Document No.	853–0682
ECN No.	99799
Date of Issue	June 14, 1990
Status	Product Specification
ECL Products	

10180
Adder/Subtractor

Dual 2-Bit Adder/Subtractor

FEATURES

- **Typical propagation delay: A_n, B_n to C_{OUT} 4.5ns**
- **Typical supply current ($-I_{EE}$): 70mA**

DESCRIPTION

The 10180 is a high-speed, low power, general purpose adder/subtractor. Inputs for each adder are: Carry-in (C_{0IN}, C_{1IN}), Operand A (A_0, A_1), Operand B (B_0, B_1). Outputs are Sum (F_0, F_1), $\overline{Sum}$ ($\overline{F_0}$, $\overline{F_1}$) and Carry-out (C_{0OUT}, C_{1OUT}). Common select inputs act as controlled lines to invert A or B for subtraction. A very high-speed operation is possible with Operand in the Sum or Carryout propagation delay of 4.5ns, and Carry-in to Carry-out propagation delay of 2.2ns. The 10180 is designed to be used in special purpose adder/subtractor or in high-speed multiplier arrays.

All unused inputs can be left open due to integrated pull-down resistors which avoid the need for a supply voltage.

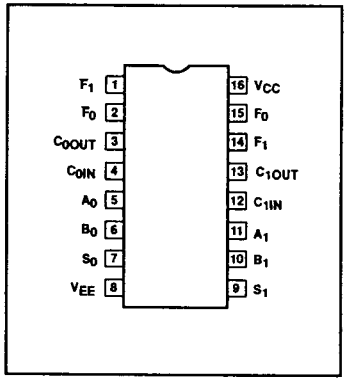
ORDERING INFORMATION

DESCRIPTION	ORDER CODE
16-Pin Plastic DIP	10180N
16-Pin Ceramic DIP	10180F

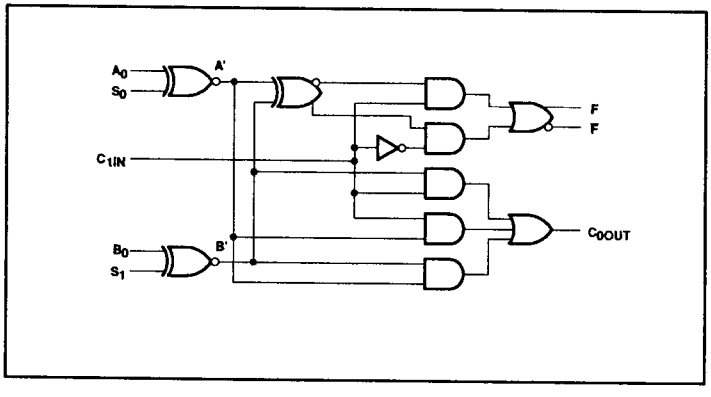
PIN DESCRIPTION

PINS	DESCRIPTION
A_0, A_1	A Operand Inputs
B_0, B_1	B Operand Inputs
S_0, S_1	Select Inputs
C_{0IN}, C_{1IN}	Carry-in Inputs
C_{0OUT}, C_{1OUT}	Carry-out Outputs
F_0, $\overline{F_0}$, F_1, $\overline{F_1}$	Sum Outputs

PIN CONFIGURATION



LOGIC DIAGRAM



Adder/Subtractor 10180

FUNCTION SELECT TABLE

INPUTS		OUTPUTS
S_0	S_1	FUNCTIONS F
H	H	$A + B + C_{IN}$
H	L	$C_{IN} + A - B$
L	H	$C_{IN} + B - A$
L	L	$C_{IN} - A - B$

H = High Voltage Level
L = Low Voltage Level
$A' = \overline{A \oplus S_0} = A \odot S_0$
$B' = \overline{B \oplus S_1} = B \odot S_1$
Both positive and negative logic:
$F = \overline{C}_{IN} (\overline{A}\,'B\,' + A\,'\overline{B}\,') + C_{IN} (A\,'B\,' + \overline{A}\,'\overline{B}\,')$
$C_{OUT} = C_{IN}A\,' + C_{IN}\,B\,' + A\,'B\,'$

FUNCTION TABLE

FUNCTION	INPUTS					OUTPUTS		
	S_0	S_1	A	B	C_{IN}	F	$\overline{F}$	C_{OUT}
ADD $(A + B + C_1)$	H	H	L	L	L	L	H	L
	H	H	L	L	H	H	L	L
	H	H	L	H	L	H	L	L
	H	H	L	H	H	L	H	H
	H	H	H	L	L	H	L	L
	H	H	H	L	H	L	H	H
	H	H	H	H	L	L	H	H
	H	H	H	H	H	H	L	H
SUBTRACT $(C_1 + A - B)$	H	L	L	L	L	H	L	L
	H	L	L	L	H	L	H	H
	H	L	L	H	L	L	H	L
	H	L	L	H	H	H	L	L
	H	L	H	L	L	L	H	H
	H	L	H	L	H	H	L	H
	H	L	H	H	L	H	L	H
	H	L	H	H	H	L	H	H
Reverse SUBTRACT $(C_1 + B - A)$	L	H	L	L	L	H	L	L
	L	H	L	L	H	L	H	H
	L	H	L	H	L	L	H	H
	L	H	L	H	H	H	L	H
	L	H	H	L	L	L	H	L
	L	H	H	L	H	H	L	L
	L	H	H	H	L	H	L	L
	L	H	H	H	H	L	H	H
$(C_1 - A - B)$	L	L	L	L	L	L	H	H
	L	L	L	L	H	H	L	H
	L	L	L	H	L	H	L	L
	L	L	L	H	H	L	H	H
	L	L	H	L	L	H	L	L
	L	L	H	L	H	L	H	H
	L	L	H	H	L	L	H	L
	L	L	H	H	H	H	L	H

ABSOLUTE MAXIMUM RATINGS

SYMBOL	PARAMETER		LIMITS	UNIT
V_{EE}	Supply voltage		–8.0	V
V_{IN}	Input voltage (V_{IN} should never be more negative than V_{EE})		0 to V_{EE}	V
I_O	Output source current (continuous)		–50	mA
T_S	Storage temperature range		–55 to +150	°C
T_J	Maximum junction temperature	Ceramic Package	+165	°C
		Plastic Package	+150	°C

NOTE:
Operation beyond the limits set forth in this table may impair the useful life of the device. Unless otherwise noted, these limits are specified over the operating ambient temperature range.

DC OPERATING CONDITIONS

SYMBOL	PARAMETER	TEST CONDITIONS	LIMITS MIN.	LIMITS NOM.	LIMITS MAX.	UNIT
V_{CC}	Circuit ground		0	0	0	V
V_{EE}	Supply voltage (negative)			–5.2		V
V_{IH}	High level input voltage	T_A = –30°C			–890	mV
		T_A = +25°C			–810	mV
		T_A = +85°C			–700	mV
V_{IHT}	High level input threshold voltage	T_A = –30°C	–1205			mV
		T_A = +25°C	–1105			mV
		T_A = +85°C	–1035			mV
V_{ILT}	Low level input threshold voltage	T_A = –30°C			–1500	mV
		T_A = +25°C			–1475	mV
		T_A = +85°C			–1440	mV
V_{IL}	Low level input voltage	T_A = –30°C	–1890			mV
		T_A = +25°C	–1850			mV
		T_A = +85°C	–1825			mV
T_A	Operating ambient temperature range		–30	+25	+85	°C

NOTE:
When operating at other than the specified V_{EE} voltage (–5.2V), the DC and AC Electrical Characteristics will vary slightly from specified values.

DC ELECTRICAL CHARACTERISTICS

V_{CC} = ground, V_{EE} = –5.2V ± 0.010V, T_A = –30°C to +85°C output loading with 50Ω to –2.0V ± 0.010V unless otherwise specified[1,3]

SYMBOL	PARAMETER		TEST CONDITIONS[2]		LIMITS MIN.	LIMITS TYP.	LIMITS MAX.	UNIT
V_{OH}	High level output voltage		T_A = –30°C	Using V_{IHMAX} and V_{ILMIN}, apply a functional	–1060		–890	mV
			T_A = +25°C	pattern as indicated in the FUNCTION TABLE	–960		–810	mV
			T_A = +85°C	and measure V_{OH} on the respective outputs.	–890		–700	mV
V_{OHT}	High level output threshold voltage		T_A = –30°C	Apply V_{IHT} or V_{ILT} to one input at a time while	–1080			mV
			T_A = +25°C	applying V_{IHMAX} or V_{ILMIN} to all other inputs in accordance with the FUNCTION TABLE and	–980			mV
			T_A = +85°C	measure V_{OHT} on the respective outputs.	–910			mV
V_{OLT}	Low level output threshold voltage		T_A = –30°C	Apply V_{ILT} or V_{IHT} to one input at a time while			–1655	mV
			T_A = +25°C	applying V_{IHMAX} or V_{ILMIN} to all other inputs in accordance with the FUNCTION TABLE and			–1630	mV
			T_A = +85°C	measure V_{OLT} on the respective outputs.			–1595	mV
V_{OL}	Low level output voltage		T_A = –30°C	Using V_{IHMAX} and V_{ILMIN}, apply a functional	–1890		–1675	mV
			T_A = +25°C	pattern as indicated in the FUNCTION TABLE	–1850		–1650	mV
			T_A = +85°C	and measure V_{OL} on the respective outputs.	–1825		–1615	mV
I_{IH}	High level input current	C_{0IN}, C_{1IN} outputs	T_A = –30°C	Apply V_{IHMAX} to each input under test, one at a time, with V_{ILMIN} applied to all other inputs.			590	µA
			T_A = +25°C				370	µA
			T_A = +85°C				370	µA
		A_0, A_1, B_0, B_1 inputs	T_A = –30°C				350	µA
			T_A = +25°C				220	µA
			T_A = +85°C				220	µA
		S_0, S_1 inputs	T_A = –30°C				460	µA
			T_A = +25°C				290	µA
			T_A = +85°C				290	µA
I_{IL}	Low level input current		T_A = –30°C	Apply V_{ILMIN} to each input under test, one at a time, with V_{IHMAX} applied to all other inputs.	0.5			µA
			T_A = +25°C		0.5			µA
			T_A = +85°C		0.3			µA
$-I_{EE}$	V_{EE} supply current		T_A = –30°C				95	mA
			T_A = +25°C			70	86	mA
			T_A = +85°C				95	mA
$\frac{\Delta V_{OH}}{\Delta V_{EE}}$	High level output voltage compensation		T_A = +25°C			0.016		V/V
$\frac{\Delta V_{OL}}{\Delta V_{EE}}$	Low level output voltage compensation					0.250		V/V
$\frac{\Delta V_{BB}}{\Delta V_{EE}}$	Reference bias voltage compensation					0.148		V/V

NOTES:

1. The specified limits represent the worst case values for the parameter. Since these worst case values normally occur at the supply voltage and temperature extremes, additional noise immunity can be achieved by decreasing the allowable operating condition ranges.
2. Conditions for testing shown in the tables are not necessarily worst case. For worst case testing guidelines, refer to DC Testing, Chapter 1, Section 3.
3. The specified limits shown in the DC Electrical Characteristics table can be met only after thermal equilibrium has been established. Thermal equilibrium is established by applying power for at least 2 minutes, while maintaining transverse airflow of 2.5 meters/sec (500 linear feet/min) over the device, mounted either in a test socket or on a printed circuit board. Test voltage values are given in the DC Operating Conditions table.

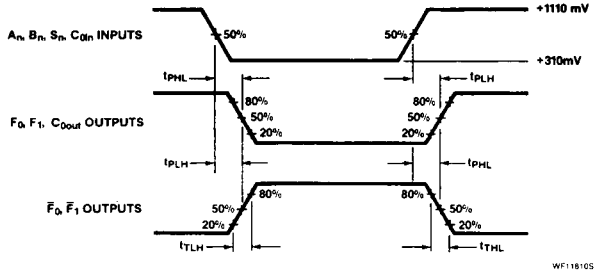
Adder/Subtractor 10180

AC ELECTRICAL CHARACTERISTICS V_{CC} = ground, V_{EE} = –5.2V ± 0.010V

SYMBOL	PARAMETER	TEST CONDITIONS	LIMITS							UNIT
			T_A = –30°C		T_A = +25°C			T_A = +85°C		
			MIN.	MAX.	MIN.	TYP.	MAX.	MIN.	MAX.	
t_{PLH} t_{PHL}	Propagation delay A_0, A_1, B_0, B_1 to F_0, F_1	Waveform 1	1.30 1.30	5.80 5.80	1.30 1.30	4.50 4.50	5.40 5.40	1.10 1.10	5.80 5.80	ns ns
t_{PLH} t_{PHL}	Propagation delay C_{0IN} to C_{0OUT}		1.00 1.00	3.40 3.40	1.00 1.00	2.20 2.20	3.30 3.30	0.90 0.90	3.60 3.60	ns ns
t_{PLH} t_{PHL}	Propagation delay S_0, S_1 to F_0, F_1		1.30 1.30	5.80 5.80	1.30 1.30	4.50 4.50	5.40 5.40	1.10 1.10	5.80 5.80	ns ns
t_{TLH} t_{THL}	Transition time 20% to 80%, 80% to 20%		1.00 1.00	3.80 3.80	1.10 1.10	2.40 2.40	3.70 3.70	1.10 1.10	3.90 3.90	ns ns

NOTE:
For AC test setup information, see AC Testing, Chapter 2, Section 3.

AC WAVEFORMS



Waveform 1. Propagation Delay and Transition Times for Operands, Selects, and Carry–in Inputs to Carry–out and Sum Outputs