Low Power, 3.3 V, RS-232 Line Drivers/Receivers

ADM3202/ADM3222/ADM1385

FEATURES

460 kbps data rate
Specified at 3.3 V
Meets EIA-232E specifications
0.1 µF charge pump capacitors
Low power shutdown (ADM3222 and ADM1385)
DIP, SO, SOIC, SSOP, and TSSOP options
Upgrade for MAX3222/32 and LTC1385
ESD protection to IEC1000-4-2 (801.2) on RS-232 pins (ADM3202 only)
±8 kV: contact discharge
±15 kV: air gap discharge

APPLICATIONS

General-purpose RS-232 data link
Portable instruments
Printers, palmtop computers, PDAs

GENERAL DESCRIPTION

The ADM3202/ADM3222/ADM1385 transceivers are high speed, 2-channel RS-232/V.28 interface devices that operate from a single 3.3 V power supply. Low power consumption and a shutdown facility (ADM3222/ADM1385) make them ideal for battery-powered portable instruments.

The ADM3202/ADM3222/ADM1385 parts conform to the EIA-232E and CCITT V.28 specifications and operate at data rates up to 460 kbps.

Four external 0.1 µF charge pump capacitors are used for the voltage doubler/inverter, permitting operation from a single 3.3 V supply.

The ADM3222 contains additional enable and shutdown circuitry. The $\overline{EN}$ input can be used to three-state the receiver outputs. The $\overline{SD}$ input is used to power down the charge pump and transmitter outputs, reducing the quiescent current to less than 0.5 µA. The receivers remain enabled during shutdown unless disabled using $\overline{EN}$.

The ADM1385 contains a driver disable mode and a complete shutdown mode.

The ADM3202 is available in a 16-lead DIP, narrow and wide SOIC as well as a space-saving 16-lead TSSOP package. The ADM3222 is available in 18-lead DIP, SO, and in 20-lead SSOP and TSSOP. The ADM1385 is available in a 20-lead SSOP package, which is pin-compatible with the LTC1385 CG.

FUNCTIONAL BLOCK DIAGRAMS

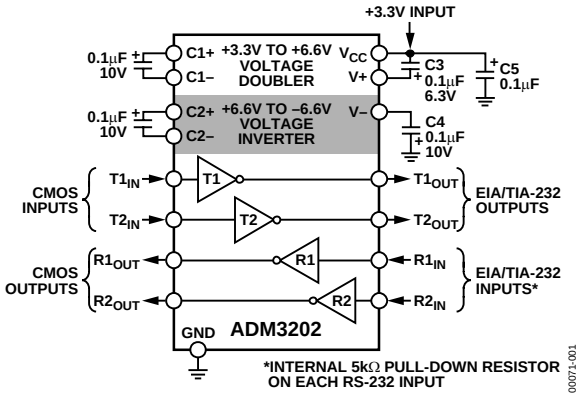

Figure 1.

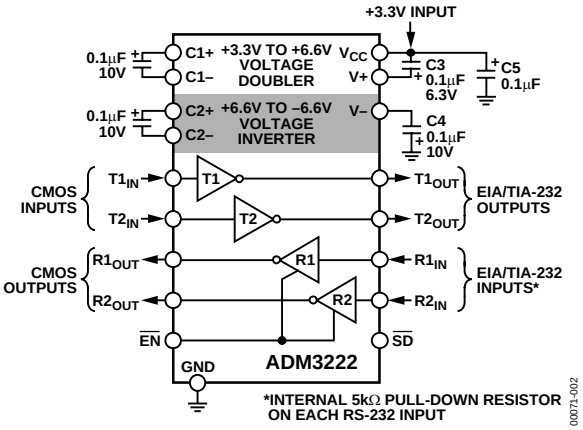

Figure 2.

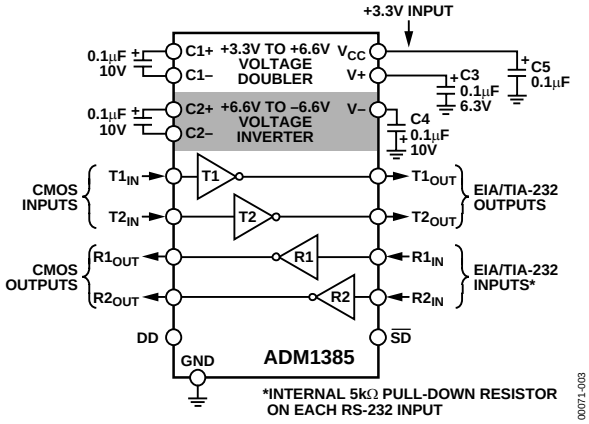

Figure 3.

Rev. C

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SPECIFICATIONS

V_{CC} = 3.3 V ± 0.3 V, C1 to C4 = 0.1 µF. All specifications T_{MIN} to T_{MAX}, unless otherwise noted.

Table 1.

Parameter	Min	Typ	Max	Unit	Test Conditions/Comments
DC CHARACTERISTICS					
Operating Voltage Range	3.0	3.3	5.5	V	
V_{CC} Power Supply Current		1.3	3	mA	No load
		8	12	mA	R_L = 3 kΩ to GND
Shutdown Supply Current		0.01	0.5	µA	
LOGIC					
Input Logic Threshold Low, V_{INL}			0.8	V	T_{IN}
Input Logic Threshold High, V_{INH}	2.0			V	T_{IN}
CMOS Output Voltage Low, V_{OL}			0.4	V	I_{OUT} = 1.6 mA
CMOS Output Voltage High, V_{OH}	V_{CC} − 0.6			V	I_{OUT} = −1 mA
Logic Pull-Up Current		5	10	µA	T_{IN} = GND to V_{CC}[1]
Output Leakage Current			±10	µA	Receivers disabled
RS-232 RECEIVER					
EIA-232 Input Voltage Range	−30		+30	V	
EIA-232 Input Threshold Low	0.6	1.2		V	
EIA-232 Input Threshold High		1.6	2.4	V	
EIA-232 Input Hysteresis		0.4		V	
EIA-232 Input Resistance	3	5	7	kΩ	
RS-232 TRANSMITTER					
Output Voltage Swing (RS-232)	±5.0	±5.2		V	V_{CC} = 3.3 V, all transmitter outputs loaded with 3 kΩ to ground
Output Voltage Swing (RS-562)	±3.7			V	V_{CC} = 3.0 V
Transmitter Output Resistance	300			Ω	V_{CC} = 0 V, V_{OUT} = ±2 V
RS-232 Output Short-Circuit Current		±15		mA	
Output Leakage Current			±25	µA	$\overline{SD}$ = low, V_{OUT} = 12 V
TIMING CHARACTERISTICS					
Maximum Data Rate	460			kbps	V_{CC} = 3.3 V, R_L = 3 kΩ to 7 kΩ, C_L = 50 pF to 1000 pF, one Tx switching
Receiver Propagation Delay					
TPHL		0.4	1	µs	
TPLH		0.4	1	µs	
Transmitter Propagation Delay		300	1.2	µs	R_L = 3 kΩ, C_L = 1000 pF
Receiver Output Enable Time		200		ns	
Receiver Output Disable Time		200		ns	
Transmitter Skew		30		ns	
Receiver Skew		300		ns	
Transition Region Slew Rate	5.5	10	30	V/µs	Measured from +3 V to −3 V or −3 V to +3 V, V_{CC} = +3.3 V; RL = 3 kΩ, CL = 1000 pF, TA = 25°C

[1] ADM1385: Input leakage current typically −10 µA when T_{IN} = GND.

ABSOLUTE MAXIMUM RATINGS

T_A = 25°C, unless otherwise noted.

Table 2.

Parameter	Rating
V_{CC}	−0.3 V to +6 V
V+	(V_{CC} − 0.3 V) to +14 V
V−	+0.3 V to −14 V
Input Voltages	
T_{IN}	−0.3 V to (V+, +0.3 V)
R_{IN}	±30 V
Output Voltages	
T_{OUT}	±15 V
R_{OUT}	−0.3 V to (V_{CC} + 0.3 V)
Short-Circuit Duration	
T_{OUT}	Continuous
Power Dissipation N-16	
(Derate 6 mW/°C above 50°C)	450 mW
θ_{JA}, Thermal Impedance	117°C/W
Power Dissipation R-16	
(Derate 6 mW/°C above 50°C)	450 mW
θ_{JA}, Thermal Impedance	158°C/W
Power Dissipation RU-16	
(Derate 6 mW/°C above 50°C)	500 mW
θ_{JA}, Thermal Impedance	158°C/W
Power Dissipation R-18	
(Derate 6 mW/°C above 50°C)	450 mW
θ_{JA}, Thermal Impedance	158°C/W
Power Dissipation RS-20	
(Derate 6 mW/°C above 50°C)	450 mW
θ_{JA}, Thermal Impedance	158°C/W
Power Dissipation RU-20	
(Derate 6 mW/°C above 50°C)	450 mW
θ_{JA}, Thermal Impedance	158°C/W
Operating Temperature Range	
Industrial (A Version)	−40°C to +85°C
Storage Temperature Range	−65°C to +150°C
Lead Temperature (Soldering, 10 sec)	JEDEC industry standard J-STD-020

Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions above those listed in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ESD CAUTION

ESD (electrostatic discharge) sensitive device. Electrostatic charges as high as 4000 V readily accumulate on the human body and test equipment and can discharge without detection. Although this product features proprietary ESD protection circuitry, permanent damage may occur on devices subjected to high energy electrostatic discharges. Therefore, proper ESD precautions are recommended to avoid performance degradation or loss of functionality.

PIN CONFIGURATION AND FUNCTION DESCRIPTIONS

PIN CONNECTIONS DIP (N, R PACKAGES)

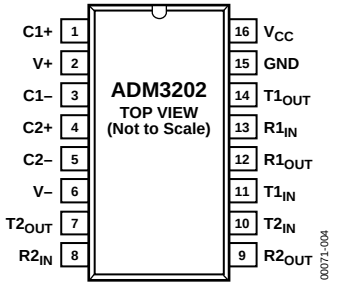


Figure 4. N Package Pin Connection

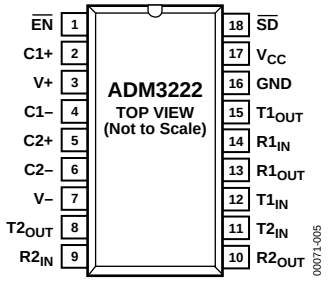


Figure 5. R Package Pin Connection

PIN CONNECTIONS DIP (RS, RU PACKAGES)

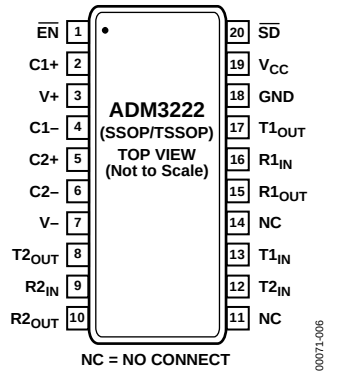


Figure 6. RU Package Pin Connection

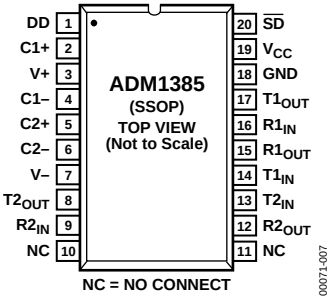


Figure 7. RS Package Pin Connection

Table 3. Pin Function Descriptions

Mnemonic	Description
V_{CC}	Power Supply Input (3.3 V ± 0.3 V).
V+	Internally Generated Positive Supply (+6 V nominal).
V–	Internally Generated Negative Supply (–6 V nominal).
GND	Ground Pin. Must be connected to 0 V.
C1+, C1–	External Capacitor 1 is connected between these pins. 0.1 µF capacitor is recommended, but larger capacitors up to 47 µF can be used.
C2+, C2–	External Capacitor 2 is connected between these pins. 0.1 µF capacitor is recommended, but larger capacitors up to 47 µF can be used.
T_{XIN}	Transmitter (Driver) Inputs. These inputs accept TTL/CMOS levels.
T_{XOUT}	Transmitter (Driver) Outputs. These are RS-232 signal levels (typically ±9 V).
R_{XIN}	Receiver Inputs. These inputs accept RS-232 signal levels. An internal 5 kΩ pull-down resistor to GND is connected on each input.
R_{XOUT}	Receiver Outputs. These are CMOS output logic levels.
$\overline{EN}$	(ADM3222) Receiver Enable. Active low. When low, the receiver outputs are enabled. When high, they are three-stated.
$\overline{SD}$	(ADM3222) Shutdown Control. Active Low. When low, the charge pump is shut down and the transmitter outputs are disabled.
$\overline{SD}$	(ADM1385) Shutdown Control. When low, the charge pump is shut down and all transmitters and receivers are disabled.
DD	(ADM1385) Driver Disable. When low, the charge pump is turned off and the transmitters are disabled. The receivers remain active.

TYPICAL PERFORMANCE CHARACTERISTICS

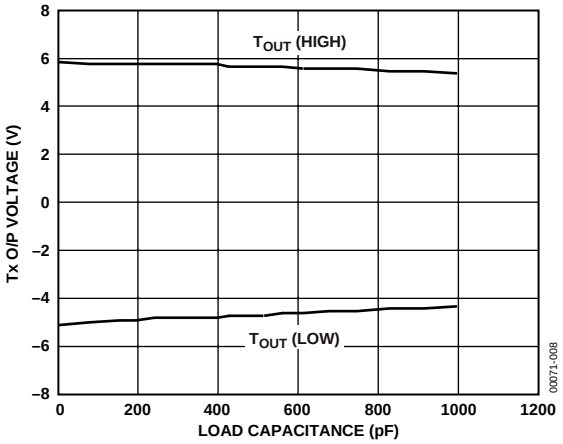


Figure 8. Transmitter Output Voltage High/Low vs. Load Capacitance @ 460 kbps

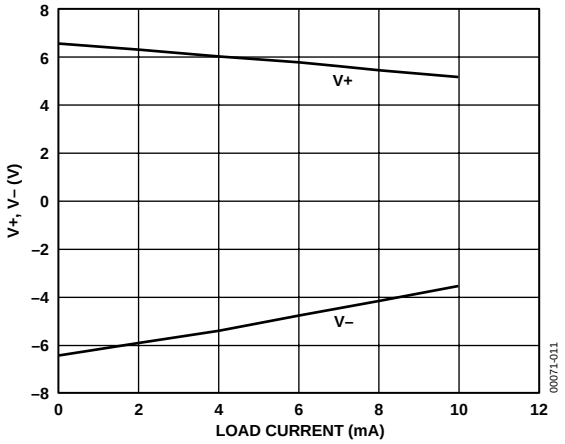


Figure 11. Charge Pump V+, V– vs. Load Current

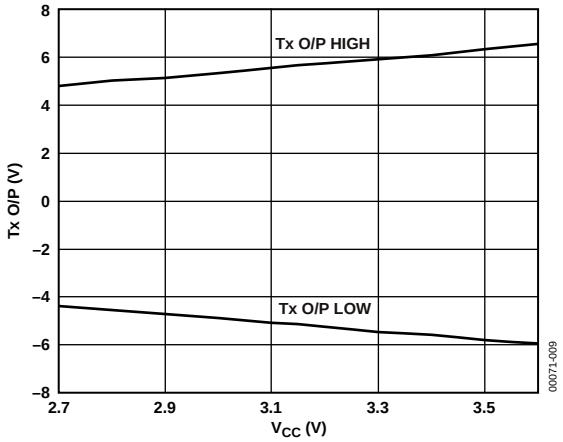


Figure 9. Transmitter Output Voltage vs. V_{CC}

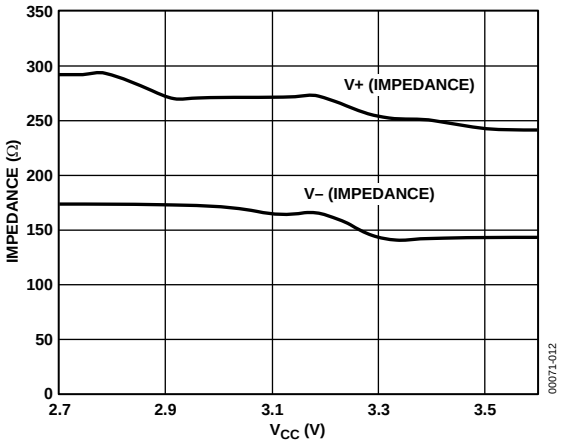


Figure 12. Charge Pump Impedance vs. V_{CC}

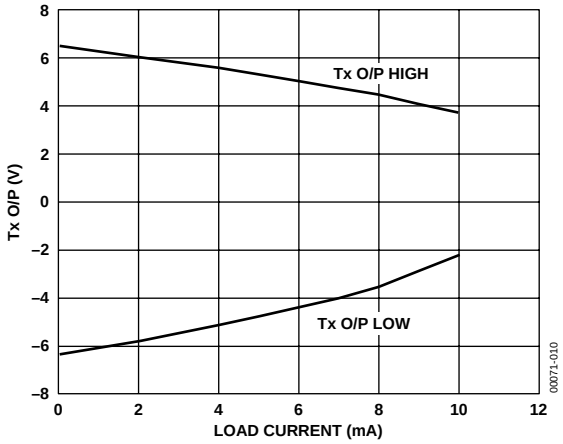


Figure 10. Transmitter Output Voltage Low/High vs. Load Current

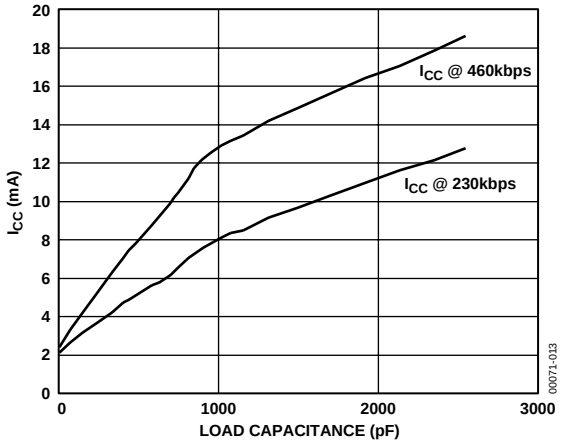


Figure 13. Power Supply Current vs. Load Capacitance

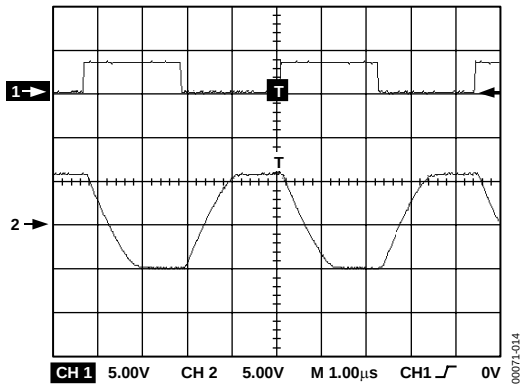


Figure 14. 460 kbps Data Transmission

GENERAL DESCRIPTION

The ADM3202/ADM3222/ADM1385 are RS-232 line drivers/receivers. Step-up voltage converters coupled with level-shifting transmitters and receivers allow RS-232 levels to be developed while operating from a single 3.3 V supply.

CMOS technology is used to keep the power dissipation to an absolute minimum, allowing maximum battery life in portable applications.

The ADM3202/ADM3222/ADM1385 are modifications, enhancements, and improvements of the AD230–AD241 family and derivatives. They are essentially plug-in-compatible and do not have any materially different applications.

CIRCUIT DESCRIPTION

The internal circuitry consists of these main sections:

- A charge pump voltage converter
- 3.3 V logic to EIA-232 transmitters
- EIA-232 to 5 V logic receivers

Charge Pump DC-DC Voltage Converter

The charge pump voltage converter consists of a 200 kHz oscillator and a switching matrix. The converter generates a ±6.6 V supply from the input 3.3 V level. This is done in two stages by using a switched capacitor technique as illustrated in Figure 18 and Figure 19. First, the 3.3 V input supply is doubled to 6.6 V by using capacitor C1 as the charge storage element. The +6.6 V level is then inverted to generate −6.6 V using C2 as the storage element. C3 is shown connected between V+ and V_{CC}, but is equally effective if connected between V+ and GND.

Capacitors C3 and C4 are used to reduce the output ripple. Their values are not critical and can be increased, if desired. Capacitor C3 is shown connected between V+ and V_{CC}. It is also acceptable to connect this capacitor between V+ and GND.

If desired, larger capacitors (up to 10 µF) can be used for capacitors C1 to C4.

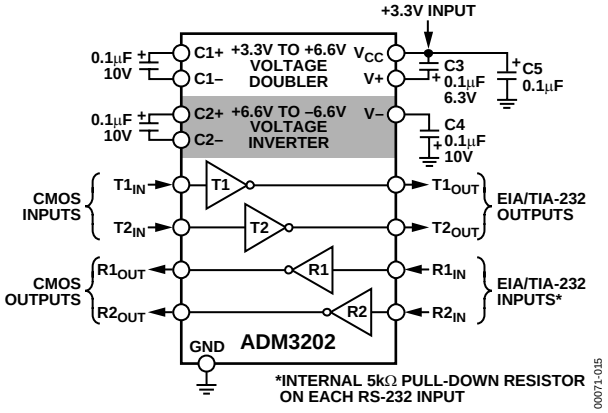


Figure 15. ADM3202 Typical Operating Circuit

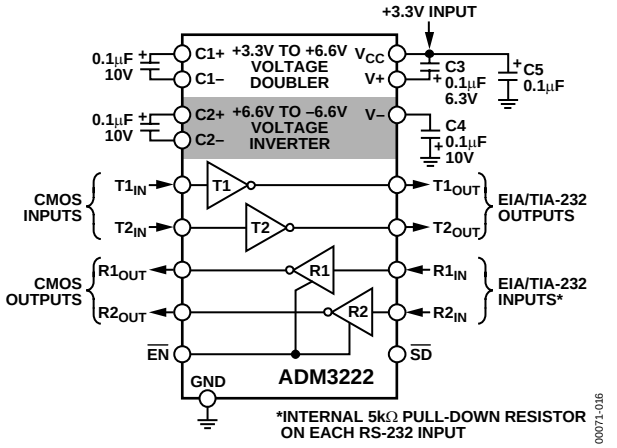


Figure 16. ADM3222 Typical Operating Circuit

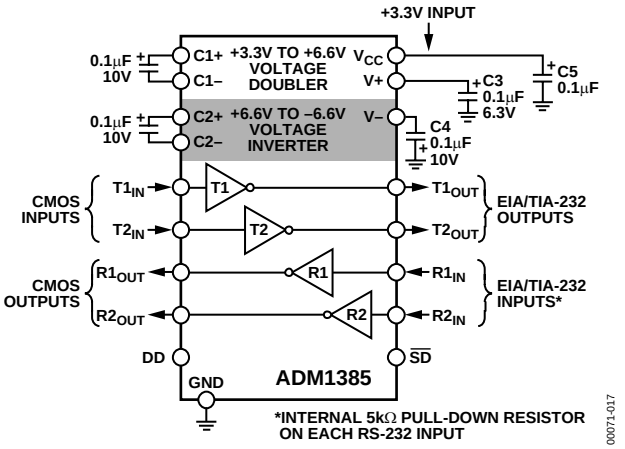


Figure 17. ADM1385 Typical Operating Circuit

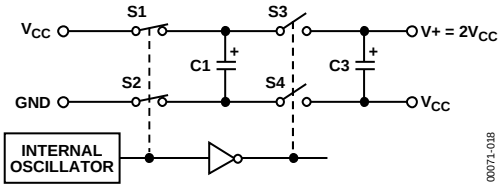


Figure 18. Charge Pump Voltage Doubler

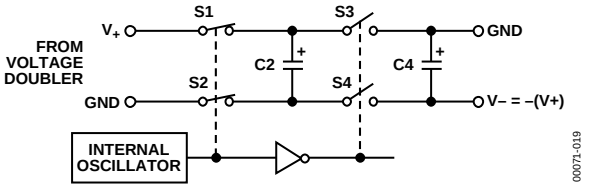


Figure 19. Charge Pump Voltage Inverter

Transmitter (Driver) Section

The drivers convert 3.3 V logic input levels into RS-232 output levels. With V_{CC} = 3.3 V and driving an RS-232 load, the output voltage swing is typically ±6 V.

Receiver Section

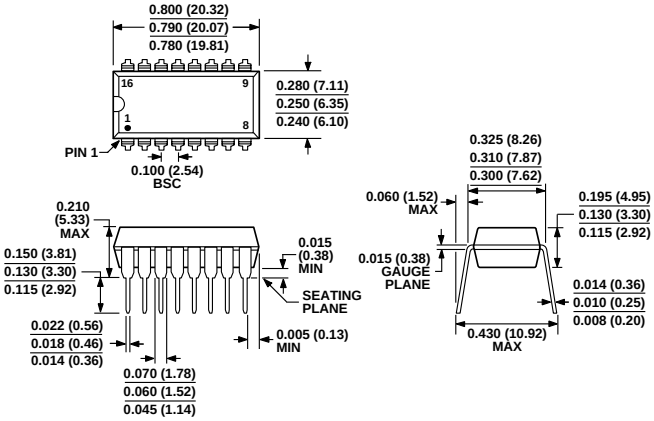
The receivers are inverting level-shifters that accept RS-232 input levels and translate them into 3 V logic output levels. The inputs have internal 5 kΩ pull-down resistors to ground and are also protected against overvoltages up to ±30 V. Unconnected inputs are pulled to 0 V by the internal 5 kΩ pull-down resistor. This results in a Logic 1 output level for unconnected inputs or for inputs connected to GND.

The receivers have Schmitt-trigger inputs with a hysteresis level of 0.4 V. This ensures error-free reception for both noisy inputs and for inputs with slow transition times.

HIGH BAUD RATE

The ADM3202/ADM3222 feature high slew rates permitting data transmission at rates well in excess of the EIA/RS-232E specifications. RS-232 voltage levels are maintained at data rates up to 460 kbps even under worst-case loading conditions. This allows high speed data links between two terminals and is suitable for the new generation ISDN modem standards that require data rates of 230 kbps. The slew rate is internally controlled to less than 30 V/µs to minimize EMI interference.

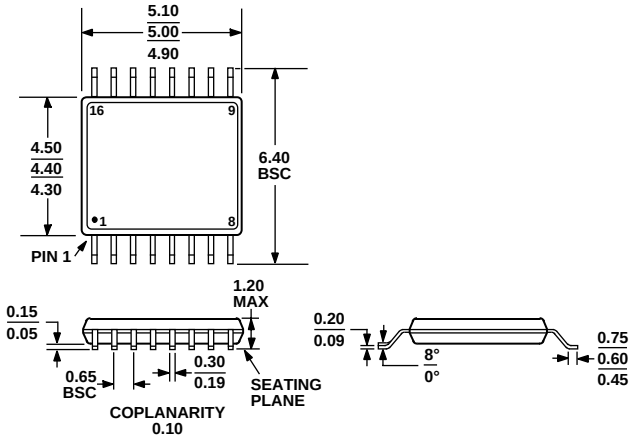
OUTLINE DIMENSIONS



COMPLIANT TO JEDEC STANDARDS MS-001-AB

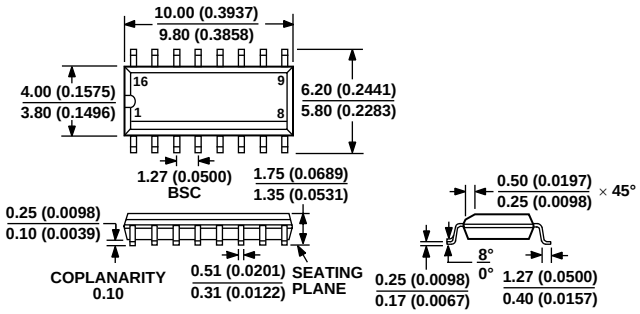
CONTROLLING DIMENSIONS ARE IN INCHES; MILLIMETER DIMENSIONS (IN PARENTHESES) ARE ROUNDED-OFF INCH EQUIVALENTS FOR REFERENCE ONLY AND ARE NOT APPROPRIATE FOR USE IN DESIGN. CORNER LEADS MAY BE CONFIGURED AS WHOLE OR HALF LEADS.

Figure 20. 16-Lead Plastic Dual In-Line Package [PDIP]
Narrow Body
(N-16)
Dimensions shown in inches and (millimeters)



COMPLIANT TO JEDEC STANDARDS MO-153-AB

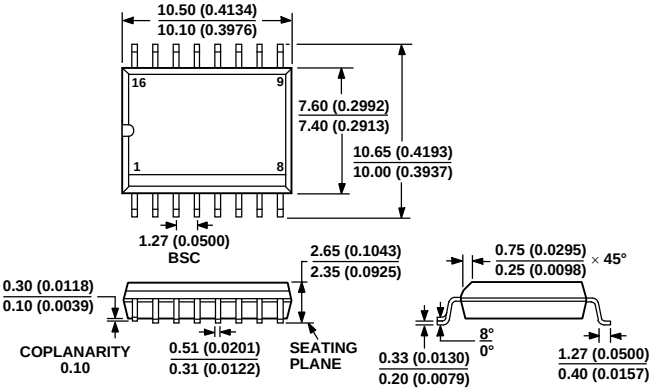
Figure 21. 16-Lead Thin Shrink Small Outline Package [TSSOP]
(RU-16)
Dimensions shown in millimeters



COMPLIANT TO JEDEC STANDARDS MS-012-AC

CONTROLLING DIMENSIONS ARE IN MILLIMETERS; INCH DIMENSIONS (IN PARENTHESES) ARE ROUNDED-OFF MILLIMETER EQUIVALENTS FOR REFERENCE ONLY AND ARE NOT APPROPRIATE FOR USE IN DESIGN

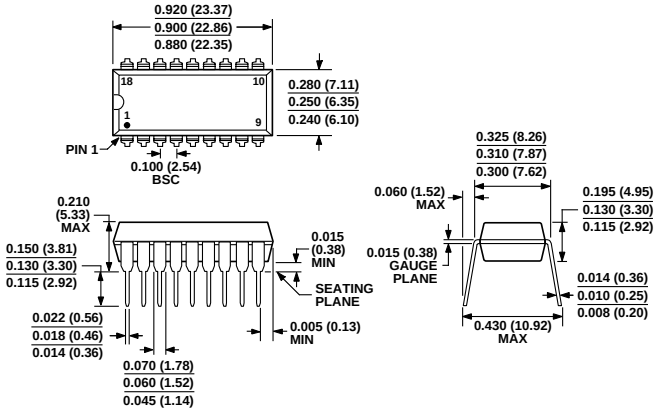
Figure 22. 16-Lead Standard Small Outline Package [SOIC_N]
Narrow Body
(RN-16)
Dimensions shown in millimeters and (inches)



COMPLIANT TO JEDEC STANDARDS MS-013-AA

CONTROLLING DIMENSIONS ARE IN MILLIMETERS; INCH DIMENSIONS (IN PARENTHESES) ARE ROUNDED-OFF MILLIMETER EQUIVALENTS FOR REFERENCE ONLY AND ARE NOT APPROPRIATE FOR USE IN DESIGN

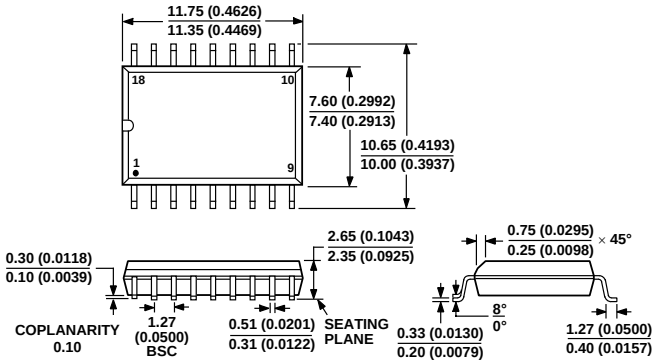
Figure 23. 16-Lead Standard Small Outline Package [SOIC_W]
Wide Body
(RW-16)
Dimensions shown in millimeters and (inches)



COMPLIANT TO JEDEC STANDARDS MS-001-AC

CONTROLLING DIMENSIONS ARE IN INCHES; MILLIMETER DIMENSIONS (IN PARENTHESES) ARE ROUNDED-OFF INCH EQUIVALENTS FOR REFERENCE ONLY AND ARE NOT APPROPRIATE FOR USE IN DESIGN. CORNER LEADS MAY BE CONFIGURED AS WHOLE OR HALF LEADS.

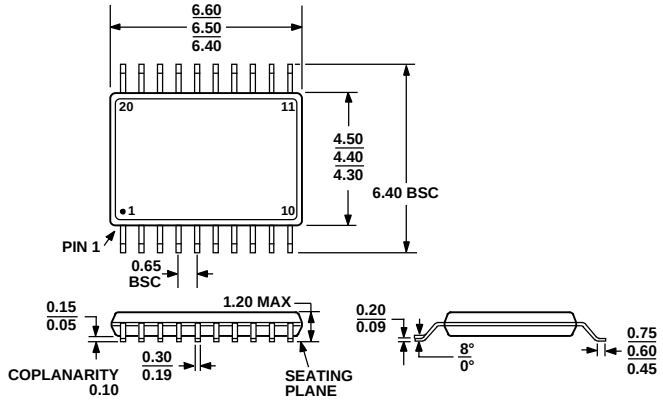
Figure 24. 18-Lead Plastic Dual In-Line Package [PDIP]
Narrow Body
(N-18)
Dimensions shown in inches and (millimeters)



COMPLIANT TO JEDEC STANDARDS MS-013-AB

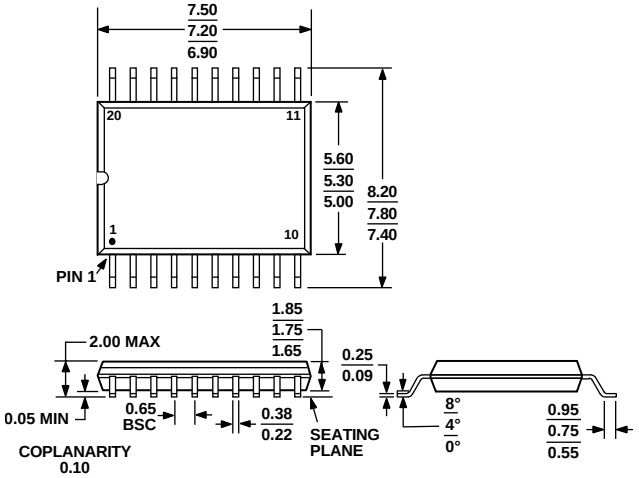
CONTROLLING DIMENSIONS ARE IN MILLIMETERS; INCH DIMENSIONS (IN PARENTHESES) ARE ROUNDED-OFF MILLIMETER EQUIVALENTS FOR REFERENCE ONLY AND ARE NOT APPROPRIATE FOR USE IN DESIGN

Figure 25. 18-Lead Standard Small Outline Package [SOIC_W]
Wide Body
(RW-18)
Dimensions shown in millimeters and (inches)



COMPLIANT TO JEDEC STANDARDS MO-153-AC

Figure 26. 20-Lead Thin Shrink Small Outline Package [TSSOP]
(RU-20)
Dimensions shown in millimeters



COMPLIANT TO JEDEC STANDARDS MO-150-AE

Figure 27. 20-Lead Shrink Small Outline Package [SSOP]
(RS-20)
Dimensions shown in millimeters

ORDERING GUIDE

Model	Temperature Range	Package Description	Package Option
ADM3202AN	–40°C to +85°C	16-Lead Plastic Dual In-Line Package [PDIP]	N-16
ADM3202ANZ[1, 2]	–40°C to +85°C	16-Lead Plastic Dual In-Line Package [PDIP]	N-16
ADM3202ARN	–40°C to +85°C	16-Lead Standard Small Outline Package [SOIC_N]	RN-16
ADM3202ARN-REEL	–40°C to +85°C	16-Lead Standard Small Outline Package [SOIC_N]	RN-16
ADM3202ARN-REEL7	–40°C to +85°C	16-Lead Standard Small Outline Package [SOIC_N]	RN-16
ADM3202ARNZ[1]	–40°C to +85°C	16-Lead Standard Small Outline Package [SOIC_N]	RN-16
ADM3202ARNZ-REEL[1]	–40°C to +85°C	16-Lead Standard Small Outline Package [SOIC_N]	RN-16
ADM3202ARNZ-REEL7[1]	–40°C to +85°C	16-Lead Standard Small Outline Package [SOIC_N]	RN-16
ADM3202ARU	–40°C to +85°C	16-Lead Thin Shrink Small Outline Package [TSSOP]	RU-16
ADM3202ARU-REEL	–40°C to +85°C	16-Lead Thin Shrink Small Outline Package [TSSOP]	RU-16
ADM3202ARU-REEL7	–40°C to +85°C	16-Lead Thin Shrink Small Outline Package [TSSOP]	RU-16
ADM3202ARUZ[1]	–40°C to +85°C	16-Lead Thin Shrink Small Outline Package [TSSOP]	RU-16
ADM3202ARUZ-REEL[1]	–40°C to +85°C	16-Lead Thin Shrink Small Outline Package [TSSOP]	RU-16
ADM3202ARUZ-REEL7[1]	–40°C to +85°C	16-Lead Thin Shrink Small Outline Package [TSSOP]	RU-16
ADM3202ARW	–40°C to +85°C	16-Lead Standard Small Outline Package [SOIC_W]	RW-16
ADM3202ARW-REEL	–40°C to +85°C	16-Lead Standard Small Outline Package [SOIC_W]	RW-16
ADM3202ARW-REEL7	–40°C to +85°C	16-Lead Standard Small Outline Package [SOIC_W]	RW-16
ADM3202ARWZ-REEL[1]	–40°C to +85°C	16-Lead Standard Small Outline Package [SOIC_W]	RW-16
ADM3202ARWZ-REEL7[1]	–40°C to +85°C	16-Lead Standard Small Outline Package [SOIC_W]	RW-16
ADM3222AN	–40°C to +85°C	18-Lead Plastic Dual In-Line Package [PDIP]	N-18
ADM3222ANZ[1, 2]	–40°C to +85°C	18-Lead Plastic Dual In-Line Package [PDIP]	N-18
ADM3222ARS	–40°C to +85°C	20-Lead Shrink Small Outline Package [SSOP]	RS-20
ADM3222ARS-REEL	–40°C to +85°C	20-Lead Shrink Small Outline Package [SSOP]	RS-20
ADM3222ARS-REEL7	–40°C to +85°C	20-Lead Shrink Small Outline Package [SSOP]	RS-20
ADM3222ARSZ[1]	–40°C to +85°C	20-Lead Shrink Small Outline Package [SSOP]	RS-20
ADM3222ARSZ-REEL[1]	–40°C to +85°C	20-Lead Shrink Small Outline Package [SSOP]	RS-20
ADM3222ARSZ-REEL7[1]	–40°C to +85°C	20-Lead Shrink Small Outline Package [SSOP]	RS-20
ADM3222ARU	–40°C to +85°C	20-Lead Thin Shrink Small Outline Package [TSSOP]	RU-20
ADM3222ARU-REEL	–40°C to +85°C	20-Lead Thin Shrink Small Outline Package [TSSOP]	RU-20
ADM3222ARU-REEL7	–40°C to +85°C	20-Lead Thin Shrink Small Outline Package [TSSOP]	RU-20
ADM3222ARUZ[1]	–40°C to +85°C	20-Lead Thin Shrink Small Outline Package [TSSOP]	RU-20
ADM3222ARUZ-REEL[1]	–40°C to +85°C	20-Lead Thin Shrink Small Outline Package [TSSOP]	RU-20
ADM3222ARUZ-REEL7[1]	–40°C to +85°C	20-Lead Thin Shrink Small Outline Package [TSSOP]	RU-20
ADM3222ARW	–40°C to +85°C	18-Lead Standard Small Outline Package [SOIC_W]	RW-18
ADM3222ARW-REEL	–40°C to +85°C	18-Lead Standard Small Outline Package [SOIC_W]	RW-18
ADM3222ARW-REEL7	–40°C to +85°C	18-Lead Standard Small Outline Package [SOIC_W]	RW-18
ADM3222ARWZ[1, 2]	–40°C to +85°C	18-Lead Standard Small Outline Package [SOIC_W]	RW-18
ADM3222ARWZ-REEL[1, 2]	–40°C to +85°C	18-Lead Standard Small Outline Package [SOIC_W]	RW-18
ADM3222ARWZ-REEL7[1, 2]	–40°C to +85°C	18-Lead Standard Small Outline Package [SOIC_W]	RW-18
ADM1385ARS	–40°C to +85°C	20-Lead Shrink Small Outline Package [SSOP]	RS-20
ADM1385ARS-REEL	–40°C to +85°C	20-Lead Shrink Small Outline Package [SSOP]	RS-20
ADM1385ARS-REEL7	–40°C to +85°C	20-Lead Shrink Small Outline Package [SSOP]	RS-20
ADM1385ARSZ[1]	–40°C to +85°C	20-Lead Shrink Small Outline Package [SSOP]	RS-20
ADM1385ARSZ-REEL[1, 2]	–40°C to +85°C	20-Lead Shrink Small Outline Package [SSOP]	RS-20
ADM1385ARSZ-REEL7[1]	–40°C to +85°C	20-Lead Shrink Small Outline Package [SSOP]	RS-20

[1] Z = Pb-free part.
[2] Please consult the ADI website at www.analog.com to find out the current release status for these models.

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