National Semiconductor

October 1999

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

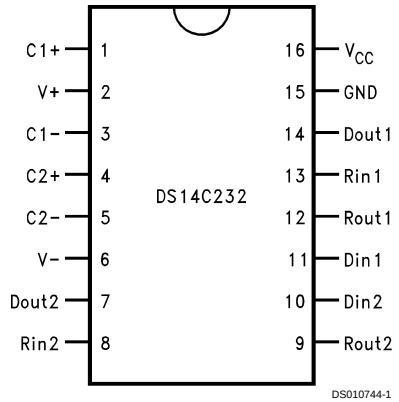
General Description

The DS14C232 is a low power dual driver/receiver featuring an onboard DC to DC converter, eliminating the need for ±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

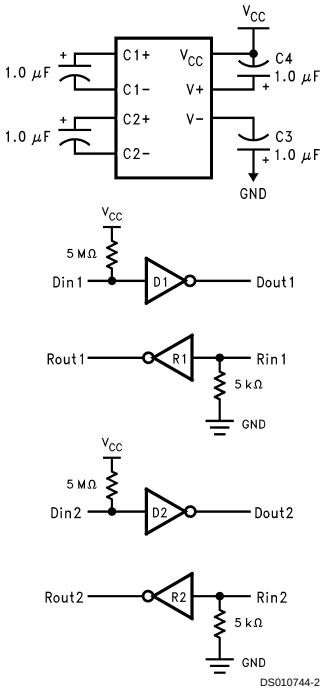
- Pin compatible with industry standard MAX232, LT1081, ICL232 and TSC232
- Single +5V power supply
- Low power — I_{CC} 3.0 mA maximum
- DS14C232C meets TIA/EIA-232-E (RS-232) and CCITT V.28 standards
- CMOS technology
- Receiver Noise Filter
- Package efficiency — 2 drivers and 2 receivers
- Available in Plastic DIP, Narrow and Wide SOIC packages
- TIA/EIA-232 compatible extended temperature range option:
  DS14C232T −40˚C to +85˚C
  DS14C232E/J: −55˚C to +125˚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	±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 kΩ, 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 kΩ, C1–C4 = 1.0 µF, D_{IN} = 0.8V			9.0		V
V^-	Negative Power Supply	R_L = 3 kΩ, C1–C4 = 1.0 µF, 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} ≥ 2.0V		−10		+10	µA
I_{IL}	Low Level Input Current	V_{IN} ≤ 0.8V		−10		+10	µA
V_{OH}	High Level Output Voltage	R_L = 3 kΩ		5.0	8.0		V
V_{OL}	Low Level Output Voltage	R_L = 3 kΩ			−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 ≤ V_O ≤ +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 ±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 ≤ V_{IN} ≤ +15V	3.0	4.7	7.0	kΩ
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 µA		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
DRIVER CHARACTERISTICS							
t_{PLH}	Propagation Delay Low to High	R_L = 3 kΩ C_L = 50 pF	*Figure 1* and *Figure 2*		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 kΩ to 7 kΩ, C_L = 50 pF	(Note 7)	4.0		30	V/µs
SR2	Output Slew Rate	R_L = 3 kΩ, C_L = 2500 pF			4.5		V/µs
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 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: IOS_+ and IOS_- 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 ns, V_{IH} = 3V, V_{IL} = −3V, f = 30 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 ΔV/Δt, measured between ±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	±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 kΩ, 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)			
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	µA
I_{IL}	Low Level Input Current	V_{IN} = 0V			100	µA
V_{OH}	High Level Output Voltage	R_L = 3 kΩ		5.0		V
V_{OL}	Low Level Output Voltage	R_L = 3 kΩ			−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 ≤ V_O ≤ +2V, T_A = 25˚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˚C, +125˚C		0.1	1.0	V
		T_A = −55˚C		0.05	1.0	V
R_{IN}	Input Resistance	V_{IN} = ±3V and ±15V, T_A = 25˚C		3.0	7.0	kΩ
V_{OH}	High Level Output Voltage	I_O = −3.2 mA		3.5		V
		I_O = −20 µA		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.

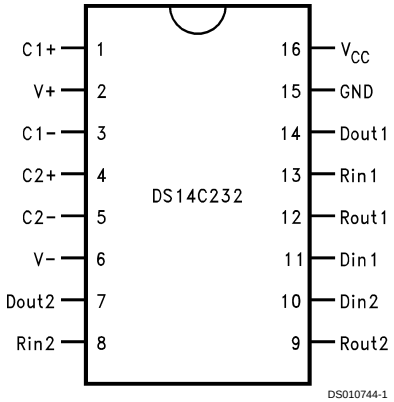
Symbol	Parameter	Conditions		Min	Max	Units
DRIVER CHARACTERISTICS (C1–C4 = 1.0 µF)						
t_{PLH}	Propagation Delay Low to High	R_L = 3 kΩ, C_L = 50 pF	*Figures 1, 2*		4.0	µs
t_{PHL}	Propagation Delay High to Low				4.0	µs
t_{SK}	Skew $\lvert t_{PLH} - t_{PHL} \rvert$				1.0	µs
SR1	Output Slew Rate	R_L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

Switching Characteristics (Continued)

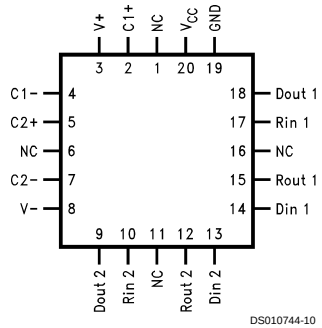
Note 8: Ratings apply to ambient temperature at +25˚C. Above this temperature derate: J Package 12.2 mW/˚C and E Package 13.3 mW/˚C.

Connection Diagrams

J Package
16-Lead Dual-In-line Package



E Package
20-Lead Ceramic Leadless Chip Carrier



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

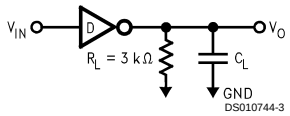


FIGURE 1. Driver Load Circuit

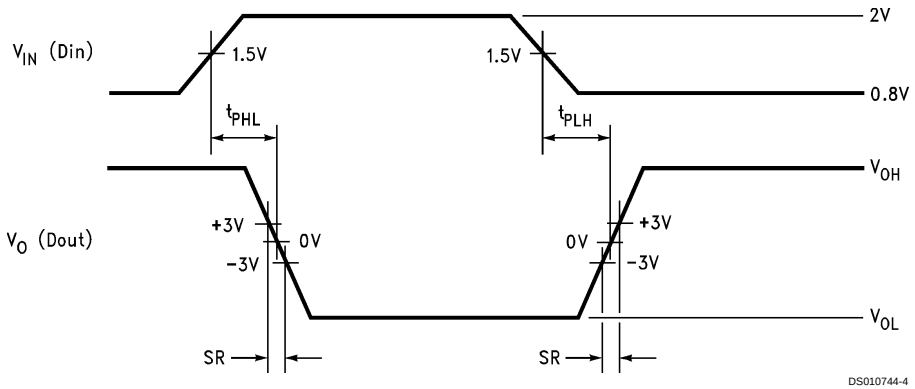


FIGURE 2. Driver Switching Waveform

Parameter Measurement Information (Continued)

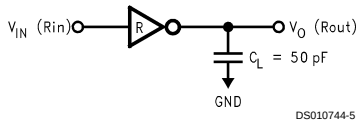


FIGURE 3. Receiver Load Circuit

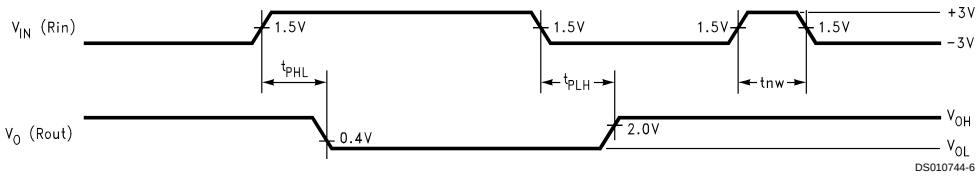


FIGURE 4. Receiver Propagation Delays and Noise Rejection (Note 4)

Pin Descriptions

V_{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_{IN}1, D_{IN}2 (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_{OUT}1, D_{OUT}2 (Pins 14, 7)

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

R_{IN}1, R_{IN}2 (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_{OUT}1, R_{OUT}2 (Pins 12, 9)

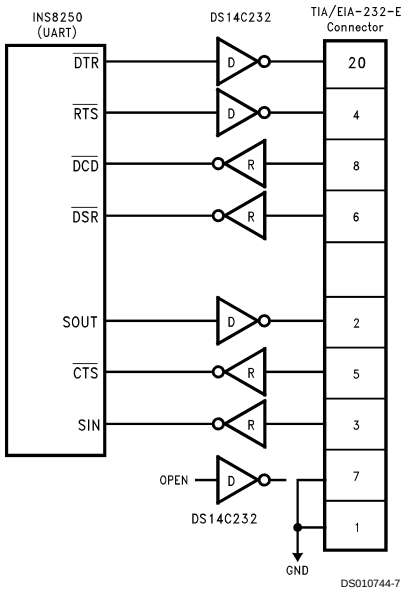
Receiver output pins are TTL/CMOS compatible. Receiver output HIGH voltage is specified for both CMOS and TTL load conditions.

GND (Pin 15)

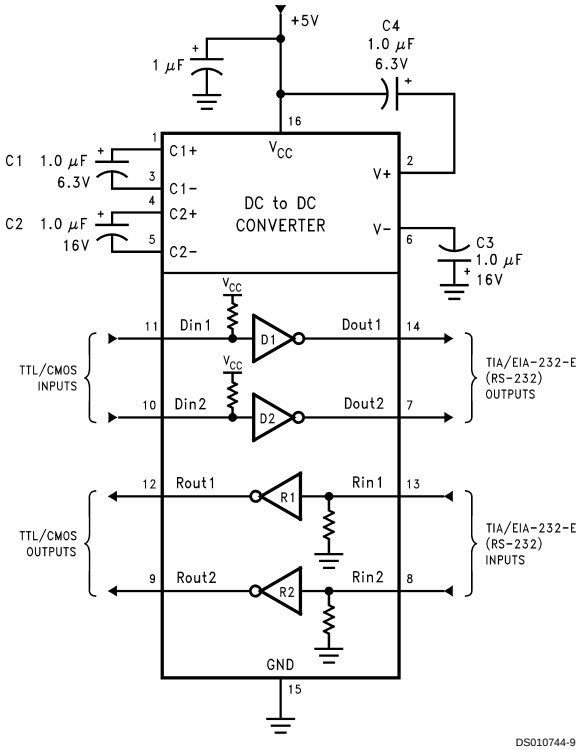
Ground Pin.

Typical Application Information

Application of DS14C232 and INS8250

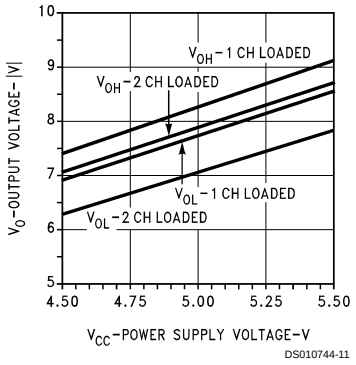


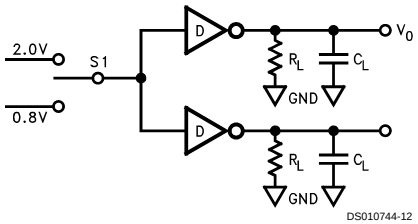
Typical Connection Diagram



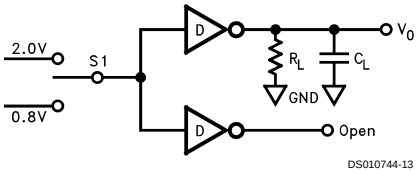
Typical Performance Characteristics

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





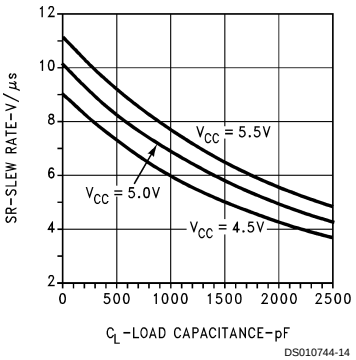
V_{CC} = 5.0V, R_L = 3 kΩ, C_L = 15 pF (includes jig and probe capacitance), C_P = 1 µF



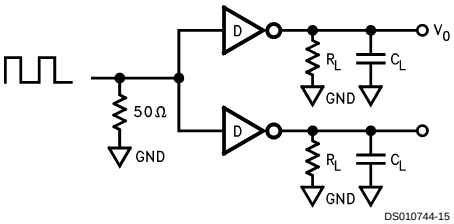
S1	V_O
2.0V	V_{OL}
0.8V	V_{OH}

Typical Performance Characteristics (Continued)

DRIVER SLEW RATE vs POWER SUPPLY VOLTAGE & LOAD CAPACITANCE



DS010744-14



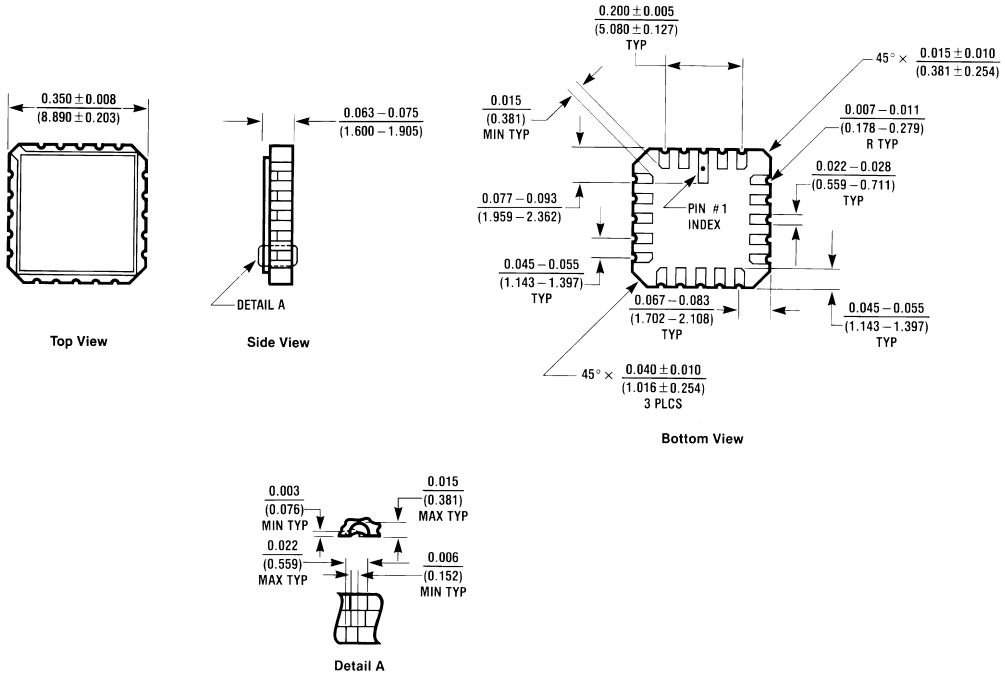
DS010744-15

T_a = 25˚C, R_L = 5 kΩ, C_P = 1 µF, f = 30 KHz

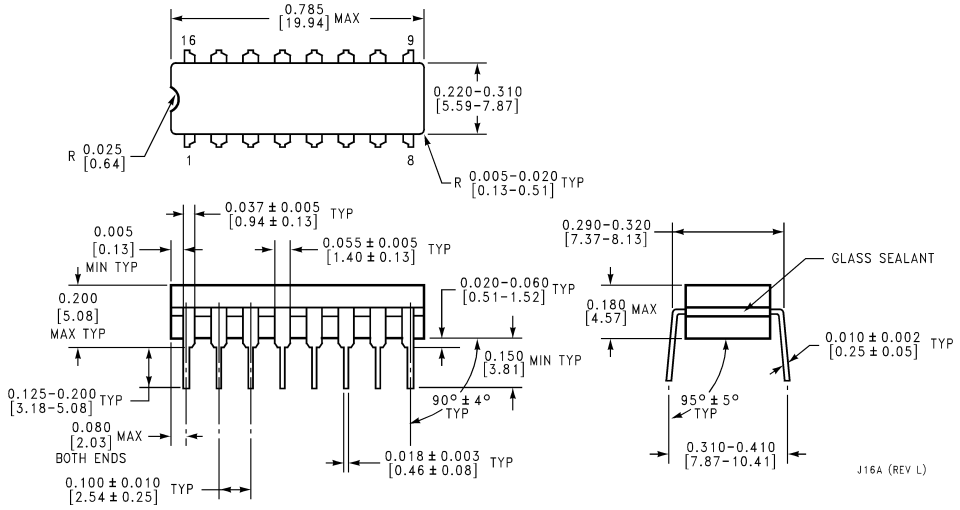
DS010744-16

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

Physical Dimensions inches (millimeters) unless otherwise noted

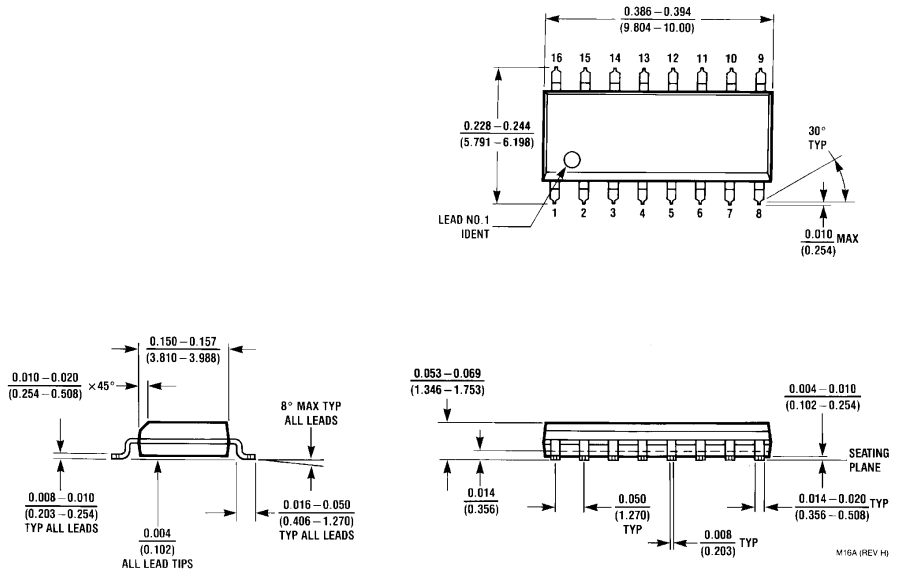


Order Number DS14C232E/883
NS Package Number E20A

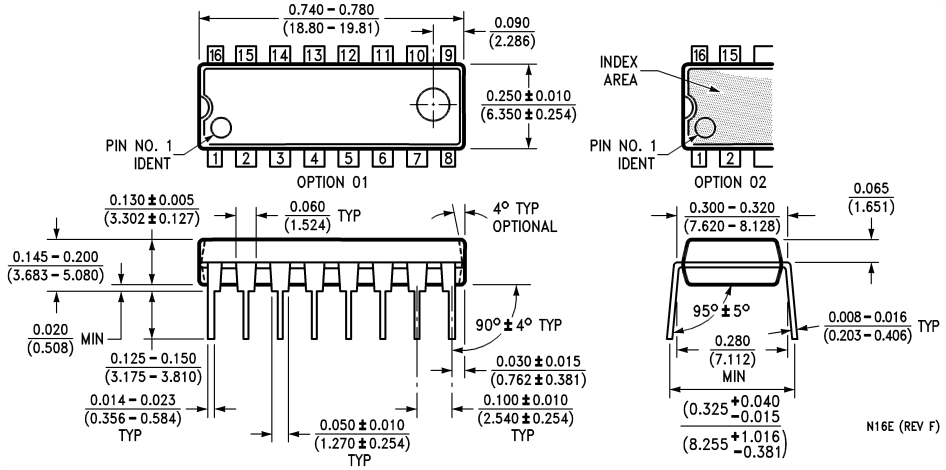


Order Number DS14C232J/883
NS Package Number J16A

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



Order Number DS14C232CM or DS14C232TM
NS Package Number M16A



Order Number DS14C232CN
NS Package Number N16E

Notes

LIFE SUPPORT POLICY

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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.

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