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IPS020 series IC 【High Freq. Type】
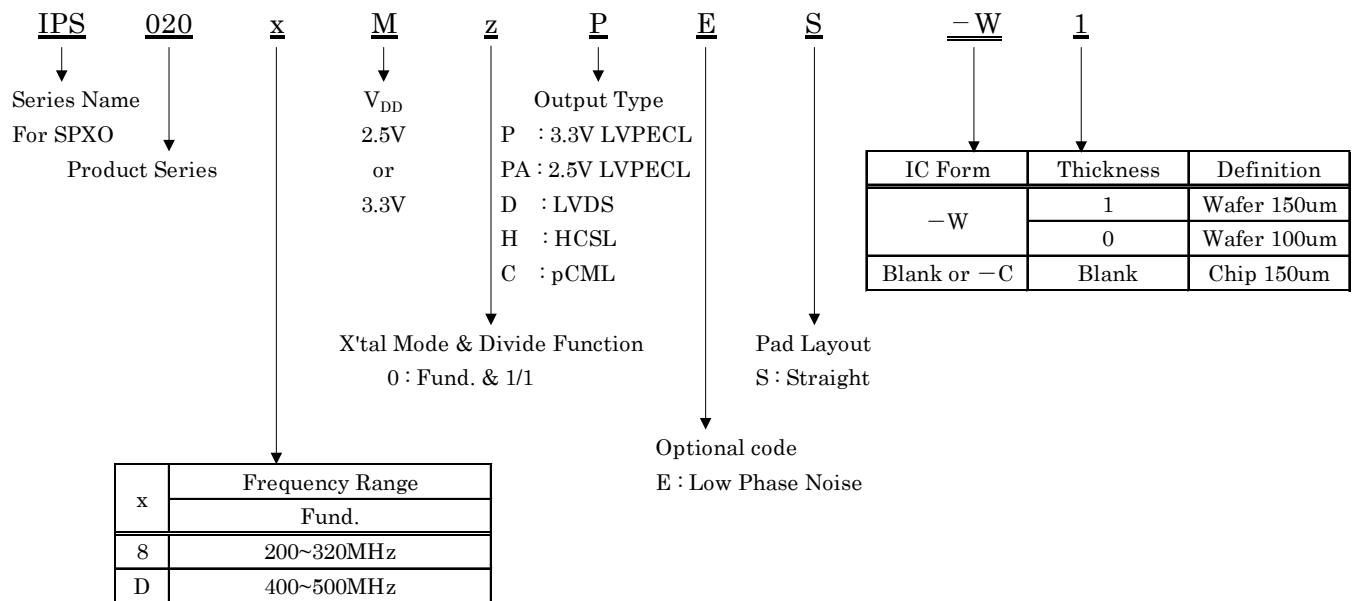Differential Output SPXO

## ■ Description

IPS020 High Frequency Type is the IC for differential output SPXO corresponding to the high frequency from 200MHz to 500MHz, and operation voltage is 2.375V minimum.

## ■ Features

- Operation temperature : -40℃~125℃
- Power supply voltage : 2.375V~3.63V
- Standby function : Oscillation stop
- Crystal frequency : 200MHz~500MHz
- Output : LVPECL / LVDS / HCSL / pCML(HDLVDS)
- Crystal mode : Fundamental
- Small chip size : 0.65mm × 0.75mm
- Pad layout : Straight type
- Duty cycle : Within 50%±5%

## 1. Part number rule

IPS  020  x  M  z  P  E  S  −W  1

Series Name
For SPXO

Product Series

$V_{DD}$
2.5V
or
3.3V

Output Type
P : 3.3V LVPECL
PA : 2.5V LVPECL
D : LVDS
H : HCSL
C : pCML

| IC Form | Thickness | Definition |
|---|---|---|
| −W | 1 | Wafer 150um |
| | 0 | Wafer 100um |
| Blank or −C | Blank | Chip 150um |

X'tal Mode & Divide Function
0 : Fund. & 1/1

Pad Layout
S : Straight

Optional code
E : Low Phase Noise

| x | Frequency Range |
|---|---|
| | Fund. |
| 8 | 200~320MHz |
| D | 400~500MHz |

The contents of this sheet are subject to change without notice.

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IPS020 series IC 【High Freq. Type】
Differential Output SPXO

## 2. Series

| Part Number | Output | Crystal Frequency (MHz) | | | Divide | Output Frequency (MHz) | | Remarks |
|---|---|---|---|---|---|---|---|---|
| | | Mode | Min. | Max. | | Min. | Max. | |
| IPS020 8 M 0 P     E S | LVPECL | Fund. | 200 | 320 | 1/1 | 200 | 320 | $V_{DD}$=3.3V±10% |
| IPS020 D M 0 P     E S | | | 400 | 500 | | 400 | 500 | |
| IPS020 8 M 0 P A E S | LVPECL | Fund. | 200 | 320 | 1/1 | 200 | 320 | $V_{DD}$=2.5V±5% |
| IPS020 D M 0 P A E S | | | 400 | 500 | | 400 | 500 | |
| IPS020 8 M 0 D     E S | LVDS | Fund. | 200 | 320 | 1/1 | 200 | 320 | |
| IPS020 D M 0 D     E S | | | 400 | 500 | | 400 | 500 | |
| IPS020 8 M 0 H     E S | HCSL | Fund. | 200 | 320 | 1/1 | 200 | 320 | |
| IPS020 8 M 0 C     E S | pCML | Fund. | 200 | 320 | 1/1 | 200 | 320 | |

## 3. Absolute Maximum Ratings

$V_{SS}$=0V, Ta=25℃± 2℃

| Parameter | Symbol | Condition | Ratings | | |
|---|---|---|---|---|---|
| | | | Min | Max | Unit |
| Supply Voltage | $V_{DD}$ | | $V_{SS}$-0.5 | 5.0 | V |
| Input Voltage | $V_{IN}$ | All Input Pin | $V_{SS}$-0.5 | $V_{DD}$+0.5 | V |
| Output Voltage | $V_{OUT}$ | | $V_{SS}$-0.5 | $V_{DD}$+0.5 | V |
| Output Current | $I_{OUT}$ | | | 25 | mA |
| Junction Temperature | Tj | | -55 | 150 | ℃ |
| Storage Temperature | Tstg | | -55 | 125 | ℃ |

IPS020 series IC【High Freq. Type】
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## 4. Recommended Operating Condition

$V_{SS}$=0V, Ta=-40℃~125℃

| Parameter | Symbol | Condition | Min | Typ | Max | Unit | Note |
|---|---|---|---|---|---|---|---|
| Supply Voltage | $V_{DD}$ | 2.5V LVPECL | 2.375 | 2.50 | 2.625 | V | $V_{DD}$ |
| | | LVDS, HCSL | 2.375 | 3.30 | 3.63 | | |
| | | 3.3V LVPECL, pCML | 2.97 | 3.30 | 3.63 | | |
| "H" Input Voltage | $V_{IH}$ | | $V_{DD}$×0.7 | | | V | CE |
| "L" Input Voltage | $V_{IL}$ | | | | $V_{DD}$×0.3 | V | CE |
| Input Voltage | $V_{IN}$ | | $V_{SS}$ | | $V_{DD}$ | V | CE |
| Output Load Resistance | RL | LVPECL ※1 | 49.5 | 50.0 | 50.5 | Ω | OUT |
| | | LVDS ※2 | 99 | 100 | 101 | | |
| | | HCSL ※3 | 49.5 | 50.0 | 50.5 | | |
| | | pCML ※4 | 80 | 100 | 120 | | |
| Ambient Temperature | Topt | | -40 | | 125 | ℃ | |

This IC has enough immunity against ESD and Latch-up, but handle with care.

※1 Terminate to $V_{DD}$-2.0V　※2 Between OUT and OUTN　※3 To GND and Rs=0Ω
※4 Between OUT and OUTN, AC coupling

## 5. Electrical Specification
### 5-1 LVPECL Output ($V_{DD}$=3.3V Operation)
#### 5-1-1 DC Characteristics

Unless otherwise stated, $V_{DD}$=2.97V~3.63V, $V_{SS}$=0V, Ta=-40℃~125℃

| Parameter | Symbol | Condition | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| Output leak current | $I_Z$ | CE=0.3V | | | | 10 | µA |
| "L" input current | $I_{IL}$ | $V_{IN}$=$V_{SS}$ | | | -10 | | µA |
| "H" output voltage | $V_{OH}$ | RL=50Ω(Terminated to $V_{DD}$-2.0V) CE=Open, OUT/OUTN | | $V_{DD}$-1.025 | $V_{DD}$-0.950 | $V_{DD}$-0.880 | V |
| "L" output voltage | $V_{OL}$ | | | $V_{DD}$-1.810 | $V_{DD}$-1.700 | $V_{DD}$-1.620 | V |
| Current consumption | $I_{DD}$ | $V_{DD}$=3.3V CE=Open RL=50Ω (Terminated to $V_{DD}$-2.0V) | IPS0208M0PES F0=314.68MHz | | 40.0 | 60.0 | mA |
| | | | IPS020DM0PES F0=500MHz | | 42.0 | 63.0 | |
| Current consumption at oscillation stop | $I_{DDD}$ | CE≦0.3V | | | 100 | 300 | uA |

IPS020 series IC【High Freq. Type】
Differential Output SPXO

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### 5-1-2 Switching Characteristics

Unless otherwise stated, $V_{DD}$=2.97V~3.63V, $V_{SS}$=0V, Ta=-40℃~125℃

| Parameter | Symbol | Condition | | Specification | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min | Typ | Max | |
| Oscillation start up time | Tstart | | | | | 2.0 | ms |
| Output Disable Time | Tplz | | | | | 200 | ns |
| Output Enable Time | Tpzl | | | | | 2.0 | ms |
| Rise time / Fall time | Tr / Tf | 20%~80% Vopp | | | 0.25 | 0.40 | ns |
| Output Duty Ratio | Duty | 1/2Vopp point | | 45 | | 55 | % |
| Output Swing | Vopp | | | 0.4 | | | V |
| Freq. $V_{DD}$ deviation | Fvst | $V_{DD}$=3.3V±10% | IPS0208M | | | ±2.0 | ppm |
| | | | IPS020DM | | | ±3.0 | |

### 5-2 LVPECL Output ($V_{DD}$=2.5V Operation)
#### 5-2-1 DC Characteristics

Unless otherwise stated, $V_{DD}$=2.375V~2.625V, $V_{SS}$=0V, Ta=-40℃~125℃

| Parameter | Symbol | Condition | | Specification | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min | Typ | Max | |
| Output leak current | $I_Z$ | CE=0.3V | | | | 10 | µA |
| "L" input current | $I_{IL}$ | $V_{IN}$=$V_{SS}$ | | | -10 | | µA |
| "H" output voltage | $V_{OH}$ | RL=50Ω(Terminated to $V_{DD}$-2.0V) CE=Open, OUT/OUTN | | $V_{DD}$ -1.105 | $V_{DD}$ -0.985 | $V_{DD}$ -0.870 | V |
| "L" output voltage | $V_{OL}$ | | | $V_{DD}$ -1.810 | $V_{DD}$ -1.700 | $V_{DD}$ -1.620 | V |
| Current consumption | $I_{DD}$ | $V_{DD}$=2.5V CE=Open RL=50Ω (Terminated to $V_{DD}$-2.0V) | IPS0208M0PAES F0=314.68MHz | | 36.0 | 54.0 | mA |
| | | | IPS020DM0PAES F0=500MHz | | 39.0 | 59.0 | |
| Current consumption at oscillation stop | $I_{DDD}$ | CE≦0.3V | | | 100 | 300 | uA |

### 5-2-2 Switching Characteristics

Unless otherwise stated, $V_{DD}$=2.375V~2.625V, $V_{SS}$=0V, Ta=-40℃~125℃

| Parameter | Symbol | Condition | | Specification | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min | Typ | Max | |
| Oscillation start up time | Tstart | | | | | 2.0 | ms |
| Output Disable Time | Tplz | | | | | 200 | ns |
| Output Enable Time | Tpzl | | | | | 2.0 | ms |
| Rise time / Fall time | Tr / Tf | 20%~80% Vopp | | | 0.25 | 0.40 | ns |
| Output Duty Ratio | Duty | 1/2Vopp point | | 45 | | 55 | % |
| Output Swing | Vopp | | | 0.4 | | | V |
| Freq. $V_{DD}$ deviation | Fvst | $V_{DD}$=2.5V±5% | IPS0208M | | | ±2.0 | ppm |
| | | | IPS020DM | | | ±5.0 | |

### 5-3 LVDS Output
#### 5-3-1 DC Characteristics

Unless otherwise stated, $V_{DD}$=2.375V~3.63V, $V_{SS}$=0V, Ta=-40℃~125℃

| Parameter | Symbol | Condition | | Specification | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min | Typ | Max | |
| Output leak current | $I_Z$ | CE=0.3V | | | | 10 | μA |
| "L" input current | $I_{IL}$ | $V_{IN}$=$V_{SS}$ | | | -10 | | μA |
| "H" output voltage | $V_{OH}$ | RL=100Ω(Between OUT & OUTN) CE=Open, OUT/OUTN | | | 1.43 | 1.60 | V |
| "L" output voltage | $V_{OL}$ | | | 0.90 | 1.10 | | V |
| Differential voltage | $V_{OD}$ | | | 247 | 330 | 454 | mV |
| Differential voltage deviation | $\triangle V_{OD}$ | | | | | 50 | mV |
| Offset voltage | $V_{OS}$ | | | 1.125 | 1.250 | 1.375 | V |
| Offset voltage deviation | $\triangle V_{OS}$ | | | | | 50 | mV |
| Current consumption | $I_{DD}$ | $V_{DD}$=3.3V CE=Open RL=100Ω (Between OUT & OUTN) | IPS0208M0DES F0=314.68MHz | | 15.0 | 30.0 | mA |
| | | | IPS020DM0DES F0=500MHz | | 18.0 | 36.0 | |
| Current consumption at oscillation stop | $I_{DDD}$ | CE≦0.3V | | | 100 | 300 | uA |

# IPS020 series IC【High Freq. Type】
## Differential Output SPXO

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### 5-3-2 Switching Characteristics

Unless otherwise stated, $V_{DD}$=2.375V~3.63V, $V_{SS}$=0V, Ta=-40℃~125℃

| Parameter | Symbol | Condition | | Specification | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min | Typ | Max | |
| Oscillation start up time | Tstart | | | | | 2.0 | ms |
| Output Disable Time | Tplz | | | | | 200 | ns |
| Output Enable Time | Tpzl | | | | | 2.0 | ms |
| Rise time / Fall time | Tr / Tf | 20%~80% Vopp | | | | 0.40 | ns |
| Output Duty Ratio | Duty | 1/2Vopp point | | 45 | | 55 | % |
| Output Swing | Vopp | | | 0.25 | | | V |
| Freq. $V_{DD}$ deviation | Fvst | $V_{DD}$=3.3V±10% | IPS0208M | | | ±2.0 | ppm |
| | | | IPS0208D | | | ±3.0 | |
| | | $V_{DD}$=2.5V±5% | IPS0208M | | | ±2.0 | |
| | | | IPS0208D | | | ±5.0 | |

### 5-4 HCSL Output
### 5-4-1 DC Characteristics

Unless otherwise stated, $V_{DD}$=2.375V~3.63V, $V_{SS}$=0V, Ta=-40℃~125℃

| Parameter | Symbol | Condition | | Specification | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min | Typ | Max | |
| Output leak current | Iz | CE=0.3V | | | | 10 | μA |
| "L" input current | IIL | $V_{IN}$=$V_{SS}$ | | | -10 | | μA |
| "H" output voltage | VOH | RL=50Ω(To GND), Rs=0Ω CE=Open, OUT/OUTN | | 550 | | 900 | mV |
| "L" output voltage | VOL | | | -150 | | 150 | mV |
| Current consumption | IDD | $V_{DD}$=3.3V CE=Open RL=50Ω (To GND) Rs=0Ω | IPS0208M0HES F0=314.68MHz | | 26.0 | 39.0 | mA |
| Current consumption at oscillation stop | IDDD | CE≦0.3V | | | 100 | 300 | uA |

IPS020 series IC【High Freq. Type】
Differential Output SPXO

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5-4-2 Switching Characteristics

Unless otherwise stated, $V_{DD}$=2.375V~3.63V, $V_{SS}$=0V, Ta=-40℃~125℃

| Parameter | Symbol | Condition | Specification | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | |
| Oscillation start up time | Tstart | | | | 2.0 | ms |
| Output Disable Time | Tplz | | | | 200 | ns |
| Output Enable Time | Tpzl | | | | 2.0 | ms |
| Rise time / Fall time | Tr / Tf | 20%~80% Vopp | | 0.30 | 0.50 | ns |
| Output Duty Ratio | Duty | 1/2Vopp point | 45 | | 55 | % |
| Output Swing | Vopp | | 0.55 | | | V |
| Freq. $V_{DD}$ deviation | Fvst | $V_{DD}$=3.3V±10% | | | ±2.0 | ppm |
| | | $V_{DD}$=2.5V±5% | | | ±2.0 | |

5-5 pCML Output
5-5-1 DC Characteristics

Unless otherwise stated, $V_{DD}$=2.97V~3.63V, $V_{SS}$=0V, Ta=-40℃~125℃

| Parameter | Symbol | Condition | | Specification | | | Unit |
|---|---|---|---|---|---|---|---|
| | | | | Min | Typ | Max | |
| Output leak current | $I_Z$ | CE=0.3V | | | | 10 | μA |
| "L" input current | $I_{IL}$ | $V_{IN}$=$V_{SS}$ | | | -10 | | μA |
| Current consumption | $I_{DD}$ | $V_{DD}$=3.3V CE=Open RL=100Ω (Between OUT & OUTN) AC Coupling | IPS0208M0CES F0=314.68MHz | | 18.5 | 37.0 | mA |
| Current consumption at oscillation stop | $I_{DDD}$ | CE≦0.3V | | | 100 | 300 | uA |

5-5-2 Switching Characteristics

Unless otherwise stated, $V_{DD}$=2.97V~3.63V, $V_{SS}$=0V, Ta=-40℃~125℃

| Parameter | Symbol | Condition | Specification | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | |
| Oscillation start up time | Tstart | | | | 2.0 | ms |
| Output Disable Time | Tplz | | | | 200 | ns |
| Output Enable Time | Tpzl | | | | 2.0 | ms |
| Rise time / Fall time | Tr / Tf | 20%~80% Vopp | | 0.25 | 0.35 | ns |
| Output Duty Ratio | Duty | 1/2Vopp point | 45 | | 55 | % |
| Output Swing | Vopp | | 0.60 | | | V |
| Freq. $V_{DD}$ deviation | Fvst | $V_{DD}$=3.3V±10% | | | ±2.0 | ppm |

IPS020 series IC【High Freq. Type】
Differential Output SPXO

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$$DUTY = \frac{TWH}{TWH+TWL} \times 100\ \%$$
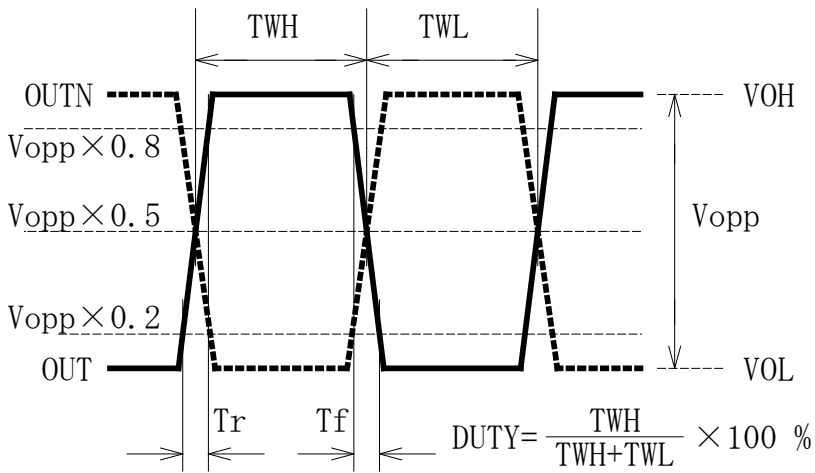
Fig. 5-1　Output Wave Form (Duty, Tr, Tf, $V_{OH}$, $V_{OL}$, Vopp) of LVPEL & HCSL

$$DUTY = \frac{TWH}{TWH+TWL} \times 100\ \%$$
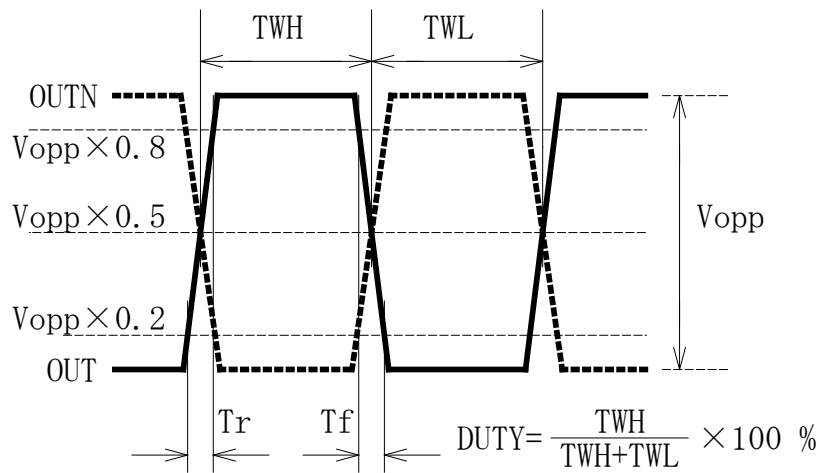
Fig. 5-2　Output Wave Form (Duty, Tr, Tf, Vopp) of pCML

IPS020 series IC【High Freq. Type】
Differential Output SPXO

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$$\triangle VOD=|VOD-VOD'|$$

$$DUTY=\frac{TWH}{TWH+TWL}\times100\ \%$$
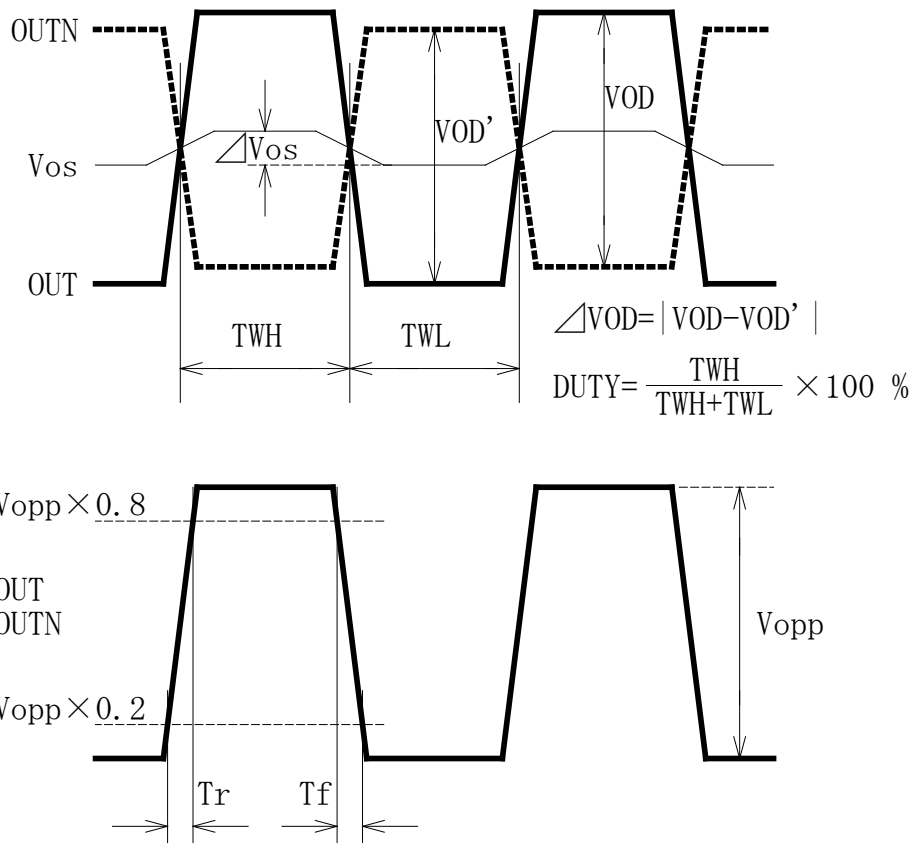
Fig. 5-3    Output Wave Form (Duty, Tr, Tf, $V_{OH}$, $V_{OL}$, $V_{OD}$, $V_{OS}$, Vopp) of LVDS
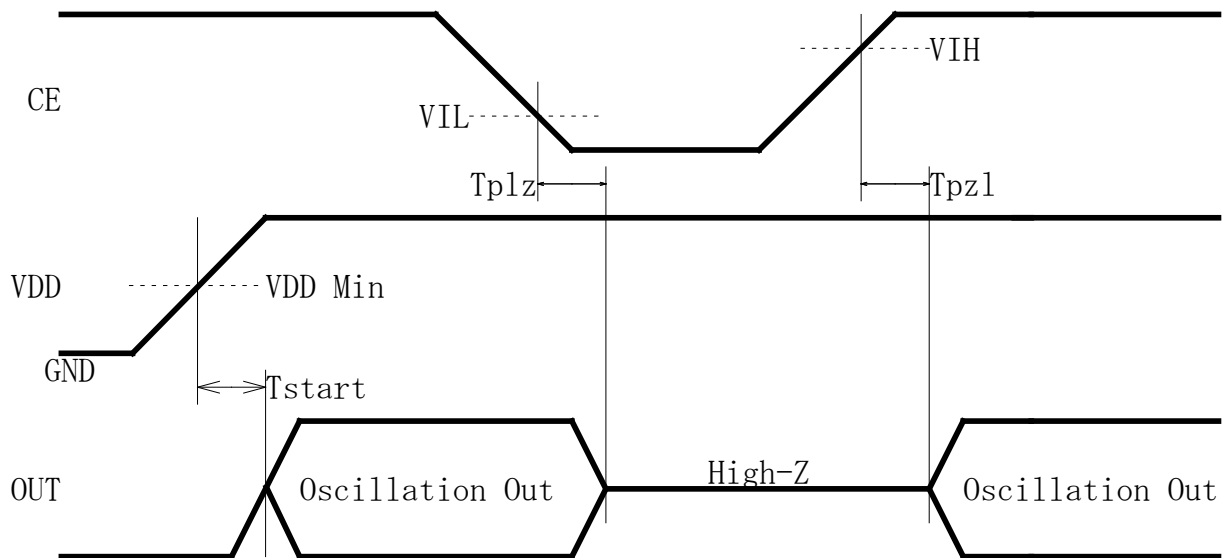
$V_{IH}$：Threshold voltage for Oscillation Start
$V_{IL}$：Threshold voltage for Oscillation Stop

Fig. 5-4    Input output signal timing

IPS020 series IC【High Freq. Type】
Differential Output SPXO

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## 6. Circuit Parameters of Oscillator (Reference Data for Circuit Design)

Ta=25℃

| Parameter | | Symbol | Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| Feedback Resistor | IPS0208M0 | Rf | Refer to Fig. 6-1 | | 200 | | kΩ |
| | IPS020DM0 | | | | 200 | | |
| Driving Resistor | IPS0208M0 | Rd | Refer to Fig. 6-1 | | 157 | | Ω |
| | IPS020DM0 | | | | 100 | | |
| Oscillation Capacitor | IPS0208M0 | Cg | Refer to Fig. 6-1 | | 6.0 | | pF |
| | | Cd | | | 8.0 | | |
| | IPS020DM0 | Cg | | | 3.0 | | |
| | | Cd | | | 7.0 | | |

*The above values are the design values and are not guaranteed by test.
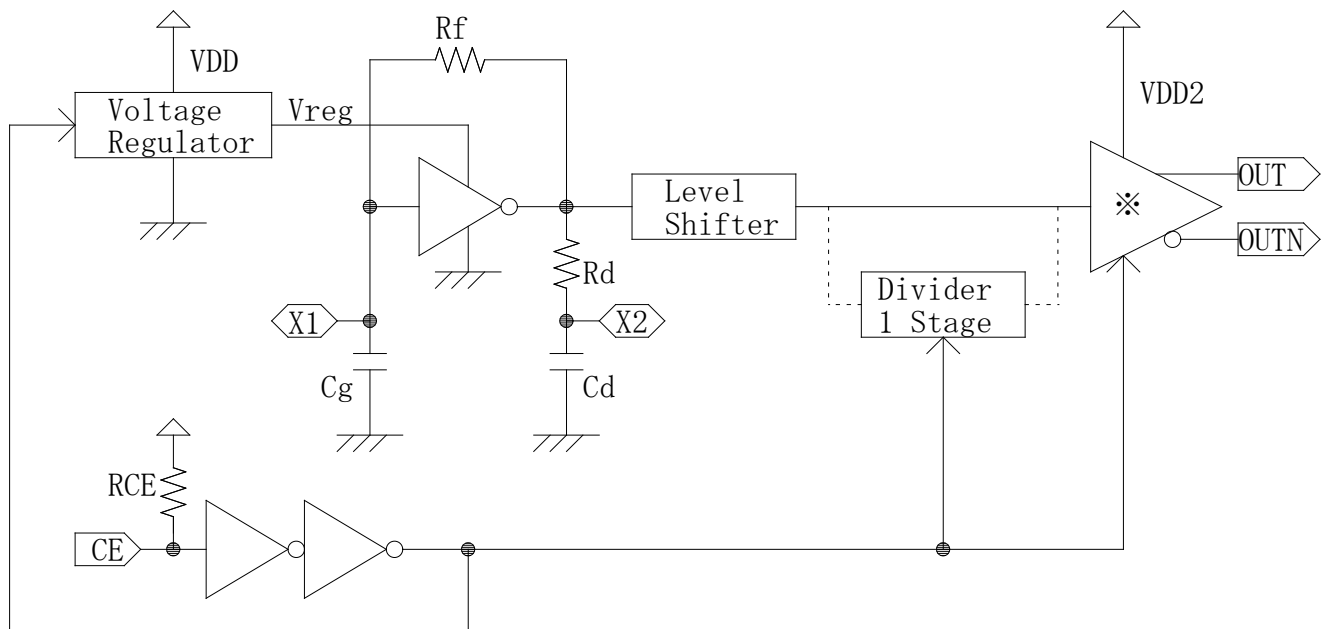


※ Output buffer according to each output waveform format

Fig. 6-1　Block Diagram

IPS020 series IC【High Freq. Type】
Differential Output SPXO

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## 7. Pad Layout
### 7-1 Straight Type
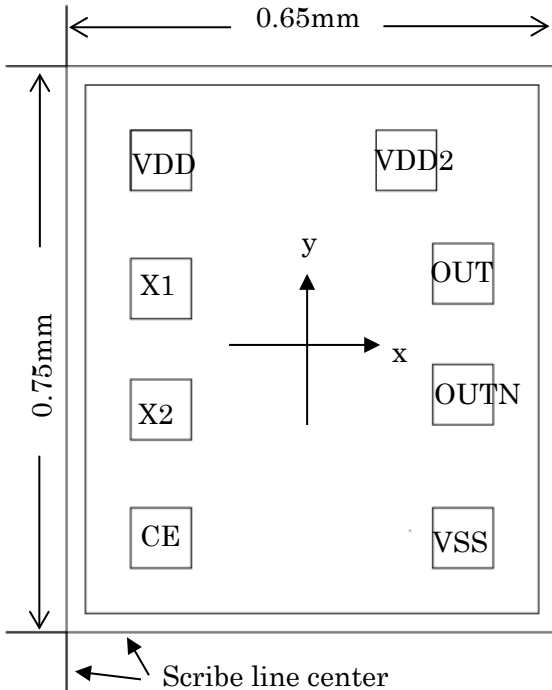


・Die Size：0.65mm × 0.75mm

・Pad Size：80um □

・Thickness：150um±20um

・IC Backside：Gnd or Open

・Swapping of OUT/OUTN with wire bond is acceptable

| Pad Name | Function | Location (μm) | |
|---|---|---|---|
| | | x | y |
| VDD | (＋) Power Supply | -206 | 256 |
| X1 | Crystal Feedback | -206 | 83 |
| X2 | Crystal Drive | -206 | -83 |
| CE | Oscillation stop "L": High-Impedance | -206 | -256 |
| VSS | (－) Ground | 206 | -256 |
| OUTN | OUT(Complementary) | 206 | -65 |
| OUT | OUT(True) | 206 | 108 |
| VDD2 | NC is acceptable | 113 | 256 |
| Chip Center | | 0 | 0 |
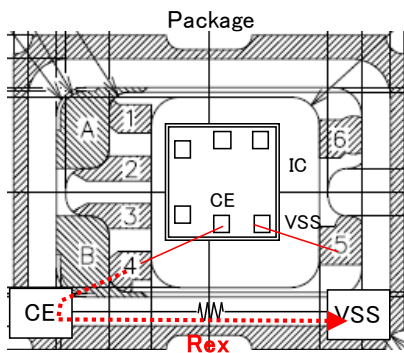


### IMPORTANT Notice for CE function

※ Oscillation will not be activated when CE=Open after CE=Low if Rex is not large.

※ Reference value of Rex is over 10MΩ with CE=Open usage.

※ There is no such issue with CE=VDD usage.

Rex： Resistance value between CE and VSS of package

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8. IC Part # Identification
9.

IC Identification Code (Option)
Fuse　□□
Code　9 10

LOGO：IPS0208M_S3

IC Identification Code
Fuse　□□□　□□□　□□
Code　1 2 3　4 5 6　7 8
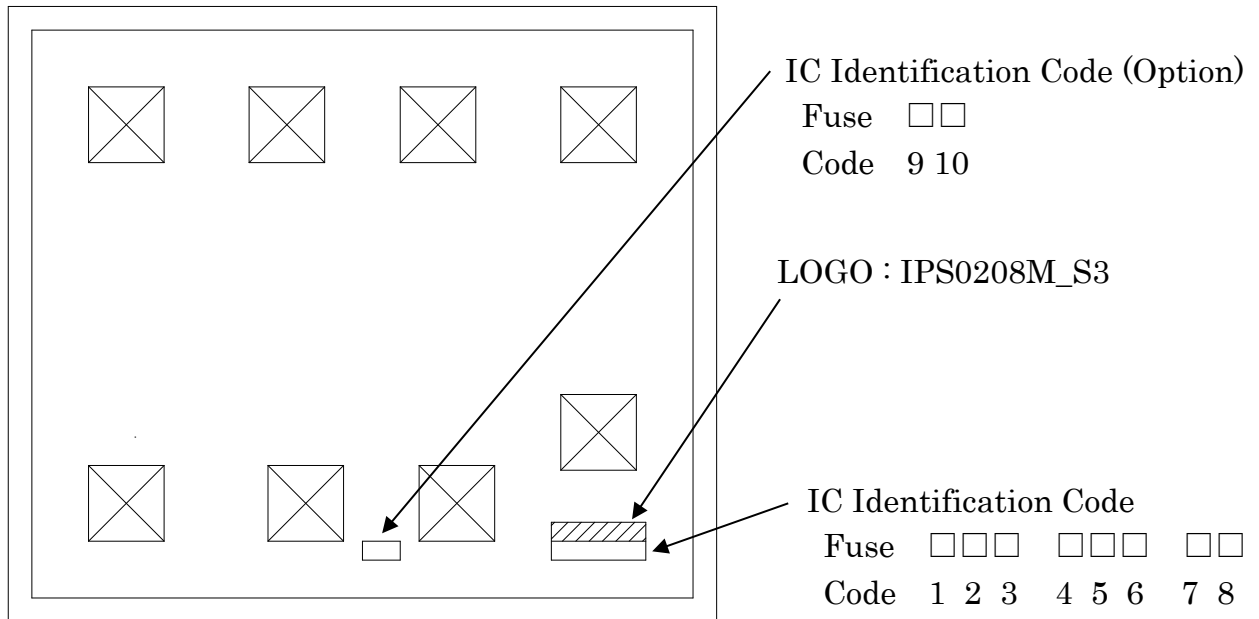
IPS020*E series(High Freq.)

| Part # | Code 1~8 | | | | | | | | Code 9, 10 | |
|---|---|---|---|---|---|---|---|---|---|---|
| IPS0208M0PEF | □ | □ | □ | □ | □ | □ | □ | □ | □ | □ |
| IPS020DM0PES | □ | ■ | □ | □ | □ | □ | □ | □ | □ | □ |
| IPS0208M0PAEF | □ | □ | □ | □ | □ | □ | □ | □ | □ | ■ |
| IPS020DM0PAES | □ | ■ | □ | □ | □ | □ | □ | □ | □ | ■ |
| IPS0208M0DEF | □ | □ | □ | □ | □ | □ | □ | ■ | □ | □ |
| IPS020DM0DES | □ | ■ | □ | □ | □ | □ | □ | ■ | □ | □ |
| IPS0208M0HES | □ | □ | □ | □ | □ | □ | ■ | □ | □ | □ |
| IPS0208M0CES | □ | □ | □ | □ | □ | □ | ■ | ■ | □ | □ |

□：Fuse no cut

■：Fuse cut