FAST CMOS 16-BIT REGISTERED TRANSCEIVER

IDT74FCT16952AT/CT/ET

FEATURES:

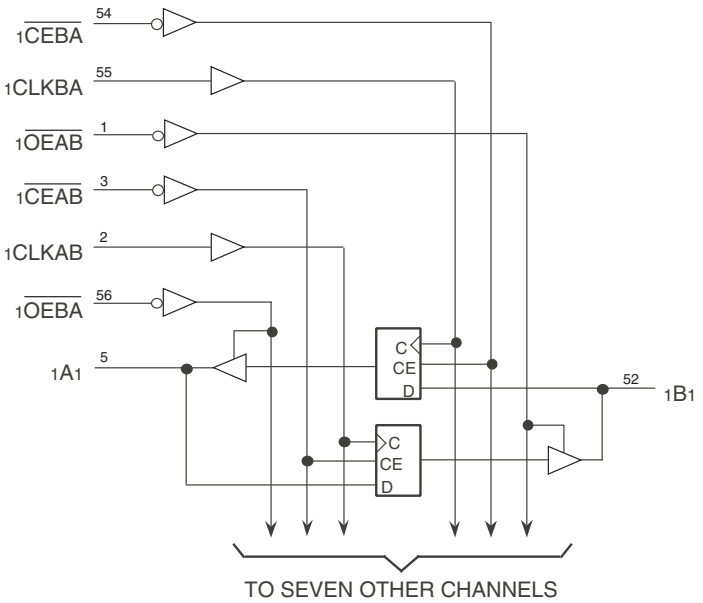
- **0.5 MICRON CMOS Technology**
- **High-speed, low-power CMOS replacement for ABT functions**
- **Typical $t_{SK(o)}$ (Output Skew) < 250ps**
- **Low input and output leakage ≤1µA (max.)**
- **High drive outputs (-32mA I_{OH}, 64mA I_{OL})**
- **Power off disable outputs permit "live insertion"**
- **Typical V_{OLP} (Output Ground Bounce) < 1.0V at V_{CC} = 5V, T_A = 25°C**
- **Available in SSOP and TSSOP packages**

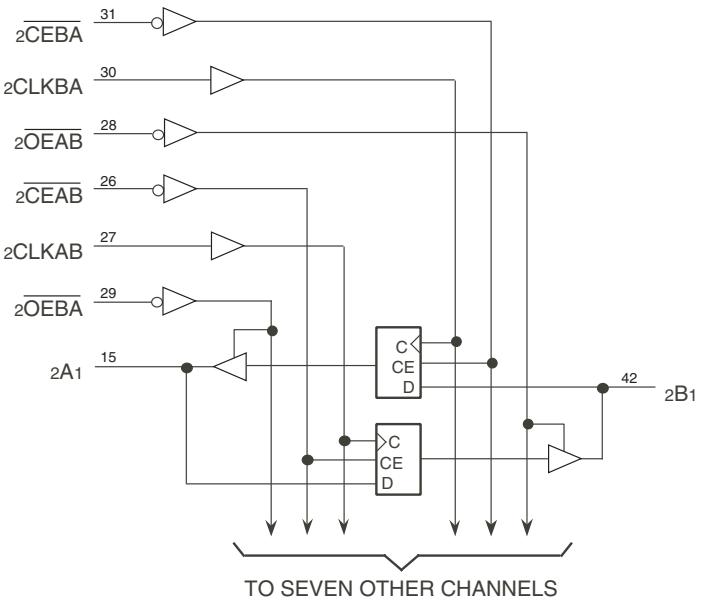
DESCRIPTION:

The FCT16952T 16-bit registered transceiver is built using advanced dual metal CMOS technology. These high-speed, low-power devices are organized as two independent 8-bit D-type registered transceivers with separate input and output control for independent control of data flow in either direction. For example, the A-to-B Enable ($xCEAB$) must be low to enter data from the A port. xCLKAB controls the clocking function. When xCLKAB toggles from low-to-high, the data present on the A port will be clocked into the register. $xOEAB$ performs the output enable function on the B port. Data flow from the B port to A port is similar but requires using $xCEBA$, xCLKBA, and $xOEBA$ inputs. Full 16-bit operation is achieved by tying the control pins of the independent transceivers together.

The FCT16952T is ideally suited for driving high-capacitance loads and low-impedance backplanes. The output buffers are designed with power off disable capability allowing "live insertion" of boards when used as backplane drivers.

FUNCTIONAL BLOCK DIAGRAM





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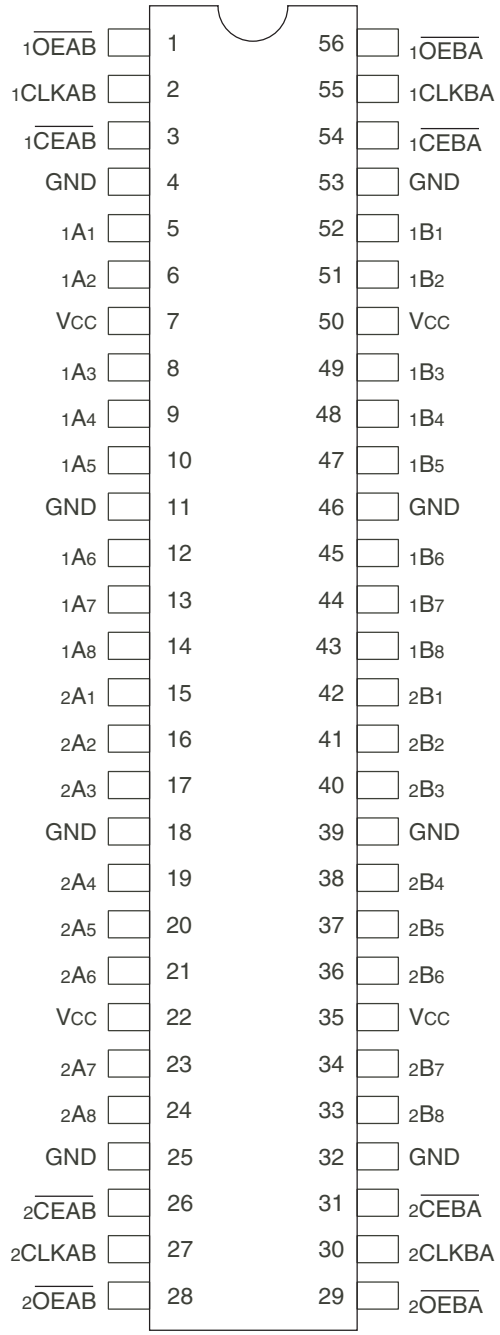
PIN CONFIGURATION



TOP VIEW

Package Type	Package Code	Order Code
TSSOP	PAG56	PAG
SSOP	PVG56	PVG

PIN DESCRIPTION

Pin Names	Description
x$\overline{OEAB}$	A-to-B Output Enable Input (Active LOW)
x$\overline{OEBA}$	B-to-A Output Enable Input (Active LOW)
x$\overline{CEAB}$	A-to-B Clock Enable Input (Active LOW)
x$\overline{CEBA}$	B-to-A Clock Enable Input (Active LOW)
xCLKAB	A-to-B Clock Input
xCLKBA	B-to-A Clock Input
xAx	A-to-B Data Inputs or B-to-A 3-State Outputs
xBx	B-to-A Data Inputs or A-to-B 3-State Outputs

ABSOLUTE MAXIMUM RATINGS(1)

Symbol	Description	Max	Unit
V_{TERM}(2)	Terminal Voltage with Respect to GND	–0.5 to +7	V
V_{TERM}(3)	Terminal Voltage with Respect to GND	–0.5 to V_{CC}+0.5	V
T_{STG}	Storage Temperature	–65 to +150	°C
I_{OUT}	DC Output Current	–60 to +120	mA

NOTES:
1. 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.
2. All device terminals except FCT162XXX Output and I/O terminals.
3. Output and I/O terminals for FCT162XXX.

CAPACITANCE (T_A = +25°C, F = 1.0MHz)

Symbol	Parameter(1)	Conditions	Typ.	Max.	Unit
C_{IN}	Input Capacitance	V_{IN} = 0V	3.5	6	pF
C_{OUT}	Output Capacitance	V_{OUT} = 0V	3.5	8	pF

NOTE:
1. This parameter is measured at characterization but not tested.

FUNCTION TABLE(1,3)

Inputs				Outputs
x$\overline{CEAB}$	xCLKAB	x$\overline{OEAB}$	xAx	xBx
H	X	L	X	B(2)
X	L	L	X	B(2)
L	↑	L	L	L
L	↑	L	H	H
X	X	H	X	Z

NOTES:
1. A-to-B data flow is shown: B-to-A data flow is similar but uses x$\overline{CEBA}$, xCLKBA, and x$\overline{OEBA}$.
2. Level of B before the indicated steady-state input conditions were established.
3. H = HIGH Voltage Level
   L = LOW Voltage Level
   X = Don't Care
   ↑ = LOW-to-HIGH Transition
   Z = High-impedance

DC ELECTRICAL CHARACTERISTICS OVER OPERATING RANGE

Following Conditions Apply Unless Otherwise Specified:
Industrial: T_A = –40°C to +85°C, V_{CC} = 5.0V ±10%

Symbol	Parameter	Test Conditions[1]		Min.	Typ.[2]	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 (Input pins)[5]	V_{CC} = Max.	V_I = V_{CC}	—	—	±1	µA
	Input HIGH Current (I/O pins)[5]			—	—	±1	
I_{IL}	Input LOW Current (Input pins)[5]		V_I = GND	—	—	±1	
	Input LOW Current (I/O pins)[5]			—	—	±1	
I_{OZH}	High Impedance Output Current	V_{CC} = Max.	V_O = 2.7V	—	—	±1	µA
I_{OZL}	(3-State Output pins)[5]		V_O = 0.5V	—	—	±1	
V_{IK}	Clamp Diode Voltage	V_{CC} = Min., I_{IN} = –18mA		—	–0.7	–1.2	V
I_{OS}	Short Circuit Current	V_{CC} = Max., V_O = GND[3]		–80	–140	–250	mA
V_H	Input Hysteresis	—		—	100	—	mV
I_{CCL} I_{CCH} I_{CCZ}	Quiescent Power Supply Current	V_{CC} = Max. V_{IN} = GND or V_{CC}		—	5	500	µA

OUTPUT DRIVE CHARACTERISTICS

Symbol	Parameter	Test Conditions[1]		Min.	Typ.[2]	Max.	Unit
I_O	Output Drive Current	V_{CC} = Max., V_O = 2.5V[3]		–50	—	–180	mA
V_{OH}	Output HIGH Voltage	V_{CC} = Min.	I_{OH} = –3mA	2.5	3.5	—	V
		V_{IN} = V_{IH} or V_{IL}	I_{OH} = –15mA	2.4	3.5	—	
			I_{OH} = –32mA[4]	2	3	—	
V_{OH}	Output LOW Voltage	V_{CC} = Min. V_{IN} = V_{IH} or V_{IL}	I_{OL} = 64mA	—	0.2	0.55	V
I_{OFF}	Input/Output Power Off Leakage[5]	V_{CC} = 0V, V_{IN} or $V_O \leq$ 4.5V		—	—	±1	µA

NOTES:
1. For conditions shown as Min. or Max., use appropriate value specified under Electrical Characteristics for the applicable device type.
2. Typical values are at V_{CC} = 5.0V, +25°C ambient.
3. Not more than one output should be shorted at one time. Duration of the test should not exceed one second.
4. Duration of the condition can not exceed one second.
5. The test limit for this parameter is ±5µA at T_A = -55°C.

POWER SUPPLY CHARACTERISTICS

Symbol	Parameter	Test Conditions[1]		Min.	Typ.[2]	Max.	Unit
ΔI_{CC}	Quiescent Power Supply Current TTL Inputs HIGH	V_{CC} = Max. V_{IN} = 3.4V[3]		—	0.5	1.5	mA
I_{CCD}	Dynamic Power Supply Current[4]	V_{CC} = Max., Outputs Open $x\overline{OEAB}$ = $x\overline{OEBA}$ = GND One Input Toggling 50% Duty Cycle	V_{IN} = V_{CC} V_{IN} = GND	—	75	120	µA/ MHz
I_C	Total Power Supply Current[6]	V_{CC} = Max., Outputs Open f_{CP} = 10MHz (xCLKAB) 50% Duty Cycle $x\overline{OEAB}$ = $x\overline{CEAB}$ = GND $x\overline{OEBA}$ = V_{CC} fi = 5MHz 50% Duty Cycle One Bit Toggling	V_{IN} = V_{CC} V_{IN} = GND	—	0.8	1.7	mA
			V_{IN} = 3.4V V_{IN} = GND	—	1.3	3.2	
		V_{CC} = Max., Outputs Open f_{CP} = 10MHz (xCLKAB) 50% Duty Cycle $x\overline{OEAB}$ = $x\overline{CEAB}$ = GND $x\overline{OEBA}$ = V_{CC} fi = 2.5MHz 50% Duty Cycle Sixteen Bits Toggling	V_{IN} = V_{CC} V_{IN} = GND	—	3.8	6.5[5]	
			V_{IN} = 3.4V V_{IN} = GND	—	8.3	20[5]	

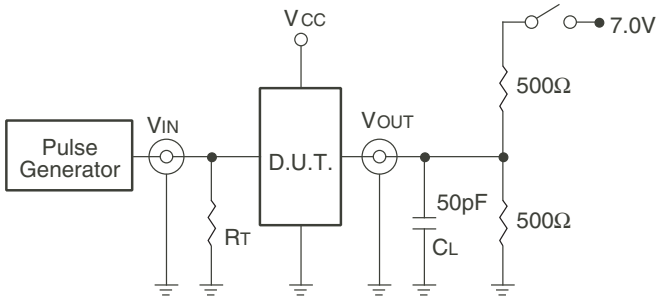
NOTES:
1. For conditions shown as Min. or Max., use appropriate value specified under Electrical Characteristics for the applicable device type.
2. Typical values are at V_{CC} = 5.0V, +25°C ambient.
3. Per TTL driven input (V_{IN} = 3.4V). All other inputs at V_{CC} or GND.
4. This parameter is not directly testable, but is derived for use in Total Power Supply Calculations.
5. Values for these conditions are examples of the I_{CC} formula. These limits are guaranteed but not tested.
6. $I_C = I_{QUIESCENT} + I_{INPUTS} + I_{DYNAMIC}$
   $I_C = I_{CC} + \Delta I_{CC} D_H N_T + I_{CCD} (f_{CP} N_{CP}/2 + f_i N_i)$
   I_{CC} = Quiescent Current (I_{CCL}, I_{CCH} and I_{CCZ})
   ΔI_{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)
   N_{CP} = Number of Clock Inputs at f_{CP}
   f_i = Input Frequency
   N_i = Number of Inputs at f_i

SWITCHING CHARACTERISTICS OVER OPERATING RANGE - INDUSTRIAL

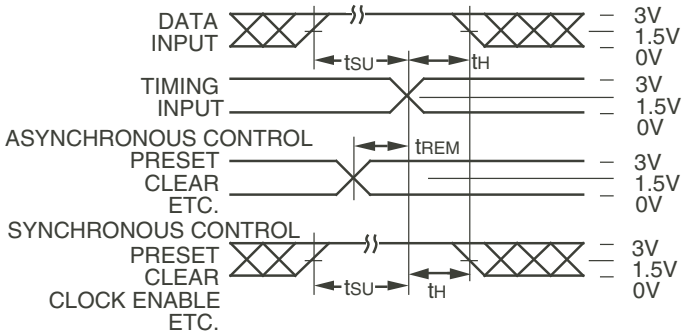
Symbol	Parameter	Condition[1]	FCT16952AT		FCT16952CT		FCT16952ET		Unit
			Min.[2]	Max.	Min.[2]	Max.	Min.[2]	Max.	
t_{PLH} t_{PHL}	Propagation Delay xCLKAB, xCLKBA to xBx, xAx	C_L = 50pF R_L = 500Ω	2	10	2	6.3	1.5	3.7	ns
t_{PZH} t_{PZL}	Output EnableTime x$\overline{OEBA}$, x$\overline{OEAB}$ to xAx, xBx		1.5	10.5	1.5	7	1.5	4.4	ns
t_{PHZ} t_{PLZ}	Output Disable Time x$\overline{OEBA}$, x$\overline{OEAB}$ to xAx, xBx		1.5	10	1.5	6.5	1.5	3.6	ns
t_{SU}	Set-up Time, HIGH or LOW xAx, xBx to xCLKAB, xCLKBA		2.5	—	2.5	—	1.5	—	ns
t_H	Hold Time, HIGH or LOW xAx, xBx to xCLKAB, xCLKBA		2	—	1.5	—	0	—	ns
t_{SU}	Set-up Time, HIGH or LOW x$\overline{CEBA}$, x$\overline{CEAB}$, to xCLKAB, xCLKBA		3	—	3	—	2	—	ns
t_H	Hold Time, HIGH or LOW x$\overline{CEBA}$, x$\overline{CEAB}$, to xCLKAB, xCLKBA		2	—	2	—	0	—	ns
t_W	Pulse Width HIGH or LOW, xCLKAB or xCLKBA [3]		3	—	3	—	3	—	ns
$t_{SK(o)}$	Output Skew[4]		—	0.5	—	0.5	—	0.5	ns

NOTES:
1. See test circuit and waveforms.
2. Minimum limits are guaranteed but not tested.
3. This limit is guaranteed but not tested.
4. Skew between any two outputs, of the same package, switching in the same direction. This parameter is guaranteed by design.

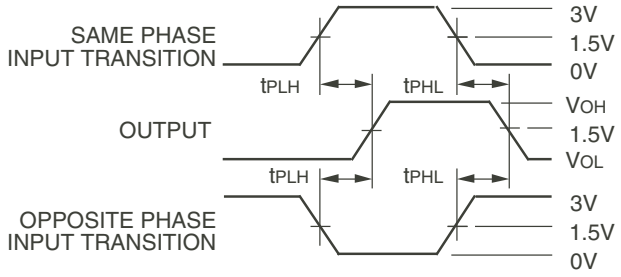
TEST CIRCUITS AND WAVEFORMS



Test Circuits for All Outputs



Set-up, Hold, and Release Times



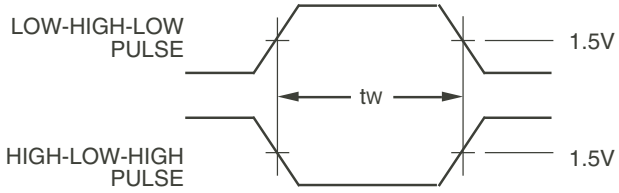
Propagation Delay

SWITCH POSITION

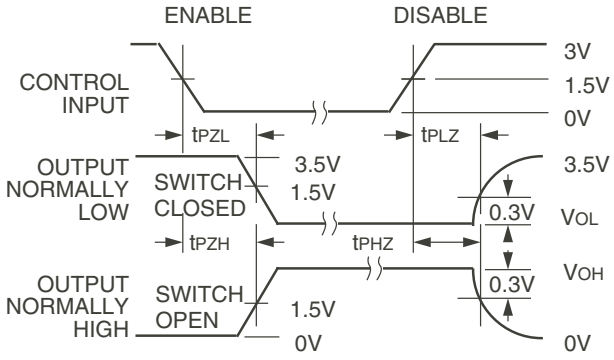
Test	Switch
Open Drain Disable Low Enable Low	Closed
All Other Tests	Open

DEFINITIONS:

C_L = Load capacitance: includes jig and probe capacitance.
R_T = Termination resistance: should be equal to Z_{OUT} of the Pulse Generator.



Pulse Width

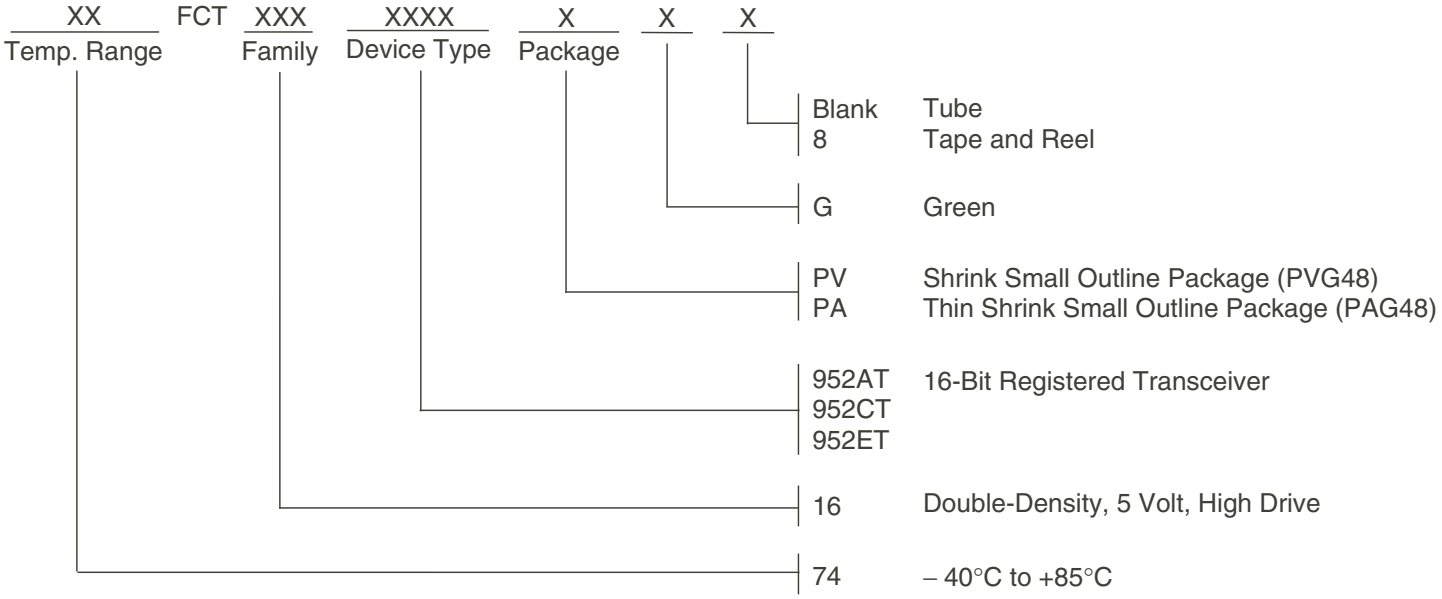


Enable and Disable Times

NOTES:

1. Diagram shown for input Control Enable-LOW and input Control Disable-HIGH.
2. Pulse Generator for All Pulses: Rate ≤ 1.0MHz; t_F ≤ 2.5ns; t_R ≤ 2.5ns.

ORDERING INFORMATION



Orderable Part Information

Speed (ns)	Orderable Part ID	Pkg. Code	Pkg. Type	Temp. Grade
A	74FCT16952ATPAG	PAG56	TSSOP	I
	74FCT16952ATPAG8	PAG56	TSSOP	I
	74FCT16952ATPVG	PVG56	SSOP	I
	74FCT16952ATPVG8	PVG56	SSOP	I
C	74FCT16952CTPAG	PAG56	TSSOP	I
	74FCT16952CTPAG8	PAG56	TSSOP	I
	74FCT16952CTPVG	PVG56	SSOP	I
	74FCT16952CTPVG8	PVG56	SSOP	I
E	74FCT16952ETPAG	PAG56	TSSOP	I
	74FCT16952ETPAG8	PAG56	TSSOP	I
	74FCT16952ETPVG	PVG56	SSOP	I
	74FCT16952ETPVG8	PVG56	SSOP	I

Datasheet Document History

09/28/2009	Pg. 7	Updated the ordering information by removing the "IDT" notation and non RoHS part.
09/25/2017	Pg. 1, 2, 5, 7	Added table under pin configuration diagram with detailed package information. Updated the ordering information diagram by adding Tube, Tape and Reel. Added orderable part information table.
05/07/2018	Pg. 2-7	Corrected typo in device name header.

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