Evaluation Data of Oscillation Circuit for Crystal Unit

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■ Murata's recommendation 推奨回路定数

Item				Condition
IC name		IC名		CC26xx(XOSC_CAPARRAY_DELTA=−16)
Parts Number of Crystal Unit		品番		XRCGB24M000FBP12R0
Circuit Parameter	External	負荷容量	CL1	Open
	load capacitance	負荷容量	CL2	Open
	Feedback resistance	帰還抵抗	Rf	No mount
	Damping resistance	制限抵抗	Rd	0ohm
Supply Voltage Range		電源電圧範囲		1.8 to 3.8V
Temp. Range		温度範囲		−30 to 85deg.C

Test Circuit

Set : 1.8 to 3.8V

Evaluation board

CC26xx(XOSC_CAPARRAY_DELTA=−16)
CL_int=6.4pF

Xin   Xout

Measurement equipment

Oscilloscope   DSO6052(K)
Current probe   CT−6(T)
Passive probe   P5100A(T)
                  (40Mohm/2.5pF)
DC supply   E3631A(K)
Frequency counter 53181A(K)
Sepectrum analyzer E4401B(K)

(K) Keysight
(T) Tektronix

Rf
Rd
Crystal Unit

VIN   CL1   CL2   VOUT

Crystal Unit : XRCGB24M000FBP12R0
    Set =1.8 to 3.8V
    CL1 =Open
    CL2 =Open
    Rf : No mount
    Rd =0ohm
    Ta =−30 to 85deg.C

■ Characteristics of oscillation circuit on above condition 推奨定数での発振回路特性

Circuit Characteristics 特性	Value 測定値		Remarks 備考
Center Frequency and Difference 発振回路における発振周波数とそのずれ量 (*1) (Typical sample at Set=3.3V,+25deg.C)	24.000110	[MHz]	Oscillating frequency and its shift against nominal frequency 発振回路における発振周波数と振動子の公称周波数に対するずれ量
	1	[ppm]	
Load Capacitance on your PCB 負荷容量値 (Typical sample at Set=3.3V,+25deg.C)	5.9	[pF]	This value shows load capacitance the evaluated circuit has 発振回路において振動子の両端に仮想的に接続される容量
Negative Resistance and Oscillation margin 負性抵抗／発振余裕度 (at Set=3.3V,+25deg.C)	|−R| 400	[Ω]	The details is explained in page 2 詳細につきましては、次頁をご参照下さい。
	Ratio 5.0	[Times]	
Drive Level ドライブレベル (Typical sample at Set=3.3V,+25deg.C)	28	[uW]	Drive power of crystal under circuit condition 発振回路が動作している状態において振動子で消費される電力
Oscillating Voltage 発振電圧 (Typical sample at Set=3.3V,+25deg.C)	VINp−p 1.0	[V]	Swing level at input side 発振入力振幅（VIN_H − VIN_L）
	VOUTp−p 1.0	[V]	Swing level at output side 発振出力振幅（VOUT_H − VOUT_L）
Oscillation Start up Time 起動時間 (*2) (Typical sample at Set=3.3V,+25deg.C)	0.22	[ms]	The time takes steady amplitude of Vout(Xout) 定常状態の発振振幅に達するまでの時間

*1 Frequency difference means the oscillating frequency difference between your PCB and Murata's frequency sorting circuit.
　　貴社基板と当社検査回路では、同一振動子を使用した場合でも発振周波数の差が生じます。これを発振周波数相関と呼びます。
*2 The measurement results is affected by the rise−up characteristics of supplied voltage on your PCB.
　　測定結果は実装基板の電源立ち上がり特性の影響を受けます。

Notes
The characteristics of the crystal oscillation circuit is affected by the circuit constants and actual mounting conditions and so on.
Therefore, it is possible to get the different results from above one due to the production variation of the crystal oscillator circuitry.
In your company, please use this results after confirmation of the matching between our crystal unit and oscillator circuit.
And furthermore, since the above−mentioned evaluation results evaluate only an oscillating circuit block, please confirm the checking of operations of a set in your company.

注意事項
発振回路の特性は回路定数や実装状態により影響を受けるため、回路や基板のバラツキ等によっては上記の結果と異なる可能性があります。
貴社におかれましても弊社水晶振動子と発振回路とのマッチングをご確認の上、ご使用下さるようお願い致します。
また上記評価結果は発振回路ブロックのみを評価したものですので、セットの動作確認は貴社にてご確認下さるようお願い致します。

Murata Manufacturing Co., Ltd.

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Center frequency   24.000110 MHz

Center frequency difference   1 ppm from 24MHz

This frequency difference causes imbalance of initial frequency tolerance on your PCB, because of load capacitance difference.

Load capacitance of the circuit   5.9 pF

This value shows load capacitance the evaluated circuit has.

Our crystal proposed in this report is sorted with 6pF as load capacitance

Negative resistance

Ratio of negative resistance |-R| to R1spec.

Ratio   5.0 times

Ratio = |-R| / R1spec.

|-R| 400 ohm

Negative resistance |-R| = Rs_max + Re

Rs_max: 346 ohm

Maximum series resistance for Crystal Unit to keep oscillation

Re: 54.0 ohm

Effective resistance of Crystal Unit at actual oscillation frequency

R1spec.   80 ohm

Equivalent series resistance

Drive level

Drive power of crystal under circuit condition shown in page 1

Drive level   28 uW

Drive level = I^2 x R1

I: 0.80 mA (RMS)

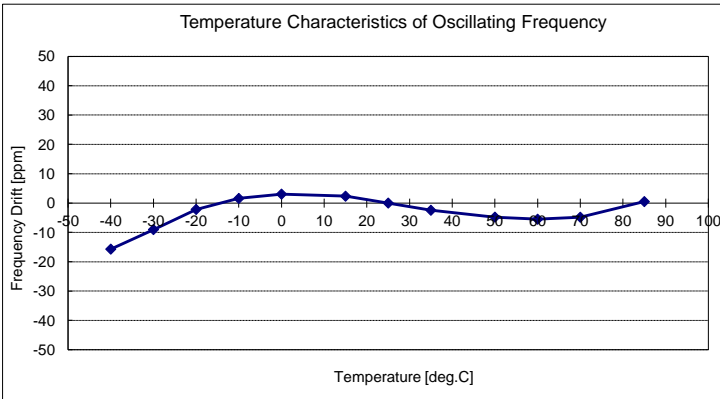Current through Crystal Unit measured by current probe

R1:   43.9 ohm

■ Test Data : Characteristics of recommended conditions
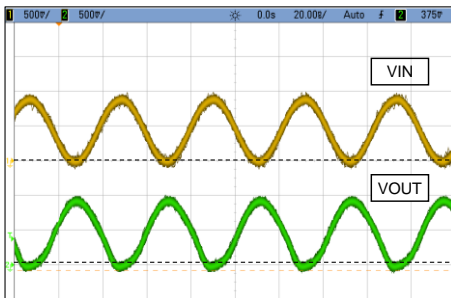
Temperature Characteristics
MODEL : XRCGB24M000FBP12R0 with CC26xx(XOSC_CAPARRAY_DELTA=-16)

Typical sample at Set=3.3V

Temperature Characteristics of Oscillating Frequency

Frequency Drift [ppm] vs Temperature [deg.C]

Oscillation waveform
MODEL : XRCGB24M000FBP12R0 with CC26xx(XOSC_CAPARRAY_DELTA=-16)

VIN [V]			VOUT [V]		
High	Low	p-p	High	Low	p-p
0.9	0.0	1.0	0.9	-0.1	1.0

Typical sample at Set=3.3V, +25deg.C

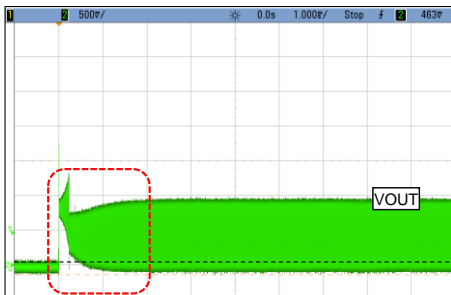[VIN] Vertical: 0.5V/div., Horizontal: 20ns/div.
Broken line: GND

[VOUT] Vertical: 0.5V/div., Horizontal: 20ns/div.
Broken line: GND

Oscillation start up waveform
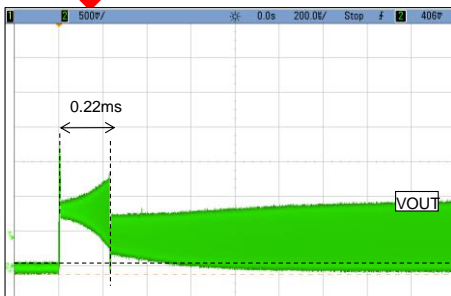MODEL : XRCGB24M000FBP12R0 with CC26xx(XOSC_CAPARRAY_DELTA=-16)

Start up time
The time takes steady amplitude of Vout(Xout) after oscillation circuit starts working.

Typical sample at Set=3.3V, +25deg.C

[VOUT] Vertical: 0.5V/div., Horizontal: 1ms/div.
Broken line: GND

Zoom

0.22ms

[VOUT] Vertical: 0.5V/div., Horizontal: 200us/div.
Broken line: GND

TCD-16-0046