



## DS75160A/DS75161A/DS75162A IEEE-488 GPIB Transceivers

### General Description

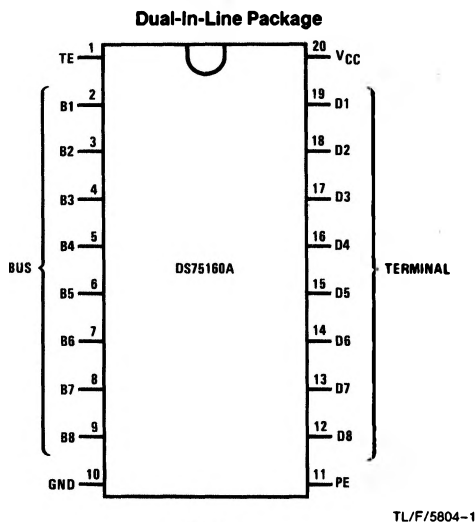
This family of high-speed-Schottky 8-channel bi-directional transceivers is designed to interface TTL/MOS logic to the IEEE Standard 488-1978 General Purpose Interface Bus (GPIB). PNP inputs are used at all driver inputs for minimum loading, and hysteresis is provided at all receiver inputs for added noise margin. The IEEE-488 required bus termination is provided internally with an active turn-off feature which disconnects the termination from the bus when  $V_{CC}$  is removed.

The General Purpose Interface Bus is comprised of 16 signal lines — 8 for data and 8 for interface management. The data lines are always implemented with DS75160A, and the management lines are either implemented with DS75161A in a single-controller system, or with DS75162A in a multi-controller system.

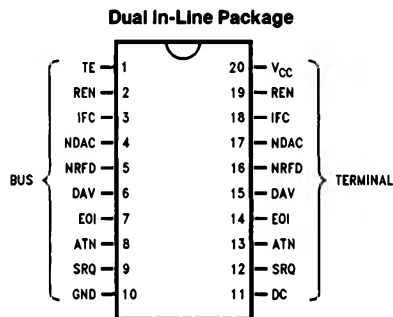
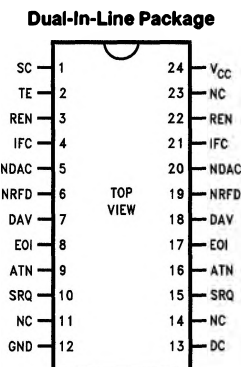
### Features

- 8-channel bi-directional non-inverting transceivers
- Bi-directional control implemented with TRI-STATE® output design
- Meets IEEE Standard 488-1978
- High-speed Schottky design
- Low power consumption
- High impedance PNP inputs (drivers)
- 500 mV (typ) input hysteresis (receivers)
- On-chip bus terminators
- No bus loading when  $V_{CC}$  is removed
- Pin selectable open collector mode on DS75160A driver outputs
- Accommodates multi-controller systems

### Connection Diagrams



Top View



**Absolute Maximum Ratings** (Note 1)

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

Supply Voltage, $V_{CC}$	7.0V
Input Voltage	5.5V
Storage Temperature Range	-65°C to +150°C
Lead Temperature (Soldering, 4 sec.)	260°C
Maximum Power Dissipation* at 25°C	
Molded Package	1897 mW

\*Derate molded package 15.2 mW/°C above 25°C.

**Operating Conditions**

	Min	Max	Units
$V_{CC}$ , Supply Voltage	4.75	5.25	V
$T_A$ , Ambient Temperature	0	70	°C
$I_{OL}$ , Output Low Current		48	mA
Bus Terminal		16	mA

**Electrical Characteristics** (Notes 2 and 3)

Symbol	Parameter		Conditions		Min	Typ	Max	Units
V <sub>IH</sub>	High-Level Input Voltage				2			V
V <sub>IL</sub>	Low-Level Input Voltage						0.8	V
V <sub>IK</sub>	Input Clamp Voltage		I <sub>I</sub> = −18 mA			−0.8	−1.5	V
V <sub>HYS</sub>	Input Hysteresis	Bus			400	500		mV
V <sub>OH</sub>	High-Level Output Voltage	Terminal	I <sub>OH</sub> = −800 μA		2.7	3.5		V
		Bus (Note 5)	I <sub>OH</sub> = −5.2 mA		2.5	3.4		
V <sub>OL</sub>	Low-Level Output Voltage	Terminal	I <sub>OL</sub> = 16 mA			0.3	0.5	V
		Bus	I <sub>OH</sub> = 48 mA			0.4	0.5	
I <sub>IH</sub>	High-Level Input Current	Terminal and TE, PE, DC, SC Inputs	V <sub>I</sub> = 5.5V			0.2	100	μA
			V <sub>I</sub> = 2.7V			0.1	20	
I <sub>IL</sub>	Low-Level Input Current		V <sub>I</sub> = 0.5V			−10	−100	μA
V <sub>BIAS</sub>	Terminator Bias Voltage at Bus Port	Bus	Driver Disabled	I <sub>I(bus)</sub> = 0 (No Load)	2.5	3.0	3.7	V
I <sub>LOAD</sub>	Terminator Bus Loading Current		Driver Disabled	V <sub>I(bus)</sub> = −1.5V to 0.4V	−1.3			mA
				V <sub>I(bus)</sub> = 0.4V to 2.5V	0		−3.2	
				V <sub>I(bus)</sub> = 2.5V to 3.7V			2.5 −3.2	
				V <sub>I(bus)</sub> = 3.7V to 5V	0		2.5	
				V <sub>I(bus)</sub> = 5V to 5.5V	0.7		2.5	
			V <sub>CC</sub> = 0V, V <sub>I(bus)</sub> = 0V to 2.5V				40	μA
I <sub>OS</sub>	Short-Circuit Output Current	Terminal	V <sub>I</sub> = 2V, V <sub>O</sub> = 0V (Note 4)		−15	−35	−75	mA
		Bus (Note 5)			−35	−75	−150	
I <sub>CC</sub>	Supply Current	DS75160A	Transmit, TE = 2V, PE = 2V, V <sub>I</sub> = 0.8V			85	125	mA
			Receive, TE = 0.8V, PE = 2V, V <sub>I</sub> = 0.8V			70	100	
		DS75161A	TE = 0.8V, DC = 0.8V, V <sub>I</sub> = 0.8V			84	125	
		DS75162A	TE = 0.8V, DC = 0.8V, SC = 2V, V <sub>I</sub> = 0.8V			85	125	
C <sub>IN</sub>	Bus-Port Capacitance	Bus	V <sub>CC</sub> = 5V or 0V, V <sub>I</sub> = 0V to 2V, f = 1 MHz			20	30	pF

**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 device should be operated at these limits. The table of "Electrical Characteristics" provides conditions for actual device operation.

**Note 2:** Unless otherwise specified, min/max limits apply across the 0°C to +70°C temperature range and the 4.75V to 5.25V power supply range. All typical values are for  $T_A = 25^\circ\text{C}$  and  $V_{CC} = 5.0\text{V}$ .

**Note 3:** All currents into device pins are shown as positive; all currents out of device pins are shown as negative; all voltages are referenced to ground, unless otherwise specified. All values shown as max or min are so classified on absolute value basis.

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

**Note 5:** This characteristic does not apply to outputs on DS75161A and DS75162A that are open collector.

# Switching Characteristics $V_{CC} = 5.0V \pm 5\%$ , $T_A = 0^\circ C$ to $70^\circ C$ (Note 1)

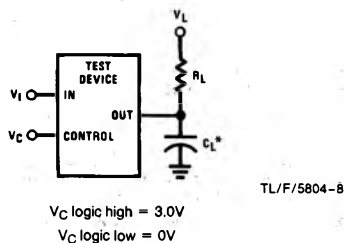
Symbol	Parameter	From	To	Conditions	DS75160A			DS75161A			DS75162A			Units
					Min	Typ	Max	Min	Typ	Max	Min	Typ	Max	
$t_{PLH}$	Propagation Delay Time, Low to High Level Output	Terminal	Bus	$V_L = 2.3V$ $R_L = 38.3\Omega$ $C_L = 30\text{ pF}$ <i>Figure 1</i>		10	20		10	20		10	20	ns
$t_{PHL}$	Propagation Delay Time, High to Low Level Output					14	20		14	20		14	20	ns
$t_{PLH}$	Propagation Delay Time, Low to High Level Output	Bus	Terminal	$V_L = 5.0V$ $R_L = 240\Omega$ $C_L = 30\text{ pF}$ <i>Figure 2</i>		14	20		14	20		14	20	ns
$t_{PHL}$	Propagation Delay Time, High to Low Level Output					10	20		10	20		10	20	ns
$t_{pZH}$	Output Enable Time to High Level	TE, DC, or SC	Bus	$V_I = 3.0V$ $V_L = 0V$ $R_L = 480\Omega$ $C_L = 15\text{ pF}$ <i>Figure 1</i>		19	32		23	40		23	40	ns
$t_{pHZ}$	Output Disable Time From High Level			$V_I = 0V$ $V_L = 2.3V$ $R_L = 38.3\Omega$ $C_L = 15\text{ pF}$ <i>Figure 1</i>		15	22		15	25		15	25	ns
$t_{pZL}$	Output Enable Time to Low Level					24	35		28	48		28	48	ns
$t_{PLZ}$	Output Disable Time From Low Level					17	25		17	27		17	27	ns
$t_{pZH}$	Output Enable Time to High Level	TE, DC, or SC	Terminal	$V_I = 3.0V$ $V_L = 0V$ $R_L = 3\text{ k}\Omega$ $C_L = 15\text{ pF}$ <i>Figure 1</i>		17	33		18	40		18	40	ns
$t_{pHZ}$	Output Disable Time From High Level			$V_I = 0V$ $V_L = 5V$ $R_L = 280\Omega$ $C_L = 15\text{ pF}$ <i>Figure 1</i>		15	25		22	33		22	33	ns
$t_{pZL}$	Output Enable Time to Low Level					25	39		28	52		28	52	ns
$t_{PLZ}$	Output Disable Time From Low Level					15	27		20	35		20	35	ns
$t_{pZH}$	Output Pull-Up Enable Time (DS75160A Only)	PE (Note 2)	Bus	$V_I = 3V$ $V_L = 0V$ $R_L = 480\Omega$ $C_L = 15\text{ pF}$ <i>Figure 1</i>		10	17		NA			NA		ns
$t_{pHZ}$	Output Pull-Up Disable Time (DS75160A Only)			$V_I = 3V$ $V_L = 0V$ $R_L = 480\Omega$ $C_L = 15\text{ pF}$ <i>Figure 1</i>		10	15		NA			NA		ns

**Note 1:** Typical values are for  $V_{CC} = 5.0V$  and  $T_A = 25^\circ C$  and are meant for reference only.

**Note 2:** Refer to Functional Truth Tables for control input definition.

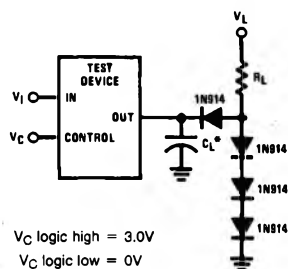
**Note 3:** Test configuration should be connected to only one transceiver at a time due to the high current stress caused by the  $V_I$  voltage source when the output connected to that input becomes active.

## Switching Load Configurations



\* $C_L$  includes jig and probe capacitance

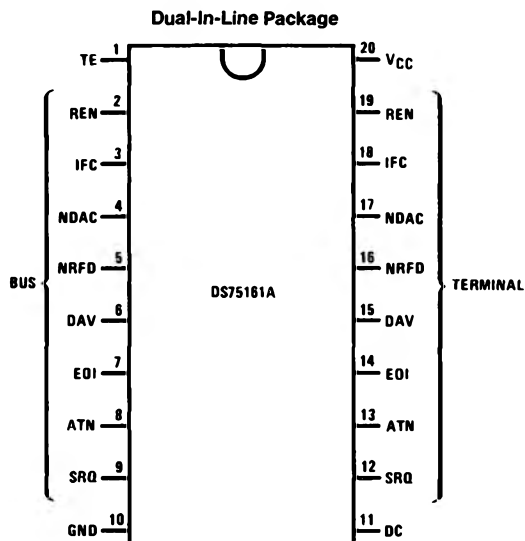
**FIGURE 1**



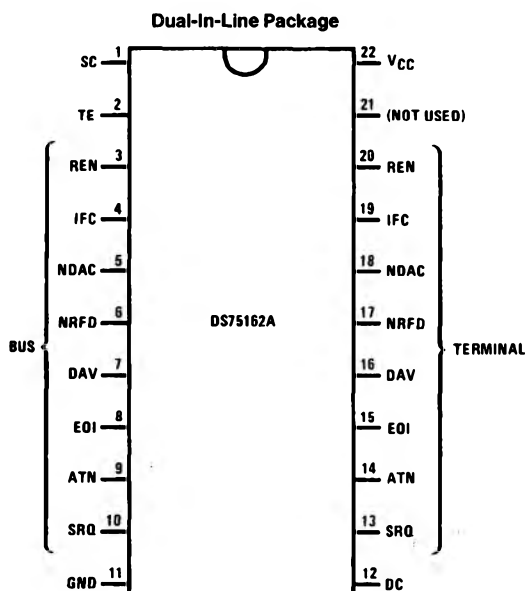
\* $C_L$  includes jig and probe capacitance

**FIGURE 2**

# Connection Diagrams (Continued)



TL/F/5804-2



TL/F/5804-3

Order Number DS75161AN, DS75162AN or DS75161AWM  
See NS Package Number M20B, N20A or N22A

## Functional Description

### DS75160A

This device is an 8-channel bi-directional transceiver with one common direction control input, denoted TE. When used to implement the IEEE-488 bus, this device is connected to the eight data bus lines, designated DIO<sub>1</sub>–DIO<sub>8</sub>. The port connections to the bus lines have internal terminators, in accordance with the IEEE-488 Standard, that are deactivated when the device is powered down. This feature guarantees no bus loading when  $V_{CC} = 0V$ . The bus port outputs also have a control mode that either enables or disables the active upper stage of the totem-pole configuration. When this control input, denoted PE, is in the high state, the bus outputs operate in the high-speed totem-pole mode. When PE is in the low state, the bus outputs operate as open collector outputs which are necessary for parallel polling.

### DS75161A

This device is also an 8-channel bi-directional transceiver which is specifically configured to implement the eight management signal lines of the IEEE-488 bus. This device, paired with the DS75160A, forms the complete 16-line interface between the IEEE-488 bus and a single controller instrumentation system. In compliance with the system organization of the management signal lines, the SRQ, NDAC, and NRFD bus port outputs are open collector. In contrast to the DS75160A, these open collector outputs are a fixed configuration. The direction control is divided into three groups. The DAV, NDAC, and NRFD transceiver directions are controlled by the TE input. The ATN, SRQ, REN, and IFC transceiver directions are controlled by the DC input. The EOI transceiver direction is a function of both the TE and DC inputs, as well as the logic level present on the ATN channel. The port connections to the bus lines have internal terminators identical to the DS75160A.

### DS75162A

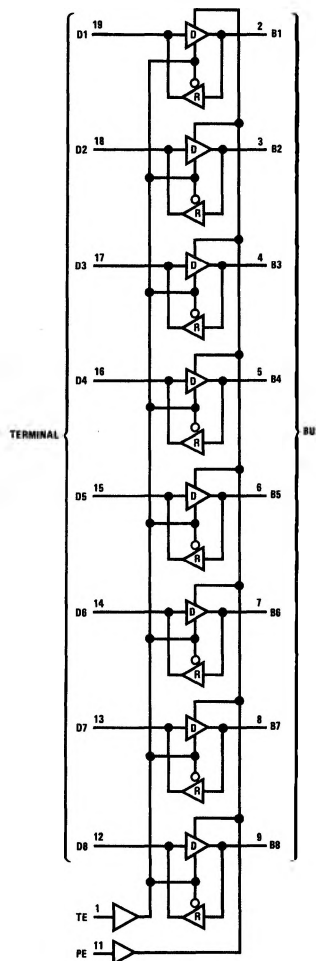
This device is identical to the DS75161A, except that an additional direction control input is provided, denoted SC. The SC input controls the direction of the REN and IFC transceivers that are normally controlled by the DC input on the DS75161A. This additional control function is instrumental in implementing multiple controller systems.


**Table of Signal Line Abbreviations**


Signal Line Classification	Mnemonic	Definition	Device
Control Signals	DC	Direction Control	DS75161A/ DS75162A
	PE	Pull-Up Enable	DS75160A
	TE	Talk Enable	All
	SC	System Controller	DS75162A
Data I/O Ports	B1–B8	Bus Side of Device	DS75160A
	D1–D8	Terminal Side of Device	
Management Signals	ATN	Attention	DS75161A/ DS75162A
	DAV	Data Valid	
	EOI	End or Identify	
	IFC	Interface Clear	
	NDAC	Not Data Accepted	
	NRFD	Not Ready for Data	
	REN	Remote Enable	
	SRQ	Service Request	

## Logic Diagrams

**DS75160A**



Note 1:  Denotes driver

Note 2:  Denotes receiver

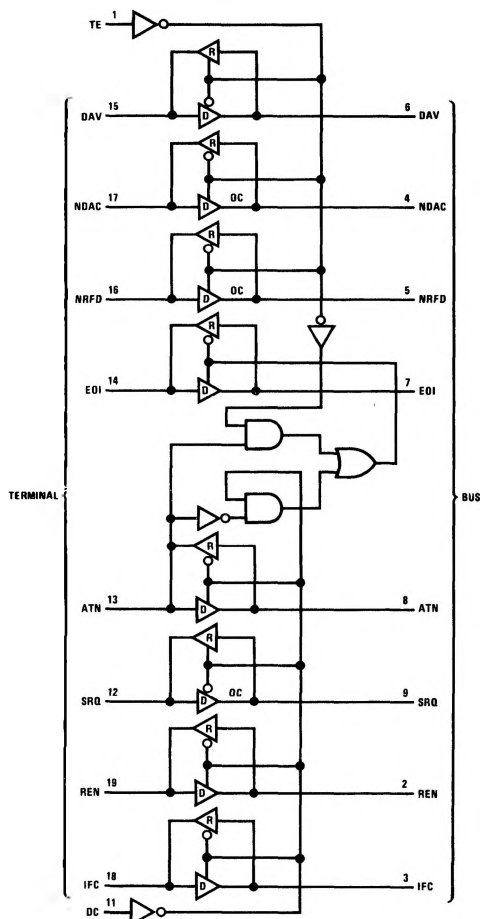
Note 3: Driver and receiver outputs are totem-pole configurations

Note 4: The driver outputs of DS75160A can have their active pull-ups disabled by switching the PE input (pin 11) to the logic low state. This mode configures the outputs as open collector.

TL/F/5804-4

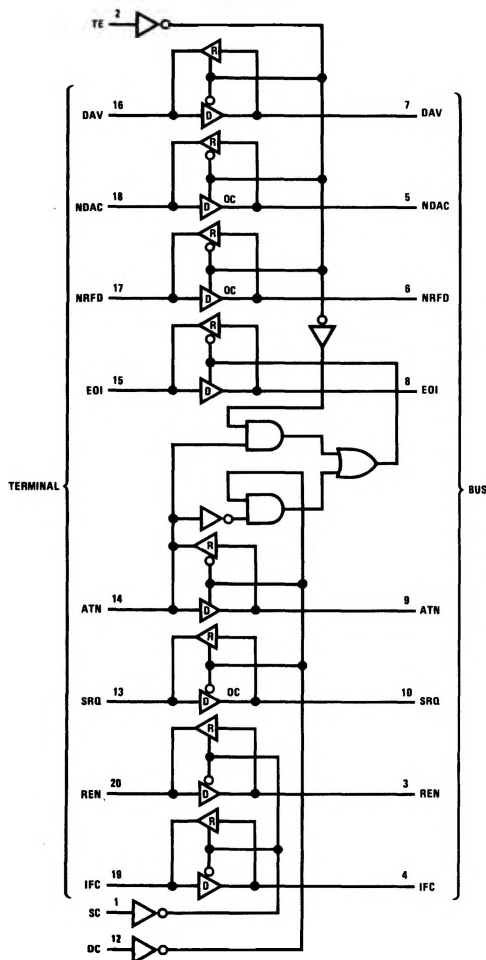
## Logic Diagrams (Continued)

DS75161A



TL/F/5804-5

DS75162A



TL/F/5804-6

**Note 1:** Denotes driver

**Note 2:** Denotes receiver

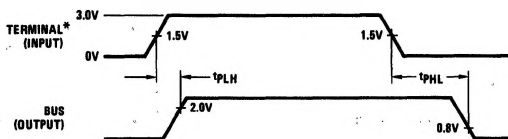
**Note 3:** Symbol "OC" specifies open collector output

**Note 4:** Driver and receiver outputs that are not specified "OC" are totem-pole configurations

TL/F/5804-7

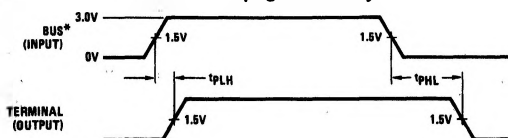
## Switching Waveforms

### Transmit Propagation Delays



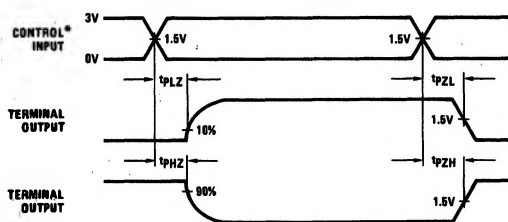
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### Receive Propagation Delays



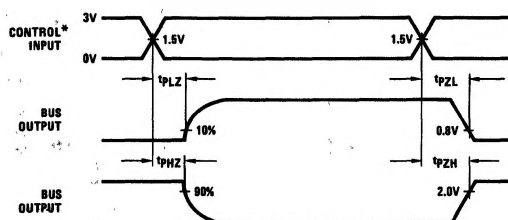
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### Terminal Enable/Disable Times



TL/F/5804-12

### Bus Enable/Disable Times

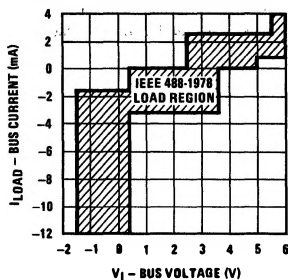


TL/F/5804-13

\*Input signal:  $f = 1.0$  MHz, 50% duty cycle,  $t_r = t_f \leq 5$  ns

## Performance Characteristics

### Bus Port Load Characteristics



TL/F/5804-14

Refer to Electrical Characteristics table

## Functional Truth Tables

DS75160A

Control Input Level		Data Transceivers	
TE	PE	Direction	Bus Port Configuration
H	H	T	Totem-Pole Output
H	L	T	Open Collector Output
L	X	R	Input

DS75161A

Control Input Level			Transceiver Signal Direction							
TE	DC	ATN*		EOI	REN	IFC	SRQ	NRFD	NDAC	DAV
H	H		R		R	R	T	R	R	T
H	L		T		T	T	R	R	R	T
L	H				R	R	T	T	T	R
L	L		T		T	T	R	T	T	R
H	X	H		T						
L	X	H		R						
X	H	L		R						
X	L	L		T						

DS75162A

Control Input Level				Transceiver Signal Direction							
SC	TE	DC	ATN*	EOI	REN	IFC	SRQ	NRFD	NDAC	DAV	
H	H	H		R		T	T	T	R	R	T
H	H	L		T		T	T	T	T	T	R
H	L	H		T		T	T	R	T	T	R
L	H	H		R		R	R	T	R	R	T
L	H	L		T		R	R	R	R	R	T
L	L	H		R		R	R	T	T	T	R
L	L	L		T		R	R	T	T	T	R
X	H	X	H		T						
X	L	X	H		R						
X	X	H	L		R						
X	X	L	L		T						

H = High level input

L = Low level input

X = Don't care

T = Transmit, i.e., signal outputted to bus

R = Receive, i.e., signal outputted to terminal

\*The ATN signal level is sensed for internal multiplex control of EOI transmission direction logic.