钍地半导体
Tudi Semiconductor

Product Specification

TUDI-SN65HVD230/231/232

3.3-V CAN TRANSCEIVERS

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semiconductor device manufacturer

- Design
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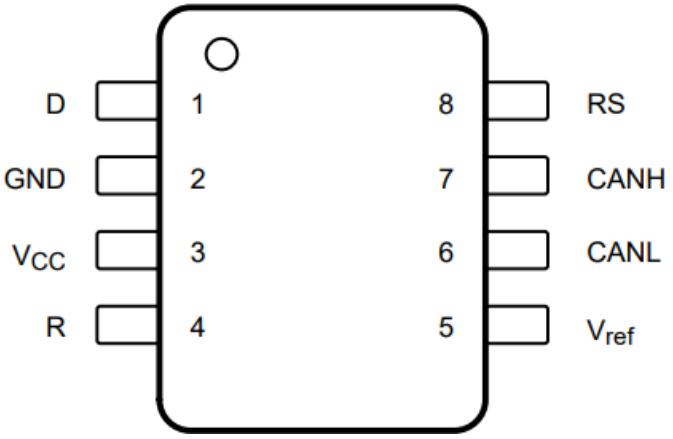
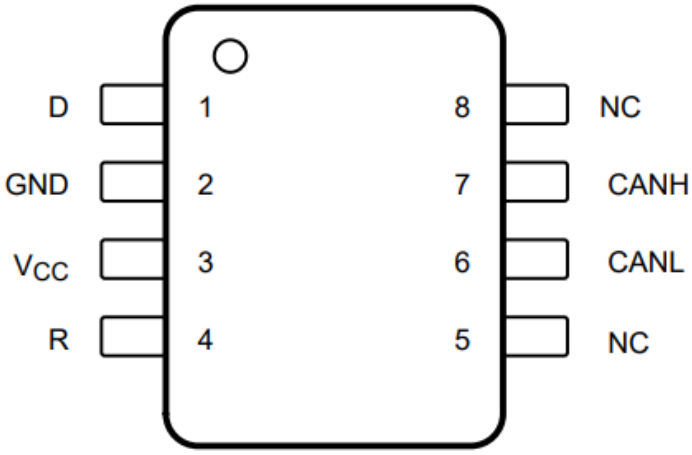
FEATURES



- Operates With a 3.3-V Supply
- Bus/Pin ESD Protection Exceeds 16 kV HBM
- High Input Impedance Allows for 120 Nodes on a
- Controlled Driver Output Transition Times for Improved Signal Quality on the SN65HVD230and SN65HVD231
- Unpowered Node Does Not Disturb the Bus
- Compatible With the Requirements of the ISO 11898 Standard
- Low-Current SN65HVD230 Standby Mode 370 μA Typical
- Low-Current SN65HVD231 Sleep Mode 40 nA Typical
- Designed for Signaling Rates(1)up to 1 Megabit/Second(Mbps)
- Thermal Shutdown Protection
- Open-Circuit Fail-Safe Design
- Glitch-Free Power-Up and Power-Down Protection for Hot-Plugging Applications



APPLICATIONS

- Motor Control
- Industrial Automation
- Basestation Control and Status
- Robotics
- Automotive
- UPS Control

FUNCTION TABLES

DRIVER(SN65HVD230,SN65HVD231)(1)				
INPUT D	Rs	OUTPUTS		BUS STATE
		CANH	CANL	
L	V(Rs)<1.2V	H	L	Dominant
H		Z	Z	Recessive
Open	X	Z	Z	Recessive
X	V(Rs)>0.75 Vcc	Z	Z	Recessive

(1) H = high level; L = low level; X = irrelevant; ? = indeterminate; Z = high impedance

DRIVER(SN65HVD232)[1]			
INPUT D	OUTPUTS		BUS STATE
	CANH	CANL	
L	H	L	Dominant
H	Z	Z	Recessive
Open	Z	Z	Recessive

(1) H = high level; L = low level; Z = high impedance

DESCRIPTION

The SN65HVD230,SN65HVD231,and SN65HVD232 controller area network(CAN)transceivers are intended for use in applications employing the CAN serial communication physical layer inaccordance with the ISO 11898 standard.Each CAN transceiver is designed to provide differential transmitcapability to the bus and differential receive capability to a CAN controller at speeds up to 1 Mbps.

Designed for operation in especially-harsh environments,these devices feature cross-wire protection,loss-of-ground and overvoltage protection,overtemperature protection,as well as wide common-mode range.

The transceiver interfaces the single-ended CAN controller with the differential CAN bus found in industrial,building automation,and automotive applications.It operates over a -2-V to 7-V common-mode range on thebus,and it can withstand common-mode transients of ±25V.

On the SN65HVD230 and SN65HVD231,pin 8 provides three different modes of operation:high-speed,slopecontrol,and low-power modes.The high-speed mode of operation is selected by connecting pin 8 to ground,allowing the transmitter output transistors to switch on and off as fast as possible with no limitation on the riseand fall slopes.The rise and fall slopes can be adjusted by connecting a resistor to ground at pin 8,since theslope is proportional to the pin's output current.This slope control is implemented with external resistor values of10 kQ,to achieve a 15-Vlus slew rate,to 100 kQ,to achieve a 2-Vlus slew rate.See the Application Informationsection of this data sheet.

The circuit of the SN65HVD230 enters a low-current standby mode during which the driver is switched off andthe receiver remains active if a high logic level is applied to pin 8.The DSP controller reverses this low-currentstandby mode when a dominant state (bus differential voltage >900 mV typical)occurs on the bus.

The unique difference between the SN65HVD230 and the SN65HVD231 is that both the driver and the receiverare switched off in the SN65HVD231 when a high logic level is applied to pin 8 and remain in this sleep modeuntil the circuit is reactivated by a low logic level on pin 8.

The Vref pin 5 on the SN65HVD230 and SN65HVD231 is available as aVcc/2 voltage reference.

The SN65HVD232 is a basic CAN transceiver with no added options;pins 5 and 8 are NC,no connection.

RECEIVER(SN65HVD230)(1)		
DIFFERENTIAL INPUTS	R_S	OUTPUT R
$V_{ID} \geq 0.9V$	X	L
$0.5V < V_{ID} < 0.9V$	X	?
$V_{ID} \leq 0.5V$	X	H
Open	X	H

(1) H = high level; L = low level; X = irrelevant; Z = indeterminate

RECEIVER(SN65HVD231)(1)		
DIFFERENTIAL INPUTS	R_S	OUTPUT R
$V_{ID} \geq 0.9V$	$V(R_S) < 1.2V$	L
$0.5V < V_{ID} < 0.9V$		?
$V_{ID} \leq 0.5V$		H
X	$V(R_S) > 0.75\ V_{CC}$	H
X	$1.2\ V < V(R_S) < 0.75\ V_{CC}$	?
Open	X	H

(1) H = high level; L = low level; X = irrelevant; ? = indeterminate

RECEIVER(SN65HVD232)(1)	
DIFFERENTIAL INPUTS	OUTPUTR
$V_{ID} \geq 0.9V$	L
$0.5V < V_{ID} < 0.9V$	?
$V_{ID} \leq 0.5V$	H
Open	H

(1) H = high level; L = low level; X = irrelevant; ? = indeterminate

TRANSCEIVER MODES (SN65HVD230,SN65HVD231)	
$V_{(Rs)}$	OPERATING MODE
$V_{(Rs)}$>0.75 V_{cc}	Standby
10 kQ to 100 kΩ to ground	Slope control
$V_{(Rs)}$<1V	High speed (no slope control)

TERMINAL FUNCTIONS

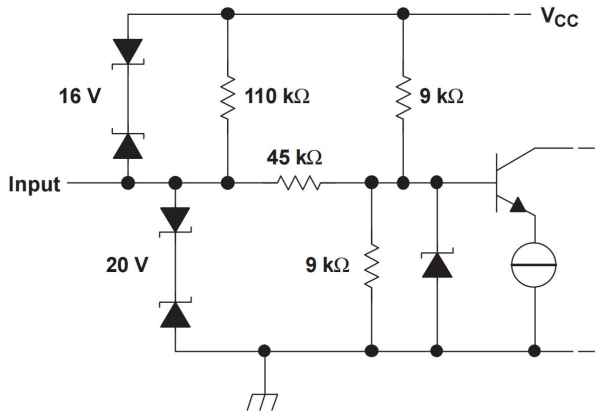
TERMINAL		DESCRIPTION
NAME	NO.	
SN65HVD230, SN65HVD231		
CANL	6	Low bus output
CANH	7	High bus output
D	1	Driver input
GND	2	Ground
R	4	Receiver output

TERMINAL FUNCTIONS (continued)

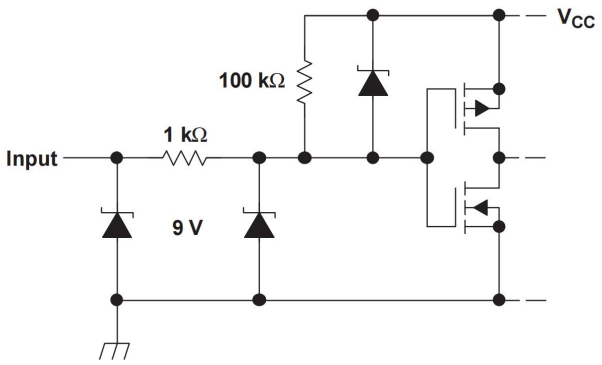
TERMINAL		DESCRIPTION
NAME	NO.	
R_s	8	Standby/slope control
V_{cc}	3	Supply voltage
V_{ref}	5	Reference output
SN65HVD232		
CANL	6	Low bus output
CANH	7	High bus output
D	1	Driver input
GND	2	Ground
NC	5,8	No connection
R	4	Receiver output
V_{cc}	3	Supply voltage

EQUIVALENT INPUT AND OUTPUT SCHEMATIC DIAGRAMS

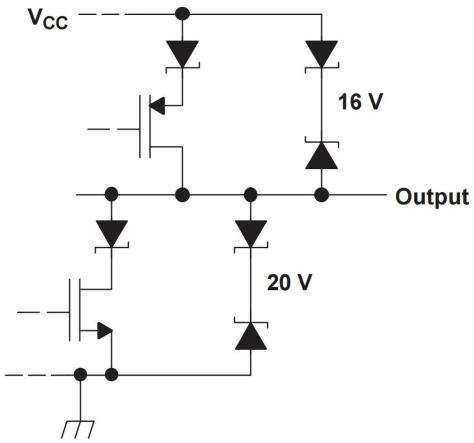
CANH and CANL Inputs



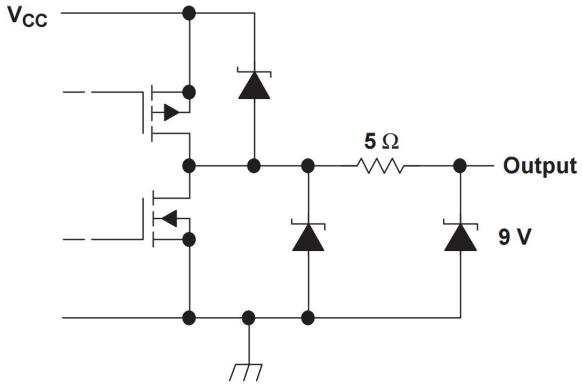
D Input



CANH and CANL Outputs



D Input



ABSOLUTE MAXIMUM RATINGS

over operating free-air temperature range (unless otherwise noted)[1][2]

			UNIT
Supply voltage range,V_{CC}			-0.3 V to 6V
Voltage range at any bus terminal(CANH or CANL)			-4 V to 16V
Voltage input range,transient pulse,CANH and CANL,through 100Ω (see Figure 7)			-25V to 25V
Input voltage range,V_I (D or R)			-0.5V to V_{CC}+0.5V
Receiver output current,I_O			±11 mA
Electrostatic discharge	Human body model[3]	CANH,CANL and GND	16 KV
		All Pins	4KV
	Charged-device model[4]	All pins	1 kV
Continuous total power dissipation			See Dissipation Rating Table

(1) Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under " recommended operating conditions" is not implied. Exposure to absolute-maximum-rated conditions for extended periods amy affect device reliability.
(2) All voltage values, except differential I/O bus voltages, are with respect to network ground terminal.
(3) Tested in accordance with JEDEC Standard 22, Test Method A114-A.
(4) Tested in accordance with JEDEC Standard 22, Test Method C101.

DISSIPATION RATING TABLE

PACKAGE	$T_A \leq 25°C$ POWER RATING	DERATING FACTOR[1] ABOVE T_A=25°C	T_A=70°C POWER RATING	T_A=85°C POWER RATING
D	725 mW	5.8 mW/°C	464 mW	377 mW

(1) This is the inverse of the junction-to-ambient thermal resistance when board-mounted and with no air flow.

RECOMMENDED OPERATING CONDITIONS

		MIN	NOM	MAX	UNIT
Supply voltage, V_{CC}		3		3.6	V
Voltage at any bus terminal (common mode) V_{IC}		-2[(1)]		7	V
Voltage at any bus terminal (separately) V_I		-2.5		7.5	V
High-level input voltage, V_{IH}	D,R	2			V
Low-level input voltage, V_{IL}	D,R			0.8	V
Differential input voltage, V_{ID} (see Figure 5)		-6		6	V
Input voltage, $V_{(Rs)}$		0		V_{CC}	V
Input voltage for standby or sleep, $V_{(Rs)}$		0.75V_{CC}		V_{CC}	V
Wave-shaping resistance, Rs		0		100	kΩ
High-level output current, I_{OH}	Driver	-40			mA
	Receiver	-8			
Low-level output current, I_{OL}	Driver			48	mA
	Receiver			8	
Operating free-air temperature, T_A		-40		85	℃

(1) The algebraic convention, in which the least positive (most negative) limit is designated as minimum is used in this data sheet.

DRIVER ELECTRICAL CHARACTERISTICS

over recommended operating conditions (unless otherwise noted)

PARAMETER			TEST CONDITIONS		MIN	TYP(1)	MAX	UNIT
V_{OH}	Bus output voltage	Dominant	V_I= 0V,See Figure 1 and Figure 3	CANH	2.45		V_{CC}	V
				CANL	0.5		1.25	
V_{OL}		Recessive	V_I=3 V,See Figure 1 and Figure 3	CANH		2.3		
				CANL		2.3		
$V_{OD(D)}$	Differential output voltage	Dominant	V_I= 0V, See Figure 1		1.5	2	3	V
			V_I= 0V, See Figure 2		1.2	2	3	
$V_{OD(R)}$		Recessive	V_I=3 V, See Figure 1		-120	0	12	mV
			V_I=3 V, No load		-0.5	-0.2	0.05	V
I_{IH} High-level input current			V_I=2V		-30			μA
I_{IL} Low-level input current			V_I= 0.8 V		-30			μA
I_{OS} Short-circuit output current			V_{CANH}=-2V		-250		-250	mA
			V_{CANL}=7V		-250		-250	
C_O Output capacitance			See receiver					
I_{CC} Supply current		Standby	SN65HVD230	$V_{(Rs)}$=V_{CC}		370	600	μA
		Sleep	SN65HVD231	$V_{(Rs)}$=V_{CC},D at V_{CC}		0.04	1	
		All devices	Dominant	V_I=0 V, No load	Dominant	10	17	mA
			Recessive	V_I= V_{CC}, No load	Recessive	10	17	

(1) All typical values are at 25 ° C and with a 3.3-V supply.

DRIVER ELECTRICAL CHARACTERISTICS

over recommended operating conditions (unless otherwise noted)

PARAMETER		TESTCONDITIONS	MIN	TYP	MAX	UNIT
SN65HVD230 AND SN65HVD231						
t_{PLH}	Propagation delay time,low-to-high-leveloutput	$V_{(Rs)}$=0V		35	85	ns
		R_s with 10 kQ to ground		70	125	
		R_s with 100 kQ to ground		500	870	
t_{PHL}	Propagation delay time,high-to-low-leveloutput	$V_{(Rs)}$=0V		70	120	ns
		R_s with 10 kQ to ground		130	180	
		R_s with 100 kQ to ground		870	1200	
tsk(p) Pulse skew(ItpHL-tpLHl)		$V_{(Rs)}$=0V		35		ns
		R_s with 10 kQ to ground		60		
		R_s with 100 kQ to ground		370		
t_r	Differential output signal rise time	$V_{(Rs)}$=0V	25	50	100	ns
t_f	Differential output signal fall time		40	55	80	ns
t_r	Differential output signal rise time	R_s with 10 kQ to ground	80	120	160	ns
t_f	Differential output signal fall time		80	125	150	ns
t_r	Differential output signal rise time	R_s with 100 kQ to ground	600	800	1200	ns
t_f	Differential output signal fall time		600	825	1000	ns
SN65HVD232						
t_{PLH}	Propagation delay time,low-to-high-level output	C_L=50 pF,See Figure 4		35	85	ns
t_{PHL}	Propagation delay time,high-to-low-level output			70	120	
$t_{sK(p)}$	Pulse skew(ItPHL-tPLHl)			35		
t_r	Differential output signal rise time		25	50	100	
t_f	Differential output signal fall time		40	55	80	

DRIVER ELECTRICAL CHARACTERISTICS

over recommended operating conditions (unless otherwise noted)

PARAMETER	TEST CONDITIONS		MIN	TYP(1)	MAX	UNIT
V_{IT+} Positive-going input threshold voltage	See Table 1			750	900	mV
V_{IT-} Negative-going input threshold voltage			500	650		mV
V_{nys} Hysteresis voltage (V_{IT+}-V_{IT-})				100		
V_{OH} High-level output voltage	-6V≤V_{ID}≤500 mV,I_O=-8 mA, See Figure 5		2.4			V
V_{OL} Low-level output voltage	900 mV≤V_{ID}≤6V,I_O=8 mA,See Figure 5				0.4	
I_I Bus input current	V_{IH}=7V	Other input at 0V ,D=3V	100		250	μA
	V_{IH}=7V, V_{CC}=0V		100		350	
	V_{IH}=-2V		-200		-30	μA
	V_{IH}=-2V, V_{CC}=0V		-100		-20	
C_i CANH,CANL input capacitance	Pin-to-ground,V_I=0.4 sin(4E6πt)+0.5V $V_{(D)}$=3V,			32		pF
C_{diff} Differential input capacitance	Pin-to-pin,V_I=0.4 sin(4E6πt)+0.5V $V_{(D)}$=3V,			16		pF
R_{diff} Differential input resistance	Pin-to-pin, $V_{(D)}$=3V		40	70	100	kΩ
R_I CANH,CANL input resistance			20	35	50	kΩ
I_{CC} Supply current	See driver					

(1) All typical values are at 25 ° C and with a 3.3-V supply.

RECEIVER SWITCHING CHARACTERISTICS

over recommended operating conditions (unless otherwise noted)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{pLH} Propagation delay time,low-to-high-level output	See Figure 6		35	50	ns
t_{PHL} Propagation delay time,high-to-low-level output			35	50	ns
$t_{sk(p)}$ Pulse skew($|t_{PHL}-t_{pLH}|$)				10	ns
t_r Output signal rise time	See Figure 6		1.5		ns
t_f Output signal fall time			1.5		ns

DEVICE SWITCHING CHARACTERISTICS

over recommended operating conditions (unless otherwise noted)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
$t_{(LOOP1)}$ Total loop delay,driver input to receiveroutput,recessive to dominant	$V(R_S)$ =0V, See Figure 9		70	115	ns
	R_S with 10 kQ to ground, See Figure 9		105	175	
	R_S with 100 kΩ to ground, See Figure 9		535	920	
$t_{(LOOP2)}$ Total loop delay,driver input to receiveroutput,dominant to recessive	$V(R_S)$=0V, See Figure 9		100	135	ns
	R_S with 10 kQ to ground, See Figure 9		155	185	
	R_S with 100 kΩ to ground, See Figure 9		830	990	

DEVICE SWITCHING CHARACTERISTICS

over recommended operating conditions (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP1(1)	MAX	UNIT
$t_{(WAKE)}$	SN65HVD230 wake-up time fromstandby modewith Rs	See Figure 8		0.55	1.5	μ S
	SN65HVD231 wake-up time from sleepmode withRs			3	5	μ S

(1) All typical values are at 25 ° C and with a 3.3-V supply.

DEVICE CONTROL-PIN CHARACTERISTICS (continued)

over recommended operating conditions (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP(1)	MAX	UNIT
V_{ref}	Reference output voltage	-5 μA<1(v_{res})<5μA	0.45V_{cc}		0.55V_{cc}	V
		-50 μA<I(V_{ref})50 μA	0.4 V_{cc}		0.6 V_{cc}	
$I_{(Rs)}$	Input current for high-speed	V(R_s)<1V	-450		0	μA

PARAMETER MEASUREMENT INFORMATION

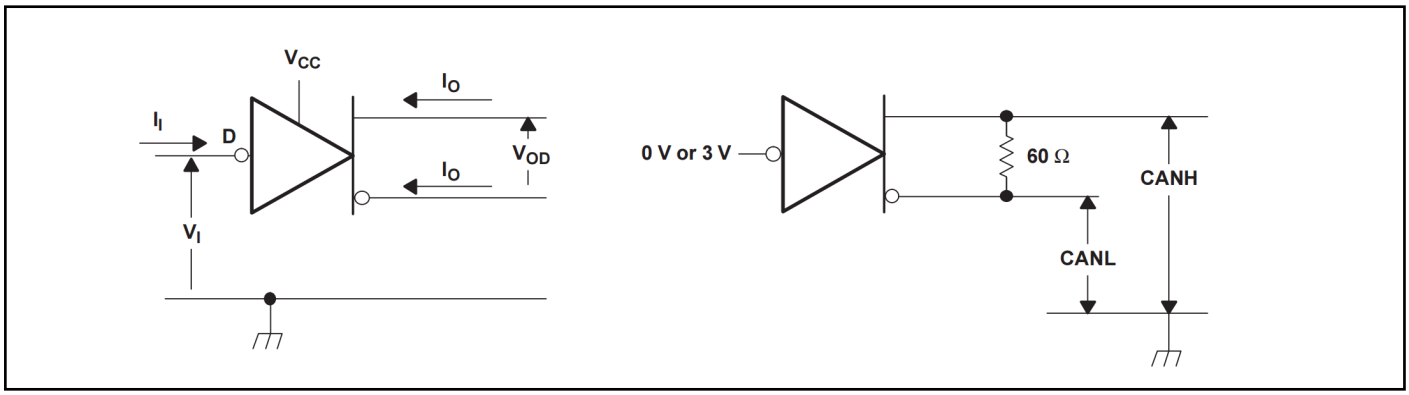


Figure 1. Driver Voltage and Current Definitions

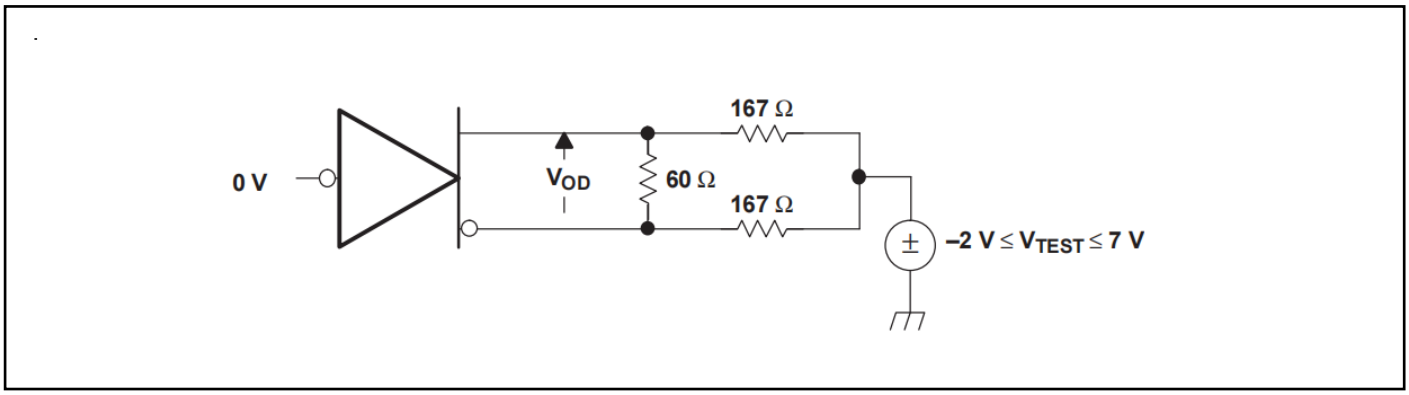


Figure 2. Driver V_{OD}

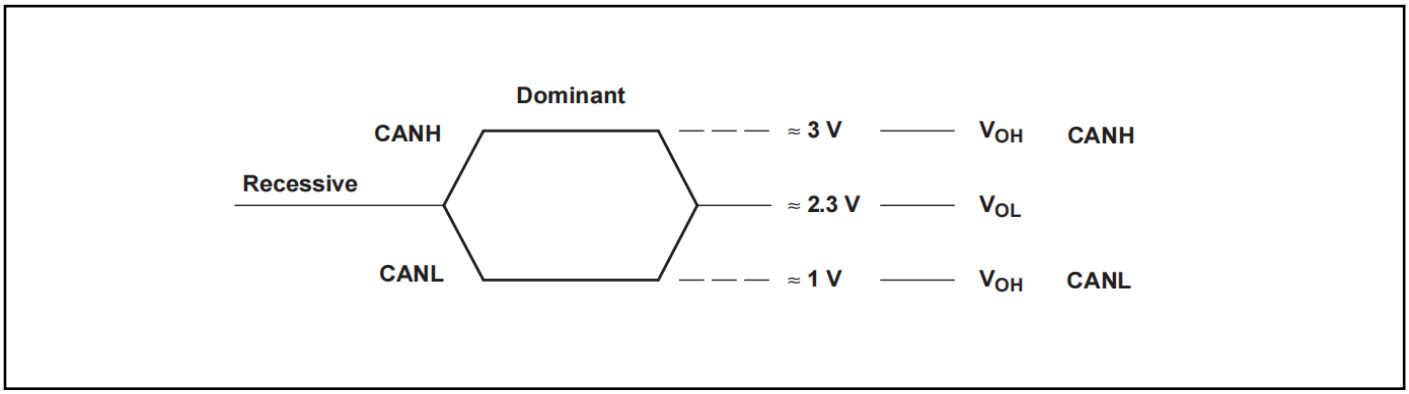
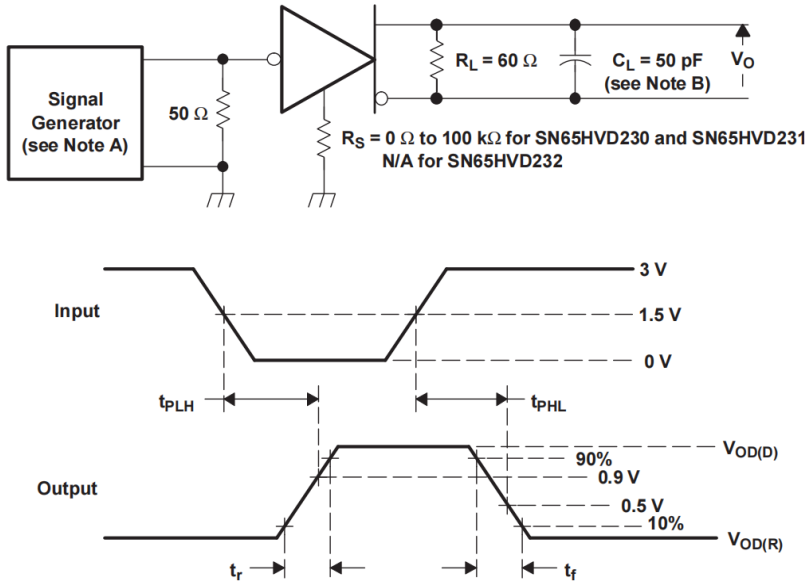


Figure 3. Driver Output Voltage Definitions

PARAMETER MEASUREMENT INFORMATION (continued)



A. The input pulse is supplied by a generator having the following characteristics: PRR ≤ 500 kHz, 50% duty cycle, t_r ≤ 6 ns, t_f ≤ 6 ns, Z_O = 50 Ω.

B. C_L includes probe and jig capacitance.

Figure 4. Driver Test Circuit and Voltage Waveform

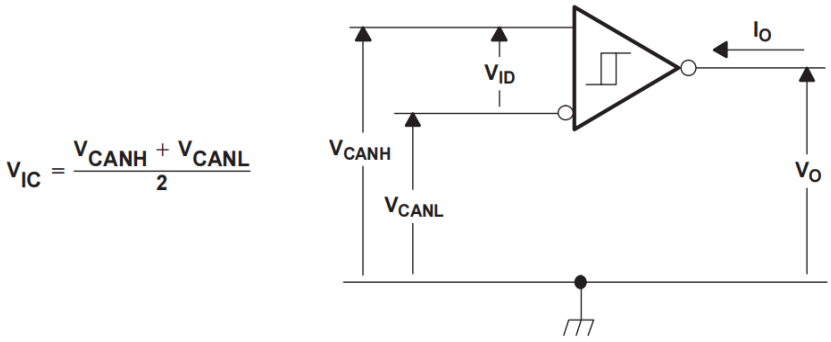
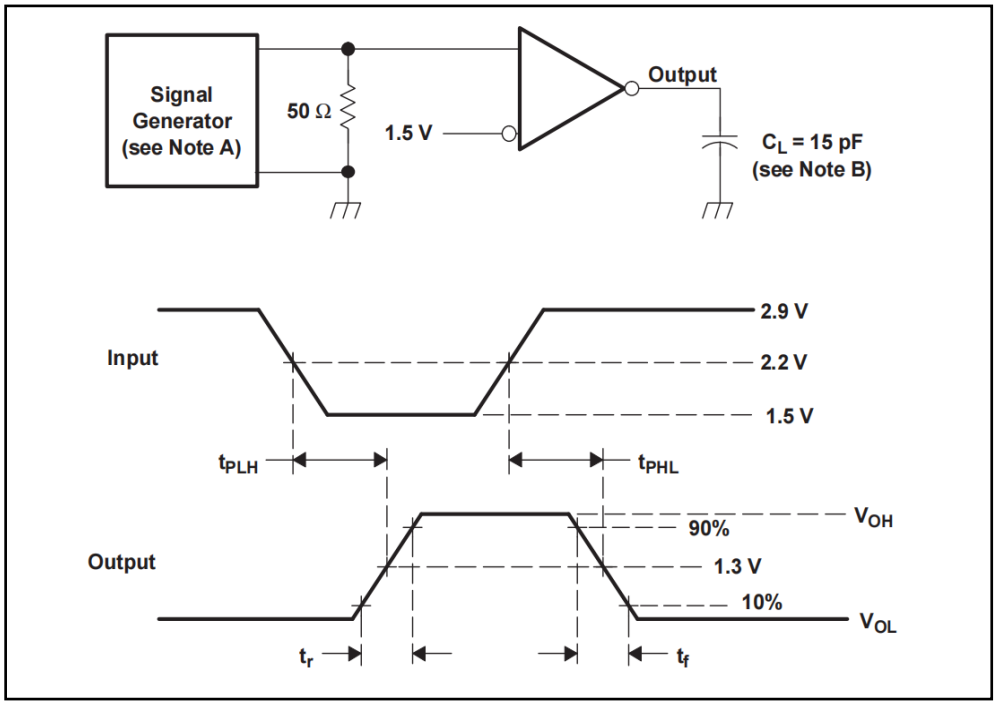


Figure 5. Receiver Voltage and Current Definitions

PARAMETER MEASUREMENT INFORMATION (continued)



A. The input pulse is supplied by a generator having the following characteristics: PRR ≤ 500 kHz, 50% duty cycle, t_r ≤ 6 ns, t_f ≤ 6 ns, Z_o = 50 Ω.

B. C_L includes probe and jig capacitance.

Figure 6. Receiver Test Circuit and Voltage Waveforms

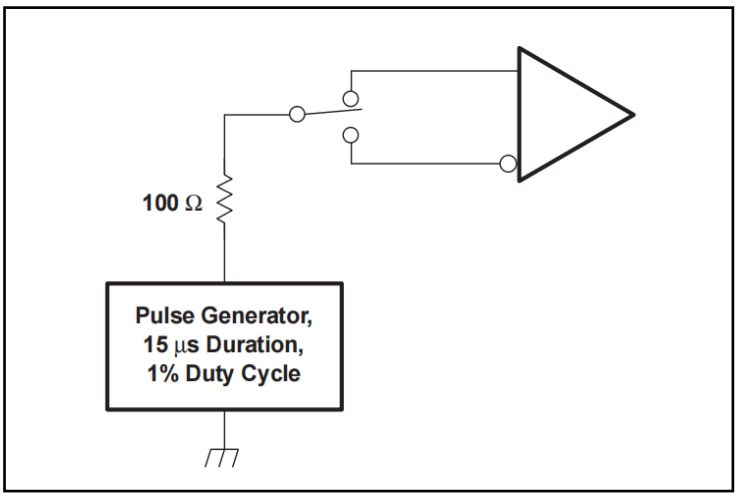


Figure 7. Overvoltage Protection

PARAMETER MEASUREMENT INFORMATION (continued)

Table 1. Receiver Characteristics Over Common Mode With V(Rs)= 1.2 V

V_{IC}	V_{ID}	V_{CANH}	V_{CANL}	R OUTPUT	
-2V	900 mV	-1.55V	-2.45V	L	V_{OL}
7V	900 mV	8.45V	6.55V	L	
1V	6V	4V	-2V	L	
4V	6V	7V	1V	L	
-2V	500 mV	-1.75V	-2.25V	H	V_{OH}
7V	500 mV	7.25V	6.75V	H	
1V	-6V	-2V	4V	H	
4V	-6V	1V	7V	H	
X	X	Open	Open	H	

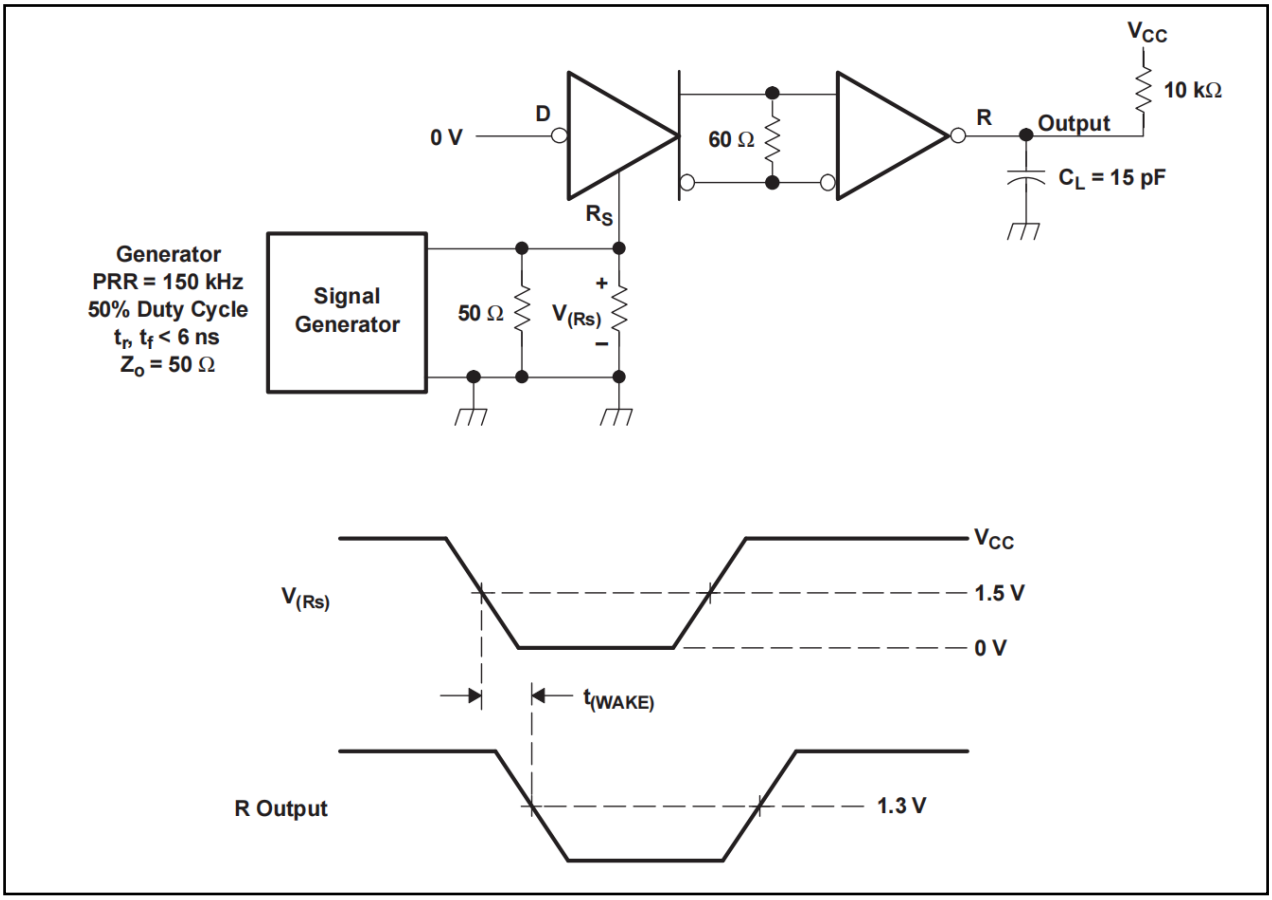
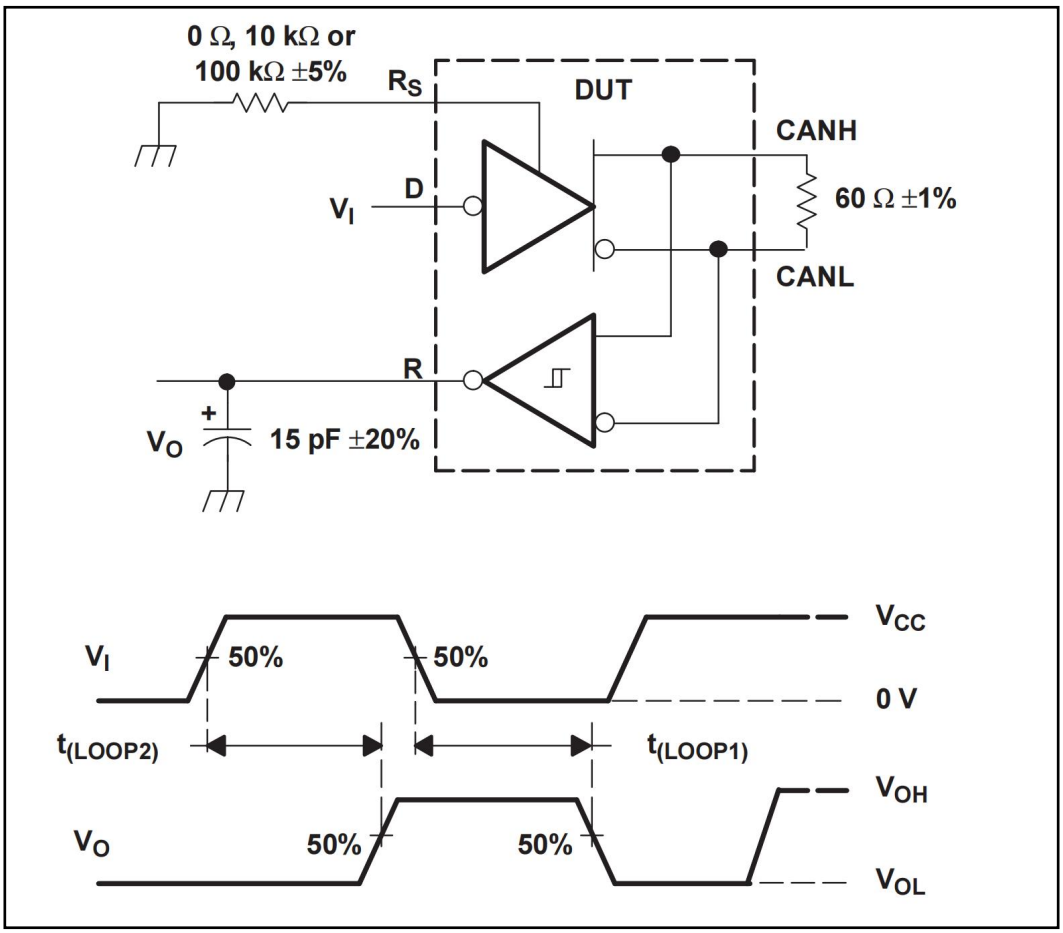


Figure 8. $t_{(WAKE)}$ Test Circuit and Voltage Waveforms



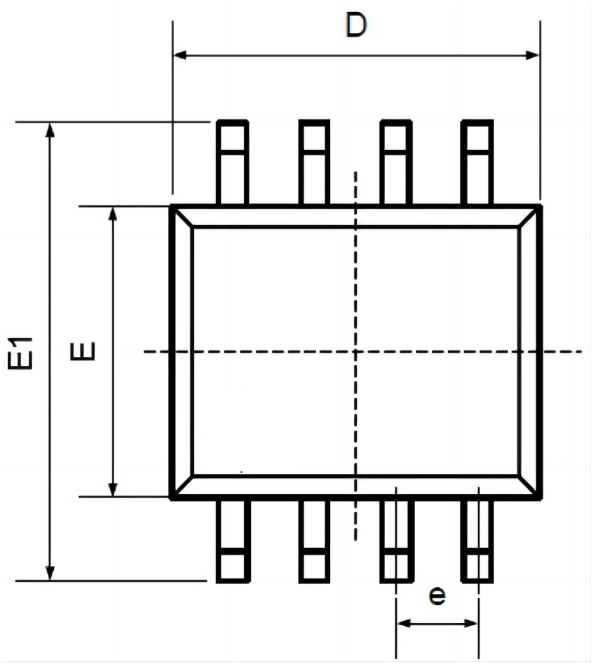
A. All V_I input pulses are supplied by a generator having the following characteristics: t_r or t_f ≤ 6 ns, Pulse Repetition Rate (PRR) = 125 kHz, 50% duty cycle.

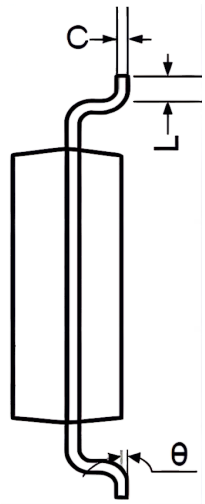
Figure 9. $t_{(LOOP)}$ Test Circuit and Voltage Waveforms

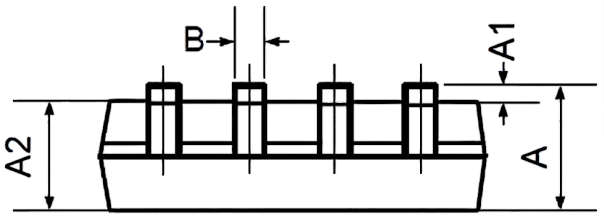
ORDERING INFORMATION

Order Number	Package	Package Quantity	Marking On The park	Temperature
SN65HVD230DR-TUDI	SOP8	Tape,Reel,2500	VP230	-40℃ to 85℃
SN65HVD231DR-TUDI	SOP8	Tape,Reel,2500	VP231	
SN65HVD232DR-TUDI	SOP8	Tape,Reel,2500	VP232	

Package SOP8







Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
B	0.330	0.510	0.013	0.020
C	0.190	0.250	0.007	0.010
D	4.780	5.000	0.188	0.197
E	3.800	4.000	0.150	0.157
E1	5.800	6.300	0.228	0.248
e	1.270TYP		0.050TYP	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

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