Part Number(s): 000566-01

	Name	Part Number(s)	Qty	Sheet No.	Schematic No.
Item:	Host Processor CCA	000801-02	1		
	Video Input CCA	000574-03	1		000626
	Video Output CCA	000575-02	1		000628
	Video Processor CCA	000576-02	1		000630

Function: Video Input CCA

On the VIC, the two video signals conditioned by the VBC are fed to two NTSC decoder devices where the colour signal is filtered out and the videos are digitized by Analog to Digital converters. The digitized video is stored in two 1024 x 512 x 16 Video Random Access Memory (VRAM) banks for 8 bit digitized video processing on this card, and is also routed to the VPC. The 40MHz TMS320C40 Digital Signal Processor (DSP) on this card provides the Video Input Processor (VIP) function. The DSP has 128K x 32 Static RAM (SRAM) for code and data storage. The SRAM has Error Detection and Correction (EDAC) which provides the capability for single bit error correction and multiple bit error detection. The VIP receives window position and threshold parameters from the HPC via the Host VME Bus interface through a 4K x 16 dual port memory. The VIP uses this data to process the digitized video from the VRAM and to generate a threshold map which is stored in the DSP RAM and passed to the VPC using a C40 communication port connection.

Video Output CCA

The VOC card provides the Video Output Processor (VOP) function, which is essentially a graphics accelerator. This card contains two Double buffered VRAMs of 768 pixels x 480 lines controlled by a 40MHz TMS320C40 DSP located on this card. The DSP has EDAC protected SRAM and a dual port RAM for communication with the HPC via the VME Bus interface, of similar design to the DSP located on the VIC. The VOP receives graphic primitives and enhancement overlay controls from the HPC via the Host VME Bus interface. This DSP then generates and stores in memory the graphics for each of the video outputs. Two RGB to NTSC encoders provide two separate video outputs which are independently phase locked to either Camera 1 or 2 and can be used for Graphical User Interface (GUI), Synthetics or video enhancements. Each encoder can generate 4 colour text and 16 colour graphics. A software controlled video look-up table translates 4/16 colours to any 24 bit colour. The VOP also stores data in the VRAMs to control selection of the enhancement overlays. The NTSC video outputs and overlay control bits are fed to the multiplexers on the VBC.

Video Processor CCA

The VPC provides the Image Pre-Processor (IPP) function for the two Video Input channels. The two digital video channels and the threshold from the VIC are fed to two custom hardware video processing channels, implemented in an ACTEL 1020 FPGA, which generate the binary video signal and the accumulated line moment and area for each channel. The binary video generated on this card is routed to the VBC for video output. The accumulated line areas, moments and binary video are stored in 4K x 32 DPRAMs accessible by a 40MHz TMS320C40 DSP located on this card. The DPRAMs buffer two lines of video data. The DSP accumulates window X and Y moments and calculates centroids. The DSP has EDAC protected SRAM and a dual port RAM for communication with the HPC via the VME Bus interface of similar design to the DSP located on the VIC.

Host Processor CCA

The HPC is a COTS PC compatible ruggedized Industry Standard Extended VME Bus (64 bit) card based on the 133MHz Intel Pentium Processor. The HPC uses a COTS Basic I/O Subsystem (BIOS), Real Time Clock with battery backup power and includes 16M EDO RAM with EDAC protection and 256K cache. Peripheral drivers include the RS-422 serial interfaces to connect to the Orbiter PGSC, a VGA video driver, keyboard / trackball PS2 interfaces, and an enhanced IDE Hard drive. The HPC interfaces to the VIC, VPC, VOC and IFC via the VME Bus and provides photogrammetric solutions, coordinate system transformations, synthetic and enhanced display generation, camera control, single joint operations and calibration data.

Failure Mode: Radiation Induced Corruption of Static Data inside a processor

	H/W	Func.	Screen	Failures
Criticality:	3	1R		

Mission Phase: Orbit

Cause(s):	Host Processor CCA	Data corrupted internally due to radiation effect.
	Video Input CCA	Data corrupted internally due to radiation effect.
	Video Output CCA	Data corrupted internally due to radiation effect.
	Video Processor CCA	Data corrupted internally due to radiation effect.

Failure effect on unit/end item: 1. OSVU: Failure Imminent. Data integrity is not monitored within the DSP or HPC Pentium. If a bit is flipped on data or code while it is in an internal register or ALU this piece of data or code will be used as is. If this occurs during initialization or when the system is being placed into RUN then incorrect database items may be saved in EDAC protected memory and used as correct. The effect on the system will depend on what data or code items are corrupted due to radiation effects. Background scrubbing will be ineffective in this situation because the data comming from the processor is assumed correct. It is likely to result in the system halting.
2. Interfacing Subsystems: No effect.
3. Mission: No effect.
4. Crew/Vehicle: May result in a collision if the flipped bit occurs on a data or code item which results in an undetected display of erroneous data to the operator.
5. Operational Considerations: The Crew is trained to use as many cues as possible to perform any mating/berthing task and insure the cues are consistent with pre-flight training. The available cues to perform mating/berthing tasks include the OSVU steering display, RMS digitals, out the window views, other camera views, and EVA personnel as necessary. To prevent the crew from using corrupted data, the graphical cue (i.e. Steering Display) provided by the OSVU will not be the only cue used to perform a mating/berthing task. If the cues are inconsistent, the operation will be paused, and the crew will check MCC for futher evaluation.

Worst Case: Delay of mission while system is rebooting or due to the use of alternate cues. The available cues to perform mating/berthing tasks other than the OSVU steering display include the RMS digitals, out the window views, other camera views, and EVA personnel.

Redundant Paths: The Crew is trained to use as many cues as possible to perform any mating/berthing task and insure the cues are consistent with pre-flight training. The available cues to perform mating/berthing tasks include the OSVU steering display, RMS digitals, out the window views, other camera views, and EVA personnel as necessary. To prevent the crew from using corrupted data, the graphical cue (i.e. Steering Display) provided by the OSVU will not be the only cue used to perform a mating/berthing task. If the cues are inconsistent, the operation will be paused, and the crew will check MCC for futher evaluation.

Failure Detection: OSVU does not initialize (No Displays) or,
Halt Symbol displayed on Steering Display with fatal error message or,
Activity Indicator Inactive or,
Operator is unable to issue commands or acquire targets or,
OSVU video (System, Steering, Enhanced) absent or distorted.
Operator detects corrupt OSVU data by verifying consistency of OSVU Steering Display cues with redundant operator cues (RMS digitals, out the window views, other camera views, and EVA personnel)

Corrective Action: Reinitialize OSVS

Time to Effect: Immediate

Time to Correct: Immediate

Hazard/Remarks: As a design this failure mode is a 1/1 criticality because corruption of sensitive data or code items could result in incorrect data being presented to the operator which might result in damage to the Crew/Vehicle before the system halts and until the system halts the failure will not necessarily be detectable. However this failure mode criticality has been reduced to an operationnal criticality of 3/1R through the crew use of alternate operator cues. The following sequence of events outlines the scenario.

1. A bit is flipped within a static parameter (constant, lookup table, database item) or executable instruction while it is being generated or modified inside the HPC Pentium or DSP registers or ALU's, either during Initialization or when the system is placed into RUN Mode.

2. All data which is written by the processors into memory is considered by the EDAC function to be good data. Therefore the EDAC circuitry calculates the correction codes required to ensure that the bad data stays bad.

3. This corrupted static data causes an error in the displayed photo-solution.

4. This error does not cause any of the error limits to be exceeded or otherwise trigger a software or unrecoverable error.

5. The Crew is trained to use as many cues as possible to perform any mating/berthing task and insure the cues are consistent with pre-flight training. The available cues to perform mating/berthing tasks include the OSVU steering display, RMS digitals, out the window views, other camera views, and EVA personnel as necessary. To prevent the crew from using corrupted data, the graphical cue (i.e. Steering Display) provided by the OSVU will not be the only cue used to perform a mating/berthing task. If the cues are inconsistent, the operation will be paused, and the crew will check MCC for futher evaluation.

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Rev 1 of FMEA 19 Oct 1998: Changes made as a result of subsequent review with NASA MOD and indication that other redundant cues were available to verify OSVU cues.

Changed criticality: Changed From 1/1 To 3/1R
Changed Effect:
Changed Item 4 to remove reference to collision
Added Item 5: Operational Considerations: ...
Changed Detection:
Deleted Item 1 "No detection"
Deleted Item 2 "or one of the Following"
Changed Item 4 to remove reference to collision
Added Item 6 "Operator detects corrupt OSVU data by verifying.... consistency of OSVU Steering Display cues with redundant operator cues (RMS digitals, out the window views, other camera views, and EVA personnel)
Changed Worst Case:
Deleted item 1 "Loss of Crew/Vehicle"
Added item 1 "Delay of mission while system is rebooting or due to the use of alternate cues... "
Changed Redundant Path:
Removed item 3 "During normal operation: none"
Added item 3 "The Crew is trained to use as many cues as possible... If the cues are inconsistent...the crew will check MCC for futher evaluation."
Remarks:
Changed first para to indicate design is crit 1/1 but use of redundant cues reduces criticality to 3/1R.
Changed item 5 in remarks to refer to redundant cues

Approvals:

Functional Group	Name	Position	Telephone	Date Signed	Status
Engineer	Brule, Dave / Neptec	Design Engineer	613-599-7602 EX	02Nov98	Signed
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Program Management Offi	Beach, Larisa / Neptec	SVS Program Manager	613 599 7602 EX	04Nov98	Signed
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Customer, S & MA	Kokosz, Cheryl / JSC-NC	SR & QA Leaves User - NASA	281-244-1954	05Nov98	Signed
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