



Oscillator with built-in AT-cut crystal unit sealed in heat-resistant cylinder  
 Reference output frequency range:  
 1.0250 MHz - 26.00000 MHz  
 Output enable function included  
 Operating voltage: 5.0 V  $\pm$  0.5 V  
 Operating temperature: -40°C to +85°C  
 Soldering conditions:  
 $\leq$  260°C x 10 sec. Max. x 2 times or less;  
 or  $\leq$  230°C x 3 min. or less  
 Dimensions: (W) 14.00 x (D) 8.65 x (H) 4.7 mm  
 Current consumption: 25 mA MAX.

### Product Features

The SG-615, the quartz device industry's first crystal oscillator to come in a plastic SMD (surface mount device) package, was released in April 1987 to answer the growing need for components that could be mounted directly onto the surface of a circuit board. The conventional method of mounting components onto a board involved inserting the component's leads through holes provided in the board, and then soldering the leads in place. This method, however, required that through-holes be created from the topmost layer of the board to the bottommost layer. This through-hole method presented numerous problems: the holes made the board structurally weaker; the holes took time to machine; more components had to be mounted; the through-holes limited wiring layout options; wiring densities were lower, and so on. With surface mount boards, on the other hand, components are connected only to the surface, so they offer more wiring options, components can be downsized, and components can be assembled in high densities on the board. For these reasons, surface mount devices had started to catch on for office equipment and the like. This trend gave rise to the advent of SMD ICs and other components, but crystal devices were still normally encased in metal packages. Thus Epson decided to launch an effort to develop plastic packages for crystal devices and an SMD-type crystal using the volume production technology refined via semiconductor manufacturing.

The resulting SG-615 used a thermosetting epoxy resin for the plastic material. The built-in AT-cut crystal unit was encased in a newly developed heat-resistant cylinder to enable it to withstand the temperature conditions inside a reflow soldering system used for surface-mounting components. This design allowed the product to be used under soldering temperature conditions equivalent to those for generic SMD ICs. The reference output frequency range was approximately 1 MHz to 26 MHz, and overtone oscillation made even higher order frequency output possible. In addition, the SG-615 was equipped with an output-enable function capable of stopping/sending output signals, thus allowing output signals to be changed. Epson also made use of its strength in semiconductors by using a CMOS IC to realize low maximum current consumption of just 25 mA.

### Background

Epson's quartz device business was established in 1969 with the original development of a crystal resonator for a quartz watch. In the first half of the 1970s, most of Epson's quartz device products were 32-kHz crystal resonators for watches. Beginning in the latter half of the decade, however, the company began eyeing control clock applications in the growing field of office equipment. The company launched programs to develop crystal resonators and crystal oscillators in higher frequency bands. It was during this time that Epson began looking at developing plastic packaged crystal oscillators as a means to differentiate from the competition. Most crystal oscillators of the day came in metal packages, but it was becoming popular to use ICs and other components in plastic packages. Equipment manufacturers were anxious to find a plastic package crystal device that would help further rationalize the board assembly process. Epson used the volume production technology it had cultivated in the manufacture of semiconductors to develop the SG-51, a crystal oscillator in a plastic dual inline package (DIP) that was announced in 1986. From that product the company developed an SMD version in response to the need for board downsizing. The result was the launch in April 1987 of the SG-615, the industry's first SMD-type crystal oscillator in a plastic package.

### Impact

The SG-615 drew the attention of industry as the crystal device industry's first plastic SMD-type crystal oscillator. This was the groundbreaking product that opened the door to the use of SMD packages throughout the crystal oscillator industry. The moment the SG-615 was adopted by a major American personal computer manufacturer as a control clock, sales of the product skyrocketed, as other companies followed suit. The SG-615 became the de facto standard in the industry; and at its peak, production reached 3,000,000 pieces per month. This product thus enabled Epson to establish its position as a leader in SMD products in the crystal device industry and served as the springboard to further enhancement of the product line.