



ECSEL Joint Undertaking
Electronic Components and Systems for European Leadership

CONNECT: Innovative smart components, modules and appliances for a truly connected, efficient and secure smart grid

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Newsletter
January 2019
Issue Number 2



During the first half of the second year of the CONNECT project, the consortium has achieved significant progress in all the three innovation areas: power conversion, smart energy management systems, and smart-grid communication infrastructure.

CONNECT investigates new concepts and technologies for power conversion targeting bi-directional power exchange with the grid and extended integration of local storage and renewables such as PV. Specifically, CONNECT's work on power conversion is focused on three main pillars: i) **high power AC-DC grid interfacing power converters**, by developing a 50 kW bi-direction AC/DC converter and battery storage, a 100-300 kW high power electric bus charger, and a 3 phase four leg inverter for power quality improvement, ii) **close to zero standby power switch-mode AC-DC power converters**, by working on the design and implementation of highly integrated AC-DC power converter powering wake-up transceivers and low Power AC-DC converter for sensor-nodes, and, iii) **highly efficient DC-DC converters**, by developing DC-DC converters for microgrid applications and for energy harvesters, a DC-DC level shifter for DC microgrid applications, and DC-DC converter switched capacitors.

In parallel, the CONNECT's work on energy management systems is focused on four main areas: i) **smart metering tools**, by defining the

architectures for the smart metering devices and SDN management tools, and by implementing the designed smart metering solution on a chosen platform, ii) **energy consumption monitoring via autonomous wireless sensor networks**, by developing an evaluation board for the RF wake-up zero stand-by and dedicated RF transmitter board, an ad hoc prototype platform of WSN for environmental measurement, thermoelectric energy scavengers for batteryless operation in 0.18 mm CMOS, prototype boards for wireless sensor network with Arduino form factor, including security chip, example sensors and sub-GHz transceiver, and a power management module based on energy harvesting suitable for standard wireless sensor nodes, iii) **energy management and control architectures for DC micro-grids**, by defining algorithms for real-time management of the DC microgrid, optimum schedules in case of stochastic variables such as electric vehicles arrival time, energy production and consumption and strategies for droop controllers in DC microgrids in order to minimize bus capacitance, by developing lab-scale DC microgrid to be used for the validation of the proposed unified power-based droop control method, and, iv) **energy management system at the district level based on cooperation algorithms**, by developing novel cooperative energy management schemes for the optimization of the energy generated, stored and consumed at microgrids.

Finally, CONNECT also provides

significant contributions on the communication infrastructure of the smart grid. Specifically, CONNECT's work focuses on i) **smart home systems for network-connected devices**, including an over-the-distance wireless battery charger, and a low power wireless transceiver with high degree of flexibility regarding radio standards, ii) **advanced current sensors based on Hall effect or magneto-resistance**, where both simulations and experiments are used to validate the X-Hall architecture, while a TMR current sensor with temperature compensation & gain selection is also designed and currently tested, iii) **high data-rate PLC**, by investigating the low-frequency communications in isolated resonant DC-DC converters, by designing a class-E dc-dc resonant converter prototype capable of bidirectional over-the-barrier communication, and by developing a prototype for an ITU G.hn modem with repeating functionality, and, iv) **network security solutions for smart homes and smart grids**, by developing a prototype for the secure communication between a wireless sensor network and a Communication Hub, while also incorporating SDN functions and protection of cryptographic credentials, providing a highly secure wireless sensor node concept.

CONNECT Meetings



The CONNECT 3rd General Assembly was successfully held on Oct. 8th, 9th, 2018, at the premises of GREENFLUX in Amsterdam!!

CONNECT Dissemination Activities

IoTWC 2018



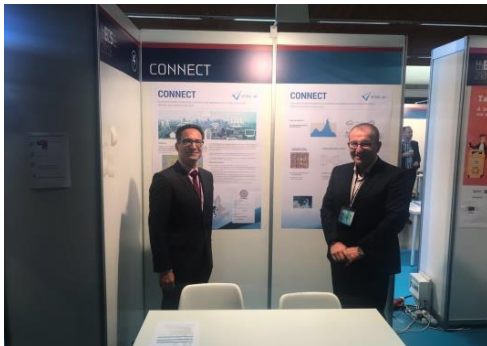
CONNECT was represented by CTTC, IQU and LEITAT in the IoT World Congress 2018, in Barcelona

SCEWC 2018



CONNECT was also represented by IQU & CTTC in SmartCity Expo World Congress 2018, in Barcelona

EF ECS 2018



CONNECT was also represented by CTTC & IFAG in the European Forum for Electronic Components and Systems 2018 in Lisbon.

Italian Society of Electronics



University of Bologna presented the CONNECT project in the Italian Society of Electronics in Naples, Italy on 22nd of June 2018

IoT Security Circle



Mixed Mode presented their demonstrator from the research project CONNECT during the IoT Security Circle at the Campeon in Neubiberg.

SMARTCOMP 2018



CONNECT participated in the SMARTCOMP 2018 panel on Challenges in Enabling Effective Smart Cities and Communities

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Project Duration:
01.04.2017 – 31.03.2020

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LinkedIn
<https://www.linkedin.com/in/connect-project-716228152/>

Publications

Journals

1. M. Rakus, et al., [Analysis of BDMOS and DTMOS Current Mirrors in 130 nm CMOS Technology](#). *Advances in Electrical and Electronic Engineering*, 16(2), June 2018.
2. M. Crescentini, et al., [Bandwidth enhancement in Hall probe by X-Hall DC biasing](#). *Journal of Physics: Conference Series*, Aug. 2018.
3. M. Crescentini, et al., [An empirical dynamic model of Hall-effect sensors](#). *Journal of Physics: Conference Series*, vol. 1065, no. 5, Aug. 2018.
4. T. Saalfeld, et al., [A digital receiver signal strength detector for multi-standard low-IF receivers](#). *Advances in Radio Science*, 16(C.), 51-57, Sept. 2018.
5. Y. Zhang, et al., [Voltage Harmonic Suppression by Means of Grid-Connected Converters Using only Local Measurements](#). *Energies*, 11(10), 2515, Sept. 2018.
6. J. Vardakas, et al., [Electrical Energy Savings through Efficient Cooperation of Urban Buildings: The Smart Community Case of Superblocks' in Barcelona](#). *IEEE Commun. Magazine*, vol. 56, no. 11, Nov. 2018.
7. F. Cucchi, et al., [Variability-aware design of a bandgap voltage reference with 0.18% standard deviation and 68 nW power consumption](#). *Int. Journal of Circuit Theory and Applications*, 46(11), Nov. 2018.
8. D. Bellasi, et al., [A Broadband Multi-Mode Compressive Sensing Current Sensor SoC in 0.16 \$\mu\$ m CMOS](#), *IEEE Transactions on Circuits and Systems I: Regular Papers*, vol. 66, no. 1, Jan. 2019.

Conferences

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2. B. Aluisio, et al., [AC and DC Solutions for Electric Vehicle Microgrid: Sizing and Reliability Analysis](#), in *Proc. IEEE EEEIC/I&CPS Europe*, June 2018.
3. T. Saalfeld, et al., [Analysis of Gain and Bandwidth Limitations of Operational Amplifiers in Sigma-Delta Modulators](#), in *Proc. IEEE PRIME*, July 2018.
4. G. Liu, et al., [Design of Droop Controllers for Converters in DC Microgrids Towards Reducing Bus Capacitance](#), in *Proc. EPE'18 ECCE Europe*, Sept. 2018
5. Y. Zhang, et al., [Sequence-decoupled resonant control of three-phase grid-interfacing inverter for local voltage support under unbalanced load](#), in *Proc. EPE'18 ECCE Europe*, Sept. 2018.
6. J. Brenkuš, et al., [Energy Monitoring Platform for Smart Grid Applications](#), in *Proc. ICAE*, Sept. 2018.
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8. E.B. Kapisch, et al., [Frequency estimation for grid-connected converters under time-varying harmonics and inter-harmonics](#), in *Proc. IEEE CAMAD*, Sept. 2018.
9. C. Tamburini et al., [A CMOS RF-Powered Tag with Sensing and Localization Capabilities](#), in *Proc. IEEE CAMAD*, Sept. 2018.
10. L. Perilli, et al. [PV Cell Characteristic Extraction to Verify Power Transfer Efficiency in Indoor Harvesting System](#), in *Proc. IEEE CAMAD*, Sept. 2018.
11. A. Abdelhakim et al., [Bidirectional DC-DC Converter Topologies for Low-Voltage Battery Interface: Comparative Assessment](#) in *Proc. IEEE RTSI*, Sept. 2018.
12. G. Liu, et al., [Plug and Play DC-DC Converters for Smart DC Nanogrids with Advanced Control Ancillary Services](#), in *Proc. IEEE CAMAD*, Sept. 2018.
13. F. M. Cru, et al., [Why Use RF Energy Harvesting in Smart Grids](#), in *Proc. IEEE CAMAD*, Sept. 2018.
14. J. Hiller, "Secure Low Latency Communication for Constrained Industrial IoT Scenarios", in *Proc. IEEE LCN*, Oct. 2018.
15. M. Potočný, et al., [A 200 MHz RF wireless power transfer receiver for implantable medical devices fully integrated in 130 nm CMOS](#), in *Proc. BEC*, Oct. 2018.
16. C. Aguzzi et al., [From Heterogeneous Sensor Networks to Integrated Software Services: Design and Implementation of a Semantic Architecture for the Internet of Things at ARCES@UNIBO](#), in *Proc. FRUCT*, Nov. 2018
17. T. Saalfeld, et al., [A Tracking Quantizer for Continuous Time Quadrature Bandpass Sigma-Delta Modulators](#), in *Proc. ICECS*, Dec. 2018.

CONNECT in social media



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