National Semiconductor

MILITARY DATA SHEET

MN54F181-X REV 1A0

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4-BIT ARITHMETIC LOGIC UNIT

General Description

The F181 is a 4-bit Arithmetic logic Unit (ALU) which can perform all the possible 16 logic operations on two variables and a variety of arithmetic operations. It is 40% faster than the Schottky ALU and only consumes 30% as mucc power.

Industry Part Number

54F181

NS Part Numbers

54F181DMQB
54F181FMQB
54F181LMQB

Prime Die

M181

Processing

MIL-STD-883, Method 5004

Quality Conformance Inspection

MIL-STD-883, Method 5005

Subgrp	Description	Temp (°C)
1	Static tests at	+25
2	Static tests at	+125
3	Static tests at	-55
4	Dynamic tests at	+25
5	Dynamic tests at	+125
6	Dynamic tests at	-55
7	Functional tests at	+25
8A	Functional tests at	+125
8B	Functional tests at	-55
9	Switching tests at	+25
10	Switching tests at	+125
11	Switching tests at	-55

Features

- Full lookahead for high-speed arithmetic operation on long words

(Absolute Maximum Ratings)

(Note 1)

Storage Temperature	-65 C to +150 C
Ambient Temperature under Bias	-55 C to +125 C
Junction Temperature under Bias	-55 C to +175 C
Vcc Pin Potential to Ground Pin	-0.5V to +7.0V
Input Voltage (Note 2)	-0.5V to +7.0V
Input Current (Note 2)	-30 mA to +5.0mA
Voltage Applied to Output in HIGH State (with Vcc=0V)	
Standard Output	-0.5V to Vcc
TRI-STATE Output	-0.5V to +5.5V
Current Applied to Output in LOW State (Max)	twice the rated Iol(mA)
ESD Last Passing Voltage (Min)	4000V

Note 1: Absolute Maximum ratings are those values beyond which the device may be damaged or have its useful life impaired. Functional operation under these conditions is not implied.

Note 2: Either voltage limit or current limit is sufficient to protect inputs.

Recommended Operating Conditions

Free Air Ambient Temperature	
Commercial	0 C to +70 C
Military	-55 C to +125 C
Supply Voltage	
Military	+4.5V to +5.5V
Commercial	+4.5V to +5.5V

Electrical Characteristics

DC PARAMETER

(The following conditions apply to all the following parameters, unless otherwise specified.)
DC: VCC 4.5V to 5.5V, Temp range: -55C to 125C

SYMBOL	PARAMETER	CONDITIONS	NOTES	PIN-NAME	MIN	MAX	UNIT	SUB-GROUPS
IIH	Input High Current	VCC=5.5V, VM=2.7V, VINH=5.5V, VINL=0.0V	1, 3	INPUTS		20	uA	1, 2, 3
IBVI	Input High Current	VCC=5.5V, VM=7.0V, VINH=5.5V, VINL=0.0V	1, 3	INPUTS		100	uA	1, 2, 3
IIL	Input LOW Current	VCC=5.5V, VM=0.5V, VINH=5.5V, VINL=0.0V	1, 3	M INPUTS		-0.6	mA	1, 2, 3
IIL3	Input LOW Current	VCC=5.5V, VM=0.5V, VINH=5.5V, VINL=0.0V	1, 3	$\overline{A}$n, $\overline{B}$n INPUTS		-1.8	mA	1, 2, 3
IIL4	Input LOW Current	VCC=5.5V, VM=0.5V, VINH=5.5V, VINL=0.0V	1, 3	Sn INPUTS		-2.4	mA	1, 2, 3
IIL5	Input LOW Current	VCC=5.5V, VM=0.5V, VINH=5.5V, VINL=0.0V	1, 3	Cn INPUTS		-3.0	mA	1, 2, 3
VOL	Output LOW Voltage	VCC=4.5V, VIL=0.8V, VIH=2.0V, IOL=20mA, VINL=0.0V, VINH=5.5V	1, 3	ALL OUTPUTS		0.5	V	1, 2, 3
IOH	Output OFF Leakage tests, Open Collector	VCC=4.5V, VOUT=4.5V, VIL=0.8V, VIH=2.0V, VINL=0.0V, VINH=5.5V	1, 3	A=B OUTPUTS		250	uA	1, 2, 3
VOH	Output HIGH Voltage	VCC=4.5V, VIL=0.8V, VIH=2.0V, IOH=-1mA, VINL=0.0V, VINH=5.5V	1, 3	OTHER OUTPUTS	2.5		V	1, 2, 3
ICEX	Output HIGH Leakage Current	VCC=5.5V, VINH=5.5V, VINL=0.0V, VM=5.5V ($\overline{F}$, $\overline{G}$, $\overline{P}$, Cn+4)	1, 3	Outputs		250	uA	1, 2, 3
IOS	Short Circuit Current	VCC=5.5V, VINH=5.5V, VINL=0.0V, VM=0.0V	1, 3	OUTPUTS EXCEPT A=B	-60	-150	mA	1, 2, 3
VCD	Input Clamp Diode Voltage	VCC=4.5V, IM=-18mA, VINH=5.5V	1, 3	INPUTS		-1.2	V	1, 2, 3
ICCH	Power Supply Current	VCC=5.5V, VINL=0.0V, VINH=5.5V	1, 3	VCC		65	mA	1, 2, 3
ICCL	Power Supply Current	VCC=5.5V, VINL=0.0V, VINH=5.5V	1, 3	VCC		65	mA	1, 2, 3

AC PARAMETER

(The following conditions apply to all the following parameters, unless otherwise specified.)
AC: CL=50pf, RL=500 OHMS, TR=2.5ns, TF=2.5ns SEE AC FIGS

tpLH(1)	Propagation Delay	VCC=5.0V @25C, VCC=4.5V & 5.5V @-55/125C	2, 4	Cn to Cn+4	3.0	8.5	ns	9
			2, 4	Cn to Cn+4	3.0	10.0	ns	10, 11

Electrical Characteristics

AC PARAMETER(Continued)

(The following conditions apply to all the following parameters, unless otherwise specified.)
AC: CL=50pf, RL=500 OHMS, TR=2.5ns, TF=2.5ns SEE AC FIGS

SYMBOL	PARAMETER	CONDITIONS	NOTES	PIN-NAME	MIN	MAX	UNIT	SUB-GROUPS
tpHL(1)	Propagation Delay	VCC= 5.0V @25C, VCC=4.5V & 5.5V @-55/125C	2, 4	Cn to Cn+4	3.0	8.0	ns	9
			2, 4	Cn to Cn+4	3.0	9.5	ns	10, 11
tpLH(2)	Propagation Delay $\overline{A}$ or $\overline{B}$ to Cn+4 (Sum)	VCC= 5.0V @25C, VCC=4.5V & 5.5V @-55/125C	2, 4		5.0	13.0	ns	9
tpLH(2)	Propagation Delay $\overline{A}$ or $\overline{B}$ to Cn+4 (Sum)	VCC= 5.0V @25C, VCC=4.5V & 5.5V @-55/125C	2, 4		5.0	15.5	ns	10, 11
tpHL(2)	Propagation Delay $\overline{A}$ or $\overline{B}$ to Cn+4 (Sum)	VCC= 5.0V @25C, VCC=4.5V & 5.5V @-55/125C	2, 4		3.5	12.0	ns	9
tpHL(2)	Propagation Delay $\overline{A}$ or $\overline{B}$ to Cn+4 (Sum)	VCC= 5.0V @25C, VCC=4.5V & 5.5V @-55/125C	2, 4		3.5	16.5	ns	10, 11
tpLH(3)	Propagation Delay $\overline{A}$ or $\overline{B}$ to Cn+4 (Dif)	VCC= 5.0V @25C, VCC=4.5V & 5.5V @-55/125C	2, 4		5.0	14.0	ns	9
tpLH(3)	Propagation Delay $\overline{A}$ or $\overline{B}$ to Cn+4 (Dif)	VCC= 5.0V @25C, VCC=4.5V & 5.5V @-55/125C	2, 4		5.0	17.0	ns	10, 11
tpHL(3)	Propagation Delay $\overline{A}$ or $\overline{B}$ to Cn+4 (Dif)	VCC= 5.0V @25C, VCC=4.5V & 5.5V @-55/125C	2, 4		5.0	13.0	ns	9
tpHL(3)	Propagation Delay $\overline{A}$ or $\overline{B}$ to Cn+4 (Dif)	VCC= 5.0V @25C, VCC=4.5V & 5.5V @-55/125C	2, 4		4.0	15.0	ns	10, 11
tpLH(4)	Propagation Delay	VCC= 5.0V @25C, VCC=4.5V & 5.5V @-55/125C	2, 4	Cn to $\overline{F}$ (Any)	3.0	8.5	ns	9
			2, 4	Cn to $\overline{F}$ (Any)	2.5	16.0	ns	10, 11
tpHL(4)	Propagation Delay	VCC= 5.0V @25C, VCC=4.5V & 5.5V @-55/125C	2, 4	Cn to $\overline{F}$ (Any)	3.0	8.5	ns	9
			2, 4	Cn to $\overline{F}$ (Any)	2.5	12.0	ns	10, 11
tpLH(5)	Propagation Delay $\overline{A}$ or $\overline{B}$ to $\overline{G}$ (Sum)	VCC= 5.0V @25C, VCC=4.5V & 5.5V @-55/125C	2, 4		2.5	7.5	ns	9
tpLH(5)	Propagation Delay $\overline{A}$ or $\overline{B}$ to $\overline{G}$ (Sum)	VCC= 5.0V @25C, VCC=4.5V & 5.5V @-55/125C	2, 4		2.5	9.0	ns	10, 11

Electrical Characteristics

AC PARAMETER(Continued)

(The following conditions apply to all the following parameters, unless otherwise specified.)
AC: CL=50pf, RL=500 OHMS, TR=2.5ns, TF=2.5ns SEE AC FIGS

SYMBOL	PARAMETER	CONDITIONS	NOTES	PIN-NAME	MIN	MAX	UNIT	SUB-GROUPS
tpHL(5)	Propagation Delay $\overline{A}$ or $\overline{B}$ to $\overline{G}$ (Sum)	VCC= 5.0V @25C, VCC=4.5V & 5.5V @-55/125C	2, 4		2.5	7.5	ns	9
tpHL(5)	Propagation Delay $\overline{A}$ or $\overline{B}$ to $\overline{G}$ (Sum)	VCC= 5.0V @25C, VCC=4.5V & 5.5V @-55/125C	2, 4		2.5	9.5	ns	10, 11
tpLH(6)	Propagation Delay $\overline{A}$ or $\overline{B}$ to $\overline{G}$ (Dif)	VCC= 5.0V @25C, VCC=4.5V & 5.5V @-55/125C	2, 4		3.0	9.0	ns	9
tpLH(6)	Propagation Delay $\overline{A}$ or $\overline{B}$ to $\overline{G}$ (Dif)	VCC= 5.0V @25C, VCC=4.5V & 5.5V @-55/125C	2, 4		2.5	11.5	ns	10, 11
tpHL(6)	Propagation Delay $\overline{A}$ or $\overline{B}$ to $\overline{G}$ (Dif)	VCC= 5.0V @25C, VCC=4.5V & 5.5V @-55/125C	2, 4		2.5	9.5	ns	9
tpHL(6)	Propagation Delay $\overline{A}$ or $\overline{B}$ to $\overline{G}$ (Dif)	VCC= 5.0V @25C, VCC=4.5V & 5.5V @-55/125C	2, 4		2.5	11.0	ns	10, 11
tpLH(7)	Propagation Delay $\overline{A}$ or $\overline{B}$ to $\overline{P}$ (Sum)	VCC= 5.0V @25C, VCC=4.5V & 5.5V @-55/125C	2, 4		2.5	7.0	ns	9
tpLH(7)	Propagation Delay $\overline{A}$ or $\overline{B}$ to $\overline{P}$ (Sum)	VCC= 5.0V @25C, VCC=4.5V & 5.5V @-55/125C	2, 4		2.5	8.5	ns	10, 11
tpHL(7)	Propagation Delay $\overline{A}$ or $\overline{B}$ to $\overline{P}$ (Sum)	VCC= 5.0V @25C, VCC=4.5V & 5.5V @-55/125C	2, 4		3.0	7.5	ns	9
tpHL(7)	Propagation Delay $\overline{A}$ or $\overline{B}$ to $\overline{P}$ (Sum)	VCC= 5.0V @25C, VCC=4.5V & 5.5V @-55/125C	2, 4		3.0	9.5	ns	10, 11
tpLH(8)	Propagation Delay $\overline{A}$ or $\overline{B}$ to $\overline{P}$ (Dif)	VCC= 5.0V @25C, VCC=4.5V & 5.5V @-55/125C	2, 4		2.5	8.0	ns	9
tpLH(8)	Propagation Delay $\overline{A}$ or $\overline{B}$ to $\overline{P}$ (Dif)	VCC= 5.0V @25C, VCC=4.5V & 5.5V @-55/125C	2, 4		2.5	11.0	ns	10, 11
tpHL(8)	Propagation Delay $\overline{A}$ or $\overline{B}$ to $\overline{P}$ (Dif)	VCC= 5.0V @25C VCC=4.5V & 5.5V @-55/125C	2, 4		3.0	8.5	ns	9
tpHL(8)	Propagation Delay $\overline{A}$ or $\overline{B}$ to $\overline{P}$ (Dif)	VCC= 5.0V @25C VCC=4.5V & 5.5V @-55/125C	2, 4		3.0	11.0	ns	10, 11
tpLH(9)	Propagation Delay $\overline{A}$1 or $\overline{B}$1 to $\overline{F}$1 (Sum)	VCC= 5.0V @25C, VCC=4.5V & 5.5V @-55/125C	2, 4		3.0	9.0	ns	9

Electrical Characteristics

AC PARAMETER(Continued)

(The following conditions apply to all the following parameters, unless otherwise specified.)
AC: CL=50pf, RL=500 OHMS, TR=2.5ns, TF=2.5ns SEE AC FIGS

SYMBOL	PARAMETER	CONDITIONS	NOTES	PIN-NAME	MIN	MAX	UNIT	SUB-GROUPS
tpLH(9)	Propagation Delay $\overline{A}1$ or $\overline{B}1$ to $\overline{F}1$ (Sum)	VCC= 5.0V @25C, VCC=4.5V & 5.5V @-55/125C	2, 4		3.0	14.5	ns	10, 11
tpHL(9)	Propagation Delay $\overline{A}1$ or $\overline{B}1$ to $\overline{F}1$ (Sum)	VCC= 5.0V @25C VCC=4.5V & 5.5V @-55/125C	2, 4		3.0	10.0	ns	9
tpHL(9)	Propagation Delay $\overline{A}1$ or $\overline{B}1$ to $\overline{F}1$ (Sum)	VCC= 5.0V @25C VCC=4.5V & 5.5V @-55/125C	2, 4		3.0	14.5	ns	10, 11
tpLH(10)	Propagation Delay $\overline{A}1$ or $\overline{B}1$ to $\overline{F}1$ (Dif)	VCC= 5.0V @25C, VCC=4.5V & 5.5V @-55/125C	2, 4		3.0	11.0	ns	9
tpLH(10)	Propagation Delay $\overline{A}1$ or $\overline{B}1$ to $\overline{F}1$ (Dif)	VCC= 5.0V @25C, VCC=4.5V & 5.5V @-55/125C	2, 4		3.0	17.5	ns	10, 11
tpHL(10)	Propagation Delay $\overline{A}1$ or $\overline{B}1$ to $\overline{F}1$ (Dif)	VCC= 5.0V @25C, VCC=4.5V & 5.5V @-55/125C	2, 4		3.0	11.0	ns	9
tpHL(10)	Propagation Delay $\overline{A}1$ or $\overline{B}1$ to $\overline{F}1$ (Dif)	VCC= 5.0V @25C, VCC=4.5V & 5.5V @-55/125C	2, 4		3.0	14.5	ns	10, 11
tpLH(11)	Propagation Delay $\overline{A}$ or $\overline{B}$ to Any $\overline{F}$ (sum)	VCC= 5.0V @25C, VCC=4.5V & 5.5V @-55/125C	2, 4		4.0	10.5	ns	9
tpLH(11)	Propagation Delay $\overline{A}$ or $\overline{B}$ to Any $\overline{F}$ (sum)	VCC= 5.0V @25C, VCC=4.5V & 5.5V @-55/125C	2, 4		3.5	16.5	ns	10, 11
tpHL(11)	Propagation Delay $\overline{A}$ or $\overline{B}$ to Any $\overline{F}$ (Sum)	VCC= 5.0V @25C, VCC=4.5V & 5.5V @-55/125C	2, 4		4.0	10.0	ns	9
tpHL(11)	Propagation Delay $\overline{A}$ or $\overline{B}$ to Any $\overline{F}$ (Sum)	VCC= 5.0V @25C, VCC=4.5V & 5.5V @-55/125C	2, 4		4.0	13.5	ns	10, 11
tpLH(12)	Propagation Delay $\overline{A}$ or $\overline{B}$ to Any $\overline{F}$ (Dif)	VCC= 5.0V @25C, VCC=4.5V & 5.5V @-55/125C	2, 4		4.0	12.0	ns	9
tpLH(12)	Propagation Delay $\overline{A}$ or $\overline{B}$ to Any $\overline{F}$ (Dif)	VCC= 5.0V @25C, VCC=4.5V & 5.5V @-55/125C	2, 4		3.5	17.5	ns	10, 11
tpHL(12)	Propagation Delay $\overline{A}$ or $\overline{B}$ to Any $\overline{F}$ (Dif)	VCC= 5.0V @25C, VCC=4.5V & 5.5V @-55/125C	2, 4		3.0	12.0	ns	9
tpHL(12)	Propagation Delay $\overline{A}$ or $\overline{B}$ to Any $\overline{F}$ (Dif)	VCC= 5.0V @25C, VCC=4.5V & 5.5V @-55/125C	2, 4		3.0	14.0	ns	10, 11

Electrical Characteristics

AC PARAMETER(Continued)

(The following conditions apply to all the following parameters, unless otherwise specified.)
AC: CL=50pf, RL=500 OHMS, TR=2.5ns, TF=2.5ns SEE AC FIGS

SYMBOL	PARAMETER	CONDITIONS	NOTES	PIN-NAME	MIN	MAX	UNIT	SUB-GROUPS
tpLH(13)	Propagation Delay $\overline{A}$ or $\overline{B}$ to $\overline{F}$ (Logic)	VCC= 5.0V @25C, VCC=4.5V & 5.5V @-55/125C	2, 4		3.5	9.5	ns	9
tpLH(13)	Propagation Delay $\overline{A}$ or $\overline{B}$ to $\overline{F}$ (Logic)	VCC= 5.0V @25C, VCC=4.5V & 5.5V @-55/125C	2, 4		3.5	14.5	ns	10, 11
tpHL(13)	Propagation Delay $\overline{A}$ or $\overline{B}$ to $\overline{F}$ (Logic)	VCC= 5.0V @25C, VCC=4.5V & 5.5V @-55/125C	2, 4		3.0	10.0	ns	9
tpHL(13)	Propagation Delay $\overline{A}$ or $\overline{B}$ to $\overline{F}$ (Logic)	VCC= 5.0V @25C, VCC=4.5V & 5.5V @-55/125C	2, 4		3.0	15.5	ns	10, 11
tpLH(14)	Propagation Delay $\overline{A}$ or $\overline{B}$ to A=B (Dif)	VCC= 5.0V @25C, VCC=4.5V & 5.5V @-55/125C	2, 4		11.0	27.0	ns	9
tpLH(14)	Propagation Delay $\overline{A}$ or $\overline{B}$ to A=B (Dif)	VCC= 5.0V @25C, VCC=4.5V & 5.5V @-55/125C	2, 4		8.0	35.0	ns	10, 11
tpHL(14)	Propagation Delay $\overline{A}$ or $\overline{B}$ to A=B (Dif)	VCC= 5.0V @25C, VCC=4.5V & 5.5V @-55/125C	2, 4		5.5	13.5	ns	9
tpHL(14)	Propagation Delay $\overline{A}$ or $\overline{B}$ to A=B (Dif)	VCC= 5.0V @25C, VCC=4.5V & 5.5V @-55/125C	2, 4		5.5	21.0	ns	10, 11

Note 1: Screen tested 100% on each device at +25C, +125C & -55C temperature, subgroups A1, 2, 3, 7 & 8.
Note 2: Screen tested 100% on each device at +25C temperature only, subgroup A9.
Note 3: Sample tested (Method 5005, Table 1) on each MFG. lot at +25C, +125C & -55C temperature, subgroups A1, 2, 3, 7 & 8.
Note 4: Sample tested (Method 5005, Table 1) on each MFG. lot at +25C subgroup A9, and periodically at +125C & -55C temperature, subgroups 10 & 11.