RibEye Communications Protocol
Revision 7

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1.0 Overview
This protocol describes RibEye communications over serial or Ethernet ports. Control software for the current RibEye models – Hybrid III 5th and 50th, and WorldSID 5th and 50th as well as older RibEyes models such as SIDIIs, Polar, and Ballistic – support this protocol. The RibEye will be a Slave, and the external device the Master.

The 5th, 50th, and SIDIIs RibEye controllers use RS232 serial communications. These units are supplied with a trunk box that includes a serial-to-Ethernet converter, allowing Ethernet communications to the RibEye.

The Polar and WorldSID RibEyes have the serial-to-Ethernet converter built into the controller, so only Ethernet communication is available. However, they can be wired to provide serial communications.

The protocol includes two types of commands and responses:

1. Information commands: These commands request static information about the RibEye and its capabilities.
2. Control and Data Download commands: These are used for arming the RibEye and transferring data from the RibEye to the Master.

2.0 Port Setup
If connecting via a serial port, the serial port should be configured for 115 kBaud, 8 data bits, no parity, 1 stop bit, and no flow control.

If connecting via Ethernet through a trunk box, use the trunk box IP address (default is 192.168.0.240) and port 3000. Be aware that on older units the first character sent after the RibEye has booted might get dropped and result in a bad checksum response (see Section 4.0).

3.0 Generic Command Format
command [#param1] [#param2,]#checksumCRLF
where:
- command is the text command in all caps
- param1 is an ASCII integer, checked that it is within the correct range
- param2 is an ASCII integer, checked that it is within the correct range
- pound symbols (#) are used as delimiters between the command and the parameters and the checksum
- checksum is an 8-bit checksum of the whole line including all # delimiters up to the checksum
- CRLF is a carriage return followed by a linefeed, used as a command terminator.

Note: No additional spaces are allowed.
Note: The parameters are only used on specific commands, and are not optional if the command needs parameters.

4.0 Bad Checksum
If a command is received with a bad checksum the RibEye will respond with ?1.
Note that most versions of the firmware have left debugging code enabled, so a bad checksum response will include the expected checksum, such as:

```
?1 - should be 0
```

5.0 Bad Command

If a command is received with a good checksum, but is not recognized, RibEye will respond with ?2.

6.0 Special Cases during Acquisition and post-test writing to Flash, and Erase

While the RibEye is busy during acquisition, during immediate post-test transfer of data to flash, and during flash erase, the RibEye will only respond to certain commands as defined below.

6.1 Acquisition Special Case

RibEye will only respond to S# (status), T# (force trigger), and D#(disarm) commands.
Due to limited time available for command parsing during acquisition, the RibEye looks for a good command first, and if it receives a command other than S, T, or D it reports a bad command by sending ?2.
If an S, T, or D command is received with a bad checksum, RibEye will respond with ?1.

6.2 Post-test Writing Data to Flash Special Case

If acquisition is terminated normally, and not by a D disarm command, it will immediately write a partial data set to flash to prevent loss of data from a loss of power. During this time, commands will be parsed normally, with the checksum tested first. The RibEye will respond to any command except the Status command with ?2 – the bad command response. This is because writing to flash is the highest priority, and no other commands can be accepted.
The RibEye will respond to a status command with S#2#203CRLF, which indicates it is busy.

6.3 Erase Command Special Case

Erasing flash typically takes about 12 seconds, but it can take up to 90 seconds worst case. During this time, commands will be parsed normally, with the checksum tested first. The RibEye will respond to any command except the Status command with ?2 – the bad command response. This is because erasing flash is the highest priority, and no other commands can be accepted.
The RibEye will respond to a status command with S#2#203CRLF to indicate it is busy.
An Erase Status command E#104CRLF has been added to get progress of data flash erasing. It responds with E#p1#p2#checksumCRLF, where p1 is the current sector being erased, and p2 is the total number of sectors to be erased.

7.0 Command Response Times

The longest response should be less than 50 ms except for:

- CURRENT_POSITIONS command can take up to 0.3 second.
- SAVE and SETTESTCOMMENT commands have to erase one sector of flash. A sector erase will typically take less than 1 second, but can take up to 6 seconds worst case.
- ERASE command – see above.

8.0 Static Information Commands

These commands report static information about the RibEye.

8.1 WHO_ARE_YOU

parameters: none
returns: WHO_ARE_YOU#XXXXXXXXXX#checksum
where XXXXXXXXXX is a character string up to 10 characters long, and will be the RibEye type, such as 5th_Female, 50th_Male, SIDIIs, WorldSID50, Rollover, etc.

Example Command: WHO_ARE_YOU#164CRLF
Example Response: WHO_ARE_YOU#5th_Female#129CRLF

8.2 SERIAL_NUMBER

parameters: none
returns: SERIAL_NUMBER#XXXXXXXXXX#checksum
where XXXXXXXXXX is a character string up to 10 characters long
Example Command: SERIAL_NUMBER#11CRLF
Example Response: SERIAL_NUMBER#0075#250CRLF

8.3 CAL_DATE

parameters: none
returns: CAL_DATE#XXXXXXXXXXXXXXXXXXXX#checksum
where XXXXXXXXXXXXXXXXXXXX is a string up to 20 characters long
Example Command: CAL_DATE#112CRLF
Example Response: CAL_DATE#SEPTEMBER 12, 2007#178CRLF

8.4 CAL_LOC

parameters: none
returns: CAL_LOC#XXXXXXXXXXXXXXXXXXXX#checksum
where XXXXXXXXXXXXXXXXXXXX is a string up to 20 characters long
Example Command: CAL_LOC#48CRLF
Example Response: CAL_LOC#R.A. DENTON, MI#12CRLF

8.5 FIRMWARE

parameters: none
returns: FIRMWARE #XXXXXXXXXX#checksum
where XXXXXXXXXX is a string up to 10 characters long
Example Command: FIRMWARE#128CRLF
Example Response: FIRMWARE#5A0002#219CRLF

8.6 HOW_MANY_LEDS

parameters: none
returns: HOW_MANY_LEDS #XX#checksum
where XX is a decimal number of LEDs the RibEye monitors
Example Command: HOW_MANY_LEDS#44CRLF
Example Response: HOW_MANY_LEDS#12#178CRLF

8.7 HOW_MANY_AXES

parameters: none
returns: HOW_MANY_AXES #XX#checksum
where XX is a one digit decimal number of axes for each LED reported (2 or 3)
Example Command: HOW_MANY_AXES#53CRLF
Example Response: HOW_MANY_AXES#3#139CRLF

Note: Number of LEDs x number of axes = number of “data channels” collected.

8.8 CURRENT_POSITIONS

parameters: none

returns: CURRENT_POSITIONS#n#CH1, CH2, …,CHn-1, CHn #checksum

where:

n = number of channels

CHi = a decimal number (xxx.x) in millimeters

The channel order for a 2-axis system is: LED1X, LED1Y, LED2X, LED2Y, …,LEDnY

The order for a 3-axis system is: LED1X, LED1Y, LED1Z, LED2X, LED2Y,…,LEDnZ

Example command: CURRENT_POSITIONS#109CRLF

Example Response (for a 6-LED, 3-axis system):

CURRENT_POSITIONS#18#1.0,165.0,-113.5,0.0,167.0,-67.0,0.0,167.0,
-22.5,1.0,166.5,22.5,-1.2, 166.8,66.2,0.0,168.0,112.5#72CRLF

Note: Embedded in the current positions are error codes. For a two-axis system, if the light from a LED can't get to sensor 1, both of the X and Y values will be forced to a 1. If the light can't get to sensor 2, the X and Y values will be forced to 2. If the light can't get to both sensors, the X and Y values will be forced to 3. For a three-axis system the error codes are 1,2,3,4,5,6,7, and ALL axes will report the same number. So if you want to get fancy, you can turn any number on all axes less than10 red to flag the user. The system will return an 8 if it can't resolve a good reading because some other problem occurs that can cause a divide by zero in the code. So you can also flag any 8's that you receive. WorldSIDs can also report and error code of 9 indicating that the end of a calibration curve has been passed

The LED positions on the ATD are shown in the tables below.

LED Number	5th Female	50th Male	SIDIIs	Ballistic SIDIIs	Polar
1	Rib 1 Left	Rib 1 Left	Rib 1	Rib 1	Rib 4 Outer
2	Rib 2 Left	Rib 2 Left	Rib 2	Rib 2	Rib 5 Outer
3	Rib 3 Left	Rib 3 Left	Rib 3	Rib 3	Rib 6 Outer
4	Rib 4 Left	Rib 4 Left	Rib 4		Rib 4 Middle
5	Rib 5 Left	Rib 5 Left	Rib 5		Rib 5 Middle
6	Rib 6 Left	Rib 6 Left	Rib 6		Rib 6 Middle
7	Rib 1 Right	Rib 1 Right			
8	Rib 2 Right	Rib 2 Right			
9	Rib 3 Right	Rib 3 Right			
10	Rib 4 Right	Rib 4 Right			
11	Rib 5 Right	Rib 5 Right			
12	Rib 6 Right	Rib 6 Right			

Note: current WorldSIDs (5th and 50th) use same led positions for both Left and Right

LED Number	Current WorldSID on ATD Left Side	Current WorldSID on ATD Right Side	Obsolete (sn 75) WorldSID on ATD Left Side	Obsolete (sn 75) WorldSID on ATD Right Side
1	Rib 1 Rear	Rib 1 Rear	Rib 1 Rear	Rib 1 Front
2	Rib 1 Middle	Rib 1 Middle	Rib 1 Middle	Rib 1 Middle
3	Rib 1 Front	Rib 1 Front	Rib 1 Front	Rib 1 Rear
4	Rib 2 Rear	Rib 2 Rear	Rib 2 Rear	Rib 2 Front
5	Rib 2 Middle	Rib 2 Middle	Rib 2 Middle	Rib 2 Middle
6	Rib 2 Front	Rib 2 Front	Rib 2 Front	Rib 2 Rear
7	Rib 3 Rear	Rib 3 Rear	Rib 3 Rear	Rib 3 Front
8	Rib 3 Middle	Rib 3 Middle	Rib 3 Middle	Rib 3 Middle
9	Rib 3 Front	Rib 3 Front	Rib 3 Front	Rib 3 Rear
10	Rib 4 Rear	Rib 4 Rear	Rib 4 Rear	Rib 4 Front

11	Rib 4 Middle	Rib 4 Middle	Rib 4 Middle	Rib 4 Middle
12	Rib 4 Front	Rib 4 Front	Rib 4 Front	Rib 4 Rear
13	Rib 5 Rear	Rib 5 Rear	Rib 5 Rear	Rib 5 Front
14	Rib 5 Middle	Rib 5 Middle5	Rib 5 Middle	Rib 5 Middle
15	Rib 5 Front	Rib 5 Front	Rib 5 Front	Rib 5 Rear
16	Rib 6 Rear	Rib 6 Rear	Rib 6 Rear	Rib 6 Front
17	Rib 6 Middle	Rib 6 Middle	Rib 6 Middle	Rib 6 Middle
18	Rib 6 Front	Rib 6 Front	Rib 6 Front	Rib 6 Rear

Getting the current LED positions is the only way to tell whether the RibEye is performing properly. You can define a range of acceptable numbers for the default unloaded rib positions based on the dummy type.

8.9 SAMPLE_RATE

parameters: none
returns: SAMPLE_RATE #XXXXX#checksumCRLF
where XXXXX is a five digit decimal sample rate in Hz for all channels
Example Command: SAMPLE_RATE#112CRLF
Example Response: SAMPLE_RATE#10000#132CRLF

Note: All current RibEyes run at 10 kHz except the Ballistic SIDIIs (3 LEDs, 3 axes) for weapons testing. The Ballistic SIDIIs runs at 20 kHz.

8.10 DIRECTION

parameters: none
returns: DIRECTION#XXXXX#checksumCRLF
where XXXXX is either LEFT or RIGHT
Example Command: DIRECTION#196CRLF
Example Response: DIRECTION#LEFT#18CRLF
Example Response: DIRECTION#RIGHT#101CRLF

The Direction command is used for WorldSID 5th and 50th and refers to the struck side ribs that the RibEye is monitoring. All other ATDs will return the ?2 Bad command response.

9.0 Configuration and Control Commands

These commands are for configuring the RibEye, initiating data acquisition, erasing flash, downloading, and checking the RibEye status.

9.1 S (status command)

command has no parameters
returns: S#P1#checksumCRLF
where P1 is:

0 = idle, no data in RAM or flash, ready to run a test
1 = if armed and collecting pre-trigger data
2 = if busy. Busy states are:

- collecting post-trigger data
- storing data in flash post-test
- erasing flash pre-test

3 = idle with data in RAM or flash, ready to download

Example Command: S#118CRLF
Example Response: S#3#204CRLF

9.2 T (force trigger command, only active during acquisition)

command has no parameters
returns: T#119CRLF
Notes:
During acquisition this command will force a T0 event as if a hardware T0 had occurred.
If this command is received at any time other than during data acquisition, a bad command response will be issued (?2).

9.3 D (disarm command during acquisition)

command has no parameters
returns: D#103CRLF
During acquisition, this command will force the RibEye to return to the idle state immediately. NO DATA WILL BE STORED.
If this command is received at any time other than during data acquisition, a bad command response will be issued (?2).

9.4 ERASE (erase flash memory)

command has no parameters
response: (after the erase is complete) ERASE#P1#checksumCRLF
where P1 = 0 for a successful erase
P1 >0 if any sector erase failed

Example Command: ERASE#147CRLF
Example Response: ERASE#0#230CRLF

9.5 E (erase status command)

command has no parameters
response: (during erase) ERASE#P1#P2#checksumCRLF
where P1 = current sector being erased
P2 = total number of sectors to be erased (depends on model)

Example Command: E#104CRLF
Example Response: E#31#32#119CRLF
Note that this command is only valid during a flash erase. If issued at other times you will get a bad command response (?2)
Typically you would issue an erase command, then issue erase status commands until the erase is complete. Below is a typical scenario:

```
ERASE#147      //erase command sent
E#104          //erase status command sent
E#1#32#68      //erase status response – erasing sector 1 of 32
E#104          //erase status command sent
E#12#32#118    //erase status response – erasing sector 12 of 32
E#104          //erase status command sent
E#23#32#120    //erase status response – erasing sector 23 of 32
E#104          //erase status command sent
E#31#32#119    //erase status response – erasing sector 31 of 32
ERASE#0#230    //response to original erase command – no errors reported
E#104          //erase status command sent
?2             //bad command response since erase was finished
```

9.6 ARM (initiates data collection)

Note: RibEye sends an ARM response immediately, then enters acquisition mode
Parameters: Tstop (in integer ms) and Tpost (in integer ms)
returns: ARM#Tstop#Tpost#checksumCRLF
Example Command (for circular buffer, collect for 2 secs after trigger):

```
ARM#0#2000#59CRLF
```

Example response: ARM#0#2000#59CRLF

Example bad command:	ARM#-10#2000#153CRLF
Example bad response:	ARM#BAD#2000#210CRLF
Example bad command:	ARM#0#32000#110CRLF
Example bad response:	ARM#0#BAD#64CRLF

Valid Tstop and Tpost are:
Tstop must be >= 0 ms
Tpost must be >=0 and <= 30000 ms (25000 ms for WorldSID)

If data memory is not erased, the arm command will return:
ARM#ERROR-NOT_ERASED#225

The RibEye has a 30-second RAM buffer (25 seconds for WorldSID), and behaves as follows:

- If Tstop = 0, then the buffer will be treated as a circular buffer. After arming, the RibEye will collect data into the circular buffer. When a trigger is received (hardware or T# command) data will be collected for an additional Tpost time. If no trigger is received, the RibEye will just keep collecting forever unless it receives a d# disarm command..
- If Tstop <= 30000 ms, the buffer will be treated as a linear buffer.
  If a trigger is received before Tstop, the RibEye will continue to collect data for Tpost more seconds, or until 30,000 ms has elapsed since the Arm command, whichever is shorter.
  If no trigger is received, data collection will stop Tstop ms after the ARM command
  Note that for DTS interface versions, the ARM command starts acquisition, but the linear buffer timer is not started until the DTS Start signal changes state.
- If Tstop > 30000 ms, the buffer will be treated as a circular buffer.
  If a trigger is received before Tstop, the RibEye will continue to collect data for Tpost more seconds, or until Tstop ms has elapsed since the Arm command, whichever is shorter.
  If no trigger is received, the RibEye will stop collecting data Tstop ms after the ARM command, and the buffer will hold data from (Tstop-30000) to Tstop ms after the ARM command.

For WorldSID all 30,000 ms times SHOWN above are 25000 ms

Data time definitions:
If a trigger occurs during acquisition, all pre-trigger data is considered negative time, and all post-trigger data is considered positive time.

If no trigger occurs during acquisition, all data times are considered positive. The first sample will be at 0 ms if Tstop <=30000 ms. The first sample will be at (Tstop-30000) ms for Tstop > 30000 ms.

9.7 DUMPINFO (reports data available for download)

no parameters for command
returns: DUMPINFO#T1#T2#checksumCRLF
Where: T1 is the data start time in ms
T2 is the data stop time in ms
Example command: DUMPINFO#133CRLF
Example response: DUMPINFO#-2126#1000#132CRLF
data available from –2126 ms to +1000 ms.

9.8 DUMPBIN (requests data in binary format)

parameters: T1, T2
T1 is the download start time in integer ms.
T2 is the download stop time in integer ms.
returns: DUMPBIN#X1#X2#checksumCRLF followed by a binary spew.
X1 is the number of data points for each time sample. (24 for the 5th and 50th, 18 for the SIDIIs).
X2 is the number of time samples being sent.
A checksum will be inserted at the end of the data points for each time sample.
Each data point will be a 16 bit binary number = millimeter * 100.
Each data point is sent least significant byte first.
The checksum is one byte.
For 24 data points per sample, 49 bytes are sent (24 * 2 byte + 1 checksum byte).

SIDIIs Example command: DUMPBIN#-90#200#160CRLF
This command requests data from –90 ms to 200 ms for all channels.

SIDIIs Example response: DUMPBIN#18#2910#173CRLF
(18 data points per sample, 2910 samples at 10 kHz)
The spew will look like:
LED1X LED1Y LED1Z LED2X ……LED6X LED6Y LED6Z checksum
LED1X LED1Y LED1Z LED2X ……LED6X LED6Y LED6Z checksum
LED1X LED1Y LED1Z LED2X ……LED6X LED6Y LED6Z checksum
No carriage returns or linefeeds are inserted in the spew.

Example Bad Command (assuming data starts at –90 ms):
DUMPBIN#-100#200#200CRLF
Example Bad Response: DUMPBIN#BAD#200#209CRLF

If DUMPINFO reports data start time of TSTART and stop time of TSTOP, then the DUMPBIN command will report errors if:
T1 bad if T1 < TSTART or T1 >= TSTOP
T2 bad if T1 <= T1 or T2 >TSTOP

Note: Error codes are inserted in the data if the LED positions cannot be accurately calculated. The error codes are described in section 8.8 CURRENT_POSITIONS. The error codes will be reported on the X, Y, and Z data for the LED that cannot be resolved.

Figure 1 shows a C program for a PC that reads in the DUMPBIN data that was captured by a terminal program to a file. The program writes out a comma delimited ASCII file of the data. The last column of the output file is a Boolean value comparing the calculated checksum to the sent checksum.

Figure 1 – C program on PC for processing DUMPBIN command data

```
#include <stdio.h>

void main (void)
{
FILE *fpin;
FILE *fpout;
int data;
char *pdata;
unsigned char c1, c2, checksum;
int darray[25];
int i,j,k;

fpin = fopen("danbin.txt","r+b");  //data captured to danbin.txt
fpout = fopen("dan.csv","w+");     // converted data put in dan.csv


while(getc(fpin) != '\n');  // throw away the command response


while(!feof(fpin) )
      {
      checksum = 0;
      for(i=0;i<24;i++)  // get 48 chars, process into 24 ints
            {
            pdata = (char*)&data;
            c1=getc(fpin);
            checksum += c1;
            c2=getc(fpin);
            checksum += c2;
            *pdata++ = c1;
            *pdata = c2;
            darray[i]=data;
            }
      c1=getc(fpin);  //read the checksum
      if(feof(fpin)) break;
      darray[24]=(checksum == c1);  // check the checksum
      for(j=0;j<24; j++)fprintf(fpout,"%d,",darray[j]);  //send 24 nums
      fprintf(fpout,"%d\n",darray[24]); //send the checksum check
      }
fclose(fpin);
fclose(fpout);
fprintf(stdout,"all done ...............................");
fflush(stdout);
```

9.9 DUMPBINA (include ambient light data)

This command performs the same as the DUMPBIN command, but it appends the ambient light readings for each sensor. So for a 5th Female, instead of getting 24 (12 LEDs X and Y) short ints (16 bits) data points per line, you get 26 short ints, where the last two are the ambient light readings for sensor 1 and sensor 2 respectively. For a SIDIIs, a DUMPBIN command will send 18 data points per line (6 LEDs, 3 axes), while DUMPBINA will send 21 data points per line (6 LEDs, 3 axes, + 3 ambient light readings). The WorldSID has 6 ambient light readings

Since the ambient light readings could theoretically be full scale 65,535 counts, and all other data is treated as signed short ints, the ambient light data is divided by two before being sent. On the receiving side, the ambient light data should be multiplied by two to get back to counts.

Note: Error codes are inserted in the data if the LED positions cannot be accurately calculated. The error codes are described in section 8.8 CURRENT_POSITIONS. The error codes will be reported on the X, Y, and Z data for the LED that cannot be resolved.

9.10 TRIGGERSET (sets the trigger polarity and type, stores the setting in flash)

Parameters: one parameter P1 as follows:

0 – for leading edge, switch or TTL input
1 – for trailing edge, switch or TTL input
3 – for leading edge, differential input *
4 – for trailing edge, differential input *

returns: TRIGGERSET#P1#checksumCRLF
Where: P1 is the trigger setting as above
Example command: TRIGGERSET#0#118CRLF
Example response: TRIGGERSET#0#118CRLF

Example Bad Command: TRIGGERSET#5#123 CRLF
Example Bad Response: TRIGGERSET#BAD#13

*Note: Most models do not have a differential receiver, and the optically isolated switch input is used to connect to systems using a differential (RS485) trigger bus. Current WorldSID models only have an optically isolated trigger input and will respond with the BAD response if you attempt to set the trigger to the differential settings 3 or 4. Other models without differential trigger receivers will accept the differential settings, but will actually use an optically isolated trigger input.

9.11 GETTRIGGER (gets the trigger polarity and type)

Parameters: none
returns: GETTRIGGER#P1#checksumCRLF
Where: P1 is the trigger setting as above
Example command: GETTRIGGER#23CRLF
Example response: GETTRIGGER#0#106CRLF

NOTE: For units such as the Polar, where the trigger comes from the G5DB, the trigger will always be set to 0 for leading edge. It will be set at the factory and won't need to be changed. For units that have a trunk box to interface to any type of DAS, such as the current 5th, 50th, and SIDIIs, all of the trigger options can be used.

9.12 GETTESTCOMMENT (get a string from RibEye flash memory)

An 80-character text string that is stored in flash is called the Test Comment, but it is typically used in my application to store the ATD type and serial number, like 5th#103.

Parameters: none
returns: GETTESTCOMMENT #P1#checksumCRLF
Where: P1 is the text string, up to 80 characters
Example command: GETTESTCOMMENT #86CRLF
Example response: GETTESTCOMMENT #5th s/n 103#106CRLF

Note that the Test Comment text string can have a # symbol in it when it is written (see Section 9.13, SETTESTCOMMENT). However, when the Test Comment is sent back from the RibEye, in response to a GETTESTCOMMENT command, it replaces all # symbols with 0x03, so as not to appear as a command delimiter. Your code should look for 0x03 characters and switch them back to #'s.

9.13 SETTESTCOMMENT (set a string in RibEye flash memory)

The behavior of this command is different from other commands.

Command: SETTESTCOMMENT#98
The RibEye will send back: COMMENT?\n
then send the test comment string terminated with a \r
After the RibEye saves the string in flash, it will respond with:
SETTESTCOMMENT#OK#31

Example:

SETTESTCOMMENT#98	{sent to RibEye}
COMMENT?\n	{response from RibEye}
Foo bar moo\r	{the text string sent to RibEye}
SETTESTCOMMENT#OK#31	

Note that the response will be slow since it has to erase an 8k flash block.
Below is a snippet of the firmware that responds to the command:

```
printf("COMMENT?\n");              // ask for the test comment
fflush(stdout);
UART_gets(TestComment, 81);   // get response, no more than 81 chars, terminated by \r
TestComment[strlen(TestComment)-1] = '\0';  // null terminate the string
*(strpbrk(TestComment,"\r")) = '\0';           // get rid of the \r, replace with \0 just in case
save_params();                                 // save the parameters in flash
strcpy(response,"SETTESTCOMMENT#OK#");
```

9.14 ARMTRIGGER (used for trigger received checking)

Parameters: none
returns: ARMTRIGGER#OK#checksumCRLF
Example command: ARMTRIGGER#23CRLF
Example response: ARMTRIGGER#OK#212CRLF

NOTE: The ARMTRIGGER command reads the trigger configuration from Flash memory, as it was defined in a previous TRIGGERSET command. The trigger circuit is configured and the trigger input latch is cleared so any subsequent triggers received will be latched

9.15 TRIGGERCHECK (used for trigger received checking)

Parameters: none
returns: TRIGGERCHECK#P1#checksumCRLF
Where: P1 is 0 if no trigger received, or 1 if a trigger has been received
Example command: TRIGGERCHECK#49CRLF
Example response: TRIGGERCHECK#0#232CRLF
Example response: TRIGGERCHECK#1#233CRLF

Appendix A – Command Summary

Section	Command	Parameter 1	Parameter 2	Function
8.1	WHO_ARE_YOU#164	x	x	reports RibEye model type
8.2	SERIAL_NUMBER#11	x	x	reports serial number
8.3	CAL_DATE#112	x	x	reports calibration date
8.4	CAL_LOC#48	x	x	reports calibration location
8.5	FIRMWARE#128	x	x	reports firmware revision
8.6	HOW_MANY_LEDS#44	x	x	reports number of LEDs
8.7	HOW_MANY_AXES#53	x	x	reports number of axes per LED
8.8	CURRENT_POSITIONS#109	x	x	reports XY or XYZ position of each LED
8.9	SAMPLE_RATE#112	x	x	reports sample rate per LED
8.10	DIRECTION#196	x	x	reports WorldSID impact side
9.1	S#118	x	x	reports status
9.2	T#119	x	x	force trigger
9.3	D#103	x	x	disarm
9.4	ERASE#147	x	x	erase memory
9.5	E#104	x	x	erase status
9.6	ARM#0#2000#59	Tstop	Tpost	arm the RibEye
9.7	DUMPINFO#133	start time	end time	reports how much data is in memory
9.8	DUMPBIN#-90#200#160	start time	end time	send data
9.9	DUMPBINA#0#50#78	start time	end time	send data and ambient light
9.10	TRIGGERSET#0#118	trigger		set the trigger polarity and type
9.11	GETTRIGGER#23	x	x	set the trigger polarity and type
9.12	GETTESTCOMMENT#86	x	x	get the text string in flash
9.13	SETTESTCOMMENT#98	x	x	set the text string in flash
9.14	ARMTRIGGER#23	x	x	Arms and configures the trigger circuit
9.15	TRIGGERCHECK#49	x	x	Checks if a trigger occurred since arming

Appendix B. Behavior on Boot

Upon boot, the RibEye checks the flash for valid data by calculating a checksum. If the flash checksum does not match the checksum stored in the flash, the RibEye will report the data in flash as –

Start Time = –29, 999 ms
Stop Time = -27,9999 ms (-28,299 for WorldSID)

There may or may not be any good data in flash, but the data can be downloaded and inspected.

When the RibEye boots, it will flash all LEDs in sequence, starting with LED #1. Each LED will be turned on for approximately 1 second.

Units using Ethernet communications take approximately 10 seconds for the Ethernet processor to be ready to respond to commands. On older units the first character sent after boot may be dropped, resulting in a bad checksum response.

Units using a serial interface will be ready for communications less than 1 second after booting.

The RibEye control processor is set up so that it can boot to one of two versions of the application code stored in flash. This allows it to run DAS-specific code and the normal RibEye code. Unless a specific DAS interface is selected, the normal RibEye firmware will be installed in both locations in flash. Contact the factory for more information, or to request modifications to the normal firmware.

Appendix C – Hardware Interface Circuits

Please refer to the RibEye hardware manuals for information on the hardware interfaces. The manuals can be downloaded from the Boxboro Systems Web page – www.boxborosystems.com Go to the RibEye tab to download the manuals. For previous versions of the RibEye manuals, and manuals for obsolete products, follow the link on the RibEye tab.

On the RibEye tab there is also a link to a document describing the cable assemblies available to connect a RibEye to various DAS systems. Contact the factory if a cable you need is not included in the document. Currently cables are provided for Kistler KiDau, KiHub,NXT32, and DTI hub, DTS Distributors, Kyowa Junction Unit DIS61A, as well as generic cable assemblies for trigger, power, and ethernet.

Appendix D – Document Change History

Rev 7 Changed from Rev 6 (2010)

- Added more notes on error codes to current position s command in section 8.8
  Also updated WorldSID LED positions table for current models. Left in data for the one obsolete unit still in the field
- Added 8.10 DIRECTION command
- 9.10 – updated note on the TRIGGERSET command
- 9.14 ARMTRIGGER command added for trigger checking
- 9.15 TRIGGERCHECK command added for trigger checking
- 10.0 LOADER command removed – done with Boxboro Systems software
- Appendix A updated command summary with new commands, removed Loader
- Updated information in Appendix B – dual boot capability
- Appendix C - removed old information, added references to RibEye Hardware and DAS interface manuals

Rev 6 Changes from Rev 5

- Added some notes about WorldSID only having a 25 second data buffer where all other units have 30 second data buffer. WorldSID can only store 1.7 seconds of data in flash versus 2 seconds for all other units.
- Added Appendix E, Special Commands for 50th Male Adjustable LED Position RibEye
- Added Appendix F, Notes on Sign Conventions and Coordinate Transformations

Rev 5 Changes from Rev 4:

- Major cleanup and reformatting
- Eliminated the DUMPBINX and DUMPBINXA commands
- For the DUMPBIN and DUMPBINA commands each data point will be a 16-bit binary number = millimeter * 100, not mm*10
- The DUMPBIN and DUMPBINA commands all report error codes in the data as described in the CURRENT-POSITIONS command in section 8.8
- Since all users do not change the LED positions – the LEDs are always run in the default positions - the LED_POSN, SHOW-LEDS , and SAVE commands were removed.
- Added note to TRIGGERSET command that the differential input receiver is in the Trunk box, so RibEyes without a Trunk box treat a differential trigger setting the same as a switch input.
- Fixed typo in GETTRIGGER
- Added GETTESTCOMMENT
- Added SETTESTCOMMENT
- Updated command response times section 7.0
- Updated section 2 port setup to add Ethernet connections
- Updated section 4, bad checksum
- Updated appendix A, command summary
- Updated ARM command for DTS interface versions
- Added Appendix B - Behavior on Boot
- Added Appendix C - Hardware Interfaces
- Moved revision history to Appendix D

Rev 4 changes from Rev 3:

- Fixed formatting error in section 9.1

- Updated behavior at boot in Appendix C

Rev 3 Changes from Rev 2:

- Added Erase Status (E)command
- Added DUMPBINA and DUMPBINXA commands
- Added TRIGGERSET command
- Added GETTRIGGER command
- Updated the SAVE command with Polar, WorldSID, and Ballistic SIDIIs
- Updated Appendix A, Command Summary

Rev 2 Changes from Rev1:

- Added Appendix A, Command summary
- Added Appendix B, Connector Pinouts and Wiring for CrashLink Hub
- Added Appendix C, Protocol Test Rig Behaviors
- Added documentation of ARM response when memory not erased
- Added Loader command to load new code
- Added DUMBINX command

Rev 1 Changes from Rev 0:

- Added status command (S) to report current status
- Added force trigger command (T) to force a trigger during acquisition
- Added disarm command (D) to stop acquisition immediately
- Added DUMPINFO command to report available data for downloading
- Added SHOW_LEDS command to show the current LED position codes
- Added SAVE command to save and LED position changes in flash
- Added ?1 response to a bad checksum
- Added ?2 response for a bad command
- Eliminated trigger setting command (TRIGGER#) and put the acquisition times (Tstop and Tpost) parameters into the ARM command.
- Added Error response to ARM command if flash is not erased
- Changed DUMPALL to DUMPBIN to allow for possible future DUMPCSV command to dump the data in CSV format, and future DUMPISO command to dump in ISO format.
- Changed ERASE command to include a parameter to indicate successful erase or failure.
- Fixed checksums in some command examples
- Fixed LED position codes for 5th Female

Appendix E

Special Commands for 50th Male Adjustable LED Positions

Special firmware is available for the 50th Male, 2-axis RibEye that allows the user to put any LED on any rib. The user may also place multiple LEDs on a rib. Special LED mounts are available that attach the LEDs to the rib stiffener bars in addition to the normal LEDs that attach to the ribs with nylon zip ties.

In order to be able to place any LED on any rib, the user must tell the RibEye which rib the LED is on, so that the RibEye can use the correct calibration curve to process the RibEye data into engineering units. The commands LED_RIB and SHOW_LEDRIB are used to set and read the LED position. The SAVE command stores the LED data in flash.
LED_POSN and SHOW_LEDPOSN commands are also implemented to allow the application program to store some additional information in the RibEye flash memory. In the RibEye application program the position codes are used for right/left side and rib/sternum.

LED_RIB (sets the rib that the LED is mounted on)

Parameters: two parameters P1 and P2 as follows:

P1 is the LED number, 1 through 12

P2 is the rib number, 1 through 6

returns: LED_RIB#P1#P2#checksumCRLF

Example command: LEDRIB#1#2#118CRLF

Example response: LEDRIB#1#2#118CRLF

If either parameter is out of range, the response will contain BAD instead of the parameter, such as:

Example bad command: LED_RIB#0#0#218CRLF

Example bad response: LED_RIB#BAD#BAD#8CRLF

LED_POSN (set the position code for a LED)

Parameters: two parameters P1 and P2as follows:

P1 is the LED number, 1 through 12

P2 is the position code, 0 though 3

returns: LED_POSN#P1#P2#checksumCRLF

Example command: LEDPOSN#1#2#64CRLF

Example response: LEDPOSN#1#2#64CRLF

If either parameter is out of range, the response will contain BAD instead of the parameter, such as:

Example bad command: LED_POSN#0#0#221CRLF

Example bad response: LED_POSN#BAD#0#212CRLF

Note: your application software can use the position codes however you want

SAVE (saves the LED rib and position codes in flash memory

Parameters: none

returns: SAVE#82CRLF

Example command: SAVE#82CRLF

SHOW_LEDRIB (shows the rib that each LED is mounted on

Parameters: none

returns: SHOW_LEDRIB#12#R1,R2,R3,R4,R5,R6,R7,R8,R9,R10,R11R12#118CRLF

where R1 through R12 are the rib numbers (1-6) that the LEDs are mounted on

Example command: SHOW_LEDRIB#117CRLF

Example response: SHOW_LEDRIB#12#2,2,3,4,5,6,1,2,3,4,5,6#109

SHOW_LEDPOSN (shows the position code for each LED

Parameters: none

returns: SHOW_LEDPOSN#12#P1,P2,P3,P4,P5,P6,P7,P8,P9,P10,P11P12#118CRLF

where P1 through P12 are the position codes (1-4) for each LED

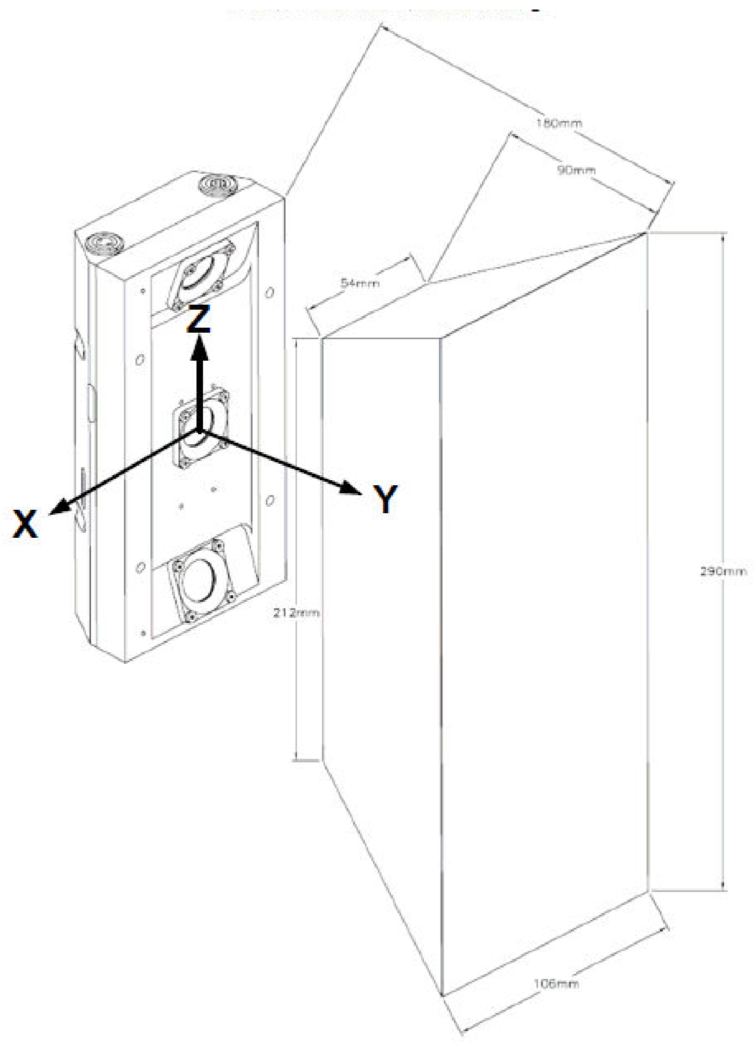
Example command: SHOW_LEDPOSN#216

Example response: SHOW_LEDPOSN#12#2,0,0,0,0,0,2,2,2,2,2,2#179

Appendix F
Sign Conventions and Coordinate Transformations

The RibEyes for all frontal dummies provide data with the correct signs.
For side impact dummies such as the SIDIIs and WorldSID, the application program must convert the signs of some of the data to meet SAE/ISO conventions, and the signs depend on which side of the dummy the RibEye is mounted on.

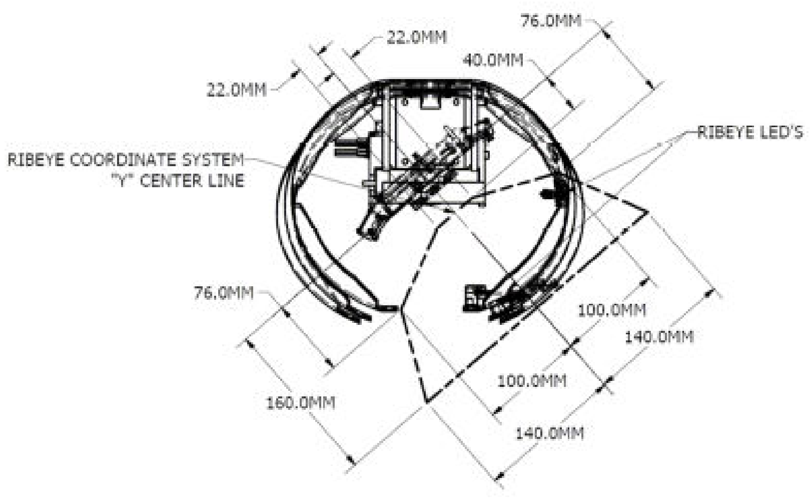
The RibEye reports data with respect to its center sensor, and it does not know which side of the dummy it is mounted on. The figure below shows the SIDIIs RibEye with the positive direction of each axis shown. The WorldSID uses the same sign convention.



If a SIDIIS or WorldSID RibEye is mounted so that it faces toward the dummy's left side, then the Y data sign must be changed.

If a SIDIIS or WorldSID RibEye is mounted so that it faces toward the dummy's right side, then the X data sign must be changed.

For the Polar dummy, the RibEye can be mounted at a 41-degree angle facing either the left or right side of the dummy. The figure below shows the Polar RibEye mounted facing the dummy's left side.



To rotate the data from the RibEye to the ATD coordinate system, first calculate:

Theta = atan2(y.x)
and
R = sqrt(x^2 +y^2)

Then, if the RibEye is facing the dummy's right side add 41 degrees to theta
or if the RibEye is facing the dummy's left side subtract 41 degrees from theta.

Then calculate:
x = R * cos(Theta)   and   y = R * sin(Theta)

x and y are now in the dummy coordinate system

Note: You should check that the data is not at the error code levels (x=y=1 or 2 or 3) prior to doing the coordinate conversions, or the error codes will get converted.