



# AmPAL22P10B/AL/A

## 24-Pin Combinatorial TTL Programmable Array Logic

### DISTINCTIVE CHARACTERISTICS

- As fast as 15 ns maximum propagation delay
- Universal combinatorial architecture
- Programmable output polarity
- Programmable replacement for high-speed TTL logic
- Extensive third-party software and programmer support through FusionPLD partners
- 24-pin SKINNYDIP and 28-pin PLCC packages save space

### GENERAL DESCRIPTION

The AmPAL22P10 utilizes Advanced Micro Devices' diffusion isolated bipolar process and fuse-link technology. The devices provide user-programmable logic for replacing conventional SSI/MSI gates and flip-flops at a reduced chip count.

The AmPAL22P10 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

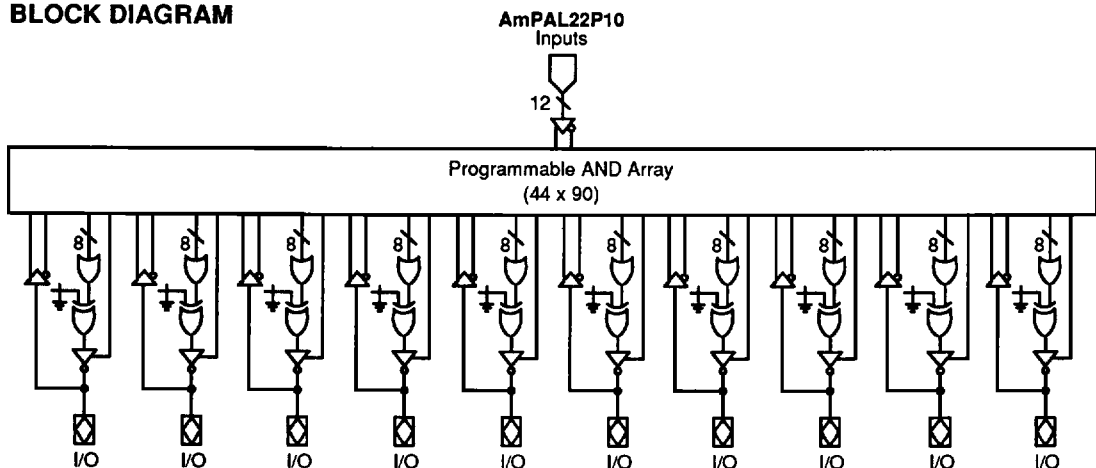
outputs. In addition, the PAL device provides the following options:

- Variable input/output pin ratio
- Programmable three-state outputs

Product terms with all fuses opened assume the logical HIGH state; product terms connected to both true and complement of any single input assume the logical LOW state. Unused input pins should be tied to V<sub>cc</sub> or GND.

The entire PAL device family is supported by the FusionPLD partners. 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 fuse may be opened to prevent pattern readout. This feature secures proprietary circuits.

### BLOCK DIAGRAM



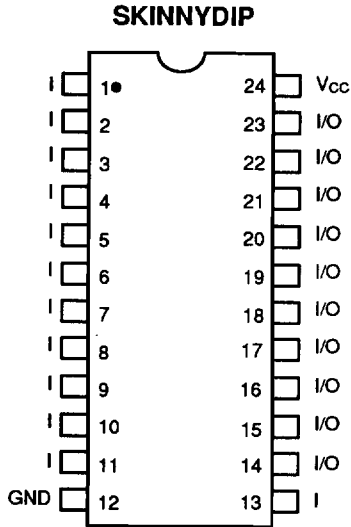
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## PRODUCT SELECTOR GUIDE

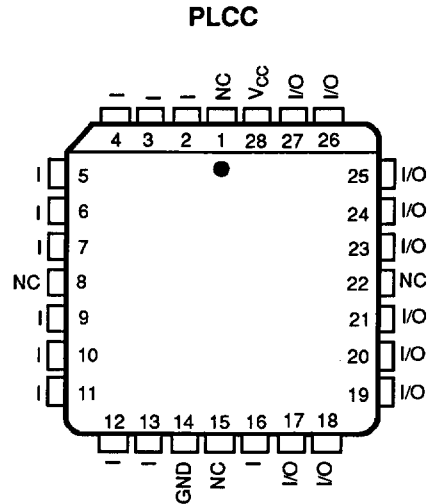
Family	$t_{PD}$ ns (Max)	$I_{CC}$ mA (Max)	$I_{OL}$ mA (Min)
Very High Speed ("B") Versions	15	210	24
Very High Speed ("A") Versions	25	210	24
High Speed, Half Power ("AL") Versions	25	105	24

## CONNECTION DIAGRAMS

### Top View



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12984E-3

**Note:**

Pin 1 is marked for orientation

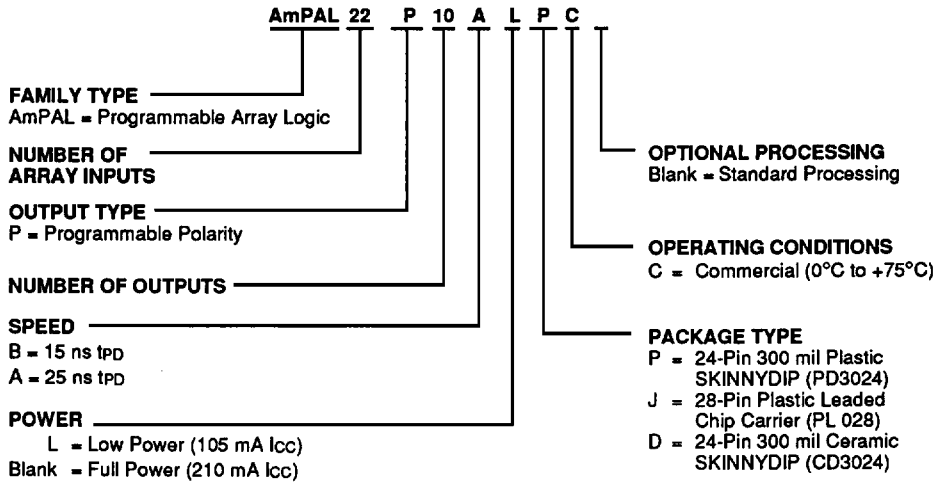
## PIN DESIGNATIONS

- GND = Ground
- I = Input
- I/O = Input/Output
- NC = No Connect
- Vcc = Supply Voltage

## ORDERING INFORMATION

### Commercial Products

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



Valid Combinations		
AmPAL22P10	B, AL, A	PC, JC, DC

#### Valid Combinations

Valid Combinations 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.*

## FUNCTIONAL DESCRIPTION

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 AmPAL22P10 has twelve dedicated input lines, and all ten 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  $V_{CC}$  or GND.

### Programmable Three-State Outputs

Each output has a three-state output buffer with three-state control. 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 buffer is always disabled.

### Programmable Polarity

The polarity of each output can be active-high or active-low, either to match output signal needs or to reduce product terms. Programmable polarity allows Boolean

expressions to be written in their most compact form (true or inverted), and the output can still be of the desired polarity. It can also save "DeMorganizing" efforts.

Selection is through a programmable fuse which controls an exclusive-OR gate at the output of the AND/OR logic. The output is active high if the fuse is 1 (programmed) and active low if the fuse is 0 (intact).

### Security Fuse

After programming and verification, an AmPAL22P10 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 programmed.

### Quality and Testability

The AmPAL22P10 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.

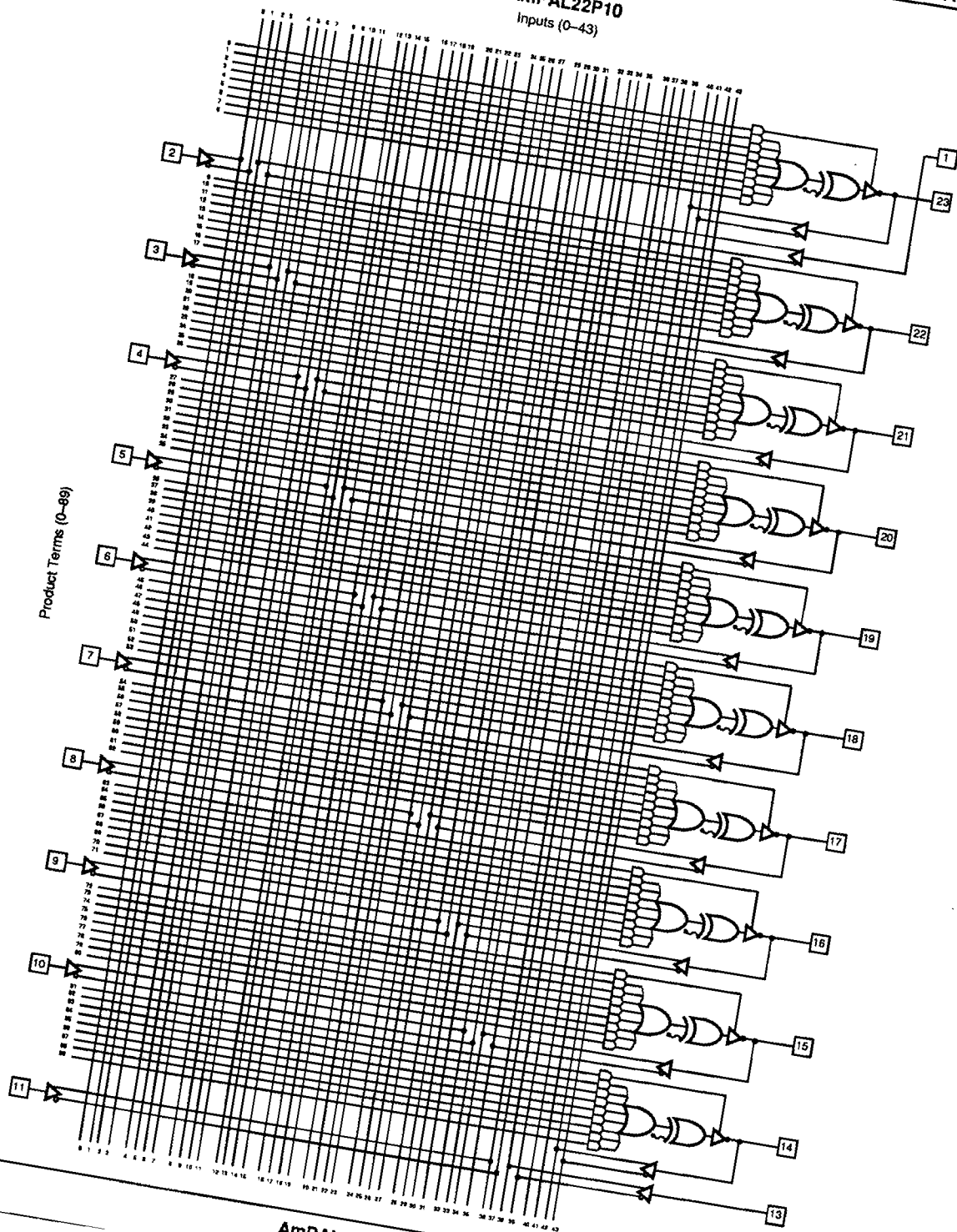
### Technology

The AmPAL22P10 is fabricated with AMD's diffusion-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 reliable operation.

# LOGIC DIAGRAM



AmpPAL22P10  
Inputs (0-43)



Product Terms (0-89)

AmpPAL22P10B/AL/A

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2-263



## ABSOLUTE MAXIMUM RATINGS

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 I/O Pin Voltage	-0.5 V to V <sub>CC</sub> Max
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 <sub>A</sub> ) Operating in Free Air	0°C to +75°C
Supply Voltage (V <sub>CC</sub> ) 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 Conditions	Min	Max	Unit
V <sub>OH</sub>	Output HIGH Voltage	I <sub>OH</sub> = -3.2 mA V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> V <sub>CC</sub> = Min	2.4		V
V <sub>OL</sub>	Output LOW Voltage	I <sub>OL</sub> = 24 mA V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> V <sub>CC</sub> = Min		0.5	V
V <sub>IH</sub>	Input HIGH Voltage	Guaranteed Input Logical HIGH Voltage for all Inputs (Note 1)	2.0	5.5	V
V <sub>IL</sub>	Input LOW Voltage	Guaranteed Input Logical LOW Voltage for all Inputs (Note 1)		0.8	V
V <sub>I</sub>	Input Clamp Voltage	I <sub>IN</sub> = -18 mA, V <sub>CC</sub> = Min		-1.2	V
I <sub>IH</sub>	Input HIGH Current	V <sub>IN</sub> = 2.7 V, V <sub>CC</sub> = Max (Note 2)		25	μA
I <sub>IL</sub>	Input LOW Current	V <sub>IN</sub> = 0.4 V, V <sub>CC</sub> = Max (Note 2)		-100	μA
I <sub>I</sub>	Maximum Input Current	V <sub>IN</sub> = 5.5 V, V <sub>CC</sub> = Max		1	mA
I <sub>ozH</sub>	Off-State Output Leakage Current HIGH	V <sub>OUT</sub> = 2.7 V, V <sub>CC</sub> = Max V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> (Note 2)		100	μA
I <sub>ozL</sub>	Off-State Output Leakage Current LOW	V <sub>OUT</sub> = 0.4 V, V <sub>CC</sub> = Max V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub> (Note 2)		-100	μA
I <sub>sc</sub>	Output Short-Circuit Current	V <sub>OUT</sub> = 0.5 V, V <sub>CC</sub> = Max (Note 3)	-30	-90	mA
I <sub>CC</sub>	Supply Current	V <sub>IN</sub> = 0 V, Outputs Open (I <sub>OUT</sub> = 0 mA) V <sub>CC</sub> = Max			
		B, A		210	mA
		AL		105	mA

### Notes:

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

## CAPACITANCE (Note 1)

Parameter Symbol	Parameter Description	Test Conditions	Typ	Unit	
C <sub>IN</sub>	Input Capacitance	Pins 1, 13	V <sub>IN</sub> = 2.0 V	V <sub>CC</sub> = 5.0 V T <sub>A</sub> = +25°C	11
		Others			6
C <sub>OUT</sub>	Output Capacitance	V <sub>OUT</sub> = 2.0 V	f = 1 MHz	9	pF

**Note:**

1. 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.

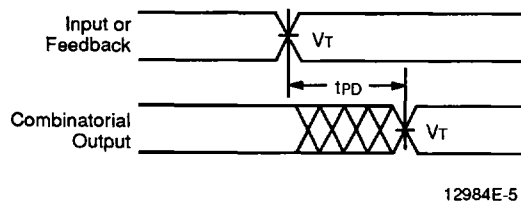
## SWITCHING CHARACTERISTICS over COMMERCIAL operating ranges (Note 2)

Parameter Symbol	Parameter Description	B		A, AL		Unit
		Min	Max	Min	Max	
t <sub>PD</sub>	Input or Feedback to Combinatorial Output		15		25	ns
t <sub>EA</sub>	Input to Output Enable Using Product Term Control		18		25	ns
t <sub>ER</sub>	Input to Output Disable Using Product Term Control		15		25	ns

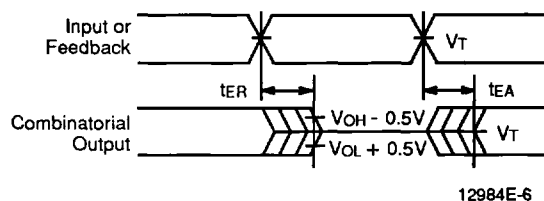
**Note:**

2. See Switching Test Circuit for test conditions.

## SWITCHING WAVEFORMS



**Combinatorial Output**



**Input to Output Disable/Enable**

**Notes:**

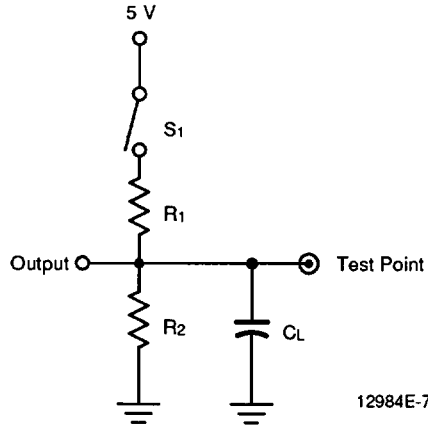
1.  $V_T = 1.5\text{ V}$
2. Input pulse amplitude 0 V to 3.0 V
3. Input rise and fall times 2 ns–5 ns typical.

## 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

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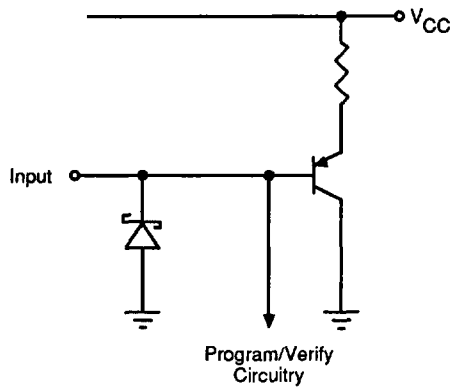
## SWITCHING TEST CIRCUIT



Specification	S <sub>1</sub>	C <sub>L</sub>	R <sub>1</sub>	R <sub>2</sub>	Measured Output Value
t <sub>PD</sub>	Closed	50 pF	200 Ω	390 Ω	1.5 V
t <sub>EA</sub>	Z → H: Open Z → L: Closed				1.5 V
t <sub>ER</sub>	H → Z: Open L → Z: Closed	5 pF			H → Z: V <sub>OH</sub> - 0.5 V L → Z: V <sub>OL</sub> + 0.5 V

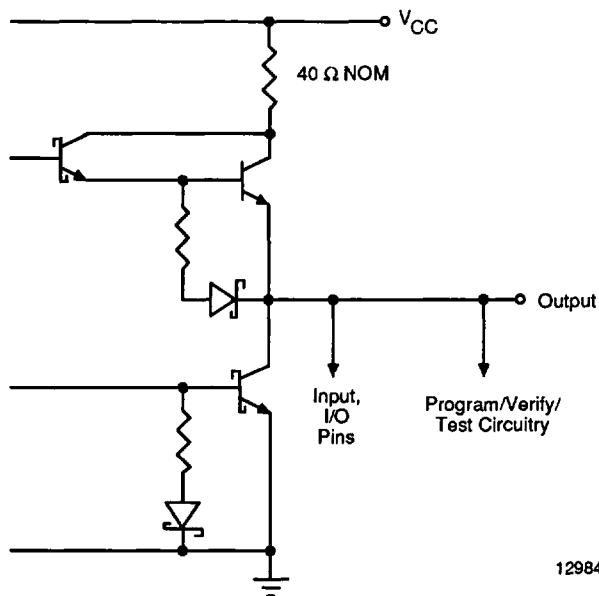


**INPUT/OUTPUT EQUIVALENT SCHEMATICS**



**Typical Input**

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**Typical Output**

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