OVERVIEW

5058Hx1 series are crystal oscillator module CMOS ICs for +125°C operation. They support 20MHz to 50MHz fundamental-frequency, and have an oscillator amplifier, voltage regulator circuit and output buffer.

FEATURES

- Operating supply voltage: 1.60V to 3.63V
- Recommended oscillation frequency (Fundamental-frequency): 20MHz to 50MHz
- Phase noise : Typical -98dBc/Hz @HA1ver., Offset Frequency=10Hz, f_{OSC}=49MHz, V_{DD}=1.8V
- Current consumption :1.0mA typ. @ Hx1 ver. f_{OSC}=49MHz, V_{DD}=1.8V, no load
- Operation temperature: -40 to +125°C
- Standby function
  High impedance in standby mode, oscillator stops
- Oscillation detection circuit built-in
- Output drive capability: ±4mA
- CMOS output duty level (1/2V_{DD})
- 50±5% output duty
- 15pF output drive capability
- Oscillator capacitors C_G, C_D built-in
- Output 3-state function
- 3 pad layout options for mounting
  5058HA1: for Flip Chip Bonding
  5058HB1: for Wire Bonding (Type I)
  5058HC1: for Wire Bonding (Type II)
- Wafer form (WF5058Hx1)0
- Chip form (CF5058Hx1)

APPLICATIONS

- 3.2 × 2.5 , 2.5 × 2.0 , 2.0 × 1.6 size miniature crystal oscillator modules

SERIES CONFIGURATION

Operating supply voltage range[V]	Output drive capability [mA]	PAD layout	Recommended oscillation frequency range*1 [MHz]	Output frequency f_{osc} [MHz]	Version name*2
1.60 to 3.63	±4	Flip Chip Bonding	20 to 50	20 to 50	5058HA1
		Wire Bonding Type I			5058HB1
		Wire Bonding Type II			5058HC1

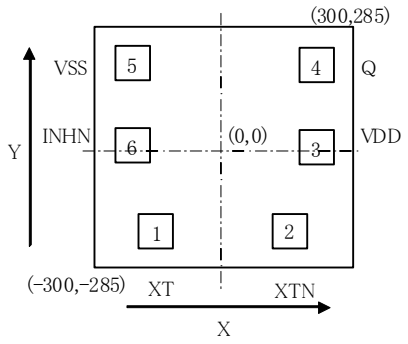
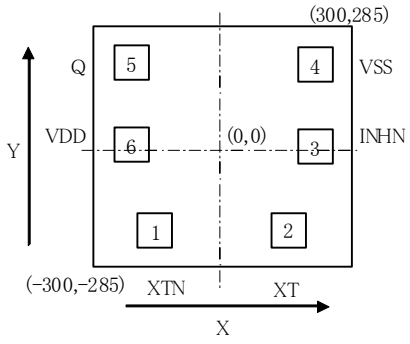
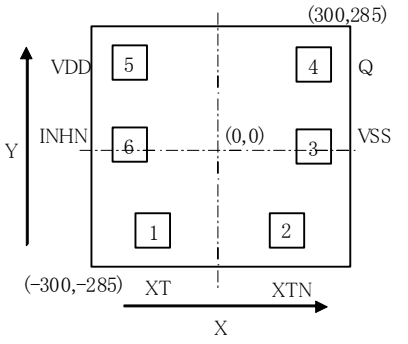
*1. The oscillation frequency is a yardstick value derived from the crystal used for NPC characteristics authentication. However, the oscillation frequency range is not guaranteed. Specifically, the characteristics can vary greatly due to crystal characteristics and mounting conditions, so the oscillation characteristics of components must be carefully evaluated.

*2. It becomes WF5058Hx1 in case of the wafer form and CF5058Hx1 in case of the chip form.

ORDERING INFORMATION

Device	Package	Version name
WF5058Hx1-x	Wafer form	WF5058H□1-□ Form WF : Wafer form CF : Chip(Die) form Chip thickness 4:130µm PAD layout A: for Flip Chip Bonding B: for Wire Bonding (Type I) C: for Wire Bonding (Type II)
CF5058Hx1-x	Chip form	

PAD LAYOUT

5058HA1	5058HB1	5058HC1
for Flip Chip Bonding	for Wire Bonding (Type I)	for Wire Bonding (Type II)
		

· Chip size : 0.60×0.57mm, PAD size : 80µm×80µm, Chip base : V_{SS} level
· Coordinates at the chip center are (0,0).

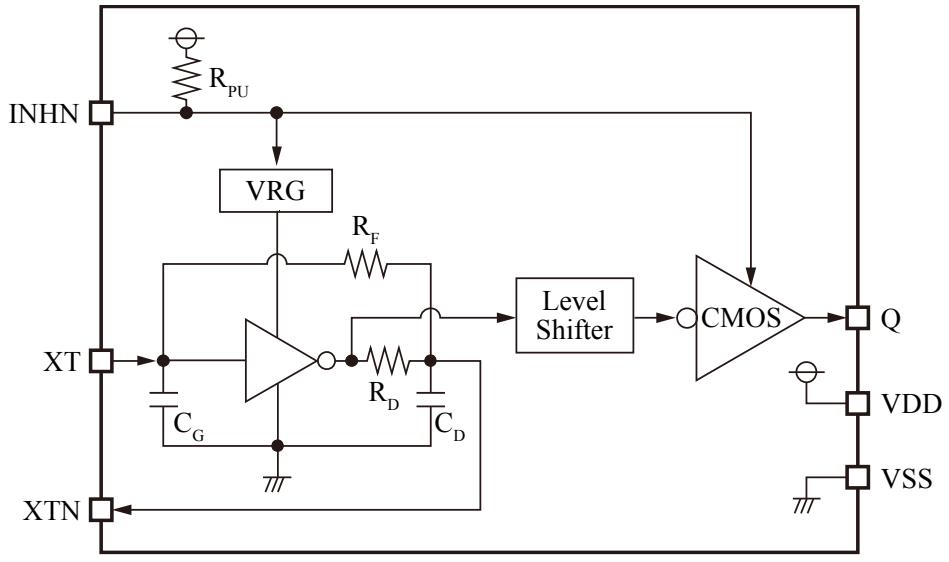
PAD COORDINATES

PAD No.	PAD coordinate[µm]	
	X	Y
1	-145.2	-193.5
2	145.2	-193.5
3	208.5	-1.1
4	208.5	193.5
5	-208.5	193.5
6	-208.5	-1.1

PIN DESCRIPTION

PAD No.			Pin	Function
5058HA1	5058HB1	5058HC1		
1	2	1	XT	Crystal connection pins. Crystal is connected between XT and XTN.
2	1	2	XTN	
3	6	5	VDD	(+)supply voltage
4	5	4	Q	High-impedance output in standby mode
5	4	3	VSS	(-)ground
6	3	6	INHN	Input pin controlled output state(oscillator stops when LOW), Power-saving pull-up resistor built-in

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

V_{SS}=0V

Parameter	Symbol	Condition	Rating	Unit
Supply voltage range*1	V_{DD}	Voltage between VDD and VSS	-0.3 to +4.0	V
Input voltage range*1*2	V_{IN}	Input pins	-0.3 to V_{DD}+0.3	V
Output voltage range*1*2	V_{OUT}	Output pins	-0.3 to V_{DD}+0.3	V
Output current*3	I_{OUT}	Q pin	±20	mA
Junction temperature*3	T_j		150	°C
Storage temperature range*4	T_{STG}	Chip form, Wafer form	-55 to +150	°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

V_{SS}=0V

Parameter	Symbol	Condition	MIN	TYP	MAX	Unit
Oscillator frequency*1	f_{OSC}	V_{DD}=1.60 to 3.63V	20	-	50	MHz
Output frequency	f_{OUT}	V_{DD}=1.60 to 3.63V, C_{LOUT}≤15pF	20	-	50	MHz
Operating supply voltage	V_{DD}	Voltage between VDD and VSS*2	1.60	-	3.63	V
Input voltage	V_{IN}	Input pins	V_{SS}	-	V_{DD}	V
Operating temperature	T_a		-40	-	+125	°C
Output load capacitance	C_{LOUT}	Q output	-	-	15	pF

*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 5058H 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}=1.60 to 3.63V, V_{SS}=0V, T_a= -40 to +125°C unless otherwise noted.

Parameter	Symbol	Conditions		MIN	TYP	MAX	Unit
Q pin HIGH-level output voltage	V_{OH}	measurement circuit 3, I_{OH}=-4mA		V_{DD}-0.4	-	V_{DD}	V
Q pin LOW-level output voltage	V_{OL}	measurement circuit 3, I_{OL}=4mA		0	-	0.4	V
INHN pin HIGH-level input voltage	V_{IH}	measurement circuit 4		0.7V_{DD}	-	-	V
INHN pin LOW-level input voltage	V_{IL}	measurement circuit 4		-	-	0.3V_{DD}	V
Q pin Output leakage current	I_Z	measurement circuit 5, INHN=LOW	Q=V_{DD}	-	-	10	µA
			Q=V_{SS}	-10	-	-	
Current consumption[*1] (Hx1 version: fundamental frequency output)	I_{DD1}_3.3V	Measurement circuit 1, INHN=OPEN, no load, f_{OSC}=49MHz, f_{OUT}=49Hz	V_{DD}=3.3V	-	2.2	3.5	mA
	I_{DD1}_2.5V		V_{DD}=2.5V	-	1.4	2.5	
	I_{DD1}_1.8V		V_{DD}=1.8V	-	1.0	1.5	
Standby current	I_{ST}	Measurement circuit 1, INHN= V_{SS}	T_a=-40 to +85°C	-	-	10	µA
			T_a=-40 to +125°C	-	-	20	µA
INHN pin 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	R_f			50	100	200	kΩ
Oscillator capacitance	C_G	Confirmed using monitor pattern on the wafer. Design value, excluding parasitic capacitance		9.6	12	15	pF
	C_D			14.4	18	22.5	

*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.

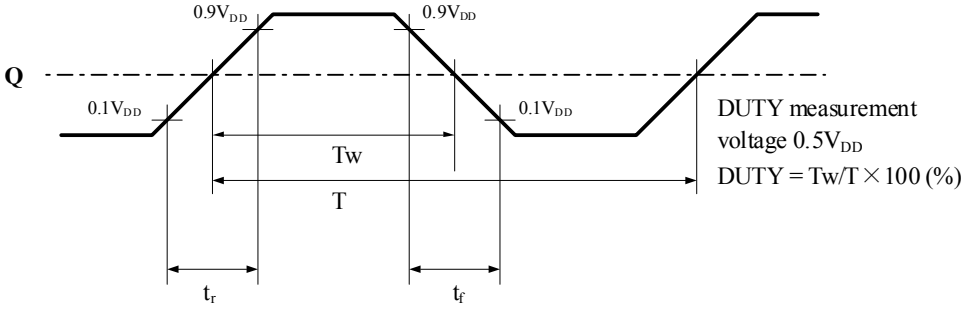
$$I_{DD}(C_{LOUT})[mA] = I_{DD}[mA]+C_{LOUT}[pF]\times V_{DD}[V]\times f_{OUT}[MHz]\cdot 10^{-3}$$

AC Characteristics

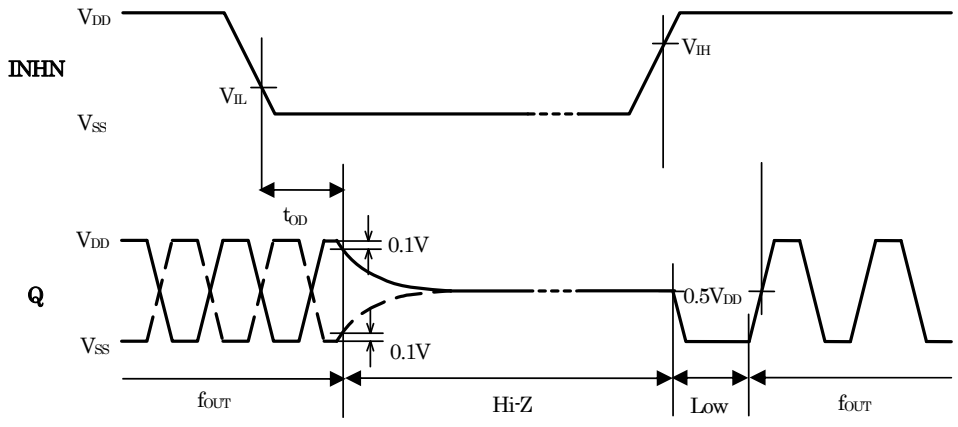
V_{DD} = 1.60 to 3.63V, V_{SS} = 0V, T_a = -40 to +125°C unless otherwise noted

Parameter	Symbol	Condition	MIN	TYP	MAX	Unit
Q pin 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	-	1.5	5.0	ns
	t_{r2}	Measurement circuit 1, C_{LOUT}=15pF, $0.1V_{DD} \rightarrow 0.9V_{DD}$, V_{DD}=1.60 to 2.25V	-	2.0	6.0	
Q pin 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	-	1.5	5.0	ns
	t_{f2}	Measurement circuit 1, C_{LOUT}=15pF, $0.9V_{DD} \rightarrow 0.1V_{DD}$, V_{DD}=1.60 to 2.25V	-	2.0	6.0	
Q pin Output duty cycle	DUTY	Measurement circuit 1, T_a=25°C, C_{LOUT}=15pF, V_{DD}=1.60 to 3.63V	45	50	55	%
Q pin Output disable delay time	t_{OD}	Measurement circuit 2, T_a=25°C, C_{LOUT}≤15pF	-	-	200	ns

Timing chart



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.

Output disable and oscillation start timing chart

FUNCTIONAL DESCRIPTION

INHN Function

Q output is stopped and becomes high impedance.

INHN	Q	Oscillator
HIGH or 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

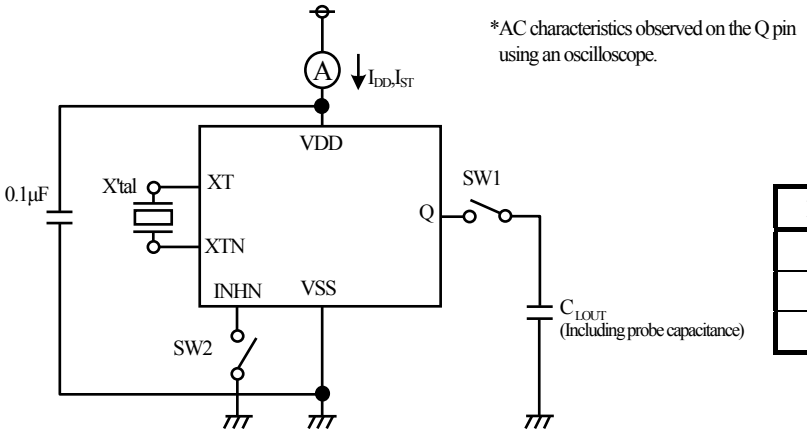
The 5058H series have an oscillation detection circuit.

The oscillation detection circuit disables the output until crystal oscillation becomes stable when oscillation circuit starts up. This function avoids the abnormal oscillation in the initial power up and in a reactivation by INHN.

MEASUREMENT CIRCUITS

Measurement Circuit 1

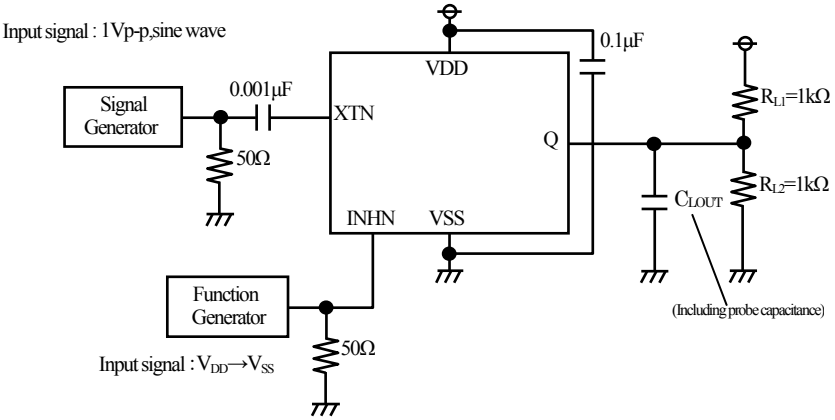
Measurement Parameter : I_{DD}, I_{ST}, DUTY t_r, t_f



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

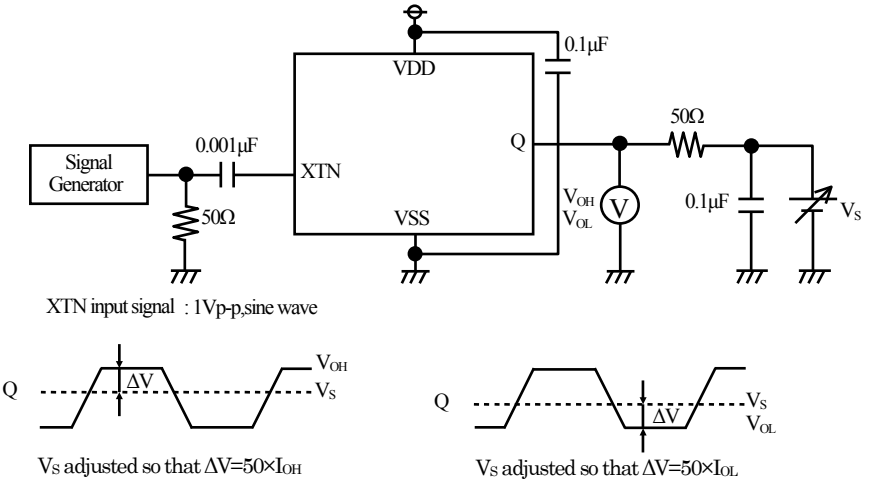
Measurement Circuit 2

Measurement Parameter : t_{OD}



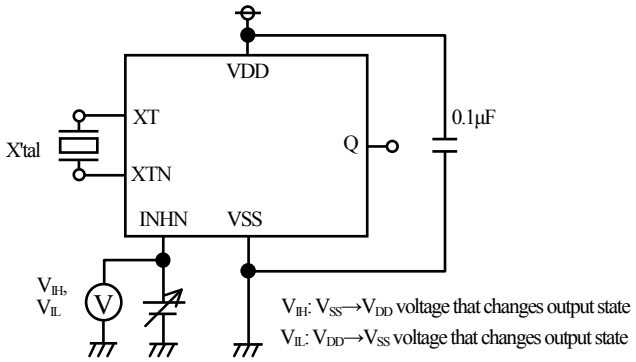
Measurement Circuit 3

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



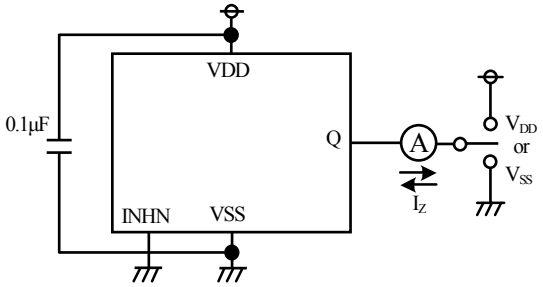
Measurement Circuit 4

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



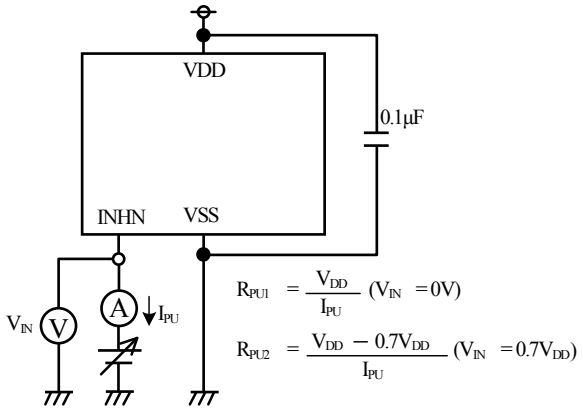
Measurement Circuit 5

Measurement Parameter : I_Z



Measurement Circuit 6

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



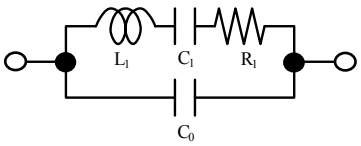
REFERENCE DATA (5058H A1 TYPICAL CHARACTERISTICS)

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

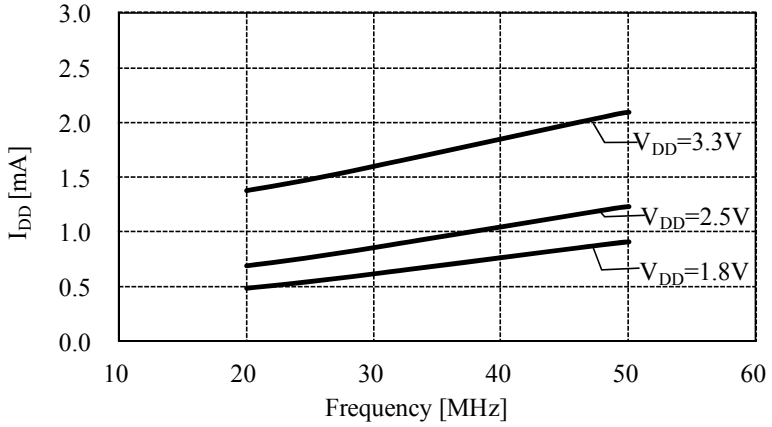
Crystal used for measurement

Parameter	49.15MHz
C_0(pF)	0.9
R_1(Ω)	10

Crystal parameters

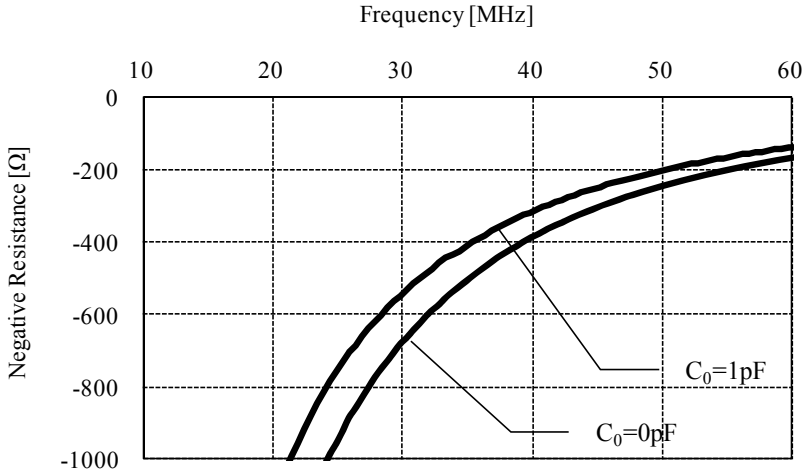


Current Consumption



5058HA1, T_a=25°C, no load

Negative Resistance

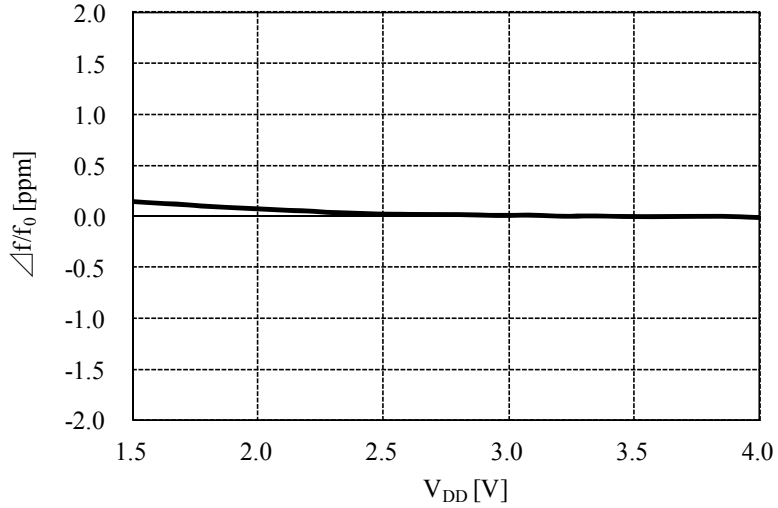


5058HA1, V_{DD}=1.8V, T_a=25°C

Measurement equipment: Agilent Impedance analyzer 4396B

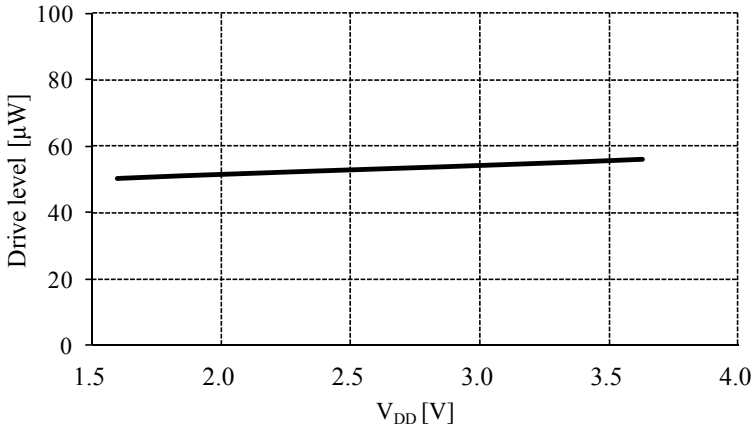
The figures show the measurement result of the crystal equivalent circuit C_0 capacitance, connected between the XT and XTN pins.
They were performed with Agilent 4396B using the NPC test jig.
They may vary in a measurement jig, and measurement environment.

Frequency Deviation with Voltage



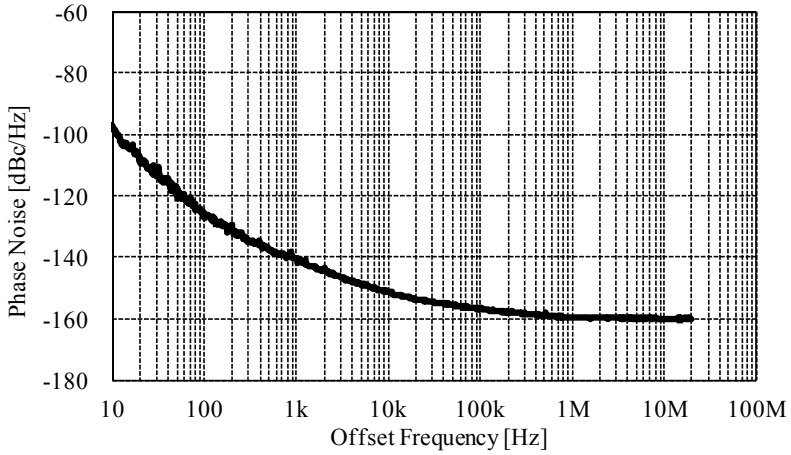
5058HA1, f_{OSC}=49.15MHz, T_a=25°C, 3.3V std.

Drive Level



5058HA1, f_{OSC}=49.15MHz, T_a=25°C

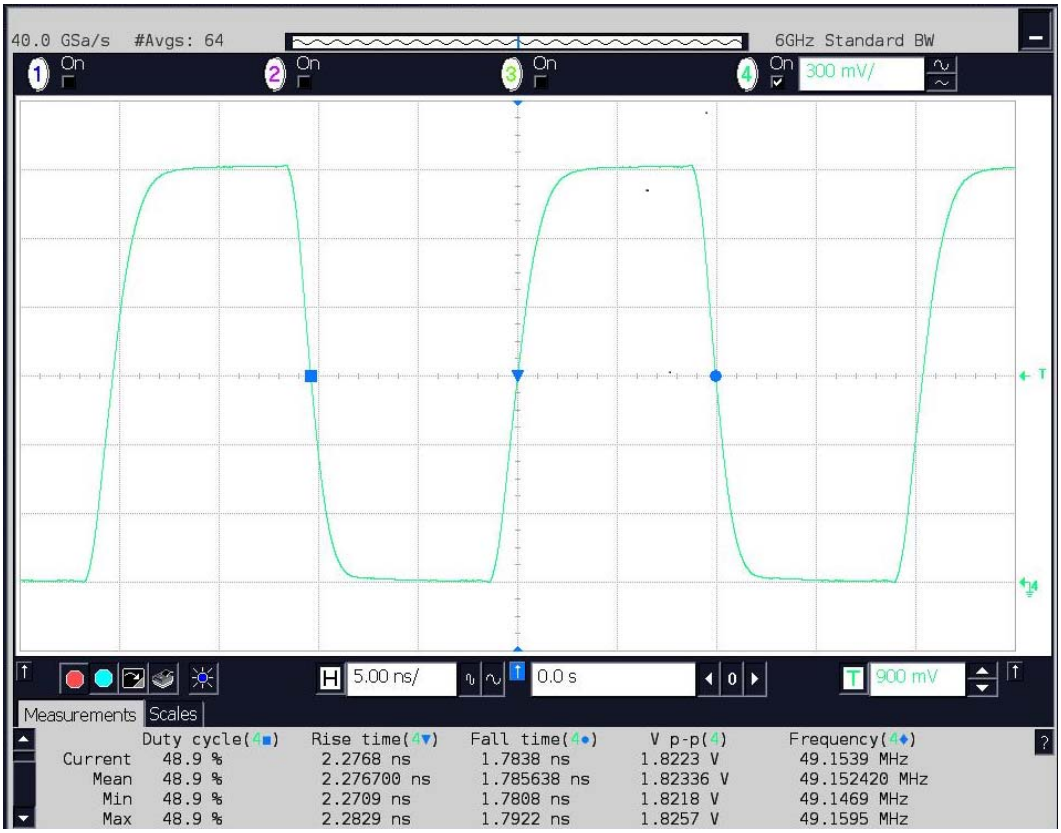
Phase Noise



5058HA1, f_{OSC}=49.15MHz, V_{DD}=1.8V, T_a=25°C

Measurement equipment: Signal Source Analyzer Agilent E5052B

Output Waveform



5058HA1 version, V_{DD}=1.8V, f_{OUT}=49.15MHz, C_{LOUT}=15pF, T_a: Room temperature

Measurement equipment: Oscilloscope Agilent DSO80604B

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.

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

ND15022-E-00 2016.01