USING CERAMIC RESONATORS WITH THE ST7

by Microcontroller Division Applications

INTRODUCTION

The goal of this application note is to show, using results obtained by Murata, that ceramic resonators can be used instead of quartz crystals. Ceramic resonators are cheaper than quartz crystals and as some resonators have built-in capacitors, so they allow you to use less components.

The results described here have been obtained for the ST72251 but are also available for ST72101, ST72121, ST72212, ST72213, ST72221, ST72331 and ST72311.
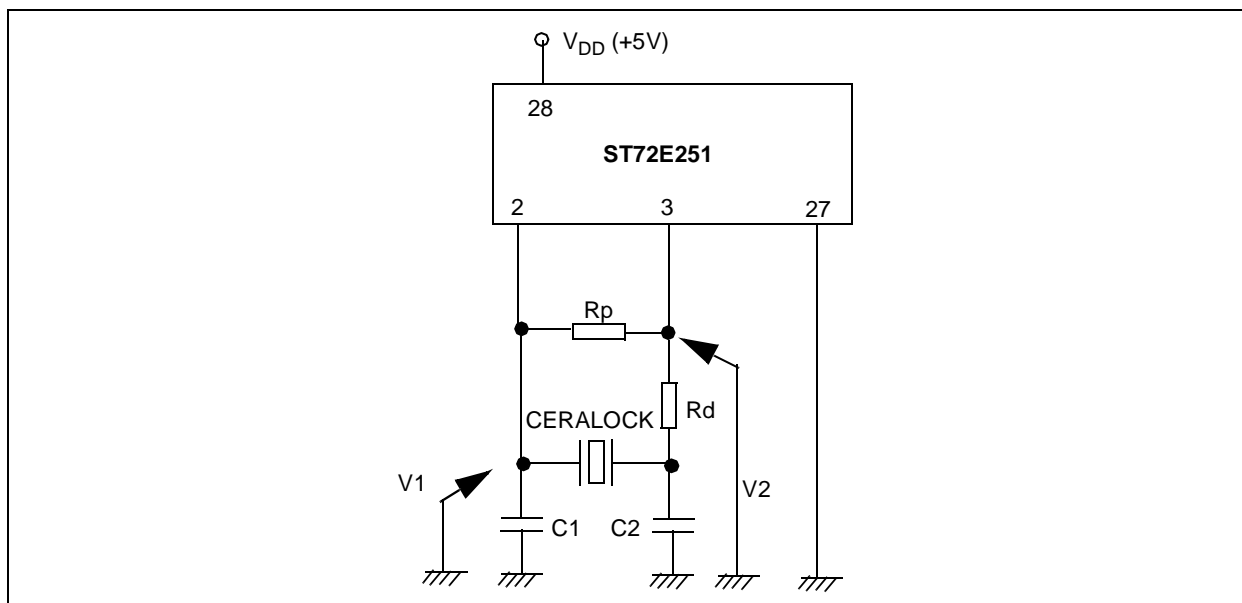
1 CERAMIC RESONATORS FOR ST72251

Murata Electronics is a manufacturer of passive electronic components such as capacitors, filters, oscillators and resonators.

They have done several tests with different resonators (CERALOCK) for STMicroelectronics 8-bit microcontrollers at 4 MHz, 8 MHz and 16 MHz. Some resonators have built-in capacitors (see Table 1).

The test circuit is shown in Figure 1.

Figure 1. Test circuit

Table 1 shows the recommended conditions at different frequencies.

Table 1. Obtained Results

Freq. (MHz)	Parts Number	C1 (PF)	C2 (PF)	Rp (Ohm)	Rd (Ohm)	Vdd (V)
4	CSA4.00MG040[1]	100	100	Open	0	3.0 to 5.5
	CST4.00MGW040[2]	(100)	(100)	Open	0	
	CSAC4.00MGC(M)040[3]	100	100	Open	0	
	CSTCC4.00MG0H6[4]	(47)	(47)	Open	0	
8	CSA8.00MTZ[1]	30	30	Open	0	3.0 to 5.5
	CST8.00MTW[2]	(30)	(30)	Open	0	
	CSACV8.00MTJ[3]	30	30	Open	0	
	CSTCC8.00MG0H6[4]	(47)	(47)	Open	0	3.0 to 5.5
16	CSA16.00MXZ040[1]	10	10	Open	0	4.5 to 5.5
	CSACV16.00MXJ040[3]	10	10	Open	0	

Advantages of using ceramic resonators:

■ CST, CSTCC, CSTCV types have built-in loading capacitors (those with values shown in parentheses ()).

■ Rp is always open in the previous table because there is no need for a parallel resistor with a resonator (it is needed only with a crystal).

For automotive applications, the Part Number suffix "A" is added except for CSACV and CSTCV types.

For SMD-type 8 MHz resonators for automotive applications, the Part Number is CSTCC8.00MGA0H6.

Test conditions:

■ The evaluation conditions are 1.8 to 5.5 V for the supply voltage and -40° to 85° C for the temperature range.

Caution:
Above circuit condition is for a design reference only.
Recommendable C1, C2 value is dependent on the circuit board used.
Request Murata for characterization.

Notes:

1) CSA series: ceramic resonators from 1.25 MHz to 60 MHz. Initial frequency tolerance of +/-0.5%.

2) CST series: ceramic resonators from 1.80 MHz to 60 MHz with built-in load capacitors. Initial frequency tolerance of +/- 0.5%. The built-in capacitor values are in parentheses.

3) CSAC series: surface mount ceramic resonators from 1.80MHz to 60MHz. Initial frequency tolerance of +/-0.5%.

4) CSTC series: surface mount ceramic resonators from 1.80MHz to 60MHz with built-in load capacitor. Initial frequency tolerance of +/- 0.5%. The built-in capacitor values are in parentheses.

2 RESULTS AND DIAGRAMS

The diagrams which follow show some of the important features and characteristics of Murata ceramic resonators used with ST72251.

Figure 2. Oscillating Frequency vs V_{DD} Characteristics
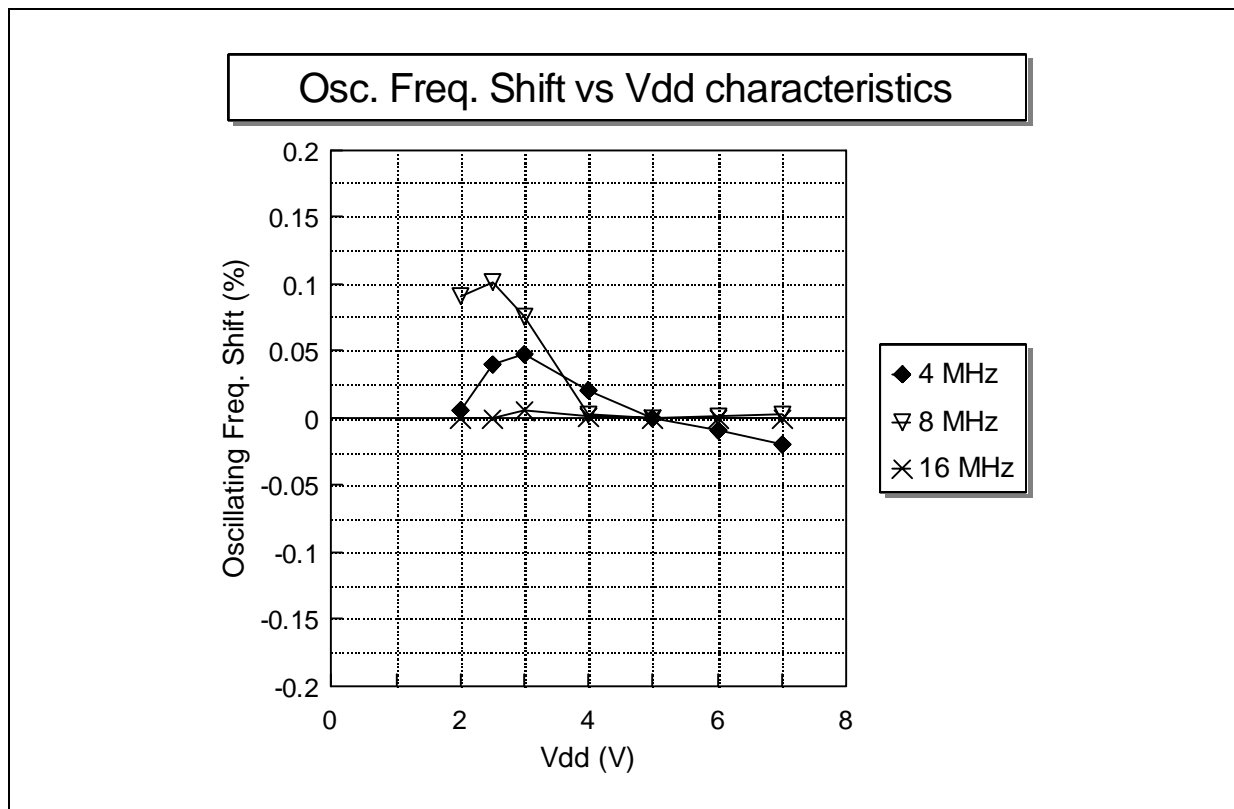
We can see in the previous diagram that between 4 and 6 Volts, the biggest frequency shift is 0.025% for the 4MHz curve (1kHz in fact).

Figure 3. Start-up Time vs V_{DD} Characteristics.
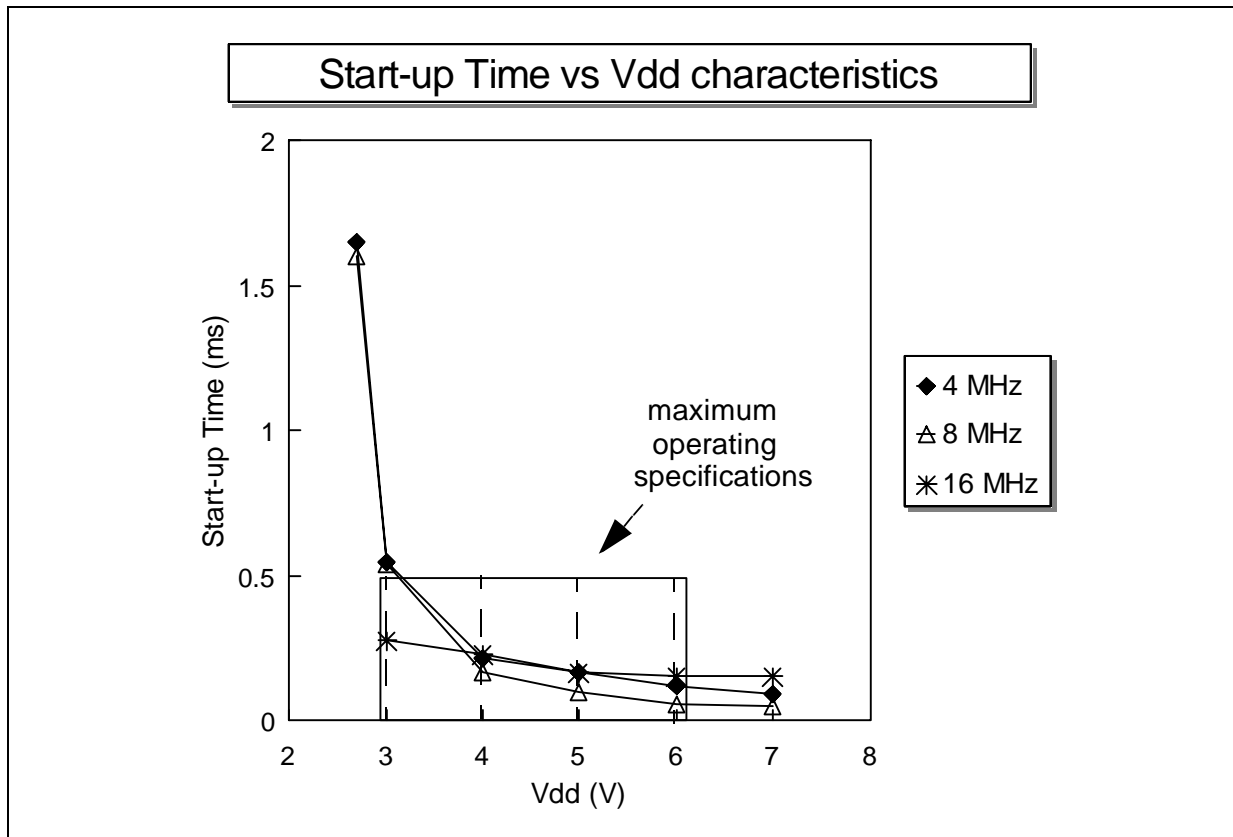
Operating specifications are between 3 and 6 Volts (V_{DD}) for a frequency (f_{CPU}) of between 4 and 8 MHz and 3.5 to 6 Volts (V_{DD}) for an fcpu of 16 MHz. The start-up time is the time the microcontroller takes to reach 90% of the V_{DD} voltage level.

In the previous diagram, we can see that the worst case (longest time) is obtained for 3 Volts (about 0.5ms).

For a better understanding of what start-up time is, see the following diagram:
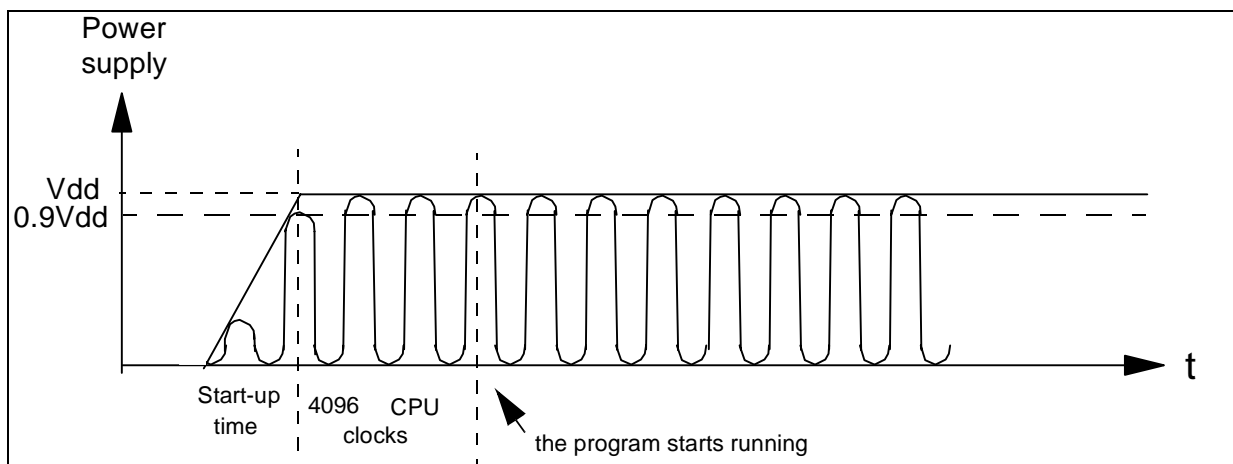
The ST7 microcontroller starts executing the program after an initial delay due to:

■ the oscillator start-up time

■ a delay of 4096 CPU clock cycles (i.e. 512µs at f_{CPU}=8 MHz).

The ceramic resonators used to obtain the previous diagrams were:

Table 2. Resonators used in previous tests.

	Figure 2	**Figure 3**
4 MHz	CSA4.00MG040	CSTCC4.00MG0H6
8 MHz	CSA8.00MTZ	CSTCC8.00MG0H6
16 MHz	CSACV16.00MXJ040	CSA16.00MXZ040

3 CONCLUSION

As shown by the results given in this Application Note, Murata's resonators have been qualified for use as oscillators for ST7 microcontrollers. This means you can use these ceramic resonators in any ST7 application.

For more information, you can contact Murata at the following address:

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