



V6602 RS-485 Transceiver

Version: 0.4
Release Date: October 19, 2017

Specifications are subject to change without notice.

© 2016Vango Technologies, Inc.

This document contains information that is proprietary to Vango Technologies, Inc.

Unauthorized reproduction of this information in whole or in part is strictly prohibited.

Revision History

Date	Version	Description
2016.02.03	0.1	Initial release
2016.04.29	0.2	● Added polarity detection and adaption ● Updated descriptions of pin "A" and pin "B"
2016.09.14	0.3	● Updated power consumption in shutdown mode to 1μA ● Removed polarity detection and adaption ● Updated descriptions of pin "A" and pin "B"
2017.10.19	0.4	● Add absolute maximum ratings ● Updated some electrical characteristic due to chip-version update

General Description

The V6602 is an RS-485 transceiver featuring half-duplex, low power consumption, and low-slew-rate. It is completely compliant with the EIA/TIA-485 standard.

The V6602 integrates one driver and one receiver, both can be enabled independently. When both driver and receiver are disabled, the device will output the high impedance (Tri-State). The V6602 has high driving capability allowing up to 256 transceivers on the same communication bus. The low-slew-rate driver can reduce EMI and reflections caused by inappropriate terminal matching. It can also realize the error-free data transmission up to 500 Kbps.

V6602 can support the wide supply voltage input of 3.3V/5V. In the application of 3.3V power supply, the input/output logic level is 3.3V. In the application of 5V power supply, the input/output logic level is 5V. The V6602 has less than 0.6-mA supply current under the no-load condition. In the shutdown mode, the power consumption is less than 1μA.

The V6602 is protected from faults due to shorted or open receiver input, and integrates over-temperature, over-current, and over-voltage protection.

Features

- Supply voltage range: 3.3 V/5V
- Half-duplex mode
- Maximum data rate: <500 Kbps
- High driving capability: Up to 256 transceivers on one bus
- Differential driver output: $1.4V \leq V_{OD} \leq V_{CC}$ @54Ω
- Fail-safe receiver
- ESD protection: ±15kV Human Body Model (HBM)
- Over-temperature, over-current, and over-voltage protection
- Low-slew-rate driver to minimize EMI and reduce reflections caused by inappropriate terminal matching
- Operation temperature: -40°C ~+85°C
- Package: SOP-8

Applications

- Utility meters
- Industrial control

Table of Contents

Revision History	1
General Description.....	2
Features	2
Applications	2
Table of Contents	3
Figure List	4
Table List	5
1. Pin Descriptions	6
2. Truth Tables	7
3. Specifications	8
3.1 Absolute Maximum Ratings.....	8
3.2 Electrical Characteristics	8
4. Typical Operating Characteristics	11
5. Test Circuits and Waveforms	14
6. Circuit Description	15
6.1 Fail-Safe Protection	15
6.2 Over-Temperature Protection	15
6.3 Output Circuit Protection	15
6.4 Up to 256 Transceivers One Bus	16
7. Outline Dimensions	17

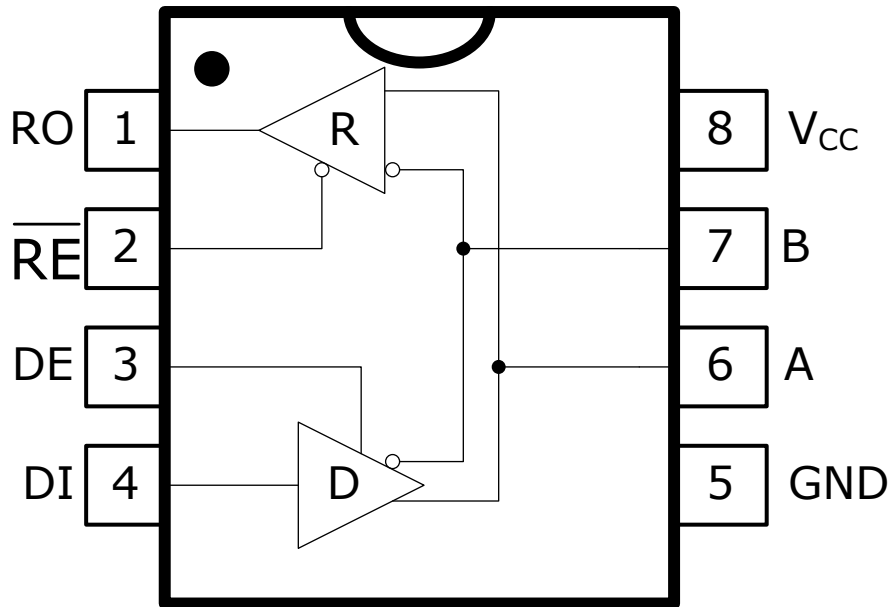
Figure List

Figure 4-1 Supply Current vs. Temperature.....	11
Figure 4-2 Driver Differential Output Voltage vs. Temperature	11
Figure 4-3 Shutdown Current vs. Temperature.....	12
Figure 4-4 Receiver Output High Voltage vs. Temperature	12
Figure 5-1 Driver Test Circuits.....	14
Figure 5-2 Driver Propagation Delay Waveform.....	14
Figure 5-3 Receiver Propagation Delay Test Circuit and Waveform	14
Figure 6.3-1 RS-485 Network with V6602.....	16

Table List

Table 2-1 Transmitting	7
Table 2-2 Receiving	7

1. Pin Descriptions



No.	Pin	Description
1	RO	Receiver output. When $\overline{RE}$ is logic low, and if $(A-B) > -10\text{mV}$, RO is logic high; if $(A-B) < -50\text{mV}$, RO is logic low.
2	$\overline{RE}$	Receiver output enable. When $\overline{RE}$ is logic low, RO is active. When $\overline{RE}$ is logic high, RO is in a high impedance state. When $\overline{RE}$ is logic high, and DE is logic low, the device enters low-power shutdown mode.
3	DE	Driver output enable. When DE is logic high, the driver output is enabled. When DE is logic low, the driver output is in a high impedance state. When $\overline{RE}$ is logic high, and DE is logic low, the device enters low-power shutdown mode.
4	DI	Driver input. With DE high, logic low at DI enforces noninverting output low, and inverting output high, and logic high at DI enforces noninverting output high, and inverting output low.
5	GND	Ground
6	A	Noninverting receiver input/ Noninverting driver output
7	B	Inverting Receiver input/ Inverting driver output
8	V _{CC}	Positive supply input: $3.3\text{ V} \leq V_{CC} \leq 5\text{V}$ Bypass V _{CC} to GND with a 0.1uF capacitor.

2. Truth Tables

Table 2-1 Transmitting

Input			Output	
$\overline{RE}$	DE	DI	B	A
X	1	1	0	1
X	1	0	1	0
0	0	X	Z	Z
1	0	X	Shutdown	

Table 2-2 Receiving

Input			Output
$\overline{RE}$	DE	A-B	RO
0	X	> -10mV	1
0	X	< -50mV	0
0	X	Open/shorted	1
1	1	X	Z
1	0	X	Shutdown

In the table, "1" represents logic high, "0" represents logic low, "Z" represents high impedance state, and "X" represents "Don't care".

3. Specifications

3.1 Absolute Maximum Ratings

Parameter	Symbol	Test Conditions	Min.	Max.	Unit
Supply Voltage	V_{CC}			+6	V
Control Input Voltage	/RE, DE		-0.3	+6	V
Driver Input Voltage	DI		-0.3	+6	V
Driver Output Voltage	A, B		-8	+13	V
Receiver Input Voltage	A, B		-8	+13	V
Receiver Output Voltage	RO		-0.3	$V_{CC}+0.3$	V
Continuous Power Dissipation		$T_A=+70^{\circ}\text{C}$, Derate 5.85 mW/ $^{\circ}\text{C}$ above $+70^{\circ}\text{C}$		471	mW
Operating Temperature			-40	85	$^{\circ}\text{C}$
Storage Temperature Range			-65	150	$^{\circ}\text{C}$
Soldering temperature		Soldering, 10s		300	$^{\circ}\text{C}$

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 in the operational sections of the specifications are not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

3.2 Electrical Characteristics

All maximum/minimum specifications apply over the entire recommended operation range, unless otherwise noted. All typical specifications are at $T_A=25^{\circ}\text{C}$, $V_{CC}=5.0\text{V}$ unless otherwise noted.

All current into the device is positive, and all current out of the device is negative. All voltages are relative to the respective ground.

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Driver						
Supply Voltage Range	V_{CC}		3.15		5.5	V
Driver Differential Outputs	V_{OD}	$R_L=100\Omega$	2.0		V_{CC}	V
		$R_L=54\Omega$	1.4	1.6	V_{CC}	
		No load			V_{CC}	

V6602 RS-485 Transceiver

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Change in Magnitude of Differential Output Voltage ¹	ΔV_{OD}	$R_L = 100\Omega$ or 54Ω			0.2	V
Common-Mode Output Voltage	V_{OC}	$R_L = 100\Omega$ or 54Ω		$V_{CC}/2$		V
Change in Magnitude of Common-Mode Output Voltage	ΔV_{OC}	$R_L = 100\Omega$ or 54Ω			0.2	V
Input Threshold High	V_{IH}	DE, DI, $\overline{RE}$	2.5			V
Input Threshold Low	V_{IL}	DE, DI, $\overline{RE}$			0.8	V
Input Hysteresis	V_{HYS}	DE, DI, $\overline{RE}$		100		mV
Driver Short-Circuit Output Current	I_{OSD}	$0 \leq V_{OUT} \leq +12V$		70	100	mA
		$-7V \leq V_{OUT} \leq V_{CC}$		-70	100	
Thermal-Shutdown Threshold	T_{TS}			150		°C
Thermal-Shutdown Hysteresis	T_{TSH}			30		°C
Receiver						
Receiver Differential Threshold Voltage	V_{TH}	$-7V \leq V_{OUT} \leq 12V$	-10		-50	mV
Receiver Input Hysteresis	ΔV_{TH}			20	30	mV
RO Threshold High	V_{OH}	$I_O = -5mA$	$V_{CC} - 0.5$			V
RO Threshold Low	V_{OL}	$I_O = 5mA$			0.5	V
Three-State Output Current at Receiver	I_{ORZ}	$0 \leq V_O \leq V_{CC}$			1	μA
Receiver Input Impedance	R_{IN}	$-7V \leq V_{CM} \leq 12V$	96			k Ω
Receiver Short-Circuit Output Current	I_{OSR}	$0 \leq V_{RO} \leq V_{CC}$		17	30	mA
Supply Current						
Supply current	I_{CC}	No load, $\overline{RE} = DE = V_{CC}$		0.5	0.6	mA
		No load, $\overline{RE} = DE = 0$		0.4	0.6	mA
Supply Current in Low-Power Shutdown Mode	I_{SHDN}	$\overline{RE} = V_{CC}, DE = 0$		0.5	1	μA
ESD Protection						

¹ ΔV_{OD} denotes the change in magnitude of V_{OD} , and ΔV_{OC} denotes the change in magnitude of V_{OC} , when the DI input changes state.

V6602 RS-485 Transceiver

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit
A, B port ESD Protection		Human Body Model (HBM)		±15		KV
		Contact Discharge, IEC 61000-4-2		±15		KV
Driver Switching Characteristics						
Propagation Delay	t_{DPLH}	$R_{DIFF}=54\Omega, C_L=50pF$	40		100	ns
	t_{DPHL}		40		100	ns
Driver Differential Output Rise or Fall Time				70		ns
Maximum Data Rate	F_{MAX}		500			kbps
Receiver Switching Characteristics						
Propagation Delay	t_{RPLH}	$ V_A-V_B \geq 2.0V$		60	80	ns
	t_{RPHL}	Rise or fall time is less than 15ns				ns
Receiver Input Rise or Fall Time	t_{RSKD}	$ V_A-V_B \geq 2.0V$		60	80	ns
		Rise or fall time is less than 15ns				
Maximum Data Rate	F_{MAX}		500			kbps
Temperature						
Operation Temperature	T_A		-40		+85	°C
Storage Temperature	T_S		-65		+150	°C
Lead Temperature (Soldering, 10s)				300		°C

4. Typical Operating Characteristics

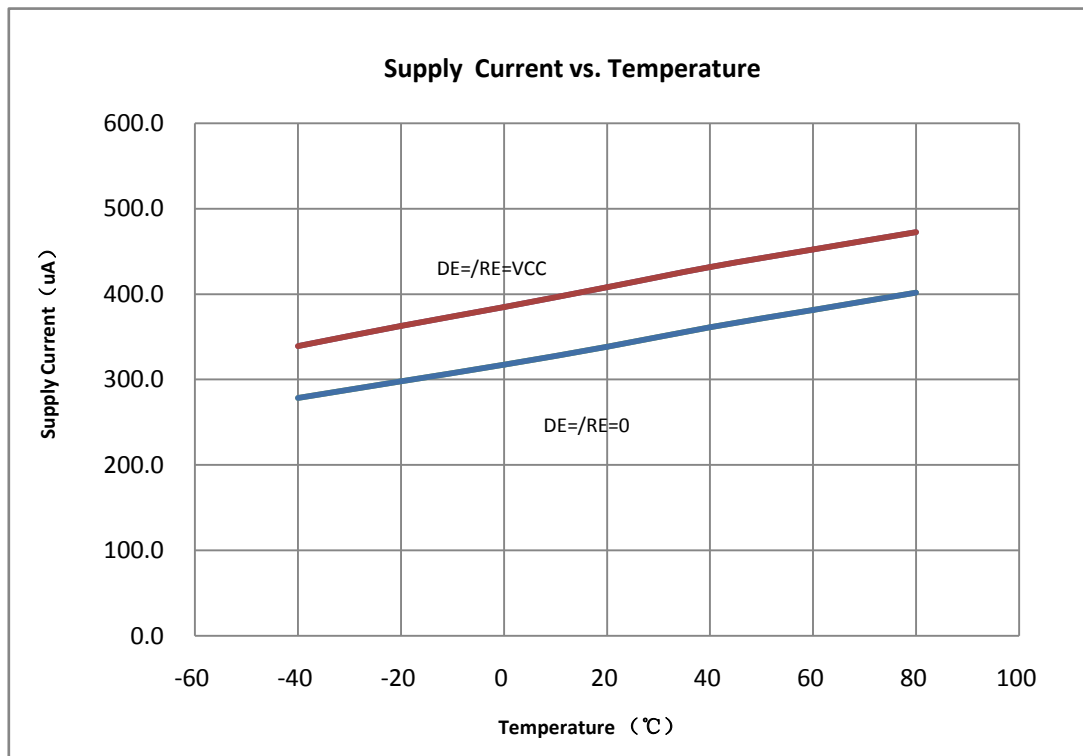


Figure 4-1 Supply Current vs. Temperature

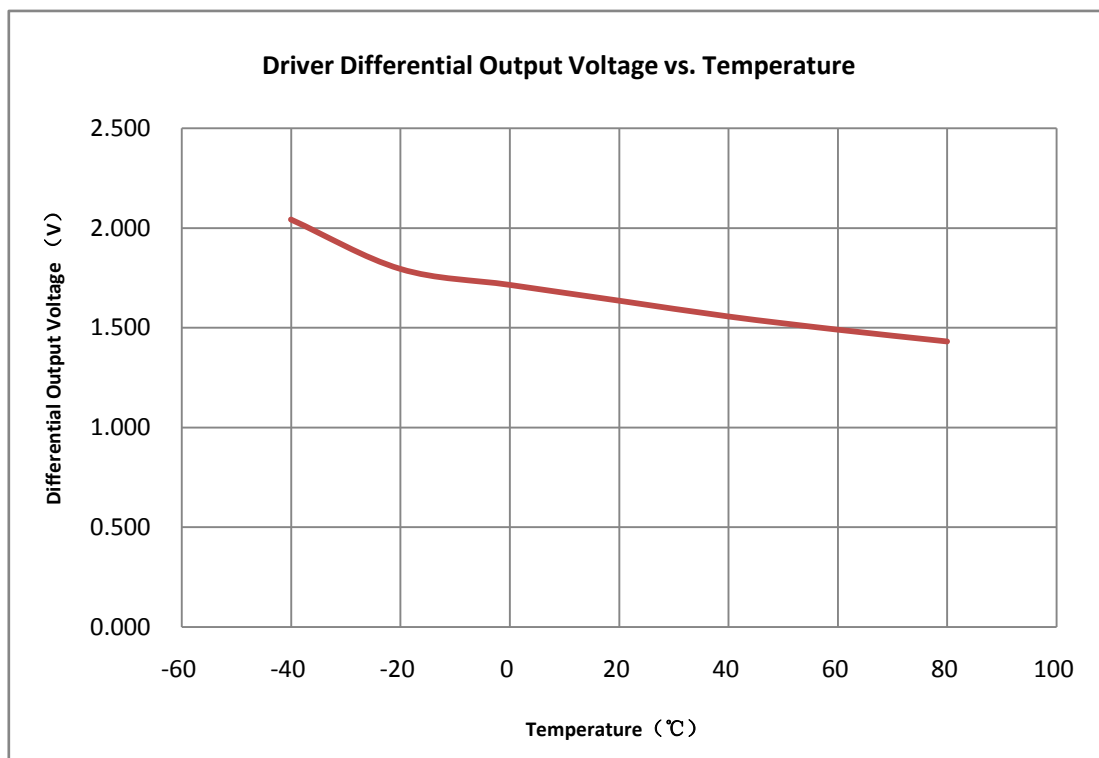


Figure 4-2 Driver Differential Output Voltage vs. Temperature

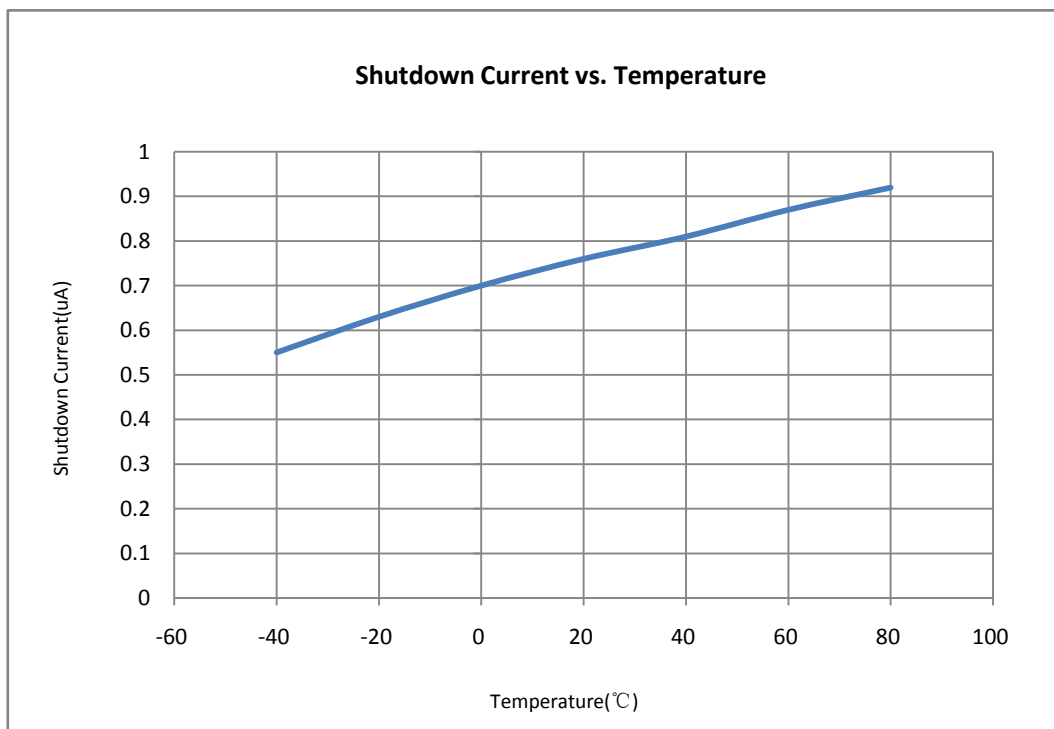


Figure 4-3 Shutdown Current vs. Temperature

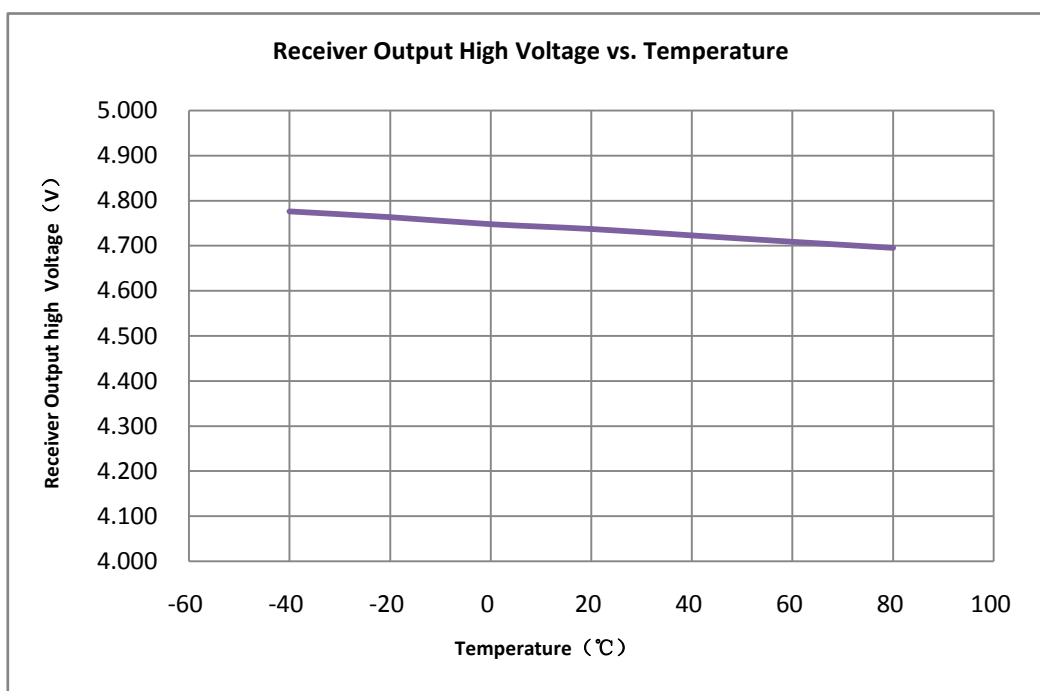


Figure 4-4 Receiver Output High Voltage vs. Temperature

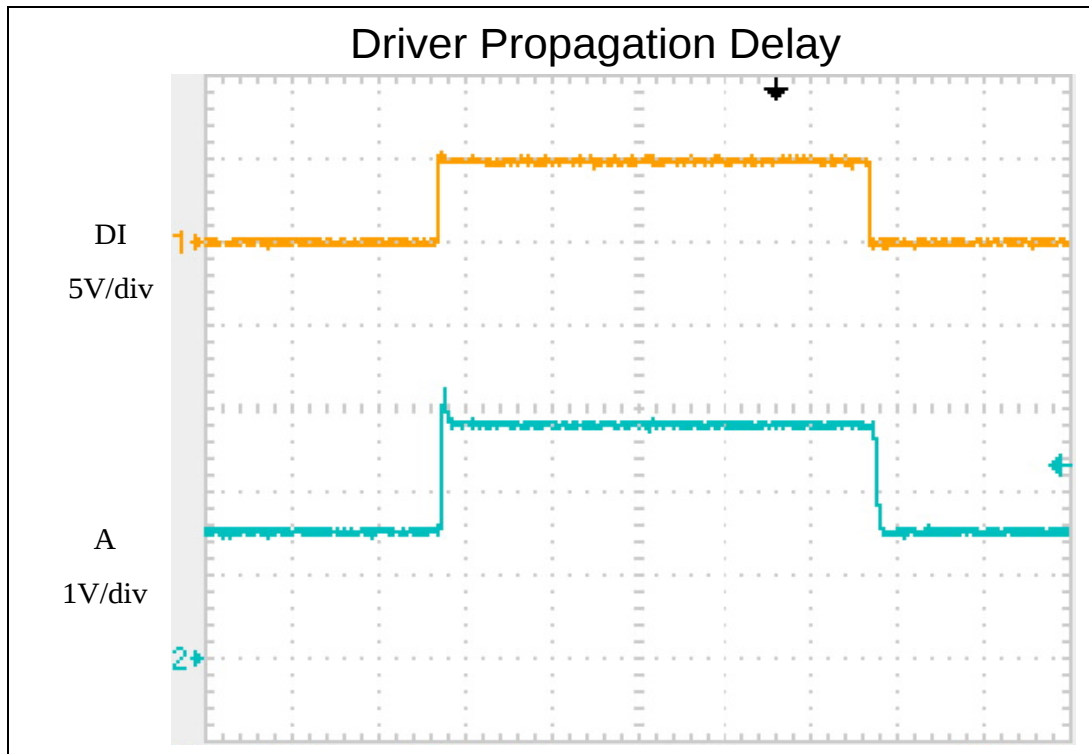


Figure 4-5 Driver Propagation Delay

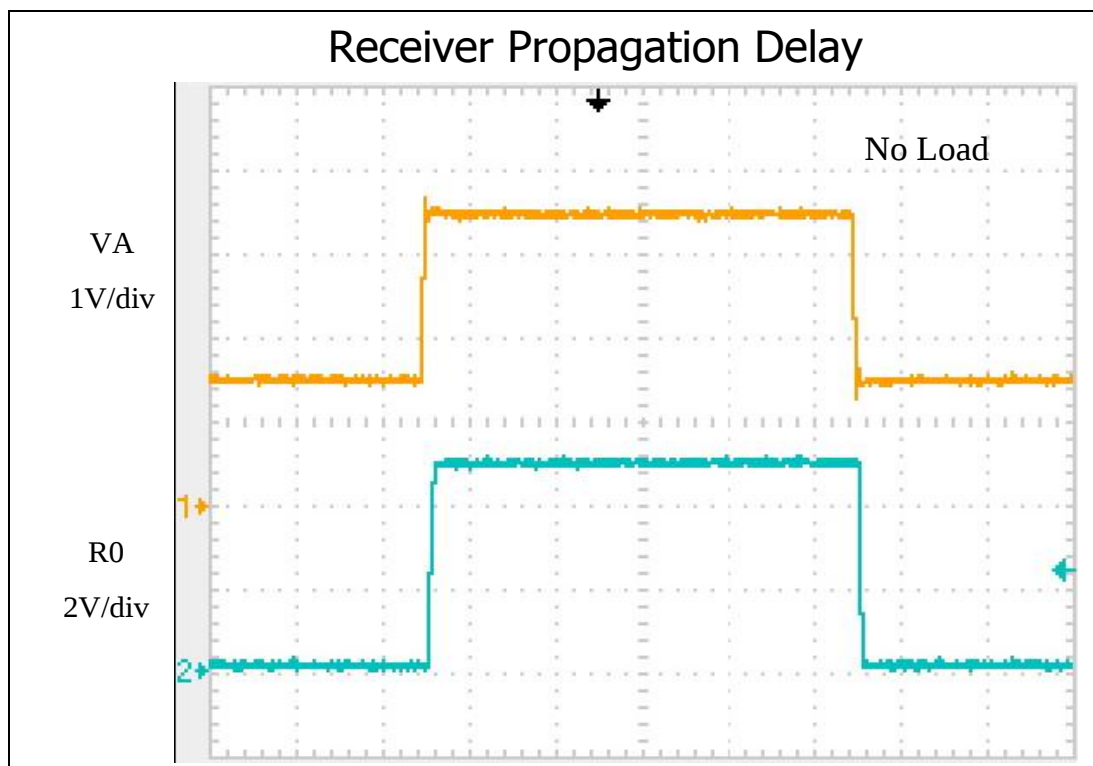


Figure 4-6 Receiver Propagation Delay

5. Test Circuits and Waveforms

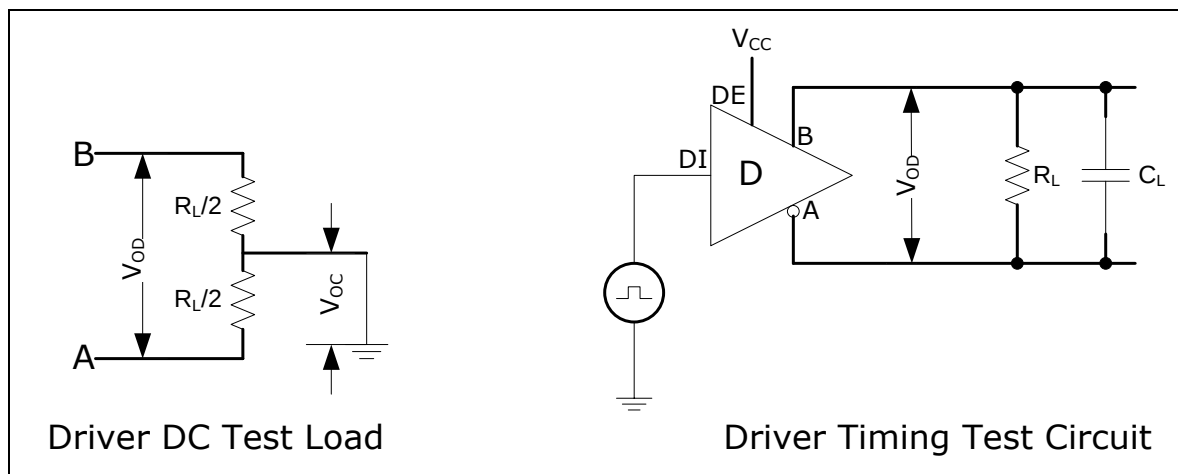


Figure 5-1 Driver Test Circuits

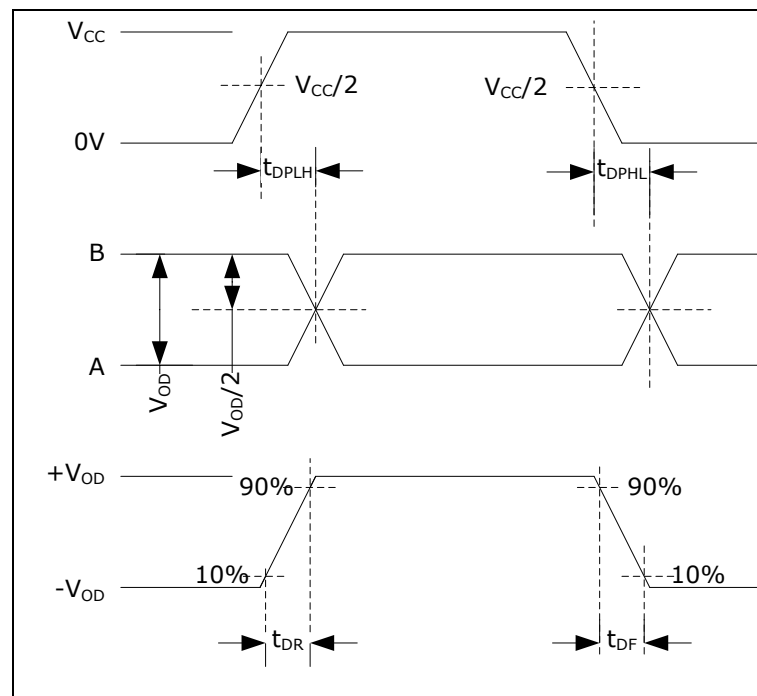


Figure 5-2 Driver Propagation Delay Waveform

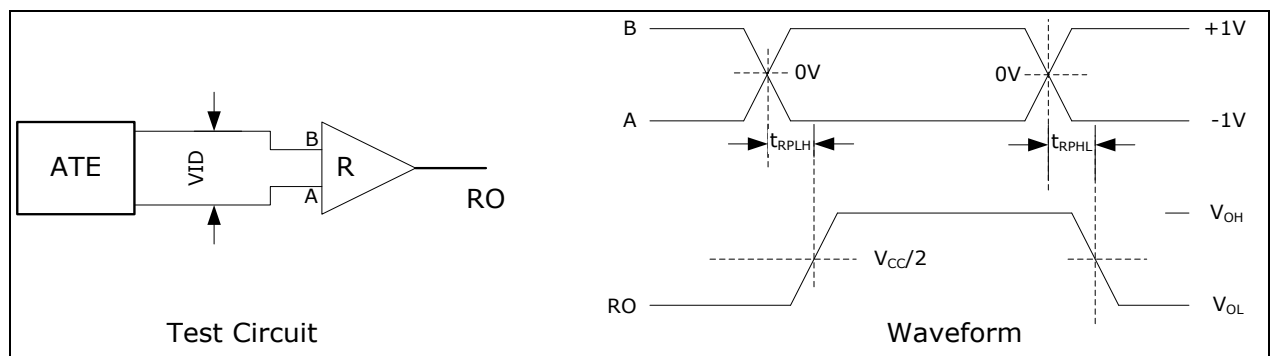


Figure 5-3 Receiver Propagation Delay Test Circuit and Waveform

6. Circuit Description

The V6602 is an RS-485 transceiver featuring half-duplex, low power consumption, and low-slew-rate. It is completely compliant with the EIA/TIA-485 standard.

The V6602 integrates one driver and one receiver, both can be enabled independently. When both driver and receiver are disabled, the device will output the high impedance (Tri-State). The V6602 has high driving capability allowing up to 256 transceivers on the same communication bus. The low-slew-rate driver can reduce EMI and reflections caused by inappropriate terminal matching. It can also realize the error-free data transmission up to 500 Kbps.

V6602 can support the wide supply voltage input of 3.3V/5 V. In the application of 3.3V power supply, the input/output logic level is 3.3V. In the application of 5V power supply, the input/output logic level is 5V. The V6602 has less than 0.6-mA supply current under the no-load condition. In the shutdown mode, the power consumption is less than 1 μ A.

The V6602 is protected from faults due to shorted or open receiver input, and integrates over-temperature, over-current, and over-voltage protection.

6.1 Fail-Safe Protection

The V6602 has a fail-safe-protected receiver input. When the receiver input is shorted or open, or when all the drivers on the terminated cable are disabled, the device can guarantee the RO is logic high.

In the V6602, the receiver differential threshold voltage is -10mV and -50mV. If the differential input of the receiver (A-B) is higher than -10mV, RO will be logic high. If all the drivers on the terminated cable are disabled, the differential input of the receiver (A-B) will be pulled down to 0V, and RO will be logic high.

6.2 Over-Temperature Protection

The integrated thermal shutdown circuit in the V6602 can protect the device from the power dissipation caused by faults. When the temperature of the device exceeds +150°C, the device will go to thermal shutdown mode.

6.3 Output Circuit Protection

In the V6602, the overvoltage protection is intended to protect the device from overvoltage.

The overvoltage protection circuit compares the output voltage of port A and port B all the time when both $\overline{RE}$ and DE are in the transmitting state ($\overline{RE}=V_{CC}$, 且 $DE=V_{CC}$). When V_A or V_B is less than GND, or V_A or V_B is higher than V_{CC} , the device enters over-voltage protecting mode, and the circuit will protect the device from damage due to the overvoltage faults. In the low power shutdown mode, this circuit stops working.

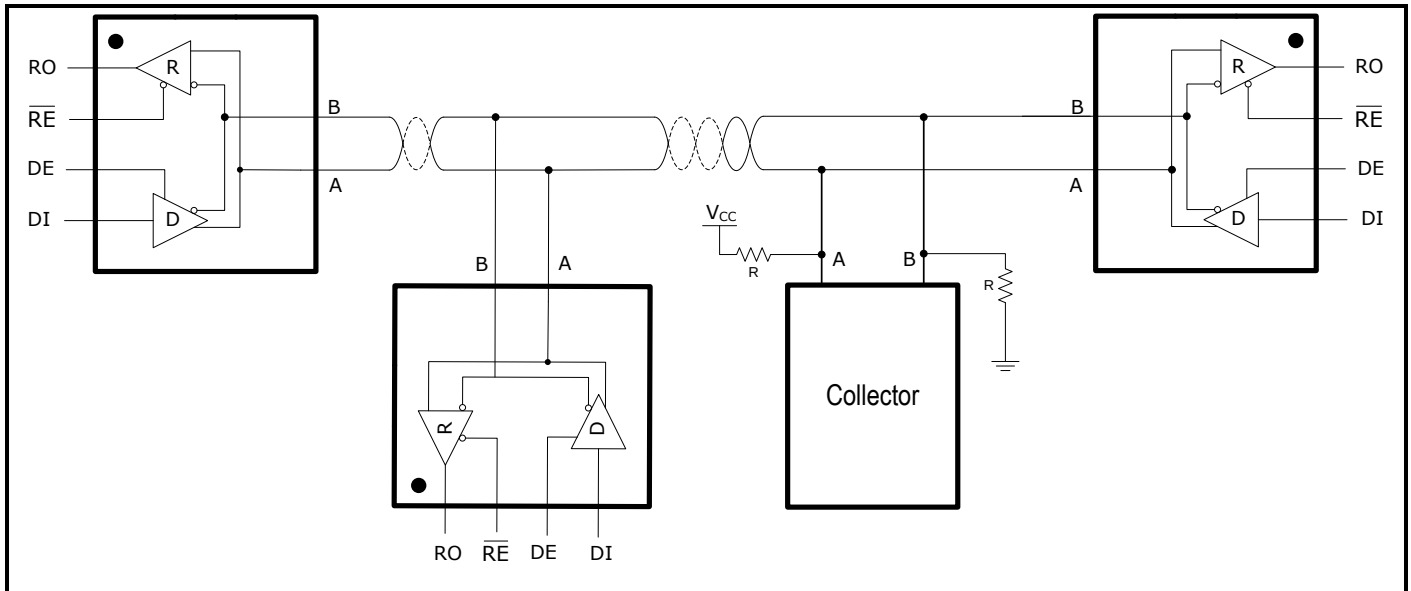


Figure 6-1 RS-485 Network with V6602

6.4 Up to 256 Transceivers One Bus

With regard to a standard RS-485 transceiver, the receiver input impedance is $12k\Omega$ (1-unit load), and the driver can drive up to 32-unit loads.

As for the V6602, the receiver input impedance is higher than 1/8-unit loads ($R1 > 96k\Omega$), which allows up to 256 transceivers on the bus. All drivers can be connected to one bus in any combination only if the total loads are no more than 32 units.

7. Outline Dimensions

