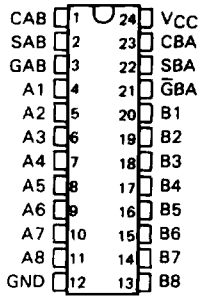
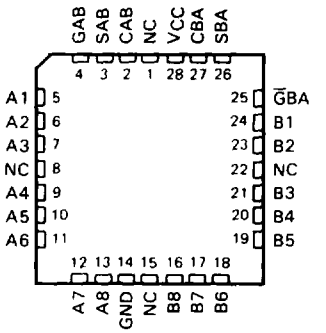
D2804, MARCH 1984 – REVISED SEPTEMBER 1987

- Inputs are TTL-Voltage Compatible
- Bus Transceivers and Registers
- Independent Registers and Enables for A and B Buses
- High-Current 3-State Outputs Can Drive Up to 15 LSTTL Loads
- Multiplexed Real-Time and Stored Data
- Choice of True and Inverting Data Paths
- Package Options Include Plastic "Small Outline" Packages, Ceramic Chip Carriers, and Standard Plastic and Ceramic 300-mil DIPs
- Dependable Texas Instruments Quality and Reliability

SN54HCT651, SN54HCT652 . . . JT PACKAGE
SN74HCT651, SN74HCT652 . . . DW OR NT PACKAGE
(TOP VIEW)



SN54HCT651, SN54HCT652 . . . FK PACKAGE
(TOP VIEW)



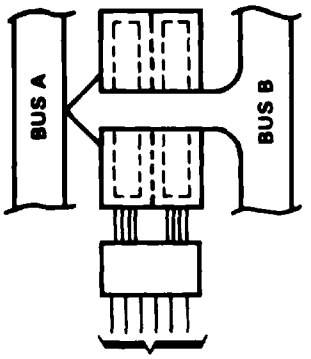
NC – No internal connection

description

These devices consist of bus transceiver circuits, D-type flip-flops, and control circuitry arranged for multiplexed transmission of data directly from the data bus or from the internal storage registers. Enable GAB and $\overline{G}$BA are provided to control the transceiver functions. SAB and SBA control pins are provided to select whether real-time or stored data is transferred. A low input level selects real-time data, and a high selects stored data. The examples on the following page demonstrate the four fundamental bus-management functions that can be performed with the 'HCT651 and 'HCT652.

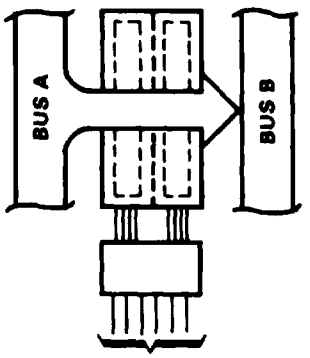
Data on the A or B data bus, or both, can be stored in the internal D flip-flops by low-to-high transitions at the appropriate clock pins (CAB or CBA) regardless of the select or enable control pins. When SAB and SBA are in the real-time transfer mode, it is also possible to store data without using the internal D-type flip-flops by simultaneously enabling GAB and $\overline{G}$BA. In this configuration each output reinforces its input. Thus, when all other data sources to the two sets of bus lines are at high impedance, each set of bus lines will remain at its last state.

The SN54HCT651 and SN54HCT652 are characterized for operation over the full military temperature range of −55°C to 125°C. The SN74HCT651 and SN74HCT652 are characterized for operation from −40°C to 85°C.



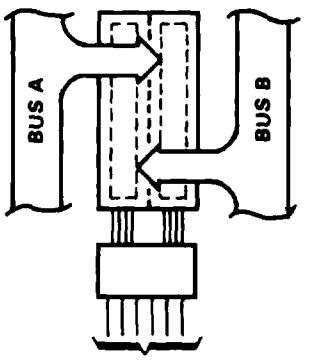
(3) GAB	(21) $\overline{G}$BA	(1) CAB	(23) CBA	(2) SAB	(22) SBA
L	L	X	X	X	L

REAL-TIME TRANSFER
BUS B TO BUS A



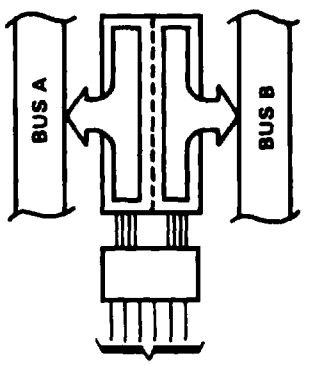
(3) GAB	(21) $\overline{G}$BA	(1) CAB	(23) CBA	(2) SAB	(22) SBA
H	H	X	X	L	X

REAL-TIME TRANSFER
BUS A TO BUS B



(3) GAB	(21) $\overline{G}$BA	(1) CAB	(23) CBA	(2) SAB	(22) SBA
X	H	↑	X	X	X
L	X	X	↑	X	X
L	H	↑	↑	X	X

STORAGE FROM
A AND/OR B



(3) GAB	(21) $\overline{G}$BA	(1) CAB	(23) CBA	(2) SAB	(22) SBA
H	L	H or L	H or L	H	H

TRANSFER
STORED DATA
TO A AND/OR B

Pin numbers shown are for DW, JT, and NT packages.

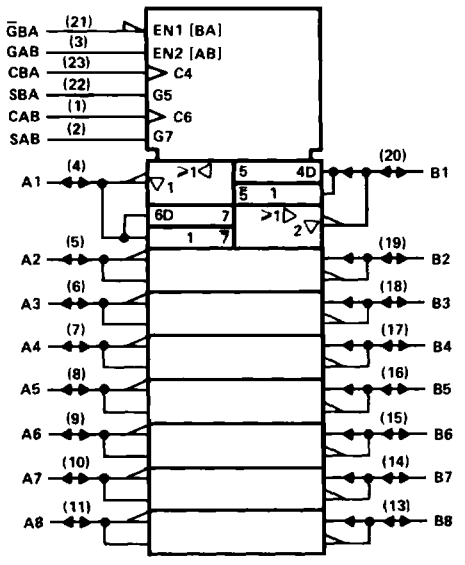
FUNCTION TABLE

INPUTS						DATA I/O†		OPERATION OR FUNCTION	
GAB	$\overline{G}$BA	CAB	CBA	SAB	SBA	A1 THRU A8	B1 THRU B8	'HCT651	'HCT652
L	H	H or L	H or L	X	X	Input	Input	Isolation	Isolation
L	H	↑	↑	X	X			Store A and B Data	Store A and B Data
X	H	↑	H or L	X	X	Input	Not specified	Store A, Hold B	Store A, Hold B
H	H	↑	↑	X	X	Input	Output	Store A in both registers	Store A in both registers
L	X	H or L	↑	X	X	Not specified	Input	Hold A, Store B	Hold A, Store B
L	L	↑	↑	X	X	Output	Input	Store B in both registers	Store B in both registers
L	L	X	X	X	L	Output	Input	Real-Time $\overline{B}$ Data to A Bus	Real-Time B Data to A Bus
L	L	X	H or L	X	H			Stored $\overline{B}$ Data to A Bus	Stored B Data to A Bus
H	H	X	X	L	X	Input	Output	Real-Time $\overline{A}$ Data to B Bus	Real-Time A Data to B Bus
H	H	H or L	X	H	X			Stored $\overline{A}$ Data to B Bus	Stored A Data to B Bus
H	L	H or L	H or L	H	H	Output	Output	Stored $\overline{A}$ Data to B Bus and	Stored A Data to B Bus and
								Stored $\overline{B}$ Data to A Bus	Stored B Data to A Bus

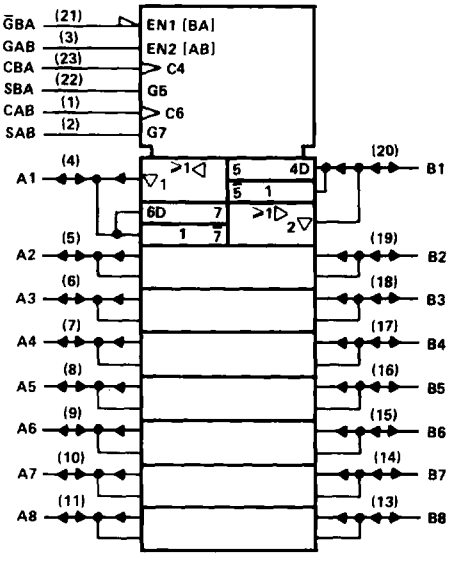
†The data output functions may be enabled or disabled by various signals at the GAB and $\overline{G}$BA inputs. Data input functions are always enabled, i.e., data at the bus pins will be stored on every low-to-high transition on the clock inputs.

logic symbols‡

'HCT651



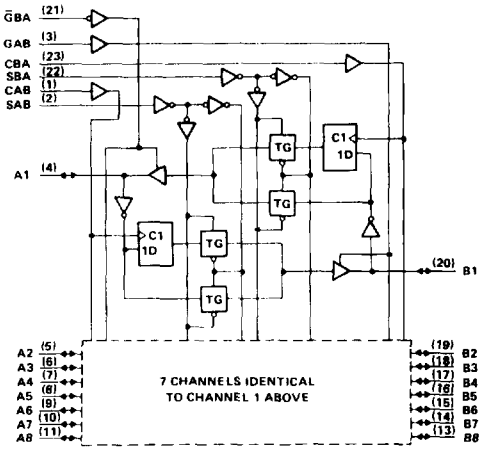
'HCT652



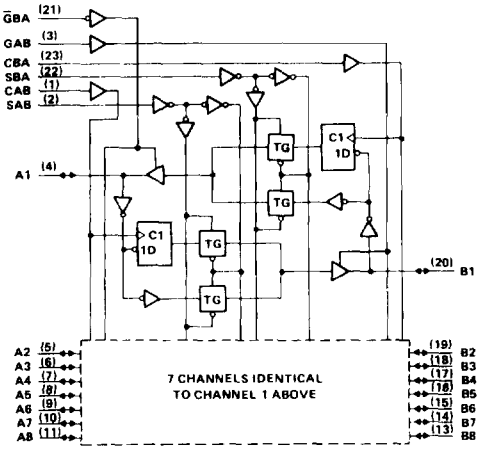
‡These symbols are in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.
Pin numbers shown are for DW, JT, and NT packages.

logic diagrams (positive logic)

'HCT651



'HCT652



Pin numbers shown are for DW, JT, and NT packages.

absolute maximum ratings over operating free-air temperature range†

Supply voltage, V_{CC}	−0.5 V to 7 V
Input clamp current, I_{IK} (V_I < 0 or V_I > V_{CC})	±20 mA
Output clamp current, I_{OK} (V_O < 0 or V_O > V_{CC})	±20 mA
Continuous output current, I_O (V_O = 0 to V_{CC})	±35 mA
Continuous current through V_{CC} or GND pins	±70 mA
Lead temperature 1,6 mm (1/16 in) from case for 60 s: FK or JT package	300°C
Lead temperature 1,6 mm (1/16 in) from case for 10 s: DW or NT package	260°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.

recommended operating conditions

			SN54HCT651 SN54HCT652			SN74HCT651 SN74HCT652			UNIT
			MIN	NOM	MAX	MIN	NOM	MAX	
V_{CC}	Supply voltage		4.5	5	5.5	4.5	5	5.5	V
V_{IH}	High-level input voltage	V_{CC} = 4.5 V to 5.5 V	2			2			V
V_{IL}	Low-level input voltage	V_{CC} = 4.5 V to 5.5 V	0		0.8	0		0.8	V
V_I	Input voltage		0		V_{CC}	0		V_{CC}	V
V_O	Output voltage		0		V_{CC}	0		V_{CC}	V
t_t	Input transition (rise and fall) times		0		500	0		500	ns
T_A	Operating free-air temperature		−55		125	−40		85	°C

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

PARAMETER		TEST CONDITIONS	V_{CC}	T_A = 25°C			SN54HCT651 SN54HCT652		SN74HCT651 SN74HCT652		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
V_{OH}		V_I = V_{IH} or V_{IL}, I_{OH} = −20 μA	4.5 V	4.4	4.499		4.4		4.4		V
		V_I = V_{IH} or V_{IL}, I_{OH} = −6 mA	4.5 V	3.98	4.30		3.7		3.84		
V_{OL}		V_I = V_{IH} or V_{IL}, I_{OL} = 20 μA	4.5 V		0.001	0.1		0.1		0.1	V
		V_I = V_{IH} or V_{IL}, I_{OL} = 6 mA	4.5 V		0.17	0.26		0.4		0.33	
I_I	Control Inputs	V_I = V_{CC} or 0	5.5 V		±0.1	±100		±1000		±1000	nA
I_{OZ}	A or B	V_O = V_{CC} or 0, V_I = V_{IH} or V_{IL}, Data = V_{CC} or 0	5.5 V		±0.01	±0.5		±10		±5	μA
I_{CC}		V_I = V_{CC} or 0, I_O = 0	5.5 V			8		160		80	μA
ΔI_{CC}†		One input at 0.5 V or 2.4 V, Other inputs at 0 V or V_{CC}	5.5 V		1.4	2.4		3		2.9	mA
C_i	Control Inputs		4.5 to 5.5 V		3	10		10		10	pF

†This is the increase in supply current for each input that is at one of the specified TTL voltage levels rather than 0 V or V_{CC}.

timing requirements over recommended operating free-air temperature range (unless otherwise noted)

		V_{CC}	T_A = 25°C		SN54HCT651 SN54HCT652		SN74HCT651 SN74HCT652		UNIT
			MIN	MAX	MIN	MAX	MIN	MAX	
f_{clock}	Clock frequency	4.5 V	0	25	0	17	0	20	MHz
		5.5 V	0	28	0	19	0	22	
t_w	Pulse duration, CBA or CAB high or low	4.5 V	20		30		25		ns
		5.5 V	18		27		23		
t_{su}	Setup time, A before CAB↑ or B before CBA↑	4.5 V	15		23		19		ns
		5.5 V	14		21		17		
t_h	Hold time, A after CAB↑ or B after CBA↑	4.5 V	5		5		5		ns
		5.5 V	5		5		5		

switching characteristics over recommended operating free-air temperature range (unless otherwise noted), C_L = 50 pF (see Note 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CC}	T_A = 25°C			SN54HCT651 SN54HCT652		SN74HCT651 SN74HCT652		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
f_{max}			4.5 V	25	35		17		20		MHz
			5.5 V	28	40		19		22		
t_{pd}	CBA or CAB	A or B	4.5 V		18	36		54		45	ns
			5.5 V		16	32		49		41	
t_{pd}	A or B	B or A	4.5 V		14	27		41		34	ns
			5.5 V		12	24		37		31	
t_{pd}	SBA or SAB†	A or B	4.5 V		20	38		57		48	ns
			5.5 V		17	34		51		43	
t_{en}	$\overline{G}$BA or GAB	A or B	4.5 V		25	49		74		61	ns
			5.5 V		22	44		67		55	
t_{dis}	$\overline{G}$BA or GAB	A or B	4.5 V		25	49		74		61	ns
			5.5 V		22	44		67		55	
t_t		Any	4.5 V		9	12		18		15	ns
			5.5 V		7	11		16		14	

C_{pd}	Power dissipation capacitance	No load, T_A = 25°C	50 pF typ

switching characteristics over recommended operating free-air temperature range (unless otherwise noted), C_L = 150 pF (see Note 1)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	V_{CC}	T_A = 25°C			SN54HCT651 SN54HCT652		SN74HCT651 SN74HCT652		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
t_{pd}	CBA or CAB	A or B	4.5 V		24	53		80		66	ns
			5.5 V		22	47		72		60	
t_{pd}	A or B	B or A	4.5 V		22	44		70		55	ns
			5.5 V		20	39		60		50	
t_{pd}	SBA or SAB†	A or B	4.5 V		26	55		83		69	ns
			5.5 V		24	49		74		62	
t_{en}	$\overline{G}$BA or GAB	A or B	4.5 V		33	66		100		82	ns
			5.5 V		30	59		90		74	
t_t		Any	4.5 V		17	42		63		53	ns
			5.5 V		14	38		57		48	

NOTE 1: Load circuits and voltage waveforms are shown in Section 1.
†These parameters are measured with the internal output state of the storage register opposite to that of the bus input.

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