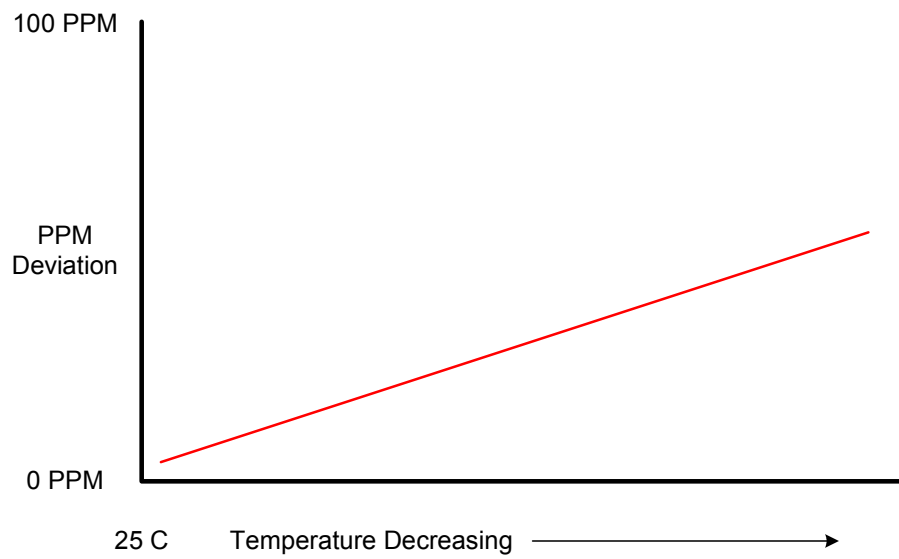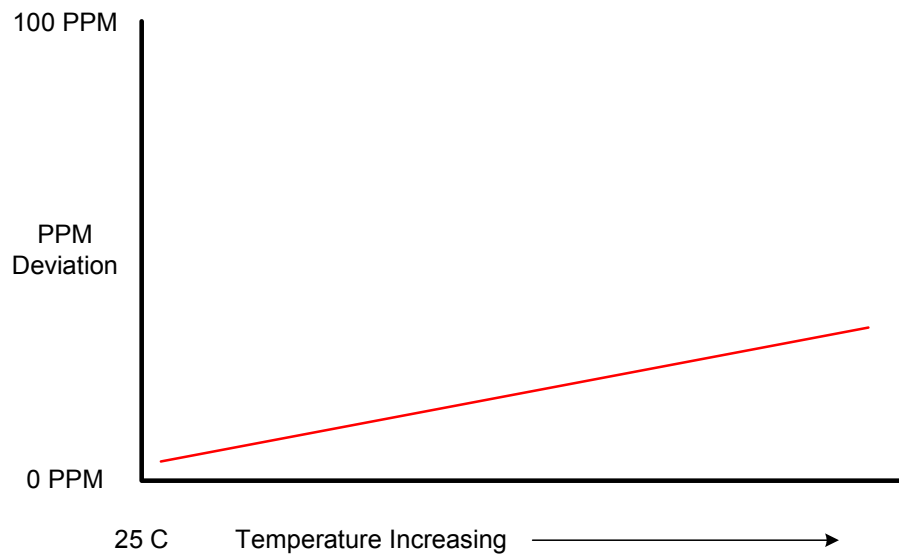# Crystal Frequency Stability Selection

One of the criteria to be considered in selecting a proper Crystal Oscillator for an SMSC LAN product is the Frequency Stability. There are basically three manners in which a crystal will drift off the intended nominal frequency (for our Ethernet products, this nominal frequency is 25.000 MHz). The frequency will change with respect to temperature, it will drift over time and there is a basic production accuracy that is characterized by the manufacturer.

In selecting a correct crystal, the customer must outline his system requirements with all three of these factors in mind. Once the system is characterized, the crystal data sheet should have all the pertinent numbers in order to correctly evaluate the crystal selected. The table below can be used to illustrate the three different deviations.

Crystal Stability Selection Table	
Frequency Stability Over Temperature	
Frequency Deviation Over Time (Aging)	
Frequency Tolerance at 25° C	
Total PPM Bit Budget Allowed by IEEE 802.3u	$\pm$ 50 PPM

In order to be guaranteed IEEE compliance, all three of the above deviations must add up to less than the IEEE required $\pm$ 50 PPM. One should start with Frequency Stability Over Temperature factor. This will drive the basic Frequency Tolerance at 25° C number. The customer must determine the high and the low operational temperatures for their product. As can be seen from the following graphs, higher and lower temperatures from 25° C cause an increase in the deviation. Depending upon how hot and how cold the product will be operating at, will determine how large the Frequency Stability Over Temperature factor will be.

100 PPM

PPM
Deviation

0 PPM

25 C　　　Temperature Increasing ⟶

100 PPM

PPM
Deviation

0 PPM

25 C　　　Temperature Decreasing ⟶

The Frequency Deviation Over Time (Aging) is a fixed number, usually on the order of $\pm 2 - 5$ PPM per year. Then the Frequency Tolerance at 25° C factor can be decided upon by making sure all three add up to less than ± 50 PPM.