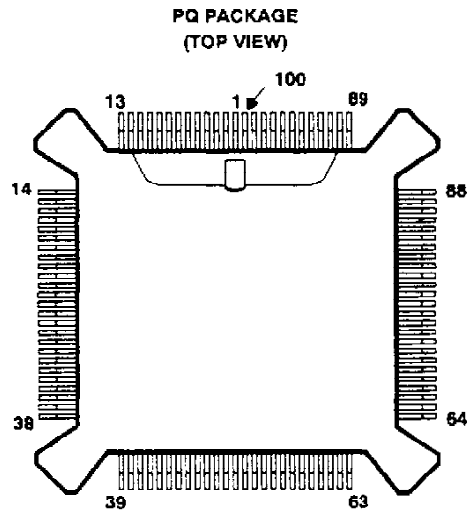


MCP NuBus™ ADDRESS/DATA REGISTERED TRANSCEIVER

SN74BCT2425

SDIS011B D3361, FEBRUARY 1990—REVISED JANUARY 1991

- Designed to Support Apple Computer Macintosh Coprocessor Platform (MCP) Interface Applications
- Designed to Operate with the SN74ACT2441 MCP NuBus™ Interface Controller
- Includes NuBus™ Address and Data Path Circuitry Along with Memory Address Drivers
- Conforms to Apple Computer Macintosh II Family NuBus™ Interface Specifications
- BiCMOS Design Substantially Reduces Standby Current
- Available in 100-pin Plastic Quad Flat Package



description

The SN74BCT2425 consists of bus transceiver circuits, D-type flip-flops, memory drivers, and control circuitry arranged for multiplexed transmission of address and data information in Macintosh Coprocessor Platform (MCP) applications.

The MCP is a generic software and hardware foundation developed by Apple Computer and may be used in the development of add-in cards and software applications for the Macintosh II computer.

The MCP provides an intelligent NuBus™ interface that includes hardware support for an MC68000 processor, an application specific I/O processor, ROM, and dynamic memory. Software support for the MCP architecture consists of the A/ROSE operating system (Apple Real-time Operating System Environment). A/ROSE is downloaded onto the Macintosh II I/O card for execution by the on-board MC68000.

For a complete description of the Apple Macintosh NuBus™ implementation, see *Designing Cards and Drivers for Macintosh II and Macintosh SE* published by Addison Wesley, or contact the Apple Programmers and Developers Association (APDA). For additional information on MCP or A/ROSE, contact Apple Computer directly.

The SN74BCT2425 is characterized for operation from 0°C to 70°C.

NuBus is a trademark of Texas Instruments Incorporated.

PRODUCTION DATA documents contain information current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

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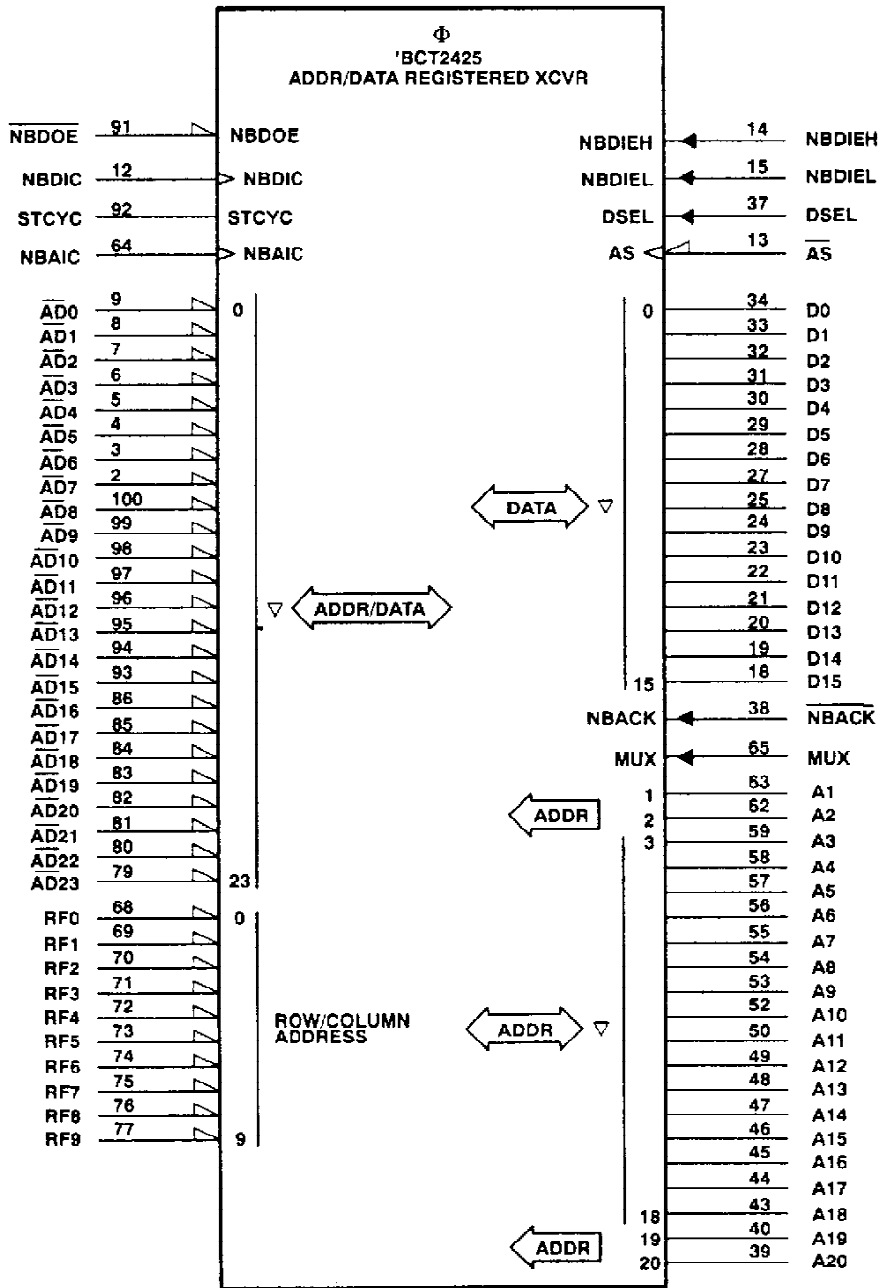
MCP NuBus™ ADDRESS/DATA REGISTERED TRANSCEIVER

Pin Assignments

PIN		PIN		PIN		PIN		PIN	
NO.	NAME	NO.	NAME	NO.	NAME	NO.	NAME	NO.	NAME
1	GND	21	D12	41	VCC	61	VCC	81	AD21
2	AD7	22	D11	42	GND	62	A2	82	AD20
3	AD6	23	D10	43	A18	63	A1	83	AD19
4	AD5	24	D9	44	A17	64	NBAIC	84	AD18
5	AD4	25	D8	45	A16	65	MUX	85	AD17
6	AD3	26	GND	46	A15	66	VCC	86	AD16
7	AD2	27	D7	47	A14	67	GND	87	GND
8	AD1	28	D6	48	A13	68	RF0	88	VCC
9	AD0	29	D5	49	A12	69	RF1	89	VCC
10	GND	30	D4	50	A11	70	RF2	90	GND
11	VCC	31	D3	51	GND	71	RF3	91	NBD0E
12	NBDIC	32	D2	52	A10	72	RF4	92	STCYC
13	AS	33	D1	53	A9	73	RF5	93	AD15
14	NBDIEH	34	D0	54	A8	74	RF6	94	AD14
15	NBDIEL	35	GND	55	A7	75	RF7	95	AD13
16	VCC	36	VCC	56	A6	76	RF8	96	AD12
17	GND	37	DSEL	57	A5	77	RF9	97	AD11
18	D15	38	NBACK	58	A4	78	GND	98	AD10
19	D14	39	A20	59	A3	79	AD23	99	AD9
20	D13	40	A19	60	GND	80	AD22	100	AD8

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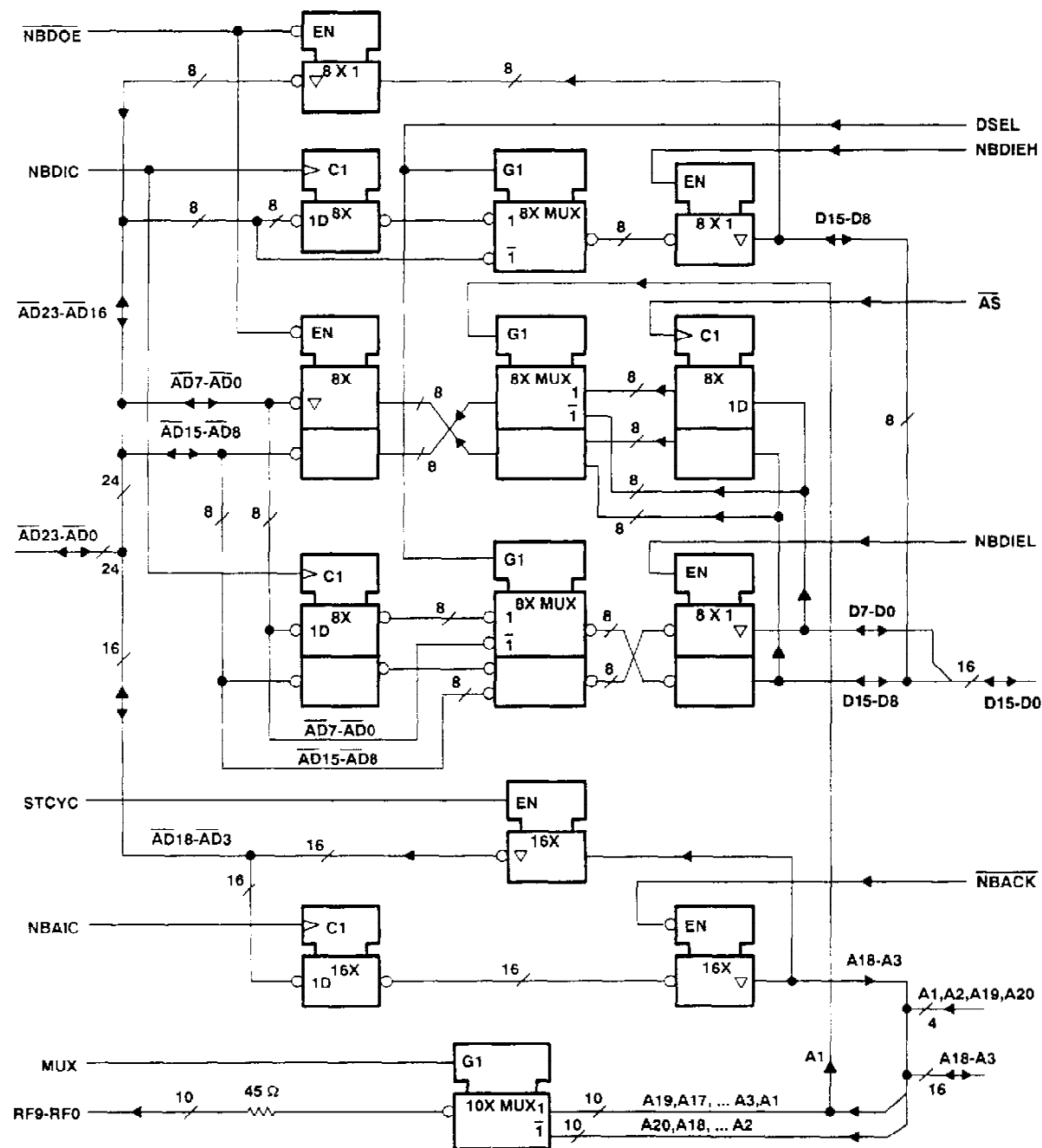
logic symbol†



† This symbol is in accordance with ANSI/IEEE Std 91-1984.

SN74BCT2425
MCP NuBus™ ADDRESS/DATA REGISTERED TRANSCEIVER

logic diagram



SN74BCT2425

MCP NuBus™ ADDRESS/DATA REGISTERED TRANCEIVER

TERMINAL FUNCTIONS

PIN NAME	DESCRIPTION
A20-A1	Local Address Bus. This 20-bit I/O port directly interfaces to the local address bus A23-A0.
$\overline{AD23-AD0}$	Address/Data Port. This 24-bit active low I/O port directly interfaces to the NuBus™ address/data lines. These lines are multiplexed to carry address at the beginning of a NuBus™ cycle, and data information in the last portion of the NuBus™ cycle.
\overline{AS}	Address Strobe. This input is used for saving data information on the low-to-high transition of \overline{AS} . The \overline{AS} input is typically connected to both the 'ACT2441 and the MC6800.
D15-D0	Data Address Bus. This 16-bit I/O port directly interfaces to the local data bus.
DSEL	Data Select. This input controls the data multiplexer for the local data bus. When this input is driven low, the NuBus™ addresses $\overline{AD23-AD0}$ are selected as inputs to the output data buffer. When DSEL is driven high, the NuBus™ data saved in the data input registers are selected as inputs to the output data buffer.
MUX	Multiplex Row/Column Addresses. This input is used to select between row and column addresses when reading or writing to memory. This signal is driven by the 'ACT2441.
\overline{NBACK}	NuBus™ Acknowledge. This active-low input is used to enable NuBus™ address information, saved via the NBAIC input, onto the local A20-A1 address lines.
NBAIC	NuBus™ Address Input Clock. This input is used for saving the address portion of NuBus™ read or write cycles. Data present at the $\overline{AD18-AD3}$ I/O port is clocked into the address register on the low-to-high transition of NBAIC.
NBDIC	NuBus™ Data Input Clock. This input is used for saving the data portion of NuBus™ read or write cycles. Data present at the $\overline{AD23-AD0}$ I/O port is clocked into the data registers on the low-to-high transition of NBDIC.
NBDIEL	NuBus™ Data Input Enable Low. This active-high input is used to enable NuBus™ data information onto the local bus (D15-D0) for the lower 16-bits corresponding to $\overline{AD15-AD0}$.
NBDIEH	NuBus™ Data Input Enable High. This active-high input is used to enable NuBus™ data information onto the local bus (D15-D8) for the upper 8-bits corresponding to $\overline{AD23-AD16}$. The remaining 8-bits D7-D0, corresponding to $\overline{AD31-AD24}$, are supplied by the 'ACT2441.
\overline{NBDOE}	NuBus™ Data Output Enable. This active-low input is used to enable the $\overline{AD23-AD0}$ outputs. When \overline{NBDOE} is taken inactive (high), the $\overline{AD23-AD0}$ outputs are at high impedance (assuming STCYC is also inactive).
RF0-RF9	Memory Row/Column Addresses. These outputs are used for driving row and column address information onto the DRAM address bus. Each output has an internal 45- Ω resistor in series with the output pin for the purpose of suppressing signal overshoot and undershoot.
STCYC	Start Cycle Active. This active-high input is used to enable the local bus address lines A18-A3 onto the NuBus™ $\overline{AD18-AD3}$ bus lines. The remainder of the 24-bit address lines are driven directly from the 'ACT2441 MCP NuBus™ controller. When STCYC is taken inactive (low), the $\overline{AD18-AD3}$ outputs are at high impedance.

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MCP NuBus™ ADDRESS/DATA REGISTERED TRANSCEIVER

Function Tables

DATA BUS PORT MODE

CONTROL INPUTS				DATA INPUTS			OUTPUTS	
DSEL	NBDIC	NBDIEL	NBDIEH	AD23-AD16	AD15-AD8	AD7-AD0	D15-D8	D7-D0
X	X	L	L	X	X	X	Z	Z
L	X	L	H	L	X	X	H	Z
				H	X	X	L	Z
L	X	H	L	X	H	L	H	L
				X	L	H	L	H
L	X	H	H	Unallowed input condition				
H	↑	L	H	L	X	X	H	Z
				H	X	X	L	Z
	No↑			X	X	X	NC	Z
H	↑	H	L	X	H	L	H	L
				X	L	H	L	H
	No↑			X	X	X	NC	NC
H	X	H	H	Unallowed input condition				

Inputs AD15-AD8 map to outputs D7-D0, and inputs AD7-AD0 map to outputs D15-D8, respectively, in the applicable mode.
 Inputs AD23-AD16 map to outputs D15-D8, respectively, in the applicable mode.

NuBus™ PORT OUTPUT MODE

CONTROL INPUTS				DATA INPUTS			OUTPUTS			
A1	AS	NBDOE	STCYC	A18-A3	D15-D8	D7-D0	AD23-AD19	AD18-AD16	AD15-AD3	AD2-AD0
X	X	H	L	X	X	X	Z	Z	Z	Z
L	X	H	H	L	X	X	Z	H	H	Z
				H	X	X	Z	L	L	Z
L	X	L	L	X	L	L	H	H	H	H
				X	H	H	L	L	L	L
L	X	L	H	Unallowed input condition						
H	X	H	H	L	X	X	Z	H	H	Z
				H	X	X	Z	L	L	Z
H	↑	L	L	X	L	L	H	H	H	H
				X	H	H	L	L	L	L
H	No↑	L	L	X	L	L	H	H	NC	NC
				X	H	H	L	L	NC	NC
H	X	L	H	Unallowed input condition						

Inputs A18-A3 map to outputs AD18-AD3, respectively in the applicable mode.
 Inputs D15-D8 map to outputs AD23-AD16, respectively in the applicable mode.
 Inputs D7-D0 map to outputs AD15-AD8, and inputs D15-D8 map to outputs AD7-AD0, respectively in the applicable mode.
 H denotes a high level, L denotes a low level, Z denotes a high-impedance state, ↑ denotes a low-to-high logic level transition, NC denotes no change, and X denotes a level that does not affect the result.

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MCP NuBus™ ADDRESS/DATA REGISTERED TRANCEIVER

Function Tables

MEMORY DRIVER PORT

CONTROL	DATA INPUTS		OUTPUTS
MUX	A20, A18, A16, A14, A12, A10, A8, A6, A4, A2	A19, A17, A15, A13, A11, A9, A7, A5, A3, A1	RF9-RF0
L	L		X
	H		X
H	X		L
	X		H

Inputs A20, A18, A16, A14, A12, A10, A8, A6, A4, A2 map to outputs RF9-RF0, respectively.
 Inputs A19, A17, A15, A13, A11, A9, A7, A5, A3, A1 map to outputs RF9-RF0, respectively.

ADDRESS PORT OUTPUT MODE

CONTROL		DATA INPUTS	OUTPUTS
NBAIC	NBACK	AD18-AD3	A18-A3
X	H	X	Z
†	L	L	H
†		H	L
No †		X	NC

Inputs AD18-AD3 map to A18-A3, respectively.
 H denotes a high level, L denotes a low level, Z denotes a high-impedance state, * denotes a low-to-high logic level transition, NC denotes no change, and X denotes a level that does not affect the result.

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

Supply voltage, V_{CC} (see Note 1)	7 V
Input voltage range, V_I	5.5 V
Operating free-air temperature, T_A	0°C to 70°C
Storage temperature range	-65°C to 150°C

† Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTE 1: All voltage values are with respect to the GND terminal.

recommended operating conditions

	MIN	NOM	MAX	UNIT
V_{CC} Supply voltage	4.5	5	5.5	V
V_{IH} High-level input voltage	2			V
V_{IL} Low-level input voltage			0.8	V
I_{OH} High-level output current			-15	mA
I_{OL} Low-level output current	Ax, Dx, ADx, outputs		24	mA
	RFx outputs		12	
t_w Pulse duration	Clocks high		12.5	ns
	Clocks low		12.5	
t_{SU} Setup time	10			ns
t_H Hold time	3			ns
T_A Operating free-air temperature	0		70	°C

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MCP NuBus™ ADDRESS/DATA REGISTERED TRANSCEIVER

electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER		TEST CONDITIONS		MIN	TYP [†]	MAX	UNIT
V _{IK}		V _{CC} = 4.5 V,	I _I = -18 mA			-1.2	V
V _{OH}		V _{CC} = 4.5 to 5.5 V,	I _{OH} = -400 μA	V _{CC} - 1.5			V
		V _{CC} = 4.5 V,	I _{OH} = -3 mA	2.8	3.6		
		V _{CC} = 4.5 V,	I _{OH} = -15 mA	2			
V _{OL}	Ax, Dx, \overline{ADx}	V _{CC} = 4.5 V,	I _{OL} = 12 mA	0.25	0.4		V
	Ax, Dx, \overline{ADx}	V _{CC} = 4.5 V,	I _{OL} = 24 mA	0.35	0.5		
	RF	V _{CC} = 4.5 V,	I _{OL} = 1 mA	0.2	0.4		
	RF	V _{CC} = 4.5 V,	I _{OL} = 12 mA	0.8	1		
I _I		V _{CC} = 5.5 V,	V _I = 5.5 V			100	μA
I _{OL}	RF	V _{CC} = 4.5 V,	V _O = 2 V	15			mA
I _{IH} [‡]	NBACK, NBDIEL, NBDOE	V _{CC} = 5.5 V,	V _I = 2.7 V			20	μA
	All other inputs	V _{CC} = 5.5 V,	V _I = 2.7 V			-100	
I _{IL} [‡]	NBDIEL, NBDIEH, NBDOE, STCYC	V _{CC} = 5.5 V,	V _I = 0.4 V			-300	μA
	All other inputs	V _{CC} = 5.5 V,	V _I = 0.4 V			-200	
I _O [§]	Ax, Dx, \overline{ADx}	V _{CC} = 5.5 V,	V _O = 2.25 V	-30		-112	mA
	RF	V _{CC} = 5.5 V,	V _O = 2.25 V	-20		-50	
I _{CC}		V _{CC} = 5.5 V, V _{IH} = 3 V, V _{IL} = 0, Outputs open	Maximum number of outputs low	111	172		mA
			Maximum number of outputs disabled (high-Z)	40	68		

[†] All typical values are at V_{CC} = 5 V, T_A = 25°C.

[‡] For I/O ports, the parameters I_{IH} and I_{IL} include the off-state output current.

[§] The output conditions have been selected to produce a current that closely approximates one half of the true short-circuit current I_{OS}.

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switching characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted)†

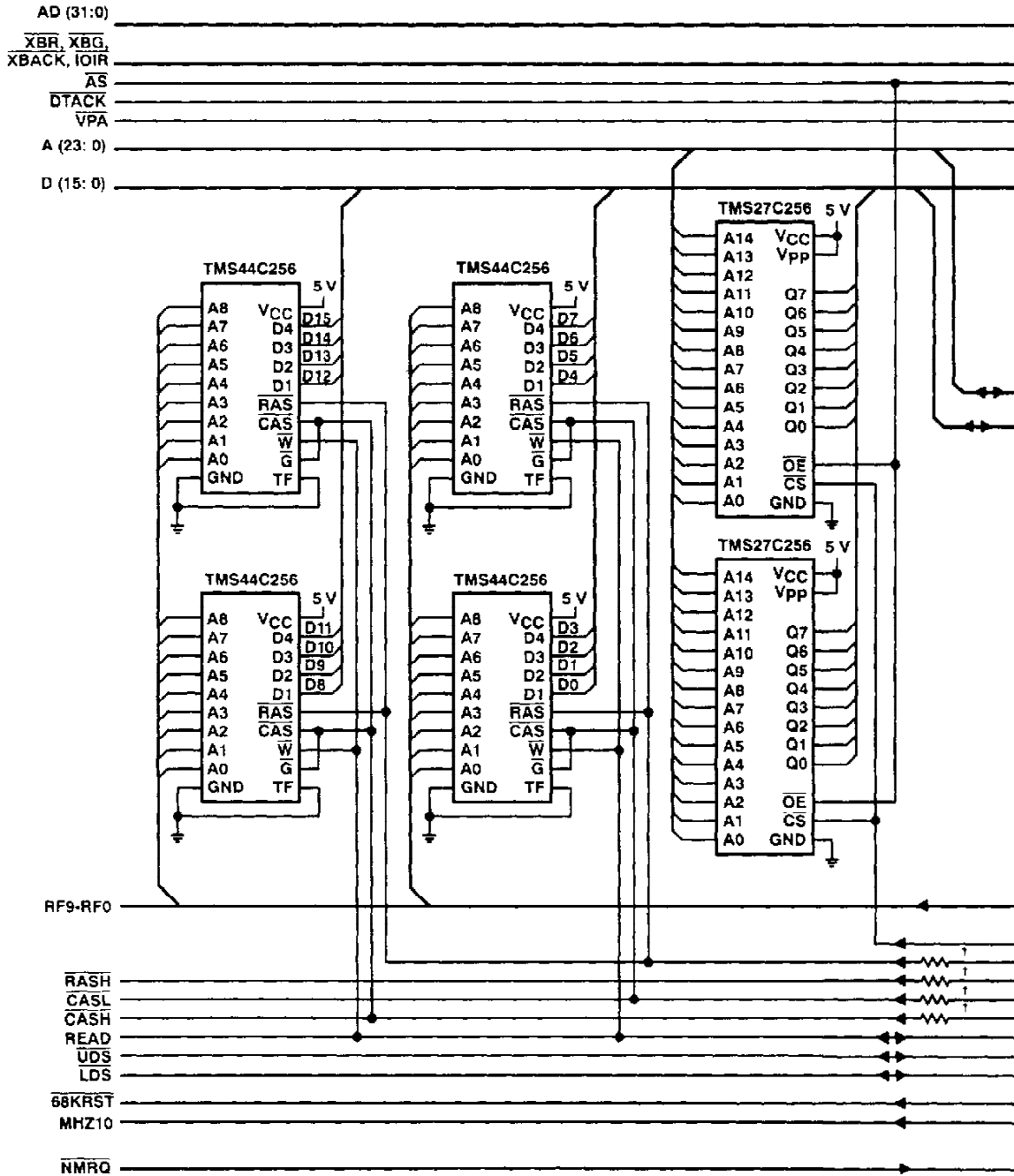
PARAMETER	FROM (INPUT)	TO (OUTPUT)†	TEST CONDITIONS				MIN	TYP‡	MAX	UNIT
			V _L (V)	R1 (Ω)	R2 (Ω)	C _L (pF)				
t _{pd}	A3-A18	AD3-AD18	V _{CC}	270	470	130	11	18	ns	
t _{pd}	D0-D15	AD0-AD15					11	18	ns	
t _{pd}	D8-D15	AD16-AD23					11	18	ns	
t _{pd}	AS†	AD0-AD15					14	22	ns	
t _{pd}	A1	AD0-AD15					14	22	ns	
t _{pd}	AD0-AD23	D0-D15	open	open	500	50	9	16	ns	
t _{pd}	NBDIC†	D0-D15					12	21	ns	
t _{pd}	OSEL	D0-D15					15	23	ns	
t _{pd}	NBAIC†	A3-A18					10	18	ns	
t _{pd}	A1-A20	RF0-RF9	open	open	2 k	50	9	16	ns	
t _{pd}	MUX	RF0-RF9					9	16	ns	
t _{en}	NBDOE	AD0-AD23	V _{CC}	270	470	130	12	20	ns	
t _{en}	STCYC	AD3-AD18					14	22	ns	
t _{en}	NBDIEL	D0-D15					11	22	ns	
t _{en}	NBDIEH	D8-D15	7	500	500	50	11	22	ns	
t _{en}	NBACK	A3-A18					10	20	ns	
t _{dis}	NBDOE	AD0-AD23					V _{CC}	270	470	50
t _{dis}	STCYC	AD3-AD18	6	10	ns					
t _{dis}	NBDIEL	D0-D15	6	10	ns					
t _{dis}	NBDIEH	D8-D15	6	10	ns					
t _{dis}	NBACK	A3-A18	6	10	ns					

† The outputs are measured one at a time with one transition per measurement or in the PAD mode two outputs switching at one time.

‡ All typical values are at V_{CC} = 5 V, T_A = 25°C.

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MCP NuBus™ ADDRESS/DATA REGISTERED TRANSCEIVER

APPLICATION INFORMATION



† Series damping resistors are recommended but may not be required depending on system environment.

**Figure 1. Macintosh Coprocessor Platform (MCP) Architecture
 (configured with 1 row of 245K x 4 DRAMs)**

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MCP NuBus™ ADDRESS/DATA REGISTERED TRANCEIVER

APPLICATION INFORMATION

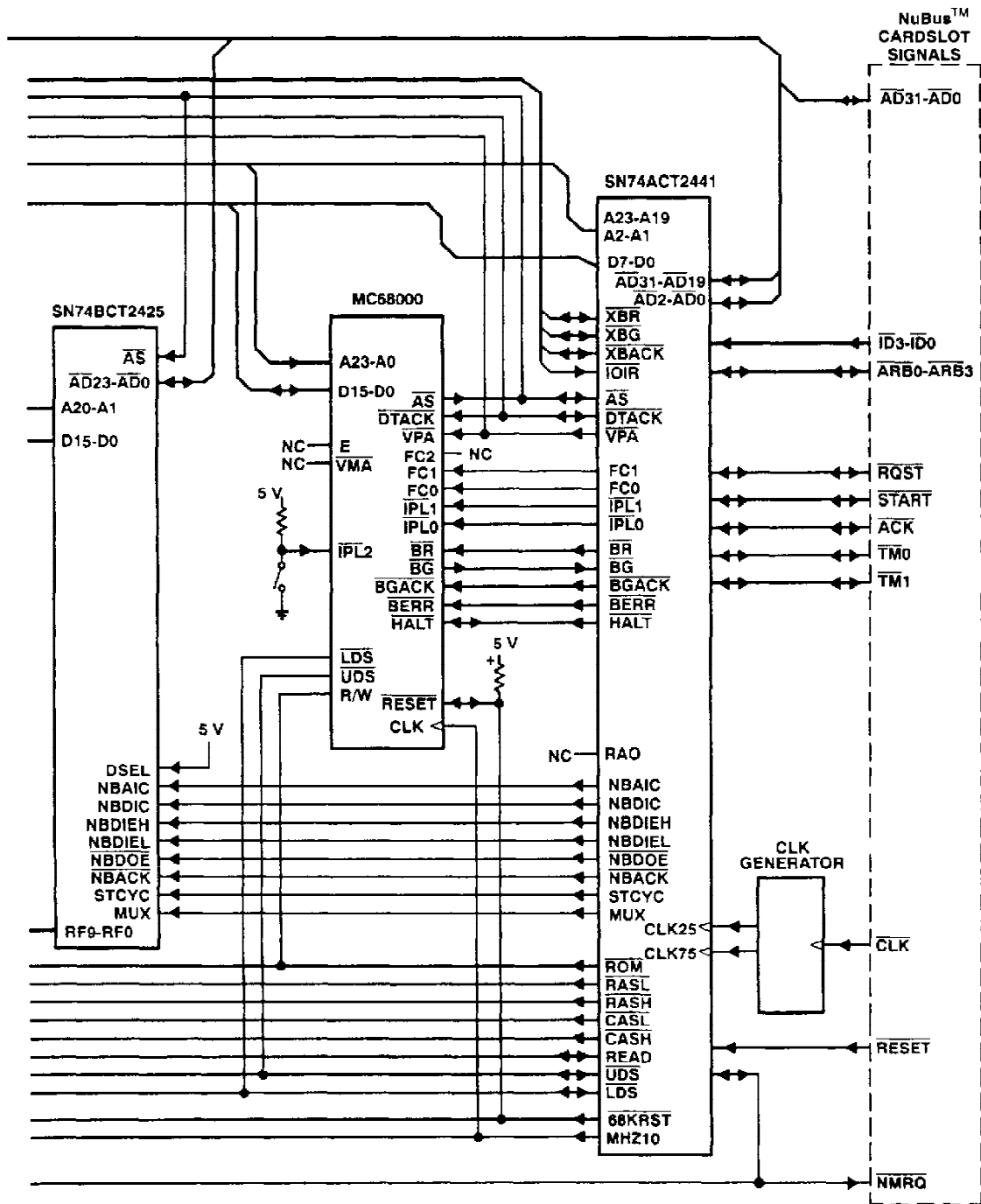
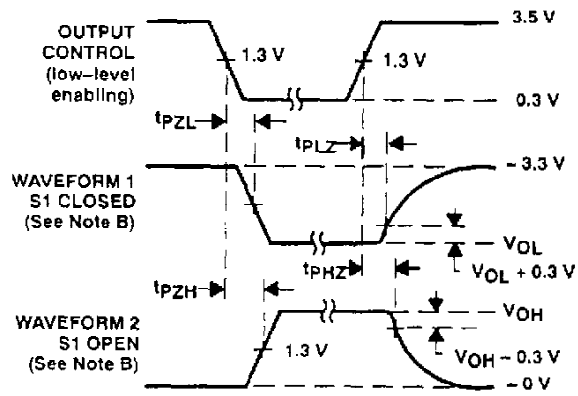
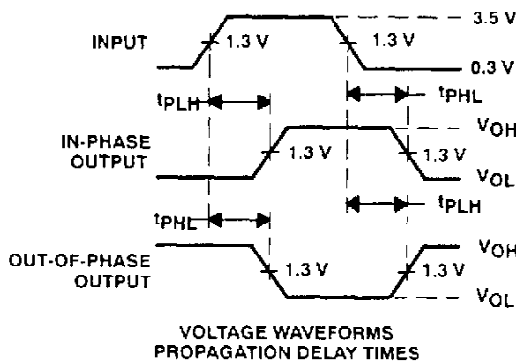
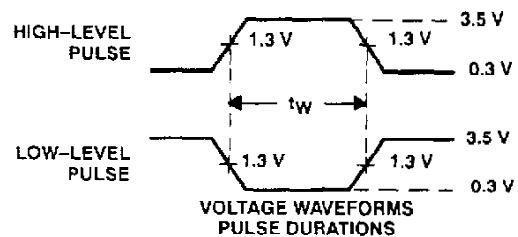
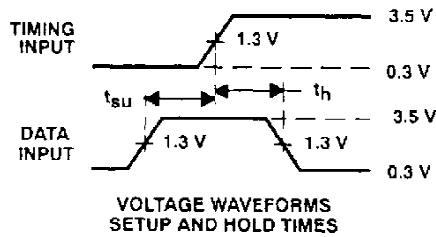
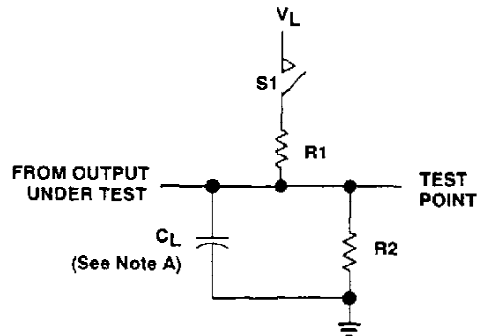


Figure 1. Macintosh Coprocessor Platform (MCP) Architecture (Continued)
 (configured with 1 row of 245K x 4 DRAMs)

PARAMETER MEASUREMENT INFORMATION

SWITCH POSITION TABLE

TEST	S1
t_{PLH}	Open
t_{PHL}	Open
t_{PZH}	Open
t_{PZL}	Closed
t_{PHZ}	Open
t_{PLZ}	Closed



- NOTES: A. C_L includes probe and jig capacitance.
 B. Waveform 1 is for an output with internal conditions such that the output is low except when disabled by the output control.
 Waveform 2 is for an output with internal conditions such that the output is high except when disabled by the output control.
 C. All input pulses have the following characteristics: PRR \leq 1 MHz, $t_r = t_f = 2$ ns, duty cycle = 50%.
 D. The outputs are measured one at a time with one transition per measurement.

Figure 2

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PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
SN74BCT2425PQ	OBSOLETE	BQFP	PQ	100		TBD	Call TI	Call TI

⁽¹⁾ The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

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OBSOLETE: TI has discontinued the production of the device.

⁽²⁾ Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS) or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

TBD: The Pb-Free/Green conversion plan has not been defined.

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⁽³⁾ MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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