S3 Group

ASIC design and supply
Agenda

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  - Industrial Process Control
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- Advantages of using an ASIC
About S3 Group

Global, Market leading provider of Custom Mixed-Signal ASICs and IP to OEMs, System vendors and semiconductor companies worldwide, lowering the risk in IC development and accelerating time to revenue of our customers

- Founded in 1986
- Independent, VC funded since 2006
- 280+ Employees
- 1000s of IC solutions delivered
- Complementary offering Product Portfolio & Services
- ISO9001
- ISO13485

- 5 R&D Centers
- Global Sales Support
- Business Units:
  - Semiconductor Solutions
  - Connected Health
About Semiconductor Solutions

“Trusted Mixed-Signal ASIC Solutions”

Custom ASICS

- Complete Turnkey solutions, delivering spec to packaged-tested parts
- 100’s of Millions devices shipped with ICs designed by S3 Group to-date
- OEM focus

Enabled by Proven IP

- #1 ranked Mixed-Signal (MS) IP provider
- Strong RF design experience
- 280 Employees, 30 years in business
- > 300 MS IP’s

“Delivering lower cost, higher performance, product differentiation”
Global Locations

- San Jose, US
- Kfar Saba, Israel
- Dublin / Cork, Ireland
- Lisbon, Portugal
- Wroclaw, Poland
- Prague, Czech Republic
- Beijing, China
- Shanghai
IP Portfolio includes..

- Power Management
- Wireline AFE’s (analog front-end)
- Wireless AFE’s (analog front-end)
- Sensing
- Precision Converters
- Clocking
- Aux Control
S3 Group Integration Expertise

We are **Expert** at

**Integrating Performance**

**Mixed-Signal & RF**

**with any Processor**

**on silicon**
We provide **Custom Mixed-Signal ASICs** - from design to supply of end product
# Summary of Mixed-Signal IP Portfolio

## Available MS IPs!

<table>
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<tr>
<th>Technology</th>
<th>ADC</th>
<th>DAC</th>
<th>AFE</th>
<th>PLL</th>
<th>PMU</th>
<th>RF</th>
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### Specifications:
- **ADC**: Up to 16 bit, 424 MS/s
- **DAC**: 16 bit, 1 GS/s
- **AFE**: 12 bit, 424 MS/s
- **PLL**: 1.2 GHz, <1 ps (jitter)
- **PMU**: 95% \( \eta \)

Please visit our website: [http://www.s3group.com/semiconductor_solutions/products/](http://www.s3group.com/semiconductor_solutions/products/)
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Salland Engineering
S3 Group ASIC design strengths
S3 Group ASIC design strengths

• **Sense it**
  • Data gathering via connectivity to local and remote temperature, pressure, flow and other sensors
  • Integrated Wired and Wireless connectivity
  • Wireless connectivity via network technologies including ISM, SIGFOX, NB-IoT, 802.11x

• **Process it**
  • Integrated high resolution Data Converters to accurately process (and digitise) data gathered
  • Integrated processor (including ARM core and other cores) and peripherals used to manage all aspects of the data gathering and communication functions

• **Communicate it**
  • Integrated communication functions
  • Wired communication via UART, SPI, I2C, CAN Bus, Foundation Fieldbus, HART
  • Wireless communication via network technologies including ISM, SIGFOX, NB-IoT, 802.11x
Tailored ASICs
Sample Completed ASIC Projects

• Smart Valve (flow control) ASIC
• Power Management Unit (PMU)
• MEMS Interface ASIC
• Bluetooth Headset Controller
• Satellite/Modem Handset RF ASIC
• Cellular Basestation Mixed Signal IC
• Wireless HDMI
...and more..
Satellite ASIC developments

> We have developed numerous L-band satellite Transceivers for numerous customers since 2008
> Publically we are allowed to reveal that Iridium is one such customer
> Our solution is found in both their satellite phone and M2M terminal equipment
> We continue to provide solutions for their NEXT program

> We are engaged with numerous other Satellite Operators to provide similar integrated Transceiver solutions
Smart Valve Monitoring & Control
- ASIC example
A customer example - background

- Our customer is an OEM that provides valves (flow process control) solutions to the Oil & Gas Industry
- No ASIC experience
- However they heard that through customised silicon integration they could:
  - Increase their top-line by adding more value to their existing product line
  - Increase their bottom line by reducing their eBOM
  - Extend their portfolio into new application areas
- With enhanced connectivity they could introduce new service centric revenue streams
The Customer’s Requirements

Technical Requirements

> Allow for portfolio tiering
> Multiple Sensor Interfaces - Pressure, Temp, Diagnostics
> Integrated Smart Control Loop
> Valve Positioning
> Communications (FF, HART)
> Integrated ARM processor core
> Designed to be intrinsically safe
> Low Power (<20mW)
S3 Group Approach

- Review the Customer’s product roadmap
- What assets are they trying to Sense, Control & Connect
- What can we do to build a solution that meets their current needs as well as is scalable to allow them to enter parallel application areas?
- We discussed sensing needs, measurement needs, control & programmability needs, connectivity needs and security needs
- Applied our Silicon Economics and Systems knowledge to provide an integrated mixed-signal SoC, leveraging from the rich portfolio of IP, all available at mature TSMC foundry nodes
The ASIC Solution

- Technology: 180nm eLL
- Dynamic Power: 157 uW/MHz
- Main Blocks
  - ARM Cortex-M4 core
  - PIC microcontroller
  - AFE including
  - 14bit ultra-low power SAR ADCs
  - 12bit control DACs,
  - Power switches
  - Analog multiplexors & op-amps,
  - Temperature sense,
  - Optimised power management blocks
  - FLASH & SRAM memories
- Industrial Communication interfaces (Foundation Fieldbus MAU and HART)
- Multiple Digital interfaces (SPI, UART, I2C, Parallel)
Custom Mixed-Signal ASIC for Process Control

Sensors & Actuators

Data Processing & Communication

- 14bit ADCs
- 12bit DACs
- LDO Reference
- ARM Cortex M4
- SRAM
- FLASH
- GPIO
- UART
- SPI & I2C
- PWM
- / FF
- AHB Bus
- RTC
- WatchDog
- GPIO
- UART
- SPI & I2C
- PWM
- / FF

- Temp Sensor
Custom ASIC Solution - Features

- Key features
  - Can operate from current loop of 4-20mA
  - Temperature range from -52°C to 85°C
  - Supports full control of the valve, upgrades of the firmware
  - Variable core frequency
  - Industrial interfaces (HART and FF-MAU)
  - Variety of digital interfaces allow for connection of different peripherals to add more functionality/connectivity
  - External FLASH and SRAM interfaces allow for extra SW functionality
  - Not used sub-blocks can be independently powered-off
Custom ASIC Solution - S3 Group project elements

- **ASIC development**
  - System architecture development
  - Design Specification generation
  - Verification Plan generation
  - Test Plan generation
  - Digital RTL design, integration and verification
  - Analog block schematic development, simulation and implementation
  - Top-level physical implementation
  - DfT insertion, test patterns generation, ATE bring-up support

- **Prototyping**
  - FPGA Prototyping Plan generation
  - FPGA Prototyping of the digital core

- **Validation/Qualification**
  - Validation Plan generation
  - Validation board development and manufacturing
  - Validation of real chip across PVT corners
  - Validation Report generation

- **Part delivery (supply chain management)**
The Customer’s Outcome

- Reduced Power
- Smaller Form Factor
- Improved reliability, due to less components
- Better signal integrity
- > 80% saving in eBOM
- Feature differentiation - they defined their solution & now own their solution
- Roadmap success - can be leveraged across their connectivity portfolio
- IP security - solution is not readily copied
- Simpler inventory management - one part for all the end-product tiers
Advantages of using an ASIC
Advantages of using an ASIC

- Significant eBOM (electronic Bill-of-Materials) cost savings
- Full Custom capability - ASIC is manufactured to Customer’s design specifications
- ASIC may be designed to support a portfolio of products using one programmable device
- Increased performance and reliability
- Lower power consumption and dissipation
- Smaller form factor - since ASIC is manufactured to Customer’s design specifications
- Customer’s IP is protected
- Lower unit cost, particularly when there is moderate shipment volumes
- Complete ASIC supply chain managed
Thank you

www.s3group.com/semiconductor-solutions