

FEATURES:

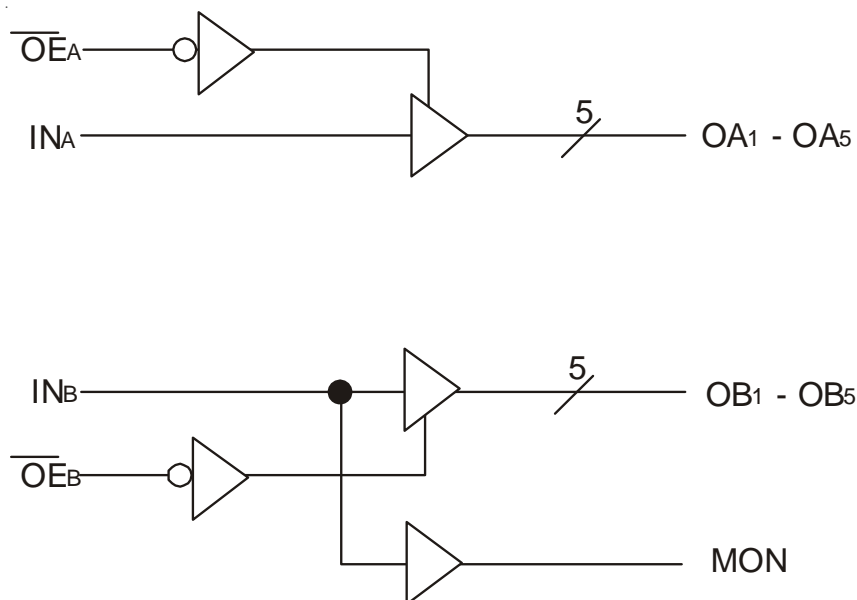
- Advanced CMOS Technology
- Guaranteed low skew < 200ps (max.)
- Very low propagation delay < 2.5ns (max)
- Very low duty cycle distortion < 270ps (max)
- Very low CMOS power levels
- Operating frequency up to 166MHz
- TTL compatible inputs and outputs
- Two independent output banks with 3-state control
- 1:5 fanout per bank
- "Heartbeat" monitor output
- $V_{CC} = 2.5V \pm 0.2V$
- Available in SSOP and QSOP packages

DESCRIPTION:

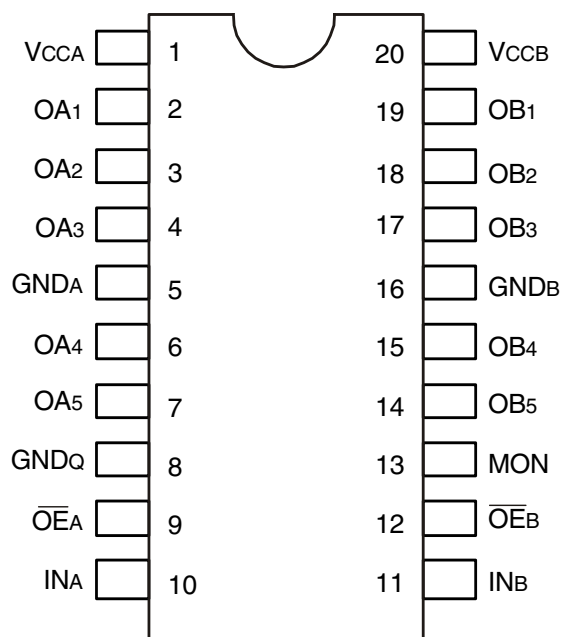
The FCT20805 is a 2.5 volt clock driver built using advanced CMOS technology. The device consists of two banks of drivers, each with a 1:5 fanout and its own output enable control. The device has a "heartbeat" monitor for diagnostics and PLL driving. The MON output is identical to all other outputs and complies with the output specifications in this document. The FCT20805 offers low capacitance inputs.

The FCT20805 is designed for high speed clock distribution where signal quality and skew are critical. The FCT20805 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.

FUNCTIONAL BLOCK DIAGRAM



## PIN CONFIGURATIONS



SSOP/ QSOP  
TOP VIEW

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

| Symbol           | Description                | Max                          | Unit |
|------------------|----------------------------|------------------------------|------|
| V <sub>CC</sub>  | Input Power Supply Voltage | -0.5 to +4.6                 | V    |
| V <sub>I</sub>   | Input Voltage              | -0.5 to +5.5                 | V    |
| V <sub>O</sub>   | Output Voltage             | -0.5 to V <sub>CC</sub> +0.5 | V    |
| T <sub>J</sub>   | Junction Temperature       | 150                          | °C   |
| T <sub>STG</sub> | Storage Temperature        | -65 to +165                  | °C   |

NOTE:

- 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.

## 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  | 3    | 4    | pF   |
| C <sub>OUT</sub> | Output Capacitance       | V <sub>OUT</sub> = 0V | —    | 6    | pF   |

NOTE:

- 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 <sup>(1)</sup>

| 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:

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

## DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE

Following Conditions Apply Unless Otherwise Specified

Industrial:  $T_A = -40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ ,  $V_{CC} = 2.5\text{V} \pm 0.2\text{V}$ 

| Symbol    | Parameter                     | Test Conditions <sup>(1)</sup>  |                            | Min.               | Typ. <sup>(2)</sup> | Max.    | Unit          |
|-----------|-------------------------------|---|----------------------------|--------------------|---------------------|---------|---------------|
| $V_{IH}$  | Input HIGH Level              |   |                            | 1.7                | —                   | 5.5     | V             |
| $V_{IL}$  | Input LOW Level               |   |                            | -0.5               | —                   | 0.7     | V             |
| $I_{IH}$  | Input HIGH Current            | $V_{CC} = \text{Max.}$  | $V_i = 5.5\text{V}$        | —                  | —                   | $\pm 1$ | $\mu\text{A}$ |
| $I_{IL}$  | Input LOW Current             | $V_{CC} = \text{Max.}$  | $V_i = \text{GND}$         | —                  | —                   | $\pm 1$ |               |
| $I_{OZH}$ | High Impedance Output Current | $V_{CC} = \text{Max.}$  | $V_o = V_{CC}$             | —                  | —                   | $\pm 1$ |               |
| $I_{OZL}$ | (3-State Outputs Pins)        |   | $V_o = \text{GND}$         | —                  | —                   | $\pm 1$ |               |
| $V_{IK}$  | Clamp Diode Voltage           | $V_{CC} = \text{Min.}, I_{IN} = -18\text{mA}$                                   |                            | —                  | -0.7                | -1.2    | V             |
| $I_{ODH}$ | Output HIGH Current           | $V_{CC} = 2.5\text{V}, V_{IN} = V_{IH}$ or $V_{IL}, V_o = 1.25\text{V}^{(3,4)}$ |                            | -15                | -35                 | -90     | mA            |
| $I_{ODL}$ | Output LOW Current            | $V_{CC} = 2.5\text{V}, V_{IN} = V_{IH}$ or $V_{IL}, V_o = 1.25\text{V}^{(3,4)}$ |                            | 25                 | 55                  | 100     | mA            |
| $I_{OS}$  | Short Circuit Current         | $V_{CC} = \text{Max.}, V_o = \text{GND}^{(3,4)}$                                |                            | -30                | -50                 | -120    | mA            |
| $V_{OH}$  | Output HIGH Voltage           | $V_{CC} = \text{Min.}$<br>$V_{IN} = V_{IH}$ or $V_{IL}$                         | $I_{OH} = -8\text{mA}$     | 1.7 <sup>(5)</sup> | —                   | —       | V             |
|           |                               |   | $I_{OH} = -100\mu\text{A}$ | $V_{CC} - 0.2$     | —                   | —       |               |
| $V_{OL}$  | Output LOW Voltage            | $V_{CC} = \text{Min.}$<br>$V_{IN} = V_{IH}$ or $V_{IL}$                         | $I_{OL} = 8\text{mA}$      | —                  | 0.2                 | 0.4     | V             |
|           |                               |   | $I_{OL} = 100\mu\text{A}$  | —                  | —                   | 0.2     |               |

## NOTES:

- For conditions shown as Max. or Min., use appropriate value specified under Electrical Characteristics for the applicable device type.
- Typical values are at  $V_{CC} = 2.5\text{V}$ ,  $25^{\circ}\text{C}$  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   |
|---|--|--|---|------|---------------------|------|--------|
| I <sub>CC</sub><br>I <sub>CC</sub> H<br>I <sub>CC</sub> Z | Quiescent Power Supply Current                         | V <sub>CC</sub> = Max.<br>V <sub>IN</sub> = GND or V <sub>CC</sub>                                 |   | —    | 0.1                 | 20   | μA     |
| ΔI <sub>CC</sub>  | Power Supply Current per Input HIGH                    | V <sub>CC</sub> = Max.<br>V <sub>IN</sub> = V <sub>CC</sub> - 0.6V                                 |   | —    | 35                  | 250  | μA     |
| I <sub>CCD</sub>  | Dynamic Power Supply Current per Output <sup>(3)</sup> | V <sub>CC</sub> = Max.<br>C <sub>L</sub> = 15pF<br>All Outputs Toggling                            | V <sub>IN</sub> = V <sub>CC</sub><br>V <sub>IN</sub> = GND        | —    | 65                  | 100  | μA/MHz |
| I <sub>C</sub>  | Total Power Supply Current <sup>(4)</sup>              | V <sub>CC</sub> = Max.<br>C <sub>L</sub> = 15pF<br>All Outputs Toggling<br>f <sub>i</sub> = 133MHz | V <sub>IN</sub> = V <sub>CC</sub><br>V <sub>IN</sub> = GND        | —    | 100                 | 125  | mA     |
|   |  | V <sub>CC</sub> = Max.<br>C <sub>L</sub> = 15pF<br>All Outputs Toggling<br>f <sub>i</sub> = 133MHz | V <sub>IN</sub> = V <sub>CC</sub> - 0.6V<br>V <sub>IN</sub> = GND | —    | 100                 | 125  |        |
|   |  | V <sub>CC</sub> = Max.<br>C <sub>L</sub> = 15pF<br>All Outputs Toggling<br>f <sub>i</sub> = 166MHz | V <sub>IN</sub> = V <sub>CC</sub><br>V <sub>IN</sub> = GND        | —    | 115                 | 150  |        |
|   |  | V <sub>CC</sub> = Max.<br>C <sub>L</sub> = 15pF<br>All Outputs Toggling<br>f <sub>i</sub> = 166MHz | V <sub>IN</sub> = V <sub>CC</sub> - 0.6V<br>V <sub>IN</sub> = GND | —    | 115                 | 150  |        |

NOTES:

1. For conditions shown as Max. or Min., use appropriate value specified under Electrical Characteristics for the applicable device type.

2. Typical values are at V<sub>CC</sub> = 2.5V, +25°C ambient.

3. This parameter is not directly testable, but is derived for use in Total Power Supply calculations.

4. I<sub>C</sub> = I<sub>QUIESCENT</sub> + I<sub>INPUTS</sub> + I<sub>DYNAMIC</sub>

I<sub>C</sub> = I<sub>CC</sub> + ΔI<sub>CC</sub> D<sub>H</sub>N<sub>T</sub> + I<sub>CCD</sub> (f<sub>o</sub>N<sub>o</sub>)

I<sub>CC</sub> = Quiescent Current (I<sub>CC</sub>L, I<sub>CC</sub>H and I<sub>CC</sub>Z)

ΔI<sub>CC</sub> = Power Supply Current for a TTL High Input (V<sub>IN</sub> = V<sub>CC</sub> - 0.6V)

D<sub>H</sub> = Duty Cycle for TTL Inputs High

N<sub>T</sub> = Number of TTL Inputs at D<sub>H</sub>

I<sub>CCD</sub> = Dynamic Current Caused by an Input Transition Pair (HLH or LHL)

f<sub>o</sub> = Output Frequency

N<sub>o</sub> = Number of Outputs at f<sub>o</sub>

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

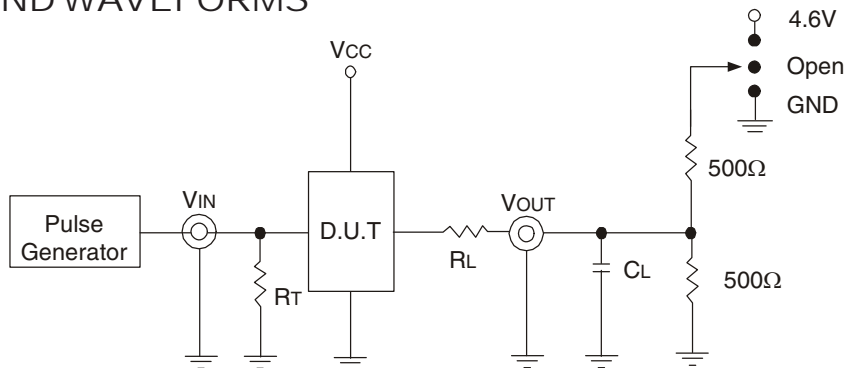
| Symbol              | Parameter   | Conditions <sup>(1)</sup> | Min. <sup>(2)</sup> | Max. | Unit |
|---------------------|---|---------------------------|---------------------|------|------|
| t <sub>PLH</sub>    | Propagation Delay                                 | CL = 15pF<br>f ≤ 133MHz   | 1                   | 3    | ns   |
| t <sub>PHL</sub>    | INA to OAn, INb to OBn                            |                           |                     |      |      |
| t <sub>R</sub>      | Output Rise Time (0.8V to 2V)                     |                           | —                   | 1.5  | ns   |
| t <sub>F</sub>      | Output Fall Time (2V to 0.8V)                     |                           | —                   | 1.5  | ns   |
| t <sub>SK(O)</sub>  | Same device output pin to pin skew <sup>(5)</sup> |                           | —                   | 270  | ps   |
| t <sub>SK(P)</sub>  | Pulse skew <sup>(6,9)</sup>                       |                           | —                   | 270  | ps   |
| t <sub>SK(PP)</sub> | Part to part skew <sup>(7)</sup>                  |                           | —                   | 550  | ps   |
| t <sub>PZL</sub>    | Output Enable Time                                |                           | —                   | 5.2  | ns   |
| t <sub>PZH</sub>    | OEA to OAn, OEB to OBn                            |                           |                     |      |      |
| t <sub>PLZ</sub>    | Output Disable Time                               |                           | —                   | 5.2  | ns   |
| t <sub>PHZ</sub>    | OEA to OAn, OEB to OBn                            |                           |                     |      |      |
| f <sub>MAX</sub>    | Input Frequency                                   |                           | —                   | 133  | MHz  |

| Symbol              | Parameter   | Conditions <sup>(1,8)</sup>      | Min. <sup>(2)</sup> | Max. | Unit |
|---------------------|---|----------------------------------|---------------------|------|------|
| t <sub>PLH</sub>    | Propagation Delay                                 | CL = 15pF<br>133MHz ≤ f ≤ 166MHz | 0.5                 | 2.5  | ns   |
| t <sub>PHL</sub>    | INA to OAn, INb to OBn                            |                                  |                     |      |      |
| t <sub>R</sub>      | Output Rise Time (0.7V to 1.7V)                   |                                  | —                   | 1.25 | ns   |
| t <sub>F</sub>      | Output Fall Time (1.7V to 0.7V)                   |                                  | —                   | 1.25 | ns   |
| t <sub>SK(O)</sub>  | Same device output pin to pin skew <sup>(5)</sup> |                                  | —                   | 200  | ps   |
| t <sub>SK(P)</sub>  | Pulse skew <sup>(6,9)</sup>                       |                                  | —                   | 270  | ps   |
| t <sub>SK(PP)</sub> | Part to part skew <sup>(7)</sup>                  |                                  | —                   | 550  | ps   |
| t <sub>PZL</sub>    | Output Enable Time                                |                                  | —                   | 5.2  | ns   |
| t <sub>PZH</sub>    | OEA to OAn, OEB to OBn                            |                                  |                     |      |      |
| t <sub>PLZ</sub>    | Output Disable Time                               |                                  | —                   | 5.2  | ns   |
| t <sub>PHZ</sub>    | OEA to OAn, OEB to OBn                            |                                  |                     |      |      |
| f <sub>MAX</sub>    | Input Frequency                                   |                                  | —                   | 166  | MHz  |

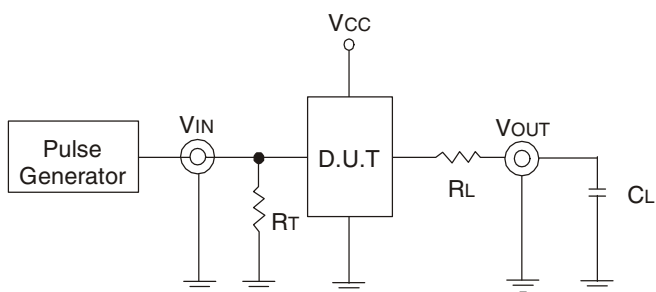
## NOTES:

- See test circuits and waveforms.
- Minimum limits are guaranteed but not tested on Propagation Delays.
- t<sub>PLH</sub> and t<sub>PHL</sub> 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.
- Skew measured between all outputs under identical transitions and load conditions.
- Skew measured is difference between propagation delay times t<sub>PHL</sub> and t<sub>PLH</sub> of same outputs under identical load conditions.
- Part to part skew for all outputs given identical transitions and load conditions at identical V<sub>CC</sub> levels and temperature.
- Airflow of 1m/s is recommended for frequencies above 133MHz.
- This parameter is measured using f = 1MHz.

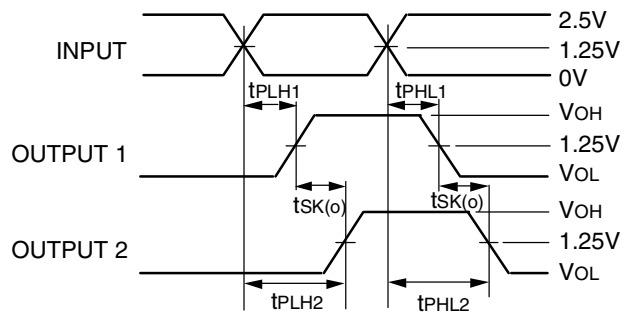
## TEST CIRCUITS AND WAVEFORMS



Enable and Disable Time Circuit



$C_L = 15\text{pF}$  Test Circuit



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

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

## SWITCH POSITION

| Test                        | Switch |
|-----------------------------|--------|
| Disable Low<br>Enable Low   | 4.6V   |
| Disable High<br>Enable High | GND    |

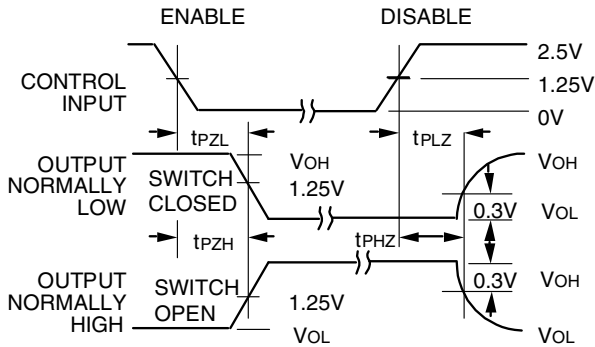
## TEST CONDITIONS

| Symbol      | $V_{CC} = 2.5\text{V} \pm 0.2\text{V}$ | Unit     |
|-------------|--|----------|
| $C_L$       | 15                                     | pF       |
| $R_T$       | $Z_{out}$ of pulse generator           | $\Omega$ |
| $R_L$       | 33                                     | $\Omega$ |
| $t_r / t_f$ | 1 (0V to 2.5V or 2.5V to 0V)           | ns       |

### DEFINITIONS:

$C_L$  = Load capacitance: includes jig and probe capacitance.  
 $R_T$  = Termination resistance: should be equal to  $Z_{out}$  of the Pulse Generator.  
 $t_r / t_f$  = Rise/Fall time of the input stimulus from the Pulse Generator.

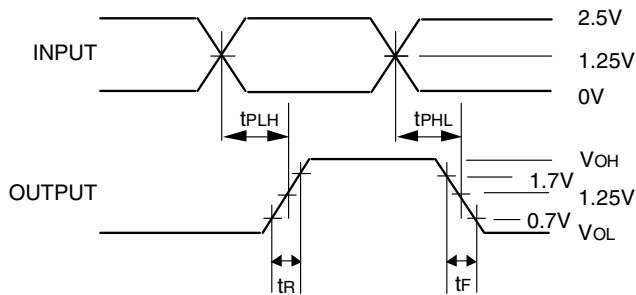
## TEST CIRCUITS AND WAVEFORMS



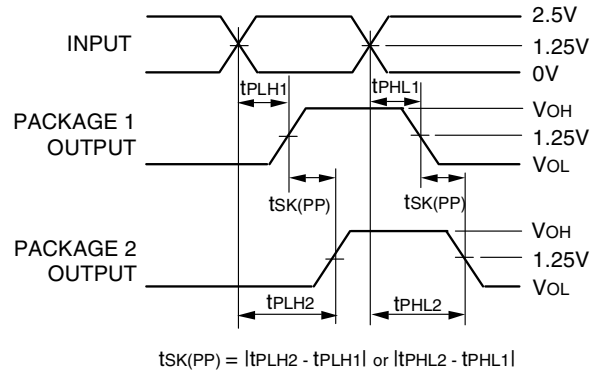
*Enable and Disable Times*

**NOTE:**

- Diagram shown for input Control Enable-LOW and input Control Disable-HIGH

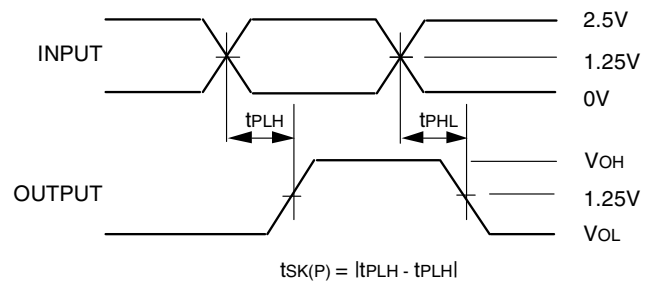


*Propagation Delay*



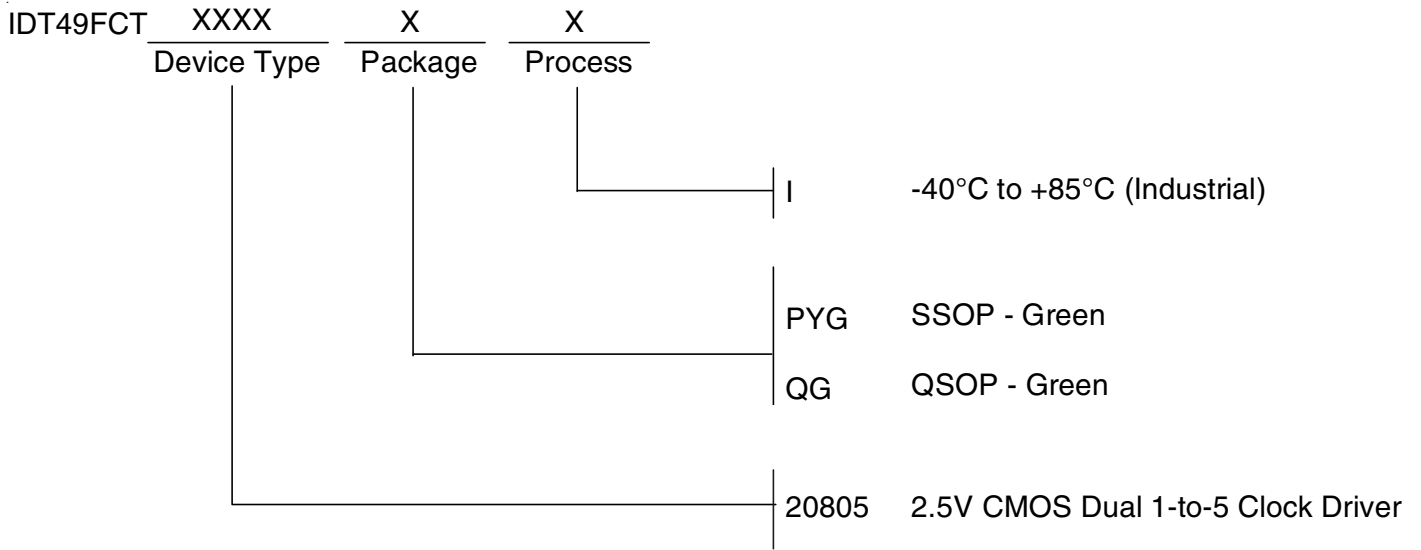
*Part-to-Part Skew - tsk(PP)*

Part-to-Part Skew is for the same package and speed grade.



*Pulse Skew*

### ORDERING INFORMATION





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