FAIRCHILD SEMICONDUCTOR™

March 1998

74VHC244 • 74VHCT244
Octal Buffer/Line Driver with 3-STATE Outputs

General Description

The VHC/VHCT244 is an advanced high speed CMOS octal bus buffer fabricated with silicon gate CMOS technology. It achieves high speed operation similar to equivalent Bipolar Schottky TTL while maintaining the CMOS low power dissipation. The VHC/VHCT244 is a non-inverting 3-STATE buffer having two active-low output enables. These devices are designed to be used as 3-STATE memory address drivers, clock drivers, and bus oriented transmitter/receivers.

An input protection circuit ensures that 0V–7V can be applied to the input pins without regard to the supply voltage. This device can be used to interface 5V to 3V systems and two supply systems such as battery back up. This circuit prevents device destruction due to mismatched supply and input voltages.

Features

- High Speed:
  VHC t_{pd} = 3.9ns (typ) at V_{CC} = 5V
  VHCT t_{pd} = 5.4ns (typ) at V_{CC} = 5V
- High noise immunity:
  VHC $V_{NIH} = V_{NIL}$ = 28% V_{CC} (min)
  VHCT V_{IH} = 2.0V, V_{IL} = 0.8V
- Power down protection:
  VHC inputs only
  VHCT inputs and outputs
- Low noise:
  VHC V_{OLP} = 0.6V (typ)
  VHCT V_{OLP} = 0.7V (typ)
- Low power dissipation:
  I_{CC} = 4 μA (max) @ T_A = 25˚C
- Pin and function compatible with 74HC/HCT244

Note 1: Add External Pull Up Resistor To VHCT Outputs To Drive CMOS Inputs

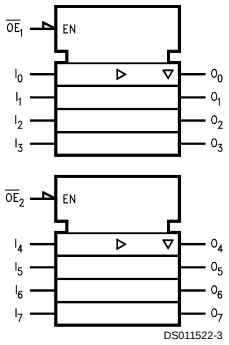
Ordering Code:

Commercial	Package Number	Package Description
74VHC244M	M20B	20-Lead Molded JEDEC SOIC
74VHC244SJ	M20D	20-Lead Molded EIAJ SOIC
74VHC244MTC	MTC20	20-Lead Molded JEDEC Type 1 TSSOP
74VHC244N	N20A	20-Lead Molded DIP
74VHCT244M	M20B	20-Lead Molded JEDEC SOIC
74VHCT244SJ	M20D	20-Lead Molded EIAJ SOIC
74VHCT244MTC	MTC20	20-Lead Molded JEDEC Type 1 TSSOP
74VHCT244N	N20A	20-Lead Molded DIP

Surface mount packages are also available on Tape and Reel. Specify by appending the suffix letter "X" to the ordering code.

Logic Symbol

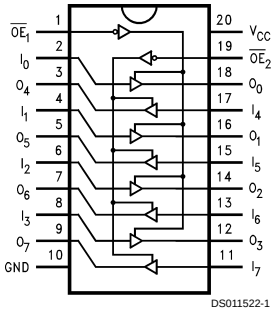
IEEE/IEC



DS011522-3

Connection Diagram

Pin Assignment for DIP, TSSOP and SOIC



DS011522-1

Pin Descriptions

Pin Names	Description
$\overline{OE}_1$, $\overline{OE}_2$	3-STATE Output Enable Inputs
I_0–I_7	Inputs
O_0–O_7	3-STATE Outputs

Truth Table

Inputs		Outputs
$\overline{OE}_1$	I_n	(Pins 12, 14, 16, 18)
L	L	L
L	H	H
H	X	Z

Inputs		Outputs
$\overline{OE}_2$	I_n	(Pins 3, 5, 7, 9)
L	L	L
L	H	H
H	X	Z

H = HIGH Voltage Level
I = Immaterial
L = LOW Voltage Level
Z = High Impedance

Absolute Maximum Ratings (Note 2)

Supply Voltage (V_{CC})	−0.5V to +7.0V
DC Input Voltage (V_{IN})	−0.5V to +7.0V
DC Output Voltage (V_{OUT})	
VHC	−0.5V to V_{CC} + 0.5V
VHCT (Note 3)	−0.5V to 7.0V
Input Diode Current (I_{IK})	−20 mA
Output Diode Current (I_{OK})	
VHC	±20 mA
VHCT	−20 mA
DC Output Current (I_{OUT})	±25 mA
DC V_{CC}/GND Current (I_{CC})	±75 mA
Storage Temperature (T_{STG})	−65˚C to +150˚C
Lead Temperature (T_L)	
(Soldering, 10 seconds)	260˚C

Recommended Operating Conditions (Note 4)

Supply Voltage (V_{CC})	
VHC	2.0V to 5.5V
VHCT	4.5V to 5.5V
Input Voltage (V_{IN})	0V to +5.5V
Output Voltage (V_{OUT})	0V to V_{CC}
Operating Temperature (T_{OPR})	−40˚C to +85˚C
Input Rise and Fall Time (t_r, t_f)	
V_{CC} = 3.3V ±0.3V (VHC Only)	0 ns/V ~ 100 ns/V
V_{CC} = 5.0V ±0.5V	0 ns/V ~ 20 ns/V

Note 2: Absolute Maximum Ratings are values beyond which the device may be damaged or have its useful life impaired. The databook specifications should be met, without exception, to ensure that the system design is reliable over its power supply, temperature, and output/input loading variables. Fairchild does not recommend operation outside databook specifications.

Note 3: $V_{OUT} > V_{CC}$ only if output is in H or Z state.

Note 4: Unused inputs must be held HIGH or LOW. They may not float.

DC Electrical Characteristics for VHC Family Devices

Symbol	Parameter	V_{CC} (V)	T_A = 25˚C			T_A = −40˚C to +85˚C		Units	Conditions	
			Min	Typ	Max	Min	Max			
V_{IH}	High Level Input Voltage	2.0	1.5			1.5				
		3.0–5.5	0.7 V_{CC}			0.7 V_{CC}		V		
V_{IL}	Low Level Input Voltage	2.0			0.5		0.5			
		3.0–5.5			0.3 V_{CC}		0.3 V_{CC}	V		
V_{OH}	High Level Output Voltage	2.0	1.9	2.0		1.9			V_{IN} = V_{IH} or V_{IL}	I_{OH} = −50 µA
		3.0	2.9	3.0		2.9		V		
		4.5	4.4	4.5		4.4				
		3.0	2.58			2.48		V		I_{OH} = −4 mA
		4.5	3.94			3.80				I_{OH} = −8 mA
V_{OL}	Low Level Output Voltage	2.0		0.0	0.1		0.1		V_{IN} = V_{IH} or V_{IL}	I_{OL} = 50 µA
		3.0		0.0	0.1		0.1	V		
		4.5		0.0	0.1		0.1			
		3.0			0.36		0.44	V		I_{OL} = 4 mA
		4.5			0.36		0.44			I_{OL} = 8 mA
I_{OZ}	3-STATE Output Off-State Current	5.5			±0.25		±2.5	µA	V_{IN} = V_{IH} or V_{IL}; V_{OUT} = V_{CC} or GND	
I_{IN}	Input Leakage Current	0–5.5			±0.1		±1.0	µA	V_{IN} = 5.5V or GND	
I_{CC}	Quiescent Supply Current	5.5			4.0		40.0	µA	V_{IN} = V_{CC} or GND	

DC Electircal Characteristics for VHC Family Devices

Symbol	Parameter	V_{CC} (V)	T_A = 25°C		Units	Conditions
			Typ	Limits		
V_{OLP} (Note 5)	Quiet Output Maximum Dynamic V_{OL}	5.0	0.6	0.9	V	C_L = 50 pF
V_{OLV} (Note 5)	Quiet Output Minimum Dynamic V_{OL}	5.0	−0.6	−0.9	V	C_L = 50 pF
V_{IHD} (Note 5)	Minimum High Level Dynamic Input Voltage	5.0		3.5	V	C_L = 50 pF
V_{ILD} (Note 5)	Maximum High Level Dynamic Input Voltage	5.0		1.5	V	C_L = 50 pF

Note 5: Parameter guaranteed by design.

DC Electrical Characteristics for VHCT Family Devices

Symbol	Parameter	V_{CC} (V)	T_A = 25°C			T_A = −40°C to +85°C		Units	Conditions	
			Min	Typ	Max	Min	Max			
V_{IH}	High Level Input Voltage	4.5 5.5	2.0 2.0			2.0 2.0		V		
V_{IL}	Low Level Input Voltage	4.5 5.5			0.8 0.8		0.8 0.8	V		
V_{OH}	High Level Output Voltage	4.5	3.15	3.65		3.15		V	V_{IN} = V_{IH} or V_{IL}	I_{OH} = −50 μA
		4.5	2.5			2.4				I_{OH} = −8 mA
V_{OL}	Low Level Output Voltage	4.5		0.0	0.1		0.1	V	V_{IN} = V_{IH} or V_{IL}	I_{OL} = 50 μA
		4.5			0.36		0.44			I_{OL} = 8 mA
I_{OZ}	3-STATE Output Off-State Current	5.5			±0.25		±2.5	μA	V_{IN} = V_{IH} or V_{IL} V_{OUT} = V_{CC} or GND	
I_{IN}	Input Leakage Current	0–5.5			±0.1		±1.0	μA	V_{IN} = 5.5V or GND	
I_{CC}	Quiescent Supply Current	5.5			4.0		40.0	μA	V_{IN} = V_{CC} or GND	
I_{CCT}	Maximum I_{CC}/Input	5.5			1.35		1.50	mA	V_{IN} = 3.4V, Other Inputs = V_{CC} or GND	
I_{OFF}	Output Leakage (Power Down State)	0.0			+0.5		+5.0	μA	V_{OUT} = 5.5V	

DC Electrical Characteristics for VHCT Family Devices

Symbol	Parameter	V_{CC} (V)	T_A = 25°C		Units	Conditions
			Typ	Limits		
V_{OLP} (Note 6)	Quiet Output Maximum Dynamic V_{OL}		0.7	1.0	V	C_L = 50 pF
V_{OLV} (Note 6)	Quiet Output Minimum Dynamic V_{OL}		−0.7	−1.0	V	C_L = 50 pF
V_{IHD} (Note 6)	Minimum High Level Dynamic Input Voltage			2.0	V	C_L = 50 pF
V_{ILD} (Note 6)	Maximum High Level Dynamic Input Voltage			0.8	V	C_L = 50 pF

Note 6: Parameter guaranteed by design.

AC Electrical Characteristics for VHC Family Devices

Symbol	Parameter	V_{CC} (V)	T_A = 25°C			T_A = −40°C to +85°C		Units	Conditions	
			Min	Typ	Max	Min	Max			
t_{PLH}	Propagation Delay	3.3 ±0.3		5.8	8.4	1.0	10.0	ns		C_L = 15 pF
t_{PHL}	Time			8.3	11.9	1.0	13.5			C_L = 50 pF
		5.0 ±0.5		3.9	5.5	1.0	6.5	ns		C_L = 15 pF
				5.4	7.5	1.0	8.5			C_L = 50 pF
t_{PZL}	3-STATE Output	3.3 ±0.3		6.6	10.6	1.0	12.5	ns	R_L = 1 kΩ	C_L = 15 pF
t_{PZH}	Enable Time			9.1	14.1	1.0	16.0			C_L = 50 pF
		5.0 ±0.5		4.7	7.3	1.0	8.5	ns		C_L = 15 pF
				6.2	9.3	1.0	10.5			C_L = 50 pF
t_{PLZ}	3-STATE Output	3.3 ± 0.3		10.3	14.0	1.0	16.0	ns	R_L = 1 kΩ	C_L = 50 pF
t_{PHZ}	Disable Time	5.0 ±0.5		6.7	9.2	1.0	10.5			C_L = 50 pF
t_{OSLH}	Output to Output	3.3 ±0.3			1.5		1.5	ns	(Note 7)	C_L = 50 pF
t_{OSHL}	Skew	5.0 ±0.5			1.0		1.0			C_L = 50 pF
C_{IN}	Input Capacitance			4	10		10	pF	V_{CC} = Open	
C_{OUT}	Output Capacitance			6				pF	V_{CC} = 5.0V	
C_{PD}	Power Dissipation Capacitance			19				pF	(Note 8)	

Note 7: Parameter guaranteed by design. $t_{OSLH} = |t_{PLHmax} - t_{PLHmin}|$; $t_{OSHL} = |t_{PHLmax} - t_{PHLmin}|$.

Note 8: C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load. Average operating current can be obtained by the equation: I_{CC} (OPR.) = $C_{PD} * V_{CC} * f_{IN} + I_{CC}/8$ (per bit).

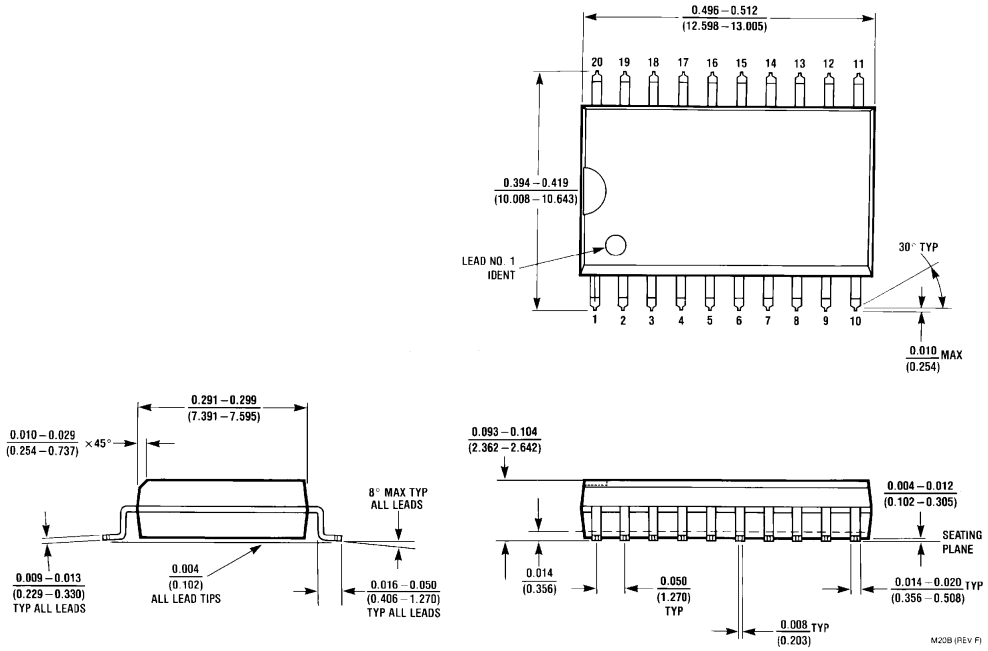
AC Electrical Characteristics for VHCT Family Devices

Symbol	Parameter	V_{CC} (V)	T_A = 25°C			T_A = −40°C to +85°C		Units	Conditions	
			Min	Typ	Max	Min	Max			
t_{PLH}	Propagation Delay	5.0 ±0.5		5.4	7.4	1.0	8.5	ns		C_L = 15 pF
t_{PHL}	Time			5.9	8.4	1.0	9.5			C_L = 50 pF
t_{PZL}	3-STATE Output	5.0 ±0.5		7.7	10.4	1.0	12.0	ns	R_L = 1 kΩ	C_L = 15 pF
t_{PZH}	Enable Time			8.2	11.4	1.0	13.0			C_L = 50 pF
t_{PLZ} t_{PHZ}	3-STATE Output Disable Time	5.0 ±0.5		8.8	11.4	1.0	13.0	ns	R_L = 1 kΩ	C_L = 50 pF
t_{OSLH} t_{OSHL}	Output to Output Skew	5.0 ±0.5			1.0		1.0	ns	(Note 9)	C_L = 50 pF
C_{IN}	Input Capacitance			4	10		10	pF	V_{CC} = Open	
C_{OUT}	Output Capacitance			9				pF	V_{CC} = 5.0V	
C_{PD}	Power Dissipation Capacitance			18				pF	(Note 10)	

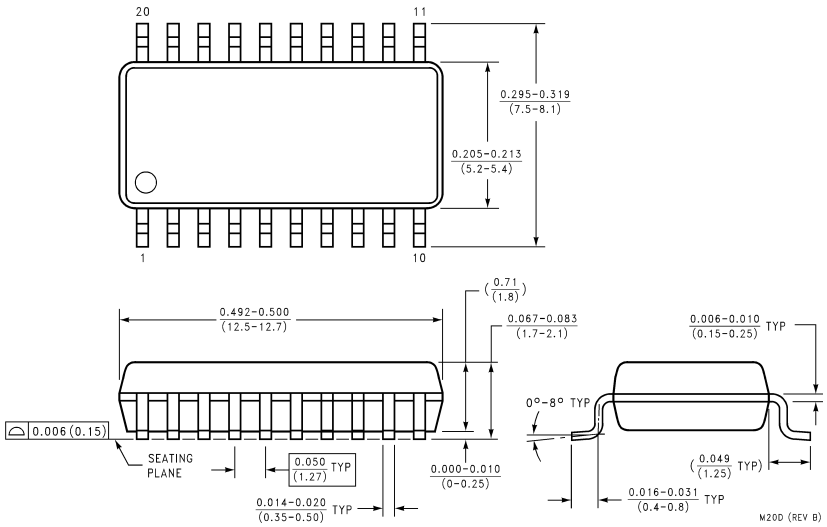
Note 9: Parameter guaranteed by design. $t_{OSLH} = |t_{PLHmax} - t_{PLHmin}|$; $t_{OSHL} = |t_{PHLmax} - t_{PHLmin}|$.

Note 10: C_{PD} is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load. Average operating current can be obtained by the equation: I_{CC} (OPR.) = $C_{PD} * V_{CC} * f_{IN} + I_{CC}/8$ (per bit).

Physical Dimensions inches (millimeters) unless otherwise noted

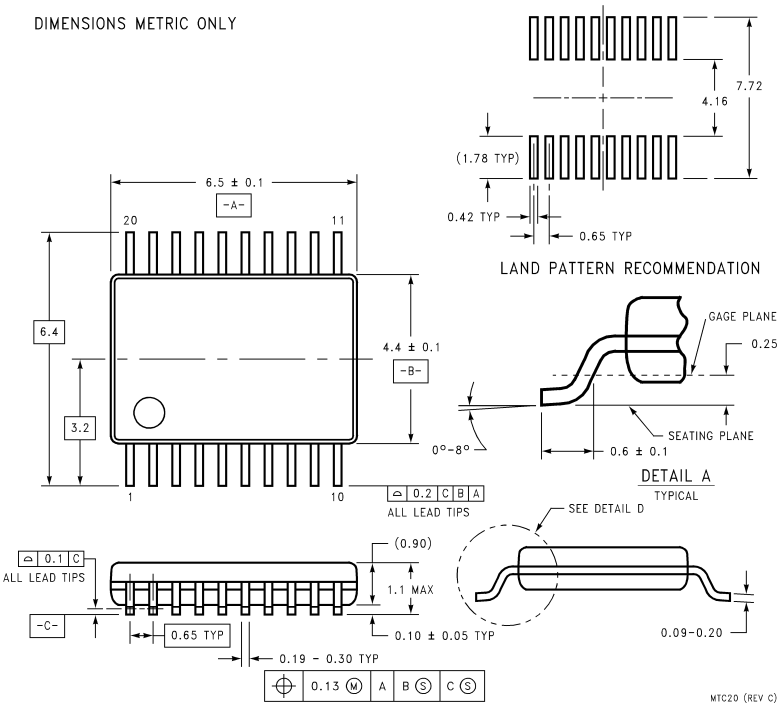


20-Lead Small Outline Integrated Circuit JEDEC SOIC (M)
Package Number M20B

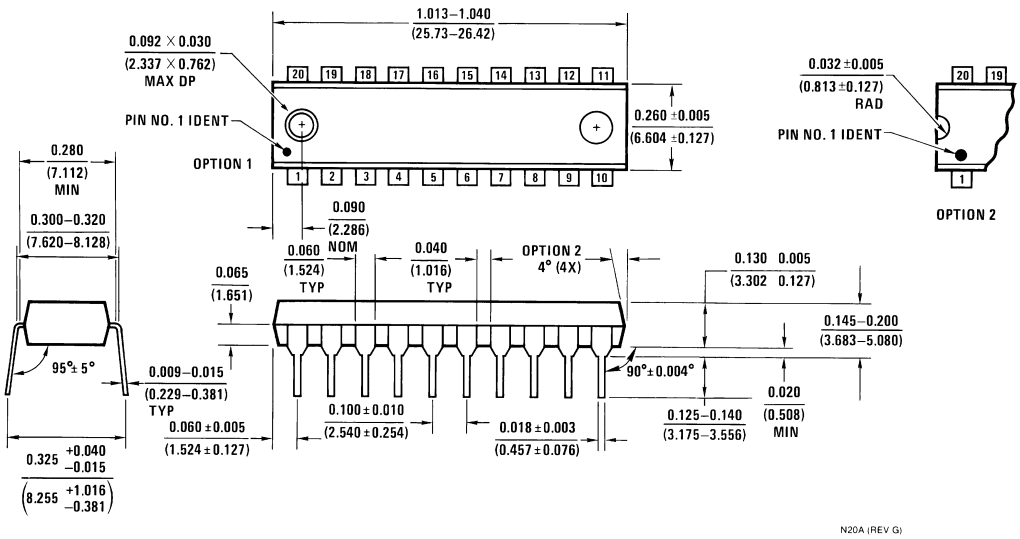


20-Lead Small Outline Integrated Circuit JEDECEIAJ SOIC (S-J)
Package Number M20D

Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



20-Lead Plastic JEDEC TSSOP Type I (MTC)
Package Number MTC20



20-Lead Molded DIP
Package Number N20A

LIFE SUPPORT POLICY

FAIRCHILD'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT OF FAIRCHILD SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and (c) whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component in any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

Fairchild Semiconductor Corporation
Americas
Customer Response Center
Tel: 1-888-522-5372

Fairchild Semiconductor Europe
Fax: +49 (0) 1 80-530 85 86
Email: europe.support@nsc.com
Deutsch Tel: +49 (0) 8 141-35-0
English Tel: +44 (0) 1 793-85-68-56
Italy Tel: +39 (0) 2 57 5631

Fairchild Semiconductor Hong Kong Ltd.
13th Floor, Straight Block,
Ocean Centre, 5 Canton Rd.
Tsimshatsui, Kowloon
Hong Kong
Tel: +852 2737-7200
Fax: +852 2314-0061

National Semiconductor Japan Ltd.
Tel: 81-3-5620-6175
Fax: 81-3-5620-6179

www.fairchildsemi.com