VC7051H Series

LV-PECL Output Oscillator ASIC 20MHz to 320MHz
2.375V to 3.63V -55°C to 125° Operation

FEATURES

- Rugged & reliable, LV-PECL clock
- Open emitter unterminated zero impedance (0Ω) bipolar output design
- Single Chip solution
- INHN detects oscillation before enable
- 3.3, 2.5 volt supply (2.375V to 3.63V)
- Excellent stability & startup
- Output 100Ω
- Low Phase noise & jitter

BENEFITS

- Excellent startup characteristics
- Stable bipolar LV-PECL differential clock operation
- Small board footprint

APPLICATIONS

- System clocks
- Data and voice Communications
- Packaging in 5.0x7.0 and 5.0x3.2mm

DEFENSE, AEROSPACE and MEDICAL APPLICATIONS

- Controlled Baseline
- Single Fabrication Site
- Temperature Range –55°C to 125°C
- Extended Product Life-Cycle
- Extended Product Change Notification
- Product Traceability

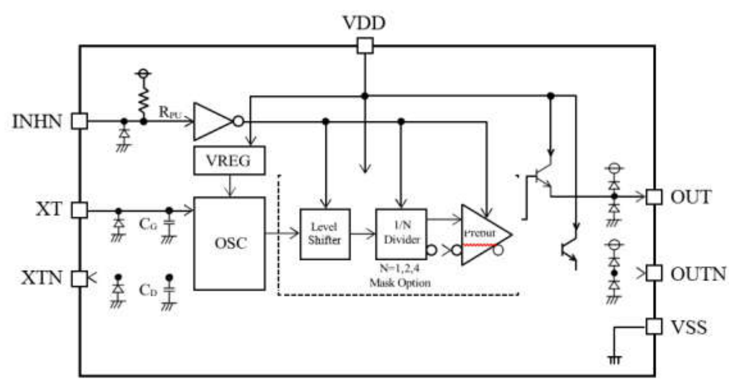
GENERAL DESCRIPTION

The VC7051H series LV-PECL oscillator provide zero impedance differential output drive for stable single or multi-point connections of varying line lengths and sized to fit in 5x3.2mm or 3.2x2.5 mm ceramic LCC. Output frequency range of 20 MHz to 320MHz. Significantly improved lower phase noise and better jitter performance, This series support fundamental and overtone mode operation.

The devices are fabricated using a BiCMOS process and design. Inhibit circuit function enables output after oscillation is detected.

The VC7051H series is specified for –55°C to 125°C operation. For applications requiring processing to Mil-PRF-38534 or Mil-PRF-38535, refer to ordering guide

BLOCK DIAGRAM (equivalent circuit)



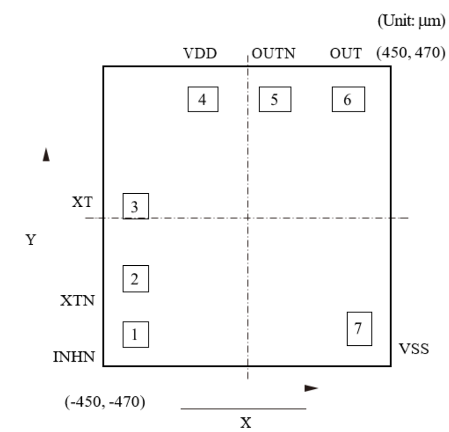
-55°C to 125°C Operation	Recommended Oscillation frequency Range [MHz]	Oscillation Mode	Output Division	Output Frequency Range
VC7051HA1	80 to 180	Fundamental	F_{OSC}	80 to 180
(VC7051HA2)			F_{OSC} / 2	40 to 90
(VC7051HA3)			F_{OSC} / 4	20 to 45
VC7051HB1	180 to 320		F_{OSC}	180 to 320
VC7051HM1	105 to 130	Overtone	F_{OSC}	105 to 130
VC7051HN1	130 to 170		F_{OSC}	130 to 170

See page 6 for ordering IC processed to Mil-PRF-55310 Appendix B table B-I Class “B” or Mil-PRF-38534 Class H / K

TABLE OF CONTENTS

PHYSICAL DIMENSIONS AND PAD LAYOUT

Chip Size	Pad no.	Micron	Mils
Chip length X		900	35.4
Chip length Y		940	37.0
Chip thickness		130	5.1
Pad size	1,2,3	80 x 80	3.15x3.15
	4,5,6	110 x 80	4.33x3.15
	7	80 x 110	3.15x4.33
Chip base = V_{SS}			



PAD COORDINATES AND PIN DESCRIPTION

PAD No.	Name	I/O	Function	PAD coordinates [µm] X	PAD coordinates [µm] Y
1	INHN	I	Output enable input. With pull-up built-in	-350	-370
2	XTN	O	Crystal connection pins. Crystal is connected between XT and XTN.	-350	-194
3	XT	I		-350	34
4	V_{DD}	-	(+) supply voltage	-142	370
5	OUTN	O	LV-PECL output (differential inverted output)	83	370
6	OUT	O	LV-PECL output (differential output)	313	370
7	V_{SS}	-	(-) ground	350	-355

ABSOLUTE MAXIMUM RATINGS

V_{SS}= 0V

Parameter[*1]	Symbol	Condition	Rating	Unit
Supply voltage range [*2]	V_{DD}	Between V_{DD} and V_{SS}	-0.3 to +5.0	V
Input voltage [*1*2]	V_{IN}	(XT, INHN)	-0.3 to V_{DD} +0.3	V
Output voltage range	V_{OUT}	XTN, OUT, OUTN	-0.3 to V_{DD} +0.3	V
Junction temperature	T_J		+175	°C
Storage temperature range[*3]	T_{STG}	Chip form, Wafer form	-55 to +150	°C

[*1] Parameter rating values must never be exceeded even for a moment or this product may suffer breakdown or its reliability degraded.
Operation and characteristics are guaranteed only when the product is operated at recommended operating conditions.
[*2] V_{DD} is a voltage value of recommended operating conditions.
[*3] When stored in nitrogen or vacuum atmosphere and applies to IC itself only (excluding packaging materials).

RECOMMENDED OPERATING CONDITIONS

V_{SS}=0V

Parameter	Symbols	Condition	MIN	MAX	Unit
Operating supply voltage	V_{DD}	Between V_{DD} and V_{SS}[*5]	2.375	3.63	V
Input voltage	V_{IN}	INHN	V_{SS}	V_{DD}	V
Operating temperature	T_{OP}		-55	+125	°C
Output Load	R_L	VDD-2V termination	49.5	50.5	Ω
Oscillator & Output Frequency [*6] (fundamental)	F_{OSC}	VC7051HA1, VC7051HA2, VC7051HA3	80	180	MHz
	F_{OUT}	VC7051HA1 $F_{OSC}/1$	80	180	
		VC7051HA2 $F_{OSC}/2$	40	90	
		VC5051HA3 $F_{OSC}/4$	20	45	
	F_{OSC} & F_{OUT}	VC7501HB1	180	320	
Oscillator & Output Frequency [*6] (3rd overtone)	F_{OSC} & F_{OUT}	VC7051HM1	105	130	
		VC7051HN1	130	170	

*[5] Mount a ceramic chip capacitor ≥ 0.01 μF close to IC (within approximately 3mm) between V_{DD} and V_{SS} for stable operation of VCVC7051H series. The wiring pattern between IC and capacitor should be as wide as possible.

*[6] The Oscillation frequency is a guideline value derived from crystal used for characterization. The oscillator frequency range may be varied by crystal characteristics, design, and mounting conditions, hence the actual oscillator is not limited to these values. The oscillation characteristics of components must be carefully evaluated to confirm stable and proper operation.

The recommended crystal motional values for fundamental mode are R1 < 20Ω and C_0 <2.0pF

The recommended crystal motional values for overtone mode are R1 < 60Ω and $_{C0}$ <2.0pF

TABLE III DC Electrical Characteristics [*1]

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}, Ta = 25°C		-	-	15	mA
HIGH-level output voltage	V_{OH}	Measurement circuit 5 OUT and OUTN	Ta=0°C to +125°C	V_{DD} -1.025	V_{DD} -0.950	V_{DD} - 0.880	V
			Ta=-40°C 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 and OUTN		V_{DD} -1.810	V_{DD} -1.700	V_{DD} - 1.620	V
Output leakage current	I_Z	Measurement circuit 3, INHN = V_{SS}, OUT and OUTN, Ta= 25°C		-5	-	5	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

*1. Refer To Measurement Circuits section for test circuit used in Table III DC Electrical Test

TABLE III AC Electrical Characteristics [*1]

V_{DD}=2.375 to 3.63V, V_{SS} = 0V, T = -55°C 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	80 to 20% output amplitude, measurement circuit 5*2, single-ended output signal	-	0.3	1.0	ns
Output disable propagation delay	t_{OD}	Ta=25°C, measurement circuit 6	-	-	200	ns

*1. Refer To Measurement Circuits section and Timing Diagram for test circuit used in Table III AC Electrical Tests

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

Notes

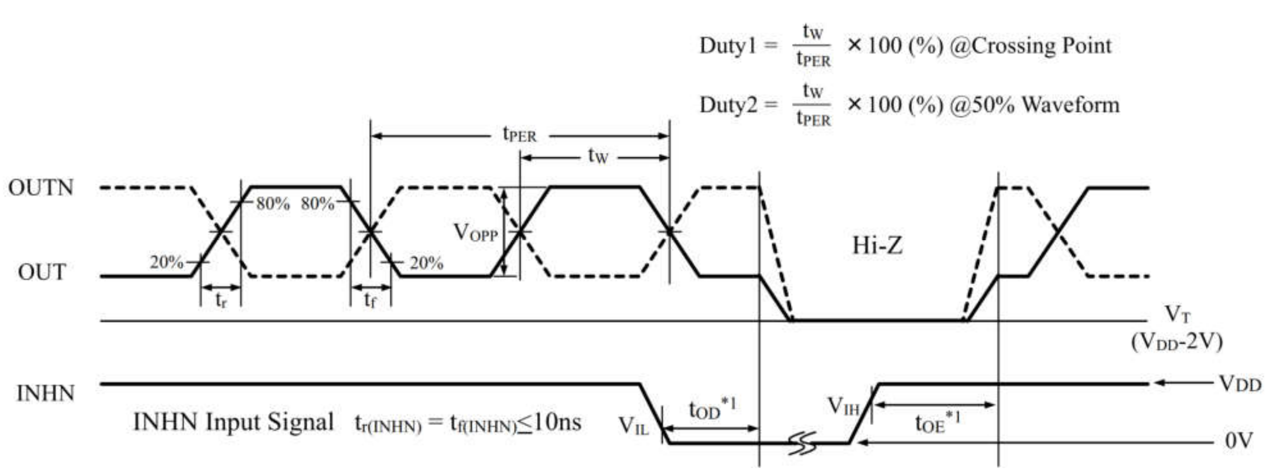
The ratings above are values obtained by measurements using evaluation standard crystal element on a standards testing jig. Ratings may have wide tolerances due to crystal element characteristics; thorough evaluation is recommended.

The recommended crystal motional values for fundamental mode are R1 < 20Ω and C_0 <2.0pF

The recommended crystal motional values for overtone mode are R1 < 60Ω and C_0 <2.0pF

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 (tOD) has elapsed. When this occurs, the output signal is pulled down to VT (termination voltage) by load resistance. On an INHN rising edge, the output starts after the output enable propagation delay (tOE) has elapsed.

FUNCTIONAL DESCRIPTION

INHN Function.

When INHN goes LOW, the oscillator stops and the output pins (OUT, OUTN) become high impedance

INHN	Oscillator	Outputs
HIGH (or open)	Normal Operation	F_{OUT}
LOW	Stopped	High Impedance

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 increases (R_{PU1}), thus reducing the current consumed.

When INHN is left open circuit or tied to High level, the pull-up resistance is smaller (R_{PU2}). In addition to changing INHN state to High, the lower pull-up resistance increases immunity from noise, keeping the oscillator in the high /On-state and working properly.

Oscillation Detection Function

The VC7051H series incorporates an oscillation detection circuit which disables OUT / OUTN until the oscillator circuit starts. This prevents unstable oscillation and other problems which otherwise may occur when power is applied or the oscillator is restarted using INHN.

PACKING

IC are shipped as bare die / chip form and packed in 2” square waffle packs 400 chips per tray, nitrogen-purged and vacuum sealed, and labeled with:

Manufacturer
Part number
Lot code
Wafer number [when class K]
Quantity

Devices processed to Mil-PRF-55310 Appendix B table B-I Class “B” or Mil-PRF=38534 Class H and K include qualification reports. Class K include SEM report when ordered. Variables Data may be specified. Certificate of Conformance / compliance is included with each order and shipment.

ORDERING GUIDE

F_{OUT} range	Standard	Level B	Class H	Class K
80 to 180 MHz, $F_{OUT} = F_{OSC}$	VC7051HA1	VC7051HA1B	VC7051HA1H	VC7051HA1K
40 to 90 MHz, $F_{OUT} = F_{OSC}/2$	[VC7051HA2]	[VC7051HA2B]	[VC7051HA2H]	[VC7051HA2K]
20 to 45 MHz, $F_{OUT} = F_{OSC}/4$	[VC7051HA3]	[VC7051HA3B]	[VC7051HA3H]	[VC7051HA3K]
180 to 320 MHz, $F_{OUT} = F_{OSC}$	VC7051HB1	VC7051HB1B	VC7051HB1H	VC7051HB1K
105 to 130 MHz, $F_{OUT} = F_{OSC}/16$	VC7051HM1	VC7051HM1B	VC7051HM1H	VC7051HM1K
130 to 170 MHz, $F_{OUT} = F_{OSC}$	VC7051HN1	VC7051HN1B	VC7051HN1H	VC7051HN1K

Please contact sales for current ordering information (price, delivery, order quantities)
Email: sales@vcamerica.com Phone: 702-597-2495

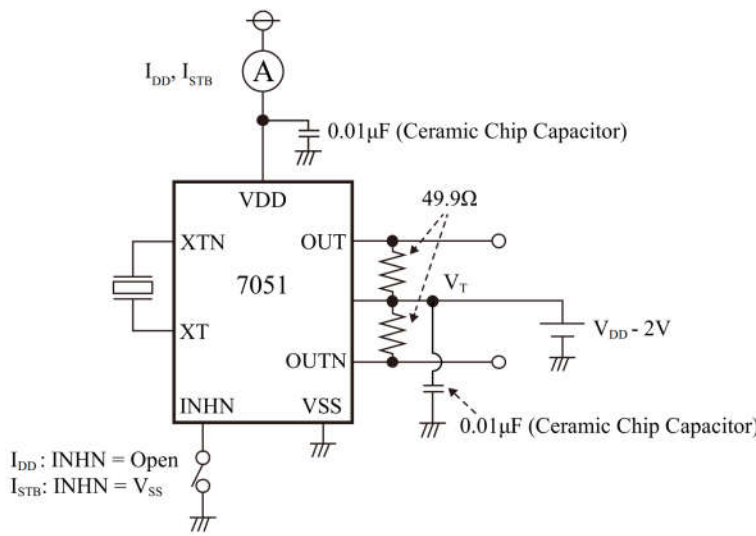
MEASUREMENT CIRCUITS

Note

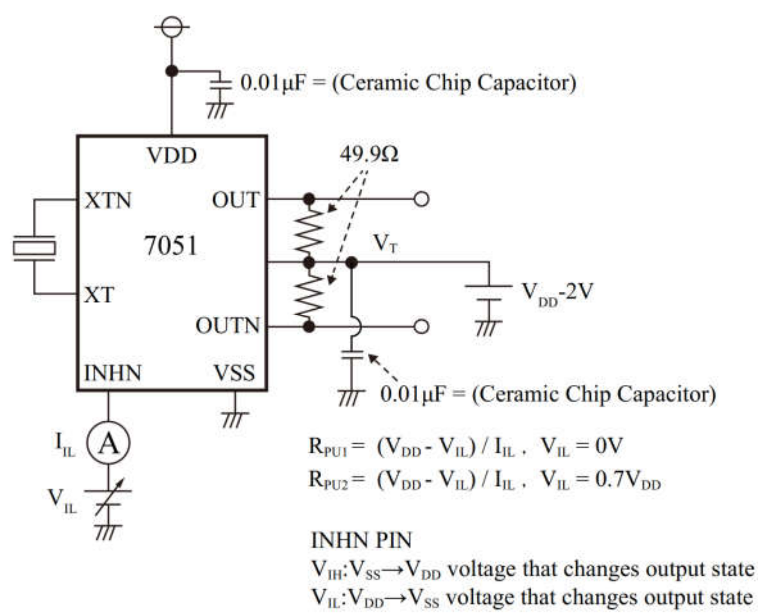
1) Connect bypass capacitors specified in the measurement circuits between V_{DD} to V_{SS} and V_T to VSS
2) Connect load resistors specified in the measurement circuits to OUT and OUTN outputs
3) The wiring pattern for bypass capacitors and load resistors are required to be kept as short as possible and <3mm length). Capacitor traces should be as wide as possible. If wiring is too long, the expected AC characteristics cannot be obtained.
4) If bypass capacitor and resistors other than recommended are used or components not connected properly, the expected characteristics may not be obtained.

Recommended capacitor and resistors
Capacitors: 0.01µF GRM188B11H103K (Murata Mfg. Co.)
Resistors: 49.9Ω RN732ATTD49R9B25 (KOA Corp)

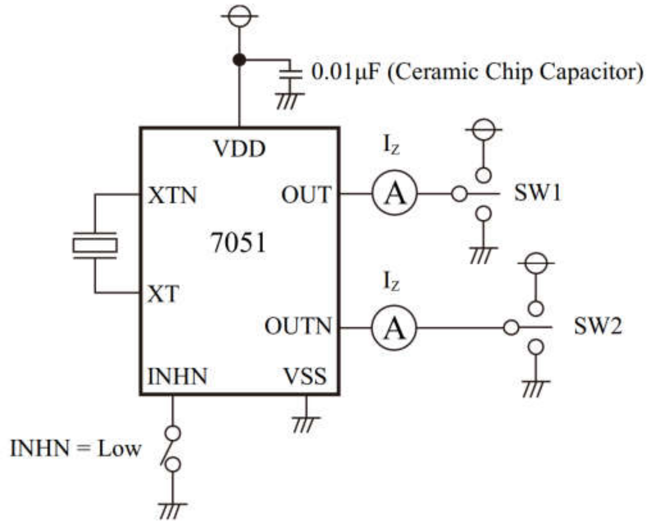
Measurement circuit 1
Measurement Parameter. I_{DD}, I_{STB}



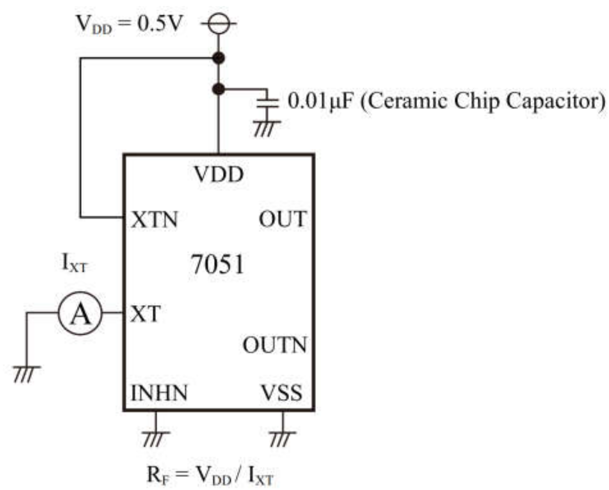
Measurement circuit 2
Measurement Parameter.
V_{IH} ,V_{ILH} ,R_{PU1} ,R_{PU2}



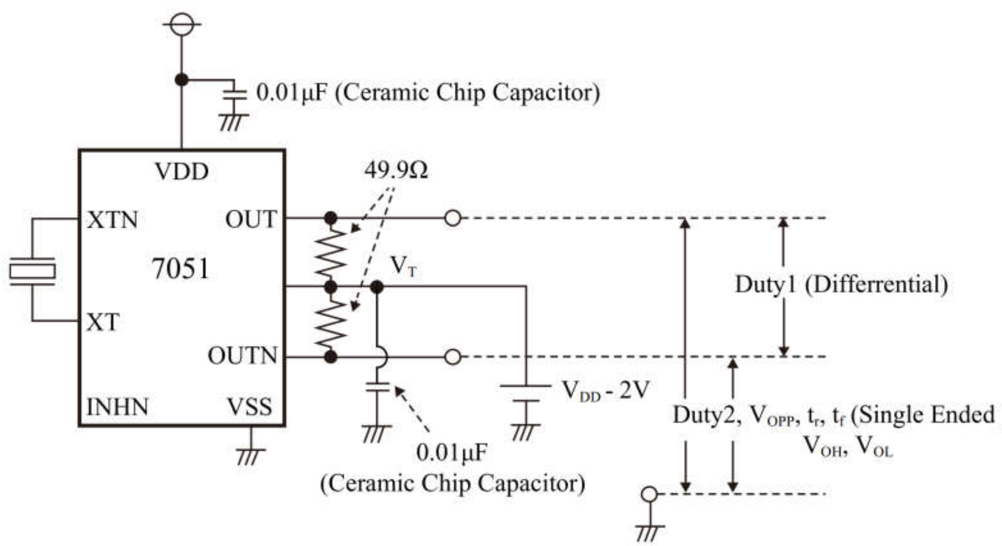
Measurement circuit 3
Measurement Parameter. I_Z



Measurement circuit 4
Measurement Parameter. R_F

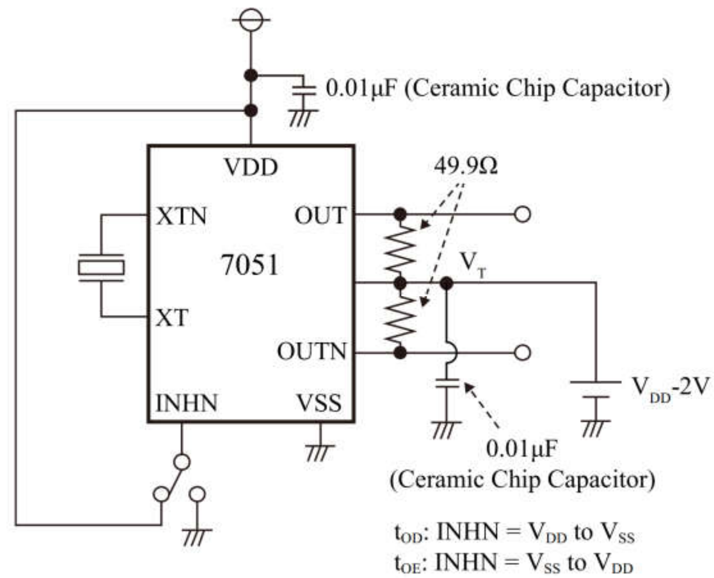


Measurement circuit 5
Measurement Parameter. Duty1, Duty2, V_{OPP}, t_r, t_f, V_{OH},V_{OL}



Measurement circuit 6

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



DESIGN VALUES

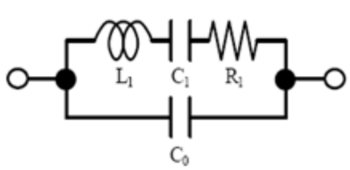
The following design values are monitored by measuring test pattern on wafer, (not the IC).

Parameter	Sym-bol	Conditions	MIN	TYP	MAX	Unit
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	

DATA REFERENCE CHARACTERIZATION (VC7051Hxx Typical Characteristics)

The characteristics measured use our standards jig and standard crystal elements and do not represent a guarantee of device characteristics. Characteristics vary due to measurement environment and the oscillator element, package, and mounting conditions. Designers must evaluate their designs and manufacturing process to confirm proper operation and adequate design margins

Crystals used for measurement

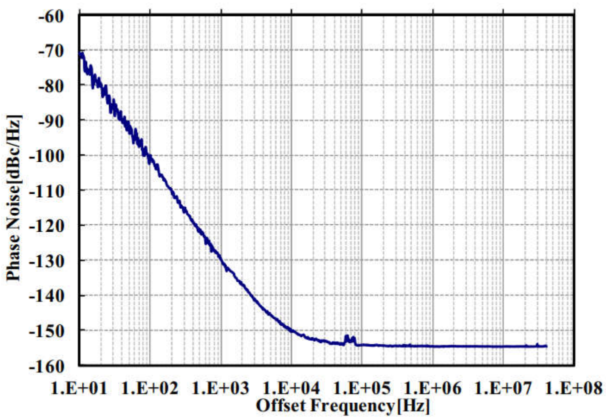


Parameter	A1, A2, A3	B1	M1	N1
F_0 *1 (MHz)	155.52	245.76	125	155.52
C0(pF)	1.7	1.4	2.3	2.4
R1(Ω)	12	17	32	39

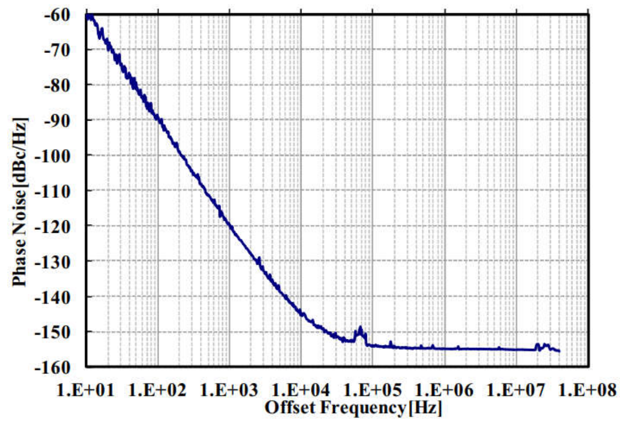
VC7051H CHARACTERISTIC CURVES

PHASE NOISE

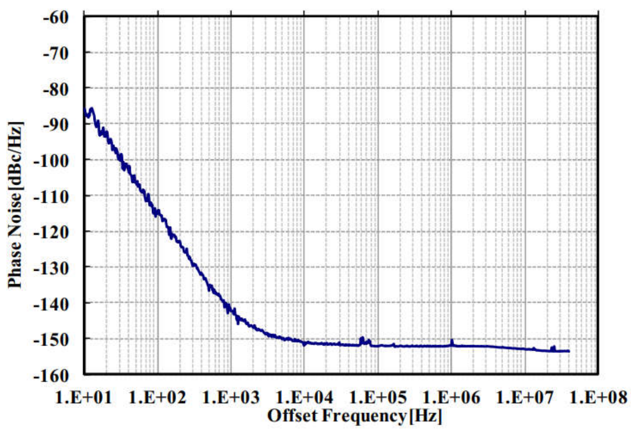
Measurement equipment: Signal Source Analyzer Agilent E5052B



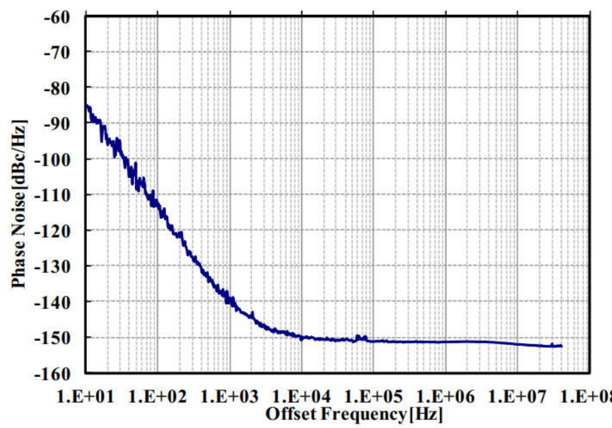
7051A1 f_0 = 155.52MHz, Ta = R.T. (Room Temperature)



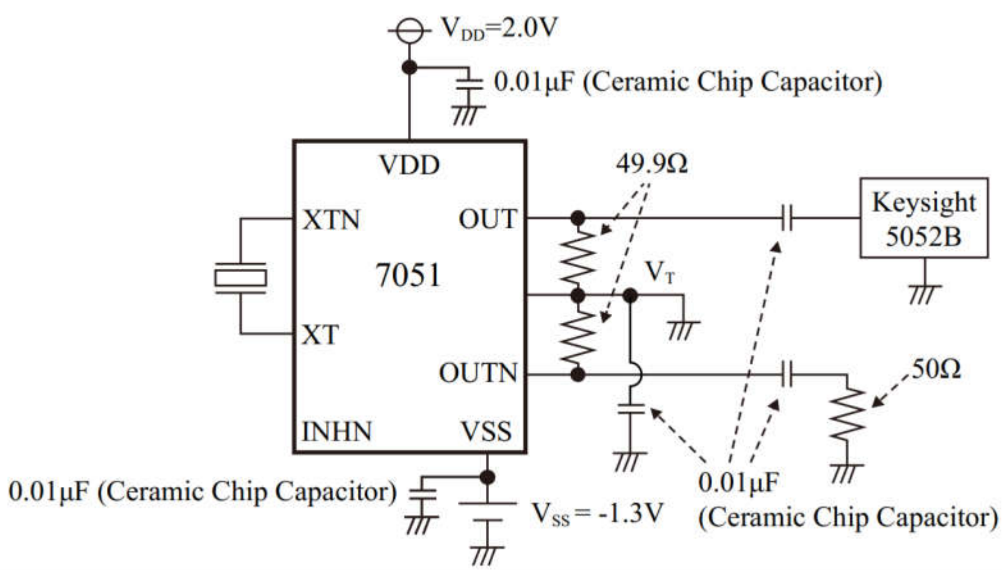
7051B1 f_0 = 245.76MHz, Ta = R.T.



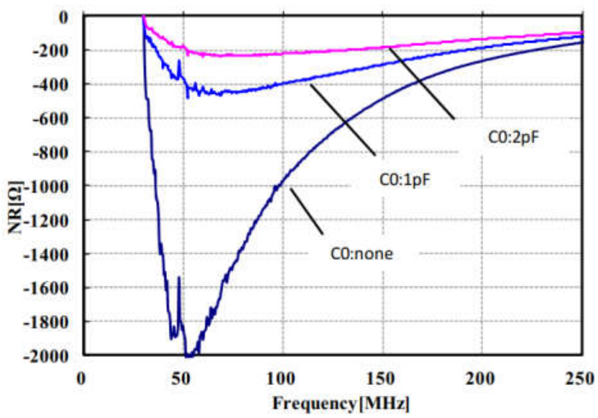
7051M1 f_0 = 125MHz, Ta = R.T.



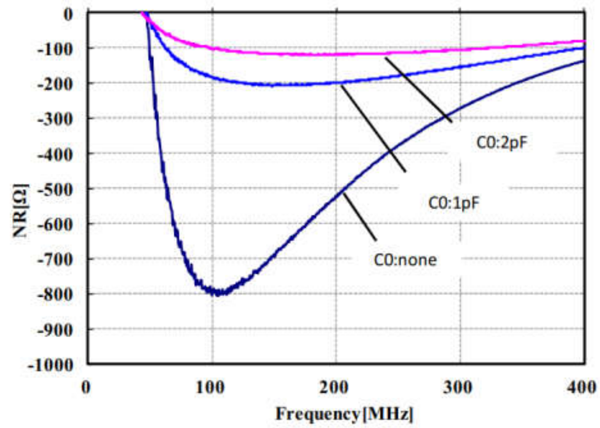
7051N1 f_0 = 155.52MHz, Ta = R.T.



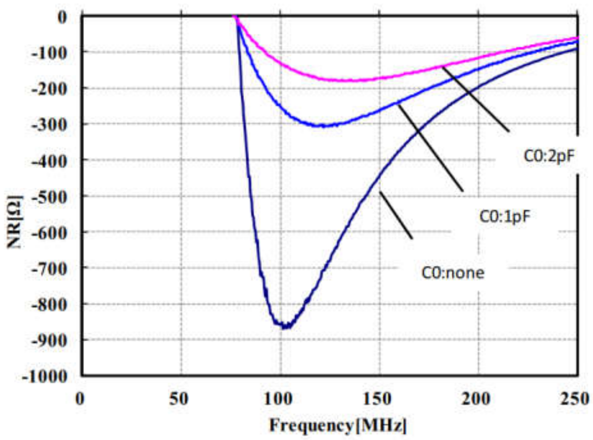
NEGATIVE RESISTANCE



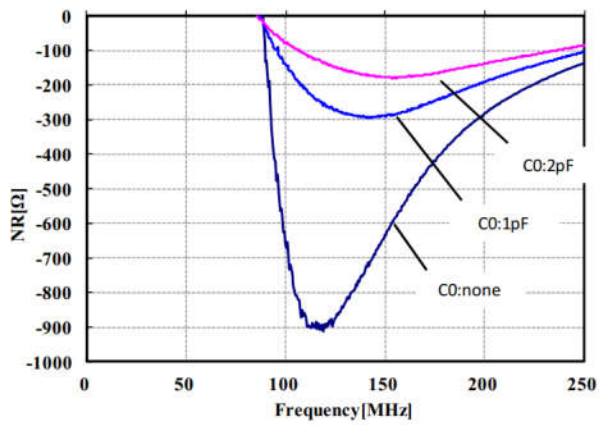
7051A1 $V_{DD}=3.3V$, Ta = 25°C



7051B1 $V_{DD}=3.3V$, Ta = 25°C



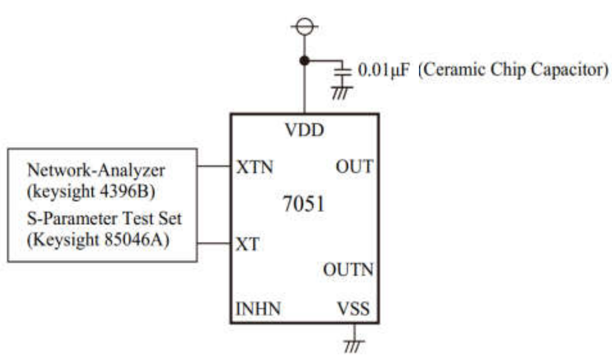
7051M1 $V_{DD}=3.3V$, Ta=25°C



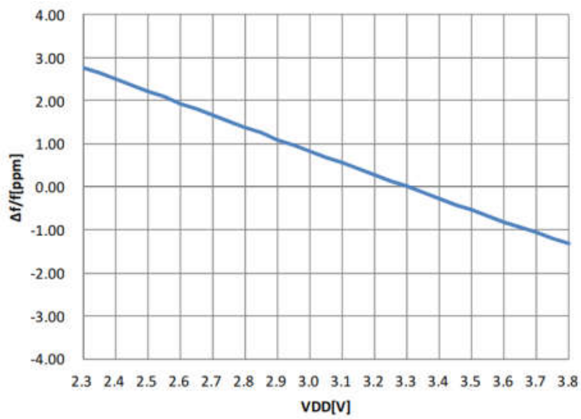
7051N1 $V_{DD}=3.3V$, Ta=25°C

Measurement equipment : Agilent Impedance analyzer 4396B and S-Parameter Test Set 85046A

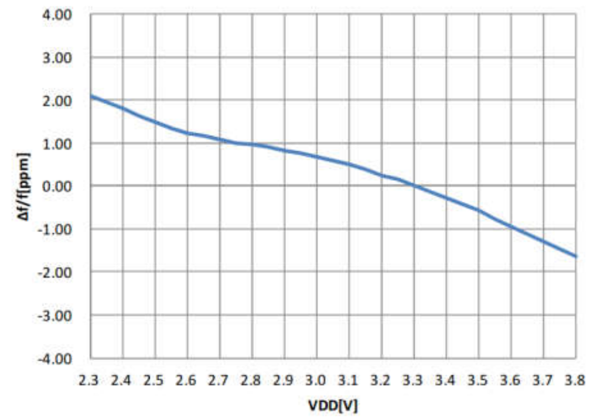
The figures show the negative resistance measurements for crystal equivalent circuit C0 capacitance as connected between the XT and XTN pins. Tests were conducted using Agilent 4396B using factory test fixture, Results will vary based on measurement environment and fixtures used. .



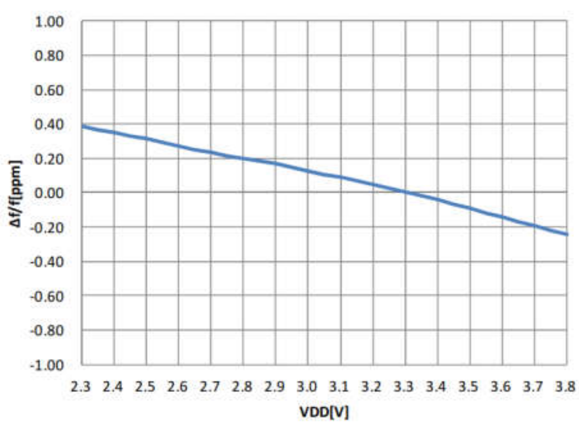
FREQUENCY DEVIATION BY VOLTAGE



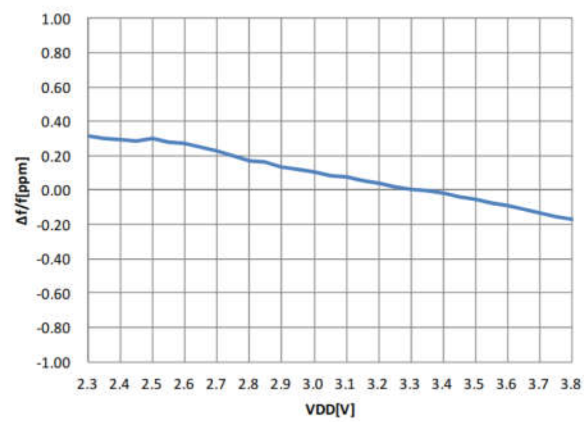
7051A1 $f_0 = 155.52MHz$, Ta=25°C



7051B1 $f_0 = 245.76MHz$, Ta=25°C

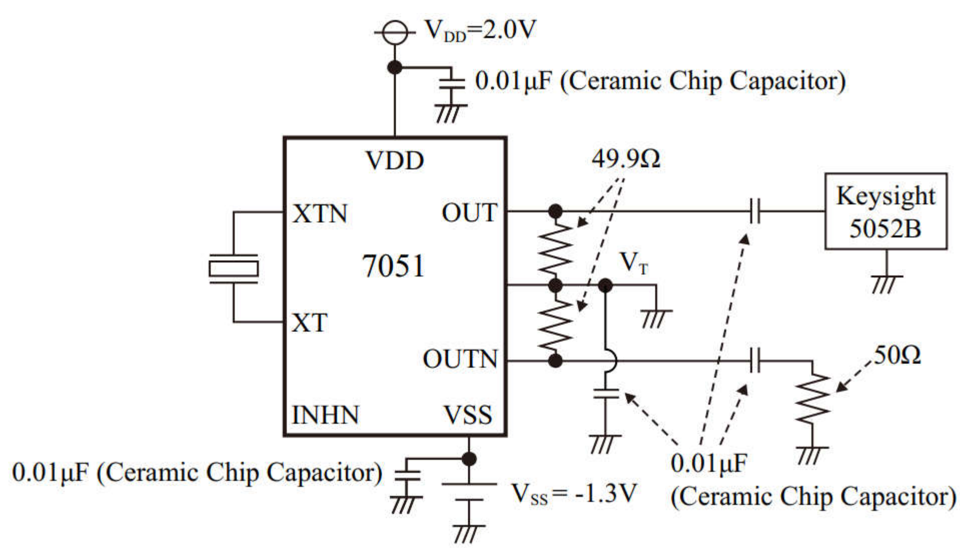


7051M1 $f_0 = 125MHz$, Ta=25°C

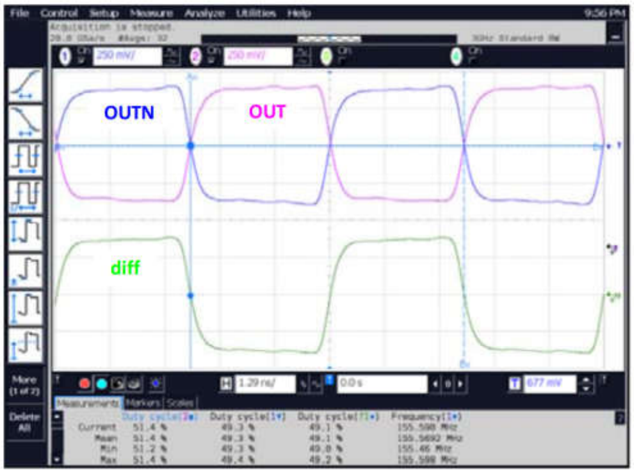


7051N1 $f_0 = 155.52MHz$, Ta=25°C

Measurement Circuit Diagram

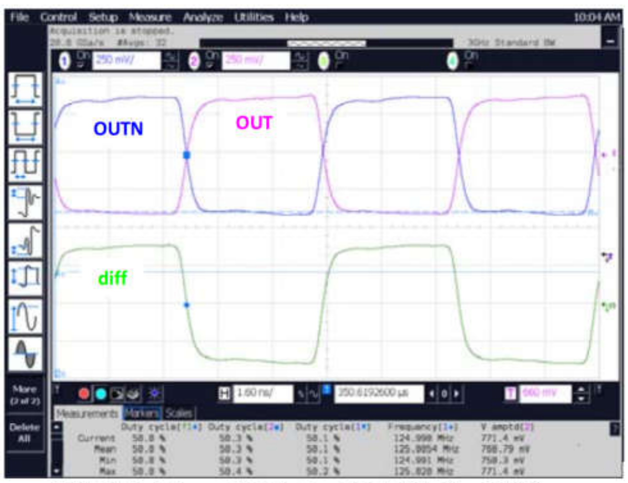


OUTPUT WAVEFORM

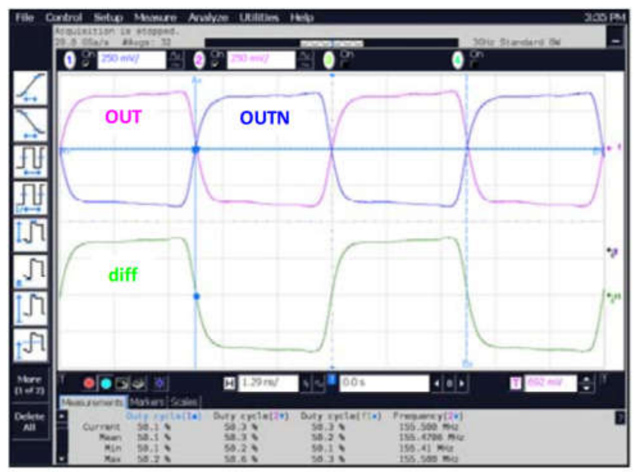


7051A1 $V_{DD}=3.3V$, $f_0=155.52MHz$, Ta=25°C

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 equipment: Oscilloscope Agilent DSO80604B

NOTICES

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