

Octal Bus Buffer/Line Driver

MC74VHC245, MC74VHCT245A

The MC74VHC245/MC74VHCT245A is an advanced high speed CMOS octal bus buffer fabricated with silicon gate CMOS technology.

It is intended for two-way asynchronous communication between data buses. The direction of data transmission is determined by the level of the DIR input. The output enable pin (OE) can be used to disable the device, so that the buses are effectively isolated.

All inputs are equipped with protection circuits against static discharge.

The MC74VHC245 inputs are compatible with standard CMOS levels while the MC74VHCT245A inputs are compatible with TTL levels. The MC74VHCT245A device can be used as a level converter for interfacing 3.3 V to 5.0 V, because it has full 5.0 V CMOS level output swings.

The MC74VHC245 and MC74VHCT245A inputs tolerate voltages up to 5.5 V, allowing the interface of 5 V systems to 3 V systems.

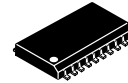
The MC74VHCT245A output structures provide protection when $V_{CC} = 0$ V. These output structures help prevent device destruction caused by supply voltage – input/output voltage mismatch, battery backup, hot insertion, etc.

Features

- High Speed: $t_{PD} = 4.0$ ns (Typ) at $V_{CC} = 5.0$ V (VHC)
 $t_{PD} = 4.9$ ns (Typ) at $V_{CC} = 5.0$ V (VHCT)
- Low Power Dissipation: $I_{CC} = 4.0$ μ A (Max) at $T_A = 25^\circ$ C
- High Noise Immunity: $V_{NIH} = V_{NIL} = 28\%$
- Power Down Protection Provided
- Balanced Propagation Delays
- Designed for: 2.0 V to 5.5 V (VHC)
4.5 V to 5.5 V (VHCT)
- Low Noise: $V_{OLP} = 1.2$ V (Max) (VHC)
 $V_{OLP} = 1.6$ V (Max) (VHCT)
- Pin and Function Compatible with Other Standard Logic Families
- Latchup Performance Exceeds 100 mA
- ESD Performance: Human Body Model > 2000 V;
- Chip Complexity: 308 FETs
- –Q Suffix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable
- These Devices are Pb-Free, Halogen Free and are RoHS Compliant

Application Notes

- Do not force a signal on an I/O pin when it is an active output, damage may occur.
- All floating (high impedance) input or I/O pins must be fixed by means of pull up or pull down resistors or bus terminator ICs.
- A parasitic diode is formed between the bus and V_{CC} terminals. Therefore, the VHC245 cannot be used to interface 5 V to 3 V systems directly.

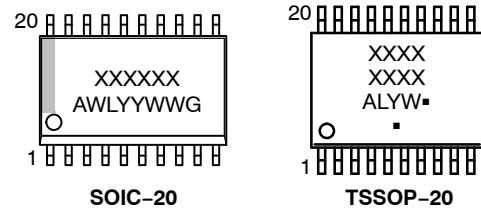


SOIC-20
DW SUFFIX
CASE 751D



TSSOP-20
DT SUFFIX
CASE 948E

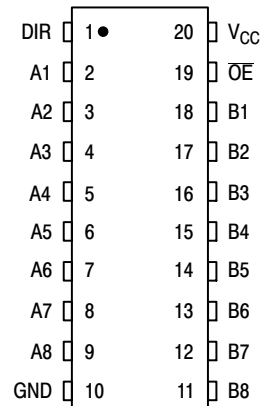
MARKING DIAGRAMS



- A = Assembly Location
 WL, L = Wafer Lot
 YY, Y = Year
 WW, W = Work Week
 G or ■ = Pb-Free Package

(Note: Microdot may be in either location)

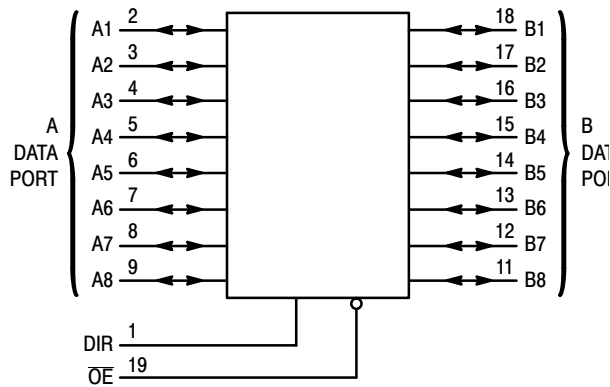
PIN ASSIGNMENT



ORDERING INFORMATION

See detailed ordering and shipping information on page 9 of this data sheet.

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FUNCTION TABLE

Control Inputs		Operation
OE	DIR	
L	L	Data Transmitted from Bus B to Bus A
L	H	Data Transmitted from Bus A to Bus B
H	X	Buses Isolated (High-Impedance State)

Figure 1. Logic Diagram

MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CC}	DC Supply Voltage	-0.5 to +6.5	V
V_{IN}	DC Input Voltage	-0.5 to +6.5	V
V_{OUT}	DC Output Voltage (MC74VHC)	-0.5 to $V_{CC}+0.5$	V
	DC Output Voltage (MC74VHCT)	-0.5 to $V_{CC}+0.5$	
	Active Mode (High or Low State)	-0.5 to $V_{CC}+0.5$	
	Tristate Mode (Note 1)	-0.5 to +6.5	
	Power-Off Mode ($V_{CC} = 0$ V)	-0.5 to +6.5	
I_{IN}	DC Input Current, per Pin	± 20	mA
I_{OUT}	DC Output Current, Per Pin	± 25	mA
I_{CC}	DC Supply Current, V_{CC} and GND Pins	± 75	mA
I_{IK}	Input Clamp Current	-20	mA
I_{OK}	Output Clamp Current	MC74VHC	± 20
		MC74VHCT	-20
T_{STG}	Storage Temperature Range	-65 to +150	°C
T_L	Lead Temperature, 1 mm from Case for 10 secs	260	°C
T_J	Junction Temperature Under Bias	+150	°C
θ_{JA}	Thermal Resistance (Note 2)	SOIC-20W	96
		TSSOP-20	150
P_D	Power Dissipation in Still Air at 25°C	SOIC-20W	1302
		TSSOP-20	833
MSL	Moisture Sensitivity	SOIC-20W	Level 3
		All Other Packages	Level 1
F_R	Flammability Rating	Oxygen Index: 28 to 34	UL 94 V-0 @ 0.245 in
V_{ESD}	ESD Withstand Voltage (Note 3)	Human Body Model	2000
		Charged Device Model	N/A
$I_{LATCHUP}$	Latchup Performance (Note 4)	± 100	mA

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Applicable to devices with outputs that may be tri-stated.

2. Measured with minimum pad spacing on an FR4 board, using 76 mm-by-114 mm, 2-ounce copper trace no air flow per JESD51-7.

3. HBM tested to EIA / JESD22-A114-A. CDM tested to JESD22-C101-A. JEDEC recommends that ESD qualification to EIA/JESD22-A115A (Machine Model) be discontinued.

4. Tested to EIA/JESD78 Class II.

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RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Max	Unit	
MC74VHC					
V _{CC}	DC Supply Voltage	2.0	5.5	V	
V _{IN}	DC Input Voltage (Note 5)	0	5.5	V	
V _{OUT}	DC Output Voltage (Note 5)	0	V _{CC}	V	
T _A	Operating Temperature	−40	+85	°C	
t _r , t _f	Input Rise or Fall Rate	V _{CC} = 3.0 V to 3.6 V	0	100	ns/V
		V _{CC} = 4.5 V to 5.5 V	0	20	

MC74VHCT

V _{CC}	DC Supply Voltage	4.5	5.5	V
V _{IN}	DC Input Voltage (Note 5)	0	5.5	V
V _{OUT}	DC Output Voltage (Note 5)	0	V _{CC}	V
	Active Mode (High or Low State)	0	5.5	
	Tristate Mode	0	5.5	
	Power-Off Mode (V _{CC} = 0 V)	0	5.5	
T _A	Operating Temperature	−40	+85	°C
t _r , t _f	Input Rise or Fall Rate	0	20	ns/V
	V _{CC} = 4.5 V to 5.5 V			

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

5. Unused inputs must always be tied to an appropriate logic voltage level (e.g., either GND or V_{CC}). Unused outputs must be left open.

DC ELECTRICAL CHARACTERISTICS (MC74VHC245)

Symbol	Parameter	Test Conditions	V_{CC} V	$T_A = 25^\circ\text{C}$			$T_A = -40\text{ to }85^\circ\text{C}$		Unit
				Min	Typ	Max	Min	Max	
V_{IH}	Minimum High-Level Input Voltage		2.0 3.0 to 5.5	1.50 $V_{CC} \times 0.7$			1.50 $V_{CC} \times 0.7$		V
V_{IL}	Maximum Low-Level Input Voltage		2.0 3.0 to 5.5			0.50 $V_{CC} \times 0.3$		0.50 $V_{CC} \times 0.3$	V
V_{OH}	Minimum High-Level Output Voltage	$V_{in} = V_{IH}$ or V_{IL} $I_{OH} = -50\text{ }\mu\text{A}$	2.0 3.0 4.5	1.9 2.9 4.4	2.0 3.0 4.5		1.9 2.9 4.4		V
		$V_{in} = V_{IH}$ or V_{IL} $I_{OH} = -4\text{ mA}$ $I_{OH} = -8\text{ mA}$	3.0 4.5	2.58 3.94			2.48 3.80		
V_{OL}	Maximum Low-Level Output Voltage	$V_{in} = V_{IH}$ or V_{IL} $I_{OL} = 50\text{ }\mu\text{A}$	2.0 3.0 4.5		0.0 0.0 0.0	0.1 0.1 0.1		0.1 0.1 0.1	V
		$V_{in} = V_{IH}$ or V_{IL} $I_{OL} = 4\text{ mA}$ $I_{OL} = 8\text{ mA}$	3.0 4.5			0.36 0.36		0.44 0.44	
I_{in}	Maximum Input Leakage Current	$V_{in} = 5.5\text{ V}$ or GND (DIR, OE)	0 to 5.5			± 0.1		± 1.0	μA
I_{OZ}	Maximum Three-State Leakage Current	$V_{in} = V_{IL}$ or V_{IH} $V_{out} = V_{CC}$ or GND	5.5			± 0.25		± 2.5	μA
I_{CC}	Maximum Quiescent Supply Current	$V_{in} = V_{CC}$ or GND	5.5			4.0		40.0	μA

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

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AC ELECTRICAL CHARACTERISTICS (MC74VHC245)

Symbol	Parameter	Test Conditions	T _A = 25°C			T _A = - 40 to 85°C		Unit
			Min	Typ	Max	Min	Max	
t _{PLH} , t _{PHL}	Maximum Propagation Delay, A to B or B to A	V _{CC} = 3.3 ± 0.3 V C _L = 15 pF C _L = 50 pF		5.8 8.3	8.4 11.9	1.0 1.0	10.0 13.5	ns
		V _{CC} = 5.0 ± 0.5 V C _L = 15 pF C _L = 50 pF		4.0 5.5	5.5 7.5	1.0 1.0	6.5 8.5	
t _{PZL} , t _{PZH}	Output Enable Time OE to A or B	V _{CC} = 3.3 ± 0.3 V C _L = 15 pF C _L = 50 pF		8.5 11.0	13.2 16.7	1.0 1.0	15.5 19.0	ns
		V _{CC} = 5.0 ± 0.5 V C _L = 15 pF C _L = 50 pF		5.8 7.3	8.5 10.6	1.0 1.0	10.0 12.0	
t _{PLZ} , t _{PHZ}	Output Disable Time OE to A or B	V _{CC} = 3.3 ± 0.3 V C _L = 50 pF		11.5	15.8	1.0	18.0	ns
		V _{CC} = 5.0 ± 0.5 V C _L = 50 pF		7.0	9.7	1.0	11.0	
t _{OSLH} , t _{OSHL}	Output to Output Skew	V _{CC} = 3.3 ± 0.3 V C _L = 50 pF (Note 6)			1.5		1.5	ns
		V _{CC} = 5.0 ± 0.5 V C _L = 50 pF (Note 6)			1.0		1.0	ns
C _{in}	Maximum Input Capacitance DIR, OE			4	10		10	pF
C _{I/O}	Maximum Three-State I/O Capacitance			8				pF

C _{PD}	Power Dissipation Capacitance (Note 7)	Typical @ 25°C, V _{CC} = 5.0 V	pF
		21	

6. Parameter guaranteed by design. t_{OSLH} = |t_{PLHm} - t_{PLHn}|, t_{OSHL} = |t_{PHLm} - t_{PHLn}|.
7. 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). C_{PD} is used to determine the no-load dynamic power consumption; P_D = C_{PD} • V_{CC}² • f_{in} + I_{CC} • V_{CC}.

NOISE CHARACTERISTICS (MC74VHC245)

Symbol	Parameter	T _A = 25°C		Unit
		Typ	Max	
V _{OLP}	Quiet Output Maximum Dynamic V _{OL}	0.9	1.2	V
V _{OLV}	Quiet Output Minimum Dynamic V _{OL}	-0.9	-1.2	V
V _{IHD}	Minimum High Level Dynamic Input Voltage		3.5	V
V _{ILD}	Maximum Low Level Dynamic Input Voltage		1.5	V

MC74VHC245, MC74VHCT245A

DC ELECTRICAL CHARACTERISTICS (MC74VHCT245A)

Symbol	Parameter	Test Conditions	V _{CC} V	T _A = 25°C			T _A = - 40 to 85°C		Unit
				Min	Typ	Max	Min	Max	
V _{IH}	Minimum High-Level Input Voltage		4.5 to 5.5	2.0			2.0		V
V _{IL}	Maximum Low-Level Input Voltage		4.5 to 5.5			0.8		0.8	V
V _{OH}	Minimum High-Level Output Voltage V _{in} = V _{IH} or V _{IL}	I _{OH} = - 50 µA	4.5	4.4	4.5		4.4		V
		I _{OH} = - 8 mA	4.5	3.94			3.80		
V _{OL}	Maximum Low-Level Output Voltage V _{in} = V _{IH} or V _{IL}	I _{OL} = 50 µA	4.5		0.0	0.1		0.1	V
		I _{OL} = 8 mA	4.5			0.36		0.44	
I _{in}	Maximum Input Leakage Current	V _{in} = 5.5 V or GND	0 to 5.5			± 0.1		± 1.0	µA
I _{OZ}	Maximum 3-State Leakage Current	V _{in} = V _{IL} or V _{IH} V _{out} = V _{CC} or GND	5.5			± 0.25		± 2.5	µA
I _{CC}	Maximum Quiescent Supply Current	V _{in} = V _{CC} or GND	5.5			4.0		40.0	µA
I _{CC} T	Quiescent Supply Current	Per Input: V _{IN} = 3.4 V Other Input: V _{CC} or GND	5.5			1.35		1.50	mA
I _{OPD}	Output Leakage Current	V _{OUT} = 5.5 V	0			0.5		5.0	µA

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

MC74VHC245, MC74VHCT245A

AC ELECTRICAL CHARACTERISTICS (MC74VHCT245A)

Symbol	Parameter	Test Conditions	T _A = 25°C			T _A = - 40 to 85°C		Unit
			Min	Typ	Max	Min	Max	
t _{PLH} , t _{PHL}	Maximum Propagation Delay A to B or B to A	V _{CC} = 5.0 ± 0.5 V C _L = 15 pF C _L = 50 pF		4.9 5.4	7.7 8.7	1.0 1.0	8.5 9.5	ns
t _{PZL} , t _{PZH}	Output Enable Time OE to A or B	V _{CC} = 5.0 ± 0.5 V C _L = 15 pF C _L = 50 pF		9.4 9.9	13.8 14.8	1.0 1.0	15.0 16.0	ns
t _{PLZ} , t _{PHZ}	Output Disable Time OE to A or B	V _{CC} = 5.0 ± 0.5 V C _L = 50 pF		10.1	15.4	1.0	16.5	ns
t _{OSLH} , t _{OSHL}	Output to Output Skew	V _{CC} = 5.0 ± 0.5 V (Note 8) C _L = 50 pF			1.0		1.0	ns
C _{in}	Maximum Input Capacitance			4	10		10	pF
C _{out}	Maximum 3-State Output Capacitance (Output in High-Impedance State)			13				pF

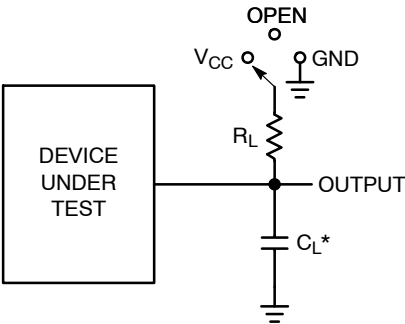
C _{PD}	Power Dissipation Capacitance (Note 9)	Typical @ 25°C, V _{CC} = 5.0 V	pF
		16	

8. Parameter guaranteed by design. t_{OSLH} = |t_{PLHm} - t_{PLHn}|, t_{OSHL} = |t_{PHLm} - t_{PHLn}|.
9. 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). C_{PD} is used to determine the no-load dynamic power consumption; P_D = C_{PD} • V_{CC}² • f_{in} + I_{CC} • V_{CC}.

NOISE CHARACTERISTICS (MC74VHCT245A)

Symbol	Parameter	T _A = 25°C		Unit
		Typ	Max	
V _{OLP}	Quiet Output Maximum Dynamic V _{OL}	1.2	1.6	V
V _{OLV}	Quiet Output Minimum Dynamic V _{OL}	-1.2	-1.6	V
V _{IHD}	Minimum High Level Dynamic Input Voltage		2.0	V
V _{ILD}	Maximum Low Level Dynamic Input Voltage		0.8	V

MC74VHC245, MC74VHCT245A



*C_L Includes probe and jig capacitance
Input signal t_R = t_F = 3 ns

Test	Switch Position	C _L	R _L
t _{PLH} / t _{PHL}	Open	See AC Characteristics Table	1 kΩ
t _{PLZ} / t _{PZL}	V _{CC}		
t _{PHZ} / t _{PZH}	GND		

Figure 2. Test Circuits

SWITCHING WAVEFORMS

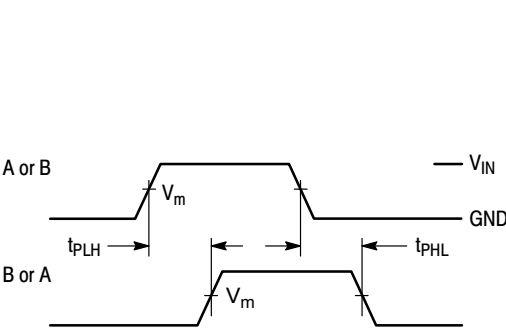


Figure 3.

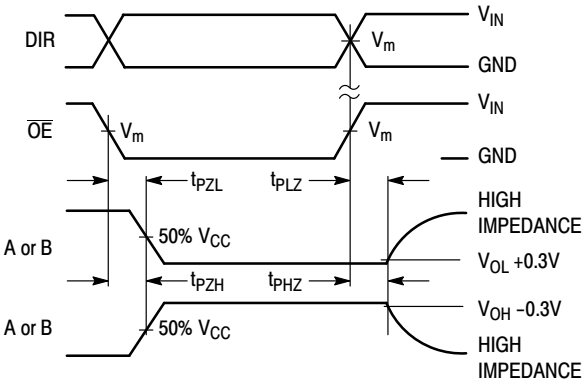


Figure 4.

Device	V _{IN} , V	V _m , V
MC74VHC245	V _{CC}	50% x V _{CC}
MC74VHCT245A	3 V	1.5 V

MC74VHC245, MC74VHCT245A

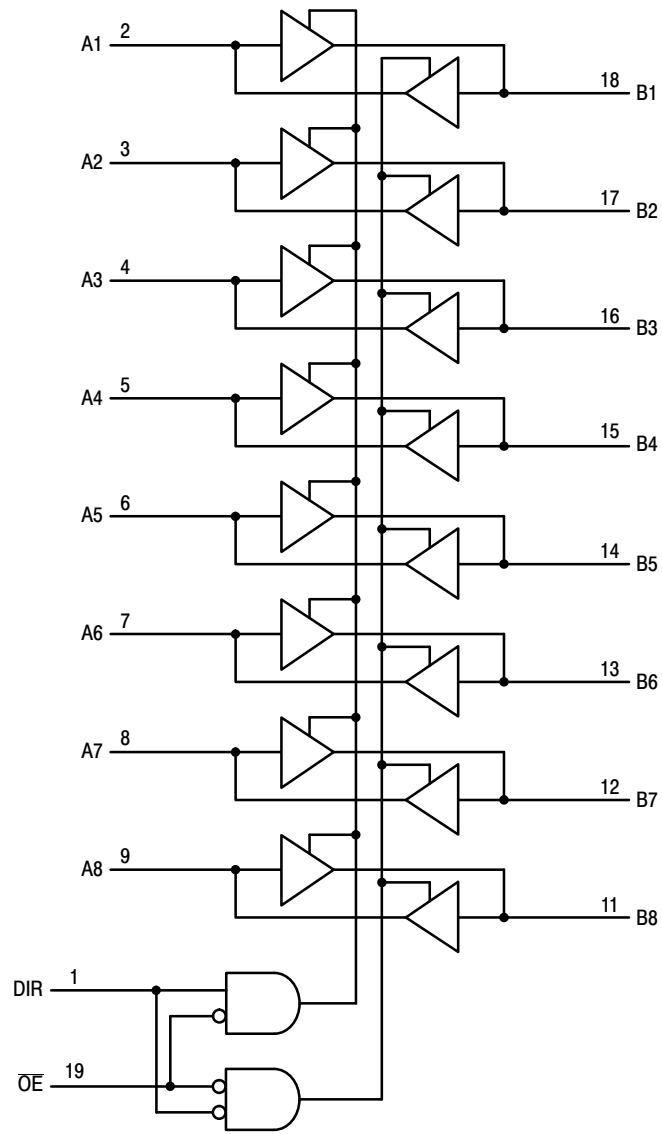


Figure 5. Expanded Logic Diagram

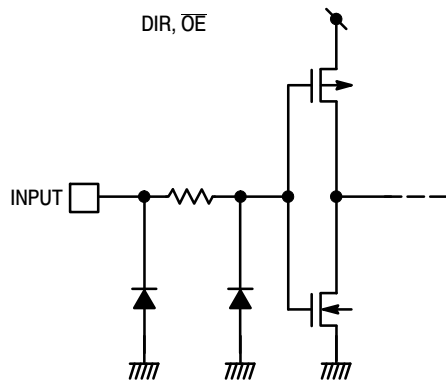


Figure 6. Input Equivalent Circuit

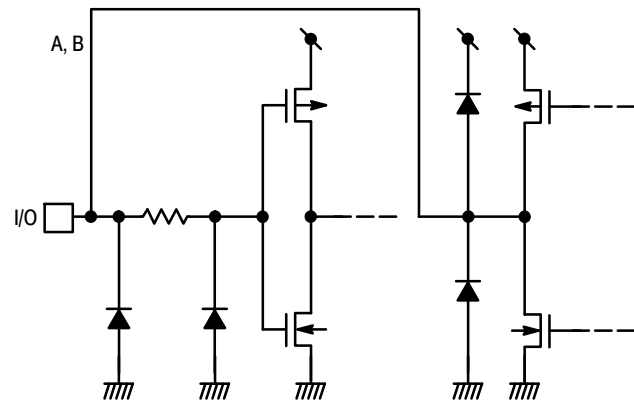


Figure 7. Bus Terminal Equivalent Circuit

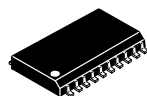
MC74VHC245, MC74VHCT245A

ORDERING INFORMATION

Device	Marking	Package	Shipping [†]
MC74VHC245DWG	VHC245G	SOIC-20 WB	38 Units / Rail
MC74VHC245DWR2G	VHC245G	SOIC-20 WB	2500 / Tape & Reel
MC74VHC245DTG	VHC 245	TSSOP-20	75 Units / Rail
MC74VHC245DTR2G	VHC 245	TSSOP-20	1000 / Tape & Reel
MC74VHCT245ADWG	VHCT245AG	SOIC-20 WB	38 Units / Rail
MC74VHCT245ADWR2G	VHCT245AG	SOIC-20 WB	2500 / Tape & Reel
MC74VHCT245ADTG	VHCT 245A	TSSOP-20	75 Units / Rail
MC74VHCT245ADTR2G	VHCT 245A	TSSOP-20	1000 / Tape & Reel

[†]For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

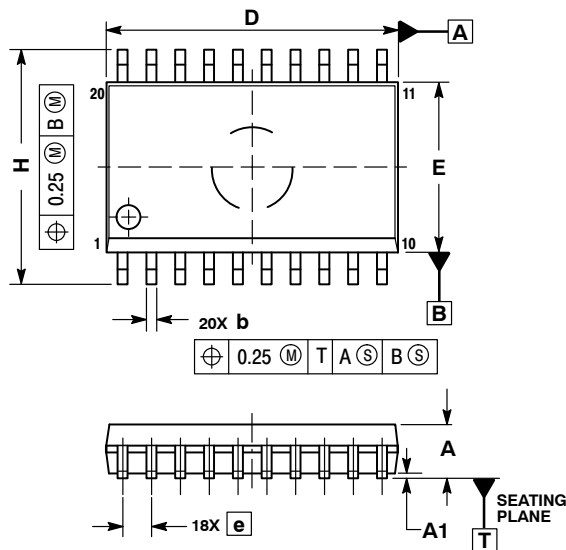
*-Q Suffix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC-Q100 Qualified and PPAP Capable



SCALE 1:1

SOIC-20 WB
CASE 751D-05
ISSUE H

DATE 22 APR 2015

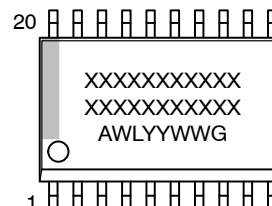


NOTES:

1. DIMENSIONS ARE IN MILLIMETERS.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
3. DIMENSIONS D AND E DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.
5. DIMENSION B DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.13 TOTAL IN EXCESS OF B DIMENSION AT MAXIMUM MATERIAL CONDITION.

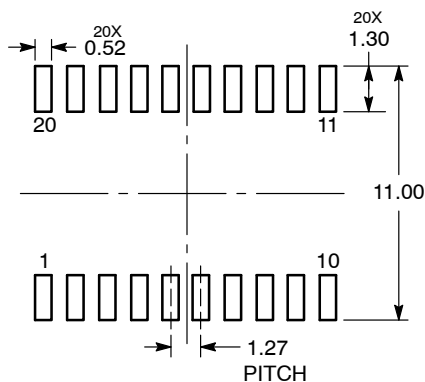
DIM	MILLIMETERS	
	MIN	MAX
A	2.35	2.65
A1	0.10	0.25
b	0.35	0.49
c	0.23	0.32
D	12.65	12.95
E	7.40	7.60
e	1.27 BSC	
H	10.05	10.55
h	0.25	0.75
L	0.50	0.90
θ	0°	7°

GENERIC
MARKING DIAGRAM*



XXXXXX = Specific Device Code
A = Assembly Location
WL = Wafer Lot
YY = Year
WW = Work Week
G = Pb-Free Package

RECOMMENDED
SOLDERING FOOTPRINT*



DIMENSIONS: MILLIMETERS

*For additional information on our Pb-Free strategy and soldering details, please download the **onsemi** Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G" or microdot "▪", may or may not be present. Some products may not follow the Generic Marking.

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