CONAN – An Electronic Circuit Breaker for Next Generation PCDU

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Abstract—**CONAN IC has been designed in the framework of ARTES ESA program by a consortium composed of Airbus Defence and Space, which has specified the requirement for this electronic circuit breaker, and Weeroc which has designed the CONAN IC. Telecom Satellite Power Control and Distribution Units (PCDUs) in particular and most satellite PCDUs in general still use fuses as circuit breaker. Having a programmable electronic circuit breaker controller device featuring double isolation, redundancy, telemetry and latch-up current limitation will be a game changer for PCDUs circuit breaking. CONAN is a dual power P-channel MOSFET controller IC (nominal and redundant) designed in XFAB XT018 technology. It embeds all these features over a 20 V to 136 V voltage span and a 0.5 A to 12.5 A current limitation span. CONAN features a nominal and redundant space serial bus communication line allowing the TM/TC of 254 CONAN on the same bus line. CONAN embeds 8-heater drivers and 8-heater status on top of the circuit breaking capability. CONAN complete features and architecture will be presented in this paper along with simulation and measurement results.**

I. INTRODUCTION

Protection function is currently ensured by fuse technology and thermal groups on Telecom platform, ON/OFF switching function is ensured by relay technology located in bracket; equipment command and control is performed thanks to harness matrices. The aim of the CONAN controller is to replace these functions by a compacter and more efficient solution based on power MOSFET allowing much more telemetry and telecommand as well as the possibility to reprogram parameters in flight.

II. GENERAL PRESENTATION OF CONAN

A. Block Scheme and Main Features

Conan is a space-grade electronic circuit breaker and current limiter controller aiming to drive one or two PMOS (nominal or nominal with redundant) to ensure programmable and fail-safe power control on rail from 20 V to 136 V with a current limitation up to 12.5 A (Class 10 LCL).

Conan can be programmed to trip on UVD, excess temperature, over-current consumption and can either restart automatically or upon user request. The controller can be programmed through a dual Serial Space Bus (SSB, nominal and redundant) or be used as a standalone device programmed by resistors.

Conan acts as a current limiter with programmable threshold and trip time. Several parameters (Power rail voltage, output voltage, redundant MOSFET voltage, current, temperature) are constantly acquired as telemetry parameters and can be sent through the serial bus.

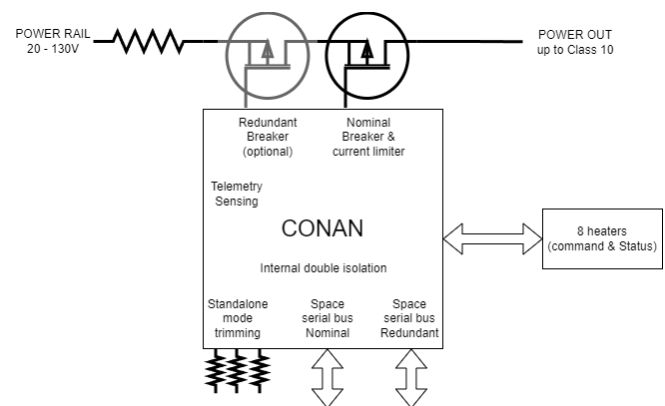Conan can control 8 heaters using up to 15 V internal drivers.

Figure 1 - CONAN Block Scheme

B. Package and Quality Level

CONAN is packaged in a plastic BGA package using a space-qualified European-based fabrication line. BGA is 10x10 balls with a 1.27 mm pitch. Package size is 15x15 mm².
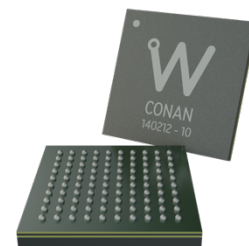

Figure 2 – CONAN Package Artist View

CONAN is foreseen to be released in Class 1, Class 2 and New Space (without screening) quality level.

III. PERFORMANCES

Only simulations are available at the time of the abstract writing. However, CONAN characterization results shall be available during the conference presentation.

A. ON-OFF behaviour

CONAN can be used as a power switch by sending SSB commands. Simulated behaviour of ON-OFF sequence is shown in Figure 3.
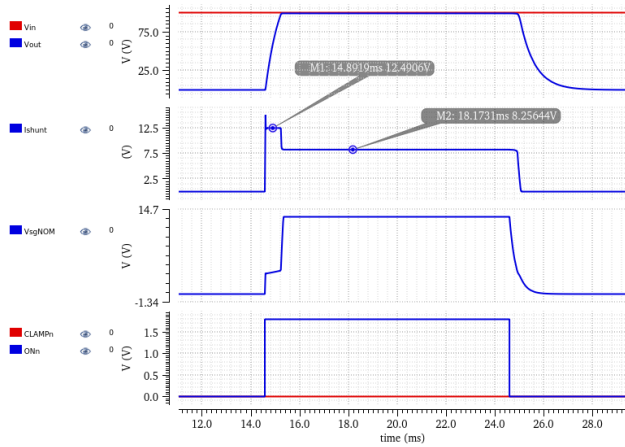

Figure 3 - CONAN ON-OFF Sequence (Top is Power rail live [red] and Power out [blue], below is current in power MOSFET, below is gate source voltage of power MOSFET and last is internal ON and CLAMP signal value)

LCL CONAN feature is also demonstrated in this simulation with the current limitation of class 10 LCL at 12.5 A during the load charging up to the 100 V of power rail live.

B. Overcurrent behaviour with Custom Class

CONAN is configured as a LCL, with a variable current limitation threshold, a trip-off time of 19_{10} (2 ms) and an undervoltage threshold of 0_{10} (10 V). Three simulations with a current limitation threshold of 0_{10} (0.5 A), 25_{10} (5 A), 51_{10} (10 A) ar shown below.
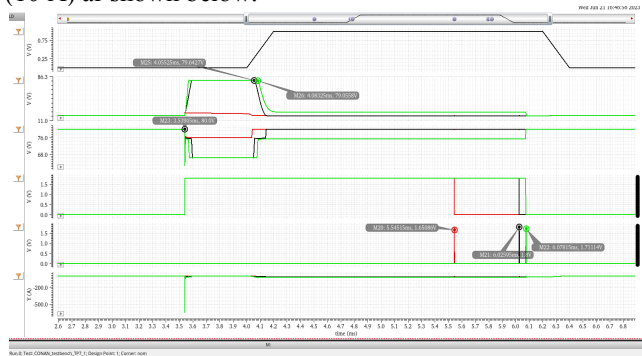

Figure 4 - CONAN Overcurrent Behaviour for Three Current Limitation Threshold

Power rail live is set at 80 V and the device is turned on at 3.5ms.

Upon Vcontrol being raised, the resistance between the power rail and the ground drops to simulate a short-circuit; this happens at 4ms. At the lowest possible threshold, the device starts limiting as soon as it turns on, and clamps at 5.5 ms. At the middle and high thresholds, the device starts limiting when detecting a short-circuit, around 4 ms.

C. UVD protection behaviour

CONAN is configured as a RLCL, with a current limitation threshold of 1_{10}, a trip-off time of 11_{10} (1.2 ms) and an undervoltage threshold of 56_{10} (66 V).

The power rail provides 80 V, until 2 ms, where the voltage provided drops down to 70 V.
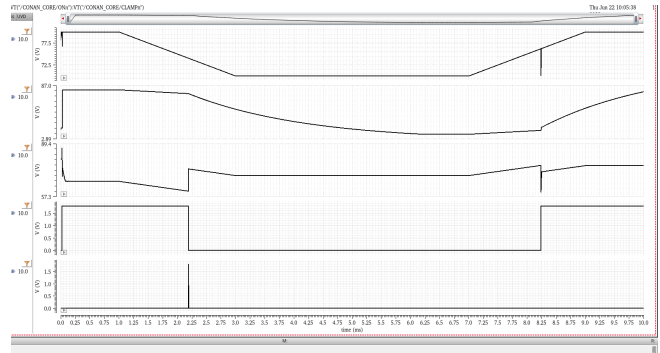

Figure 5 - CONAN Undervoltage Protection Behaviour

CONAN clamps due to the undervoltage at roughly 2.1 ms, and turns back on as soon as the voltage recovers to a level that is above the undervoltage threshold, at 8.2 ms.

IV. ACKNOWLEDGMENT

V. CONCLUSION

CONAN is a versatile and fully programmable circuit breaker controller featuring advanced telemetry and telecommand to be used in flight. Architecture of the IC and measurements will be presented in the paper.

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