

# Spacecraft With CAMBR Chips

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## **Rossi X-Ray Timing Explorer (RXTE) / NASA**

- Reed Solomon CCSDS Telemetry Channel Coder (RS16e)
  - Rad Hard 1.2 $\mu$ m Gate Array (Aeroflex)
- Bus Controller ASIC
  - Rad Hard 1.2 $\mu$ m Gate Array (Aeroflex)

Launched: December 30, 1995, currently operating in Earth orbit.

## **Near Earth Asteroid Rendezvous (NEAR) / NASA**

- Reed Solomon CCSDS Telemetry Channel Coder (RS16e)
  - Rad Hard 1.2 $\mu$ m Gate Array (Aeroflex)

Launched: February 17, 1996

Successfully soft landed on asteroid Eros February 14, 2001, from where it continued to send telemetry back to Earth.

## **Solar Extreme UV Rocket Telescope and Spectrograph (SERTS) / NASA**

- CCSDS Lossless Data Compressor (USES)
  - Rad Hard 1.2 $\mu$ m Gate Array (Aeroflex)

Launched: November 13, 1996 on-board Sounding Rocket, payload recovered

Launched: November 18, 1997 on-board Sounding Rocket, payload recovered

## **Hubble Space Telescope (HST) / NASA**

- Bus Controller ASIC
  - Rad Hard 1.2 $\mu$ m Gate Array (Aeroflex)
- Reed Solomon Encoder/Decoder for Solid State Recorder (EDAC5)
  - 1.0 $\mu$ m CMOS (AMI) - Radiation Tolerant Design

Launched: February 1997 Servicing Mission 2 (STS-82/SM 2). A second EDAC5 based SSR was successfully tested on board the HST Orbital Systems Test Platform (HOST) during STS-95, October 29-November 7, 1998 and installed on-board HST during STS-103/SM 3A in December 1999.

## **Lewis / NASA**

- CCSDS Lossless Data Compressor (USES)
  - Rad Hard 1.2 $\mu$ m Gate Array (Aeroflex)

Launched: August 22, 1997

Mission lost due to attitude control thruster malfunction. Reentered atmosphere September 28, 1997.

## **Tropical Rainfall Measuring Mission (TRMM) / NASA**

- Reed Solomon CCSDS Telemetry Channel Coder (RS16e)
  - Rad Hard 1.2 $\mu$ m Gate Array (Aeroflex)
- Bus Controller ASIC
  - Rad Hard 1.2 $\mu$ m Gate Array (Aeroflex)

Launched: November 27, 1997, currently operating in Earth orbit.

## **Cobra Brass - E / DOE**

- CCSDS Lossless Data Compressor (USES)
  - Rad Hard 1.2 $\mu$ m Gate Array (Aeroflex)
- Reed Solomon CCSDS Telemetry Channel Coder (RS16e)
  - Rad Hard 1.2 $\mu$ m Gate Array (Aeroflex)

Launched: Sometime 1997/early 1998 (classified)

## **Submillimeter Wave Astronomy Satellite (SWAS) / NASA**

- CCSDS Lossless Data Compression (software implementation)

Launched: December 5, 1998, placed in to hibernation July 21, 2004 after a highly successful 5.5 year mission and reactivated June 1, 2005 to observe the July 4, 2005 Deep Impact Mission rendezvous, collision, and aftermath with Comet Tempel 1.

## **ROCSAT-1 / NSPO**

- Reed Solomon CCSDS Telemetry Channel Coder (RS16e)
  - Rad Hard 1.2 $\mu$ m Gate Array (Aeroflex)

Launched: January 27, 1999

## **Landsat7 / NASA**

- Reed Solomon Encoder/Decoder for Solid State Recorder (EDAC5)
  - 1.0 $\mu$ m CMOS (AMI) - Radiation Tolerant Design

Launched: April 15, 1999, currently operating in Earth orbit.

## **Chandra X-Ray Observatory / NASA**

- Reed Solomon CCSDS Telemetry Channel Coder (RS16e)
  - Rad Hard 1.2 $\mu$ m Gate Array (Aeroflex)

Launched: July 23, 1999 via Space Shuttle Columbia (STS-93), currently operating in Earth orbit.

## **TERRA / NASA**

- Reed Solomon Encoder/Decoder for Solid State Recorder (EDAC5)
  - 1.0 $\mu$ m CMOS (AMI) - Radiation Tolerant Design
- Reed Solomon CCSDS Telemetry Channel Coder (RS16e)
  - Rad Hard 1.2 $\mu$ m Gate Array (Aeroflex)

Launched: December 18, 1999, currently operating in Earth orbit.

## **Korean Multipurpose Satellite (KOMPSAT) / KARI**

- CCSDS Lossless Data Compressor (USES)
  - Rad Hard 1.2 $\mu$ m Gate Array (Aeroflex)

Launched: December 21, 1999

## **Multi-spectral Thermal Imager (MTI) /DOE**

- CCSDS Lossless Data Compressor (USES)
  - Rad Hard 1.2 $\mu$ m Gate Array (Aeroflex)

Launched: March 12, 2000, currently operating in Earth orbit.

## **EO-1 / NASA**

- Reed Solomon CCSDS Telemetry Channel Coder (RS16e)
  - Rad Hard 1.2 $\mu$ m Gate Array (Aeroflex)
- Reed Solomon EDAC5-HS for Wide-band Advanced Recorder Processor (WARP)
  - 0.65 $\mu$ m RICMOS IV SOI Gate Array (Honeywell)

Launched: November 21, 2000, currently operating in Earth orbit.

## **2001 Mars Odyssey / Thermal Emission Imaging System (THEMIS) / NASA**

- CCSDS Lossless Data Compressor (USES)
  - Rad Hard 1.2 $\mu$ m Gate Array (Aeroflex)

Launched: April 7, 2001

Entered Mars orbit October 23, 2001, currently operating in Martian orbit.

## **Wilkinson Microwave Anisotropy Probe (WMAP) / NASA**

- CCSDS Lossless Data Compression (software implementation)

Launched: June 30, 2001, operating in orbit around the Sun about the L2 Sun-Earth Lagrange point.

## **Thermo-sphere Ionosphere Mesosphere Energetics & Dynamics (TIMED) / NASA/APL**

- Reed Solomon Encoder/Decoder for Solid State Recorder (EDAC5)
  - 1.0 $\mu\text{m}$  CMOS (AMI) - Radiation Tolerant Design

Launched: December 7, 2001, currently operating in Earth orbit.

## **Comet Nucleus Tour (CONTOUR) / NASA/APL**

- Reed Solomon Encoder/Decoder for Solid State Recorder (EDAC5)
  - 1.0 $\mu\text{m}$  CMOS (AMI) - Radiation Tolerant Design

Launched: July 3, 2002.

Mission lost August 15, 2002 during solid rocket transfer insertion burn.

## **AURA / NASA**

- CCSDS Lossless Data Compressor (USES)
  - Rad Hard 1.2 $\mu\text{m}$  Gate Array (Aeroflex)

Launched: July 15, 2004, currently operating in Earth orbit.

## **NOAA-N**

- Reed Solomon Encoder/Decoder for Solid State Recorder (EDAC5)
  - 1.0 $\mu\text{m}$  CMOS (AMI) - Radiation Tolerant Design

Launched: May 20, 2005, currently operating in Earth orbit.

## **New Horizons / NASA/APL**

- Reed Solomon Encoder/Decoder for Solid State Recorder (EDAC5)
  - 1.0 $\mu\text{m}$  CMOS (AMI) - Radiation Tolerant Design

Launch: January 11, 2006

## **New Millennium Program (NMP) Space Technology 5 (ST5) Cluster / NASA**

- CMOS Ultra Low Power Radiation Tolerant (CULPRiT) Reed Solomon CCSDS Telemetry Channel Coder

- 0.35 $\mu\text{m}$  ULP CMOS (AMI) - Radiation Tolerant Design

Launch: NET February 28, 2006

## **Space Based Infra-Red System (SBIRS - High) / DOD**

- CCSDS Lossless Data Compressor (USES)

- Rad Hard 1.2 $\mu\text{m}$  Gate Array (Aeroflex)

Launch: 2007

## **Solar Dynamics Observatory (SDO) / NASA**

- Reed Solomon CCSDS Telemetry Channel Coder (RS16e)

- Rad Hard 1.2 $\mu\text{m}$  Gate Array (Aeroflex)

Launch: April 2008

## **NPOES Preparatory Project(NPP) / NOAA/NASA**

- CCSDS Lossless Data Compressor (USES)

- Rad Hard 1.2 $\mu\text{m}$  Gate Array (Aeroflex)

Launch: 2008

## **GOES-R / NOAA/NASA**

- CCSDS Lossless Data Compressor (USES)

- Rad Hard 0.6 $\mu\text{m}$  Gate Array (Aeroflex)

Launch: 2012

# Ground observatories supported by CAMBR chips

**Green Bank National Radio Astronomy Observatory**

**Max Planck Institut für Radioastronomie**

**Sub Millimeter Array - Mauna Kea**

**Arecibo 305m Radio Telescope**

**Haystack Observatory**