HIN232A

High Speed +5V Powered RS-232 Transmitters/Receivers

FN4316
Rev 1.00
March 13, 2006

The HIN232A high-speed RS-232 transmitter/receiver interface circuit meets all EIA high-speed RS-232E and V.28 specifications, and is particularly suited for those applications where ±12V is not available. They require a single +5V power supply and feature onboard charge pump voltage converters which generate +10V and -10V supplies from the 5V supply.

The drivers feature true TTL/CMOS input compatibility, slew rate-limited output, and 300Ω power-off source impedance. The receivers can handle up to ±30V input, and have a 3kΩ to 7kΩ input impedance. The receivers also feature hysteresis to greatly improve noise rejection.

Ordering Information

PART NO.	PART MARKING	TEMP. RANGE (^{o}C)	PACKAGE	PKG. DWG. #
HIN232ACB	232ACB	0 to 70	16 Ld SOIC	M16.3
HIN232ACB-T	232ACB	0 to 70	16 Ld SOIC Tape and Reel	M16.3
HIN232ACBZ (See Note)	232ACBZ	0 to 70	16 Ld SOIC (Pb-free)	M16.3
HIN232ACBZ-T (See Note)	232ACBZ	0 to 70	16 Ld SOIC Tape and Reel (Pb-free)	M16.3
HIN232ACBN	232ACBN	0 to 70	16 Ld SOIC (N)	M16.15
HIN232ACBN-T	232ACBN	0 to 70	16 Ld SOIC (N) Tape and Reel	M16.15
HIN232ACBNZ (See Note)	232ACBNZ	0 to 70	16 Ld SOIC (N) (Pb-free)	M16.15
HIN232ACBNZ-T (See Note)	232ACBNZ	0 to 70	16 Ld SOIC (N) Tape and Reel (Pb-free)	M16.15
HIN232ACP	HIN232ACP	0 to 70	16 Ld PDIP	E16.3
HIN232ACPZ (See Note)	232ACPZ	0 to 70	16 Ld PDIP* (Pb-free)	E16.3

*Pb-free PDIPs can be used for through hole wave solder processing only. They are not intended for use in Reflow solder processing applications.

NOTE: Intersil Pb-free plus anneal products employ special Pb-free material sets; molding compounds/die attach materials and 100% matte tin plate termination finish, which are 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.

Features

- Meets All RS-232E and V.28 Specifications
- Requires Only 0.1µF or Greater External Capacitors
- High Data Rate. 230kbit/s
- Requires Only Single +5V Power Supply
- Onboard Voltage Doubler/Inverter
- Low Power Consumption (Typ) 5mA
- Multiple Drivers
  - ±10V Output Swing for +5V Input
  - 300Ω Power-Off Source Impedance
  - Output Current Limiting
  - TTL/CMOS Compatible
- Multiple Receivers
  - ±30V Input Voltage Range
  - 3kΩ to 7kΩ Input Impedance
  - 0.5V Hysteresis to Improve Noise Rejection
- Pb-Free Plus Anneal Available (RoHS Compliant)

Applications

- Any System Requiring High-Speed RS-232 Communication Ports
  - Computer - Portable, Mainframe, Laptop
  - Peripheral - Printers and Terminals
  - Instrumentation, UPS
  - Modems

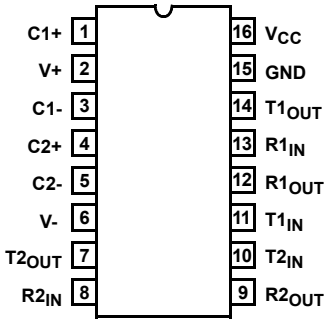
Selection Table

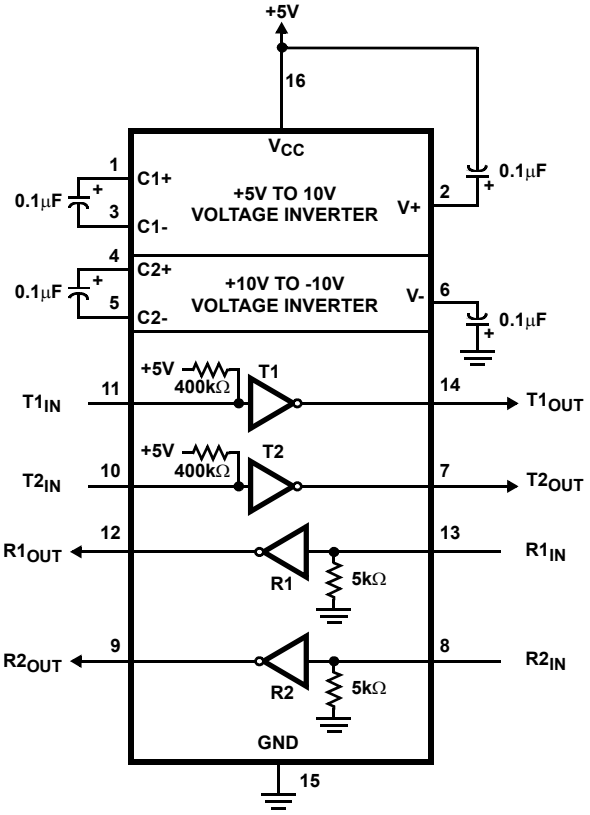
PART NUMBER	POWER SUPPLY VOLTAGE	NUMBER OF RS-232 DRIVERS	NUMBER OF RS-232 RECEIVERS	NUMBER OF 0.1µF EXTERNAL CAPACITORS	LOW POWER SHUTDOWN/TTL THREE-STATE	NUMBER OF RECEIVERS ACTIVE IN SHUTDOWN
HIN232A	+5V	2	2	4 Capacitors	No/No	0

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Pinout

HIN232A (PDIP, SOIC)
TOP VIEW





Pin Descriptions

PIN	FUNCTION
V_{CC}	Power Supply Input 5V ±10%.
V+	Internally generated positive supply (+10V nominal).
V-	Internally generated negative supply (-10V nominal).
GND	Ground Lead. Connect to 0V.
C1+	External capacitor (+ terminal) is connected to this lead.
C1-	External capacitor (- terminal) is connected to this lead.
C2+	External capacitor (+ terminal) is connected to this lead.
C2-	External capacitor (- terminal) is connected to this lead.
T_{IN}	Transmitter Inputs. These leads accept TTL/CMOS levels. An internal 400kΩ pull-up resistor to V_{CC} is connected to each lead.
T_{OUT}	Transmitter Outputs. These are RS-232 levels (nominally ±10V).
R_{IN}	Receiver Inputs. These inputs accept RS-232 input levels. An internal 5kΩ pull-down resistor to GND is connected to each input.
R_{OUT}	Receiver Outputs. These are TTL/CMOS levels.

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Absolute Maximum Ratings

V_{CC} to Ground . . . . . (GND -0.3V) <V_{CC} < 6V
V+ to Ground . . . . . (V_{CC} -0.3V) <V+ < 12V
V- to Ground. . . . . -12V < V- < (GND +0.3V)
Input Voltages
T_{IN} . . . . . -0.3V < V_{IN} < (V+ +0.3V)
R_{IN} . . . . . ±30V
Output Voltages
T_{OUT} . . . . . (V- -0.3V) < V_{TXOUT} < (V+ +0.3V)
R_{OUT} . . . . . (GND -0.3V) < V_{RXOUT} < (V+ +0.3V)
Short Circuit Duration
T_{OUT} . . . . . Continuous
R_{OUT} . . . . . Continuous
ESD Classification . . . . . See Specification Table

Thermal Information

Thermal Resistance (Typical, Note 1)	θ_{JA} (^{o}C/W)
16 Ld SOIC (N) Package	105
16 Ld SOIC (W) Package	110
16 Ld PDIP Package*	85

Maximum Junction Temperature (Plastic Package) . . . . . 150^{o}C
Maximum Storage Temperature Range . . . . . -65^{o}C to 150^{o}C
Maximum Lead Temperature (Soldering 10s) . . . . . 300^{o}C
(SOIC - Lead Tips Only)

*Pb-free PDIPs can be used for through hole wave solder processing only. They are not intended for use in Reflow solder processing applications.

Operating Conditions

Temperature Range
HIN232ACX . . . . . 0^{o}C to 70^{o}C

CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

NOTE:

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

Electrical Specifications

Test Conditions: V_{CC} = +5V ±10%, C1-C4 = 0.1µF; T_A = Operating Temperature Range

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
SUPPLY CURRENTS					
Power Supply Current, I_{CC}	No Load, T_A = 25^{o}C	-	5	10	mA
LOGIC AND TRANSMITTER INPUTS, RECEIVER OUTPUTS					
Input Logic Low, V_{IL}	T_{IN}	-	-	0.8	V
Input Logic High, V_{IH}	T_{IN}	2.0	-	-	V
Transmitter Input Pullup Current, I_P	T_{IN} = 0V	-	15	200	µA
TTL/CMOS Receiver Output Voltage Low, V_{OL}	I_{OUT} = 3.2mA	-	0.1	0.4	V
TTL/CMOS Receiver Output Voltage High, V_{OH}	I_{OUT} = -1mA	3.5	4.6	-	V
RECEIVER INPUTS					
RS-232 Input Voltage Range, V_{IN}		-30	-	+30	V
Receiver Input Impedance, R_{IN}	V_{IN} = ±3V, T_A = 25^{o}C	3.0	5.0	7.0	kΩ
Receiver Input Low Threshold, V_{IN} (H-L)	V_{CC} = 5V, T_A = 25^{o}C	-	1.2	-	V
Receiver Input High Threshold, V_{IN} (L-H)	V_{CC} = 5V, T_A = 25^{o}C	-	1.7	2.4	V
Receiver Input Hysteresis, V_{HYST}	V_{CC} = 5V	0.2	0.5	1.0	V
TIMING CHARACTERISTICS					
Transmitter, Receiver Propagation Delay, t_{PD}		-	0.5	10	µs
Transition Region Slew Rate, SR_T	R_L = 3kΩ, C_L = 1000pF, Measured from +3V to -3V or -3V to +3V, (Note 2) 1 Transmitter Switching	3	20	45	V/µs
TRANSMITTER OUTPUTS					
Output Voltage Swing, T_{OUT}	Transmitter Outputs, 3kΩ to Ground	±5	±9	±10	V
Output Resistance, T_{OUT}	V_{CC} = V+ = V- = 0V, V_{OUT} = ±2V	300	-	-	Ω
RS-232 Output Short Circuit Current, I_{SC}	T_{OUT} Shorted to GND	-	±10	-	mA
ESD PERFORMANCE					
RS-232 Pins (T_{OUT}, R_{IN})	Human Body Model	-	±15	-	kV
	IEC1000-4-2 Contact Discharge	-	±8	-	kV
	IEC1000-4-2 Air Gap (Note 3)	-	±15	-	kV
All Other Pins	Human Body Model	-	±2	-	kV

NOTES:

2. Guaranteed by design.
3. Meets level 4.

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Test Circuits (HIN232A)

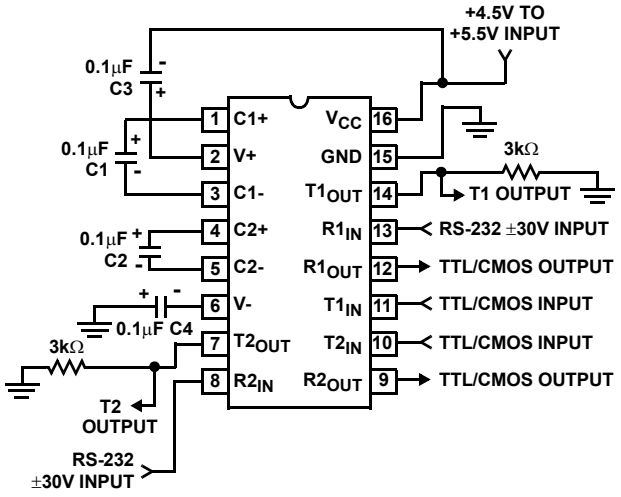


FIGURE 1. GENERAL TEST CIRCUIT

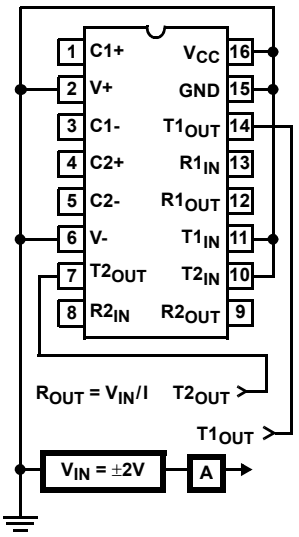


FIGURE 2. POWER-OFF SOURCE RESISTANCE CONFIGURATION

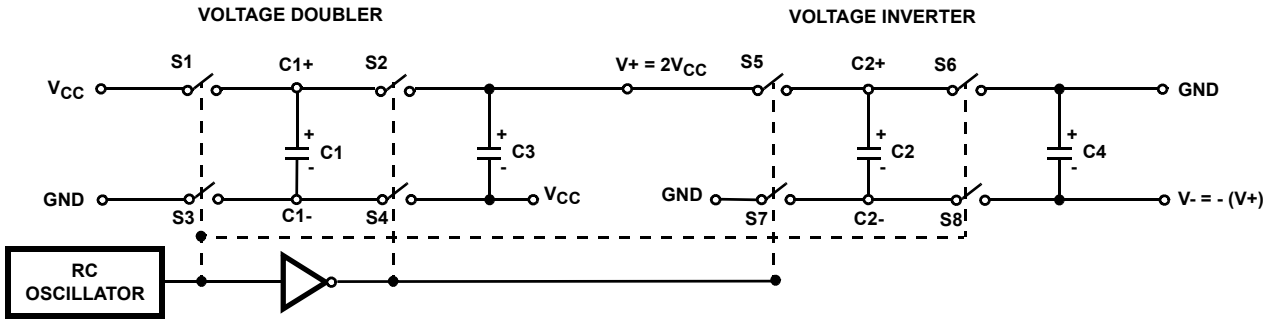


FIGURE 3. CHARGE PUMP

Detailed Description

The HIN232A is a high-speed RS-232 transmitter/receiver that is powered by a single +5V power supply, features low power consumption, and meets all EIA RS232C and V.28 specifications. The circuit is divided into three sections: the charge pump, transmitter, and receiver.

Charge Pump

An equivalent circuit of the charge pump is illustrated in Figure 3. The charge pump contains two sections: The voltage doubler and the voltage inverter. Each section is driven by a two phase, internally generated clock to generate +10V and -10V. The nominal clock frequency is 125kHz. During phase one of the clock, capacitor C1 is charged to V_{CC}. During phase two, the voltage on C1 is added to V_{CC}, producing a signal across C3 equal to twice V_{CC}. During phase two, C2 is also charged to $2V_{CC}$, and then during phase one, it is inverted with respect to ground to produce a signal across C4 equal to $-2V_{CC}$. The charge pump accepts input voltages up to 5.5V. The output impedance of the voltage doubler section (V+) is approximately 200Ω, and the output impedance of the voltage inverter section (V-) is approximately 450Ω. A typical application uses 0.1µF capacitors for C1-C4, however, the value is not critical. Increasing the values of C1 and C2 will lower the output impedance of the voltage doubler and inverter, increasing the values of the reservoir capacitors, C3 and C4, lowers the ripple on the V+ and V- supplies.

Transmitters

The transmitters are TTL/CMOS compatible inverters which translate the inputs to RS-232 outputs. The input logic threshold is about 26% of V_{CC}, or 1.3V for V_{CC} = 5V. A logic 1 at the input results in a voltage of between -5V and V- at the output, and a logic 0 results in a voltage between +5V and (V+ -0.6V). Each transmitter input has an internal 400kΩ pullup resistor so any unused input can be left unconnected and its output remains in its low state. The output voltage swing meets the RS-232C specifications of ±5V minimum with the worst case conditions of: all transmitters driving 3kΩ minimum load impedance, V_{CC} = 4.5V, and maximum allowable operating temperature. The

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transmitters have an internally limited output slew rate which is less than 30V/µs. The outputs are short circuit protected and can be shorted to ground indefinitely. The powered down output impedance is a minimum of 300Ω with ±2V applied to the outputs and V_{CC} = 0V.

Receivers

The receiver inputs accept up to ±30V while presenting the required 3kΩ to 7kΩ input impedance even if the power is off (V_{CC} = 0V). The receivers have a typical input threshold of 1.3V which is within the ±3V limits, known as the transition region, of the RS-232 specifications. The receiver output is 0V to V_{CC}. The output will be low whenever the input is greater than 2.4V and high whenever the input is floating or driven between +0.8V and -30V. The receivers feature 0.5V hysteresis (except during shutdown) to improve noise rejection.

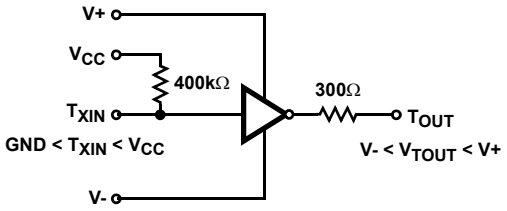


FIGURE 4. TRANSMITTER

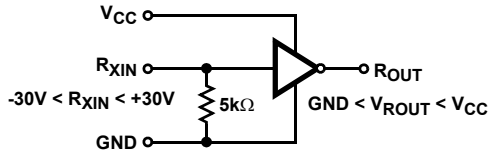


FIGURE 5. RECEIVER

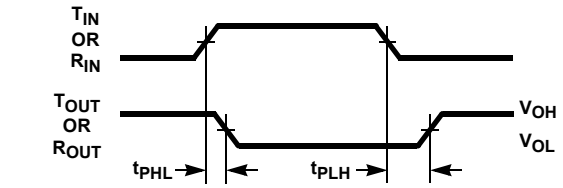


FIGURE 6. PROPAGATION DELAY DEFINITION

Application Information

The HIN232A may be used for all RS-232 data terminal and communication links. It is particularly useful in applications where ±12V power supplies are not available for conventional RS-232 interface circuits. The applications presented represent typical interface configurations.

A simple duplex RS-232 port with CTS/RTS handshaking is illustrated in Figure 7. Fixed output signals such as DTR (data terminal ready) and DSRS (data signaling rate select) is generated by driving them through a 5kΩ resistor connected to V+.

In applications requiring four RS-232 inputs and outputs (Figure 8), note that each circuit requires two charge pump capacitors (C1 and C2) but can share common reservoir capacitors (C3 and C4). The benefit of sharing common reservoir capacitors is the elimination of two capacitors and the reduction of the charge pump source impedance which effectively increases the output swing of the transmitters.

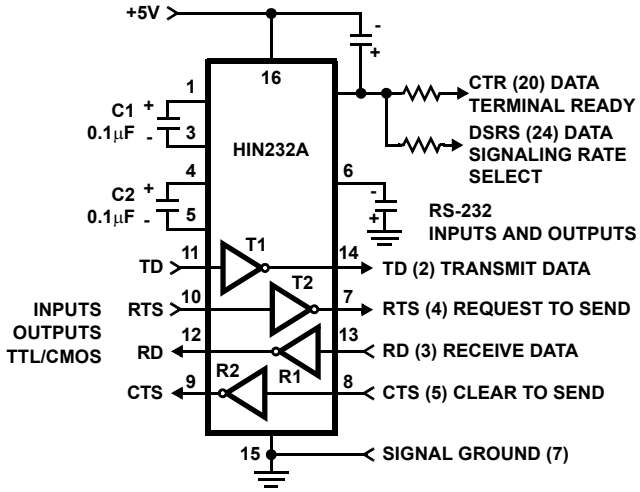


FIGURE 7. SIMPLE DUPLEX RS-232 PORT WITH CTS/RTS HANDSHAKING

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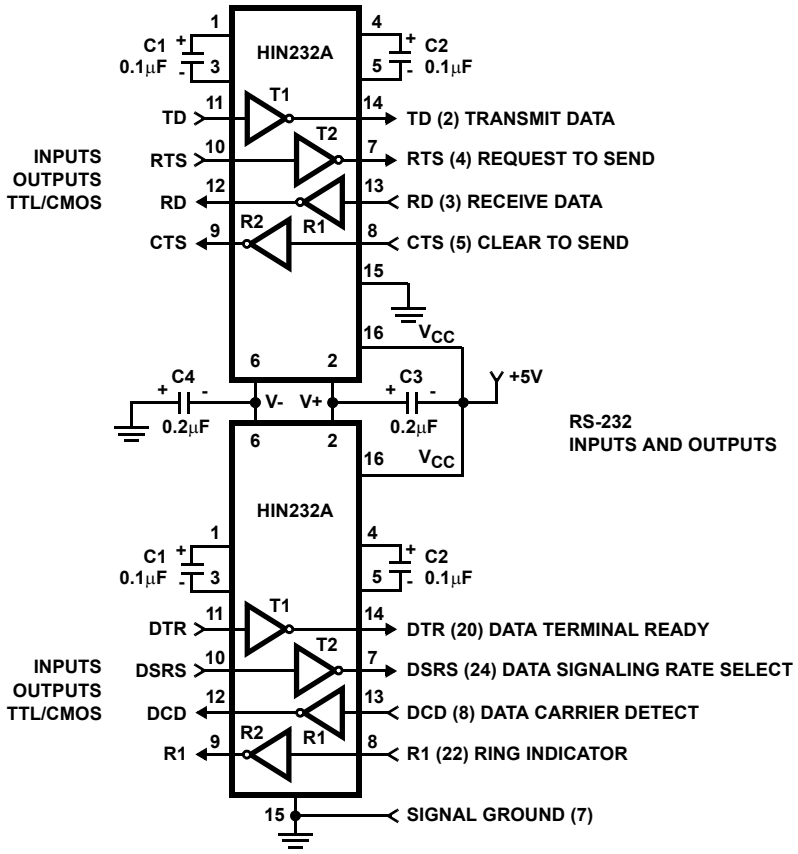


FIGURE 8. COMBINING TWO HIN232As FOR 4 PAIRS OF RS-232 INPUTS AND OUTPUTS

Typical Performance Curves

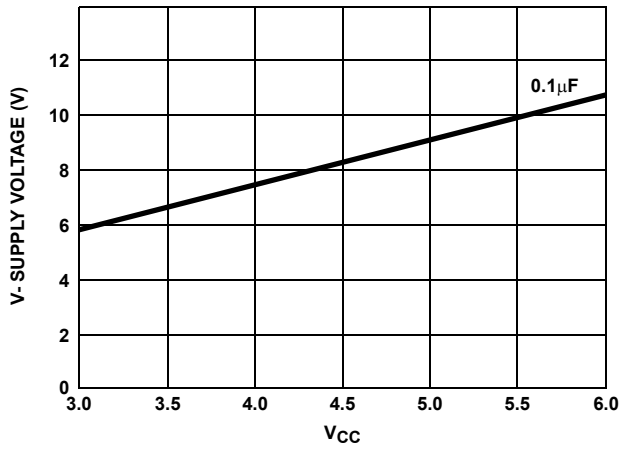


FIGURE 9. V- SUPPLY VOLTAGE vs V_{CC}

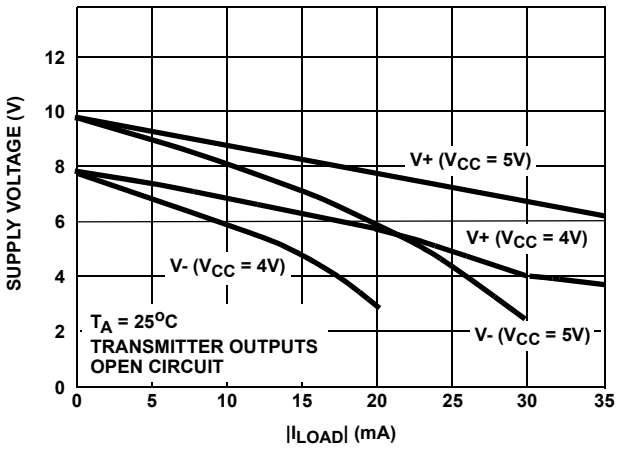


FIGURE 10. V+, V- OUTPUT VOLTAGE vs LOAD

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Die Characteristics

DIE DIMENSIONS

160 mils x 140 mils

METALLIZATION

Type: Al
Thickness: 10kÅ ±1kÅ

SUBSTRATE POTENTIAL

V+

PASSIVATION

Type: Nitride over Silox
Nitride Thickness: 8kÅ
Silox Thickness: 7kÅ

TRANSISTOR COUNT

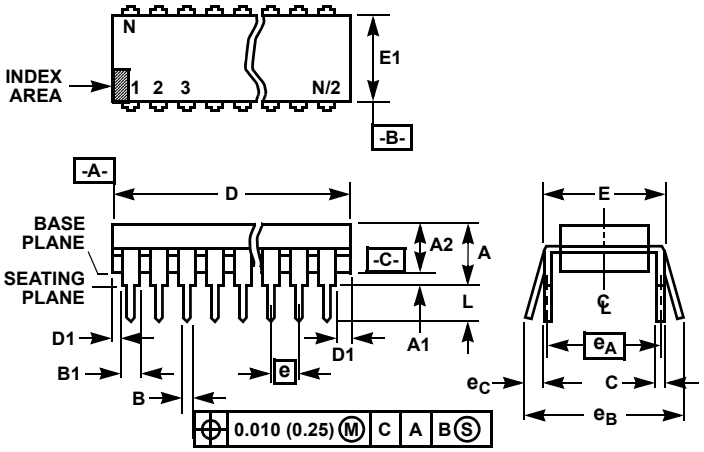
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PROCESS

CMOS Metal Gate

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Dual-In-Line Plastic Packages (PDIP)



NOTES:

1. Controlling Dimensions: INCH. In case of conflict between English and Metric dimensions, the inch dimensions control.
2. Dimensioning and tolerancing per ANSI Y14.5M-1982.
3. Symbols are defined in the “MO Series Symbol List” in Section 2.2 of Publication No. 95.
4. Dimensions A, A1 and L are measured with the package seated in JEDEC seating plane gauge GS-3.
5. D, D1, and E1 dimensions do not include mold flash or protrusions. Mold flash or protrusions shall not exceed 0.010 inch (0.25mm).
6. E and e_A are measured with the leads constrained to be perpendicular to datum -C-.
7. e_B and e_C are measured at the lead tips with the leads unconstrained. e_C must be zero or greater.
8. B1 maximum dimensions do not include dambar protrusions. Dambar protrusions shall not exceed 0.010 inch (0.25mm).
9. N is the maximum number of terminal positions.
10. Corner leads (1, N, N/2 and N/2 + 1) for E8.3, E16.3, E18.3, E28.3, E42.6 will have a B1 dimension of 0.030 - 0.045 inch (0.76 - 1.14mm).

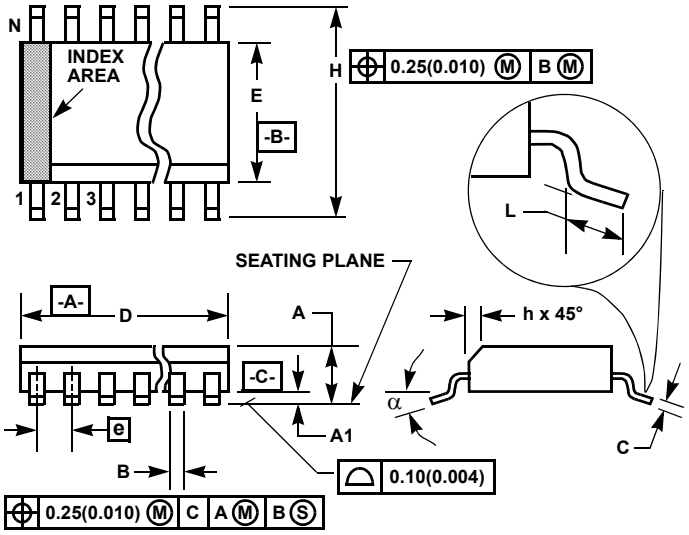
E16.3 (JEDEC MS-001-BB ISSUE D)
16 LEAD DUAL-IN-LINE PLASTIC PACKAGE

SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	-	0.210	-	5.33	4
A1	0.015	-	0.39	-	4
A2	0.115	0.195	2.93	4.95	-
B	0.014	0.022	0.356	0.558	-
B1	0.045	0.070	1.15	1.77	8, 10
C	0.008	0.014	0.204	0.355	-
D	0.735	0.775	18.66	19.68	5
D1	0.005	-	0.13	-	5
E	0.300	0.325	7.62	8.25	6
E1	0.240	0.280	6.10	7.11	5
e	0.100 BSC		2.54 BSC		-
e_A	0.300 BSC		7.62 BSC		6
e_B	-	0.430	-	10.92	7
L	0.115	0.150	2.93	3.81	4
N	16		16		9

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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.

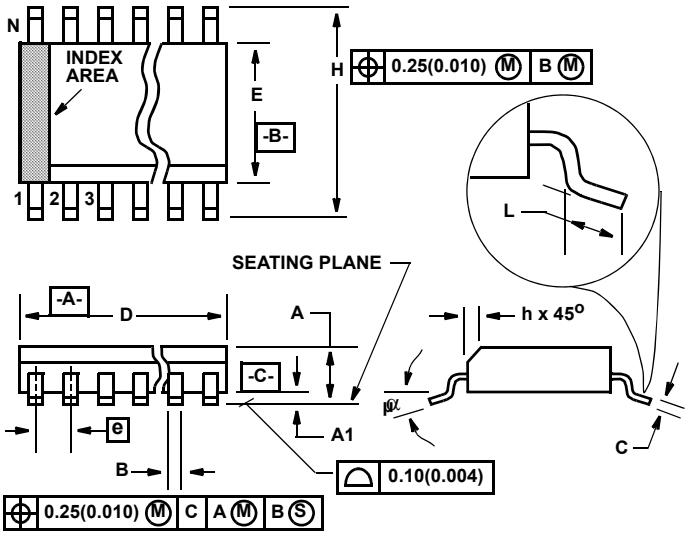
M16.3 (JEDEC MS-013-AA ISSUE C)
16 LEAD WIDE BODY SMALL OUTLINE PLASTIC PACKAGE

SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	0.0926	0.1043	2.35	2.65	-
A1	0.0040	0.0118	0.10	0.30	-
B	0.013	0.0200	0.33	0.51	9
C	0.0091	0.0125	0.23	0.32	-
D	0.3977	0.4133	10.10	10.50	3
E	0.2914	0.2992	7.40	7.60	4
e	0.050 BSC		1.27 BSC		-
H	0.394	0.419	10.00	10.65	-
h	0.010	0.029	0.25	0.75	5
L	0.016	0.050	0.40	1.27	6
N	16		16		7
α	0°	8°	0°	8°	-

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Small Outline Plastic Packages (SOIC)



M16.15 (JEDEC MS-012-AC ISSUE C)
16 LEAD NARROW BODY SMALL OUTLINE PLASTIC PACKAGE

SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	0.053	0.069	1.35	1.75	-
A1	0.004	0.010	0.10	0.25	-
B	0.014	0.019	0.35	0.49	9
C	0.007	0.010	0.19	0.25	-
D	0.386	0.394	9.80	10.00	3
E	0.150	0.157	3.80	4.00	4
e	0.050 BSC		1.27 BSC		-
H	0.228	0.244	5.80	6.20	-
h	0.010	0.020	0.25	0.50	5
L	0.016	0.050	0.40	1.27	6
N	16		16		7
α	0°	8°	0°	8°	-

Rev. 1 02/02

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.

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