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## Wide Supply TIA-485/TIA-422 Transceiver with 1.65V-5.5V I/O Interface

### Description

The XR33202 is a high performance TIA-485/TIA-422 transceiver designed to meet the increasing system requirements found in today's portable/handheld, process control and industrial equipment environments. This is a wide supply (3.0V to 5.5V) device that operates at maximum data rate of 20Mbps and features a 1.65V to 5.5V I/O logic supply, simplifying multi-voltage system interfacing requirements.

The receiver includes full fail-safe circuitry, guaranteeing a logic-high receiver output when the receiver inputs are open, shorted or undriven. The XR33202 receiver input impedance is at least 96k $\Omega$  (1/8 unit load), allowing more than 256 devices on the bus.

The driver is protected by short circuit detection as well as thermal shutdown and maintains high impedance in shutdown or when powered off. The XR33202 does not have slew limiting and is intended for high speed applications requiring data rates up to 20Mbps.

The DE and  $\overline{RE}$  pins include hot swap circuitry to prevent false transitions on the bus during power up or live insertion and can enter a 1 $\mu$ A low current shutdown mode for extreme power savings.

The XR33202 is a half-duplex device that operates at max data rates of 20Mbps. It is available in a 10-pin DFN package.

### FEATURES

- Wide 3.0V to 5.5V supply operation
- 1.65V to 5.5V I/O logic interface VL pin
- Enhanced receiver fail-safe protection for open, shorted or terminated but idle data lines
- Hot swap glitch protection on DE and RE Pins
- Robust ESD (Electrostatic Discharge) protection for TIA-485 bus pins
  - $\pm 15$ kV human body model
  - $\pm 15$ kV IEC61000-4-2 air discharge
  - $\pm 8$ kV IEC61000-4-2 contact discharge
- Driver short circuit limit and thermal shutdown for overload protection
- -40°C to 125°C ambient operating temperature range
- Lead-free (RoHS 6) DFN

### APPLICATIONS

- Portable and handheld equipment
- Industrial and process control equipment
- Point-of-sale equipment
- Building security and automation

### Typical Application

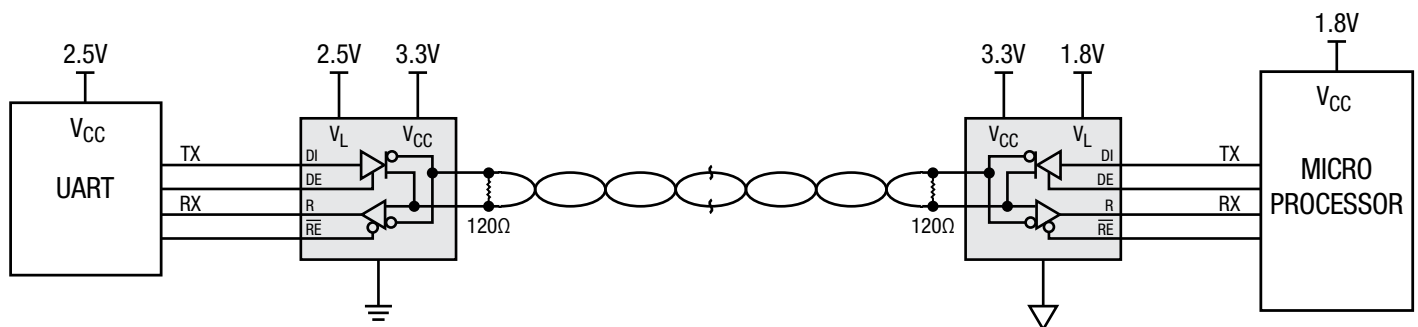


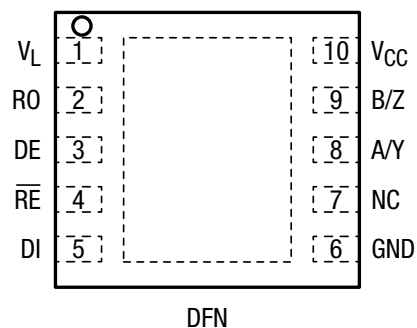
Figure 1. Typical Application

## Absolute Maximum Ratings

Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to any Maximum Rating condition for extended periods may affect device reliability and lifetime.

Supply voltage ( $V_{CC}$ )		-0.3V to 7.0V
Logic interface voltage ( $V_L$ )		$V_L \leq V_{CC}$
Junction temperature		150°C
Input voltages	DE and DI	-0.3V to 6.0V
	$\overline{RE}$	-0.3V to ( $V_L + 0.3V$ )
Output voltage	RO	-0.3V to ( $V_L + 0.3V$ )
Driver output voltage	A/Y, B/Z	$\pm 18V$
Receiver input voltages	A/Y, B/Z	$\pm 18V$
<b>Operating Conditions</b>		
Operating temperature range		-40°C to 125°C
$V_{CC}$ supply range		3.0V to 5.5V
$V_L$ I/O supply range ( $V_L \leq V_{CC}$ )		1.65V to 5.5V
<b>Thermal Information</b>		
$\theta_{JA}$		40.5°C/W
$\theta_{JC}$		8.5°C/W

## Pin Configuration



## Pin Functions

Pin Number	Pin Name	Type	Description
1	V <sub>L</sub>	Supply	I/O power supply, sets the logic levels for RO, DE, $\overline{RE}$ and DI
2	RO	Output	Receiver output
3	DE	Input	Driver enable, driver active when DE = 1, disabled when DE = 0
4	$\overline{RE}$	Input	Receiver enable, receiver is disabled when $\overline{RE}$ = 1, enabled when $\overline{RE}$ = 0
5	DI	Input	Driver input
6	GND	Supply	Ground
7	NC		No connection, can be connected to ground
8	A/Y	I/O	$\pm 15\text{kV}$ ESD protected, TIA-485/TIA-422 half-duplex non-inverting receiver input and non-inverting driver output
9	B/Z	I/O	$\pm 15\text{kV}$ ESD protected, TIA-485/TIA-422 half-duplex inverting receiver input and inverting driver output
10	V <sub>CC</sub>	Supply	Power supply
*	Paddle		Exposed paddle (DFN package), connect to ground



## Electrical Characteristics

Specifications are at  $T_A = 25^\circ\text{C}$ ,  $V_{CC} = 3.3\text{V} \pm 10\%$  or  $5.0\text{V} \pm 10\%$ ,  $V_L = V_{CC}$  unless otherwise noted. Typical values represent the most likely parametric norm at  $T_A = 25^\circ\text{C}$ , and are provided for reference purposes only.

Symbol	Parameter	Conditions	Min	Typ	Max	Units
Driver DC Characteristics						
$V_{OD}$	Differential driver output	$R_L = 100\Omega$ (TIA-422), $V_{CC} = 3.0\text{V}$	2.0			V
		$R_L = 54\Omega$ (TIA-485), $V_{CC} = 3.0\text{V}$	1.5			V
		$R_L = 100\Omega$ (TIA-422), $V_{CC} = 4.5\text{V}$	2.25			V
		$R_L = 54\Omega$ (TIA-485), $V_{CC} = 4.5\text{V}$	2.25			V
$\Delta V_{OD}$	Change in magnitude of differential output voltage	$R_L = 100\Omega$ or $54\Omega$	-0.2		0.2	V
$V_{CM}$	Driver common-mode output voltage (steady state)	$R_L = 100\Omega$ or $54\Omega$		$V_{CC}/2$	3	V
$\Delta V_{CM}$	Change in magnitude of common-mode output voltage	$R_L = 100\Omega$ or $54\Omega$	-0.2		0.2	V
$I_{A, B}$	Input current (A and B)	$V_{OUT} = 12\text{V}$ , $DE = 0\text{V}$ $V_{CC} = 0\text{V}$ or $5.5\text{V}$			125	$\mu\text{A}$
		$V_{OUT} = -7\text{V}$ , $DE = 0\text{V}$ $V_{CC} = 0\text{V}$ or $5.5\text{V}$	-100			$\mu\text{A}$
$I_{OL}$	Output leakage (Y and Z)	$V_{OUT} = 12\text{V}$ , $DE = 0\text{V}$ $V_{CC} = 0\text{V}$ or $5.5\text{V}$			125	$\mu\text{A}$
		$V_{OUT} = -7\text{V}$ , $DE = 0\text{V}$ $V_{CC} = 0\text{V}$ or $5.5\text{V}$	-100			$\mu\text{A}$
$I_{OSD}$	Driver short-circuit output current	$-7\text{V} \leq V_{OUT} \leq +12\text{V}$	-250		250	mA
Receiver DC Characteristics						
$V_{TH}$	Receiver differential threshold voltage ( $V_A - V_B$ )	$-7\text{V} \leq V_{CM} \leq 12\text{V}$	-200	-125	-50	mV
$\Delta V_{OH}$	Receiver input hysteresis	$V_{CM} = 0\text{V}$		25		mV
$R_{IN}$	Receiver input resistance	$-7\text{V} \leq V_{CM} \leq 12\text{V}$	96			k $\Omega$
$I_{OSC}$	Receiver output short-circuit current	$0\text{V} \leq V_{RO} \leq V_L$	-120		120	mA
Logic Inputs and Outputs						
$V_{IH}$	Logic input thresholds (DI, DE, $\overline{RE}$ ) $1.65\text{V} \leq V_L \leq 5.5\text{V}$ & $V_L \leq V_{CC}$	Logic input high	$2/3 \cdot V_L$			V
$V_{IL}$		Logic input low			$1/3 \cdot V_L$	
$V_{HYS}$	Input hysteresis (DI, DE, $\overline{RE}$ )			50		mV
$I_{IN}$	Logic input current (DI, DE, $\overline{RE}$ )	$0\text{V} \leq V_{IN} \leq V_L$ , after first transition			1	$\mu\text{A}$
$I_{INHS}$	Logic input current hot swap (DE and $\overline{RE}$ )	Until first transition			$\pm 320$	$\mu\text{A}$
$V_{OH}$	Receiver output high voltage (RO)	$3.0\text{V} \leq V_L \leq 5.5\text{V}$ , $I_{OUT} = -1\text{mA}$ $1.6\text{V} \leq V_L \leq 3.0\text{V}$ , $I_{OUT} = -1\text{mA}$	$V_L - 0.6$			V
$V_{OL}$	Receiver output low voltage (RO)	$3.0\text{V} \leq V_L \leq 5.5\text{V}$ , $I_{OUT} = 1\text{mA}$ $1.6\text{V} \leq V_L \leq 3.0\text{V}$ , $I_{OUT} = 1\text{mA}$			0.4	V
$I_{OZR}$	High-Z receiver output current	$0\text{V} \leq V_{OUT} \leq V_L$	-1		1	$\mu\text{A}$

## Electrical Characteristics

Specifications are at  $T_A = 25^\circ\text{C}$ ,  $V_{CC} = 3.3\text{V}\pm 10\%$  or  $5.0\text{V}\pm 10\%$ ,  $V_L = V_{CC}$  unless otherwise noted. Typical values represent the most likely parametric norm at  $T_A = 25^\circ\text{C}$ , and are provided for reference purposes only.

Symbol	Parameter	Conditions	Min	Typ	Max	Units
Supply						
$V_{CC}$	Supply voltage range		3.0		5.5	V
$I_{CC}$	Supply current	No load. $\overline{RE} = 0\text{V}$ , $DE = V_L$ , $DI = 0\text{V}$		400	600	$\mu\text{A}$
		No load. $\overline{RE} = V_L$ , $DE = V_L$ , $DI = 0\text{V}$		300	600	$\mu\text{A}$
		No load. $\overline{RE} = 0\text{V}$ , $DE = 0\text{V}$ , receiver A and B inputs open		300	500	$\mu\text{A}$
$I_{SHDN}$	Supply current in shutdown mode	$\overline{RE} = V_L$ , $DE = 0\text{V}$		0.05	3	$\mu\text{A}$
ESD Protection						
	ESD protection for TIA-485 bus pins (A/Y, B/Z)	Human body model (HBM)		$\pm 15$		kV
		IEC 61000-4-2 airgap		$\pm 15$		kV
		IEC 61000-4-2 contact		$\pm 8$		kV
	ESD protection for all other pins	Human body model (HBM)		$\pm 4$		kV

## Driver AC Characteristics - XR33202

Specifications are at  $T_A = 25^\circ\text{C}$ ,  $V_{CC} = 3.3\text{V}\pm 10\%$  or  $5.0\text{V}\pm 10\%$ ,  $V_L = V_{CC}$  unless otherwise noted. Typical values represent the most likely parametric norm at  $T_A = 25^\circ\text{C}$ , and are provided for reference purposes only.

Symbol	Parameter	Conditions	Min	Typ	Max	Units
$t_{DPLH}$	Driver prop. delay (low to high)	$C_L = 50\text{pF}$ , $R_L = 54\Omega$ ,			30	ns
$t_{DPHL}$	Driver prop. delay (high to low)				30	ns
$ t_{DPLH} - t_{DPHL} $	Differential driver output skew				5	ns
$t_{DR}$ , $t_{DF}$	Driver differential output rise or fall time				17	ns
	Maximum data rate	$1/t_{UI}$ , duty cycle 40% to 60%	20			Mbps
$t_{DZH}$	Driver enable to output high	$C_L = 50\text{pF}$ , $R_L = 500\Omega$ ,			50	ns
$t_{DZL}$	Driver enable to output low				50	ns
$t_{DZH}$	Driver disable from output high				50	ns
$t_{DLZ}$	Driver disable from output low				50	ns
$t_{DZH(SHDN)}$	Driver enable from shutdown to output high	$C_L = 50\text{pF}$ , $R_L = 500\Omega$ ,			250	ns
$t_{DZL(SHDN)}$	Driver enable from shutdown to output low				250	ns
$t_{SHDN}$	Time to shutdown		50	200	600	ns

### Receiver AC Characteristics - XR33202

Specifications are at  $T_A = 25^\circ\text{C}$ ,  $V_{CC} = 3.3\text{V} \pm 10\%$  or  $5.0\text{V} \pm 10\%$ ,  $V_L = V_{CC}$  unless otherwise noted. Typical values represent the most likely parametric norm at  $T_A = 25^\circ\text{C}$ , and are provided for reference purposes only.

Symbol	Parameter	Conditions	Min	Typ	Max	Units
$t_{RPLH}$	Receiver prop. delay (low to high)	$C_L = 50\text{pF}$ , $R_L = 54\Omega$			50	ns
$t_{RPHL}$	Receiver prop. delay (high to low)				50	ns
$ t_{RPLH} - t_{RPHL} $	Receiver propagation delay skew				5	ns
	Maximum data rate	$1/t_{UI}$ , duty cycle 40% to 60%	20			Mbps
$t_{RZH}$	Receiver enable to output high	$C_L = 50\text{pF}$ , $R_L = 1\text{k}\Omega$ ,			50	ns
$t_{RZL}$	Receiver enable to output low				50	ns
$t_{RHZ}$	Receiver disable from output high				50	ns
$t_{RLZ}$	Receiver disable from output low				50	ns
$t_{RZH(SHDN)}$	Receiver enable from shutdown to output high	$C_L = 50\text{pF}$ , $R_L = 1\text{k}\Omega$ ,			2200	ns
$t_{RZL(SHDN)}$	Receiver enable from shutdown to output low				2200	ns
$t_{SHDN}$	Time to shutdown		50	200	600	ns

### Block Diagram

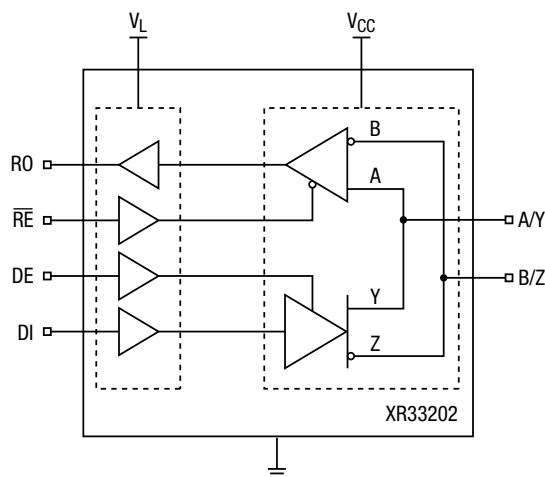
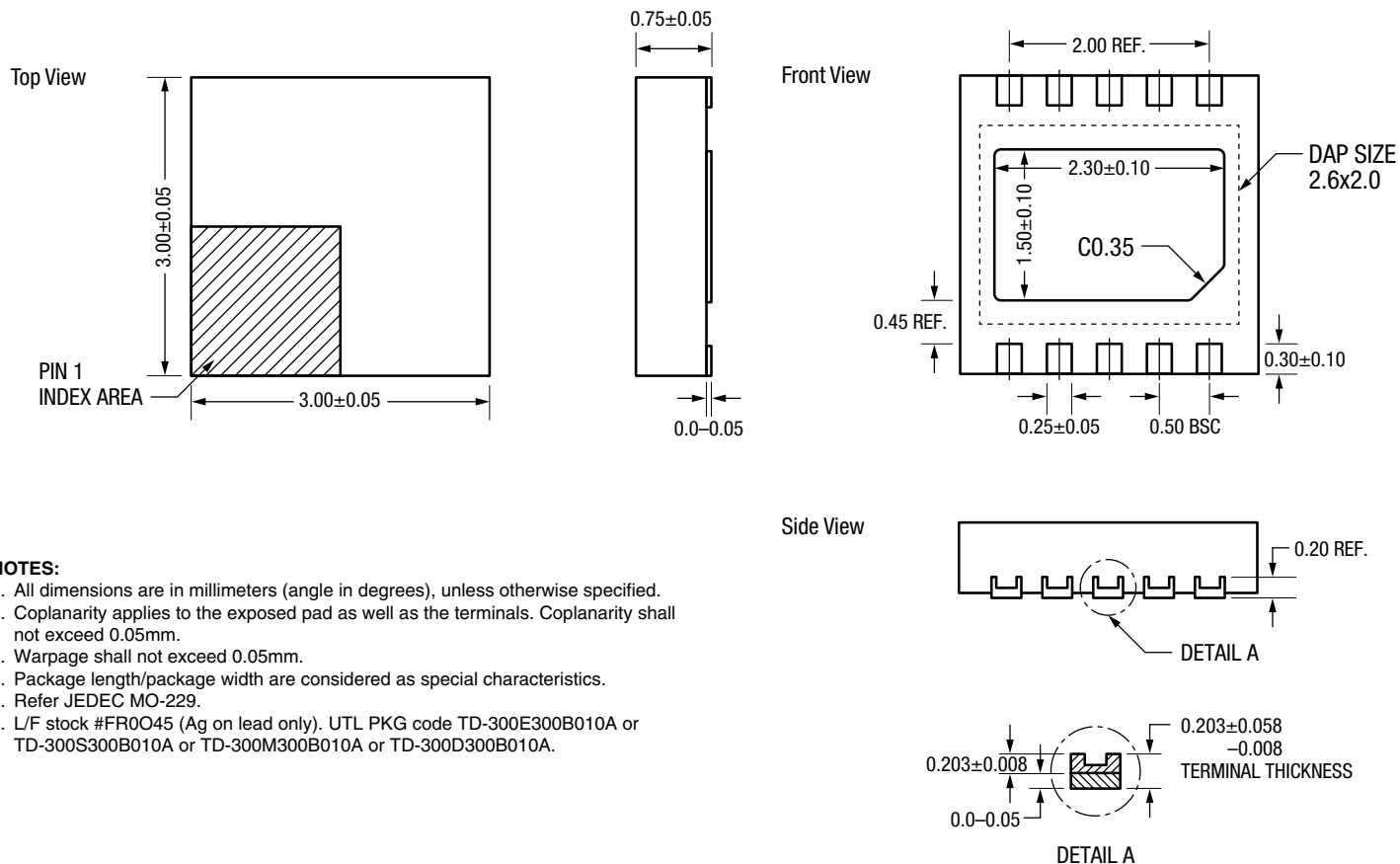


Figure 2. Block Diagram

## Package Description

### 10-Pin DFN Package (3mm x 3mm)



**NOTES:**

1. All dimensions are in millimeters (angle in degrees), unless otherwise specified.
2. Coplanarity applies to the exposed pad as well as the terminals. Coplanarity shall not exceed 0.05mm.
3. Warpage shall not exceed 0.05mm.
4. Package length/package width are considered as special characteristics.
5. Refer JEDEC MO-229.
6. L/F stock #FR0045 (Ag on lead only). UTL PKG code TD-300E300B010A or TD-300S300B010A or TD-300M300B010A or TD-300D300B010A.

## Order Information

Part Number	Package	Environmental Rating	Operating Temperature Range
XR33202EEHB-F	10-pin DFN	Green	-40°C to 125°C
XR33202EEHBTR-F	10-pin DFN	Green	-40°C to 125°C



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