



## FAST CMOS 16-BIT BUFFER/LINE DRIVER

**IDT74FCT162H244AT/CT**

### FEATURES:

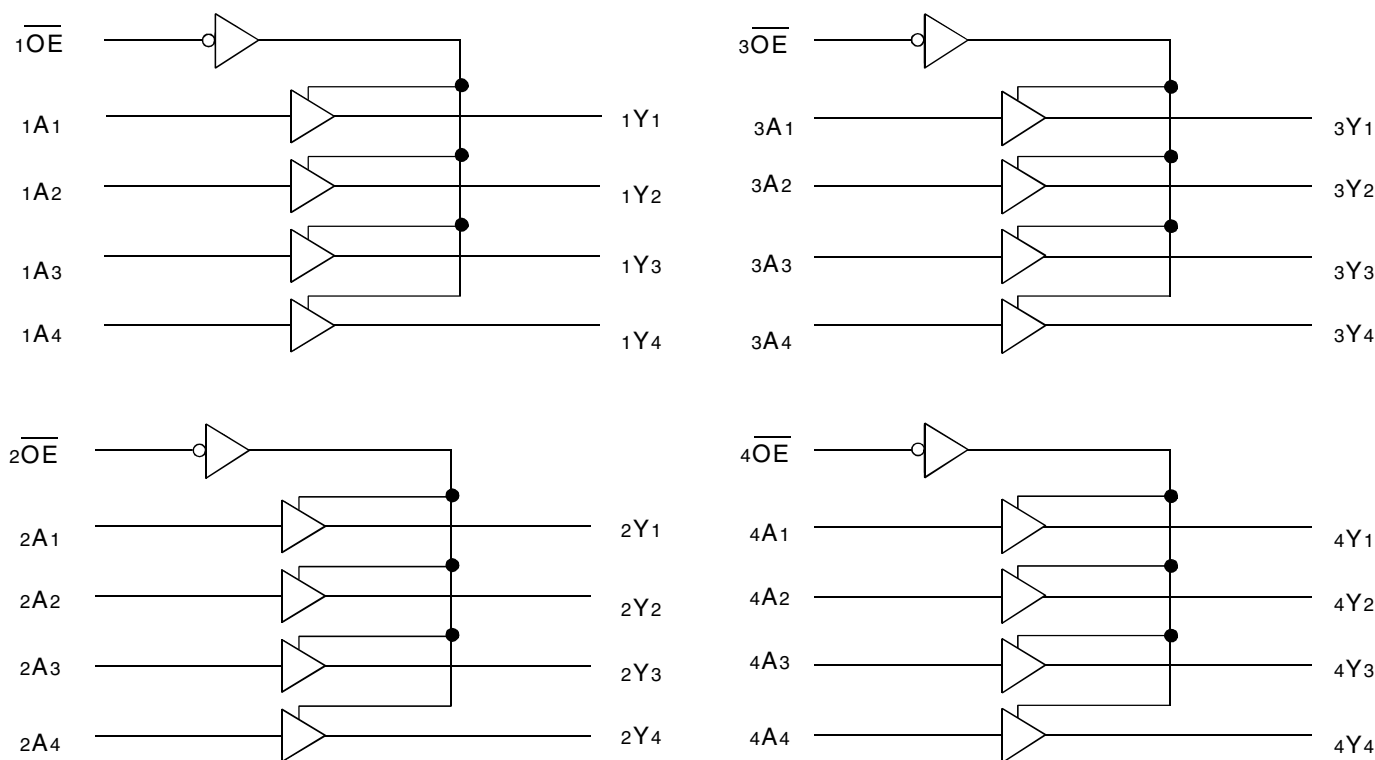
- 0.5 MICRON CMOS Technology
- High-speed, low-power CMOS replacement for ABT functions
- Typical  $t_{sk(o)}$  (Output Skew) < 250ps
- Low input and output leakage  $\leq 1\mu A$  (max.)
- ESD > 2000V per MIL-STD-883, Method 3015; > 200V using machine model (C = 200pF, R = 0)
- Bus-Hold retains last active bus state during 3-state
- Eliminates the need for external pull up resistors
- Available in TSSOP and SSOP packages

### DESCRIPTION:

The FCT162H244T 16-Bit Buffer/Line Driver is for bus interface or signal buffering applications requiring high speed and low power dissipation. These devices have a flow through pin organization, and shrink packaging to simplify board layout. All inputs are designed with hysteresis for improved noise margin. The three-state controls allow independent 4-bit, 8-bit or combined 16-bit operation. These parts are plug in replacements for 74ABT16244 where higher speed, lower noise or lower power dissipation levels are desired.

The FCT162H244T has "Bus-Hold" which retains the input's last state whenever the input goes to high impedance. This prevents "floating" inputs and eliminates the need for pull-up/down resistors.

### FUNCTIONAL BLOCK DIAGRAM

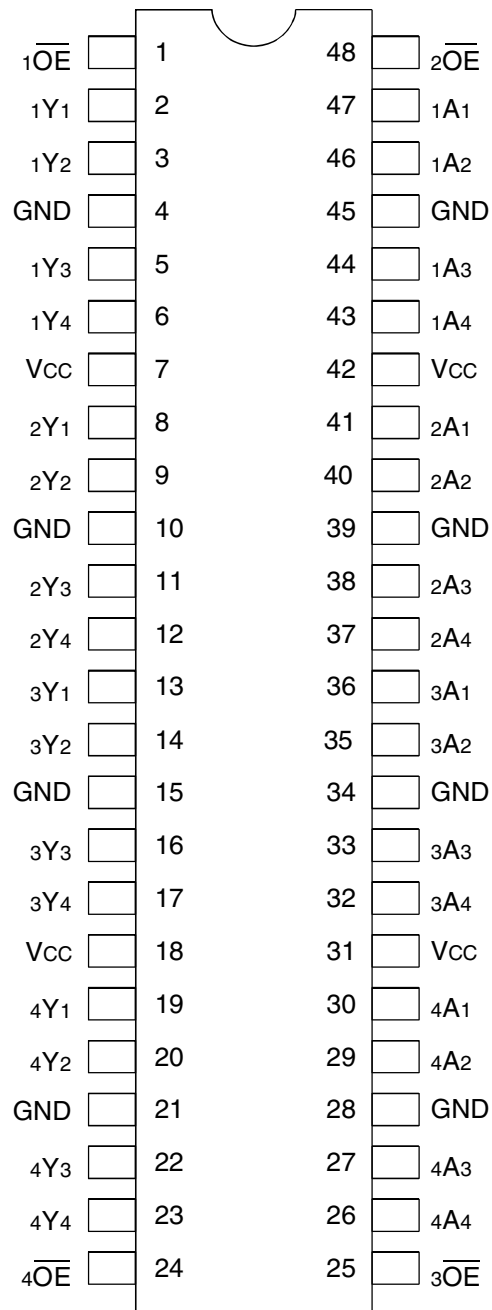


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INDUSTRIAL TEMPERATURE RANGE

MAY 2002

## PIN CONFIGURATION



SSOP/ TSSOP  
TOP VIEW

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

| Symbol               | Description                          | Max             | Unit |
|----------------------|--------------------------------------|-----------------|------|
| VTERM <sup>(2)</sup> | Terminal Voltage with Respect to GND | -0.5 to 7       | V    |
| VTERM <sup>(3)</sup> | Terminal Voltage with Respect to GND | -0.5 to VCC+0.5 | V    |
| TSTG                 | Storage Temperature                  | -65 to +150     | °C   |
| IOUT                 | DC Output Current                    | -60 to +120     | mA   |

### NOTES:

- 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.
- All device terminals except FCT162XXX Output and I/O terminals.
- Output and I/O terminals for FCT162XXX and FCT166XXX.

## CAPACITANCE (TA = +25°C, f = 1.0MHz)

| Symbol | Parameter <sup>(1)</sup> | Conditions | Typ. | Max. | Unit |
|--------|--------------------------|------------|------|------|------|
| CIN    | Input Capacitance        | VIN = 0V   | 3.5  | 6    | pF   |
| COUT   | Output Capacitance       | VOUT = 0V  | 3.5  | 8    | pF   |

### NOTE:

- This parameter is measured at characterization but not tested.

## PIN DESCRIPTION

| Pin Names | Description                               |
|-----------|-------------------------------------------|
| xOE       | 3-State Outputs Enable Input (Active LOW) |
| xAx       | Data Inputs <sup>(1)</sup>                |
| xYx       | 3-State Outputs                           |

### NOTE:

- These pins have "Bus-hold". All other pins are standard inputs, outputs, or I/Os.

## FUNCTION TABLE<sup>(1, 2)</sup>

| Inputs |     | Output |
|--------|-----|--------|
| xOE    | xAx | xYx    |
| L      | L   | L      |
| L      | H   | H      |
| H      | X   | Z      |

### NOTES:

- H = HIGH Voltage Level  
X = Don't Care  
L = LOW Voltage Level  
Z = High-Impedance

## DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE

Following Conditions Apply Unless Otherwise Specified:

Industrial:  $T_A = -40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ ,  $V_{CC} = 5.0\text{V} \pm 10\%$

| Symbol                                                   | Parameter                                                                |                               | Test Conditions <sup>(1)</sup>                                     |                                  | Min. | Typ. <sup>(2)</sup> | Max. | Unit |
|----------------------------------------------------------|--------------------------------------------------------------------------|-------------------------------|--------------------------------------------------------------------|----------------------------------|------|---------------------|------|------|
| V <sub>IH</sub>                                          | Input HIGH Level                                                         |                               | Guaranteed Logic HIGH Level                                        |                                  | 2    | —                   | —    | V    |
| V <sub>IL</sub>                                          | Input LOW Level                                                          |                               | Guaranteed Logic LOW Level                                         |                                  | —    | —                   | 0.8  | V    |
| I <sub>IH</sub>                                          | Input<br>HIGH<br>Current <sup>(4)</sup>                                  | Standard Input <sup>(5)</sup> | V <sub>CC</sub> = Max.                                             | V <sub>I</sub> = V <sub>CC</sub> | —    | —                   | ±1   | μA   |
|                                                          |                                                                          | Standard I/O <sup>(5)</sup>   |                                                                    |                                  | —    | —                   | ±1   |      |
|                                                          |                                                                          | Bus-hold Input                |                                                                    |                                  | —    | —                   | ±100 |      |
|                                                          |                                                                          | Bus-hold I/O                  |                                                                    |                                  | —    | —                   | ±100 |      |
| I <sub>IL</sub>                                          | Input<br>LOW<br>Current <sup>(4)</sup>                                   | Standard Input <sup>(5)</sup> | V <sub>I</sub> = GND                                               | —                                | —    | ±1                  |      |      |
|                                                          |                                                                          | Standard I/O <sup>(5)</sup>   |                                                                    | —                                | —    | ±1                  |      |      |
|                                                          |                                                                          | Bus-hold Input                |                                                                    | —                                | —    | ±100                |      |      |
|                                                          |                                                                          | Bus-hold I/O                  |                                                                    | —                                | —    | ±100                |      |      |
| I <sub>BHH</sub><br>I <sub>BHL</sub>                     | Bus-hold Sustain<br>Current <sup>(4)</sup>                               | Bus-hold Input                | V <sub>CC</sub> = Min.                                             | V <sub>I</sub> = 2.0V            | –50  | —                   | —    | μA   |
|                                                          |                                                                          |                               | V <sub>I</sub> = 0.8V                                              | 50                               | —    | —                   |      |      |
| I <sub>OZH</sub>                                         | High Impedance Output Current<br>(3-State Output pins) <sup>(5, 6)</sup> |                               | V <sub>CC</sub> = Max.                                             | V <sub>O</sub> = 2.7V            | —    | —                   | ±1   | μA   |
| I <sub>OZL</sub>                                         |                                                                          |                               |                                                                    | V <sub>O</sub> = 0.5V            | —    | —                   | ±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>OS</sub>                                          | Short Circuit Current                                                    |                               | V <sub>CC</sub> = Max., V <sub>O</sub> = GND <sup>(3)</sup>        |                                  | –80  | –140                | –250 | mA   |
| V <sub>H</sub>                                           | Input Hysteresis                                                         |                               | —                                                                  |                                  | —    | 100                 | —    | 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> |                                  | —    | 5                   | 500  | μA   |

## OUTPUT DRIVE CHARACTERISTICS

| Symbol    | Parameter           | Test Conditions <sup>(1)</sup>                                             |                         | Min. | Typ. <sup>(2)</sup> | Max. | Unit |
|-----------|---------------------|----------------------------------------------------------------------------|-------------------------|------|---------------------|------|------|
| $I_{ODL}$ | Output LOW Current  | $V_{CC} = 5\text{V}, V_{IN} = V_{IH}$ or $V_{IL}, V_O = 1.5\text{V}^{(3)}$ |                         | 60   | 115                 | 200  | mA   |
| $I_{ODH}$ | Output HIGH Current | $V_{CC} = 5\text{V}, V_{IN} = V_{IH}$ or $V_{IL}, V_O = 1.5\text{V}^{(3)}$ |                         | –60  | –115                | –200 | mA   |
| $V_{OH}$  | Output HIGH Voltage | $V_{CC} = \text{Min.}$<br>$V_{IN} = V_{IH}$ or $V_{IL}$                    | $I_{OH} = -24\text{mA}$ | 2.4  | 3.3                 | —    | V    |
| $V_{OL}$  | Output LOW Voltage  | $V_{CC} = \text{Min.}$<br>$V_{IN} = V_{IH}$ or $V_{IL}$                    | $I_{OH} = 24\text{mA}$  | —    | 0.3                 | 0.55 | V    |

### NOTES:

- For conditions shown as Min. or Max., use appropriate value specified under Electrical Characteristics for the applicable device type.
- Typical values are at  $V_{CC} = 5.0\text{V}$ ,  $+25^{\circ}\text{C}$  ambient.
- Not more than one output should be shorted at one time. Duration of the test should not exceed one second.
- Duration of the condition can not exceed one second.
- This test limit for this parameter is  $\pm 5\mu\text{A}$  at  $T_A = -55^{\circ}\text{C}$ .
- Does not include Bus-hold I/O pins.

## 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>$V_{IN} = 3.4V^{(3)}$                                                                                             |                                            | —    | 0.5                 | 1.5                 | mA               |
| $I_{CCD}$       | Dynamic Power Supply<br>Current <sup>(4)</sup>    | $V_{CC} = \text{Max.}$<br>Outputs Open<br>$\overline{xOE} = \text{GND}$<br>One Input Toggling<br>50% Duty Cycle                             | $V_{IN} = V_{CC}$<br>$V_{IN} = \text{GND}$ | —    | 60                  | 100                 | $\mu A /$<br>MHz |
| $I_C$           | Total Power Supply Current <sup>(6)</sup>         | $V_{CC} = \text{Max.}$<br>Outputs Open<br>$f_i = 10\text{MHz}$<br>50% Duty Cycle<br>$\overline{xOE} = \text{GND}$<br>One Bit Toggling       | $V_{IN} = V_{CC}$<br>$V_{IN} = \text{GND}$ | —    | 0.6                 | 1.5                 | mA               |
|                 |                                                   |                                                                                                                                             | $V_{IN} = 3.4V$<br>$V_{IN} = \text{GND}$   | —    | 0.9                 | 2.3                 |                  |
|                 |                                                   | $V_{CC} = \text{Max.}$<br>Outputs Open<br>$f_i = 2.5\text{MHz}$<br>50% Duty Cycle<br>$\overline{xOE} = \text{GND}$<br>Sixteen Bits Toggling | $V_{IN} = V_{CC}$<br>$V_{IN} = \text{GND}$ | —    | 2.4                 | 4.5 <sup>(5)</sup>  |                  |
|                 |                                                   |                                                                                                                                             | $V_{IN} = 3.4V$<br>$V_{IN} = \text{GND}$   | —    | 6.4                 | 16.5 <sup>(5)</sup> |                  |

### NOTES:

- For conditions shown as Min. or Max., use appropriate value specified under Electrical Characteristics for the applicable device type.
- Typical values are at  $V_{CC} = 5.0V$ ,  $+25^\circ\text{C}$  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 but not tested.
- $I_C = I_{QUIESCENT} + I_{INPUTS} + I_{DYNAMIC}$   
 $I_C = I_{CC} + \Delta I_{CC} D_H N_T + I_{CCD} (f_{CP} N_{CP} / 2 + f_i N_i)$   
 $I_{CC} = \text{Quiescent Current (} I_{CCL}, I_{CCH} \text{ and } I_{CCZ} \text{)}$   
 $\Delta I_{CC} = \text{Power Supply Current for a TTL High Input (} V_{IN} = 3.4V \text{)}$   
 $D_H = \text{Duty Cycle for TTL Inputs High}$   
 $N_T = \text{Number of TTL Inputs at } D_H$   
 $I_{CCD} = \text{Dynamic Current caused by an Input Transition Pair (HLH or LHL)}$   
 $f_{CP} = \text{Clock Frequency for Register Devices (Zero for Non-Register Devices)}$   
 $N_{CP} = \text{Number of Clock Inputs at } f_{CP}$   
 $f_i = \text{Input Frequency}$   
 $N_i = \text{Number of Inputs at } f_i$

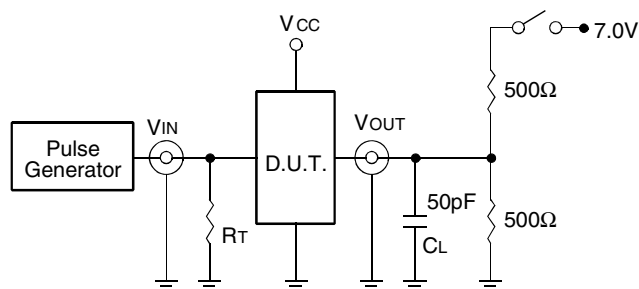
## SWITCHING CHARACTERISTICS OVER OPERATING RANGE

| Symbol                 | Parameter                           | Condition <sup>(1)</sup>          | FCT162H244AT        |      | FCT162H244CT        |      | Unit |
|------------------------|-------------------------------------|-----------------------------------|---------------------|------|---------------------|------|------|
|                        |                                     |                                   | Min. <sup>(2)</sup> | Max. | Min. <sup>(2)</sup> | Max. |      |
| $t_{PLH}$<br>$t_{PHL}$ | Propagation Delay<br>$xAX$ to $xYx$ | $C_L = 50pF$<br>$R_L = 500\Omega$ | 1.5                 | 4.8  | 1.5                 | 3.6  | ns   |
| $t_{PZH}$<br>$t_{PZL}$ | Output Enable Time                  |                                   | 1.5                 | 6.2  | 1.5                 | 4.4  | ns   |
| $t_{PHZ}$<br>$t_{PLZ}$ | Output Disable Time                 |                                   | 1.5                 | 5.6  | 1.5                 | 4.1  | ns   |
| $t_{SK(o)}$            | Output Skew <sup>(3)</sup>          |                                   | —                   | 0.5  | —                   | 0.5  | ns   |

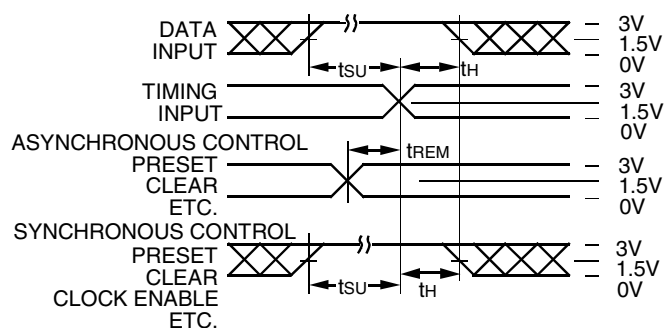
### NOTES:

- See test circuit and waveforms.
- Minimum limits are guaranteed but not tested on Propagation Delays.
- Skew between any two outputs of the same package switching in the same direction. This parameter is guaranteed by design.

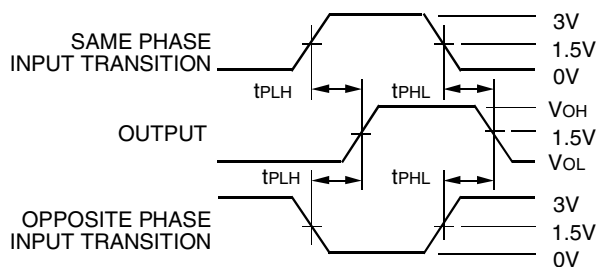
## TEST CIRCUITS AND WAVEFORMS



Test Circuits for All Outputs



Set-up, Hold, and Release Times



Propagation Delay

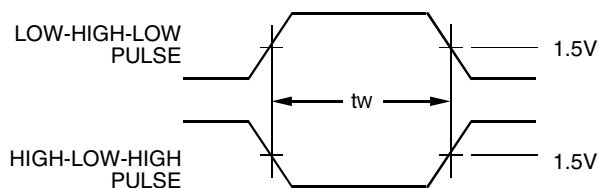
## SWITCH POSITION

| Test                                    | Switch |
|-----------------------------------------|--------|
| Open Drain<br>Disable Low<br>Enable Low | Closed |
| All Other Tests                         | Open   |

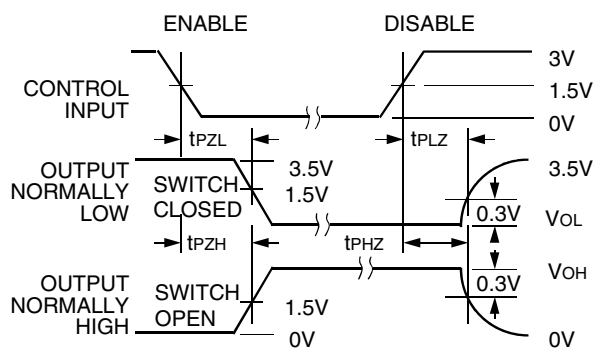
### DEFINITIONS:

CL = Load capacitance: includes jig and probe capacitance.

RT = Termination resistance: should be equal to Zout of the Pulse Generator.



Pulse Width



Enable and Disable Times

### NOTES:

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

## ORDERING INFORMATION

| IDT | XX          | FCT | XXX    | X        | XXXX           | XX       |                                                                   |
|-----|-------------|-----|--------|----------|----------------|----------|-------------------------------------------------------------------|
|     | Temp. Range |     | Family | Bus Hold | Device Type    | Package  |                                                                   |
|     |             |     |        |          |                | PV<br>PA | Shrink Small Outline Package<br>Thin Shrink Small Outline Package |
|     |             |     |        |          | 244AT<br>244CT |          | 16-Bit Buffer/Line Driver                                         |
|     |             |     |        | H        |                |          | Bus-hold                                                          |
|     |             |     | 162    |          |                |          | Double-Density, 5 Volt, Balanced Drive                            |
|     |             |     | 74     |          |                |          | – 40°C to +85°C                                                   |



**CORPORATE HEADQUARTERS**  
6024 Silver Creek Valley Road  
San Jose, CA 95138

**for SALES:**  
800-345-7015 or 408-284-8200  
fax: 408-284-2775  
www.idt.com

**for Tech Support:**  
logichelp@idt.com