

MAX3221

3V至5.5V单通道RS-232线驱动器/接收器

一 概述

1. 1 特点

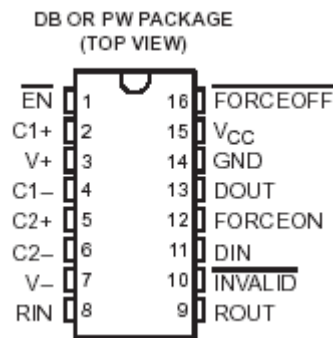
- 能满足或超过TIA/EIA-232-F和ITU v.28 标准的要求
- 工作电源电压为3V至5.5V
- 最多可处理250 kbit/s
- 一个驱动器和一个接收器
- 低待机电流（典型值为1 μ A）
- 外接电容器（4 \cdot 0.1 μ F）
- 接受5V逻辑输入电平和3.3V电源电压
- 可与Maxim MAX3221互换使用
- 可供选择的高速引脚可兼容器件(1 Mbit/s) – SNx5C3221
- RS-232 总线引脚 ESD保护超过 \pm 15 kV时采用人体模型（HBM）
- 自动掉电特点可自动使驱动器失效以节约电源

1. 2 应用范围

- 电池上电、手持和便携式设备
- PDA和掌上个人电脑
- 数码相机
- 移动电话和无线设备

1. 3 描述/订购信息

MAX3221包含一个线驱动器、一个线接收器和一个带有 \pm 15-kV ESD保护的双电荷泵。该器件可满足TIA/EIA-232-F要求，并在一个异步通信控制器和串行端口连接器之间提供接口。电荷泵和四个小型外接电容器可在单路3V至5.5V电源电压下工作。这些器件在数据信号率达到250 kbit/s且最大的30-V/ μ s驱动输出回速率时工作。



ORDERING INFORMATION

T _A	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
-0°C to 70°C	SSOP (DB)	Reel of 2000	MAX3221 CDBR	MA3221C
	TSSOP (PW)	Tube of 90	MAX3221 CPW	MA3221C
		Reel of 2000	MAX3221 CPWR	
-40°C to 85°C	SSOP (DB)	Reel of 2000	MAX3221 IDBR	MB3221I
	TSSOP (PW)	Tube of 90	MAX3221 IPW	MB3221I
		Reel of 2000	MAX3221 IPWR	

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.

当串行端口失效时，可对电压管理进行灵活的控制选择。在 FORCEON 为低且 FORCEOFF 为高时自动掉电功能起作用。在这种工作方式中，若器件未感应到接收器输入端上的一个有效的 RS-232 信号，则驱动器输出端被禁止。若 FORCEOFF 置为低且 EN 为高，则驱动器和接收器均被切断，电源电流降至 1 μ A。断开串行端口或关闭外围驱动器将会导致自动掉电。当 FORCEON 和 FORCEOFF 为高时，自动掉电被禁止。当自动掉电被使能且在接收器输入端加一个有效信号时器件被激活。无效 (INVALID) 输出告知用户查看 RS-232 信号是否加在接收器输入端。如果接收器输入端电压高于 2.7 V 或低于 -2.7 V 或在 ± 0.3 V 之间并持续少于 30 μ s，INVALID 为高 (数据有效)；如果接收器输入端电压在 ± 0.3 V 之间并持续超过 30 μ s，则 INVALID 为低 (数据无效)。接收器输入端电平请参见图 5。

Function Tables

EACH DRIVER

INPUTS				OUTPUT DOUT	DRIVER STATUS
DIN	FORCEON	FORCEOFF	VALID RIN RS-232 LEVEL		
X	X	L	X	Z	Powered off
L	H	H	X	H	Normal operation with auto-powerdown disabled
H	H	H	X	L	
L	L	H	Yes	H	Normal operation with auto-powerdown enabled
H	L	H	Yes	L	
L	L	H	No	Z	Powered off by auto-powerdown feature
H	L	H	No	Z	

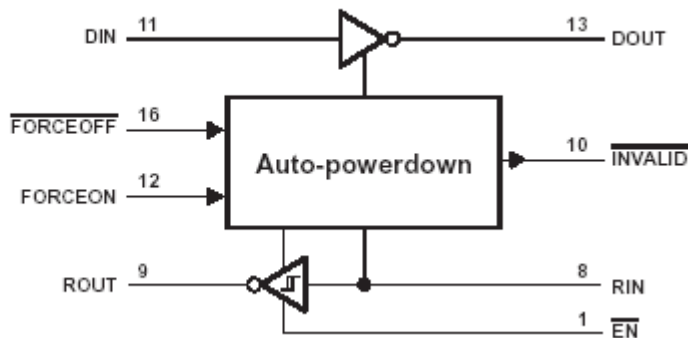
H = high level, L = low level, X = irrelevant, Z = high impedance

EACH RECEIVER

INPUTS			OUTPUT ROUT
RIN	$\overline{\text{EN}}$	VALID RIN RS-232 LEVEL	
L	L	X	H
H	L	X	L
X	H	X	Z
Open	L	No	H

H = high level, L = low level, X = irrelevant, Z = high impedance (off), Open = disconnected input or connected driver off

logic diagram (positive logic)



二 特性

2. 1 极限参数（除非另有规定，否则请在推荐工作温度范围内工作）*

电源电压范围, V_{CC} (见注解1)	-0.3 V 至 6 V
正极输出电源电压范围, $V+$ (见注解1)	-0.3 V 至 7V
负极输出电源电压范围, $V-$ (见注解1)	0.3 V 至 -7V
正负极电源电压差, $V+ - V-$ (见注解1)	13V
输入电压范围, V_I : 驱动器 (FORCEOFF、FORCEON、EN)	-0.3 V 至 6 V
接收器	-25 V 至25 V
输出电压范围, V_O : 驱动器	-13.2 V 至 13.2 V
接收器 (INVALID)	-0.3 V 至 $V_{CC} + 0.3 V$
封装热阻抗, θ_{JA} (见注解2和3): DB封装	82°C/W
PW封装	108°C/W
工作结点温度, T_J	150°C
导线温度1,6 mm (1/16英寸) (10秒)	260°C
存储温度范围, T_{stg}	-65°C 至 150°C

*注：强度超出所列的极限参数可能导致器件的永久性损坏。这些仅仅是极限参数，并不意味着在极限条件下或在任何其它超出推荐工作条件所示参数的情况下器件能有效工作。延长在极限参数条件下的工作时间会影响器件的可靠性。

注解：1 所有电压是相对于 GND 而言的。

2 最大电压损耗为 $T_J(\text{最大})$, θ_{JA} , 和 T_A 函数。在任何允许的周围环境温度下的最大允许电压损耗为 $PD = (T_J(\text{最大}) - T_A) / \theta_{JA}$ 。在 150°C 最大 T_J 下工作会影响可靠性。

3 封装热阻抗根据 JESD51-7 计算得出。

recommended operating conditions (see Note 4 and Figure 6)

		MIN	NOM	MAX	UNIT
Supply voltage	$V_{CC} = 3.3 V$	3	3.3	3.6	V
	$V_{CC} = 5 V$	4.5	5	5.5	
V_{IH} Driver and control high-level input voltage	DIN, FORCEOFF, FORCEON, EN	$V_{CC} = 3.3 V$			V
		$V_{CC} = 5 V$			
V_{IL} Driver and control low-level input voltage	DIN, FORCEOFF, FORCEON, EN	0.8			V
V_I Driver and control input voltage	DIN, FORCEOFF, FORCEON	0	5.5		V
V_I Receiver input voltage		-25	25		V
T_A Operating free-air temperature	MAX3221C	0	70		°C
	MAX3221I	-40	85		

NOTE 4: Test conditions are C1-C4 = 0.1 μF at $V_{CC} = 3.3 V \pm 0.3 V$; C1 = 0.047 μF , C2-C4 = 0.33 μF at $V_{CC} = 5 V \pm 0.5 V$.

electrical characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Note 4 and Figure 6)

PARAMETER		TEST CONDITIONS	MIN	TYP†	MAX	UNIT
I_l	Input leakage current	FORCEOFF, FORCEON, EN	± 0.01		± 1	μA
I_{CC}	Supply current ($T_A = 25^\circ C$)	Auto-powerdown disabled	No load, FORCEOFF and FORCEON at V_{CC}		0.3	1
		Powered off	No load, FORCEOFF at GND		1	10
		Auto-powerdown enabled	No load, FORCEOFF at V_{CC} , FORCEON at GND, All RIN are open or grounded		1	10

† All typical values are at $V_{CC} = 3.3 V$ or $V_{CC} = 5 V$, and $T_A = 25^\circ C$.

NOTE 4: Test conditions are C1-C4 = 0.1 μF at $V_{CC} = 3.3 V \pm 0.3 V$; C1 = 0.047 μF , C2-C4 = 0.33 μF at $V_{CC} = 5 V \pm 0.5 V$.

DRIVER SECTION

electrical characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Note 4 and Figure 6)

PARAMETER	TEST CONDITIONS	MIN	TYP†	MAX	UNIT
V _{OH} High-level output voltage	DOUT at R _L = 3 kΩ to GND, DIN = GND	5	5.4		V
V _{OL} Low-level output voltage	DOUT at R _L = 3 kΩ to GND, DIN = V _{CC}	-5	-5.4		V
I _{IH} High-level input current	V _I = V _{CC}		±0.01	±1	μA
I _{IL} Low-level input current	V _I at GND		±0.01	±1	μA
I _{OS} Short-circuit output current‡	V _{CC} = 3.6 V, V _O = 0 V		±35	±60	mA
	V _{CC} = 5.5 V, V _O = 0 V		±35	±60	
r _o Output resistance	V _{CC} , V+, and V- = 0 V, V _O = ±2 V	300	10M		Ω
I _{off} Output leakage current	FORCEOFF = GND, V _O = ±12 V, V _{CC} = 0 to 5.5 V			±25	μA

† All typical values are at V_{CC} = 3.3 V or V_{CC} = 5 V, and T_A = 25°C.

‡ Short-circuit durations should be controlled to prevent exceeding the device absolute power-dissipation ratings, and not more than one output should be shorted at a time.

NOTE 4: Test conditions are C1–C4 = 0.1 μF at V_{CC} = 3.3 V ± 0.3 V; C1 = 0.047 μF, C2–C4 = 0.33 μF at V_{CC} = 5 V ± 0.5 V.

switching characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Note 4 and Figure 6)

PARAMETER	TEST CONDITIONS	MIN	TYP†	MAX	UNIT
Maximum data rate	C _L = 1000 pF, R _L = 3 kΩ, See Figure 1	150	250		kbit/s
t _{sk(p)} Pulse skew§	C _L = 150 pF to 2500 pF, R _L = 3 kΩ to 7 kΩ, See Figure 2		100		ns
SR(tr) Slew rate, transition region (see Figure 1)	V _{CC} = 3.3 V, R _L = 3 kΩ to 7 kΩ		6	30	V/μs
	C _L = 150 pF to 1000 pF		4	30	

† All typical values are at V_{CC} = 3.3 V or V_{CC} = 5 V, and T_A = 25°C.

§ Pulse skew is defined as |t_{PLH} - t_{PHL}| of each channel of the same device.

NOTE 4: Test conditions are C1–C4 = 0.1 μF at V_{CC} = 3.3 V ± 0.3 V; C1 = 0.047 μF, C2–C4 = 0.33 μF at V_{CC} = 5 V ± 0.5 V.

ESD protection

TERMINAL	TEST CONDITIONS	TYP	UNIT
NAME NO.			
DOUT 13	HBM	±15	kV

RECEIVER SECTION

electrical characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Note 4 and Figure 6)

PARAMETER	TEST CONDITIONS	MIN	TYP†	MAX	UNIT
V_{OH} High-level output voltage	$I_{OH} = -1 \text{ mA}$	$V_{CC} - 0.6 \text{ V}$	$V_{CC} - 0.1 \text{ V}$		V
V_{OL} Low-level output voltage	$I_{OL} = 1.6 \text{ mA}$			0.4	V
V_{IT+} Positive-going input threshold voltage	$V_{CC} = 3.3 \text{ V}$		1.6	2.4	V
	$V_{CC} = 5 \text{ V}$		1.9	2.4	
V_{IT-} Negative-going input threshold voltage	$V_{CC} = 3.3 \text{ V}$	0.6	1.1		V
	$V_{CC} = 5 \text{ V}$	0.8	1.4		
V_{hys} Input hysteresis ($V_{IT+} - V_{IT-}$)			0.5		V
I_{off} Output leakage current	FORCEOFF = 0 V		± 0.05	± 10	μA
r_i Input resistance	$V_I = \pm 3 \text{ V to } \pm 25 \text{ V}$	3	5	7	$\text{k}\Omega$

† All typical values are at $V_{CC} = 3.3 \text{ V}$ or $V_{CC} = 5 \text{ V}$, and $T_A = 25^\circ\text{C}$.

NOTE 4: Test conditions are C1–C4 = 0.1 μF at $V_{CC} = 3.3 \text{ V} \pm 0.3 \text{ V}$; C1 = 0.047 μF , C2–C4 = 0.33 μF at $V_{CC} = 5 \text{ V} \pm 0.5 \text{ V}$.

switching characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Note 4)

PARAMETER	TEST CONDITIONS	MIN	TYP†	MAX	UNIT
t_{PLH} Propagation delay time, low- to high-level output	$C_L = 150 \text{ pF}$, See Figure 3		150		ns
t_{PHL} Propagation delay time, high- to low-level output	$C_L = 150 \text{ pF}$, See Figure 3		150		ns
t_{en} Output enable time	$C_L = 150 \text{ pF}$, $R_L = 3 \text{ k}\Omega$, See Figure 4		200		ns
t_{dis} Output disable time	$C_L = 150 \text{ pF}$, $R_L = 3 \text{ k}\Omega$, See Figure 4		200		ns
$t_{sk(p)}$ Pulse skew‡	See Figure 3		50		ns

† All typical values are at $V_{CC} = 3.3 \text{ V}$ or $V_{CC} = 5 \text{ V}$, and $T_A = 25^\circ\text{C}$.

‡ Pulse skew is defined as $|t_{PLH} - t_{PHL}|$ of each channel of the same device.

NOTE 4: Test conditions are C1–C4 = 0.1 μF at $V_{CC} = 3.3 \text{ V} \pm 0.3 \text{ V}$; C1 = 0.047 μF , C2–C4 = 0.33 μF at $V_{CC} = 5 \text{ V} \pm 0.5 \text{ V}$.

ESD protection

TERMINAL	TEST CONDITIONS		TYP	UNIT
NAME NO.				
RIN 8	HBM		± 15	kV

AUTO-POWERDOWN SECTION

electrical characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Figure 5)

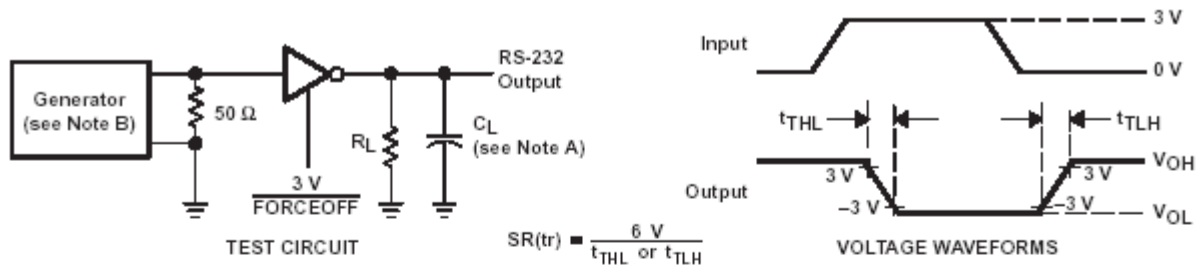
PARAMETER		TEST CONDITIONS	MIN	MAX	UNIT
$V_{T+}(\text{valid})$	Receiver input threshold for $\overline{\text{INVALID}}$ high-level output voltage	FORCEON = GND, $\overline{\text{FORCEOFF}} = V_{CC}$		2.7	V
$V_{T-}(\text{valid})$	Receiver input threshold for $\overline{\text{INVALID}}$ high-level output voltage	FORCEON = GND, $\overline{\text{FORCEOFF}} = V_{CC}$	-2.7		V
$V_{T}(\text{invalid})$	Receiver input threshold for $\overline{\text{INVALID}}$ low-level output voltage	FORCEON = GND, $\overline{\text{FORCEOFF}} = V_{CC}$	-0.3	0.3	V
V_{OH}	$\overline{\text{INVALID}}$ high-level output voltage	$I_{OH} = -1 \text{ mA}$, FORCEON = GND, $\overline{\text{FORCEOFF}} = V_{CC}$	$V_{CC}-0.6$		V
V_{OL}	$\overline{\text{INVALID}}$ low-level output voltage	$I_{OL} = 1.6 \text{ mA}$, FORCEON = GND, $\overline{\text{FORCEOFF}} = V_{CC}$		0.4	V

switching characteristics over recommended ranges of supply voltage and operating free-air temperature (unless otherwise noted) (see Figure 5)

PARAMETER		MIN	TYP†	MAX	UNIT
t_{valid}	Propagation delay time, low- to high-level output		1		μs
t_{invalid}	Propagation delay time, high- to low-level output		30		μs
t_{en}	Supply enable time		100		μs

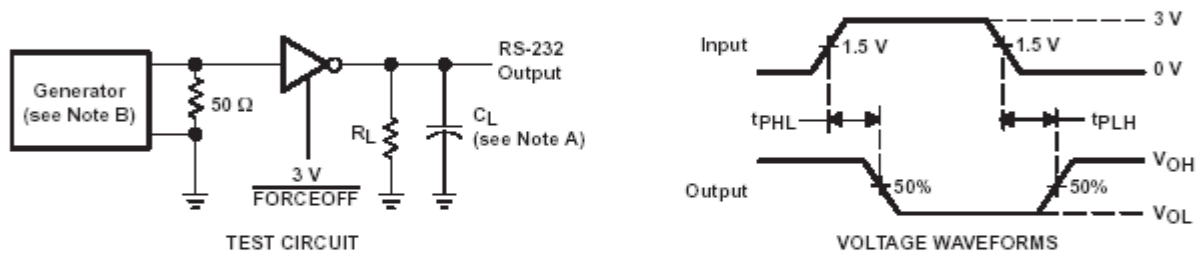
†All typical values are at $V_{CC} = 3.3 \text{ V}$ or $V_{CC} = 5 \text{ V}$, and $T_A = 25^\circ\text{C}$.

PARAMETER MEASUREMENT INFORMATION



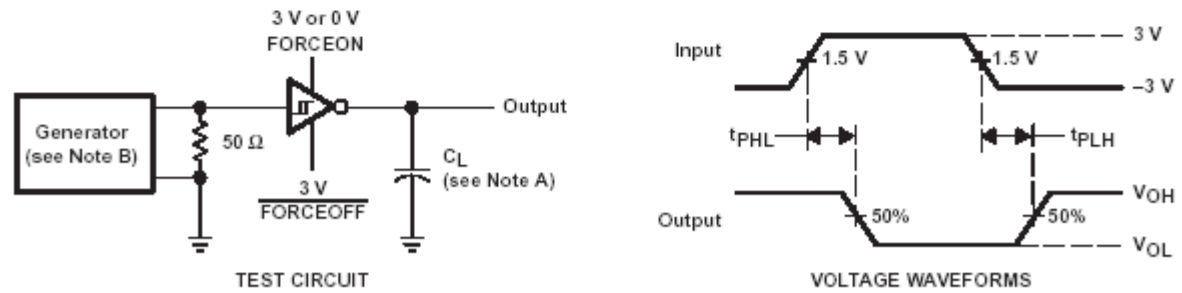
NOTES: A. C_L includes probe and jig capacitance.
 B. The pulse generator has the following characteristics: PRR = 250 kbit/s, $Z_O = 50 \Omega$, 50% duty cycle, $t_r \leq 10$ ns, $t_f \leq 10$ ns.

Figure 1. Driver Slew Rate



NOTES: A. C_L includes probe and jig capacitance.
 B. The pulse generator has the following characteristics: PRR = 250 kbit/s, $Z_O = 50 \Omega$, 50% duty cycle, $t_r \leq 10$ ns, $t_f \leq 10$ ns.

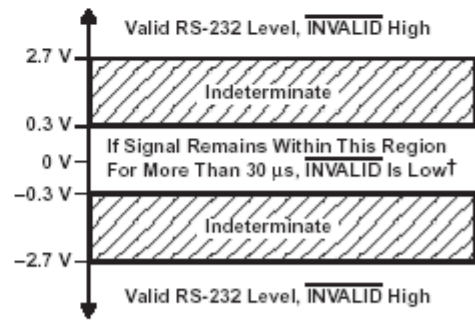
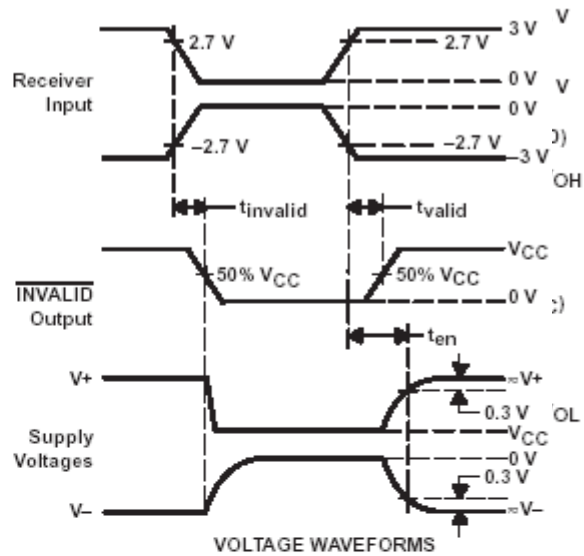
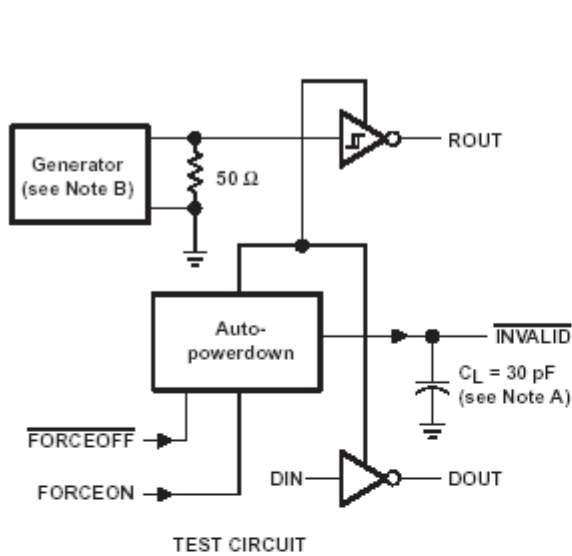
Figure 2. Driver Pulse Skew



NOTES: A. C_L includes probe and jig capacitance.
 B. The pulse generator has the following characteristics: $Z_O = 50 \Omega$, 50% duty cycle, $t_r \leq 10$ ns, $t_f \leq 10$ ns.

Figure 3. Receiver Propagation Delay Times

PARAMETER MEASUREMENT INFORMATION

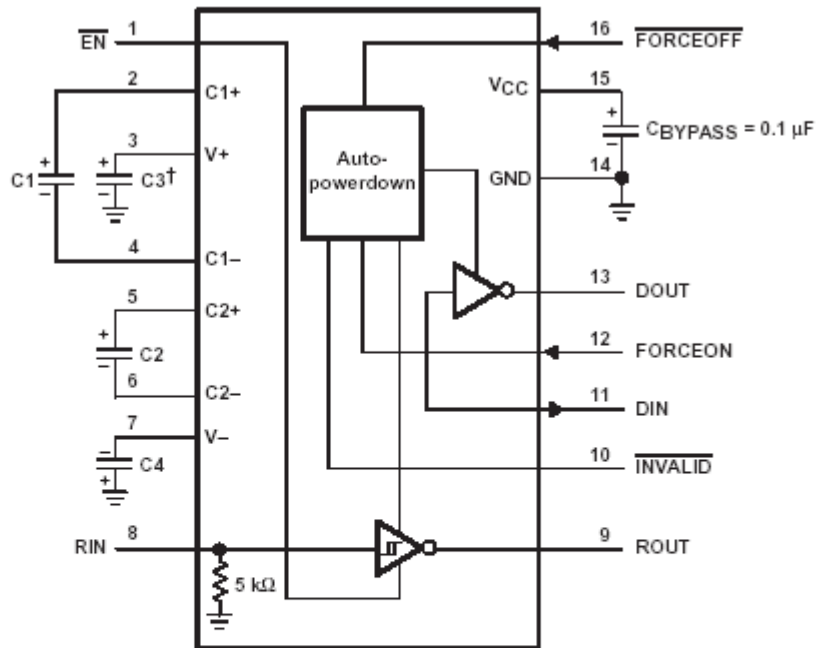


† Auto-powerdown disables drivers and reduces supply current to 1 μ A.

- NOTES: A. C_L includes probe and jig capacitance.
 B. The pulse generator has the following characteristics: PRR = 5 kbit/s, $Z_O = 50 \Omega$, 50% duty cycle, $t_r \leq 10$ ns, $t_f \leq 10$ ns.

Figure 5. $\overline{\text{INVALID}}$ Propagation Delay Times and Driver Enabling Time

APPLICATION INFORMATION



† C3 can be connected to V_{CC} or GND.
 NOTE A: Resistor values shown are nominal.

V_{CC} vs CAPACITOR VALUES

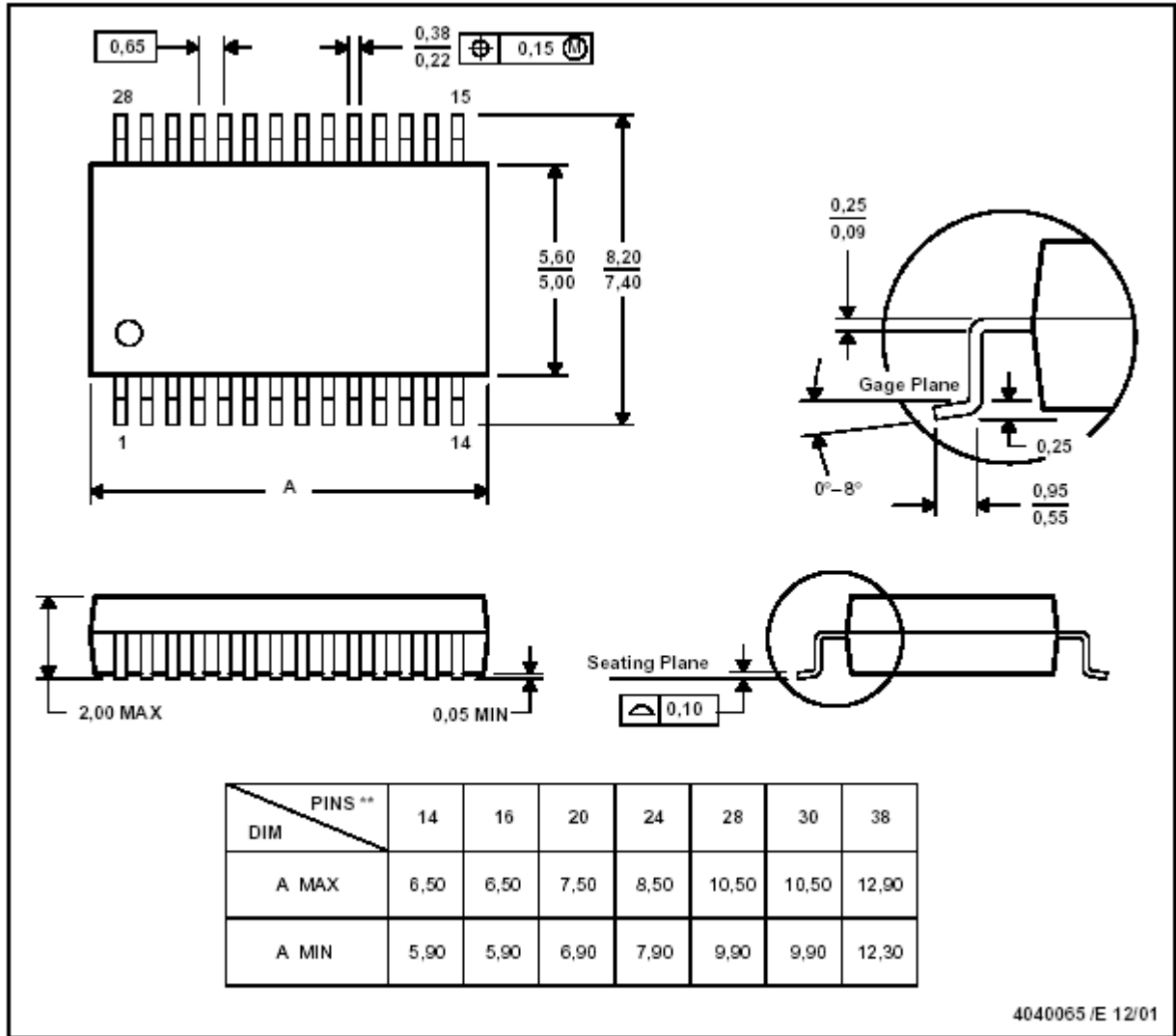
V _{CC}	C1	C2, C3, and C4
3.3 V ± 0.3 V	0.1 μF	0.1 μF
5 V ± 0.5 V	0.047 μF	0.33 μF
3 V to 5.5 V	0.1 μF	0.47 μF

Figure 6. Typical Operating Circuit and Capacitor Values

三 封装
 (1)

DB (R-PDSO-G**)
 28 PINS SHOWN

PLASTIC SMALL-OUTLINE

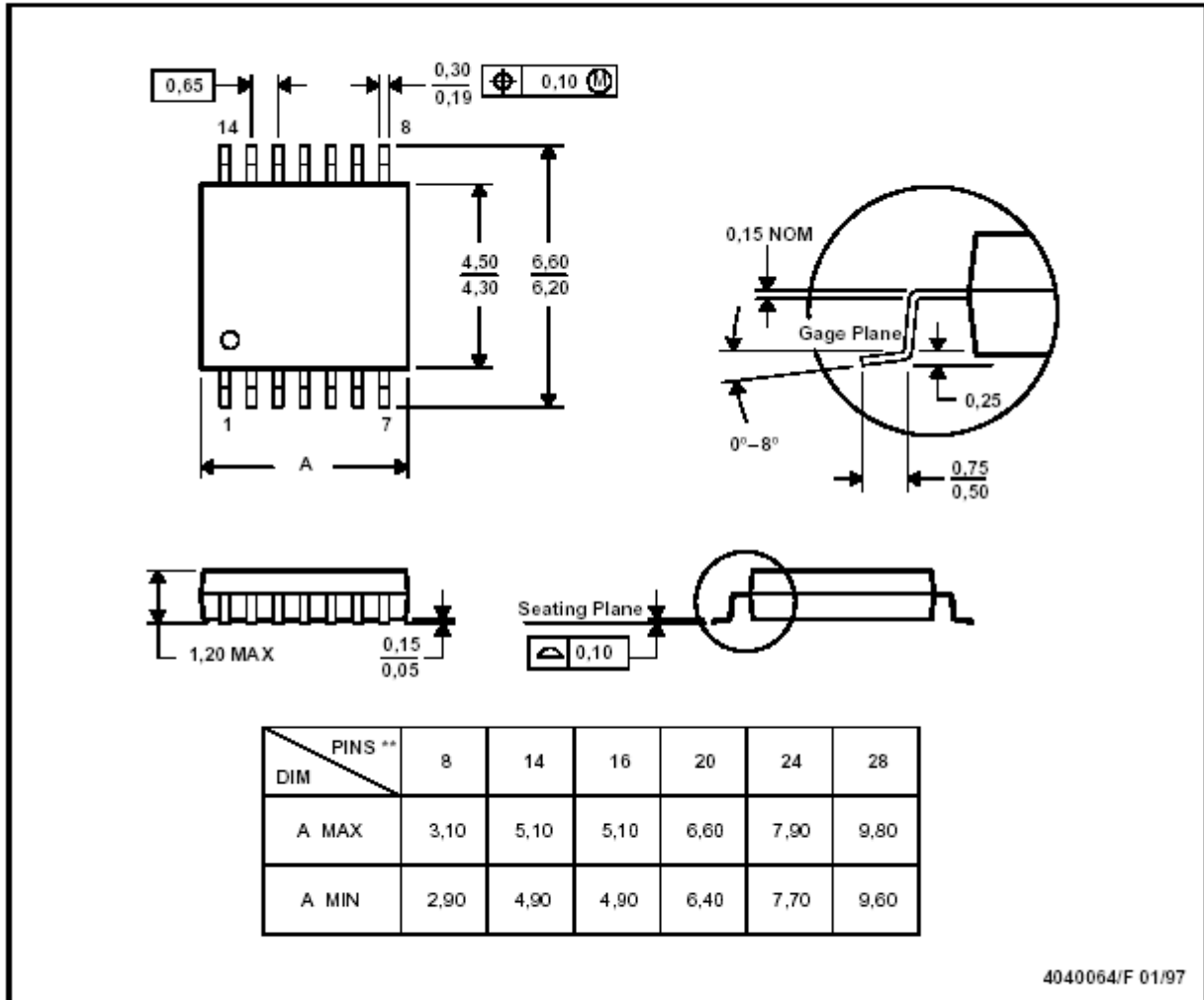


- NOTES: A. All linear dimensions are in millimeters.
 B. This drawing is subject to change without notice.
 C. Body dimensions do not include mold flash or protrusion not to exceed 0,15.
 D. Falls within JEDEC MO-150

(2)

PW (R-PDSO-G**)
 14 PINS SHOWN

PLASTIC SMALL-OUTLINE PACKAGE



- 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-153