



# TTL Compatible CMOS Analog Switches

## General Description

Maxim's DG300-DG303 and DG300A-DG303A CMOS dual and quad analog switches combine low power operation with fast switching times and superior DC and AC switch characteristics. On-resistance is less than  $50\Omega$  and is essentially constant over the analog signal range. Device specifications are ideal for battery-powered circuitry.

These switches are available in a variety of formats as outlined in the *Pin Configurations* section. The switch control logic inputs are fully TTL and CMOS compatible. Also featured are "break-before-make" switching and low charge injection.

Maxim's DG300-DG303 and DG300A-DG303A families are electrically compatible and pin compatible with the original manufacturer's devices. All devices operate with power supplies ranging from  $\pm 5V$  to  $\pm 18V$ . Single-supply operation is implemented by connecting  $V^-$  to GND.

## Applications

Portable Instruments  
Low-Power Sample/Holds  
Power-Supply Switching  
Programmable Gain Amplifiers  
SPDT and DPDT Functions  
Process Control and Telemetry

## Features

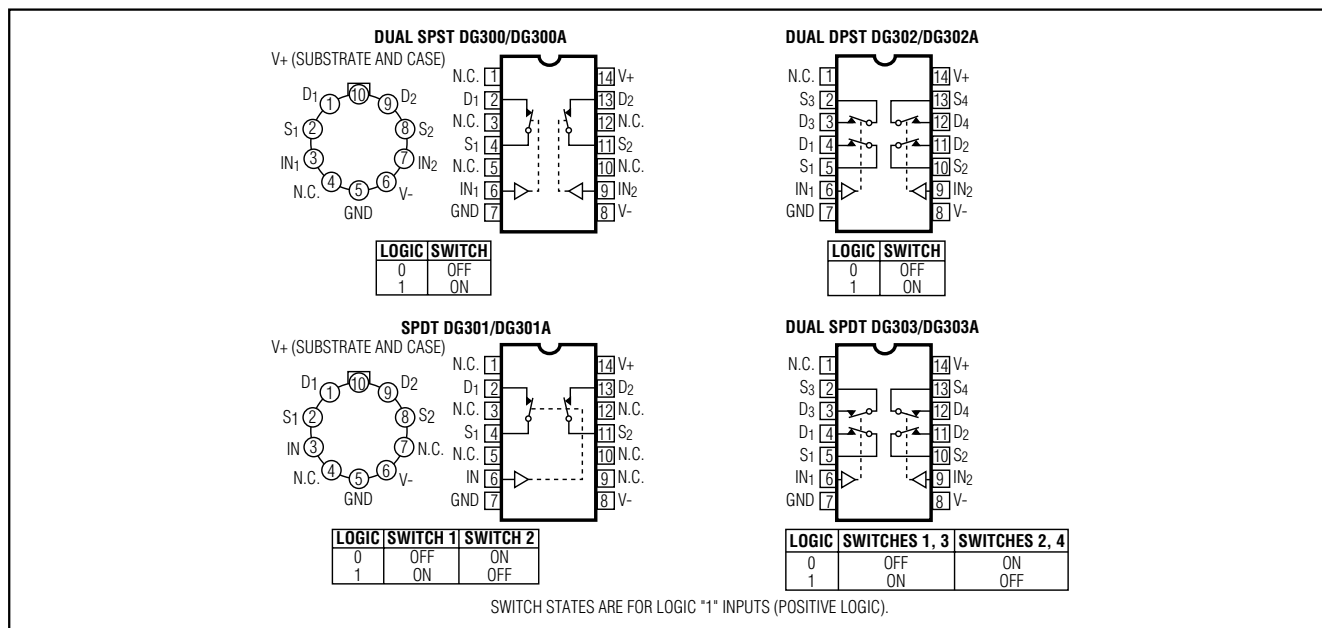
- ◆ Monolithic Low-Power CMOS
- ◆ Latchup Proof Construction
- ◆ Fully Compatible 2nd Source
- ◆ Low On-Resistance,  $<50\Omega$
- ◆ Fast Switching Time
- ◆  $V^+$  to  $V^-$  Analog Signal Range
- ◆ Single-Supply Capability

## Ordering Information

| PART     | TEMP RANGE                                  | PIN-PACKAGE         |
|----------|---------------------------------------------|---------------------|
| DG300C/D | $0^\circ\text{C}$ to $+70^\circ\text{C}$    | Dice                |
| DG300CJ  | $0^\circ\text{C}$ to $+70^\circ\text{C}$    | 14 Lead Plastic DIP |
| DG300CWE | $0^\circ\text{C}$ to $+70^\circ\text{C}$    | 16 Lead Wide SO     |
| DG300CK  | $0^\circ\text{C}$ to $+70^\circ\text{C}$    | 14 Lead CERDIP      |
| DG300BWE | $-25^\circ\text{C}$ to $+85^\circ\text{C}$  | 16 Lead Wide SO     |
| DG300BK  | $-25^\circ\text{C}$ to $+85^\circ\text{C}$  | 14 Lead CERDIP      |
| DG300BA  | $-25^\circ\text{C}$ to $+85^\circ\text{C}$  | 10 Lead Metal Can   |
| DG300AK  | $-55^\circ\text{C}$ to $+125^\circ\text{C}$ | 14 Lead CERDIP      |
| DG300AA  | $-55^\circ\text{C}$ to $+125^\circ\text{C}$ | 10 Lead Metal Can   |

Ordering Information continued at end of data sheet.

## Pin Configurations



# TTL Compatible CMOS Analog Switches

## ABSOLUTE MAXIMUM RATINGS

Voltages Referenced to V-  
V+ (DG300–DG303) .....36V  
V+ (DG300A–DG303A) .....44V  
GND .....25V  
Digital Inputs, V<sub>S</sub>, V<sub>D</sub>, (Note 1) .....-4V to (V+ + 4V) or  
30mA, whichever occurs first  
Current, Any Terminal Except S or D .....30mA  
Continuous Current, S or D .....30mA  
(pulsed at 1ms, 10% duty cycle max) .....100mA  
Storage Temperature (A & B suffix) .....-65°C to +150°C  
(C suffix) .....-65°C to +125°C

Operating Temperature (A suffix) .....-55°C to +125°C  
(B suffix) .....-25°C to +85°C  
(C suffix) .....0°C to +70°C  
Lead Temperature (soldering 10s) .....+300°C  
Power Dissipation\*  
Cerdip (K) (derate 11mW/°C above +75°C) .....825mW  
Plastic DIP (J) (derate 6.5mW/°C above +25°C) .....470mW  
Metal Can (A) (derate 6mW/°C above +75°C) .....450mW

\*Device mounted with all leads soldered or welded to PC board.

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 in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

## ELECTRICAL CHARACTERISTICS

(V+ = +15V, V- = -15V, GND = 0V, T<sub>A</sub> = +25°C, unless otherwise noted.)

|         | PARAMETER                      | SYMBOL                                  | TEST CONDITIONS                                                     | DG300–DG303A<br>DG300A–DG303AA                |          |     | DG300–DG303B/C<br>DG300A–DG303AB/C |          |      | UNITS |
|---------|--------------------------------|-----------------------------------------|---------------------------------------------------------------------|-----------------------------------------------|----------|-----|------------------------------------|----------|------|-------|
|         |                                |                                         |                                                                     | MIN                                           | TYP      | MAX | MIN                                | TYP      | MAX  |       |
|         |                                |                                         |                                                                     | (Note 2)                                      | (Note 3) |     | (Note 2)                           | (Note 3) |      |       |
|         |                                |                                         |                                                                     |                                               |          |     |                                    |          |      |       |
| SWITCH  | Analog Signal Range            | V <sub>ANALOG</sub>                     | I <sub>S</sub> = 10mA, V <sub>IN</sub> = 0.8V or 4.0V               | -15                                           |          | +15 | -15                                |          | +15  | V     |
|         | Drain-Source ON-Resistance     | R <sub>DS(ON)</sub>                     | V <sub>IN</sub> = 0.8V<br>or<br>V <sub>IN</sub> = 0.8V              | I <sub>S</sub> = -10mA, V <sub>D</sub> = 10V  |          | 30  | 50                                 | 30       | 50   | Ω     |
|         |                                |                                         |                                                                     | I <sub>S</sub> = -10mA, V <sub>D</sub> = -10V |          | 30  | 50                                 | 30       | 50   |       |
|         | Source OFF-Leakage Current     | I <sub>S(OFF)</sub>                     |                                                                     | V <sub>S</sub> = 14V, V <sub>D</sub> = -14V   |          | 0.1 | 1                                  | 0.1      | 5    | nA    |
|         | Drain OFF-Leakage Current      | I <sub>D(OFF)</sub>                     |                                                                     | V <sub>S</sub> = -14V, V <sub>D</sub> = 14V   |          | -1  | -0.1                               | -5       | -0.1 | nA    |
|         | Drain ON-Leakage Current       | I <sub>D(ON)</sub>                      |                                                                     | V <sub>S</sub> = 14V, V <sub>D</sub> = -14V   |          | -1  | -0.1                               | -5       | -0.1 | nA    |
| INPUT   | Input Current/<br>Voltage High | I <sub>INH</sub>                        | V <sub>IN</sub> = 5.0V                                              | -1                                            | -0.001   |     | -1                                 | -0.001   |      | μA    |
|         |                                |                                         | V <sub>IN</sub> = 15V                                               |                                               | 0.001    | 1   |                                    | 0.001    | 1    |       |
|         | Input Current/<br>Voltage Low  | I <sub>INL</sub>                        | V <sub>IN</sub> = 0V                                                | -1                                            | -0.001   |     | -1                                 | -0.001   |      | μA    |
| DYNAMIC | Turn-ON Time                   | t <sub>ON</sub>                         | See Switching Time Test Circuit                                     | 150                                           | 300      |     | 150                                | 300      |      | ns    |
|         | Turn-OFF Time                  | t <sub>OFF</sub>                        |                                                                     | 130                                           | 250      |     | 130                                | 250      |      | ns    |
|         | Break-Before-Make Interval     | t <sub>ON</sub> - t <sub>OFF</sub>      | See Break-Before-Make Time Test Circuit, DG301(A)/DG303(A) only     | 50                                            |          |     | 50                                 |          |      | ns    |
|         | Charge Injection               | Q                                       | C <sub>L</sub> = 10nF, R <sub>GEN</sub> = 0Ω, V <sub>GEN</sub> = 0V | 12                                            |          |     | 12                                 |          |      | pC    |
|         | Source OFF-Capacitance         | C <sub>S(OFF)</sub>                     | f = 1MHz, V <sub>S</sub> = 0V                                       | 14                                            |          |     | 14                                 |          |      | pF    |
|         | Drain OFF-Capacitance          | C <sub>D(OFF)</sub>                     | V <sub>IN</sub> = 0.8V or V <sub>D</sub> = 0V                       | 14                                            |          |     | 14                                 |          |      | pF    |
|         | Channel ON-Capacitance         | C <sub>D(ON)</sub> + C <sub>S(ON)</sub> | V <sub>IN</sub> = 4.0V V <sub>S</sub> = V <sub>D</sub> = 0V         | 40                                            |          |     | 40                                 |          |      | pF    |
|         | Input Capacitance              | C <sub>IN</sub>                         | f = 1MHz V <sub>IN</sub> = 0V                                       | 6                                             |          |     | 6                                  |          |      | pF    |
|         |                                |                                         | V <sub>IN</sub> = 15V                                               | 7                                             |          |     | 7                                  |          |      |       |
|         | Off-Isolation (Note 4)         |                                         | V <sub>IN</sub> = 0V, R <sub>L</sub> = 1kΩ                          | 62                                            |          |     | 62                                 |          |      | dB    |
|         | Crosstalk (Channel-to-Channel) |                                         | V <sub>S</sub> = 1V <sub>RMS</sub> , f = 500kHz                     | 74                                            |          |     | 74                                 |          |      | dB    |

# TTL Compatible CMOS Analog Switches

## ELECTRICAL CHARACTERISTICS (continued)

(V+ = +15V, V- = -15V, GND = 0V, TA = +25°C, unless otherwise noted.)

|        | PARAMETER               | SYMBOL | TEST CONDITIONS                          | DG300–DG303A<br>DG300A–DG303AA |          |     | DG300–DG303B/C<br>DG300A–DG303AB/C |          |     | UNITS |
|--------|-------------------------|--------|------------------------------------------|--------------------------------|----------|-----|------------------------------------|----------|-----|-------|
|        |                         |        |                                          | MIN                            | TYP      | MAX | MIN                                | TYP      | MAX |       |
|        |                         |        |                                          | (Note 2)                       | (Note 3) |     | (Note 2)                           | (Note 3) |     |       |
| SUPPLY | Positive Supply Current | I+     | VIN = 4V (one input)<br>(all others = 0) |                                | 0.23     | 0.5 |                                    | 0.23     | 0.5 | mA    |
|        | Negative Supply Current | I-     |                                          | -10                            | -0.001   |     | -10                                | -0.001   |     | μA    |
|        | Positive Supply Current | I+     | VIN = 0.8V (all inputs)                  |                                | 0.001    | 10  |                                    | 0.001    | 10  | μA    |
|        | Negative Supply Current | I-     |                                          | -10                            | -0.001   |     | -10                                | -0.001   |     | μA    |

## ELECTRICAL CHARACTERISTICS (Over Temperature)

(V+ = +15V, V- = -15V, GND = 0V, TA = Over Temperature Range, unless otherwise noted.)

|         | PARAMETER                      | SYMBOL  | TEST CONDITIONS                          | DG300–DG303A<br>DG300A–DG303AA |          |     | DG300–DG303B/C<br>DG300A–DG303AB/C |          |     | UNITS |
|---------|--------------------------------|---------|------------------------------------------|--------------------------------|----------|-----|------------------------------------|----------|-----|-------|
|         |                                |         |                                          | MIN                            | TYP      | MAX | MIN                                | TYP      | MAX |       |
|         |                                |         |                                          | (Note 2)                       | (Note 3) |     | (Note 2)                           | (Note 3) |     |       |
| SWITCH  | Analog Signal Range            | VANALOG | IS = -10mA, VIN = 0.8V or 4.0V           | -15                            |          | +15 | -15                                |          | +15 | V     |
|         | Drain-Source ON-Resistance     | RDS(ON) | IS = -10mA, VD = 10V                     |                                |          | 75  |                                    |          | 75  | Ω     |
|         |                                |         | IS = -10mA, VD = -10V                    |                                |          | 75  |                                    |          | 75  |       |
|         | Source OFF-Leakage Current     | IS(OFF) | VIN = 0.8V or<br>VIN = 0.8V              |                                |          | 100 |                                    |          | 100 | nA    |
|         |                                |         | VS = 14V, VD = -14V                      |                                |          |     |                                    |          |     |       |
|         |                                |         | VS = -14V, VD = 14V                      | -100                           |          |     | -100                               |          |     |       |
|         | Drain OFF-Leakage Current      | ID(OFF) | VS = -14V, VD = 14V                      |                                |          | 100 |                                    |          | 100 | nA    |
|         |                                |         | VS = 14V, VD = -14V                      | -100                           |          |     | -100                               |          |     |       |
| INPUT   | Drain ON-Leakage Current       | ID(ON)  | VD = VS = 14V                            |                                |          | 200 |                                    |          | 200 | nA    |
|         |                                |         | VD = VS = -14V                           | -200                           |          |     | -200                               |          |     |       |
|         | Input Current/<br>Voltage High | IINH    | VIN = 5.0V                               | -1                             |          |     | -10                                |          |     | μA    |
|         |                                |         | VIN = 15V                                |                                |          | 1   |                                    |          | 10  |       |
| SUPPLY  | Input Current/<br>Voltage Low  | IINL    | VIN = 0V                                 | -1                             |          |     | -10                                |          |     | μA    |
|         | Positive Supply Current        | I+      | VIN = 4V (one input)<br>(all others = 0) |                                |          | 1   |                                    |          | 1   | mA    |
|         | Negative Supply Current        | I-      |                                          | -100                           |          |     | -200                               |          |     | mA    |
|         | Positive Supply Current        | I+      | VIN = 0.8V (all inputs)                  |                                |          | 100 |                                    |          | 200 | μA    |
| DYNAMIC | Negative Supply Current        | I-      |                                          | -100                           |          |     | -200                               |          |     | μA    |
|         | Turn-ON Time                   | tON     | See Switching Time Test Circuit          |                                |          | 500 |                                    |          |     | ns    |
|         | Turn-OFF Time                  | tOFF    |                                          |                                |          | 450 |                                    |          |     | ns    |

DG300(A)/DG301(A)/DG302(A)/DG303(A)

# TTL Compatible CMOS Analog Switches

## ELECTRICAL CHARACTERISTICS (Over Temperature) (continued)

( $V_+ = +15V$ ,  $V_- = -15V$ , GND = 0V,  $T_A$  = Over Temperature Range, unless otherwise noted.)

**Note 1:** Signals on  $S_X$ ,  $D_X$ , or  $IN_X$  exceeding  $V_+$  or  $V_-$  are clamped by internal diodes. Limit diode forward current to maximum current ratings.

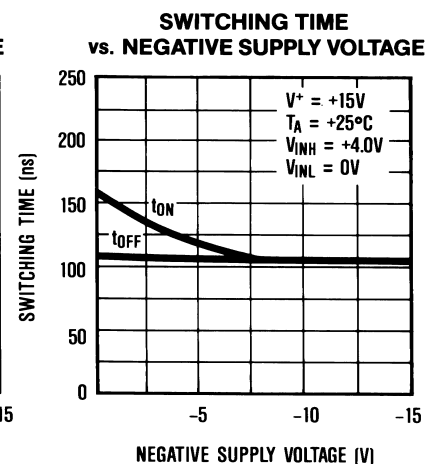
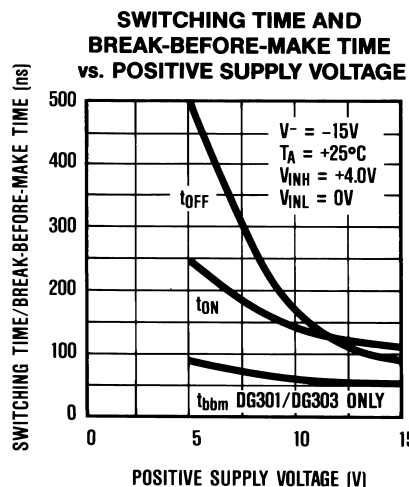
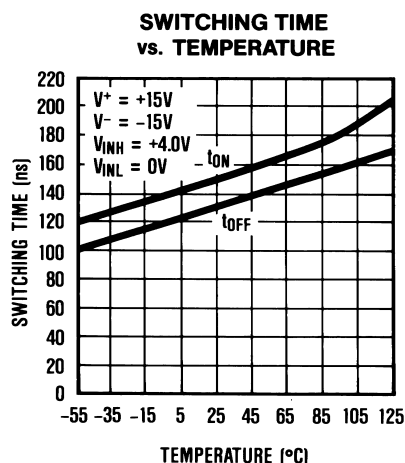
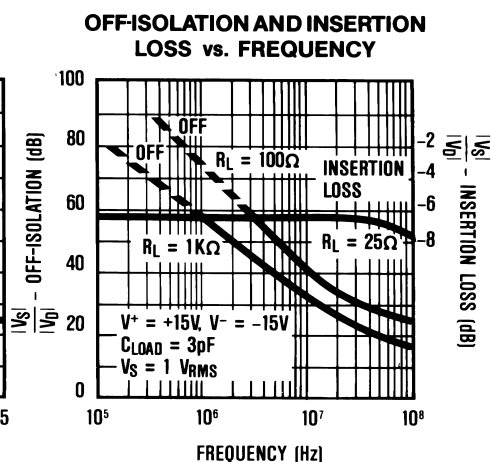
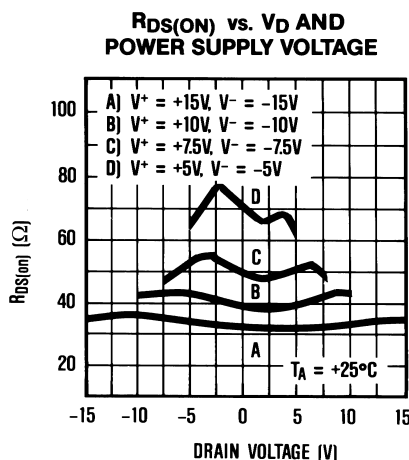
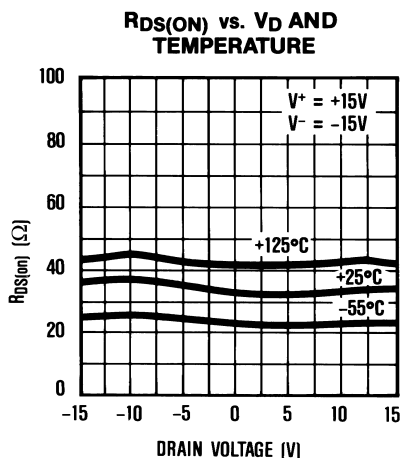
**Note 2:** The algebraic convention whereby the most negative value is a minimum, and the most positive value is a maximum is used in this data sheet.

**Note 3:** Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.

**Note 4:** OFF-isolation =  $20 \log \frac{V_S}{V_D}$ ,  $V_S$  = input to OFF switch,  $V_D$  = output.

## Typical Operating Characteristics

( $T_A = +25^\circ C$ , unless otherwise noted.)



# TTL Compatible CMOS Analog Switches

## Test Circuits

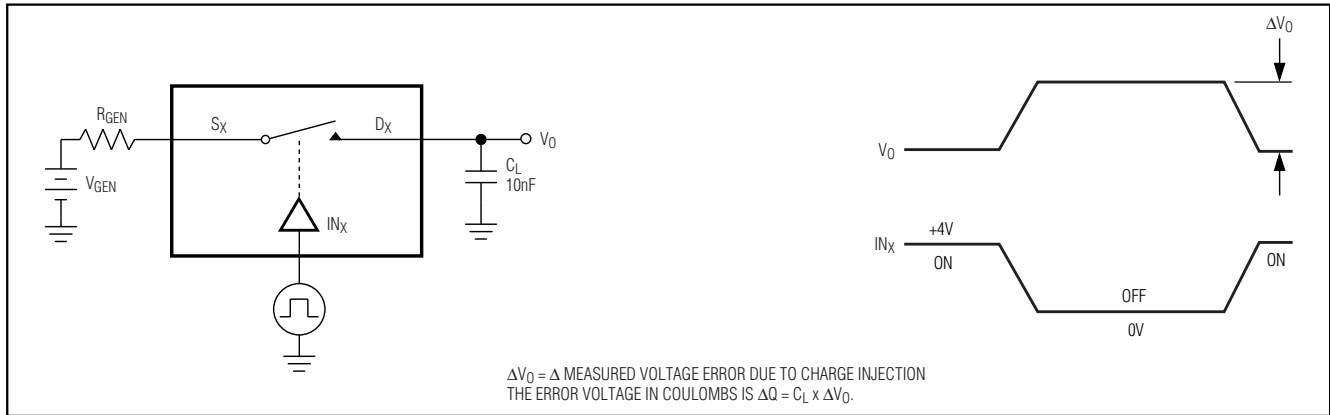


Figure 1. Charge Injection Test Circuit

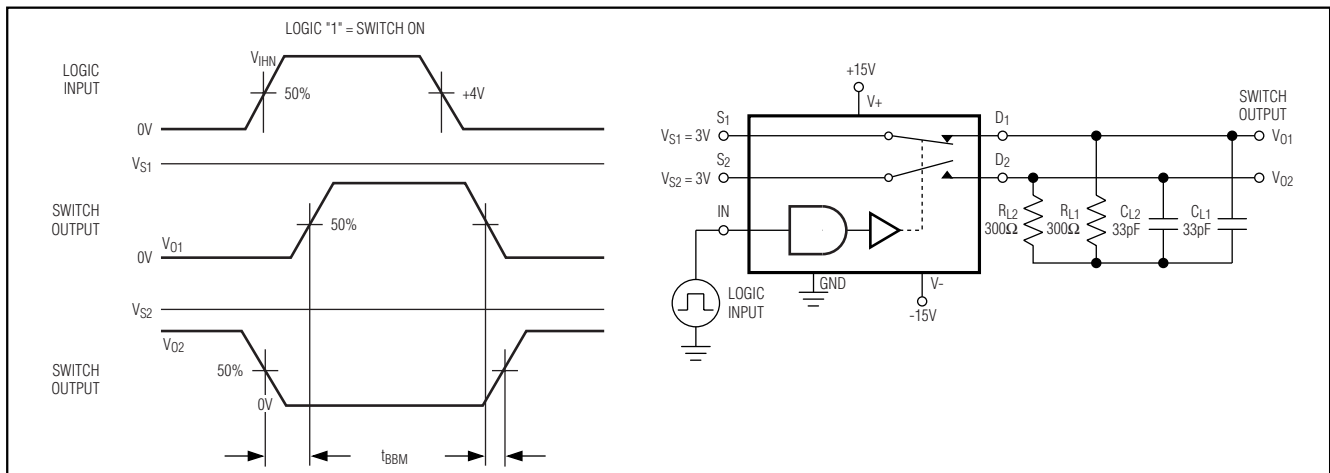


Figure 2. Break-Before-Make Time Test Circuit SPDT (DG301(A), DG303(A))

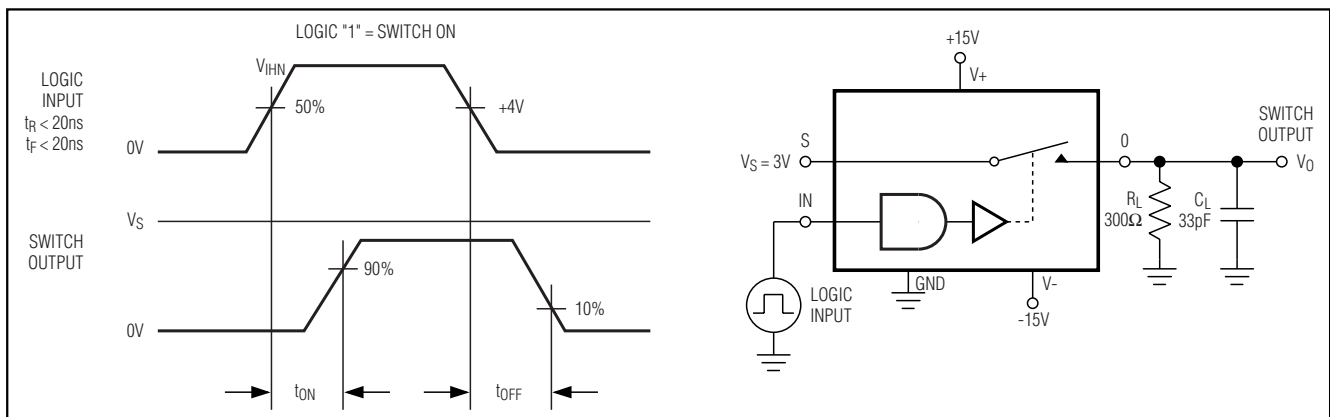


Figure 3. Switching Time Test Circuit

# TTL Compatible CMOS Analog Switches

**Table 1. Typical Single Supply Parameters**

| PARAMETER                           |                       | V+ SUPPLY VOLTAGE (V- = 0V) |             |             |             |
|-------------------------------------|-----------------------|-----------------------------|-------------|-------------|-------------|
|                                     |                       | +10V                        | +15V        | +20V        | +30V        |
| Switching Time ( $R_L = 1k\Omega$ ) | $t_{ON}$              | 190ns                       | 150ns       | 110ns       | 70ns        |
|                                     | $t_{OFF}$             | 40ns                        | 40ns        | 40ns        | 40ns        |
| On-Resistance                       | $V_{SIGNAL} = +1V$    | 71 $\Omega$                 | 51 $\Omega$ | 42 $\Omega$ | 31 $\Omega$ |
|                                     | $V_{SIGNAL} = V+ / 2$ | 77 $\Omega$                 | 54 $\Omega$ | 43 $\Omega$ | 30 $\Omega$ |
|                                     | $V_{SIGNAL} = V+$     | 84 $\Omega$                 | 63 $\Omega$ | 54 $\Omega$ | 43 $\Omega$ |
| Input Logic Levels                  |                       | 0.8V, 4.0V                  | 0.8V, 4.0V  | 0.8V, 4.0V  | 0.8V, 4.5V  |

## Applications Information

All DG300 family switches will operate with  $\pm 5V$  to  $\pm 15V$  power supplies. They can also be used with single-ended power supplies ranging from +10V to +30V where the V-terminal is connected to ground. In either case, analog signals ranging from V+ to V- can be switched.

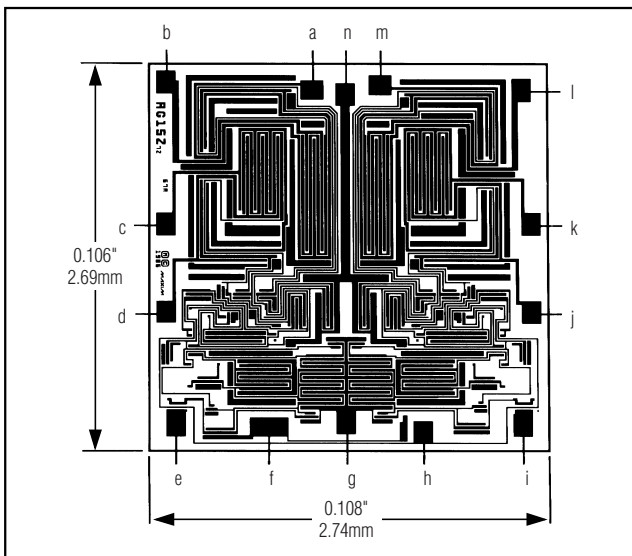
The on-resistance variation with analog signal and supply voltage is shown in the *Typical Operating Characteristics*. The temperature coefficient of  $R_{ON}$  is typically 0.5%/°C. Typical on-resistance matching from channel to channel is 10%. In addition, Table 1 outlines some typical parameters for single-supply operation.

**Table 2. Charge Injection ( $\pm 15V$  Supplies)**

| ANALOG INPUT (V) | INJECTED Q (pC) |
|------------------|-----------------|
| +10              | 4               |
| +5               | 8               |
| 0                | 12              |
| -5               | 8               |
| -10              | 5               |

The charge injection test circuit is shown in Figure 1. Table 2 lists the typical injected charge for DG300 series switches with various input voltages.

## Chip Topography



| DIE PAD | DG300<br>DG300A | DG301<br>DG301A | DG302/DG303<br>DG302A/DG303A |
|---------|-----------------|-----------------|------------------------------|
| a       | N.C.            | N.C.            | S3                           |
| b       | D1              | D1              | D3                           |
| c       | D1              | S1              | D1                           |
| d       | S1              | IN1             | S1                           |
| e       | IN1             | IN1             | IN1                          |
| f       | V+              | V+              | V+                           |
| g       | GND             | GND             | GND                          |
| h       | V-              | V-              | V-                           |
| i       | IN2             | GND             | IN2                          |
| j       | S2              | V-              | S2                           |
| k       | D2              | S2              | D2                           |
| l       | D2              | D2              | D4                           |
| m       | N.C.            | N.C.            | S4                           |
| n       | V+              | V+              | V+                           |

# TTL Compatible CMOS Analog Switches

## Ordering Information (continued)

| PART            | TEMP RANGE      | PIN-PACKAGE         |
|-----------------|-----------------|---------------------|
| DG300AC/D       | 0°C to +70°C    | Dice                |
| DG300ACJ        | 0°C to +70°C    | 14 Lead Plastic DIP |
| DG300ACWE       | 0°C to +70°C    | 16 Lead Wide SO     |
| DG300ACK        | 0°C to +70°C    | 14 Lead CERDIP      |
| DG300ABWE       | -25°C to +85°C  | 16 Lead Wide SO     |
| DG300ABK        | -25°C to +85°C  | 14 Lead CERDIP      |
| DG300ABA        | -25°C to +85°C  | 10 Lead Metal Can   |
| <b>DG301C/D</b> | 0°C to +70°C    | Dice                |
| DG301CJ         | 0°C to +70°C    | 14 Lead Plastic DIP |
| DG301CWE        | 0°C to +70°C    | 16 Lead Wide SO     |
| DG301CK         | 0°C to +70°C    | 14 Lead CERDIP      |
| DG301BWE        | -25°C to +85°C  | 16 Lead Wide SO     |
| DG301BK         | -25°C to +85°C  | 14 Lead CERDIP      |
| DG301BA         | -25°C to +85°C  | 10 Lead Metal Can   |
| DG301AK         | -55°C to +125°C | 14 Lead CERDIP      |
| DG301AA         | -55°C to +125°C | 10 Lead Metal Can   |
| DG301AC/D       | 0°C to +70°C    | Dice                |
| DG301ACJ        | 0°C to +70°C    | 14 Lead Plastic DIP |
| DG301ACWE       | 0°C to +70°C    | 16 Lead Wide SO     |
| DG301ACK        | 0°C to +70°C    | 14 Lead CERDIP      |
| DG301ABWE       | -25°C to +85°C  | 16 Lead Wide SO     |
| DG301ABK        | -25°C to +85°C  | 14 Lead CERDIP      |
| DG301ABA        | -25°C to +85°C  | 10 Lead Metal Can   |
| <b>DG302C/D</b> | 0°C to +70°C    | Dice                |
| DG302CJ         | 0°C to +70°C    | 14 Lead Plastic DIP |

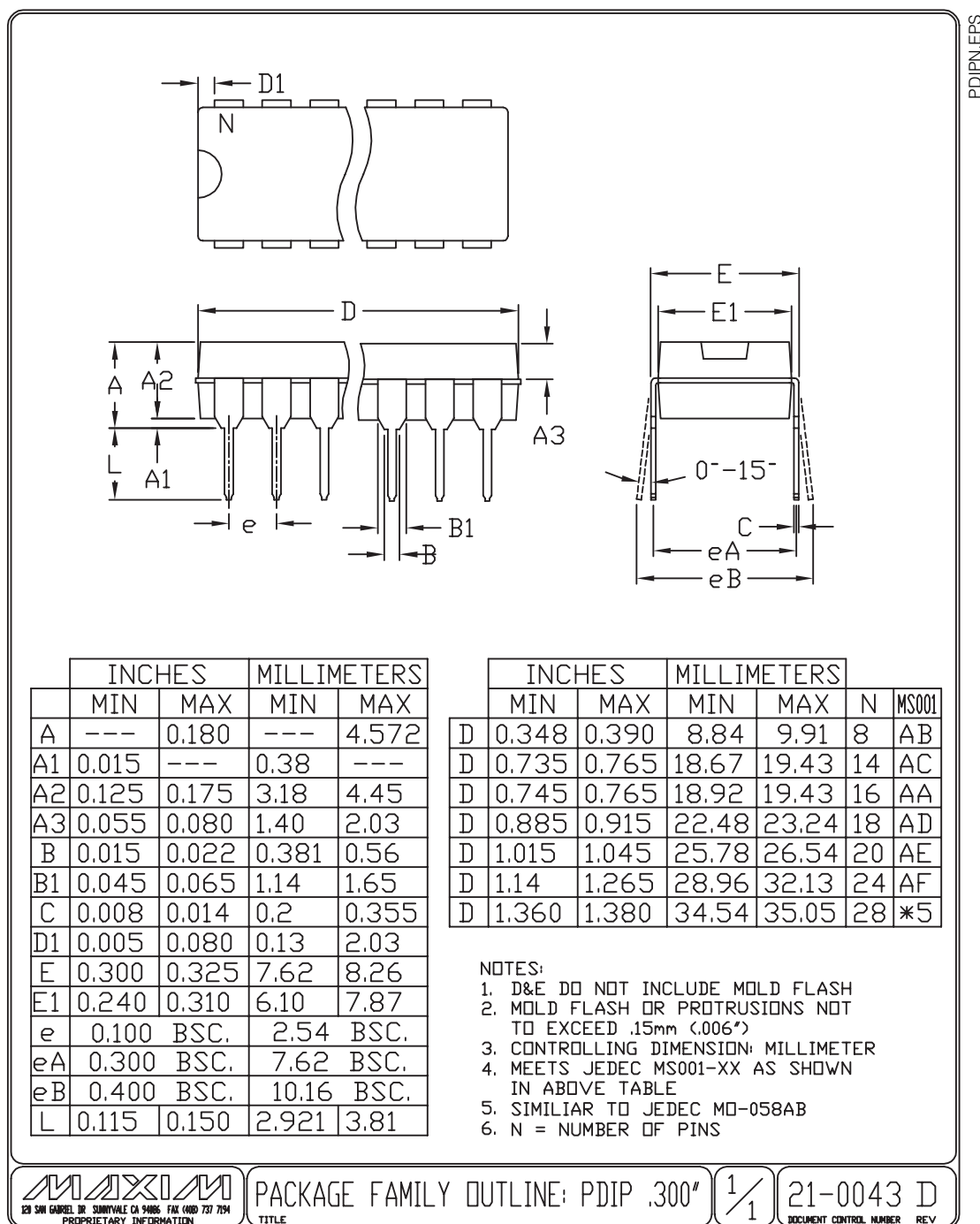
| PART            | TEMP RANGE      | PIN-PACKAGE         |
|-----------------|-----------------|---------------------|
| DG302CWE        | 0°C to +70°C    | 16 Lead Wide SO     |
| DG302CK         | 0°C to +70°C    | 14 Lead CERDIP      |
| DG302BWE        | -25°C to +85°C  | 16 Lead Wide SO     |
| DG302BK         | -25°C to +85°C  | 14 Lead CERDIP      |
| DG302AK         | -55°C to +125°C | 14 Lead CERDIP      |
| DG302AC/D       | 0°C to +70°C    | Dice                |
| DG302ACJ        | 0°C to +70°C    | 14 Lead Plastic DIP |
| DG302ACWE       | 0°C to +70°C    | 16 Lead Wide SO     |
| DG302ACK        | 0°C to +70°C    | 14 Lead CERDIP      |
| DG302ABWE       | -25°C to +85°C  | 16 Lead Wide SO     |
| DG302ABK        | -25°C to +85°C  | 14 Lead CERDIP      |
| <b>DG303C/D</b> | 0°C to +70°C    | Dice                |
| DG303CJ         | 0°C to +70°C    | 14 Lead Plastic DIP |
| DG303CWE        | 0°C to +70°C    | 16 Lead Wide SO     |
| DG303CK         | 0°C to +70°C    | 14 Lead CERDIP      |
| DG303BWE        | -25°C to +85°C  | 16 Lead Wide SO     |
| DG303BK         | -25°C to +85°C  | 14 Lead CERDIP      |
| DG303AK         | -55°C to +125°C | 14 Lead CERDIP      |
| DG303AC/D       | 0°C to +70°C    | Dice                |
| DG303ACJ        | 0°C to +70°C    | 14 Lead Plastic DIP |
| DG303ACWE       | 0°C to +70°C    | 16 Lead Wide SO     |
| DG303ACK        | 0°C to +70°C    | 14 Lead CERDIP      |
| DG303ABWE       | -25°C to +85°C  | 16 Lead Wide SO     |
| DG303ABK        | -25°C to +85°C  | 14 Lead CERDIP      |

DG300(A)/DG301(A)/DG302(A)/DG303(A)

# TTL Compatible CMOS Analog Switches

## Package Information

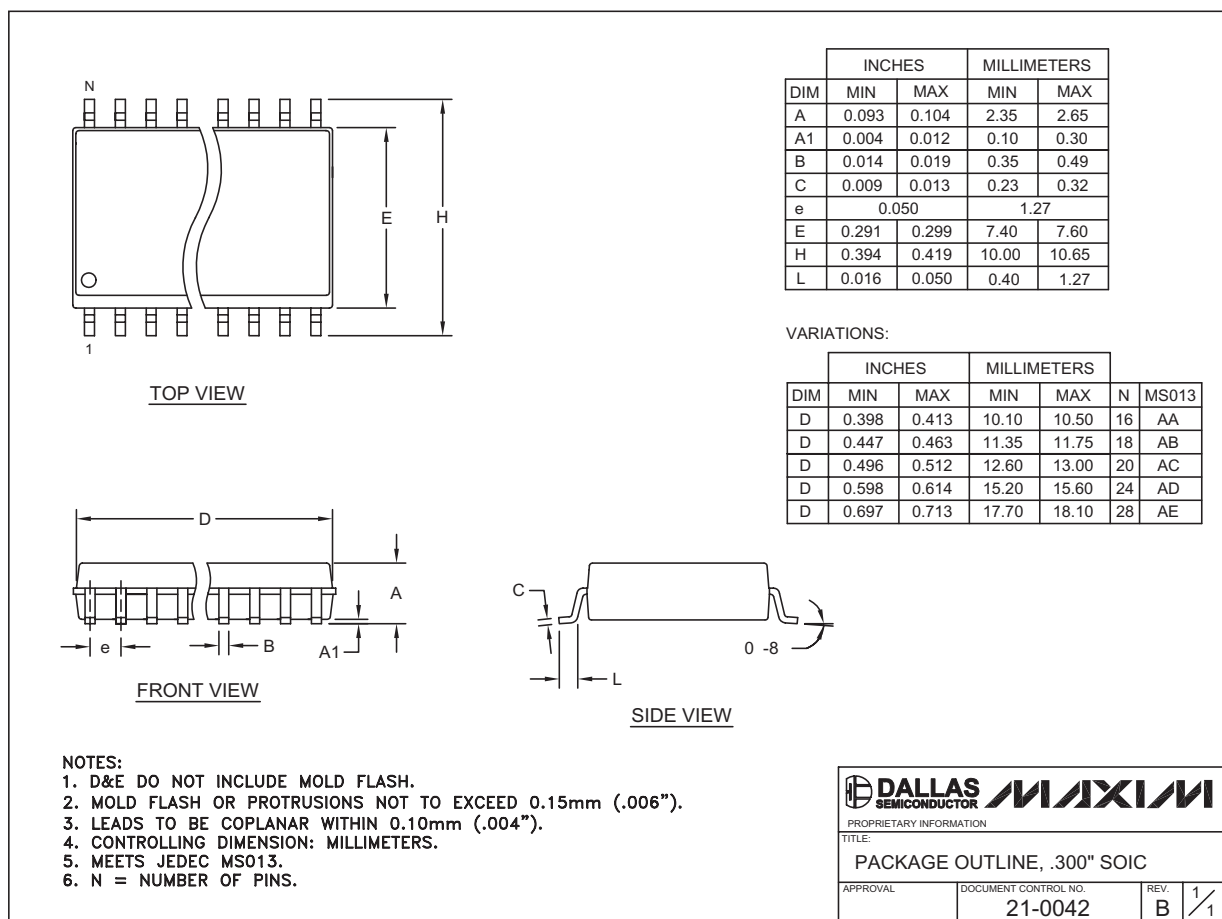
(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information, go to [www.maxim-ic.com/packages](http://www.maxim-ic.com/packages).)



# TTL Compatible CMOS Analog Switches

## Package Information (continued)

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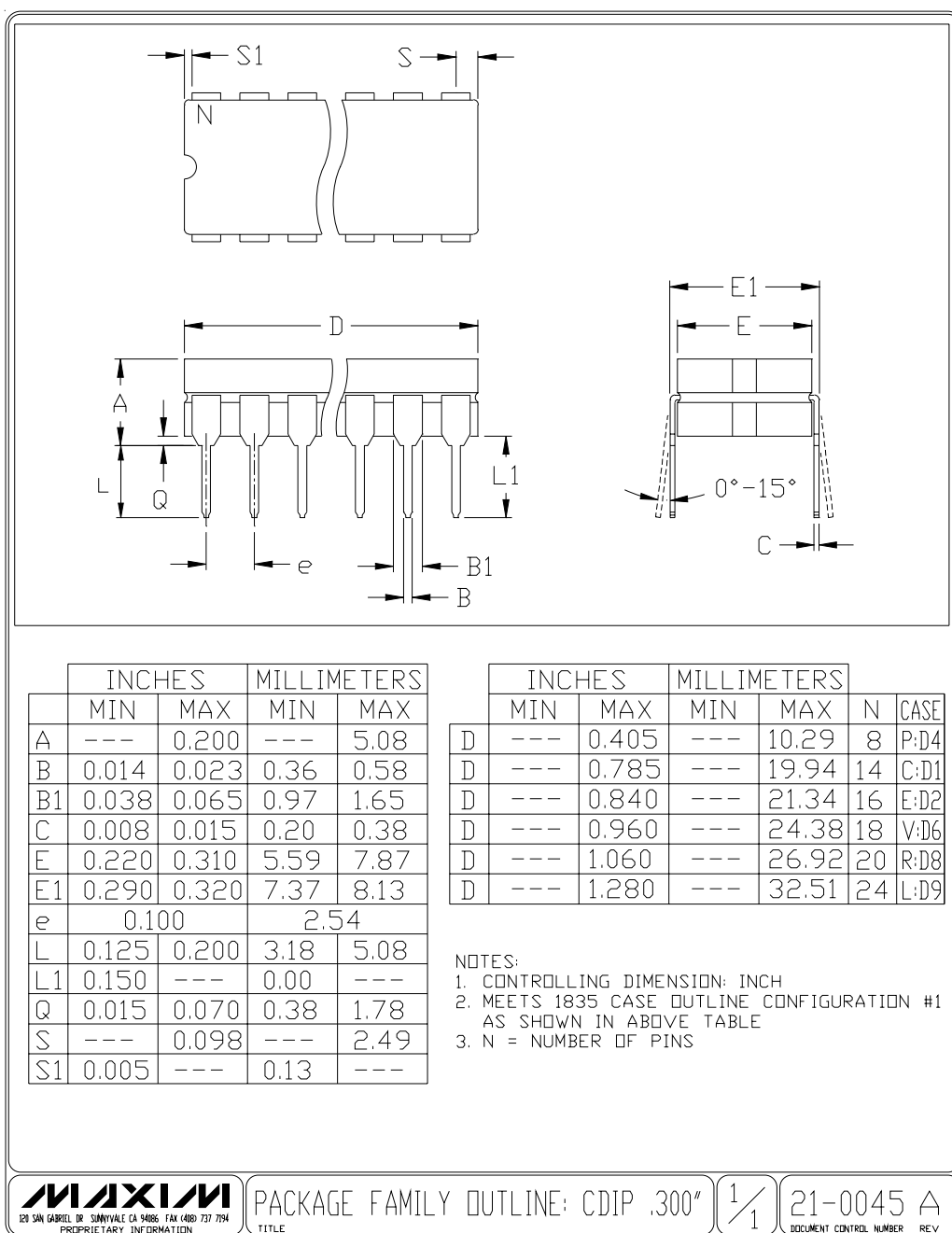
SOICWEPES

DG300(A)/DG301(A)/DG302(A)/DG303(A)

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## Package Information (continued)

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