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The Algorithm Theoretical Basis Document for Level 1A Processing

Peggy Jester and David Hancock

National Aeronautics and
Space Administration

Goddard Space Flight Center
Greenbelt, Maryland 20771

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The Algorithm Theoretical Basis Document for Level 1A Processing

Peggy L. Jester
SGT, Inc., Wallops Island, VA

David W. Hancock III
Sigma Space Corporation, Wallops Island, VA

National Aeronautics and
Space Administration

Goddard Space Flight Center
Greenbelt, Maryland 20771

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Foreword

The GEOSCIENCE LASER ALTIMETER SYSTEM (GLAS) is a part of the EOS program. This laser altimetry mission will be carried on the spacecraft designated EOS ICESat (Ice, Cloud, and Land Elevation Satellite). The GLAS laser is a frequency-doubled, cavity-pumped, solid state Nd:YAG laser. The GLAS instrument will provide both surface laser altimetry and atmospheric lidar data. The science goals and requirements are documented in the GLAS Science Requirements Document which is listed in the Bibliography. This document provides the algorithms to convert the instrument data from raw counts into engineering units suitable for input to the science algorithms described in further ATBDs.

This document was prepared by the Observational Science Branch at NASA GSFC/WFF, Wallops Island, VA, in support of Bob E. Schutz, GLAS Science Team Leader for the GLAS Investigation. The information in this document was collected by Peggy L. Jester, SGT, Inc., Instrument Support Facility Lead, in support of the GLAS Instrument Team. This work was performed under the direction of David W. Hancock, III, who may be contacted at (757) 824-1238, hancock@osb.wff.nasa.gov (e-mail), or (757) 824-1036 (FAX).

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Section 1

Introduction

The first process of the Geoscience Laser Altimeter System (GLAS) Science Algorithm Software converts the Level 0 data into the Level 1A Data Products. The Level 1A Data Products are the time ordered instrument data converted from counts to engineering units. This document defines the equations that convert the raw instrument data into engineering units. Required scale factors, bias values, and coefficients are defined in this document. Additionally, required quality assurance and browse products are defined in this document.

The GLAS Level 0 data consists of a number of different instrument packet types, each type having its own application identifier (APID). Each packet type generally contains data relative to one of the prime GLAS measurements or subsystems. The EOS Data and Operations System (EDOS) delivers the instrument packets to the ICESat Science Investigator-led Processing System (I-SIPS) in Production Data Sets (PDS). Each PDS is a time-ordered set of packets received during a telemetry dump for a particular APID. At EDOS, the packets are Reed-Solomon decoded; redundant packets associated with previous dumps are removed; and some frame error checking is done. The Level 0 APIDs are listed in Table 1-1 "GLAS Telemetry Packets". The level 0 data is described in Appendix B.

Table 1-1 GLAS Telemetry Packets

Packet Name	APID
Altimeter Digitizer Data-Large	12
Altimeter Digitizer Data-Small	13
Altimeter Digitize Engineering Mode	14
Photon Counter (PC) Science	15
PC Engineering	16
Cloud Digitizer (CD) Science	17
CD Engineering	18
Ancillary Science	19
Laser Profiler Array Data	26
Command History	39
Laser Monitor Board, Temperature Controller Module, Motor Control System & High Voltage Power Supply Housekeeping Telemetry	20
PDU Housekeeping Telemetry	21
Housekeeping Temperatures #1 Telemetry	22
Housekeeping Temperatures #2 Telemetry	23

Table 1-1 GLAS Telemetry Packets (Continued)

Packet Name	APID
Small Software #1 Telemetry	24
Small Software #2 Telemetry	50
Large Software Telemetry #1	25
Large Software Telemetry #2	55
DSP Code Memory Dump	31
DSP Data Memory Dump	32
C&T Dwell	33
Memory Dwell #1	27
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Etalon Calibration	37
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The Level 1A Data Products produced by the algorithms described in this document are listed in Table 1-2 "The GLAS Level 1A Data Products". The Level 1A Data Products contents and format are defined in the *Level 1A Data Product Specification*; listed in the Bibliography in Section 5. Prior to storage in the Level 1A products the Level 1A data in engineering units are scaled to integer. The scale factors are defined in this document. The Level 0 and Level 1A detailed descriptions are not repeated in this document.

Table 1-2 The GLAS Level 1A Data Products

Product ID and Name	Description
GLA01 - Altimetry Data Product	Contains the waveforms and the altimeter and timing data required to produce higher level range and elevation products.
GLA02 - Atmosphere Data Product	Contains the normalized backscatter, photon counter, cloud digitizer, timing, and location data required to produce the higher level atmosphere data products.
GLA03 - Engineering Data Product	Contains the GLAS instrument's engineering and housekeeping data.
GLA04 - SRS and GPS Data Product	Contains the Global Positioning System data, Stellar Reference System data, and other instrument and spacecraft position and attitude data required to produce the precision orbit and precision attitude data.

Section 2

Algorithm Description

2.1 Level 0 to Level 1A Conversions

Generally, each measurement in an APID will have a calibration equation determined during GLAS system testing that will be used to convert the measured counts into engineering units. The conversions of the counts to engineering units will be one or more of several types: straight polynomial conversion based on the measurement counts; multi-variable conversions with dependence on additional measurements such as temperature; special conversions based on a complex dependence of several measurements, interpretation of data, table look-up, and geophysical based conversions. Some data will not require conversion and will be retained in counts. The Stellar Reference System (SRS) attitude and position data and the GPS data will be from standard existing systems similar to those used on other spacecraft. The SRS and GPS data along with the laser pointing monitor data will be packaged into the GLA04 data product and provided to the GLAS Science Team. This document will specify the algorithms that process the GLAS altimeter, lidar and housekeeping level 0 packets and the position and attitude data. Appendix B contains tables listing the GLAS instrument telemetry.

2.1.1 Polynomial Expansion Conversions

Most of the GLAS data will be converted by simple polynomial equations of fifth degree or less. Temperature, voltage, and current telemetry data are in this category.

The form for the conversion will be

A*(X**5) + B*(X**4) + C*(X**3) + D*(X**2) + E*(X) + F

where X is the raw measured value and A, B, C, D, E and F are constant coefficients.

The polynomial conversion factors for the telemetry data are defined in Appendix A. The table lists the telemetry data that is converted through polynomial expansion, the source APID, the conversion factors, and the resulting units.

2.1.2 Multi-variable Conversions

Multi-variable conversions will primarily be used to apply instrument temperature and voltage corrections to data. Below is a generic example of this type of correction.

Xeu = Xct* (A*(T1)**2 + B*(T1)) +C

where

Xeu = The telemetry value in engineering units
Xct = The raw telemetry value in counts
T1 = telemetry value upon which Xct is dependent
A, B, C = conversion coefficients

Some measurements may require more than one such type correction or are dependent on more than one temperature or other telemetry value.

For the PDU housekeeping data, the engineering unit conversions are dependent upon monitor calibration values that are telemetered within the PDU packet (APID=21). The conversion for the monitor calibration values and the conversion for the telemetry based on these values in contained in Appendix A, Section A.2.

2.1.3 Special Conversions

There are some conversions that will require special forms based on the analysis of instrument test data or simulations.

2.1.3.1 Bit Interpretation

The interpretation of flags and status words does not usually depend on conversion factors or biases. It is usually a matter of evaluating bits or bit patterns. Appendix A defines those telemetry values which require interpretation and explains how the values are to be interpreted.

2.1.3.1.1 Instrument State Flag

This flag describes the hardware state of the instrument. It describes which of the instrument's redundant systems is operating. The flag is stored in the data product headers and it is composed from the bit interpretation of several telemetered status words. The detailed description including source information is in Appendix A.24.

2.1.3.2 1064 nm Transmitted and Received Pulse Energy

To calculate the 1064 nm transmitted and received pulse energies, the telemetry data for the transmitted and received waveforms is inspected. For each, from the peak location, the waveform is searched (in both directions) until reaching 3% or less of the peak value. The waveform data between the two points is summed. The pulse energies are the product of the sum of the waveform data and a calibration constant. For now, the constant is set to 1.0.

2.1.3.3 Background Mean and Standard Deviation for all Filters

The background mean and standard deviation for the 4 nanosecond (ns) filter are given in telemetry.

The background mean for the other five filters (8 ns, 16 ns, 32 ns, 64 ns, 128 ns) equals the mean for the 4 ns filter. The standard deviation for each of the other filters is computed as shown in the following equation:

standard deviation for filter i =
standard deviation for filter (i-1)/(square root (2)) for (i=2,3,4,5,6)

where i=1 is the 4ns filter whose mean and standard deviation is downlinked, i=2 is the 8ns filter, etc.

2.1.3.4 Table Look-up

Some conversions will be table lookup, based on single or multiple parameters. On past projects it was found that for multiple single byte telemetry values requiring the same conversion factors (temperatures, for example) it was more efficient to use a lookup table to obtain the engineering unit value based on the telemetry counts rather than executing the equation. Table lookup will be implemented for the conversion of one byte telemetry values to engineering units, when that conversion is by polynomial expansion.

2.1.3.5 L1A Time Tagging

The L1A time tagging algorithm computes the exact UTC time for each laser shot and the UTC time for all associated data in order to process the GLAS data into L1A granules. See the report, *ICESat Observatory Timing and Event Time Reconstruction*, which is listed in the Bibliography in Section 5 for a description of the timing scheme used by the ICESat observatory. This report discusses how the precise times of events on the observatory can be reconstructed from the downlinked telemetry.

The time tagging algorithm requirements are listed in this section. The algorithm specification is contained in Appendix A. Background information for the data alignment and time tagging algorithm are contained in Appendix C.

<u>Algorithm Requirements - General</u>

1) GPS time is to be used as the prime time reference. If GPS is not available spacecraft time as determined from the spacecraft vehicle time code word (BVTCW) shall be used as the time reference.
2) The shot time (time of altimeter digitizer bin one (or zero)) in UTC is computed from the Fire Command Time in the ancillary science packet. The UTC time tag for each shot shall be computed by referencing its fire command time word to GPS or spacecraft time.
3) Oscillator frequency offsets and drift between various subsystems will be properly handled.
4) If the ancillary science packet is missing but other packets are present the expected, i.e. predicted, time tag will be assigned to those shots.
5) Time computed for an Expedited Data Set (EDS) will be the same for that data on its Production Data Set (PDS).
6) Alignment must be made to the SRS (LRS, IST, Gyro) data by assigning proper shot number and shot time.
7) Shot and data UTC times will be computed from the reference time that occurs prior to the time of the data, e.g. times will not be backwards interpolated.

<u>Algorithm Requirements - GPS is available</u>

8) GPS can reset and must be handled properly. It takes 10 minutes to recover and provide new position data. During this period the GPS does not provide the once per 10 second pulse, so there is no updated GPS reference time. The previous GPS reference time should be used. This condition can span across PDSs.
9) A record must be kept relating the GPS time used to every time computed.
10) Leapseconds shall be added to the GPS Time to get UTC. The leapseconds correction will be stored in a GPS to UTC Leapseconds file.

11) A constant shall be defined that is the GPS time of midnight January 1, 2000 (the UTC reference time). This constant will be negative because it used to remove from the laser shot GPS time the amount of GPS time occurring from the GPS time reference time (January 6, 1980) to the UTC reference time.

Algorithm Requirements - GPS is not available

12) Spacecraft time in UTC (as computed from BVTCW) will be used as the reference time if GPS is not available.
13) The time tagging algorithm will not automatically switch to the BVTCW time reference upon detection of missing GPS.
14) The BVTCW of the 10 hz LRS Data shall be aligned to the correct shot and its fire command time. The 10 Hz shot time shall then be computed based on the UTC of the BVTCW. The 40 Hz shot times and any other data times can be interpolated from the 10 Hz UTC BVTCW shot times.

2.1.3.6 GPS Black Jack to RINEX Format Conversion

A program will be provided from the GLAS Science Team that will convert the downlinked GPS data from the Black Jack format to the RINEX format. The RINEX is a standard ASCII format for the GPS data and is described at the following website: ftp://igscb.jpl.nasa.gov/igscb/data/format/rinex2.txt. The GPS data is stored in the GLA04 Data Product.

2.1.3.7 Position and Attitude Telemetry Data Storage in GLA04

The position and attitude data will be telemetered in a spacecraft packet known as the Position, Rate, and Attitude Packet (PRAP). The position and attitude data is collected from the following systems on-board the spacecraft:

- spacecraft star tracker (2), also known as Ball Star Tracker 1 (BST1) and Ball Star Tracker 2 (BST2),
- instrument star tracker (IST),
- gyro, also known as the IRU, and
- Laser Reference System (LRS).

The Laser Profiling Array (LPA) data will be telemetered via the instrument. The data from each system will be stored in a separate file in the GLA04 product. The PRAP data conversions are defined in the *Data Interface Control Document between the ICESat Spacecraft and the EOS Ground System (EGS)*, referenced in Section 5, the Bibliography.

2.1.4 Geophysical Conversions

Conversions for the Photon Counter and Cloud Digitizer LIDAR data and backgrounds are found in the *GLAS Atmospheric Data Products ATBD*, referenced in Section 5.

2.1.5 Laser Energy Calculation

The GLAS instrument does not monitor or report the GLAS 1064nm transmitted or received energy. Through ground testing, an algorithm was developed to compute the energy during post-processing of the science data. The energy equation is

laser_energy(i)=(delta_T*area_txp(i))/
(n_circuit*n_optical_new*r_detector*gain_norm*a_cal)

where

i = current shot

delta_T = 1.0E-09

n_circuit = 0.923

n_optical_new = x(depending on laser)

2.9650E-14(LASER 1)

2.7868E-14 (LASER 2)

2.7937E-14 (LASER 3)

r_detector = 2.28E+07

gain= transmitted gain (from telemetry)

gain_normal = gain/255D0

gain_adj (for laser 1) = 1.0 (was not used)

gain_adj (for laser 2) = -2.5616417E-08*gain^3+1.1939701E-05*gain^2-2.2665959E-03*gain + 1.0746249E+00

gain_adj (for laser 3) = -4.0666979D-08*gain^3+1.8456647D-05*gain^2-3.0427996D-03*gain + 1.096532D00

a_cal = 1.12

To compute area_txp(i) (area under the transmit waveform for each shot):

1. Convert the counts (txwf_count) in each bin (47 bins) to volts (txwf_volt):

IF (txwf_count LE 127) THEN

txwf_volt = al*txwf_count + b1

ELSE txwf_volt = a2*txwf_count + b2

where:

a1 = 0.006675

b1 = -0.1953

a2 = 0.006198

b2 = -0.1344

2. Compute the mean (mean-txp) of the first 9 bins of the waveform.

3. Compute the area as the sum of all bins after subtracting the mean from each bin:

area_txp(i) = TOTAL(txwf_volt(i,1:47) - mean_txp)

Detailed discussion of the laser energy calibration and gain correction is contained in Appendix E.

2.2 Quality Assurance

This section shall describe the quality assurance data for the Level 1A granules.

2.2.1 Altimetry Product (GLA01)

1) Expected number of Ancillary Science packets (APID 19) based on time span of data.
2) Actual number of Ancillary Science packets based on number read.
3) Percentage missing Ancillary Science packets: [1-(item 2 / item 1)] * 100.
4) Expected number of waveform packets (APIDs 12 and 13) based on time span of data.
5) Actual number of waveform packets based on number read.
6) Percentage missing waveform packets: [1-(item 5 / item 4)] * 100.
7) Percentage of total actual waveform packets that is:
    - long waveform data (based on number of APID 12 packets read),
    - short waveform data (based on number of APID 13 packets read),
    - no signal acquired (from threshold crossing flag in APID 12) for long waveform data,
    - no signal acquired (from threshold crossing flag in APID 13) for short waveform data,
8) Granule statistics (Maximum, Minimum, Average, Standard Deviation, Number of Points) for:
    - transmit peak location,
    - difference between last and next to last threshold crossing locations of the received waveform,
    - background mean for 4 ns filter,
    - background standard deviation for each filter,
    - 4 ns filter peak value,
    - peak value for each filter (based on when filters are selected by on-board algorithm),
    - 1064 nm laser transmit energy,
    - 1064 nm laser received energy,
    - time between each shot, and

- A/D receiver gain setting.

9) Once per 16 second statistics (Maximum, Minimum, Average) for:
   - 1064 nm laser transmit energy,
   - 1064 nm laser received energy,
   - peak value for selected filter, and
   - difference between last and next to last threshold crossing locations of the received waveform.
10) Track the number of times each filter is selected for long waveform data (where signal is detected) over the period of the granule.
11) Track the number of times each filter is selected for short waveform data (where signal is detected) over the period of the granule.
12) Compute the average filter number and average surface type over 16 seconds (it can be a fraction) over the time of the granule. Set a flag indicating during the 16 seconds, whether the waveform type is predominately long or short.

2.2.2 Atmosphere Product (GLA02)

1) Expected number of photon counter packets (APID 15)
2) Actual number of photon counter packets (APID 15)
3) Percentage missing photon counter packets (APID 15)
4) Expected number of cloud digitizer packets (APID 17)
5) Actual number of cloud digitizer packets (APID 17)
6) Percentage missing cloud digitizer packets (APID 17)
7) Expected number of ancillary science packets (APID 19)
8) Actual number of ancillary science packets (APID 19)
9) Percentage missing ancillary science packets (APID 19)
10) Percentage saturated bins for 10 to -1 km profile
11) Percentage saturated bins for 20 to 10 km profile
12) Percentage saturated bins for 40 to 20 km profile
13) Granule statistics (Maximum, Minimum, Average, Number of Points) for:

- 532 nm laser transmit energy at 40 Hz,
- 1064 nm laser transmit energy at 40 Hz,
- 532 nm Backgrounds (4) at 40 Hz,
- 1064 nm Backgrounds (4) at 40 Hz,
- Cloud Return Peak Signal,
- Ground Return Peak Signal,

- Ground Return Peak location, and
- Dual Pin A / 532 transmit energy at 40 Hz.

14) Average 532 integrated return over 16 seconds.
15) Number of 532 laser transmit energy values at 40 Hz from 0 to 10 mJ
16) Number of 532 laser transmit energy values at 40 Hz from 10 to 20 mJ
17) Number of 532 laser transmit energy values at 40 Hz from 20 to 30 mJ
18) Number of 532 laser transmit energy values at 40 Hz from 30 to 40 mJ
19) Number of 532 laser transmit energy values at 40 Hz from above 40 mJ
20) Number of 1064 laser transmit energy values at 40 Hz from 0 to 10 mJ
21) Number of 1064 laser transmit energy values at 40 Hz from 10 to 20 mJ
22) Number of 1064 laser transmit energy values at 40 Hz from 20 to 30 mJ
23) Number of 1064 laser transmit energy values at 40 Hz from 30 to 40 mJ
24) Number of 1064 laser transmit energy values at 40 Hz from above 40 mJ

2.2.3 Engineering Data Product (GLA03)

1) Expected number of records per APID (for all APIDs) based on time.
2) Actual number of records per APID based on number read for each APID.
3) Percentage missing data per APID: [1-(item 2 / item 1)] * 100.
4) Change in instrument configuration and time of change.
5) Final instrument configuration.
6) Granule statistics (Maximum, Minimum, Average, Standard Deviation, Number of points, Number of Times Out of Limits) for each temperature, voltage, and current.
7) Once per hour (3600 seconds) statistics (Maximum, Minimum, Average, Standard Deviation, Number of Points) for each temperature, voltage and current.
8) For each status indicator over the granule, compute number of times status changed, and final status.
9) Granule statistics (Maximum, Minimum, Average, Standard Deviation, Number of Points) for:
   - the difference between the laser fire command time and the laser fire acknowledge time,
   - the difference between the spacecraft time (BVTCW) of the spacecraft time and position packet and the GLAS MET of the spacecraft time and position packet,
   - sum of Post-Delay pulse waveform bin values (32 bins); average and standard deviation only,
   - the peak of the Post-Delay Laser pulse,

- the pulse width of the Post-Delay Laser pulse,
- the peak of the four OTS laser pulse, and
- the pulse width of the four OTS laser pulses.

10) Etalon tuning QA - TBD

2.2.4 Global Stellar Reference and Global Positioning System Data Product (GLA04)

1) Expected number of records of LPA data (APID 26) based on time.
2) Actual number of records of LPA data based on number read.
3) Percentage missing LPA data: [1-(item 2 / item 1)] * 100.
4) Expected number of records of PRAP data (APID 1984) based on time.
5) Actual number of records of PRAP data based on number read.
6) Percentage missing PRAP data: [1-(item 5 / item 4)] * 100.
7) For the LPA data, store the following data to arrays:
   - Computed centroid location statistics over 60 seconds (Maximum, Minimum, Average, Number of Points).
   - Area above noise of Transmit waveform statistics over 60 seconds (Maximum, Minimum, Average, Number of Points). Noise = 30 counts; area is equivalent to sum of data from each bin (48) where data is greater than 30 counts. Note: Subtract off the 30 counts of noise prior to summing the data.
   - Time of Transmit waveform peak statistics over 60 seconds (Maximum, Minimum, Average, Number of Points).
   - Sample time: time of first shot in the first and last frames included in the average. These will be the only times stored in the along-track record.
8) For the LPA data for each granule, store:
   - First and last LPA 20x20 image.
   - Mean and standard deviation of the LPA 20x20 image.
9) For the first valid star for each virtual tracker in the LRS data, store the following data to arrays:
   - Encircled energy statistics over 60 seconds (Maximum, Minimum, Average, Number of Points).
   - Background bias statistics over 60 seconds (Maximum, Minimum, Average, Number of Points).
   - Centroid row statistics over 60 seconds (Maximum, Minimum, Average, Number of Points).
   - Centroid column statistics over 60 seconds (Maximum, Minimum, Average, Number of Points).

  - Sample time: time of first shot in the first and last frames included in the average. These will be the only times stored in the along-track record.

10) First and last valid LRS laser images of the granule with the start and end times of the record in which they occur.
11) For the LRS data, collect once per granule data for:
    - Number of points processed
    - Number of shot numbers that are zero
    - Number of messages incomplete
    - Number of time tag rollovers
    - Number of valid and invalid stars by tracker: star, laser, and CRS.
    - Number of stars by star tracker by magnitude from 0 to 6.3 with .5 magnitude categories.
    - For each valid virtual tracker for the laser and CRS (Maximum, Minimum, Mean, Standard Deviation, and Number of Points): Encircled energy, Background bias, Centroid row, and Centroid column
    - CCD temperature (Minimum, Maximum, Mean, Standard Deviation, and Number of Points)
    - Lens Cell temperature (Minimum, Maximum, Mean, Standard Deviation, and Number of Points)
12) Once per 60 seconds statistics (Maximum, Minimum, Mean, Standard Deviation, Number of points) on each valid Gyro's (A, B, C, D) integrated angle data. Also report the number of invalid integrated angles for each Gyro.
13) For the first valid star for each virtual tracker in the Instrument Star Tracker (IST) data, store the following data to arrays at 60 second intervals:
    - Sample time
    - Encircled energy
    - Background bias
    - Star magnitude
    - Boresight H
    - Boresight V
14) For the Instrument Star Tracker (IST) data, collect the once per granule data for:
    - Number of points processed
    - Number of shot numbers that are zero
    - Number of messages incomplete
    - Number of time tag rollovers

- Number of valid and invalid stars by tracker: star, laser, and CRS.
- Number of stars by magnitude from 0 to 6.3 with .5 magnitude categories.
- CCD temperature (Minimum, Maximum, Mean)
- Lens Cell temperature (Minimum, Maximum, Mean)

15) For the first valid star for each virtual tracker in the Ball Star Tracker (BST) data (two BSTs), store the following data to arrays at 60 second intervals:
    - Sample time
    - Star position X and Y
    - Star intensity
16) For both BSTs, collect once per granule data of:
    - Number of points processed
    - Number of commands received and rejected
    - For each tracker, the number of stars by magnitude from 0 to 6.3 with .5 magnitude categories.
    - CCD temperature (Minimum, Maximum, Mean)
    - Lens Cell temperature (Minimum, Maximum, Mean)
    - +8 Volt supply voltage (Minimum, Maximum, Mean)
    - Background reading (Minimum, Maximum, Mean)
17) For the spacecraft data, for the first valid point, store the following data to arrays at 60 second intervals:
    - Sample time
    - Solar array 1 position
    - Solar array 2 position
    - Solar Array 1 autonomous flag
    - Solar Array 2 autonomous flag
    - Quaternions 1 through 4
18) For the spacecraft data, compute for the granule:
    - Number of times solar array 1 is in fixed position and total time in fixed position
    - Number of times solar array 2 is in fixed position and total time in fixed position
    - Number of times solar arrays are in fixed position simultaneously and total time in fixed position
    - Number of times GPS time changes

2.3 Browse Products

This section defines the browse products for the Level 1A granules.

2.3.1 Altimetry Product (GLA01)

1) Table (for the granule) showing:
- percent missing waveform packets,
- percent missing ancillary science packets,
- percent data is long waveform data,
- percent data is short waveform data,
- percent of long waveform data where no signal was acquired, and
- percent of short waveform data where no signal was acquired.

2) Statistics table (for the granule) which includes the Maximum, Minimum, Average, Standard Deviation, and Number of Points for:
   - transmit peak location,
   - sum of transmit waveform bins (average and standard deviation only),
   - difference between last and next to last threshold crossing locations,
   - background mean for 4 ns filter,
   - background standard deviation for each filter,
   - 4 ns filter peak value,
   - peak value for each filter (based on when filters are selected by on-board algorithm),
   - 1064 nm laser transmit energy,
   - 1064 nm laser received energy,
   - time between each shot, and
   - A/D receiver gain setting.
3) Color coded plot of the ground track, with colors indicating whether the flight algorithms selected long or short waveforms for a location,
4) Histogram of 1064 nm laser transmit energy averaged n per second,
5) Histogram of 1064 nm laser received energy averaged n per second,
6) Histogram of the received waveform average peak value per selected filter per second,
7) Histogram of the difference between last and next to last threshold crossing locations averaged n per second,
8) Color coded plot of the ground track, with colors indicating the average selected filter number for a location,

9) Color coded plot of the ground track, with colors indicating the average transmitted and received energy for a location,
10) Histogram of the long waveform data selected filter numbers, and
11) Histogram of the short waveform data selected filter numbers.

2.3.2 Atmosphere Product (GLA02)

1) Table (for the granule) showing:
- percent missing photon counter packets,
- percent missing cloud digitizer packets,
- percent missing ancillary science packets,
- percentage of saturated bins for the 10 to -1 km profile,
- percentage of saturated bins for the 20 to 10 km profile, and
- percentage of saturated bins for the 40 to 20 km profile.

2) Statistics table (for the granule) which includes the Maximum, Minimum, Average, and Number of Points for:
   - 532 laser transmit energy at 40 Hz,
   - 1064 laser transmit energy at 40 Hz,
   - 532 backgrounds (4) at 40 Hz,
   - 1064 backgrounds (4) at 40 Hz,
   - cloud return peak signal,
   - ground return peak signal,
   - ground return peak location, and
   - Dual pin A /532 transmit energy at 40 Hz.
3) Color coded plot of the ground track, with colors indicating 532 integrated return value for a location
4) Histograms of 532 and 1064 transmit energy
- Number of 532 laser transmit energy values at 40 Hz from 0 to 10 mJ,
- Number of 532 laser transmit energy values at 40 Hz from 10 to 20 mJ,
- Number of 532 laser transmit energy values at 40 Hz from 20 to 30 mJ,
- Number of 532 laser transmit energy values at 40 Hz from 30 to 40 mJ,
- Number of 532 laser transmit energy values at 40 Hz from above 40 mJ,
- Number of 1064 laser transmit energy values at 40 Hz from 0 to 10 mJ,
- Number of 1064 laser transmit energy values at 40 Hz from 10 to 20 mJ,
- Number of 1064 laser transmit energy values at 40 Hz from 20 to 30 mJ,

- Number of 1064 laser transmit energy values at 40 Hz from 30 to 40 mJ, and
- Number of 1064 laser transmit energy values at 40 Hz from above 40 mJ.

2.3.3 Engineering Data Product (GLA03)

1) Plots of average temperatures per hour,
2) Plots of average voltages per hour,
3) Plots of average currents per hour,
4) Table of operating laser, detector, digitizer, oscillator and time instrument configuration changed during granule,
5) Table of granule statistics, and
6) Etalon tuning - TBD.

2.3.4 Global Stellar Reference and Global Positioning System Data Product (GLA04)

1) Table and bar chart (for the granule) showing:
   - Percentage and number missing LPA data.
   - Percentage and number missing PRAP data.
2) Statistics table/bar chart (for the granule) which includes:
   - LRS CCD temperature (Minimum, Maximum, Mean)
   - LRS Lens Cell temperature (Minimum, Maximum, Mean)
   - IST CCD temperature (Minimum, Maximum, Mean)
   - IST Lens Cell temperature (Minimum, Maximum, Mean)
   - BST1 and BST2 CCD temperature (Minimum, Maximum, Mean)
   - BST1 and BST2 Lens Cell temperature (Minimum, Maximum, Mean)
   - BST1 and BST2 +8 Volt supply voltage (Minimum, Maximum, Mean)
   - BST1 and BST2 Background reading (Minimum, Maximum, Mean)
   - Mean and standard deviation of the LPA 20x20 images
3) Star magnitude histogram for the LRS, IST, BST1, and BST2 indicating for each tracker, the number of stars by magnitude from 0 to 6.3 with .5 magnitude categories.
4) First and last laser and LPA images in the granule. The SRS images in the granule cannot be tied unequivocally to a shot or frame number. Instead, the first and last good images in the granule should be labelled with the times of the first and last shots in the frames in which they are found.
5) Number of times solar array 1 is in fixed position and total time in fixed position for the granule.

6) Number of times solar array 2 is in fixed position and total time in fixed position for the granule.
7) Number of times solar arrays are in fixed position simultaneously and total time in fixed position for the granule.
8) Number of times GPS time changes for the granule.
9) Color coded plots of the granule timeline, with colors indicating when Solar Array 1 autonomous flag is set to auto (1) or off (0).
10) Color coded plots of the granule timeline, with colors indicating when Solar Array 2 autonomous flag is set to auto (1) or off (0).
11) Histograms of:
    - Computed centroid location
    - Area above noise of Transmit waveform.
    - Time of Transmit waveform peak.

Section 3

Implementation Considerations

The GLAS data level 1A conversion does not require any complicated or interactive processing. The data rate is 500 kbps.

3.1 Standards

The GLAS Level 1A algorithm implementation will follow the software development process defined in the *GLAS Science Software Management Plan* listed in Section 5.

3.2 Ancillary Inputs

3.2.1 Predict (Operational) orbit

The best available orbit predicts will be used to append location to the level 1 A data. No corrections will be applied to the data based on the predicted location data. This position data will be replaced on higher level products with the precision orbit data. The predicted location will be used to help with the QA and any quick look analysis of the GLAS data.

3.2.2 GLAS Coefficients and Constants File

Provides the coefficients and constants that are subject to modification based on: pre-flight testing, on-orbit performance, or electronic component aging. To avoid creating and delivering new versions of software due to changes in operating parameters, the GLAS Coefficients and Constants File provides a location to store those software parameters.

Include in the GLAS Coefficients and Constants File, the QA statistical sampling rate in seconds for each L1A product. Therefore, if the sampling rates are modified, the L1A Code will not have to be changed. A CR will be written to update this ATBD and the value(s) in the GLAS Coefficients and Constants File.

3.3 Accuracy

All level 1A data conversions will be designed to meet the accuracy of the science requirements. Where the capability to invert from the level 1A data back to the level 0 raw counts is needed, there will not be any loss of accuracy. GLAS measurement capabilities will not be degraded during the creation of the level 1A product.

3.4 Computational: CPU and Disk Storage

GLAS level 1A processing can be done easily within the capabilities of a large workstation. A processing load has been estimated by using the TOPEX Radar Altimeter SDR processing resources and scaling them by the ratio of the data rate. This is considered to be a worst case analysis. Disk storage space has been estimated based on the design of the level 1A data product.

3.5 Software Validation

The validation of the software will be from processing known data from the GLAS instrument testing or the GLAS simulator into a level 1 A product. This product will be compared to the GLAS Instrument team results from ground testing or simulator outputs.

QA processes to automatically provide data product quality information are defined in Section 2.

Section 4

Constraints, Limitations, and Assumptions

4.1 Constraints and Limitations

The following is a list of the constraints and limitations that will exist on this algorithm.

1) The GLAS level 1A data products should be ready within 24 hours of the availability of the level 0.
2) The implementation of this algorithm will follow the software development life cycle described in the *GLAS Science Software Management Plan*, listed in the Bibliography in Section 6.
3) The Engineering Data Product (GLA03) should be produced first since data on that product may be used to further correct or calibrate the altimeter or lidar data.

4.2 Assumptions

The following are assumptions made for the definition, development and use of this algorithm.

1) Level 0 data will be time ordered and contain no duplicate data.
2) GLAS instrument data will be within the ground tested limits for the data to be valid. However, checks will be made on the data and flags set indicating data anomalies.

Section 5

Bibliography

1) *GLAS Level 0 Instrument Data product Specification,* Version 2.2, March 1998, NASA Goddard Space Flight Center, Wallops Flight Facility.
2) *GLAS Standard Data Products Specification - Level 1*, Version 2.0, December 1998, NASA Goddard Space Flight Center, Wallops Flight Facility.
3) *GLAS Science Software Management Plan*, Version 3.0, August 1998, NASA Goddard Space Flight Center, Wallops Flight Facility.
4) *GLAS Science Data Management Plan* (GLAS SDMP), Version 4.0, June 1999, NASA Goddard Space Flight Center Wallops Flight Facility, GLAS-DMP-1200.
5) *NASA Earth Observing System Geoscience Laser Altimeter System GLAS Science Requirements Document,* Version 2.01, October 1997, Center for Space Research, University of Texas at Austin.
6) *GLAS Atmospheric Data Products ATBD*, Version 3.0, July 1999, NASA Goddard Space Flight Center.
7) *ICESat Observatory Timing and Event Time Reconstruction*, Rev. G, February 2001
8) *I-SIPS Version 2 Delivery Package*, TBD
9) *Data Interface Control Document between the ICESat Spacecraft and the EOS Ground System (EGS)*, TBD

Appendix A
Conversion Tables

A.1 Conversion Description for Each APID

Table A-1 "Conversion Description for GLAS Telemetry Data" lists each telemetry value for all the GLAS APIDs, the conversion type, the conversion description, resulting units, and destination L1A product ID. The conversion type can be

- Interpretation (I)- Evaluates the values of a bit or bits in a telemetry word to determine the value. All flags and status words are assumed to be converted in this manner. The description of the bit values is in the Conversion Description column;
- Polynomial (P)- A polynomial equation for the conversion from raw counts to engineering units. The polynomial equation looks like:
  Y = A + B*(X) + C*(X**2) +...
  where
  Y is the resulting instrument value in engineering units
  X is the raw instrument value in counts
  and A, B, C,... are the polynomial coefficients.

  In the tables the coefficients are listed in the order A, B, C... in the Coefficient Description column;
- Multi-variable (M) - the conversion for a raw telemetry value requires additional telemetry values (raw or in engineering units), such as temperatures or voltages. Depending on the complexity of the algorithm, the Conversion Description column will include the algorithm or will reference another section containing the algorithm;
- Table-lookup (T) - Using the raw counts as an index to a table, the converted value is obtained;
- Geophysical (G) -;
- None (N) - No conversion is required; and
- Unknown (U) - the conversion algorithm is currently unknown or not documented.

A.2 Telemetry Pseudo Engineering Unit Conversion

Table A-1 Conversion Description for GLAS Telemetry Data

APID	Name	Conv. Type	Conversion Description	Units	L1A Product ID
ALL	Primary Header	I			GLA03
ALL	Secondary Header (time stamp)	U			GLA03
20	LMB Laser 1 Reference Temperature	P	-33.84,5.368E-1, -1.622E-5,3.155E-6	Deg C	GLA03
20	Laser 1 Doubler Temperature	P	20.84,1.032E-1, -2.879E-5,1.446E-7	Deg C	GLA03
20	Laser 1 Oscillator Temperature	P	20.84,1.032E-1, -2.879E-5,1.446E-7	Deg C	GLA03
20	Laser 1 Electronics Temperature (MEU)	P	-33.84,5.368E-1, -1.622E-5,3.155E-6	Deg C	GLA03
20	LMB Laser 2 Reference Temperature	P	-33.84,5.368E-1, -1.622E-5,3.155E-6	Deg C	GLA03
20	Laser 2 Doubler Temperature	P	20.84,1.032E-1, -2.879E-5,1.446E-7	Deg C	GLA03
20	Laser 2 Oscillator Temperature	P	20.84,1.032E-1, -2.879E-5,1.446E-7	Deg C	GLA03
20	Laser 2 Electronics Temperature (MEU)	P	-33.84,5.368E-1, -1.622E-5,3.155E-6	Deg C	GLA03
20	LMB Laser 3 Reference Temperature	P	-33.84,5.368E-1, -1.622E-5,3.155E-6	Deg C	GLA03
20	Laser 3 Doubler Temperature	P	20.84,1.032E-1, -2.879E-5,1.446E-7	Deg C	GLA03
20	Laser 3 Oscillator Temperature	P	20.84,1.032E-1, -2.879E-5,1.446E-7	Deg C	GLA03
20	Laser 3 Electronics Temperature (MEU)	P	-33.84,5.368E-1, -1.622E-5,3.155E-6	Deg C	GLA03
20	Laser Osc Current	M	1.898 + 0.4878*(Laser Osc Current counts) - 1.406E-2*(Laser Monitor Board Temperature counts)	Amps	GLA03
20	Laser Amp Current	M	2.062 + 0.4865*(Laser Amp Current counts) - 1.406E-2*(Laser Monitor Board Temperature counts)	Amps	GLA03
20	Laser Dr Pulse Width	P	131.08,0.512	pulse width in usec	GLA03

Table A-1 Conversion Description for GLAS Telemetry Data (Continued)

APID	Name	Conv. Type	Conversion Description	Units	L1A Product ID
50	OTS Level 1 readback	P	40, -0.15625	micro Amps	GLA03
50	OTS Level 2 readback	P	40, -0.15625	micro Amps	GLA03
50	OTS Level 3 readback	P	40, -0.15625	micro Amps	GLA03
50	OTS Level 4 readback	P	40, -0.15625	micro Amps	GLA03
50	OTS Trigger Count 1 readback	P	0.0,0.256	micro-seconds	GLA03
50	OTS Trigger Count 2 readback	P	0.0,0.256	micro-seconds	GLA03
20	AD Detector Outgoing Gain readback	P	-1, 0.0078125	Volts	GLA03
20	AD Detector Return Gain readback	P	-1, 0.0078125	Volts	GLA03
20	Laser and OTS Enable readbacks	I	See Section A.3	n/a	GLA03
20	Dual Pin A	M	0.5609 + 0.3823*(Dual Pin A counts) + 3.848E-5*(Dual Pin A counts^2) - 5.737E-3*(Laser Monitor Board Temperature counts)	%	GLA03
20	Dual Pin B	M	1.108 + 0.4143*(Dual Pin B counts) -8.671E-5*(Dual Pin B counts^2) - 1.159E-3*(Laser Monitor Board Temperature counts)	%	GLA03
20	532 Energy	M	-0.969 + 0.4095*(532 Energy counts) -6.601E-5*(532 Energy counts^2) + 8.765E-3*(Laser Monitor Board Temperature counts)	%	GLA03
20	Primary Altimeter Detector 550 V	P	0.0, 3.581	Volts	GLA03
20	Secondary Altimeter Detector 550 V	P	0.0, 3.581	Volts	GLA03
20	SPCM Detector #1 550 V	P	0.0, 3.581	Volts	GLA03
20	SPCM Detector #2 550 V	P	0.0, 3.581	Volts	GLA03
20	SPCM Detector #3 550 V	P	0.0, 3.581	Volts	GLA03
20	SPCM Detector #4 550 V	P	0.0, 3.581	Volts	GLA03
20	SPCM Detector #5 550 V	P	0.0, 3.581	Volts	GLA03
20	SPCM Detector #6 550 V	P	0.0, 3.581	Volts	GLA03

Table A-1 Conversion Description for GLAS Telemetry Data (Continued)

APID	Name	Conv. Type	Conversion Description	Units	L1A Product ID
20	SPCM Detector #7 550 V	P	0.0, 3.581	Volts	GLA03
20	SPCM Detector #8 550 V	P	0.0, 3.581	Volts	GLA03
20	Internal Temp #1	P	- 50.0, 0.781	Deg C	GLA03
20	C&T Positive Rail	P	9.0, 0.031	Volts	GLA03
20	Internal Temp #3	P	-50.0, 0.781	Deg C	GLA03
20	VC Motor Current	P	-100.0, 0.048828125	mAmps	GLA03
20	VC Motor Current	P	-100.0, 0.048828125	mAmps	GLA03
20	X Position	P	-10.0, 0.0048828125	Volts	GLA03
20	Y Position	P	-10.0, 0.0048828125	Volts	GLA03
21	Primary Monitor Calibration, Upper Byte	M	Pseudo Telemetry Eqn 7		GLA03
21	Primary Monitor Calibration, Lower Byte	M	Pseudo Telemetry Eqn 7/8		GLA03
21	+28V Bus A Instrument Voltage	M	Pseudo Telemetry Eqn 9	Volts	GLA03
21	Hybrid Supplies Current	M	Pseudo Telemetry Eqn 10	Amps	GLA03
21	HVPS Detector Supplies Current	M	Pseudo Telemetry Eqn 11	Amps	GLA03
21	Operational Heaters Current	M	Pseudo Telemetry Eqn 12	Amps	GLA03
21	Mechanical System Current	M	Pseudo Telemetry Eqn 13	Amps	GLA03
21	+28V Bus B Laser 1 Voltage	M	Pseudo Telemetry Eqn 14	Volts	GLA03
21	+28V Bus B Laser 1 Current	M	Pseudo Telemetry Eqn 15	Amps	GLA03
21	+28V Bus C Laser 2 Voltage	M	Pseudo Telemetry Eqn 16	Volts	GLA03
21	+28V Bus C Laser 2 Current	M	Pseudo Telemetry Eqn 17	Amps	GLA03
21	+28V Bus D Laser 3 Voltage	M	Pseudo Telemetry Eqn 18	Volts	GLA03
21	+28V Bus D Laser 3 Current	M	Pseudo Telemetry Eqn 19	Amps	GLA03
21	Secondary Monitor Calibration, Upper Byte	M	Pseudo Telemetry Eqn 20	n/a	GLA03
21	Secondary Monitor Calibration, Lower Byte	M	Pseudo Telemetry Eqn 20/21	n/a	GLA03
21	+ 5 V Hybrid # 1 Voltage	M	Pseudo Telemetry Eqn 22	Volts	GLA03
21	+ 5 V Hybrid # 1 Current	M	Pseudo Telemetry Eqn 23	Amps	GLA03
21	+12 V Hybrid # 2 Voltage	M	Pseudo Telemetry Eqn 24	Volts	GLA03
21	+ 12 V Hybrid # 2 Current	M	Pseudo Telemetry Eqn 25	Amps	GLA03
21	- 12 V Hybrid # 3 Voltage	M	Pseudo Telemetry Eqn 26	Volts	GLA03

Table A-1 Conversion Description for GLAS Telemetry Data (Continued)

APID	Name	Conv. Type	Conversion Description	Units	L1A Product ID
21	- 12 V Hybrid # 3 Current	M	Pseudo Telemetry Eqn 27	Amps	GLA03
21	+ 5 V Hybrid # 4 Voltage	M	Pseudo Telemetry Eqn 28	Volts	GLA03
21	+ 5 V Hybrid # 4 Current	M	Pseudo Telemetry Eqn 29	Amps	GLA03
21	- 5 V Hybrid # 5 Voltage	M	Pseudo Telemetry Eqn 30	Volts	GLA03
21	- 5 V Hybrid # 5 Current	M	Pseudo Telemetry Eqn 31	Amps	GLA03
21	- 5 V Hybrid # 6 Voltage	M	Pseudo Telemetry Eqn 32	Volts	GLA03
21	- 5 V Hybrid # 6 Current	M	Pseudo Telemetry Eqn 33	Amps	GLA03
21	+ 15 V Boost Post Register Voltage	M	Pseudo Telemetry Eqn 34	Volts	GLA03
21	- 15 V Boost Post Register Voltage	M	Pseudo Telemetry Eqn 35	Volts	GLA03
21	+12 V Prim Osc Thermal Control Current	M	Pseudo Telemetry Eqn 36	Amps	GLA03
21	+12 V Sec Osc Thermal Control Current	M	Pseudo Telemetry Eqn 37	Amps	GLA03
21	-2 V Discrete Voltage	M	Pseudo Telemetry Eqn 38	Volts	GLA03
21	Hybrid Heatsink Temperature	M	Pseudo Telemetry Eqn 39	Deg C	GLA03
21	FET Switch Bank Heatsink Temperature	M	Pseudo Telemetry Eqn 40	Deg C	GLA03
21	FET Switch Bank	I	See Section A.4	n/a	GLA03
21	HVPS +0 Volts Reference	P	0.0, 0.026	Volts	GLA03
21	HVPS +5 V Reference	P	0.0, 0.052	Volts	GLA03
21	MCS Mux Counter (4-bits)	N		Counts	GLA03
21	Optical Sensor Status	I	See Section A.5	n/a	GLA03
21	Status Cmd Telemetry	I	See Section A.6	n/a	GLA03
22	Housekeeping Board Temperature	P	-20.4, 0.3984	Deg C	GLA03
22	Instrument Processor System Board Temperature	P	-23.5, 0.3984	Deg C	GLA03
22	Photon Counter Board Temperature	P	-21.6, 0.3984	Deg C	GLA03
22	Cloud Digitizer/Frequency & Time Board Temperature	P	-21.6, 0.3984	Deg C	GLA03
22	Altimeter Digitizer 1 DSP Temperature	P	-21.0, 0.3984	Deg C	GLA03
22	Altimeter Digitizer 2 DSP Temperature	P	-21.0, 0.3984	Deg C	GLA03
22	Data Collection & Handling Board Temp	P	-20.7, 0.3984	Deg C	GLA03
22	Laser Monitor Board Temperature	P	-21.0, 0.3984	Deg C	GLA03

Table A-1 Conversion Description for GLAS Telemetry Data (Continued)

APID	Name	Conv. Type	Conversion Description	Units	L1A Product ID
22	Temperature Controller Monitor Board Temperature	P	-21.0, 0.3984	Deg C	GLA03
22	Oven-crystal-controlled Oscillator (OXCO)1 Board Temperature	P	-21.0, 0.3984	Deg C	GLA03
22	OXCO 2 Board Temperature	P	-21.0, 0.3984	Deg C	GLA03
22	Oscillator Board Temperature	P	-21.0, 0.3984	Deg C	GLA03
22	OTS Board Temperature	P	-21.0, 0.3984	Deg C	GLA03
22	LPA Temperature 1	P	-21.0, 0.3984	Deg C	GLA03
22	LPA Temperature 2	P	-21.0, 0.3984	Deg C	GLA03
22	AD 1 ECLA Temperature	P	-21.0, 0.3984	Deg C	GLA03
22	AD 2 ECLA Temperature	P	-21.0, 0.3984	Deg C	GLA03
22	AD 1 ECLB Temperature	P	-21.0, 0.3984	Deg C	GLA03
22	AD 2 ECLB Temperature	P	-21.0, 0.3984	Deg C	GLA03
22	AD 1 ADC Temperature	P	-21.0, 0.3984	Deg C	GLA03
22	AD 2 ADC Temperature	P	-21.0, 0.3984	Deg C	GLA03
22	SPCM Temperature	P	-18.113, 0.3083	Deg C	GLA03
22	Telescope Mount Temperature	P	-18.113, 0.3083	Deg C	GLA03
22	Telescope Baffle Temperature	P	-18.113, 0.3083	Deg C	GLA03
22	AD 1 Temperature	P	-18.113, 0.3083	Deg C	GLA03
22	AD 2 Temperature	P	-18.113, 0.3083	Deg C	GLA03
22	Face 1 LTR to SRS Temperature	P	-18.113, 0.3083	Deg C	GLA03
22	Face 2 LTR to SRS Temperature	P	-18.113, 0.3083	Deg C	GLA03
22	Fiber Delay Line Temperature	P	-18.113, 0.3083	Deg C	GLA03
22	Fiber Box Temperature	P	-18.113, 0.3083	Deg C	GLA03
22	Face 1 Fold Around Bench Temperature	P	-18.113, 0.3083	Deg C	GLA03
22	Face 2 Fold Around Bench Temperature	P	-18.113, 0.3083	Deg C	GLA03
22	Face 1 LTR CRS Temperature	P	-18.113, 0.3083	Deg C	GLA03
22	Face 2 LTR CRS Temperature	P	-18.113, 0.3083	Deg C	GLA03
22	SRS Parabola Temperature	P	-18.113, 0.3083	Deg C	GLA03
22	PRT Cal Low	P	-18.113, 0.3083	Deg C	GLA03
22	PRT Cal High	P	-18.113, 0.3083	Deg C	GLA03
22	Pin Diode Bias Voltage	P	0,0.2949	Volts	GLA03
22	AD1 High Speed Ram Temperature	P	-21.0, 0.3984	Deg C	GLA03

Table A-1 Conversion Description for GLAS Telemetry Data (Continued)

APID	Name	Conv. Type	Conversion Description	Units	L1A Product ID
22	Spares	N		n/a	GLA03
23	Laser Select Mechanism 1 Temperature	P	-1456.13,0.5664055703	Deg C	GLA03
23	Laser Select Mechanism 2 Temperature	P	-1456.13,0.5664055703	Deg C	GLA03
23	Altimeter Digitizer Select Mechanism Temperature	P	-1456.13,0.5664055703	Deg C	GLA03
23	Laser Beam Select Mechanism Electronics Temperature	P	-1456.13,0.5664055703	Deg C	GLA03
23	Laser Beam Select Mechanism Mirror Temperature	P	-1456.13,0.5664055703	Deg C	GLA03
23	HOP1 Actuator Current - Heater 1	P	-2.0,976.5625E-6	Amps	GLA03
23	HOP1 Actuator Current - Heater 2	P	-2.0,976.5625E-6	Amps	GLA03
23	HOP2 Actuator Current - Heater 1	P	-2.0,976.5625E-6	Amps	GLA03
23	HOP2 Actuator Current - Heater 2	P	-2.0,976.5625E-6	Amps	GLA03
23	HOP3 Actuator Current - Heater 1	P	-2.0,976.5625E-6	Amps	GLA03
23	HOP3 Actuator Current - Heater 2	P	-2.0,976.5625E-6	Amps	GLA03
23	LHP 1 and 2 Heater Status	I	LHP 1 Heater Status, Mask=0x01, 0=Off, 1=On; LHP 2 Heater Status, Mask=0x02, 0=Off, 1=On	n/a	GLA03
23	Telescope Prim Mirror Heater Enable Readback	I	0=Disabled, 0xFF=Enabled	n/a	GLA03
23	Telescope Prim Mirror Heater Temp Setpoint Readback	P	0.1586, 0.1027, -4.253E-05, 3.833E-07	Deg C	GLA03
23	spares	N		n/a	GLA03
23	Telescope Tower Heater Enable Readback	I	0=Disabled, 0xFF=Enabled	n/a	GLA03
23	Telescope Tower Heater Temp Setpoint Readback	P	0.1392, 0.104, -5.962E-05, 4.304E-07	Deg C	GLA03
23	Etalon Heater Enable Readback	I	0=Disabled, 0xFF=Enabled	n/a	GLA03
23	Etalon Heater Temp Setpoint Readback	P	29.27, 0.09251, 9.919E-06, 1.022E-07	Deg C	GLA03
23	LHP 1 Enable Readback	I	0=Disabled, 0xFF=Enabled	n/a	GLA03
23	LHP 1 Temp Setpoint Readback	P	0.02609, 0.1173, -6.871E-05, 2.629E-07	Deg C	GLA03
23	LHP 2 Enable Readback	I	0=Disabled, 0xFF=Enabled	n/a	GLA03

Table A-1 Conversion Description for GLAS Telemetry Data (Continued)

APID	Name	Conv. Type	Conversion Description	Units	L1A Product ID
23	LHP 2 Temp Setpoint Readback	P	-7.696, 0.11, -5.1E-05, 2.007E-07	Deg C	GLA03
23	Thermistor Select - Tscope Prim Mirror - Status Readback	I	0=Thermistor 1, 0xFF=Thermistor 2	n/a	GLA03
23	Thermistor Select - Tscope Sec Mirror - Status Readback	I	0=Thermistor 1, 0xFF=Thermistor 2	n/a	GLA03
23	Thermistor Select Tscope Sec Support Structure Status Readback	I	0=Thermistor 1, 0xFF=Thermistor 2	n/a	GLA03
23	Thermistor Select LHP1(lasers) Status Readback	I	0=Thermistor 1, 0xFF=Thermistor 2	n/a	GLA03
23	Thermistor Select LHP2(rest of instrument) Status Readback	I	0=Thermistor 1, 0xFF=Thermistor 2	n/a	GLA03
23	Thermistor Select Etalon Status Readback	I	0=Thermistor 1, 0xFF=Thermistor 2	n/a	GLA03
23	Spare	N		n/a	GLA03
50	Telescope Primary Mirror Temperature	P	0.1586, 0.1027, -4.253E-05, 3.833E-07	Deg C	GLA03
50	Telescope Secondary Mirror Temperature	P	0.02506,0.1051, -6.469E-05,4.376E-07	Deg C	GLA03
50	Telescope Tower Temperature	P	0.1392, 0.104, -5.962E-05, 4.304E-07	Deg C	GLA03
50	Etalon Temperature	P	29.27, 0.09251, 9.919E-06, 1.022E-07	Deg C	GLA03
50	LHP 1 Temperature	P	0.02609, 0.1173, -6.871E-05, 2.629E-07	Deg C	GLA03
50	LHP 2 Temperature	P	-7.696, 0.11, -5.1E-05, 2.007E-07	Deg C	GLA03
50	Telescope Primary Mirror Heater drive current	P	0.0008, 0.003678	Amps	GLA03
50	Telescope Secondary Mirror Heater drive current	P	0.0008, 0.003113	Amps	GLA03
50	spares	N		n/a	GLA03
50	Etalon Drive Heater Current	P	1.35E-3, 0.003468	Amps	GLA03
50	Delay Line All Temperature	P	-33.84, 0.5368, -1.622E-3, 3.155E-6	Deg C	GLA03
50	Delay Line Mid Temperature	P	-2.406, 0.06459, -7.58E-6, 5.591E-8	Deg C	GLA03

Table A-1 Conversion Description for GLAS Telemetry Data (Continued)

APID	Name	Conv. Type	Conversion Description	Units	L1A Product ID
50	Delay Line Hi Temperature	P	13.33, 0.06518, -5.261E-6, 4.076E-8	Deg C	GLA03
50	Spares	N		n/a	GLA03
24	HS Task Cmd Processed Counter	N		n/a	GLA03
24	HS Task Cmd Rejected (or Error) Counter	N		n/a	GLA03
24	CS Task Cmd Processed Counter	N		n/a	GLA03
24	CS Task Cmd Rejected (or Error) Counter	N		n/a	GLA03
24	TC Task Cmd Processed Counter	N		n/a	GLA03
24	TC Task Cmd Rejected (or Error) Counter	N		n/a	GLA03
24	SB Task Cmd Processed Counter	N		n/a	GLA03
24	SB Task Cmd Rejected (or Error) Counter	N		n/a	GLA03
24	SM Task Cmd Processed Counter	N		n/a	GLA03
24	SM Task Cmd Rejected (or Error) Counter	N		n/a	GLA03
24	RT Task Cmd Processed Counter	N		n/a	GLA03
24	RT Task Cmd Rejected (or Error) Counter	N		n/a	GLA03
24	RT Task RCH3 (SA22-25, CSA 26) Commands Received	N		n/a	GLA03
24	RT Task RCH3 (SA22-25, CSA 26) Commands Rejected	N		n/a	GLA03
24	MD Task Cmd Processed Counter	N		n/a	GLA03
24	MD Task Cmd Rejected (or Error) Counter	N		n/a	GLA03
24	AD Task Cmd Processed Counter	N		n/a	GLA03
24	AD Task Cmd Rejected (or Error) Counter	N		n/a	GLA03
24	AD Target Status and Mode Flags	I	See Section A.30	n/a	GLA03
24	CD Task CMD Processed Counter	N		n/a	GLA03
24	CD Task CMD Rejected (or Error) Counter	N		n/a	GLA03
24	CD Status Flags	I	See Section A.7	n/a	GLA03

Table A-1 Conversion Description for GLAS Telemetry Data (Continued)

APID	Name	Conv. Type	Conversion Description	Units	L1A Product ID
24	DC Task Cmd Processed Counter	N		n/a	GLA03
24	DC Task Cmd Rejected (or Error) Counter	N		n/a	GLA03
24	DC Status flag	I	See Section A.8	n/a	GLA03
24	GP Task Cmd Processed Counter	N		n/a	GLA03
24	GP Task Cmd Rejected (or Error) Counter	N		n/a	GLA03
24	GP Status Bits	I	See Section A.25	n/a	GLA03
24	GP Spare	N		n/a	GLA03
24	PC Task Cmd Processed Counter	N		n/a	GLA03
24	PC Task Cmd Rejected (or Error) Counter	N		n/a	GLA03
24	PC Status Flag	I	See Section A.9	n/a	GLA03
24	CT Task Cmd Processed Counter	N		n/a	GLA03
24	CT Task Cmd Rejected (or Error) Counter	N		n/a	GLA03
24	CT Task Mode	I	See Section A.10	n/a	GLA03
25	HS Processor Previous Mode	I	0,1,4=Unknown, 2=PROM, 3=EEPROM	n/a	GLA03
25	HS Processor Current Mode	I	0,1,4=Unknown, 2=PROM, 3=EEPROM	n/a	GLA03
25	Subsystem Present Flags	I	See Section A.11	n/a	GLA03
25	HS Warm Restart Count	N		n/a	GLA03
25	HS Cold Restart Count	N		n/a	GLA03
25	HS Max Warm Restart Count	N		n/a	GLA03
25	HS Cold-Warm Flag	N		n/a	GLA03
25	HS OS Caused Reset Flag	N		n/a	GLA03
25	HS OS Tick Count	N		n/a	GLA03
25	HS HS Exec Count	N		n/a	GLA03
25	HS CS Exec Count	N		n/a	GLA03
25	HS TC Exec Count	N		n/a	GLA03
25	HS SB Exec Count	N		n/a	GLA03
25	HS SM Exec Count	N		n/a	GLA03
25	HS RT Exec Count	N		n/a	GLA03

Table A-1 Conversion Description for GLAS Telemetry Data (Continued)

APID	Name	Conv. Type	Conversion Description	Units	L1A Product ID
25	HS MD Exec Count	N		n/a	GLA03
25	HS AD Exec Count	N		n/a	GLA03
25	HS CD Exec Count	N		n/a	GLA03
25	HS DC Exec Count	N		n/a	GLA03
25	HS GP Exec Count	N		n/a	GLA03
25	HS PC Exec Count	N		n/a	GLA03
25	HS CT Exec Count	N		n/a	GLA03
25	HS FPU Underflow Count	N		n/a	GLA03
25	HS Timer 2 ISR Count	N		n/a	GLA03
25	HS FP ISR Count	N		n/a	GLA03
25	HS TC Fire Cmd ISR Count	N		n/a	GLA03
25	HS RT ISR Count - Low Priority	N		n/a	GLA03
25	HS Spare ISR Count	N		n/a	GLA03
25	HS CT ISR Count	N		n/a	GLA03
25	HS PCI Initiator ISR Count	N		n/a	GLA03
25	HS GPS UART ISR Count	N		n/a	GLA03
25	HS GPS 10 Sec ISR Count	N		n/a	GLA03
25	HS DC ISR Count	N		n/a	GLA03
25	HS PC ISR Count	N		n/a	GLA03
25	HS WD ISR Count	N		n/a	GLA03
25	HS AD ISR Count	N		n/a	GLA03
25	HS CD ISR Count	N		n/a	GLA03
25	HS OS Event Sequence Number	N		n/a	GLA03
25	HS Peak CPU Utilization	N		n/a	GLA03
25	HS Last CPU Utilization	N		n/a	GLA03
25	HS OS PCI Bus Target Enable and Interrupt status	N		n/a	GLA03
25	HS OS Performance Log Enable Flag	I	0x01; 0=Disabled, 1=Enabled	n/a	GLA03
25	HS OS Performance Log Item Count	N		n/a	GLA03
25	HS OS Performance Log Filter Start Address	N		n/a	GLA03
25	HS OS Performance Log Filter Mask	N		n/a	GLA03
25	Spares	N		n/a	GLA03

Table A-1 Conversion Description for GLAS Telemetry Data (Continued)

APID	Name	Conv. Type	Conversion Description	Units	L1A Product ID
25	CS Status Flags	I	See Section A.12	n/a	GLA03
25	CS Code Segment Error Count	N		n/a	GLA03
25	CS EEPROM Segment Error Count	N		n/a	GLA03
25	CS Table Ram Segment Error Count	N		n/a	GLA03
25	CS Table ID of last Code Error	N		n/a	GLA03
25	CS Table ID of last EEPROM Error	N		n/a	GLA03
25	CS Table ID of last Table RAM Error	N		n/a	GLA03
25	CS Code Segment Master Checksum	N		n/a	GLA03
25	CS Table RAM Master Checksum	N		n/a	GLA03
25	CS EEPROM Master Checksum	N		n/a	GLA03
25	CS Checksum of EEPROM Boot Memory	N		n/a	GLA03
25	CS Checksum of EEPROM Memory	N		n/a	GLA03
25	CS Checksum of PROM Memory	N		n/a	GLA03
25	CS Spare	N		n/a	GLA03
25	TC GLAS MET Upper 2 bytes	U	0xFF0000		GLA03
25	TC GLAS MET Lower 4 bytes	U	0x00FFFF		GLA03
25	TC Fire Command Time Increment Upper 2 bytes	U			GLA03
25	TC Fire Command Time Increment Lower 4 bytes	U			GLA03
25	TC GLAS MET Working Time seconds	U			GLA03
25	TC GLAS MET Working Time microseconds	U			GLA03
25	Spare	N		n/a	GLA03
25	SB Send Error Count	N		n/a	GLA03
25	SB Receive Error Count	N		n/a	GLA03
25	SB OS Error Count	N		n/a	GLA03
25	SB Queue Full Error Count	N		n/a	GLA03
25	SB Buffer overrun Error Count	N		n/a	GLA03
25	SB last buffer overrun - Stream Id	N		n/a	GLA03
25	SB last buffer overrun - Pipeline Id	N		n/a	GLA03
25	SB last buffer overrun - Sender Task ID	N		n/a	GLA03

Table A-1 Conversion Description for GLAS Telemetry Data (Continued)

APID	Name	Conv. Type	Conversion Description	Units	L1A Product ID
25	SB last queue full - Stream Id	N		n/a	GLA03
25	SB last queue full - Pipeline Id	N		n/a	GLA03
25	SB last queue full - Sender Task ID	N		n/a	GLA03
25	SB Spare	N		n/a	GLA03
25	SM number of remaining copies to be dumped	N		n/a	GLA03
25	SM table/memory dump in progress flag	I	0=False, 1=True	n/a	GLA03
25	SM table operations flag	I	See Section A.13	n/a	GLA03
25	SM table operations from image type	I	0=None, 1=EEPROM, 2=RAM, 3=NULL	n/a	GLA03
25	SM table id selected	N		n/a	GLA03
25	SM currently selected table size in words	N		n/a	GLA03
25	SM currently selected table checksum	N		n/a	GLA03
25	SM table commit success count	N		n/a	GLA03
25	SM table commit failure count	N		n/a	GLA03
25	SM table num. of words loaded	N		n/a	GLA03
25	SM FSW build number	N		n/a	GLA03
25	SM FSW version number	N		n/a	GLA03
25	SM spares	N		n/a	GLA03
25	BCRT CONTROL REGISTER WORD	I	See Section A.14	n/a	GLA03
25	BCRT Status Register	I	0=RT Mode Disabled, 1=RT Mode Enabled	n/a	GLA03
25	BCRT INTERRUPT STATUS REGIS-TER	N		n/a	GLA03
25	RT 1553 MESSAGE ERRORS	N		n/a	GLA03
25	RT 1553 RETRY COUNT	N		n/a	GLA03
25	RT 1553 INVALID COMMANDS	N		n/a	GLA03
25	RT 1553 INVALID BROADCAST CMDS	N		n/a	GLA03
25	RT MODE CODES RECEIVED	N		n/a	GLA03
25	SPARE	N		n/a	GLA03
25	RT PACKETS RECEIVED ON RCH1	N		n/a	GLA03
25	RT PACKETS Rejected ON RCH1	N		n/a	GLA03

Table A-1 Conversion Description for GLAS Telemetry Data (Continued)

APID	Name	Conv. Type	Conversion Description	Units	L1A Product ID
25	RT PACKETS SENT ON XCH1	N		n/a	GLA03
25	RT PACKETS SENT ON XCH2	N		n/a	GLA03
25	RT Number of Command History Packets Sent	N		n/a	GLA03
25	RT Checksum Status	I	0=Cmd CS Disabled, 1=Cmd CS Enabled	n/a	GLA03
25	Spares	N		n/a	GLA03
25	MD Enable/Disable Flag	I	See Section A.22	n/a	GLA03
25	MD Table 1 Address Count	N		n/a	GLA03
25	MD Table 2 Address Count	N		n/a	GLA03
25	MD Table 1 Rate	P	0.0,0.125	seconds	GLA03
25	MD Table 2 Rate	P	0.0,0.125	seconds	GLA03
25	MD spare	N		n/a	GLA03
55	AD Software Error Count	N		n/a	GLA03
55	AD Hardware Error Count	N		n/a	GLA03
55	AD Shot Count Value	N		n/a	GLA03
55	AD Shot Count Skip Detected	I	0= no skip, 1=skip	n/a	GLA03
55	AD Synchronized Flag	I	0=not in sync, 1=in sync	n/a	GLA03
55	AD Spare	N		n/a	GLA03
55	AD DSP Laser Fire Count	N		n/a	GLA03
55	AD DSP Alive Count	N		n/a	GLA03
55	AD Ancillary Packets Sent	N		n/a	GLA03
55	AD Engineering Packets Sent	N		n/a	GLA03
55	AD Science Small Packets Sent	N		n/a	GLA03
55	AD Science Large Packets Sent	N		n/a	GLA03
55	AD DSP Load Packets Processed Count	N		n/a	GLA03
55	AD DSP Memory Dump Packets Sent	N		n/a	GLA03
55	AD Memory Load Command Errors	N		n/a	GLA03
55	AD Memory Dump Command Errors	N		n/a	GLA03
55	AD DSP Checksum Rate	N		n/a	GLA03
55	AD DSP Checksum S/W Valid Status	I	0=Not Valid, 1=Valid	n/a	GLA03
55	AD DSP # of times all of memory has been checksummed	N		n/a	GLA03

Table A-1 Conversion Description for GLAS Telemetry Data (Continued)

APID	Name	Conv. Type	Conversion Description	Units	L1A Product ID
55	AD DSP Bootstrap Checksum Lower 16 bits	N		n/a	GLA03
55	AD DSP EPROM Checksum Lower 16 bits	N		n/a	GLA03
55	AD DSP RAM Checksum Lower 16 bits	N		n/a	GLA03
55	AD DSP Bootstrap Checksum Upper 32 bits	N		n/a	GLA03
55	AD DSP EPROM Checksum Upper 32 bits	N		n/a	GLA03
55	AD DSP RAM Checksum Upper 32 bits	N		n/a	GLA03
55	AD DSP S/W Build Number	N		n/a	GLA03
55	AD DSP S/W Version Number	N		n/a	GLA03
55	AD GPS Range Window Packets received	N		n/a	GLA03
55	AS DSP Patch Checksum bits 15..0	N		n/a	GLA03
55	AS DSP Patch Checksum bits 47...16	N		n/a	GLA03
55	AD Auto Reset DSP Flag	I	0=False; 1=True	n/a	GLA03
55	AD Software Enable Flag	I	See Section A.26	n/a	GLA03
55	AD DSP Trouble Indicator Status Word	I	See Section A.27	n/a	GLA03
55	AD DSP Memory Table Load Error Counter	N		n/a	GLA03
55	AD Fixed Return Gain Setting	N		n/a	GLA03
55	AD Spares	N		n/a	GLA03
55	CD Software Error Count	N		n/a	GLA03
55	CD Shot Count	N		n/a	GLA03
55	CD Science Mode Packets Sent	N		n/a	GLA03
55	CD Engineering Mode Packets Sent	N		n/a	GLA03
55	CD Ancillary Packet Sent	N		n/a	GLA03
55	CD Range Gate Packets Received	N		n/a	GLA03
55	CD 40-bit Counter Packets Sent	N		n/a	GLA03
55	Spare	N		n/a	GLA03
55	CD Background #1 Delay	P	0.0,128.0	nanosec-onds	GLA03

Table A-1 Conversion Description for GLAS Telemetry Data (Continued)

APID	Name	Conv. Type	Conversion Description	Units	L1A Product ID
55	CD Background #2 Delay	P	0.0,128.0	nanosec-onds	GLA03
55	CD Range Gate Delay	P	0.0,128.0	nanosec-onds	GLA03
55	Spare	N		n/a	GLA03
55	CD Raw A/D Output Data	I	See Section A.15	n/a	GLA03
55	CD GPS 40 bit Latch Value 32 lsb	U			GLA03
55	CD Fire Acknowledge 40 bit Latch Value 32 lsb	U			GLA03
55	CD Fire Cmd 40 bit Latch Value 32 lsb	U			GLA03
55	Spare	N		n/a	GLA03
55	CD Fire Cmd 40 bit Latch Value 8 msb	U			GLA03
55	CD Fire Acknowledge 40 bit Latch Value 8 msb	U			GLA03
55	CD GPS 40 bit Latch Value 8 msb	U			GLA03
55	CD Data Ready Counter	I	CD Fire Acknowledge Counter mask 0x0000FF00; CD Data Ready Counter mask 0x000000FF	n/a	GLA03
55	CD Interrupt Status	I	See Section A.16	n/a	GLA03
55	Spare	N		n/a	GLA03
55	DC Software Fail Count	N		n/a	GLA03
55	DC Shot Count	N		n/a	GLA03
55	DC X Position	N		n/a	GLA03
55	DC Y Position	N		n/a	GLA03
55	DC LPA Packets Sent	N		n/a	GLA03
55	DC Test Mode Rate	N		n/a	GLA03
55	DC Packets Sent	N		n/a	GLA03
55	DC Bytes Sent	N		n/a	GLA03
55	DC Output bit rate in BPS	N		n/a	GLA03
55	DC Interrupt register	N		n/a	GLA03
55	DC Control latch register	N		n/a	GLA03
55	DC Interrupt Mask Register	I	See Section A.17	n/a	GLA03
55	DC fifo flags register	I	See Section A.18	n/a	GLA03

Table A-1 Conversion Description for GLAS Telemetry Data (Continued)

APID	Name	Conv. Type	Conversion Description	Units	L1A Product ID
55	DC LPA gain register	I	See Section A.19	n/a	GLA03
55	DC LPA packet count register	I	See Section A.20	n/a	GLA03
55	DC Spares	N		n/a	GLA03
55	GP GPS 10 second Interrupt Count	N		n/a	GLA03
55	GP Number of Position Packets received	N		n/a	GLA03
55	GP Number of Housekeeping packets sent	N		n/a	GLA03
55	GP Number of Ancillary Packets sent	N		n/a	GLA03
55	GP GPS 10 second Pulse 40-Bit Counter Requests sent	N		n/a	GLA03
55	GP GPS 10 sec. Pulse 40-Bit Counter Packets Received	N		n/a	GLA03
55	GP Packets with bad X,Y,Z position data	N		n/a	GLA03
55	GP Packets with X,Y,Z position data below tolerance	N		n/a	GLA03
55	GP Number of range packets sent	N		n/a	GLA03
55	GP Spares	N		n/a	GLA03
55	PC Software Error Count	N		n/a	GLA03
55	PC Shot Counter	N		n/a	GLA03
55	PC SCIENCE MODE PACKETS SENT	N		n/a	GLA03
55	PC ENGINEERING MODE PACKETS SENT	N		n/a	GLA03
55	PC ANCILLARY MODE PACKETS SENT	N		n/a	GLA03
55	PC RANGE GATE DELAY PACKETS RECEIVED	N		n/a	GLA03
55	PC SPCM Gate Delay	P	0.0,128.0	nanoseconds	GLA03
55	PC Background 1 Delay	P	0.0,128.0	nanoseconds	GLA03
55	PC Background 2 Delay	P	0.0,128.0	nanoseconds	GLA03
55	PC Range Gate Delay	P	0.0,128.0	nanoseconds	GLA03

Table A-1 Conversion Description for GLAS Telemetry Data (Continued)

APID	Name	Conv. Type	Conversion Description	Units	L1A Product ID
55	PC Hardware Mode Status Word	I	See Section A.21	n/a	GLA03
55	PC SPCM STATUS	I	Bits indicate which SPCM are enabled; 0=Enabled, 1=Disabled.: SPCM 1: mask 0x00000100; SPCM 2: mask 0x00000200; SPCM 3: mask 0x00000400; SPCM 4: mask 0x00000800; SPCM 5: mask 0x00001000; SPCM 6: mask 0x00002000; SPCM 7: mask 0x00004000; SPCM 8: mask 0x00008000	n/a	GLA03
55	PC Data Ready Counter	I	PC Fire Acknowledge Counter: mask 0x00FF00 PC Data Ready Counter: mask 0x0000FF		GLA03
55	PC SPCM 1 THROUGH 4 RAW COUNTS	I	SPCM Raw Counts; SPCM 1: mask 0x000000FF SPCM 2: mask 0x0000FF00 SPCM 3: mask 0x00FF0000 SPCM 4: mask 0xFF000000	counts	GLA03
55	PC SPCM 5 THROUGH 8 RAW COUNTS	I	SPCM Raw Counts; SPCM 5: mask 0x000000FF SPCM 6: mask 0x0000FF00 SPCM 7: mask 0x00FF0000 SPCM 8: mask 0xFF000000	counts	GLA03
55	PC SPCM Duty Cycle	N			GLA03
55	PC Coarse Boresite Calibration X Start Pos	N			GLA03
55	PC Coarse Boresite Calibration Y Start Pos	N			GLA03
55	PC Fine Boresite Calibration X Start Pos	N			GLA03
55	PC Fine Boresite Calibration Y Start Pos	N			GLA03
55	PC Coarse Boresite Calibration X Increment	N			GLA03
55	PC Coarse Boresite Calibration Y Increment	N			GLA03
55	PC Fine Boresite Calibration X Increment	N			GLA03

Table A-1 Conversion Description for GLAS Telemetry Data (Continued)

APID	Name	Conv. Type	Conversion Description	Units	L1A Product ID
55	PC Fine Boresite Calibration Y Increment	N			GLA03
55	PC Coarse Boresite Calibration Integration Seconds	N			GLA03
55	PC Fine Boresite Calibration Integration Seconds	N			GLA03
55	PC Boresite Calibration Best X Position	N			GLA03
55	PC Boresite Calibration Best Y Position	N			GLA03
55	PC Boresite Calibration Seconds Remaining	N			GLA03
55	Spares	N		n/a	GLA03
55	CT State Machine Current State	I	0=Unknown, 1=Reset, 2=Timeout, 3=Acquire Sync, 4=Wait for Muxes, 5=Process Telemetry, 6=Unknown	n/a	GLA03
55	CT COMMAND ECHO ERRORS	N		n/a	GLA03
55	CT LM BOARD CMDS RECEIVED	N		n/a	GLA03
55	CT TM BOARD CMDS RECEIVED	N		n/a	GLA03
55	CT MC BOARD CMDS RECEIVED	N		n/a	GLA03
55	CT HK BOARD CMDS RECEIVED	N		n/a	GLA03
55	CT HVPS Cmds Received	N		n/a	GLA03
55	CT PDU Cmds Received	N		n/a	GLA03
55	CT HW TLM 1 PACKETS SENT	N		n/a	GLA03
55	CT HW TLM 2 PACKETS SENT	N		n/a	GLA03
55	CT HW TLM 3 PACKETS SENT	N		n/a	GLA03
55	CT HW TLM 4 PACKETS SENT	N		n/a	GLA03
55	CT HW TLM 5 PACKETS SENT	N		n/a	GLA03
55	CT DWELL PACKETS SENT	N		n/a	GLA03
55	CT ANCILLARY PACKETS SENT	N		n/a	GLA03
55	CT TIMEOUT COUNT	N		n/a	GLA03
55	CT INTERRUPT COUNT	N		n/a	GLA03
55	CT Shot Counter Errors	N		n/a	GLA03
55	CT Dwell Mode	I	0=None, 1=LMB, 2=HK, 4=TCM, 8=MCS, 16=PDU, 32=HVPS	n/a	GLA03

Table A-1 Conversion Description for GLAS Telemetry Data (Continued)

APID	Name	Conv. Type	Conversion Description	Units	L1A Product ID
55	CT Dwell Channel	N		n/a	GLA03
55	CT Laser Monitor Board Mux Error Counter	N		n/a	GLA03
55	CT Housekeeping Board Mux Error Counter	N		n/a	GLA03
55	CT Housekeeping Board Submux Error Counter	N		n/a	GLA03
55	CT Temperature Controller Board Mux Error Counter	N		n/a	GLA03
55	CT Mechanism Controller Board Mux Error Counter	N		n/a	GLA03
55	CT High Voltage Power Supply Mux Error Counter	N		n/a	GLA03
55	CT Power Distribution Unit Mux Error Counter	N		n/a	GLA03
55	CT Command Echo Success Count	N		n/a	GLA03
55	CT Suppressed Event Message Error Flags	I	See Section A.23	n/a	GLA03
55	CT LHP1 Temperature Control State	I	See Section A.24	n/a	GLA03
55	CT LHP2 Temperature Control State	I	See Section A.24	n/a	GLA03
55	CT LHP1 Temperature Setpoint	N		n/a	GLA03
55	CT LHP2 Temperature Setpoint	N		n/a	GLA03
55	CT LHP1 Temperature Control Counter	N		n/a	GLA03
55	CT LHP2 Temperature Control Counter	N		n/a	GLA03
55	CT LHP1 Minimum Temperature	N		n/a	GLA03
55	CT LHP2 Minimum Temperature	N		n/a	GLA03
55	CT LHP1 Temperature Change	N		n/a	GLA03
55	CT LHP2 Temperature Change	N		n/a	GLA03
55	CT LHP1 Temperature Control Cycle Time	N		n/a	GLA03
55	CT LHP2 Temperature Control Cycle Time	N		n/a	GLA03
55	CT Misc Status Flags	I	0=HK SubMUX Paused 1=OK	n/a	GLA03
55	CT Spares	N		n/a	GLA03

Table A-1 Conversion Description for GLAS Telemetry Data (Continued)

APID	Name	Conv. Type	Conversion Description	Units	L1A Product ID
31	Dump Packet CRC Error	I	0 = No Errors 1 = CRC Error Detected	n/a	*
31	Start address	N			*
31	Number of 48-bit words in packet	N		n/a	*
31	Type	I	0=data memory, 1=program memory	n/a	*
31	Data	I	100 48 bit-words. Every 2 consecutive 32-bit words contain a 48-bit word. The first 32-bit word contains the most significant 32 bits and the second contains the least significant 16-bits with the upper 16 bits zero filled.		*
32	Dump Packet CRC Error	I	0 = No Errors 1 = CRC Error Detected	n/a	*
32	Start address	N			*
32	Number of 32-bit words in packet	N	For Altimeter Digitizer one shot mode, multiply this number by 4 to get the number of waveform bins contained in the packet.	n/a	*
32	Type	I	0=data memory, 1=program memory	n/a	*
32	Data	N		n/a	*
33	C&T Board where telemetry point is being dwelled on	I	1= LMB, 2=HK, 4=TCM, 8=MCS, 16=PDU, 32=HVPS	n/a	*
33	Telemetry channel (or point) to dwell on	N		n/a	*
33	Data from 1st second (older)	N		n/a	*
33	Data from 2nd second	N		n/a	*
33	Data from 3rd second	N		n/a	*
33	Data from 4th second	N		n/a	*
27/28	The number of words currently used by Dwell Table 1 or 2	N		n/a	*
27/28	The dwell rate for Table 1 or 2	P	[(rate+1)*(1/8) sec], must be greater than 1/2 second, Polynomial coeff=(0.125, 0.125)		*
27 /28	The stored values sampled by Memory Dwell Table 1 or 2	N		n/a	*

Table A-1 Conversion Description for GLAS Telemetry Data (Continued)

APID	Name	Conv. Type	Conversion Description	Units	L1A Product ID
27/28	Spare	N		n/a	*
34	Event Message Characters	N	66 bytes that contain a ASCII text message to be displayed on GLAS operator console (may have to be byte swapped)		*
35	Processor ID	N		n/a	*
35	Current Dump Copy Number	N		n/a	*
35	Memory Address of First Word in this Packet	N		n/a	*
35	Num. of Words Dumped in this Packet	N		n/a	*
35	Dumped Data Words	N		n/a	*
36	Table Id Number	N		n/a	*
36	Current Table Dump Copy Number	N		n/a	*
36	Table Offset	N		n/a	*
36	Num. of Words Dumped in this Packet	N		n/a	*
36	Table Source Type	I	1 = EEPROM; 2 = RAM; 4 = BUFFER	n/a	*
36	Dumped Table Data Words	N		n/a	*
48	Data Types Packet Fixed Pattern	N		n/a	*
12/13/14	Spare	N		n/a	*
12/13/14	Shot Counter	N		n/a	GLA01
12/13/14	Transmit Pulse Waveform	N		n/a	GLA01, GLA04
12/13/14	Transmit Pulse Waveform Peak Time	N		ns	GLA01, GLA04
12/13/14	Transmit Pulse Waveform Peak Threshold Flag	I	Bit 0: Software Error Bit 1: Search Failure (below threshold) Bit 2: Search Failure Latch. Value of 0 = False, 1 = True. Note: once set to true, Bit 2 can only be cleared by a DSP reset or by a ground command.	n/a	GLA01, GLA04
12/13/14	Starting Address of Transmit Pulse Sample	N		ns	GLA01, GLA04

Table A-1 Conversion Description for GLAS Telemetry Data (Continued)

APID	Name	Conv. Type	Conversion Description	Units	L1A Product ID
12/13/ 14	Ending Address of Range Response Surface Echo Dump	N		ns	GLA01
12/13/ 14	Last Threshold Crossing Time(Trailing Edge)	N		ns	GLA01
12/13/ 14	Next to Last Threshold Crossing Time(Leading Edge)	N		ns	GLA01
12/13/ 14	4ns Filter Peak Value	N		counts	GLA01
12/13/ 14	8ns Filter Peak Value	N		counts	GLA01
12/13/ 14	Peak Value for the selected filter	N		counts	GLA01
12/13/ 14	Time of the Peak Value for the selected filter	N		ns	GLA01
12/13/ 14	Filter Selected	I	0 = 4 ns filter 1 = 8 ns filter 2 = 16 ns filter 3 = 32 ns filter 4 = 64 ns filter 5 = 128 ns filter	n/a	GLA01
12/13/ 14	Threshold Value	N		counts	GLA01
12/13/ 14	Background Noise Mean Value for 4 ns filter	N			GLA01
12/13/ 14	Background Noise Standard Deviation Value for the 4 ns filter	N			GLA01
12/13/ 14	Range Window Status Word	I	See Section A.29	n/a	GLA01
12/13/ 14	Calculated Weights for all Filters	U			GLA01
12/13/ 14	Altimeter Digitizer Gain Setting	U			GLA01
12/13/ 14	Surface Echo Sample Padding	N		n/a	GLA01
12/13/ 14	Surface Echo Compress Type	N	0=N, p & q 1=r	n/a	GLA01
12/13/ 14	Surface Echo Data Samples (may have been averaged)	N		counts	GLA01
15	Shot Counter	N			GLA02

Table A-1 Conversion Description for GLAS Telemetry Data (Continued)

APID	Name	Conv. Type	Conversion Description	Units	L1A Product ID
15	-1 km to 10 km Data	N		n/a	GLA02
15	Background	N		n/a	GLA02
15	error flags	N		n/a	GLA02
15	spares	N		n/a	GLA02
15	10 km to 20 km data	N		n/a	GLA02
15	20 km to 40 km data	N		n/a	GLA02
16	Shot Counter	N		n/a	*
16	40 km to 20 km data	N		n/a	*
16	20 km to 10 km data	N		n/a	*
16	10 km to -1km data	N		n/a	*
17	Shot Counter	N		n/a	GLA02
17	-1 km to 10 km Data	N		n/a	GLA02
17	Background	N		n/a	GLA02
17	10 km to 20 km data	N		n/a	GLA02
18	Shot Counter	N		n/a	*
18	20 km to 10 km data	N		n/a	*
18	10 km to -1 km data	N		n/a	*
19	Shot counter	N		n/a	GLA03
19	Check-In Flags	I	1= tlm in ancillary packet, 0=tlm NOT in ancillary packet; AD Checkin Flag:Mask=0x01 PC Checkin Flag: Mask 0x02 CD Checkin Flag: Mask 0x04 GP Checkin Flag: Mask 0x08 CT Checkin Flag: Mask 0x10	n/a	GLA03
19	Shot Counter	N		n/a	GLA03
19	Altimeter Dig. Range Window Rmin	N		ns	GLA01
19	Altimeter Dig. Range Window Rmax	N		ns	GLA01
19	RMS Noise calculation start time offset	N		ns	GLA01

Table A-1 Conversion Description for GLAS Telemetry Data (Continued)

APID	Name	Conv. Type	Conversion Description	Units	L1A Product ID
19	Filter Selection Mask	I	0=Filter Disabled, 1=Filter Enabled. 4 ns: Mask=0x0001 8 ns: Mask=0x0002 16 ns: Mask=0x0004 32 ns: Mask=0x0008 64 ns: Mask=0x0010 128 ns: Mask=0x0020	n/a	GLA01
19	Shot Counter for PDL waveform	N		n/a	GLA03
19	Post Delay Laser Pulse Response Start Address	N		ns	GLA03
19	Sampled Post Delay Pulse Waveform	N		n/a	GLA03
19	OTS Laser Pulse Response Start Address	N		ns	GLA03
19	Shot Counter for OTS	N		n/a	GLA03
19	Sampled OTS Pulse Waveform	N		n/a	GLA03
19	Location of transmit pulse search window (start)	N		ns	GLA03
19	Number of No Threshold Crossing Shots for Error Condition	N		n/a	GLA03
19	Spare Telemetry Byte	N		n/a	GLA03
19	Surface Echo Land Type	I	0=sea, 1=land, 2=sea/ice, 3=land/ice	n/a	GLA01
19	Value of 'p' used for frame	N		n/a	GLA01
19	Value of 'q' used for frame	N		n/a	GLA01
19	Value of 'N' used for frame	N		n/a	GLA01
19	Value of 'r' used for frame	N		n/a	GLA01
19	Transmit Pulse Threshold Value	N		counts	GLA03
19	Filter Weight Param C0 for 4 ns filter	N		n/a	GLA03
19	Filter Weight Param C1 for 4 ns filter	N		n/a	GLA03
19	Filter Weight Param C2 for 4 ns filter	N		n/a	GLA03
19	Filter Weight Param C3 for 4 ns filter	N		n/a	GLA03
19	Filter Weight Param C0 for 8 ns filter	N		n/a	GLA03
19	Filter Weight Param C1 for 8 ns filter	N		n/a	GLA03
19	Filter Weight Param C2 for 8 ns filter	N		n/a	GLA03
19	Filter Weight Param C3 for 8 ns filter	N		n/a	GLA03

Table A-1 Conversion Description for GLAS Telemetry Data (Continued)

APID	Name	Conv. Type	Conversion Description	Units	L1A Product ID
19	Filter Weight Param C0 for 16 ns filter	N		n/a	GLA03
19	Filter Weight Param C1 for 16 ns filter	N		n/a	GLA03
19	Filter Weight Param C2 for 16 ns filter	N		n/a	GLA03
19	Filter Weight Param C3 for 16 ns filter	N		n/a	GLA03
19	Filter Weight Param C0 for 32 ns filter	N		n/a	GLA03
19	Filter Weight Param C1 for 32 ns filter	N		n/a	GLA03
19	Filter Weight Param C2 for 32 ns filter	N		n/a	GLA03
19	Filter Weight Param C3 for 32 ns filter	N		n/a	GLA03
19	Filter Weight Param C0 for 64 ns filter	N		n/a	GLA03
19	Filter Weight Param C1 for 64 ns filter	N		n/a	GLA03
19	Filter Weight Param C2 for 64 ns filter	N		n/a	GLA03
19	Filter Weight Param C3 for 64 ns filter	N		n/a	GLA03
19	Filter Weight Param C0 for 128 ns filter	N		n/a	GLA03
19	Filter Weight Param C1 for 128 ns filter	N		n/a	GLA03
19	Filter Weight Param C2 for 128 ns filter	N		n/a	GLA03
19	Filter Weight Param C3 for 128 ns filter	N		n/a	GLA03
19	Background Noise A1 Coefficient for 4ns Filter	N		n/a	GLA03
19	Background Noise A2 Coefficient for 4ns Filter	N		n/a	GLA03
19	Background Noise A3 Coefficient for 4ns Filter	N		n/a	GLA03
19	Background Noise A1 Coefficient for 8ns Filter	N		n/a	GLA03
19	Background Noise A2 Coefficient for 8ns Filter	N		n/a	GLA03
19	Background Noise A3 Coefficient for 8ns Filter	N		n/a	GLA03
19	Background Noise A1 Coefficient for 16ns Filter	N		n/a	GLA03
19	Background Noise A2 Coefficient for 16ns Filter	N		n/a	GLA03
19	Background Noise A3 Coefficient for 16ns Filter	N		n/a	GLA03

Table A-1 Conversion Description for GLAS Telemetry Data (Continued)

APID	Name	Conv. Type	Conversion Description	Units	L1A Product ID
19	Background Noise A1 Coefficient for 32ns Filter	N		n/a	GLA03
19	Background Noise A2 Coefficient for 32ns Filter	N		n/a	GLA03
19	Background Noise A3 Coefficient for 32ns Filter	N		n/a	GLA03
19	Background Noise A1 Coefficient for 64ns Filter	N		n/a	GLA03
19	Background Noise A2 Coefficient for 64ns Filter	N		n/a	GLA03
19	Background Noise A3 Coefficient for 64ns Filter	N		n/a	GLA03
19	Background Noise A1 Coefficient for 128ns Filter	N		n/a	GLA03
19	Background Noise A2 Coefficient for 128ns Filter	N		n/a	GLA03
19	Background Noise A3 Coefficient for 128ns Filter	N		n/a	GLA03
19	Spare Telemetry Bytes	N		n/a	GLA03
19	Enable/Disable Auto Gain Calculation	N	0 = fixed; 1 = Auto	n/a	GLA03
19	Enable/Disable Use of 8ns Filter for Auto Gain Calculation	N	0 = Selected Filter; 1 = 8 ns Filter	n/a	GLA03
19	Return Gain Value	N		n/a	GLA03
19	Auto Gain Calculation A1 Parameter	N		n/a	GLA03
19	Auto Gain Calculation A2 Parameter	N		n/a	GLA03
19	Auto Gain Calculation A3 Parameter	N		n/a	GLA03
19	Auto Gain Calculation A4 Parameter	N		n/a	GLA03
19	Auto Gain Calculation B1 Parameter	N		n/a	GLA03
19	Auto Gain Calculation B2 Parameter	N		n/a	GLA03
19	Auto Gain Calculation B3 Parameter	N		n/a	GLA03
19	Auto Gain Calculation B4 Parameter	N		n/a	GLA03
19	Auto Gain Calculation C0 parameter	N		n/a	GLA03
19	Auto Gain Calculation C1 parameter	N		n/a	GLA03
19	Auto Gain Calculation Vref Parameter	N		n/a	GLA03
19	Auto Gain Calculation Zmin Parameter	N		n/a	GLA03

Table A-1 Conversion Description for GLAS Telemetry Data (Continued)

APID	Name	Conv. Type	Conversion Description	Units	L1A Product ID
19	Auto Gain Calculation Zmax Parameter	N		n/a	GLA03
19	Auto Gain Calculation Vmin Parameter	N		n/a	GLA03
19	Auto Gain Calculation Ginit Parameter	N		n/a	GLA03
19	Auto Gain Calculation Gmin Parameter	N		n/a	GLA03
19	Auto Gain Calculation Gmax Parameter	N		n/a	GLA03
19	Tolerance for Coincidence of Filters	N		ns	GLA03
19	Range Window Dump (waveform time) Offset for 4 ns filter	N		ns	GLA03
19	Range Window Dump (waveform time) Offset for 8 ns filter	N		ns	GLA03
19	Range Window Dump (waveform time) Offset for 16 ns filter	N		ns	GLA03
19	Range Window Dump (waveform time) Offset for 32 ns filter	N		ns	GLA03
19	Range Window Dump (waveform time) Offset for 64 ns filter	N		ns	GLA03
19	Range Window Dump (waveform time) Offset for 128 ns filter	N		ns	GLA03
19	Surface (Pulse) Return Threshold Values for All Filters	N	2 spare bytes; 6 threshold values - one for each filter.	n/a	GLA03
19	FIR Filter Coefficients	N		n/a	GLA03
19	Filter Weight Min Standard Deviation	N		n/a	GLA03
19	Filter Noise Minimum thresholds for 4 ns filter	N		counts	GLA03
19	Filter Noise Minimum thresholds for 8 ns filter	N		counts	GLA03
19	Filter Noise Minimum thresholds for 16 ns filter	N		counts	GLA03
19	Filter Noise Minimum thresholds for 32 ns filter	N		counts	GLA03
19	Filter Noise Minimum thresholds for 64 ns filter	N		counts	GLA03
19	Filter Noise Minimum thresholds for 128 ns filter	N		counts	GLA03
19	Filter Reject Mask for Leading Edge Failures	N		counts	GLA03

Table A-1 Conversion Description for GLAS Telemetry Data (Continued)

APID	Name	Conv. Type	Conversion Description	Units	L1A Product ID
19	Filter Reject Mask for Trailing Edge Failures	N		counts	GLA03
19	Spare Telemetry Bytes	N		n/a	GLA03
19	Spare	N		n/a	GLA03
19	SPCM 1-4 Raw Counts	N		counts	GLA02
19	SPCM 5-8 Raw Counts	N		counts	GLA02
19	SPCM Gate Delay and Background #1 Delay	N		counts	GLA02
19	Background #2 Delays and Range Gate Delay	N		counts	GLA02
19	SPCM status	N		counts	GLA02
19	Spare	N		counts	GLA02
19	A/D output and CD Amplifier Attenua-tion (gain) setting	N		counts	GLA02
19	Background #1 Delay	N		counts	GLA02
19	Background #2 and Range Gate Delay	N		counts	GLA02
19	Detector status	N		counts	GLA02
19	Spare	N		n/a	GLA03
19	Shot Counter for start of Frame	N		n/a	GLA03
19	Shot Counter	N		counts	GLA03
19	Fire Acknowledge Time (from Freq and Time Bd)	M			GLA03
19	Fire Command Time (from Freq and Time Bd)	M	See Section A.32 for shot time tag specification. The raw value will be stored on GLA03. The shot times will be stored on GLA01 and GLA04		GLA03, GLA01, GLA04
19	Latitude	N		degrees	GLA03
19	Longitude	N		degrees	GLA03
19	Height (Hsat)	P	0.0, 1000.0	meters	GLA02, GLA03
19	Rsat	P	0.0, 1000.0	meters	GLA01
19	Rmin	P	0.0, 1000.0	meters	GLA01
19	Rmax	P	0.0, 1000.0	meters	GLA01
19	Wmin	P	0.0, 1000.0	meters	GLA01

Table A-1 Conversion Description for GLAS Telemetry Data (Continued)

APID	Name	Conv. Type	Conversion Description	Units	L1A Product ID
19	Wmax	P	0.0, 1000.0	meters	GLA01
19	Hoffmin (DEM uncertainty + bias)	P	0.0, 1000.0	meters	GLA01, GLA02
19	Hoffmax (DEM uncertainty - bias)	P	0.0, 1000.0	meters	GLA01, GLA02
19	Rbmin	P	0.0, 1000.0	meters	GLA01
19	Rbmax	P	0.0, 1000.0	meters	GLA01
19	PC Range Bias	P	0.0, 1000.0	meters	GLA02
19	CD Range Bias	P	0.0, 1000.0	meters	GLA02
19	Surface Type	I	0=ocean & no ice 1=land & no ice 2=ocean & ice 3=land & ice	n/a	GLA01
19	Position data valid flag	I	0 = no errors detected during position data processing otherwise non-zero.	n/a	GLA03
19	Spacecraft time & position packet data	N	Format is defined in spacecraft ICD.	n/a	GLA03
19	Shot Count for 1553 Spacecraft Position and command packet.	N	Only lower 8 bits valid	n/a	GLA03
19	GLAS MET for 1553 Spacecraft Position and command packet.	U			GLA03
19	DEM minimum byte	I, P	See Section A.28	meters	GLA01, GLA02, GLA03
19	DEM maximum byte	I, P	See Section A.28	meters	GLA01, GLA02, GLA03
19	Range data source	I	0=s/c time & pos packet 1=uplinked DEM bytes 2=uplinked Rmin/Rmax	n/a	GLA01, GLA03
19	GPS 10 Sec Pulse 40 bit count value	N		n/a	GLA03
19	GLAS MET for GPS 0.1 Hz Pulse	N		n/a	GLA03
19	Spare Bytes	N		n/a	GLA03
19	Etalon Calibration - Current mode	I	0 = off, 1 = Acquire, 2 = Tracking	n/a	GLA03

Table A-1 Conversion Description for GLAS Telemetry Data (Continued)

APID	Name	Conv. Type	Conversion Description	Units	L1A Product ID
19	Etalon State	I	0 = Idle, 1 = Init, 2 = Set Temperature, 3 = Settle, 4 = Average, 5 = Open Loop, 6 = Modified	n/a	GLA03
19	Etalon Temperature Settle Time	N		sec	GLA02, GLA03
19	Etalon Flags	I	See Section A.31	n/a	GLA02, GLA03
19	Etalon Averaged On-Axis Transmission	N		n/a	GLA02, GLA03
19	Etalon Averaged Off-Axis Transmission	N		n/a	GLA02, GLA03
19	Etalon Temperature Error	N		C	GLA02, GLA03
19	Etalon Tracking Loop Filter Output	N		n/a	GLA02, GLA03
19	Etalon Tracking Failure Average	N		n/a	GLA02, GLA03
19	Etalon Start Temperature for Acquire Command	N		C	GLA02, GLA03
19	Etalon Stop Temperature for Acquire Command	N		C	GLA02, GLA03
19	Etalon Temperature Step for Acquire Command	N		Deg C	GLA02, GLA03
19	Etalon Averaging Time for Acquire Command	N		sec	GLA02, GLA03
19	Etalon Temperature Settle Time for Acquire Command	N		sec	GLA02, GLA03
19	Etalon Averaging Update Counter	I	0=off, 1=on	n/a	GLA02, GLA03
19	Spare Bytes	N		n/a	GLA02, GLA03
19	Dual Pin A (Etalon Feedback Monitor Value)	N		n/a	GLA02, GLA03
19	Dual Pin B (Etalon Feedback Monitor Value)	N		n/a	GLA02, GLA03
19	Etalon 532 Energy	N		n/a	GLA02, GLA03
26	Spare	N		n/a	GLA03

Table A-1 Conversion Description for GLAS Telemetry Data (Continued)

APID	Name	Conv. Type	Conversion Description	Units	L1A Product ID
26	Shot Counter	N		counts	GLA04
26	X Position of Box	N		pixel number	GLA04
26	Y Position of Box	N		pixel number	GLA04
26	LPA Data	N			GLA04
49	Valid Commands in Packet	N		counts	*
49	GLAS Time of Command	U			*
49	Command (first 20 bytes)	U			*
126	Shot Counter	N		n/a	*
126	LPA Data	N		n/a	*
38	Calibration Type	I	0 = Coarse, 1 = Fine	n/a	*
38	X Position Of The Mirror	U			*
38	Y Position Of The Mirror	U			*
38	Integration Result	U			*

Several more complicated conversion equations and conversion equations that are based on telemetered calibration values are titled by the flight software team to be Pseudo equations. These equations are defined in Table A-2 "Pseudo-Telemetry Conversions". Table A-1 references the appropriate equation by the equation number. In Table A-2, the terms TLM_raw and TLM_proc, refer to the raw telemetry data in counts and the processed telemetry data in engineering units respectively.

Table A-2 Pseudo-Telemetry Conversions

Eqn. No.	APID / Telemetry Data	Pseudo Equation
7	21 / Primary Monitor Calibration, Upper Byte; Primary Monitor Calibration, Lower Byte	SLOPE1 = 5.0 / (GPDMON1CALUB - GPDMON1CALLB) note: used in equations 8 - 19
8	21 / Primary Monitor Calibration, Upper Byte	INTERCEPT1 = 5.0 - (SLOPE1 * GPDMON1CALUB) note: used in equations 9 - 19
9	21 / +28V Bus A Instrument	TLM_proc = ((SLOPE1 * TLM_raw) + INTERCEPT1)* 9.22
10	21 / Hybrid Supplies	TLM_proc = ((SLOPE1*(TLM_raw - 10.0)) + INTERCEPT1) * 1.52
11	21 / HVPS Detector Supplies	TLM_proc = ((SLOPE1*(TLM_raw - 4.0)) + INTERCEPT1) * 0.408

Table A-2 Pseudo-Telemetry Conversions (Continued)

Eqn. No.	APID / Telemetry Data	Pseudo Equation
12	21 / Operational Heaters	TLM_proc = ((SLOPE1*(TLM_raw - 2.0)) + INTERCEPT1) * 0.41
13	21 / Mechanical System	TLM_proc = ((SLOPE1*(TLM_raw - 3.0)) + INTERCEPT1) * 0.407
14	21 / +28V Bus B Laser 1	TLM_proc = ((SLOPE1 * TLM_raw) + INTERCEPT1) * 9.2
15	21 / +28V Bus B Laser 1	TLM_proc = ((SLOPE1 * (TLM_raw - 8.0)) + INTERCEPT1) * 1.25
16	21 / +28V Bus C Laser 2	TLM_proc = ((SLOPE1 * TLM_raw) + INTERCEPT1) * 9.25
17	21 / +28V Bus C Laser 2	TLM_proc = ((SLOPE1*(TLM_raw - 10.0)) + INTERCEPT1) * 1.25
18	21 / +28V Bus D Laser 3	TLM_proc = ((SLOPE1 * TLM_raw) + INTERCEPT1) * 9.25
19	21 / +28V Bus D Laser 3	TLM_proc = ((SLOPE1 * (TLM_raw - 13.0)) + INTERCEPT1) * 1.25
20	21 / Secondary Monitor Calibration, Upper Byte; Secondary Monitor Calibration, Lower Byte	SLOPE2 = 5.0 / (GPDMON2CALUB - GPDMON2CALLB) note: used in equations 21 - 40
21	21 / Secondary Monitor Calibration, Upper Byte	INTERCEPT2 = 5.0 - (SLOPE2 * GPDMON2CALUB) note: used in equations 22 - 40
22	21 / + 5 V Hybrid # 1	TLM_proc = ((SLOPE2 * TLM_raw) + INTERCEPT2) * 1.514
23	21 / + 5 V Hybrid # 1	TLM_proc = ((SLOPE2 * TLM_raw) + INTERCEPT2) * 1.91
24	21 / +12 V Hybrid # 2	TLM_proc = ((SLOPE2 * TLM_raw) + INTERCEPT2) * 3.52
25	21 / + 12 V Hybrid # 2	TLM_proc = ((SLOPE2 * TLM_raw) + INTERCEPT2) * 0.66
26	21 / - 12 V Hybrid # 3	TLM_proc = ((SLOPE2 * TLM_raw) + INTERCEPT2) * (-3.515)
27	21 / - 12 V Hybrid # 3	TLM_proc = ((SLOPE2 * TLM_raw) + INTERCEPT2) * 0.63
28	21 / + 5 V Hybrid # 4	TLM_proc = ((SLOPE2 * TLM_raw) + INTERCEPT2) * 1.515
29	21 / + 5 V Hybrid # 4	TLM_proc = ((SLOPE2 * TLM_raw) + INTERCEPT2) * 1.91
30	21 / - 5 V Hybrid # 5	TLM_proc = ((SLOPE2 * TLM_raw) + INTERCEPT2) * (-1.532)
31	21 / - 5 V Hybrid # 5	TLM_proc = ((SLOPE2 * TLM_raw) + INTERCEPT2) * 1.49
32	21 / - 5 V Hybrid # 6	TLM_proc = ((SLOPE2 * TLM_raw) + INTERCEPT2) * (-1.52)
33	21 / - 5 V Hybrid # 6	TLM_proc = ((SLOPE2 * (TLM_raw - 3.0))+ INTERCEPT2) * 2.05
34	21 / + 15 V Boost Post Reg	TLM_proc = ((SLOPE2 * TLM_raw) + INTERCEPT2) * 4.05
35	21 / - 15 V Boost Post Reg	TLM_proc = ((SLOPE2 * TLM_raw) + INTERCEPT2) * (-4.078)

Table A-2 Pseudo-Telemetry Conversions (Continued)

Eqn. No.	APID / Telemetry Data	Pseudo Equation
36	21 / +12 V Prim Osc Thermal Control	TLM_proc = ((SLOPE2 * (TLM_raw - 3.0)) + INTERCEPT2) * 0.054
37	21 / +12 V Sec Osc Thermal Control	TLM_proc = ((SLOPE2 * (TLM_raw - 7.0)) + INTERCEPT2) * 0.052
38	21 / -2 V Discrete Voltage	TLM_proc = (((SLOPE2 * TLM_raw) + INTERCEPT2) * 2.0) - 5.0
39	21 / Hybrid Heatsink Temperature	TLM_proc = (((SLOPE2 * TLM_raw) + INTERCEPT2) * 30.2) - 30.0
40	21 / FET Switch Bank Heatsink Temperature	TLM_proc = (((SLOPE2 * TLM_raw) + INTERCEPT2) * 30.2) - 30.0

A.3 Laser and OTS Enable readbacks

The interpretation of the Laser and OTS Readback telemetry word is in Table A-3 "Laser and OTS Readback Interpretation" on page -36.

Table A-3 Laser and OTS Readback Interpretation

Status	Mask	Possible Values
Laser 1 Enable/Disable Status	0x01	0=ENABLED, 1=DISABLED
Laser 2 Enable/Disable Status	0x02	0=ENABLED, 1=DISABLED
Laser 3 Enable/Disable Status	0x04	0=ENABLED, 1=DISABLED
OTS Enable/Disable Status	0x08	0=ENABLED, 1=DISABLED

A.4 FET Switch Bank

The interpretation of the FET Switch Bank telemetry word is in Table A-4 "FET Switch Bank Interpretation".

Table A-4 FET Switch Bank Interpretation

Flag	Mask	Possible Values
Primary Oscillator	0x01	0=off, 1=on
Secondary Oscillator	0x02	0=off, 1=on
Primary Altimeter Digitizer	0x10	0=off, 1=on
Secondary Altimeter Digitizer	0x20	0=off, 1=on

A.5 Optical Sensor Status

The interpretation of the Optical Sensor Status telemetry word is in Table A-5 "Optical Sensor Status Interpretation" on page -37.

Table A-5 Optical Sensor Status Interpretation

Status	Mask	Possible Values
Primary Sensor Position Laser Select Mechanism 1, HOP-1	0x0C00	0=In-Deployment, 1=Unknown, 2=Deployed, 3=Stowed
Primary Sensor Position Laser Select Mechanism 2, HOP-2	0x0300	0=In-Deployment, 1=Unknown, 2=Deployed, 3=Stowed
Primary Sensor Position Altimeter Digitizer Detector Select Mechanism, HOP-3	0x00C0	0=In-Deployment, 1=Unknown, 2=Detector 2, 3=Detector 1
Secondary Sensor Position Laser Select Mechanism 1, HOP-1	0x0030	0=In-Deployment, 1=Unknown, 2=Deployed, 3=Stowed
Secondary Sensor Position Laser Select Mechanism 2, HOP-2	0x000C	0=In-Deployment, 1=Unknown, 2=Deployed, 3=Stowed
Secondary Sensor Position Altimeter Digitizer Detector Select Mechanism, HOP-3	0x0003	0=In-Deployment, 1=Unknown, 2=Detector 2, 3=Detector 1

A.6 Status Command Telemetry

The interpretation of the Status Command telemetry word is in Table A-6 "Command Status Interpretation".

Table A-6 Command Status Interpretation

Status	Mask	Possible Values
HOP Temperature Status	0x0800	0=In Tolerance, 1=Out of Tolerance
ADC Pulse Status	0x0400	0=Not Received, 1= Received
Deployed optic diodes power status	0x0200	0=ON, 1=OFF
Stowed optic diodes power status	0x0100	0=ON, 1=OFF
HOP LED Turn Off	0x0080	0=Armed, 1=Triggered
HOP Temp Turn Off	0x0040	0=Armed, 1=Triggered

Table A-6 Command Status Interpretation (Continued)

Status	Mask	Possible Values
HOP Timer Turn Off	0x0020	0=Armed, 1=Triggered
HOP Command Trigger Status	0x0010	0=Not Received, 1= Received
Reset Latch relay command status	0x0008	0=Not Received, 1= Received
Set latch relay command status	0x0004	0=Not Received, 1= Received
DAC Initial Conversion Signal Status	0x0002	0=Not Sent, 1=Sent
DAC Latch Data Signal Status	0x0001	0=Not Sent, 1=Sent

A.7 CD Status Flags

The interpretation of the CD Status flag telemetry word is in Table A-7 "CD Status Flag Interpretation".

Table A-7 CD Status Flag Interpretation

Status	Mask	Possible Values
CD Timeout Occurred Flag	0x01	0 = no timeout 1 = timeout
CD Target Present Flag	0x02	0 = not configured 1 = configured
CD Event Messages Disable Flag	0x04	0=Enabled, 1=Disabled
CD Measurement Reference Source	0x08	0=Fire Acknowledge 1= Fire Command
CD 40Hz Interrupt	0x10	0=Enabled, 1=Disabled
CD AD Detector Selected	0x020	0= AD #1 Selected, 1=AD #2 Selected
CD Detector Selected	0x40	0= CD #1 Selected, 1=CD #2 Selected
CD AD Board Selected	0x80	0= AD #1 Selected, 1=AD #2 Selected
CD Hardware Mode	0x0F00	1=Idle, 2=Engineering, 4=Science, Other values invalid
CD Software Mode	0xF000	0=Idle, 1=Engineering, 2=Science, 3=Memory test, Other values invalid

A.8 DC Status Flags

The interpretation of the DC Status flag telemetry word is in Table A-8 "DC Status Flag Interpretation".

Table A-8 DC Status Flag Interpretation

Status	Mask	Possible Values
DC TimeoutStatus	0x01	0 = no timeout 1 = timeout
DC Target Present Flag	0x02	0 = not present 1 = target present
DC Event Messages Disable Flag	0x04	0=Enabled, 1=Disabled
DC Software Mode	0xFF00	0=SSR, 1=SSR_LPA, 2=TEST

A.9 PC Status Flags

The interpretation of the PC Status flag telemetry word is in Table A-9 "PC Status Flag Interpretation".

Table A-9 PC Status Flag Interpretation

Status	Mask	Possible Values
PC Timeout Status	0x01	0 = no timeout 1 = timeout
PC Target Present Flag	0x02	0 = not configured 1 = configured
PC Calibration Type	0x04	0=Coarse, 1=Fine
PC Event Messages Disable Flag	0x08	0=Enabled, 1=Disabled
PC Range Gate Dither Flag	0x10	0=Disabled, 1=Enabled
PC Measurement Reference Source	0x20	0=Fire Acknowledge 1= Fire Command

Table A-9 PC Status Flag Interpretation

Status	Mask	Possible Values
PC Hardware Mode	0x0F00	1=Idle, 2=Engineering, 4=Science, Other values invalid
PC Software Mode	0xF000	0=Idle, 1=Engineering, 2=Science, 3=Boresite Cal, 4=Memory test, Other values invalid

A.10 CT Task Mode

The interpretation of the CT Task Mode telemetry word is in Table A-10 "CT Task Mode Interpretation" on page -40.

Table A-10 CT Task Mode Interpretation

Status	Mask	Possible Values
CT Task Software Mode	0x0001	0=Manual, 1=Normal
CT Task C&T Control Hardware Mode Register bit	0x0002	0=Manual, 1=Normal
CT Task Startup Mode, Discrete cmd	0x0004	0=Manual, 1=Auto Power Up Osc/AD
CT Task Startup AD/OSC, Discrete cmd mask	0x0008	0=Primary, 1= Secondary
CT Etalon Mode	0x0070	0=Off, 1=Acquire, 2=Tracking, 4=Test, 5=Test/Acquire, 6=Test/Tracking
CT Etalon Tracking Active Flag	0x0080	0=Paused, 1=Active
CT Etalon Tracking Low Transmission Flag	0x0100	0=Good, 1=Low
CT Etalon Tracking Open-Loop Flag	0x0200	0=Normal, 1=Open-loop

A.11 Subsystem Present Flags

The interpretation of the Subsystem Present Flags is in Table A-11 "Subsystem Present Flag Interpretation" on page -40.

A.12 CS Status Flag

The interpretation of the CS Status Flag is in Table A-12 "CS Status Flag Interpretation".

Table A-11 Subsystem Present Flag Interpretation

Flag	Mask	Possible Values
HS Subsystem Present Flag	0x0001	0=No, 1=Yes Subsystem Telemetry is present in Small and Large Telemetry Packets
CS Subsystem Present Flag	0x0002	0=No, 1=Yes Subsystem Telemetry is present in Small and Large Telemetry Packets
TC Subsystem Present Flag	0x0004	0=No, 1=Yes Subsystem Telemetry is present in Small and Large Telemetry Packets
SB Subsystem Present Flag	0x0008	0=No, 1=Yes Subsystem Telemetry is present in Small and Large Telemetry Packets
SM Subsystem Present Flag	0x0010	0=No, 1=Yes Subsystem Telemetry is present in Small and Large Telemetry Packets
RT Subsystem Present Flag	0x0020	0=No, 1=Yes Subsystem Telemetry is present in Small and Large Telemetry Packets
MD Subsystem Present Flag	0x0040	0=No, 1=Yes Subsystem Telemetry is present in Small and Large Telemetry Packets
AD Subsystem Present Flag	0x0080	0=No, 1=Yes Subsystem Telemetry is present in Small and Large Telemetry Packets
CD Subsystem Present Flag	0x0100	0=No, 1=Yes Subsystem Telemetry is present in Small and Large Telemetry Packets
DC Subsystem Present Flag	0x0200	0=No, 1=Yes Subsystem Telemetry is present in Small and Large Telemetry Packets
GP Subsystem Present Flag	0x0400	0=No, 1=Yes Subsystem Telemetry is present in Small and Large Telemetry Packets
PC Subsystem Present Flag	0x0800	0=No, 1=Yes Subsystem Telemetry is present in Small and Large Telemetry Packets
CT Subsystem Present Flag	0x1000	0=No, 1=Yes Subsystem Telemetry is present in Small and Large Telemetry Packets

Table A-12 CS Status Flag Interpretation

Flag	Mask	Possible Values
CS Enable/Disabled Flag	0x03	0=Disabled, 1=Enabled
CS Code Memory Checksum Status	0x0C	0=Disabled, 1=Enabled, 2=Disabled and Recomputing, 3=Enabled and Recomputing

Table A-12 CS Status Flag Interpretation

Flag	Mask	Possible Values
CS Table Memory Checksum Status	0x30	0=Disabled, 1=Enabled, 2=Disabled and Recomputing, 3=Enabled and Recomputing
CS EEPROM Checksum status flag	0xC0	0=Disabled, 1=Enabled, 2=Disabled and Recomputing, 3=Enabled and Recomputing

A.13 SM Table Operations Flag

The interpretation of the SM Table Operations Flag is in Table A-13 "SM Table Operations Flag Interpretation".

Table A-13 SM Table Operations Flag Interpretation

Flag	Mask	Possible Values
SM Table Session Type	0x3F	0=None, 5=DUMP_ONLY, 6=REP_EEPROM, 7=REP_RAM, 8=APPD_ACTV
SM Table Operations Flag	0x40	0=Inactive, 1=Active

A.14 BCRT Control Register Word

The interpretation of the BCRT Control Register word is in Table A-14 "BCRT Register Control Word Interpretation".

Table A-14 BCRT Register Control Word Interpretation

Status	Mask	Possible Values
RT Channel A Select	0x0080	0=OFF, 1=ON
RT Channel B Select	0x0100	0=OFF, 1=ON

A.15 CD Raw A/D Output Data

The interpretation of the CD Raw A/D Output Data word is in Table A-15 "CD Raw A/D Output Data Interpretation".

Table A-15 CD Raw A/D Output Data Interpretation

Flag	Mask	Possible Values
CD Raw A/D Overflow Flag	0x0100	0=No overflow, 1=Overflow
CD Attenuation Settings	0x3E00	1=0.0, 2=1/1.77, 4=1/3.16, 8=1/5.6, 16=1/10

A.16 CD Interrupt Status

The interpretation of the CD Interrupt Status word is in Table A-16 "CD Interrupt Status Interpretation".

Table A-16 CD Interrupt Status Interpretation

Flag	Mask	Possible Values
CD Data Ready Interrupt	0x00000008	0=Enabled, 1=Disabled
CD Interrupt Source	0x00003000	1= Fire Command, 2= fire acknowledge

A.17 DC Interrupt Mask Register

The interpretation of the DC Interrupt Mask Register word is in Table A-17 "DC Interrupt Mask Register Interpretation".

Table A-17 DC Interrupt Mask Register Interpretation

Flag	Mask	Possible Values
DC Interrupt 1	0x00000001	0=Disabled, 1=Enabled
DC LPA Interrupt	0x00000002	0=Disabled, 1=Enabled
DC Output FIFO Full Interrupt	0x00000004	0=Disabled, 1=Enabled
DC Output FIFO Empty Interrupt	0x00000008	0=Disabled, 1=Enabled
DC RAM Busy Interrupt	0x00000010	0=Disabled, 1=Enabled
DC Interrupt 6	0x00000020	0=Disabled, 1=Enabled

A.18 DC FIFO Flags Register

The interpretation of the DC FIFO Flags Register is in Table A-18 "DC FIFO Flags Register Interpretation".

A.19 DC LPA Gain Register

The interpretation of the DC LPA Gain Register is in Table A-19 "DC LPA Gain Register Interpretation" on page -43.

Table A-18 DC FIFO Flags Register Interpretation

Flag	Mask	Possible Values
DC FIFO Full	0x00000001	0=True, 1=False
DC FIFO Almost Full	0x00000004	0=True, 1=False
DC FIFO Almost Empty	0x00000002	0=True, 1=False
DC FIFO Empty	0x00000008	0=True, 1=False

Table A-19 DC LPA Gain Register Interpretation

Flag	Mask	Possible Values
DC LPA Gain	0x00000007	0=4.00, 1=2.80, 2=2.15, 3=1.75, 4=1.47, 5=1.27, 6=1.12, 7=1.00
DC LPA Reset	0x00000008	0=In Reset, 1=Not in Reset

A.20 DC LPA Packet Count Register

The interpretation of the DC LPA Packet Count Register is in Table A-20 "DC LPA Packet Count Register Interpretation".

Table A-20 DC LPA Packet Count Register Interpretation

Flag	Mask	Possible Values
DC LPA Frame Byte Count	0x00003FFF	counter
DC LPA Packet (Frame) Count	0x00FF0000	counter

A.21 PC Hardware Mode Status

The interpretation of the PC Hardware Mode Status word is in Table A-21 "PC Hardware Mode Status Interpretation".

Table A-21 PC Hardware Mode Status Interpretation

Flag	Mask	Possible Values
PC Board Hardware Mode	0x00000007	1=Idle, 2=Engineering, 4=Science
PC Interrupt Source	0x00003000	1=Fire Command, 2=Fire Acknowledge
PC Measurement Source	0x00004000	0=Fire Acknowledge, 1=Fire Command

A.22 MD Enable / Disable Flag

The interpretation of the MD Enable/Disable Flag word is in Table A-22 "MD Enable /Disable Flag Interpretation".

Table A-22 MD Enable /Disable Flag Interpretation

Flag	Mask	Possible Values
MD Global Enable/Disable Flag	0x001	0=Disabled 1=Enabled
MD Table 1 Enable/Disable Flag	0x002	0=Disabled 1=Enabled
MD Table 2 Enable/Disable Flag	0x004	0=Disabled 1=Enabled

A.23 CT Suppressed Event Message Error Flag

The interpretation of the CT Suppressed Event Message Error Flag word is in Table A-23 "CT Suppressed Event Message Error Flag Interpretation".

Table A-23 CT Suppressed Event Message Error Flag Interpretation

Flag	Mask	Possible Values
CT Event Messages Enabled/Disabled Flag	0x0001	0=All Enabled 1=Some Disabled
CT Shot Count Error Flag	0x0002	0=OK 1=Error
CT Laser Monitor Board Mux Error Flag	0x0004	0=OK 1=Error
CT Housekeeping Board Mux Error Flag	0x0008	0=OK 1=Error
CT Housekeeping Board Submux Error Flag	0x0010	0=OK 1=Error
CT Temperature Controller Board Mux Error Flag	0x0020	0=OK 1=Error
CT Mechanism Controller Board Mux Error Flag	0x0040	0=OK 1=Error
CT Power Distribution Unit Mux Error Flag	0x0080	0=OK 1=Error

Table A-23 CT Suppressed Event Message Error Flag Interpretation (Continued)

Flag	Mask	Possible Values
CT High Voltage Power Supply Mux Error Flag	0x0100	0=OK 1=Error
CT Ancillary Packet Allocation Error FlagMD Global Enable/ Disable Flag	0x0200	0=OK 1=Error

A.24 CT Loop Heat Pipe Control State

The interpretation of the CT Loop Heat Pipe (LHP) Control State words for LHP 1 and LHP 2 is in Table A-24 "CT LHP Control State Interpretation".

Table A-24 CT LHP Control State Interpretation

Flag	Mask	Possible Values
CT LHP Temperature Control Enabled Flag	0x0001	0=Off 1=On
CT LHP Temperature Control Active Flag	0x0002	0=Idle 1=Active

A.25 GP Task Status Bits

The interpretation of the GP Task Status Bits word is in Table A-25 "GP Task Status Bits Interpretation".

Table A-25 GP Task Status Bits Interpretation

Flag	Mask	Possible Values
Position Data Source	0x0003	0= spacecraft 1=Ground Hmin/Hmax 2=Ground Rmin/Rmax
Position Data Status Flag	0x000C	0=OK 1=No data 2=Calculation Error
GPS Pulse Received Flag	0x0010	0=Not Receiving Pulse 1=Receiving Pulse
GPS Pulse Select	0x0020	0=GPS1 1=GPS2

A.26 AD Software Enable Flags

The interpretation of the AD Software Enable Flags is in Table A-26 "AD Software Enable Flag Interpretation".

Table A-26 AD Software Enable Flag Interpretation

Flag	Mask	Possible Values
AD Auto Reset DSP Flag	0x0001	0=False, 1=True
AD Auto Gain Use 8ns Filter Flag	0x0010	0=Disabled, 1=Enabled
AD Auto Gain Enable Flag	0x0020	0=Disabled, 1=Enabled
AD Hardware Error Events Flag	0x0040	0=Disabled, 1=Enabled
AD Software Error Events Flag	0x0080	0=Disabled, 1=Enabled

A.27 AD DSP Trouble Indicator Status Word

The interpretation of the AD DSP Trouble Indicator Status word is in Table A-27 "AD DSP Trouble Indicator Status Word Interpretation".

Table A-27 AD DSP Trouble Indicator Status Word Interpretation

Flag	Mask	Possible Values
Invalid Search	0x0001	0=No problem 1=Invalid search
Laser Failure	0x0002	0=No problem 1=Laser Failure
Multiple Interrupts	0x0004	0=No problem 1=Multiple Interrupts
Buffer Full	0x0008	0=No problem 1=Buffer Ful
Invalid Mode	0x0010	0=No problem 1=Invalid Mode
Infinite Loop	0x0020	0=No problem 1=Infinite Loop
Invalid Range Window	0x0040	0=No problem 1=Invalid Range Window
Invalid Tournament	0x0080	0=No problem 1=Invalid Tournament
Noise Region Outside Acq Memory	0x0100	0=No problem 1=Noise Region Outside Acq Memory
Invalid Sample Size for Noise region	0x0200	0=No problem 1=Invalid Sample Size for Noise region

A.28 DEM Minimum and Maximum Bytes

The DEM Minimum (Min) and Maximum (Max) bytes are converted to Hmin and Hmax in meters by masking off bit 7 and multiplying the result by 125. Bit 7 of the DEM Min and Max bytes is the DEM surface type indicator. Bit 7 of the DEM Min byte indicates the surface is land (=1) or sea (=0). Bit 7 of the DEM Max byte indicates the surface is ice (=1) or no ice (=0). Bit 7 is the most significant bit.

A.29 Range Window Status

The interpretation of the Range Window Status word is in Table A-28 "Range Window Status Interpretation" on page -48.

Table A-28 Range Window Status Interpretation

Flag	Mask	Possible Values
No first crossing (rising edge) found on 4ns filter	0x00000001	0=False, 1=True
No first crossing (rising edge) found on 8ns filter	0x00000002	0=False, 1=True
No first crossing (rising edge) found on 16ns filter	0x00000004	0=False, 1=True
No first crossing (rising edge) found on 32ns filter	0x00000008	0=False, 1=True
No first crossing (rising edge) found on 64ns filter	0x00000010	0=False, 1=True
No first crossing (rising edge) found on 128ns filter	0x00000020	0=False, 1=True
No second crossing (falling edge) found on 4ns filter	0x00000040	0=False, 1=True
No second crossing (falling edge) found on 8ns filter	0x00000080	0=False, 1=True
No second crossing (falling edge) found on 16ns filter	0x00000100	0=False, 1=True
No second crossing (falling edge) found on 32ns filter	0x00000200	0=False, 1=True
No second crossing (falling edge) found on 64ns filter	0x00000400	0=False, 1=True
No second crossing (falling edge) found on 128ns filter	0x00000800	0=False, 1=True
First sample in range >= threshold for 4ns filter	0x00001000	0=False, 1=True
First sample in range >= threshold for 8ns filter	0x00002000	0=False, 1=True
First sample in range >= threshold for 16ns filter	0x00004000	0=False, 1=True
First sample in range >= threshold for 32ns filter	0x00008000	0=False, 1=True
First sample in range >= threshold for 64ns filter	0x00010000	0=False, 1=True
First sample in range >= threshold for 128ns filter	0x00020000	0=False, 1=True
All filters were rejected flag. True if bits 0 - 5 are true.	0x00040000	0=False, 1=True
No filters were ever selected; all previous selections failed. (Happens on DSP reset.)	0x00080000	0=False, at least one previous selection succeeded, 1=True

Table A-28 Range Window Status Interpretation

Flag	Mask	Possible Values
4ns filter failed	0x00100000	0=False, 1=True
8ns filter failed	0x00200000	0=False, 1=True
16ns filter failed	0x00400000	0=False, 1=True
32ns filter failed	0x00800000	0=False, 1=True
64ns filter failed	0x01000000	0=False, 1=True
128ns filter failed	0x02000000	0=False, 1=True
Return range is invalid	0x40000000	0=Range OK, 1=Failure
Science processing is incomplete	0x80000000	0=Ready, 1=Failure

A.30 AD Target Status and Mode Flags

The interpretation of the AD Target Status and Mode Flag word is in Table A-29 "AD Target Status and Mode Flag Word Interpretation".

Table A-29 AD Target Status and Mode Flag Word Interpretation

Flag	Mask	Possible Values
AD Target Present Flag	0x80	0=Not Present, 1=Target Present
AD Target Timeout Flag	0x40	0=No Timeout, 1=Timeout
AD Mode of Operations	0x38	0=Idle, 1=Science, 2=OneShot, 3=Load, 4=Dump
AD DSP Software Mode	0x07	0=Science, 1=Idle, 2=Load, 3=Dump

A.31 Etalon Flags

The interpretation of the Etalon Status Flags word is in Table A-30 "Etalon Flags Word Interpretation".

Table A-30 Etalon Flags Word Interpretation

Flag	Mask	Possible Values
Etalon Tracking Low Transmission Flag	0x01	0=Good, 1=Low
Etalon Tracking Active Flag	0x02	0=Paused, 1=Active
Etalon Tracking Test Mode Flag	0x04	0=Normal, 1=Test
Etalon Tracking Openloop Mode Flag	0x08	0=Normal, 1=Openloop
Etalon Tracking Openloop Update Toggle	0x10	

A.32 Time Tagging Algorithm

A.32.1 Definitions

The GLAS time tag on all products is the time in seconds from noon January 1, 2000 in Universal Time Code reference frame (includes leap seconds).

The GPS time in the packets received from the Backjack GPS flight receiver is time in seconds from the start of GPS time (January 1980). GPS time is continuous and does not include leap seconds. GPS ticks are always on integer seconds.

The GPS to UTC offset is a constant that shall be defined as the GPS time of Noon January 1, 2000 (the UTC reference time). This constant will be negative because it used to remove from the laser shot GPS time the amount of GPS time occurring from the GPS time reference time (January 1, 1980) to the UTC reference time.

A.32.2 Basic Algorithm with GPS

1) Determine the current leapsecond correction to use from the GPS to UTC Leapseconds File.

2) Compute the laser shot time in UTC:

a) Find the largest GLAS GPS latch time (to the .1 Hz GPS pulse) from the frequency and time board (accounting for roll over) less then the first Fire Command Time of packet (note: both times are 40 bit counters found in GLAS APID 19).

b) Until the first Fire Command Time of the packet is greater than the next GLAS GPS latch time compute the laser shot time in GPS. There is a delay between the fire command time and the start of digitization. This delay must be applied to the fire command time to get the correct laser shot time. Also the time from the start of the digitization to the time of the transmit pulse peak must be included in the algorithm to get to the time of the laser shot. Since the 1 Gigahertz oscillator does not operate perfectly the oscillator frequency must be computed and applied to the 40 bit counter time. Compute the laser shot time in GPS units by the equation:

Laser Shot Time in GPS = {[(Fire Command Time – GLAS GPS latchtime) * freqbrdscale] + time of transmit pulse peak}*oscillator frequency +
GPS time + digitizer delay

Where freqbrdscale is the oscillator frequency scale factor to convert counts to seconds. The GPS time in GPS seconds is contained in the spacecraft time and position packet which is downlinked in GLAS APID 19. The format of the spacecraft time and position packet is contained in Appendix C. The digitizer delay and oscillator frequency are provided by the GLAS instrument operations team. The time of the transmit peak is provided in the GLAS waveform data (APIDs 12 and 13).

[Note: any 40 bit counter time from the GLAS frequency and time board can be converted by using the largest GLAS GPS latch time less then the 40 bit counter by the following equation:

40 bit counter time in GPS = [(40 bit counter – GLAS GPS latch time) * freqbrdscale]*oscillator frequency} + GPS time

c) For each shot, determine the correct leapsecond correction to use from the GPS to UTC Leapsecond File. Compute the laser shot time in UTC by the following equation:

Laser Shot Time in UTC = Laser Shot Time in GPS + Leapseconds + GPStoUTCoffset

Where, Leapseconds is the correction from the GPS to UTC Leapseconds File and GPStoUTCoffset is the offset from the GPS reference time to the UTC reference time.

3) Convert spacecraft time (Bvtcw) to UTC:

a) Correct for the delay in the reported Bvtcw latched to the GPS .1 Hz pulse and the actual Bvtcw latched to the GPS .1 Hz pulse. The Bvtcw GPS latch time is reported in the spacecraft time and position packet contained in GLAS APID 19. To compute the corrected Bvtcw GPS latch time add a spacecraft time calibration offset (Btimeoffset):

Corrected Bvtcw GPS latch time = Bvtcw GPS latch time + Btimeoffset

b) The Corrected Bvtcw GPS latch time corresponds directly to the GPS time in UTC that is in the spacecraft time and position packet.

c) Any spacecraft time (Bvtcw) can be converted to UTC by using the largest Bvtcw GPS latch time less then the Bvtcw by the following equation:

Bvtcw in UTC = (Bvtcw - Corrected Bvtcw GPS latch time) * BvtcwScale + GPS time in UTC

where BvtcwScale is from the Bvtcw to UTC table.

4) Compute Laser Reference System (LRS) Time Tags:

a) Compute the estimated 10 Hz LRS time of the GLAS laser fire command in UTC using the LRS Bvtcw, the LRS increment time tag, and the GPS time. The LRS increment time tag is latched upon the detection of a GLAS fire command signal and provides the precise timing of the LRS data. The LRS Bvtcw and increment time tag are in the spacecraft's Position, Rate, and Attitude Packet (PRAP). The equation is:

estimated LRS fire command time tag in UTC = (LRS Bvtcw – Corrected Bvtcw GPS latch time)*BvtcwScale + GPS time in UTC + LRS increment time tag

b) Apply the delay from the recording of the time of the LRS 10 Hz data to the actual time of the 10 Hz data to get the corrected LRS fire command time. The delay (Lrs_bvtcw_delay) is constant. The equation is:

corrected LRS fire command time in UTC = estimated LRS fire command time in UTC + Lrs_bvtcw_delay

c) Compute the actual 10 Hz LRS time of the GLAS laser fire command time. Find the nearest (within 12.5 millisecond) actual laser fire command time to the corrected LRS fire command time tag. The time of the LRS 10 Hz sample is the laser fire command time and the LRS Center of Integration (COI) time. The LRS COI time is found in the spacecraft's Position, Rate, and Attitude Packet (PRAP). The equation is:

LRS sample time in UTC = actual laser fire command time + LRS COI time

d) Determine the corresponding GLAS laser shots for the LRS 10Hz data. Find the Laser Shot Time in UTC that is within 12.5 milliseconds of the LRS sample time in UTC for each LRS sample. Assign the LRS sample this shot number and time. Keep all times with the record.

e) The LRS health data shall be assigned the shot and time of the first 10 Hz sample.

f) The LRS star, laser, and Collimated Reference Source (CRS) images correspond to the shot and time for matching frame numbers of the LRS data samples.

5) Convert Instrument Star Tracker (IST) time tags to UTC:

a) Compute the estimated 10 Hz IST time of the GLAS laser fire command in UTC using the IST Bvtcw, the IST increment time tag, and the GPS time. The IST increment time tag is latched upon the detection of a GLAS fire command signal and provides the precise timing of the IST data. The IST Bvtcw and increment time tag are in the spacecraft's Position, Rate, and Attitude Packet (PRAP). The equation is:

estimated IST fire command time tag in UTC = (IST Bvtcw –
Corrected Bvtcw GPS latch time) * BvtcwScale + GPS time in UTC +
IST increment time tag*IST time scale

b) Apply the delay from the recording of the time of the IST 10 Hz data to the actual time of the 10 Hz data to get the corrected IST fire command time. The delay (Ist_bvtcw_delay) is constant. The equation is:

corrected IST fire command time in UTC =
estimated IST fire command time in UTC + Ist_bvtcw_delay

c) Compute the actual 10 Hz IST time of the GLAS laser fire command time. Find the nearest (within 12.5 millisecond) actual laser fire command time to the corrected IST fire command time tag. The time of the IST 10 Hz sample is the laser fire command time and the IST Center of Integration (COI) time. The IST COI time is found in the spacecraft's Position, Rate, and Attitude Packet (PRAP). The equation is:

IST sample time in UTC = actual laser fire command time + IST COI time

d) Determine the corresponding GLAS laser shots for the IST 10Hz data. Find the Laser Shot Time in UTC that is within 12.5 milliseconds of the IST sample time in UTC for each IST sample. Assign the IST sample this shot number and time. Keep all times with the record.

6) Convert the 10 Hz IRU time tags to UTC by the method in step 3 above. The IRU Bvtcw is in the spacecraft's PRAP. Additionally, the IRU BVTCW needs to be adjusted by the delay from the recording of the time of the IRU 10 Hz data to the actual time of the 10 Hz data. The delay (G_bvtcw_delay) is constant. The equation is:

IRU Bvtcw in UTC = (IRU Bvtcw – Corrected Bvtcw GPS latch time) *
BvtcwScale + G_bvtcw_delay + GPS time in UTC

7) Convert the Ball Star Tracker (BST) time tags to UTC by the method in step 3 above. There

are two BSTs on the ICESat spacecraft. The BST1 and BST2 Bvtcw are in the spacecraft's PRAP. Additionally, the BST BVTCW needs to be adjusted by the delay from the recording of the time of the BST 10 Hz data to the actual time of the 10 Hz data. Each BST has its own delay (B_bvtcw_delay) and the delays are constant. The equation is:

BST Bvtcw in UTC = (BST Bvtcw – Corrected Bvtcw GPS latch time) * BvtcwScale + B_bvtcw_delay + GPS time in UTC

8) Convert the spacecraft quaternion data time tags to UTC by the method in step 3 above. The quaternion data is time tagged by the ADCS Bvtcw found in the PRAP. The ADCS Bvtcw needs to be adjusted by the delay from the recording of the time of the PRAP to the actual time of the quaternion data. The delay (Q_bvtcw_delay) is constant. The equation is:

Quaternion Data Bvtcw in UTC = (ADCS Bvtcw –
Corrected Bvtcw GPS latch time)*BvtcwScale + Q_bvtcw_delay +
GPS time in UTC

9) The IRU and BST data will not be shot aligned to the GLAS data. Assign to the IRU and BST data the first laser shot time in UTC from the GLAS APID 19 that corresponds to that data.

10) If the GLAS APID 19 is missing, estimate the shot time for events by using the secondary header time from the Altimeter Digitizer science packet (GLAS APID 12 or 13 depending on the surface type). The secondary header time must be corrected such that it corresponds to the time of the first laser shot in the packet. For most of the GLAS packets, the secondary header time corresponds to the last shot in the packet. The nominal time between shots is 25 milliseconds. Use the following equation to estimate the time of a shot:

Estimated Laser Shot Time in UTC =
(estimated shot number -1)*25 ms*freqbrdscale +
Secondary header time corresponding to the first shot in the packet

A.32.3 Basic Algorithm without GPS

1) Compute the LRS 10Hz sample time tags.

a) Compute the time of each 10hz LRS Data pulse in UTC. The LRS data is contained in the spacecraft's PRAP. Convert the LRS Bvtcw (VTCW echo) to UTC using the Bvtcw to UTC table. The LRS Bvtcw must be corrected by the increment (LRS increment time tag) to the GLAS 10 Hz pulse to get the correct time of the latch. Additionally, the LRS BVTCW needs to be adjusted by the delay from the recording of the time of the LRS 10 Hz data to the actual time of the 10 Hz data. The delay (Lrs_bvtcw_delay) is constant. The equation is for each pulse:

LRS data pulse time in UTC = (LRS Bvtcw – Bvtcw from table)*BvtcwScale
+ Bvtcw from table in UTC + LRS increment time tag*LRS Time scale
+ Lrs_bvtcw_delay

Where 'Bvtcw from table' is the largest Bvtcw in the Bvtcw to UTC table just less than the Bvtcw being converted and BvtcwScale is from the Bvtcw to UTC table.

b) The time of the LRS 10 Hz sample is the sum of the LRS data pulse time tag and the LRS Center of Integration (COI) time. The LRS COI time is found in the spacecraft's Position, Rate, and Attitude Packet (PRAP). The equation is:

LRS sample time in UTC = LRS data pulse time in UTC + LRS COI time

2) Convert GLAS Mission Elapsed Time (MET) of spacecraft time and position packet (position and command packet) to UTC using the GLAS MET to UTC conversion table. The GLAS MET of the spacecraft time and position packet is in GLAS APID 19.

3) Compute the estimated fire command time in UTC for 40 shots. Use the fire command time (40 bit counter) of the shot corresponding to the spacecraft time and position packet as the reference point. Since the 1 Gigahertz oscillator is not perfect, the oscillator frequency must be computed and applied to the 40 bit counter data. For each shot the equation is:

Estimated fire command time of shot in UTC = [(fire command time of shot - fire command time of time and position packet)*freqbrdscale] *
oscillator frequency + GLAS MET of time and position packet in UTC

Where freqbrdscale is the oscillator frequency scale factor the converts the counts to seconds. The oscillator frequency is provided by the GLAS instrument operations team.

[Note: Must take care of rollover of shot and fire command time counters]

4) Time align fire command times in UTC to LRS 10 Hz Data pulse times (prior to LRS COI time being applied).

a) Compare estimated fire command times in UTC to the LRS data pulse time in UTC for each pulse. Align a laser shot to an LRS sample when the difference between the times are within a predetermined range of milliseconds. To start the range will be -9 to 24 milliseconds.

b) Check that the shot numbers corresponding to the LRS samples increment by 4 and the LRS data pulse time in UTC increments by about 100 ms. Set error flag if these conditions are not met.

5) Compute the estimated laser shot time in UTC by referencing to the closest matched laser shot/LRS sample pair. The digitizer delay (delay between the fire command time and the start of digitization) and the time from the start of digitization to the transmit pulse peak must be applied. the digitizer delay is provided by the GLAS Instrument Operations team and the time of the transmit pulse peak is contained in the GLAS Altimeter Digitizer packets. The oscillator frequency must also be applied. For each shot:

Corrected laser shot time in UTC = {[(fire command time of shot –
fire command time of first match)*freqbrdscale] + transmit pulse peak} *
oscillator frequency + LRS data pulse time in UTC of match + digitizer delay

[Note: Must take care of rollover of shot and fire command time counters.]

6) Determine the corresponding GLAS laser shots for the LRS 10 Hz data and LRS star, laser, and CRS images by the same method used in "Basic Algorithm with GPS", Appendix A.32.2 steps 4.d, 4.e, and 4.f.

7) Compute the 10 Hz IST Data sample times in UTC. The IST data is contained in the spacecraft's PRAP.

a) Convert the IST Bvtcw (VTCW echo) to UTC using the Bvtcw to UTC table. The IST Bvtcw must be corrected by the increment (IST increment time tag) to the GLAS 10 Hz pulse to get the correct time of the sample. Additionally, the IST BVTCW needs to be adjusted by the delay from the recording of the time of the IST 10 Hz data to the actual time of the 10 Hz data and the IST Center of Integration (COI) time. The delay (Ist_bvtcw_delay) is constant. The IST COI time is found in the spacecraft's Position, Rate, and Attitude Packet (PRAP). The equation is for each sample:

   IST data sample times in UTC = (IST Bvtcw – Bvtcw from table)*BvtcwScale+ Bvtcw from table in UTC + IST time tag*IST time scale + Ist_bvtcw_delay + IST COI time

   Where Bvtcw from table is the largest Bvtcw in the Bvtcw to UTC table just less than the Bvtcw being converted and BvtcwScale is from the Bvtcw to UTC table.

b) Determine the corresponding GLAS laser shots for the IST 10 Hz data by the same method used in "Basic Algorithm with GPS", Appendix A.32.2 step 5.d.

8) Convert IRU Bvtcw to UTC using the Bvtcw to UTC table. Additionally, the IRU BVTCW needs to be adjusted by the delay from the recording of the time of the IRU 10 Hz data to the actual time of the 10 Hz data. The delay (G_bvtcw_delay) is constant. The equation is:

IRU Bvtcw in UTC = (IRU Bvtcw – Bvtcw from table)*BvtcwScale + G_bvtcw_delay + Bvtcw from table in UTC

Where Bvtcw from table is the largest Bvtcw in the Bvtcw to UTC table just less than the Bvtcw being converted and BvtcwScale is from the Bvtcw to UTC table.

9) Convert BST Bvtcw to UTC using the Bvtcw to UTC table. Additionally, the BST BVTCW needs to be adjusted by the delay from the recording of the time of the BST 10 Hz data to the actual time of the 10 Hz data. Each BST has its own delay (B_bvtcw_delay) and the delays are constant.:

BST Bvtcw in UTC = (BST Bvtcw – Bvtcw from table)*BvtcwScale + B_bvtcw_delay + Bvtcw from table in UTC

Where Bvtcw from table is the largest Bvtcw in the Bvtcw to UTC table just less than the Bvtcw being converted and BvtcwScale is from the Bvtcw to UTC table.

10) Convert spacecraft's quaternion data Bvtcw to UTC using the Bvtcw to UTC table. The quaternion data is time tagged by the Bvtcw from the spacecraft's PRAP secondary header. Additionally, the PRAP secondary header time (Bvtcw) needs to be adjusted by the delay from the recording of the time of the PRAP to the actual time of the quaternion data. The delay (Q_bvtcw_delay) is constant. The equation is:

Quaternion Data Bvtcw in UTC = (PRAP Bvtcw – Bvtcw from table) * BvtcwScale + Q_bvtcw_delay + Bvtcw from table in UTC

Where Bvtcw from table is the largest Bvtcw in the Bvtcw to UTC table just less than the Bvtcw being converted and BvtcwScale is from the Bvtcw to UTC table.

11) The IRU and BST data will not be shot aligned to the GLAS data. Assign to the IRU and BST data the first laser shot time in UTC from the GLAS APID 19 that corresponds to that data.

12) If the GLAS APID 19 is missing, compute the estimated laser shot time in UTC by the same method used in “Basic Algorithm with GPS”, Appendix A.32.2 step 10.

Appendix B

GLAS Telemetry Description

The format of the GLAS telemetry packets and their engineering unit conversions are defined in the following sections.

Appendix B.1 contains the housekeeping and diagnostic packet descriptions.

Appendix B.2 contains the science packet descriptions.

B.1 GLAS Housekeeping and Diagnostic Telemetry Description

Pkt Name	App id	Size	Pkt Freq.	Pkt Interval	Rate	Output to			Confidence	CCSDS Primary	Data uses	Output
		in bytes	in Hertz	in seconds	bps	SSR	1553 Bus		In contents	Header	SA Range	by Task
		(max)					HK	Diag	H, M, L	hex		
CT HW Tlm#1	20	56	0.25	4	112	Yes	Yes	No	High	#NAME?	1	CT
CT HW Tlm#2	21	56	0.25	4	112	Yes	Yes	No	High	#NAME?	1	CT
CT HW Tlm#3	22	56	0.0625	16	28	Yes	Yes	No	High	#NAME?	1	CT
CT HW Tlm#4	23	56	0.0625	16	28	Yes	Yes	No	High	#NAME?	1	CT
CT HW Tlm#5	50	56	0.03125	32	14	Yes	Yes	No	High	#NAME?	1	CT
Small Software #1 Tlm	24	56	0.25	4	112	Yes	Yes	No	High	#NAME?	1	HS
Large Software Tlm #1	25	300	0.25	4	600	Yes	No	Yes	High	#NAME?	3..10	HS
Large Software Tlm #2	55	376	0.25	4	752	Yes	No	Yes	High	#NAME?	3..10	HS
DSP Code Memory Dump	31	828	Async(1)			Yes	No	No	High	#NAME?	3..10	AD
DSP Data Memory Dump	32	828	Async(1)			Yes	No	No	High	#NAME?	3..10	AD
C&T Dwell Packet	33	336	Async(2)			Yes	No	Yes	High	#NAME?	3..10	CT
Memory Dwell Packet #1	27	212	Async(3)			Yes	No	Yes	High	#NAME?	3..10	MD
Memory Dwell Packet #2	28	212	Async(3)			Yes	No	Yes	High	#NAME?	3..10	MD
Event Message	34	80	Async			Yes	No	Yes	High	#NAME?	3..10	HS
Memory Dump	35	224	Async(4)			Yes	No	Yes	High	#NAME?	3..10	SM
Table Dump	36	224	Async(4)			Yes	No	Yes	High	#NAME?	3..10	SM
Etalon Calibration	37	2076	Async			Yes	No	No	Med	#NAME?	3..10	CT
GLAS Data Types Packet	48	72	Async			Yes	No	No	High	#NAME?	3..10	DC
	Synchronous HK 1553 Bus Data Rate				406	bps			Max HK Bandwitdh	448	bps	
	Synchronous DIAG 1553 Bus Data Rate				1352	bps			Max DIAG Bandwidth	11,808	bps	

(1) - These Packets are produced at a 4 pkts per second rate when AD is in Idle mode

(2) - This packet will be output at a 4 second interval when one of the C&T Boards is in dwell mode.

(3) - During a Memory Dwell the rate for these packets is commandable.

(4) - During memory or table dumps these packets will be output at a max 1 packets per second rate

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NOTES:

1- The size of all packets must be a multiple of 4, This is because the SSR FIFO width is 32 bits and all packets go to the SSR

2- Max Packet Size to SSR is 16 Kbytes. This is the size of the SSR interface FIFO

3- 1553 Diag channel packets will be output to 1553 Bus interface and continually read by the Bus Controller,
but only in GLAS Diagnostics mode (16 kbps) will they be telemetered to the Ground

4- Mnemonics use only 'G' as prefix to indicate GLAS(instead of the GL)

5- Mnemonics for the CCSDS header are not in spreadsheet, but

Suggested Mnemoncic names	Bits	Word	Mask
GPxxxPVNO	0..2	1st	0xE000
GPxxxPCKT	3	1st	0x1000
GPxxxSHDF	4	1st	0x0800
GPxxxID	5..15	1st	0x07FF
GPxxxSEGF	0..1	2nd	0xC000
GPxxxSCNT	2..15	2nd	0x3000
GPxxxPLEN	0..15	3rd	0xFFFF
GPxxxSTIME		4th..7th	

where xxx is the app id in hex zero padded

6-Telemetry Points which are at the same offset and have a mask associated with them indicate that the telemetry point consists of only the bits in the mask

7- The Shot Counter is always a 8 bit counter, where depicted as an 2 or 4 byte entity there is padding in the upper bytes

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Worksheet: Summary

Change History

Name	Date	Version	Change Description
M. Maldonado	22-Jan-99	1	Initial Creation
M.Maldonado	26-Jan-99	1.1	
M.Maldonado	30-Mar-99	1.1	Added LMB New Telemetry in version 3.10 of C&T document
M.Maldonado	30-Mar-99	1.1	Added spares to all packets to complete the 56 bytes max
			Phil Parongs changes to MCS board C&T Ver 3.11
M.Maldonado	16-Apr-99	2	Updated Mnemoncs per Karen Phams Corrections. Corrected some packet names.
M.Maldonado	12-May-99	2.1	Updated Mnemoncs per Karen Phams Corrections. Corrected some packet names.
M.Maldonado	26-Jun-99	2.11	Added two additional HVPS mnemonics to end of app id 21(PDU)
			Added Commandable MCS telemetry to end of ap id 21(PDU)
			Renamed HK Telemetry channels 23 and 24 to spares
R.McGraw	17-Sep-99	2.12	Updated HK Temp#1 pkt to reflect the 33 HK telemetry changes. Some changes are
			moving data from one chan to another, some changes are renaming telemetry. Also
			the spares on HK chan 23 and on HK chan 39 are now being used.
R.McGraw	8-Oct-99	2.13	Updated packet 20 with the 3 Laser Monitor Telemetry changes. 'Osc temp' moved from ch.1 to ch.3.
			Power Supply temp' moved from ch.3 to ch.4. And 'Preamp temp' moved from ch.4 to ch.1
R.McGraw	15-Feb-00	4	Added a new hardware telemetry packet(CT HW TLM#5) with apid 50 and rate of 32 seconds
			Renamed the following packets - apid 20,21,22,23
			Moved TCM's LHP tlm byte from CT HW TLM #1 offset 34 to CT HW TLM # 4 offset 36
			Moved 10 bytes of hk submux tlm from CT HW TLM#4(offset14-23) to new CT HW TLM #5 pkt(offset14-23).
			Added new HK submux byte (HK Brd OTS on/off readback)to new pkt CT HW TLM #5 offset 24.
			Added new TCM telemetry (18 bytes, ch 1-18) to CT HW TLM #4
			Small SW #2 packet rate changed from 16 secs to 32 secs(this is a spare packet).
			Changed the CT dwell rate specified from 5 seconds to 4 second on summary page.
M Maldonado	4-Apr-00	4	Added changes to CT HW TLM # 5 for three additional LMB tlm points and removed
			one tlm point in same packet
M Maldonado	5-Apr-00	4	Updated SM Memory Dump Packet by removing a spare 2 byte field per Art Ferrers 3/20/2000 e-mail
		4	Updated Large SW Tlm Packet per RJ
M.Maldonado	10-Apr-00	Rev -	Updated mnemonics and descriptions based on a review with RJ Mcgraw and Karen Pham
M.Maldonado	11-Apr-00	Rev -	Updated ap id 24 from rdl file
M.Maldonado	28-Sep-00	Rev -	Updated for GLAS FSW Build 3.0 release
M.Maldonado	29-Sep-00	Rev -	Corrected AD telemetry in apid
M.Maldonado	16-Oct-00	Rev -	Steve Slegel Comments. Corrected incorret masks at offset 172 and 176 in apid 55.
			Swapped tlm points in apid 55 offsets 127 and 128.Corrected masks at offset 38 in apdi 24
			Removed tlm points in apdi 24 offsets 38 and 39
M.Maldonado	17-Oct-00	Rev -	Corrected AD tlm descriptions for apid 55 offsets 48-52 (Dwaines Molocks Comments)
			Corrected incorrect offset calculation in apid 25 and minor tlm defs in apid 25 SM and CS sections
M.Maldonado	9-Nov-00	Rev A	Added Polynomial conversion factors and units to all points that have them. Added 4 new tlm mnemonics
			GLML1ENST, GLML2ENST, GLML3ENST and GLMOTSENST that define the bits of GLMLOTSENRB
			Added the pseudo tlm conversions that use GLMOTSTC1LB, GLMOTSTC1UB, GLMOTSTC2LB, GLMOTSTC2UB
			For the HVPS section in app id 20 changed the mnemonics of the raw counts used to calculate the actual HVPS
			voltages to the actual converted values so that pseudo tlm does not need to be used for these tlm points.
			These are the changed HVPS mnemonics: GHVPADT1V, GHVPADT2V, GHVPSPCM1V, GHVPSPCM2V, GHVPSPCM3V
			GHVPSPCM4V, GHVPSPCM5V, GHVPSPCM6V, GHVPSPCM7V, GHVPSPCM8V, GHVPIN1T, GHVPIN2T
			GHVPIN3T. The old mnemonics did not have the 3rd letter P that these new mnemonics have.
			Added a new sheet for Pseudo telemetry where most of the PDU telemetry is defined.
			This Database corresponds to GLAS FSW Build 3.0 Release
			This is the baseline release for Ball's OASYS database fro Real Time Housekeeping Telemetry
M.Maldonado	28-Nov-00	Rev A	Changed the following mnemonics: from GLMH1PPOS to GMCH1PPOS; from GLMH2PPOS to GMCH2PPOS;
			from GLMH3PPOS to GMCH3PPOS; from GLMH1SPOS to GMCH1SPOS; from GLMH2SPOS to GMCH2SPOS;
			from GLMH3SPOS to GMCH3SPOS;
			Replaced constants in pseudo equations 1, 2, 3 and 4 to correct constants for FLIGHT LASERS
			Added two new mnemonics GPCDRCNT at apid 55 offset 266 and GCDFACKCTR at appid 55 offset 130
			Added masks to GPCFACKCTR and GCDDRCNT which are at the same offset as previous menmonics
M.Maldonado	30-Nov-00	Rev A	Redefined app id 31 and 32 packets to reflect reality. These packets do not come down the HK or DIAG channels.
			The packets come down the recorder SSR and are used for either one-shot and dump or for DSP troubleshooting.
			They do not need to be defined in the Database.
M.Maldonado	1-Dec-00	Rev A	Substituted mnemonic GCDOPMOD for GCDHWMODE in apid 24 at offset 38 and removed 0=Clear mem from def.
			Substituted mnemonic GCDIDLMOD for GCDIDLSRC in appid 24 at offset 38
			Substituted mnemonic GCDRNGGATE for GCDMSMTSRC in appid 24 at offset 38
			Substituted mnemonic GCD40HZTIME for GCD40HZINT in appid 24 at offset 39
			Substituted mnemonic GCDRGATE for GCDRGDLY in appid 55 at offset 108
			Substituted mnemonic GCDFACK40M for GCDFCMDMSB in appid 55 at offset 127
			Substituted mnemonic GCDFCMD40M for GCDFACKMSB in appid 55 at offset 128
			Substituted mnemonic GCDGPS40M for GCDGPSMSB in appid 55 at offset 129
M.Maldonado	06-Dec-00	Rev B	These changes correspond to the new GLASFSW Build 3.1
			5 New mnemonic in appid 55 starting at offset 70, which used to be spares
			GADPACSL, GADPACSM, GADARSTD, GADSWEEV, GADHWEEV
			Changed spare array size on mnemonic GADSPARE from 18 to 10 to accommodate new mnemonics
			Deleted mnemonic GLMPLSR at apid 20 offset 31.
			CCR-108 Changes:
			Convert the 4 active laser temperatures (reference, doubler, oscillator and electronics) into the laser 1 temperatures
			Changed mnemonics for Laser 1 temperatures to be consistent by adding L1.
			Changed mnemonic GLMREFT to GLML1REFT
			Changed mnemonic GLMDBT to GLML1DBT

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Change History

Name	Date	Version	Change Description
			Changed mnemonic GLMOSCT to GLML1OSCT
			Changed mnemonic GLMMET to GLML1ET
			Move the 8 telemetry points starting at appid 20 offset 21 to apid 50 starting at offset 27 which are currently spares
			Moved mnemonic GLMOTSLVL1 from apid 20 offset 21 to apid 50 offset 27
			Moved mnemonic GLMOTSLVL2 from apid 20 offset 22 to apid 50 offset 28
			Moved mnemonic GLMOTSLVL3 from apid 20 offset 23 to apid 50 offset 29
			Moved mnemonic GLMOTSLVL4 from apid 20 offset 24 to apid 50 offset 30
			Moved mnemonic GLMOTSTC1UB from apid 20 offset 25 to apid 50 offset 31
			Moved mnemonic GLMOTSTC1LB from apid 20 offset 26 to apid 50 offset 32
			Moved mnemonic GLMOTSTC2UB from apid 20 offset 27 to apid 50 offset 33
			Moved mnemonic GLMOTSTC2LB from apid 20 offset 28 to apid 50 offset 34
			Add 8 new mnemonics for laser 2 and laser 3 temperatures (reference, doubler, oscillator and electronics)
			The new mnemonics are GLML2REFT, GLML2DBT, GLML2OSCT, GLML2ET, GLML3REFT, GLML3DBT, GLML3OSCT
			and GLML3ET. They have been added to apid 20 starting at offset 21 and they occupy the locations
			vacated by moved mnemonics.
M.Maldonado	07-Dec-00	Rev B	Corrected Polynomial Conversion Factors for the following mnemonics in apid 23, starting at offset 14
			GMCHOP1T, GMCHOP2T, GMCHOP3T, GMCVCXT, GMCVCYT, GMCHOP1HTR1I, GMCHOP1HTR2I, GMCHOP2HTR1I,
			GMCHOP2HTR2I, GMCHOP3HTR1I and GMCHOP3HTR2I
			Changed Units on GMCVCXMTRI and GMCVCYMTRI from Volts to MilliAmps and modified conversion factors accordingly
			Changed GMCXPOS and GMCYPOS conversion factors to be more precise
M.Maldonado	14-Dec-00	Rev B	Added additional voltage and current descriptions to apid 21 mnemonics
			Changed mnemonic GMCCADCPUL to GMCADCPUL in apid 21 offset 54
			Added additional laser monitor description to apid 50 offsets 24, 25 & 26
			Changed GGCTSTAT to GCTSTAT in apid 24 offset 54
			Named a spare byte at apid24 offset 55GCTSPARE1
			Changed two discrete conversions from 1=Auto to 1=Normal at apid 24 offset 54, mnemonics GCTSWMODE and GCTHWMODE
			Changed mnemonic GCTANPST to GCTANPS in apid 55 offset 336 to be consistent
M.Maldonado	15-Dec-00	Rev B	Converted 2 bytes of spares in app id 55 offset 216 into a telemetry point mnemonic GGPBADXYZ
M.Maldonado	05-Mar-01	Rev B	CCR-120, Changed mnemonics at apid 50 offsets 18 and 19. From GHKLHP1T to GHKLHP1CNTRLT and
			GHKLHP2T to GHKLHP2CNTRLT
D. Molock	22-Jun-01	Rev B	Updated AD fast and slow telemetery packet to reflect changes made for build 3.3
S. Slegel	27-Jun-01	Rev B	Updated PC, CD, and DC Fast and Slow Telemetry Packet to reflect changes made for build 3.3
P. Kutt	03-Jul-01	Rev B	Updated CT fast and slow telemetery packet to reflect changes made for build 3.3:
			Replaced spare byte in CT fast telemetry with additional status bits for etalon.
			Replaced 2 spare bytes in CT slow telemetry with status bits for suppressed event messages.
			Replaced 12 spare bytes in CT slow telemetry with mnemonics for LHP temperature control.
			Replaced spare byte in CT slow telemetry with status bits for telemetry updates.
K.Naylor	10-Jul-01	Rev B	Updated the MD comments in the Summary. Added MD telemetry to Large SW #1. Updated MD Packet (27,28) information.
M.Maldonado	09-Aug-01	Rev B	Updated Mnemonics per GLAS-CCR-114
			Changed telemetry mnemonic from GHKFDLT to GHK1FOLDT in apid 22 offset 42
			Changed telemetry mnemonic from GHKSPCMT to GHKLIDBOXT in apid 22 offset 35
J. Polk	26-Jun-02	Rev C	Updated "confidence status" of memory dwell packets from low to high, and etalon calibration from low to medium.
			Removed pseudo equations worksheet, and replaced all references to pseudo telemetry in the "conversion factors" column with the
			appropriate pseudo telemetry mnemonic.
			Corrected HVPS mnemonics by removing the "P". E.G., GHVPADT1V to GHVADT1V
			Changed definition of GMCH3PPOS and GMCH3SPOS bits from 2="DEPLOYED",3="STOWED" to 2="DET#2",3="DET#1"
			Corrected mnemonics for GMCHOP1T, GMCHOP2T, GMCHOP3T, GMCVCXT, and GMCVCYT to GMCLSM1T, GMCLSM2T,
			GMCADSMT,GMCLBSMET, and GMCLBSMMT.
			Removed TM mnemonics GTMSMIRHTR and GTMSMIRTSP, and HK mnemonic GHKSMIRI
			Reversed the order of TM mnemonics GTMSMIRTHSEL and GTMSSSTHSEL, and HK mnemonics GHKSMIRT AND GHKTOWT.
			Updated polynomials for various mnemonics: GTMTOWTSP,GHKTOWT,GHKSMIRT,GMCLSM1T,GMCCLS2T,GMCADSMT,
			GMCLBSMET, GMCLBSMMT, GHKTOWI
			Replaced single byte (UB) OTS trigger count values with 2 byte (UI) values. GLMOTSTC1UB/LB with GLMOTSTC1 and
			GLMOTSTC2UB/LB with GLMOTSTC2.
			Added GP status bit mask definitions in packet 24, and corrected masks for AD, PC, DC, and CD software/hardware mode flags
			Added new (for Bld 3.8) Etalon Open-Loop flag (GCTEOLMODE)
			In the Large SW Tlm #1 packet (pkt 25): (a) changed GHSWDISR to GHSCDISR, (b) changed names of unused ISRs to indicate that they are
			spares, (c) corrected mnemonic for GPS 10 sec ISR count (GHSGPSISR to GHSGPS1ISR), (d) corrected mnemonic for "AD Subsystem Present
			Flag" from GHSDAPF to GHSADPF, (e) corrected mask for "CS Enabled/Disabled Flag" from 0x01 to 0x03, (f) corrected mask for "SM table
			Operations Flag" from 0xFF to 0x3F, (g) corrected "Fire Command Time Increment" mnemonic (changed GTCINCL4/GTCINU2 to
			GTCINCRL4/GTCINCRU2).
			In the Large SW Tlm #2 packet (pkt 55): (a) Increased the size of the CD A/D Raw Data and Ovcerflow flag from 2 to 4 bytes and removed the 2 spare bytes, (b) corrected the mask for the "DC Output FIFO Full/Empty Interrupt (the masks were reversed), (c) Added GDCGAIN values, (d) removed GP status flags and added GGPBADXYZCNT, GGPTOLERXYZ, and GGPRANGEPKTS, (e) DC FIFO Almost Full/Almost Empty mnemonics were reversed (fixed this).
			Added mnemonic names in mnemonics column for packets 35 and 36
			Changed size of Etalon Calibration packet (on summary page) from 492 to 2076 , and added etalon calibration packet to "other pkts" spreadsheet
	24-Sep-02		Replaced polynomial conversion factors with pseudo tlm mnemonic for the following: GLMOSCI, GLMAMPI, GLMPINA, GLMPINB, GLM532NRG.

Filename: GLAS_HK_PKTs.xls

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Worksheet: Change History

Pkt Name	CT HW TLM #1			Size	56	Octets		
App Id	20			Frequency	0.250	Hz		
				Interval	4.000	seconds		
Offset in Octets	Name	idx	Size in Octets	Mnemonics	Ident.# Mask	Description	Conversion Factors	Units
0	Primary Header		6					
6	Secondary Header(time stamp)		8			Time when packet is sent		
14	Laser 1 Reference Temperature	1	1	GLML1REFT		LMB	Pseudo Mnemonic GLML1REFTP	Counts
15	Laser 1 Doubler Temperature	2	1	GLML1DBT		LMB	Pseudo Mnemonic GLML1DBTP	Counts
16	Laser 1 Oscillator Temperature	3	1	GLML1OSCT		LMB	Pseudo Mnemonic GLML1OSCTP	Counts
17	Laser 1 Electronics Temperature	4	1	GLML1ET		LMB	Pseudo Mnemonic GLML1ETP	Counts
18	Laser Osc Current	6	1	GLMOSCI		LMB	Pseudo Mnemonic GLMPOSCCDI	Counts
19	Laser Amp Current	7	1	GLMAMPI		LMB	Pseudo Mnemonic GLMPAMPCDI	Counts
20	Laser Dr Pulse Width	8	1	GLMDRPW		LMB	POLY=(131.08,0.512)	pulse width in usec
21	Laser 2 Reference Temperature	24	1	GLML2REFT		LMB	Pseudo Mnemonic GLML1REFTP	Counts
22	Laser 2 Doubler Temperature	25	1	GLML2DBT		LMB	Pseudo Mnemonic GLML1DBTP	Counts
23	Laser 2 Oscillator Temperature	26	1	GLML2OSCT		LMB	Pseudo Mnemonic GLML1OSCTP	Counts
24	Laser 2 Electronics Temperature	27	1	GLML2ET		LMB	Pseudo Mnemonic GLML1ETP	Counts
25	Laser 3 Reference Temperature	28	1	GLML3REFT		LMB	Pseudo Mnemonic GLML1REFTP	Counts
26	Laser 3 Doubler Temperature	29	1	GLML3DBT		LMB	Pseudo Mnemonic GLML1DBTP	Counts
27	Laser 3 Oscillator Temperature	30	1	GLML3OSCT		LMB	Pseudo Mnemonic GLML1OSCTP	Counts
28	Laser 3 Electronics Temperature	31	1	GLML3ET		LMB	Pseudo Mnemonic GLML1ETP	Counts
29	AD Detector Outgoing Gain readback	17	1	GLMADTOGGN		LMB	POLY=(-1, 0.0078125)	Volts
30	AD Detector Return Gain readback	18	1	GLMADTRTNGN		LMB	POLY=(-1, 0.0078125)	Volts
31	Laser 1 Eanble/Disable Status	19		GLML1ENST	0x01	LMB	0=ENABLED, 1=DISABLED	
31	Laser 2 Eanble/Disable Status	19		GLML2ENST	0x02	LMB	0=ENABLED, 1=DISABLED	
31	Laser 3 Eanble/Disable Status	19		GLML3ENST	0x04	LMB	0=ENABLED, 1=DISABLED	
31	OTS Enable/Disable Status	19		GLMOTSENST	0x08	LMB	0=ENABLED, 1=DISABLED	
31	Laser and OTS Enable readbacks	19	1	GLMLOTSENRB	0xFF	LMB		
32	Dual Pin -A		1	GLMPINA		LMB	Pseudo Mnemonic GLMPPINACD	Counts
33	Dual Pin -B		1	GLMPINB		LMB	Pseudo Mnemonic GLMPPINBCD	Counts
34	532 Energy		1	GLM532NRG		LMB	Pseudo Mnemonic GLMP532NRGCD	Counts
35	Primary Altimeter Detector 550 V	1	1	GHVADT1V		HVPS	POLY=(0.0, 3.581)	Volts
36	Secondary Altimeter Detector 550 V	2	1	GHVADT2V		HVPS	POLY=(0.0, 3.581)	Volts
37	SPCM Detector #1 550 V	3	1	GHVSPCM1V		HVPS	POLY=(0.0, 3.581)	Volts
38	SPCM Detector #2 550 V	4	1	GHVSPCM2V		HVPS	POLY=(0.0, 3.581)	Volts
39	SPCM Detector #3 550 V	5	1	GHVSPCM3V		HVPS	POLY=(0.0, 3.581)	Volts
40	SPCM Detector #4 550 V	6	1	GHVSPCM4V		HVPS	POLY=(0.0, 3.581)	Volts
41	SPCM Detector #5 550 V	7	1	GHVSPCM5V		HVPS	POLY=(0.0, 3.581)	Volts
42	SPCM Detector #6 550 V	8	1	GHVSPCM6V		HVPS	POLY=(0.0, 3.581)	Volts
43	SPCM Detector #7 550 V	9	1	GHVSPCM7V		HVPS	POLY=(0.0, 3.581)	Volts
44	SPCM Detector #8 550 V	10	1	GHVSPCM8V		HVPS	POLY=(0.0, 3.581)	Volts
45	Internal Temp #1	11	1	GHVIN1T		HVPS	POLY=(- 50.0, 0.781)	Deg C
46	Internal Temp #2	12	1	GHVIN2T		HVPS	POLY=(9.0, 0.031)	Deg C
47	Internal Temp #3	13	1	GHVIN3T		HVPS	POLY= (-50.0, 0.781)	Deg C

Filename: GLAS_HK_PKTs.xls   Page 1 of 2   Worksheet : CT HW TLM #1

Pkt Name	CT HW TLM #1			Size	56	Octets		
App Id	20			Frequency	0.250	Hz		
				Interval	4.000	seconds		
Offset in Octets	Name	idx	Size in Octets	Mnemonics	Ident.# Mask	Description	Conversion Factors	Units
48	Voice Coil X Motor Current	7	2	GMCVCXMTRI		MCS	POLY=(-100, 0.048828125)	milli Amps
50	Voice Coil Y Motor Current	8	2	GMCVCYMTRI		MCS	POLY=(-100, 0.048828125)	milli Amps
52	Mirror X Position	9	2	GMCXPOS		MCS	POLY=(-10, 0.0048828125)	Volts
54	Mirror Y Position	10	2	GMCYPOS		MCS	POLY=(-10, 0.0048828125)	Volts

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Worksheet : CT HW TLM #1

Pkt Name	CT HW TLM #2			Size	56	Octets		
App Id	21			Frequency	0.250	Hz		
				Interval	4.000	seconds		
Offset	Name	idx	Size in	Mnemonics	Ident.#	Description		
in Octets			Octets		Mask		Conversion Factors	Units
0	Primary Header		6					
6	Secondary Header(time stamp)		8			Time when packet is sent		
14	Primary Monitor Calibration, Upper Byte	0	1	GPDMON1CALUB		PDU	Pseudo Mnemonic SLOPE1	
15	Primary Monitor Calibration, Lower Byte	1	1	GPDMON1CALLB		PDU	Pseudo Mnemonic INTERCEPT1	
16	+28V Bus A Instrument Voltage	2	1	GPDBAP28V		PDU	Pseudo Mnemonic GPDPBAP28V	Counts
17	Hybrid Supplies Current	3	1	GPDHYPSI		PDU	Pseudo Mnemonic GPDPHYPSI	Counts
18	HVPS Detector Supplies Current	4	1	GPDDTHVI		PDU	Pseudo GPDPDTHVI	Counts
19	Operational Heaters Current	5	1	GPDOPHTRI		PDU	Pseudo GPDPOPHTRI	Counts
20	Mechanical System Current	6	1	GPDMSI		PDU	Pseudo GPDPMSI	Counts
21	+28V Bus B Laser 1 Voltage	7	1	GPDBBL1P28V		PDU	Pseudo GPDPBBL1P28V	Counts
22	+28V Bus B Laser 1 Current	8	1	GPDBBL1P28I		PDU	Pseudo GPDPBBL1P28I	Counts
23	+28V Bus C Laser 2 Voltage	9	1	GPDBCL2P28V		PDU	Pseudo GPDPBCL2P28V	Counts
24	+28V Bus C Laser 2 Current	10	1	GPDBCL2P28I		PDU	Pseudo GPDPBCL2P28I	Counts
25	+28V Bus D Laser 3 Voltage	11	1	GPDBDL3P28V		PDU	Pseudo GPDPBDL3P28V	Counts
26	+28V Bus D Laser 3 Current	12	1	GPDBDL3P28I		PDU	Pseudo GPDPBDL3P28I	Counts
27	Secondary Monitor Calibration, Upper Byte	16	1	GPDMON2CALUB		PDU	Pseudo Mnemonic SLOPE2	
28	Secondary Monitor Calibration, Lower Byte	17	1	GPDMON2CALLB		PDU	Pseudo Mnemonic INTERCEPT2	
29	+ 5 V Hybrid # 1 Voltage	18	1	GPDHY1P5V		PDU	Pseudo GPDPHY1P5V	Counts
30	+ 5 V Hybrid # 1 Current	19	1	GPDHY1P5I		PDU	Pseudo GPDPHY1P5I	Counts
31	+12 V Hybrid # 2 Voltage	20	1	GPDHY2P12V		PDU	Pseudo GPDPHY2P12V	Counts
32	+ 12 V Hybrid # 2 Current	21	1	GPDHY2P12I		PDU	Pseudo GPDPHY2P12I	Counts
33	- 12 V Hybrid # 3 Voltage	22	1	GPDHY3M12V		PDU	Pseudo GPDPHY3M12V	Counts
34	- 12 V Hybrid # 3 Current	23	1	GPDHY3M12I		PDU	Pseudo GPDPHY3M12I	Counts
35	+ 5 V Hybrid # 4 Voltage	24	1	GPDHY4P5V		PDU	Pseudo GPDPHY4P5V	Counts
36	+ 5 V Hybrid # 4 Current	25	1	GPDHY4P5I		PDU	Pseudo GPDPHY4P5I	Counts
37	- 5 V Hybrid # 5 Voltage	26	1	GPDHY5M5V		PDU	Pseudo GPDPHY5M5V	Counts
38	- 5 V Hybrid # 5 Current	27	1	GPDHY5M5I		PDU	Pseudo GPDPHY5M5I	Counts
39	- 5 V Hybrid # 6 Voltage	28	1	GPDHY6M5V		PDU	Pseudo GPDPHY6M5V	Counts
40	- 5 V Hybrid # 6 Current	29	1	GPDHY6M5I		PDU	Pseudo GPDPHY6M5I	Counts
41	+ 15 V Boost Post Reg Voltage	30	1	GPDBTP15V		PDU	Pseudo GPDPBTP15V	Counts
42	- 15 V Boost Post Reg Voltage	31	1	GPDBTM15V		PDU	Pseudo GPDPBTM15V	Counts
43	+12 V Prim Osc Thermal Control Current	32	1	GPDTHC1P12I		PDU	Pseudo GPDPTHC1P12I	Counts

Filename: GLAS_HK_PKTs.xls Page 1 of 3 Worksheet: CT HW TLM #2

Pkt Name	CT HW TLM #2			Size	56	Octets		
App Id	21			Frequency	0.250	Hz		
				Interval	4.000	seconds		
Offset	**Name**	**idx**	**Size in**	**Mnemonics**	**Ident.#**	**Description**		
in Octets			**Octets**		**Mask**		**Conversion Factors**	**Units**
44	+12 V Sec Osc Thermal Control Current	33	1	GPDTHC2P12I		PDU	Pseudo GPDPTHC2P12I	Counts
45	-2 V Discrete Voltage	34	1	GPDDISM2V		PDU	Pseudo GPDPDISM2V	Counts
46	Hybrid Heatsink Temperature	35	1	GPDHYHST		PDU	Pseudo GPDPHYHST	Counts
47	FET Switch Bank Heatsink Temperature	36	1	GPDFETSBHST		PDU	Pseudo GPDPFETSBHST	Counts
48	Primary Oscillator Status	39		GPDOSC1ST	0x01	PDU	0=Off, 1=On	
48	Secondary Oscillator Status	39		GPDOSC2ST	0x02	PDU	0=Off, 1=On	
48	Primary AD Status	39		GPDAD1ST	0x10	PDU	0=Off, 1=On	
48	Secondary AD Status	39		GPDAD2ST	0x20	PDU	0=Off, 1=On	
48	FET Switch Bank Configuration	39	1	GPDFETSB		PDU		
49	HVPS +0 Volts Reference	14	1	GHVREFP0V		HVPS Bd	POLY=(0.0, 0.026)	Volts
50	HVPS +5 Volts Reference	15	1	GHVREFP5V		HVPS Bd	POLY=(0.0, 0.052)	Volts
51	MCS Mux Counter (4-bits)		1	GMCCTRINFO	0x0F	MCS Bd Commandable tlm		Counts
52	Primary Sensor Position Laser Select Mechanism 1, HOP-1			GMCH1PPOS	0x0C00	MCS Bd Commandable tlm	0=In-Deployment, 1=Unknown, 2=Deployed, 3=Stowed	
52	Primary Sensor Position Laser Select Mechanism 2, HOP-2			GMCH2PPOS	0x0300	MCS Bd Commandable tlm	0=In-Deployment, 1=Unknown, 2=Deployed, 3=Stowed	
52	Primary Sensor Position Altimeter Digitizer Detector Select Mechanism, HOP-3			GMCH3PPOS	0x00C0	MCS Bd Commandable tlm	0=In-Deployment, 1=Unknown, 2=DET#2, 3=DET#1	
52	Secondary Sensor Position Laser Select Mechanism 1, HOP-1			GMCH1SPOS	0x0030	MCS Bd Commandable tlm	0=In-Deployment, 1=Unknown, 2=Deployed, 3=Stowed	
52	Secondary Sensor Position Laser Select Mechanism 2, HOP-2			GMCH2SPOS	0x000C	MCS Bd Commandable tlm	0=In-Deployment, 1=Unknown, 2=Deployed, 3=Stowed	
52	Secondary Sensor Position Altimeter Digitizer Detector Select Mechanism, HOP-3			GMCH3SPOS	0x0003	MCS Bd Commandable tlm	0=In-Deployment, 1=Unknown, 2=DET#2, 3=DET#1	
52	Optical Sensor Status		2	GMCOPTSST	0xFFFF	MCS Bd Commandable tlm		

Filename: GLAS_HK_PKTs.xls Page 2 of 3 Worksheet: CT HW TLM #2

Pkt Name	CT HW TLM #2			Size	56	Octets		
App Id	21			Frequency	0.250	Hz		
				Interval	4.000	seconds		
Offset	Name	idx	Size in	Mnemonics	Ident.#	Description		
in Octets			Octets		Mask		Conversion Factors	Units
54	HOP Temperature Status			GMCHOPT	0x0800	MCS Bd Commandable tlm	0=In Tolerance, 1=Out of Tolerance	
54	ADC Pulse Status			GMCADCPUL	0x0400	MCS Bd Commandable tlm	0=Not Received, 1= Received	
54	Deployed optic diodes power status			GMCDPLYOPTPWR	0x0200	MCS Bd Commandable tlm	0=ON, 1=OFF	
54	Stowed optic diodes power status			GMCSTOPTPWR	0x0100	MCS Bd Commandable tlm	0=ON, 1=OFF	
54	HOP LED Turn Off			GMCHOPLEDOF	0x0080	MCS Bd Commandable tlm	0=Armed, 1=Triggered	
54	HOP Temp Turn Off			GMCHOPTEMPOF	0x0040	MCS Bd Commandable tlm	0=Armed, 1=Triggered	
54	HOP Timer Turn Off			GMCHOPTIMOF	0x0020	MCS Bd Commandable tlm	0=Armed, 1=Triggered	
54	HOP Command Trigger Status			GMCHOPTRIG	0x0010	MCS Bd Commandable tlm	0=Not Received, 1= Received	
54	Reset Latch relay command status			GMCRSTLRLY	0x0008	MCS Bd Commandable tlm	0=Not Received, 1= Received	
54	Set latch relay command status			GMCSETLRLY	0x0004	MCS Bd Commandable tlm	0=Not Received, 1= Received	
54	DAC Init Conversion Signal Status			GMCINCONSIG	0x0002	MCS Bd Commandable tlm	0=Not Sent, 1=Sent	
54	DAC Latch Data Signal Status			GMCDACLDSIG	0x0001	MCS Bd Commandable tlm	0=Not Sent, 1=Sent	
54	Status Cmd Telemetry		2	GMCSTCM	0xFFFF	MCS Bd Commandable tlm		

Filename: GLAS_HK_PKTs.xls Page 3 of 3 Worksheet: CT HW TLM #2

Pkt Name	CT HW TLM #3			Size	56	Octets		
App Id	22			Frequency	0.0625	Hz		
				Interval	16.000	seconds		
Offset	Name	idx	Size in	Mnemonics	Ident.#	Description		
in Octets			Octets				Conversion Factors	Units
0	Primary Header		6					
6	Secondary Header(time stamp)		8			Time when packet is sent		
14	Housekeeping Board Temperature	0	1	GHKHKT		HK	POLY=(-20.4, 0.3984)	Deg C
15	Instrument Processor System Board Temperature	1	1	GHKIPST		HK	POLY=(-23.5, 0.3984)	Deg C
16	Photon Counter Board Temperature	2	1	GHKPCT		HK	POLY=(-21.6, 0.3984)	Deg C
17	Cloud Digitizer/Frequency & Time Board Temperature	3	1	GHKCDT		HK	POLY=(-21.6, 0.3984)	Deg C
18	Altimeter Digitizer 1 DSP Temperature	4	1	GHKAD1DSPT		HK	POLY=(-21.0, 0.3984)	Deg C
19	Altimeter Digitizer 2 DSP Temperature	5	1	GHKAD2DSPT		HK	POLY=(-21.0, 0.3984)	Deg C
20	Data Collection & Handling Board Temp	6	1	GHKDCT		HK	POLY=(-20.7, 0.3984)	Deg C
21	Laser Monitor Board Temperature	7	1	GHKLMT		HK	POLY=(-21.0, 0.3984)	Deg C
22	Temperature Controller Monitor Board Temperature	8	1	GHKTMT		HK	POLY=(-21.0, 0.3984)	Deg C
23	Oven-crystal-controlled Oscillator(OXCO) 1 Board Temperature	9	1	GHKOXCO1T		HK	POLY=(-21.0, 0.3984)	Deg C
24	Oven-crystal-controlled Oscillator(OXCO) 2 Board Temperature	10	1	GHKOXCO2T		HK	POLY=(-21.0, 0.3984)	Deg C
25	Oscillator Board Temperature	11	1	GHKOSCT		HK	POLY=(-21.0, 0.3984)	Deg C
26	Optical Test Source (OTS) Board Temperature	12	1	GHKOTST		HK	POLY=(-21.0, 0.3984)	Deg C
27	Laser Profiler Array (LPA) Temperature 1	13	1	GHKLPAT1T		HK	POLY=(-21.0, 0.3984)	Deg C
28	Laser Profiler Array (LPA) Temperature 2	14	1	GHKLPAT2T		HK	POLY=(-21.0, 0.3984)	Deg C
29	Altimeter Digitizer 1 ECLA Temperature	15	1	GHKAD1ECLAT		HK	POLY=(-21.0, 0.3984)	Deg C
30	Altimeter Digitizer 2 ECLA Temperature	16	1	GHKAD2ECLAT		HK	POLY=(-21.0, 0.3984)	Deg C
31	Altimeter Digitizer 1 ECLB Temperature	17	1	GHKAD1ECLBT		HK	POLY=(-21.0, 0.3984)	Deg C
32	Altimeter Digitizer 2 ECLB Temperature	18	1	GHKAD2ECLBT		HK	POLY=(-21.0, 0.3984)	Deg C
33	Altimeter Digitizer 1 ADC Temperature	19	1	GHKAD1ADCT		HK	POLY=(-21.0, 0.3984)	Deg C
34	Altimeter Digitizer 2 ADC Temperature	20	1	GHKAD2ADCT		HK	POLY=(-21.0, 0.3984)	Deg C
35	Lidar Box Temperature	21	1	GHKLIDBOXT		HK-PRT	POLY=(-18.113, 0.3083)	Deg C
36	Telescope Mount Temperature	22	1	GHKTELMTT		HK-PRT	POLY=(-18.113, 0.3083)	Deg C
37	Telescope Baffle Temperature	23	1	GHKTELBFT		HK-PRT	POLY=(-18.113, 0.3083)	Deg C
38	Altimeter Detector 1 Temperature	24	1	GHKADT1T		HK-PRT	POLY=(-18.113, 0.3083)	Deg C
39	Altimeter Detector 2 Temperature	25	1	GHKADT2T		HK-PRT	POLY=(-18.113, 0.3083)	Deg C
40	Face 1 LTR to SRS Temperature	26	1	GHKF1LTRT		HK-PRT	POLY=(-18.113, 0.3083)	Deg C
41	Face 2 LTR to SRS Temperature	27	1	GHKF2LTRT		HK-PRT	POLY=(-18.113, 0.3083)	Deg C
42	SRS First Fold Optics Temperature	28	1	GHK1FOLDT		HK-PRT	POLY=(-18.113, 0.3083)	Deg C
43	Fiber Box Temperature	29	1	GHKFBOXT		HK-PRT	POLY=(-18.113, 0.3083)	Deg C

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Pkt Name	CT HW TLM #3			Size	56	Octets		
App Id	22			Frequency	0.0625	Hz		
				Interval	16.000	seconds		
Offset in Octets	Name	idx	Size in Octets	Mnemonics	Ident.#	Description	Conversion Factors	Units
44	Face 1 Fold Around Bench Temperature	30	1	GHKF1FABT		HK-PRT	POLY=(-18.113, 0.3083)	Deg C
45	Face 2 Fold Around Bench Temperature	31	1	GHKF2FABT		HK-PRT	POLY=(-18.113, 0.3083)	Deg C
46	Face 1 LTR CRS Temperature	32	1	GHKF1CRST		HK-PRT	POLY=(-18.113, 0.3083)	Deg C
47	Face 2 LTR CRS Temperature	33	1	GHKF2CRST		HK-PRT	POLY=(-18.113, 0.3083)	Deg C
48	Stellar Reference System (SRS) Parabola Temperature	34	1	GHKSRSPT		HK-PRT	POLY=(-18.113, 0.3083)	Deg C
49	PRT Cal Low	35	1	GHKCALLO		HK-PRT	POLY=(-18.113, 0.3083)	Deg C
50	PRT Cal High	36	1	GHKCALHI		HK-PRT	POLY=(-18.113, 0.3083)	Deg C
51	Pin Diode Bias Voltage	38	1	GHKBIASV		HK	POLY=(0,0.2949)	Volts
52	AD1 High Speed Ram Temperature	39	1	GHKAD1HSRT		HK	POLY=(-21.0, 0.3984)	Deg C
53	Spare		1	GHKSPR1				
54	Spare		1	GHKSPR2				
55	Spare		1	GHKSPR3				

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Pkt Name	CT HW TLM #4			Size	56	Octets		
App Id	23			Frequency	0.0625	Hz		
				Interval	16.000	seconds		
Offset	Name	idx	Size in	Mnemonics	Ident.#	Description		
in Octets			Octets		Mask		Conversion Factors	Units
0	Primary Header		6					
6	Secondary Header(time stamp)		8			Time when packet is sent		
14	Laser Select Mechanism #1 Temperature	0-0	2	GMCLSM1T		MCS	POLY=(-1456.13, 0.5664055703)	Deg C
16	Laser Select Mechanism # 2 Temperature	0-1	2	GMCLSM2T		MCS	POLY=(-1456.13, 0.5664055703)	Deg C
18	Altimeter Detector Select Mechanism Temp.	0-2	2	GMCADSMT		MCS	POLY=(-1456.13, 0.5664055703)	Deg C
20	Laser Beam Select Mech Electronics Temp	0-3	2	GMCLBSMET		MCS	POLY=(-1456.13, 0.5664055703)	Deg C
22	Laser Beam Select Mechanism Mirror Temp	0-4	2	GMCLBSMMT		MCS	POLY=(-909.090909, 0.4438920455)	Deg C
24	HOP 1 Actuator Current - Heater 1	1	2	GMCHOP1HTR1I		MCS	POLY=(-2.0, 976.5625E-6)	Amps
26	HOP 1 Actuator Current - Heater 2	2	2	GMCHOP1HTR2I		MCS	POLY=(-2.0, 976.5625E-6)	Amps
28	HOP 2 Actuator Current - Heater 1	3	2	GMCHOP2HTR1I		MCS	POLY=(-2.0, 976.5625E-6)	Amps
30	HOP 2 Actuator Current - Heater 2	4	2	GMCHOP2HTR2I		MCS	POLY=(-2.0, 976.5625E-6)	Amps
32	HOP 3 Actuator Current - Heater 1	5	2	GMCHOP3HTR1I		MCS	POLY=(-2.0, 976.5625E-6)	Amps
34	HOP 3 Actuator Current - Heater 2	6	2	GMCHOP3HTR2I		MCS	POLY=(-2.0, 976.5625E-6)	Amps
36	Loop Heat Pipe 1 Heater Status, Mask=0x01	0		GTMLHP1	0x01	TCM	0=Off, 1=On	
36	Loop Heat Pipe 2 Heater Status, Mask=0x02	0	1	GTMLHP2	0x02	TCM	0=Off, 1=On	
37	Telescope Prim Mirror Heater Enable Readback	1	1	GTMPMIRHTR			0=Disabled, 0xFF=Enabled	
38	Telescope Prim Mirror Heater Temp Setpoint Readback	2	1	GTMPMIRTSP		TCM	POLY=(0.16, 0.1027, -4.253E-05, 3.833E-07)	Deg C
39	Telescope Tower Heater Enable Readback	5	1	GTMTOWHTR		TCM	0=Disabled, 0xFF=Enabled	
40	Telescope Tower Heater Temp Setpoint Readback	6	1	GTMTOWTSP		TCM	POLY=(0.03, 0.1051, -6.469E-05, 4.376E-07)	Deg C
41	Spare		1	GTMSPR3		TCM		
42	Spare		1	GTMSPR4		TCM		
41	Etalon Heater Enable Readback	7	1	GTMETHTR		TCM	0=Disabled, 0xFF=Enabled	
42	Etalon Heater Temp Setpoint Readback	8	1	GTMETTSP		TCM	POLY=(29.27, 0.09251, 9.19E-06, 1.022E-07)	Deg C
43	Loop Heat Pipe 1 Enable Readback	9	1	GTMLHP1HTR		TCM	0=Disabled, 0xFF=Enabled	
44	Loop Heat Pipe 1 Temp Setpoint Readback	10	1	GTMLHP1TSP		TCM	POLY=(0.03, 0.1173, -6.871E-05, 2.629E-07)	Deg C
45	Loop Heat Pipe 2 Enable Readback	11	1	GTMLHP2HTR		TCM	0=Disabled, 0xFF=Enabled	
46	Loop Heat Pipe 2 Temp Setpoint Readback	12	1	GTMLHP2TSP		TCM	POLY=(-7.7, 0.11, -5.1E-05, 2.007E-07)	Deg C
47	Thermister Select - Tscope Prim Mirror - Status Readback	13	1	GTMPMIRTHSEL		TCM	0=Thermistor 1, 0xFF=Thermistor 2	
50	Thermister Select Tscope Sec Support Structure Status Readback	15	1	GTMSSSTHSEL		TCM	0=Thermistor 1, 0xFF=Thermistor 2	

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Worksheet: CT HW TLM #4

Pkt Name	CT HW TLM #4			Size	56	Octets		
App Id	23			Frequency	0.0625	Hz		
				Interval	16.000	seconds		
Offset	Name	idx	Size in	Mnemonics	Ident.#	Description		
in Octets			Octets		Mask		Conversion Factors	Units
51	Thermister Select - Tscope Sec Mirror - Status Readback	14	1	GTMSMIRTHSEL		TCM	0=Thermistor 1, 0xFF=Thermistor 2	
52	Thermister Select LHP1(lasers) Status Readback	16	1	GTMLHP1THSEL		TCM	0=Thermistor 1, 0xFF=Thermistor 2	
53	Thermister Select LHP2(rest of instrument) Status Readback	17	1	GTMLHP2THSEL		TCM	0=Thermistor 1, 0xFF=Thermistor 2	
54	Thermister Select Etalon Status Readback	18	1	GTMETTHSEL		TCM	0=Thermistor 1, 0xFF=Thermistor 2	
55	Spare		1	GHW4SPR1				

Filename: GLAS_HK_PKTs.xls Page 2 of 2 Worksheet: CT HW TLM #4

Pkt Name	CT HW TLM #5			Size	56	Octets		
App Id	50			Frequency	0.0313	Hz		
				Interval	32.000	seconds		
Offset	Name	idx	Size in	Mnemonics	Ident.#	Description		
in Octets			Octets		Mask		Conversion Factors	Units
0	Primary Header		6					
6	Secondary Header(time stamp)		8			Time when packet is sent		
14	Telescope Primary Mirror Temperature	37a	1	GHKPMIRT		HK SubComm	POLY=(0.16, 0.1027, -4.253E-05, 3.833E-07)	Deg C
15	Telescope Tower Temperature	37b	1	GHKTOWT		HK SubComm	POLY=(0.03, 0.1051, -6.469E-05, 4.376E-07)	Deg C
16	Telescope Secondary Mirror Temperature	37c	1	GHKSMIRT		HK SubComm	POLY=(0.14,0.104,-5.962E-05,4.304E-07)	Deg C
16	Etalon Temperature	37d	1	GHKETT		HK SubComm	POLY=(29.27, 0.09251, 9.19E-06, 1.022E-07)	Deg C
17	Loop Heat Pipe 1 Controller Temperature	37e	1	GHKLHP1CTRLT		HK SubComm	POLY=(0.03, 0.1173, -6.871E-05, 2.629E-07)	Deg C
18	Loop Heat Pipe 2 Controller Temperature	37f	1	GHKLHP2CTRLT		HK SubComm	POLY=(-7.7, 0.11, -5.1E-05, 2.007E-07)	Deg C
19	Telescope Primary Mirror Heater drive current	37g	1	GHKPMIRI		HK SubComm	POLY=(0.0008, 0.00368)	Amps
21	Telescope Tower Heater drive current	37h	1	GHKTOWI		HK SubComm	POLY=(0.0008, 0.00311)	Amps
22	HK Spare	37i	1	GHKSPR5		HK SubComm		
22	Etalon Drive Heater Current	37j	1	GHKETHTRI		HK SubComm	POLY=(-0.0002, 0.00347)	Amps
23	Laser Monitor Delay Line All Temperature	21	1	GLMDLYALLT		LMB	POLY=(-33.84, 0.5368, -1.622E-3, 3.155E-6)	Deg C
24	Laser Monitor Delay Line Mid Temperature	22	1	GLMDLYMIDT		LMB	POLY=(-2.406, 0.06459, -7.58E-6, 5.591E-8)	Deg C
25	Laser Monitor Delay Line Hi Temperature	23	1	GLMDLYHIT		LMB	POLY=(13.33, 0.06518, -5.261E-6, 4.076E-8)	Deg C
26	OTS Level 1 readback	9	1	GLMOTSLVL1		LMB	POLY=(40, -0.15625)	micro Amps
27	OTS Level 2 readback	10	1	GLMOTSLVL2		LMB	POLY=(40, -0.15625)	micro Amps
28	OTS Level 3 readback	11	1	GLMOTSLVL3		LMB	POLY=(40, -0.15625)	micro Amps
29	OTS Level 4 readback	12	1	GLMOTSLVL4		LMB	POLY=(40, -0.15625)	micro Amps
30	OTS Trigger Count 1 readback	13	2	GLMOTSTC1		LMB	POLY=(0.0, 0.256)	micro secs
32	OTS Trigger Count 2 readback	14	2	GLMOTSTC2		LMB	POLY=(0.0, 0.256)	micro secs
34	Spares		21	GHW5SPR[21]				

Filename: GLAS_HK_PKTs.xls Page 1 of 1 Worksheet: CT HW TLM #5

Pkt Name	Small Software #1 Tlm			Size	56	Octets
App Id	24			Frequency	0.250	Hz
				Interval	4.000	seconds
Offset in Octets	**Name**	**idx**	**Size in Octets**	**Mnemonics**	**Ident.# Mask**	**Description**
0	Primary Header		6			
6	Secondary Header(time stamp)		8			Time when packet is sent
14	HS Task Cmd Processed Counter	1	1	GHSCMDPC		
15	HS Task Cmd Rejected(or Error) Counter	2	1	GHSCMDEC		
16	CS Task Cmd Processed Counter	1	1	GCSCMDPC		
17	CS Task Cmd Rejected(or Error) Counter	2	1	GCSCMDEC		
18	TC Task Cmd Processed Counter	1	1	GTCCMDPC		
19	TC Task Cmd Rejected(or Error) Counter	2	1	GTCCMDEC		
20	SB Task Cmd Processed Counter	1	1	GSBCMDPC		
21	SB Task Cmd Rejected(or Error) Counter	2	1	GSBCMDEC		
22	SM Task Cmd Processed Counter	1	1	GSMCMDPC		
23	SM Task Cmd Rejected(or Error) Counter	2	1	GSMCMDEC		
24	RT Task Cmd Processed Counter	1	1	GRTCMDPC		
25	RT Task Cmd Rejected(or Error) Counter	2	1	GRTCMDEC		
26	RT Task RCH3 (SA22-25, CSA 26) Commands Received	3	1	GRTRCH3RX		Does not count spacecraft position and command packet
27	RT Task RCH3 (SA22-25, CSA 26) Commands Rejected	4	1	GRTRCH3RJ		Commands are rejected for Checksumm problems
28	MD Task Cmd Processed Counter	1	1	GMDCMDPC		
29	MD Task Cmd Rejected(or Error) Counter	2	1	GMDCMDEC		
30	AD Task Cmd Processed Counter	1	1	GADCMDPC		
31	AD Task Cmd Rejected(or Error) Counter	2	1	GADCMDEC		
32	AD Target Present Flag			GADTGTPFLG	0x80	0=Not Present, 1=Target Present
32	AD Target Timeout Flag			GADTGTTOFLG	0x40	0=No Timeout, 1=Timeout
32	AD Mode of Operations			GADSWMODE	0x38	0=Idle, 1=Science, 2=OneShot, 3=Load, 4=Dump
32	AD DSP Software Mode			GADDSPSWMODE	0x07	0=Science, 1=Idle, 2=Load, 3=Dump
32	AD Target Status and Mode Flags	3	1	UNION AD_TLM_U		
33	AD Spare Telemetry	4	3	GADSPARE[3]		AD Spare Telemetry
36	CD Task CMD Processed Counter	1	1	GCDCMDPC		
37	CD Task CMD Rejected(or Error) Counter	2	1	GCDCMDEC		
38	CD Timeout Occurred Flag			GCDTIMEOUT	0x01	0=No Timeout, 1=Timeout
38	CD Target Present Flag			GCDTARCONF	0x02	0=Not Configured, 1=Configured
38	CD Event Messages Disabled Flag			GCDEVTMFLG	0x04	0=Enabled, 1=Disabled
38	CD Measurement Reference Source			GCDMSMTSRC	0x08	0=Fire Ack, 1=Fire Cmd
38	CD 40Hz Interrupt			GCD40HZINT	0x10	0=Enabled, 1=Disabled

Filename: GLAS_HK_PKTs.xls Page 1 of 3 Worksheet: Small SW #1

Pkt Name	Small Software #1 Tlm			Size	56	Octets
App Id	24			Frequency	0.250	Hz
				Interval	4.000	seconds
Offset in Octets	Name	idx	Size in Octets	Mnemonics	Ident.# Mask	Description
38	CD AD Detector Select			GCDADDET	0x20	0=AD #1, 1=AD #2
38	CD Detector Select			GCDCDDET	0x40	0=CD #1, 1=CD #2
38	CD AD Board Select			GCDADBRD	0x80	0=AD #1, 1=AD #2
38	CD Hardware Mode			GCDHWMODE	0x0F00	1=Idle, 2=Engineering, 4=Science, Other values invalid
38	CD Software Mode			GCDSWMODE	0xF000	0=Idle, 1=Engineering, 2=Science, 3=Mem Tst, Other values invalid
38	CD Status Flags		2			
40	DC Task Cmd Processed Counter	1	1	GDCCMDPC		
41	DC Task Cmd Rejected(or Error) Counter	2	1	GDCCMDEC		
42	DC Timeout Status			GDCTIMEOUT	0x01	0=No Timeout, 1=Timeout
42	DC Target Present Status			GDCTGTPRES	0x02	0=Not Present, 1=Target Present
42	DC Event Message Disabled Flag			GDCEVTMFLG	0x04	0=Enabled, 1=Disabled
42	DC Software Mode			GDCSWMODE	0xFF00	0=SSR, 1=SSR_LPA, 2=TEST
42	DC Status Flags		2			
44	GP Task Cmd Processed Counter	1	1	GGPCMDPC		
45	GP Task Cmd Rejected(or Error) Counter	2	1	GGPCMDEC		
46	GP GPS Pulse Select			GGPPULSEBIT	0x0020	0=GPS1, 1=GPS2
46	GP Receiving GPS Pulse Flag			GGPRVCPLS	0x0010	0=Not receiving pulse, 1=Receiving pulse
46	GP Position Data Status Flag			GGPPOSFLG	0x000C	0=OK, 1=No Data, 2=Data Calculation Err
46	GP Source of Position Data			GGPSRCDAT	0x0003	0=S/C, 1=Grd Hmin/Hmax, 2=Grd Rmin/Rmax
46	GP Status Flags		2		0x003F	GP status word, see bit mask above
48	PC Task Cmd Processed Counter	1	1	GPCCMDPC		
49	PC Task Cmd Rejected(or Error) Counter	2	1	GPCCMDEC		
50	PC Timeout Status			GPCTIMEOUT	0x01	0=No Timeout, 1=Timeout
50	PC Target Present Status			GPCTARCONF	0x02	0=Not Configured, 1=Configured
50	PC Calibration Type			GPCCALTYPE	0x04	0=Coarse, 1=Fine
50	PC Event Messages Disabled			GPCEVTMFLG	0x08	0=Enabled, 1=Disabled
50	PC Range Gate Dither Flag			GPCRGDIFLG	0x10	0=Disabled, 1=Enabled
50	PC Measurement Reference Source			GPCMSMTSRC	0x20	0=Fire Ack, 1=Fire Cmd
50	PC Hardware Mode			GPCHWMODE	0x0F00	1=Idle, 2=Engineering, 4=Science, Other values invalid
50	PC Software Mode			GPCSWMODE	0xF000	0=Idle, 1=Engineering, 2=Science, 3=Boresite Cal, 4=Mem Tst, Other values invalid
50	PC Status Flags		2			

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Pkt Name	Small Software #1 Tlm			Size	56	Octets
App Id	24			Frequency	0.250	Hz
				Interval	4.000	seconds
Offset in Octets	Name	idx	Size in Octets	Mnemonics	Ident.# Mask	Description
52	CT Task Cmd Processed Counter	1	1	GCTCMDPC		
53	CT Task Cmd Rejected(or Error) Counter	2	1	GCTCMDEC		
54	CT Task Software Mode			GCTSWMODE	0x01	0=Manual, 1=Normal
54	CT Task C&T Control Hardware Mode, Register bit			GCTHWMODE	0x02	0=Manual, 1=Normal
54	CT Task Startup Mode, Discrete cmd			GCTSUMODE	0x04	0=Manual, 1=Auto Power Up Osc/AD
54	CT Task Startup AD/OSC, Discrete cmd			GCTSUAO	0x08	0=Primary, 1= Secondary
54	CT Etalon Tracking Mode			GCTETMODE	0x70	0=Off, 1=Acquire, 2=Tracking, 4=Test, 5=Test/Acquire, 6=Test/Tracking
54	CT Etalon Tracking Active Flag			GCTETRACK	0x80	0=Paused, 1=Active
54	CT Etalon Tracking Low Transmission Flag			GCTELOWTR	0x100	0=Good, 1=Low
54	CT Etalon Tracking Open-Loop Flag			GCTEOLMODE	0x200	0=Normal, 1=OpenLoop
54	CT Task Mode		2	GCTMSTAT		All bits together

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Pkt Name	Large Software Tlm #1			Size	300	Octets
App Id	25			Frequency	0.250	Hz
				Interval	4.000	seconds
Offset in Octets	Name	Idx	Size in Octets	Mnemonics	Ident.# Mask	Description
0	Primary Header		6			
6	Secondary Header(time stamp)		8			Time when packet is sent
14	HS Processor Previous Mode		1	GHSPMODE		0,1,4=Unknown, 2=PROM, 3=EEPROM
15	HS Processor Current Mode		1	GHSCMODE		0,1,4=Unknown, 2=PROM, 3=EEPROM
16	Subsystem Present Flags			GHSSSPF	0xFFFF	0=No, 1=Yes Subsystem Telemetry is present in Small and Large Telemetry Packets
16	HS Subsystem Present Flag			GHSHSPF	0x0001	0=No, 1=Yes
16	CS Subsystem Present Flag			GHSCSPF	0x0002	0=No, 1=Yes
16	TC Subsystem Present Flag			GHSTCPF	0x0004	0=No, 1=Yes
16	SB Subsystem Present Flag			GHSSBPF	0x0008	0=No, 1=Yes
16	SM Subsystem Present Flag			GHSSMPF	0x0010	0=No, 1=Yes
16	RT Subsystem Present Flag			GHSRTPF	0x0020	0=No, 1=Yes
16	MD Subsystem Present Flag			GHSMDPF	0x0040	0=No, 1=Yes
16	AD Subsystem Present Flag			GHSADPF	0x0080	0=No, 1=Yes
16	CD Subsystem Present Flag			GHSCDPF	0x0100	0=No, 1=Yes
16	DC Subsystem Present Flag			GHSDCPF	0x0200	0=No, 1=Yes
16	GP Subsystem Present Flag			GHSGPPF	0x0400	0=No, 1=Yes
16	PC Subsystem Present Flag			GHSPCPF	0x0800	0=No, 1=Yes
16	CT Subsystem Present Flag		2	GHSCTPF	0x1000	0=No, 1=Yes
18	HS Warm Restart Count		2	GHSWRC		
20	HS Cold Restart Count		2	GHSCRC		
22	HS Max Warm Restart Count		2	GHSMAXWR		
24	HS Cold-Warm Flag		2	GHSCWF		
26	HS OS Caused Reset Flag		2	GHSOSRST		
28	HS OS Tick Count		2	GHSOSTICK		
30	HS HS Exec Count		4	GHSHSEX		
34	HS CS Exec Count		2	GHSCSEX		
36	HS TC Exec Count		2	GHSTCEX		
38	HS SB Exec Count		2	GHSSBEX		
40	HS SM Exec Count		2	GHSSMEX		
42	HS RT Exec Count		2	GHSRTEX		
44	HS MD Exec Count		2	GHSMDEX		
46	HS AD Exec Count		2	GHSADEX		
48	HS CD Exec Count		2	GHSCDEX		
50	HS DC Exec Count		2	GHSDCEX		

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Pkt Name	Large Software Tlm #1			Size	300	Octets
App Id	25			Frequency	0.250	Hz
				Interval	4.000	seconds
Offset in Octets	Name	Idx	Size in Octets	Mnemonics	Ident.# Mask	Description
52	HS GP Exec Count		2	GHSGPEX		
54	HS PC Exec Count		2	GHSPCEX		
56	HS CT Exec Count		2	GHSCTEX		
58	HS FPU Underflow Count		4	GHSFPUUF		
62	HS Spare ISR Count 1		4	GHST2ISR		
66	HS Spare ISR Count 2		2	GHSFPISR		
68	HS TC Fire Cmd ISR Count		2	GHSTCFCISR		
70	HS RT ISR Count - Low Priority		2	GHSRTISR		
72	HS Spare ISR Count 3		2	GHSSPISR		
74	HS CT ISR Count		2	GHSCTISR		
76	HS Spare ISR Count 4		2	GHSPCIISR		
78	HS Spare ISR Count 5		2	GHSGPSISR		
80	HS GPS 10 Sec ISR Count		2	GHSGPS1ISR		
82	HS DC ISR Count		2	GHSDCISR		
84	HS PC ISR Count		2	GHSPCISR		
86	HS CD ISR Count		2	GHSCDISR		
88	HS AD ISR Count		2	GHSADISR		
90	HS Spare ISR Count 6		2	GHSCSISR		
92	HS OS Event Seq Number		2	GHSOSESN		
94	HS Peak CPU Utilization		1	GHSPCPU		
95	HS Last CPU Utililzation		1	GHSLCPU		
96	HS OS PCI Bus Target Enable and Interrupt status		1	GHSPCIFLAGS		
97	HS OS Performance Log Enable Flag		1	GHSOSLOG	0x01	0=Disabled, 1=Enabled
98	HS OS Performance Log Item Count		2	GHSOSLOGCNT		
100	HS OS Performance Log Filter Start Address		4	GHSLOGADDR		
104	HS OS Performance Log Filter Mask		4	GHSOSLOGFM		
108	Spares		6	GHSSPARE[6]		
114	CS Enable/Disabled Flag			GCSENFLG	0x03	0=Disabled, 1=Enabled
114	CS Code Memory Checksum Status			GCSCMSTFLG	0x0C	0=Disabled, 1=Enabled, 2=Disabled and Recomputing, 3=Enabled and Recomputing
114	CS Table Memory Checksum Status			GCSTMSTFLG	0x30	0=Disabled, 1=Enabled, 2=Disabled and Recomputing, 3=Enabled and Recomputing
114	CS EEPROM Checksum status flag			GCSEESTFLG	0xC0	0=Disabled, 1=Enabled, 2=Disabled and Recomputing, 3=Enabled and Recomputing
114	CS Status Flags		1	GCSSTATFLG	0xFF	

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Pkt Name	Large Software Tlm #1			Size	300	Octets
App Id	25			Frequency	0.250	Hz
				Interval	4.000	seconds
Offset in Octets	**Name**	**Idx**	**Size in Octets**	**Mnemonics**	**Ident.# Mask**	**Description**
115	CS Code Segment Error Count		1	GCSCSERRCNT		
116	CS EEPROM Segment Error Count		1	GCSEEERRCNT		
117	CS Table Ram Segment Error Count		1	GCSTRERRCNT		
118	CS Table ID of last Code Error		2	GCSIDCODEERR		
120	CS Table ID of last EEPROM Error		2	GCSIDEEERR		
122	CS Table ID of last Table RAM Error		2	GCSIDRAMERR		
124	CS Code Segment Master Checksum		2	GCSSEGMSCS		
126	CS Table RAM Master Checksum		2	GCSRAMMSCS		
128	CS EEPROM Master Checksum		2	GCSEEMSCS		
130	CS Checksum of EEPROM Boot Memory		2	GCSEEBTMEM		
132	CS Checksum of EEPROM Memory		2	GCSEEMEM		
134	CS Checksum of PROM Memory		2	GCSPROMMEM		
136	CS Spare		18	GCSSPARE[18]		
154	TC GLAS MET Upper 2 bytes			GTCMETU2	0xFF0000	
154	TC GLAS MET Lower 4 bytes			GTCMETL4	0x00FFFF	
154	TC GLAS MET		6	GTCMET		
160	TC Fire Command Time Increment Upper 2 bytes		2	GTCINCRU2		
162	TC Fire Command Time Increment Lower 4 bytes		4	GTCINCRL4		
166	TC GLAS MET Working Time seconds		4	GTCWMETSEC		
170	TC GLAS MET Working Time micro-seconds		4	GTCWMETMSEC		
174	Spare		18	GTCSPARE[18]		
192	SB Send Error Count		1	GSBSNDEC		
193	SB Receive Error Count		1	GSBRCVEC		
194	SB OS Error Count		1	GSBOSEC		
195	SB Queue Full Error Count		1	GSBQFEC		
196	SB Buffer overrun Error Count		2	GSBBOVEC		
198	SB last buffer overrun - Stream Id		2	GSBOVSID		
200	SB last buffer overrun - Pipeline Id		2	GSBOVPID		
202	SB last buffer overrun - Sender Task ID		2	GSBOVTID		
204	SB last queue full - Stream Id		2	GSBQFSID		
206	SB last queue full - Pipeline Id		2	GSBQFPID		
208	SB last queue full - Sender Task ID		2	GSBQFTID		
210	SB Spare		8	GSBSPARE[8]		
218	SM num of remaining copies to be dumped		1	GSMDMPCR		
219	SM tbl/mem dump in progress flag		1	GSMDMPFLG		0=False, 1=True

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Pkt Name	Large Software Tlm #1			Size	300	Octets
App Id	25			Frequency	0.250	Hz
				Interval	4.000	seconds
Offset in Octets	**Name**	**Idx**	**Size in Octets**	**Mnemonics**	**Ident.# Mask**	**Description**
220	SM Table Session Type			GSMTSEST	0x3F	0=None, 5=DUMP_ONLY, 6=REP_EEPROM, 7=REP_RAM, 8=APPD_ACTV
220	SM Table Operations Flag			GSMTBOAF	0x40	0=Inactive, 1=Active
220	SM table operations flag		1	GSMTBLOPS	0x7F	
221	SM table operations from image type		1	GSMIMGTYP		0=None, 1=EEPROM, 2=RAM, 3=NULL
222	SM table id selected		2	GSMTBLID		
224	SM currently selected tbl size in words		2	GSMTBLSZ		
226	SM currently selected table checksum		2	GSMTBLCS		
228	SM table commit success count		1	GSMTCSCNT		
229	SM table commit failure count		1	GSMTCFCNT		
230	SM table num. of words loaded		2	GSMTBLWLD		
232	SM FSW build number		1	GSMSWBUILD		
233	SM FSW version number		1	GSMSWVERN		
234	SM spares		10	GSMSPARE[10]		
244	BCRT CONTROL REGISTER WORD			GRTBCRTCW		
244	RT Channel A Select			GRTSELA	0x0080	0=OFF, 1=ON
244	RT Channel B Select		2	GRTSELB	0x0100	0=OFF, 1=ON
246	BCRT Status Register			GRTBCRTSR		
246	RT Status, RT Mode Enabled Flag		2	GRTACT	0x0001	0=Disabled, 1=Enabled
248	BCRT INTERRUPT STATUS REGISTER		2	GRTBCRTISR		
250	RT 1553 MESSAGE ERRORS		2	GRTMSGERR		
252	RT 1553 RETRY COUNT		2	GRTRETRY		
254	RT 1553 INVALID COMMANDS		1	GRTINV		
255	RT 1553 INVALID BROADCAST CMDS		1	GRTINVBC		
256	RT MODE CODES RECEIVED		1	GRTMODE		
257	SPARE		1	GRTSP1		
258	RT PACKETS RECEIVED ON RCH1		2	GRTRCH1RX		
260	RT PACKETS Rejected ON RCH1		2	GRTRCH1RJ		
262	RT PACKETS SENT ON XCH1		2	GRTXCH1		HK Channel
264	RT PACKETS SENT ON XCH2		2	GRTXCH2		Diag Channel
266	RT Number of Command History Packets Sent		2	GRTCMDHIST		
268	RT Checksum Status		2	GRTCSSTAT		0=Cmd CS Disabled, 1=Cmd CS Enabled
270	Spares		8	GRTSPARE[8]		
278	MD Global Enable/Disable Flag			GMDWELL	0x01	0=Disabled, 1=Enabled
278	MD Table #1 Enable Flag			GMDTBL1	0x02	0=Disabled, 1=Enabled

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Pkt Name	Large Software Tlm #1			Size	300	Octets
App Id	25			Frequency	0.250	Hz
				Interval	4.000	seconds
Offset	Name	Idx	Size in	Mnemonics	Ident.#	Description
in Octets			Octets		Mask	
278	MD Table #2 Enable Flag		1	GMDTBL2	0x04	0=Disabled, 1=Enabled
279	MD Spare		1	GMDSPARE		
280	MD Table #1 Address Count		2	GMDADDRCNT1		
282	MD Table #2 Address Count		2	GMDADDRCNT2		
284	MD Table #1 Rate		2	GMDTBLRATE1		Number of 1/8 sec waits between dwell collections for Table #1. Polynomial coeff=(0.0, 0.125).
286	MD Table #2 Rate		2	GMDTBLRATE2		Number of 1/8 sec waits between dwell collections for Table #2. Polynomial coeff=(0.0, 0.125).
288	MD Spares		12	GMDSPARE2[12]		

Filename: GLAS_HK_PKTs.xls   Page 5 of 5   Worksheet: Large SW #1

Pkt Name	Large Software Tlm #2			Size	376	Octets
App Id	55			Frequency	0.2500	Hz
				Interval	4.000	seconds
Offset in Octets	Name	idx	Size in Octets	Mnemonics	Ident.# Mask	Description
0	Primary Header		6			
6	Secondary Header(time stamp)		8			Time when packet is sent
14	AD Software Error Count		2	GADSWEC		Software errors detected
16	AD Hardware Error Count		2	GADHWEC		Hardware errors detected
18	AD Shot Count Value		1	GADSHCNT		
19	AD Shot Count Skip Detected		1	GADSHCNTSKIP		0= no skip, 1=skip
20	AD Synchronized Flag		1	GADSYNCFLG		0=not in sync, 1=in sync
21	AD Spare Telemery		1	GADSPARE2		
22	AD DSP Laser Fire Count		2	GADDSPLFCNT		Indicates the number of laser fire cmds detected.
24	AD DSP Alive Count		2	GADDSPACNT		Increments once every 75ms when laser fire cmd fails
26	AD Ancillary Packets Sent		2	GADANCPKTCNT		
28	AD Engineering Packets Sent		2	GADENGPKTCNT		
30	AD Science Small Packets Sent		2	GADSPKTCNT		
32	AD Science Large Packets Sent		2	GADLPKTCNT		
34	AD DSP Load Packets Processed Count		2	GADDSPLPPCNT		
36	AD DSP Memory Dump Packets Sent		2	GADDSPMDPCNT		
38	AD Memory Load Command Errors		2	GADDSPMLERR		
40	AD Memory Dump Command Errors		2	GADDSPMDERR		
42	AD DSP Checkum Rate		2	GADDSPCSRATE		# of 48-bit words checked in each of 3 memory types of DSP memory each shot (40 Hz)
44	AD DSP Checksum S/W Enable Status		2	GADDSPCSSW	0x0001	0=Disable, 1=Enable
46	AD DSP # of times all of memory has been checksumed		2	GADDSPCSCNT		
48	AD DSP Bootstrap Checksum Lower 16 bits		2	GADDSPBSLSB		
50	AD DSP EPROM Checksum Lower 16 bits		2	GADDSPEPLSB		
52	AD DSP RAM Checksum Lower 16 bits		2	GADDSPRAMLSB		
54	AD DSP Bootstrap Checksum Upper 32 bits		4	GADDSPBSMSB		
58	AD DSP EPROM Checksum Upper 32 bits		4	GADDSPEPMSB		
62	AD DSP RAM Checksum Upper 32 bits		4	GADDSPRAMMSB		
66	AD DSP S/W Build Number		1	GADDSPBNUM		
67	AD DSP S/W Version Number		1	GADDSPVNUM		
68	AD GPS Range Window Packets received		2	GADGPSRWRCV		
70	AS DSP Patch Checksum bits 15..0		2	GADPACSL		Lower 16 bits of a 48-bit address
72	AS DSP Patch Checksum bits 47..16		4	GADPACSM		Upper 32 bits of a 48-bit address
76	AD Auto Reset DSP Flag		1	GADARSTD	0x01	0=False, 1=True
77	AD SW Error Events Flag			GADSWEEV	0x80	0=Disabled, 1=Enabled
77	AD HW Error Events Flag			GADHWEEV	0x40	0=Disabled, 1=Enabled
77	AD Auto Gain Enable Flag			GADGAINEN	0x20	0=Disabled, 1=Enabled
77	AD Auto Gain Use Raw Waveform Flag			GADGAINFE	0x10	0=Disabled, 1=Enabled
77	AD Software Enable Flags		1	UNION GAD_DSP_FLAGS		
78	Trouble Indicator: Invalid Search			GADTFB0	0x0001	0=No Problem 1=Invalid Search
78	Trouble Indicator: Laser Failure			GADTFB1	0x0002	0=No Problem 1=Laser Failure
78	Trouble Indicator: Multiple Interrupts			GADTFB2	0x0004	0=No Problem 1=Multiple Interrupts

Filename: GLAS_HK_PKTs.xls Page 1 of 6 Worksheet: Large SW #2

Pkt Name	Large Software Tlm #2			Size	376	Octets
App Id	55			Frequency	0.2500	Hz
				Interval	4.000	seconds
Offset in Octets	Name	idx	Size in Octets	Mnemonics	Ident.# Mask	Description
78	Trouble Indicator: Buffer Full			GADTFB3	0x0008	0=No Problem 1=Buffer Full
78	Trouble Indicator: Invalid Mode			GADTFB4	0x0010	0=No Problem 1=Invalid Mode
78	Trouble Indicator: Infinite Loop			GADTFB5	0x0020	0=No Problem 1=Infinite Loop
78	Trouble Indicator: Invalid Range Window			GADTFB6	0x0040	0=No Problem 1=Invalid Range Window
78	Trouble Indicator: Invalid Tournament			GADTFB7	0x0080	0=No Problem 1=Invalid Tournament
78	Trouble Indicator: Noise Region Outside Acq Mem			GADTFB8	0x0100	0=No Problem 1=Noise Region Outside Acquisition Memory
78	Trouble Indicator: Invalid Sample Size for Noise Region			GADTFB9	0x0200	0=No Problem 1=Invalid Sample Size for Noise Region
78	AD DSP Trouble Indicator Status Word		2	GADDSPTBLE		
80	AD DSP Memory Table Load Error Counter		2	GADMLTEC		
82	AD Fixed Return Gain Setting		1	GADFRGAIN		
83	AD Spares		5	GADSPARE1[5]		
88	CD Software Error Count		2	GCDSWERRCNT		
90	CD Shot Count		2	GCDSHOTCNT		
92	CD Science Mode Packets Sent		2	GCDSCIPKT		
94	CD Engineering Mode Packets Sent		2	GCDENGPKT		
96	CD Ancillary Packet Sent		2	GCDANCPKT		
98	CD Range Gate Pkts Received		2	GCDRGDPKTRV		
100	CD 40-bit Counter Packets Sent		2	GCDGPS40BPKT		
102	Spare		2			
104	CD Background #1 Delay		2	GCDBGD1DLY		Unit = nanoseconds Poly=(0.0,128)
106	CD Background #2 Delay		2	GCDBGD2DLY		Unit = nanoseconds Poly=(0.0,128)
108	CD Range Gate Delay		2	GCDRGDLY		Unit = nanoseconds Poly=(0.0,128)
110	CD Raw A/D Output Data			GCDADRAWDATA	0x00FF	
110	CD Raw A/D Overflow Flag			GCDADRAWFLG	0x0100	0=No Overflow 1=Overflow
110	CD Attenuation Settings		4	GCDATTEN	0x3E00	1=0.0, 2=1/1.77, 4=1/3.16, 8=1/5.6, 16=1/10
114	CD GPS 40 bit Latch Value 32 lsb		4	GCDGPSLSB		
118	CD Fire Acknowledge 40 bit Latch Value 32 lsb		4	GCDFACKLSB		
122	CD Fire Cmd 40 bit Latch Value 32 lsb		4	GCDFCMDLSB		
126	Spare		1			
127	CD Fire Cmd 40 bit Latch Value 8 msb		1	GCDFCMDMSB		
128	CD Fire Acknowledge 40 bit Latch Value 8 msb		1	GCDFACKMSB		
129	CD GPS 40 bit Latch Value 8 msb		1	GCDGPSMSB		
130	CD FIRE ACKNOWLEDGE COUNTER			GCDFACKCTR	0x0000FF00	
130	CD Data Ready Counter		4	GCDDRCTR	0x000000FF	
134	CD Data Ready Interrupt			GCDDATRDY	0x00000008	0=Enabled, 1=Disabled
134	CD Interrupt Source		4	GCDIDLESRC	0x00003000	1=Fire Command, 2=Fire Acknowledge
134	CD Pulse Width Limit Violation Accumulating Counter		4	GCDPWACCUM		
142	CD Long Pulse Violation 4sec Counter		1	GCDPWLONG		
143	CD Short Pulse Violation 4sec Counter		1	GCDPWSHORT		
144	CD Pulse Width Most Significant Byte		1	GCDPWMSB		
145	Spare		1	GCDSPARE[1]		

Filename: GLAS_HK_PKTs.xls Page 2 of 6 Worksheet: Large SW #2

Pkt Name	Large Software Tlm #2			Size	376	Octets
App Id	55			Frequency	0.2500	Hz
				Interval	4.000	seconds
Offset in Octets	Name	idx	Size in Octets	Mnemonics	Ident.# Mask	Description
146	DC Software Fail Count		2	GDCSWFC		Counts internal errors like timeout, shot count skip and PCI read/write errors. Sometimes occur on power on initialization. System can work correctly even if they occur.
148	DC Shot Count		2	GDCSHOTCNT		
150	DC X Postition		1	GDCXPOS		
151	DC Y Postition		1	GDCYPOS		
152	DC LPA Packets Sent		2	GDCLPAPKTSNT		
154	DC Test Mode Rate		2	GDCMODERATE		
156	DC Packets Sent		2	GDCPKTSNT		
158	DC Spare 1		2	CDCSPARE1		
160	DC Bytes Sent		4	GDCBYTESNT		
164	DC Output bit rate in BPS		4	GDCOUTRATE		
168	DC Interrupt register		4	GDCINTRGS		
172	DC Control latch register		4	GDCCNTLTCH		
176	DC Interrupt 1			GDCINT1	0x00000001	0=Disabled, 1=Enabled
176	DC LPA Interrupt			GDCLPAINT	0x00000002	0=Disabled, 1=Enabled
176	DC Output FIFO Full Interrupt			GDCOUTFFINT	0x00000004	0=Disabled, 1=Enabled
176	DC Output FIFO Empty Interrupt			GDCOUTFEINT	0x00000008	0=Disabled, 1=Enabled
176	DC RAM Busy Interrupt			GDCRAMBINT	0x00000010	0=Disabled, 1=Enabled
176	DC Interrupt 6			GDCINT6	0x00000020	0=Disabled, 1=Enabled
176	DC intr mask register		4	GDCINTMASK	0xFFFFFFFF	
180	DC FIFO Full			GDCFF	0x00000001	0=True, 1=False
180	DC FIFO Almost Full			GDCFAF	0x00000004	0=True, 1=False
180	DC FIFO Almost Empty			GDCFAE	0x00000002	0=True, 1=False
180	DC FIFO Empty			GDCFE	0x00000008	0=True, 1=False
180	DC fifo flags register		4	GDCFIFOFLG	0xFFFFFFFF	
184	DC LPA Gain			GDCGAIN	0x00000007	0=4.00,1=2.80,2=2.15,3=1.75,4=1.47,5=1.27,6=1.12,7=1.00
184	DC LPA Reset			GDCRST	0x00000008	0=In Reset, Not in Reset
184	DC LPA gain register		4	GDCLPAGAIN	0xFFFFFFFF	
188	DC LPA Frame Byte Count			GDCLPABYCNT	0x00003FFF	
188	DC LPA Packet (Frame) Count			GDCLPAPKTCNT	0x00FF0000	
188	DC LPA packet count register		4	GDCLPACNT	0xFFFFFFFF	
192	DC Spares		8	GDCSPARE2[8]		
200	GP GPS 10 second Interrupt Count		2	GGPISRINT		
202	GP Number of Position Packets received		2	GGP1553PKTS		
204	GP Number of Housekeeping packets sent		2	GGPHSPKTS		
206	GP Number of Ancillary Packets sent		2	GGPANPKTS		
208	GP Number of 40-bit Counter Pkts Requested		2	GGP40BPKTSS		
210	GP GPS 10 sec Pulse 40-Bit Counter Packets Received		2	GGP40BPKTSR		
212	GP Packets with bad X,Y,Z Position Data		2	GGPBADXYZCNT		This count increments any time the GP task encounters a position packet with a badly formatted or out of range (32768 < x,y,z < -32768) X, Y, Z in the s/c position packet
214	GP Packets with X,Y,Z Position Data Below Tolerance		2	GGPTOLERXYZ		

Filename: GLAS_HK_PKTs.xls Page 3 of 6 Worksheet: Large SW #2

Pkt Name	Large Software Tlm #2			Size	376	Octets
App Id	55			Frequency	0.2500	Hz
				Interval	4.000	seconds
Offset in Octets	Name	idx	Size in Octets	Mnemonics	Ident.# Mask	Description
216	GP Number of Range Packets Sent		2	GGPRANGEPKTS		
218	GP Spares		22	GGPSPARE[22]		
240	PC Software Error Count	4	2	GPCSWERRCNT		Counts internal errors like timeout, shot count skip and PCI read/write errors. Sometimes occur on power on initialization. System can work correctly even if they occur.
242	PC Shot Counter		2	GPCSHOTCNT		
244	PC SCIENCE MODE PACKETS SENT		2	GPCSCIPKT		
246	PC ENGINEERING MODE PACKETS SENT		2	GPCENGPKT		
248	PC ANCILLARY MODE PACKETS SENT		2	GPCANCPKT		
250	PC RANGE GATE DELAY PACKETS RECEIVED		2	GPCRGDPKTRV		
252	PC Spare1		2	GPCSPARE1		
254	PC SPCM Gate Delay		2	GPCSPCMDLY		Units = Nanoseconds Poly=(0.0,128)
256	PC Background 1 Delay		2	GPCBGD1DLY		Units = Nanoseconds Poly=(0.0,128)
258	PC Background 2 Delay		2	GPCBGD2DLY		Units = Nanoseconds Poly=(0.0,128)
260	PC Range Gate Delay		2	GPCRGDLY		Units = Nanoseconds Poly=(0.0,128)
262	PC Board Hardware Mode			GPCHWMODE	0x00000007	1=Idle, 2=Engineering, 4=Science
262	PC Interrupt Source			GPCINTSRC	0x00003000	1=Fire Command, 2=Fire Acknowledge
262	PC Measurement Source			GPCMSMTSRC	0x00004000	0=Fire Acknowledge, 1= Fire Command
262	PC Hardware Mode Status Word		4	GPCMODESTAT	0xFFFFFFFF	
266	PC SPCM 1 Enable/Disable			GPCSPCM1	0x00000100	0=Enabled, 1=Disabled
266	PC SPCM 2 Enable/Disable			GPCSPCM2	0x00000200	0=Enabled, 1=Disabled
266	PC SPCM 3 Enable/Disable			GPCSPCM3	0x00000400	0=Enabled, 1=Disabled
266	PC SPCM 4 Enable/Disable			GPCSPCM4	0x00000800	0=Enabled, 1=Disabled
266	PC SPCM 5 Enable/Disable			GPCSPCM5	0x00001000	0=Enabled, 1=Disabled
266	PC SPCM 6 Enable/Disable			GPCSPCM6	0x00002000	0=Enabled, 1=Disabled
266	PC SPCM 7 Enable/Disable			GPCSPCM7	0x00004000	0=Enabled, 1=Disabled
266	PC SPCM 8 Enable/Disable			GPCSPCM8	0x00008000	0=Enabled, 1=Disabled
266	PC SPCM STATUS		4	GPCSPCMSTAT	0xFFFFFFFF	
270	PC FIRE ACKNOWLEDGE COUNTER			GPCFACKCTR	0x0000FF00	
270	PC Data Ready Counter		4	GPCDRCNT	0x000000FF	
274	PC SPCM 1 Raw Counts			GPCSPCM1RAW	0x000000FF	
274	PC SPCM 2 Raw Counts			GPCSPCM2RAW	0x0000FF00	
274	PC SPCM 3 Raw Counts			GPCSPCM3RAW	0x00FF0000	
274	PC SPCM 4 Raw Counts			GPCSPCM4RAW	0xFF000000	
274	PC SPCM 1 THROUGH 4 RAW COUNTS		4	GPCSPCM1TO4	0xFFFFFFFF	
278	PC SPCM 5 Raw Counts			GPCSPCM5RAW	0x000000FF	
278	PC SPCM 6 Raw Counts			GPCSPCM6RAW	0x0000FF00	
278	PC SPCM 7 Raw Counts			GPCSPCM7RAW	0x00FF0000	
278	PC SPCM 8 Raw Counts			GPCSPCM8RAW	0xFF000000	
278	PC SPCM 5 THROUGH 8 RAW COUNTS		4	GPCSPCM5TO8	0xFFFFFFFF	
282	PC SPCM Duty Cycle		4	GPCDUTYCYCLE		
286	PC Coarse Boresite Calibration X Start Pos		2	GPCCSTARTX		

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Pkt Name	Large Software Tlm #2			Size	376	Octets
App Id	55			Frequency	0.2500	Hz
				Interval	4.000	seconds
Offset in Octets	Name	idx	Size in Octets	Mnemonics	Ident.# Mask	Description
288	PC Coarse Boresite Calibration Y Start Pos		2	GPCCSTARTY		
290	PC Fine Boresite Calibration X Start Pos		2	GPCFSTARTX		
292	PC Fine Boresite Calibration Y Start Pos		2	GPCFSTARTY		
294	PC Coarse Boresite Calibration X Increment		2	GPCCINCX		
296	PC Coarse Boresite Calibration Y Increment		2	GPCCINCY		
298	PC Fine Boresite Calibration X Increment		2	GPCFINCX		
300	PC Fine Boresite Calibration Y Increment		2	GPCFINCY		
302	PC Coarse Boresite Cal Integration Seconds		2	GPCCINTSEC		
304	PC Fine Boresite Cal Integration Seconds		2	GPCFINTSEC		
306	PC Boresite Calibration Best X Position		2	GPCBPOSX		
308	PC Boresite Calibration Best Y Position		2	GPCBPOSY		
310	PC Boresite Cal Seconds Remaining		2	GPCSECREM		
312	Spares		10	GPCLRGSPR2[10]		
322	CT State Machine Current State		1	GCTSTATE		0=Unknown, 1=Reset, 2=Timeout, 3=Acquire Sync, 4=Wait for Muxes, 5=Process Telemetry, 6=Unknown
323	CT COMMAND ECHO ERRORS		1	GCTCMDEERR		
324	CT LM BOARD CMDS RECEIVED		1	GCTLMCMDRC		
325	CT TM BOARD CMDS RECEIVED		1	GCTTMCMDRC		
326	CT MC BOARD CMDS RECEIVED		1	GCTMCCMDRC		
327	CT HK BOARD CMDS RECEIVED		1	GCTHKCMDRC		
328	CT HVPS Cmds Received		1	GCTHVCMDRC		
329	CT PDU Cmds Received		1	GCTPDCMDRC		
330	CT HW TLM 1 PACKETS SENT		1	GCTHW1PS		
331	CT HW TLM 2 PACKETS SENT		1	GCTHW2PS		
332	CT HW TLM 3 PACKETS SENT		1	GCTHW3PS		
333	CT HW TLM 4 PACKETS SENT		1	GCTHW4PS		
334	CT HW TLM 5 PACKETS SENT		1	GCTHW5PS		
335	CT DWELL PACKETS SENT		1	GCTDWLPS		
336	CT ANCILLARY PACKETS SENT		1	GCTANPS		
337	CT TIMEOUT COUNT		1	GCTTOCNT		
338	CT INTERRUPT COUNT		1	GCTINTCNT		
339	CT Shot Counter Errors		1	GCTSCNTER		
340	CT Dwell Mode		1	GCTDWELL		0=None, 1=LMB, 2=HK, 4=TCM, 8=MCS, 16=PDU, 32=HVPS
341	CT Dwell Channel		1	GCTDWLCH		
342	CT Laser Monitor Board Mux Error Counter		1	GCTLMMXER		
343	CT Housekeeping Board Mux Error Counter		1	GCTHKMXER		
344	CT Housekeeping Board Submux Error Counter		1	GCTHKSMXER		
345	CT Temperature Controller Board Mux Error Counter		1	GCTTMMXER		
346	CT Mechanism Controller Board Mux Error Counter		1	GCTMCMXER		
347	CT High Voltage Power Supply Mux Error Counter		1	GCTHVMXER		
348	CT Power Distribution Unit Mux Error Counter		1	GCTPDMXER		
349	CT Command Echo Success Count		1	GCTCESCNT		

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Pkt Name	Large Software Tlm #2			Size	376	Octets
App Id	55			Frequency	0.2500	Hz
				Interval	4.000	seconds
Offset in Octets	Name	idx	Size in Octets	Mnemonics	Ident.# Mask	Description
350	CT Event Messages Enabled/Disabled Flag			GCTEVTMFLG	0x0001	0=All Enabled, 1=Some Disabled
350	CT Shot Count Error Flag			GCTSHCTEF	0x0002	0=OK, 1=Error
350	CT Laser Monitor Board Mux Error Flag			GCTLMMXEF	0x0004	0=OK, 1=Error
350	CT Housekeeping Board Mux Error Flag			GCTHKMXEF	0x0008	0=OK, 1=Error
350	CT Housekeeping Board Submux Error Flag			GCTHKSMXEF	0x0010	0=OK, 1=Error
350	CT Temperature Controller Board Mux Error Flag			GCTTMMXEF	0x0020	0=OK, 1=Error
350	CT Mechanism Controller Board Mux Error Flag			GCTMCMXEF	0x0040	0=OK, 1=Error
350	CT Power Distribution Unit Mux Error Flag			GCTPDMXEF	0x0080	0=OK, 1=Error
350	CT High Voltage Power Supply Mux Error Flag			GCTHVMXEF	0x0100	0=OK, 1=Error
350	CT Ancillary Packet Allocation Error Flag			GCTANPKTEF	0x0200	0=OK, 1=Error
350	CT Suppressed Event Message Error Flags		2	UN_GCTERRFLG		
352	CT LHP1 Temperature Control Enabled Flag			GCTLHP1ENAB	0x01	0=Off, 1=On
352	CT LHP1 Temperature Control Active Flag			GCTLHP1ACT	0x02	0=Idle, 1=Active
352	CT LHP1 Temperature Control State		1	UN_GCTLHP1STATE		
353	CT LHP2 Temperature Control Enabled Flag			GCTLHP2ENAB	0x01	0=Off, 1=On
353	CT LHP2 Temperature Control Active Flag			GCTLHP2ACT	0x02	0=Idle, 1=Active
353	CT LHP2 Temperature Control State		1	UN_GCTLHP2STATE		
354	CT LHP1 Temperature Setpoint		1	GCTLHP1TSET		
355	CT LHP2 Temperature Setpoint		1	GCTLHP2TSET		
356	CT LHP1 Temperature Control Counter		1	GCTLHP1CCT		
357	CT LHP2 Temperature Control Counter		1	GCTLHP2CCT		
358	CT LHP1 Minimum Temperature (Tmin)		1	GCTLHP1TMIN		
359	CT LHP2 Minimum Temperature (Tmin)		1	GCTLHP2TMIN		
360	CT LHP1 Temperature Change (Delta)		1	GCTLHP1DELTA		
361	CT LHP2 Temperature Change (Delta)		1	GCTLHP2DELTA		
362	CT LHP1 Temperature Control Cycle Time		1	GCTLHP1CYCLE		
363	CT LHP2 Temperature Control Cycle Time		1	GCTLHP2CYCLE		
364	CT Housekeeping Board Submux Telemetry Update Flag			GCTHKSUPD	0x01	0=Paused, 1=OK
364	CT Misc Status Flags		1	UN_GCTTLMFLG		
365	CT Spares		11	GCTSPARE2[11]		

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Pkt Name	DSP Code Memory Dump			Size	828	Octets
App Id	31					
Offset in Octets	**Name**	**idx**	**Size in Octets**	**Mnemonics**	**Ident.#**	**Description**
0	Primary Header		6			
6	Secondary Header(time stamp)		8			Time when packet is sent
14	Dump Packet CRC Error		2			0=No Errors 1=CRC Error Detected
16	Start address		4			DSP processor address
20	Number of 48-bit words in packet		4			
24	Type		4			0=data memory, 1=program memory
28	Data		800			100 48 bit-words. Every 2 consecutive 32-bit words contain a 48-bit word. The first 32-bit word contains the most significant 32 bits and the second contains the least significant 16-bits with the upper 16 bits zero filled.

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Pkt Name	DSP Data Memory Dump			Size	828	Octets
App Id	32					
Offset in Octets	Name	idx	Size in Octets	Mnemonics	Ident.#	Description
0	Primary Header		6			
6	Secondary Header(time stamp)		8			Time when packet is sent
14	Dump Packet CRC Error		2			0=No Errors 1=CRC Error Detected
16	Start address		4			DSP processor address
20	Number of 32-bit words in packet		4			
24	Type		4			0=data memory, 1=program memory
28	Data		800			200 32-bit words

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Pkt Name	C&T Dwell Packet			Size	336	Octets
App Id	33					
Offset in Octets	Name	idx	Size in Octets	Mnemonics	Ident.#	Description
0	Primary Header		6			
6	Secondary Header(time stamp)		8			Time when packet is sent
14	C&T Board where telemetry point that is being dwelled on		1			0=invalid, 1= HK, 2=TCM, 3=MCS, 4=PDU, 5=HVPS, 6=LMB
15	Telemetry channel(or point) to dwell on		1			Mux value from Register
16	Data from 1st second(older)		80			8 or 12 bit data from C&T Telemetry Register
96	Data from 2nd second		80			
176	Data from 3rd second		80			
256	Data from 4th second		80			

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Pkt Name	Memory Dwell Packets 1 & 2			Size	212	Octets
App Id	27,28					
Offset in Octets	Name	idx	Size in Octets	Mnemonics	Ident.#	Description
0	Primary Header		6			
6	Secondary Header(time stamp)		8			Time when packet is sent
14	The number of addresses currently dwelled on by Dwell Table 1 or 2		2	GMDADDRPKT1 GMDADDRPKT2		
16	The dwell rate for Table 1 or 2		2	GMDRATEPKT1 GMDRATEPKT2		[(rate)*(1/8) sec], must be 1/2 second or greater, Polynomial coeff=(0.0, 0.125)
18	The values sampled by Memory Dwell Table 1 or 2		192	GMDDATA1[48] GMDDATA2[48]		Data stored as 48 'UINT32' values
210	Spare		2	GMDSPARE3 GMDSPARE4		Spare to make packet divisible by 4
Note:	**There are 2 copies of this packet one for each memory dwell table.**					

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Worksheet: Other Pkts

Pkt Name	Event Message Packet			Size	80	Octets
App Id	34					
Offset in Octets	**Name**	**idx**	**Size in Octets**	**Mnemonics**	**Ident.#**	**Description**
0	Primary Header		6			
6	Secondary Header(time stamp)		8			Time when packet is sent
14	Event Message Characters		66			66 bytes that contain a ASCII text message to be displayed on GLAS operator console.

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Pkt Name	Memory Dump Packet			Size	224	Octets
App Id	35					
Offset in Octets	Name	idx	Size in Octets	Mnemonics	Ident.#	Description
0	Primary Header		6			
6	Secondary Header(time stamp)		8			Time when packet is sent
14	Processor ID		2	GSMPRCID		
16	Current Dump Copy Number		2	GSMCPNUM1		
18	Memory Address of First Word in this Packet		4	GSMSRCADD		
22	Num. of Words Dumped in this Packet		2	GSMNUMWDS1		
24	Dumped Data Words		200	GSMDPDATA1[100]		

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Pkt Name	Table Dump Packet			Size	224	Octets
App Id	36					
Offset in Octets	Name	idx	Size in Octets	Mnemonics	Ident.#	Description
0	Primary Header		6			
6	Secondary Header(time stamp)		8			Time when packet is sent
14	Table Id Number		2	GSMTBLID1		
16	Current Table Dump Copy Number		2	GSMCPNUM		
18	Table Offset		2	GSMTBLOS		
20	Num. of Words Dumped in this Packet		2	GSMNUMWDS		
22	Table Source Type		2	GSMTBLSRC		1=EEPROM, 2=RAM,3=BUFFER
24	Dumped Table Data Words		200	GSMDPDATA[100]		

Pkt Name	GLAS Data Types Packet			Size	72	Octets
App Id	48					
Offset in Octets	Name	idx	Size in Octets	Mnemonics	Ident.#	Description
0	Primary Header		6			
6	Secondary Header(time stamp)		8			Time when packet is sent
14	Data Types Packet Fixed Pattern		58			

Pkt Name	Etalon Calibration Packet			Size	2076	Octets
App Id	37					

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Offset in Octets	Name	idx	Size in Octets	Mnemonics	Ident.#	Description
0	Primary Header		6			
6	Secondary Header(time stamp)		8			Time when packet is sent
14	Spare byte in GLAS time field		1			
15	Etalon Calibration Starting Time		6	GCTECSTIME		
21	Spare byte in GLAS time field		1			
22	Etalon Calibration Start Temperature		1	GCTECSTRTT		
23	Etalon Calibration Stop Temperature		1	GCTECSTOPT		
24	Etalon Calibration Temperature Step		1	GCTECTSTEP		
25	Etalon Calibration AveragingTime		1	GCTECAVGTIM		
26	Etalon Calibration SettleTime		2	GCTECSTLTIM		
28	Etalon Calibration Measured On-Axis Trans.		1024	GCTECTRON[256]		
1052	Etalon Calibration Measured Off-Axis Trans.		1024	GCTECTROFF[256]		

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B.2 Science Packet Descriptions

Pkt Name	App id	Size	Pkt Freq.	Pkt Interval	Rate	Output to			Confidence	CCSDS Primary
		in bytes	in Hertz	in seconds	bps	SSR	1553 Bus		In contents	Header
	decimal						HK	Diag	H, M, L	hex
Altimeter Digitizer Data-Large	12	6856	4	0.25	219392.0	Yes	No	No	High	080C C000 1AC1
Altimeter Digitizer Data-Small	13	3416	4	0.25	109312.0	Yes	No	No	High	080D C000 0D51
AD Eng Mode - One Shot	14	700	1	1		Yes	No	No	High	080E C000 02B5
Photon Counter (PC) Science Pkt	15	8112	1	1	64896.0	Yes	No	No	High	080F C000 1FA9
PC Eng Pkt	16	8236	1	1		Yes	No	No	High	0810 C000 2025
Cloud Digitizer (CD) Science Pkt	17	7576	1	1	60608.0	Yes	No	No	High	0811 C000 1D91
CD Eng Pkt	18	5616	1	1		Yes	No	No	High	0812 C000 15E9
Ancilary Science Pkt	19	1368	1	1	10944.0	Yes	No	No	High	0813 C000 0551
LPA Data Pkt	26	4056	4	0.25	129792.0	Yes	No	No	High	081A C000 0FD1
Command History Packet	49	296	Async			Yes	No	No		0831 C000 0121
Spare	40									
LPA 80x80 Test Data Pkt	126	6416	Async			Yes	No	No	High	087E C000 1909
Boresite Calibration Results Pkt	38	1816	Async			Yes	No	No	High	0826 C000 0711
				Total Rate*	436096.0	bps				

*** This total assumes a 55%-45% distribution betwee Alt. Digitizer Large and Small Data Packets and does NOT include 1553, Asynchronous Data Packets, Gyro or LRS Data**

Notes: 1- The size of all packets going to the SSR must be a multiple of 4, This is because the FIFO width is 32 bits
2- Max Packet Size to SSR is 16 Kbytes. This is the size of the FIFO
3- LPA 80x80Test Packet is not use during Flight, but only for integration

1- Mnemonics use only 'G' as prefix to indicate GLAS(instead of the GL)
2- Mnemonics for the CCSDS header are not in spreadsheet.

Suggested Mnemoncic names are:	Bits	Word	Mask
GPxxxPVNO	0..2	1st	0xE000
GPxxxPCKT	3	1st	0x1000
GPxxxSHDF	4	1st	0x0800
GPxxxID	5..15	1st	0x07FF
GPxxxSEGF	0..1	2nd	0xC000
GPxxxSCNT	2..15	2nd	0x3000
GPxxxPLEN	0..15	3rd	0xFFFF
GPxxxSTIME		4th..7th	

where xxx is the app id in hex
3- The shot counter is only a 8 bit counter. Where it is depicted as a two or four octet entity it contains padding in the upper bytes.

Filename: GLAS_SCI_PKTs.xls Page 1 of 1 Worksheet: Summary

Change History

Name	Date	Version	Change Description
M. Maldonado	22-Jan-99	1.0	Initial Creation
M.Maldonado	25-Jan-99	1.1	Added Button fro Print all, Changed heading and footer on Ancillary data packet, Removed not applicable notes
J.Firer	25-Jan-99	1.1	Added calculated weight field, fixed sizes
M.Maldonado	13-May-99	2.0	Added CD engineering, PC Engineering, moved OTS stuff to ancillary, added gain setting
			Added 40 instances of 532 energy in ancillary
M.Maldonado	17-May-99	2.0	Changes per Jenny Geigers review. Corrected number of samples in CD Science Data.
			And reordered Fire Command and Fire Acknowledge 40 bit count in Ancillary data packet.
	21-May-99	2.0	Corrected ancillary byte offset 358 detector status to be 2 bytes per Dave Hancock suggestions
			This make it even number of bytes in that section.
M.Maldonado	17-Sep-99	2.0	Added Command History packet
M.Maldonado	19-Nov-99	2.0	Added spares for CD Science to be aligned at 4-byte boundaries per Jenny Geigers Instructions
M.Maldonado, D. Molock	08-Dec-99	2.0	Corrected AD large and small and AD ancillary data per meeting with David Hancock and others
M.Maldonado	19-Jan-00	3.0	Removed 532 energy from PC Science Packet, left spare in its place
			Converted CD and PC Ancillary data not used into spares
			Corrected size of spacecraft position and gps time packet to not include CCSDS header
Steve Slegel	21-Jan-00	3.0	Corrected CD Eng packet to be every other shot instead of the first 20 shots
			Corrected spelling of shot counter in PC Science packet definition
			Replaced LIDAR Delay with Range Gate Delay for PC task ancillary data
Dwaine Molock	24-Jan-00	3.0	Modified the AD large, small & ancillary science packets according to comments received from David Hancock.
M. Maldonado	23-Feb-00	3.0	Modified comments on PC Science and Ancillary Packet per Steve Palms comments
			Corrected size of CD shot sample to match PC
			Aditional Changes to descriptions in AD pkts
			Changed CD Eng packet to be every other shot of unaveraged data
			Added Tolerance for Coincidence of Filter to Ancillary tlm
M.Maldonado	31-Mar-00	3.0	Modified Ancillary GPS/DEM Section
M.Maldonado	4-Apr-00	3.0	Modified Ancillary C&T Section
M.Maldonado	11-Apr-00	Rev A	Added valid number of commands to cmd history packet and corrected print areas in ancillary
M.Maldonado	14-Apr-00	Rev A	Corrected LPA Comment that said x, y window starting postion range was 1 to 80 to say 0 to 79
			and moved spare in LPA packet to after secondary header from end of packet
			Changed all headers to say Rev A and spelled out Telemetry
M.Maldonado, Robert McGraw	28-Apr-00	Rev A	Added to ancillary tlm pkt checkin flags and start of frame shot counter
			Added spare bytes to make packet sizes divisible by 4
M.Maldonado, Dwaine Molock	8-May-00	Rev A	Updated AD large and small and AD ancillary data per Dwaine Molock comments
Dwaine Molock	10-May-00	Rev A	Realignment for DWORDs
M.Maldonado	10-Jul-00	Rev A	Corrected incorrect offset calculation in app ids 12 and 14 after the CCSDS header

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Change History

Name	Date	Version	Change Description
M.Maldonado	13-Sep-00	Rev B	Corrected PC eng(apid16) packet size to inlcude only 15th shots of data
			Corrected small altimeter digitizer science packet (apid 13) size calculation
			Updated AD Ancillary section for Build 3.0 Release
			Updated apid 12 and 13 to increase Transmit Pulse waveform to 48 bytes and decrease the background
			noise mean and std dev, These are the changes for the GLAS FSW Build 3.0 release
M.Maldonado	17-Sep-00	Rev B	Corrected GPS/DEM Ancillary per Joe Polk's input
M.Maldonado	19-Sep-00	Rev B	Corrected PC and CD Range Bias default to -41 km
M.Maldonado	28-Sep-00	Rev B	Added Boresite Cal and LPA 80x80 test packets def from Steve Slegel
M.Maldonado	3-Oct-00	Rev B	Corrected Offsets in Ancillary tlm, Removed repetitively defined data in AD packets 12 and 13
			Added various clarifying comments to AD, PC, CD and Ancillary packet telemetry
			This makes the printed version much smaller
			Final for Rev B and GLAS FSW Build 3.0
M.Maldonado	13-Dec-00	Rev C	Changed headers to say Rev C
M.Maldonado	25-Jan-01	Rev C	Converted Data in Ancillary packet at offset 572 to a spare. Data was already defined below.
Dwaine Molock	27-Feb-01	Rev D	Added units, data ranges, formulas, and DSP addresses for the AD Science, Engineering, and Ancillary packets
Steven Slegel	28-Feb-01	Rev D	Added units, data ranges, formulas, and HW addresses for the PC/CD Science, Engineering, and Ancillary packets as well as the LPA and Boresite Calibration packets.
Joseph Polk	29-Feb-01	Rev D	Added units, data ranges, formulas, and HW addresses for the GPS ancillary packet section.
			Updates for GLAS FSW Build 3.3
Dwaine Molock	22-Jun-01	Rev D	Added 8ns Filter Peak Value to the AD Large, Small and Engineering Packets
Steve Slegel	28-Jun-01	Rev D	Split the Shot Count in the PC Sci and Eng Pkts into 2 fields (Shot Count and Dithering Enabled)
Joseph Polk	11-Jul-01	Rev D1	Updated "Position Data Status Flag" description in GPS/DEM Ancillary Science
M.Maldonado	10-Oct-01	Rev D1	Updated spreadsheet per Dwaine Molocks Comment in RDL file for May 25, 2001 where 8 bytes were deleted from apid 19 AD section and spares were increased to 30. That change had never made this spreadsheet.
Joseph Polk	26-Jun-02	Rev E	Supplied mnemonics in the Mnemonics column for all appropriate science telemetry
			Generic changes; 1)replaced duplicate row descriptions for the same items with a single comment indicating such, 2) added the bit mask to the "Mask" column for all mnemonics using bit masks.
			Added byte order comment for PC science pkt (apid 15), PC Eng pkt (apid 16) ,CD science pkt (apid 17), CD Eng pkt (apid 18)
			Added comment to indicate order of samples in PC and CD engineering packet
			Added comment describing the time field for the the "command history" packet (apid 49)
			Added comment to indicate order of the pixels for the LPA data in packets 26 and 126
			Changed "background noise search offset startpoint" from UINT_32 to INT_32 in ancillary pkt (apid 19)
			Added reject mask for leading/trailing edge in ancillary science packet
			Removed "range gate delay mask", "Background #2 delay mask", and "40 hz signal enable" items from the
			CD ancillary science packet.
			Added etalon tracking mnemonics GANCTEOLMODE and GANCTEOLUPD to the CT ancillary science data (packet 19).
Joseph Polk	30-Aug-02	Rev E	Changed the Type definition of the following mnemonics from INT_32 to Floating point: GADLNMU4 and GADLNSIG4 (apid 12), GADSNMU4 and GADSNSIG4 (apid 13), GADENMU4 and GADENSIG4 (apid 14). DR 523.
	27-Sep-02	Rev E	Changed GANCTESTATE telemetry mnemonic definition to include 2 new states, "openloop" and "modified" per Build 4.1 patch (Etalon Closed-Loop Patch)

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Worksheet: Change History

Pkt Name	Altimeter Digitizer - Large Sci Pkt			Size	6856	Octets			
App Id	12			Frequency	4	Hz			
				Interval	0.250	seconds			
Offset	Name	idx	Size in Octets	Mnemonics	Ident.# Mask	Description	Type	Data Range/Formula	DSP Address
0	Primary Header		6						
6	Secondary Header(time stamp)		8			Time when sent from AD task			
14	Spare		2			Spare bytes	UINT_16		
16	***Shot #1 Data in Packet***								
16	AD Land Packet Shot Count	1	4	GADLSHC		Corresponds to the data that follows. Unit=shots	UINT_32	1-200	
20	AD Land Pkt Transmit Waveform	2	48	GADLXW		Peak of Transmit Pulse stored within 48 samples. Unit=counts	UINT_8	0-255	0300h to 030bh
68	AD Land Pkt Transmit Pulse Peak Time	3	4	GADLXPT		Address in nanoseconds resolution of the Transmit Pulse Peak as measured from the start of Acquisition Memory, i.e. start of digitization.	UINT_32	0 - 500000	030ch
72	Transmit Peak Internal S/W Failure	5		GADLXSWF	0x0001	0=No Problem; 1=internal software failure	UINT_32		
72	Transmit Peak Search Failure (below threshold)	6		GADLXF	0x0002	0=No Problem; 1=Peak Below Threshold	UINT_32		
72	Transmit Peak Search Failure Latch	7		GADLXFL	0x0004	0=No Problem; 1=Peak Never Found (latch)	UINT_32		
72	AD Land Pkt Transmit Peak Failure Bits	4	4	GADLXFAIL		0=No Problem; Non-zero=Peak search problem (see mask descriptions above)	UINT_32		
76	Starting Address of Transmit Pulse Sample	8	4	GADLXWST		Starting Address in nanosecond resolution of the Transmit Pulse sample relative to the start of digitization.	UINT_32	0 - 500000	030eh
80	Ending Address of Range Response	9	4	GADLRWET		Address (in nanosecond resolution) of the 2000-byte surface echo data dump (as measured from the start of Acquisition Memory, i.e. Start of digitization). Last in time.	UINT_32	0 - 5100000	030fh
84	Last Threshold Crossing Location for Selected Filter	10	4	GADLSFTET		Address, in nanosecond resolution, of the detected last threshold crossing (as measured from the start of Acquisition Memory, i.e. Start of digitization, that is, last in time). Also called the trailing edge. Set to 0 if threshold crossing was NOT detected.	UINT_32	0 - 5100000	0310h
88	Next to Last Threshold Crossing Location for Selected Filter	11	4	GADLSFLET		Address (in nanosecond resolution) of the detected next to last threshold crossing (as measured from the start of Acquisition Memory, i.e. Start of digitization. Next to last in time). Also called the leading edge. Set to 0 if a threshold crossing was NOT detected.	UINT_32	0 - 5100000	0311h
92	4ns Filter Peak Height	12	2	GADLF4PH		Peak value returned by the FIR filter engine for the 4ns Filter. Unit=counts	UINT_16	0 - 255	0312h
94	8ns Filter Peak Height	13	2	GADLF8PH		Peak value returned by the FIR filter engine for the 4ns Filter. Unit=counts	UINT_16	0 - 255	0312h
96	Peak Value for the selected filter	14	4	GADLSFPH		Peak value for the selected filter returned by the FIR filter engine. Set to 0 if a threshold crossing was not detected. Unit=counts	UINT_32	0 - 255	0313h
100	Peak Value Location for the selected filter	15	4	GADLSFPT		Address (in nanosecond resolution) of the detected peak value (as measured from the start of Acquisition Memory, i.e. Start of digitization). Set to 0 if a threshold crossing was NOT detected.	UINT_32	0 - 5100000	0314h
104	Filter Selected	16	4	GADLSFNUM		Filter with the highest weight (0 for 4 nsec filter; 1 for 8 nsec filter; 2 for 16 nsec filter; 3 for 32 nsec filter; 4 for 64 nsec filter; 5 for 128 nsec filter). May or may not be selectable! If no selectable filter can be chosen, then the last successful filter, selectable or NOT is chosen.	UINT_32	0 - 5	0315h
108	Threshold Value	17	4	GADLSFTHR		Threshold crossing values used to find the last thrshold crossings for the selected filter. Unit=counts	UINT_32	0 - 255	0316h
112	Mean Value of the Background Noise Mean for 4 ns filter	18	4	GADLNMU4		Calculated Mean value for the 4ns filter.	FLOAT (IEEE754)	0.0 - 10,000.0	0317h
116	Standard Deviation of the Background Noise for the 4 ns filter	19	4	GADLNSIG4		Calculated Standard Deviation for the 4ns filter.	FLOAT (IEEE754)	0.0 - 10,000.0	0318h
120	AD Land Pkt Return Peak Failure Word			GADLRFAIL		Peak failure word. Bit masks are defined below	UINT_32		
120	AD Land Pkt Threshold Crossing Failure Mask			GADLTCF	0x0000003F	Threshold Crossing Failure Mask. Bit masks are defined below.	UINT_32		
120	No first crossing(rising edge) on 4-nsec filter flag	20			0x00000001	0=No Problem; 1=No first crossing found on 4-nsec filter			
120	No first crossing(rising edge) on 8-nsec filter flag	21			0x00000002	0=No Problem; 1=No first crossing found on 8-nsec filter			
120	No first crossing(rising edge) on 16-nsec filter flag	22			0x00000004	0=No Problem; 1=No first crossing found on 16-nsec filter			
120	No first crossing(rising edge) on 32-nsec filter flag	23			0x00000008	0=No Problem; 1=No first crossing found on 32-nsec filter			
120	No first crossing(rising edge) on 64-nsec filter flag	24			0x00000010	0=No Problem; 1=No first crossing found on 64-nsec filter			
120	No first crossing(rising edge) on 128-nsec filter flag	25			0x00000020	0=No Problem; 1=No first crossing found on 128-nsec filter			
120	No second crossing(falling edge) on 4-nsec filter flag	26			0x00000040	0=No Problem; 1=No second crossing found on 4-nsec filter			
120	No second crossing(falling edge) on 8-nsec filter flag	27			0x00000080	0=No Problem; 1=No second crossing found on 8-nsec filter			
120	No second crossing(falling edge) on 16-nsec filter flag	28			0x00000100	0=No Problem; 1=No second crossing found on 16-nsec filter			
120	No second crossing(falling edge) on 32-nsec filter flag	29			0x00000200	0=No Problem; 1=No second crossing found on 32-nsec filter			
120	No second crossing(falling edge) on 64-nsec filter flag	30			0x00000400	0=No Problem; 1=No second crossing found on 64-nsec filter			
120	No second crossing(falling edge) on 128-nsec filter flag	31			0x00000800	0=No Problem; 1=No second crossing found on 128-nsec filter			
120	AD Land Pkt Leading Edge Failure Mask			GADLLEF	0x00000FC0	Leading Edge Failure Mask. Bit masks are defined below.	UINT_32		
120	First Sample in range >= to threshold for 4 ns filter flag	32			0x00001000	0=No Problem; 1=First sample in range greater than or equal to threshold for 4 nsec filter			
120	First Sample in range >= to threshold for 8 ns filter flag	33			0x00002000	0=No Problem; 1=First sample in range greater than or equal to threshold for 8 nsec filter			
120	First Sample in range >= to threshold for 16 ns filter flag	34			0x00004000	0=No Problem; 1=First sample in range greater than or equal to threshold for 16 nsec filter			

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Worksheet: Alt Dig-Large

Pkt Name	Altimeter Digitizer - Large Sci Pkt			Size	6856	Octets			
App Id	12			Frequency	4	Hz			
				Interval	0.250	seconds			
Offset	Name	idx	Size in Octets	Mnemonics	Ident.# Mask	Description	Type	Data Range/Formula	DSP Address
120	First Sample in range >= to threshold for 32 ns filter flag	35			0x00008000	0=No Problem; 1=First sample in range greater than or equal to threshold for 32 nsec filter			
120	First Sample in range >= to threshold for 64 ns filter flag	36			0x00010000	0=No Problem; 1=First sample in range greater than or equal to threshold for 64 nsec filter			
120	First Sample in range >= to threshold for 128 ns filter flag	37			0x00020000	0=No Problem; 1=First sample in range greater than or equal to threshold for 128 nsec filter			
120	AD Land Pkt Trailng Edge Failure Mask			GADLTEF	0x0003F000	Trailing Edge Failure Mask.	UINT_32		
120	AD Land Pkt Selection Failure	38		GADLSELF	0x00040000	0=All filters were not rejected; 1=All filters were rejected. This flag will be set to true (1) if bits 0 through 5 in Range_Status are set.			
120	AD Land Pkt Previous Selection Failure	39		GADLPSELF	0x00080000	0=Select 1=Fail	UINT_32		
120	AD Land Pkt Filter Failure Mask			GADLFF	0x03F00000	Land packet filter failure mask. Individual filter bit masks are defined below.	UINT_32		
120	4 NS Filter Failure			GADLF4F	0x00100000	0=OK 1=Failure	UINT_32		
120	8 NS Filter Failure			GADLF8F	0x00200000	0=OK 1=Failure	UINT_32		
120	16 NS Filter Failure			GADLF16F	0x00400000	0=OK 1=Failure	UINT_32		
120	32 NS Filter Failure			GADLF32F	0x00800000	0=OK 1=Failure	UINT_32		
120	64 NS Filter Failure			GADLF64F	0x01000000	0=OK 1=Failure	UINT_32		
120	128 NS Filter Failure			GADLF128F	0x02000000	0=OK 1=Failure	UINT_32		
120	AD Land Pkt Return Range Failure			GADLRANF	0x40000000	0=Range OK 1=Failure	UINT_32		
120	AD Land Pkt Science Processing Ready Flag			GADLRDYF	0x80000000	0=Ready 1=Failure	UINT_32		
120	Range Window Status Word	41	4			Bits 0 through 5 indicate if there was a first rising (SCANNING BACKWARDS) above the threshold for each of the various filters. Note that if there is no first rising, there CANNOT be a first falling value, so the appropriate "no second crossing" bit (bits 6 through 11) is also set. Bit 0 corresponds to bit 6, bit 1 corresponds to bit 7 and so on.	Bit Field (UINT_32)	N/A	0319h
124	Calculated Weights for all Filters	42	24	GADLFWGT		Results of weight formulas for all FIR filters.	INT_32		031ah to 031fh
148	Altimeter Digitizer Raw Peak	43	1	GADLRWPH		Land packet raw waveform peak height	UINT_8	0 - 255	N/A
149	Altimeter Digitizer Selected Filter Coincidences	43	1	GADLSFNC		Land packet selected filter number of coincidences	UINT_8	0 - 255	N/A
150	Altimeter Digitizer Status Byte	43	1	GADLGSTAT		Land packet gain status byte	UINT_8	0 - 255	N/A
150	Altimeter Digitizer Bypass Flag	43	1	GADLGLBYP	0x00000001	0=OK 1=BYPASS	UINT_8	0 - 255	N/A
150	Altimeter Digitizer Bypass Timeout Flag	43	1	GADLGLTMO	0x00000002	0=OK 1=TIMEOUT	UINT_8	0 - 255	N/A
151	Altimeter Digitizer Gain Setting	43	1	GADLGAIN		Result of Gain Algorithm that was written to the hardware on the previous shot	UINT_8	0 - 255	N/A
152	Surface Echo Sample Padding	44	2	GADLNPAD		Number of zero bytes used to pad the sufrace echo data samples after averaging	UINT_32	0 - 544	N/A
154	Surface Echo Compress Type	45	2	GADLCOM P		Indicates the type of Compression performed 0=N, p & q; 1=r	UINT_32	0 - 1	N/A
156	Surface Echo Data Samples (may have been averaged)	46	544	GADLRW		544 bytes of digitized data averaged according to p;q;N;r in inverse time order.(From lastest in time to earliest in time)	UINT_8	0 - 255	N/A
700	Shot #2 Data in Packet		684			These 684 bytes of data have the same definition as the first 684 bytes in the packet			
1384	Shot #3 Data in Packet		684			These 684 bytes of data have the same definition as the first 684 bytes in the packet			
2068	Shot #4 Data in Packet		684			These 684 bytes of data have the same definition as the first 684 bytes in the packet			
2752	Shot #5 Data in Packet		684			These 684 bytes of data have the same definition as the first 684 bytes in the packet			
3436	Shot #6 Data in Packet		684			These 684 bytes of data have the same definition as the first 684 bytes in the packet			
4120	Shot #7 Data in Packet		684			These 684 bytes of data have the same definition as the first 684 bytes in the packet			
4804	Shot #8 Data in Packet		684			These 684 bytes of data have the same definition as the first 684 bytes in the packet			
5488	Shot #9 Data in Packet		684			These 684 bytes of data have the same definition as the first 684 bytes in the packet			
6172	Shot #10 Data in Packet		684			These 684 bytes of data have the same definition as the first 684 bytes in the packet			

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Pkt Name	Altimeter Digitizer - Small Sci Pkt			Size	3416	Octets			
App Id	13			Frequency	4	Hz			
				Interval	0.250	seconds			
Offset	Name	idx	Size in Octets	Mnemonics	Ident.# Mask	Description	Type	Data Range/Formula	DSP Address
0	Primary Header		6						
6	Secondary Header(time stamp)		8			Time when sent from AD task			
14	Spare		2	GADSSSPARE		Spare bytes	UINT_16		
	Shot #1 Data in Packet								
16	Shot Counter	1	4	GADSSHC		Corresponds to the data that follows	UINT_32	1-200	
20	Transmit Pulse	2	48	GADSXW		Peak of Transmit Pulse stored within 48 samples.	UINT_8	0-255	0300h to 030bh
68	Transmit Pulse Peak Location	3	4	GADSXPT		Address in nanoseconds resolution of the Transmit Pulse Peak as measured from the start of Acquisition Memory, i.e. start of digitization.	UINT_32	0 - 500000	030ch
72	Transmit Peak Internal SW Failure	4		GADSXSWF	0x0001	0=No Problem; 1=Peak Not Found			
72	Transmit Peak Failure (below threshold)	4		GADSXF	0x0002	0=No Problem; 1=Peak Below Threshold			
72	Transmit Peak Failure (latch)	4		GADSFXL	0x0004	0=No Problem; 1=Peak Never Found			
72	AD Sea Pkt Transmit Peak Failure Word	4	4	GADSXFAIL		Indicates the status of the Transmit Pulse.	Bit Field (UINT_32)	N/A	030dh
76	Starting Address of Transmit Pulse Sample	5	4	GADSXWST		Starting Address in nanosecond resolution of the Transmit Pulse sample relative to the start of digitization.	UINT_32	0 - 500000	030eh
80	Ending Address of Range Response	6	4	GADSRWET		Address (in nanosecond resolution) of the 2000-byte surface echo data dump (as measured from the start of Acquisition Memory, i.e. Start of digitization). Last in time.	UINT_32	0 - 5100000	030fh
84	Last Threshold Crossing Location for Selected Filter	7	4	GADSSFTET		Address, in nanosecond resolution, of the detected last threshold crossing (as measured from the start of Acquisition Memory, i.e. Start of digitization, that is, last in time). Also called the trailing edge. Set to 0 if threshold crossing was NOT detected.	UINT_32	0 - 5100000	0310h
88	Next to Last Threshold Crossing Location for Selected Filter	8	4	GADSSFLET		Address (in nanosecond resolution) of the detected next to last threshold crossing (as measured from the start of Acquisition Memory, i.e. Start of digitization. Next to last in time). Also called the leading edge. Set to 0 if a threshold crossing was NOT detected.	UINT_32	0 - 5100000	0311h
92	4ns Filter Peak Height	9	2	GADSF4PH		Peak value returned by the FIR filter engine for the 4ns Filter.	UINT_16	0 - 255	0312h
94	8ns Filter Peak Height	10	2	GADSF8PH		Peak value returned by the FIR filter engine for the 8ns Filter.	UINT_16	0 - 255	0312h
96	Peak Value for the selected filter	11	4	GADSSFPH		Peak value for the selected filter returned by the FIR filter engine. Set to 0 if a threshold crossing was not detected.	UINT_32	0 - 255	0313h
100	Peak Value Location for the selected filter	12	4	GADSSFPT		Address (in nanosecond resolution) of the detected peak value (as measured from the start of Acquisition Memory, i.e. Start of digitization). Set to 0 if a threshold crossing was NOT detected.	UINT_32	0 - 5100000	0314h
104	Filter Selected	13	4	GADSSFNUM		Filter with the highest weight (0 for 4 nsec filter; 1 for 8 nsec filter; 2 for 16 nsec filter; 3 for 32 nsec filter; 4 for 64 nsec filter; 5 for 128 nsec filter). May or may not be selectable! If no selectable filter can be chosen, then the last successful filter, selectable or NOT is chosen.	UINT_32	0 - 5	0315h
108	Threshold Value	14	4	GADSSFTHR		Threshold crossing values used to find the last threshold crossings for the selected filter.	UINT_32	0 - 255	0316h
112	Mean Value of the Background Noise Mean for 4 ns filter	15	4	GADSNMU4		Calculated Mean value for the 4ns filter.	FLOAT (IEEE754)	0.0 - 10,000.0	0317h
116	Standard Deviation of the Background Noise for the 4 ns filter	16	4	GADSNSIG4		Calculated Standard Deviation for the 4ns filter.	FLOAT (IEEE754)	0.0 - 10,000.0	0318h
120	AD Sea Pkt Return Peak Failure Word			GADSRFAIL		Sea packet return peak failure word. Indivudual bit masks are defined below.	UINT_32		
120	Threshold Crossing Failure Mask			GADSTCF	0x0000003F	Threshold crossing failure mask. Indivudual bit masks are defined below.	UINT_32		
120	No first crossing(rising edge) on 4-nsec filter flag	20			0x00000001	0=No Problem; 1=No first crossing found on 4-nsec filter			
120	No first crossing(rising edge) on 8-nsec filter flag	21			0x00000002	0=No Problem; 1=No first crossing found on 8-nsec filter			
120	No first crossing(rising edge) on 16-nsec filter flag	22			0x00000004	0=No Problem; 1=No first crossing found on 16-nsec filter			
120	No first crossing(rising edge) on 32-nsec filter flag	23			0x00000008	0=No Problem; 1=No first crossing found on 32-nsec filter			
120	No first crossing(rising edge) on 64-nsec filter flag	24			0x00000010	0=No Problem; 1=No first crossing found on 64-nsec filter			
120	No first crossing(rising edge) on 128-nsec filter flag	25			0x00000020	0=No Problem; 1=No first crossing found on 128-nsec filter			
120	Leading Edge Failure Mask			GADSLEF	0x00000FC0	Leading edge failure. Indivudual bit masks are defined below.	UINT_32		
120	No second crossing(falling edge) on 4-nsec filter flag	26			0x00000040	0=No Problem; 1=No second crossing found on 4-nsec filter			
120	No second crossing(falling edge) on 8-nsec filter flag	27			0x00000080	0=No Problem; 1=No second crossing found on 8-nsec filter			
120	No second crossing(falling edge) on 16-nsec filter flag	28			0x00000100	0=No Problem; 1=No second crossing found on 16-nsec filter			
120	No second crossing(falling edge) on 32-nsec filter flag	29			0x00000200	0=No Problem; 1=No second crossing found on 32-nsec filter			
120	No second crossing(falling edge) on 64-nsec filter flag	30			0x00000400	0=No Problem; 1=No second crossing found on 64-nsec filter			

Filename: GLAS_SCI_PKTs.xls Page 1 of 2 Worksheet: Alt Dig-Small

Pkt Name	Altimeter Digitizer - Small Sci Pkt			Size	3416	Octets			
App Id	13			Frequency	4	Hz			
				Interval	0.250	seconds			
Offset	Name	idx	Size in Octets	Mnemonics	Ident.# Mask	Description	Type	Data Range/Formula	DSP Address
120	No second crossing(falling edge) on 128-nsec filter flag	31			0x00000800	0=No Problem; 1=No second crossing found on 128-nsec filter			
120	Trailing Edge Failure Mask			GADSTEF	0x0003F000	Trailing edge failure. Indivudual bit masks are defined below.	UINT_32		
120	First Sample in range >= to threshold for 4 ns filter flag	32			0x00001000	0=No Problem; 1=First sample in range greater than or equal to threshold for 4 nsec filter			
120	First Sample in range >= to threshold for 8 ns filter flag	33			0x00002000	0=No Problem; 1=First sample in range greater than or equal to threshold for 8 nsec filter			
120	First Sample in range >= to threshold for 16 ns filter flag	34			0x00004000	0=No Problem; 1=First sample in range greater than or equal to threshold for 16 nsec filter			
120	First Sample in range >= to threshold for 32 ns filter flag	35			0x00008000	0=No Problem; 1=First sample in range greater than or equal to threshold for 32 nsec filter			
120	First Sample in range >= to threshold for 64 ns filter flag	36			0x00010000	0=No Problem; 1=First sample in range greater than or equal to threshold for 64 nsec filter			
120	First Sample in range >= to threshold for 128 ns filter flag	37			0x00020000	0=No Problem; 1=First sample in range greater than or equal to threshold for 128 nsec filter			
120	Sea Packet Selection Failure			GADSSELF	0x00040000	Sea packet selection failure. 0=Select 1=Fail	UINT_32		
120	Sea Packet Previous Selection Failure			GADSPSELF	0x00080000	Previous selection failure. 0=Select 1=Fail	UINT_32		
120	Sea Packet Filter Failure Mask			GADSFF	0x03F00000	Sea packet filter failure mask. Individual filter bit masks are defined below.	UINT_32		
120	4 NS Filter Failure			GADSF4F	0x00100000	0=OK 1=Failure	UINT_32		
120	8 NS Filter Failure			GADSF8F	0x00200000	0=OK 1=Failure	UINT_32		
120	16 NS Filter Failure			GADSF16F	0x00400000	0=OK 1=Failure	UINT_32		
120	32 NS Filter Failure			GADSF32F	0x00800000	0=OK 1=Failure	UINT_32		
120	64 NS Filter Failure			GADSF64F	0x01000000	0=OK 1=Failure	UINT_32		
120	128 NS Filter Failure			GADSF128F	0x02000000	0=OK 1=Failure	UINT_32		
120	AD Sea Pkt Return Range Failure			GADSRANF	0x40000000	0=Range OK 1=Failure	UINT_32		
120	AD Sea Pkt Science Processing Ready Flag			GADSRDYF	0x80000000	0=Ready 1=Failure	UINT_32		
120	Range Window Status Word	41	4			Bits 0 through 5 indicate if there was a first rising (SCANNING BACKWARDS) above the threshold for each of the various filters. Note that if there is no first rising, there CANNOT be a first falling value, so the appropriate "no second crossing" bit (bits 6 through 11) is also set. Bit 0 corresponds to bit 6, bit 1 corresponds to bit 7 and so on.	Bit Field (UINT_32)	N/A	0319h
124	Calculated Weights for all Filters	42	24	GADSFWGT		Results of weight formulas for all FIR filters.	(INT_32) x 6		031ah to 031fh
148	Altimeter Digitizer Raw Peak	43	1	GADSRWPH		Sea packet raw waveform peak height	UINT_8	0 - 255	N/A
149	Altimeter Digitizer Selected Filter Coincidences	43	1	GADSSFNC		Sea packet selected filter number of coincidences	UINT_8	0 - 255	N/A
150	Altimeter Digitizer Status Byte	43	1	GADSGSTAT		Sea packet gain status byte	UINT_8	0 - 255	N/A
150	Altimeter Digitizer Bypass Flag	43	1	GADSGLBYP	0x00000001	0=OK 1=BYPASS	UINT_8	0 - 255	N/A
150	Altimeter Digitizer Bypass Timeout Flag	43	1	GADSGLTMO	0x00000002	0=OK 1=TIMEOUT	UINT_8	0 - 255	N/A
151	Altimeter Digitizer Gain Setting	43	1	GADSGAIN		Result of Gain Algorithm that was written to the hardware on the previous shot	UINT_8	0 - 255	N/A
1036	Shot #4 Data in Packet		340			The 21 items here have the same definition as the first 21 items in this packet			
1376	Shot #5 Data in Packet		340			The 21 items here have the same definition as the first 21 items in this packet			
1716	Shot #6 Data in Packet		340			The 21 items here have the same definition as the first 21 items in this packet			
2056	Shot #7 Data in Packet		340			The 21 items here have the same definition as the first 21 items in this packet			
2396	Shot #8 Data in Packet		340			The 21 items here have the same definition as the first 21 items in this packet			
2736	Shot #9 Data in Packet		340			The 21 items here have the same definition as the first 21 items in this packet			
3076	Shot #10 Data in Packet		340			The 21 items here have the same definition as the first 21 items in this packet			

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Pkt Name	Altimeter Digitizer Eng Pkt - One Shot			Size	700	Octets			
App Id	14			Frequency	1	Hz			

Offset	Name	idx	Size in Octets	Mnemonics	Ident.# Mask	Description	Type	Data Range/Formula	DSP Address
0	Primary Header		6						
6	Secondary Header(time stamp)		8			Time when sent from AD task			
14	Spare	1	2	GADESSPARE		Spare Data Bytes to Align Packet	UINT_16		
16	Shot Counter	1	4	GADESHC		Corresponds to the data that follows	UINT_32	1-200	
20	Transmit Pulse	2	48	GADEXW		Peak of Transmit Pulse stored within 48 samples. Units= counts	UINT_8	0-255	0300h to 030bh
68	Transmit Pulse Peak Location	3	4	GADEXPT		Address in nanoseconds resolution of the Transmit Pulse Peak as measured from the start of Acquisition Memory, i.e. start of digitization.	UINT_32	0 - 500000	030ch
72	Transmit Pulse Internal SW Failure	4		GADEXSWF	0x0001	0=No Problem; 1=Peak Not Found	UINT_32		
72	Transmit Pulse Search Failure (below threshold)	4		GADEXF	0x0002	0=No Problem; 1=Peak Below Threshold	UINT_32		
72	Transmit Pulse Search Failure (Latch)	4		GADEXFL	0x0004	0=No Problem; 1=Peak Never Found	UINT_32		
72	AD Eng Pkt Transmit Pulse Status Word	4	4	GADEXFAIL		Indicates the status of the Transmit Pulse.	Bit Field (UINT_32)	N/A	030dh
76	Starting Address of Transmit Pulse Sample	5	4	GADEXWST		Starting Address in nanosecond resolution of the Transmit Pulse sample relative to the start of digitization.	UINT_32	0 - 500000	030eh
80	Ending Address of Range Response	6	4	GADERWET		Address (in nanosecond resolution) of the 2000-byte surface echo data dump (as measured from the start of Acquisition Memory, i.e. Start of digitization). Last in time.	UINT_32	0 - 5100000	030fh
84	Last Threshold Crossing Location for Selected Filter	7	4	GADESFTET		Address, in nanosecond resolution, of the detected last threshold crossing (as measured from the start of Acquisition Memory, i.e. Start of digitization, that is, last in time). Also called the trailing edge. Set to 0 if threshold crossing was NOT detected.	UINT_32	0 - 5100000	0310h
88	Next to Last Threshold Crossing Location for Selected Filter	8	4	GADESFLET		Address (in nanosecond resolution) of the detected next to last threshold crossing (as measured from the start of Acquisition Memory, i.e. Start of digitization. Next to last in time). Also called the leading edge. Set to 0 if a threshold crossing was NOT detected.	UINT_32	0 - 5100000	0311h
92	4ns Filter Peak Height	12	2	GADEF4PH		Peak value returned by the FIR filter engine for the 4ns Filter.	UINT_16	0 - 255	0312h
94	8ns Filter Peak Height	13	2	GADEF8PH		Peak value returned by the FIR filter engine for the 4ns Filter.	UINT_16	0 - 255	0312h
96	Peak Value for the selected filter	14	4	GADESFPH		Peak value for the selected filter returned by the FIR filter engine. Set to 0 if a threshold crossing was not detected.	UINT_32	0 - 255	0313h
100	Peak Value Location for the selected filter	15	4	GADESFPT		Address (in nanosecond resolution) of the detected peak value (as measured from the start of Acquisition Memory, i.e. Start of digitization). Set to 0 if a threshold crossing was NOT detected.	UINT_32	0 - 5100000	0314h
104	Filter Selected	16	4	GADESFNUM		Filter with the highest weight (0 for 4 nsec filter; 1 for 8 nsec filter; 2 for 16 nsec filter; 3 for 32 nsec filter; 4 for 64 nsec filter; 5 for 128 nsec filter). May or may not be selectable! If no selectable filter can be chosen, then the last successful filter, selectable or NOTgis chosen.	UINT_32	0 - 5	0315h
108	Threshold Value	17	4	GADESFTHR		thrshold crossings for the selected filter.	UINT_32	0 - 255	0316h
112	Mean Value of the Background Noise Mean for 4 ns filter	18	4	GADENMU4		Calculated Mean value for the 4ns filter.	FLOAT (IEEE754)	0.0 - 10,000.0	0317h
116	Standard Deviation of the Background Noise for the 4 ns filter	19	4	GADENSIG4		Calculated Standard Deviation for the 4ns filter.	FLOAT (IEEE754)	0.0 - 10,000.0	0318h

Filename: GLAS_SCI_PKTs.xls Page 1 of 3 Worksheet: AD Eng

Pkt Name	Altimeter Digitizer Eng Pkt - One Shot			Size	700	Octets				
App Id	14			Frequency	1	Hz				
Offset	Name	idx	Size in Octets	Mnemonics	Ident.# Mask	Description		Type	Data Range/Formula	DSP Address
120	AD Eng Pkt Return Peak Failure Word			GADERFAIL		Eng packet return peak failure word. Indivudual bit masks are defined below.		UINT_32		
120	Threshold Crossing Failure Mask			GADETCF	0x0000003F	Threshold crossing failure mask. Indivudual bit masks are defined below.		UINT_32		
120	No first crossing(rising edge) on 4-nsec filter flag	20			0x00000001	0=No Problem; 1=No first crossing found on 4-nsec filter				
120	No first crossing(rising edge) on 8-nsec filter flag	21			0x00000002	0=No Problem; 1=No first crossing found on 8-nsec filter				
120	No first crossing(rising edge) on 16-nsec filter flag	22			0x00000004	0=No Problem; 1=No first crossing found on 16-nsec filter				
120	No first crossing(rising edge) on 32-nsec filter flag	23			0x00000008	0=No Problem; 1=No first crossing found on 32-nsec filter				
120	No first crossing(rising edge) on 64-nsec filter flag	24			0x00000010	0=No Problem; 1=No first crossing found on 64-nsec filter				
120	No first crossing(rising edge) on 128-nsec filter flag	25			0x00000020	0=No Problem; 1=No first crossing found on 128-nsec filter				
120	Leading Edge Failure Mask			GADELEF	0x00000FC0	Leading edge failure. Indivudual bit masks are defined below.		UINT_32		
120	No second crossing(falling edge) on 4-nsec filter flag	26			0x00000040	0=No Problem; 1=No second crossing found on 4-nsec filter				
120	No second crossing(falling edge) on 8-nsec filter flag	27			0x00000080	0=No Problem; 1=No second crossing found on 8-nsec filter				
120	No second crossing(falling edge) on 16-nsec filter flag	28			0x00000100	0=No Problem; 1=No second crossing found on 16-nsec filter				
120	No second crossing(falling edge) on 32-nsec filter flag	29			0x00000200	0=No Problem; 1=No second crossing found on 32-nsec filter				
120	No second crossing(falling edge) on 64-nsec filter flag	30			0x00000400	0=No Problem; 1=No second crossing found on 64-nsec filter				
120	No second crossing(falling edge) on 128-nsec filter flag	31			0x00000800	0=No Problem; 1=No second crossing found on 128-nsec filter				
120	Trailing Edge Failure Mask			GADETEF	0x0003F000	Trailing edge failure. Indivudual bit masks are defined below.		UINT_32		
120	First Sample in range >= to threshold for 4 ns filter flag	32			0x00001000	0=No Problem; 1=First sample in range greater than or equal to threshold for 4 nsec filter				
120	First Sample in range >= to threshold for 8 ns filter flag	33			0x00002000	0=No Problem; 1=First sample in range greater than or equal to threshold for 8 nsec filter				
120	First Sample in range >= to threshold for 16 ns filter flag	34			0x00004000	0=No Problem; 1=First sample in range greater than or equal to threshold for 16 nsec filter				
120	First Sample in range >= to threshold for 32 ns filter flag	35			0x00008000	0=No Problem; 1=First sample in range greater than or equal to threshold for 32 nsec filter				
120	First Sample in range >= to threshold for 64 ns filter flag	36			0x00010000	0=No Problem; 1=First sample in range greater than or equal to threshold for 64 nsec filter				
120	First Sample in range >= to threshold for 128 ns filter flag	37			0x00020000	0=No Problem; 1=First sample in range greater than or equal to threshold for 128 nsec filter				
120	Eng Packet Selection Failure			GADESELF	0x00040000	Eng packet selection failure. 0=Select 1=Fail		UINT_32		
120	Eng Packet Previous Selection Failure			GADEPSELF	0x00080000	Previous selection failure. 0=Select 1=Fail		UINT_32		
120	Eng Packet Filter Failure Mask			GADEFF	0x03F00000	Eng packet filter failure mask. Individual filter bit masks are defined below.		UINT_32		
120	4 NS Filter Failure			GADEF4F	0x00100000	0=OK 1=Failure		UINT_32		
120	8 NS Filter Failure			GADEF8F	0x00200000	0=OK 1=Failure		UINT_32		
120	16 NS Filter Failure			GADEF16F	0x00400000	0=OK 1=Failure		UINT_32		
120	32 NS Filter Failure			GADEF32F	0x00800000	0=OK 1=Failure		UINT_32		
120	64 NS Filter Failure			GADEF64F	0x01000000	0=OK 1=Failure		UINT_32		
120	128 NS Filter Failure			GADEF128F	0x02000000	0=OK 1=Failure		UINT_32		

Filename: GLAS_SCI_PKTs.xls Page 2 of 3 Worksheet: AD Eng

Pkt Name	Altimeter Digitizer Eng Pkt - One Shot			Size	700	Octets				
App Id	14			Frequency	1	Hz				
Offset	Name	idx	Size in Octets	Mnemonics	Ident.# Mask	Description		Type	Data Range/Formula	DSP Address
120	AD Eng Pkt Return Range Failure			GADERANF	0x40000000	0=Range OK 1=Failure		UINT_32		
120	AD Eng Pkt Science Processing Ready Flag			GADERDYF	0x80000000	0=Ready 1=Failure		UINT_32		
120	Range Window Status Word	41	4			Bits 0 through 5 indicate if there was a first rising (SCANNING BACKWARDS) above the threshold for each of the various filters. Note that if there is no first rising, there CANNOT be a first falling value, so the appropriate "no second crossing" bit (bits 6 through 11) is also set. Bit 0 corresponds to bit 6, bit 1 corresponds to bit 7 and so on.		Bit Field (UINT_32)	N/A	0319h
124	Calculated Weights for all Filters	42	24	GADEFWGT		Results of weight formulas for all FIR filters.		INT_32		031ah to 031fh
148	Altimeter Digitizer Raw Peak	43	1	GADERWPH		Engineering packet raw waveform peak height		UINT_8	0 - 255	N/A
149	Altimeter Digitizer Selected Filter Coincidences	43	1	GADESFNC		Engineering packet selected filter number of coincidences		UINT_8	0 - 255	N/A
150	Altimeter Digitizer Status Byte	43	1	GADEGSTAT		Engineering packet gain status byte		UINT_8	0 - 255	N/A
150	Altimeter Digitizer Bypass Flag	43	1	GADEGLBYP	0x00000001	0=OK 1=BYPASS		UINT_8	0 - 255	N/A

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Pkt Name	Photon Counter Sci Pkt			Size	8112	Octets		
App Id	15			Frequency	1	Hz		
				Interval	1.000	seconds		
Offset	**Name**	**idx**	**Size in Octets**	**Mnemonics**	**Ident.# Mask**	**Description**	**Type**	**Data Range/Formula**
0	Primary Header		6					
6	Secondary Header(time stamp)		8			Time when sent from PC task		
14	Shot Counter		1	GPCSSHOTC		Corresponds to the first data sample	UINT_8	1-200
15	Dithering Enabled		1	GPCDITHER		0=DISABLED, 1=ENABLED	UINT_8	0-1
16	(-1 km to 10 km Data, plus Background)	1				148 8-bit Digitizer Samples from the enabled SPCMs plus 2 16-bit Background Measurements plus 4 spare bytes.		
16	8-bit Digitizer Samples for Shot 1.	1		GPCSCIBINS			UINT_8 [148]	0-255
16	Elevation Bin (Highest -3)	1	1		1st 32-bit hardward read	Samples are read as 32-bit words starting from HW address 0xB1020990. The byte order of the 32-bit word is: |h-3|h-2|h-1|h|, where h represents the highest elevation sample.	UINT_32[37]	0-255
17	Elevation Bin (Highest -2)	1	1					
18	Elevation Bin (Highest -1)	1	1					
19	Elevation Bin (Highest)	1	1					
20	Elevation Bin (Highest -7)	1	1		2nd 32-bit hardward read			
21	Elevation Bin (Highest -6)	1	1					
22	Elevation Bin (Highest -5)	1	1					
23	Elevation Bin (Highest -4)	1	1					
24	. . . .	1	136					
160	Elevation Bin (Highest -147)	1	1		37th (last) 32-bit h/w read			
161	Elevation Bin (Highest -146)	1	1					
162	Elevation Bin (Highest -145)	1	1					
163	Elevation Bin (Highest -144)	1	1					
164	Background Measurement 1	1	2	GPCSCIBKGND1		Read from HW address 0xB1800010.	UINT_16	0-65535
166	Background Measurement 2	1	2	GPCSCIBKGND2		Read from HW address 0xB1800010.	UINT_16	0-65535
168	spare bytes	1	4	GPCSCIERRSP			UINT_32	NA
172	The previous 156 bytes are repeated 39 more times to correspond to Shots 2-40 for the -1km to 10km data.	2..40	6084					

Filename: GLAS_SCI_PKTs.xls Page 1 of 2 Worksheet: PC Sci

Pkt Name	Photon Counter Sci Pkt			Size	8112	Octets		
App Id	15			Frequency	1	Hz		
				Interval	1.000	seconds		
Offset	**Name**	**idx**	**Size in Octets**	**Mnemonics**	**Ident.# Mask**	**Description**	**Type**	**Data Range/Formula**
6256	10 km to 20 km data. Sums for shots 1-8	1		GPCSCI8SEC		132 (16-bit) sums of 1st eight samples in the frame (1 sec) for the enabled SPCMs.	UINT_16 [132]	0-65535
6256	16-bit sum for (Highest Elevation bin - 1)	1	2		1st 32-bit h/w read			
6258	16-bit sum for (Highest Elevation bin)	1	2			The 16-bit sums are read as 32-bit words starting from HW address 0xB1020888. The byte order of the 32-bit word is: |h-2|h-3|h|h-1|, where h represents the highest elevation sample.	UINT_32[66]	0-65535
6260	16-bit sum for (Highest Elevation bin - 3)	1	2		2nd 32-bit h/w read			
6262	16-bit sum for (Highest Elevation bin - 2)	1	2					
6264	....	1	252					
6516	16-bit sum for (Highest Elevation bin - 131)	1	2		66th (last) 32-bit h/w read			
6518	16-bit sum for (Highest Elevation bin - 130)	1	2					
6520	10 km to 20 km data. Sums for shots 9-16	2	264			Same format as sums for shots 1 through 8	UINT_32[66]	
6784	10 km to 20 km data. Sums for shots 17-24	3	264			Same format as sums for shots 1 through 8	UINT_32[66]	
7048	10 km to 20 km data. Sums for shots 25-32	4	264			Same format as sums for shots 1 through 8	UINT_32[66]	
7312	10 km to 20 km data. Sum for shots 33-40	5	264			Same format as sums for shots 1 through 8	UINT_32[66]	
7576	20 km to 40 km data.	1	0	GPCSCI40_20		268 (16-bit) sums of forty samples in the frame (1 sec) for the enabled SPCMs.	UINT_16 [268]	0-65535
7576	16-bit sum for (Highest Elevation bin - 1)	1	2		1st 32-bit h/w read			
7578	16-bit sum for (Highest Elevation bin)	1	2			The 16-bit sums are read as 32-bit words starting from HW address 0xB1020670. The byte order is: |h-2|h-3|h|h-1|, where h is the high order byte.	UINT_32[134]	0-65535
7580	16-bit sum for (Highest Elevation bin - 3)	1	2		2nd 32-bit h/w read			
7582	16-bit sum for (Highest Elevation bin - 2)	1	2					
7584	....	1	524					
8108	16-bit sum for (Highest Elevation bin - 267)	1	2		134th (last) 32-bit h/w read			
8110	16-bit sum for (Highest Elevation bin - 266)	1	2					

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Pkt Name	Photon Counter Engineering Pkt			Size	8236	Octets		
App Id	16			Frequency	1	Hz		
				Interval	1.000	seconds		
Offset	Name	idx	Size in Octets	Mnemonics	Ident.# Mask	Description	Type	Data Range/Formula
0	Primary Header		6					
6	Secondary Header(time stamp)		8					
14	Shot Counter		1	GPCESHOTC		Corresponds to the first data sample	UINT_8	1-200
15	Dithering Enabled		1	GPCEDITHER		0=DISABLED, 1=ENABLED	UINT_8	0-1
16	40 km to 20 km data	1	268	GPCE20_40		268 8 bit values, 1st shot in frame. Read from HW address 0xB1020800. Data is read as 32-bit words and the order of samples is high altitude to low altitude.	UINT_8 [268]	0-255
284	20 km to 10 km data	1	132	GPCE10_20		132 8 bit values, 1st shot in frame. Read from HW address 0xB102090C. Data is read as 32-bit words and the order of samples is high altitude to low altitude.	UINT_8 [132]	0-255
416	10 km to -1km data	1	148	GPCE1_10		148 8 bit values, 1st shot in frame. Read from HW address 0xB1020990. Data is read as 32-bit words and the order of samples is high altitude to low altitude.	UINT_8[148]	0-255
	The previous 3 fields are repeated for every odd numbered shot in the frame starting from the shot count specified at offset 14, with 29 being the maximum shot count. For example, if the shot specified at offset 14 is 5, then shots 5,7,9,….,29,3,1 (15 total) would be sampled.							
	Note: The data is written as 32-bit words with the byte order as follows; |h-3|h-2|h-1|h| where h is the highest elevation sample.							
564	40 km to 20 km data	2	268			3rd shot in frame		
832	20 km to 10 km data	2	132			3rd shot in frame		
964	10 km to -1km data	2	148			3rd shot in frame		
1112	40 km to 20 km data	3	268			5th shot in frame		
1380	20 km to 10 km data	3	132			5th shot in frame		
1512	10 km to -1km data	3	148			5th shot in frame		
1660	40 km to 20 km data	4	268			7th shot in frame		
1928	20 km to 10 km data	4	132			Note: All this data is from the enabled SPCM		
2060	10 km to -1km data	4	148					
2208	40 km to 20 km data	5	268			9th shot in frame		
2476	20 km to 10 km data	5	132					
2608	10 km to -1km data	5	148					
2756	40 km to 20 km data	6	268			11th shot in frame		
3024	20 km to 10 km data	6	132					
3156	10 km to -1km data	6	148					
3304	40 km to 20 km data	7	268			13th shot in frame		
3572	20 km to 10 km data	7	132					
3704	10 km to -1km data	7	148					
3852	40 km to 20 km data	8	268			15th shot in frame		
4120	20 km to 10 km data	8	132					
4252	10 km to -1km data	8	148					
4400	40 km to 20 km data	9	268			17th shot in frame		
4668	20 km to 10 km data	9	132					
4800	10 km to -1km data	9	148					
4948	40 km to 20 km data	10	268			19th shot in frame		
5216	20 km to 10 km data	10	132					

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Pkt Name	Photon Counter Engineering Pkt			Size	8236	Octets			
App Id	16			Frequency	1	Hz			
				Interval	1.000	seconds			
Offset	Name	idx	Size in Octets	Mnemonics	Ident.# Mask	Description		Type	Data Range/Formula
5348	10 km to -1km data	10	148						
5496	40 km to 20 km data	11	268			21st shot in frame			
5764	20 km to 10 km data	11	132						
5896	10 km to -1km data	11	148						
6044	40 km to 20 km data	12	268			23rd shot in frame			
6312	20 km to 10 km data	12	132						
6444	10 km to -1km data	12	148						
6592	40 km to 20 km data	13	268			25th shot in frame			
6860	20 km to 10 km data	13	132						
6992	10 km to -1km data	13	148						
7140	40 km to 20 km data	14	268			27th shot in frame			
7408	20 km to 10 km data	14	132						
7540	10 km to -1km data	14	148						
7688	40 km to 20 km data	15	268			29th shot in frame			
7956	20 km to 10 km data	15	132			29th shot in frame			
8088	10 km to -1km data	15	148			29th shot in frame			

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Pkt Name	Cloud Digitizer Science Pkt			Size	7576	Octets		
App Id	17			Frequency	1	Hz		
				Interval	1.000	seconds		
Offset	Name	idx	Size in Octets	Mnemonics	Ident.# Mask	Description	Type	Data Range/Formula
0	Primary Header		6					
6	Secondary Header(time stamp)		8			Time when sent from CD task		
14	Shot Counter		2			Corresponds to first data sample	UINT_16	1-200
16	148 8-bit Digitizer Samples from the enabled SPCMs plus background for -1 km to 10 km data.					The 148 8-bit Digitizer Samples are read as 32-bit words from the enabled SPCMs starting from HW address 0xB2020990. The order of samples is from high altitude to low altitude.The byte order is: |h-3|h-2|h-1|h|, where h is the highest elevation sample.	UINT_8 [148]	0-255
16	8-bit Digitizer Samples for Shot 1.	1					UINT_8 [148]	0-255
16	Elevation Bin (Highest -3)	1	1		1st 32-bit hardward read	Samples are read as 32-bit words starting from HW address 0xB2020990. The byte order of the 32-bit word is: |h-3|h-2|h-1|h|, where h represents the highest elevation sample.	UINT_32[37]	0-255
17	Elevation Bin (Highest -2)	1	1					
18	Elevation Bin (Highest -1)	1	1					
19	Elevation Bin (Highest)	1	1					
20	Elevation Bin (Highest -7)	1	1		2nd 32-bit hardward read			
21	Elevation Bin (Highest -6)	1	1					
22	Elevation Bin (Highest -5)	1	1					
23	Elevation Bin (Highest -4)	1	1					
24	. . . .	1	136					
160	Elevation Bin (Highest -147)	1	1		37th (last) 32-bit h/w read			
161	Elevation Bin (Highest -146)	1	1					
162	Elevation Bin (Highest -145)	1	1					
163	Elevation Bin (Highest -144)	1	1					
164	Background Measurement 1	1	2			Read from HW address 0xB2800010.	UINT_16	0-65535
166	Background Measurement 2	1	2			Read from HW address 0xB2800010.	UINT_16	0-65535
168	spare bytes	1	4			Spare	UINT_32	NA
172	The previous 156 bytes are repeated 39 more times to correspond to Shots 2-40 for the -1km to 10km data.	2..40	6084					

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Pkt Name	Cloud Digitizer Science Pkt			Size	7576	Octets		
App Id	17			Frequency	1	Hz		
				Interval	1.000	seconds		
Offset	Name	idx	Size in Octets	Mnemonics	Ident.# Mask	Description	Type	Data Range/Formula
6256	10 km to 20 km data. Sums for shots 1-8	1				132 (16-bit) sums of 1st eight samples in the frame (1 sec) for the enabled SPCMs.	UINT_16 [132]	0-65535
6256	16-bit sum for (Highest Elevation bin - 1)	1	2		1st 32-bit h/w read	The 16-bit sums are read as 32-bit words starting from HW address 0xB2020888. The byte order of the 32-bit word is: |h-2|h-3|h|h-1|, where h represents the highest elevation sample.	UINT_32[66]	0-65535
6258	16-bit sum for (Highest Elevation bin)	1	2					
6260	16-bit sum for (Highest Elevation bin - 3)	1	2		2nd 32-bit h/w read			
6262	16-bit sum for (Highest Elevation bin - 2)	1	2					
6264	……………………………………….	1	252					
6516	16-bit sum for (Highest Elevation bin - 131)	1	2		66th (last) 32-bit h/w read			
6518	16-bit sum for (Highest Elevation bin - 130)	1	2					
6520	10 km to 20 km data. Sums for shots 9-16	2	264			Same format as sums for shots 1 through 8	UINT_32[66]	
6784	10 km to 20 km data. Sums for shots 17-24	3	264			Same format as sums for shots 1 through 8	UINT_32[66]	
7048	10 km to 20 km data. Sums for shots 25-32	4	264			Same format as sums for shots 1 through 8	UINT_32[66]	
7312	10 km to 20 km data. Sum for shots 33-40	5	264			Same format as sums for shots 1 through 8	UINT_32[66]	

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Pkt Name	Cloud Digitizer Engineering Pkt			Size	5616	Octets		
App Id	18			Frequency	1	Hz		
				Interval	1.000	seconds		
Offset	**Name**	**idx**	**Size in Octets**	**Mnemonics**	**Ident.# Mask**	**Description**	**Type**	**Data Range/Formula**
0	Primary Header		6					
6	Secondary Header(time stamp)		8					
14	Shot Counter		2			Corresponds to the first data sample	UINT_16	1-200
16	20 km to 10 km data	1	132			132 8 bit values, 1st shot in frame. Read from HW address 0xB202090C. Order of samples is high altitude to low altitude.	UINT_8 [132]	0-255
148	10 km to -1 km data	1	148			148 8 bit values, 1st shot in frame. Read from HW address 0xB2020990. Order of samples is high altitude to low altitude.	UINT_8 [148]	0-255
	The previous 2 fields are repeated for every odd numbered shot in the frame starting from the shot counter specified at offset 14.							
	For example, if shot specified at offset 14 is 5, then shots 5,7,9,etc. (up to 20 shots) would be sampled.							
	Note: The data is written as 32-bit words with the byte order as follows; |h-3|h-2|h-1|h| where h is the high elevation sample.							
296	20 km to 10 km data	2	132			3rd shot in frame		
428	10 km to -1 km data	2	148			3rd shot in frame		
576	20 km to 10 km data	3	132			5th shot in frame		
708	10 km to -1 km data	3	148			5th shot in frame		
856	20 km to 10 km data	4	132			7th shot in frame		
988	10 km to -1 km data	4	148			7th shot in frame		
1136	20 km to 10 km data	5	132			9th shot in frame		
1268	10 km to -1 km data	5	148			9th shot in frame		
1416	20 km to 10 km data	6	132			11th shot in frame		
1548	10 km to -1 km data	6	148			11th shot in frame		
1696	20 km to 10 km data	7	132			13th shot in frame		
1828	10 km to -1 km data	7	148			13th shot in frame		
1976	20 km to 10 km data	8	132			15th shot in frame		
2108	10 km to -1 km data	8	148			15th shot in frame		
2256	20 km to 10 km data	9	132			17th shot in frame		
2388	10 km to -1 km data	9	148			17th shot in frame		
2536	20 km to 10 km data	10	132			19th shot in frame		
2668	10 km to -1 km data	10	148			19th shot in frame		
2816	20 km to 10 km data	11	132			21st shot in frame		
2948	10 km to -1 km data	11	148			21st shot in frame		
3096	20 km to 10 km data	12	132			23rd shot in frame		
3228	10 km to -1 km data	12	148			23rd shot in frame		
3376	20 km to 10 km data	13	132			25th shot in frame		
3508	10 km to -1 km data	13	148			25th shot in frame		
3656	20 km to 10 km data	14	132			27th shot in frame		
3788	10 km to -1 km data	14	148			27th shot in frame		
3936	20 km to 10 km data	15	132			29th shot in frame		
4068	10 km to -1 km data	15	148			29th shot in frame		
4216	20 km to 10 km data	16	132			31st shot in frame		
4348	10 km to -1 km data	16	148			31st shot in frame		
4496	20 km to 10 km data	17	132			33rd shot in frame		
4628	10 km to -1 km data	17	148			33rd shot in frame		
4776	20 km to 10 km data	18	132			35th shot in frame		
4908	10 km to -1 km data	18	148			35th shot in frame		
5056	20 km to 10 km data	19	132			37th shot in frame		
5188	10 km to -1 km data	19	148			37th shot in frame		

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Pkt Name	Cloud Digitizer Engineering Pkt			Size	5616	Octets			
App Id	18			Frequency	1	Hz			
				Interval	1.000	seconds			
Offset	**Name**	**idx**	**Size in Octets**	**Mnemonics**	**Ident.# Mask**	**Description**		**Type**	**Data Range/Formula**
5336	20 km to 10 km data	20	132			39th shot in frame			
5468	10 km to -1 km data	20	148			39th shot in frame			

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Pkt Name	Ancillary Science Pkt			Size	1368	Octets			
App Id	19			Frequency	1	Hz			
				Interval	1	seconds			
Offset	Name	idx	Size in Octets	Mnemonics	Ident.# Mask	Description	Type	Data Range/Formula	Shared Memory Address
0	Primary Header		6						
6	Secondary Header(time stamp)		8			Time when sent from task			
14	Shot counter		1	GANSHOTC		First shot of frame	UINT_8		
15	AD Checkin Flag, Mask=0x01			GANADPRESF	0x01	1=AD tlm in ancillary pkt, 0=tlm NOT in ancillary pkt			
15	PC Checkin Flag, Mask 0x02			GANPCPRESF	0x02	1=PC tlm in ancillary pkt, 0=tlm NOT in ancillary pkt			
15	CD Checkin Flag, Mask 0x04			GANCDPRESF	0x04	1=CD tlm in ancillary pkt, 0=tlm NOT in ancillary pkt			
15	GP Checkin Flag, Mask 0x08			GANGPPRESF	0x08	1=GP tlm in ancillary pkt, 0=tlm NOT in ancillary pkt			
15	CT Checkin Flag, Mask 0x10			GANCTPRESF	0x10	1=CT tlm in ancillary pkt, 0=tlm NOT in ancillary pkt			
15	Task Data Present in Ancillary Flags		1	GANPKTPRES	0x1F	Flags described above	UINT_8		
16	***Altimeter Digitizer Task Section***								
16	Shot Counter	1	2	GANADSHC		As recorded for the data that follows	UINT_16	1- 200	N/A
18	Altimeter Dig. Range Window Rmin	2	4	GANADRMIN		Address in nanosecond reslution measured from the location of the Trasnmit Pulse Peak	UINT_32	0 - 5100000	0015h
22	Altimeter Dig. Range Window Rmax	3	4	GANADRMAX		Address in nanosecond reslution measured from the location of the Trasnmit Pulse Peak	UINT_32	0 - 5100000	0016h
26	Background Noise Search Offset Startpoint	4	4	GANADNTO		Address in nanoseconds resolution of the start of the 1-km Background Noise search area measured from the end of search window.	INT_32	0 - 5000000	0002h
30	4 ns Filter Enable Mask	6		GANADF4EN	0x0001	0=Disable, 1=Enable			
30	8 ns Filter Enable	7		GANADF8EN	0x0002	0=Disable, 1=Enable			
30	16 ns Filter Enable Mask	8		GANADF16EN	0x0004	0=Disable, 1=Enable			
30	32 ns Filter Enable Mask	9		GANADF32EN	0x0008	0=Disable, 1=Enable			
30	64 ns Filter Enable Mask	10		GANADF64EN	0x0010	0=Disable, 1=Enable			
30	128 ns Filter Enable Mask	11		GANADF128EN	0x0020	0=Disable, 1=Enable			
30	Filter Enable Mask	5	4	GANADFMASK	0x003F	Indicates filters selected used for this frame. This parameter is commandable	Bit Field (UINT_32)	0x0 - 0x3F	003ch
34	Shot Counter for PDL waveform	12	4	GANADPDLSHC		As recorded for the data that follows	UINT_32	1 - 200	N/A
38	Post Delay Laser Pulse Response Start Address	13	4	GANADPDLWST		Start Address of Post Laser Pulse in nanosecond resolution relative to first sample of the waveform.	UINT_32	0 - 500000	0320h
42	Sampled Post Delay Pulse Waveform	14	32	GANADPDLW		32 8-bit data samples. Note: the offset for this data is from Transmit Pulse Peak	UINT_8	0 - 255	0321h to 0328h
74	OTS Laser Pulse Response Start Address	15	4	GANADOTSWST		Start Address of the following four OTS Laser Pulse waveforms in nanosecond resolution relative to first sample of the waveform.	UINT_32	0 - 500000	0330h
78	Shot Counter for OTS #1	16	4	GANADOTS1SHC		Corresponds to the data that follows	UINT_32	1 - 200	N/A
82	Sampled OTS Pulse Waveform #1	17	32	GANADOTS1W		32 8-bit data samples. Note: the offset for this data is from laser fire (location 0).	UINT_8	0 - 255	0331h to 0338h
114	Shot Counter for OTS #2	18	4	GANADOTS2SHC		Corresponds to the data that follows	UINT_32	1 - 200	N/A
118	Sampled OTS Pulse Waveform #2	19	32	GANADOTS2W		32 8-bit data samples. Note: the offset for this data is from laser fire (location 0).	UINT_8	0 - 255	0331h to 0338h
150	Shot Counter #3	20	4	GANADOTS3SHC		Corresponds to the data that follows	UINT_32	1 - 200	N/A
154	Sampled OTS Pulse Waveform #3	21	32	GANADOTS3W		32 8-bit data samples. Note: the offset for this data is from laser fire (location 0).	UINT_8	0 - 255	0331h to 0338h
186	Shot Counter for OTS #4	22	4	GANADOTS4SHC		Corresponds to the data that follows	UINT_32	1 - 200	N/A
190	Sampled OTS Pulse Waveform #4	23	32	GANADOTS4W		32 8-bit data samples. Note: the offset for this data is from laser fire (location 0).	UINT_8	0 - 255	0331h to 0338h
222	Location of transmit pulse seach window (start)	24	4	GANADXSST		Reflects commanded value	UINT_32	0 - 300000	0000h
226	Number of No Threshold Crossing Shots for Error Condition for Surface Echo Compression	25	4	GANADFFLIM		Reflects commanded value	UINT_32	0 - 255	N/A
230	Spare Telemetry Byte	26	1	GANADSPARE1			UNIT_8	N/A	N/A
231	Surface Echo Land Type for Compression	27	1	GANADSURFTYPE		0=sea, 1=land, 2=sea/ice, 3=land/ice	UINT_8	0 - 3	N/A
232	Value of 'p' used for frame	29	2	GANADCOMPP		AD compresssion factor P	UINT_16	1, 2, 4, 8	N/A
234	Value of 'q' used for frame	31	2	GANADCOMPQ		AD compresssion factor Q	UINT_16	1, 2, 4, 8	N/A
236	Value of 'N' used for frame	33	2	GANADCOMPN		# of samples to compress by P	UINT_16	Land: 0-544; Sea: 0-200	N/A
238	Value of 'r' used for frame	35	2	GANADCOMPR		AD compresssion factor R	UINT_16	1, 2, 4, 8	N/A
240	Transmit Pulse Threshold Value	36	2	GANADXTHR		Reflects commanded value or default	UINT_16	0 - 255	0001h
242	Range Window Weighting Scale Factor A1 Coefficient for 4 ns filter	37	4	GANADWP[1]		Reflects commanded value or default	FLOAT (IEEE754)	0.000 to +100.000	001dh
246	Range Window Weighting Scale Factor A2 Coefficient for 4 ns filter	38	4	GANADWP[2]		Reflects commanded value or default	FLOAT (IEEE754)	-100.000 to 0.000	001eh
250	Range Window Weighting Scale Factor A3 Coefficient for 4 ns filter	39	4	GANADWP[3]		Reflects commanded value or default	FLOAT (IEEE754)	-1000.000 to 0.000	001fh

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254	Range Window Weighting Scale Factor A4 Coefficient for 4 ns filter	40	4	GANADWP[4]		Reflects commanded value or default	FLOAT (IEEE754)	0.000 to +100.000	0020h		
258	Range Window Weighting Scale Factor A1 Coefficient for 8 ns filter	41	4	GANADWP[5]		Reflects commanded value or default	FLOAT (IEEE754)	0.000 to +100.000	0021h		
262	Range Window Weighting Scale Factor A2 Coefficient for 8 ns filter	42	4	GANADWP[6]		Reflects commanded value or default	FLOAT (IEEE754)	-100.000 to 0.000	0022h		
266	Range Window Weighting Scale Factor A3 Coefficient for 8 ns filter	43	4	GANADWP[7]		Reflects commanded value or default	FLOAT (IEEE754)	-1000.000 to 0.000	0023h		
270	Range Window Weighting Scale Factor A4 Coefficient for 8 ns filter	44	4	GANADWP[8]		Reflects commanded value or default	FLOAT (IEEE754)	0.000 to +100.000	0024h		
274	Range Window Weighting Scale Factor A1 Coefficient for 16 ns filter	45	4	GANADWP[9]		Reflects commanded value or default	FLOAT (IEEE754)	0.000 to +100.000	0025h		
278	Range Window Weighting Scale Factor A2 Coefficient for 16 ns filter	46	4	GANADWP[10]		Reflects commanded value or default	FLOAT (IEEE754)	-100.000 to 0.000	0026h		
282	Range Window Weighting Scale Factor A3 Coefficient for 16 ns filter	47	4	GANADWP[11]		Reflects commanded value or default	FLOAT (IEEE754)	-1000.000 to 0.000	0027h		
286	Range Window Weighting Scale Factor A4 Coefficient for 16 ns filter	48	4	GANADWP[12]		Reflects commanded value or default	FLOAT (IEEE754)	0.000 to +100.000	0028h		
290	Range Window Weighting Scale Factor A1 Coefficient for 32 ns filter	49	4	GANADWP[13]		Reflects commanded value or default	FLOAT (IEEE754)	0.000 to +100.000	0029h		
294	Range Window Weighting Scale Factor A2 Coefficient for 32 ns filter	50	4	GANADWP[14]		Reflects commanded value or default	FLOAT (IEEE754)	-100.000 to 0.000	002ah		
298	Range Window Weighting Scale Factor A3 Coefficient for 32 ns filter	51	4	GANADWP[15]		Reflects commanded value or default	FLOAT (IEEE754)	-1000.000 to 0.000	002bh		
302	Range Window Weighting Scale Factor A4 Coefficient for 32 ns filter	52	4	GANADWP[16]		Reflects commanded value or default	FLOAT (IEEE754)	0.000 to +100.000	002ch		
306	Range Window Weighting Scale Factor A1 Coefficient for 64 ns filter	53	4	GANADWP[17]		Reflects commanded value or default	FLOAT (IEEE754)	0.000 to +100.000	002dh		
310	Range Window Weighting Scale Factor A2 Coefficient for 64 ns filter	54	4	GANADWP[18]		Reflects commanded value or default	FLOAT (IEEE754)	-100.000 to 0.000	002eh		
314	Range Window Weighting Scale Factor A3 Coefficient for 64 ns filter	55	4	GANADWP[19]		Reflects commanded value or default	FLOAT (IEEE754)	-1000.000 to 0.000	002fh		
318	Range Window Weighting Scale Factor A4 Coefficient for 64 ns filter	56	4	GANADWP[20]		Reflects commanded value or default	FLOAT (IEEE754)	0.000 to +100.000	0030h		
322	Range Window Weighting Scale Factor A1 Coefficient for 128 ns filter	57	4	GANADWP[21]		Reflects commanded value or default	FLOAT (IEEE754)	0.000 to +100.000	0031h		
326	Range Window Weighting Scale Factor A2 Coefficient for 128 ns filter	58	4	GANADWP[22]		Reflects commanded value or default	FLOAT (IEEE754)	-100.000 to 0.000	0032h		
330	Range Window Weighting Scale Factor A3 Coefficient for 128 ns filter	59	4	GANADWP[23]		Reflects commanded value or default	FLOAT (IEEE754)	-1000.000 to 0.000	0033h		
334	Range Window Weighting Scale Factor A4 Coefficient for 128 ns filter	60	4	GANADWP[24]		Reflects commanded value or default	FLOAT (IEEE754)	0.000 to +100.000	0034h		
338	Background Noise A1 Coefficient for 4ns Filter	61	4	GANADNP[1]		Reflects commanded value or default	FLOAT (IEEE754)	0.000 to 10.000	0003h		
342	Background Noise A2 Coefficient for 4ns Filter	62	4	GANADNP[2]		Reflects commanded value or default	FLOAT (IEEE754)	-10.000 to +10.000	0004h		
346	Background Noise A3 Coefficient for 4ns Filter	63	4	GANADNP[3]		Reflects commanded value or default	FLOAT (IEEE754)	-10.000 to +10.000	0005h		
350	Background Noise A1 Coefficient for 8ns Filter	64	4	GANADNP[4]		Reflects commanded value or default	FLOAT (IEEE754)	0.000 to 10.000	0006h		
354	Background Noise A2 Coefficient for 8ns Filter	65	4	GANADNP[5]		Reflects commanded value or default	FLOAT (IEEE754)	-10.000 to +10.000	0007h		
358	Background Noise A3 Coefficient for 8ns Filter	66	4	GANADNP[6]		Reflects commanded value or default	FLOAT (IEEE754)	-10.000 to +10.000	0008h		
362	Background Noise A1 Coefficient for 16ns Filter	67	4	GANADNP[7]		Reflects commanded value or default	FLOAT (IEEE754)	0.000 to 10.000	0009h		
366	Background Noise A2 Coefficient for 16ns Filter	68	4	GANADNP[8]		Reflects commanded value or default	FLOAT (IEEE754)	-10.000 to +10.000	000ah		
370	Background Noise A3 Coefficient for 16ns Filter	69	4	GANADNP[9]		Reflects commanded value or default	FLOAT (IEEE754)	-10.000 to +10.000	000bh		
374	Background Noise A1 Coefficient for 32ns Filter	70	4	GANADNP[10]		Reflects commanded value or default	FLOAT (IEEE754)	0.000 to 10.000	000ch		
378	Background Noise A2 Coefficient for 32ns Filter	71	4	GANADNP[11]		Reflects commanded value or default	FLOAT (IEEE754)	-10.000 to +10.000	000dh		
382	Background Noise A3 Coefficient for 32ns Filter	72	4	GANADNP[12]		Reflects commanded value or default	FLOAT (IEEE754)	-10.000 to +10.000	000eh		
386	Background Noise A1 Coefficient for 64ns Filter	73	4	GANADNP[13]		Reflects commanded value or default	FLOAT (IEEE754)	0.000 to 10.000	000fh		
390	Background Noise A2 Coefficient for 64ns Filter	74	4	GANADNP[14]		Reflects commanded value or default	FLOAT (IEEE754)	-10.000 to +10.000	0010h		
394	Background Noise A3 Coefficient for 64ns Filter	75	4	GANADNP[15]		Reflects commanded value or default	FLOAT (IEEE754)	-10.000to +10.000	0011h		
398	Background Noise A1 Coefficient for 128ns Filter	76	4	GANADNP[16]		Reflects commanded value or default	FLOAT (IEEE754)	0.000 to 10.000	0012h		
402	Background Noise A2 Coefficient for 128ns Filter	77	4	GANADNP[17]		Reflects commanded value or default	FLOAT (IEEE754)	-10.000 to +10.000	0013h		
406	Background Noise A3 Coefficient for 128ns Filter	78	4	GANADNP[18]		Reflects commanded value or default	FLOAT (IEEE754)	-10.000 to +10.000	0014h		
410	Spare Telemetry Byte	79	1				UINT_8	N/A	N/A		
411	Enable/Disable Auto Gain Calculation	80	1	GANADAGENAB		0=Fixed, 1=Auto; Reflects commanded value or default	UINT_8	N/A	N/A		
412	Enable/Disable Use of 4ns Filter for Auto Gain Calculation	81	1	GANADAGFILT		0=Select, 1=Raw; Reflects commanded value or default	UINT_8	N/A	N/A		
413	Return Gain Value	82	1	GANADFIXGAIN		Reflects commanded value or default	UINT_8	0 - 200	N/A		
414	Auto Gain Calculation A1 Parameter	83	4	GANADAGAP[1]		Reflects commanded value or default	FLOAT (IEEE754)		N/A		
418	Auto Gain Calculation A2 Parameter	84	4	GANADAGAP[2]		Reflects commanded value or default	FLOAT (IEEE754)		N/A		
422	Auto Gain Calculation A3 Parameter	85	4	GANADAGAP[3]		Reflects commanded value or default	FLOAT (IEEE754)		N/A		
426	Auto Gain Calculation A4 Parameter	86	4	GANADAGAP[4]		Reflects commanded value or default	FLOAT (IEEE754)		N/A		

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430	Auto Gain Calculation B1 Parameter	87	4	GANADAGBP[1]		Reflects commanded value or default	FLOAT (IEEE754)		N/A
434	Auto Gain Calculation B2 Parameter	88	4	GANADAGBP[2]		Reflects commanded value or default	FLOAT (IEEE754)		N/A
438	Auto Gain Calculation B3 Parameter	89	4	GANADAGBP[3]		Reflects commanded value or default	FLOAT (IEEE754)		N/A
442	Auto Gain Calculation B4 Parameter	90	4	GANADAGBP[4]		Reflects commanded value or default	FLOAT (IEEE754)		N/A
446	Auto Gain Calculation C0 parameter	91	4	GANADAGCP[1]		Reflects commanded value or default	FLOAT (IEEE754)		N/A
450	Auto Gain Calculation C1 parameter	92	4	GANADAGCP[2]		Reflects commanded value or default	FLOAT (IEEE754)		N/A
454	Auto Gain Calculation Vref Parameter	93	4	GANADAGVREF		Reflects commanded value or default	FLOAT (IEEE754)		N/A
458	Auto Gain Calculation Zmin Parameter	94	4	GANADAGZMIN		Reflects commanded value or default	FLOAT (IEEE754)		N/A
462	Auto Gain Calculation Zmax Parameter	95	4	GANADAGZMAX		Reflects commanded value or default	FLOAT (IEEE754)		N/A
466	Auto Gain Calculation Vmin Parameter	96	1	GANADAGVMIN		Reflects commanded value or default	UINT_8	0 - 255	N/A
467	Auto Gain Calculation Ginit Parameter	97	1	GANADAGGINIT		Reflects commanded value or default	UINT_8	0 - 255	N/A
468	Auto Gain Calculation Gmin Parameter	98	1	GANADAGGMAX		Reflects commanded value or default	UINT_8	0 - 255	N/A
469	Auto Gain Calculation Gmax Parameter	99	1	GANADAGGMIN		Reflects commanded value or default	UINT_8	0 - 255	N/A
470	Tolerance for Coincidence of Filters	100	4	GANADFCTOL		Reflects commanded value or default	UINT_32	0 - 2000	0037h
474	Range Window Dump (waveform time) Offsets for 4 ns filter	101	4	GANADRWTO[1]		Reflects commanded value or default	INT_32	0-500	0017h
478	Range Window Dump (waveform time) Offsets for 8 ns filter	102	4	GANADRWTO[2]		Reflects commanded value or default	INT_32	0-500	0018h
482	Range Window Dump (waveform time) Offsets for 16 ns filter	103	4	GANADRWTO[3]		Reflects commanded value or default	INT_32	0-500	0019h
486	Range Window Dump (waveform time) Offsets for 32 ns filter	104	4	GANADRWTO[4]		Reflects commanded value or default	INT_32	0-500	001ah
490	Range Window Dump (waveform time) Offsets for 64 ns filter	105	4	GANADRWTO[5]		Reflects commanded value or default	INT_32	0-500	001bh
494	Range Window Dump (waveform time) Offsets for 128 ns filter	106	4	GANADRWTO[6]		Reflects commanded value or default	UINT_32	0-500	001ch
498	Spare bytes	108	2				UINT_8		
500	Surface (Pulse) Return Threshold Values for All Filters (4 ns through 128 ns filters)	107	6	GANADRTHR[1..6]		Reflects commanded value or default. 6 bytes total; byte 1 represents 4ns filter, byte 2 = 8ns, etc.	UINT_8		0035h to 0036h
506	FIR Filter Coefficients	109	8	GANADFFIR[1..8]		Reflects commanded value or default. Total of 8 bytes	UINT_8		003ah to 003bh
514	Filter Weight Min Std Deviation	110	4	GANADWMINSTD		Reflects commanded value or default	FLOAT (IEEE754)	0.0001 - 1.0	003dh
518	Filter Noise Minimum thresholds for 4 ns filter	111	4	GANADNMIN[1]		Reflects commanded value or default	FLOAT (IEEE754)	0-255	003eh
522	Filter Noise Minimum thresholds for 8 ns filter	112	4	GANADNMIN[2]		Reflects commanded value or default	FLOAT (IEEE754)	0-255	003fh
526	Filter Noise Minimum thresholds for 16 ns filter	113	4	GANADNMIN[3]		Reflects commanded value or default	FLOAT (IEEE754)	0-255	0040h
530	Filter Noise Minimum thresholds for 32 ns filter	114	4	GANADNMIN[4]		Reflects commanded value or default	FLOAT (IEEE754)	0-255	0041h
534	Filter Noise Minimum thresholds for 64 ns filter	115	4	GANADNMIN[5]		Reflects commanded value or default	FLOAT (IEEE754)	0-255	0042h
538	Filter Noise Minimum thresholds for 128 ns filter	116	4	GANADNMIN[6]		Reflects commanded value or default	FLOAT (IEEE754)	0-255	0043h
542	Filter reject mask for leading edge	117	4	GANADFRLEF		Reflects commanded value or default	UINT_32		
546	Filter reject mask for trailing edge	118	4	GANADFRTEF		Reflects commanded value or default	UINT_32		
550	Spare Telemetry Bytes	119	22			Spare Telemetry	UINT_8	N/A	N/A
572	***Photon Counter Task Section***								
572	Spare	1	2			Spare	UINT_16	NA	NA
574	SPCM 1 RAW Counts Mask	3		GANSPCMRC[1]	0x000000FF			0-255	
574	SPCM 2 RAW Counts Mask	4		GANSPCMRC[2]	0x0000FF00			0-255	
574	SPCM 3 RAW Counts Mask	5		GANSPCMRC[3]	0x00FF0000			0-255	
574	SPCM 4 RAW Counts Mask	6		GANSPCMRC[4]	0xFF000000			0-255	
574	SPCM 1-4 Raw Counts	2	4	GANSPCMRC		Photon Counter Bd address 0xB1800018	UINT_32	0-4294967295	NA
578	SPCM 5 RAW Counts Mask	8		GANSPCMRC1[1]	0x000000FF			0-255	
578	SPCM 6 RAW Counts Mask	9		GANSPCMRC1[2]	0x0000FF00			0-255	
578	SPCM 7 RAW Counts Mask	10		GANSPCMRC1[3]	0x00FF0000			0-255	
578	SPCM 8 RAW Counts Mask	11		GANSPCMRC1[4]	0xFF000000			0-255	
578	SPCM 5-8 Raw Counts	7	4	GANSPCMRC1		Photon Counter Bd address 0xB180001C	UINT_32	0-4294967295	NA
582	SPCM Gate Delay	12	2	GANPCSPCMG		Photon Counter Bd address 0xB1000004	UINT_16	0-65535	NA
584	PC Background #1 Delay	13	2	GANPCBKGN1			UINT_16	0-65535	NA
586	PC Background #2 Delay	14	2	GANPCBKGN2		Photon Counter Bd address 0xB1000008	UINT_16	0-65535	NA
588	PC Range Gate (Lidar) Delay	15	2	GANPCMBLID			UINT_16	0-65535	NA
590	SPCM 1 Mask				0x0100				
	SPCM 2 Mask				0x0200				
	SPCM 3 Mask				0x0400				
	SPCM 4 Mask				0x0800				
	SPCM 5 Mask				0x1000				
	SPCM 6 Mask				0x2000				
	SPCM 7 Mask				0x4000				
	SPCM 8 Mask				0x8000				
590	SPCM status	16	2	GANSPCMSTAT	0xFF00	Photon Counter Bd address 0xB1800004	UINT_16	0-65535	NA
592	***Cloud Digitizer Task Section (Freq & Time Bd Data)***								
592	Spare		2			Spare	UINT_16	0-65535	NA
594	Attenuation = 0.				0x0002				

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594	Attenuation = 1/1.77.				0x0004				
594	Attenuation = 1/3.16.				0x0008				
594	Attenuation = 1/5.6.				0x0010				
594	Attenuation = 1/10.				0x0020				
594	A/D output and CD Amplifier Attenuation(gain) setting		2	GANCDADOA		Cloud Digitizer Bd address 0xB2800004	UINT_16	0-65535	NA
596	Background #1 Delay		2	GANCDBKD		Cloud Digitizer Bd address 0xB2000004	UINT_16	0-65535	NA
598	Background #2 and Range Gate Delay		4	GANCDBKLID[4]		Cloud Digitizer Bd address 0xB2000008	UINT_8	0-4294967295	NA
602	Detector status		2	GANCDDSTAT		Cloud Digitizer Bd address 0xB2400004	UINT_16	0-65535	NA
604	Spare		2			Spare	UINT_16	NA	NA
606	Shot Counter for start of Frame		2	GANCDSHTCST		Corresponds to first 40 bit counter sample	UINT_16	1-200	NA
608	Shot Counter	1	2	GANCDSHTC		As recorded when the next two values were read	UINT_16	1-200	NA
610	Fire Acknowledge Time(from Freq and Time Bd)	1	5	GANCDFAT		Freq & Time Board Tlm, 40 bit counter	UINT_40	0-0xFFFFFFFFFF	NA
615	Fire Command Time(from Freq and Time Bd)	1	5	GANCDFCT		Freq & Time Board Tlm, 40 bit counter	UINT_40	0-0xFFFFFFFFFF	NA
620	***The above 3 values are added for shots 2 through 39.***		468						
1088	***GPS/DEM Section***								
1088	Latitude	1	2	GANGPLAT		S/C latitude calculated from s/c position data in degrees	INT_16	-90 to +90	
1090	Longitude	2	2	GANGPLONG		S/C longitude calculated from s/c position data in degrees	INT_16	0 to 180	
1092	Height (Hsat)	3	4	GANGPHSAT		S/C geodetic altitude of s/c above earth's surface in kilometers.	FLOAT (IEEE754)	0.0 to 1000.0	
1096	Rsat	4	4	GANGPRSAT		Distance from s/c to center of earth in kilometers.	FLOAT (IEEE754)	0.0 to 10,000.0	
1100	Rmin	5	4	GANGPRMIN		Range window start in kilometers.	FLOAT (IEEE754)	0.0 to 1000.0	
1104	Rmax	6	4	GANGPRMAX		Range window stop in kilometers.	FLOAT (IEEE754)	0.0001 to 1000.0	
1108	Wmin	7	4	GANGPWMIN		Minimum window size. Default is 2km	FLOAT (IEEE754)	0.0001 to 1000.0	
1112	Wmax	8	4	GANGPWMAX		Maximum window size. Default is 11km	FLOAT (IEEE754)	0.0 to 1000.0	
1116	Hoffmin (DEM uncertainty + bias)	9	4	GANGPHOFFMIN		Offset associated with the minimum height. Default is 1.125km	FLOAT (IEEE754)	-1000.0 to 1000.0	
1120	Hoffmax (DEM uncertainty - bias)	10	4	GANGPHOFFMAX		Offset associated with the maximum height. Default is negative 0.875km	FLOAT (IEEE754)	-1000.0 to 1000.0	
1124	Rbmin	11	4	GANGPRBMIN		Bias added to the mimimum range for Altimeter Digitizer (in kilometers). Default is 0.	FLOAT (IEEE754)	-1000.0 to 1000.0	
1128	Rbmax	12	4	GANGPRBMAX		Bias added to the maximum range for Altimeter Digitizer (in kilometers). Default is 0.	FLOAT (IEEE754)	-1000.0 to 1000.0	
1132	PC Range Bias	13	4	GANGPPCBIAS		PC Range Bias. Default is -41km	FLOAT (IEEE754)	-1000.0 to 1000.0	
1136	CD Range Bias	14	4	GANGPCDBIAS		CD Range Bias. Default is -41km	FLOAT (IEEE754)	-1000.0 to 1000.0	
1140	Surface Type	15	1	GANGPSURFTYP		Surface type. 0=sea 1=land 2=sea_ice 3=land_ ice. The default is sea (0).	UINT_8	0-3	
1141	Position data status flag	16	1	GANGPPOSVLD		Set to 0 if receiving position data and no errors, 1 if not receiving position data, and 2 if processing errors encountered on position data received.	UINT_8	0-2	
1142	Spacecraft time & position packet data	17	40			Spacecraft position and GPS Time command packet received over 1553 bus minus 8 byte CCSDS command header. Format is defined in spacecraft ICD.	See BALL Spacecraft to GLAS ICD for details		
1182	Shot Count for 1553 Spacecraft Time and Position packet.	18	2	GANGPSHOTCNT		Shot count captured by RT task when it receives spacecraft time and position packet. Only lower 8 bytes valid.	UINT_16	1-200	
1184	Spare byte in GLAS MET below	19	1	GANGPMETSP1		Spare GLAS MET byte that is not used.	UINT_8	N/A	
1185	GLAS MET for 1553 Spacecraft Position and command packet.	20	6	GANGPMETPOS		GLAS MET captured by RT task when it receives spacecraft time and position packet. Time is in microseconds. 8 bytes allotted for GLAS MET but only the middle 6 bytes actually used.	UINT_48	0 to 0xFFFFFFFFFFFF	
1191	Spare byte in GLAS MET above	21	1	GANGPMETSP2		GLAS MET expedite flag. This flag not used.	UINT_8	N/A	
1192	DEM minimum byte	22	1	GANGPMINBYTE		DEM mininum elevation byte used to calculate hmin	UINT_8	0x00 to 0xFFFFFF	
1193	DEM maximum byte	23	1	GANGPMAXBYTE		DEM maximum elevation byte used to calculate hmax	UINT_8	0x00 to 0xFFFFFF	
1194	Range data source	24	1	GANGPRNGSRC		Source of range data: 0=s/c time & pos pkt 1=uplinked DEM bytes 2=uplinked Rmin/Rmax	UINT_8	0-2	
1195	High order byte of GPS 10 Sec Pulse 40 bit count value	25	1	GANGP40BIT1		Last 40-bit count value from frequency & time board. Corresponds to the last GPS 10 second pulse.	UINT_8	0xFF	
1196	Low order 4 bytes of GPS 10 Sec Pulse 40 bit count value	26	4	GANGP40BIT4		Last 40-bit count value from frequency & time board. Corresponds to the last GPS 10 second pulse.	UINT_32	0xFFFFFFFF	
1200	Spare byte in GLAS MET below	27	1	GANGPMETSPR1		Spare GLAS MET byte that is not used.	UINT_8	N/A	
1201	GLAS MET for GPS 0.1 Hz Pulse	28	6	GANGPMET		GLAS MET at time of last GPS 10 sec pulse. Time is in microseconds. 8 bytes allotted for GLAS MET but only the middle 6 bytes actually used.	UINT_48	0 to 0xFFFFFFFFFFFF	
1207	Spare byte in GLAS MET above	29	1	GANGPEXPEDFL		GLAS MET expedite flag. This flag is not used.	UINT_8	N/A	
1208	GP ancillary data spare bytes	30	8	GANGPFILL		GP ancillary data spare bytes for future growth	UINT_8 * 8	N/A	
1216	***C&T Task Section***								
1216	Etalon Calibration - Current mode		1	GANCTEMODE		OFF=0, Acquire=1, Tracking=2	UNIT_8		

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1217	Etalon State		1	GANCTESTATE		Idle=0, Init=1, Set Temp=2, Settle=3, Average=4, 5=Openloop, 6=Modified	UINT_8				
1218	Etalon Temperature Settle Time		1	GANCTETMPSET		in seconds	UINT_8				
1219	Etalon tracking low transmission flag			GANCTELOWTR	0x01	0 = Good 1 = Low					
1219	Etalon tracking active flag			GANCTETRACK	0x02	0 = Paused 1 = Active					
1219	Etalon tracking test mode flag			GANCTETEST	0x04	0 = Normal 1 = Test					
1219	Etalon tracking openloop mode flag			GANCTEOLMODE	0x08	0 = Normal 1 = OpenLoop					
1219	Etalon tracking openloop update toggle			GANCTEOLUPD	0x10						
1219	Etalon Flags		1	GANCTEFLAGS		Etalon status flags	UINT_8				
1220	Etalon Averaged on-axis transmission		4	GANCTETRON			FLOAT (IEEE754)				
1224	Etalon Averaged off-axis transmission		4	GANCTETROFF			FLOAT (IEEE754)				
1228	Etalon temperature error		4	GANCTEDTEMP		In degrees	FLOAT (IEEE754)				
1232	Etalon tracking loop filter output		4	GANCTETOUT			FLOAT (IEEE754)				
1236	Etalon tracking failure average		4	GANCTETFAVG			FLOAT (IEEE754)				
1240	Etalon start temperature for acquire command		1	GANCTESTRTT			UINT_8				
1241	Etalon stop temperature for acquire command		1	GANCTESTOPT			UINT_8				
1242	Etalon temperature step for acquire command		1	GANCTETSTEP			UINT_8				
1243	Etalon averaging time for acquire command		1	GANCTEAVGTIM		in seconds	UINT_8				
1244	Etalon temperature setle time for acquire cmd		2	GANCTESTLTIM		in seconds	UINT_16				
1246	Etalon averaging update counter		1	GANCTEAVGUP			UINT_8				
1247	Spare byte		1	GANCTASPARE			UINT_8				
1248	Etalon FBack Mon val (Pin Diode A)		40	GANCTDPA		From LMB. Each corresponds to one of the 40 shots in the frame	UINT_8				
1288	Etalon FBack Mon val (Pin Diode B)		40	GANCTDPB		From LMB. Each corresponds to one of the 40 shots in the frame	UINT_8				
1328	Etalon 532 Energy		40	GANCTE532		From LMB. Each corresponds to one of the 40 shots in the frame	UINT_8				

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Pkt Name	LPA Data Pkt			Size	4056	Octets		
App Id	26			Frequency	4	Hz		
				Interval	0.25	seconds		
Offset	**Name**	**idx**	**Size in Octets**	**Mnemonics**	**Ident.# Mask**	**Description**	**Type**	**Data Range/Formula**
0	Primary Header		6					
6	Secondary Header(time stamp)		8					
14	Spare		2			Spare	UINT_16	NA
16	Shot Counter	1	2			Correponding to LPA Data	UINT_16	1-200
18	X Position of Box	1	1			X Coordinate where LPA Data starts	UINT_8	0-79
19	Y Position of Box	1	1			Y Coordinate where LPA Data starts	UINT_8	0-79
20	LPA Data	1	400			20x20 box of LPA pixel intensity data. Pixel = 8 bits. The pixel order is row major: [row,col]; [1,1],[1,2],….,[2,1,[2,2],…….	UINT_8 [400]	0-255, 20 bytes X 20 rows
420	Shot Counter	2	2			Correponding to LPA Data		
422	X Position of Box	2	1			X Coordinate where LPA Data starts		
423	Y Position of Box	2	1			Y Coordinate where LPA Data starts		
424	LPA Data	2	400			20x20 box of LPA pixel intensity data		
824	Shot Counter	3	2			Correponding to LPA Data		
826	X Position of Box	3	1			X Coordinate where LPA Data starts		
827	Y Position of Box	3	1			Y Coordinate where LPA Data starts		
828	LPA Data	3	400			20x20 box of LPA pixel intensity data		
1228	Shot Counter	4	2			Correponding to LPA Data		
1230	X Position of Box	4	1			X Coordinate where LPA Data starts		
1231	Y Position of Box	4	1			Y Coordinate where LPA Data starts		
1232	LPA Data	4	400			20x20 box of LPA pixel intensity data		
1632	Shot Counter	5	2			Correponding to LPA Data		
1634	X Position of Box	5	1			X Coordinate where LPA Data starts		
1635	Y Position of Box	5	1			Y Coordinate where LPA Data starts		
1636	LPA Data	5	400			20x20 box of LPA pixel intensity data		
2036	Shot Counter	6	2			Correponding to LPA Data		
2038	X Position of Box	6	1			X Coordinate where LPA Data starts		
2039	Y Position of Box	6	1			Y Coordinate where LPA Data starts		
2040	LPA Data	6	400			20x20 box of LPA pixel intensity data		
2440	Shot Counter	7	2			Correponding to LPA Data		
2442	X Position of Box	7	1			X Coordinate where LPA Data starts		
2443	Y Position of Box	7	1			Y Coordinate where LPA Data starts		
2444	LPA Data	7	400			20x20 box of LPA pixel intensity data		
2844	Shot Counter	8	2			Correponding to LPA Data		
2846	X Position of Box	8	1			X Coordinate where LPA Data starts		
2847	Y Position of Box	8	1			Y Coordinate where LPA Data starts		
2848	LPA Data	8	400			20x20 box of LPA pixel intensity data		
3248	Shot Counter	9	2			Correponding to LPA Data		
3250	X Position of Box	9	1			X Coordinate where LPA Data starts		
3251	Y Position of Box	9	1			Y Coordinate where LPA Data starts		
3252	LPA Data	9	400			20x20 box of LPA pixel intensity data		
3652	Shot Counter	10	2			Correponding to LPA Data		
3654	X Position of Box	10	1			X Coordinate where LPA Data starts		
3655	Y Position of Box	10	1			Y Coordinate where LPA Data starts		
3656	LPA Data	10	400			20x20 box of LPA pixel intensity data		
	LPA data for all 40 shots is sent down each second. There are 10 shots per packet and 4 packets per second.							

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Pkt Name	Command History			Size	296	Octets
App Id	49			Frequency	Async	Hz
				Interval		seconds
Offset	**Name**	**idx**	**Size in Octets**	**Mnemonics**	**Ident.# Mask**	**Description**
0	Primary Header		6			
6	Secondary Header(time stamp)		8			
14	Valid Commands in Packet		2			Number of valid commands in this command history packet
16	GLAS Time of Command #1	1	8			Only the middle 6 bytes are used for the time. The first and last byte (bytes 0 & 7) are spares.
24	Command #1 (first 20 bytes)	1	20			First 20 bytes of CCSDS packet
44	GLAS Time of Command #2	2	8			
52	Command #2 (first 20 bytes)	2	20			
72	GLAS Time of Command #3	3	8			
80	Command #3 (first 20 bytes)	3	20			
100	GLAS Time of Command #4	4	8			
108	Command #4 (first 20 bytes)	4	20			
128	GLAS Time of Command #5	5	8			
136	Command #5 (first 20 bytes)	5	20			
156	GLAS Time of Command #6	6	8			
164	Command #6 (first 20 bytes)	6	20			
184	GLAS Time of Command #7	7	8			
192	Command #7 (first 20 bytes)	7	20			
212	GLAS Time of Command #8	8	8			
220	Command #8 (first 20 bytes)	8	20			
240	GLAS Time of Command #9	9	8			
248	Command #9 (first 20 bytes)	9	20			
268	GLAS Time of Command #10	10	8			
276	Command #10 (first 20 bytes)	10	20			

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Pkt Name	LPA 80x80 Test Data Pkt			Size	6416	Octets			
App Id	126			Frequency	1	Hz			
				Interval	1	seconds			
Offset	Name	idx	Size in Octets	Mnemonics	Ident.# Mask	Description		Type	Data Range/Formula
0	Primary Header		6						
6	Secondary Header(time stamp)		8						
14	Shot Counter		2			Correponding to LPA Data		UINT_16	1-200
16	LPA Data		6400			80x80 box of LPA pixel intensity data. Pixel = 8 bits. The pixel order is row major: [row,col]; [1,1],[1,2],….,[2,1],[2,2],…….		UINT_8 [6400]	0-255, 80 bytes X 80 columns

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Pkt Name	Boresite Calibration Results Pkt			Size	1816	Octets			
App Id	38			Frequency	Async	Hz			
				Interval	Async	seconds			
Offset	Name	idx	Size in Octets	Mnemonics	Ident.# Mask	Description		Type	Data Range/Formula
0	Primary Header		6						
6	Secondary Header(time stamp)		8						
14	Calibration Type		2			0 = Coarse, 1 = Fine		UINT_16	0-1
16	X Position Of The Mirror	1	2			Position X		UINT_16	0-4095
18	Y Position Of The Mirror	1	2			Position Y		UINT_16	0-4095
20	Integration Result	1	4			Integration Result For The Current Position		UINT_32	0-4294967295
24	Rest of Packet consisting of 224 X and Y mirror positions and the integration result	2-224	1792			There are 224(for a total of 225) X and Y Position and Integration results, Each is 8 bytes long. 1792=224x8			

Filename: GLAS_SCI_PKTs.xls

Page 1 of 1

Worksheet: Boresite Cal

Appendix C

Background Information for Time Tagging Algorithm

C.1 Information

1) There are 2 data types or streams downlinked from the GLAS instrument: science and engineering. The science data contain the science measurements recorded by GLAS and the parameters calculated by the flight software algorithm. Also, included in the science data are commanded flight software parameters. The GPS packet and the spacecraft Position, Rate, and Attitude Packet (PRAP) are science data collected and downlinked directly by the spacecraft. The engineering data contain the instrument health and status data including temperatures, currents, and software status indicators. There are several types of packets within each data type. These packets are defined by their APID (Application ID). The raw ICESat telemetry dumps are processed by EDOS to remove redundant packets and create data files on even 6 hour boundaries for each APID. Table C-1 "APIDs used by Normal I-SIPS Processing" lists the science and engineering data that is normally ingested by the I-SIPS to perform the GLAS data processing. As shown in the table, the Altimeter Digitizer has two different APIDs (12 and 13) but during any one second only one APID will exist.

Table C-1 APIDs used by Normal I-SIPS Processing

APID	Packet Name	Data Type	Frequency (/ = per)	Secondary Header Time
19	Ancillary Science	Science	1 per second	MET
12	Altimeter Digitizer (AD)-Large	Science	4 per second	MET
13	Altimeter Digitizer-Small	Science	4 per second	MET
14	AD Engineering	Science	1 per second*	MET
15	Photon Counter (PC) Science	Science	1 per second	MET
16	PC Engineering	Science	1 per second*	MET
17	Cloud Digitizer (CD) Science	Science	1 per second	MET
18	CD Engineering	Science	1 per second*	MET
26	LPA Data	Science	4 per second	MET
1088	GPS	Science	1 per 10 seconds	BVTCW
1984	PRAP	Science	1 per second	BVTCW
20	CT HW 1	Engineering	1 per 4 seconds	MET
21	CT HW 2	Engineering	1 per 4 seconds	MET
22	CT HW 3	Engineering	1 per16 seconds	MET

Table C-1 APIDs used by Normal I-SIPS Processing (Continued)

APID	Packet Name	Data Type	Frequency (/ = per)	Secondary Header Time
23	CT HW 4	Engineering	1 per16 seconds	MET
24	Small Software	Engineering	1 per 4 seconds	MET
25	Large Software 1	Engineering	1 per 4 seconds	MET
50	CT HW 5	Engineering	1per 32 seconds	MET
55	Large Software 2	Engineering	1 per 4 seconds	MET
* When particular board is commanded to engineering mode				

2) The Ancillary Science packet is always output from GLAS, but for AD, CD, and PC either science or engineering exists but not both. However at any time any packet may be lost from the telemetry stream during data transmission.

3) A number of diagnostic packets from the engineering data stream will need to be accommodated. The diagnostic packets are sent upon request and will not appear regularly in the stream.

4) GLAS packets contain the GLAS Mission Elapsed Time (MET) in their secondary header. GLAS science packets are synchronized.

5) As part of the initial telemetry data processing (GL0P - GLAS Level 0 Processing) by the I-SIPS, an index number is assigned for each received ancillary science packet. All other GLAS APIDs that correspond time-wise (using the secondary header) to that ancillary science packet will be assigned the same index number. Subsequent processing can align the data by the index number.

6) GLAS science packets also contain the shot counter in order to exactly align the data, however this counter rolls over every 5 seconds (200 shots) so the secondary header time must be used for initial alignment.

7) GLAS engineering packets occur at various rates as shown in Table C-1. These are considered asynchronous to the science packets but are output on fixed shot counts. The initial telemetry processing assigns to the GLAS engineering data the index number of the GLAS APID 19 record that has a MET that is greater than the MET of the engineering data (less than 1, 4, 16, or 32 seconds before).

8) GPS and PRAP packets are asynchronous.

9) The latched BVTCW at GPS time and the GPS time are provided in the PRAP (Position, Rate, and Attitude Packet) and in the spacecraft time and position packet which is contained in the GLAS APID 19 (Ancillary science).

10) In addition to secondary header time, GLAS APID 19 contains: shot counter, Fire command time and fire acknowledge time (40 bit counters), GPS time, GLAS frequency and time board time latched to GPS time (40 bit counter), BVTCW at GPS

time, BVTCW of spacecraft position and time packet, GLAS MET near spacecraft position and time packet, and shot near spacecraft position and time packet.

11) In the spacecraft position and time packet (contained in GLAS APID 19) the GPS time and Bvtcw at GPS time pair are repeated for about 10 packets (~10 seconds). The other position packet parameters (Bvtcw for the position packet, GLAS MET and shot number near the position packet) update each second. The Bvtcw of the position packet has a small delay offset. The GLAS MET and shot number near the position packet are not absolute; these values are the latest available when the packet is received.

12) The GLAS frequency and time board time latched to GPS time appears in the GLAS APID 19 after the GPS pulse. It will be repeated for about 10 times (~10 seconds). This time must be matched to the correct GPS time of the pulse in order to convert the 40 bit counter to UTC.

13) The correct GPS time (and its latched Bvtcw) will appear in the position and time packet, contained in GLAS APID 19, approximately 10 seconds after the pulse (the Bvtcw of the position and time packet is about 10 seconds past Bvtcw latched to the GPS time).

14) The GPS/DEM information contained in GLAS APID19 is used for data collection in the next frame. Therefore, the time of this data is one second later than the time of the altimeter digitizer task data contained in GLAS APID19. See Appendix D for packet timing details.

15) The LRS and IST receive a 10 hz signal from the GLAS that requires alignment to the exact laser shot. The LRS And IST are contained in the spacecraft's PRAP. The time of the PRAP is not synchronized to the 1/second GLAS data. The index number assigned to the PRAP during initial telemetry processing provides alignment to GLAS APID 19 within two (three?) records (seconds).

16) The ISF will maintain the GLAS MET close to the spacecraft time (Bvtcw).

17) The Bvtcw will be maintained by the ICESat Mission Operations Center (MOC) to be close to continuous during the mission. MOC will reset Bvtcw after power off and for drift to maintain spacecraft time to about 3 milliseconds.

C.2 Problems to Consider:

1) For a second, some packet types may be missing when others are available.

2) At the start of a PDS or EDS any packet type may be the earliest UTC and the 4hz AD science packet set may be separated (1,2, or 3 packets at the beginning or end).

3) After time gap of all packets, any packet type may be present first.

4) ISF provides the correction table for GLAS MET. MET is a software counter therefore it increments the exact number of counts for each laser shot for a perfect 40 hz timing. It therefore will not be true time that accounts for any oscillator drift. The correction table will account for MET losses during:

- GLAS processor resets - The MET will lose some “ticks” during a reset.
- GLAS warm reboots - the MET counter attempts to keep the time (counter) but will lose a few pulse interrupts (ticks) so will “miss” time (for example if two pulses are missed the time will increment by 25 msec but really 75 ms will have really elapsed).

5) Since GLAS engineering packets occur asynchronously to the science packets are their any issues with assigning the index number to the engineering packets? (Need to determine if any smoothing needed on engineering).

C.3 Telemetry Definitions

For the GLAS Science Telemetry Definition and GLAS Engineering Telemetry Definition, see Appendix B. A high level description of the spacecraft’s Position, Rate, and Attitude Packet is contained in Table C-2 "Format of PRAP". The detailed description of the PRAP is contained in the Details of the PRAP contents are defined in the *Data Interface Control Document between the ICESat Spacecraft and the EOS Ground System (EGS)*, listed in Section 5. The format of the spacecraft’s position and time packet is shown in Table C-3 "Time and Position Message Packet Description" on page C-5.

Table C-2 Format of PRAP

Item	Size (Bytes)	Samples/ Sec	# Bytes	Cumulative Bytes
VTCW	6	1	6	6
VTCW IRU Time Tag	6	10	60	66
IRU Data	14	10	140	206
VTCW BST1 Time Tag	6	10	60	266
BST1 Data	60	10	600	866
VTCW BST2 Time Tag	6	10	60	926
BST2 Data	60	10	600	1526
IST VTCW Echo	6	10	60	1586
IST Data	64	10	640	2226
IST Health	10	10	100	2326
LRS VTCW Echo	6	10	60	2386
LRS Data	64	10	640	3026
LRS Health	4	1	4	3030
LRS Star Image	512	5	2560	5590
LRS Laser Image	512	4	2048	7638
LRS CRS Image	512	1	512	8150

Table C-2 Format of PRAP (Continued)

Item	Size (Bytes)	Samples/ Sec	# Bytes	Cumulative Bytes
Estimated Quaternion	8	1	8	8158
Estimated Position (x,y,z) - 4xf32	6	1	6	8164
Estimated Rate (x,y,z) - 3xf32	6	1	6	8170
Solar Array Position - 2xf32	4	1	4	8174
GPS Receiver Time	4	1	4	8178
VTCW latched to GPS	6	1	6	8184

Table C-3 Time and Position Message Packet Description

Description	Word
CCSDS Header (hex value = 180F)	0
CCSDS Header (hex value = C000)	1
CCSDS Header (hex value = 002B)	2
CCSDS Header (hex value = 0A00)	3
BVTCW - Most Significant Word (us)	4
BVTCW - Mid Significant Word (us)	5
BVTCW - Least Significant Word (us)	6
ECEF Position (Km) – Vector 1 –X - double	7
ECEF Position (Km) – Vector 1–X – double	8
ECEF Position (Km) – Vector 1–X – double	9
ECEF Position (Km) – Vector 1–X – double	10
ECEF Position (Km) – Vector 2–Y - double	11
ECEF Position (Km) – Vector 2–Y – double	12
ECEF Position (Km) – Vector 2–Y – double	13
ECEF Position (Km) – Vector 2–Y – double	14
ECEF Position (Km) – Vector 3–Z - double	15
ECEF Position (Km) – Vector 3–Z – double	16
ECEF Position (Km) – Vector 3–Z – double	17
ECEF Position (Km) – Vector 3–Z - double	18
GPS Rcvr Time (Seconds) - unsigned long int	19

Table C-3 Time and Position Message Packet Description (Continued)

Description	Word
GPS Rcvr Time (Seconds) – unsigned long int	20
BVTCW@ 0.1 Hz pulse - Most Significant Word (us)	21
BVTCW@ 0.1 Hz pulse - Mid Significant Word (us)	22
BVTCW@ 0.1 Hz pulse - Least Significant Word (us)	23
Note1: This message is time-tagged when sent, which is within 300 msec of when the position data is valid. Note2: The position message in GLAS APID 19 does not include the CCSDS header.	

Appendix D

GLAS Science Packets
Synchronization and Alignment Information

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER

ICESAT GLAS Flight Software

GLAS Science Packets
Synchronization and Alignment

Prepared by
Steven Slegel

December 5, 2001

Author:

Steven Slegel/ GLAS Flight Software Engineer
Date

Approvals:

Kris Naylor/Build/Acceptance Test Lead
Date

Eleanor Ketchum/GLAS Systems Engineer
Date

Peggy Jester/ICESAT Science Processing Engineer
Date

David Hancock/ICESAT Science Ground System Manager
Date

Manuel Maldonado/GLAS Software Lead Engineer
Date

Joseph Polk/ GLAS Flight Software Engineer
Date

Dwaine Molock/GLAS Flight Software Engineer
Date

Peter Kutt/ GLAS Flight Software Engineer
Date

Overview

This document describes when and how often Science and Ancillary data is collected and how this data correlates with each other. For more information regarding the contents of each packet see the GLAS SCIENCE TELEMETRY PACKETS DEFINITION DOCUMENT (GLAS-582-SPEC-002).

GLAS Science Packets

The following Science packets are generated by the GLAS flight software.

Photon Counter Science Packet

The Photon Counter task generates 1 Photon Counter Science Packet per second while the task is in Science Mode. This packet contains 40 shots of data. The Science packet is time stamped when the packet is sent; on the 40^{th} shot. The shot counter is recorded on the first shot of the frame.

Photon Counter Engineering Packet

The Photon Counter task generates 1 Photon Counter Engineering Packet per second while the task is in Engineering Mode. This packet contains 15 shots of data. The Engineering packet is time stamped when the packet is sent; on the 40^{th} shot. The shot counter is recorded on the first shot of the frame.

Cloud Digitizer Science Packet

The Cloud Digitizer task generates 1 Cloud Digitizer Science Packet per second while the task is in Science Mode. This packet contains 40 shots of data. The Science packet is time stamped when the packet is sent; on the 40^{th} shot. The shot counter is recorded on the first shot of the frame.

Cloud Digitizer Engineering Packet

The Cloud Digitizer task generates 1 Cloud Digitizer Engineering Packet per second while the task is in Engineering Mode. This packet contains 20 shots of data. The Engineering packet is time stamped when the packet is sent; on the 40^{th} shot. The shot counter is recorded on the first shot of the frame.

Altimeter Digitizer Science Packet

The Altimeter Digitizer task generates four Altimeter Digitizer Science packets per second while the task is in Science mode. Each science packet contains 10 shots of science data. Each shot of science data contains the shot counter value indicating the shot in which the data was sampled. The Altimeter Digitizer science packets are time stamped when the packet is sent; on the 10^{th}, 20^{th}, 30^{th}, and 40^{th} shots.

LPA Data Packet

The DC&H task generates four LPA Data packets per second while the task is in SSR_LPA mode. The LPA packet is time stamped when the packet is sent; on the 10^{th}, 20^{th}, 30^{th}, and 40^{th} shots. There are ten shots of LPA data per packet and the shot count is recorded separately for each shot in the packet.

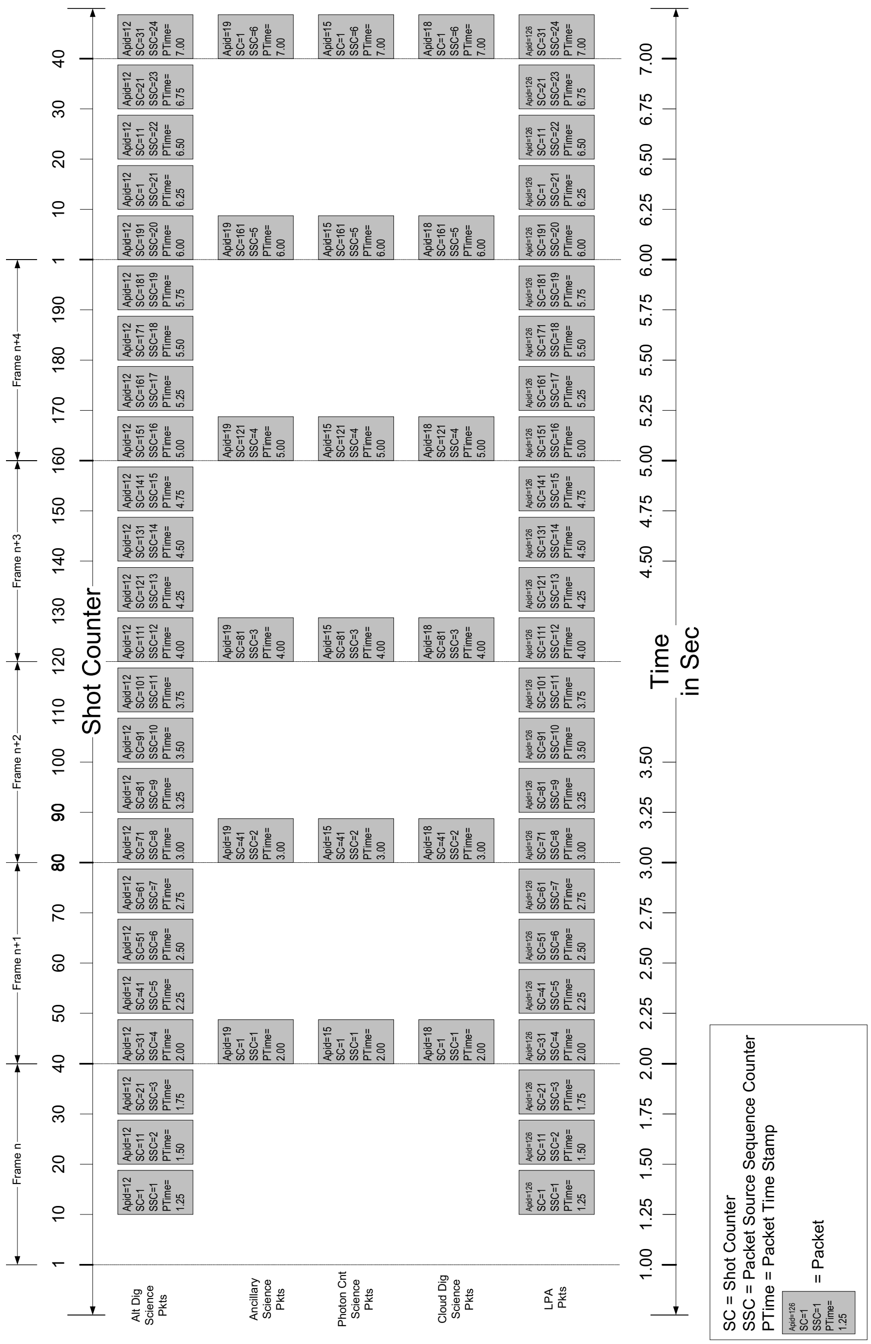
Ancillary Data Packet

The Ancillary packet is generated once per second by the CT Task while the task is in NORMAL mode. The Ancillary packet is time stamped when it is sent; on the 40th shot. The Ancillary packet is a combination of data collected by various tasks. Each task that contributes to the ancillary packet will send it's portion of the ancillary data to the CT task every second. The CT task will then collect the various pieces of ancillary data and combine them together into one packet. Not all tasks will provide ancillary data all the time. That will depend on the current mode of the task. A flag in the ancillary packet indicates which tasks have contributed data to the current combined ancillary packet. The following table describes in what mode each task generates ancillary telemetry.

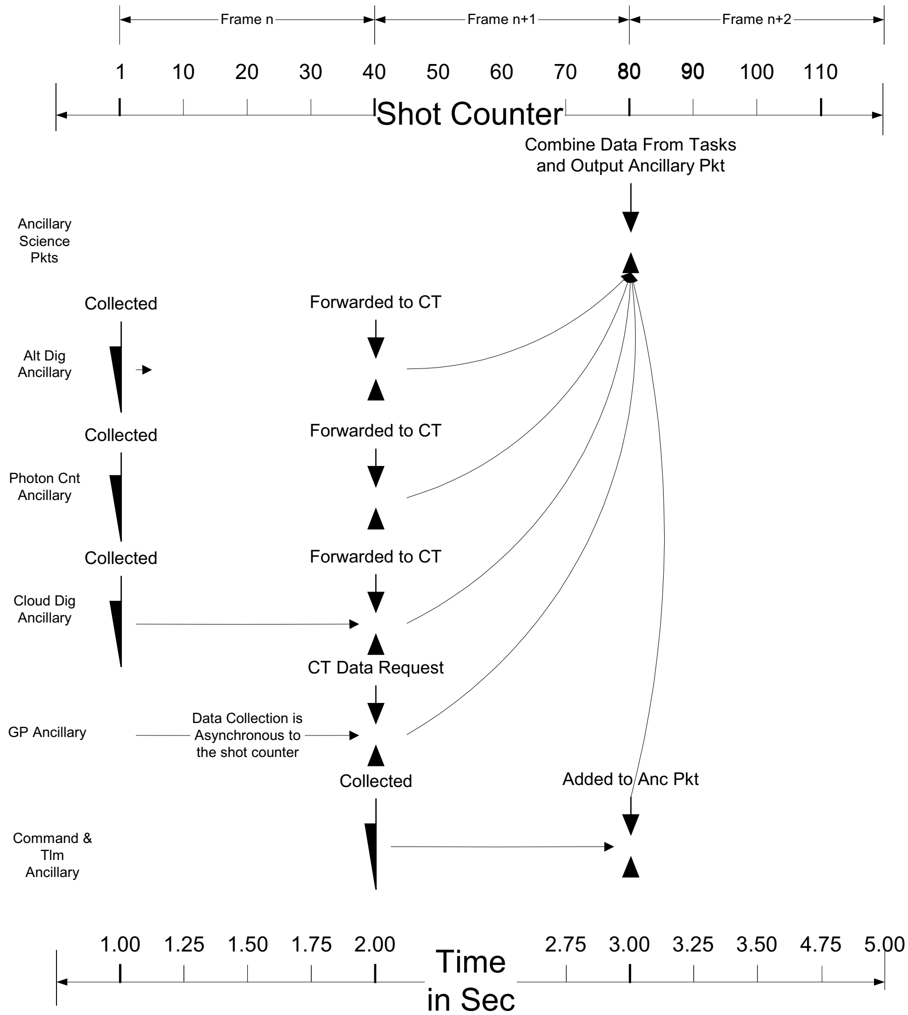
Task	Mode	Generates Ancillary Data
Photon Counter	Idle	No
	Science	Yes
	Engineering	Yes
	Boresite Cal	No
	Memory Test	No
Altimeter Digitizer	Idle	No
	Science	Yes
	1-Shot	Yes (Only 1 packet)
	Load	No
	Dump	No
Cloud Digitizer	Idle	Yes
	Science	Yes
	Engineering	Yes
	Memory Test	No
DC&H	SSR	No
	SSR_LPA	No
	Test	No
CT	Manual	No
	Normal	Yes
GP	N/A	Always sends when requested by CT

Timing Relationship Between Different Science Packets

The diagram below shows graphically the relationship between when each science packet is generated.



Synchronizing the Ancillary packet with it's corresponding Science packets can be confusing because Science Data is collected at different rates and the Ancillary Packet is output at a different time than it's corresponding Science Packets. The diagram below shows graphically when each task collects it's portion of the ancillary in relation to when the ancillary packet is output by the CT task.



Notes:
Altimeter Digitizer Ancillary:

- Ancillary telemetry is collected during the first 4 shots of the frame.
- Ancillary telemetry is stamped with the shot count value for the first shot in the frame where the data is collected.
- Ancillary telemetry is collected during the first shot of the frame in 1-Shot mode.
- Only one ancillary telemetry packet is generated in 1-Shot mode.
- Ancillary data is forwarded to CT on the 40^{th} shot.

Photon Counter Ancillary:

- Collected on shot 1 in Science and Engineering modes.
- Ancillary telemetry is stamped with the shot count value for the first shot in the frame where the data is collected.
- Ancillary data is forwarded to CT on the 40^{th} shot.

Cloud Digitizer Ancillary:

- Fire Cmd, Fire Ack, and GPS 10 Second Pulse forty bit counters are collected on every shot in all modes.
- The rest of the CD ancillary data is collected on shot 1 in Science and Engineering modes.
- Ancillary telemetry is stamped with the shot count value for the first shot in the frame where the data is collected.
- Ancillary data is forwarded to CT on the 40^{th} shot.

GP Ancillary:

- GPS collects the GPS 40 bit counter from the CD task every 10 seconds upon the receipt of the GPS 10 second pulse. This 40 bit counter corresponds to the last 10 second GPS pulse and is included as part of GP's ancillary telemetry.
- Position/Range data is also part of GP’s ancillary telemetry and is updated every second.
- GP will only send ancillary data to the CT task when it receives a ancillary telemetry request packet from CT.

CT Ancillary:

- Etalon status information is collected on shot 1.
- Dual pin A, B and 532 energy data is collected on every shot.
- CT requests ancillary data from the GP task on the 40^{th} shot. All other tasks automatically forward the data to CT on the 40^{th} shot.
- CT adds the new ancillary data from the other tasks to the combined ancillary packet on the 20^{th} shot.
- CT adds it’s own piece of the ancillary data to the combined ancillary packet on the 40^{th} shot.
- Since CT is the sender of the ancillary packet it's own ancillary data is collected on the current frame where the other tasks data is collected on the previous frame.

DC&H does not contribute to the ancillary telemetry

Appendix E

Laser Energy Calibration

The Laser Energy GLAS Instruments Measurements Summary and the GLAS Laser Gain Correction are discussed in the assigned sub-Appendices.

E.1 Laser Energy GLAS Instruments Measurements Summary - Discussion of Laser Energy Calibration

E.2 GLAS Laser Gain Correction - Discussion of Gain Correction to be applied within the Laser Energy Calculation.

Appendix E.1

Laser Energy GLAS Instruments Measurements Summary

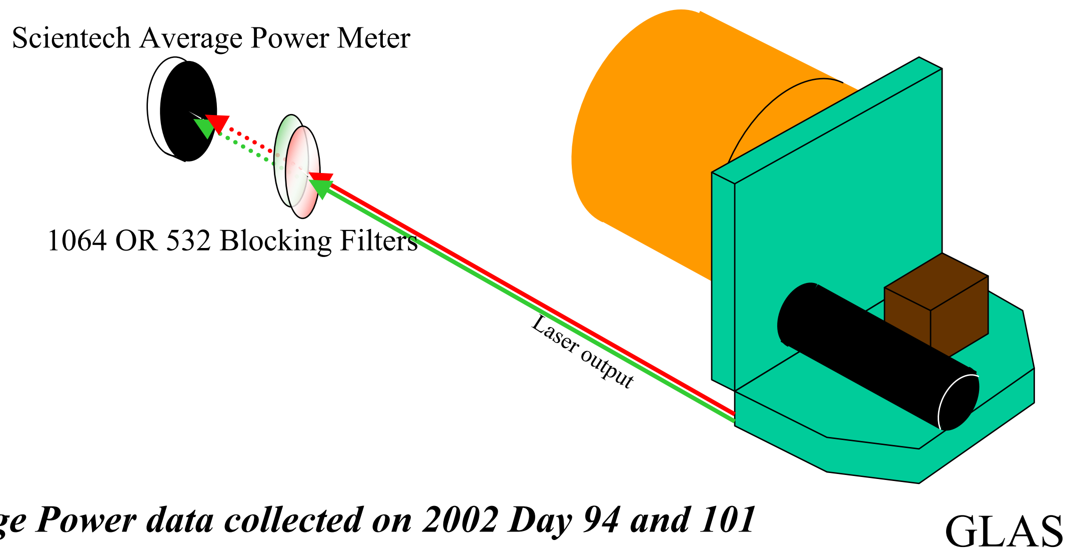
GLAS BCE Group
H.Riris, P.Liiva, J.Hirs, J.Schafer, J.Nissley
10/8/2003

Measurements Summary

- Average power and laser energy measurements during GLAS instrument testing at GSFC - Comparison with SLTC average power measurements before delivery to GLAS
- Laser energy measurements at observatory
- Altimeter Detector laser energy calibration
- *Relative* Laser energy measurements during instrument TVAC - Comparison with Altimeter Detector laser energy
- *Relative* Laser energy during observatory TVAC - Comparison with Altimeter Detector laser energy
- Correlation of Laser energy measurements with LPA
- Correlation of Laser energy measurements with LRS

Average power and energy measurements during GLAS instrument testing at GSFC Comparison with SLTC average power measurements before delivery to GLAS

Average laser power measurement at GSFC
(similar to SLTC method)



Average Power data collected on 2002 Day 94 and 101

Average Power Measurements Comparison with SLTC

		GLAS Measured Power (W)			GLAS Actual Power (W)			Delta ABS	Delta %	SLTC Measurements* Power (W)				Delta GLAS-SLTC ABS	ABS	ABS	Delta GLAS-SLTC %	%	%
Laser	**Date**	**532**	**1064**	**Total**	**532**	**1064**	**Total**			**Laser**	**532**	**1064**	**Total**	**532**	**1064**	**Total**	**532**	**1064**	**Total**
Laser 1	4/11/2002	1.11	2.81	4.3	1.41	2.88	4.29	0.01	0.3%	SN2	1.36	2.80	4.16	0.05	0.08	0.13	3.5%	2.8%	3.0%
Laser 2	4/11/2002	1.01	3.12	4.45	1.28	3.20	4.48	-0.03	-0.7%	SN3	1.29	3.10	4.39	-0.01	0.10	0.09	-0.7%	3.1%	2.0%
Laser 3	4/4/2002	0.78	3.2	4.27	0.99	3.28	4.27	0.00	0.0%	SN1	1.18	3.26	4.43	-0.19	0.02	-0.16	-19.2%	0.8%	-3.9%

**From SLTC delivery package 3/26/02*

GLAS Energy Derived Energy (mJ)		SLTC Energy Derived Energy (mJ)	
532	**1064**	**532**	**1064**
35.2	72.0	34.0	70.0
32.0	79.9	32.3	77.5
24.7	82.0	29.5	81.4

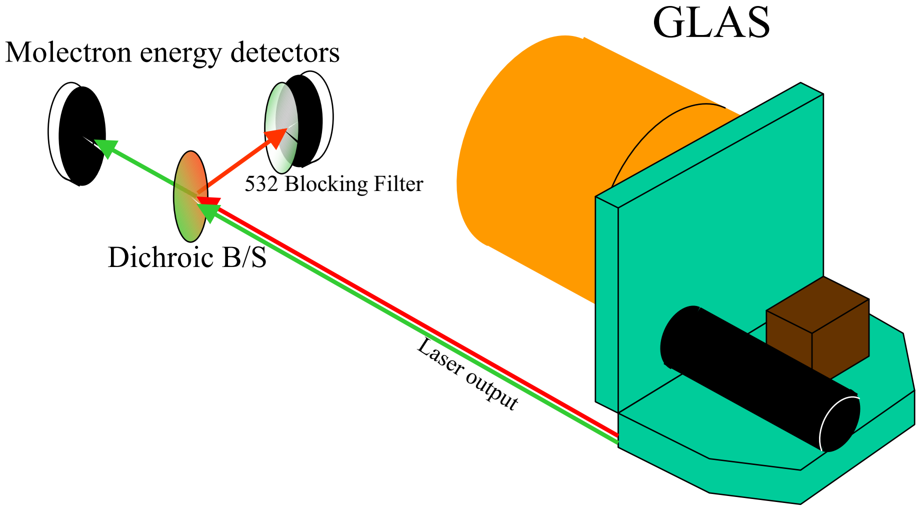
Derived Energy (mJ) ≡ Average Power(W)/40 Hz

Explanation of Terms

Measured Power (W)	**GLAS**
532	Power Measured with 1064 blocking filters in place
1064	Power Measured with 532 blocking filters in place
Total	Power Measured with no blocking filters in place
Actual Power (W)	**GLAS**
532	Power adjusted for 1064 blocking filters loss
1064	Power adjusted for 532 blocking filters loss
Total	Sum of Actual Power 532 + 1064; should equal Measured Power Total
Delta ABS	Absolute Difference between Measured Power - Actual Power (should be zero if filter attenuation is correct)
Delta %	Percentage Difference between Measured Power - Actual Power (should be zero if filter attenuation is correct)
Delta GLAS-SLTC	Difference between GLAS Actual Power and SLTC Power (Absolute or percentage)

5

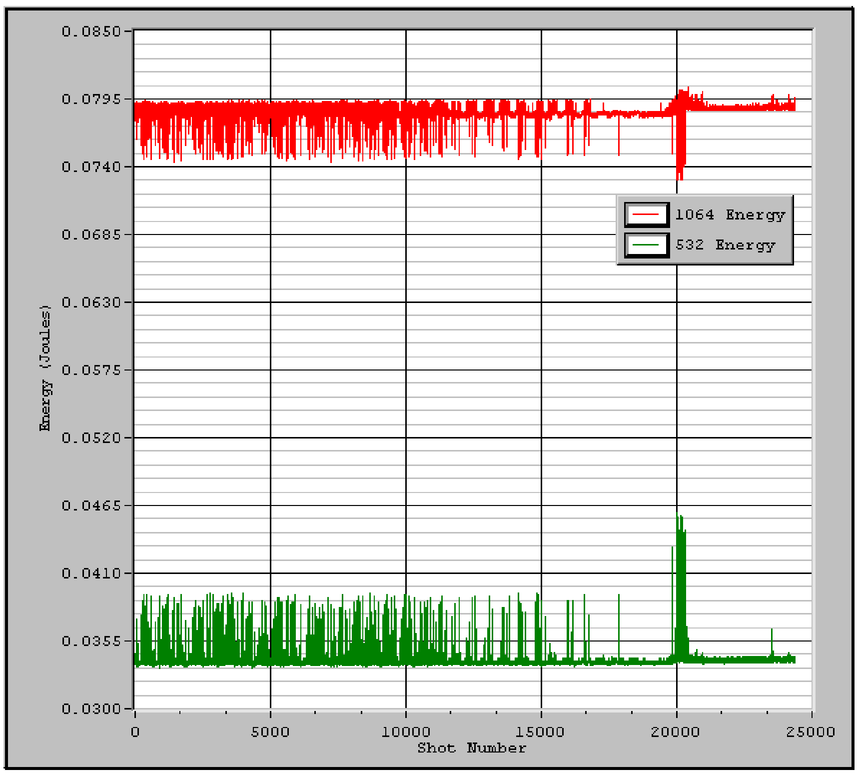
Laser Energy measurement using high energy optical detectors



Energy data collected on 2002 Day 156
No Laser 1 data were collected

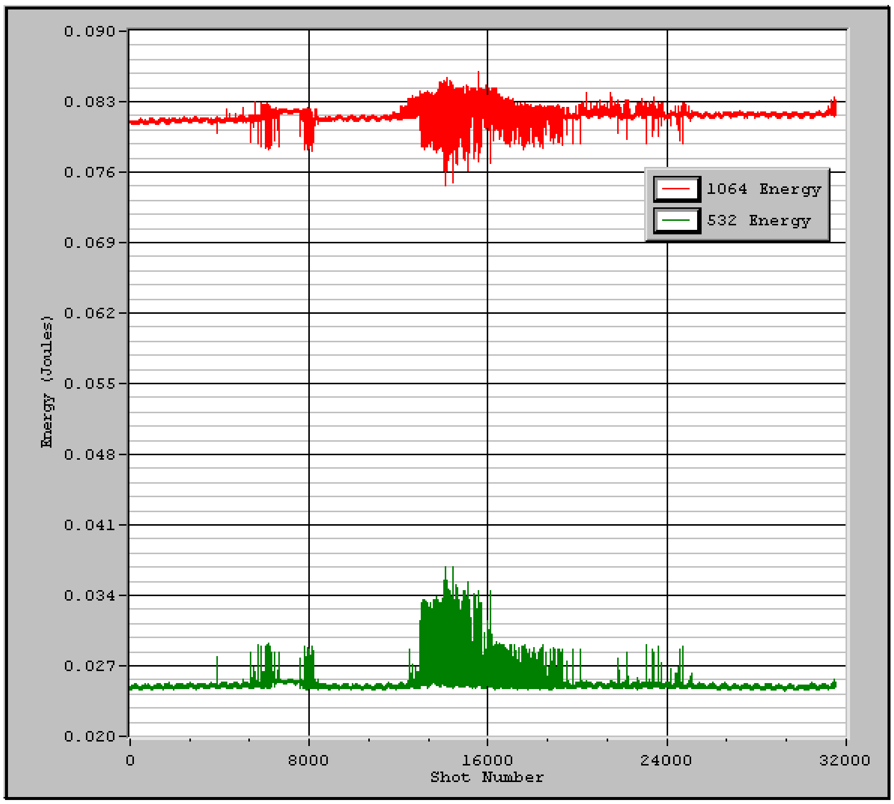
Laser 2 - at nominal Temperature

Data have been corrected for B/S and filter Transmittance



Laser 3 - at nominal Temperature

Data have been corrected for B/S and filter Transmittance



Laser Energy Summary June 5 2002

	GSFC High Energy Molectron Measurements						GLAS Derived Energy*		SLTC Derived Energy	
	Min. Energy (mJ)		Max. Energy (mJ)		Aver. Energy (mJ)		Derived Energy (mJ)		Derived Energy (mJ)	
Laser	**532**	**1064**	**532**	**1064**	**532**	**1064**	**532**	**1064**	**532**	**1064**
Laser 1	*Not Measured*		*Not Measured*		*Not Measured*		35.2	72.0	34.0	70.0
Laser 2*	33.0	72.9	45.9	84.0	33.9	78.5	32.0	79.9	32.3	77.5
Laser 3**	24.5	74.6	36.8	86.0	25.2	81.7	24.7	82.0	29.5	81.4

**Derived Energy = Average Power/40 Hz (From Slide 5)*

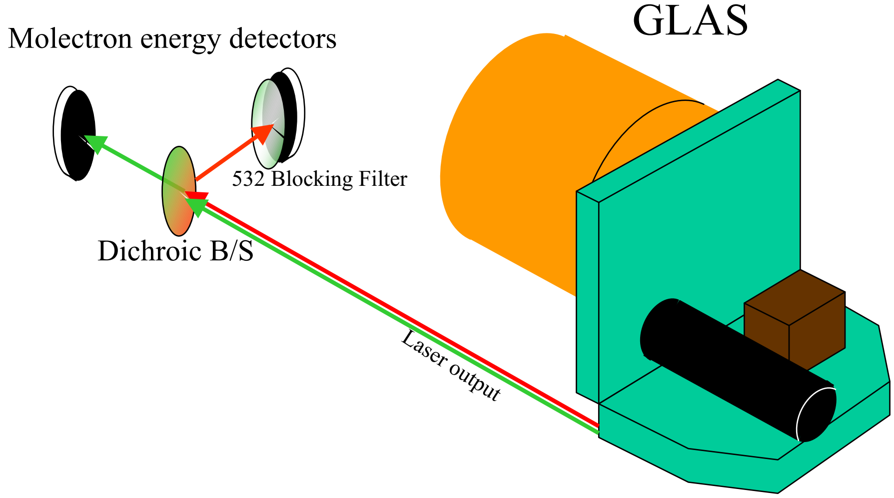
	GSFC High Energy Molectron Measurements						Molectron - GLAS Derived		Molectron - GLAS Derived	
	Min. Energy (mJ)		Max. Energy (mJ)		Aver. Energy (mJ)		ABS	ABS	%	%
Laser	**532**	**1064**	**532**	**1064**	**532**	**1064**	**532**	**1064**	**532**	**1064**
Laser 1	*Not Measured*		*Not Measured*		*Not Measured*		*Not Measured*		*Not Measured*	
Laser 2*	33.0	72.9	45.9	84.0	33.9	78.5	1.9	-1.4	5.5%	-1.8%
Laser 3**	24.5	74.6	36.8	86.0	25.2	81.7	0.5	-0.3	1.8%	-0.4%

	GSFC High Energy Molectron Measurements						Molectron- SLTC		Molectron- SLTC	
	Min. Energy (mJ)		Max. Energy (mJ)		Aver. Energy (mJ)		ABS	ABS	%	%
Laser	**532**	**1064**	**532**	**1064**	**532**	**1064**	**532**	**1064**	**532**	**1064**
Laser 1	*Not Measured*		*Not Measured*		*Not Measured*		*Not Measured*		*Not Measured*	
Laser 2*	33.0	72.9	45.9	84.0	33.9	78.5	1.7	1.0	4.9%	1.3%
Laser 3**	24.5	74.6	36.8	86.0	25.2	81.7	-4.3	0.3	-17.0%	0.4%

**Statistics on 24393 points*
***Statistics on 31531 points*

Laser energy measurements at observatory

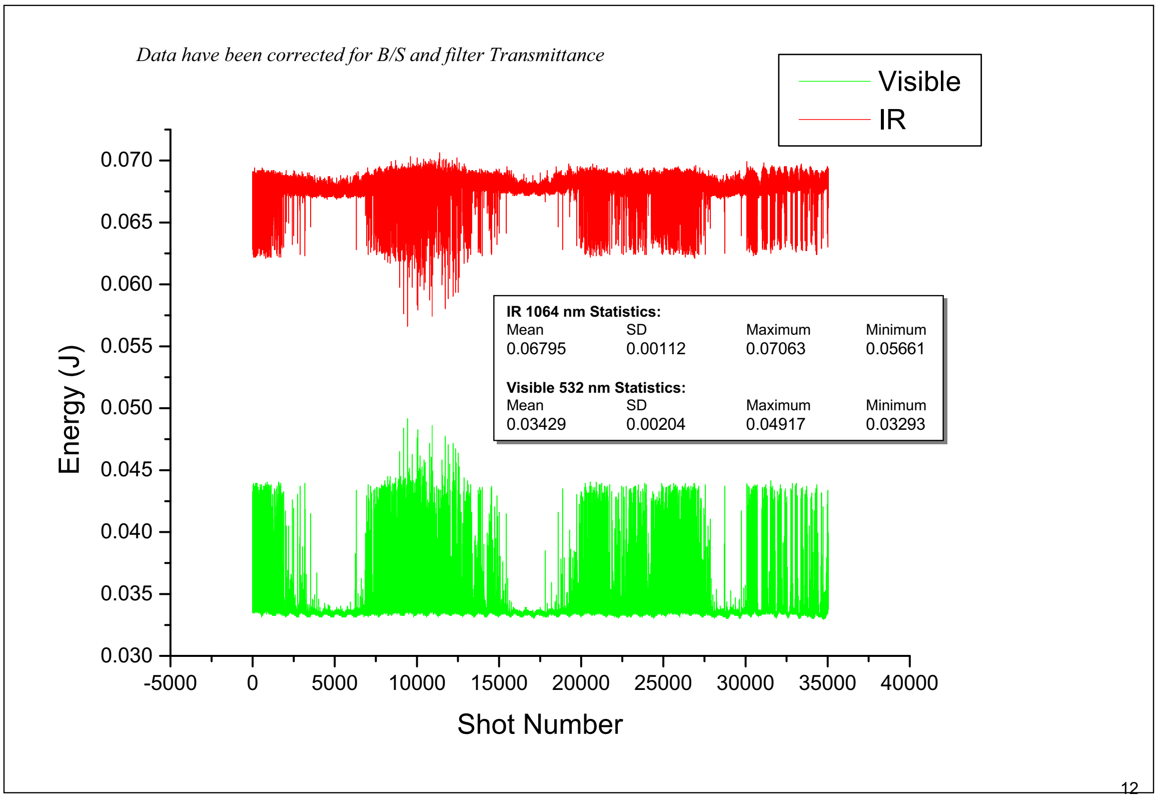
Laser Energy measurement using high energy optical detectors at Observatory level



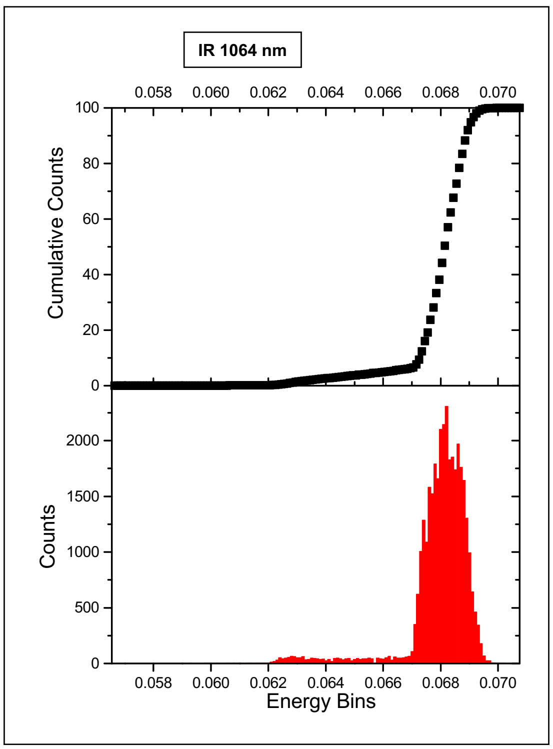
Energy data collected on 2002 Day 281

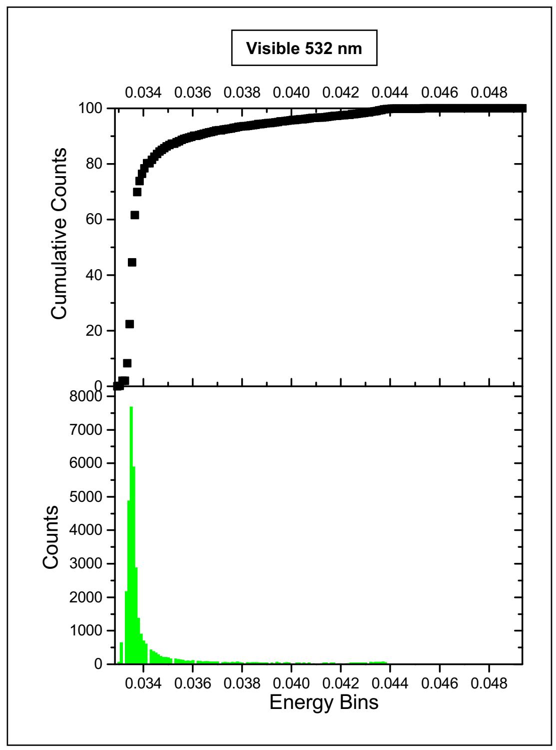
11

Laser 1 Energy - at nominal Temperature



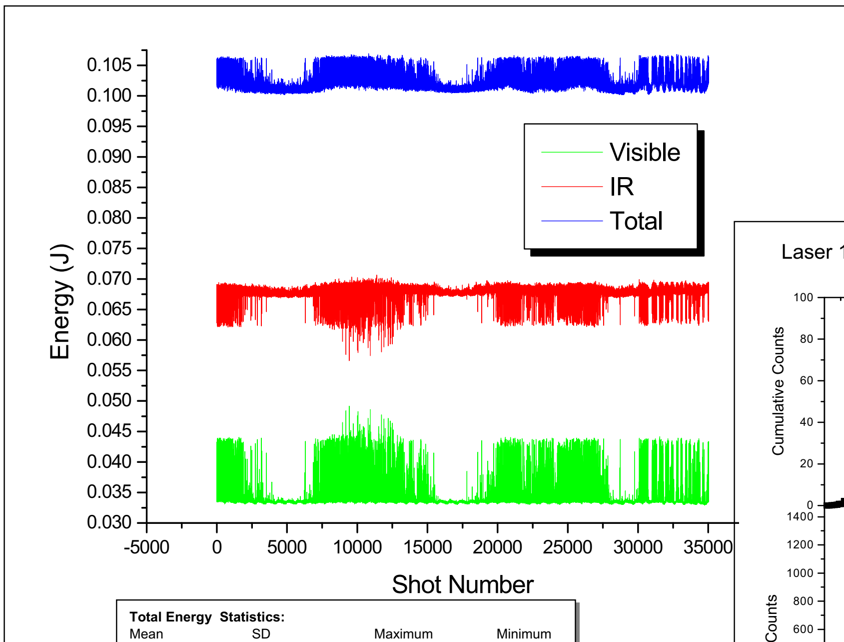
Laser 1 Energy Distributions



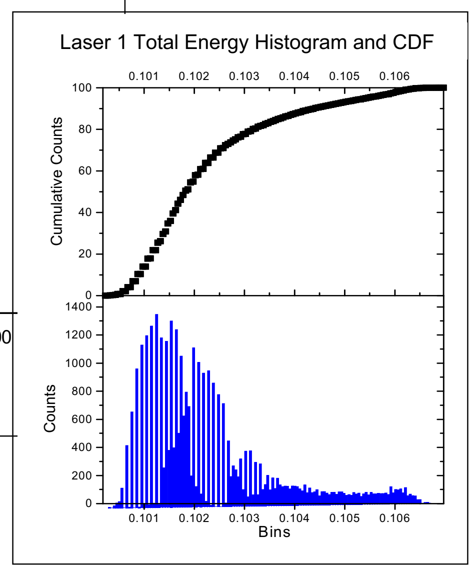


13

Laser 1 Total Energy - at nominal Temperature

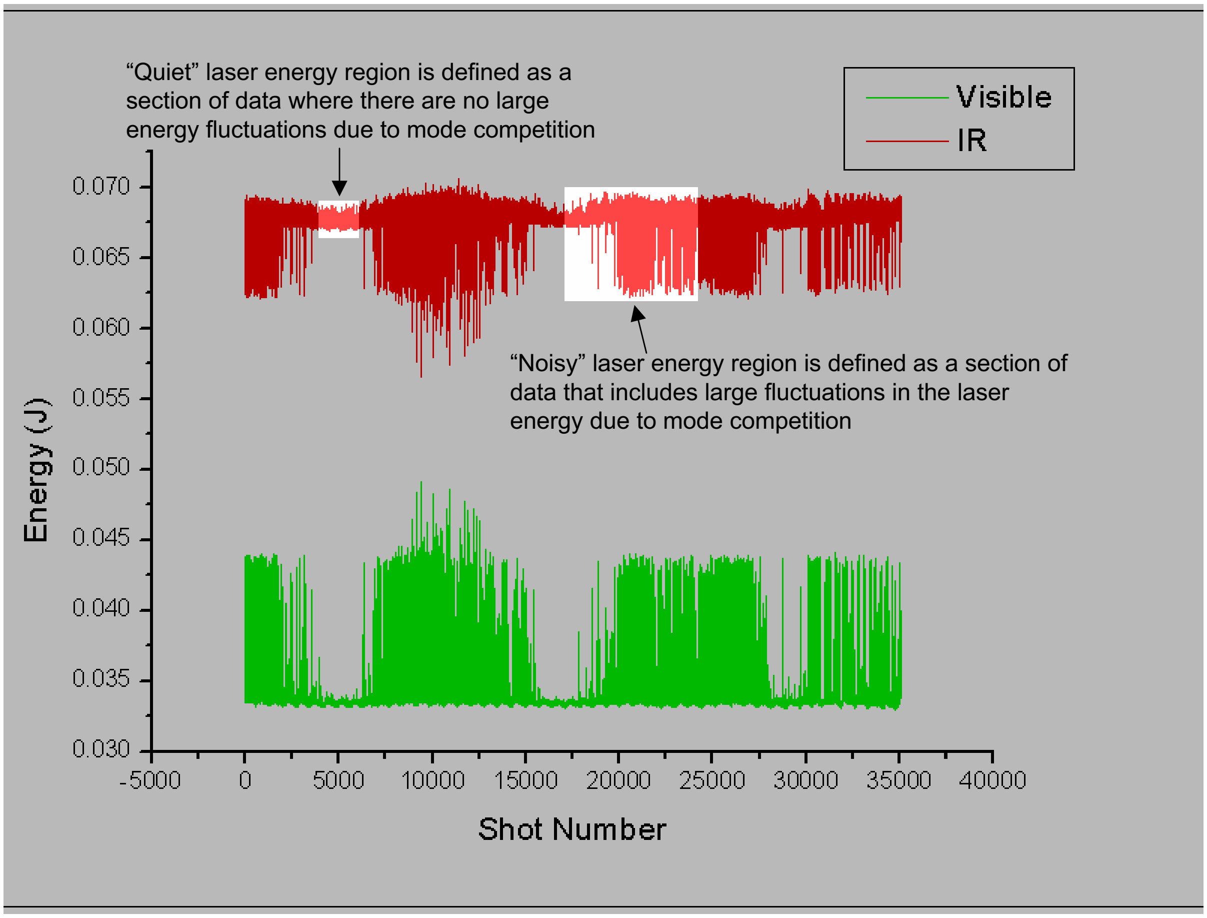


Total Energy Statistics:			
Mean	SD	Maximum	Minimum
0.10224	0.00137	0.10694	0.10021
IR 1064 nm Statistics:			
Mean	SD	Maximum	Minimum
0.06795	0.00112	0.07063	0.05661
Visible 532 nm Statistics:			
Mean	SD	Maximum	Minimum
0.03429	0.00204	0.04917	0.03293

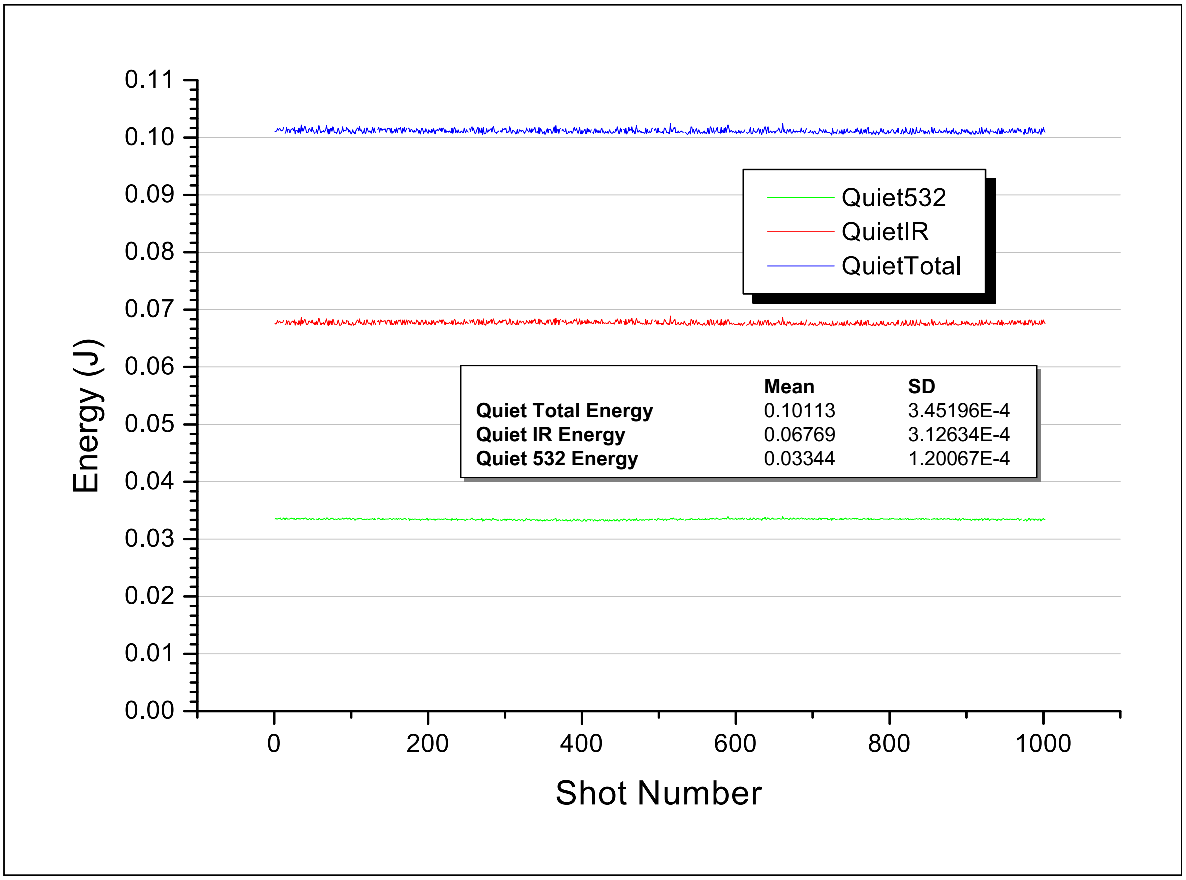


15

Comparison of “Quiet” with “Noisy” Data Statistics



Laser 1 "Quiet Energy Region"



Laser 1 Noisy Data and Quiet Energy Data Comparison

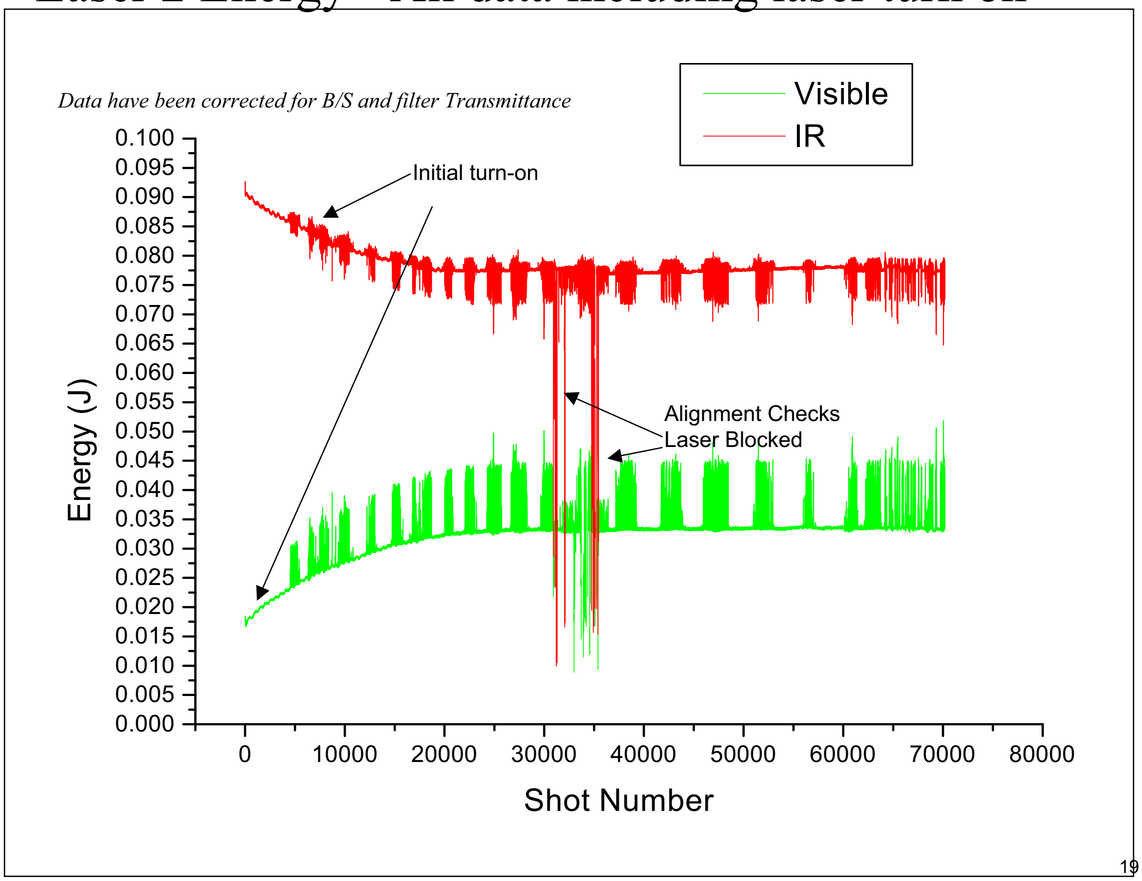
	Noisy Data		Quiet Data		Noisy - Quiet
	Average	St Dev	Average	St Dev	Delta Average
Total Energy (mJ)	102.24	1.37	101.13	0.345	1.11
1064 nm Energy (mJ	67.95	1.12	67.69	0.312	0.26
532 nm Energy (mJ)	34.29	2.04	33.44	0.12	0.85

Conclusion:
In this example, when comparing arbitrary sections of “quiet” and “noisy” data, the mean value of the total laser energy can change by 1.11 mJ (or ~ 1%).

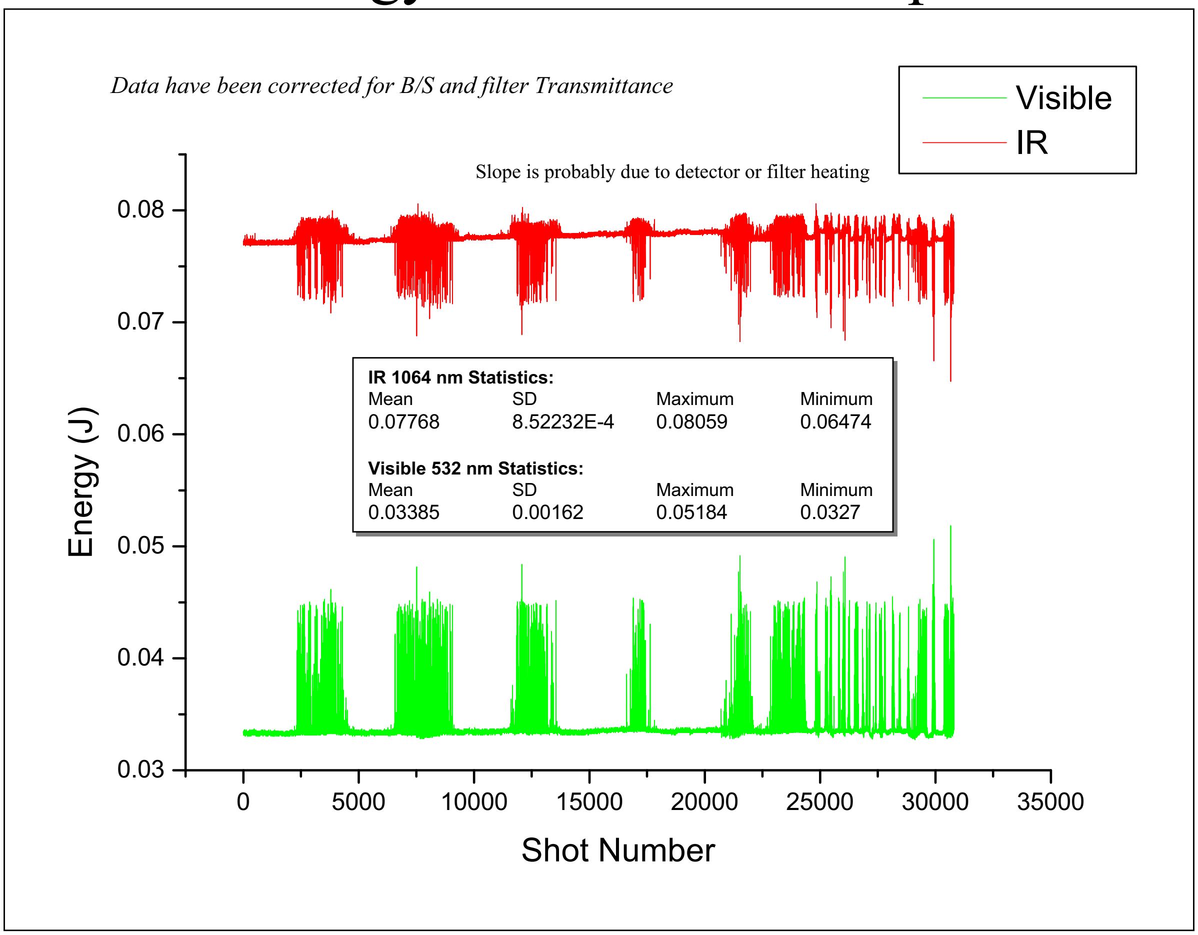
The mean of the 1064 and 532 nm (Green) energies can change by 0.26 mJ and 0.85 mJ (or 0.38% and 2.47% respectively).

Thus, any laser energy measurement will have a small error (~1%) depending on the sampling time (region) and the number of “noisy” data included in the sample.

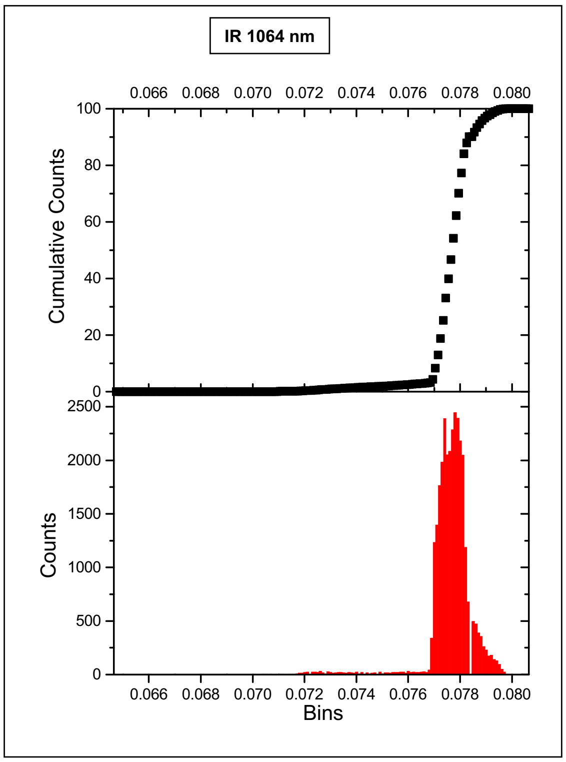
Laser 2 Energy - All data including laser turn on

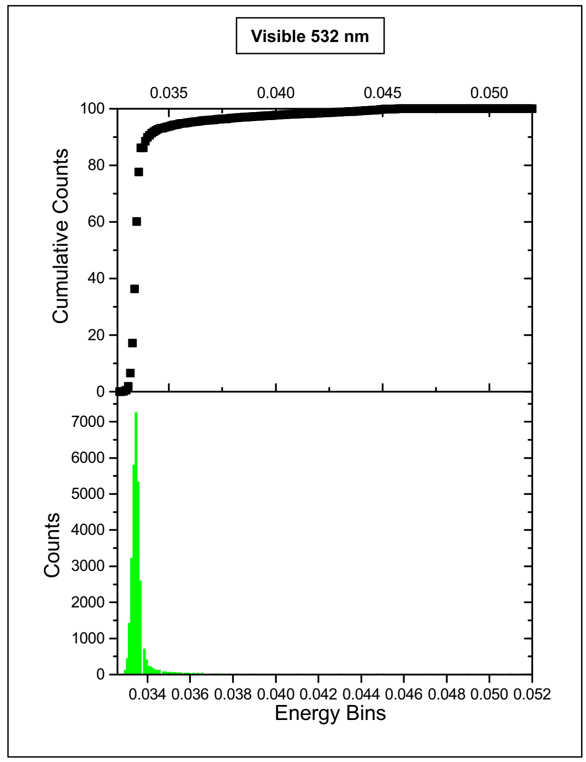


Laser 2 Energy - at nominal Temperature



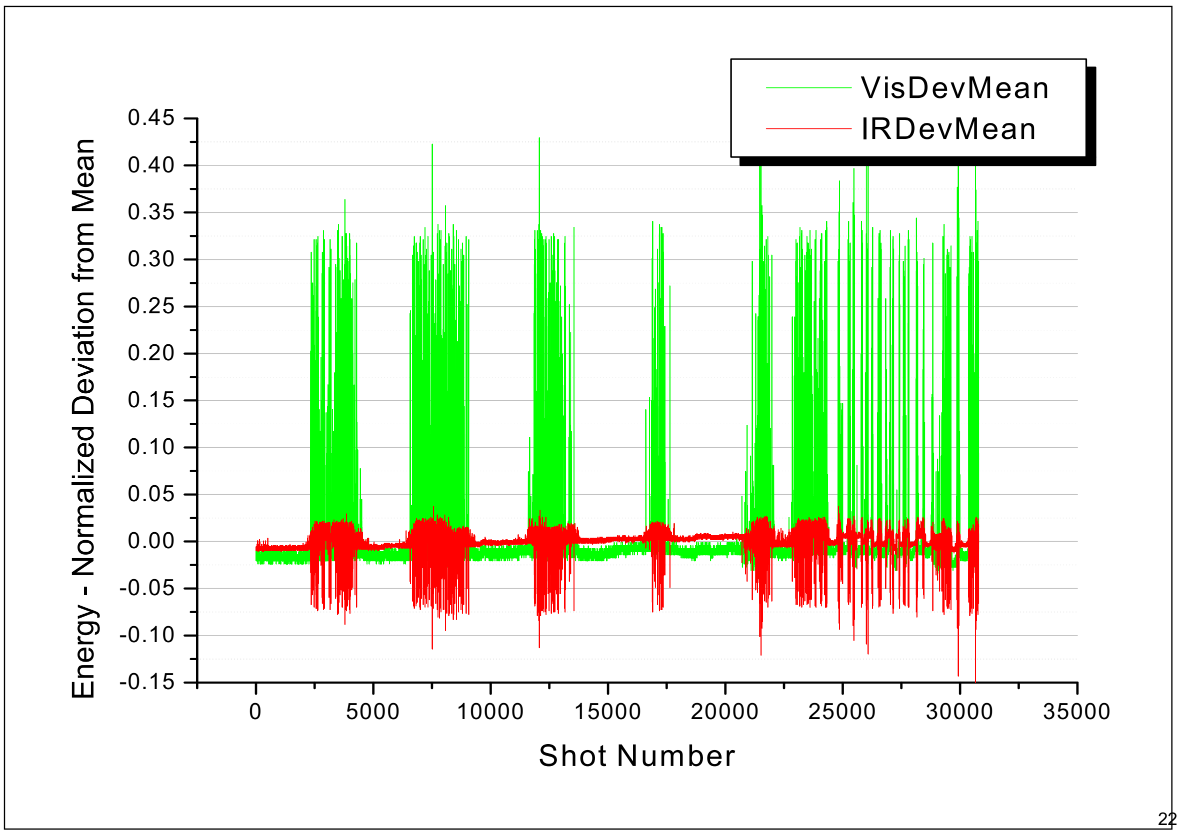
Laser 2 Energy Distributions



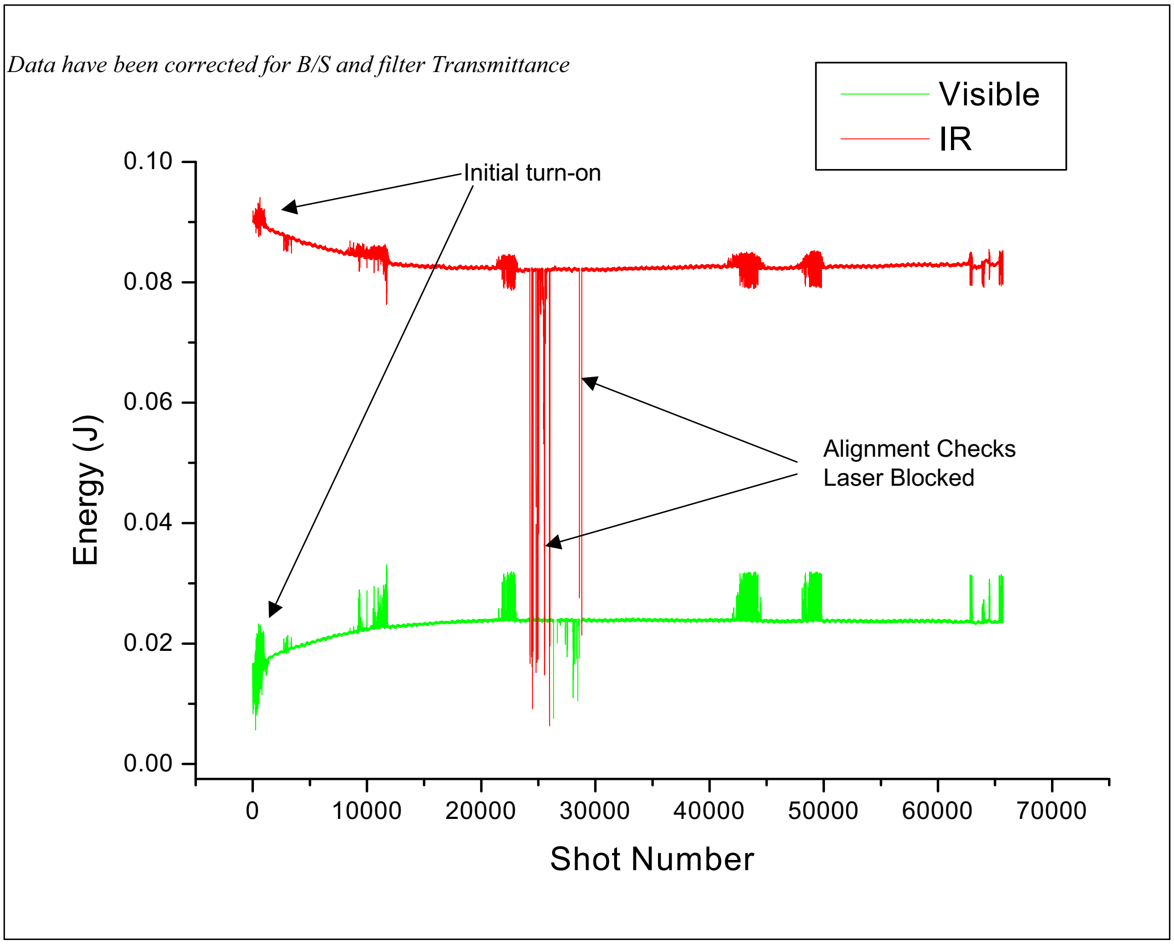


2

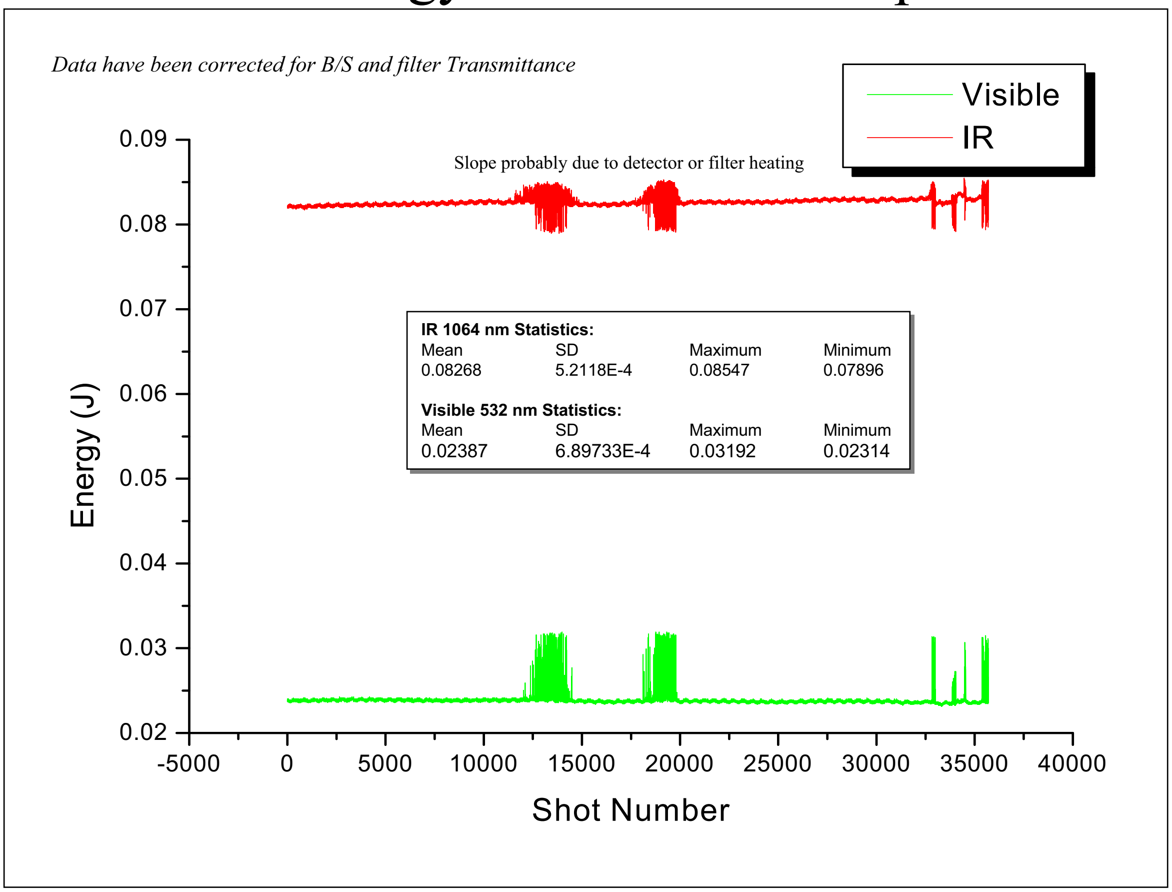
Laser 2 Energy - Normalized Deviation from the Mean



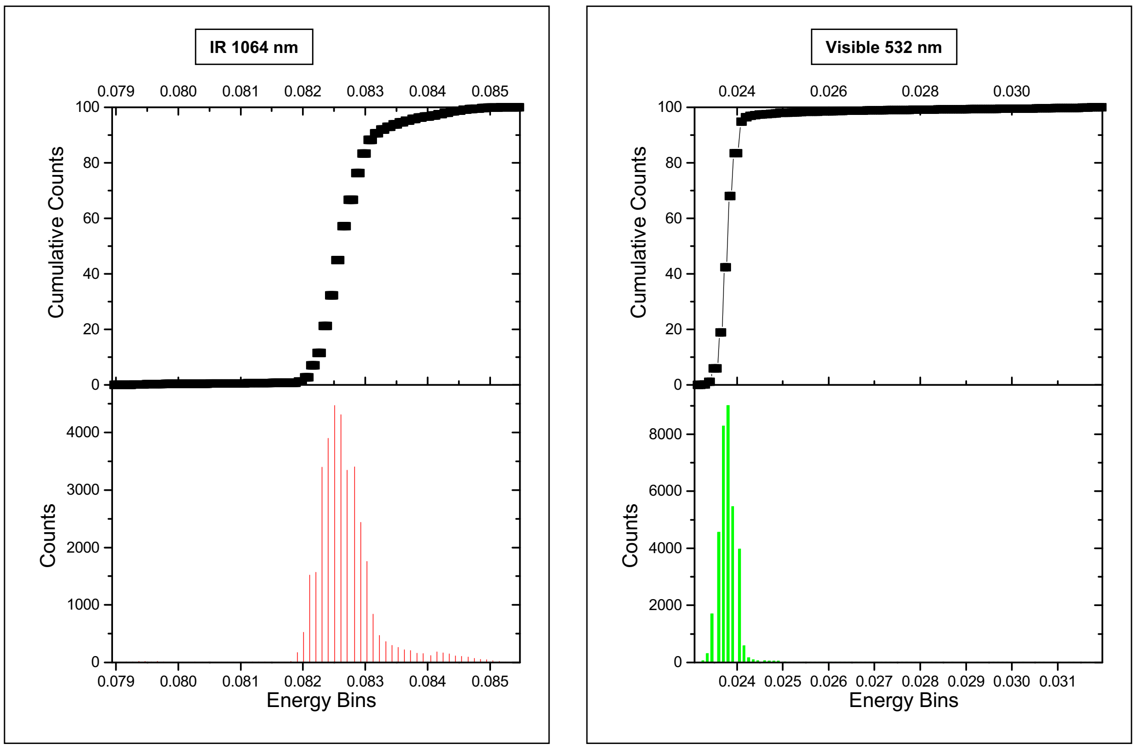
Laser 3 Energy - All data, including laser turn on



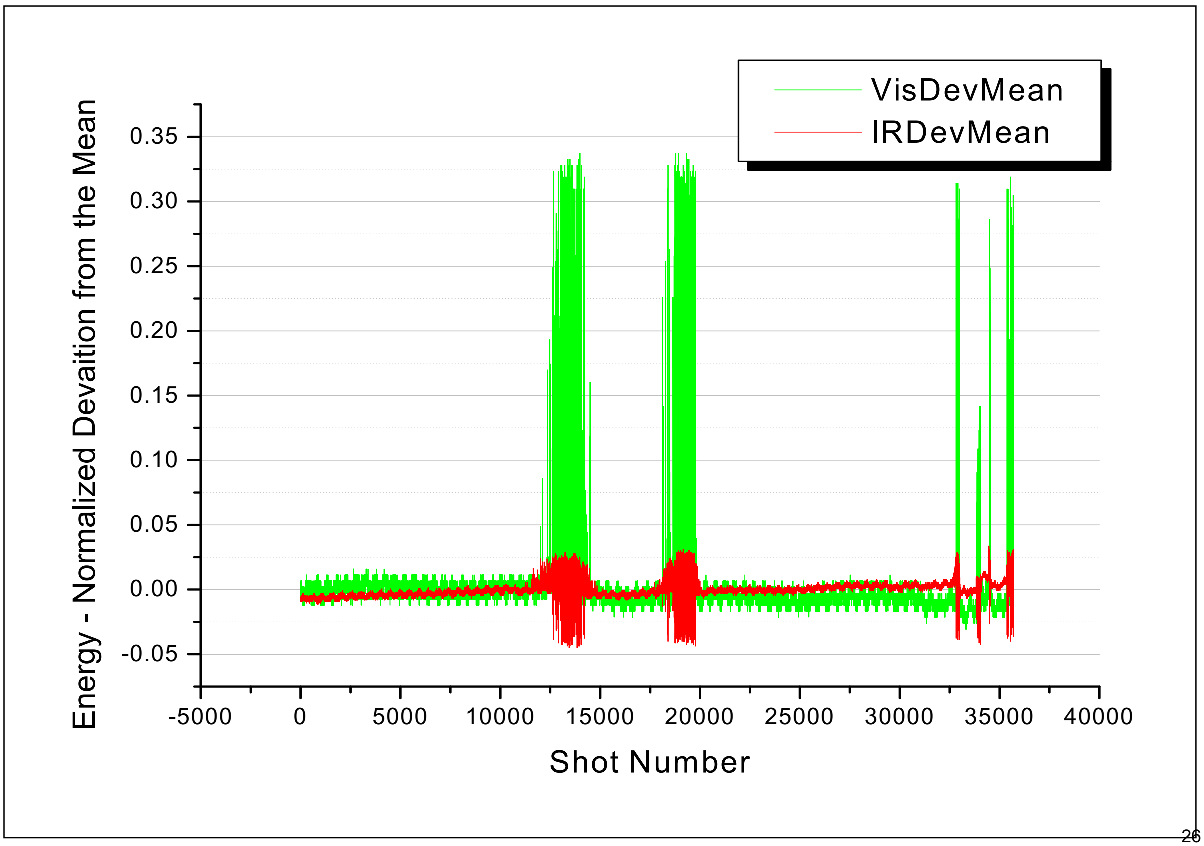
Laser 3 Energy - at nominal Temperature



Laser 3 Energy Distributions



Laser 3 Energy - Normalized Deviation from the Mean



Laser Energy Summary
Oct 8 2002

	Observatory High Energy Molectron Measurements						Observatory - GSFC Delta			
	Min. Energy (mJ)		Max. Energy (mJ)		Aver. Energy (mJ)		ABS	ABS	%	%
Laser	**532**	**1064**	**532**	**1064**	**532**	**1064**	**532**	**1064**	**532**	**1064**
Laser 1	32.9	56.61	49.2	70.6	34.3	68.0	*Not Measured*		*Not Measured*	
Laser 2	32.7	64.7	80.6	80.6	33.9	77.7	0.0	-0.8	-0.1%	-1.1%
Laser 3	23.1	79.0	31.9	85.5	23.9	82.7	-1.33	1.0	-5.6%	1.2%

	GSFC High Energy Molectron Measurements					
	Min. Energy (mJ)		Max. Energy (mJ)		Aver. Energy (mJ)	
Laser	**532**	**1064**	**532**	**1064**	**532**	**1064**
Laser 1	*Not Measured*		*Not Measured*		*Not Measured*	
Laser 2*	33.0	72.9	45.9	84.0	33.9	78.5
Laser 3**	24.5	74.6	36.8	86.0	25.2	81.7

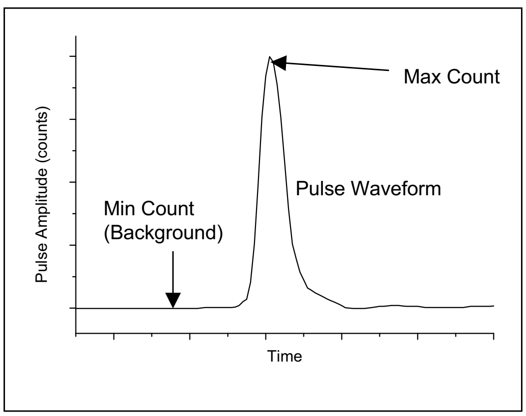
Altimeter Detector laser energy calibration

GLAS detector data collected on:

2002, Day 264 with Detector 1, Digitizer 1 (Tx Gain=41)

2002, Days 184, 201, and 247 with Detector 2, Digitizer 2 (Tx Gain=41)

Assumption: Nothing changed between Days 264, 184, 201, 247 and Day 281 when the detector 1, and 2, and the high energy Molectron measurements were taken



Estimate of GLAS Energy from Altimeter Detectors

$$\hat{E} = \frac{\Delta\tau \times \sum_{0}^{47} v_r(i)}{\eta_c \cdot \eta_{optical} \cdot R_{det} \cdot G_{VGA} \cdot \alpha_{cal}} \qquad (5)$$

where

$\hat{E}$ is the laser pulse energy in Joules corresponding to the waveform sample.

$\Delta\tau$ is the sampling interval = 1×10^{-9} secs.

η_c = 92.3% is the circuit throughput from the detector to the digitizer

$\eta_{optical}$ is the fiber box and fiber transmission for the transmitted pulse, per laser per detector/digitizer combination. $\eta_{optical}$ was estimated from ground testing data:

	Detector 1	Detector 2
Laser 1	2.965×10^{-14}	N/A
Laser 2	2.786×10^{-14}	2.257×10^{-14}
Laser 3	2.793×10^{-14}	2.336×10^{-14}

R_{det}=2.28e7 Volts/Watts is the detector responsivity

α_{cal} is a calibration coefficient determined by system level test data to be 1.12

G_{VGA} is the normalized gain of the variable gain amplifier (VGA).

$$G_{VGA} = \frac{C_{gain}}{2^8 - 1}$$

with C_{gain} the integer valued detector gain in the telemetry. Nominal value for C_{gain} is 41.

Estimate of GLAS Energy from Altimeter Detectors

The relationship between the digitizer output and the input can be written as

$$y_i = f_{AD}[v_r(i) + \delta v_{DC}]$$

where

$f_{AD}(x)$ is the altimeter digitizer voltage to counts conversion function,

$v(i)$ is the i[th] waveform sample in volts, $i = 0, 1, \ldots 47$

δv_{DC} is a random DC offset in volts.

To convert the integer valued waveform data, y_i, and integer valued DC offset, y_{DC_tx}, to voltage, use the equations

$$v_r(i) = f_{AD}^{-1}(y_i) - f_{AD}^{-1}(y_{DC\_tx})$$

The conversion function, $f_{AD}^{-1}(x)$, is given by:

$$f_{AD}^{-1}(x) = \begin{cases} a_1 \cdot x_i + b_1 & \text{if } 0 \le x_i \le 127 \\ a_2 \cdot x_i + b_2 & \text{if } 127 < x_i \le 255 \end{cases}$$

with the coefficient values given in the following table:

	a_1	b_1	a_2	b_2
Dig#1 (SN1)	0.006675	-0.195279	0.006198	-0.134420
Dig#2 (SN2)	0.006625	-0.193828	0.006128	-0.130443

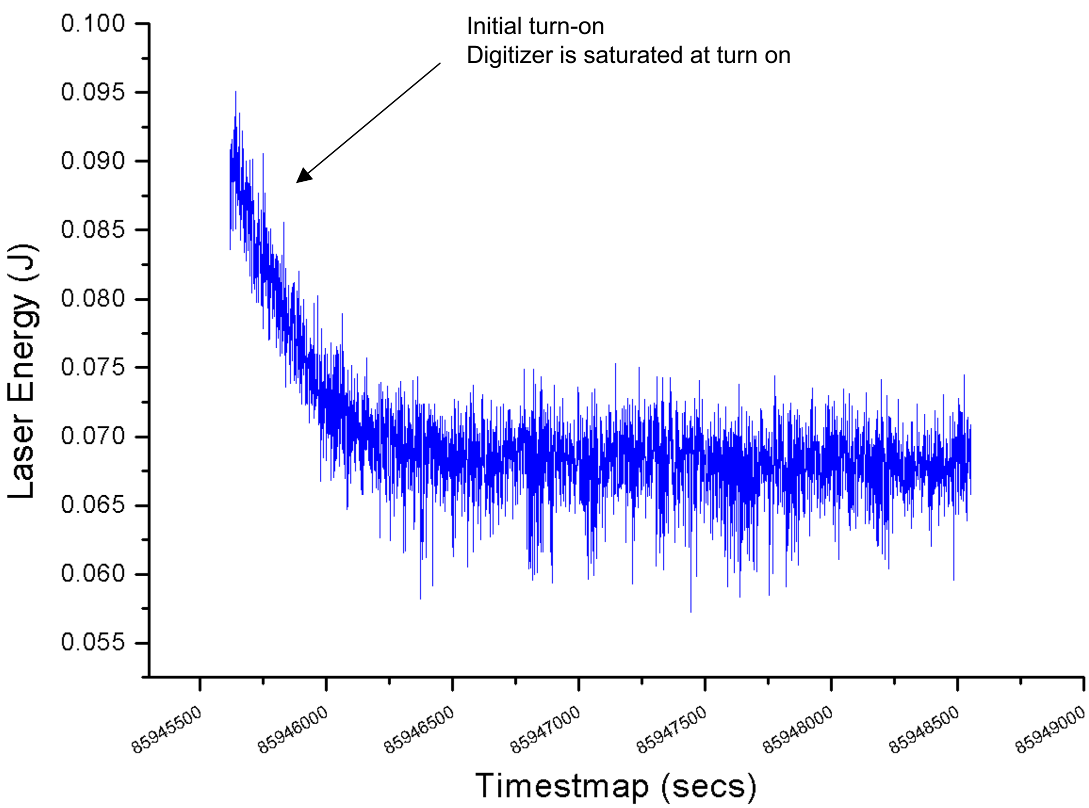
y_{DC_tx} is estimated by taking the *mean* value of the first nine (*i=0 to 8*) points in the transmit waveform.

$f_{AD}^{-1}(y_{DC\_tx})$ always uses the a_1, b_1 coefficients since it is always less than 127 counts.

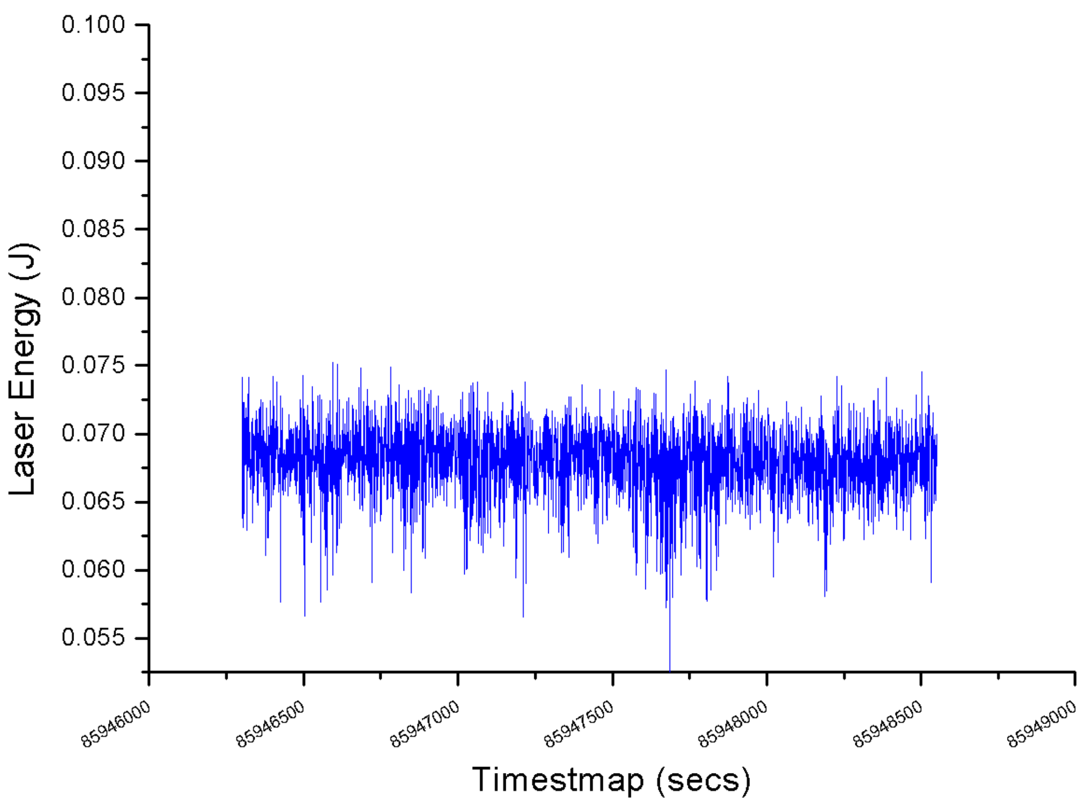
y_{DC_tx} is typically near 30 counts.

Altimeter Detector laser energy calibration
Detector1 Digitizer 1
Day 264

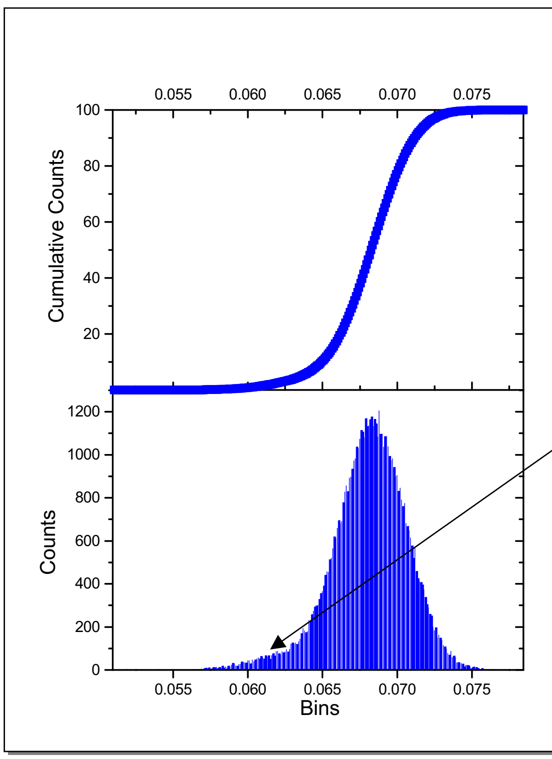
Laser 1 GLAS Detector1 - ALL data, including laser turn on



Laser 1 GLAS Detector1 - at nominal Temperature



Laser 1 GLAS Detector1 Energy Statistics - at nominal Temperature



Energy Statistics (J):

Mean	StDev	Maximum	Minimum
0.06809	0.00259	0.07833	0.05106

Tail in the distribution reflects fluctuations
in the laser energy due to mode competition (“noisy” data)

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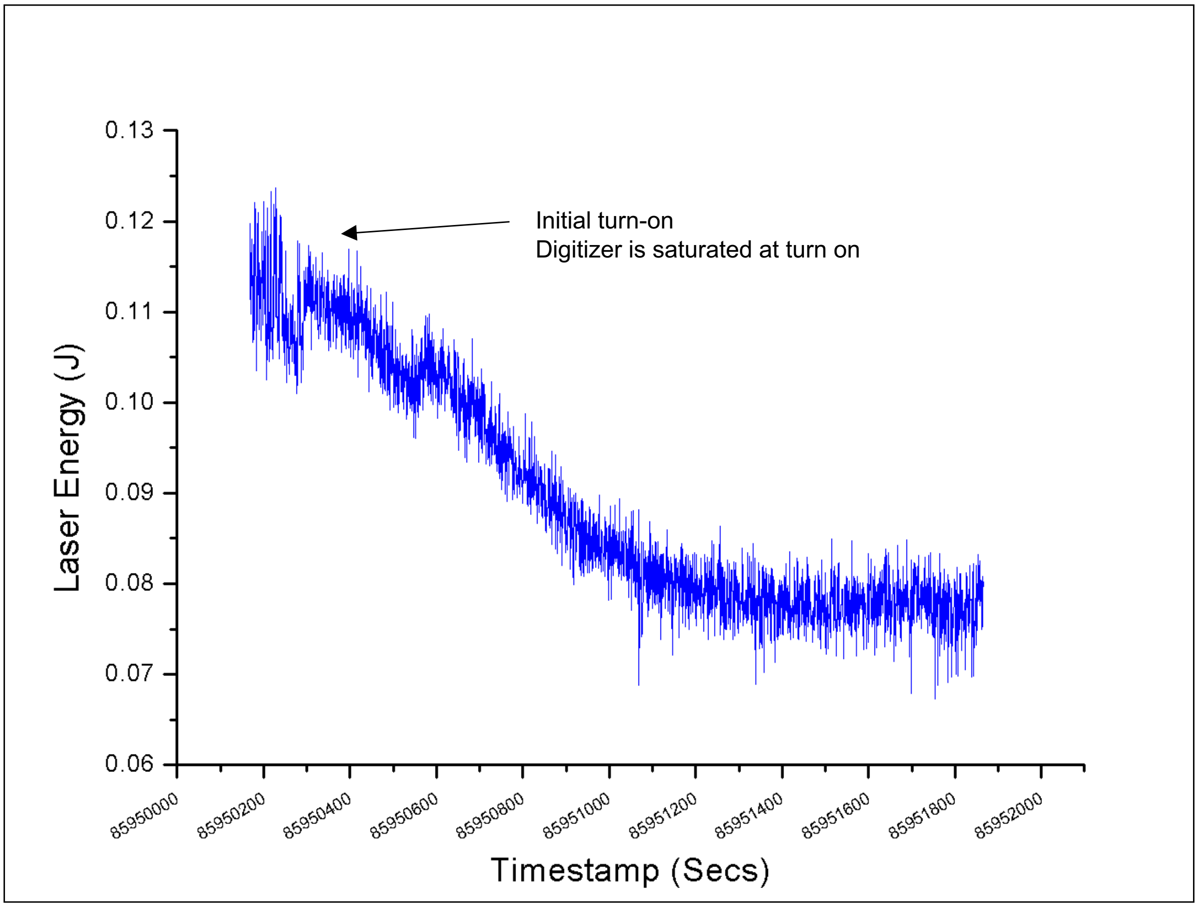
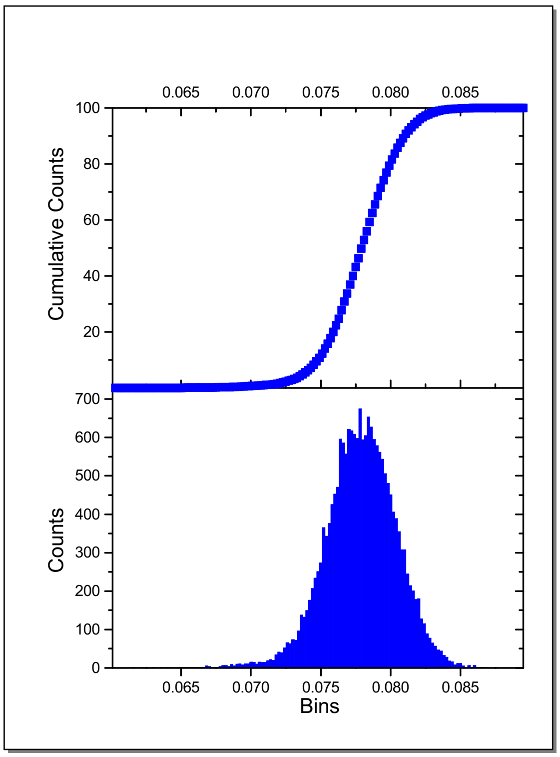
Laser 2 GLAS Detector1 - ALL data, including laser turn on



Laser 2 GLAS Detector1 - at nominal Temperature



Energy Statistics (J):			
Mean	StDev	Maximum	Minimum
0.07787	0.00255	0.08904	0.06025

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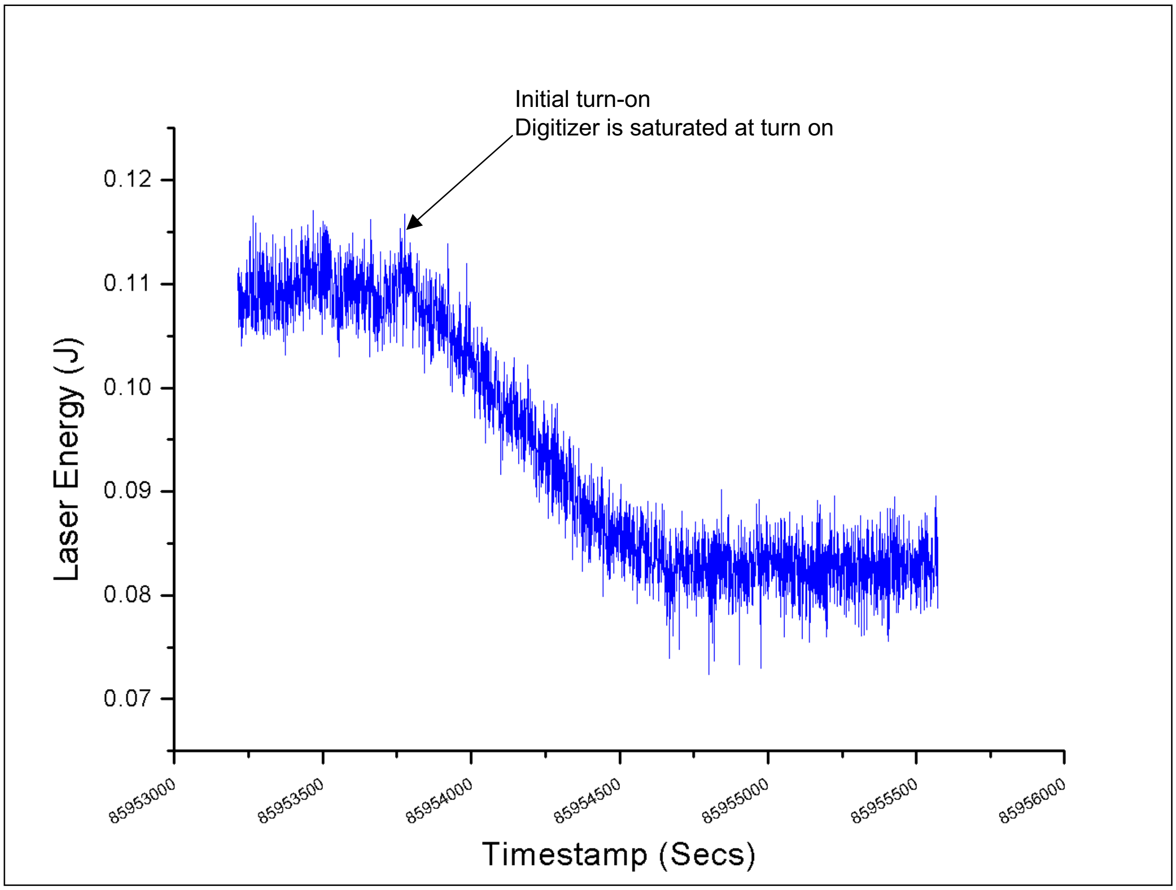
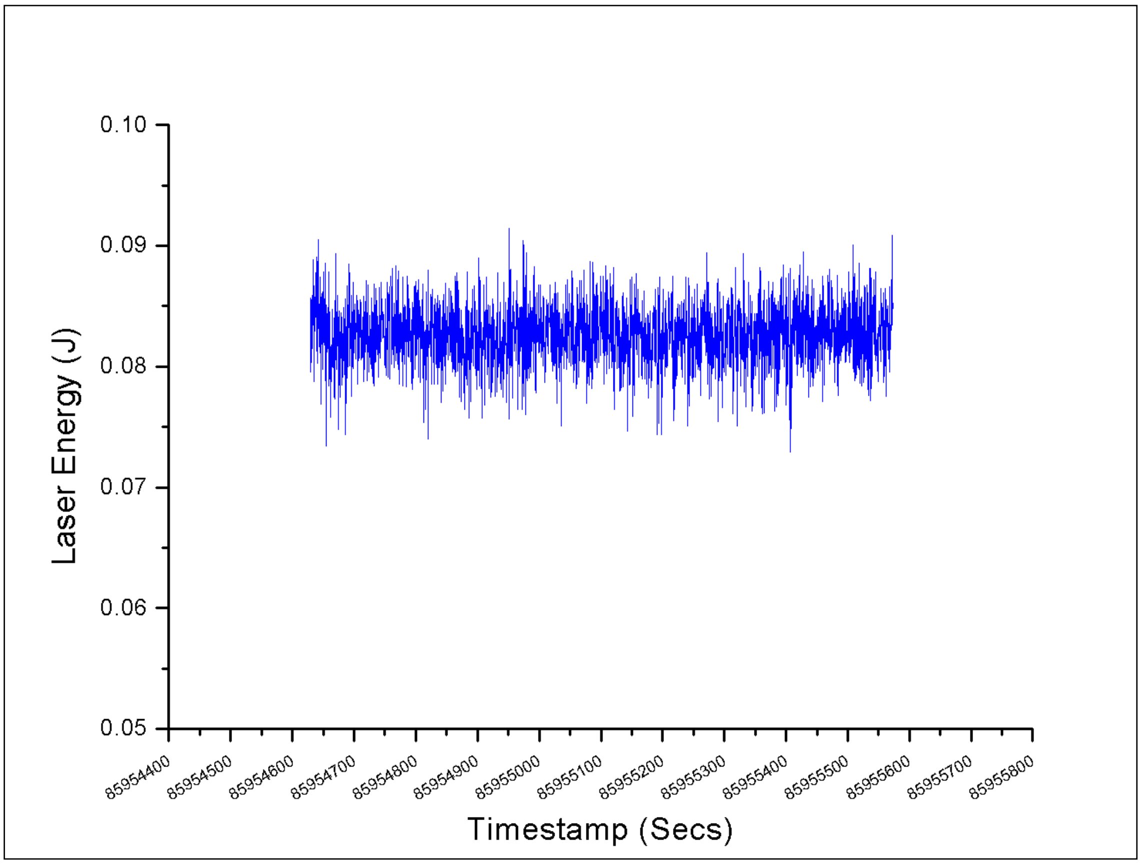
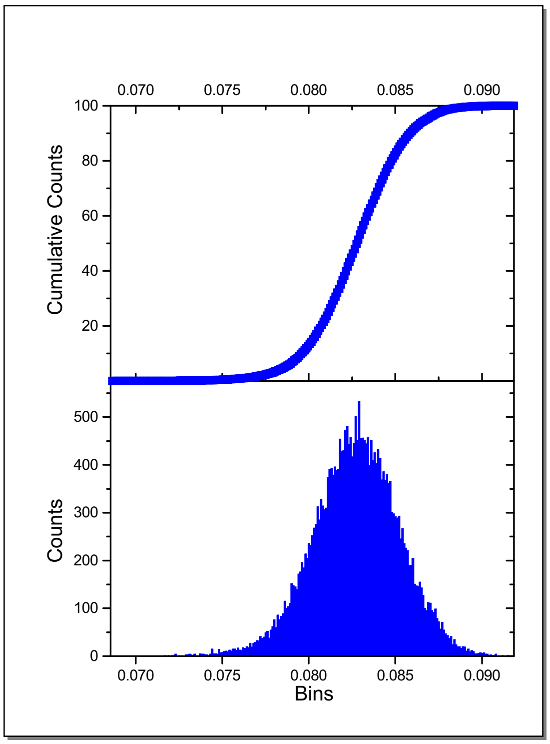
Laser 3 GLAS Detector1 - ALL data, including laser turn on



Laser 3 GLAS Detector1 - at nominal Temp.



Laser 3 GLAS Detector1 Statistics- at nominal Temp



Energy Statistics (J):

Mean	StDev	Maximum	Minimum
0.08272	0.0025	0.09174	0.06866

3

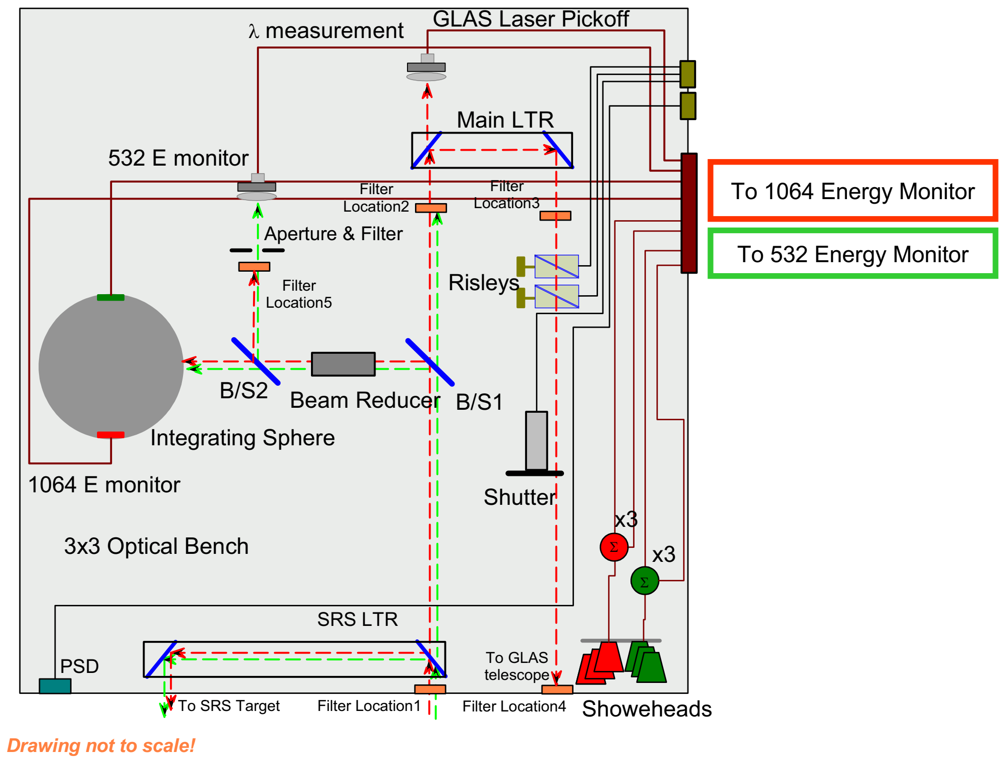
Relative Laser Energy Measurements during instrument and observatory TVAC

- **All** TVAC data are in air-vacuum.
- All BCE energy (Molectron) measurements are ***relative***
- Adjustments to the BCE attenuation levels were needed during the test (highlighted in most plots)
- The altimeter detector energy values (1064 nm only) are derived using the same algorithm as in orbit
- Note that there will be a change in the altimeter detector energy when Tx gain adjustments were made

Relative Laser Energy Measurements during instrument TVAC with Main Target

- The 1064 and 532 nm energy measurements from the Main Target use two, low-energy detectors (Molectron J3S-10) with fiber pick offs on an integrating sphere (see next slide).
- All Molectron energies are ***relative not absolute***
- Adjustments to the attenuation levels were made during the test (highlighted in most plots)
- The altimeter detector energy values (1064 nm only) are derived using the same algorithm as in orbit
- Note that there will be a change in the altimeter detector energy when Tx gain adjustments were made.

Relative Laser Energy Measurements during Instrument TVAC using Main Target and BCE Laser Test System (LsrTS)



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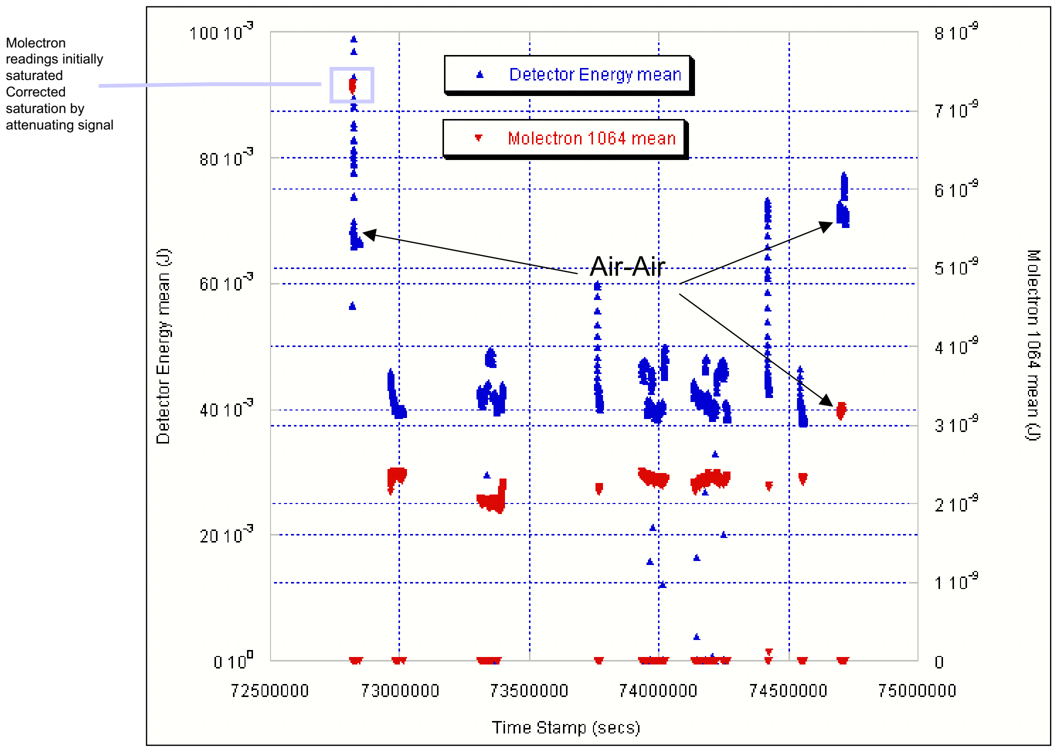
Laser 1

Laser 1 Detector and Molectron Relative Energies vs. Time (1 min averages)



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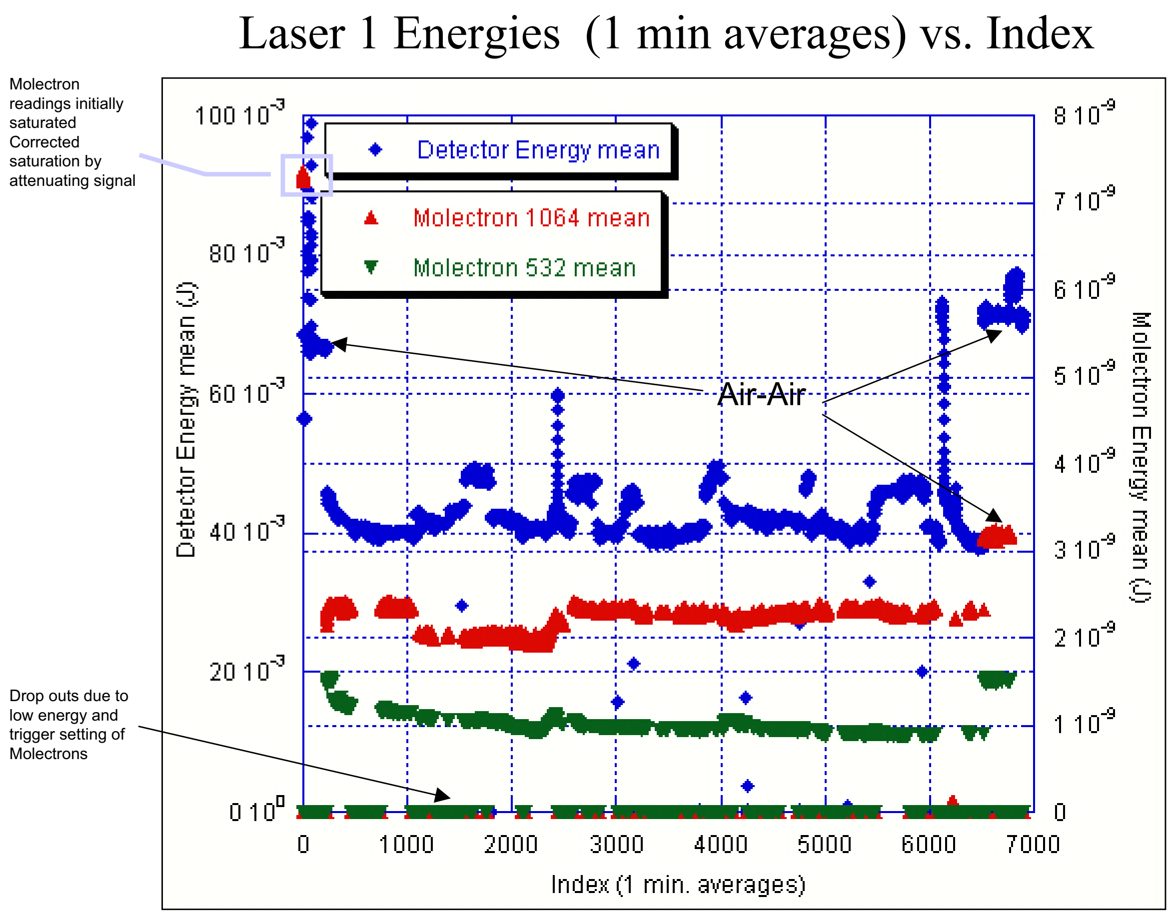
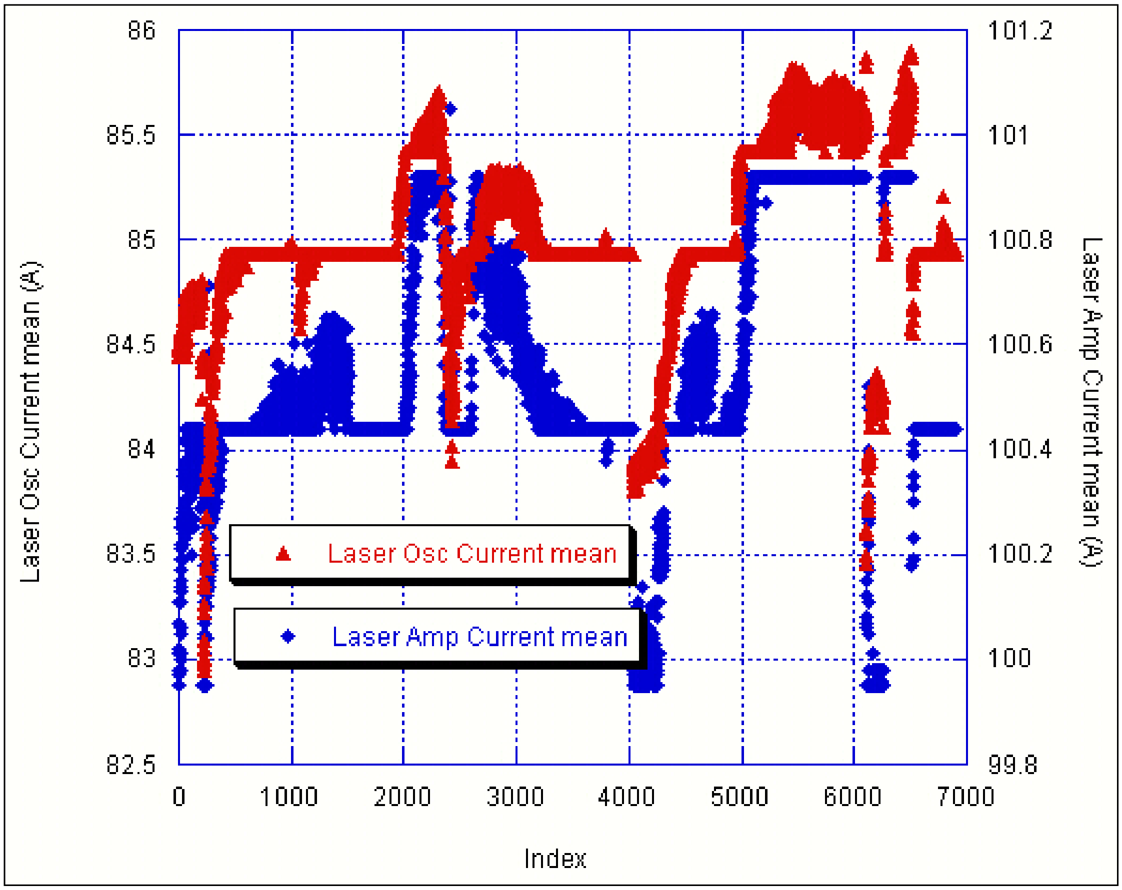
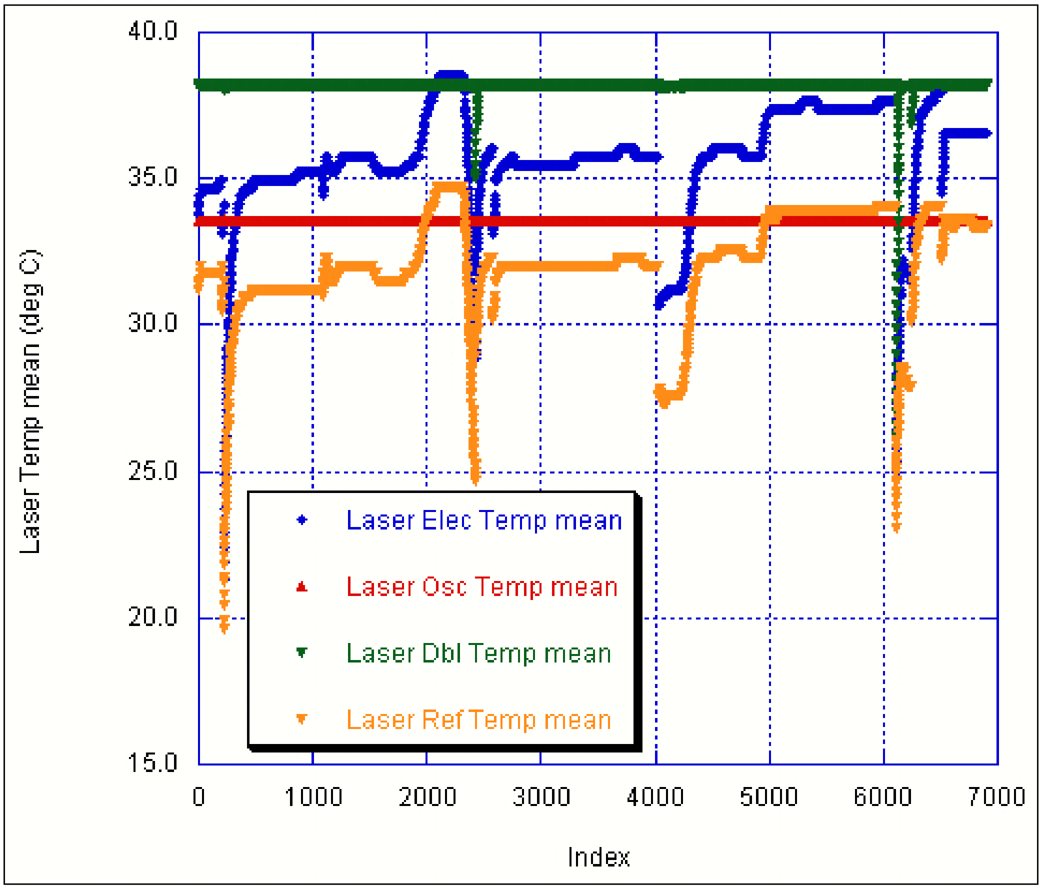

Laser 1 Energies (1 min averages) vs. Index
Molectron readings initially saturated Corrected saturation by attenuating signal
Drop outs due to low energy and trigger setting of Molectrons
Detector Energy mean
Molectron 1064 mean
Molectron 532 mean
Air-Air
Detector Energy mean (J)
Molectron Energy mean (J)
Index (1 min. averages)
100 10-3
80 10-3
60 10-3
40 10-3
20 10-3
0 100
8 10-9
7 10-9
6 10-9
5 10-9
4 10-9
3 10-9
2 10-9
1 10-9
0
0
1000
2000
3000
4000
5000
6000
7000

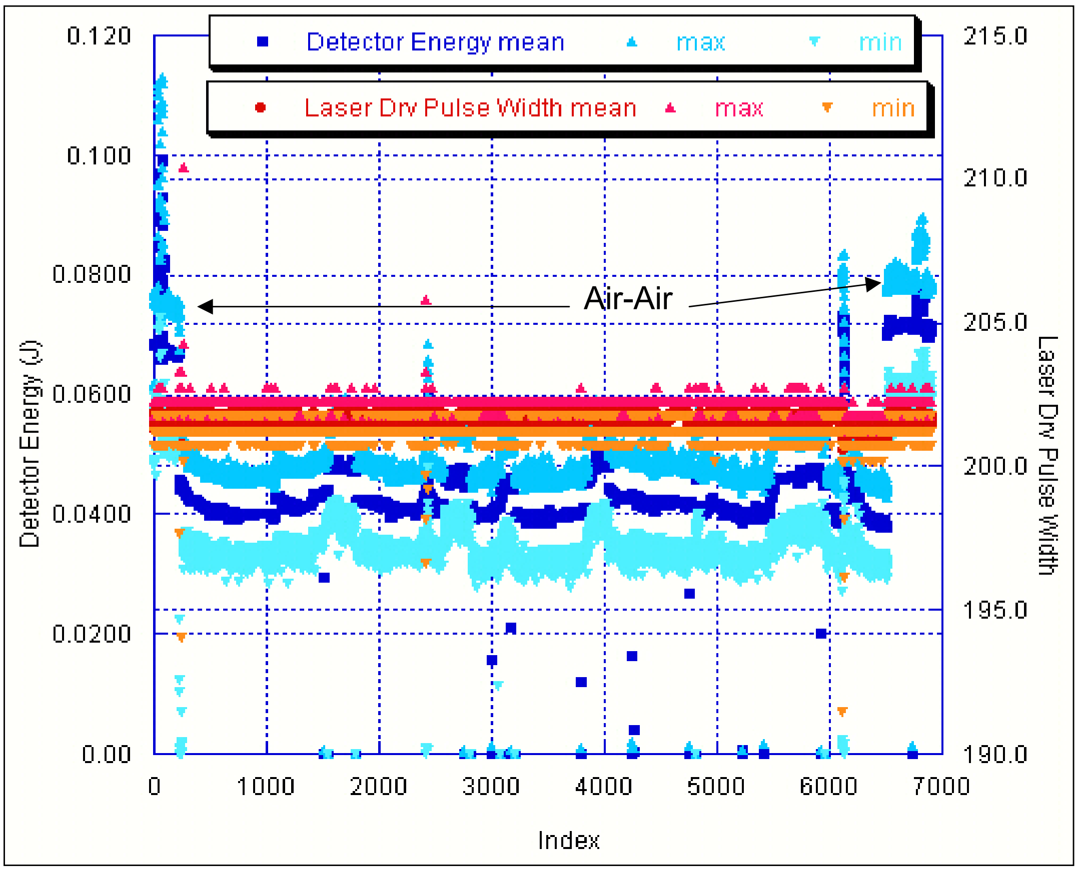
Laser 1 Osc. & Amp. Current (1 min averages) vs. Index



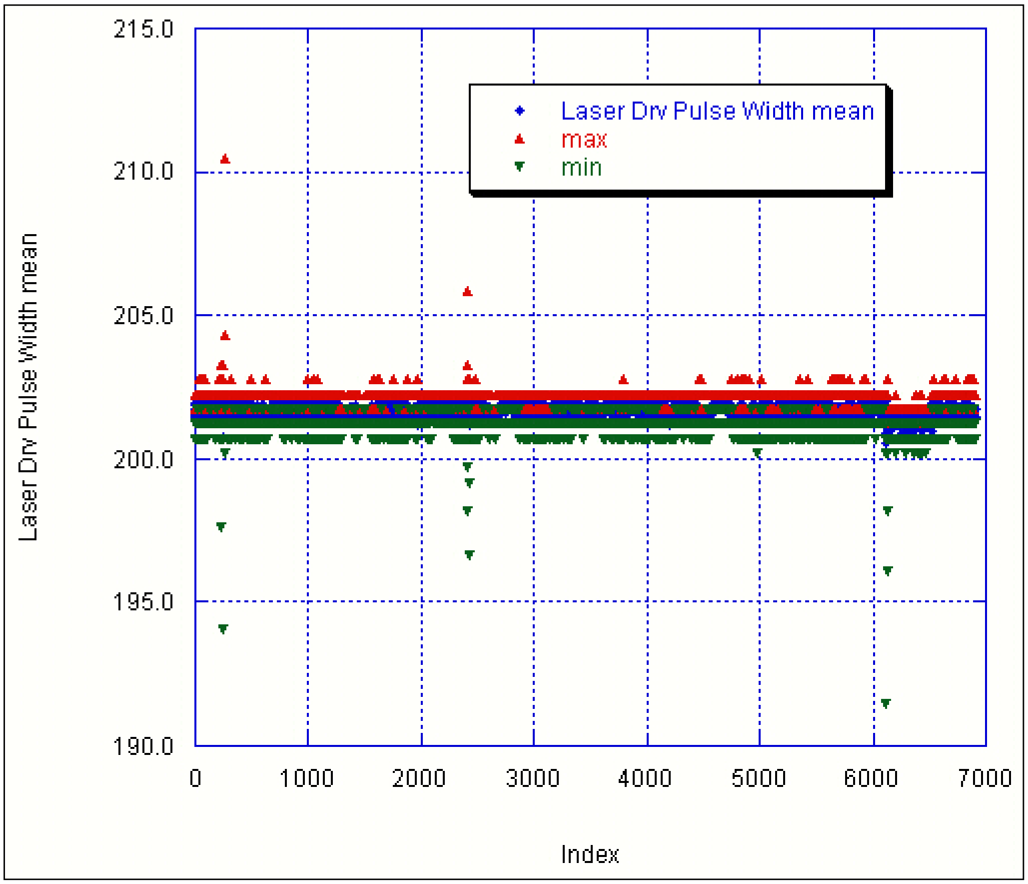
Laser 1 Temperatures (1 min averages) vs. Index



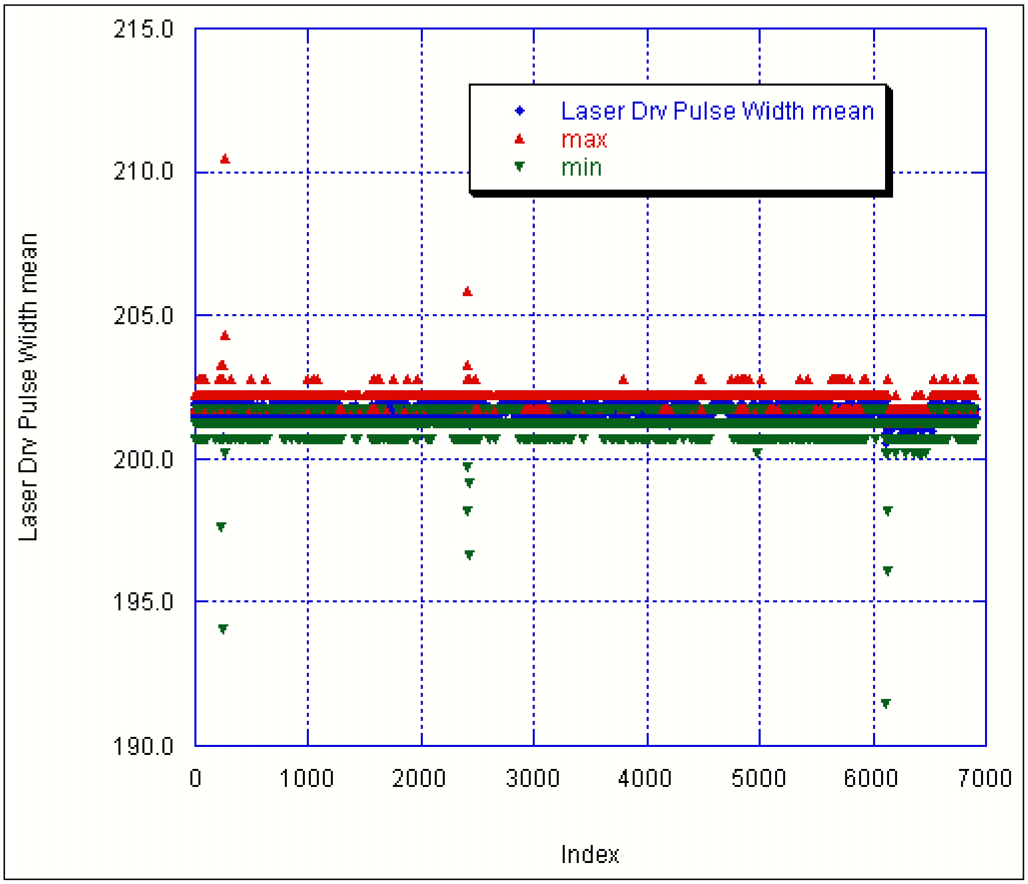
Laser 1 Energy and Drive Pulsewidth (1 min averages) vs. Index



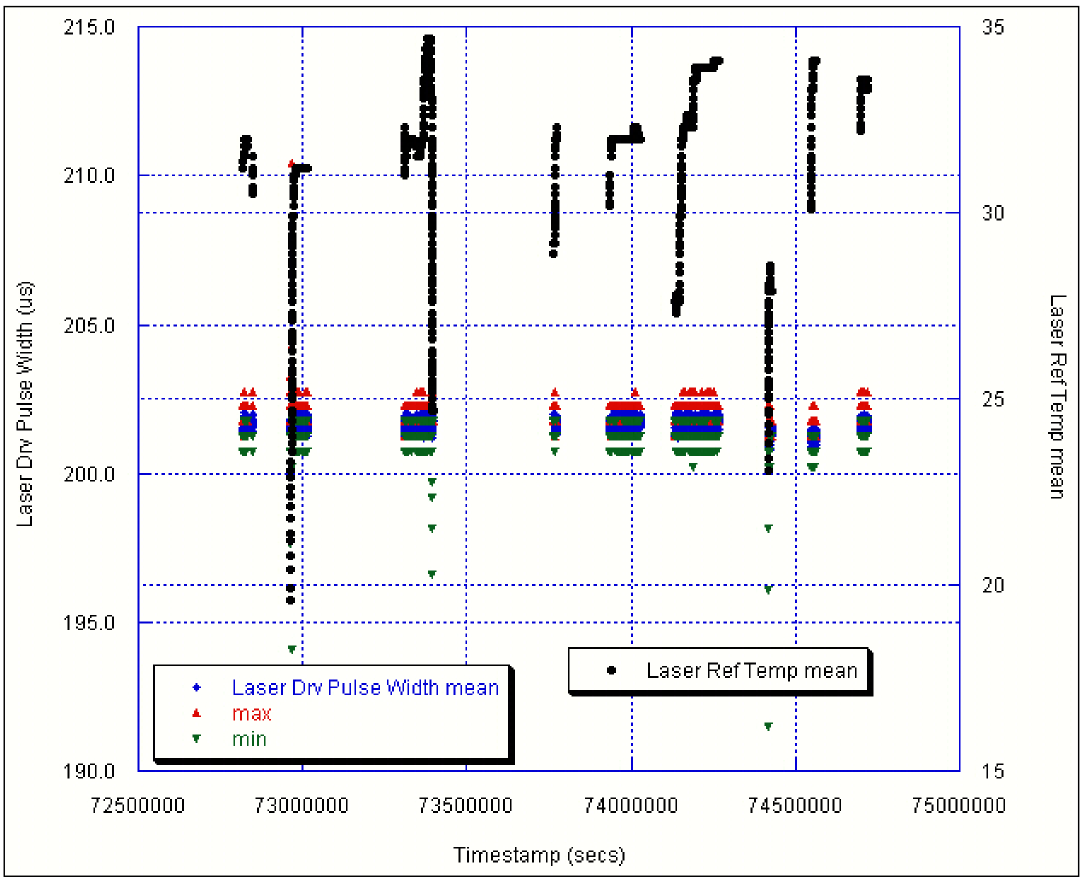
Laser 1 Drive Pulsewidth (1 min averages) vs. Index



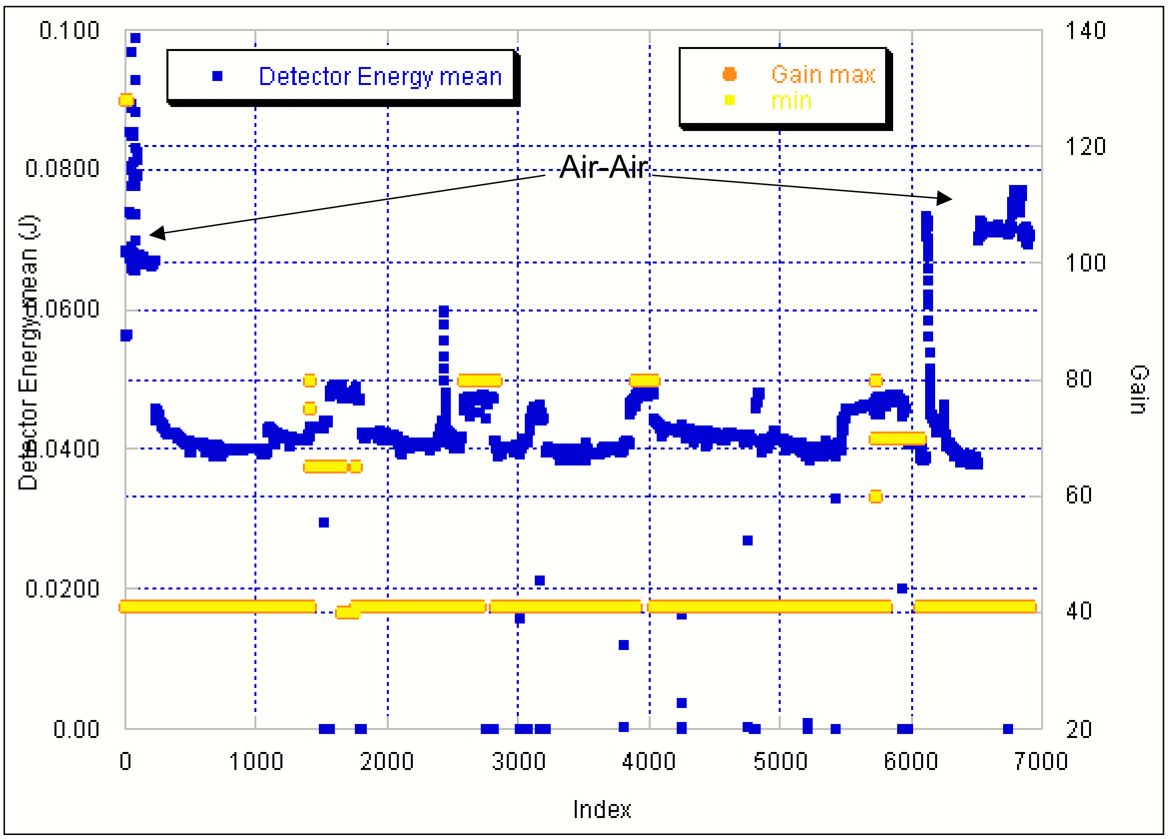
Laser 1 Drive Pulsewidth (1 min averages) vs. Index



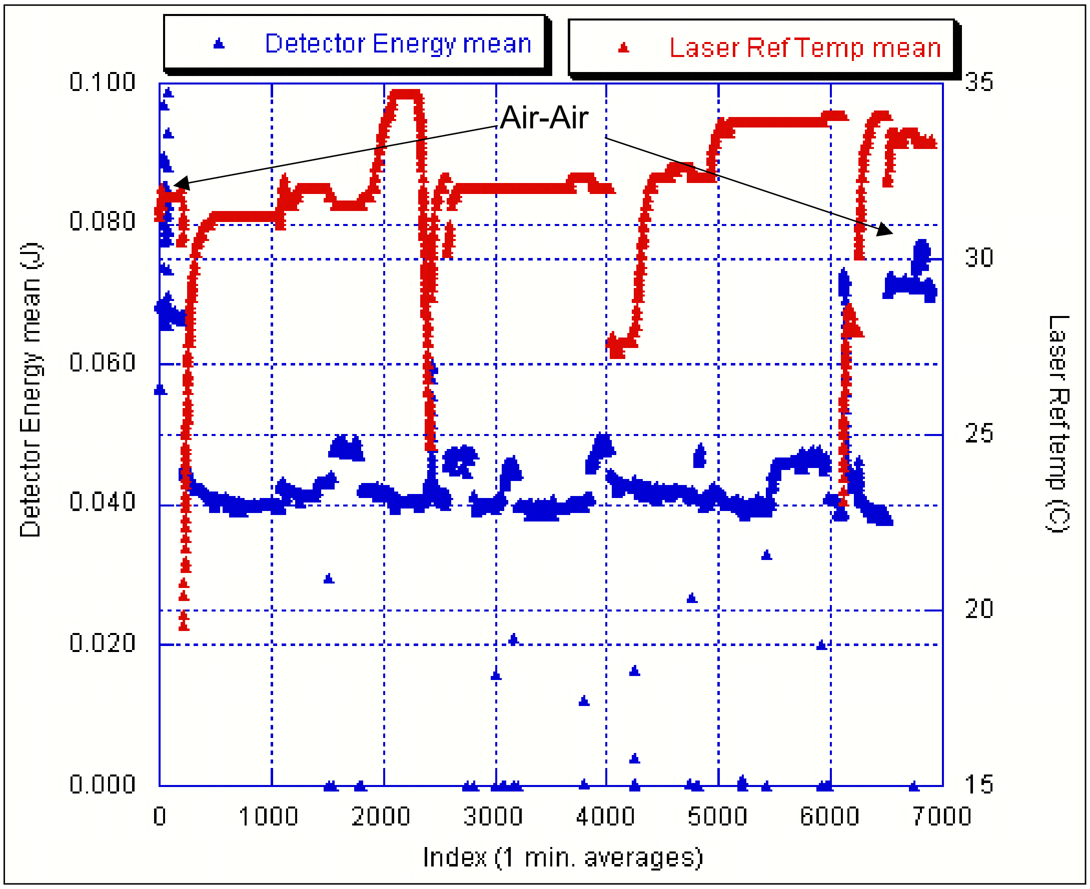
Laser 1 Drive Pulsewidth and Reference Temperature (1 min averages) vs. Time



Laser 1 Energy and Gain (1 min averages) vs. Index



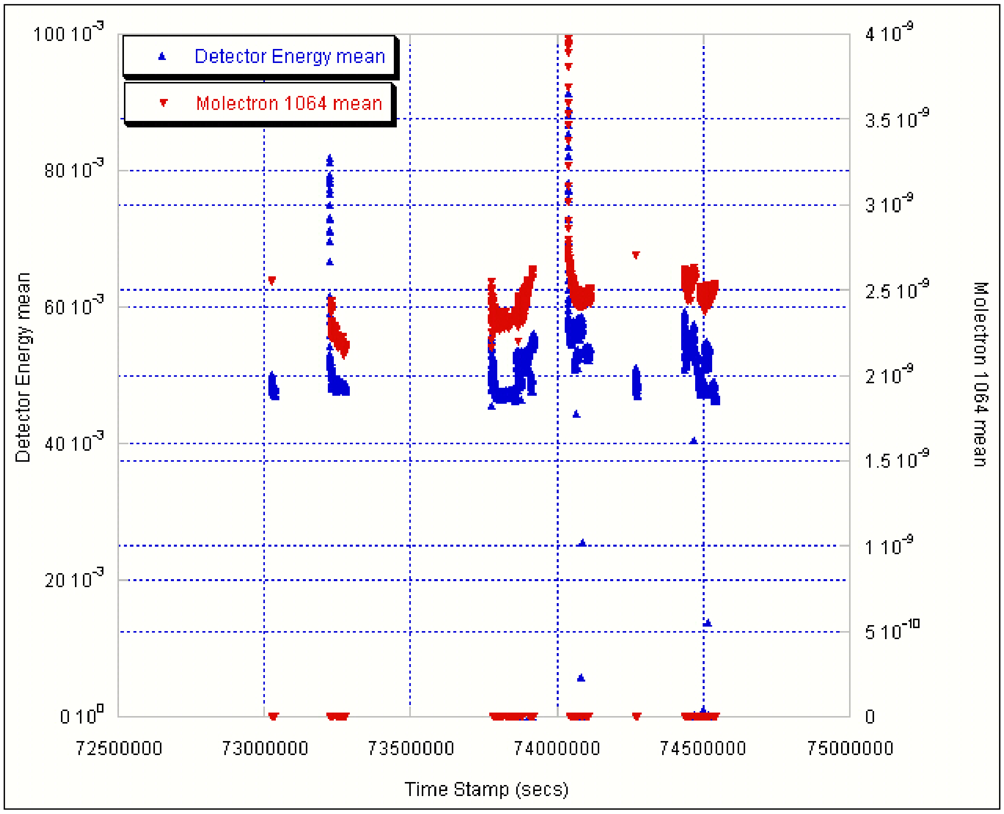
Laser 1 Energy and Ref. Temp. (1 min averages) vs. Index



Laser 2

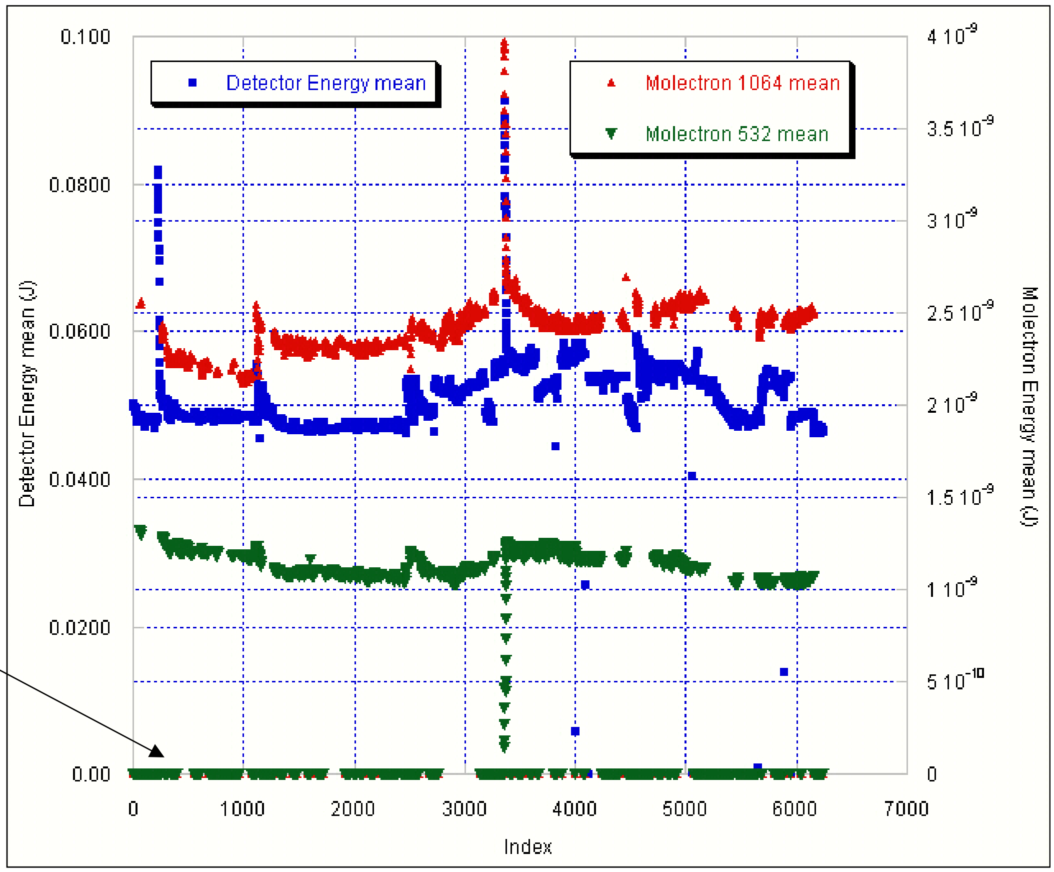
Laser 2 Detector and Molectron Relative Energies vs. Time
(1 min averages)

No air-air baseline data available for Laser 2

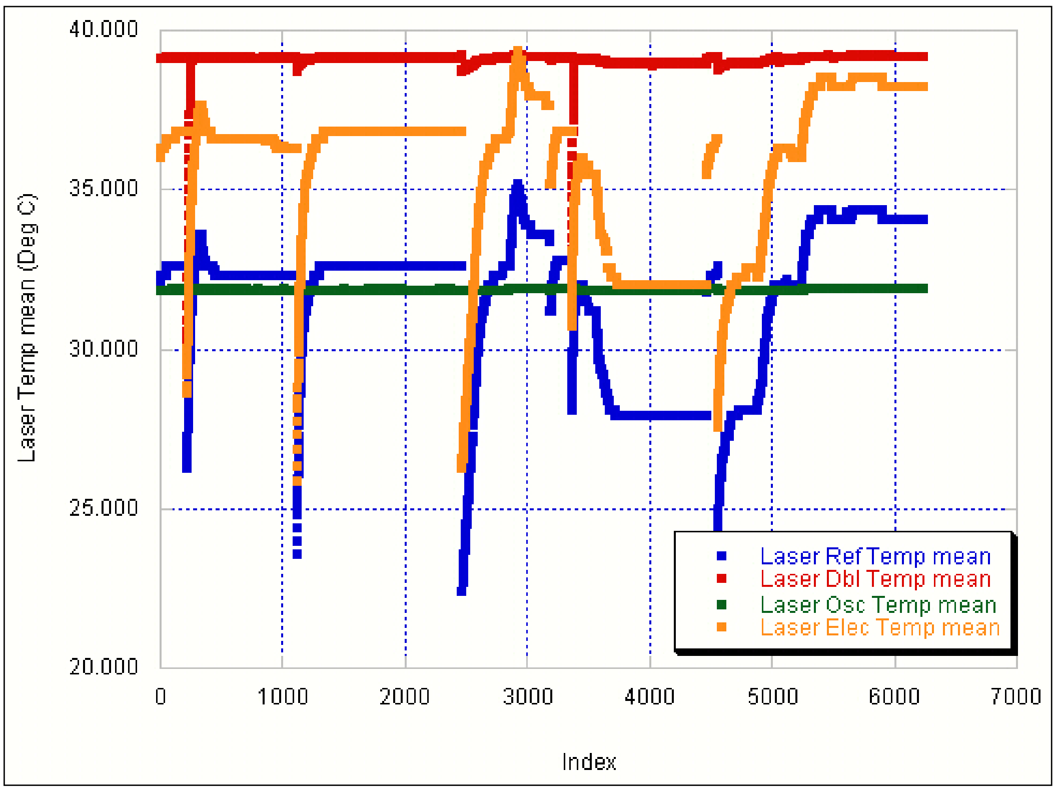


Laser 2 Energies (1 min averages) vs. Index

Drop outs due to low energy and trigger setting of Molectrons



Laser 2 Temperatures (1 min averages) vs. Index



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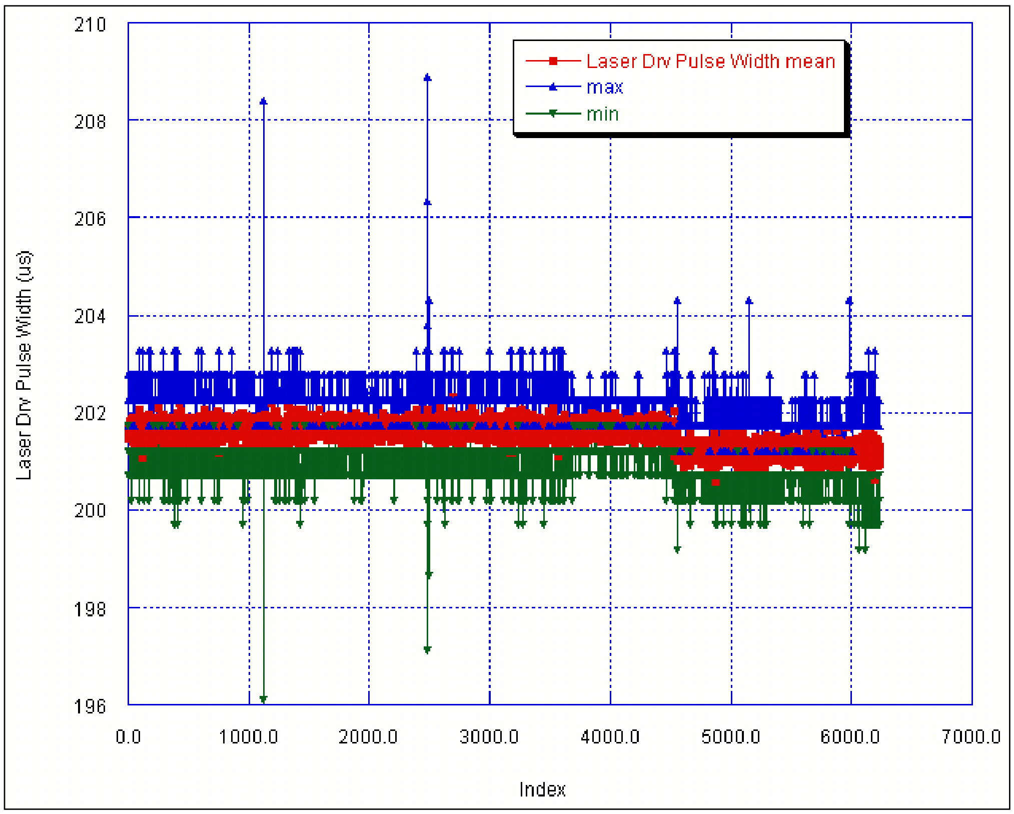
Laser 2 Drive Pulsewidth(1 min averages) vs. Index



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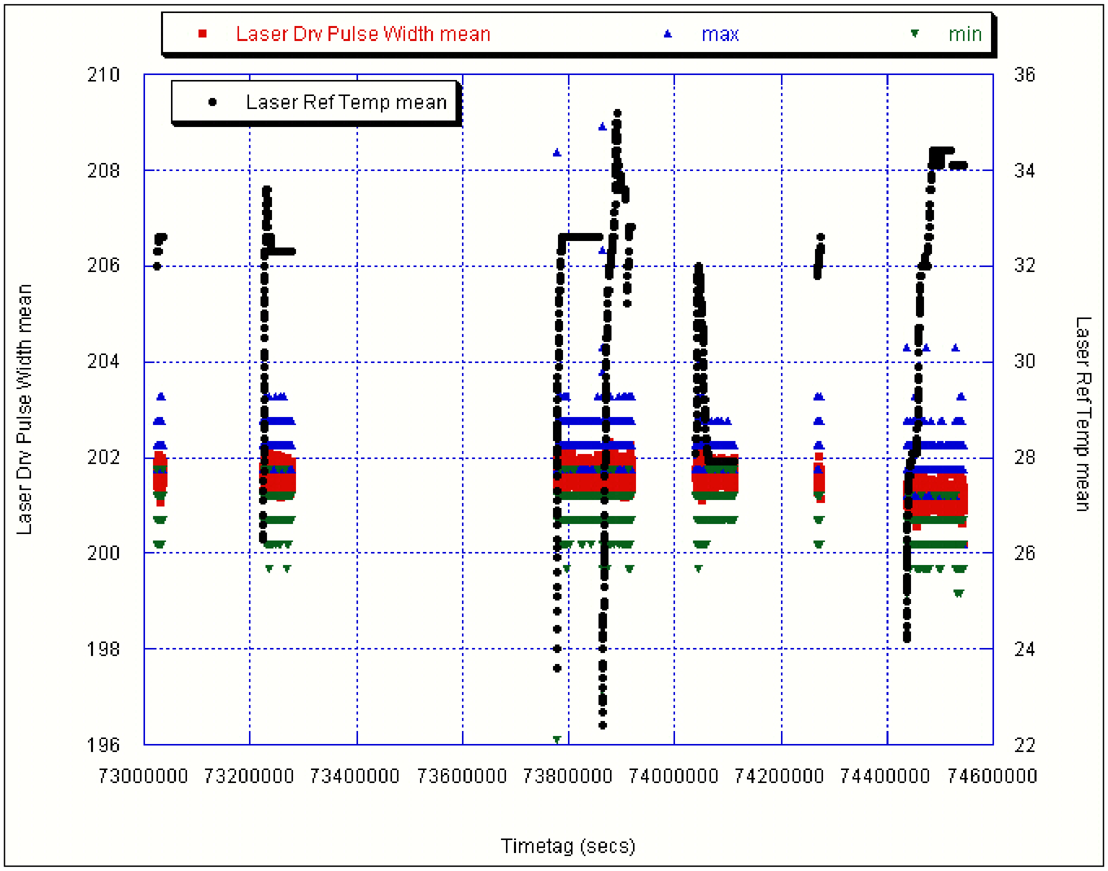
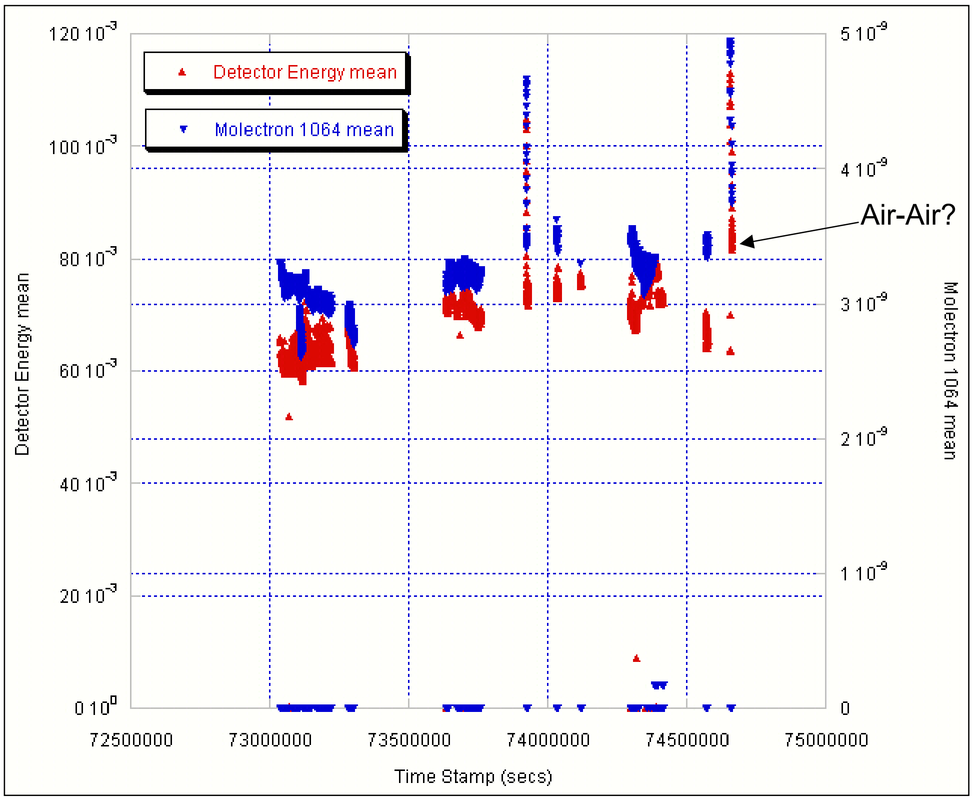
Laser 2 Drive Pulsewidth and Reference Temperature (1 min averages) vs. Time



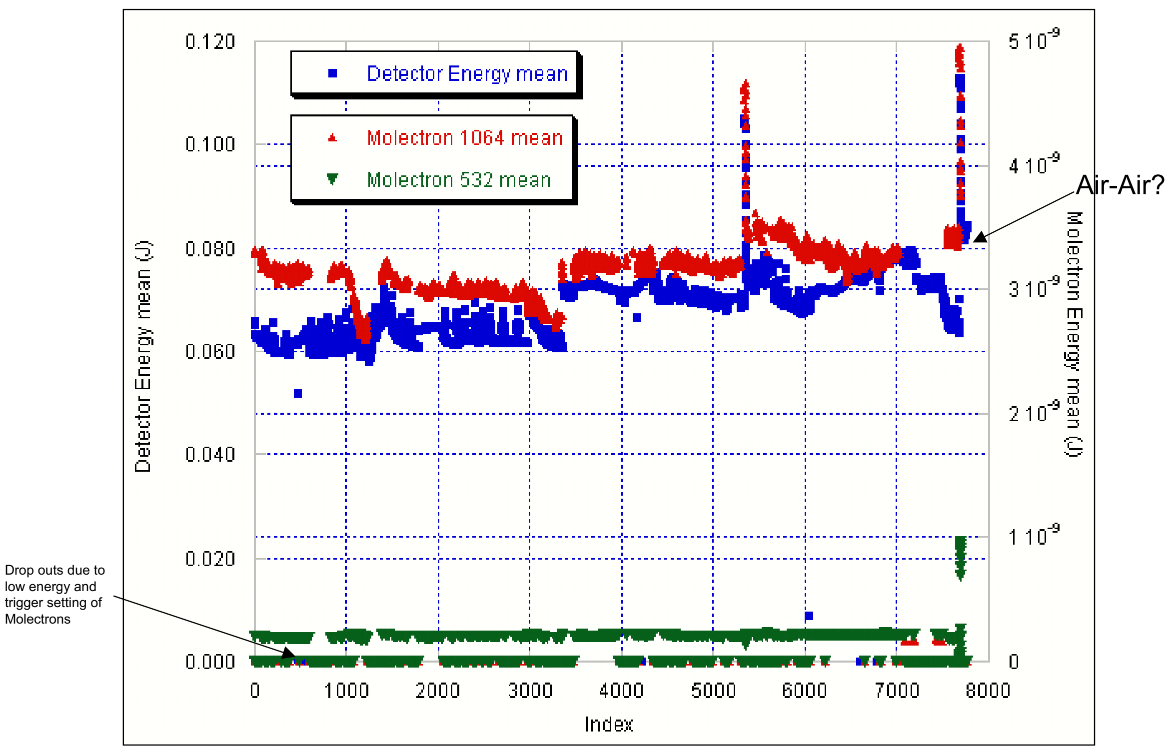
Laser 3

Laser 3 Detector and Molectron Relative Energies vs. Time (1 min averages)

No air-air baseline data available for Laser 3 prior to start of TVAC



Laser 3 Energies (1 min averages) vs. Index



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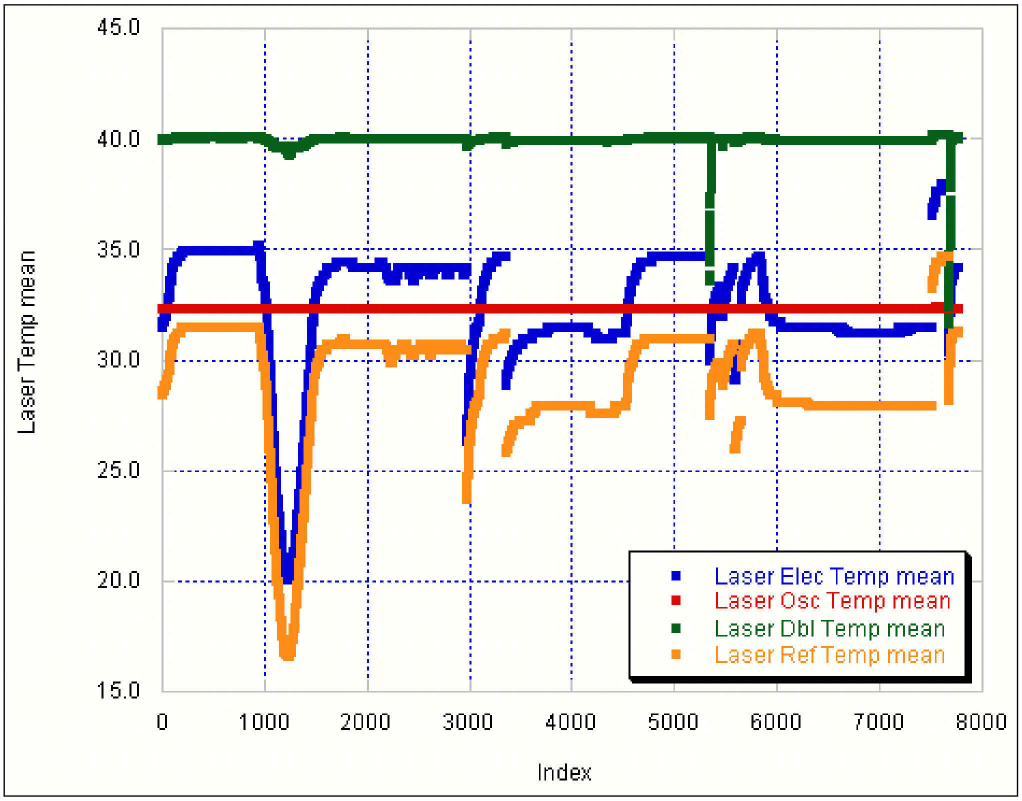
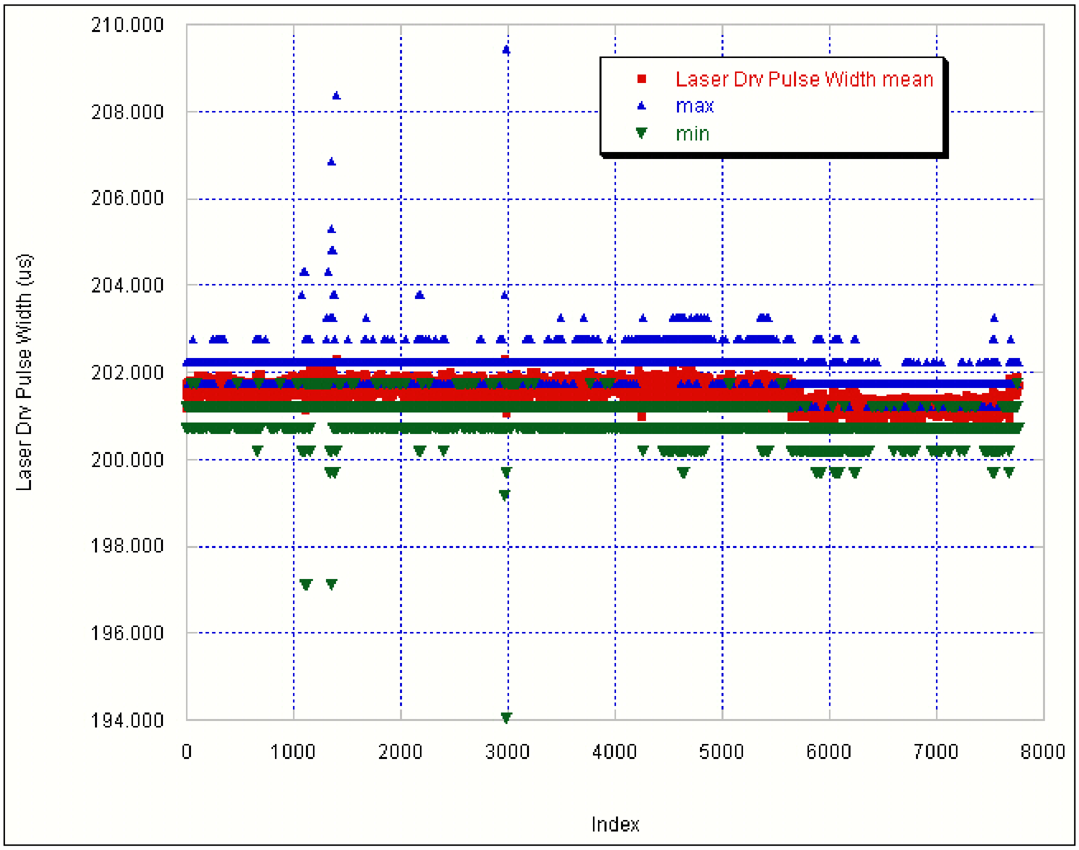
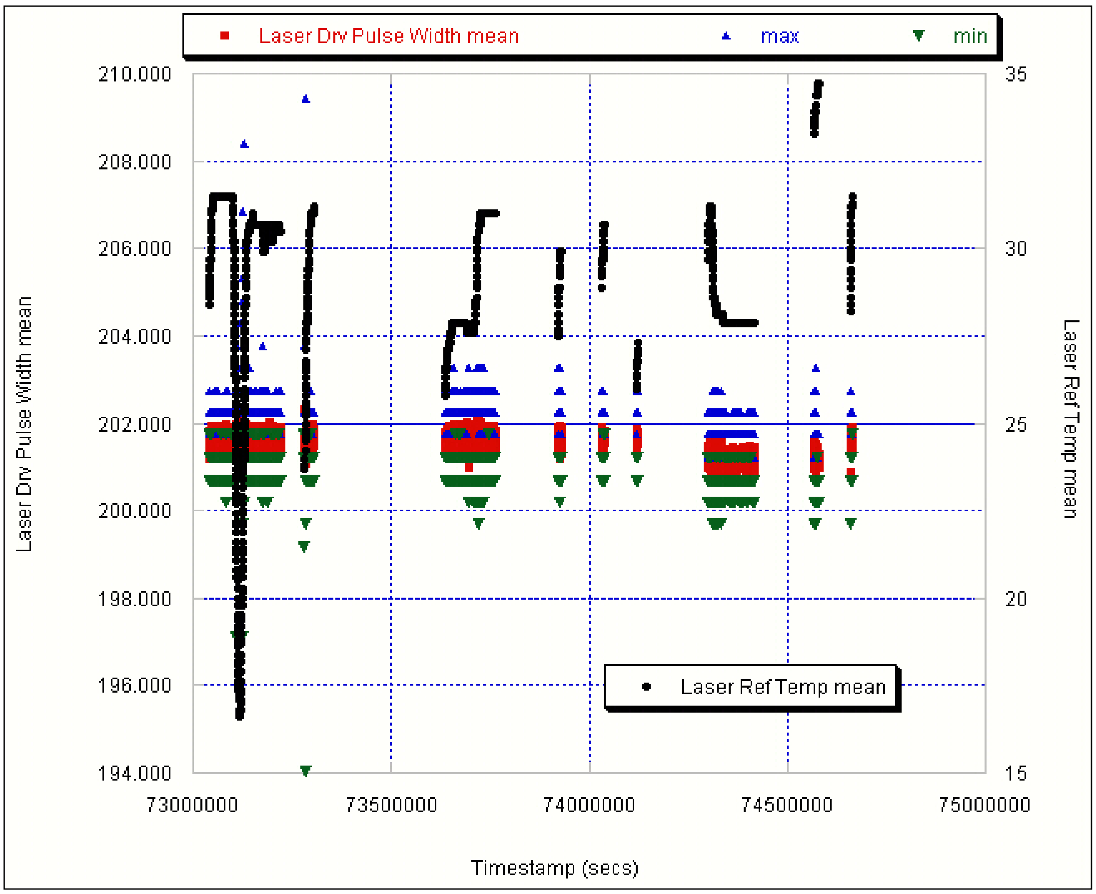
Laser 3 Temperatures (1 min averages) vs. Index



Laser 3 Drive Pulsewidth (1 min averages) vs. Index



Laser 3 Drive Pulsewidth & Ref Temp (1 min averages) vs. Time



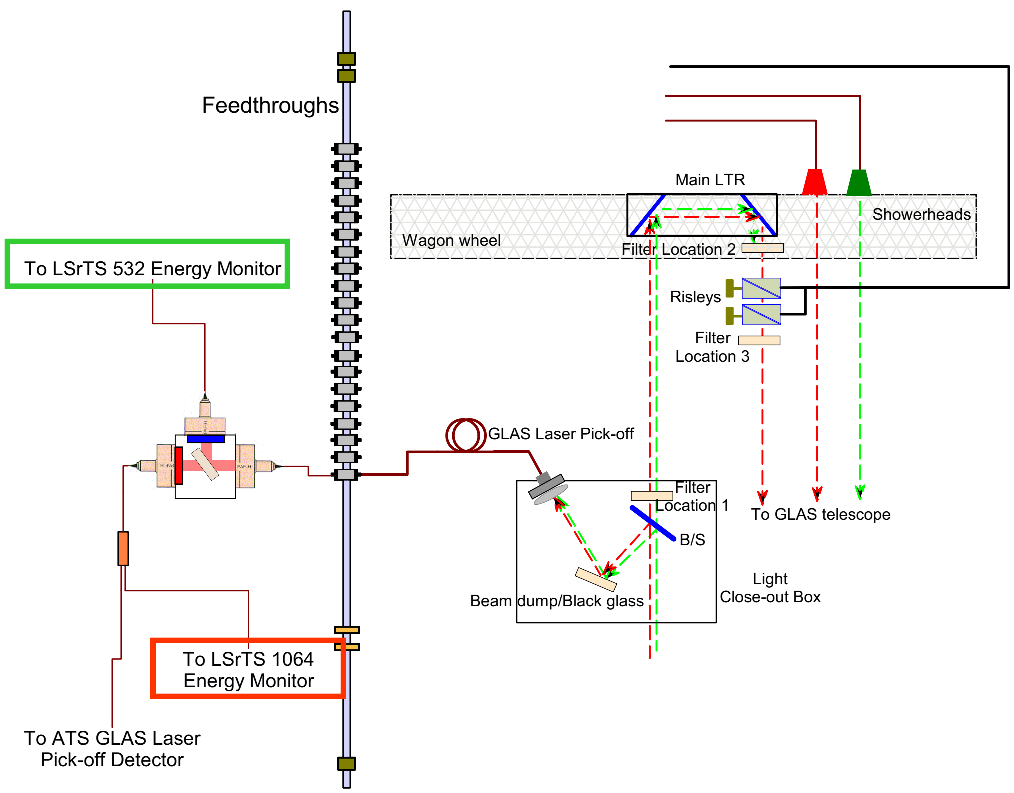
Relative Laser Energy Measurements during instrument TVAC Mini Target

All TVAC data are one minute averages

Relative Laser Energy Measurements during instrument TVAC with Mini Target

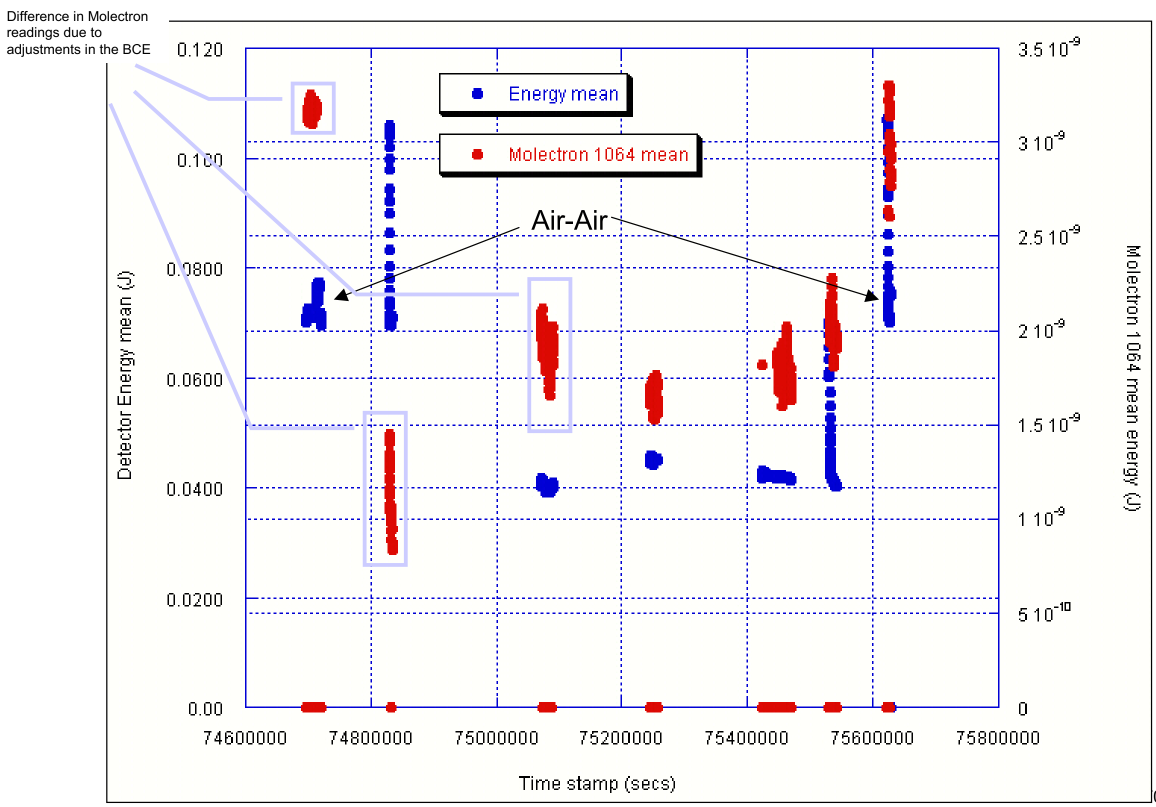
- The 1064 and 532 nm energy measurements from the Mini Target use two, low-energy detectors (Molectron J3S-10) with a fiber pick off (see next slide).
- All Molectron energies are ***relative not absolute***
- Adjustments to the attenuation levels were made during the test (highlighted in plots)
- The altimeter detector energy values (1064 nm only) are derived using the same algorithm as in orbit
- Note that there will be a change in the altimeter detector energy when gain adjustments were made.

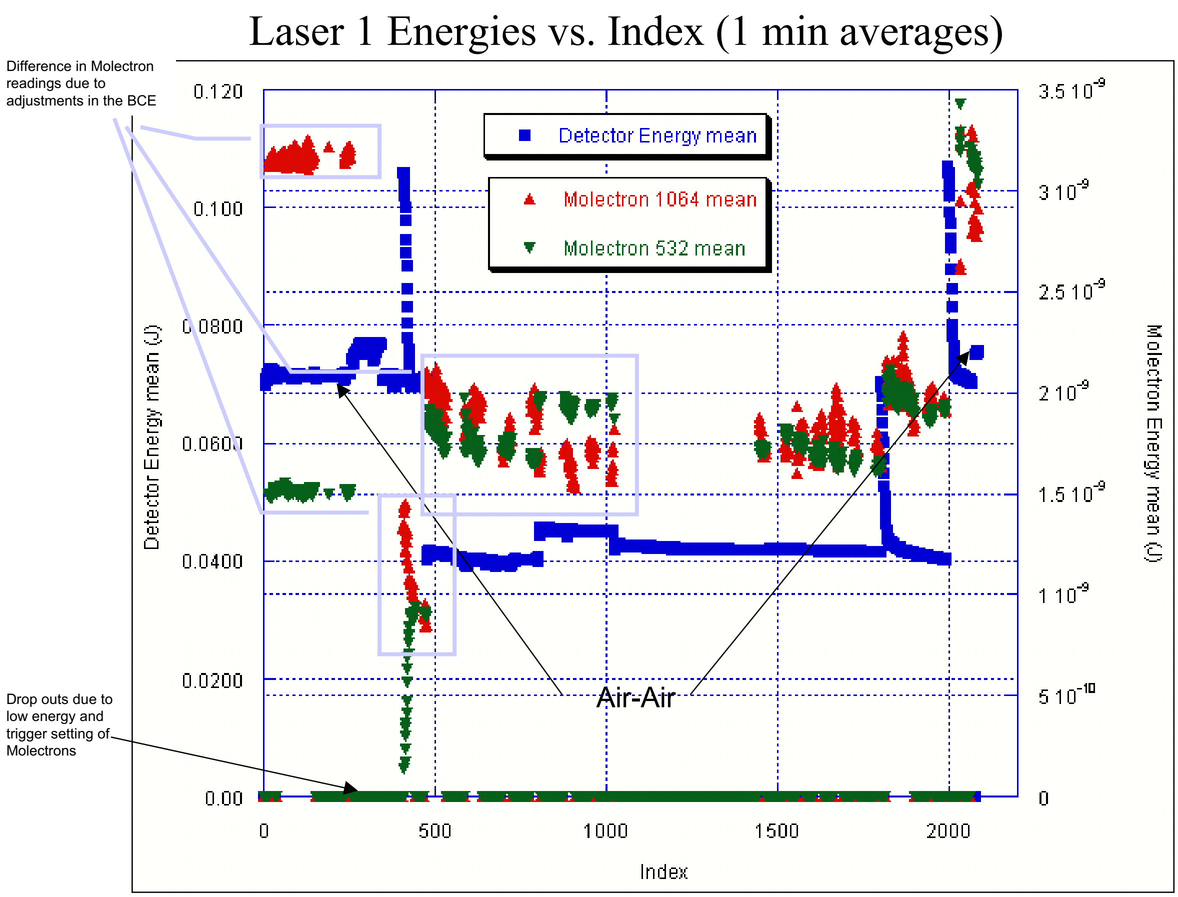
Relative Laser Energy Measurements during Instrument TVAC using Mini Target Beam Dump and BCE Laser Test System (LsrTS)



Laser 1

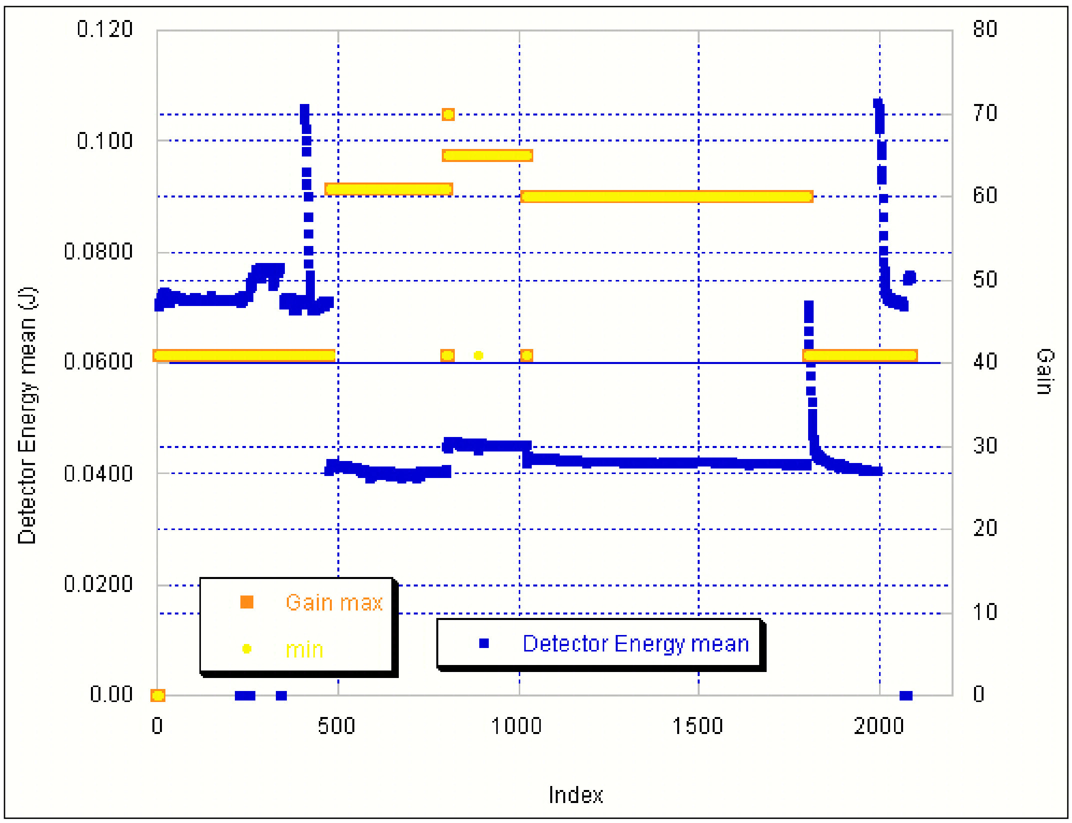
Laser 1 Detector and Molectron Relative Energies vs. Time



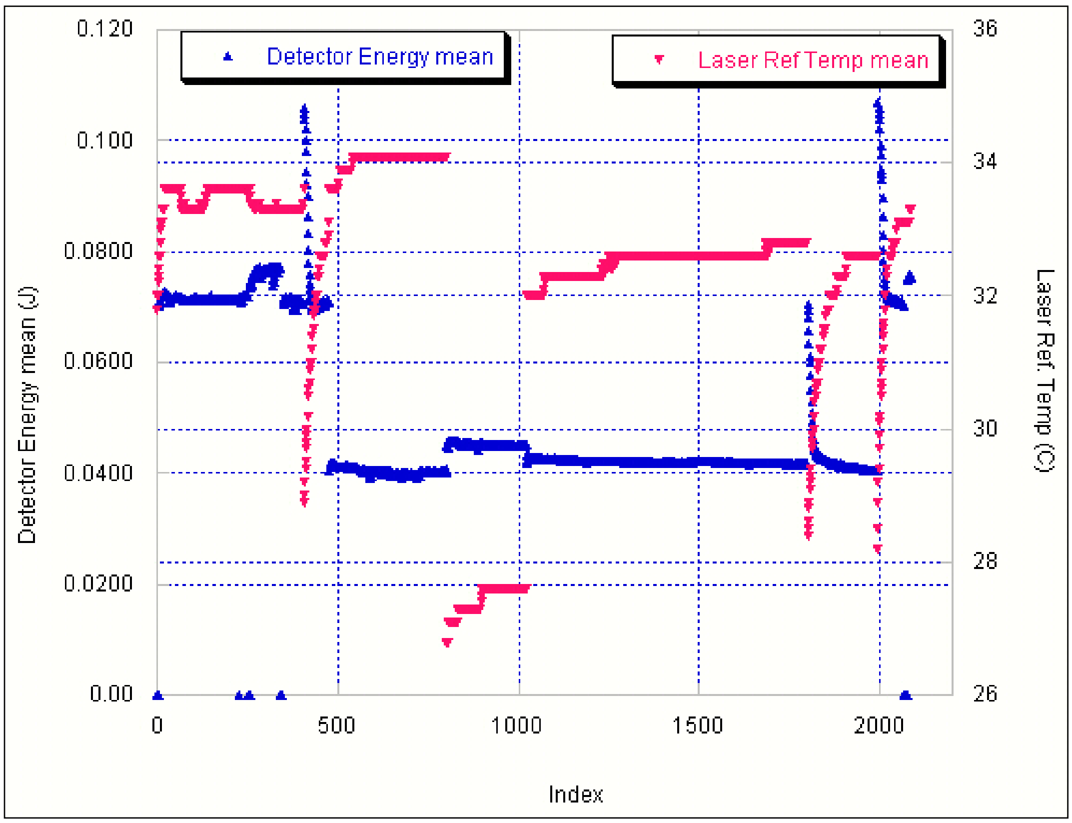

Laser 1 Energies vs. Index (1 min averages)
Difference in Molectron readings due to adjustments in the BCE
Drop outs due to low energy and trigger setting of Molectrons
Detector Energy mean
Molectron 1064 mean
Molectron 532 mean
Air-Air
Detector Energy mean (J)
Molectron Energy mean (J)
Index
0.120
0.100
0.0800
0.0600
0.0400
0.0200
0.00
0
500
1000
1500
2000
3.5 10-9
3 10-9
2.5 10-9
2 10-9
1.5 10-9
1 10-9
5 10-10
0

7

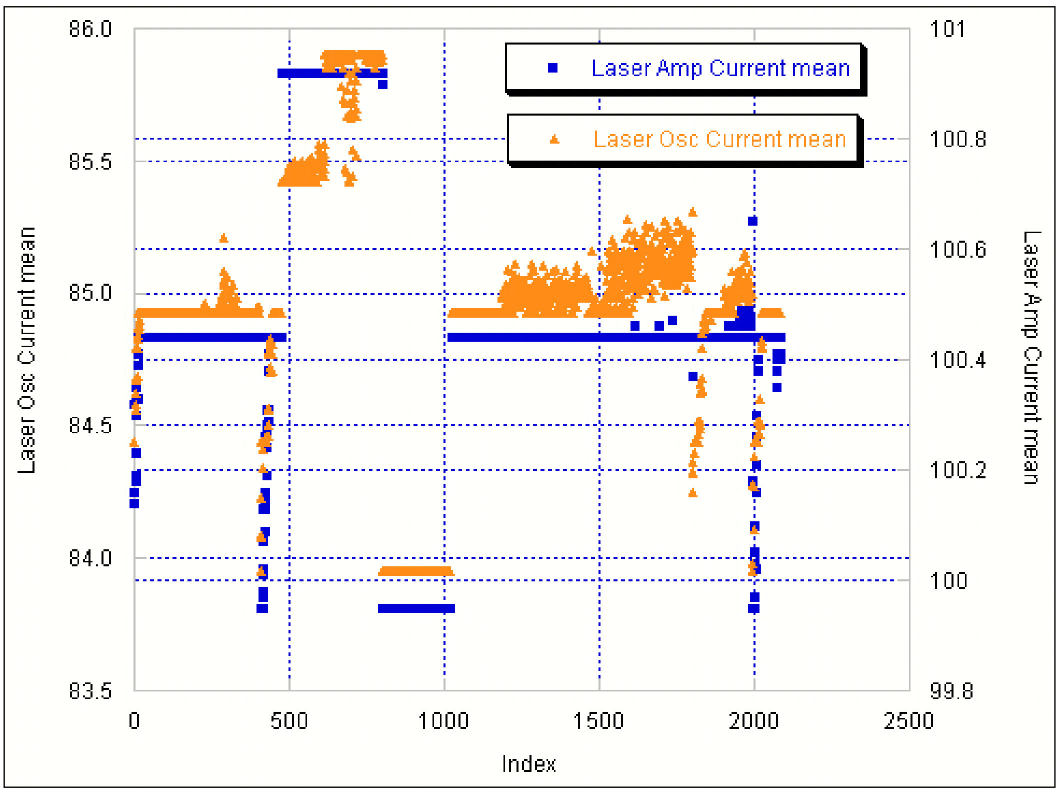
Laser 1 Energy and Gain (1 min averages) vs. Index



Laser 1 Energy and Ref. Temp. (1 min averages) vs. Index



Laser 1 Osc. & Amp. Current (1 min averages) vs. Index



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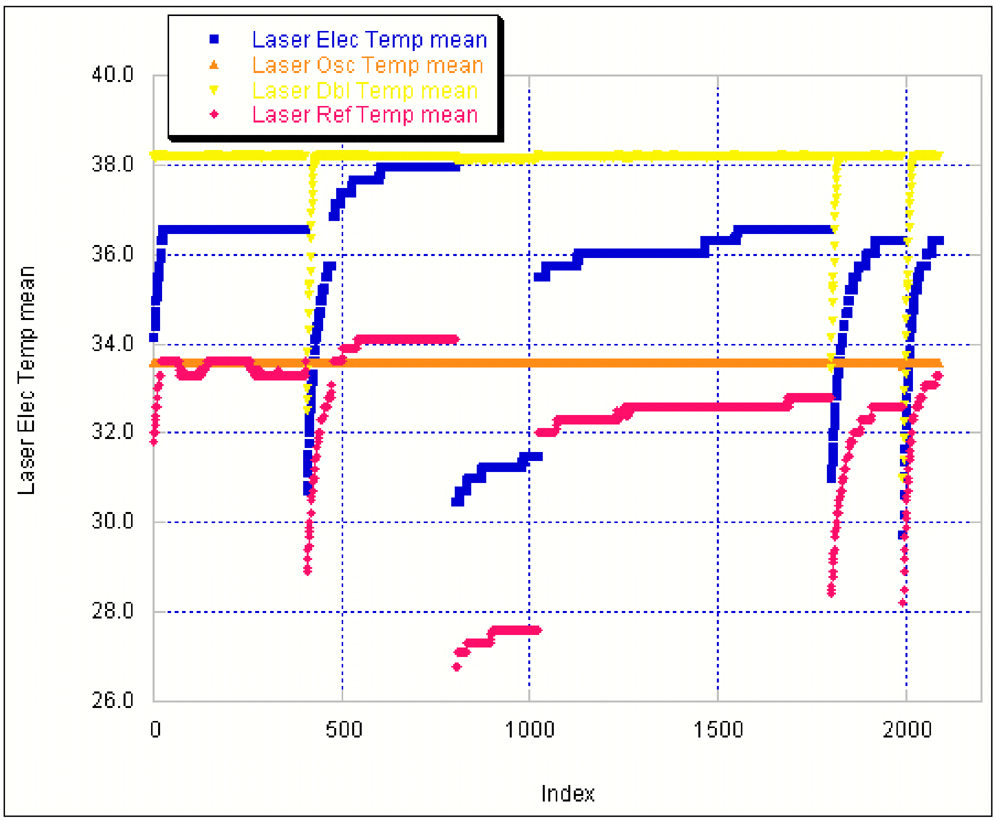
Laser 1 Temperatures vs. Index (1 min averages)



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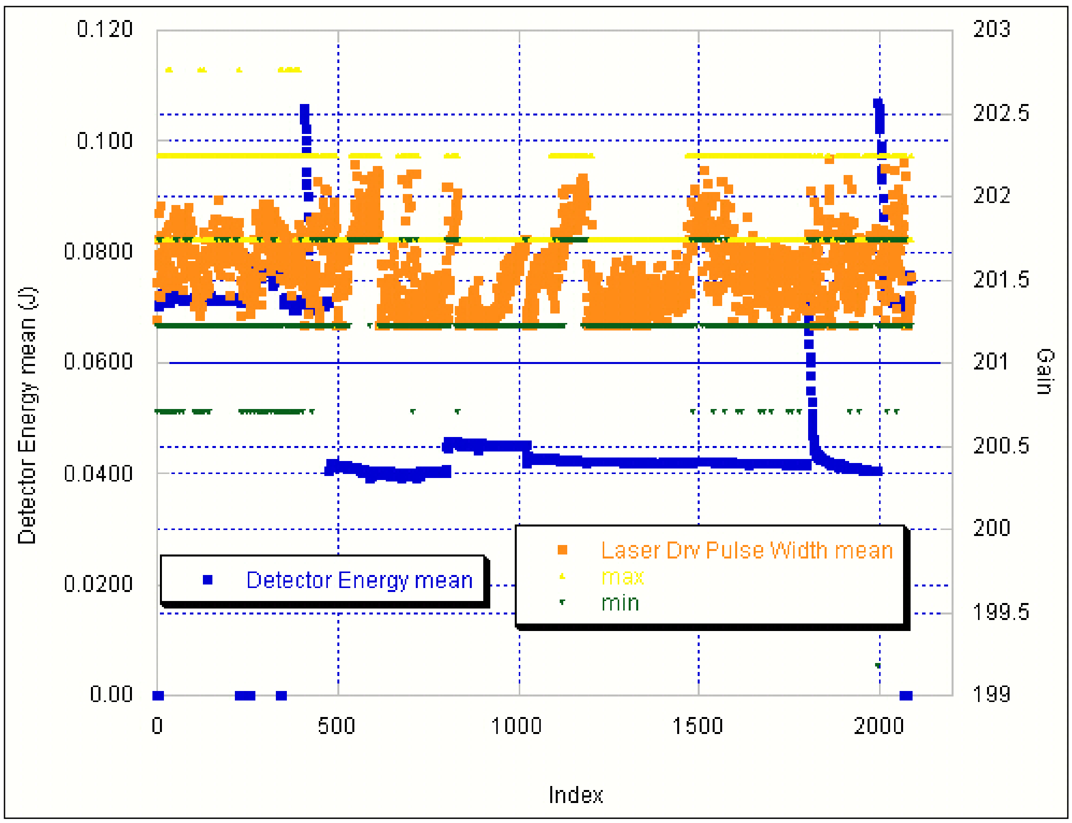
Laser 1 Energy and Drive Pulsewidth (1 min averages) vs. Index



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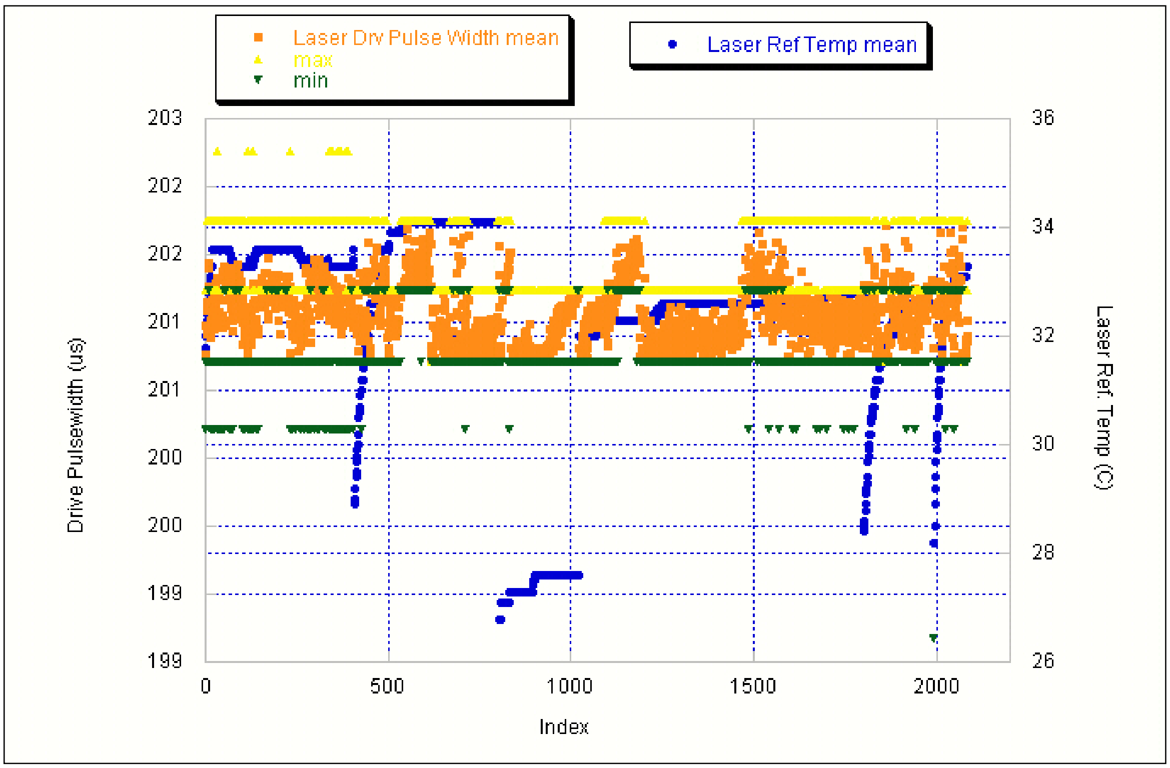
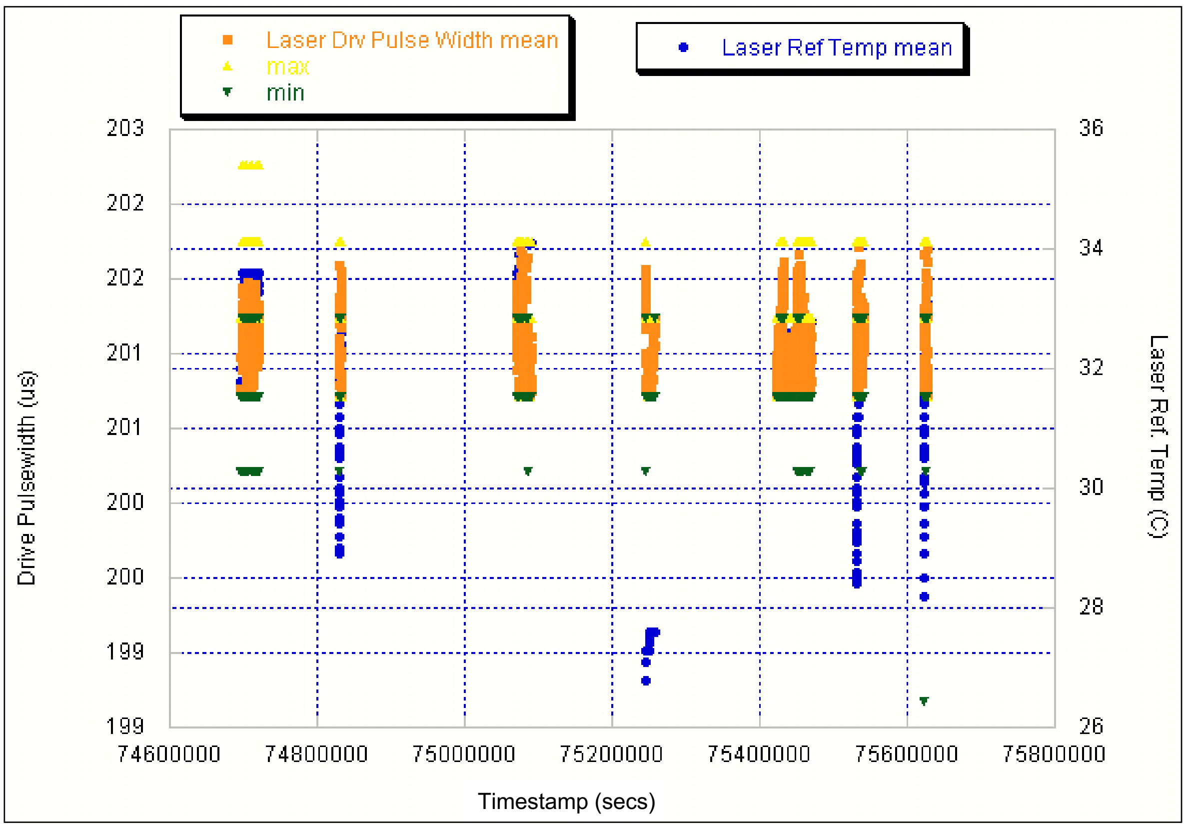
Laser 1 Reference Temperature and Drive Pulsewidth (1 min averages) vs. Index

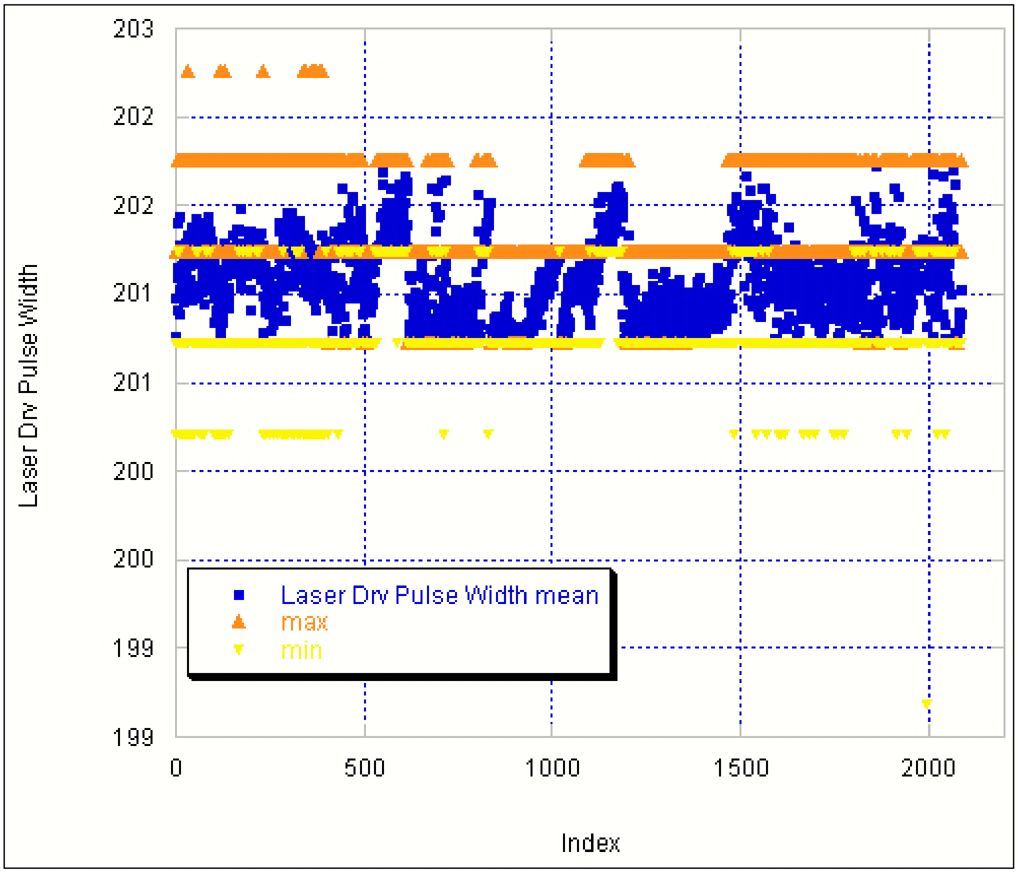


77

Laser 1 Reference Temperature and Drive Pulsewidth (1 min averages) vs. Time

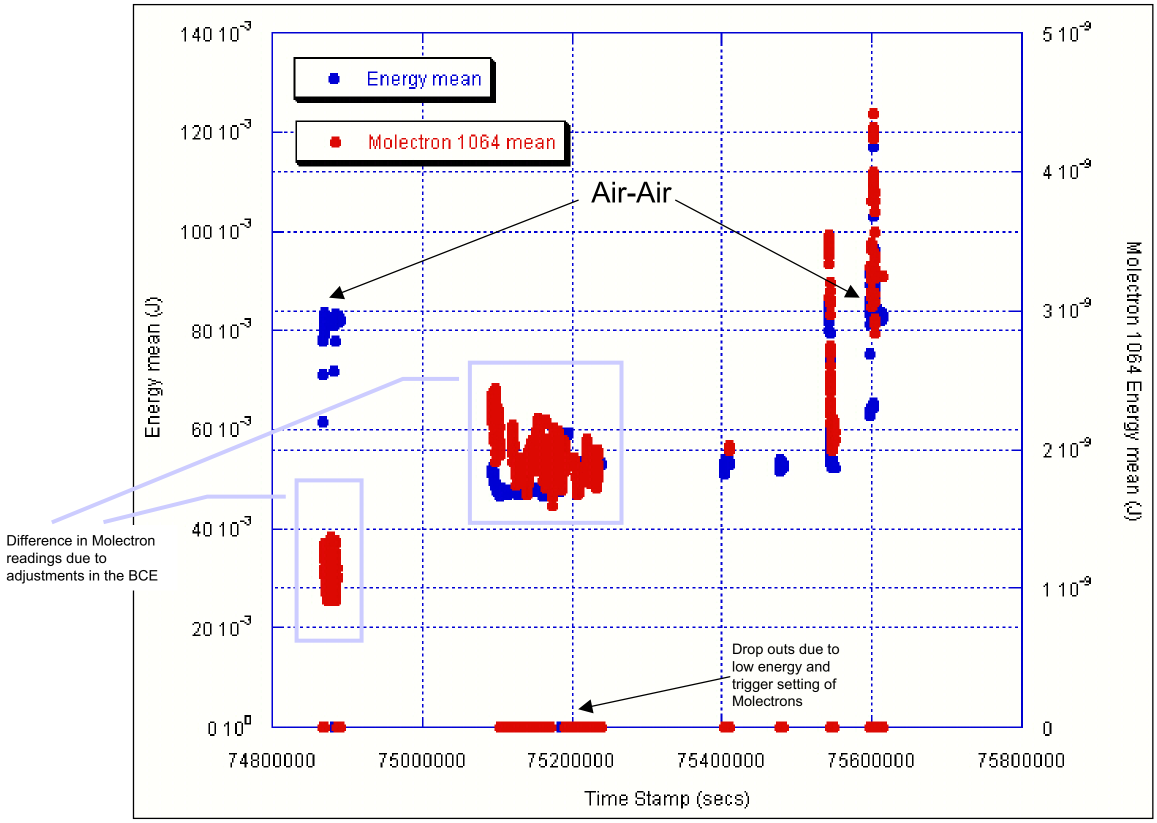


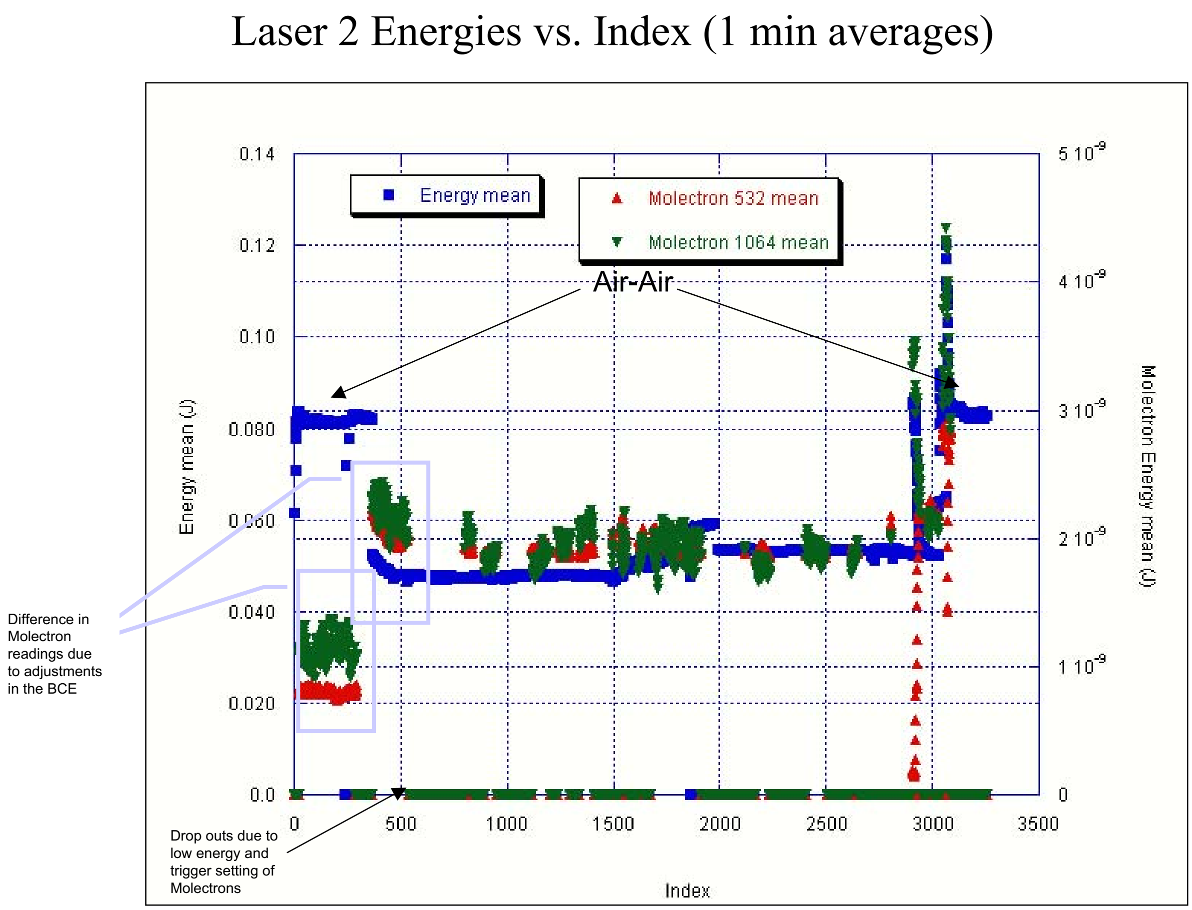
Laser 1 Drive Pulsewidth (1 min averages) vs. Index



Laser 2

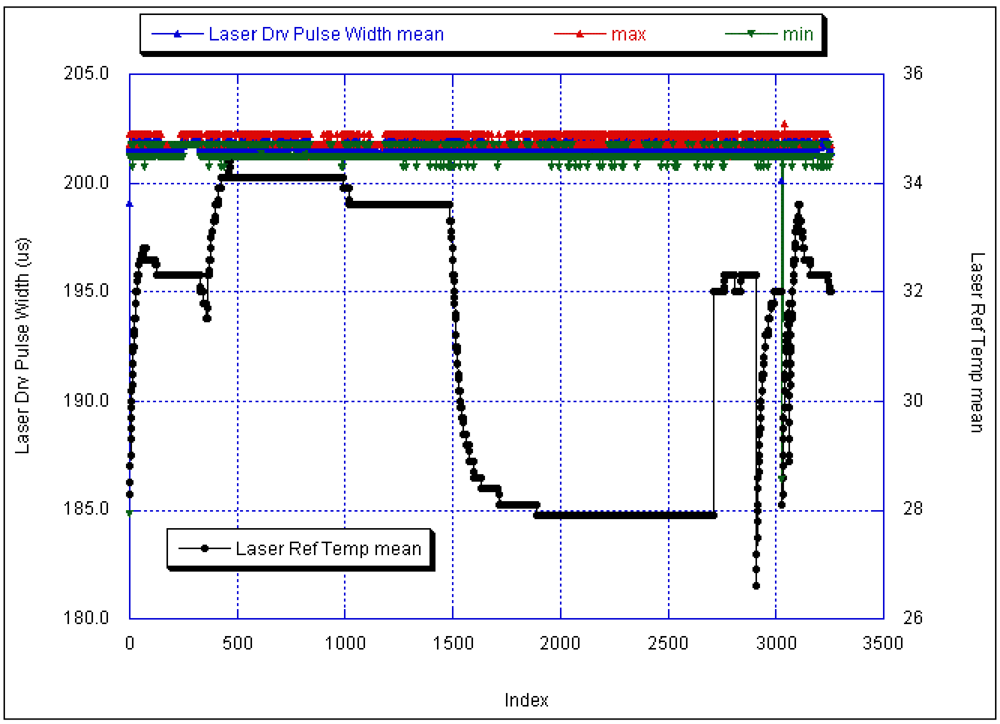
Laser 2 Detector and Molectron Relative Energies vs. Time
(1 min averages)



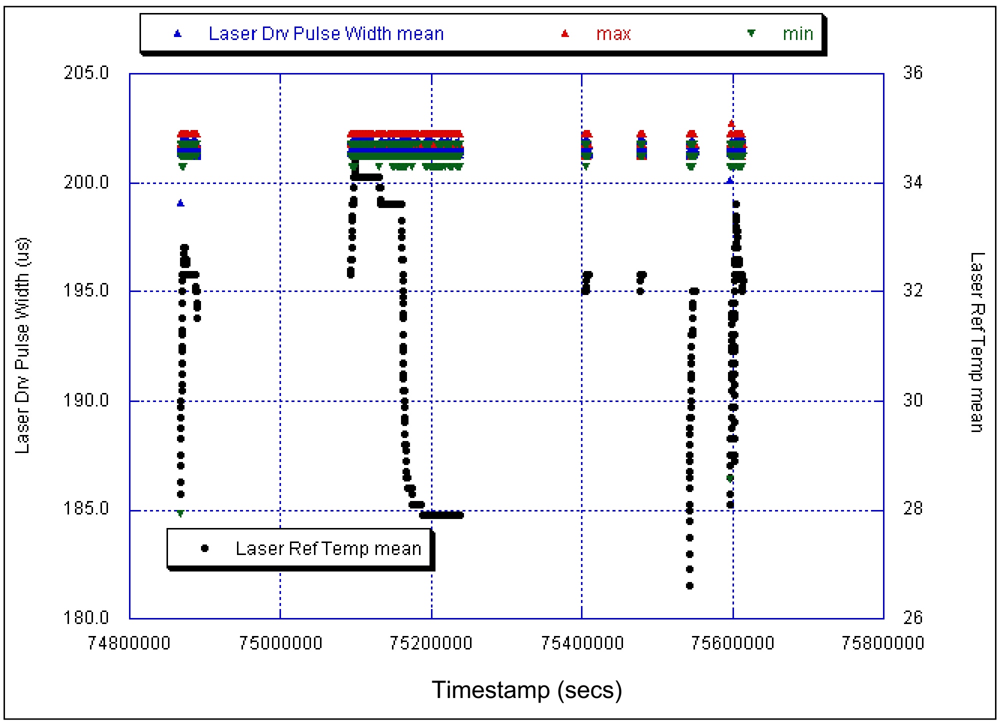

Laser 2 Energies vs. Index (1 min averages)
Energy mean
Molectron 532 mean
Molectron 1064 mean
Air-Air
Difference in Molectron readings due to adjustments in the BCE
Drop outs due to low energy and trigger setting of Molectrons
Energy mean (J)
Molectron Energy mean (J)
Index
0.14
0.12
0.10
0.080
0.060
0.040
0.020
0.0
0
500
1000
1500
2000
2500
3000
3500
5 10-9
4 10-9
3 10-9
2 10-9
1 10-9
0

8

Laser 2 Reference Temperature and Drive Pulsewidth (1 min averages) vs. Index

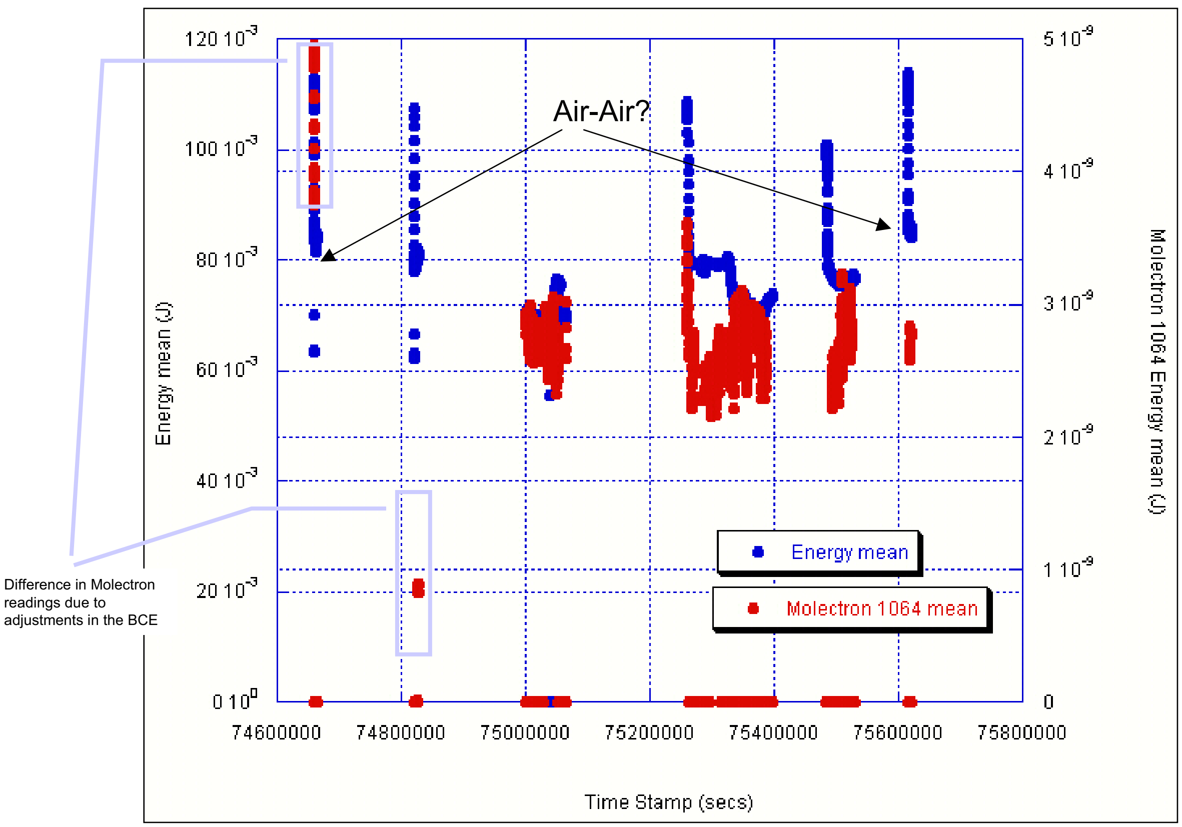


Laser 2 Reference Temperature and Drive Pulsewidth (1 min averages) vs. Time

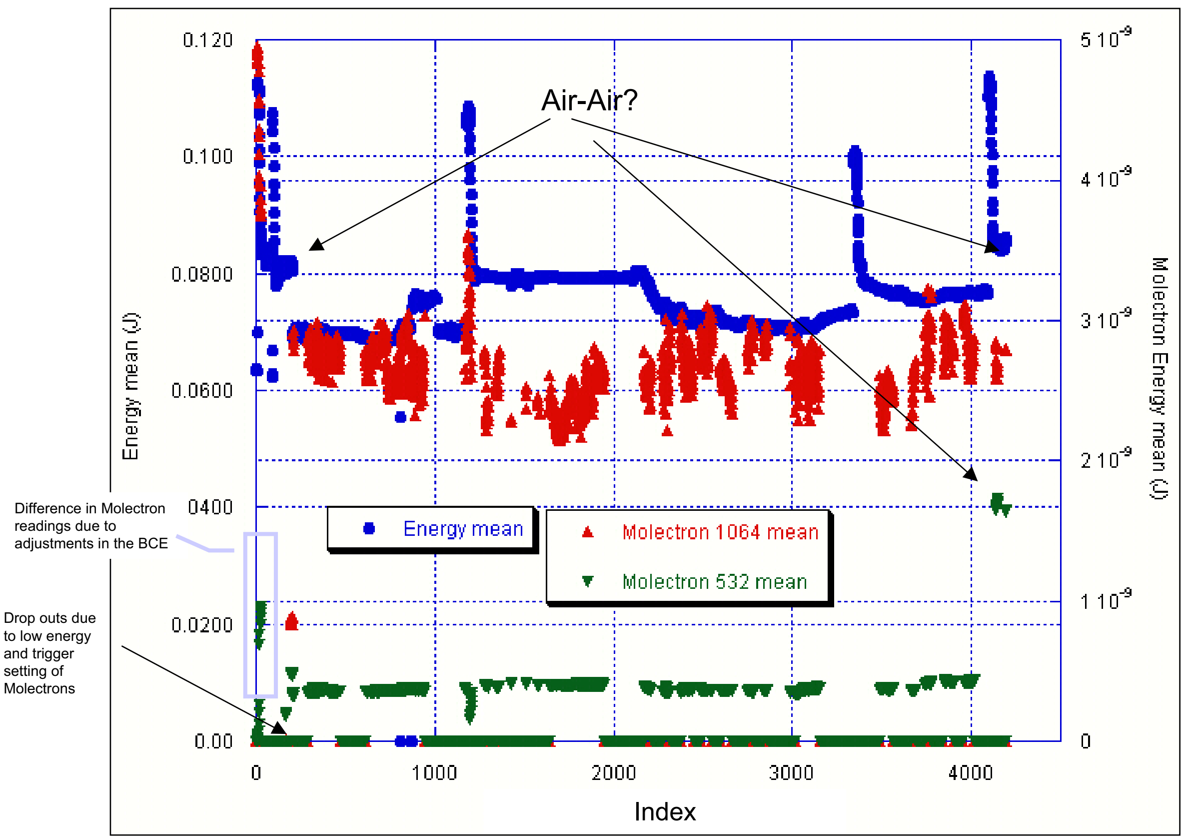


Laser 3

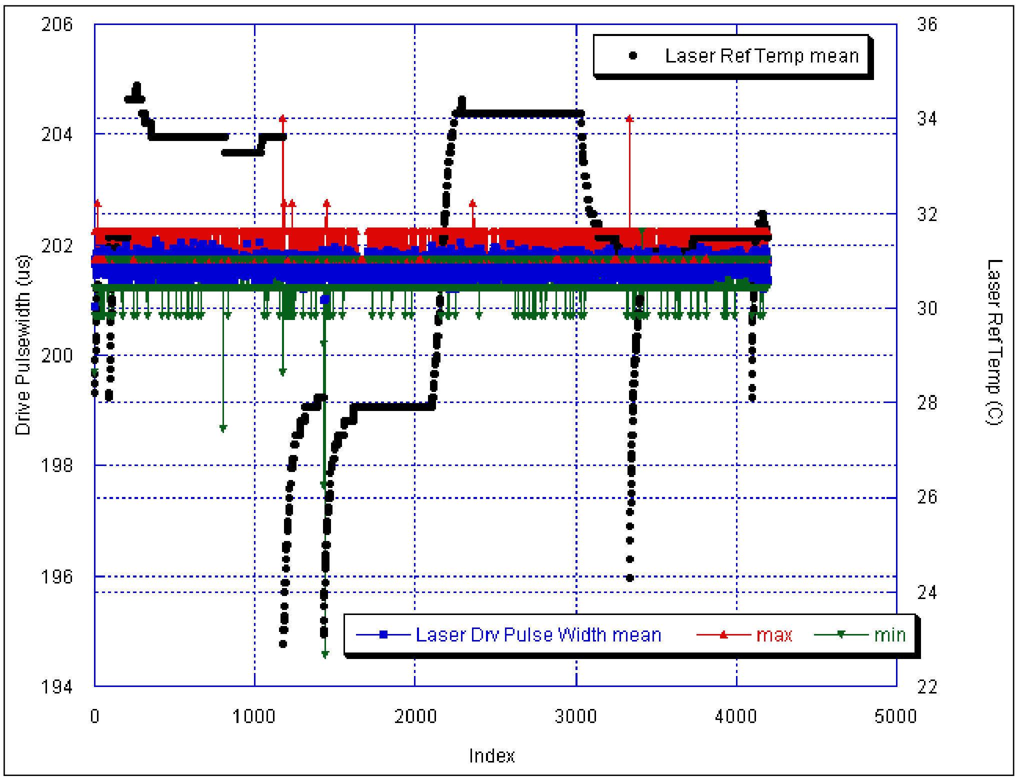
Laser 3 Detector and Molectron Relative Energies vs. Time (1 min averages)



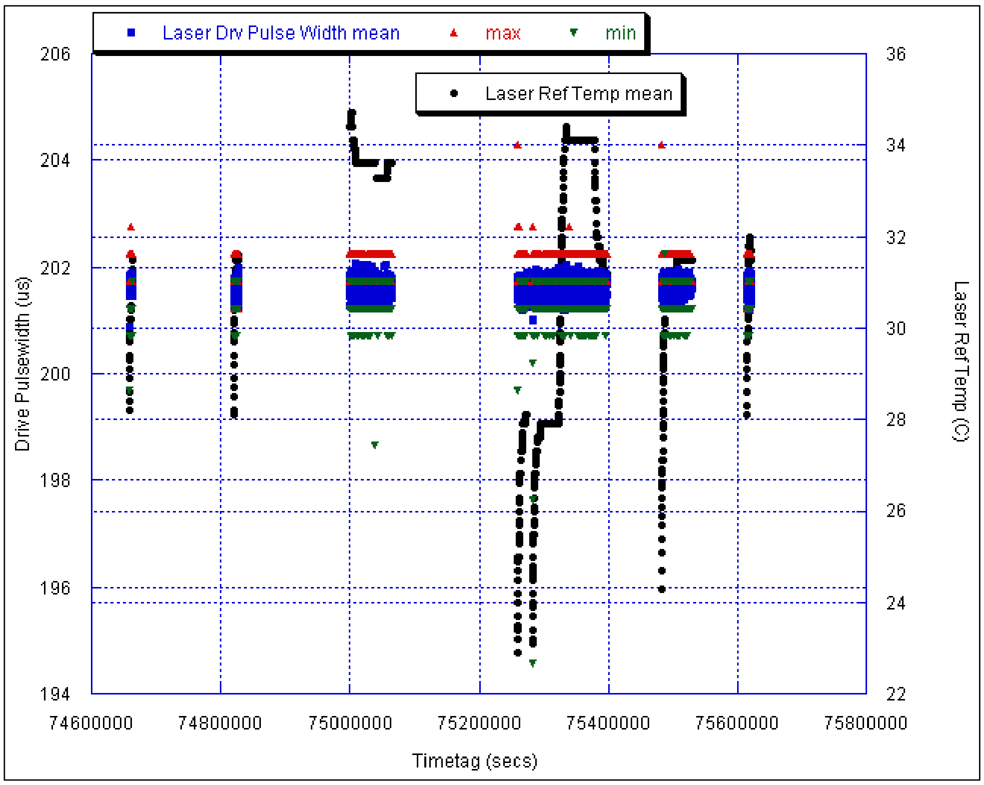
Laser 3 Energies vs. Index (1 min averages)



Laser 3 Reference Temperature and Drive Pulsewidth (1 min averages) vs. Index



Laser 3 Reference Temperature and Drive Pulsewidth (1 min averages) vs. Time



Relative Laser Energy Measurements during observatory TVAC

All TVAC data are one minute averages

Relative Laser Energy Measurements during observatory TVAC

The 1064 and 532 nm energy measurements from the Mini Target use two, low-energy detectors (Molectron J3S-10) with fiber pick offs on an integrating sphere (see next slide).

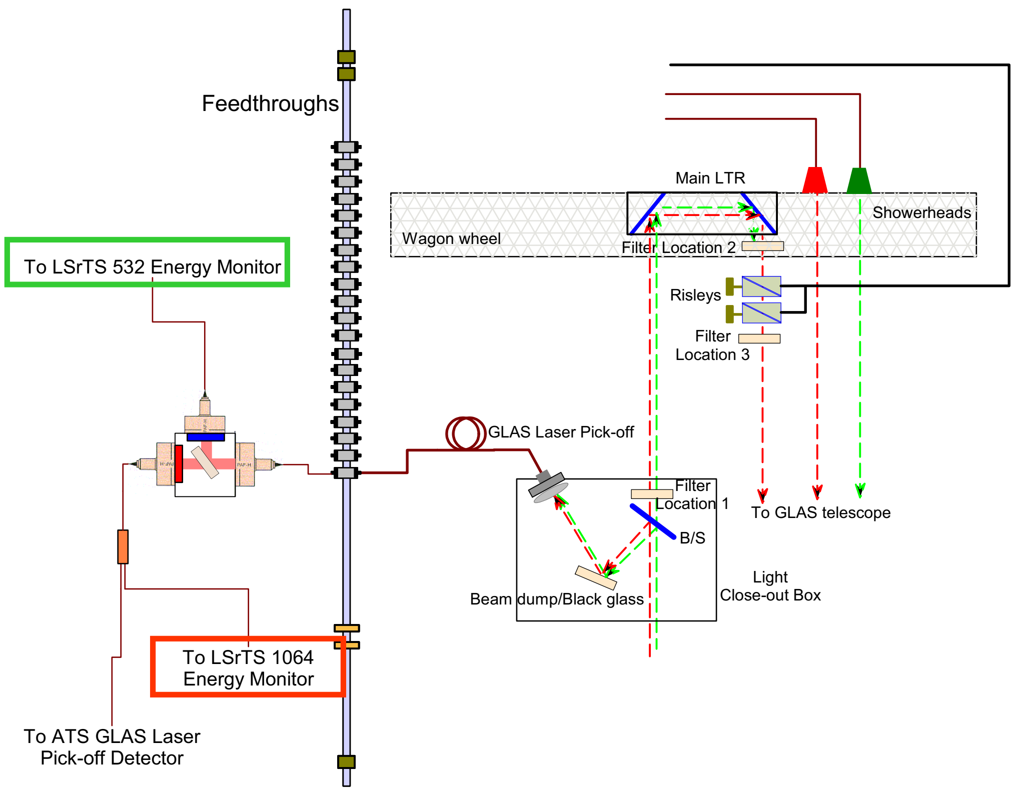
All Molectron energies are ***relative not absolute***

Adjustments to the attenuation levels were made during the test (highlighted in plots)

The altimeter detector energy values (1064 nm only) are derived using the same algorithm as in orbit

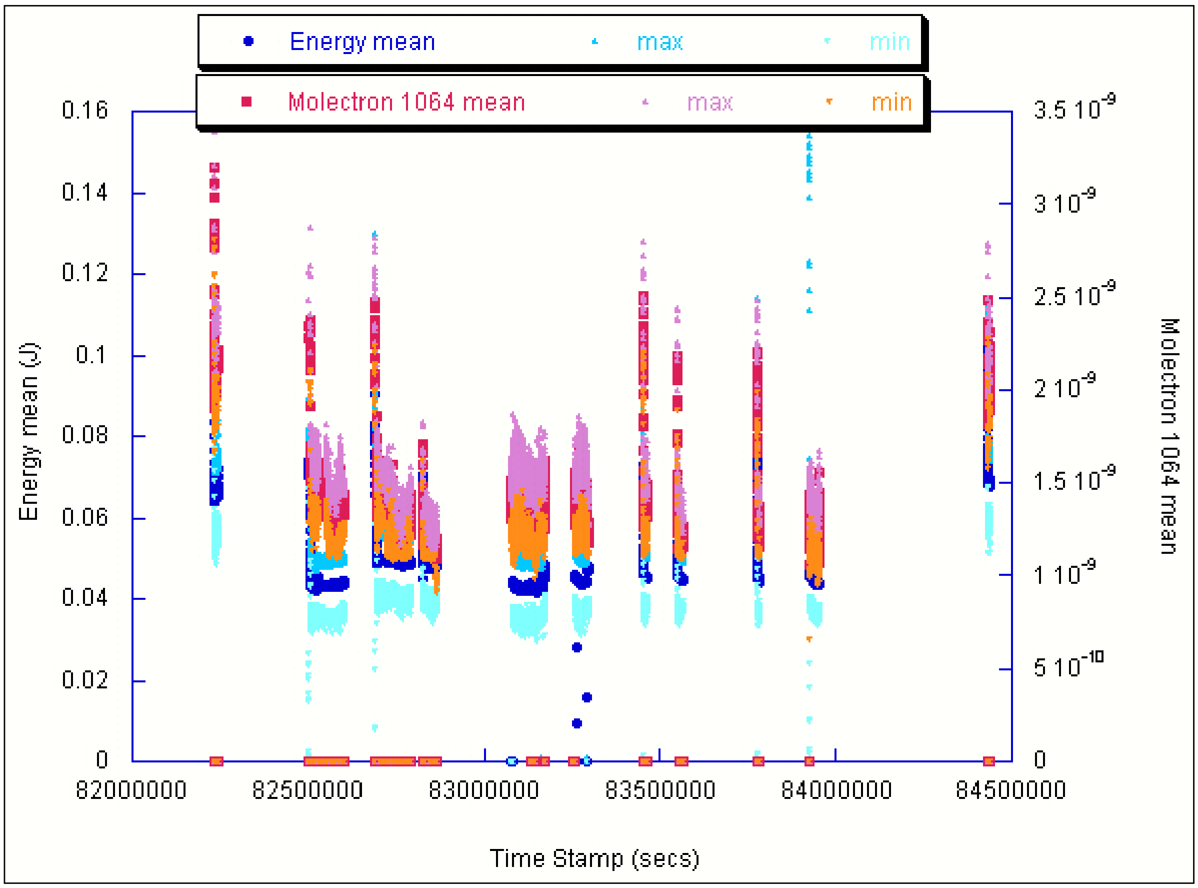
Note that there will be a change in the altimeter detector energy when gain adjustments were made.

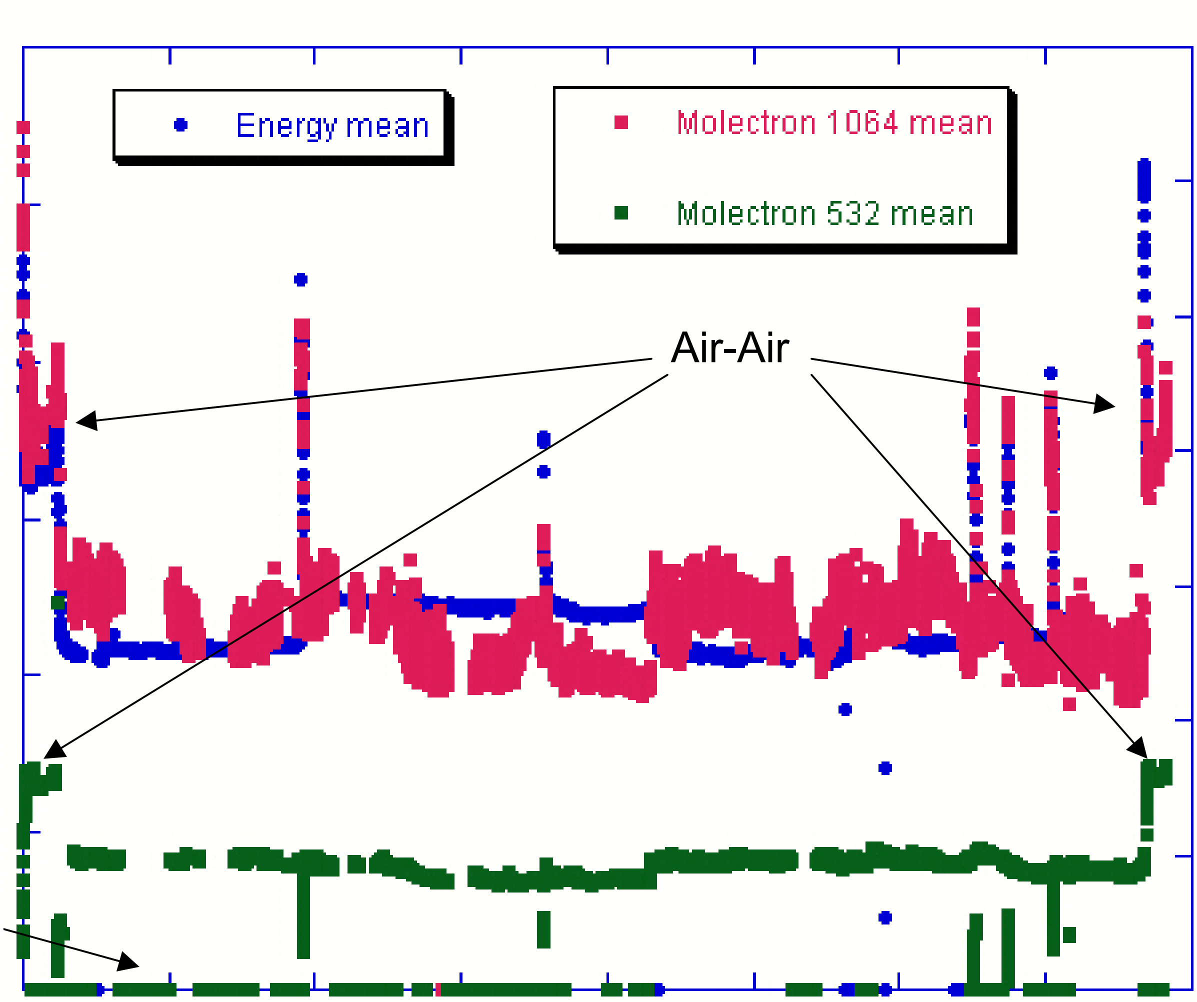
Relative Laser Energy Measurements during Observatory TVAC using Mini Target Beam Dump and BCE Laser Test System (LsrTS)



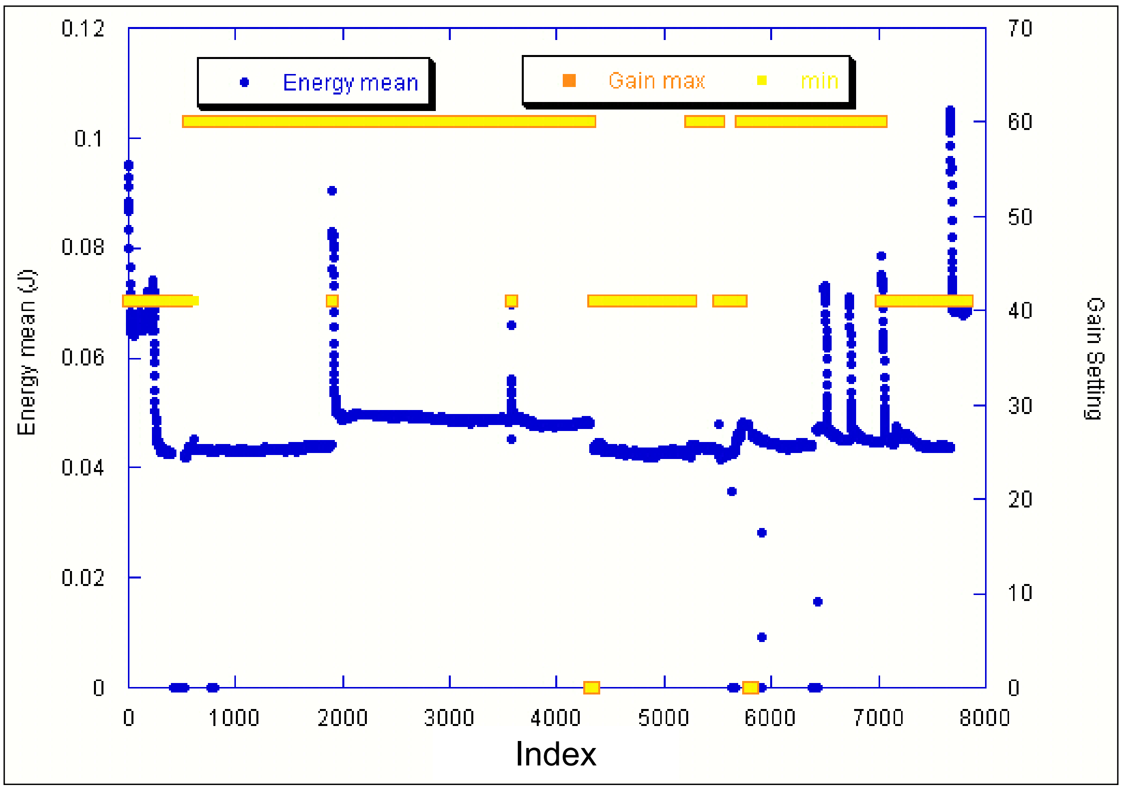
Laser 1

Laser 1 Detector and Molectron Relative Energies vs. Time

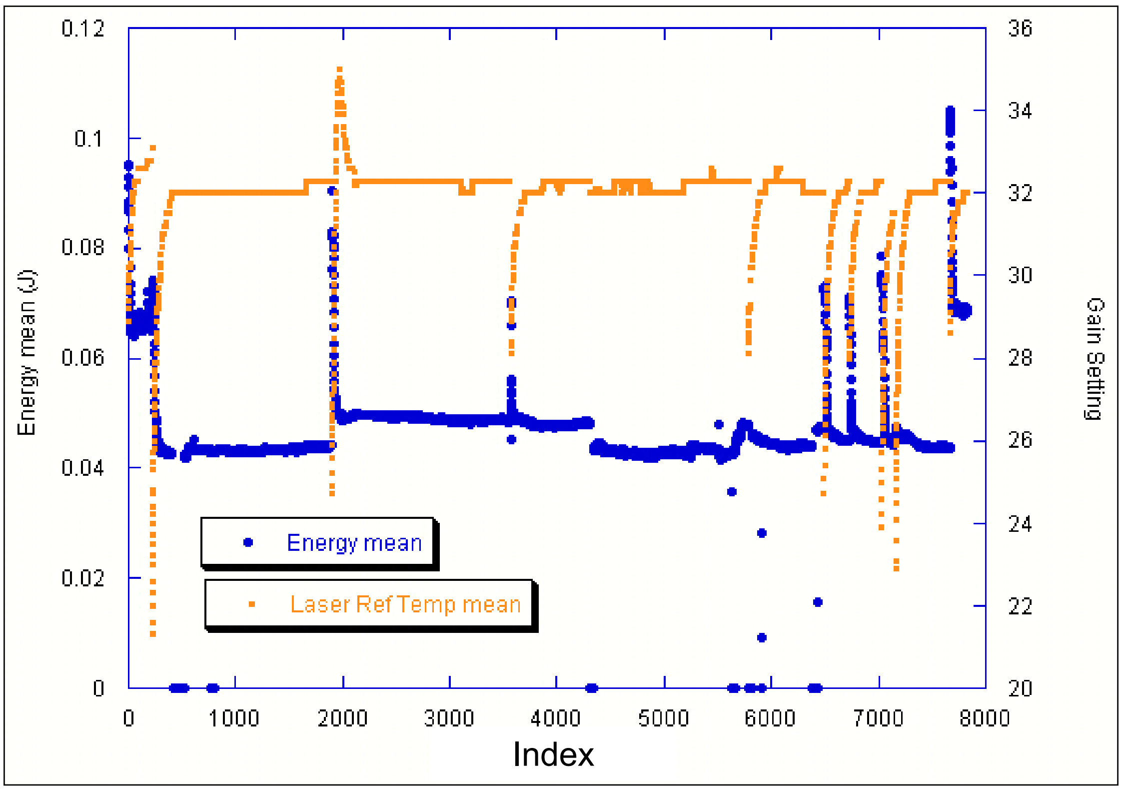



Energy mean
Molectron 1064 mean
Molectron 532 mean
Air-Air

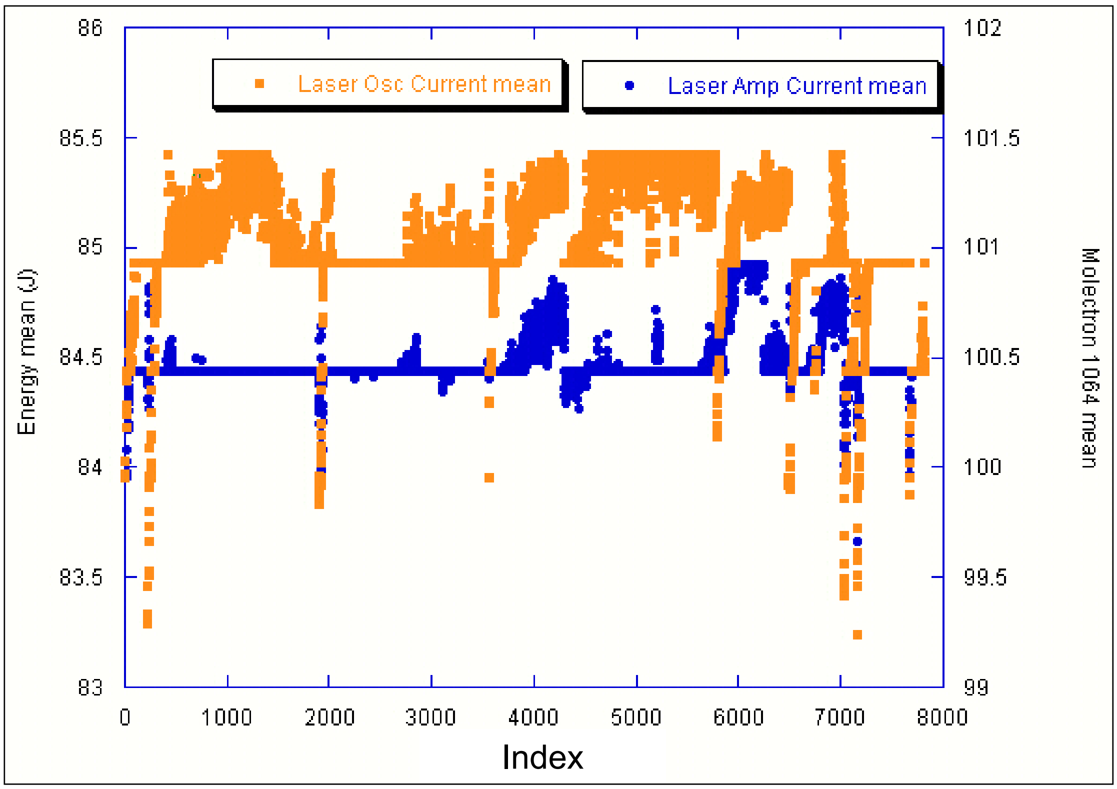
Laser 1 Energy and Gain (1 min averages) vs. Index



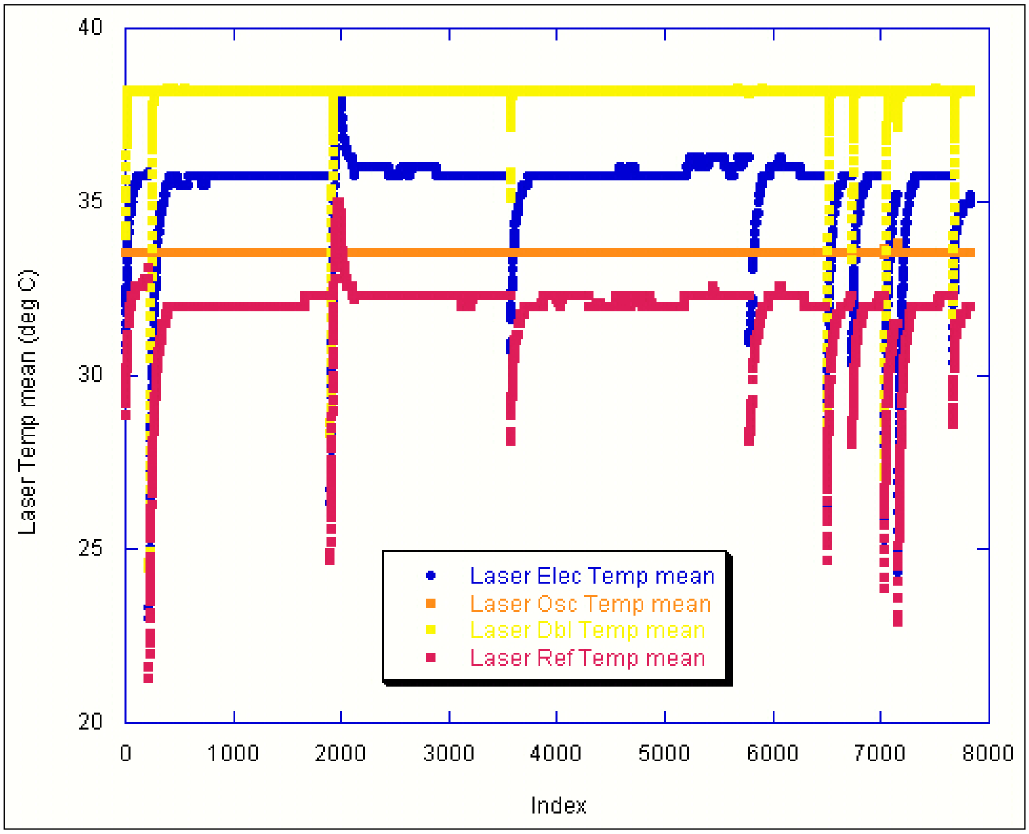
Laser 1 Energy and Ref. Temp. (1 min averages) vs. Index



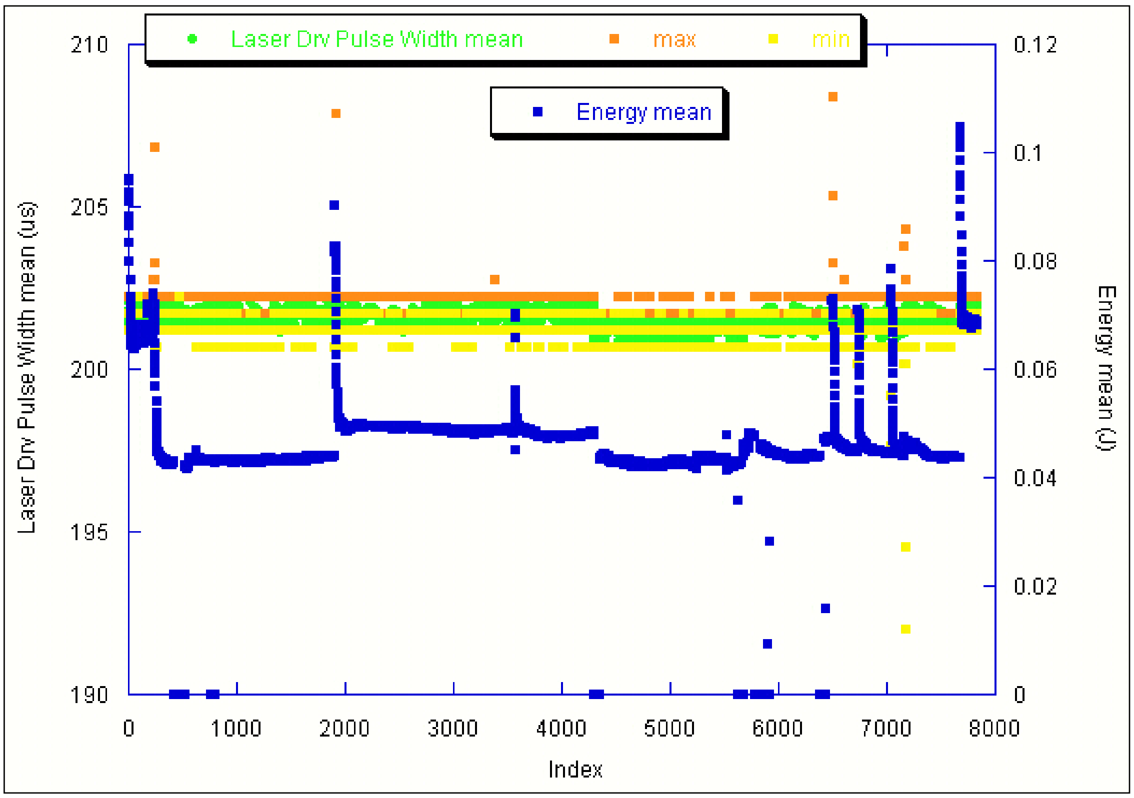
Laser 1 Osc. & Amp. Current (1 min averages) vs. Index



Laser 1 Temperatures vs. Index (1 min averages)



Laser 1 Drive Pulsewidth (1 min averages) vs. Index



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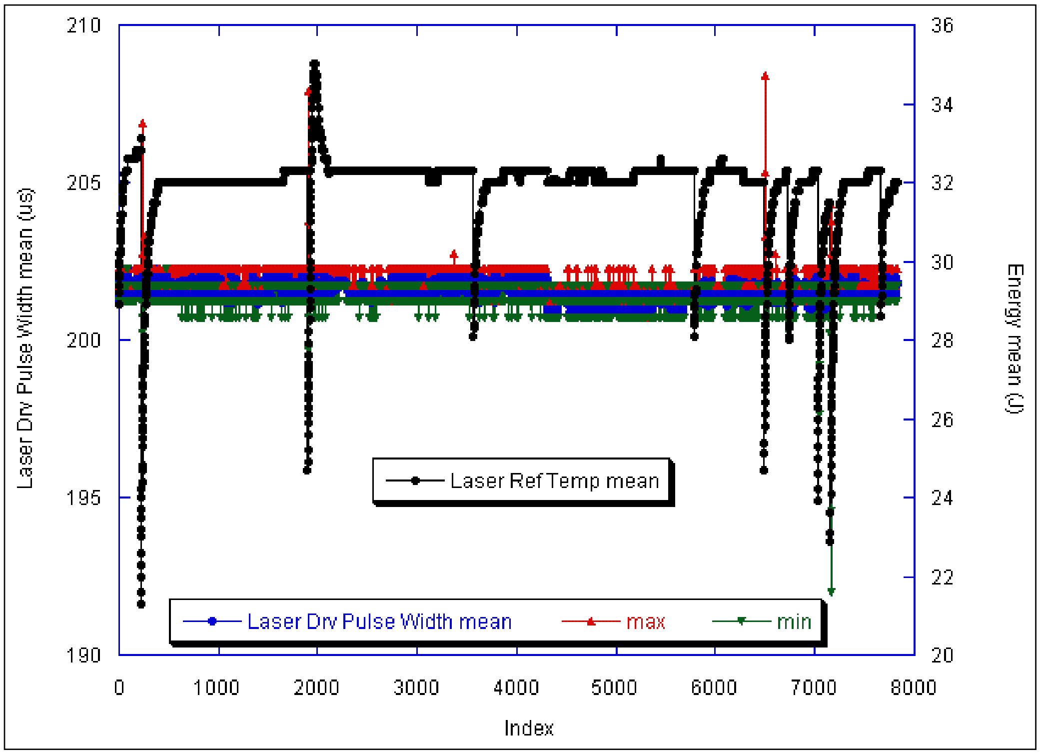
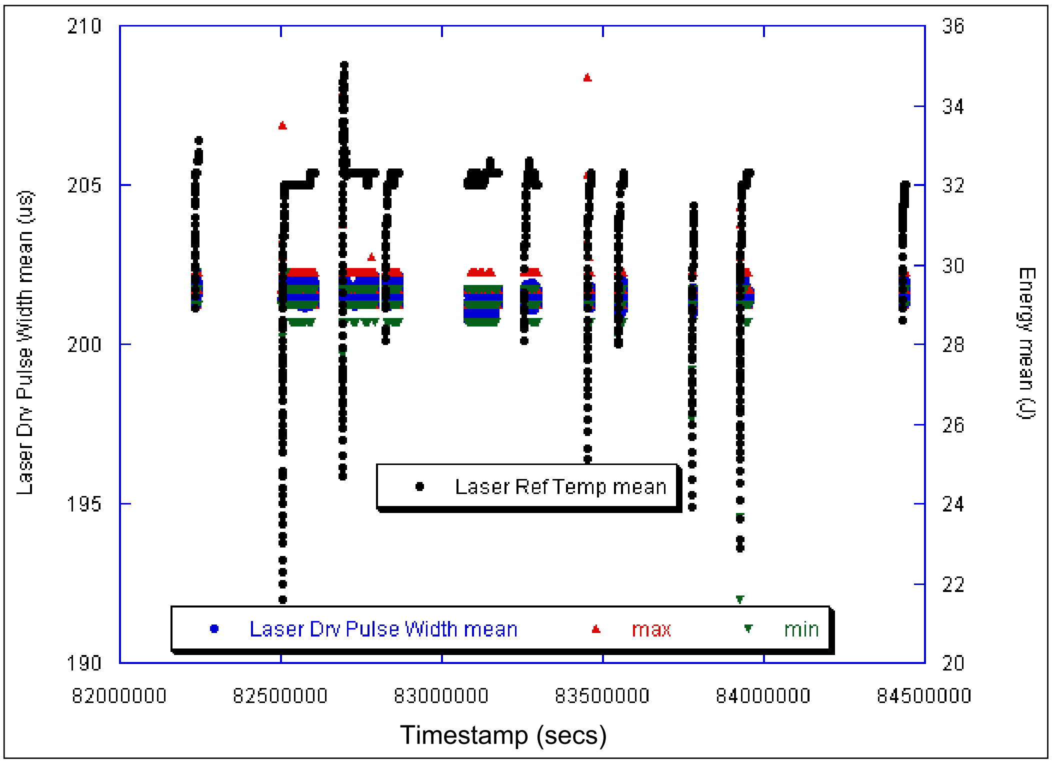
Laser 1 Drive Pulsewidth (1 min averages) and Reference Temperature vs. Index



1

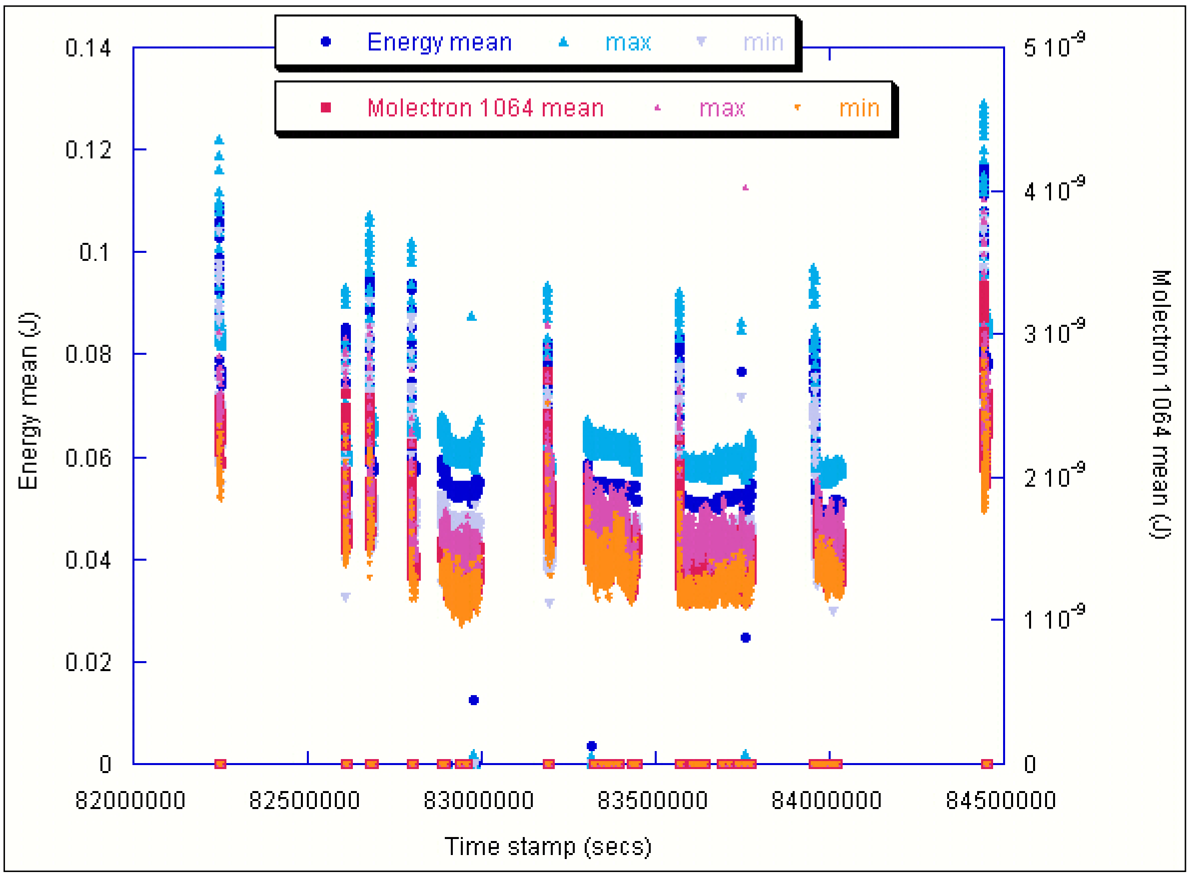
Laser 1 Drive Pulsewidth (1 min averages) and Reference Temperature vs. Time



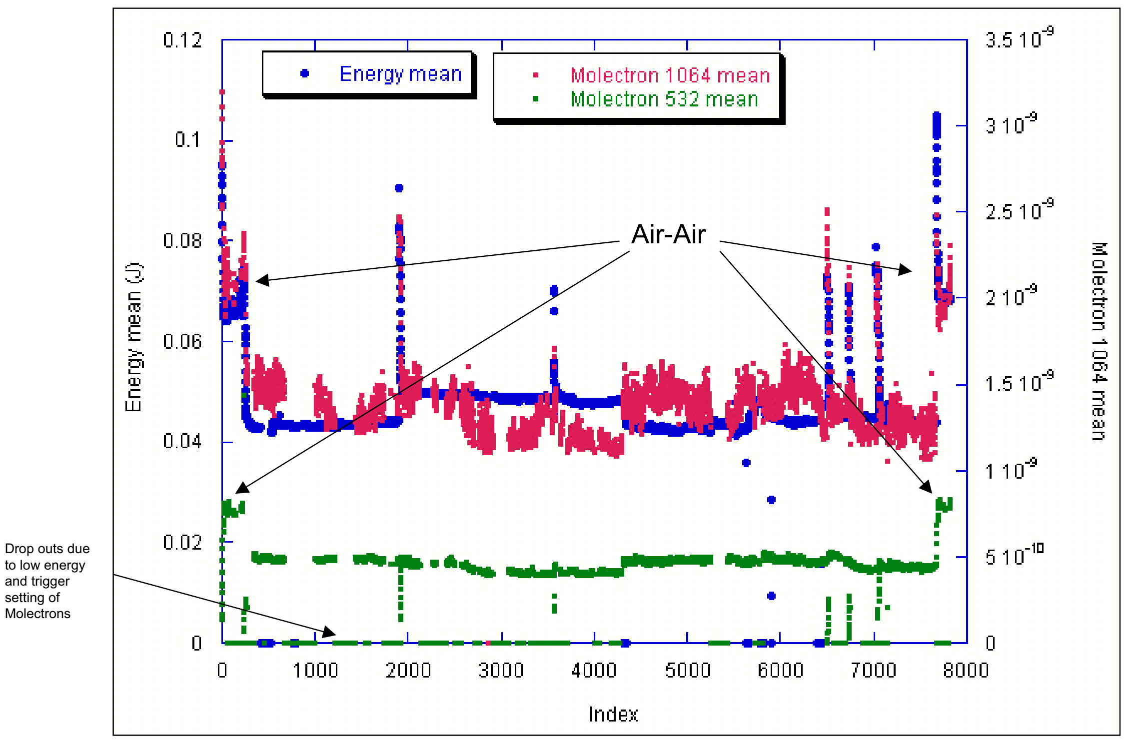
1

Laser 2

Laser 2 Detector and Molectron Relative Energies vs. Time (1 min averages)



Laser 2 Energies vs. Index (1 min averages)



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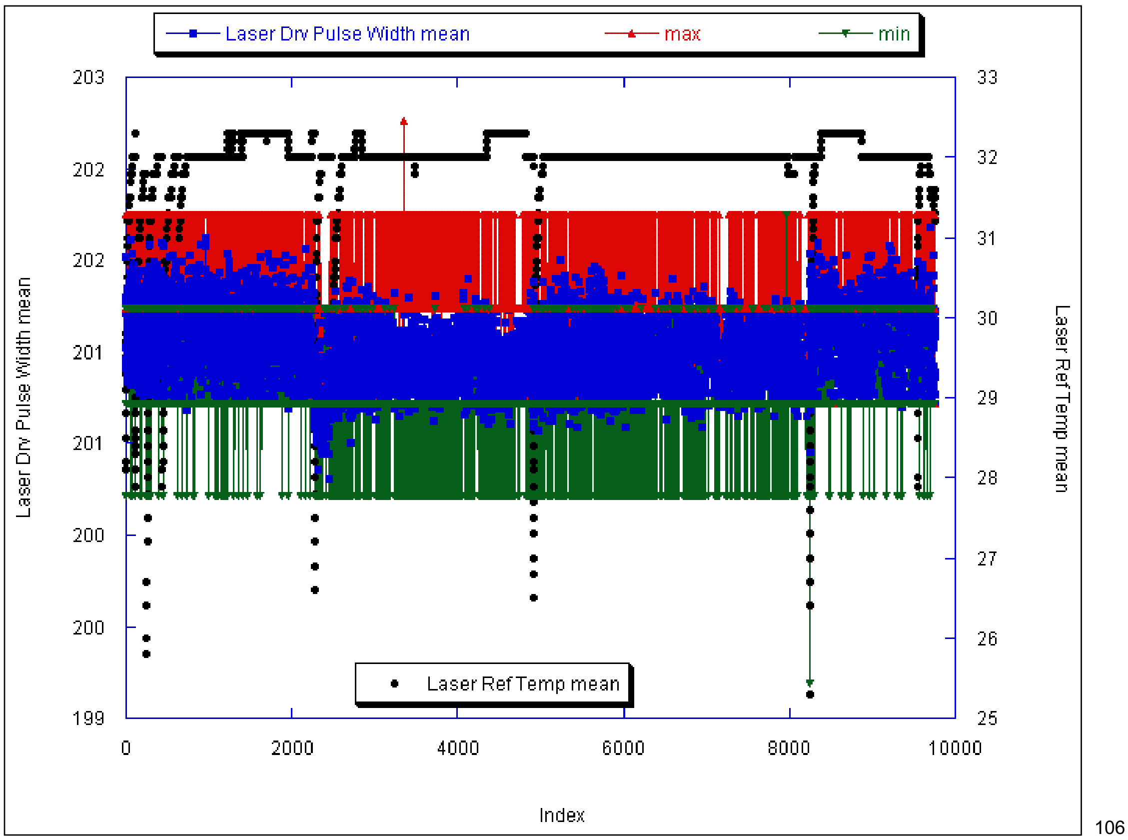
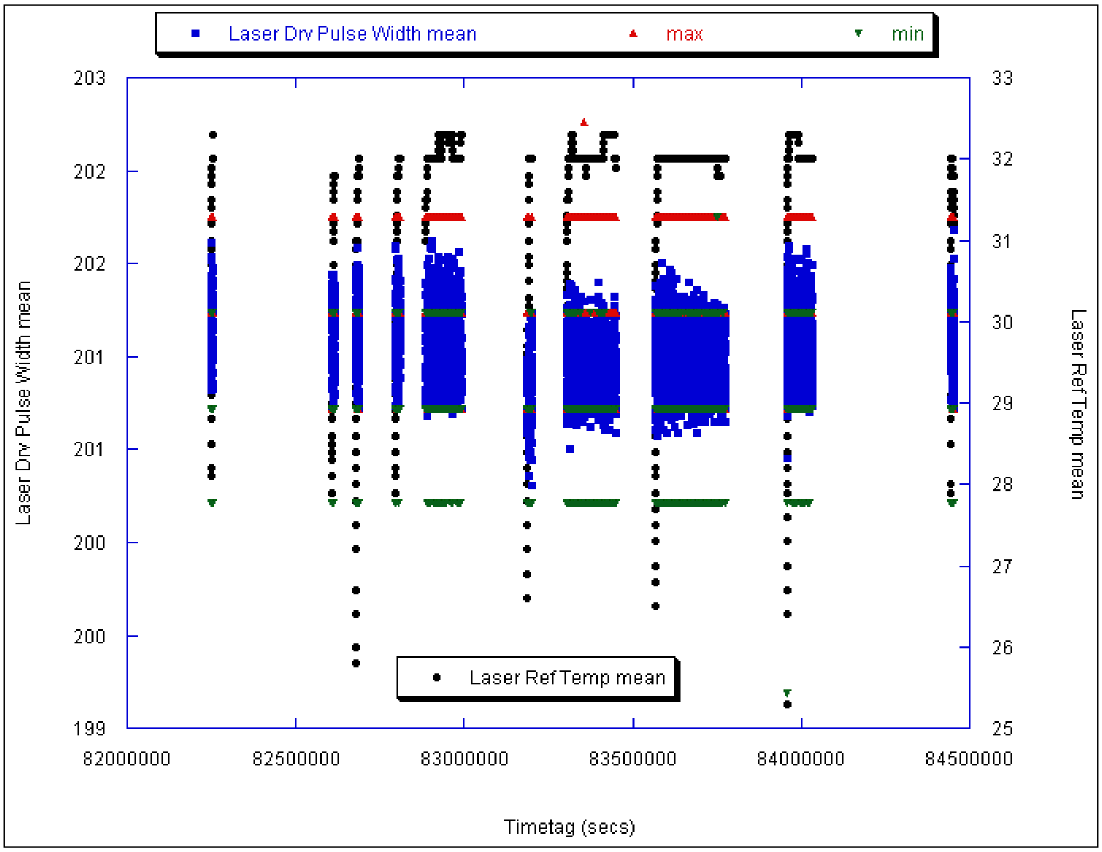
Laser 2 Drive Pulsewidth (1 min averages) and Reference Temperature vs. Index

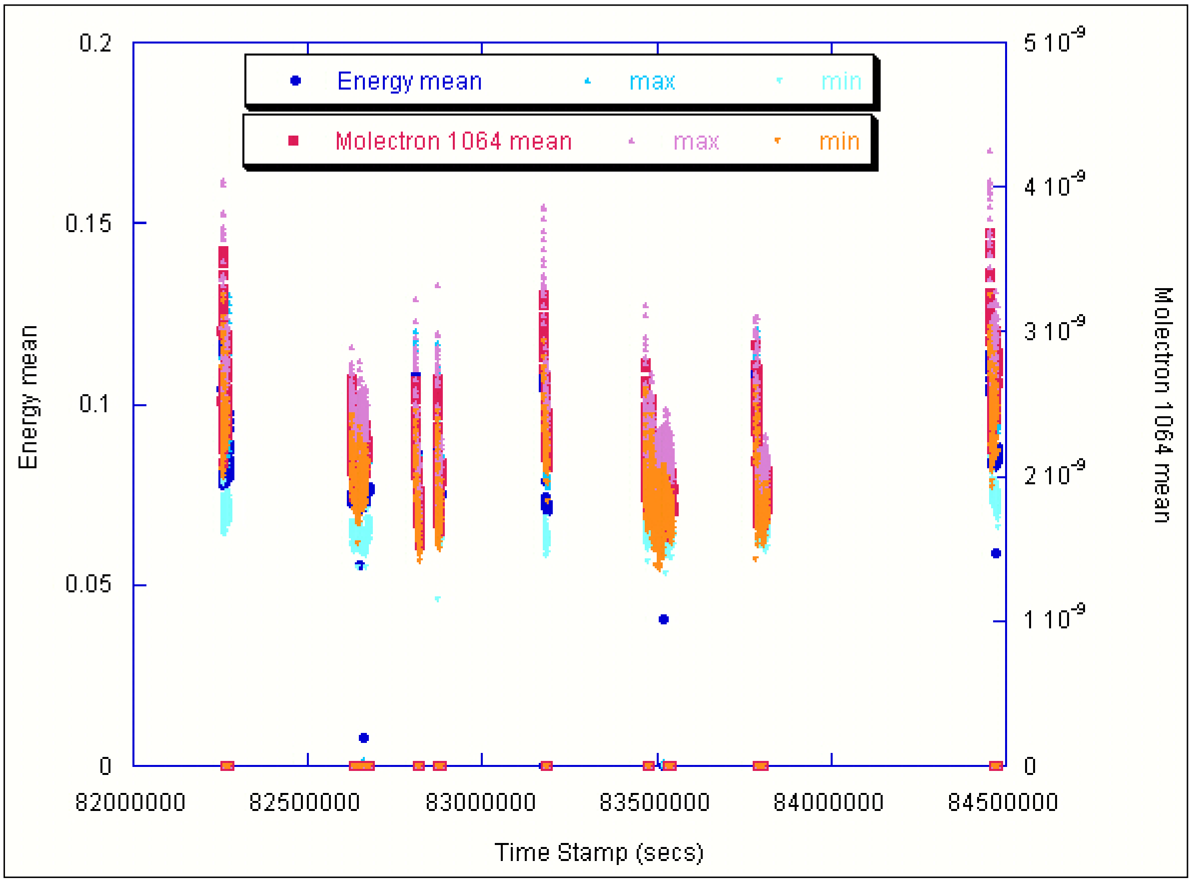


Laser 2 Drive Pulsewidth (1 min averages) and Reference Temperature vs. Time

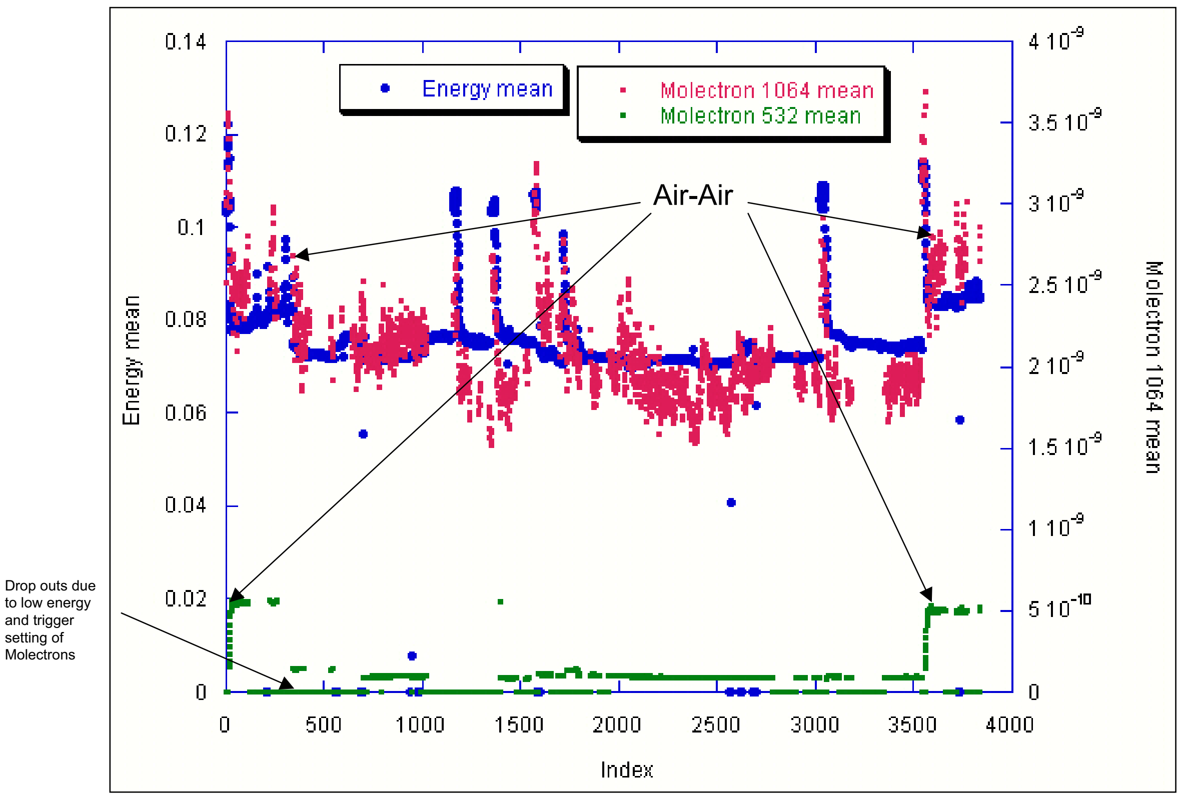


Laser 3

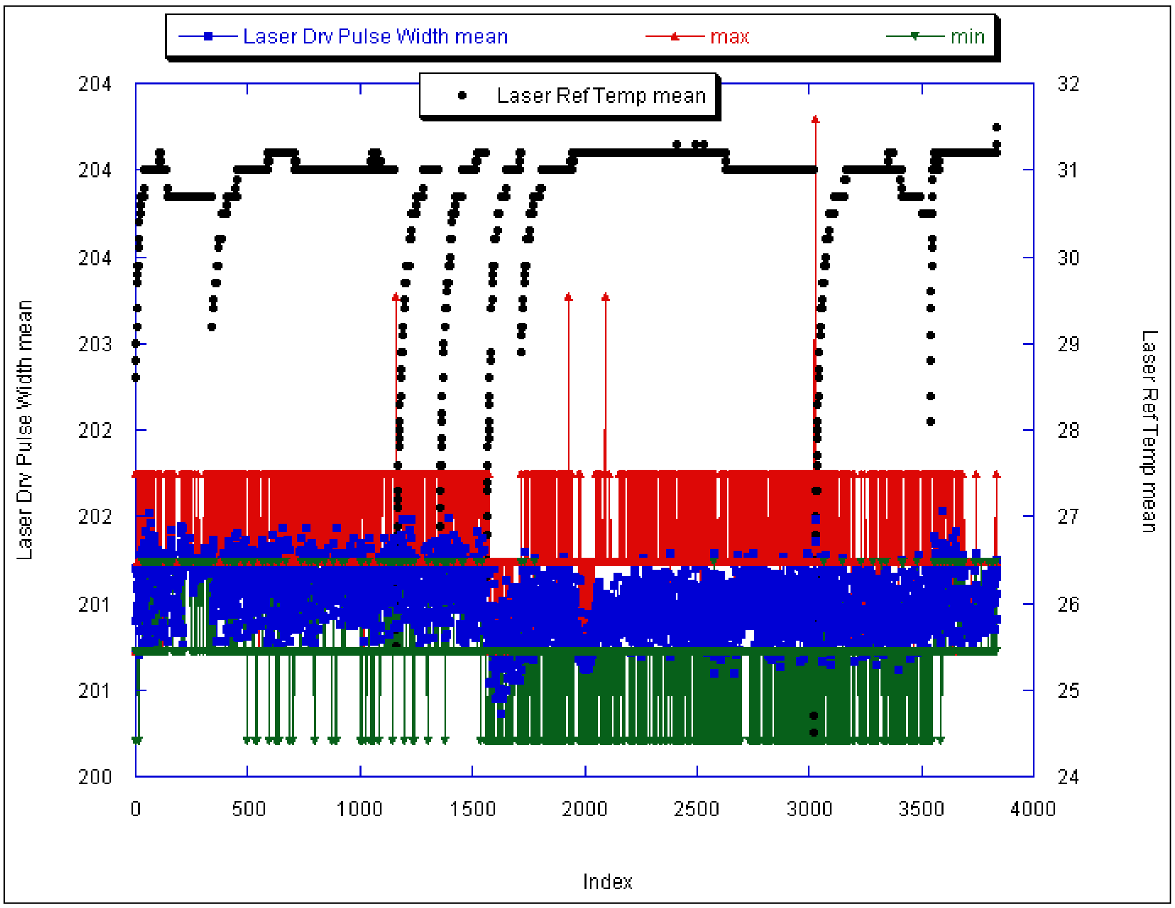
Laser 3 Detector and Molectron Relative Energies vs. Time
(1 min averages)



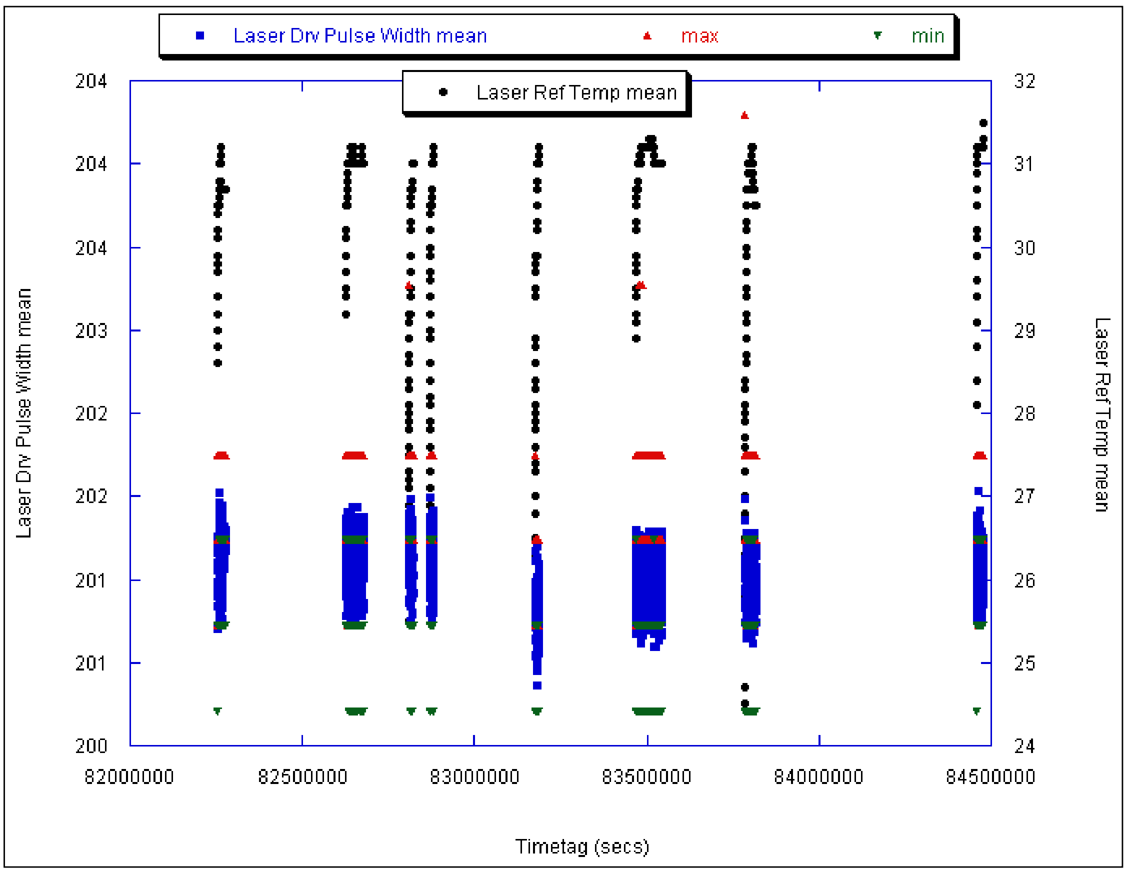
Laser 3 Energies vs. Index (1 min averages)



Laser 3 Drive Pulsewidth (1 min averages) and Reference Temperature vs. Index



Laser 3 Drive Pulsewidth (1 min averages) and Reference Temperature vs. Time



Number of Laser Shots Fired
from Laser Delivery to I&T until 2002 Day 278 (Oct 4)

Component	Total On Time (hours)	On/Off Cycles (or mechanism actuations)	Notes
Laser 1	656.07	133	Data as of 10/04/02 Shots Fired=86,816,480
Laser 2	533.32	93	Data as of 10/04/02 Shots Fired=72,178,760
Laser 3	420.01	72	Data as of 10/04/02 Shots Fired=55,825,360

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Summary

- **Average power measurements during GLAS instrument testing at GSFC**
- **Comparison with SLTC average power measurements before delivery to GLAS**

	GLAS			SLTC Measurements				Delta GLAS-SLTC			Delta GLAS-SLTC		
	Average Power (W)			Average Power (W)				ABS	ABS	ABS	%	%	%
Laser	**532**	**1064**	**Total**	**Laser**	**532**	**1064**	**Total**	**532**	**1064**	**Total**	**532**	**1064**	**Total**
Laser 1	1.41	2.88	4.29	SN2	1.36	2.80	4.16	0.05	0.08	0.13	3.5%	2.8%	3.0%
Laser 2	1.28	3.20	4.48	SN3	1.29	3.10	4.39	-0.01	0.10	0.09	-0.7%	3.1%	2.0%
Laser 3	0.99	3.28	4.27	SN1	1.18	3.26	4.43	-0.19	0.02	-0.16	-19.2%	0.8%	-3.9%

- **Energy measurements during GLAS instrument testing at GSFC**

High Energy Molectron			GLAS Energy		SLTC Energy	
	Aver. Energy (mJ)		Derived Energy (mJ)		Derived Energy (mJ)	
Laser	**532**	**1064**	**532**	**1064**	**532**	**1064**
Laser 1	*Not Measured*		35.2	72.0	34.0	70.0
Laser 2	33.9	78.5	32.0	79.9	32.3	77.5
Laser 3	25.2	81.7	24.7	82.0	29.5	81.4

Derived Energy (mJ) ≡ Average Power(W)/40 Hz

- **Energy measurements at observatory - Comparison with GSFC Energy measurements**

	GSFC		Observatory		Observatory - GSFC Delta			
	Aver. Energy (mJ)		Aver. Energy (mJ)		ABS	ABS	%	%
Laser	**532**	**1064**	**532**	**1064**	**532**	**1064**	**532**	**1064**
Laser 1	*Not Measured*		34.3	68.0	*Not Measured*		*Not Measured*	
Laser 2	33.9	78.5	33.9	77.7	0.0	-0.8	-0.1%	-1.1%
Laser 3	25.2	81.7	23.9	82.7	-1.3	1.0	-5.6%	1.2%

- **Altimeter Detector laser energy calibration**

$$\hat{E} = \frac{\Delta\tau \sum_{\text{Pulse Interval}} v_r(i)}{\eta_{circuit} \cdot \eta_{optical} \cdot R_{\det} \cdot G_{VGA} \cdot \alpha_{cal}}$$

All parameters known (calibrated) for each laser-detector/digitizer combination within ~ 12%

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Summary - continued

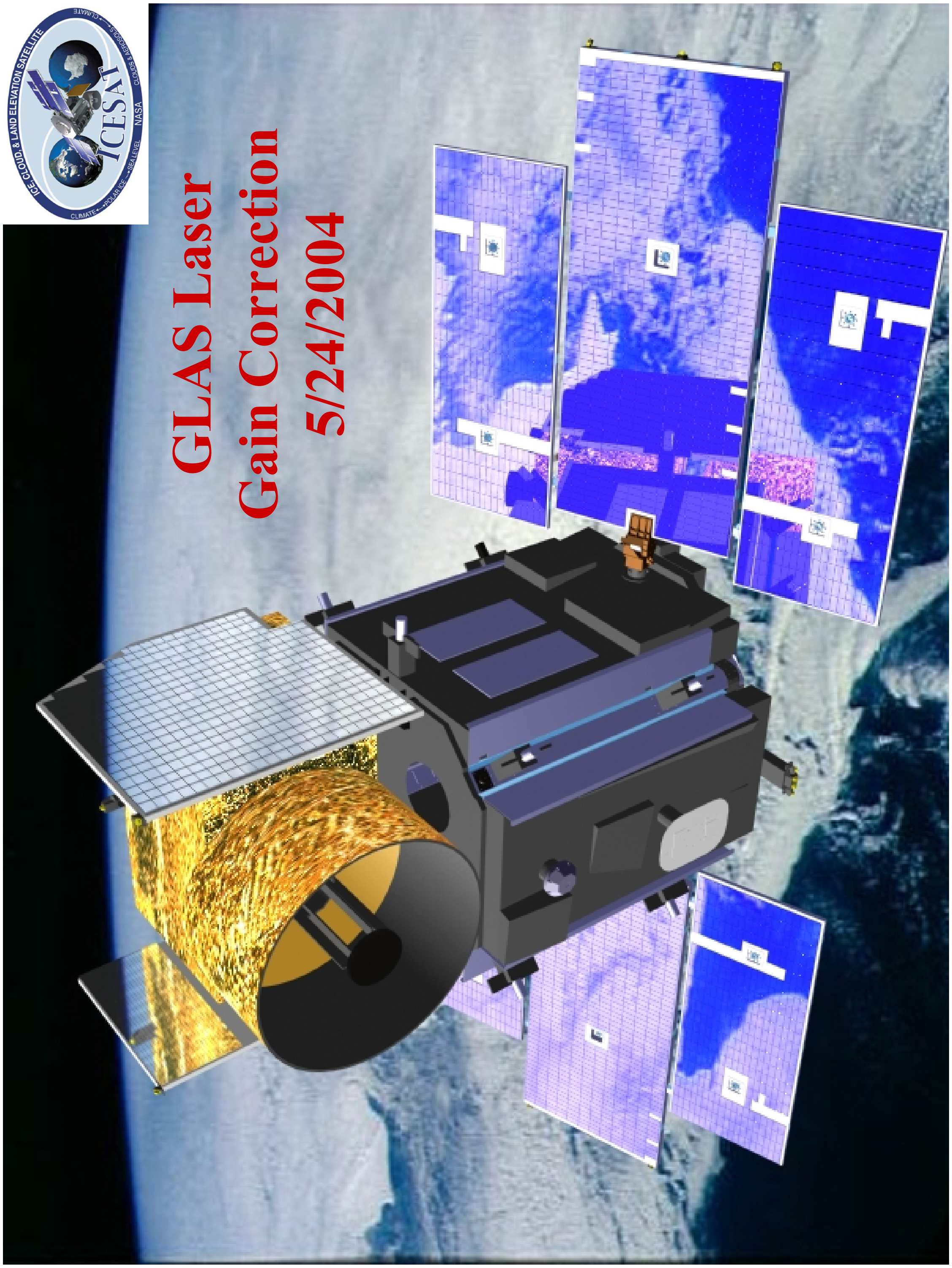
- ***Relative* Laser energy during instrument TVAC**
- Comparison with Altimeter Detector laser energy
  - Parameters determined
- ***Relative* Laser energy during observatory TVAC**
- Comparison with Altimeter Detector laser energy
  - Parameters determined
- **Correlation with LRS**
  - **See separate C. Field Report (attached)**
- **Correlation with LPA**
  - **See separate C. Field Report (attached)**
- *Relative* Laser energy measurements during instrument TVAC - Comparison with Altimeter Detector laser energy

Conclusions

- •1064 nm laser energy:
  - • No significant change since laser delivery to GLAS.
- •532 nm energy:
  - • No significant change for lasers 1 and 2, since GSFC measurements
  - • Declined by ~ 5.6% (1.3 mJ) for Laser 3 since GSFC measurements
- •Altimeter detectors/digitizers calibrated to provide an on-orbit estimate of the laser energy
- •Correlation with LPA - no strong correlation found
- •Correlation with LRS - no strong correlation found

1

Appendix E.2



Energy Estimate from Altimeter Detector Start Pulse

$$\hat{E} = \frac{\Delta\tau \cdot \sum_{0}^{47} v_r(i)}{\eta_c \cdot \eta_{optical} \cdot R_{det} \cdot G_{VGA} \cdot \alpha_{cal}}$$

where

$\hat{E}$ is the laser pulse energy in Joules corresponding to the waveform sample.

$\Delta\tau$ is the sampling interval = 1×10^{-9} secs.

$v(i)$ is the i[th] waveform sample in volts, $i = 0, 1, \ldots 47$

$\eta_c = 92.3\%$ is the circuit throughput from the detector to the digitizer

$\eta_{optical}$ is the fiber box and fiber transmission for the transmitted pulse, per laser per detector/digitizer combination. $\eta_{optical}$ was estimated from ground testing data:

	Detector 1	Detector 2
Laser 1	2.9650E-14	N/A
Laser 2	2.7868E-14	2.2572E-14
Laser 3	2.7937E-14	2.3357E-14

R_{det}=2.28e7 Volts/Watts is the detector responsivity

α_{cal} is a calibration coefficient determined by system level test data to be 1.12

G_{VGA} is the normalized gain of the variable gain amplifier (VGA).

$$G_{VGA} = \frac{C_{gain}}{2^8 - 1}$$

with C_{gain} the integer valued detector gain in the telemetry. Nominal value for C_{gain} is 41.

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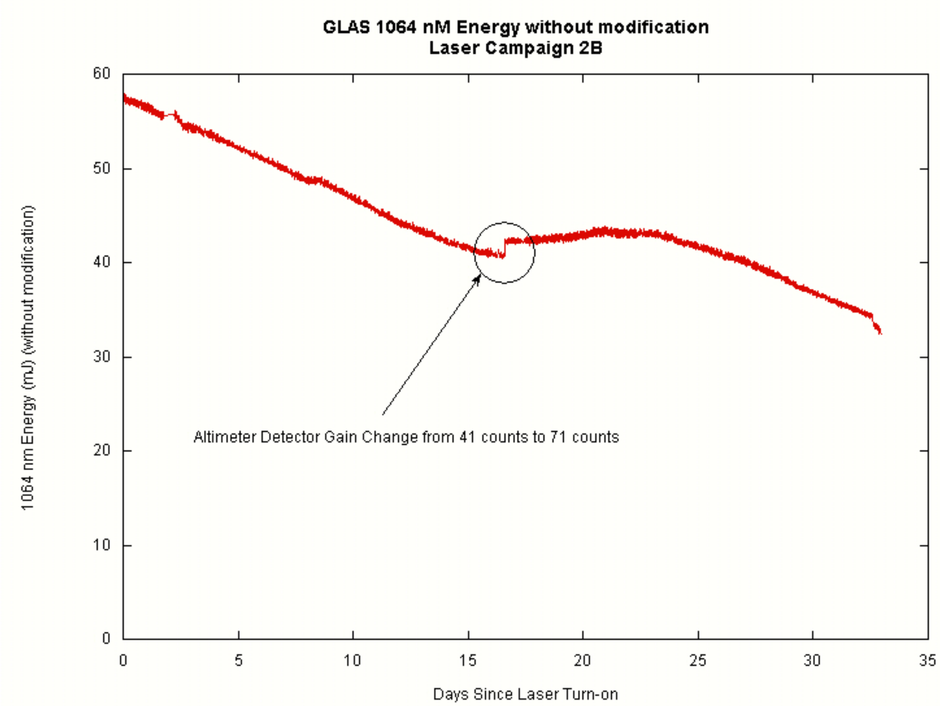
Laser Campaign 2B Laser History



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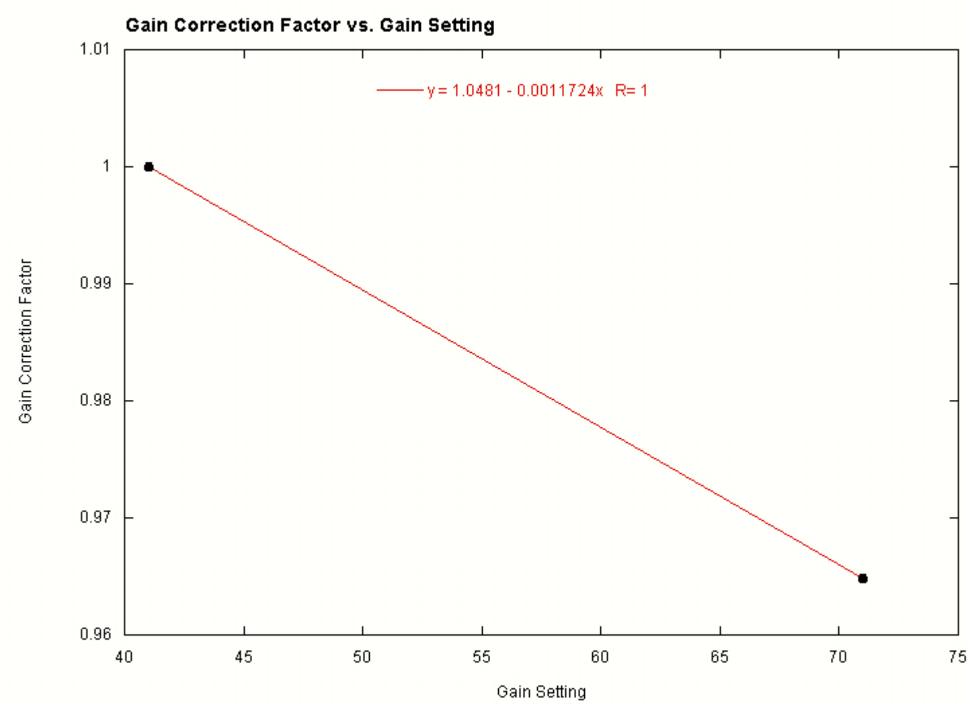
Laser Campaign 2B Laser History Implications

- About a 1.6 mJ jump in estimated Laser Energy with original formula.
- “Quick and dirty” fix was to subtract 1.6 mJ from Laser Energy output.
- This subtractive offset has the problem that as the energy asymptotes to zero, the energy will eventually show as “negative” Laser energy, clearly non-representative.
- If a multiplicative factor of 0.96 is applied to the data after the gain change, the same smoothing effect of the discontinuity can be achieved.

Gain Correction vs. Gain Setting Correlation



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New Gain Formula

$$G_{VGA} = C_{gain}/((2^8 - 1) * (1.0481 - (1.172x10^{-3} * C_{gain})))$$

- **At Gain = 41 (the gain at which all of our calibrations are based) formula output is unchanged from previous formula.**
- **At Gain = 71 (present setting) formula output decreases estimate by a factor of ~0.96, which smoothes out the Laser Energy curve for the Laser Campaign 2B.**
- **At next gain change, the new offset can be checked against this formula. If it does not "fit" with a linear approximation, a 2nd order polynomial fit can be applied.**

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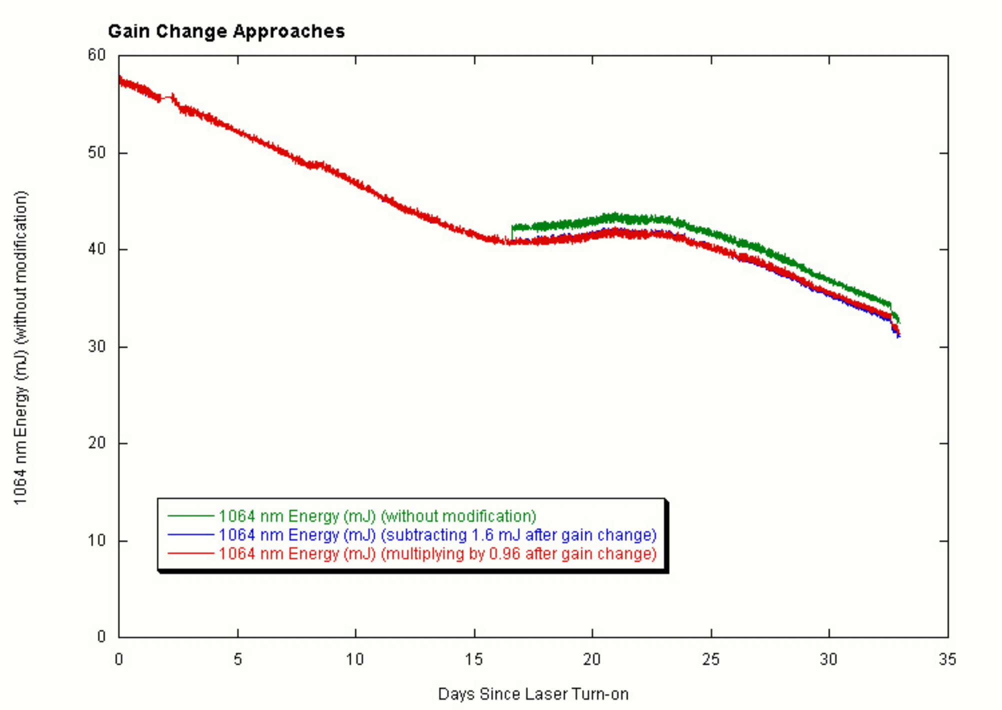
Application of New Gain Formula



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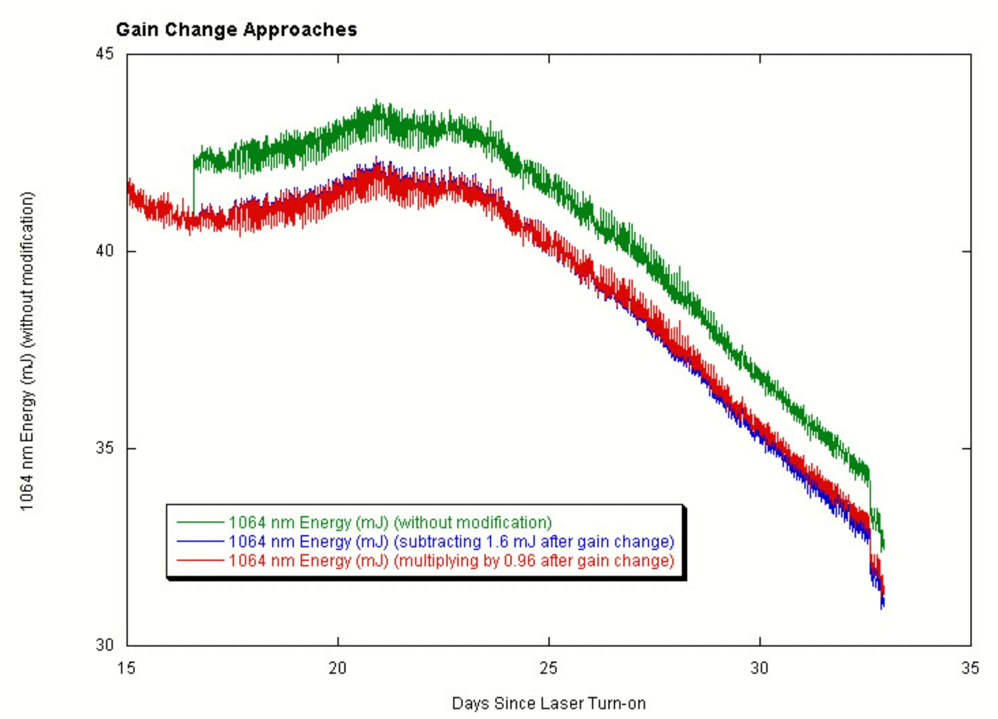
Application of New Gain Formula – Finer Scale



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Advantages/Disadvantages

- Advantages
  - New curve fit is a factor change instead of an applied offset.
  - Should be more accurate as energy asymptotes to zero.
  - Can be quickly modified when new gain changes occur as needed.
- Disadvantages
  - It will subtly change the already existing energy history (but should make it more accurate).
  - Slightly more complicated (but not overwhelmingly so – It has already been implemented as an option for the preparing of this presentation).

Summary

- A new gain formula for Laser Energy Estimation is proposed.
- New formula should increase the accuracy of past, present and future energy estimates.
- Easy to implement, but requires a re-reduction of all historical data since the gain change from 41 to 71 occurred during Laser Campaign 2B.

Abbreviations & Acronyms

APID	Application Process Identifier. CCSDS Packets identify the APID as supplied by the Spacecraft Instrument; EDOS identifies the APID as a concatenation of Spacecraft Identification (SCID) and the APID.
CCSDS	Consultative Committee for Space Data Systems
EDOS	EOS Data and Operations System
EOS	NASA Earth Observing System Mission Program
EOSDIS	Earth Observing System Data and Information System
GLAS	Geoscience Laser Altimeter System instrument or investigation
GPS	Global Positioning System
GSFC	NASA Goddard Space Flight Center at Greenbelt, Maryland
GSFC/WFF	NASA Goddard Space Flight Center/Wallops Flight Facility at Wallops Island, Virginia
HK	Housekeeping
ID	Identification
LASER	Light Amplification by Stimulated Emission of Radiation
LIDAR	Light Detection and Ranging
LPA	LASER Profiler Array
N/A	Not (/) Applicable
NASA	National Aeronautics and Space Administration
NOAA	National Oceanic and Atmospheric Administration
PDS	Production Data Sets
POD	Precision Orbit Determination
PROD ID	Data Product Identification
SCF	GLAS investigation Science Computing Facility and workstation(s)
SRS	Stellar Reference System
TBD	to be determined, to be done, or to be developed
TLM	Telemetry
UNIX	the operating system jointly developed by the AT&T Bell Laboratories and the University of California-Berkeley System Division

Glossary

Level 0	The level designation applied to an EOS data product that consists of raw instrument data, recorded at the original resolution, in time order, with any duplicate or redundant data packets removed.
Level 1A	The level designation applied to an EOS data product that consists of reconstructed, unprocessed Level 0 instrument data, recorded at the full resolution with time referenced data records, in time order. The data are annotated with ancillary information including radiometric and geometric calibration coefficients, and georeferencing parameter data (i.e., ephemeris data). The included, computed coefficients and parameter data have not however been applied to correct the Level 0 instrument data contents.
Level 1B	The level designation applied to an EOS data product that consists of Level 1A data that have been radiometrically corrected, processed from raw data into sensor data units, and have been geolocated according to applied georeferencing data.
Level 2	The level designation applied to an EOS data product that consists of derived geophysical data values, recorded at the same resolution, time order, and georeference location as the Level 1A or Level 1B data.
Level 3	The level designation applied to an EOS data product that consists of geophysical data values derived from Level 1 or Level 2 data, recorded at a temporally or spatially resampled resolution.
Level 4	The level designation applied to an EOS data product that consists of data from modeled output or resultant analysis of lower level data that are not directly derived by the GLAS instrument and supplemental sensors.
product	Specifically, the Data Product or the EOS Data Product. This is implicitly the labeled data product or the data product as produced by software on the SDPS or SCF. A GLAS data product refers to the data file or record collection either prefaced with a product label or standard formatted data label or linked to a product label or standard formatted data label file. Loosely used, it may indicate a single pass file aggregation, or the entire set of product files contained in a data repository.
record	A specific organization or aggregate of data items. It represents the collection of EOS Data Parameters within a given time interval, such as a one-second data record. It is the first level decomposition of a product file.

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6. AUTHOR(S)

Peggy L. Jester
David W. Hancock III

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Goddard Space Flight Center
Wallops Flight Facility
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14. ABSTRACT

The first process of the Geoscience Laser Altimeter System (GLAS) Science Algorithm Software converts the Level 0 data into the Level 1A Data Products. The Level 1A Data Products are the time ordered instrument data converted from counts to engineering units. This document defines the equations that convert the raw instrument data into engineering units. Required scale factors, bias values, and coefficients are defined in this document. Additionally, required quality assurance and browse products are defined in this document.

15. SUBJECT TERMS

GLAS, quality assurance, data, conversion

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