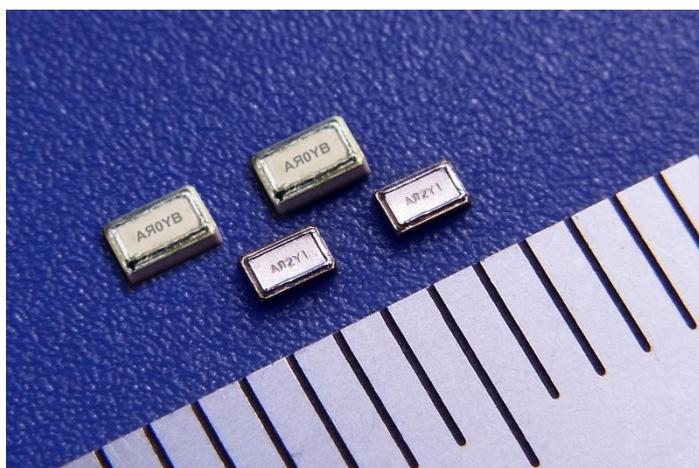


# PRESS RELEASE

## RIVER ELETEC Launched the World's Smallest Tuning Fork Crystal Unit with Ultra-Low Power-Loss (Ultra-Low ESR)

Ideal for ultra-low-power applications, such as IoT.



TFX-03C (upper) & TFX-04C (lower)

**Japan, Oct. 11, 2016:** RIVER ELETEC started the mass-production of two new tuning fork crystal units, "TFX-03C" (2012 size) and "TFX-04C" (1610 size: the smallest tuning fork crystal unit in the world). On top of their incredibly compact sizes, both of them achieve the industry's lowest power-loss (or lowest Equivalent Series Resistance) in their own classes.

Battery-powered devices nowadays, such as smartphones and wearable devices, have come to consume more electric power as they have become more multifunctional and more sophisticated. For such devices, saving current-consumption on standby-state to enable longer battery life is one of main challenges, and compact tuning fork crystal units capable of operating at low current-consumption are gathering market's attentions. However, despite the high demands from the market, it has been difficult to commercialize a tuning fork crystal unit that combines a compact size with low-power-loss performance because the electrical characteristics of crystal units, such as series resistance, typically tend to deteriorate as their sizes become smaller.

Responding such market needs, RIVER ELETEC developed new tuning fork crystal units, "TFX-03C"(2012 size) and "TFX-04C"(1610 size: the smallest tuning fork crystal unit in the world). Utilizing their microfabrication technology, they reduced the ESR (the indicator of the loss of vibration energy) of these new tuning forks to the lowest in the industry to enable them to operate at ultra-low current-consumption.

RIVER ELETEC believes that these new products will enhance the miniaturization, as well as the power reduction, of many types of devices and be highly demanded from growing markets, such as IoT.

#### Technology features

With 3-dimensional crystal fabrication established by utilizing their unique photolithography technology, RIVER ELETEC enhanced the efficiency of the electric field of tuning forks to the maximum and succeeded in reducing the power-loss (ESR) significantly. This enabled an ESR of 60 k $\Omega$  on "TFX-04C" and 50 k $\Omega$  on "TFX-03", both of which are the industry's lowest ESR in their own classes, despite their incredibly compact sizes.

Standard Specifications	TFX-04C	TFX-03C
Size (Max.)	1.6×1.0×0.5 mm	2.0×1.2×0.6 mm
Nominal Frequency	32.768 kHz	
Frequency Tolerance (@25°C)	±10 ppm, ±20 ppm, ±30 ppm, ±50 ppm, and others	
Operating Temperature Range	-20 to +70°C -40 to +85°C -40 to +105°C and others	
Equivalent Series Resistance (Max.)	60 k $\Omega$	50 k $\Omega$
Motional Capacitance / Shunt Capacitance (Typ.)	7.5 fF / 1.5 pF	9.5 fF / 1.8 pF
Load Capacitance	5.0 pF, 7.0 pF, 9.0 pF, and 12.5 pF (Other values available on request)	
Drive Level (Max.)	0.5 $\mu$ W	
Others	Lead-free RoHS-compliant Specifications in conformity with AEC-Q200 available on request	
Applications	Ultra-low-power devices, such as smartphones, wearable devices, and IoT. Clock sources for electric power control, multifunctional watches, modules, and others.	

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