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Lunar Reconnaissance Orbiter Project

Cosmic Ray Telescope for the Effects of Radiation to Spacecraft Electrical Interface Control Document

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CM FOREWORD

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LUNAR RECONNAISSANCE ORBITER PROJECT

DOCUMENT CHANGE RECORD

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Rev –	Released per 431-CCR-000006	C. Tooley	8/4/2005
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1.0 INTRODUCTION

1.1 PURPOSE

This document details the electrical interfaces between the Cosmic Ray Telescope for the Effects of Radiation (CRaTER) instrument and the Lunar Reconnaissance Orbiter (LRO) spacecraft. The interfaces described include the power and command and data handling (C&DH) interfaces.

1.2 INSTRUMENT ELECTRICAL SYSTEM OVERVIEW

The CRaTER Instrument electrical system is comprised of the CRaTER detectors and read-out electronics, a MIL-STD-1553 interface, and a low voltage power converter. A block diagram is shown in Figure 1-1. CRaTER will handle all of its own data processing requirements.

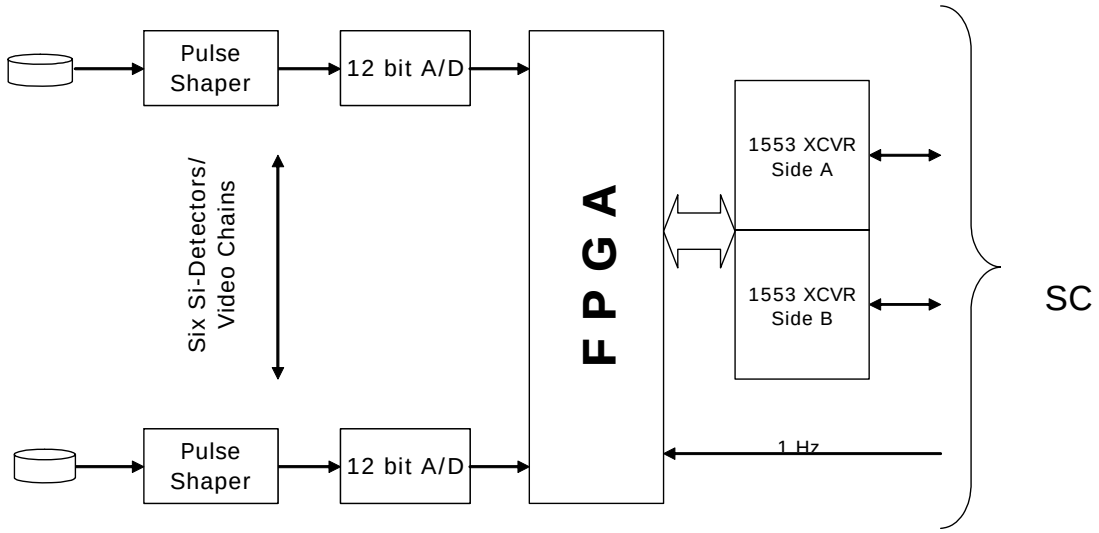

Figure 1-1. CRaTER Functional Block Diagram

CRaTER detects charged particles which transit one or more of six silicon detectors.

The signals from those detectors are amplified in analog video chains and then sampled by analog-to-digital (A/D) converters (ADC). The resulting values are packed into Consultative Committee for Spacecraft Data Systems (CCSDS) compliant data packets for transmission to the spacecraft C&DH system over the 1553 data bus. The output data rate can vary from a few hundred bits per second to a hundred thousand bits per second depending upon the solar activity level.

The instrument is ready to take data immediately upon power up and the receipt of observation-dependant parameters received from the spacecraft over the 1553 data bus. These parameters include selection of the coincidence criteria for valid particle events and upper and lower energy

range boundaries. Diagnostic functions such as internally generated test signals are also available. A 1 Hertz timing pulse and the associated spacecraft time information received over the 1553 data bus are use to time-tag the data.

1.3 DEFINITIONS AND TERMINOLOGY

In this document, a requirement is identified by “shall,” a good practice by “should”, permission by “may”, or “can”, expectation by “will”, and descriptive material by “is.”

2.0 DOCUMENTATION

2.1 APPLICABLE DOCUMENTS

431-ICD-000104	Cosmic Ray Telescope for Effects of Radiation to Spacecraft Data Interface Control Document
431-ICD-000118	Cosmic Ray Telescope for Effects of Radiation to Spacecraft Thermal Interface Control Document
431-RQMT-000004	Lunar Reconnaissance Orbiter Mission Requirements Document
431-RQMT-000112	Lunar Reconnaissance Orbiter Technical Resources Requirements
431-SPEC-000008	Lunar Reconnaissance Orbiter Electrical Systems Specification
431-SPEC-000091	Lunar Reconnaissance Orbiter Thermal Systems Specification

2.2 REFERENCE DRAWINGS

2082885	LRO Spacecraft Harness Drawing
32-02003.02	CRaTER Mechanical-Thermal Interface Drawing

3.0 LRO ELECTRICAL SYSTEM REQUIREMENTS

The CRaTER instrument shall adhere to the following requirements stated in the Lunar Reconnaissance Orbiter Electrical Systems Specification (431-SPEC-000008). Where this document conflicts or differs with the Lunar Reconnaissance Orbiter Electrical Systems Specification (431-SPEC-000008), this document shall take precedence. Interfaces are as shown in Figure 3-1.

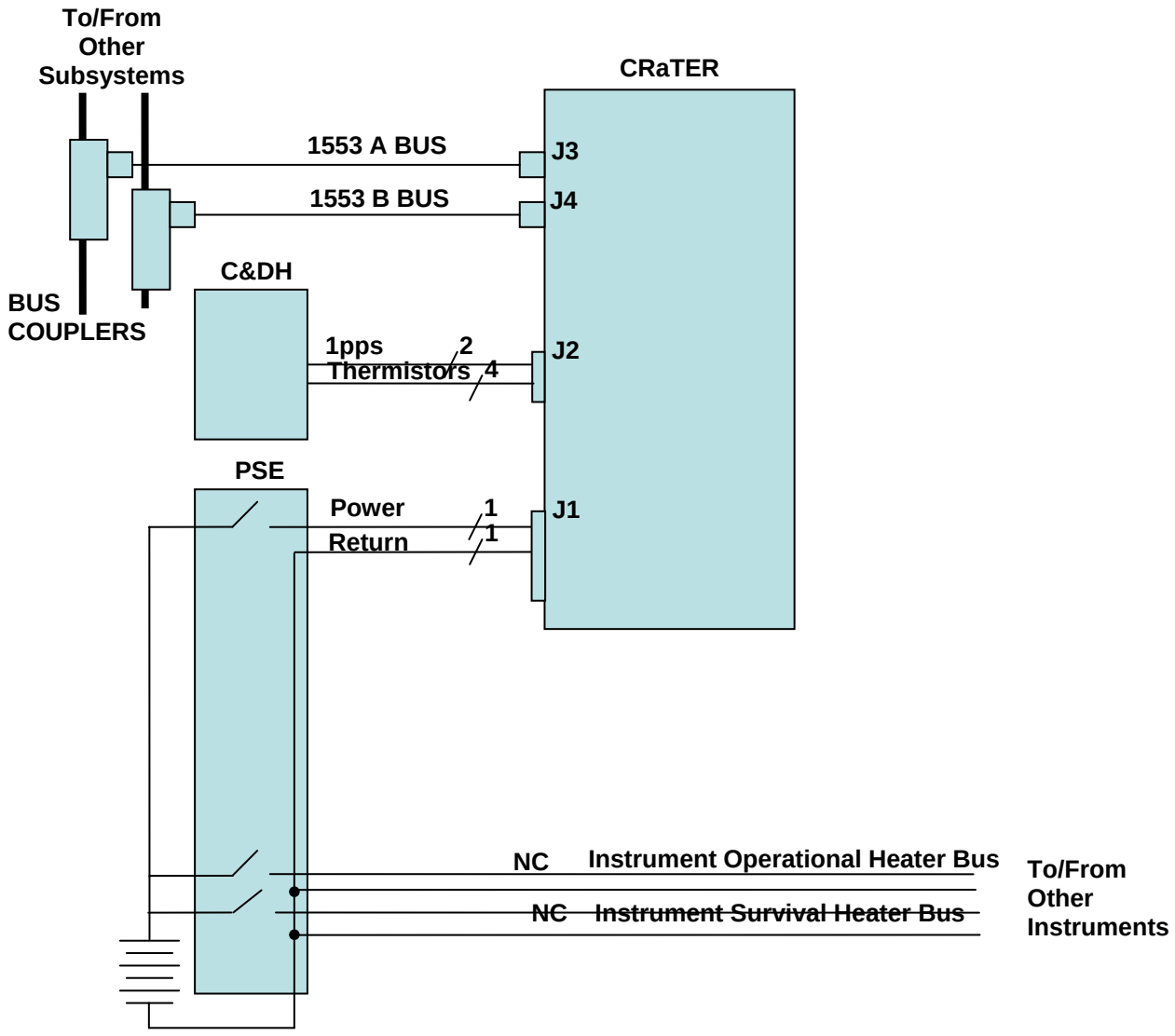

Figure 3-1. CRaTER Instrument Power Interface

3.1 POWER

The LRO Power subsystem shall supply a single 1 Amp (A) switched power service for the CRaTER instrument.

Table 3-1. CRaTER Power Consumption

PARAMETER NAME	VALUE
CRaTER Steady State Power, current best estimate	5.1 Watts (W)
CRaTER Peak Power, current best estimate	5.1 W

The CRaTER instrument power allocations shall be per the Lunar Reconnaissance Orbiter Technical Resources Requirements (431-RQMT-000112).

3.1.1 Power Profile

The CRaTER instrument operates in only one mode. Power consumption is the same all of the time, as identified in Table 3-1.

3.1.2 Instrument Power Specifications

The instrument power system shall comply with the User (Subsystem) requirements stated in Section 3.1.3 of the Lunar Reconnaissance Orbiter Electrical Systems Specification (431-SPEC-000008). The specifications in this section apply to voltage seen at the CRaTER end of the interface between the instrument and the spacecraft.

3.2 SYSTEM GROUNDING REQUIREMENTS

The CRaTER Instrument shall comply with the System Grounding requirements as stated in Sections 3.2.1 – 3.2.6.2 of the Lunar Reconnaissance Orbiter Electrical Systems Specification (431-SPEC-000008). Specific implementation regarding any ground straps necessary to meet this requirement are shown in the CRaTER Mechanical-Thermal Interface Drawing (32-02003.02).

3.3 EMI/EMC REQUIREMENTS

The CRaTER Instrument shall comply with the Electromagnetic Interference (EMI)/ Electromagnetic Compatibility (EMC) requirements as stated in Section 3.3 of the Lunar Reconnaissance Orbiter Electrical Systems Specification (431-SPEC-000008). The CRaTER shall be OFF from launch until at least launch vehicle separation.

3.4 DATA AND SIGNAL INTERFACES

The CRaTER Instrument shall comply with the Data and Signal Interface requirements as stated in Section 3.4 of the Lunar Reconnaissance Orbiter Electrical Systems Specification (431-SPEC-000008).

The CRaTER Instrument shall be a Remote Terminal on the LRO 1553 Data Bus, and shall comply with the requirements as stated in Section 3.4.1.1 of the Lunar Reconnaissance Orbiter Electrical Systems Specification (431-SPEC-000008). The CRaTER Instrument 1553 data bus interface shall comply with the data and protocol requirements as stated in the Cosmic Ray

Telescope for Effects of Radiation to Spacecraft Data Interface Control Document (431-ICD-000104).

The CRaTER Instrument shall receive the 1 Pulse-per-second (pps) and shall comply with the requirements as stated in Section 3.4.1.7 of the Lunar Reconnaissance Orbiter Electrical Systems Specification (431-SPEC-000008).

3.5 MULTIPACTION AND CORONA

The CRaTER Instrument shall comply with the Multipaction and Corona requirements as stated in Section 3.5 of the Lunar Reconnaissance Orbiter Electrical Systems Specification (431-SPEC-000008).

3.6 DESIGN FOR RADIATION

The CRaTER instrument shall meet its performance requirements with acceptable degradation due to radiation induced effects. The LRO radiation requirements are contained within the Radiation Requirements Document for the Lunar Reconnaissance Orbiter (431-RQMT-000045).

3.7 CHARGING AND DISCHARGING REQUIREMENTS

The CRaTER Instrument shall comply with the Charging and Discharging requirements as stated in Section 3.7 of the Lunar Reconnaissance Orbiter Electrical Systems Specification (431-SPEC-000008).

3.8 HARNESS REQUIREMENTS

CRaTER has no harnesses external to the instrument housing, however must comply with regard to connector placement and other applicable requirements of the Harness Guidelines as stated in Section 4.0 of the Lunar Reconnaissance Orbiter Electrical Systems Specification (431-SPEC-000008).

3.9 CRATER TEMPERATURE SENSORS

The LRO spacecraft shall provide one (1) Platinum Resistance Thermometer (PRT) to be read by the LRO spacecraft. The PRT part number is defined in the Lunar Reconnaissance Orbiter Thermal System Specification (431-SPEC-000091). The PRT shall be internal to the CRaTER instrument with electrical interface on the housekeeping connector below. The location of this PRT is defined in the CRaTER Mechanical-Thermal Interface Drawing (32-02003.02).

3.10 CRATER OPERATIONAL HEATERS

Not Applicable. CRaTER has no operational heater.

3.11 CRATER SURVIVAL HEATERS

CRaTER will not have an internally mounted survival heater. The survival heater for CRaTER will be mounted on the spacecraft side of the interface. Power for the CRaTER survival heater shall be provided by the LRO instrument survival heater bus.

3.12 EXTERNAL ELECTRICAL INTERFACES

Not Applicable. CRaTER does not have any external interfaces or test connectors.

3.13 CONNECTOR/PIN OUT DEFINITION

3.13.1 CRaTER Power Connector

Table 3-2. CRaTER Power Connector

Power Interface Connector (Designation J1) MALE 9-POSITION LOW-DENSITY (BOARD-EDGE) P/N: 311-P409-1P-B-12				
Pin No.	**Description**	**AWG**	**Type**	**Mate**
1	CASE			NC
2	No Connect (NC)			NC
3	+VCC	22	Power Input, Twisted Pair (TP), Twist with pin 7	Power System Electronics (PSE)
4	NC			NC
5	NC			NC
6	NC			NC
7	-VCC	22	Power Return, TP, Twist with pin 3	PSE
8	NC			NC
9	NC			NC

The CRaTER instrument shall deliver 3 sets of mating connectors for J1 to be used in the fabrication of the flight harness.

3.13.2 CRaTER Housekeeping Connector

Table 3-3. CRaTER Housekeeping Connector

Power Interface Connector (Designation J2) FEMALE 9-POSITION LOW-DENSITY P/N: 311-P409-1S-B-12				
Pin No.	**Description**	**AWG**	**Type**	**Mate**
1	NC			NC
2	+1PPS	24	RS-422, Twisted Shielded Pair (TSP), twist with pin 6	C&DH
3	+PRT_1	24	Analog Telemetry, TSP, twist with pin 7	C&DH
4	Ground Test Input	24	Analog MUX	NC (may be looped back to J2-3 for CRaTER ground test)
5	NC			NC
6	-1PPS	24	RS-422, Twisted Shielded Pair (TSP), twist with pin 2	C&DH
7	-PRT_1	24	Analog Telemetry, TSP, twist with pin 3	C&DH
8	Ground Test Input	24	Analog Return	NC (may be looped back to J2-7 for CRaTER ground test)
9	NC			NC

The CRaTER instrument shall deliver 3 sets of flight quality mating connectors for J2 to be used in the fabrication of the flight harness.

3.13.3 CRaTER 1553 Connectors

The CRaTER Instrument shall utilize 2 Trompeter BJ3150 connectors, with reference designators J-3 (A-bus) and J-4 (B-bus), which are compatible with the LRO spacecraft connector identified in Section 3.4.1.1.4 of the Lunar Reconnaissance Orbiter Electrical Systems Specification (431-SPEC-000008). Mating connectors are provided by the LRO project.

Appendix A. Abbreviations and Acronyms

Abbreviation/ Acronym	DEFINITION
A	Amp
A/D	Analog-to-Digital
ADC	A/D Converter
AWG	American Wire Gauge
C&DH	Command and Data Handling
CCB	Configuration Change Board
CCR	Configuration Change Request
CCSDS	Consultative Committee for Spacecraft Data Systems
CM	Configuration Management
CMO	Configuration Management Office
CRaTER	Cosmic Ray Telescope for Effects of Radiation
EMC	Electro-Magnetic Compatibility
EMI	Electro-Magnetic Interference
GSFC	Goddard Space Flight Center
ICD	Interface Control Document
LRO	Lunar Reconnaissance Orbiter
MIL	Military
MIT	Massachusetts Institute of Technology
NASA	National Aeronautics and Space Administration
NC	No Connect
P/N	Part Number
pps	Pulse-Per-Second
PRT	Platinum Resistance Thermometer
PSE	Power Systems Electronics
RQMT	Requirement
SC	Spacecraft
SPEC	Specification
STD	Standard
XCVR	Transceiver
TP	Twisted Pair
TSP	Twisted Shielded Pair