“The 3D silicon leader”

March 2012
IPDiA overview

- Company located in Caen, Normandy, France
- Dedicated to manufacturing of integrated passive devices
- Employing 100 people and operating own wafer fab
- Strong R&D team and collaborations with leading institutes
What do we do?

Strategy based on two main axes:
- Submounts for High Brightness LED market
- Integrated Passive Devices (IPD) for Medical, Industrial, Aerospace and Defense
What is **IPD? Integrated Passive Device**

PICS is IPDiA IPD Passive Integrated Connecting Substrate

A highly efficient way to integrate several passive components such as resistors, capacitors, inductors, ESD diodes and PIN diodes in a single. All of them, thanks to our technology very flexible.

**What is IPD?**

Integrated Passive Device

A highly efficient way to integrate several passive components such as resistors, capacitors, inductors, ESD diodes and PIN diodes in a single. All of them, thanks to our technology very flexible.
IPDiA’s quality certifications

The IPDiA manufacturing center is certified:

- ISO-9001
- ISO-14001
- ISO-TS16949 (Automotive)
- ISO-13485 (Medical)
- OHSAS-18001

IPDiA is RoHS compliant
IPDIA has implemented a global approach from the start.
IPDiA value proposition: Technology that enables

- **Miniaturization**
  - Size of electronic devices can be reduced by a factor of 10
  - Thickness as low as 100 µm

- **Performance**
  - High stability (temp, voltage, ageing…)
  - High reliability (no cracking unlike Ceramic)
  - Low consumption (battery lifetime)

- **Reduced Cost**
  - BOM level
  - Simpler manufacturing
Why IPD’s : main drivers
In the Medical Market, PASSIVES are NOT at all commodities.
Miniaturization: Example of medical devices

Cardiac Rythm Management

Today: 10 cm³  2013: 3 cm³  2015: 1 cm³

More than 40 mm² of PICS inside

IP protected (all generations)
Implantable devices

Existing programs:
- Prototypes
- Products in qualification
Product offer

• **3D Silicon Submounts**
  - Submount for HB LED Packaging + ESD Protection
  - TVS (transient voltage suppressor) for HB LED

• **3D Silicon RF**
  - A range of standard products such as filter, balun, coupler…
  - Customized component network (Application Specific Integrated Passives) for RF applications.

• **3D Silicon Capacitors**
  - A range of standard products
    - High stability for “demanding application”
    - Low Profile for ”height constraint application “
    - Wire bonding for near decoupling in IC packaging
  - Customized component network ASIP (Application Specific Integrated Passives) for advanced decoupling applications.
Some products with Silicon Passive components

- Silicon passive as **Low profile** 1µF capacitor in a SiP

- Silicon Passive as **network component**
  40 SMDs integrated in a single Silicon die

- Silicon Passive as **packaging platform** as well as passive network
Several billions of products over the world, with our «3D silicon passive inside»

Wireless

E-metering

Medical Devices

High Brightness LED protection
IPDIA’s technology
The world record of capacitance density in silicon and in mass production

250nF/mm$^2$ in production
500 nF/mm$^2$ demonstrated
Technology offer

- All our products are based on optimized combinations of our 3D Silicon capacitors with additional passive components

**PICS3 250nF/mm²**
- Unique technology tailored to Capacitors and decoupling in Digital ASIP
- World record of capacitance integration in Silicon in Production

**PICS2 80nF/mm²**
- High performance technology optimized for RF

**PICS1 25nF/mm²**
- High value technology optimized for RF power

**PICS 2DCS 2D-Connecting Substrate**
- High performance technology optimized for RF baluns and filtering

Company confidential
3D silicon passive devices with outstanding performances

**Capacitors**
- Superior temperature stability (<20ppm)
  → Technology characterized to +200°C
- Very low leakage current (<40nA)
- Superior DC voltage stability (<0.1%/V)
  → No capacitance change over voltage variation.
- Very low ESR < 40mOhm

**Zener Diodes**
- BV>10V and ESD Capability 15KV Air discharge (IEC 61000-4-2, level4)

**Resistors**
- Excellent matching (better than 0.5%)

**Coils**
- Superior Q-factor (> 80)
- Self-res. freq. > 45GHz

3D silicon passive technology allows the complete integration of:
- excellent RF filtering
- full RF-digital cross-talk cancellation
- excellent DC decoupling filtering
High Stability and High Temp Capacitors

High Stability Silicon Capacitor: Very Low derating rate, ageing close to 0%, Low ESR & ESL,

- Medical Devices
- Medical Equipment
- Automotive equipment ...etc.
High Stability and high temp Silicon Capacitor

Dedicated to applications requiring optimum Stability and Reliability in term of Temperature, Voltage, Ageing from -55 to 300°C

Key Benefits: The Lowest Derating Rate (<1%)
- Ageing rate: 0.001% per decade
- Temperature: < ±0.5%
- Voltage: 0.1% / Volts
- Longer battery lifetime
- ESR down to 90mΩ
- ESL down to 100pH

HSSC capacitor is suitable to Industries devices such as:

1. HIGH RELIABILITY Applications
   - Defense
   - Space

2. MEDICAL
   - Implants and stimulators
   - Medical Equipment

3. AUTOMOTIVE
   - Motor control Modules
   - Sensors

Pacemaker

Electronic components in automotive
Failure Predictions of Tantalum, Ceramic ‘X7R’ and 3D-Si based Capacitors

- Used at 85°C and 50% of the Rating voltage the **Failure Rate** of a **Silicon Capacitor** is **Insignificant** (Only 2 Units failed on a Million after 10 Years operation time)

- This **very low Failure Rate** confirms the **Excellent Reliability** of **3D Silicon Capacitors**
High Temperature Silicon Capacitor (HTSC)

1206 EIA Case size Capacitors comparison
High Temperature Applications (-55°C to 300°C)

- IPDIA: 1000nF
- KEMET: 100nF
- NOVACAP: 5.6nF
- JOHANSON: 1.5nF
- EUROFARAD: 0.68nF
Low Profile Silicon Capacitor (LPSC)  Thickness down to 100µm

- System in Package (SiP), ...etc.
- IC modules
- ASICS
- Embedded Electronics (cellphones, smartphones, ...etc)
Low Profile Silicon Capacitor (LPSC)

- **Dedicated** to applications where **Space** plays a key role like embedded capacitors, System in Package ‘SiP’, IC modules, ASICS

- **Key Benefits**
  - **Unique** capacitor of 1 µF available in **100µm Thickness**
  - ESR down to 90mΩ
  - ESL down to 100pH
  - Same **Out of Standard** performances that HSSC capacitor

Silicon passive as Low profile 1µF capacitor in a SiP Stand-alone component
Low Profile Silicon Capacitor (LPSC)

Typical 100nF Capacitor Thickness

Volume comparison of 1206 Case size capacitors
Silicon Capacitors Array

**Embedded capacitors**
- Market: communication
- Frequency range: from 1 to 2GHz
- Embedded binary capacitor (150µm thickness)
- Application: decoupling and RF matching

**Capacitors array**
- Market Application: Medical
- Frequency range: 1GHz
- Components: decoupling capacitors.
- Capacitance matching better than 1.5%
Packaging roadmap: WLP, SiP and interposers
Packaged IPDs

1. Companion chip on Board
2. Embedded die in Board
3. Stacked dies
IPDs and 2/2.5/3D interposers in SiP

1. Companion chip in MCM
2. Embedded die
3. SiP Carrier +DFC
4. MCM Carrier +SFC
5. IPDs and TSVs