OVERVIEW

The 7051 series are 80 to 320MHz oscillator frequency, LV-PECL output, SPXO module IC with 125°C operating temperature.
The output circuit used LV-PECL logic.
The 7051 series have achieved a low phase noise characteristic and small chip size allowing crystal oscillator modules to be implemented 3225 package.

FEATURES

- Operating supply voltage range: 2.375 to 3.63V
- Recommended oscillation frequency range (varies with version)
  80MHz to 320MHz fundamental oscillation (Ax, B1 ver.)
  105MHz to 170MHz 3rd overtone oscillation (M1, N1 ver.)
- -40 to 125°C operating temperature range
- LV-PECL output
- Oscillation detection circuit built-in
- Frequency divider built-in: Selectable by version: f_0, $f_0/2$, $f_0/4$
- Standby function: High impedance in standby mode, oscillator stops
- Power-saving pull-up resistor built-in (INHN pin)
- Wafer form (WF5051xx)
- Chip form (CF5051xx)
- Phase noise characteristics (typ) : -130dBc/Hz (A1 version, 1kHz offset, f=122.88MHz (γ=330, C_0=1.6pF))
  : -155dBc/Hz (A1 version, 10MHz offset, f=122.88MHz)
- RMS jitter (typ): 0.15ps (A1 version, 12kHz to 20MHz, f=122.88MHz)
- Application: Base station, SONET/SDH, Ethernet, Fibre Channel, LTE

SERIES CONFIGURATION

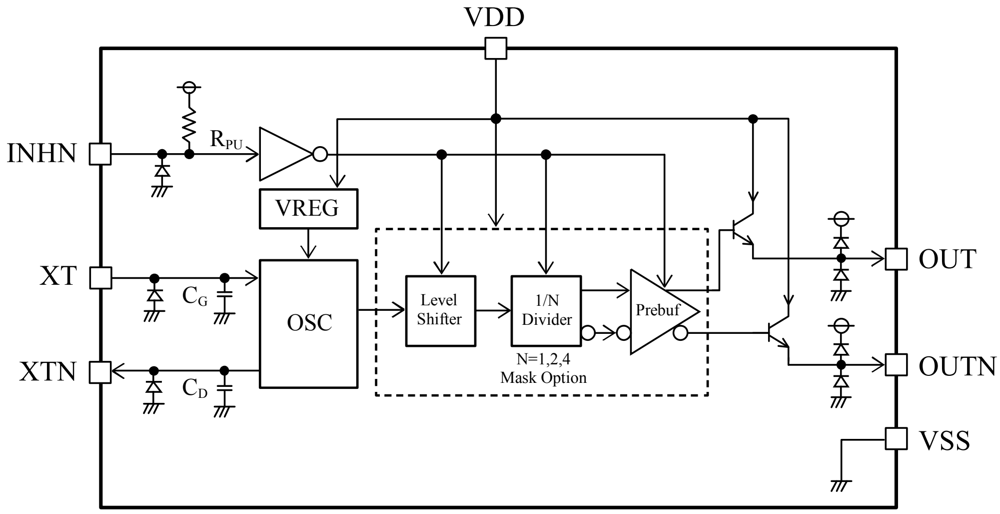
Oscillation mode	Recommended oscillation frequency range f_0*1 [MHz]	Output frequency		
		f_0	$f_0/2$	$f_0/4$
fundamental	80 to 180	7051A1	(7051A2)	(7051A3)
	180 to 320	7051B1	-	-
3rd overtone fundamental	105 to 130	7051M1*2	-	-
	130 to 170	7051N1*2	-	-

*1. Recommended values based on IC characteristics.
The oscillator characteristics are determined by the combination of crystal element and the IC, hence the actual oscillator is not limited to these values.
Always conduct thorough circuit evaluation beforehand.
The recommended characteristics for the crystal element are $R_1 < 20\Omega$, $C_0 < 2.0$pF.
*2. M1, N1 are available for 3rd overtone oscillation. The recommended characteristics for the crystal element are $R_1 < 60\Omega$, $C_0 < 2.0$pF.
*3.Versions in parentheses ( ) are under development.

ORDERING INFORMATION

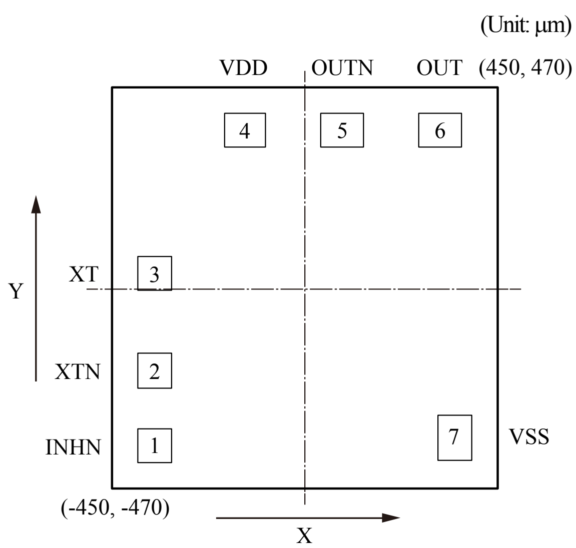
Device	Package	Version Name
WF7051xx-4	Wafer form	WF7051□□-4 Form WF: Wafer form CF: Chip (Die) form Output frequency 1: f_0, 2 : $f_0/2$, 3 : $f_0/4$ Oscillation frequency A: 80 MHz ~ 180MHz (Fundamental) B:180 MHz ~ 320MHz (Fundamental) M:105 MHz ~ 130MHz (3rd overtone) N:130 MHz ~ 170MHz (3rd overtone)
CF7051xx-4	Chip form	

BLOCK DIAGRAM



The CF7051/WF7051 incorporated standard PECL output schemes, which are un-terminated emitters.

PAD LAYOUT



Chip size: 0.9mm×0.94mm
Chip thickness: 130µm
PAD size: 80µm×80µm (No.1, 2, 3)
110µm×80µm (No. 4, 5, 6)
80µm×110µm (No.7)
Chip base: Vss level

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

PIN DESCRIPTION and PAD COORDINATES

No.	Pin	I/O*1	Function	PAD coordinates [µm]	
				X	Y
1	INHN	I	Output enable input. With pull-up built-in. Refer to page 6 for INHN function.	-350	-370
2	XTN	O	Crystal connection pins Crystal is connected between XIN and XOUT.	-350	-194
3	XT	I		-350	34
4	VDD	-	(+) supply voltage	-142	370
5	OUTN	O	LV-PECL output pin (differential inverted output)	83	370
6	OUT	O	LV-PECL output pin (differential output)	313	370
7	VSS	-	(-) ground	350	-355

*1. I: Input pin O: Output pin

ABSOLUTE MAXIMUM RATINGS

Vss=0V

Parameter	Symbol	Condition	Rating	Unit
Supply voltage range[*1]	V_{DD}	Between VDD and VSS	-0.3 to +5.0	V
Input voltage range[*1*2]	V_{IN}	XT, INHN	-0.3 to VDD+0.3	V
Output voltage range[*1*2]	V_{OUT}	XTN, OUT, OUTN	-0.3 to VDD+0.3	V
Junction temperature[*3]	T_j		+150	°C
Storage temperature range[*4]	T_{STG}	Chip form, Wafer form	-55 to~ +150	°C

*1. Parameters must not exceed ratings, not even momentarily. If a rating is exceeded, there is a risk of IC failure, deterioration in characteristics, and decrease in reliability.

*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	Conditions	MIN	TYP	MAX	Unit
Operating supply voltage	V_{DD}	Between VDD and VSS[*2]	2.375	3.3	3.63	V
Input voltage	V_{IN}	INHN	0	-	V_{DD}	V
Operating temperature	Ta		-40	-	125	°C
Output load	R_L	V_{DD}-2V termination	49.5	50.0	50.5	Ω
Oscillator frequency[*1] (fundamental)	f_{OUT}	7051Ax	80	-	180	MHz
		7051B1	180	-	320	
Oscillator frequency[*1] (3rd overtone)		7051M1	105	-	130	MHz
		7051N1	130	-	170	

*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 7051 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

Measurement circuits 1 to 5 in “Conditions” are shown in Page 7 to 9 “MEASUREMENT CIRCUITS.”

V_{DD}=2.375 to 3.63V, V_{SS}=0V, Ta= -40 to +125°C unless otherwise noted.

Parameter	Symbol	Conditions		MIN	TYP	MAX	Unit
Current consumption (Ax ver.)	I_{DDA}	Measurement circuit 1, V_{DD}-2V termination, INHN=Open		-	60	80	mA
Current consumption (B1 ver.)	I_{DDB}	Measurement circuit 1, V_{DD}-2V termination, INHN=Open		-	63	90	mA
Current consumption (M1 ver.)	I_{DDM}	Measurement circuit 1, V_{DD}-2V termination, INHN=Open		-	60	80	mA
Current consumption (N1 ver.)	I_{DDN}	Measurement circuit 1, V_{DD}-2V termination, INHN=Open		-	60	80	mA
Standby Current	I_{STB}	Measurement circuit 1, INHN=V_{SS}, oscillator :disabled, outputs :disabled, Ta=25°C		-	-	10	µA
HIGH-level output voltage	V_{OH}	Measurement circuit 5 OUT/OUTN	Ta=0 to +125°C	V_{DD} -1.025	V_{DD} -0.950	V_{DD} -0.880	V
			Ta=-40 to 0°C	V_{DD} -1.085	V_{DD} -1.005	V_{DD} -0.880	
LOW-level output voltage	V_{OL}	Measurement circuit 5, OUT/OUTN		V_{DD} -1.810	V_{DD} -1.700	V_{DD} -1.620	V
Output leakage current	I_Z	Measurement circuit 3, INHN=LOW, OUT/OUTN, Ta= 25°C		-1	-	1	µA
HIGH-level input voltage	V_{IH}	Measurement circuit 2, INHN		0.7V_{DD}	-	-	V
LOW-level input voltage	V_{IL}	Measurement circuit 2, INHN		-	-	0.3V_{DD}	V
Power save Pull-up resistance	R_{PU1}	Measurement circuit 2, INHN=V_{SS}		1	3	14	MΩ
Pull-up resistance	R_{PU2}	Measurement circuit 2, INHN=0.7V_{DD}		50	100	200	kΩ
Oscillator feedback resistance (Ax ver.)	R_{FA}	Measurement circuit 4, XT-XTN		8	17.5	40	kΩ
Oscillator feedback resistance (B1 ver.)	R_{FB}	Measurement circuit 4, XT-XTN		8	17.5	40	kΩ
Oscillator feedback resistance (M1 ver.)	R_{FM}	Measurement circuit 4, XT-XTN		1	1.75	3	kΩ
Oscillator feedback resistance (N1 ver.)	R_{FN}	Measurement circuit 4, XT-XTN		1	1.75	3	kΩ
Oscillator capacitance (Ax ver.)	C_{GA}	Design value, excluding parasitic capacitance*1		3.0	4.0	5.0	pF
	C_{DA}			4.5	6.0	7.5	
Oscillator capacitance (B1 ver.)	C_{GB}	Design value, excluding parasitic capacitance*1		1.5	2.0	2.5	pF
	C_{DB}			2.2	3.0	3.8	
Oscillator capacitance (M1 ver.)	C_{GM}	Design value, excluding parasitic capacitance*1		3.0	4.0	5.0	pF
	C_{DM}			5.2	7.0	8.8	
Oscillator capacitance (N1 ver.)	C_{GN}	Design value, excluding parasitic capacitance*1		1.5	2.0	2.5	pF
	C_{DN}			5.2	7.0	8.8	

*1. Confirmed by acceptance sampling using wafer monitor pattern.

AC Characteristics

Measurement circuits 5 and 6 in “Conditions” are shown in page 9 to 10 “MEASUREMENT CIRCUITS.”
The conditions for each parameter assume the timing shown in “Timing Diagram.”
V_{DD}=2.375 to 3.63V, V_{SS}=0V, Ta=–40 to +125°C unless otherwise noted

Parameter	Symbol	Conditions	MIN	TYP	MAX	Unit
Duty cycle	Duty1	Measured at output crossing point, Ta=25°C, V_{DD}=3.3V, measurement circuit 5	45	50	55	%
	Duty2	Measured at 50% output amplitude, Ta=25°C, V_{DD}=3.3V, measurement circuit 5	45	50	55	%
Output amplitude	V_{OPP}	Peak-to-peak output waveform, measurement circuit 5, single-ended output signal	0.4	-	-	V
Output rise time	t_r	20 to 80% output amplitude, measurement circuit 5*2, single-ended output signal	-	0.3	1.0	ns
Output fall time	t_f	20 to 80% output amplitude, measurement circuit 5*2, single-ended output signal	-	0.3	1.0	ns
Output disable propagation delay	t_{OD}	Ta=25°C, design value, measurement circuit 6	-	-	200	ns

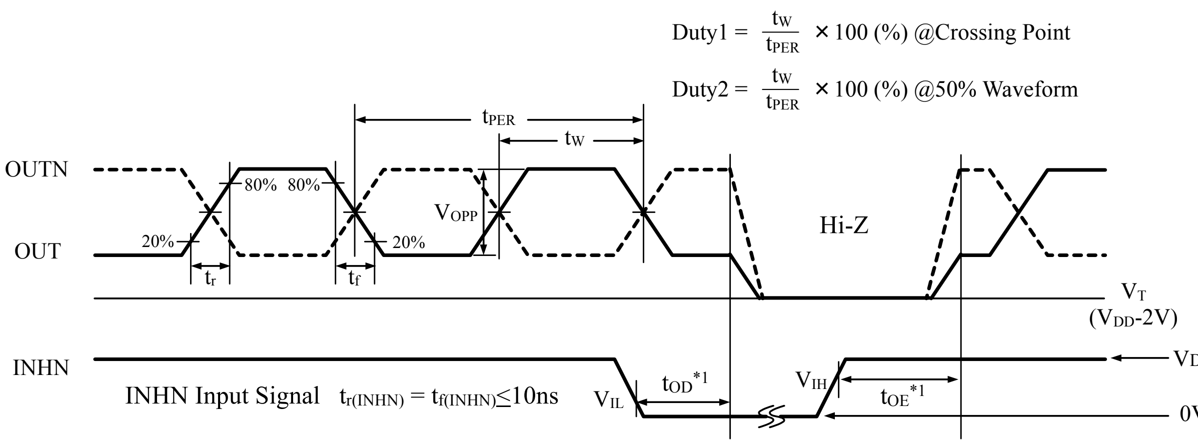
*1. Output rise time and output fall time may vary depending on measurement environment.

Notes

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.
The recommended crystal element characteristics are $R_1 < 20\Omega$ and $C_0 < 2.0$pF (Fundamental).
The recommended crystal element characteristics are $R_1 < 60\Omega$ and $C_0 < 2.0$pF (3rd overtone).

Timing Diagram

The timing diagram applies to the “Conditions” in the table in “AC Characteristics.”



*1. On an INHN falling edge, the outputs go high impedance (Hi-Z) after the output disable propagation delay (t_{OD}) has elapsed. When this occurs, the output signal is pulled down to V_T (termination voltage) by the load resistance. On an INHN rising edge, the output starts after the output enable propagation delay (t_{OE}) has elapsed.

FUNCTIONAL DESCRIPTION

INHN Function

INHN (pull-up resistance built-in)	Oscillator	Output stage
HIGH/Open	Operating	Operating
LOW	Disabled	Disabled (Hi-Z)

Power Saving Pull-up Resistor

The INHN terminal pull-up resistance switches between R_{PU1} and R_{PU2}, depending on the input level (HIGH or LOW).
When the INHN terminal is held LOW, the built-in INHN terminal pull-up resistance increases (R_{PU1}), reducing the current consumed by the pull-up resistance when the outputs are disabled.
When the device is operating with the INHN terminal HIGH or open circuit, the pull-up resistance decreases (R_{PU2}), reducing internal susceptibility to the effects of external noise. The INHN terminal is held HIGH internally to prevent problems that might otherwise cause the outputs to stop abruptly.

Oscillator Startup Detection Function

An oscillator startup detection circuit is built-in. The circuit disables the OUT/OUTN outputs (high impedance) until the oscillator starts. This function prevents unstable oscillation and other problems, which can occur when power is applied, from appearing at the output.

MEASUREMENT CIRCUITS

These measurement circuits are used for the evaluation of the electrical and AC characteristics.

Notes

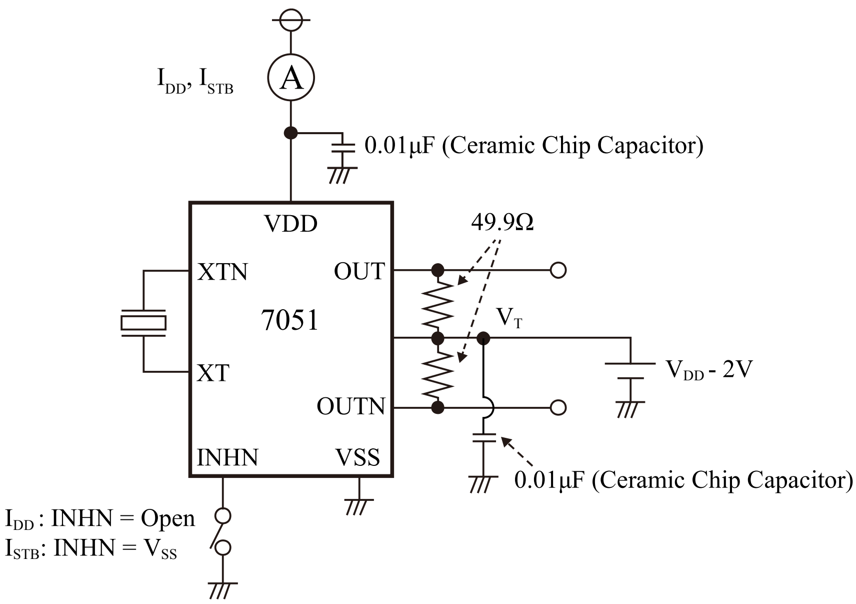
Connect the bypass capacitors, specified in the measurement circuits, between VDD-VSS and V_T-VSS.
Connect the load resistors, specified in the measurement circuits, to the OUT and OUTN outputs.
Connect the bypass capacitors and load resistors with wiring pattern as short as possible (less than 3mm length). If the wiring pattern is too long, the desired characteristics cannot be obtained.
Note that if bypass capacitors and load resistors other than the specified values are connected, or if the components are not connected at all, the desired characteristics cannot be obtained.

* Capacitor and resistor values used by NPC

Capacitors: 0.01μF GRM188B11H103K (Murata Manufacturing Co., Ltd.)
Resistors: 49.9Ω RN732ATTD49R9B25 (KOA Corporation)

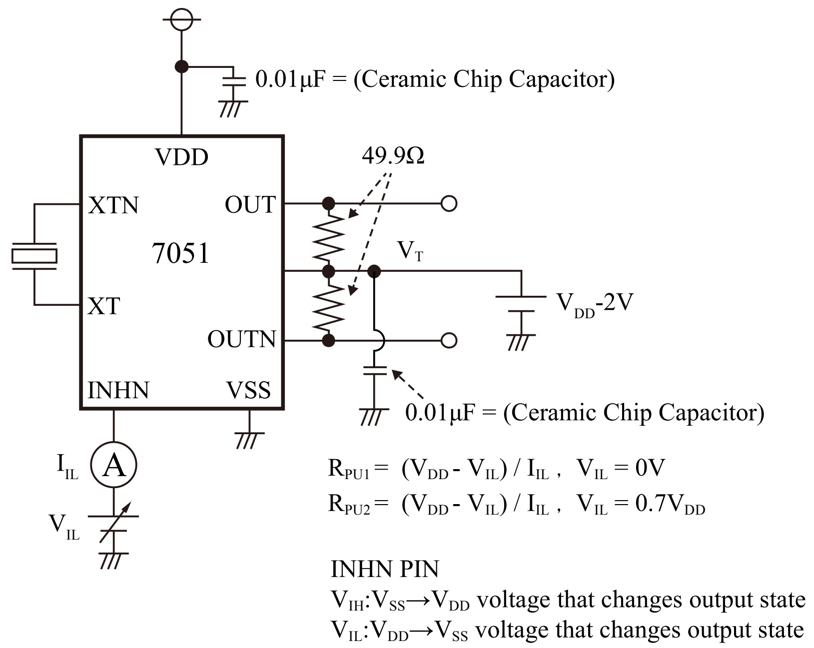
Measurement circuit 1

Measurement Parameter: I_{DD}, I_{STB}



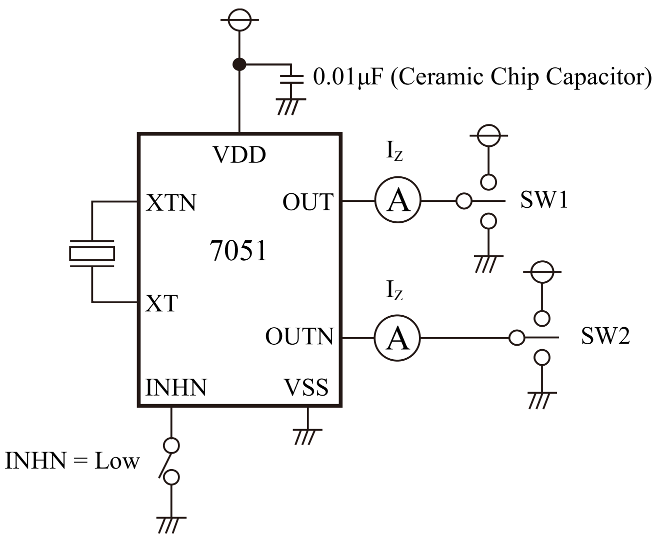
Measurement circuit 2

Measurement Parameter: V_{IH}, V_{IL}, R_{PU1}, R_{PU2}



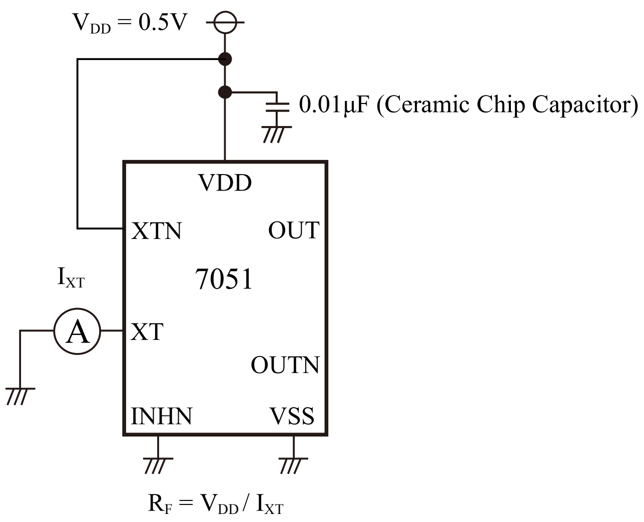
Measurement circuit 3

Measurement Parameter: I_Z



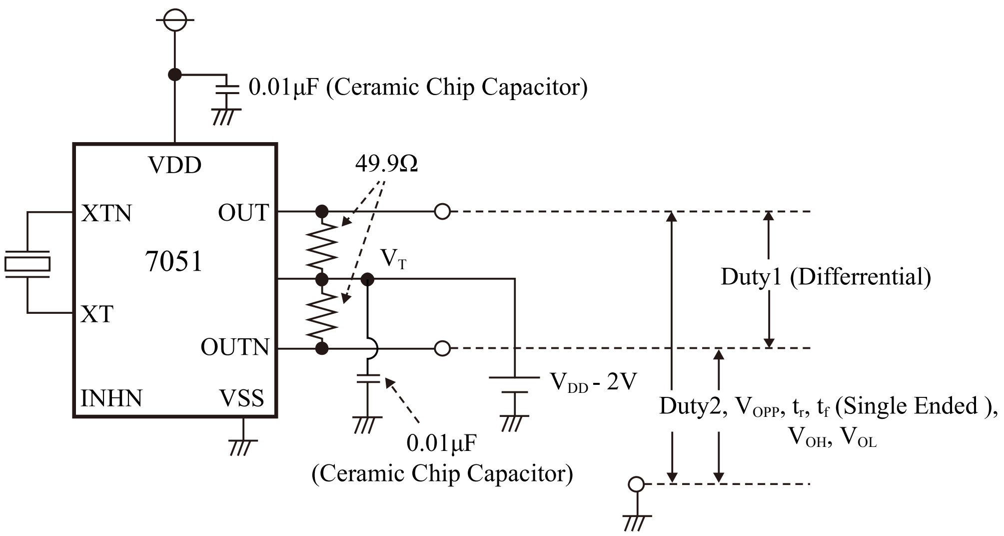
Measurement circuit 4

Measurement Parameter: R_F



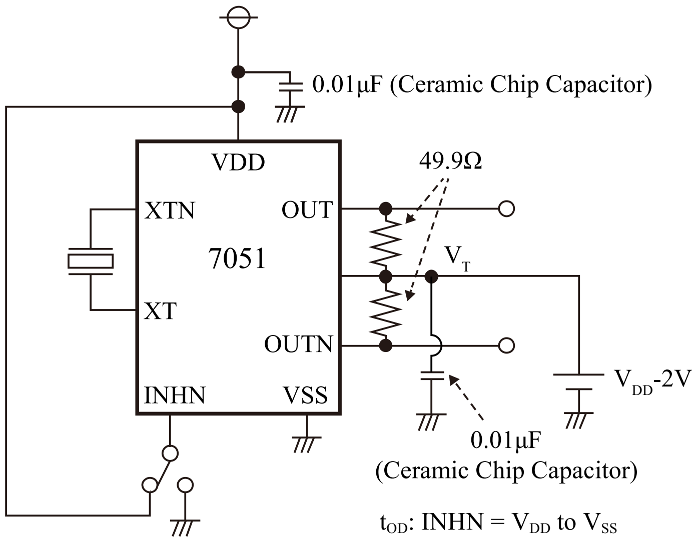
Measurement circuit 5

Measurement Parameter: Duty1, Duty2, V_{OPP}, t_r, t_f, V_{OH}, V_{OL}



Measurement circuit 6

Measurement Parameter: t_{OE}, t_{OD}



t_{OD}: INHN = V_{DD} to V_{SS}
t_{OE}: INHN = V_{SS} to V_{DD}

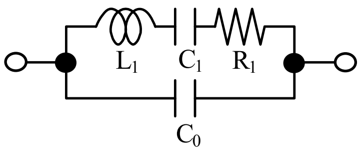
REFERENCE CHARACTERISTICS EXAMPLE (7051 Typical Characteristics)

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 environment and the oscillator element used.

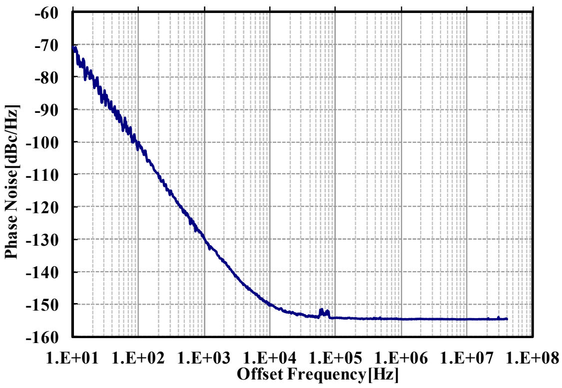
Crystal used for evaluation

Parameter	Ax	B1	M1	N1
f_0 *1(MHz)	155.52MHz	245.76MHz	125MHz	155.52MHz
C_0 (pF)	1.7	1.4	2.3	2.4
R_1 (Ω)	12	17	32	39

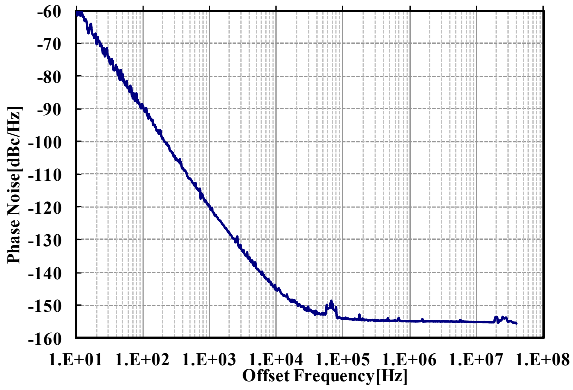
Crystal parameters



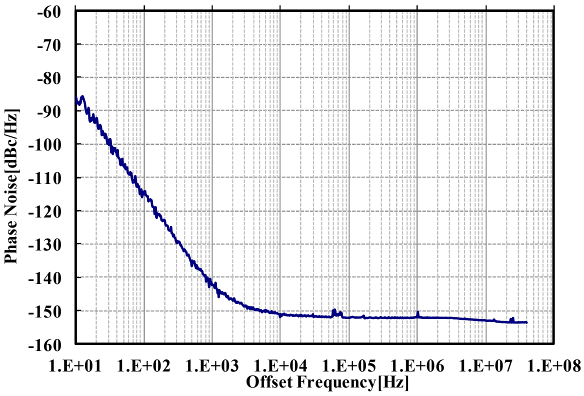
Phase Noise



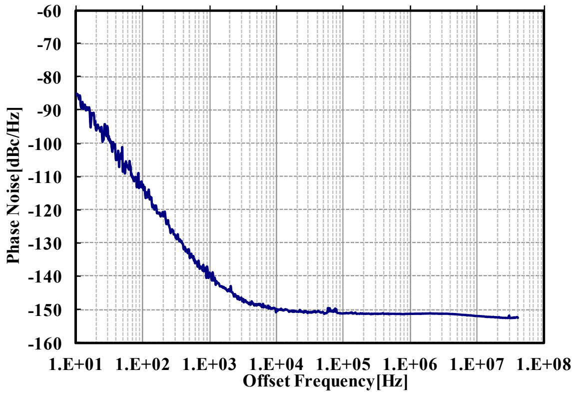
7051A1 f_0 = 155.52MHz, Ta = R.T. (Room Temperature)



7051B1 f_0 = 245.76MHz, Ta = R.T.

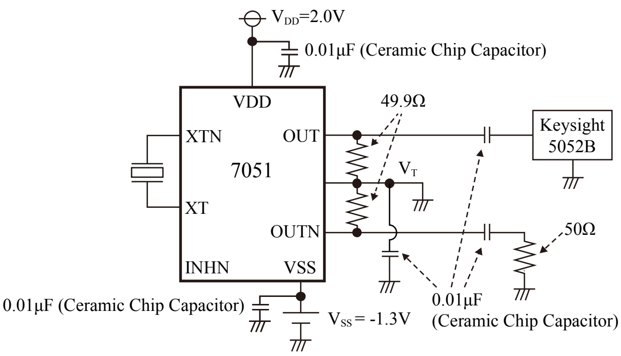


7051M1 f_0 = 125MHz, Ta = R.T.

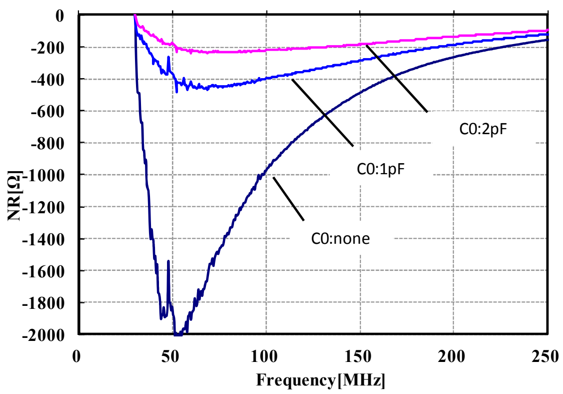


7051N1 f_0 = 155.52MHz, Ta = R.T.

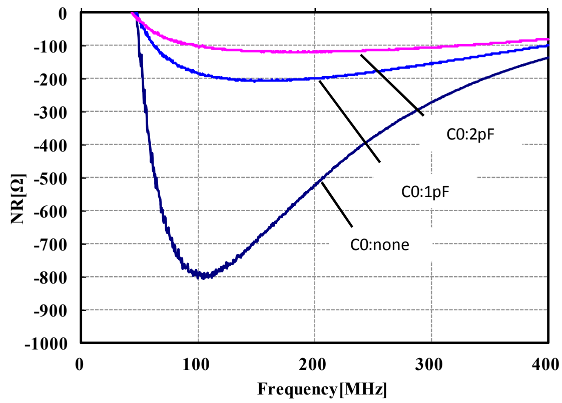
[Measurement circuit diagram]



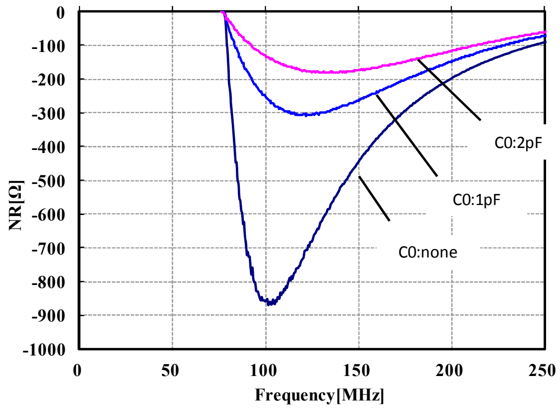
Negative Resistance



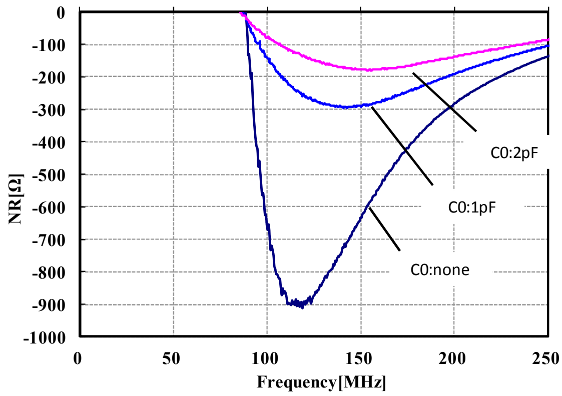
7051A1 V_{DD} = 3.3V, Ta = 25°C



7051B1 V_{DD} = 3.3V, Ta = 25°C

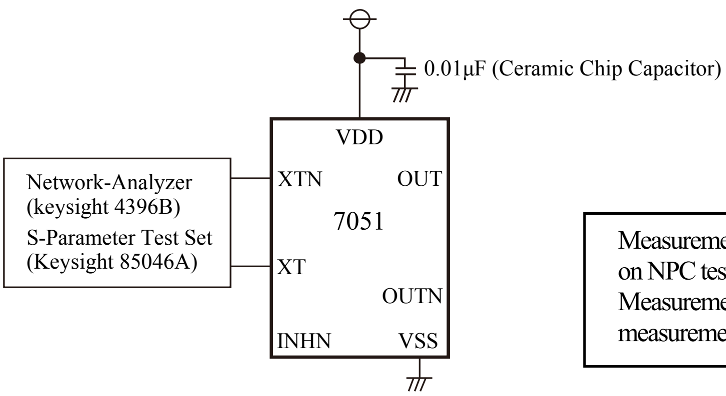


7051M1 V_{DD} = 3.3V, Ta=25°C



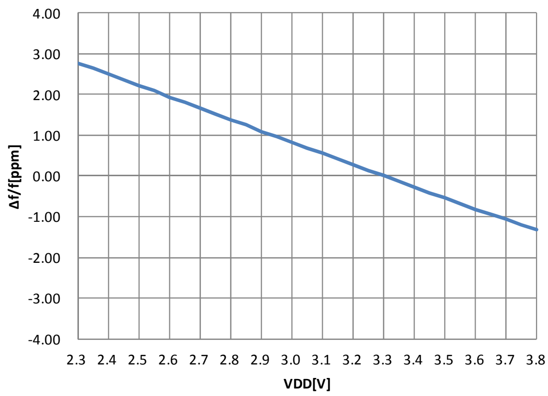
7051N1 V_{DD} = 3.3V, Ta=25°C

[Measurement circuit diagram]

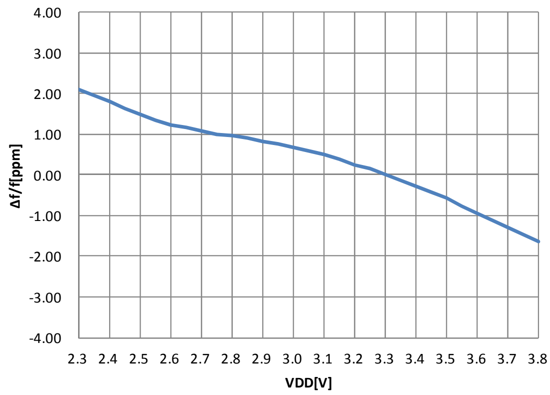


Measurement results using 4396B Agilent analyzer on NPC test jig.
Measurements will vary with test jig and measurement environment.

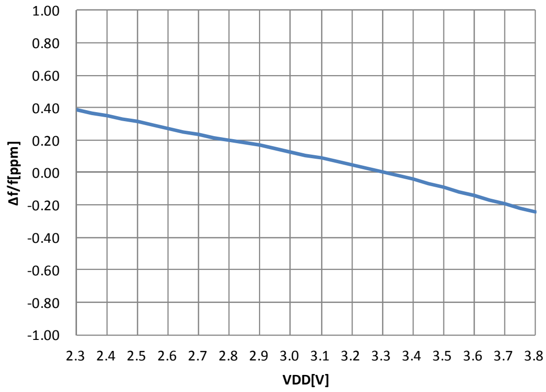
Frequency Deviation with Voltage



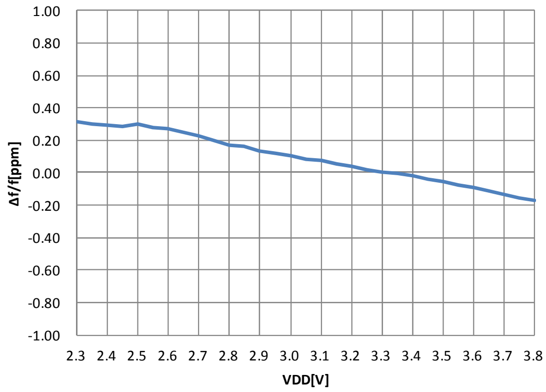
7051A1 f_0 = 155.52MHz, Ta=25°C



7051B1 f_0 = 245.76MHz, Ta=25°C

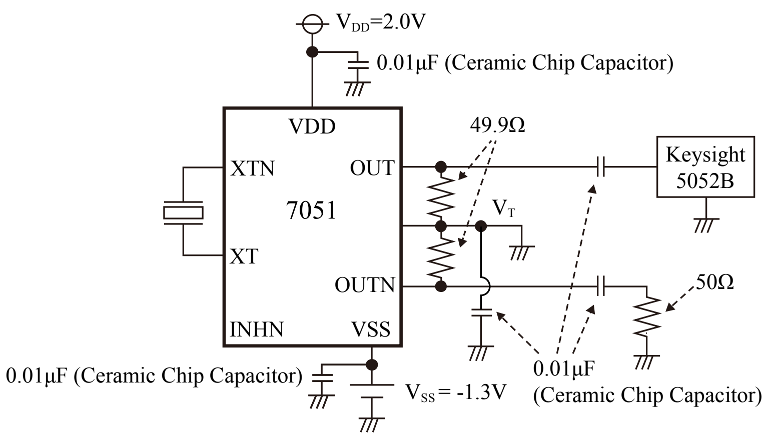


7051M1 f_0 = 125MHz, Ta=25°C

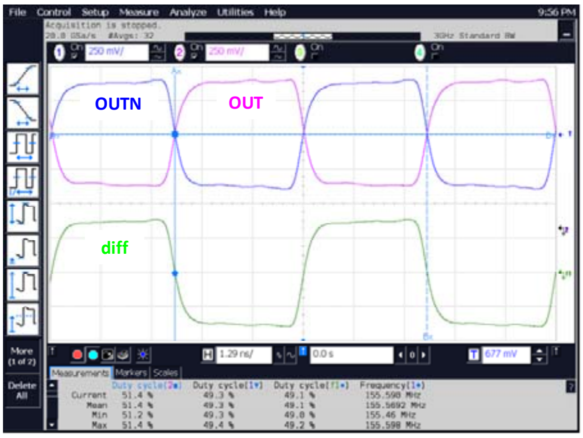


7051N1 f_0 = 155.52MHz, Ta=25°C

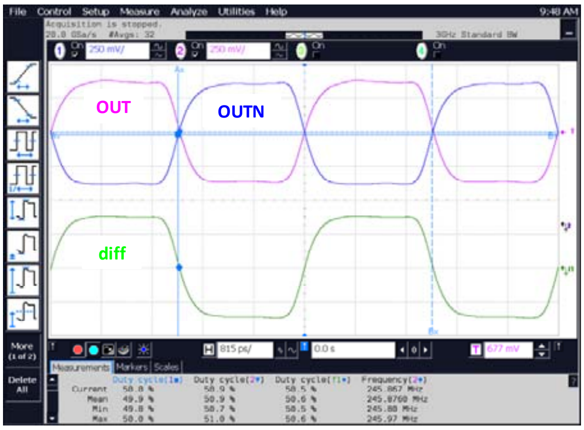
[Measurement circuit diagram]



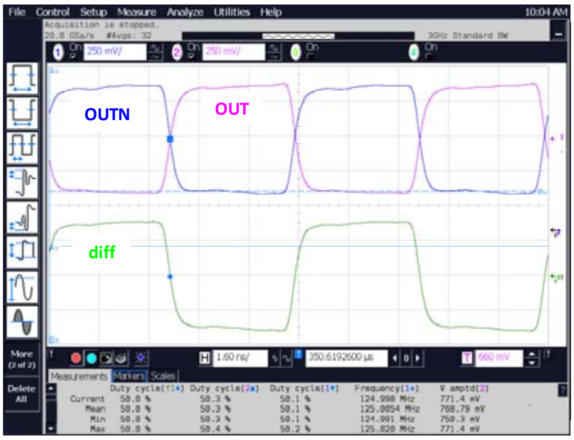
Output Waveform



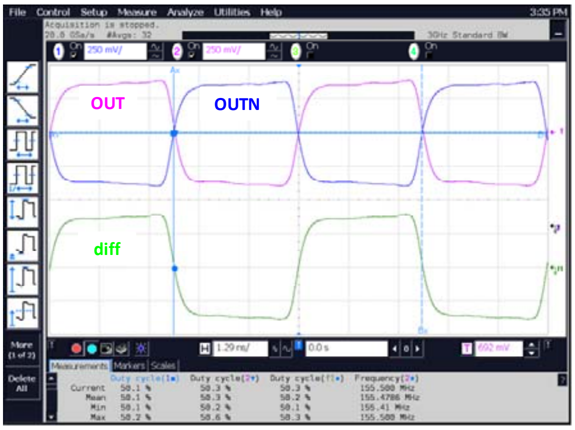
7051A1 V_{DD} = 3.3V, f_0 = 155.52MHz, Ta=25°C



7051B1 V_{DD}=3.3V, f_0 = 245.76MHz, Ta=25°C



7051M1 V_{DD} = 3.3V, f_0 = 125MHz,Ta=25°C



7051N1 V_{DD} = 3.3V, f_0 = 155.52MHz, Ta=25°C

[Measurement circuit diagram]

Page 9 Measurement circuit 5

Measurement equipment：Oscilloscope　DSO80604B (keysight)

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.
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