National Semiconductor

April 1999

DS14185
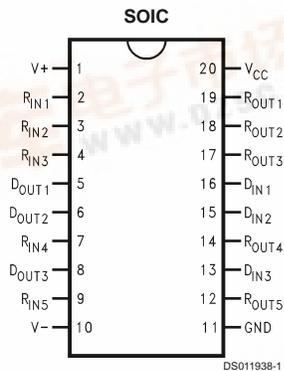# EIA/TIA-232   3 Driver x 5 Receiver

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.
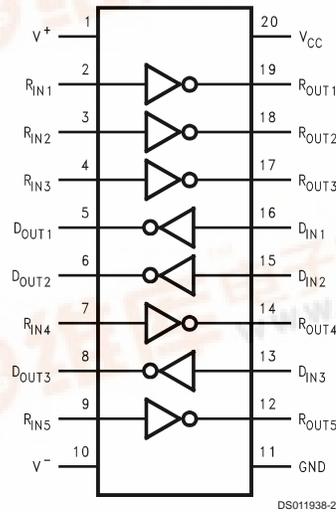
Features

- 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

SOIC

Pin	Signal		Pin	Signal
1	V+		20	V_{CC}
2	R_{IN1}		19	R_{OUT1}
3	R_{IN2}		18	R_{OUT2}
4	R_{IN3}		17	R_{OUT3}
5	D_{OUT1}		16	D_{IN1}
6	D_{OUT2}		15	D_{IN2}
7	R_{IN4}		14	R_{OUT4}
8	D_{OUT3}		13	D_{IN3}
9	R_{IN5}		12	R_{OUT5}
10	V–		11	GND

DS011938-1

Order Number DS14185WM
See NS Package M20B

Functional Diagram

DS011938-2

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DS011938   www.national.com

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)	±15V
Receiver Input Voltage	±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 kΩ, 100 pF)	≥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
DEVICE CHARACTERISTICS							
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 All Receiver Inputs at 0.8V or 2.4V.	$V^+ = 9V, V^- = −9V$		8.7	15	mA
			$V^+ = 13.2V, V^- = −13.2V$		13	22	mA
I^-	V^- Supply Current (Note 2)		$V^+ = 9V, V^- = −9V$		−12.5	−22	mA
			$V^+ = 13.2V, V^- = −13.2V$		−16.5	−28	mA
DRIVER CHARACTERISTICS							
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	μA
I_{IL}	Low Level Input Current (Note 2)	$V_{IN} = 0V$			−1.24	−1.5	mA
V_{OH}	High Level Output Voltage (Note 2)	$R_L = 3$ kΩ, $V_{IN} = 0.8V$, $V^+ = 9V, V^- = −9V$		6	7		V
		$R_L = 3$ kΩ, $V_{IN} = 0.8V$, $V^+ = +12V, V^- = −12V$		8.5	9		V
		$R_L = 7$ kΩ, $V_{IN} = 0.8V$, $V^+ = +13.2V, V^- = −13.2V$		10	11.5		V
V_{OL}	Low Level Output Voltage (Note 2)	$R_L = 3$ kΩ, $V_{IN} = 2V$, $V^+ = 9V, V^- = −9V$			−7	−6	V
		$R_L = 3$ kΩ, $V_{IN} = 2V$, $V^+ = +12V, V^- = −12V$			−8	−7.5	V
		$R_L = 7$ kΩ, $V_{IN} = 0.8V$, $V^+ = +13.2V, V^- = −13.2V$			−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
R_O	Output Resistance	$−2V \leq V_O \leq +2V$, $V^+ = V^- = V_{CC} = 0V$		300			Ω
		$−2V \leq V_O \leq +2V$, $V^+ = V^- = V_{CC} = $ Open Ckt		300			Ω

Electrical Characteristics (Note 2) (Continued)

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

Symbol	Parameter	Conditions	Min	Typ	Max	Units
RECEIVER CHARACTERISTICS						
V_{TH}	Input High Threshold (Recognized as a High Signal)	$V_O \leq 0.4V$, $I_O = 3.2$ mA		1.85	2.4	V
V_{TL}	Input Low Threshold (Recognized as a Low Signal)	$V_O \geq 2.5V$, $I_O = -0.5$ mA	0.7	1.0		V
R_{IN}	Input Resistance	$V_{IN} = \pm3V$ to $\pm15V$	3.0	4.1	7.0	kΩ
I_{IN}	Input Current (Note 2)	$V_{IN} = +15V$	2.1	4.1	5.0	mA
		$V_{IN} = +3V$	0.43	0.7	1	mA
		$V_{IN} = -15V$	−5.0	−4.1	−2.1	mA
		$V_{IN} = -3V$	−1	−0.65	−0.43	mA
V_{OH}	High Level Output Voltage (Note 7)	$I_{OH} = -0.5$ mA, $V_{IN} = -3V$	2.6	4		V
		$I_{OH} = -10$ µA, $V_{IN} = -3V$	4.0	4.9		V
		$I_{OH} = -0.5$ mA, V_{IN} = Open Circuit	2.6	4		V
		$I_{OH} = -10$ µA, V_{IN} = Open Circuit	4.0	4.9		V
V_{OL}	Low Level Output Voltage	$I_{OL} = 3.2$ mA, $V_{IN} = +3V$		0.2	0.4	V
I_{OSR}	Short Circuit Current (Note 2)	$V_O = 0V$, $V_{IN} = 0V$	−4	−2.7	−1.7	mA

Switching Characteristics (Note 2)

$T_A = 25°C$

Symbol	Parameter	Conditions	Min	Typ	Max	Units
DRIVER CHARACTERISTICS						
t_{PHL}	Propagation Delay High to Low	$R_L = 3$ kΩ, $C_L = 50$ pF (*Figures 1, 2*)		60	350	ns
t_{PLH}	Propagation Delay Low to High			240	350	ns
t_r, t_f	Output Slew Rate (Note 8)			50		ns
RECEIVER CHARACTERISTICS						
t_{PHL}	Propagation Delay High to Low	$R_L = 1.5$ kΩ, $C_L = 15$ pF (includes fixture plus probe), (*Figures 3, 4*)		150	350	ns
t_{PLH}	Propagation Delay Low to High			240	350	ns
t_r	Rise Time			87	175	ns
t_f	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: $V_{CC} = +5.0V$, $V^+ = +12.0V$, $V^- = -12V$, $T_A = +25°C$.

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

Note 5: Generator characteristics for driver input: f = 64 kHz (128 kbits/sec), $t_r = t_f < 10$ ns, $V_{IH} = 3V$, $V_{IL} = 0V$, duty cycle = 50%.

Note 6: Generator characteristics for receiver input: f = 64 kHz (128 kbits/sec), $t_r = t_f = 200$ ns, $V_{IH} = 3V$, $V_{IL} = -3V$, 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_{CC} or GND. Slew rate is determined by load capacitance. To comply with a 30 V/µs maximum slew rate, a minimum load capacitance of 390 pF is recommended.
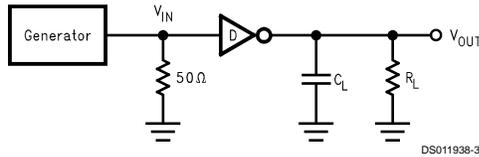
Parameter Measurement Information

DS011938-3

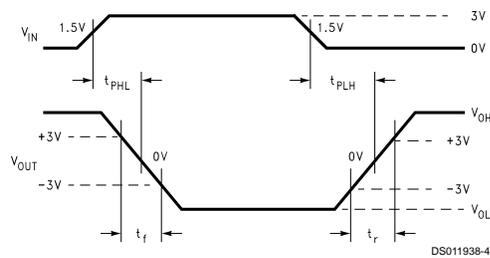**FIGURE 1. Driver Propagation Delay and Transition Time Test Circuit** (Note 5)

DS011938-4

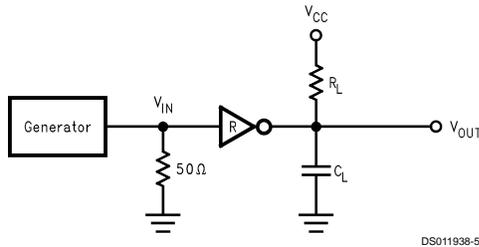**FIGURE 2. Driver Propagation Delay and Transition Time Waveforms Slew Rate (SR) = 6V/(t$_r$ or t$_f$)**

DS011938-5

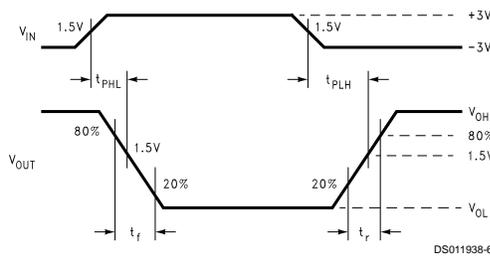**FIGURE 3. Receiver Propagation Delay and Transition Time Test Circuit** (Note 6)

DS011938-6

**FIGURE 4. Receiver Propagation Delay and
Transition Time Waveform**

Pin Descriptions

Pin #	Name	Description
13, 15, 16	D$_{IN}$	Driver Input Pins
5, 6, 8	D$_{OUT}$	Driver Output Pins, RS-232 Levels
2, 3, 4, 7, 9	R$_{IN}$	Receiver Input Pins, RS-232 Levels
12, 14, 17, 18, 19	R$_{OUT}$	Receiver Output Pins
11	GND	Ground
1	V$^+$	Positive Power Supply Pin (+9.0 ≤ V$^+$ ≤ +13.2)

Pin Descriptions (Continued)

Pin #	Name	Description
10	V$^-$	Negative Power Supply Pin ($-9.0 \leq$ V$^- \leq -13.2$)
20	V$_{CC}$	Positive Power Supply Pin (+5V ±5%)

Applications Information

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 solutuion 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.

LapLink COMPATIBILITY

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

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

MOUSE DRIVING

A typical mouse can be powered from the drivers. Two driver outputs connected in parallel and set to V$_{OH}$ can be used to supply power to the V$^+$ pin of the mouse. The third driver output is set to V$_{OL}$ to sink the current from the V$^-$ terminal. Refer to typical curves of V$_{OUT}$/I$_{OUT}$.Typical mouse specifications are:
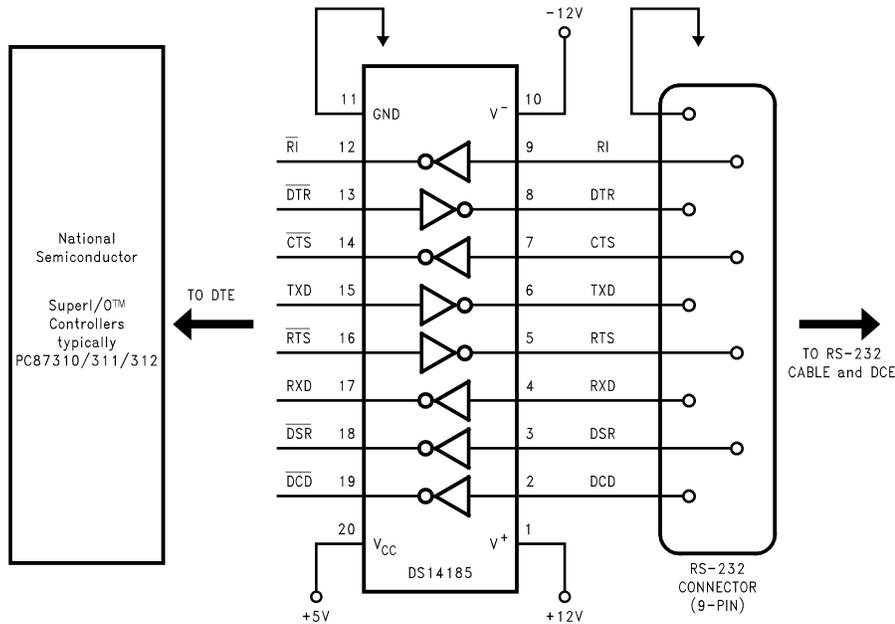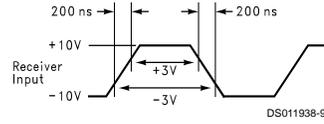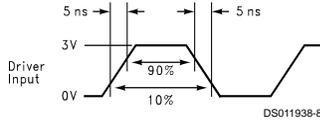
10 mA at +6V

5 mA at −6V

FIGURE 5. Typical DTE Application

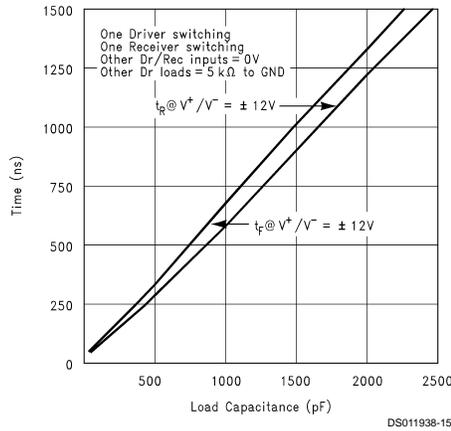# Typical Performance Characteristics

Driver Input: 5 ns, 3V, 90%, 10%, 0V, 5 ns DS011938-8

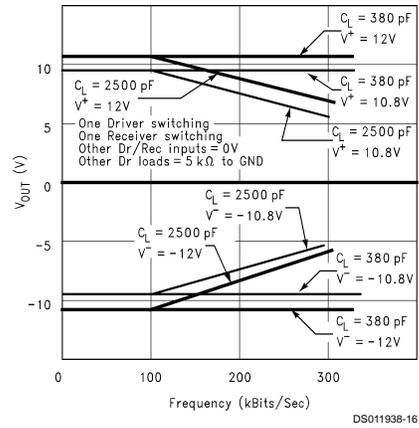Receiver Input: 200 ns, +10V, +3V, −3V, −10V, 200 ns DS011938-9

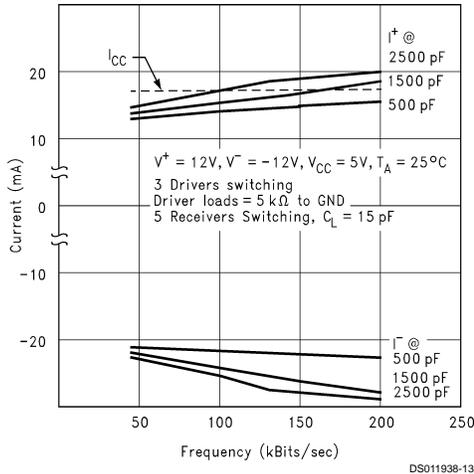The above input waveforms were used to generate all Typical AC Characteristics.

Driver Output Slew Rate between +3V and −3V vs Load Capacitance
Conditions: V_{CC} = 5V, R_L = 5 kΩ, T_A = 25˚C, f_{IN} = 64 kHz Square Wave

One Driver switching
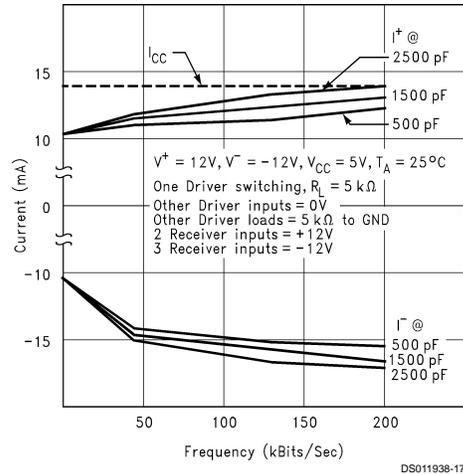One Receiver switching
Other Dr/Rec inputs = 0V
Other Dr loads = 5 kΩ to GND

t_R @ V^+/V^- = ± 12V

t_F @ V^+/V^- = ± 12V

Time (ns) vs Load Capacitance (pF) DS011938-15

Driver Output Voltage vs Frequency and C_L
Conditions: V_{CC} = 5V, R_L = 5 kΩ, T_A = 25˚C

C_L = 380 pF, V^+ = 12V
C_L = 2500 pF, V^+ = 12V
C_L = 380 pF, V^+ = 10.8V
C_L = 2500 pF, V^+ = 10.8V

One Driver switching
One Receiver switching
Other Dr/Rec inputs = 0V
Other Dr loads = 5 kΩ to GND

C_L = 2500 pF, V^- = −10.8V
C_L = 2500 pF, V^- = −12V
C_L = 380 pF, V^- = −10.8V
C_L = 380 pF, V^- = −12V

V_{OUT} (V) vs Frequency (kBits/Sec) DS011938-16

Supply Current vs Frequency and Driver C_L

I_{CC}
I^+ @ 2500 pF, 1500 pF, 500 pF

V^+ = 12V, V^- = −12V, V_{CC} = 5V, T_A = 25°C
3 Drivers switching
Driver loads = 5 kΩ to GND
5 Receivers Switching, C_L = 15 pF

I^- @ 500 pF, 1500 pF, 2500 pF

Current (mA) vs Frequency (kBits/sec) DS011938-13

Supply Current vs Frequency and Driver C_L

I_{CC}
I^+ @ 2500 pF, 1500 pF, 500 pF

V^+ = 12V, V^- = −12V, V_{CC} = 5V, T_A = 25°C
One Driver switching, R_L = 5 kΩ
Other Driver inputs = 0V
Other Driver loads = 5 kΩ to GND
2 Receiver inputs = +12V
3 Receiver inputs = −12V

I^- @ 500 pF, 1500 pF, 2500 pF

Current (mA) vs Frequency (kBits/Sec) DS011938-17

Typical Performance Characteristics (Continued)

Supply Current vs Frequency

$V^+ = 12V, V^- = -12V, V_{CC} = 5V, T_A = 25°C$
One Receiver switching, $C_L = 15$ pF
2 Driver inputs = 5V
1 Driver input = GND
Driver loads = 5 kΩ to GND
3 Receiver inputs = +12V
1 Receiver input = -12V

Current (mA) vs Frequency (kBits/Sec)

DS011938-18
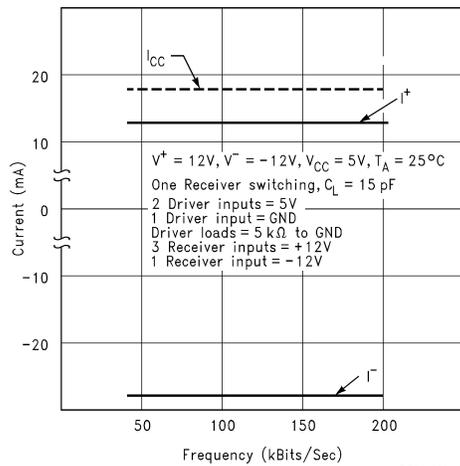
Driver Output Current vs Output Voltage

$V^+ = +12V$
$V^- = -12V$
$V_{CC} = +5V$

I_{OL}/V_{OL}

No Load
Voltage = +11.5V

No Load
Voltage = -11.2V

I_{OH}/V_{OH}

I_{OUT} (mA) vs V_{OUT} (V)

DS011938-19
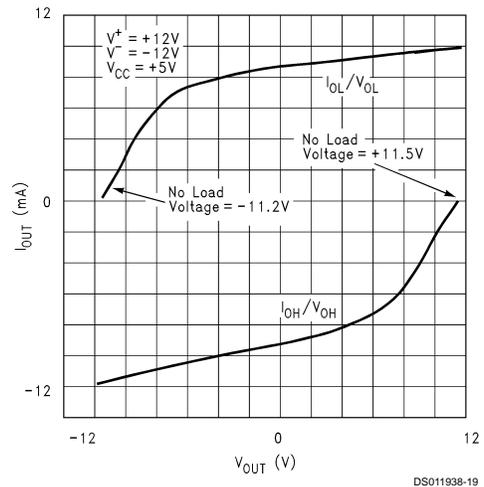
Physical Dimensions inches (millimeters) unless otherwise noted

0.496 − 0.512
(12.598 − 13.005)

20 19 18 17 16 15 14 13 12 11

0.394 − 0.419
(10.008 − 10.643)

LEAD NO. 1
IDENT

30° TYP

1 2 3 4 5 6 7 8 9 10

0.010 MAX
(0.254)

0.291 − 0.299
(7.391 − 7.595)

0.010 − 0.029
(0.254 − 0.737) ×45°

8° MAX TYP
ALL LEADS

0.009 − 0.013
(0.229 − 0.330)
TYP ALL LEADS

0.004
(0.102)
ALL LEAD TIPS

0.016 − 0.050
(0.406 − 1.270)
TYP ALL LEADS

0.093 − 0.104
(2.362 − 2.642)

0.004 − 0.012
(0.102 − 0.305)

SEATING
PLANE

0.014
(0.356)

0.050
(1.270)
TYP

0.008 TYP
(0.203)

0.014 − 0.020 TYP
(0.356 − 0.508)

M20B (REV F)

Small Outline Package
Order Number DS14185WM
NS Package M20B

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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.