ISL3333EVAL1Z

Evaluation Board

The ISL3333EVAL1Z evaluation board is RoHS compliant, and provides a quick and easy method for evaluating this two-port Dual Protocol IC. The evaluation board also accommodates the ISL3331; see the "ISL3331EVAL1Z User's Manual" for details.

This board was designed to allow the user to evaluate all the features available on the ISL3332 and ISL3333 products. The ISL3333 is the full featured version (see "Key Features" in next section), where the QFN package's increased pin count gives the user access to functionality not available on the pin limited ISL3332. The same die is used in both products, so other than minor package effects, evaluating the QFN packaged ISL3333 is a reasonable substitute for evaluating the ISL3332.

By changing jumper positions the user can quickly set the board to evaluate any of the ISL3333's many modes and features, and the input states can also be set via jumpers.

Refer to the ISL3333 data sheet for complete details regarding the functions and features of this device. These dual protocol ICs feature many modes. However, studying the device's truth table along with its operating circuits and detailed description is the best way to gain an understanding of how the part works.

Key Features

- QFN Version Demonstrates All Enhanced Features:
  - Logic Supply Pin (V_L)
  - Three RS-485 Speed Options - 115kbps/460kbps/20Mbps
  - Active Low RS-485 Rx Enable for Simple Direction Control
  - Active Low RS-232 Tx Disable Function
- Quick Configuration Using Jumpers
- State of All Inputs Can be Set by Jumper Positions
- No Bus Termination Resistors on Port 1 Allows Easy RS-232 Evaluation; Bus Termination Resistors on Port 2 for RS-485 Evaluation
- Simple Operation Requires Only One, 3.3V Power Supply

Important Notes

To facilitate locating jumpers on this board, Figure 3 is a jumper locator and, in this Application Note, the (#) following a jumper mention corresponds to the red jumper number on the locator. See "Jumper Definitions" on page 7 for a description of the function of each jumper.

The base board is used to evaluate both the ISL3333 (2-port) and ISL3331 (1-port) products, so the jumper and connector names reflect the functionality of both products. Due to space

limitations some jumper labels are abbreviated, but the corresponding BNC connector has the full label.

In most cases, a name that applies to both products contains no parenthesis (e.g., "B1"), and a name that applies to only the ISL3333 is followed by "(NC)" (e.g., "B2 (NC)").

It is important to note that the ISL333x do not follow the RS-485 convention whereby the inverting I/O is labeled "B/Z", and the non-inverting I/O is "A/Y". Thus, the ISL3332 and ISL3333 A/Y (B/Z) pins connect to the B/Z (A/Y) pins of generic RS-485/422 ICs.

Input signals that connect to a BNC connector, because they are likely to be driven by a generator, include a 50Ω termination resistor to GND when the jumper is in the "LOW" position.

Port 1 includes no Rx input nor Tx output termination resistors, as this port is intended for RS-232 evaluation. Port 2, intended for RS-485/422 evaluation, includes 120Ω differential termination resistors across the Rx inputs, and across the Tx outputs.

Default Configuration

As delivered (see "Functional Diagram (Default Configuration)" on page 2), the board is configured for Port 1 in RS-232 mode with Tx and Rx enabled, Rx inputs floating, and Tx inputs low. Port 2 is in RS-485 mode with Tx and Rx enabled, Tx set for high speed (20Mbps) operation, driver input (DY) low, Rx inputs floating but shorted together through a 120Ω termination resistor. Additionally, the ISL3333 is powered-up (i.e., not SHDN), has internal loopback disabled, and has V_L shorted to V_{CC}. To achieve this configuration, the jumpers (see "Jumper Definitions" on page 7) are installed as follows (unlisted jumpers are not installed, and (#) indicates the jumper number on Figure 3 jumper locator): SEL1 (7) = LOW; SEL2 (8) = VH; (DEN) (28) = VH; $\overline{RXEN1}$ (15) = LOW; SPA (16) = VH; SPB (17) = VH; $\overline{RXEN2}$ (18) = LOW; (RXEN) (29) = VH; DE2 (19) = VH; DY2 (20) = LOW; ON/$\overline{OFF}$ (21) = VH; $\overline{LB}$ (22) = VH; DY1 (DZ/SLEW) (23) = LOW; DZ1/DE1 (DY) (24) = LOW; RXBIAS-VCC (25) = installed; VCC-VL (26) = installed; VL-VHIGH (27) = installed.

Functional Diagram *(Default Configuration)*
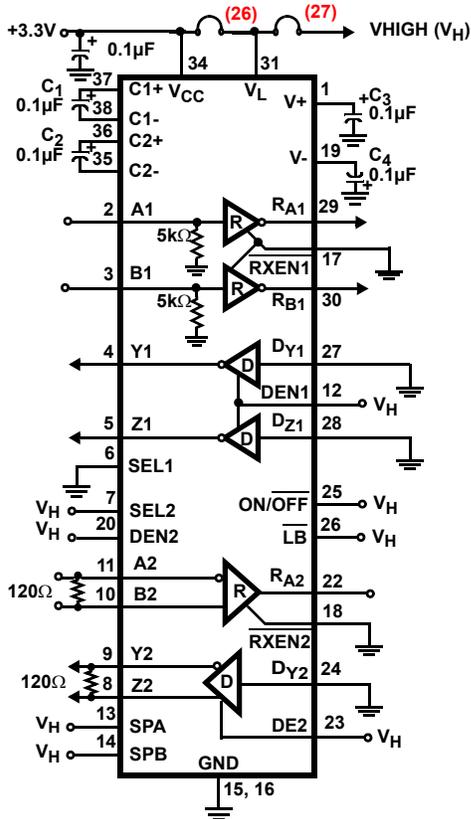
Supply Banana Jacks

There are eight banana jacks at the top of the board for power supply connections, but only V_{CC} and GND are required connections. The function and use of each jack (from left to right) are:

VLOAD - This is a load voltage driving the load resistors connected to the Rx and Tx outputs (Tx resistors - R_5, R_6, R_{10}, R_{11} - are not populated); used mostly during output enable and disable time characterizations.

GND - Common connection for any supplies used.

RXBIAS - A voltage that can be applied to any or all Rx inputs via jumpers ((2), (3), (11), (12)); the "RXBIAS-VCC" (25) jumper shorts this jack to V_{CC}, so remove this jumper if supplying a voltage other than V_{CC}.

V+ - Used to monitor the positive charge pump voltage in RS-232 mode.

V- - Used to monitor the negative charge pump voltage in RS-232 mode.

VCC - The 3.3V supply connection.

VHIGH - Connects to all the "VH" positions on the jumpers to define the high level voltage for logic and Tx inputs; the "VL-VHIGH" (27) jumper shorts this jack to V_L, so remove this jumper if supplying a voltage other than V_L.

VL - The logic supply voltage that sets the ISL3333's Rx output V_{OH} levels, and the logic and Tx input switching points; the "VCC-VL" (26) jumper shorts this jack to V_{CC}, so remove this jumper if supplying a voltage other than V_{CC}.

Getting Started

Connect a 3.3V, 500mA minimum, power supply to the V_{CC} and GND banana jacks. It is recommended that an ammeter be used between the supply and the board, in order for I_{CC} to be monitored. Ensure that the "RXBIAS-VCC" (25), "VCC-VL" (26) and "VL-VHIGH" (27) jumpers are installed in the upper right hand corner of the board.

For simplicity, the following discussions assume that Port 1 is used for RS-232 evaluations, and Port 2 for RS-485 evaluations. Of course, the user is free to configure either port for either protocol.

External Loopback Via Jumpers

To evaluate the Rx and Tx performance at the same time, an external loopback can be implemented simply by installing jumpers "A1/Y1_LB" (5) and "B1/Z1_LB" (6) for Port 1, and jumpers "A2/Y2_LB" (10) and "B2/Z2_LB" (9) for Port 2. In this configuration, the Tx output lines connect to the corresponding Rx input lines, so the data driven on the Tx input(s) appears at the Rx output(s). In RS-485 mode, data driven on DY loops back through A and B to R_A. In RS-232 mode, DY loops back to R_A, and DZ loops back to R_B.

Basic RS-485 DC Evaluation (Port 2)

GENERAL OBSERVATIONS

I_{CC} should be approximately 23mA. Most of this current is due to the RS-485 Tx driving the 120Ω termination resistor (R13). To get just the quiescent ISL3333 I_{CC}, simply move jumper "DE2" (19) to the "LOW" position. I_{CC} should now be approximately 3.9mA, due to the charge pumps running to provide the RS-232 transmitter supplies for Port 1. Move jumper "DE2" back to the "VH" position.

Measure V+ and V- at the banana jacks - V+ $\approx$ +6V and V- $\approx$ -5.7V, indicating that the charge pumps are on. If both ports were programmed for RS-485 mode, then I_{CC} drops to 1.2mA (if "DE2" = "LOW"), and V+ $\approx V_{CC}$, V- = GND.

RA2 is high (due to the "full failsafe" Rx) while RB2 is tri-stated, but pulled high by a weak internal current source, because it is unused in RS-485 mode.

RECEIVER TESTS

The "full failsafe" nature of the Rx can be evaluated by manipulating the "A2 (485/$\overline{232}$)" (14) and "B2" (13) input jumpers. In the default configuration, A2 and B2 are "shorted" via a 120Ω termination resistor, but RA2 (measure at the "RA2 (NC)" test point, located between test points "TP17" and "TP21") remains high due to the failsafe "terminated but undriven" functionality. Installing jumpers "A2" (14) (to the "LOW" position) and "B2" effectively shorts the two inputs together (i.e., $V_{ID} = V_{B2} - V_{A2} = 0$). RA2 still

RENESAS

remains high, indicating that the Rx is also failsafe "shorted". Failsafe "open" is best demonstrated using Port 1. Simply move the "SEL1" (7) jumper to the VH position to place Port 1 in RS-485 mode (note that I_{CC} drops to 1.1mA, if "DE2" is "LOW"). In this configuration, A1 and B1 float (5kΩ pull-down resistors only connect in RS-232 mode), but RA1 (measure at the "RA1 (RB)" test point to the left of jumper (24)) remains high due to the failsafe "open" functionality. This combination of failsafe "open", "shorted", and "terminated but undriven" yields a "full-failsafe" Rx. Switch the "SEL1" jumper back to the "LOW" position.

To switch the port 2 Rx output state leave the "B2" jumper installed, remove the "A2" jumper, and install the A2 Rx bias jumper, "J12" (11). The "RXBIAS-VCC" (25) jumper now drives the A2 input voltage to V_{CC}, which switches RA2 low. Removing the "RXBIAS-VCC" jumper, and connecting a power supply between the "RXBIAS" banana jack and GND now sets the Rx differential input voltage, via A2, and varying this supply switches the Rx output state. For example, with the RXBIAS supply = 0V (V_{ID} = 0V) RA2 is high, and increasing RXBIAS to at least +200mV (V_{ID} = -200mV) switches the output low. When finished, remove jumper "J12".

To disable the RA2 output via the active low $\overline{RXEN2}$ pin, move jumper "$\overline{RXEN2}$" (18) to the "VH" position. Note that the RB2 internal current source still keeps this output high.

Move the "$\overline{RXEN2}$" jumper back to the "LOW" position, remove the "RXBIAS" power supply and the "B2" jumper, and reinstall the "RXBIAS-VCC" (25) jumper.

DRIVER TESTS

Tx DC output levels are independent of Tx speed setting. In the default configuration, the driver input, DY2, is low, so the Tx non-inverting output, Z2, is low ($\approx$0.8V), while the inverting output, Y2, is high ($\approx$3.1V). To switch the output states, simply move the "DY2" (20) jumper to the "VH" position. In either state, note the differential output voltage (V_{OD}) of $\approx$2.3V into the 120Ω load. To evaluate the double terminated V_{OD} ($\approx$2.0V), configure Port 2 for "external loopback", as described previously (i.e., install jumpers (9) and (10)).

To disable the Tx output via the active high DE2 pin, move the "DE2" (19) jumper from the "VH" to the "LOW" position.

When finished, return the "DE2" jumper to the "VH" position, return the "DY2" jumper to the "LOW" position, and remove the "external loopback" jumpers.

INTERNAL LOOPBACK

Before enabling loopback mode, note that the RA2 output is high. To configure the ISL3333 for internal loopback, simply move jumper "$\overline{LB}$" (22) from the "VH" to the "LOW" position. Note that I_{CC} increases by $\approx$3mA, due to the enabling of the loopback receivers, and note that the $\overline{LB}$ pin controls both ports. RA2 is now low due to the Tx outputs internally driving

the Rx. You can repeat the previous Rx switching tests to confirm that the external Rx input pins now have no affect on RA2.

When finished, return the "$\overline{LB}$" jumper to the "VH" position.

LOW POWER SHDN

SHDN automatically powers down both ports, shuts off the charge pumps (V+ collapses to V_{CC}, V- to GND), disables the Tx and Rx outputs, and places the ISL3333 in it's lowest power mode. Before entering SHDN, remove the "ON/$\overline{OFF}$ (NC)" (21) jumper, and note that the pin's on-chip pull-up resistor keeps the ISL3333 powered-up. To enter SHDN, move the "ON/$\overline{OFF}$ (NC)" jumper from the "VH" to the "LOW" position. In the default configuration, the I_{CC} drops to 22μA.

Return the "ON/$\overline{OFF}$" jumper to the "VH" position.

Basic RS-485 AC Evaluation

RECEIVER TESTS

Before starting, ensure that the jumpers are back in the default positions. Note that the RS-485 Rx operates at high speed, regardless of the Tx speed selection.

Due to the Rx differential termination resistor (R14) across A2 and B2, the easiest way to evaluate the Rx by itself is by using Port 1. Move the "SEL1" (7) jumper to the "VH" position to set Port 1 to RS-485 mode.

Add jumper "B1" (4) to connect that input to GND, and add jumper "A1" (1) to engage the 50Ω term. Connect a generator to the "A1" BNC, and set it for a -1.5V to +1.5V swing. Monitoring test points "TP6" (input), and "RA1(RB)" (output) with a scope allows the Rx prop delays and skews to be measured. If desired, you can load the Rx output with a 1kΩ resistor by adding jumper "J13" (not numbered), located below, and left of, test point "RA1 (RB)". This resistor terminates to the "VLOAD" banana jack (upper left hand corner), allowing the resistor to be terminated to GND by shorting "VLOAD" to GND, or terminated to any voltage by connecting "VLOAD" to an external supply.

You can also measure the Rx enable/disable time to/from a low output state via the active low $\overline{RXEN1}$ pin. From the previous jumper configuration, leave the "B1" and "J13" jumpers installed, remove the "A1" jumper, and install the A1 Rx bias jumper, "J10" (2). Connect the "VLOAD" jack to V_{CC}, switch the "$\overline{RXEN1}$" (15) jumper to the low position to engage the 50Ω term, set the generator to swing from 0V to 3V, and move the generator to the "$\overline{RXEN1}$" BNC. Monitoring test points "TP11" (input), and "RA1(RB)" (output) with a scope allows the Rx enable and disable times to be measured. To evaluate the Rx enable/disable time to/from a high output state, simply remove "J10", and connect "VLOAD" to GND.

TX SPEED SELECTION

Before performing any driver AC evaluation, ensure that all jumpers are in their default positions, and then configure the

"SPA" (16) and "SPB" (17) jumpers for the desired Tx speed setting. Table 1 details the jumper settings for each of the speed options.

TABLE 1. JMPR SETTINGS FOR Tx SPEED SELECTION

DATA RATE	J-SPA (16)	J-SPB (17)
115kbps	"LOW"	"VH"
460kbps	"LOW"	"LOW"
20Mbps	"VH"	"LOW" or "VH"

DRIVER TESTS (PORT 2)

R_{13} provides a differential 120Ω load across the driver outputs, and, if desired, a differential capacitive load may be soldered on top of R_{13}. Alternatively, single ended (Y2 or Z2 to GND) resistive and/or capacitive loads may be added at positions "C_3" and "C_5", if so desired.

Ensure that the "DY2" (20) jumper is in the "LOW" position to engage the 50Ω term resistor, connect the generator to the "DY2 (NC)" BNC, and set the swing for 0V to 3V. Monitoring test points "TP19" (input), and "TP3" and "TP7" (Y2 and Z2 outputs respectively) with a scope allows the Tx prop delays, skews, and transition times to be measured. To view the differential waveform, use the scope's math function to generate "Z-Y".

To measure the Tx output enable and disable times, start with the previous jumper configuration and move the "DZ2/DE2 (NC)" (19) jumper to the "LOW" position to engage its 50Ω term resistor. Connect the generator to the "DZ2/DE2 (NC)" BNC, and set the swing for 0 to 3V. Monitoring test points "TP21" (input), and "TP3" and "TP7" (Y2 and Z2 outputs respectively) with a scope allows the enable and disable times to be measured. Note that the differential termination resistor collapses the disabled outputs.

EVALUATING DRIVER AND RECEIVER COMBINED PERFORMANCE

Start with the default jumper configuration. Performance through a cascaded Tx and Rx can easily be evaluated, utilizing the external loopback function, by installing jumpers "A2/Y2_LB (10) and "B2/Z2_LB (9). In this configuration, the Tx output lines connect to the corresponding Rx input lines, so the data driven on the Tx input (DY2) appears at the Rx output (RA2).

DIfferential 120Ω resistors R_{13} and R_{14} allow evaluation of the Tx performance while driving a double terminated load.

INTERCONNECTING DRIVER AND RECEIVER WITH A CABLE

To evaluate the performance of the Tx and Rx (Port 2) interconnected by a cable, start with the default configuration, connect one wire of a twisted pair between test points "TP7" and "TP8", and connect the other wire in the pair between "TP3" and "TP4". Ensure that the "DY2 (NC)" (20) jumper is in the "LOW" position to engage the

50Ω term resistor, connect the generator to the "DY2 (NC)" BNC, and set the swing for 0V to 3V. Monitoring test points "TP19" (input), and test point "RA2 (NC)" (Rx output) illustrates the overall input to output performance.

Resistors R_{14} and R_{13} provide source and load terminations for the cable.

Basic RS-232 DC Evaluation (Port 1)

GENERAL OBSERVATIONS

To better evaluate the RS-232 mode I_{CC}, it is a good idea to disable the RS-485 drivers by moving jumper "DZ2/DE2 (NC)" (19) to the "LOW" position. I_{CC} should be approximately 3.9mA after this change.

Note that RS-232 drivers and receivers are inverting by definition.

Don't use Port 2 for RS-232 evaluation without removing the input and output differential termination resistors (R_{13} and R_{14}), or the RS-232 waveforms will be severely distorted.

RECEIVER TESTS

In the default configuration - (see "Functional Diagram (Default Configuration)" on page 2) - RA1 (measure at the "RA1(RB)" test point to the left of jumper (24)) and RB1 (measure at the "RB1(RA)" test point to the right of jumper (1)) are high due to the A1 and B1 $5k\Omega$ input resistors to GND.

To switch the port 1 Rx output states, install the A1 and B1 Rx bias jumpers, "J10" (2) and "J9" (3). The "RXBIAS-VCC" (25) jumper now drives the Rx input voltages to V_{CC}, which switches RA1 and RB1 low. Removing the "RXBIAS-VCC" jumper and connecting a power supply between the "RXBIAS" banana jack and GND, allows this supply to set the Rx input voltages, in case the user wants to evaluate the Rx switching points. When finished, remove jumpers "J10" and "J9".

To disable the Rx outputs via the active low $\overline{RXEN1}$ pin, move jumper "$\overline{RXEN1}$" (15) to the "VH" position.

Return the "$\overline{RXEN1}$" jumper to the "LOW" position, remove the "RXBIAS" power supply, and reinstall the "RXBIAS-VCC" jumper.

DRIVER TESTS

The RS-232 Tx outputs, Y1 and Z1, are high ($\approx 6.2V$) in the default configuration, because DY1 and DZ1 are low. To switch the output states ($V_{OL} \approx -5.7V$), simply move the "DY1 (DZ/SLEW)" (23) and "DZ1/DE1 (DY)" (24) jumpers to the "VH" position. To evaluate the loaded driver output voltages, configure Port 1 for "external loopback", as described previously (i.e., install jumpers (5) and (6)). Each driver output is now loaded by an Rx input resistor, and the output voltages still exceed ±5.5V.

The Tx outputs are disabled in SHDN, or by driving DEN1(DEN) low (move jumper (DEN) (28) to the "LOW" position).

Remove the "external loopback" jumpers when finished, and switch the "DY1 (DZ/SLEW)" and "DZ1/DE1 (DY)" jumpers back to the "LOW" positions, and the (DEN) jumper back to the "VH" position.

INTERNAL LOOPBACK

Before enabling loopback mode, note that the RA1 and RB1 outputs are high. To configure the ISL3333 for internal loopback, simply move jumper "$\overline{\text{LB}}$" (22) from the "VH" to the "LOW" position. Note that I_{CC} increases by ≈4.5mA, due to the enabling of the loopback receivers, and note that the $\overline{\text{LB}}$ pin controls both ports. RA1 and RB1 are now low due to the Tx outputs internally driving the Rx. You can repeat the previous Rx switching tests to confirm that the external Rx input pins now have no affect on the Rx outputs. Switching the state of jumpers "DY1 (DZ/SLEW)" (23) and "DZ1/DE1 (DY)" (24) will toggle RA1 and RB1 accordingly.

When finished, return the "$\overline{\text{LB}}$" jumper to the "VH" position.

LOW POWER SHDN

SHDN automatically powers down both ports, shuts off the charge pumps (V+ collapses to V_{CC}, V- to GND), disables the Tx and Rx outputs, and places the ISL3333 in it's lowest power mode. To enter SHDN, move the "ON/OFF" (21) jumper from the "VH" to the "LOW" position. In the default configuration, the I_{CC} drops to 22µA.

Basic RS-232 AC Evaluation (Port 1)

Before starting, ensure that the jumpers are back in the default positions, with the "DZ2/DE2" (19) jumper in the "LOW" position. Note that the RS-232 data rate is fixed, so the speed select pins have no effect.

RECEIVER TESTS

Add jumper "A1" (1) to engage the 50Ω term, connect a generator to the "A1" BNC, and set it for at least a 0V to 3V swing. Monitoring test points "TP6" (input), and "RA1 (RB)" (output) with a scope allows the Rx prop delays and skews to be measured. If desired, you can load the Rx output with a 1kΩ resistor by adding jumper "J13" (not numbered), located below, and left of, test point "RA1 (RB)". This resistor terminates to the "VLOAD" banana jack (upper left hand corner), allowing the resistor to be terminated to GND by shorting "VLOAD" to GND, or terminated to any voltage by connecting "VLOAD" to an external supply.

To measure the Rx enable/disable time to/from a high output state via the active low $\overline{\text{RXEN}}$ pin, start from the previous jumper configuration, leave the "J13" jumper installed, and connect the "VLOAD" banana jack to GND. Remove the "A1" jumper (Rx input is pulled low by its on-chip pull-down), ensure the "$\overline{\text{RXEN1}}$" (15) jumper is in the low position to engage the 50Ω term, set the generator to swing from 0V to

3V, and move the generator to the "$\overline{\text{RXEN1}}$" BNC. Monitoring test points "TP11" (input), and "RA1(RB)" (output) with a scope allows the Rx enable and disable times to be measured. To evaluate the Rx enable/disable time to/from a low output state, install the A1 Rx bias jumper, "J10" (2), and connect the "VLOAD" banana jack to V_{CC}.

DRIVER TESTS

Ensure that the "DY1 (DZ/SLEW)" (23) jumper is in the "LOW" position to engage the 50Ω term resistor, connect the generator to the "DY1 (DZ/SLEW)" BNC, and set the swing for 0 to 3V. Monitoring test points "TP20" (input) and "TP5" (output) with a scope, allows the Tx prop delays, skews, and transition times to be measured.

To measure the "loaded" driver performance, simply remove the "J10" (2) jumper, and add the "A1/Y1_LB" (5) jumper, which connects an Rx input, including its 5kΩ pull-down, to the driver output. Capacitive loading can be added at position C4.

To measure the Y1 Tx enable/disable time to/from a high output state via the active high DEN1 pin, start from the previous jumper configuration, and ensure that the "DY1 (DZ/SLEW)" jumper is in the "LOW" positions. Ensure that the "(DEN)" (28) jumper is in the "LOW" position to engage the 50Ω term resistor, and connect the generator (set for a 0 to 3V swing) to the "DEN1(DEN)" BNC. Monitoring test points "TP9" (input) and "TP5" (output) with a scope, allows the measuring of the enable and disable times. To evaluate the Tx enable/disable time to/from a low output state, move jumper "DY1 (DZ/SLEW)" to the "VH" position.

EVALUATING DRIVER AND RECEIVER COMBINED PERFORMANCE

Performance through a cascaded Tx and Rx can easily be evaluated utilizing the external loopback function. Ensure that the "A1/Y1_LB" (5) jumper is installed, that the "$\overline{\text{RXEN1}}$" (15) and "DY1 (DZ/SLEW)" (23) jumpers are set to the "LOW" position, and that the "(DEN)" (28) jumper is in the "VH" position. Connect the generator to the "DY1 (DZ/SLEW)" BNC, and set the swing for 0V to 3V. Monitoring test points "TP20" (input), and "RA1 (RB)" (output) with a scope allows evaluation of the total Tx and Rx performance. In this configuration, the Tx output line connects to an Rx input line, so the data driven on the Tx input (DY) appears at the Rx output (RA).

Evaluating the Logic Supply (V_L) Function

The ISL3333 includes a V_L pin that powers the logic inputs (Tx inputs and control pins) and Rx outputs, regardless of protocol selection. These pins interface with "logic" devices such as UARTs, ASICs, and µcontrollers, and today most of these devices use power supplies significantly lower than 3.3V. Connecting the V_L pin to the power supply of the logic device limits the ISL3333's Rx output V_{OH} to V_L, and reduces the Tx and control input switching points to values

compatible with the logic device's output levels. If the logic device is also powered by 3.3V, then the V_L pin should be shorted to the V_{CC} pin.

To evaluate the V_L pin performance, remove the "VCC-VL" (26) jumper, and connect a supply between the "VL" and "GND" banana jacks. V_L can be anywhere from V_{CC} down to 1.2V, but the input switching points may not provide enough noise margin when V_L < 1.5V. Table 2 indicates typical V_{IH} and V_{IL} values for various V_L values so the user can ascertain whether or not a particular V_L voltage meets his needs.

TABLE 2. V_{IH} AND V_{IL} vs V_L FOR V_{CC} = 3.3V

V_L (V)	V_{IH} (V)	V_{IL} (V)
1.2	0.85	0.26
1.5	0.9	0.5
1.8	0.9	0.73
2.3	1.2	1
2.7	1.4	1.3
3.3	1.8	1.7

To evaluate the V_L impact on Rx V_{OH}, vary the V_L voltage while monitoring a high Rx output. To evaluate the V_L effect on input switching points, remove the "VL-VHIGH" (27) jumper, connect a new supply between the "VHIGH" and "GND" banana jacks, set the V_L supply to the desired voltage, move the jumper of the input to be tested to the "VH" position, and vary the "VHIGH" supply to determine the switching point.

Connecting the ISL3333 as an RS-232 to RS-485 Converter

This two port dual protocol IC is ideal for implementing a two wire (RxD and TxD) RS-232 to RS-485 converter, as shown in Figure 1. To evaluate this circuit using the evaluation board (starting with the default configuration): install the "B1" (4) jumper to connect the 50Ω termination on the input; remove the "DY1 (DZ/SLEW)" (23) and "DY2 (NC)" (20) jumpers; connect a wire from the "RB1 (RA)" test point to the DY2 test point ("TP19"); connect a wire from the "RA2 (NC)" test point to the DY1 test point ("TP20"); connect the port 2 "external loopback" jumpers (9 and 10), and move the "SPA" (16) and "SPB" (17) jumpers to the "LOW" positions to set the RS-485 Tx speed to the medium data rate option. Note that the RS-232 Tx output (Y1) is unloaded in this configuration, while the RS-485 Tx output drives a double terminated load (R_{13} and R_{14}). The RS-232 output can be resistively loaded by looping it back to the "A1" input via the "A1/Y1_LB" (5) jumper, and can be capacitively loaded by soldering the desired load value in position C4. To add a differential capacitive load to the RS-485 driver, simply solder the capacitor on top of termination resistor R_{13}, or

solder a capacitor across the C3 and C5 pads that connect to Y2 and Z2, respectively.

Connect a generator to the "B1" BNC connector, and drive the input from 0V to 3V at a data rate up to 400kbps (generator period $\geq$ 5µs). The data will loop through the RS-232 Rx, to the RS-485 Tx, to the RS-485 Rx, and back through the RS-232 Tx, appearing at the "Y1" output back in RS-232 form.

To evaluate the performance with the RS-485 Tx driving a cable, remove the port 2 external loopback jumpers, and connect a twisted pair cable from "Y2" ("TP3") and "Z2" ("TP7") to "A2 (485/$\overline{232}$)" ("TP4") and "B2" ("TP8") respectively.
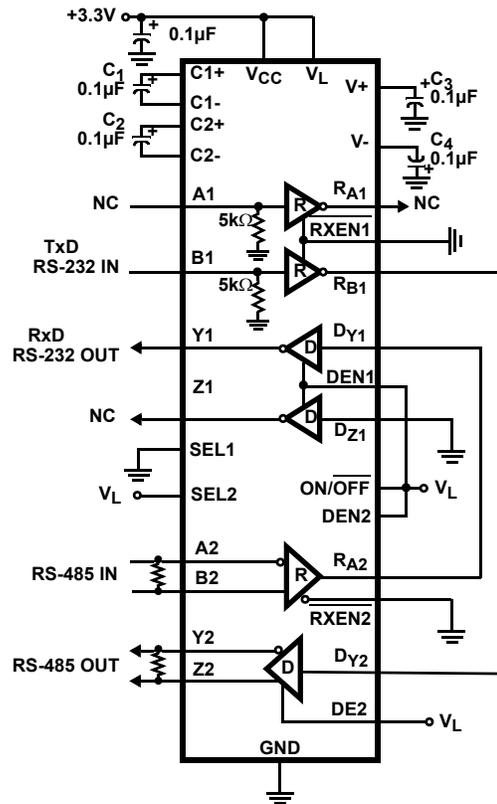
FIGURE 1. SINGLE IC RS-232 TO RS-485 CONVERTER

Jumper Definitions

The jumpers used to evaluate the ISL3333 are (ordered by red jumper numbers):

J-A1 (1) - Connects A1 input to GND through a 50Ω resistor.

J10 (2) - Connects A1 input to the RXBIAS jack.

J9 (3) - Connects B1 input to the RXBIAS jack.

J-B1 (4) - Connects B1 input to GND through a 50Ω resistor.

A1/Y1_LB (5) - Loops output Y1 back to input A1.

B1/Z1_LB (6) - Loops output Z1 back to input B1.

J-SEL1 (NC) (7) - "VH" sets port 1 to RS-485 mode; "LOW" sets it to RS-232 mode.

J-SEL2 (NC) (8) - "VH" sets port 2 to RS-485 mode; "LOW" sets it to RS-232 mode.

B2/Z2_LB (9) - Loops output Z2 back to input B2.

A2/Y2_LB (10) - Loops output Y2 back to input A2.

J12 (11) - Connects A2 input to the RXBIAS jack.

J11 (12) - Connects B2 input to the RXBIAS jack.

J-B2 (13) - Connects B2 input to GND through a 50Ω resistor.

J-A2 (485/$\overline{232}$) (14) - "LOW" connects A2 input to GND through a 50Ω resistor; "VH" connects A2 to the "VHIGH" jack.

J-$\overline{RXEN1}$ (15) - "LOW" enables port 1 Rx; "VH" disables Rx.

J-SPA (NC) (16) - Used with SPB to set the RS-485 Tx data rate (see Table 1).

J-SPB (17) - Used with SPA to set the RS-485 Tx data rate (see Table 1).

J-$\overline{RXEN2}$ (NC) (18) - "LOW" enables port 2 Rx; "VH" disables Rx.

J-DZ2/DE2 (NC) (19) - "LOW" disables port 2 Tx in RS-485 mode, or sets the Z Tx input low in RS-232 Mode; "VH" enables port 2 Tx in RS-485 mode, or sets the Z Tx input high in RS-232 Mode.

J-DY2 (NC) (20) - Sets the state of the port 2 DY Tx input.

J- ON/$\overline{OFF}$ (NC) (21) - "LOW" places IC in low power SHDN; "VH" sets IC for normal operation.

J- $\overline{LB}$ (NC) (22) - "LOW" enables internal loopback; "VH" disables it.

J- DY1 (DZ/SLEW) (23) - Sets the state of the port 1 DY Tx input.

J- DZ1/DE1 (DY) (24) - "LOW" disables port 1 Tx in RS-485 mode, or sets the Z Tx input low in RS-232 Mode; "VH" enables port 1 Tx in RS-485 mode, or sets the Z Tx input high in RS-232 Mode.

RXBIAS-VCC (25) - Connects V_{CC} to the "RXBIAS" jack; if driving RXBIAS from a voltage other than V_{CC}, remove this jumper.

VCC-VL (26) - Connects V_{CC} to the "VL" jack; if driving VL from a voltage other than V_{CC}, remove this jumper.

VL-VHIGH (27) - Connects V_L to the "VHIGH" jack; if driving VHIGH from a voltage other than V_L, remove this jumper.

J-(DEN) (28) - Sets the DEN1 state. "LOW" disables the port 1 Tx outputs if port 1 is set to RS-232 mode. "VH" enables the port 1 RS-232 Tx.

J-(RXEN) (29) - Sets the DEN2 state. "LOW" disables the port 2 Tx outputs if port 2 is set to RS-232 mode. "VH" enables the port 2 RS-232 Tx.

PCB Layout Information

The dimensions for the QFN land pattern used on this board are shown in Figure 2.
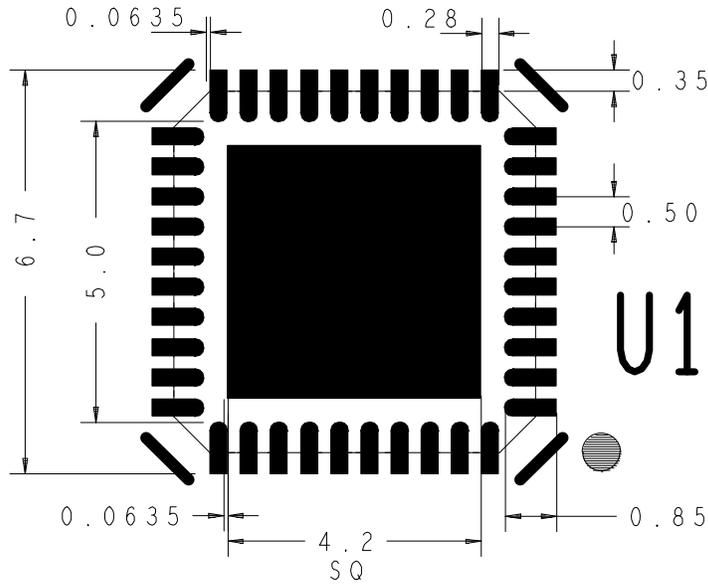
FIGURE 2. QFN LAND PATTERN AND DIMENSIONS (in mm)
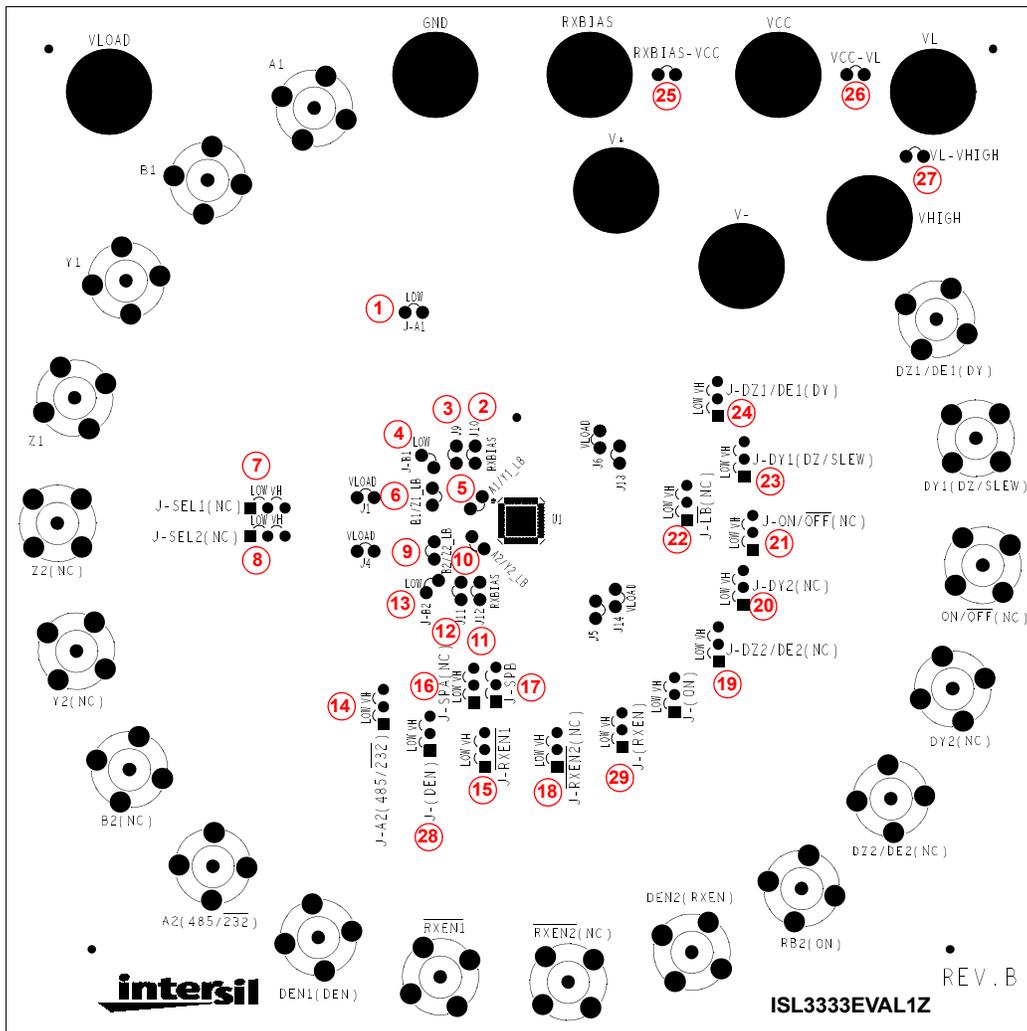
FIGURE 3. JUMPER LOCATOR DIAGRAM

R1, 3, 4, 8, 12, 15-18, 20, 24-26, 28 = 49.9Ω
R5, 6, 10, 11 = 499Ω (NOT POPULATED)
R7, 9 = 121Ω (NOT POPULATED)
R13, 14 = 121Ω
R19, 22, 23, 27 = 1kΩ
C1, 6-8,10-14, 16, 18-21, 23-26 = 0.1µF
C2-5 = 0.1µF (NOT POPULATED)
C9, 15, 17, 22, 27 = 10µF

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