CHIPLET DATA EXCHANGE MARKUP LANGUAGE (CDXML)

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Executive Summary

Chiplet Design Exchange (CDX) Workstream of ODSA focuses on electrical, mechanical, and thermal design exchange standards related to chiplets and integration in the context of multi chiplet modules, 2.5D and 3D Integrated Circuits (IC). This initial release of Chiplet Data Exchange in XML Format (CDXML) for but not limited to the following chiplets purposes:

- Data exchange between different formats
- Design
- Integration
- Assembly rules

This format is based on the zGlue Chiplets Info Exchange Format (ZEF) released with open-source copyright in 2019. As requested by the authors of ZEF, we acknowledge zGlue Inc for releasing ZEF in the open-source domain. All of the authors of ZEF have agreed to participate in developing this CDXML to replace the obsolete ZEF.

CDX is promoting this chiplet model for wider usage through open initiatives. CDXML sets a foundation for the standard machine-readable description of Chiplets, in order to help automate design and business processes across companies when it comes to chiplet-based business ecosystems. The spirit of this disclosure is to encourage openness in an otherwise closed-source industry of chip design. CDX and OCP are releasing this license based on creative commons open source license. The developers of this document have agreed to adopt the OCP Creative Commons License for this format.

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Introduction

CDXML is in Extensible Markup Language format (XML). The earlier version of ZEF consists of a set of ASCII text files in a comma-separated variable (CSV) format. CDXML enhances the format to the XML format, in particular, to support the following:

- Multiple value options data such as the IO modes
- Grouping of data such as min, typ, and max
- Nested values
- Customizable units
- Optional information such as tag and description
- Schema-based with XSD, the XML schema definition
- Easily extensible data
- Backward compatible with the older version

CDXML contains the XML data file. The filename will follow the format of <MPN>.xml. MPN stands for Manufacturer's Part Number which is a unique product identifier. The schema.xsd XSD file defines the schema of the XML file. The first line of each file consists of the file description and then follow by the name and value pair for each parameter. For example, the file for chiplet ZGL12345FC would be ZGL12345FC.xml.

There are 3 sections in CDXML; MECH, IO, and ELECT in the file, representing the mechanical, IO, and electrical information of chiplets respectively. Most of this information can be found in the datasheets.

Parameters

CDXML parameters are broken into three sections, (a) mechanical, (b) io, and (c) electrical. These parameters define the interfaces and outside characteristics of these chiplets.

Mechanical

Parameters	Type	Unit	Nested Values and Descriptions
ID	Int		This parameter is reserved as a designator for the Chiplet in the chiplet library. This field will be left blank for a single chiplet but will be useful as an identifier in a library.

MPN	Str		Manufacturer's part number. Refer to unique SKU and ordering information
Version	Str		Version control
Authors	Str		Authors
Datetime	Date		Created time
Manufacturer	Txt		Manufacturer’s name
SMT_compatible	Int	qty	A predicate that tells the reader whether this part is compatible with SMT or not. Valid values are 0 or 1. For most of the chiplets, this field will be set to 1
Width	Int	um	Chiplet width in (um): Typ - Typical value Tol - Tolerance value Min - Min value Max - Max value
Length	Int	um	Chiplet length in (um): Typ - Typical value Tol - Tolerance value Min - Min value Max - Max value
Thickness	Int	um	Chiplet thickness in (um): Typ - Typical value Tol - Tolerance value Min - Min value Max - Max value
Orientation_angle_ccw	Int	Deg	Orientation angle (degree). Possible options are 0 degrees, 90 degrees, 180 degrees, and 270 degrees. If pin A1 (or pin 1) is on the top left with respect to the IO map, the orientation angle is 0 degrees
Bump	Int	um	Pitch - Nominal Distance between the centers of 2 consecutive balls. This parameter can be used to populate IO maps that are geometrically regular. -Typ - Typical value -Tol - Tolerance value
	Int	um	Thickness - Typical thickness of the bumps or balls (Refers to z-direction). -Tol - Tolerance value -Min - Min value -Max - Max value

	Int	um	Dia - Typical diameter of the solder balls (Refers to horizontal footprint) -Tol - Tolerance
	Int	qty	Pop_count - Number of balls, or IOs in a chiplet. Unpop_count - For a possibly regular bump pattern, count the unpopulated bumps.
Mold Material	Str		For a molded chiplet, name the mold material (String)
Reflow Profile	Str		The recommended reflow profile for SMT or Flipchip process. It should be provided as a list of time vs temperature pairs. (String)

IO

Parameters	Type	Unit	Nested Values and Descriptions
Number	Int		Index of the pin/ball/bump on the chiplet. For example, pin A1 or pin 1
Name	Str		Name of the pin/ball/bump on the chiplet
Signal_type	Str		Choose one from {Analog Input, Analog Output, Digital Input, Digital Output, Digital Input/Output, Power, Bypass, Reference, Ground, Clock, Xcvr, I2C, RF, DFT}.
Dir	Str		This field may seem redundant in addition to the signal type. It is used for determining the direction of the signal as input/output (IO), input(I) or output(O).
F	Int	MHz	Frequency of the signal -Typ - Typical value -Min - Min value -Max - Max value
Mechanical_type	Str		Choose one from {solderball, ubump, land, lead}.
Ball_position	Int	um	Relative to the center of the chiplet, list the (x, y) coordinate of the ball location. -x -y
Signal_group	Str		Used for grouping such as a bus or a pair sharing similar constraints. This should correspond to the mode for Pin_name entry.
	Int		Index - index of the pin in a group of signals.
Netlist_name	Str		Default netname used internally (schematic can override).

Pin_mode	Str		Mode - Mode of operation. Pins that are used for multiple usages can be described with multiple entries, but each mode should have a unique mode index. Valid values include 0,1,2....
	Int		Index - Index of Mode of operation. The total number of modes the current pin has. Most of the pins will have only one mode.
ESD	Str		ESD_type - Describe any ESD (Electrostatic Discharge) anomaly for this pin. For example, some pins may need special design consideration for ESD purpose.
	Int	V	Rating (V) - ESD Sensitivity Classification Levels. There are 3 different ESD models from the ESD Association: 1. Human Body Model (HBM) [100 pF @ 1.5 kilohms], ESD STM5.1. This is most common 2. Charge Device Model (CDM) [4 pF/30 pF], ESD DS5.3.1 3. Machine Model (MM) [200 pF @ 0 ohms], ESD STM5.2
Controlled_Impedance	Int	Ohm	A controlled impedance is desired for the signal trace
Vdd_pin	Str		Pin name for the pin that is used as a VDD reference for this signal. Leave empty for VDD or GND pins.
Gnd_pin	Str		Pin name for the pin that is used as a GND reference for this signal. Leave empty for VDD or GND pins.
V_max	Int	V	Abs Max Voltage.
C	Int	F	Capacitance load -Max - Maximum recommended capacitance load (including -self-capacitance). -Typ - Typical load capacitance (includes self-capacitance

Electrical

Electrical contains overall electrical characteristics information to aid in power scenarios calculations, modes of operation, absolute maximum ratings, recommended operating conditions, and ESD

Parameters	Type	Unit	Nested Values and Descriptions
Op_modes	Str		Modes of Operation
V_modes	Str		Lists of Voltages vs Modes

Current_modes	Str		Lists of Current Draw vs Modes
PVT	Str		Process, Voltage and Temperature Normalizing Data
ESD	Str		Type - Describe any ESD (Electrostatic Discharge) anomaly for this pin. For example, some pin may need special design consideration for ESD purpose.
	Int	V	Rating - ESD Sensitivity Classification Levels. There are 3 different ESD models from the ESD Association: 1. Human Body Model (HBM) [100 pF @ 1.5 kilohms], ESD STM5.1. This is most common 2. Charge Device Model (CDM) [4 pF/30 pF], ESD DS5.3.1 3. Machine Model (MM) [200 pF @ 0 ohms], ESD STM5.2

References

XSD Schema

```
<xsd:schema xmlns:xsd="http://www.w3.org/2001/XMLSchema"
xmlns:tns="http://www.paloaloelectron.com"
targetNamespace="http://www.paloaltoelectron.xsd"
elementFormDefault="qualified">
<xsd:element name="CDXML" type="xs:string"/>
<xsd:element name="mech"/>
  <xsd:complexType name="width" unit=”um”>
    <xsd:sequence>
      <xsd:element name="typ" type="xs:integer"/>
      <xsd:element name="tol" type="xs:integer"/>
      <xsd:element name="min" type="xs:integer"/>
      <xsd:element name="max" type="xs:integer"/>
    </xsd:sequence>
  <xsd:complexType/>
<xsd:complexType name="io">
  <xsd:sequence>
    <xsd:element name="pnum" type="xs:integer"/>
    <xsd:element name="pname" type="xs:string"/>
  </xsd:sequence>
<xsd:complexType/>
<xsd:element name="elect"/>
```

```
  <xsd:complexType name="abs_rating">
    <xsd:sequence>
      <xsd:element name="v_max" type="xs:integer" unit=”um”/>
    </xsd:sequence>
  <xsd:complexType/>
</xsd:schema>
```

XML Example

```
<?xml version="1.0"?>
<name=”ZGL12345FC”>
<mech>
   <width>
    <typ>1550</typ>
    <min>1550</min>
    <max>1550</max>
  </width>
</mech>
<io>
  <pnum>1</pin_number>
  <pname>VDD</pin_name>
</io>
<elect>
  <absolute_rating>
    <v_max>Input Voltage</v_max>
  </absolute_rating>
</elect>
```

License