1. OVERVIEW

The CF5053HCPN/WF5053HCPN are 100 to 170MHz oscillation frequency, miniature crystal oscillator module CMOS ICs optimized for miniature fundamental crystal elements.

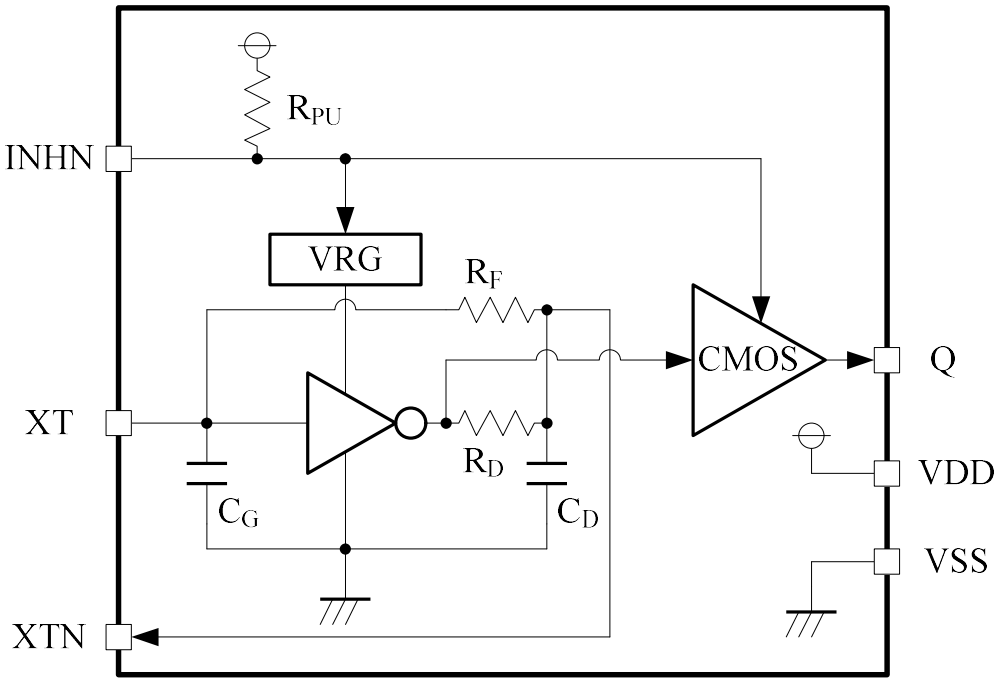
They incorporate a built-in high-frequency oscillator circuit and an output buffer.

The oscillator circuit is excited by a constant-voltage drive circuit, resulting in low voltage dependency, low current consumption, and low drive level.

2. FEATURES

- Operating supply voltage: 2.25 to 3.63V
- Recommended oscillator frequency (fundamental oscillation):
  100 to170MHz (V_{DD}=2.25 to 3.63V, HCPN version)
- Low current consumption due to oscillator constant voltage drive circuit:
  8.0mA@ 155MHz (typ), V_{DD}=3.3V, no load
- Operating temperature: -40 to +125°C
- Output drivability: ±8mA
- Output level: CMOS
- Optimized oscillator circuit for miniature fundamental crystal element
- Oscillator capacitances C_G and C_D built-in
- Output frequency: f_{OSC} (oscillator frequency)
- Output 3-state function
- Low standby current (oscillator stopped, power saving pull-up resistor)
- Oscillation detection circuit built-in

3. BLOCK DIAGRAM



4. 5053HCPN VERSION LINEUP

Version name	Oscillator frequency (reference value)	C0 cancellation circuit	Oscillator capacitance (pF)*1		Output stage		Standby state	
			C_G	C_D	Output duty level	Output current	Oscillator stopped	Output
5053HCPN	100 to 170MHz	No	1	3	1/2VDD	±8mA	Yes	Hi-Z

*1: Excluding parasitic capacitance

4.1. Version Name Format

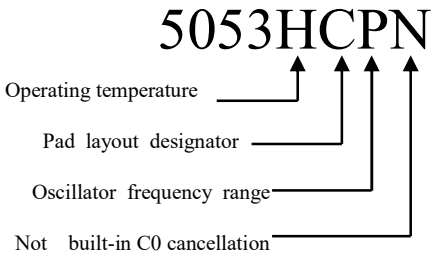
The version name comprises 3 characters (C and P and N).
The meaning of each character is given below.

(1) Operating temperature
H: -40 to 125°C

(2) Character 1: Pad layout designator
C: Wire bonding 2

(3) Character 2: Oscillator frequency range
P: 100 to 170MHz

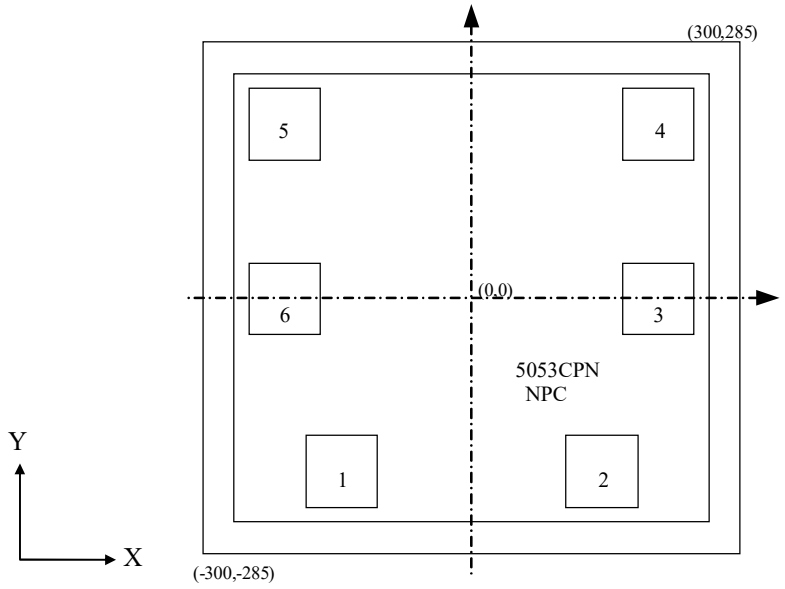
(4) Character3: C0 cancellation circuit
N :Not built-in C0 cancellation



5. PAD LAYOUT

(1) Chip size:*1 X=0.60mm, Y=0.57mm
(2) Rear surface potential: Vss
(3) Pad aperture size: 80μm × 80μm
(4) Chip dimensions

*1: The chip size is the value measured between scribe line centers.



Pad coordinates Unit: [μm]

No.	X	Y	Version name 1st character
			C
1	-145.2	-193.5	XT
2	145.2	-193.5	XTN
3	208.5	-1.1	VSS
4	208.5	193.5	Q
5	-208.5	193.5	VDD
6	-208.5	-1.1	INHN

6. PAD DESCRIPTION

Name	I/O	Function
XT	I	Crystal element connection terminals • Connect crystal between XT and XTN
XTN	O	
VDD	-	Supply voltage
Q	O	Oscillator output • High-impedance in standby mode
VSS	-	Ground
INHN	I	Output state control input • Oscillator stopped and device in standby mode when LOW • Pull-up resistor built-in

7. ABSOLUTE MAXIMUM RATINGS

V_{SS}=0V

Parameter	Symbol	Conditions	Rating	Unit	Note
Supply voltage	V_{DD}	Between VDD-VSS	-0.3 to +4.0	V	*1
Input voltage	V_{IN}	Inputs	-0.3 to V_{DD}+0.3	V	*1, *2
Output voltage	V_{OUT}	Outputs	-0.3 to V_{DD}+0.3	V	*1, *2
Maximum output current	I_{OUT}	Q output	±20	mA	*3
Junction temperature	T_j		150	°C	*3
Storage temperature	T_{STG}		-55 to 150	°C	*4

*1: Absolute maximum ratings are the values that must never exceed even for a moment. This product may suffer breakdown if any one of these parameter ratings is exceeded. Operation and characteristics are guaranteed only when the product is operated at recommended supply voltage range.
*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 alone in nitrogen or vacuum atmosphere.

8. RECOMMENDED OPERATING CONDITIONS

V_{SS}=0V

Parameter	Symbol	Conditions	MIN	TYP	MAX	Unit
Oscillator frequency*1	f_{OSC}	HCPN version: V_{DD}=2.25 to 3.63V	100		170	MHz
Output frequency	f_{OUT}	HCPN version: V_{DD}=2.25 to 3.63V	100		170	MHz
Operating supply voltage	V_{DD}	HCPN version: Between VDD-VSS*2	2.25		3.63	V
Input voltage	V_{IN}	Inputs	V_{SS}		V_{DD}	V
Operating temperature	T_a		-40		+125	°C
Output load capacitance	C_L	Q output			15	pF

*1: The oscillation frequency is a yardstick value and 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: For stable operation of this product, please mount ceramic chip capacitor that is more than 0.01uF between VDD and VSS in close proximity to IC. Wiring pattern between IC and capacitor should be as thick as possible.

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

9. ELECTRICAL CHARACTERISTICS

9.1. DC Characteristics

V_{DD}=2.25 to 3.63V, V_{SS}=0V, T_a=-40 to +125°C unless otherwise noted

Parameter	Symbol	Conditions		MIN	TYP	MAX	Unit
HIGH-level output voltage	V_{OH}	Q output, measurement circuit 3, I_{OH}=-8mA, T_a=-40 to +85°C		V_{DD}-0.4		V_{DD}	V
		Q output, measurement circuit 3, I_{OH}=-8mA		V_{DD}-0.45			
LOW-level output voltage	V_{OL}	Q output, measurement circuit 3, I_{OL}=8mA, T_a=-40 to +85°C		0		0.4	V
		Q output, measurement circuit 3, I_{OL}=8mA				0.45	
HIGH-level input voltage	V_{IH}	INHN input, measurement circuit 4		0.7V_{DD}			V
LOW-level input voltage	V_{IL}	INHN input, measurement circuit 4				0.3V_{DD}	V
Output leakage current	I_Z	Q output, measurement circuit 5, INHN=LOW, T_a=-40 to +85°C	Q=V_{DD}			10	µA
			Q=V_{SS}	-10			µA
		Q output, measurement circuit 5, INHN=LOW	Q=V_{DD}			100	µA
			Q=V_{SS}	-100			
Current consumption*1 (HCPN version)	$I_{DD\_3.3V}$	Measurement circuit 1, INHN=Open, no load, f_{OSC}=155MHz, f_{OUT}=155MHz, V_{DD}=3.3V			8.0	14.0	mA
	$I_{DD\_2.5V}$	Measurement circuit 1, INHN=Open, no load, f_{OSC}=155MHz, f_{OUT}=155MHz, V_{DD}=2.5V			6.5	12.0	
Standby current	I_{ST}	Measurement circuit 1, INHN=LOW, T_a=-40 to +85°C				10	µA
		Measurement circuit 1, INHN=LOW				100	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	R_F	Design value		50	100	200	kΩ
Oscillator capacitance (x1 version)	C_G	Confirmed by sampling inspection, using monitor pattern on the wafer.		0.8	1.0	1.2	pF
	C_D	Design value. Excludes parasitic capacitance.		2.4	3.0	3.6	pF
Oscillator capacitance (xP version)	C_G	Confirmed by sampling inspection, using monitor pattern on the wafer.		0.8	1.0	1.2	pF
	C_D	Design value. Excludes parasitic capacitance.		2.4	3.0	3.6	pF

*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.

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

9.2. AC Characteristics

V_{DD}=2.25to 3.63V, V_{SS}=0V, T_a=-40 to +125°C unless otherwise noted

Parameter	Symbol	Conditions	MIN	TYP	MAX	Unit
Output rise time	t_{r1}	Measurement circuit 1, C_L=15pF, 0.1V_{DD} to 0.9V_{DD}, V_{DD}=2.25 to 3.63V		1.0	2.0	ns
Output fall time	t_{f1}	Measurement circuit 1, C_L=15pF, 0.9V_{DD} to 0.1V_{DD}, V_{DD}=2.25 to 3.63V		1.0	2.0	ns
Output duty cycle	DUTY	Measurement circuit 1, T_a=25°C, C_L=15pF, V_{DD}=2.25 to 3.63V, HCPN version	45	50	55	%
Output disable propagation delay	t_{OD}	Measurement circuit 2, T_a=25°C, C_L≤15pF			200	ns

The ratings above are values obtained by measurements using NPC evaluation standard crystal element on a standards testing jig.
Ratings may have wide tolerances due to crystal element characteristics; thorough evaluation is recommended.

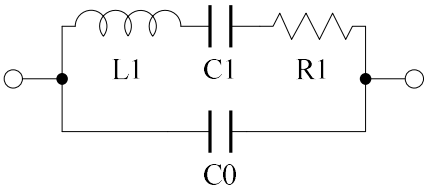
10. REFERENCE CHARACTERISTICS EXAMPLE (5053 Typical Characteristics)

The characters given below were measured using an NPC standards jig and standard crystal element, and do not represent a guarantee of device characteristics.

Note that the characteristics will vary due to measurement environement and the oscillator element used.

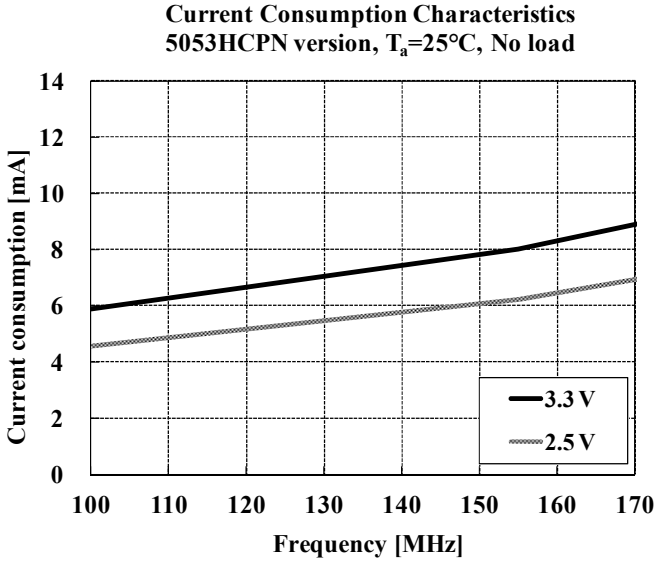
*Crystal used for evaluation

Parameter	100MHz	155MHz
C0(pF)	2.1	1.8
R1(Ω)	8	11

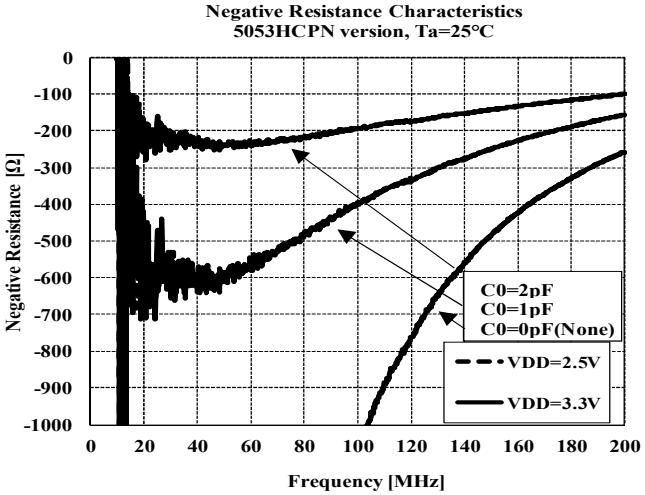


Crystal element parameters

10.1. Current Consumption



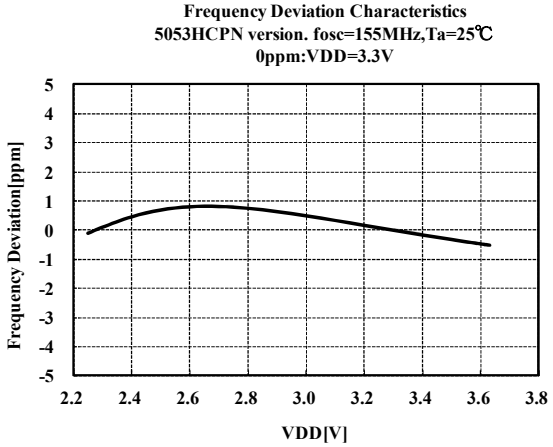
10.2. Negative Resistance



Measurement equipment: Agilent 4396B Impedance Analyzer

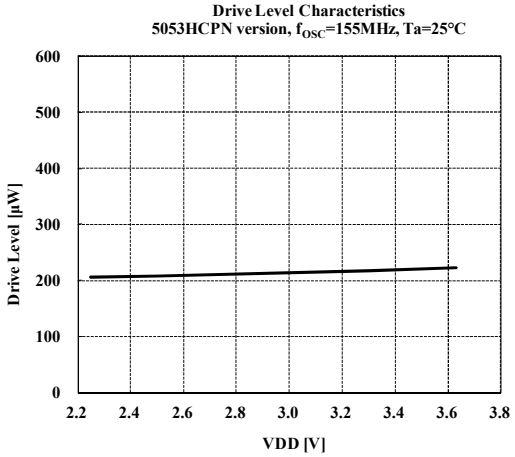
Characteristics are measured with a capacitance C0, representing the crystal equivalent circuit C0 capacitance, connected between the XT and XTN pins. Measurements are performed with Agilent 4396B using the NPC test jig. Characteristics may vary with measurement jig and measurement conditions.

10.3. Frequency Deviation with Voltage



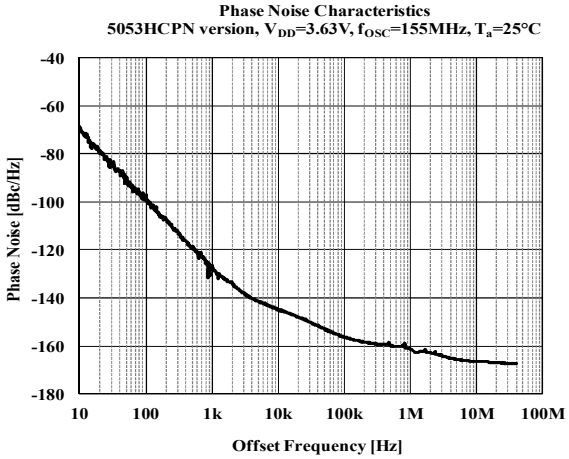
10.4. Drive Level

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



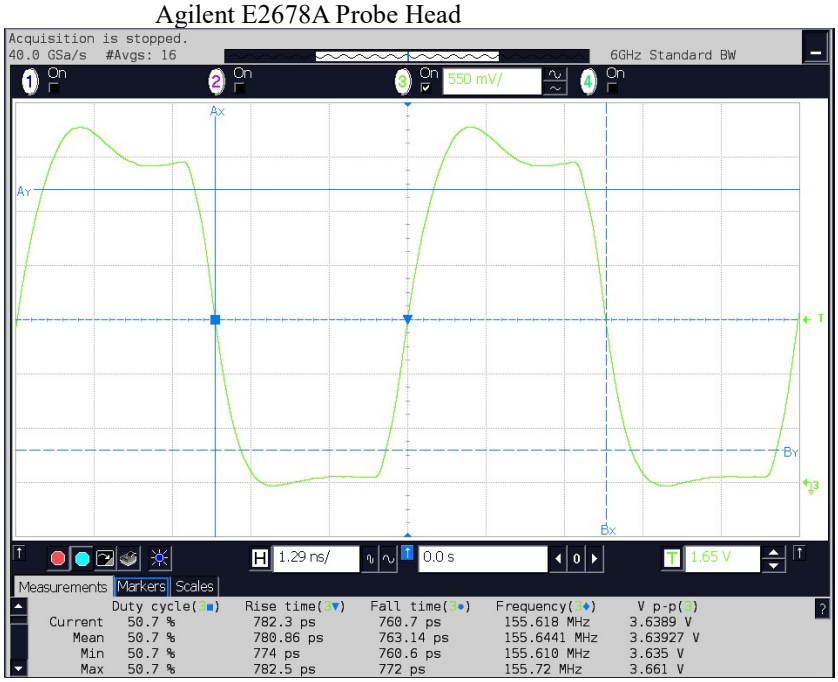
10.5. Phase Noise

Measurement equipment: Agilent E5052B Signal Source Analyzer



10.6. Output Waveform

Measurement equipment: Agilent DSO80604B Oscilloscope
Agilent 1134A Differential Probe
Agilent E2678A Probe Head



11. TIMING DIAGRAMS

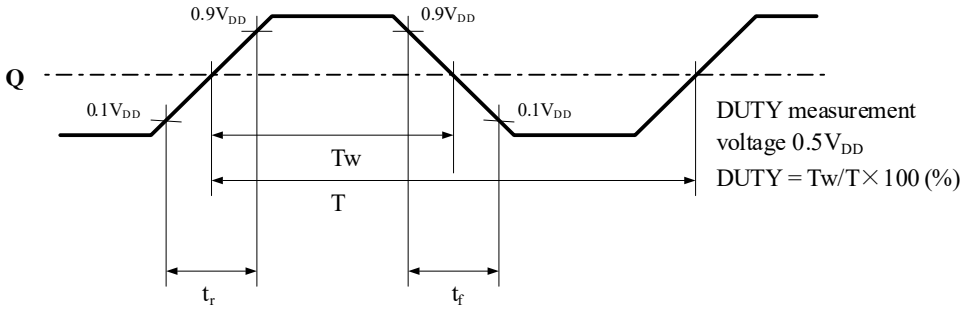


Figure 11-1. Output switching waveform

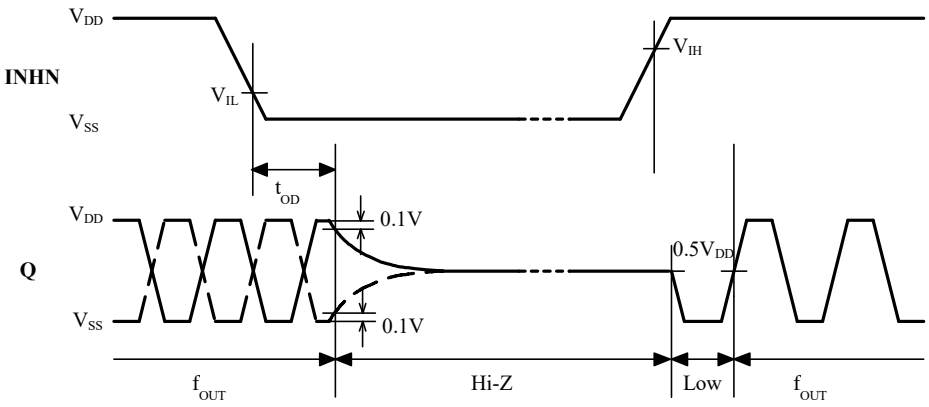


Figure 11-2. Output disable delay (t_{OD})

12. FUNCTIONAL DESCRIPTION

12.1. INHN Function

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

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

12.2. 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.

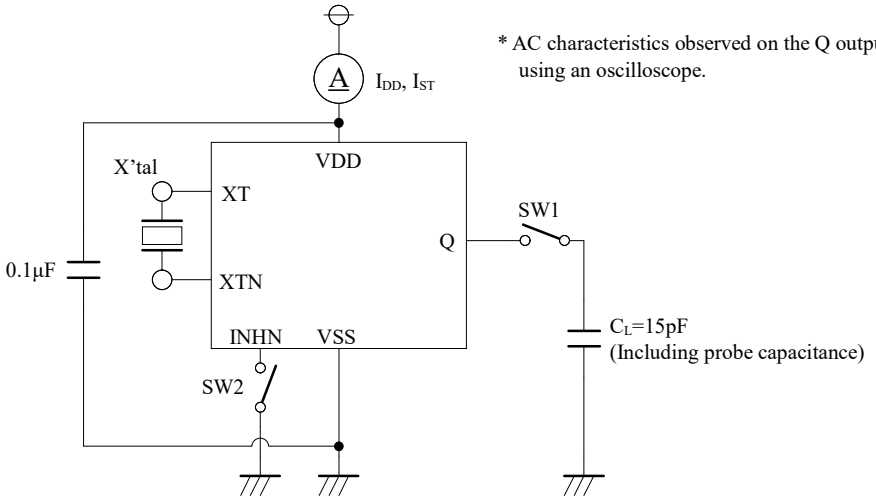
12.3. Oscillation Detection Function

The IC has a built-in 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.

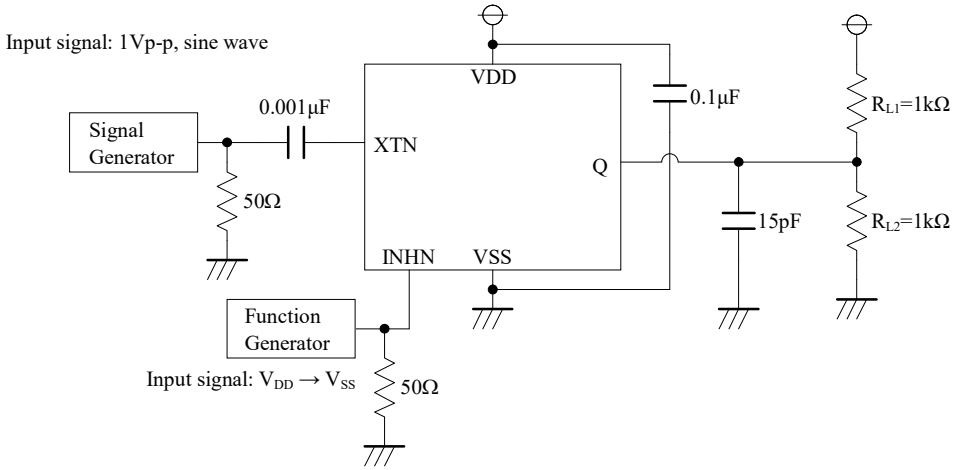
13. MEASUREMENT CIRCUITS

- Measurement circuit 1
  Parameters: I_{DD}, I_{ST}, Duty, t_r, t_f

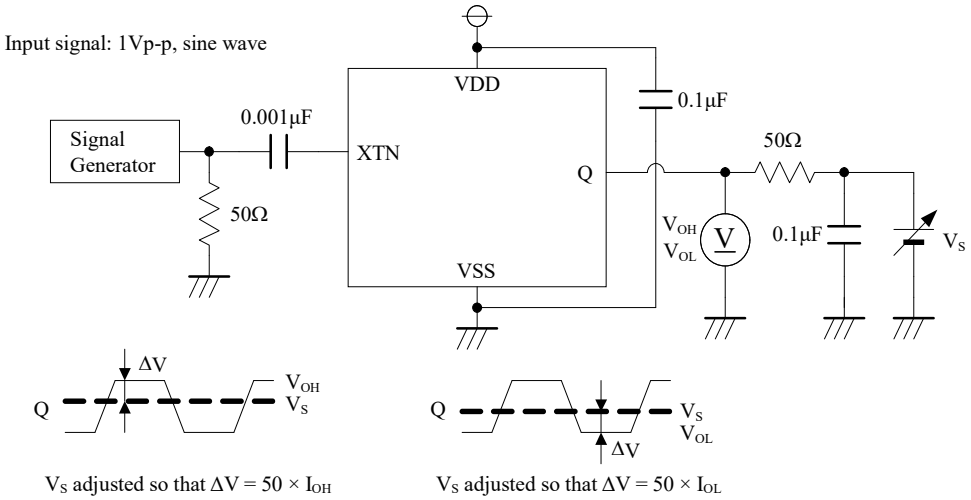


Measurement parameter	SW1	SW2
I_{DD}	OFF	OFF
I_{ST}	ON or OFF	ON
DUTY、t_r、t_f	ON	OFF

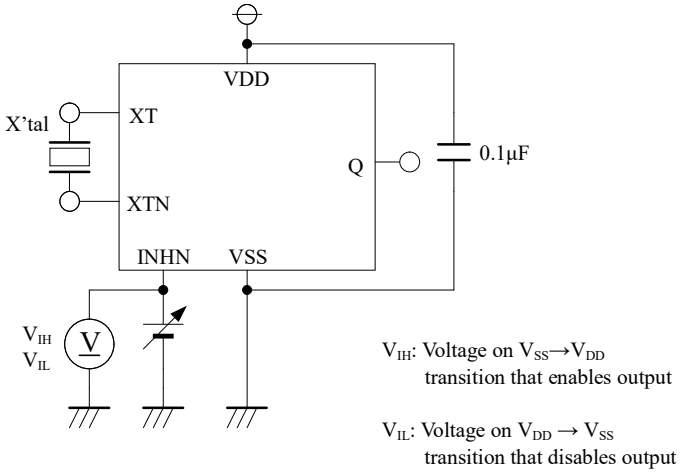
- Measurement circuit 2
  Parameter: t_{OD}



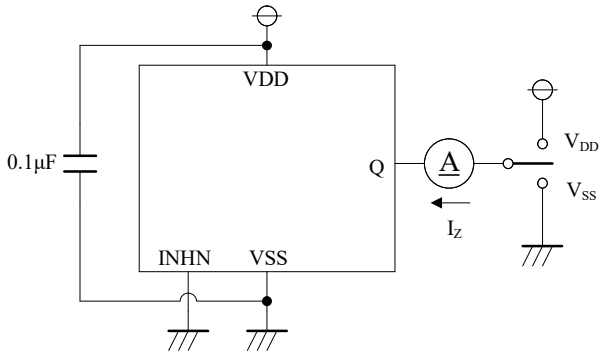
- Measurement circuit 3
  Parameters: V_{OH}, V_{OL}



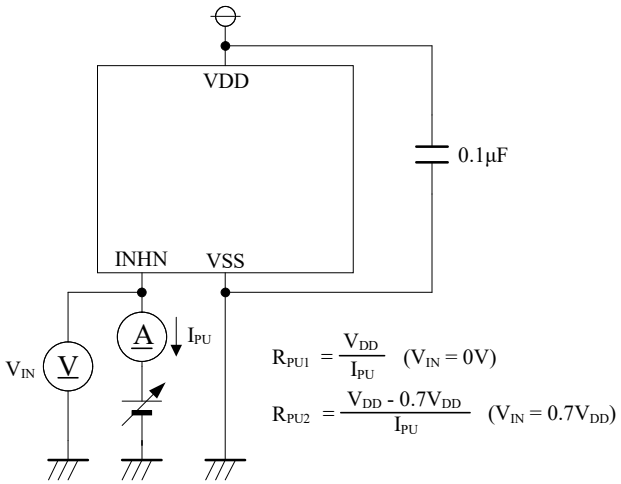
- Measurement circuit 4
  Parameters: V_{IH}, V_{IL}



- Measurement circuit 5
  Parameter: I_Z

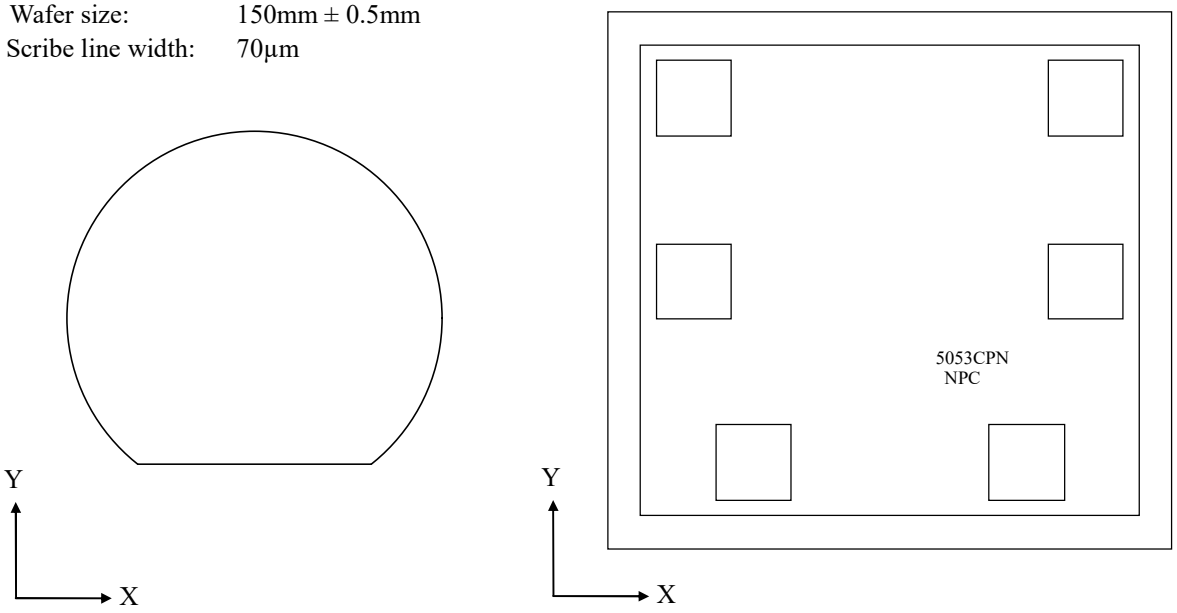


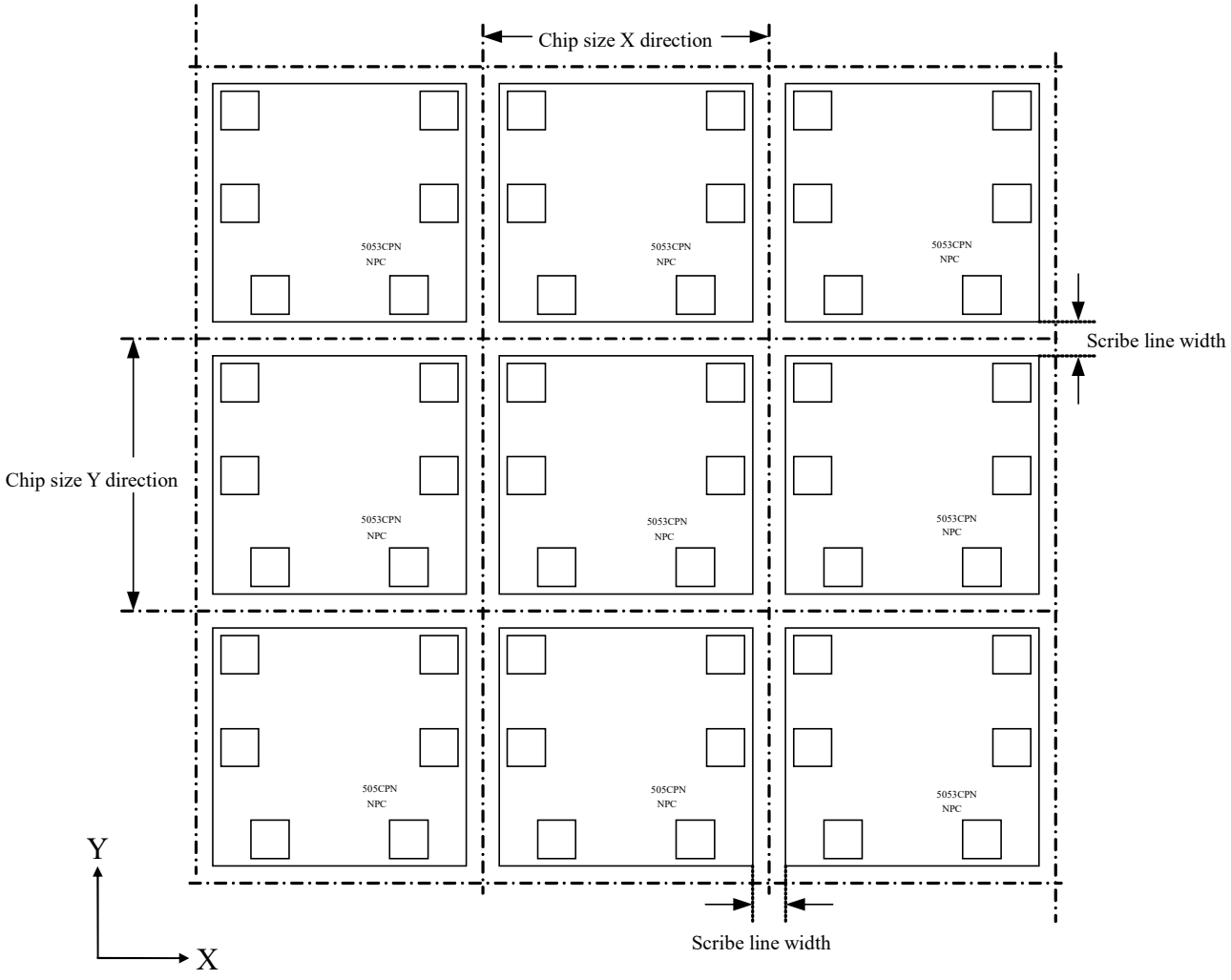
- Measurement circuit 6
  Parameters: R_{PU1}, R_{PU2}



14. WAFER SURFACE ALIGNMENT DIAGRAM

Wafer size: 150mm ± 0.5mm
Scribe line width: 70µm





15. USAGE AND PRECAUTIONS

This product is 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. This product is 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.
If you wish to use this product in equipment requiring extremely high level of reliability, please contact our sales department or representative in advance.
In the event that this product is used in such equipment, please take scrupulous care and apply fail-safe techniques including redundancy and malfunction prevention in order to prevent damage to life, health, property, or infrastructure etc. in case there is some malfunction in the product.

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.
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DE180220E 2018.10