ICD 1.9f/3.1

"Near-infrared Integral Field Spectrograph (NIFS) to Observatory Control System"

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Chapter 1 Introduction

1–1.0 Description

1–1.1 Purpose

This Interface Control Document (ICD) serves the following purposes:

- To describe the commands and parameters that will pass between the OCS and the NIFS sequencer and subsystems;
- To provide the necessary declarations of commands, parameters and Status and Information records that are required in an "Instrument to OCS ICD." This document provides the required tables, using the required "Parameter Definition Format", described in [9].

This document is based very closely on ICD 1.9a/3.1 [10], describing the OCS interface with NIRI, the basis of much of NIFS.

In addition to the documents mentioned in the previous paragraphs, the specific interfaces described in this document are governed by the following parent Interface Control Documents, which describe the general properties of particular kinds of interfaces:

- ICD 1a [6], which describes how the OCS deals with commands and attributes and the behavior the OCS expects from the systems it commands.
- ICD 1b [7], which gives a general description of the way the Observatory Control System communicates with the other principal systems. It is also related to ICD 7a, [11], which describes the way an Instrument Control System communicates with its subsystems.
- ICD 2 [8], which describes the way in which an Instrument Control System makes information available to the outside world (and the OCS) by means of "Status Information Records".

The intended audience for this document is:

- the NIFS reviewers;
- the developers of the Gemini Observatory Control System (OCS).

1–1.2 Scope

This document describes only aspects of the NIFS software system which differ from, or are more specific than, the Gemini standard instrument, described in [4]. It is assumed that the reader is familiar with that document.

This document does *not* describe the following:

- The NIFS Interlock system is the same as used by NIRI (see [3])[1];
- The NIFS hardware and electronics (see [1] and [2]);

1. All interlock commands are available from within the components controller, by using a nifs:cc: prefix, instead of the nifs:wfs: prefix.

- The NIFS On Instrument Wavefront Sensor, a close copy of NIRI's (see [3]);
- The software design (see [1], and [2]).

1–2.0 Related Documents and Drawings

1–2.1 References

[1] *"NIFS Conceptual Design Review Vol 1"*, Research School of Astronomy and Astrophysics, Australian National University

[2] *"NIFS Critical Design Review Vol 1"*, Research School of Astronomy and Astrophysics, Australian National University

[3] niri_hty_008.fm *"A&G to NIRI/GNIRS On Instrument Wavefront Sensor"*, Hubert Yamada, University of Hawaii, Institute for Astronomy.

[4] cics_smb_013, *"Science Instrument to Observatory Control System"*, Steven Beard, Royal Observatory Edinburgh.

[5] cics_smb_039, *"CICS Project Glossary and References"*, Steven Beard, Royal Observatory Edinburgh.

[6] gscg.kkg.009, *"ICD 1a — The System Command Interface"*, Kim Gillies, NOAO.

[7] gscg.kkg.024, *"ICD 1b — The Baseline Attribute/Value Interface"*, Kim Gillies, NOAO.

[8] gscg.kkg.010, *"ICD 2 — Systems Status and Alarm Interfaces"*, Gemini 8m Telescopes Project.

[9] gscg.grp.025, *"ICD 16 - The Parameter Definition Format"*, Steve Wampler, Gemini 8m Telescopes Project

[10] niri_hty_003, *"ICD1.9a/3.1 Near IR Imager (NIRI) to Observatory Control System"*, Hubert Yamada, University of Hawaii, Institute for Astronomy

[11] gscg.grp.015 *"ICD 7a - ICS Subsystem Interfaces"* Steven Beard, Steve Wampler and Chris Mayer, Gemini 8m Telescopes Project

[12] *"NIFS Software Maintenance Manual" - To be written,* Research School of Astronomy and Astrophysics, Australian National University

[13] ocs.kkg.031, *"Sequence Command Specifications"*, Kim Gillies, Shane Walker & Steven Beard, NOAO/Gemini 8m Telescopes Project.

[14] *"EPICS Channel Access Reference Manual"*, J. O. Hill, Los Alamos National Laboratory

[15] gscg.grp.007, "*ICD 3 — Bulk Data Transfer"*, Norm Hill, Severin Gaudet & Steven Beard, DAO.

1–2.2 Acronyms and Abbreviations

A&G	Acquisition and Guidance
CAD	Command Action Directive
CAR	Command Action Response
CC	Components Controller
CICS	Core Instrument Control System
DC	Detector Controller (software system)
DHS	Data Handling System
EPICS	Experimental Physics and Industrial Control System
FITS	Flexible Image Transport System
ICD	Interface Control Document

ICS	Instrument Control System
ID	Identifier
IOC	Input Output Controller
IR	Infrared
IS	Instrument Sequencer
ISS	Instrument Support Structure
LAN	Local Area Network
N/A	Not Applicable
OCS	Observatory Control System
OIWFS	On Instrument Wavefront Sensor
PDF	Parameter Description File
SAD	Status and Alarm Database
SDSU	San Diego State University
SIR	Status and Information Record
STP	Stop command to the SDSU controller
TBD	To Be Decided
TDL	Test data link command to the SDSU controller.
TCS	Telescope Control System
VSM	Virtual system mode
WCS	World Coordinate System
WFS	Wavefront Sensor

1–2.3 Definitions

Action. The process started as a result of a **Command**. For example, a command to select a new filter will start the filter wheel mechanism in motion. There can be a many-to-one correspondence between commands and actions. For example, several different filter commands can all result in the same filter wheel movement action. The status of an action is reported through a CAR record.

Attribute. An entity which describes some aspect of the configuration of a science instrument, such as the name of a filter or the tilt angle of a grating. Some attributes will be used by the Instrument Control System as command parameters. The OCS communicates with a science instrument by sending it sets of "**Attribute**" and "**Value**s".

Bulk data. Header and pixel data which is to be transferred to the DHS for display or storage. Bulk data is transmitted using the protocol of ICD/3, [15], rather than by EPICS channel access, [14]. Compare with **Status information**.

Combined readout. This refers to the data resulting from the combination (e.g. coadding) of several detector **Readout**s.

Command. An instruction commanding the Instrument Control System to start some action. The action may result in a mechanism moving or some internal parameters being set to particular values. A command may have command parameters (aka "command arguments") which contain the details of the instruction to be obeyed. Commands are activated by means of CAD records, and the OCS maps each command arguments onto an "**Attribute**".

Components Controller (CC). An instrument subsystem responsible for the various mechanisms (e.g. motors and heaters) contained in an instrument.

Control LAN. The Local Area Network in the Gemini system devoted to the transfer of commands, responses and status information.

Data label. A unique label for a **Data set** assigned by the DHS or OCS which is used to identify data being sent to or requested from the DHS. When an instrument obeys an OBSERVE command, the **Data label** for the **Data set** generated is provided by the OCS. The **Data label** for data generated spontaneously by a non-instrument data source, such as a wavefront sensor, is provided by the DHS.

Data LAN. The Local Area Network in the Gemini system devoted to the transfer of bulk data.

Data set. A self-contained collection of data generated as a result of an instrument obeying an OBSERVE command. Each OBSERVE command results in one and only one **Data set**. All the data relating to one **Data set** will be maintained by the DHS in a single container. A data set consists of some **Header data** describing the **Data set** plus one or more **Frame**s.

Datum. The reference point used to define the coordinate system of a mechanism which does not have absolute encoders. Also knows as "**Index**" and "**Home**".

Destructive read. A clocking out of the integrated signal recorded by a detector which results in that signal being discarded. A detector can only be read out once in such a mode.

Detector Controller (DC). An instrument subsystem responsible for controlling a detector array and reading data from it. Note that this term has been used in Gemini documentation to refer both to the detector control *electronics* and the detector control *software system*. In the context of this software document the term refers to the detector control *software system* unless otherwise stated.

Dynamic Header. That part of the **Header data** containing information about the **Data set** which needs to be collected at a very precise time (such as the time at which the data collection started and finished). This part of the **Header data** is typically provided by an instrument.

Encoder. A device used to sense the location of a mechanism. An absolute encoder gives a direct reading of the position of a mechanism. A relative encoder is used to count how far a mechanism has moved from its previous position.

Exposure. The array of data resulting from reading the detector during or after a single exposure of the detector array to light. An exposure is made by resetting the detector, exposing it to light, and reading it one or more times (e.g. once in a **Destructive read** mode or several times in a **Non-destructive read** mode).

Frame. An image or spectrum capable of being displayed or processed as a discrete entity (for example an image of all the coadded observations in one beam of an observation made in chop mode). A **Data set** can be made of one or more frame (for example a **Data set** in chop mode might consist of frames of coadded exposures in beams A and B). Each frame can consist of one or more **Exposure**s.

Hall-effect Sensor. An electronic component which is used to detect and to measure magnetic field strength.

Header data. A collection of attribute/value pairs which describe a **Data set** or a **Frame** within a **Data set**.

Home. See "**Datum**".

Index. See "**Datum**".

Instrument Sequencer (IS). That part of an Instrument Control System responsible for coordinating the actions of a Detector Controller and one or more Components Controllers. The A&G subsystem has a "Guidance and Beam Direction Sequencer" for coordinating its components.

Non-destructive read. A clocking out of the integrated signal recorded by a detector in a way which maintains that signal intact. The signal recorded by a detector can be sampled more than once in such a mode. This mode is often used to minimise the contribution from detector read noise.

Observation. An observation is a procedure, specified by the observer, designed to obtain scientific information from the light acquired from an object. To complete an observation, the OCS may need to issue several OBSERVE commands, which could result in several **Data set**s. The term **Observation** has also been used in the CICS documentation to refer to the act of accumulating light from a source on a detector.

Parameter Definition Format (PDF). A document describing the commands and parameters recognised by a principal system, and the status information made available by that system.

Pointing origin information. This is the information which the instrument supplies to the TCS describing where on the telescope focal plane the light from a particular source object should be directed. This information can be used to position an object at a certain place on a detector array or at a certain place on the instrument's slit, for example. If not specified, the default pointing origin will be at the centre of the Cassegrain rotator axis.

Preset. The act of defining and testing a set of attributes to make sure they are valid before executing the command(s) associated with them.

Principal Systems. The Gemini Control System is made up of the OCS, TCS, DHS and one ICS for each instrument. These systems constitute the principal systems of the Gemini Control System.

Read. When used in the context of a detector controller, this refers to the read of a single pixel on the detector array.

Readout. When used as a noun to describe instrument data, this refers to the array resulting from a **Read** of all the pixels on the detector inside a given region of interest (which may be the whole detector array). An **Exposure** can be made from one or more readouts or **Combined readout**s.

Region of interest. This is an area on the surface of a detector whose data are of interest. There may be one or more regions of interest on a detector array.

SDSU. San Diego

Shack-Hartmann. A type of wavefront sensor in which the field is imaged onto a detector through an array of small lenslets, causing a star to be imaged as an array of spots. The relative location of the centroids of these spots can be used to determine the shape of the incoming wavefront.

Static header. That part of the **Header data** containing information which changes little with time during an observation (such as the telescope target coordinates and name of the observer). This part of the **Header data** is typically provided by the OCS, but some wavefront sensors may need to provide the information themselves.

Status information. Small quantities of information describing the configuration or status of a system. This information is usually stored in an EPICS database and communicated by channel access, [14]. Compare with **Bulk data**.

Sequence Commands. The set of standard commands mandated by the OCS which all instruments must obey. These are described in reference [13].

Status/Alarm Database (SAD). This is an EPICS database containing the public status information for a Gemini principal system. For an Instrument Control System, the SAD would contain information about the configuration of the instrument's mechanisms, its current state and health, and information obtained from sensors.

Value. The value associated with an "**Attribute**".

VME. A real-time system obeying the ANSI/IEEE 1014-1987 Versatile Backplane Bus standard.

VxWorks. The Real Time Operating system from Wind River.

World Coordinate System (WCS) information. Information describing the transformation between pixel coordinates in the data array and (RA, Dec) coordinates on the sky.

1–2.4 Stylistic Conventions

References to documents are given like this [1].

Chapter 2 Details of the NIFS to OCS Interface

2–1.0 Introduction

2–2.0 Physical System Interfaces

2–2.1 Mechanical Interface

Not Applicable for a software ICD.

2–2.2 Optical Interface

Not Applicable for a software ICD.

2–2.3 Electronic Interface

The system hardware architecture for the NIFS control software is described in [2].

2–2.4 Mass/Balance

Not Applicable for a software ICD.

2–2.5 Thermal Interface

Not Applicable for a software ICD.

2–3.0 Software / Control Function Interface

2–3.1 Overview

2–3.1.1 Communications infrastructure

The communications infrastructure is the same as described in [4].

2–3.1.2 Software architecture

The software architecture is described in [2].

2–3.2 Behavior

The behavior of the NIFS/OCS interface is the same as described in [4].

2–3.3 Implementation

This section contains tables summarizing the EPICS records used for the interface. The next sections contain the details of what those records do.

It is assumed in all cases that the record names given in this document are prefixed by the string “nifs:”. Records in the SAD database are prefixed by “nifs:”.

2–3.3.1 Command (CAD/CAR) records

The columns of the command record tables are as follows:

Description. A brief description of the command.

Attribute. The name of the attribute which the Observatory Control System associates with a particular parameter of a particular command. Component position names are listed separately in Table 14.

CAD record / CAD record.FIELD. The name of the EPICS CAD record (minus the "nifs:" prefix) together with the field in that CAD record associated with each parameter of the command (Note that if no field is specified, then EPICS uses the VAL field.)

CAD ordering number. The recommended order in which this command should be executed. CAD records should be connected to their associated APPLY record in the order 1, 2, 3, 4, 5, etc. CAD records within the same ordering number set can be connected to the APPLY record in any order in that set.

CAR record. The CAR record associated with the command. Note that several CAD records may share the same CAR record.

2–3.3.1.1 Sequence command CAD/CAR records

The NIFS sequencer recognizes all the OCS sequence commands and uses the CAD/CAR records specified in ICD 1b [7]. See also ICD 1a [6], for a description of what these commands do.

TABLE 1. NIFS sequence command CAD/CAR records

Description	Attribute[a]	CAD record / CAD record.FIELD ("nifs:" +)	CAD ordering number	CAR record[b] ("nifs:" +)
Test	(none)	test	1	testC
Initialize	(none)	init	2	initC
Datum mechanisms.	(none)	datum	3	datumC
Park	(none)	park	4	parkC
Verify	(none)	verify	7	verifyC
End verify	(none)	endVerify	8	endVerifyC
Guide	(none)	guide	5	guideC
End guide	(none)	endGuide	6	endGuideC

TABLE 1. NIFS sequence command CAD/CAR records

Description	Attribute[a]	CAD record / CAD record.FIELD ("nifs:" +)	CAD ordering number	CAR record[b] ("nifs:" +)
Observe	Observation ID	observe.A	9	observeC
	Image type (IMAGE | DARK | FLAT | ARC | BIAS)	observe.B		
	Comment	observe.C		
Stop	(none)	stop	12	
Abort	(none)	abort	13	
Pause	(none)	pause	10	
Continue	(none)	continue	11	
End Observe	(none)	endObserve	14	endObserveC

a. "(none)" means that there are no arguments

b. Currently, it is required to have separate TestC, InitC, etc. CAR records. There is some disagreement over this requirement, and all of these CAR records may disappear, to be replaced by the global applyC.

2–3.3.1.2 General observing command CAD/CAR records

The commands in Table 2 are the only ones that are used during routine observation.

TABLE 2. NIFS general observing command CAD/CAR records

Description	Attribute[a]	CAD record / CAD record.FIELD ("nifs:" +)	CAD ordering number	CAR record ("nifs:" +)
Select a filter in the filter wheel.	filter name	cc:filtSel.A	27	cc:filtC
Park the filter wheel.	(none)	cc:filtPark	26	
Select a grating in the grating turret.	grating name	cc:gratSel.A	35	cc:gratC
Park the grating turret.	(none)	cc:gratPark	34	
Offset the grating so that it is centred on a new wavelength (in µm)	central wavelength	cc:gratMoveOff.A	38	
Select the flip mirror position	position name	cc:flipSel.A	51	cc:flipC
Park the flip mirror.	(none)	cc:flipPark	50	
Select the focal-plane mask.	position name	cc:foplSel.A	19	cc:foplC
Park the focal-plane mask wheel.	(none)	cc:foplPark	18	
Offset the focal plane mask as projected onto the detector. Offset is in units of displacement of arcseconds across the detector.	offset	cc:foplMoveOff.A	22	
Select the window-cover position.	position name	cc:covSel.A	43	cc:covC
Park the window cover.[b]	(none)	cc:covPark	42	

TABLE 2. NIFS general observing command CAD/CAR records

Description	Attribute[a]	CAD record / CAD record.FIELD ("nifs:" +)	CAD ordering number	CAR record ("nifs:" +)
Setup readout sequence parameters for VIEW mode. A separate set of parameters are maintained for each NIFS mode (view and obs)	Read method (DCS | FOWLER | LINEAR) Number of resets Reset delay Number of Fowler samples Period between sample sets Number of periods Number of co-adds Number of reference samples Number of pixel reads for averaging Perform cosmic ray rejection? Cosmic ray rejection threshold Simulation rate of cosmic rays	dc:seqView.A dc:seqView.B dc:seqView.C dc:seqView.D dc:seqView.E dc:seqView.F dc:seqView.G dc:seqView.H dc:seqView.I dc:seqView.J dc:seqView.K dc:seqView.L	15	dc:seqviewC
Setup readout sequence parameters for OBS mode. A separate set of parameters are maintained for each NIFS mode (view and obs)	Read method (DCS | FOWLER | LINEAR) Number of resets Reset delay Number of Fowler samples Period between sample sets Number of periods Number of co-adds Numer of reference samples Number of pixel reads for averaging Perform cosmic ray rejection? Cosmic ray rejection threshold Simulation rate of cosmic rays	dc:seqObs.A dc:seqObs.B dc:seqObs.C dc:seqObs.D dc:seqObs.E dc:seqObs.F dc:seqObs.G dc:seqObs.H dc:seqObs.I dc:seqObs.J dc:seqObs.K dc:seqObs.L	16	dc:seqObsC
Setup DHS parameters for VIEW mode. Like the readout parameters, a separate set is maintained for each operating mode.	Send data to the DHS? Subtract image from raw data? Subtract image name Simulation file name Simulation integration time Wavelength minimum Wavelength maximum	dc:dataView.A dc:dataView.B dc:dataView.C dc:dataView.D dc:dataView.E dc:dataView.F dc:dataView.G	17	dc:dataViewC

TABLE 2. NIFS general observing command CAD/CAR records

Description	Attribute[a]	CAD record / CAD record.FIELD ("nifs:" +)	CAD ordering number	CAR record ("nifs:" +)
Setup DHS parameters for OBS mode. Like the readout parameters, a separate set is maintained for each operating mode.	Send data to the DHS or FITS server?	dc:dataObs.A	18	dc:dataObsC
	Save to permanent storage?	dc:dataObs.B		
	Save each sample?[c]	dc:dataObs.C		
	Subtract image from raw data?	dc:dataObs.D		
	Subtract image name	dc:dataObs.E		
	Simulation input image name	dc:dataObs.F		
	Simulation image integration time	dc:dataObs.G		
	Save variance data?	dc:dataObs.H		
	Save quality data?	dc:dataObs.I		
	Bad pixel file name	dc:dataObs.J		
	Wavelength minimum	dc:dataObs.K		
	Wavelength maximum	dc:dataObs.L		
Set DHS quick look stream information for observe mode - this is a required Gemini CAD.	Obs mode, raw data quick look stream	dc:setDhsInfo.A	19	dc:setDhsInfoC
	Obs mode, compressed image quick look stream	dc:setDhsInfo.B		
	View mode, raw data quick look stream	dc:setDhsInfo.C		
	View mode, compressed image quick look stream	dc:setDhsInfo.D		
	DHS server name	dc:setDhsInfo.E		
	DHS server IP address	dc:setDhsInfo.F		

a. "(none)" means that there are no arguments

b. Equivalent to closing the window cover.

c. The detector is read out a number of times during the integration, this parameter allows each readout to be saved temporarily to the DHS or FITS server.

2–3.3.1.3 Engineering command CAD/CAR records—System Commands

The following commands are used for engineering purposes, and are not expected to be used during observing. These are normally activated by the engineering user interface.

These commands affect the overall behavior of NIFS and the NIFS OIWFS. Note, in particular, that it is not possible to reboot the NIFS IS, CC and OIWFS separately.

TABLE 3. NIFS system engineering command CAD/CAR records

Description	Attribute[a]	CAD record / CAD record.FIELD ("nifs:" +)	CAD ordering number	CAR record
Reboot.	(none)	reboot	16	N/A
Select debug mode.	Debug mode (NOLOG | NONE | MIN | FULL)	debug.A	15	immediate completions

a. "(none)" means that there are no arguments.

2–3.3.1.4 CC Sequence command CAD/CAR records

The NIFS components controller control software recognizes all the OCS sequence commands and uses the CAD/CAR records specified in ICD 1b, [7]. See also ICD 1a, [6], for a description of what these commands do.

TABLE 4. NIFS CC sequence command CAD/CAR records

Description	Attribute[a]	CAD record / CAD record.FIELD ("nifs:" +)	CAD ordering number	CAR record ("nifs:" +)
Test.	(none)	cc:test	1	cc:testC
Initialize.	(none)	cc:init	2	cc:initC
Datum mechanisms.	(none)	cc:datum	3	cc:datumC
Verify	(none)	cc:verify	7	cc:verifyC
End verify (no action)	(none)	cc:endVerify	8	cc:endVerifyC
Guide	(none)	cc:guide	5	cc:guideC
End guide (no effect)	(none)	cc:endGuide	6	cc:endGuideC
Park	(none)	cc:park	4	cc:parkC
Reboot	(none)	cc:reboot	10	N/A
Set debug mode	debug mode (NOLOG | NONE | MIN | FULL)	cc:debug	9	Immediate completion

a. "(none)" means that there are no arguments.

2–3.3.1.5 Engineering command NIFS CC CAD/CAR records

The following commands are used for engineering purposes, and are not expected to be used during normal observing. Note that, although these commands are connected to the APPLY record, they are normally activated directly by the engineering user interface.

TABLE 5. NIFS CC engineering command CAD/CAR records

Description	Attribute[a]	CAD record / CAD record.FIELD ("nifs:" +)	CAD ordering number	CAR record ("nifs:" +)
Datum filter wheel.	(none)	cc:filtDatm	23	cc:filtC
Set the filter-wheel position using position numbers[b].	position	cc:filtMove.A	29	
Set the filter wheel position in engineering units[b].	motor position	cc:filtEngMove.A	28	
Redatum - Confirm that the filter wheel has not lost its datum position.	(none)	cc:filtRdtm	24	
Confirm that the filter wheel and its Hall-effect sensors are operational.	(none)	cc:filtDiag	25	

TABLE 5. NIFS CC engineering command CAD/CAR records

Description	Attribute[a]	CAD record / CAD record.FIELD ("nifs:" +)	CAD ordering number	CAR record ("nifs:" +)
Datum grating turret.	(none)	cc:gratDatm	31	cc:gratC
Set the grating turret position using position number[b].	position	cc:gratMove.A	37	
Set the grating turret position in engineering units[b].	motor position	cc:gratEngMove.A	36	
Redatum - Confirm that the grating turret has not lost its datum position.	(none)	cc:gratRdtm	32	
Confirm that the grating turret and its Hall-effect sensors are operational	(none)	cc:gratDiag	33	
Datum the focal-plane mask wheel.	(none)	cc:foplDatm	15	cc:foplC
Set the focal-plane mask wheel position using position number[b].	position	cc:foplMove.A	21	
Set the focal-plane mask wheel position in engineering units[b].	motor position	cc:foplEngMove.A	20	
Redatum - Confirm that the focal-plane mask wheel has not lost its datum position.	(none)	cc:foplRdtm	16	
Confirm that the focal-plane mask wheel and its Hall-effect sensors are operational	(none)	cc:foplDiag	17	
Datum the flip mirror	(none)	cc:flipDatm	47	cc:flipC
Set the flip mirror position[c].	position	cc:flipMove.A	53	
Set the flip mirror position in engineering units[c].	motor position	cc:flipEngMove.A	52	
Redatum - Confirm that the flip mirror has not lost its datum position	(none)	cc:flipRdtm	48	
Confirm that the flip mirror and its Hall-effect sensors are operational	(none)	cc:flipDiag	49	
Datum the window cover.	(none)	cc:covDatm	39	cc:covC
Set the window-cover position.	position	cc:covMove.A	45	
Set the window cover position in engineering units.	motor position	cc:covEngMove.A	44	
Redatum - Confirm that the window cover has not lost its datum position.	(none)	cc:covRdtm	40	
Confirm that the window cover and its Hall-effect sensors are operational	(none)	cc:covDiag	41	

a. "(none)" means that a command accepts no arguments

b. Only the standard positions (excluding datum and park) are repeatable.

c. *This is strongly discouraged*. Only the standard positions (excluding datum and park) are repeatable. The predefined locations are only stable when approached in the correct fashion.

2–3.3.1.6 DC Sequence Command CAD/CAR Records

The NIFS detector controller control software recognizes all the OCS sequence commands and uses the CAD/CAR records specified in ICD 1b, [7]. See also ICD 1a, [6], for a descrip-

tion of what these commands do. Some of these sequences are not used for NIFS and are

TABLE 6. NIFS DC sequence command CAD/CAR records

Description[a]	Attribute[b]	CAD record / CAD record.FIELD ("nifs" +)	CAD ordering number	CAR record ("nifs:" +)
Reboot.	(none)	dc:reboot	1	N/A
Initialize.	Simulation mode (NONE | VSM | FAST | FULL)	dc:init.A	2	dc:initC
Test. For ENGINEERING test mode, this sequence runs the SDSU TDL commands to test the communication links between the VME interface card and the controller electronics.	Test mode (FULL | ENGINEERING | SCIENCE)	dc:test.A	3	dc:testC
Park	(none)	dc:park	4	dc:parkC
Set debug mode	Debug mode (NOLOG | NONE | MIN | FULL)	dc:debug.A	5	Immediate completion
Observe.	Observation ID	dc:observe.A	20	dc:observeC
	Image type (IMAGE | DARK | FLAT | ARC | BIAS)	dc:observe.B		
	Comment	dc:observe.C		
Abort.	(none)	dc:abort	21	
Stop.	(none)	dc:stop	22	
Verify (no operation).	(none)	dc:verify	23	dc:verifyC
End verify (no operation).	(none)	dc:endVerify	24	dc:endVerifyC
Guide (no operation).	(none)	dc:guide	25	dc:guideC
End guide (no operation).	(none)	dc:endGuide	26	dc:endGuideC
End observe (no operation).	(none)	dc:endObserve	27	dc:endObserveC
Datum (no operation).	(none)	dc:datum	28	dc:datumC
Pause (no operation).	(none)	dc:pause	29	dc:pauseC
Continue (no operation).	(none)	dc:continue	30	dc:continueC

a. "(no operation)" means that this command is accepted but no action is performed,

b. "(none)" means that there are no arguments.

handled by just cycling the corresponding CAR record from BUSY to IDLE without taking any further action. These are indicated by the "no-operation" label in Table 6.

2–3.3.1.7 Engineering command NIFS DC CAD/CAR records

The following commands are used for engineering purposes, and are not expected to be used during normal observing. Note that, although these commands are connected to the APPLY

record, they are normally activated directly by the engineering user interface.

TABLE 7. NIFS DC engineering command CAD/CAR records

Description	Attribute	CAD record / CAD record.FIELD ("nifs:" +)	CAD ordering number	CAR record ("nifs:" +)
Sets up the bias voltages for the SDSU detector controller. These parameters will only be applied when the initSDSU CAD is marked and applied.	VDD - Digital Power VDDA - Analog high power PLOAD - Pullup voltage of detector mux bus DRAIN - Output amplifier drain voltage SWPWR - Video switch power BIASGATE - Gate voltage of bias P-FET BIASPWR - Source voltage of bias P-FET VRESET - Control signal for resetting all the pixels VINOFFSET0 - Video input 0 offset voltage VINOFFSET1 - Video input ‘ offset voltage VINOFFSET2 - Video input 2 offset voltage VINOFFSET3 - Video input 3 offset voltage	dc:SDSUBias.A dc:SDSUBias.B dc:SDSUBias.C dc:SDSUBias.D dc:SDSUBias.E dc:SDSUBias.F dc:SDSUBias.G dc:SDSUBias.H dc:SDSUBias.I dc:SDSUBias.J dc:SDSUBias.K dc:SDSUBias.L	6	dc:setupSDSUC
Sets up the clock voltages for the SDSU detector controller. These parameters will only be applied when the initSDSU CAD is marked and applied.	CLK1 - Horizontal register pixel clock 1 CLK2 - Horizontal regsiter pixel clock 2 CLKB1 - Horizontal register pixel clock 1B CLKB2 - Horizontal register pixel clock 2B LSYNC - External line sync FSYNC - External frame sync VCLK - Master clock for vertical register RESET - Control signal for resetting all the pixels READ - Vertical register bus enable signal RESETEN - Reset the column bus to CELLDRAIN while no readout SWITCHCNTRL - Controls switch of video input between signal and reference REFOFFSET - Reference and signal video offset voltage FLAGPULSE - Clock signal used for monitoring SPARE 1 - Spare clock 1	dc:SDSUClk.A dc:SDSUClk.B dc:SDSUClk.C dc:SDSUClk.D dc:SDSUClk.E dc:SDSUClk.F dc:SDSUClk.G dc:SDSUClk.H dc:SDSUClk.I dc:SDSUClk.J dc:SDSUClk.K dc:SDSUClk.L dc:SDSUClk.M dc:SDSUClk.N	7	dc:setupSDSUC

TABLE 7. NIFS DC engineering command CAD/CAR records

Description	Attribute	CAD record / CAD record.FIELD ("nifs:" +)	CAD ordering number	CAR record ("nifs:" +)
Load DSP Code	Timing board DSP codefile name VME board DSP code file name	dc:dspCode.A dc:dspCode.B	8	dc:setupSDSUC
Initialize SDSU controller		dc:initSDSU	9	dc:setupSDSUC
Reset SDSU Controller		dc:resetSDSU	10	dc:setupSDSUC
VME Board DSP Command	Command (RDM | WRM | TDL) Space (X | Y | PROGRAM) Address Data	dc:SDSU-VMEDSP.A dc:SDSU-VMEDSP.B dc:SDSU-VMEDSP.C dc:SDSU-VMEDSP.D	11	dc:SDSU-VMEC
Timing Board DSP Command	Command (RDM | WRM | TDL | SBV | CLR | SBN | SMX) Space (X | Y | PROGRAM) Address Data	dc:SDSU-TimingDSP.A dc:SDSU-TimingDSP.B dc:SDSU-TimingDSP.C dc:SDSU-TimingDSP.D	12	dc:SDSUTim-ingC
Coadder Board DSP Command	Command (RDM | WRM |TDL) Space (X | Y | PROGRAM) Address Data	dc:SDSUCoad-derDSP.A dc:SDSUCoad-derDSP.B dc:SDSUCoad-derDSP.C dc:SDSUCoad-derDSP.D	13	dc:SDSUCoad-derC
Calibrate Frame Read Time		dc:calibFRT	14	dc:CRTC

2–3.3.2 Status Information Records

The following set of tables show the status information provided by NIFS, together with the subset of that information which is written to the FITS header. The tables distinguish status information provided by the Instrument Sequencer, Components Controller and, Detector Controller, but all the information shown is available over the OCS-to-NIFS interface. The tables have the following columns:

SIR record. The part of the name of the EPICS SIR record which follows the "nifs:" prefix..

FITS Keyword. The FITS keyword that would be used if the item were included in a FITS header.

FITS Included. Indicates how the item is normally included in the FITS header. Items labelled "start" are sampled at the start of a data set observation; those labelled "end" are sampled at the end of a data set observation, and those labelled "never" are never written to the FITS header.

Type. The data type

Units / Values. The units in which the quantity is stored and / or the range of values that are taken.

- Ustep refers to motor microsteps.
- "User units" or "real-world" units refer to the units that are stored in the Units SIR variable.

Comments. A description of the item. The first paragraph of this will go into the SIR record description and also the comment field in the FITS header.

Note that only the type, units and comments are actually contained in the SIR records. The FITS keyword is provided by the DHS.

2–3.3.2.1 Compulsory Instrument Sequencer Status Information

Table 8 contains status information for all of NIFS, particularly, the instrument sequencer.

TABLE 8. Compulsory Instrument Sequencer (IS) Status Information

SIR record ("nifs:")	FITS Keyword	FITS Included	Type	Units/Values	Comments
dcAbort		never	long	0/1	Shows that an abort is in progress
debugMode		never	string		Debugging mode [NOLOG | NONE | MIN | FULL]
health		never	string		Instrument health [GOOD | WARNING | BAD]
heartBeat		never	long	count	Heartbeat: Shows that IS is still alive by increasing at a steady rate
historyLog		never	array of char		History-log record[a]
issPort	INPORT	start	long	number	ISS port on which instrument is installed
label		never	string		The FDSC field describes the Instrument
name		never	string		Instrument Name
simMode		never	string		Instrument simulation mode [NONE | FULL | FAST | VSM]
state		never	string		Instrument state [BOOTING | INITIALIZING | RUNNING | CONFIGURING]
wfsBeam		never	long		Is the WFS detector unobstructed [0=YES | 1=NO]

a. This record is not particularly useful, because of various EPICS limitations.

2–3.3.2.2 Compulsory Components Controller Status Information

Table 9 contains the compulsory Components Controller SIRs.

TABLE 9. Compulsory Components Controller (CC) Status Information

SIR record ("nifs:" +)	FITS Keyword	FITS Included	Type	Units	Comments
cc:sad:debugMode		never	string		Debugging mode [NOLOG | NONE | MIN | FULL]
cc:sad:health		never	string		CC Health [GOOD | WARNING | BAD]
cc:sad:heartBeat		never	long	count	Heart beat record: Shows that CC is still alive by increasing at a steady rate.
cc:sad:historyLog		never	array of char		History log record[a]
cc:sad:issPort		never	long	number	ISS port on which instrument is installed
cc:sad:label		never	string		The FDSC field describes the Components Controller
cc:sad:name		never	string		Components Controller Name
cc:sad:simMode		never	string		Simulation mode [NONE | FULL | FAST | VSM]
cc:sad:state		never	string		Instrument state [BOOTING | INITIALIZING | RUNNING | CONFIGURING]
cc:sad:wfsBeam		never	long	0/1	Is the WFS detector unobstructed? [YES=0 | NO=1][b]

a. This record is not useful, because of various EPICS limitations.

b. The cc:sad:wfsBeam record only indicates whether any components controller mechanisms are obstructing the wavefront sensor. For most purposes, wfsBeam (which combines cc:sad:wfsBeam and wfs:wfsBeam) should be used.

2–3.3.2.3 The Components Controller Component Status Information

The following table summarizes the information for the various components.

TABLE 10. Components Controller (CC) Component Status Information

SIR record ("nifs:"+)	FITS Keyword	FITS Included	Type	Units	Comments
cc:sad:covDatumed		never	long	0/1	Is the window cover datumed? [YES=0 | NO=1]
cc:sad:covEngCyclic		never	long	0/1	Ignore limits for the window cover [YES=0 | NO=1]
cc:sad:covEngMax		never	long	motor microsteps	The maximum position of the window cover in engineering units
cc:sad:covEngMin		never	long	motor microsteps	The minimum position of the window cover in engineering units

TABLE 10. Components Controller (CC) Component Status Information

SIR record ("nifs:"+)	FITS Keyword	FITS Included	Type	Units	Comments
cc:sad:covEng-Name		never	string		Engineering name of the window cover position
cc:sad:covEngPos		never	long	motor microsteps	The position of the window cover in engineering units
cc:sad:covLabel		never	string		The FDSC field describes the window cover
cc:sad:covMax		never	double	position number	The maximum position of the window cover in real-world units (position number).
cc:sad:covMin		never	double	position number	The minimum position of the window cover in real-world units (position number).
cc:sad:covName		never	string		User name of the window cover position
cc:sad:covParked		never	long	0/1	Is the window cover parked? [YES=0 | NO=1]
cc:sad:covPos		never	double	position number	The window cover position in real-world units (position number).
cc:sad:covRdtm-Val		never	long	motor microsteps	Returned value from the window cover redatum command
cc:sad:covReject		never	long	0/-1	Combined window cover CAR state [GOOD=0 | REJECT=-1]
cc:sad:covState		never	string		the window cover SNL state
cc:sad:covUnits		never	string		Definition of real-world units for the window cover ("position number").
cc:sad:filtDatumed		never	long	0/1	Is the filter wheel datumed? [YES=0 | NO=1]
cc:sad:filtEngCy-clic		never	long	0/1	Ignore limits for filter wheel? [YES=0 | NO=1]
cc:sad:filtEngMax		never	long	motor microsteps	The maximum position of the filter wheel in engineering units
cc:sad:filtEngMin		never	long	motor microsteps	The minimum position of the filter wheel in engineering units
cc:sad:filtEng-Name		never	string		Engineering name of the filter wheel position
cc:sad:filtEngPos		never	long	motor microsteps	The position of the filter wheel in engineering units
cc:sad:filtLabel		never	string		The FDSC field describes the filter wheel
cc:sad:filtMax		never	double	position number	The maximum position of the filter wheel in real-world units (position number).
cc:sad:filtMin		never	double	position number	The minimum position of the filter wheel in real-world units (position number).
cc:sad:filtName	FILTER	start	string		User name of the filter wheel position
cc:sad:filtParked		never	long	0/1	Is the filter wheel parked? [YES=0 | NO=1]

TABLE 10. Components Controller (CC) Component Status Information

SIR record ("nifs:"+)	FITS Keyword	FITS Included	Type	Units	Comments
cc:sad:filtPos	FILTPOS	start	double	position number	The position of the filter wheel in real-world units (position number).
cc:sad:filtRdtmVal		never	long	motor microsteps	Returned value from the filter wheel redatum command
cc:sad:filtReject	FILTRJCT	start	long	0/-1	Combined filter wheel CAR state [GOOD=0 | REJECT=-1]
cc:sad:filtState		never	string		Filter wheel SNL state
cc:sad:filtUnits		never	string		Definition of real-world units for the filter wheel("pos num").
cc:sad:gratDatumed		never	long	0/1	Is the grating turret datumed? [YES=0 | NO=1]
cc:sad:gratEngCyclic		never	long	0/1	Ignore limits for the grating turret? [YES=0 | NO=1]
cc:sad:gratEngMax		never	long	motor microsteps	The maximum position of the grating turret in engineering units
cc:sad:gratEngMin		never	long	motor microsteps	The minimum position of the grating turret in engineering units
cc:sad:gratEngName		never	string		The engineering name of the grating turret position
cc:sad:gratEngPos		never	long	motor microsteps	The position of the grating turret in engineering units
cc:sad:gratLabel		never	string		The FDSC field describes the grating turret
cc:sad:gratMax		never	double	position number	The maximum position of the grating turret in real-world units (position number).
cc:sad:gratMin		never	double	position number	The minimum position of the grating turret in real-world units (position number)
cc:sad:gratName	GRATING	start	string		User name of the grating turret position
cc:sad:gratParked		never	long	0/1	Is the grating turret parked? [YES=0 | NO=1]
cc:sad:gratPos	GRATPOS	start	double	position number	The grating turret position in real-world units (position number)
cc:sad:gratRdtmVal		never	long	motor microsteps	Returned value from the grating turret redatum command
cc:sad:gratCurOffset	GRATCW	start	double	υm	Central wavelength of grating
cc:sad:gratOffsetUnits		never	string		Units used for grating offset
cc:sad:gratOffsetUnits.DESC		never	string		Describes the grating offset
cc:sad:gratReject	GRATRJCT	start	long	0/-1	Combined grating turret CAR state [GOOD=0 | REJECT=-1]
cc:sad:gratState		never	string		The grating turret SNL state
cc:sad:gratUnits		never	string		Definition of real-world units for the grating turret ("pos num").

TABLE 10. Components Controller (CC) Component Status Information

SIR record ("nifs:"+)	FITS Keyword	FITS Included	Type	Units	Comments
cc:sad:foplDatumed		never	long	0/1	Is the focal-plane mask wheel datumed? [YES=0 | NO=1]
cc:sad:foplEngCyclic		never	long	0/1	Ignore limits for the focal-plane mask wheel? [YES=0 | NO=1]
cc:sad:foplEngMax		never	long	motor microsteps	The maximum position of the focal-plane mask wheel in engineering units
cc:sad:foplEngMin		never	long	motor microsteps	The minimum position of the focal-plane mask wheel in engineering units
cc:sad:foplEngName		never	string		The engineering name of the focal-plane mask wheel position
cc:sad:foplEngPos		never	long	motor microsteps	The position of the focal-plane mask wheel in engineering units
cc:sad:foplLabel		never	string		The FDSC field describes the focal-plane mask wheel
cc:sad:foplMax		never	double	position number	The maximum position of the focal-plane mask wheel in real-world units (position number).
cc:sad:foplMin		never	double	position number	The minimum position of the focal-plane mask wheel in real-world units (position number).
cc:sad:foplName	APERTURE	start	string		User name of the focal-plane mask wheel position
cc:sad:foplParked		never	long	0/1	Is the focal-plane mask wheel parked? [YES=0 | NO=1]
cc:sad:foplPos	APPOS	start	double	position number	The focal-plane mask wheel position in real-world units (position number).
cc:sad:foplRdtmVal		never	long	motor microsteps	Returned value from the focal-plane mask wheel redatum command
cc:sad:foplCurOffset	APOFFST	start	double	arcseconds	Offset of mask from nominal position as projected onto the detector
cc:sad:foplOffsetUnits		never	string		Units used by the offset
cc:sad:foplOffsetUnits.DESC		never	string		Describes the focal plane mask offset.
cc:sad:foplReject	APRJCT	start	long	0/-1	Combined the focal-plane mask wheel CAR state [GOOD=0 | REJECT=-1]
cc:sad:foplState		never	string		the focal-plane mask wheel SNL state
cc:sad:foplUnits		never	string		Definition of real-world units for the focal-plane mask wheel ("pos num").
cc:sad:flipDatumed		never	long	0/1	Is the flip mirror datumed? [YES=0 | NO=1]
cc:sad:flipEngCyclic		never	long	0/1	Ignore limits for the flip mirror? [YES=0 | NO=1]

TABLE 10. Components Controller (CC) Component Status Information

SIR record ("nifs:"+)	FITS Keyword	FITS Included	Type	Units	Comments
cc:sad:flipEngMax		never	long	motor microsteps	The maximum position of the flip mirror in engineering units
cc:sad:flipEngMin		never	long	motor microsteps	The minimum position of the flip mirror in engineering units
cc:sad:flipEng-Name		never	string		The engineering name of the flip mirror position
cc:sad:flipEngPos		never	long	motor microsteps	The position of the flip mirror in engineering units
cc:sad:flipLabel		never	string		The FDSC field describes the flip mirror
cc:sad:flipMax		never	double	position number	The maximum position of the flip mirror in real-world units (position number).
cc:sad:flipMin		never	double	position number	The minimum position of the flip mirror in real-world units (position number).
cc:sad:flipName	FLIP	start	string		User name of the flip mirror position
cc:sad:flipParked		never	long	0/1	Is the flip mirror parked? [YES=0 | NO=1]
cc:sad:flipPos	FLIPPOS	start	double	position number	The flip mirror position in real-world units (position number).
cc:sad:flipRdtm-Val		never	long	motor microsteps	Returned value from the flip mirror redatum command
cc:sad:flipReject	FLIPRJCT	start	long	0/-1	Combined flip mirror CAR state [GOOD=0 | REJECT=-1]
cc:sad:flipState		never	string		The flip mirror SNL state
cc:sad:flipUnits		never	string		Definition of real-world units for the flip mirror ("pos num").

2–3.3.2.4 Temperature Control and Monitoring Subsystem, Status Information

The following table summarizes the provided information for the temperature subsystem.

TABLE 11. Components Controller (CC) Temperature Control and Monitoring Subsystem, Status Information

SIR record ("nifs:" +)	FITS Keyword	FITS Included	Type	Units	Comments
cc:sad:tmpC1Setp		never	double	K	OIWFS Set-point temperature
cc:sad:tmpC1Tmp		never	double	K	OIWFS temperature
cc:sad:tmpC2Setp		never	double	K	Cold work surface set-point temperature
cc:sad:tmpC2Tmp	TCWS	start	double	K	Cold work surface temperature
cc:sad:tmpC3Setp		never	double	K	Detector set-point temperature

TABLE 11. Components Controller (CC) Temperature Control and Monitoring Subsystem, Status Information

SIR record ("nifs:" +)	FITS Keyword	FITS Included	Type	Units	Comments
cc:sad:tmpC3Tmp	TDET	start	double	K	Detector temperature
cc:sad:tmpC4Setp		never	double	K	Detector-housing set-point temperature
cc:sad:tmpC4Tmp	TDETHOUS	start	double	K	Detector-housing temperature
cc:sad:tmpCool-Busy		never	string		Cooling motor activity
cc:sad:tmpCoolRate1		never	double	motor-microsteps / s	Cooling motor 1 rate
cc:sad:tmpCoolRate2		never	double	motor-microsteps / s	Cooling motor 2 rate
cc:sad:tmpLabel		never	string		The FDSC field describes the temperature Subsystem
cc:sad:tmpS1Tmp1		never	double	K	The temperature on the first stage of the cryocooler, cooling the science detector
cc:sad:tmpS1Tmp2		never	double	K	The temperature on the attachment of the coldstrap surface from the science detector cryocooler to the cold work surface
cc:sad:tmpS1Tmp3		never	double	K	The temperature on the getter assembly which is connected to the second stage of the cryocooler not cooling the science detector.
cc:sad:tmpS1Tmp4		never	double	K	The temperature at the edge of the cold work surface near the entrance window
cc:sad:tmpS1Tmp5		never	double	K	An unused temperature-sensor channel (5)
cc:sad:tmpS1Tmp6		never	double	K	An unused temperature-sensor channel (6)
cc:sad:tmpS1Tmp7		never	double	K	An unused temperature-sensor channel (7)
cc:sad:tmpS1Tmp8		never	double	K	An unused temperature-sensor channel (8)

2–3.3.2.5 Component Health Information

The following table summarizes the health information records. All records return one of the strings: “GOOD”, “WARNING”, or “BAD”. Each record describes one aspect of the health of a component.

TABLE 12. Components Controller (CC) Component Health Information

SIR record (“nifs:” +)	FITS Keyword	FITS Included	Type	Units	Comments
cc:sad:covDatum-Health		never	string		The health of the window cover datum state
cc:sad:covHallHealth		never	string		The health of the window cover Hall-effect sensors
cc:sad:covHealth		never	string		The overall health of Window Cover
cc:sad:covModule-Health		never	string		The health of the window-cover steppermotor driver module
cc:sad:covPosEr-rHealth		never	string		The health of the window cover backlash correction
cc:sad:covSnlHealth		never	string		The health of the window cover State code
cc:sad:filtDatum-Health		never	string		The health of the filter wheel datum state
cc:sad:filtHallHealth		never	string		The health of the filter wheel Hall-effect sensors
cc:sad:filtHealth		never	string		The overall health of filter wheel
cc:sad:filtModule-Health		never	string		The health of filter wheel driver module
cc:sad:filtPosEr-rHealth		never	string		The health of the filter wheel backlash correction
cc:sad:filtSnlHealth		never	string		The health of the filter wheel state code
cc:sad:gratDatum-Health		never	string		The health of the grating turret datum state
cc:sad:gratHallHealth		never	string		The health of the grating turret Hall-effect sensors
cc:sad:gratHealth		never	string		The overall health of the grating turret
cc:sad:gratModule-Health		never	string		The health of the grating turret driver module
cc:sad:gratPosEr-rHealth		never	string		The health of the grating turret backlash correction
cc:sad:gratSnlHealth		never	string		The health of the grating turret state code
cc:sad:foplDatum-Health		never	string		The health of the focal-plane mask wheel datum state
cc:sad:foplHallHealth		never	string		The health of the focal-plane mask wheel Hall-effect sensors
cc:sad:foplHealth		never	string		The overall health of the focal-plane mask wheel
cc:sad:foplModule-Health		never	string		The health of the focal-plane mask wheel driver module
cc:sad:foplPosEr-rHealth		never	string		The health of the focal-plane mask wheel backlash correction
cc:sad:foplSnlHealth		never	string		The health of the focal-plane mask wheel state code

TABLE 12. Components Controller (CC) Component Health Information

SIR record ("nifs:" +)	FITS Keyword	FITS Included	Type	Units	Comments
cc:sad:flipDatum-Health		never	string		The health of the flip mirror datum state
cc:sad:flipHallHealth		never	string		The health of the flip mirror Hall-effect sensors
cc:sad:flipHealth		never	string		The overall health of the flip mirror
cc:sad:flipModule-Health		never	string		The health of the flip mirror driver module
cc:sad:flipPosEr-rHealth		never	string		The health of the flip mirror backlash correction
cc:sad:flipSnlHealth		never	string		The health of the flip mirror state code

2–3.3.2.6 The Temperature Control and Monitoring Subsystem Health Information

Table 13 summarizes the heath messages involving the temperature monitoring and control subsystem. All records return one of the strings: "GOOD", "WARNING", or "BAD".

TABLE 13. Components Controller (CC) Temperature Subsystem Health Information

SIR record ("nifs:" +)	FITS Keyword	FITS Included	Type	Units	Comments
cc:sad:tmpC1Health		never	string		The health of temperature controller 1, controlling the On-Instrument Wavefront Sensor.
cc:sad:tmpC2Health		never	string		The health of temperature controller 2, controlling the imager buffer mass.
cc:sad:tmpC3Health		never	string		The health of temperature controller 3, controlling the detector temperature.
cc:sad:tmpC4Health		never	string		The health of temperature controller 4, controlling the detector housing.
cc:sad:tmpCoolMode-Health		never	string		The health of cooling motor on/off state
cc:sad:tmpHealth		never	string		The overall health of the temperature subsystem
cc:sad:tmpModeHealth		never	string		The health of Heater / motor mode
cc:sad:tmpS1Health		never	string		The health of the temperature-sensor
cc:sad:tmpTmpCheck-Health		never	string		The health of the temperature-in-range indicator

2–3.3.3 Position names

Table 14 contains a list of valid position names. Note that these names are case sensitive and must be entered exactly as presented here, including underscores. In addition to the listed

positions, all mechanisms respond to the special names “datum” and “park” which may or may not be distinct from the listed positions.

TABLE 14. Position Names (observing commands)

Component	Position Names	Engineering Position[a]	Comments
Window Cover	Open	(tbd)	
	Closed	(tbd)	
Filter Wheel	*Z*	(tbd)	*Z* grating band pass filter
	J	(tbd)	*J* grating band pass filter
	H	(tbd)	*H* grating band pass filter
	K	(tbd)	*K* grating band pass filter
	Grid	(tbd)	*K* grating band pass filter and wire grid analyser
	pos05	(tbd)	Blocked
	pos06	(tbd)	Blocked
	Blocked	(tbd)	Blocked
Grating Turret	*Z*	(tbd)	*Z* grating band pass filter
	J	(tbd)	*J* grating band pass filter
	H	(tbd)	*H* grating band pass filter
	K	(tbd)	*K* grating band pass filter (2.00 - 2.42 μm)
	Ks	(tbd)	*K* grating band pass filter (1.90 - 2.32 μm)
	Kl	(tbd)	*K* grating band pass filter (2.10 - 2.52 μm)
	Blank	(tbd)	Blank
	Mirror	(tbd)	Mirror
Focal Plane Mask Wheel	Clear	(tbd)	Clear
	0.1"	(tbd)	0.1" occulting disk
	0.2"	(tbd)	0.2" occulting disk
	0.5"	(tbd)	0.5" occulting disk
	ND	(tbd)	Neutral density filter
	Mask	(tbd)	Calibration slit mask
	Hole	(tbd)	0.1" diameter pinhole
	Slit	(tbd)	0.1" wide slit
	Blocked	(tbd)	Blocked
	pos09	(tbd)	Blocked
	pos10	(tbd)	Blocked
	pos11	(tbd)	Blocked
Flip Mirror	in	(tbd)	
	out	(tbd)	

a. “(tbd)” means that the mapping from user positions to engineering positions has yet to be determined.

2–3.3.3.1 Compulsory Detector Controller Status Information

Table 15 contains the same information as Table 8, but for the Detector Controller.

TABLE 15. Compulsory Detector Controller (DC) Status Information

SIR record (instrument prefix +)	FITS keyword	FITS included?	Type	Units	Comments
dc:sad:name	DCNAME	start	string		Detector Controller name
dc:sad:state	DCSTATE		string		Detector Controller state [BOOTING | INITIALISING | RUNNING | CONFIGURING]
dc:sad:health	DCHEALTH	start	string		Detector Controller health [GOOD | WARNING | BAD]
dc:sad:historyLog		never	string		Detector Controller log message.
dc:sad:heartBeat		never	integer		Continuously changing variable used to detect whether the system is still alive.
dc:sad:prep		never	boolean		Flag to indicate that the Detector Controller is preparing to make an observation (e.g. the detector is preflashing, or it is waiting for the chopper to reach the right phase). When this flag is TRUE the instrument beam and the detector array are both “busy”.
dc:sad:acq		never	boolean		Flag to indicate that the Detector Controller is doing whatever is necessary to make an observation (e.g. the detector is integrating upon the sky or is going through a sequence of short exposures). The instrument mechanisms should not be reconfigured during this period. When this flag is TRUE the instrument light path is “busy” and cannot be changed.
dc:sad:rdout		never	boolean		Flag to indicate that the Detector Controller is reading out its data. The instrument may reconfigure its mechanisms if *acq* is FALSE. The detector cannot observe again until this flag goes false. When this flag is TRUE the detector array is “busy” and cannot start a new observation.

SIR record (instrument prefix +)	FITS keyword	FITS included?	Type	Units	Comments
dc:sad:debugMode		never	string		Debugging mode [NOLOG | NONE | MIN | FULL]
dc:sad:simMode	DCSMODE	start	string		Simulation mode [NONE | FULL | FAST | VSM]

2–3.3.3.2 The Detector Controller Status Information

Table 16 contains the remaining status information for the Detector Controller.

TABLE 16. Detector Controller (DC) Status Information

SIR record (instrument prefix +)	FITS keyword	FITS included?	Type	Units	Comments
dc:sad:sdsuHealth		never	string		Health of sdsu controller
dc:sad:initSDSUDone		never	boolean		Has the SDSU controller been initialized?
dc:sad:detType	DETTYPE	start	string		Description of detector array type
dc:sad:detID	DETID	start	string		Detector array chip identifier.
dc:sad:timingDSP	TIMDSP	start	string		Name of DSP code for SDSU timing board
dc:sad:timingDSPVersion	TIMDSPV	start	string		Version of DSP code for SDSU timing board
dc:sad:VMEDSP	VMEDSP	start	string		Name of DSP code for SDSU VME board
dc:sad:VMEDSPVersion	VMEDSPV	start	string		Version of DSP code for SDSU VME board
dc:sad:vInOffset0	VINOFFS0	start	float	volts	Video input 1 offset voltage
dc:sad:vInOffset1	VINOFFS1	start	float	volts	Video input 2 offset voltage
dc:sad:vInOffset2	VINOFFS2	start	float	volts	Video input 3offset voltage
dc:sad:vInOffset3	VINOFFS3	start	float	volts	Video input 4offset voltage
dc:sad:biasGate	BIASGATE	start	float	volts	Gate voltage of bias P-FET
dc:sad:vReset	VRESET	start	float	volts	Control signal for resetting all pixels
dc:sad:biasPwr	BIASPWR	start	float	volts	Source voltage of bias P-FET
dc:sad:vdda	VDDA	start	float	volts	Analog high power
dc:sad:vdd	VDD	start	float	volts	Digital power
dc:sad:pload	PLOAD	start	float	volts	Pullup voltage of detector mux bus
dc:sad:drain	DRAIN	start	float	volts	Output amplifier drain voltage
dc:sad:swPwr	SWPWR	start	float	volts	Video switch power
dc:sad:clk1	CLK1	start	float	volts	Horizontal register pixel clock 1
dc:sad:clk2	CLK2	start	float	volts	Horizontal register pixel clock 2

SIR record (instrument prefix +)	FITS keyword	FITS included?	Type	Units	Comments
dc:sad:clk1b	CLK1B	start	float	volts	Horizontal register pixel clock 1b
dc:sad:clk2b	CLK2B	start	float	volts	Horizontal register pixel clock 2b
dc:sad:lsync	LSYNC	start	float	volts	External line sync
dc:sad:fsync	FSYNC	start	float	volts	External frame sync
dc:sad:vclk	VCLK	start	float	volts	Master clock for vertical register
dc:sad:reset	RESET	start	float	volts	Control signal for resetting all pixels
dc:sad:read	VREAD	start	float	volts	vertical register bus enable signal
dc:sad:reseten	RESETEN	start	float	volts	Reset the column bus
dc:sad:switchcntrl	SWCNTRL	start	float	volts	Voltage controlling switch of video input between signal and reference
dc:sad:refoffset	REFOFF	start	float	volts	Reference and signal video offset voltage
dc:sad:flagpulse	FLAGPLS	start	float	volts	Clock signal used for monitoring
dc:sad:spare1	SPARE1	start	float	volts	Spare clock 1
dc:sad:VMEDSPRes		never	string		Result of VME Board DSP operation
dc:sad:timingDSPRes		never	string		Result of timing board DSP operation
dc:sad:coadderDSPRes		never	string		Result of coadder board DSP operation
dc:sad:nreadsDone		never	long		Number of reads completed
dc:sad:ncoaddsDone		never	long		Number of coadds completed
dc:sad:opState		never	integer	0/1	Indicates whether in OBS mode (1) or not (0)
dc:sad:viewEnabled		never	integer	0/1	Indicates whether VIEW mode is enabled (1) or not (0). View mode can be disabled for debugging.
dc:sad:replyStatus		never	integer		Status from last SDSU operation
dc:sad:timeLeft		never	float	seconds	Time remaining in current data set observation.
dc:sad:elapsed	ELAPSED	end	float	seconds	Total elapsed time in current data set observation.
dc:sad:obs:nresets	DETNRST	start	long		Number of detector resets between each exposure
dc:sad:obs:resetDelay	DETRSTD	start	float	microseconds	Time delay to allow detector to reset.
dc:sad:obs:readMode	READMODE	start	string		Read mode (DCS|FOWLER|LINEAR)
dc:sad:obs:nref	REFSAMP	start	integer		Number of reference samples

SIR record (instrument prefix +)	FITS keyword	FITS included?	Type	Units	Comments
dc:sad:obs:expMode	EXPMODE	start	string		Exposure mode [DESTRUCTIVE | NONDE-STRUCTIVE]
dc:sad:obs:npixReads	FILTSAMP	start	integer		Number of digital filter samples
dc:sad:obs:nfowler	NFOWLER	start	long		Number of Fowler samples per exposure .
dc:sad:obs:period	PERIOD	start	double	seconds	Period between sets of samples
dc:sad:obs:nperiods	NPERIODS	start	double	seconds	Number of sampling periods in an exposure
dc:sad:obs:readIntvl	RDDELT	start	float	microseconds	Interval between reads
dc:sad:obs:ncoadds	DETNCOAD	start	long		Number of detector co-adds for each exposure.
dc:sad:obs:exposedRQ	EXPRQ		float	seconds	Requested total integration time.
dc:sad:obs:exposed	EXPTIME	end	float	seconds	Actual total integration time.
dc:sad:obs:badPixFile	BADPIX	start			Name of file mapping bad pixels
dc:sad:obs:cosmRej	COSMREJ	start	integer	0/1	Indicates whether cosmic ray rejection is performed (1) or not (0)
dc:sad:obs:cosmThrsh	COSMTHR	start	float		Cosmic ray rejection threshhold
dc:sad:obs:cosmicRate		never	float	sec-1	Simulation rate of cosmic rays
dc:sad:obs:dataDest		never	string		Data destination (FITS | DHS).
dc:sad:obs:doSubFile		never	integer	0/1	Is image subtracted from raw data (1=YES, 0 = NO)
dc:sad:obs:subFile		never	string		Name of file to subtract from raw data
dc:sad:fitsPort		never	integer		FITS server's port
dc:sad:fitsServer		never	string		Name of FITS server
dc:sad:obs:saveReads		never	integer	0/1	Save each read? .(1= YES, 0 = NO)
dc:sad:obs:savePerm		never	integer	0/1	Save image to permanent stor-age? (1= YES, 0 = NO)
dc:sad:obs:saveQual		never	integer	0/1	Save quality data? (1= YES, 0 = NO)
dc:sad:obs:saveVar		never	integer	0/1	Save variance data (1= YES, 0 = NO)?
dc:sad:obs:simFile		never	string		Simulation file name
dc:sad:obs:simIntTime		never	float	seconds	Simulated integration time
dc:sad:obs:waveMin		never	float	µm	Wavelength minimum
dc:sad:obs:waveMax		never	float	µm	Wavelength maximum
dc:sad:view:nresets		never	integer		Number of detector resets between each exposure
dc:sad:view:resetDelay		never	float	microseconds	Time delay to allow detector to reset
dc:sad:view:readMode		never	string		Read mode (DCS|FOWLER|LINEAR)

SIR record (instrument prefix +)	FITS keyword	FITS included?	Type	Units	Comments
dc:sad:view:expMode		never	string		Exposure mode [DESTRUCTIVE | NONDE-STRUCTIVE] (VIEW mode)
dc:sad:view:npixReads		never	integer		Number of digital filter samples (view mode)
dc:sad:view:nfowler		never	integer		Number of Fowler samples per exposure (VIEW mode)
dc:sad:view:period		never	float	seconds	Period between sets of samples
dc:sad:view:nperiods		never	integer		Number of sampling periods in an exposure (VIEW mode)
dc:sad:view:readIntvl		never	float	microseconds	Interval between reads (VIEW mode)
dc:sad:view:nref		never	integer		Number of reference samples (VIEW mode)
dc:sad:view:ncoadds		never	integer		Number of detector co-adds for each exposure.(VIEW mode)
dc:sad:view:exposed		never			Actual total integration time.(VIEW mode)
dc:sad:view:exposedRQ		never			Requested total integration time (VIEW mode)
dc:sad:view:cosmRej		never	integer	(0=NO, 1= YES)	Do cosmic ray rejection (VIEW mode)
dc:sad:view:cosmThrsh		never	float		Cosmic ray rejection thresh-hold(VIEW mode)
dc:sad:view:cos-micRate		never	float	sec^{-1}	Simulation rate of cosmic rays
dc:sad:view:doSubFile		never	integer	(0=NO, 1= YES)	Is image subtracted from raw data (YES | NO) (VIEW mode)
dc:sad:view:subFile		never	integer		Name of file to subtract from raw data (VIEW mode)
dc:sad:view:simFile		never	string		Simulation file name (VIEW mode)
dc:sad:view:simIntTime		never	float	seconds	Simulated integration time (VIEW mode)
dc:sad:view:sendDHS		never	integer	(0=NO, 1= YES)	Send view mode data to the DHS? (VIEW mode)
dc:sad:view:waveMin		never	float	µm	Wavelength minimum (VIEW mode)
dc:sad:view:waveMax		never	float	µm	Wavelength maximum (VIEW mode)
dc:sad:nexpRQ	NEXPRQ	start	integer		Requested exposures per data set
dc:sad:nexp	NEXP	end	integer		Actual exposures per data set
dc:sad:dataLabel		never	string		Most recent DHS data label for data to be downloaded to the DHS. Not currently used.

SIR record (instrument prefix +)	FITS keyword	FITS included?	Type	Units	Comments
dc:sad:calLabel	CALLABEL		string		Most recent DHS data label for calibration data uploaded from DHS
dc:sad:nframes	NFRAMES	end	integer		Frames per data set
dc:sad:obsID		never	string		Current observation ID. Currently handled by the OCS.
dc:sad:obsType	OBSTYPE	start	string		Observation type (IMAGE | DARK | FLAT | ARC | BIAS))
dc:sad:svName		never	string		DHS server host name
dc:sad:svAddr		never	string		DHS server IP address
dc:sad:bunit	BUNIT	start	string		Data units Units of quantity read from detector array (e.g. “ADU” or “Volts/S”).
dc:sad:utnow		never	string	TBD	UT now.
dc:sad:utstart	UTSTART	start	string	TBD	UT at exposure start.
dc:sad:utend	UTEND	end	string	TBD	UT at exposure end.
dc:sad:obsRawQLS		never	string		Name of obs mode Quick Look Display stream for spectral data
dc:sad:obsCompQLS		never	string		Name of obs mode Quick Look Display stream for NIFS compressed image cube
dc:sad:viewRawQLS		never	string		Name of view mode Quick Look Display stream
dc:sad:viewCompQLS		never	string		Name of view mode Quick Look Display stream for NIFS compressed image cube
dc:sad:dhsConnected		never	integer		Is DHS connected?
dc:sad:dhsHealth		never	string		Health of DHS data connection. (GOOD | WARNING | BAD
dc:sad:wcsDec		TBD	float	radians	World Coordinate System declination of the centre of projection
dc:sad:wcsRa		TBD	float	radians	World Coordinate System right ascension of the centre of projection
dc:sad:wcsTai		TBD	float	Gemini raw time	World Coordinate System time stamp

2–3.4 Detailed Command Description

A general table of the commands accepted by the NIFS control software, together with their arguments, is given in Table 2 on page 11. This section contains a detailed description of each of the commands that can be sent between the OCS and the NIFS control software.

Any directive asserted on the top-level APPLY record will be forwarded to all the CAD records in the sequencer, CC, and DC (perhaps via lower-level APPLY records). Only the marked CAD records will respond. If the directive is accepted it will cause the NIFS control software to change its configuration. The “applyC” CAR record will go “BUSY” while the NIFS control software is changing its configuration and go to “IDLE” if completed successfully or to “ERR” if the configuration change fails.

2–3.4.1 Sequence Commands

2–3.4.1.1 APPLY

The APPLY command causes the system to match the configuration that has been sent to it by the OCS. Depending on the APPLY directive and which CADs are marked, commands will be accepted for execution, if verified, in predetermined order. If any CAD parameter is not verified the command will be rejected.

2–3.4.1.2 INIT

On receipt of this command, the IS ensures that an observation is not taking place. It then executes its initialization sequence, in which it reads its hardware set-up files and lookup tables, and resets itself to the start-up state. This command is forwarded to the CC, DC, and OIWFS CC. The "initC" CAR record goes "BUSY" while the initialization is being carried out and will go to "IDLE" if completed suc-cessfully or to "ERR" if the initialization fails.

The CC reads its hardware set-up files and lookup tables, and resets itself to the start-up state. No mechanisms are moved.

The DC reads its hardware setup files, and starts/restarts the VxWorks control tasks which are put into the *READY* state.

2–3.4.1.3 TEST

On receipt of this command, the IS ensures that an observation is not taking place, and then forwards this command to the DC and CC. The "testC" CAR record will go "BUSY" while the tests are being carried out and go to "IDLE" if completed successfully or to "ERR" if the tests fail.

The CC accepts, but ignores this command.

The DC accepts this command if an INIT has been successfully performed. Depending on the testMode parameter, communication link tests between the DC IOC and the SDSU controller electronics are performed using the SDSU TDL command.

For the CC, because the TEST command is not permitted to move any mechanisms, it is unable to detect any problems with the Components Controller. Use the REDATUM command (Table 5) instead.

2–3.4.1.4 DATUM

On receipt of this command, the IS ensures that an observation is not taking place and then forwards the command to the CC, the DC, and the OIWFS CC. The "datumC" CAR record goes "BUSY" while the datum search is being carried out and goes to "IDLE" if completed successfully or to "ERR" if the datum search fails.

The CC locates the datum for all its mechanisms.

The DC accepts but ignores this command.

2–3.4.1.5 VERIFY

On receipt of this command, the IS ensures that an observation is not taking place and then forwards the command to the CC and DC.

The CC does not support this command.

The DC accepts but ignores this command.

2–3.4.1.6 ENDVERIFY

On receipt of this command, the IS ensures that an observation is not taking place and then forwards the command to the CC and DC.

The CC does not support this command.

The DC accepts but ignores this command.

2–3.4.1.7 GUIDE

On receipt of this command, the IS ensures that an observation is not taking place. It then sets a flag as a reminder that guiding is taking place (as this information may affect its interaction with the On-Instrument Wavefront Sensor). The IS also forwards this command to the CC and DC.

The CC does not support this command.

The DC accepts but ignores this command.

2–3.4.1.8 ENDGUIDE

On receipt of this command, the IS ensures that an observation is not taking place. It then resets the guiding flag to indicate guiding has stopped. The IS then forwards this command to the CC and DC.

The CC does not support this command.

The DC accepts but ignores this command.

2–3.4.1.9 OBSERVE

On receipt of this command, the IS ensures that an observation is not taking place and then forwards the command to the DC. The IS rejects the command if its control software or the CC control software is still configuring its mechanisms. If accepted, the DC "observeC" CAR record is changed to "BUSY". It goes back to "IDLE" when the data set observation completes (or "ERR" if the observation was not successful).

The CC does not support this command.

The DC will start an observation according to the currently set observation parameters. The NIFS DC supports two readout modes – VIEW and OBS. At startup NIFS will automatically go into VIEW mode, move to OBS mode during an OBSERVE sequence, and return to VIEW mode at the end of the sequence. Separate parameters are maintained for each mode. Whilst observing, the nifs:dc:sad:irMode flag is set to 1, and when the observation is complete, the nifs:dc:sad:obsMode flag is set to a value other than 1 (0 for NULL mode, and 2 for VIEW mode).

2–3.4.1.10 ENDOBSERVE

On receipt of this command, the IS forwards the command to the DC. No changes are made to the "observeC" CAR record.

The CC does not support this command.

The DC accepts but ignores this command.

2–3.4.1.11 PAUSE

On receipt of this command, the IS forwards the command to the DC.

The CC does not support this command.

In the DC accepts but ignores this command.

2–3.4.1.12 CONTINUE

On receipt of this command, the IS forwards the command to the DC. The command is rejected if an observation has not been paused. If successful, the "observeC" CAR record is changed to "BUSY".

The CC does not support this command.

The DC accepts but ignores this command.

2–3.4.1.13 STOP

On receipt of this command, the IS forwards the command to the DC. The command is rejected if an observation is not being made. If successful, the "observeC" CAR record is changed to "IDLE".

The CC does not support this command.

The DC stops the current observation at the next non-destructive read (NDR) cycle and retains any data up to that point.

2–3.4.1.14 ABORT

On receipt of this command, the IS forwards the command to the DC. If successful, the "observeC" CAR record is changed to "IDLE".

The CC does not support this command.

The DC stops the current observation immediately and throws out any data. The system is returned to the *READY* state.

2–3.4.1.15 PARK

On receipt of this command, the IS ensures that an observation is not taking place and then forwards the command to the DC and the CC.

The CC moves its mechanisms to a configuration in which it can safely be switched off. It utilizes all the low-level CAD records dedicated to parking the individual mechanisms. The "parkC" CAR record will go "BUSY" while the mechanisms are being parked and then go to "IDLE" if completed successfully or to "ERR" if any mechanism fails to park.

The DC readies the SDSU controller electronics so that they can be safely switched off.

2–3.4.2 General Engineering Commands

2–3.4.2.1 REBOOT

This command causes the system to reboot, reload the software, and perform the init command.

The CC shuts down its VxWorks control tasks cleanly.

The DC shuts down its VxWorks control tasks cleanly.

2–3.4.2.2 DEBUG

On receipt of this command, the control software changes to the given debug mode (NONE, MIN, or FULL). This mode determines the amount and frequency of information logged, as described in the "Debugging Modes" section of ICD 1a. The "debugC" CAR record will go briefly "BUSY" and then back to "IDLE".

The CC sets its debug level.

The DC sets its debug level.

2–3.4.2.3 Temperature-controller commands

All temperature-controller commands are part of the engineering interface, and are not within the scope of this document.

2–3.4.3 NIFS Standard Mechanisms

NIFS has an environmental cover, a filter wheel, a grating turret, a flip mirror and a focal-plane mask wheel.

The following commands will act on all of the above mentioned mechanisms; however, as noted below, the use of certain commands with certain mechanisms is discouraged.

2–3.4.3.1 Sel—Select Position by Name

This is the principal interface for all continuous mechanisms. It is provided as a convenience for discrete mechanisms.

On receipt of this command, the NIFS CC control software will:

```
Ensure an observation is not taking place.
Translate desired position name into an engineering position with the
   aid of a look-up table.
Look up the expected value for the Hall-effect sensors at the desired
   position location.
Check to insure that protective interlocks are not set.
Wait until the number of active mechanisms drops below the number of
   mechanisms that the power supply can support.
Move the mechanism to the engineering position corresponding to the
   desired position.
Verify that the expected sensor value matches the measured value.
```

2–3.4.3.2 Move—Move to specified Position

This is the principal interface for all discrete components. It is available for continuous components, but is of limited use for normal use of the instrument[2].

On receipt of this command, the NIFS CC control software will:

```
Ensure an observation is not taking place.
Check to insure that protective interlocks are not set.
Wait until the number of active mechanisms drops below the number of
   mechanisms that the power supply can support.
Move the focus mechanism to the engineering position corresponding to
   the desired focus.
For some mechanisms, compute the expected values for the Hall-effect
   sensors.
For some mechanisms, verify that the final hall effect sensors match
   the expected values.
```

2. For discrete mechanisms, the units are position numbers; i.e., the first position is at 1.0, the second position is at 2.0.

2–3.4.3.3 Park—Park Mechanism

This command is used to prepare a mechanism for instrument shutdown.

On receipt of this command, the NIFS CC control software will:

```
Ensure an observation is not taking place.
Check to insure that protective interlocks are not set.
Wait until the number of active mechanisms drops below the number of
   mechanisms that the power supply can support.
Move the mechanism to its parking position.
Verify that the expected sensor value matches the measured value.
```

The park command is not needed for most NIFS components, and is provided for uniformity.

2–3.4.3.4 Datm—Datum mechanism

This command is used to find the datum (home) position which defines the mechanism locations.

On receipt of this command, the NIFS CC control software will:

```
Ensure an observation is not taking place.
Check to insure that protective interlocks are not set.
Wait until the number of active mechanisms drops below the number of
   mechanisms that the power supply can support.
Move the mechanism and search for its datum.
Set the hardware datum position.
```

2–3.4.3.5 MoveEng—Set position in engineering units

This command is used to move the component to locations using units that are convenient for working directly with the hardware.

On receipt of this command, the NIFS CC control software will:

```
Ensure an observation is not taking place.
Check to insure that protective interlocks are not set.
Wait until the number of active mechanisms drops below the number of
   mechanisms that the power supply can support.
Move the mechanism to the specified engineering position.
```

The Hall-effect sensors will not be used for confirmation.

2–3.4.3.6 MoveOff—Offset from current position

This command is used to move the component from its nominal selected position. The units used depend upon the component (and are described in the OffsetUnits SIR)

On receipt of this command, the NIFS CC control software will:

```
Ensure an observation is not taking place.
Check to insure that protective interlocks are not set.
Wait until the number of active mechanisms drops below the number of
   mechanisms that the power supply can support.
Offset the mechanism by the specified engineering offset.
```

The Hall-effect sensors will not be used for confirmation.

2–3.4.3.7 Rdtm—Redatum mechanism.

This command provides a quick test that will detect a loss of positioning. It will detect small positioning errors, but can underestimate large positioning errors. Note that for multi-axis components (e.g., the gimbal mirror), the command acts only on the individual mechanisms. It returns an estimate of the difference between the actual datum position and the current datum position (which can occur, e.g., if a mechanism is sticking, being driven too quickly, or being driven with too high an acceleration).

On receipt of this command, the NIFS CC control software will:

```
Ensure an observation is not taking place.
Check to insure that protective interlocks are not set.
Wait until the number of active mechanisms drops below the number of
   mechanisms that the power supply can support.
Move the mechanism and search for its datum.
```

The hardware datum position will be left unchanged. This command returns a value in the RdtmVal record for this mechanism.

This command is neither supported by the flip mirror nor the window cover, because those mechanisms use a home-finding algorithm which is incompatible with this command.

2–3.4.3.8 Diag—Diagnose mechanism

This is a quick test that will detect a loss of positioning. It will detect arbitrarily large positioning errors, but will fail to detect small positioning errors.

On receipt of this command, the NIFS CC control software will:

```
Ensure that an observation is not taking place.
Check to insure that protective interlocks are not set.
Wait until the number of active mechanisms drops below the number of
   mechanisms that the power supply can support.
Move the mechanism and attempt to verify that the motors and Hall-
   effect sensors are operating.
```

If an error is detected, the diagnose command will fail and will return an error code in its CAR record.

2–3.4.4 NIFS Detector Controller Observing Commands

2–3.4.4.1 seqObs - Setup the sequence parameters for OBS mode

Sets up the readout sequence parameters for OBS mode.

2–3.4.4.2 dataObs - Setup the data processing parameters for OBS mode

Sets up the data processing parameters for OBS mode.

2–3.4.4.3 seqView - Setup the sequence parameters for VIEW mode

Sets up the readout sequence parameters for VIEW mode.

2–3.4.4.4 dataView - Setup the data processing parameters for VIEW mode

Sets up the data processing parameters for VIEW mode.

2–3.4.4.5 setDhsInfo - Setup the DHS parameters

Sets up parameters for the DHS server.

2–3.4.5 NIFS Detector Controller Engineering Commands

NIFS supports the following DC engineering commands:

2–3.4.5.1 initSDSU—Initialize the SDSU controller electronics

This command will initialize the SDSU controller electronics using the currently set SDSU parameters. This will include downloading timing and VME DSP codes, setting voltages, setting the video mode, setting the number of samples of digital filtering and turning the power on/off.

On receipt of this command, the NIFS DC control software will:

```
Ensure an observation is not taking place.
Stop VIEW mode if currently running.
Download the timing DSP code from disk file.
Download the VME DSP code from disk file.
Set voltages vInOffset1, vInOffset2, vInOffset3, vInOffset4, biasGate,
   vReset, biasPwr, vdda and, vdd.
Set the video mode to either VD1, VD2 or stop.
Set the number of samples to digitally filter.
Turn the power on/off.
Restart VIEW mode if required.
Place the SDSU status value in the replyStatus SIR.
```

2–3.4.5.2 resetSDSU—Reset the SDSU controller electronics

This command will reset the SDSU controller electronics. On receipt of this command, the NIFS DC control software will:

```
Ensure an observation is not taking place.
Stop VIEW mode if currently running.
Turn the power on/off.
Restart VIEW mode if required.
Place the SDSU status value in the replyStatus SIR.
```

2–3.4.5.3 SDSUVMEDSP, SDSUTimingDSP and SDSUCoadderDSP

This command is used to execute a DSP command on the VME, Timing or Coadder board. On receipt of this command, the NIFS DC control software will:

```
Ensure an observation is not taking place.
Stop VIEW mode if currently running.
Perform the SDSU DSP command.
Place the SDSU status value in the VMEDSPRes, timingDSPRes or
   coadderDSPRes SIR
Restart VIEW mode if required.
```

2–3.4.5.4 calibFRT—Calibrate Frame Read Time

This command is used to execute the FRT DSP command, which measures the frame read time. On receipt of this command, the NIFS DC control software will:

```
Ensure an observation is not taking place.
Stop VIEW mode if currently running.
Perform the SDSU FRT instruction.
Place the SDSU status value in the replyStatus SIR.
Restart VIEW mode if required.
```

2–3.5 Detailed Status information

2–3.5.1 General records

2–3.5.1.1 name

This record contains a string constant describing the name of the instrument. For NIFS this record will contain “NIFS”.

2–3.5.1.2 state

This record will take the values BOOTING, INITIALISING, RUNNING and CONFIGURING[3] and reflect the state of the NIFS control software while it is initializing. The activities corresponding to these states are

- BOOTING — the state during IOC Init and while any database default values are being set.
- INITIALISING — the NIFS control software is checking its own hardware and reading its hardware configuration files during this phase.
- RUNNING — the NIFS control software is ready to accept commands.
- CONFIGURING — the NIFS control software is ready to accept commands but it is busy configuring and unable to make observations.

2–3.5.1.3 health

This record will reflect the overall health of the NIFS control software (including the components controller and the detector controller). Expected values are GOOD, WARNING or BAD. If the overall health is BAD then the NIFS control software is unusable. If the Health is set to WARNING then the NIFS control software is able to execute some functions but not perhaps to specification.

2–3.5.1.4 historyLog[4]

The record used to contain messages to be recorded in the history log.

2–3.5.1.5 dcAbort

Indicates that an exposure is being aborted..

2–3.5.1.6 debugMode

This record contains a string indicating the current debugging mode.

3. Currently unimplemented
4. Currently unusable

2–3.5.1.7 heartBeat

This record is a simple incremental counter, whose changing value indicates that the IS is still alive.

2–3.5.1.8 issPort

The record which reports the ISS port on which the insturment is installed..

2–3.5.1.9 label

This record contains a string constant describing the name of the instrument. For NIFS this record will contain “NIFS”. This is the same as the “name” record.

2–3.5.1.10 simMode

This record contains a string indicating the instrument’s simulation mode.

2–3.5.1.11 wfsBeam

Indicates whether the OIWFS beam is obstructed or not..

2–3.5.2 Component Status Records

2–3.5.2.1 Datumed

This record indicates that a component has been datumed. For multi-axis components, this flag will only be set if all mechanisms have been datumed. This record takes on the following values:

- 0 = Datumed
- 1 = Not Datumed

2–3.5.2.2 EngCyclic

This record indicates that a mechanism may be set to a location beyond its physical limits (convenient for circular mechanisms like filter wheels). Note that this only affects the higher level commands; the low-level software may choose to ignore any invalid requests. This record takes on the following values:

- 0 = Limits can be exceeded
- 1 = Limits may not be exceeded

This record is for internal use by the NIFS software. Its value should not be changed. It is documented here only for completeness.

2–3.5.2.3 EngMax

This record contains the maximum position that the mechanism can be moved to, in engineering units.

2–3.5.2.4 EngMin

This record contains the minimum position that the mechanism can be moved to, in engineering units.

2–3.5.2.5 EngName

This record contains the engineering name of the current mechanism position. This represents a physical configuration of a component, and will never change (unlike the “Name” record which may change, if filters or other optical elements are replaced or rearranged). The names of the positions are:

- park;
- home;
- pos00, pos01, pos02, ... , up to the maximum number of positions;
- INVALID (if not in a standard location).

2–3.5.2.6 EngPos

This record contains the current position of a mechanism, in engineering units.

2–3.5.2.7 Label

The FDSC field of this record contains a text string which describes a component. This is convenient in providing a title string for edd/dm screens.

2–3.5.2.8 Max

This record contains the maximum position that the mechanism can be moved to, in real-world units. A text string describing the real-world units may be found in the Units record. For mechanisms such as a filter wheel in which there are no appropriate units, the position will typically be given as a position number, i.e., position 0 is 0.0, position 1 is 1.0.

2–3.5.2.9 Min

This record contains the maximum position that the mechanism can be moved to, in real-world units. A text string describing the real-world units may be found in the Units record. For mechanisms such as a filter wheel in which there are no appropriate units, the position will typically be given as a position number, i.e., position 0 is 0.0, position 1 is 1.0.

2–3.5.2.10 Name

This record contains the name of the current component position. This name typically describes a filter or other optical element and will be redefined if filters or other optical elements are replaced or rearranged (unlike the “EngName” record which describes a component’s physical configuration).

Note that for multi-axis components, there will be a Name record for each individual mechanism, as well as for the component as a whole.

2–3.5.2.11 Parked

This record indicates that a component is in a parked state. For multi-axis components, this record will be set only if all mechanisms are parked. This field takes the values:

- 0 = All mechanisms parked;
- 1 = Not all mechanisms are parked.

2–3.5.2.12 Pos

This record contains the current position of a mechanism, in real-world units. A text string describing the real-world units may be found in the Units record. For mechanisms such as a filter wheel in which there are no appropriate units, the position will typically be given as a position number, i.e., position 0 is 0.0, position 1 is 1.0.

2–3.5.2.13 RdtmVal

This record contains the result of the last redatum command, in engineering units. (The redatum command returns an estimate of the how far the current mechanism datum position is from the actual datum position; it is useful in diagnosing hardware problems.)

2–3.5.2.14 Reject

This record contains a combination of the values of all CAD records for all mechanisms that make up a component. It contains the following values:

- -1 = At least one CAD record is in a reject state;
- 0 = No CAD records are in a reject state.

This record exists as a convenience for the user interface. There is no reason for the OCS to use it. It is documented here only for completeness.

2–3.5.2.15 State

This record contains a string which describes the current state of the mechanism-support code.

This record is for debugging the NIFS software. The possible values that this record may take may change, without notice. It is documented here only for completeness.

2–3.5.2.16 Units

This record contains a text string which describes the real world units (e.g., “mm” or “arc sec”)

2–3.5.3 Component Health Records

All of these records return the standard health values: “GOOD”, “WARNING”, and “BAD”.

2–3.5.3.1 DatumHealth

This record reports “WARNING” if a mechanism (or if any mechanism of a multi-axis component) is not datumed. It is cleared by successful execution of a datum command.

2–3.5.3.2 HallHealth

This record reports “WARNING” if a Hall-effect sensor has been disabled. (The sensors can only be disabled from the engineering user interface, and are normally disabled only to deal with a failed sensor.)

This record reports “BAD” if both sensors of a Hall-effect sensor pair have been disabled. Note that a mechanism is still usable if both sensors are disabled, but cannot be datumed. (The sensors can only be disabled from the engineering user interface, and are normally disabled only to deal with a failed sensor.)

2–3.5.3.3 Health

This record reports the most severe error value of all other health records.

2–3.5.3.4 ModuleHealth

This record reports “BAD” if the stepper-motor driver module has entered a fault state. This normally indicates a serious hardware problem. It may be possible to clear the error state by issuing a driver-reset from the engineering user interface. If it is not possible to clear the error, then the stepper-motor driver module or other related hardware has failed, and must be repaired.

2–3.5.3.5 PosErrHealth

This record reports “WARNING” if a mechanism (or if any mechanism of a multi-axis component) has been moved in such a way that proper backlash correction has not been made. In this case, the reported mechanism position may not be the actual mechanism position. This situation can arise if a movement command has been canceled while a motion is in progress; if a movement command failed to complete correctly, if certain low-level engineering com-

mands are executed, and immediately after the control software has been rebooted. It is cleared by successful execution of any motion command.

2–3.5.3.6 SnlHealth
This record reports “BAD” or “WARNING” if the underlying mechanism support code detects an error while a mechanism is in motion. The only situation which is likely to arise is “WARNING”, if an operation takes longer than expected.

2–3.5.4 Temperature Monitoring and Control Status Records

2–3.5.4.1 C1Setp, C2Setp, C3Setp, C4Setp
These records report the current set-point temperature which for each temperature controller.

2–3.5.4.2 C1Tmp, C2Tmp, C3Tmp, C4Tmp
These records report the current temperature which is reported by each temperature controller.

2–3.5.4.3 CoolBusy
This record returns one of the three strings: “Off”, “High”, or “Low”, to indicate whether the cooling motors are off or operating at high or low speed.

2–3.5.4.4 CoolRate1
This record returns the rate of cold-cycle cooler 1, in microsteps per second.

2–3.5.4.5 CoolRate2
This record returns the rate of cold-cycle cooler 2, in microsteps per second.

2–3.5.4.6 Label
The FDSC field of this record returns a string describing the temperature control and monitoring system, for use in the title of edd/dm screens.

2–3.5.4.7 S1Tmp1, S1Tmp2, S1Tmp3, ... , S1Tmp8
These records report the current temperature which is reported by each temperature sensor which is connected to the temperature-sensor controller.

2–3.5.5 Temperature Monitoring and Control—Health Records

All of these records return the standard health values: “GOOD”, “WARNING”, and “BAD”.

2–3.5.5.1 C1Health, C2Health, C3Health
This record will report “BAD” if a temperature controller is not functioning properly. This can indicate either a communications problem, a hardware failure with the temperature controller, or a faulty temperature sensor.

2–3.5.5.2 CoolModeHealth
This record will report “BAD” if the cooling motors are off, when the instrument should be cold, or if the cooling motors are on, when the instrument should be warm.

2–3.5.5.3 Health
This record combines all of the other heath records for the temperature control and monitoring subsystem, and reports the most severe condition.

2–3.5.5.4 ModeHealth
This record will report “BAD” if the external mode-selector connector is not in the appropriate position for normal operation. (If the connector is in the “warm-up mode”, the motors cannot be operated.)

2–3.5.5.5 S1Health
This record will report “BAD” if the temperature sensor unit is not functioning properly. This can indicate either a communications problem or a hardware failure with the temperature sensor unit.

2–3.5.5.6 TmpCheckHealth
This record will report “BAD” if any temperature is unreasonably high while the system is expected to be cold or if a temperature is too low, while the system is expected to be warm.

2–3.5.6 Detector Controller Status Records

2–3.5.6.1 name
The name of the detector controller.

2–3.5.6.2 state
Detector controller state: one of BOOTING, INITIALIZING, RUNNING or CONFIGURING

2–3.5.6.3 historyLog
Detector controller log message

2–3.5.6.4 heartBeat
Continuously changing variable which indicates that the system is still alive.

2–3.5.6.5 debugMode
The current debugging mode: one of NOLOG, NONE, MIN or FULL.

2–3.5.6.6 simMode
The current simulation mode: one of NONE, FULL, FAST or VSM.

2–3.5.6.7 prep
This record indicates that the DC is preparing to make an observation.

2–3.5.6.8 acq
This record indicates that the DC is making an observation. The instrument mechanisms should not be reconfigured during this period.

2–3.5.6.9 rdout
This record indicates that the DC is reading out its data. If *acq* is also set to TRUE then the detector is also still exposing otherwise the instrument may reconfigure its mechanisms.

2–3.5.6.10 detType and detID
For NIFS these will be a strings like “Rockwell Hawaii II, SDSU II” and “TBD”.

2–3.5.6.11 obsType and obsID
Current observation type (FLAT, BIAS etc) and ID.

The following SIRs report SDSU settings and states,

2–3.5.6.12 initSDSUDone
A value of 1 indicates that the SDSU controller has been initialized, and a value of 0 indicates that it has not been initialized.

2–3.5.6.13 timingDSP and timingDSPVersion
The name and version number of the current timing DSP code filename..

2–3.5.6.14 VMEDSP and VMEDSPVersion
The name and version number of the current VME DSP code filename..

2–3.5.6.15 vInOffset0-3
Video input channel offset voltages for channels 0-3.

2–3.5.6.16 vReset
Control signal for resetting all pixels.

2–3.5.6.17 biasGate and biasPwr
Gate and source voltages of bias P-FET.

2–3.5.6.18 vdda and vdd
Analog high and digital power voltages.

2–3.5.6.19 pload
Pullup voltage of detector mux bus.

2–3.5.6.20 drain
Output amplifier drain voltage

2–3.5.6.21 swPwr
Video switch power

2–3.5.6.22 clk1, clk2, clk1b, clk2b
Horizontal register pixel clocks.

2–3.5.6.23 lsync
External line sync.

2–3.5.6.24 fsync
External frame sync

2–3.5.6.25 vclk
Master clock for vertical register

2–3.5.6.26 reset
Control signal for resetting all pixels.

2–3.5.6.27 read
Vertical register bus enable signal.

2–3.5.6.28 reseten
Control signal for restting the column bus.

2–3.5.6.29 switchcntrl
Voltage controlling switch of video input between signal and reference.

2–3.5.6.30 refoffset
Reference and signal video offset voltage.

2–3.5.6.31 flagpulse
Clock signal used for monitoring.

2–3.5.6.32 spare1
Spare clock 1

2–3.5.6.33 VMEDSPRes. timingDSPRes, coadderDSPRes
Result of DSP operation ont he VME, timing and coadder boards, respectively.

2–3.5.6.34 replyStatus
Each SDSU command results in either a DON or ERR status. This is recorded here for the latest SDSU command..

A number of SIRs exist for both the OBS and VIEW modes. They are described together below.

2–3.5.6.35 nresets and resetDelay
Number of detector resets between each exposure and the time delay to allow detector to reset.

2–3.5.6.36 readMode
This is the mode that is used to produce the final image intensities. NIFS supports double-correlated sampling, Fowler sampling and linear fitting (i.e., DCS | FOWLER | LINEAR). Refer to [1] and [2] for a complete description of each mode.

2–3.5.6.37 npixReads
Number of ADC conversion samples per pixel to use for multiplexer glow (read noise) reduction.

2–3.5.6.38 nfowler
The number of samples in a “read” (*q.v.* MDD’s doc TBD)

2–3.5.6.39 period
The period between sets of samples

2–3.5.6.40 nperiods
The numbef of sampling periods in an exposure.

2–3.5.6.41 ncoadds
Number of NDRs that are co-added before performing the next exposure mode processing step.

2–3.5.6.42 readInterval
The shortest time between successive reads.

2–3.5.6.43 exposedRQ, exposed
The requested total exposure time, actual exposure time recorded and the elapsed time between the detector reset at the beginning of the exposure and the finish of the final read..

2–3.5.6.44 expMode
This will be always “NONDESTRUCTIVE” for NIFS.

2–3.5.6.45 nref
Number of reference circuit samples per row (or column) to use for residual drift reduction

2–3.5.6.46 cosmRej
Indicates whether cosmic ray rejection is performed (1 = YES, 0 = NO)

2–3.5.6.47 cosmThrsh
Cosmic ray rejection threshhold

2–3.5.6.48 cosmicRate
Simulation rate of cosmic rays

2–3.5.6.49 doSubFile
Indicates whether image is subtracted from raw data (1 = YES, 0 = NO)

2–3.5.6.50 subFile
The file name of the image to be subtracted from the raw data.

2–3.5.6.51 simFile
The file name of the simulation file.

2–3.5.6.52 simIntTime
The simulated integration time.

2–3.5.6.53 waveMin
Wavelength minimum

2–3.5.6.54 waveMax
Wavelength maximum

Some SIRs are unique for the OBS mode:

2–3.5.6.55 badPixFile
The name of the file mapping the bad pixels.

2–3.5.6.56 dataDest
Data destination: either FITS or DHS

2–3.5.6.57 saveRead
Indicates whether each read is saved (1 = YES, 0 = NO)

2–3.5.6.58 savePerm
Indicates whether the image is to be saved to permanent storage (1 = YES, 0 = NO)

2–3.5.6.59 saveQual
Indicates whether quality data is to be saved (1 = YES, 0 = NO).

2–3.5.6.60 saveVar
Indicates whether variance data is to be saved (1 = YES, 0 = NO).

One SIR is unique for the VIEW mode:

2–3.5.6.61 sendDHS
Indicates whether VIEW mode data is to be sent to the DHS (1 = YES, 0 = NO)

Three SIRs report information about the current exposure, independent of whether the controller is in VIEW or OBS mode.

2–3.5.6.62 nreadsDone
Number of sampling periods completed

2–3.5.6.63 ncoaddsDone
Number of coadds completed.

2–3.5.6.64 timeLeft
Time remaining in current exposure.

2–3.5.6.65 elapsed
Total elapsed time in current data set observation.

2–3.5.6.66 opState
Indicates whether in OBS mode (1) or not (0). Note that a value of 0 does not necessarily indicate whether the controller is in VIEW mode, since VIEW mode can be disabled with the viewEnabled flag.

2–3.5.6.67 nexpRQ and nexp
The requested number of exposures (NDRs) and the actual number of exposures recorded for the data set.

2–3.5.6.68 dataLabel and calLabel
Most recent DHS data label that has been downloaded to the DHS. And the most recent calibration label requested from the DHS for using in producing the compressed spatial image for quick-look display. *calLabel* is also used by the raw-image quick look tool for subtracting from *dataLabel.*

2–3.5.6.69 nframes
The number of frames in a NIFS dataset - this will be always be 16, including 4 frames for each quadrant of the detector. These will be intensity, variance, quality and reference frames.

2–3.5.6.70 viewEnabled
Indicates whether VIEW mode is enabled. VIEW mode may be disabled when testing.

2–3.5.6.71 fitsServer
The name of the FITS server

2–3.5.6.72 fitsPort
The port number of the FITS server.

2–3.5.6.73 svName and svAddr
Host name and IP address of the DHS server.

2–3.5.6.74 utnow, utstart and utend
UT now, UT at exposure start and UT at exposure end.

2–3.5.6.75 bunit
Units of quantity read from detector array (e.g. “ADU” or “V/s”)

2–3.5.6.76 wcsDec, wcsRa
The World Coordinate System declination and right ascension of the centre of projection.

2–3.5.6.77 wcsTai
The World Coordinate System time stamp.

2–3.5.6.78 obsRawQLS, obsCompQLS, viewRawQLS and viewCompQLS
Quick-look streams for OBS and VIEW modes. *rawQLS* for each mode is used for the NIFS spectral data display. It will be set to subtract *calLabel* from each NIFS raw image. *compQLS* for each mode is used to display the compressed spatial image.

2–3.5.6.79 dhsConnected
This will be set TRUE if the DHS is being used and connected.

2–3.5.7 Detector Controller Health Records
All of these records return the standard health values: “GOOD”, “WARNING”, and “BAD”.

2–3.5.7.1 Health
This record reports the most severe error value of all other health records.

2–3.5.7.2 dhsHealth
This record reports the health of the DHS connection.

2–3.6 Alarm conditions
The following situations will generate an alarm.

- Hall effect sensor disabled
- Motor-control module fault
- Mechanism not datumed
- Mechanism not backlash corrected
- Problem detected by SNL code (time-out)
- Temperature changing
- Temperature out of range

2–3.7 Debugging and Maintenance
This interface can be tested and debugged by means of an engineering user interface supplied as part of the NIFS.

2–3.7.1 Debugging Modes
The NIFS control software will have the standard debugging modes described in ICD 1a, [6].

2–3.7.2 Calibration

If a Hall effect sensor fails or if a mechanism must be disassembled for maintenance, the sensors will need to be recalibrated. A separate program is provided for this purpose. Calibration procedures are described in a separate document [12].

2–3.8 Simulation

The Gemini simulation modes are described in ICD 1a, [6]. The NIFS control software will use the FAST and FULL modes, and by default it begins in “NONE” mode. VSM mode may be supported, if time permits.

2–4.0 Safety Issues

It is necessary to avoid moving NIFS components while the mechanical components are not at thermal equilibrium. NIFS uses records to provide a temperature interlock.

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