

DS14C232

DS14C232 Low Power +5V Powered TIA/EIA-232 Dual Driver/Receiver



Literature Number: SNLS076B

DS14C232

Low Power +5V Powered TIA/EIA-232 Dual Driver/Receiver

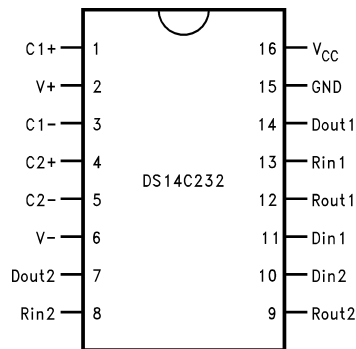
General Description

The DS14C232 is a low power dual driver/receiver featuring an onboard DC to DC converter, eliminating the need for $\pm 12V$ power supplies. The device only requires a +5V power supply. I_{CC} is specified at 3.0 mA maximum, making the device ideal for battery and power conscious applications. The drivers' slew rate is set internally and the receivers feature internal noise filtering, eliminating the need for external slew rate and filter capacitors. The device is designed to interface data terminal equipment (DTE) with data circuit-terminating equipment (DCE). The driver inputs and receiver outputs are TTL and CMOS compatible. DS14C232C driver outputs and receiver inputs meet TIA/EIA-232-E (RS-232) and CCITT V.28 standards.

Features

- Pin compatible with industry standard MAX232, LT1081, ICL232 and TSC232
- Single +5V power supply
- Low power — I_{CC} 3.0 mA maximum
- DS14C232C meets TIA/EIA-232-E (RS-232) and CCITT V.28 standards
- CMOS technology
- Receiver Noise Filter
- Package efficiency — 2 drivers and 2 receivers
- Available in Plastic DIP, Narrow and Wide SOIC packages
- TIA/EIA-232 compatible extended temperature range option:
DS14C232T $-40^{\circ}C$ to $+85^{\circ}C$
DS14C232E/J: $-55^{\circ}C$ to $+125^{\circ}C$

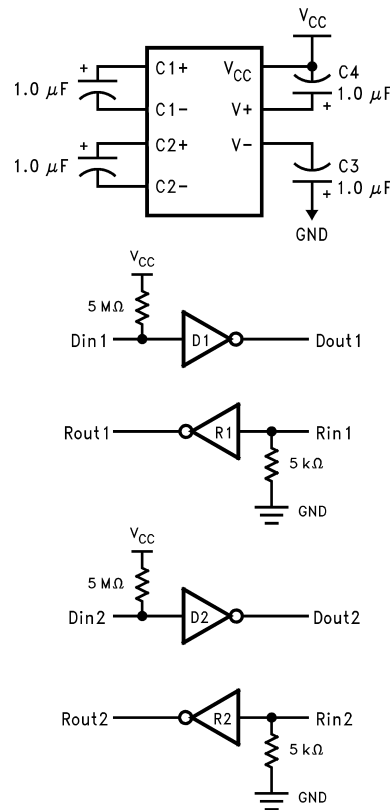
Connection Diagram



01074401

Order Number DS14C232CN, DS14C232CM, or DS14C232TM
See NS Package Number N16E, or M16A

Functional Diagram



01074402

Absolute Maximum Ratings (Note 1)

Specifications for the 883 version of this product are listed separately on the following pages.

Supply Voltage, V_{CC}	-0.3V to 6V
V^+ Pin	$(V_{CC} - 0.3)V$ to +14V
V^- Pin	+0.3V to -14V
Driver Input Voltage	-0.3V to $(V_{CC} + 0.3V)$
Driver Output Voltage	$(V^+ + 0.3V)$ to $(V^- - 0.3V)$
Receiver Input Voltage	$\pm 25V$
Receiver Output Voltage	-0.3V to $(V_{CC} + 0.3V)$
Junction Temperature	+150°C
Maximum Package Power Dissipation @ 25°C (Note 6)	
N Package	1698 mW
M Package	1156 mW
Short Circuit Duration, D_{OUT}	Continuous

Storage Temp. Range	-65°C to +150°C
Lead Temp. (Soldering, 4 sec.)	+260°C
ESD Rating (HBM, 1.5 k Ω , 100 pF)	≥ 2.5 kV

Recommended Operating Conditions

	Min	Max	Units
Supply Voltage, V_{CC}	4.5	5.5	V
Operating Free Air Temp. (T_A)			
DS14C232C	0	+70	°C
DS14C232T	-40	+85	°C

Electrical Characteristics (Note 2)

Over recommended operating conditions, unless otherwise specified

Symbol	Parameter	Conditions	Min	Typ	Max	Units	
DC TO DC CONVERTER CHARACTERISTICS							
V^+	Positive Power Supply	$R_L = 3$ k Ω , C1-C4 = 1.0 μ F, $D_{IN} = 0.8V$		9.0		V	
V^-	Negative Power Supply	$R_L = 3$ k Ω , C1-C4 = 1.0 μ F, $D_{IN} = 2.0V$		-8.5		V	
I_{CC}	Supply (V_{CC}) Current	No Load		1.0	3.0	mA	
DRIVER CHARACTERISTICS							
V_{IH}	High Level Input Voltage		2		V_{CC}	V	
V_{IL}	Low Level Input Voltage		GND		0.8	V	
I_{IH}	High Level Input Current	$V_{IN} \geq 2.0V$	-10		+10	μ A	
I_{IL}	Low Level Input Current	$V_{IN} \leq 0.8V$	-10		+10	μ A	
V_{OH}	High Level Output Voltage	$R_L = 3$ k Ω	5.0	8.0		V	
V_{OL}	Low Level Output Voltage	$R_L = 3$ k Ω		-7.0	-5.0	V	
I_{OS+}	Output High Short Circuit Current	$V_O = 0V$, $V_{IN} = 0.8V$	(Note 3)	-30	-15	-5.0	mA
I_{OS-}	Output Low Short Circuit Current	$V_O = 0V$, $V_{IN} = 2V$		5.0	11	30	mA
R_O	Output Resistance	$-2V \leq V_O \leq +2V$, $V_{CC} = 0V = GND$	300			Ω	
RECEIVER CHARACTERISTICS							
V_{TH}	Input High Threshold Voltage	$V_{CC} = 5.0V$		1.9	2.4	V	
		$V_{CC} = 5.0V \pm 10\%$		1.9	2.6	V	
V_{TL}	Input Low Threshold Voltage		0.8	1.5		V	
V_{HY}	Hysteresis		0.2	0.4	1.0	V	
R_{IN}	Input Resistance		-15V $\leq V_{IN} \leq$ +15V	3.0	4.7	7.0	k Ω
I_{IN}	Input Current	$V_{IN} = +15V$		+2.14	+3.75	+5.0	mA
		$V_{IN} = +3V$		+0.43	+0.64	+1.0	mA
		$V_{IN} = -3V$		-1.0	-0.64	-0.43	mA
		$V_{IN} = -15V$		-5.0	-3.75	-2.14	mA
V_{OH}	High Level Output Voltage	$V_{IN} = -3V$, $I_O = -3.2$ mA	3.5	4.5		V	

Electrical Characteristics (Note 2) (Continued)

Over recommended operating conditions, unless otherwise specified

Symbol	Parameter	Conditions	Min	Typ	Max	Units
RECEIVER CHARACTERISTICS						
		$V_{IN} = -3V, I_O = -20 \mu A$	4.0	4.9		V
V_{OL}	Low Level Output Voltage	$V_{IN} = +3V, I_O = +3.2 \text{ mA}$		0.15	0.4	V

Switching Characteristics

Over recommended operating conditions, unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Units
DRIVER CHARACTERISTICS						
t_{PLH}	Propagation Delay Low to High	$R_L = 3 \text{ k}\Omega$ $C_L = 50 \text{ pF}$		1.0	4.0	μs
t_{PHL}	Propagation Delay High to Low			1.0	4.0	μs
t_{SK}	Skew $ t_{PLH} - t_{PHL} $			0.1	1.0	μs
SR1	Output Slew Rate	$R_L = 3 \text{ k}\Omega$ to $7 \text{ k}\Omega$, $C_L = 50 \text{ pF}$	4.0		30	$V/\mu s$
SR2	Output Slew Rate	$R_L = 3 \text{ k}\Omega$, $C_L = 2500 \text{ pF}$		4.5		$V/\mu s$

Symbol	Parameter	Conditions	Min	Typ	Max	Units
RECEIVER CHARACTERISTICS						
t_{PLH}	Propagation Delay Low to High	Input Pulse Width > 10 μs		2.9	6.5	μs
t_{PHL}	Propagation Delay High to Low	$C_L = 50 \text{ pF}$		2.5	6.5	μs
t_{SK}	Skew $ t_{PLH} - t_{PHL} $	(Figures 3, 4)		0.4	2.0	μs
t_{nw}	Noise Pulse Width Rejected	(Figures 3, 4)		0.7	0.5	μs

Note 1: "Absolute Maximum Ratings" are those values beyond which the safety of the device cannot be guaranteed. They are not meant to imply that the devices should be operated at these limits. The tables of "Electrical Characteristics" specify conditions for device operation.

Note 2: Current into device pins is defined as positive. Current out of device pins is defined as negative. All voltages are referenced to ground unless otherwise specified.

Note 3: I_{OS+} and I_{OS-} values are for one output at a time. If more than one output is shorted simultaneously, the device power dissipation may be exceeded.

Note 4: Receiver AC input waveform for test purposes: $t_r = t_f = 200 \text{ ns}$, $V_{IH} = 3V$, $V_{IL} = -3V$, $f = 30 \text{ kHz}$.

Note 5: All typicals are given for $V_{CC} = 5.0V$.

Note 6: Ratings apply to ambient temperature at +25°C. Above this temperature derate: N Package 15.6 mW/°C, and M Package 10.6 mW/°C.

Note 7: Slew rate is defined as $\Delta V/\Delta t$, measured between $\pm 3V$ level.

Absolute Maximum Ratings (Note 1)

For complete Military Product Specifications, refer to the appropriate SMD or MDS.

Supply Voltage, V_{CC}	-0.3V to 6V
V^+ Pin	$(V_{CC} - 0.3)V$ to +14V
V^- Pin	+0.3V to -14V
Driver Input Voltage	-0.3V to $(V_{CC} + 0.3V)$
Driver Output Voltage	$(V^+ + 0.3V)$ to $(V^- - 0.3V)$
Receiver Input Voltage	$\pm 25V$
Receiver Output Voltage	-0.3V to $(V_{CC} + 0.3V)$
Maximum Package Power Dissipation @ 25°C (Note 8)	
J Package	1520 mW
E Package	2000 mW
Short Circuit Duration, D_{OUT}	Continuous

Storage Temp. Range -65°C to +150°C

Lead Temp. (Soldering, 4 sec.) +260°C

ESD Rating (HMB, 1.5 k Ω , 100 pF) $\geq 2.5 \text{ kV}$ **Recommended Operating Conditions**

	Min	Max	Units
Supply Voltage, V_{CC}	4.5	5.5	V
Operating Free Air Temp. (T_A) DS14C232E/J	-55	+125	°C

Electrical Characteristics (Note 2)

Over recommended operating conditions, unless otherwise specified

Symbol	Parameter	Conditions	Min	Max	Units
DEVICE CHARACTERISTICS (C1–C4 = 1.0 μF)					
I_{CC}	Supply (V_{CC}) Current	No Load		8.0	mA
DRIVER CHARACTERISTICS					
V_{IH}	High Level Input Voltage		2		V
V_{IL}	Low Level Input Voltage			0.8	V
I_{IH}	High Level Input Current	$V_{IN} \geq 2.0V$		100	μ A
I_{IL}	Low Level Input Current	$V_{IN} = 0V$		100	μ A
V_{OH}	High Level Output Voltage	$R_L = 3 k\Omega$	5.0		V
V_{OL}	Low Level Output Voltage	$R_L = 3 k\Omega$		-5.0	V
I_{OS+}	Output High Short Circuit Current	$V_O = 0V$	(Note 3)	-25	mA
I_{OS-}	Output Low Short Circuit Current	$V_O = 0V$		25	mA
R_O	Output Resistance	$-2V \leq V_O \leq +2V$, $T_A = 25^\circ C$, $V_{CC} = 0V = GND$	300		Ω
RECEIVER CHARACTERISTICS (C1–C4 = 1.0 μF)					
V_{TH}	Input High Threshold Voltage			3.0	V
V_{TL}	Input Low Threshold Voltage		0.2		V
V_{HY}	Hysteresis	$T_A = 25^\circ C, +125^\circ C$	0.1	1.0	V
		$T_A = -55^\circ C$	0.05	1.0	V
R_{IN}	Input Resistance	$V_{IN} = \pm 3V$ and $\pm 15V$, $T_A = 25^\circ C$	3.0	7.0	k Ω
V_{OH}	High Level Output Voltage	$I_O = -3.2 mA$	3.5		V
		$I_O = -20 \mu A$	4.0		V
V_{OL}	Low Level Output Voltage	$I_O = +3.2 mA$		0.4	V

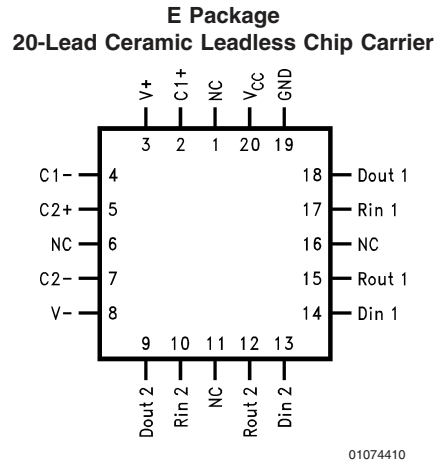
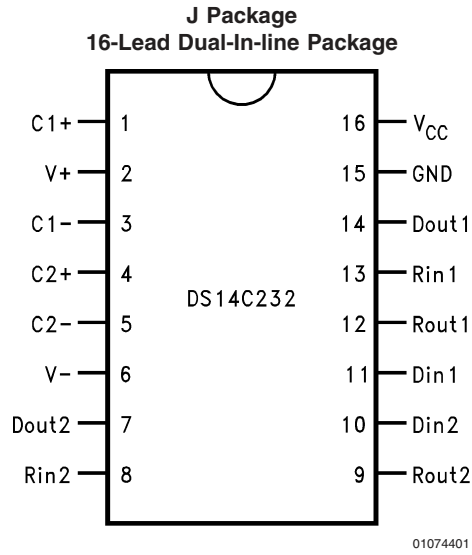
Switching Characteristics

Over recommended operating conditions, unless otherwise specified.

Symbol	Parameter	Conditions	Min	Max	Units
DRIVER CHARACTERISTICS (C1–C4 = 1.0 μF)					
t_{PLH}	Propagation Delay Low to High	$R_L = 3 k\Omega$, $C_L = 50 pF$	<i>Figures 1, 2</i>	4.0	μ s
t_{PHL}	Propagation Delay High to Low			4.0	μ s
t_{SK}	Skew $ t_{PLH} - t_{PHL} $			1.0	μ s
SR1	Output Slew Rate	$R_L = 3 k\Omega$ to $7 k\Omega$, $C_L = 2500 pF$	(Note 7)	1.5	30 V/ μ s
RECEIVER CHARACTERISTICS (C1–C4 = 1.0 μF)					
t_{PLH}	Propagation Delay Low to High	Input Pulse Width $> 10 \mu$ s		8.0	μ s
t_{PHL}	Propagation Delay High to Low	$C_L = 50 pF$		8.0	μ s
t_{SK}	Skew $ t_{PLH} - t_{PHL} $	<i>(Figures 3, 4)</i>		2.0	μ s

Note 8: Ratings apply to ambient temperature at $+25^\circ C$. Above this temperature derate: J Package 12.2 mW/ $^\circ C$ and E Package 13.3 mW/ $^\circ C$.

Connection Diagrams



For Complete Military Product Specifications
See MDS or SMD.
Order Number DS14C232J/883 or DS14C232E/883
See NS Package Number E20A or J16A

Parameter Measurement Information

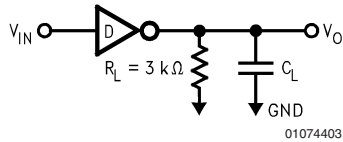


FIGURE 1. Driver Load Circuit

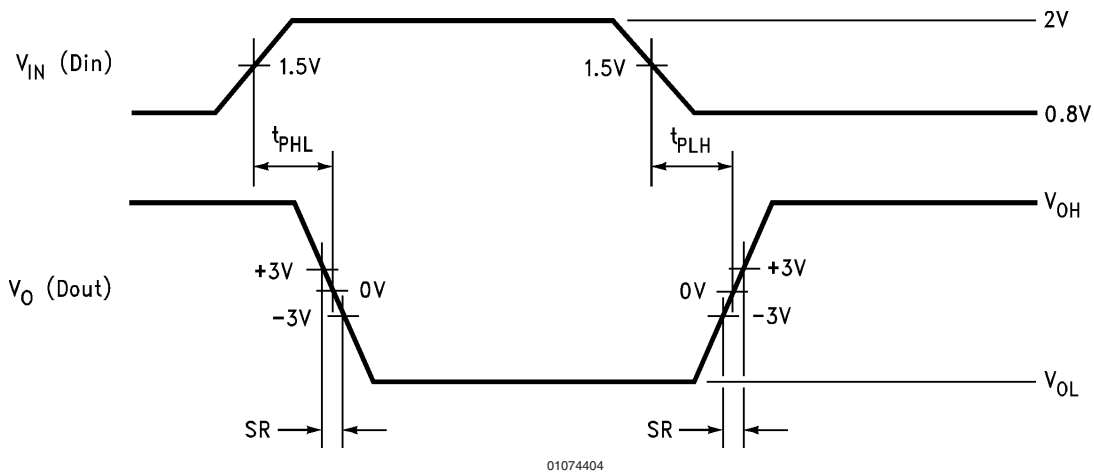
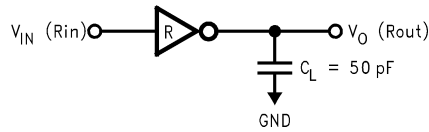


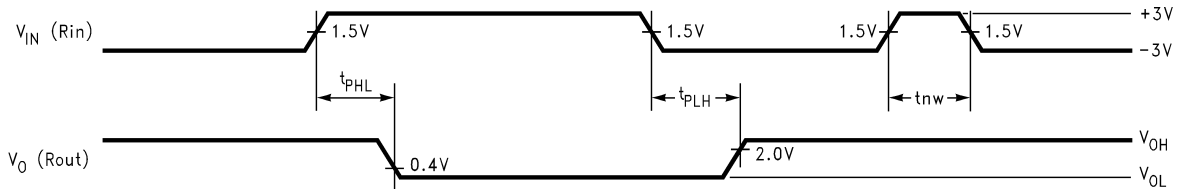
FIGURE 2. Driver Switching Waveform

Parameter Measurement Information (Continued)



01074405

FIGURE 3. Receiver Load Circuit



01074406

FIGURE 4. Receiver Propagation Delays and Noise Rejection (Note 4)

Pin Descriptions

V_{CC} (Pin 16)

Power supply pin for the device, +5V (±10%).

V₊ (Pin 2)

Positive supply for TIA/EIA-232-E drivers. Recommended external capacitor: C4-1.0 μF (6.3V). Capacitor value should be larger than 1 μF. This supply is not intended to be loaded externally.

V₋ (Pin 6)

Negative supply for TIA/EIA-232-E drivers. Recommended external capacitor: C3-1.0 μF (16V). Capacitor value should be larger than 1 μF. This supply is not intended to be loaded externally.

C1+, C1- (Pins 1, 3)

External capacitor connection pins. Recommended capacitor: 1.0 μF (6.3V). Capacitor value should be larger than 1 μF.

C2+, C2- (Pins 4, 5)

External capacitor connection pins. Recommended capacitor: 1.0 μF (16V). Capacitor value should be greater than 1 μF.

D_{IN1}, D_{IN2} (Pins 11, 10)

Driver input pins are TTL/CMOS compatible. Inputs of unused drivers may be left open, an internal active pull-up resistor (500 kΩ minimum, typically 5 MΩ) pulls input HIGH. Output will be LOW for open inputs.

D_{OUT1}, D_{OUT2} (Pins 14, 7)

Driver output pins conform to TIA/EIA-232-E levels.

R_{IN1}, R_{IN2} (Pins 13, 8)

Receiver input pins accept TIA/EIA-232-E input voltages (±25V). Receivers feature a noise filter and guaranteed hysteresis of 100 mV. Unused receiver input pins may be left open. Internal input resistor 4.7 kΩ pulls input low, providing a failsafe high output.

R_{OUT1}, R_{OUT2} (Pins 12, 9)

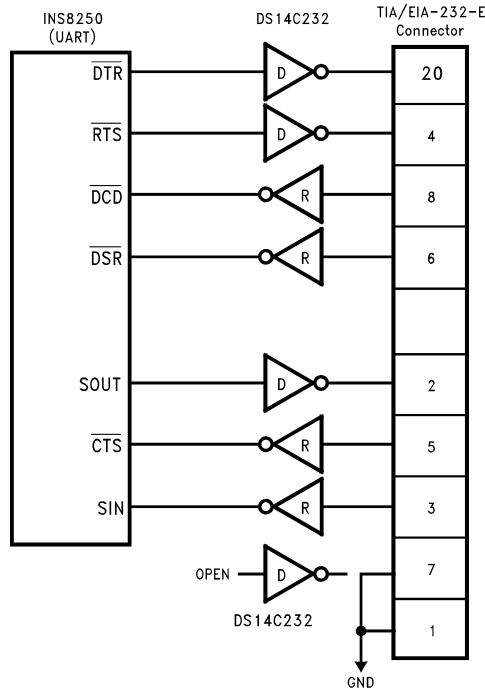
Receiver output pins are TTL/CMOS compatible. Receiver output HIGH voltage is specified for both CMOS and TTL load conditions.

GND (Pin 15)

Ground Pin.

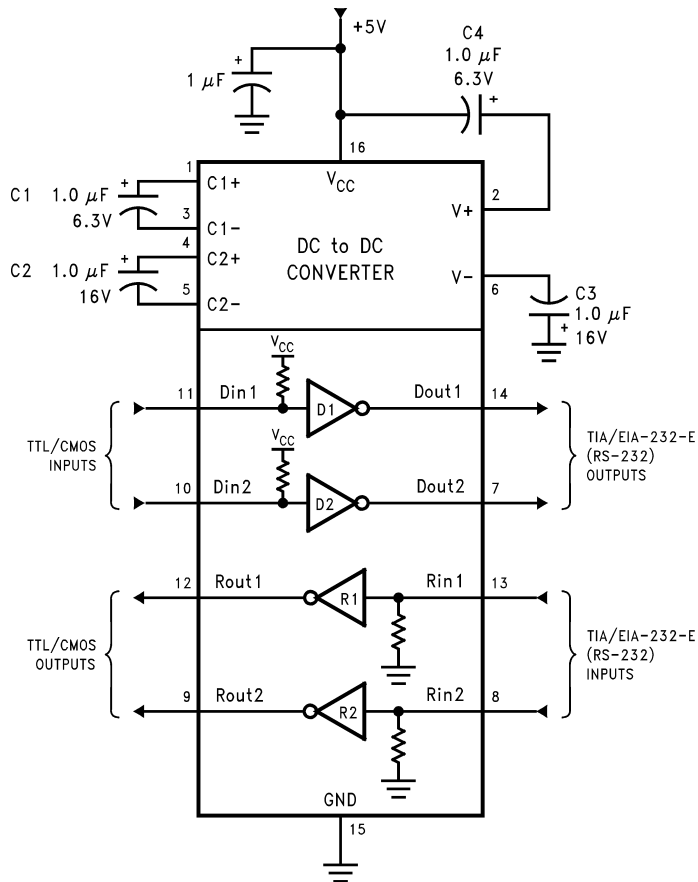
Typical Application Information

Application of DS14C232 and INS8250



01074407

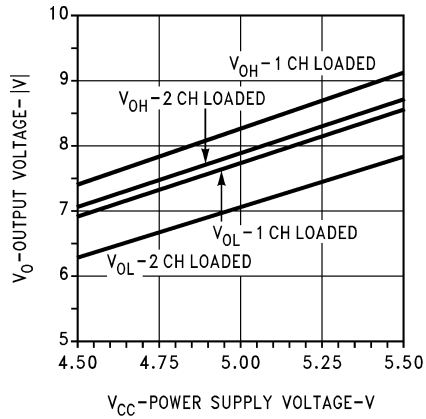
Typical Connection Diagram



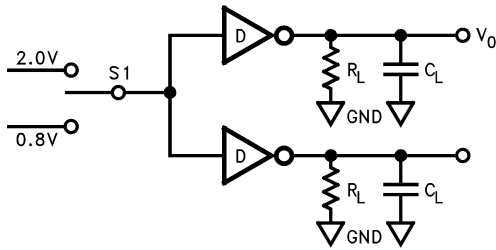
01074409

Typical Performance Characteristics

DRIVER V_{OH} & V_{OL} vs POWER SUPPLY VOLTAGE

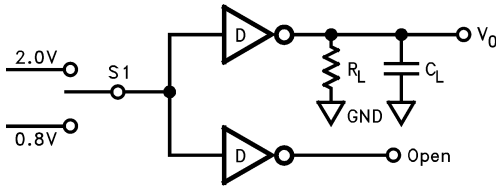


01074411



01074412

$V_{CC} = 5.0V$, $R_L = 3 k\Omega$, $C_L = 15 pF$ (includes jig and probe capacitance), $C_P = 1 \mu F$

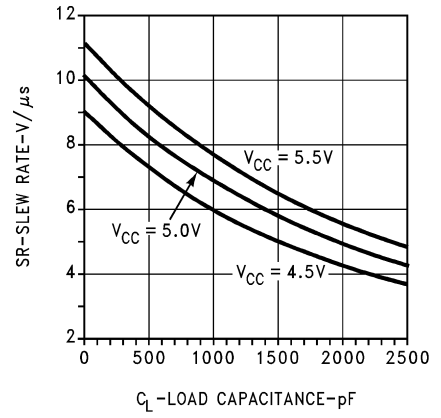


01074413

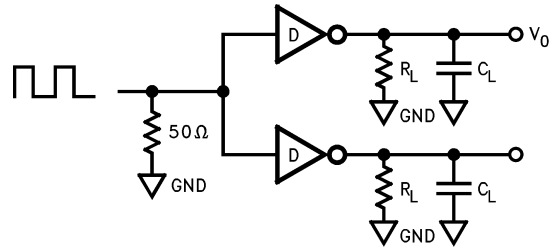
S1	V_O
2.0V	V_{OL}

S1	V_O
0.8V	V_{OH}

DRIVER SLEW RATE vs POWER SUPPLY VOLTAGE & LOAD CAPACITANCE



01074414



01074415

$T_a = 25^\circ C$, $R_L = 5 k\Omega$, $C_P = 1 \mu F$, $f = 30 KHz$

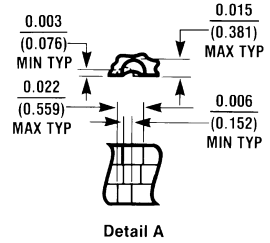
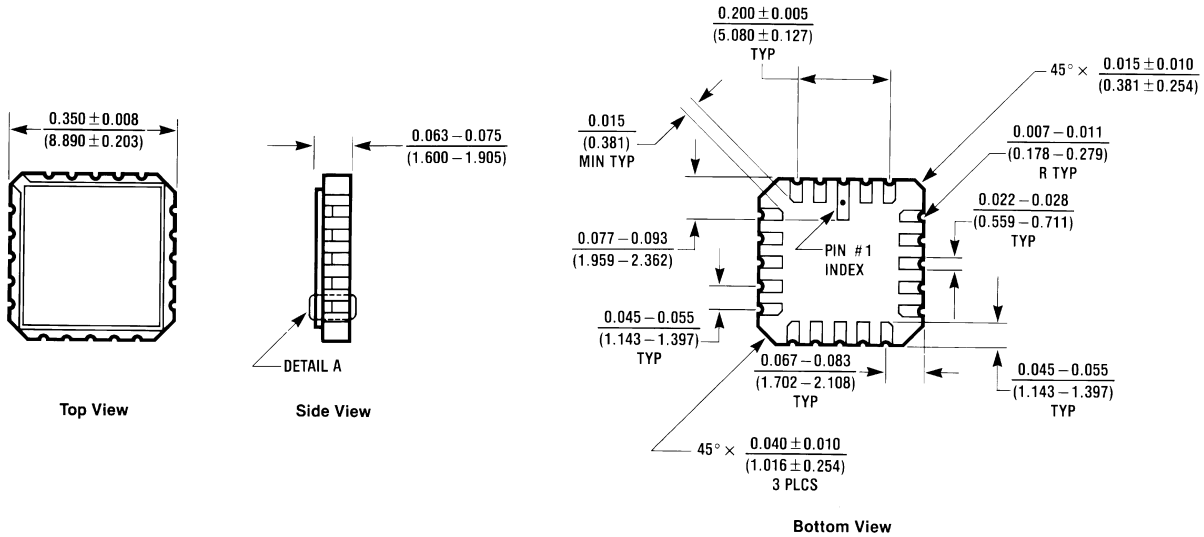


01074416

$SR = 6V/t1$ or $6V/t2$, whichever is greater.

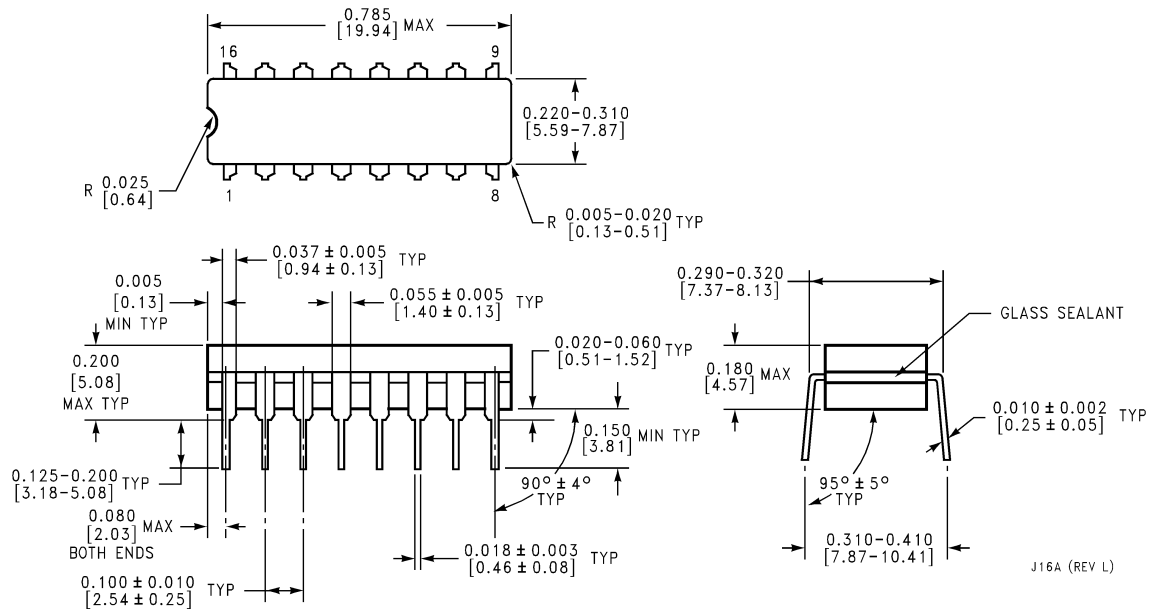
Physical Dimensions inches (millimeters)

unless otherwise noted



Order Number DS14C232E/883
NS Package Number E20A

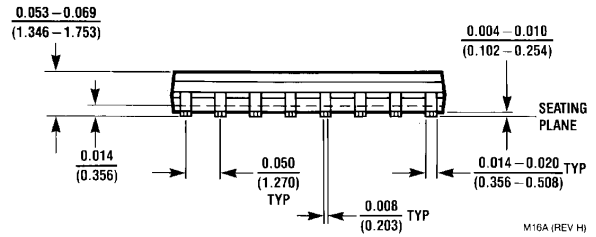
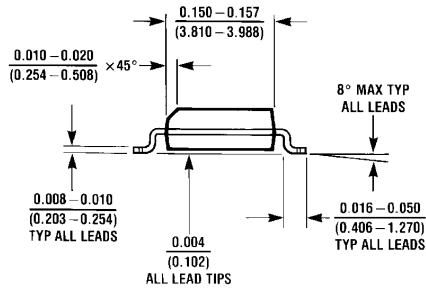
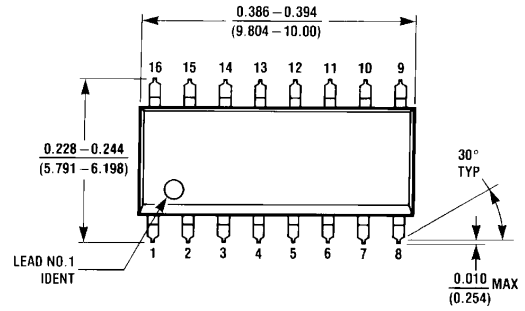
E20A (REV D)



Order Number DS14C232J/883
NS Package Number J16A

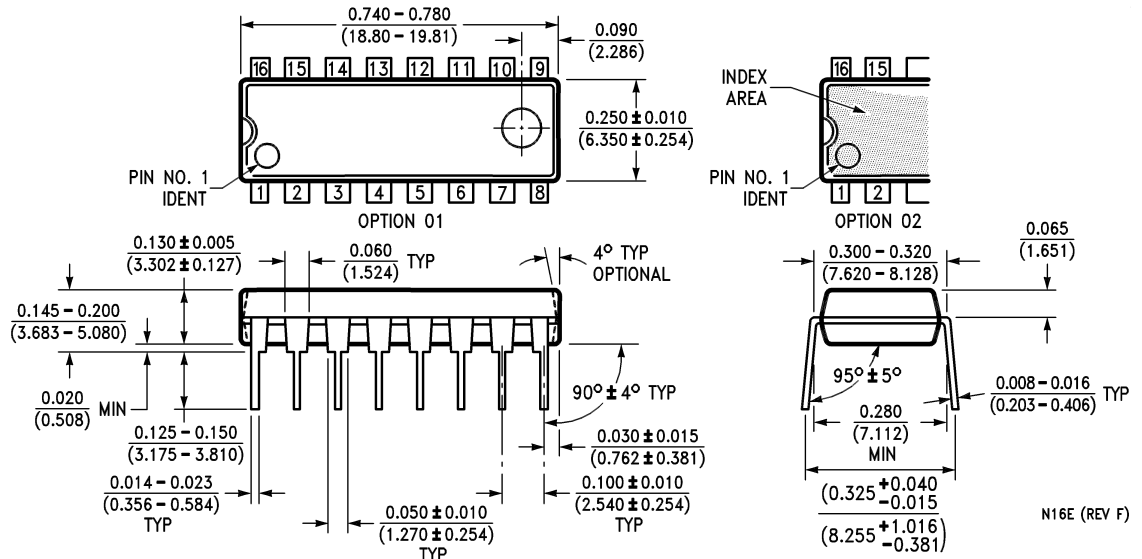
J16A (REV L)

Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



M16A (REV H)

Order Number DS14C232CM or DS14C232TM
NS Package Number M16A



N16E (REV F)

Order Number DS14C232CN
NS Package Number N16E

Notes

LIFE SUPPORT POLICY

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT AND GENERAL COUNSEL OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

BANNED SUBSTANCE COMPLIANCE

National Semiconductor certifies that the products and packing materials meet the provisions of the Customer Products Stewardship Specification (CSP-9-111C2) and the Banned Substances and Materials of Interest Specification (CSP-9-111S2) and contain no "Banned Substances" as defined in CSP-9-111S2.



National Semiconductor
Americas Customer
Support Center
Email: new.feedback@nsc.com
Tel: 1-800-272-9959

www.national.com

National Semiconductor
Europe Customer Support Center
Fax: +49 (0) 180-530 85 86
Email: europe.support@nsc.com
Deutsch Tel: +49 (0) 69 9508 6208
English Tel: +44 (0) 870 24 0 2171
Français Tel: +33 (0) 1 41 91 8790

National Semiconductor
Asia Pacific Customer
Support Center
Email: ap.support@nsc.com

National Semiconductor
Japan Customer Support Center
Fax: 81-3-5639-7507
Email: jpn.feedback@nsc.com
Tel: 81-3-5639-7560

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products

Audio	www.ti.com/audio
Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DLP® Products	www.dlp.com
DSP	dsp.ti.com
Clocks and Timers	www.ti.com/clocks
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
OMAP Mobile Processors	www.ti.com/omap
Wireless Connectivity	www.ti.com/wirelessconnectivity

Applications

Communications and Telecom	www.ti.com/communications
Computers and Peripherals	www.ti.com/computers
Consumer Electronics	www.ti.com/consumer-apps
Energy and Lighting	www.ti.com/energy
Industrial	www.ti.com/industrial
Medical	www.ti.com/medical
Security	www.ti.com/security
Space, Avionics and Defense	www.ti.com/space-avionics-defense
Transportation and Automotive	www.ti.com/automotive
Video and Imaging	www.ti.com/video

TI E2E Community Home Page

e2e.ti.com

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2011, Texas Instruments Incorporated