OVERVIEW

The 5037 series are 2.5V operation, LVDS output oscillator ICs. They support 80MHz to 400MHz 3rd overtone oscillation and 80MHz to 600MHz fundamental oscillation. The 5037 series can be used to construct high-frequency LVDS output oscillators.

FEATURES

- 2.375 to 3.6V operating supply voltage range
- Recommended oscillation frequency range (varies with version)
  - 80MHz to 600MHz fundamental oscillation
  - 80MHz to 400MHz 3rd overtone oscillation
- – 40 to 85°C operating temperature range
- LVDS output
- 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 (CF5037××, CF5037×××)

SERIES CONFIGURATION

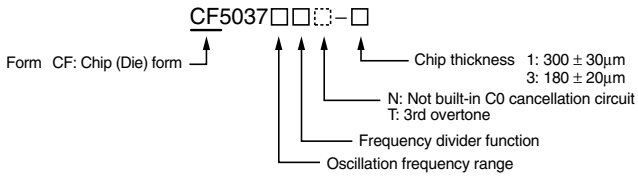
Version	Built-in C0 cancellation circuit	Recommended C0 value [pF]	Recommended crystal unit/ resonator	Recommended oscillation frequency range*1 [MHz]	Output frequency*2	
					f_O	$f_O/2$
5037A1	Yes	≥ 2	Fundamental, 3rd overtone, SAW	80 to 120	5037A1	–
5037B×				100 to 180	5037B1	5037B2*3
5037C×				150 to 250	5037C1	5037C2
5037D×			Fundamental, SAW	250 to 400	5037D1	5037D2
5037E×		2		400 to 600	5037E1	(5037E2)
5037D1T		≥ 2.5	Fundamental, 3rd overtone, SAW	250 to 400	5037D1T	–
5037A1N	No	≤ 2.5	Fundamental, SAW	80 to 120	5037A1N	–
5037B1N				110 to 180	5037B1N	–

*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.

*2. This version in parentheses ( ) is under development. Please ask our Sales & Marketing section for further detail.

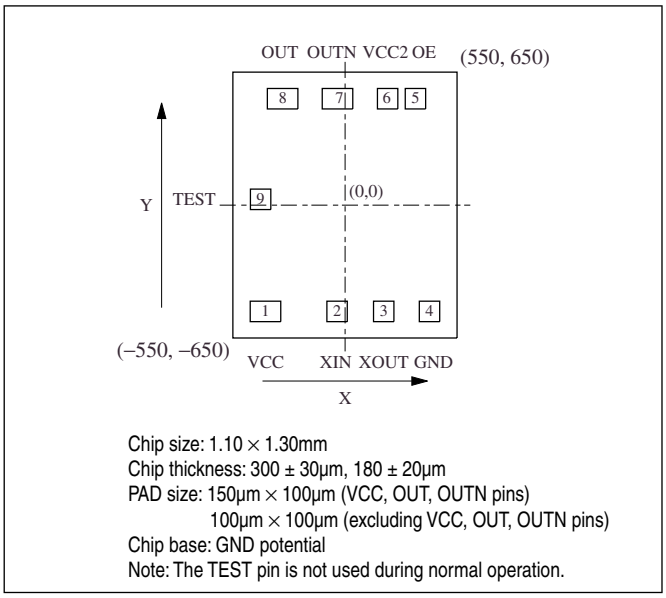
*3. Minimum output frequency: 80MHz

ORDERING INFORMATION

Device	Package	Version name
CF5037××–1	Chip form	
CF5037D1T–1		
CF5037×1N–3		

PAD LAYOUT

(Unit: µm)



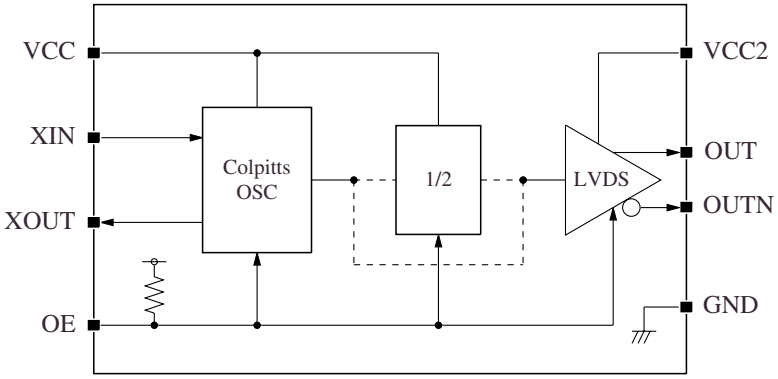
Chip size: 1.10 × 1.30mm
Chip thickness: 300 ± 30µm, 180 ± 20µm
PAD size: 150µm × 100µm (VCC, OUT, OUTN pins)
100µm × 100µm (excluding VCC, OUT, OUTN pins)
Chip base: GND potential
Note: The TEST pin is not used during normal operation.

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 5037 series oscillator setting varies with device version to optimize characteristics over the recommended operating frequency range.

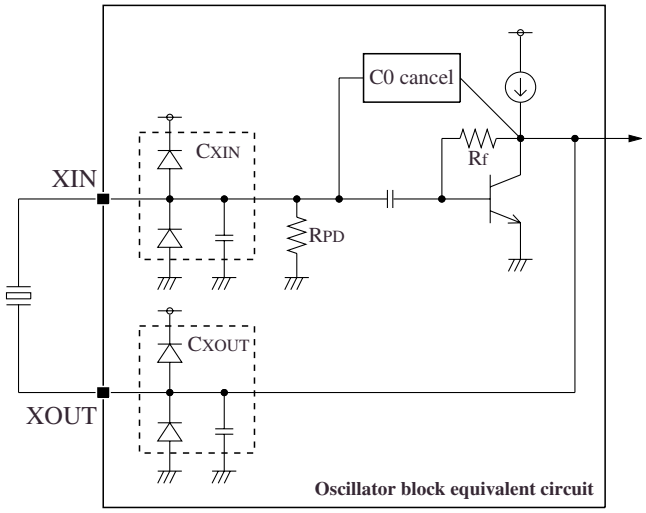
5037A1, 5037B×, 5037C×, 5037D×, 5037E×, 5037D1T

The 5037A1/B×/C×/D×/D1T versions are suitable for use of crystal unit with large C0 value (approximately C0 ≥ 2.0pF (5037A1/B×/C×/D×)/ C0 ≥ 2.5pF (5037D1T)). The 5037E× 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}	
5037A1	Fundamental, 3rd overtone, SAW	12	12	80 to 120
5037B×		8	8	100 to 180
5037C×		6	6	150 to 250
5037D×	Fundamental, SAW	5	5	250 to 400
5037E×		5	5	400 to 600
5037D1T	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



Oscillator block equivalent circuit

The 5037A1/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 5037E× 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.

5037A1N, 5037B1N

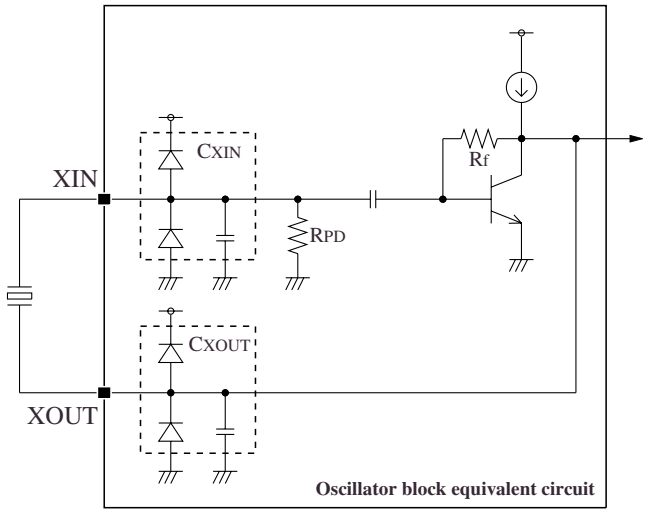
The 5037A1N/B1N versions are suitable for use of crystal unit with small C0 value (approximately C0 ≤ 2.5pF).

Version	Recommended crystal unit/ resonator	Built-in capacitance*1[pF]		Recommended oscillation frequency range*2 [MHz]
		C_{XIN}	C_{XOUT}	
5037A1N	Fundamental, SAW	12	16	80 to 120
5037B1N		11	13	110 to 180

*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



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	Between OUT and OUTN pins	99	100	101	Ω
Output frequency*1	f_{OUT}		80	–	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	5037A1(N), B×(N), C×, D×(T)	–	45	66	mA
			5037E×	–	53	73	mA
Standby current	I_{STB}	Measurement cct. 1, OE = LOW		–	–	30	µA
HIGH-level output voltage	V_{OH}	Measurement cct. 1, OE = open, TEST = LOW, R_L = 100Ω, f_{OUT} = 100MHz, Duty = 50%, OUT/OUTN pins		–	1.43	1.6	V
LOW-level output voltage	V_{OL}			0.9	1.1	–	V
Differential output voltage	V_{OD}	Measurement cct. 1, OE = open, TEST = LOW, R_L = 100Ω, f_{OUT} = 100MHz, Duty = 50%		247	330	454	mV
Differential output error	ΔV_{OD}			–	–	50	mV
Offset voltage	V_{OS}	Measurement cct. 1, OE = open, TEST = LOW, R_L = 100Ω, f_{OUT} = 100MHz, Duty = 50%		1.125	1.25	1.375	V
Offset error	ΔV_{OS}			–	–	50	mV
Output leakage current	I_Z	Measurement cct. 2, 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. 2, 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	5037A1(N), B×(N), C×, D×(T)	–	43	63	mA
			5037E×	–	51	70	mA
Standby current	I_{STB}	Measurement cct. 1, OE = LOW		–	–	30	µA
HIGH-level output voltage	V_{OH}	Measurement cct. 1, OE = open, TEST = LOW, R_L = 100Ω, f_{OUT} = 100MHz, Duty = 50%, OUT/OUTN pins		–	1.43	1.6	V
LOW-level output voltage	V_{OL}			0.9	1.1	–	V
Differential output voltage	V_{OD}	Measurement cct. 1, OE = open, TEST = LOW, R_L = 100Ω, f_{OUT} = 100MHz, Duty = 50%		247	330	454	mV
Differential output error	ΔV_{OD}			–	–	50	mV
Offset voltage	V_{OS}	Measurement cct. 1, OE = open, TEST = LOW, R_L = 100Ω, f_{OUT} = 100MHz, Duty = 50%		1.125	1.25	1.375	V
Offset error	ΔV_{OS}			–	–	50	mV
Output leakage current	I_Z	Measurement cct. 2, 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. 2, 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	Duty	Measurement cct. 3, measured at 0V differential output (crossing point), Ta = 25°C, V_{CC} = 3.3V	5037××, 5037D1T	f < 350MHz	45	–	55	%
				f ≥ 350MHz	40	–	60	%
			5037×1N		40	–	60	%
Output swing*1	V_{Opp}	Measurement cct. 3, Ta = T_{OPR}, differential output waveform peak-to-peak	5037A1(N): f = 120MHz		0.35	–	–	V
			5037B×(N): f = 180MHz		0.35	–	–	V
			5037C×: f = 250MHz		0.35	–	–	V
			5037D×(T): f = 400MHz		0.35	–	–	V
			5037E×: f = 600MHz		0.35	–	–	V
Output rise time	t_r	Measurement cct. 3, 20 to 80% differential output swing			–	0.3	0.7	ns
Output fall time	t_f	Measurement cct. 3, 80 to 20% differential 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

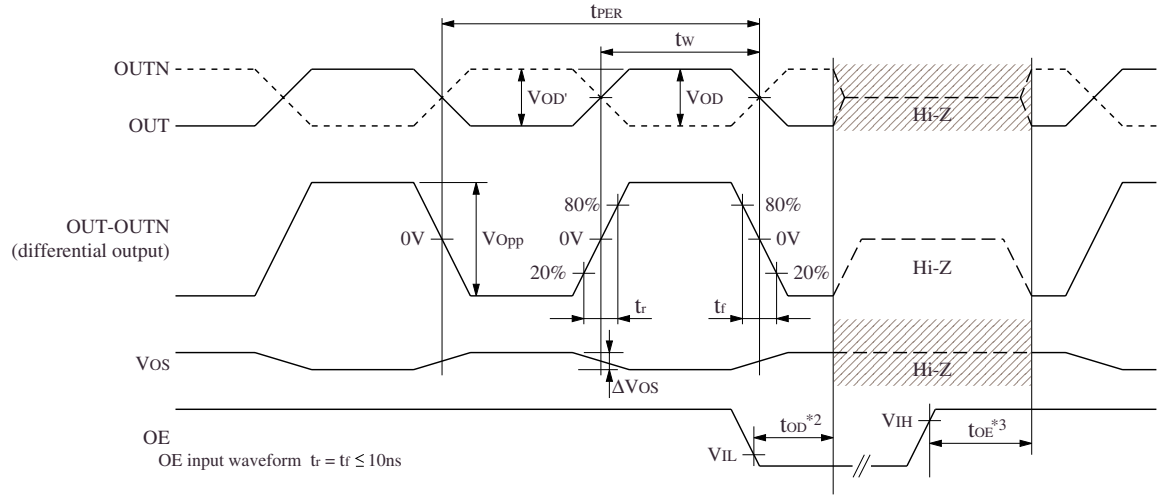
*1. The said values are measured by using the NPC standard jig.

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	Duty	Measurement cct. 3, measured at 0V differential output (crossing point), Ta = 25°C, V_{CC} = 2.5V	5037××, 5037D1T	f < 350MHz	45	–	55	%
				f ≥ 350MHz	40	–	60	%
			5037×1N		40	–	60	%
Output swing*1	V_{Opp}	Measurement cct. 3, Ta = T_{OPR}, differential output waveform peak-to-peak	5037A1(N): f = 120MHz		0.25	–	–	V
			5037B×(N): f = 180MHz		0.25	–	–	V
			5037C×: f = 250MHz		0.25	–	–	V
			5037D×(T): f = 400MHz		0.25	–	–	V
			5037E×: f = 600MHz		0.25	–	–	V
Output rise time	t_r	Measurement cct. 3, 20 to 80% differential output swing			–	0.3	0.7	ns
Output fall time	t_f	Measurement cct. 3, 80 to 20% differential 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.



$DUTY = t_W/t_{PER} \times 100$ (%) @ crossing point

$\Delta V_{OD} = |V_{OD}' - V_{OD}|$

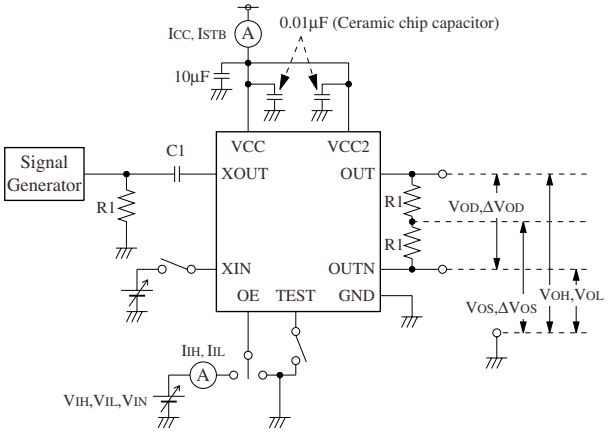
*2. The OUT/OUTN output goes high impedance after the OE is fallen and then the output disable time "t_{OD}" has elapsed.
*3. The normal output occurs after the OE is raised and then the output enable time "t_{OE}" has elapsed.

Timing chart

MEASUREMENT CIRCUITS

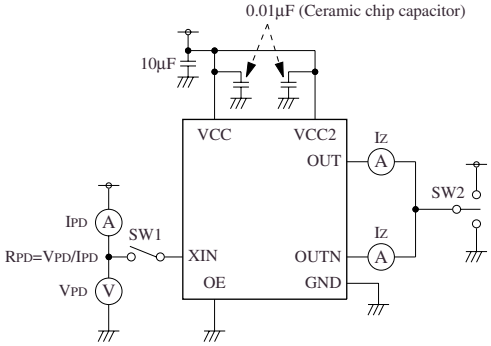
■ Note: Bypass capacitors specified in each measurement circuit below should be connected between VCC and GND, and VCC2 and GND. Load resistance specified in each measurement circuit below should be connected between OUT and OUTN pins (excluding measurement circuit 2).
Circuit wiring of bypass capacitors 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

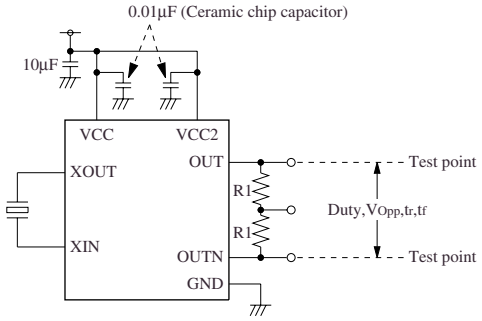


C1: 0.01µF, R1: 49.9Ω

Measurement Circuit 2



Measurement Circuit 3



R1: 49.9Ω

Note 1. The recommended differential probe used for measurement should have 5GHz analog bandwidth, ≥ 50kΩ impedance, and < 1pF capacitive load.

Note 2. If common-mode noise becomes a problem, a DC decoupling capacitor (approximately 1000pF) and terminating resistor matching the common-mode signal should be connected to the output center tap.

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 5037 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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