

# DS14185

## EIA/TIA-232 3 Driver x 5 Receiver

### General Description

The DS14185 is a three driver, five receiver device which conforms to the EIA/TIA-232-E standard.

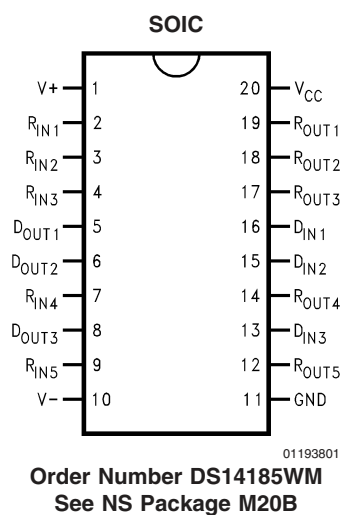
The flow-through pinout facilitates simple non-crossover board layout. The DS14185 provides a one-chip solution for the common 9-pin serial RS-232 interface between data terminal and data communications equipment.

### Features

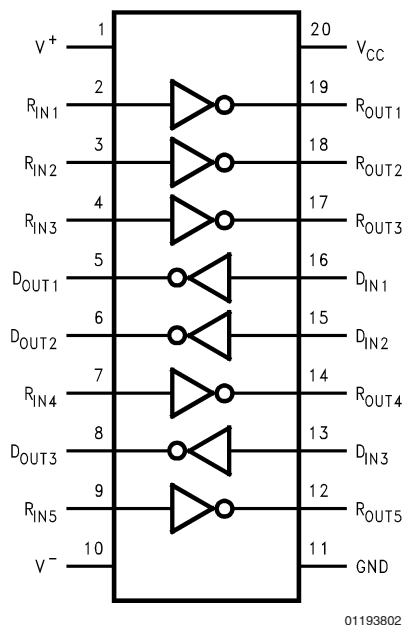
- Replaces one 1488 and two 1489s
- Conforms to EIA/TIA-232-E
- 3 drivers and 5 receivers

- Flow through pinout
- Failsafe receiver outputs
- 20-pin SOIC package
- LapLink® compatible –200 kbps data rate

### Connection Diagram



### Functional Diagram



**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 ( $V_{CC}$ )               | +7V                    |
| Supply Voltage ( $V^+$ )                  | +15V                   |
| Supply Voltage ( $V^-$ )                  | -15V                   |
| Driver Input Voltage                      | 0V to $V_{CC}$         |
| Driver Output Voltage (Power Off)         | $\pm 15V$              |
| Receiver Input Voltage                    | $\pm 25V$              |
| Receiver Output Voltage ( $R_{OUT}$ )     | 0V to $V_{CC}$         |
| Maximum Package Power Dissipation @ +25°C |                        |
| M Package                                 | 1488 mW                |
| Derate M Package                          | 11.9 mW/°C above +25°C |

|                                               |                 |
|-----------------------------------------------|-----------------|
| Storage Temperature Range                     | -65°C to +150°C |
| Lead Temperature Range (Soldering, 4 seconds) | +260°C          |
| ESD Ratings (HBM, 1.5 k $\Omega$ , 100 pF)    | $\geq 1.5$ kV   |

**Recommended Operating Conditions**

|                                          | Min   | Typ   | Max   | Units |
|------------------------------------------|-------|-------|-------|-------|
| Supply Voltage ( $V_{CC}$ )              | +4.75 | +5.0  | +5.25 | V     |
| Supply Voltage ( $V^+$ )                 | +9.0  | +12.0 | +13.2 | V     |
| Supply Voltage ( $V^-$ )                 | -13.2 | -12.0 | -9.0  | V     |
| Operating Free Air Temperature ( $T_A$ ) | 0     | 25    | 70    | °C    |

**Electrical Characteristics** (Note 2)

Over recommended supply voltage and operating temperature ranges, unless otherwise specified.

| Symbol                        | Parameter                                  | Conditions                                                          | Min                         | Typ   | Max  | Units   |
|-------------------------------|--------------------------------------------|---------------------------------------------------------------------|-----------------------------|-------|------|---------|
| <b>DEVICE CHARACTERISTICS</b> |                                            |                                                                     |                             |       |      |         |
| $I_{CC}$                      | $V_{CC}$ Supply Current                    | No Load, All Inputs at +5V                                          |                             | 21.0  | 30   | mA      |
| $I^+$                         | $V^+$ Supply Current (Note 2)              | No Load, All Driver Inputs at 0.8V or +2V                           | $V^+ = 9V, V^- = -9V$       | 8.7   | 15   | mA      |
|                               |                                            |                                                                     | $V^+ = 13.2V, V^- = -13.2V$ | 13    | 22   | mA      |
| $I^-$                         | $V^-$ Supply Current (Note 2)              | All Receiver Inputs at 0.8V or 2.4V.                                | $V^+ = 9V, V^- = -9V$       | -12.5 | -22  | mA      |
|                               |                                            |                                                                     | $V^+ = 13.2V, V^- = -13.2V$ | -16.5 | -28  | mA      |
| <b>DRIVER CHARACTERISTICS</b> |                                            |                                                                     |                             |       |      |         |
| $V_{IH}$                      | High Level Input Voltage                   |                                                                     | 2.0                         |       |      | V       |
| $V_{IL}$                      | Low Level Input Voltage                    |                                                                     |                             |       | 0.8  | V       |
| $I_{IH}$                      | High Level Input Current (Note 2)          | $V_{IN} = 5V$                                                       |                             |       | 10   | $\mu A$ |
| $I_{IL}$                      | Low Level Input Current (Note 2)           | $V_{IN} = 0V$                                                       |                             | -1.24 | -1.5 | mA      |
| $V_{OH}$                      | High Level Output Voltage (Note 2)         | $R_L = 3\text{ k}\Omega, V_{IN} = 0.8V, V^+ = 9V, V^- = -9V$        | 6                           | 7     |      | V       |
|                               |                                            | $R_L = 3\text{ k}\Omega, V_{IN} = 0.8V, V^+ = +12V, V^- = -12V$     | 8.5                         | 9     |      | V       |
|                               |                                            | $R_L = 7\text{ k}\Omega, V_{IN} = 0.8V, V^+ = +13.2V, V^- = -13.2V$ | 10                          | 11.5  |      | V       |
| $V_{OL}$                      | Low Level Output Voltage (Note 2)          | $R_L = 3\text{ k}\Omega, V_{IN} = 2V, V^+ = 9V, V^- = -9V$          |                             | -7    | -6   | V       |
|                               |                                            | $R_L = 3\text{ k}\Omega, V_{IN} = 2V, V^+ = +12V, V^- = -12V$       |                             | -8    | -7.5 | V       |
|                               |                                            | $R_L = 7\text{ k}\Omega, V_{IN} = 0.8V, V^+ = +13.2V, V^- = -13.2V$ |                             | -11   | -10  | V       |
| $I_{OS+}$                     | Output High Short Circuit Current (Note 2) | $V_O = 0V, V_{IN} = 0.8V$                                           | -6                          | -13   | -18  | mA      |
| $I_{OS-}$                     | Output Low Short Circuit Current (Note 2)  | $V_O = 0V, V_{IN} = 2.0V$                                           | 6                           | 13    | 18   | mA      |

## Electrical Characteristics (Note 2) (Continued)

Over recommended supply voltage and operating temperature ranges, unless otherwise specified.

| Symbol                   | Parameter                                             | Conditions                                                                                  | Min  | Typ   | Max   | Units |
|--------------------------|-------------------------------------------------------|---------------------------------------------------------------------------------------------|------|-------|-------|-------|
| DRIVER CHARACTERISTICS   |                                                       |                                                                                             |      |       |       |       |
| R <sub>O</sub>           | Output Resistance                                     | -2V ≤ V <sub>O</sub> ≤ +2V,<br>V <sup>+</sup> = V <sup>-</sup> = V <sub>CC</sub> = 0V       | 300  |       |       | Ω     |
|                          |                                                       | -2V ≤ V <sub>O</sub> ≤ +2V,<br>V <sup>+</sup> = V <sup>-</sup> = V <sub>CC</sub> = Open Ckt | 300  |       |       | Ω     |
| RECEIVER CHARACTERISTICS |                                                       |                                                                                             |      |       |       |       |
| V <sub>TH</sub>          | Input High Threshold<br>(Recognized as a High Signal) | V <sub>O</sub> ≤ 0.4V, I <sub>O</sub> = 3.2 mA                                              |      | 1.85  | 2.4   | V     |
| V <sub>TL</sub>          | Input Low Threshold<br>(Recognized as a Low Signal)   | V <sub>O</sub> ≥ 2.5V, I <sub>O</sub> = -0.5 mA                                             | 0.7  | 1.0   |       | V     |
| R <sub>IN</sub>          | Input Resistance                                      | V <sub>IN</sub> = ±3V to ±15V                                                               | 3.0  | 4.1   | 7.0   | kΩ    |
| I <sub>IN</sub>          | Input Current (Note 2)                                | V <sub>IN</sub> = +15V                                                                      | 2.1  | 4.1   | 5.0   | mA    |
|                          |                                                       | V <sub>IN</sub> = +3V                                                                       | 0.43 | 0.7   | 1     | mA    |
|                          |                                                       | V <sub>IN</sub> = -15V                                                                      | -5.0 | -4.1  | -2.1  | mA    |
|                          |                                                       | V <sub>IN</sub> = -3V                                                                       | -1   | -0.65 | -0.43 | mA    |
| V <sub>OH</sub>          | High Level Output Voltage<br>(Note 7)                 | I <sub>OH</sub> = -0.5 mA, V <sub>IN</sub> = -3V                                            | 2.6  | 4     |       | V     |
|                          |                                                       | I <sub>OH</sub> = -10 μA, V <sub>IN</sub> = -3V                                             | 4.0  | 4.9   |       | V     |
|                          |                                                       | I <sub>OH</sub> = -0.5 mA, V <sub>IN</sub> = Open Circuit                                   | 2.6  | 4     |       | V     |
|                          |                                                       | I <sub>OH</sub> = -10 μA, V <sub>IN</sub> = Open Circuit                                    | 4.0  | 4.9   |       | V     |
| V <sub>OL</sub>          | Low Level Output Voltage                              | I <sub>OL</sub> = 3.2 mA, V <sub>IN</sub> = +3V                                             |      | 0.2   | 0.4   | V     |
| I <sub>OSR</sub>         | Short Circuit Current (Note 2)                        | V <sub>O</sub> = 0V, V <sub>IN</sub> = 0V                                                   | -4   | -2.7  | -1.7  | mA    |

## Switching Characteristics (Note 2)

T<sub>A</sub> = 25°C

| Symbol                          | Parameter                     | Conditions                                                                                          | Min | Typ | Max | Units |
|---------------------------------|-------------------------------|-----------------------------------------------------------------------------------------------------|-----|-----|-----|-------|
| DRIVER CHARACTERISTICS          |                               |                                                                                                     |     |     |     |       |
| t <sub>PHL</sub>                | Propagation Delay High to Low | R <sub>L</sub> = 3 kΩ, C <sub>L</sub> = 50 pF<br>(Figures 1, 2)                                     |     | 60  | 350 | ns    |
| t <sub>PLH</sub>                | Propagation Delay Low to High |                                                                                                     |     | 240 | 350 | ns    |
| t <sub>r</sub> , t <sub>f</sub> | Output Slew Rate (Note 8)     |                                                                                                     |     | 50  |     | ns    |
| RECEIVER CHARACTERISTICS        |                               |                                                                                                     |     |     |     |       |
| t <sub>PHL</sub>                | Propagation Delay High to Low | R <sub>L</sub> = 1.5 kΩ, C <sub>L</sub> = 15 pF<br>(includes fixture plus probe),<br>(Figures 3, 4) |     | 150 | 350 | ns    |
| t <sub>PLH</sub>                | Propagation Delay Low to High |                                                                                                     |     | 240 | 350 | ns    |
| t <sub>r</sub>                  | Rise Time                     |                                                                                                     |     | 87  | 175 | ns    |
| t <sub>f</sub>                  | Fall Time                     |                                                                                                     |     | 40  | 100 | ns    |

**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 table of Electrical Characteristics specifies conditions of 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. For current, minimum and maximum values are specified as an absolute value and the sign is used to indicate direction. For voltage logic levels, the more positive value is designated as maximum. For example, if -6V is a maximum, the typical value (-6.8V) is more negative.

**Note 3:** All typicals are given for: V<sub>CC</sub> = +5.0V, V<sup>+</sup> = +12.0V, V<sup>-</sup> = -12V, T<sub>A</sub> = +25°C.

**Note 4:** Only one driver output shorted at a time.

**Note 5:** Generator characteristics for driver input: f = 64 kHz (128 kbits/sec), t<sub>r</sub> = t<sub>f</sub> < 10 ns, V<sub>IH</sub> = 3V, V<sub>IL</sub> = 0V, duty cycle = 50%.

**Note 6:** Generator characteristics for receiver input: f = 64 kHz (128 kbits/sec), t<sub>r</sub> = t<sub>f</sub> = 200 ns, V<sub>IH</sub> = 3V, V<sub>IL</sub> = -3V, duty cycle = 50%.

**Note 7:** If receiver inputs are unconnected, receiver output is a logic high.

**Note 8:** Refer to typical curves. Driver output slew rate is measured from the +3.0V to the -3.0V level on the output waveform. Inputs not under test are connected to V<sub>CC</sub> or GND. Slew rate is determined by load capacitance. To comply with a 30 V/ $\mu$ s maximum slew rate, a minimum load capacitance of 390 pF is recommended.

## Parameter Measurement Information

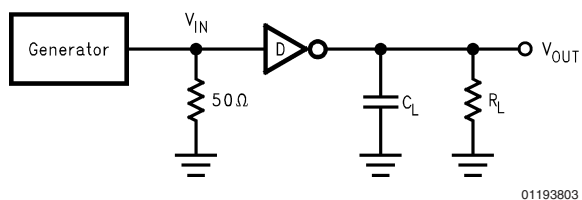


FIGURE 1. Driver Propagation Delay and Transition Time Test Circuit (Note 5)

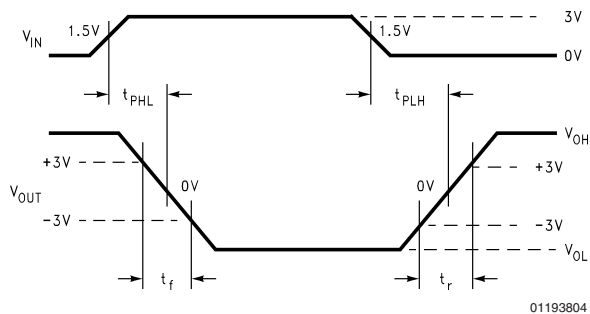


FIGURE 2. Driver Propagation Delay and Transition Time Waveforms Slew Rate (SR) = 6V/( $t_r$  or  $t_f$ )

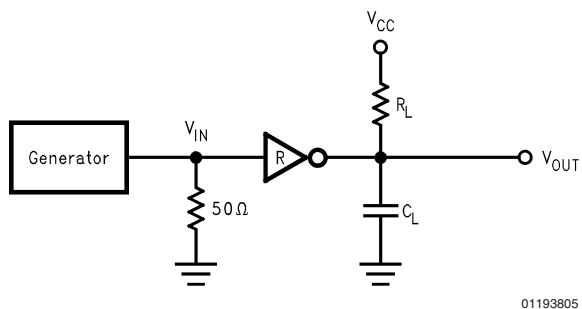


FIGURE 3. Receiver Propagation Delay and Transition Time Test Circuit (Note 6)

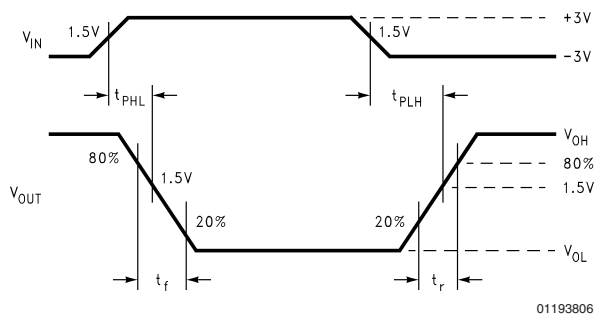


FIGURE 4. Receiver Propagation Delay and Transition Time Waveform

## Pin Descriptions

| Pin #              | Name             | Description                                               |
|--------------------|------------------|-----------------------------------------------------------|
| 13, 15, 16         | D <sub>IN</sub>  | Driver Input Pins                                         |
| 5, 6, 8            | D <sub>OUT</sub> | Driver Output Pins, RS-232 Levels                         |
| 2, 3, 4, 7, 9      | R <sub>IN</sub>  | Receiver Input Pins, RS-232 Levels                        |
| 12, 14, 17, 18, 19 | R <sub>OUT</sub> | Receiver Output Pins                                      |
| 11                 | GND              | Ground                                                    |
| 1                  | V <sup>+</sup>   | Positive Power Supply Pin (+9.0 ≤ V <sup>+</sup> ≤ +13.2) |
| 10                 | V <sup>-</sup>   | Negative Power Supply Pin (-9.0 ≤ V <sup>-</sup> ≤ -13.2) |
| 20                 | V <sub>CC</sub>  | Positive Power Supply Pin (+5V ±5%)                       |

## Applications Information

$$V_{CC} = 4.75V, V^+ = 10.8V, V^- = -10.8V$$

In a typical Data Terminal Equipment (DTE) to Data Circuit-Terminating Equipment (DCE) 9-pin de-facto interface implementation, 2 data lines and 6 control lines are required. The data lines are TXD and RXD. The control lines are RTS, DTR, DSR, DCD, CTS, and RI.

The DS14185 is a 3 x 5 Driver/Receiver and offers a single chip solution for this DTE interface. As shown in Figure 5, this interface allows for direct flow-thru interconnect. For a more conservative design, the user may wish to insert ground traces between the signal lines to minimize cross talk.

### MOUSE DRIVING

A typical mouse can be powered from the drivers. Two driver outputs connected in parallel and set to V<sub>OH</sub> can be used to supply power to the V<sup>+</sup> pin of the mouse. The third driver output is set to V<sub>OL</sub> to sink the current from the V<sup>-</sup> terminal. Refer to typical curves of V<sub>OUT</sub>/I<sub>OUT</sub>. Typical mouse specifications are:

10 mA at +6V

5 mA at -6V

### LapLink COMPATIBILITY

The DS14185 can easily provide 128 kbps data rate under maximum driver load conditions of C<sub>L</sub> = 2500 pF and R<sub>L</sub> = 3 kΩ, while power supplies are:

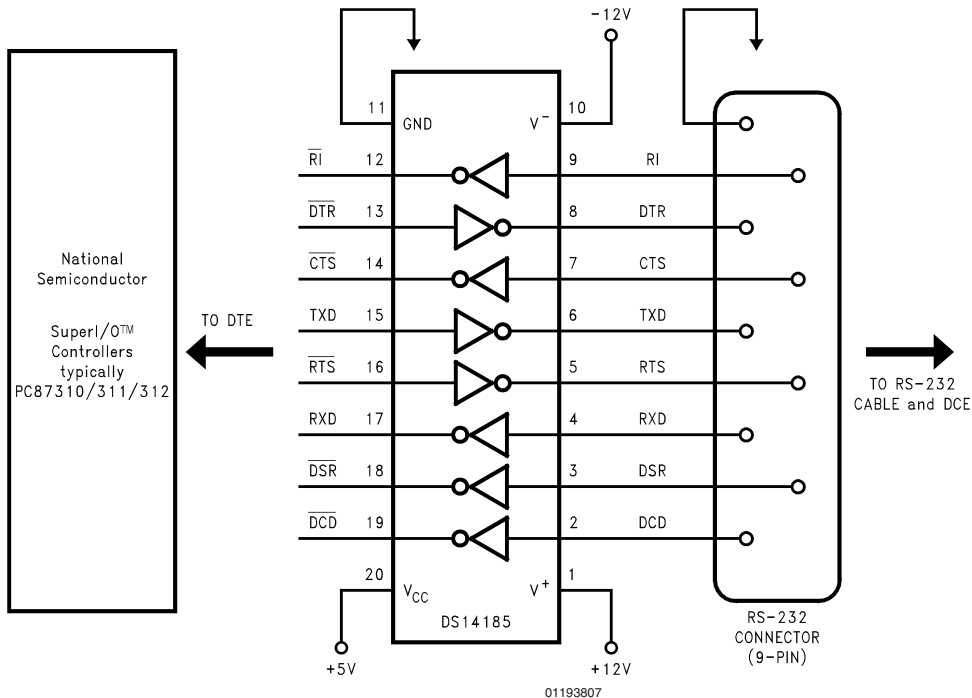
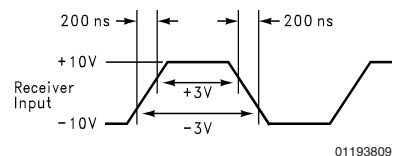
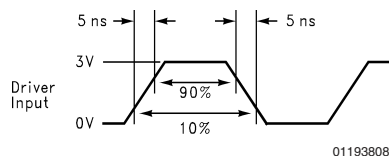


FIGURE 5. Typical DTE Application

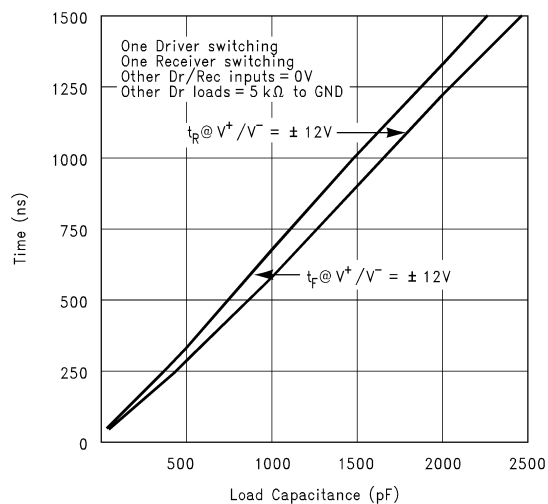
## Typical Performance Characteristics



The above input waveforms were used to generate all Typical AC Characteristics.

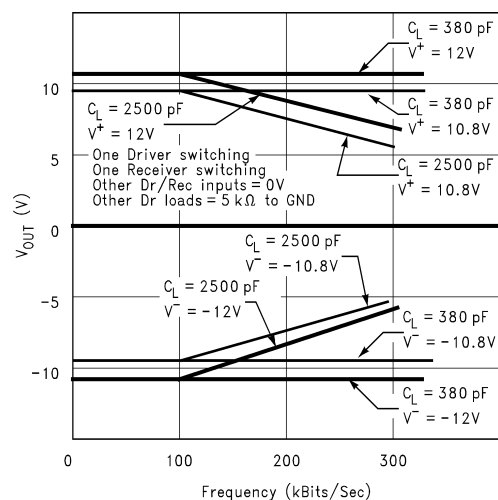
### Driver Output Slew Rate between +3V and -3V vs Load Capacitance

Conditions:  $V_{CC} = 5V$ ,  $R_L = 5 k\Omega$ ,  $T_A = 25^\circ C$ ,  $f_{IN} = 64 kHz$  Square Wave

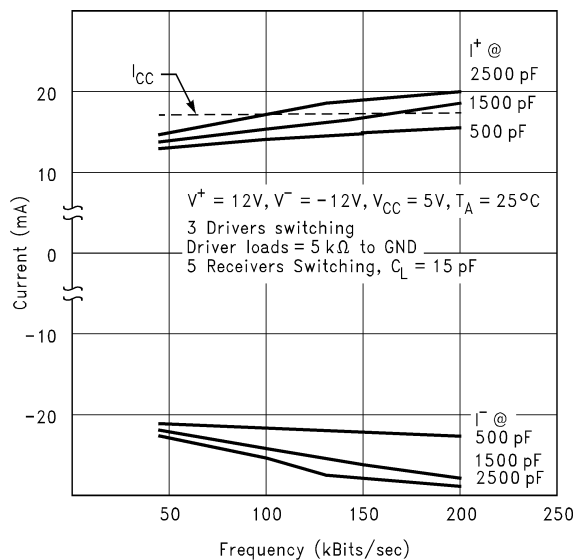


### Driver Output Voltage vs Frequency and $C_L$

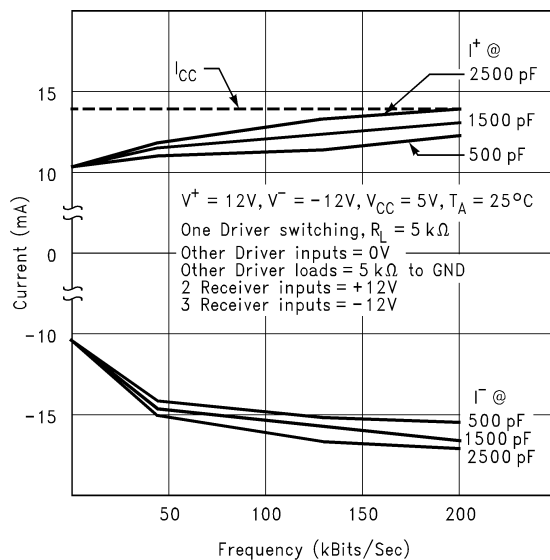
Conditions:  $V_{CC} = 5V$ ,  $R_L = 5 k\Omega$ ,  $T_A = 25^\circ C$



### Supply Current vs Frequency and Driver $C_L$

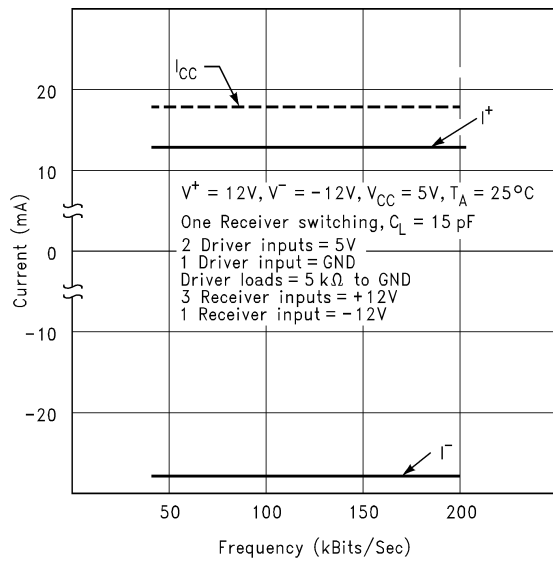


### Supply Current vs Frequency and Driver $C_L$

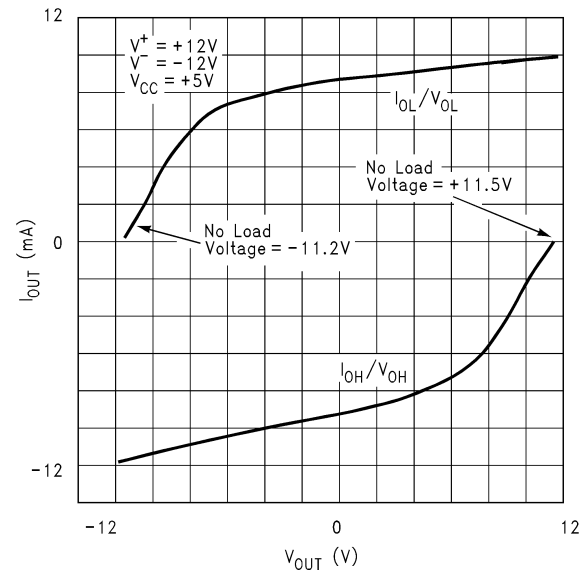


# Typical Performance Characteristics (Continued)

## Supply Current vs Frequency

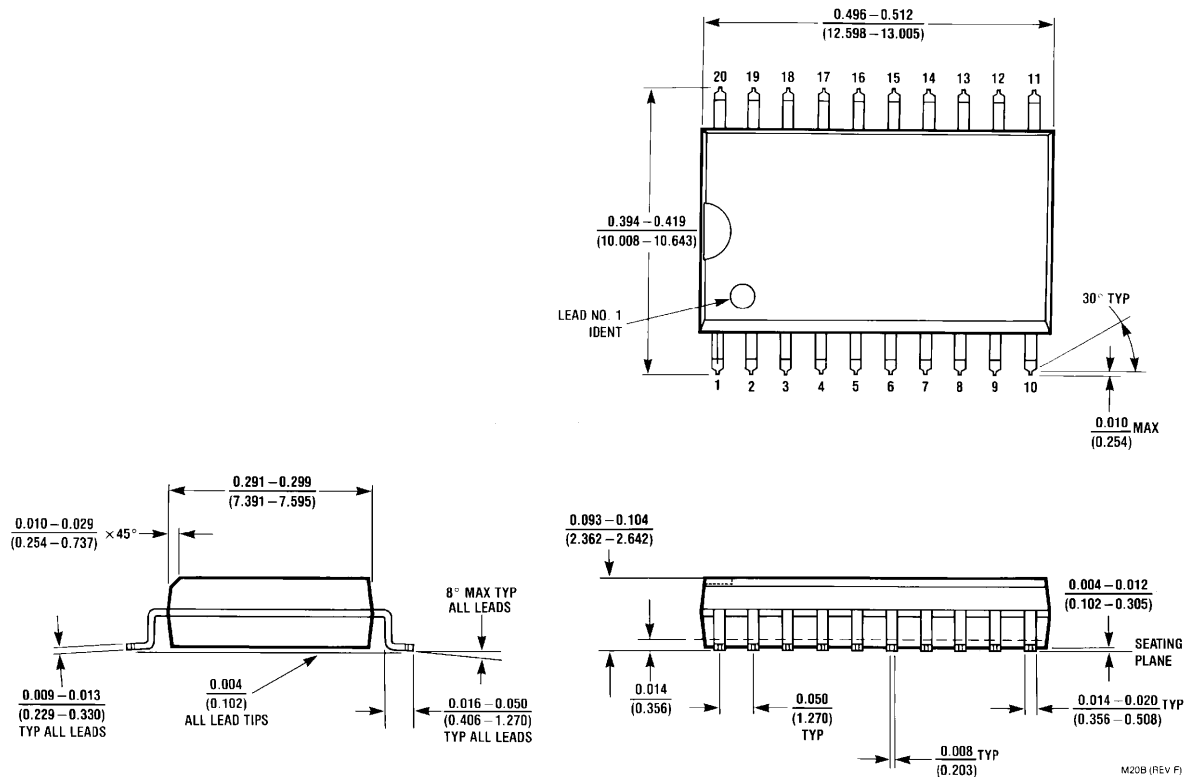


## Driver Output Current vs Output Voltage



## Physical Dimensions inches (millimeters)

unless otherwise noted



Small Outline Package  
Order Number DS14185WM  
NS Package M20B

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