

# DLPR410 Configuration PROM

## 1 Features

- Pre-programmed Xilinx® PROM configures the DLPC410ZYR 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 DLPR410 device is a programmed PROM used to properly configure the DLPC410ZYR Controller to operate five different digital micromirror device (DMD) options: DLP650LNIRFYL, DLP7000FLP, DLP7000UVFLP, DLP9500FLN and, DLP9500UVFLN DMDs. The firmware in this device enables the DLPC410ZYR Controller to provide system data throughput rates up to 48 Gigabits per second (Gbps) with the options for random row addressing and Load4 capabilities. Often this family of chips is designed into high speed UV and NIR optical systems such as direct imaging lithography, 3D printing and laser marking equipment that need fast throughput and pixel accurate control.

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<sup>(1)</sup>

PART NUMBER	PACKAGE	BODY SIZE (NOM)
DLPR410	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.

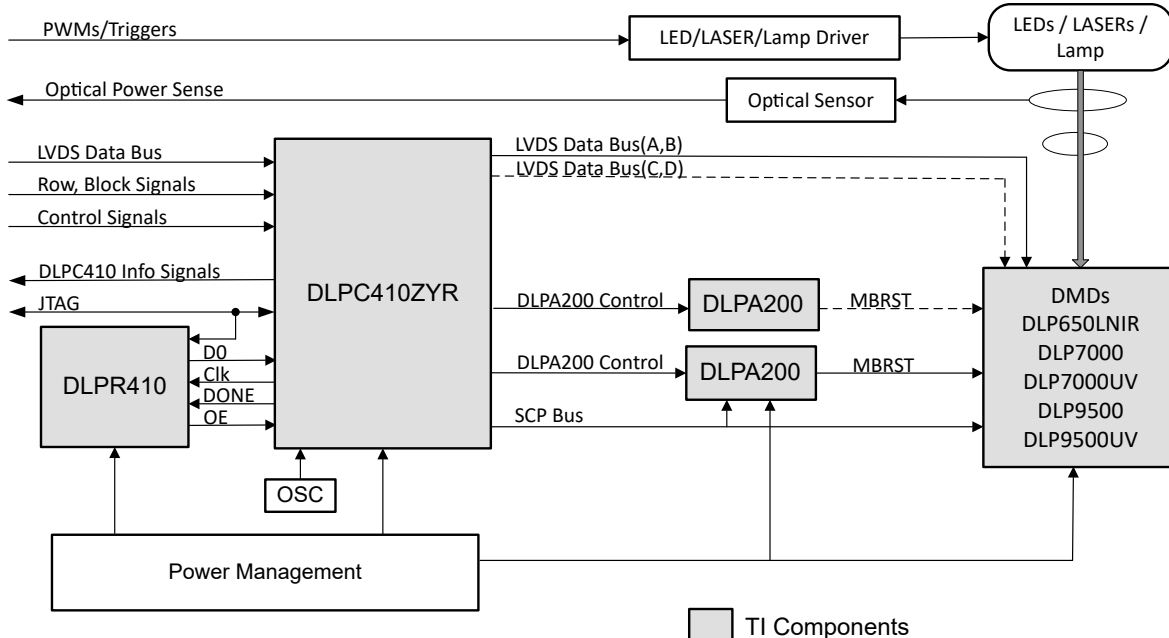


Figure 3-1. Simplified Application



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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 F (January 2020) to Revision G (August 2021)	Page
• Updated all references to DLPC410 Controller in data sheet to <a href="#">DLPC410ZYR</a> Controller.....	1
• Updated Applications List.....	1
• Updated Simplified Application Diagram in Description section.....	1
• Moved Xilinx XCF specifications link to top of Specifications section.....	1
• Removed numbers appended to all DNC signals in Pin Functions table.....	4
• Added entry for V <sub>CCJ</sub> to Absolute Maximum Ratings.....	6
• Removed footnote reference to JEDEC Standard JESD22-A114A in ESD Ratings.....	6
• Added entry for V <sub>CCJ</sub> to Recommended Operating Conditions.....	6
• Updated <a href="#">DLPC410ZYR</a> and DLPR410 Connection Schematic.....	10
• Updated DLPR410 and DLPC410ZYR with DMD Example Block Diagram .....	11
• Added Application Curves section.....	12
• Added 0.047- $\mu$ F decoupling capacitor to GND for all Power Pins in Power Supply Recommendations.....	13
• Added Layout Example section.....	14
• Added DLPR410BYVA to Device Compatibility table.....	15
• Added DLPR410BYVA to Part Number Description table.....	15
• Added DLPR410B Device Markings.....	15

Changes from Revision E (December 2018) to Revision F (January 2020)	Page
• Corrected Max Tstg per Xilinx data sheet .....	6
• Pulled in specific layout information from referenced document and removed reference.....	13
• Corrected DDC_Version(3:0) bus width to DDC_Version(2:0). .....	15

Changes from Revision D (April 2015) to Revision E (December 2018)	Page
• Updated <i>Applications</i> and <i>Description</i> to include new DLP650LNIR, removed data transfer rate .....	1
• Corrected Min Tstg per Xilinx data sheet .....	6
• Corrected Min VCCO per Xilinx data sheet .....	6
• Added support information for new DLP650LNIR DMD (multiple places).....	8
• Updated <a href="#">Section 7.2</a> .....	8

• Corrected improper "DLPC910" reference to "DLPC410" .....	11
• Updated <a href="#">Figure 8-1</a> .....	11
• Added <a href="#">Section 11.1.1</a> table.....	15
• Updated <a href="#">Section 11.1.2</a> .....	15
• Updated <a href="#">Section 11.1.3</a> section.....	15
• Added DLP650LNIR to <a href="#">Table 11-2</a> section.....	17
• Deleted DLP Discovery 4100 Chipset reference in <a href="#">Table 11-2</a> .....	17

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<b>Changes from Revision C (March 2013) to Revision D (October 2015)</b>	<b>Page</b>
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• Updated <i>Features, Applications, and Description</i> .....	1
• Deleted DLPR4101 (enhanced functionality PROM part number) throughout document .....	1
• Added <i>ESD Rating</i> table, <i>Feature Description</i> section, <i>Device Functional Modes, Application and Implementation</i> section, <i>Power Supply Recommendations</i> section, <i>Layout</i> section, <i>Device and Documentation Support</i> section, and <i>Mechanical, Packaging, and Orderable Information</i> section.....	1
• Deleted 1.8 V and 3.3 V operation values from $V_{CCO}$ , $V_{IL}$ , and $V_{IH}$ - this implementation is 2.5 V .....	6
• Changed Device Marking Image .....	15
• Changed Device Marking Image .....	15
• Deleted DLP® Discovery™ 4100 Chipset Datasheet from <i>Related Documentation</i> .....	17
• Added Link to XCF16P data sheet at xilinx.com .....	17

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<b>Changes from Revision B (March 2013) to Revision C (April 2013)</b>	<b>Page</b>
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• Added Top View of Device.....	1
• Added DLPR4101 "Load 4" enhanced functionality to Features.....	1
• Added DLPR410 and DLPR4101 (enhanced functionality PROM part number) to DLPR410 throughout document .....	1
• Added a link to the data sheet.....	1
• Added the Version column to the <i>Ordering Information</i> table.....	4
• Updated DLPC and DLP7000 / DLP7000UV Embedded Example Block Diagram.....	11
• Added DLP7000UV and DLP9500UV well suited for direct imaging lithography, 3D printing, and UV applications .....	12
• Added DLPR4101YVA as equivalent to TI part number 2510442-0006 .....	15
• Added Reference to DLPC410 data sheet.....	15
• Added DLPR410 to <a href="#">Figure 11-2</a> .....	15
• Added Top View of Device to device marking .....	15
• Added DLP7000UV Related Documentation.....	17
• Added DLP9500UV Related Documentation.....	17

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• Changed the top-side marking in the <i>Ordering Information</i> table.....	4
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<b>Changes from Revision * (August 2012) to Revision A (September 2012)</b>	<b>Page</b>
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• Changed the device From: Product Preview To: Production.....	1
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## 5 Pin Configuration and Functions

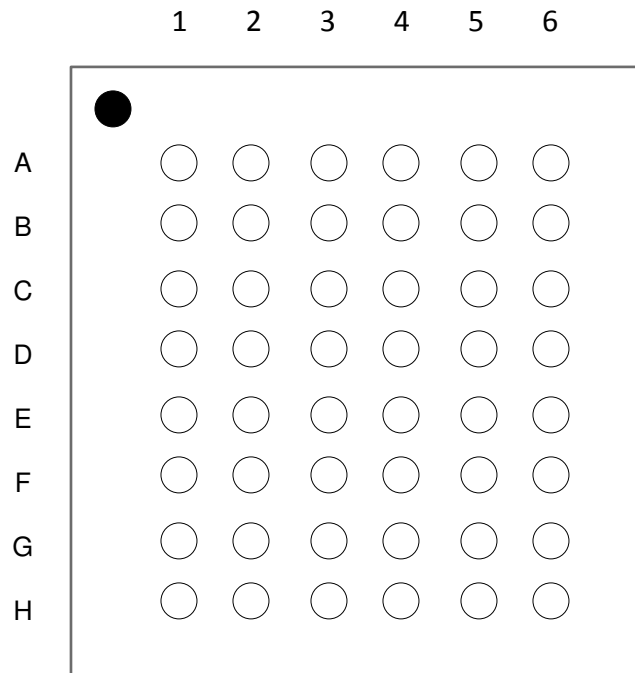


Figure 5-1. YVA Package 48-Pin DSBGA Top View

Table 5-1. Pin Functions

PIN		TYPE <sup>(1)</sup>	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. <b>Pin must be pulled High using an external 4.7-k<math>\Omega</math> pull-up to V<sub>CC0</sub>.</b>
DNC	A4	—	Do Not Connect. Leave unconnected.
D6	A5	—	Do Not Connect. Leave unconnected.
D7	A6	—	Do Not Connect. Leave unconnected.
VCCINT1	B1	P	Positive 1.8-V supply voltage for internal logic.
VCCO1	B2	P	Positive supply voltage connected to the output voltage drivers and internal buffers.
CLK	B3	I	Do Not Connect. Leave unconnected.
$\overline{\text{CE}}$	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. <b>Pin must be pulled High using an external 4.7-k<math>\Omega</math> pull-up to V<sub>CC0</sub>.</b>
D5	B5	—	Do Not Connect. Leave unconnected.
GND	B6	G	Ground
BUSY	C1	—	Do Not Connect. Leave unconnected.
CLKOUT	C2	—	Configuration clock output. Each rising edge on the CLK input increments the internal address counter. <b>Pin must be pulled High and Low using an external 100-<math>\Omega</math> pull-up to V<sub>CC0</sub> and an external 100-<math>\Omega</math> pull-down to Ground. Place resistors close to pin.</b>
DNC	C3	—	Do Not Connect. Leave unconnected.
DNC	C4	—	Do Not Connect. Leave unconnected.
D4	C5	—	Do Not Connect. Leave unconnected.

**Table 5-1. Pin Functions (continued)**

PIN		TYPE <sup>(1)</sup>	DESCRIPTION
NAME	NO.		
VCCO2	C6	P	Positive supply voltage connected to the output voltage drivers and internal buffers.
$\overline{CF}$	D1	I	Configuration pin. <b>The <math>\overline{CF}</math> pin must be pulled High using an external 4.7-k<math>\Omega</math> pull-up to <math>V_{CCO}</math>.</b> Selects serial mode configuration.
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.
VCCO4	D6	P	Positive supply voltage connected to the output voltage drivers and internal buffers.
VCCINT2	E1	P	Positive 1.8-V supply voltage for internal logic.
TMS	E2	I	JTAG Mode Select Input. TMS has an internal 50-k $\Omega$ 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-k $\Omega$ 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- $\Omega$ 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-k $\Omega$ resistive pull-up to $V_{CCO}$ . <b>The REV_SEL0 pin must be pulled Low using an external 4.7-k<math>\Omega</math> pull-down to Ground. The REV_SEL1 pin must be pulled Low using an external 4.7-k<math>\Omega</math> pull-down to Ground.</b>
REV_SEL1	G4	I	
VCCO3	G5	P	Positive supply voltage connected to the output voltage drivers and internal buffers.
VCCINT3	G6	P	Positive 1.8-V supply voltage for internal logic.
GND	H1	G	Ground
VCCJ	H2	P	Positive 2.5-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-k $\Omega$ resistive pull-up to $V_{CCO}$ . <b>The <math>\overline{EN\_EXT\_SEL}</math> pin must be connected to Ground.</b>
D1	H5	—	Do Not Connect. Leave unconnected.
D0	H6	O	DATA output pin to provide data for configuring the <a href="#">DLPC410ZYR</a> in serial mode.

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

## 6 Specifications

For complete electrical and mechanical specifications of the DLPR410, see the [XCF16P](#) product specification listed in [Related Documentation](#).

### 6.1 Absolute Maximum Ratings

over operating free-air temperature (unless otherwise noted) (see <sup>(1)</sup> <sup>(2)</sup>)

			MIN	MAX	UNIT
V <sub>CCINT</sub>	Internal supply voltage	Relative to ground	-0.5	2.7	V
V <sub>CCO</sub>	I/O supply voltage	Relative to ground	-0.5	4.0	V
V <sub>CCJ</sub>	JTAG I/O supply voltage	Relative to ground	-0.5	4.0	V
V <sub>IN</sub>	Input voltage with respect to ground	V <sub>CCO</sub> < 2.5 V	-0.5	3.6	V
		V <sub>CCO</sub> ≥ 2.5 V	-0.5	3.6	V
V <sub>TS</sub>	Voltage applied to high-impedance output	V <sub>CCO</sub> < 2.5 V	-0.5	3.6	V
		V <sub>CCO</sub> ≥ 2.5 V	-0.5	3.6	V
T <sub>J</sub>	Junction temperature			125	°C
T <sub>stg</sub>	Storage temperature, ambient		-65	150	°C

- 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.
- 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 <sub>(ESD)</sub> <sup>(1)</sup>	Electrostatic discharge	Human body model (HBM), per ANSI/ESDA/JEDEC JS-001, all pins <sup>(2)</sup>	2000	V

- Electrostatic discharge (ESD) to measure device sensitivity and immunity to damage caused by assembly line electrostatic discharges in to the device.
- 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 <sub>CCINT</sub>	Internal voltage supply		1.65	1.8	2.0	V
V <sub>CCO</sub>	Supply voltage for output drivers	2.5-V operation	2.3	2.5	2.7	V
V <sub>CCJ</sub>	JTAG I/O Supply voltage	2.5-V operation	2.3	2.5	2.7	V
V <sub>IL</sub>	Low-level input voltage	2.5-V operation	0		0.7	V
V <sub>IH</sub>	High-level input voltage	2.5-V operation	1.7		3.6	V
V <sub>O</sub>	Output voltage		0		V <sub>CCO</sub>	V
t <sub>IN</sub>	Input signal transition time (measured between 10% V <sub>CCO</sub> and 90% V <sub>CCO</sub> )				500	ns
T <sub>A</sub>	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](http://www.xilinx.com).

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

(see <sup>(1)</sup>)

		MIN	MAX	UNIT
$t_{VCC}$	$V_{CCINT}$ rise time from 0 V to nominal voltage <sup>(2)</sup>	0.2	50	ms
$V_{CCPOR}$	POR threshold for $V_{CCINT}$ supply	0.5	–	V
$t_{OER}$	OE/ $\overline{RESET}$ release delay following POR <sup>(3)</sup>	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/  $\overline{RESET}$  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](http://www.xilinx.com).

## 7 Detailed Description

### 7.1 Overview

The configuration bit stream stored in the DLPR410 device supports reliable operation of the [DLPC410ZYR](#) device with the [DLP650LNIRFYL](#), [DLP7000FLP](#), [DLP7000UVFLP](#), [DLP9500FLN](#) and, [DLP9500UVFLN](#) DMDs. The [DLPC410ZYR](#) digital controller loads this configuration bit stream from the DLPR410 device.

### 7.2 Functional Block Diagram

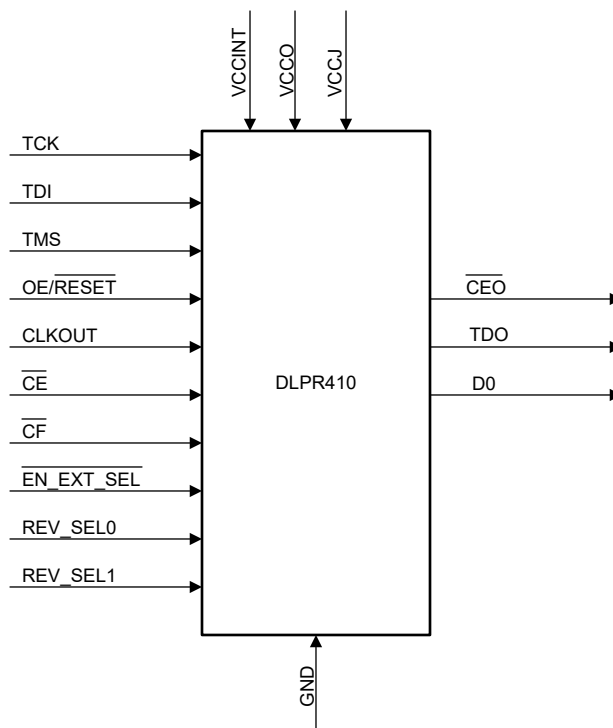


Figure 7-1. Functional Block Diagram

### 7.3 Feature Description

#### 7.3.1 Data Interface

##### 7.3.1.1 Data Outputs

The DLPR410 device is configured for serial mode operation, where D0 is the data output pin. D0 output pin provides a serial connection to the [DLPC410ZYR](#) controller, where the configuration is read out by the [DLPC410ZYR](#) controller.

##### 7.3.1.2 Configuration Clock Input

The configuration CLK is connected to the [DLPC410ZYR](#) controller in Primary Serial mode, where the [DLPC410ZYR](#) controller provides the clock pulses to read the configuration from the DLPR410 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-k $\Omega$  pull-up to V<sub>CCO</sub>.**

##### 7.3.1.4 Chip Enable

The  $\overline{\text{CE}}$  input is asserted by the [DLPC410ZYR](#) controller to enable the Data (D0) and CLKOUT outputs. When  $\overline{\text{CE}}$  is held high, the DLPR410 device address counter is reset, and the Data and CLKOUT outputs are placed in high-impedance states.



### **7.3.1.5 Configuration Pulse**

The DLPR410 device is configured in serial mode when it holds configuration pulse pin,  $\overline{CF}$ , high and it enables the  $\overline{CE}$  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  $\overline{EN\_EXT\_SEL}$  signals to select a revision to act as the default. Setting all three signals to GND defaults to revision 0 for simple DLPR410 device setup.

## **7.4 Device Functional Modes**

To successfully program the [DLPC410ZYR](#) controller upon power-up, the DLPR410 device must be configured and connected to the [DLPC410ZYR](#) controller as shown in [Figure 7-2](#).

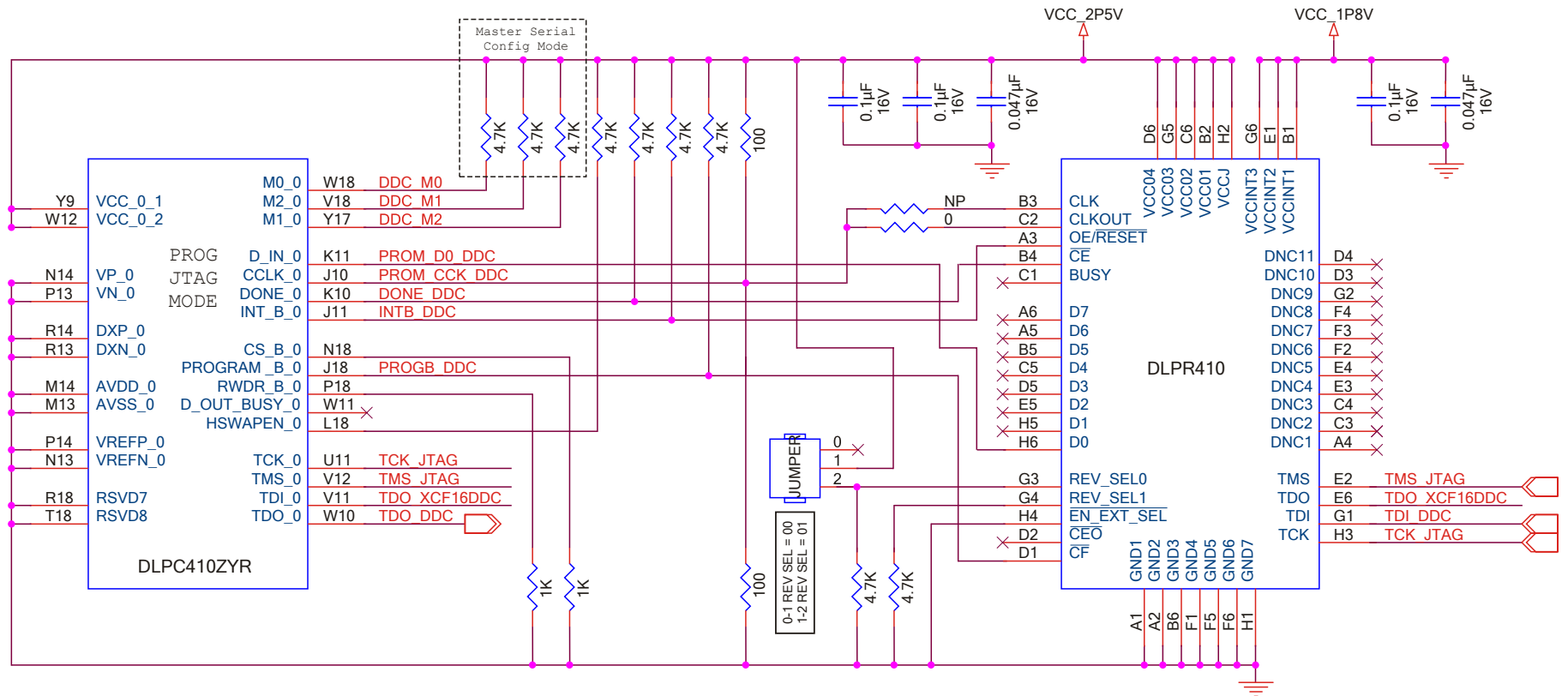


Figure 7-2. DLPC410ZYR and DLPR410 Connection Schematic

## 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 DLPR410 device configuration PROM ships pre-programmed with configuration code for the DLPC410ZYZR controller. Upon power-up, the DLPC410ZYZR controller and the DLPR410 device connect to enable configuration information to be sent from the DLPR410 device to the DLPC410ZYZR controller, such that the DLPC410ZYZR controller can configure itself for proper operation within the application. Without the DLPR410 device properly connected to the DLPC410ZYZR controller in the application system, the DLPC410ZYZR controller does not boot and the system remains inoperable.

### 8.2 Typical Application

A typical embedded system application using the DLPR410 device to program the DLPC410 controller (to drive one of 5 different DMDs) is shown in Figure 8-1. For complete details of this typical application refer to the DLPC410 controller data sheet listed in Table 11-2.

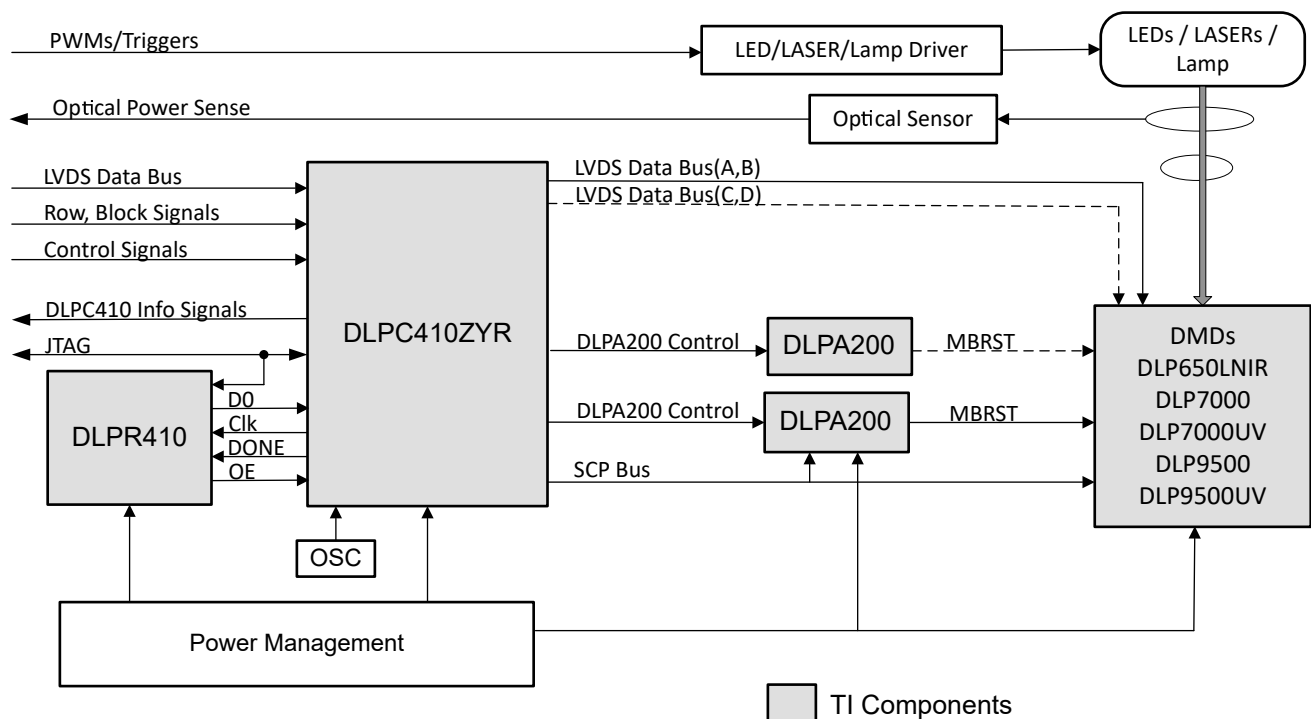


Figure 8-1. DLPR410 and DLPC410ZYZR with DMD Example Block Diagram

#### 8.2.1 Design Requirements

The DLPR410 is part of a multi-chipset solution, and it is required to be coupled with the DLPC410ZYZR controller for reliable operation of the DLP650LNIRFYL, DLP7000FLP, DLP7000UVFLP, DLP9500FLN and, DLP9500UVFLN DMDs. For more information, refer to the DLPC410ZYZR datasheet listed in Section 11.2.1.

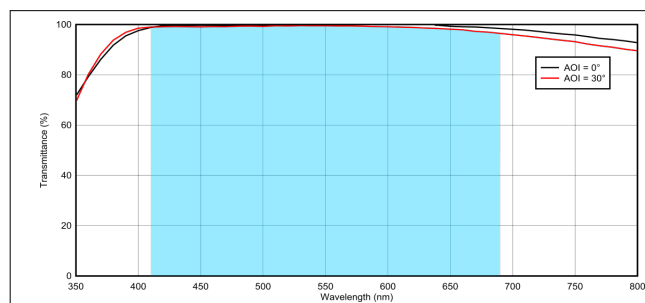
## 8.2.2 Detailed Design Procedure

The DMDs are designed to be operated by the [DLPC410ZYR](#) Digital Controller:

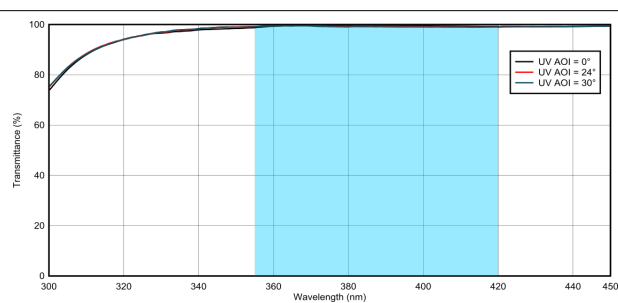
- The [DLP7000FLP](#) and [DLP9500FLN](#) DMDs are well suited for visible light applications requiring fast, spatially programmable light patterns using the micromirror array.
- The [DLP7000UVFLP](#) and [DLP9500UVFLN](#) DMDs are well suited for direct imaging lithography, 3D printing applications, and other applications requiring ultraviolet light (UVA).
- The [DLP650LNIRFYL](#) DMD enables high-power NIR laser illumination for dynamic digital printing, sintering and marking solutions.

Connections between the [DLPC410ZYR](#) Digital Controller, the DLPR410 Configuration PROM, and the [DLPA200](#) DMD micromirror driver(s) must follow the layout guidelines for reliability.

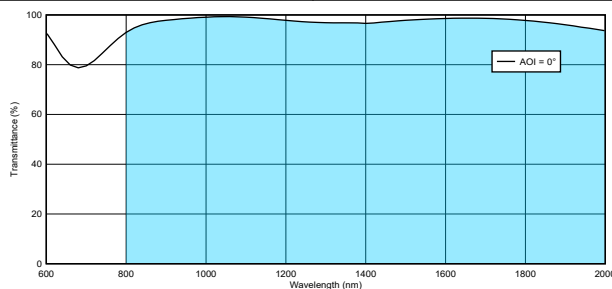
## 8.2.3 Application Curves



**Figure 8-2. DLP7000 and DLP9500 Transmittance (Visible Window)**



**Figure 8-3. DLP7000UV and DLP9500UV Transmittance (UV Window)**



**Figure 8-4. DLP650LNIR Transmittance (NIR Window)**

## 9 Power Supply Recommendations

The DLPR410 uses two power supply rails as shown in [Table 9-1](#).

**Table 9-1. DLPR410 Power Supply Rails**

SUPPLY	POWER PINS	COMMENTS
1.8 V	V <sub>CCINT1</sub> , V <sub>CCINT2</sub> , and V <sub>CCINT3</sub>	All V <sub>CCINT</sub> pins must be connected with a 0.1-μF and a 0.047-μF decoupling capacitor to GND.
2.5 V	V <sub>CCO1</sub> , V <sub>CCO2</sub> , V <sub>CCO3</sub> , V <sub>CCO4</sub> , and V <sub>CCJ</sub>	All V <sub>CCO</sub> and V <sub>CCJ</sub> 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 DLPR410 is part of a multi-chipset solution. It is required to be used with the [DLPC410ZYR Controller](#) to provide reliable control of any attached DMDs. These guidelines are targeted at designing a PCB board with the DLPR410.

#### 10.1.1 Component Placement

The DLPR410 must be placed adjacent to the [DLPC410ZYR Controller](#) with a maximum electrical distance of 4 inches (10 cm).

#### 10.1.2 Impedance Requirements

Signals between the DLPR410 and the [DLPC410ZYR Controller](#) must be routed to have a matched impedance of 50 Ω ±10%.

#### 10.1.3 PCB Signal Routing

When designing a PCB board which includes the DLPR410 and the [DLPC410ZYR Controller](#), the following are recommended:

Signal trace corners must be no sharper than 45°. Adjacent signal layers must have the predominate traces routed orthogonal to each other.

TI does not recommend signal routing on power or ground planes.

TI does not recommend ground plane slots.

High speed signal traces must not cross over slots in adjacent power and/or ground planes.

#### 10.1.4 Fiducials

Fiducials for automatic component insertion must be 0.05-inch copper with a 0.1-inch cutout (antipad). Fiducials for optical auto insertion are placed on three corners of both sides of the PCB.

#### 10.1.5 PCB Decoupling Guidelines

Decoupling capacitors must be utilized to provide instantaneous current sources to components and to help mitigate ground bounce.

##### 10.1.5.1 Bulk Decoupling

Bulk decoupling capacitors for the board must be distributed around the PCB and be sized to handle the current demands for the board.

##### 10.1.5.1.1 DLPR410 Decoupling Capacitors

Decoupling capacitors (0.1 μF recommended) are placed to minimize the distance from the decoupling capacitor to the supply and ground pins of the component. It is recommended that the placement of and routing for the decoupling capacitors meet the following guidelines:

- The supply voltage pin of the capacitor must be located close to the device supply voltage pin(s). The decoupling capacitor must have vias to ground and voltage planes. The device can be connected directly to

the decoupling capacitor (no via) if the trace length is less than 0.1 inch. Otherwise, the component must be tied to the voltage or ground plane through separate vias.

- The trace lengths of the voltage and ground connections for decoupling capacitors and components must be less than 0.1 inch to minimize inductance.
- The trace width of the power and ground connection to decoupling capacitors and components must be as wide as possible to minimize inductance.
- Connecting decoupling capacitors to ground and power planes through multiple vias can reduce inductance and improve noise performance. Via sharing between components (discrete or integrated) is discouraged.
- Decoupling performance can be improved by utilizing low ESR and low ESL capacitors.

#### 10.1.6 Layout Example

Please refer to the [DLPLCRC410EVM Design files](#) for an example of how to layout the DLPR410 Configuration PROM.

## 11 Device and Documentation Support

### 11.1 Device Support

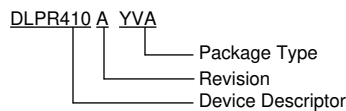
#### 11.1.1 Device Compatibility

TI PART NUMBER	DDC_Version(2:0) <sup>(2)</sup>	Compatible DMDs <sup>(1)</sup>
DLPR410YVA	5	DLP7000FLP, DLP7000UVFLP, DLP9500FLN and, DLP9500UVFLN DMDs.
DLPR410AYVA	7	DLP650LNIRFYL, DLP7000FLP, DLP7000UVFLP, DLP9500FLN and, DLP9500UVFLN DMDs.
DLPR410BYVA	0	DLP650LNIRFYL, DLP7000FLP, DLP7000UVFLP, DLP9500FLN and, DLP9500UVFLN DMDs.

- (1) Refer to each individual DMD datasheet under Device and Documentation Support for more DMD information.  
 (2) Refers to the DDC\_Version(2:0) output pins of the DLPC410 Controller once configured by this Configuration PROM. See the DLPC410 datasheet (DLPS024) for more information.

#### 11.1.2 Device Nomenclature

The device nomenclature is as shown in Figure 11-1. The part number description for previously and currently available part numbers is shown in Table 11-1.



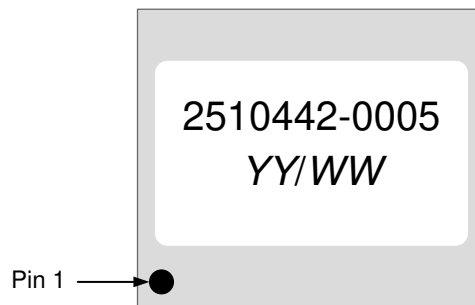
**Figure 11-1. Device Nomenclature**

**Table 11-1. Part Number Description**

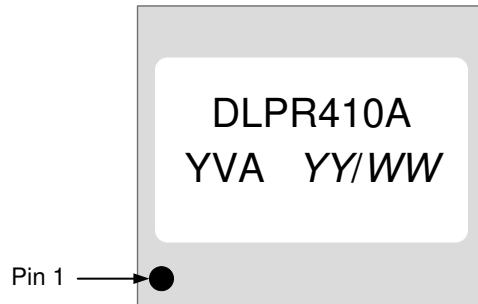
TI PART NUMBER	DESCRIPTION	REFERENCE NUMBER
DLPR410YVA	DLPR410 Configuration PROM	2510442-0005
DLPR410AYVA	DLPR410A Configuration PROM (Added compatibility with DLP650LNIR)	DLPR410AYVA
DLPR410BYVA	DLPR410B Configuration PROM (Compatible with DLP650LNIR)	DLPR410BYVA

#### 11.1.3 Device Markings

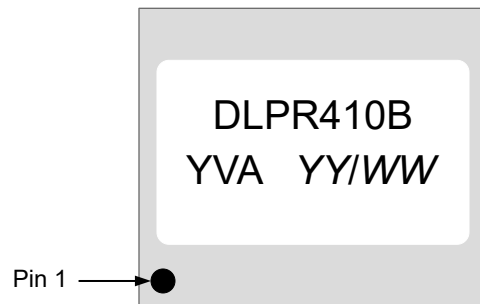
Figure 11-2 shows the previous device marking for the DLPR410 device. For the DLPR410A and DLPR410B, this device marking nomenclature has been updated to use the DLPR410A and DLPR410B device part numbers instead of the previous 2510442 marking, as shown in Figure 11-3 and Figure 11-4.



**Figure 11-2. DLPR410 Device Markings**



**Figure 11-3. DLPR410A Device Markings**



**Figure 11-4. DLPR410B Device Markings**

Where YY/WW is the year/week the part was programmed.



## 11.2 Documentation Support

### 11.2.1 Related Documentation

For related documentation, see the following:

**Table 11-2. Related Documentation**

DOCUMENT	TI LITERATURE NUMBER
DLP650LNIR 0.65 NIR WXGA S450 DMD data sheet	<a href="#">DLPS136</a>
DLP7000 DLP 0.7 XGA 2xLVDS Type A DMD data sheet	<a href="#">DLPS026</a>
DLP7000UV DLP 0.7 UV XGA 2xLVDS Type-A DMD data sheet	<a href="#">DLPS061</a>
DLP9500 DLP 0.95 1080p 2xLVDS Type-A DMD data sheet	<a href="#">DLPS025</a>
DLP9500UV DLP 0.95 UV 1080p 2xLVDS Type-A DMD data sheet	<a href="#">DLPS033</a>
DLPA200 DMD Micromirror Driver data sheet	<a href="#">DLPS015</a>
DLPC410 DMD Digital Controller data sheet	<a href="#">DLPS024</a>
<a href="#">XCF16P</a> data sheet	available at <a href="http://www.xilinx.com">www.xilinx.com</a>

### 11.3 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on [ti.com](http://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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### 11.5 Trademarks

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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.

**PACKAGING INFORMATION**

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
DLPR410BYVA	LIFEBUY	DSBGA	YVA	48	3	TBD	Call TI	Call TI	-40 to 85		

(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.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSELETE:** TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(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 one 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.

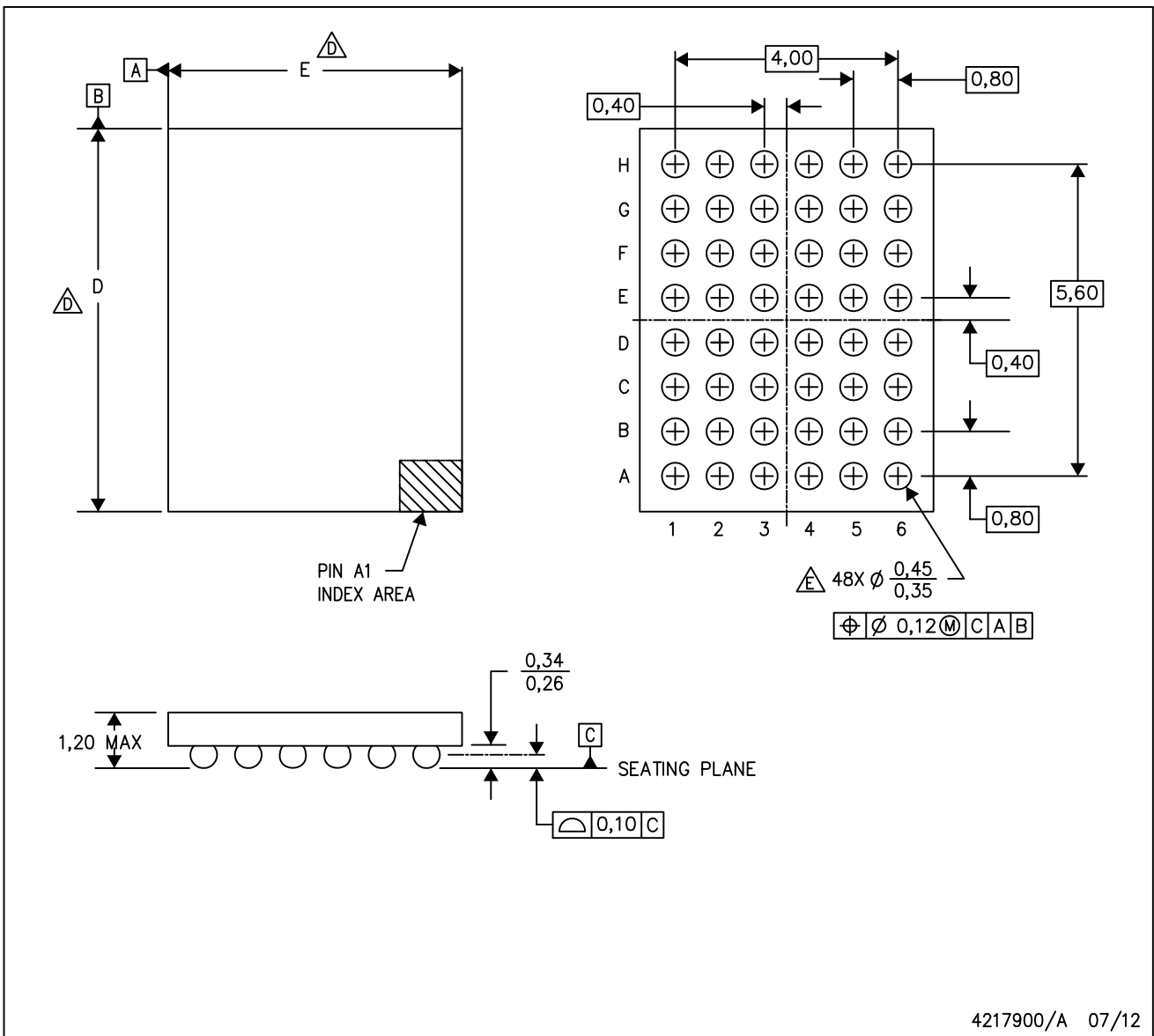
(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

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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.
  - △ 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.

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