20Mbps RS-485 Transceivers with ±20kV IEC ESD Protection

1 FEATURES

- **High-Performance and Compliant with RS-485 TIA/EIA-485 Standard**
- **3.0V to 5.5V Supply Voltage**
- **Bus I/O Protection**
  - ±20kV HBM ESD
  - ±6kV IEC 6100-4-2 Contact Discharge
- **-7V to +12V Common-Mode Input Voltage**
- **Up to 256 Nodes on the Same Bus (1/8 unit load)**
- **Low Stand-By Current: <5μA**
- **Full Fail-safe Guarantees Known Receiver Output State**
- **Glitch-Free during Power on/Power off**
- **Short-Circuit Protection**
- **Over Temperature Protection**
- **$|V_{OD}|$ >2.1V at 5V Supply Voltage**
- **Operating Temperature Range: -40°C to +125°C**
- **Packages: SOP8**

2 APPLICATIONS

- **Electricity Meters (E-Meters)**
- **Inverters**
- **HVAC Systems**
- **Video Surveillance Systems**
- **Industrial Automation & Control**

3 DESCRIPTIONS

The RS1920S is a robust half-duplex RS-485 transceiver for industrial applications. The bus pins are immune to high levels of IEC Contact Discharge ESD events eliminating need of additional system level protection components.

The device operates from a single 3.0V to 5.5V supply. The RS1920S device can transmit and receive at data rate up to 20Mbps. The wide common-mode voltage range and low input leakage on bus pins make RS1920S suitable for multi-point applications over long cable runs.

The RS1920S is available in industry standard 8-pin SOP, package for drop-in compatibility. It operates over an ambient temperature range of -40°C to +125°C.

Device Information (1)

PART NUMBER	PACKAGE	BODY SIZE(NOM)
RS1920S	SOP8	4.90mm × 3.90mm

(1) For all available packages, see the orderable addendum at the end of the data sheet.

4 TYPICAL APPLICATION

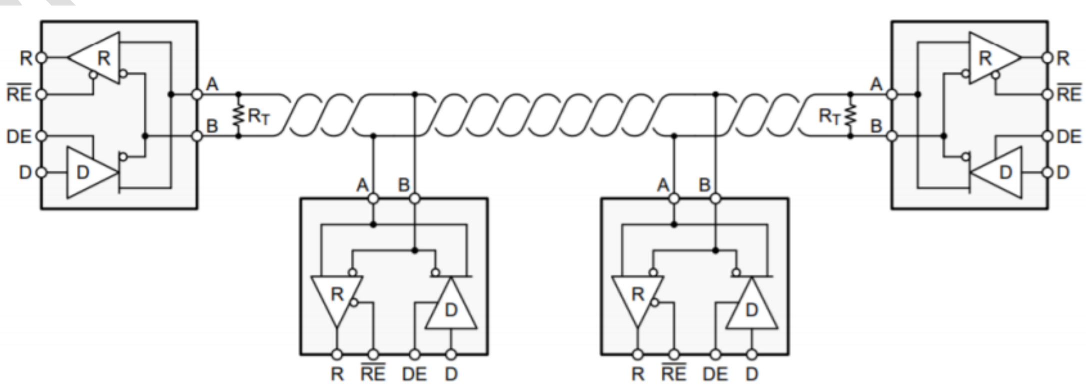


Table of Contents

5 REVISION HISTORY

Note: Page numbers for previous revisions may different from page numbers in the current version.

VERSION	Change Date	Change Item
A.0	2026/04/24	Preliminary version completed

6 PACKAGE/ORDERING INFORMATION [1]

PRODUCT	ORDERING NUMBER	TEMPERATURE RANGE	PACKAGE LEAD	PACKAGE MARKING [2]	MSL [3]	PACKAGE OPTION
RS1920S	RS1920SXK	-40°C ~+125°C	SOP8	RS1920S	MSL3	Tape and Reel, 4000

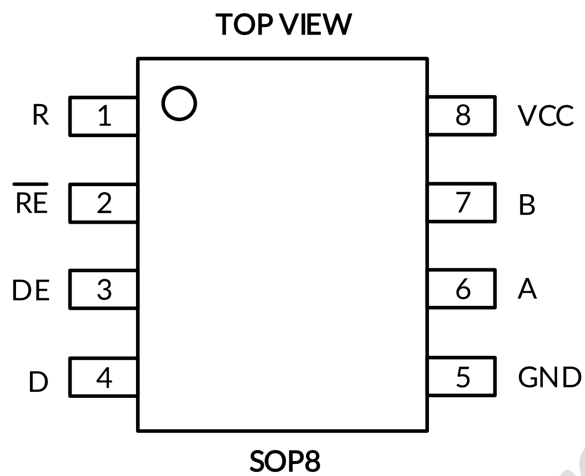
NOTE:

(1) This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the right-hand navigation.

(2) There may be additional marking, which relates to the lot trace code information (data code and vendor code), the logo or the environmental category on the device.

(3) RUNIC classify the MSL level with using the common preconditioning setting in our assembly factory conforming to the JEDEC industrial standard J-STD-20F. Please align with RUNIC if your end application is quite critical to the preconditioning setting or if you have special requirement.

7 PIN CONFIGURATION AND FUNCTIONS



PIN DESCRIPTION

NAME	PIN SOP8	I/O (1)	DESCRIPTION
R	1	O	Receiver Data Output
$\overline{RE}$	2	I	Receiver Enable, Active low (with internal pull-up)
DE	3	I	Driver Enable, Active high (with internal pull-down)
D	4	I	Driver Data Input (with internal pull-up)
GND	5	Ground	Ground
A	6	I/O	Bus I/O port, A
B	7	I/O	Bus I/O port, B
VCC	8	Power	Power supply

(1) I = Input, O = Output, I/O = Input and Output.

8 SPECIFICATIONS

8.1 Absolute Maximum Ratings

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

SYMBOL			MIN	MAX	UNIT
V_{CC}	Supply voltage		-0.5	7	V
V_{IO}	Bus A&B voltage		-8	13	V
	Logic input pin ($\overline{RE}$, DE, D)		-0.3	V_{CC}+0.3	V
	Logic output pin (R)		-0.3	V_{CC}+0.3	V
V_{IO_DIFF}	The voltage difference between bus voltage A and B		-8	13	V
θ_{JA}	Package thermal impedance [3]	SOP8		110	°C/W
T_A	Operating temperature		-40	125	°C
T_J	Junction temperature [4]			150	
T_{stg}	Storage temperature		-65	150	

(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 may affect device reliability.
(2) All voltages are with respect to the GND pin.
(3) The package thermal impedance is calculated in accordance with JESD-51.
(4) The maximum power dissipation is a function of $T_{J(MAX)}$, $R_{\theta JA}$, and T_A. The maximum allowable power dissipation at any ambient temperature is $PD = (T_{J(MAX)} - T_A) / R_{\theta JA}$. All numbers apply for packages soldered directly onto a PCB.

8.2 ESD Ratings

The following ESD information is provided for handling of ESD-sensitive devices in an ESD protected area only.

				VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM), EIA/JESD22-a114	Bus A &B	±20	kV
			Other pins	±8	kV
		Charge device model (CDM), ANSI/ESDA/JEDEC JS-002-2025	All pins	±2	kV
		Contact Discharge, per IEC 61000-4-2	Bus A &B	±6	kV
		Air Gap Discharge, per IEC 61000-4-2	Bus A &B	±12	kV

ESD SENSITIVITY CAUTION

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

8.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)

SYMBOL	PARAMETER	MIN	MAX	UNIT
V_{CC}	Supply voltage	3.0	5.5	V
V_{IN}	Bus input voltage	-7.0	12	V
V_{IH}	Input high voltage	2.0	V_{CC}	V
V_{IL}	Input low voltage	0	0.8	V
$1/t_{UI}$	Data rate		20	Mbps
R_L	Differential Load	54		Ω
T_A	Operating ambient temperature	-40	125	°C

8.4 Electrical Characteristics

at T_A = 25°C, and V_{CC} = 5 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN (2)	TYP (3)	MAX (2)	UNIT
Driver Differential Output Voltage Magnitude	$\lvert V_{OD} \rvert$	R_L = 60 Ω, -7 V ≤ V_{test} ≤ 12	1.5	3.6		V
		R_L = 60 Ω, -7 V ≤ V_{test} ≤ 12, 4.5V ≤ V_{CC} ≤ 5.5V	2.1	3.6		
		R_L = 100 Ω, C_L = 50pF	2.0	4.2		
		R_L = 54 Ω, C_L = 50pF	1.5	3.6		
Change in Differential Output Voltage	$\Delta \lvert V_{OD} \rvert$	R_L = 54 Ω or 100 Ω, C_L = 50pF	-50		50	mV
Common-Mode Output Voltage	V_{OC}	R_L = 54 Ω or 100 Ω, C_L = 50pF	1	V_{CC}/2	3.3	V
Steady-State Common-Mode Output Voltage	$\Delta V_{OC(SS)}$	R_L = 54 Ω or 100 Ω, C_L = 50pF	-50		50	mV
Short-Circuit Output Current	I_{OS}	DE = V_{CC}, -7 V ≤ V_O ≤ 12 V		100	150	mA
Bus Input Current		DE=0, V_{CC}=0V or 5.5V, V_I=12V		75	125	µA
		DE=0, V_{CC}=0V or 5.5V, V_I=-7V	-100	-40		µA
Bus Input Impedance	RI	V_A/ V_B=-7V or V_A/ V_B=12V	96			kΩ
Positive-Going Input Threshold Voltage	V_{TH+}			-110	-50	mV
Negative-Going Input Threshold Voltage	V_{TH-}		-200	-140		mV
Input Hysteresis	V_{HYS}			30		mV
Output High Voltage	V_{OH}	I_{OH} = -4mA	V_{CC}-0.5	V_{CC}-0.3		V
Output Low Voltage	V_{OL}	I_{OL} = 4mA		0.2	0.4	V
Output High-Impedance Current	I_{OZ}	V_O=0V or V_{CC}, $\overline{RE}$ =V_{CC}	-1		+1	µA
Output Short-Circuit Current	I_{OSR}	$\overline{RE}$=0, DE=0			95	mA
Input Current (D, DE, RE)	I_{IN}		-5		+5	µA
Supply Current (Quiescent)	I_{CC}	Driver and receiver enabled $\overline{RE}$=0V, DE=V_{CC}, no load		0.9	1.4	mA
		Driver enabled, receiver disabled $\overline{RE}$=V_{CC}, DE=V_{CC}, no load		0.55	0.9	mA
		Driver disabled, receiver enabled $\overline{RE}$=0V, DE=0V, no load		0.5	0.8	mA
		Driver and receiver disabled $\overline{RE}$=V_{CC}, DE=0V, DI=V_{CC}, no load			5.0	µA
Thermal Shutdown Temperature				165		°C
Thermal Shutdown Hysteresis				15		°C

NOTE:

(1) Under any condition, ensure that V_{TH+} is at least V_{HYS} higher than V_{TH-}.

(2) Limits are 100% production tested at 25°C. Limits over the operating temperature range are ensured through correlations using statistical quality control (SQC) method.

(3) Typical values represent the most likely parametric norm as determined at the time of characterization. Actual typical values may vary over time and will also depend on the application and configuration.

8.5 Switching Characteristics

Over recommended operating conditions

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
Driver						
Differential Output Rise/Fall Time	t_r, t_f	R_L = 54 Ω, C_L = 50pF		5	12	ns
Propagation Delay	t_{PHL}, t_{PLH}	R_L = 54 Ω, C_L = 50pF		10	25	ns
Pulse Skew, $\|t_{PHL}- t_{PLH}\|$	$t_{sk(P)}$	R_L = 54 Ω, C_L = 50pF			5	ns
Disable Time	t_{PHZ}, t_{PLZ}			10	30	ns
Enable Time	t_{PZH}, t_{PZL}	$\overline{RE}$=0V		10	40	ns
	t_{PZH}, t_{PZL}	$\overline{RE}$=V_{CC}		6	12	µs
Receiver						
Differential Output Rise/Fall Time	t_r, t_f	C_L = 15pF		5	15	ns
Propagation Delay	t_{PHL}, t_{PLH}	C_L = 15pF		40	80	ns
Pulse Skew, $\|t_{PHL}- t_{PLH}\|$	$t_{sk(P)}$	C_L = 15pF			10	ns
Disable Time	t_{PHZ}, t_{PLZ}			10	25	ns
Enable Time	t_{PZH}, t_{PZL}	DE = V_{CC}		35	100	ns
	t_{PZH}, t_{PZL}	DE = 0V		6	12	µs

Note:

(1) C_L includes external circuit (fixture and instrumentation etc.) capacitance.

8.6 Typical Characteristics

NOTE: The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only.

At T_A = 25°C, V_{IN}= 5V power supply, Min/Max specs are over recommended operating conditions unless otherwise specified.

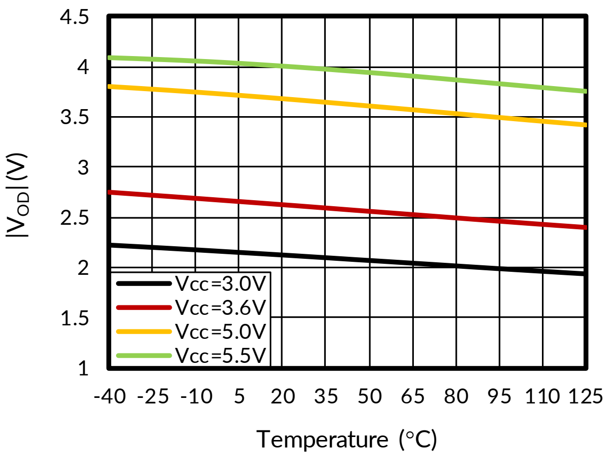


Figure 1. Differential Output Voltage vs Temperature (R_L=54Ω)

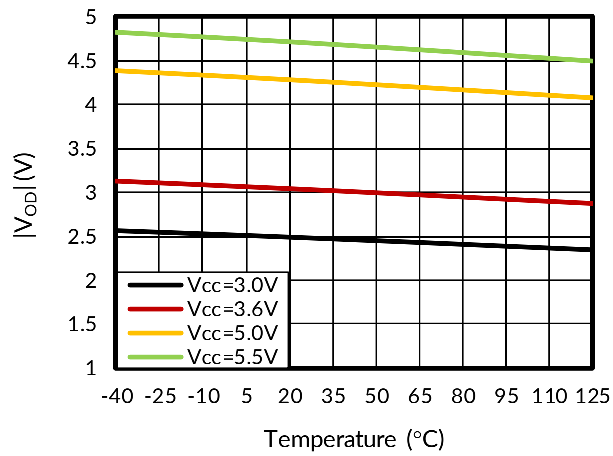


Figure 2. Differential Output Voltage vs Temperature (R_L=100Ω)

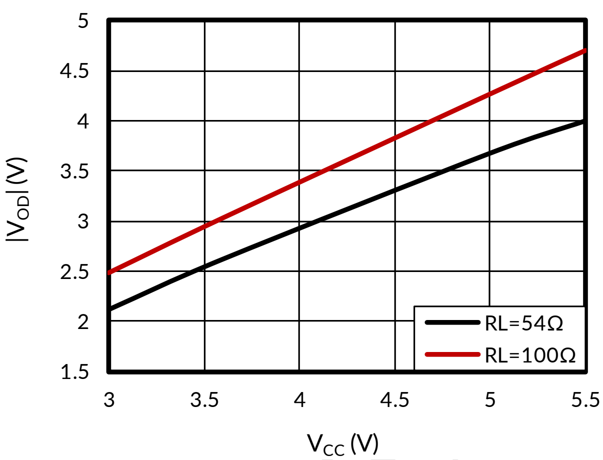


Figure 3. Differential Output Voltage vs Supply Voltage

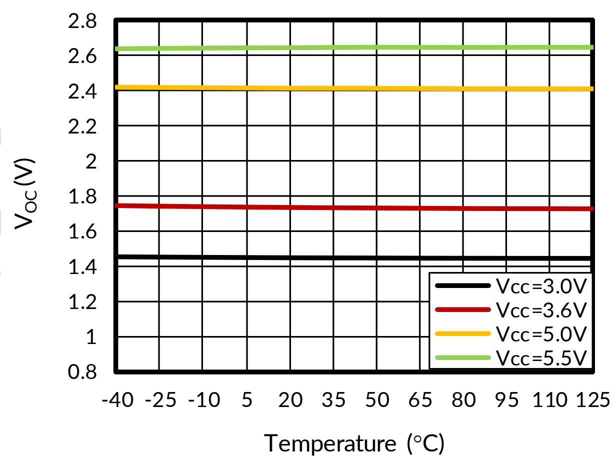


Figure 4. Common-mode Output Voltage vs Temperature

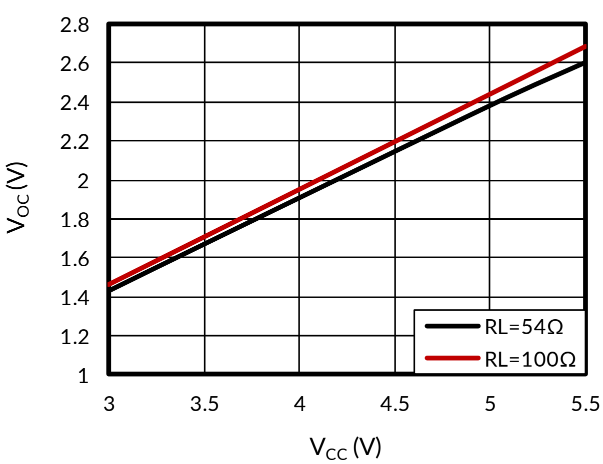


Figure 5. Common-mode Output Voltage vs Supply Voltage

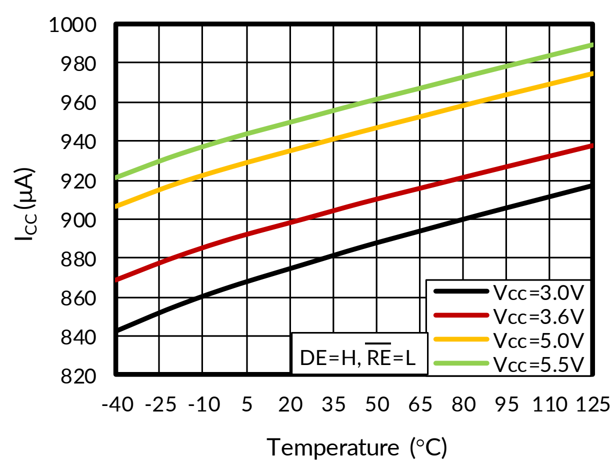


Figure 6. Supply Current vs Temperature

Typical Characteristics

NOTE: The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only.

At T_A = 25°C, V_{IN}= 5V power supply, Min/Max specs are over recommended operating conditions unless otherwise specified.

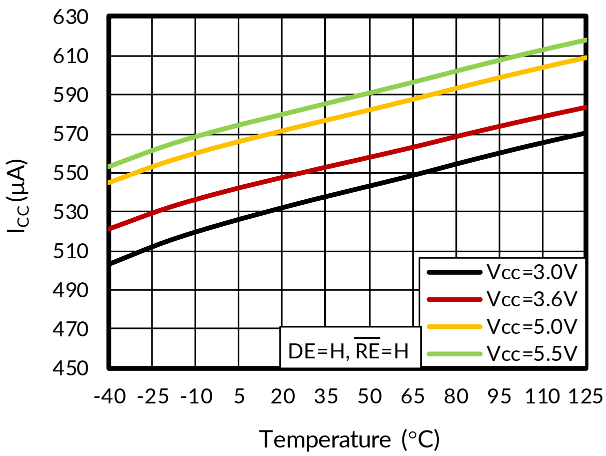


Figure 7. Supply Current vs Temperature

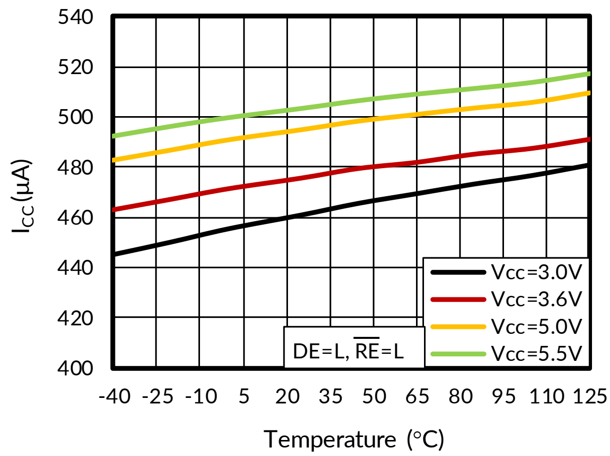


Figure 8. Supply Current vs Temperature

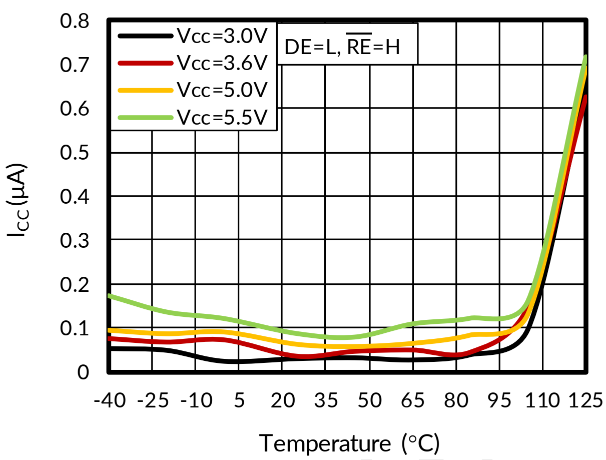


Figure 9. Supply Current vs Temperature

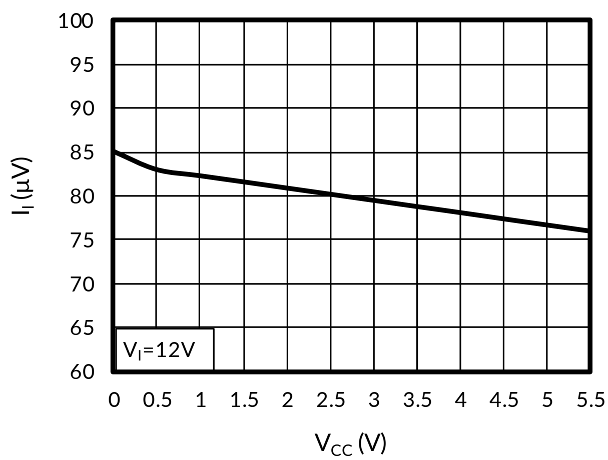


Figure 10. Bus Input Current vs Supply Voltage

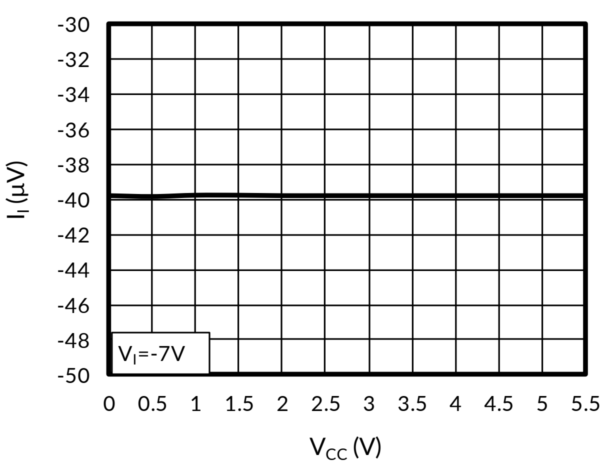


Figure 11. Bus Input Current vs Supply Voltage

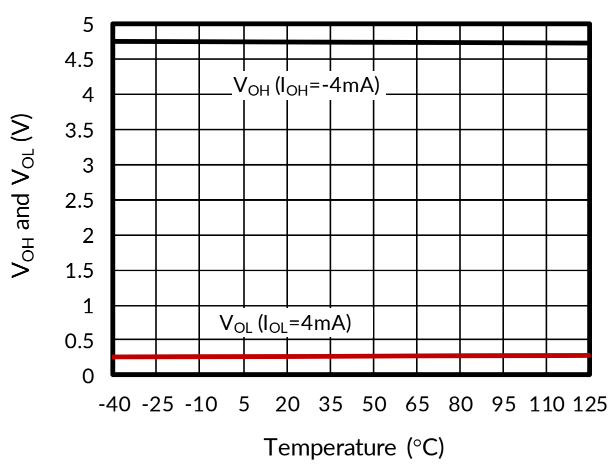


Figure 12. Receiver Output vs Temperature

Typical Characteristics

NOTE: The graphs and tables provided following this note are a statistical summary based on a limited number of samples and are provided for informational purposes only.

At T_A = 25°C, V_{IN}= 5V power supply, Min/Max specs are over recommended operating conditions unless otherwise specified.

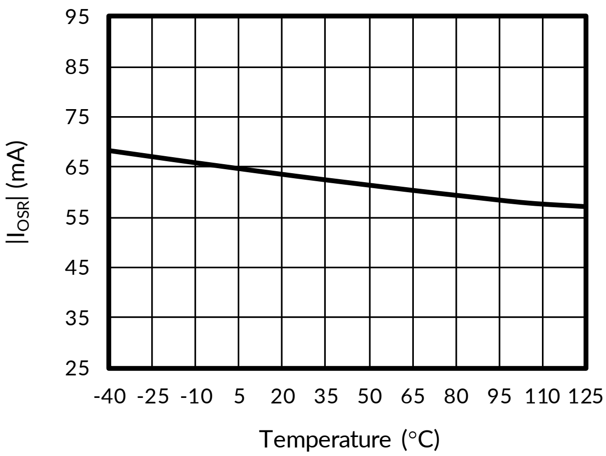


Figure 13. Receiver Output Short Current vs Temperature

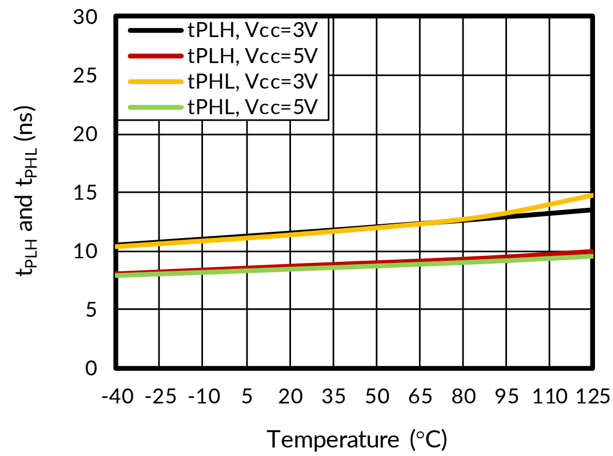


Figure 14. Driver Propagation Delay vs Temperature

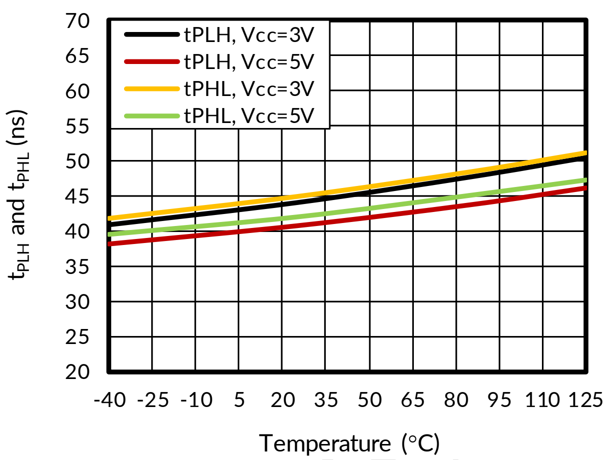


Figure 15. Receiver Propagation Delay vs Temperature

9 PARAMETER MEASUREMENT INFORMATION

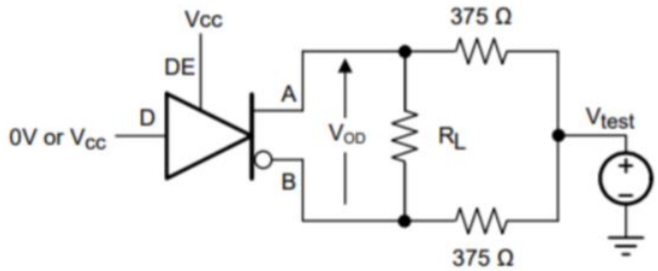


Figure 16. Measurement of Driver Differential Output Voltage With Common-Mode Load

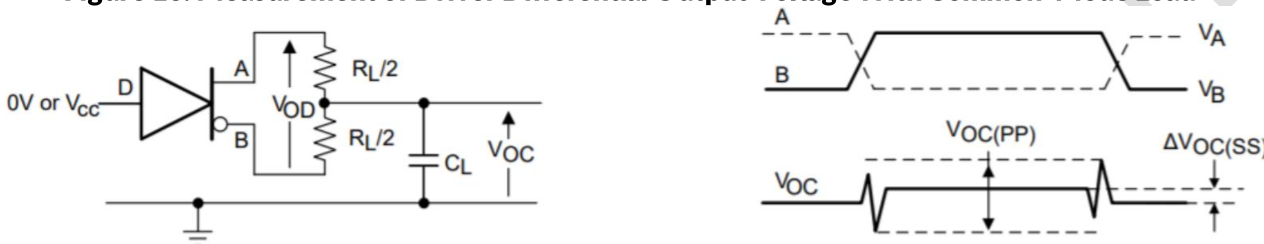


Figure 17. Measurement of Driver Differential and Common-Mode Output With RS-485 Load

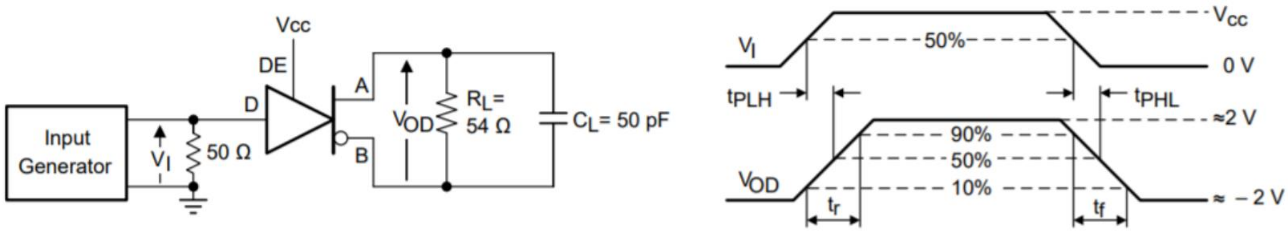


Figure 18. Measurement of Driver Differential Output Rise and Fall Times and Propagation Delays

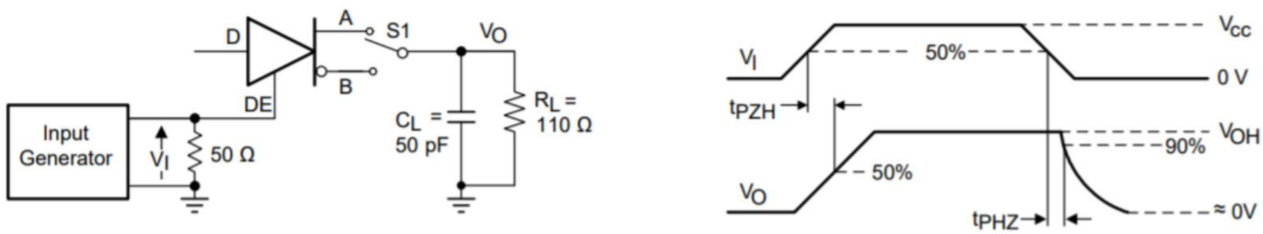


Figure 19. Measurement of Driver Enable and Disable Times With Active High Output and Pull Down Load

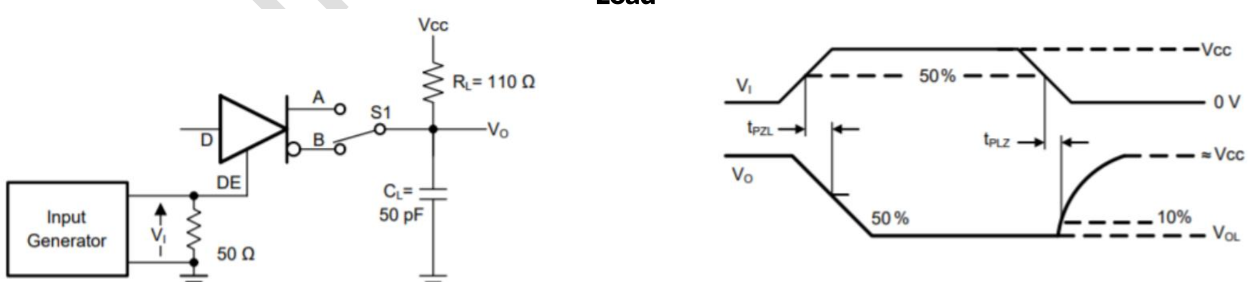


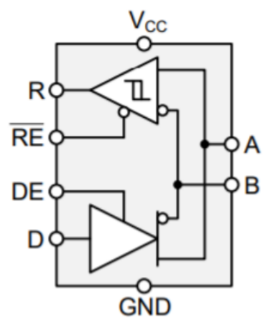
Figure 20. Measurement of Driver Enable and Disable Times With Active Low Output and Pull- Up Load

10 DETAILED DESCRIPTION

10.1 Overview

The RS1920S is a low-power, half-duplex RS-485 transceiver suitable for data transmission up to 20Mbps.

10.2 Functional Block Diagram



10.3 Feature Description

Internal ESD protection circuits protect the transceiver against Electrostatic Discharges (ESD) according to IEC 61000-4-2 of up to ±6kV (Contact Discharge), ±20kV (Human-body model). The RS1920S provides internal biasing of the receiver input thresholds in combination with large input threshold hysteresis. With a positive input threshold of V_{IT+} = –50mV and an input hysteresis of V_{HYS} = 50mV, the receiver output remains logic high under a bus-idle or bus-short conditions without the need for external failsafe biasing resistors. Device operation is specified over a wide temperature range from –40°C to 125°C.

10.4 Device Functional Modes

When the driver enable pin, DE, is logic high, the differential outputs A and B follow the logic states at data input D. A logic high at D causes A to turn high and B to turn low. In this case, the differential output voltage defined as $V_{OD} = V_A – V_B$ is positive. When D is low, the output states reverse, B turns high, A becomes low, and V_{OD} is negative. When DE is low, both outputs turn high-impedance. In this condition the logic state at D is irrelevant. The DE pin has an internal pull-down resistor to ground, thus when left open the driver is disabled (high-impedance) by default. The D pin has an internal pull-up resistor to VCC, thus, when left open while the driver is enabled, output A turns high and B turns low.

Table 1. Driver Function Table

Input	Enable	Output		Function
D	DE	A	B	
H	H	H	L	Actively drive bus high
L	H	L	H	Actively drive bus low
X	L	Z	Z	Driver disabled
X	OPEN	Z	Z	Driver disabled by default
OPEN	H	H	L	Actively drive bus high by default

Note:
X means don't care,
Z means high resistance

When the receiver enable pin, $\overline{RE}$, is logic low, the receiver is enabled. When the differential input voltage defined as $V_{ID} = V_A – V_B$ is positive and higher than the positive input threshold, V_{IT+}, the receiver output, R, turns high. When V_{ID} is negative and lower than the negative input threshold, V_{IT-}, the receiver output, R, turns low. If V_{ID} is between V_{IT+} and V_{IT-} the output is indeterminate. When RE is logic high or left open, the receiver output is high-impedance and the magnitude and polarity of V_{ID} are irrelevant. Internal biasing of the receiver inputs causes the output to go failsafe-high when the transceiver is disconnected from the bus (open-circuit), the bus lines are shorted (short-circuit), or the bus is not actively driven (idle bus).

Table 2. Receiver Function Table

Differential Input	Enable	Output	Function
$V_{ID} = V_A - V_B$	$\overline{RE}$	R	
$V_{IT+} < V_{ID}$	L	H	Receive valid bus high
$V_{IT-} < V_{ID} < V_{IT+}$	L	Indeterminate	Indeterminate bus state
$V_{ID} < V_{IT-}$	L	L	Receive valid bus low
X	H	Z	Receiver disabled
X	OPEN	Z	Receiver disabled by default
Open-circuit bus	L	H	Fail-safe high output
Short-circuit bus	L	H	Fail-safe high output
Idle(terminated) bus	L	H	Fail-safe high output

Note:
X means don't care,
Z means high resistance

11 APPLICATION AND IMPLEMENTATION

Information in the following applications sections is not part of the RUNIC component specification, and RUNIC does not warrant its accuracy or completeness. RUNIC's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

11.1 Application Information

The RS1920S is a half-duplex RS-485/RS-422 transceiver commonly used for asynchronous data transmissions. The driver and receiver enable pins allow for the configuration of different operating modes.

11.2 Typical Application

An RS-485 bus consists of multiple transceivers connecting in parallel to a bus cable. To eliminate line reflections, each cable end is terminated with a termination resistor, R_T, whose value matches the characteristic impedance, Z0, of the cable. This method, known as parallel termination, allows for higher data rates over longer cable length.

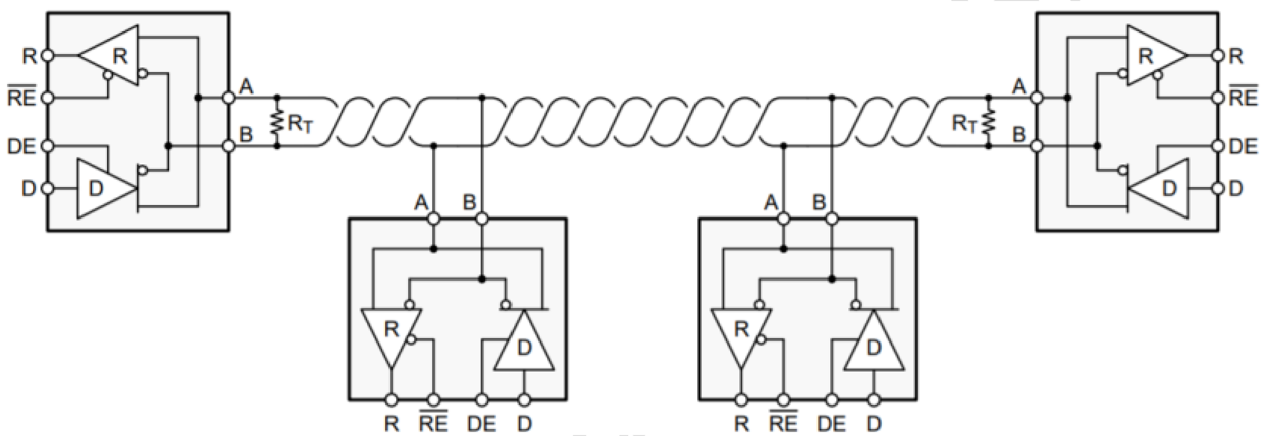


Figure 21. Typical RS-485 Network With Half-Duplex Transceivers

11.3 Supply Voltage Design Requirements

In order to ensure the reliability of data transmission and power supply, it is recommended to place decoupling capacitors from 100nF to 220nF as close as possible to the VCC pin of each transceiver.

12 LAYOUT

12.1 Layout Guidelines

Robust and reliable bus node design often requires the use of external transient protection devices in order to protect against surge transients that may occur in industrial environments. Since these transients have a wide frequency bandwidth (from approximately 3MHz to 300MHz), high-frequency layout techniques should be applied during PCB design.

1. Place the protection circuitry close to the bus connector to prevent noise transients from propagating across the board.
2. Use VCC and ground planes to provide low inductance. Note that high-frequency currents tend to follow the path of least impedance and not the path of least resistance.
3. Design the protection components into the direction of the signal path. Do not force the transient currents to divert from the signal path to reach the protection device.
4. Apply 100nF to 220nF bypass capacitors as close as possible to the VCC pins of transceiver, UART and/or controller ICs on the board.
5. Use at least two vias for VCC and ground connections of bypass capacitors and protection devices to minimize effective via inductance.
6. Use 1kΩ to 10kΩ pullup and pulldown resistors for enable lines to limit noise currents in these lines during transient events.
7. Insert pulse-proof resistors into the A and B bus lines if the TVS clamping voltage is higher than the specified maximum voltage of the transceiver bus pins. These resistors limit the residual clamping current into the transceiver and prevent it from latching up.
8. While pure TVS protection is sufficient for surge transients up to 1kV, higher transients require metal-oxide varistors (MOVs) which reduce the transients to a few hundred volts of clamping voltage, and transient blocking units (TBUs) that limit transient current to less than 1mA.

12.2 Layout Example

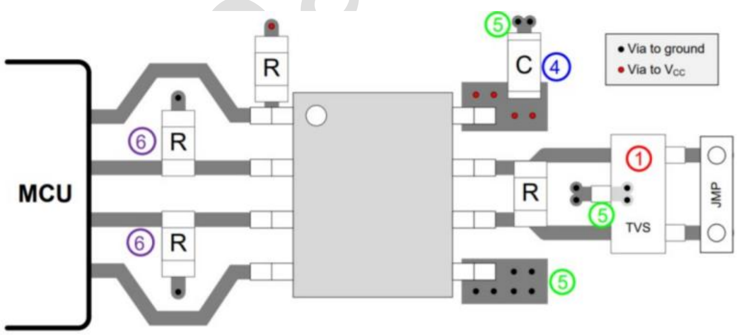
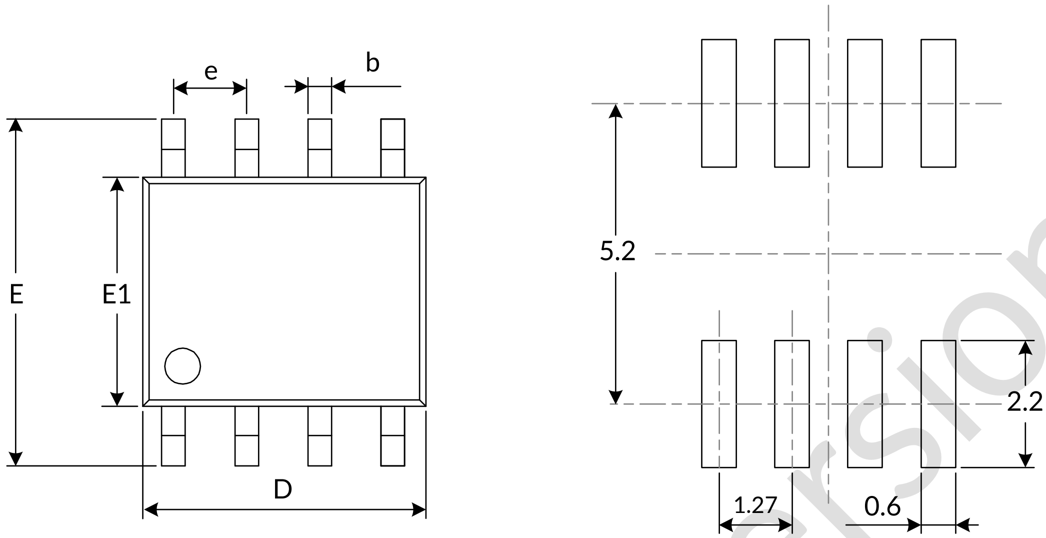


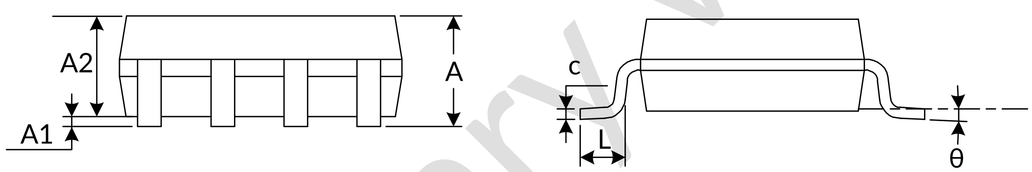
Figure 22. Layout Example

13 PACKAGE OUTLINE DIMENSIONS

SOP8 (3)



RECOMMENDED LAND PATTERN (Unit: mm)



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A (1)	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	0.170	0.250	0.007	0.010
D (1)	4.800	5.000	0.189	0.197
e	1.270(BSC) (2)		0.050(BSC) (2)	
E	5.800	6.200	0.228	0.244
E1 (1)	3.800	4.000	0.150	0.157
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

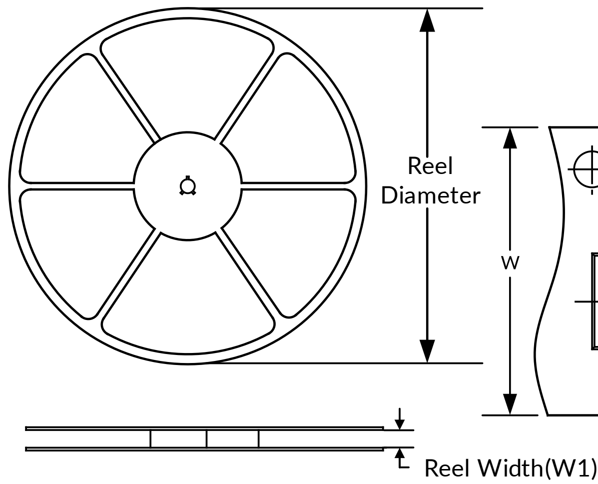
NOTE:

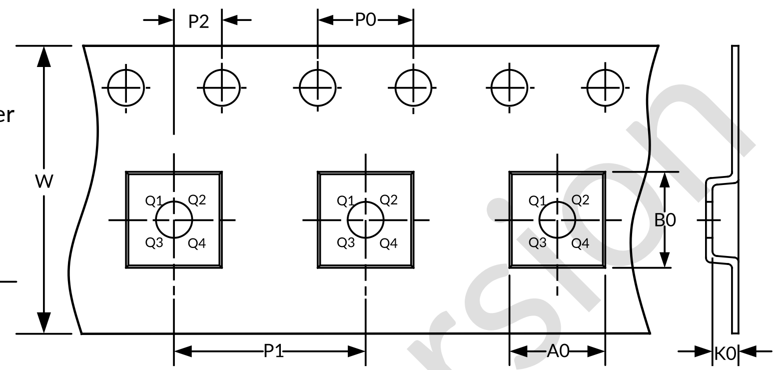
1. Plastic or metal protrusions of 0.15mm maximum per side are not included.
2. BSC (Basic Spacing between Centers), "Basic" spacing is nominal.
3. This drawing is subject to change without notice.

14 TAPE AND REEL INFORMATION

REEL DIMENSIONS

TAPE DIMENSION





NOTE: The picture is only for reference. Please make the object as the standard.

KEY PARAMETER LIST OF TAPE AND REEL

Package Type	Reel Diameter	Reel Width (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
SOP8	13"	12.4	6.40	5.40	2.10	4.0	8.0	2.0	12.0	Q1

NOTE:
1. All dimensions are nominal.
2. Plastic or metal protrusions of 0.15mm maximum per side are not included.

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