

# XC2164 Series

# ICs for use with Crystal Oscillators

July 30, 2003 Ver. 5

- ◆ CMOS Low Power Consumption
- ◆ Oscillation Frequency 4MHz to 125MHz
  - 4MHz to 30MHz (Fundamental Oscillation)
  - 20MHz to 125MHz (3rd Overtone Oscillation)
- ◆ 3 State Output
- ◆ Built-in Capacitors Cg, Cd
- ◆ Built-in Feedback Resistor
- ◆ Chip form
- ◆ Mini Mold SOT-26 Package

## GENERAL DESCRIPTION

The XC2164 series are high frequency, low current consumption CMOS ICs with built-in crystal oscillator and divider circuits.

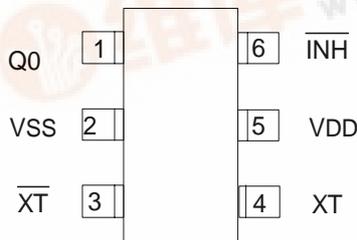
For fundamental oscillation, output is selectable from any one of the following values for  $f_0$  :  $f_0/1$ ,  $f_0/2$ ,  $f_0/4$ ,  $f_0/8$ .

With oscillation capacitors and a feedback resistor built-in, it is possible to configure a stable fundamental oscillator or 3rd overtone oscillator using only an external crystal.

Also available is an external oscillation capacitor / external oscillation feedback resistor type which makes oscillation frequency control possible.

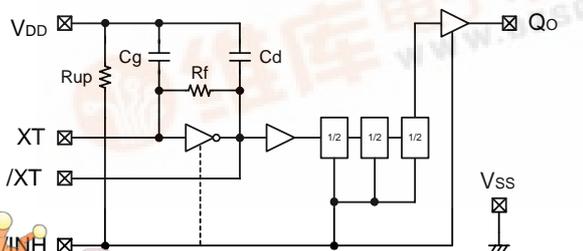
The XC2164 series are integrated into SOT-26 packages. The series is also available in chip form.

## PIN CONFIGURATION



SOT-26 (TOP VIEW)

## BLOCK DIAGRAM



Built-in oscillation capacitors, oscillation feedback resistor

## APPLICATIONS

- Crystal Oscillation Modules
- Micro computer, DSP Clocks
- Communication Equipment
- Various System Clocks

## FEATURES

- Oscillation Frequency: 4MHz to 30MHz (Fundamental)  
20MHz to 125MHz (3rd Overtone)
- Divider Ratio: Selectable from  $f_0/1$ ,  $f_0/2$ ,  $f_0/4$ ,  $f_0/8$ .  
( $f_0/2$ ,  $f_0/4$ ,  $f_0/8$  are fundamental only)
- Output: 3-State
- Operating Voltage Range:  $3.3V \pm 10\%$ ,  $5.0V \pm 10\%$
- Low Power Consumption: Stand -by function included  
Selectable from C/E type and O/E type
- Chip Form: Chip Size  $1.3 \times 0.8$  mm
- Ultra Small Package: SOT-26 mini mold

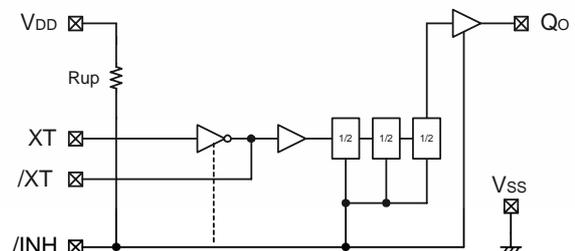
## PIN ASSIGNMENT

PIN NUMBER	PIN NAME	FUNCTION
1	Q0	Clock Output
2	VSS	Ground
3	XT	Crystal Oscillator Connection (Output)
4	XT	Crystal Oscillator Connection (Input)
5	VDD	Power Supply
6	INH	Stand-by Control*

\* Stand-by control pin has a pull-up resistor built-in.

## /INH, Q0 PIN FUNCTION

/INH	Q0
"H" or OPEN	Clock Output
"L"	High Impedance



External oscillation capacitors, oscillation feedback resistor

## ORDERING INFORMATION

### XC2164①②③④⑤⑥

DESIGNATOR	SYMBOL	DESCRIPTION	DESIGNATOR	SYMBOL	DESCRIPTION	
①	Ratio Divider & Stand-By Mode		③	1	Duty Level CMOS (VDD/2) Note : TTL : Fundamental 4MHz to 30MHz	
	A	f0/1 Chip Enable				
	B	f0/2 Chip Enable				
	④	C	f0/4 Chip Enable	④	Recommended Frequency Range & Rf, Cg, Cd values	
		D	f0/8 Chip Enable		Built-in Type (3rd O/T) =refer to table 1	
		K	f0/1 Output Enable		Built-in Type (Fundamental) =refer to table 2	
		L	f0/2 Output Enable			
		M	f0/4 Output Enable			
	⑤	N	f0/8 Output Enable	⑤	Package	
Note : f0/2, f0/4, f0/8 are fundamental only		C	Chip Form			
②	5	Fixed Number	⑥	M	SOT-26	
				R	Embossed Tape: Standard Feed	
				L	Embossed Tape: Reverse Feed	
				T	Chip Tray	
				W	Wafer	

Table 1: Built-in Type (3rd O/T)

SYMBOL	Frequency Range		Rf (kΩ)	Cg (pF)	Cd (pF)
	3.3V ± 10%	5.0V ± 10%			
A	-	20MHz to 30MHz	9.0	21.5	21.5
B	20MHz to 30MHz	30MHz to 40MHz	6.5	20.0	20.0
C	30MHz to 40MHz	40MHz to 50MHz	5.0	16.0	16.0
D	40MHz to 50MHz	50MHz to 65MHz	3.5	14.0	14.0
E	50MHz to 65MHz	65MHz to 80MHz	2.8	12.5	12.5
F	65MHz to 80MHz	80MHz to 95MHz	2.5	10.0	10.0
H	80MHz to 95MHz	95MHz to 110MHz	2.2	8.0	8.0
K	95MHz to 110MHz	110MHz to 125MHz	2.0	7.0	7.0
L	110MHz to 125MHz	-	2.3	5.5	5.5

Table 2 : Built-In Type (Fundamental)

SYMBOL	Frequency Range		Rf (*) (MΩ)	Cg (pF)	Cd (pF)
	3.3V ± 10%	5.0V ± 10%			
M, V	4MHz to 30MHz	4MHz to 30MHz	3.5	35.0	35.0
			7.0		
T	4MHz to 30MHz	4MHz to 30MHz	3.5	20.0	20.0
			7.0		

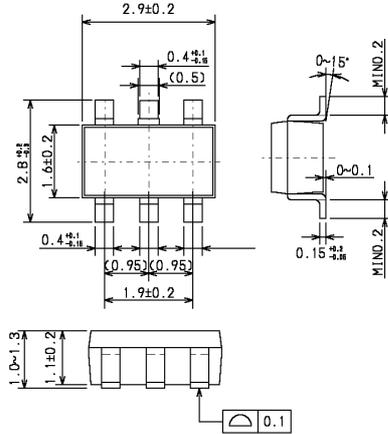
(\*) Rf=3.5MΩ @VDD=5.0V Operation  
Rf=7.0MΩ @VDD=3.3V Operation

# XC2164 Series

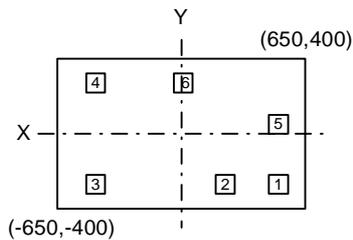
# ICs for use with Crystal Oscillators

## PACKAGING INFORMATION

○ SOT-26



## PAD LAYOUT



Chip Size 1.3×0.8 mm  
 Chip Thickness 280 ± 20 μm  
 Pad Aperture 100 × 100 μm

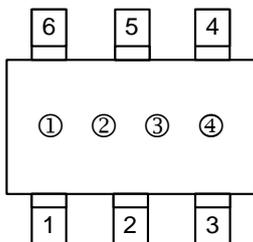
## PAD DIMENSIONS

unit [μm]

PIN NUMBER	PIN NAME	FUNCTION	PAD DIMENSIONS	
			X	Y
1	Q0	Clock Output	514	-264
2	VSS	Ground	222	-264
3	$\overline{XT}$	Crystal Oscillator Connection (Output)	-450	-264
4	XT	Crystal Oscillator Connection (Input)	-450	264
5	VDD	Power Supply	514	27
6	$\overline{INH}$	Stand-by Control*	47	264

\* Stand-by control pin has a pull-up resistor built-in.

## MARKING RULE



SOT-26 (TOP-VIEW)

① Represents product series : XC2164 series

② Represents divider ratio

<Chip Enable>

MARK	RATIO	MARK	RATIO
A	f0/1	C	f0/4
B	f0/2	D	f0/8

\* B,C,D : fundamental only.

<Output Enable>

MARK	RATIO	MARK	RATIO
K	f0/1	M	f0/4
L	f0/2	N	f0/8

\* L,M,N : fundamental only.

③ Represents recommended frequency & Rf, Cg & Cd values

\*) Please refer to the ordering information table above.

④ Represents the assembly lot no.

(Based on internal standards.)

## ■ ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	CONDITIONS	UNITS
Supply Voltage	VDD	V <sub>SS</sub> - 0.3 to V <sub>SS</sub> + 7.0	V
Input Voltage	V <sub>IN</sub>	V <sub>SS</sub> - 0.3 to VDD + 0.3	V
Continuous Total Power Dissipation	P <sub>d</sub>	250*	mW
Operating Ambient Temperature	T <sub>opr</sub>	-40 ~ +85	°C
Storage Temperature	T <sub>stg</sub>	-65 ~ +150 (Chip Form)	°C
		-55 ~ +125 (SOT-26)	°C

\*When implemented on a glass epoxy PCB (SOT26 package)

## ■ ELECTRICAL CHARACTERISTICS

### XC2164A51M, T, V Fundamental

5.0V Operation (unless otherwise stated, VDD=5.0V, No Load, T<sub>a</sub>=30 ~ + 80°C)

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNITS
Operating Supply Voltage	VDD		4.5	5.0	5.5	V
"H" Level Input Voltage	V <sub>IH</sub>		2.4			V
"L" Level Input Voltage	V <sub>IL</sub>				0.4	V
"H" Level Output Voltage	V <sub>OH</sub>	CMOS : VDD = 4.5V, I <sub>OH</sub> = -16mA	3.9	4.2		V
"L" Level Output Voltage	V <sub>OL</sub>	CMOS : VDD = 4.5V, I <sub>OH</sub> = 16mA		0.3	0.4	V
Consumption Current 1	IDD1	/INH=Open, Q0=Open f=30MHz	XC2164A51M, V	11	(15)	mA
			XC2164A51T	11	(15)	
Consumption Current 2	IDD2	/INH= " L ", Q0=Open f=30MHz	XC2164A51M, V	5	(8)	μA
			XC2164A51T	5	(8)	
Input pull up resistance 1	R <sub>up1</sub>	/INH="L"	0.5	1.0	2.0	MΩ
Input pull up resistance 2	R <sub>up2</sub>	/INH=0.7VDD	25	50	100	kΩ
Internal Oscillation Capacitance	C <sub>g</sub>	(*)	XC2164A51M, V	35		pF
			XC2164A51T	20		
	C <sub>d</sub>	(*)	XC2164A51M, V	35		
			XC2164A51T	20		
Internal Oscillation Feedback Resistance	R <sub>f</sub>			3.5		MΩ
Output Disable Leakage Current	IOZ	/INH="L"			10	μA

note 1 : the values for C<sub>g</sub>, C<sub>d</sub> are the designed values.

### XC2164A51M Fundamental

3.3V Operation (unless otherwise stated, VDD=3.3V, No Load, T<sub>a</sub>=30 ~ + 80°C)

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNITS
Operating Supply Voltage	VDD		2.97	3.30	3.63	V
"H" Level Input Voltage	V <sub>IH</sub>		2.4			V
"L" Level Input Voltage	V <sub>IL</sub>				0.4	V
"H" Level Output Voltage	V <sub>OH</sub>	CMOS : 2.97V, I <sub>OH</sub> = -8mA	2.5			V
"L" Level Output Voltage	V <sub>OL</sub>	CMOS : 2.97V, I <sub>OH</sub> = 8mA			0.4	V
Consumption Current 1	IDD1	/INH=Open, Q0=Open f=30MHz	XC2164A51M, V	5	(8)	mA
			XC2164A51T	4	(6.5)	
Consumption Current 2	IDD2	/INH= " L ", Q0=Open f=30MHz	XC2164A51M, V	2	(4)	μA
			XC2164A51T	2	(4)	
Input pull up resistance 1	R <sub>up1</sub>	/INH="L"	1.0	2.0	4.0	MΩ
Input pull up resistance 2	R <sub>up2</sub>	/INH=0.7VDD	35	70	140	kΩ
Internal Oscillation Capacitance	C <sub>g</sub>	(*)	XC2164A51M, V	35		pF
			XC2164A51T	20		
	C <sub>d</sub>	(*)	XC2164A51M, V	35		
			XC2164A51T	20		
Internal Oscillation Feedback Resistance	R <sub>f</sub>			7.0		MΩ
Output Diable Leakage Current	IOZ	/INH="L"			10	μA

\* note 1 : the values for C<sub>g</sub>, C<sub>d</sub> are the designed values.

## ■ ELECTRICAL CHARACTERISTICS (Continued)

### XC2164A51T, V Fundamental

3.3V Operation (unless otherwise stated, VDD=3.3V, No Load, Ta=30 ~ + 80°C)

PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNITS
Operating Supply Voltage	VDD		2.5	3.30	3.63	V
"H" Level Input Voltage	VIH		2.4			V
"L" Level Input Voltage	VIL				0.4	V
"H" Level Output Voltage	VOH	CMOS : 2.97V, IOH= - 8mA	2.5			V
"L" Level Output Voltage	VOL	CMOS : 2.97V, IOH=8mA			0.4	V
Consumption Current 1	IDD1	/INH=Open, Q0=Open f=30MHz	XC2164A51M, V	5	( 8 )	mA
			XC2164A51T	4	( 6.5 )	
Consumption Current 2	IDD2	/INH= " L ", Q0=Open f=30MHz	XC2164A51M, V	2	( 4 )	μA
			XC2164A51T	2	( 4 )	
Input pull up resistance 1	Rup1	/INH="L"	1.0	2.0	4.0	MΩ
Input pull up resistance 2	Rup2	/INH=0.7VDD	35	70	140	kΩ
Internal Oscillation Capacitance	Cg	(*)	XC2164A51M, V	35		pF
			XC2164A51T	20		
	Cd	(*)	XC2164A51M, V	35		
			XC2164A51T	20		
Internal Oscillation Feedback Resistance	Rf			7.0		MΩ
Output Diabie Leakage Current	IOZ	/INH="L"			10	μA

\* note 1 : the values for Cg, Cd are the designed values.

Comparative Chart of Oscillation Frequency vs. Supply Voltage, and Negative Resistance Value (The designed value when 300MHz Crystal is used.)

SYMBOL	OSCILLATION FREQUENCY vs. SUPPLY VOLTAGE		NEGATIVE RESISTANCE VALUE	
	VDD = 3.3 V, ±10%	VDD = 5.0 V, ±10%	VDD = 3.3V	VDD = 5.0V
M	± 4.3 ppm	± 4.5 ppm	- 130 Ω	- 220 Ω
V	± 1.2 ppm	± 2.1 ppm	- 150 Ω	- 250 Ω
T	± 9.4 ppm	± 7.0 ppm	- 660 Ω	- 760 Ω

# XC2164 Series

# ICs for use with Crystal Oscillators

## ELECTRICAL CHARACTERISTICS (Continued)

### XC2164A51A ~ XC2164A51L 3rd Overtone

5.0 Operation (Unless otherwise stated, VDD=5.0V, No Load, Ta=30 ~ + 80°C)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS	
Operating Supply Voltage	VDD		4.5	5.0	5.5	V	
"H" Level Input Voltage	VIH		2.4			V	
"L" Level Input Voltage	VIL				0.4	V	
"H" Level Output Voltage	VOH	CMOS : VDD = 4.5V, IOH= - 16mA	3.9	4.2		V	
"L" Level Output Voltage	VOL	CMOS : VDD = 4.5V, IOH=16mA		0.3	0.4	V	
Consumption Current 1	IDD1	/INH = Open, Q0 = Open	XC2164A51A, f0=30MHz		17.0	(23)	mA
			XC2164A51B, f0=40MHz		17.0	(23)	
			XC2164A51C, f0=55MHz		19.0	(26)	
			XC2164A51D, f0=70MHz		23.0	(32)	
			XC2164A51E, f0=85MHz		24.0	(32)	
			XC2164A51F, f0=100MHz		30.0	(40)	
			XC2164A51H, f0=110MHz		30.0	(40)	
		XC2164A51K, f0=125MHz		30.0	(40)		
Consumption Current 2	IDD2	/INH="L", Q0=Open		5.0	(8)	μA	
Input Pull Up Resistance 1	Rup1	/INH="L"	0.5	1.0	2.0	MΩ	
Input Pull Up Resistance 2	Rup2	/INH=0.7VDD	25	50	100	kΩ	
Internal Oscillation Feedback Resistance	Rf	XC2164A51A		9.0		kΩ	
		XC2164A51B		6.5			
		XC2164A51C		5.0			
		XC2164A51D		3.5			
		XC2164A51E		2.8			
		XC2164A51F		2.5			
		XC2164A51H		2.2			
		XC2164A51K		2.0			
Output Disable Leakage Current	Ioz	/INH="L"			10	μA	

### XC2164A51A ~ XC2164A51L 3rd Overtone

3.3V Operation (Unless otherwise stated, VDD=3.3V, No Load, Ta=30 ~ + 80°C)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS	
Operating Supply Voltage	VDD		2.97	3.30	3.63	V	
"H" Level Input Voltage	VIH		2.4			V	
"L" Level Input Voltage	VIL				0.4	V	
"H" Level Output Voltage	VOH	CMOS : VDD = 2.97V, IOH= - 8mA	2.5			V	
"L" Level Output Voltage	VOL	CMOS : VDD = 2.97V, IOH=8mA			0.4	V	
Consumption Current 1	IDD1	/INH = Open, Q0 = Open	XC2164A51B, f0=30MHz		4.5	(7)	mA
			XC2164A51C, f0=40MHz		5.0	(8)	
			XC2164A51E, f0=70MHz		8.0	(13)	
			XC2164A51F, f0=85MHz		8.5	(13)	
			XC2164A51H, f0=100MHz		9.5	(15)	
			XC2164A51K, f0=110MHz		10.0	(15)	
			XC2164A51L, f0=125MHz		10.5	(15)	
Consumption Current 2	IDD2	/INH="L", Q0=Open		2.0	(4)	μA	
Input Pull Up Resistance 1	Rup1	/INH="L"	1.0	2.0	4.0	MΩ	
Input Pull Up Resistance 2	Rup2	/INH=0.7VDD	35	70	140	kΩ	
Internal Oscillation Feedback Resistance	Rf	XC2164A51A		6.5		kΩ	
		XC2164A51B		5.0			
		XC2164A51C		3.5			
		XC2164A51D		2.8			
		XC2164A51E		2.5			
		XC2164A51F		2.2			
		XC2164A51H		2.0			
		XC2164A51K		2.3			
Output Disable Leakage Current	Ioz	/INH="L"			10	μA	

## ELECTRICAL CHARACTERISTICS (Continued)

**XC2164A51D** 3.3V Operation (Unless otherwise stated, VDD=3.3V, Oscillation Frequency f0=48MHz, No Load, Ta=-30 ~ + 80°C)

PARAMETER	SYMBOL	CONDITIONS	STANDARD VALUES			UNITS	CIRCUITS
			MIN	TYP	MAX		
Operating Voltage	VDD		2.70	3.30	3.63	V	
'H' Level Input Voltage	VIH		2.4			V	①
'L' Level Input Voltage	VIL				0.4	V	①
'H' Level Output Voltage	VOH	CMOS : 2.97V, IOH = - 8mA	2.5			V	②
'L' Level Output Voltage	VOL	CMOS : 2.97V, IOH = 8mA			0.4	V	②
Supply Current 1	IDD1	/INH=Open, Q0=Open XC2164A51D, F0=55MHz		6.5	(10)	mA	③
Supply Current 2	IDD2	/INH = 'L', Q0=Open		2.0		μA	③
Input Pull-Up Resitance 1	Rup1	/INH = 'L'	1.0	2.0	4.0	MΩ	④
Input Pull-Up Resitance 2	Rup2	/INH = 0.7VDD	35	70	140	kΩ	④
Internal Oscillation Feedback Resistance	Rf	XC2164A51D		3.5		kΩ	⑤
Output Disable Leakage Current	loz	/INH = 'L'			10	μA	⑥

## SWITCHING CHARACTERISTICS

**XC2164A51M, T, V Fundamental** (Unless otherwise stated, VDD=3.3V or 5.0V, No Load, Ta=30 ~ + 80°C)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Output Rise Time (note 1)	tr	CMOS: CL=15pF 0.1VDD→0.9VDD		1.5		ns
		TTL : Load=10TTL, 0.4V →2.4V		1.5		ns
Output Fall Time (note 1)	tf	CMOS: CL=15pF 0.9VDD→0.1VDD		1.5		ns
		TTL : Load=10TTL, 2.4V →0.4V		1.5		ns
Output Duty Cycle	DUTY	CMOS: CL=15pF @ 0.5VDD	45		55	%
		TTL : Load=10TTL, 1.4V	45		55	%

note 1 : the values for tr, tf are the designed values.

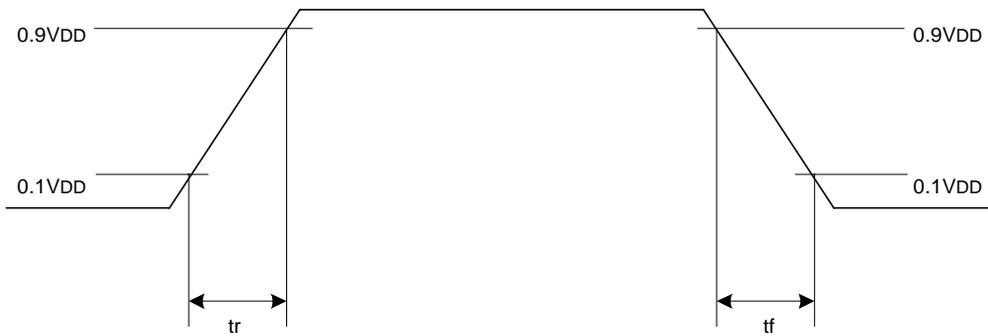
**XC2164A51A ~ XC2164A51L 3rd Overtone** (Unless otherwise stated, VDD=3.3V or 5.0V, No Load, Ta=30 ~ + 80°C)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Output Rise Time (note 1)	tr	CMOS: CL=15pF 0.1VDD→0.9VDD		1.5		ns
Output Fall Time (note 1)	tf	CMOS: CL=15pF 0.9VDD→0.1VDD		1.5		ns
Output Duty Cycle	DUTY	CMOS: CL=15pF @ 0.5VDD	45		55	%

note 1 : the values for tr, tf are the designed values.

## SWITCHING WAVEFORMS

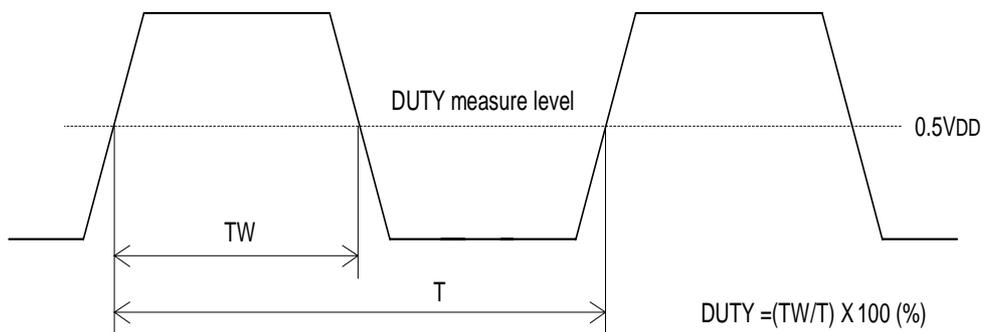
### ● Switching Time CMOS Output



### TTL Output



### ● Duty Cycle CMOS Output



### TTL Output

