ISL33354E, ISL33357E

5V, ±15kV ESD Protected, Two Port, Dual Protocol (RS-232/RS-485) Transceivers

FN8775
Rev 1.00
Oct 21, 2016

The ISL33354E, ISL33357E are two port interface ICs where port 1 is configured as a dual (2 Tx, 2 Rx) RS-232 transceiver, and port 2 is a single RS-485/422 transceiver.

An on-board charge pump generates RS-232 compliant ±5V Tx output levels from a single V_{CC} supply as low as 4.5V. The transceivers are RS-232 compliant, with the Rx inputs handling up to ±25V.

The port 2 transceiver supports both the RS-485 and RS-422 differential communication standards. The receiver features "full fail-safe" operation, so the Rx output remains in a high state if the inputs are open or shorted together. The transmitter supports two data rates, one of which is slew rate limited for problem free communication at low data rates. The active low Rx enable pin ($\overline{RE485}$) allows Tx/Rx direction control, via a single signal, simply by connecting the corresponding DE485 and $\overline{RE485}$ pins together.

The ISL33354E and ISL33357E also include a shutdown function, which disables the Tx and Rx outputs, disables the charge pumps and places the IC in a low current (55µA) mode.

The ISL33357E is a QFN packaged device for space constrained applications.

Related Literature

- For a full list of related documents, visit our website
  - ISL33354E, ISL33357E product pages

Features

- ±15kV (HBM) ESD protected bus pins (RS-232 or RS-485)
- Operates from a single 5V supply
- Two independent ports: port 1 set for RS-232 (2 transceivers) and port 2 for RS-485/RS-422 (1 transceiver)
- True flow-through pinouts (Rx inputs and Tx outputs all on the same side) simplify board layouts
- Pb-free (RoHS compliant)
- Full fail-safe (open/short) RS-485/422 port 2 Rx
- User selectable RS-485 data rates
  - Fast speed. . . . . up to 20Mbps
  - Slew rate limited . . . . . up to 115kbps
- Fast RS-232 data rate . . . . . 460kbps (Minimum)
- Small charge pump capacitors . . . . . 4 x 0.1µF
- Low current shutdown mode 55µA
- QFN package saves board space (ISL33357E only)

Applications

- Gaming applications (e.g., slot machines)
- Single board computers
- Factory automation
- Security networks
- Industrial/process control networks
- Level translators (e.g., RS-232 to RS-422)
- Point-of-sale equipment

TABLE 1. SUMMARY OF FEATURES

PART NUMBER	PACKAGE OPTION	PORT 2 RS-485 DATA RATE	PORT 1 RS-232 DATA RATE	LOW POWER SHUTDOWN?	PORT 2 RS-485 Rx AND Tx
ISL33354E	28 Ld SSOP	20M, 115k	650k	YES	YES
ISL33357E	40 Ld QFN (6 x 6mm)	20M, 115k	650k	YES	YES

Ordering Information

PART NUMBER (Notes 2, 3)	PART MARKING	TEMPERATURE RANGE (°C)	TAPE AND REEL (UNITS)	PACKAGE (RoHS COMPLIANT)	PKG. DWG. #
ISL33354EIAZ	33354 EIAZ	-40 to +85	-	28 Ld SSOP	M28.209
ISL33354EIAZ-T (Note 1)	33354 EIAZ	-40 to +85	1k	28 Ld SSOP	M28.209
ISL33357EIRZ	33357E IRZ	-40 to +85	-	40 Ld QFN	L40.6x6
ISL33357EIRZ-T (Note 1)	33357E IRZ	-40 to +85	1k	40 Ld QFN	L40.6x6
ISL33357EIRZ-T7A (Note 1)	33357E IRZ	-40 to +85	250	40 Ld QFN	L40.6x6

NOTES:

1. Refer to TB347 for details on reel specifications.
2. These Intersil Pb-free plastic packaged products employ special Pb-free material sets, molding compounds/die attach materials, and 100% matte tin plate plus anneal (e3 termination finish, which is RoHS compliant and compatible with both SnPb and Pb-free soldering operations). Intersil Pb-free products are MSL classified at Pb-free peak reflow temperatures that meet or exceed the Pb-free requirements of IPC/JEDEC J STD-020.
3. For Moisture Sensitivity Level (MSL), see product information page for ISL33354E, ISL33357E. For more information on MSL, see tech brief TB363.

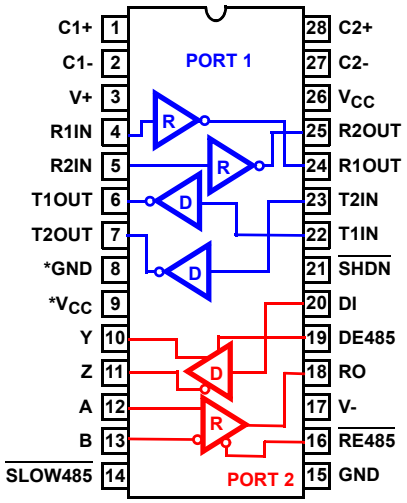
TABLE 2. KEY DIFFERENCES BETWEEN FAMILY OF PARTS

PART NUMBER	VCC (V)	PKG	RS485 (bps) DATA RATE	RS232 (bps) DATA RATE
ISL33354E	5	28Ld SSOP	20M, 115k	650k
ISL33357E	5	40Ld QFN	20M, 115k	650k
ISL33334E	3.3	28Ld SSOP	20M, 115k	400k
ISL33337E	3.3	40Ld QFN	20M, 115k	400k

NOTE: For a full list of dual protocol transceivers, please visit our website.

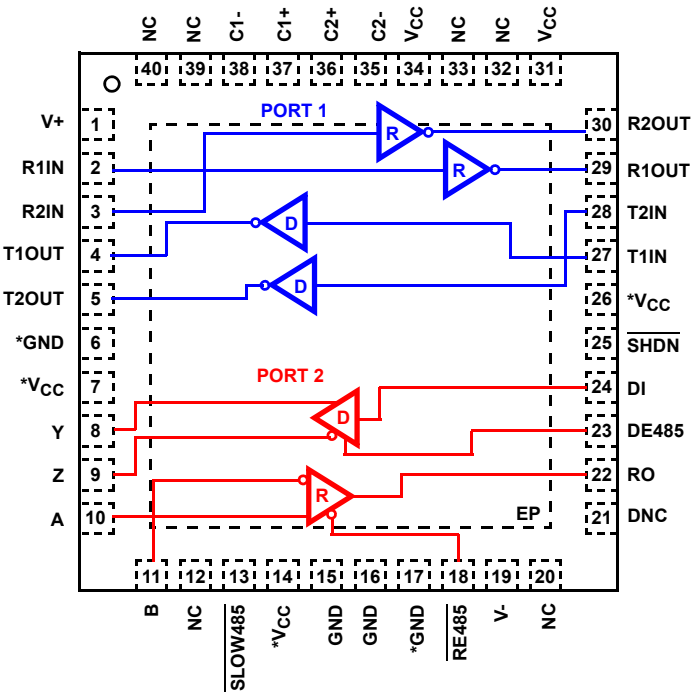
Pin Configurations

ISL33354E
(28 LD SSOP)
TOP VIEW



* NOT A SUPPLY PIN, BUT MUST BE CONNECTED TO THE NOTED SUPPLY.

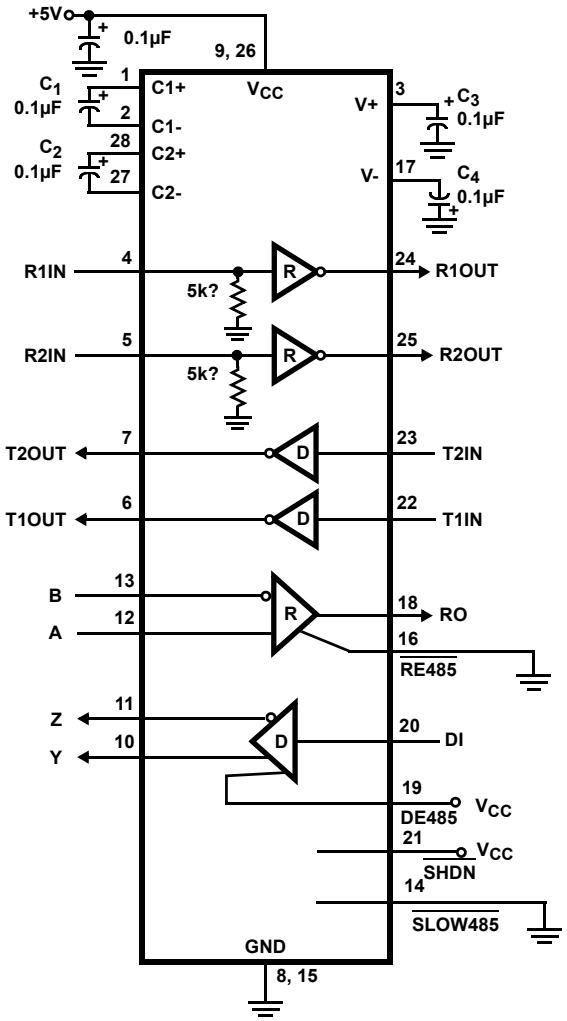
ISL33357E
(40 LD QFN)
TOP VIEW



Pin Descriptions

PIN NAME	PIN # for SSOP	PIN # for QFN	PORT/MODE	FUNCTION
NC	-	12, 20, 32, 33, 39, 40	BOTH	No Internal Connection.
DNC	-	21	BOTH	Do not make any external connections to this pin.
$\overline{SHDN}$	21	25	BOTH	A low on $\overline{SHDN}$ disables the charge pumps, disables all the outputs and places the device in low power shutdown. Internally pulled-high. $\overline{SHDN}$ = 1 for normal operation.
V_{CC}	26	31, 34	BOTH	System power supply input (4.5V to 5.5V). Both pins 31 and 34 must connect to the V_{CC} supply.
GND	15	15, 16	BOTH	Ground connection. QFN pins 15 and 16 must both connect to GND. This is also the potential of the QFN's exposed metal pad (EP).
*V_{CC}	9	7, 14, 26	BOTH	For proper operation, connect this lead to the V_{CC} supply. This is not a power supply lead, so no decoupling is required.
*GND	8	6, 17	BOTH	For proper operation, connect this lead to GND. This is not a power supply lead.
RxIN	4, 5	2, 3	1 / RS-232	RS-232 receiver input with ±15kV ESD protection. A low on RxIN forces RxOUT high; a high on RxIN forces RxOUT low.
RxOUT	24, 25	29, 30	1 / RS-232	RS-232 receiver output.
TxIN	22, 23	27, 28	1 / RS-232	RS-232 transmitter input. A low on TxIN drives the corresponding TxOUT high, while a high on TxIN drives the corresponding TxOUT low.
TxOUT	6, 7	4, 5	1 / RS-232	RS-232 transmitter output with ±15kV ESD protection.
C1+	1	37	1 / RS-232	External charge pump capacitor is connected to this lead.
C1-	2	38	1 / RS-232	External charge pump capacitor is connected to this lead.
C2+	28	36	1 / RS-232	External charge pump capacitor is connected to this lead.
C2-	27	35	1 / RS-232	External charge pump capacitor is connected to this lead.
V+	3	1	1 / RS-232	Internally generated positive RS-232 transmitter supply (+6V).
V-	17	19	1 / RS-232	Internally generated negative RS-232 transmitter supply (-7V).
A	12	10	2 / RS-485	RS-485 noninverting receiver input with ±15kV ESD protection.
B	13	11	2 / RS-485	RS-485 inverting receiver input with ±15kV ESD protection.
Y	10	8	2/ RS-485	RS-485 noninverting driver output with ±15kV ESD protection.
Z	11	9	2/ RS-485	RS-485 inverting driver output with ±15kV ESD protection.
DI	20	24	2 / RS-485	RS-485 driver input. A low on DI forces output Y low and output Z high.
RO	18	22	2 / RS-485	RS-485 receiver output: If A > B by at least -40mV, RO is high; If A < B by -200mV or more, RO is low; RO = High if A and B are unconnected (floating) or shorted together (i.e., full fail-safe).
$\overline{SLOW485}$	14	13	2 / RS-485	RS-485 data rate control. A low on $\overline{SLOW485}$ selects the 115kbps RS-485 data rate (slew rate limited output transitions); a high selects the 20Mbps data rate (full speed transitions). Internally pulled-high.
$\overline{RE485}$	16	18	2/ RS-485	RS-485 active low receiver output enable. RO is enabled when $\overline{RE485}$ is low; RO is high impedance when $\overline{RE485}$ is high. Internally pulled low.
DE485	19	23	2/ RS-485	RS-485 driver output enable (DE). The driver outputs, Y and Z, are enabled by driving DE485 high. They are high impedance when DE485 is low. Internally pulled high.
EP	-	EP	BOTH	QFN exposed thermal pad (EPAD). Connect to GND.

Typical Operating Circuits



NOTE: PINOUT FOR SSOP

FIGURE 1. 1 PORT IN RS-232 MODE AND 1 PORT IN RS-485 MODE

TABLE 3. ISL33354E AND ISL33357E FUNCTION TABLE

INPUTS					RECEIVER OUTPUTS		DRIVER OUTPUTS		CHARGE PUMPS (Note 4)	DRIVER DATA RATE (bps)	MODE
PORT	$\overline{SHDN}$	$\overline{RE485}$	DE485	$\overline{SLOW485}$	RO	R1OUT AND R2OUT	Y AND Z	T1OUT AND T2OUT			
1	1	N.A.	N.A.	N.A.	N.A.	ON	N.A.	ON	ON	460k	RS-232
2	1	0	0	0	ON	N.A.	High-Z	N.A.	ON	115k	RS-485 Rx
2	1	0	1	0	ON	N.A.	ON	N.A.	ON	115k	RS-485 Tx and Rx
2	1	1	1	0	High-Z	N.A.	ON	N.A.	ON	115k	RS-485 Tx
2	1	0	0	1	ON	N.A.	High-Z	N.A.	ON	20M	RS-485 Rx
2	1	0	1	1	ON	N.A.	ON	N.A.	ON	20M	RS-485 Tx and Rx
2	1	1	1	1	High-Z	N.A.	ON	N.A.	ON	20M	RS-485 Tx
1 and 2	0	X	X	X	High-Z	High-Z	High-Z	High-Z	OFF	N.A.	Shutdown

NOTE:

4. Charge pumps are off if $\overline{SHDN}$ = 0. If $\overline{SHDN}$ = 1, the charge pumps are on.

Truth Tables

RS-232 TRANSMITTING (PORT 1)				
INPUTS			OUTPUTS	
$\overline{SHDN}$	T1IN	T2IN	T1OUT	T2OUT
1	0	0	1	1
1	0	1	1	0
1	1	0	0	1
1	1	1	0	0
0	X	X	High-Z	High-Z

RS-232 RECEIVING (PORT 1)				
INPUTS			OUTPUTS	
$\overline{SHDN}$	R1IN	R2IN	R1OUT	R2OUT
1	0	0	1	1
1	0	1	1	0
1	1	0	0	1
1	1	1	0	0
1	Open	Open	1	1
0	X	X	High-Z	High-Z

RS-485 TRANSMITTING (PORT 2)						
INPUTS				OUTPUTS		
$\overline{SHDN}$	DE485	DI	$\overline{SLOW485}$	Y	Z	DATA RATE (bps)
1	1	0	0	0	1	115k
1	1	1	0	1	0	115k
1	1	0	1	0	1	20M
1	1	1	1	1	0	20M
1	0	X	X	High-Z	High-Z	N.A.
0	X	X	X	High-Z	High-Z	N.A.

RS-485 RECEIVING (PORT 2)			
INPUTS			OUTPUT
$\overline{SHDN}$	$\overline{RE485}$	A-B	RO
1	0	≥-40mV	1
1	0	≤-200mV	0
1	0	Open or shorted together	1
1	1	X	High-Z
0	X	X	High-Z

Absolute Maximum Ratings (T_A = +25°C)

V_{CC} to Ground 7V
Input Voltages
All Except A, B, RxIN ..... -0.5V to 7V
Input/Output Voltages
A, B, RxIN ..... -25V to +25V
Y, Z, TxOUT (Note 5) ..... -12.5V to +12.5V
RO, RxOUT ..... -0.5V to (V_{CC} + 0.5V)
Output Short-Circuit Duration
Y, Z, TxOUT, RxOUT ..... Indefinite
ESD Rating ..... See Specification Table on page 7
Latch-Up (per JESD78, Level 2, Class A) ..... +85°C

Thermal Information

Thermal Resistance (Typical)	θ_{JA} (°C/W)	θ_{JC} (°C/W)
28 Ld SSOP Package (Notes 7, 9)	60	36
40 Ld QFN Package (Notes 6, 8)	32	2.5

Maximum Junction Temperature (Plastic Package) ..... +150°C
Maximum Storage Temperature Range ..... -65°C to +150°C
Pb-Free Reflow Profile ..... see TB493

Recommended Operating Conditions

Supply Voltage (V_{CC}) 5V
Temperature Range ..... -40°C to +85°C
RS-485 Tx Load ..... One or two 120Ω Terminations

CAUTION: Do not operate at or near the maximum ratings listed for extended periods of time. Exposure to such conditions may adversely impact product reliability and result in failures not covered by warranty.

NOTES:

5. One output at a time, I_{OUT} ≤ 100mA for ≤10 mins.
6. θ_{JA} is measured in free air with the component mounted on a high effective thermal conductivity test board with "direct attach" features. See Tech Brief TB379.
7. θ_{JA} is measured with the component mounted on a high effective thermal conductivity test board in free air. See Tech Brief TB379 for details.
8. For θ_{JC}, the "case temp" location is the center of the exposed metal pad on the package underside.
9. For θ_{JC}, the "case temp" location is taken at the package top center.

Electrical Specifications

Test Conditions: V_{CC} = 4.5V to 5.5V, C_1 - C_4 = 0.1µF, unless otherwise specified. Typicals are at V_{CC} = 5V, T_A = +25°C (Note 10). **Boldface limits apply across the operating temperature range, -40°C to +85°C.**

PARAMETER	SYMBOL	TEST CONDITIONS		TEMP (°C)	MIN (Note 15)	TYP	MAX (Note 15)	UNIT
DC CHARACTERISTICS - RS-485 DRIVER (Port 2)								
Driver Differential V_{OUT} (No Load)	V_{OD1}			Full	-	-	**V_{CC}**	V
Driver Differential V_{OUT} (with Load)	V_{OD2}	R = 50Ω (RS-422) (Figure 2)		Full	**2.5**	3.1	-	V
		R = 27Ω (RS-485) (Figure 2)		Full	**2.2**	2.7	**5**	V
	V_{OD3}	R_D = 60Ω, R = 375Ω, V_{CM} = -7V to 12V (Figure 2)		Full	**2**	2.7	**5**	V
Change in Magnitude of Driver Differential V_{OUT} for Complementary Output States	ΔV_{OD}	R = 27Ω or 50Ω (Figure 2)		Full	-	0.01	**0.2**	V
Driver Common-Mode V_{OUT}	V_{OC}	R = 27Ω or 50Ω (Figure 2) (Note 14)		Full	-	-	**3.1**	V
Change in Magnitude of Driver Common-Mode V_{OUT} for Complementary Output States	ΔV_{OC}	R = 27Ω or 50Ω (Figure 2) (Note 14)		Full	-	0.01	**0.2**	V
Driver Short-Circuit Current, V_{OUT} = High or Low	I_{OS}	-7V ≤ (V_Y or V_Z) ≤ 12V (Note 12)		Full	**35**	-	**250**	mA
Driver Three-State Output Leakage Current (Y, Z)	I_{OZ}	Outputs disabled, V_{CC} = 0V or 5.5V	V_{OUT} = 12V	Full	-	-	**500**	µA
			V_{OUT} = -7V	Full	**-200**	-	-	µA
DC CHARACTERISTICS - RS-232 DRIVER (PORT 1)								
Driver Output Voltage Swing	V_O	All T_{OUTS} loaded with 3kΩ to ground		Full	**±5**	+6/-7	-	V
Driver Output Short-Circuit Current	I_{OS}	V_{OUT} = 0V		Full	**-60**	25/-35	**60**	mA
DC CHARACTERISTICS - LOGIC PINS (i.e., DRIVER AND CONTROL INPUT PINS)								
Input High Voltage	V_{IH}			Full	**2**	1.6	-	V
Input Low Voltage	V_{IL}			Full	-	1.4	**0.8**	V

Electrical Specifications

Test Conditions: V_{CC} = 4.5V to 5.5V, C_1 - C_4 = 0.1µF, unless otherwise specified. Typicals are at V_{CC} = 5V, T_A = +25°C (Note 10). **(Continued) Boldface limits apply across the operating temperature range, -40°C to +85°C. (Continued)**

PARAMETER	SYMBOL	TEST CONDITIONS		TEMP (°C)	MIN (Note 15)	TYP	MAX (Note 15)	UNIT
Input Current	I_{IN1}	Pins without pull-ups or pull-downs		Full	**-2**	-	**2**	µA
	I_{IN2}	$\overline{SLOW485}$, DE485, $\overline{RE485}$, $\overline{SHDN}$		Full	**-25**	-	**25**	µA
DC CHARACTERISTICS - RS-485 RECEIVER INPUTS (PORT 2)								
Receiver Differential Threshold Voltage	V_{TH}	-7V ≤ V_{CM} ≤ 12V, full fail-safe		Full	**-0.2**	-	**-0.04**	V
Receiver Input Hysteresis	ΔV_{TH}	V_{CM} = 0V		25	-	35	-	mV
Receiver Input Current (A, B)	I_{IN}	V_{CC} = 0V or 4.5 to 5.5V	V_{IN} = 12V	Full	-	-	**0.8**	mA
			V_{IN} = -7V	Full	**-0.64**	-	-	mA
Receiver Input Resistance	R_{IN}	-7V ≤ V_{CM} ≤ 12V, V_{CC} = 0 (Note 13) or 4.5V ≤ V_{CC} ≤ 5.5V		Full	**15**	-	-	kΩ
DC CHARACTERISTICS - RS-232 RECEIVER INPUTS (PORT 1)								
Receiver Input Voltage Range	V_{IN}			Full	**-25**	-	**25**	V
Receiver Input Threshold	V_{IL}			Full	-	1.4	**0.8**	V
	V_{IH}			Full	**2.4**	1.9	-	V
Receiver Input Hysteresis	ΔV_{TH}			25	-	0.5	-	V
Receiver Input Resistance	R_{IN}	V_{IN} = ±15V, V_{CC} powered up (Note 13)		Full	**3**	5	**7**	kΩ
DC CHARACTERISTICS - RECEIVER OUTPUTS (PORTS 1 and 2)								
Receiver Output High Voltage	V_{OH}	I_O = -2mA		Full	**3.5**	4.6	-	V
Receiver Output Low Voltage	V_{OL}	I_O = 3mA		Full	-	0.1	**0.4**	V
Receiver Short-Circuit Current	I_{OSR}	0V ≤ V_O ≤ V_{CC}		Full	**7**	-	**85**	mA
Receiver Three-State Output Current	I_{OZR}	Output disabled, 0V ≤ V_O ≤ V_{CC}		Full	-	-	**±10**	µA
POWER SUPPLY CHARACTERISTICS								
No-Load Supply Current, (Note 11)	I_{CC}	$\overline{SHDN}$ = V_{CC}		Full	-	3.7	**7**	mA
Shutdown Supply Current	I_{SHDN}	$\overline{SHDN}$ = $\overline{SLOW485}$ = GND, $\overline{RE485}$ = V_{CC}, DE485 = GND		Full	-	55	**160**	µA
ESD CHARACTERISTICS								
Bus Pins (A, B, Y, Z, RxIN, TxOUT)		Human body model, Bus pin to GND		25	-	±15	-	kV
All Other Pins		Human body model (per JEDEC)		25	-	±4	-	kV
		Machine model (per JEDEC)		25	-	±200	-	V
RS-232 DRIVER AND RECEIVER SWITCHING CHARACTERISTICS (PORT 1)								
Driver Output Transition Region Slew Rate	SR	R_L = 3kΩ, measured from 3V to -3V or -3V to 3V	C_L ≥15pF	Full	-	18	**30**	V/µs
			C_L ≤2500pF	Full	**4**	12	-	V/µs
Driver Output Transition Time	t_r, t_f	R_L = 3kΩ, C_L = 2500pF, 10% - 90%		Full	**0.22**	1.2	**3.1**	µs
Driver Propagation Delay	t_{DPHL}	R_L = 3kΩ C_L = 1000pF (Figure 7)		Full	-	1	**2**	µs
	t_{DPLH}			Full	-	1.2	**2**	µs
Driver Propagation Delay Skew	t_{DSKEW}	t_{DPHL} - t_{DPLH} (Figure 7)		Full	-	240	**400**	ns
Driver Enable Time from Shutdown	t_{DENSD}	V_{OUT} = ±3.0V, C_L = 1000pF		25	-	20	-	µs
Driver Maximum Data Rate	DR_D	R_L = 3kΩ, C_L = 1000pF, one transmitter switching		Full	**460**	650	-	kbps

Electrical Specifications Test Conditions: V_{CC} = 4.5V to 5.5V, C_1 - C_4 = 0.1µF, unless otherwise specified. Typicals are at V_{CC} = 5V, T_A = +25°C (Note 10). **(Continued) Boldface limits apply across the operating temperature range, -40°C to +85°C. (Continued)**

PARAMETER	SYMBOL	TEST CONDITIONS	TEMP (°C)	MIN (Note 15)	TYP	MAX (Note 15)	UNIT
Receiver Propagation Delay	t_{RPHL}	C_L = 15pF (Figure 8)	Full	-	50	**120**	ns
	t_{RPLH}		Full	-	40	**120**	ns
Receiver Propagation Delay Skew	t_{RSKEW}	t_{RPHL} - t_{RPLH} (Figure 8)	Full	-	10	**40**	ns
Receiver Maximum Data Rate	DR_R	C_L = 15pF	Full	**0.46**	2	-	Mbps
RS-485 DRIVER SWITCHING CHARACTERISTICS (FAST DATA RATE (20Mbps), PORT 2, ($\overline{SLOW485}$ = V_{CC}))							
Driver Differential Input to Output Delay	t_{DLH}, t_{DHL}	R_{DIFF} = 54Ω, C_L = 100pF (Figure 3)	Full	**15**	30	**50**	ns
Driver Output Skew	t_{SKEW}	R_{DIFF} = 54Ω, C_L = 100pF (Figure 3)	Full	-	3	**10**	ns
Driver Differential Rise or Fall Time	t_R, t_F	R_{DIFF} = 54Ω, C_L = 100pF, (Figure 3)	Full	**3**	11	**20**	ns
Driver Enable to Output Low	t_{ZL}	C_L = 100pF, SW = V_{CC} (Figure 4)	Full	-	27	**60**	ns
Driver Enable to Output High	t_{ZH}	C_L = 100pF, SW = GND (Figure 4)	Full	-	24	**60**	ns
Driver Disable from Output Low	t_{LZ}	C_L = 15pF, SW = V_{CC} (Figure 4)	Full	-	31	**60**	ns
Driver Disable from Output High	t_{HZ}	C_L = 15pF, SW = GND (Figure 4)	Full	-	24	**60**	ns
Driver Enable from Shutdown to Output Low	$t_{ZL(SHDN)}$	R_L = 500Ω, C_L = 100pF, SW = V_{CC} (Figure 4)	Full	-	65	**250**	ns
Driver Enable from Shutdown to Output High	$t_{ZH(SHDN)}$	R_L = 500Ω, C_L = 100pF, SW = GND (Figure 4)	Full	-	152	**250**	ns
Driver Maximum Data Rate	f_{MAX}	R_{DIFF} = 54Ω, C_L = 100pF (Figure 3)	Full	-	30	-	Mbps
RS-485 DRIVER SWITCHING CHARACTERISTICS (SLOW DATA RATE (115kbps), PORT 2, ($\overline{SLOW485}$ = GND))							
Driver Differential Input to Output Delay	t_{DLH}, t_{DHL}	R_{DIFF} = 54Ω, C_L = 100pF (Figure 3)	Full	**800**	1500	**2500**	ns
Driver Output Skew	t_{SKEW}	R_{DIFF} = 54Ω, C_L = 100pF (Figure 3)	Full	-	350	**1250**	ns
Driver Differential Rise or Fall Time	t_R, t_F	R_{DIFF} = 54Ω, C_L = 100pF (Figure 3)	Full	**1000**	2000	**3100**	ns
Driver Enable to Output Low	t_{ZL}	C_L = 100pF, SW = V_{CC} (Figure 4)	Full	-	32	**600**	ns
Driver Enable to Output High	t_{ZH}	C_L = 100pF, SW = GND (Figure 4)	Full	-	300	**600**	ns
Driver Disable from Output Low	t_{LZ}	C_L = 15pF, SW = V_{CC} (Figure 4)	Full	-	31	**60**	ns
Driver Disable from Output High	t_{HZ}	C_L = 15pF, SW = GND (Figure 4)	Full	-	24	**60**	ns
Driver Enable from Shutdown to Output Low	$t_{ZL(SHDN)}$	R_L = 500Ω, C_L = 100pF, SW = V_{CC} (Figure 4)	Full	-	65	**800**	ns
Driver Enable from Shutdown to Output High	$t_{ZH(SHDN)}$	R_L = 500Ω, C_L = 100pF, SW = GND (Figure 4)	Full	-	420	**800**	ns
Driver Maximum Data Rate	f_{MAX}	R_{DIFF} = 54Ω, C_L = 100pF (Figure 3)	Full	-	800	-	kbps
RS-485 RECEIVER SWITCHING CHARACTERISTICS (PORT 2, ALL SPEEDS)							
Receiver Input to Output Delay	t_{PLH}, t_{PHL}	(Figure 5)	Full	**20**	50	**90**	ns
Receiver Skew | t_{PLH} - t_{PHL} |	t_{SKEW}	(Figure 5)	Full	-	0.1	**10**	ns
Receiver Maximum Data Rate	f_{MAX}		Full	-	40	-	Mbps
Receiver Enable to Output Low	t_{ZL}	C_L = 15pF, SW = V_{CC} (Figure 6)	Full	-	22	**60**	ns
Receiver Enable to Output High	t_{ZH}	C_L = 15pF, SW = GND (Figure 6)	Full	-	23	**60**	ns
Receiver Disable from Output Low	t_{LZ}	C_L = 15pF, SW = V_{CC} (Figure 6)	Full	-	24	**60**	ns
Receiver Disable from Output High	t_{HZ}	C_L = 15pF, SW = GND (Figure 6)	Full	-	25	**60**	ns

Electrical Specifications Test Conditions: V_{CC} = 4.5V to 5.5V, C_1 - C_4 = 0.1µF, unless otherwise specified. Typicals are at V_{CC} = 5V, T_A = +25°C (Note 10). **(Continued) Boldface limits apply across the operating temperature range, -40°C to +85°C. (Continued)**

PARAMETER	SYMBOL	TEST CONDITIONS	TEMP (°C)	MIN (Note 15)	TYP	MAX (Note 15)	UNIT
Receiver Enable from Shutdown to Output Low	t_{ZLSHDN}	C_L = 15pF, SW = V_{CC} (Figure 6)	Full	-	260	**700**	ns
Receiver Enable from Shutdown to Output High	t_{ZHSHDN}	C_L = 15pF, SW = GND (Figure 6)	Full	-	260	**700**	ns

NOTES:

10. All currents into device pins are positive; all currents out of device pins are negative. All voltages are referenced to device ground unless otherwise specified.
11. Supply current specification is valid for loaded RS-485 (port 2) drivers when DE485 = 0V.
12. Applies to peak current. See "Typical Performance Curves" on page 12 for more information.
13. A, B, RxIN defaults to RS-485 mode (>15kΩ) when the device is unpowered (V_{CC} = 0V), or in SHDN.
14. V_{CC} ≤ 5.25V.
15. Compliance to datasheet limits is assured by one or more methods: production test, characterization and/or design.

Test Circuits and Waveforms

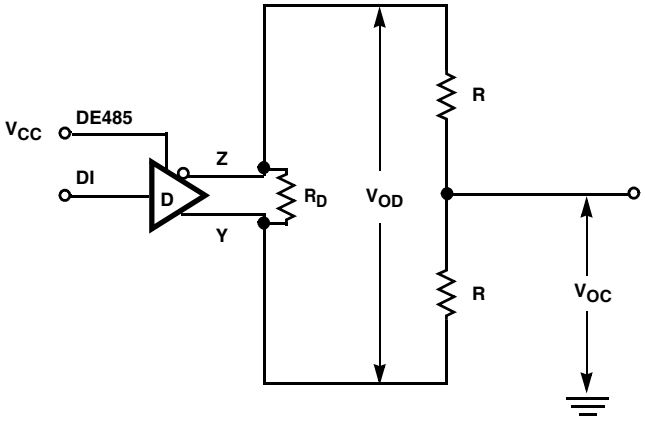


FIGURE 2. RS-485 DRIVER V_{OD} AND V_{OC} TEST CIRCUIT

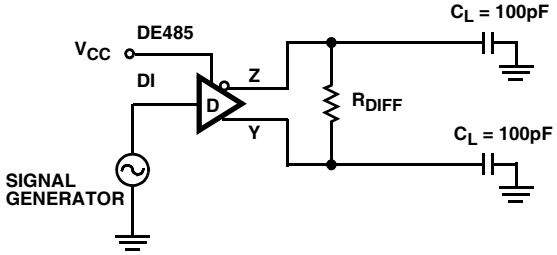
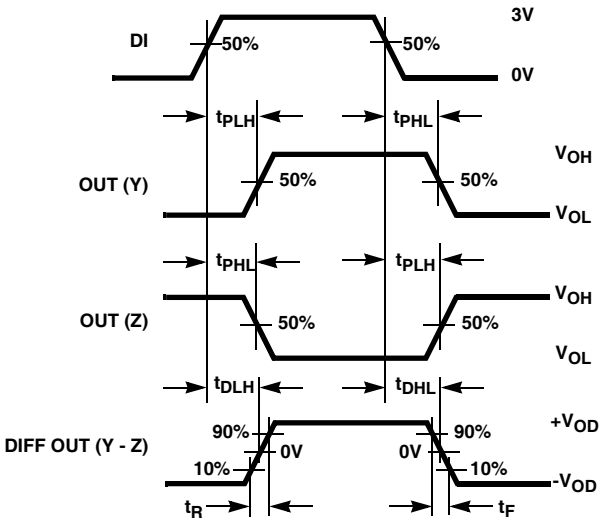


FIGURE 3A. TEST CIRCUIT

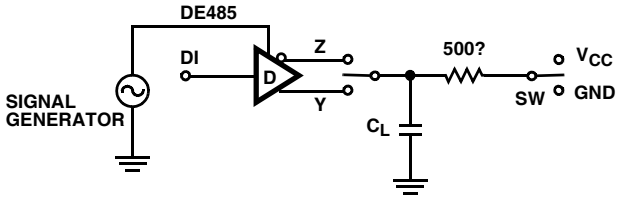


SKEW = |t_{PLH} (Y or Z) - t_{PHL} (Z or Y)|

FIGURE 3B. MEASUREMENT POINTS

FIGURE 3. RS-485 DRIVER PROPAGATION DELAY AND DIFFERENTIAL TRANSITION TIMES

Test Circuits and Waveforms (Continued)



FOR SHDN TESTS, SWITCH $\overline{SHDN}$ RATHER THAN DE485

PARAMETER	$\overline{SHDN}$/DE485	OUTPUT	DI	SW	C_L (pF)
t_{HZ}	1/-	Y/Z	1/0	GND	15
t_{LZ}	1/-	Y/Z	0/1	V_{CC}	15
t_{ZH}	1/-	Y/Z	1/0	GND	100
t_{ZL}	1/-	Y/Z	0/1	V_{CC}	100
$t_{ZH(SHDN)}$	-/1	Y/Z	1/0	GND	100
$t_{ZL(SHDN)}$	-/1	Y/Z	0/1	V_{CC}	100

FIGURE 4A. TEST CIRCUIT

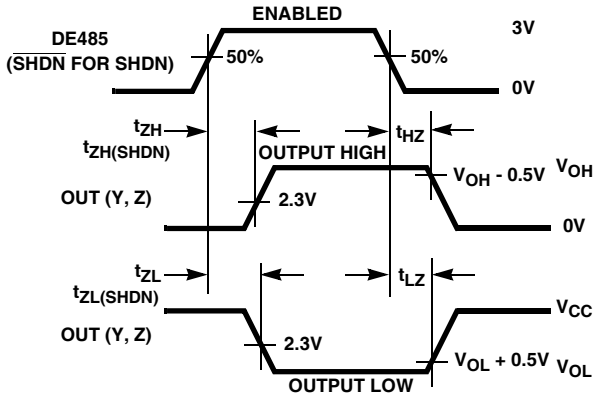


FIGURE 4B. MEASUREMENT POINTS

FIGURE 4. RS-485 DRIVER ENABLE AND DISABLE TIMES

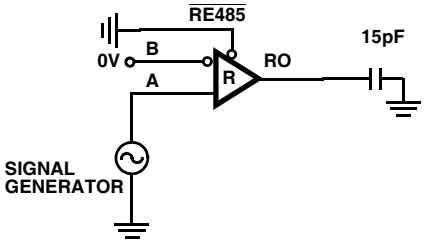


FIGURE 5A. TEST CIRCUIT

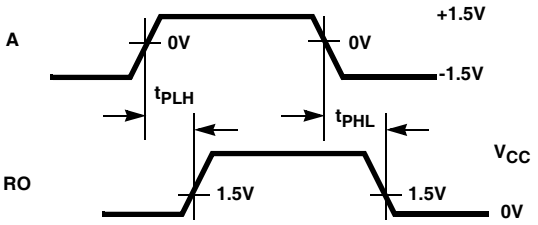
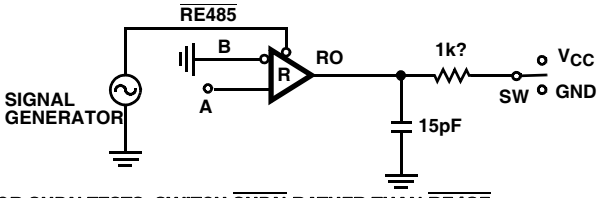


FIGURE 5B. MEASUREMENT POINTS

FIGURE 5. RS-485 RECEIVER PROPAGATION DELAY



FOR SHDN TESTS, SWITCH $\overline{SHDN}$ RATHER THAN $\overline{RE485}$

PARAMETER	$\overline{SHDN}$/$\overline{RE485}$	A	SW
t_{HZ}	1/-	+1.5V	GND
t_{LZ}	1/-	-1.5V	V_{CC}
t_{ZH}	1/-	+1.5V	GND
t_{ZL}	1/-	-1.5V	V_{CC}
$t_{ZH(SHDN)}$	-/0	+1.5V	GND
$t_{ZL(SHDN)}$	-/0	-1.5V	V_{CC}

FIGURE 6A. TEST CIRCUIT

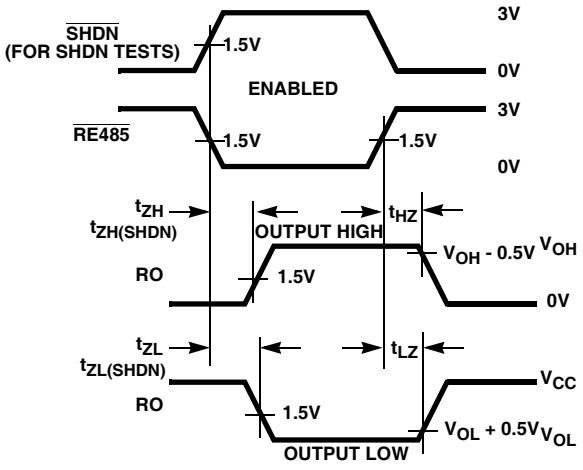


FIGURE 6B. MEASUREMENT POINTS

FIGURE 6. RS-485 RECEIVER ENABLE AND DISABLE TIMES

Test Circuits and Waveforms (Continued)

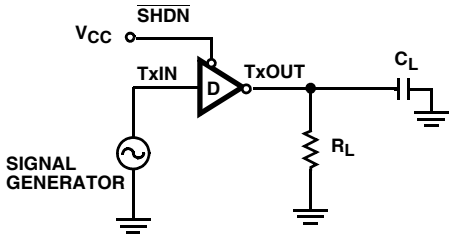


FIGURE 7A. TEST CIRCUIT

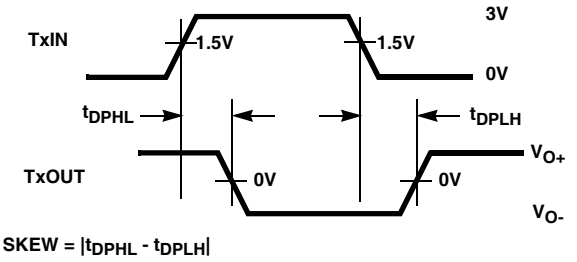


FIGURE 7B. MEASUREMENT POINTS

FIGURE 7. RS-232 DRIVER PROPAGATION DELAY AND TRANSITION TIMES

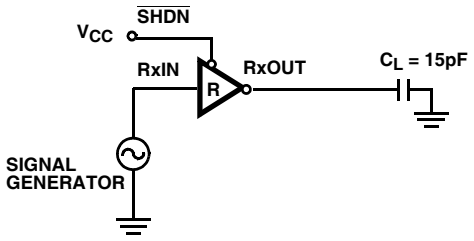


FIGURE 8A. TEST CIRCUIT

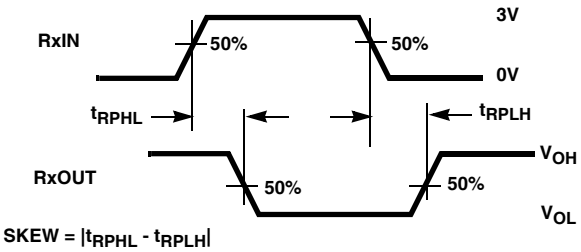


FIGURE 8B. MEASUREMENT POINTS

FIGURE 8. RS-232 RECEIVER PROPAGATION DELAY AND TRANSITION TIMES

Typical Performance Curves V_{CC} = 5V, T_A = +25°C, unless otherwise specified

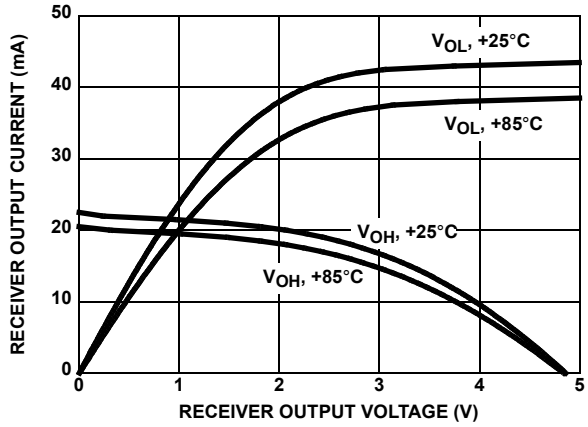


FIGURE 9. RECEIVER OUTPUT CURRENT vs RECEIVER OUTPUT VOLTAGE

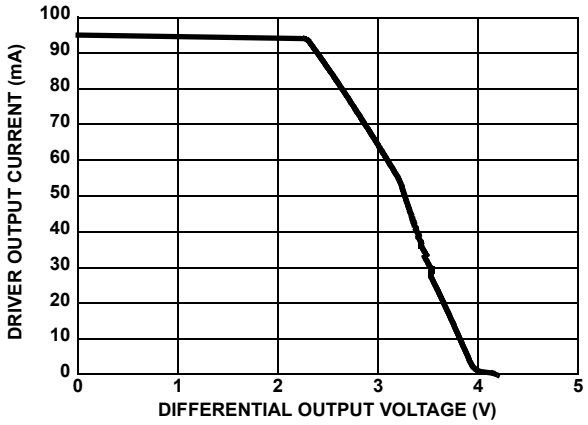


FIGURE 10. RS-485, DRIVER OUTPUT CURRENT vs DIFFERENTIAL OUTPUT VOLTAGE

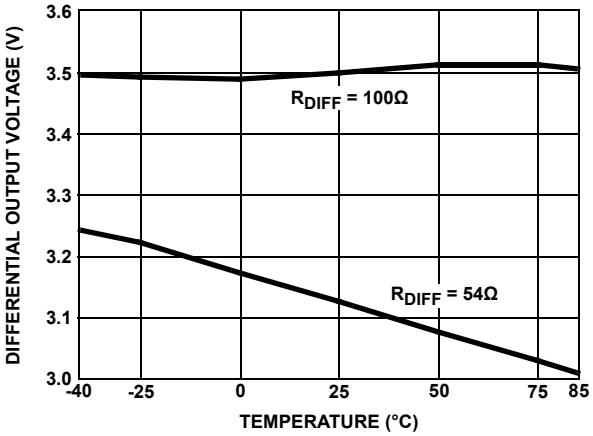


FIGURE 11. RS-485, DRIVER DIFFERENTIAL OUTPUT VOLTAGE vs TEMPERATURE

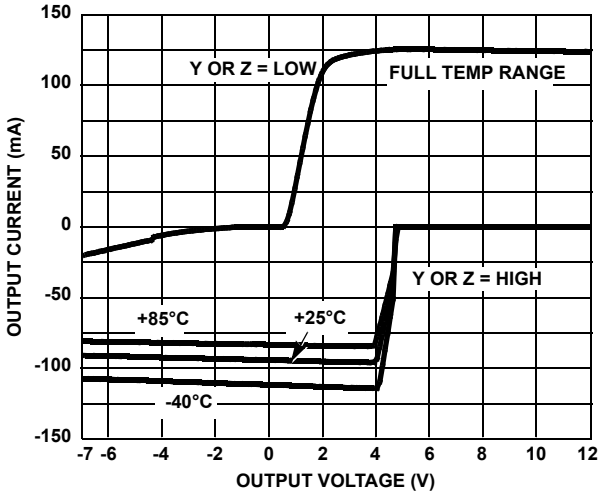


FIGURE 12. RS-485, DRIVER OUTPUT CURRENT vs SHORT-CIRCUIT VOLTAGE

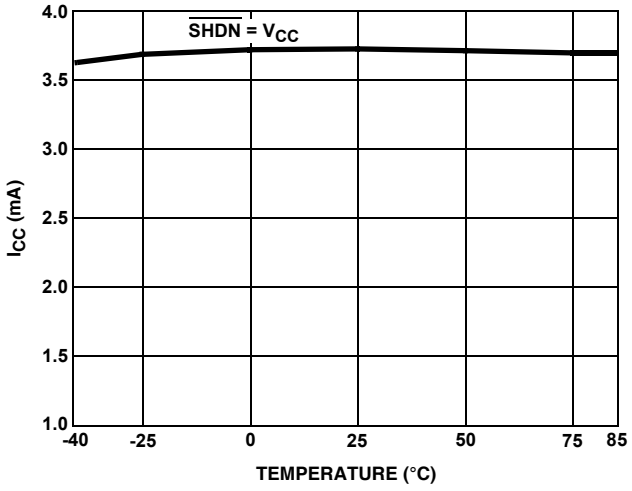


FIGURE 13. SUPPLY CURRENT vs TEMPERATURE

Typical Performance Curves V_{CC} = 5V, T_A = +25°C, unless otherwise specified (Continued)

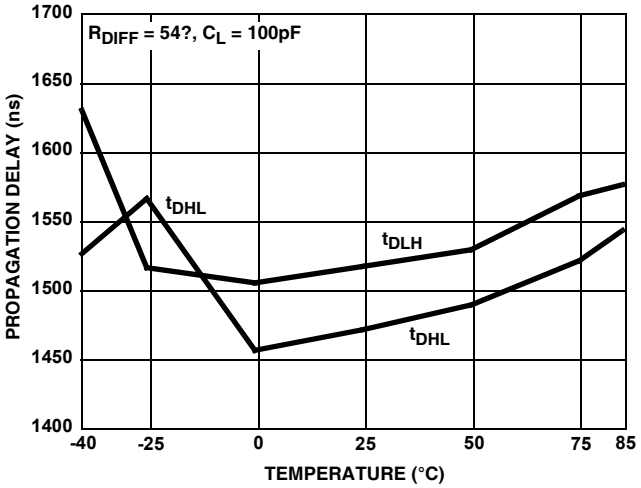


FIGURE 14. RS-485, DRIVER PROPAGATION DELAY vs TEMPERATURE (SLOW DATA RATE)

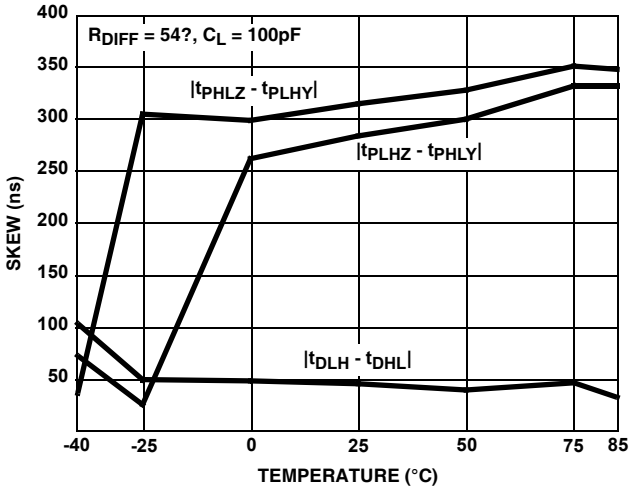


FIGURE 15. RS-485, DRIVER SKEW vs TEMPERATURE (SLOW DATA RATE)

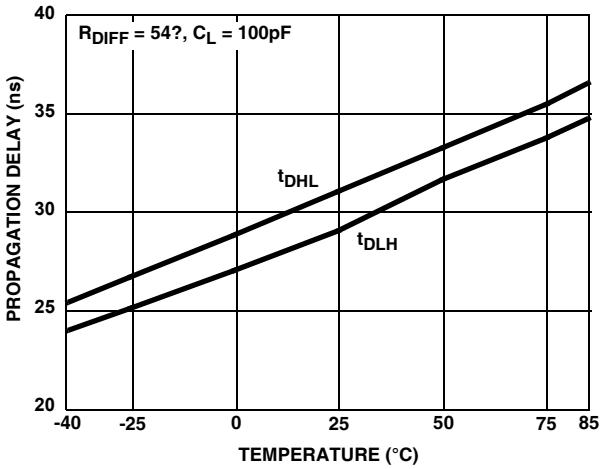


FIGURE 16. RS-485, DRIVER PROPAGATION DELAY vs TEMPERATURE (FAST DATA RATE)

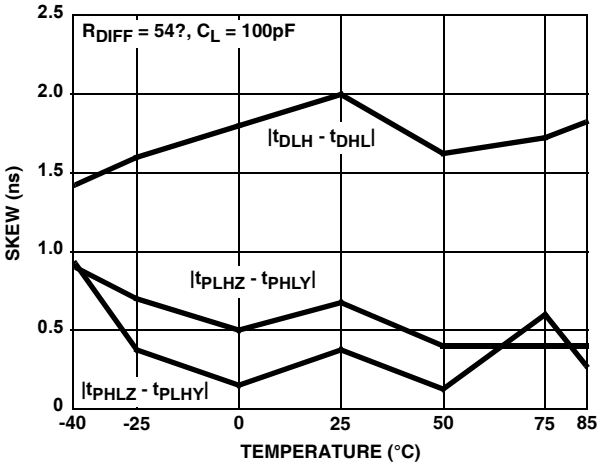


FIGURE 17. RS-485, DRIVER SKEW vs TEMPERATURE (FAST DATA RATE)

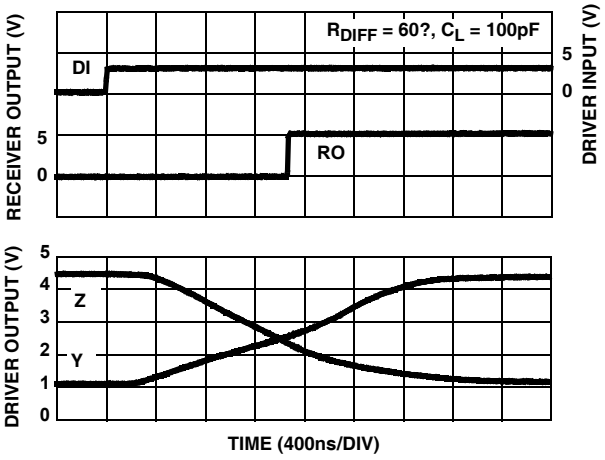


FIGURE 18. RS-485, DRIVER AND RECEIVER WAVEFORMS, LOW TO HIGH (SLOW DATA RATE)

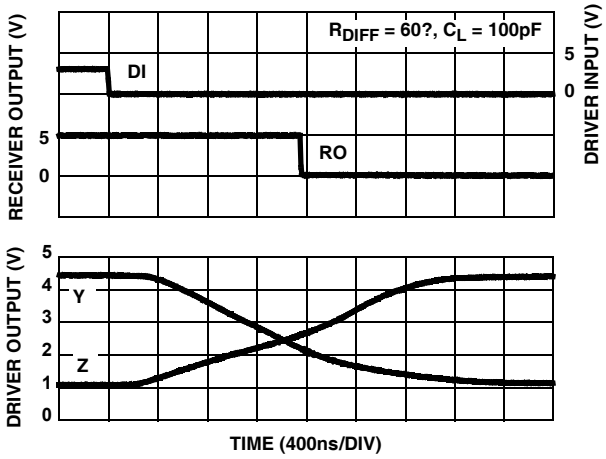


FIGURE 19. RS-485, DRIVER AND RECEIVER WAVEFORMS, HIGH TO LOW (SLOW DATA RATE)

Typical Performance Curves V_{CC} = 5V, T_A = +25°C, unless otherwise specified (Continued)

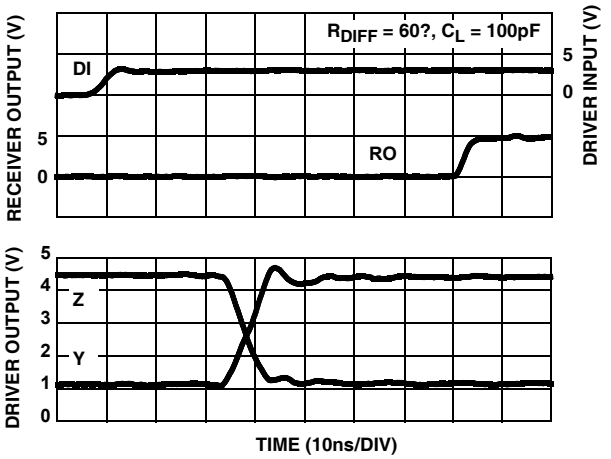


FIGURE 20. RS-485, DRIVER AND RECEIVER WAVEFORMS, LOW TO HIGH (FAST DATA RATE)

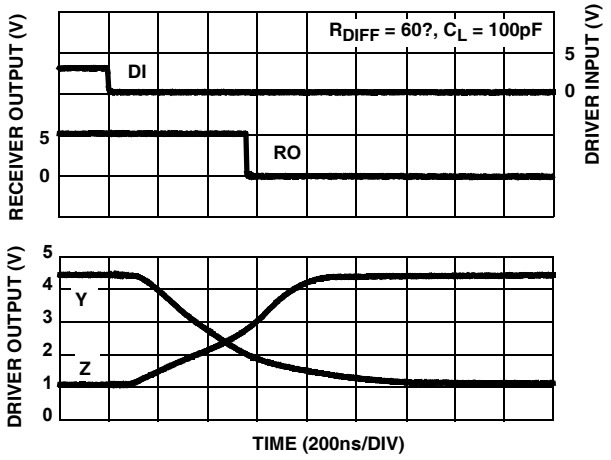


FIGURE 21. RS-485, DRIVER AND RECEIVER WAVEFORMS, HIGH TO LOW (FAST DATA RATE)

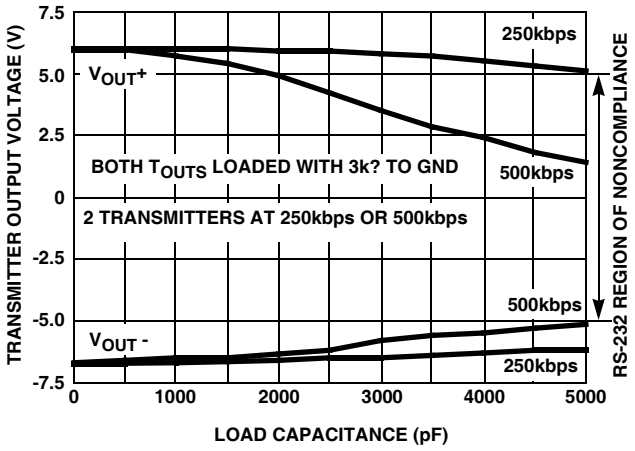


FIGURE 22. RS-232, TRANSMITTER OUTPUT VOLTAGE vs LOAD CAPACITANCE

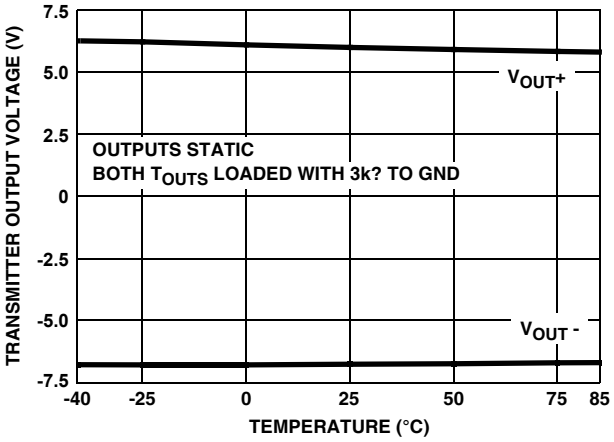


FIGURE 23. RS-232, TRANSMITTER OUTPUT VOLTAGE vs TEMPERATURE

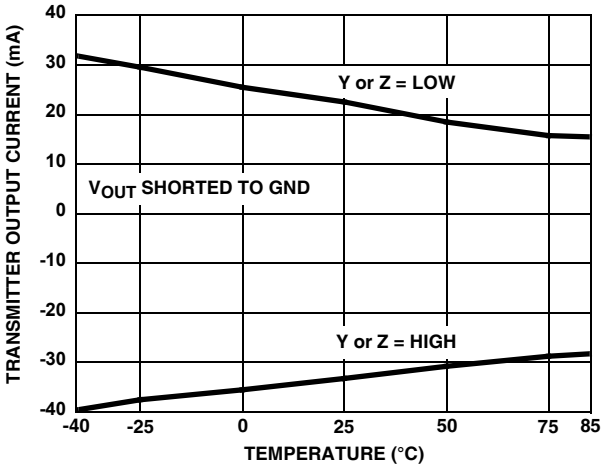


FIGURE 24. RS-232, TRANSMITTER SHORT-CIRCUIT CURRENT vs TEMPERATURE

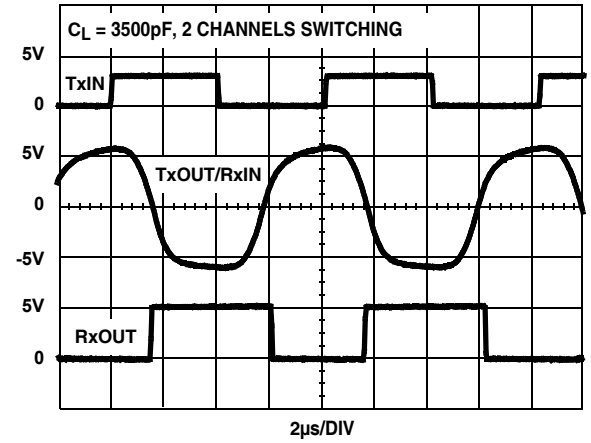


FIGURE 25. RS-232, TRANSMITTER AND RECEIVER WAVEFORMS AT 250kbps

Typical Performance Curves V_{CC} = 5V, T_A = +25°C, unless otherwise specified (Continued)

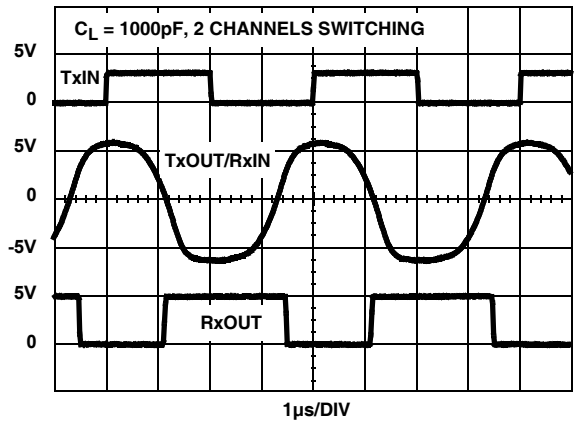


FIGURE 26. RS-232, TRANSMITTER AND RECEIVER WAVEFORMS AT 500kbps

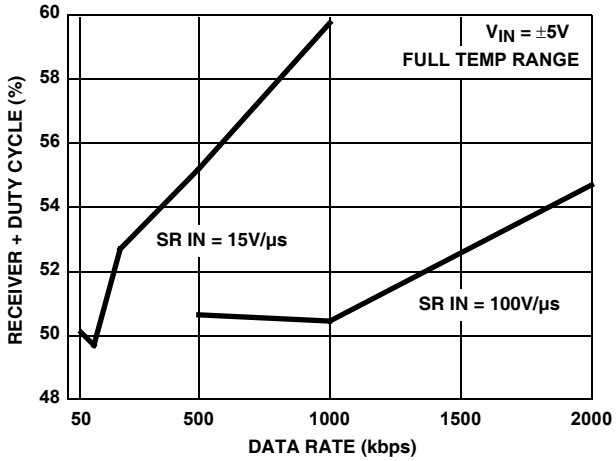


FIGURE 27. RS-232, RECEIVER OUTPUT + DUTY CYCLE vs DATA RATE

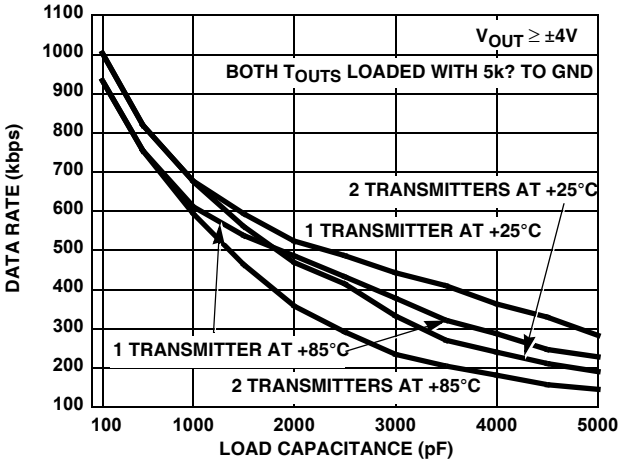


FIGURE 28. RS-232, TRANSMITTER MAXIMUM DATA RATE vs LOAD CAPACITANCE

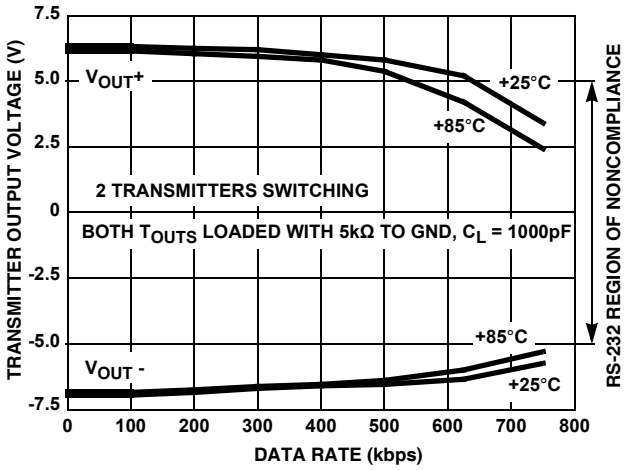


FIGURE 29. RS-232, TRANSMITTER OUTPUT VOLTAGE vs DATA RATE

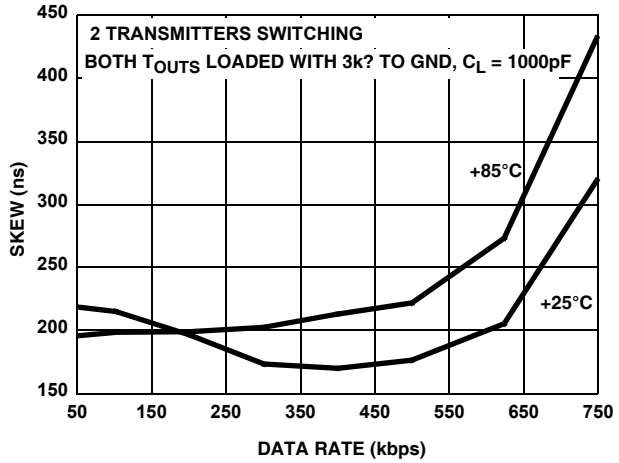


FIGURE 30. RS-232, TRANSMITTER SKEW vs DATA RATE

Die Characteristics

SUBSTRATE AND QFN PAD POTENTIAL (POWERED UP):

GND

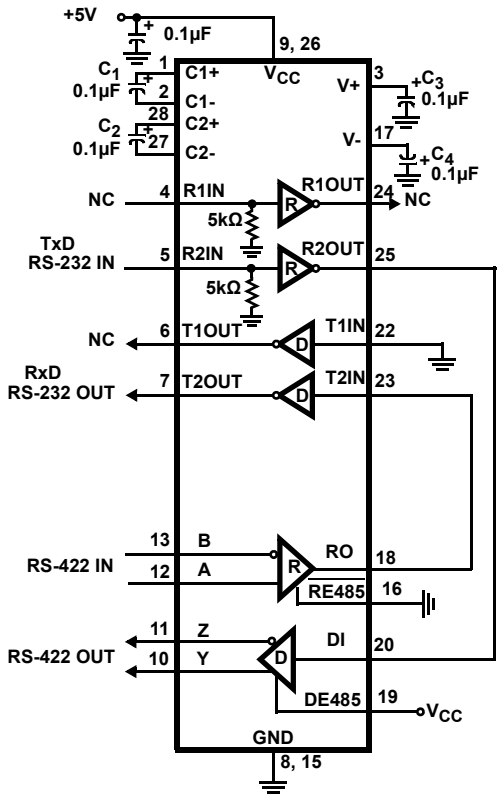
PROCESS:

BiCMOS

Typical Application

RS-232 to RS-485 Converter

The ISL33354E, ISL33357E are ideal for implementing a single IC 2-wire (Tx Data, Rx Data) protocol converter, because each port is programmed for a different protocol. Figure 31 illustrates the simple connections to create a single transceiver RS-232 to RS-422 converter. Depending on the RS-232 data rate, using an RS-422 bus as an RS-232 “extension cord” can extend the transmission distance up to 4000’ (1220m). A similar circuit on the other end of the cable completes the conversion to/from RS-232.



NOTE: PINOUT FOR SSOP

FIGURE 31. SINGLE IC RS-232 TO RS-485 CONVERTER

Detailed Description

Each of the ISL3335XE parts supports dual protocols: RS-485/422 (port 2), and RS-232 (port 1). RS-485 and RS-422 are differential (balanced) data transmission standards for use in high speed (up to 20Mbps) networks, or long haul and noisy environments. The differential signaling, coupled with RS-485’s requirement for an extended Common-Mode Range (CMR) of +12V to -7V make these transceivers extremely tolerant of ground potential differences, as well as voltages induced in the cable by external fields. Both of these effects are real concerns when communicating over the RS-485/422 maximum distance of 4000’ (1220m).

RS-422 is typically a point-to-point (one driver talking to one receiver on a bus), or a point-to-multireceiver (multidrop) standard that allows only one driver and up to 10 receivers on each bus. Because of the one driver per bus limitation, RS-422 networks use a two bus, full duplex structure for bidirectional communication, and the Rx inputs and Tx outputs (no tri-state required) connect to different busses, as shown in Figure 33 on page 17.

Conversely, RS-485 is a true multipoint standard, which allows up to 32 devices (any combination of drivers - must be tri-statable - and receivers) on each bus. Now, bidirectional communication takes place on a single bus, so the Rx inputs and Tx outputs of a port connect to the same bus lines, as shown in Figure 32. Port 2 is set to RS-485/422 mode and includes one Rx and one Tx.

RS-232 is a point-to-point, single ended (signal voltages referenced to GND) communication protocol targeting fairly short (<150’, 46m) and low data rate (<1Mbps) applications. Port 1 contains two RS-232 transceivers (2 Tx and 2 Rx).

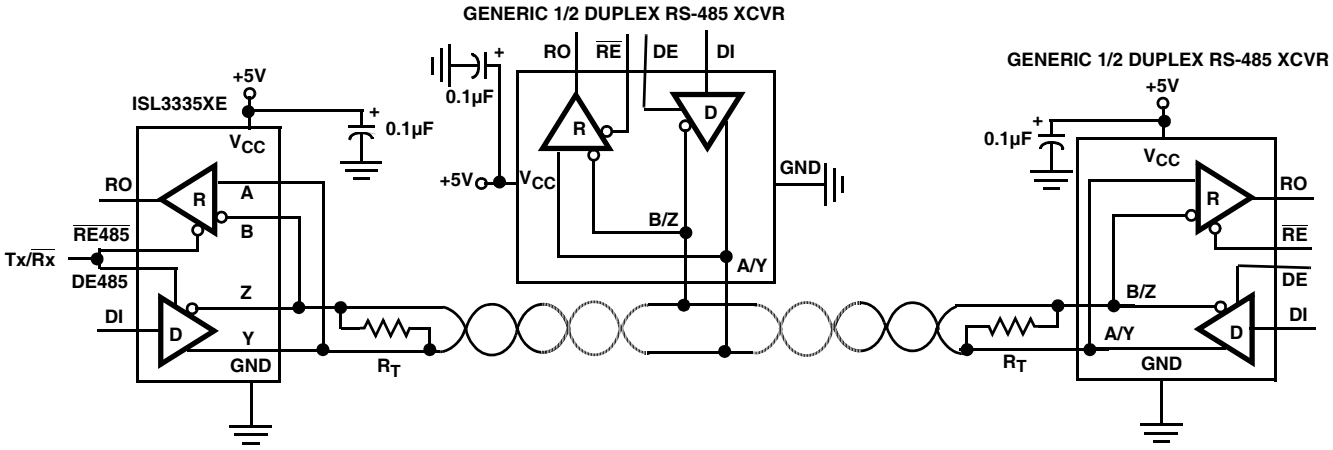


FIGURE 32. TYPICAL HALF DUPLEX RS-485 NETWORK

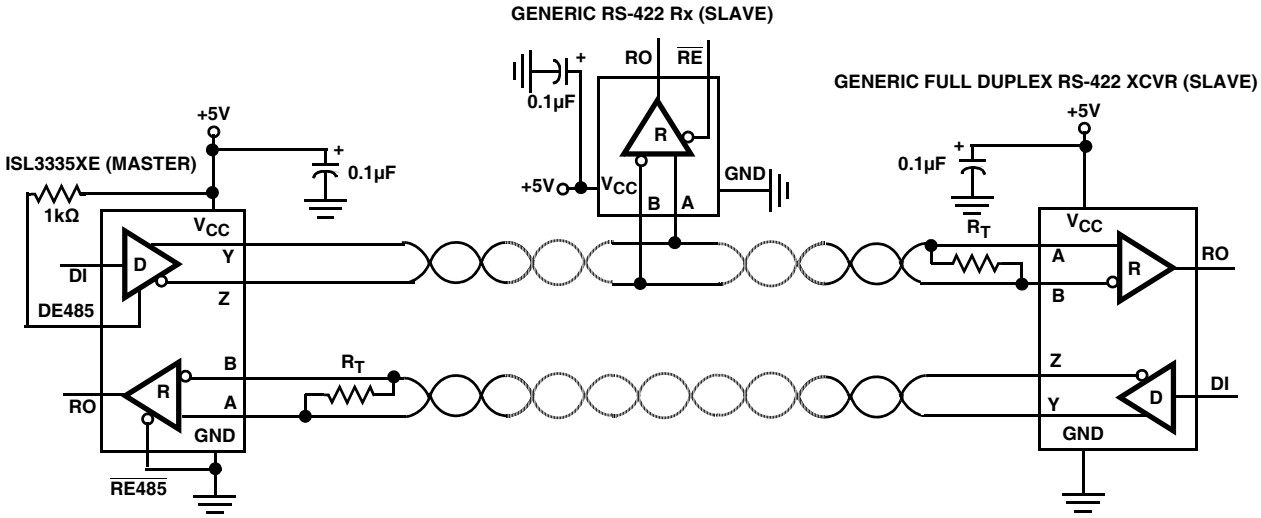


FIGURE 33. TYPICAL RS-422 NETWORK

ISL3335XE Advantages

These dual protocol ICs offer many parametric improvements vs those offered on competing dual protocol devices. Some of the major improvements are:

- **15kV Bus Pin ESD** - Eases board level requirements
- **Full Fail-Safe RS-485 Rx** - Eliminates bus biasing
- **Selectable RS-485 Data Rate** - Up to 20Mbps, or slew rate limited for low EMI and fewer termination issues
- **High RS-232 Data Rate** - >460kbps
- **Lower Tx and Rx Skews** - Wider, consistent bit widths
- **Lower I_{CC}** - Max I_{CC} is 2x to 4x lower than competition
- **Flow-Through Pinouts** - Tx, Rx bus pins on one side, logic pins on the other, for easy routing to connector/UART
- **Packaging** - Smaller (QFN) and Pb-free

RS-232 Mode (Port 1)

Rx Features

RS-232 receivers invert and convert RS-232 input levels (±3V to ±25V) to the standard TTL/CMOS levels required by a UART, ASIC, or µcontroller serial port. Receivers are designed to operate at faster data rates than the drivers, and they feature very low skews (10ns) so the receivers contribute negligibly to bit width distortion. Inputs include the standards required 3kΩ to 7kΩ pull-down resistor, so unused inputs may be left unconnected. Rx inputs also have built-in hysteresis to increase noise immunity and to decrease erroneous triggering due to slowly transitioning input signals.

Rx outputs are short-circuit protected, and are only tri-statable when the entire IC is shutdown via the $\overline{SHDN}$ pin (see Table 3 on page 5 and "Low Power Shutdown (SHDN) Mode" on page 20 for more details).

Tx Features

RS-232 drivers invert and convert the standard TTL/CMOS levels from a UART, or µcontroller serial port to RS-232 compliant levels (±5V minimum). The Tx delivers these compliant output levels even at data rates of 650kbps, with loads of 1000pF. The drivers are designed for low skew (typically 12% of the 500kbps bit width), and are compliant to the RS-232 slew rate spec (4 to 30V/µs) for a wide range of load capacitances. Tx inputs float if left unconnected and may cause I_{CC} increases. For the best results, connect unused inputs to GND.

Tx outputs are short-circuit protected, and incorporate a thermal shutdown feature to protect the IC in situations of severe power dissipation - see the RS-485 "Tx Features" on page 19 section for more details. Both Tx outputs disable when the IC enters thermal shutdown.

Drivers also tri-state in SHDN mode ($\overline{SHDN}$ = 0), or when the 5V power supply is off (see Table 3 and "Low Power Shutdown (SHDN) Mode" on page 20 for more details). SHDN is a global function - affecting both ports - so it is useful for disabling the RS-232 outputs only if both ports will always be disabled together, and if it is acceptable for the Rx to be disabled as well.

Charge Pumps

The on-chip charge pumps create the RS-232 transmitter power supplies (typically +6/-7V) from a single supply as low as 4.5V, and are enabled all the time unless in SHDN via the $\overline{SHDN}$ pin. The efficient design requires only four small 0.1µF capacitors for the voltage doubler and inverter functions. By operating discontinuously (i.e., turning off as soon as V+ and V- pump up to the nominal values), the charge pump contribution to I_{CC} reduces significantly.

Data Rates and Cabling

Drivers operate at data rates up to 650kbps and are guaranteed for data rates up to 460kbps. The charge pumps and drivers are designed such that both drivers in port 1 can be operated at the rated load, and at 460kbps (see Figure 22 on page 14). Figure 22 also shows that drivers can easily drive several thousand picofarads at data rates up to 250kbps, while still delivering compliant ±5V output levels.

Receivers operate at data rates up to 2Mbps. They are designed for a higher data rate to facilitate faster factory downloading of software into the final product, thereby improving the user's manufacturing throughput.

Figures 25 and 26 illustrate driver and receiver waveforms at 250kbps, and 500kbps, respectively. For these graphs, both drivers of port 1 drive the specified capacitive load and a receiver in the port.

RS-232 doesn't require anything special for cabling; just a single bus wire per transmitter and receiver, and another wire for GND. So an ISL3335XE RS-232 port uses a five conductor cable for interconnection. Bus terminations are not required, nor allowed, by the RS-232 standard.

RS-485 Mode (Port 2)

Rx Features

RS-485 receivers convert differential input signals as small as 200mV, as required by the RS-485 and RS-422 standards, to TTL/CMOS output levels. The differential Rx provides maximum sensitivity, noise immunity and common-mode rejection. Per the RS-485 standard, receiver inputs function with common-mode voltages from +12V to -7V, regardless of supply voltage, making them ideal for long networks where induced voltages are a realistic concern. The RS-485/RS-422 port includes a single receiver (RO).

Worst case receiver input currents are 20% lower than the 1 "unit load" (1mA) RS-485 limit, which translates to a 15kΩ minimum input resistance.

This receiver includes a "full fail-safe" function that guarantees a high level receiver output if the receiver inputs are unconnected (floating), shorted together, or if the bus is terminated but undriven (i.e., differential voltage collapses to near zero due to termination). Fail-safe with shorted, or terminated and undriven inputs is accomplished by setting the Rx upper switching point at -40mV, thereby ensuring that the Rx recognizes a 0V differential as a high level.

The Rx output is short-circuit protected and is tri-stated when the $\overline{RE485}$ input is driven low or when the IC is forced into SHDN via a logic low on the $\overline{SHDN}$ pin.

Tx Features

The RS-485/RS-422 driver is a differential output device that delivers at least 2.2V across a 54Ω load (RS-485), and at least 2.5V across a 100Ω load (RS-422). Both levels significantly exceed the standards' requirements, and these exceptional output voltages increase system noise immunity, and/or allow for transmission over longer distances. The drivers feature low propagation delay skew to maximize bit widths and to minimize EMI.

To allow multiple drivers on a bus, the RS-485 specification requires that drivers survive worst case bus contentions undamaged. The ISL3335XE drivers meet this requirement via driver output short-circuit current limits and on-chip thermal shutdown circuitry. The output stages incorporate current limiting circuitry that ensures that the output current never exceeds the RS-485 specification, even at the common-mode voltage range extremes of 12V and -7V. In the event of a major short-circuit condition, devices also include a thermal shutdown feature that disables the drivers whenever the die temperature becomes excessive. This eliminates the power dissipation, allowing the die to cool. The drivers automatically re-enable after the die temperature drops about 15 degrees. If the contention persists, the thermal shutdown/re-enable cycle repeats until the fault is cleared. Receivers stay operational during thermal shutdown.

RS-485 multidriver operation also requires drivers to include tri-state functionality, so port 2 has a DE485 pin to control this function. If the driver is used in an RS-422 network, such that driver tri-state isn't required, then the DE485 pin should be connected to V_{CC}, through a 1kΩ resistor, to keep the Tx in the enabled state. Drivers are also tri-stated when the IC is in SHDN, or when the 5V power supply is off.

Speed Options

The ISL3335XE offer two RS-485 speed options selectable via the $\overline{SLOW485}$ pin (see Table 3); "Fast" mode selects high slew rate driver outputs optimized for 20Mbps data rates while "Slow" mode uses slew rate limiting designed for 115kbps operation. See the "RS-485 Slew Rate Limited Data Rates" and "Data Rate, Cables and Terminations" sections for more information.

Receiver performance is the same for both speed options.

RS-485 Slew Rate Limited Data Rates

This IC allows the user to select fast Tx output transitions optimized for a 20Mbps data rate, or slew rate limited transitions optimized for a data rate of 115kbps. The 20Mbps fast edges may increase EMI and reflection issues, even though fast transitions aren't required at the lower data rates used by many applications. Choosing the slew limited edges for lower data rates permits longer unterminated networks, or longer stubs off terminated busses, and helps minimize EMI and reflections.

Nevertheless, for the best jitter performance when driving long cables, the faster speed option may be preferable, even at lower data rates. The faster output transitions deliver less variability (jitter) when loaded with the large capacitance associated with long cables. Of course, faster transitions require more attention to ensuring short stub lengths and quality terminations, so there are trade-offs to be made. Assuming a jitter budget of 10%, it is likely better to go with the slow speed option for data rates of 115kbps or less, to minimize fast edge effects. For higher data rates, or when the absolute best jitter is required, use the high speed option. The data rate selection pertains to only port 2.

Data Rate, Cables and Terminations

RS-485/RS-422 are intended for network lengths up to 4000' (1220m), but the maximum system data rate decreases as the transmission length increases. Devices operating at the maximum data rate of 20Mbps are limited to maximum lengths of 20-100' (6-31m), while devices operating at or below 115kbps can operate at the maximum length of 4000' (1220m).

Higher data rates require faster edges, so both of the ISL3335XE versions offer an edge rate capable of 20Mbps data rates. These ICs also offer a slew rate limited option to minimize problems at slower data rates. Nevertheless, for the best jitter performance when driving long cables, the faster speed settings may be preferable, even at low data rates. See the "RS-485 Slew Rate Limited Data Rates" section for details.

Twisted pair is the cable of choice for RS-485/RS-422 networks. Twisted pair cables tend to pick up noise and other electromagnetically induced voltages as common-mode signals, which are effectively rejected by the differential receivers in these ICs.

The preferred cable connection technique is "daisy-chaining", where the cable runs from the connector of one device directly to the connector of the next device, such that cable stub lengths are negligible. A "backbone" structure, where stubs run from the main backbone cable to each device's connector, is the next best choice, but care must be taken to ensure that each stub is electrically "short". See Table 4 for recommended maximum stub lengths for each speed option.

TABLE 4. RECOMMENDED STUB LENGTHS

SPEED OPTION	MAXIMUM STUB LENGTH ft (m)
SLOW	350-500 (107-152)
FAST	1-3 (0.3 - 0.9)

Proper termination is imperative to minimize reflections when using the 20Mbps speed option. Short networks using the slow speed option need not be terminated, but terminations are recommended unless power dissipation is an overriding concern. Note that the RS-485 spec allows a maximum of two terminations on a network, otherwise the Tx output voltage may not meet the required V_{OD}.

In point-to-point, or point-to-multireceiver (RS-422) networks, the main cable should be terminated in its characteristic

impedance (typically 120Ω) at the end farthest from the driver. In multireceiver applications, stubs connecting receivers to the main cable should be kept as short as possible, but definitely shorter than the limits shown in Table 4. Multipoint (RS-485) systems require that the main cable be terminated in its characteristic impedance at both ends. Again, keep stubs connecting a transceiver to the main cable as short as possible and refer to Table 4. Avoid “star” and other configurations, where there are many “ends” which would require more than the two allowed terminations to prevent reflections.

Active Low Rx Enable ($\overline{RE485}$)

In many RS-485 applications, especially half duplex configurations, users like to implement “echo suppression” by disabling the corresponding receiver while its driver is transmitting data. This function is available on the ISL3335XE parts via an active low $\overline{RE485}$ pin for port 2. The active low function simplifies direction control, by allowing a single GPIO line to provide a Tx/$\overline{Rx}$ direction control signal. Figure 34 details the advantage of using the $\overline{RE485}$ pin.

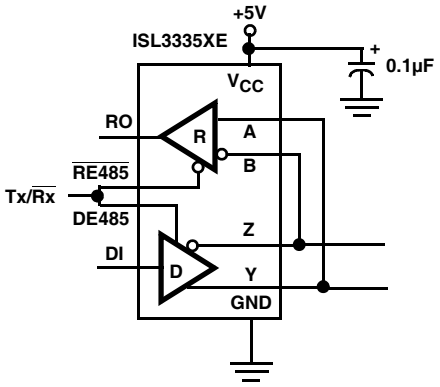


FIGURE 34. USING ACTIVE LOW RX ENABLE

Additional Features

High ESD

All pins on the ISL3335XE include ESD protection structures rated at ±4kV (HBM), which is good enough to survive ESD events commonly seen during manufacturing. But the bus pins (Tx outputs and Rx inputs) are particularly vulnerable to ESD events because they connect to an exposed port on the exterior of the finished product. Simply touching the port pins, or connecting a cable, can destroy an unprotected port. ISL3335XE bus pins are fitted with advanced structures that deliver ESD protection in excess of ±15kV (HBM), without interfering with any signal in the RS-485 or the RS-232 range. This high level of protection may eliminate the need for board level protection, or at the very least will increase the robustness of any board level scheme.

Small Packages

Many competing dual protocol devices are only available in monstrously large 24 to 28 Ld SOIC packages. The ISL33354’s 28 Ld SSOP is 50% smaller than even a 24 Ld SOIC, and the ISL33357E’s small 6x6mm QFN footprint is 80% smaller than a 28 Ld SOIC.

Flow-Through Pinouts

Even the ISL3335XE pinouts are features, in that the **true** flow-through design simplifies board layout. Having the bus pins all on one side of the package for easy routing to a cable connector, and the Rx outputs and Tx inputs (logic pins) on the other side for easy connection to a UART, avoids costly and problematic crossovers. Competing “flow-through” pinouts mix logic and bus pin inputs on one side of the package, and logic and bus pin outputs on the other side. This forces the designer to route four traces from the right side of the IC around the IC to the cable connector. Figure 35 illustrates the flow-through nature of the ISL3335XE’s pinout.

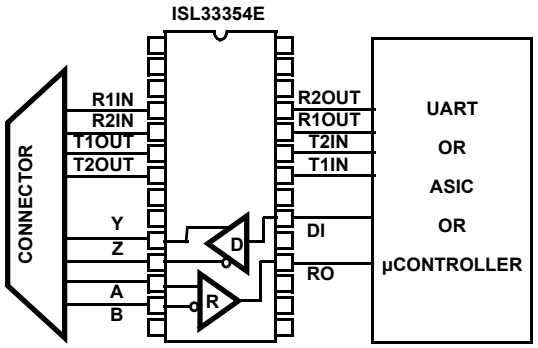


FIGURE 35. ILLUSTRATION OF FLOW-THROUGH PINOUT

Low Power Shutdown (SHDN) Mode

The $\overline{SHDN}$ pin is driven low to place the IC (both ports) in the SHDN mode, and the already low supply current drops to as low as 55µA. If this functionality isn’t desired, the $\overline{SHDN}$ pin should be connected to V_{CC} through a 1kΩ resistor. SHDN disables the Tx and Rx outputs, and disables the charge pumps, so V+ collapses to V_{CC}, and V- collapses to GND.

All but 5µA of SHDN supply current is due to control input ($\overline{SHDN}$, $\overline{SLOW485}$, DE485) pull-up resistors (~17µA/resistor when the input = 0V), so SHDN supply current varies depending on the ISL3335XE configuration. For example, the RS-485 drivers are disabled in SHDN, so driving the DE485 pin high during this time reduces the SHDN supply current. The spec table indicates the SHDN I_{CC} for the worst case configuration.

When enabling from SHDN, allow at least 20µs for the charge pumps to stabilize before transmitting RS-232 data. The charge pumps aren’t used by the RS-485 port, so the transceiver is ready to send or receive data in less than 1µs, which is much faster than competing devices that require the charge pump for all modes of operation.

Revision History

The revision history provided is for informational purposes only and is believed to be accurate, but not warranted. Please visit our website to make sure you have the latest revision.

DATE	REVISION	CHANGE
October 21, 2016	FN8775.1	Added Related Literature section on page 1. Added Table 2 on page 2. Added Tape and Reel column to Ordering information table.
October 5, 2015	FN8775.0	Initial Release

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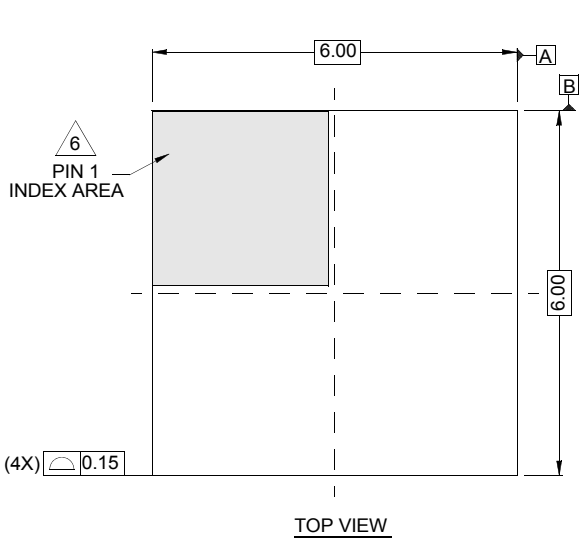
Package Outline Drawing

For the most recent package outline drawing, see L40.6x6.

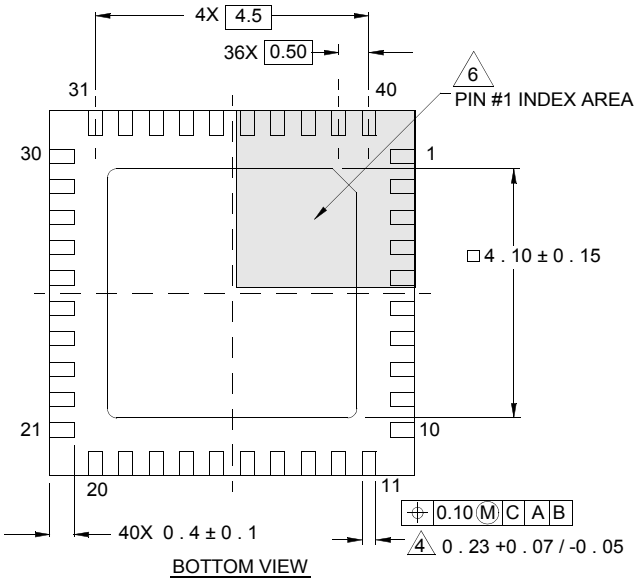
L40.6x6

40 LEAD QUAD FLAT NO-LEAD PLASTIC PACKAGE

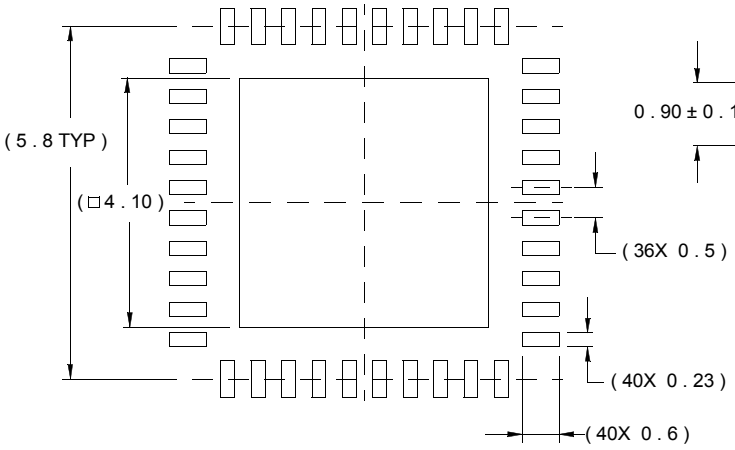
Rev 3, 10/06



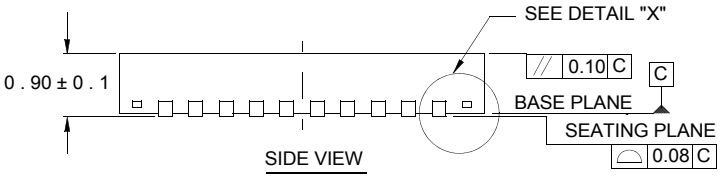
TOP VIEW



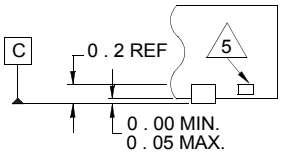
BOTTOM VIEW



TYPICAL RECOMMENDED LAND PATTERN



SIDE VIEW

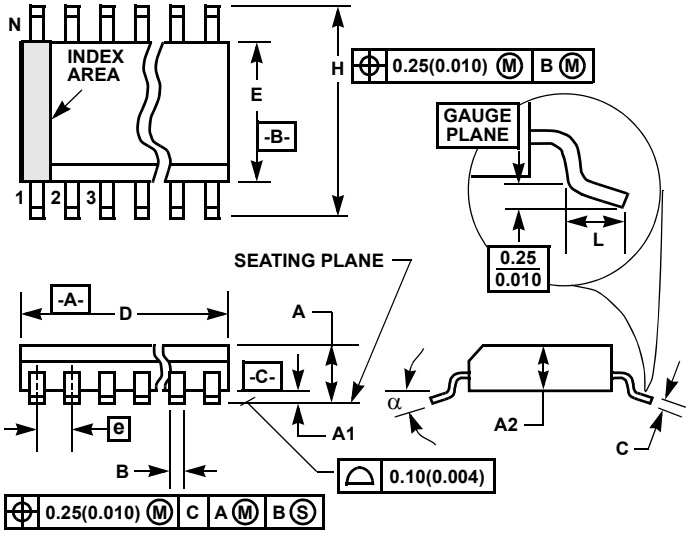


DETAIL "X"

NOTES:

1. Dimensions are in millimeters.
   Dimensions in ( ) for Reference Only.
2. Dimensioning and tolerancing conform to AMSE Y14.5m-1994.
3. Unless otherwise specified, tolerance : Decimal ± 0.05
4. Dimension b applies to the metallized terminal and is measured between 0.15mm and 0.30mm from the terminal tip.
5. Tiebar shown (if present) is a non-functional feature.
6. The configuration of the pin #1 identifier is optional, but must be located within the zone indicated. The pin #1 indentifier may be either a mold or mark feature.

Shrink Small Outline Plastic Packages (SSOP)



NOTES:

1. Symbols are defined in the “MO Series Symbol List” in Section 2.2 of Publication Number 95.
2. Dimensioning and tolerancing per ANSI Y14.5M-1982.
3. Dimension “D” does not include mold flash, protrusions or gate burrs. Mold flash, protrusion and gate burrs shall not exceed 0.20mm (0.0078 inch) per side.
4. Dimension “E” does not include interlead flash or protrusions. Interlead flash and protrusions shall not exceed 0.20mm (0.0078 inch) per side.
5. The chamfer on the body is optional. If it is not present, a visual index feature must be located within the crosshatched area.
6. “L” is the length of terminal for soldering to a substrate.
7. “N” is the number of terminal positions.
8. Terminal numbers are shown for reference only.
9. Dimension “B” does not include dambar protrusion. Allowable dambar protrusion shall be 0.13mm (0.005 inch) total in excess of “B” dimension at maximum material condition.
10. Controlling dimension: MILLIMETER. Converted inch dimensions are not necessarily exact.

M28.209 (JEDEC MO-150-AH ISSUE B)

28 LEAD SHRINK SMALL OUTLINE PLASTIC PACKAGE

SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	-	0.078	-	2.00	-
A1	0.002	-	0.05	-	-
A2	0.065	0.072	1.65	1.85	-
B	0.009	0.014	0.22	0.38	9
C	0.004	0.009	0.09	0.25	-
D	0.390	0.413	9.90	10.50	3
E	0.197	0.220	5.00	5.60	4
e	0.026 BSC		0.65 BSC		-
H	0.292	0.322	7.40	8.20	-
L	0.022	0.037	0.55	0.95	6
N	28		28		7
α	0°	8°	0°	8°	-

Rev. 2 6/05

For the most recent package outline drawing, see M28.209.

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