A FAULT-TOLERANT RISC MICROPROCESSOR
FOR SPACECRAFT APPLICATIONS

CONSTANTIN TIMOC
SPACEBORNE INC.

HARRY BENZ
NASA/LaRC
REDUCED INSTRUCTION SET COMPUTER

CONTROL UNIT

HARDWIRED
(NOT MICROPROGRAMMED)

DATA AND ADDRESS UNIT

ADDRESS ADDER

PC INCREMENTER/MUX

GENERAL REGISTERS (32 x 32)

ALU

SHIFTER

MULTIPLIER/DIVIDER

INTERRUPT UNIT

INTERRUPT REGISTERS

PRIORITY INTERRUPT LOGIC
FAULT TOLERANT REGISTERS

GENERAL REGISTERS
(32 x 32)

CHECK BITS

DOUBLE-RAIL

ERROR DETECTION AND CORRECTION LOGIC

FAULT TOLERANT ALU
FAULT TOLERANT ALU

DATA A

DOUBLE-RAIL

DATA B

DOUBLE-RAIL

32-BIT ALU

32-BIT ALU

ERROR CORRECTOR

DOUBLE-RAIL

SUM
DOUBLE RAIL CMOS LOGIC

\[ F = x_0 \cdot x_1 \]

\[ \overline{F} = x_0 \cdot x_1 \]
DOUBLE RAIL CMOS LOGIC
(GOOD CIRCUIT)
DOUBLE RAIL CMOS LOGIC
(TRANSISTOR STUCK-ON)
DOUBLE RAIL CMOS LOGIC
(TRANSISTOR STUCK-OFF)