NIPPON PRECISION CIRCUITS INC.

SM5005A series

Crystal Oscillator Module ICs

OVERVIEW

The SM5005A series are crystal oscillator module ICs, that incorporate high-frequency, low current consumption oscillator and output buffer circuits. Highly accurate thin-film feedback resistors and high-frequency capacitors are built-in, eliminating the need for external components to make a stable 3rd-harmonic oscillator.

FEATURES

- High-frequency operation
- 3rd-harmonic oscillation
- Capacitors C_G , C_D built-in
- Standby function (oscillator stops)
- Power-save pull-up resistor built-in
- Inverter amplifier feedback resistor built-in
- CMOS input level
- 8 mA (V_{DD} = 2.7 V) drive capability
- CMOS output duty level
- Output three-state function
- 2.25 to 3.6 V supply voltage
- Oscillator frequency output
- 8-pin VSOP (SM5005A××V)
- Chip form (CF5005A××)

SERIES CONFIGURATION

Version[1]	Recommended operating frequency [MHz]		gm ratio	Output duty level	Output current [mA]	Built-in capacitance [pF]		R_f [kΩ]
	V_{DD} = 2.25 to 2.75 V	V_{DD} = 2.7 to 3.6 V				C_G	C_D	
SM5005ALAV	60 to 70	70 to 100	1.0	CMOS	8	8	10	2.2
SM5005ALBV	–	90 to 110	1.5	CMOS	8	6	6	3.3
SM5005ALCV[2]	–	107 to 125	1.5	CMOS	8	3	3	3.3
CF5005ALD[3]	45 to 60	60 to 80	1.0	CMOS	8	8	10	3.5
CF5005ALE[3]	30 to 45	40 to 60	1.0	CMOS	8	8	15	5.6

1. Chip form devices have designation CF5005A××
2. Based on Preliminary Constants Data from Crystal MFG.
3. Chip form only.

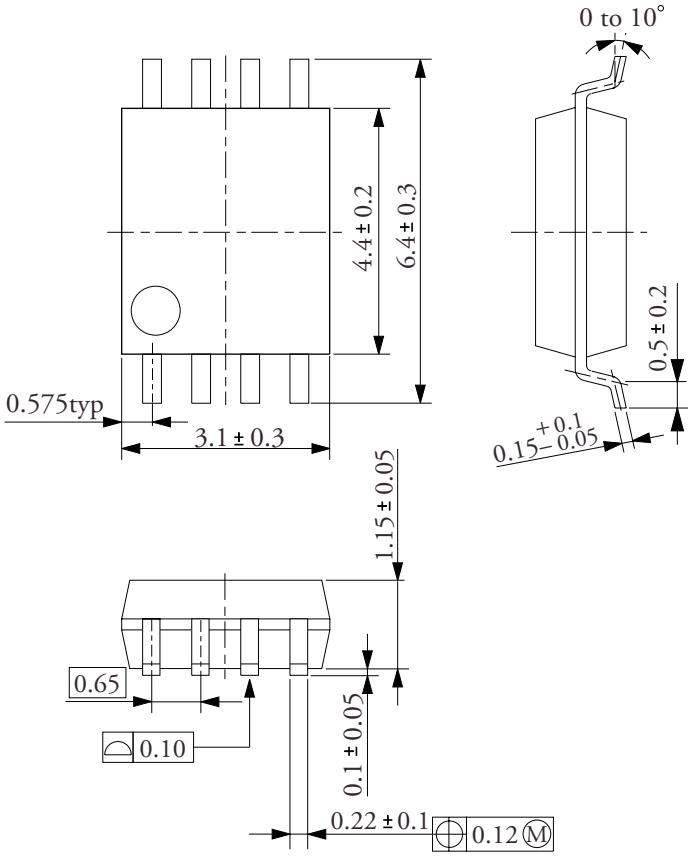
ORDERING INFORMATION

Device	Package
SM5005A××V	8-pin VSOP
CF5005A×× –1	Chip form

PACKAGE DIMENSIONS

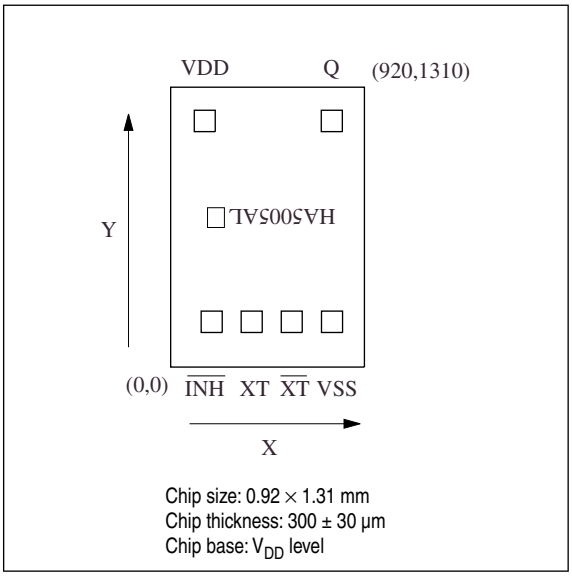
(Unit:mm)

• 8-pin VSOP



PAD LAYOUT

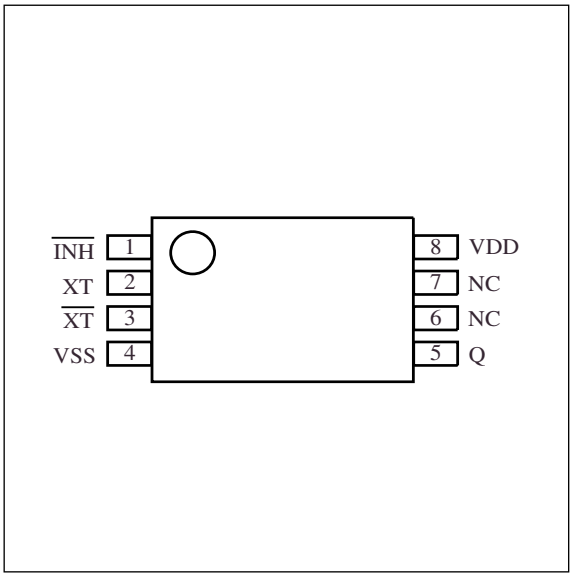
(Unit:µm)



Chip size: 0.92 × 1.31 mm
Chip thickness: 300 ± 30 µm
Chip base: V_{DD} level

PINOUT

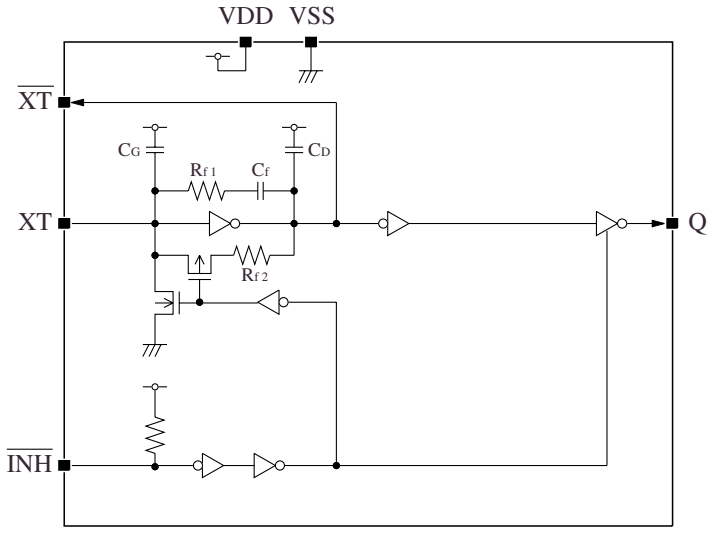
(Top View)



PIN DESCRIPTION and PAD DIMENSIONS

Number	Name	I/O	Description		Pad dimensions [µm]	
					X	Y
1	$\overline{INH}$	I	Output state control input. Oscillator stopped when LOW. Power-saving pull-up resistor built in		195	212
2	XT	I	Amplifier input.	Crystal oscillator connection pins. Crystal oscillator connected between XT and $\overline{XT}$	385	212
3	$\overline{XT}$	O	Amplifier output.		575	212
4	VSS	–	Ground		766	212
5	Q	O	Output. Output frequency (f_O)		765	1152
6	NC	–	No connection		–	–
7	NC	–	No connection		–	–
8	VDD	–	Supply voltage		162	1152

BLOCK DIAGRAM



SPECIFICATIONS

Absolute Maximum Ratings

V_{SS} = 0 V

Parameter	Symbol	Condition	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
Operating temperature range	T_{opr}		–40 to 85	°C
Storage temperature range	T_{stg}	Chip form	–65 to 150	°C
		8-pin VSOP	–40 to 125	
Output current	I_{OUT}		25	mA
Power dissipation	P_D	8-pin VSOP	300	mW

Recommended Operating Conditions

CF5005AL×

V_{SS} = 0 V, f ≤ 125MHz unless otherwise noted.

Parameter	Symbol	Condition	Rating			Unit
			min	typ	max	
Supply voltage	V_{DD}	C_L ≤ 15pF	2.7	–	3.6	V
		C_L ≤ 30pF	3.0	–	3.6	
Input voltage	V_{IN}		V_{SS}	–	V_{DD}	V
Operating temperature	T_{OPR}		–20	–	80	°C

CF5005ALA/CF5005ALD/CF5005ALE

V_{SS} = 0 V, f ≤ 70MHz unless otherwise noted.

Parameter	Symbol	Condition	Rating			Unit
			min	typ	max	
Supply voltage	V_{DD}	C_L ≤ 30pF	2.25	–	2.75	V
Input voltage	V_{IN}		V_{SS}	–	V_{DD}	V
Operating temperature	T_{OPR}		–20	–	80	°C

SM5005AL×V

V_{SS} = 0 V, f ≤ 125MHz unless otherwise noted.

Parameter	Symbol	Condition	Rating			Unit
			min	typ	max	
Supply voltage	V_{DD}	C_L ≤ 15pF	2.7	–	3.6	V
Input voltage	V_{IN}		V_{SS}	–	V_{DD}	V
Operating temperature	T_{OPR}		–20	–	80	°C

Electrical Characteristics

V_{DD} = 2.7 to 3.6 V, V_{SS} = 0 V, Ta = –20 to 80 °C unless otherwise noted.

Parameter	Symbol	Condition			Rating min	Rating typ	Rating max	Unit
HIGH-level output voltage	V_{OH}	Q: Measurement cct 1, V_{DD} = 2.7 V, I_{OH} = 8 mA			2.2	2.4	–	V
LOW-level output voltage	V_{OL}	Q: Measurement cct 2, V_{DD} = 2.7 V, I_{OL} = 8 mA			–	0.3	0.4	V
Output leakage current	I_Z	Q: Measurement cct 2, $\overline{INH}$ = LOW, V_{DD} = 3.6 V		$V_{OH} = V_{DD}$	–	–	10	µA
				$V_{OL} = V_{SS}$	–	–	10	
HIGH-level input voltage	V_{IH}	$\overline{INH}$			$0.7V_{DD}$	–	–	V
LOW-level input voltage	V_{IL}	$\overline{INH}$			–	–	$0.3V_{DD}$	V
Current consumption	I_{DD}	$\overline{INH}$ = open, Measurement cct 3, load cct 1, V_{DD} = 3.0 V to 3.6 V f = 125 MHz	C_L = 30 pF	CF5005AL×	–	40	100	mA
			C_L = 15 pF	SM5005AL×V CF5005AL×	–	25	60	
Standby current	I_{ST}	$\overline{INH}$ = LOW, Measurement cct 3			–	–	10	µA
$\overline{INH}$ pull-up resistance	R_{UP1}	Measurement cct 4, $\overline{INH}$ = LOW			0.4	–	4	MΩ
	R_{UP2}	Measurement cct 4, $\overline{INH}$ = 0.7 V_{DD}			50	–	150	kΩ
AC feedback resistance	R_{f1}	Design value, determined by the internal wafer pattern		SM5005ALAV CF5005ALA	1.76	2.2	2.64	kΩ
				SM5005ALBV CF5005ALB	2.64	3.3	3.96	
				SM5005ALCV CF5005ALC	2.64	3.3	3.96	
				CF5005ALD	2.80	3.5	4.20	
				CF5005ALE	4.48	5.6	6.72	
DC feedback resistance	R_{f2}	Measurement cct 5			50	–	150	kΩ
AC feedback capacitance	C_f	Design value, determined by the internal wafer pattern			9.3	10	10.7	pF
Built-in capacitance	C_G	Design value, determined by the internal wafer pattern		SM5005ALAV CF5005ALA CF5005ALD CF5005ALE	7.44	8	8.56	pF
				SM5005ALBV CF5005ALB	5.58	6	6.42	
				SM5005ALCV CF5005ALC	2.79	3	3.21	
	C_D	Design value, determined by the internal wafer pattern		SM5005ALAV CF5005ALA CF5005ALD	9.3	10	10.7	pF
				SM5005ALBV CF5005ALB	5.58	6	6.42	
				SM5005ALCV CF5005ALC	2.79	3	3.21	
				CF5005ALE	13.95	15	16.05	

Switching Characteristics

3V operation

V_{SS} = 0 V, Ta = −20 to 80 °C unless otherwise noted.

Parameter	Symbol	Condition			Rating			Unit
					min	typ	max	
Output rise time	t_{r1}	Measurement cct 3, load cct 1, 0.1V_{DD} to 0.9V_{DD}	C_L = 15 pF, V_{DD} = 2.7V to 3.6V	SM5005AL×V CF5005AL×	–	1	3	ns
	t_{r2}		C_L = 30 pF, V_{DD} = 3.0V to 3.6V	CF5005AL×	–	1.5	4	
Output fall time	t_{f1}	Measurement cct 3, load cct 1, 0.9V_{DD} to 0.1V_{DD}	C_L = 15 pF, V_{DD} = 2.7V to 3.6V	SM5005AL×V CF5005AL×	–	1	3	ns
	t_{f2}		C_L = 30 pF, V_{DD} = 3.0V to 3.6V	CF5005AL×	–	1.5	4	
Output duty cycle[1]	Duty	Measurement cct 3, load cct 1, Ta = 25 °C, V_{DD} = 3.0 V	C_L = 30 pF, f ≤ 125 MHz	CF5005AL×	45	–	55	%
			C_L = 15 pF, f ≤ 107 MHz	SM5005AL×V	45	–	55	
			C_L = 15 pF, 107 MHz < f < 125 MHz		40	–	60	
Output disable delay time[2]	t_{PLZ}	Measurement cct 6, Ta = 25 °C, V_{DD} = 2.7 V, C_L ≤ 15 pF			–	–	100	ns
Output enable delay time[2]	t_{PZL}	Measurement cct 6, Ta = 25 °C, V_{DD} = 2.7 V, C_L ≤ 15 pF			–	–	100	ns

1. Monitored in sample lots.
2. Oscillator stop function is built-in. When $\overline{INH}$ goes LOW, normal output stops. When $\overline{INH}$ goes HIGH, normal output is not resumed until after the oscillator start-up time has elapsed.

2.5V operation (CF5005ALA, CF5005ALD, CF5005ALE)

V_{SS} = 0 V, Ta = −20 to 80 °C unless otherwise noted.

Parameter	Symbol	Condition	Rating			Unit
			min	typ	max	
Output rise time	t_{r3}	Measurement cct 3, load cct 1, 0.1V_{DD} to 0.9V_{DD}, C_L = 30 pF, V_{DD} = 2.25V to 2.75V	–	2	6	ns
Output fall time	t_{f3}	Measurement cct 3, load cct 1, 0.9V_{DD} to 0.1V_{DD}, C_L = 30 pF, V_{DD} = 2.25V to 2.75V	–	2	6	ns
Output duty cycle[1]	Duty	Measurement cct 3, load cct 1, Ta = 25 °C, V_{DD} = 2.5 V, C_L = 30 pF, f ≤ 70 MHz	40	–	60	%
Output disable delay time[2]	t_{PLZ}	Measurement cct 6, Ta = 25 °C, V_{DD} = 2.25 V, C_L ≤ 15 pF	–	–	300	ns
Output enable delay time[2]	t_{PZL}	Measurement cct 6, Ta = 25 °C, V_{DD} = 2.25 V, C_L ≤ 15 pF	–	–	300	ns

1. Monitored in sample lots.
2. Oscillator stop function is built-in. When $\overline{INH}$ goes LOW, normal output stops. When $\overline{INH}$ goes HIGH, normal output is not resumed until after the oscillator start-up time has elapsed.

FUNCTIONAL DESCRIPTION

Standby Function

The oscillator stops when $\overline{INH}$ goes LOW. When the oscillator stops, the oscillator output on Q goes high impedance.

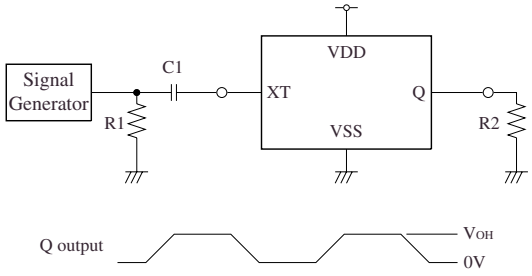
$\overline{INH}$	Q	Oscillator
HIGH (or open)	f_O output frequency	Normal operation
LOW	High impedance	Stopped

Power-save Pull-up Resistance

The $\overline{INH}$ pull-up resistance changes in response to the input level (HIGH or LOW). When $\overline{INH}$ goes LOW (standby state), the pull-up resistance becomes large to reduce the current consumption during standby.

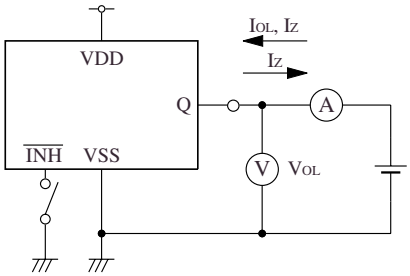
MEASUREMENT CIRCUITS

Measurement cct 1

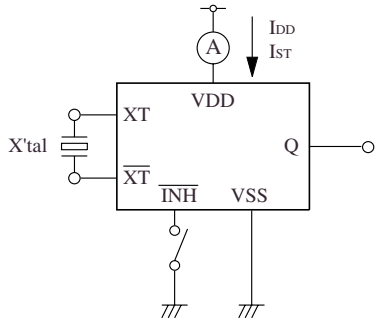


2.5V_{P-P} , 10MHz sine wave input signal
C1 : 0.001µF
R1 : 50Ω
R2 : 275Ω

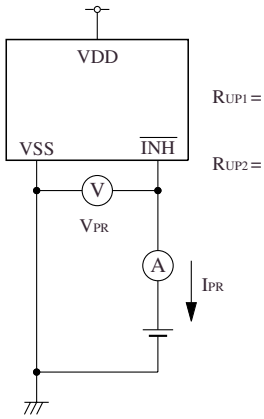
Measurement cct 2



Measurement cct 3



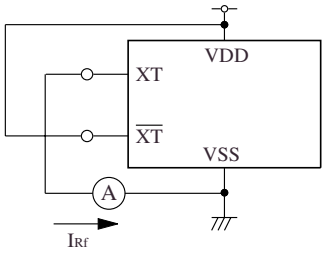
Measurement cct 4



$R_{UP1} = \frac{V_{DD}}{I_{PR}}$ ($V_{PR} = V_{SS}$)

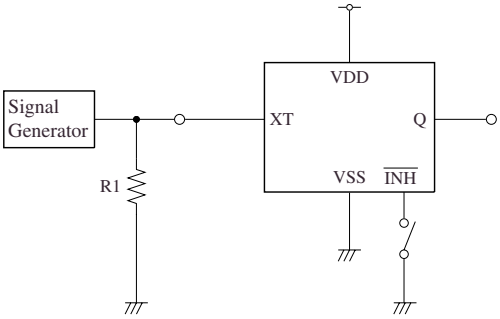
$R_{UP2} = \frac{V_{DD} - 0.7V_{DD}}{I_{PR}}$ ($V_{PR} = 0.7V_{DD}$)

Measurement cct 5



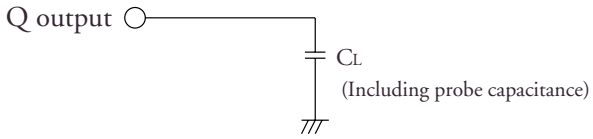
$R_{f2} = \frac{V_{DD}}{I_{Rf}}$

Measurement cct 6



R1 : 50Ω

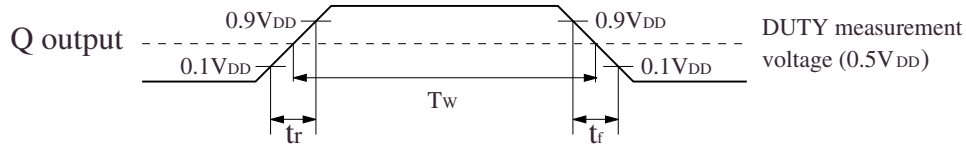
Load cct 1



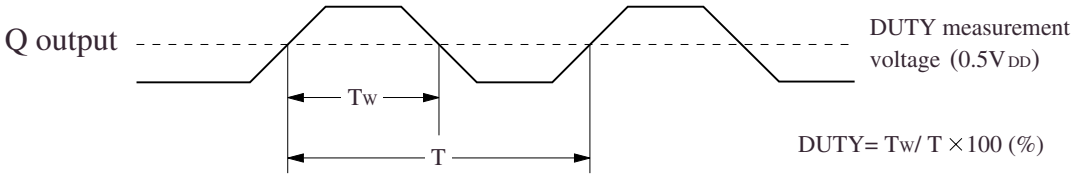
C_L = 15pF: t_{r1}, t_{f1}, I_{DD} (SM5005AL×V, CF5005AL×)
C_L = 30pF: t_{r2} , t_{f2} , t_{r3} , t_{f3} , I_{DD} (CF5005AL×)

Switching Time Measurement Waveform

Output duty level (CMOS)

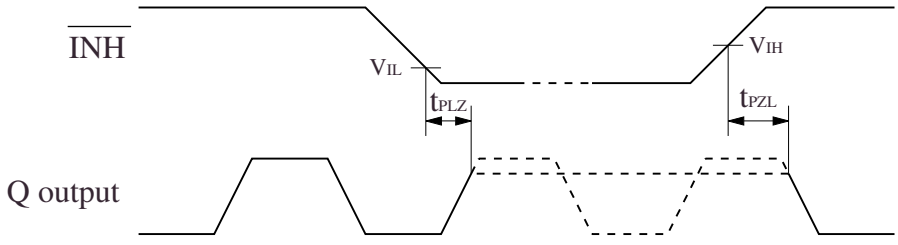


Output duty cycle (CMOS)



Output Enable/Disable Delay

The following figure shows the oscillator timing during normal operation. Note that when the device is in standby, the oscillator stops. When standby is released, the oscillator starts and stable oscillator output occurs after a short delay.



$\overline{INH}$ input waveform $t_r = t_f \leq 10ns$

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