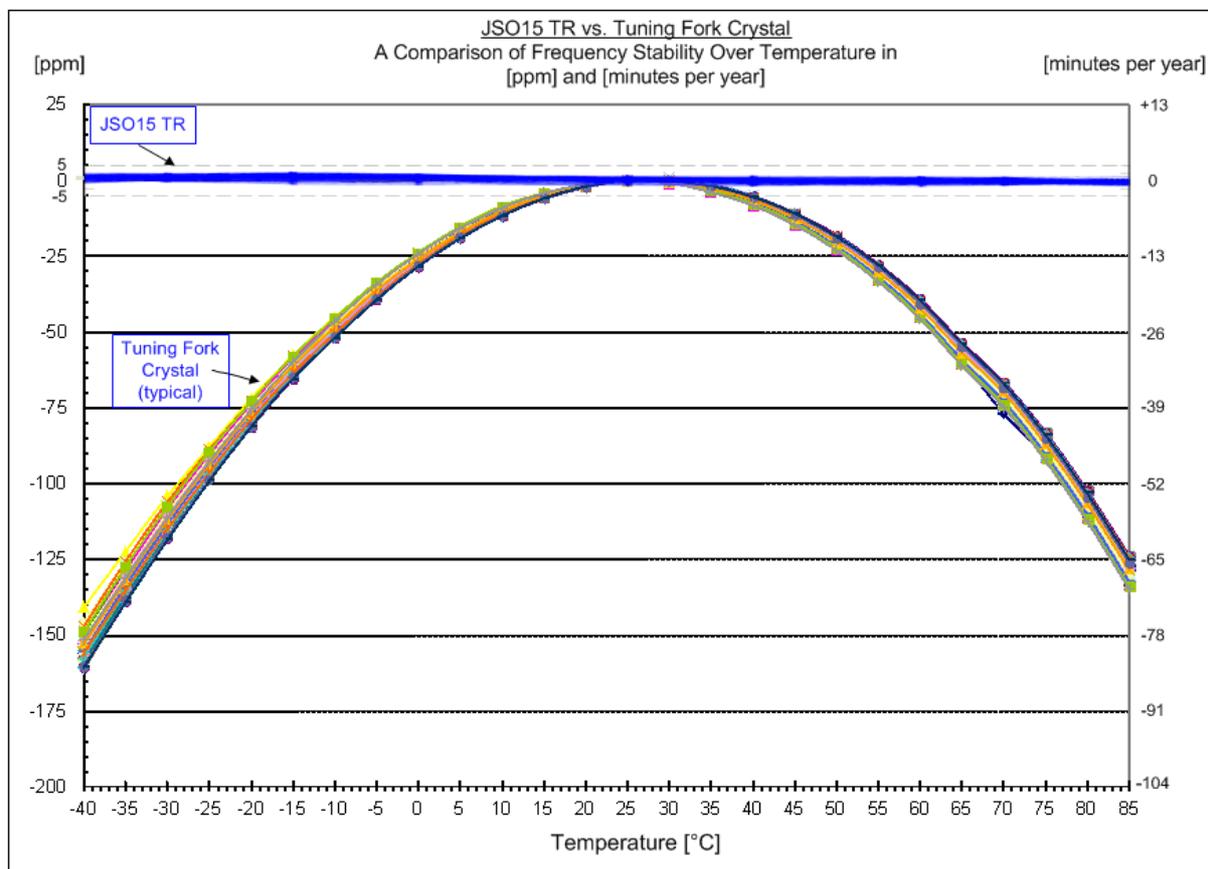


**JSO15 TR – a 32.768kHz TCXO with excellent frequency stability for RTC applications:**

The JSO15 TR is an ultra-low power 32.768kHz oscillator in a tiny CSP package. It offers an unrivaled frequency stability down to +/-5ppm in a temperature range of -40°C ~ +85°C. This excellent stability is achieved by a temperature compensation that is performed at multiple temperatures during the production process. The factory trimming also makes this 32.768kHz oscillator very insensitive to supply voltage variations.

**Stability Comparison – JSO15 TR vs. Tuning Fork**

The frequency stability of JSO15 TR is better by far than the typical stability of tuning fork crystals. This makes the JSO15 TR the ideal choice for applications that require a stable clock over the long term. In addition, due to its miniature size the JSO15 TR is the right choice for hand-held instruments and wearables.



**Applications:**

- Highly accurate Real Time Clocks (RTC)
- Smart Meters / Automated Meter Reading (AMR)
- Wearables / Activity Trackers / Smart Watches
- Mobile Medical Instruments
- Health and Wellness Monitors
- Tablets / Mobile Phones

**Variable supply voltage:**

The supply voltage offers a variable range from 1.50V ~ 3.63V, and the frequency variation is kept within the range of +/-1.5ppm in this supply voltage range.

**Ultra low power:**

During continuous operation, the supply current of the internal circuit is as low as 1.0µA (typical, no load, output current not included). For temperature measurement and calibration, every 350ms the supply current increases to about 6µA for approximately 10ms. Only at start-up, the supply current is 28µA max. for about 200ms.

At any supply voltage in the range of 1.5 ~ 3.63V and any temperature in the range of -40°C ~ +85°C, the supply current of the internal circuit stays typically below 1.4µA.

**Active output can feed multiple inputs:**

Due to its active output, the JSO15 TR is able to feed the 32.768kHz clock signal to multiple ICs. Instead of using one tuning fork crystal per IC, only one JSO15 TR may be required to feed multiple inputs with its highly stable clock.

Please note that the rail-to-rail LVCMOS amplitude will depend on the supply voltage of the JSO15 TR device, which can be variable in the range of 1.5V ~ 3.63V.

**Supply current calculation:**

The total supply current consists of three contributions.

$$IDC \text{ (total)} = IDC \text{ (internal)} + IDC \text{ (driver)} + IDC \text{ (load)}$$

Please refer to the section “Ultra low power” that contains information about the internal supply current IDC (internal).

The typical internal supply current IDC (internal) is as low as 1µA.

IDC (driver) is the supply current for the output stage itself, feeding a stray capacitance of 3.5pF. It depends on the supply voltage.

IDC (load) is the supply current for the output stage which depends on the load capacitance being coupled to the output of the JSO15 TR 32.768kHz TCXO, as well as the supply voltage.

**Supply current at DC-coupled rail-to-rail output**

- (1)  $IDC \text{ (total)} = IDC \text{ (internal)} + IDC \text{ (driver \& load)}$
- (2)  $IDC \text{ (driver \& load)} = (CL + CD) \times (VDC) \times FO$

with

IDC (internal) = supply current of internal circuit, typ. 1 [µA] at 1.8 [V], typ. 1.4 [µA] at 3.3 [V]

IDC (driver & load) = supply current in [A]

CL = external load in [F]

CD = internal stray capacitance of  $3.5 \times 10^{-12}$  [F]

VDC = supply voltage [V]

FO = 32.768 [kHz]

**Example1**

ext. load 10pF, rail-to-rail output, supply voltage VDC = 1.8V

$$IDC \text{ (driver \& load)} [A] = (10 + 3.5) \times 10^{-12} [F] \times 1.8 [V] \times 32.768 [kHz]$$

$$IDC \text{ (driver \& load)} = 796 [nA]$$

$$IDC \text{ (internal)} = 1.0 [\mu A] \text{ typ.}$$

$$IDC \text{ (total)} = (1.0 + 0.796) [\mu A] = 1.8 [\mu A] \text{ typ.}$$

**Example2**

ext. load 10pF, rail-to-rail output, supply voltage VDC = 3.3V

$$IDC \text{ (driver \& load) [A]} = (10 + 3.5) \cdot 10^{-12} \text{ [pF]} \times 3.3 \text{ [V]} \times 32.768 \text{ [kHz]}$$

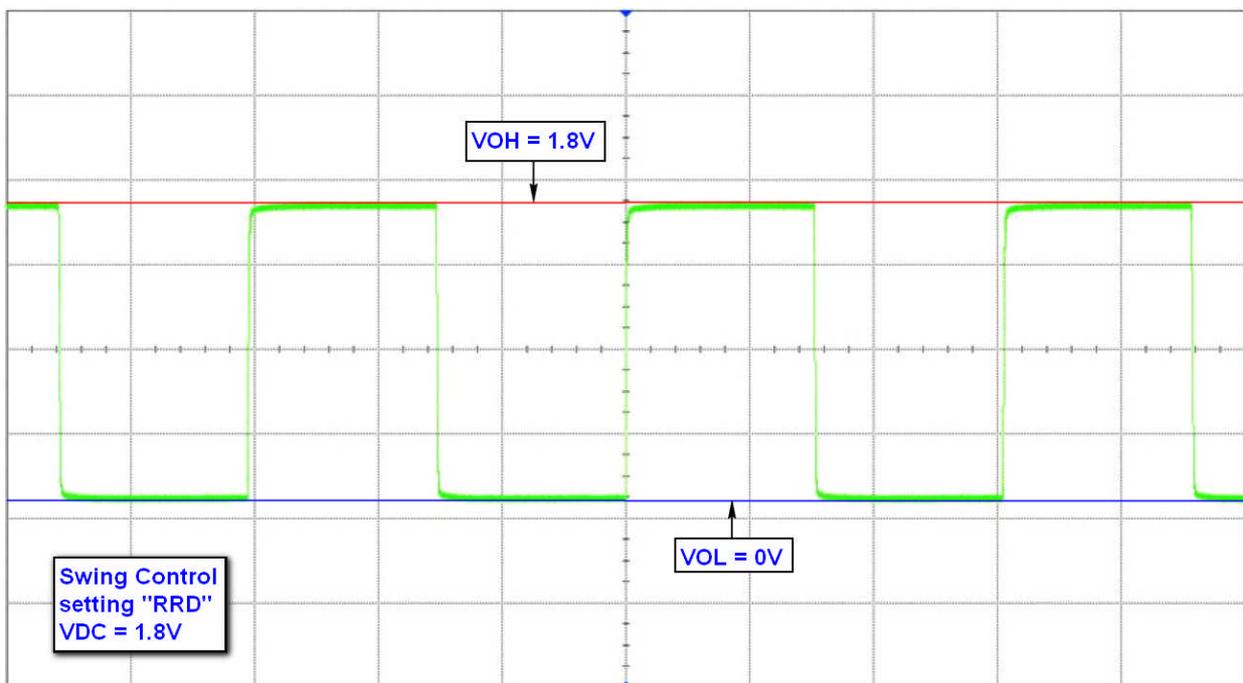
$$IDC \text{ (driver \& load)} = 1.46 \text{ [\mu A]}$$

$$IDC \text{ (internal)} = 1.4 \text{ [\mu A] typ.}$$

$$IDC \text{ (total)} = (1.4 + 1.46) \text{ [\mu A]} = 2.9 \text{ [\mu A] typ.}$$

**Signal Waveform:**

VDC = 1.8V, output load 10pF, rail-to-rail output



X: 10μs/Div; Y: 500mV/Div