198 Stauffer Blvd., San Jose, CA 94125 Tel: (408) 995-6200 Fax: (408) 938-5580

NJU6355 Application Note

1. Quartz Crystal

The NJU6355 requires an external 32.768kHz quartz crystal. It is important to keep in mind that the time keeping accuracy is determined by the oscillation frequency of the crystal.

1-1). Selecting Quartz Crystal

The equivalent capacitance of the quartz crystal should ideally match the load capacitance of the real time clock. Therefore, NJU6355 incorporates internal oscillation capacitance in order to provide the customer the flexibility of selecting a crystal with a higher load capacitance.

The key parameter in identifying the correct crystal to be used with the NJU6355 is the equivalent capacitance (CL). This value is typically listed in the specification sheet for the crystal. The formula for calculation of the CL is defined by the following equation:

CL=(Cg x Cd)/(Cg+Cd)+Cs [pF]

where Cg and Cd are oscillation capacitance values and Cs is the stray capacitance of the circuit.

The NJU6355 incorporates feedback resistance (Rf) and oscillation capacitance (Cg,Cd) the values of which are as follows:

Parameter	Symbol	Min.	Typ.	Max.	Unit
Internal Capacitor*	Cg		21.0		pF
	Cd		21.0		pF
Feedback Resistance	Rf		2.0		MΩ

* Note: Cg is the capacitance at XT terminal (Pin 2) and Cd is the capacitance at Pin 3.

Therefore,

CL=(Cg X Cd)/(Cg+Cd)+Cs

=(21 X 21)/(21+21)+Cs
=10.5pF (Cs is usually less than 1pF and therefore is negligible)

This value represents the ideal equivalent capacitance of the crystal. However, due to the inherent tolerance of the crystal, this value may in some cases be higher resulting in frequency greater than the target value by anywhere from 5 to 30 PPM. Therefore , a smaller CL such as 9pF is recommended.

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1-2). Using a Standard Crystal

A standard crystal often features load capacitance (CL) of 14pF. In general, adding 10 to 33 pF of capacitance to both Cg and Cd, depending on the crystal, will insure a high level of time keeping accuracy.

Adding external capacitance may be essential in the following cases:

(A) Application requiring precise timing accuracy

(B) Selecting the optimum area of operation
⇒ Least delta oscillation versus a change in load capacitance

Please see section 3, “Customizing the Design” for these types of applications.

2. Frequency Checking Mode (Testing Mode)

The NJU6355 features a frequency test mode to monitor the clock frequency. To use this function, please follow the procedure below:

1. The CE terminal is to be set to "H" level.
2. Input the pulse signal as shown in Fig-1 to the I/O terminal and then hold it at "L" level
3. The output at the DATA terminal will represent the frequency of the crystal divided by 256. Since the crystal frequency is 32.768kHz, the ideal measurement frequency of the signal, f_{meas}, is therefore 128.000000Hz. Frequency error in PPM is then calculated as follows:

   Frequency error [PPM] = $(128 - f_{meas})/128 \times 1{,}000{,}000$
4. To resume normal operation, The CE Terminal should be set to "L" level.

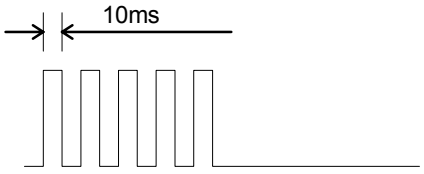

Fig-1
Signal format to activate Test Mode

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3. Customizing the Design

In cases where an extreme level of accuracy is required by the application and/or the crystal with the desired CL value is not available, there is a method allowing the designer to select the external values of Cg and Cd to exactly match the load capacitance of the crystal.

This technique consists of measuring the frequency error (∆f/f) using the method discussed in Section 2 for several values of Cg while holding Cd constant. This data is then plotted as shown in Fig-2. It is also acceptable to plot ∆f/f versus Cd while holding Cg constant. The objective is to find the values of Cg and Cd corresponding to ∆f/f=0. In addition, one may look for the area of "gentle curve" or a relatively flat curve where a change in capacitance (Cg or Cd) will cause minimal delta oscillation.

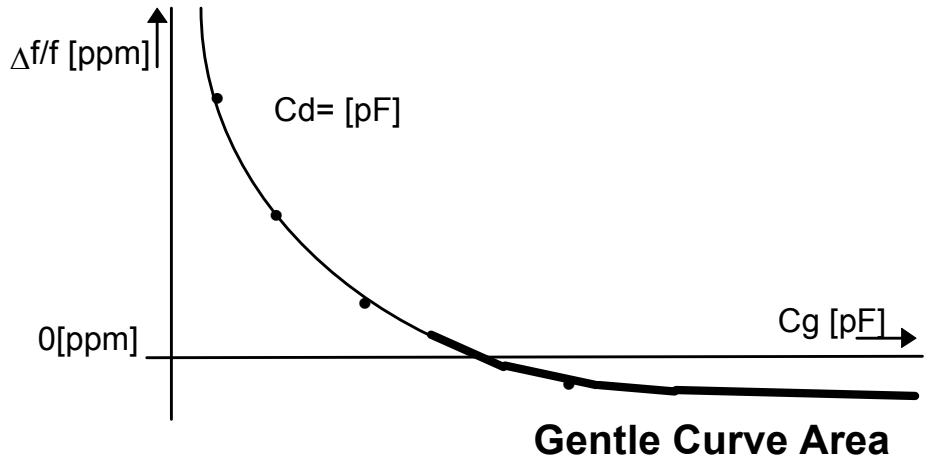

Fig-2
∆f/f vs. Capacitance Graph