1. DESCRIPTION

The XL/XD232 series of line drivers/receivers is intended for all EIA/TIA-232E and V.28/V.24 communications interfaces, particularly applications where ±12V is not available.

The XL/XD232 series are offered in 4 different packages with temperatures from -40°C to +85°C.

2. FEATURES

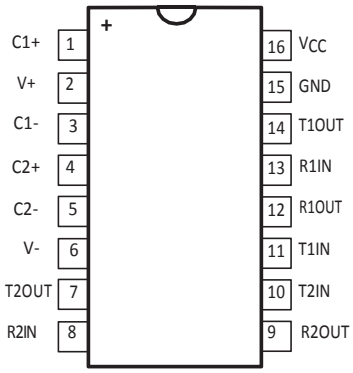
- Saves Board Space
- Integrated Charge Pump Circuitry
- Eliminates the Need for a Bipolar ±12V Supply
- Enables Single Supply Operation from +5V Supply
- Saves Power for Reduced Power Requirements

3. Applications

- Interface Translation
- Multidrop RS-232 Networks
- Portable Diagnostics Equipment

4. PIN CONFIGURATIONS AND FUNCTIONS

XL232Z
XL232K
XL232-TS
XD232

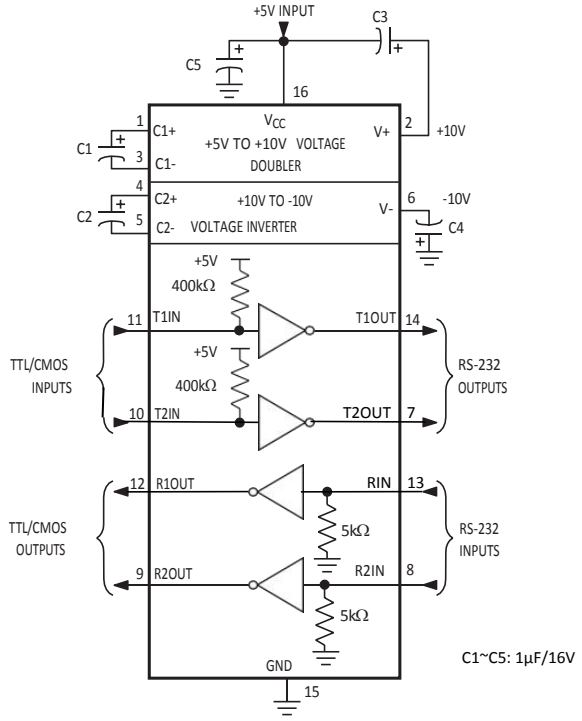


(TOP VIEW)

PIN		TYPE	DESCRIPTION
NAME	NO.		
C1+	1	—	Positive lead of C1 capacitor
VS+	2	O	Positive charge pump output for storage capacitor only
C1-	3	—	Negative lead of C1 capacitor
C2+	4	—	Positive lead of C2 capacitor
C2-	5	—	Negative lead of C2 capacitor
VS-	6	O	Negative charge pump output for storage capacitor only
T2OUT, T1OUT	7, 14	O	RS232 line data output (to remote RS232 system)
R2IN, R1IN	8, 13	I	RS232 line data input (from remote RS232 system)
R2OUT, R1OUT	9, 12	O	Logic data output (to UART)
T2IN, T1IN	10, 11	I	Logic data input (from UART)
GND	15	—	Ground
V_{CC}	16	—	Supply Voltage, Connect to external 5V power supply

5. TYPICAL OPERATING CIRCUIT

XL232Z
XL232K
XL232-TS
XD232



Block Diagram

6. SPECIFICATIONS

6.1. Absolute Maximum Ratings

SYMBOL	PARAMETER	TEST CONDITIONS	MIN	MAX	UNIT
VCC	Supply voltage range		-0.3	+6	V
V^+	(Note 1)		VCC - 0.3	+14	V
V^-	(Note 1)		-14	+0.3	V
V_{IN}	Input voltage		-	-	-
	TIN		-0.3	VCC+ 0.3	V
	RIN		-30	+30	V
V_{OUT}	Output voltage		-	-	-
	TOUT		V- -0.3	V+ +0.3	V
	ROUT		-0.3	VCC + 0.3	V
P P_{DIP} P_N P_W P_C	Driver/Receiver Output Short Circuited to GND	Continuous Power Dissipation (TA = +70°C)	-	-	-
	DIP16	derate 10.53mW/°C above +70°C	-	820	mW
	SOP16	derate 8.70mW/°C above +70°C	-	660	mW
	SOP16(W)	derate 9.52mW/°C above +70°C	-	720	mW
	TSSOP16	derate 18.60mW/°C above +70°C	-	580	mW
Totr	Operating Temperature Ranges		-40	+85	℃
T_{stg}	Storage temperature range		-45	+125	
TLT	Lead Temperature	soldering, 10s		+300	℃
T_{ST}	Soldering Temperature	reflow		+225	℃
T_f	All other lead(Pb)-free packages			+260	℃
Tc	All other packages containing lead(Pb)			+240	℃

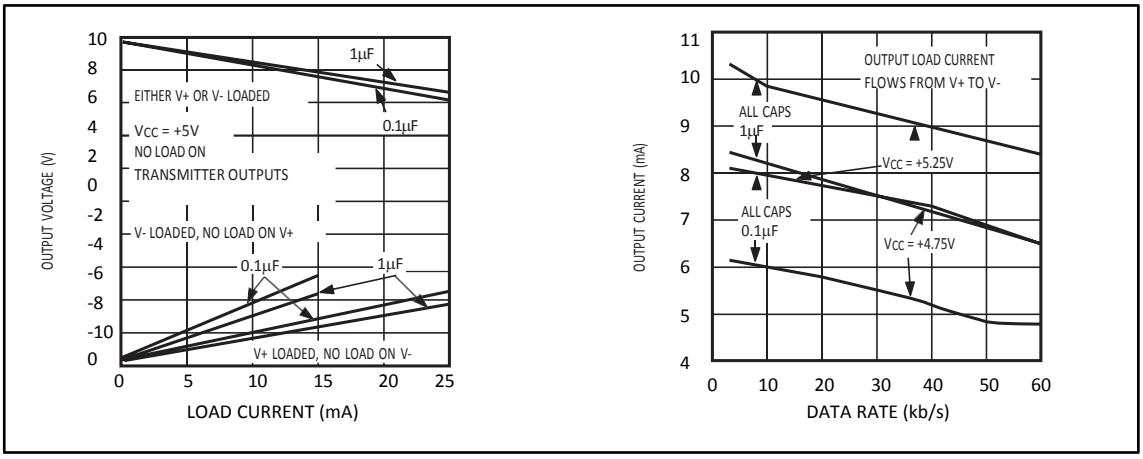
[1] Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

6.2. Electrical Characteristics

VCC = +5V ±5%, C1–C4 = 1μF/16V, T_A = free-air temperature range; unless otherwise specified.

PARAMETER	CONDITIONS		MIN	TYP	MAX	UNITS
Output Voltage Swing	All transmitter outputs loaded with 3kΩ to ground		±5.0	±7.3		V
VCC Supply Current	No load, TA = +25°C			8	16	mA
Logic Pullup Current	VTIN = 0V			1.5	200	μA
Receiver Input Voltage Operating Range			-30		+30	V
RS-232 Input Hysteresis	VCC = +5V, no hysteresis in shutdown		0.2	0.5	1.0	V
RS-232 Input Resistance	TA = +25°C, VCC = +5V		3	5	7	kΩ
TTL/CMOS Output Voltage Low	IOUT = 1.6mA (IOUT = 3.2mA)				0.4	V
TTL/CMOS Output Voltage High	IOUT = -1mA		3.5	VCC - 0.4		V
Propagation Delay	RS-232 IN to TTL/CMOS OUT, CL = 150pF	t_{PHLS}		4	40	μs
		t_{PLHS}		6	40	
Transition Region Slew Rate	TA = +25°C, VCC = +5V, RL = 3kΩ to 7kΩ, CL = 50pF to 2500pF, measured from +3V to -3V or -3V to +3V			4	30	V/μs
Transmitter Output Resistance	VCC = V+ = V- = 0V, VOUT = ±2V		300			Ω
Transmitter Output Short-Circuit Current				±10		mA

6.3. Typical Operating Characteristics



7. Test Circuits/Timing Diagrams

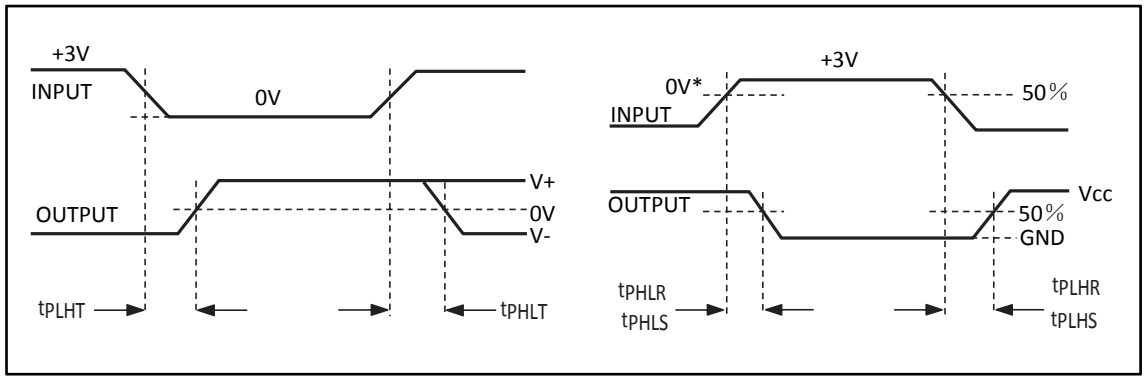


Figure 1. Transmitter Propagation-Delay Timing

Figure 2. Receiver Propagation-Delay Timing

8. Detailed Description

The XL/XD232 series contain four sections: dual charge-pump DC-DC voltage converters, RS-232 drivers, RS-232 receivers, and receiver and transmitter enable control inputs.

8.1. Dual Charge-Pump Voltage Converter

The XL/XD232 series have two internal charge-pumps that convert +5V to ±10V (unloaded) for RS-232 driver operation. The first converter uses capacitor C1 to double the +5V input to +10V on C3 at the V+ output. The second converter uses capacitor C2 to invert +10V to -10V on C4 at the V- output.

A small amount of power may be drawn from the +10V (V+) and -10V (V-) outputs to power external circuitry (see the Typical Operating Characteristics section). V+ and V- are not regulated, so the output voltage drops with increasing load current. Do not load V+ and V- to a point that violates the mini- mum ±5V EIA/TIA-232E driver output voltage when sourcing current from V+ and V- to external circuitry.

8.2. RS-232 Drivers

The typical driver output voltage swing is ±8V when loaded with a nominal 5k RS-232 receiver and VCC = +5V. Output swing is guaranteed to meet the EIA/TIA-232E and V.28 specification, which calls for ±5V mini- mum driver output levels under worst-case conditions. These include a minimum 3k load, VCC = +4.5V, and maximum operating temperature. Unloaded driver out- put voltage ranges from (V+ -1.3V) to (V- +0.5V).

Input thresholds are both TTL and CMOS compatible. The inputs of unused drivers can be left unconnected since 400k input pull up resistors to VCC are built in. The pull up resistors force the outputs of unused drivers low because all drivers invert. The internal input pull up resistors typically source 12µA, except in shutdown mode where the pull ups are disabled. Driver outputs turn off and enter a high-impedance state—where leakage current is typically microamperes (maximum 25µA)—when in shutdown mode, in three-state mode, or when device power is removed. Outputs can be driven to ±15V. The power- supply current typically drops to 8µA in shutdown mode. Connect unused inputs to GND or VCC.

When in low-power shutdown mode, the driver outputs are turned off and their leakage current is less than 1µA with the driver output pulled to ground. The driver output leakage remains less than 1µA, even if the transmitter output is backdriven between 0V and (VCC + 6V). Below -0.5V, the transmitter is diode clamped to ground with 1kΩ series impedance. The transmitter is also zener clamped to approximately VCC + 6V, with a series impedance of 1kΩ.

The driver output slew rate is limited to less than 30V/µs as required by the EIA/TIA-232E and V.28 specifications. Typical slew rates are 24V/µs unloaded and 10V/µs loaded with 3Ω and 2500pF.

Note: the The XL/XD232 series of line drivers/receivers still don't support shutdown mode currently.

8.3. RS-232 Receivers

EIA/TIA-232E and V.28 specifications define a voltage level greater than 3V as a logic 0, so all receivers invert. Input thresholds are set at 0.8V and 2.4V, so receivers respond to TTL level inputs as well as EIA/TIA-232E and V.28 levels.

The receiver inputs withstand an input over voltage up to ±25V and provide input terminating resistors with nominal 5k values. The receivers implement Type 1 interpretation of the fault conditions of V.28 and EIA/TIA-232E.

The receiver input hysteresis is typically 0.5V with a guaranteed minimum of 0.2V. This produces clear out- put transitions with slow-moving input signals, even with moderate amounts of noise and ringing. The receiver propagation delay is typically 600ns and is independent of input swing direction.

8.4. Applications Information

In applications that are sensitive to power-supply noise, VCC should be decoupled to ground with a capacitor of the same value as C1 and C2 connected as close as possible to the device.

9. ORDERING INFORMATION

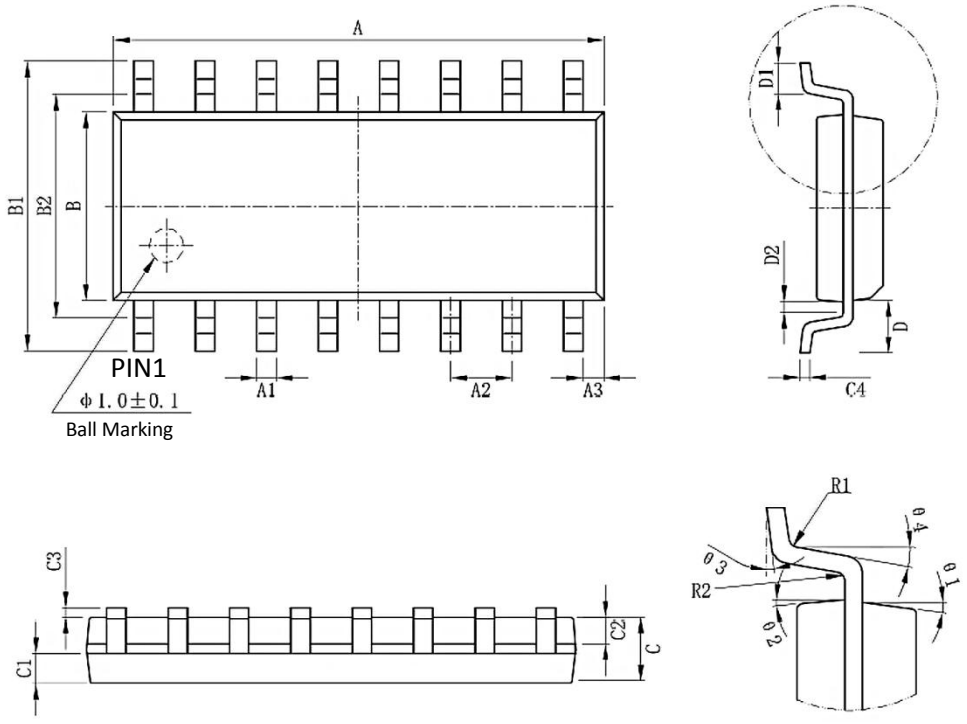
Ordering Information

Part Number	Device Marking	Package Type	Body size (mm)	Temperature (°C)	MSL	Transport Media	Package Quantity
XL232Z	XL232Z	SOP16	10.00 * 3.95	-40 to +85	MSL3	T&R	2500
XL232-TS	XL232-TS	TSSOP16	5.00 * 3.90	-40 to +85	MSL3	T&R	2500
XL232K	XL232K	SOP16(W)	10.45 * 7.5	-40 to +85	MSL3	T&R	1000
XD232	XD232	DIP16	19.05 * 6.35	-40 to +85	MSL3	Tube 25	1000

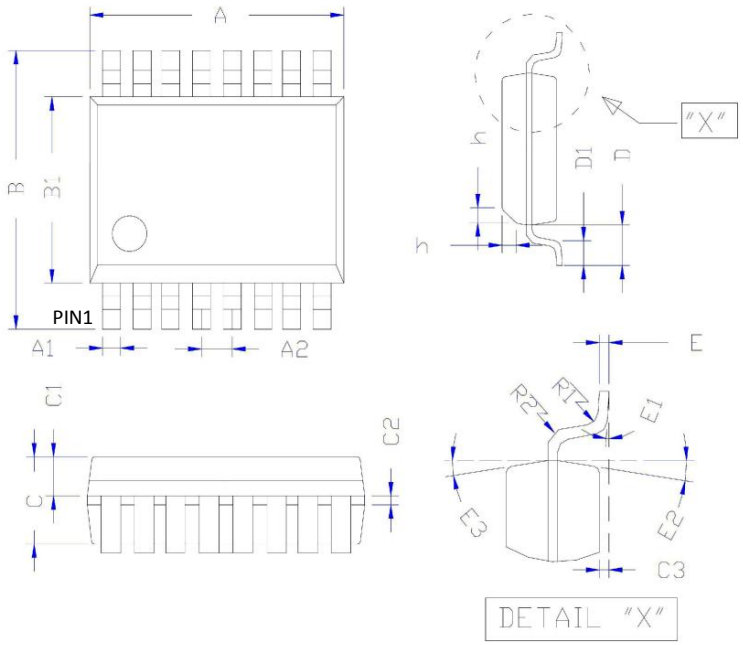
10. DIMENSIONAL DRAWINGS

SOP16

Size / Mark	Min (mm)	Max (mm)	Size / Mark	Min (mm)	Max (mm)
A	9.80	10.00	C4	0.203	0.233
A1	0.356	0.456	D	1.05TYP	
A2	1.27TYP		D1	0.40	0.70
A3	0.302TYP		D2	0.15	0.25
B	3.85	3.95	R1	0.20TYP	
B1	5.84	6.24	R2	0.20TYP	
B2	5.00TYP		θ1	8° ~ 12° TYP4	
C	1.40	1.60	θ2	8° ~ 12° TYP4	
C1	0.61	0.71	θ3	0° ~ 8°	
C2	0.54	0.64	θ4	4° ~ 12°	
C3	0.05	0.25			

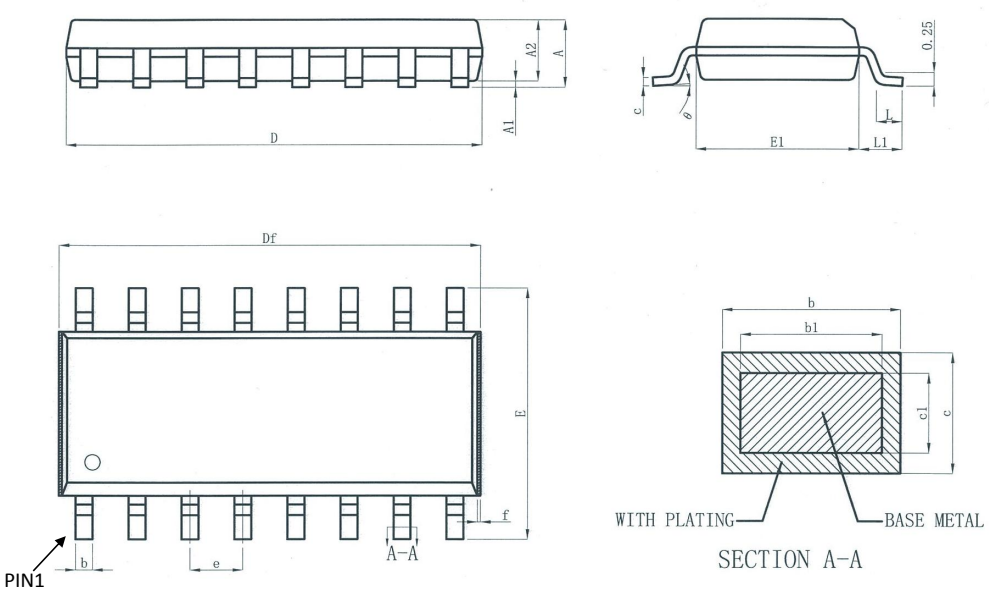


TSSOP16



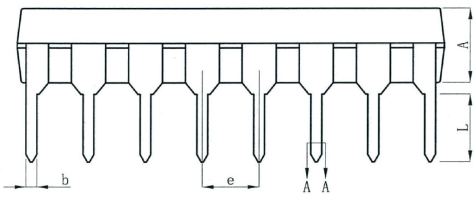
Symbol	Indicate	MIN	NOM	MAX
A	Overall length	4.95	5.00	5.05
A1	Foot width	0.20	0.22	0.24
A2	Foot spacing	0.60	0.65	0.70
B	Span	5.70	6.00	6.30
B1	Colloid width	3.80	3.90	4.00
C	Colloid thickness	0.95	1.00	1.05
C1	Thickness of upper colloid	0.40	0.41	0.42
C2		0.05	0.15	0.25
C3	Stand height	0.02	0.08	0.10
D	Fingle-sided Factory	0.85	1.05	1.25
D1	Foot length	0.40	0.65	0.85
E	Foot Thickness	0.15	0.20	0.25
E2	Foot Angle	0°		8°
h		0.30	0.40	0.50

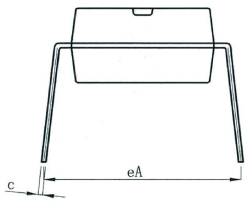
SOP16(W)

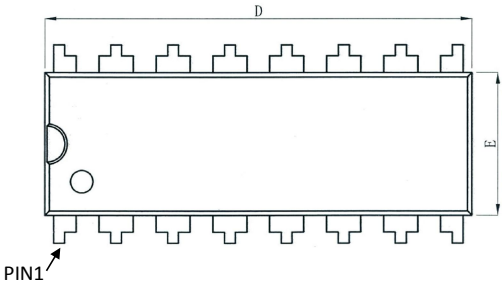


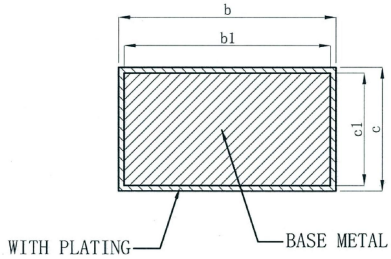
symbol	millimeter		
	Min	Nom	Max
A	---	---	2.65
A1	0.10	0.20	0.30
A2	2.20	2.30	2.40
b	0.39	---	0.47
b1	0.38	0.41	0.43
c	0.25	---	0.30
c1	0.24	0.25	0.26
D	10.10	10.20	10.30
Df	10.20	---	10.70
E	10.26	10.41	10.60
E1	7.40	7.50	7.60
e	1.27BSC		
L	0.55	---	0.85
L1	---	1.40	---
θ	0°	---	8°
f	0.05	---	0.20

DIP16









symbol	millimeter		
	Min	Nom	Max
A	3.20	3.30	3.40
b	0.44	---	0.53
b1	0.43	0.46	0.49
c	0.25	---	0.30
c1	0.24	0.25	0.26
D	18.95	19.05	19.15
E	6.25	6.35	6.45
e	2.54BSC		
eA	8.30	8.80	9.30
L	3.00	---	---

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