Lattice

ispGAL16Z8

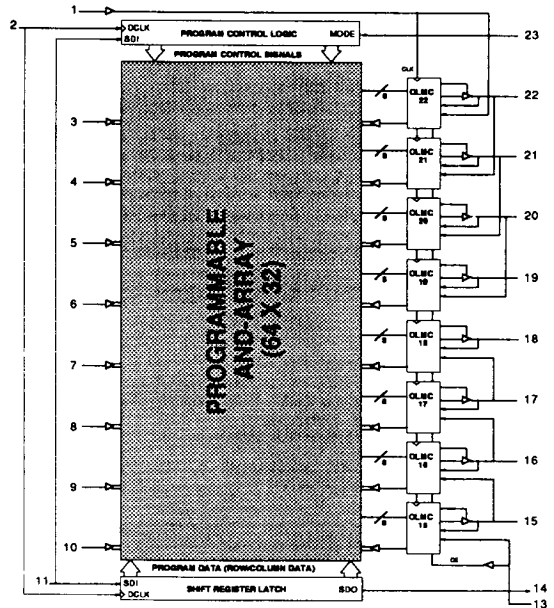**In-System Programmable
High Performance E²CMOS PLD**

FEATURES

- IN-SYSTEM-PROGRAMMABLE — 5-VOLT ONLY
  - **Change Logic "On The Fly" In Seconds**
  - **Non-volatile E² Technology**
- MINIMUM 10,000 ERASE/WRITE CYCLES
- DIAGNOSTIC MODE FOR CONTROLLING AND OBSERVING SYSTEM LOGIC
- HIGH PERFORMANCE E²CMOS® TECHNOLOGY
  - **20 ns Maximum Propagation Delay**
  - **Fmax = 41.6 MHz**
  - **90 mA MAX Icc**
- E² CELL TECHNOLOGY
  - **100% Tested/Guaranteed 100% Yields**
  - **20 Year Data Retention**
- EIGHT OUTPUT LOGIC MACROCELLS
  - **Maximum Flexibility for Complex Logic Designs**
  - **Programmable Output Polarity**
  - **Also Emulates 20-pin PAL® Devices with Full Function/Fuse Map/Parametric Compatibility**
- PRELOAD AND POWER-ON RESET OF REGISTERS
  - **100% Functional Testability**
- APPLICATIONS INCLUDE:
  - **Reconfigurable Interfaces and Decoders**
  - **"Soft" Hardware (Generic Systems)**
  - **Copy Protection and Security Schemes**
  - **Reconfiguring Systems for Testing**
- ELECTRONIC SIGNATURE FOR IDENTIFICATION

FUNCTIONAL BLOCK DIAGRAM

DESCRIPTION

The Lattice ispGAL® 16Z8 is a revolutionary programmable logic device featuring 5-volt only in-system programmability and in-system diagnostic capabilities. This is made possible by on-chip circuitry which generates and shapes the necessary high voltage programming signals. Using Lattice's proprietary UltraMOS® technology, this device provides true bipolar performance at significantly reduced power levels.

The 24-pin ispGAL16Z8 is architecturally and parametrically identical to the 20-pin GAL16V8, but includes 4 extra pins to control in-system programming. These pins are not associated with normal logic functions and are used only during programming and diagnostic operations. This 4-pin interface allows an unlimited number of devices to be cascaded to form a serial programming and diagnostics loop.

Unique test circuitry and reprogrammable cells allow complete AC, DC, and functional testing during manufacture. Therefore, LATTICE is able to guarantee 100% field programmability and functionality of all GAL® products.

PIN CONFIGURATION
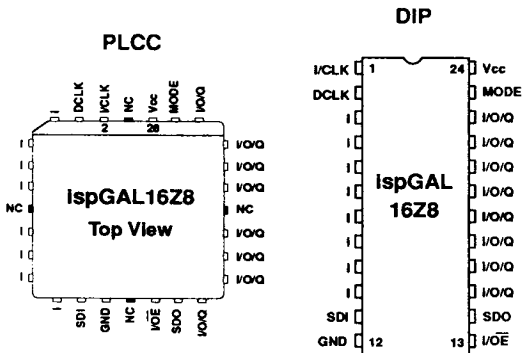
ABSOLUTE MAXIMUM RATINGS[1]

Supply voltage V_{cc} ....-0.5 to +7V
Input voltage applied ....-2.5 to V_{cc} +1.0V
Off-state output voltage applied ....-2.5 to V_{cc} +1.0V
Storage Temperature ....-65 to 150°C
Ambient Temperature with
  Power Applied ....-55 to 125°C

1. Stresses above those listed under the "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress only ratings and functional operation of the device at these or at any other conditions above those indicated in the operational sections of this specification is not implied (while programming, follow the programming specifications).

RECOMMENDED OPERATING COND.

Ambient Temperature (T_A) ....0 to +75°C
Supply voltage (V_{cc})
  with Respect to Ground ....+4.75 to +5.25V

DC ELECTRICAL CHARACTERISTICS

Over Recommended Operating Conditions (Unless Otherwise Specified)

SYMBOL	PARAMETER	CONDITION	MIN.	TYP.[2]	MAX.	UNITS
V_{IL}	Input Low Voltage		$V_{ss} - 0.5$	—	0.8	V
V_{IH}	Input High Voltage		2.0	—	$V_{cc}+1$	V
I_{IL}	Input or I/O Low Leakage Current	$0V \leq V_{IN} \leq V_{IL}$ (MAX.)	—	—	-10	µA
I_{IH}	Input or I/O High Leakage Current	$V_{IH} \leq V_{IN} \leq V_{cc}$	—	—	10	µA
V_{OL}	Output Low Voltage	I_{OL} = MAX. Vin = V_{IL} or V_{IH}	—	—	0.5	V
V_{OH}	Output High Voltage	I_{OH} = MAX. Vin = V_{IL} or V_{IH}	2.4	—	—	V
I_{OL}	Low Level Output Current		—	—	24	mA
I_{OH}	High Level Output Current		—	—	-3.2	mA
I_{OS}[1]	Output Short Circuit Current	V_{cc} = 5V V_{OUT} = 0.5V T_A = 25°C	-30	—	-150	mA
I_{CC}	Operating Power Supply Current	VIL = 0.5V VIH = 3.0V f_{toggle} = 15Mhz Outputs Open	—	75	90	mA

1) One output at a time for a maximum duration of one second. Vout = 0.5V was selected to avoid test problems caused by tester ground degradation. Guaranteed but not 100% tested.
2) Typical values are at Vcc = 5V and T_A = 25 °C

CAPACITANCE (T_A = 25 C, f = 1.0 MHz)

SYMBOL	PARAMETER	MAXIMUM*	UNITS	TEST CONDITIONS
C_I	Input Capacitance	8	pF	V_{cc} = 5.0V, V_I = 2.0V
$C_{I/O}$	I/O Capacitance	10	pF	V_{cc} = 5.0V, $V_{I/O}$ = 2.0V

*Guaranteed but not 100% tested.

AC SWITCHING CHARACTERISTICS

Over Recommended Operating Conditions

PARAMETER	TEST COND.[1]	DESCRIPTION	-20		-25		UNITS
			MIN.	MAX.	MIN.	MAX.	
t_{pd}	1	Input or I/O to Combinational Output	3	20	3	25	ns
t_{co}	1	Clock to Output Delay	2	15	2	15	ns
t_{su}	—	Setup Time, Input or Feedback before Clock↑	15	—	20	—	ns
t_h	—	Hold Time, Input or Feedback after Clock↑	0	—	0	—	ns
f_{max}[2]	1	Maximum Clock Frequency with External Feedback, 1/(tsu + tco)	33.3	—	28.5	—	MHz
	1	Maximum Clock Frequency with No Feedback	41.6	—	33.3	—	MHz
t_{wh}[3]	—	Clock Pulse Duration, High	12	—	15	—	ns
t_{wl}[3]	—	Clock Pulse Duration, Low	12	—	15	—	ns
t_{en}	2	Input or I/O to Output Enabled	—	20	—	25	ns
	2	OE↓ to Output Enabled	—	18	—	20	ns
t_{dis}	3	Input or I/O to Output Disabled	—	20	—	25	ns
	3	OE↑ to Output Disabled	—	18	—	20	ns

1) Refer to **Switching Test Conditions** section.
2) Refer to **fmax Description** section.
3) Clock pulses of widths less than the specification may be detected as valid clock signals.

SWITCHING TEST CONDITIONS

Input Pulse Levels	GND to 3.0V
Input Rise and Fall Times	3ns 10% – 90%
Input Timing Reference Levels	1.5V
Output Timing Reference Levels	1.5V
Output Load	See Figure

3-state levels are measured 0.5V from steady-state active level.

Output Load Conditions (see figure)

Test Condition		R_1	R_2	C_L
1		200Ω	390Ω	50pF
2	Active High	∞	390Ω	50pF
	Active Low	200Ω	390Ω	50pF
3	Active High	∞	390Ω	5pF
	Active Low	200Ω	390Ω	5pF
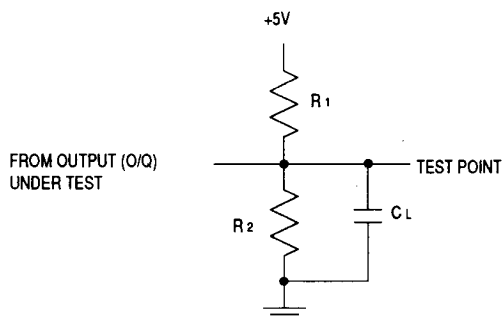
CL INCLUDES JIG AND PROBE TOTAL CAPACITANCE

ispGAL16Z8 ORDERING INFORMATION

Commercial Grade Specifications

Tpd (ns)	Tsu (ns)	Tco (ns)	Icc (mA)	Ordering #	Package
20	15	15	90	ispGAL16Z8-20LP	24-Pin Plastic DIP
			90	ispGAL16Z8-20LJ	28-Lead PLCC
25	20	15	90	ispGAL16Z8-25LP	24-Pin Plastic DIP
			90	ispGAL16Z8-25LJ	28-Lead PLCC

PART NUMBER DESCRIPTION

XXXXXXXX – XX   X   X   X

ispGAL16Z8 **Device Name**

Speed (ns)

L = Low Power **Power**

Grade   Blank = Commercial

Package   P = Plastic DIP
J = PLCC