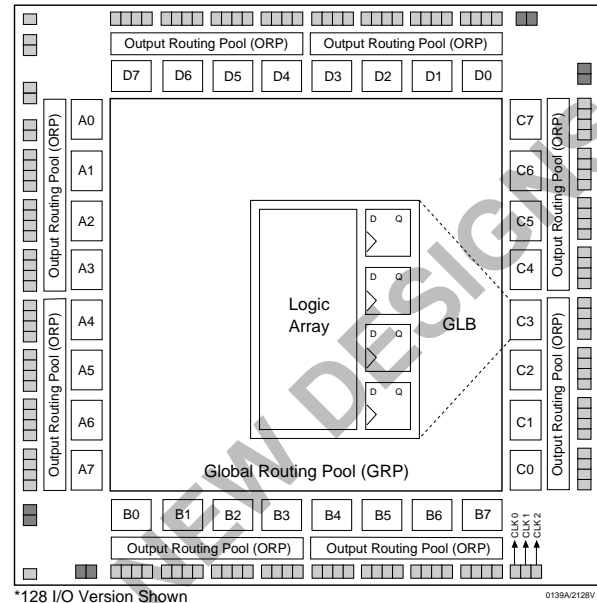


### Features

- **HIGH DENSITY PROGRAMMABLE LOGIC**
  - 6000 PLD Gates
  - 128 and 64 I/O Pin Versions, Eight Dedicated Inputs
  - 128 Registers
  - High Speed Global Interconnect
  - Wide Input Gating for Fast Counters, State Machines, Address Decoders, etc.
  - Small Logic Block Size for Random Logic
- **3.3V LOW VOLTAGE 2128 ARCHITECTURE**
  - Interfaces with Standard 5V TTL Devices
  - The 128 I/O Pin Version is Fuse Map Compatible with 5V ispLSI 2128
- **HIGH PERFORMANCE E<sup>2</sup>CMOS<sup>®</sup> TECHNOLOGY**
  - $f_{max} = 80$  MHz Maximum Operating Frequency
  - $t_{pd} = 10$  ns Propagation Delay
  - Electrically Erasable and Reprogrammable
  - Non-Volatile
  - 100% Tested at Time of Manufacture
  - Unused Product Term Shutdown Saves Power
- **IN-SYSTEM PROGRAMMABLE**
  - 3.3V In-System Programmability (ISP<sup>™</sup>) Using Boundary Scan Test Access Port (TAP)
  - Open-Drain Output Option for Flexible Bus Interface Capability, Allowing Easy Implementation of Wired-OR or Bus Arbitration Logic
  - Increased Manufacturing Yields, Reduced Time-to-Market and Improved Product Quality
  - Reprogram Soldered Devices for Faster Prototyping
- **THE EASE OF USE AND FAST SYSTEM SPEED OF PLDs WITH THE DENSITY AND FLEXIBILITY OF FPGAS**
  - Enhanced Pin Locking Capability
  - Three Dedicated Clock Input Pins
  - Synchronous and Asynchronous Clocks
  - Programmable Output Slew Rate Control
  - Flexible Pin Placement
  - Optimized Global Routing Pool Provides Global Interconnectivity
- **ispDesignEXPERT<sup>™</sup> – LOGIC COMPILER AND COMPLETE ISP DEVICE DESIGN SYSTEMS FROM HDL SYNTHESIS THROUGH IN-SYSTEM PROGRAMMING**
  - Superior Quality of Results
  - Tightly Integrated with Leading CAE Vendor Tools
  - Productivity Enhancing Timing Analyzer, Explore Tools, Timing Simulator and ispANALYZER<sup>™</sup>
  - PC and UNIX Platforms

### Functional Block Diagram\*



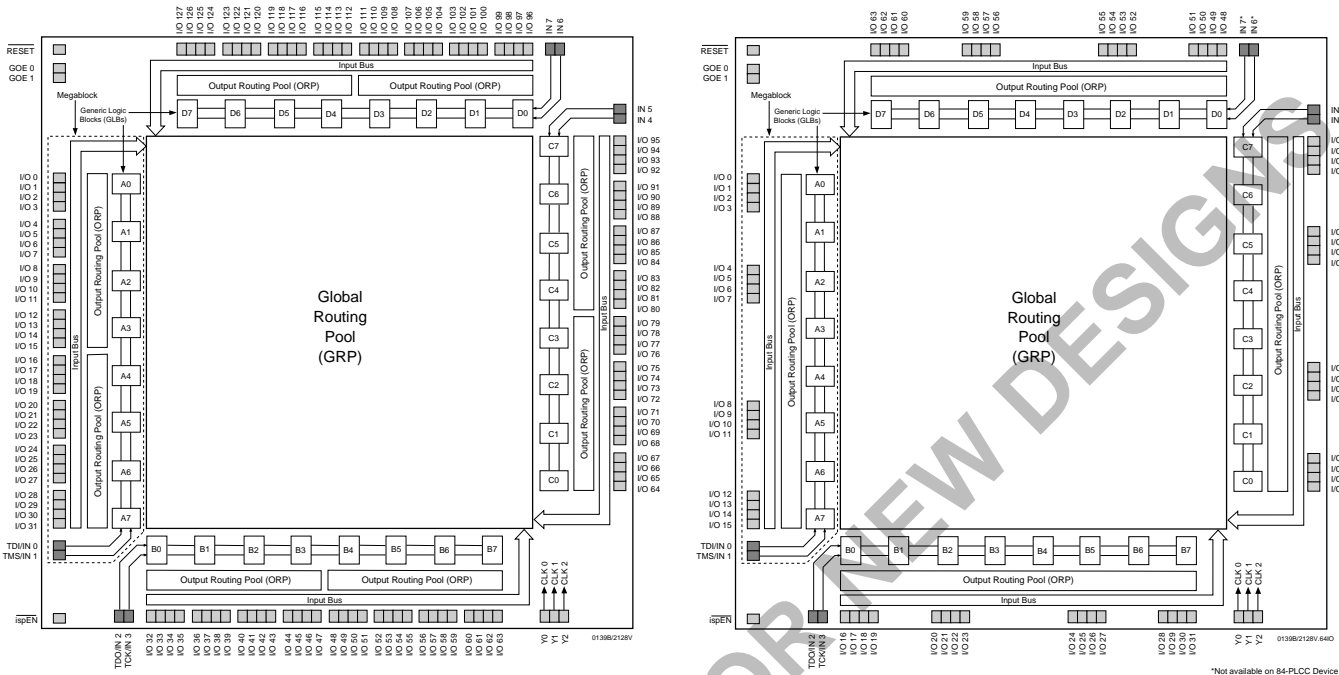
### Description

The ispLSI 2128V is a High Density Programmable Logic Device available in 128 and 64 I/O-pin versions. The device contains 128 Registers, eight Dedicated Input pins, three Dedicated Clock Input pins, two dedicated Global OE input pins and a Global Routing Pool (GRP). The GRP provides complete interconnectivity between all of these elements. The ispLSI 2128V features in-system programmability through the Boundary Scan Test Access Port (TAP). The ispLSI 2128V offers non-volatile reprogrammability of the logic, as well as the interconnect to provide truly reconfigurable systems.

The basic unit of logic on the ispLSI 2128V device is the Generic Logic Block (GLB). The GLBs are labeled A0, A1 .. D7 (see Figure 1). There are a total of 32 GLBs in the ispLSI 2128V device. Each GLB is made up of four macrocells. Each GLB has 18 inputs, a programmable AND/OR/Exclusive OR array, and four outputs which can be configured to be either combinatorial or registered. Inputs to the GLB come from the GRP and dedicated inputs. All of the GLB outputs are brought back into the GRP so that they can be connected to the inputs of any GLB on the device.

**Functional Block Diagram**

Figure 1. ispLSI 2128V Functional Block Diagram (128-I/O and 64-I/O Versions)



The 128-I/O 2128V contains 128 I/O cells, while the 64-I/O version contains 64 I/O cells. Each I/O cell is directly connected to an I/O pin and can be individually programmed to be a combinatorial input, output or bi-directional I/O pin with 3-state control. The signal levels are TTL compatible voltages and the output drivers can source 4mA or sink 8mA. Each output can be programmed independently for fast or slow output slew rate to minimize overall output switching noise. Device pins can be safely driven to 5V signal levels to support mixed-voltage systems.

Eight GLBs, 32 or 16 I/O cells, two dedicated inputs and two or one ORPs are connected together to make a Megablock (see Figure 1). The outputs of the eight GLBs are connected to a set of 32 or 16 universal I/O cells by the two or one ORPs. Each ispLSI 2128V device contains four Megablocks.

The GRP has as its inputs, the outputs from all of the GLBs and all of the inputs from the bi-directional I/O cells. All of these signals are made available to the inputs of the GLBs. Delays through the GRP have been equalized to minimize timing skew.

Clocks in the ispLSI 2128V device are selected using the dedicated clock pins. Three dedicated clock pins (Y0, Y1,

Y2) or an asynchronous clock can be selected on a GLB basis. The asynchronous or Product Term clock can be generated in any GLB for its own clock.

**Programmable Open-Drain Outputs**

In addition to the standard output configuration, the outputs of the ispLSI 2128V are individually programmable, either as a standard totem-pole output or an open-drain output. The totem-pole output drives the specified Voh and Vol levels, whereas the open-drain output drives only the specified Vol. The Voh level on the open-drain output depends on the external loading and pull-up. This output configuration is controlled by a programmable fuse. When this fuse is erased (JEDEC "1"), the output is configured as a totem-pole output. When this fuse is programmed (JEDEC "0"), the output is configured as an open-drain. The default configuration when the device is in bulk erased state is totem-pole configuration. The open-drain/totem-pole option is selectable through the ispDesignEXPERT software tools.

## Absolute Maximum Ratings <sup>1</sup>

Supply Voltage  $V_{CC}$  ..... -0.5 to +5.6V  
 Input Voltage Applied ..... -0.5 to +5.6V  
 Off-State Output Voltage Applied ..... -0.5 to +5.6V  
 Storage Temperature ..... -65 to 150°C  
 Case Temp. with Power Applied ..... -55 to 125°C  
 Max. Junction Temp. ( $T_J$ ) with Power Applied ... 150°C

1. Stresses above those listed under the “Absolute Maximum Ratings” may cause permanent damage to the device. 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).

## DC Recommended Operating Condition

SYMBOL	PARAMETER	MIN.	MAX.	UNITS	
$V_{CC}$	Supply Voltage	Commercial $T_A = 0^\circ\text{C to } +70^\circ\text{C}$	3.0	3.6	V
		Industrial $T_A = -40^\circ\text{C to } +85^\circ\text{C}$	3.0	3.6	V
$V_{IL}$	Input Low Voltage	$V_{SS} - 0.5$	0.8	V	
$V_{IH}$	Input High Voltage	2.0	5.25	V	

Table 2-0005/2128V

## Capacitance ( $T_A=25^\circ\text{C}$ , $f=1.0\text{ MHz}$ )

SYMBOL	PARAMETER	TYPICAL	UNITS	TEST CONDITIONS
$C_1$	Dedicated Input Capacitance	10	pf	$V_{CC} = 3.3\text{V}$ , $V_{IN} = 2.0\text{V}$
$C_2$	I/O Capacitance	10	pf	$V_{CC} = 3.3\text{V}$ , $V_{IO} = 2.0\text{V}$
$C_3$	Clock and Global Output Enable Capacitance	15	pf	$V_{CC} = 3.3\text{V}$ , $V_Y = 2.0\text{V}$

Table 2-0006/2128V

## Data Retention Specifications

PARAMETER	MINIMUM	MAXIMUM	UNITS
Data Retention	20	–	Years
ispLSI Erase/Reprogram Cycles	10000	–	Cycles

Table 2-0008/2128V

**Switching Test Conditions**

Input Pulse Levels	GND to 3.0V
Input Rise and Fall Time	≤ 3ns 10% to 90%
Input Timing Reference Levels	1.5V
Output Timing Reference Levels	1.5V
Output Load	See Figure 2

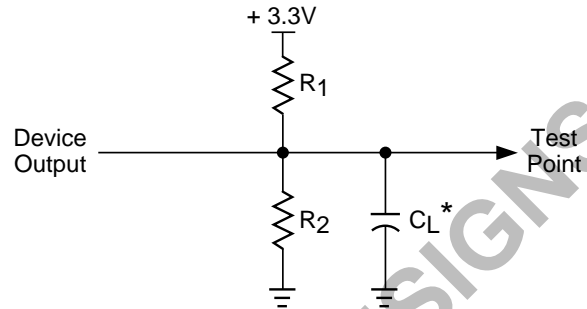
3-state levels are measured 0.5V from steady-state active level. Table 2 - 0003/2000

**Output Load Conditions (see Figure 2)**

TEST CONDITION		R1	R2	CL
A		316Ω	348Ω	35pF
B	Active High	∞	348Ω	35pF
	Active Low	316Ω	348Ω	35pF
C	Active High to Z at $V_{OH}-0.5V$	∞	348Ω	5pF
	Active Low to Z at $V_{OL}+0.5V$	316Ω	348Ω	5pF

Table 2-0004/2128V

**Figure 2. Test Load**



\*CL includes Test Fixture and Probe Capacitance.

0213A/2128V

**DC Electrical Characteristics**

**Over Recommended Operating Conditions**

SYMBOL	PARAMETER	CONDITION	MIN.	TYP. <sup>3</sup>	MAX.	UNITS
<b>V<sub>OL</sub></b>	Output Low Voltage	$I_{OL} = 8 \text{ mA}$	–	–	0.4	V
<b>V<sub>OH</sub></b>	Output High Voltage	$I_{OH} = -4 \text{ mA}$	2.4	–	–	V
<b>I<sub>IL</sub></b>	Input or I/O Low Leakage Current	$0V \leq V_{IN} \leq V_{IL} \text{ (Max.)}$	–	–	-10	μA
<b>I<sub>IH</sub></b>	Input or I/O High Leakage Current	$(V_{CC} - 0.2)V \leq V_{IN} \leq V_{CC}$	–	–	10	μA
		$V_{CC} \leq V_{IN} \leq 5.25V$	–	–	50	mA
<b>I<sub>IL-isp</sub></b>	ispEN Input Low Leakage Current	$0V \leq V_{IN} \leq V_{IL}$	–	–	-150	μA
<b>I<sub>IL-PU</sub></b>	I/O Active Pull-Up Current	$0V \leq V_{IN} \leq V_{IL}$	–	–	-150	μA
<b>I<sub>OS</sub><sup>1</sup></b>	Output Short Circuit Current	$V_{CC} = 3.3V, V_{OUT} = 0.5V$	–	–	-100	mA
<b>I<sub>CC</sub><sup>2, 4</sup></b>	Operating Power Supply Current	$V_{IL} = 0.0V, V_{IH} = 3.0V$ $f_{CLOCK} = 1 \text{ MHz}$	–	195	–	mA

Table 2-0007/2128V

- One output at a time for a maximum duration of one second.  $V_{OUT} = 0.5V$  was selected to avoid test problems by tester ground degradation. Characterized but not 100% tested.
- Measured using eight 16-bit counters.
- Typical values are at  $V_{CC} = 3.3V$  and  $T_A = 25^\circ C$ .
- Maximum  $I_{CC}$  varies widely with specific device configuration and operating frequency. Refer to the Power Consumption section of this data sheet and Thermal Management section of the Lattice Semiconductor Data Book or CD-ROM to estimate maximum  $I_{CC}$ .

**External Timing Parameters**

**Over Recommended Operating Conditions**

PARAMETER	TEST COND. <sup>4</sup>	# <sup>2</sup>	DESCRIPTION <sup>1</sup>	-80		-60		UNITS
				MIN.	MAX.	MIN.	MAX.	
t <sub>pd1</sub>	A	1	Data Propagation Delay, 4PT Bypass, ORP Bypass	-	10.0	-	15.0	ns
t <sub>pd2</sub>	A	2	Data Propagation Delay	-	15.0	-	20.0	ns
f <sub>max</sub>	A	3	Clock Frequency with Internal Feedback <sup>3</sup>	80.0	-	61.7	-	MHz
f <sub>max</sub> (Ext.)	-	4	Clock Frequency with External Feedback ( $\frac{1}{t_{su2} + t_{co1}}$ )	64.5	-	51.3	-	MHz
f <sub>max</sub> (Tog.)	-	5	Clock Frequency, Max. Toggle	100	-	71.4	-	MHz
t <sub>su1</sub>	-	6	GLB Reg. Setup Time before Clock, 4 PT Bypass	7.0	-	9.0	-	ns
t <sub>co1</sub>	A	7	GLB Reg. Clock to Output Delay, ORP Bypass	-	6.5	-	8.5	ns
t <sub>h1</sub>	-	8	GLB Reg. Hold Time after Clock, 4 PT Bypass	0.0	-	0.0	-	ns
t <sub>su2</sub>	-	9	GLB Reg. Setup Time before Clock	9.0	-	11.0	-	ns
t <sub>co2</sub>	-	10	GLB Reg. Clock to Output Delay	-	7.5	-	9.5	ns
t <sub>h2</sub>	-	11	GLB Reg. Hold Time after Clock	0.0	-	0.0	-	ns
t <sub>r1</sub>	A	12	Ext. Reset Pin to Output Delay	-	14.0	-	16.0	ns
t <sub>rw1</sub>	-	13	Ext. Reset Pulse Duration	7.0	-	8.0	-	ns
t <sub>pto<sub>en</sub></sub>	B	14	Input to Output Enable	-	15.0	-	18.0	ns
t <sub>pto<sub>edis</sub></sub>	C	15	Input to Output Disable	-	15.0	-	18.0	ns
t <sub>go<sub>en</sub></sub>	B	16	Global OE Output Enable	-	10.0	-	12.0	ns
t <sub>go<sub>edis</sub></sub>	C	17	Global OE Output Disable	-	10.0	-	12.0	ns
t <sub>wh</sub>	-	18	External Synchronous Clock Pulse Duration, High	5.0	-	7.0	-	ns
t <sub>wl</sub>	-	19	External Synchronous Clock Pulse Duration, Low	5.0	-	7.0	-	ns

Table 2-0030/2128V

1. Unless noted otherwise, all parameters use the GRP, 20 PTXOR path, ORP and Y0 clock.
2. Refer to Timing Model in this data sheet for further details.
3. Standard 16-bit counter using GRP feedback.
4. Reference Switching Test Conditions section.

## Internal Timing Parameters<sup>1</sup>

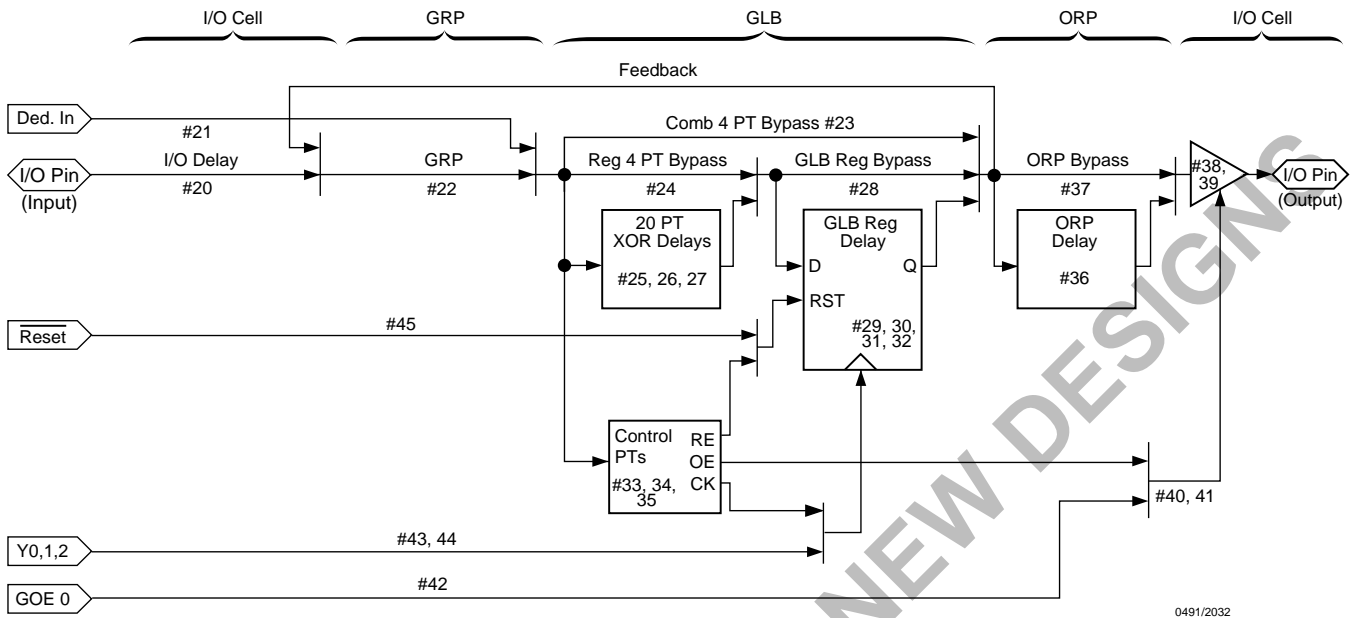
Over Recommended Operating Conditions

PARAMETER	# <sup>2</sup>	DESCRIPTION	-80		-60		UNITS
			MIN.	MAX.	MIN.	MAX.	
<b>Inputs</b>							
<b>t<sub>io</sub></b>	20	Input Buffer Delay	–	0.4	–	0.6	ns
<b>t<sub>din</sub></b>	21	Dedicated Input Delay	–	1.3	–	1.4	ns
<b>GRP</b>							
<b>t<sub>grp</sub></b>	22	GRP Delay	–	1.2	–	2.1	ns
<b>GLB</b>							
<b>t<sub>4ptbpc</sub></b>	23	4 Product Term Bypass Path Delay (Combinatorial)	–	5.8	–	9.6	ns
<b>t<sub>4ptbpr</sub></b>	24	4 Product Term Bypass Path Delay (Registered)	–	7.5	–	10.3	ns
<b>t<sub>1ptxor</sub></b>	25	1 Product Term/XOR Path Delay	–	9.2	–	12.3	ns
<b>t<sub>20ptxor</sub></b>	26	20 Product Term/XOR Path Delay	–	9.5	–	12.3	ns
<b>t<sub>xoradj</sub></b>	27	XOR Adjacent Path Delay <sup>3</sup>	–	11.3	–	14.4	ns
<b>t<sub>gbp</sub></b>	28	GLB Register Bypass Delay	–	0.3	–	1.3	ns
<b>t<sub>gsu</sub></b>	29	GLB Register Setup Time before Clock	0.2	–	0.2	–	ns
<b>t<sub>gh</sub></b>	30	GLB Register Hold Time after Clock	5.4	–	8.0	–	ns
<b>t<sub>gco</sub></b>	31	GLB Register Clock to Output Delay	–	1.6	–	1.6	ns
<b>t<sub>gro</sub></b>	32	GLB Register Reset to Output Delay	–	2.5	–	2.8	ns
<b>t<sub>ptre</sub></b>	33	GLB Product Term Reset to Register Delay	–	5.6	–	9.3	ns
<b>t<sub>ptoe</sub></b>	34	GLB Product Term Output Enable to I/O Cell Delay	–	8.5	–	10.4	ns
<b>t<sub>ptck</sub></b>	35	GLB Product Term Clock Delay	3.8	5.6	6.5	9.3	ns
<b>ORP</b>							
<b>t<sub>orp</sub></b>	36	ORP Delay	–	1.4	–	1.5	ns
<b>t<sub>orpbp</sub></b>	37	ORP Bypass Delay	–	0.4	–	0.5	ns
<b>Outputs</b>							
<b>t<sub>ob</sub></b>	38	Output Buffer Delay	–	2.2	–	2.2	ns
<b>t<sub>sl</sub></b>	39	Output Slew Limited Delay Adder	–	12.2	–	12.2	ns
<b>t<sub>oen</sub></b>	40	I/O Cell OE to Output Enabled	–	4.9	–	4.9	ns
<b>t<sub>odis</sub></b>	41	I/O Cell OE to Output Disabled	–	4.9	–	4.9	ns
<b>t<sub>goe</sub></b>	42	Global Output Enable	–	5.1	–	7.1	ns
<b>Clocks</b>							
<b>t<sub>gy0</sub></b>	43	Clock Delay, Y0 to Global GLB Clock Line (Ref. clock)	2.3	2.3	4.2	4.2	ns
<b>t<sub>gy1/2</sub></b>	44	Clock Delay, Y1 or Y2 to Global GLB Clock Line	2.3	2.3	4.2	4.2	ns
<b>Global Reset</b>							
<b>t<sub>gr</sub></b>	45	Global Reset to GLB	–	7.9	–	9.5	ns

Table 2-0036/2128V

1. Internal Timing Parameters are not tested and are for reference only.
2. Refer to Timing Model in this data sheet for further details.
3. The XOR adjacent path can only be used by hard macros.

**ispLSI 2128V Timing Model**



0491/2032

**Derivations of tsu, th and tco from the Product Term Clock**

$$\begin{aligned}
 \text{tsu} &= \text{Logic} + \text{Reg su} - \text{Clock (min)} \\
 &= (\mathbf{t_{io}} + \mathbf{t_{grp}} + \mathbf{t_{20ptxor}}) + (\mathbf{t_{gsu}}) - (\mathbf{t_{io}} + \mathbf{t_{grp}} + \mathbf{t_{ptck(min)}}) \\
 &= (\#20 + \#22 + \#26) + (\#29) - (\#20 + \#22 + \#35) \\
 5.9 \text{ ns} &= (0.4 + 1.2 + 9.5) + (0.2) - (0.4 + 1.2 + 3.8) \\
 \text{th} &= \text{Clock (max)} + \text{Reg h} - \text{Logic} \\
 &= (\mathbf{t_{io}} + \mathbf{t_{grp}} + \mathbf{t_{ptck(max)}}) + (\mathbf{t_{gh}}) - (\mathbf{t_{io}} + \mathbf{t_{grp}} + \mathbf{t_{20ptxor}}) \\
 &= (\#20 + \#22 + \#35) + (\#30) - (\#20 + \#22 + \#26) \\
 1.5 \text{ ns} &= (0.4 + 1.2 + 5.6) + (5.4) - (0.4 + 1.2 + 9.5) \\
 \text{tco} &= \text{Clock (max)} + \text{Reg co} + \text{Output} \\
 &= (\mathbf{t_{io}} + \mathbf{t_{grp}} + \mathbf{t_{ptck(max)}}) + (\mathbf{t_{gco}}) + (\mathbf{t_{orp}} + \mathbf{t_{ob}}) \\
 &= (\#20 + \#22 + \#35) + (\#31) + (\#36 + \#38) \\
 12.4 \text{ ns} &= (0.4 + 1.2 + 5.6) + (1.6) + (1.4 + 2.2)
 \end{aligned}$$

Note: Calculations are based upon timing specifications for the ispLSI 2128V-80L.

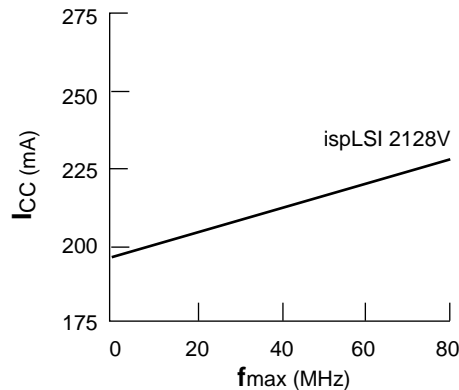
Table 2-0042/2128V

## Power Consumption

Power consumption in the ispLSI 2128V device depends on two primary factors: the speed at which the device is operating and the number of Product Terms used.

Figure 3 shows the relationship between power and operating speed.

**Figure 3. Typical Device Power Consumption vs fmax**



Notes: Configuration of eight 16-bit counters  
Typical current at 3.3V, 25° C

ICC can be estimated for the ispLSI 2128V using the following equation:

$$I_{CC} \text{ (mA)} = 40 + (\# \text{ of PTs} * 0.6) + (\# \text{ of nets} * \text{Max freq} * 0.004)$$

Where:

- # of PTs = Number of Product Terms used in design
- # of nets = Number of Signals used in device
- Max freq = Highest Clock Frequency to the device (in MHz)

The ICC estimate is based on typical conditions (VCC = 3.3V, room temperature) and an assumption of two GLB loads on average exists. These values are for estimates only. Since the value of ICC is sensitive to operating conditions and the program in the device, the actual ICC should be verified.

0127/2128V

## Power-up Considerations

When Lattice 3.3V 2000V devices are used in mixed 5V/3.3V applications, some consideration needs to be given to the power-up sequence. When the I/O pins on the 3.3V ispLSI devices are driven directly by 5V devices, a low impedance path can exist on the 3.3V device between its I/O and Vcc pins when the 3.3V supply is not present. This low impedance path can cause current to flow from the 5V device into the 3.3V ispLSI device. The maximum current occurs when the signals on the I/O pins are driven high by the 5V devices. If a large enough current flows through the 3.3V I/O pins, latch-up can occur and permanent device damage may result.

This latch-up condition occurs only during the power-up sequence when the 5V supply comes up before the 3.3V supply. The Lattice 3.3V ispLSI devices are guaranteed to withstand 5V interface signals within the device operating Vcc range of 3.0V to 3.6V.

The recommended power-up options are as follows:

Option 1: Ensure that the 3.3V supply is powered-up and stable before the 5V supply is powered up.

Option 2: Ensure that the 5V device outputs are driven to a high impedance or logic low state during power-up.



**Pin Description**

NAME	160-PIN PQFP PIN NUMBERS	176-PIN TQFP PIN NUMBERS	DESCRIPTION
I/O 0 - I/O 4 I/O 5 - I/O 9 I/O 10 - I/O 14 I/O 15 - I/O 19 I/O 20 - I/O 24 I/O 25 - I/O 29 I/O 30 - I/O 34 I/O 35 - I/O 39 I/O 40 - I/O 44 I/O 45 - I/O 49 I/O 50 - I/O 54 I/O 55 - I/O 59 I/O 60 - I/O 64 I/O 65 - I/O 69 I/O 70 - I/O 74 I/O 75 - I/O 79 I/O 80 - I/O 84 I/O 85 - I/O 89 I/O 90 - I/O 94 I/O 95 - I/O 99 I/O 100 - I/O 104 I/O 105 - I/O 109 I/O 110 - I/O 114 I/O 115 - I/O 119 I/O 120 - I/O 124 I/O 125 - I/O 127	25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 40, 41, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 80, 81, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 120, 121, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 160, 1, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16	28, 29, 30, 31, 32, 33, 34, 35, 37, 38, 39, 40, 41, 42, 44, 45, 47, 48, 49, 50, 51, 52, 53, 54, 56, 57, 58, 59, 60, 61, 62, 63, 70, 71, 72, 73, 74, 75, 76, 77, 79, 80, 81, 82, 83, 84, 85, 86, 88, 89, 91, 92, 93, 94, 95, 96, 98, 99, 100, 101, 102, 103, 104, 105, 116, 117, 118, 119, 120, 121, 122, 123, 125, 126, 127, 128, 129, 130, 132, 133, 135, 136, 137, 138, 139, 140, 141, 142, 144, 145, 146, 147, 148, 149, 150, 151, 158, 159, 160, 161, 162, 163, 164, 165, 167, 168, 169, 170, 171, 172, 173, 174, 176, 1, 3, 4, 5, 6, 7, 8, 10, 11, 12, 13, 14, 15, 16, 17	Input/Output Pins - These are the general purpose I/O pins used by the logic array.
IN 4 - IN 7	104, 141, 61, 17	114, 155, 67, 19	Dedicated input pins to the device
GOE 0, GOE 1	100, 21	110, 23	Global Output Enable input pins
RESET	19	21	Active Low (0) Reset pin which resets all the registers in the device.
Y0, Y1, Y2	18, 103, 98	20, 113, 108	Dedicated Clock input. This clock input is connected to one of the clock inputs of all the GLBs in the device.
$\overline{\text{ispEN}}$	23	25	Input Dedicated in-system programming Boundary Scan enable input pin. This pin is brought low to enable the programming mode. The TMS, TDI, TDO and TCK controls become active.
TDI/IN 0	24	26	Input This pin performs two functions. When $\overline{\text{ispEN}}$ is logic low, it functions as a serial data input pin to load programming data into the device. When $\overline{\text{ispEN}}$ is high, it functions as a dedicated input pin.
TCK/IN 3	97	107	Input This pin performs two functions. When $\overline{\text{ispEN}}$ is logic low, it functions as a clock pin for the ISP/Boundary Scan state machine. When $\overline{\text{ispEN}}$ is high, it functions as a dedicated input pin.
TMS/IN 1	60	66	Input This pin performs two functions. When $\overline{\text{ispEN}}$ is logic low, it functions as a mode control pin for the ISP/Boundary Scan state machine. When $\overline{\text{ispEN}}$ is high, it functions as a dedicated input pin.
TDO/IN 2	140	154	Output/Input This pin performs two functions. When $\overline{\text{ispEN}}$ is logic low, it functions as an output pin to read serial shift register data. When $\overline{\text{ispEN}}$ is high, it functions as a dedicated input pin.
GND	22, 42, 62, 79, 99, 122, 139, 159	24, 46, 68, 87, 109, 134, 153, 175	Ground (GND)
VCC	2, 20, 39, 59, 82, 101, 119, 142	2, 22, 43, 65, 90, 111, 131, 156	Vcc
NC <sup>1</sup>	102	9, 18, 27, 36, 55, 64, 69, 78, 97, 106, 112, 115, 124, 143, 152, 157, 166	No Connect.

1. NC pins are not to be connected to any active signal, VCC or GND.

## Pin Description

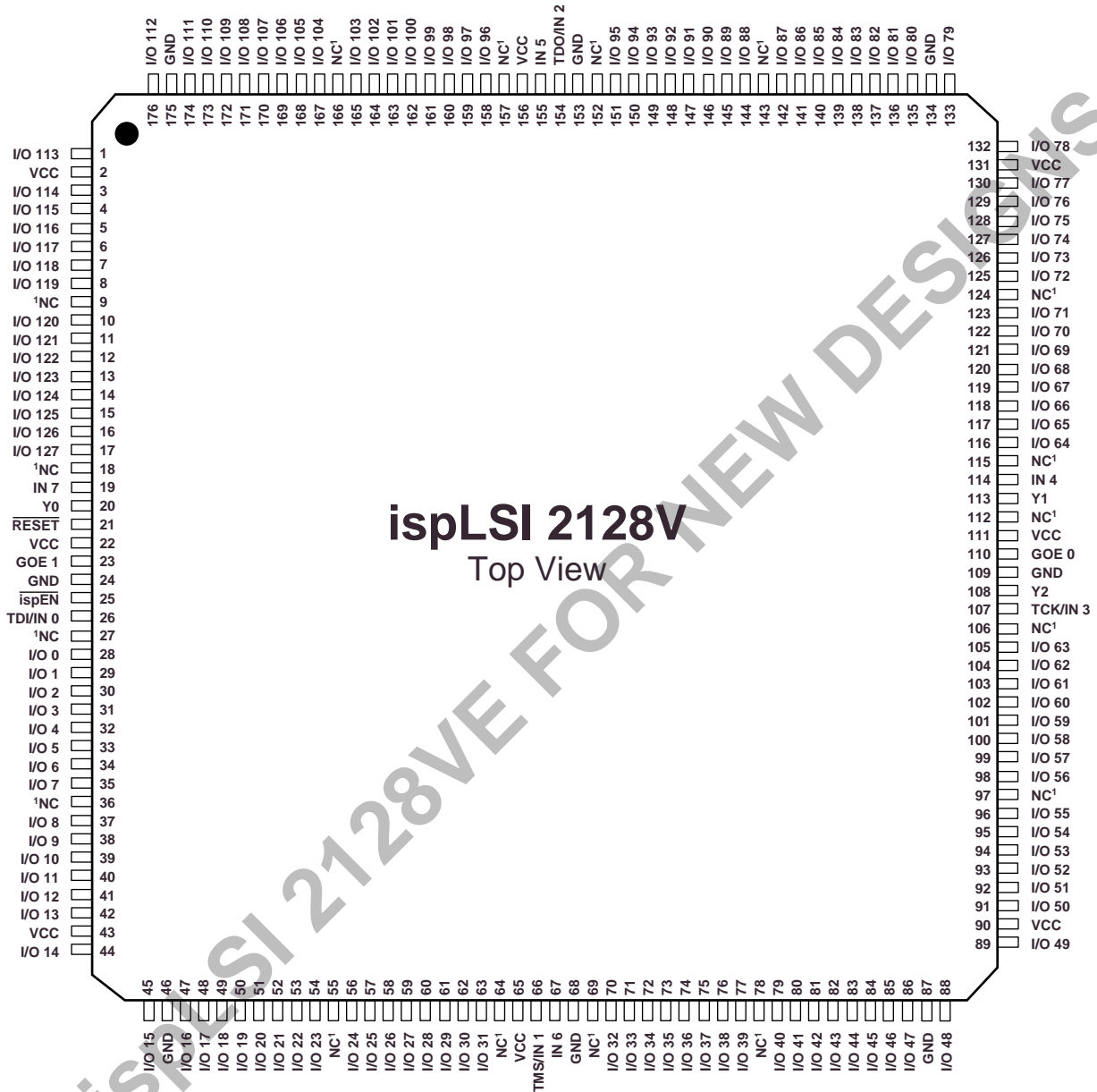
NAME	84-PIN PLCC PIN NUMBERS	100-PIN TQFP PIN NUMBERS	DESCRIPTION
I/O 0 - I/O 3 I/O 4 - I/O 7 I/O 8 - I/O 11 I/O 12 - I/O 15 I/O 16 - I/O 19 I/O 20 - I/O 23 I/O 24 - I/O 27 I/O 28 - I/O 31 I/O 32 - I/O 35 I/O 36 - I/O 39 I/O 40 - I/O 43 I/O 44 - I/O 47 I/O 48 - I/O 51 I/O 52 - I/O 55 I/O 56 - I/O 59 I/O 60 - I/O 63	26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18	17, 18, 19, 20, 22, 23, 24, 26, 27, 28, 29, 30, 32, 33, 34, 35, 40, 41, 42, 43, 45, 46, 47, 48, 49, 51, 52, 53, 55, 56, 57, 58, 67, 68, 69, 70, 72, 73, 74, 76, 77, 78, 79, 80, 82, 83, 84, 85, 90, 91, 92, 93, 95, 96, 97, 98, 99, 1, 2, 3, 5, 6, 7, 8	Input/Output Pins - These are the general purpose I/O pins used by the logic array.
IN 4 - IN 7		66, 88, 38, 9	Dedicated input pins to the device
GOE 0, GOE 1	64, 22	62, 13	Global Output Enable input pins
RESET Y0, Y1, Y2	20 19, 67, 62	11 10, 65, 60	Active Low (0) Reset pin which resets all the registers in the device. Dedicated Clock input. This clock input is connected to one of the clock inputs of all the GLBs in the device.
ispEN	24	15	Input — Dedicated in-system programming Boundary Scan enable input pin. This pin is brought low to enable the programming mode. The TMS, TDI, TDO and TCK controls become active.
TDI/IN 0	25	16	Input — This pin performs two functions. When $\overline{\text{ispEN}}$ is logic low, it functions as a serial data input pin to load programming data into the device. When $\overline{\text{ispEN}}$ is high, it functions as a dedicated input pin.
TCK/IN 3	61	59	Input — This pin performs two functions. When $\overline{\text{ispEN}}$ is logic low, it functions as a clock pin for the ISP/Boundary Scan state machine. When $\overline{\text{ispEN}}$ is high, it functions as a dedicated input pin.
TMS/IN 1	43	37	Input — This pin performs two functions. When $\overline{\text{ispEN}}$ is logic low, it functions as a mode control pin for the ISP/Boundary Scan state machine. When $\overline{\text{ispEN}}$ is high, it functions as a dedicated input pin.
TDO/IN 2	1	87	Output/Input — This pin performs two functions. When $\overline{\text{ispEN}}$ is logic low, it functions as an output pin to read serial shift register data. When $\overline{\text{ispEN}}$ is high, it functions as a dedicated input pin.
GND	23, 44, 63, 84	14, 39, 61, 86	Ground (GND)
VCC	2, 21, 42, 65	12, 36, 63, 89	Vcc
NC <sup>1</sup>	66	4, 21, 25, 31, 44, 50, 54, 64, 71, 75, 81, 94, 100	No Connect.

1. NC pins are not to be connected to any active signal, VCC or GND.

Table 2-0002B/2128V

**Pin Configuration**

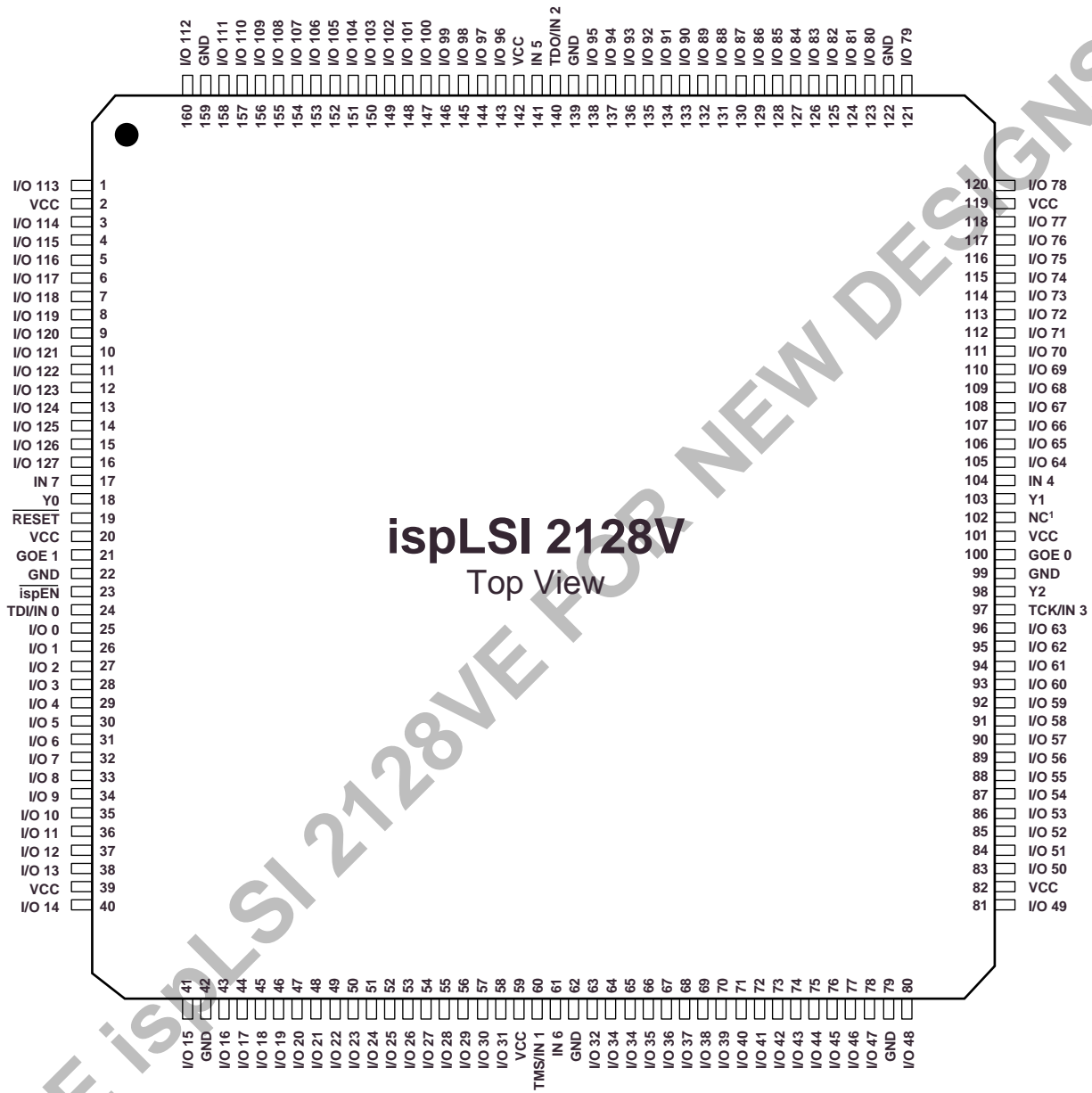
ispLSI 2128V 176-Pin TQFP Pinout Diagram



1. NC pins are not to be connected to any active signals, VCC or GND.

**Pin Configuration**

**ispLSI 2128V 160-Pin PQFP Pinout Diagram**

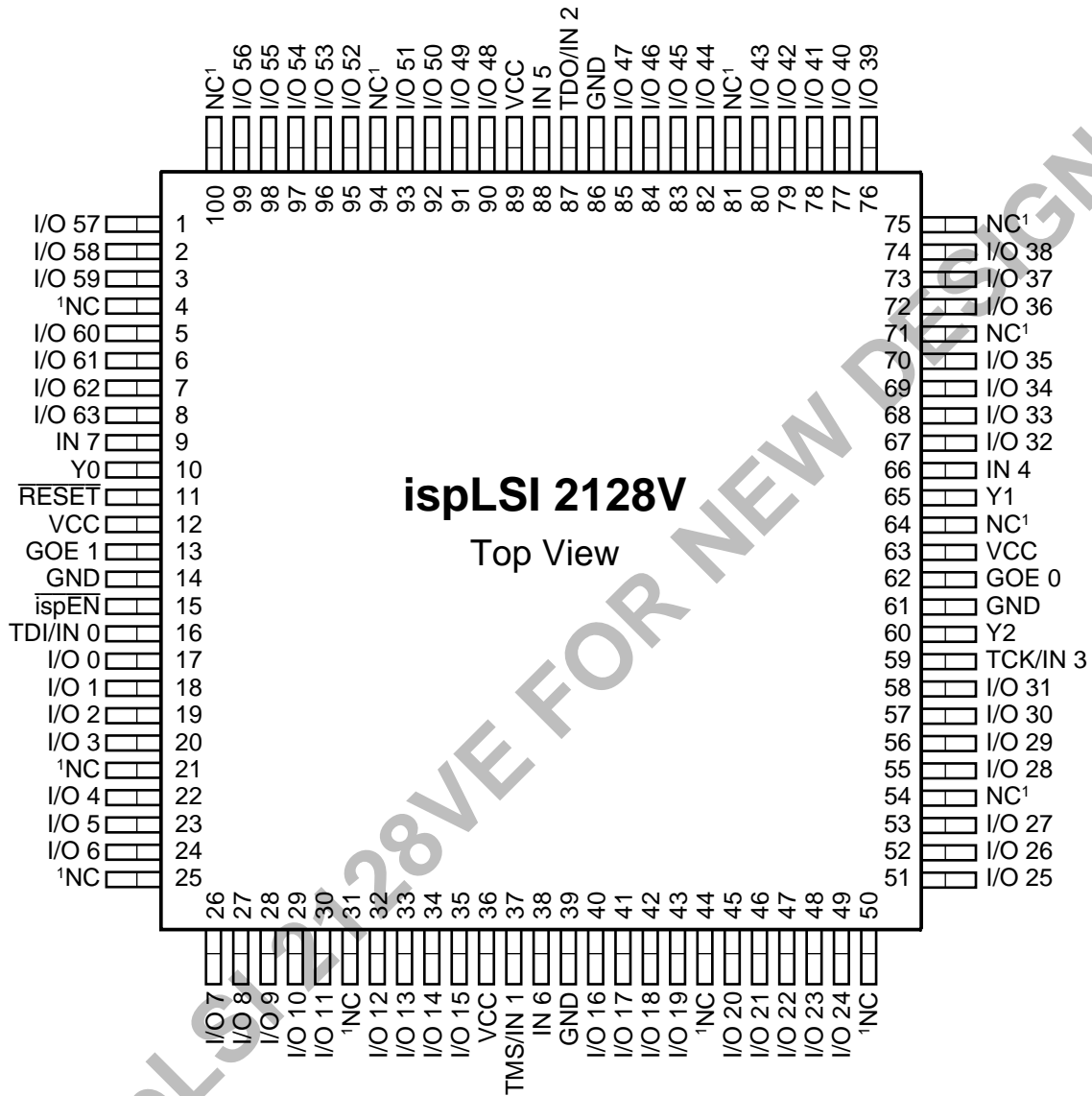


160-PQFP/2128LV

1. NC pins are not to be connected to any active signal, VCC or GND.

**Pin Configuration**

ispLSI 2128V 100-Pin TQFP Pinout Diagram

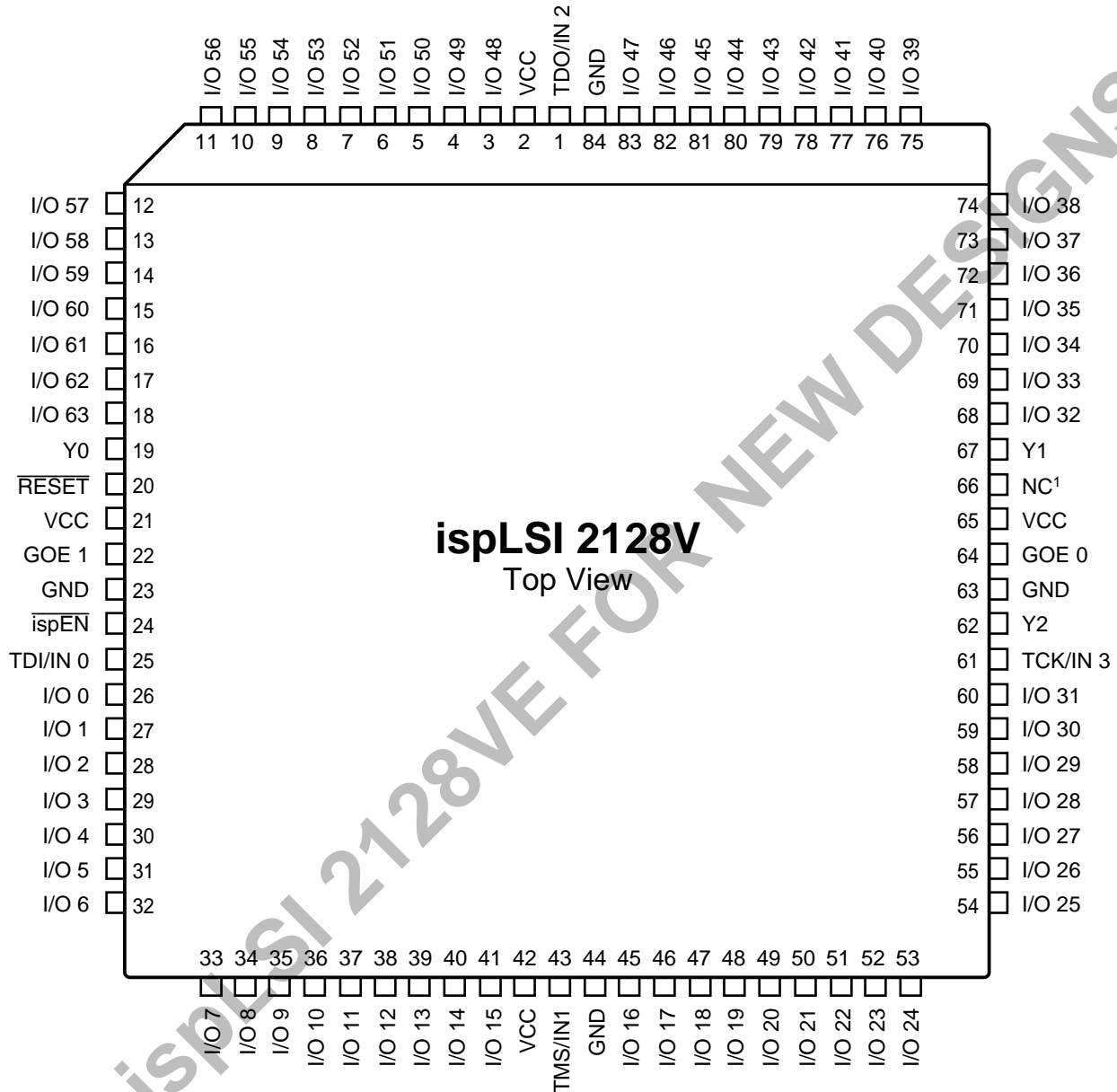


100-TQFP/2128V

1. NC pins are not to be connected to any active signals, VCC or GND.

**Pin Configuration**

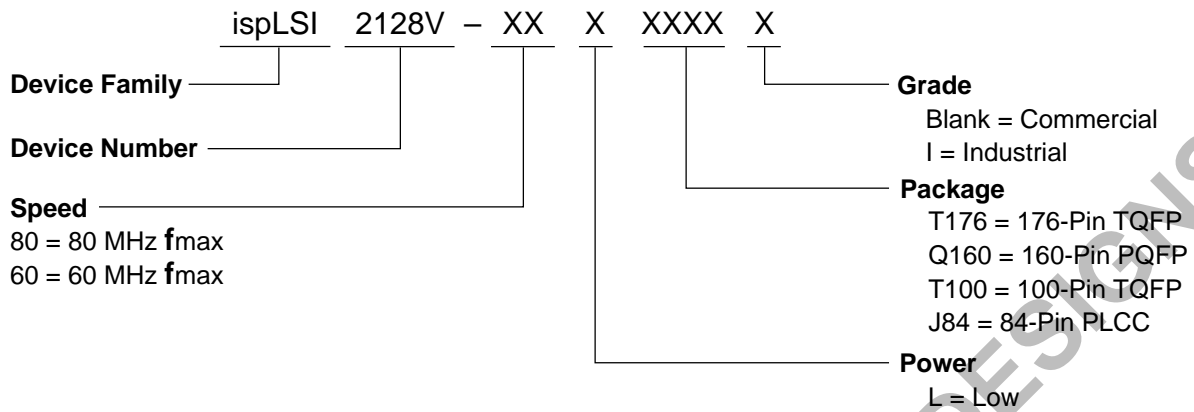
ispLSI 2128V 84-Pin PLCC Pinout Diagram



1. NC pins are not to be connected to any active signals, VCC or GND.

0123/2128V

**Part Number Description**



0212/2128V

**ispLSI 2128V Ordering Information**

**COMMERCIAL**

FAMILY	$f_{max}$ (MHz)	tpd (ns)	I/Os	ORDERING NUMBER	PACKAGE
ispLSI	80	10	128	ispLSI 2128V-80LT176	176-Pin TQFP
	80	10	128	ispLSI 2128V-80LQ160	160-Pin PQFP
	80	10	64	ispLSI 2128V-80LT100	100-Pin TQFP
	80	10	64	ispLSI 2128V-80LJ84	84-Pin PLCC
	60	15	128	ispLSI 2128V-60LT176	176-Pin TQFP
	60	15	128	ispLSI 2128V-60LQ160	160-Pin PQFP
	60	15	64	ispLSI 2128V-60LT100	100-Pin TQFP
	60	15	64	ispLSI 2128V-60LJ84	84-Pin PLCC

\*Contact factory for availability.

Table 2-0041A/2128V

**INDUSTRIAL**

FAMILY	$f_{max}$ (MHz)	tpd (ns)	I/Os	ORDERING NUMBER	PACKAGE
ispLSI	60	15	128	ispLSI 2128V-60LT176I	176-Pin TQFP
	60	15	64	ispLSI 2128V-60LT100I	100-Pin TQFP

Table 2-0041B/2128V