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

SDSU INTERFACE CONTROL DOCUMENT
VERSION 2.3

Peter Moore 11th April 2000.

Version Summary

This version extends the functionality of Version 2.3 to include the readout mode, 'read up ramp', and to support simple windowed readout from one quadrant.

Read up ramp mode is selected by passing a data value of 3 with the **DAT** command. While in this mode the sdsu controller will invoke frame readouts beginning from the post reset read and then every n seconds for a total of mndr reads (where n = integration time set by the command **SET** and mndr = the data value passed with the **MRA** command that normally establishes the number of mndr reads).

Simple single quadrant readout is effected by setting the quadrant readout mask bits in X memory space, QUAD, to enable (bit = 1) or disable (bit = 0) the four quadrants. Bit 0 corresponds to quadrant 1, bit 1 to quadrant 2, etc. Furthermore, the X memory space variables NROW and NCOL (Number of rows and number of columns) can be modified to provide a reduced readout area. The position of this area can be modified by assigning values to the origin row and origin column variables, OROW and OCOL, also in X memory space.

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
TDL nnnnnn 0≤ nnnnnn ≤ ffffff (BOOT)	**HOST**	**TIMING, UTILITY**	**3**	**nnnnnn**	Test Data Link. Destination echoes nnnnnn back to Source.	
NOP (BOOT)	**HOST**	**TIMING, UTILITY**	**2**	**DON**	No Operation	A NOP command useful to determine if the system is responding to polling.
RDM maaaaa dddddd 0 ≤ aaaaa ≤ 0ffff 0≤ dddddd ≤ ffffff (BOOT)	**HOST**	**TIMING, UTILITY**	**3**	**dddddd**	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	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
WRM maaaaa dddddd 0 ≤ aaaa ≤ 0ffff 0≤ dddddd ≤ ffffff (BOOT)	**HOST**	**TIMING, UTILITY**	**4**	**DON**	Write Memory. Write dddddd 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.
MRA n 0≤n≤ 0xffffff (APPL)	**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)
TST (APPL)	**HOST**	**TIMING**	**2**	**DON**	Put Controller into Continuous Clock Test Mode	DO NOT USE IN ANY HOST PROGRAM Array must not be connected during this mode

Command	Source	Destination	Words	Response	Action	Remarks
ABR (APPL)	**HOST**	**TIMING**	**2**	**DON**	Abort Mode that Controller is in and return to Idle Mode – Post reset image data is transmitted.	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. Must be executed before CON command.	This command must be used before the CON command. Must be used before telemetry is read.
POF (APPL)	**HOST**	**UTILITY**	**2**	**DON**	Disable voltages to analogue circuitry	
SET nnnnnn 0≤ nnnnnn ≤ 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 (See previous discussion)	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).	Must be sent after the PON command
COF (APPL)	**HOST**	**TIMING**	**2**	**DON**	Switch voltages OFF to array	
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.	

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**		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.
FOR (BOOT)	**TIMING, UTILITY**	**HOST**	**2**	Informs HOST that first word of command (i.e. source, destination or number) was invalid
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	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	Name	Addr	Avail	Format	Description
Timing	BVER	P:6	BOOT	Ascii	Version No. of Boot code
Timing	AVER	P:7	BOOT	Ascii	Version No. of Application code
Timing	STAT	X:0	BOOT	Boolean	Timing status word (note 1).
Timing	TIME	X:1	BOOT	Integer	Integration time as set by SET.
Timing	ELAP	X:2	APPL	Integer	Elapsed Integration Time in ms.
Timing	NCOL	X:2E	APPL	Integer	Number of columns in image data divided by
Timing	NROW	X:2F	APPL	Integer	Number of rows in image data divided by 2
Timing	MNRA	X:30	APPL	Integer	Number of reads in MRA sequence
Timing	NRST	X:36	APPL	Integer	Number of reset cycles pre-readout
Timing	TPIX	X:37	APPL	Integer	Pixel Time in units of ns
Timing	MINE	X:38	APPL	Integer	Minimum Exposure Time in ms.
Timing	PREC	X:39	APPL	Integer	Number of read precondition cycles
Timing	MODE	X:3A	APPL	Integer	Readout mode
Timing	BIAS	X:3C	APPL	Integer	Detector bias voltage in millivolts
Timing	VRST	X:3D	APPL	Integer	Detector reset voltage in millivolts
Timing	QUAD	X:3E	APPL	Boolean	Quadrant enable mask.
Timing	OCOL		APPL	Integer	Origin for first column of readout area
Timing	OROW		APPL	Integer	Origin for first row of readout area
Utility	BVER	P:6	BOOT	Ascii	Version No. of Boot code
Utility	AVER	P:7	BOOT	Ascii	Version No. of Application code
Utility	STAT	X:0	BOOT	Boolean	Utility status word (note 2).
Utility	STMP	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	Clear if ready for command.
1	Reset mode	Set if continuous reset mode active.
3	Test mode	Set if clock test mode active.
4	Readout mode	Set if readout is in progress.

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

Bit	Significance	Comment
2	Shutter status	Set if shutter open.
5	Pre-flash status	Set if Pre-flash LED is on.