MxL83235 and MxL83236

High-Performance RS-485/422 Transceivers with 1.65V-5.5V I/O Interface and Extended IEC ESD and EFT Protection

Data Sheet

General Description

The MxL83235 and MxL83236 are high-performance RS-485 / RS-422 transceivers designed to meet demanding system requirements. They support a wide operating supply range (from 3.0V to 5.5V) and deliver maximum data rates of 20Mbps and 50Mbps, respectively. Both devices feature a flexible I/O logic supply from 1.65V to 5.5V, simplifying multi-voltage system interfacing. A selectable slew-rate control pin enables reduced EMI and limits data rates to 500kbps when required.

The receivers incorporate enhanced fail-safe circuitry, ensuring a logic-high output when inputs are open, shorted, or idle. With an input impedance of at least 96kΩ (1/8 unit load), the devices allow up to 256 nodes on the bus. The drivers include short-circuit protection, thermal shutdown, and maintain high impedance during shutdown or power-off.

Additional features include hot-swap circuitry on DE and $\overline{RE}$ pins to prevent bus glitches during power-up or live insertion, and a low-power shutdown mode that reduces supply current to 1µA. Both devices are half-duplex and available in compact 10-pin DFN and MSOP packages.

Applications

- Industrial control systems
- High-performance electric motor drives
- Industrial and single board computers
- Smart Grid
- Building security and automation
- Industrial and process control equipment
- HVAC Equipment
- Portable Internet of Things

Features

- Meets or exceeds the requirements of the TIA/EIA-485A standard
- Supports 1.65V to 5.5V I/O logic interface VL pin
- Maximum data rate of 20Mbps/50Mbps. Slew limiting data rate of 500kbps
- Wide supply range from 3.0V to 5.5V
- Differential output exceeds 2.1V for PROFIBUS compatibility with a 5V supply
- Extended operating temp range from –40°C to 125°C
- Hot swap glitch protection on DE and $\overline{RE}$ Pins
- Extended operational common-mode range of ±15V
- Low-power shutdown mode
- Enhanced failsafe protection for open, short, idle
- 1/8 unit load (256 bus nodes)
- Small form factor MSOP and DFN packages
- Glitch-free power-up/down capability
- Robust system protection
  - ±4kV EFT *(IEC 61000-4-4)*
  - ±8kV ESD Contact *(IEC 61000-4-2)*
  - ±15kV ESD Airgap (*IEC 61000-4-2*)
  - ±15kV ESD Human Body Model (HBM)

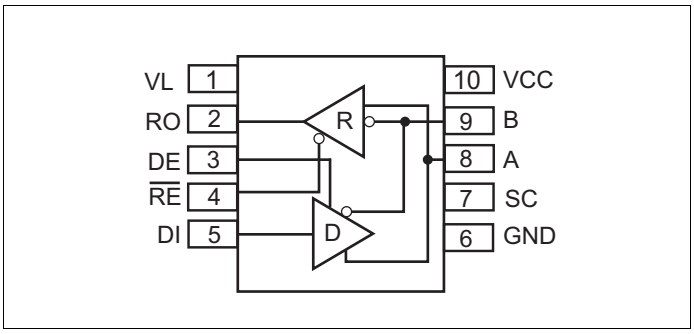

Figure 1: 10-Pin Half Duplex Diagram

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Revision History

Document No.	Release Date	Change Description
288-3536DSR01	December 12, 2025	Initial final release.

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Specifications

Absolute Maximum Ratings

Important: The stresses above what is listed under the following table may cause permanent damage to the device. This is a stress rating only—functional operation of the device above what is listed under the following table or any other conditions beyond what MaxLinear recommends is not implied. Exposure to conditions above the recommended conditions for the extended periods of time may affect device reliability. Solder reflow profile is specified in the *IPC/JEDEC J-STD-020C* standard.

Table 1: Absolute Maximum Ratings

Parameter	Minimum	Maximum	Units
Supply Voltage (V_{CC})	–0.3	6	V
Bus Voltage (Pin A and B)	–18	18	V
Logic Interface Voltage (Pin V_L) ($V_L \leq V_{CC}$)	–0.3	6	V
TTL Input Voltage (Pin DI, DE, $\overline{RE}$, SC)	–0.3	V_L + 0.3	V
Receiver Output Voltage (Pin RO)	–0.3	V_L + 0.3	V
Receiver Output Current (Pin RO)	–24	24	mA
Driver Output Current (Pin A and B)	–250	250	mA
Storage Temperature	–65	150	°C
Operating Junction Temperature (T_J)	–40	150	°C

ESD and EFT Ratings

Table 2: ESD and EFT Ratings

Parameter	Limit	Units
HBM—Human Body Model (pins A, B)	±15	kV
IEC 61000-4-2 Airgap Discharge (pins A, B)	±15	kV
IEC 61000-4-2 Contact Discharge (pins A, B)	±8	kV
IEC 61000-4-4 Electrical Fast Transient (pins A, B)	±4	kV

Thermal Information

Table 3: Thermal Information

Symbol	Thermal Metric	MxL83235, MxL83236		Units
		MSOP-10	DFN-10	
θ_{JA}	Junction-to-Ambient Thermal Resistance	175.7	37.7	°C/W
Ψ_{JT}	Junction-to-Top Characterization Parameter	2.63	2.09	°C/W
Ψ_{JB}	Junction-to-Board Characterization Parameter	146.3	18.5	°C/W
θ_{JB}	Junction-to-Board Thermal Resistance	136.9	20.3	°C/W
θ_{JC}	Junction-to-Case Thermal Resistance	58.8	24.82	°C/W

Power Dissipation

Table 4: Power Dissipation

Parameter	Description	Test Condition	Minimum	Typical	Maximum	Unit
PD	Driver and receiver enabled, V_{CC} = 5.5V, V_L = V_{CC}, T_A = 125°C, 50% duty cycle square wave at 0.5Mbps signaling rate, MxL83235/MxL83236	Load: R_L = 300Ω, C_L = 50pF	-	102	-	mW
		RS-422 load: R_L = 100Ω, C_L = 50pF	-	120	-	mW
		RS-485 load: R_L = 54Ω, C_L = 50pF	-	175	-	mW
		No Load	-	100	-	mW
	Driver and receiver enabled, V_{CC} = 5.5V, V_L = V_{CC}, T_A = 125°C, 50% duty cycle square wave at 20Mbps signaling rate, MxL83235	Load: R_L = 300Ω, C_L = 50pF	-	265	-	mW
		RS-422 load: R_L = 100Ω, C_L = 50pF	-	275	-	mW
		RS-485 load: R_L = 54Ω, C_L = 50pF	-	315	-	mW
		No Load	-	270	-	mW
	Driver and receiver enabled, V_{CC} = 5.5V, V_L = V_{CC}, T_A = 125°C, 50% duty cycle square wave at 50Mbps signaling rate, MxL83236	Load: R_L = 300Ω, C_L = 50pF	-	310	-	mW
		RS-422 load: R_L = 100Ω, C_L = 50pF	-	305	-	mW
		RS-485 load: R_L = 54Ω, C_L = 50pF	-	325	-	mW
		No Load	-	255	-	mW

Recommended Operating Conditions

Table 5: Operating Conditions

Parameter	Minimum	Maximum	Units
Supply Voltage (V_{CC})	3	5.5	V
Control Supply Voltage (V_L), $V_L \le V_{CC}$	1.65	5.5	V
Common Mode Voltage	–15	15	V
Input Bus Voltage (A, B)	–15	15	V
Input Differential Bus Voltage (V_{ID})	–15	15	V
Operating ambient temperature range (T_A)	–40	125	°C

Electrical Characteristics

Unless otherwise noted, V_{CC} = 3V to 5.5V, ambient temperature $T_{MIN} < T_A < T_{MAX}$. Typical values are at V_{CC} = 3.3V, V_L=V_{CC}, ambient temperature T_A = 25°C. The specifications apply over the full operating range from –40°C to 125°C, unless otherwise noted.

Table 6: Electrical Characteristics

Symbol	Parameter	Test Condition		Minimum	Typical	Maximum	Units
V_{OD}	Differential Driver Output	R_L = 100Ω (RS-422)		2	-	V_{CC}	V
		R_L = 54Ω (RS-485)		1.5	-	V_{CC}	
		R_L = 60Ω, –15V ≤ V_{CM} ≤ 15V		1.5	-	V_{CC}	
		R_L = 60Ω, –15V ≤ V_{CM} ≤ 15V 4.5 ≤ V_{CC} ≤ 5.5V		2.1	-	V_{CC}	
$\lvert\Delta V_{OD}\rvert$	Change in Magnitude of Differential Output Voltage	R_L = 54Ω or 100Ω		–0.2	-	0.2	V
V_{OC}	Driver Common Mode Output Voltage	R_L = 54Ω or 100Ω		1	V_{CC}/2	3	V
$\lvert\Delta V_{OC}\rvert$	Change in Steady State of Common Mode Output Voltage	R_L = 54Ω or 100Ω		–0.2	-	0.2	V
V_{IH}	Input High Voltage	DE, DI, $\overline{RE}$, SC		2/3 × V_L	-	-	V
V_{IL}	Input Low Voltage	DE, DI, $\overline{RE}$, SC		-	-	1/3 × V_L	V
V_{HYS}	Input Hysteresis	DE, DI, $\overline{RE}$, SC		-	100	-	mV
I_{IN}	Input Current	DE, DI, $\overline{RE}$		–1	-	1	µA
I_{INSC}	Input Current	SC (when pulled up)		-	-	100	µA
-	Input Current until First Transition (Hot Swap)	DE, $\overline{RE}$ Until First transition draws more current (hot swap)		-	±100	±200	µA
I_{OSD}	Driver Short-Circuit Current	–15V ≤ V_{OUT} ≤ 15V		–250	-	250	mA
T_{TS}	Thermal-Shutdown Threshold	-		-	175	-	°C
T_{TSH}	Thermal-Shutdown Hysteresis	-		-	15	-	°C
Receiver							
V_{TH}	Receiver Differential Threshold (Sensitivity)	–15V ≤ V_{CM} ≤ 15V		–200	–125	–20	mV
V_{HYS}	Receiver Input Hysteresis	–15V ≤ V_{CM} ≤ 15V		-	65	-	mV
V_{OH}	RO Output High Voltage	I_O = –8mA		V_L - 0.4	-	-	V
V_{OL}	RO Output Low Voltage	I_O = 8mA		-	-	0.4	V
I_{OZR}	Tri-State Output Current at Receiver	0 ≤ V_O ≤ V_L		–1	-	1	µA
R_{IN}	Receiver Input Resistance	–15V ≤ V_{CM} ≤ 15V		96	-	-	kΩ
$I_{A,B}$	Input Current (A, B)	DE = GND, $\overline{RE}$ = GND 0 ≤ V_{CC} ≤ 5.5V	V_{IN} = 12V	-	50	125	µA
			V_{IN} = –7V	–100	–65	-	
			V_{IN} = 15V	-	60	150	
			V_{IN} = –15V	–167	–130	-	

Table 6: Electrical Characteristics (Continued)

Symbol	Parameter	Test Condition	Minimum	Typical	Maximum	Units
I_{CC}	Supply Current	No load, $\overline{RE}$ = GND, DE = V_L, DI = GND	-	1	2	mA
		No load, $\overline{RE}$ = V_L, DE = V_L, DI = GND	-	1	2	
		No load, $\overline{RE}$ = GND, DE = GND, A/B open	-	0.7	1.10	
I_{SHDN}	Supply Current in Shutdown Mode	$\overline{RE}$ = V_L, DE = GND (T_A < 125°C)	-	0.1	1	µA

Note: Voltages are measured with respect to the device ground, unless otherwise noted.

Driver Switching Characteristics—MxL83235/MxL83236

Unless otherwise noted, V_{CC} = 3V to 5.5V ambient temperature $T_{MIN} < T_A < T_{MAX}$. Typical values are at V_{CC} = 3.3V, $V_L = V_{CC}$, ambient temperature T_A = 25°C. The specifications apply over the full operating range from –40°C to 125°C, unless otherwise noted.

Table 7: MxL83235/MxL83236 Driver Switching Characteristics

Symbol	Driver Characteristic	Conditions	Minimum	Typical	Maximum	Unit
-	Data signaling rate	Duty cycle 40 to 60%	500	-	-	kbps
t_{DPHL}, t_{DPLH}	Driver propagation delay	R_L = 54Ω, C_L = 50pF	180	440	1000	ns
t_{DR}, t_{DF}	Driver output rise/fall time		200	285	850	ns
$\lvert t_{DPLH} - t_{DPHL} \rvert$	Driver differential skew		-	20	70	ns
t_{DZH}	Driver enable to output high	R_L = 500Ω, C_L = 50pF	-	110	1000	ns
t_{DZL}	Driver enable to output low		-	130	1000	ns
t_{DHZ}	Driver disable from output high		-	27	100	ns
t_{DLZ}	Driver disable from output low		-	27	100	ns
$t_{DZH(SHDN)}$	Driver enable from shutdown to output high		-	-	12	µs
$t_{DZL(SHDN)}$	Driver enable from shutdown to output low		-	-	12	µs
t_{DSHDN}	Time to shutdown	-	50	270	600	ns

Receiver Switching Characteristics—MxL83235/MxL83236

Unless otherwise noted, V_{CC} = 3V to 5.5V ambient temperature $T_{MIN} < T_A < T_{MAX}$. Typical values are at V_{CC} = 3.3V, $V_L = V_{CC}$, ambient temperature T_A = 25°C. The specifications apply over the full operating range from –40°C to 125°C, unless otherwise noted.

Table 8: MxL83235/MxL83236 Receiver Switching Characteristics

Symbol	Receiver Characteristic	Conditions	Minimum	Typical	Maximum	Unit
-	Data signaling rate	Duty cycle 40 to 60%	500	-	-	kbps
t_{RPHL}, t_{RPLH}	Receiver propagation delay	C_L = 15pF	-	50	200	ns
t_{RR}, t_{RF}	Receiver output rise/fall time		-	3	15	ns
$\lvert t_{RPLH} - t_{RPHL} \rvert$	Propagation delay skew		-	3	30	ns
t_{RZH}	Receiver enable to output high	R_L = 1kΩ, C_L = 50pF	-	11	50	ns
t_{RZL}	Receiver enable to output low		-	11	50	ns
t_{RHZ}	Receiver disable from output high		-	12	50	ns
t_{RLZ}	Receiver disable from output low		-	12	50	µs
$t_{RZH(SHDN)}$	Receiver enable from shutdown to output high		-	-	12	µs
$t_{RZL(SHDN)}$	Receiver enable from shutdown to output low		-	-	12	µs
t_{RSHDN}	Time to shutdown	-	50	270	600	ns

Driver Switching Characteristics—MxL83235

Unless otherwise noted, V_{CC} = 3V to 5.5V ambient temperature $T_{MIN} < T_A < T_{MAX}$. Typical values are at V_{CC} = 3.3V, $V_L = V_{CC}$, ambient temperature T_A = 25°C. The specifications apply over the full operating range from –40°C to 125°C, unless otherwise noted.

Table 9: MxL83235 Driver Switching Characteristics

Symbol	Driver Characteristic	Conditions	Minimum	Typical	Maximum	Unit
-	Data signaling rate	Duty cycle 40 to 60%	20	-	-	Mbps
t_{DPHL}, t_{DPLH}	Driver propagation delay	R_L = 54Ω, C_L = 50pF	-	15	30	ns
t_{DR}, t_{DF}	Driver output rise/fall time		5	9	17	ns
$\|t_{DPLH} - t_{DPHL}\|$	Driver differential skew		-	0.8	4	ns
t_{DZH}	Driver enable to output high	R_L = 500Ω, C_L = 50pF	-	17	50	ns
t_{DZL}	Driver enable to output low		-	17	50	ns
t_{DHZ}	Driver disable from output high		-	25	50	ns
t_{DLZ}	Driver disable from output low		-	23	50	ns
$t_{DZH(SHDN)}$	Driver enable from shutdown to output high		-	-	12	µs
$t_{DZL(SHDN)}$	Driver enable from shutdown to output low		-	-	12	µs
t_{DSHDN}	Time to shutdown	-	50	270	600	ns

Receiver Switching Characteristics—MxL83235

Unless otherwise noted, V_{CC} = 3V to 5.5V ambient temperature $T_{MIN} < T_A < T_{MAX}$. Typical values are at V_{CC} = 3.3V, $V_L = V_{CC}$, ambient temperature T_A = 25°C. The specifications apply over the full operating range from –40°C to 125°C, unless otherwise noted.

Table 10: MxL83235 Receiver Switching Characteristics

Symbol	Receiver Characteristic	Conditions	Minimum	Typical	Maximum	Unit
-	Data signaling rate	Duty cycle 40 to 60%	20	-	-	Mbps
t_{RPHL}, t_{RPLH}	Receiver propagation delay	C_L = 15pF	-	11	50	ns
t_{RR}, t_{RF}	Receiver output rise/fall time			2	6	ns
$\|t_{RPLH} - t_{RPHL}\|$	Propagation delay skew		-	0.8	4	ns
t_{RZH}	Receiver enable to output high	R_L = 1kΩ, C_L = 50pF	-	11	50	ns
t_{RZL}	Receiver enable to output low		-	11	50	ns
t_{RHZ}	Receiver disable from output high		-	12	50	ns
t_{RLZ}	Receiver disable from output low		-	12	50	ns
$t_{RZH(SHDN)}$	Receiver enable from shutdown to output high		-	-	12	µs
$t_{RZL(SHDN)}$	Receiver enable from shutdown to output low		-	-	12	µs
t_{RSHDN}	Time to shutdown	-	50	270	600	ns

Driver Switching Characteristics—MxL83236

Unless otherwise noted, V_{CC} = 3V to 5.5V, ambient temperature $T_{MIN} < T_A < T_{MAX}$. Typical values are at V_{CC} = 3.3V, $V_L = V_{CC}$, ambient temperature T_A = 25°C. The specifications apply over the full operating range from –40°C to 125°C, unless otherwise noted.

Table 11: MxL83236 Driver Switching Characteristics

Symbol	Driver Characteristic	Conditions	Minimum	Typical	Maximum	Unit
-	Data signaling rate	Duty cycle 40 to 60%	50	-	-	Mbps
t_{DPHL}, t_{DPLH}	Driver propagation delay	R_L = 54Ω, C_L = 50pF	-	8	20	ns
t_{DR}, t_{DF}	Driver output rise/fall time		-	4	6.7	ns
$\|t_{DPLH} - t_{DPHL}\|$	Driver differential skew		-	0.8	3.5	ns
t_{DZH}	Driver enable to output high	R_L = 500Ω, C_L = 50pF	-	15	50	ns
t_{DZL}	Driver enable to output low		-	15	50	ns
t_{DHZ}	Driver disable from output high		-	20	50	ns
t_{DLZ}	Driver disable from output low		-	17	50	ns
$t_{DZH(SHDN)}$	Driver enable from shutdown to output high		-	-	12	µs
$t_{DZL(SHDN)}$	Driver enable from shutdown to output low		-	-	12	µs
t_{DSHDN}	Time to shutdown	-	50	270	600	ns

Receiver Switching Characteristics—MxL83236

Unless otherwise noted, V_{CC} = 3V to 5.5V, ambient temperature $T_{MIN} < T_A < T_{MAX}$. Typical values are at V_{CC} = 3.3V, $V_L = V_{CC}$, ambient temperature T_A = 25°C. The specifications apply over the full operating range from –40°C to 125°C, unless otherwise noted.

Table 12: MxL83236 Receiver Switching Characteristics

Symbol	Receiver Characteristic	Conditions	Minimum	Typical	Maximum	Unit
-	Data signaling rate	Duty cycle 40 to 60%	50	-	-	Mbps
t_{RPHL}, t_{RPLH}	Receiver propagation delay	C_L = 15pF	-	12	40	ns
t_{RR}, t_{RF}	Receiver output rise/fall time		-	2	6	ns
$\|t_{RPLH} - t_{RPHL}\|$	Propagation delay skew		-	0.5	3.5	ns
t_{RZH}	Receiver enable to output high	R_L = 1kΩ, C_L = 50pF	-	11	50	ns
t_{RZL}	Receiver enable to output low		-	11	50	ns
t_{RHZ}	Receiver disable from output high		-	12	50	ns
t_{RLZ}	Receiver disable from output low		-	12	50	ns
$t_{RZH(SHDN)}$	Receiver enable from shutdown to output high		-	-	12	µs
$t_{RZL(SHDN)}$	Receiver enable from shutdown to output low		-	-	12	µs
t_{RSHDN}	Time to shutdown	-	50	270	600	ns

Test Circuits and Timing Diagrams

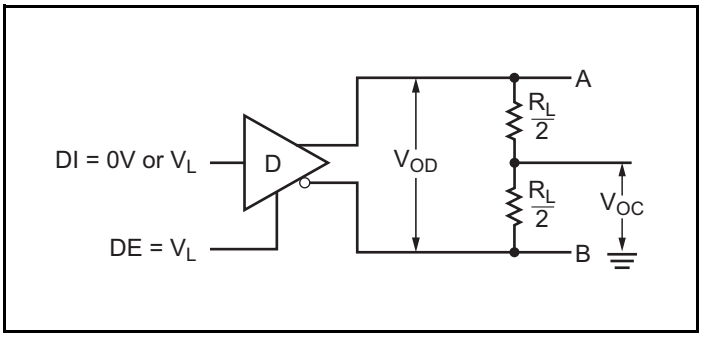


Figure 2: Driver DC Test Circuit

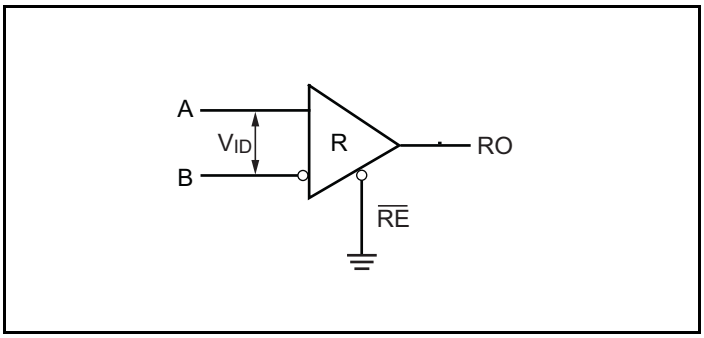


Figure 3: Receiver DC Test Circuit

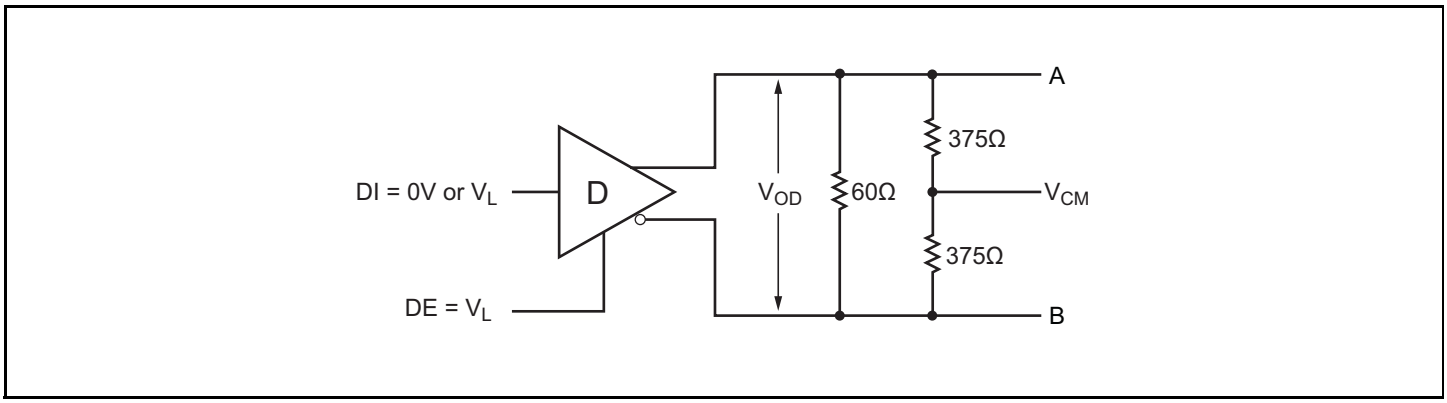


Figure 4: Differential Driver Output Voltage over Extended Common Mode

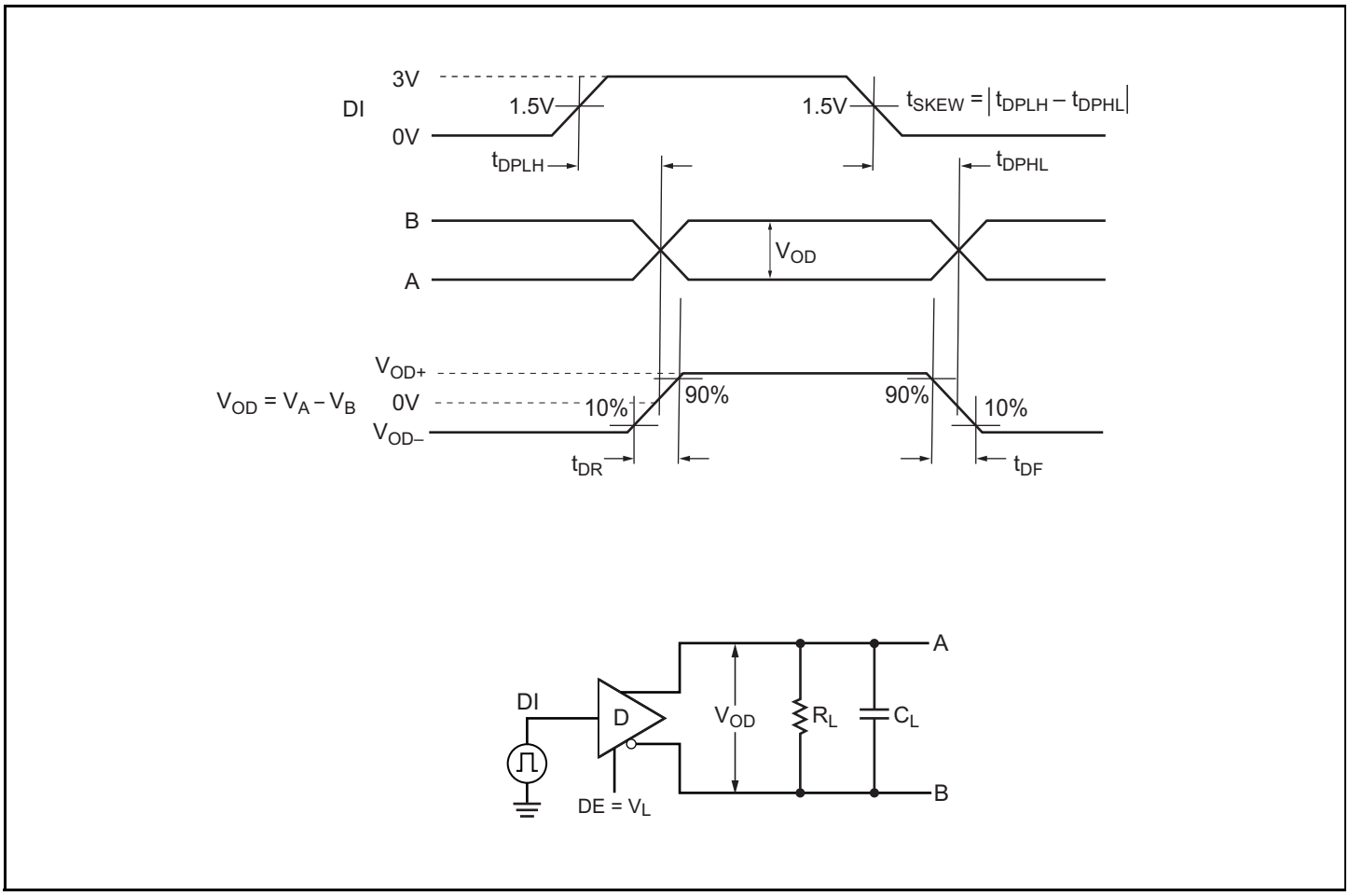


Figure 5: Driver Propagation Delay Time Test Circuit and Timing Diagram

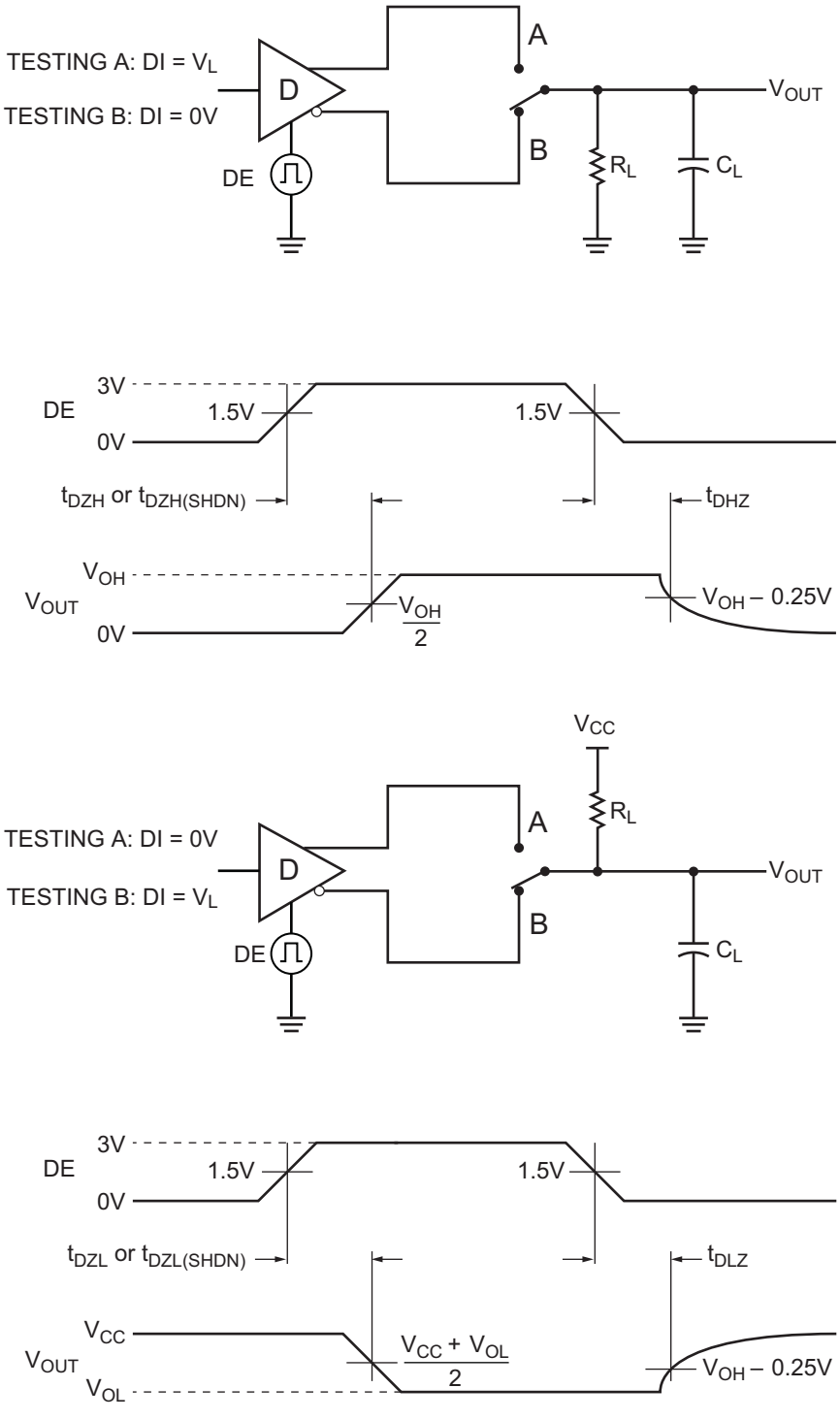


Figure 6: Driver Enable and Disable Times Test Circuit and Timing Diagram

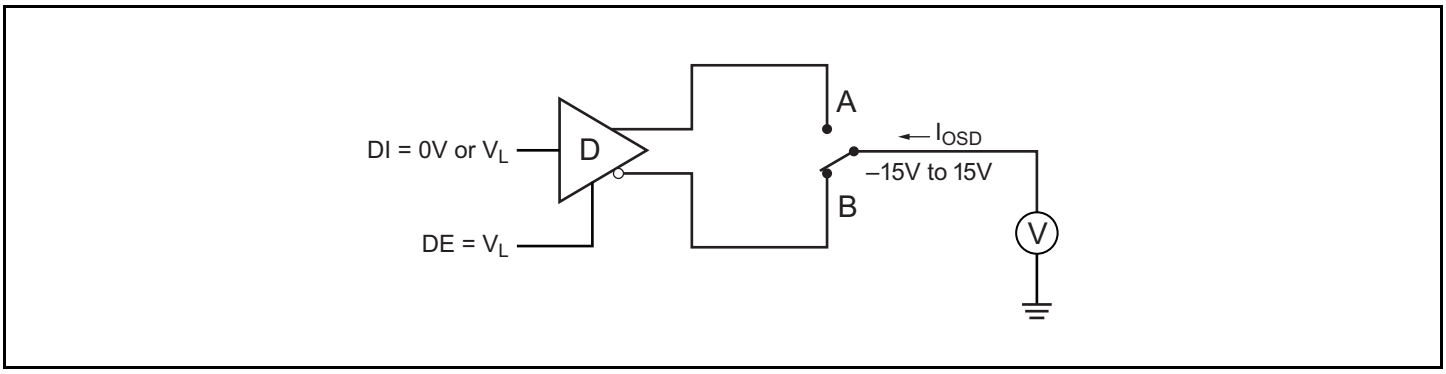


Figure 7: Driver Short Circuit Current Test

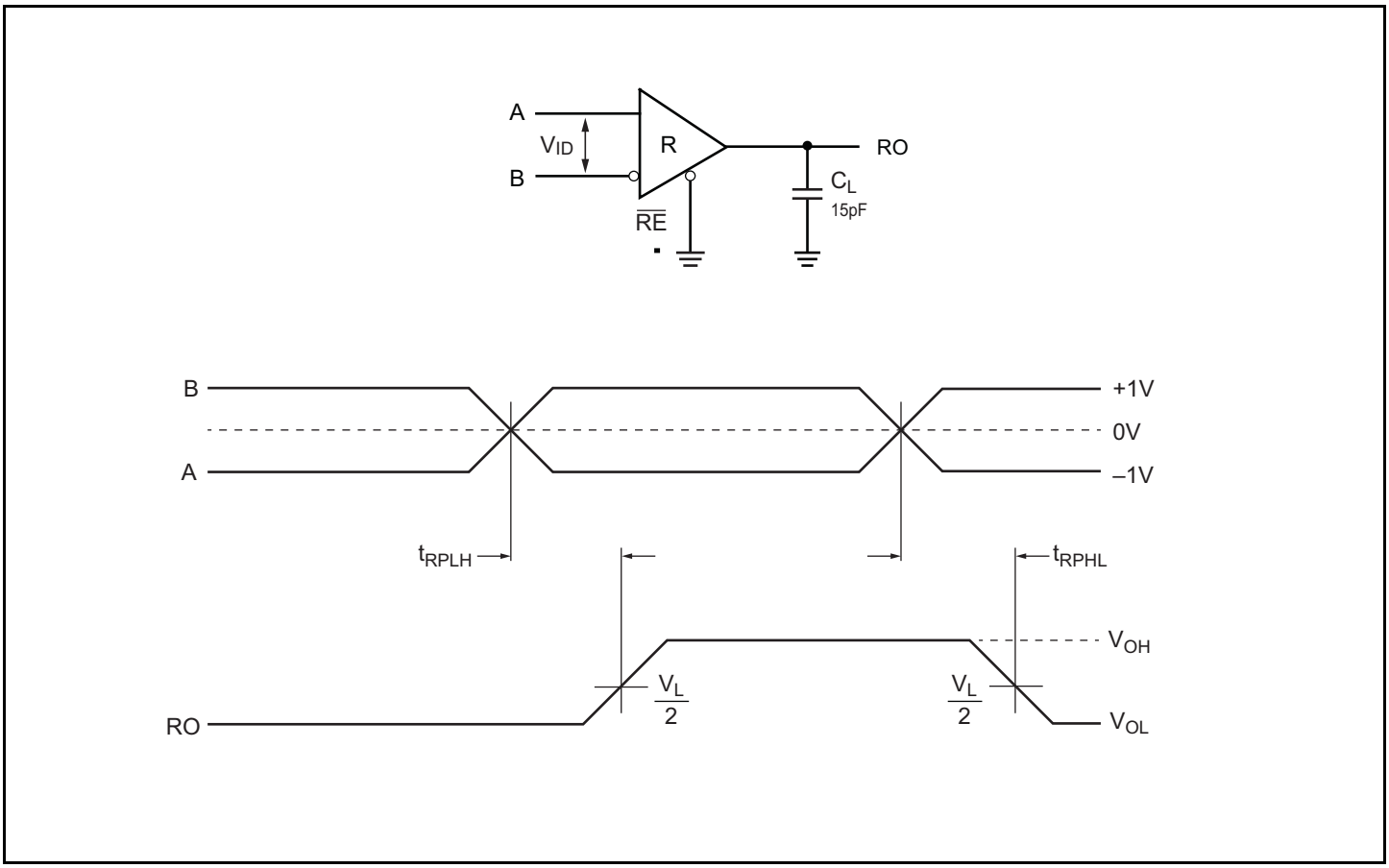


Figure 8: Receiver Propagation Delay Test Circuit and Timing Diagram

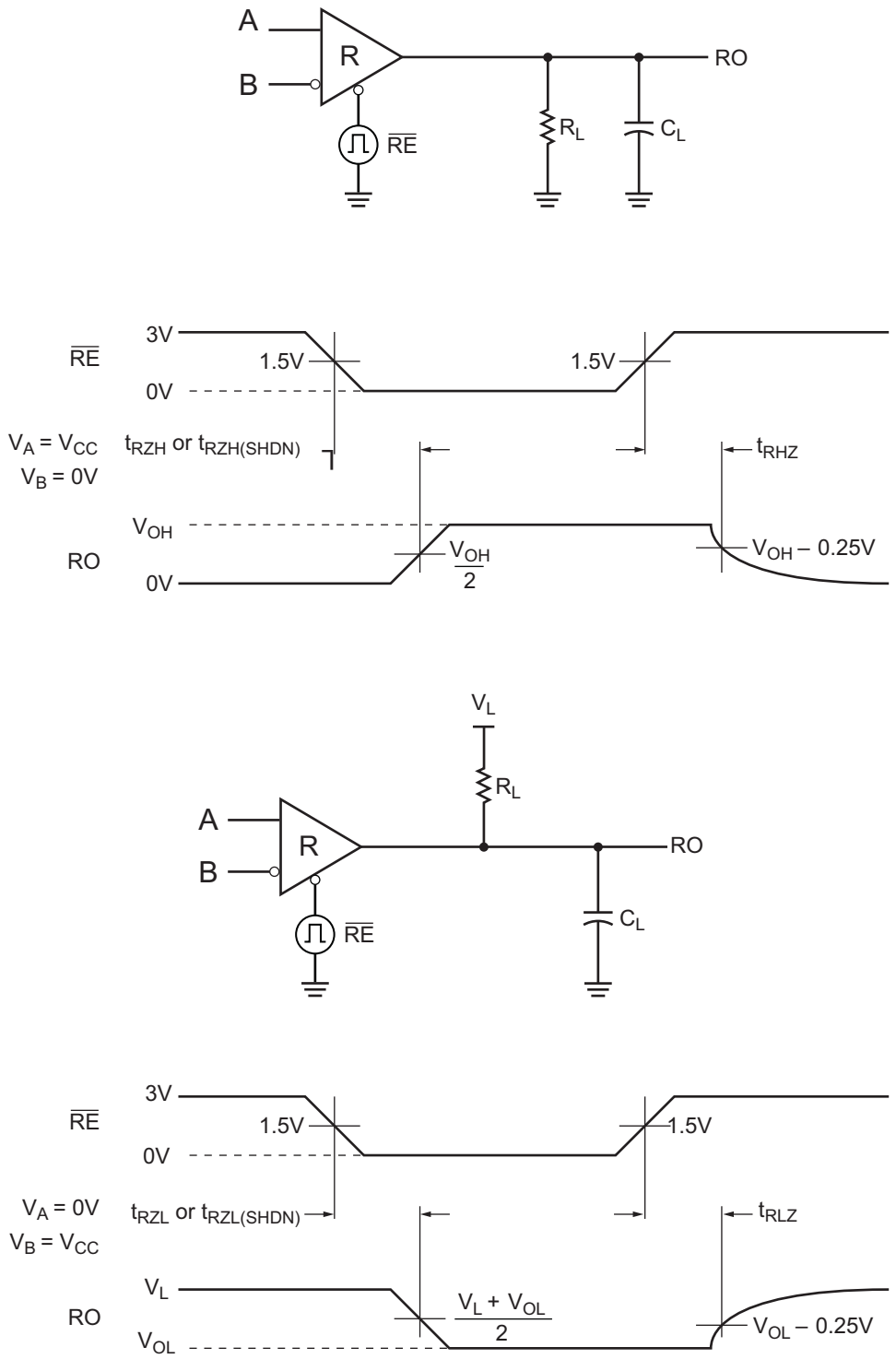


Figure 9: Receiver Enable and Disable Times Test Circuit and Timing Diagram

Function Tables

Table 13: MxL83235, MxL83236 Tx (Half-Duplex)

Slew Control (SC)	Input	Enable		Outputs		Function
	DI	DE	$\overline{RE}$	A	B	
SC = H, for Low Speed SC = L, for High Speed	H	H	X	H	L	Actively drive bus high.
	L	H	X	L	H	Actively drive bus low.
	X	L	L	Z	Z	Driver disabled.
	X	L	H	Z	Z	Driver and receiver disabled (shutdown mode).

Table 14: MxL83235, MxL83236 Rx (Half-Duplex)

Differential Input	Enable		Output	Function
$V_{ID} = V_A – V_B$	$\overline{RE}$	DE	RO	
$–20mV \le V_{ID}$	L	X	H	Receive valid bus high.
$–200mV \le V_{ID} \le –20mV$	L	X	X	Indeterminate bus state
$V_{ID} \le –200mV$	L	X	L	Receive valid bus low.
X	H	X	Z	Receiver disabled.
Open-Circuit Bus (Unterminated)	L	X	H	Fail-safe high output.
Short-Circuit Bus	L	X	H	Fail-safe high output.
Idle (Terminated) Bus	L	X	H	Fail-safe high output.
X	H	L	Z	Driver and receiver disabled (shutdown mode).

Pin Information

Pin Configurations

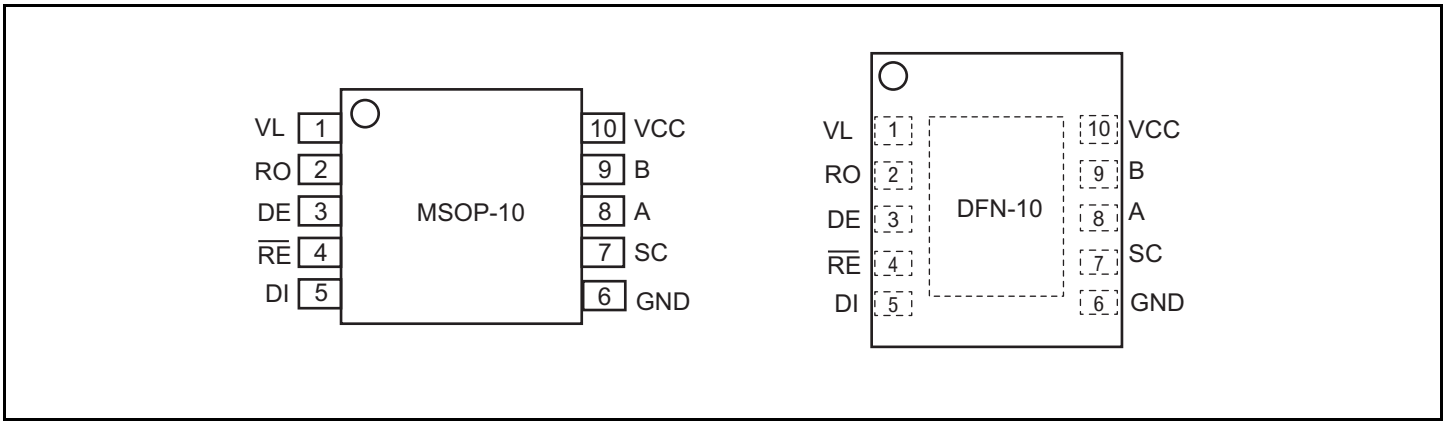


Figure 10: Pin Configurations

Pin Descriptions

Table 15: MxL83235/MxL83236 Pin Descriptions

Pin#	Pin Name	Pin Function
1	VL	V_L logic input supply voltage. Bypassed with a 0.1µF as close as possible to pin.
2	RO	Receiver Output.
3	DE	Driver Output Enable/Disable. DE = High to enable outputs. DE = Low to disable outputs to high impedance. DE = Low and $\overline{RE}$ = High to enter shutdown mode.
4	$\overline{RE}$	Receiver Output Enable/Disable. $\overline{RE}$ = Low to enable RO output. $\overline{RE}$ = High to disable RO output to high impedance.
5	DI	Driver input.
6	GND	Ground.
7	SC	Slew control, 100K internal pull down if pin left OPEN, SC = high for slew limited (≤500kbps).
8	A	Non-inverting Driver Output/Non-inverting Receiver Input.
9	B	Inverting Driver Output/Inverting Receiver Input.
10	VCC	Input supply voltage. Bypassed with a 0.1µF as close as possible to pin.

Detailed Description

The MxL83235 and MxL83236 are a family of half-duplex transceivers for RS-485 / RS-422 communication. It contains one driver and one receiver, and can be configured as both driver and receiver at a time.These devices feature fail-safe circuitry, which guarantees a logic-high receiver output when the receiver inputs are open or shorted, or when they are connected to a terminated transmission line with all drivers disabled. The MxL83235 and MxL83236 also feature a hot-swap capability allowing live insertion without error data transfer. By making the SC pin pulled high, both MxL83235 and MxL83236 feature reduced slew-rate drivers that minimize EMI and reduce reflections caused by improperly terminated cables, allowing error-free data transmission up to 500kbps. For high-speed transmission the SC pin should be kept float/pulled low to achieve transmission speed up to 20Mbps and 50Mbps respectively.

All devices operate with two independent power supplies V_{CC} and V_L.The V_{CC} supply power the internal core circuitry and logic functions and in the range from 3V to 5.5V. The V_L provides power to the input/output pins, defining the logic levels for the external interfaces, in the range from 1.65V to 5.5V. Drivers are output short-circuit current limited. Thermal-shutdown circuitry protects drivers against excessive power dissipation. When activated, the thermal-shutdown circuitry places the driver outputs into a high-impedance state.

Receiver Input Filtering

The MxL83235 and MxL83236 receivers incorporate input filtering in addition to input hysteresis in slow speed mode. This filtering enhances noise immunity with differential signals that have very slow rise and fall times

Enhanced Failsafe

The MxL83235 and MxL83236 devices guarantee a logic-high receiver output when the receiver inputs are shorted, open, or when they are connected to a terminated transmission line with all drivers disabled. If A–B is less than or equal to –200mV, the RO is logic low. In the case of a terminated bus with all transmitters disabled, the receiver's differential input voltage is pulled to 0V by the termination. With the receiver thresholds of these devices, it results in a logic high with a 65mV typical noise margin. In compliance with the *EIA/TIA-485* standard, this family has a threshold range from –20mV to –200mV.

Hot-Swap Capability

When circuit boards are inserted into a hot backplane, differential disturbances to the data bus can lead to data errors. Upon initial circuit board insertion, the data communication processor undergoes its own power-up sequence. During this period, the processor's logic-output drivers are high impedance and are unable to drive the DE and $\overline{RE}$ inputs of these devices to a defined logic level. Leakage currents up to 10µA from the high-impedance state of the processor's logic drivers could cause standard CMOS enable inputs of a transceiver to drift to an incorrect logic level. Additionally, the parasitic circuit board capacitance can cause coupling of V_{CC} or GND to the enable inputs. Without the hot-swap capability, these factors could improperly enable the transceiver's driver or receiver.

When V_L rises, an internal pull-down circuit holds DE low and $\overline{RE}$ high for approximately 10µs. After the initial power-up sequence, the pull-down circuit becomes transparent, resetting the hot-swap tolerable input.

ESD Test Conditions (IEC 61000-4-2)

The *IEC 61000-4-2* standard covers the ESD testing and performance of finished equipment. However, it does not refer to integrated circuits. The MxL83235 and MxL83236 devices help you design equipment to meet *IEC 61000-4-2* without the need for additional ESD-protection components. The major difference between tests done using the *Human Body Model (HBM)* and *IEC 61000-4-2* is higher peak current in *IEC 61000-4-2*, because series resistance is lower in the *IEC 61000-4-2* model. Hence, the ESD withstand voltage measured to *IEC 61000-4-2* is generally lower than that measured using the *HBM*. The air-gap test involves approaching the device with a charged probe. The contact discharge method connects the probe to the device before the probe is energized. As with all MaxLinear devices, the ESD-protection structures are incorporated on all pins to protect against electrostatic discharges encountered during handling and assembly. The driver output and receiver inputs of the MxL83235 and MxL83236 family has extra protection against static electricity. MaxLinear develops state-of-the-art structures to protect these pins against ESD without damage. The ESD structures withstand high ESD in all states: normal operation, shutdown, and powered down. After an ESD event, the MxL83235 and MxL83236 devices keep working

without latchup or damage.

The ESD performance depends on a variety of conditions. For more information about reliability report that documents test setup, methodology, and results, contact MaxLinear Customer Technical Support.

Electrical Fast Transient (IEC 61000-4-4)

Inductive loads such as relays, switch contactors, or heavy-duty motors can create high-frequency bursts during transition. The electrical fast transient (EFT) tests evaluate immunity of electrical and electronic equipment when subjected to repetitive electrical fast transient/bursts on supply, signal, control and earth ports. The *IEC 61000-4-4* test simulates the transients created by such switching of inductive loads on AC power lines.

Evaluation of Test Results

The test results are classified in terms of the loss of function or degradation of performance of the equipment under test, relative to a performance level defined by its manufacturer of the requestor of the test or agreed between the manufacturer and the purchaser of the product.

MaxLinear recommends the following classification:

- **a.** Normal performance within the specification limits.
- **b.** Temporary loss of function or degradation of performance which is self-recoverable.
- **c.** Temporary loss of function or degradation of performance which requires operator intervention or system reset.
- **d.** Loss of function or degradation of performance which is not recoverable due to damage of equipment (components) or software, or loss of data.

For device-level pass or fail test, a) to c) can be considered passing results, and d) can be considered failing results.

256 Transceivers on the Bus

The standard RS-485 receiver input impedance is 12kΩ (1 unit load), and the standard driver can drive up to 32 unit loads. The MxL83235 and MxL83236 family of transceivers has a $^1/_8$-unit load receiver input impedance (96kΩ), allowing up to 256 transceivers to be connected in parallel on one communication line. Any combination of these devices as well as other RS-485 transceivers with a total of 32 unit loads or fewer can be connected to the line.

Reduced EMI and Reflections

In slow speed mode, the MxL83235 and MxL83236 devices feature reduced slew-rate drivers that minimize EMI and reduce reflections caused by improperly terminated cables, allowing error-free data transmission up to 500kbps.

Low-Power Shutdown

The low-power shutdown mode is initiated by bringing both $\overline{RE}$ high and DE low. In shutdown, the devices typically draw only 50nA of supply current. $\overline{RE}$ and DE can be driven simultaneously; the parts are guaranteed not to enter shutdown if $\overline{RE}$ is high and DE is low for less than 50ns. If the inputs are in this state for at least 600ns, the parts are guaranteed to enter shutdown. Enable times t_{ZH} and t_{ZL} assume the part was not in a low-power shutdown state. Enable times $t_{ZH(SHDN)}$ and $t_{ZL(SHDN)}$ assume the parts are shut down. It takes drivers and receivers longer to become enabled from low-power shutdown mode $t_{ZH(SHDN)}$ and $t_{ZL(SHDN)}$ than from driver or receiver disable mode (t_{ZH}, t_{ZL}).

Driver Output Protection

Two mechanisms prevent excessive output current and power dissipation caused by faults or by bus contention. First, a current limit on the output stage provides immediate protection against short circuits over the whole common-mode voltage range.
Second, a thermal-shutdown circuit forces the driver outputs into a high-impedance state if the die temperature becomes excessive.

Line Length

The RS-485/RS422 standard covers line lengths up to 4000ft. For design recommendations, refer to the *RS-485 Cable Lengths against Data Signaling Rate Application Note* (292AN).

Typical Applications

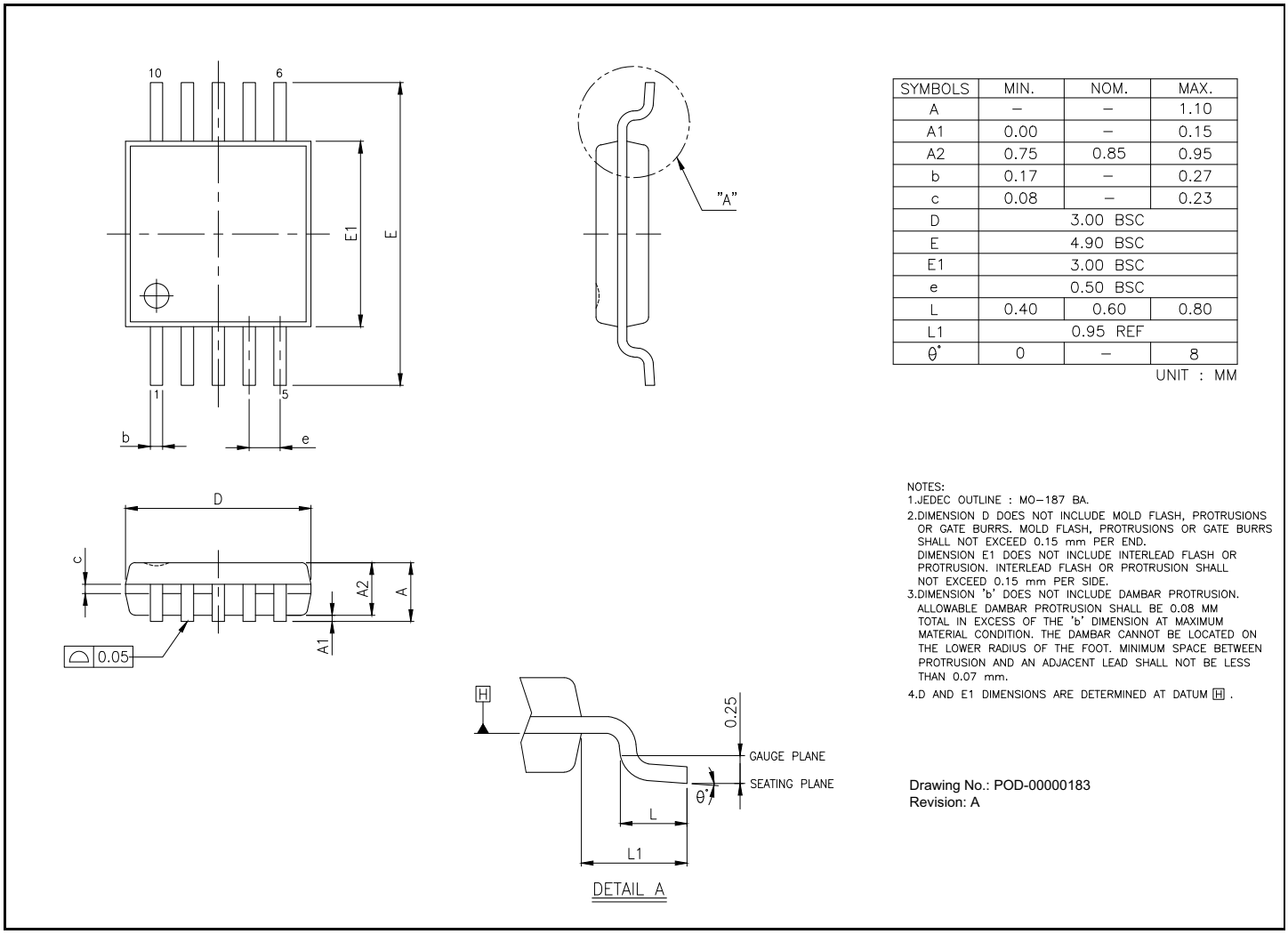
The MxL83235 and MxL83236 transceivers are designed for bidirectional data communications on multipoint bus transmission lines.

To minimize reflections, terminate the line at both ends in its characteristic impedance, and keep stub lengths off the main line as short as possible. In slow speed mode, the slew-rate-limited MxL83235 and MxL83236 devices are more tolerant of imperfect termination.

For design recommendations on cable termination, refer to the *A.1.2 Cable Termination section in the TIA/EIA-422-B specification*.MaxLinear recommends that you consider the overall system behavior during operation. A common failure of RS-485 circuits occurs when multiple drivers transmit data simultaneously on the same bus, causing bus contention. Allow appropriate idle time for the bus line to reach normal common-mode voltage when switching between bus drivers to ensure reliability and proper functionality of the system.

Mechanical Dimensions

MSOP-10



SYMBOLS	MIN.	NOM.	MAX.
A	–	–	1.10
A1	0.00	–	0.15
A2	0.75	0.85	0.95
b	0.17	–	0.27
c	0.08	–	0.23
D		3.00 BSC	
E		4.90 BSC	
E1		3.00 BSC	
e		0.50 BSC	
L	0.40	0.60	0.80
L1		0.95 REF	
θ°	0	–	8

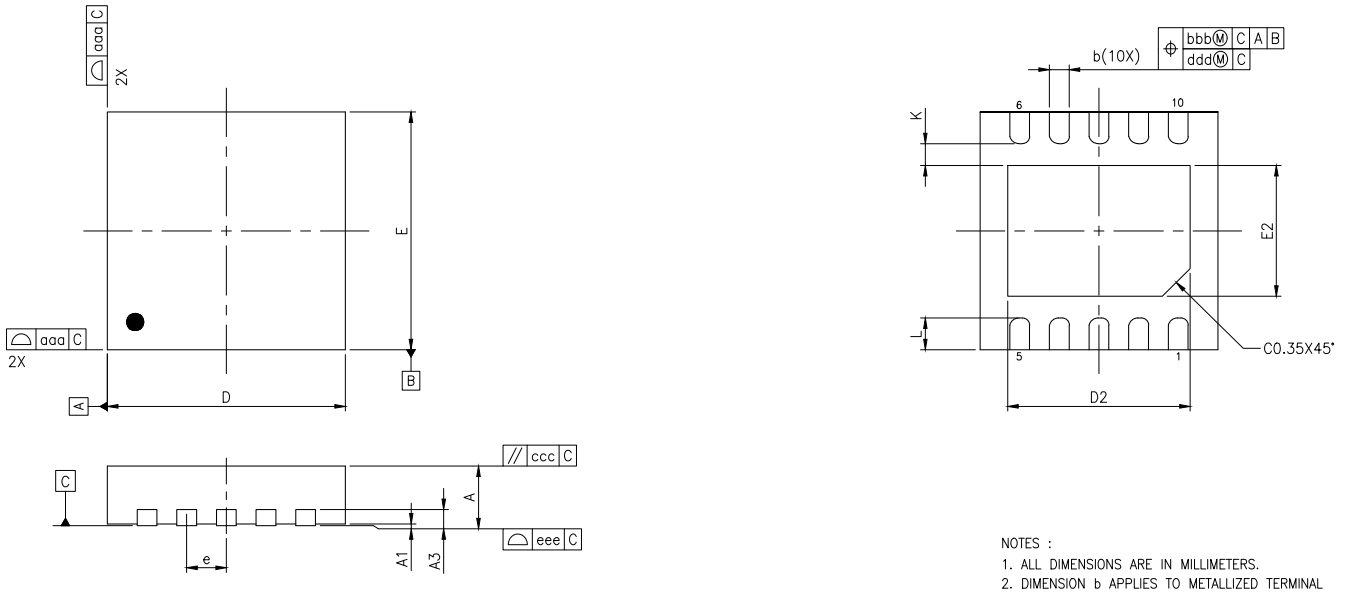
UNIT : MM

NOTES:
1. JEDEC OUTLINE : MO-187 BA.
2. DIMENSION D DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH, PROTRUSIONS OR GATE BURRS SHALL NOT EXCEED 0.15 mm PER END. DIMENSION E1 DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.15 mm PER SIDE.
3. DIMENSION 'b' DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 MM TOTAL IN EXCESS OF THE 'b' DIMENSION AT MAXIMUM MATERIAL CONDITION. THE DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OF THE FOOT. MINIMUM SPACE BETWEEN PROTRUSION AND AN ADJACENT LEAD SHALL NOT BE LESS THAN 0.07 mm.
4. D AND E1 DIMENSIONS ARE DETERMINED AT DATUM H .

Drawing No.: POD-00000183
Revision: A

Figure 11: Mechanical Dimensions—MSOP-10

DFN-10



JEDEC OUTLINE	MO-229		
PKG CODE	WDFN(X310)		
SYMBOLS	MIN.	NOM.	MAX.
A	0.70	0.75	0.80
A1	0.00	0.02	0.05
A3	0.203 REF.		
b	0.20	0.25	0.30
D	2.90	3.00	3.10
E	2.90	3.00	3.10
e	0.50 BSC		
L	0.30	0.40	0.50
K	0.20	—	—
aaa	0.10		
bbb	0.10		
ccc	0.10		
ddd	0.05		
eee	0.08		

PAD SIZE	D2			E2			LEAD FINISH		JEDEC CODE
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.	Pure Tin	PPF	
73X98R MIL	2.20	2.30	2.40	1.50	1.60	1.70	V	V	W3030D-5

NOTES :
1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. DIMENSION b APPLIES TO METALLIZED TERMINAL AND IS MEASURED BETWEEN 0.15mm AND 0.30mm FROM THE TERMINAL TIP. IF THE TERMINAL HAS THE OPTIONAL RADIUS ON THE OTHER END OF THE TERMINAL, THE DIMENSION b SHOULD NOT BE MEASURED IN THAT RADIUS AREA.
3. BILATERAL COPLANARITY ZONE APPLIES TO THE EXPOSED HEAT SINK SLUG AS WELL AS THE TERMINALS.

Drawing No.: POD-00000184
Revision: A

Figure 12: Mechanical Dimensions—DFN-10

Ordering Information

Table 16: Ordering Information

Ordering Part Number	Data Rate (Mbps)	Package	Packaging Method	Operating Temperature Range
MXL83235E-ARA-R	0.5/20	MSOP-10	Reel	–40°C to 125°C
MXL83235E-AHA-R	0.5/20	DFN-10	Reel	–40°C to 125°C
MXL83236E-ARA-R	0.5/50	MSOP-10	Reel	–40°C to 125°C
MXL83236E-AHA-R	0.5/50	DFN-10	Reel	–40°C to 125°C
MXL83236E-AHA-EVK-1	MxL83236 Evaluation Kit			

Note:

- For more information about part numbers, as well as the most up-to-date ordering information and additional information on environmental rating, go to www.maxlinear.com/MxL83235 and www.maxlinear.com/MxL83236.
- For more information about the EVK, refer to the *MxL83236 EVK User Manual* (039UM).

MaxLinear, Inc.
5966 La Place Court, Suite 100
Carlsbad, CA 92008
Tel.: +1 (760) 692-0711
Fax: +1 (760) 444-8598

www.maxlinear.com