

DS3695/DS3695T/DS3696/DS3696T/DS3697/DS3698 Multipoint RS485/RS422 Transceivers/Repeaters

General Description

The DS3695, DS3696, DS3697 and DS3698 are high speed differential TRI-STATE® bus/line transceivers/repeaters designed to meet the requirements of EIA standard RS485 with extended common mode range (+12V to -7V), for multipoint data transmission.

The driver and receiver outputs feature TRI-STATE capability. The driver outputs remain in TRI-STATE over the entire common mode range of +12V to -7V. Bus faults that cause excessive power dissipation within the device trigger a thermal shutdown circuit, which forces the driver outputs into the high impedance state. The DS3696 and DS3698 provide an output pin TS (thermal shutdown) which reports the occurrence of the thermal shutdown of the device. This is an "open collector" pin with an internal 10 k Ω pull-up resistor. This allows the line fault outputs of several devices to be wire OR-ed.

Both AC and DC specifications are guaranteed over the 0°C to 70°C temperature and 4.75V to 5.25V supply voltage range.

Features

- Meets EIA standard RS485 for multipoint bus transmission and is compatible with RS-422
- 15 ns driver propagation delays with 2 ns skew (typical) ■ Single +5V supply
- -7V to +12V bus common mode range permits $\pm 7V$ ground difference between devices on the bus
- Thermal shutdown protection
- High impedance to bus with driver in TRI-STATE or with power off, over the entire common mode range allows the unused devices on the bus to be powered down
- Combined impedance of a driver output and receiver input is less than one RS485 unit load, allowing up to 32 transceivers on the bus
- 70 mV typical receiver hysteresis



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Absolute Maximum Ratings (Note 1)

Control Input Voltages

Driver Output Voltages

Driver Input Voltage

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications. Supply Voltage, V_{CC} 7V

Continuous Power Dissipation @ 25°CN Package1.07W (Note 4)Storage Temperature Range-65°C to +150°C

Lead Temperature (Soldering, 4 sec.)

260°C

Recommended Operating Conditions

Receiver Input Voltages			Min	Max	Units
(DS3695, DS3696) +	-15V/-10V	Supply Voltage, V _{CC}	4.75	5.25	V
Receiver Common Mode Voltage		Bus Voltage	-7	+12	V
(DS3697, DS3698)	$\pm 25V$	Operating Free Air Temp. (T _A)			
Receiver Output Voltage	5.5V	Commercial	0	+70	°C
		Industrial	-40	+85	°C

7V

7V

+15V/-10V

$\label{eq:Electrical Characteristics} \text{ 0°C} \leq \text{ T}_{\text{A}} \leq +70^{\circ}\text{C}, 4.75\text{V} < \text{V}_{\text{CC}} < 5.25\text{V} \text{ unless otherwise specified (Notes 2 & 3)}$

Symbol	Param	eter	Conditions		Min	Тур	Max	Units
V _{OD1}	Differential Driver Ou Voltage (Unloaded)	tput	I _O = 0				5	v
V _{OD2}	Differential Driver Ou	tput	(Figure 1)	$R = 50\Omega$; (RS-422) (Note 5)	2			V
	Voltage (with Load)			R = 27Ω; (RS-485)	1.5			V
ΔV _{OD}	Change in Magnitude of Driver Differential Output Voltage for Complementary Output States						0.2	v
V _{OC}	Driver Common Mode	e Output Voltage	(Figure 1)	$R = 27\Omega$			3.0	V
$\Delta V_{OC} $	Change in Magnitude Common Mode Outp for Complementary C	of Driver ut Voltage Putput States					0.2	v
VIH	Input High Voltage				2			V
VIL	Input Low Voltage						0.8	V
V _{CL}	Input Clamp Voltage	RE, E	E, RE/DE	$I_{IN} = -18 \text{ mA}$			-1.5	V
IIL	Input Low Current			$V_{IL} = 0.4V$			-200	μΑ
IIH	Input High Current			$V_{IH} = 2.4V$			20	μA
I _{IN}	Input Current	DO/RI, DO/RI	$V_{CC} = 0V \text{ or } 5.25V$	$V_{IN} = 12V$			+1.0	mA
		RI, RI	RE/DE or DE = 0V	$V_{IN} = -7V$			-0.8	mA
I _{OZD}	TRI-STATE Current DS3697 & DS3698	DO, DO	$V_{CC} = 0V \text{ or } 5.25V, -7V < V_O < +12V$	E = 0V			±100	μΑ
V_{TH}	V _{TH} Differential Input Threshold Voltage for Receiver		$-7V \le V_{CM} \le +12V$		-0.2		+0.2	v
ΔV_{TH}	Receiver Input Hyste	resis	$V_{CM} = 0V$			70		mV
V _{OH}	Receiver Output High	Voltage	$I_{OH} = -400 \ \mu A$		2.4			V
V _{OL}	Output Low Voltage	RO	$I_{OL} = 16 \text{ mA}$ (Note §	5)			0.5	V
		TS	$I_{OL} = 8 \text{ mA}$				0.45	V
I _{OZR}	OFF-State (High Impo Output Current at Rea	edance) ceiver	$V_{CC} = Max$ $0.4V \le V_0 \le 2.4V$				±20	μΑ
R _{IN}	Receiver Input Resist	eceiver Input Resistance		V	12			kΩ
ICC	Supply Current		No Load	Driver Outputs Enabled		42	60	mA
			(Note 5)	Driver Outputs Disabled		27	40	mA

	P	arameter		Conditions			Тур	Max	Unit
SD	Driver Short-Cir	r Short-Circuit Output Current $V_0 = V_0$		V (Note 5)				-250	m/
				I2V (Note 5)				+250	m/
OSR	Receiver Short-	Circuit Output Current	$V_{O} = 0V$			-15		-85	m/
be operat Note 2: / specified. Note 3: A Note 3: A Note 4: C Note 5: A range dev Switt 0°C ≤ - Rece Sy tpLL tpHI tpHI tpL	$\begin{array}{c} \text{red} \text{ at these limits. If }\\ All currents into deviation of the set of the $	the tables of Electrical Character in tables of Electrical Character is a positive; all currer for $V_{CC} = 5V$ and $T_A = 25^{\circ}$ the table of the table of the table of tables of tab	nless otherv	ice pins are negative 33695T and DS3696T vise specified (N 5 (<i>Figures 2, 3</i> an <u>Min</u> 15 15 0	a device operation. All voltages are refe otes 3, 6) d 4) Typ 25 25	main the same for	ground u	unless oth ded tempe Unit ns ns ns	erwise erature
t _{PLZ}	7	C _L = 15 pF, S2 C	pen	5	12	16		ns	
t _{PH} ;	t _{PHZ} C _L = 15 pF, S1 Oper		pen	5	12	16		ns	
t _{PZI}		C _L = 15 pF, S2 Open		7	15	20		ns	
t _{P7}	4	C _I = 15 pF, S1 C	pen	7	15	20		ns	
Drive	er Switchi	ng Characteri	stics	Min	Тур	Max		Uni	ts
NGLE E	NDED CHARAC	TERISTICS (Figures 5	, 6 and 7)		.,,				
t _{PLH}	1	$\begin{array}{c c} R_{L_{DIFF}} = 60\Omega \\ C_{L1} = C_{L2} = 100 \text{ pF} \end{array}$		9	15	22		ns	
t _{PHL}				9	15	22		ns	
tSKE	w t _{PLH} -t _{PHL}				2	8		ns	
t _{PLZ}		C _L = 15 pF, 5	S2 Open	7	15	30		ns	;
t _{PHZ}	2	C _L = 15 pF,	S1 Open	7	15	30		ns	
t_{P71} $C_1 = 100 \text{ pF}.$		C _L = 100 pF	S2 Open	30	35	50		ns	;
t _{PZL}	l	C _L = 100 pF	S1 Open	30	35	50		ns	;
t _{PZL} t _{PZH}									
t _{PZL} t _{PZH}	NTIAL CHARAC	TERISTICS (Figures 5	and 8)						
t _{PZL} t _{PZH} FFEREN t _r , t _f	NTIAL CHARAC	TERISTICS (Figures 5 RLDIFF	and 8) ດ	6	10	18		ns	,



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Function Tables

DS3695/DS3696 Transmitting

Inputs			Thermal	Outputs			
RE	DE	DI	Shutdown	DO	DO	TS* (DS3696 Only)	
Х	1	1	OFF	0	1	Н	
X	1	0	OFF	1	0	Н	
X	0	Х	OFF	Z	Z	Н	
X	1	Х	ON	Z	Z	L	

DS3695/DS3696 Receiving

Inputs			Outputs		
RE	DE	RI-RI	RO	TS* (DS3696 Only)	
0	0	\geq +0.2V	1	Н	
0	0	$\leq -0.2V$	0	н	
1	0	X	Z	н	

DS3697/DS3698

Inputs		Thermal	Outputs					
Е	RI-RI	Shutdown	DO	DO	RO (DS3697 Only)	TS* (DS3698 Only)		
1	\geq +0.2V	OFF	0	1	1	Н		
1	$\leq -0.2V$	OFF	1	0	0	Н		
0	X	OFF	Z	Z	Z	Н		
1	\geq +0.2V	ON	Z	Z	1	L		
1	$\leq -0.2V$	ON	Z	Z	0	L		

X—Don't care condition Z—High impedance state

 $*\overline{\text{TS}}$ is an "open collector" output with an on-chip 10 k Ω pull-up resistor that reports the occurrence of a thermal shutdown of the device.

Typical Application











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