National Semiconductor

AUGUST 1978

INS8216/8226 4-Bit Bidirectional Bus Transceivers

General Description

The INS8216 and INS8226 are four-bit bidirectional bus drivers for use in bus oriented applications. The non-inverting INS8216 and inverting INS8226 drivers are provided for flexibility in system design.

Each buffered line of the four-bit driver consists of two separate buffers that are TRI-STATE® to achieve direct bus interface and bidirectional capability. On one side of the driver the output of one buffer and the input of another are tied together (DB); this side is used to interface to the system side components such as memories, I/O, etc., because its interface is TTL compatible and it has high drive (50mA). On the other side of the driver the inputs and outputs are separated to provide maximum flexibility. Of course, they can be tied together so that the driver can be used to buffer a true bidirectional bus. The DO outputs on this side of the driver have a special high voltage output drive capability so that direct interface to the 8080 type CPUs is achieved with an adequate amount of noise immunity.

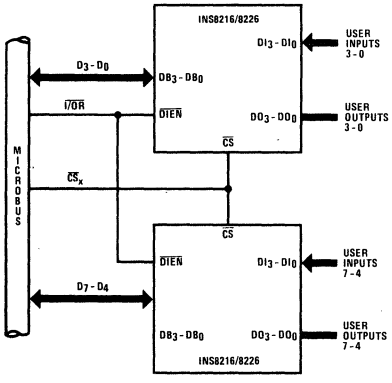
The $\overline{CS}$ input is a device enable. When it is "high" the output drivers are all forced to their high-impedance state. When it is a "low" the device is enabled and the direction of the data flow is determined by the $\overline{DIEN}$ input.

The $\overline{DIEN}$ input controls the direction of data flow, which is accomplished by forcing one of the pair of buffers into its high-impedance state and allowing the other to transmit its data. A simple two-gate circuit is used for this function.

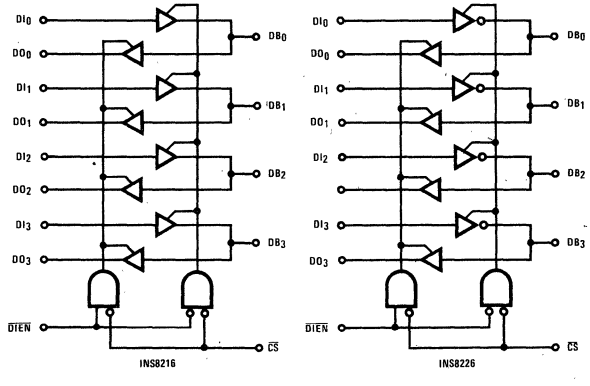
Features

- Data bus buffer driver for 8080 type CPUs
- Low input load current — 0.25mA maximum
- High output drive capability for driving system data bus — 50mA at 0.5V
- Power up-down protection
- The INS8216 has non-inverting outputs.
- The INS8226 has inverting outputs.
- Output high voltage compatible with direct interface to MOS
- TRI-STATE outputs
- Advanced Schottky processing
- Available in military and commercial temperature ranges
- MICROBUS™* compatible

INS8216/8226 MICROBUS Configuration



Logic Diagrams



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Absolute Maximum Ratings (Note 1)

	Min	Max	Units
All Output and Supply Voltages	−0.5	+7.0	V
All Input Voltages	−1.0	+5.5	V
Output Currents		125	mA
Lead Temperature (soldering, 10 seconds)		+300	°C
Storage Temperature	−65	+150	°C
Power Dissipation*			
Cavity Package		1160	mW
Molded Package		1000	mW

*Derate Cavity Package at 80°C/W above 70°C; derate Molded Package at 90°C/W above 70°C.

Operating Conditions

	Min	Max	Units
Supply Voltage, V_{CC}			
INS8216, INS8226	4.75	5.25	V
Temperature, T_A			
INS8216, INS8226	0	+70	°C

DC Electrical Characteristics V_{CC} = 5V ± 5% (Notes 2, 3, and 4)

Symbol	Parameter	Conditions	Limits			Units
			Min	Typ	Max	
DRIVERS						
V_{IL}	Input Low Voltage				0.95	V
V_{IH}	Input High Voltage		2			V
I_F	Input Load Current	V_F = 0.45V		−0.03	−0.25	mA
I_R	Input Leakage Current	V_R = 5.25V			10	μA
V_C	Input Clamp Voltage	I_C = −5mA			−1.2	V
V_{OL1}	Output Low Voltage	I_{OL} = 25mA		0.3	0.45	V
V_{OL2}	Output Low Voltage	INS8216 — I_{OL} = 55mA INS8226 — I_{OL} = 50mA		0.5	0.6	V
V_{OH}	Output High Voltage	I_{OH} = −10mA	2.4	3.0		V
I_{SC}	Output Short Circuit Current	V_{CC} = 5.0V	−30	−75	−120	mA
$\|I_O\|$	Output Leakage Current TRI-STATE	V_O = 0.45V/5.5V			100	μA
RECEIVERS						
V_{IL}	Input Low Voltage				0.95	V
V_{IH}	Input High Voltage		2			V
I_F	Input Load Current	V_F = 0.45V		−0.08	−0.25	mA
V_C	Input Clamp Voltage	I_C = −5mA			−1.2	V
V_{OL}	Output Low Voltage	I_{OL} = 15mA		0.3	0.45	V
V_{OH1}	Output High Voltage	I_{OH} = −1mA	3.65	4.0		V
I_{SC}	Output Short Circuit Current	$V_O \approx 0V$	−15	−35	−65	mA
$\|I_O\|$	Output Leakage Current TRI-STATE	V_O = 0.45V/5.5V			20	μA
CONTROL INPUTS ($\overline{CS}$, $\overline{DIEN}$)						
V_{IL}	Input Low Voltage				0.95	V
V_{IH}	Input High Voltage		2			V
I_F	Input Load Current	V_F = 0.45V		−0.15	−0.5	mA
I_R	Input Leakage Current	V_R = 5.25V			20	μA
I_{CC}	Power Supply Current					
	INS8216			95	130	mA
	INS8226			85	120	mA

AC Electrical Characteristics (Notes 2, 3, and 4)

Symbol	Parameter	Conditions	Limits Min	Limits Typ	Limits Max	Units
INS8216/8226 — V_{CC} = 5.0V ± 5%						
t_{PD1}	Input to Output Delay, DO Outputs	C_L = 30pF, R_1 = 300Ω, R_2 = 600Ω		15	25	ns
t_{PD2}	Input to Output Delay, DB Outputs	C_L = 300pF, R_2 = 90Ω, R_2 = 180Ω				
	INS8216			20	30	ns
	INS8226			16	25	ns
t_E	Output Enable Time	DO Outputs: C_L = 30pF, R_1 = 300Ω/10kΩ, R_2 = 600Ω/1kΩ DB Outputs: C_L = 300pF, R_1 = 90Ω/10kΩ, R_2 = 180Ω/1kΩ				
	INS8216			45	65	ns
	INS8226			35	54	ns
t_D	Output Disable Time	C_L = 5pF, R_1 = 300Ω/10kΩ, R_2 = 600Ω/1kΩ DB Outputs: C_L = 5pF, R_1 = 90Ω/10kΩ, R_2 = 180Ω/1kΩ		20	35	ns

Note 1: "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. They are not meant to imply that the devices should be operated at these limits. The tables of "Electrical Characteristics" provide conditions for actual device operation.

Note 2: Unless otherwise specified, min/max limits apply across the 0°C to +70°C temperature range for the INS8216 and INS8226. All typical values are given for V_{CC} = 5V and T_A = 25°C.

Note 3: All currents into device pins are positive; all currents out of device pins are negative. All voltages are referenced to ground unless otherwise specified.

Note 4: Only one output at a time should be shorted.

Capacitance T_A = 25°C

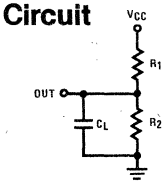
Symbol	Parameter	Limit Min	Limit Typ	Limit Max	Units
C_{IN}	Input Capacitance		4	6	pF
C_{OUT}	Output Capacitance				
	DO Outputs		6	10	pF
	DB Outputs		13	18	pF

Note: This parameter is periodically sampled and is not 100% tested. Condition of measurement is f = 1MHz, V_{BIAS} = 2.5V, V_{CC} = 5.0V, and T_A = 25°C.

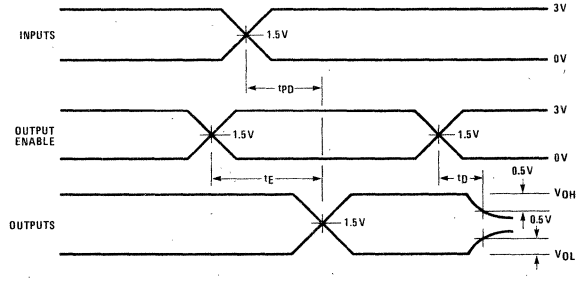
Test Conditions

Input pulse amplitude of 2.5V.
Input rise and fall times of 5.0ns between 1.0V and 2.0V.
Output loading is 5.0mA and 10pF.
Speed measurements are made at 1.5V levels.

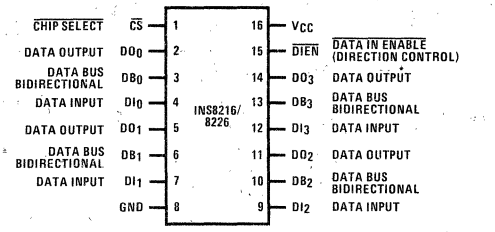
Test Load Circuit



Switching Time Waveforms



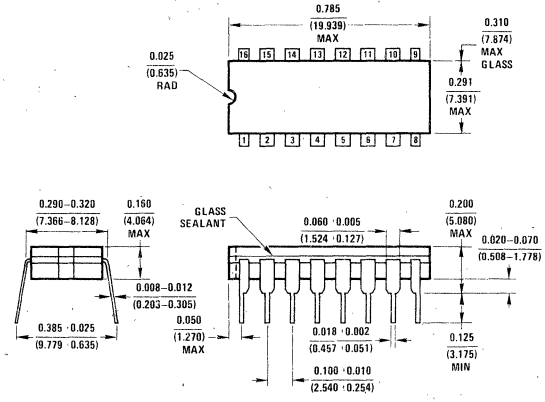
Pin Configuration



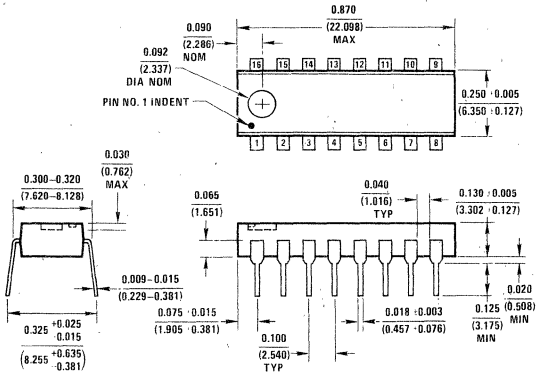
NOTE: THE INS8216/8226 ARE IDENTICAL TO THE DP8216/6226.

Physical Dimensions

inches (millimeters)



16-Lead Cavity DIP (J)
Order Numbers INS8216J, INS8226J
NS Package Number J16A



16-Lead Molded DIP (N)
Order Numbers INS8216N, INS8226N
NS Package Number N16A

Note: The INS8216/8226 are identical to the DP8216/8226.

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