



# FAST CMOS OCTAL REGISTERED TRANSCEIVER

**IDT29FCT52AT/BT/CT/DT**

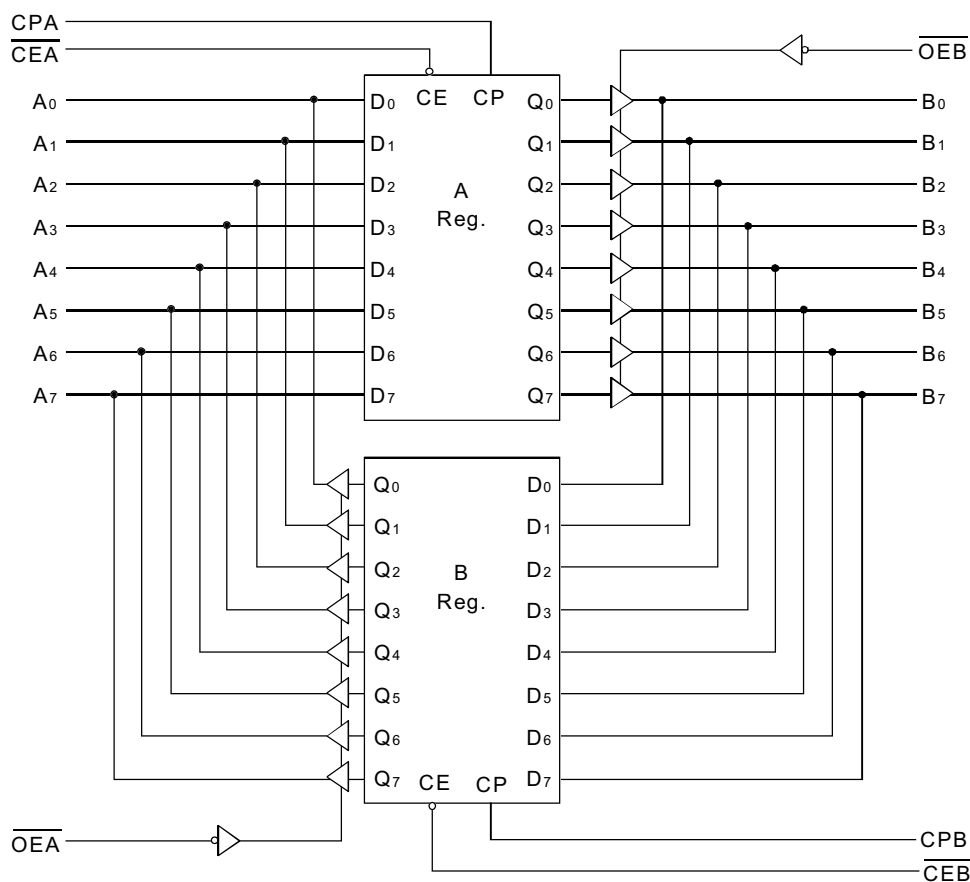
## FEATURES:

- Low input and output leakage  $\leq 1\mu\text{A}$  (max.)
- Extended commercial range of  $-40^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$
- CMOS power levels
- True TTL input and output compatibility
  - $V_{OH} = 3.3\text{V}$  (typ.)
  - $V_{OL} = 0.3\text{V}$  (typ.)
- Meets or exceeds JEDEC standard 18 specifications
- Product available in Radiation Tolerant and Radiation Enhanced versions
- Available in PDIP, SOIC, SSOP, QSOP, and TSSOP packages
- A, B, C and D speed grades
- High drive outputs (-15mA IOH, 64mA IOL)
- Power off disable outputs permit "live insertion"

## DESCRIPTION:

The IDT29FCT52AT/BT/CT/DT is an 8-bit registered transceiver built using an advanced dual metal CMOS technology. Two 8-bit back-to-back registers store data flowing in both directions between two bidirectional buses. Separate clock, clock enable and 3-state output enable signals are provided for each register. Both A outputs and B outputs are guaranteed to sink 64mA.

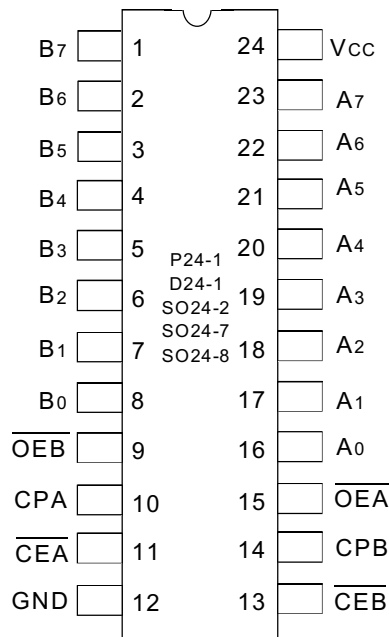
## FUNCTIONAL BLOCK DIAGRAM



**COMMERCIAL TEMPERATURE RANGE**

**SEPTEMBER 1999**

## PIN CONFIGURATION



PDIP/ SOIC/ SSOP/ QSOP  
TOP VIEW

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

Symbol	Rating	Max.	Unit
V <sub>TERM</sub> <sup>(2)</sup>	Terminal Voltage with Respect to GND	-0.5 to +7	V
T <sub>STG</sub>	Storage Temperature	-65 to +150	°C
I <sub>OUT</sub>	DC Output Current	-65 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.

## 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	6	10	pF
C <sub>OUT</sub>	Output Capacitance	V <sub>OUT</sub> = 0V	8	12	pF

81-link

### NOTE:

- This parameter is measured at characterization but not tested.

## REGISTER FUNCTION TABLE<sup>(1)</sup>

(Applies to A or B Register)

Inputs			Internal Q	Function
D	CP	CE̅		
X	X	H	NC	Hold Data
L	↑	L	L	Load Data
H	↑	L	H	

### NOTE:

- H = HIGH Voltage Level  
L = LOW Voltage Level  
X = Don't Care  
NC = No Change  
↑ = LOW-to-HIGH Transition

## OUTPUT CONTROL<sup>(1)</sup>

OE̅	Internal Q	Y-Outputs	Function
H	X	Z	Disable Outputs
L	L	L	Enable Outputs
L	H	H	

### NOTE:

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

## PIN DESCRIPTION

Name	I/O	Description
A0-7	I/O	Eight bidirectional lines carrying the A Register inputs or B Register outputs.
B0-7	I/O	Eight bidirectional lines carrying the B Register inputs or A Register outputs.
CPA	I	Clock for the A Register. When $\overline{CEA}$ is LOW, data is entered into the A Register on the LOW-to-HIGH transition of the CPA signal.
$\overline{CEA}$	I	Clock Enable for the A Register. When $\overline{CEA}$ is LOW, data is entered into the A Register on the LOW-to-HIGH transition of the CPA signal. When $\overline{CEA}$ is HIGH, the A Register holds its contents, regardless of CPA signal transitions.
$\overline{OEB}$	I	Output Enable for the A Register. When $\overline{OEB}$ is LOW, the A Register outputs are enabled onto the B0-7 lines. When $\overline{OEB}$ is HIGH, the B0-7 outputs are in the high-impedance state.
CPB	I	Clock for the B Register. When $\overline{CEB}$ is LOW, data is entered into the B Register on the LOW-to-HIGH transition of the CPB signal.
$\overline{CEB}$	I	Clock Enable for the B Register. When $\overline{CEB}$ is LOW, data is entered into the B Register on the LOW-to-HIGH transition of the CPB signal. When $\overline{CEB}$ is HIGH, the B Register holds its contents, regardless of CPB signal transitions.
$\overline{OEA}$	I	Output Enable for the B Register. When $\overline{OEA}$ is LOW, the B Register outputs are enabled onto the A0-7 lines. When $\overline{OEA}$ is HIGH, the A0-7 outputs are in the high-impedance state.

## DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE

Following Conditions Apply Unless Otherwise Specified:

Commercial:  $T_A = -40^\circ\text{C}$  to  $+85^\circ\text{C}$ ,  $V_{CC} = 5.0\text{V} \pm 5\%$

Symbol	Parameter	Test Conditions <sup>(1)</sup>	Min.	Typ. <sup>(2)</sup>	Max.	Unit
$V_{IH}$	Input HIGH Level	Guaranteed Logic HIGH Level	2	—	—	V
$V_{IL}$	Input LOW Level	Guaranteed Logic LOW Level	—	—	0.8	V
$I_{IH}$	Input HIGH Current <sup>(4)</sup>	$V_{CC} = \text{Max.}$ $V_I = 2.7\text{V}$	—	—	$\pm 1$	$\mu\text{A}$
$I_{IL}$	Input LOW Current <sup>(4)</sup>		$V_I = 0.5\text{V}$	—	—	
$I_{OZH}$	High Impedance Output Current (3-State Output pins) <sup>(4)</sup>	$V_{CC} = \text{Max.}$ $V_O = 2.7\text{V}$	—	—	$\pm 1$	$\mu\text{A}$
$I_{OZL}$			$V_O = 0.5\text{V}$	—	—	
$I_I$	Input HIGH Current <sup>(4)</sup>	$V_{CC} = \text{Max.}, V_I = V_{CC} (\text{Max.})$	—	—	$\pm 1$	$\mu\text{A}$
$V_{IK}$	Clamp Diode Voltage	$V_{CC} = \text{Min.}, I_{IN} = -18\text{mA}$	—	-0.7	-1.2	V
$V_H$	Input Hysteresis	—	—	200	—	mV
$I_{CC}$	Quiescent Power Supply Current	$V_{CC} = 3\text{V}, V_{IN} = \text{GND or } V_{CC}$	—	0.01	1	mA

## OUTPUT DRIVE CHARACTERISTICS

Symbol	Parameter	Test Conditions <sup>(1)</sup>	Min.	Typ. <sup>(2)</sup>	Max.	Unit	
$V_{OH}$	Output HIGH Voltage	$V_{CC} = \text{Min.}$ $V_{IN} = V_{IH} \text{ or } V_{IL}$	$I_{OH} = -8\text{mA}$	2.4	3.3	—	V
			$I_{OH} = -15\text{mA}$	2	3	—	
$V_{OL}$	Output LOW Voltage	$V_{CC} = \text{Min.}$ $V_{IN} = V_{IH} \text{ or } V_{IL}$	—	0.3	0.55	V	
$I_{OS}$	Short Circuit Current	$V_{CC} = \text{Max.}, V_O = \text{GND}^{(3)}$	-60	-120	-225	mA	
$I_{OFF}$	Input/Output Power Off Leakage <sup>(5)</sup>	$V_{CC} = 0\text{V}, V_{IN} \text{ or } V_O \leq 4.5\text{V}$	—	—	$\pm 1$	$\mu\text{A}$	

### NOTES:

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

## POWER SUPPLY CHARACTERISTICS

Symbol	Parameter	Test Conditions <sup>(1)</sup>		Min.	Typ. <sup>(2)</sup>	Max.	Unit
$\Delta I_{CC}$	Quiescent Power Supply Current TTL Inputs HIGH	$V_{CC} = \text{Max.}$ $V_{IN} = 3.4V^{(3)}$		—	0.5	2	mA
$I_{CCD}$	Dynamic Power Supply Current <sup>(4)</sup>	$V_{CC} = \text{Max.}$ Outputs Open $\overline{OE}_A$ or $\overline{OE}_B = \text{GND}$ One Input Toggling 50% Duty Cycle	$V_{IN} = V_{CC}$ $V_{IN} = \text{GND}$	—	0.15	0.25	mA/ MHz
$I_C$	Total Power Supply Current <sup>(6)</sup>	$V_{CC} = \text{Max.}$ Outputs Open $f_{CP} = 10\text{MHz}$ 50% Duty Cycle $\overline{OE}_A$ or $\overline{OE}_B = \text{GND}$ One Bit Toggling at $f_i = 5\text{MHz}$ 50% Duty Cycle	$V_{IN} = V_{CC}$ $V_{IN} = \text{GND}$	—	1.5	3.5	mA
			$V_{IN} = 3.4V$ $V_{IN} = \text{GND}$	—	2	5.5	
		$V_{CC} = \text{Max.}$ Outputs Open $f_{CP} = 10\text{MHz}$ 50% Duty Cycle $\overline{OE}_A$ or $\overline{OE}_B = \text{GND}$ Eight Bits Toggling at $f_i = 2.5\text{MHz}$ 50% Duty Cycle	$V_{IN} = V_{CC}$ $V_{IN} = \text{GND}$	—	3.8	7.3 <sup>(5)</sup>	
			$V_{IN} = 3.4V$ $V_{IN} = \text{GND}$	—	6	16.3 <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  $V_{CC} = 5.0V$ ,  $+25^\circ\text{C}$  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.
- $I_C = I_{QUIESCENT} + I_{INPUTS} + I_{DYNAMIC}$   
 $I_C = I_{CC} + \Delta I_{CC} D_H N_T + I_{CCD} (f_{CP}/2 + f_i N_i)$   
 $I_{CC}$  = Quiescent Current  
 $\Delta I_{CC}$  = Power Supply Current for a TTL High Input ( $V_{IN} = 3.4V$ )  
 $D_H$  = Duty Cycle for TTL Inputs High  
 $N_T$  = Number of TTL Inputs at  $D_H$   
 $I_{CCD}$  = Dynamic Current Caused by an Input Transition Pair (HLH or LHL)  
 $f_{CP}$  = Clock Frequency for Register Devices (Zero for Non-Register Devices)  
 $f_i$  = Input Frequency  
 $N_i$  = Number of Inputs at  $f_i$   
 All currents are in milliamps and all frequencies are in megahertz.

**SWITCHING CHARACTERISTICS OVER OPERATING RANGE (1)**

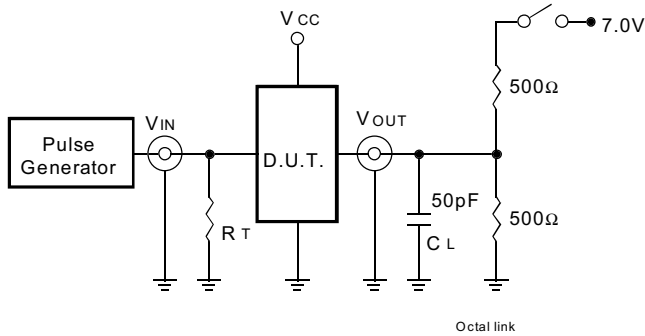
Symbol	Parameter	Condition <sup>(1)</sup>	29FCT52AT		29FCT52BT		29FCT52CT		29FCT52DT		Unit
			Min. <sup>(2)</sup>	Max.	Min. <sup>(2)</sup>	Max.	Min. <sup>(2)</sup>	Max.	Min. <sup>(2)</sup>	Max.	
t <sub>PLH</sub> t <sub>PHL</sub>	Propagation Delay CPA, CPB to An, Bn	C <sub>L</sub> = 50pF R <sub>L</sub> = 500Ω	2	10	2	7.5	2	6.3	2	4.5	ns
t <sub>PZH</sub> t <sub>PZL</sub>	Output Enable Time $\overline{OEA}$ or $\overline{OEB}$ to An, Bn		1.5	10.5	1.5	8	1.5	7	1.5	5.6	ns
t <sub>PHZ</sub> t <sub>PLZ</sub>	Output Disable Time $\overline{OEA}$ or $\overline{OEB}$ to An, Bn		1.5	10	1.5	7.5	1.5	6.5	1.5	4.3	ns
t <sub>SU</sub>	Set-up Time, HIGH or LOW An, Bn to CPA, CPB		2.5	—	2.5	—	2.5	—	1.5	—	ns
t <sub>H</sub>	Hold Time, HIGH or LOW An, Bn to CPA, CPB		2	—	1.5	—	1.5	—	1	—	ns
t <sub>SU</sub>	Set-up Time, HIGH or LOW $\overline{CEA}$ , $\overline{CEB}$ to CPA, CPB		3	—	3	—	3	—	2	—	ns
t <sub>H</sub>	Hold Time, HIGH or LOW $\overline{CEA}$ , $\overline{CEB}$ to CPA, CPB		2	—	2	—	2	—	1	—	ns
t <sub>w</sub>	Clock Pulse Width HIGH or LOW <sup>(3)</sup>		3	—	3	—	3	—	3	—	ns

**NOTES:**

1. See test circuit and waveforms.
2. Minimum limits are guaranteed but not tested on Propagation Delays.
3. This parameter is guaranteed but not tested.

## TEST CIRCUITS AND WAVEFORMS

### TEST CIRCUITS FOR ALL OUTPUTS



### SWITCH POSITION

Test	Switch
Open Drain	Closed
Disable Low	
Enable Low	
All Other Tests	Open

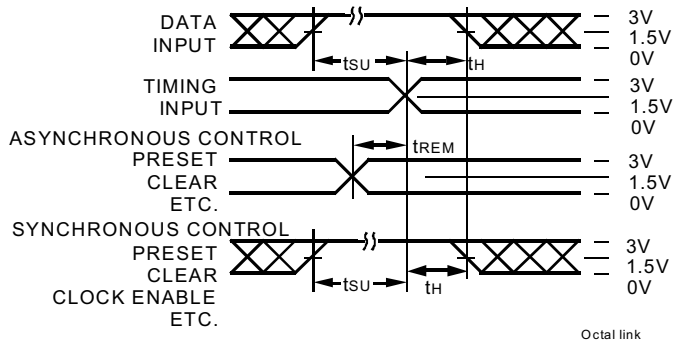
8-link

#### DEFINITIONS:

CL = Load capacitance: includes jig and probe capacitance.

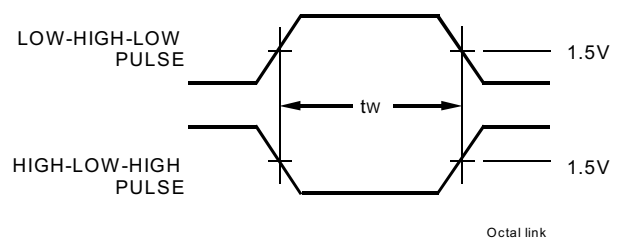
RT = Termination resistance: should be equal to ZOUT of the Pulse Generator.

### SET-UP, HOLD, AND RELEASE TIMES



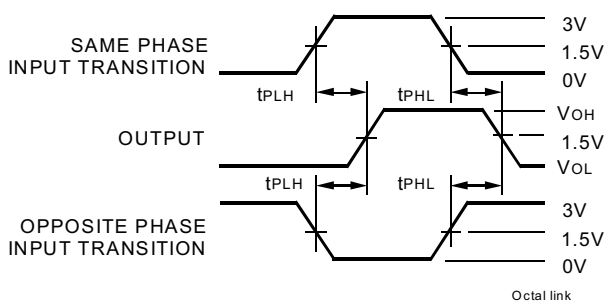
Octal link

### PULSE WIDTH



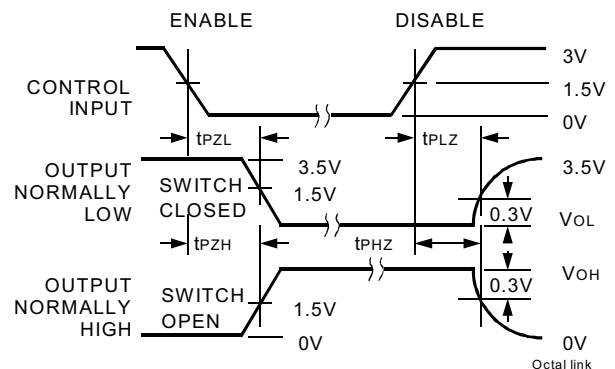
Octal link

### PROPAGATION DELAY



Octal link

### ENABLE AND DISABLE TIMES

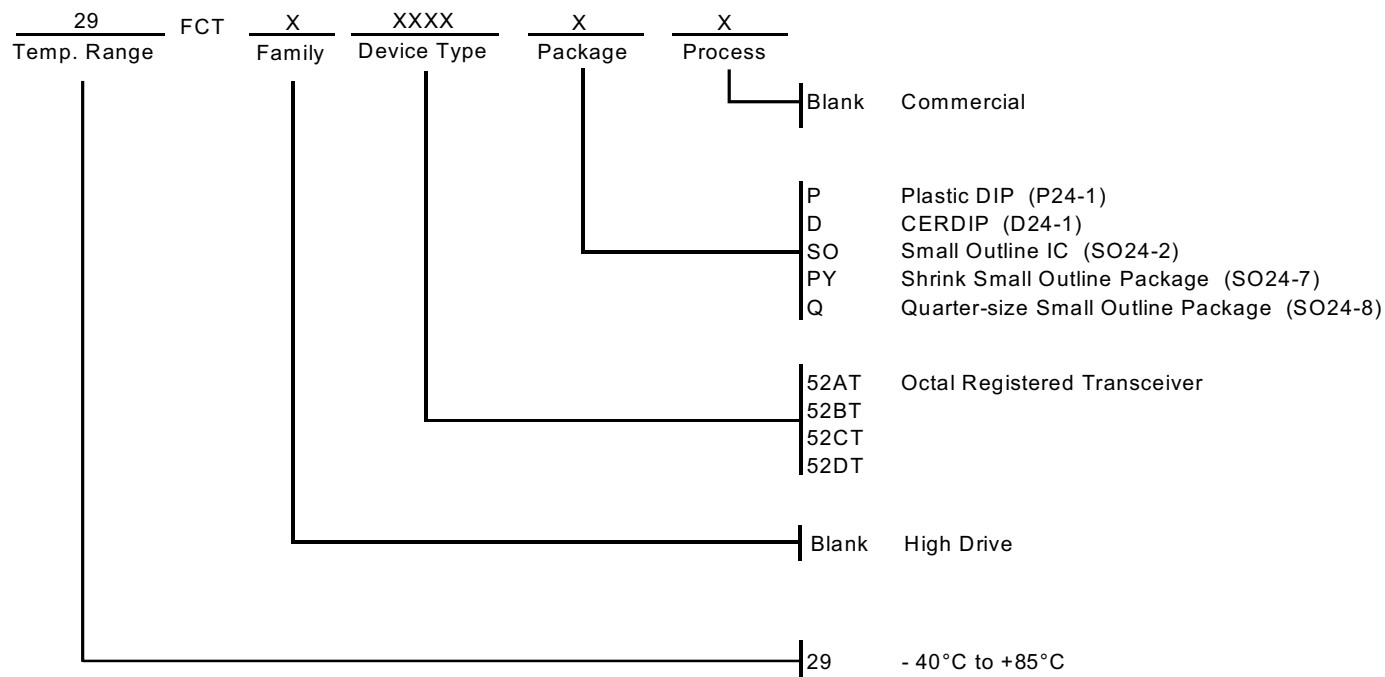


Octal link

#### NOTES:

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

**ORDERING INFORMATION**



**CORPORATE HEADQUARTERS**  
 2975 Stender Way  
 Santa Clara, CA 95054

**for SALES:**  
 800-345-7015 or 408-727-6116  
 fax: 408-492-8674  
[www.idt.com](http://www.idt.com)\*

\*To search for sales office near you, please click the sales button found on our home page or dial the 800# above and press 2.  
 The IDT logo is a registered trademark of Integrated Device Technology, Inc.