

PAL16R8

20-Pin TTL Programmable Array Logic

The PAL16R8 Family (PAL16L8, PAL16R8, PAL 16R6, PAL 16R4) is AMD's standard 20-pin PAL device family. The devices provide user-programmable logic for replacing conventional SSI/MSI gates and flip-flops at a reduced chip count.

The family allows the systems engineer to implement the design on-chip, by opening fuse links to configure AND and OR gates within the device, according to the desired logic function. Complex interconnections between gates, which previously required time-consuming layout, are lifted from the PC board and placed on silicon, where they can be easily modified during prototyping or production.

The PAL device implements the familiar Boolean logic transfer function, the sum of products. The PAL device is a programmable AND array driving a fixed OR array. The AND array is programmed to create custom product terms, while the OR array sums selected terms at the outputs.

Rochester Electronics Manufactured Components

Rochester branded components are manufactured using either die/wafers purchased from the original suppliers or Rochester wafers recreated from the original IP. All re-creations are done with the approval of the Original Component Manufacturer (OCM).

Parts are tested using original factory test programs or Rochester developed test solutions to guarantee product meets or exceeds the OCM data sheet.

Quality Overview

- ISO-9001
- AS9120 certification
- Qualified Manufacturers List (QML) MIL-PRF-35835
 - Class Q Military
 - Class V Space Level
- Qualified Suppliers List of Distributors (QSLD)
 - Rochester is a critical supplier to DLA and meets all industry and DLA standards.

Rochester Electronics, LLC is committed to supplying products that satisfy customer expectations for quality and are equal to those originally supplied by industry manufacturers.

The original manufacturer's datasheet accompanying this document reflects the performance and specifications of the Rochester manufactured version of this device. Rochester Electronics guarantees the performance of its semiconductor products to the original OCM specifications. 'Typical' values are for reference purposes only. Certain minimum or maximum ratings may be based on product characterization, design, simulation, or sample testing.

FOR REFERENCE ONLY

PAL16R8 Family

20-pin TTL Programmable Array Logic

Advanced Micro Devices

DISTINCTIVE CHARACTERISTICS

- As fast as 7.5 ns maximum propagation delay
- Popular 20-pin architectures: 16L8, 16R8, 16R6, 16R4
- Programmable replacement for high-speed TTL logic
- Power-up reset for initialization on most devices

- **■** Easy design with PALASM® software
- Programmable on standard PAL[®] device programmers
- 20-pin DIP and PLCC packages save space

GENERAL DESCRIPTION

The PAL16R8 Family (PAL16L8, PAL16R8, PAL16R6, PAL16R4) is AMD's standard 20-pin PAL device family. The devices provide user-programmable logic for replacing conventional SSI/MSI gates and flip-flops at a reduced chip count.

The family allows the systems engineer to implement the design on-chip, by opening fuse links to configure AND and OR gates within the device, according to the desired logic function. Complex interconnections between gates, which previously required time-consuming layout, are lifted from the PC board and placed on silicon, where they can be easily modified during prototyping or production.

The PAL device implements the familiar Boolean logic transfer function, the sum of products. The PAL device is a programmable AND array driving a fixed OR array. The AND array is programmed to create custom product terms, while the OR array sums selected terms at the outputs.

In addition, the PAL device provides the following options:

- Variable input/output pin ratio
- Programmable three-state outputs
- Registers with feedback

Product terms with all connections opened assume the logical HIGH state; product terms connected to both true and complement of any single input assume the logical LOW state. Registers consist of D-type flip-flops that are loaded on the LOW-to-HIGH transition of the clock. Unused input pins should be tied to Vcc or GND.

The entire PAL device family is supported by the PALASM software package. The PAL family is programmed on conventional PAL device programmers with appropriate personality and socket adapter modules. See the Programmer Reference Guide for approved programmers. Once the PAL device is programmed and verified an additional connection may be opened to prevent pattern readout. This feature secures proprietary circuits.

PRODUCT SELECTOR GUIDE

DEVICE	DEDICATED INPUTS	OUTPUTS	PRODUCT TERMS/ OUTPUT	FEEDBACK	ENABLE
PAL16L8	10	6 comb. 2 comb.	7 7	1/0	prog. prog.
PAL16R8	8	8 reg.	8	reg.	pin
PAL16R6	8	6 reg. 2 comb.	8 7	reg. I/O	pin prog.
PAL16R4	8	4 reg. 4 comb.	8 7	reg. I/O	pin prog.

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PERFORMANCE OPTIONS

(Commercial)

Speed (t_{PD}, ns)

35	B–4	A-2	
25		B-2	Α
15		H-15	В
10			D
7.5			-7
	55	80-100	155-180

Power (I_{CC}, mA)

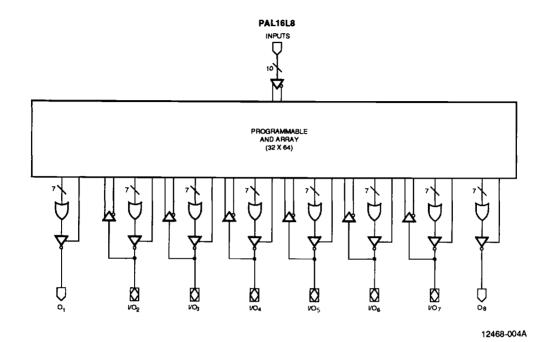
Note:

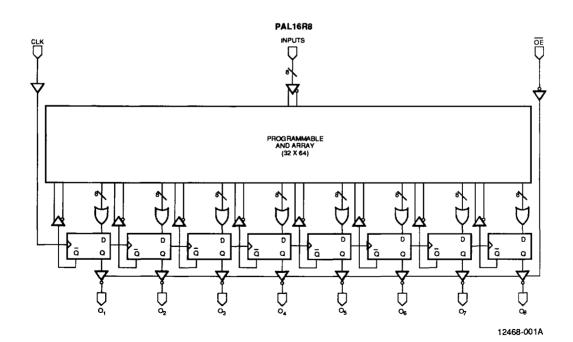
For low power and high speed, the EE CMOS PALCE16V8 can directly replace the PAL16R8 Family.

OPERATING RANGES

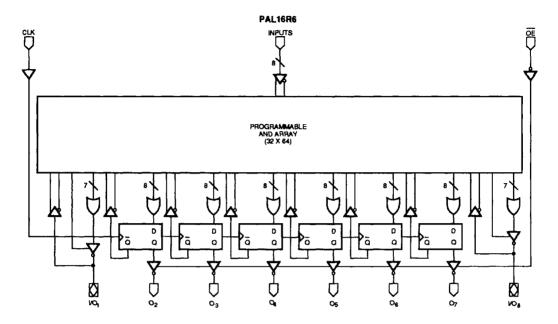
Commercial	Military
-7	-12
D (10 ns)	D (15 ns)
H-15	
B (15 ns)	B (20 ns)
B-2 (25 ns)	B-2 (30 ns)
A (25 ns)	A (30 ns)
B-4 (35 ns)	B-4 (50 ns)
A-2 (35 ns)	A-2 (50 ns)

BLOCK DIAGRAMS

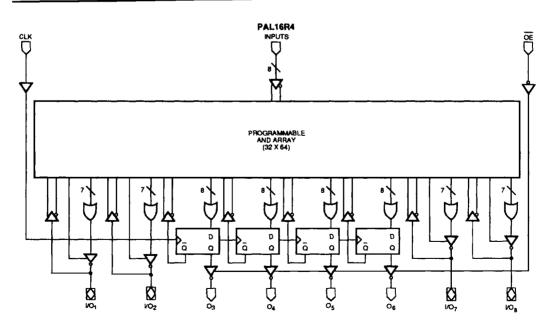




BLOCK DIAGRAMS



12468-002A



12468-003A

CONNECTION DIAGRAMS Top View

17 [

18

GND

8

9

10

DIP/FLATPACK (NOTE 1) 20 V_{CC} 4 2 19 (NOTE 10) 12 3 18 (NOTE 9) 13 [17 (NOTE 8) 14 5 16 (NOTE 7) 15 6 15 (NOTE 6) 7 (NOTE 5) 16 14 (NOTE 4)

13

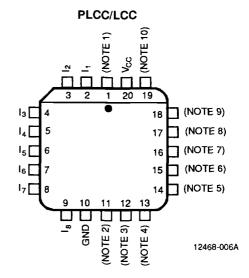
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12468-005A

(NOTE 3)

(NOTE 2)



Note	16L8	16R8	16R6	16R4
1	lo	CLK	CLK	CLK
2	lg	ŌĒ	ŌĒ	ŌĒ
3	O ₁	O ₁	I/O ₁	I/O ₁
4	I/O ₂	O ₂	O ₂	I/O ₂
5	I/O ₃	O ₃	О3	O ₃
6	I/O ₄	O ₄	04	O ₄
7	I/O ₅	O ₅	O ₅	O ₅
8	I/O ₆	O ₆	O ₆	O ₆
9	I/O ₇	O ₇	O ₇	1/07
10	O ₈	Ов	1/O ₈	I/O ₈

PIN DESIGNATIONS

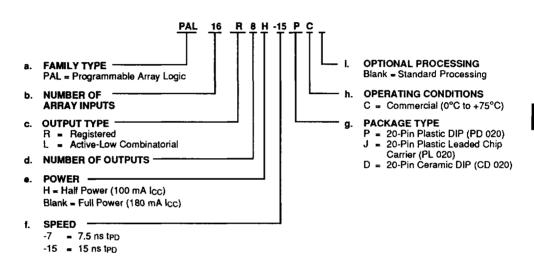
CLK	Clock
GND	Ground
1	Input
1/0	Input/Output
0	Output
ŌĒ	Output Enable
Vcc	Supply Voltage

ORDERING INFORMATION

Commercial Products (AMD Marking Only)

AMD programmable logic products for commercial applications are available with several ordering options. The order number (Valid Combination) is formed by a combination of:

- a. Family Type
- b. Number of Array Inputs
- c. Output Type
- d. Number of Outputs
- e. Power
- f. Speed
- g. Package Type
- h. Operating Conditions
- i. Optional Processing



Valid Combinations					
PAL16L8					
PAL16R8	-7, H-15	PC, JC, DC			
PAL16R6	-7, 11-15	PO, 30, DC			
PAL16R4					

Valid Combinations

The Valid Combinations table lists configurations planned to be supported in volume for this device. Consult the local AMD sales office to confirm availability of specific valid combinations, and to check on newly released combinations.

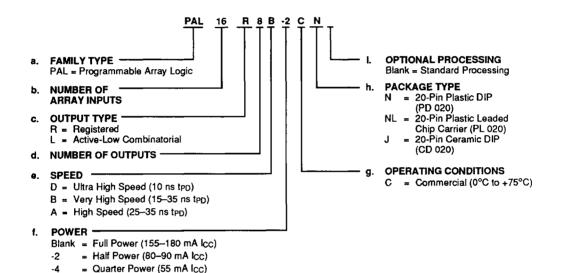
Note: Marked with AMD logo.

ORDERING INFORMATION

Commercial Products (MMI Marking Only)

AMD programmable logic products for commercial applications are available with several ordering options. The order number (Valid Combination) is formed by a combination of: **a.** Family Type

- b. Number of Array Inputs
- c. Output Type
- d. Number of Outputs
- e. Speed
- i. Power
- g. Operating Conditions
- h. Package Type
- I. Optional Processing



Valid Combinations						
PAL16L8	D, B	CN, CNL, CJ				
PAL16R8	B-2, A					
PAL16R6	B-4, A-2					
PAL16R4						

Valid Combinations

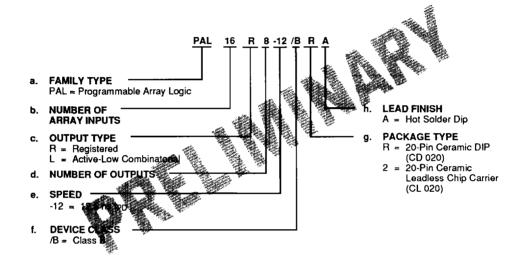
The Valid Combinations table lists configurations planned to be supported in volume for this device. Consult the local AMD sales office to confirm availability of specific valid combinations, and to check on newly released combinations.

Note: Marked with MMI logo.

ORDERING INFORMATION **APL Products (AMD Marking Only)**

AMD programmable logic products for Aerospace and Defense applications are available with several ordering options. APL (Approved Products List) products are fully compliant with MIL-STD-883 requirements. The order number (Valid Combination) is formed by a combination of: a. Family Type

- b. Number of Array Inputs
- c. Output Type
- d. Number of Outputs
- e. Speed
- **Device Class**
- g. Package Type
- h. Lead Finish



Valid Combinations					
PAL16L8					
PAL16R8	-12	/BRA, /82A			
PAL16R6	-12	76NA, 762A			
PAL16R4					

Valid Combinations

The Valid Combinations table lists configurations planned to be supported in volume for this device. Consult the local AMD sales office to confirm availability of specific valid combinations, to check on newly released combinations, and to obtain additional data on AMD's standard military grade products.

Note: Marked with AMD logo.

Group A Tests

Group A Tests consist of Subgroups: 1, 2, 3, 7, 8, 9, 10, 11.

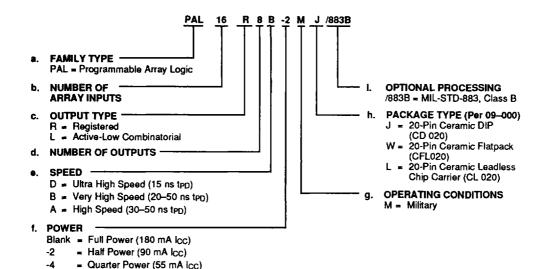
Military Burn-In

Military burn-in is in accordance with the current revision of MIL-STD-883, Test Methods 1015, Conditions A through E. Test conditions are selected at AMD's option.

ORDERING INFORMATION APL Products (MMI Marking Only)

AMD programmable logic products for Aerospace and Defense applications are available with several ordering options. APL (Approved Products List) products are fully compliant with MIL-STD-883 requirements. The order number (Valid Combination) is formed by a combination of:

- a. Family Type
- b. Number of Array Inputs
- c. Output Type
- d. Number of Outputs
- e. Speed
- f. Power
- g. Operating Conditions
- h. Package Type
- I. Optional Processing



Valid Combinations					
PAL16L8	D, B,	MJ/883B,			
PAL16R8	B-2, A,	MW/883B,			
PAL16R6	B-4, A-2	ML/883B			
PAL16R4]				

Valid Combinations

The Valid Combinations table lists configurations planned to be supported in volume for this device. Consult the local AMD sales office to confirm availability of specific valid combinations, to check on newly released combinations, and to obtain additional information on AMD's Standard Military grade products.

Note: Marked with MMI logo.

Group A Tests

Group A Tests consist of Subgroups: 1, 2, 3, 7, 8, 9, 10, 11.

Military Burn-In

Military burn-in is in accordance with the current revision of MIL-STD-883, Test Methods 1015, Conditions A through E. Test conditions are selected at AMD's option.

FUNCTIONAL DESCRIPTION Standard 20-pin PAL Family

The standard bipolar 20-pin PAL family devices have common electrical characteristics and programming procedures. Four different devices are available, including both registered and combinatorial devices. All parts are produced with a fuse link at each input to the AND gate array, and connections may be selectively removed by applying appropriate voltages to the circuit. Utilizing an easily-implemented programming algorithm, these products can be rapidly programmed to any customized pattern. Information on approved programmers can be found in the Programmer Reference Guide. Extra test words are pre-programmed during manufacturing to ensure extremely high field programming yields, and provide extra test paths to achieve excellent parametric correlation.

Variable Input/Output Pin Ratio

The registered devices have eight dedicated input lines, and each combinatorial output is an I/O pin. The PAL16L8 has ten dedicated input lines and six of the eight combinatorial outputs are I/O pins. Buffers for device inputs have complementary outputs to provide user-programmable input signal polarity. Unused input pins should be tied to Vcc or GND.

Programmable Three-State Outputs

Each output has a three-state output buffer with three-state control. On combinatorial outputs, a product term controls the buffer, allowing enable and disable to be a function of any product of device inputs or output feedback. The combinatorial output provides a bidirectional I/O pin and may be configured as a dedicated input if the output buffer is always disabled. On registered outputs, an input pin controls the enabling of the three-state outputs.

Registers with Feedback

Registered outputs are provided for data storage and synchronization. Registers are composed of D-type flip-flops that are loaded on the LOW-to-HIGH transition of the clock input.

Power-Up Reset

Applies to -7 (-12 Mil), H-15, B, B-2, A, A-2 Series Only

All flip-flops power-up to a logic LOW for predictable system initialization. Outputs of the listed Series will be

HIGH due to the active-low outputs. The V_{CC} rise must be monotonic and the reset delay time is 1000 ns maximum.

Register Preload

Applies to -7 (-12 Mil), H-15 Series Only

The register on the listed Series can be preloaded from the output pins to facilitate functional testing of complex state machine designs. This feature allows direct loading of arbitrary states, making it unnecessary to cycle through long test vector sequences to reach a desired state. In addition, transitions from illegal states can be verified by loading illegal states and observing proper recovery.

Security Fuse

After programming and verification, a PAL16R8 Family design can be secured by programming the security fuse. Once programmed, this fuse defeats readback of the internal programmed pattern by a device programmer, securing proprietary designs from competitors. When the security fuse is programmed, the array will read as if every fuse is intact. Exceptions are the -7 (-12 Mil) Series, where the array will read as if every fuse is programmed.

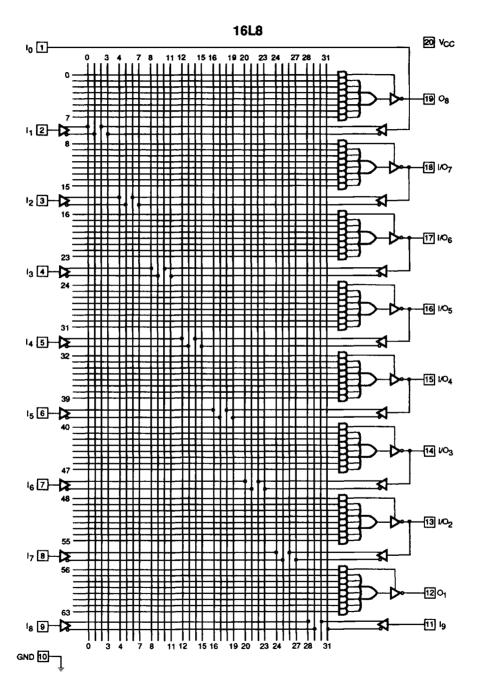
Quality and Testability

The PAL16R8 Family offers a very high level of built-in quality. Extra programmable fuses provide a means of verifying performance of all AC and DC parameters. In addition, this verifies complete programmability and functionality of the device to provide the highest programming yields and post-programming functional yields in the industry.

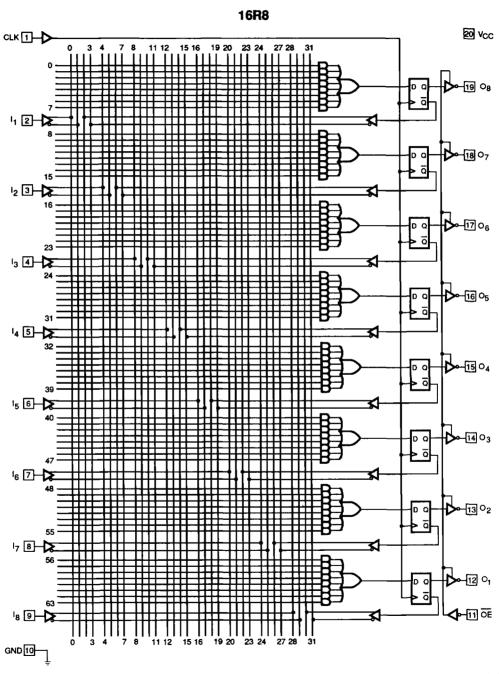
Technology

The high-speed -7 (-12 Mil), D, and H-15 Series are fabricated with AMD's advanced oxide-isolated bipolar process. This process reduces parasitic capacitances and minimum geometries to provide higher performance. The array connections are formed with proven PtSi fuses for the -7 Series and TiW fuses for the D and H-15 Series. The remaining Series are fabricated with AMD's junction-isolated process, utilizing TiW fuses.

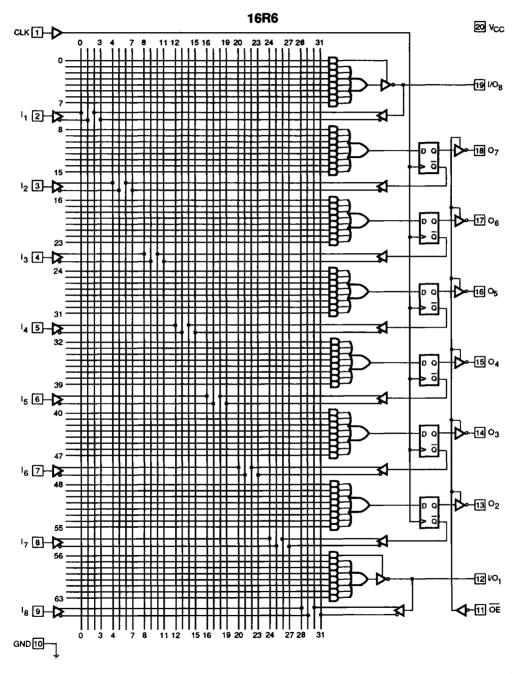
LOGIC DIAGRAM



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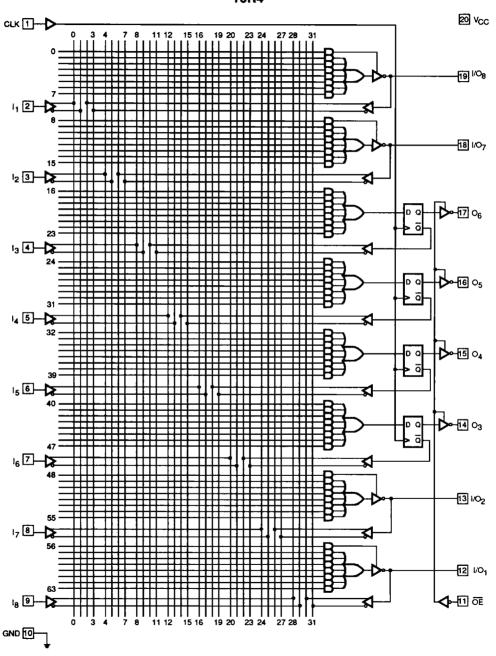


12468-013A



12468-014A

16R4



12468-015A

Storage Temperature -65°C to +150°C

Ambient Temperature with

Power Applied -55°C to +125°C

Supply Voltage with

Respect to Ground -0.5 V to +7.0 V

DC Input Voltage -1.2 V to +7.0 VDC Input Current -30 mA to +5 mA

DC Output or I/O Pin Voltage -0.5 V to $V_{CC} + 0.5 \text{ V}$

Static Discharge Voltage 2001 V

Stresses above those listed under Absolute Maximum Ratings may cause permanent device failure. Functionality at or above these limits is not implied. Exposure to Absolute Maximum Ratings for extended periods may affect device reliability. Programming conditions may differ.

OPERATING RANGES

Commercial (C) Devices

Ambient Temperature (T_A)

Operating in Free Air 0°C to +75°C

Supply Voltage (Vcc)

with Respect to Ground

+4.75 V to +5.25 V

Operating ranges define those limits between which the func-

tionality of the device is guaranteed.

DC CHARACTERISTICS over COMMERCIAL operating ranges unless otherwise specified

Parameter Symbol	Parameter Description	Test Conditions	Min.	Max.	Unit
Vон	Output HIGH Voltage	$I_{OH} = -3.2 \text{ mA}$ $V_{IN} = V_{IH} \text{ or } V_{IL}$ $V_{CC} = \text{Min.}$	2.4		V
Vol	Output LOW Voltage	I_{OL} = 24 mA V_{IN} = V_{IH} or V_{IL} V_{CC} = Min.		0.5	٧
V _{IH}	Input HIGH Voltage	Guaranteed Input Logical HIGH Voltage for all Inputs (Note 1)	2.0		V
VIL	Input LOW Voltage	Guaranteed Input Logical LOW Voltage for all Inputs (Note 1)		8.0	V
Vı	Input Clamp Voltage	I _{IN} = -18 mA, V _{CC} = Min.		-1.2	٧
Ìн	Input HIGH Current	V _{IN} = 2.7 V, V _{CC} = Max. (Note 2)		25	μΑ
l _{IL}	Input LOW Current	V _{IN} = 0.4 V, V _{CC} = Max. (Note 2)		-250	μΑ
l _l	Maximum Input Current	V _{IN} = 5.5 V, V _{CC} = Max.		1	mΑ
Іогн	Off-State Output Leakage Current HIGH	$V_{OUT} = 2.7 \text{ V}, V_{CC} = \text{Max}.$ $V_{IN} = V_{IH} \text{ or } V_{IL} \text{ (Note 2)}$		100	μА
lozL	Off-State Output Leakage Current LOW	$V_{OUT} = 0.4 \text{ V}, V_{CC} = \text{Max}.$ $V_{IN} = V_{IH} \text{ or } V_{IL} \text{ (Note 2)}$		-100	μА
Isc	Output Short-Circuit Current	V _{OUT} = 0.5 V, V _{CC} = Max. (Note 3)	-30	-130	mA
lcc	Supply Current	V _{IN} = 0 V, Outputs Open (I _{OUT} = 0 mA) V _{CC} = Max.		180	mA

- 1. These are absolute values with respect to device ground and all overshoots due to system and/or tester noise are included.
- 2. I/O pin leakage is the worst case of I_{II} and I_{OZL} (or I_{IH} and I_{OZH}).
- 3. Not more than one output should be tested at a time. Duration of the short-circuit should not exceed one second. Vout = 0.5 V has been chosen to avoid test problems caused by tester ground degradation.

Parameter Symbol	Parameter Description	Test Conditions		Тур.	Unit
Cin	Input Capacitance	V _{IN} = 2.0 V	V _{CC} = 5.0 V T _A = 25°C	5	
Соит	Output Capacitance	V _{OUT} = 2.0 V	f = 1 MHz	8	pF

Note:

 These parameters are not 100% tested, but are evaluated at initial characterization and at any time the design is modified where capacitance may be affected.

SWITCHING CHARACTERISTICS over COMMERCIAL operating ranges (Note 2)

Parameter Symbol	Parameter Description				Min. (Note 3)	Max.	Unit	
t _{PO}	Input or Feedba Combinatorial C		Output S	witching	16L8, 16R6 16R4	3	7.5 7	ns
ts	Setup Time from	n Input or Feed	back to	Clock		7		ns
tн	Hold Time					0		ns
tco	Clock to Output	-				3	6.5	ns
tcF	Clock to Feedba	ack (Note 4)	ck (Note 4)				3	ns
tskew	Skew Between	Registered Out	Registered Outputs (Note 5)				1	ns
tw.	Clock Width	LOW)W		16R4	5		ns
twn		HIGH				5		ns
	Maximum	External Fee	edback	1/(ts + tco)		74		MHz
fmax	Frequency	Internal Fee	dback	1/(ts + tcF)		100		MHz
	(Note 6)	No Feedbac	:k	1/(tw+ + twL)		100		MHz
tpzx	OE to Output E	nable				3	8	ns
tpxz	OE to Output D	ut Disable				3	8	ns
tea	Input to Output Enable Using Product Term Control			16L8, 16R6	3	10	ns	
ter	Input to Output	Disable Using I	Product	Term Control	16R4	3	10	ns

Notae:

- 2. See Switching Test Circuit for test conditions.
- 3. Output delay minimums are measured under best-case conditions.
- 4. Calculated from measured fmax internal.
- 5. Skew is measured with all outputs switching in the same direction.
- These parameters are not 100% tested, but are calculated at initial characterization and at any time the design is modified where the frequency may be affected.

Storage Temperature

-65°C to +150°C

Ambient Temperature

with Power Applied -55°C to +125°C

Supply Voltage with

Respect to Ground

-0.5 V to +7.0 V

DC Input Voltage -0.5 V to +5.5 V

DC Input Current

-30 mA to +5 mA

DC Output or I/O Pin Voltage

-0.5 V to $V_{CC} + 0.5 \text{ V}$

Stresses above those listed under Absolute Maximum Ratings may cause permanent device failure. Functionality at or above these limits is not implied. Exposure to Absolute Maximum Ratings for extended periods may affect device reliability. Programming conditions may differ. Absolute Maximum Ratings are for system design reference; parameters given are not tested.

OPERATING RANGES

Military (M) Devices (Note 1)

Ambient Temperature (T_A)

Operating in Free Air

-55°C Min

Operating Case (Tc)

Temperature

125°C Max

Supply Voltage (Vcc)

with Respect to Ground

+4.50 V to +5.50 V

Operating ranges define those limits between which the functionality of the device is quaranteed.

Note:

1. Military products are tester +25°C, +125°C, and -55°C, per Mil

DC CHARACTERISTICS over MILITARY operating něrwise specified (Note 2)

Parameter Symbol	Parameter Description	Seet Caronitions	Min.	Max.	Unit
V _{OH}	Output HIGH Voltage	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	2.4		٧
V _{OL}	Output LOW Vo	= 12 mA $V_{IN} = V_{IH}$ or V_{IL} $V_{CC} = Min$.		0.5	٧
V _{IH}	Input NGE Volage	Guaranteed Input Logical HIGH Voltage for all Inputs (Note 3)	2.0		V
V _{IL}	Inpo LOW Vollage	Guaranteed Input Logical LOW Voltage for all Inputs (Note 3)		8.0	V
VI	Input Člamp Voltage	I _{IN} = -18 mA, V _{CC} = Min.		-1.2	٧
liн	Input HIGH Current	V _{IN} = 2.7 V, V _{CC} = Max. (Note 4)		25	μА
I _{IL}	Input LOW Current	V _{IN} = 0.4 V, V _{CC} = Max. (Note 4)		-250	μА
l _l	Maximum Input Current	V _{IN} = 5.5 V, V _{CC} = Max.		1	mA
Іогн	Off-State Output Leakage Current HIGH	$V_{OUT} = 2.7 \text{ V}, V_{CC} = \text{Max}.$ $V_{IN} = V_{IH} \text{ or } V_{IL} \text{ (Note 4)}$		100	μА
l _{OZL}	Off-State Output Leakage Current LOW	$V_{OUT} = 0.4 \text{ V}, V_{CC} = \text{Max}.$ $V_{IN} = V_{IH} \text{ or } V_{IL} \text{ (Note 4)}$		-100	μA
Isc	Output Short-Circuit Current	V _{OUT} = 0.5 V, V _{CC} = Max. (Note 5)	-30	-130	mΑ
lcc	Supply Current	V _{IN} = 0 V, Outputs Open (I _{OUT} = 0 mA) V _{CC} = Max.		180	mA

- 2. For APL Products, Group A, Subgroups 1, 2, and 3 are tested per MIL-STD-883, Method 5005, unless otherwise noted.
- 3. VII and VIH are input conditions of output tests and are not themselves directly tested. VIL and VIH are absolute voltages with respect to device ground and include all overshoots due to system and/or tester noise. Do not attempt to test these values without suitable equipment.
- 4. I/O pin leakage is the worst case of IIL and IOZL (or IIH and IOZH).
- 5. Not more than one output should be tested at a time. Duration of the short-circuit should not exceed one second. Vout = 0.5 V has been chosen to avoid test problems caused by tester ground degradation.

Parameter Symbol	Parameter Description	Test Conditions		Тур.	Unit
CiN	Input Capacitance	V _{IN} = 2.0 V	V _{CC} = 5.0 V T _A = 25°C	5	
Соит	Output Capacitance	V _{OUT} = 2.0 V	f = 1 MHz	8	pF

Note:

 These parameters are not 100% tested, but are evaluated at initial characterization and at any time the design is modified where capacitance may be affected.

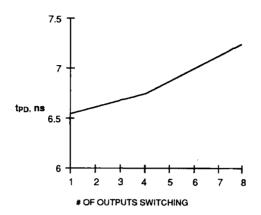
SWITCHING CHARACTERISTICS over MILITARY operating ranges (Note 2)

Parameter Symbol	Parameter Description				MÍ)	Max.	Unit
tpo	Input or Feedback to Combinatorial Output	1 Output S	Switching	16L8, 16	3	12.5 12	ns
ts	Setup Time from Input or Feedback to Clock				2		ns
tH	Hold Time		4	T PA	0		ns
tco	Clock to Output				3	11	ns
tcF	Clock to Feedback (Note 4)			*		6.5	ns
tskew	Skew Between Registere	d Out	42			1	ns
t _{WL}	Clock Width LOW		8.4	16R8, 16R6	10		ns
twn	GU	A P		16R4	8		ns
	Maximum A II	Fudback	1/(ts + tco)		43.4		MHz
fmax	Fre el 116, 10	l Feedback	1/(ts + tcF)		54		MHz
	(No. No Fee	edback	1/(tw+ + twL)		55.5		MHz
tezx	OE to tput Enable (Not	e 7)		1	3	10	ns
t _{PXZ}	OE to Output Disable (No	te 7)			3	10	ns
tea	Input to Output Enable Us Term Control (Note 7)	sing Product		16L8, 16R6	3	15	กร
t _{ER}	Input to Output Disable U Term Control (Note 7)	sing Product		16R4	3	12	ns

- See Switching Test Circuit for test conditions. For APL products Group A, Subgroups 9, 10, and 11 are tested per MiL-STD-883, Method 5005, unless otherwise noted.
- Minimum value for tpD, tcO, tpzx, tpxz, teA, and teR parameters should be used for simulation purposes only and are not tested.
- 4. Calculated from measured f_{MAX} internal.
- 5. Skew is measured with all outputs switching in the same direction.
- These parameters are not 100% tested, but are calculated at initial characterization and at any time the design is modified where frequency may be affected.
- These parameters are not 100% tested, but are evaluated at initial characterization and at any time the design is modified where these parameters may be affected.

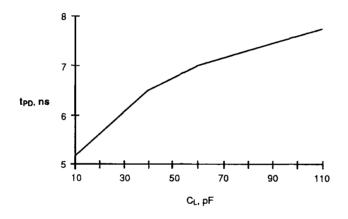
MEASURED SWITCHING CHARACTERISTICS

V_{CC} = 4.75 V, T_A = 75°C (Note 1)



tpp vs. Number of Outputs Switching

10240-001A



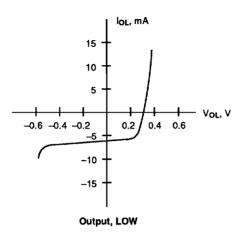
tpD vs. Load Capacitance

10240-002A

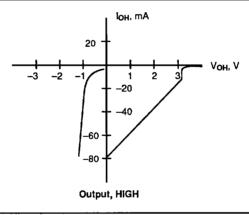
Note:

 These parameters are not 100% tested, but are evaluated at initial characterization and at any time the design is modified where tpD may be affected.

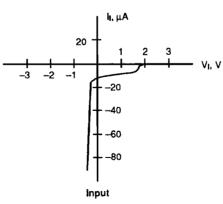
CURRENT VS. VOLTAGE (I-V) CHARACTERISTICS $V_{CC} = 5.0 \text{ V}$, $T_A = 25 ^{\circ}\text{C}$



10240-003A



10240-004A



10240-005A

Storage Temperature -65°C to +150°C

Ambient Temperature with

Power Applied -55°C to +125°C

Supply Voltage with

Respect to Ground -0.5 V to +7.0 V DC Input Voltage -1.5 V to +5.5 V

DC Output or I/O Pin Voltage -0.5 V to +5.5 V

Static Discharge Voltage 2001 V

ity. Programming conditions may differ.

Stresses above those listed under Absolute Maximum Ratings may cause permanent device failure. Functionality at or above these limits is not implied. Exposure to Absolute Maximum Ratings for extended periods may affect device reliabil-

OPERATING RANGES

Commercial (C) Devices

Ambient Temperature (T_A)

Operating in Free Air 0°C to +75°C

Supply Voltage (Vcc)

with Respect to Ground

+4.75 V to +5.25 V

Operating ranges define those limits between which the func-

tionality of the device is guaranteed.

DC CHARACTERISTICS over COMMERCIAL operating ranges unless otherwise specified

Parameter Symbol	Parameter Description	Test Conditions	Min.	Max.	Unit
V _{OH}	Output HIGH Voltage	$I_{OH} = -3.2 \text{ mA}$ $V_{IN} = V_{IH} \text{ or } V_{IL}$ $V_{CC} = \text{Min.}$	2.4		٧
Vol	Output LOW Voltage	$I_{OL} = 24 \text{ mA}$ $V_{IN} = V_{IH} \text{ or } V_{IL}$ $V_{CC} = \text{Min.}$		0.5	٧
V _{IH}	Input HIGH Voltage	Guaranteed Input Logical HIGH Voltage for all Inputs (Note 1)	2.0		٧
VIL	Input LOW Voltage	Guaranteed Input Logical LOW Voltage for all Inputs (Note 1)		0.8	٧
VI	Input Clamp Voltage	$I_{IN} = -18$ mA, $V_{CC} = Min$.	L	-1.5	٧
lін	Input HIGH Current	V _{IN} = 2.4 V, V _{CC} = Max. (Note 2)		25	μА
l _{IL}	Input LOW Current	V _{IN} = 0.4 V, V _{CC} = Max. (Note 2)		-250	μА
lį	Maximum Input Current	$V_{IN} = 5.5 \text{ V}, V_{CC} = \text{Max}.$		100	μА
Іохн	Off-State Output Leakage Current HIGH	$V_{OUT} = 2.4 \text{ V}, V_{CC} = \text{Max}.$ $V_{IN} = V_{IH} \text{ or } V_{IL} \text{ (Note 2)}$		100	μА
lozL	Off-State Output Leakage Current LOW	V _{OUT} = 0.4 V, V _{CC} = Max. V _{IN} = V _{IH} or V _{IL} (Note 2)		-100	μА
Isc	Output Short-Circuit Current	V _{OUT} = 0.5 V, V _{CC} = Max. (Note 3)	-30	-130	mA
Icc	Supply Current	V _{IN} = 0 V, Outputs Open (l _{OUT} = 0 mA) V _{CC} = Max.		180	mA

- 1. These are absolute values with respect to device ground and all overshoots due to system and/or tester noise are included.
- 2. I/O pin leakage is the worst case of IIL and IOZL (or IIH and IOZH).
- Not more than one output should be tested at a time. Duration of the short-circuit should not exceed one second.
 V_{OUT} = 0.5 V has been chosen to avoid test problems caused by tester ground degradation.

Parameter Symbol	Parameter Description	Test Conditio	ns		Тур.	Unit
C _{IN}	Input Capacitance	$V_{IN} = 2.0 \text{ V}$	V _{CC} = 5.0 V	CLK, OE	9	
			T _A = 25°C	Other Inputs	2	pF
Соит	Output Capacitance	V _{OUT} = 2.0 V	f = 1 MHz	Outputs	4	•

Note:

SWITCHING CHARACTERISTICS over COMMERCIAL operating ranges (Note 2)

Parameter Symbol	Parameter Des	scription			Min. (Note 3)	Max.	Unit
t _{PD}	Input or Feedback to Combinatorial Output			16L8, 16R6 16R4	3	10	ns
ts	Setup Time from	m Input or Feedback to	Clock	,	10		ns
ŧн	Hold Time				0		ns
tco	Clock to Output	t ===		2	7	ns	
tcf	Clock to Feedb	ack (Note 4)	16R8, 16R6	2	6.5	ns	
tw∟	Clock Width	LOW		16R4	8		ns
twn]	HIGH			8		ns
	Maximum	External Feedback	1/(ts + tco)		58.8	_	MHz
fmax	Frequency	Internal Feedback	1/(ts + tcF)		60		MHz
	(Note 5)	No Feedback	1/(t _{WH} + t _{WL})		62.5		MHz
tpzx	OE to Output E	nable		ı	3	10	ns
texz	OE to Output Disable				3	10	ns
tea	Input to Output Enable Using Product Term Control			16L8, 16R6	1	10	ns
ten	Input to Output	Disable Using Product	Term Control	16R4	1	10	ns

- 2. See Switching Test Circuit for test conditions.
- 3. Output delay minimums are measured under best-case conditions.
- 4. Calculated from measured fMAX internal.
- 5. These parameters are not 100% tested, but are calculated at initial characterization and at any time the design is modified where the frequency may be affected.

These parameters are not 100% tested, but are evaluated at initial characterization and at any time the design is modified where capacitance may be affected.

Storage Temperature

-65°C to +150°C

Military (M) Devices (Note 1)

OPERATING RANGES

Ambient Temperature

with Power Applied

Ambient Temperature (T_A)
Operating in Free Air

-55°C to +125°C

-55°C Min.

Supply Voltage with Respect to Ground

Operating Case (Tc)
Temperature

125°C Max.

DC Input Voltage

are not tested.

-0.5 V to +7.0 V

-1.5 V to +5.5 V

5.5 V

Supply Voltage (Vcc) with Respect to Ground

+4.50 V to +5.50 V

DC Output or I/O Pin Voltage Static Discharge Voltage

2001 V

Operating ranges define those limits between which the functionality of the device is guaranteed.

Stresses above those listed under Absolute Maximum Ratings may cause permanent device failure. Functionality at or above these limits is not implied. Exposure to Absolute Maximum Ratings for extended periods may affect device reliability. Programming conditions may differ. Absolute Maximum Ratings are for system design reference; parameters given

Note:

 Military products are tested at T_C = +25°C, +125°C, and -55°C, per MIL-STD-883.

DC CHARACTERISTICS over MILITARY operating ranges unless otherwise specified (Note 2)

Parameter Symbol	Parameter Description	Test Conditions	Min.	Max.	Unit
V _{OH}	Output HIGH Voltage	$I_{OH} = -2 \text{ mA}$ $V_{IN} = V_{IH} \text{ or } V_{IL}$ $V_{CC} = \text{Min.}$	2.4		V
V _{OL}	Output LOW Voltage	$I_{OL} = 12 \text{ mA}$ $V_{IN} = V_{IH} \text{ or } V_{IL}$ $V_{CC} = \text{Min.}$		0.5	V
V _{IH}	Input HIGH Voltage	Guaranteed Input Logical HIGH Voltage for all Inputs (Note 3)	2.0		V
VIL	Input LOW Voltage	Guaranteed Input Logical LOW Voltage for all Inputs (Note 3)		0.8	٧
Vı	Input Clamp Voltage	$I_{IN} = -18$ mA, $V_{CC} = Min$.		-1.5	٧
I _{IH}	Input HIGH Current	V _{IN} = 2.4 V, V _{CC} = Max. (Note 4)		25	μА
l _{IL}	Input LOW Current	V _{IN} = 0.4 V, V _{CC} = Max. (Note 4)		-250	μА
h	Maximum Input Current	$V_{IN} = 5.5 \text{ V}, V_{CC} = \text{Max}.$		1	mA
Гохн	Off-State Output Leakage Current HIGH	V _{OUT} = 2.4 V, V _{CC} = Max. V _{IN} = V _{IH} or V _{IL} (Note 4)		100	μΑ
lozL	Off-State Output Leakage Current LOW	$V_{OUT} = 0.4 \text{ V}, V_{CC} = \text{Max}.$ $V_{\text{IN}} = V_{\text{IH}} \text{ or } V_{\text{IL}} \text{ (Note 4)}$		-100	μΑ
I _{SC}	Output Short-Circuit Current	V _{OUT} = 0.5 V, V _{CC} = Max. (Note 5)	-30	-130	mA
lcc	Supply Current	$V_{IN} = 0 V$, Outputs Open ($I_{OUT} = 0 mA$) $V_{CC} = Max$.		180	mA

- 2. For APL Products, Group A, Subgroups 1, 2, and 3 are tested per MIL-STD-883, Method 5005, unless otherwise noted.
- V_{IL} and V_{IH} are input conditions of output tests and are not themselves directly tested. V_{IL} and V_{IH} are absolute voltages with
 respect to device ground and include all overshoots due to system and/or tester noise. Do not attempt to test these values
 without suitable equipment.
- 4. I/O pin leakage is the worst case of IIL and IOZL (or IIH and IOZH).
- Not more than one output should be tested at a time. Duration of the short-circuit should not exceed one second. Vour = 0.5 V
 has been chosen to avoid test problems caused by tester ground degradation.

Parameter Symbol	Parameter Description	Test Conditio	ns		Тур.	Unit
CiN	Input Capacitance	$V_{IN} = 2.0 \text{ V}$	$V_{CC} = 5.0 \text{ V}$	CLK, OE	9	
		1	T _A = 25°C	Other Inputs	2	pF
Соит	Output Capacitance	V _{OUT} = 2.0 V	f = 1 MHz	Outputs	4	F .

Note:

 These parameters are not 100% tested, but are evaluated at initial characterization and at any time the design is modified where capacitance may be affected.

SWITCHING CHARACTERISTICS over MILITARY operating ranges (Note 2)

Parameter Symbol	Parameter Desc	Parameter Description				Max.	Unit
t _{PD}	Input or Feedback Combinatorial Ou			16L8, 16R6 16R4	3	15	ns
ts	Setup Time from	rom Input or Feedback to Clock			15		ns
tн	Hold Time				0		ns
tco	Clock to Output o	Feedback			2	12	ns
twL	Clock Width	LOW	LOW		12		ns
twn	1	HIGH		16R4	8		ns
	Max. Frequency	External Feedback	1/(ts + tco)		37		MHz
f _{MAX}	(Note 4)	No Feedback	1/(tw+ + twL)		50		MHz
tpzx	OE to Output Ena	able (Note 5)			3	12	ns
l _{PXZ}	OE to Output Dis	able (Note 5)			3	10	ns
tea	Input to Output Enable Using Product Term Control (Note 5)		16L8, 16R6	1	17	ns	
ten	Input to Output D Term Control (No	isable Using Product te 5)		16R4	1	13	ns

- See Switching Test Circuit for test conditions. For APL products Group A, Subgroups 9, 10, and 11 are tested per MIL-STD-883, Method 5005, unless otherwise noted.
- Minimum value for tpD, tcO, tpzx, tpxz, teA, and teR parameters should be used for simulation purposes only and are not tested.
- 4. These parameters are not 100% tested, but are calculated at initial characterization and at any time the design is modified where frequency may be affected.
- 5. These parameters are not 100% tested, but are evaluated at initial characterization and at any time the design is modified where these parameters may be affected.

Storage Temperature -65°C to +150°C

Ambient Temperature with

Power Applied -55°C to +125°C

Supply Voltage with

Respect to Ground -0.5 V to +7.0 V DC Input Voltage -1.5 V to Vcc + 0.5 V

DC Output or I/O Pin Voltage -0.5 V to V_{CC} + 0.5 V

DC Output Current 16 mA Static Discharge Voltage 2001 V

Stresses above those listed under Absolute Maximum Ratings may cause permanent device failure. Functionality at or above these limits is not implied. Exposure to Absolute Maximum Ratings for extended periods may affect device reliability. Programming conditions may differ.

OPERATING RANGES

Commercial (C) Devices

Ambient Temperature (T_A)

Operating in Free Air 0°C to +75°C

Supply Voltage (Vcc)

with Respect to Ground

+4.75 V to +5.25 V

Operating ranges define those limits between which the functionality of the device is guaranteed.



specified					
Parameter Symbol	Parameter Description	Test Congres	Min.	Max.	Unit
V _{ОН}	Output HIGH Voltage	$-2. m. V_{IN} V_{IH} \text{ or } V_{IL}$ $V_{CC} = \text{Min.}$	2.4		٧
Vol	Output LOW Voltage	$\begin{array}{cccccccccccccccccccccccccccccccccccc$		0.5	٧
V _{IH}	Input HIC Itage	Guarantee pure ic ill Voltage ic il Inputs of	2.0		V
V _{IL}	at V Su e	Gu africed but Logical LOW Volt e for all cats (Note 1)		0.8	٧
Vį	Inplace of Voltage	I _{IN} = - Vcc = Min.		-1.5	٧
l _{iH}	Input HIGH Curr	2.4 V, V _{CC} = Max. (Note 2)		25	μΑ
lic	Input LOW Cure 11	V _{IN} = 0.4 V, V _{CC} = Max. (Note 2)		-250	μΑ
lı	Maximum Input C. cent	V _{IN} = 5.5 V, V _{CC} = Max.		100	μA
lozн	Off-State Output Leakage Current HIGH	V _{OUT} = 2.4 V, V _{CC} = Max. V _{IN} = V _{IH} or V _{IL} (Note 2)		100	μA
lozL	Off-State Output Leakage Current LOW	V _{OUT} = 0.4 V, V _{CC} = Max. V _{IN} = V _{IH} or V _{IL} (Note 2)		-100	μА
1 _{SC}	Output Short-Circuit Current	V _{OUT} = 0.5 V, V _{CC} = Max. (Note 3)	-30	-130	mA
lcc	Supply Current	V _{IN} = 0 V, Outputs Open (lout = 0 mA) V _{CC} = Max.		100	mA

- 1. These are absolute values with respect to device ground and all overshoots due to system and/or tester noise are included.
- 2. I/O pin leakage is the worst case of IIL and IOZL (or IIH and IOZH).
- Not more than one output should be tested at a time. Duration of the short-circuit should not exceed one second. V_{OUT} = 0.5 V
 has been chosen to avoid test problems caused by tester ground degradation.

Parameter Symbol	Parameter Description	Test Conditio	ns		Тур.	Unit
CiN	Input Capacitance	$V_{IN} = 2.0 \text{ V}$	$V_{CC} = 5.0 \text{ V}$	CLK, OE	9	
			T _A = 25°C	Other Inputs	2	pF
Соит	Output Capacitance	V _{OUT} = 2.0 V	f = 1 MHz	Outputs	4	

Note:

SWITCHING CHARACTERISTICS over COMMERCIAL operating ranges (Note 2)

Parameter Symbol	Parameter Des	cription		JAME .	Max.	Unit
tPD	Input or Feedba Combinatorial C		16L8, 16B6		15	ns
ts	Setup Time from	n Input or Feedback to Clock		All I		ns
tH	Hold Time	_		0		ns
tco	Clock to Output			e de la companya de l	12	ns
tcF	Clock to Feedba	ack (Note 3)	6R8, 16R6		11	ns
tw.	Clock Width	LOW	16P4			ns
twn	1	HIG				ns
	Maximum	Exter Feedbook 1/(ts + tco)		37		MHz
fMAX	Frequenc	Internal aback 1/(to acr)		38.4		MHz
	(No	No Feedback	L)	52.6		MHz
tezx	JE O Th	abie			12	ns
tpxz	Ētoit Ď	sable 1			10	ns
tea	put to Output	En U. s room m Control	16L8, 16R6		15	ns
ter	Input to Output	L Jb Us Juct Term Contro	16R4		15	ns

- 2. See Switching Test Circuit for test conditions.
- 3. Calculated from measured fmax internal.
- 4. These parameters are not 100% tested, but are calculated at initial characterization and at any time the design is modified where the frequency may be affected.

These parameters are not 100% tested, but are evaluated at initial characterization and at any time the design is modified where capacitance may be affected.

Storage Temperature -65°C to +150°C

Ambient Temperature with

Power Applied -55°C to +125°C

Supply Voltage with

Respect to Ground -0.5 V to +7.0 VDC Input Voltage $-1.5 \text{ V to V}_{CC} + 0.5 \text{ V}$

DC Output or I/O Pin Voltage -0.5 V to V_{CC} + 0.5 V

Stresses above those listed under Absolute Maximum Ratings may cause permanent device failure. Functionality at or above these limits is not implied. Exposure to Absolute Maximum Ratings for extended periods may affect device reliability. Programming conditions may differ.

OPERATING RANGES

Commercial (C) Devices

Ambient Temperature (T_A)

Operating in Free Air 0°C to +75°C

Supply Voltage (Vcc)

with Respect to Ground

+4.75 V to +5.25 V

Operating ranges define those limits between which the functionality of the device is guaranteed.

DC CHARACTERISTICS over COMMERCIAL operating ranges unless otherwise specified

Parameter Symbol	Parameter Description	Test Condition	Min.	Max.	Unit
Vон	Output HIGH Voltage	I _{OH} = −3.2 mA V _{III} V _{IH} Or V _{II} V _{IC} = M _I In.	2.4		٧
Vol	Output LOW Voltage	1 24 A VIN VIH OF VIL VCC = Min.		0.5	٧
V _{IH}	Input HIGH Voltage	contained Input Logical CiGR Vol. ge for all Inputs (Site 4)	2.0		٧
V _{IL}	Input LOW-Foltage	Guaranteed to Lancia Co. Voltage to I Inputs Sot		8.0	>
Vı	Input Clamp Voltage	IN TO MA ICC = Miles		-1.2	٧
I _{IH}	Input HIGH Current	V _{IN} 4 V V _N Max. (Note 2)		25	μΑ
IIL 🔮	mput Lew Current	V _{IN} = 0, V _{CC} = Max. (Note 2)		-250	μA
lı 🦠	Maximum Input Coment	5.5 7, Vcc = Max.		100	μА
lozн	Off-State Output Lange Current HIGH	Vout = 2.4 V, Vcc = Max. Vin = Vih or ViL (Note 2)		100	μА
lozL	Off-State Output Leakage Current LOW	Vout = 0.4 V, V _{CC} = Max. V _{IN} = V _{IH} or V _{IL} (Note 2)		-100	μА
Isc	Output Short-Circuit Current	Vout = 0.5 V, Vcc = Max. (Note 3)	-30	-130	mA
Icc	Supply Current	V _{IN} = 0 V, Outputs Open (I _{OUT} = 0 mA) V _{CC} = Max.		180	mA

- 1. These are absolute values with respect to device ground and all overshoots due to system and/or tester noise are included.
- 2. I/O pin leakage is the worst case of I_{IL} and I_{OZL} (or I_{IH} and I_{OZH}).
- Not more than one output should be tested at a time. Duration of the short-circuit should not exceed one second.
 V_{OUT} = 0.5 V has been chosen to avoid test problems caused by tester ground degradation.

Parameter Symbol	Parameter Description	Test Conditions		Тур.	Unit
C _{IN}	Input Capacitance	V _{IN} = 2.0 V	V _{CC} = 5.0 V T _A = 25°C	8	_
Соит	Output Capacitance	V _{OUT} = 2.0 V	f = 1 MHz	9	pF

Note:

SWITCHING CHARACTERISTICS over COMMERCIAL operating ranges (Note 2)

Parameter Symbol	Parameter De	Parameter Description					Unit
tPD	Input or Feedb Combinatorial			16L8, 16R6 167	1	15	ns
ts	Setup Time fro	up Time from Input or Feedback to Clock			\ <u>"</u>		ns
tн	Hold Time				٥		ns
tco	Clock to Output	t or Feedback				12	ns
t _{WL}	Clock Width	LOW		R8, 16R6			ns
twn	1	HIGH		16R4			ns
4	Maximum	Externee	(Is + Ico)				MHz
fmax	Frequency (Note 3)	No Fundback	1/(tw+ + tw)	TO V	50		MHz
tezx	OE to Ou	ble				15	ns
texz	OF YE	ble				15	ns
tea	10 0	Enable Using Product	m Cort	16L8, 16R6		15	ns
ten	ui pu	Disable Using Pictuct To	ntrol	16R4		15	ns

- 2. See Switching Test Circuit for the addition
- 3. These parameters are not 100% and, but are calculated at initial characterization and at any time the design is modified where frequency may be affected.

These parameters are not 100% tested, but are evaluated at initial characterization and at any time the design is modified where capacitance may be affected.

Storage Temperature -65°C to +150°C

Ambient Temperature

with Power Applied -55°C to +125°C

Supply Voltage with

Respect to Ground -0.5 V to +7.0 V

DC Input Voltage -1.5 V to +5.5 V

DC Output or I/O Pin Voltage 5.5 V

Stresses above those listed under Absolute Maximum Ratings may cause permanent device failure. Functionality at or above these limits is not implied. Exposure to Absolute Maximum Ratings for extended periods may affect device reliability. Programming conditions may differ. Absolute Maximum Ratings are for system design reference; parameters given are not tested.

OPERATING RANGES

Military (M) Devices (Note 1)

Ambient Temperature (T_A)

Operating in Free Air -55°C Min.

Operating Case (Tc)

Temperature 125°C Max.

Supply Voltage (Vcc)

with Respect to Ground +4,50 V to +5,50 V

Operating ranges define those limits between which the functionality of the device is guaranteed.

Note:

Military products are tested and --55°C, per MIL-ST 18383

±25°C, +125°C,

DC CHARACTERISTICS over MILITARY operating ranges unless officer specified (Note 2)

Parameter Symbol	Parameter Description	Test Called on the	Min.	Max.	Unit
V _{OH}	Output HIGH Voltage	t A Vi 1H or ViL Vcc = Min.	2.4		٧
Vol	Output LOW Voltage	mA		0.5	V
V _{IH}	Input HIGH Stage	Guaranteed House ic allow Voltage to all Inputs, ou	2.0		٧
VIL	I and Washington	Guerriced of Ut Logical LOW Voltage for all as (Note 3)		0.8	>
Vı	npt Wap Voltage	IN = Vcc = Min.		-1.5	٧
JH A	Input HIGH Current	2.4 V, V _{CC} = Max. (Note 4)		25	μА
I _{IL}	PInput LOW Cun int	VIN = 0.4 V, V _{CC} = Max. (Note 4)		-250	μА
Ìį .	Maximum Input Cont	V _{IN} = 5.5 V, V _{CC} = Max.	_	1	mA
Іохн	Off-State Output Lessage Current HIGH	V _{OUT} = 2.4 V, V _{CC} = Max. V _{IN} = V _{IH} or V _{IL} (Note 4)		100	μА
lozu	Off-State Output Leakage Current LOW	Vout = 0.4 V, Vcc = Max. V _{IN} = V _{IH} or V _{IL} (Note 4)		-100	μА
Isc	Output Short-Circuit Current	V _{OUT} = 0.5 V, V _{CC} = Max. (Note 5)	-30	-130	mA
Icc	Supply Current	V _{IN} = 0 V, Outputs Open (I _{OUT} = 0 mA) V _{CC} = Max.		180	mA

- 2. For APL Products, Group A, Subgroups 1, 2, and 3 are tested per MIL-STD-883, Method 5005, unless otherwise noted.
- 3. V_{IL} and V_{IH} are input conditions of output tests and are not themselves directly tested. V_{IL} and V_{IH} are absolute voltages with respect to device ground and include all overshoots due to system and/or tester noise. Do not attempt to test these values without suitable equipment.
- 4. I/O pin leakage is the worst case of IIL and IOZL (or IIH and IOZH).
- Not more than one output should be tested at a time. Duration of the short-circuit should not exceed one second. V_{OUT} = 0.5 V
 has been chosen to avoid test problems caused by tester ground degradation.

Parameter Symbol	Parameter Description	Test Conditions		Тур.	Unit
Cin	Input Capacitance	V _{IN} = 2.0 V	V _{CC} = 5.0 V	9	_
Соит	Output Capacitance	V _{OUT} = 2.0 V	T _A = 25°C f = 1 MHz	10	pF

Note:

SWITCHING CHARACTERISTICS over MILITARY operating ranges (Note 2)

Parameter Symbol	Parameter Desc	ription				Max.	Unit
tpD		Input or Feedback to 16L8, 1986 Combinatorial Output		X	20	ns	
ts	Setup Time from	Input or Feedback t	o Clock				ns
tH	Hold Time	•			0		ns
tco	Clock to Output of	or Feedback				15	ns
tw.		LOW		R8, 16R6			ns
twn	Clock Width	HIGH		16R			ns
fmax	Maximum	Exte airFeeu o	12 + tco)			1	MHz
	Frequency (Note 3)	No Fell bar	1/(twn wu		41.6		MHz
tpzx	OE to Out 1	ble (Note -/				20	ns
tpxz	1 1 2 To 1	e (Note 4)				20	ns
tea	Inpl. & Pl.	Enable Using Parluc ote 4)		161.0 1606		25	ns
ten	put to Output D rerm Control (N			16L8, 16R6 16R4		20	ns

- See Switching Test Circuit for test Enditions. For APL products Group A, Subgroups 9, 10, and 11 are tested per MIL-STD-883, Method 5005, unless otherwise noted.
- These parameters are not 100% tested, but are calculated at initial characterization and at any time the design is modified where frequency may be affected.
- 4. These parameters are not 100% tested, but are evaluated at initial characterization and at any time the design is modified where these parameters may be affected.

These parameters are not 100% tested, but are evaluated at initial characterization and at any time the design is modified where capacitance may be affected.

Storage Temperature -65°C to +150°C

Ambient Temperature with

Power Applied -55°C to +125°C

Supply Voltage with

Respect to Ground -0.5 V to +7.0 V

DC Input Voltage -1.5 V to V_{CC} + 0.5 V

DC Output or I/O Pin Voltage -0.5 V to V_{CC} + 0.5 V

Stresses above those listed under Absolute Maximum Ratings may cause permanent device failure. Functionality at or above these limits is not implied. Exposure to Absolute Maximum Ratings for extended periods may affect device reliability. Programming conditions may differ.

OPERATING RANGES

Commercial (C) Devices

Ambient Temperature (T_A)

Operating in Free Air 0°C to +75°C

Supply Voltage (Vcc)

with Respect to Ground +4.75 V to +5.25 V

Operating ranges define those limits between which the functionality of the device is guaranteed.

DC CHARACTERISTICS over COMMERCIAL operating ranges un as operwise specified

Parameter Symbol	Parameter Description	Test Condition	Min.	Max.	Unit
V _{OH}	Output HIGH Voltage	I _{OH} = −3.2 mA V _{IM} V _{IH} or V _{IE} v _{ec} = Min.	2.4		٧
Vol	Output LOW Voltage	L 24 A VINE VIH OF VIL VCC = Min.		0.5	V
V _{IH}	Input HIGH Voltage	Grananteed Input Logical IGH Younge for all Inputs (Note 4)			٧
V _{IL}	Input LOW Moltage	Guaranteed hipu a nice (O Voltage for all Inputs More		8.0	٧
Vı	input Clares Voltage	In TomA cc = Mile.		-1.2	٧
he 🦸	Input High Carrent	V _{IN} 2,7 V ₂ V ₂ Max. (Note 2)		25	μΑ
l _{IL}	rnput CW Current	V _{IN} = V _I V _{CC} = Max. (Note 2)		-100	μA
-	Maximum Input Current	5.5 V, V _{CC} ≈ Max.		100	μА
lozн	Off-State Output Leding Current HIGH	V _{OUT} = 2.7 V, V _{CC} = Max. V _{IN} = V _{IH} or V _{IL} (Note 2)		100	μА
lozL	Off-State Output Leakage Current LOW	$V_{OUT} = 0.4 \text{ V}, V_{CC} = \text{Max}.$ $V_{IN} = V_{IH} \text{ or } V_{IL} \text{ (Note 2)}$		-100	μΑ
Isc	Output Short-Circuit Current	V _{OUT} = 0.5 V, V _{CC} = Max. (Note 3)	-30	-130	mA
Icc	Supply Current	V _{IN} = 0 V, Outputs Open (I _{OUT} = 0 mA) V _{CC} = Max.		90	mA

- 1. These are absolute values with respect to device ground and all overshoots due to system and/or tester noise are included.
- 2. I/O pin leakage is the worst case of IIL and IOZL (or IIH and IOZH).
- Not more than one output should be tested at a time. Duration of the short-circuit should not exceed one second. V_{OUT} = 0.5 V
 has been chosen to avoid test problems caused by tester ground degradation.

Parameter Symbol	Parameter Description	Test Conditions		Тур.	Unit
CiN	Input Capacitance	V _{IN} = 2.0 V	V _{CC} = 5.0 V	7	
Соит	Output Capacitance	V _{OUT} = 2.0 V	T _A = 25°C f = 1 MHz	7	pF

Note:

SWITCHING CHARACTERISTICS over COMMERCIAL operating ranges (Note 2)

Parameter Symbol	Parameter Desc	ription			M	Max.	Unit
tpD	Input or Feedback Combinatorial Ou			16L8, 16R6 16 P		25	ns
ts	Setup Time from	Setup Time from Input or Feedback to Clock			24		ns
tн	Hold Time				0		ns
tco	Clock to Output					15	ns
tcF	Clock to Feedbac	k (Note 3)		R8, 16R6	45	10	ns
tw∟	Clock Width	LOW		16R4	16		ns
twn		HIGH				i Buk	ns
	Maximum	Externi Feedb	k 1/(ts + tco)		25		MHz
fmax	Frequency	Interna Tee a	ok 1/(ts + 1/e)		28.5		MHz
	(Note 4)	No Feedback	1/(tv + twc)		33		MHz
tezx	OE to Output Enia	dia .				20	ns
1pxz 1	OF It Dulp at Dis	able				20	ns
tea	ERROR.	and the same of th	et Term control	16L8, 16R6		25	ns
ter	but to Output B	so Us q You	erm Control	16R4		25	ns

- 2. See Switching Test Circuit for test canditions.
- 3. Calculated from measured fMAX internal.
- 4. These parameters are not 100% tested, but are calculated at initial characterization and at any time the design is modified where frequency may be affected.

These parameters are not 100% tested, but are evaluated at initial characterization and at any time the design is modified where capacitance may be affected.

Storage Temperature -65°C to +150°C

Ambient Temperature

with Power Applied -55°C to +125°C

Supply Voltage with

Respect to Ground -0.5 V to +7.0 V

DC input Voltage -1.5 V to +5.5 V

DC Output or I/O Pin Voltage 5.5 V

Stresses above those listed under Absolute Maximum Ratings may cause permanent device failure. Functionality at or above these limits is not implied. Exposure to Absolute Maximum Ratings for extended periods may affect device reliability. Programming conditions may differ. Absolute Maximum Ratings are for system design reference; parameters given are not tested.

OPERATING RANGES

Military (M) Devices (Note 1)

Ambient Temperature (T_A)

Operating in Free Air -55°C Min.

Operating Case (Tc)

Temperature 125°C Max.

Supply Voltage (Vcc)

with Respect to Ground +4.50 V to +5.50 V

Operating ranges define those limits between which the functionality of the device is guaranteed.

Note:

1. Military products are tested at and -55°C, per MIL-S1 -83.

<u>+2</u>5°C, +125°C,

DC CHARACTERISTICS over MILITARY operating ranges up a specified (Note 2)

Parameter Symbol	Parameter Description	Test Control	Min.	Max.	Unit
Vон	Output HIGH Voltage	$-$ TA V_{CC} H or V_{IL} V_{CC} = Min.	.4		٧
Vol	Output LOW Voltage	$V_{CM} = V_{MN}$		0.5	٧
ViH	Input HIGHEDItage	Guaranteed to the state of the Voltage for all Inputs of the Volta	2.0		٧
Va		Gui inteed out Loglan LOW Vol. e for al. (Note 3)		0.8	V
Vı	np. 2 p Voltage	Vcc = Min.		-1.5	٧
lін	Input HIGH Current	2.4 V, V _{CC} = Max. (Note 4)		25	μA
I _{IL}	Input LOW Cul. 1	V _{IN} = 0.4 V, V _{CC} = Max. (Note 4)		250	μА
It	Maximum Input C ent	V _{IN} = 5.5 V, V _{CC} = Max.		1	mA
Іохн	Off-State Output Legiage Current HIGH	V _{OUT} = 2.4 V, V _{CC} = Max. V _{IN} = V _{IH} or V _{IL} (Note 4)		100	μΑ
łozu	Off-State Output Leakage Current LOW	V _{OUT} = 0.4 V, V _{CC} = Max. V _{IN} = V _{IH} or V _{IL} (Note 4)		-100	μА
Isc	Output Short-Circuit Current	V _{OUT} = 0.5 V, V _{CC} = Max. (Note 5)	-30	-130	mA
lcc	Supply Current	V _{IN} = 0 V, Outputs Open (I _{OUT} = 0 mA) V _{CC} = Max.		90	mA

- 2. For APL Products, Group A, Subgroups 1, 2, and 3 are tested per MIL-STD-883, Method 5005, unless otherwise noted.
- V_{IL} and V_{IH} are input conditions of output tests and are not themselves directly tested. V_{IL} and V_{IH} are absolute voltages with
 respect to device ground and include all overshoots due to system and/or tester noise. Do not attempt to test these values
 without suitable equipment.
- 4. I/O pin leakage is the worst case of IIL and IOZL (or IIH and IOZH).
- Not more than one output should be tested at a time. Duration of the short-circuit should not exceed one second. V_{OUT} = 0.5 V
 has been chosen to avoid test problems caused by tester ground degradation.

Parameter Symbol	Parameter Description	Test Conditions	-	Тур.	Unit
Cin	Input Capacitance	V _{IN} = 2.0 V	$V_{CC} = 5.0 \text{ V}$ $T_A = 25^{\circ}\text{C}$	7	
Соит	Output Capacitance	V _{OUT} = 2.0 V	f = 1 MHz	7	pF

Note:

 These parameters are not 100% tested, but are evaluated at initial characterization and at any time the design is modified where capacitance may be affected.

SWITCHING CHARACTERISTICS over MILITARY operating ranges (Note 2)

					- 18 to		
Parameter Symbol	Parameter Desc	ription			MN	Max.	Unit
tpp	Input or Feedbac Combinatorial Ou		•	16L8, 16R6 16 R4		30	ns
ts	Setup Time from	Input or Feedback to	Clock		30	_	ns
ŧн	Hold Time				0		ns
tco	Clock to Output of	r Feedback			- William	20	ns
twL	Clock Width	LOW		#6R8, 16R6	20		ns
twн		HIGH		16R4	20	2	ns
	Maximum	External Feed and	1/(s + tco)		20		MHz
fmax	Frequency (Note 3)	No Feedback	1/(twn + twc)		25		MHz
tpzx	OE to Output Em	ble (Note 4)				25	ns
texz	OE to Output Dis	able (Note 4)				25	пs
tea	Input to Octour E Term Control (No	nable Using P ind uctote 4)		16L8, 16R6		30	ns
ten		isable Using Produc		16R4		30	ns

- See Switching Test Circuit for test conditions. For APL products Group A, Subgroups 9, 10, and 11 are tested per MIL-STD-883, Method 5005, unless otherwise noted.
- These parameters are not 100% tested, but are calculated at initial characterization and at any time the design is modified where frequency may be affected.
- 4. These parameters are not 100% tested, but are evaluated at initial characterization and at any time the design is modified where these parameters may be affected.

Storage Temperature

-65°C to +150°C

Ambient Temperature with

Power Applied

-55°C to +125°C

Supply Voltage with

Respect to Ground DC Input Voltage

-0.5 V to +7.0 V -1.5 V to V_{CC} + 0.5 V

DC Output or I/O Pin Voltage

-0.5 V to $V_{CC} + 0.5 \text{ V}$

Stresses above those listed under Absolute Maximum Ratings may cause permanent device failure. Functionality at or above these limits is not implied. Exposure to Absolute Maxi-

mum Ratings for extended periods may affect device reliability. Programming conditions may differ.

OPERATING RANGES

Commercial (C) Devices

Ambient Temperature (T_A)

Operating in Free Air

Supply Voltage (Vcc)

with Respect to Ground

+4.75 V to +5.25 V

0°C to +75°C

Operating ranges define those limits between which the func-

tionality of the device is guaranteed.

DC CHARACTERISTICS over COMMERCIAL operating ranges un specified

Parameter Symbol	Parameter Descrip	otion	Test Conditions	Min.	Max.	Unit
Vон	Output HIGH Voltage		IOH = -3,2 mA VINCY (IH OF VIL.	2.4		٧
Vol	Output LOW Voltage		$V_{\text{CC}} = \text{Min.}$	4	0.5	٧
VIH	Input HIGH Voltage		rauged Input Logica G. Younge for all Inputs on ter U.			٧
VIL	Input LOW tage		Guaranteer Course io Course Voltage is all Inputs		8.0	٧
Vι	Lan an Alberta		IIN TO TO CC = MI		-1.2	٧
l _{IH}	In the til rrent		V _{IN} 7 V V Max. (Note 2)		25	μА
1 _{fL}	mpt // Current		V _{IN} = V _{CC} = Max. (Note 2)		-250	μА
1	Maximum Input		5.5 V, V _{CC} = Max.		100	μА
lozh	Off-State Output Carago Current HIGH		V _{OUT} = 2.7 V, V _{CC} = Max. V _{IN} = V _{IH} or V _{IL} (Note 2)		100	μА
lozL	Off-State Output Leakage Current LOW		Vout = 0.4 V, Vcc = Max. V _{IN} = V _{IH} or V _{IL} (Note 2)		-100	μА
Isc	Output Short-Circuit Current		V _{OUT} = 0.5 V, V _{CC} = Max. (Note 3)	-30	-130	mA
lcc	Supply Current	16L8 16R8/6/4	V _{IN} = 0 V, Outputs Open (I _{OUT} = 0 mA) V _{CC} = Max.		155 180	mA

- 1. These are absolute values with respect to device ground and all overshoots due to system and/or tester noise are included.
- 2. I/O pin leakage is the worst case of IIL and IOZL (or IIH and IOZH).
- 3. Not more than one output should be tested at a time. Duration of the short-circuit should not exceed one second. V_{CC} = 0.5 V has been chosen to avoid test problems caused by tester ground degradation.

Parameter Symbol	Parameter Description	Test Conditions		Тур.	Unit
CIN	Input Capacitance	V _{IN} = 2.0 V	V _{CC} = 5.0 V	7	
Соит	Output Capacitance	V _{OUT} = 2.0 V	T _A = 25°C f = 1 MHz	7	pF

Note:

 These parameters are not 100% tested, but are evaluated at initial characterization and at any time the design is modified where capacitance may be affected.

SWITCHING CHARACTERISTICS over COMMERCIAL operating ranges (Note 2)

Parameter Symbol	Parameter Desc	ription				Max.	Unit
t _{PD}	Input or Feedback Combinatorial Ou			16L8, 16R6 16P		25	ns
ts	Setup Time from	Input or Feedback to	Clock	The same	1		ns
tH	Hold Time				0		ns
tco	Clock to Output					15	ns
tcF	Clock to Feedbac	k (Note 3)		6R8, 16R6		10	ns
twL	Clock Width	LOW		16R4			ns
twn		HIGH			5.3		ns
	Maximum	External Feedlanck	17(ts + tco)		25		MHz
f _{MAX}	Frequency	Interna Fe back	1/(ts ====================================	$N \circ N$	28.5		MHz
	(Note 4)	No Feedback	(iverage)		33		MHz
tezx	On to Output End					20	ns
t _{PXZ}	OE to Du t bis	able				20	ns
tea	nput to Output E	nable University	Torm-Control	16L8, 16R6		25	ns
ter	Mput to Output 1	ab Us o dus	Term Control	16R4		25	ns

- 2. See Switching Test Circuit for test conditions.
- 3. Calculated from measured fMAX internal.
- 4. These parameters are not 100% tested, but are calculated at initial characterization and at any time the design is modified where frequency may be affected.

Storage Temperature

-65°C to +150°C

Military (M) Devices (Note 1)

OPERATING RANGES

Ambient Temperature

with Power Applied

-55°C to +125°C

Ambient Temperature (TA) Operating in Free Air

Operating Case (Tc)

-55°C Min.

Supply Voltage with Respect to Ground

-0.5 V to +7.0 V

Temperature

125°C Max.

DC Input Voltage

are not tested.

-1.5 V to +5.5 V

Supply Voltage (V_{CC})

+4.50 V to +5.50 V

DC Output or I/O Pin Voltage 5.5 V

Stresses above those listed under Absolute Maximum Rat-

ings may cause permanent device failure. Functionality at or

above these limits is not implied. Exposure to Absolute Maximum Ratings for extended periods may affect device reliabil-

ity. Programming conditions may differ. Absolute Maximum

Ratings are for system design reference; parameters given

with Respect to Ground

Operating ranges define those limits between which the functionality of the device is guaranteed.

Note:

1. Military products are tested and -55°C, per MIL-S

25°C, +125°C,

DC CHARACTERISTICS over MILITARY operating ranges in (Note 2)

Parameter Symbol	Parameter Description	Test Question	Min.	Max.	Unit	
V _{OH}	Output HIGH Voltage	- gA V H or V _{IL} V _{CC} = Min.	.4		٧	
Vol	Output LOW Voltage	$ \begin{array}{ccc} $		0.5	٧	
V _{IH}	Input HIGH toltage	Guaranteed to the life allevoltage to all inputs to	2.0		٧	
V _{IL}	Cut DN or as	Guarkeek out Logical LOW Volume for all the (Note 3)		0.8	٧	
Vı	npt Closip Voltage	J _{IN} = - V _{CC} = Min.		-1.5	٧	
lin T	Input HIGH Current	2.4 V, V _{CC} = Max. (Note 4)		25	μΑ	
l _{IL}	Input LOW Cul. 1t	Vin = 0.4 V, V _{CC} = Max. (Note 4)		-250	μΑ	
l ₁	Maximum Input Carent	V _{IN} = 5.5 V, V _{CC} = Max.		1	mA	
Іохн	Off-State Output La age Current HIGH	$V_{OUT} = 2.4 \text{ V}, V_{CC} = \text{Max}.$ $V_{IN} = V_{IH} \text{ or } V_{IL} \text{ (Note 4)}$		100	μА	
lozL	Off-State Output Leakage Current LOW	V _{OUT} = 0.4 V, V _{CC} = Max. V _{IN} = V _{IH} or V _{IL} (Note 4)		-100	μΑ	
Isc	Output Short-Circuit Current	V _{OUT} = 0.5 V, V _{CC} = Max. (Note 5)	-30	-130	mA	
lcc	Supply Current	V _{IN} = 0 V, Outputs Open (I _{OUT} = 0 mA) V _{CC} = Max.		180	mA	

- 2. For APL Products, Group A, Subgroups 1, 2, and 3 are tested per MIL-STD-883, Method 5005, unless otherwise noted.
- 3. VIL and VIH are input conditions of output tests and are not themselves directly tested. VIL and VIH are absolute voltages with respect to device ground and include all overshoots due to system and/or tester noise. Do not attempt to test these values without suitable equipment.
- 4. I/O pin leakage is the worst case of IIL and IOZL (or IIH and IOZH).
- 5. Not more than one output should be tested at a time. Duration of the short-circuit should not exceed one second. Vout = 0.5 V has been chosen to avoid test problems caused by tester ground degradation.

Parameter Symbol	Parameter Description	Test Conditions		Тур.	Unit
C _{IN}	Input Capacitance	V _{IN} = 2.0 V	V _{CC} = 5.0 V	7	
Соит	Output Capacitance	V _{OUT} = 2.0 V	T _A = 25°C f = 1 MHz	7	pF

Note:

 These parameters are not 100% tested, but are evaluated at initial characterization and at any time the design is modified where capacitance may be affected.

SWITCHING CHARACTERISTICS over MILITARY operating ranges (Note 2)

Parameter Symbol	Parameter Desc	ription		4	s Mi	Max.	Unit
tpD	Input or Feedbac Combinatorial O			16L8, 16B6		0	ns .
ts	Setup Time from	Input or Feedback t	to Clock		3.0		ns
tн	Hold Time				0		ns
tco	Clock to Output of	or Feedback				20	ns
twL	Clock Width	LOW		6R8, 16R6	6		ns
twn		HIGH		16P			ns
	Maximum	Exte al-Feet o	1) s + tco)				MHz
fmax	Frequency (Note 3)	No Fell ball	1/(twn wyt	16.00	25		MHz
t _{PZX}	OE to Out	ble (Note 4)		M. Contraction		25	ns
tpxz	T 6 2 1	(Note 4)	AT W.	*		25	ns
tea		inable Using Plantuc ote 4)		16L8, 16R6		30	ns
ter	out to Output [rerm Control (N	U. 9 700		16R4		30	ns

- See Switching Test Circuit for test conditions. For APL products Group A, Subgroups 9, 10, and 11 are tested per MIL-STD-883, Method 5005, unless otherwise noted.
- 3. These parameters are not 100% tested, but are calculated at initial characterization and at any time the design is modified where frequency may be affected.
- 4. These parameters are not 100% tested, but are evaluated at initial characterization and at any time the design is modified where these parameters may be affected.

Storage Temperature -65°C to +150°C

Ambient Temperature with

Power Applied -55°C to +125°C

Supply Voltage with

Respect to Ground -0.5 V to +7.0 V

DC Output or I/O Pin Voltage 5.5 V

ity. Programming conditions may differ.

DC Input Voltage -1.5 V to +5.5 V

Stresses above those listed under Absolute Maximum Ratings may cause permanent device failure. Functionality at or above these limits is not implied. Exposure to Absolute Maximum Ratings for extended periods may affect device reliabil-

OPERATING RANGES

Commercial (C) Devices

Ambient Temperature (TA)

Operating in Free Air

Supply Voltage (Vcc)

with Respect to Ground

+4.75 V to +5.25 V

0°C to +75°C

Operating ranges define those limits between which the functionality of the device is quaranteed.

DC CHARACTERISTICS over COMMERCIAL operating ranges und specified

pecified						
Parameter Symbol	Parameter Description	Test Conditions	Min.	Max.	Unit	
VoH	Output HIGH Voltage	I _{OH} = -1 mA (M V _{IH} or V _{IL} = Min.	2.4		٧	
VOL	Output LOW Voltage	Villed Hor VIL Vcc = Min.		0.5	٧	
V _{IH}	Input HIGH Voltage	Characteed Input Logical (Gr. Younge for all Inputs (Aste 1)	2.0		>	
VIL	Input LOW Maltage	Guaranteed labulate ica O		0.8	V	
Vı	In a Claim Voltage	In the man cc = Min		-1.5	٧	
Ли 🏈	In the dearrent	V _{IN} 4 V, V Max. (Note 2)		25	μА	
lyr 💮	Input Current	V _{IN} = V _{CC} = Max. (Note 2)		-250	μΑ	
lı 🔻	Maximum Input Coment	5.5 V, V _{CC} = Max.		100	μΑ	
lozh	Off-State Output Leasing 6 Current HIGH	V _{OUT} = 2.4 V, V _{CC} = Max. V _{IN} = V _{IH} or V _{IL} (Note 2)		100	μА	
lozL	Off-State Output Legicage Current LOW	V _{OUT} = 0.4 V, V _{CC} = Max. V _{IN} = V _{IH} or V _{IL} (Note 2)		-100	μА	
Isc	Output Short-Circuit Current	V _{OUT} = 0.5 V, V _{CC} = Max. (Note 3)	-30	-250	mA	
lcc	Supply Current	V _{IN} = 0 V, Outputs Open (I _{OUT} = 0 mA) V _{CC} = Max.		55	mA	

- 1. These are absolute values with respect to device ground and all overshoots due to system and/or tester noise are included.
- 2. I/O pin leakage is the worst case of IIL and IOZL (or IIH and IOZH).
- 3. Not more than one output should be tested at a time. Duration of the short-circuit should not exceed one second. Vour = 0.5 V as been chosen to avoid test problems caused by tester ground degradation.

SWITCHING CHARACTERISTICS over COMMERCIAL operating ranges (Note 1)

					•	•	
Parameter Symbol	Parameter Des	Parameter Description				Max.	Unit
tpD	Input or Feedback to Combinatorial Output		16L8, 16R6 16R4		35	ns	
ts	Setup Time from Input or Feedback to Clock				35		ns
tн	Hold Time			0		กร	
tco	Clock to Output	or Feedback	16R8, 16R6		25	ns	
twL	Clock Width	LOW	LOW		25		ns
twn	1	HiGH			25		ns
	Maximum	External Feedback	1/(ts + tco)		16		MHz
fmax	(Note 2) No Feedback		1/(twn + twL)	4	26		MHz
t _{PZX}	OE to Output E	nable				25	ns
texz	OE to Output Disable				1	25	ns
t _{EA}	Input to Output Enable Using Product Term Cont			16L8, 16R6	***	35	ns
ter	Input to Output	Disable Using Product	Terr	16R4		35	ns

- 1. See Switching Test Circuit for test conditions
- 2. These parameters are not 100% tested are are already initial characters are any one design is modified where frequency may be affected.



Storage Temperature -65°C to +150°C

Ambient Temperature

with Power Applied -55°C to +125°C

Supply Voltage with

Respect to Ground

-0.5 V to +7.0 V

DC Input Voltage -1.5 V to +5.5 V

DC Output or I/O Pin Voltage 5.5 V **OPERATING RANGES**

Military (M) Devices (Note 1)

Ambient Temperature (TA)

Operating in Free Air

Operating Case (Tc)

Temperature

125°C Max.

-55°C Min

Supply Voltage (Vcc)

with Respect to Ground

+4.50 V to +5.50 V

Stresses above those listed under Absolute Maximum Ratings may cause permanent device failure. Functionality at or above these limits is not implied. Exposure to Absolute Maximum Ratings for extended periods may affect device reliability. Programming conditions may differ. Absolute Maximum Ratings are for system design reference; parameters given are not tested.

Operating ranges define those limits between which the functionality of the device is guaranteed.

Note:

1. Military products are tested at T_C = +25°C, +125°C, and -55°C, per MIL-STD-883.

DC CHARACTERISTICS over MILITARY operating ranges unless otherwise specified (Note 2)

Parameter Symbol	Parameter Description	Test Conditions	Min.	Max.	Unit
VoH	Output HIGH Voltage	$I_{OH} = -1 \text{ mA}$ $V_{IN} = V_{IH} \text{ or } V_{IL}$ $V_{CC} = \text{Min.}$	2.4		٧
VoL	Output LOW Voltage	$I_{OL} = 4 \text{ mA}$ $V_{IN} = V_{IH} \text{ or } V_{IL}$ $V_{CC} = \text{Min.}$		0.5	٧
ViH	Input HIGH Voltage	Guaranteed Input Logical HIGH Voltage for all Inputs (Note 3)	2.0		٧
V _{IL}	Input LOW Voltage	Guaranteed Input Logical LOW Voltage for all Inputs (Note 3)		8.0	٧
VI	Input Clamp Voltage	I _{IN} = -18 mA, V _{CC} = Min.		-1.5	V
lін	Input HIGH Current	V _{IN} = 2.4 V, V _{CC} = Max. (Note 4)		25	μА
l _{IL}	Input LOW Current	V _{IN} = 0.4 V, V _{CC} = Max. (Note 4)		-250	μA
fi	Maximum Input Current	V _{IN} = 5.5 V, V _{CC} = Max.		1	mA
lozн	Off-State Output Leakage Current HIGH	V _{OUT} = 2.4 V, V _{CC} = Max. V _{IN} = V _{IH} or V _{IL} (Note 4)		100	μА
lozL	Off-State Output Leakage Current LOW	V _{OUT} = 0.4 V, V _{CC} = Max. V _{IN} = V _{IH} or V _{IL} (Note 4)		-100	μA
Isc	Output Short-Circuit Current	V _{OUT} = 0.5 V, V _{CC} = Max. (Note 5)	-30	-250	mA
lcc	Supply Current	V _{IN} = 0 V, Outputs Open (lour = 0 mA) V _{CC} = Max.		55	mA

- 2. For APL Products, Group A, Subgroups 1, 2, and 3 are tested per MIL-STD-883, Method 5005, unless otherwise noted.
- 3. V_{IL} and V_{IH} are input conditions of output tests and are not themselves directly tested. V_{IL} and V_{IH} are absolute voltages with respect to device ground and include all overshoots due to system and/or tester noise. Do not attempt to test these values without suitable equipment.
- 4. I/O pin leakage is the worst case of IIL and IOZL (or IIH and IOZH).
- 5. Not more than one output should be tested at a time. Duration of the short-circuit should not exceed one second. Vout = 0.5 V has been chosen to avoid test problems caused by tester ground degradation.

SWITCHING CHARACTERISTICS over MILITARY operating ranges (Note 1)

Parameter Symbol	Parameter Des	Parameter Description					Unit
tPD	Input or Feedba Combinatorial (16L8, 16R6 16R4		50	ns
ts	Setup Time from	m Input or Feedback to	Clock		50		ns
tн	Hold Time				0		ns
tco	Clock to Output	t or Feedback			25	ns	
twL	Clock Width	LOW	LOW		25		ns
twn		HIGH		16R4	25		ns
6	Maximum	External Feedback	1/(ts + tco)		13.3		MHz
fmax	Frequency (Note 2)	No Feedback	1/(tw+ + twL)		20		MHz
t _{PZX}	OE to Output E	nable (Note 3)				25	ns
t _{PXZ}	OE to Output D	isable (Note 3)				25	ns
tea	Input to Output Enable Using Product Term Control (Note 3)			16L8, 16R6		45	ns
t _{ER}	Input to Output Term Control (I	Disable Using Product Note 3)		16R4		45	ns

- See Switching Test Circuit for test conditions. For APL products Group A, Subgroups 9, 10, and 11 are tested per MIL-STD-883, Method 5005, unless otherwise noted.
- These parameters are not 100% tested, but are calculated at initial characterization and at any time the design is modified where frequency may be affected.
- These parameters are not 100% tested, but are evaluated at initial characterization and at any time the design is modified where these parameters may be affected.

Storage Temperature

-65°C to +150°C

Ambient Temperature with

Power Applied

-55°C to +125°C

Supply Voltage with

Respect to Ground

--0.5 V to +7.0 V

DC Input Voltage -1.5 V to Vcc + 0.5 V

DC Output or I/O Pin Voltage -0.5 V to V_{CC} + 0.5 V

OPERATING RANGES

Commercial (C) Devices

Ambient Temperature (T_A)

Operating in Free Air

Supply Voltage (Vcc) with Respect to Ground 0°C to +75°C +4.75 V to +5.25 V

Operating ranges define those limits between which the func-

tionality of the device is quaranteed.

Stresses above those listed under Absolute Maximum Ratings may cause permanent device failure. Functionality at or above these limits is not implied. Exposure to Absolute Maximum Ratings for extended periods may affect device reliability. Programming conditions may differ.

DC CHARACTERISTICS over COMMERCIAL operating ranges u specified

Parameter Symbol	Parameter Descrip	ption	Test Condition	Mìn.	Max.	Unit
Vон	Output HIGH Volta	ge	I _{OH} = -3.2 mA V _M V _{IH} or V _{IE} V _{CC} = Min.	2.4		٧
V _{OL}	Output LOW Voltag	je	$\label{eq:VC} \begin{split} \psi_{a} &= 24 \text{ mA}, V_{W} = V_{IH} \text{ or } V_{IL} \\ V_{CC} &= Min. \end{split}$		0.5	V
ViH	Input HIGH Voltage		aranteed Input Logical M Git. Veitage for all Inputs (Note 1)	.0		V
VIL	Input LOW Voltage		Guaranteed Inc. Legistr QW Voltage for all Inputs (Note 1)		0.8	٧
VI	mpo, Jaka velleg	e	18 W Vcc Min.		-1.2	>
IIH W	in but HIGH current	t die	= 2.4		25	μΑ
lıı.	Inpu W Current		V _{IN} D V, V _{CC} = Max. (Note 2)		-250	μА
lı 🔻	Maximum Input Cu	rrent	V = 5.5 V, V _{CC} = Max.		100	μА
lozн	Off-State Output a Current HIGH	akeo	V _{OUT} = 2.4 V, V _{CC} = Max. V _{IN} = V _{IH} or V _{IL} (Note 2)		100	μА
lozı	Off-State Output eakage Current LOW		$V_{OUT} = 0.4 \text{ V}, V_{CC} = \text{Max}.$ $V_{IN} = V_{IH} \text{ or } V_{IL} \text{ (Note 2)}$		-100	μА
Isc	Output Short-Circuit Current		V _{OUT} = 0.5 V, V _{CC} = Max. (Note 3)	-30	-130	mA
Icc	Supply Current	16L8 16R8/6/4	V _{IN} = 0 V, Outputs Open (I _{OUT} ≈ 0 mA) V _{CC} = Max.		80 90	mA

- 1. These are absolute values with respect to device ground and all overshoots due to system and/or tester noise are included.
- 2. I/O pin leakage is the worst case of IIL and IOZL (or IIH and IOZH).
- 3. Not more than one output should be tested at a time. Duration of the short-circuit should not exceed one second. Vout = 0.5 V as been chosen to avoid test problems caused by tester ground degradation.

Parameter Symbol	Parameter Descriptions	Test Conditions	-	Тур.	Unit
CiN	Input Capacitance	V _{IN} = 2.0 V	V _{CC} = 5.0 V	7	
Соит	Output Capacitance	V _{OUT} = 2.0 V	T _A = 25°C f = 1 MHz	7	pF

Note:

SWITCHING CHARACTERISTICS over COMMERCIAL operating ranges (Note 2)

				_ :	•	
Parameter Desc	ription			M	Max.	Unit
Input or Feedback to Combinatorial Output			16L8, 16R6 1654		35	ns
Setup Time from	Input or Feedback t	o Clock				ns
Hold Time				0		ns
Clock to Output or Feedback			16R8, 16R6		25	ns
Clock Width	LOW		16R4	25		ns
	HIGH 🦽			- 25		ns
Maximum	External Fe	((ts + tco)		(1)		MHz
(Note 3)	No handback	1/(twn + 1)		20		MHz
OE to Output Co.	able				25	ns
OF to Dutput De	sble				25	ns
Input to Dutput E	nable Using Produ	Term c pt	16L8, 16R6		35	ns
Aput to Cutput D	isable Using Produc	er Centrol	16R4		35	ns
	Input or Feedbac Combinatorial Ou Setup Time from Hold Time Clock to Output of Clock Width Maximum Frequency (Note 3) OE to Output OF Utp	Combinatorial Output Setup Time from Input or Feedback t Hold Time Clock to Output or Feedback Clock Width LOW HIGH Maximum Frequency (Note 3) OE to Output able OE utp ble Input to output Enable Using Product	Input or Feedback to Combinatorial Output Setup Time from Input or Feedback to Clock Hold Time Clock to Output or Feedback Clock Width LOW HIGH Maximum Frequency (Note 3) No Indiback It/(twn + 1) OE to Output Table OF Cutput Bable Input to Supp Enable Using Prodic Term Cash	Input or Feedback to Combinatorial Output Setup Time from Input or Feedback to Clock Hold Time Clock to Output or Feedback Clock Width LOW HIGH Maximum Frequency (Note 3) DE to Output able OF Utp Selection Production of Term Coults 16L8, 16R6 16R8, 16R6 16R4 16R4 1/(ts + tco) 1/(twn + tc) 16L8, 16R6	Input or Feedback to 16L8, 16R6 16F6 16F6	Input or Feedback to Combinatorial Output

- 2. See Switching Test Circuit to test cond
- 3. These parameters are not 1000 tested out are calculated at initial characterization and at any time the design is modified where frequency may be affect.

These parameters are not 100% tested, but are evaluated at initial characterization and at any time the design is modified where capacitance may be affected.

Storage Temperature

-65°C to +150°C

Ambient Temperature

with Power Applied

-55°C to +125°C

Supply Voltage with

Respect to Ground

-0.5 V to +7.0 V

DC Input Voltage -1.5 V to +5.5 V

DC Output or I/O Pin Voltage

Stresses above those listed under Absolute Maximum Ratings may cause permanent device failure. Functionality at or above these limits is not implied. Exposure to Absolute Maximum Ratings for extended periods may affect device reliability. Programming conditions may differ. Absolute Maximum Ratings are for system design reference; parameters given are not tested.

OPERATING RANGES

Military (M) Devices (Note 1)

Ambient Temperature (T_A)

Operating in Free Air

Supply Voltage (Vcc)

with Respect to Ground

-55°C to +125°C +4.50 V to +5.50 V

Operating ranges define those limits between which the functionality of the device is guaranteed.

Note:

1. Military products are tested at T_C = +25°C, +125°C. and -55°C, per MIL-STD-883.

DC CHARACTERISTICS over MILITARY operating ranges

Parameter Symbol	Parameter Description	Test	Min.	Max.	Unit
V _{OH}	Output HIGH Voltage	$=-m\cdot V_{IN}\cdot V_{IH} \text{ or } V_{IL}$ $V_{CC}=Min.$	2.4		>
V _{OL}	Output LOW Voltage	= 2 mA V _{IN} = V _{IN} or V _{IL} V _C Min.		0.5	٧
V _{IH}	Input HIGH pitage	Guaranteed It L. L. (GH Voltage Call In C. S. (1984)	2.0		>
V _{IL}	20 000	ntage it all pouts (Note 3)		0.8	٧
VI	Inp Voltage	III1 , No., Vcc = Min.		-1.5	٧
l _{IH}	Input HIGH Current	V ₄ = ∠.4 V, V _{CC} = Max. (Note 4)		25	μА
l _{IL}	Input LOW 16	V _{IN} = 0.4 V, V _{CC} = Max. (Note 4)		-250	μА
l _l	Maximum Inp. surrer	V _{IN} = 5.5 V, V _{CC} = Max.		1	mA
lozн	Off-State Output eakage Current HIGH	V _{OUT} = 2.4 V, V _{CC} = Max. V _{IN} = V _{IH} or V _{IL} (Note 4)		100	μΑ
lozL	Off-State Output Leakage Current LOW	V _{OUT} = 0.4 V, V _{CC} = Max. V _{IN} = V _{IH} or V _{IL} (Note 4)		-100	μΑ
Isc	Output Short-Circuit Current	V _{OUT} = 0.5 V, V _{CC} = Max. (Note 5)	-30	-250	mA
lcc	Supply Current	$V_{IN} = 0 \text{ V}$, Outputs Open ($I_{OUT} = 0 \text{ mA}$) $V_{CC} = \text{Max}$.		90	mA

- 2. For APL Products, Group A, Subgroups 1, 2, and 3 are tested per MIL-STD-883, Method 5005, unless otherwise noted.
- 3. VII and VIH are input conditions of output tests and are not themselves directly tested. VIL and VIH are absolute voltages with respect to device ground and include all overshoots due to system and/or tester noise. Do not attempt to test these values without suitable equipment.
- I/O pin leakage is the worst case of I_{IL} and I_{OZL} (or I_{IH} and I_{OZH}).
- 5. Not more than one output should be tested at a time. Duration of the short-circuit should not exceed one second. Vouт ≈ 0.5 V has been chosen to avoid test problems caused by tester ground degradation.

Parameter Symbol	Parameter Description	Test Conditions		Тур.	Unit
CiN	Input Capacitance	V _{IN} = 2.0 V	V _{CC} = 5.0 V	7	
			T _A = 25°C		рF
Cout	Output Capacitance	$V_{OUT} = 2.0 \text{ V}$	f = 1 MHz	7	

Note:

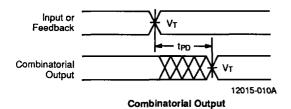
 These parameters are not 100% tested, but are evaluated at initial characterization and at any time the design is modified where capacitance may be affected.

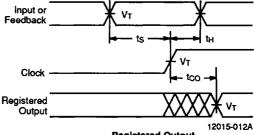
SWITCHING CHARACTERISTICS over MILITARY operating ranges (Note_2)

Parameter Symbol	Parameter Desc	ription			Min	Max.	Unit
tPD	Input or Feedback Combinatorial Ou			16L8, 16R6		50	ns
ts	Setup Time from	Input or Feedback to	Clock		50		ns
tн	Hold Time			197	0		ns
tco	Clock to Output o	r Feedback			Atte.	25	ns
twL	Clock Width	LOW		16R8, 16R6	25		ns
twn		HIGH		1684	25		ns
,	Maximum	External Feedback	ts + tco)		10.8		MHz
fmax	Frequency (Note 3)	No Feedback	1/(type +		20		MHz
t _{PZX}	OE to Output Ena	able (Note 4)				25	ns
tpxz	OF to Output Dis	ble (Note 4)		*		25	ns
tea 1	Input to Output E Term Control (No	nable Usi ng Produ s ete 4)		16L8, 16R6		45	ns
ten	Input to Output D	isable Using Product		16R4		45	ns

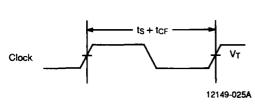
- See Switching Test Circuit for test conditions. For APL products Group A, Subgroups 9, 10, and 11 are tested per MIL-STD-883, Method 5005, unless otherwise noted.
- 3. These parameters are not 100% tested, but are calculated at initial characterization and at any time the design is modified where frequency may be affected.
- 4. These parameters are not 100% tested, but are evaluated at initial characterization and at any time the design is modified where these parameters may be affected.

SWITCHING WAVEFORMS

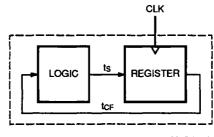




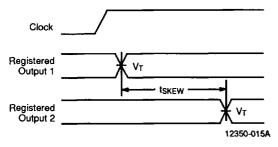
Registered Output



Clock to Feedback (f_{MAX} Internal) See Path at Right



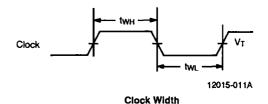
12015-021A

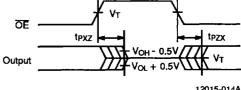


Registered Output Skew for Outputs Switching in the Same Direction

tea

12015-013A







Notes:

ter

1. $V_T = 1.5 V$

Input

Output

- 2. Input pulse amplitude 0 V to 3.0 V
- 3. Input rise and fall times 2-5 ns typical. (2-4 ns for -7 (-12 Mil) Series)

12015-014A

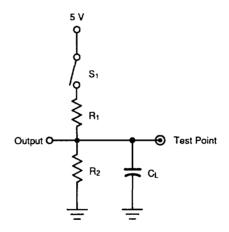
OE to Output Disable/Enable

KEY TO SWITCHING WAVEFORMS

WAVEFORM	INPUTS	OUTPUTS
	Must be Steady	Will be Steady
	May Change from H to L	Will be Changing from H to L
	May Change from L to H	Will be Changing from L to H
	Don't Care; Any Change Permitted	Changing, State Unknown
>>	Does Not Apply	Center Line is High- Impedance "Off" State

KS000010-PAL

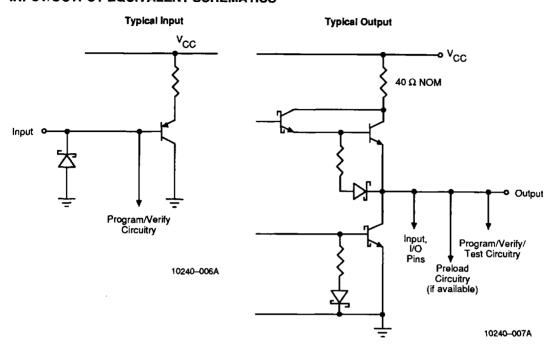
SWITCHING TEST CIRCUIT



12350-019A

			Comn	Commercial		itary	Measured				
Specification	S ₁	CL	R ₁ R ₂ R ₁ R ₂		R ₁ R ₂		R ₁ R ₂		R ₁ R ₂ R ₁		Output Value
tpo, tco, tcf	Closed		_				1.5 V				
tpzx, tea	Z → H: Open	50 pF					1.5 V				
	Z → L: Closed	<u> </u>	200 Ω	390 Ω	390 Ω	750 Ω					
t _{PXZ} , t _{ER}	H → Z: Open L → Z: Closed	5 pF	B-4: 800 Ω	B-4: 1.56 ΚΩ	B-4: 800 Ω	B-4: 1.56 KΩ	$H \rightarrow Z$: $V_{OH} - 0.5 V$ L $\rightarrow Z$: $V_{OL} + 0.5 V$				

INPUT/OUTPUT EQUIVALENT SCHEMATICS



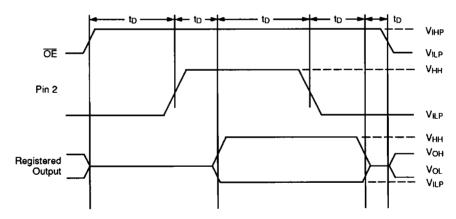
OUTPUT REGISTER PRELOAD Applies to -7 (-12 Mil) Series Only

The preload function allows the register to be loaded from the output pins. This feature aids functional testing of sequential designs by allowing direct setting of output states. The procedure for preloading follows.

- 1. Raise Vcc to Vcch.
- 2. Set \overline{OE} to V_{IHP} to disable output registers.
- 3. Raise pin 2 to V_{HH} to enter preload mode.
- Apply either V_{HH} or V_{ILP} to all registered outputs. Use V_{HH} to preload a LOW in the flip-flop; use V_{ILP} to

- preload a HIGH in the flip-flop. Leave combinatorial outputs floating.
- 5. Lower pin 2 to VILP.
- 6. Remove V_{ILP}/V_{HH} from all registered output pins.
- 7. Lower OE to VILP to enable the output registers.
- Verify V_{OL}/V_{OH} at all registered output pins. Note that because of the output inverter, a register that has been preloaded HIGH will provide a LOW at the output.

Parameter Symbol	Parameter Description	Min.	Rec.	Max.	Unit
V _{HH}	Super-level input voltage	10	11	12	٧
V _{ILP}	Low-level input voltage	0	0	0.5	٧
V _{IHP}	High-level input voltage	2.4	5.0	5.5	٧
Vcch	Power supply during preload	5.4	5.7	6.0	٧
t _D	Delay time	100	200	1000	ns



10294-003A

Output Register Preload Waveform

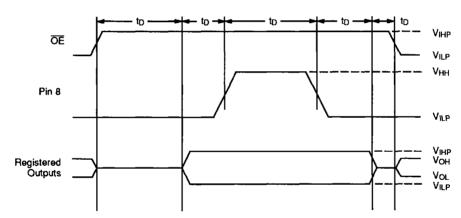
OUTPUT REGISTER PRELOAD Applies to H-15 Series Only

The preload function allows the register to be loaded from the output pins. This feature aids functional testing of sequential designs by allowing direct setting of output states. The procedure for preloading follows.

- 1. Raise V_{CC} to 4.5 V.
- 2. Set OE to Vihit to disable output registers.
- 3. Apply either V_{IHP} or V_{ILP} to all registered outputs. Use V_{IHP} to preload a HIGH in the flip-flop; use V_{ILP} to

- preload a LOW in the flip-flop. Leave combinatorial outputs floating.
- 4. Pulse pin 8 to V_{HH}, then back to 0 V.
- 5. Remove VILP/VIHP from all registered output pins.
- 6. Lower OE to VILP to enable the output registers.
- Verify V_{OL}/V_{OH} at all registered output pins. Note that because of the output inverter, a register that has been preloaded HIGH will provide a LOW at the output.

Parameter Symbol	Parameter Description	Min.	Rec.	Max.	Unit
Vнн	Super-level input voltage	19	20	21	٧
VILP	Low-level input voltage	0	0	0.5	٧
VIHP	High-level input voltage	2.4	5.0	5.5	٧
to	Delay time	100	200	1000	ns



10240-008A

Output Register Preload Waveform

POWER-UP RESET

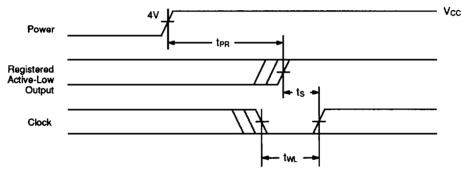
Applies to -7 (-12 Mil), H-15, B, B-2, A, A-2 Series Only

The power-up reset feature ensures that all flip-flops will be reset to LOW after the device has been powered up. The output state will be HIGH due to the inverting output buffer. This feature is valuable in simplifying state machine initialization. A timing diagram and parameter table are shown below. Due to the synchronous operation

of the power-up reset and the wide range of ways V_{CC} can rise to its steady state, two conditions are required to ensure a valid power-up reset. These conditions are:

- 1. The V_{CC} rise must be monotonic.
- Following reset, the clock input must not be driven from LOW to HIGH until all applicable input and feedback setup times are met.

Parameter Symbol	Parameter Description	Max.	Unit		
tpR	Power-up Reset Time	1000	ns		
ts	Input or Feedback Setup Time	See Switch	ing		
twL	Clock Width LOW	Characteris	Characteristics		



12350-024A

Power-Up Reset Waveform