

SN54LV4066A, SN74LV4066A QUADRUPLE BILATERAL ANALOG SWITCHES

SCLS4271 – APRIL 1999 – REVISED APRIL 2005

- 2-V to 5.5-V V_{CC} Operation
- Support Mixed-Mode Voltage Operation on All Ports
- High On-Off Output-Voltage Ratio
- Low Crosstalk Between Switches
- Individual Switch Controls
- Extremely Low Input Current
- ESD Protection Exceeds JESD 22
 - 2000-V Human-Body Model (A114-A)
 - 200-V Machine Model (A115-A)
 - 1000-V Charged-Device Model (C101)

description/ordering information

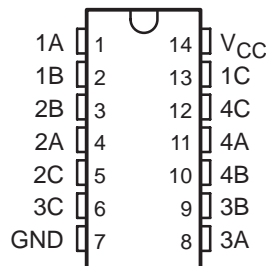
This quadruple silicon-gate CMOS analog switch is designed for 2-V to 5.5-V V_{CC} operation.

These switches are designed to handle both analog and digital signals. Each switch permits signals with amplitudes up to 5.5 V (peak) to be transmitted in either direction.

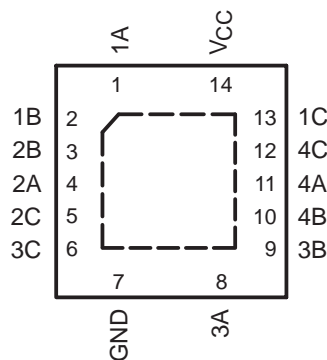
Each switch section has its own enable-input control (C). A high-level voltage applied to C turns on the associated switch section.

Applications include signal gating, chopping, modulation or demodulation (modem), and signal multiplexing for analog-to-digital and digital-to-analog conversion systems.

SN54LV4066A . . . J OR W PACKAGE
SN74LV4066A . . . D, DB, DGV, N, NS, OR PW PACKAGE
(TOP VIEW)



SN74LV4066A . . . RGY PACKAGE
(TOP VIEW)



NC – No internal connection

ORDERING INFORMATION

T_A	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
–40°C to 85°C	PDIP – N	Tube of 25	SN74LV4066AN	SN74LV4066AN
	QFN – RGY	Reel of 1000	SN74LV4066ARGYR	LW066A
	SOIC – D	Tube of 50	SN74LV4066AD	LV4066A
		Reel of 2500	SN74LV4066ADR	
	SOP – NS	Reel of 2000	SN74LV4066ANSR	74LV4066A
	SSOP – DB	Reel of 2000	SN74LV4066ADBR	LW066A
	TSSOP – PW	Tube of 90	SN74LV4066APW	LW066A
		Reel of 2000	SN74LV4066APWR	
Reel of 250		SN74LV4066APWT		
TVSOP – DGV	Reel of 2000	SN74LV4066ADGVR	LW066A	
–55°C to 125°C	CDIP – J	Tube of 25	SNJ54LV4066AJ	SNJ54LV4066AJ
	CFP – W	Tube of 150	SNJ54LV4066AW	SNJ54LV4066AW

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



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 **TEXAS
INSTRUMENTS**

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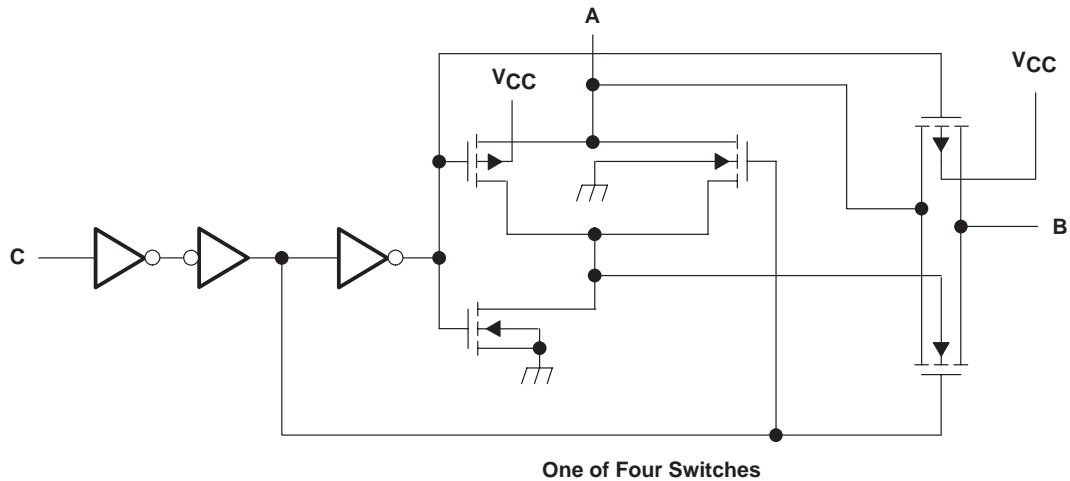
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FUNCTION TABLE
(each switch)

INPUT CONTROL (C)	SWITCH
L	OFF
H	ON

logic diagram (positive logic)



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

Supply voltage range, V_{CC} (see Note 1)	-0.5 V to 7 V
Input voltage range, V_I (see Note 1)	-0.5 V to 7 V
Switch I/O voltage range, V_{IO} (see Notes 1 and 2)	-0.5 V to $V_{CC} + 0.5$ V
Control-input clamp current, I_{IK} ($V_I < 0$)	-20 mA
I/O diode current, I_{IOK} ($V_{IO} < 0$)	-50 mA
On-state switch current, I_T ($V_{IO} = 0$ to V_{CC})	± 25 mA
Continuous current through V_{CC} or GND	± 50 mA
Package thermal impedance, θ_{JA} (see Note 3): D package	86°C/W
(see Note 3): DB package	96°C/W
(see Note 3): DGV package	127°C/W
(see Note 3): N package	80°C/W
(see Note 3): NS package	76°C/W
(see Note 3): PW package	113°C/W
(see Note 4): RGY package	47°C/W
Storage temperature range, T_{stg}	-65°C to 150°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. The input and output negative-voltage ratings may be exceeded if the input and output current ratings are observed.
 2. This value is limited to 5.5 V maximum.
 3. The package thermal impedance is calculated in accordance with JESD 51-7.
 4. The package thermal impedance is calculated in accordance with JESD 51-5.

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recommended operating conditions (see Note 5)

		SN54LV4066A		SN74LV4066A		UNIT
		MIN	MAX	MIN	MAX	
V _{CC}	Supply voltage	2†	5.5	2†	5.5	V
V _{IH}	High-level input voltage, control inputs	V _{CC} = 2 V	1.5	1.5		V
		V _{CC} = 2.3 V to 2.7 V	V _{CC} × 0.7	V _{CC} × 0.7		
		V _{CC} = 3 V to 3.6 V	V _{CC} × 0.7	V _{CC} × 0.7		
		V _{CC} = 4.5 V to 5.5 V	V _{CC} × 0.7	V _{CC} × 0.7		
V _{IL}	Low-level input voltage, control inputs	V _{CC} = 2 V		0.5	0.5	V
		V _{CC} = 2.3 V to 2.7 V		V _{CC} × 0.3	V _{CC} × 0.3	
		V _{CC} = 3 V to 3.6 V		V _{CC} × 0.3	V _{CC} × 0.3	
		V _{CC} = 4.5 V to 5.5 V		V _{CC} × 0.3	V _{CC} × 0.3	
V _I	Control input voltage	0	5.5	0	5.5	V
V _{IO}	Input/output voltage	0	V _{CC}	0	V _{CC}	V
Δt/Δv	Input transition rise or fall rate	V _{CC} = 2.3 V to 2.7 V		200	200	ns/V
		V _{CC} = 3 V to 3.6 V		100	100	
		V _{CC} = 4.5 V to 5.5 V		20	20	
T _A	Operating free-air temperature	-55	125	-40	85	°C

† With supply voltages at or near 2 V, the analog switch on-state resistance becomes very nonlinear. Only digital signals should be transmitted at these low supply voltages.

NOTE 5: All unused inputs of the device must be held at V_{CC} or GND to ensure proper device operation. Refer to the TI application report, *Implications of Slow or Floating CMOS Inputs*, literature number SCBA004.

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electrical characteristics over recommended operating free-air temperature range (unless otherwise noted)

PARAMETER	TEST CONDITIONS	V _{CC}	T _A = 25°C			SN54LV4066A		SN74LV4066A		UNIT	
			MIN	TYP	MAX	MIN	MAX	MIN	MAX		
r _{on} On-state switch resistance	I _T = -1 mA, V _I = V _{CC} or GND, V _C = V _{IH} (see Figure 1)	2.3 V		38	180		225		225	Ω	
		3 V		29	150		190		190		
		4.5 V		21	75		100		100		
r _{on(p)} Peak on-state resistance	I _T = -1 mA, V _I = V _{CC} to GND, V _C = V _{IH}	2.3 V		143	500		600		600	Ω	
		3 V		57	180		225		225		
		4.5 V		31	100		125		125		
Δr _{on} Difference in on-state resistance between switches	I _T = -1 mA, V _I = V _{CC} to GND, V _C = V _{IH}	2.3 V		6	30		40		40	Ω	
		3 V		3	20		30		30		
		4.5 V		2	15		20		20		
I _I Control input current	V _I = 5.5 V or GND	0 to 5.5 V				±0.1		±1		±1	μA
I _{S(off)} Off-state switch leakage current	V _I = V _{CC} and V _O = GND, or V _I = GND and V _O = V _{CC} , V _C = V _{IL} (see Figure 2)	5.5 V				±0.1		±1		±1	μA
I _{S(on)} On-state switch leakage current	V _I = V _{CC} or GND, V _C = V _{IH} (see Figure 3)	5.5 V				±0.1		±1		±1	μA
I _{CC} Supply current	V _I = V _{CC} or GND	5.5 V						20		20	μA
C _{ic} Control input capacitance				1.5							pF
C _{io} Switch input/output capacitance				5.5							pF
C _F Feed-through capacitance				0.5							pF

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**switching characteristics over recommended operating free-air temperature range,
V_{CC} = 2.5 V ± 0.2 V (unless otherwise noted)**

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	T _A = 25°C			SN54LV4066A		SN74LV4066A		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
t _{PLH} t _{PHL}	Propagaton delay time	A or B	B or A	C _L = 15 pF, (see Figure 4)	1.2	10		16		16	ns
t _{PZH} t _{PZL}	Switch turn-on time	C	A or B	C _L = 15 pF, R _L = 1 kΩ (see Figure 5)	3.3	15		20		20	ns
t _{PLZ} t _{PHZ}	Switch turn-off time	C	A or B	C _L = 15 pF, R _L = 1 kΩ (see Figure 5)	6	15		23		23	ns
t _{PLH} t _{PHL}	Propagaton delay time	A or B	B or A	C _L = 50 pF, (see Figure 4)	2.6	12		18		18	ns
t _{PZH} t _{PZL}	Switch turn-on time	C	A or B	C _L = 50 pF, R _L = 1 kΩ (see Figure 5)	4.2	25		32		32	ns
t _{PLZ} t _{PHZ}	Switch turn-off time	C	A or B	C _L = 50 pF, R _L = 1 kΩ (see Figure 5)	9.6	25		32		32	ns

**switching characteristics over recommended operating free-air temperature range,
V_{CC} = 3.3 V ± 0.3 V (unless otherwise noted)**

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	T _A = 25°C			SN54LV4066A		SN74LV4066A		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
t _{PLH} t _{PHL}	Propagaton delay time	A or B	B or A	C _L = 15 pF, (see Figure 4)	0.8	6		10		10	ns
t _{PZH} t _{PZL}	Switch turn-on time	C	A or B	C _L = 15 pF, R _L = 1 kΩ (see Figure 5)	2.3	11		15		15	ns
t _{PLZ} t _{PHZ}	Switch turn-off time	C	A or B	C _L = 15 pF, R _L = 1 kΩ (see Figure 5)	4.5	11		15		15	ns
t _{PLH} t _{PHL}	Propagaton delay time	A or B	B or A	C _L = 50 pF, (see Figure 4)	1.5	9		12		12	ns
t _{PZH} t _{PZL}	Switch turn-on time	C	A or B	C _L = 50 pF, R _L = 1 kΩ (see Figure 5)	3	18		22		22	ns
t _{PLZ} t _{PHZ}	Switch turn-off time	C	A or B	C _L = 50 pF, R _L = 1 kΩ (see Figure 5)	7.2	18		22		22	ns

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switching characteristics over recommended operating free-air temperature range,
 $V_{CC} = 5\text{ V} \pm 0.5\text{ V}$ (unless otherwise noted)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	$T_A = 25^\circ\text{C}$			SN54LV4066A		SN74LV4066A		UNIT
				MIN	TYP	MAX	MIN	MAX	MIN	MAX	
t _{PLH} t _{PHL}	Propagation delay time	A or B	B or A	C _L = 15 pF, (see Figure 4)	0.3	4	7	7	7	ns	
t _{PZH} t _{PZL}	Switch turn-on time	C	A or B	C _L = 15 pF, R _L = 1 k Ω (see Figure 5)	1.6	7	10	10	10	ns	
t _{PLZ} t _{PHZ}	Switch turn-off time	C	A or B	C _L = 15 pF, R _L = 1 k Ω (see Figure 5)	3.2	7	10	10	10	ns	
t _{PLH} t _{PHL}	Propagation delay time	A or B	B or A	C _L = 50 pF, (see Figure 4)	0.6	6	8	8	8	ns	
t _{PZH} t _{PZL}	Switch turn-on time	C	A or B	C _L = 50 pF, R _L = 1 k Ω (see Figure 5)	2.1	12	16	16	16	ns	
t _{PLZ} t _{PHZ}	Switch turn-off time	C	A or B	C _L = 50 pF, R _L = 1 k Ω (see Figure 5)	5.1	12	16	16	16	ns	

analog switch characteristics over operating free-air temperature range (unless otherwise noted)

PARAMETER	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	V _{CC}	$T_A = 25^\circ\text{C}$			UNIT	
					MIN	TYP	MAX		
Frequency response (switch on)	A or B	B or A	C _L = 50 pF, R _L = 600 Ω , f _{in} = 1 MHz (sine wave) 20log ₁₀ (V _O /V _I) = -3 dB (see Figure 6)	2.3 V	30			MHz	
				3 V	35				
				4.5 V	50				
Crosstalk (between any switches)	A or B	B or A	C _L = 50 pF, R _L = 600 Ω , f _{in} = 1 MHz (sine wave) (see Figure 7)	2.3 V	-45			dB	
				3 V	-45				
				4.5 V	-45				
Crosstalk (control input to signal output)	C	A or B	C _L = 50 pF, R _L = 600 Ω , f _{in} = 1 MHz (square wave) (see Figure 8)	2.3 V	15			mV	
				3 V	20				
				4.5 V	50				
Feed-through attenuation (switch off)	A or B	B or A	C _L = 50 pF, R _L = 600 Ω , f _{in} = 1 MHz (see Figure 9)	2.3 V	-40			dB	
				3 V	-40				
				4.5 V	-40				
Sine-wave distortion	A or B	B or A	C _L = 50 pF, R _L = 10 k Ω , f _{in} = 1 kHz (sine wave) (see Figure 10)	V _I = 2 V _{p-p}	2.3 V	0.1			%
				V _I = 2.5 V _{p-p}	3 V	0.1			
				V _I = 4 V _{p-p}	4.5 V	0.1			

operating characteristics, $T_A = 25^\circ\text{C}$

PARAMETER	TEST CONDITIONS	TYP	UNIT
C _{pd} Power dissipation capacitance	C _L = 50 pF, f = 10 MHz	4.5	pF

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PARAMETER MEASUREMENT INFORMATION

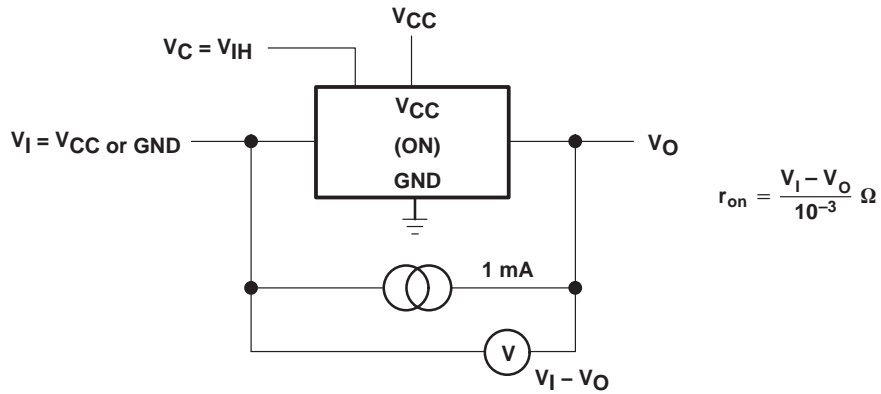


Figure 1. On-State Resistance Test Circuit

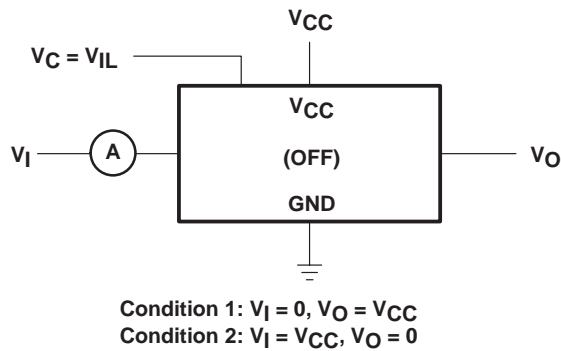


Figure 2. Off-State Switch Leakage-Current Test Circuit

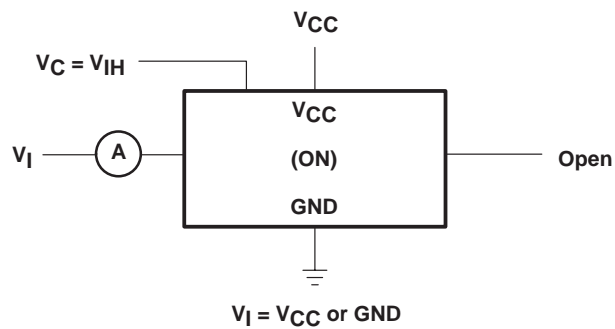
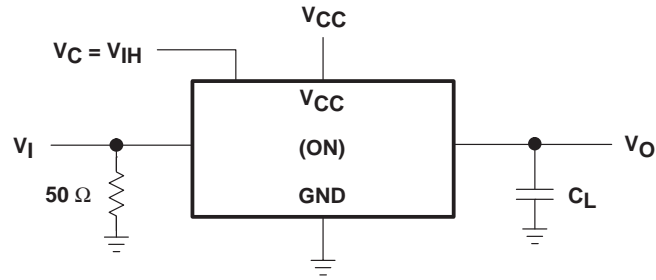


Figure 3. On-State Leakage-Current Test Circuit

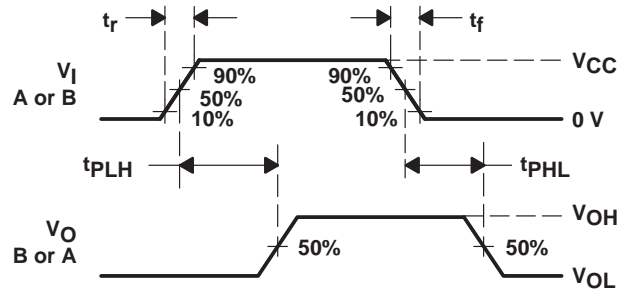
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PARAMETER MEASUREMENT INFORMATION



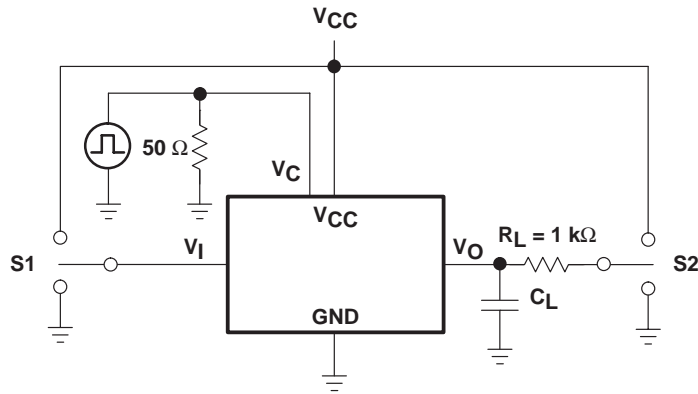
TEST CIRCUIT



VOLTAGE WAVEFORMS

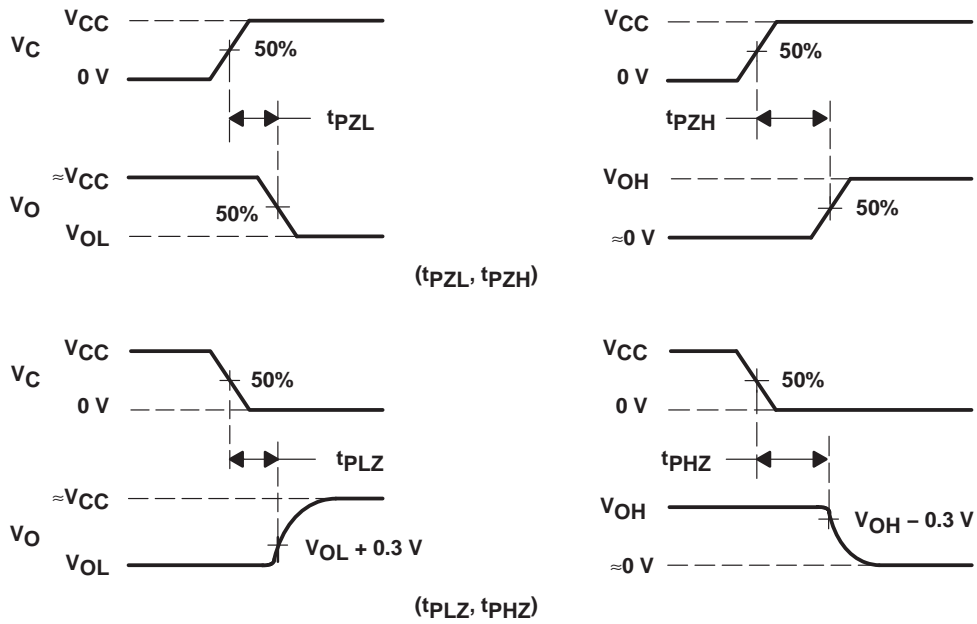
Figure 4. Propagation Delay Time, Signal Input to Signal Output

PARAMETER MEASUREMENT INFORMATION



TEST	S1	S2
t_{PZL}	GND	V_{CC}
t_{PZH}	V_{CC}	GND
t_{PLZ}	GND	V_{CC}
t_{PHZ}	V_{CC}	GND

TEST CIRCUIT



VOLTAGE WAVEFORMS

Figure 5. Switching Time (t_{PZL} , t_{PLZ} , t_{PZH} , t_{PHZ}), Control to Signal Output

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PARAMETER MEASUREMENT INFORMATION

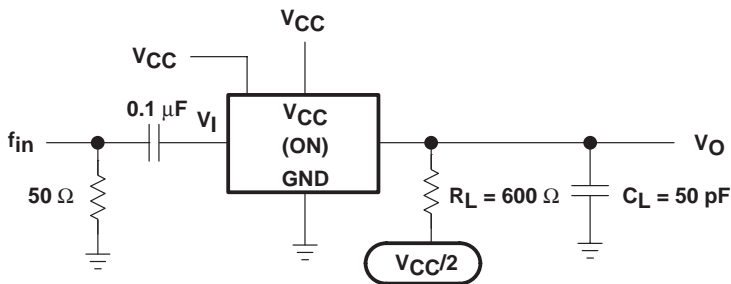


Figure 6. Frequency Response (Switch On)

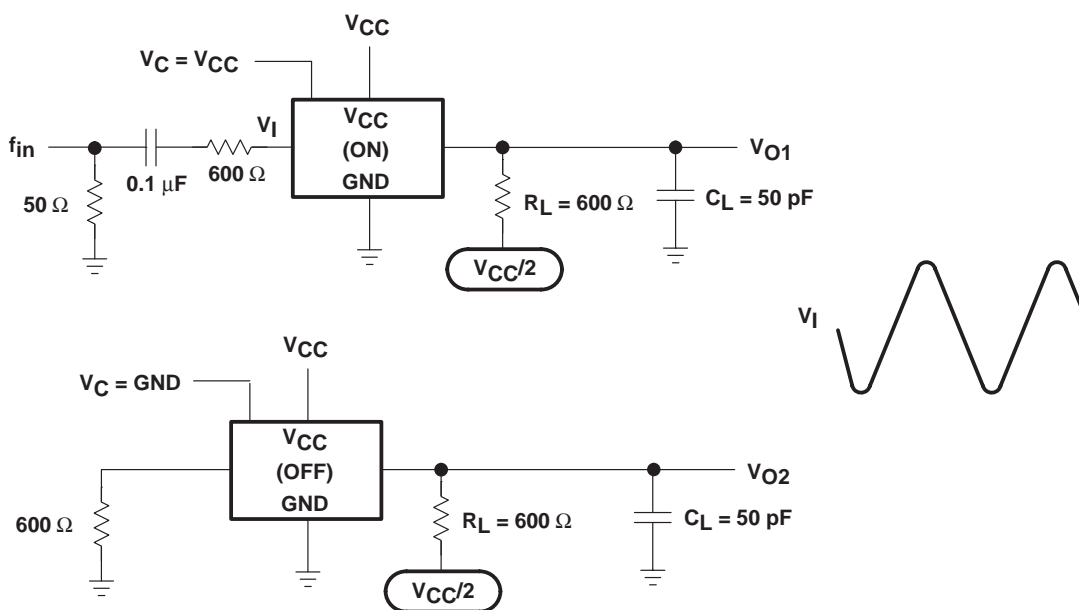


Figure 7. Crosstalk Between Any Two Switches

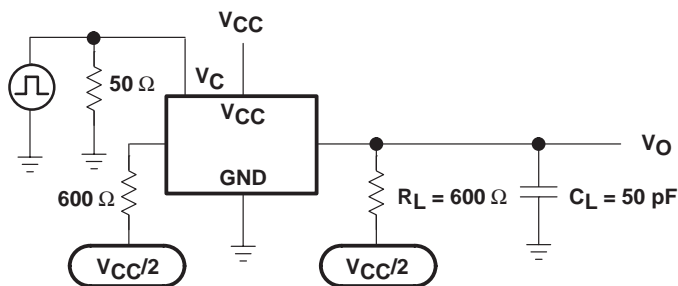


Figure 8. Crosstalk (Control Input – Switch Output)

PARAMETER MEASUREMENT INFORMATION

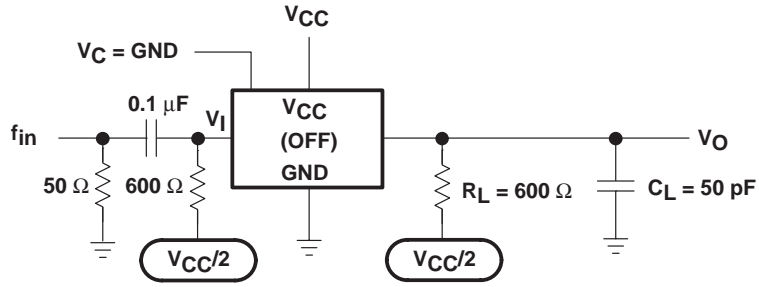


Figure 9. Feed-Through Attenuation (Switch Off)

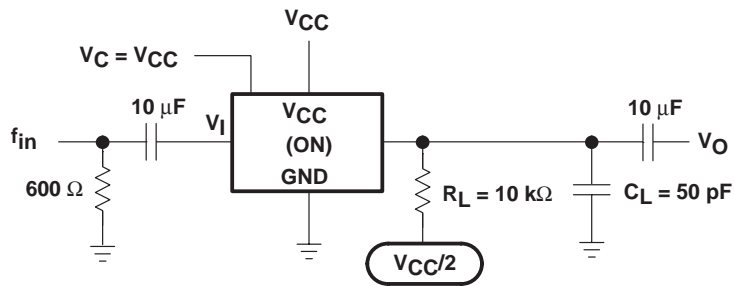


Figure 10. Sine-Wave Distortion

PACKAGING INFORMATION

Orderable Device	Status ⁽¹⁾	Package Type	Package Drawing	Pins	Package Qty	Eco Plan ⁽²⁾	Lead/Ball Finish	MSL Peak Temp ⁽³⁾
SN74LV4066AD	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LV4066ADBR	ACTIVE	SSOP	DB	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LV4066ADBRG4	ACTIVE	SSOP	DB	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LV4066ADE4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LV4066ADGVR	ACTIVE	TVSOP	DGV	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LV4066ADGVRE4	ACTIVE	TVSOP	DGV	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LV4066ADR	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LV4066ADRE4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LV4066AN	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN74LV4066ANE4	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type
SN74LV4066ANSR	ACTIVE	SO	NS	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LV4066ANSRE4	ACTIVE	SO	NS	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LV4066APW	ACTIVE	TSSOP	PW	14	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LV4066APWE4	ACTIVE	TSSOP	PW	14	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LV4066APWG4	ACTIVE	TSSOP	PW	14	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LV4066APWR	ACTIVE	TSSOP	PW	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LV4066APWRE4	ACTIVE	TSSOP	PW	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LV4066APWRG4	ACTIVE	TSSOP	PW	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LV4066APWT	ACTIVE	TSSOP	PW	14	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LV4066APWTE4	ACTIVE	TSSOP	PW	14	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LV4066APWTG4	ACTIVE	TSSOP	PW	14	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM
SN74LV4066ARGYR	ACTIVE	QFN	RGY	14	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1YEAR
SN74LV4066ARGYRG4	ACTIVE	QFN	RGY	14	1000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1YEAR

⁽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.

Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

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.

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N (R-PDIP-T**)

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



- NOTES:
- A. All linear dimensions are in inches (millimeters).
 - B. This drawing is subject to change without notice.
 - Falls within JEDEC MS-001, except 18 and 20 pin minimum body length (Dim A).
 - The 20 pin end lead shoulder width is a vendor option, either half or full width.

DGV (R-PDSO-G**)

PLASTIC SMALL-OUTLINE

24 PINS SHOWN

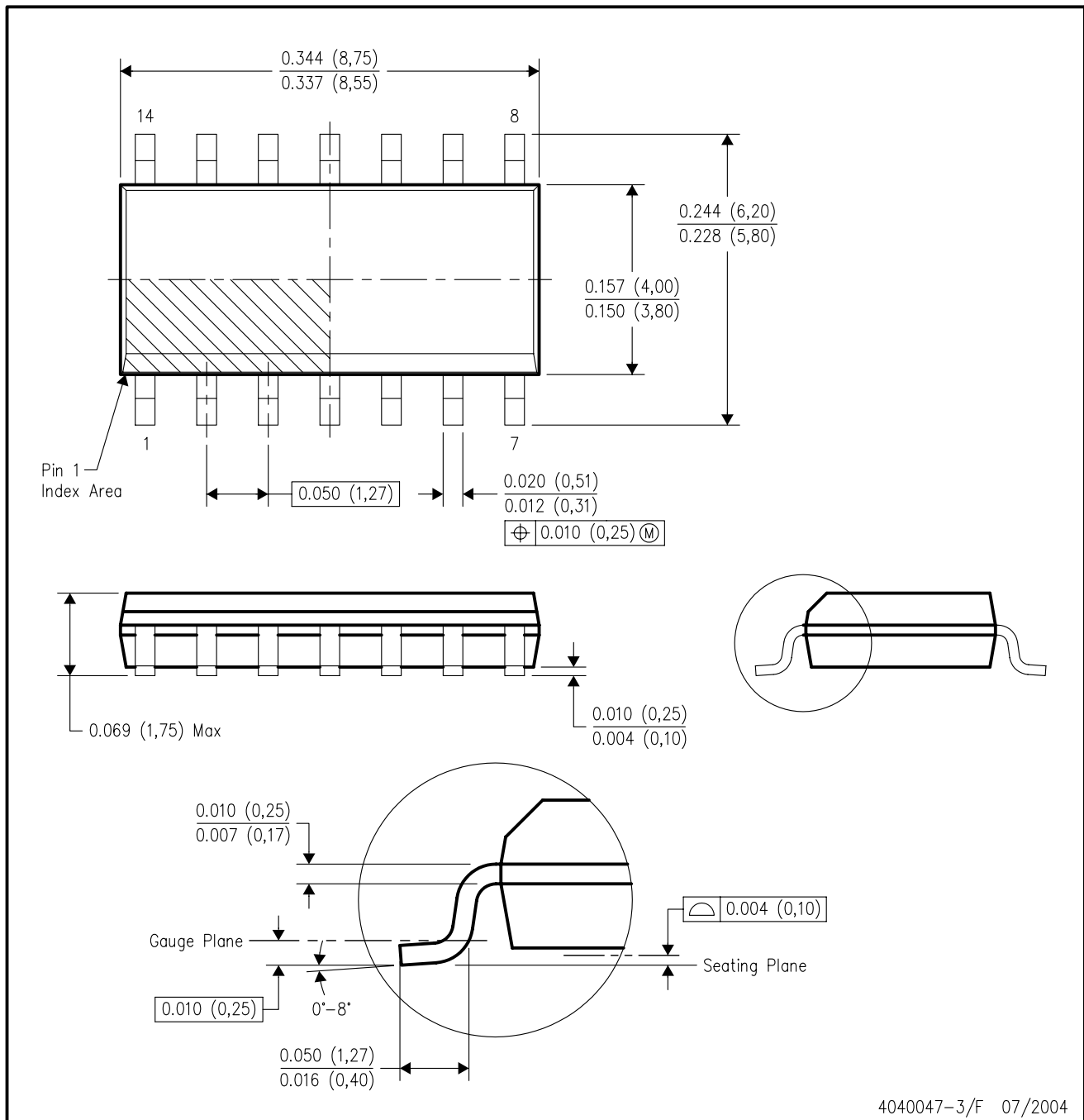


4073251/E 08/00

- 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 per side.
 D. Falls within JEDEC: 24/48 Pins – MO-153
 14/16/20/56 Pins – MO-194

D (R-PDSO-G14)

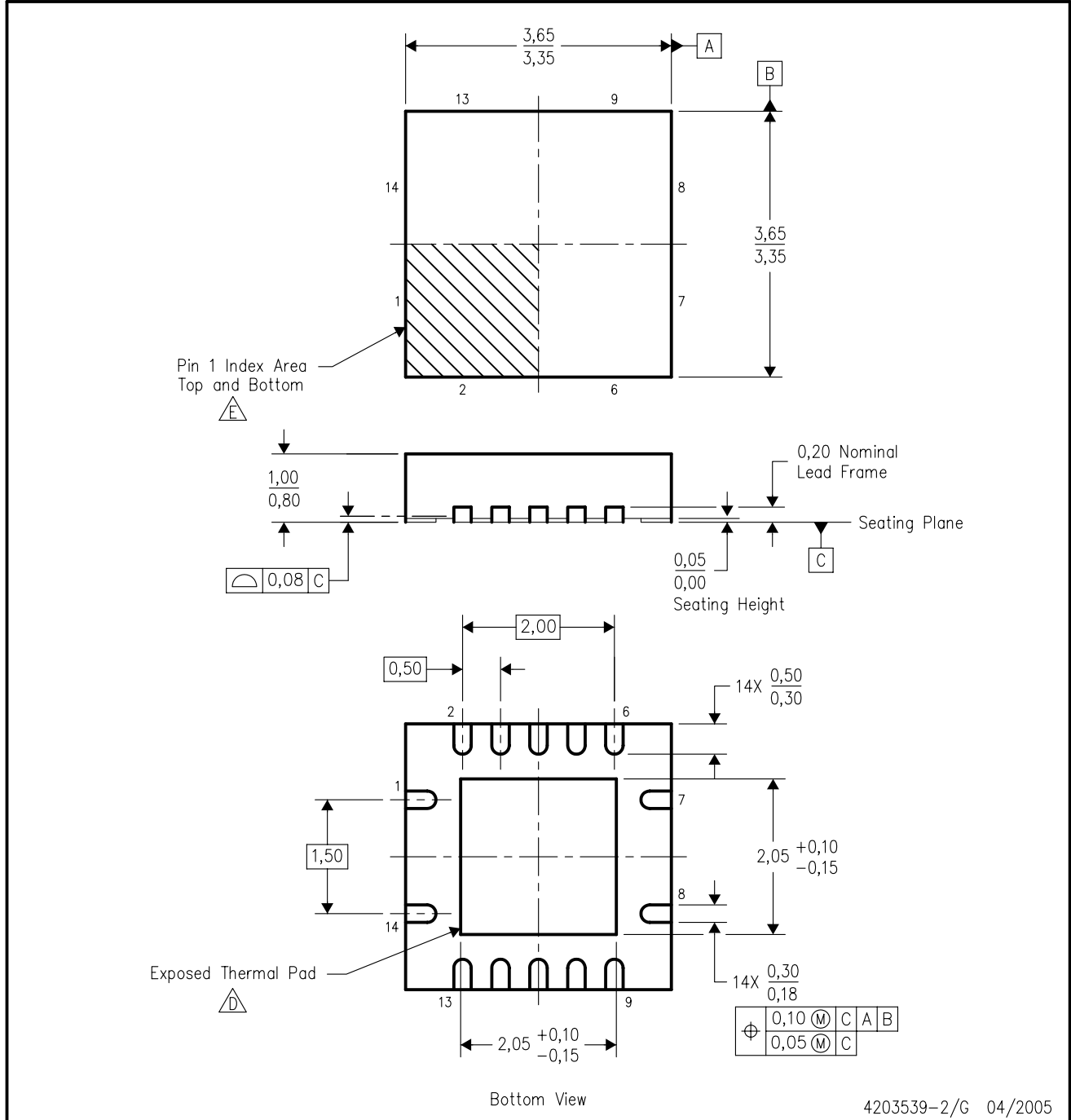
PLASTIC SMALL-OUTLINE PACKAGE



- 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).
 - D. Falls within JEDEC MS-012 variation AB.

RGY (S-PQFP-N14)

PLASTIC QUAD FLATPACK



- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
 - B. This drawing is subject to change without notice.
 - C. QFN (Quad Flatpack No-Lead) package configuration.
 - The package thermal pad must be soldered to the board for thermal and mechanical performance.
 - Pin 1 identifiers are located on both top and bottom of the package and within the zone indicated. The Pin 1 identifiers are either a molded, marked, or metal feature.
 - F. Package complies to JEDEC MO-241 variation BA.

MECHANICAL DATA

NS (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

14-PINS SHOWN



- 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.

DB (R-PDSO-G**)

PLASTIC SMALL-OUTLINE

28 PINS SHOWN



- 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

PW (R-PDSO-G**)

PLASTIC SMALL-OUTLINE PACKAGE

14 PINS SHOWN



4040064/F 01/97

- 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

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