Philips Semiconductors-Signetics

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Status	Product Specification
FAST Products	

FAST 74F381
Arithmetic Logic Unit

TYPE	TYPICAL PROPAGATION DELAY	TYPICAL SUPPLY CURRENT (TOTAL)
74F381	6.5 ns	59mA

ORDERING INFORMATION

PACKAGES	COMMERCIAL RANGE V_{CC} = 5V±10%; T_A = 0°C to +70°C
20-Pin Plastic DIP	N74F381N
20-Pin Plastic SOL	N74F381D

FEATURES

- **Low-input loading minimizes drive requirements**
- **Performs six arithmetic and logic functions**
- **Selectable Low (clear) and High (preset) functions**
- **Carry Generate and Propagate outputs for use with Carry look-ahead generator**

DESCRIPTION

The 74F381 performs three arithmetic and three logic operations on two 4-bit words, A and B. Three additional Select (S_0-S_2) input codes force the Function outputs Low or High. Carry Propagate ($\overline{P}$) and Generate ($\overline{G}$) outputs are provided for use with the 'F182 Carry Look Ahead Generator for high-speed expansion to longer word lengths. For ripple expansion, refer to the 'F382 ALU data sheet.

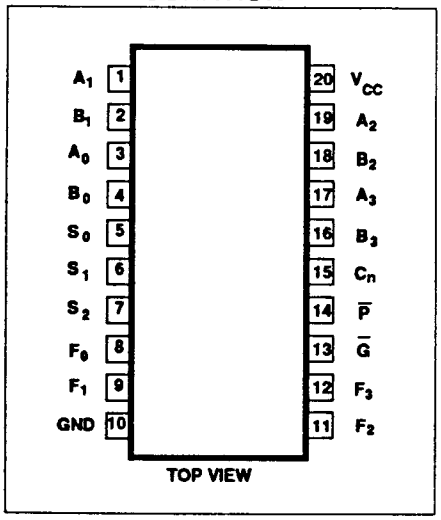
Signals applied to the Select inputs (S_0-S_2) determine the mode of operation, as indicated in the Function Select Table. An extensive listing of input and output function levels is shown in the Function Table. The circuit performs the arithmetic functions for either active-High or active-Low operands, with output levels in the same convention. In the subtract operating modes, it is necessary to force a Carry (High for active-High operands, Low for active-Low operands) into the C_n input of the least significant package. The Carry Generate ($\overline{G}$) and Carry Propagate ($\overline{P}$) outputs supply input signals to the 'F182 Carry look-ahead generator for expansion to longer word length, as shown in Figure 1. Note that an 'F382 ALU is used for the most significant package. Typical delays for Figure 1 are given in Table 1.

INPUT AND OUTPUT LOADING AND FAN-OUT TABLE

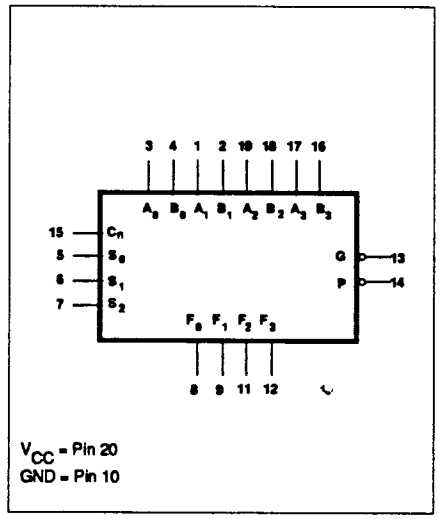
PINS	DESCRIPTION	74F(U.L.) HIGH/LOW	LOAD VALUE HIGH/LOW
A_0-A_3	A operand inputs	1.0/4.0	20µA/2.4mA
B_0-B_3	B operand inputs	1.0/4.0	20µA/2.4mA
S_0-S_2	Function select inputs	1.0/1.0	20µA/0.6mA
C_n	Carry input	1.0/4.0	20µA/2.4mA
$\overline{P}$	Carry Propagate output (active-Low)	50/33	1.0mA/20mA
$\overline{G}$	Carry Generate output (active-Low)	50/33	1.0mA/20mA
F_0-F_3	Outputs	50/33	1.0mA/20mA

NOTE: One (1.0) FAST Unit Load is defined as: 20µA in the High state and 0.6mA in the Low state.

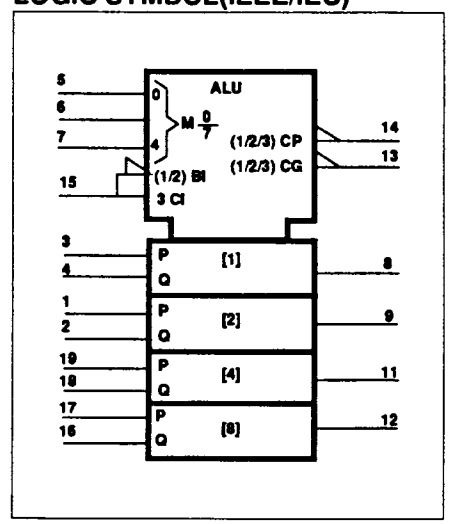
PIN CONFIGURATION



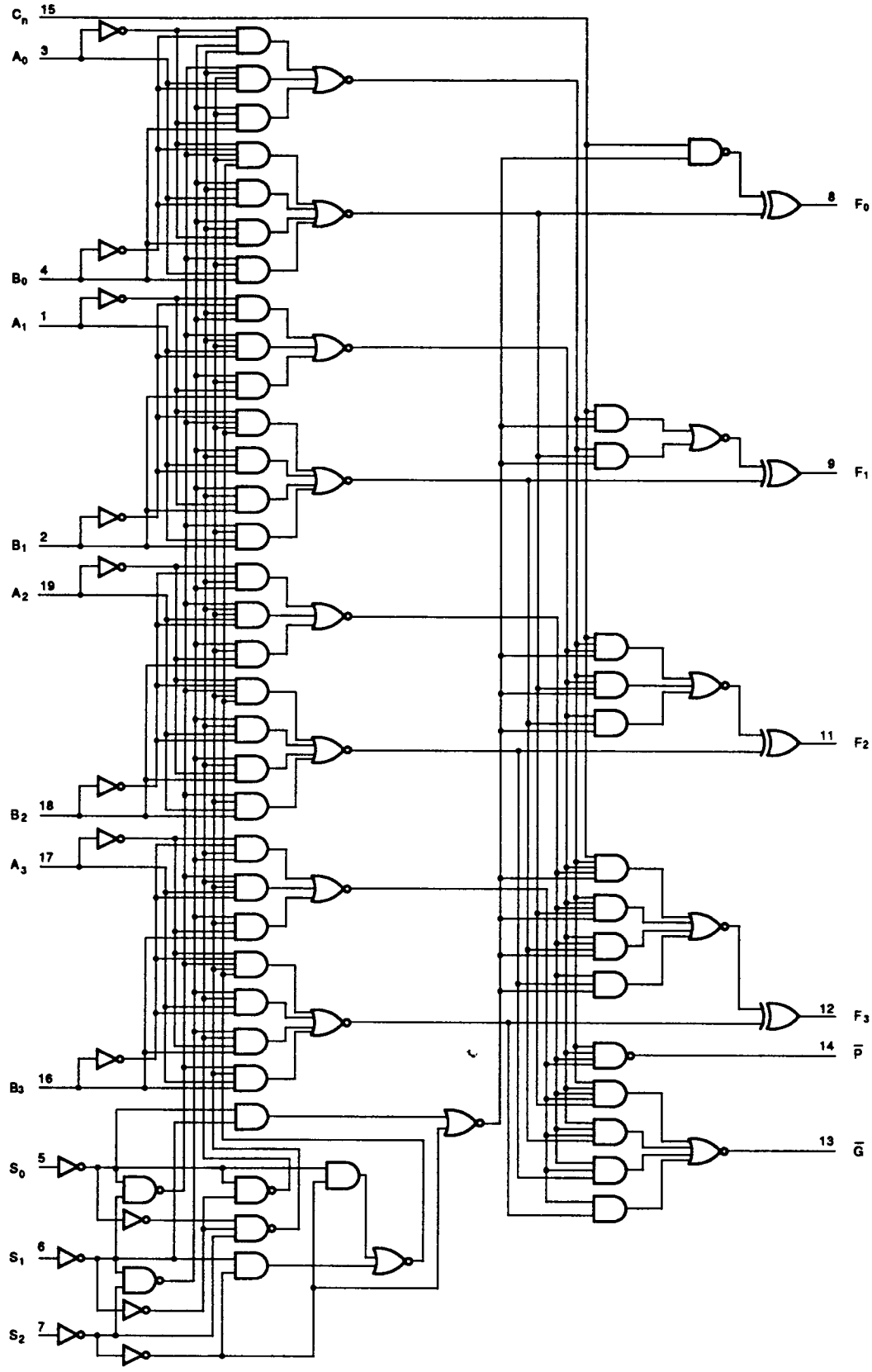
LOGIC SYMBOL



LOGIC SYMBOL(IEEE/IEC)



LOGIC DIAGRAM



FUNCTION TABLE

INPUTS						OUTPUTS						OPERATING MODE
S_0	S_1	S_2	C_n	A_n	B_n	F_0	F_1	F_2	F_3	$\overline{G}$	$\overline{P}$	
L	L	L	X	X	X	L	L	L	L	L	L	Clear
H	L	L	L	L	L	H	H	H	H	H	L	B minus A
H	L	L	L	L	H	L	H	H	H	L	L	
H	L	L	L	H	L	L	L	L	L	H	H	
H	L	L	L	H	H	H	H	H	H	H	L	
H	L	L	H	L	L	L	L	L	L	H	L	
H	L	L	H	L	H	H	H	H	H	L	L	
H	L	L	H	H	L	H	L	L	L	H	H	
H	L	L	H	H	H	L	L	L	L	H	L	
L	H	L	L	L	L	H	H	H	H	H	L	A minus B
L	H	L	L	L	H	L	L	L	L	H	H	
L	H	L	L	H	L	L	H	H	H	L	L	
L	H	L	L	H	H	H	H	H	H	H	L	
L	H	L	H	L	L	L	L	L	L	H	L	
L	H	L	H	L	H	H	L	L	L	H	H	
L	H	L	H	H	L	H	H	H	H	L	L	
L	H	L	H	H	H	L	L	L	L	H	L	
H	H	L	L	L	L	L	L	L	L	H	H	A Plus B
H	H	L	L	L	H	H	H	H	H	H	L	
H	H	L	L	H	L	H	H	H	H	H	L	
H	H	L	L	H	H	L	H	H	H	L	L	
H	H	L	H	L	L	H	L	L	L	H	H	
H	H	L	H	L	H	L	L	L	L	H	L	
H	H	L	H	H	L	L	L	L	L	H	L	
H	H	L	H	H	H	H	H	H	H	L	L	
L	L	H	X	L	L	L	L	L	L	H	H	A ⊕ B
L	L	H	X	L	H	H	H	H	H	H	H	
L	L	H	X	H	L	H	H	H	H	H	L	
L	L	H	X	H	H	L	L	L	L	L	L	
H	L	H	X	L	L	L	L	L	L	H	H	A + B
H	L	H	X	L	H	H	H	H	H	H	H	
H	L	H	X	H	L	H	H	H	H	H	H	
H	L	H	X	H	H	H	H	H	H	H	L	
L	H	H	X	L	L	L	L	L	L	L	L	AB
L	H	H	X	L	H	L	L	L	L	H	H	
L	H	H	X	H	L	L	L	L	L	L	L	
L	H	H	X	H	H	H	H	H	H	H	L	
H	H	H	X	L	L	H	H	H	H	H	H	Preset
H	H	H	X	L	H	H	H	H	H	H	H	
H	H	H	X	H	L	H	H	H	H	H	H	
H	H	H	X	H	H	H	H	H	H	H	L	

H = High voltage level
L = Low voltage level
X = Don't care

FUNCTION SELECT TABLE

SELECT			OPERATING MODE
S_0	S_1	S_2	
L	L	L	Clear
H	L	L	B Minus A
L	H	L	A Minus B
H	H	L	A Plus B
L	L	H	A⊕B
H	L	H	A + B
L	H	H	AB
H	H	H	Preset

H = High voltage level
L = Low voltage level

Table 1. 16-Bit Delay Tabulation

PATH SEGMENT	TOWARD F	OUTPUT Cn+4, OVR
A_i or B_i to $\overline{P}$	7.2 ns	7.2ns
$\overline{P}_i$ to C_{n+i} ('F182)	6.2 ns	6.2ns
C_n to F	8.1 ns	-
C_n to C_{n+4}, OVR	-	8.0ns
Total Delay	21.5 ns	21.4 ns

APPLICATION

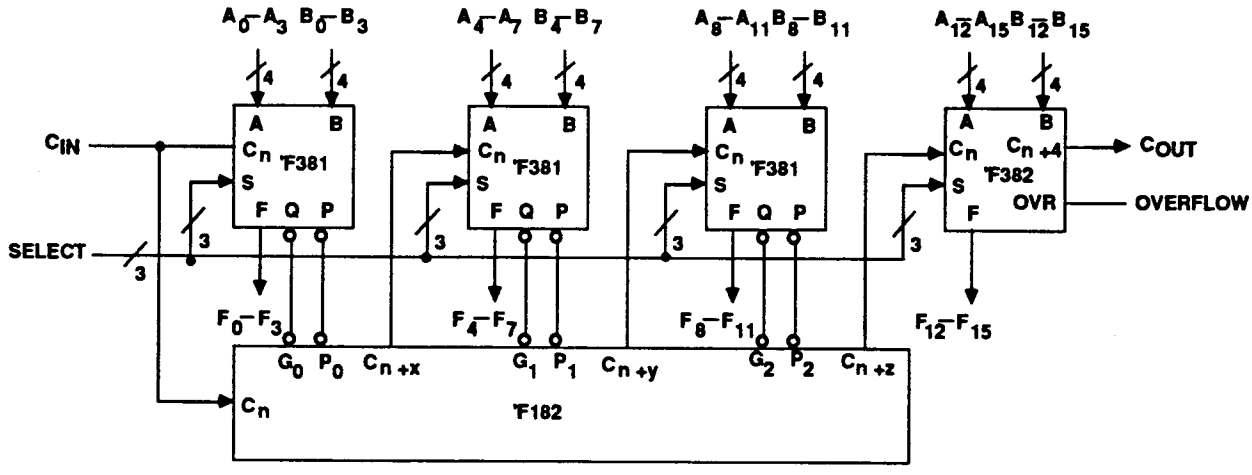


Figure 1. 16-Bit Look-Ahead Carry ALU Expansion

ABSOLUTE MAXIMUM RATINGS

(Operation beyond the limits set forth in this table may impair the useful life of the device. Unless otherwise noted these limits are over the operating free-air temperature range.)

SYMBOL	PARAMETER	RATING	UNIT
V_{CC}	Supply voltage	-0.5 to +7.0	V
V_{IN}	Input voltage	-0.5 to +7.0	V
I_{IN}	Input current	-30 to +1	mA
V_{OUT}	Voltage applied to output in High output state	-0.5 to +V_{CC}	V
I_{OUT}	Current applied to output in Low output state	40	mA
T_A	Operating free-air temperature range	0 to +70	°C
T_{STG}	Storage temperature	-65 to +150	°C

RECOMMENDED OPERATING CONDITIONS

SYMBOL	PARAMETER	LIMITS			UNIT
		Min	Nom	Max	
V_{CC}	Supply voltage	4.5	5.0	5.5	V
V_{IH}	High-level input voltage	2.0			V
V_{IL}	Low-level input voltage			0.8	V
I_{IK}	Input clamp current			-18	mA
I_{OH}	High-level output current			-1	mA
I_{OL}	Low-level output current			20	mA
T_A	Operating free-air temperature range	0		70	°C

DC ELECTRICAL CHARACTERISTICS (Over recommended operating free-air temperature range unless otherwise noted.)

SYMBOL	PARAMETER		TEST CONDITIONS[1]		LIMITS			UNIT
					Min	Typ[2]	Max	
V_{OH}	High-level output voltage		V_{CC} = MIN, V_{IL} = MAX	±10%V_{CC}	2.5			V
			V_{IH} = MIN, I_{OH} = MAX	±5%V_{CC}	2.7	3.4		V
V_{OL}	Low-level output voltage		V_{CC} = MIN, V_{IL} = MAX	±10%V_{CC}		0.30	0.50	V
			V_{IH} = MIN, I_{OL} = MAX	±5%V_{CC}		0.30	0.50	V
V_{IK}	Input clamp voltage		V_{CC} = MIN, I_I = I_{IK}			-0.73	-1.2	V
I_I	Input current at maximum input voltage		V_{CC} = MAX, V_I = 7.0V				100	µA
I_{IH}	High-level input current		V_{CC} = MAX, V_I = 2.7V				20	µA
I_{IL}	Low-level input current	A_n, B_n, C_n	V_{CC} = MAX, V_I = 0.5V				-2.4	mA
		S_0, S_1, S_2					-0.6	mA
I_{OS}	Short circuit output current[3]		V_{CC} = MAX		-60		-150	mA
I_{CC}	Supply current (total)		V_{CC} = MAX			59	89	mA

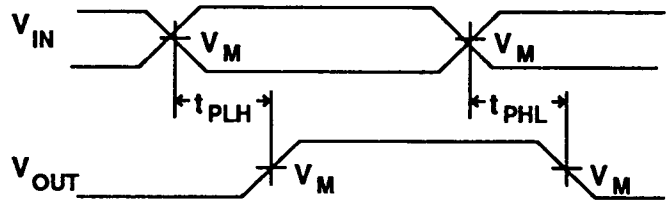
NOTES:

1. For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions for the applicable type.
2. All typical values are at V_{CC} = 5V, T_A = 25°C.
3. Not more than one output should be shorted at a time. For testing I_{OS}, the use of high-speed test apparatus and/or sample-and-hold techniques are preferable in order to minimize internal heating and more accurately reflect operational values. Otherwise, prolonged shorting of a High output may raise the chip temperature well above normal and thereby cause invalid readings in other parameter tests. In any sequence of parameter tests, I_{OS} tests should be performed last.

AC ELECTRICAL CHARACTERISTICS

SYMBOL	PARAMETER	TEST CONDITION	LIMITS					UNIT
			T_A = +25°C, V_{CC} = 5V, C_L = 50pF, R_L = 500Ω			T_A = 0°C to +70°C, V_{CC} = 5V ±10%, C_L = 50pF, R_L = 500Ω		
			Min	Typ	Max	Min	Max	
t_{PLH} t_{PHL}	Propagation delay C_n to F_n	Waveform 1	2.5 2.5	6.0 4.5	11.0 6.5	2.5 2.5	12.5 7.5	ns
t_{PLH} t_{PHL}	Propagation delay Any A_n or B_n to any F_n	Waveform 1	3.5 3.0	7.0 6.0	13.0 9.0	3.5 3.0	16.0 10.0	ns
t_{PLH} t_{PHL}	Propagation delay S_n to F_n	Waveform 1	5.0 4.0	9.0 7.5	20.0 10.5	5.0 4.0	21.5 11.5	ns
t_{PLH} t_{PHL}	Propagation delay A_n or B_n to $\overline{G}$	Waveform 1	3.5 3.0	6.5 6.0	9.0 8.5	3.5 3.0	10.0 9.0	ns
t_{PLH} t_{PHL}	Propagation delay A_n or B_n to $\overline{P}$	Waveform 1	3.0 3.5	5.5 6.0	8.0 8.5	3.0 3.5	9.0 9.0	ns
t_{PLH} t_{PHL}	Propagation delay S_n to $\overline{G}$ or $\overline{P}$	Waveform 1	5.0 5.5	7.5 8.5	11.0 12.5	5.0 5.0	12.5 14.0	ns

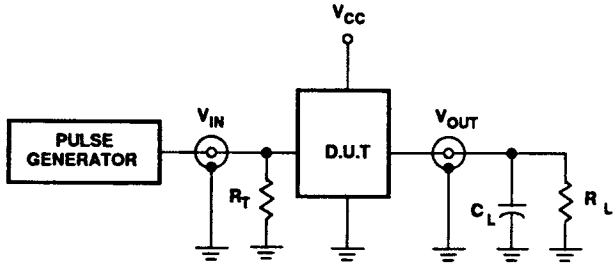
AC WAVEFORMS



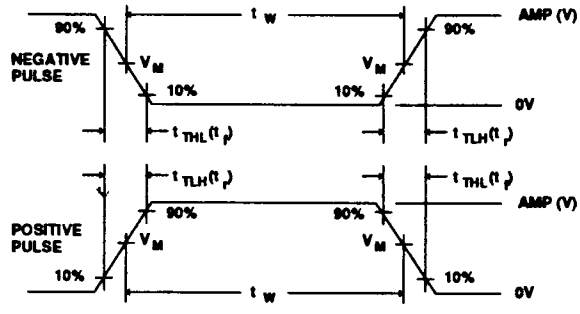
Waveform 1. Propagation Delay for Non-Inverting or Inverting paths

NOTE: For all waveforms, V_M = 1.5V

TEST CIRCUIT AND WAVEFORMS



Test Circuit For Totem-Pole Outputs



V_M = 1.5V

Input Pulse Definition

DEFINITIONS

R_L = Load resistor; see AC CHARACTERISTICS for value.

C_L = Load capacitance includes jig and probe capacitance; see AC CHARACTERISTICS for value.

R_T = Termination resistance should be equal to Z_{OUT} of pulse generators.

FAMILY	INPUT PULSE REQUIREMENTS				
	Amplitude	Rep. Rate	t_W	t_{TLH}	t_{THL}
74F	3.0V	1MHz	500ns	2.5ns	2.5ns

VI. COMMERCIAL PRODUCT SPECIAL PROCESSING T-90-20

SUPR II LEVEL B

Signetics Upgraded Product Reliability (SUPR) program is designed to provide customers whose systems require an infant mortality level less than that of our non-burned-in products (which is typically below 1000 PPM).

DEVICE AVAILABILITY

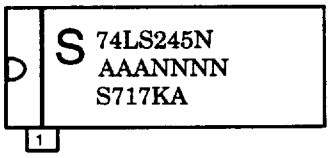
Products available for Level B processing are identified in the Price Book with a "B" suffix to the basic part number.

SUPR II LEVEL B PRICING ADDERS

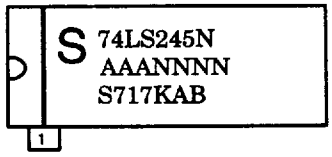
PRODUCT FAMILY	SUGGESTED RESALE ADDERS 1–99	100–999	OVER 1000
LIN	.14	.14	.11
LOG (TTL)			
(SSI)	.12	.10	.08
(MSI)	.16	.14	.11
(OCT)	.16	.14	.11
(CTM)	.16	.14	.11
LOG (ECL)			
(SSI)	.25	.23	.20
(MSI)	.25	.23	.20
LOG (LSI) (RAM) MIC (8X)	Consult Factory for Pricing		
PLD	Consult Factory for Pricing		
MCG	Consult Factory for Pricing		
DAT MIC	Not Available		

MARKING FORMAT EXAMPLES

Standard (no Burn-In) Products (Dual-in-line)



SUPR II (Burned-In) Products (Dual-in-line)



NOTE: The "B" in the 7th position on the 3rd line, when present, is the SUPR II Burn-In indicator.

TAPE AND REEL PACKAGING

SPECIFICATIONS

Tape and Reel specifications conform to Electronic Industries Association (EIA) Proposed Specification #EIA-481-A using 13 inch reels. Current incremental quantities reflect the quantities per reel. As more customers are able to handle a larger quantity per reel, this quantity will be increased.

DEVICE AVAILABILITY

Products available in tape and reel packaging are identified in the Price Book with a "T" suffix to the basic part number and are only offered as a product for sale by the reel. Return of product is limited to full reels with unbroken quality seals.

TAPE AND REEL PRICING ADDERS

PRODUCT FAMILY	SUGGESTED RESALE ADDER
MCG	.07
LIN	.07
LOG	.07
DAT MIC	PACKAGE A28 = .20 A44 = .25 A52 = .30 A68 = .40 A84 = .45 D24 = .17

VII. PACKING QUANTITY INFORMATION T-90-20

CERAMIC DUAL IN-LINE (CERDIP)

PACKAGE CODE	PIN COUNT	QUANTITIES	
		DEVICES PER TUBE	DEVICES PER BOX
F/FE, BPA, PA	8-pin (300-mil)	48	1920
F, BCA, CA	14-pin (300-mil)	25	1000
F, BEA, EA	16-pin (300-mil)	25	1000
F, BVA, MVA	18-pin (300-mil)	21	840
F/FA, BRA, RA	20-pin (300-mil)	20	800
F, BWA, WA	22-pin (400-mil)	17	544
F/FA/F6, BJA, JA	24-pin (600-mil)	15	360
F/FA/F3/F24, BLA, LA	24-pin (300-mil)	15	600
F, BXA, XA	24-pin (400-mil)	15	480
F/FA/F28, BXA, XA	28-pin (600-mil)	13	312
FA	32-pin (600-mil)	11	264
F/FA/F40, BQA, MQA, QA	40-pin (600-mil)	9	216

CERPAC

PACKAGE CODE	PIN COUNT	QUANTITIES
		DEVICES PER TUBE
BDA/DA/W	14-pin	145
BFA/FA/W	16-pin	145
BXA/BYA/W	18-pin	100
BSA/SA/W/WB	20-pin	100
BKA/KA/W	24-pin	120
BYA/YA/W	28-pin	50

CERQUAD

PACKAGE CODE	PIN COUNT	QUANTITIES	
		DEVICES PER TRAY	DEVICES PER BOX
KA/K44	44-pin	6	6
KA/K68	68-pin	4	4
KA	84-pin	42	210

LEADLESS CHIP CARRIER

PACKAGE CODE	PIN COUNT	QUANTITIES
		DEVICES PER TUBE
B2A/2A/GA	20-pin	55
B3A/3A/GA/GC1	28-pin	43
YA/YA/GC2	32-pin	35
BUA/MXA/MUA/UA/XA/GA/GC	44-pin	27
BZA/BUA/UA/ZA/GA/GC	68-pin	19

QUANTITIES SHOWN IN GRAY REQUIRE PURCHASE TO BE MADE IN EXACT MULTIPLES OF THAT QUANTITY.

VII. PACKING QUANTITY INFORMATION

T-90-20

PLASTIC DUAL IN-LINE

PACKAGE CODE	PIN COUNT	QUANTITIES	
		DEVICES PER TUBE	DEVICES PER BOX
N/N8	8-pin (300-mil)	50	2000
N/N14/N16	14- 16-pin (300-mil)	25	1000
N	18-pin (300-mil)	20	800
N/N20	20-pin (300-mil)	18	720
N	22-pin (400-mil)	17	544
N/N6	24-pin (600-mil)	15	360
N/N3/N24	24-pin (300-mil)	15	600
N/N24	24-pin (400-mil)	15	480
N/N28	28-pin (600-mil)	13	312
N/N3	28-pin (300-mil)	13	520
N	32-pin (600-mil)	11	264
N/N40	40-pin (600-mil)	9	216
NB (Shrink)	42-pin (600-mil)	12	288
N/N48	48-pin (600-mil)	7	168
N	50-pin (900-mil)	7	112
N/N64	64-pin (900-mil)	5	80

PLASTIC LEADED CHIP CARRIER (PLCC)

PACKAGE CODE	PIN COUNT	QUANTITIES		
		DEVICES PER TUBE	DEVICES PER BOX	DEVICES PER REEL
A	20-pin	46	3680	1000
A/A28	28-pin	37	2368	750
A	32-pin	31	2232	750
A/A44	44-pin	26	1248	500
A/A52	52-pin	23	1012	500
A/A68	68-pin	18	648	250
A/A84	84-pin	15	420	250

QUANTITIES SHOWN IN GRAY REQUIRE PURCHASE TO BE MADE IN EXACT MULTIPLES OF THAT QUANTITY.

VII. PACKING QUANTITY INFORMATION

T-90-20

PLASTIC SMALL OUTLINE (SO)

PACKAGE CODE	PIN COUNT	QUANTITIES		
		DEVICES PER TUBE	DEVICES PER BOX	DEVICES PER REEL
D/D8	8-pin (150-mil)	100	10000	2500
D	8-pin (300-mil)	64	2560	1000 – 13" 700 – 7"
D/D14	14-pin (150-mil)	57	5700	2500
D	16-pin (150-mil)	50	5000	2500
D	16-pin (300-mil)	48	1920	1000
DK(SSOP)	20-pin (170-mil)	75	6750	2500
D	20-pin (300-mil)	38	1520	1000
D/D24	24-pin (300-mil)	32	1280	1000
D	28-pin (300-mil)	27	1080	1000
D	40-pin (VSO-40)	31	1240	1000 – 13" 300 – 7"
D	56-pin (VSO-56)	22	616	1000

QUAD FLAT PACK*

PACKAGE CODE	PIN COUNT	QUANTITIES	
		DEVICES PER TRAY	DEVICES PER BOX
B/B44	44-pin	50	500
B/B44	44-pin	96	480
B	52-pin	119	595
B	80-pin	66	330
B	100-pin	50	250
B	120-pin	24	120
B	120-pin (Philips source)	30	150

* Quad Flat Pack parts require dry pack handling according to EIA Standard - 583. These parts are identified in part list section with DRY PACK in the Cross Ref Part No field.

QUANTITIES SHOWN IN GRAY REQUIRE PURCHASE TO BE MADE IN EXACT MULTIPLES OF THAT QUANTITY.