

## DS14C232

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

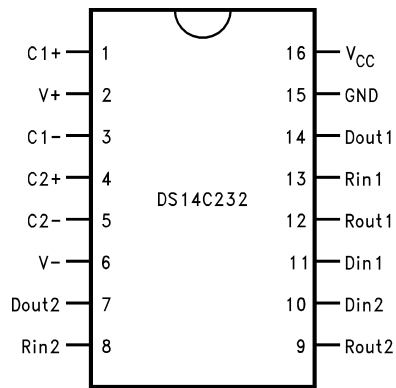
#### General Description

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

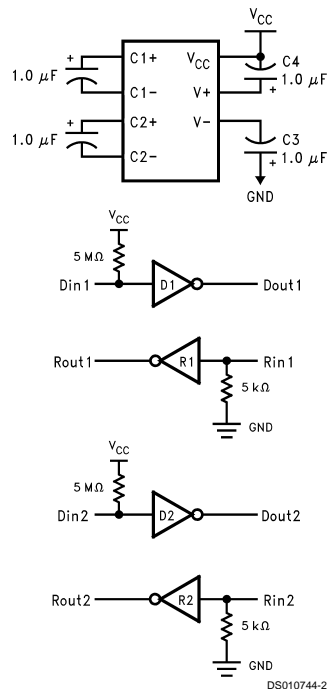
- Pin compatible with industry standard MAX232, LT1081, ICL232 and TSC232
- Single +5V power supply
- Low power —  $I_{CC}$  3.0 mA maximum
- DS14C232C meets TIA/EIA-232-E (RS-232) and CCITT V.28 standards
- CMOS technology
- Receiver Noise Filter
- Package efficiency — 2 drivers and 2 receivers
- Available 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



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

#### Functional Diagram



**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 $\Omega$ , 100 pF)  $\geq 2.5$  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	
<b>DC TO DC CONVERTER CHARACTERISTICS</b>							
$V^+$	Positive Power Supply	$R_L = 3$ k $\Omega$ , C1-C4 = 1.0 $\mu$ F, $D_{IN} = 0.8V$		9.0		V	
$V^-$	Negative Power Supply	$R_L = 3$ k $\Omega$ , C1-C4 = 1.0 $\mu$ F, $D_{IN} = 2.0V$		-8.5		V	
$I_{CC}$	Supply ( $V_{CC}$ ) Current	No Load		1.0	3.0	mA	
<b>DRIVER CHARACTERISTICS</b>							
$V_{IH}$	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	$\mu$ A	
$I_{IL}$	Low Level Input Current	$V_{IN} \leq 0.8V$	-10		+10	$\mu$ A	
$V_{OH}$	High Level Output Voltage	$R_L = 3$ k $\Omega$	5.0	8.0		V	
$V_{OL}$	Low Level Output Voltage	$R_L = 3$ k $\Omega$		-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			$\Omega$	
<b>RECEIVER CHARACTERISTICS</b>							
$V_{TH}$	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 $\Omega$
$I_{IN}$	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	
		$V_{IN} = -3V$ , $I_O = -20$ $\mu$ A		4.0	4.9	V	
$V_{OL}$	Low Level Output Voltage	$V_{IN} = +3V$ , $I_O = +3.2$ mA		0.15	0.4	V	

## Switching Characteristics

Over recommended operating conditions, unless otherwise specified.

Symbol	Parameter	Conditions	Min	Typ	Max	Units	
<b>DRIVER CHARACTERISTICS</b>							
$t_{PLH}$	Propagation Delay Low to High	$R_L = 3\text{ k}\Omega$ $C_L = 50\text{ pF}$		Figure 1 and Figure 2	1.0	4.0	$\mu\text{s}$
$t_{PHL}$	Propagation Delay High to Low				1.0	4.0	$\mu\text{s}$
$t_{SK}$	Skew $ t_{PLH} - t_{PHL} $				0.1	1.0	$\mu\text{s}$
SR1	Output Slew Rate	$R_L = 3\text{ k}\Omega$ to $7\text{ k}\Omega$ , $C_L = 50\text{ pF}$	(Note 7)	4.0		30	$\text{V}/\mu\text{s}$
SR2	Output Slew Rate			$R_L = 3\text{ k}\Omega$ , $C_L = 2500\text{ pF}$	4.5		$\text{V}/\mu\text{s}$
<b>RECEIVER CHARACTERISTICS</b>							
$t_{PLH}$	Propagation Delay Low to High	Input Pulse Width $> 10\text{ }\mu\text{s}$		2.9	6.5	$\mu\text{s}$	
$t_{PHL}$	Propagation Delay High to Low	$C_L = 50\text{ pF}$		2.5	6.5	$\mu\text{s}$	
$t_{SK}$	Skew $ t_{PLH} - t_{PHL} $	(Figures 3, 4)		0.4	2.0	$\mu\text{s}$	
$t_{nw}$	Noise Pulse Width Rejected	(Figures 3, 4)		0.7	0.5	$\mu\text{s}$	

**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:  $t_r = t_f = 200\text{ ns}$ ,  $V_{IH} = 3\text{V}$ ,  $V_{IL} = -3\text{V}$ ,  $f = 30\text{ kHz}$ .

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

**Note 6:** Ratings apply to ambient temperature at  $+25^\circ\text{C}$ . Above this temperature derate: N Package  $15.6\text{ mW}/^\circ\text{C}$ , and M Package  $10.6\text{ mW}/^\circ\text{C}$ .

**Note 7:** Slew rate is defined as  $\Delta V/\Delta t$ , measured between  $\pm 3\text{V}$  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 $\Omega$ , 100 pF)	$\geq 2.5$ kV

**Recommended Operating Conditions**

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

**Electrical Characteristics** (Note 2)

Over recommended operating conditions, unless otherwise specified

Symbol	Parameter	Conditions	Min	Max	Units
<b>DEVICE CHARACTERISTICS (C1-C4 = 1.0 <math>\mu</math>F)</b>					
$I_{CC}$	Supply ( $V_{CC}$ ) Current	No Load		8.0	mA
<b>DRIVER CHARACTERISTICS</b>					
$V_{IH}$	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	$\mu$ A
$I_{IL}$	Low Level Input Current	$V_{IN} = 0V$		100	$\mu$ 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		$\Omega$
<b>RECEIVER CHARACTERISTICS (C1-C4 = 1.0 <math>\mu</math>F)</b>					
$V_{TH}$	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°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 $\Omega$
$V_{OH}$	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**

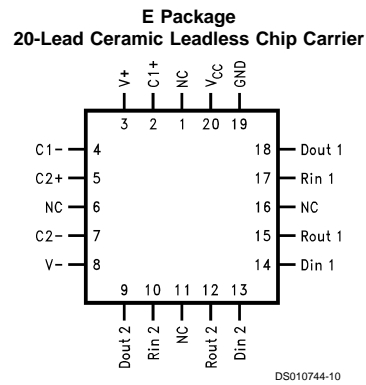
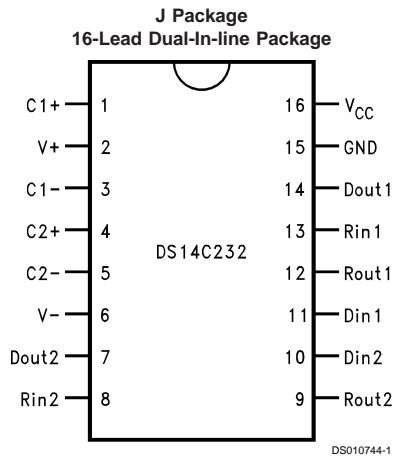
Over recommended operating conditions, unless otherwise specified.

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

## Switching Characteristics (Continued)

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

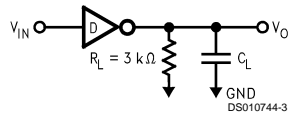


FIGURE 1. Driver Load Circuit

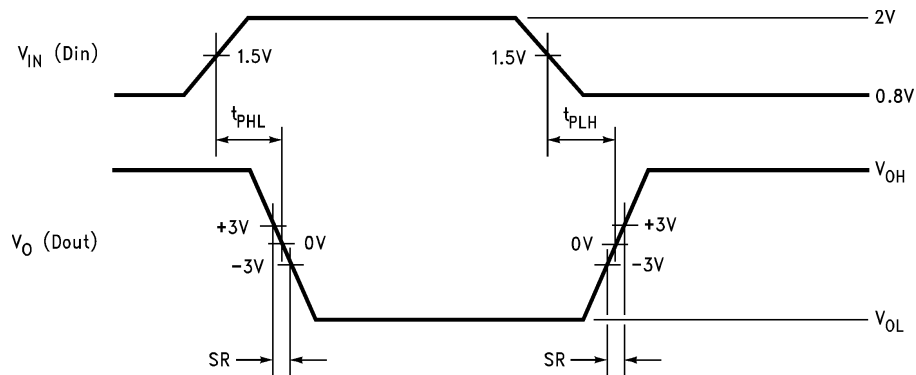


FIGURE 2. Driver Switching Waveform

## Parameter Measurement Information (Continued)

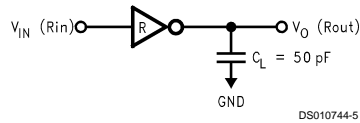


FIGURE 3. Receiver Load Circuit

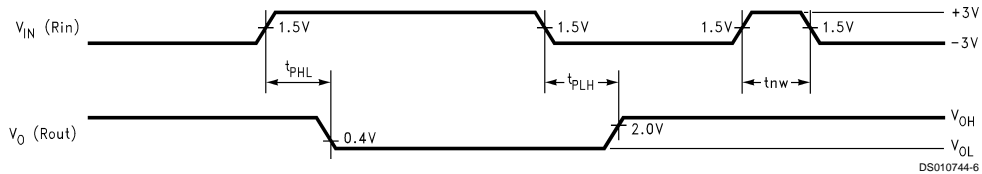


FIGURE 4. Receiver Propagation Delays and Noise Rejection (Note 4)

## Pin Descriptions

### V<sub>CC</sub> (Pin 16)

Power supply pin for the device, +5V ( $\pm 10\%$ ).

### V+ (Pin 2)

Positive supply for TIA/EIA-232-E drivers. Recommended external capacitor: C4-1.0  $\mu\text{F}$  (6.3V). Capacitor value should be larger than 1  $\mu\text{F}$ . 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  $\mu\text{F}$  (16V). Capacitor value should be larger than 1  $\mu\text{F}$ . This supply is not intended to be loaded externally.

### C1+, C1- (Pins 1, 3)

External capacitor connection pins. Recommended capacitor: 1.0  $\mu\text{F}$  (6.3V). Capacitor value should be larger than 1  $\mu\text{F}$ .

### C2+, C2- (Pins 4, 5)

External capacitor connection pins. Recommended capacitor: 1.0  $\mu\text{F}$  (16V). Capacitor value should be greater than 1  $\mu\text{F}$ .

### D<sub>IN1</sub>, D<sub>IN2</sub> (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 k $\Omega$  minimum, typically 5 M $\Omega$ ) pulls input HIGH. Output will be LOW for open inputs.

### D<sub>OUT1</sub>, D<sub>OUT2</sub> (Pins 14, 7)

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

### R<sub>IN1</sub>, R<sub>IN2</sub> (Pins 13, 8)

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

### R<sub>OUT1</sub>, R<sub>OUT2</sub> (Pins 12, 9)

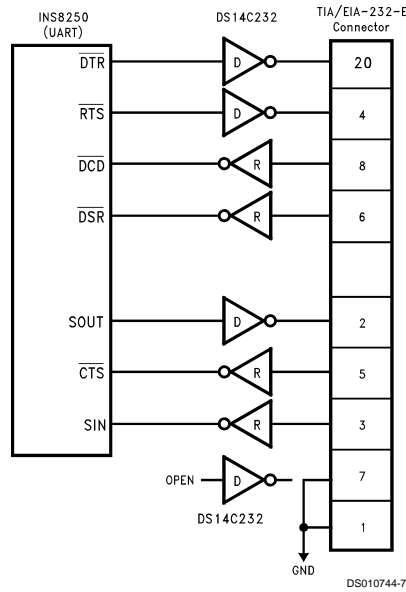
Receiver output pins are TTL/CMOS compatible. Receiver output HIGH voltage is specified for both CMOS and TTL load conditions.

### GND (Pin 15)

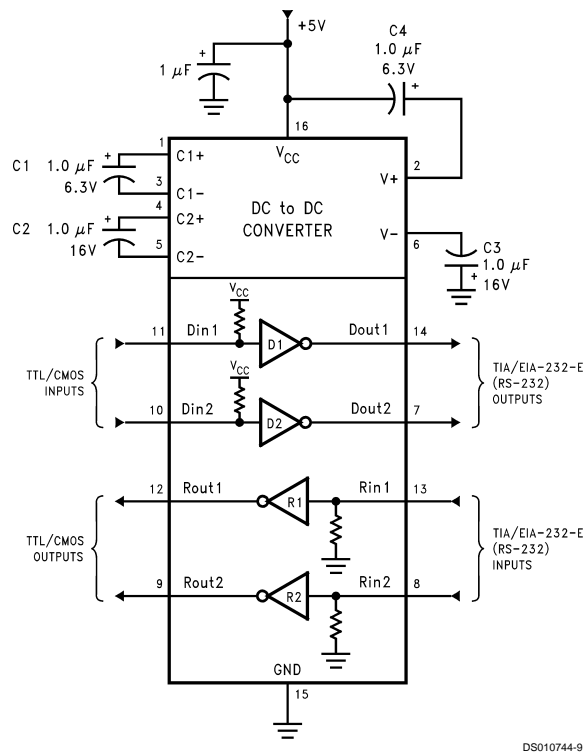
Ground Pin.

### Typical Application Information

Application of DS14C232 and INS8250

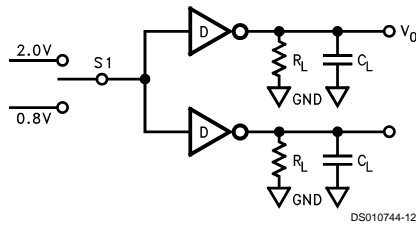
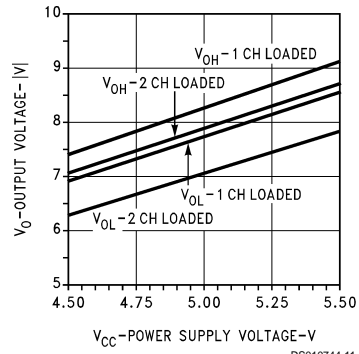


### Typical Connection Diagram

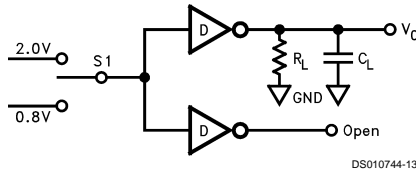


## Typical Performance Characteristics

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



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

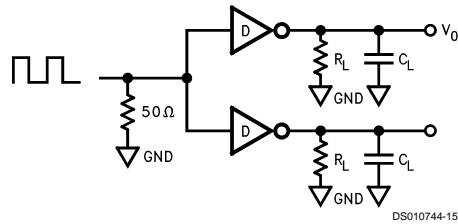
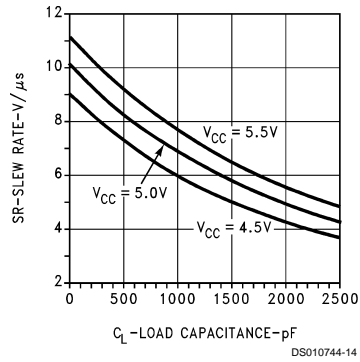


S1	$V_O$
2.0V	$V_{OL}$
0.8V	$V_{OH}$

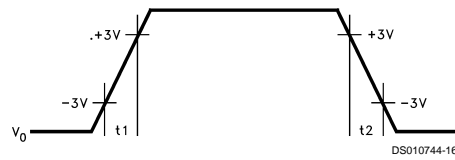


**Typical Performance Characteristics** (Continued)

**DRIVER SLEW RATE vs POWER  
SUPPLY VOLTAGE & LOAD  
CAPACITANCE**

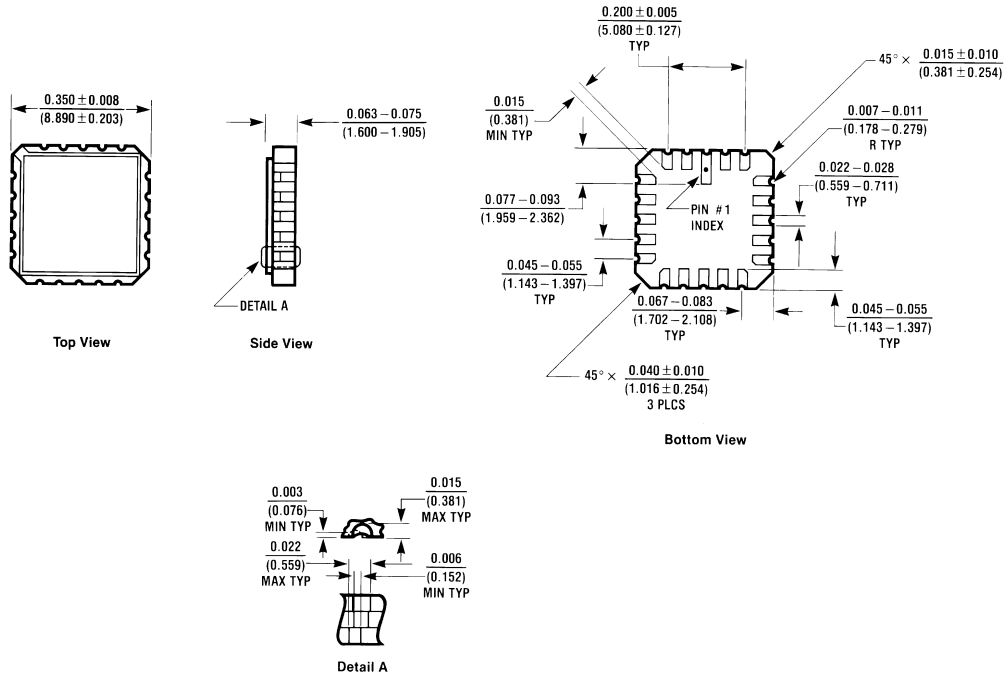


T<sub>a</sub> = 25°C, R<sub>L</sub> = 5 kΩ, C<sub>P</sub> = 1 μF, f = 30 KHz



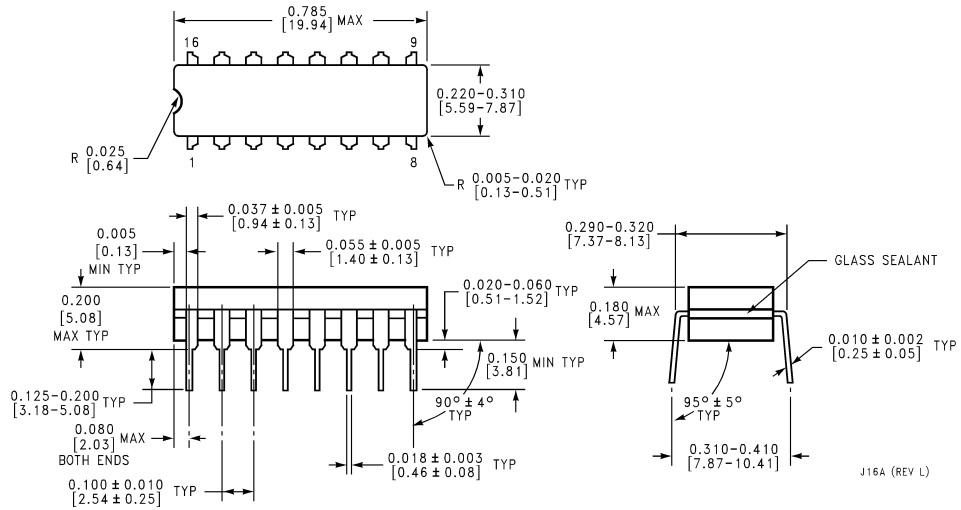
SR = 6V/t<sub>1</sub> or 6V/t<sub>2</sub>, whichever is greater.

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



**Order Number DS14C232E/883**  
**NS Package Number E20A**

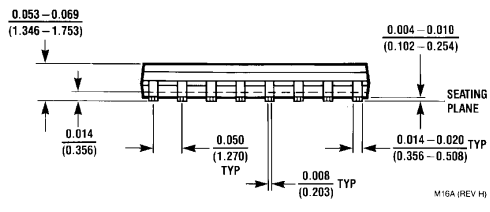
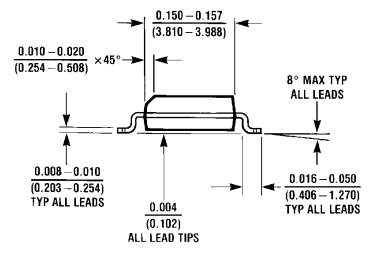
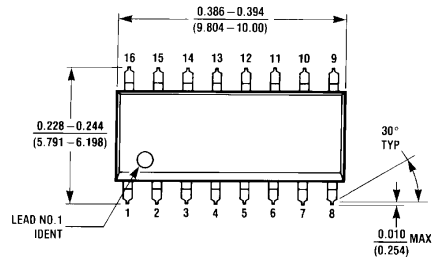
E20A (REV 01)



**Order Number DS14C232J/883**  
**NS Package Number J16A**

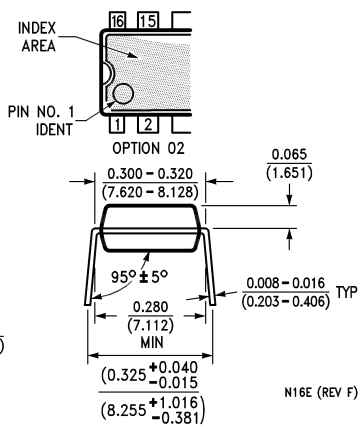
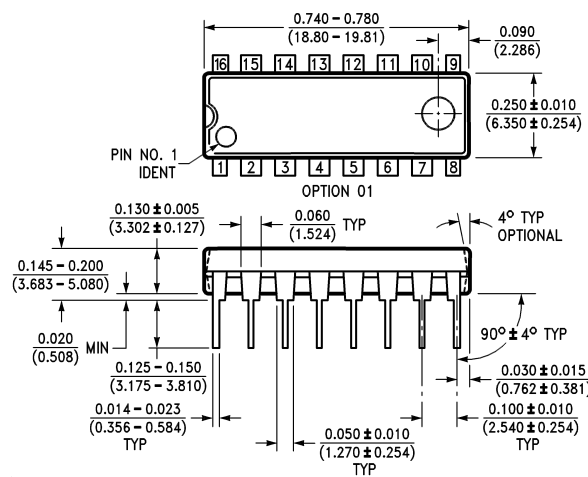
J16A (REV L)

**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

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