Data Sheet | May 6, 2009 | FN6887.1

±15kV ESD Protected, 3.3V, Full Fail-Safe, Low Power, High Speed or Slew Rate Limited, RS-485/RS-422 Transceivers

The Intersil ISL3178AE is ±15kV IEC61000 ESD Protected, 3.3V-powered, single transceivers that meet both the RS-485 and RS-422 standards for balanced communication. This device has very low bus currents (+125mA/-100mA), which presents a true “1/8 unit load” to the RS-485 bus. This allows up to 256 transceivers on the network without violating the RS-485 specification’s 32 unit load maximum, and without using repeaters. For example, in a remote utility meter reading system, individual meter readings are routed to a concentrator via an RS-485 network, so the high allowed node count minimizes the number of repeaters required.

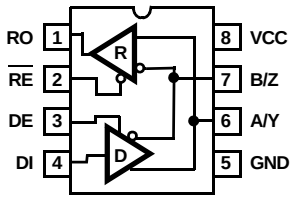
Receiver (Rx) inputs feature a “Full Fail-Safe” design, which ensures a logic high Rx output if Rx inputs are floating, shorted, or terminated but undriven.

Hot Plug circuitry ensures that the Tx and Rx outputs remain in a high impedance state while the power supply stabilizes.

The ISL3178AE is a half duplex version. It multiplexes the Rx inputs and Tx outputs to allow transceivers with output disable functions in an 8 Ld package.

Pinout

ISL3178AE
(8 LD SOIC)
TOP VIEW



Features

- IEC61000 ESD Protection on RS-485 I/O Pins . . . . ±15kV
  - Class 3 ESD Level on all Other Pins . . . . . >7kV HBM
- Full Fail-safe (Open, Short, Terminated/Floating) Receivers
- Hot Plug - Tx and Rx Outputs Remain Three-state During Power-up (Only Versions with Output Enable Pins)
- True 1/8 Unit Load Allows up to 256 Devices on the Bus
- Single 3.3V Supply
- High Data Rates. . . . . up to 10Mbps
- Low Quiescent Supply Current . . . . . .800µA (Max)
  - Ultra Low Shutdown Supply Current 10nA
- -7V to +12V Common Mode Input/Output Voltage Range
- Half Duplex Pinouts
- Three State Rx and Tx Outputs Available
- Current Limiting for Driver Overload Protection
- Pb-Free (RoHS Compliant)

Applications

- Automated Utility Meter Reading Systems
- High Node Count Systems
- Field Bus Networks
- Security Camera Networks
- Building Environmental Control/ Lighting Systems
- Industrial/Process Control Networks

TABLE 1. SUMMARY OF FEATURES

PART NUMBER	HALF/FULL DUPLEX	DATA RATE (Mbps)	SLEW-RATE LIMITED?	HOT PLUG?	# DEVICES ON BUS	RX/TX ENABLE?	QUIESCENT I_{CC} (µA)	LOW POWER SHUTDOWN?	PIN COUNT
ISL3178AEM	HALF	10	NO	YES	256	YES	510	YES	8
ISL3178AEMW	HALF	10	NO	YES	256	YES	510	YES	N/A

Ordering Information

PART NUMBER (Note)	PART MARKING	TEMP. RANGE (°C)	PACKAGE (Pb-Free)	PKG. DWG. #
ISL3178AEMBZ*	3178A EMBZ	-55 to +125	8 Ld SOIC	M8.15
ISL3178AEMW		-55 to +125	Wafer	

*Add “-T” suffix for tape and reel. Please refer to TB347 for details on reel specifications.

NOTE: These Intersil Pb-free plastic packaged products employ special Pb-free material sets, molding compounds/die attach materials, and 100% matte tin plate plus anneal (e3 termination finish, which is RoHS compliant and compatible with both SnPb and Pb-free soldering operations). Intersil Pb-free products are MSL classified at Pb-free peak reflow temperatures that meet or exceed the Pb-free requirements of IPC/JEDEC J STD-020.

Truth Tables

TRANSMITTING				
INPUTS			OUTPUTS	
$\overline{RE}$	DE	DI	Z	Y
X	1	1	0	1
X	1	0	1	0
0	0	X	High-Z	High-Z
1	0	X	High-Z *	High-Z *

NOTE: *Shutdown Mode (see Note 7)

Truth Tables *(continued)*

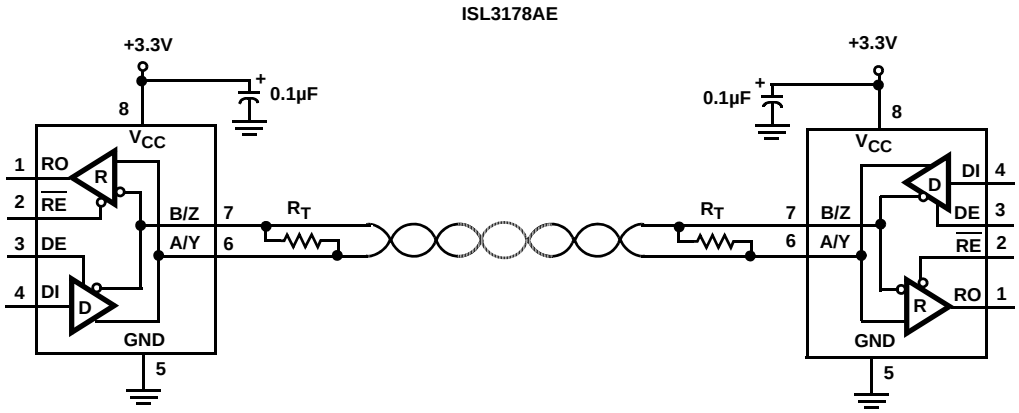
RECEIVING				
INPUTS				OUTPUT
$\overline{RE}$	DE Half Duplex	DE Full Duplex	A-B	RO
0	0	X	≥ -0.05V	1
0	0	X	≤ -0.2V	0
0	0	X	Inputs Open/Shorted	1
1	0	0	X	High-Z *
1	1	1	X	High-Z

NOTE: *Shutdown Mode (see Note 7)

Pin Descriptions

PIN	FUNCTION
RO	Receiver output: If A-B ≥ -50mV, RO is high; If A-B ≤ -200mV, RO is low; RO = High if A and B are unconnected (floating) or shorted.
$\overline{RE}$	Receiver output enable. RO is enabled when $\overline{RE}$ is low; RO is high impedance when $\overline{RE}$ is high. If the Rx enable function isn’t required, connect $\overline{RE}$ directly to GND or through a 1kΩ to 3kΩ resistor to GND.
DE	Driver output enable. The driver outputs, Y and Z, are enabled by bringing DE high, and are high impedance when DE is low. If the Tx enable function isn’t required, connect DE to V_{CC} through a 1kΩ to 3kΩ resistor.
DI	Driver input. A low on DI forces output Y low and output Z high. Similarly, a high on DI forces output Y high and output Z low.
GND	Ground connection.
A/Y	±15kV IEC61000 ESD Protected RS-485/422 level, noninverting receiver input and noninverting driver output. Pin is an input if DE = 0; pin is an output if DE = 1.
B/Z	±15kV IEC61000 ESD Protected RS-485/422 level, Inverting receiver input and inverting driver output. Pin is an input if DE = 0; pin is an output if DE = 1.
V_{CC}	System power supply input (3.0V to 3.6V).

Typical Application Circuit



Absolute Maximum Ratings

V_{CC} to GND 7V
Input Voltages
DI, DE, $\overline{RE}$ . . . . . -0.3V to 7V
Input/Output Voltages
A/Y, B/Z . . . . . -8V to +13V
RO . . . . . -0.3V to (V_{CC} +0.3V)
Short Circuit Duration
Y, Z . . . . . Continuous
ESD Rating . . . . . See Specification Table

Thermal Information

Thermal Resistance (Typical, Note 1) θ_{JA} (°C/W)
8 Ld SOIC Package 120
Maximum Junction Temperature (Plastic Package) . . . . . +150°C
Maximum Storage Temperature Range . . . . . -65°C to +150°C
Pb-free Reflow Profile . . . . . .see link below
http://www.intersil.com/pbfree/Pb-FreeReflow.asp

Operating Conditions

Temperature Range . . . . . -55°C to +125°C

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

NOTE:

1. θ_{JA} is measured with the component mounted on a high effective thermal conductivity test board in free air. See Tech Brief TB379 for details.

Electrical Specifications

Test Conditions: V_{CC} = 3.0V to 3.6V; Unless Otherwise Specified. Typicals are at V_{CC} = 3.3V, T_A = +25°C, (Note 2). Parameters with MIN and/or MAX limits are 100% tested at +25°C, unless otherwise specified. Temperature limits established by characterization and are not production tested.

PARAMETER	SYMBOL	TEST CONDITIONS	TEMP (°C)	MIN	TYP	MAX	UNITS
DC CHARACTERISTICS							
Driver Differential V_{OUT}	V_{OD}	R_L = 100Ω (RS-422) (Figure 1A, Note 11)	Full	2	2.3	-	V
		R_L = 54Ω (RS-485) (Figure 1A)	Full	1.5	2	V_{CC}	V
		No Load		-	-	V_{CC}	
		R_L = 60Ω, -7V ≤ V_{CM} ≤ 12V (Figure 1B)	Full	1.5	2.2	-	V
Change in Magnitude of Driver Differential V_{OUT} for Complementary Output States	ΔV_{OD}	R_L = 54Ω or 100Ω (Figure 1A)	Full	-	0.01	0.2	V
Driver Common-Mode V_{OUT}	V_{OC}	R_L = 54Ω or 100Ω (Figure 1A)	Full	-	2	3	V
Change in Magnitude of Driver Common-Mode V_{OUT} for Complementary Output States	ΔV_{OC}	R_L = 54Ω or 100Ω (Figure 1A)	Full	-	0.01	0.2	V
Logic Input High Voltage	V_{IH}	DI, DE, $\overline{RE}$	Full	2	-	-	V
Logic Input Low Voltage	V_{IL}	DI, DE, $\overline{RE}$	Full	-	-	0.8	V
Logic Input Hysteresis	V_{HYS}	DE, $\overline{RE}$ (Note 12)	25	-	100	-	mV
Logic Input Current	I_{IN1}	DI = DE = $\overline{RE}$ = 0V or V_{CC} (Note 13)	Full	-2	-	2	µA
Input Current (A/Y, B/Z)	I_{IN2}	DE = 0V, V_{CC} = 0V or 3.6V; V_{IN} = 12V	Full	-	80	125	µA
		DE = 0V, V_{CC} = 0V or 3.6V; V_{IN} = -7V	Full	-100	-50	-	µA
Driver Short-Circuit Current, V_O = High or Low	I_{OSD1}	DE = V_{CC}, -7V ≤ V_Y or V_Z ≤ 12V (Note 4)	Full	-	-	±250	mA
Receiver Differential Threshold Voltage	V_{TH}	-7V ≤ V_{CM} ≤ 12V (Note 12)	Full	-200	-125	-50	mV
Receiver Input Hysteresis	ΔV_{TH}	V_{CM} = 0V	25	-	15	-	mV
Receiver Output High Voltage	V_{OH}	I_O = -4mA, V_{ID} = -50mV	Full	V_{CC} - 0.6	-	-	V
Receiver Output Low Voltage	V_{OL}	I_O = -4mA, V_{ID} = -200mV	Full	-	0.17	0.4	V
Three-State (high impedance) Receiver Output Current	I_{OZR}	0.4V ≤ V_O ≤ 2.4V	Full	-1	0.015	1	µA
Receiver Input Resistance	R_{IN}	-7V ≤ V_{CM} ≤ 12V	Full	96	150	-	kΩ
Receiver Short-Circuit Current	I_{OSR}	0V ≤ V_O ≤ V_{CC}	Full	±7	30	±60	mA

Electrical Specifications

Test Conditions: V_{CC} = 3.0V to 3.6V; Unless Otherwise Specified. Typicals are at V_{CC} = 3.3V, T_A = +25°C, (Note 2). Parameters with MIN and/or MAX limits are 100% tested at +25°C, unless otherwise specified. Temperature limits established by characterization and are not production tested.

PARAMETER	SYMBOL	TEST CONDITIONS		TEMP (°C)	MIN	TYP	MAX	UNITS
SUPPLY CURRENT								
No-Load Supply Current (Note 3)	I_{CC}	DI = 0V or V_{CC}	$\overline{DE}$ = V_{CC}, $\overline{RE}$ = 0V or V_{CC}	Full	-	510	800	µA
			DE = 0V, $\overline{RE}$ = 0V	Full	-	480	700	µA
Shutdown Supply Current	I_{SHDN}	DE = 0V, $\overline{RE}$ = V_{CC}, DI = 0V or V_{CC}		Full	-	0.01	12	µA
ESD PERFORMANCE								
RS-485 Pins (A/Y, B/Z)		IEC61000-4-2, Air-Gap Discharge Method		25	-	±15	-	kV
		IEC61000-4-2, Contact Discharge Method		25	-	±8	-	kV
		Human Body Model, From Bus Pins to GND		25	-	±15	-	kV
All Pins		HBM, per MIL-STD-883 Method 3015		25	-	±7	-	kV
		Machine Model		25	-	200	-	V
DRIVER SWITCHING CHARACTERISTICS (ISL3178AE)								
Maximum Data Rate	f_{MAX}	V_{OD} = ±1.5V, C_D = 350pF (Figure 4, Note 12)		Full	-	10	-	Mbps
Driver Differential Output Delay	t_{DD}	R_{DIFF} = 54Ω, C_D = 50pF (Figure 2)		Full	-	27	40	ns
Driver Differential Output Skew	t_{SKEW}	R_{DIFF} = 54Ω, C_D = 50pF (Figure 2)		Full	-	1	3	ns
Driver Output Skew, Part-to-Part	Δt_{DSKEW}	R_{DIFF} = 54Ω, C_D = 50pF (Figure 2, Notes 10, 12)		Full	-	-	11	ns
Driver Differential Rise or Fall Time	t_R, t_F	R_{DIFF} = 54Ω, C_D = 50pF (Figure 2)		Full	-	9	15	ns
Driver Enable to Output High	t_{ZH}	R_L = 500Ω, C_L = 50pF, SW = GND (Figure 3), (Note 5)		Full	-	17	50	ns
Driver Enable to Output Low	t_{ZL}	R_L = 500Ω, C_L = 50pF, SW = V_{CC} (Figure 3), (Note 5)		Full	-	16	40	ns
Driver Disable from Output High	t_{HZ}	R_L = 500Ω, C_L = 50pF, SW = GND (Figure 3)		Full	-	25	40	ns
Driver Disable from Output Low	t_{LZ}	R_L = 500Ω, C_L = 50pF, SW = V_{CC} (Figure 3),		Full	-	28	50	ns
Time to Shutdown	t_{SHDN}	(Notes 7, 12)		Full	50	200	600	ns
Driver Enable from Shutdown to Output High	$t_{ZH(SHDN)}$	R_L = 500Ω, C_L = 50pF, SW = GND (Figure 3), (Notes 7, 8)		Full	-	180	700	ns
Driver Enable from Shutdown to Output Low	$t_{ZL(SHDN)}$	R_L = 500Ω, C_L = 50pF, SW = V_{CC} (Figure 3), (Notes 7, 8)		Full	-	90	700	ns
RECEIVER SWITCHING CHARACTERISTICS (ISL3178AE)								
Maximum Data Rate	f_{MAX}	V_{ID} = ±1.5V (Note 12)		Full	-	10	-	Mbps
Receiver Input to Output Delay	t_{PLH}, t_{PHL}	(Figure 5)		Full	25	33	65	ns
Receiver Skew | t_{PLH} - t_{PHL} |	t_{SKD}	(Figure 5)		Full	-	1.5	10	ns
Receiver Skew, Part-to-Part	Δt_{RSKEW}	(Figure 5, Notes 10, 12)		Full	-	-	15	ns
Receiver Enable to Output High	t_{ZH}	R_L = 1kΩ, C_L = 15pF, SW = GND (Figure 6), (Notes 6)		Full	5	11	17	ns
Receiver Enable to Output Low	t_{ZL}	R_L = 1kΩ, C_L = 15pF, SW = V_{CC} (Figure 6), (Notes 6,)		Full	5	11	17	ns
Receiver Disable from Output High	t_{HZ}	R_L = 1kΩ, C_L = 15pF, SW = GND (Figure 6),		Full	4	7	15	ns
Receiver Disable from Output Low	t_{LZ}	R_L = 1kΩ, C_L = 15pF, SW = V_{CC} (Figure 6),		Full	4	7	15	ns
Time to Shutdown	t_{SHDN}	(Notes 7, 12)		Full	50	180	600	ns

Electrical Specifications Test Conditions: V_{CC} = 3.0V to 3.6V; Unless Otherwise Specified. Typicals are at V_{CC} = 3.3V, T_A = +25°C, (Note 2). Parameters with MIN and/or MAX limits are 100% tested at +25°C, unless otherwise specified. Temperature limits established by characterization and are not production tested.

PARAMETER	SYMBOL	TEST CONDITIONS	TEMP (°C)	MIN	TYP	MAX	UNITS
Receiver Enable from Shutdown to Output High	$t_{ZH(SHDN)}$	R_L = 1kΩ, C_L = 15pF, SW = GND (Figure 6), (Notes 7, 9)	Full	-	240	500	ns
Receiver Enable from Shutdown to Output Low	$t_{ZL(SHDN)}$	R_L = 1kΩ, C_L = 15pF, SW = V_{CC} (Figure 6), (Notes 7, 9)	Full	-	240	500	ns

NOTES:

2. All currents into device pins are positive; all currents out of device pins are negative. All voltages are referenced to device ground unless otherwise specified.
3. Supply current specification is valid for loaded drivers when DE = 0V.
4. Applies to peak current. See “Typical Performance Curves” starting on page 10 for more information.
5. When testing devices with the shutdown feature, keep $\overline{RE}$ = 0 to prevent the device from entering SHDN.
6. When testing devices with the shutdown feature, the $\overline{RE}$ signal high time must be short enough (typically <100ns) to prevent the device from entering SHDN.
7. Versions with a shutdown feature are put into shutdown by bringing $\overline{RE}$ high and DE low. If the inputs are in this state for less than 50ns, the parts are guaranteed not to enter shutdown. If the inputs are in this state for at least 600ns, the parts are guaranteed to have entered shutdown. See “Low Power Shutdown Mode” on page 10.
8. Keep $\overline{RE}$ = VCC, and set the DE signal low time >600ns to ensure that the device enters SHDN.
9. Set the $\overline{RE}$ signal high time >600ns to ensure that the device enters SHDN.
10. Δt_{SKEW} is the magnitude of the difference in propagation delays of the specified terminals of two units tested with identical test conditions (V_{CC}, temperature, etc.).
11. $V_{CC} \geq 3.15V$
12. Limits established by characterization and are not production tested.
13. If the Tx or Rx enable function isn’t needed, connect the enable pin to the appropriate supply (see “Pin Descriptions” on page 2) through a 1kΩ to 3kΩ resistor.
14. For wafer sale the switching test limits are established by characterization.

Test Circuits and Waveforms

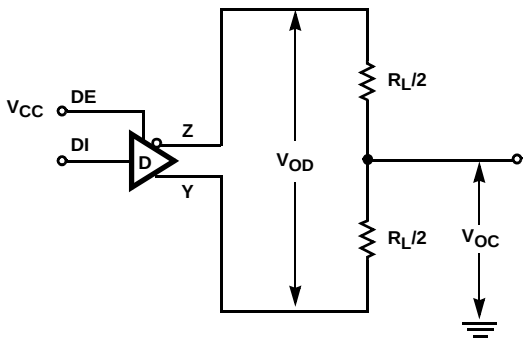


FIGURE 1A. V_{OD} AND V_{OC}

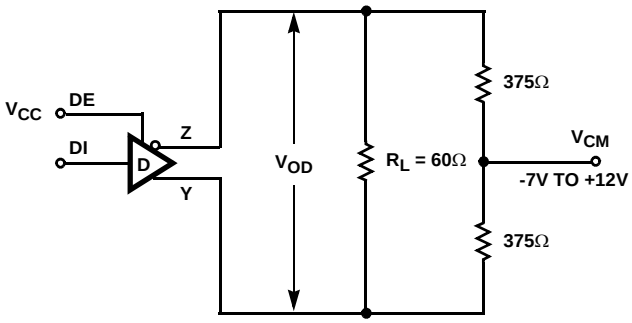


FIGURE 1B. V_{OD} WITH COMMON MODE LOAD

FIGURE 1. DC DRIVER TEST CIRCUITS

Test Circuits and Waveforms (Continued)

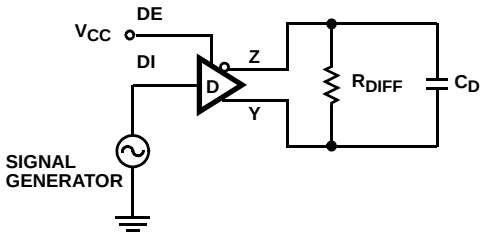


FIGURE 2A. TEST CIRCUIT

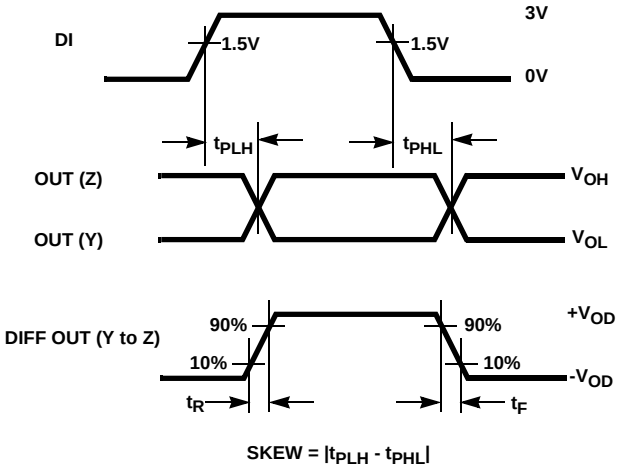
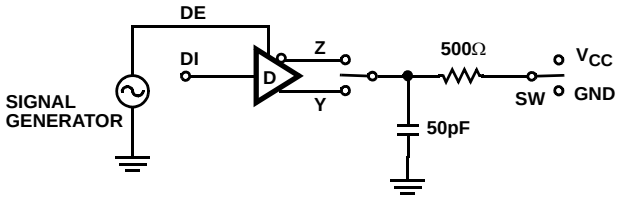


FIGURE 2B. MEASUREMENT POINTS

FIGURE 2. DRIVER PROPAGATION DELAY AND DIFFERENTIAL TRANSITION TIMES



PARAMETER	OUTPUT	$\overline{RE}$	DI	SW
t_{HZ}	Y/Z	X	1/0	GND
t_{LZ}	Y/Z	X	0/1	V_{CC}
t_{ZH}	Y/Z	0 (Note 5)	1/0	GND
t_{ZL}	Y/Z	0 (Note 5)	0/1	V_{CC}
$t_{ZH(SHDN)}$	Y/Z	1 (Note 8)	1/0	GND
$t_{ZL(SHDN)}$	Y/Z	1 (Note 8)	0/1	V_{CC}

FIGURE 3A. TEST CIRCUIT

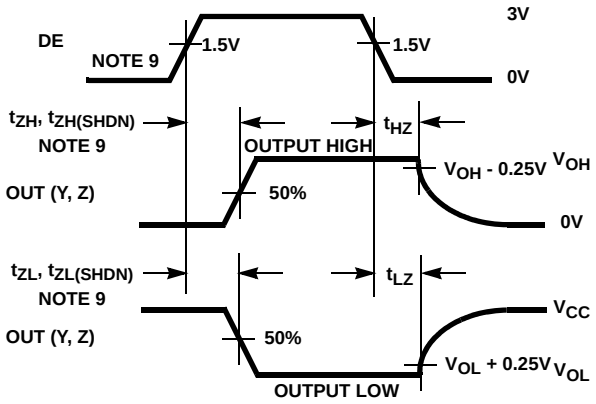


FIGURE 3B. MEASUREMENT POINTS

FIGURE 3. DRIVER ENABLE AND DISABLE TIMES

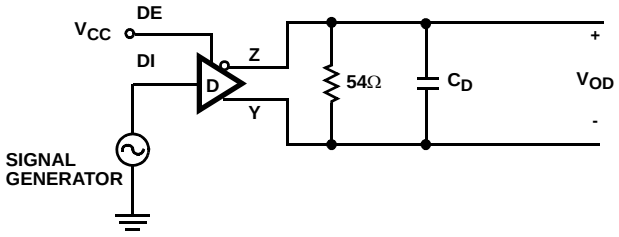


FIGURE 4A. TEST CIRCUIT

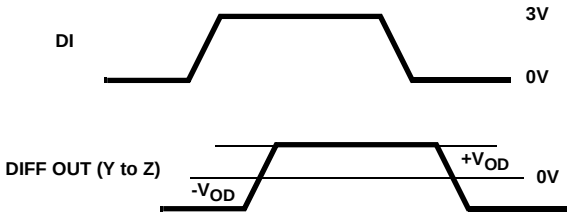


FIGURE 4B. MEASUREMENT POINTS

FIGURE 4. DRIVER DATA RATE

Test Circuits and Waveforms (Continued)

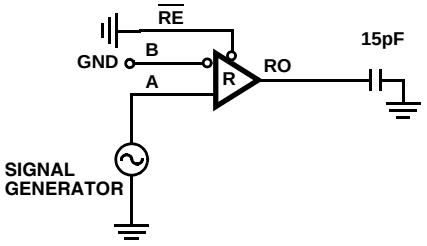


FIGURE 5A. TEST CIRCUIT

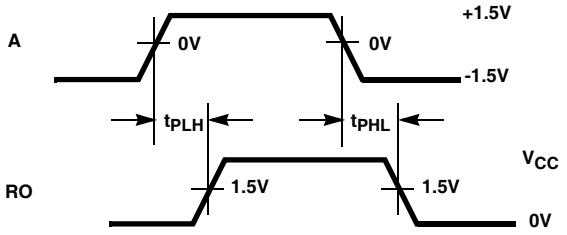
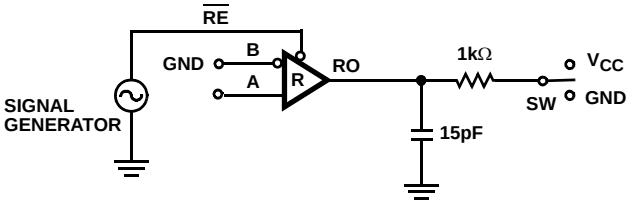


FIGURE 5B. MEASUREMENT POINTS

FIGURE 5. RECEIVER PROPAGATION DELAY



PARAMETER	DE	A	SW
t_{HZ}	X	+1.5V	GND
t_{LZ}	X	-1.5V	V_{CC}
t_{ZH} (Note 6)	0	+1.5V	GND
t_{ZL} (Note 6)	0	-1.5V	V_{CC}
$t_{ZH(SHDN)}$ (Note 9)	0	+1.5V	GND
$t_{ZL(SHDN)}$ (Note 11)	0	-1.5V	V_{CC}

FIGURE 6A. TEST CIRCUIT

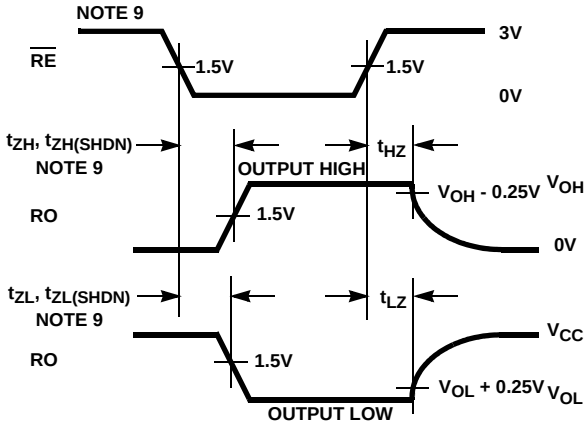


FIGURE 6B. MEASUREMENT POINTS

FIGURE 6. RECEIVER ENABLE AND DISABLE TIMES

Application Information

RS-485 and RS-422 are differential (balanced) data transmission standards for use in long haul or noisy environments. RS-422 is a subset of RS-485, so RS-485 transceivers are also RS-422 compliant. RS-422 is a point-to-multipoint (multidrop) standard, which allows only one driver and up to 10 (assuming one unit load devices) receivers on each bus. RS-485 is a true multipoint standard, which allows up to 32 one-unit load devices (any combination of drivers and receivers) on each bus. To allow for multipoint operation, the RS-485 spec requires that drivers must handle bus contention without sustaining any damage.

Another important advantage of RS-485 is the extended common mode range (CMR), which specifies that the driver outputs and receiver inputs withstand signals that range from +12V to -7V. RS-422 and RS-485 are intended for long runs, thus the wide CMR is necessary to handle ground potential differences, as well as voltages induced in the cable by external fields.

Receiver Features

This device utilizes a differential input receiver for maximum noise immunity and common mode rejection. Input sensitivity is better than ±200mV, as required by the RS-422 and RS-485 specifications.

Receiver input resistance of 96kΩ surpasses the RS-422 spec of 4kΩ and is eight times the RS-485 “Unit Load (UL)” requirement of 12kΩ minimum. Thus, these products are known as “one-eighth UL” transceivers and there can be up to 256 of these devices on a network while still complying with the RS-485 loading specification.

Receiver inputs function with common mode voltages as great as +9V/-7V outside the power supplies (i.e., +12V and -7V), making them ideal for long networks where induced voltages and ground potential differences are realistic concerns.

All the receivers include a “Full Fail-Safe” function that guarantees a high level receiver output if the receiver inputs are unconnected (floating) or shorted. Fail-safe with shorted inputs is achieved by setting the Rx upper switching point to -50mV, thereby ensuring that the Rx sees 0V differential as a high input level.

Receivers easily meet the data rates supported by the corresponding driver, and all receiver outputs are tri-statable via the active low $\overline{RE}$ input.

Driver Features

The RS-485/422 driver is a differential output device that delivers at least 1.5V across a 54Ω load (RS-485) and at least 2V across a 100Ω load (RS-422). The drivers feature low propagation delay skew to maximize bit width and to minimize EMI.

The drivers is tri-statable via the active high DE input. Outputs of the ISL3178AE drivers are not limited, so faster output transition times allow data rates of at least 10Mbps.

Hot Plug Function

When a piece of equipment powers up, there is a period of time where the processor or ASIC driving the RS-485 control lines (DE, $\overline{RE}$) is unable to ensure that the RS-485 Tx and Rx outputs are kept disabled. If the equipment is connected to the bus, a driver activating prematurely during power up may crash the bus. To avoid this scenario, the ISL3178AE versions with output enable pins incorporate a “Hot Plug” function. During power-up, circuitry monitoring V_{CC} ensures that the Tx and Rx outputs remain disabled for a period of time, regardless of the state of DE and $\overline{RE}$. This gives the processor/ASIC a chance to stabilize and drive the RS-485 control lines to the proper states.

ESD Protection

All pins on this device includes class 3 (>7kV) Human Body Model (HBM) ESD protection structures, but the RS-485 pins (driver outputs and receiver inputs) incorporate advanced structures allowing them to survive ESD events in excess of ±15kV HBM and ±15kV IEC61000. The RS-485 pins are particularly vulnerable to ESD damage because they typically connect to an exposed port on the exterior of the finished product. Simply touching the port pins, or connecting a cable, can cause an ESD event that might destroy unprotected ICs. These new ESD structures protect the device whether or not it is powered up, and without degrading the RS-485 common mode range of -7V to +12V. This built-in ESD protection eliminates the need for board level protection structures (e.g., transient suppression diodes), and the associated, undesirable capacitive load they present.

IEC61000-4-2 Testing

The IEC61000 test method applies to finished equipment, rather than to an individual IC. Therefore, the pins most likely to suffer an ESD event are those that are exposed to the outside world (the RS-485 pins in this case), and the IC is tested in its typical application configuration (power applied) rather than testing each pin-to-pin combination. The lower current limiting resistor coupled with the larger charge storage capacitor yields a test that is much more severe than the HBM test. The extra ESD protection built into this device’s RS-485 pins allows the design of equipment meeting level 4 criteria without the need for additional board level protection on the RS-485 port.

AIR-GAP DISCHARGE TEST METHOD

For this test method, a charged probe tip moves toward the IC pin until the voltage arcs to it. The current waveform delivered to the IC pin depends on approach speed, humidity, temperature, etc. so it is difficult to obtain repeatable results. The ISL3178AE RS-485 pins withstand ±15kV air-gap discharges.

CONTACT DISCHARGE TEST METHOD

During the contact discharge test, the probe contacts the tested pin before the probe tip is energized, thereby eliminating the variables associated with the air-gap discharge. The result is a more repeatable and predictable test, but equipment limits prevent testing devices at voltages higher than ±8kV. The ISL3178AE survives ±8kV contact discharges on the RS-485 pins.

Data Rate, Cables, and Terminations

RS-485/422 are intended for network lengths up to 4000’, but the maximum system data rate decreases as the transmission length increases. The device operates at 10Mbps are limited to lengths less than 100’.

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

Proper termination is imperative to minimize reflections. Short networks using the 250kbps versions need not be terminated, but, terminations are recommended unless power dissipation is an overriding concern.

In point-to-point, or point-to-multipoint (single driver on bus) networks, the main cable should be terminated in its characteristic impedance (typically 120Ω) at the end farthest from the driver. In multi-receiver applications, stubs connecting receiver to the main cable should be kept as short as possible. Multipoint (multi-driver) systems require that the main cable be terminated in its characteristic impedance at both ends. Stubs connecting a transceiver to the main cable should be kept as short as possible.

Built-In Driver Overload Protection

As stated previously, the RS-485 spec requires that drivers survive worst case bus contentions undamaged. These devices meet this requirement via driver output short circuit current limit circuitry.

The driver output stages incorporate short circuit current limiting circuitry which ensures that the output current never exceeds the RS-485 spec, even at the common mode voltage range extremes. Additionally, these devices utilize a foldback circuit which reduces the short circuit current, and

thus the power dissipation, whenever the contending voltage exceeds either supply.

Low Power Shutdown Mode

This CMOS transceiver all uses a fraction of the power required by its bipolar counterparts, but it also includes a shutdown feature that reduces the already low quiescent I_{CC} to a 10nA trickle. This device enters shutdown whenever the receiver and driver are ***simultaneously*** disabled ($\overline{RE}$ = V_{CC} and DE = GND) for a period of at least 600ns. Disabling both the driver and the receiver for less than 50ns guarantees that the transceiver will not enter shutdown.

Note that receiver and driver enable times increase when the transceiver enables from shutdown. Refer to Notes 5 through 9, at the end of the “Electrical Specification table” on page 6, for more information.

Typical Performance Curves V_{CC} = 3.3V, T_A = +25°C; Unless Otherwise Specified

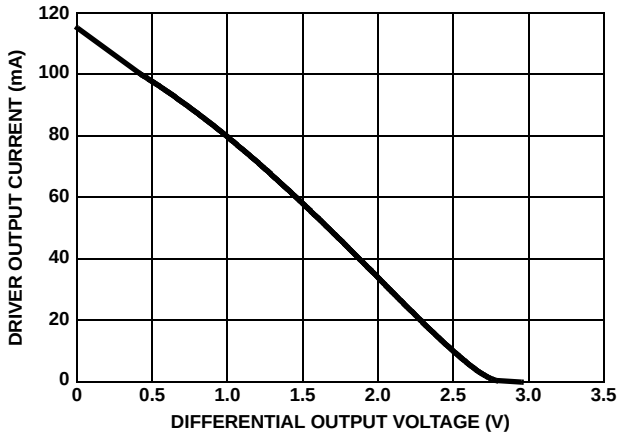


FIGURE 7. DRIVER OUTPUT CURRENT vs DIFFERENTIAL OUTPUT VOLTAGE

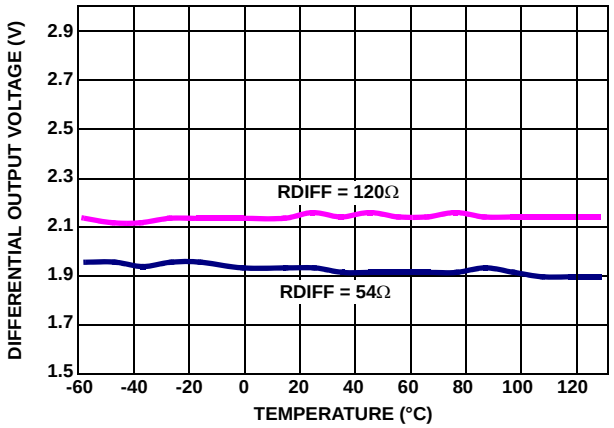


FIGURE 8. DRIVER DIFFERENTIAL OUTPUT VOLTAGE vs TEMPERATURE

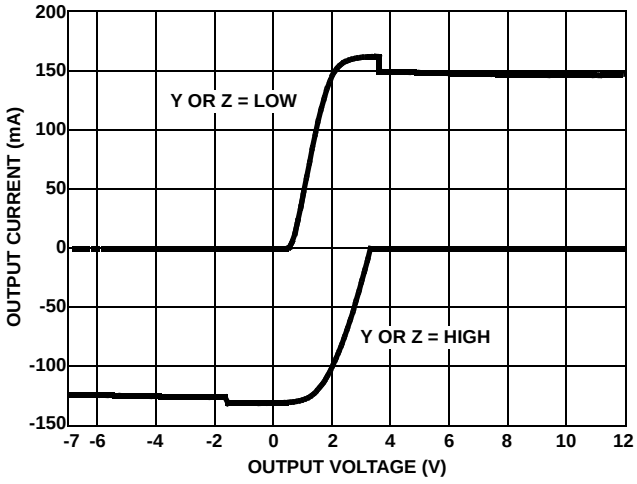


FIGURE 9. DRIVER OUTPUT CURRENT vs SHORT CIRCUIT VOLTAGE

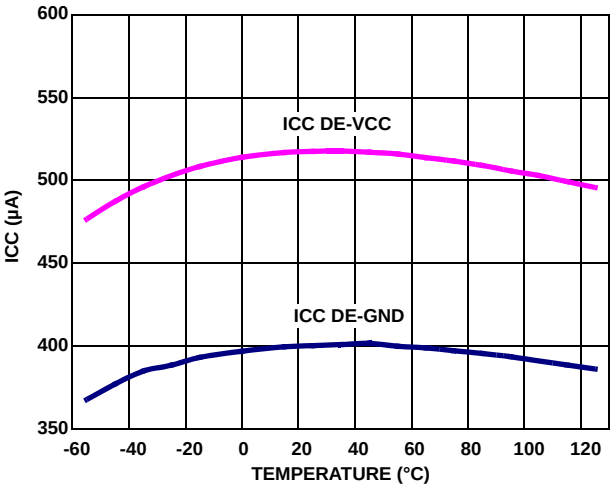


FIGURE 10. SUPPLY CURRENT vs TEMPERATURE

Typical Performance Curves V_{CC} = 3.3V, T_A = +25°C; Unless Otherwise Specified **(Continued)**

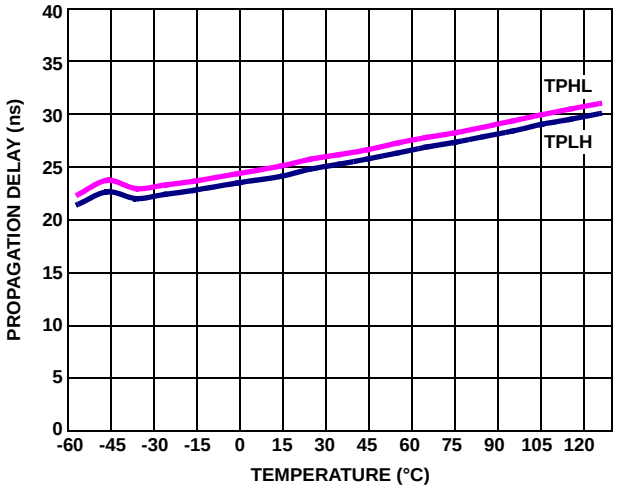


FIGURE 11. DRIVER DIFFERENTIAL PROPAGATION DELAY vs TEMPERATURE)

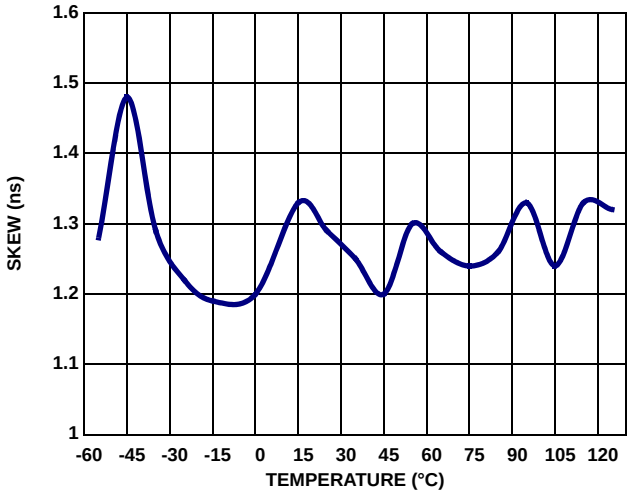


FIGURE 12. DRIVER DIFFERENTIAL SKEW vs TEMPERATURE

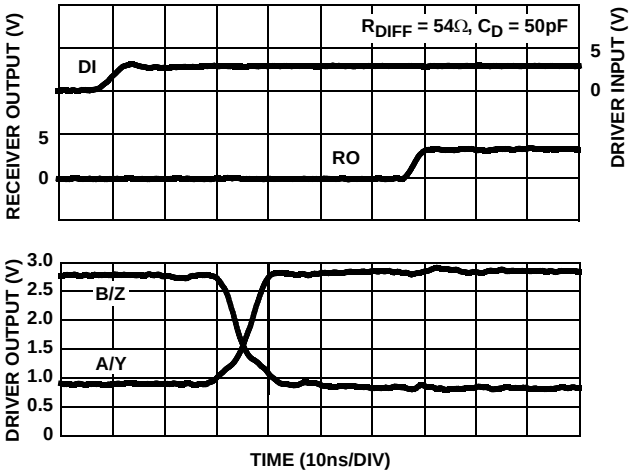


FIGURE 13. DRIVER AND RECEIVER WAVEFORMS, LOW TO HIGH

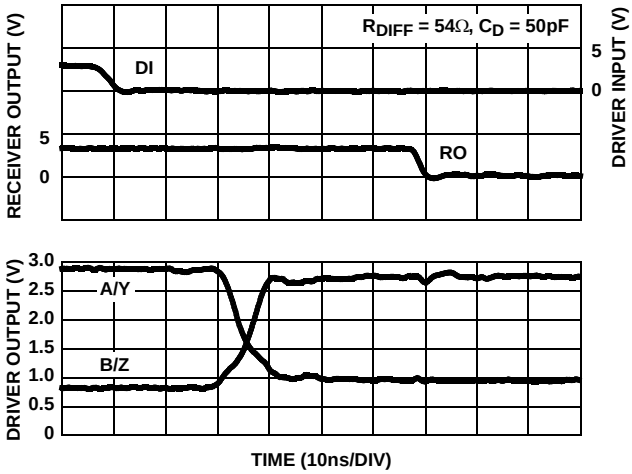


FIGURE 14. DRIVER AND RECEIVER WAVEFORMS, HIGH TO LOW

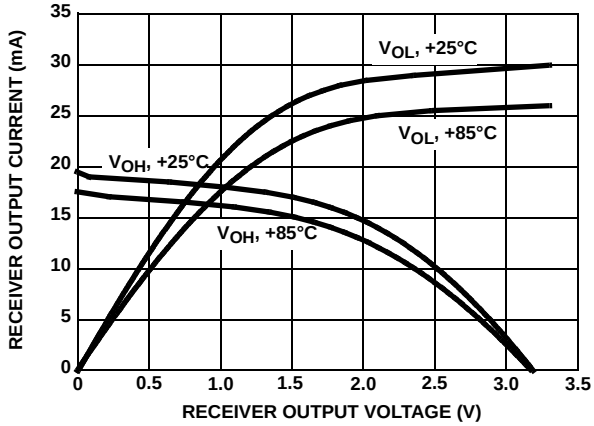


FIGURE 15. RECEIVER OUTPUT CURRENT vs RECEIVER OUTPUT VOLTAGE

Die Characteristics

DIE DIMENSIONS

Thickness: 19 mils
1295µm x 1350µm

Interface Materials

GLASSIVATION

Sandwich TEOS & Nitride

TOP METALLIZATION:

Type: Al with 0.5% Cu
Thickness: 28kA

SUBSTRATE

N/A

BACKSIDE FINISH

Silicon/Polysilicon/Oxide

Assembly Related Information

SUBSTRATE POTENTIAL

GND (powered up)

Additional Information

WORST CASE CURRENT DENSITY

N/A

PROCESS

Si GateBiCMOS

TRANSISTOR COUNT

535

PAD OPENING SIZE

90µm x 90µm

WAFER SIZE

200mm (~8 inch)

TRANSISTOR COUNT

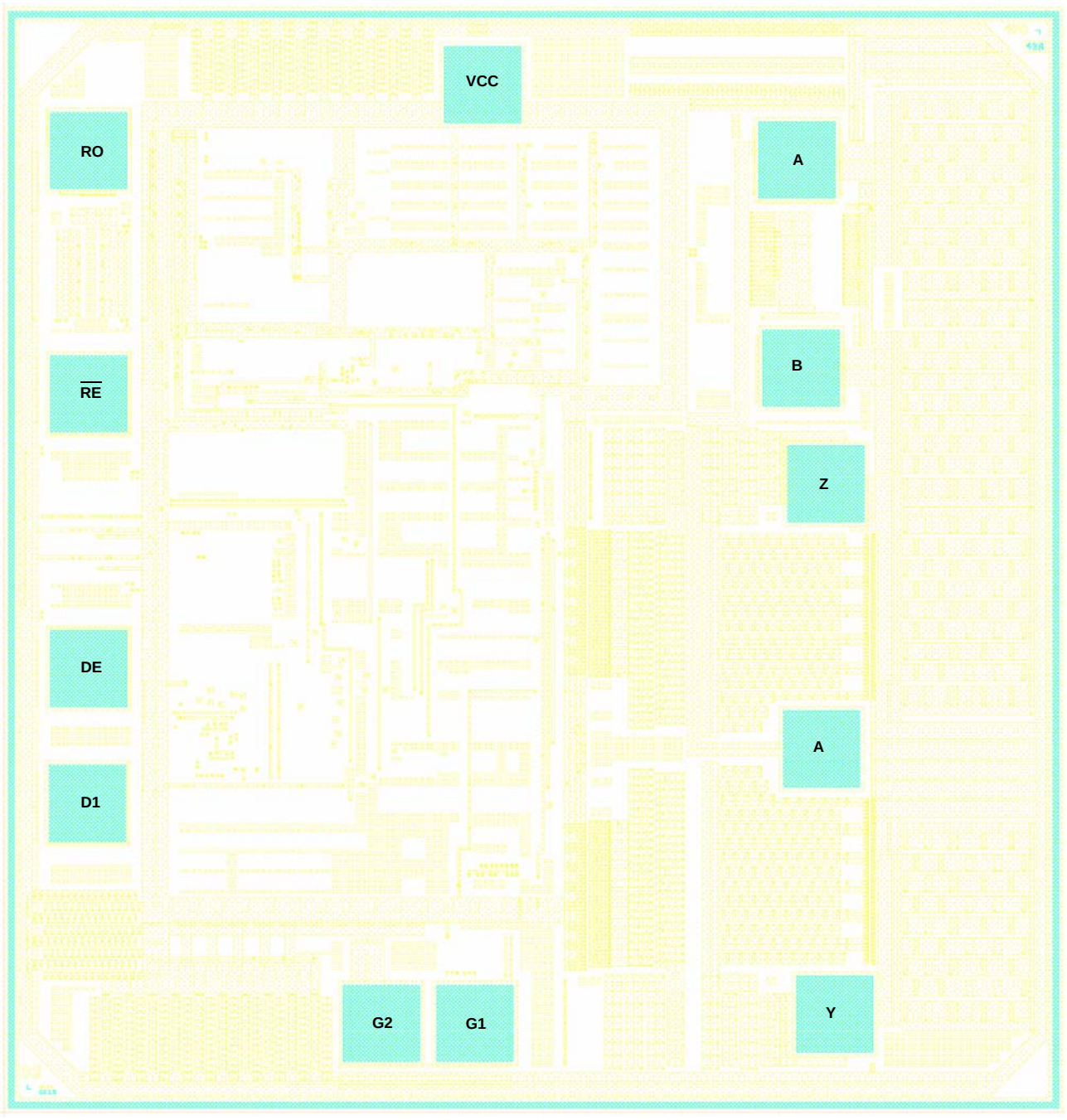
535

TABLE 2. BOND PAD FUNCTION AND COORDINATES

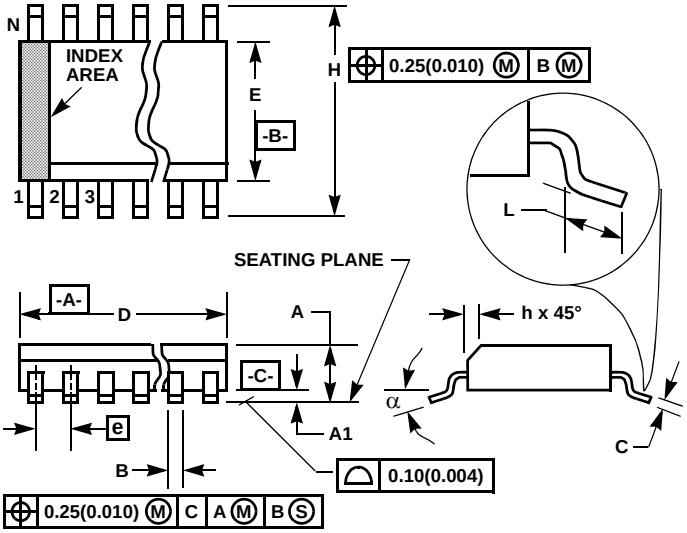
PAD #	FUNCTION	X (µm)	Y (µm)
1	RO	54.5	1086.2
2	$\overline{RE}$	54.5	800.2
3	DE	54.5	476.8
4	DI	53.0	318.35
5	GND2	398.55	59.7
6	GND1	508.55	59.7
7	Y	931.70	70.5
8	A (half duplex)	916.25	382.45
9	Z	921.2	694.4
10	B	892.1	830.35
11	A (full duplex)	887.2	1075.2
12	V_{CC}	517.55	1163.55

Metallization Mask Layout

ISL3178AE



Small Outline Plastic Packages (SOIC)



NOTES:

1. Symbols are defined in the “MO Series Symbol List” in Section 2.2 of Publication Number 95.
2. Dimensioning and tolerancing per ANSI Y14.5M-1982.
3. Dimension “D” does not include mold flash, protrusions or gate burrs. Mold flash, protrusion and gate burrs shall not exceed 0.15mm (0.006 inch) per side.
4. Dimension “E” does not include interlead flash or protrusions. Interlead flash and protrusions shall not exceed 0.25mm (0.010 inch) per side.
5. The chamfer on the body is optional. If it is not present, a visual index feature must be located within the crosshatched area.
6. “L” is the length of terminal for soldering to a substrate.
7. “N” is the number of terminal positions.
8. Terminal numbers are shown for reference only.
9. The lead width “B”, as measured 0.36mm (0.014 inch) or greater above the seating plane, shall not exceed a maximum value of 0.61mm (0.024 inch).
10. Controlling dimension: MILLIMETER. Converted inch dimensions are not necessarily exact.

M8.15 (JEDEC MS-012-AA ISSUE C)
8 LEAD NARROW BODY SMALL OUTLINE PLASTIC PACKAGE

SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	0.0532	0.0688	1.35	1.75	-
A1	0.0040	0.0098	0.10	0.25	-
B	0.013	0.020	0.33	0.51	9
C	0.0075	0.0098	0.19	0.25	-
D	0.1890	0.1968	4.80	5.00	3
E	0.1497	0.1574	3.80	4.00	4
e	0.050 BSC		1.27 BSC		-
H	0.2284	0.2440	5.80	6.20	-
h	0.0099	0.0196	0.25	0.50	5
L	0.016	0.050	0.40	1.27	6
N	8		8		7
α	0°	8°	0°	8°	-

Rev. 1 6/05