

## FEATURES:

- 0.5 MICRON CMOS Technology
- Guaranteed low skew < 500ps (max.)
- Very low duty cycle distortion < 1.0ns (max.)
- Very low CMOS power levels
- TTL compatible inputs and outputs
- Inputs can be driven from 3.3V or 5V components
- Two independent output banks with 3-state control
- 1:5 fanout per bank
- "Heartbeat" monitor output
- $V_{CC} = 3.3V \pm 0.3V$
- Available in SSOP, SOIC, and QSOP packages

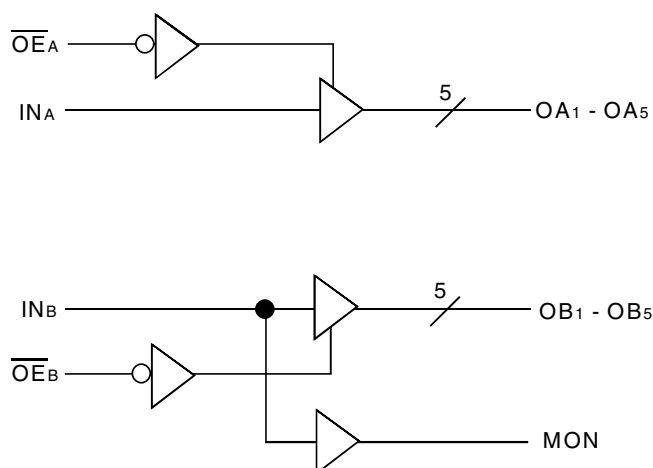
## DESCRIPTION:

The FCT3805 is a 3.3 volt, non-inverting clock driver built using advanced dual metal CMOS technology. The device consists of two banks of drivers, each with a 1:5 fanout and its own output enable control. The device has a "heartbeat" monitor for diagnostics and PLL driving. The MON output is identical to all other outputs and complies with the output specifications in this document. The FCT3805 offers low capacitance inputs with hysteresis.

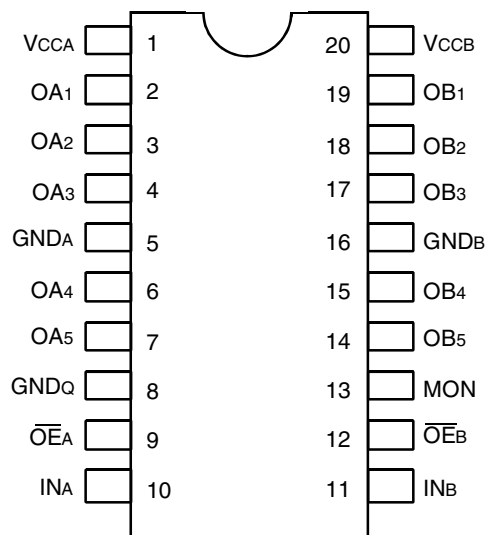
The FCT3805 is designed for high speed clock distribution where signal quality and skew are critical. The FCT3805 also allows single point-to-point transmission line driving in applications such as address distribution, where one signal must be distributed to multiple receivers with low skew and high signal quality.

For more information on using the FCT3805 with two different input frequencies on bank A and B, please see AN-236.

## FUNCTIONAL BLOCK DIAGRAM



## PIN CONFIGURATION



SOIC/ SSOP/ QSOP  
TOP VIEW

## ABSOLUTE MAXIMUM RATINGS<sup>(1)</sup>

| Symbol                           | Description                          | Max                          | Unit |
|----------------------------------|--------------------------------------|------------------------------|------|
| V <sub>TERM</sub> <sup>(2)</sup> | Terminal Voltage with Respect to GND | −0.5 to +4.6                 | V    |
| V <sub>TERM</sub> <sup>(3)</sup> | Terminal Voltage with Respect to GND | −0.5 to +7                   | V    |
| V <sub>TERM</sub> <sup>(4)</sup> | Terminal Voltage with Respect to GND | −0.5 to V <sub>CC</sub> +0.5 | V    |
| T <sub>STG</sub>                 | Storage Temperature                  | −65 to +150                  | °C   |
| I <sub>OUT</sub>                 | DC Output Current                    | −60 to +60                   | mA   |

### NOTES:

1. Stresses greater than those listed under ABSOLUTE MAXIMUM RATINGS may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.
2. V<sub>CC</sub> terminals.
3. Input terminals.
4. Outputs and I/O terminals.

## CAPACITANCE (T<sub>A</sub> = +25°C, f = 1.0MHz)

| Symbol           | Parameter <sup>(1)</sup> | Conditions            | Typ. | Max. | Unit |
|------------------|--------------------------|-----------------------|------|------|------|
| C <sub>IN</sub>  | Input Capacitance        | V <sub>IN</sub> = 0V  | 4.5  | 6    | pF   |
| C <sub>OUT</sub> | Output Capacitance       | V <sub>OUT</sub> = 0V | 5.5  | 8    | pF   |

### NOTE:

1. This parameter is measured at characterization but not tested.

## PIN DESCRIPTION

| Pin Names | Description                               |
|-----------|-------------------------------------------|
| OEA, OEB  | 3-State Output Enable Inputs (Active LOW) |
| INA, INb  | Clock Inputs                              |
| OAn, OBn  | Clock Outputs                             |
| MON       | Monitor Output                            |

## FUNCTION TABLE (1)

| Inputs   |          | Outputs  |     |
|----------|----------|----------|-----|
| OEA, OEB | INA, INb | OAn, OBn | MON |
| L        | L        | L        | L   |
| L        | H        | H        | H   |
| H        | L        | Z        | L   |
| H        | H        | Z        | H   |

### NOTE:

1. H = HIGH  
L = LOW  
Z = High-Impedance

## DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE

Following Conditions Apply Unless Otherwise Specified

Commercial:  $T_A = 0^{\circ}\text{C}$  to  $+70^{\circ}\text{C}$ , Industrial:  $T_A = -40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ ,  $V_{CC} = 3.3\text{V} \pm 0.3\text{V}$

| Symbol                                                   | Parameter                                              | Test Conditions <sup>(1)</sup>                                                                                      |                                  | Min.                 | Typ. | Max.                  | Unit |
|----------------------------------------------------------|--------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|----------------------------------|----------------------|------|-----------------------|------|
| V <sub>IH</sub>                                          | Input HIGH Level (Input pins)                          | Guaranteed Logic HIGH Level                                                                                         |                                  | 2                    | —    | 5.5                   | V    |
|                                                          | Input HIGH Level (I/O pins)                            |                                                                                                                     |                                  | 2                    | —    | V <sub>CC</sub> + 0.5 |      |
| V <sub>IL</sub>                                          | Input LOW Level (Input and I/O pins)                   | Guaranteed Logic LOW Level                                                                                          |                                  | −0.5                 | —    | 0.8                   | V    |
| I <sub>IH</sub>                                          | Input HIGH Current (Input pins)                        | V <sub>CC</sub> = Max.                                                                                              | V <sub>I</sub> = 5.5V            | —                    | —    | ±1                    | μA   |
|                                                          | Input HIGH Current (I/O pins)                          |                                                                                                                     | V <sub>I</sub> = V <sub>CC</sub> | —                    | —    | ±1                    |      |
| I <sub>IL</sub>                                          | Input LOW Current (Input pins)                         | V <sub>CC</sub> = Max.                                                                                              | V <sub>I</sub> = GND             | —                    | —    | ±1                    |      |
|                                                          | Input LOW Current (I/O pins)                           |                                                                                                                     | V <sub>I</sub> = GND             | —                    | —    | ±1                    |      |
| I <sub>OZH</sub>                                         | High Impedance Output Current<br>(3-State Output Pins) | V <sub>CC</sub> = Max.                                                                                              | V <sub>O</sub> = V <sub>CC</sub> | —                    | —    | ±1                    | μA   |
| I <sub>OZL</sub>                                         |                                                        |                                                                                                                     | V <sub>O</sub> = GND             | —                    | —    | ±1                    |      |
| V <sub>IK</sub>                                          | Clamp Diode Voltage                                    | V <sub>CC</sub> = Min., I <sub>IN</sub> = −18mA                                                                     |                                  | —                    | −0.7 | −1.2                  | V    |
| I <sub>ODH</sub>                                         | Output HIGH Current                                    | V <sub>CC</sub> = 3.3V, V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> , V <sub>O</sub> = 1.5V <sup>(3)</sup> |                                  | −36                  | −60  | −110                  | mA   |
| I <sub>ODL</sub>                                         | Output LOW Current                                     | V <sub>CC</sub> = 3.3V, V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> , V <sub>O</sub> = 1.5V <sup>(3)</sup> |                                  | 50                   | 90   | 200                   | mA   |
| V <sub>OH</sub>                                          | Output HIGH Voltage                                    | V <sub>CC</sub> = Min.<br>V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>                                      | I <sub>OH</sub> = −0.1mA         | V <sub>CC</sub> −0.2 | —    | —                     | V    |
|                                                          |                                                        |                                                                                                                     | I <sub>OH</sub> = −8mA           | 2.4 <sup>(5)</sup>   | 3    | —                     |      |
| V <sub>OL</sub>                                          | Output LOW Voltage                                     | V <sub>CC</sub> = Min.<br>V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>                                      | I <sub>OL</sub> = 0.1mA          | —                    | —    | 0.2                   | V    |
|                                                          |                                                        |                                                                                                                     | I <sub>OL</sub> = 16mA           | —                    | 0.2  | 0.4                   |      |
|                                                          |                                                        |                                                                                                                     | I <sub>OL</sub> = 24mA           | —                    | 0.3  | 0.5                   |      |
| I <sub>OFF</sub>                                         | Input Power Off Leakage                                | V <sub>CC</sub> = 0V, V <sub>IN</sub> = 4.5V                                                                        |                                  | —                    | —    | ±1                    | μA   |
| I <sub>OS</sub>                                          | Short Circuit Current <sup>(4)</sup>                   | V <sub>CC</sub> = Max., V <sub>O</sub> = GND <sup>(3)</sup>                                                         |                                  | −60                  | −135 | −240                  | mA   |
| V <sub>H</sub>                                           | Input Hysteresis                                       | —                                                                                                                   |                                  | —                    | 150  | —                     | mV   |
| I <sub>CCL</sub><br>I <sub>CCH</sub><br>I <sub>CCZ</sub> | Quiescent Power Supply Current                         | V <sub>CC</sub> = Max.<br>V <sub>IN</sub> = GND or V <sub>CC</sub>                                                  |                                  | —                    | 0.1  | 10                    | μA   |

### NOTES:

- For conditions shown as Max. or Min., use appropriate value specified under Electrical Characteristics for the applicable device type.
- Typical values are at  $V_{CC} = 3.3\text{V}$ ,  $+25^{\circ}\text{C}$  ambient.
- Not more than one output should be shorted at one time. Duration of the test should not exceed one second.
- This parameter is guaranteed but not tested.
- $V_{OH} = V_{CC} - 0.6\text{V}$  at rated current.

## POWER SUPPLY CHARACTERISTICS

| Symbol          | Parameter                                         | Test Conditions <sup>(1)</sup>                                                                                                   |                                            | Min. | Typ. <sup>(2)</sup> | Max.              | Unit    |
|-----------------|---------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|------|---------------------|-------------------|---------|
| $\Delta I_{CC}$ | Quiescent Power Supply Current<br>TTL Inputs HIGH | $V_{CC} = \text{Max.}$<br>$V_{IN} = V_{CC} - 0.6V^{(3)}$                                                                         |                                            | —    | 10                  | 30                | $\mu A$ |
| $I_{CCD}$       | Dynamic Power Supply Current <sup>(4)</sup>       | $V_{CC} = \text{Max.}$<br>Outputs Open<br>$OEA = OEB = GND$<br>Per Output Toggling<br>50% Duty Cycle                             | $V_{IN} = V_{CC}$<br>$V_{IN} = GND$        | —    | 0.035               | 0.06              | mA/MHz  |
| $I_C$           | Total Power Supply Current <sup>(6)</sup>         | $V_{CC} = \text{Max.}$<br>Outputs Open<br>$f_o = 25\text{MHz}$<br>50% Duty Cycle<br>$OEA = OEB = V_{CC}$<br>Mon. Output Toggling | $V_{IN} = V_{CC}$<br>$V_{IN} = GND$        | —    | 0.9                 | 1.6               | mA      |
|                 |                                                   |                                                                                                                                  | $V_{IN} = V_{CC} - 0.6V$<br>$V_{IN} = GND$ | —    | 0.9                 | 1.6               |         |
|                 |                                                   | $V_{CC} = \text{Max.}$<br>Outputs Open<br>$f_o = 50\text{MHz}$<br>50% Duty Cycle<br>$OEA = OEB = GND$<br>Eleven Outputs Toggling | $V_{IN} = V_{CC}$<br>$V_{IN} = GND$        | —    | 20                  | 33 <sup>(5)</sup> |         |
|                 |                                                   |                                                                                                                                  | $V_{IN} = V_{CC} - 0.6V$<br>$V_{IN} = GND$ | —    | 20                  | 33 <sup>(5)</sup> |         |

### NOTES:

- For conditions shown as Max. or Min., use appropriate value specified under Electrical Characteristics for the applicable device type.
- Typical values are at  $V_{CC} = 3.3V$ ,  $+25^\circ C$  ambient.
- Per TTL driven input ( $V_{IN} = V_{CC} - 0.6V$ ); all other inputs at  $V_{CC}$  or GND.
- This parameter is not directly testable, but is derived for use in Total Power Supply calculations.
- Values for these conditions are examples of the  $I_C$  formula. These limits are guaranteed but not tested.
- $I_C = I_{QUIESCENT} + I_{INPUTS} + I_{DYNAMIC}$   
 $I_C = I_{CC} + \Delta I_{CC} D_H N_T + I_{CCD} (f_o N_o)$   
 $I_{CC} = \text{Quiescent Current (} I_{CCL}, I_{CCH} \text{ and } I_{CCZ} \text{)}$   
 $\Delta I_{CC} = \text{Power Supply Current for a TTL High Input (} V_{IN} = V_{CC} - 0.6V \text{)}$   
 $D_H = \text{Duty Cycle for TTL Inputs High}$   
 $N_T = \text{Number of TTL Inputs at } D_H$   
 $I_{CCD} = \text{Dynamic Current Caused by an Input Transition Pair (HLH or LHL)}$   
 $f_o = \text{Output Frequency}$   
 $N_o = \text{Number of Outputs at } f_o$   
All currents are in milliamps and all frequencies are in megahertz.

## SWITCHING CHARACTERISTICS OVER OPERATING RANGE - COMMERCIAL<sup>(3,4)</sup>

| Symbol           | Parameter                                                                                                                                                      | Conditions <sup>(1)</sup>                      | FCT3805             |      | FCT3805A            |      | Unit |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|---------------------|------|---------------------|------|------|
|                  |                                                                                                                                                                |                                                | Min. <sup>(2)</sup> | Max. | Min. <sup>(2)</sup> | Max. |      |
| t <sub>PLH</sub> | Propagation Delay                                                                                                                                              | C <sub>L</sub> = 50pF<br>R <sub>L</sub> = 500Ω | 1.5                 | 5.8  | 1.5                 | 5    | ns   |
| t <sub>PHL</sub> | IN <sub>A</sub> to O <sub>AN</sub> , IN <sub>B</sub> to O <sub>BN</sub>                                                                                        |                                                |                     |      |                     |      |      |
| t <sub>R</sub>   | Output Rise Time                                                                                                                                               |                                                | —                   | 2    | —                   | 2    | ns   |
| t <sub>F</sub>   | Output Fall Time                                                                                                                                               |                                                | —                   | 2    | —                   | 2    | ns   |
| tsk(O)           | Output skew: skew between outputs of all banks of same package (inputs tied together)                                                                          |                                                | —                   | 0.5  | —                   | 0.5  | ns   |
| tsk(P)           | Pulse skew: skew between opposite transitions of same output ( t <sub>PHL</sub> – t <sub>PLH</sub>  )                                                          |                                                | —                   | 1    | —                   | 1    | ns   |
| tsk(T)           | Package skew: skew between outputs of different packages being driven by the same input source, power supply voltage, temperature, frequency, and speed grade. |                                                | —                   | 1.5  | —                   | 1.2  | ns   |
| t <sub>PZL</sub> | Output Enable Time                                                                                                                                             |                                                | 1.5                 | 6.5  | 1.5                 | 6    | ns   |
| t <sub>PZH</sub> | O <sub>EA</sub> to O <sub>AN</sub> , O <sub>EB</sub> to O <sub>BN</sub>                                                                                        |                                                |                     |      |                     |      |      |
| t <sub>PLZ</sub> | Output Disable Time                                                                                                                                            |                                                | 1.5                 | 5.5  | 1.5                 | 5    | ns   |
| t <sub>PHZ</sub> | O <sub>EA</sub> to O <sub>AN</sub> , O <sub>EB</sub> to O <sub>BN</sub>                                                                                        |                                                |                     |      |                     |      |      |

## SWITCHING CHARACTERISTICS OVER OPERATING RANGE - INDUSTRIAL<sup>(3,4)</sup>

| Symbol           | Parameter                                                                                                                                                      | Conditions <sup>(1)</sup>                      | FCT3805             |      | FCT3805A            |      | Unit |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|---------------------|------|---------------------|------|------|
|                  |                                                                                                                                                                |                                                | Min. <sup>(2)</sup> | Max. | Min. <sup>(2)</sup> | Max. |      |
| t <sub>PLH</sub> | Propagation Delay                                                                                                                                              | C <sub>L</sub> = 50pF<br>R <sub>L</sub> = 500Ω | 1.5                 | 5.8  | 1.5                 | 5.2  | ns   |
| t <sub>PHL</sub> | IN <sub>A</sub> to O <sub>AN</sub> , IN <sub>B</sub> to O <sub>BN</sub>                                                                                        |                                                |                     |      |                     |      |      |
| t <sub>R</sub>   | Output Rise Time                                                                                                                                               |                                                | —                   | 2    | —                   | 2    | ns   |
| t <sub>F</sub>   | Output Fall Time                                                                                                                                               |                                                | —                   | 2    | —                   | 2    | ns   |
| tsk(O)           | Output skew: skew between outputs of all banks of same package (inputs tied together)                                                                          |                                                | —                   | 0.6  | —                   | 0.6  | ns   |
| tsk(P)           | Pulse skew: skew between opposite transitions of same output ( t <sub>PHL</sub> – t <sub>PLH</sub>  )                                                          |                                                | —                   | 1    | —                   | 1    | ns   |
| tsk(T)           | Package skew: skew between outputs of different packages being driven by the same input source, power supply voltage, temperature, frequency, and speed grade. |                                                | —                   | 1.5  | —                   | 1.2  | ns   |
| t <sub>PZL</sub> | Output Enable Time                                                                                                                                             |                                                | 1.5                 | 6.5  | 1.5                 | 6    | ns   |
| t <sub>PZH</sub> | O <sub>EA</sub> to O <sub>AN</sub> , O <sub>EB</sub> to O <sub>BN</sub>                                                                                        |                                                |                     |      |                     |      |      |
| t <sub>PLZ</sub> | Output Disable Time                                                                                                                                            |                                                | 1.5                 | 5.5  | 1.5                 | 5    | ns   |
| t <sub>PHZ</sub> | O <sub>EA</sub> to O <sub>AN</sub> , O <sub>EB</sub> to O <sub>BN</sub>                                                                                        |                                                |                     |      |                     |      |      |

### NOTES:

- See test circuits and waveforms.
- Minimum limits are guaranteed but not tested on Propagation Delays.
- t<sub>PLH</sub>, t<sub>PHL</sub>, tsk(t) are production tested. All other parameters guaranteed but not production tested.
- Propagation delay range indicated by Min. and Max. limit is due to V<sub>cc</sub>, operating temperature and process parameters. These propagation delay limits do not imply skew.

## TEST CIRCUITS AND WAVEFORMS

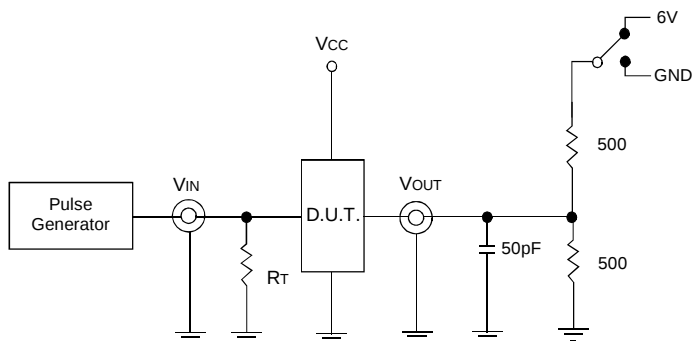
## SWITCH POSITION

| Test                        | Switch |
|-----------------------------|--------|
| Disable LOW<br>Enable LOW   | 6V     |
| Disable HIGH<br>Enable HIGH | GND    |

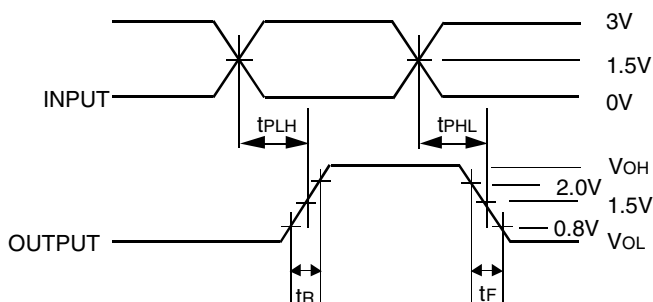
### DEFINITIONS:

$C_L$  = Load capacitance: includes jig and probe capacitance.

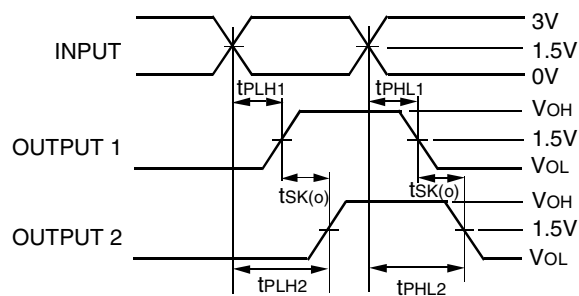
$R_T$  = Termination resistance: should be equal to  $Z_{out}$  of the Pulse Generator.



Test Circuits for All Outputs

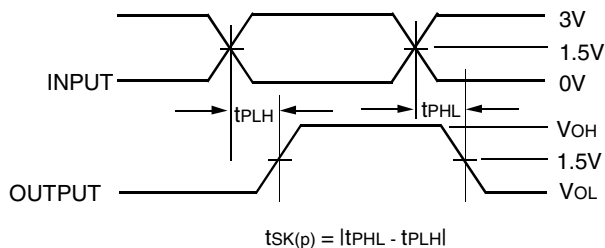


Package Delay



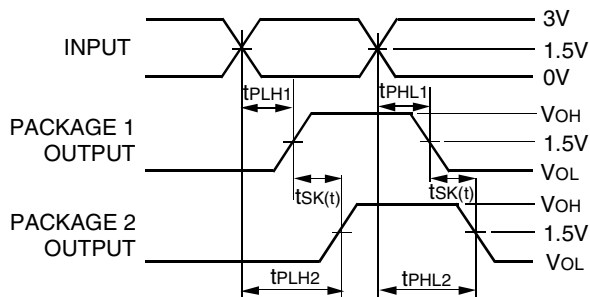
$$t_{SK(O)} = |t_{PLH2} - t_{PLH1}| \text{ or } |t_{PHL2} - t_{PHL1}|$$

Output Skew -  $t_{SK(O)}$



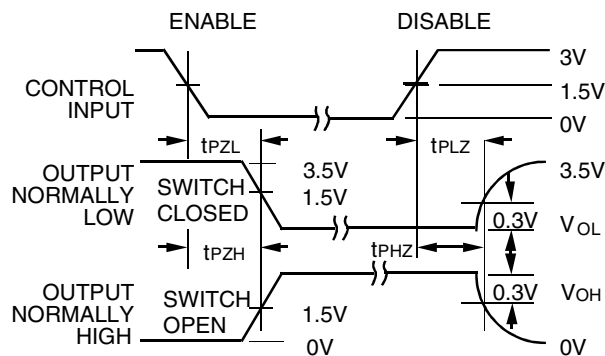
$$t_{SK(P)} = |t_{PHL} - t_{PLH}|$$

Pulse Skew -  $t_{SK(P)}$



$$t_{SK(T)} = |t_{PLH2} - t_{PLH1}| \text{ or } |t_{PHL2} - t_{PHL1}|$$

Package Skew -  $t_{SK(T)}$



Output Skew -  $t_{SK(X)}$

### NOTES:

1. Diagram shown for input Control Enable-LOW and input Control Disable-HIGH
2. Pulse Generator for All Pulses:  $f \leq 1.0\text{MHz}$ ;  $t_r \leq 2.5\text{ns}$ ;  $t_f \leq 2.5\text{ns}$

## ORDERING INFORMATION

| 49FCT | XXXX        | X       | X       |               |                                        |
|-------|-------------|---------|---------|---------------|----------------------------------------|
|       | Device Type | Package | Package |               |                                        |
|       |             |         |         | Blank         | Commercial (0°C to +70°C)              |
|       |             |         |         | I             | Industrial (-40°C to +85°C)            |
|       |             |         |         | SOG           | SOIC - Green                           |
|       |             |         |         | PYG           | SSOP - Green                           |
|       |             |         |         | QG            | QSOP - Green                           |
|       |             |         |         | 3805<br>3805A | Non-Inverting 3.3V Buffer/Clock Driver |

## IMPORTANT NOTICE AND DISCLAIMER

RENESAS ELECTRONICS CORPORATION AND ITS SUBSIDIARIES ("RENESAS") PROVIDES TECHNICAL SPECIFICATIONS AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for developers skilled in the art designing with Renesas products. You are solely responsible for (1) selecting the appropriate products for your application, (2) designing, validating, and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements. These resources are subject to change without notice. Renesas grants you permission to use these resources only for development of an application that uses Renesas products. Other reproduction or use of these resources is strictly prohibited. No license is granted to any other Renesas intellectual property or to any third party intellectual property. Renesas disclaims responsibility for, and you will fully indemnify Renesas and its representatives against, any claims, damages, costs, losses, or liabilities arising out of your use of these resources. Renesas' products are provided only subject to Renesas' Terms and Conditions of Sale or other applicable terms agreed to in writing. No use of any Renesas resources expands or otherwise alters any applicable warranties or warranty disclaimers for these products.

(Rev.1.0 Mar 2020)

### Corporate Headquarters

TOYOSU FORESIA, 3-2-24 Toyosu,  
Koto-ku, Tokyo 135-0061, Japan  
[www.renesas.com](http://www.renesas.com)

### Contact Information

For further information on a product, technology, the most up-to-date version of a document, or your nearest sales office, please visit:  
[www.renesas.com/contact/](http://www.renesas.com/contact/)

### Trademarks

Renesas and the Renesas logo are trademarks of Renesas Electronics Corporation. All trademarks and registered trademarks are the property of their respective owners.