N *National Semiconductor*

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

General Description

The DP8216/DP8216M and DP8226/DP8226M are 4-bit bi-directional 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.
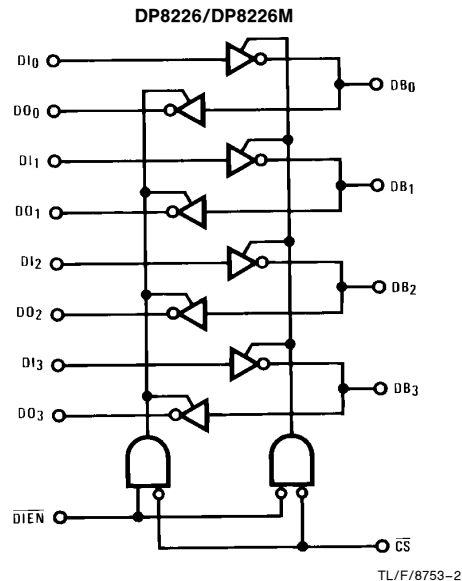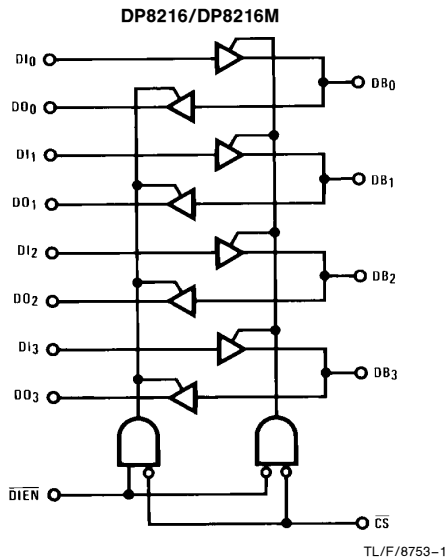
The CS input is a device enable. When it is "high" the output drivers are all forced to their high-impedance state. When it is a "low" the device is enabled and the direction of the data flow is determined by the DIEN input.

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

DP8216/DP8216M

TL/F/8753–1

DP8226/DP8226M

TL/F/8753–2

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_{CC}			
DP8216M, DP8226M	4.5	5.5	V
DP8216, DP8226	4.75	5.25	V
Temperature, T_A			
DP8216M, DP8226M	−55	+125	°C
DP8216, DP8226	0	+70	°C

Electrical Characteristics DP8216, DP8226 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 = −5 mA			−1.2	V
V_{OL1}	Output Low Voltage	I_{OL} = 25 mA		0.3	0.45	V
V_{OL2}	Output Low Voltage	DP8216 I_{OL} = 55 mA DP8226 I_{OL} = 50 mA		0.5	0.6	V
V_{OH}	Output High Voltage	I_{OH} = −10 mA	2.4	3.0		V
I_{SC}	Output Short Circuit Current	V_{CC} = 5V	−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 = −5 mA			−1.2	V
V_{OL}	Output Low Voltage	I_{OL} = 15 mA		0.3	0.45	V
V_{OH1}	Output High Voltage	I_{OH} = −1 mA	3.65	4.0		V
I_{SC}	Output Short Circuit Current	V_{CC} = 5V	−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					
	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	
DRIVERS						
V_{IL}	Input Low Voltage DP8216M DP8226M				0.95 0.90	V V
V_{IH}	Input High Voltage		2			V
I_F	Input Load Current	$V_F = 0.45V$		-0.08	-0.25	mA
I_R	Input Leakage Current	$V_R = 5.5V$			40	μA
V_C	Input Clamp Voltage	$I_C = -5$ mA			-1.2	V
V_{OL1}	Output Low Voltage	$I_{OL} = 25$ mA		0.3	0.45	V
V_{OL2}	Output Low Voltage	$I_{OL} = 45$ mA		0.5	0.6	V
V_{OH}	Output High Voltage	$I_{OH} = -5$ mA	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 DP8216M DP8226M				0.95 0.9	V 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	$I_C = -5$ mA			-1.2	V
V_{OL}	Output Low Voltage	$I_{OL} = 15$ mA		0.3	0.45	V
V_{OH1}	Output High Voltage	$I_{OH} = -0.5$ mA	3.4	3.8		V
V_{OH2}	Output High Voltage	$I_{OH} = -2$ mA	2.4			V
I_{SC}	Output Short Circuit Current	$V_{CC} = 5.0V$	-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 DP8216M DP8226M				0.95 0.9	V 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	$V_R = 5.5V$			80	μA
I_{CC}	Power Supply Current DP8216M DP8226M			95 85	130 120	mA mA

Switching Characteristics (Notes 2, 3 and 4)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
				Limits		
DP8216M, DP8226M, V_{CC} = 5V $\pm$ 10%						
t_{PD1}	Input to Output Delay, DO Outputs	C_L = 30 pF, R_1 = 300Ω, R_2 = 600Ω		15	25	ns
t_{PD2}	Input to Output Delay, DB Outputs DP8216M DP8226M	C_L = 300 pF, R_1 = 90Ω, R_2 = 180Ω		19 16	33 25	ns ns
t_E	Output Enable Time DP8216M DP8226M	DO Outputs: C_L = 30 pF, R_1 = 300Ω R_2 = 600Ω DB Outputs: C_L = 300 pF, R_1 = 90Ω R_2 = 180Ω		42 36	75 62	ns ns
t_D	Output Disable Time DP8216M DP8226M	DO Outputs: C_L = 5 pF, R_1 = 300Ω R_2 = 600Ω DB Outputs: C_L = 5 pF, R_1 = 90Ω R_2 = 180Ω		16 16	40 38	ns ns
DP8216, DP8226 V_{CC} = 5.0V $\pm$ 5%						
t_{PD1}	Input to Output Delay, DO Outputs	C_L = 30 pF, R_1 = 300Ω, R_2 = 600Ω		15	25	ns
t_{PD2}	Input to Output Delay, DB Outputs DP8216 DP8226	C_L = 300 pF, R_1 = 90Ω, R_2 = 180Ω		20 16	30 25	ns ns
t_E	Output Enable Time DP8216 DP8226	DO Outputs: C_L = 30 pF, R_1 = 300Ω R_2 = 600Ω DB Outputs: C_L = 300 pF, R_1 = 90Ω R_2 = 180Ω		45 35	65 54	ns ns
t_D	Output Disable Time	DO Outputs: C_L = 5 pF, R_1 = 300Ω R_2 = 600Ω DB Outputs: C_L = 5 pF, R_1 = 90Ω R_2 = 180Ω		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°C to +125°C temperature range for the DP8216M and DP8226M and across the 0°C to +70°C temperature range for the DP8216 and DP8226. All typical values are given for V_{CC} = 5V and T_A = 25°C.
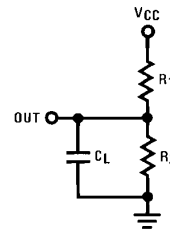
Note 3: All currents into device pins are positive; all currents out of device pins are negative. All voltages are referenced to ground unless otherwise specified.

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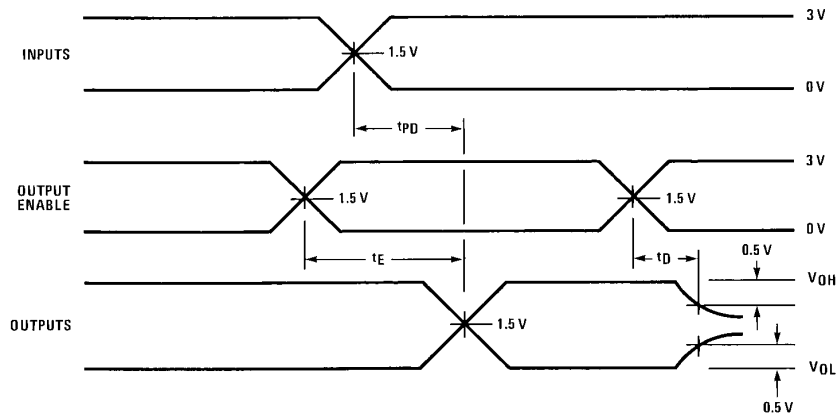
Test Conditions

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.
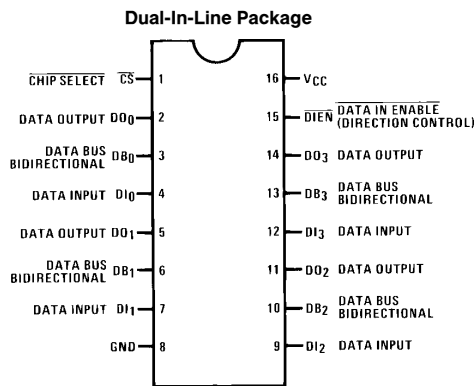
Test Load Circuit

TL/F/8753–4

Switching Time Waveforms

TL/F/8753–5

Connection Diagram
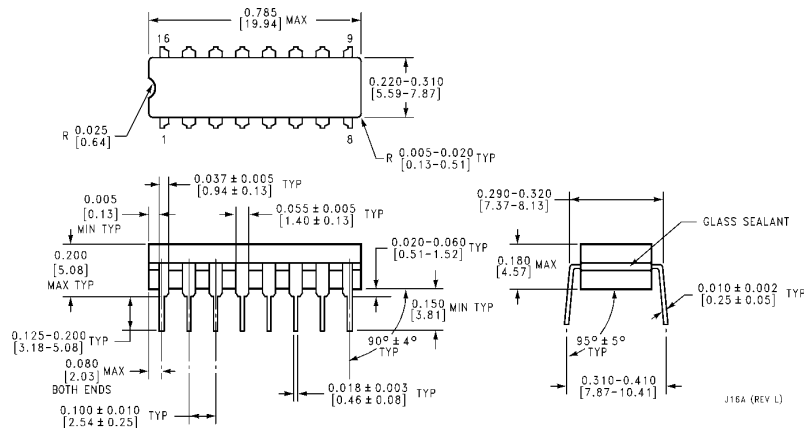
Dual-In-Line Package

CHIP SELECT $\overline{CS}$	1	16 V$_{CC}$
DATA OUTPUT DO$_0$	2	15 $\overline{DIEN}$ DATA IN ENABLE (DIRECTION CONTROL)
DATA BUS BIDIRECTIONAL DB$_0$	3	14 DO$_3$ DATA OUTPUT
DATA INPUT DI$_0$	4	13 DB$_3$ DATA BUS BIDIRECTIONAL
DATA OUTPUT DO$_1$	5	12 DI$_3$ DATA INPUT
DATA BUS BIDIRECTIONAL DB$_1$	6	11 DO$_2$ DATA OUTPUT
DATA INPUT DI$_1$	7	10 DB$_2$ DATA BUS BIDIRECTIONAL
GND	8	9 DI$_2$ DATA INPUT

TL/F/8753–3

Order Number DP8216J, DP8216N, DP8226J, DP8226N,
DP8216MJ or DP8226MJ
See NS Package Number J16A or N16A
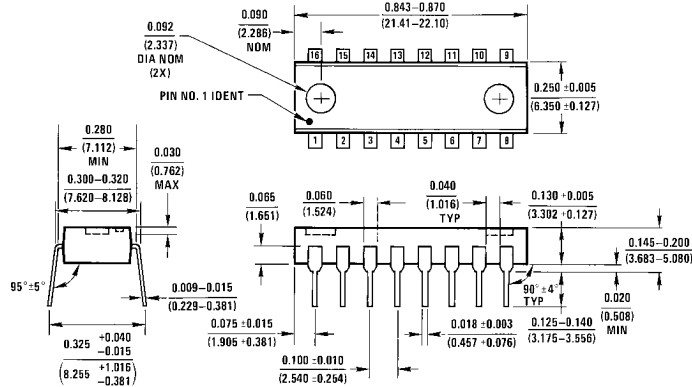
Capacitance $T_A = 25°C$

Symbol	Parameter	Limit			Unit
		Min	Typ	Min	
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 MHz, V$_{BIAS}$ = 2.5V, V$_{CC}$ = 5.0V, and T$_A$ = 25°C.

Physical Dimensions inches (millimeters)

0.785
[19.94] MAX

0.220–0.310
[5.59–7.87]

R 0.025
[0.64]

R 0.005–0.020
[0.13–0.51] TYP

0.037 ± 0.005
[0.94 ± 0.13] TYP

0.005
[0.13] MIN TYP

0.055 ± 0.005
[1.40 ± 0.13] TYP

0.290–0.320
[7.37–8.13]

GLASS SEALANT

0.200
[5.08] MAX TYP

0.020–0.060
[0.51–1.52] TYP

0.180
[4.57] MAX

0.010 ± 0.002
[0.25 ± 0.05] TYP

0.150
[3.81] MIN TYP

0.125–0.200
[3.18–5.08] TYP

0.080
[2.03] MAX BOTH ENDS

90° ± 4° TYP

95° ± 5° TYP

0.310–0.410
[7.87–10.41]

0.018 ± 0.003
[0.46 ± 0.08] TYP

0.100 ± 0.010
[2.54 ± 0.25] TYP

J16A (REV L)

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

0.092 (2.337) DIA NOM (2X)

0.090 (2.286) NOM

0.843–0.870 (21.41–22.10)

PIN NO. 1 IDENT

0.250 ±0.005 (6.350 ±0.127)

0.280 (7.112) MIN

0.030 (0.762) MAX

0.300–0.320 (7.620–8.128)

0.065 (1.651)

0.060 (1.524)

0.040 (1.016) TYP

0.130 +0.005 (3.302 +0.127)

0.145–0.200 (3.683–5.080)

95°±5°

0.009–0.015 (0.229–0.381)

0.075 ±0.015 (1.905 +0.381)

90° ±4° TYP

0.018 ±0.003 (0.457 +0.076)

0.125–0.140 (3.175–3.556)

0.020 (0.508) MIN

0.325 +0.040 −0.015 (8.255 +1.016 −0.381)

0.100 ±0.010 (2.540 ±0.254)

N16A (REV E)

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

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2. A critical component is 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.