

## General Description

The MxL83211, MxL83212, and MxL83214 (MxL8321x family) of half-duplex RS-485 transceivers support up to 50Mbps communication in harsh industrial environments. The bus pins tolerate high levels of IEC electrical fast transients (EFT), IEC electrostatic discharge (ESD), and provide an extended common mode range.

Seven product options with slew controlled 250kbps, 500kbps speeds, and high speed 50Mbps varieties in three different packages provides a broad portfolio that can be used across different applications ranging from high speed motor drives to wireless infrastructure and building automation. The combination of integrated EFT and ESD protection in small MSOP and VSON packages makes these products suited for space-constrained applications that require robust and high-performance communication.

High receiver input impedance allows 256 transceivers to share a common data bus while maintaining signal margin and without excessive loading or use of expensive repeaters. Enhanced failsafe circuitry ensures receivers provide the expected output when the bus is shorted or left open under both terminated and unterminated conditions. Drivers include built-in short-circuit protection and a thermal-overload shutdown to protect against excessive power dissipation from bus contention.

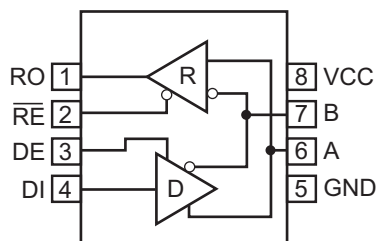
## Features

- Meets or exceeds the requirements of the *TIA/EIA-485A* standard
- Differential output exceeds 2.1V for PROFIBUS compatibility with a 5V supply
- Wide supply range from 3.0 to 5.5V
- Extended operating temperature range from  $-40^{\circ}\text{C}$  to  $125^{\circ}\text{C}$
- Extended operational common-mode range of  $\pm 15\text{V}$
- Low-power shutdown mode
- Enhanced failsafe protection for open, short, idle
- Glitch-free power-up/down hot plug capability
- 1/8 unit load (256 bus nodes)
- NSOIC and small form factor MSOP and VSON packages
- Robust system protection
  - $\pm 4\text{kV}$  EFT (*IEC 61000-4-4*)
  - $\pm 12\text{kV}$  ESD Contact (*IEC 61000-4-2*)
  - $\pm 15\text{kV}$  ESD Human Body Mode (HBM)

## Applications

- High-performance motor drives
- BBU and RRU Telecom equipment
- Industrial and single board computers
- Smart Grid
- Building security and automation
- Industrial and process control equipment
- Industrial transport

Ordering Information - [page 21](#)



**Figure 1: 8-Pin Half-Duplex**

Revision History

Document No.	Release Date	Change Description
274DSR06	August 6, 2024	<b>Added:</b> <ul style="list-style-type: none"><li>■ "Recommended Operating Conditions" section.</li></ul> <b>Updated:</b> <ul style="list-style-type: none"><li>■ In some tables, <i>Symbol</i> column moved to the first column.</li><li>■ Cross-references format updated.</li><li>■ "Mechanical Dimensions—SOIC8" figure from Rev B to Rev B.1. No change to content; MxL document registration only</li><li>■ "Mechanical Dimensions—MSOP8" figure from Rev B to Rev C. No change to content; MxL document registration only.</li><li>■ "Mechanical Dimensions—VSON8" figure from Rev B to Rev C. No change to content; MxL document registration only.</li><li>■ "Ordering Information" section.</li></ul>
274DSR05	May 14, 2024	Text alignment and color updated.
274DSR04	May 3, 2024	Initial final release.

# Table of Contents

<b>General Description</b>	<b>i</b>
<b>Applications</b>	<b>i</b>
<b>Features</b>	<b>i</b>
<b>Specifications</b>	<b>1</b>
Absolute Maximum Ratings	1
ESD and EFT Ratings	1
Thermal Information	1
Recommended Operating Conditions	2
Electrical Characteristics	3
Driver Switching Characteristics—MxL83211	5
Receiver Switching Characteristics—MxL83211	5
Driver Switching Characteristics—MxL83212	6
Receiver Switching Characteristics—MxL83212	6
Driver Switching Characteristics—MxL83214	7
Receiver Switching Characteristics—MxL83214	7
<b>Test Circuits and Timing Diagrams</b>	<b>8</b>
<b>Function Tables</b>	<b>13</b>
<b>Pin Information</b>	<b>14</b>
Pin Configurations	14
Pin Descriptions	14
<b>Detailed Description</b>	<b>15</b>
Receiver Input Filtering	15
Enhanced Failsafe	15
Hot-Swap Capability	15
ESD Test Conditions (IEC 61000-4-2)	15
Electrical Fast Transient (IEC 61000-4-4)	16
256 Transceivers on the Bus	16
Reduced EMI and Reflections	16
Low-Power Shutdown Mode	16
Driver Output Protection	16
Line Length	16
Typical Applications	17
<b>Mechanical Dimensions</b>	<b>18</b>
NSOIC8	18
MSOP8	19

VSON8 .....20

**Ordering Information.....21**

## List of Figures

Figure 1: 8-Pin Half-Duplex .....	i
Figure 2: Driver DC Test Circuit .....	8
Figure 3: Receiver DC Test Circuit.....	8
Figure 4: Differential Driver Output Voltage over Extended Common Mode.....	8
Figure 5: Driver Propagation Delay Time Test Circuit and Timing Diagram.....	9
Figure 6: Driver Enable and Disable Times Test Circuit and Timing Diagram .....	10
Figure 7: Driver Short Circuit Current Test.....	11
Figure 8: Receiver Propagation Delay Test Circuit and Timing Diagram .....	11
Figure 9: Receiver Enable and Disable Times Test Circuit and Timing Diagram.....	12
Figure 10: Pin Configurations.....	14
Figure 11: Mechanical Dimensions—SOIC8 .....	18
Figure 12: Mechanical Dimensions—MSOP8 .....	19
Figure 13: Mechanical Dimensions—VSON8.....	20

# List of Tables

Table 1: Absolute Maximum Ratings .....	1
Table 2: ESD and EFT Ratings .....	1
Table 3: Thermal Information .....	1
Table 4: Power Dissipation .....	2
Table 5: Recommended Operating Conditions .....	2
Table 6: Electrical Characteristics .....	3
Table 7: MxL83211 Driver Switching Characteristics .....	5
Table 8: MxL83211 Receiver Switching Characteristics .....	5
Table 9: MxL83212 Driver Switching Characteristics .....	6
Table 10: MxL83212 Receiver Switching Characteristics .....	6
Table 11: MxL83214 Driver Switching Characteristics .....	7
Table 12: MxL83214 Receiver Switching Characteristics .....	7
Table 13: MxL83211, MxL83212, MxL83214 Tx (Half-Duplex) .....	13
Table 14: MxL83211, MxL83212, MxL83214 Rx (Half-Duplex).....	13
Table 15: MxL83211, MxL83212, and MxL83214 Pin Descriptions .....	14
Table 16: Ordering Information.....	21

## Specifications

### Absolute Maximum Ratings

**Important:** Stresses beyond absolute maximum ratings may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these ratings or any other above those indicated in the operation sections of the specifications below is not implied. Exposure to absolute maximum rating conditions for extended periods of time may affect reliability.

**Table 1: Absolute Maximum Ratings**

Parameter	Minimum	Maximum	Units
$V_{CC}$	−0.3	6	V
Input Voltage at Control Input Pins ( $\overline{RE}$ , DE)	−0.3	6	V
Driver Input Voltage ( $\overline{RE}$ , DI)	−0.3	6	V
Bus Pin Voltage (A, B)	−18	18	V
Receiver Output Current	−24	24	mA
Storage Temperature Range	−65	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)	±16	kV
IEC 61000-4-2 Contact Discharge (pins A, B)	±12	kV
IEC 61000-4-4 Electrical Fast Transient (pins A, B)	±4	kV

### Thermal Information

**Table 3: Thermal Information**

Symbol	Thermal Metric	MxL83211, MxL83212, MxL83214			
		NSOIC8	VSON8	MSOP8	Units
$\theta_{JA}$	Junction-to-Ambient Thermal Resistance	96.1	53.9	154	°C/W
$\Psi_{JT}$	Junction-to-Top Characterization Parameter	3.7	1.5	3	°C/W
$\Psi_{JB}$	Junction-to-Board Characterization Parameter <sup>1</sup>	59.1	17.9	118.2	°C/W
$\theta_{JB}$	Junction-to-Board Thermal Resistance <sup>1</sup>	58.3	15.9	111	°C/W
$\theta_{JC}$	Junction-to-Case Thermal Resistance	42.2	29.4	54	°C/W

1. JESD51-5 (4-layer) PCB.

**Table 4: Power Dissipation**

Parameter	Description	Test Condition	Minimum	Typical	Maximum	Unit
PD	Driver and receiver enabled, $V_{CC} = 5.5\text{ V}$ , $T_A = 125^\circ\text{C}$ , 50% duty cycle square wave at 250kbps signaling rate, MxL83211	Load: $R_L = 300\Omega$ , $C_L = 50\text{pF}$	-	225	-	mW
		RS-422 load: $R_L = 100\Omega$ , $C_L = 50\text{pF}$	-	250	-	mW
		RS-485 load: $R_L = 54\Omega$ , $C_L = 50\text{pF}$	-	300	-	mW
		No Load	-	220	-	mW
	Driver and receiver enabled, $V_{CC} = 5.5\text{ V}$ , $T_A = 125^\circ\text{C}$ , 50% duty cycle square wave at 500kbps signaling rate, MxL83212	Load: $R_L = 300\Omega$ , $C_L = 50\text{pF}$	-	205	-	mW
		RS-422 load: $R_L = 100\Omega$ , $C_L = 50\text{pF}$	-	230	-	mW
		RS-485 load: $R_L = 54\Omega$ , $C_L = 50\text{pF}$	-	280	-	mW
		No Load	-	200	-	mW
	Driver and receiver enabled, $V_{CC} = 5.5\text{V}$ , $T_A = 125^\circ\text{C}$ , 50% duty cycle square wave at 50Mbps signaling rate, MxL83214	Load: $R_L = 300\Omega$ , $C_L = 50\text{pF}$	-	325	-	mW
		RS-422 load: $R_L = 100\Omega$ , $C_L = 50\text{pF}$	-	330	-	mW
		RS-485 load: $R_L = 54\Omega$ , $C_L = 50\text{pF}$	-	360	-	mW
		No Load	-	220	-	mW

## Recommended Operating Conditions

**Table 5: Recommended Operating Conditions**

Symbol	Parameter	Minimum	Maximum	Units
$V_{CC}$	Supply Voltage	3.0	5.5	V
$V_{IH}$	High-Level Input Voltage (DI, DE, and $\overline{REb}$ pins)	2.0	-	V
$V_{IL}$	Low-Level Input Voltage (DI, DE, and $\overline{REb}$ pins)	-	0.8	V
$V_{CM}$	Operational Common-Mode Input Voltage	-15	15	V
$T_A$	Operating Ambient Temperature	-40	125	$^\circ\text{C}$



## Electrical Characteristics

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

**Table 6: Electrical Characteristics**

Symbol	Parameter	Test Condition	Minimum	Typical	Maximum	Units
$V_{OD}$	Differential Driver Output	$R_L = 100\Omega$ (RS-422), Figure 2 on page 8	2	-	$V_{CC}$	V
		$R_L = 54\Omega$ (RS-485), Figure 2 on page 8	1.5	-	$V_{CC}$	
		$R_L = 60\Omega$ , $-15V \leq V_{CM} \leq 15V$ , Figure 4 on page 8	1.5	-	$V_{CC}$	
		$R_L = 60\Omega$ , $-15V \leq V_{CM} \leq 15V$ , $4.5 \leq V_{CC} \leq 5.5V$ , Figure 4 on page 8	2.1	-	$V_{CC}$	
$ \Delta V_{OD} $	Change in Magnitude of Differential Output Voltage	$R_L = 54\Omega$ or $100\Omega$ , Figure 2 on page 8	-	-	0.2	V
$V_{OC}$	Driver Common Mode Output Voltage	$R_L = 54\Omega$ or $100\Omega$ , Figure 2 on page 8	-	$V_{CC}/2$	3	V
$ \Delta V_{OC} $	Change in Steady State of Common Mode Output Voltage	$R_L = 54\Omega$ or $100\Omega$ , Figure 2 on page 8	-	-	0.2	V
$V_{IH}$	Input High Voltage	DE, DI, $\overline{RE}$	2	-	$V_{CC}$	V
$V_{IL}$	Input Low Voltage	DE, DI, $\overline{RE}$	0	-	0.8	V
$V_{HYS}$	Input Hysteresis	DE, DI, $\overline{RE}$	-	100	-	mV
$I_{IN}$	Input Current	DE, DI, $\overline{RE}$	-1	-	1	$\mu A$
-	Input Current First Transition (Hot Swap)	DE, $\overline{RE}$ First transition draws more current (hot swap)	-	$\pm 100$	$\pm 200$	$\mu A$
$I_{OSD}$	Driver Short-Circuit Current	$-15V \leq V_{OUT} \leq 15V$ , Figure 7 on page 11	-250	-	250	mA
$T_{TS}$	Thermal-Shutdown Threshold		-	170	-	$^\circ C$
$T_{TSH}$	Thermal-Shutdown Hysteresis		-	15	-	$^\circ C$
<b>Receiver</b>						
$V_{TH}$	Receiver Differential Threshold (Sensitivity)	$-15V \leq V_{CM} \leq 15V$	-200	-125	-20	mV
$V_{HYS}$	Receiver Input Hysteresis	$-15V \leq V_{CM} \leq 15V$	-	30	-	mV
$V_{OH}$	RO Output High Voltage	$I_O = -8mA$	$V_{CC} - 0.4$	$V_{CC} - 0.2$	-	V
$V_{OL}$	RO Output Low Voltage	$I_O = 8mA$	-	0.2	0.4	V
$I_{OZR}$	Tri-State Output Current at Receiver	$0 \leq V_O \leq V_{CC}$	-	-	$\pm 1$	$\mu A$
$R_{IN}$	Receiver Input Resistance	$-15V \leq V_{CM} \leq 15V$	96	-	-	k $\Omega$
$I_{A,B}$	Input Current (A, B)	DE = GND, $\overline{RE} = GND$ $0 \leq V_{CC} \leq 5.5V$	$V_{IN} = 15V$	-	-	125
			$V_{IN} = -15V$	-200	-	-

**Table 6: Electrical Characteristics (Continued)**

Symbol	Parameter	Test Condition	Minimum	Typical	Maximum	Units
$I_{CC}$	Supply Current	No load, $\overline{RE} = GND$ , $DE = V_{CC}$ , $DI = GND$	-	1	1.5	mA
		No load, $\overline{RE} = V_{CC}$ , $DE = V_{CC}$ , $DI = GND$	-	1	1.5	
		No load, $\overline{RE} = GND$ , $DE = GND$ , A/B open	-	0.8	1.2	
$I_{SHDN}$	Supply Current in Shutdown Mode	$\overline{RE} = V_{CC}$ , $DE = GND$	-	0.1	1.2	$\mu A$

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

## Driver Switching Characteristics—MxL83211

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

**Table 7: MxL83211 Driver Switching Characteristics**

Symbol	Driver Characteristic	Conditions	Minimum	Typical	Maximum	Unit
-	Data signaling rate	Duty cycle 40 to 60%	250	-	-	kbps
$t_{DPLH}$ , $t_{DPLH}$	Driver propagation delay	$R_L = 54\Omega$ , $C_L = 50pF$ , Figure 5 on page 9	450	860	1400	ns
$t_{DR}$ , $t_{DF}$	Driver output rise/fall time		350	700	1500	ns
$ t_{DPLH} - t_{DPLH} $	Driver differential skew		-	15	100	ns
$t_{DZH}$	Driver enable to output high	$R_L = 500\Omega$ , $C_L = 50pF$ , Figure 6 on page 10	-	-	2000	ns
$t_{DZL}$	Driver enable to output low		-	-	2000	ns
$t_{DZH}$	Driver disable from output high		-	30	100	ns
$t_{DLZ}$	Driver disable from output low		-	30	100	ns
$t_{DZH}(SHDN)$	Driver enable from shutdown to output high		-	7	12	$\mu s$
$t_{DZL}(SHDN)$	Driver enable from shutdown to output low		-	7	12	$\mu s$
$t_{DSHDN}$	Time to shutdown	-	50	270	600	ns

## Receiver Switching Characteristics—MxL83211

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

**Table 8: MxL83211 Receiver Switching Characteristics**

Symbol	Receiver Characteristic	Conditions	Minimum	Typical	Maximum	Unit
-	Data signaling rate	Duty cycle 40 to 60%	250	-	-	kbps
$t_{RPHL}$ , $t_{RPLH}$	Receiver propagation delay	$C_L = 15pF$ , Figure 8 on page 11	-	50	150	ns
$ t_{RPLH} - t_{RPHL} $	Propagation delay skew		-	3	30	ns
$t_{RZH}$	Receiver enable to output high		-	20	50	ns
$t_{RZL}$	Receiver enable to output low	$R_L = 1k\Omega$ , $C_L = 50pF$ , Figure 9 on page 12	-	20	50	ns
$t_{RHZ}$	Receiver disable from output high		-	20	50	ns
$t_{RLZ}$	Receiver disable from output low		-	20	50	ns
$t_{RZH}(SHDN)$	Receiver enable from shutdown to output high		-	7	12	$\mu s$
$t_{RZL}(SHDN)$	Receiver enable from shutdown to output low		-	7	12	$\mu s$
$t_{RSHDN}$	Time to shutdown	-	50	200	600	ns

## Driver Switching Characteristics—MxL83212

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

**Table 9: MxL83212 Driver Switching Characteristics**

Symbol	Driver Characteristic	Conditions	Minimum	Typical	Maximum	Unit
-	Data signaling rate	Duty cycle 40 to 60%	500	-	-	kbps
$t_{DPLH}$ , $t_{DPLH}$	Driver propagation delay	$R_L = 54\Omega$ , $C_L = 50pF$ , Figure 5 on page 9	250	400	700	ns
$t_{DR}$ , $t_{DF}$	Driver output rise/fall time		190	250	750	ns
$ t_{DPLH} - t_{DPLH} $	Driver differential skew		-	15	50	ns
$t_{DZH}$	Driver enable to output high	$R_L = 500\Omega$ , $C_L = 50pF$ , Figure 6 on page 10	-	-	1000	ns
$t_{DZL}$	Driver enable to output low		-	-	1000	ns
$t_{DZH}$	Driver disable from output high		-	40	100	ns
$t_{DLZ}$	Driver disable from output low		-	40	100	ns
$t_{DZH}(SHDN)$	Driver enable from shutdown to output high		-	7	12	$\mu s$
$t_{DZL}(SHDN)$	Driver enable from shutdown to output low		-	7	12	$\mu s$
$t_{DSHDN}$	Time to shutdown	-	50	270	600	ns

## Receiver Switching Characteristics—MxL83212

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

**Table 10: MxL83212 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	$C_L = 15pF$ , Figure 8 on page 11	-	50	150	ns
$ t_{RPLH} - t_{RPHL} $	Propagation delay skew		-	3	30	ns
$t_{RZH}$	Receiver enable to output high		-	20	50	ns
$t_{RZL}$	Receiver enable to output low	$R_L = 1k\Omega$ , $C_L = 50pF$ , Figure 9 on page 12	-	20	50	ns
$t_{RHZ}$	Receiver disable from output high		-	20	50	ns
$t_{RLZ}$	Receiver disable from output low		-	20	50	ns
$t_{RZH}(SHDN)$	Receiver enable from shutdown to output high		-	7	12	$\mu s$
$t_{RZL}(SHDN)$	Receiver enable from shutdown to output low		-	7	12	$\mu s$
$t_{RSHDN}$	Time to shutdown	-	50	270	600	ns

## Driver Switching Characteristics—MxL83214

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

**Table 11: MxL83214 Driver Switching Characteristics**

Symbol	Driver Characteristic	Conditions	Minimum	Typical	Maximum	Unit
-	Data signaling rate	Duty cycle 40 to 60%	50	-	-	Mbps
$t_{DPLH}$ , $t_{DPLH}$	Driver propagation delay	$R_L = 54\Omega$ , $C_L = 50pF$ , Figure 5 on page 9	-	7	18	ns
$t_{DR}$ , $t_{DF}$	Driver output rise/fall time		-	4	6.7	ns
$ t_{DPLH} - t_{DPLH} $	Driver differential skew		-	0.8	3.5	ns
$t_{DZH}$	Driver enable to output high	$R_L = 500\Omega$ , $C_L = 50pF$ , Figure 6 on page 10	-	18	40	ns
$t_{DZL}$	Driver enable to output low		-	18	40	ns
$t_{DZH}$	Driver disable from output high		-	18	40	ns
$t_{DLZ}$	Driver disable from output low		-	18	40	ns
$t_{DZH(SHDN)}$	Driver enable from shutdown to output high		-	7	12	$\mu s$
$t_{DZL(SHDN)}$	Driver enable from shutdown to output low		-	7	12	$\mu s$
$t_{DSHDN}$	Time to shutdown	-	50	270	600	ns

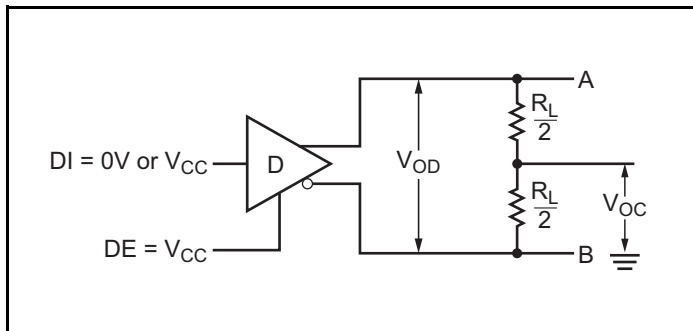
## Receiver Switching Characteristics—MxL83214

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

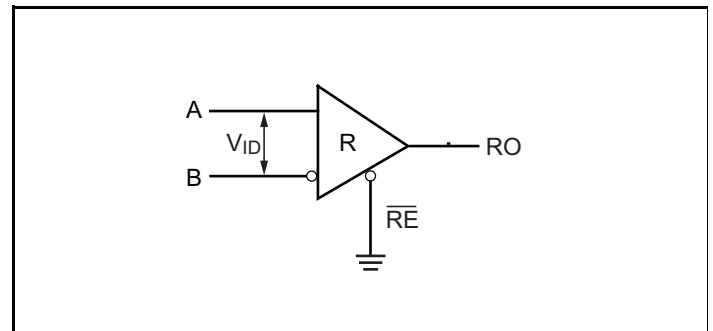
**Table 12: MxL83214 Receiver Switching Characteristics**

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	$C_L = 15pF$ , Figure 8 on page 11	-	12	30	ns
$ t_{RPLH} - t_{RPHL} $	Propagation delay skew		-	0.5	3.5	ns
$t_{RZH}$	Receiver enable to output high	$R_L = 1k\Omega$ , $C_L = 50pF$ , Figure 9 on page 12	-	15	30	ns
$t_{RZL}$	Receiver enable to output low		-	15	30	ns
$t_{RHZ}$	Receiver disable from output high		-	15	30	ns
$t_{RLZ}$	Receiver disable from output low		-	15	30	ns
$t_{RZH(SHDN)}$	Receiver enable from shutdown to output high		-	7	12	$\mu s$
$t_{RZL(SHDN)}$	Receiver enable from shutdown to output low		-	7	12	$\mu s$
$t_{RSHDN}$	Time to shutdown	-	50	270	600	ns

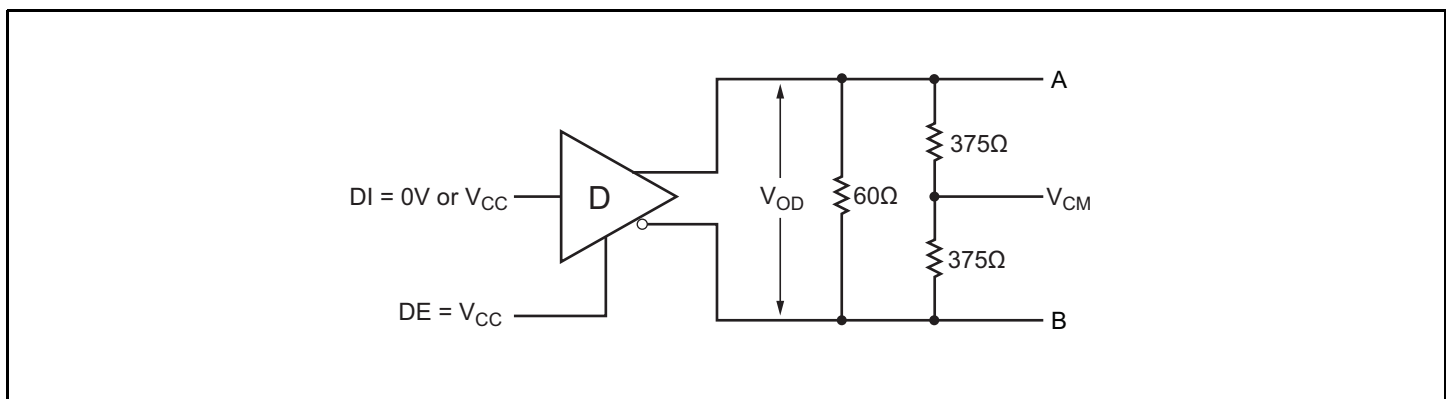
## Test Circuits and Timing Diagrams



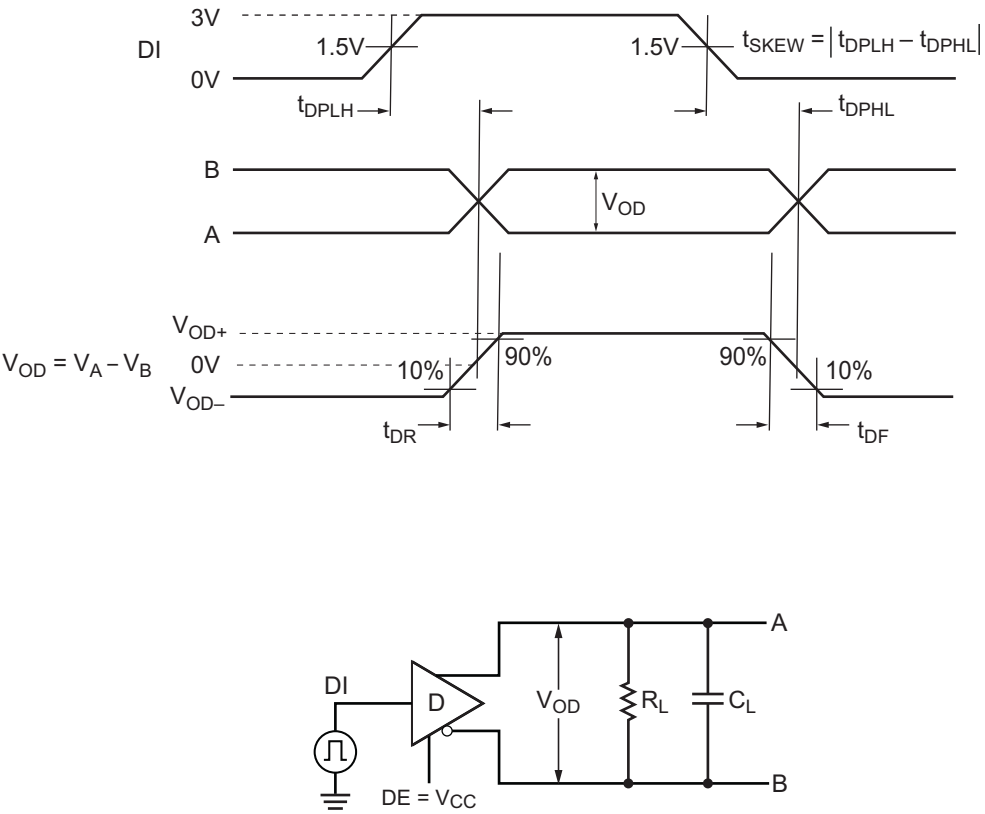
**Figure 2: Driver DC Test Circuit**



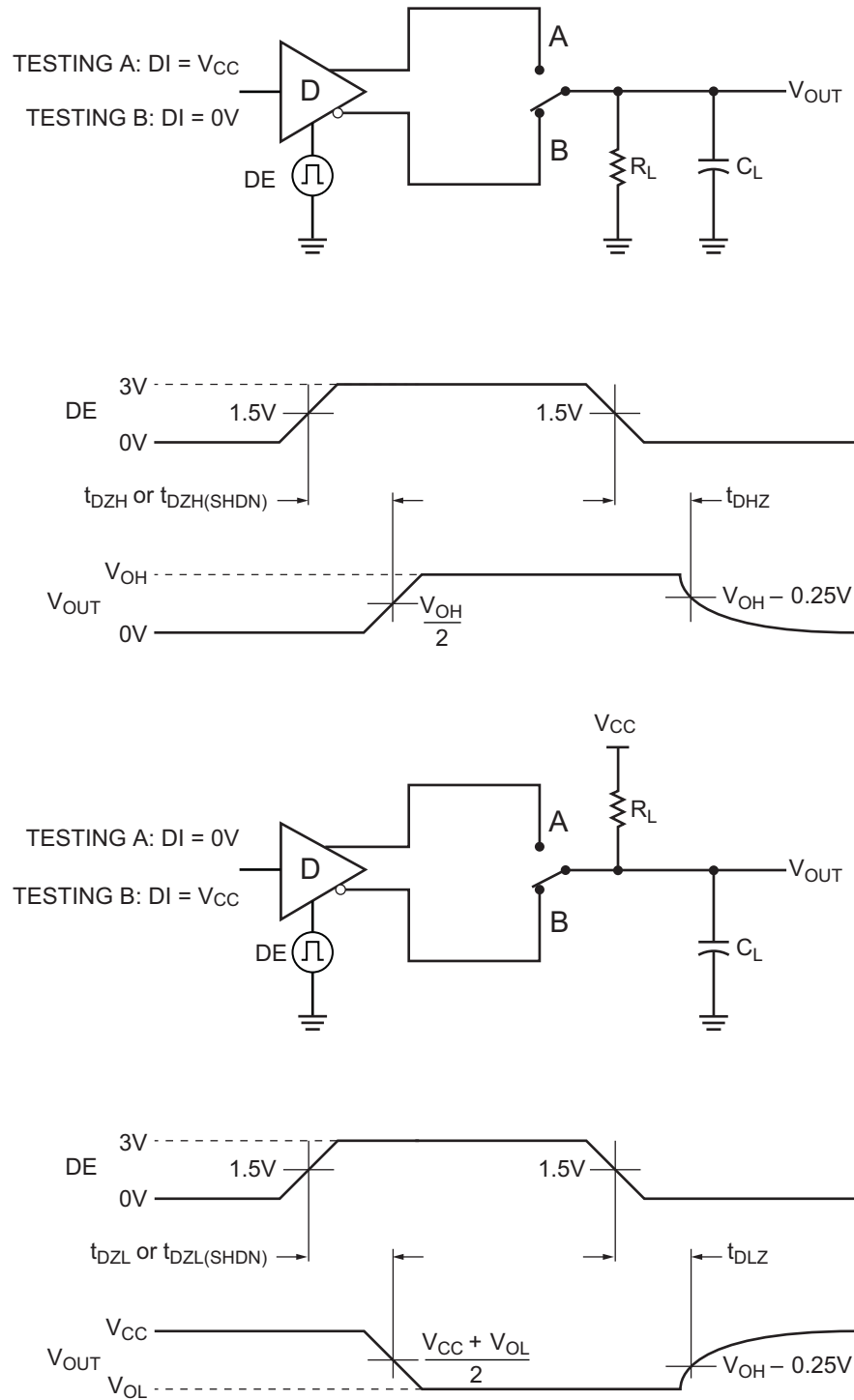
**Figure 3: Receiver DC Test Circuit**



**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**



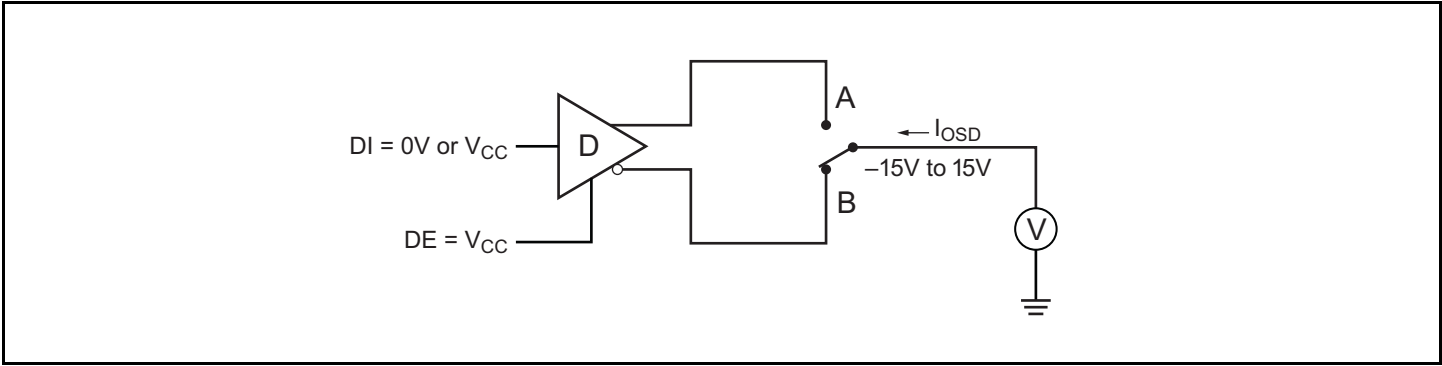


Figure 7: Driver Short Circuit Current Test

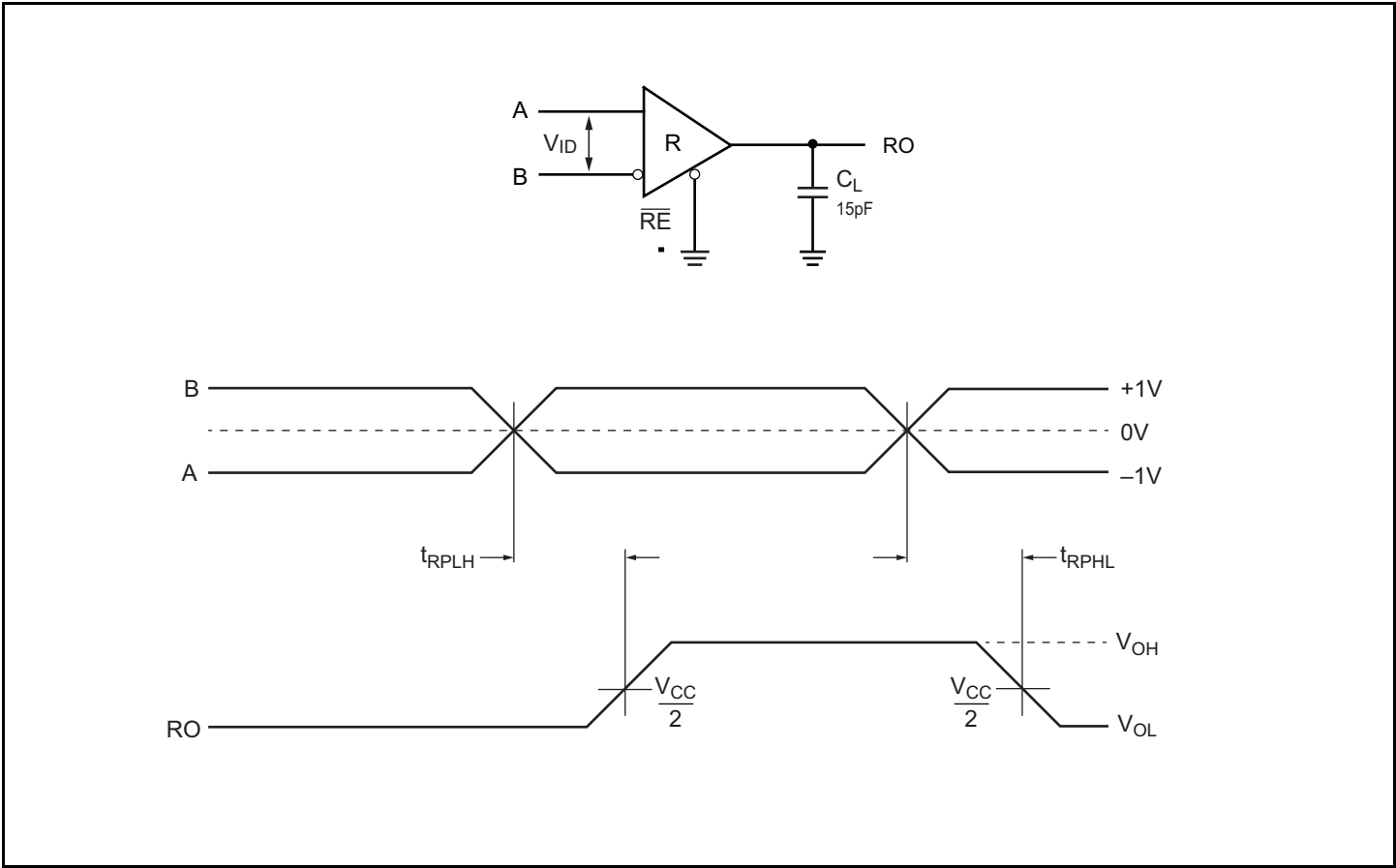
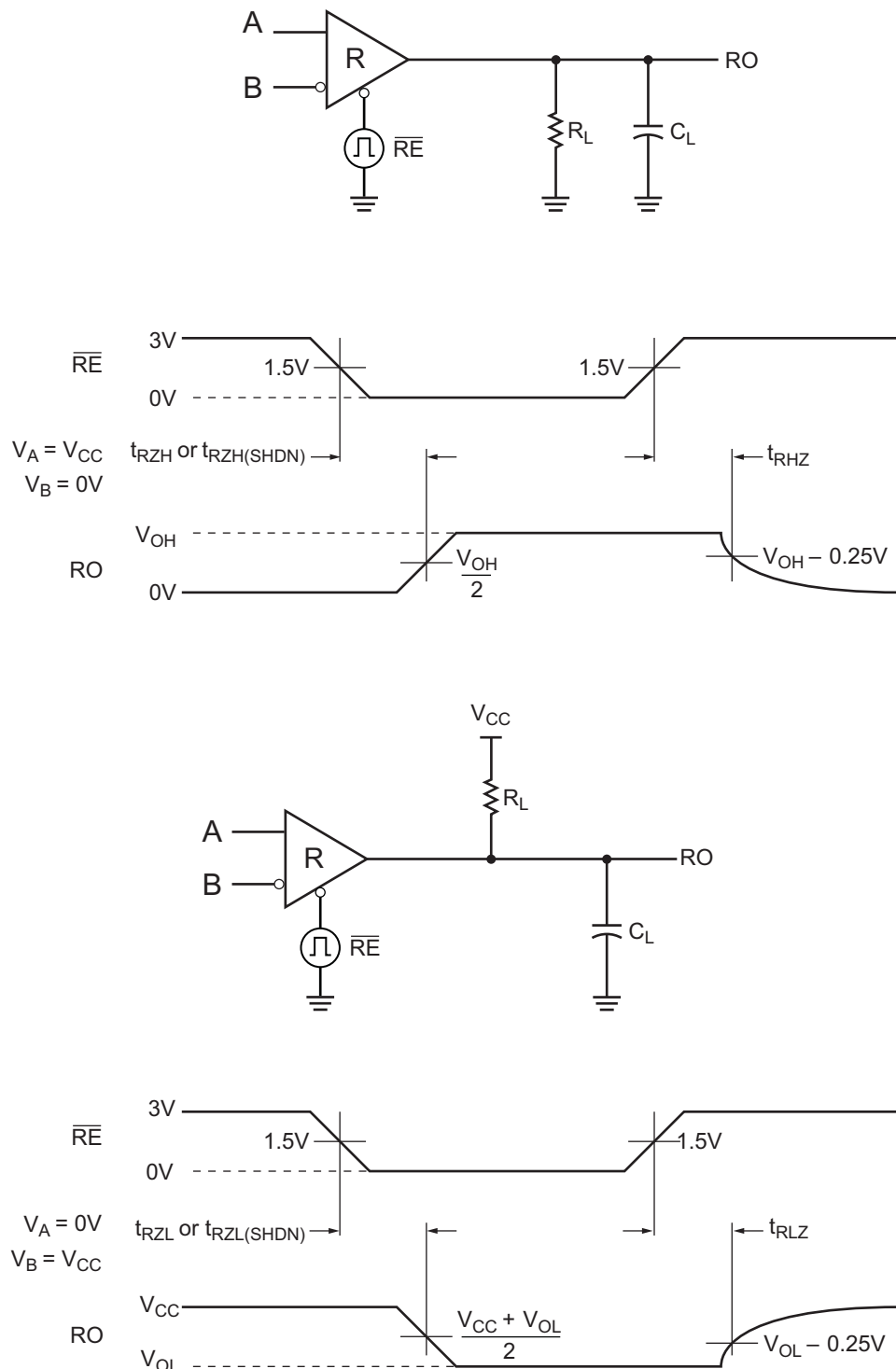


Figure 8: Receiver Propagation Delay Test Circuit and Timing Diagram

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

## Function Tables

**Table 13: MxL83211, MxL83212, MxL83214 Tx (Half-Duplex)**

Input	Enable		Outputs		Function
DI	DE	$\overline{\text{RE}}$	A	B	
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: MxL83211, MxL83212, MxL83214 Rx (Half-Duplex)**

Differential Input	Enable		Output	Function
$V_{\text{ID}} = V_{\text{A}} - V_{\text{B}}$ (Figure 3 on page 8)	$\overline{\text{RE}}$	DE	RO	
$-20\text{mV} \leq V_{\text{ID}}$	L	X	H	Receive valid bus high.
$-200\text{mV} \leq V_{\text{ID}} \leq -20\text{mV}$	L	X	X	Indeterminate bus state.
$V_{\text{ID}} \leq -200\text{mV}$	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

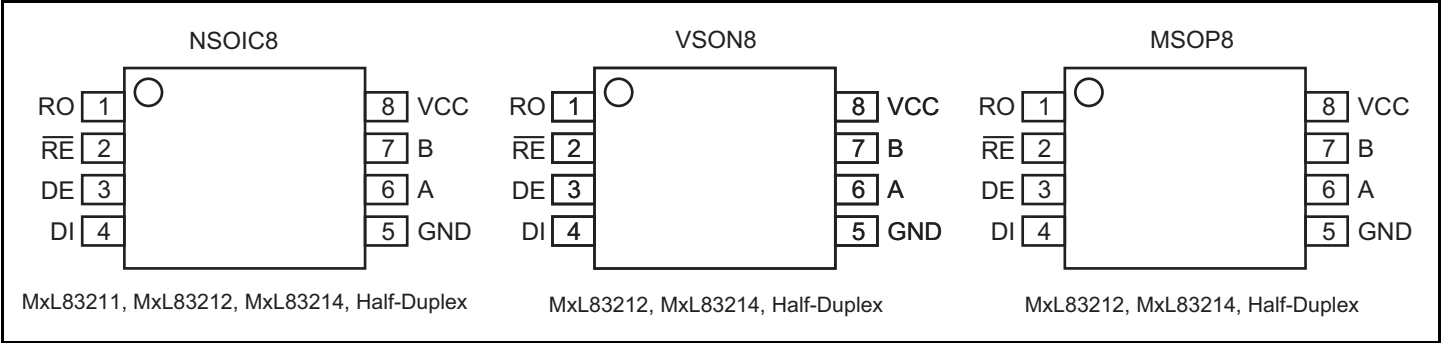


Figure 10: Pin Configurations

Pin Descriptions

Table 15: MxL83211, MxL83212, and MxL83214 Pin Descriptions

Pin#	Pin Name	Pin Function
1	RO	Receiver Output. When $\overline{RE}$ is low and if $(A-B) \geq -20\text{mV}$ , RO is high. If $(A-B) \leq -200\text{mV}$ , RO is low.
2	$\overline{RE}$	Receiver Output Enable. When $\overline{RE}$ is low, RO is enabled. When $\overline{RE}$ is high, RO is high impedance. $\overline{RE}$ should be high and DE low to enter shutdown mode. $\overline{RE}$ is a hot swap input.
3	DE	Driver Output Enable. When DE is high, outputs are enabled. When DE is low, outputs are high impedance. DE should be low and $\overline{RE}$ high to enter shutdown mode. DE is a hot-swap input.
4	DI	Driver Input. With DE high, a low level on DI forces non-inverting output low and inverting output high. Similarly, a high level on DI forces non-inverting output high and inverting output low.
5	GND	Ground.
6	A	Non-inverting Receiver Input and Non-inverting Driver Output.
7	B	Inverting Receiver Input and Inverting Driver Output.
8	V <sub>CC</sub>	Positive Supply V <sub>CC</sub> . Bypass V <sub>CC</sub> to GND with a 0.1μF capacitor.

## Detailed Description

The MxL8321x family of half-duplex transceivers for RS-485/RS-422 communication contains one driver and one receiver. 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 MxL83211, MxL83212, and MxL83214 also feature a hot-swap capability allowing live insertion without error data transfer. The MxL83211 feature reduced slew-rate drivers that minimize EMI and reduce reflections caused by improperly terminated cables, allowing error-free data transmission up to 250kbps. The MxL83212 also offers slew-rate limits allowing transmit speeds up to 500kbps. The MxL83214 driver slew rates are not limited, making transmit speeds up to 50Mbps possible.

All devices operate in a wide range from 3V to 5.5V power supply. 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 MxL8321x family receivers incorporate input filtering in addition to input hysteresis. This filtering enhances noise immunity with differential signals that have very slow rise and fall times.

### Enhanced Failsafe

The MxL8321x family guarantees 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, 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 the MxL8321x family, this results in a logic high with a 50mV minimum noise margin. In compliance with the EIA/TIA-485 standard, the MxL8321x 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 RE inputs of these devices to a defined logic level. Leakage currents up to 10 $\mu$ A 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, parasitic circuit board capacitance could cause coupling of V<sub>CC</sub> or GND to the enable inputs. Without the hot-swap capability, these factors could improperly enable the transceiver's driver or receiver.

When V<sub>CC</sub> rises, an internal pulldown circuit holds DE low and RE high for approximately 10 $\mu$ s. After the initial power-up sequence, the pulldown 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 MxL8321x family helps 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 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 Human Body Model.

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 MxL8321x family of devices have extra protection against static electricity. MaxLinear has developed 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 MxL8321x family keeps 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 contractors, or heavy-duty motors can create high-frequency bursts during transition. (EFT) tests. The tests are to 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 shall be 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.

The recommended classification is as follows:

- 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 12k $\Omega$  (1 unit load), and the standard driver can drive up to 32 unit loads. The MxL8321x family of transceivers has a 1/8-unit load receiver input impedance (96k $\Omega$ ), 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

The MxL83211 features reduced slew-rate drivers that minimize EMI and reduce reflections caused by improperly terminated cables, allowing error-free data transmission up to 250kbps. The MxL83212 offers higher driver output slew-rate limits, allowing transmit speeds up to 500kbps.

## Low-Power Shutdown Mode

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 were 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, 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 MxL83211, MxL83212, and MxL83214 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. The slew-rate-limited MxL83211 and MxL83212 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

NSOIC8

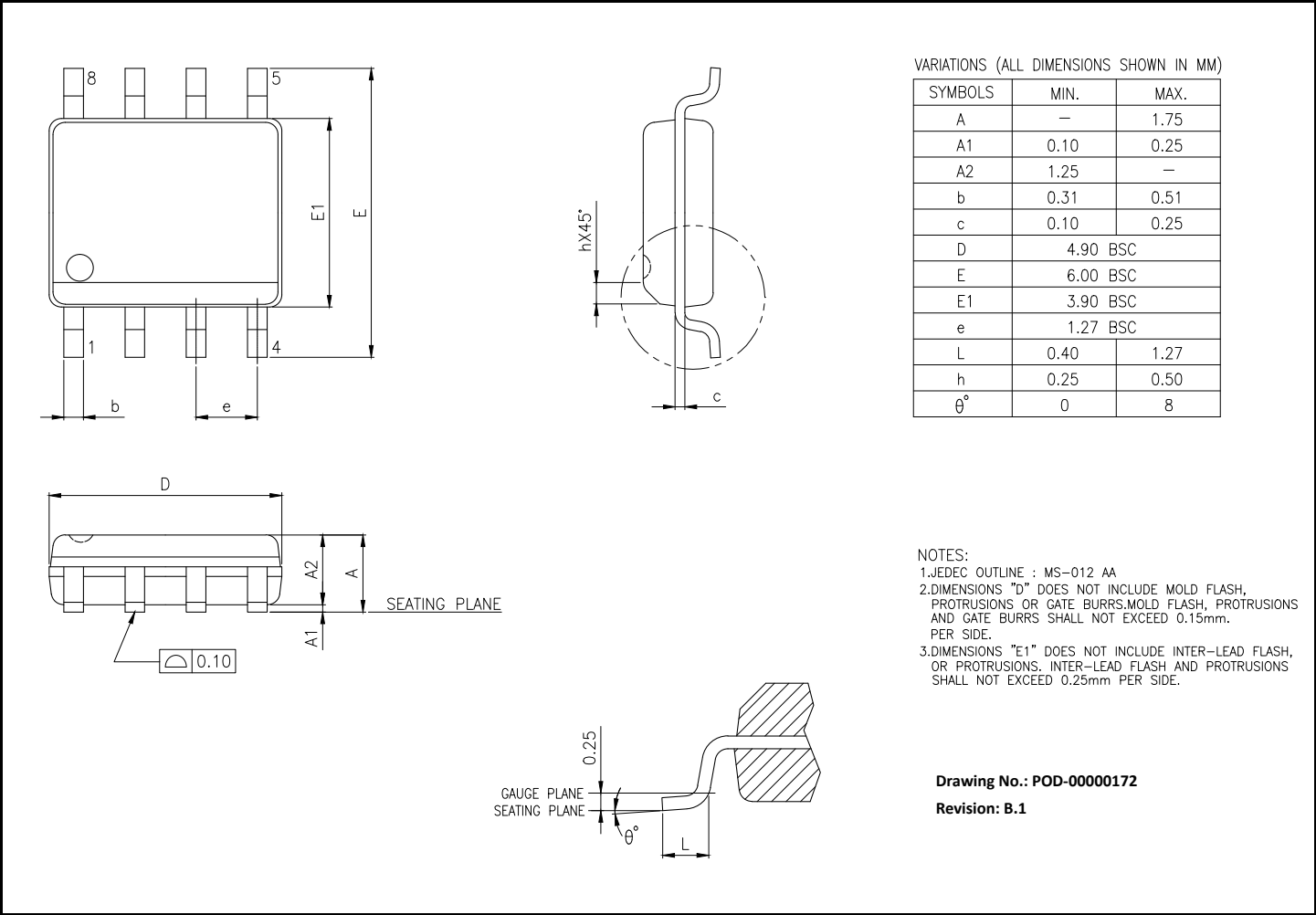


Figure 11: Mechanical Dimensions—SOIC8



MSOP8

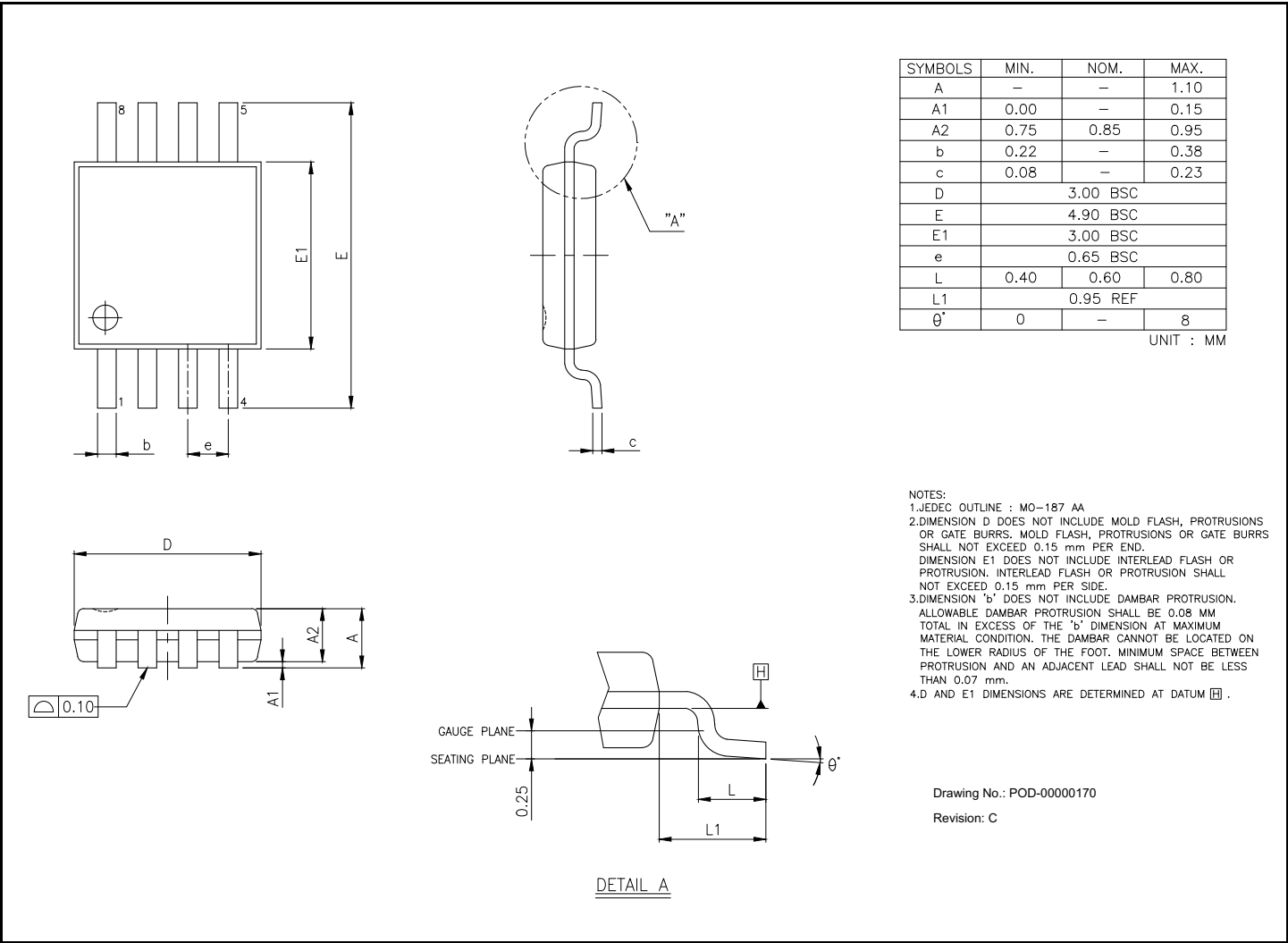


Figure 12: Mechanical Dimensions—MSOP8

VSON8

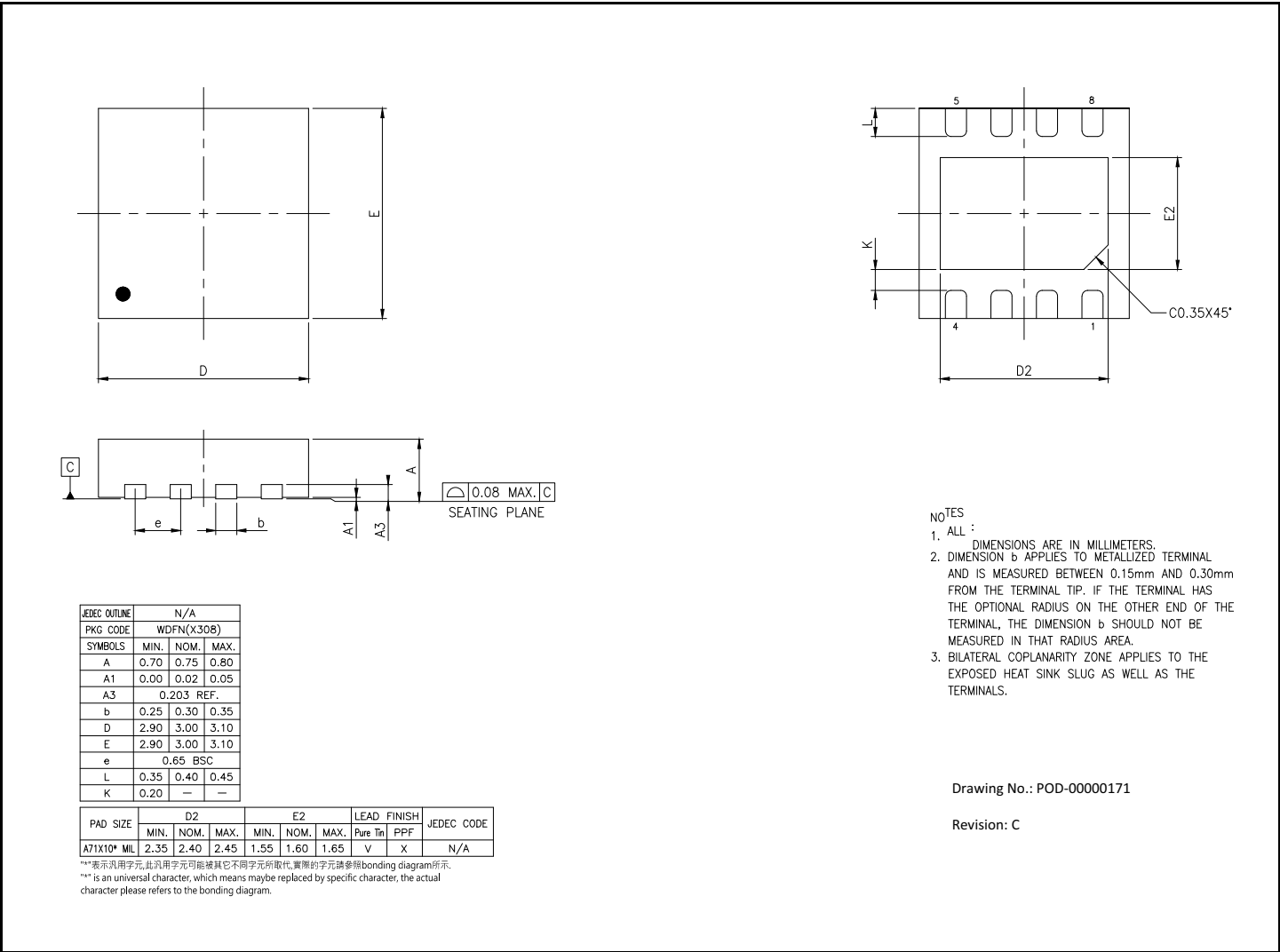


Figure 13: Mechanical Dimensions—VSON8

## Ordering Information

**Table 16: Ordering Information**

Ordering Part Number	Date Rate (Mbps)	Package	Duplex	Packaging Method	Operating Temperature Range
<b>MxL83211</b>					
MXL83211E-ADA-R	0.25	NSOIC8	Half	Reel	–40°C to 125°C
<b>MxL83212</b>					
MXL83212E-ADA-R	0.5	NSOIC8	Half	Reel	–40°C to 125°C
MXL83212E-ARA-R	0.5	MSOP8	Half	Reel	–40°C to 125°C
MXL83212E-AHA-R	0.5	VSON8	Half	Reel	–40°C to 125°C
<b>MxL83214</b>					
MXL83214E-ADA-R	50	NSOIC8	Half	Reel	–40°C to 125°C
MXL83214E-ARA-R	50	MSOP8	Half	Reel	–40°C to 125°C
MXL83214E-AHA-R	50	VSON8	Half	Reel	–40°C to 125°C
MXL83211E-ADA-EVK-1	MxL83211 Evaluation Kit				
MXL83212E-ADA-EVK-1	MxL83212 Evaluation Kit				
MXL83214E-ADA-EVK-1	MxL83214 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/MxL83211](http://www.maxlinear.com/MxL83211), [www.maxlinear.com/MxL83212](http://www.maxlinear.com/MxL83212), and [www.maxlinear.com/MxL83214](http://www.maxlinear.com/MxL83214).
- For more information about the EVKs, refer to the *MxL8321x EVK User Manual* (028UM).



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

[www.maxlinear.com](http://www.maxlinear.com)

The content of this document is furnished for informational use only, is subject to change without notice, and should not be construed as a commitment by MaxLinear, Inc. MaxLinear, Inc. assumes no responsibility or liability for any errors or inaccuracies that may appear in the informational content contained in this document. Complying with all applicable copyright laws is the responsibility of the user. Without limiting the rights under copyright, no part of this document may be reproduced into, stored in, or introduced into a retrieval system, or transmitted in any form or by any means (electronic, mechanical, photocopying, recording, or otherwise), or for any purpose, without the express written permission of MaxLinear, Inc.

EXCEPT AS OTHERWISE PROVIDED EXPRESSLY IN WRITING BY MAXLINEAR, AND TO THE MAXIMUM EXTENT PERMITTED BY LAW: (A) THE MAXLINEAR PRODUCTS ARE PROVIDED ON AN "AS IS" BASIS WITHOUT REPRESENTATIONS OR WARRANTIES OF ANY KIND, INCLUDING WITHOUT LIMITATION ANY IMPLIED OR STATUTORY WARRANTIES AND ANY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, NON-INFRINGEMENT, OR TITLE; AND (B) MAXLINEAR DOES NOT GUARANTEE THAT THE PRODUCTS WILL BE FREE OF ERRORS OR DEFECTS. MAXLINEAR PRODUCTS SHOULD NOT BE USED IN ANY EMERGENCY, SECURITY, MILITARY, LIFE-SAVING, OR OTHER CRITICAL USE CASE WHERE A FAILURE OR MALFUNCTION COULD CAUSE PERSONAL INJURY OR DEATH, OR DAMAGE TO OR LOSS OF PROPERTY. USERS ASSUME ALL RISK FOR USING THE MAXLINEAR PRODUCTS IN SUCH USE CASE. CUSTOMERS AND USERS ARE SOLELY RESPONSIBLE FOR USING THEIR OWN SKILL AND JUDGMENT TO DETERMINE WHETHER MAXLINEAR PRODUCTS ARE SUITABLE FOR THE INTENDED USE CASE.

MaxLinear, Inc. may have patents, patent applications, trademarks, copyrights, or other intellectual property rights covering subject matter in this document. Except as expressly provided in any written license agreement from MaxLinear, Inc., the furnishing of this document does not give you any license to these patents, trademarks, copyrights, or other intellectual property.

MaxLinear, the MaxLinear logo, and any other MaxLinear trademarks (including but not limited to MxL, Full-Spectrum Capture, FSC, AirPHY, Puma, AnyWAN, VectorBoost, MXL WARE, and Panther) are all property of MaxLinear, Inc. or one of MaxLinear's subsidiaries in the U.S.A. and other countries. All rights reserved.

All third-party marks and logos are trademarks™ or registered® trademarks of their respective holders/owners. Use of such marks does not imply any affiliation with, sponsorship or endorsement by the owners/holders of such trademarks. All references by MaxLinear to third party trademarks are intended to constitute nominative fair use under applicable trademark laws.

The URLs provided are for informational purposes only; they do not constitute an endorsement or an approval by MaxLinear of any of the products or services of the corporation or organization or individual. MaxLinear bears no responsibility for the accuracy, legality or content of the external site or for that of subsequent links. Contact the external site for answers to questions regarding its content.

© 2024 MaxLinear, Inc. All rights reserved.

# Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

[MaxLinear:](#)

[MXL83214E-AHA-R](#) [MXL83214E-ADA-R](#) [MXL83214E-ARA-R](#) [MXL83212E-ADA-R](#) [MXL83212E-ARA-R](#)  
[MXL83212E-AHA-R](#) [MXL83211E-ADA-R](#) [MXL83212E-ADA-EVK-1](#) [MXL83211E-ADA-EVK-1](#) [MXL83214E-ADA-EVK-1](#)