National Semiconductor

October 1999

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

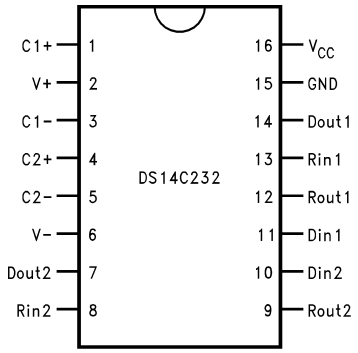
General Description

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



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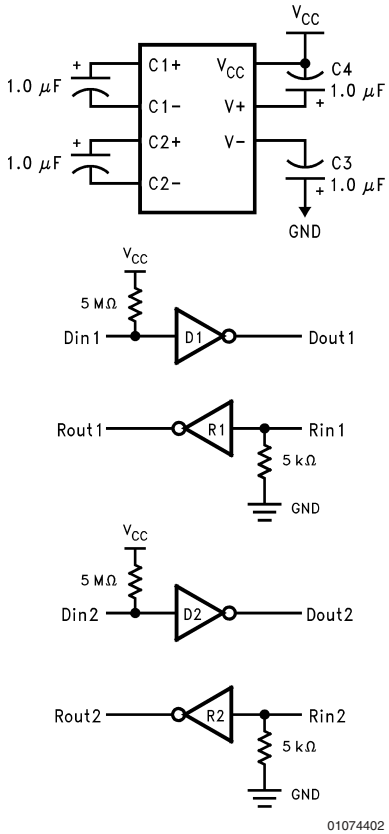
Order Number DS14C232CN, DS14C232CM, or DS14C232TM
See NS Package Number N16E, or M16A

Functional Diagram



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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

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 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 $\lvert t_{PLH} - t_{PHL} \rvert$				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 $\lvert t_{PLH} - t_{PHL} \rvert$	(*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	$R_L = 3\ k\Omega$		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	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

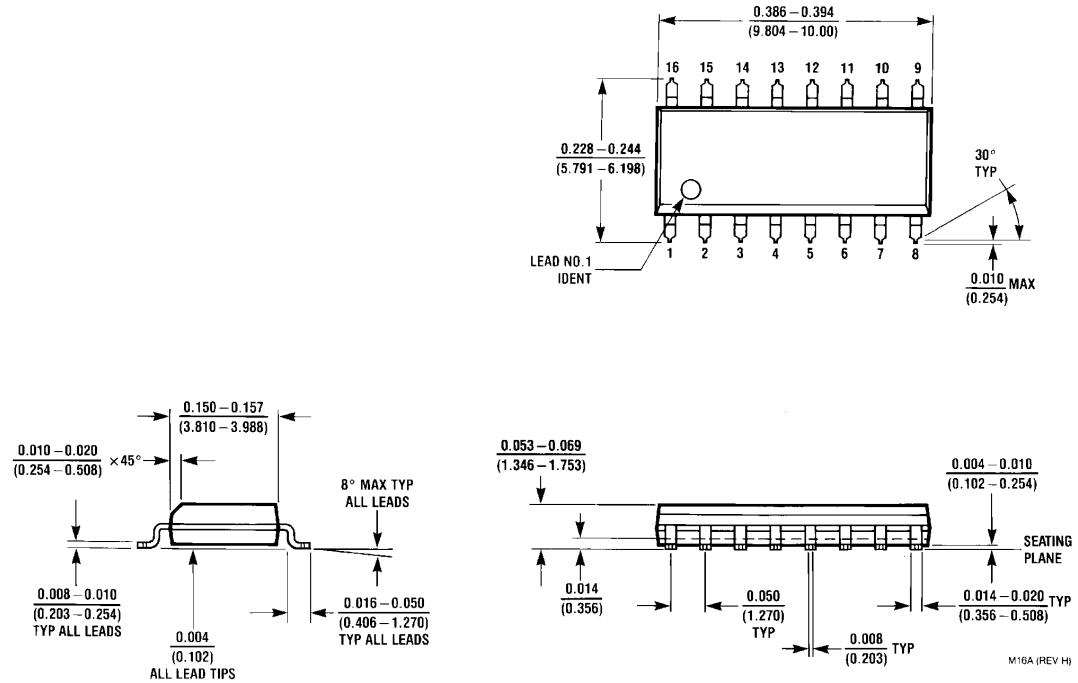
Switching Characteristics

Over recommended operating conditions, unless otherwise specified.

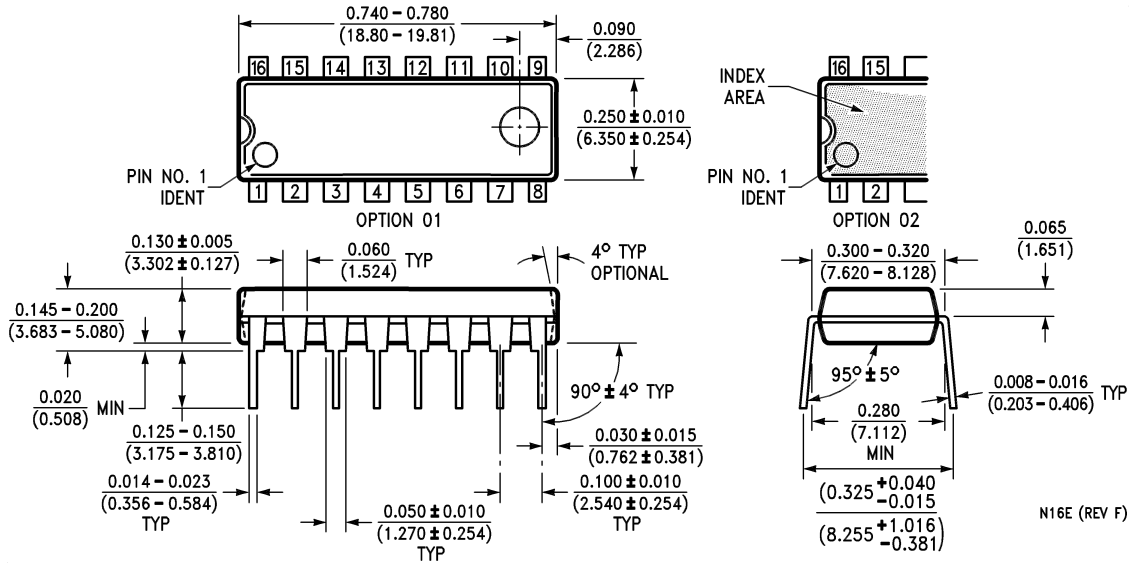
Symbol	Parameter	Conditions		Min	Max	Units
DRIVER CHARACTERISTICS (C1–C4 = 1.0 µF)						
t_{PLH}	Propagation Delay Low to High	$R_L = 3\ k\Omega$, $C_L = 50$ pF	*Figures 1, 2*		4.0	µs
t_{PHL}	Propagation Delay High to Low				4.0	µs
t_{SK}	Skew $\lvert t_{PLH} - t_{PHL} \rvert$				1.0	µs
SR1	Output Slew Rate	$R_L = 3\ k\Omega$ to $7\ k\Omega$, $C_L = 2500$ 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

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.

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



Order Number DS14C232CM or DS14C232TM
NS Package Number M16A



Order Number DS14C232CN
NS Package Number N16E