M75176P, M75177P M75178P, M75179P

RS-485 TRANSCEIVER

DESCRIPTION

Each of the M75176 to M75179 is a semiconductor IC with a built-in differential driver and a built-in differential receiver both of which meet the EIA standards RS-422A and RS-485.

FEATURES

Common
- 5V single power supply
- With output control input (except M75179P)

Driver
- 54Ω terminal resistor connectable between outputs.
- High output impedance at power-OFF time
- Built-in output current limit circuit

Receiver
- High input sensitivity (±200mV max.)
- Hysteresis input (50mV typ.)
- High input impedance (12kΩ min.)
- “H” emitted when input is open (failsafe function)

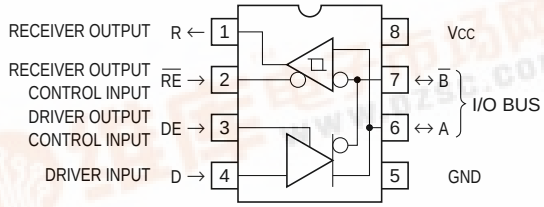
APPLICATION

High-speed data transmission interface for digital equipment

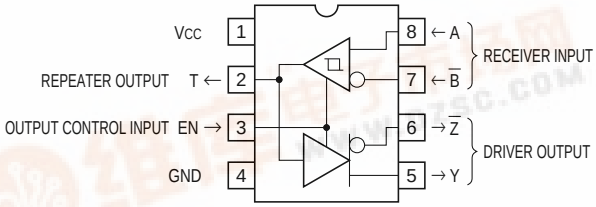
DESCRIPTION OF FUNCTION

The M75176P to M75179P are line interface ICs which meet EIA standards RS-422A and RS-485, and are suitable for long-distance, high-speed data transmission.
The M75176P is designed to connect the driver circuit output and the receiver input to each other internally, and serves as a line transceiver. The M75177P/M75178P is designed to connect the receiver circuit output and the driver circuit input internally, and serves as a line repeater. The M75177P and M75178P enter the output enabled state with active “H” and active “L”, respectively. The M75179P is equipped with a built-in differential driver and a built-in differential receiver. It does not have an output control input pin but its output impedance at the power-OFF time goes high.

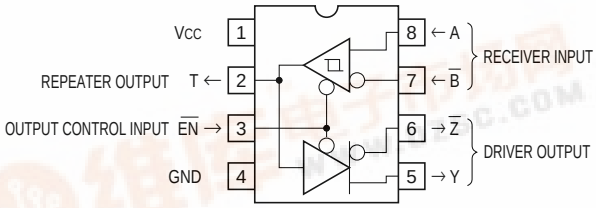
PIN CONFIGURATION (TOP VIEW)



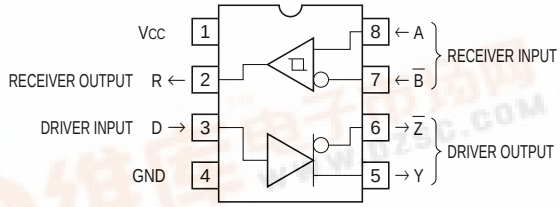
M75176P



M75177P



M75178P



M75179P

Outline 8P4

FUNCTION TABLE (Note 1)

(a) M75176P

Driver

INPUTS		OUTPUTS	
D	DE	A	$\overline{B}$
H	H	H	L
L	H	L	H
X	L	Z	Z

Receiver

INPUTS		OUTPUTS
V_{ID}	$\overline{RE}$	R
$V_{ID} > 0.2V$	L	H
$-0.2V < V_{ID} < 0.2V$	L	✻
$V_{ID} < -0.2V$	L	L
X	H	Z

(b) M75177P/M75178P

INPUTS			OUTPUTS		
V_{ID}	EN (M75177P)	$\overline{EN}$ (M75178P)	T	Y	$\overline{Z}$
$V_{ID} > 0.2V$	H	L	H	H	L
$-0.2V < V_{ID} < 0.2V$	H	L	✻	✻	✻
$V_{ID} < -0.2V$	H	L	L	L	H
X	L	H	Z	Z	Z

(c) M75179P

Driver

INPUTS	OUTPUTS	
D	Y	$\overline{Z}$
H	H	L
L	L	H

Receiver

INPUTS	OUTPUTS
V_{ID}	R
$V_{ID} > 0.2V$	H
$-0.2V < V_{ID} < 0.2V$	✻
$V_{ID} < -0.2V$	L

Note 1: V_{ID}: (A applied voltage) – ($\overline{B}$ applied voltage)
X : Either “L” or “H”
✻ : Output state is not defined.
Z : High impedance state.

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter		Conditions	Ratings	Unit
V_{CC}	Supply voltage			–0.5 ~ +7	V
V_{ID}	Differential input voltage	75177/178/179		–25 ~ +25	V
V_{IE}	Enable input voltage	75176/177/178		–0.5 ~ +5.5	V
Pd	Power dissipation (Note 2)		When T_a=25°C	925	mW
Tstg	Storage temperature			–65 ~ 150	°C

Note 2: When $T_a \geq 25$°C, do derating according to the attached thermal derating.

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter			Limits			Unit
				Min.	Typ.	Max.	
V_{CC}	Supply voltage			4.75	5	5.25	V
V_I, V_{IC}	Bus pin voltage (each pin voltage, in-phase input voltage)			–7		+12	V
V_{ID}	Differential input voltage			–12		+12	V
I_{OH}	"H" output current	Driver		0		–60	mA
		Receiver		0		–400	μA
I_{OL}	"L" output current	Driver		0		60	mA
		Receiver	V_{OL} < 0.45V	0		8	
			V_{OL} < 0.5V	0		16	
Topr	Operating ambient temperature			–20		75	°C

ELECTRICAL CHARACTERISTICS (Driver) (V_{CC} = 5V ± 5%, T_a = –20 ~ 75°C, unless otherwise noted)

Symbol	Parameter		Test conditions		Limits			Unit
					Min.	Typ.*	Max.	
V_{IH}	"H" input voltage				2			V
V_{IL}	"L" input voltage						0.8	V
V_{IK}	Input clamp voltage		I_I=–18mA				–1.5	V
$\|V_{OD1}\|$	Differential output voltage 1		I_O=0mA		1.5		6	V
$\|V_{OD2}\|$	Differential output voltage 2		R_L=100Ω See Fig. 1.		2 (Note 3)	2.42		V
					V_{OD1}/2			
			R_L=54Ω See Fig. 1.		1.5	2.18	5	
$\Delta\|V_{OD}\|$	Differential output voltage variance width						±0.2	V
V_{OL}	In-phase output voltage		R_L=54/100Ω See Fig. 1.		–1	2.08	3	V
$\Delta\|V_{OC}\|$	In-phase output voltage variance width						±0.2	V
I_O	Output current	75176	Output disable	V_O=12V			1	mA
				V_O=–7V			–0.8	
		75177/178/179	V_{CC}=0V, V_O=–7 ~ +12V				±100	μA
I_{OZ}	Off-state output current	75177/178	V_O=–7 ~ +12V				±300	μA
I_{IH}	"H" input current		V_I=2.4V				20	μA
I_{IL}	"L" input current		V_I=0.4V				–400	μA
I_{OS}	Output short-circuit current		V_O=–7V				–250	mA
			V_O=0V				–150	
			V_O=V_{CC}				250	
			V_O=12V				250	
I_{CC}	Supply voltage		No output load	Output enable		29.5	48	mA
				Output disable		32.5	48	

*: The standard value is given on the condition of V_{CC} = 5V and T_a = 25°C.
Note 3: The standard is 1.9V (min.) when $T_a \leq$ 0°C.

SWITCHING CHARACTERISTICS (Driver) (V_{CC} = 5V, T_a=25°C)

Symbol	Parameter	Test conditions	Limits			Unit
			Min.	Typ.	Max.	
t_{DD}	Differential output delay time	R_L=54Ω, C_L=50pF, See Fig. 2.		13	25	ns
t_{TD}	Differential output transition time			11	25	ns
t_{PLH}	Output “L - H” propagation delay time	R_L=27Ω, C_L=50pF, See Fig. 3.		15	25	ns
t_{PHL}	Output “H - L” propagation delay time			12	25	ns
t_{PZH}	“H” enable time	R_L=110Ω, C_L=50pF, See Figs. 4 & 5.		23	35	ns
t_{PZL}	“L” enable time			16	35	ns
t_{PHZ}	“H” disable time			11	25	ns
t_{PLZ}	“L” disable time			22	35	ns

ELECTRICAL CHARACTERISTICS (Receiver) (V_{CC} = 5V ± 5%, T_a = –20 ~ 75°C, unless otherwise noted)

Symbol	Parameter		Test conditions		Limits			Unit
					Min.	Typ.*	Max.	
V_{TH}	High threshold voltage		V_O=2.7V, I_O=–0.4mA				0.2	V
V_{TL}	Low threshold voltage		V_O=0.5V, I_O=16mA		–0.2			V
V_{T+} - V_{T-}	Hysteresis width (Note 4)					50		mV
V_{IK}	Enable input clamp voltage		I_I=–18mA				–1.5	V
V_{OH}	“H” output voltage		V_{ID}=0.2V, I_{OH}=–0.4mA		2.7	3.6		V
V_{OL}	“L” output voltage		V_{ID}=–0.2V	I_{OL}=8mA		0.23	0.45	V
				I_{OL}=16mA		0.30	0.5	
I_{OZ}	Off-state output current	75176	V_O=0.4 ~ 2.4V				±20	μA
		75177/178	V_O=0.4V				–400	
			V_O=2.4V				20	
I_I	Line input current		Other input 0V	V_O=12V			1	mA
				V_O=–7V			–0.8	
I_{IH}	“H” enable input current	75176/177/178	V_{IH}=2.7V				20	μA
I_{IL}	“L” enable input current	75176	V_{IL}=0.4V				–100	μA
		75177/178					–400	
r_i	Input resistance				12			kΩ
I_{OS}	Output short-circuit current		V_O=0V		–15		–85	mA
I_{CC}	Supply voltage		No output load	Output enable			48	mA
				Output disable			48	

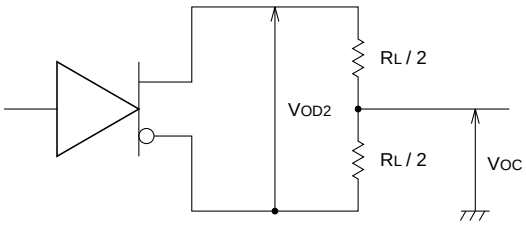
*: The standard value is given on the condition of V_{CC} = 5V and T_a = 25°C.
Note 4: The hysteresis width is the difference between positive threshold voltage V_{T+} and negative threshold voltage V_{T-}.

SWITCHING CHARACTERISTICS (Receiver) (V_{CC} = 5V, T_a=25°C)

Symbol	Parameter	Test conditions	Limits			Unit
			Min.	Typ.	Max.	
t_{PLH}	Output “L - H” propagation delay time	C_L=15pF, See Fig. 6.		22	35	ns
t_{PHL}	Output “H - L” propagation delay time			19	35	ns
t_{PZH}	“H” enable time	C_L=15pF, See Fig. 7.		9	20	ns
t_{PZL}	“L” enable time			11	20	ns
t_{PHZ}	“H” disable time	C_L=15pF, See Fig. 7.		17	35	ns
t_{PLZ}	“L” disable time			22	35	ns

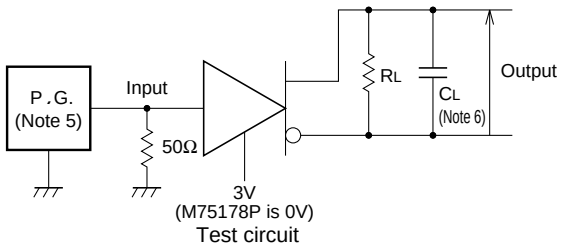
TEST CIRCUITS

Fig. 1

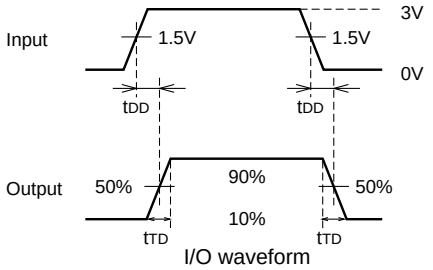


Driver differential output voltage 2, in-phase output voltage

Fig. 2



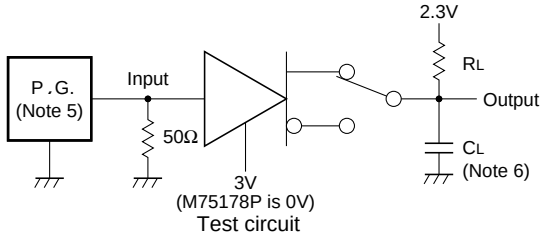
Test circuit



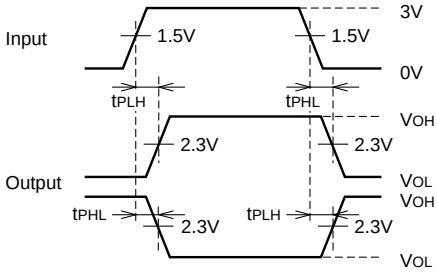
I/O waveform

Driver differential output delay time and transition time

Fig. 3



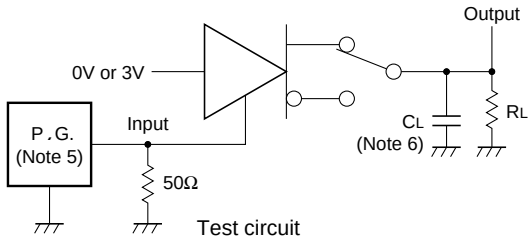
Test circuit



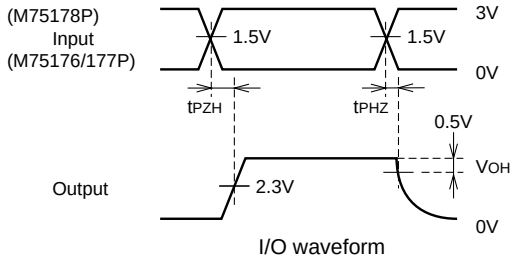
I/O waveform

Driver delay time

Fig. 4



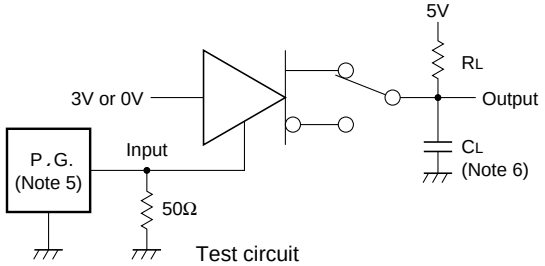
Test circuit



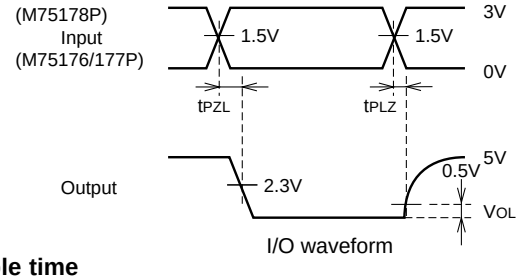
I/O waveform

Driver enable/disable time

Fig. 5



Test circuit

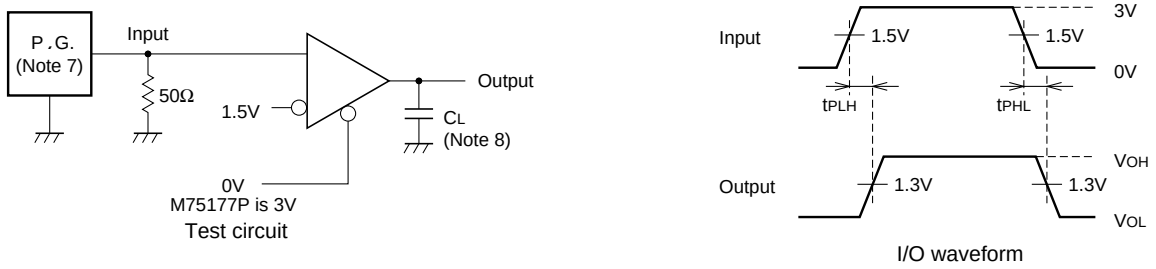


I/O waveform

Driver enable/disable time

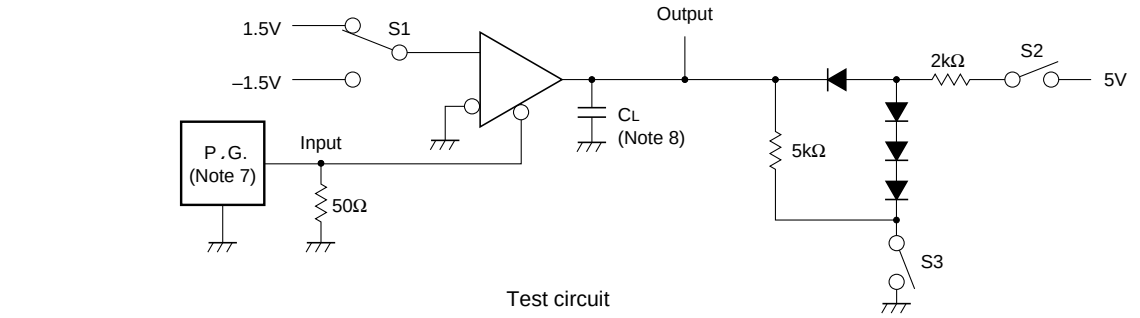
Note 5: The pulse generator is PRR ≤ 1MHz, duty ratio = 50%, t_r ≤ 6ns, t_f ≤ 6ns, Z_{OUT} = 50Ω.
6: C_L includes jigs and probe capacitance.

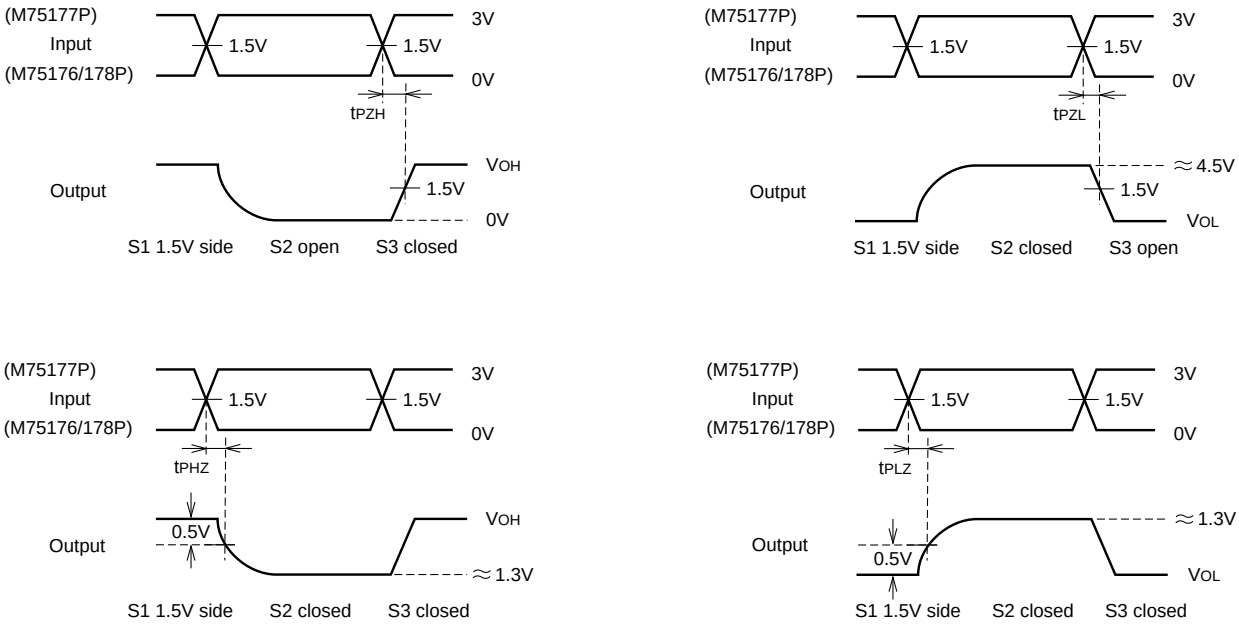
Fig. 6



Receiver propagation delay time

Fig. 7



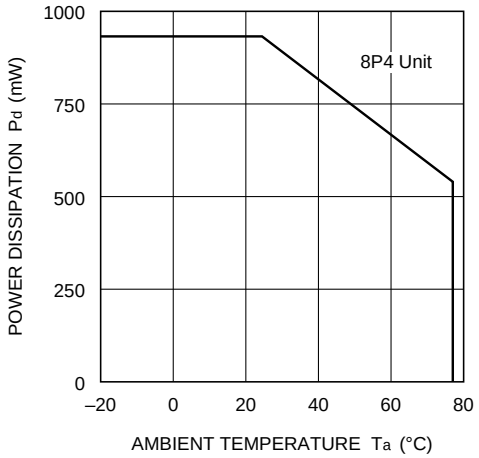


Receiver enable/disable time

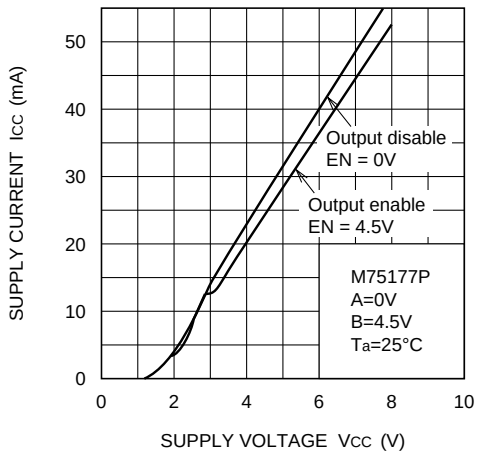
Note 7: The pulse generator is PRR ≤ 1MHz, duty ratio = 50%, t_r ≤ 6ns, t_f ≤ 6ns, Z_{OUT} = 50Ω.
8: C_L includes jigs and probe capacitance.

THERMAL DERATING

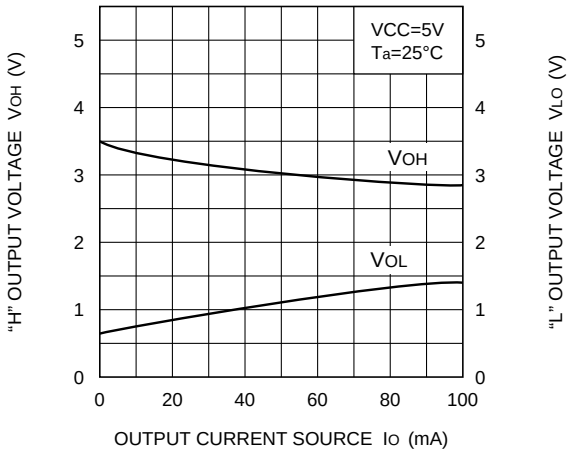
THERMAL DERATING CHARACTERISTIC



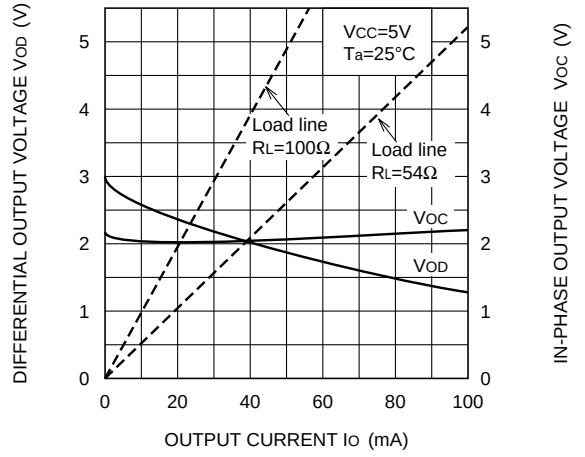
SUPPLY CURRENT - SUPPLY VOLTAGE CHARACTERISTIC



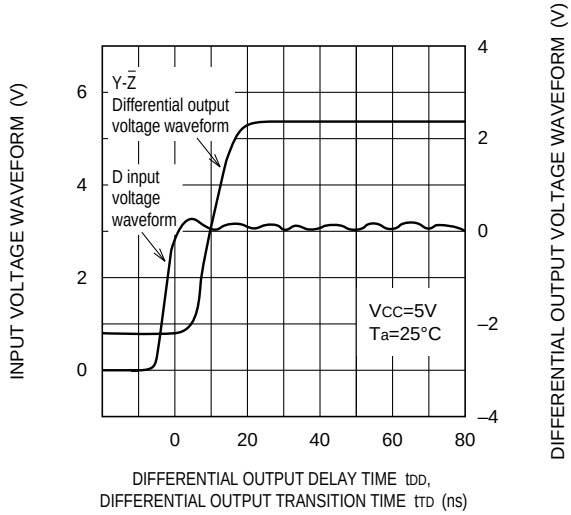
DRIVER
"H" OUTPUT VOLTAGE
"L" OUTPUT VOLTAGE - OUTPUT CURRENT CHARACTERISTIC



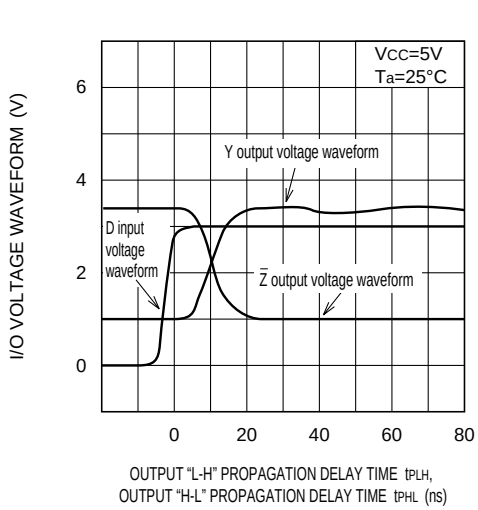
DIFFERENTIAL OUTPUT VOLTAGE
IN-PHASE OUTPUT VOLTAGE - OUTPUT CURRENT CHARACTERISTIC



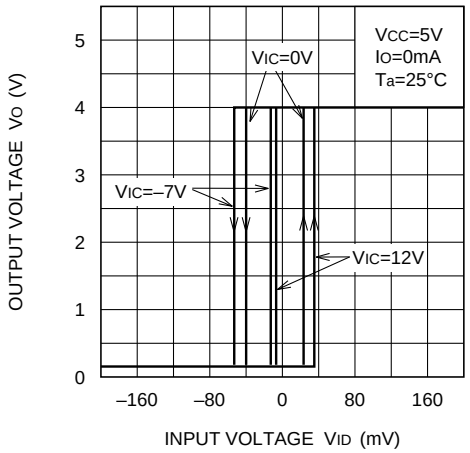
SWITCHING CHARACTERISTIC



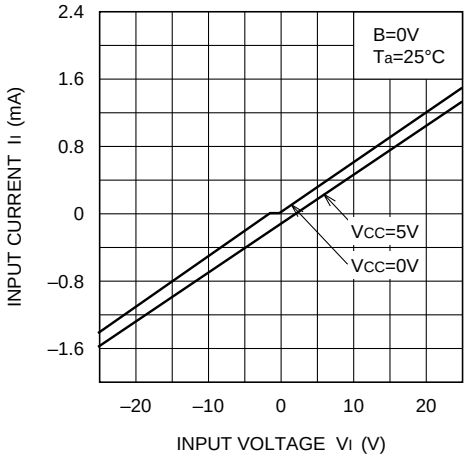
SWITCHING CHARACTERISTIC



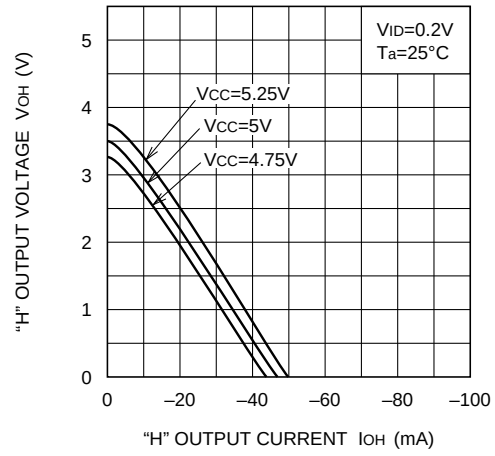
RECEIVER
I/O TRANSMISSION CHARACTERISTIC (A→R)



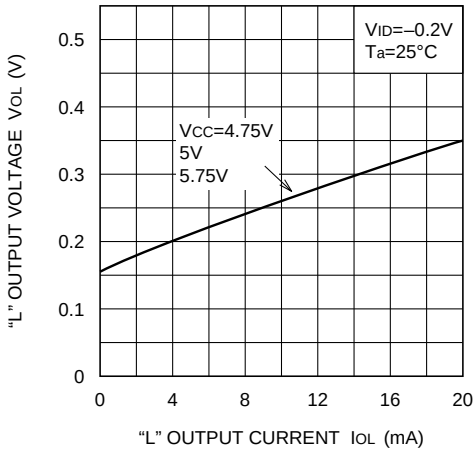
INPUT CURRENT - INPUT VOLTAGE CHARACTERISTIC (A)



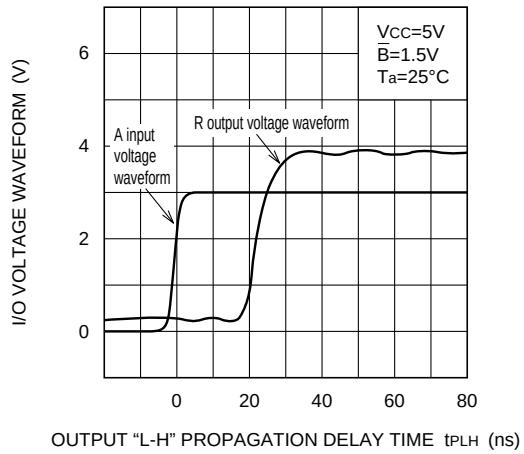
"H" OUTPUT VOLTAGE - "H" OUTPUT CURRENT CHARACTERISTIC



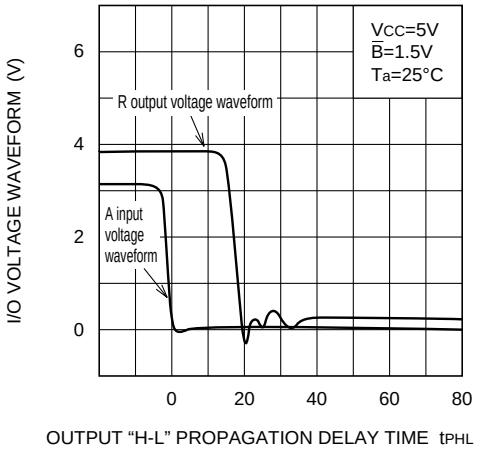
"L" OUTPUT VOLTAGE - "L" OUTPUT CURRENT CHARACTERISTIC



SWITCHING CHARACTERISTIC



SWITCHING CHARACTERISTIC



APPLICATION EXAMPLE