



# Level Translators/Buffers

## DM7800/DM8800 dual voltage translator

### general description

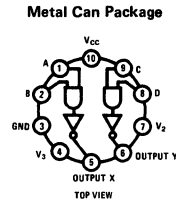
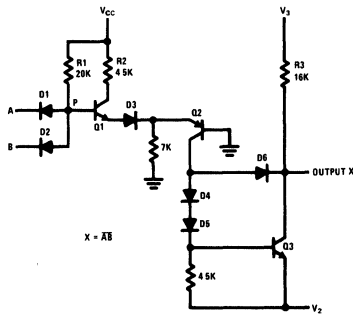
The DM7800/DM8800 are dual voltage translators designed for interfacing between conventional TTL or DTL voltage levels and those levels associated with high impedance junction or MOS FET-type devices. The design allows the user a wide latitude in his selection of power supply voltages, thus providing custom control of the output swing. The translator is especially useful in analog switching; and since low power dissipation occurs in the "off" state, minimum system power is required.

### features

- 31 volt (max) output swing
- 1 mW power dissipation in normal state
- Standard 5V power supply
- Temperature range:
 

DM7800	-55°C to +125°C
DM8800	0°C to +70°C
- Compatible with all MOS devices

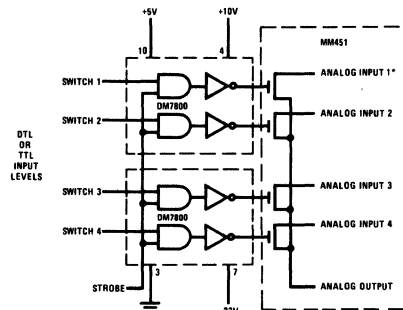
### schematic and connection diagrams



Order Number DM7800H  
or DM8800H  
See Package 12

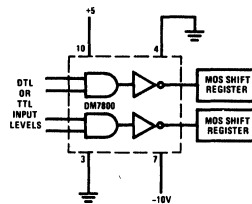
### typical applications

#### 4-Channel Analog Switch



\*Analog signals within the range of +8V to -8V

#### Bipolar to MOS Interfacing



**absolute maximum ratings**

$V_{CC}$ Supply Voltage	7.0V
$V_2$ Supply Voltage	-30V
$V_3$ Supply Voltage	+30V
$V_3$ - $V_2$ Voltage Differential	40V
Input Voltage	5.5V
Storage Temperature Range	-65°C to +150°C
Operating Temperature Range	
DM7800	-55°C to +125°C
DM8800	0°C to 70°C
Lead Temperature (Soldering, 10 sec)	300°C

**electrical characteristics** (Note 1)

PARAMETER		CONDITIONS	MIN	TYP (Note 4)	MAX	UNITS
Logical "1" Input Voltage	DM7800	$V_{CC} = 4.5V$	2.0			V
	DM8800	$V_{CC} = 4.75V$				
Logical "0" Input Voltage	DM7800	$V_{CC} = 4.5V$			0.8	V
	DM8800	$V_{CC} = 4.75V$				
Logical "1" Input Current	DM7800	$V_{CC} = 5.5V$			5	$\mu A$
	DM8800	$V_{CC} = 5.25V$				
		$V_{IN} = 2.4V$				
Logical "1" Input Current	DM7800	$V_{CC} = 5.5V$			1	mA
	DM8800	$V_{CC} = 5.25V$				
		$V_{IN} = 5.5V$				
Logical "0" Input Current	DM7800	$V_{CC} = 5.5V$	-0.2		-0.4	mA
	DM8800	$V_{CC} = 5.25V$				
		$V_{IN} = 0.4V$				
Output Leakage Current (Note 2)	DM7800	$V_{CC} = 5.5V$			10	$\mu A$
	DM8800	$V_{CC} = 5.25V$				
		$V_{IN} = 0.8V$ (Note 5)				
Output Collector Resistor		$T_A = 25^\circ C$	11.5	16.0	20.0	k $\Omega$
Logical "0" Output Voltage	DM7800	$V_{CC} = 4.5V$			$V_2 + 2.0$	V
	DM8800	$V_{CC} = 4.75V$				
		$V_{IN} = 2.0V$ (Note 5)				
Power Supply Current Logical "0" (Note 3) (Each Gate)	DM7800	$V_{CC} = 5.5V$		0.85	1.6	mA
	DM8800	$V_{CC} = 5.25V$				
		$V_{IN} = 4.5V$				
Power Supply Current Logical "1" (Note 3) (Each Gate)	DM7800	$V_{CC} = 5.5V$		0.22	0.41	mA
	DM8800	$V_{CC} = 5.25V$				
		$V_{IN} = 0V$				
Transition Time to Logical "0" Output		$T_A = 25^\circ C$ C = 15 pF (Note 6)	25	70	125	ns
Transition Time to Logical "1" Output		$T_A = 25^\circ C$ C = 15 pF (Note 7)	25	62	125	ns

**Note 1:** Min/max limits apply across the guaranteed temperature range of -55°C to +125°C for the DM7800 and 0°C to +70°C for the DM8800 unless otherwise specified.

**Note 2:** Current measured is drawn from  $V_3$  supply.

**Note 3:** Current measured is drawn from  $V_{CC}$  supply.

**Note 4:** All typical values are measured at  $T_A = 25^\circ C$  with  $V_{CC} = 5.0V$ ,  $V_2 = -22V$ ,  $V_3 = +8V$ .

**Note 5:** Specification applies for all allowable values of  $V_2$  and  $V_3$ .

**Note 6:** Measured from 1.5V on input to 50% level on output.

**Note 7:** Measured from 1.5V on input to logic "0" voltage, plus 1V.

## theory of operation

The two input diodes perform the AND function on TTL or DTL input voltage levels. When at least one input voltage is a logical "0", current from  $V_{CC}$  (nominally 5.0V) passes through  $R_1$  and out the input(s) which is at the low voltage. Other than small leakage currents, this current drawn from  $V_{CC}$  through the 20 k $\Omega$  resistor is the only source of power dissipation in the logical "1" output state.

When both inputs are at logical "1" levels, current passes through  $R_1$  and diverts to transistor  $Q_1$ , turning it on and thus pulling current through  $R_2$ . Current is then supplied to the PNP transistor,  $Q_2$ . The voltage losses caused by current through  $Q_1$ ,  $D_3$ , and  $Q_2$  necessitate that node P reach a voltage sufficient to overcome these losses before current begins to flow. To achieve this voltage at node P, the inputs must be raised to a voltage level which is one diode potential lower than node P. Since these levels are exactly the same as those experienced with conventional TTL and DTL, the interfacing with these types of circuits is achieved.

Transistor  $Q_2$  provides "constant current switching" to the output due to the common base connection of  $Q_2$ . When at least one input is at the logical "0" level, no current is delivered to  $Q_2$ ; so that its collector supplies essentially zero current to the output stage. But when both inputs are raised to a logical "1" level current is supplied to  $Q_2$ .

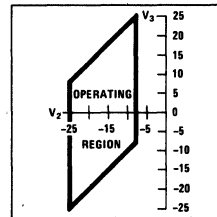
Since this current is relatively constant, the collector of  $Q_2$  acts as a constant current source for the output stage. Logic inversion is performed since logical "1" input voltages cause current to be supplied to  $Q_2$  and to  $Q_3$ . And when  $Q_3$  turns on the output voltage drops to the logical "0" level.

The reason for the PNP current source,  $Q_2$ , is so that the output stage can be driven from a high impedance. This allows voltage  $V_2$  to be adjusted in accordance with the application. Negative voltages to  $-25V$  can be applied to  $V_2$ . Since the output will neither source nor sink large amounts of current, the output voltage range is almost exclusively dependent upon the values selected for  $V_2$  and  $V_3$ .

Maximum leakage current through the output transistor  $Q_3$  is specified at 10  $\mu A$  under worst-case voltage between  $V_2$  and  $V_3$ . This will result in a logical "1" output voltage which is 0.2V below  $V_3$ . Likewise the clamping action of diodes  $D_4$ ,  $D_5$ , and  $D_6$ , prevents the logical "0" output voltage from falling lower than 2V above  $V_2$ , thus establishing the output voltage swing at typically 2 volts less than the voltage separation between  $V_2$  and  $V_3$ .

## selecting power supply voltage

The graph shows the boundary conditions which must be used for proper operation of the unit. The range of operation for power supply  $V_2$  is shown on the X axis. It must be between  $-25V$  and  $-8V$ . The allowable range for power supply  $V_3$  is governed by supply  $V_2$ . With a value chosen for  $V_2$ ,  $V_3$  may be selected as any value along a vertical line passing through the  $V_2$  value and terminated by the boundaries of the operating region. A voltage difference between power supplies of at least 5V should be maintained for adequate signal swing.



## switching time waveforms

