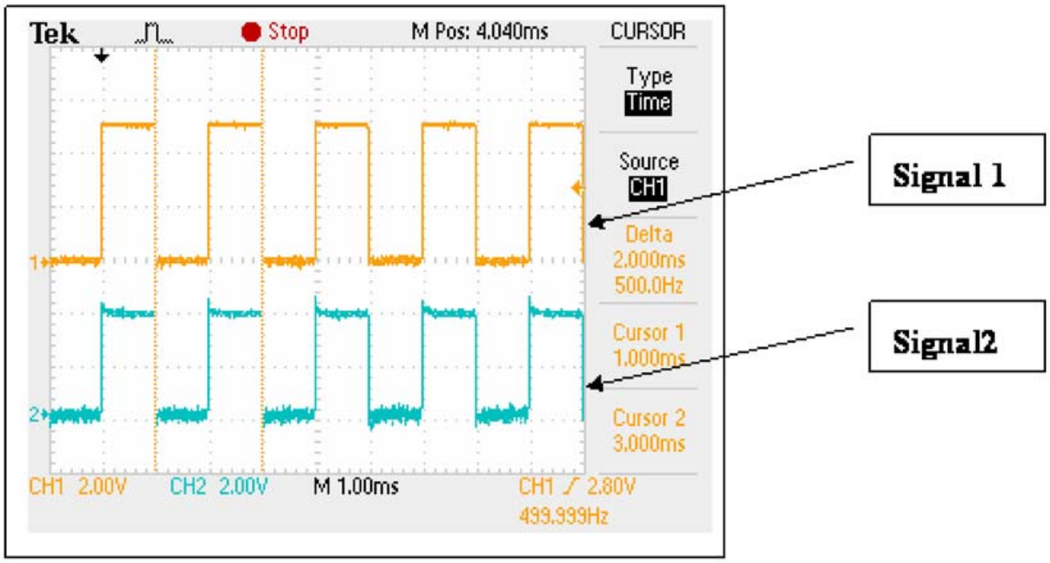


Figure 1 Input signal=500Hz & Low Pass Filter Disable

Signal 1 = input signal=500Hz, 50/50 duty cycle
Signal 2 = input signal after Xor and Low Pass Filter, now Xor=0 and Low Pass Filter is disable.

If the Low Pass Filter is disabled, signal 2 will be the same as signal 1 in the above diagram.
If the Low Pass Filter is enabled, signal 2 will be shorter than signal 1 as shown below:

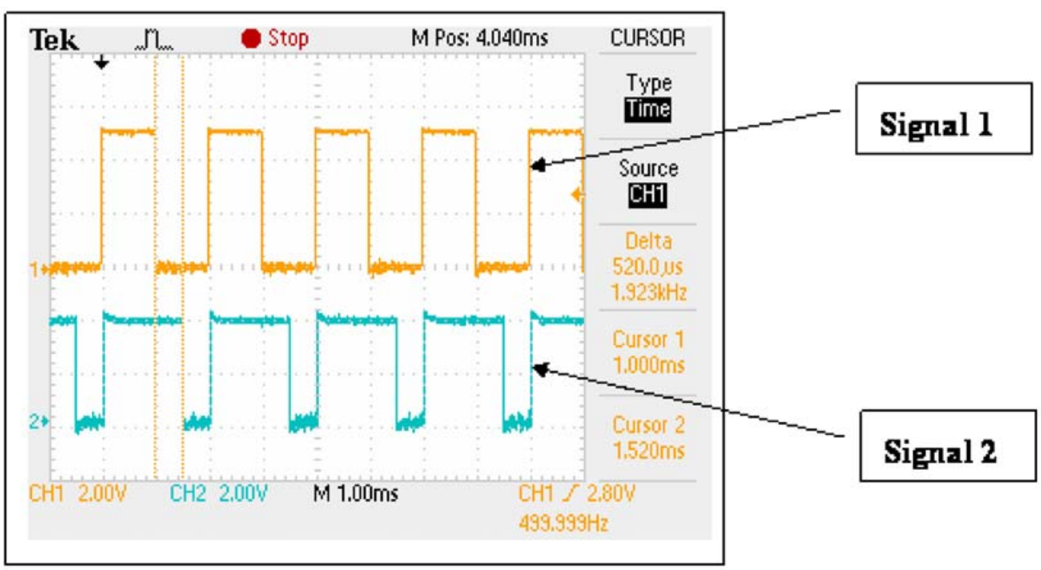


Figure 2 Input signal=500Hz & Low Pass Filter Enable=1µS

Signal 1 = input signal=500Hz, 50/50 duty cycle
Signal 2 = input signal after Xor and Low Pass Filter, now Xor=0 and the Low Pass Filter is

enabled.
Nearly all pulses are passed.

Now you can find that nearly all pulses are passed. If the input signal is increased to 600Hz, then some of the pulses are filtered as follows:

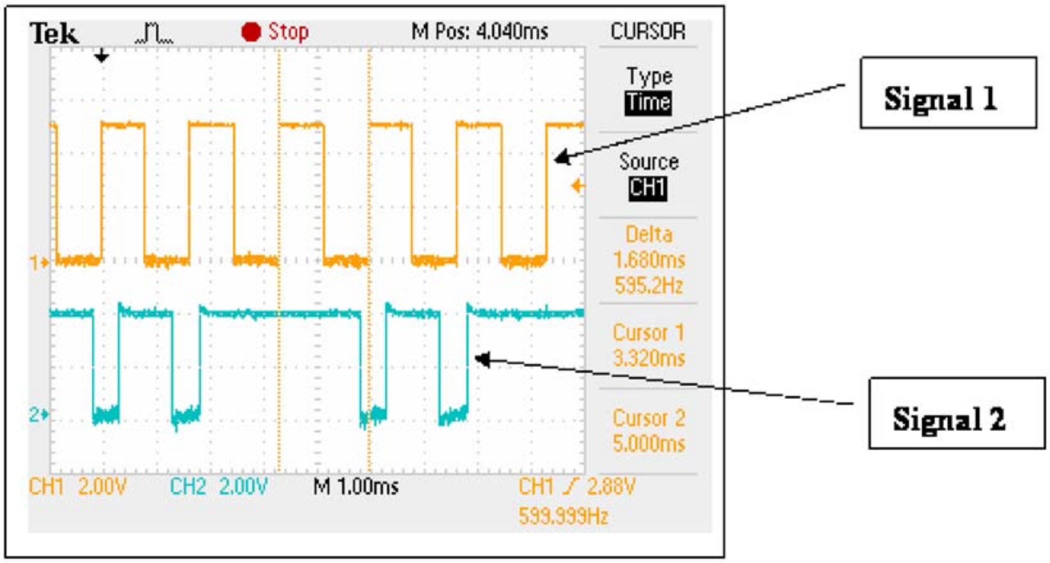


Figure 3 Input signal=600Hz & Low Pass Filter Enabled=1µS

Signal 1 = input signal=600Hz, 50/50 duty cycle.
Signal 2 = input signal after Xor and Low Pass Filter, now Xor =0 and Low Pass Filter is enabled.
Some pulses are filtered.

If the input signal is increased to 900Hz, then nearly all pulses are filtered as illustrated below:

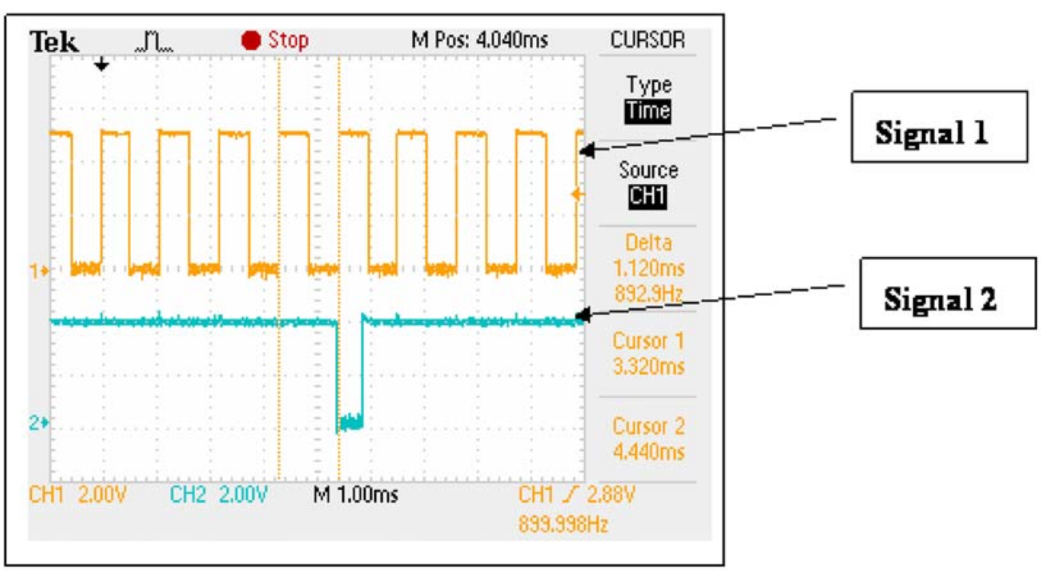


Figure 4 Input signal=900Hz & Low Pass Filter Enabled=1µS

Signal 1 = input signal=900Hz, 50/50 duty cycle
Signal 2 = input signal after Xor and Low Pass Filter, now Xor=0 and the Low Pass Filter is enabled.
Nearly all pulses are filtered.

Because there are some frequency offset errors in the internal crystal, there may be some noises when
the input signal width = Low Pass Filter/2 as follows:

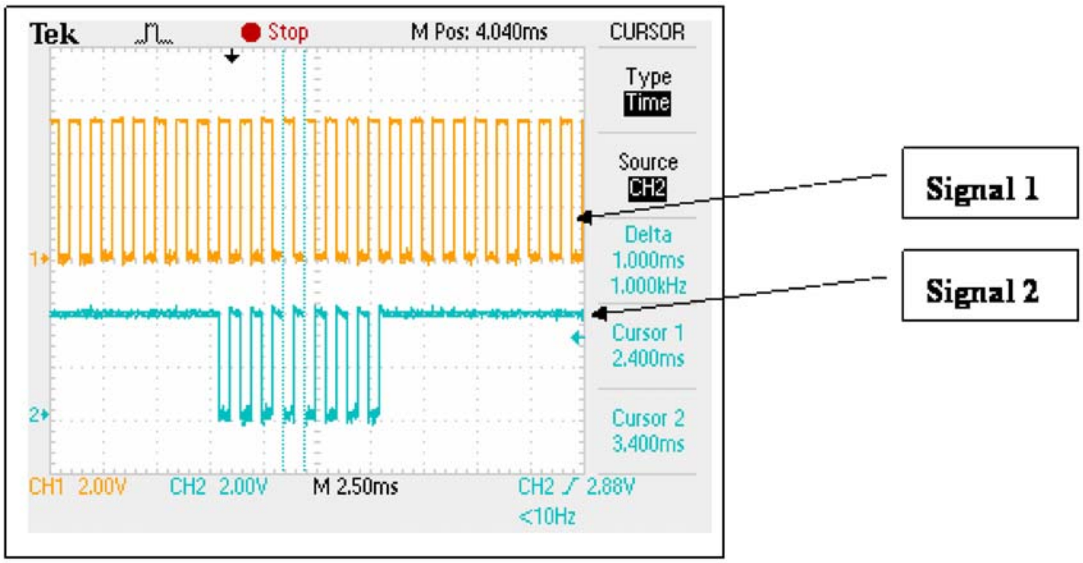


Figure 5 Input signal=1000Hz & Low Pass Filter Enabled=1µS

Signal 1 = input signal=1000Hz, 50/50 duty cycle à pulse width=500 µS
Signal 2 = input signal after Xor and Low Pass Filter, now Xor=0 and the Low Pass Filter is enabled.
Signal Pulse=500 µS=Low Pass Filter/2.
Nearly all pulses are filtered, but sometimes certain noises will not be filtered.

If the input signal is increased to 1100Hz, then all pulses will be filtered as shown in Figure 1-12:

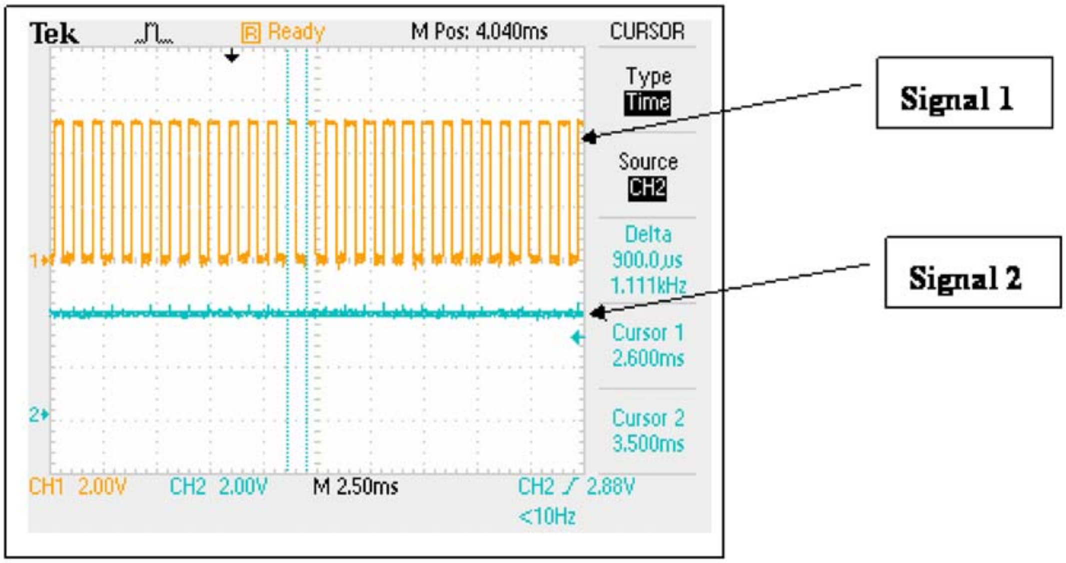


Figure 6 Input signal=1100Hz & Low Pass Filter Enabled=1μS

In summary, apply the minimum 1μS on Low Pass Filters.
The result of the signal being processed by the Low Pass Filter as follows:

Input signal frequency(Hz)	**After Low Pass Filter processing**	**Reference**
Input signal <500Hz (Low Pass Filter**=**1μS)	All signals will be passed	**Figure 1**
Input signal =500Hz (Low Pass Filter**=**1μS)	All signals should be passed	**Figure 2**
Input signal =600Hz (Low Pass Filter**=**1μS)	Some signals will be filtered and some will be passed	**Figure 3**
Input signal =900Hz (Low Pass Filter**=**1μS)	Many signals will be filtered and few will be passed	**Figure 4**
Input signal =1000Hz (Low Pass Filter**=**1μS)	Nearly all signals are filtered	**Figure 5**
Input signal =1100Hz (>1k Hz) (Low Pass Filter**=**1μS)	All signals will be filtered	**Figure 6**

For the same reason, if the signal pulse=Low Pass Filter, certain pulses may be filtered. **Therefore, it is recommended to set the cycle time of Low Pass Filter about 5% less than the cycle time of input signal pulse** as shown below:
Input pulse =1 ms = 1000 μS à set Low Pass Filter <=950 μS
if Input pulse = 100 μS , set Low Pass Filter <= 95 μS
The minimum Low Pass Filter = 1 μS , input signal < 475K, 50/50 duty cycle
As a result, the maximum speed of the 8080 is recommended to 450K, 50/50 duty cycle