

I saac N ewton G roup R ed I maging D etector

SDSU INTERFACE CONTROL DOCUMENT VERSION 3.1

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Version Summary

This version builds on from Version 2.3 to provide compatibility to the UltraDas requirements contained in document INS-DAS-18 Issue 7.2. Compatibility with version 2.3 has been maintained except for commands **TST**, **PON**, **POF** and **TIMING / UTILITY STATUS** words which have altered somewhat to accommodate UltraDas requirements. Functionality has been increased to include windowing of up to 7 x 7 window fragments and timed shutter and preflash exposure control. In addition the Utility board now has all boot AND application code in EEPROM. In this way the array warmup protection scheme is functional whenever the controller has power and does not depend on a host connection being sustained. This, in consequence, means that there is now NO DOWNLOAD FILE (.lod) for the utility board. The detector identification code for INGRID has been established as E1h for INGRID and E2h for LIRIS.

Introduction

This document describes the protocol used for communication between the Host computer system and the SDSU detector controller which forms part of the INGRID instrument. These sub systems are linked together using two fibre optic cables connected directly between the Sbus interface card in the Host Computer and the Timing Board of the SDSU controller. The uplink from Host to SDSU is a slow link operating at 4 MHz which is used for sending commands to the SDSU controller. The downlink operates at 50 MHz and is used for sending responses to the uplink commands and also image data to the Host System. There is also an electrical communication serial link

operating between the Timing Board and Utility Board in the SDSU controller using the standard Motorola DSP SSI interface.

This document presents the protocol in a table format. The significance of each of the columns is as follows:-

Column 1 = Executable Command

Column 2 = Originator of Command

Column 3 = Destination of Command (specifies if available after BOOT or only when an application APPL has been uploaded)

Column 4 = Number of words in command

Column 5 = Response to the command

Column 6 = Specifies the action taken on receiving the command

Column 7 = Remarks and more information

The format of the messages sent between HOST and SDSU has been described many times elsewhere; suffice to say that each command or response consists of 2 – 7 words. Each word is made up of 33 bits. Of these, 24 bits are valid and the rest are used as header information. The programmer need not worry about this header information. The hardware strips away the header information to leave the expected 24 bit word, which is then processed by the SDSU controller.

The downlink is used for responses and image data. When transmitting image data, then it takes the form of 17 bit words, with one stop bit and 16 data bits. The host programmer should know when to expect the 33 bit packet or 17 bit packet and act accordingly. Again this is described in more detail in the SDSU documentation.

The intended audience for this document are those who are programming either the Host computer end or SDSU controller end of the fibre links. Although not the best place for it, the document also gives information on the expected start exchange of messages as passed between the Host and SDSU. It also gives a table of useful addresses in the SDSU controller.

Command	Source	Destination	Words	Response	Action	Remarks
<p>TDL nnnnnn</p> <p>$0 \leq nnnnnn \leq ffffff$</p> <p>(BOOT)</p>	HOST	TIMING, UTILITY	3	nnnnnn	Test Data Link. Destination echoes nnnnnn back to Source.	
<p>NOP</p> <p>(BOOT)</p>	HOST	TIMING, UTILITY	2	DON	No Operation	A NOP command useful to determine if the system is responding to polling.
<p>RDM maaaaa dddddd</p> <p>$0 \leq aaaaa \leq 0ffff$ $0 \leq dddddd \leq ffffff$</p> <p>(BOOT)</p>	HOST	TIMING, UTILITY	3	dddddd	<p>Read Memory. Read DSP address maaaaa. Returned data = dddddd. The most significant nibble of the address indicates the memory type. m = 1: P memory m = 2: X memory m = 4: Y memory m = 8: EEPROM</p>	This command is used to read memory locations for low level fault finding or checking the simple variables, e.g. elapsed integration time.

Command	Source	Destination	Words	Response	Action	Remarks
<p>WRM maaaaa ddddd</p> <p>$0 \leq aaaa \leq 0fff$ $0 \leq ddddd \leq fffff$</p> <p>(BOOT)</p>	HOST	TIMING, UTILITY	4	DON	Write Memory. Write ddddd to DSP address maaaaa. The most significant nibble of the address indicates the memory type. m = 1: P memory m = 2: X memory m = 4: Y memory	This command can be used to download new applications to program memory etc.
<p>MRA n $0 \leq n \leq 0xfffff$</p> <p>(APPL)</p>	HOST	TIMING	3	image data, DON	Execute Multiple Non Destructive Read consisting of an array reset, n Reads – Integration and n reads. transmits DON at completion	The type of data sent depends on the flag set by the DAT command. A DON command is sent before and after the image data is sent (required for IRCAM usage)
<p>TST (APPL)</p>	HOST	TIMING	2	DON	Command supported but no longer functional	Removed to protect array.

Command	Source	Destination	Words	Response	Action	Remarks
ABR (APPL)	HOST	TIMING	2	DON	Abort Mode that Controller is in and return to Idle Mode – Resets READ/TIMER/VIDEO/IDLE mode flags.	ABR can be sent anytime after MRA command but will only be processed after post reset reads are completed. See v2.1 release notes for further info.
PON (APPL)	HOST	UTILITY	2	DON	Enables +15V and –15V to analogue circuitry in controller + loads clock and video boards with voltage values.	This command now calls CON command in the Timing board i.e it powers up the complete system. Must be used before telemetry is read.
POF (APPL)	HOST	UTILITY	2	DON	Disable voltages to analogue circuitry and sets array safe.	Calls COF in the timing board before powering down main supplies.
SET nnnnnn $0 \leq nnnnnn \leq ffffff$ (APPL)	HOST	TIMING	3	DON	Set the integration time to nnnnnn milliseconds. This is the time the array is integrated AFTER the post reset reads of an MRA command	Integration Time Elapsed can be determined by using RDM command

Command	Source	Destination	Words	Response	Action	Remarks
CHK (BOOT)	HOST	TIMING, UTILITY	2	nnnnnn	Calculate checksum and return the calculated value nnnnnn	Timing P:0 -> P:1FFE Timing X:80 -> X:1FFE Timing Y:0 -> Y:1FFE Utility P:0 -> P:1FE Utility X:10 -> X:7E Utility Y:70 -> Y:FE
DAT n $0 \leq n \leq 3$ (APPL)	HOST	TIMING	3	DON	Determines type of data that MRA command transmits where n=0 then data = real n=1 then data = 1111,2222... n=2 then data = 0,1,2,3..65535.... n = 3 then data is 'read up ramp' mode (not implimented as yet)	Image data is transmitted faster than the test data because its algorithms runs from fast DSP memory whereas the test data runs from slow memory – done to reduce program size Mode set to 0 by reset & CON
OSH (APPL)	HOST	UTILITY	2	DON	Open shutter	Remains OPEN until RESET or CSH sent
CSH (APPL)	HOST	UTILITY	2	DON	Close shutter	

Command	Source	Destination	Words	Response	Action	Remarks
CON (APPL)	HOST	TIMING	2	DON	Switch voltages ON to array Clears readout mode to 0 (real array data).	Automatically sent by the PON command
COF (APPL)	HOST	TIMING	2	DON	Switch voltages OFF to array	Automatically sent by the POF command.
LON (APPL)	HOST	UTILITY	2	DON	Switch internal LED ON	Remains ON until RESET or LOF sent
LOF (APPL)	HOST	UTILITY	2	DON	Switch internal LED OFF.	
TEM n $0 \leq n \leq 16$ (APPL)	HOST	UTILITY	3	xxxxxx or 'ERR'	Read temperature channels. Currently channels 5,6,7 are legitimate temperature channels corresponding to Detector, Shield and Casting respectively.	Temperature returned in milliKelvin. A value of 0 indicates a temperature channel fault (reading outside limits 0 – 333 K).

Command	Source	Destination	Words	Response	Action	Remarks
SBS (APPL)	HOST	TIMING	2	DON	Re-establishes bias voltages from table to hardware.	Allows discrete bias voltage values to be changed without rebooting the controller. Be Careful !
PWR (APPL)	HOST	UTILITY	2	DON	Checks that the +/-15 volt supplies are within tolerance.	Returns ERR if out of specification.
SDT n $0 \leq n \leq 333$ (APPL)	HOST	UTILITY	3	DON	Set detector servo temperature. Setting to > 60c (333 Kelvin) is not allowed and results in ERR. Setting 0 disabled temperature control loop.	
RST (BOOT)	HOST	TIMING UTILITY	2	SYR	Resets the complete controller. Actually performed in hardware.	Puts controller into reset (i.e BOOT) condition.

Command	Source	Destination	Words	Response	Action	Remarks
LDA n n = 0 ... 256 (BOOT)	HOST	TIMING UTILITY	3	ERR	Support for application program load from EEPROM. Not implimented and will always return ERR	Redudent command. Applications are downloaded from host only.
CLR (APPL)	HOST	TIMING	2	DON	Performs a complete reset (Clear) of the detector array.	Takes 1.3 ms + comms time to complete.
RDC (APPL)	HOST	TIMING	2	IMAGE DATA	Performs one readout of array and sends data to host.	
LSP (APPL)	HOST	TIMING	2	DON	Does nothing but return good status. Not relevent to IR system	Set low speed readout mode.
HSP (APPL)	HOST	TIMING	2	DON	Does nothing but return good status. Not relevent to IR system	Set High speed readout mode

Command	Source	Destination	Words	Response	Action	Remarks
IDL (APPL)	HOST	TIMING	2	DON	Enables periodic idle mode clearing of detector array	This mode is enabled as default when the PON/CON command is issued.
STP (APPL)	HOST	TIMING	2	DON	Disables periodic idle mode clearing of detector array	Used to establish 'INTEGRATE' mode
BEX (BOOT)	HOST	UTILITY	2	DON	Begins exposure sequence by opening shutter and starting elapsed timer running. When elapsed time is >= to demanded time will close shutter.	Sends DON flag after shutter opened but before integration time reached.
PEX (BOOT)	HOST	UTILITY	2	DON	Pause exposure. Closes shutter and stops elapsed timer running	Returns error if exposure not active
REX (BOOT)	HOST	UTILITY	2	DON	Resumes exposure. Opens shutter and continues elapsed timer.	Returns error if exposure not active and/or paused by PEX command

Command	Source	Destination	Words	Response	Action	Remarks
DEX (BOOT)	HOST	UTILITY	2	(Delayed) DON	Detect end of exposure waits for maximum of 8 seconds for elapsed timer to be = to demanded time then returns status	Returns ERR if 8 seconds elapse before end of exposure.
PFL (BOOT)	HOST	UTILITY	2	DON	Turns on preflash LED, starts preflash elapsed time timer and eturns immediately. Preflash LED will be switched off after the elapsed time >= demanded preflash time	Contary to spec DAS- 18. Note that this command returns immediately. This to allow preflash periods greater than the host command timeout period.

MSN = Most Significant Nibble
 NSN = Next Significant Nibble
 LSN = Least Significant Nibble

Notes to COMMAND Table :-

1. Not all commands are available at all times. Column #1 indicates whether each command is: (i) a BOOT command which is available on power-up or reset, or (ii) an APPLication command which is available only in an application program which has been downloaded from the Host system.

The SDSU controller is capable of replying with certain responses to the commands received from the HOST computer. These responses are shown in the table below.

Response	Source	Destination	Words	Description
Image Data (APPL)	TIMING	HOST	N pixels	Data words returned instead of replies to commands
SYR (BOOT)	TIMING	HOST	2	Informs HOST system that SDSU controller has performed a RESET. (required for IRCAM compatibility)
DON (BOOT)	TIMING, UTILITY	HOST	2	Informs HOST system that previous command action was completed successfully.
ERR (BOOT)	TIMING, UTILITY	HOST	2	Informs HOST that command was unknown

Appendix A

This table shows a typical flow of commands and responses after the system has been reset.

Sequence	HOST command	SDSU Response	Description
1			System Reset
2		SYR	SDSU replies that it has RESET and REBOOT
3	000203 TDL 555555	020002 555555	Test the link to the TIMING board
4	000303 TDL AAAAAA	030002 AAAAAA	Test the link to the UTILITY board
5	000203 RDM 100007	020002 xxxxxx	Read version no. of Timing board boot code
6	000202 CHK	020002 xxxxxx	Do checksum of Timing board
7	000303 RDM 100007	030002 xxxxxx	Read version no. of Utility board boot code
8	000302 CHK	030302 xxxxxx	Do Checksum of Utility board
9	*.lod file downloaded using WRM command		Download Timing Board Application Code
10	000203 RDM 100007	020002 xxxxxx	Read version no. of Timing board application code
11	000202 CHK	030002 xxxxxx	Do checksum of Timing board
12	*.lod file downloaded using WRM command		Download Utility Board application code
13	000303 RDM 100007	030002 xxxxxx	Read version no. of Utility board application code
14	000302 CHK	030002 xxxxxx	Do checksum of Utility board
15	000302 PON	030002 DON	Switch supplies ON to boards
16 (redundant)	000202 CON	020002 DON	Switch supplies ON to array
17	000203 SET xxxxxx	020002 DON	Set exposure time
18	000203 MRA 1	020002 DON....Image Data.... 020002 DON	Sends DON then image data then DON back

Appendix B

Addresses which can be accessed using the RDM command.

Board	Address	Available	Format	Description
Timing / Utility	P:6	BOOT	Ascii	Version No. of Boot code
Timing / Utility	P:7	BOOT	Ascii	Version No. of Application code
Timing / Utility	P:1FE	BOOT	Binary	Noticeboard offset into X:mem space for UltraDas (NBAX)
Timing / Utility	P:1FF	BOOT	Binary	Noticeboard offset into Y:mem space for UltraDas (NBAY)
Timing	X:0	BOOT	Boolean	Timing status word (note 1).
Timing	X:1	BOOT	Integer	Integration time as set by SET.
Timing	X:2	APPL	Integer	Elapsed Integration Time in ms.
Timing	X:2E	APPL	Integer	Number of columns in image data divided by 2
Timing	X:2F	APPL	Integer	Number of rows in image data divided by 2
Timing	X:30	APPL	Integer	Number of reads in MRA sequence
Timing	X:36	APPL	Integer	Number of reset cycles pre-readout
Timing	X:37	APPL	Integer	Pixel Time in units of ns
Timing	X:38	APPL	Integer	Minimum Exposure Time in ms.
Timing	X:39	APPL	Integer	Number of read precondition cycles
Timing	X:3A	APPL	Integer	Readout mode
Timing	X:3C	APPL	Integer	Detector bias voltage in millivolts
Timing	X:3D	APPL	Integer	Detector reset voltage in millivolts
Timing	NBAX	APPL	Int table	Window skip/read table origin
Timing	NBAX+FC	APPL	Boolean	UltraDas Active Flag
Timing	NBAX+FD	APPL	Integer	Binning Factor in x (Not used !)
Timing	NBAX+FE	APPL	Integer	Binning Factor in y (Not used !)
Timing	NBAX+FF	APPL	Boolean	Window table enable flag
Timing	NBAY	APPL	Integer	Error number (not used !)
Timing	NBAY+1	APPL	Integer	Window table dimension
Timing	NBAY+2	APPL	Boolean	Readout speed (not used !)
Timing	NBAY+3	APPL	Integer	Pixel rate
Timing	NBAY+2	APPL	Boolean	Clock sequencer status

Board	Address	Available	Format	Description
Utility	X:0	BOOT	Boolean	Utility status word (note 2).
Utility	Y:0	BOOT	Byte Int	Detector ID code (1Eh)
Utility	NBAX	BOOT	Integer	Demanded exposure time (ms)
Utility	NBAX+1	BOOT	Integer	Demanded detector temp (mk)
Utility	NBAX+1	BOOT	Integer	Demanded preflash time (ms)
Utility	NBAY	BOOT	Integer	Elapsed exposure time (ms)
Utility	NBAY+1	BOOT	Integer	Current detector temp (mk)
Utility	NBAY+2	BOOT	Integer	Elapsed preflash time (ms)
Utility	NBAY+3	BOOT	Boolean	Shutter status
Utility	NBAY+4	BOOT	Integer	Error number (not used !)
Utility	Y:31	APPL	Integer	Set temperature in milliKelvin

Notes

1. Bit significance for Timing Code Status Word (Read only)

Bit	Significance	Comment
0	Command mode	Power is on, doing idle loop execs.
1	Idle reset mode	Set if continuous reset mode active.
2	Video mode	Reserved for future video streaming.
3	Readout mode	Set if readout is in progress.
4	Timer mode	Set if elapsed timer active
5	Command waiting	Set if command waiting for service
6	Host Flag	Set if command from host
7	Command error	Set if command format error occurred
8	Even/Odd row	Used in window readout. Not relevant

2. Bit Significance for Utility Code Status Word (Read only)

Bit	Significance	Comment
0	Service request	1ms Service req. pending
1	Exposure timer active	Set to request exposure timer service
2	Preflash active	Set to request preflash timer service.
3	Timeout active	Set to request command timeout service.
4	BEX in progress	Indicates exposure in progress
5	PWR in progress	Indicates PWR command in progress