DLPR910 Configuration PROM

1 Features

- Pre-programmed Xilinx® PROM configures the DLPC910 DMD digital controller
- I/O pins compatible with 1.8 V to 3.3 V
- 1.8 V core supply voltage
- –40°C to 85°C operating temperature range

2 Applications

- Lithography
  - Direct Imaging
  - Flat Panel Display
  - Printed Circuit Board Manufacturing
- Industrial
  - 3D Printing
  - 3D Scanners for Machine Vision
  - Quality Control
- Displays
  - 3D Imaging
  - Intelligent and Adaptive Lighting
  - Augmented Reality and Information Overlay

3 Description

The DLPR910 device is a programmed PROM used to properly configure the DLPC910 DLPC910ZYR Controller to operate four different digital micromirror device (DMD) options: the DLP9000X, the DLP9000XUV, and the DLP6500 family (S600 and Type A packages). The firmware in this device enables the DLPC910 DLPC910ZYRController to provide system data throughput rates up to 61 Gigabits per second (Gbps) for the DLP9000X and DLP9000XUV, and up to 24 Gbps for the DLP6500 family, with the options for random row addressing and Load4 capabilities.

Get started with TI DLP® light-control technology page to learn how to get started with the DLPC410ZYR. The DLP advanced light control resources on ti.com accelerate time to market, which include evaluation modules, reference designs, optical modules manufacturers, and DLP design network partners.

Device Information(1)

PART NUMBER	PACKAGE	BODY SIZE (NOM)
DLPR910	DSBGA (48)	8.00 mm × 9.00 mm × 1.20 mm

(1) For all available packages, see the orderable addendum at the end of the data sheet.

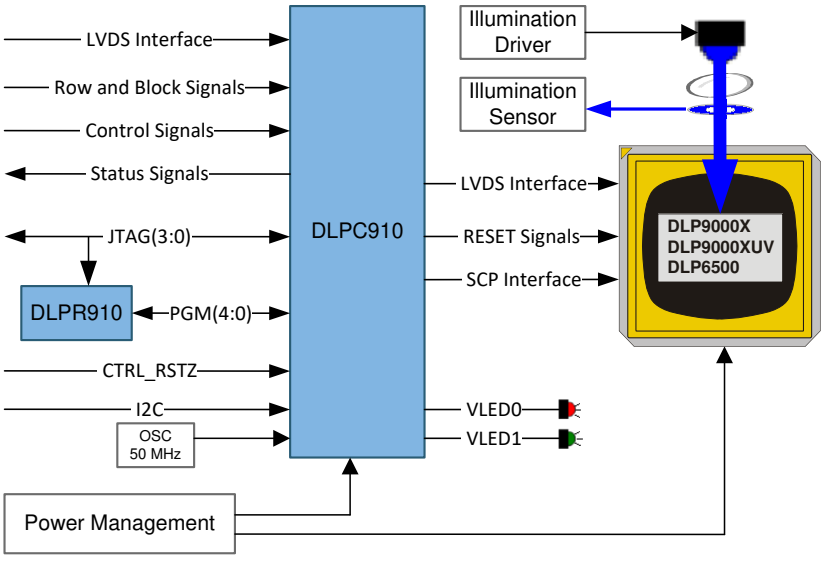

Figure 3-1. Simplified Application

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4 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Revision C (September 2019) to Revision D (December 2021)	Page
• Updated the numbering format for tables, figures, and cross-references throughout the document	1

Changes from Revision B (November 2016) to Revision C (September 2019)	Page
• Changed "three" to "four different DMD options"	1
• Added DLP9000XUV	1
• Updated Xilinx reference doc to revision v2.19 from v2.18	6
• Added DLP9000XUV	7
• Added DLP9000XUV	10
• Added DLP9000XUV to caption of Typical Application Schematic	10
• Added DLP9000XUV	11
• Updated table to indicate DLP9000XUV is not compatible with DLPR910YVA	13
• Changed Device Markings image	13
• Added DLP9000XUV datasheet	14

Changes from Revision A (October 2015) to Revision B (November 2016)	Page
• Updated *Related Documentation* to include additional supported DMD	1
• Update document to include additional supported DMD options in *Section 7*	7
• Added typical application schematic for newly supported DMD in *Section 8.2*	10
• Updated *Section 11.1.3*	13
• Added MSL Peak Temp to *Section 12.1.1*	15

Changes from Revision * (September 2015) to Revision A (October 2015)	Page
• Updated device from Product Preview to Production Data	1

5 Pin Configuration and Functions

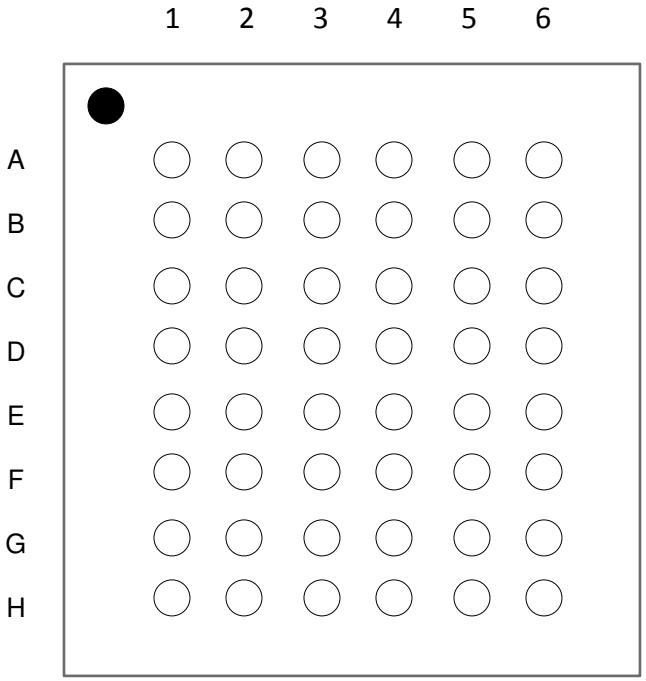

Figure 5-1. YVA Package 48-Pin DSBGA Top View

Table 5-1. Pin Functions

PIN		TYPE[1]	DESCRIPTION
NAME	NO.		
GND	A1	G	Ground
GND	A2	G	Ground
OE/ $\overline{\text{RESET}}$	A3	I/O	Output Enable/ $\overline{\text{RESET}}$ (Open-Drain I/O). When Low, this input holds the address counter reset and the DATA and CLKOUT outputs are placed in a high-impedance state. This is a bidirectional open-drain pin that is held Low while the PROM completes the internal power-on reset sequence. Polarity is not programmable. **Pin must be pulled High using an external 4.7-kΩ pull-up to V_{CCO}.**
DNC	A4	—	Do Not Connect. Leave unconnected.
D6	A5	—	Do Not Connect. Leave unconnected.
D7	A6	—	Do Not Connect. Leave unconnected.
V_{CCINT}	B1	P	Positive 1.8-V supply voltage for internal logic.
V_{CCO}	B2	P	Positive 3.3-V and 1.8-V supply voltage connected to the output voltage drivers and internal buffers.
CLK	B3	I	Configuration clock input. Each rising edge on the CLK input increments the internal address counter. **Pin must be pulled High and Low using an external 100-Ω pull-up to V_{CCO} and an external 100-Ω pull-down to Ground. Place resistors close to pin.**
$\overline{\text{CE}}$	B4	I	Chip Enable Input. When $\overline{\text{CE}}$ is High, the device is put into low-power standby mode, the address counter is reset, and the DATA and CLKOUT outputs are placed in a high impedance state. **Pin must be pulled High using an external 4.7-kΩ pull-up to V_{CCO}.**
D5	B5	—	Do Not Connect. Leave unconnected.
GND	B6	G	Ground
BUSY	C1	—	Do Not Connect. Leave unconnected.
CLKOUT	C2	—	Do Not Connect. Leave unconnected.
DNC	C3	—	Do Not Connect. Leave unconnected.
DNC	C4	—	Do Not Connect. Leave unconnected.

Table 5-1. Pin Functions (continued)

PIN		TYPE(1)	DESCRIPTION
NAME	NO.		
D4	C5	—	Do Not Connect. Leave unconnected.
V_{CCO}	C6	P	Positive 3.3-V and 1.8-V supply voltage connected to the output voltage drivers and internal buffers.
$\overline{CF}$	D1	I	Configuration pin. **The $\overline{CF}$ pin must be pulled High using an external 4.7-kΩ pull-up to V_{CCO}.** Selects serial mode configuration.
$\overline{CEO}$	D2	—	Do Not Connect. Leave unconnected.
DNC	D3	—	Do Not Connect. Leave unconnected.
DNC	D4	—	Do Not Connect. Leave unconnected.
D3	D5	—	Do Not Connect. Leave unconnected.
V_{CCO}	D6	P	Positive 3.3-V and 1.8-V supply voltage connected to the output voltage drivers and internal buffers.
V_{CCINT}	E1	P	Positive 1.8-V supply voltage for internal logic.
TMS	E2	I	JTAG Mode Select Input. TMS has an internal 50-kΩ resistive pull-up to V_{CCJ}.
DNC	E3	—	Do Not Connect. Leave unconnected.
DNC	E4	—	Do Not Connect. Leave unconnected.
DNC	E5	—	Do Not Connect. Leave unconnected.
TDO	E6	O	JTAG Serial Data Output. TDO has an internal 50-kΩ resistive pull-up to V_{CCJ}.
GND	F1	G	Ground
DNC	F2	—	Do Not Connect. Leave unconnected.
DNC	F3	—	Do Not Connect. Leave unconnected.
DNC	F4	—	Do Not Connect. Leave unconnected.
GND	F5	G	Ground
GND	F6	G	Ground
TDI	G1	I	JTAG Serial Data Input. TDI has an internal 50k-Ω resistive pull-up to V_{CCJ}.
DNC	G2	—	Do Not Connect. Leave unconnected.
REV_SEL0	G3	I	Revision Select [1:0] Inputs. When the $\overline{EN\_EXT\_SEL}$ is Low, the Revision Select pins are used to select the design revision to be enabled. The Revision Select [1:0] inputs have an internal 50-kΩ resistive pull-up to V_{CCO}. **The REV_SEL0 pin must be pulled Low using an external 4.7-kΩ pull-down to Ground. The REV_SEL1 pin must be pulled Low using an external 4.7-kΩ pull-down to Ground.**
REV_SEL1	G4	I	
V_{CCO}	G5	P	Positive 3.3-V and 1.8-V supply voltage connected to the output voltage drivers and internal buffers.
V_{CCINT}	G6	P	Positive 1.8-V supply voltage for internal logic.
GND	H1	G	Ground
VCCJ	H2	P	Positive 3.3-V JTAG I/O supply voltage connected to the TDO output voltage driver and TCK, TMS and TDI input buffers.
TCK	H3	I	JTAG Clock Input. This pin is the JTAG test clock. It sequences the TAP controller and all the JTAG test and programming electronics.
$\overline{EN\_EXT\_SEL}$	H4	I	External Selection Input. $\overline{EN\_EXT\_SEL}$ has an internal 50-kΩ resistive pull- up to V_{CCO}. **The $\overline{EN\_EXT\_SEL}$ pin must be connected to Ground**.
D1	H5	—	Do Not Connect. Leave unconnected.
D0	H6	O	DATA output pin to provide data for configuring the DLPC910 in serial mode.

(1) P = Power, G = Ground, I = Input, O = Output

6 Specifications

For complete electrical and mechanical specifications of the DLPR910, see the XCF16P product specification listed in *Related Documentation*.

6.1 Absolute Maximum Ratings

over operating free-air temperature (unless otherwise noted) (see (1) (2))

			MIN	MAX	UNIT
V_{CCINT}	Internal supply voltage	Relative to ground	–0.5	2.7	V
V_{CCO}	I/O supply voltage	Relative to ground	–0.5	4.0	V
V_{IN}	Input voltage with respect to ground	V_{CCO} < 2.5 V	–0.5	3.6	V
		V_{CCO} ≥ 2.5 V	–0.5	3.6	V
V_{TS}	Voltage applied to high-impedance output	V_{CCO} < 2.5 V	–0.5	3.6	V
		V_{CCO} ≥ 2.5 V	–0.5	3.6	V
T_J	Junction temperature			125	°C
T_{stg}	Storage temperature, ambient		–65	150	°C

(1) Stresses beyond those listed under *Absolute Maximum Ratings* can cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under *Section 6.3* is not implied. Exposure to absolute-maximum-rated conditions for extended periods can affect device reliability.
(2) Maximum DC undershoot below GND must be limited to either 0.5 V or 10 mA. During transitions, the device pins can undershoot to –2 V or overshoot to 7 V, provided this overshoot or undershoot lasts less than 10 ns and with the forcing current being limited to 200 mA.

6.2 ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$ (1)	Electrostatic discharge	Human body model (HBM), per ANSI/ESDA/JEDEC JS-001, all pins (2)	2000	V

(1) Electrostatic discharge (ESD) to measure device sensitivity and immunity to damage caused by assembly line electrostatic discharges in to the device.
(2) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.

6.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)

			MIN	NOM	MAX	UNIT
V_{CCINT}	Internal voltage supply		1.65	1.8	2.0	V
V_{CCO}	Supply voltage for output drivers	3.3-V operation	3.0	3.3	3.6	V
V_{IL}	Low-level input voltage	3.3-V operation	0		0.8	V
V_{IH}	High-level input voltage	3.3-V operation	2.0		3.6	V
V_O	Output voltage		0		V_{CCO}	V
t_{IN}	Input signal transition time (measured between 10% V_{CCO} and 90% V_{CCO})				500	ns
T_A	Operating ambient temperature		–40		85	°C

6.4 Thermal Information

Refer to the XCF16P product specifications.

6.5 Electrical Characteristics

Refer to the XCF16P product specifications at www.xilinx.com.

6.6 Supply Voltage Requirements for Power-On Reset and Power-Down

(see (1))

		MIN	MAX	UNIT
t_{VCC}	V_{CCINT} rise time from 0 V to nominal voltage (2)	0.2	50	ms
V_{CCPOR}	POR threshold for V_{CCINT} supply	0.5	–	V
t_{OER}	OE/ $\overline{\text{RESET}}$ release delay following POR (3)	0.5	30	ms
V_{CCPD}	Power-down threshold for V_{CCINT} supply		0.5	V
t_{RST}	Time required to trigger a device reset when the V_{CCINT} supply drops below the maximum V_{CCPD} threshold	10		ms

(1) V_{CCINT}, V_{CCO}, and V_{CCJ} supplies can be applied in any order.
(2) At power-up, the device requires the V_{CCINT} power supply to monotonically rise to the nominal operating voltage within the specified t_{VCC} rise time. If the power supply cannot meet this requirement, then the device might not perform power-on-reset properly. See Platform Flash PROM Power-Up Requirements, in the Xilinx XCF16P (v2.19) Product Specification for more information.
(3) If the V_{CCINT} and V_{CCO} supplies do not reach their respective recommended operating conditions before the OE/ $\overline{\text{RESET}}$ pin is released, then the configuration data from the PROM is not available at the recommended threshold levels. The configuration sequence must be delayed until both V_{CCINT} and V_{CCO} have reached their recommended operating conditions.

6.7 Timing Requirements

Refer to the XCF16P product specifications at www.xilinx.com.

7 Detailed Description

7.1 Overview

The configuration bit stream stored in the DLPR910 device supports reliable operation of the DLPC910 device with the DLP9000X and DLP9000XUV DMDs, or the DLP6500 family of DMDs. The DLPC910 digital controller loads this configuration bit stream from the DLPR910 device.

7.2 Functional Block Diagram

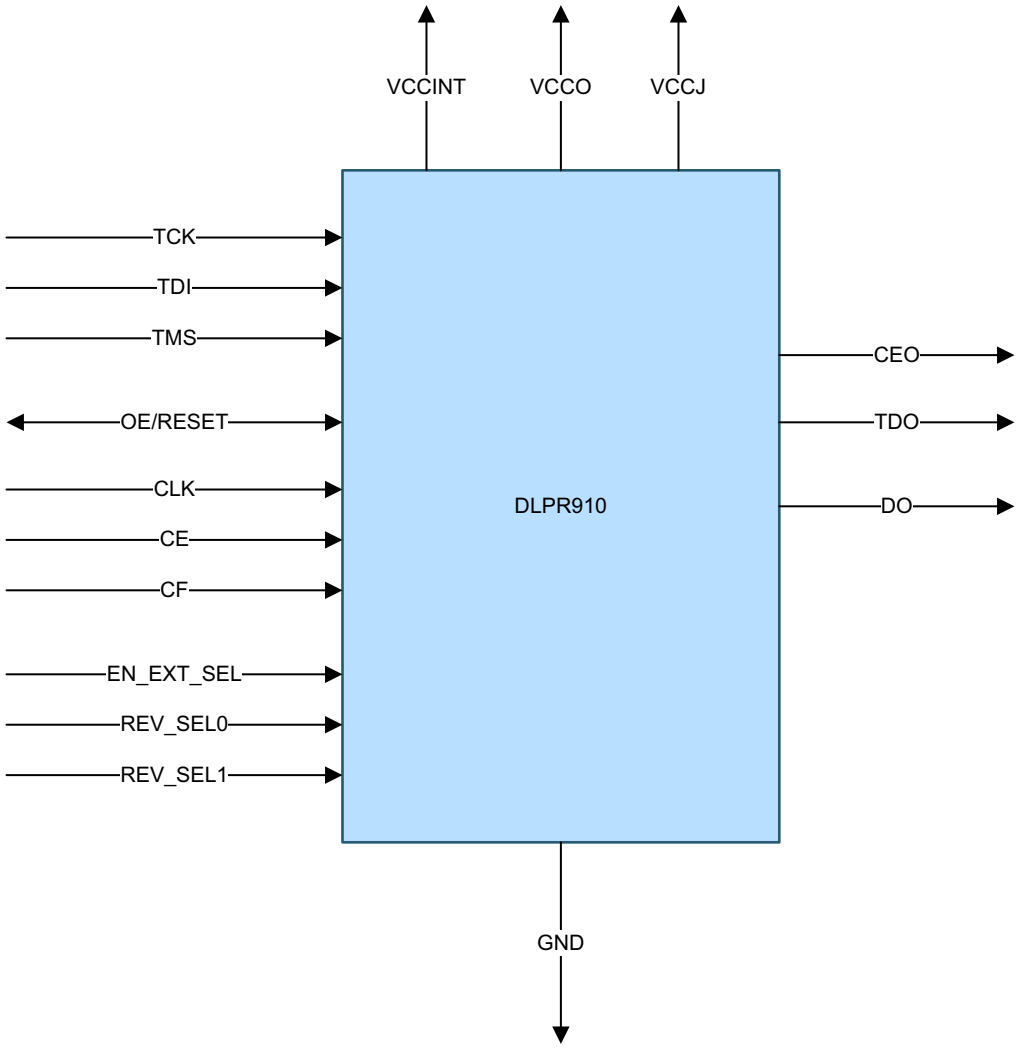

Figure 7-1. Functional Block Diagram

7.3 Feature Description

7.3.1 Data Interface

7.3.1.1 Data Outputs

The DLPR910 device is configured for serial mode operation, where D0 is the data output pin. D0 output pin provides a serial connection to the DLPC910 controller, where the configuration is read out by the DLPC910 controller.

7.3.1.2 Configuration Clock Input

The configuration CLK is connected to the DLPC910 controller in Primary Serial mode, where the DLPC910 controller provides the clock pulses to read the configuration from the DLPR910 device.

7.3.1.3 Output Enable and Reset

When the OE/ $\overline{\text{RESET}}$ input is held low, the address counter is reset and the Data (D0) and CLKOUT outputs are placed in high-impedance state. **OE/ $\overline{\text{RESET}}$ must be pulled High using an external 4.7-kΩ pull-up to V_{CCO}.**

7.3.1.4 Chip Enable

The $\overline{\text{CE}}$ input is asserted by the DLPC910 controller to enable the Data (D0) and CLKOUT outputs. When $\overline{\text{CE}}$ is held high, the DLPR910 device address counter is reset, and the Data and CLKOUT outputs are placed in high-impedance states.

7.3.1.5 Configuration Pulse

The DLPR910 device is configured in serial mode when it holds configuration pulse pin, $\overline{\text{CF}}$, high and it enables the $\overline{\text{CE}}$ and OE pins. New data is available a short time after each rising clock edge.

7.3.1.6 Revision Selection

The device uses the REV_SEL0, REV_SEL1, and $\overline{\text{EN\_EXT\_SEL}}$ signals to select a revision to act as the default. Setting all three signals to GND defaults to revision 0 for simple DLPR910 device setup.

7.4 Device Functional Modes

To successfully program the DLPC910 controller upon power-up, the DLPR910 device must be configured and connected to the DLPC910 controller as shown in Figure 7-2.

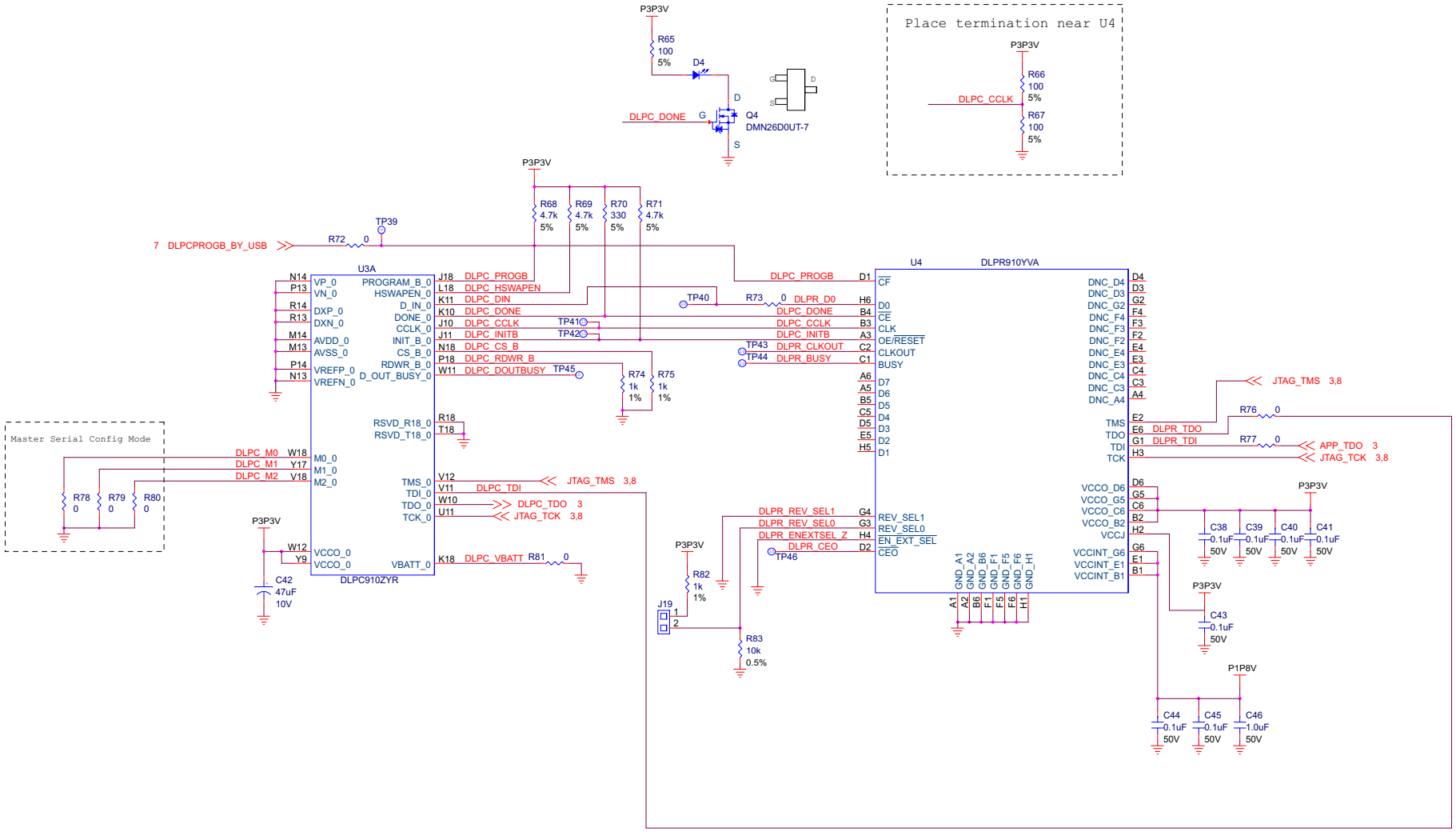

Figure 7-2. DLPC910 and DLPR910 Connection Schematic

8 Application and Implementation

Note

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes, as well as validating and testing their design implementation to confirm system functionality.

8.1 Application Information

The DLPR910 device configuration PROM ships pre-programmed with configuration code for the DLPC910 controller. Upon power-up, the DLPC910 controller and the DLPR910 device connect to enable configuration information to be sent from the DLPR910 device to the DLPC910 controller, such that the DLPC910 controller can configure itself for proper operation within the application. Without the DLPR910 device properly connected to the DLPC910 controller in the application system, the DLPC910 controller does not boot and the system remains inoperable.

8.2 Typical Application

A typical use case for a high speed lithography application is shown in Figure 8-1 and in Figure 8-2. Both applications offer continuous run of printing by changing the digitally created patterns without stopping the imaging head. The DLPR910 prom configures the DLPC910 digital controller to reliably operate with the DLP9000X and DLP9000XUV DMDs, or the DLP6500 DMDs. These chipset combinations provide an ideal back-end imager that takes in digital images at 2560 × 1600 and 1920 x 1080 in resolution to achieve speeds greater than 61 Gigabits per second (Gbps) and 24 Gbps respectively. For complete details of this typical application refer to the DLPC910 data sheet listed in *Section 11.2.1*.

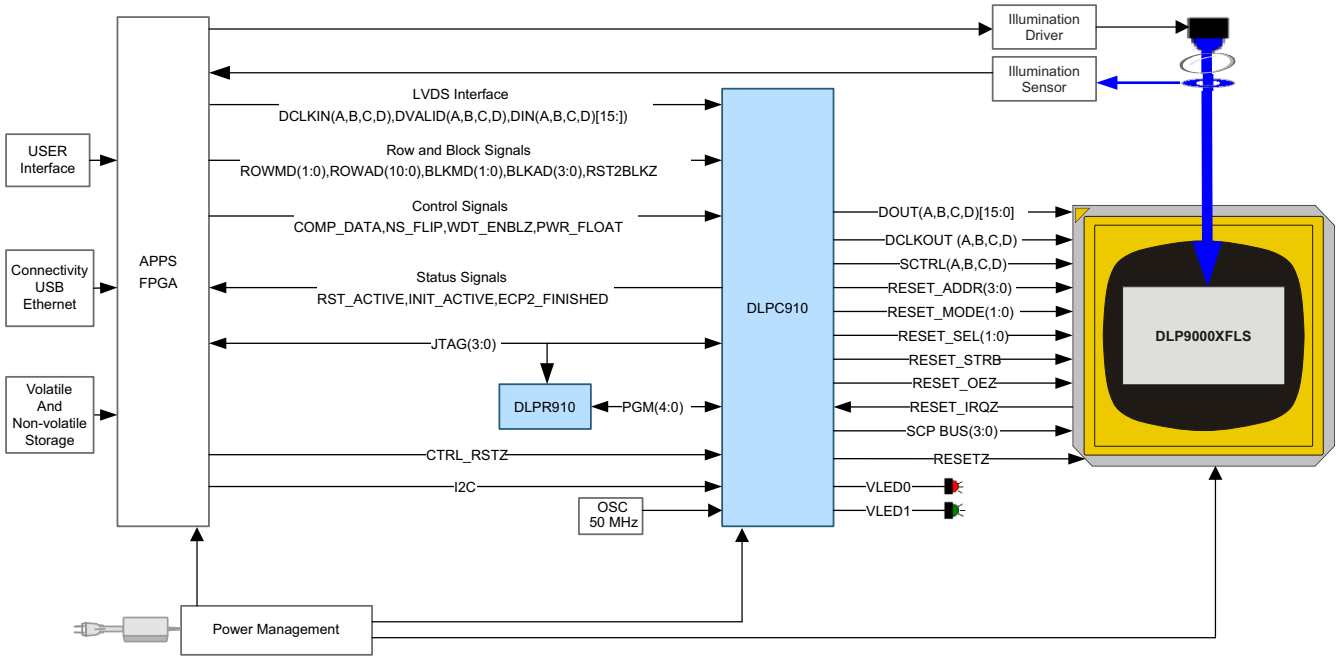

Figure 8-1. Typical High Speed DLP9000X (or DLP9000XUV) Application Schematic

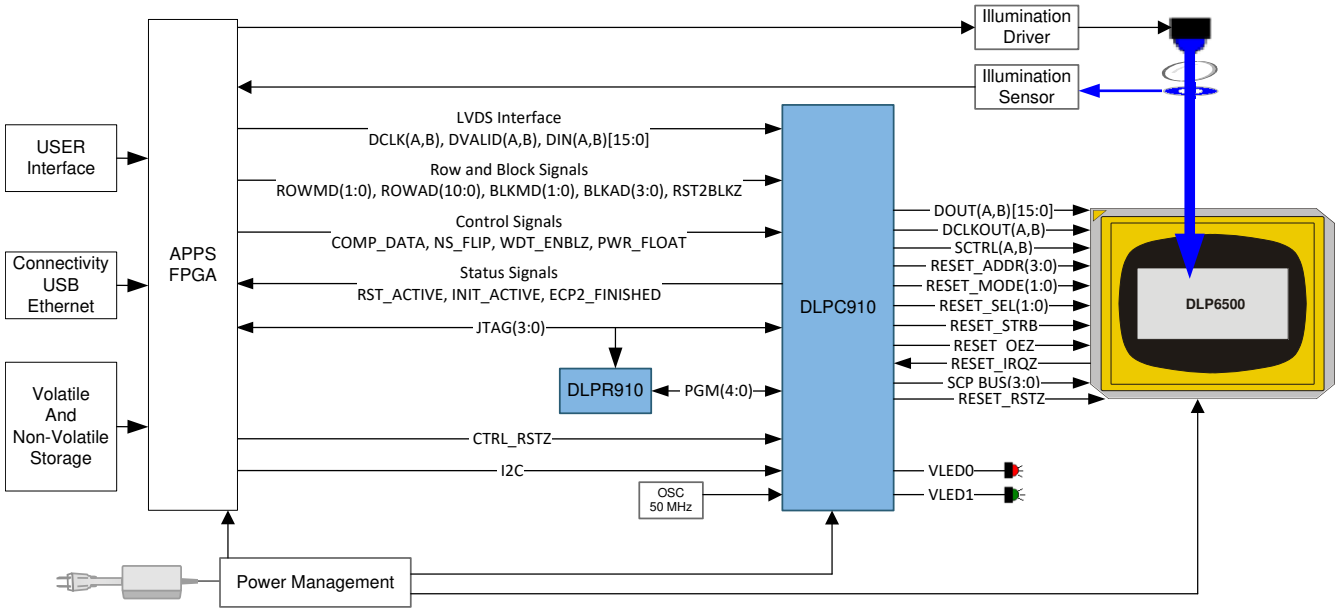

Figure 8-2. Typical High Speed DLP6500 Application Schematic

8.2.1 Design Requirements

The DLPR910 is part of a multi-chipset solution, and it is required to be coupled with the DLPC910 controller for reliable operation of the DLP9000X and DLP9000XUV DMDs, or the DLP6500 family of DMDs. For more information, refer to the DLPC910 datasheet listed in *Section 11.2.1*.

9 Power Supply Recommendations

The DLPR910 uses two power supply rails as shown in Table 9-1.

Table 9-1. DLPR910 Power Supply Rails

SUPPLY	POWER PINS	COMMENTS
1.8 V	V_{CCINT1}, V_{CCINT2}, and V_{CCINT3}	All V_{CCINT} pins must be connected with a 0.1-µF and a 0.047-µF decoupling capacitor to GND.
3.3 V	V_{CCO1},V_{CCO2},V_{CCO3}, V_{CCO4}, and V_{CCJ}	All V_{CCO} and V_{CCJ} pins must be connected with a 0.1-µF and a 0.047-µF decoupling capacitor to GND.

10 Layout

10.1 Layout Guidelines

The DLPR910 is part of a multi-chipset solution. It is required to be used with the DLPC910 Controller to provide reliable control of any attached DMDs. These guidelines are targeted at designing a PCB board with the DLPR910.

11 Device and Documentation Support

11.1 Device Support

11.1.1 Device Compatibility

TI PART NUMBER(1)	DLP9000XFLS	DLP9000XBFLS	DLP9000XUVFLS	DLP6500FYE DLP6500FLQ	DLP6500BFYE DLP6500BFLQ
DLPR910YVA	Compatible	Not Compatible	Not Compatible	Compatible	Not Compatible
DLPR910AYVA	Compatible	Compatible	Compatible	Compatible	Compatible

(1) Refer to each individual DMD datasheet under Device and Documentation Support to determine location and revision of the DMD.

11.1.2 Device Nomenclature

Table 11-1. Part Number Description

TI PART NUMBER	DESCRIPTION	REFERENCE NUMBER
DLPR910AYVA	DLPR910A Configuration PROM	2514595-0002

11.1.3 Device Markings

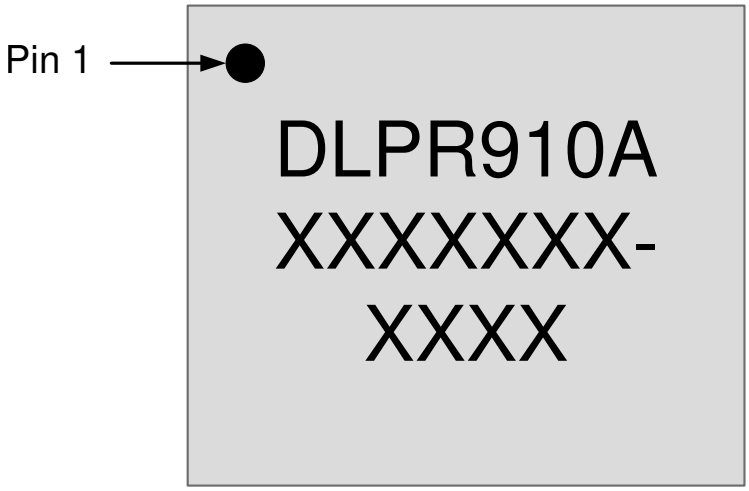

Figure 11-1. DLPR910 Device Markings

Where XXXXXXX-XXXX is the reference number located in Table 11-1.

11.2 Documentation Support

11.2.1 Related Documentation

For related documentation, see the following:

- DLPC910 datasheet (DLPS064)
- DLP9000(X) datasheet (DLPS036)
- DLP9000XUV datasheet (DLPS158)
- DLP6500 Type A datasheet (DLPS040)
- DLP6500 S600 datasheet (DLPS053)
- XCF16P data sheet (www.xilinx.com)

11.3 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on ti.com. Click on *Subscribe to updates* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

11.4 Support Resources

TI E2E™ support forums are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

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11.6 Electrostatic Discharge Caution

This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

11.7 Glossary

TI Glossary	This glossary lists and explains terms, acronyms, and definitions.

12 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this datasheet, refer to the left-hand navigation.

12.1 Package Option Addendum

12.1.1 Packaging Information

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish	MSL Peak Temp (3)	Op Temp (°C)	Device Marking(4) (5)
DLPR910AYVA	ACTIVE	DSBGA	YVA	48	1	Call TI	Call TI	Level-3-260C-168 HRS	–40 to 85	Call TI

(1) The marketing status values are defined as follows:
ACTIVE: Product device recommended for new designs.
LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
PRE_PROD Unannounced device, not in production, not available for mass market, nor on the web, samples not available.
PREVIEW: Device has been announced but is not in production. Samples may or may not be available.
OBSOLETE: TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device

(5) Multiple Device markings will be inside parentheses. Only on Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

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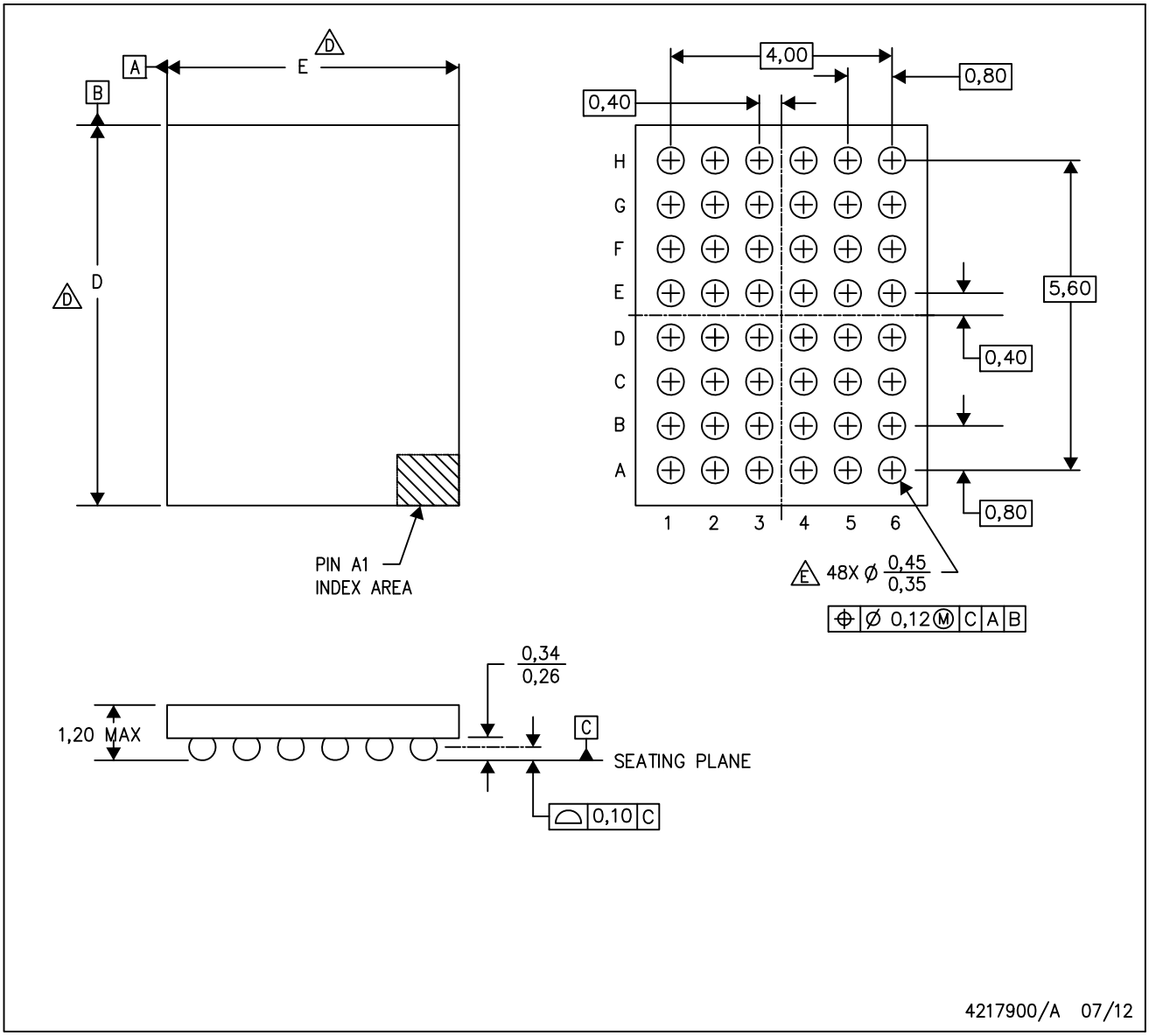
YVA (R–XBGA–N48) DIE–SIZE BALL GRID ARRAY



NOTES:
A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M–1994.
B. This drawing is subject to change without notice.
C. NanoFree™ package configuration.
D. The package size (Dimension D and E) of a particular device is specified in the device Product Data Sheet version of this drawing, in case it cannot be found in the product data sheet please contact a local TI representative.
E. Reference Product Data Sheet for array population.
6 x 8 matrix pattern is shown for illustration only.
F. This package contains Pb–free balls.

NanoFree is a trademark of Texas Instruments.

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