

DS14C237 Single Supply TIA/EIA-232 5 x 3 Driver/Receiver

General Description

The DS14C237 is a five driver, three receiver device which conforms to the TIA/EIA-232-E standard and CCITT V.28 recommendations. This device eliminates $\pm 12V$ supplies by employing an internal DC-DC converter to generate the necessary output levels from a single +5V supply. Driver slew rate control and receiver noise filtering have also been internalized to eliminate the need for external slew rate control and noise filtering capacitors.

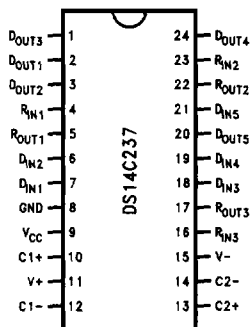
One device is capable of implementing a complete nine pin interface. The combination of its extended operating temperature range and low power requirement makes this device an ideal choice for a wide variety of commercial, industrial, and battery powered applications.

Features

- Conforms to TIA/EIA-232-E and CCITT V.28
- Internal DC-DC converter
- Operates with single +5V supply
- Low power requirement— I_{CC} 10 mA max
- Internal driver slew rate control
- Receiver Noise Filtering
- Operates above 120 kbits/sec
- Direct replacement for MAX237
- Industrial temperature range option-DS14C237T ($-40^{\circ}C$ to $+85^{\circ}C$)

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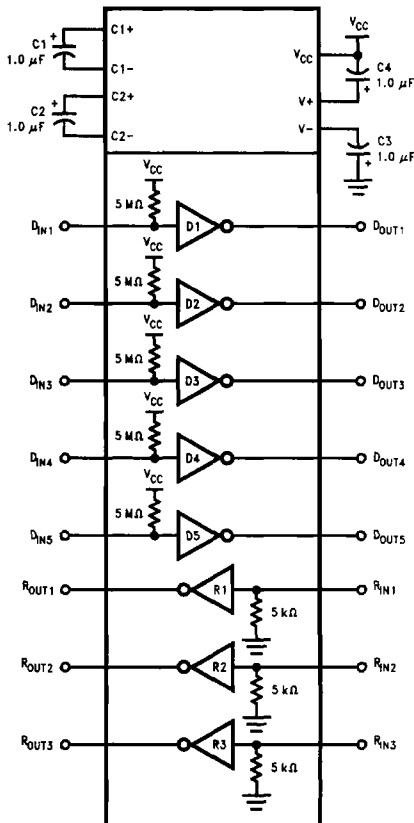
Connection Diagram



TL/F/11284-1

Order Number
DS14C237N, DS14C237WM,
DS14C237TN or DS14C237TWM
See NS Package Number M24B or NA24G

Functional Diagram



TL/F/11284-2

Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Supply Voltage (V_{CC})	-0.3V to +6V
V^+ Pin	($V_{CC} - 0.3V$) to +15V
V^- Pin	+0.3V to -15V
Driver Input Voltage	-0.3V to ($V_{CC} + 0.3V$)
Driver Output Voltage	($V^+ + 0.3V$) to ($V^- - 0.3V$)
Receiver Input Voltage	$\pm 30V$
Receiver Output Voltage	-0.3V to ($V_{CC} + 0.3V$)
Junction Temperature	+150°C
Maximum Package Power Dissipation @ +25°C (Note 6)	
N Package	2400 mW
WM Package	1400 mW

Storage Temperature Range	-65°C to +150°C
Lead Temperature (Soldering, 4 sec.)	+260°C
Short Circuit Duration (D_{OUT})	continuous
ESD Rating (HBM, 1.5 k Ω , 100 pF)	≥ 2.0 kV

Recommended Operating Conditions

	Min	Max	Units
Supply Voltage, V_{CC}	4.5	5.5	V
Operating Free Air Temperature (T_A)			
DS14C237	0	+70	°C
DS14C237T	-40	+85	°C

Electrical Characteristics

Over recommended operating conditions, unless otherwise specified (Note 2)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
DEVICE CHARACTERISTICS						
V^+	Positive Power Supply	$R_L = 3\text{ k}\Omega$, $C_1-C_4 = 1.0\text{ }\mu\text{F}$, $D_{IN} = 0.8V$		9.0		V
V^-	Negative Power Supply	$R_L = 3\text{ k}\Omega$, $C_1-C_4 = 1.0\text{ }\mu\text{F}$, $D_{IN} = 2.0V$		-8.5		V
I_{CC}	Supply Current (V_{CC})	No Load		6.5	10	mA
DRIVER CHARACTERISTICS						
V_{IH}	High Level Input Voltage		2.0		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	μA
I_{IL}	Low Level Input Current	$V_{IN} \leq 0.8V$	-10		10	μA
V_{OH}	High Level Output Voltage	$R_L = 3\text{ k}\Omega$	5.0	7.4		V
V_{OL}	Low Level Output Voltage			-6.3	-5.0	V
I_{OS}^+	Output High Short Circuit Current	$V_O = 0V$, $V_{IN} = 0.8V$	-30	-15	-5.0	mA
I_{OS}^-	Output Low Short Circuit Current	$V_O = 0V$, $V_{IN} = 2.0V$	5.0	12	30	mA
R_O	Output Resistance	$-2V \leq V_O \leq +2V$, $V_{CC} = \text{GND} = 0V$	300			Ω
RECEIVER CHARACTERISTICS						
V_{TH}	Input High Threshold Voltage			1.9	2.4	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		3.0	4.5	7.0	k Ω
I_{IN}	Input Current	$V_{IN} = +15V$	2.14	3.8	5.0	mA
		$V_{IN} = +3V$	0.43	0.6	1.0	mA
		$V_{IN} = -3V$	-1.0	-0.6	-0.43	mA
		$V_{IN} = -15V$	-5.0	-3.8	-2.14	mA
V_{OH}	High Level Output Voltage	$V_{IN} = -3V$, $I_O = -3.2\text{ mA}$	3.5	4.5		V
		$V_{IN} = -3V$, $I_O = -20\text{ }\mu\text{A}$	4.0	4.9		V
V_{OL}	Low Level Output Voltage	$V_{IN} = +3V$, $I_O = +3.2\text{ mA}$		0.25	0.4	V

Switching Characteristics

Over recommended operating conditions, unless otherwise specified (Note 4)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
DRIVER CHARACTERISTICS						
t_{PLH}	Propagation Delay LOW to HIGH	$R_L = 3\text{ k}\Omega$ $C_L = 50\text{ pF}$ <i>Figures 1 and 2</i>		0.7	4.0	μs
t_{PHL}	Propagation Delay HIGH to LOW			0.6	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	15	30	$\text{V}/\mu\text{s}$
SR2	Output Slew Rate	$R_L = 3\text{ k}\Omega$, $C_L = 2500\text{ pF}$	3.0	5.0		$\text{V}/\mu\text{s}$
RECEIVER CHARACTERISTICS						
t_{PLH}	Propagation Delay LOW to HIGH	Input Pulse Width $> 10\text{ }\mu\text{s}$ $C_L = 50\text{ pF}$ <i>Figures 3 and 4</i>		2.0	6.5	μs
t_{PHL}	Propagation Delay HIGH to LOW			2.8	6.5	μs
t_{sk}	Skew $ t_{PLH} - t_{PHL} $			0.8	2.0	μs
t_{nw}	Noise Pulse Width Rejected			2.5	1.0	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.

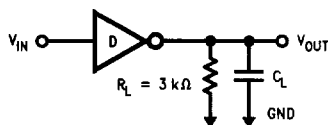
Note 3: I_{OS+} and I_{OS-} values are for one output at a time. If more than one output is shorted simultaneously, the device power dissipation may be exceeded.

Note 4: Receiver AC input waveform for test purposes: $t_r = t_f = 200\text{ ns}$, $V_{IH} = 3\text{V}$, $V_{IL} = -3\text{V}$, $f = 64\text{ kHz}$ (128 kbits/sec). Drive AC Input Waveform for test purposes: $t_r = t_f \leq 10\text{ ns}$, $V_{IH} = 3\text{V}$, $V_{IL} = 0\text{V}$, $f = 64\text{ kHz}$ (128 kbits/sec).

Note 5: All typicals are given for $V_{CC} = 5.0\text{V}$ and $T_A = +25^\circ\text{C}$.

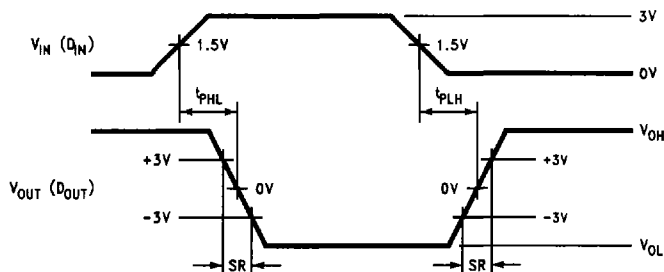
Note 6: Ratings apply to ambient temperature at $+25^\circ\text{C}$. Above this temperature derate: N package $20\text{ mW}/^\circ\text{C}$ and WM package $13.5\text{ mW}/^\circ\text{C}$.

Parameter Measurement Information



TL/F/11284-4

FIGURE 1. Driver Load Circuit



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FIGURE 2. Driver Switching Waveform

Parameter Measurement Information (Continued)

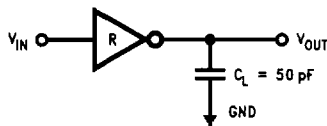


FIGURE 3. Receiver Load Circuit

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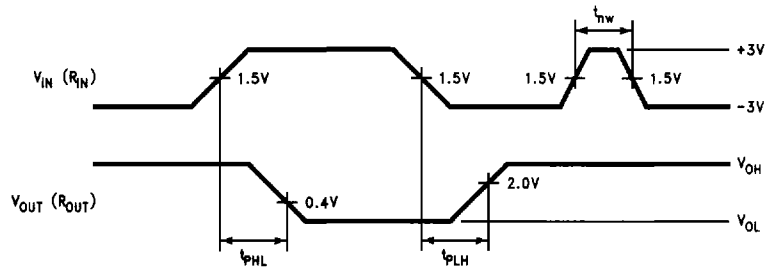


FIGURE 4. Receiver Propagation Delays and Noise Rejection

TL/F/11284-7

Pin Description

V_{CC} (Pin 9)—Power supply pin for the device, +5V ($\pm 10\%$).

V⁺ (Pin 11)—Positive supply for TIA/EIA-232-E drivers. Recommended external capacitor: C4 = 1.0 μ F (6.3V). This supply is not intended to be loaded externally.

V⁻ (Pin 15)—Negative supply for TIA/EIA-232-E drivers. Recommended external capacitor: C3 = 1.0 μ F (16V). This supply is not intended to be loaded externally.

C1⁺, C1⁻ (Pins 10, 12)—External capacitor connection pins. Recommended capacitor—1.0 μ F (6.3V).

C2⁺, C2⁻ (Pins 13, 14)—External capacitor connection pins. Recommended capacitor—1.0 μ F (16V).

D_{IN} 1–5 (Pins 7, 6, 18, 19, 21)—Driver input pins are TTL/CMOS compatible. Inputs of unused drivers may be left open, an internal pull-up resistor (500 k Ω minimum, typically 5 M Ω) pulls input to V_{CC}. Output will be LOW for open inputs.

D_{OUT} 1–5 (Pins 2, 3, 1, 24, 20)—Driver output pins conform to TIA/EIA-232-E levels.

R_{IN} 1–3 (Pins 4, 23, 16)—Receiver input pins accept TIA/EIA-232-E input voltages (± 15 V). Receivers feature a noise filter and guaranteed hysteresis of 200 mV. Unused receiver input pins may be left open. Internal input resistor (5 k Ω) pulls input LOW, providing a failsafe HIGH output.

R_{OUT} 1–3 (Pins 5, 22, 17)—Receiver output pins are TTL/CMOS compatible. Receiver output HIGH voltage is specified for both CMOS and TTL load conditions.

GND (Pin 8)—Ground Pin.