OVERVIEW

The 5056 series are 70 to 135MHz oscillation frequency, crystal oscillator module ICs optimized for 3rd overtone crystal elements with C_0 2 to 4pF. They have built-in C_0 cancelation circuit which provides high oscillation performance at high frequency. They also have CMOS output buffer which can drive 30pF output load.

FEATURES

- Operating supply voltage range: 2.25 to 3.63V
- Recommended oscillation frequency range
  (3rd overtone oscillator): 70 to 125MHz (2.5V±10%)
  75 to 135MHz (3.3V±10%)
- Output load 30pF (V_{DD}: 3.3V±10%, output frequency: 75 to 125MHz)
- Optimized oscillator circuit for large 3rd overtone crystal element with C_0 2 to 4pF
- -40 to 85°C operating temperature range
- CMOS output
- Output drive capability: ±8mA
- Standby function
  High impedance in standby mode, oscillator stops
- Power-saving pull-up resistor built-in (INHN pin)
- Wafer form (WF5056xx)
- Chip form (CF5056xx)

APPLICATIONS

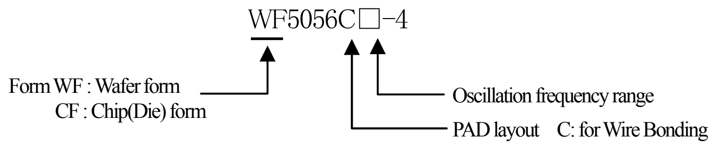
- 7.0×5.0, 5.0×3.2 size crystal oscillator modules

SERIES CONFIGURATION

Version name*1	Recommended oscillation frequency range*2[MHz]	Recommended C_0 value[pF]	Oscillator capacitance*3[pF]	
			C_G	C_D
5056CC	70 to 85	$2 \le C_0 \le 4$	1	3
5056CE	100 to 135		0	1

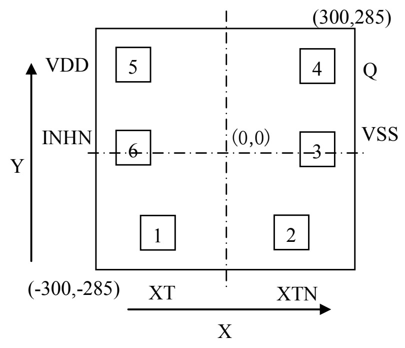
*1. It becomes WF5056xx in case of the wafer form and CF5056xx in case of the chip form.
*2. The oscillation frequency is a yardstick value derived from the crystal used for NPC characteristics authentication. However, the oscillation frequency range is not guaranteed. Specifically, the characteristics can vary greatly due to crystal characteristics and mounting conditions, so the oscillation characteristics of components must be carefully evaluated.
*3. The oscillator capacitance does not contain parasitic capacitance.

ORDERING INFORMATION

Device	Package	Version name
WF5056Cx-4	Wafer form	
CF5056Cx-4	Chip form	

PAD LAYOUT

(Unit: µm)



Chip size : 0.60×0.57mm

Chip thickness : 130µm

PAD size : 80µm

Chip base : Vss level

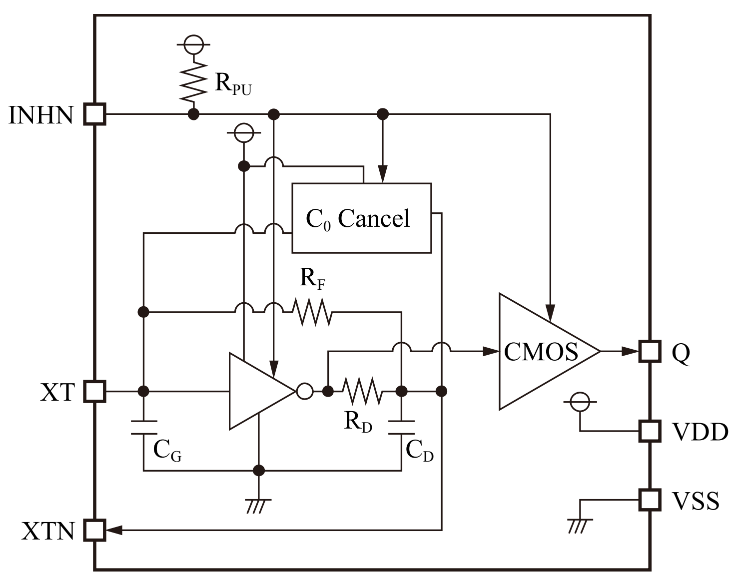
· Coordinates at the chip center are (0,0).

PIN DESCRIPTION and PAD COORDINATES

No.	Pin	I/O*1	Description	PAD coordinates [µm]	
				X	Y
1	XT	I	Crystal connection pins.	−145.2	−193.5
2	XTN	O	Crystal is connected between XT and XTN.	145.2	−193.5
3	VSS	−	(-) ground	208.5	−1.1
4	Q	O	Output pin	208.5	193.5
5	VDD	−	(+) supply voltage	−208.5	193.5
6	INHN	I	Input pin controlled output state (oscillator stops when LOW), Power-saving pull-up resistor built-in	−208.5	−1.1

*1. I: Input pin O: Output pin

BLOCK DIAGRAM



SPECIFICATIONS

Absolute Maximum Ratings

Vss=0V

Parameter	Symbol	Condition	Rating	Unit
Supply voltage range*1	V_{DD}	Between VDD and VSS	-0.3 to +4.0	V
Input voltage range*1*2	V_{IN}	Input pins	-0.3 to VDD+0.3	V
Output voltage range*1*2	V_{OUT}	Output pins	-0.3 to VDD+0.3	V
Output current*3	I_{OUT}	Q pin	±20	mA
Junction temperature*3	T_j		125	°C
Storage temperature range*4	T_{STG}	Chip form, Wafer form	-55 to +125	°C

*1. This parameter rating is the values that must never exceed even for a moment. This product may suffer breakdown if this parameter rating is exceeded. Operation and characteristics are guaranteed only when the product is operated at recommended operating conditions.
*2. V_{DD} is a V_{DD} value of recommended operating conditions.
*3. Do not exceed the absolute maximum ratings. If they are exceeded, a characteristic and reliability will be degraded.
*4. When stored in nitrogen or vacuum atmosphere applied to IC itself only (excluding packaging materials).

Recommended Operating Conditions

Vss=0V

Parameter	Symbol	Condition			Rating MIN	Rating TYP	Rating MAX	Unit
Oscillator frequency*1	f_{OSC}	CC ver.	V_{DD}=2.97 to 3.63V		75		85	MHz
			V_{DD}=2.25 to 2.75V		70		80	
		CE ver.	V_{DD}=2.97 to 3.63V		100		135	
			V_{DD}=2.25 to 2.75V		100		125	
Output frequency	f_{OUT}	CC ver.	V_{DD}=2.97 to 3.63V	C_{LOUT}≤30pF	75		85	MHz
			V_{DD}=2.25 to 2.75V	C_{LOUT}≤15pF	70		80	
		CE ver.	V_{DD}=2.97 to 3.63V	C_{LOUT}≤15pF	100		135	MHz
				C_{LOUT}≤30pF	100		125	
			V_{DD}=2.25 to 2.75V	C_{LOUT}≤15pF	100		125	
Operating supply voltage	V_{DD}	Between VDD and VSS*2			2.25		3.63	V
Input voltage	V_{IN}	Input pins			V_{SS}		V_{DD}	V
Operating temperature	T_a				-40		+85	°C
Output load capacitance (Q pin)	C_{LOUT}	CC ver.	V_{DD}=2.97 to 3.63V and 75MHz≤f_{OUT}≤85MHz				30	pF
		CE ver.	V_{DD}=2.97 to 3.63V and 100MHz≤f_{OUT}≤125MHz				30	
		Condition except the above					15	

*1. The oscillation frequency is a yardstick value derived from the crystal used for NPC characteristics authentication. However, the oscillation frequency range is not guaranteed. Specifically, the characteristics can vary greatly due to crystal characteristics and mounting conditions, so the oscillation characteristics of components must be carefully evaluated.
*2. Mount a ceramic chip capacitor that is larger than 0.01μF proximal to IC (within approximately 3mm) between VDD and VSS in order to obtain stable operation of 5056 series. In addition, the wiring pattern between IC and capacitor should be as wide as possible.

Note. Since it may influence the reliability if it is used out of range of recommended operating conditions, this product should be used within this range.

Electrical Characteristics
DC Characteristics

V_{DD}=2.25 to 3.63V, V_{SS}=0V, T_a= -40 to +85°C unless otherwise noted.

Parameter		Symbol	Condition		Rating MIN	Rating TYP	Rating MAX	Unit
HIGH-level output voltage		V_{OH}	Q pin, measurement circuit 3, I_{OH}=-8mA		V_{DD}-0.4		V_{DD}	V
LOW-level output voltage		V_{OL}	Q pin, measurement circuit 3, I_{OL}=8mA		0		0.4	V
HIGH-level input voltage		V_{IH}	INHN pin, measurement circuit 4		0.7V_{DD}			V
LOW-level input voltage		V_{IL}	INHN pin, measurement circuit 4				0.3V_{DD}	V
Output leakage current		I_Z	Q pin, measurement circuit 5 INHN="Low"	Q=V_{DD}			10	µA
				Q=V_{SS}	-10			
Current consumption*1	CC ver.	$I_{DD\_3.3V}$	Measurement circuit 1, no load INHN="OPEN", f_{OSC}=80MHz	V_{DD}=3.3V		15	30	mA
		$I_{DD\_2.5V}$		V_{DD}=2.5V		8	16	
	CE ver.	$I_{DD\_3.3V}$	Measurement circuit 1, no load INHN="OPEN", f_{OSC}=125MHz	V_{DD}=3.3V		17	34	
		$I_{DD\_2.5V}$		V_{DD}=2.5V		10	20	
Standby current		I_{ST}	Measurement circuit 1, INHN=V_{SS}				10	µA
INHN pull-up resistance		R_{PU1}	Measurement circuit 6		0.8	3	24	MΩ
		R_{PU2}	Measurement circuit 6		30	70	150	kΩ
Oscillator feedback resistance	CC ver.	R_f	Design value		2.7	4.9	7.1	kΩ
	CE ver.	R_f	Design value		2.0	3.8	5.5	
Oscillator capacitance	CC ver.	C_G	Design value (a monitor pattern on a wafer is tested), Excluding parasitic capacitance.		0.8	1	1.2	pF
		C_D			2.4	3	3.6	
	CE ver.	C_G	Design value (a monitor pattern on a wafer is tested), Excluding parasitic capacitance.		0	0	0	pF
		C_D			0.8	1	1.2	

*1. The consumption current $I_{DD}(C_{LOUT})$ with a load capacitance(C_{LOUT}) connected to the Q pin is given by the following equation, where I_{DD} is the no-load consumption current and f_{OUT} is the output frequency.

$$I_{DD}(C_{LOUT})[mA] = I_{DD}[mA] + C_{LOUT}[pF] \times V_{DD}[V] \times f_{OUT}[MHz] \cdot 10^{-3}$$

AC Characteristics

V_{DD}=2.25 to 3.63V, V_{SS}=0V, T_a= -40 to +85°C unless otherwise noted.

Parameter	Symbol	Condition	Rating			Unit
			MIN	TYP	MAX	
Output rise time	t_{r1}	Measurement circuit 1, C_{LOUT}=15pF, $0.1V_{DD} \rightarrow 0.9V_{DD}$, V_{DD}=2.25 to 3.63V		1.0	2.0	ns
	t_{r2}	Measurement circuit 1, C_{LOUT}=30pF, $0.1V_{DD} \rightarrow 0.9V_{DD}$, V_{DD}=2.97 to 3.63V		1.5	2.5	
Output fall time	t_{f1}	Measurement circuit 1, C_{LOUT}=15pF, $0.9V_{DD} \rightarrow 0.1V_{DD}$, V_{DD}=2.25 to 3.63V		1.0	2.0	ns
	t_{f2}	Measurement circuit 1, C_{LOUT}=30pF, $0.9V_{DD} \rightarrow 0.1V_{DD}$, V_{DD}=2.97 to 3.63V		1.5	3.0	
Output duty cycle	DUTY	Measurement circuit 1, T_a=25°C, C_{LOUT}=15pF, V_{DD}=2.25 to 3.63V	45	50	55	%
		Measurement circuit 1, T_a=25°C, C_{LOUT}=30pF, V_{DD}=2.97 to 3.63V	40	50	60	
Output disable delay time	t_{OD}	Measurement circuit 2, T_a=25°C, $C_{LOUT} \leq$15pF			200	ns

Note. The ratings above are measured by using the NPC standard crystal and jig. They may vary due to crystal characteristics, so they must be carefully evaluated.

Timing chart

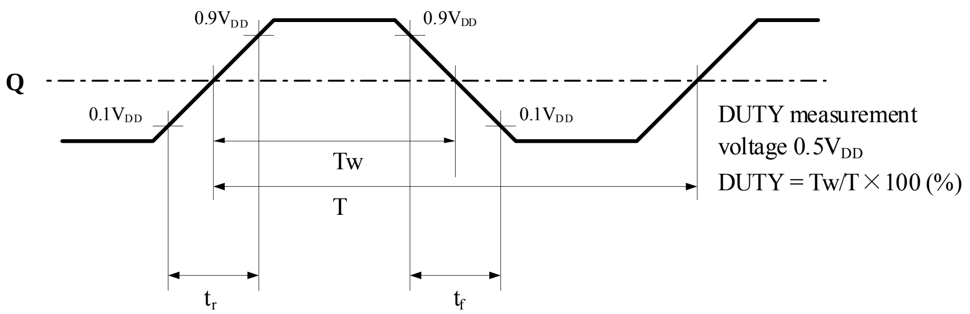
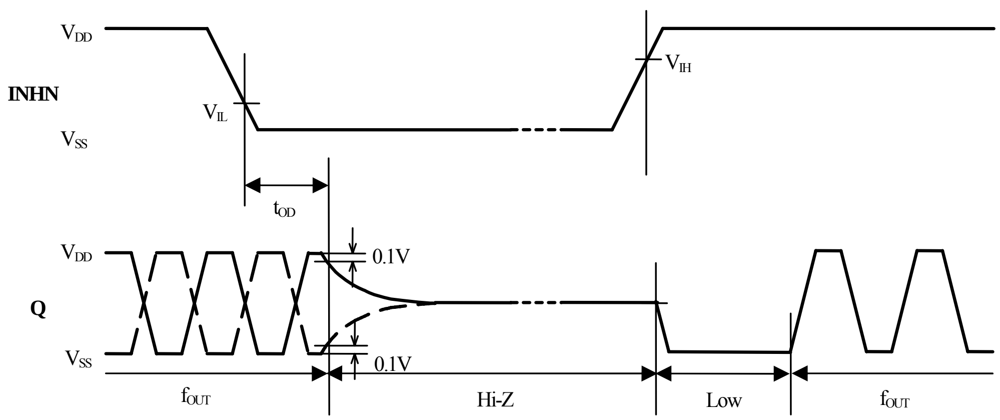


Figure 1.Output switching waveform



When INHN goes HIGH to LOW, the Q output becomes high impedance.

When INHN goes LOW to HIGH, the Q output goes LOW once and then becomes normal output operation after having detected oscillation signals.

Figure 2.Output disable and oscillation start timing chart

FUNCTIONAL DESCRIPTION

Standby Function

When INHN goes LOW level, the Q output becomes high impedance.

INHN	Q	Oscillator
HIGH(Open)	f_{OUT}	Operating
LOW	Hi-Z	Stopped

Power Saving Pull-up Resistor

The INHN pin pull-up resistance changes its value to R_{PU1} or R_{PU2} in response to the input level (HIGH or LOW).
When INHN is tied to LOW level, the pull-up resistance becomes large (R_{PU1}), thus reducing the current consumed by the resistance. When INHN is left open circuit or tied to HIGH level, the pull-up resistance becomes small (R_{PU2}), thus internal circuit of INHN becomes HIGH level. Consequently, the IC is less susceptible to the effects of noise, helping to avoid problems such as the output stopping suddenly.

Oscillation Detection Function

The 5056 series incorporate an oscillation detection circuit. The oscillation detection circuit disables the output until the oscillator circuit starts up. This function avoids the problem where the oscillator does not start, due to abnormal oscillation conditions, where power is applied or when the oscillator is restarted using INHN.

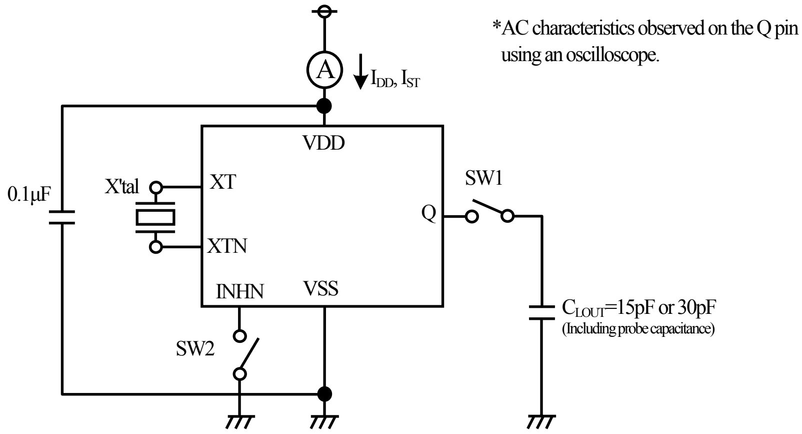
C_0 cancellation circuit

Oscillation circuit with a built-in C_0 cancellation circuit provides a fixed compensation amount to cancel the effect of the crystal C_0. It reduces the C_0 parameter in the equivalent circuit, reducing the shallow negative resistance for increasing values of C_0.
This cancellation circuit makes it easier to maintain the oscillation margin.

MEASUREMENT CIRCUITS

MEASUREMENT CIRCUIT 1

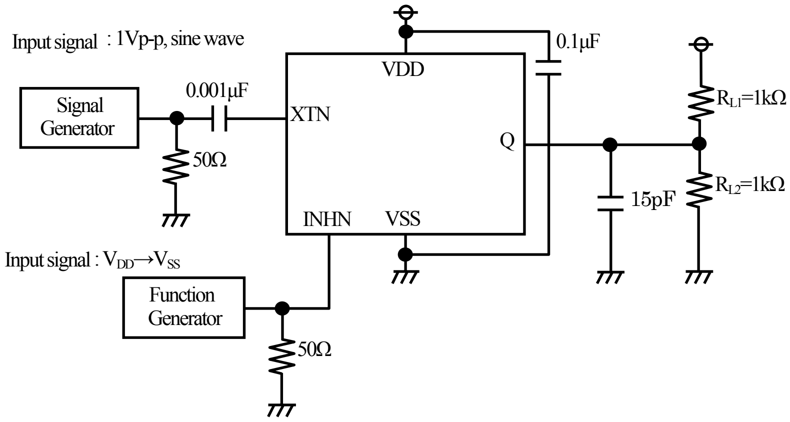
Measurement Parameter: I_{DD}, I_{ST}, DUTY, t_r, t_f



Parameter	SW1	SW2
I_{DD}	OFF	OFF
I_{ST}	ON or OFF	ON
DUTY, t_r, t_f	ON	OFF

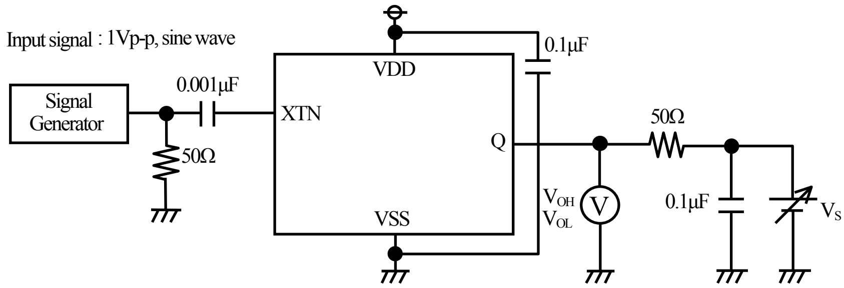
MEASUREMENT CIRCUIT 2

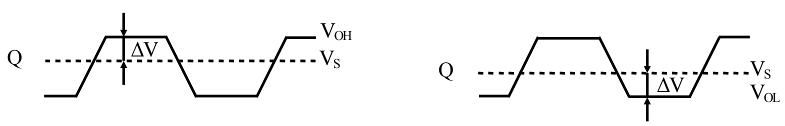
Measurement Parameter: t_{OD}



MEASUREMENT CIRCUIT 3

Measurement Parameter: V_{OH}, V_{OL}



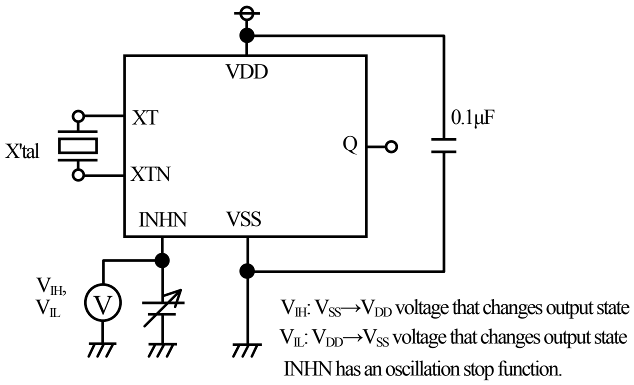


V_S adjusted so that $\Delta V = 50 \times I_{OH}$

V_S adjusted so that $\Delta V = 50 \times I_{OL}$

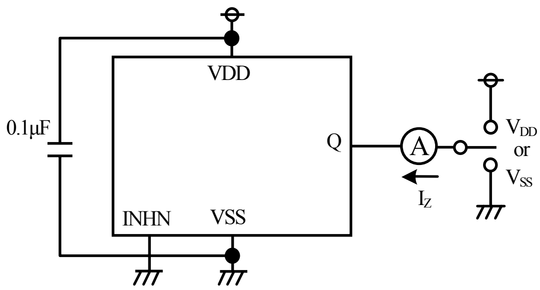
MEASUREMENT CIRCUIT 4

Measurement Parameter: V_{IH}, V_{IL}



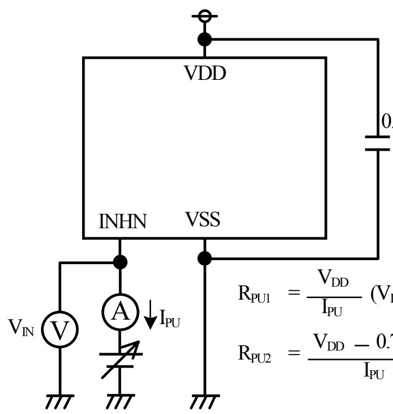
MEASUREMENT CIRCUIT 5

Measurement Parameter: I_Z



MEASUREMENT CIRCUIT 6

Measurement Parameter: R_{PU1}, R_{PU2}



$$R_{PU1} = \frac{V_{DD}}{I_{PU}} \quad (V_{IN} = 0V)$$

$$R_{PU2} = \frac{V_{DD} - 0.7V_{DD}}{I_{PU}} \quad (V_{IN} = 0.7V_{DD})$$

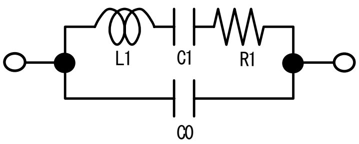
REFERENCE DATA

The following characteristics are measured using the crystal below. Note that the characteristics will vary with the crystal used.

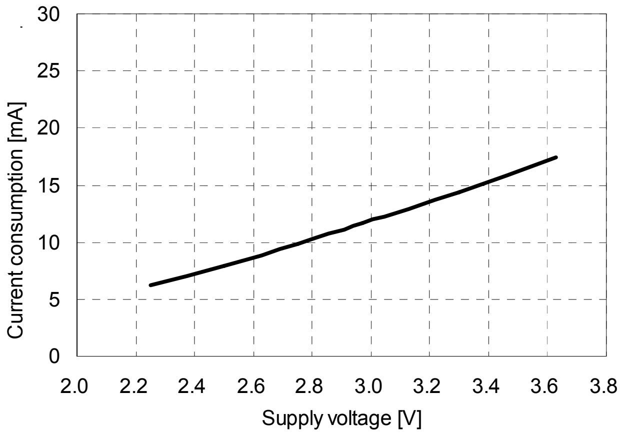
Crystal used for measurement

Parameter	80MHz	125MHz
C_0(pF)	2.4	2.0
R_1(Ω)	42	33

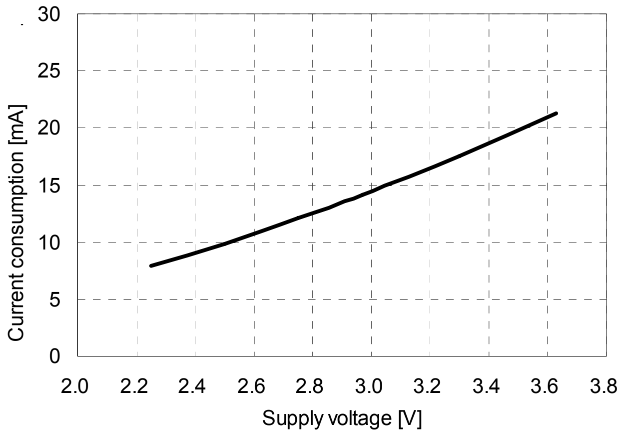
Crystal parameters



Current Consumption

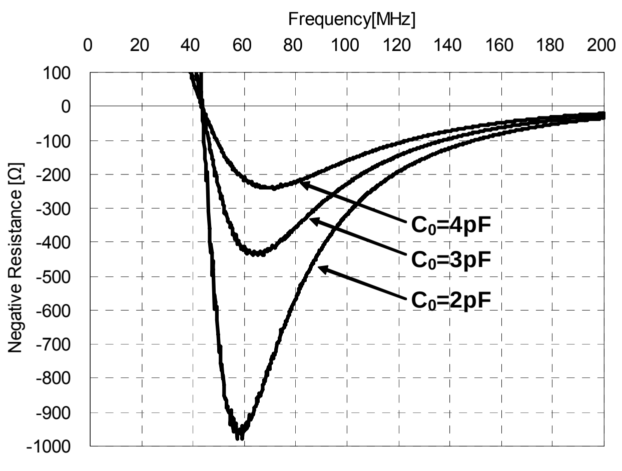


5056CC, f_{OSC}=80MHz, T_a=25°C, no load

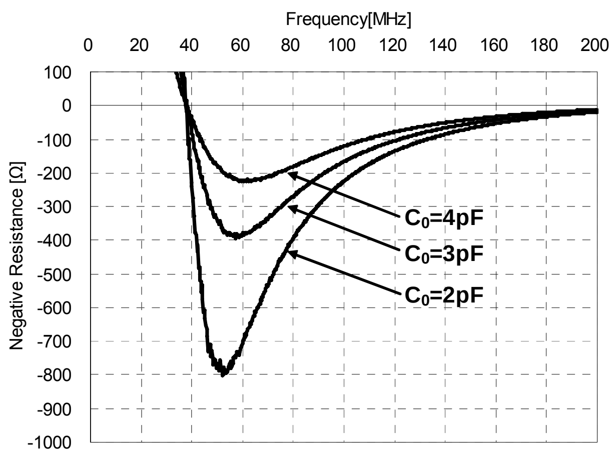


5056CE, f_{OSC}=125MHz, T_a=25°C, no load

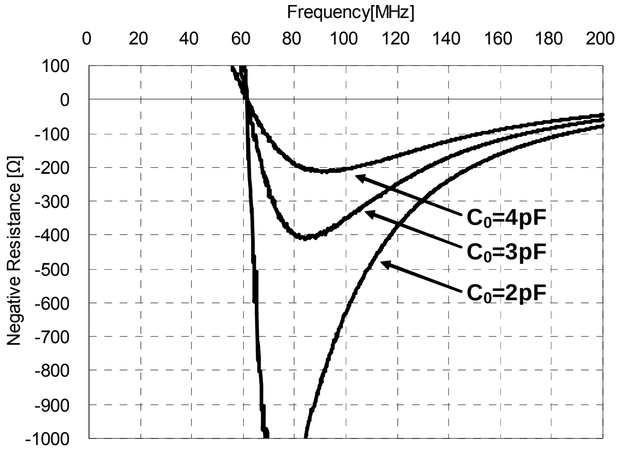
Negative Resistance



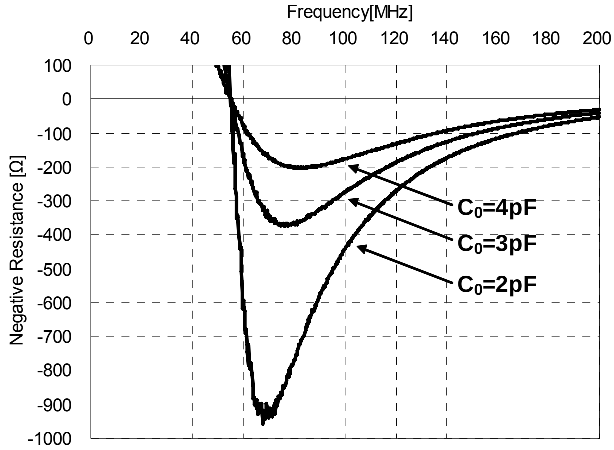
5056CC, V_{DD}=3.3V, T_a=25°C



5056CC, V_{DD}=2.5V, T_a=25°C



5056CE, V_{DD}=3.3V, T_a=25°C

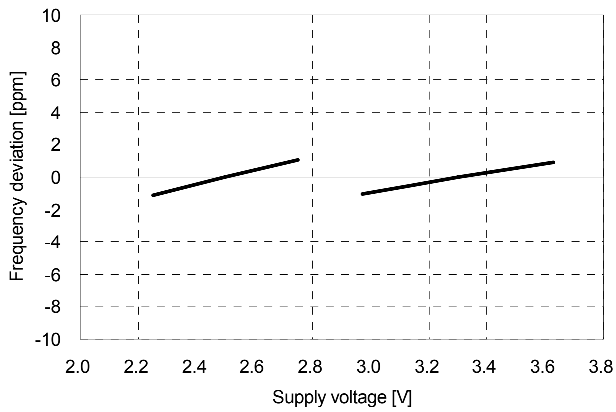


5056CE, V_{DD}=2.5V, T_a=25°C

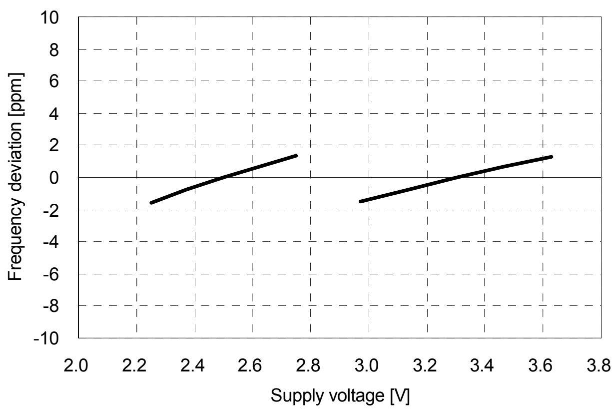
Measurement equipment: Agilent 4396B Impedance Analyzer

The figures show the measurement result of the crystal equivalent circuit C_0 capacitance, connected between the XT and XTN pins.
They were performed with Agilent 4396B using the NPC test jig.
They may vary in a measurement jig, and measurement environment.

Frequency Deviation by Voltage



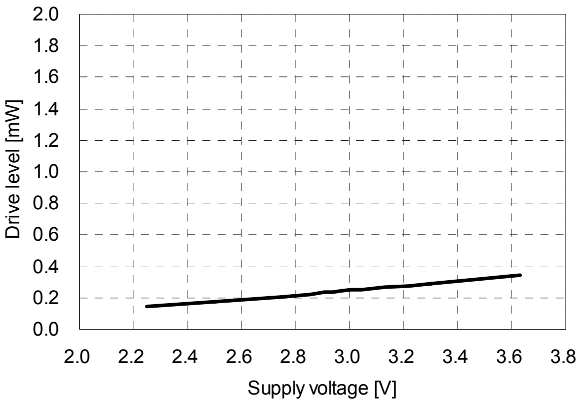
5056CC, f_{OSC}=80MHz, T_a=25°C, 2.5V and 3.3V std.



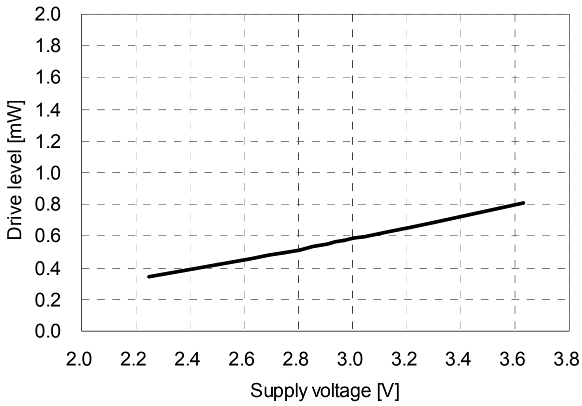
5056CE, f_{OSC}=125MHz, T_a=25°C, 2.5V and 3.3V std.

Measurement equipment: Agilent 53132A Frequency Counter

Drive Level



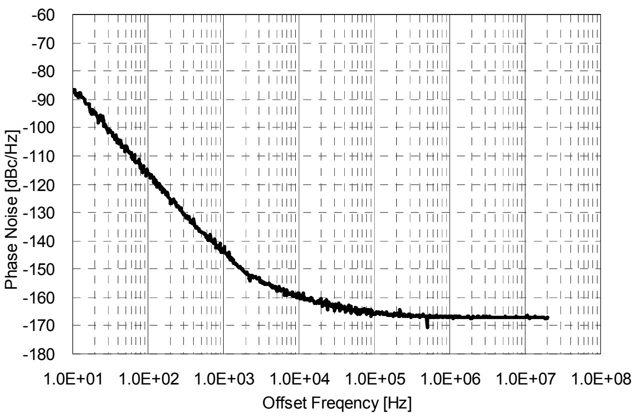
5056CC, f_{OSC}=80MHz, T_a=25°C



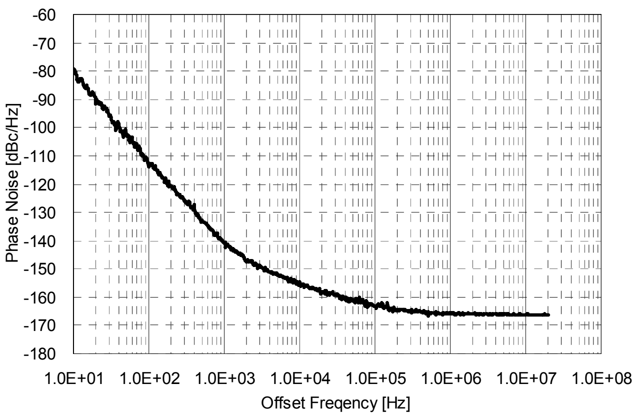
5056CE, f_{OSC}=125MHz, T_a=25°C

Measurement equipment: Agilent DSO80604B Digital Oscilloscope
Tektronix CT-6 Current probe
Agilent 53132A Frequency Counter

Phase Noise



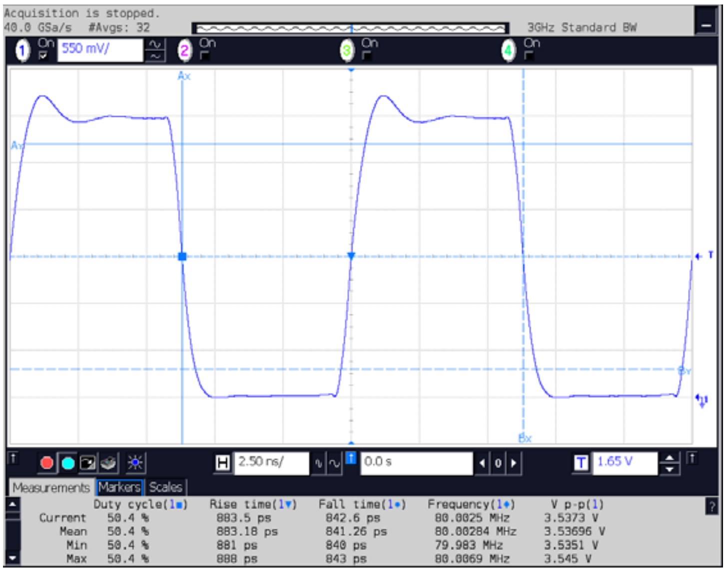
5056CC, V_{DD}=3.3V, f_{OSC}=80MHz, T_a=25°C



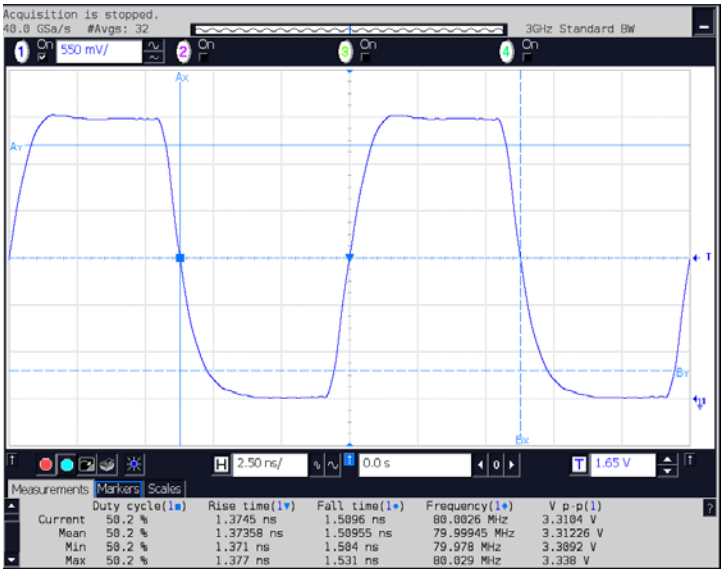
5056CE, V_{DD}=3.3V, f_{OSC}=125MHz, T_a=25°C

Measurement equipment: Signal Source Analyzer Agilent E5052B

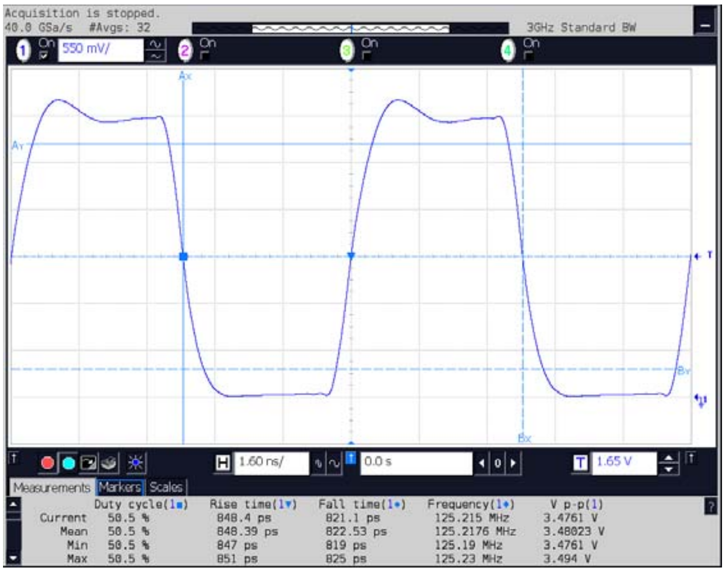
Output Waveform



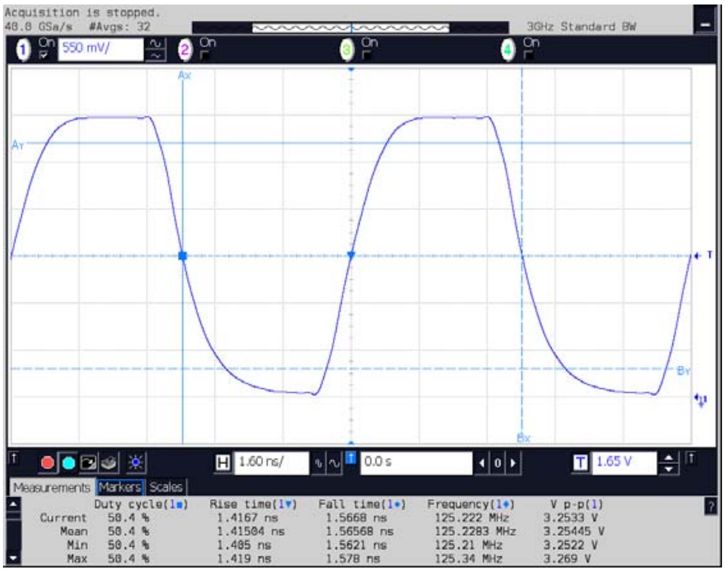
5056CC, V_{DD}=3.3V, f_{OSC}=80MHz, T_a=25°C, C_{LOUT}=15pF



5056CC, V_{DD}=3.3V, f_{OSC}=80MHz, T_a=25°C, C_{LOUT}=30pF



5056CE, V_{DD}=3.3V, f_{OSC}=125MHz, T_a=25°C, C_{LOUT}=15pF



5056CE, V_{DD}=3.3V, f_{OSC}=125MHz, T_a=25°C, C_{LOUT}=30pF

Measurement equipment: Oscilloscope Agilent DSO80604B
Differential probe 1134A (Probe head E2678A)

Please pay your attention to the following points at time of using the products shown in this document.

1. The products shown in this document (hereinafter "Products") are designed and manufactured to the generally accepted standards of reliability as expected for use in general electronic and electrical equipment, such as personal equipment, machine tools and measurement equipment. The Products are not designed and manufactured to be used in any other special equipment requiring extremely high level of reliability and safety, such as aerospace equipment, nuclear power control equipment, medical equipment, transportation equipment, disaster prevention equipment, security equipment. The Products are not designed and manufactured to be used for the apparatus that exerts harmful influence on the human lives due to the defects, failure or malfunction of the Products.
   If you wish to use the Products in that apparatus, please contact our sales section in advance.
   In the event that the Products are used in such apparatus without our prior approval, we assume no responsibility whatsoever for any damages resulting from the use of that apparatus.
2. NPC reserves the right to change the specifications of the Products in order to improve the characteristics or reliability thereof.
3. The information described in this document is presented only as a guide for using the Products. No responsibility is assumed by us for any infringements of patents or other rights of the third parties which may result from its use. No license is granted by implication or otherwise under any patents or other rights of the third parties. Then, we assume no responsibility whatsoever for any damages resulting from that infringements.
4. The constant of each circuit shown in this document is described as an example, and it is not guaranteed about its value of the mass production products.
5. In the case of that the Products in this document falls under the foreign exchange and foreign trade control law or other applicable laws and regulations, approval of the export to be based on those laws and regulations are necessary. Customers are requested appropriately take steps to obtain required permissions or approvals from appropriate government agencies.

NPC

SEIKO NPC CORPORATION

1-9-9, Hatchobori, Chuo-ku,
Tokyo 104-0032, Japan
Telephone: +81-3-5541-6501
Facsimile: +81-3-5541-6510
http://www.npc.co.jp/
Email:sales@npc.co.jp

ND13023-E-00 2013.08