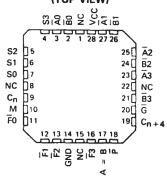
- Full Look-Ahead for High-Speed Operations on Long Words
- Input Clamping Diodes Minimize Transmission-Line Effects
- Darlington Outputs Reduce Turn-Off
   Time
- Arithmetic Operating Modes: Addition Subtraction Shift Operand A One Position Magnitude Comparison Plus Twelve Other Arithmetic Operations
- Logic Function Modes: Exclusive-OR Comparator AND, NAND, OR, NOR Plus Ten Other Logic Operations

SN54LS181	, SN54S181	•	J	OR V	V P	ACKAGE
SN74LS181,	SN74S181	• •	. D\	N OR	N	PACKAGE

	TOP (TOP)	VIEW)	
BO	d T	724	Vcc
Ão		23	Ā1
S3	[]3	22	Ā1 <b>B</b> 1 Ā2 <b>B</b> 2 <b>Ā3</b> <b>B</b> 3 <b>G</b>
S2	[]₄	21	Ā2
S1	[]5	20	<b>B</b> 2
S0	<b>[</b> 6	19	Ā3
Cn	[] <sup>1</sup>	18	<b>B</b> 3
м	<b>∐</b> 8	17	G
M F0 F1 F2	Ľ۹	16	<u>C</u> n + 4 P
F1	[]10	15	P
	יים	14	A ≃ B
GND	<u>[</u> 12	13	F3

#### SN54LS181, SN54S181... FK PACKAGE (TOP VIEW)



NC - No internal connection

#### TYPICAL ADDITION TIMES

NUMBER	ADDITI	ON TIMES	PA	CKAGE COUNT	CARRY METHOD
OF BITS	USING 'LS181 AND 'S182	USING 'S181 AND 'S182	ARITHMETIC/ LOGIC UNITS	LOOK-AHEAD CARRY GENERATORS	BETWEEN ALUs
1 to 4	24 ns	11 ns	1		NONE
5 to 8	40 ns	18 ns	2		RIPPLE
9 to 16	44 ns	19 ns	3 or 4	1	FULL LOOK-AHEAD
17 to 64	68 ns	28 ns	5 to 16	2 to 5	FULL LOOK-AHEAD

### description

The 'LS181 and 'S181 are arithmetic logic units (ALU)/function generators that have a complexity of 75 equivalent gates on a monolithic chip. These circuits perform 16 binary arithmetic operations on two 4-bit words as shown in Tables 1 and 2. These operations are selected by the four function-select lines (S0, S1, S2, S3) and include addition, subtraction, decrement, and straight transfer. When performing arithmetic manipulations, the internal carries must be enabled by applying a low-level voltage to the mode control input (M). A full carry look-ahead scheme is made available in these devices for fast, simultaneous carry generation by means of two cascade-outputs (pins 15 and 17) for the four bits in the package. When used in conjunction with the SN54S182 or SN74S182 full carry look-ahead circuits, high-speed arithmetic operations can be performed. The typical addition times shown above illustrate the little additional time required for addition of longer words when full carry look-ahead is employed. The method of cascading 'S182 circuits with these ALUs to provide multi-level full carry look-ahead is illustrated under typical applications data for the 'S182.

If high speed is not of importance, a ripple-carry input ( $C_n$ ) and a ripple-carry output ( $C_{n+4}$ ) are available. However, the ripple-carry delay has also been minimized so that arithmetic manipulations for small word lengths can be performed without external circuitry.

PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.



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### description (continued)

The 'LS181 and 'S181 will accommodate active-high data if the pin designations are interpreted as follows:

PIN NUMBER	2	1	23	22	21	20	19	18	9	10	11	13	7	16	15	17
Active-low data (Table 1)	Ā <sub>0</sub>	Bo	Ā1	B <sub>1</sub>	Ā2	B <sub>2</sub>	Ā3	B <sub>3</sub>	Ē٥	F <sub>1</sub>	F <sub>2</sub>	F3	Cn	C <sub>n+4</sub>	P	Ğ
Active-high data (Table 2)	A <sub>0</sub>	BO	A <sub>1</sub>	B1	A <sub>2</sub>	B <sub>2</sub>	A <sub>3</sub>	B3	FO	F <sub>1</sub>	F2	F3	Ē'n	Cn+4	Х	Y

Subtraction is accomplished by 1's complement addition where the 1's complement of the subtrahend is generated internally. The resultant output is A-B-1, which requires an end-around or forced carry to provide A-B.

The 'LS181 or 'S181 can also be utilized as a comparator. The A = B output is internally decoded from the function outputs (F0, F1, F2, F3) so that when two words of equal magnitude are applied at the A and B inputs, it will assume a high level to indicate equality (A = B). The ALU must be in the subtract mode with  $C_n = H$  when performing this comparison. The A = B output is open-collector so that it can be wire-AND connected to give a comparison for more than four bits. The carry output (Cn + 4) can also be used to supply relative magnitude information. Again, the ALU must be placed in the subtract mode by placing the function select inputs S3, S2, S1, S0 at L, H, H, L, respectively.

INPUT Cn	OUTPUT C <sub>n+4</sub>	ACTIVE-LOW DATA (FIGURE 1)	ACTIVE-HIGH DATA (FIGURE 2)
Н	н	A ≥ B	A < B
н	L	A < 8	A > B
L	н	A > B	A < B
L	L	A ≤ B	A ≥ B

These circuits have been designed to not only incorporate all of the designer's requirements for arithmetic operations, but also to provide 16 possible functions of two Boolean variables without the use of external circuitry. These logic functions are selected by use of the four function-select inputs (S0, S1, S2, S3) with the mode-control input (M) at a high level to disable the internal carry. The 16 logic functions are detailed in Tables 1 and 2 and include exclusive-OR, NAND, AND, NOR, and OR functions.

Series 54, 54LS, and 54S devices are characterized for operation over the full military temperature range of -55 °C to 125°C; Series 74LS and 74S devices are characterized for operation from 0°C to 70°C.

#### signal designations

In both Figures 1 and 2, the polarity indicators ( $\square$ ) indicate that the associated input or output is active-low with respect to the function shown inside the symbol, and the symbols are the same in both figures. The signal designations in Figure 1 agree with the indicated internal functions based on active-low data, and are for use with the logic functions and arithmetic operations shown in Table 1. The signal designations have been changed in Figure 2 to accommodate the logic functions and arithmetic operations for the active-high data given in Table 2. The 'LS181 and 'S181, together with the 'S182, can be used with the signal designation of either Figure 1 or Figure 2.



### SN54LS181, SN54S181 SN74LS181, SN74S181 ARITHMETIC LOGIC UNITS/FUNCTION GENERATORS SDLS136 – DECEMBER 1972 – REVISED MARCH 1988

'S182 'LS181 OR 'S181 CPG ALU C<sub>n</sub> (1) S0<u>(6)</u> S1<u>(5)</u> CI 0 PO (3) (15) P (0...15) CP CP0 \$2<sup>(4)</sup>  $M \frac{0}{31}$ (17) G G0 (2) CGO (0...15) CG \$3<sup>(3)</sup> (14) A = B P1 (5) 6(P=Q) CP1 <u>G</u>1 (4)  $(16) C_{n+4}$ M(8) Cn(7) CG1 4 (0...15) CO P2 (8) (6) Cn + 8 CI CP1 CO1 G2(7) CG2 P3(10)  $\overline{A0}\frac{(2)}{\overline{B0}}$ (11) Cn+16 (9) F0 Ρ CP3 1 CO3 [1] <u>G</u>3<sup>(9)</sup> Q  $\overline{\overline{A}1}\frac{(23)}{(22)}$   $\overline{B1}\frac{(23)}{(22)}$ CG3  $(17) C_{n+24}$ P4(14) Ρ (10) F1 [2] CP4 CO5  $\overline{G4}^{(13)}$ Ā2(21) Q CG4 B2(20) Ρ (11) F2 P5(16) (22) Cn + 32 [4] CP5 C07 Q A3(19) G5(15) (13) F3 Ρ CG5 B3(18) P6(19) [8] Q CP6 <u>G</u>6<sup>(18)</sup> CG6 P7 (21) CP7 G7<sup>(20)</sup> CG7

### logic symbols<sup>†</sup> and signal designations (active-low data)

<sup>†</sup>These symbols are in accordance with ANSI/IEEE Std. 91-1984 and IEC Publication 617-12. Pin numbers shown are for dual-in-line and "small outline" packages.

### FIGURE 1 (USE WITH TABLE 1)

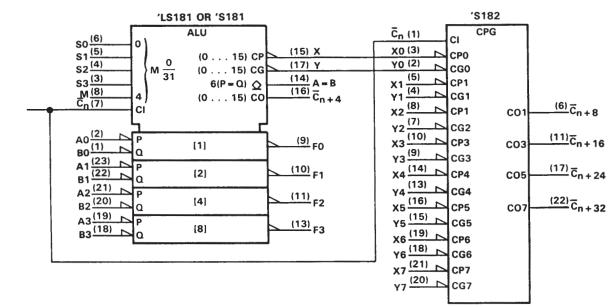
т	۰Δ	R	t.	F	1
	~	2	-	-	

					ACTIVE-LOW DA	ТА
	SELE	CTION		M = H	M = L; ARITHM	ETIC OPERATIONS
				LOGIC	Cn = L	Cn = H
S3	S2	S1	S0	FUNCTIONS	(no carry)	(with carry)
L	L	L	L	F=A	F = A MINUS 1	F = A
L	L	L	н	F = AB	F = AB MINUS 1	F = AB
ι L	L	н	L	F = A + B	$F = A\overline{B}$ MINUS 1	F = AB
L L	L	н	н	F = 1	F = MINUS 1 (2's COMP)	F = ZERO
L	н	L	L	$F = \overline{A + B}$	F = A PLUS (A + B)	F = A PLUS (A + B) PLUS 1
L	н	L	н	F = B	$F = AB PLUS (A + \overline{B})$	$F = AB PLUS (A + \overline{B}) PLUS 1$
L	н	н	L	$F = \overline{A \oplus B}$	F = A MINUS B MINUS 1	F = A MINUS B
L	н	н	н	$F = A + \overline{B}$	$F = A + \overline{B}$	$F = (A + \overline{B}) PLUS 1$
н	L	L	L	F = AB	F = A PLUS (A + B)	F = A PLUS (A + B) PLUS 1
н	L	L	н	F = A ⊕ B	F = A PLUS B	F = A PLUS B PLUS 1
н	L	н	L	F=B	F = AB PLUS (A + B)	F = AB PLUS (A + B) PLUS 1
Н	L	н	н	F = A + B	F = (A + B)	F = (A + B) PLUS 1
Н	н	L	L	F=0	$F = A PLUS A^{\ddagger}$	F = A PLUS A PLUS 1
н	н	L	н	F ≕ AB	F = AB PLUS A	F = AB PLUS A PLUS 1
Н	н	н	L	F = AB	F = AB PLUS A	F = AB PLUS A PLUS 1
н	н	н	н	F=A	F = A	F = A PLUS 1

<sup>‡</sup>Each bit is shifted to the next more significant position.



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### logic symbols<sup>†</sup> and signal designations (active-high data)

<sup>†</sup>These symbols are in accordance with ANSI/IEEE Std. 91-1984 and IEC Publication 617-12. Pin numbers shown are for dual-in-line and "small outline" packages.

### FIGURE 2 (USE WITH TABLE 2)

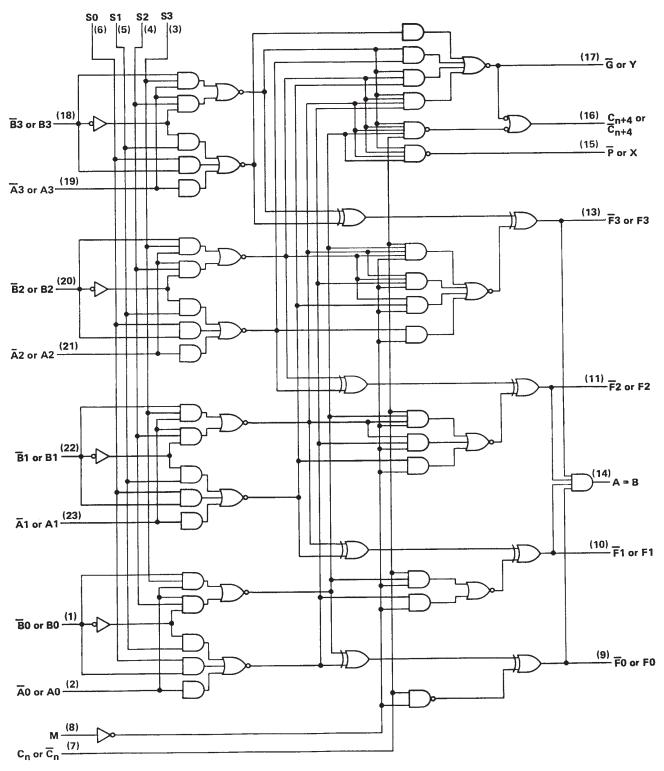
#### TABLE 2

	051.5	OTION			ACTIVE-HIGH DA	ТА
	SELE	CTION		M = H	M = L; ARITHM	ETIC OPERATIONS
<b>S</b> 3	S2	S1	S0	LOGIC	<mark>C</mark> n = H (no carry)	<mark>¯C</mark> n ≕ L (with carry)
L	L	L	L	$F = \overline{A}$	F = A	F = A PLUS 1
L	L	L	н	$F = \overline{A + B}$	F = A + B	F = (A + B) PLUS 1
L	L	н	L	F = AB	$F = A + \overline{B}$	$F = (A + \overline{B}) PLUS 1$
L	L	н	н	F = 0	F = MINUS 1 (2's COMPL)	F = ZERO
L	н	L	L	$F = \overline{AB}$	F = A PLUS AB	F = A PLUS AB PLUS 1
L	н	L	н	F = B	F = (A + B) PLUS AB	F = (A + B) PLUS AB PLUS 1
L	н	н	L	F = A 🕀 B	F = A MINUS B MINUS 1	F = A MINUS B
L	н	н	н	F = AB	F = AB MINUS 1	$F = \overline{AB}$
н	L	L	L	F = A + B	F = A PLUS AB	F = A PLUS AB PLUS 1
н	L	L	н	F = A 🕀 B	F = A PLUS B	F = A PLUS B PLUS 1
н	L	н	L	F = B	F = (A + B) PLUS AB	F = (A + B) PLUS AB PLUS 1
н	L	н	н	F = AB	F = AB MINUS 1	F = AB
н	н	L	L	F = 1	F = A PLUS A <sup>†</sup>	F = A PLUS A PLUS 1
н	н	L	н	$F = A + \overline{B}$	F = (A + B) PLUS A	F = (A + B) PLUS A PLUS 1
н	н	н	L	F = A + B	$F = (A + \overline{B}) PLUS A$	$F = (A + \overline{B}) PLUS A PLUS 1$
н	н	н	н	F=A	F = A MINUS 1	F = A

<sup>†</sup> Each bit is shifted to the next more significant position.



### logic diagram (positive logic)



Pin numbers shown are for DW, J, N, and W packages.



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absolute maximum ratings over reco	on	nm	en	nde	ed	ор	er	ati	ing	j fi	ree	)-a	ir :	ter	np	er	at	ur	e r	ar	Ige	e (1	un	le	<b>S</b> S	ot	he	rw	ise	n	oted)	
Supply voltage, V <sub>CC</sub> (see Note 1)						•											•											•			7 V	
Input voltage														•	•												•	•			5.5 V	
Interemitter voltage (see Note 2)																																
Operating free-air temperature range																																
																															70°C	
Storage temperature range	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		-6	۶°ئ	C t	<b>o</b> 1	150°C	

NOTES: 1. Voltage values, except interemitter voltage, are with respect to network ground terminal.

2. This is the voltage between two emitters of a multiple-emitter transistor. For this circuit, this rating applies to each A input in conjunction with inputs S2 or S3, and to each  $\vec{B}$  input in conjunction with inputs S0 or S3.

recommended operating conditions

	SI	N54LS1	81	SM	174LS1	81	
	MIN	NOM	MAX	MIN	NOM	MAX	רואט
Supply voltage, V <sub>CC</sub>	4.5	5	5.5	4.75	5	5.25	V
High-level output current, IOH (All outputs except A = B)			-400			-400	μA
Low-level output current, IOL			4			8	mA
Operating free-air temperature, T <sub>A</sub>	-55		125	0		70	°C

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

	DADA	METER	TEC	T CONDITIONS	.t	SI	154LS1	81	S	N74LS1	81	
	FANAI	VIETER	153	CONDITIONS		MIN	TYP <sup>‡</sup>	MAX	MIN	TYP‡	MAX	UNIT
VIH	High-level in	nput voltage				2			2			V
VIL	Low-level in	put voltage						0.7			0.8	V
VIK	Input clamp	voltage	V <sub>CC</sub> = MIN,	I <sub>I</sub> = -18 mA				-1.5			-1.5	V
Vон		utput voltage, except A = B	V <sub>CC</sub> = MIN, V <sub>IL</sub> = V <sub>IL</sub> max,			2.5	3.4		2.7	3.4		v
юн		utput current,	$V_{CC} = MIN,$ $V_{1L} = V_{1L} max,$	V <sub>IH</sub> = 2 V,	·			100			100	μA
				VOH 0.5 V	IOL = 4 mA		0.25	0.4		0.25	0.4	-
VOL	Low-level output	All outputs	V <sub>CC</sub> = MIN,	V <sub>IH</sub> = 2 V,	IOL = 8 mA					0.35	0.5	v
•OL	voltage	Output G	VIL = VIL max		I <sub>OL</sub> = 16 mA		0.47	0.7		0.47	0.7	v
	vortage	Output P			IOL = 8 mA		0.35	0.6		0.35	0.5	
	Input	Mode input						0.1			0.1	
ų.	current at	Any A or B input	V <sub>CC</sub> = MAX,	V. = 5 5 V				0.3			0.3	
1	max. input	Any S input		v] = 5.5 v				0.4			0.4	mA
	voltage	Carry input						0.5			0.5	
	High-level	Mode input						20			20	
цн	input	Any $\overline{A}$ or $\overline{B}$ input	V <sub>CC</sub> = MAX,	$V_1 = 2.7 V$				60			60	μA
.111	current	Any S input		• [ - 2.7 •				80			80	μA
	burrent	Carry input						100			100	
	Low-level	Mode input						-0.4			-0.4	
hε	input	Any A or B input	V <sub>CC</sub> = MAX,	$V_{1} = 0.4 V$				-1.2			-1.2	mA
.16	current	Any S input		1 0.41				-1.6			-1.6	
		Carry input						-2			-2	1
los		t output current, except A = B §	V <sub>CC</sub> = MAX			-6		40	-5		-42	mA
Icc	Supply curre	ent	V <sub>CC</sub> = MAX,	See Note 3	Condition A		20	32		20	34	mA
					Condition B		21	35		21	37	

<sup>†</sup>For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

<sup>‡</sup>All typical values are at  $V_{CC} = 5 V$ ,  $T_A = 25^{\circ}C$ .

§Not more than one output should be shorted at a time.

NOTE 3: With outputs open,  $I_{CC}$  is measured for the following conditions:

A. S0 through S3, M, and A inputs are at 4.5 V, all other inputs are grounded.

B. S0 through S3 and M are at 4.5 V, all other inputs are grounded.



# SN54LS181, SN54S181 SN74LS181, SN74S181 ARITHMETIC LOGIC UNITS/FUNCTION GENERATORS SDLS136 – DECEMBER 1972 – REVISED MARCH 1988

PARAMETER <sup>†</sup>	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	түр	мах	UNIT
<sup>t</sup> PLH	C				18	27	ns
<sup>t</sup> PHL	Cn	C <sub>n+4</sub>			13	20	113
<sup>t</sup> PLH	Any A or B	6	M = 0 V, S0 = S3 = 4.5 V,		25	38	ns
<sup>t</sup> PHL	Any A or B	C <sub>n+4</sub>	S1 = S2 = 0 V (SUM mode)		25	38	113
<sup>t</sup> PLH	Any Ā or B		M = 0 V, S0 = S3 = 0 V		27	41	ns
<sup>t</sup> PHL	Any A or B	C <sub>n+4</sub>	S1 = S2 = 4.5 V (DIFF mode)		27	41	] '''
<sup>t</sup> PLH	<u> </u>	A F	M = 0 V		17	26	ns
<sup>t</sup> PHL	C <sub>n</sub>	Any F	(SUM or DIFF mode)		13	20	115
tPLH		G	M = 0 V, S0 = S3 = 4.5 V,		19	29	
tPHL	Any A or B		S1 = S2 = 0 V (SUM mode)		15	23	ns
<sup>t</sup> PLH		Ğ	M = 0 V, S0 = S3 = 0 V,		21	32	
<sup>t</sup> PHL	Any A or B	G	S1 = S2 = 4.5 V (DIFF mode)		21	32	ns
<sup>t</sup> PLH		ব	M = 0 V, S0 = S3 = 4.5 V,		20	30	
tPHL	Any A or B	٢	S1 = S2 = 0 V, (SUM mode)		20	30	ns
tPLH			M = 0 V, S0 = S3 = 0 V,	1	20	30	
tPHL	Any A or B	P	S1 = S2 = 4.5 V (DIFF mode)		22	33	ns
tPLH	7 5	=	M = 0 V, S0 = S3 = 4.5 V,		21	32	
<sup>t</sup> PHL	Ā <sub>i</sub> or Ē <sub>i</sub>	Fi	S1 = S2 = 0 V (SUM mode)		13	20	ns
tPLH	<b>T D</b>		M = 0 V, S0 = S3 = 0 V,		21	32	
tPHL.	Ā <sub>i</sub> or B <sub>i</sub>	Fi	S1 = S2 = 4.5 V (DIFF mode)		21	32	ns
tPLH	7 7	7			22	33	
tPHL.	Ā; or B;	Fi	M = 4.5 V (logic mode)		26	38	ns
<sup>t</sup> PLH			M = 0 V, S0 = S3 = 0 V,	1	33	50	-
<sup>t</sup> PHL	Any Ā or B	A = B	S1 = S2 = 4.5 V (DIFF mode)		41	62	ns

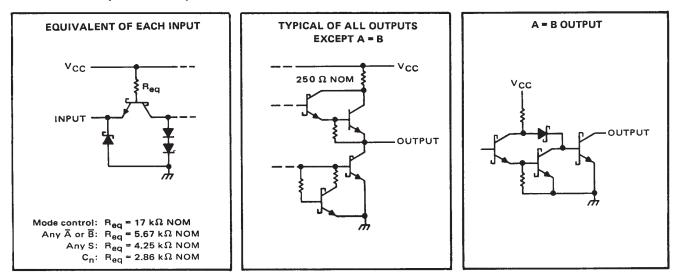
### switching characteristics, V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C, (C<sub>L</sub> = 15 pF, R<sub>L</sub> = 2 k $\Omega$ , see note 4)

<sup>†</sup>tpLH = propagation delay time, low-to-high-level output

tpHL = propagation delay time, high-to-low-level output

NOTE 4: Load circuits and voltage wveforms are shown in Section 1. Refer to Parameter Measurement Information page for test conditions.

### schematics of inputs and outputs





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

Supply voltage, V <sub>CC</sub> (see Note	1)															•		. 7	V
Input voltage															•	•		. 5.5	V
Interemitter voltage (see Note 2																		. 5.5	V
Operating free-air temperature:	SN54S181											•				5!	5°C 1	to 125`	С
	SN74S181																0°C	; to 70	C
Storage temperature range				•			•	•	•	•	•		·	•		-6	5°C 1	to 150	°C

NOTES: 1. Voltage values, except interemitter voltage, are with respect to network ground terminal.

2. This is the voltage between two emitters of a multiple emitter transistor. For this circuit, this rating applies to each A input in conjunction with inputs S2 or S3, and to each  $\overline{B}$  input in conjunction with inputs S0 or S3.

#### recommended operating conditions

	S	SN54S181					UNIT
	MIN	NOM	MAX	MIN	NOM	MAX	
Supply voltage, V <sub>CC</sub>	4.5	5	5.5	4.75	5	5.25	V
High-level output current, IOH (All outputs except A = B)			-1			-1	mA
Low-level output current, IOI			20			20	mA
Operating free-air temperature, TA	-55		125	0		70	°C

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

					+	S	SN54S18	31	5	UNIT		
	PARAN	IETER	TE	ST CONDITIONS	1	MIN	TYP‡	MAX	MIN	түр‡	MAX	UNIT
VIH	High-level in	put voltage				2			2			V
VIL	Low-level in							0.8			0.8	V
VIK	Input clamp	voltage	V <sub>CC</sub> = MIN,	l <sub>l</sub> = -18 mA				-1.2			-1.2	V
	High-level output voltage,			V <sub>IH</sub> = 2 V,		0.5	2.4		2.7	3.4		v
Vон	$H_{any output except A = B}$		V <sub>IL</sub> = 0.8 V,	IOH = -1 mA		2.5	3.4		2.1	3.4		v
	High-level o	utput current,	V <sub>CC</sub> = MIN,	V <sub>IH</sub> = 2 V,				250			250	μA
юн	OH A = B output only		V <sub>1L</sub> = 0.8 V,	V <sub>OH</sub> = 5.5 V				250			200	μ <u>η</u>
			V <sub>CC</sub> = MIN,	V <sub>IH</sub> = 2 V,				0.5			0.5	v
VOL	OL Low-level output voltage		V <sub>IL</sub> = 0.8 V,	l <sub>OL</sub> = 20 mA				0.5				
	Input current at maximum input voltage			Vi = 5.5 V				1			1	mA
ų –			V <sub>CC</sub> = MAX,	v] - 5.5 v		<u> </u>					•	<u> </u>
		Mode input		······································				50			50	
	High-level	Any Ā or B input	V <sub>CC</sub> = MAX,	V 2 E V				150			150	μA
ΙΗ	input	Any S input		v  - 2.5 v				200			200	
	current	Carry input	1				250			250		
		Mode input						-2			-2	
	Low-level	Any A or B input		Vi = 0.5 V				-6			-6	I mA
41	input	Any S input	V <sub>CC</sub> = MAX,	VI ~ 0.5 V				8			-8	
	current Carry input							-10	-10			]
1	Short-circui	t output current,	V <sub>CC</sub> = MAX			-40		-100	-40		100	mA
los	any output	except A = B §							ļ			
	<u> </u>		V <sub>CC</sub> = MAX,	T <sub>A</sub> = 125°C,	W package			195				
ICC Supply current		rent	See Note 3		only							mA
			$V_{CC} = MAX,$	See Note 3	All packages		120	220		120	220	

<sup>†</sup>For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

‡All typical values are at  $V_{CC} = 5 V$ ,  $T_A = 25^{\circ}C$ .

§Not more than one output should be shorted at a time.

NOTE 3: I<sub>CC</sub> is measured for the following conditions (the typical and maximum values apply to both):

A. S0 through S3, M, and A inputs are at 4.5 V, all other inputs are grounded, and all outputs are open.

B. S0 through S3 and M are at 4.5 V, all other inputs grounded, and all outputs are open.



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PARAMETER <sup>†</sup>	FROM (INPUT)	TO (OUTPUT)	TEST CONDITIONS	MIN	TYP	MAX	UNI
tPLH	0	6			7	10.5	ns
<sup>t</sup> PHL	C <sub>n</sub>	C <sub>n+4</sub>			7	10.5	
tPLH	A	C	M = 0 V, S0 = S3 = 4.5 V,		12.5	18.5	ns
tPHL	Any Ā or B	C <sub>n+4</sub>	S1 = S2 = 0 V (SUM mode)		12.5	18.5	
tPLH	Any Ā or B	C	M = 0 V, S0 = S3 = 0 V,		15.5	23	ns
tPHL	AnyAOrb	C <sub>n+4</sub>	S1 = S2 = 4.5 V (DIFF mode)		15.5	23	
tPLH	0	Any F	M = 0 V		7	12	ns
tPHL	- C <sub>n</sub>	Anyr	(SUM or DIFF mode)		7	12	
tPLH	A 7 7	ō	M = 0 V, S0 = S3 = 4.5 V,		8	12	ns
tPHL	- Any Ā or B	6	S1 = S2 = 0 V (SUM mode)		7.5	12	
tPLH		G	M = 0 V, S0 = S3 = 0 V,		10.5	15	ns
tPHL	Any Ā or B	G	$S1 = S2 = 4.5 V (\overline{DIFF} \text{ mode})$		10.5	15	
<sup>t</sup> PLH	A	P	M = 0 V, S0 = S3 = 4.5 V,		7.5	12	ns
tPHL	Any à or B	F	S1 = S2 = 0 V (SUM mode)		7.5	12	
tPLH		Ŧ	M = 0 V, S0 = S3 = 0 V,		10.5	15	ns
tPHL	Any Ā or B	F	S1 = S2 = 4.5 V (DIFF mode)		10.5	15	
tPLH		Fi	M = 0 V, S0 = S3 = 4.5 V,		11	16.5	ns
<sup>t</sup> PHL	- Ā <sub>i</sub> or B <sub>i</sub>	ri -	S1 = S2 = 0 V (SUM mode)		11	16.5	יי ך
<sup>t</sup> PLH			M = 0 V, S0 = S3 = 0 V,		14	20	
<sup>t</sup> PHL	$\overline{A_i}$ or $\overline{B_i}$	Fi	S1 = S2 = 4.5 V (DIFF mode)		14	22	- n
tPLH		_			14	20	
<sup>t</sup> PHL	- Ā <sub>i</sub> or B <sub>i</sub>	Fi	M = 4.5 V (logic mode)		14	22	] "
tPLH			M = 0 V, S0 = S3 = 0 V,		15	23	n
tPHL	Any Ā or B	A = B	S1 = S2 = 4.5 V (DIFF mode)		20	30	۳ [

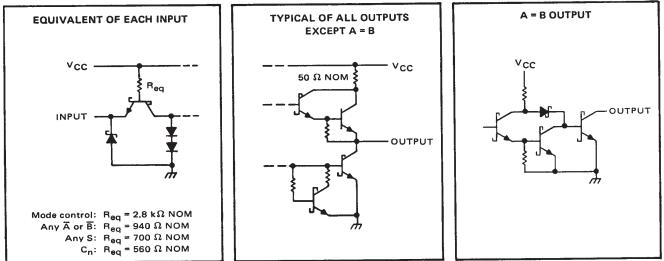
### switching characteristics, V<sub>CC</sub> = 5 V, T<sub>A</sub> = 25°C (C<sub>L</sub> = 15 pF, R<sub>L</sub> = 280 $\Omega$ , see note 4)

 $^{\dagger}t_{PLH} \equiv$  propagation delay time, low-to-high-level output

tpHL = propagation delay time, high-to-low-level output

NOTE 4: Load circuits and voltage wveforms are shown in Section 1. Refer to Parameter Measurement Information page for test conditions.

#### schematics of inputs and outputs





# SN54LS181, SN54S181 SN74LS181, SN74S181 **ARITHMETIC LOGIC UNITS/FUNCTION GENERATORS** SDLS136 - DECEMBER 1972 - REVISED MARCH 1988

#### PARAMETER MEASUREMENT INFORMATION SUM MODE TEST TABLE

			I INPUT E BIT	OTHER DA	TA INPUTS		OUTPUT WAVEFORM	
PARAMETER	TEST	APPLY 4.5 V	APPLY GND	APPLY 4.5 V	APPLY GND	TEST	(See Note 4)	
<sup>Ն</sup> ԲԼℍ ՆԲℍԼ	Āi	Ξ <sub>i</sub>	None	Remaining A and B	Cn	Fi	In-Phase	
	Bi	Āi	None	Remaining A and B	Cn	Fi	In-Phase	
tPLH tPHL	Āi	Bi	None	None	Remaining Ā and Ē, C <sub>n</sub>	P	In-Phase	
	Bi	Āi	None	None	Remaining Ā and Ē, C <sub>n</sub>	ą	in-Phase	
	Āj	None	Bi	Remaining B	Remaining Ā, C <sub>n</sub>	G	in-Phase	
tPLH tPHL	Β <sub>i</sub>	None	Āi	Remaining B	Remaining Ã, C <sub>n</sub>	G	In-Phase	
	Cn	None	None	A11 Ā	AII B	Any F or C <sub>n+4</sub>	In-Phase	
<sup>t</sup> ԲԼℍ <sup>t</sup> ԲℍԼ	Āi	None	B <sub>i</sub>	Remaining B	Remaining Ã, C <sub>n</sub>	C <sub>n+4</sub>	Out-of-Phase	
	Bi	None	Āi	Remaining B	Remaining Ā, C <sub>n</sub>	Cn+4	Out-of-Phase	

FUNCTION INPUTS: S0 = S3 = 4.5 V, S1 = S2 = M = 0 V

#### DIFF MODE TEST TABLE FUNCTION INPUTS: S1 = S2 = 4.5 V, S0 = S3 = M = 0 V

tPHL A, B, Cn Receiving						•			
APPLY TESTAPPLY 4.5 VAPPLY GNDAPPLY 4.5 VAPPLY GNDAPPLY GNDAPPLY GNDAPPLY GNDAPPLY GNDAPPLY GNDTEST(See Note 4) $IPLH$ $\overline{A}_i$ None $\overline{B}_i$ $\overline{A}_i$ Remaining $\overline{A}$ Remaining $\overline{B}, C_n$ $\overline{F}_i$ In-Phase $IPLH$ $\overline{B}_i$ $\overline{A}_i$ None $\overline{B}_i$ Remaining $\overline{A}$ $\overline{B}_i C_n$ $\overline{F}_i$ Out-of-Phase $IPLH$ $\overline{B}_i$ $\overline{A}_i$ None $\overline{B}_i$ NoneRemaining $\overline{A}$ and $\overline{B}, C_n$ $\overline{P}$ In-Phase $IPLH$ $\overline{B}_i$ $\overline{A}_i$ None $\overline{B}_i$ NoneRemaining $\overline{A}$ and $\overline{B}, C_n$ $\overline{P}$ Out-of-Phase $IPLH$ $\overline{B}_i$ $\overline{A}_i$ NoneNoneRemaining $\overline{A}$ and $\overline{B}, C_n$ $\overline{P}$ Out-of-Phase $IPLH$ $\overline{B}_i$ $\overline{A}_i$ NoneNoneRemaining $\overline{A}$ and $\overline{B}, C_n$ $\overline{G}$ Out-of-Phase $IPHL$ $\overline{A}_i$ $\overline{B}_i$ None $\overline{A}_i$ Remaining $\overline{A}$ and $\overline{B}, C_n$ $\overline{G}$ Out-of-Phase $IPHL$ $\overline{A}_i$ $\overline{A}_i$ None $\overline{A}_i$ Remaining $\overline{A}$ and $\overline{B}, C_n$ $\overline{G}$ Out-of-Phase $IPHL$ $\overline{A}_i$ None $\overline{A}_i$ Remaining $\overline{A}$ and $\overline{B}, C_n$ $\overline{A} = B$ In-Phase $IPHL$ $\overline{A}_i$ None $\overline{A}_i$ Remaining $\overline{A}$ and $\overline{B}$ $\overline{A} = B$ Out-of Phase $IPHL$ $\overline{A}_i$ $\overline{A}_i$ None $\overline{A}_i$					OTHER DA				
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	PARAMETER		APPLY	APPLY	APPLY	APPLY			
$\begin{array}{c c c c c c c c c c c c c c c c c c c $		TEST	4.5 V	GND	4.5 V	GND	1531	(266 14016 4)	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	<sup>t</sup> PLH	7.	None	<u>.</u>		-	Ē	In-Phase	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	<b>tPHL</b>		None	51	Ā	B, C <sub>n</sub>			
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	tPLH		<u></u> .	None			Ē.	Out-of-Phase	
VPLH tPHLAiNoneBi ANoneA and B. CnPIn-PhaseIPLH IPLHBiAiNoneNoneRemaining A and B. CnPOut-of-PhaseIPLH IPLHBiAiNoneNoneRemaining A and B. CnPOut-of-PhaseIPLH IPLHAiBiNoneNoneRemaining A and B. CnGIn-PhaseIPLH IPHLAiBiNoneAiNoneRemaining A and B. CnGOut-of-PhaseIPLH IPHLAiNoneAiNoneRemaining B. CnGOut-of-PhaseIPLH IPHLAiNoneBi AA B. CnA BIn-PhaseIPHLAiNoneNoneRemaining B. CnA = BOut-of-PhaseIPHLAiNoneNoneRemaining A B. CnA = BOut-of PhaseIPHLCnNoneNoneAiii A and BNoneCn+4 A or any FIn-PhaseIPLHAiBiNoneNoneRemaining A B. CnCn+4 A or any FIn-PhaseIPLHAiBiNoneNoneNoneRemaining A B. CnCn+4 A or any FIn-Phase	<sup>t</sup> ₽HL			INONE	Ā	B, C <sub>n</sub>	.,		
tPHLHighHomeOrHomeA and B, CntPLH $\overline{B}_i$ $\overline{A}_i$ NoneNoneRemaining $\overline{A}$ and B, Cn $\overline{P}$ Out-of-PhasetPLH $\overline{A}_i$ $\overline{B}_i$ NoneNoneRemaining $\overline{A}$ and B, Cn $\overline{G}$ In-PhasetPLH $\overline{A}_i$ $\overline{B}_i$ None $\overline{A}_i$ Remaining $\overline{A}$ and B, Cn $\overline{G}$ In-PhasetPLH $\overline{A}_i$ None $\overline{A}_i$ NoneRemaining $\overline{A}$ and B, Cn $\overline{G}$ Out-of-PhasetPLH $\overline{A}_i$ None $\overline{B}_i$ Remaining $\overline{A}$ and $\overline{B}$ , Cn $\overline{A} = B$ In-PhasetPLH $\overline{A}_i$ None $\overline{B}_i$ $\overline{A}$ $\overline{B}_i$ $\overline{A} = B$ In-PhasetPLH $\overline{A}_i$ None $\overline{B}_i$ $\overline{A}$ $\overline{B}_i$ $\overline{A} = B$ Out-of-PhasetPLH $\overline{B}_i$ $\overline{A}_i$ NoneRemaining $\overline{A}$ $\overline{B}_i$ $\overline{A} = B$ Out-of PhasetPLH $\overline{B}_i$ $\overline{A}_i$ None $\overline{A}$ $\overline{B}_i$ $\overline{A} = B$ Out-of PhasetPLH $\overline{B}_i$ $\overline{A}_i$ None $\overline{A}$ $\overline{B}_i$ $\overline{C}_n + 4$ In-PhasetPLH $\overline{A}_i$ $\overline{B}_i$ NoneNone $\overline{A}$ $\overline{A}$ $\overline{C}_n + 4$ In-PhasetPLH $\overline{A}_i$ $\overline{B}_i$ NoneNone $\overline{A}$ $\overline{A}$ $\overline{C}_n + 4$ Out-of-PhasetPLH $\overline{A}_i$ $\overline{B}_i$ NoneNone $\overline{A}$ $\overline{A}$ $\overline{C}_n + 4$ Out-of-Phase<	<sup>t</sup> PLH	<u>Ā</u> .	None	<b>.</b>	None	-	P	In-Phase	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	1PHL		None		None	A and B, C <sub>n</sub>			
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	<sup>t</sup> PLH	5.	ā.	None	None		ā	Out-of-Phase	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	<sup>t</sup> PHL	Pi		NONE	None	A and B, Cn		001077800	
tPHLHiHiHoneAAABOut-of-PhasetPLH $\overline{B}_i$ None $\overline{A}_i$ None $\overline{A}$ and $\overline{B}$ , $C_n$ $\overline{G}$ Out-of-PhasetPLH $\overline{A}_i$ None $\overline{B}_i$ $\overline{A}$ Remaining $\overline{A}$ $\overline{B}$ , $C_n$ $\overline{A} = B$ In-PhasetPLH $\overline{A}_i$ None $\overline{B}_i$ $\overline{A}$ $\overline{B}$ , $C_n$ $A = B$ In-PhasetPLH $\overline{B}_i$ $\overline{A}_i$ NoneRemaining $\overline{A}$ $\overline{B}$ , $C_n$ $A = B$ Out-of PhasetPLH $\overline{B}_i$ $\overline{A}_i$ None $\overline{A}$ $\overline{B}$ , $C_n$ $A = B$ Out-of PhasetPLH $C_n$ NoneNone $\overline{A}$ $\overline{B}$ , $C_n$ $A = B$ In-PhasetPLH $\overline{A}_i$ $\overline{B}_i$ NoneNone $\overline{A}$ $\overline{B}$ , $C_n$ $A = B$ Out-of PhasetPLH $\overline{A}_i$ $\overline{B}_i$ NoneNone $\overline{A}$ $\overline{B}$ $C_{n+4}$ Out-of-PhasetPHL $\overline{A}_i$ $\overline{B}_i$ NoneNone $\overline{A}$ $\overline{B}$ $C_{n+4}$ Out-of-PhasetPHL $\overline{A}_i$ $\overline{B}_i$ NoneNone $\overline{A}$ $\overline{A}$ $\overline{C}_{n+4}$ Out-of-PhasetPHL $\overline{A}_i$ $\overline{B}_i$ NoneNone $\overline{A}$ $\overline{B}$ $\overline{C}_{n+4}$ Out-of-Phase	<sup>t</sup> PLH	<u>.</u>	<u>.</u>	None	None		อ	in-Phase	
Image: termBi iNoneAi iNoneAi iNoneAi and $\overline{B}$ , $C_n$ GOut-of-PhaseIPLH $\overline{A}_i$ None $\overline{B}_i$ Remaining $\overline{A}$ Remaining $\overline{B}$ , $C_n$ A = BIn-PhaseIPLH $\overline{B}_i$ $\overline{A}_i$ NoneRemaining $\overline{A}$ Remaining $\overline{B}$ , $C_n$ A = BOut-of PhaseIPLH $\overline{B}_i$ $\overline{A}_i$ NoneRemaining $\overline{A}$ Remaining $\overline{B}$ , $C_n$ A = BOut-of PhaseIPLH $\overline{C}_n$ NoneNoneAll $\overline{A}$ and $\overline{B}$ None $\overline{C}_{n+4}$ or any $\overline{F}$ In-PhaseIPLH $\overline{A}_i$ $\overline{B}_i$ NoneNoneRemaining $\overline{A}, \overline{B}, C_n$ C_{n+4}Out-of-PhaseIPLH $\overline{A}_i$ $\overline{B}_i$ NoneNoneRemaining $\overline{A}, \overline{B}, C_n$ C_{n+4}Out-of-PhaseIPHL $\overline{A}_i$ $\overline{B}_i$ NoneNoneRemaining $\overline{A}, \overline{B}, C_n$ C_{n+4}Out-of-Phase	<sup>t</sup> PHL			None			, C		
tPHL       A       A       and B, Cn         tPLH $\overline{A}_i$ None $\overline{B}_i$ Remaining       Remaining       A = B       In-Phase         tPHL $\overline{A}_i$ None $\overline{B}_i$ $\overline{A}$ $\overline{B}_i$ $\overline{B}_i$ $\overline{A}$ $\overline{B}_i$ $\overline{B}_i$ $\overline{A}$ $\overline{B}_i$ $\overline{B}_i$ $\overline{A}$ $\overline{A}$ $\overline{B}_i$ $\overline{A}$	<sup>t</sup> PLH	<b>B</b> .	None	Δ.	None	-	5	Out-of-Phase	
ip HL     Ai     None     Bi $\overline{A}$ $\overline{B}$ , $C_n$ $A = B$ In-Phase       ip HL $\overline{B}_i$ $\overline{A}_i$ None $\overline{Remaining}$ $\overline{C_{n+4}}$ $\overline{Out-of-Phase}$ ip HL $\overline{A}_i$ $\overline{B}_i$ None     None $\overline{Remaining}$ $\overline{C_{n+4}}$ $\overline{Out-of-Phase}$ ip HL $\overline{A}_i$ $\overline{B}_i$ None     None $\overline{Remaining}$ $\overline{C_{n+4}}$ $\overline{Out-of-Phase}$	<sup>t</sup> PHL					A and B, Cn			
tPHL     A     B, Cn       tPLH $\overline{B}_i$ $\overline{A}_i$ None     Remaining     Remaining $\overline{B}_i$ $\overline{A} = B$ Out-of Phase       tPHL $\overline{C}_n$ None $\overline{A}$ $\overline{B}_i$ $\overline{N}_i$ $\overline{A}$ $\overline{B}_i$ $\overline{A}$ $\overline{A}_i$ $$	<sup>t</sup> PLH	7.	None	<b>R</b> .	-	-	A = B	In-Phase	
Image: second secon	<sup>t</sup> PHL	1 1	Roma		Ā	B, Cn			
tPHL     Di     Ai     B, Cn       tPLH     Cn     None     None     All       tPHL     Cn     None     None     All       tPLH $\overline{A}_i$ $\overline{B}_i$ None     All       tPLH $\overline{A}_i$ $\overline{B}_i$ None $\overline{A}_i$ $\overline{B}_i$ In-Phase       tPLH $\overline{A}_i$ $\overline{B}_i$ None     None $\overline{A}_i$ $\overline{B}_i$ Out-of-Phase       tPHL $\overline{A}_i$ $\overline{B}_i$ $\overline{A}_i$ $\overline{B}_i$ $\overline{A}_i$ $\overline{A}_i$ $\overline{C}_{n+4}$ $\overline{Out-of-Phase}$	1PLH	<u>.</u>	<u>.</u>	None	l ~	-	A = B	Out-of Phase	
IPLIN     Cn     None     None     A and B     None     Cn + 4 or any F     In-Phase       IPLH     Ai     Bi     None     None     Remaining A, B, Cn     Cn + 4     Out-of-Phase	<sup>t</sup> PHL		^	None	Ā	B, Cn			
tPHL     On     Hone     Ā and 6     or any F       tPLH     Ā     B     None     None     Remaining Ā, B, Cn     Cn+4     Out-of-Phase       tPHL     F     F     F     F     F     F     F	<sup>t</sup> PLH	C.	None	None		None	Cn+4	In-Phase	
tPHL Ai Bi None None Ā, B, Cn Cn+4 Out-of-Phase	<sup>t</sup> PHL			1 vone	A and B		or any F		
tPHL A, B, Cn Bampining	<b>tPLH</b>	Ā	B.	None	None	-	Cate	Out-of-Phase	
tpi H = Remaining	<sup>t</sup> PHL						-1174		
	<sup>t</sup> PLH	Ēį	None	Āi	None		Cn+4	In -Phase	
	<sup>t</sup> PHL	] -'				Ā, Ē, C <sub>n</sub>			

### LOGIC MODE TEST TABLE FUNCTION INPUTS: S1 = S2 = M = 4.5 V, S0 = S3 = 0 V

PARAMETER			E BIT	OTHER D	ATA INPUTS		OUTPUT WAVEFORM
	TEST	APPLY 4.5 V	APPLY GND	APPLY 4.5 V	APPLY GND	TEST	(See Note 4)
tPLH tPHL	Āi	Bi	None	None	Remaining Ā and B, C <sub>n</sub>	Ŧ,	Out-of-Phase
tPLH tPHL	Ēi	Āi	None	None	Remaining Ā and B, C <sub>n</sub>	Fi	Out-of-Phase

NOTE 4: Load circuits and voltage waveforms are shown in Section 1.





14-Jun-2019

### PACKAGING INFORMATION

Orderable Device	Status	Package Type	Package	Pins	Package	Eco Plan	Lead/Ball Finish	MSL Peak Temp	Op Temp (°C)	Device Marking	Samples
	(1)		Drawing		Qty	(2)	(6)	(3)		(4/5)	
JM38510/07801BJA	ACTIVE	CDIP	J	24	1	TBD	Call TI	N / A for Pkg Type	-55 to 125	JM38510/ 07801BJA	Samples
M38510/07801BJA	ACTIVE	CDIP	J	24	1	TBD	Call TI	N / A for Pkg Type	-55 to 125	JM38510/ 07801BJA	Samples
SN54LS181J	ACTIVE	CDIP	J	24	1	TBD	Call TI	N / A for Pkg Type	-55 to 125	SN54LS181J	Samples
SNJ54LS181J	ACTIVE	CDIP	J	24	1	TBD	Call TI	N / A for Pkg Type	-55 to 125	SNJ54LS181J	Samples
SNJ54S181J	LIFEBUY	CDIP	J	24		TBD	Call TI	Call TI	-55 to 125	SNJ54S181J	
SNJ54S181W	LIFEBUY	CFP	W	24		TBD	Call TI	Call TI	-55 to 125	SNJ54S181W	

<sup>(1)</sup> 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.

<sup>(2)</sup> RoHS: TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

RoHS Exempt: TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

Green: TI defines "Green" to mean the content of Chlorine (CI) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <= 1000ppm threshold. Antimony trioxide based flame retardants must also meet the <= 1000ppm threshold requirement.

<sup>(3)</sup> MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

<sup>(4)</sup> There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

<sup>(5)</sup> 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.

<sup>(6)</sup> 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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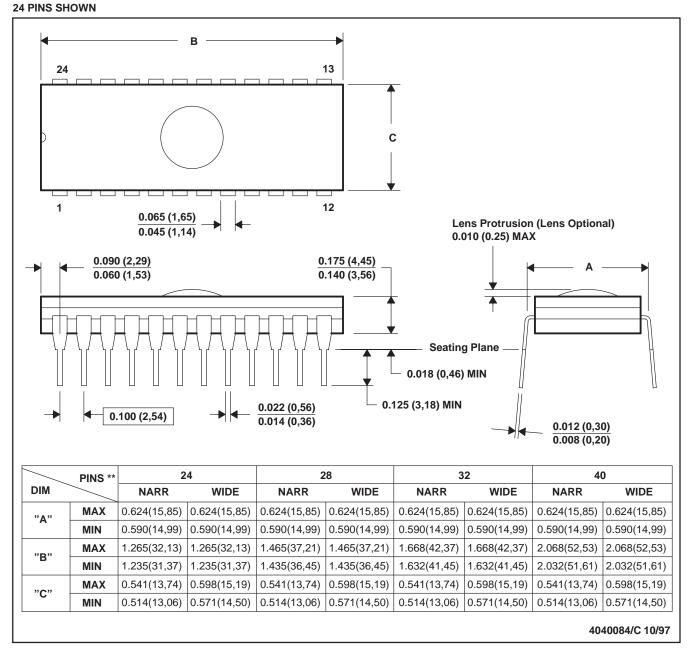
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# **MECHANICAL DATA**

MCDI004A - JANUARY 1995 - REVISED NOVEMBER 1997

#### **CERAMIC DUAL-IN-LINE PACKAGE**

J (R-GDIP-T\*\*)



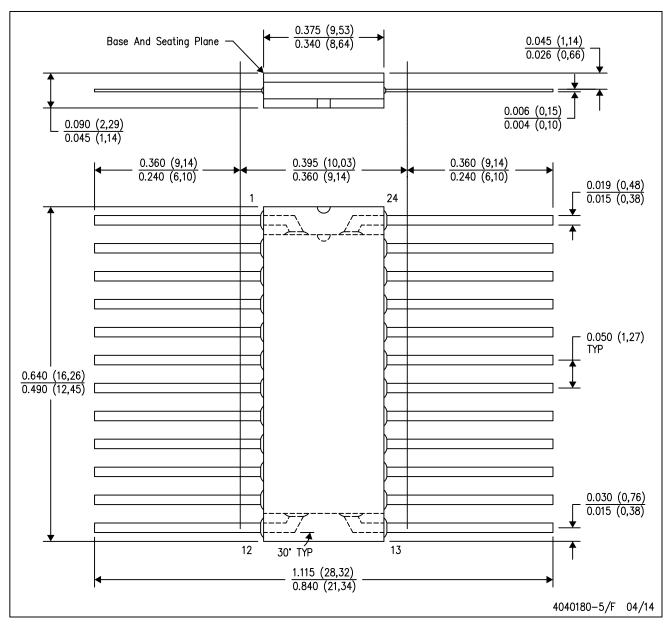
NOTES: A. All linear dimensions are in inches (millimeters).

- B. This drawing is subject to change without notice.
- C. Window (lens) added to this group of packages (24-, 28-, 32-, 40-pin).
- D. This package can be hermetically sealed with a ceramic lid using glass frit.
- E. Index point is provided on cap for terminal identification.



CERAMIC DUAL FLATPACK

W (R-GDFP-F24)



NOTES: A. All linear dimensions are in inches (millimeters).

- This drawing is subject to change without notice. В.
- C. This package can be hermetically sealed with a ceramic lid using glass frit.
- D. Index point is provided on cap for terminal identification only.
   E. Falls within Mil-Std 1835 GDFP2-F20



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