

Update on the Impact of AKM fire on TCXO / VCTCXO Availability

Background

Asahi Kasei Microsystems (AKM) is the primary TCXO/VCTCXO global IC supplier, accounting for an estimated 90%+ market share. AKM's Nobeoka City, Japan plant caught fire on 10/20/20 and burned for three days, causing large scale damage. AKM issued an advisory on 11/05/20 informing customers to seek alternate solutions, as the supplier does not anticipate recovery until 2022.

Abrakon and its associated brands offer a comprehensive set of TCXO and VCTCXO solutions that incorporate one of the AKM's IC's and are offered in package sizes such as 2.0x1.6, 2.5x2.0, 3.2x2.5, 5.0x3.2 and 9.0x7.0 mm. Below is the list of standard series that are impacted by the limited availability of the AKM IC (Table 1).

ABRACON SERIES	ILSI SERIES	MMD SERIES	FOX SERIES
ASTX-09 / ASVTX-09	I526 / I726	MTJ	FT1CN / FT1CV
ASTX-11 / ASVTX-11	I531 / I731	MTF	FT1GN / FT1GV
ASTX-12 / ASVTX-12	I547 / I747	MTA	FT2CN / FT2CV
ASTX-13 / ASVTX-13	I583 / I783	MTB	FT2GN / FT2GV
ASTX-H11	I587 / I787	MTC	FT2SN / FT2SV
ASTX-H12	I589 / I789	MTSS	FT2HE / FT2GS
ASTXR-11	I593 / I793	MTDS	FT2GC/ FT3HD
ASTXR-12	I595 / I795	MTTAS	FT3AN / FT3AV
ASTXR-13		MTVS	FT3GN / FT3GV
ABDFTCXO		MTWS	FT5SN / FT5SV
ABDFVCTCXO		MTWC	FT7SN / FT7SV
ASGTX			FT7HN / FT7HV
AST3TQ			FT7TN
AT3TQ-28			
AST3TQ-50			
AST3TQ53			

Table 1

Note: For product families highlighted in Table (1), Abracon does offer potential alternate non-AKM based TCXO solutions. See Table (2) below.

Under the ILSI and Fox brands, Abracon also offers TCXO and VCTCXO solutions that are available in both 3.2x2.5mm and 5.0x3.2 mm packages. These solutions do not incorporate AKM IC based temperature compensation but rather, an entirely different IC from another IC OEM. AKM devices incorporate the "Analog" temperature compensation methodology whereas, the ILSI and Fox series of products listed in Table (2) below incorporate the "Digital" temperature compensation technique.

Table (2) below outlines the overall capability of the non-AKM based, digitally compensated solutions under the ILSI and Fox brands. Abracon does not offer any TCXOs with a non-AKM based solution.

PACKAGE SIZE	5.0mm x 3.2mm	5.0mm x 3.2mm	3.2mm x 2.5mm	3.2mm x 2.5mm
TYPE	TCXO / TCVCXO	TCXO / TCVCXO	TCXO / TCVCXO	TCXO / TCVCXO
IC USED	Not AKM	Not AKM	Not AKM	Not AKM
COMPENSATION METHOD	Digital	Digital	Digital	Digital
AVAILABLE FREQ RANGE	6MHz ~ 40 MHz	6MHz ~ 40 MHz	8MHz ~ 40 MHz	8MHz ~ 40 MHz
OUTPUT LOGIC	Clipped Sine	HCMOS	Clipped Sine	HCMOS
STABILITY	±1.0ppm ~ ±5.0ppm	±1.0ppm ~ ±5.0ppm	±1.0ppm ~ ±5.0ppm	±1.0ppm ~ ±5.0ppm
OPERATING TEMP	-40°C ~ 85°C	-40°C ~ 85°C	-40°C ~ 85°C	-40°C ~ 85°C
SEAL METHOD	Seam Sealed	Seam Sealed	Seam Sealed	Seam Sealed
PAD 1 FUNCTION	P1 = N/C or GND/P1 = Vc	P1 = N/C or GND/P1 = Vc	P1 = N/C or GND/P1 = Vc	P1 = N/C or GND/P1 = Vc
SUPPLY VOLTAGE	2.5V, 2.7V, 3.0V, 3.3V	2.5V, 2.7V, 3.0V, 3.3V	2.5V, 2.7V, 3.0V, 3.3V	2.5V, 2.7V, 3.0V, 3.3V
ILSI SERIES	I533 / I733	I534 / I734	I537 / I737	I538 / I738
FOX SERIES	FT5CN / FT5CV	FT5HN / FT5HV	FT3CN / FT3CV	FT3HN / FT3HV

Table 2

Brief Overview of Temperature Compensation:

Most, if not all, commodity-grade TCXO & VCTCXO products employ an AT-Cut, fundamental mode quartz crystal as the resonator element. The frequency stability of this resonator over temperature is a function of the cut along the Z-Axis, as depicted in Figure (1).

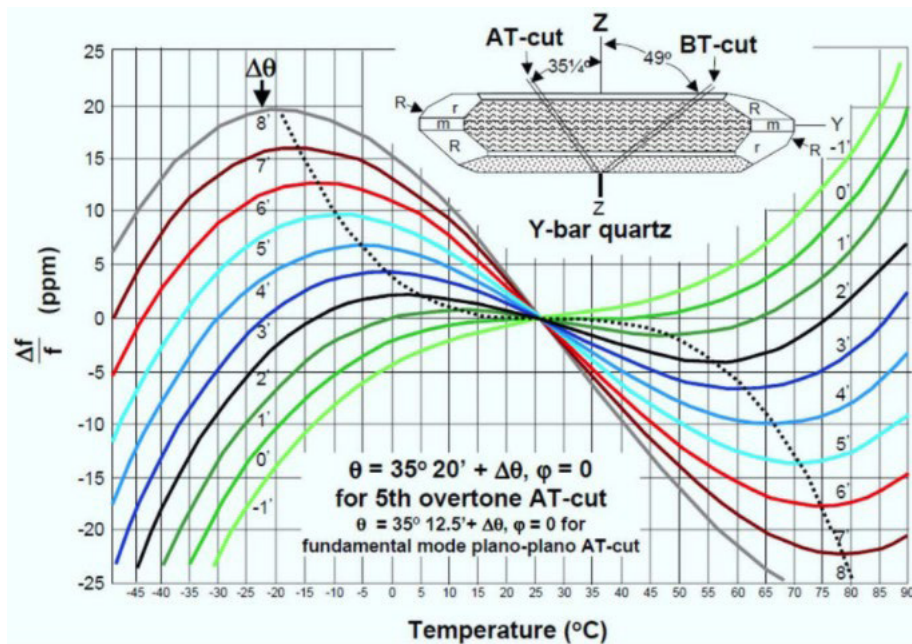


Figure 1

The objective of the temperature compensation circuit inside the TCXO / VCTCXO is to null-out the frequency variation of the quartz crystal over temperature (the “- - -” curve in Figure (2) such that, the residual error [frequency vs. temperature is minimal (the green curve depicted in Figure (2)).

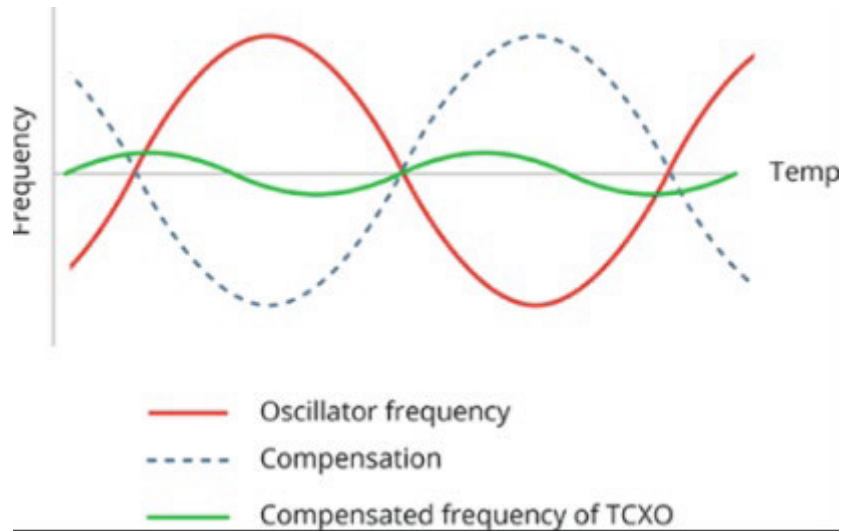


Figure 2

Two primary methodologies to achieve this temperature compensation are commonly referred to as “Analog” or “Digital.” The Analog approach approximates the frequency over temperature behavior of the quartz crystal by a third or higher order polynomial and then generates the inverted function to correct this error. An example of the residual error curve is depicted in Figure (3).

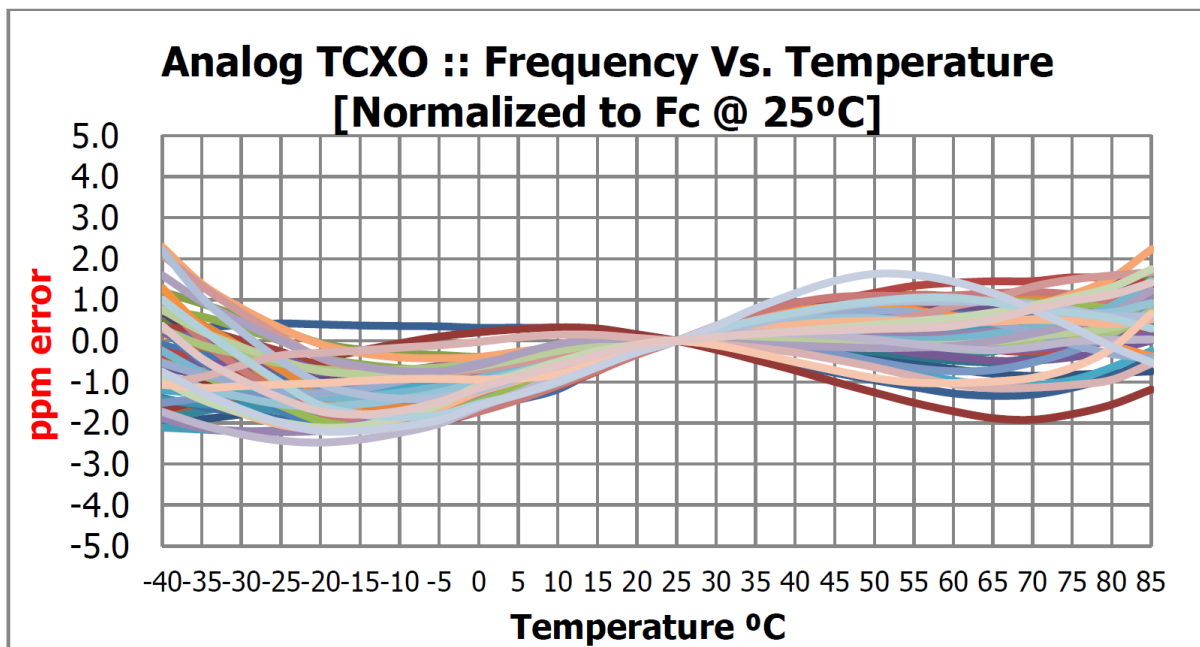


Figure 3

In a Digital temperature compensation scheme, the frequency over temperature behavior of the quartz crystal is “sliced” into small temperature segments and then an inverted curve is generated for each. An overall error curve example is depicted in Figure (4).

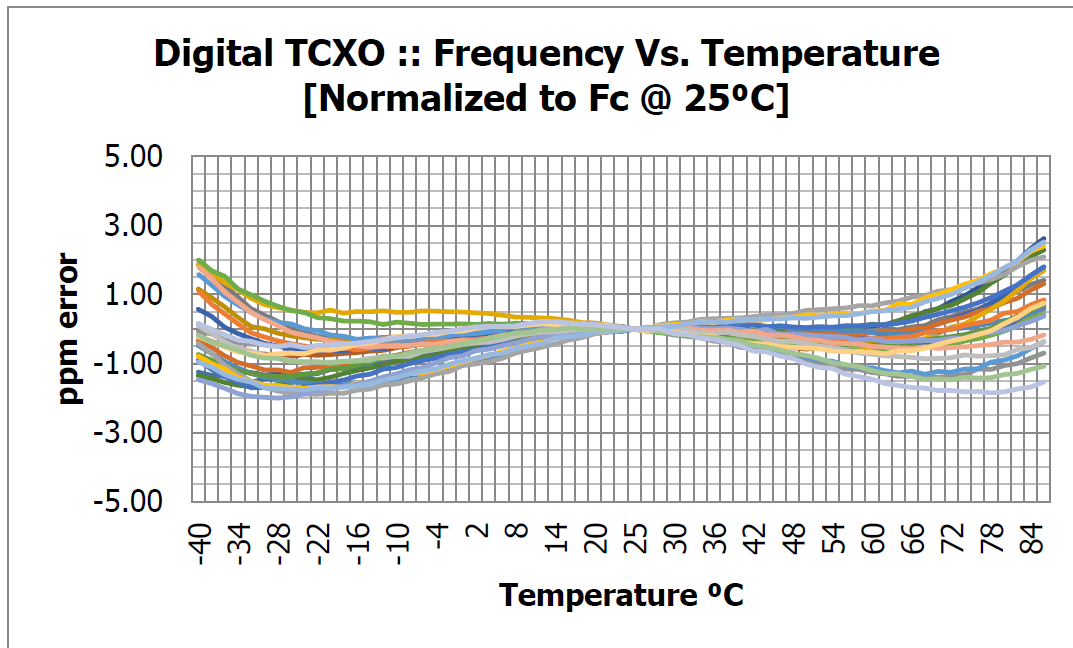


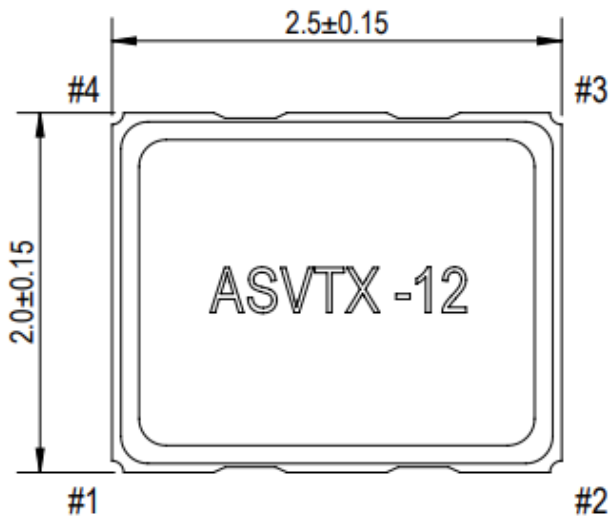
Figure 4

As is evident from comparing the data between Figure (3) and Figure (4), analog and digital temperature compensation schemes yield equivalent overall frequency stability performance.

Replacing a 2.5 x 2.0mm TCXO/VCTCXO with a 3.2 x 2.5mm Device

As shown in Table (2), the ILSI and Fox families of non-AKM based TCXO/VCTCXO’s are available in either 3.2x2.5mm or 5.0x3.2mm packages. Customers who are currently employing the 2.5x2.0 mm packaged solutions can incorporate the 3.2x2.5 mm package by simply rotating their PCB layout by 90° and extending the pad placement such that the overall increase in surface area is merely 1.2mm. See Figure (5). Please take note that the implementation of this approach will most likely require re-routing of the signal paths to the 3.2x2.5mm TCXO device on the end-customer PCB.

Figure 5 (shown on the following page)



Recommended Land Pattern

