# High-Speed CMOS 20-Bit Latch

**QUALITY SEMICONDUCTOR, INC.**

## FEATURES/BENEFITS

- Pin and function compatible with T.I. Widebus™ and IDT Double-Density™ families
- CMOS power levels: <1μW typical standby
- SSOP (PV) and TSSOP (PA) packages
- Low output skew: 0.5ns $t_{SK(O)}$
- Flow-through pinout for easy layout
- Power off disable allows hot plugging
- Industrial temperature: –40°C to +85°C
- Input hysteresis for noise immunity
- Multiple power and ground pins for low noise

### FCT16841T
- High drive standard FCT-T outputs: $I_{OL}$ = +64mA, $I_{OH}$ = −32mA
- Incident switching for driving buses and large loads
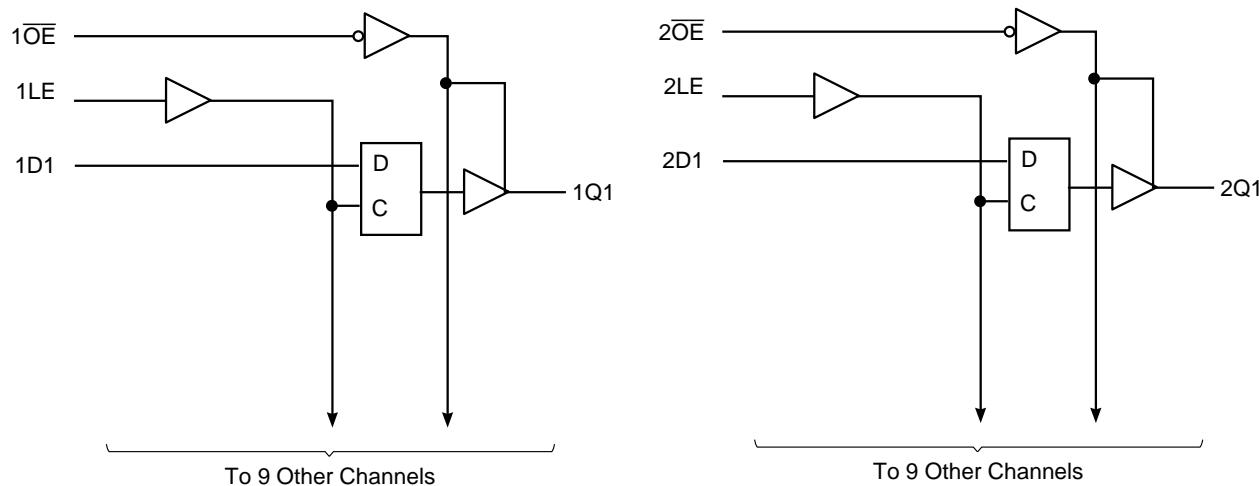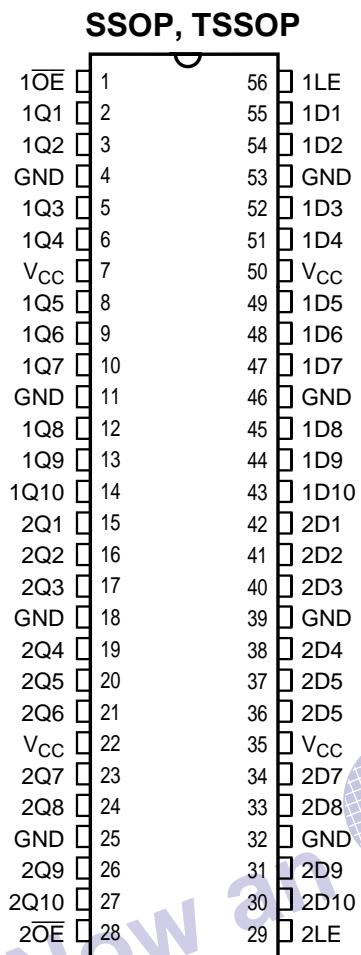
### FCT162841T
- Balanced output drivers: ±24mA
- Reduced switching noise for point to point signals

## DESCRIPTION

The FCT16841 family of products are 20-bit buffered latches with three-state outputs that are ideal for driving high capacitance loads such as memory and address buses. Easy board layout is facilitated by the use of flow-through pinouts and byte enable controls provide architectural flexibility for systems designers. All outputs have ground bounce suppression circuitry (see QSI Application Note AN-01) and many power and ground pins provide low ground bounce. To accommodate hot-plug or live insertion applications, both versions of this product were designed not to load an active bus when $V_{CC}$ is removed. In applications where bus signals are point-to-point or driving light capacitance loads, the balanced drive FCT162841 is recommended.

## Figure 1. Functional Block Diagram



To 9 Other Channels

To 9 Other Channels

## Figure 2. Pin Configuration (All Pins Top View)

**SSOP, TSSOP**

| | | | |
|---|---|---|---|
| 1$\overline{OE}$ | 1 | 56 | 1LE |
| 1Q1 | 2 | 55 | 1D1 |
| 1Q2 | 3 | 54 | 1D2 |
| GND | 4 | 53 | GND |
| 1Q3 | 5 | 52 | 1D3 |
| 1Q4 | 6 | 51 | 1D4 |
| V$_{CC}$ | 7 | 50 | V$_{CC}$ |
| 1Q5 | 8 | 49 | 1D5 |
| 1Q6 | 9 | 48 | 1D6 |
| 1Q7 | 10 | 47 | 1D7 |
| GND | 11 | 46 | GND |
| 1Q8 | 12 | 45 | 1D8 |
| 1Q9 | 13 | 44 | 1D9 |
| 1Q10 | 14 | 43 | 1D10 |
| 2Q1 | 15 | 42 | 2D1 |
| 2Q2 | 16 | 41 | 2D2 |
| 2Q3 | 17 | 40 | 2D3 |
| GND | 18 | 39 | GND |
| 2Q4 | 19 | 38 | 2D4 |
| 2Q5 | 20 | 37 | 2D5 |
| 2Q6 | 21 | 36 | 2D5 |
| V$_{CC}$ | 22 | 35 | V$_{CC}$ |
| 2Q7 | 23 | 34 | 2D7 |
| 2Q8 | 24 | 33 | 2D8 |
| GND | 25 | 32 | GND |
| 2Q9 | 26 | 31 | 2D9 |
| 2Q10 | 27 | 30 | 2D10 |
| 2$\overline{OE}$ | 28 | 29 | 2LE |

### Table 1. Pin Description

| Name | Description |
|---|---|
| xDx | Data Inputs |
| xLE | Latch Enable Input |
| x$\overline{OE}$ | Output Enable Input |
| xQx | 3-State Outputs |

## Table 2. Absolute Maximum Ratings

Supply Voltage to Ground ................................................ −0.5V to +7.0V
DC Output Voltage  V$_{OUT}$ ............................................... −0.5V to +7.0V
DC Input Voltage V$_{IN}$ ...................................................... −0.5V to +7.0V
AC Input Voltage (for a pulse width ≤ 20ns) ................................. −3.0V
DC Input Diode Current with V$_{IN}$ < 0 ........................................ −20mA
DC Output Diode Current with V$_{OUT}$ < 0 .................................. −50mA
DC Output Current Max. Sink Current/Pin ................................. 120mA
Maximum Power Dissipation ........................................................ 1.0W
T$_{STG}$ Storage Temperature .......................................... −65° to +150°C

**Note:** Stresses greater than those listed under ABSOLUTE MAXIMUM RATINGS may cause permanent damage to this device resulting in functional or reliability type failures.

## Table 3. Capacitance

T$_A$ = 25°C, f = 1MHz, V$_{IN}$ = 0V, V$_{OUT}$ = 0V

| Pins | Typ | Max | Unit |
|---|---|---|---|
| All | 6.0 | 9.0 | pF |

## Table 4. Function Table

| Inputs | | | Outputs |
|---|---|---|---|
| xDx | xLE | x$\overline{\text{OE}}$ | xQx |
| H | H | L | H |
| L | H | L | L |
| X | L | L | Q[1] |
| X | X | H | Z |

**Note:** Output level before xLE H → L transition.

## Table 5. Recommended Operating Conditions

| Symbol | Parameter | Min | Max | Unit |
|---|---|---|---|---|
| $V_{CC}$ | Supply Voltage | 4.5 | 5.5 | V |
| $V_{IN}$ | Input Voltage | 0 | $V_{CC}$ | V |
| $V_{OUT}$ | Voltage Applied to Output or I/O | 0 | $V_{CC}$ | V |
| $\Delta t/\Delta v$ | Input Transition Slew Rate | — | 10 | ns/V |
| $T_A$ | Operating Free Air Tempeature | −40 | +85 | °C |

## Table 6. DC Electrical Characteristics Over Operating Range

Recommended Operating Ranges apply unless otherwise noted.

| Symbol | Parameter | Test Conditions[1] | Min | Typ[2] | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{IH}$ | Input HIGH Voltage | Logic HIGH for All Inputs | 2.0 | — | — | V |
| $V_{IL}$ | Input LOW Voltage | Logic LOW for All Inputs | — | — | 0.8 | V |
| $\Delta V_T$ | Input Hysteresis[4] | $V_{TLH} - V_{THL}$ for All Inputs | — | 100 | — | mV |
| $\|I_{IH}\|$ $\|I_{IL}\|$ | Input Current Input HIGH or LOW | $V_{CC}$ = Max., $0 \leq V_{IN} < V_{CC}$ | — | — | 1 | μA |
| $\|I_{OZ}\|$ | Off-State Output Current (Hi-Z) | $V_{CC}$ = Max., $0 \leq V_{OUT} \leq V_{CC}$ | — | — | 1 | μA |
| $\|I_{OFF}\|$ | Power off leakage[5] | $V_{CC}$ = 0V, $V_{IN/OUT} \leq 4.5V$ | — | — | 1 | μA |
| $I_{OS}$ | Short Circuit Current[3,4] | $V_{CC}$ = Max., $V_{OUT}$ = GND | −80 | −140 | −225 | mA |
| $I_O$ | Output Current Drive[3] | $V_{CC}$ = Max., $V_{OUT}$ = 2.5V | −50 | — | −180 | mA |
| $V_{IK}$ | Input Clamp Voltage | $V_{CC}$= Min., $I_{IN}$ = −18mA | — | −0.7 | −1.2 | V |

**Notes**:
1. For conditions shown as Min. or Max. use appropriate value specified under Recommended Operating Conditions for the applicable device type.
2. Typical values indicate $V_{CC}$ = 5.0V and $T_A$ = 25°C.
3. Not more than one output should be tested at one time. Duration of test should not exceed one second.
4. These parameters are guaranteed by design but not tested.
5. The test limit for this parameter is $\pm$ 5μA at $T_A$ = −55°C

### Table 7. Output Drive Characteristics for FCT16841T

| Symbol | Parameter | Test Conditions[1] | | Min | Typ[2] | Max | Unit |
|---|---|---|---|---|---|---|---|
| $V_{OH}$ | Output HIGH Voltage | $V_{CC}$ = Min. | $I_{OH}$ = –3mA | 2.5 | 3.4 | — | V |
| | | $V_{IN} = V_{IH}$ or $V_{IL}$ | $I_{OH}$ = –15mA | 2.4 | 3.2 | — | V |
| | | | $I_{OH}$ = –32mA[4] | 2.0 | 3.0 | — | V |
| $V_{OL}$ | Output LOW Voltage | $V_{CC}$ = Min. $V_{IN} = V_{IH}$ or $V_{IL}$ | $I_{OL}$ = 64mA | — | 0.3 | 0.55 | V |

### Table 8. Output Drive Characteristics for FCT162841T

| Symbol | Parameter | Test Conditions[1] | | Min | Typ[2] | Max | Unit |
|---|---|---|---|---|---|---|---|
| $I_{ODL}$ | Output LOW Current[3] | $V_{CC}$ = 5V, $V_{IN} = V_{IH}$ or $V_{IL}$ $V_{OUT}$ =1.5V | | 60 | 115 | 200 | mA |
| $I_{ODH}$ | Output HIGH Current[3] | $V_{CC}$ = 5V, $V_{IN} = V_{IH}$ or $V_{IL}$ $V_{OUT}$ = 1.5V | | –60 | –115 | –200 | mA |
| $V_{OH}$ | Output HIGH Voltage | $V_{CC}$ = Min. $V_{IN} = V_{IH}$ or $V_{IL}$ | $I_{OH}$ = –24mA | 2.4 | 3.1 | — | V |
| $V_{OL}$ | Output LOW Voltage | $V_{CC}$ = Min. $V_{IN} = V_{IH}$ or $V_{IL}$ | $I_{OL}$ = 24mA | — | 0.3 | 0.55 | V |

**Notes**:
1. For conditions shown as Min. or Max. use appropriate value specified under Electrical Characteristics for the applicable device type.
2. Typical values indicate $V_{CC}$ = 5.0V and $T_A$ = 25°C.
3. Not more than one output should be shorted and the duration is ≤1 second.
4. Duration of the condition should not exceed one second.

## Table 9. Power Supply Characteristics

| Symbol | Parameter | Test Conditions[1] | | Typ [2] | Max | Unit |
|---|---|---|---|---|---|---|
| $I_{CCL}$ $I_{CCH}$ $I_{CCZ}$ | Quiescent Power Supply Current | $V_{CC}$ = Max., $V_{IN}$ = GND or $V_{CC}$ | | 5 | 500 | µA |
| $\Delta I_{CC}$ | Supply Current per Input @ TTL HIGH | $V_{CC}$ = Max., $V_{IN}$ = 3.4V[3] | | 0.5 | 1.5 | mA |
| $Q_{CCD}$ | Supply Current per Input per MHz[4] | $V_{CC}$ = Max., Outputs Open One Bit Toggling @ 50% Duty Cycle $x\overline{OE}$ = GND, xLE = $V_{CC}$ | $V_{IN}$ = $V_{CC}$ $V_{IN}$ = GND | 75 | 120 | µA/ MHz |
| $I_C$ | Total Power Supply Current[6] | $V_{CC}$ = Max., Outputs Open One Bit Toggling @ 50% Duty Cycle $f_I$ = 10MHz, $x\overline{OE}$ = GND, xLE = $V_{CC}$ | $V_{IN}$ = $V_{CC}$ $V_{IN}$ = GND | 0.6 | 1.5[5] | mA |
| | | | $V_{IN}$ = 3.4V $V_{IN}$ = GND | 0.9 | 2.3[5] | mA |
| | | $V_{CC}$ = Max., Outputs Open Twenty Bits Toggling @ 50% Duty Cycle $f_I$ = 2.5MHz, $x\overline{OE}$ = GND, xLE = $V_{CC}$ | $V_{IN}$ = $V_{CC}$ $V_{IN}$ = GND | 3.0 | 5.5[5] | mA |
| | | | $V_{IN}$ = 3.4V $V_{IN}$ = GND | 8.0 | 20.5[5] | mA |

**Notes:**
1. For conditions shown as Min. or Max., use the appropriate values specified under Recommended Operating Conditions for applicable device type.
2. Typical values are at $V_{CC}$ = 5.0V, +25°C ambient.
3. Per TTL driven input ($V_{IN}$ = 3.4V). All Other Inputs at $V_{CC}$ or GND.
4. This parameter is not directly testable, but is derived for use in Total Power Supply Calculations.
5. Values for these conditions are examples of the Icc formula. These limits are guaranteed by design but not tested.
6. $I_C = I_{QUIESCENT} + I_{INPUTS} + I_{DYNAMIC}$.
   $I_C = I_{CCQ} + \Delta I_{CC} D_H N_T + I_{CCD} (f_{CP}N_{CP}/2 + f_I N_I)$.
   $I_{CCQ}$ = Quiescent Current ($I_{CCL}$, $I_{CCH}$, and $I_{CCZ}$).
   $\Delta I_{CC}$ = Power Supply Current for a TTL-High Input ($V_{IN}$ = 3.4V).
   $D_H$ = Duty Cycle for TTL High Inputs.
   $N_T$ = Number of TTL High Inputs.
   $I_{CCD}$ = Dynamic Current Caused by an Input Transition Pair (HLH or LHL).
   $f_{CP}$ = Clock Frequency for Register devices (Zero for Non-Register Devices).
   $N_{CP}$ = Number of Clock Inputs at $f_{CP}$.
   $f_I$ = Input Frequency.
   $N_I$ = Number of Inputs at $f_I$.

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