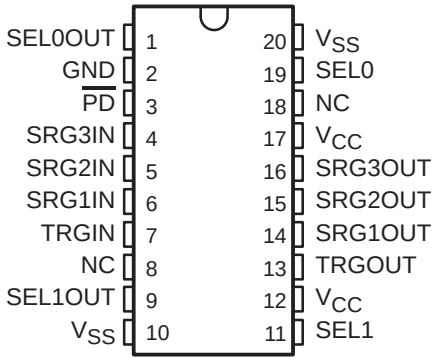
- **TTL-Compatible Inputs**
- **CCD-Compatible Outputs**
- **Full-Frame Operation**
- **Frame-Transfer Operation**
- **Solid-State Reliability**
- **Adjustable Clock Levels**

**DW PACKAGE**
**(TOP VIEW)**




NC – No internal connection

## description

The SN28846 serial driver is a monolithic CMOS integrated circuit designed to drive the serial-register gate (SRGn) and transfer-gate (TRG) inputs of the Texas Instruments (TI™) virtual-phase CCD image sensors. The SN28846 interfaces a user-defined timing generator to the CCD image sensor; it receives TTL signals from the timing generator and outputs level-shifted signals to the image sensor. The SN28846 contains three noninverting serial-gate drivers and one noninverting transfer-gate driver.

The voltage levels on SRG1OUT, SRG2OUT, SRG3OUT, and TRGOUT are controlled by the levels on $V_{SS}$ and $V_{CC}$. The propagation delays for these outputs are controlled by SEL0 and SEL1. The $\overline{PD}$, SRG1IN, SRG2IN, SRG3IN, and TRGIN are TTL compatible.

A high level on $\overline{PD}$ allows the SN28846 to operate normally with the level-shifted outputs following the inputs. When $\overline{PD}$ is low, the device is in a low power-consumption mode and all outputs are at $V_{CC}$.

The SN28846 is available in a 20-pin surface-mount package and is characterized for operation from –20°C to 45°C.

This device contains circuits to protect its inputs and outputs against damage due to high static voltages or electrostatic fields. These circuits have been qualified to protect this device against electrostatic discharges (ESD) of up to 2 kV according to MIL-STD-883C, Method 3015; however, precautions should be taken to avoid application of any voltage higher than maximum-rated voltages to these high-impedance circuits. During storage or handling, the device leads should be shorted together or the device should be placed in conductive foam. In a circuit, unused inputs should always be connected to an appropriated logic voltage level, preferably either $V_{CC}$ or ground. Specific guidelines for handling devices of this type are contained in the publication *Guidelines for Handling Electrostatic-Discharge-Sensitive (ESDS) Devices and Assemblies* available from Texas Instruments.

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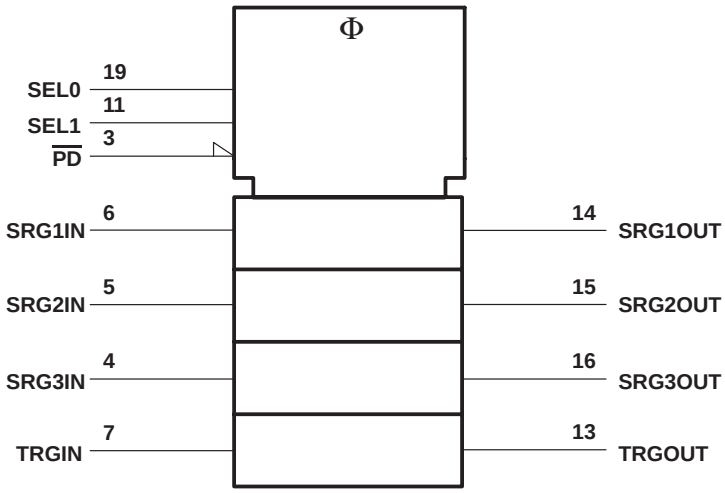
## logic symbol†




† This symbol is in accordance with ANSI/IEEE Std 91-1984 and IEC Publication 617-12.

## Terminal Functions

| TERMINAL NAME | TERMINAL NO. | I/O | DESCRIPTION |
|---|---|---|---|
| GND | 2 | | Ground |
| NC‡ | 8 | | No connect |
| NC‡ | 18 | | No connect |
| $\overline{PD}$ | 3 | I | Power down |
| SEL0 | 19 | I | Propagation delay mode select |
| SEL1 | 11 | I | Propagation delay mode select |
| SEL0OUT | 1 | O | Test pin (factory use only) |
| SEL1OUT | 9 | O | Test pin (factory use only) |
| SRG1IN | 6 | I | Serial-register gate 1 in |
| SRG2IN | 5 | I | Serial-register gate 2 in |
| SRG3IN | 4 | I | Serial-register gate 3 in |
| SRG1OUT | 14 | O | Serial-register gate 1 out |
| SRG2OUT | 15 | O | Serial-register gate 2 out |
| SRG3OUT | 16 | O | Serial-register gate 3 out |
| TRGIN | 7 | I | Transfer gate in |
| TRGOUT | 13 | O | Transfer gate out |
| $V_{CC}$‡ | 12 | I | Positive supply voltage |
| $V_{CC}$‡ | 17 | I | Positive supply voltage |
| $V_{SS}$‡ | 10 | I | Negative supply voltage |
| $V_{SS}$‡ | 20 | I | Negative supply voltage |

‡ All terminals of the same name should be connected together externally.

## absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

Positive supply voltage, $V_{CC}$ (see Note 1) . . . . . 4 V
Negative supply voltage, $V_{SS}$ (see Note 2) . . . . . –11.1 V
Input voltage range: SEL0 and SEL1 . . . . . $V_{SS}$ to $V_{CC}$
Other inputs . . . . . 0 to 5.5 V
Continuous total power dissipation at (or below) $T_A \le 25°C$: Unmounted device (see Figure 1) . . . 825 mW
. . . . . Mounted device (see Figure 1) . . . . . 1150 mW
Operating free-air temperature range, $T_A$ . . . . . –20°C to 45°C
Storage temperature range, $T_{STG}$ . . . . . –55°C to 125°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds . . . . . 260°C

† Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

NOTES: 1. All voltage values are with respect to the GND terminal.
2. The algebraic convention, in which the least positive (most negative) value is designated minimum, is used in this data sheet for voltage levels only.

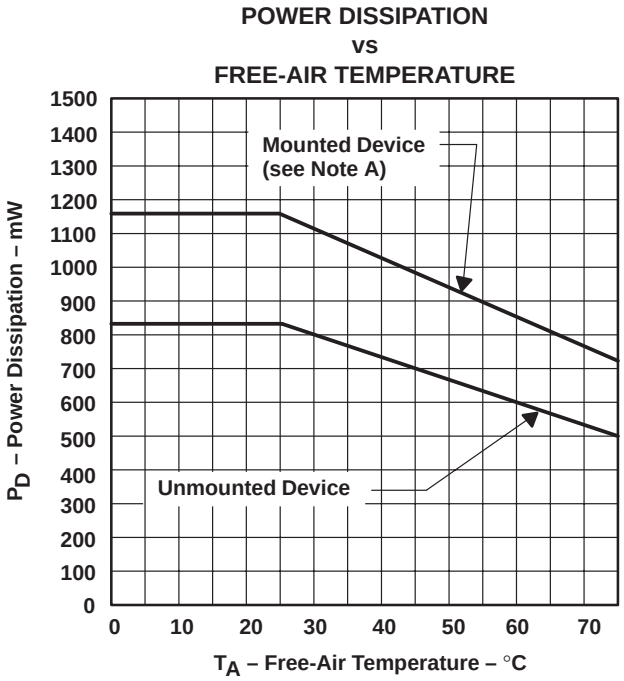



**Figure 1**

NOTE A: The mounted-device derating curve of Figure 1 is obtained under the following conditions:
The board is 50 mm by 50 mm by 1.6 mm thick.
The board material is glass epoxy.
The copper thickness of all the etch runs is 35 microns.
Etch run dimensions – All 20 etch runs are 0.4 mm by 22 mm.
Each chip is soldered to the board.
An aluminum cooling fin 10 mm by 10 mm by 1 mm thick is coupled to the chip with thermal paste.

## recommended operating conditions

| | | MIN | NOM | MAX | UNIT |
|---|---|---|---|---|---|
| Positive supply voltage, $V_{CC}$ | | 0 | 1.5 | 3 | V |
| Negative supply voltage, $V_{SS}$ (see Note 2) | | –11.1 | –10.4 | –9.7 | V |
| High-level input voltage, $V_{IH}$ | SRG1IN, SRG2IN, SRG3IN, TRGIN | 2 | 5 | | V |
| | SEL0, SEL1 | | $V_{CC}$ | | |
| | $\overline{PD}$ | 4 | 5 | | |
| Low-level input voltage, $V_{IL}$ | SRG1IN, SRG2IN, SRG3IN, TRGIN | | 0 | 0.8 | V |
| | SEL0, SEL1 | | $V_{SS}$ | | |
| | $\overline{PD}$ | | 0 | 0.4 | |
| Capacitance load | SRG1OUT, SRG2OUT, SRG3OUT | | | 200 | pF |
| | TRGOUT | | | 350 | |
| Operating free-air temperature, $T_A$ | | –20 | | 45 | °C |

NOTE 2: The algebraic convention, in which the least positive (most negative) value is designated minimum, is used in this data sheet for voltage levels only.

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

| PARAMETER | | | TEST CONDITIONS | MIN | MAX | UNIT |
|---|---|---|---|---|---|---|
| $V_{OH}$ | High-level output voltage | SRG1OUT, SRG2OUT, SRG3OUT | f = 4.8 MHz, $t_W$ = 70 ns, See Figure 2 | $V_{CC}$ – 0.5 | $V_{CC}$+0.5 | V |
| | | TRGOUT | f = 3.6 MHz, $t_W$ = 140 ns, See Figure 2 | | | |
| $V_{OL}$ | Low-level output voltage | SRG1OUT, SRG2OUT, SRG3OUT | f = 4.8 MHz, $t_W$ = 70 ns, See Figure 2 | $V_{SS}$–0.8 | $V_{SS}$+0.8 | V |
| | | TRGOUT | f = 3.6 MHz, $t_W$ = 140 ns, See Figure 2 | | | |
| $V_{N(PP)}$ | Peak-to-peak output noise voltage | SRG1OUT, SRG2OUT, SRG3OUT | See Figure 2 | | 300 | mV |
| $I_{IH}$ | High-level input current | SRG1IN, SRG2IN, SRG3IN, TRGIN, SEL0, SEL1 | $V_I$ = 5.5 V | | 50 | µA |
| $I_{IL}$ | Low-level input current | | $V_I$ = 0 | | ±10 | µA |
| $I_{SS}$ | Supply current | | No load, $\overline{PD}$ at 0 V, $T_A$ = 25°C | | –0.5 | mA |
| | | | See Note 3 | | –25 | |
| $f_{max}$ | Maximum frequency of oscillation | SRG1OUT, SRG2OUT, SRG3OUT | $C_L$ = 200 pF | 10 | | MHz |
| | | TRGOUT | $C_L$ = 350 pF | 1 | | |

NOTE 3: SRG1OUT, SRG2OUT, and SRG3OUT are loaded with 80-pF capacitive loads; TRGOUT is loaded with a 180-pF load. The SN28846 driver is clocked by the SN28835 timer. SEL0 and SEL1 are both held at –11.1 V.

## switching characteristics for SRG1OUT, SRG2OUT, and SRG3OUT, $V_{CC}$ = 2.3 V, $V_{SS}$ = –10.3 V, $T_A$ = 25°C (unless otherwise noted) (see Figure 2)†

| PARAMETER | | SELECT MODE‡ | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| $t_{PLH}$ | Propagation delay time, low-to-high-level output | 0 | $t_W$ = 70 ns, f = 4.8 MHz | | 28 | | ns |
| | | 1 | | | 36 | | |
| | | 2 | | | 42 | | |
| | | 3 | | | 48 | | |
| $t_{PHL}$ | Propagation delay time, high-to-low-level output | 0 | $t_W$ = 70 ns, f = 4.8 MHz | | 25 | | ns |
| | | 1 | | | 24 | | |
| | | 2 | | | 23 | | |
| | | 3 | | | 23 | | |
| $\Delta t_{PLH}$ | (see Note 4) | Any | $T_A$ = –20°C to 55°C | | | ±5 | ns |
| $\Delta t_{PHL}$ | (see Note 4) | | | | | ±5 | |
| $t_{sk(o)}$ | Skew time (see Note 5) | | | | | 5 | |
| | | | | | | 5 | |
| $t_W$ | Pulse duration | 0 | $t_W$ = 70 ns, f = 4.8 MHz | 63 | 68 | 73 | ns |
| | | 1 | | 54 | 59 | 64 | |
| | | 2 | | 47 | 52 | 57 | |
| | | 3 | | 40 | 45 | 50 | |
| $\lvert t_{w(n)} - t_{w(m)} \rvert$ | Pulse duration differential (see Note 6) | Any | $t_W$ = 70 ns, f = 4.8 MHz | | | 5 | ns |
| $t_r$ | Rise time | Any | $t_W$ = 70 ns, f = 4.8 MHz | 10 | 14 | 18 | ns |
| $t_f$ | Fall time | | | 6 | 10 | 13 | |

† The load is a Texas Instruments CCD image sensor.

‡ The select mode is determined by the voltage levels applied to the SEL1 and SEL0 inputs as follows:

| SELECT MODE | SEL1 | SEL0 |
|---|---|---|
| 0 | $V_{SS}$ | $V_{SS}$ |
| 1 | $V_{SS}$ | $V_{CC}$ |
| 2 | $V_{CC}$ | $V_{SS}$ |
| 3 | $V_{CC}$ | $V_{CC}$ |

NOTES: 4. For a given channel, $\Delta t_{PLH}$ and $\Delta t_{PHL}$ are the changes in $t_{PLH}$ and $t_{PHL}$, respectively, when the device is operated over the temperature range –20°C to 55°C rather than at 25°C.

5. This is the maximum absolute difference in propagation delay time, either $t_{PLH}$ or $t_{PHL}$, through the three channels at any given temperature within the specified range.

6. This is the maximum difference in the pulse duration through the three channels.

## switching characteristics for TRGOUT, $V_{CC}$ = 2.3 V, $V_{SS}$ = –10.3 V, $T_A$ = 25°C (unless otherwise noted) (see Figure 2)†

| PARAMETER | | SELECT MODE‡ | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|---|---|---|---|---|---|---|---|
| $t_{PLH}$ | Propagation delay time, low-to-high-level output | 0 | $t_W$ = 140 ns, f = 3.6 MHz | | 24 | | ns |
| | | 1 | | | 33 | | |
| | | 2 | | | 39 | | |
| | | 3 | | | 47 | | |
| $t_{PHL}$ | Propagation delay time, high-to-low-level output | 0 | $t_W$ = 140 ns, f = 3.6 MHz | | 24 | | ns |
| | | 1 | | | 23 | | |
| | | 2 | | | 22 | | |
| | | 3 | | | 22 | | |
| $\Delta t_{PLH}$ | (see Note 7) | Any | $T_A$ = –20°C to 55°C | | | 20 | ns |
| $\Delta t_{PHL}$ | (see Note 7) | | | | | 20 | |
| $t_W$ | Pulse duration | Any | $t_W$ = 140 ns, f = 3.6 MHz | 100 | 140 | 180 | ns |
| $t_r$ | Rise time | | | | 17 | | |
| $t_f$ | Fall time | | | | 10 | | |

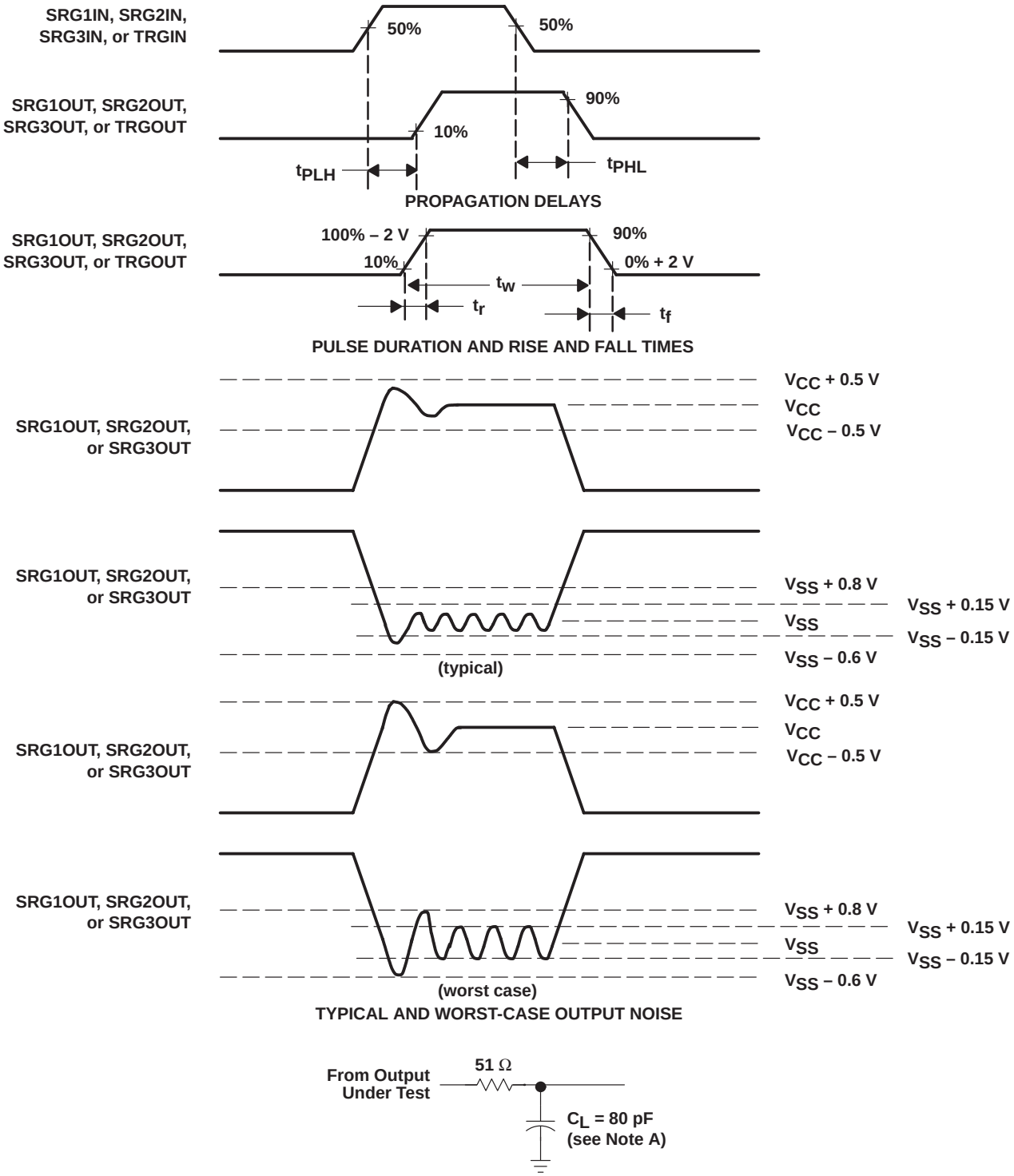
† The load is a Texas Instruments CCD image sensor.

‡ The select mode is determined by the voltage levels applied to SEL1 and SEL0 as follows:

| SELECT MODE | SEL1 | SEL0 |
|---|---|---|
| 0 | $V_{SS}$ | $V_{SS}$ |
| 1 | $V_{SS}$ | $V_{CC}$ |
| 2 | $V_{CC}$ | $V_{SS}$ |
| 3 | $V_{CC}$ | $V_{CC}$ |

NOTE 7: $\Delta t_{PLH}$ and $\Delta t_{PHL}$ are the changes in $t_{PLH}$ and $t_{PHL}$, respectively, when the device is operated over the temperature range – 20°C to 55°C rather than at 25°C.

## PARAMETER MEASUREMENT INFORMATION



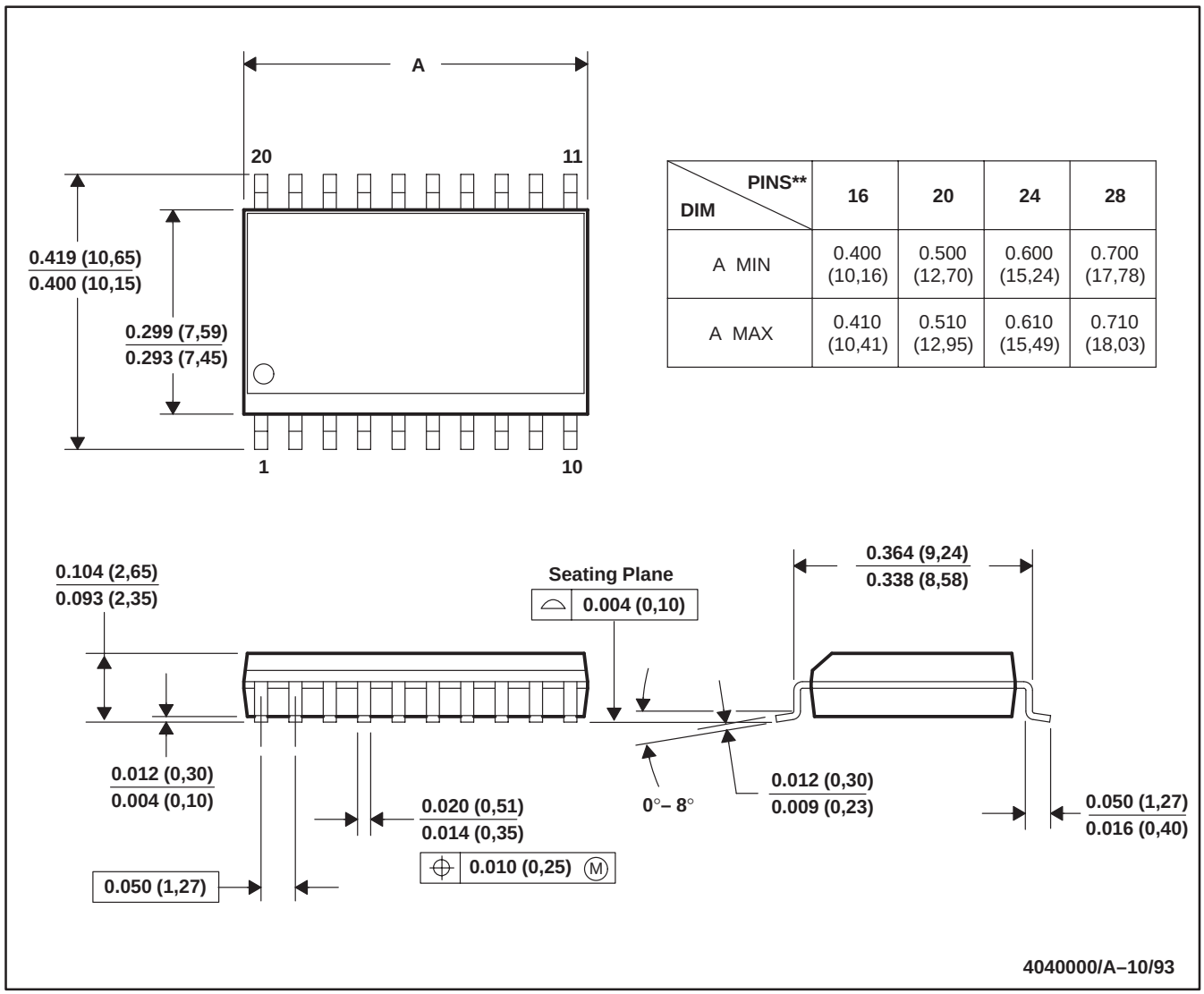

NOTE A: $C_L$ Includes probe and jig capacitance.

**Figure 2. Load Circuit and Voltage Waveforms**

## MECHANICAL DATA

**DW/R-PDSO-G**** **PLASTIC WIDE-BODY SMALL-OUTLINE PACKAGE**

**20 PIN SHOWN**




| DIM \ PINS** | 16 | 20 | 24 | 28 |
|---|---|---|---|---|
| A MIN | 0.400 (10,16) | 0.500 (12,70) | 0.600 (15,24) | 0.700 (17,78) |
| A MAX | 0.410 (10,41) | 0.510 (12,95) | 0.610 (15,49) | 0.710 (18,03) |

NOTES: A. All linear dimensions are in inches (millimeters).
B. This drawing is subject to change without notice.
C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).

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