



High Speed CMOS 16-Bit Bidirectional Transceivers

QS74FCT16245T
QS74FCT162245T

FEATURES/BENEFITS

- Pin and function compatible with T.I. Widebus™ and IDT Double-Density™ families
- CMOS power levels: <math><1 \mu\text{W}</math> typical standby
- SSOP (PV) and TSSOP (PA) packages
- Low output skew: 0.5 ns $t_{SK(O)}$
- Flow-through pinout for easy layout
- Power off disable allows hot plugging
- Extended commercial temperature: -40°C to $+85^{\circ}\text{C}$
- Input hysteresis for noise immunity
- Multiple power and ground pins for low noise
- Std., A, and C speed grades: 4.1 ns t_{PD} for C

FCT16245T

- High drive standard FCT-T outputs: $I_{OL} = +64 \text{ mA}$, $I_{OH} = -32 \text{ mA}$
- Incident switching for driving buses and large loads

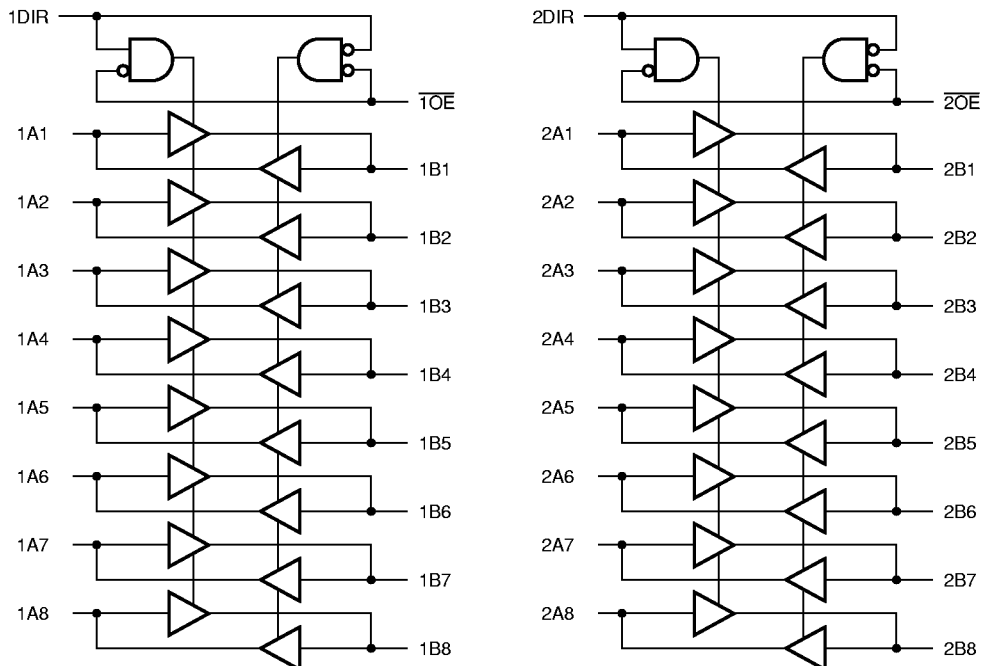
FCT162245T

- Balanced output drivers: $\pm 24 \text{ mA}$
- Reduced switching noise for point to point signals

DESCRIPTION

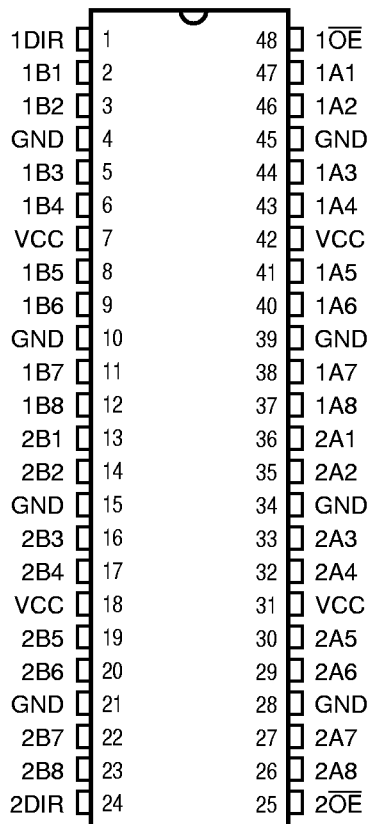
The FCT16245 family of products are 16-bit transceivers ideal for bidirectional data buffering between two buses. These devices can be used as either two independent 8-bit transceivers or one 16-bit transceiver determined by the Direction and Output Enable controls. Easy board layout is facilitated by 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 FCT162245 is recommended.

FUNCTIONAL BLOCK DIAGRAM



**PIN CONFIGURATION
(All Pins Top View)**

SSOP, TSSOP



PIN DESCRIPTION

| Name | Description |
|-------------------|------------------------|
| xDIR | Transmit/Receive Input |
| x \overline{OE} | Output Enable Inputs |
| xAx | Bus A |
| xBx | Bus B |

FUNCTION TABLE

| Inputs | | Outputs |
|-------------------|------|---------------------|
| x \overline{OE} | xDIR | |
| L | L | Bus B Data to Bus A |
| L | H | Bus A Data to Bus B |
| H | X | Hi-Z |

CAPACITANCE

T_A = 25°C, f = 1 MHz, V_{IN} = 0V, V_{OUT} = 0V

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

Note: Capacitance is characterized but not tested.

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 ≤ 20 ns) | -3.0V |
| DC Input Diode Current with $V_{IN} < 0$ | -20 mA |
| DC Output Diode Current with $V_{OUT} < 0$ | -50 mA |
| DC Output Current Max. Sink Current/Pin | 120 mA |
| Maximum Power Dissipation | 1.0 watts |
| 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.

RECOMMENDED OPERATING CONDITIONS

| Symbol | Parameter | Min | Max | Unit |
|---------------------|----------------------------------|------|----------|------|
| V_{CC} | Supply Voltage | 4.5 | 5.5 | V |
| V_{IN} | Input Voltage | -0.5 | 5.5 | 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 Temperature | -40 | +85 | °C |

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 |
| ΔV_T | Input Hysteresis | $V_{TLH} - V_{THL}$ for All Inputs ⁽⁴⁾ | — | 100 | — | mV |
| $ I_{IH} $ $ I_{IL} $ | Input Current Input HIGH or LOW | $V_{CC} = \text{Max.}, 0 \leq V_{IN} < V_{CC}$ | — | — | 1 | μA |
| $ I_{OZ} $ | Off-State Output Current (Hi-Z) | $V_{CC} = \text{Max.}, 0 \leq V_{OUT} \leq V_{CC}$ | — | — | 1 | μA |
| I_{OS} | Short Circuit Current | $V_{CC} = \text{Max.}, V_{OUT} = \text{GND}^{(3,4)}$ | -80 | -140 | -225 | mA |
| V_{IK} | Input Clamp Voltage | $V_{CC} = \text{Min.}, I_{IN} = -18 \text{ mA}$ | — | -0.7 | -1.2 | V |

Notes:

1. For conditions shown as Max or Min use appropriate value specified under Recommended Operating Conditions for the applicable device type.
2. Typical values indicate $V_{CC} = 5.0\text{V}$ and $T_A = 25^\circ\text{C}$.
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.

QS74FCT16245T, QS74FCT162245T ADVANCE INFORMATION

OUTPUT DRIVE CHARACTERISTICS FOR FCT16245T

| Symbol | Parameter | Test Conditions ⁽¹⁾ | Min | Typ ⁽²⁾ | Max | Unit | |
|------------------|--------------------------------|--|---|--------------------|------|------|---|
| I _O | Output Drive Current | V _{CC} = Max, V _{OUT} = 2.5V ⁽³⁾ | -50 | — | -180 | mA | |
| V _{OH} | Output HIGH Voltage | V _{CC} = Min. | I _{OH} = -3 mA | 2.5 | — | — | V |
| | | V _{IN} = V _{IH} or V _{IL} | I _{OH} = -15 mA | 2.4 | — | — | V |
| | | | I _{OH} = -32 mA ⁽⁴⁾ | 2.0 | — | — | V |
| V _{OL} | Output LOW Voltage | V _{CC} = Min. V _{IN} = V _{IH} or V _{IL} | I _{OL} = 64 mA | — | 0.2 | 0.55 | V |
| I _{OFF} | Input/Output Power Off Leakage | V _{CC} = 0V, V _{IN} or V _{OUT} ≤ 4.5V | — | — | ±1.0 | μA | |

OUTPUT DRIVE CHARACTERISTICS FOR FCT162245T

| Symbol | Parameter | Test Conditions ⁽¹⁾ | Min | Typ ⁽²⁾ | Max | Unit | |
|------------------|---------------------|--|--------------------------|--------------------|------|------|---|
| I _{ODL} | Output LOW Current | V _{CC} = 5V, V _{IN} = V _{IH} or V _{IL} V _{OUT} = 1.5V ⁽³⁾ | 60 | 115 | 150 | mA | |
| I _{ODH} | Output HIGH Current | V _{CC} = 5V, V _{IN} = V _{IH} or V _{IL} V _{OUT} = 1.5V ⁽³⁾ | -60 | -115 | -150 | mA | |
| V _{OH} | Output HIGH Voltage | V _{CC} = Min. V _{IN} = V _{IH} or V _{IL} | I _{OH} = -24 mA | 2.4 | 3.3 | — | V |
| V _{OL} | Output LOW Voltage | V _{CC} = Min. V _{IN} = V _{IH} or V _{IL} | I _{OL} = 24 mA | — | 0.3 | 0.55 | V |

Notes:

1. For conditions shown as Max or Min 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.

QS74FCT16245T, QS74FCT162245T ADVANCE INFORMATION

POWER SUPPLY CHARACTERISTICS - FCT16245T, FCT162245T

| Symbol | Parameter | Test Conditions ⁽¹⁾ | Typ ⁽²⁾ | Max | Unit | |
|------------------|---|--|-----------------------------------|---------------------|------------|----|
| I _{CCQ} | Quiescent Power Supply Current | V _{CC} = Max., Freq = 0 V _{IN} = GND or V _{CC} | 5 | 500 | μA | |
| ΔI _{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 | 60 | 100 | μA/ MHz | |
| I _C | Total Power Supply Current ⁽⁶⁾ | V _{CC} = Max., Outputs Open One Bit Toggling @ 50% Duty Cycle x \overline{OE} = GND, f _i = 10 MHz | V _{IN} = V _{CC} | 0.6 | 1.5 | mA |
| | | | V _{IN} = GND | | | |
| | | V _{CC} = Max., Outputs Open Sixteen Bits Toggling @ 50% Duty Cycle x \overline{OE} = GND, f _i = 2.5 MHz | V _{IN} = 3.4V | 0.9 | 2.3 | mA |
| | | | V _{IN} = GND | | | |
| | | V _{IN} = V _{CC} | 2.4 | 4.5 ⁽⁵⁾ | mA | |
| | | V _{IN} = GND | | | | |
| | | V _{IN} = 3.4V | 6.4 | 16.5 ⁽⁵⁾ | mA | |
| | | V _{IN} = GND | | | | |

Notes:

- For conditions shown as Min. or Max., use the appropriate values specified under Recommended Operating Conditions for applicable device type.
- Typical values are at V_{CC} = 5.0V, +25°C ambient.
- Per TTL driven input (V_{IN} = 3.4V). 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_{CC} formula. These limits are guaranteed by design but not tested.
- 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_{CCCH}, and I_{CCZ}).
ΔI_{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.

QS74FCT16245T, QS74FCT162245T ADVANCE INFORMATION

SWITCHING CHARACTERISTICS OVER OPERATING RANGE

Recommended Operating Ranges apply unless otherwise specified.

$C_{LOAD} = 50 \text{ pF}$, $R_{LOAD} = 500\Omega$ unless otherwise noted.

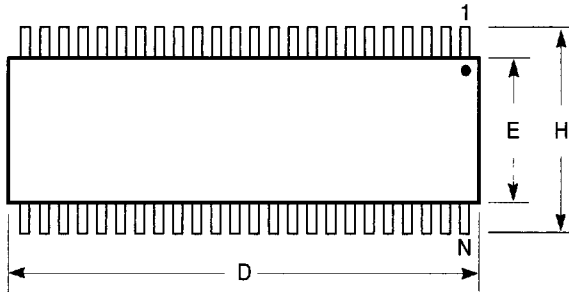
| Symbol | Description ⁽¹⁾ | FCT16245T FCT162245T | | FCT16245AT FCT162245AT | | FCT16245CT FCT162245CT | | Unit |
|--------------------------------------|---|-------------------------|-----|---------------------------|-----|---------------------------|-----|------|
| | | Min | Max | Min | Max | Min | Max | |
| t _{PHL} t _{PLH} | Propagation Delay A to B, B to A | 1.5 | 7.0 | 1.5 | 4.6 | 1.5 | 4.1 | ns |
| t _{PZH} t _{PZL} | Output Enable Time x \overline{OE} to A or B | 1.5 | 9.5 | 1.5 | 6.2 | 1.5 | 5.8 | ns |
| t _{PHZ} t _{PLZ} | Output Disable Time ⁽²⁾ x \overline{OE} to A or B | 1.5 | 7.5 | 1.5 | 5.0 | 1.5 | 4.8 | ns |
| t _{PZH} t _{PZL} | Output Enable Time xDIR to A or B | 1.5 | 9.5 | 1.5 | 6.2 | 1.5 | 5.8 | ns |
| t _{PHZ} t _{PLZ} | Output Disable Time ⁽²⁾ xDIR to A or B | 1.5 | 7.5 | 1.5 | 5.0 | 1.5 | 4.8 | ns |
| t _{SK(o)} | Output Skew ⁽³⁾ | — | 0.5 | — | 0.5 | — | 0.5 | ns |

Notes:

1. Minimums guaranteed but not tested. See Test Circuit and Waveforms.
2. Guaranteed by design, but not tested.
3. Skew between any two outputs of the same package switching in the same direction.
This parameter is guaranteed by design but not tested.

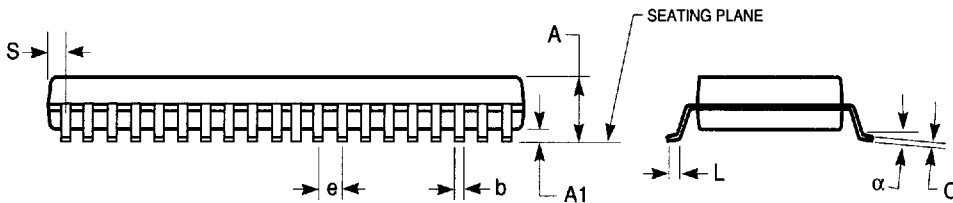
300-MIL SSOP - Package Code PV

**Shrink Small Outline Package
Plastic Small Outline Gull-Wing**



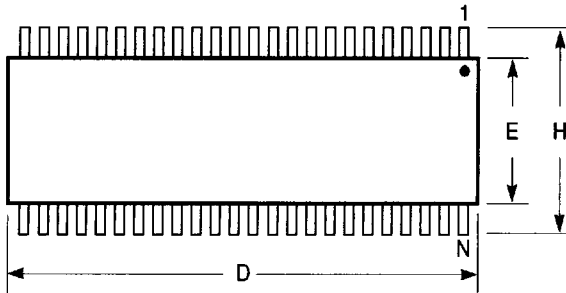
Notes:

1. Refer to applicable symbol list.
2. All dimensions are in inches.
3. N is the number of lead positions.
4. Dimensions D and E are to be measured at maximum material condition but do not include mold flash. Allowable mold flash is 0.006in. per side.
5. Lead coplanarity is 0.004in. maximum.



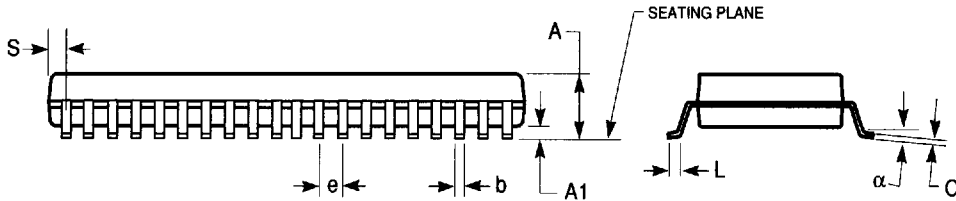
| JEDEC# | MO-118AA | | | MO-118AB | | |
|--------|-----------|-------|--------|-----------|-------|--------|
| DWG# | PSS-48B | | | PSS-56B | | |
| Symbol | Min | Nom | Max | Min | Nom | Max |
| A | 0.095 | 0.102 | 0.110 | 0.095 | 0.102 | 0.110 |
| A1 | 0.008 | 0.012 | 0.016 | 0.008 | 0.012 | 0.016 |
| b | 0.008 | 0.010 | 0.0135 | 0.008 | 0.010 | 0.0135 |
| C | 0.005 | 0.008 | 0.010 | 0.005 | 0.008 | 0.010 |
| D | 0.620 | 0.625 | 0.630 | 0.720 | 0.725 | 0.730 |
| E | 0.291 | 0.295 | 0.299 | 0.291 | 0.295 | 0.299 |
| e | 0.025 BSC | | | 0.025 BSC | | |
| H | 0.395 | 0.410 | 0.420 | 0.395 | 0.410 | 0.420 |
| L | 0.020 | 0.030 | 0.040 | 0.020 | 0.030 | 0.040 |
| N | 48 | | | 56 | | |
| alpha | 0° | 5° | 8° | 0° | 5° | 8° |
| S | 0.022 | 0.025 | 0.028 | 0.022 | 0.025 | 0.028 |

240-MIL TSSOP - Package Code PA
Thin Shrink Small Outline Package
Plastic Small Outline Gull-Wing



Notes:

1. Refer to applicable symbol list.
2. N is the number of lead positions.
3. Dimensions D, E, and S are to be measured at maximum material condition but do not include mold flash. Allowable mold flash is 0.006 in. per side.
4. Lead coplanarity is 0.004in. maximum.



| JEDEC# | MO-153ED | | | MO-153EE | | | MO-153ED | | | MO-153EE | | |
|--------|------------|-------|-------|------------|-------|-------|----------|-------|-------|----------|-------|-------|
| DWG# | PSS-48C | | | PSS-56C | | | PSS-48C | | | PSS-56C | | |
| Symbol | Min | Nom | Max | Min | Nom | Max | Min | Nom | Max | Min | Nom | Max |
| A | 0.039 | 0.043 | 0.047 | 0.039 | 0.043 | 0.047 | 1.00 | 1.10 | 1.20 | 1.00 | 1.10 | 1.20 |
| A1 | 0.002 | 0.004 | 0.006 | 0.002 | 0.004 | 0.006 | 0.05 | 0.10 | 0.15 | 0.05 | 0.10 | 0.15 |
| b | 0.006 | 0.008 | 0.011 | 0.006 | 0.008 | 0.011 | 0.17 | 0.20 | 0.27 | 0.17 | 0.20 | 0.27 |
| C | 0.004 | 0.006 | 0.008 | 0.004 | 0.006 | 0.008 | 0.09 | 0.15 | 0.20 | 0.09 | 0.15 | 0.20 |
| D | 0.488 | 0.492 | 0.496 | 0.547 | 0.551 | 0.555 | 12.40 | 12.50 | 12.60 | 13.90 | 14.00 | 14.10 |
| E | 0.236 | 0.240 | 0.244 | 0.236 | 0.240 | 0.244 | 6.00 | 6.10 | 6.20 | 6.00 | 6.10 | 6.20 |
| e | 0.0197 BSC | | | 0.0197 BSC | | | 0.50 BSC | | | 0.50 BSC | | |
| H | 0.315 | 0.319 | 0.323 | 0.315 | 0.319 | 0.323 | 8.00 | 8.10 | 8.20 | 8.00 | 8.10 | 8.20 |
| L | 0.018 | 0.024 | 0.030 | 0.018 | 0.024 | 0.030 | 0.45 | 0.60 | 0.75 | 0.45 | 0.60 | 0.75 |
| N | 48 | | | 56 | | | 48 | | | 56 | | |
| alpha | 0° | 5° | 8° | 0° | 5° | 8° | 0° | 5° | 8° | 0° | 5° | 8° |
| S | 0.015 | 0.020 | 0.025 | 0.006 | 0.010 | 0.014 | 0.38 | 0.50 | 0.65 | 0.15 | 0.25 | 0.35 |

DIMENSIONS IN INCHES

DIMENSIONS IN MILLIMETERS

7466803 0003757 T&T

QUALITY SEMICONDUCTOR, INC.