



Quad SPST CMOS Analog Switches

General Description

The DG201A and DG211 are normally closed, quad single-pole single-throw (SPST) analog switches. These CMOS switches can be continuously operated with power supplies ranging from $\pm 4.5\text{V}$ to $\pm 18\text{V}$. Maxim guarantees that these switches will not latch up if the power supplies are disconnected with input signals still connected.

Both devices have guaranteed break-before-make switching. The DG201A differs from the DG211 primarily in switching speeds. The DG201A has a maximum turn-off time of 450ns and a maximum turn-on time of 600ns. The DG211 has a maximum turn-off time of 500ns and a maximum turn-on time of 1000ns.

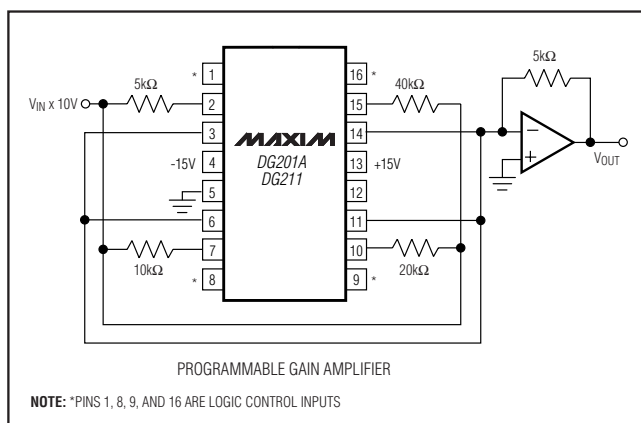
Compared to the original manufacturer's products, Maxim's DG201A and DG211 consume significantly lower power making them better suited for portable applications. Maxim has also eliminated the need for the third (V_L) power supply that is required for the operation of the original manufacturer's DG211.

Applications

Winchester Disk Drives
Test Equipment
Communications Systems
PBX, PABX
Guidance and Control Systems
Head Up Displays
Military Radios

Pin Configurations continued at end of data sheet.

Typical Operating Circuit



Features

- ◆ Guaranteed $\pm 4.5\text{V}$ to $\pm 18\text{V}$ Operation
- ◆ No V_L Supply Required
- ◆ Nonlatching with Supplies Turned Off and Input Signals Present
- ◆ CMOS and TTL Logic Compatible
- ◆ Monolithic, Low-Power CMOS Design

Ordering Information

PART	TEMP RANGE	PIN-PACKAGE
DG201ACUE	0°C to +70°C	16 TSSOP
DG201ACSE	0°C to +70°C	16 SO
DG201ACJ	0°C to +70°C	16 Plastic DIP
DG201C/D	0°C to +70°C	Dice
DG201AECE	-40°C to +85°C	16 QFN (5 × 5)
DG201AEUE	-40°C to +85°C	16 TSSOP
DG201ADY	-40°C to +85°C	16 SO
DG201ADJ	-40°C to +85°C	16 Plastic DIP
DG201AAK	-55°C to +125°C	16 Cerdip
DG201ABK	-25°C to +85°C	16 Cerdip
DG211CUE	0°C to +70°C	16 TSSOP
DG211CSE	0°C to +70°C	16 SO
DG211CJ	0°C to +70°C	16 Plastic DIP
DG211C/D	0°C to +70°C	Dice
DG211ECE	-40°C to +85°C	16 QFN (5 × 5)
DG211EUE	-40°C to +85°C	16 TSSOP
DG211DY	-40°C to +85°C	16 SO
DG211DJ	-40°C to +85°C	16 Plastic DIP

Pin Configurations



Quad SPST CMOS Analog Switches

ABSOLUTE MAXIMUM RATINGS (DG211)

V ₊ to V ₋	44V
V _{IN} to Ground.....	V ₋ , V ₊
V _L to Ground.....	-0.3V, 25V
V _S or V _D to V ₊	0, -40V
V _S or V _D to V ₋	0, 40V
V ₊ to Ground.....	25V
V ₋ to Ground.....	-25V
Current, Any Terminal Except S or D.....	30mA
Continuous Current, S or D.....	20mA
Peak Current, S or D (pulsed at 1ms 10% duty cycle max).....	70mA

Storage Temperature Range.....	-65°C to +125°C
Operating Temperature Range	
DG211C	0°C to +70°C
DG211D/E	-40°C to +85°C
Power Dissipation (T _A = +70°C) (Note 1)	
16-Pin Plastic Dip (derate 10.5mW/°C above +70°C) ..	842mW
16-Pin Narrow SO (derate 8.3mW/°C above +70°C)	696mW
16-Pin TSSOP (derate 9.4mW/°C above +70°C)	755mW
16-Pin QFN (5 × 5) (derate 19.2mW/°C above +70°C).....	1538mW

Note 1: Device mounted with all leads soldered 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 (DG211)

(V₊ = +15V, V₋ = -15V, GND = 0, T_A = +25°C, unless otherwise noted.) (For more information on TYP values see Note 2.)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
SWITCH							
Analog Signal Range	V _{ANALOG}			-15		15	V
Drain-Source ON-Resistance	R _{DS (ON)}	V _D = ±10V, V _{IN} = 0.8V, I _S = 1mA			115	175	Ω
Source OFF-Leakage Current	I _{S (OFF)}	V _{IN} = 2.4V	V _S = 14V, V _D = -14V		0.01	5.0	nA
			V _S = -14V, V _D = 14V	-5.0	-0.02		
Drain OFF-Leakage Current	I _{D (OFF)}	V _{IN} = 2.4V	V _S = 14V, V _D = -14V		0.01	5.0	
			V _S = -14V, V _D = 14V	-5.0	-0.02		
Drain ON-Leakage Current (Note 3)	I _{D (ON)}	V _{IN} = 0.8V	V _S = V _D = -14V		0.1	5.0	
			V _S = V _D = -14V	-5.0	-0.15		
INPUT							
Input Current with Input Voltage High	I _{INH}	V _{IN} = 2.4V		-1.0	-0.0004		μA
		V _{IN} = 15V			0.003 1.0		
Input Current with Input Voltage Low	I _{INL}	V _{IN} = 0		-1.0	-0.0004		
DYNAMIC							
Turn-ON Time	t _{ON}	See Switching Time Test Circuit V _S = 2V, R _L = 1kΩ, C _L = 35pF			460	1000	ns
Turn-OFF Time	t _{OFF1}				360	500	
	t _{OFF2}				450		
Source OFF-Capacitance	C _{S (OFF)}	V _S = 0, V _{IN} = 5V, f = 1MHz			5		pF
Drain OFF-Capacitance	C _{D (OFF)}	V _D = 0, V _{IN} = 5V, f = 1MHz			5		
Channel ON-Capacitance	C _{D + S (ON)}	V _D = V _S = 0, V _{IN} = 0, f = 1MHz			16		
OFF-Isolation (Note 4)	OIRR	V _{IN} = 5V, R _L = 1kΩ, C _L = 15pF, V _S = 1VRMS, f = 100kHz			70		dB
Crosstalk (Channel to Channel)	CCRR				90		

Quad SPST CMOS Analog Switches

ELECTRICAL CHARACTERISTICS (DG211) (continued)

(V+ = +15V, V- = -15V, GND = 0, T_A = +25°C, unless otherwise noted.) (For more information on TYP values see Note 2.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
SUPPLY						
Positive Supply Current	I ⁺	V _{IN} = 0 and 2.4V (all)		0.02	0.4	mA
Negative Supply Current	I ⁻			0.01	0.4	
Logic Supply Current	I _L			0	0	
Power-Supply Range for Continuous Operation	V _{OP}		±4.5		±18	V

Note 2: Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.

Note 3: I_{D(ON)} is leakage from driver into "ON" switch.

Note 4: OFF-Isolation = 20 log V_S/V_D, V_S = input to OFF switch, V_D = output.

ABSOLUTE MAXIMUM RATINGS (DG201A)

Voltages Reference to V-

V+44V

GND25V

Digital Inputs (Note 1), V_S, V_D-2V to (V+ + 2V)

or 20mA, whichever occurs first

Current, Any Terminal Except S or D30mA

Continuous Current, S or D20mA

Peak Current, S or D

(pulsed at 1ms 10% duty cycle max)70mA

Operating Temperature Range

DG201AA-55°C to +125°C

DG201AD/E-40°C to +85°C

DG201AC0°C to +70°C

Storage Temperature Range-65°C to +150°C

Power Dissipation (Note 2)

16-Pin Plastic Dip (derate 10.5mW/°C above +70°C) ...842mW

16-Pin SO (derate 8.7mW/°C above +70°C)696mW

16-Pin TSSOP (derate 9.4mW/°C above +70°C)755mW

16-Pin QFN (5 × 5)

(derate 19.2mW/°C above +70°C)1538mW

16-Pin CERDIP (derate 10.0mW/°C above +70°C)800mW

Note 1: Signals on S₋, D₋, or IN₋ exceeding V+ or V- on Maxim's DG201A will be clamped by internal diodes, and are also internally current limited to 25mA.

Note 2: Device mounted with all leads soldered 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 (DG201A)

(V+ = +15V, V- = -15V, GND = 0, T_A = +25°C, unless otherwise noted.) (For more information on TYP values see Note 3.)

PARAMETER	SYMBOL	CONDITIONS	DG201AA			DG201AC, D, E			UNITS
			MIN	TYP	MAX	MIN	TYP	MAX	
SWITCH									
Analog Signal Range	V _{ANALOG}		-15		15	-15		15	V
Drain-Source ON Resistance	R _{DS (ON)}	V _D = ±10V, V _{IN} = 0.8V, I _S = 1mA		115	175		115	200	Ω
Source OFF-Leakage Current	I _{S (OFF)}	V _{IN} = 2.4V	V _S = 14V, V _D = -14V		0.01	1.0	0.01	5.0	nA
			V _S = -14V, V _D = 14V		-1.0	-0.02	-5.0	-0.02	
Drain OFF-Leakage Current	I _{D (OFF)}	V _{IN} = 2.4V	V _S = 14V, V _D = -14V		0.01	1.0	0.01	5.0	
			V _S = -14V, V _D = 14V		-1.0	-0.02	-5.0	-0.02	
Drain ON-Leakage Current (Note 4)	I _{D (ON)}	V _{IN} = 0.8V	V _S = -14V		0.1	1.0	0.1	1.0	
			V _S = 14V		-1.0		-1.0		

Quad SPST CMOS Analog Switches

ELECTRICAL CHARACTERISTICS (DG201A) (continued)

(V+ = +15V, V- = -15V, GND = 0, TA = +25°C, unless otherwise noted.) (For more information on TYP values see Note 3.)

PARAMETER	SYMBOL	CONDITIONS		DG201AA			DG201AC, D, E			UNITS
				MIN	TYP	MAX	MIN	TYP	MAX	
INPUT										
Input Current with Input Voltage High	I _{INH}	V _{IN} = 2.4V		-1.0			-1.0			μA
		V _{IN} = 15V		1.0			1.0			
Input Current with Input Voltage Low	I _{INL}	V _{IN} = 0+		-1.0			-1.0			
DYNAMIC										
Turn-ON Time	t _{ON}	See Figure 1 Switching Time Test Circuit		480 600		480 600		ns		
Turn-OFF Time	t _{OFF1}			370 450		370 450				
Charge Injection	Q	C _L = 1000pF, V _{GEN} = 0, R _{GEN} = 0		20		20		pC		
Source OFF-Capacitance	C _S (OFF)	V _S = 0,	f = 140kHz	5		5		pF		
Drain OFF-Capacitance	C _D (OFF)	V _{IN} = 5V		5		5				
Channel ON-Capacitance	C _D (ON) + C _S (ON)	V _D = V _S = 0, V _{IN} = 0		16		16				
OFF-Isolation		V _{IN} = 5V, Z _L = 75Ω		70		70		dB		
Crosstalk (Channel to Channel)		V _S = 2.0V, f = 100kHz		90		90				
SUPPLY										
Positive Supply Current	I ⁺	All channels ON or OFF		0.02 0.1		0.02 0.1		mA		
Negative Supply Current	I ⁻	All channels ON or OFF		-0.1 -0.01		-0.1 -0.01				
Power-Supply Range for Continuous Operation	V _{OP}			±4.5 ±18		±4.5 ±18		V		

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

Note 4: I_D (ON) is leakage from driver into "ON" switch.

Quad SPST CMOS Analog Switches

ELECTRICAL CHARACTERISTICS (DG201A)

(V+ = +15V, V- = -15V, GND = 0, T_A = full operating temperature range, unless otherwise noted.) (For more information on TYP values see Note 3.)

PARAMETER	SYMBOL	CONDITIONS		DG201AA			DG201AC, D, E			UNITS
				MIN	TYP	MAX	MIN	TYP	MAX	
SWITCH										
Analog Signal Range	V _{ANALOG}			-15		15	-15		15	V
Drain-Source ON Resistance (Note 5)	R _{DS (ON)}	V _D = ±10V, V _{IN} = 0.8V, I _S = 1mA		250			250			Ω
Source OFF Leakage Current	I _{S (OFF)}	V _{IN} = 2.4V	V _S = 14V, V _D = -14V	100			100			nA
			V _S = -14V, V _D = 14V	-100			-100			
Drain OFF Leakage Current	I _{D (OFF)}	V _{IN} = 2.4V	V _S = 14V, V _D = -14V	100			100			
			V _S = -14V, V _D = 14V	-100			-100			
Drain ON Leakage Current (Note 6)	I _{D (ON)}	V _{IN} = 0.8V	V _S = -14V	200			200			
			V _D = 14V	-200			-200			
INPUT										
Input Current with Input Voltage High	I _{INH}	V _{IN} = 2.4V		-1.0			-1.0			μA
		V _{IN} = 15V		1.0			1.0			
Input Current with Input Voltage Low	I _{INL}	V _{IN} = 0		-1.0			-1.0			

Note 5: Electrical characteristics, such as ON-Resistance, will change when power supplies other than ±15V, are used.

Note 6: I_{D (ON)} is leakage from driver into “ON” switch.

Pin Description

PIN		NAME	FUNCTION
DIP/SO/TSSOP	QFN		
1, 16, 9, 8	15, 14, 7, 6	IN1–IN4	Input
2, 15, 10, 7	16, 13, 8, 5	D1–D4	Analog Switch Drain Terminal
3, 14, 11, 6	1, 12, 9, 4	S1–S4	Analog Switch Source Terminal
4	2	V-	Negative-Supply Voltage Input
5	3	GND	Ground
12	10	N.C.	No Connection
13	11	V+	Positive-Supply Voltage Input—Connected to Substrate

Switching Time Test Circuit

Switch output waveform shown for V_S = constant with logic input waveform as shown. Note that V_S may be +ve or -ve as per switching times test circuit. V_O is the steady state output with switch on. Feedthrough via gate capacitance may result in spikes at leading and trailing edge of output waveform.

Quad SPST CMOS Analog Switches

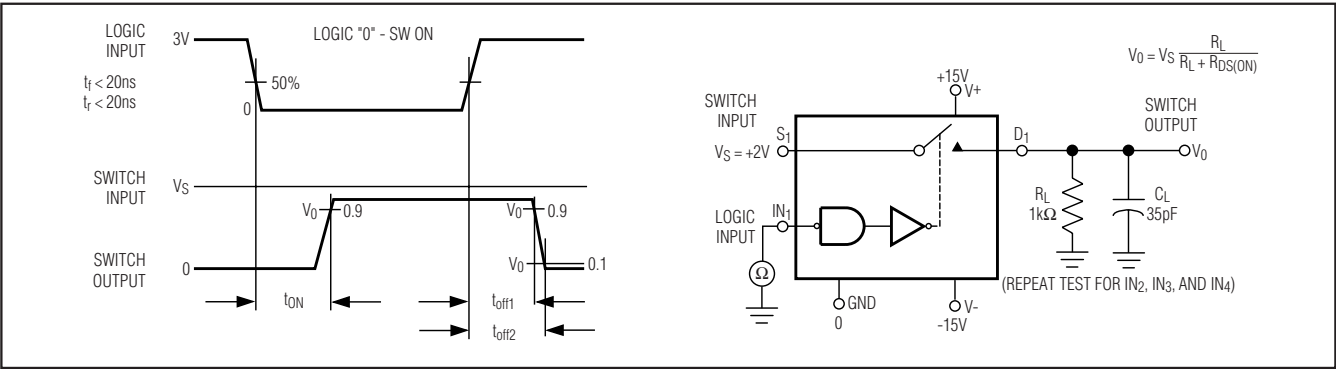


Figure 1. Switching Time

Typical RDS(ON) vs. Power Supplies for Maxim's DG201A, and DG211

POWER SUPPLIES	RDS(ON) AT ANALOG SIGNAL LEVEL					
	-5V	+5V	-10V	+10V	-15V	+15V
±5V	350Ω	380Ω	—	—	—	—
±10V	—	—	165Ω	250Ω	—	—
±15V	—	—	125Ω	160Ω	135Ω	155Ω

Protecting Against Fault Conditions

Fault conditions occur when power supplies are turned off when input signals are still present, or when overvoltages occur at the inputs during normal operation. In either case, source-to-body diodes can be forward biased and conduct current from the signal source. If this current is required to be kept to low (μA) levels then the addition of external protection diodes is recommended.

To provide protection for overvoltages up to 20V above the supplies, a 1N4001 or 1N914 type diode should be placed in series with the positive and negative supplies as shown in Figure 2. The addition of these diodes will reduce the analog signal range to 1V below the positive supply and 1V above the negative supply.

Pin Configurations (continued)

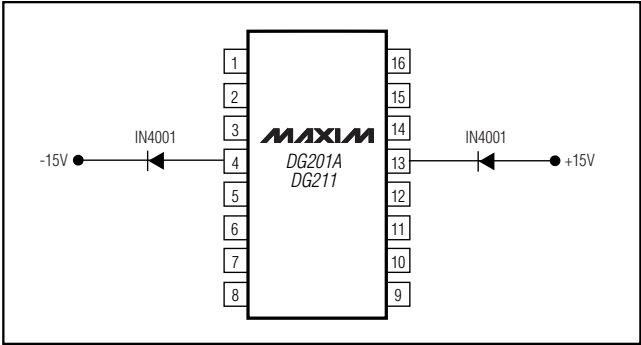
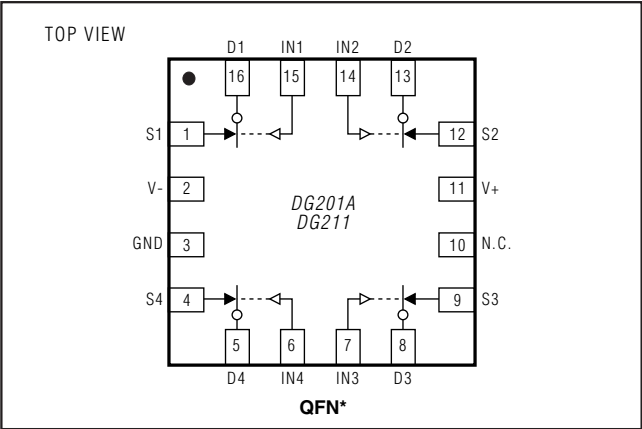


Figure 2. Protection against Fault Conditions

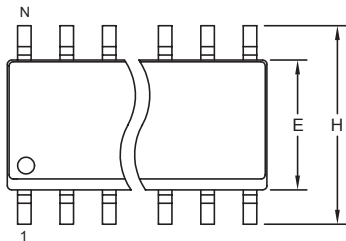
Quad SPST CMOS Analog Switches

Package Information

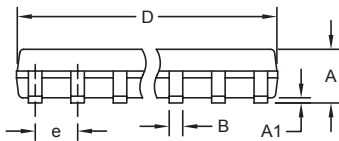
(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information, go to www.maxim-ic.com/packages.)

DG201A/DG211

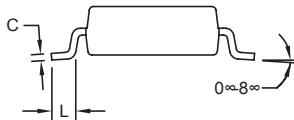
SOICN.EPS



TOP VIEW



FRONT VIEW



SIDE VIEW

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.053	0.069	1.35	1.75
A1	0.004	0.010	0.10	0.25
B	0.014	0.019	0.35	0.49
C	0.007	0.010	0.19	0.25
e	0.050 BSC		1.27 BSC	
E	0.150	0.157	3.80	4.00
H	0.228	0.244	5.80	6.20
L	0.016	0.050	0.40	1.27

VARIATIONS:

DIM	INCHES		MILLIMETERS		N	MS012
	MIN	MAX	MIN	MAX		
D	0.189	0.197	4.80	5.00	8	AA
D	0.337	0.344	8.55	8.75	14	AB
D	0.386	0.394	9.80	10.00	16	AC

NOTES:

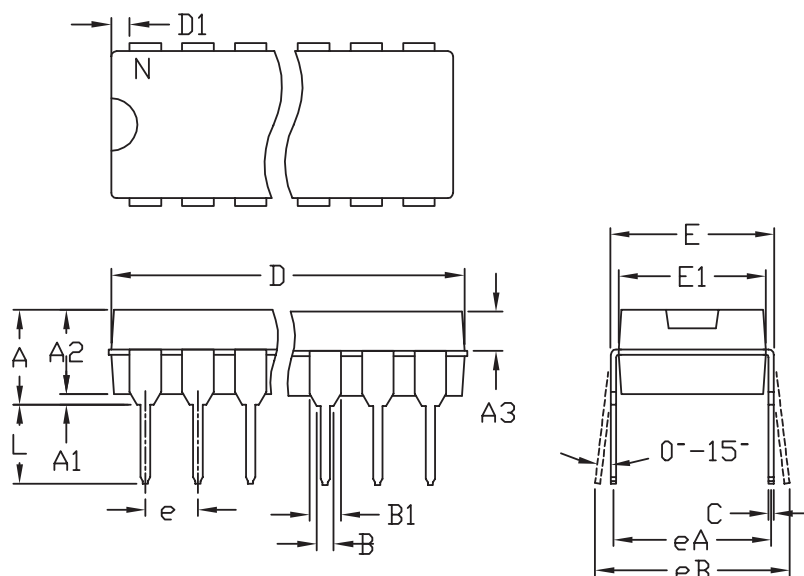
1. D&E DO NOT INCLUDE MOLD FLASH.
2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED 0.15mm (.006").
3. LEADS TO BE COPLANAR WITHIN 0.10mm (.004").
4. CONTROLLING DIMENSION: MILLIMETERS.
5. MEETS JEDEC MS012.
6. N = NUMBER OF PINS.

 DALLAS SEMICONDUCTOR			
PROPRIETARY INFORMATION			
TITLE: PACKAGE OUTLINE, .150" SOIC			
APPROVAL	DOCUMENT CONTROL NO. 21-0041	REV. B	1/4

Quad SPST CMOS Analog Switches

Package Information (continued)

(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.)



PDIPN.EPS

	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	---	0.180	---	4.572
A1	0.015	---	0.38	---
A2	0.125	0.175	3.18	4.45
A3	0.055	0.080	1.40	2.03
B	0.015	0.022	0.381	0.56
B1	0.045	0.065	1.14	1.65
C	0.008	0.014	0.2	0.355
D1	0.005	0.080	0.13	2.03
E	0.300	0.325	7.62	8.26
E1	0.240	0.310	6.10	7.87
e	0.100	BSC.	2.54	BSC.
eA	0.300	BSC.	7.62	BSC.
eB	0.400	BSC.	10.16	BSC.
L	0.115	0.150	2.921	3.81

	INCHES		MILLIMETERS			
	MIN	MAX	MIN	MAX	N	MS001
D	0.348	0.390	8.84	9.91	8	AB
D	0.735	0.765	18.67	19.43	14	AC
D	0.745	0.765	18.92	19.43	16	AA
D	0.885	0.915	22.48	23.24	18	AD
D	1.015	1.045	25.78	26.54	20	AE
D	1.14	1.265	28.96	32.13	24	AF
D	1.360	1.380	34.54	35.05	28	*5

NOTES:

1. D&E DO NOT INCLUDE MOLD FLASH
2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED .15mm (.006")
3. CONTROLLING DIMENSION: MILLIMETER
4. MEETS JEDEC MS001-XX AS SHOWN IN ABOVE TABLE
5. SIMILAR TO JEDEC MO-058AB
6. N = NUMBER OF PINS



PACKAGE FAMILY OUTLINE: PDIP .300"

1/1

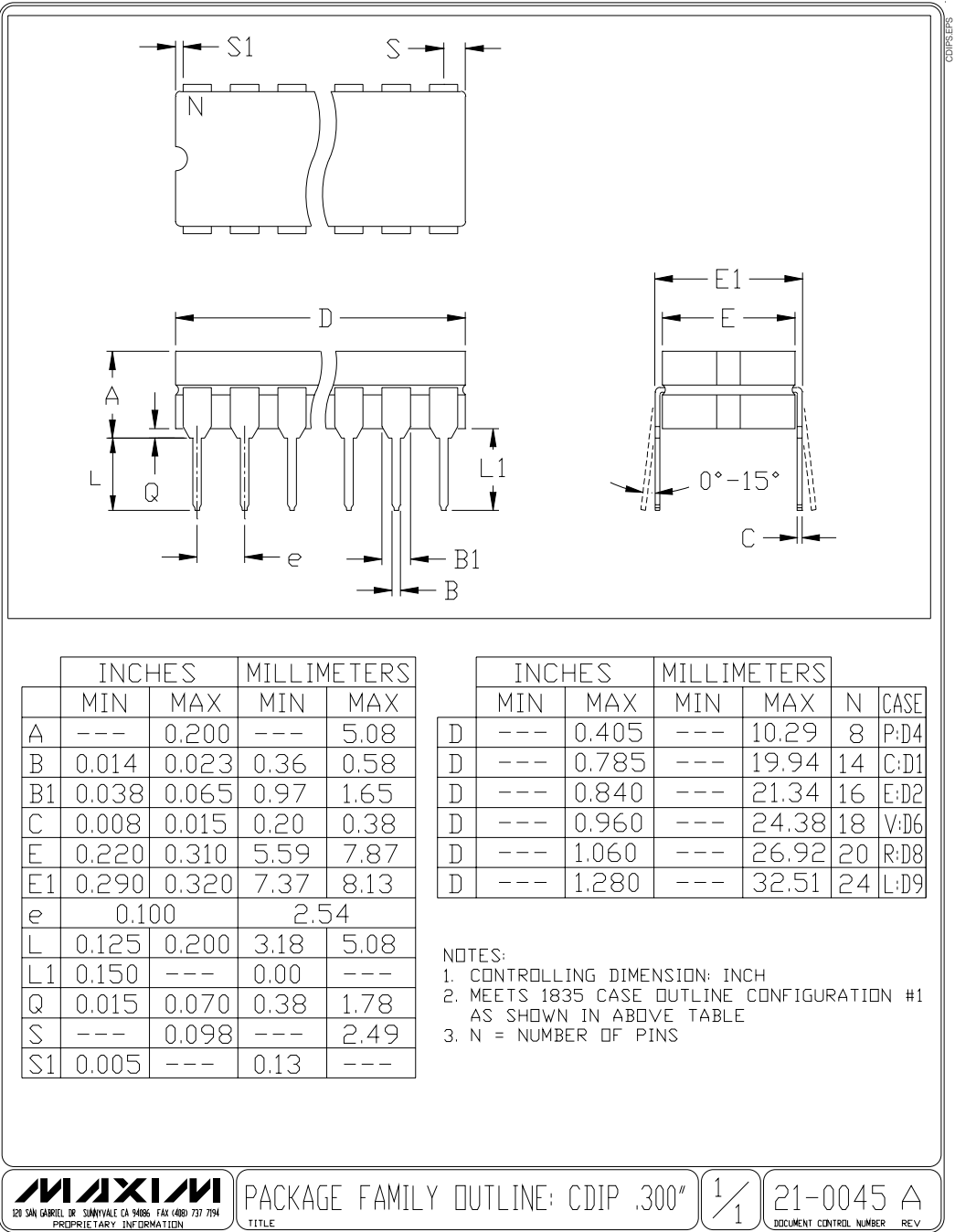
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Quad SPST CMOS Analog Switches

Package Information (continued)

(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.)

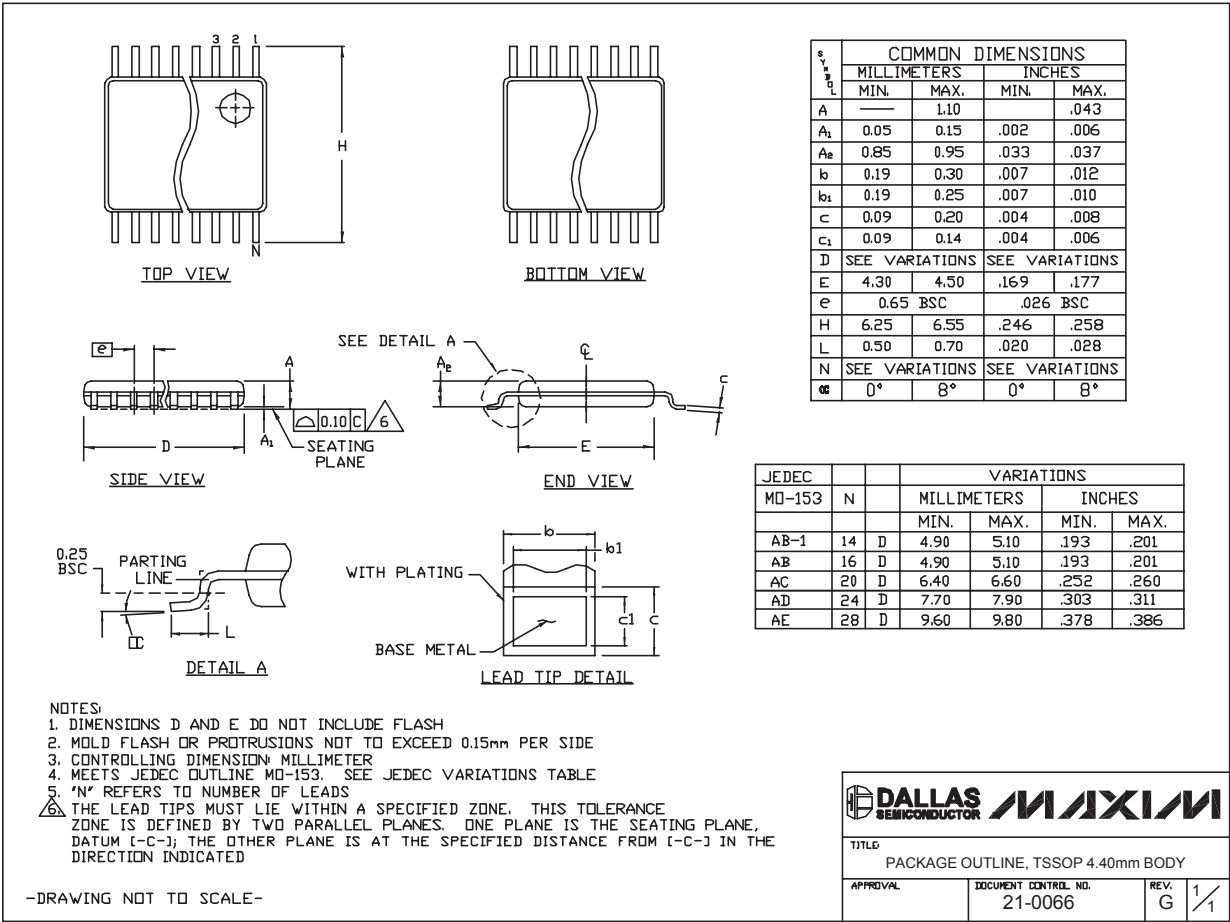
DG201A/DG211



Quad SPST CMOS Analog Switches

Package Information (continued)

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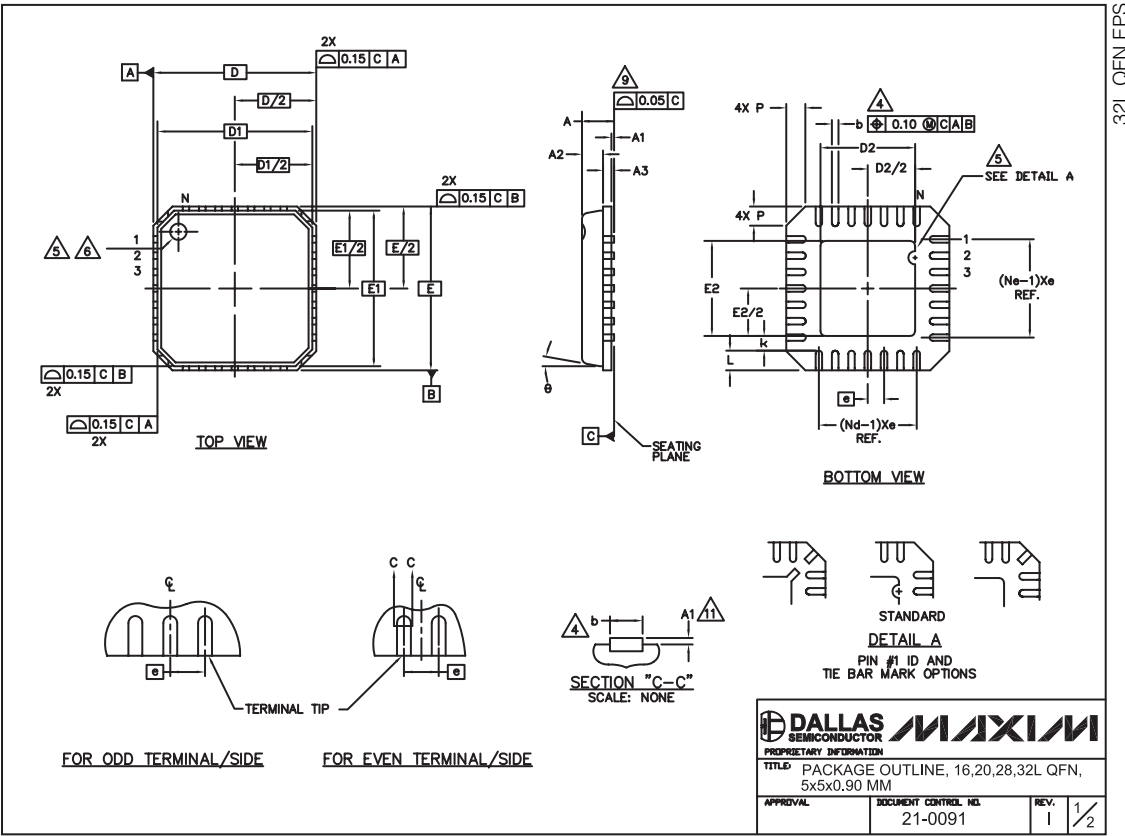


TSSOP4, 4.0mm, EPS

Quad SPST CMOS Analog Switches

Package Information (continued)

(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.)



DG201A/DG211

Quad SPST CMOS Analog Switches

Package Information (continued)

(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.)

COMMON DIMENSIONS												
PKG	16L 5x5			20L 5x5			28L 5x5			32L 5x5		
SYMBOL	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	0.80	0.90	1.00	0.80	0.90	1.00	0.80	0.90	1.00	0.80	0.90	1.00
A1	0.00	0.01	0.05	0.00	0.01	0.05	0.00	0.01	0.05	0.00	0.01	0.05
A2	0.00	0.65	1.00	0.00	0.65	1.00	0.00	0.65	1.00	0.00	0.65	1.00
A3	0.20 REF			0.20 REF			0.20 REF			0.20 REF		
b	0.28	0.33	0.40	0.23	0.28	0.35	0.18	0.23	0.30	0.18	0.23	0.30
D	4.90	5.00	5.10	4.90	5.00	5.10	4.90	5.00	5.10	4.90	5.00	5.10
D1	4.75 BSC			4.75 BSC			4.75 BSC			4.75 BSC		
E	4.90	5.00	5.10	4.90	5.00	5.10	4.90	5.00	5.10	4.90	5.00	5.10
E1	4.75 BSC			4.75 BSC			4.75 BSC			4.75 BSC		
e	0.80 BSC			0.65 BSC			0.50 BSC			0.50 BSC		
k	0.25	—	—	0.25	—	—	0.25	—	—	0.25	—	—
L	0.35	0.55	0.75	0.35	0.55	0.75	0.35	0.55	0.75	0.30	0.40	0.50
N	16			20			28			32		
ND	4			5			7			8		
NE	4			5			7			8		
P	0.00	0.42	0.60	0.00	0.42	0.60	0.00	0.42	0.60	0.00	0.42	0.60
ø	0"			12"			0"			12"		

EXPOSED PAD VARIATIONS

PKG. CODES	D2			E2		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
G1655-3	2.95	3.10	3.25	2.95	3.10	3.25
G2055-1	2.55	2.70	2.85	2.55	2.70	2.85
G2055-2	2.95	3.10	3.25	2.95	3.10	3.25
G2855-1	2.55	2.70	2.85	2.55	2.70	2.85
G2855-2	2.95	3.10	3.25	2.95	3.10	3.25
G3255-1	2.95	3.10	3.25	2.95	3.10	3.25

NOTES:

- DIE THICKNESS ALLOWABLE IS 0.305mm MAXIMUM (.012 INCHES MAXIMUM)
- DIMENSIONING & TOLERANCES CONFORM TO ASME Y14.5M. — 1994.
- N IS THE NUMBER OF TERMINALS.
Nd IS THE NUMBER OF TERMINALS IN X-DIRECTION & Ne IS THE NUMBER OF TERMINALS IN Y-DIRECTION.
- DIMENSION b APPLIES TO PLATED TERMINAL AND IS MEASURED BETWEEN 0.20 AND 0.25mm FROM TERMINAL TIP.
- THE PIN #1 IDENTIFIER MUST BE EXISTED ON THE TOP SURFACE OF THE PACKAGE BY USING INDENTATION MARK OR INK/LASER MARKED. DETAILS OF PIN #1 IDENTIFIER IS OPTIONAL, BUT MUST BE LOCATED WITHIN ZONE INDICATED.
- EXACT SHAPE AND SIZE OF THIS FEATURE IS OPTIONAL.
- ALL DIMENSIONS ARE IN MILLIMETERS.
- PACKAGE WARPAGE MAX 0.05mm.
- APPLIED FOR EXPOSED PAD AND TERMINALS. EXCLUDE EMBEDDED PART OF EXPOSED PAD FROM MEASURING.
- MEETS JEDEC MO220; EXCEPT DIMENSION "b".
- APPLIED FOR EXPOSED PAD AND TERMINALS. EXCLUDE EMBEDDING PART OF EXPOSED PAD FROM MEASURING.
- THIS PACKAGE OUTLINE APPLIES TO ANVIL SINGULATION (STEPPED SIDES).

DALLAS SEMICONDUCTOR

PROPRIETARY INFORMATION

TITLE:

PACKAGE OUTLINE, 16,20,28,32L QFN, 5x5x0.90 MM

APPROVAL

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21-0091

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Офис по работе с юридическими лицами:

105318, г.Москва, ул.Щербаковская д.3, офис 1107, 1118, ДЦ «Щербаковский»

Телефон: +7 495 668-12-70 (многоканальный)

Факс: +7 495 668-12-70 (доб.304)

E-mail: info@moschip.ru

Skype отдела продаж:

moschip.ru

moschip.ru_4

moschip.ru_6

moschip.ru_9