XR34350

RS-232/485/422 Serial Transceiver with Internal Termination and Wide Output Swing

Description

The XR34350 is an advanced multiprotocol transceiver supporting RS-232, RS-485, and RS-422 serial standards in a 40-pin QFN package. Integrated cable termination and four configuration modes allow all three protocols to be used interchangeably over a single cable or connector with no additional switching components. Full operation requires only four external charge pump capacitors.

The RS-485/RS-422 modes feature one driver and one receiver (1Tx/1Rx) in both half and full duplex configurations. The RS-232 mode (3Tx/5Rx) provides full support of all eight signals commonly used with the DB9 RS-232 connector. A dedicated diagnostic loopback mode is also provided.

The high speed drivers operate up to 20Mbps in RS-485/RS-422 modes, and up to 1Mbps in RS-232 mode. All drivers can be slew limited to 250kbps in any mode to minimize Electromagnetic Interference (EMI).

All transmitter outputs and receiver inputs feature robust Electrostatic Discharge (ESD) protection to ±15kV IEC-61000-4-2 air gap, ±8kV IEC-61000-4-2 contact, and ±15kV Human Body Model (HBM). Each receiver output has full fail-safe protection to avoid system lockup, oscillation, or indeterminate states by defaulting to logic-high output level when the inputs are open, shorted, or terminated but undriven. No external biasing resistors are required.

The RS-232 receiver inputs include a 5kΩ pull-down to ground. The RS-485/RS-422 receiver inputs are high impedance (>96kΩ when termination is disabled), allowing up to 256 devices on a single communication bus (1/8th unit load).

The XR34350 operates from a single power supply, either 3.3V or 5V, with low idle current (2mA typical in all modes). The shutdown mode consumes less than 10µA for low power standby operation.

FEATURES

- Rx enabled during Tx short-circuit condition
- Pin selectable cable termination
- No external resistors required for RS-485/ RS-422 termination and biasing
- 3.3V or 5V single supply operation
- Robust ESD protection on bus pins
  - ±15kV IEC 61000-4-2 (air gap)
  - ± 8kV IEC 61000-4-2 (contact)
  - ±15kV (HBM)
- Max data rate of 20Mbps in RS-485/ RS-422 modes and up to 1Mbps in RS-232 modes
- Pin selectable 250kbps slew limiting
- 3 drivers, 5 receivers RS-232/V.28
- 1 driver, 1 receiver RS-485/RS-422
- High swing RS-232 driver outputs (±10.0V no load)
  - Full and half duplex configuration
  - 1/8th unit load, up to 256 receivers on bus
- RS-485/RS-422 enhanced failsafe for open, shorted, or terminated but idle inputs
- Space saving 40-pin 6mm x 6mm QFN package
- Pin compatible with SP339E and SP338E

APPLICATIONS

- Dual protocol serial ports (RS-232 or RS-485/RS-422)
- Industrial and process control equipment
- Point-of-sale equipment
- HVAC controls equipment
- Building security and automation equipment

Ordering Information - Back Page

Typical Application

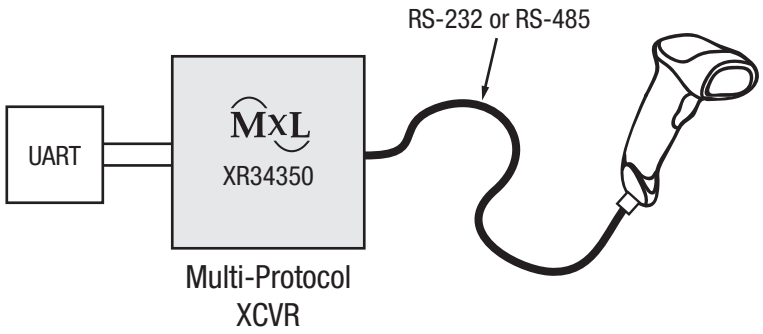


Figure 1: Typical Application

Absolute Maximum Ratings

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

Supply voltage V_{CC} ..... -0.3V to 6.0V

Receiver input voltage (from ground) ..... ±18V

Driver output voltage (from ground)..... ±18V

Short-circuit duration, Tx out to ground ..... Continuous

Voltage at TTL input pins..... -0.3V to (V_{CC} + 0.5V)

Storage temperature range ..... -65°C to 150°C

Lead temperature (soldering 10 seconds)..... 300°C

Power dissipation 40-pin QFN (derate 17mW/°C above 70°C) 500mW

Operating Conditions

Supply voltage V_{CC} .....3.135V to 5.25V

Operating temperature range .....-40° to 85°C

ESD Ratings

Human Body Model (HBM), Tx and Rx pins..... ±15kV

Human Body Model (HBM), all other pins ..... ±4kV

IEC 61000-4-2 (contact), Tx and Rx pins ..... ±8kV

IEC 61000-4-2 (air gap), Tx and Rx pins..... ±15kV

Electrical Characteristics

Unless otherwise noted: V_{CC} = 3.3V ±5% or 5.0V ±5%, C1 to C4 = 0.1µF; T_A = T_{MIN} to T_{MAX}. Typical values are at V_{CC} = 3.3V, T_A = 25°C.

Symbol	Parameter	Conditions	Min	Typ	Max	Units
DC Characteristics						
I_{CC}	Supply current, RS-232	No load, idle inputs		2	8	mA
	Supply current, RS-485	No load, idle inputs		2	8	mA
	V_{CC} shutdown current	Enable = 0V		1	10	µA
Transmitter and Logic Input Pins: Pins 3, 4, 6, 11, 12, 14, 15, 17 to 19						
V_{IH}	Logic input voltage High	V_{CC} = 3.3V	2.0			V
		V_{CC} = 5.0V	2.4			V
V_{IL}	Logic input voltage Low				0.8	V
I_{IL}	Logic input leakage current low	Input low, V_{IN} = 0V			1	µA
I_{IH}	Logic input leakage current high	Input high, V_{IN} = V_{CC}, pins 3, 4 and 6			1	µA
I_{PD}	Logic input pull-down current	Input high V_{IN} = V_{CC}, pins 11, 12, 14, 15, 17 to 19			50	µA
V_{HYS}	Logic input hysteresis			200		mV
Receiver Outputs: Pins 1, 2, 5, 7, 8						
V_{OH}	Receiver output voltage high	I_{OUT} = -1.5mA	V_{CC} -0.6			V
V_{OL}	Receiver output voltage low	I_{OUT} = 2.5mA			0.4	V
I_{OSS}	Receiver output short-circuit current	0 ≤ V_O ≤ V_{CC}		±20	±60	mA
I_{OZ}	Receiver output leakage current	0 ≤ V_O ≤ V_{CC}, receivers disabled		±0.1	±1	µA
Single-Ended Receiver Inputs, RS-232						
V_{IN}	Input voltage range		-15		15	V
V_{IL}	Input threshold low	V_{CC} = 3.3V	0.6	1.2		V
		V_{CC} = 5.0V	0.8	1.5		V
V_{IH}	Input threshold high	V_{CC} = 3.3V		1.5	2.0	V
		V_{CC} = 5.0V		1.8	2.4	V
V_{HYS}	Input hysteresis			0.3		V
R_{IN}	Input resistance	-15V ≤ V_{IN} ≤ 15V	3	5	7	kΩ
Single-Ended Driver Outputs, RS-232						
V_O	Output voltage	V_{CC} = 5.0V, output loaded 3kΩ to GND		±8.6		V
		V_{CC} = 5.0V, unloaded output			±10.0	V
		V_{CC} = 3.3V, output loaded 3kΩ to GND	±5.0	±5.5		V
		V_{CC} = 3.3V, unloaded output			±7.0	V
I_{SC}	Short-circuit current	V_O = 0V			±60	mA
R_{OFF}	Power off impedance	V_{CC} = 0V, V_O = ±2V	300	10M		Ω

Electrical Characteristics (Continued)

Unless otherwise noted: V_{CC} = 3.3V ±5% or 5.0V ±5%, C1 to C4 = 0.1µF; T_A = T_{MIN} to T_{MAX}. Typical values are at V_{CC} = 3.3V, T_A = 25°C.

Symbol	Parameter	Conditions	Min	Typ	Max	Units
Differential Receiver Inputs, RS-485/RS-422						
R_{IN}	Receiver input resistance	TERM = 0V, -7V ≤ V_{IN} ≤ 12V	96			kΩ
V_{TH}	Receiver differential threshold voltage		-200	-125	-50	mV
ΔV_{TH}	Receiver input hysteresis	V_{CM} = 0V		25		mV
I_{IN}	Receiver input current	V_{IN} = 12V			125	µA
		V_{IN} = -7V			-100	µA
R_{TERM}	Termination resistance	TERM = V_{CC}, Figure 6, -7V ≤ V_{CM} ≤ 12V	100	120	155	Ω
		TERM = V_{CC}, Figure 6, V_{CM} = 0V	100	120	140	Ω
Differential Driver Outputs, RS-485/RS-422						
V_{OD}	Differential driver output	R_L = 100Ω, RS-422, Figure 7	2		V_{CC}	V
		R_L = 54Ω, RS-485, Figure 7	1.5		V_{CC}	V
		-7V ≤ V_{CM} ≤12V, Figure 8	1.5		V_{CC}	V
		No load			V_{CC}	V
ΔV_{OD}	Change in magnitude of differential output voltage	R_L = 54Ω or 100Ω, Figure 7	-0.2		0.2	V
V_{CM}	Driver common mode output voltage				3	V
ΔV_{CM}	Change in magnitude of common mode output voltage				0.2	V
I_{OSD}	Driver output short-circuit current	-7V ≤ V_O ≤ 12V, Figure 9	-250		250	mA
I_O	Driver output leakage current	DIR1 = 0V in Mode 11, or Enable = 0V, V_O = 12V, V_{CC} = 0V or 5.25V			100	µA
		DIR1 = 0V in Mode 11, or Enable = 0V, V_O = -7V, V_{CC} = 0V or 5.25V	-100			µA

Timing Characteristics

Unless otherwise noted: V_{CC} = 3.3V ±5% or 5.0V ±5%, C1 to C4 = 0.1µF; T_A = T_{MIN} to T_{MAX}. Typical values are at V_{CC} = 3.3V, T_A = 25°C.

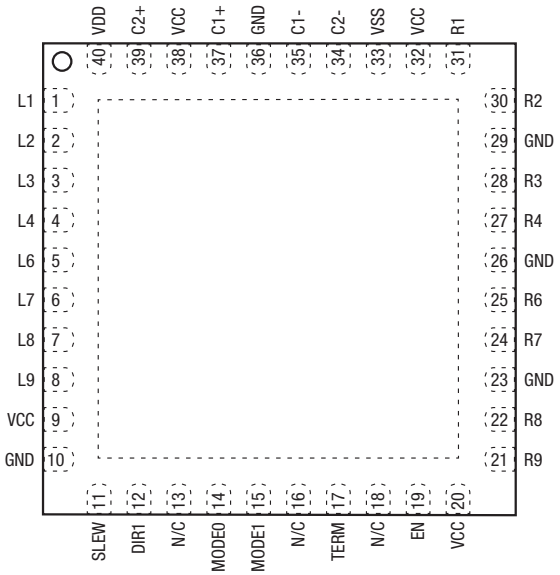
Symbol	Parameter	Conditions	Min	Typ	Max	Units
All Modes						
t_{ENABLE}	Enable from shutdown			1000		ns
$t_{SHUTDOWN}$	Enable to shutdown			1000		ns
RS-232, Data Rate = 250kbps, SLEW = V_{CC}, One Transmitter Switching						
	Maximum data rate	R_L = 3kΩ, C_L = 1000pF	250			kbps
t_{RHL}, t_{RLH}	Receiver propagation delay	C_L = 150pF, Figure 10		100		ns
$\lvert t_{RHL} - t_{RLH} \rvert$	Receiver propagation delay skew				100	ns
t_{DHL}, t_{DLH}	Driver propagation delay	R_L = 3kΩ, C_L = 2500pF, Figure 11		1400		ns
$\lvert t_{DHL} - t_{DLH} \rvert$	Driver propagation delay skew				600	ns
t_{SHL}, t_{SLH}	Transition region slew rate from 3.0V to -3.0V or -3.0V to 3.0V	V_{CC} = 3.3V, R_L = 3kΩ to 7kΩ, C_L = 150pF to 2500pF, Figure 11	4		30	V/µs
		V_{CC} = 3.3V, R_L = 3kΩ to 7kΩ, C_L = 150pF to 2500pF, T_A = 25°C, Figure 11	6		30	V/µs
RS-232, Data Rate = 1Mbps, SLEW = 0V, One Transmitter Switching						
	Maximum data rate	R_L = 3kΩ, C_L = 250pF	1			Mbps
t_{RHL}, t_{RLH}	Receiver propagation delay	C_L = 150pF, Figure 10		100		ns
$\lvert t_{RHL} - t_{RLH} \rvert$	Receiver propagation delay skew				100	ns
t_{DHL}, t_{DLH}	Driver propagation delay	R_L = 3kΩ, C_L = 1000pF, Figure 11		300		ns
$\lvert t_{DHL} - t_{DLH} \rvert$	Driver propagation delay skew				150	ns
t_{SHL}, t_{SLH}	Transition region slew rate from 3.0V to -3.0V or -3.0V to 3.0V	V_{CC} = 3.3V, R_L = 3kΩ to 7kΩ, C_L = 150pF to 1000pF, Figure 11	15		150	V/µs
		V_{CC} = 3.3V, R_L = 3kΩ to 7kΩ, C_L = 150pF to 1000pF, T_A = 25°C, Figure 11	24		150	V/µs

Timing Characteristics (Continued)

Unless otherwise noted: V_{CC} = 3.3V ±5% or 5.0V ±5%, C1 to C4 = 0.1µF; T_A = T_{MIN} to T_{MAX}. Typical values are at V_{CC} = 3.3V, T_A = 25°C.

Symbol	Parameter	Conditions	Min	Typ	Max	Units
RS-485/RS-422, Data Rate = 250kbps, SLEW = V_{CC}, One Transmitter Switching						
	Maximum data rate	RL = 54Ω, C_L = 50pF	250			kbps
t_{RPHL}, t_{RPLH}	Receiver propagation delay	C_L = 15pF, Figure 12		50	150	ns
$\lvert t_{RPHL} - t_{RPLH} \rvert$	Receiver propagation delay skew				20	ns
t_{DPHL}, t_{DPLH}	Driver propagation delay	R_L = 54Ω, C_L = 50pF, Figure 13		500	1000	ns
$\lvert t_{DPHL} - t_{DPLH} \rvert$	Driver propagation delay skew				100	ns
t_{DR}, t_{DF}	Driver rise and fall time		300	650	1200	ns
t_{RZH}, t_{RZL}	Receiver output enable Time	C_L = 15pF, Figure 14			200	ns
t_{RHZ}, t_{RLZ}	Receiver output disable time				200	ns
t_{DZH}, t_{DZL}	Driver output enable time	R_L = 500Ω, C_L = 50pF, Figure 15			1000	ns
t_{DHZ}, t_{DLZ}	Driver output disable time				200	ns
RS-485/RS-422, Data Rate = 20Mbps, SLEW = 0V, One Transmitter Switching						
	Maximum data rate	RL = 54Ω, C_L = 50pF	20			Mbps
t_{RPHL}, t_{RPLH}	Receiver propagation delay	C_L = 15pF, Figure 12		50	150	ns
$\lvert t_{RPHL} - t_{RPLH} \rvert$	Receiver propagation delay skew				10	ns
t_{DPHL}, t_{DPLH}	Driver propagation delay	R_L = 54Ω, C_L = 50pF, Figure 13		30	100	ns
$\lvert t_{DPHL} - t_{DPLH} \rvert$	Driver propagation delay skew				10	ns
t_{DR}, t_{DF}	Driver rise and fall time			10	20	ns
t_{RZH}, t_{RZL}	Receiver output enable Time	C_L = 15pF, Figure 14			200	ns
t_{RHZ}, t_{RLZ}	Receiver output disable time				200	ns
t_{DZH}, t_{DZL}	Driver output enable time	R_L = 500Ω, C_L = 50pF, Figure 15			200	ns
t_{DHZ}, t_{DLZ}	Driver output disable time				200	ns

Pin Configuration, Top View



Pin Functions

Pin Number	Pin Name	Descriptions by Mode (MODE1, MODE0)			
		Mode 00, Figure 2	Mode 01, Figure 3	Mode 10, Figure 4	Mode 11, Figure 5
1	L1	R1 output		1	1
2	L2	R2 output		R1 output	R1 output
3	L3	T1 input		T1 input	T1 input
4	L4	T2 input			
5	L6	R3 output		1	1
6	L7	T3 input			
7	L8	R4 output		1	1
8	L9	R5 output		1	1
9	VCC	V_{CC}			
10	GND	Ground			
11	SLEW		SLEW = V_{CC} enables 250kbps slew limiting		
12	DIR1			T1 enable, R1 disable	T1 enable
13	N/C	This pin is not used and is not connected internally			
14	MODE0	0	1	0	1
15	MODE1	0	0	1	1
16	N/C	This pin is not used and is not connected internally			
17	TERM			Enables RS-485/RS-422 receiver termination	
18	N/C	This pin is not used and is not connected internally			
19	EN	Enable = V_{CC} for operation, Enable = 0V for shutdown			
20	VCC	V_{CC}			

Pin Functions (Continued)

Pin Number	Pin Name	Descriptions by Mode (MODE1, MODE0)			
		Mode 00, Figure 2	Mode 01, Figure 3	Mode 10, Figure 4	Mode 11, Figure 5
21	R9		R5 input		
22	R8		R4 input		
23	GND	Ground			
24	R7		T3 output		
25	R6		R3 input		
26	GND	Ground			
27	R4		T2 output		R1 input B
28	R3		T1 output		R2 input A
29	GND	Ground			
30	R2		R2 input	R1 input A, T1 output A	T1 output A
31	R1		R1 input	R1 input B, T1 output B	T1 output B
32	VCC	Supply voltage, 1.0µF to ground recommended for supply decoupling			
33	VSS	Charge pump negative supply (V-), 0.1µF from ground			
34	C2-	Charge pump cap 2 negative lead			
35	C1-	Charge pump cap 1 negative lead			
36	GND	Ground			
37	C1+	Charge pump cap 1 positive lead, 0.1µF			
38	VCC	V_{CC}			
39	C2+	Charge pump cap 2 positive lead, 0.1µF			
40	VDD	Charge pump positive supply (V+), 0.1µF to ground			

Suggested DB9 Connector Pinout

DB9 Pin	RS-232	RS-485/RS-422 Full Duplex	RS-485 Half Duplex
1	DCD	TX-	Data-
2	RXD	TX+	Data+
3	TXD	RX+	
4	DTR	RX-	
5	Ground		
6	DSR		
7	RTS		
8	CTS		
9	RI		

Functional Block Diagrams by Mode (MODE1, MODE0)

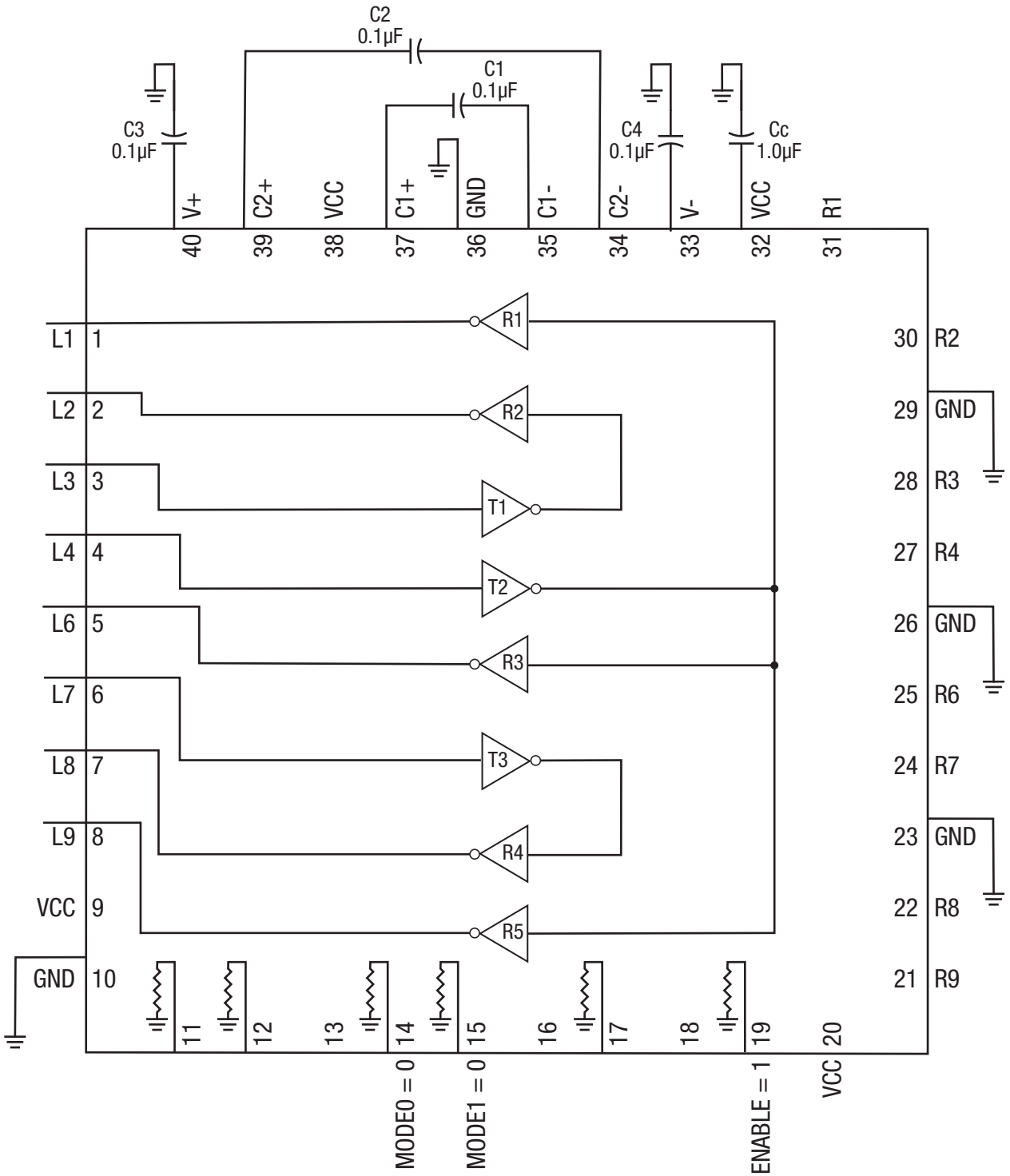


Figure 2: Functional Block Diagram - Mode 00, Loopback

Functional Block Diagrams by Mode (MODE1, MODE0) (Continued)

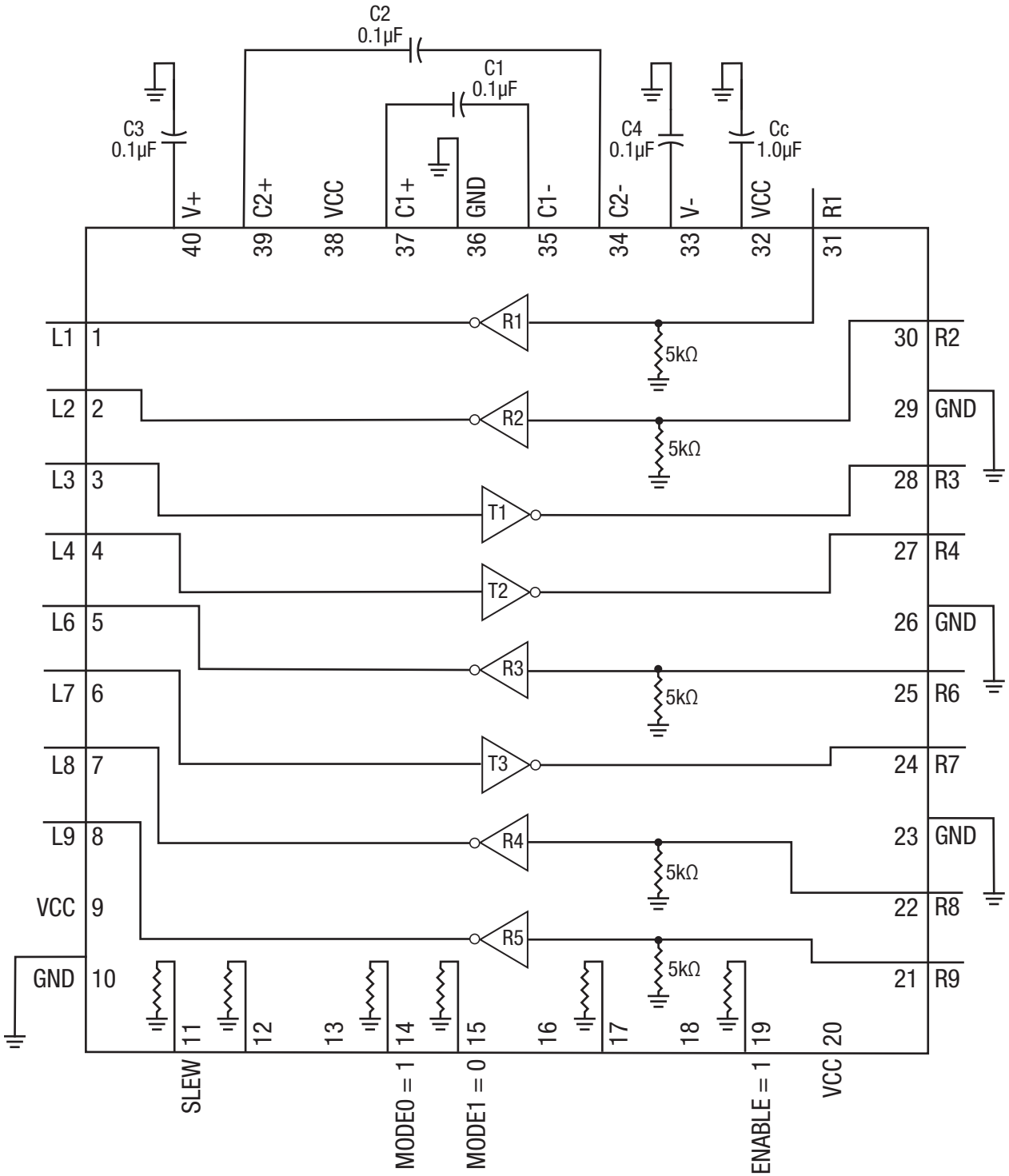


Figure 3: Functional Block Diagram - Mode 01, RS-232

Functional Block Diagrams by Mode (MODE1, MODE0) (Continued)

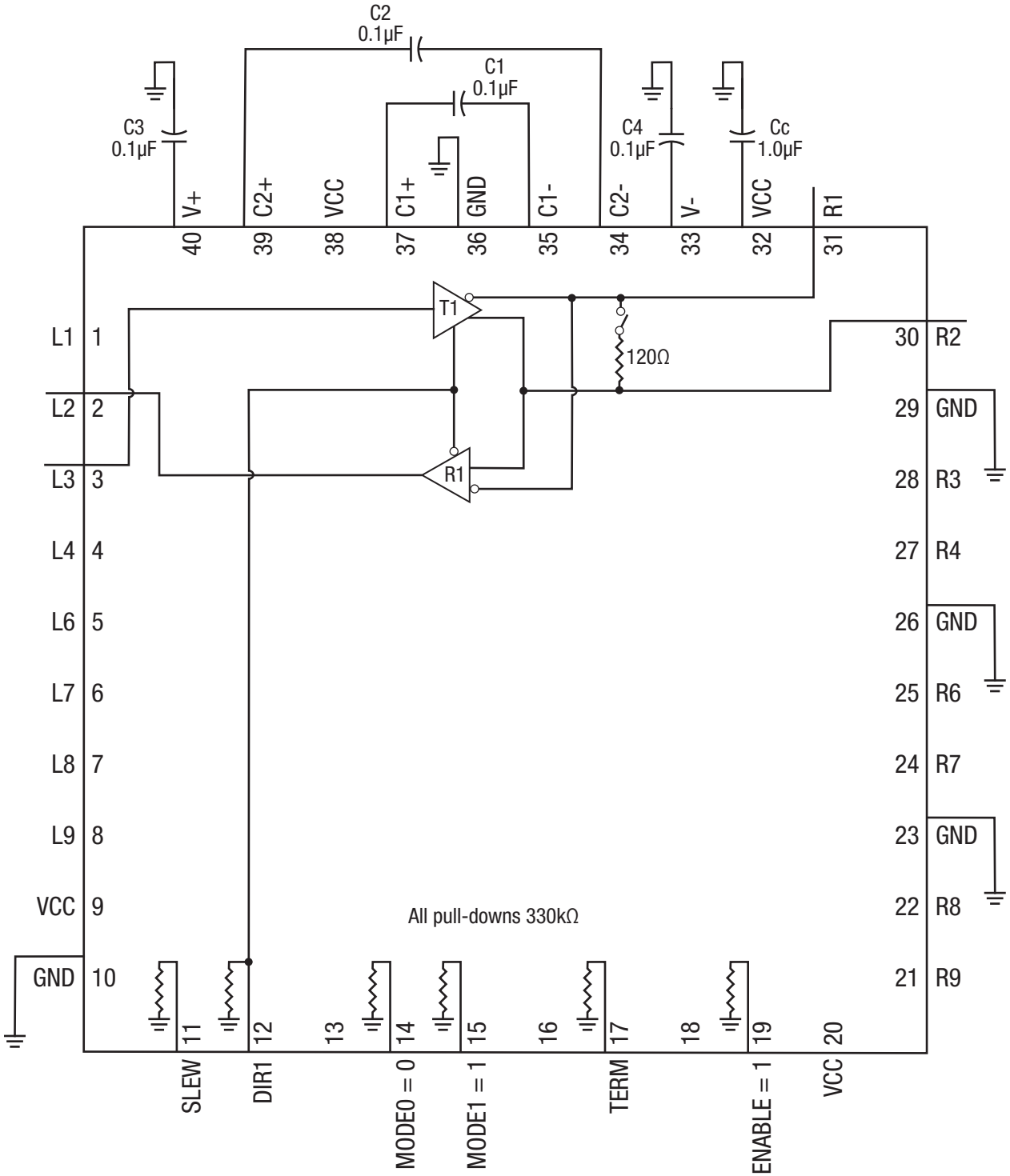


Figure 4: Functional Block Diagram - Mode 10, RS-485 Half Duplex

Functional Block Diagrams by Mode (MODE1, MODE0) (Continued)

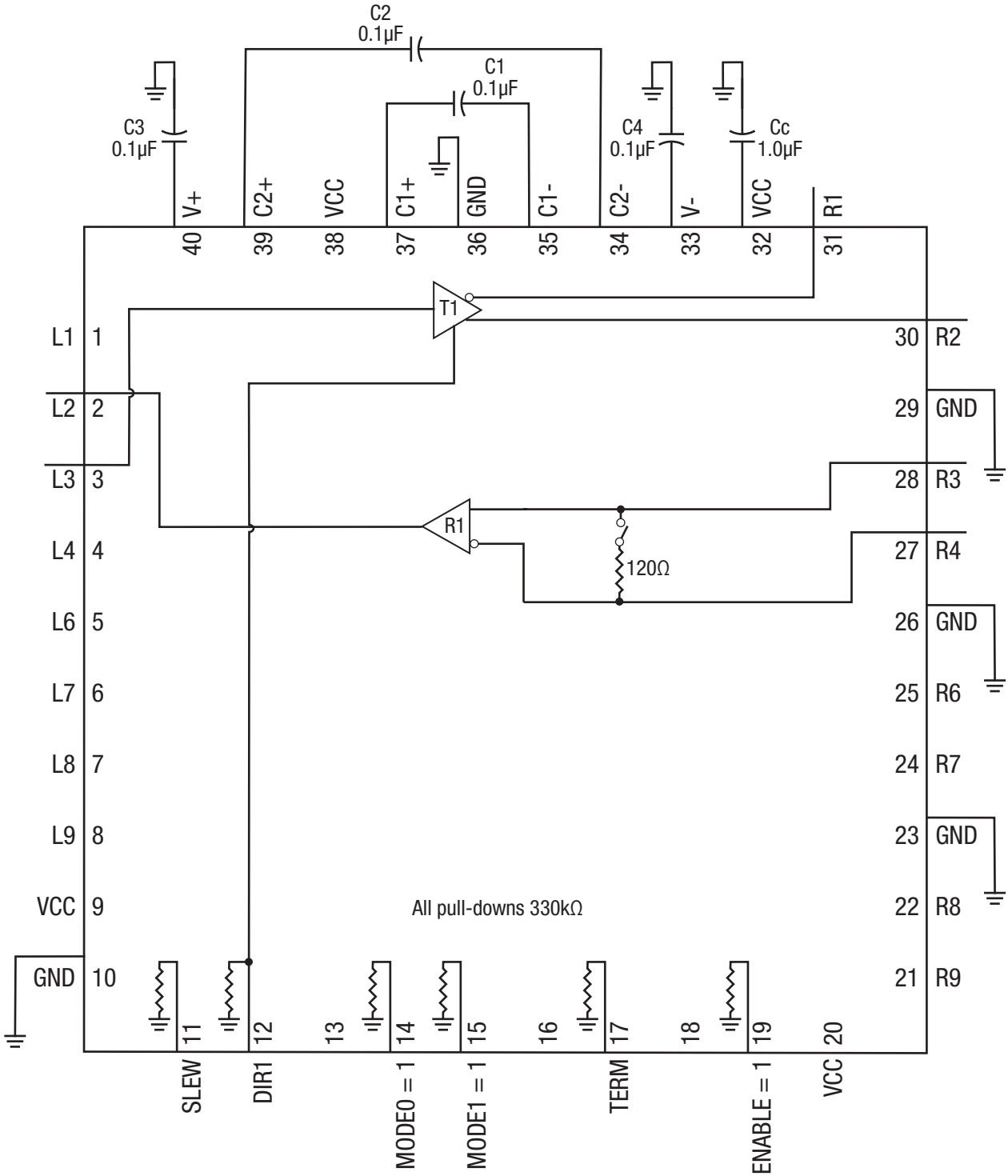
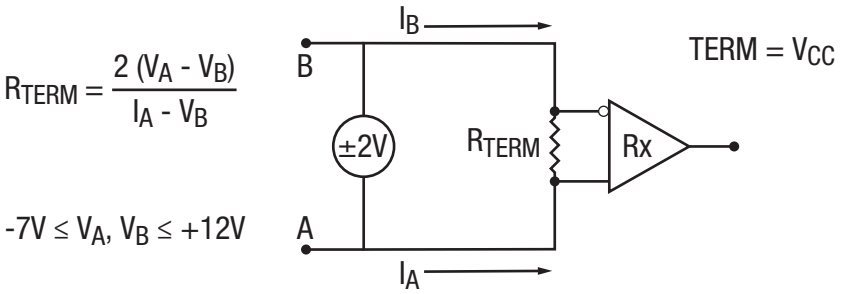


Figure 5: Functional Block Diagram - Mode 11, RS-485/RS-422 Full Duplex

Test Circuits



Termination is enabled in RS-485/RS-422 modes when the TERM pin is held high (V_{CC}).

Figure 6: RS-485/RS-422 Receiver Termination Resistance

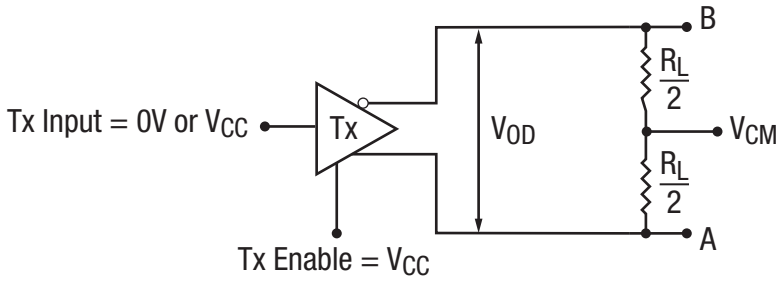


Figure 7: RS-485/RS-422 Differential Driver Output Voltage

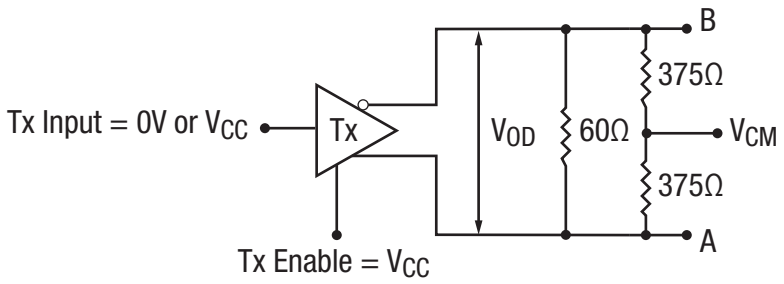


Figure 8: RS-485/RS-422 Differential Driver Output Voltage Over Common Mode

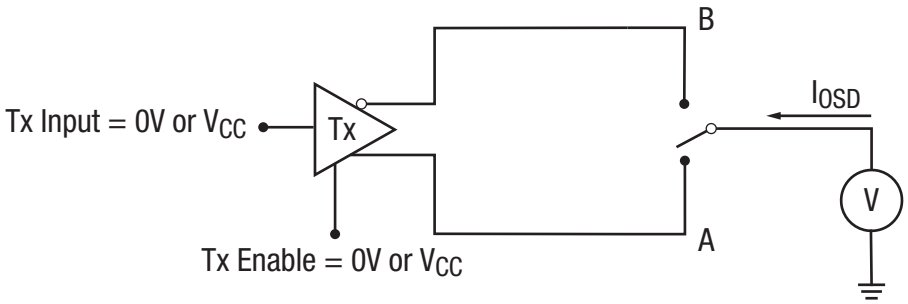


Figure 9: RS-485/RS-422 Driver Output Short-circuit Current

Test Circuits (Continued)

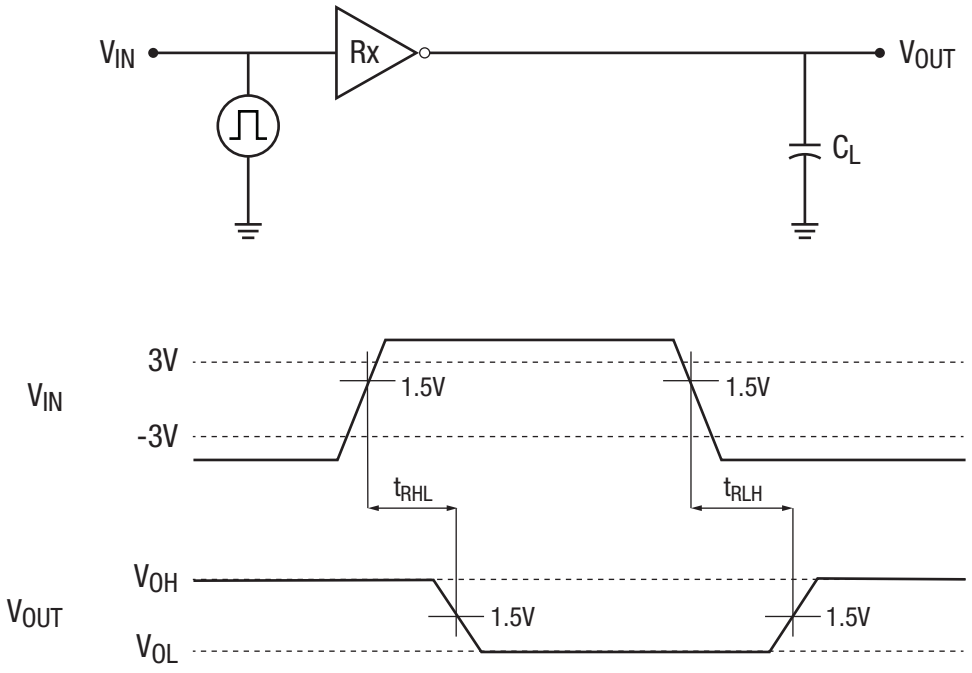


Figure 10: RS-232 Receiver Propagation Delay

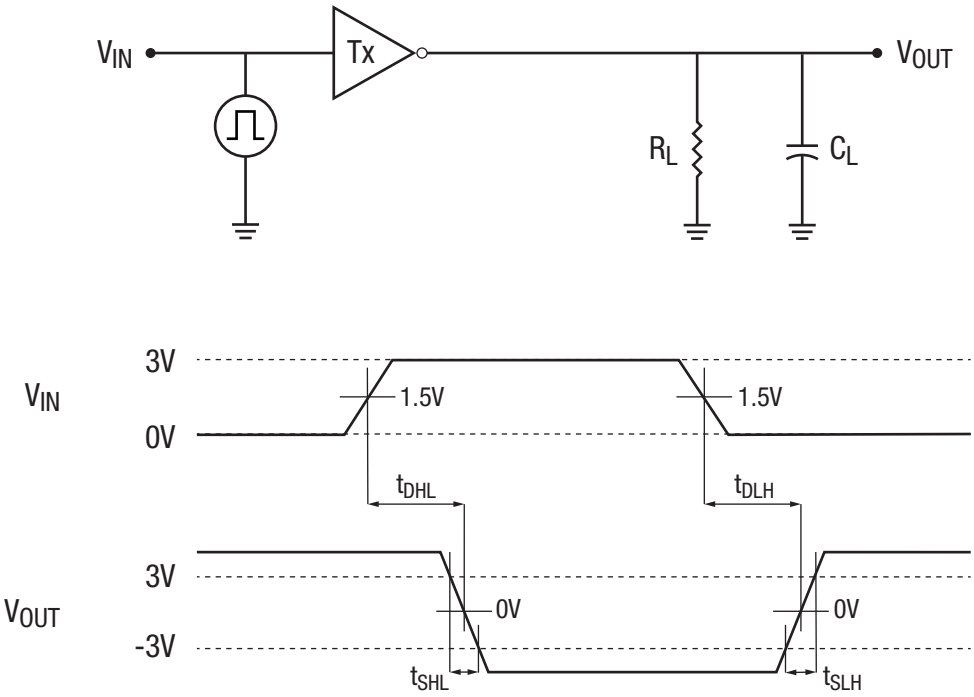


Figure 11: RS-232 Driver Propagation Delay

Test Circuits (Continued)

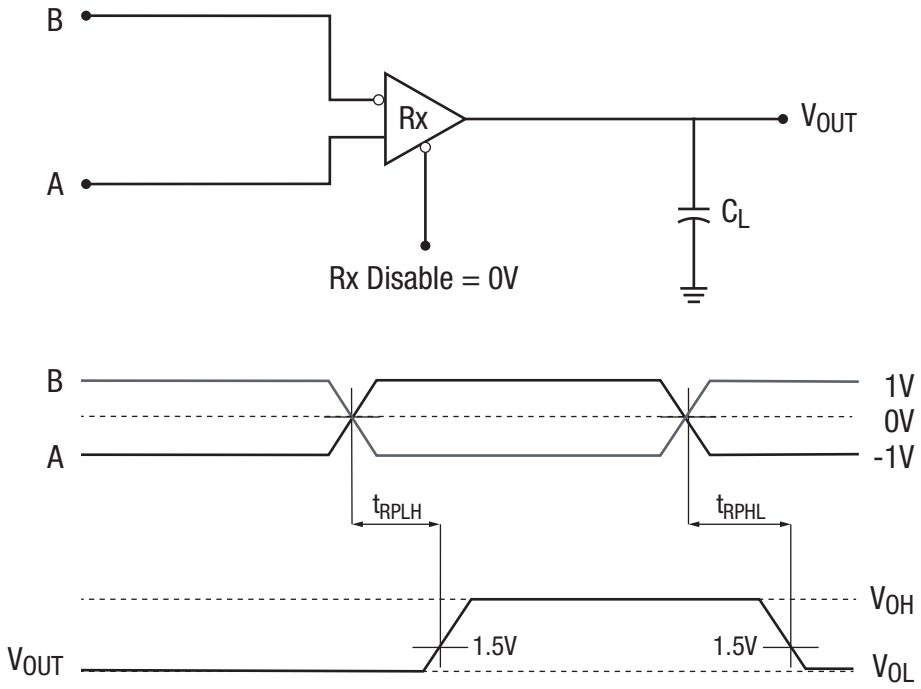


Figure 12: RS-485/RS-422 Receiver Propagation Delay

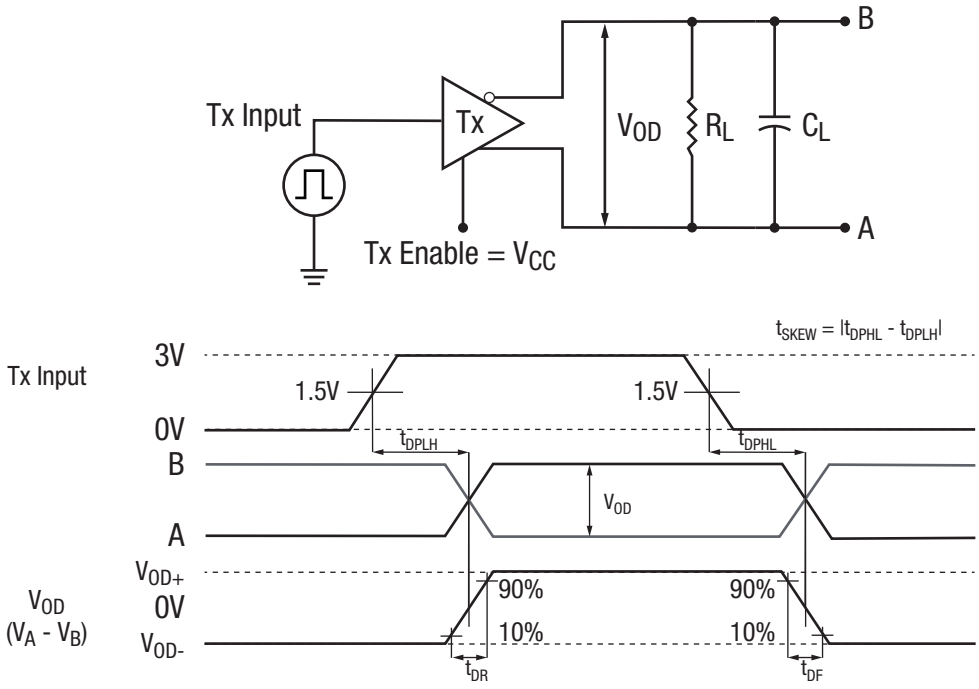


Figure 13: RS-485/RS-422 Driver Propagation Delay and Rise/Fall Times

Test Circuits (Continued)

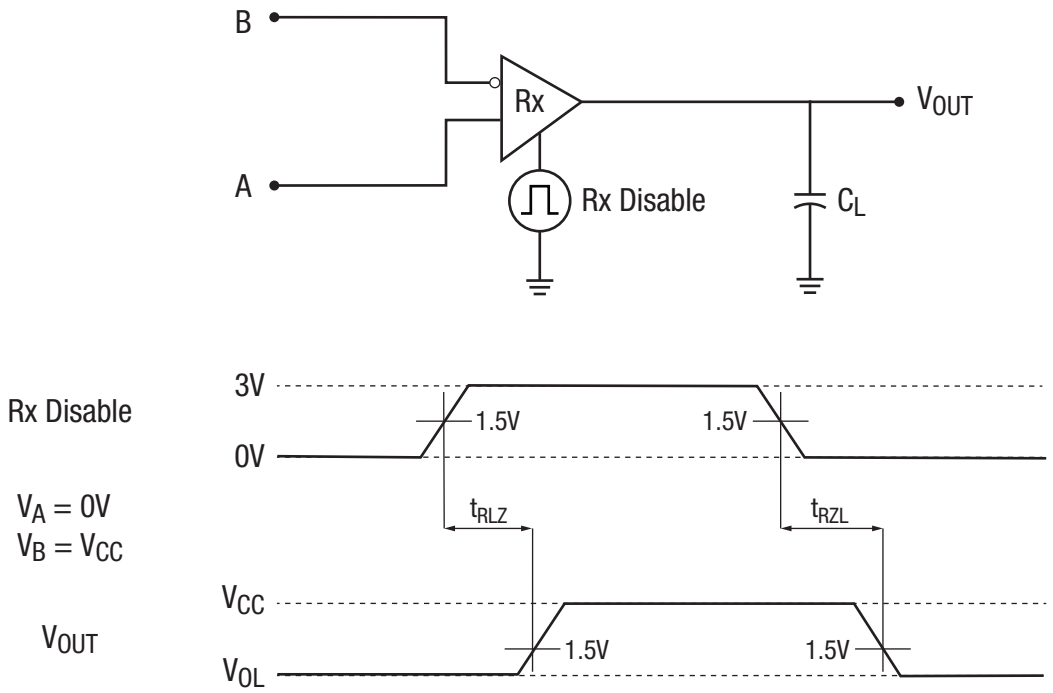


Figure 14: RS-485/RS-422 Receiver Output Enable/Disable Times

Test Circuits (Continued)

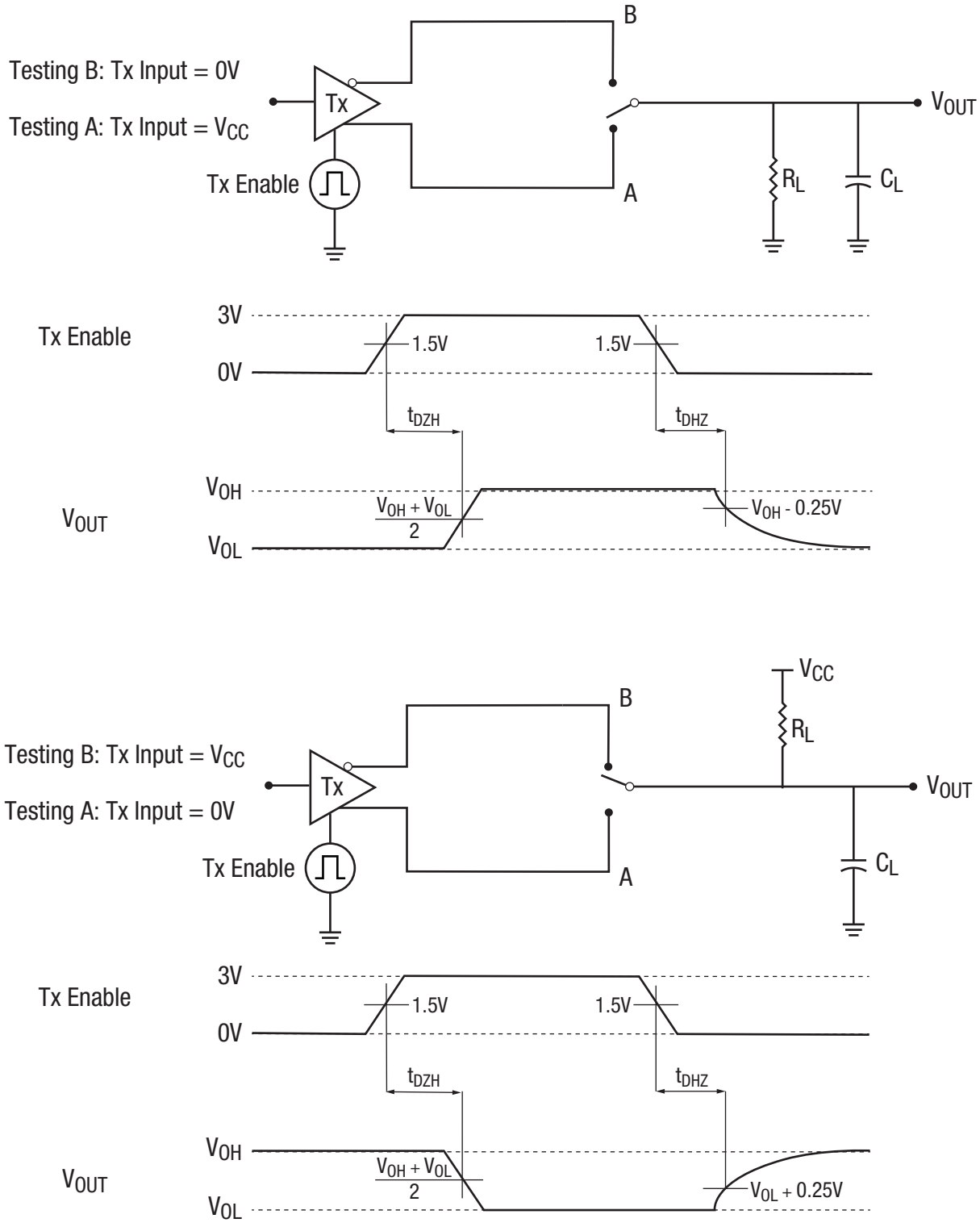


Figure 15: RS-485/RS-422 Driver Output Enable/Disable Times

Applications Information

Product Summary

The XR34350 is an advanced multiprotocol transceiver supporting RS-232, RS-485, and RS-422 serial standards in a 40-pin QFN package. Integrated cable termination and four configuration modes allow all three protocols to be used interchangeably over a single cable or connector with no additional switching components. The RS-485/RS-422 modes feature one driver and one receiver (1TX/1RX) in both half and full duplex configurations. The RS-232 mode (3TX/5RX) provides full support of all eight signals commonly used with the DB9 RS-232 connector. A dedicated mode is also available for diagnostic loopback testing.

Internally Switched Cable Termination

Enabling and disabling the RS-485/RS-422 termination resistor is one of the largest challenges system designers face when sharing a single connector or pair of lines across multiple serial protocols. A termination resistor may be necessary for accurate RS-485/RS-422 communication, but must be removed when the lines are used for RS-232. XR34350 provides an elegant solution to this problem by integrating the termination resistor and switching control, and allowing it to be switched in and out of the circuit with a single pin. No external switching components are required.

Enhanced Failsafe

Ordinary RS-485 differential receivers will be in an indeterminate state whenever the data bus is not being actively driven. The enhanced failsafe feature of the XR34350 guarantees a logic-high receiver output when the receiver inputs are open, shorted, or terminated but idle/undriven. The enhanced failsafe interprets 0V differential as a logic high with a minimum 50mV noise margin, while maintaining compliance with the EIA/TIA-485 standard of ±200mV. No external biasing resistors are required, further easing the usage of multiple protocols over a single connector.

±15kV ESD Protection

ESD protection structures are incorporated on all pins to protect against electrostatic discharges encountered during handling and assembly. The bus pins (driver outputs and receiver inputs) have extra protection structures, which have been tested up to ±15kV without damage. These structures withstand high ESD in all states: normal operation, shutdown and powered down.

ESD protection is be tested in various ways. MaxLinear uses the following methods to qualify the protection structures designed into XR34350:

- ±15kV using the Human Body Model (HBM)
- ± 8kV using IEC 61000-4-2 Contact Discharge
- ± 15kV using IEC 61000-4-2 Air Gap Discharge

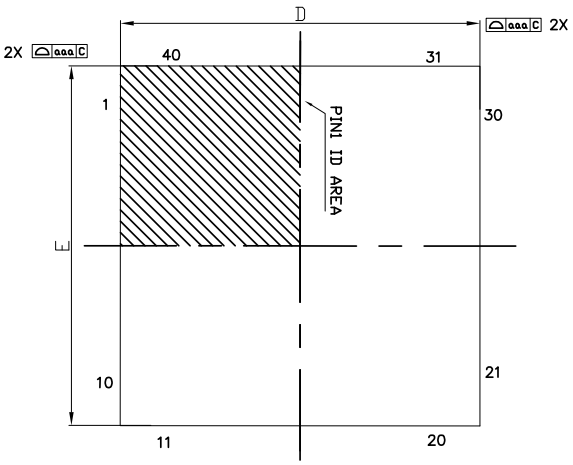
The IEC 61000-4-2 standard is more rigorous than HBM, resulting in lower voltage levels compared with HBM for the same level of ESD protection. Because IEC 61000-4-2 specifies a lower series resistance, the peak current is higher than HBM. The XR34350 has passed both HBM and IEC 61000-4-2 testing without damage.

Diagnostic Loopback Mode

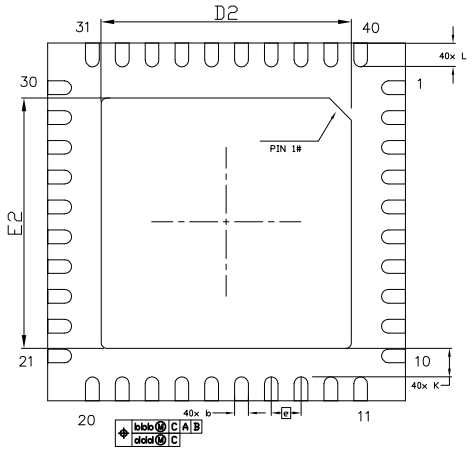
The XR34350 includes a diagnostic digital loop back mode for system testing as shown in Figure 2. The loopback mode connects the TTL driver inputs to the TTL receiver outputs, bypassing the analog driver and receiver circuitry. The analog/bus pins are internally disconnected in this mode.

Mechanical Dimensions

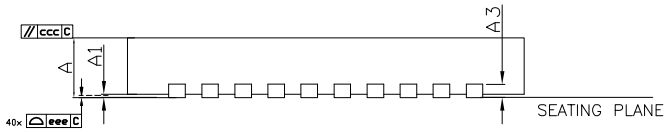
QFN-40



TOP VIEW



BOTTOM VIEW



SIDE VIEW

DIMENSION TABLE				
SYMBOL	MIN	NOM	MAX	NOTE
A	0.80	0.90	1.00	
A1	0.00	0.02	0.05	
A3	---	0.20Ref	---	
b	0.20	0.25	0.30	
D		6.00 BSC		
E		6.00 BSC		
e		0.50 BSC		
D2	4.50	4.65	4.80	
E2	4.50	4.65	4.80	
L	0.35	0.40	0.45	
K	0.20	–	–	
aaa		0.15		
bbb		0.10		
ccc		0.10		
ddd		0.05		
eee		0.08		
N		40		

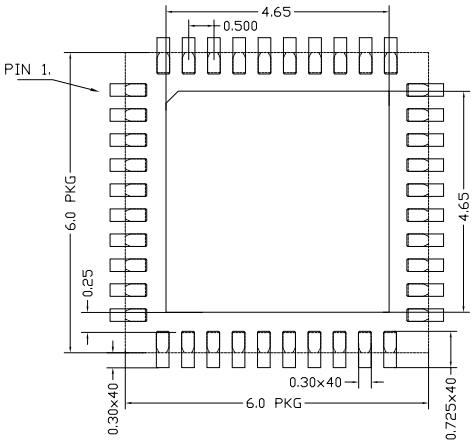
TERMINAL DETAILS

- ALL DIMENSIONS ARE IN MILLIMETERS, ANGLES ARE IN DEGREES.
- DIMENSIONS AND TOLERANCE PER JEDEC MO-220.

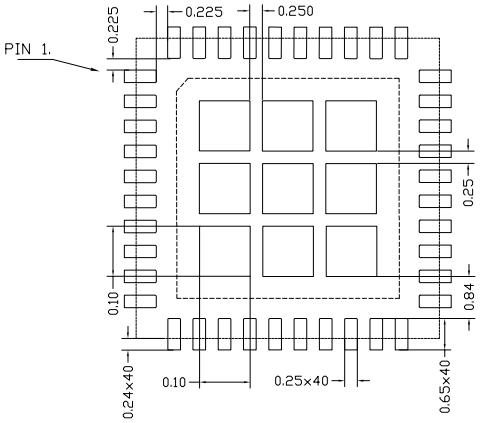
Drawing No.: POD-00000041

Revision: B.2

Recommended Land Pattern and Stencil



TYPICAL RECOMMENDED LAND PATTERN

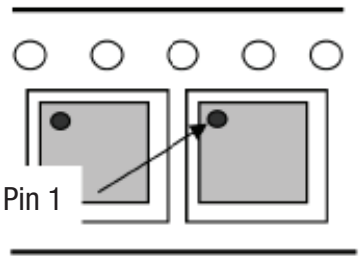


TYPICAL RECOMMENDED STENCIL

Drawing No.: POD-00000041

Revision: B.2

Tape Orientation



Pin 1 Orientation in Tape

Order Information[1]

Part Number	Operating Temperature Range	Lead-Free	Package	Packaging Method
XR34350IL	-40°C to 85°C	Yes[2]	40-pin QFN	Tray
XR34350ILTR				Tape and Reel
XR34350ILEVB	XR34350 Evaluation Board			

NOTE:
1. Refer to www.exar.com/XR34350 for most up-to-date Ordering Information.
2. Visit www.exar.com for additional information on Environmental Rating.

Revision History

Revision	Date	Description
1A	March 2016	Initial Release
1B	June 2016	Updated datasheet format
1C	March 2018	Corrected 120Ω resistor values in Figures 4 and 5; corrected Figure 5 T1 trace. Updated to MaxLinear logo. Updated format and ordering information, added EVB.

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