

## DP8216/DP8216M/DP8226/DP8226M 4-Bit Bidirectional Bus Transceivers

### General Description

The DP8216/DP8216M and DP8226/DP8226M are 4-bit bidirectional bus drivers to use in bus oriented applications. The non-inverting DP8216/DP8216M and inverting DP8226/DP8226M drivers are provided for flexibility in system design.

Each buffered line of the four-bit drivers 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 driver (50 mA). 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.

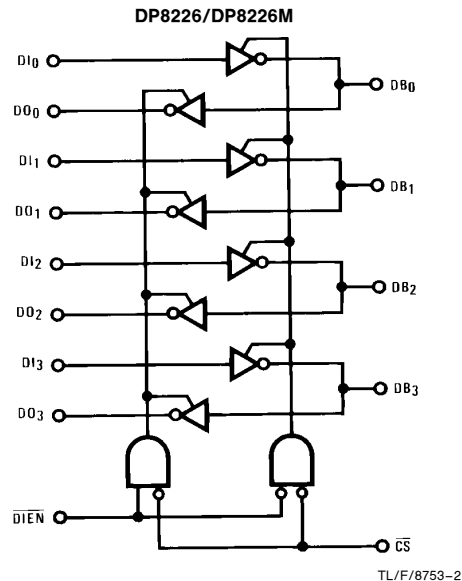
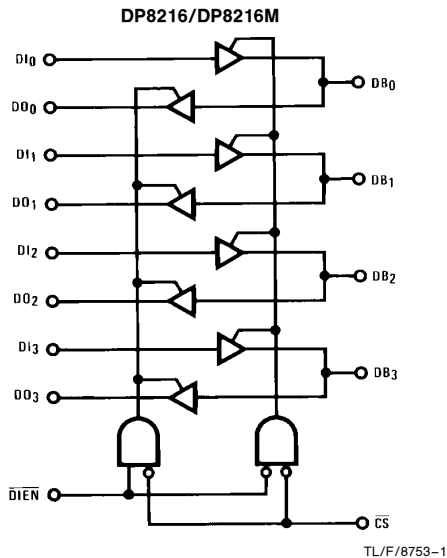
The CS input is a device enable. When it is "high" the output drivers are all forced to their high-impedance state. When it is a "low" the device is enabled and the direction of the data flow is determined by the DIEN input.

The 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 to 8080 type CPUs
- Low input load current—0.25 mA maximum
- High output drive capability for driving system data bus—50 mA at 0.5V
- Power up-down protection
- DP8216/DP8216M have non-inverting outputs
- DP8226/DP8226M have inverting outputs
- Output high voltage compatible with direct interface to MOS
- TRI-STATE outputs
- Advanced Schottky processing
- Available in military and commercial temperature

### Logic Diagrams



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## Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

	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
Maximum Power Dissipation* at 25°C			
Cavity Package		1509	mW
Molded Package		1476	mW

Note: \*Derate cavity package 10.1 mW/°C above 25°C; derate molded package 11.8 mW/°C above 25°C.

	Min	Max	Units
Storage Temperature	-65	+150	°C
Lead Temperature (soldering, 4 seconds)		260	°C

## Operating Conditions

	Min	Max	Units
Supply Voltage, V <sub>CC</sub>			
DP8216M, DP8226M	4.5	5.5	V
DP8216, DP8226	4.75	5.25	V
Temperature, T <sub>A</sub>			
DP8216M, DP8226M	-55	+125	°C
DP8216, DP8226	0	+70	°C

## Electrical Characteristics DP8216, DP8226 V<sub>CC</sub> = 5V ± 5% (Notes 2, 3, and 4)

Symbol	Parameter	Conditions	Limits			Units
			Min	Typ	Max	
<b>DRIVERS</b>						
V <sub>IL</sub>	Input Low Voltage				0.95	V
V <sub>IH</sub>	Input High Voltage		2			V
I <sub>F</sub>	Input Load Current	V <sub>F</sub> = 0.45V		-0.03	-0.25	mA
I <sub>R</sub>	Input Leakage Current	V <sub>R</sub> = 5.25V			10	μA
V <sub>C</sub>	Input Clamp Voltage	I <sub>C</sub> = -5 mA			-1.2	V
V <sub>OL1</sub>	Output Low Voltage	I <sub>OL</sub> = 25 mA		0.3	0.45	V
V <sub>OL2</sub>	Output Low Voltage	DP8216 I <sub>OL</sub> = 55 mA DP8226 I <sub>OL</sub> = 50 mA		0.5	0.6	V
V <sub>OH</sub>	Output High Voltage	I <sub>OH</sub> = -10 mA	2.4	3.0		V
I <sub>SC</sub>	Output Short Circuit Current	V <sub>CC</sub> = 5V	-30	-75	-120	mA
I <sub>O</sub>	Output Leakage Current TRI-STATE	V <sub>O</sub> = 0.45V/5.5V			100	μA
<b>RECEIVERS</b>						
V <sub>IL</sub>	Input Low Voltage				0.95	V
V <sub>IH</sub>	Input High Voltage		2			V
I <sub>F</sub>	Input Load Current	V <sub>F</sub> = 0.45V		-0.08	-0.25	mA
V <sub>C</sub>	Input Clamp Voltage	I <sub>C</sub> = -5 mA			-1.2	V
V <sub>OL</sub>	Output Low Voltage	I <sub>OL</sub> = 15 mA		0.3	0.45	V
V <sub>OH1</sub>	Output High Voltage	I <sub>OH</sub> = -1 mA	3.65	4.0		V
I <sub>SC</sub>	Output Short Circuit Current	V <sub>CC</sub> = 5V	-15	-35	-65	mA
I <sub>O</sub>	Output Leakage Current TRI-STATE	V <sub>O</sub> = 0.45V/5.5V			20	μA
<b>CONTROL INPUTS (CS, DIEN)</b>						
V <sub>IL</sub>	Input Low Voltage				0.95	V
V <sub>IH</sub>	Input High Voltage		2			V
I <sub>F</sub>	Input Load Current	V <sub>F</sub> = 0.45V		-0.15	-0.5	mA
I <sub>R</sub>	Input Leakage Current	V <sub>R</sub> = 5.25V			20	μA
I <sub>CC</sub>	Power Supply Current					
	DP8216			95	130	mA
	DP8226			85	120	mA

**Electrical Characteristics** (Continued) DP8216M, DP8226M  $V_{CC} = 5V \pm 10\%$  (Notes 2, 3 and 4)

Symbol	Parameter	Conditions	Limits			Units
			Min	Typ	Max	
<b>DRIVERS</b>						
V <sub>IL</sub>	Input Low Voltage				0.95	V
	DP8216M DP8226M				0.90	V
V <sub>IH</sub>	Input High Voltage		2			V
I <sub>F</sub>	Input Load Current	V <sub>F</sub> = 0.45V		-0.08	-0.25	mA
I <sub>R</sub>	Input Leakage Current	V <sub>R</sub> = 5.5V			40	μA
V <sub>C</sub>	Input Clamp Voltage	I <sub>C</sub> = -5 mA			-1.2	V
V <sub>OL1</sub>	Output Low Voltage	I <sub>OL</sub> = 25 mA		0.3	0.45	V
V <sub>OL2</sub>	Output Low Voltage	I <sub>OL</sub> = 45 mA		0.5	0.6	V
V <sub>OH</sub>	Output High Voltage	I <sub>OH</sub> = -5 mA	2.4	3.0		V
I <sub>SC</sub>	Output Short Circuit Current	V <sub>CC</sub> = 5.0V	-30	-75	-120	mA
I <sub>O</sub>	Output Leakage Current TRI-STATE	V <sub>O</sub> = 0.45V/5.5V			100	μA
<b>RECEIVERS</b>						
V <sub>IL</sub>	Input Low Voltage				0.95	V
	DP8216M DP8226M				0.9	V
V <sub>IH</sub>	Input High Voltage		2			V
I <sub>F</sub>	Input Load Current	V <sub>F</sub> = 0.45V		-0.08	-0.25	mA
V <sub>C</sub>	Input Clamp Voltage	I <sub>C</sub> = -5 mA			-1.2	V
V <sub>OL</sub>	Output Low Voltage	I <sub>OL</sub> = 15 mA		0.3	0.45	V
V <sub>OH1</sub>	Output High Voltage	I <sub>OH</sub> = -0.5 mA	3.4	3.8		V
V <sub>OH2</sub>	Output High Voltage	I <sub>OH</sub> = -2 mA	2.4			V
I <sub>SC</sub>	Output Short Circuit Current	V <sub>CC</sub> = 5.0V	-15	-35	-65	mA
I <sub>O</sub>	Output Leakage Current TRI-STATE	V <sub>O</sub> = 0.45V/5.5V			20	μA
<b>CONTROL INPUTS (<math>\overline{CS}</math>, <math>\overline{DIEN}</math>)</b>						
V <sub>IL</sub>	Input Low Voltage				0.95	V
	DP8216M DP8226M				0.9	V
V <sub>IH</sub>	Input High Voltage		2			V
I <sub>F</sub>	Input Load Current	V <sub>F</sub> = 0.45V		-0.15	-0.5	mA
I <sub>R</sub>	Input Leakage Current	V <sub>R</sub> = 5.5V			80	μA
I <sub>CC</sub>	Power Supply Current					
	DP8216M DP8226M			95 85	130 120	mA mA

## Switching Characteristics (Notes 2, 3 and 4)

Symbol	Parameter	Conditions	Limits			Units
			Min	Typ	Max	
<b>DP8216M, DP8226M, <math>V_{CC} = 5V \pm 10\%</math></b>						
$t_{PD1}$	Input to Output Delay, DO Outputs	$C_L = 30 \text{ pF}$ , $R_1 = 300\Omega$ , $R_2 = 600\Omega$		15	25	ns
$t_{PD2}$	Input to Output Delay, DB Outputs DP8216M DP8226M	$C_L = 300 \text{ pF}$ , $R_1 = 90\Omega$ , $R_2 = 180\Omega$		19	33	ns
				16	25	ns
$t_E$	Output Enable Time DP8216M DP8226M	DO Outputs: $C_L = 30 \text{ pF}$ , $R_1 = 300\Omega$ $R_2 = 600\Omega$ DB Outputs: $C_L = 300 \text{ pF}$ , $R_1 = 90\Omega$ $R_2 = 180\Omega$		42	75	ns
				36	62	ns
$t_D$	Output Disable Time DP8216M DP8226M	DO Outputs: $C_L = 5 \text{ pF}$ , $R_1 = 300\Omega$ $R_2 = 600\Omega$ DB Outputs: $C_L = 5 \text{ pF}$ , $R_1 = 90\Omega$ $R_2 = 180\Omega$		16	40	ns
				16	38	ns
<b>DP8216, DP8226 <math>V_{CC} = 5.0V \pm 5\%</math></b>						
$t_{PD1}$	Input to Output Delay, DO Outputs	$C_L = 30 \text{ pF}$ , $R_1 = 300\Omega$ , $R_2 = 600\Omega$		15	25	ns
$t_{PD2}$	Input to Output Delay, DB Outputs DP8216 DP8226	$C_L = 300 \text{ pF}$ , $R_1 = 90\Omega$ , $R_2 = 180\Omega$		20	30	ns
				16	25	ns
$t_E$	Output Enable Time DP8216 DP8226	DO Outputs: $C_L = 30 \text{ pF}$ , $R_1 = 300\Omega$ $R_2 = 600\Omega$ DB Outputs: $C_L = 300 \text{ pF}$ , $R_1 = 90\Omega$ $R_2 = 180\Omega$		45	65	ns
				35	54	ns
$t_D$	Output Disable Time	DO Outputs: $C_L = 5 \text{ pF}$ , $R_1 = 300\Omega$ $R_2 = 600\Omega$ DB Outputs: $C_L = 5 \text{ pF}$ , $R_1 = 90\Omega$ $R_2 = 180\Omega$		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  $-55^\circ\text{C}$  to  $+125^\circ\text{C}$  temperature range for the DP8216M and DP8226M and across the  $0^\circ\text{C}$  to  $+70^\circ\text{C}$  temperature range for the DP8216 and DP8226. All typical values are given for  $V_{CC} = 5V$  and  $T_A = 25^\circ\text{C}$ .

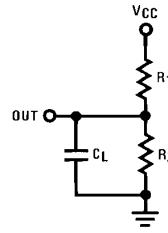
**Note 3:** All currents into device pins are positive; all currents out of device pins are negative. All voltages are referenced to ground unless otherwise specified.

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

## Test Conditions

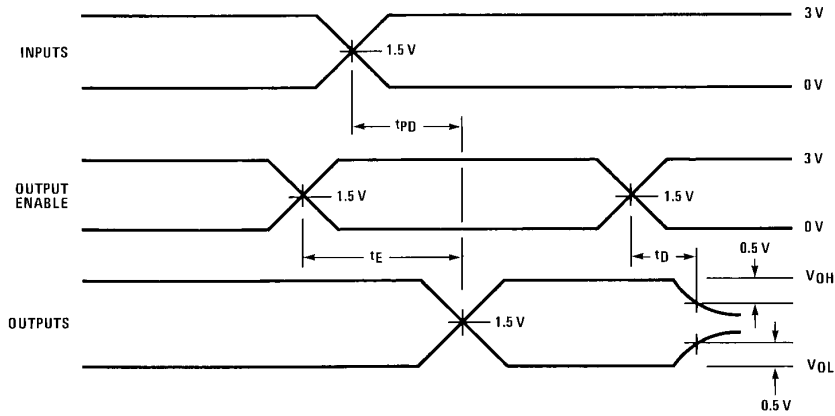
Input rise and fall times of 5.0 ns between 1.0V and 2.0V.  
Output loading is 5.0 mA and 10 pF.  
Speed measurements are made at 1.5V levels.

## Test Load Circuit



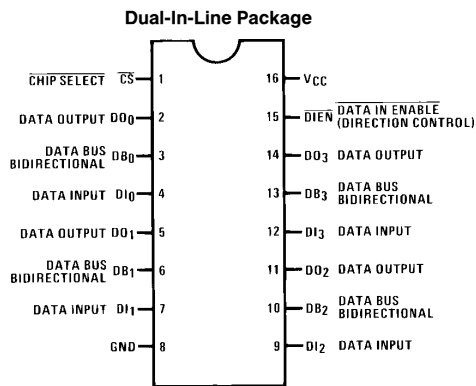
TL/F/8753-4

## Switching Time Waveforms



TL/F/8753-5

## Connection Diagram



TL/F/8753-3

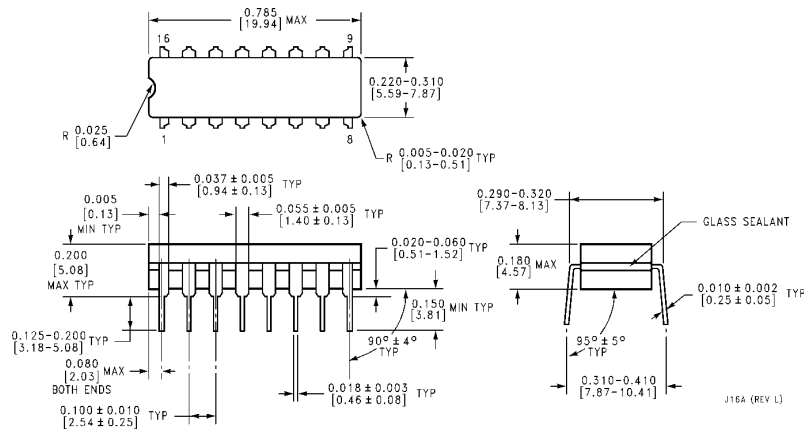
**Order Number DP8216J, DP8216N, DP8226J, DP8226N,  
DP8216MJ or DP8226MJ  
See NS Package Number J16A or N16A**

## Capacitance $T_A = 25^\circ\text{C}$

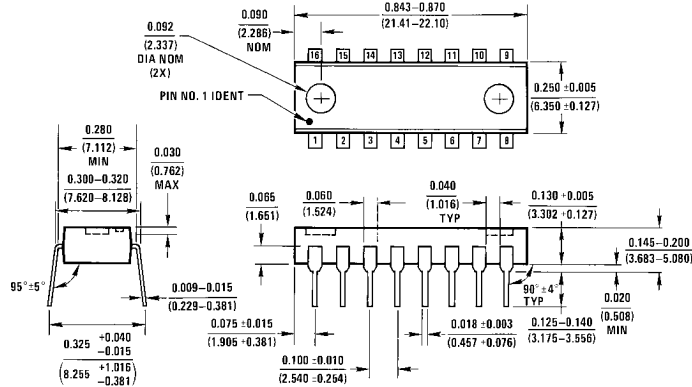
Symbol	Parameter	Limit			Unit
		Min	Typ	Max	
$C_{IN}$	Input Capacitance		4	6	pF
$C_{OUT}$	Output Capacitance DO Outputs		6	10	pF
	DO Outputs		13	18	pF

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

**Physical Dimensions** inches (millimeters)



**Ceramic Dual-In-Line Package (J)**  
**Order Number DP8216J, DP8226J, DP8216MJ or DP8226MJ**  
**NS Package Number J16A**



**Molded Dual-In-Line Package (N)**  
**Order Number DP8216N, or DP8226N**  
**NS Package Number N16A**

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