OVERVIEW

The 5036 series are 2.5V operation, differential LV-PECL output oscillator ICs. They support 50MHz to 400MHz 3rd overtone oscillation and 50MHz to 600MHz fundamental oscillation. The devices are fabricated using a proprietary BiCMOS process, enabling a high-frequency oscillator circuit and differential LV-PECL output buffer to be incorporated on a single chip. The 5036 series can be used to construct high-frequency LV-PECL output oscillators.

FEATURES

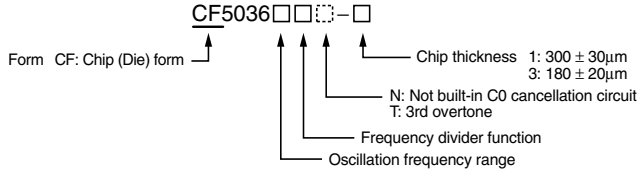
- 2.375 to 3.6V operating supply voltage range
- Recommended oscillation frequency range (varies with version)
  - 50MHz to 600MHz fundamental oscillation
  - 50MHz to 400MHz 3rd overtone oscillation
- – 40 to 85°C operating temperature range
- Differential LV-PECL output
- 50Ω output load (terminated to V_{CC} – 2V)
- Standby function
  - Outputs are high impedance when OE is LOW. (oscillator stops)
- Power-saving pull-up resistor built-in (pin OE)
- BiCMOS process
- Chip form (CF5036××, CF5036×××)

SERIES CONFIGURATION

Version	Built-in C0 cancellation circuit	Recommended C0 value [pF]	Recommended crystal unit/ resonator	Recommended oscillation frequency range*1 [MHz]	Output frequency	
					f_O	$f_O/2$
5036G×	Yes	≥ 2	Fundamental, 3rd overtone, SAW	50 to 80	5036G1	5036G2
5036A×				80 to 120	5036A1	5036A2
5036B×				100 to 180	5036B1	5036B2
5036C×				150 to 250	5036C1	5036C2
5036D×			Fundamental, SAW	250 to 400	5036D1	5036D2
5036E×		2		400 to 600	5036E1	5036E2
5036D1T		≥ 2.5	Fundamental, 3rd overtone, SAW	250 to 400	5036D1T	–
5036G×N	No	≤ 2.5	Fundamental, SAW	50 to 100	5036G1N	5036G2N
5036A×N				80 to 120	5036A1N	5036A2N
5036B×N				110 to 180	5036B1N	5036B2N
5036C1N				170 to 250	5036C1N	–
5036D1N				250 to 400	5036D1N	–

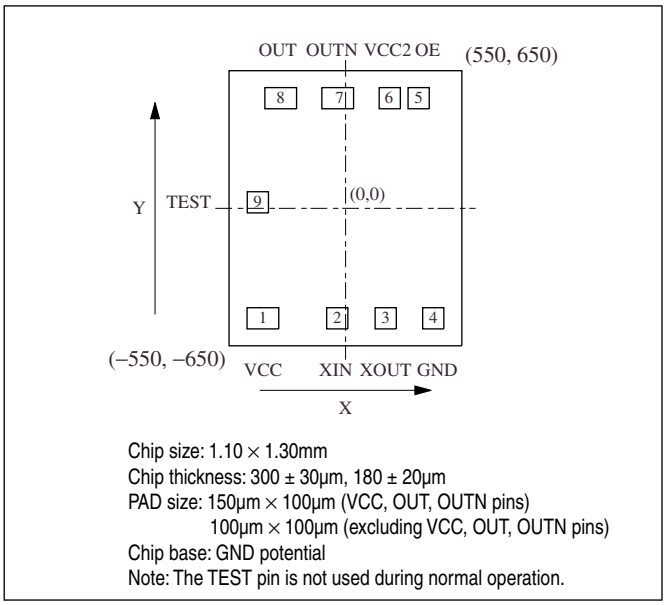
*1. The recommended oscillation frequency is a yardstick value derived from the crystal used for NPC characteristics authentication. However, the oscillator frequency band is not guaranteed. Specifically, the characteristics can vary greatly due to crystal characteristics and mounting conditions, so the oscillation characteristics of components must be carefully evaluated.

ORDERING INFORMATION

Device	Package	Version name
CF5036××–1	Chip form	
CF5036D1T–1		
CF5036××N–3		

PAD LAYOUT

(Unit: µm)



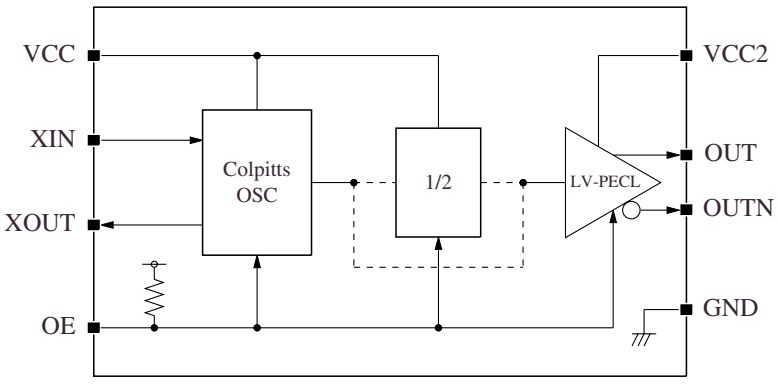
Chip size: 1.10 × 1.30mm
Chip thickness: 300 ± 30µm, 180 ± 20µm
PAD size: 150µm × 100µm (VCC, OUT, OUTN pins)
100µm × 100µm (excluding VCC, OUT, OUTN pins)
Chip base: GND potential
Note: The TEST pin is not used during normal operation.

PIN DESCRIPTION and PAD DIMENSIONS

Pad No.	Name	I/O*1	Function	Pad dimensions [µm]	
				X	Y
1	VCC	–	(+) supply pin	–390	–520
2	XIN	I	Oscillator input pin	–39	–520
3	XOUT	O	Oscillator output pin	190	–520
4	GND	–	(–) ground pin	415	–520
5	OE	I	Output enable pin. Outputs are high impedance when LOW (oscillator stopped). Power-saving pull-up resistor built-in.	346	520
6	VCC2	–	(+) output buffer supply pin	209	520
7	OUTN	O	Complementary output pin	–27	520
8	OUT	O	Output pin	–306	520
9	TEST	–	IC test pin. Leave open circuit for normal operation.	–414	28

*1. I: input, O: output

BLOCK DIAGRAM



OSCILLATOR CIRCUIT CONSTANT

The 5036 series oscillator setting varies with device version to optimize characteristics over the recommended oscillation frequency range.

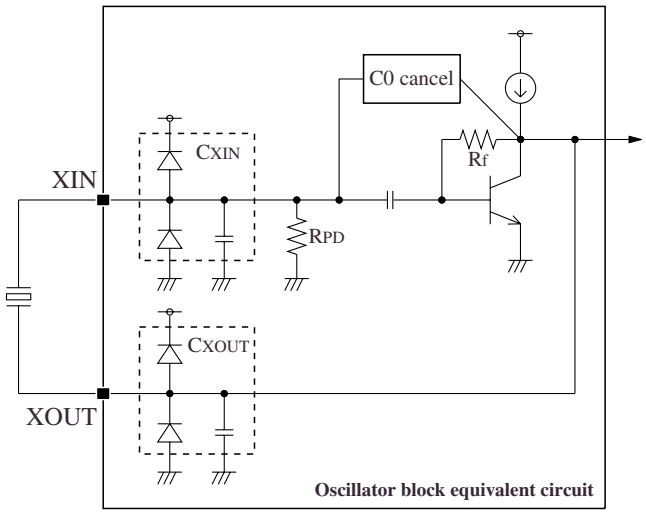
5036G×, 5036A×, 5036B×, 5036C×, 5036D×, 5036E×, 5036D1T

The 5036G×/A×/B×/C×/D×/D1T versions are suitable for use of crystal unit with large C0 value (approximately C0 ≥ 2.0pF (5036G×/A×/B×/C×/D×)/ C0 ≥ 2.5pF (5036D1T)). The 5036E× version is suitable for use of crystal unit with C0 value of approximately 2pF.

Version	Recommended crystal unit/ resonator	Built-in capacitance*1 [pF]		Recommended oscillation frequency range*2 [MHz]
		C_{XIN}	C_{XOUT}	
5036G×	Fundamental, 3rd overtone, SAW	16	16	50 to 80
5036A×		12	12	80 to 120
5036B×		8	8	100 to 180
5036C×		6	6	150 to 250
5036D×	Fundamental, SAW	5	5	250 to 400
5036E×		5	5	400 to 600
5036D1T	Fundamental, 3rd overtone, SAW	5	5	250 to 400

*1. The oscillator internal capacitance values includes parasitic capacitance.
*2. The recommended oscillation frequency is a yardstick value derived from the crystal used for NPC characteristics authentication. However, the oscillator frequency band is not guaranteed. Specifically, the characteristics can vary greatly due to crystal characteristics and mounting conditions, so the oscillation characteristics of components must be carefully evaluated.

Oscillator equivalent circuit



The 5036G×/A×/B×/C×/D×(T)/E× oscillator circuit has a C0 cancel circuit built-in to improve the oscillator margin. If power is applied when there is an open circuit between XIN and XOUT, self oscillation may occur, which is not abnormal. Users should confirm that the oscillator operates normally when a crystal unit is connected.
The XOUT pin of 5036E× version emphasizes high frequency characteristics. Accordingly, its electrostatic withstand voltage is significantly lower than that of the other pins. ESD breakdown prevention handling precautions are strongly recommended.

5036G×N, 5036A×N, 5036B×N, 5036C1N, 5036D1N

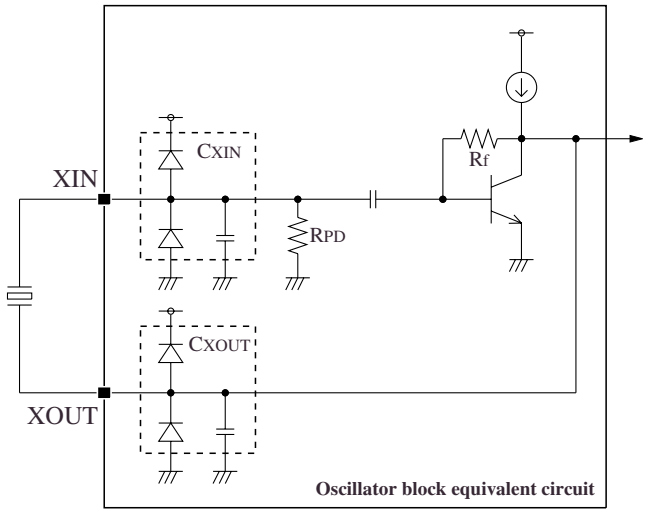
The 5036G×N/A×N/B×N/C1N/D1N versions are suitable for use of crystal unit with small C0 value (approximately C0 ≤ 2.5pF).

Version	Recommended crystal unit/ resonator	Built-in capacitance*1[pF]		Recommended oscillation frequency range*2 [MHz]
		C_{XIN}	C_{XOUT}	
5036G×N	Fundamental, SAW	16	16	50 to 100
5036A×N		12	16	80 to 120
5036B×N		11	13	110 to 180
5036C1N		10	10	170 to 250
5036D1N		8	8	250 to 400

*1. The oscillator internal capacitance values includes parasitic capacitance.

*2. The recommended oscillation frequency is a yardstick value derived from the crystal used for NPC characteristics authentication. However, the oscillator frequency band is not guaranteed. Specifically, the characteristics can vary greatly due to crystal characteristics and mounting conditions, so the oscillation characteristics of components must be carefully evaluated.

Oscillator equivalent circuit



Oscillator block equivalent circuit

SPECIFICATIONS

Absolute Maximum Ratings

Parameter	Symbol	Conditions	Rating	Unit
Supply voltage range*1	V_{CC}	VCC, VCC2 pins	–0.5 to +5.0	V
Input voltage range*1 *2	V_{IN}	XIN, OE pins	GND – 0.5 to V_{CC} + 0.5	V
Output voltage range*1 *2	V_{OUT}	XOUT, OUT/OUTN pins	GND – 0.5 to V_{CC} + 0.5	V
Storage temperature range*3	T_{STG}	Chip form	–65 to +150	°C

*1. This parameter rating is the values that must never exceed even for a moment. This product may suffer breakdown if this parameter rating is exceeded. Operation and characteristics are guaranteed only when the product is operated at recommended operating conditions.
*2. V_{CC} is a V_{CC} value of recommended operating conditions.
*3. When stored in nitrogen or vacuum atmosphere applied to IC itself only (excluding packaging materials).

Recommended Operating Conditions

Parameter	Symbol	Conditions	Rating			Unit
			Min	Typ	Max	
Operating supply voltage	V_{CC}	VCC, VCC2 pins	2.375	–	3.6	V
Operating supply voltage difference	ΔV_{CC}	Voltage difference between VCC and VCC2 pins	–0.1	–	+0.1	V
Input voltage	V_{IN}	XIN, OE pins	GND	–	V_{CC}	V
Operating temperature	T_{OPR}		–40	+25	+85	°C
Output load	R_L	Terminated to V_{CC} – 2V	49.5	50	50.5	Ω
Output frequency*1	f_{OUT}		25	–	600	MHz

*1. Output frequency varies by version. Refer to “SERIES CONFIGURATION”.

Note. Since it may influence the reliability if it is used out of range of recommended operating conditions, this product should be used within this range.

Electrical Characteristics

3.3V operation

V_{CC} = 3.0 to 3.6V, GND = 0V, Ta = –40 to +85°C unless otherwise noted.

Parameter	Symbol	Conditions		Rating			Unit
				Min	Typ	Max	
Current consumption	I_{CC}	Measurement cct. 1, OE = open	5036G×(N), A×(N), B×(N), C×(N), D×(×)	–	55	88	mA
			5036E×	–	64	98	mA
Standby current	I_{STB}	Measurement cct. 1, OE = LOW		–	–	30	µA
HIGH-level output voltage	V_{OH}	Measurement cct. 2, V_{CC} = 3.3V, OE = open, TEST = LOW, XIN = HIGH or LOW, OUT/OUTN pins	Ta = 0 to 85°C	2.275	2.350	2.420	V
			Ta = –40°C to 0°C	2.215	2.295	2.420	V
LOW-level output voltage	V_{OL}		Ta = 0 to 85°C	1.490	1.600	1.680	V
			Ta = –40°C to 0°C	1.470	1.605	1.745	V
Output leakage current	I_Z	Measurement cct. 3, SW2 = HIGH or LOW, OE = LOW, OUT/OUTN pins		–	–	10	µA
HIGH-level input voltage	V_{IH}	Measurement cct. 1, OE pin		$0.7V_{CC}$	–	–	V
LOW-level input voltage	V_{IL}	Measurement cct. 1, OE pin		–	–	$0.3V_{CC}$	V
HIGH-level input current	I_{IH}	Measurement cct. 1, V_{IN} = $0.7V_{CC}$, OE pin		–20	–	–200	µA
LOW-level input current	I_{IL}	Measurement cct. 1, V_{IN} = 0V, OE pin		–2	–	–20	µA
Pull-down resistance	R_{PD}	Measurement cct. 3, SW1 = ON, XIN pin		12	24	48	kΩ

2.5V operation

V_{CC} = 2.375 to 2.625V, GND = 0V, Ta = –40 to +85°C unless otherwise noted.

Parameter	Symbol	Conditions		Rating			Unit
				Min	Typ	Max	
Current consumption	I_{CC}	Measurement cct. 1, OE = open	5036G×(N), A×(N), B×(N), C×(N), D×(×)	–	55	88	mA
			5036E×	–	64	98	mA
Standby current	I_{STB}	Measurement cct. 1, OE = LOW		–	–	30	µA
HIGH-level output voltage	V_{OH}	Measurement cct. 2, V_{CC} = 2.5V, OE = open, TEST = LOW, XIN = HIGH or LOW, OUT/OUTN pins	Ta = 0 to 85°C	1.475	1.550	1.760	V
			Ta = –40°C to 0°C	1.415	1.495	1.620	V
LOW-level output voltage	V_{OL}		Ta = 0 to 85°C	0.690	0.800	1.095	V
			Ta = –40°C to 0°C	0.670	0.805	1.195	V
Output leakage current	I_Z	Measurement cct. 3, SW2 = HIGH or LOW, OE = LOW, OUT/OUTN pins		–	–	10	µA
HIGH-level input voltage	V_{IH}	Measurement cct. 1, OE pin		$0.7V_{CC}$	–	–	V
LOW-level input voltage	V_{IL}	Measurement cct. 1, OE pin		–	–	$0.3V_{CC}$	V
HIGH-level input current	I_{IH}	Measurement cct. 1, V_{IN} = $0.7V_{CC}$, OE pin		–10	–	–150	µA
LOW-level input current	I_{IL}	Measurement cct. 1, V_{IN} = 0V, OE pin		–2	–	–20	µA
Pull-down resistance	R_{PD}	Measurement cct. 3, SW1 = ON, XIN pin		12	24	48	kΩ

Switching Characteristics

3.3V operation

V_{CC} = 3.0 to 3.6V, GND = 0V, Ta = −40 to +85°C unless otherwise noted.

Parameter	Symbol	Conditions			Rating			Unit
					Min	Typ	Max	
Output duty cycle 1	Duty1	Measurement cct. 4, measured at output crossing point, Ta = 25°C, V_{CC} = 3.3V	5036××, 5036D1T	f < 350MHz	45	–	55	%
				f ≥ 350MHz	40	–	60	%
			5036××N		40	–	60	%
Output duty cycle 2	Duty2	Measurement cct. 4, measured at 50% output swing, Ta = 25°C, V_{CC} = 3.3V	5036××	f < 250MHz	45	–	55	%
				f ≥ 250MHz	40	–	60	%
			5036D1T	f < 350MHz	45	–	55	%
				f ≥ 350MHz	40	–	60	%
			5036××N		40	–	60	%
Output swing*1	V_{Opp}	Measurement cct. 4, Ta = T_{OPR}, Peak to peak of single output waveform	5036G×(N): f = 80MHz		0.4	–	–	V
			5036A×(N): f = 120MHz		0.4	–	–	V
			5036B×(N): f = 180MHz		0.4	–	–	V
			5036C×(N): f = 250MHz		0.4	–	–	V
			5036D×(×): f = 400MHz		0.4	–	–	V
			5036E×: f = 600MHz		0.4	–	–	V
Output rise time	t_r	Measurement cct. 4, 20 to 80% output swing			–	0.3	0.7	ns
Output fall time	t_f	Measurement cct. 4, 80 to 20% output swing			–	0.3	0.7	ns
Output enable time	t_{OE}	Measurement cct. 1, Ta = 25°C			–	–	2	ms
Output disable time	t_{OD}	Measurement cct. 1, Ta = 25°C			–	–	200	ns

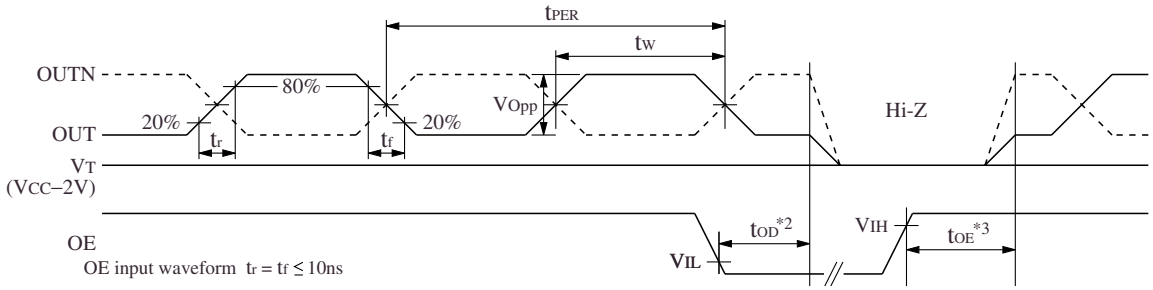
*1. The said values are measured by using the NPC standard jig.

2.5V operation

V_{CC} = 2.375 to 2.625V, GND = 0V, Ta = −40 to +85°C unless otherwise noted.

Parameter	Symbol	Conditions			Rating Min	Rating Typ	Rating Max	Unit
Output duty cycle 1	Duty1	Measurement cct. 4, measured at output crossing point, Ta = 25°C, V_{CC} = 2.5V	5036××, 5036D1T	f < 350MHz	45	–	55	%
				f ≥ 350MHz	40	–	60	%
			5036××N		40	–	60	%
Output duty cycle 2	Duty2	Measurement cct. 4, measured at 50% output swing, Ta = 25°C, V_{CC} = 2.5V	5036××	f < 250MHz	45	–	55	%
				f ≥ 250MHz	40	–	60	%
			5036D1T, 5036××N		40	–	60	%
Output swing*1	V_{Opp}	Measurement cct. 4, Ta = T_{OPR}, Peak to peak of single output waveform	5036G×(N): f = 80MHz		0.2	–	–	V
			5036A×(N): f = 120MHz		0.2	–	–	V
			5036B×(N): f = 180MHz		0.2	–	–	V
			5036C×(N): f = 250MHz		0.2	–	–	V
			5036D×(×): f = 400MHz		0.2	–	–	V
			5036E×: f = 600MHz		0.2	–	–	V
Output rise time	t_r	Measurement cct. 4, 20 to 80% output swing			–	0.3	0.7	ns
Output fall time	t_f	Measurement cct. 4, 80 to 20% output swing			–	0.3	0.7	ns
Output enable time	t_{OE}	Measurement cct. 1, Ta = 25°C			–	–	2	ms
Output disable time	t_{OD}	Measurement cct. 1, Ta = 25°C			–	–	200	ns

*1. The said values are measured by using the NPC standard jig.



DUTY1 = $t_W/t_{PER} \times 100$ (%) @ crossing point
DUTY2 = $t_W/t_{PER} \times 100$ (%) @ 50% waveform

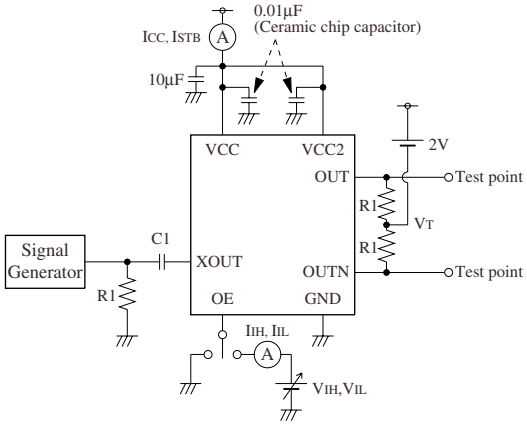
*2. The OUT/OUTN output goes high impedance after the OE is fallen and then the output disable time "t_{OD}" has elapsed. The output signal is pulled down to V_T (terminated voltage) by load resistance.
*3. The normal output occurs after the OE is raised and then the output enable time "t_{OE}" has elapsed.

Timing chart

MEASUREMENT CIRCUITS

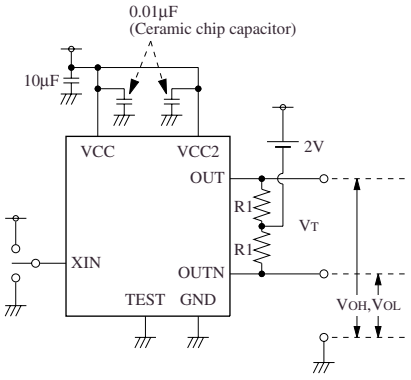
■ Note: Bypass capacitors specified in each measurement circuit below should be connected between VCC and GND, and VCC2 and GND. Load resistance specified in each measurement circuit below should be connected to OUT and OUTN pins (excluding measurement circuit 3).
Circuit wiring of bypass capacitors and load resistance should be connected as short as possible. If the circuit wiring is long, the required characteristics may not be realized. Also, if the values of bypass capacitors and load resistance differ from the description in this document or are not connected, the required characteristics may not be realized.

Measurement Circuit 1



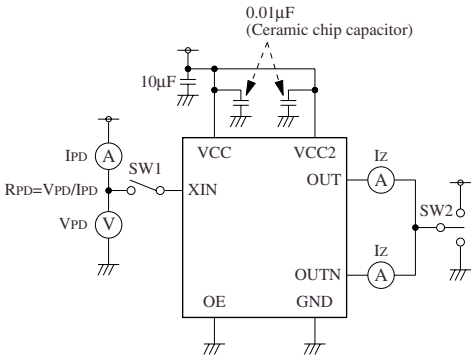
C1: 0.01µF
R1: 49.9Ω

Measurement Circuit 2

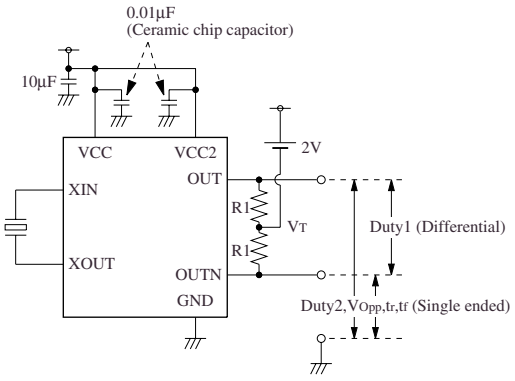


R1: 49.9Ω
XIN = HIGH: OUT = HIGH, OUTN = LOW
XIN = LOW : OUT = LOW, OUTN = HIGH

Measurement Circuit 3



Measurement Circuit 4



R1: 49.9Ω

FUNCTIONAL DESCRIPTION

Standby Function

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

OE	OUT, OUTN	Oscillator
HIGH (or open)	Either f_O or $f_O/2$	Normal operation
LOW	High impedance	Stopped

Power-saving Pull-up Resistor

The OE pin pull-up resistance changes in response to the input level (HIGH or LOW). When OE is tied LOW (standby state), the pull-up resistance becomes large, reducing the current consumed by the resistance. When OE is open circuit, the pull-up resistance becomes small, decreasing the susceptibility to the effects of external noise.

Oscillation Detector Function

The 5036 series also feature an oscillation detector circuit. This circuit functions to disable the outputs until the oscillator circuit starts and oscillation becomes stable. This alleviates the danger of abnormal oscillator output at oscillator start-up when power is applied or when OE is switched.

Please pay your attention to the following points at time of using the products shown in this document.

1. The products shown in this document (hereinafter "Products") are designed and manufactured to the generally accepted standards of reliability as expected for use in general electronic and electrical equipment, such as personal equipment, machine tools and measurement equipment. The Products are not designed and manufactured to be used in any other special equipment requiring extremely high level of reliability and safety, such as aerospace equipment, nuclear power control equipment, medical equipment, transportation equipment, disaster prevention equipment, security equipment. The Products are not designed and manufactured to be used for the apparatus that exerts harmful influence on the human lives due to the defects, failure or malfunction of the Products.
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NC0308HE 2010.11