NPC

CF5074B

VCXO Module IC with Built-in Varicap

OVERVIEW

The CF5074B is VCXO module IC with built-in varicap diodes. The integrated varicap diode BiCMOS process allows the device to be fabricated on a single chip. A newly developed oscillator circuit features reduced drive level of crystal and wide pullrange. A VCXO module can be constructed with just the connection of a crystal unit, making the devices ideal as surface-mounted, compact VCXO modules.

FEATURES

- 2.25 to 3.6V operating supply voltage range
- 50MHz to 80MHz operating frequency range
- Varicap diode built-in
- Oscillation start-up detector function
- CMOS output duty level
- 4mA (min) output drive capability
- 15pF output load
- Standby function
  - High impedance in standby mode
- BiCMOS process
- Chip form (CF5074B)

APPLICATIONS

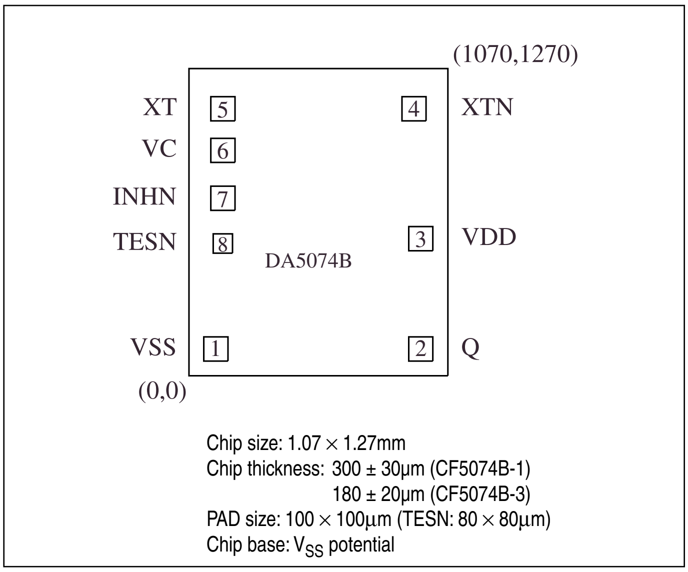
- VCXO modules

ORDERING INFORMATION

Device	Package
CF5074B–1	Chip form
CF5074B–3	

PAD LAYOUT

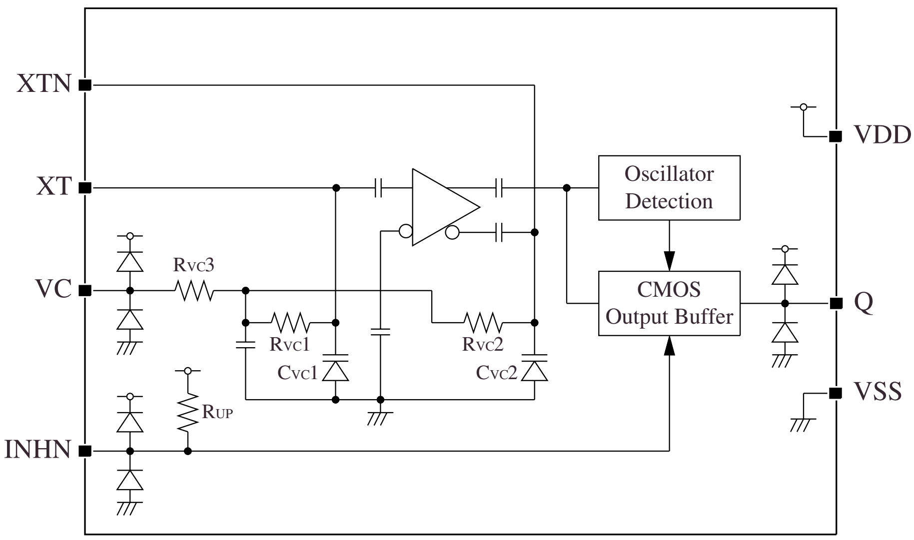
(Unit: µm)



PAD DESCRIPTION AND DIMENSIONS

Pad No.	Name	I/O	Description	Pad dimensions [µm]	
				X	Y
1	VSS	–	(–) supply pin	111	111
2	Q	O	Output pin. High-impedance in standby mode	958	111
3	VDD	–	(+) supply pin	958	567
4	XTN	O	Oscillator output. Crystal connection pin	930	1104
5	XT	I	Oscillator input. Crystal connection pin	140	1104
6	VC	I	Oscillation frequency control voltage input pin. Positive polarity (frequency increases with increasing voltage)	140	932
7	INHN	I	Output state control voltage input pin. Standby mode when LOW. Power-saving pull-up resistor built-in	140	734
8	TESN	I	Test pin (leave open)	140	547

BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

V_{SS} = 0V unless otherwise noted.

Parameter	Symbol	Rating	Unit
Supply voltage range	V_{DD}	–0.5 to 7.0	V
Input voltage range	V_{IN}	–0.5 to V_{DD} + 0.5	V
Output voltage range	V_{OUT}	–0.5 to V_{DD} + 0.5	V
Storage temperature range	T_{STG}	–65 to +150	°C
Output current	I_{OUT}	20	mA

RECOMMENDED OPERATING CONDITIONS

V_{SS} = 0V unless otherwise noted.

Parameter	Symbol	Rating			Unit
		Min	Typ	Max	
Operating supply voltage	V_{DD}	2.25	–	3.6	V
Output frequency	f_{OUT}	50	–	80	MHz
Output load capacitance	C_L	–	–	15	pF
Input voltage	V_{IN}	V_{SS}	–	V_{DD}	V
Operating temperature	T_{OPR}	–40	+25	+85	°C

ELECTRICAL CHARACTERISTICS

V_{DD} = 2.25 to 3.6V, V_C = 0.5V_{DD}, V_{SS} = 0V, Ta = –40 to +85°C unless otherwise noted.

Parameter	Symbol	Conditions		Rating			Unit
				Min	Typ	Max	
Current consumption	I_{DD}	Measurement circuit 2, load circuit 1, INHN = open, C_L = 15pF, f = 80MHz	V_{DD} = 2.25 to 2.75V	–	20	30	mA
			V_{DD} = 3.0 to 3.6V	–	26	36	mA
HIGH-level output voltage	V_{OH}	Q: Measurement circuit 1, I_{OH} = –4mA		V_{DD} – 0.4	V_{DD} – 0.2	–	V
LOW-level output voltage	V_{OL}	Q: Measurement circuit 1, I_{OL} = 4mA		–	0.2	0.4	V
Output leakage current	I_Z	Q: Measurement circuit 6, INHN = LOW	V_{OH} = V_{DD}	–	–	10	μA
			V_{OL} = V_{SS}	–	–	10	μA
HIGH-level input voltage	V_{IH}	INHN		0.7V_{DD}	–	–	V
LOW-level input voltage	V_{IL}	INHN		–	–	0.3V_{DD}	V
INHN pull-up resistance	R_{UP1}	Measurement circuit 3	INHN = V_{SS}	0.4	0.8	1.2	MΩ
	R_{UP2}		INHN = 0.7V_{DD}	15	–	150	kΩ
Oscillator block built-in resistance	R_{VC1}	Measurement circuit 4		75	150	225	kΩ
	R_{VC2}			75	150	225	kΩ
	R_{VC3}			10	30	90	kΩ
Oscillator block built-in capacitance	C_{VC}	Capacitance of C_{VC1} and C_{VC2}	V_C = 0.3V	13	16.3	19.6	pF
			V_C = 1.65V	6.7	8.9	10.9	pF
			V_C = 3.0V	3.3	4.7	6.1	pF
VC input resistance	R_{VIN}	Measurement circuit 7, Ta = 25°C		10	–	–	MΩ
VC input impedance	Z_{VIN}	Measurement circuit 8, V_C = 0V, f = 10kHz, Ta = 25°C		–	250	–	kΩ
VC input capacitance	C_{VIN}	Measurement circuit 8, V_C = 0V, f = 10kHz, Ta = 25°C		–	60	–	pF
Modulation bandwidth	fm	Measurement circuit 9, –3dB frequency, V_{DD} = 3.3V, V_C = 3.3Vp-p, Ta = 25°C, crystal: f = 80MHz, C0 = 4.8pF, $\gamma \leq 440$		–	30	–	kHz

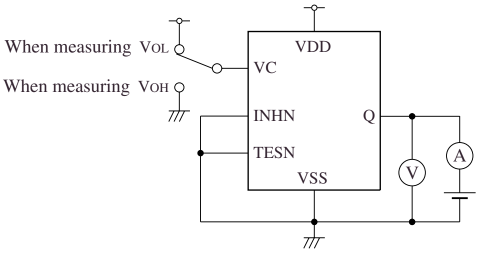
SWITCHING CHARACTERISTICS

V_{DD} = 2.25 to 3.6V, V_C = 0.5V_{DD}, V_{SS} = 0V, Ta = –40 to +85°C unless otherwise noted.

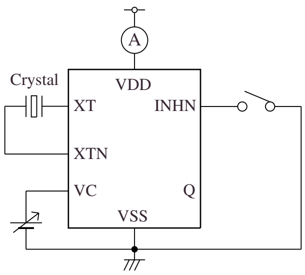
Parameter	Symbol	Conditions		Rating			Unit
				Min	Typ	Max	
Output rise time	t_{r1}	Measurement circuit 2, load circuit 1, 0.2V_{DD} → 0.8V_{DD}, Ta = 25°C, C_L = 15pF		–	2.5	4	ns
Output fall time	t_{f1}	Measurement circuit 2, load circuit 1, 0.8V_{DD} → 0.2V_{DD}, Ta = 25°C, C_L = 15pF		–	2.5	4	ns
Output duty cycle	Duty	Measurement circuit 2, load circuit 1, Ta = 25°C, C_L = 15pF	V_{DD} = 2.5V	40	50	60	%
			V_{DD} = 3.3V	45	50	55	%
Output disable delay time	t_{PLZ}	Measurement circuit 5, load circuit 1, Ta = 25°C, $C_L \leq$ 15pF		–	–	100	ns
Output enable delay time	t_{PZL}			–	–	100	ns

MEASUREMENT CIRCUITS

Measurement Circuit 1

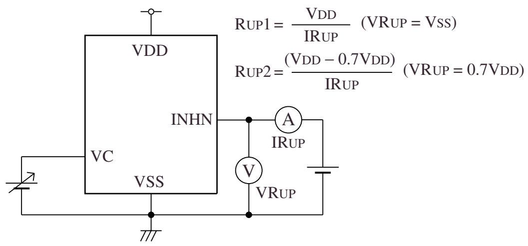


Measurement Circuit 2



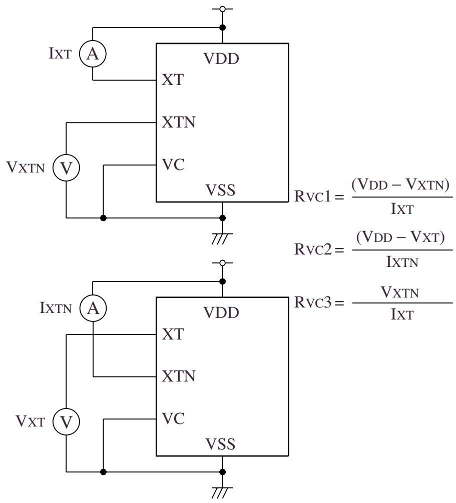
$V_C = 0.5V_{DD}$, INHN = open, crystal oscillation

Measurement Circuit 3

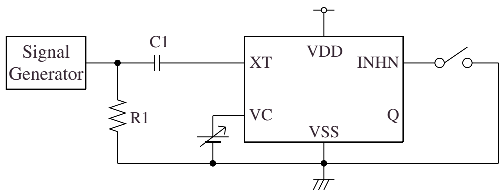


$V_C = 0.5V_{DD}$

Measurement Circuit 4

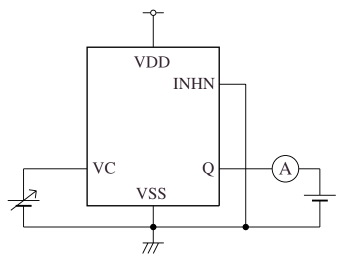


Measurement Circuit 5



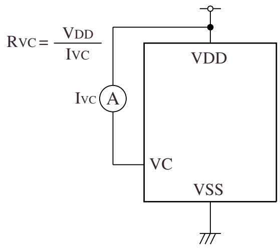
XT input signal: 10MHz, 1.0Vp-p
C1 = 0.001μF, R1 = 50Ω, $V_C = 0.5V_{DD}$

Measurement Circuit 6

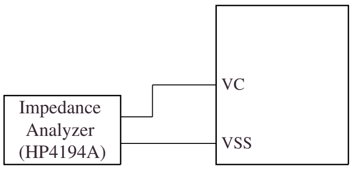


$V_C = 1/2V_{DD}$

Measurement Circuit 7

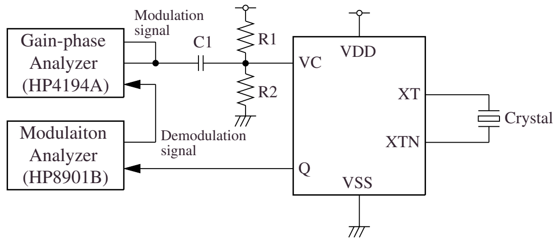


Measurement Circuit 8



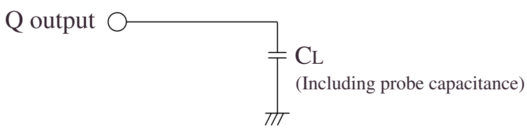
VC input signal: 100Hz to 10kHz, 0.1Vp-p, V_C = 0V

Measurement Circuit 9



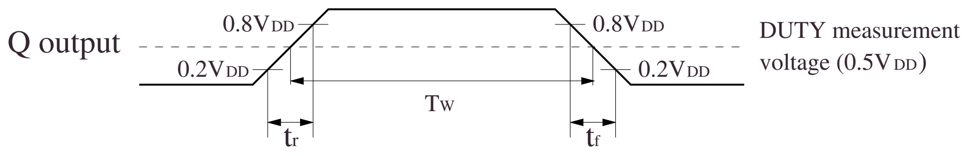
C1 = 20μF, R1 = R2 = 100MΩ, V_{DD} = 3.3V
VC modulation signal: 100Hz to 100kHz, 3.3Vp-p

Load Circuit 1

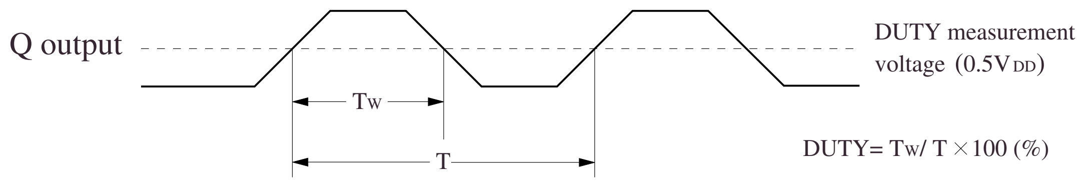


Switching Time Measurement Waveform

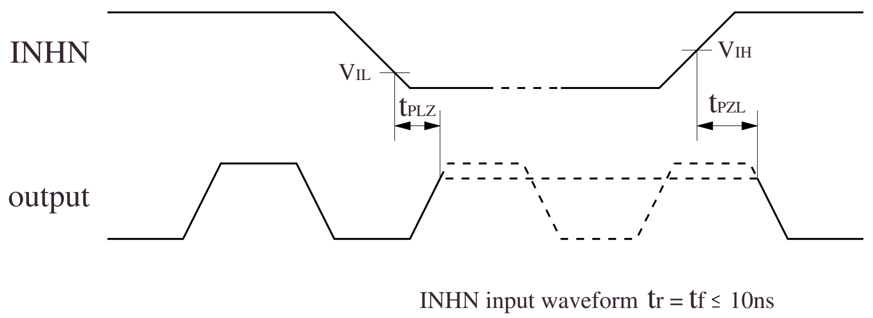
Output duty level, t_r, t_f



Output duty cycle



Output Enable/Disable Delay Times



FUNCTIONAL DESCRIPTION

Standby Function

When INHN goes LOW, the device is in standby mode. The Q output becomes high impedance and the oscillator circuit continues running.

INHN	Q	Oscillator
HIGH (or open)	f_O	Operating
LOW	High impedance	Operating

Power-saving Pull-up Resistor

The INHN pin pull-up resistance changes in response to the input level (HIGH or LOW). When INHN is tied LOW, the pull-up resistance becomes large, reducing the current consumed by the resistance. When INHN is left open, the pull-up resistance becomes small, such that even if the input is affected by external noise the outputs are stable due to INHN being tied HIGH by the pull-up resistor.

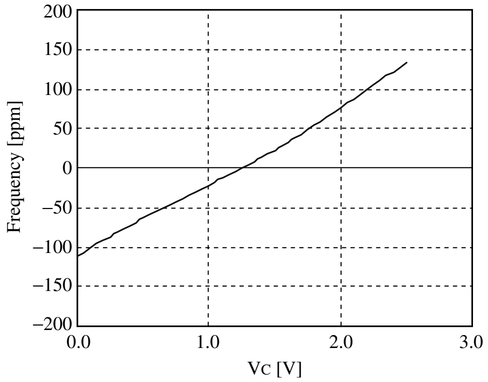
Oscillation Start-up Detector Function

The devices also feature an oscillation start-up detector circuit. This circuit functions to disable the outputs until the oscillation starts. This prevents unstable oscillator output at oscillator start-up when power is applied.

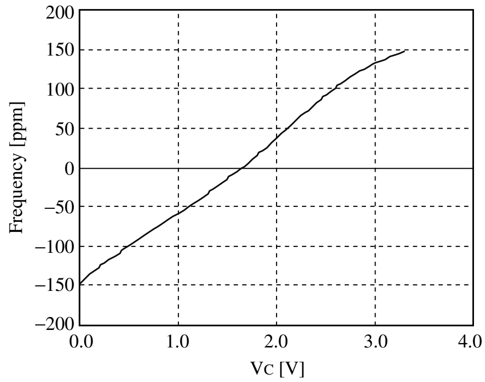
TYPICAL CHARACTERISTICS

The following characteristics measured using the crystal for NPC characteristics authentication. Note that the characteristics will vary with the crystal used.

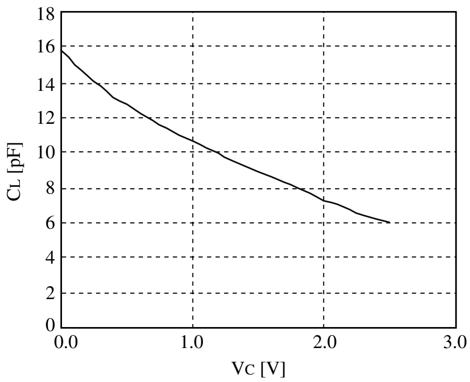
Frequency Pullrange, Oscillator Equivalent Capacitance (C_L) Characteristics



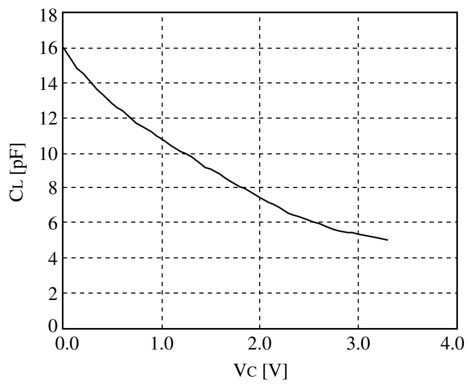
V_{DD} = 2.5V (V_C = 1.25V reference)



V_{DD} = 3.3V (V_C = 1.65V reference)

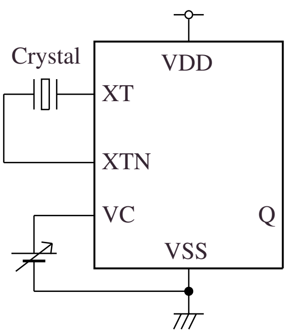


V_{DD} = 2.5V



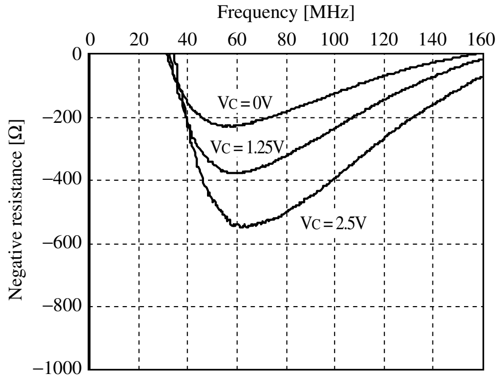
V_{DD} = 3.3V

Measurement circuit

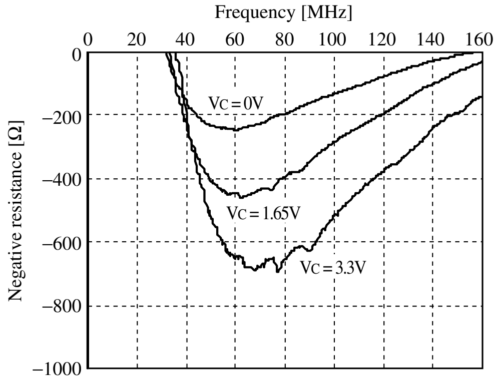


Crystal: f = 80MHz, C0 = 4.8pF, γ = 440
C_L: Oscillator equivalent capacitance is determined by the oscillator frequency.

Negative Resistance Characteristics

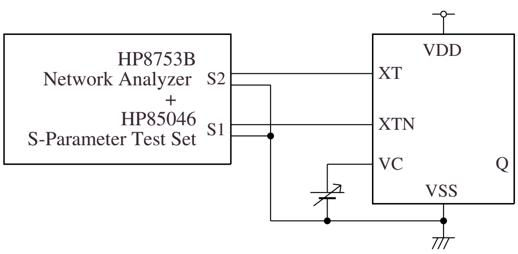


V_{DD} = 2.5V

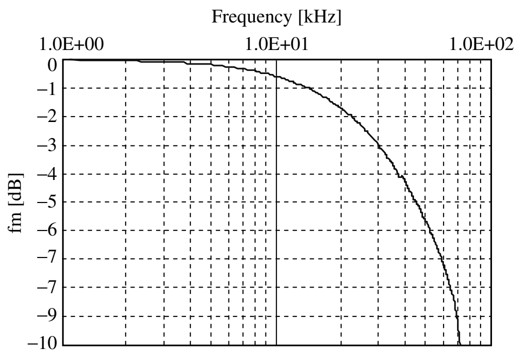


V_{DD} = 3.3V

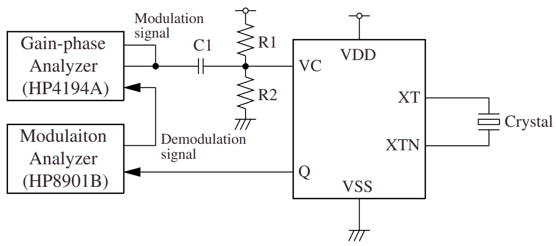
Measurement circuit



Modulation Characteristics



Measurement circuit

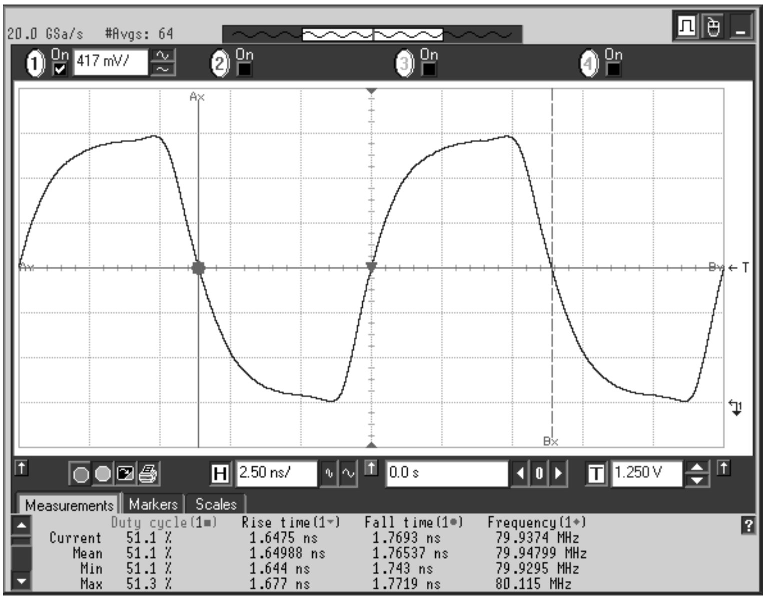


C1 = 20μF, R1 = R2 = 100MΩ, V_{DD} = 3.3V
VC modulation signal: 100Hz to 100kHz, 3.3Vp-p

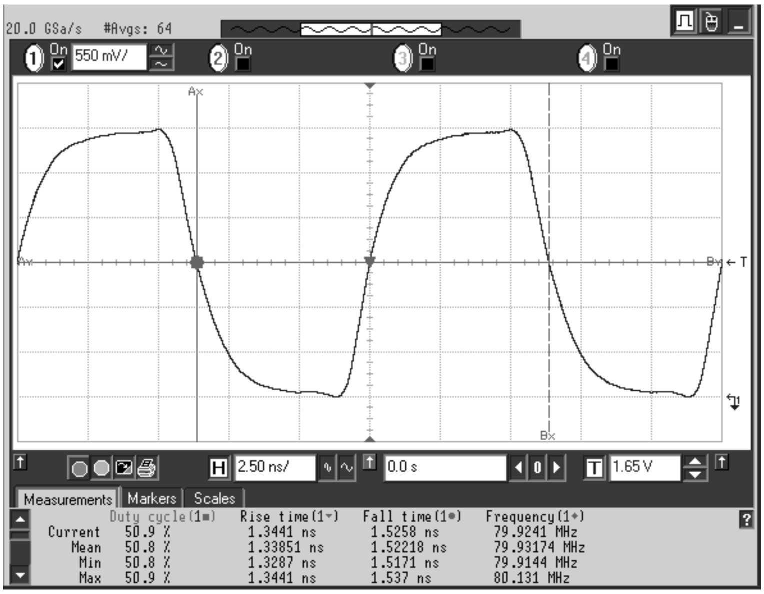
Output Waveform

Measurement equipment

- Oscilloscope: 54855A (Agilent)

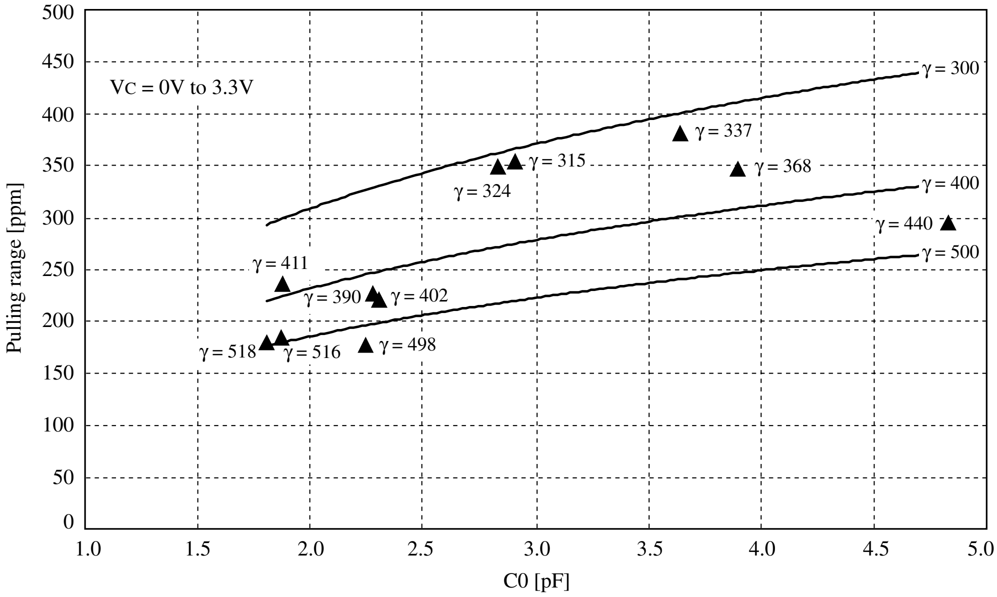


V_{DD} = 2.5V, 15pF load, V_C = 1.25V



V_{DD} = 3.3V, 15pF load, V_C = 1.65V

Relation Between Pulling Range and Constants for Crystal Units

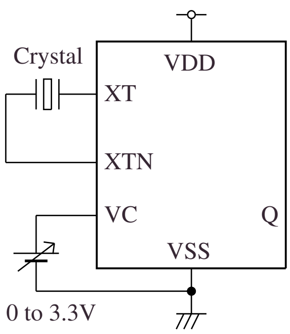


Measurement data when crystal is changed.

	A	B	C	D	E	F	G	H	I	J	L
C0 [pF]	4.8	3.6	1.8	1.9	2.2	1.9	2.3	3.9	2.9	2.8	2.3
γ	440	337	518	411	498	516	402	368	315	324	390
Pulling range[1] [ppm]	295	381	179	235	177	184	220	346	354	349	227

1. Pulling range: Value of changes in VC voltage from 0V to 3.3V.

Measurement circuit



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