

## OVERVIEW

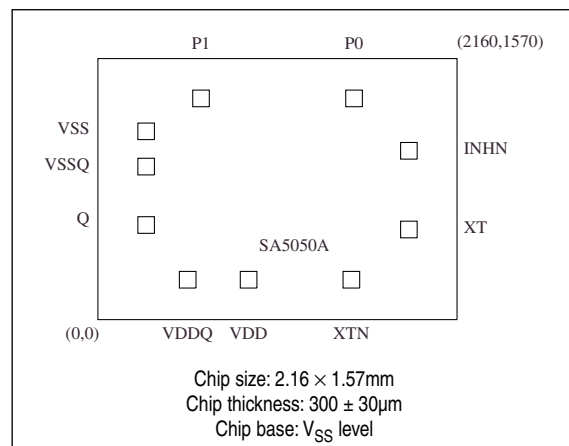
The SM5050A is a single-output clock generator IC that generates standard high-frequency clocks derived from a 20 to 40MHz crystal oscillator master clock. The high-frequency output stage uses optimized PLL circuits for low jitter output. The oscillator capacitors  $C_G$  and  $C_D$  are built-in, realizing a high-frequency output oscillator by just the connection of a crystal. Two program inputs allows selection from 4 frequency multipliers, making the SM5050A able to generate multi-standard frequency clock outputs.

## FEATURES

- 2.7 to 3.6V operating supply voltage
- 20 to 40MHz master clock frequency (fundamental)
- Output frequency ranges
  - 100 to 166.6MHz ( $V_{DD} = V_{DDQ} = 3.0$  to 3.6V)
  - 100 to 125MHz ( $V_{DD} = V_{DDQ} = 2.7$  to 3.6V)
- 8mA output drive capability
- Oscillator capacitors ( $C_G$ ,  $C_D$ ) and feedback resistor ( $R_f$ ) built-in
- 100ps (typ) low jitter output (peak-to-peak)
- 2 program inputs for 4 selectable multiplier ratios
- Standby function
- Packaging
  - Chip form (CF5050A)
  - 8-pin VSOP package (SM5050AV)

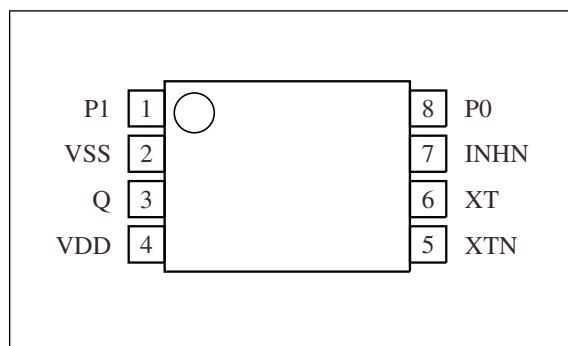
## PAD DIMENSIONS

(Unit:  $\mu\text{m}$ )



## PINOUT

(Top view)

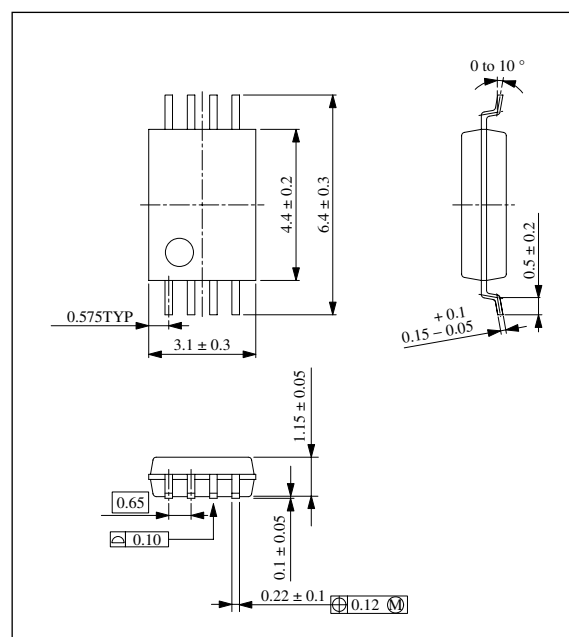


## ORDERING INFORMATION

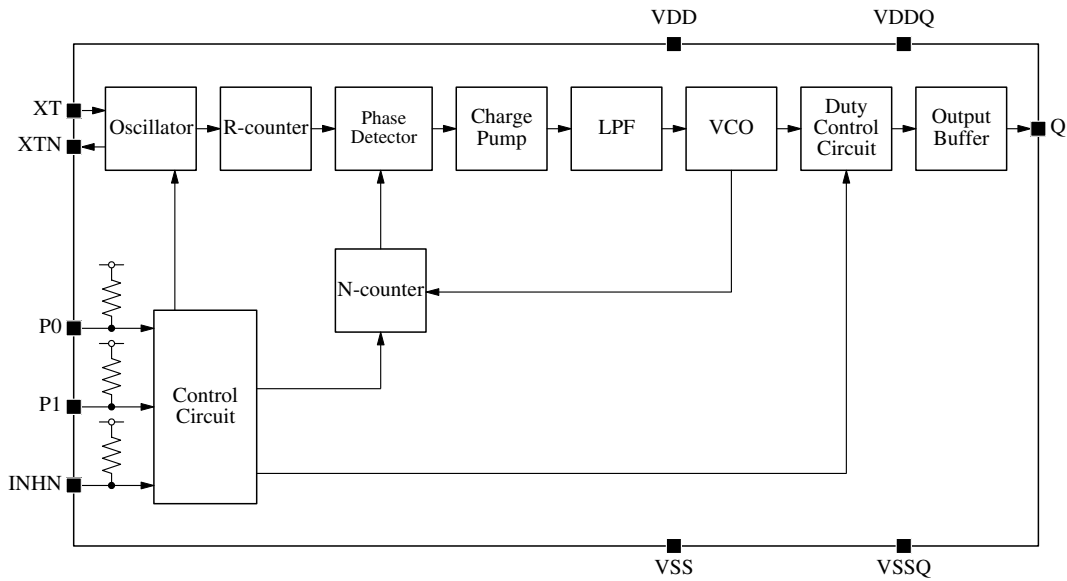
Device	Package
CF5050A-1	Chip form
SM5050AV	8-pin VSOP

## PACKAGE DIMENSIONS

(Unit: mm)



## BLOCK DIAGRAM



## PIN DESCRIPTION

SM5050AV		CF5050A			I/O <sup>1</sup>	Description
Number	Name	Name	Pad dimensions [μm]			
			X	Y		
1	P1	P1	620	1330	I <sub>p</sub>	Program input 1. Selects the output frequency multiplier ratio.
2	VSS	VSS	290	1132	–	Ground
		VSSQ	290	920	–	Output circuit ground
3	Q	Q	290	569	O	Output (CMOS)
4	VDD	VDDQ	540	240	–	Output circuit supply
		VDD	906	240	–	Supply
5	XTN	XTN	1524	240	O	Crystal oscillator connection pins. Crystal connected between XT and XTN.
6	XT	XT	1870	542	I	
7	INH <sub>N</sub>	INH <sub>N</sub>	1870	1015	I <sub>p</sub>	Operating state control (inhibit). When INH <sub>N</sub> is LOW, output is high impedance and PLL circuits stop.
8	P0	P0	1540	1330	I <sub>p</sub>	Program input 0. Selects the output frequency multiplier ratio.

1. I<sub>p</sub> = input with built-in pull-up resistor.

## OUTPUT FREQUENCY SETTINGS

Program inputs		Multiplier ratio	Master clock frequency [MHz]	Output frequency [MHz]	Supply voltage [V]
P0	P1				
LOW	LOW	× 4	25.00	100	2.7 to 3.6
LOW	HIGH	× 4.25	25.00	106.25	
HIGH	LOW	× 5	25.00	125	
			26.66	133.3	
HIGH	HIGH	× 6.25	24.8832	155.52	3.0 to 3.6
			26.66	166.6	

Note: The output frequency range is 100 to 166.6MHz. The master clock frequency can be adjusted to any value within the range 20 to 40MHz, so the master clock frequency and multiplier should be selected such that the output frequency is within the output frequency range.

## SPECIFICATIONS

### Absolute Maximum Ratings

$V_{SS} = 0V$

Parameter	Symbol	Condition	Rating	Unit
Supply voltage range	$V_{DD}$		-0.5 to 6.0	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	$T_{stg}$	CF5050A	-65 to 150	°C
		SM5050AV	-55 to 125	°C
Operating temperature range	$T_{opr}$		-40 to 85	°C
Output current	$I_{OUT}$		25	mA
Power dissipation	$P_D$	SM5050AV	150	mW

### Recommended Operating Conditions

$V_{SS} = 0V$ ,  $f_{OUT} = 100$  to 166.6MHz,  $C_L = 15pF$

Parameter	Symbol	Condition	Rating			Unit
			min	typ	max	
Operating supply voltage	$V_{DD}$	$f_{OUT} \leq 125MHz$	2.7	-	3.6	V
		$f_{OUT} \leq 166.6MHz$	3.0	-	3.6	
Input voltage	$V_{IN}$		$V_{SS}$	-	$V_{DD}$	V
Operating temperature	$T_{opr}$		-20	-	80	°C

SM5050A

**DC Characteristics**

$V_{DD} = 2.7$  to  $3.6V$ ,  $V_{SS} = 0V$ ,  $T_a = -20$  to  $80^{\circ}C$  unless otherwise noted.

Parameter	Symbol	Condition	Rating			Unit	
			min	typ	max		
Q HIGH-level output voltage	$V_{OH}$	$V_{DD} = 2.7V$ , $I_{OH} = 8mA$	2.2	–	–	V	
Q LOW-level output voltage	$V_{OL}$	$V_{DD} = 2.7V$ , $I_{OL} = 8mA$	–	–	0.4	V	
Q output leakage current	$I_Z$	Measurement circuit 4, INHN = $V_{SS}$	$V_{OH} = V_{DD}$	–	–	10	$\mu A$
			$V_{OL} = V_{SS}$	–	–	10	
INHN HIGH-level input voltage	$V_{IH1}$		$0.7V_{DD}$	–	–	V	
P0, P1 HIGH-level input voltage	$V_{IH2}$		$0.9V_{DD}$	–	–	V	
INHN LOW-level input voltage	$V_{IL1}$		–	–	$0.3V_{DD}$	V	
P0, P1 LOW-level input voltage	$V_{IL2}$		–	–	$0.1V_{DD}$	V	
Current consumption	$I_{DD}$	25MHz crystal, measurement circuit 1, load circuit 1, INHN = open, $C_L = 15pF$ , P0 = HIGH, P1 = LOW, $V_{DD} = 3.0V$	–	23	–	mA	
		25MHz crystal, measurement circuit 1, load circuit 1, INHN = open, $C_L = 15pF$ , P0 = HIGH, P1 = LOW	–	–	42		
Standby current	$I_{ST}$	INHN = $V_{SS}$ , measurement circuit 1	–	–	40	$\mu A$	
INHN, P0, P1 input pull-up resistance	$R_{UP1}$	$V_{DD} = 3V$ , measurement circuit 2	0.3	–	6	$M\Omega$	
	$R_{UP2}$		10	–	200	$k\Omega$	
Negative resistance	$-R_L$	$V_{DD} = 3V$ , $T_a = 25^{\circ}C$ , $f = 30MHz$	–	–240	–	$\Omega$	
Feedback resistance	$R_f$	Measurement circuit 3	100	300	900	$k\Omega$	
Internal capacitance	$C_G$	Design values	15.98	18.44	20.90	pF	
	$C_D$		15.98	18.44	20.90	pF	

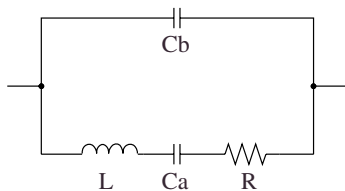
### Switching Characteristics

$V_{DD} = 2.7$  to  $3.6V$ ,  $V_{SS} = 0V$ ,  $T_a = -20$  to  $80^{\circ}C$  unless otherwise noted.

Parameter	Symbol	Condition	Rating			Unit	
			min	typ	max		
Output rise time	$t_r$	$0.2V_{DD} \rightarrow 0.8V_{DD}$ , measurement circuit 1, load circuit 1, $C_L = 15pF$	–	1	2.5	ns	
Output fall time	$t_f$	$0.8V_{DD} \rightarrow 0.2V_{DD}$ , measurement circuit 1, load circuit 1, $C_L = 15pF$	–	1	2.5	ns	
Output duty cycle	Duty	$V_{DD} = 3V$ , $T_a = 25^{\circ}C$ , measurement circuit 1, load circuit 1, $C_L = 15pF$ , $f \leq 166.6MHz$	40	–	60	%	
Output disable delay time <sup>1</sup>	$t_{PLZ}$	$V_{DD} = 3V$ , $T_a = 25^{\circ}C$ , measurement circuit 1, load circuit 1, $C_L = 15pF$	–	–	100	ns	
Startup time <sup>2,3</sup>	$t_{SZL}$	$V_{DD} = 3V$ , $T_a = 25^{\circ}C$ , measurement circuit 1, load circuit 1, $C_L = 15pF$	–	1	–	ms	
Oscillator frequency	f	Measurement circuit 1	20	–	40	MHz	
Output frequency	$f_{OUT}$	Measurement circuit 1	$V_{DD} = 2.7V$	100	–	125	MHz
			$V_{DD} = 3.0V$	100	–	166.6	
Output clock jitter <sup>3</sup>	Jitter	$V_{DD} = 3V$ , $T_a = 25^{\circ}C$ , 25MHz crystal, P0 = HIGH, P1 = LOW, measurement circuit 1, load circuit 1, $C_L = 15pF$ , peak-to-peak	–	100	–	ps	

1. Time from when INHN goes LOW until Q output goes high impedance.
2. Time from when either INHN goes LOW to HIGH or supply voltage  $V_{DD} = 3.0V$  until normal signal output.
3. Measured values using NPC characteristics standard evaluation board and standard crystal.

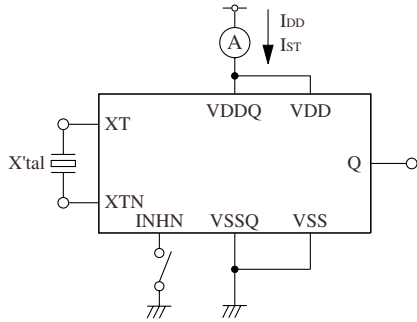
### NPC STANDARD CRYSTAL DATA



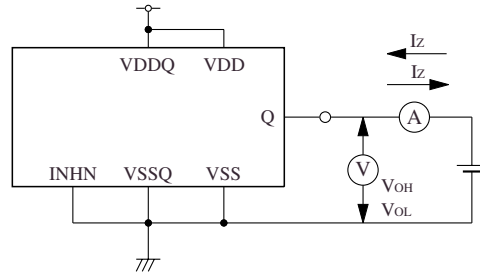
f (MHz)	R ( $\Omega$ )	L (mH)	Ca (fF)	Cb (pF)
25	4.368	1.885	21.52	4.793
27	7.421	2.402	14.48	4.097

**MEASUREMENT CIRCUITS**

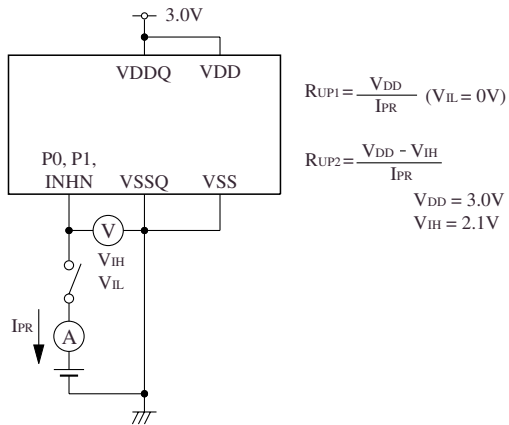
**Measurement Circuit 1**



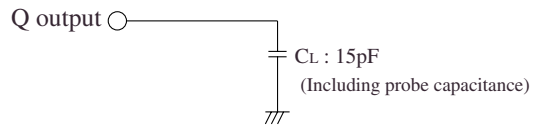
**Measurement Circuit 4**



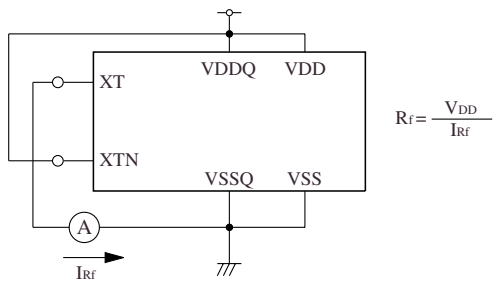
**Measurement Circuit 2**



**Load Circuit 1**

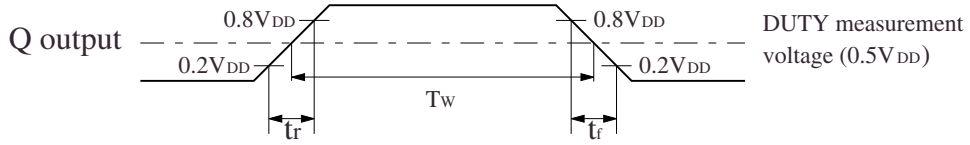


**Measurement Circuit 3**

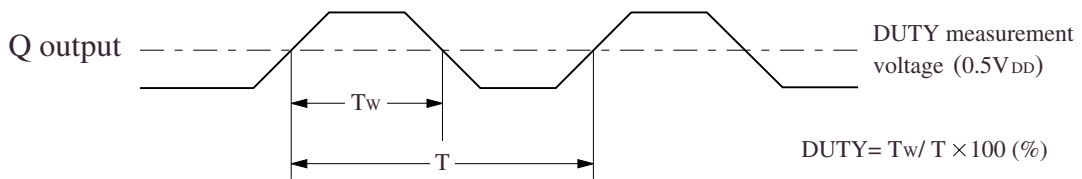


**Switching Time Measurement Waveforms**

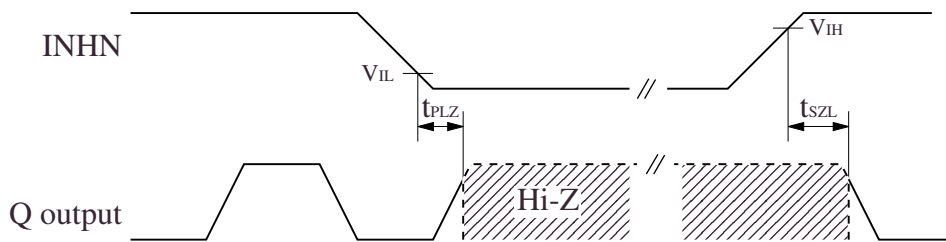
**Output duty level**



**Output duty cycle time**



**Output Disable Delay Time/Startup Time**



INHN input waveform  $t_r = t_f \leq 10\text{ns}$

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