National Semiconductor

March 1996

DS14C239
Dual Supply TIA/EIA-232 3 x 5 Driver/Receiver

General Description

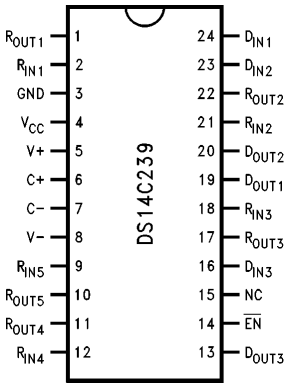
The DS14C239 is a three driver, five receiver device which conforms to the TIA/EIA-232-E standard and CCITT V.28 recommendations. This device eliminates −12V supply by employing an internal DC-DC converter to generate the necessary output levels from a single +5V supply and a positive voltage power supply (+7.5V to +13.2V). 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. With the addition of TRI-STATE® receiver outputs, device power consumption is kept to a minimum.

The combination of its low power requirement and extended operating temperature range 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
- Low power requirement: $I^+ = 10$ mA max
  $I_{CC} = 1$ mA max
- Internal driver slew rate control
- Receiver Noise Filtering
- Operates above 120 kbits/sec
- TRI-STATE Receiver Outputs
- Direct replacement for MAX239
- Industrial temperature range option—DS14C239T (−40°C to +85°C)

Connection Diagram



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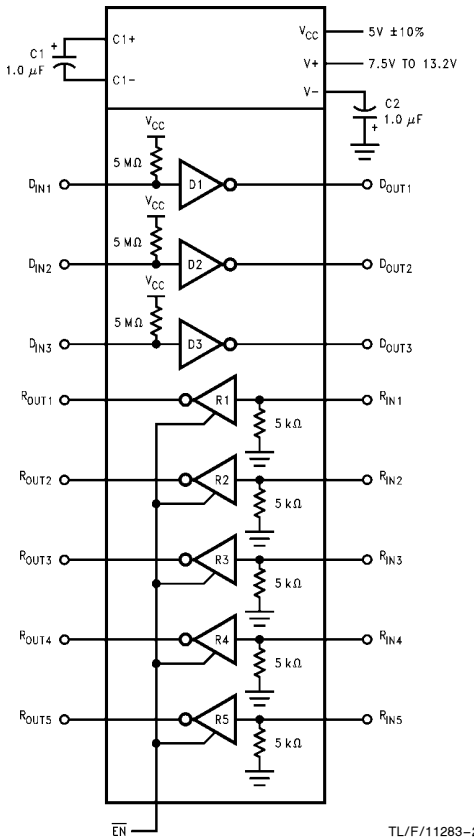
Order Number DS14C239N, DS14C239WM, DS14C239TN or DS14C239TWM
See NS Package Number M24B or NA24G

Functional Diagram



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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	±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 kΩ, 100 pF)	≥ 2.0 kV

Recommended Operating Conditions

	Min	Max	Units
Supply Voltage (V_{CC})	4.5	5.5	V
Supply Pin (V^+)	7.5	13.2	V
Operating Free Air Temp. (T_A)			
DS14C239	0	+70	°C
DS14C239T	−40	+85	°C

Electrical Characteristics

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

Symbol	Parameter	Conditions	Min	Typ	Max	Units
DEVICE CHARACTERISTICS						
V^-	Negative Power Supply	R_L = 3 kΩ, C1, C2 = 1.0 μF, D_{IN} = 2.0V		−9.5		V
I^+	Supply Current (V^+)	No Load		4	10	mA
I_{CC}	Supply Current (V_{CC})	No Load		0.1	1.0	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 kΩ	5.0	8.7		V
V_{OL}	Low Level Output Voltage			−8.0	−5.0	V
I_{OS}^+	Output High Short Circuit Current	V_O = 0V, V_{IN} = 0.8V	−40	−20	−5.0	mA
I_{OS}^-	Output Low Short Circuit Current	V_O = 0V, V_{IN} = 2.0V	5.0	16	40	mA
R_O	Output Resistance	−2V ≤ V_O ≤ +2V, V_{CC} = V^+ = GND = 0V	300			Ω
RECEIVER CHARACTERISTICS						
V_{TH}	Input High Threshold Voltage	T_A = 25°C		2	2.4	V
		T_A = −40°C to +85°C		2	2.6	V
V_{TL}	Input Low Threshold Voltage		0.8	1.5		V
V_{HY}	Hysteresis	T_A = 25°C	0.2	0.5	1.0	V
		T_A = −40°C to +85°C	0.1	0.5	1.0	V

Electrical Characteristics (Continued)

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

Symbol	Parameter	Conditions		Min	Typ	Max	Units
RECEIVER CHARACTERISTICS (Continued)							
R_{IN}	Input Resistance			3.0	4.5	7.0	kΩ
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	$V_{IN} = -3V$, $I_O = -3.2$ 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			0.25	0.4	V
V_{IH}	High Level Input Voltage		$\overline{EN}$	2.4		V_{CC}	V
V_{IL}	Low Level Input Voltage			GND		0.8	V
I_{IH}	High Level Input Current	$V_{IN} \geq 2.4V$		−10		+10	μA
I_{IL}	Low Level Input Current	$V_{IN} \leq 0.8V$		−10		+10	μA
I_{OZ}	Output Leakage Current	$\overline{EN} = V_{CC}$, $0V \leq R_{OUT} \leq V_{CC}$		−10	0.1	+10	μA

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	$R_L = 3$ kΩ, $C_L = 50$ pF *(Figures 1 and 2)*			0.7	4.0	μs
t_{PHL}	Propagation Delay HIGH to LOW				0.7	4.0	μs
t_{sk}	Skew $\lvert t_{PLH} - t_{PHL} \rvert$				0	1.0	μs
SR1	Output Slew Rate	$R_L = 3$kΩ to 7 kΩ, $C_L = 50$ pF, $V^+ \leq 10.35V$		4.0	17	30	V/μs
SR2	Output Slew Rate	$R_L = 3$ kΩ, $C_L = 2500$ pF, $V^+ \leq 10.35V$		3.0	6.4		V/μs
RECEIVER CHARACTERISTICS							
t_{PLH}	Propagation Delay LOW to HIGH	Input Pulse Width > 10 μs, $C_L = 50$ pF *(Figures 3 and 4)*			2.1	6.5	μs
t_{PHL}	Propagation Delay HIGH to LOW				2.9	6.5	μs
t_{sk}	Skew $\lvert t_{PLH} - t_{PHL} \rvert$				0.8	2.0	μs
t_{PLZ}		*(Figures 5 and 7)*			0.25	2.0	μs
t_{PZL}					0.70	2.0	μs
t_{PHZ}		*(Figures 5 and 6)*			0.25	2.0	μs
t_{PZH}					0.70	2.0	μs
t_{nw}	Noise Pulse Width Rejected	*(Figures 3 and 4)*			2.0	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: $t_r = t_f = 200$ ns, $V_{IH} = 3V$, $V_{IL} = -3V$, f = 64 kHz (128 kbits/sec). Driver AC input waveform for test purposes: $t_r = t_f \leq 10$ ns, $V_{IH} = 3V$, $V_{IL} = 0V$, f = 64 kHz (128 kbits/sec).

Note 5: All typicals are given for $V_{CC} = 5.0V$ and $T_A = +25°C$, $V^+ = 10.35V$.

Note 6: Ratings apply to ambient temperature at +25°C. Above this temperature derate: N package 20 mW/°C and WM package 13.5 mW/°C.

Parameter Measurement Information

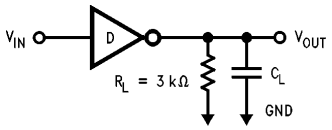

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FIGURE 1. Driver Load Circuit

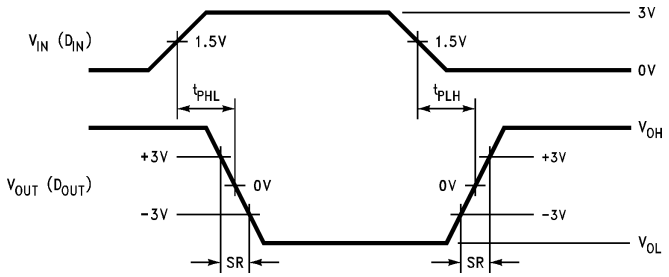

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FIGURE 2. Driver Switching Waveform

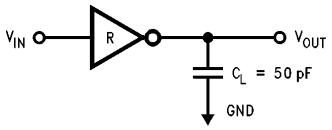

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FIGURE 3. Receiver Load Circuit

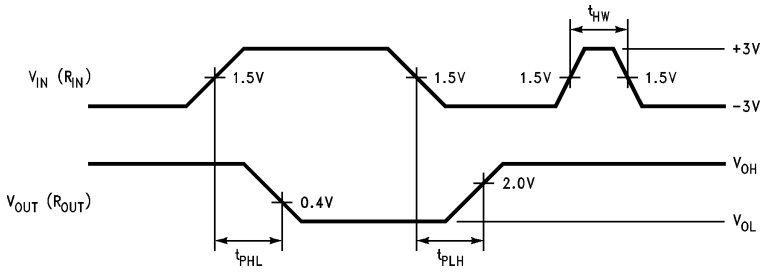

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FIGURE 4. Receiver Propagation Delays and Noise Rejection

Parameter Measurement Information (Continued)

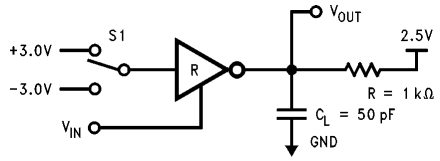

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FIGURE 5. Receiver Disable Load Circuit

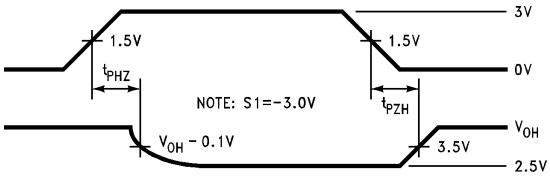

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FIGURE 6. Receiver TRI-STATE Timing (t_{PHZ}, t_{PZH})

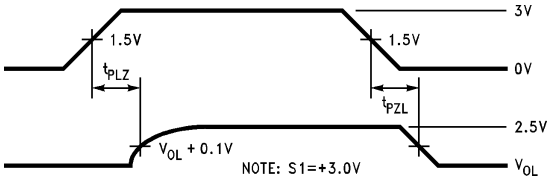

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FIGURE 7. Receiver TRI-STATE Timing (t_{PLZ}, t_{PZL})

Pin Descriptions

V_{CC} (pin 4)—Power supply pin for the device, +5V (±10%).

V^+ (pin 5)—Positive supply for TIA/EIA-232-E drivers. Specified at 7.5V minimum and 13.2V maximum.

V^- (pin 8)—Negative supply for TIA/EIA-232-E drivers. Recommended external capacitor: C2 = 1.0 μF (16V). This supply is not intended to be loaded externally.

$C1^+$, $C1^-$ (pins 6, 7)—External capacitor connection pins. Recommended capacitor—1.0 μF (16V).

$\overline{EN}$ (pin 14)—Controls the Receiver output TRI-STATE Circuit. A High level on this pin will disable the Receiver Output.

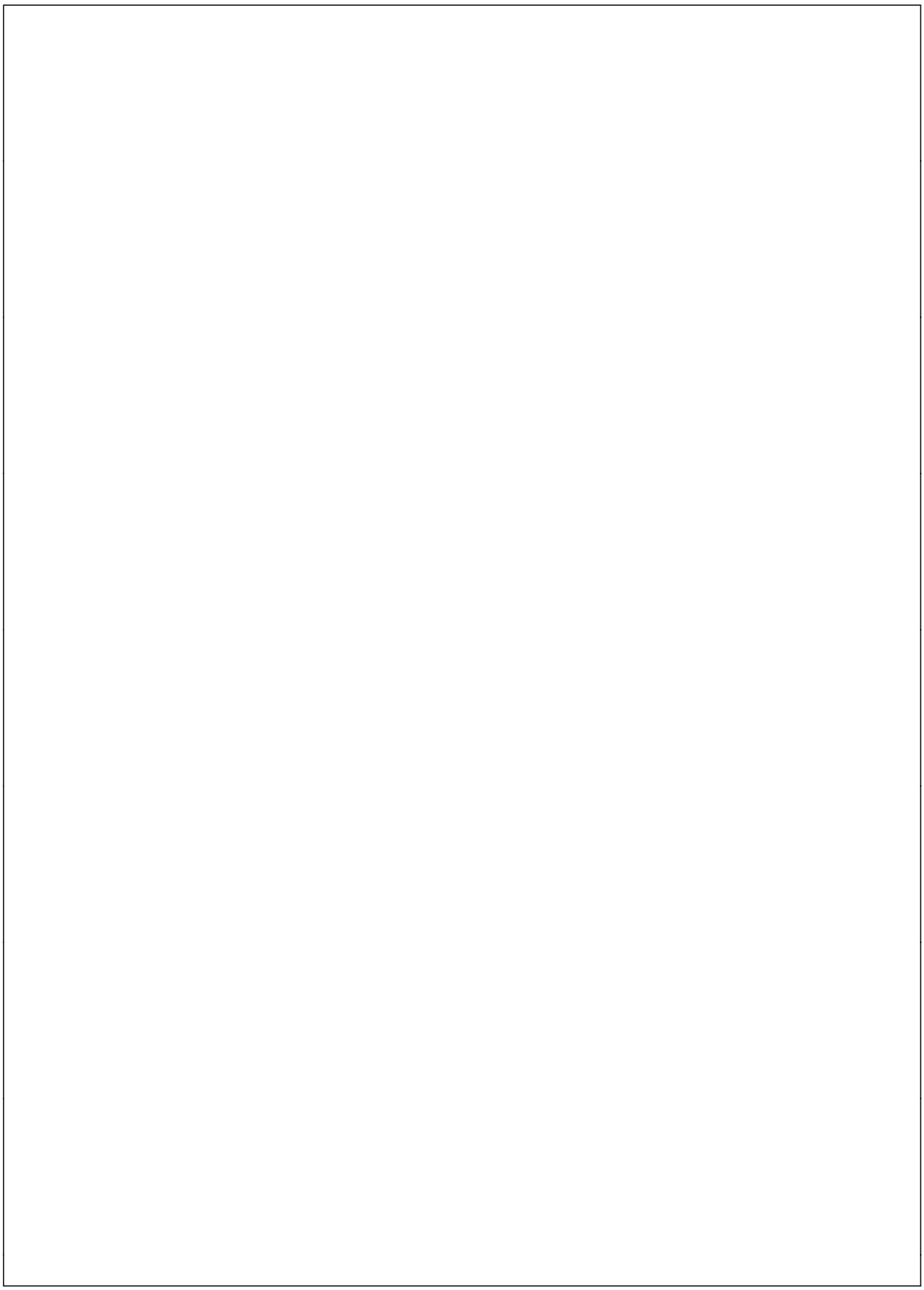
D_{IN} 1–3 (pins 24, 23, 16)—Driver input pins are TTL/CMOS compatible. Inputs of unused drivers may be left open, an internal pull-up resistor (500 kΩ minimum, typically 5 MΩ) pulls input to V_{CC}. Output will be LOW for open inputs.

D_{OUT} 1–3 (pins 19, 20, 13)—Driver output pins conform to TIA/EIA-232-E levels.

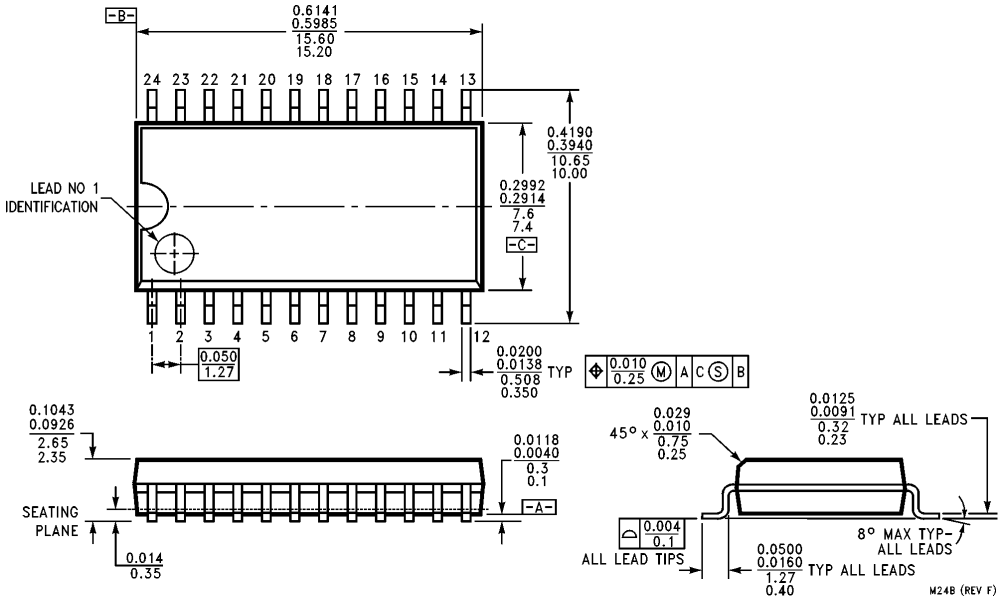
R_{IN} 1–5 (pins 2, 21, 18, 12, 9)—Receiver input pins accept TIA/EIA-232-E input voltages (±15V). Receivers feature a noise filter and guaranteed hysteresis of 100 mV. Unused receiver input pins may be left open. Internal input resistor (5 kΩ) pulls input LOW, providing a failsafe HIGH output.

R_{OUT} 1–5 (pins 1, 22, 17, 11, 10)—Receiver output pins are TTL/CMOS compatible. Receiver output HIGH voltage is specified for both CMOS and TTL load conditions.

GND (pin 3)—Ground pin.

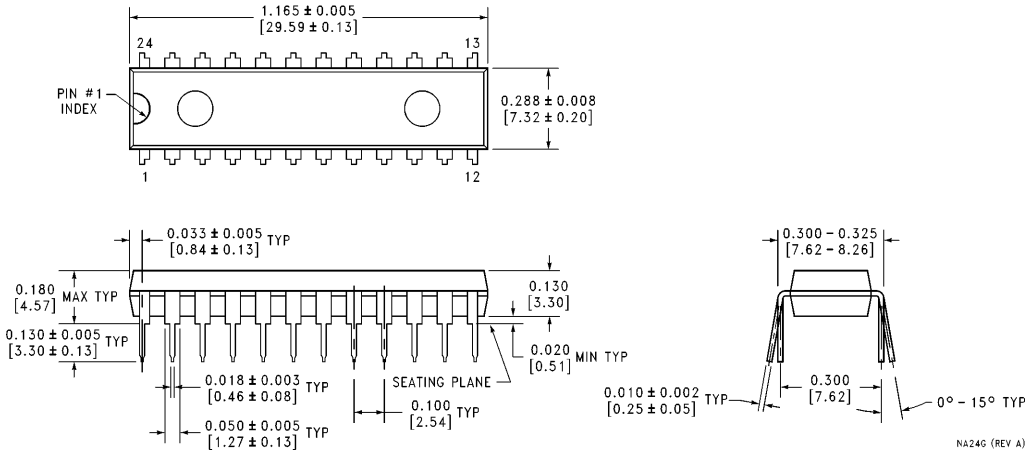


Physical Dimensions inches (millimeters) unless otherwise noted



Order Number DS14C239WM or DS14C239TWM
NS Package Number M24B

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



Order Number DS14C239N or DS14C239TN
See NS Package Number NA24G

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