DS14C535 +5V Supply EIA/TIA-232 3 x 5 Driver/Receiver

Check for Samples: DS14C535

FEATURES

- **Pin compatible with DS14C335**
- **Conforms to EIA/TIA-232-E and CCITT (ITU-T) V.28 specifications**
- **Failsafe receiver outputs high when inputs open**
- **Operates with single +5V power supply**
- **Low power requirement—I_{CC} 12 mA maximum**
- **SHUTDOWN mode—I_{CX} 10 µA maximum**
- **One Receiver (R5) active during SHUTDOWN**
- **Operates up to 128 kbps— Lap-Link® Compatible**
- **4V/µs minimum Slew Rate guaranteed**
- **ESD rating of 3 kV on all pins (H, B, M)**
- **Available in 28-lead SSOP EIAJ Type II package**
- **Only four 0.1 µF capacitors required for the DC-DC converter**

DESCRIPTION

The DS14C535 is three driver, five receiver device which conforms to EIA/TIA-232-E and CCITT (ITU-T) V.28 standard specifications. This device employs an internal DC-DC converter to generate the necessary output levels from a +5V power supply. A SHUTDOWN (SD) mode reduces the supply current to 10 µA maximum. In the SD mode, one receiver is active, allowing ring indicator (RI) to be monitored. PC Board space consumption is minimized by the availability of Shrink Small Outline Packaging (SSOP).

The DS14C535 provides a one-chip solution for the common 9-pin serial RS-232 interface between data terminal and data circuit-terminating equipment.

This device allows an easy migration path to the 3.3V DS14C335. The packages are the same. The N/C pins on the DS14C535 are not physically connected to the chip. Board layout for the DS14C335 will accommodate both devices.

This device's low power requirement and small footprint makes it an ideal choice for Laptop and Notebook applications.

Connection Diagram

DS14C535

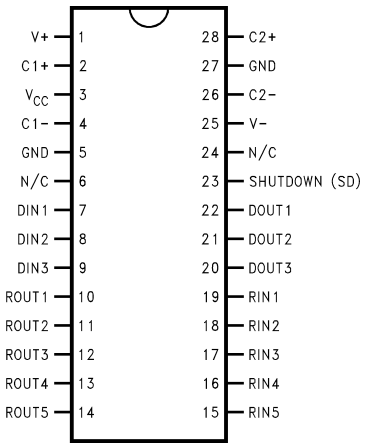
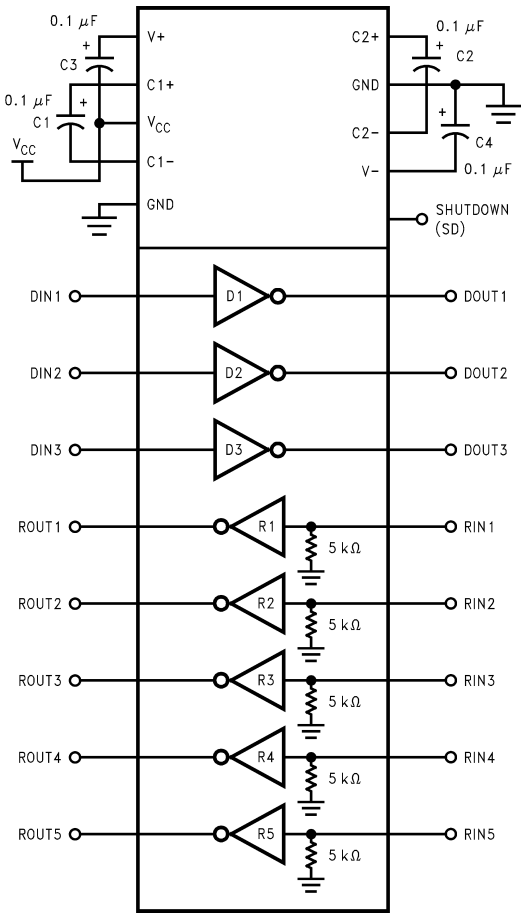


Figure 1. Top View

Functional Diagram



These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

Absolute Maximum Ratings (1)

Supply Voltage (V_{CC})	−0.3V to +6V
V^+ Pin	(V_{CC} − 0.3V) to +14V
V^- Pin	+0.3V to −14V
Input Voltage (D_{IN}, SD)	−0.3V to +5.5V
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
Storage Temperature Range	−65°C to +150°C
Lead Temperature (Soldering 4 sec.)	+260°C
Short Circuit Duration (D_{OUT})	Continuous
Maximum Package Power Dissipation @ +25°C	
SSOP MSA Package	1286 mW
Derate MSA Package	10.3 mW/°C above +25°C
ESD Rating (HBM, 1.5 kΩ, 100 pF)	≥ 3.0 kV

(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.

Recommended Operating Conditions

	Min	Max	Units
Supply Voltage (V_{CC})	4.5	5.5	V
Operating Free Air Temperature (T_A)			
DS14C535	0	+70	°C

Electrical Characteristics (1) (2)

Over recommended operating conditions, SD = 0.8V, unless otherwise specified.

Symbol	Parameter	Conditions			Min	Typ	Max	Units
DEVICE CHARACTERISTICS								
V^+	Positive Power Supply	No Load	D_{IN} = 0.8V			+8.5		V
V^-	Negative Power Supply	C1–C4 = 0.1 µF	D_{IN} = 2.0V			−7.0		V
I_{CC}	Supply Current	No Load					12	mA
I_{CX}	SHUTDOWN Supply Current	R_L = 3 kΩ, SD = V_{CC}				1.0	10	µA
V_{IH}	High Level Enable Voltage			SD	2.0			V
V_{IL}	Low Level Enable Voltage				GND		0.8	V
I_{IH}	High Level Enable Current	2.0V ≤ V_{IN} ≤ 5.5V					+2.0	µA
I_{IL}	Low Level Enable Current	GND ≤ V_{IN} ≤ 0.8V			−2.0			µA
DRIVER CHARACTERISTICS								
V_{IH}	High Level Input Voltage		D_{IN}		2.0			V
V_{IL}	Low Level Input Voltage				GND		0.8	V
I_{IH}	High Level Input Current	2.0V ≤ V_{IN} ≤ 5.5V					+1.0	µA
I_{IL}	Low Level Input Current	GND ≤ V_{IN} ≤ 0.8V			−1.0			µA
V_{OH}	High Level Output Voltage	R_L = 3 kΩ			+5.0	8		V
V_{OL}	Low Level Output Voltage					−6.7	−5.0	V
I_{OS+}	Output High Short Circuit Current	V_O = 0V, V_{IN} = 0.8V (3)			−40	−20	−8	mA
I_{OS-}	Output Low Short Circuit Current	V_O = 0V, V_{IN} = 2.0V (3)			6	15	40	mA
R_O	Output Resistance	−2V ≤ V_O ≤ +2V, V_{CC} = GND = 0V			300	1200		Ω
RECEIVER CHARACTERISTICS (4)								
V_{TH}	Input High Threshold Voltage	R1–R5, SD = 0.8V (Active Mode)				1.4	2.4	V
		R5, 2.0V ≤ SD ≤ 5.5V (Shutdown Mode)				2.0	2.8	V
V_{TL}	Input Low Threshold Voltage	R1–R5, SD = 0.8V (Active Mode)			0.8	1.1		V
		R5, 2.0V ≤ SD ≤ 5.5V (Shutdown Mode)			0.8	1.1		V
V_{HY}	Hysteresis (Note 4)				0.15		1.0	V
R_{IN}	Input Resistance	V_{IN} = ±3V to ±15V			3.0	5.4	7.0	kΩ
I_{IN}	Input Current	V_{IN} = +15V			2.14		5.0	mA
		V_{IN} = +3V			0.43		1.0	mA
		V_{IN} = −3V			−1.0		−0.43	mA
		V_{IN} = −15V			−5.0		−2.14	mA
V_{OH}	High Level Output Voltage	V_{IN} = −3V, I_{OH} = −2.0 mA			3.8			V
		V_{IN} = −3V, I_{OH} = −20 µA			4.0			V
V_{OL}	Low Level Output Voltage	V_{IN} = +3V, I_{OL} = +2.0 mA				0.23	0.4	V

(1) Typical values are given for V_{CC} = 5V and T_A = +25°C.
(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 voltage logic levels, the more positive value is designated as maximum. For example, if −5V is a maximum, the typical value (−6.7V) is more negative.
(3) Only one driver output shorted at a time.
(4) Receiver characteristics are guaranteed for SD = 0.8V. When SD = 2.0V, receiver five (R5) is active and meets receiver parameters in SHUTDOWN (SD) mode, unless otherwise specified.

Switching Characteristics (1)

Over recommended operating conditions, SD = 0.8V, 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 2 Figure 3)	0.1	0.6	1.0	µs
t_{PHL}	Propagation Delay HIGH to LOW		0.1	0.6	1.0	µs
t_{SK}	Skew $\|t_{PLH}–t_{PHL}\|$			0	0.2	µs
SR1	Output Slew Rate	R_L = 3 kΩ to 7 kΩ, C_L = 50 pF (Figure 3)	4	13	30	V/µs
SR2	Output Slew Rate	R_L = 3 kΩ, C_L = 2500 pF (Figure 3)	4	10	30	V/µs
t_{PLS}	Propagation Delay LOW to SD	(Figure 6 Figure 7)		0.48		ms
t_{PSL}	Propagation Delay SD to LOW	R_L = 3 kΩ C_L = 50 pF		1.88		ms
t_{PHS}	Propagation Delay HIGH to SD			0.62		ms
t_{PSH}	Propagation Delay SD to HIGH			1.03		ms
RECEIVER CHARACTERISTICS						
t_{PLH}	Propagation Delay LOW to HIGH	C_L = 50 pF (Figure 4 Figure 5)	0.1	0.4	1.0	µs
t_{PHL}	Propagation Delay HIGH to LOW		0.1	0.6	1.0	µs
t_{SK}	Skew $\|t_{PLH}–t_{PHL}\|$			0.1	0.5	µs
t_{PLS}	Propagation Delay LOW to SD	R_L = 1 kΩ C_L = 50 pF R1–R4 Only (Figure 8 Figure 9)		0.13		µs
t_{PSL}	Propagation Delay SD to LOW			1.0		µs
t_{PHS}	Propagation Delay HIGH to SD			0.19		µs
t_{PSH}	Propagation Delay SD to HIGH			0.58		µs

(1) Receiver characteristics are guaranteed for SD = 0.8V. When SD = 2.0V, receiver five (R5) is active and meets receiver parameters in SHUTDOWN (SD) mode, unless otherwise specified.

Parameter Measurement Information

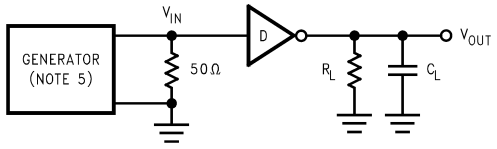


Figure 2. Driver Propagation Delay and Slew Rate Test Circuit

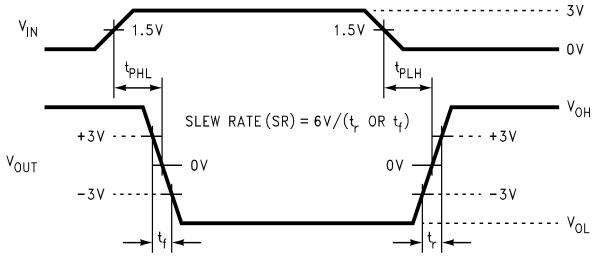


Figure 3. Driver Propagation Delay and Slew Rate Timing

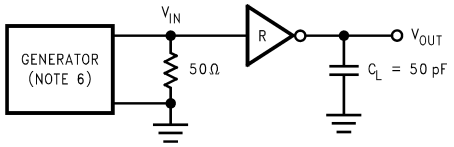


Figure 4. Receiver Propagation Delay Test Circuit

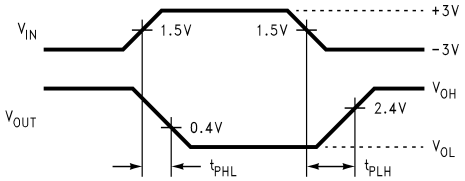


Figure 5. Receiver Propagation Delay Timing

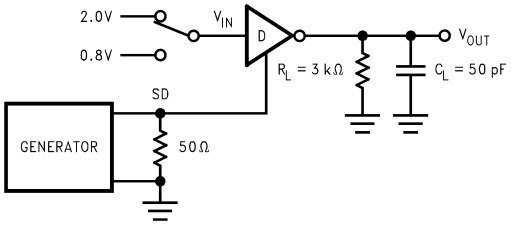


Figure 6. Driver SHUTDOWN (SD) Delay Test Circuit

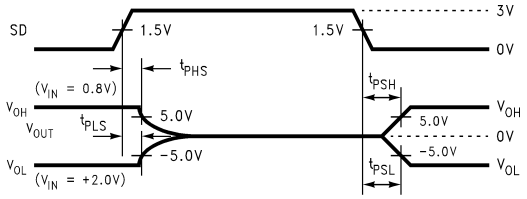


Figure 7. Driver SHUTDOWN (SD) Delay Timing

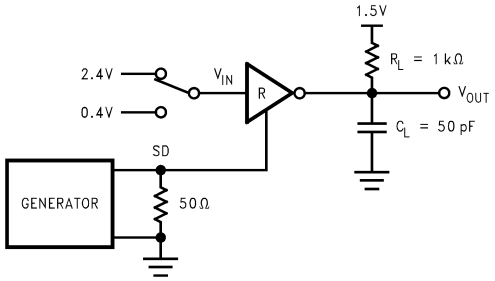


Figure 8. Receiver SHUTDOWN (SD) Delay Test Circuit

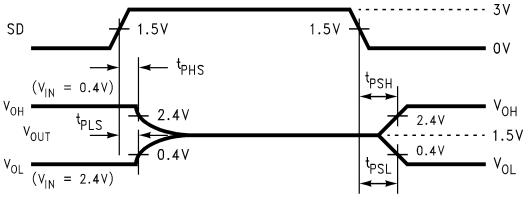


Figure 9. Receiver SHUTDOWN (SD) Delay Timing

Pin Functions

Pin Descriptions

V_{CC} (Pin 3). Power supply pin for the device, +5V (±0.5V).

V+ (Pin 1). Positive supply for EIA/TIA-232-E drivers. Recommended external capacitor—0.1 µF (16V). This supply is not intended to be loaded externally.

V− (Pin 25). Negative supply for EIA/TIA-232-E drivers. Recommended external capacitor—0.1 µF (16V). This supply is not intended to be loaded externally.

C1+, C1− (Pins 2, 4). External capacitor connection pins.

C2+, C2− (Pins 28, 26). External capacitor connection pins.

SHUTDOWN (SD) (Pin 23). A High on the SHUTDOWN pin will lower the total I_{CC} current to less than 10 µA, providing a low power state. In this mode receiver R5 remains active. The SD pin should be driven or tied low (GND) to disable the shutdown mode.

D_{IN} 1–3 (Pins 7, 8, 9). Driver input pins.

D_{OUT} 1–3 (Pins 22, 21, 20). Driver output pins conform to EIA/TIA-232 -E levels.

R_{IN} 1–5 (Pins 19, 18, 17, 16, 15). Receiver input pins accept EIA/TIA-232-E input voltages (±25V). Receivers guarantees hysteresis of TBD 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 10, 11, 12, 13, 14). Receiver output pins.

GND (Pins 5, 27). Ground Pins. Both pins must be connected to external ground. These pins are not connected together on the chip.

Application 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 and the control lines are RTS, DTR, DSR, DCD, CTS and RI. The DS14C535 is a 3 x 5 Driver/Receiver and offers a single chip solution for the DTE interface as shown in Figure 10.

Ring Indicator (RI) is used to inform the DTE that an incoming call is coming from a remote DCE. When the DS14C535 is in SHUTDOWN (SD) mode, receiver five (R5) remains active and monitors RI circuit. This active receiver (R5) alerts the DTE to switch the DS14C535 from SHUTDOWN to active mode.

To achieve minimum power consumption, the DS14C535 can be in SHUTDOWN mode and only activated when communications are needed.

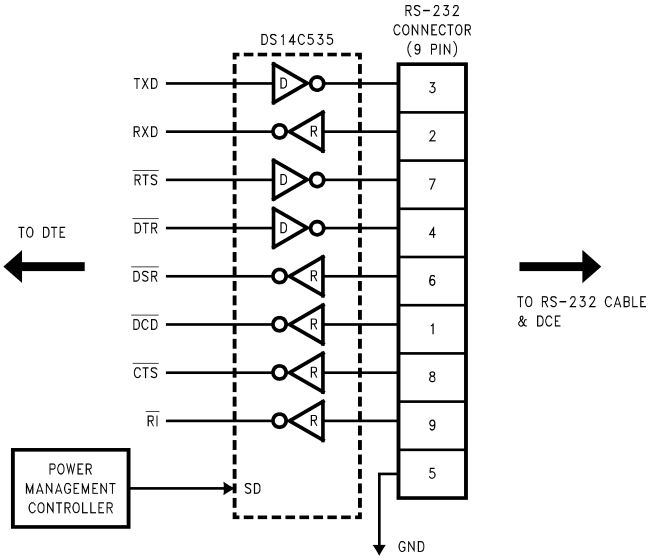


Figure 10. Typical DTE Application

CAPACITORS

Capacitors can be ceramic or tantalum. Standard surface mount in the range of 0.1 µF to 0.68 µF are readily available from several manufacturers. A minimum 20V rating is recommended. Contact manufacturers for specific detail on surface mounting and dielectrics. A partial list of manufacturers include:

Manufacturer	Phone Number
KEMET	803-963-6300
AVX	803-448-9411
MURATA-ERIE	800-831-9172

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Top-Side Markings (4)	Samples
DS14C535MSA	ACTIVE	SSOP	DB	28	47	TBD	Call TI	Call TI	0 to 70	DS14C535 MSA	Samples
DS14C535MSA/NOPB	ACTIVE	SSOP	DB	28	47	Green (RoHS & no Sb/Br)	SN	Level-3-260C-168 HR	0 to 70	DS14C535 MSA	Samples
DS14C535MSAX	ACTIVE	SSOP	DB	28	2000	TBD	Call TI	Call TI	0 to 70	DS14C535 MSA	Samples
DS14C535MSAX/NOPB	ACTIVE	SSOP	DB	28	2000	Green (RoHS & no Sb/Br)	SN	Level-3-260C-168 HR	0 to 70	DS14C535 MSA	Samples

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
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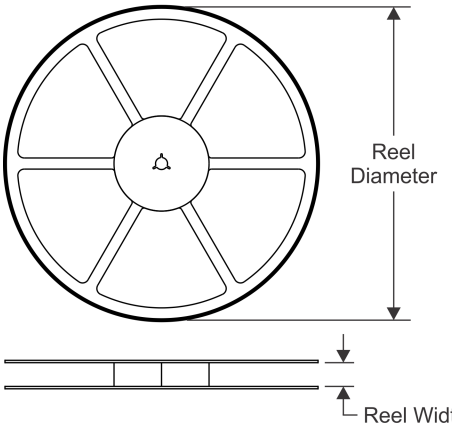
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

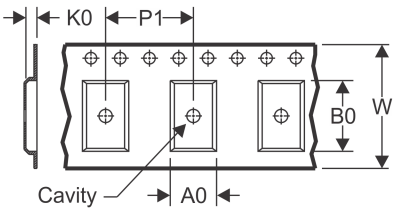
(4) Only one of markings shown within the brackets will appear on the physical device.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

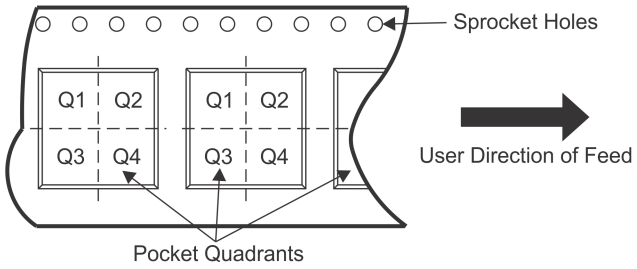


TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

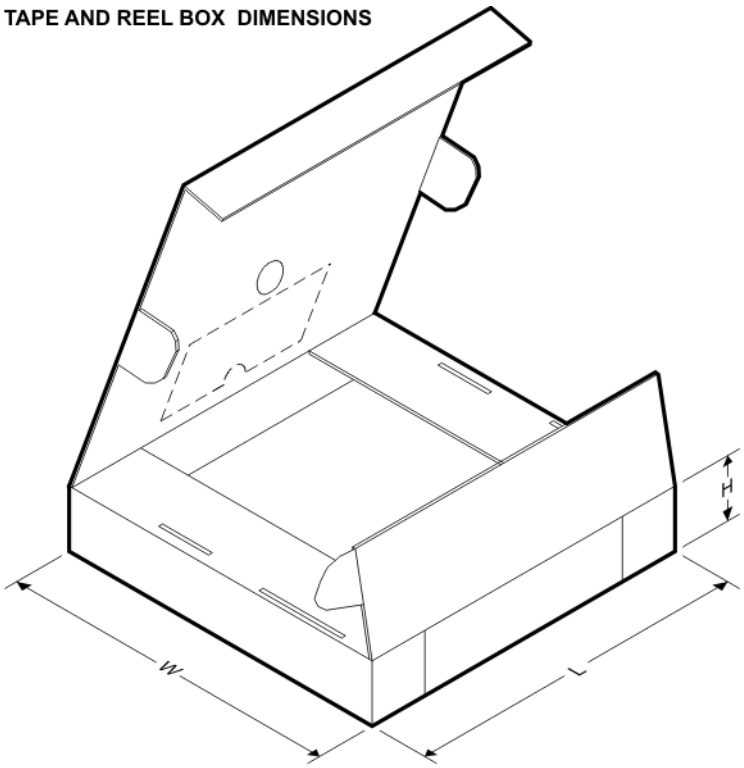
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
DS14C535MSAX	SSOP	DB	28	2000	330.0	16.4	8.4	10.7	2.4	12.0	16.0	Q1
DS14C535MSAX/NOPB	SSOP	DB	28	2000	330.0	16.4	8.4	10.7	2.4	12.0	16.0	Q1

TAPE AND REEL BOX DIMENSIONS



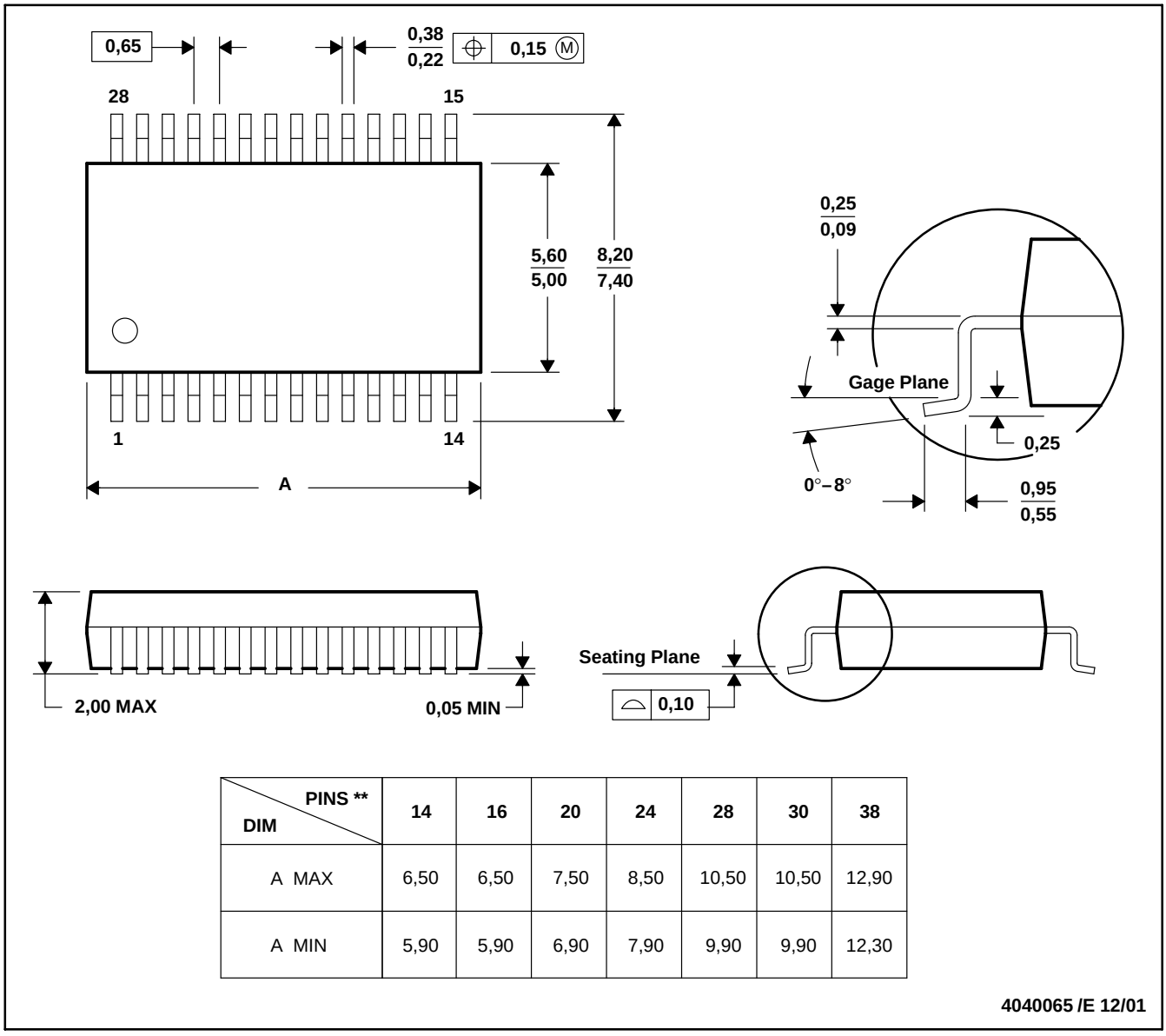
*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
DS14C535MSAX	SSOP	DB	28	2000	367.0	367.0	38.0
DS14C535MSAX/NOPB	SSOP	DB	28	2000	367.0	367.0	38.0

MSSO002E – JANUARY 1995 – REVISED DECEMBER 2001

DB (R-PDSO-G)** **PLASTIC SMALL-OUTLINE**

28 PINS SHOWN



DIM \ PINS **	14	16	20	24	28	30	38
A MAX	6,50	6,50	7,50	8,50	10,50	10,50	12,90
A MIN	5,90	5,90	6,90	7,90	9,90	9,90	12,30

4040065 /E 12/01

NOTES: A. All linear dimensions are in millimeters.
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion not to exceed 0,15.
D. Falls within JEDEC MO-150

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