SN74HC4066 QUADRUPLE BILATERAL ANALOG SWITCH

SCLS325G - MARCH 1996 - REVISED JULY 2003

- Wide Operating Voltage Range of 2 V to 6 V
- Typical Switch Enable Time of 18 ns
- Low Power Consumption, 20-μA Max I_{CC}
- Low Input Current of 1 μA Max
- High Degree of Linearity
- High On-Off Output-Voltage Ratio
- Low Crosstalk Between Switches
- Low On-State Impedance . . .
 50-Ω TYP at V_{CC} = 6 V
- Individual Switch Controls

D, DB, N, NS, OR PW PACKAGE (TOP VIEW) 14 🛮 V_{CC} 1A 1B 🛛 13 1 1C 2B **∏** 3 12 AC 11 4A 2A 🛮 4 2C 3C [6 9 3B GND [8∏ 3A

description/ordering information

The SN74HC4066 is a silicon-gate CMOS quadruple analog switch designed to handle both analog and digital signals. Each switch permits signals with amplitudes of up to 6 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.

ORDERING INFORMATION

TA	PACK	AGE†	ORDERABLE PART NUMBER	TOP-SIDE MARKING	
	PDIP – N	Tube of 25	SN74HC4066N	SN74HC4066N	
		Tube of 50	SN74HC4066D		
	SOIC - D	Reel of 2500	SN74HC4066DR	HC4066	
		Reel of 250	SN74HC4066DT		
-40°C to 85°C	SOP - NS	Reel of 2000	SN74HC4066NSR	HC4066	
	SSOP – DB	Reel of 2000	SN74HC4066DBR	HC4066	
		Tube of 90	SN74HC4066PW	HC4066	
	TSSOP – PW	Reel of 2000	SN74HC4066PWR		
		Reel of 250	SN74HC4066PWT		

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

FUNCTION TABLE (each switch)

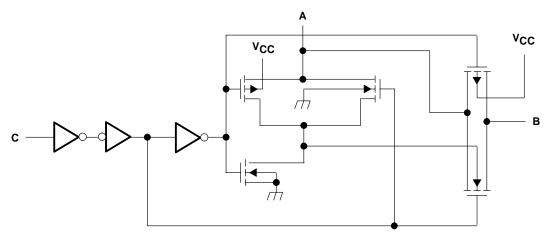
INPUT CONTROL (C)	SWITCH
L	OFF
Н	ON



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.



logic diagram, each switch (positive logic)



One of Four Switches

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
Control-input diode current, I_1 ($V_1 < 0$ or $V_1 > V_0$	CC)	±20 mA
I/O port diode current, $I_I (V_I < 0 \text{ or } V_{I/O} > V_{CC})$	·	±20 mA
On-state switch current ($V_{I/O} = 0$ to V_{CC})		±25 mA
Continuous current through V _{CC} or GND		
Package thermal impedance, θ _{JA} (see Note 2)): D package	86°C/W
	DB package	96°C/W
	N package	80°C/W
	NS package	76°C/W
	PW package	113°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. All voltages are with respect to ground unless otherwise specified.
 - 2. The package thermal impedance is calculated in accordance with JESD 51-7.



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recommended operating conditions (see Note 3)

			MIN	NOM	MAX	UNIT
Vcc	Supply voltage		2†	5	6	V
V _{I/O}	I/O port voltage		0		VCC	V
		V _{CC} = 2 V	1.5		VCC	
VIН	High-level input voltage, control inputs		3.15		VCC	V
		V _{CC} = 6 V	4.2		VCC	
		V _{CC} = 2 V	0		0.3	
VIL	Low-level input voltage, control inputs	V _{CC} = 4.5 V	0		0.9	V
		V _{CC} = 6 V	0		1.2	
		V _{CC} = 2 V			1000	
Δt/Δν	Input transition rise/fall time	V _{CC} = 4.5 V			500	ns
		VCC = 6 V			400	
TA	Operating free-air temperature		-40		85	°C

T With supply voltages at or near 2 V, the analog switch on-state resistance becomes very nonlinear. It is recommended that only digital signals be transmitted at these low supply voltages.

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

	PARAMETER		TEST CONDITIONS	\ , \	TA	\ = 25°C	;	MIN	MAX	UNIT
	PARAMETER		TEST CONDITIONS	VCC	MIN	TYP	MAX	IVIIIN	WAX	ONIT
			2 V		150					
ron	ron On-state switch resistance		$I_T = -1$ mA, $V_I = 0$ to V_{CC} , $V_C = V_{IH}$ (see Figure 1)	4.5 V		50	85		106	Ω
			VC = VIH (See Figure 1)	6 V		30				
	r _{on(p)} Peak on-state resistance			2 V		320				
r _{on(p)}			$V_I = V_{CC}$ or GND, $V_C = V_{IH}$, $I_T = -1$ mA	4.5 V		70	170		215	Ω
			11 - 1111/2	6 V		50				
Ιį	Control input current		$V_C = 0$ or V_{CC}	6 V		±0.1	±100		±1000	nA
I _{soff}	Off-state switch leakag	ge current	$V_I = V_{CC}$ or 0, $V_O = V_{CC}$ or 0, $V_C = V_{IL}$ (see Figure 2)	6 V			±0.1		±5	μΑ
I _{son}	On-state switch leakaç	ge current	V _I = V _{CC} or 0, V _C = V _{IH} (see Figure 3)	6 V			±0.1		±5	μΑ
Icc	Supply current		$V_I = 0$ or V_{CC} , $I_O = 0$	6 V			2		20	μΑ
C.	lanut conscitores	A or B		5 V	9					~F
Ci	Input capacitance	С		5 V		3	10		10	pF
Cf	Feed-through capacitance	A to B	V _I = 0			0.5				pF
Со	Output capacitance	A or B		5 V		9				pF

NOTE 3: 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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switching characteristics over recommended operating free-air temperature range

BAI	RAMETER	FROM	то	TEST	Vaa	Τ _Δ	(= 25°C	;	MIN	MAX	UNIT
FAI	RAMETER	(INPUT)	(OUTPUT)	CONDITIONS	Vcc	MIN	TYP	MAX	IVIIIN	IVIAA	UNIT
Ī.					2 V		10	60		75	
t _{PLH} ,	Propagation delay time	A or B	B or A	C _L = 50 pF (see Figure 4)	4.5 V		4	12		15	ns
'FIIL	dolay iiiilo			(See Figure 1)	6 V		3	10		13	
				$R_1 = 1 k\Omega$	2 V		70	180		225	
tPZH, tPZL	Switch turn-on time	С	A or B	$C_{L} = 50 pF$	4.5 V		21	36		45	ns
,PZL	(se	(see Figure 5)	6 V		18	31		38			
		$R_L = 1 \text{ k}\Omega$, $C_L = 50 \text{ pF}$	$R_1 = 1 k\Omega$.	2 V		50	50 200	250			
^t PLZ [,] ^t PHZ	t _{PLZ} , Switch tpuz turn-off time		A or B		4.5 V		25	40		50	ns
'PHZ	tarri on time				6 V		22	34		43	
	Control			$C_L = 15 \text{ pF},$ $R_I = 1 \text{ k}\Omega,$	2 V		15				
fĮ	input	С	A or B	$V_C = V_{CC}$ or GND,	4.5 V		30				MHz
	frequency			VO = VCC/2 (see Figure 6)	6 V		30				
	Control $R_{in} = R_L =$	$C_L = 50 \text{ pF},$ $R_{\text{in}} = R_L = 600 \Omega,$	4.5 V		15				mV		
feed-through noise	J	AUID	$V_C = V_{CC}$ or GND, $f_{in} = 1$ MHz (see Figure 7)	6 V		20	·		·	(rms)	

operating characteristics, V_{CC} = 4.5 V, T_A = 25°C

	PARAMETER	TEST C	TYP	UNIT	
C _{pd}	Power dissipation capacitance per gate	$C_L = 50 \text{ pF},$	f = 1 MHz	45	pF
	Minimum through bandwidth, A to B or B to A^{\dagger} [20 log (V_O/V_I)] = -3 dB	$C_L = 50 \text{ pF},$ $V_C = V_{CC}$	R _L = 600Ω , (see Figure 8)	30	MHz
	Crosstalk between any switches‡	C _L = 10 pF, f _{in} = 1 MHz	$R_L = 50 \Omega$, (see Figure 9)	45	dB
	Feed through, switch off, A to B or B to A [‡]	C _L = 50 pF, f _{in} = 1 MHz	R_L = 600 Ω, (see Figure 10)	42	dB
	Amplitude distortion rate, A to B or B to A	C _L = 50 pF, f _{in} = 1 kHz	R_L = 10 kΩ, (see Figure 11)	0.05%	

 $[\]uparrow$ Adjust the input amplitude for output = 0 dBm at f = 1 MHz. Input signal must be a sine wave.

[‡] Adjust the input amplitude for input = 0 dBm at f = 1 MHz. Input signal must be a sine wave.

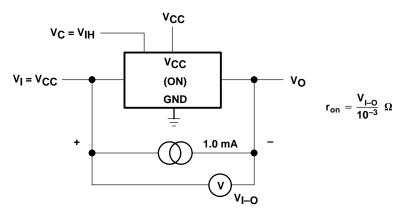


Figure 1. On-State Resistance Test Circuit

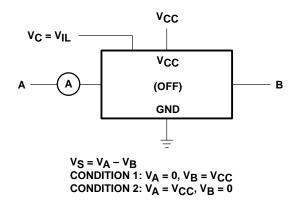


Figure 2. Off-State Switch Leakage-Current Test Circuit

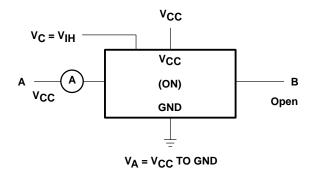


Figure 3. On-State Leakage-Current Test Circuit

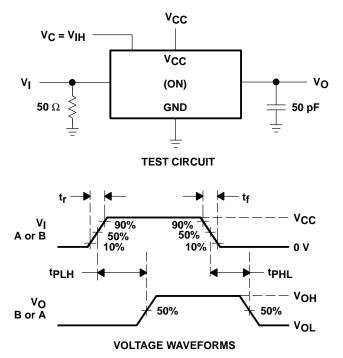
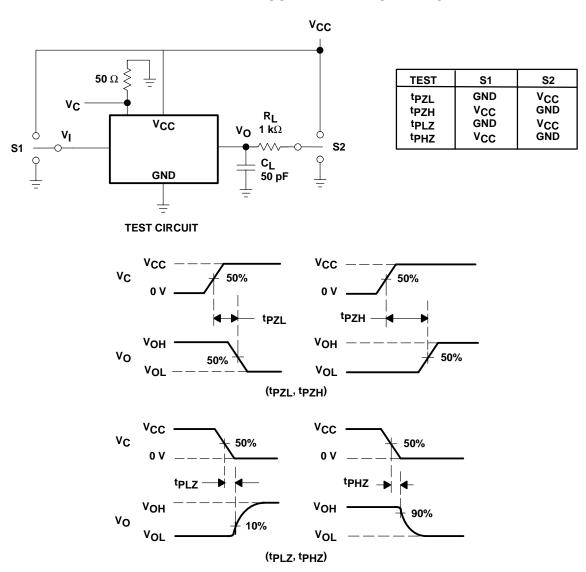


Figure 4. Propagation Delay Time, Signal Input to Signal Output



VOLTAGE WAVEFORMS

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

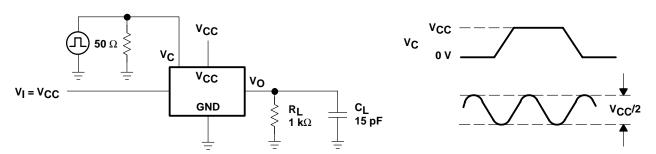


Figure 6. Control-Input Frequency

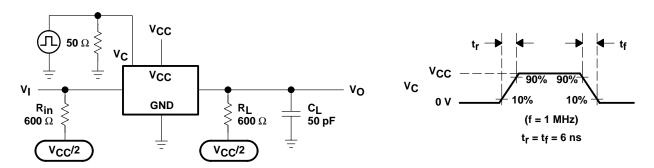


Figure 7. Control Feed-Through Noise

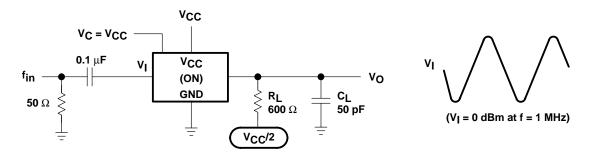


Figure 8. Minimum Through Bandwidth

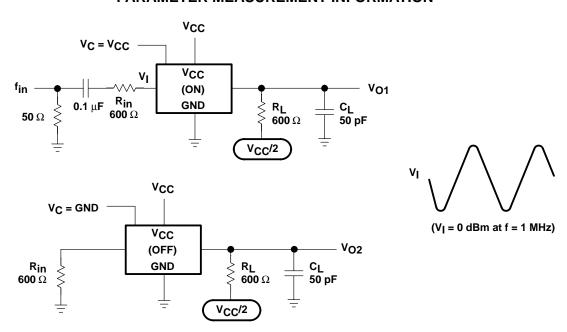


Figure 9. Crosstalk Between Any Two Switches

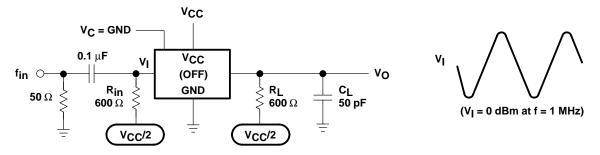


Figure 10. Feed Through, Switch Off

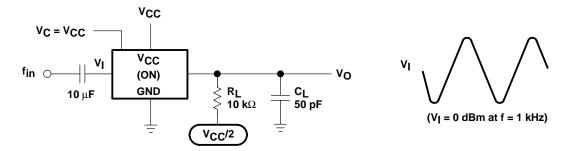


Figure 11. Amplitude-Distortion Rate





10-Jun-2014

PACKAGING INFORMATION

Orderable Device	Status	Package Type	Package Drawing	Pins	Package Qty	Eco Plan	Lead/Ball Finish	MSL Peak Temp	Op Temp (°C)	Device Marking (4/5)	Samples
SN74HC4066D	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	HC4066	Samples
SN74HC4066DBLE	OBSOLETE	SSOP	DB	14		TBD	Call TI	Call TI	-40 to 85		
SN74HC4066DBR	ACTIVE	SSOP	DB	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	HC4066	Samples
SN74HC4066DBRE4	ACTIVE	SSOP	DB	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	HC4066	Samples
SN74HC4066DG4	ACTIVE	SOIC	D	14	50	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	HC4066	Samples
SN74HC4066DR	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	HC4066	Samples
SN74HC4066DRE4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	HC4066	Samples
SN74HC4066DRG4	ACTIVE	SOIC	D	14	2500	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	HC4066	Samples
SN74HC4066DT	ACTIVE	SOIC	D	14	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	HC4066	Samples
SN74HC4066N	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	-40 to 85	SN74HC4066N	Samples
SN74HC4066NE4	ACTIVE	PDIP	N	14	25	Pb-Free (RoHS)	CU NIPDAU	N / A for Pkg Type	-40 to 85	SN74HC4066N	Samples
SN74HC4066NSR	ACTIVE	SO	NS	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	HC4066	Samples
SN74HC4066PW	ACTIVE	TSSOP	PW	14	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	HC4066	Samples
SN74HC4066PWG4	ACTIVE	TSSOP	PW	14	90	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	HC4066	Samples
SN74HC4066PWLE	OBSOLETE	TSSOP	PW	14		TBD	Call TI	Call TI	-40 to 85		
SN74HC4066PWR	ACTIVE	TSSOP	PW	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	HC4066	Samples
SN74HC4066PWRG4	ACTIVE	TSSOP	PW	14	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	HC4066	Samples
SN74HC4066PWT	ACTIVE	TSSOP	PW	14	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	HC4066	Samples



PACKAGE OPTION ADDENDUM

10-Jun-2014

(1) The marketing status values are defined as follows:

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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.
- (4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.
- (5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.
- (6) Lead/Ball Finish Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

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PACKAGE MATERIALS INFORMATION

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TAPE AND REEL INFORMATION

REEL DIMENSIONS



TAPE DIMENSIONS



A0	Dimension designed to accommodate the component width
В0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

TAPE AND REEL INFORMATION

*All dimensions are nominal

Device	Package Type	Package Drawing		SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
SN74HC4066DBR	SSOP	DB	14	2000	330.0	16.4	8.2	6.6	2.5	12.0	16.0	Q1
SN74HC4066DR	SOIC	D	14	2500	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1
SN74HC4066DT	SOIC	D	14	250	330.0	16.4	6.5	9.0	2.1	8.0	16.0	Q1
SN74HC4066NSR	SO	NS	14	2000	330.0	16.4	8.2	10.5	2.5	12.0	16.0	Q1
SN74HC4066PWR	TSSOP	PW	14	2000	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1
SN74HC4066PWT	TSSOP	PW	14	250	330.0	12.4	6.9	5.6	1.6	8.0	12.0	Q1

PACKAGE MATERIALS INFORMATION

www.ti.com 14-Jul-2012



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
SN74HC4066DBR	SSOP	DB	14	2000	367.0	367.0	38.0
SN74HC4066DR	SOIC	D	14	2500	367.0	367.0	38.0
SN74HC4066DT	SOIC	D	14	250	367.0	367.0	38.0
SN74HC4066NSR	SO	NS	14	2000	367.0	367.0	38.0
SN74HC4066PWR	TSSOP	PW	14	2000	367.0	367.0	35.0
SN74HC4066PWT	TSSOP	PW	14	250	367.0	367.0	35.0

N (R-PDIP-T**)

PLASTIC DUAL-IN-LINE PACKAGE

16 PINS SHOWN



- 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.



D (R-PDSO-G14)

PLASTIC SMALL OUTLINE



- A. All linear dimensions are in inches (millimeters).
- B. This drawing is subject to change without notice.
- Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.006 (0,15) each side.
- Body width does not include interlead flash. Interlead flash shall not exceed 0.017 (0,43) each side.
- E. Reference JEDEC MS-012 variation AB.



D (R-PDSO-G14)

PLASTIC SMALL OUTLINE



- A. All linear dimensions are in millimeters.
- B. This drawing is subject to change without notice.
- C. Publication IPC-7351 is recommended for alternate designs.
- D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
- E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.



PW (R-PDSO-G14)

PLASTIC SMALL OUTLINE



- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M—1994.
- B. This drawing is subject to change without notice.
- Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0,15 each side.
- Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.
- E. Falls within JEDEC MO-153



PW (R-PDSO-G14)

PLASTIC SMALL OUTLINE



- A. All linear dimensions are in millimeters.
- B. This drawing is subject to change without notice.
- C. Publication IPC-7351 is recommended for alternate designs.
- D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.
- E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.



MECHANICAL DATA

NS (R-PDSO-G**)

14-PINS SHOWN

PLASTIC SMALL-OUTLINE PACKAGE



- 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

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