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INGRID - SDSU Interface Control Document

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Introduction

This document describes the protocol used for communication between the Host computer system and the SDSU controller which form part of the INGRID camera. These 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.	
RDM maaaaa dddddd 0 ? aaaaa ? 0fff 0? ddddddd ? ffffff (BOOT)	HOST	TIMING, UTILITY	3	dddddd	ReaD Memory. Read DSP address maaaaa. Returned data = ddddd. 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 memory locations for low level fault finding or checking the elapsed integration time.
WRM maaaaa dddddd 0 ? aaaa ? 0fff 0? ddddddd ? ffffff (BOOT)	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 m = 8: EEPROM	This command can be used to download new applications to program memory etc.

MRA n 1?n?16 (APPL)	HOST	TIMING	3	image data, DON	Execute Multiple Non Destructive Read consisting of n Resets 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	Array should not normally be connected during this mode
ABR (APPL)	HOST	TIMING	2	DON	Abort Mode that Controller is in and return to Idle Mode – No image data is transmitted.	Idle Mode continuously resets the array
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
POF (APPL)	HOST	UTILITY	2	DON	Disable voltages to analogue circuitry	

<p>SET nnnnnn 0? nnnnnn ? ffffff (APPL)</p>	HOST	TIMING	3	DON	Set the integration time to nnnnnn milliseconds	Integration Time Elapsed can be determined by using RDM command
<p>CHK (BOOT)</p>	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
<p>DAT n n=1,2 or 4 (APPL)</p>	HOST	TIMING	3	DON	Determines type of data that MRA command transmits where n=1 then data = real n=2 then data = 1111,2222... n=4 then data = 0,1,2,3..65535.... n is set to 1 at end of readout	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
<p>OSH (APPL)</p>	HOST	UTILITY	2	DON	Open shutter	Remains OPEN until RESET or CSH sent

CSH (APPL)	HOST	UTILITY	2	DON	Shut shutter	
CON (APPL)	HOST	TIMING	2	DON	Switch voltages ON to array	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 n=1,2,3 (APPL)	HOST	UTILITY	3	xxxxxx	Read temperature channels	0 < xxxxxx < 000fff

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.
2. All modes of operation should be possible by using particular combinations of the above command set.

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

Useful addresses, which can be accessed using the RDM command, as specified above.

Board	Address	Available	Description
Timing	P:6	BOOT	Version No. of Boot code
Timing	P:7	APPL	Version NO. of Application code
Timing	X:2F	APPL	Pixel Time in units of 40ns
Timing	X:30	APPL	Minimum Exposure Time=1.457s
Timing	X:2	APPL	Elapsed Integration Time
Utility	P:6	BOOT	Version No. of Boot code
Utility	P:7	APPL	Version NO. of Application code