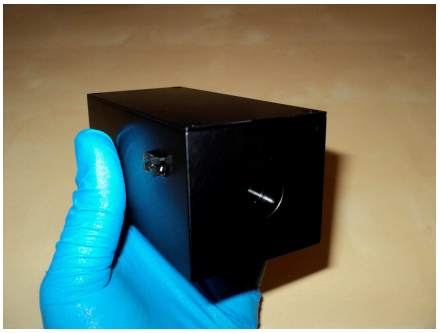
THOTH TECHNOLOGY, INC.

Aurora 1000 Line-Scan Camera



Owner's Manual

Document Number	**Issue**
OG287002	Release 1.02

Thoth Technology Inc., Algonquin Radio Observatory, Achray Road, RR6 Pembroke, Ontario K8A 6W7, Canada

Tel: +(1) (905) 713-2884. Email: space@thoth.ca, www.thoth.ca

Table of Contents

Release Notes

Issue	Revisions	Date
1.01	For release.	November 2012
1.02	Updated data packet format	December 2012

1 Product Key

The product code format for the Aurora instruments described in this manual is:

AURORA1000XY-NN.

The code descriptions are as follows:

Table 1: X Letter Code Key

Letter Code	Description
A	Aluminum optics
G	Gold optics
S	Space certified
N	UAV grade
E	Extended range

Table 2: Y Letter Code Key

Letter Code	Description
none	Unit only (kit excluded)
K	Kit included

Table 3: NN Number Code Key

Number Code	Description
01	700 nm – 1150 nm range
02	1000 nm –1650 nm range
03	1240 nm – 2000 nm extended range
04	1800 nm – 2400 nm extended range

2 Purpose

The purpose of this guide is to provide explanations and procedures for installing, operating, maintaining and troubleshooting the Aurora 1000 Line-Scan Camera.

3 Scope

This document provides safety guidelines, setup information, operating instructions, troubleshooting procedures and interface and technical specifications for the Aurora 1000 Line-Scan Camera.

4 Symbols Used

The following symbols are used in this document.

CAUTION

Cautions identify conditions or practices that could result in damage to the instrument or other equipment.

5 Trademarks

Aurora is a registered trademark of Thoth Technology Inc.

6 Important Safety Instructions

CAUTION

This guide contains important safety instructions that should be followed during handling, installation and operation of this product. Be sure to read and understand these safety instructions prior to handling.

- Before installing or using this product, read all instructions and cautionary markings located in this guide.
- The instrument should be handled with gloves in a suitable clean room environment. Care should be taken not to contact optical surfaces or instrument corners.

- Do not attempt to open or unseal the unit. This product contains no serviceable parts.
- The instrument shall be accommodated in a temperature and humidity controlled clean room of cleanliness class no worse than 100,000 during handling, assembly, integration and test.
- Anti-static grounding procedures must be observed when handling the instrument or interface electronics. Care should be taken to align connector keys prior to insertion of instrument interface.
- Do not shock the instrument physically or expose this unit to liquids of any type.

7 Package Contents

The Aurora instrument and GSE Kit includes the items shown in Figure 1 and itemized in Table 4.

Figure 1: Aurora Instrument and GSE Kit.

Table 4: Aurora GSE Kit Contents

Item	Location (Figure 1)	Description
1	Bottom Center	Aurora unit
2	Top right	Shipping case
3	Top left	Aurora ground test display laptop
4	Bottom Left	Laptop power module (19V)
5	Middle Right	Aurora USB serial interface and power adapter
6	Bottom Right	Aurora interface cable with free ends and example mounting hardware.

8 Product Features

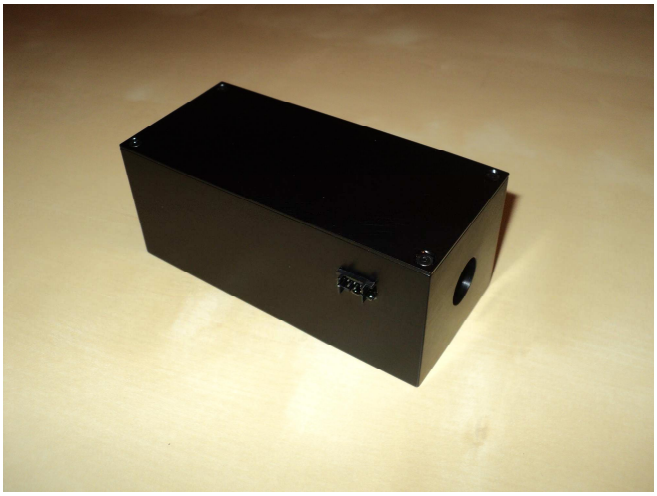


Figure 2: Aurora Line Scan Camera, (1000XY-G shown).

The Aurora 1000 Camera is a 256 pixel line-camera. The 1000XY-G format camera is shown in Figure 2. Aurora uses the same heritage electronics as the Argus 1000 Spectrometer, but in a camera format. Focussed near infinity, the instrument images a line of pixels of format 10:1. The instrument can be used to image a swath from mobile platforms. Repeated scanning may be used to build a two-dimensional image of the observation target as the platform's motion traverses the scene. The instrument comes in a range of focus formats and with filters covering regions between 1000-1700 nm and up to 2400 nm in the extended range version.

The Aurora 1000 Line-Scan Camera has low mass and power, making it easy to integrate with most payloads. The mass of the complete Aurora 1000 Line-Scan Camera is less than 285 g in all formats.

8.1 Specifications

The technical specifications for Aurora 1000 are summarised below.

Table 5: Technical Specifications, Aurora 1000 Line-Scan Camera

Aurora 1000	**Specification**
1. Type	Line-Scan Camera
2. Configuration	Single aperture Line-Scan Camera
3. Field of View	See Table 3
4. Mass	>280 g for Aurora 1000XY-A to 1000XY-F 281g for Aurora 1000XY-G
5. Accommodation	45 mm x 50 mm x 80 mm for Aurora 1000XY-A to 1000XY-E 45 mm x 50 mm x 110 mm Aurora 1000XY-F 45 mm x 50 mm x 110 mm Aurora 1000XY-G
6. Operating Temp.	-20ºC to +40ºC operating temperature
7. Survival Temp.	-35ºC to + 65ºC survival temperature
8. Detector	256 element InGaAs diode arrays with Peltier cooler
9. Electronics	microprocessor controlled 10-bit ADC with multi-pixel sampling feature providing 12-bit resolution and co-adding feature to enhance precision by a further 3-bits, 3.6-4.2V input rail 250mA-1500mA (375mA typical)
10. Operational Modes	–Continuous cycle, constant integration time –Adaptive Exposure mode
11. Data Delivery	Fixed length parity striped packets of single or co-added spectra with sequence number, temperature, array temperature and operating parameters
12. Interface	Prime and redundant serial interfaces RS232 protocol
13. Channels	256 (typical)
14. Integration Time	500 µs to 4.096 sec
15. Handling	Shipped by courier in ruggedized carrying case

8.2 Format and Filter Options

The Aurora 1000 line-scan camera is available in seven format options with varying FOV full angles, ranging from 48.9 degrees for the Aurora 1000XY-A to 9.8 degrees for the Aurora 1000XY-G. Assuming a distance to the target objective of 600 km, the pixel size at the objective ranges from 2 km for the Aurora 1000XY-A to 400 meters for the 1000XY-G, and the corresponding image width at the objective ranges from 512 km to 102.4 km. Parameters may be scaled linearly with altitude such that, for example, at an altitude of 1 km, the pixel size becomes 0.67m (for Aurora 1000XY-G).

Table 6: Aurora 1000 Line Camera Format Options

Format Options		A	B	C	D	E	F	G
Focal Length	m	0.015	0.02	0.03	0.04	0.05	0.06	0.075
Field of View full angle	rad	0.85	0.64	0.43	0.32	0.26	0.21	0.17
Field of View full angle	deg	48.9	36.7	24.4	18.3	14.7	12.2	9.8
Objective Distance*	m	600000	600000	600000	600000	600000	600000	600000
Pixel size at Objective*	m	2000.0	1500.0	1000.0	750.0	600.0	500.0	400.0
Image Width at Objective*	m	512000	384000	256000	192000	153600	128000	102400
		*analysis assumes typical value for LEO orbit, no adjustment for curvature						

Table 7: Aurora 1000 Line Camera Filter Options, Standard Range

Broad Filter Options - Standard Range		01	02	03	04	05	06	07
Transmission Band Start	nm	750	815	850	965	1020	1120	1200
Transmission Band Stop	nm	1700	1650	1100	1150	1700	1700	1650
Narrow band Filter Options - Standard Range		**08**	**09**	**10**	**11**	**12**	**13**	**14**
Center Wavelength	nm	850	940	1000	1200	1300	1500	1550
Full Width Half Manimium	nm	10	10	10	10	12	12	12

8.3 Detector System

A linear gallium arsenide (InGaAs) photodiode array with high-quantum efficiency pixels in the infrared detect radiation. The array is a hybrid InGaAs and CMOS acitve-pixel readout electronics in which the photo-current is buffered, amplified and stored according to an idealised schematic shown in Figure 3.

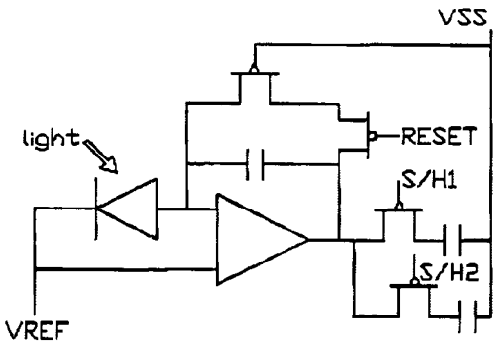


Figure 3: Principle of operation.

The readout process is clocked and triggered. Channels are differentially sampled as a form of double correlated sampling. Two values of feedback capacitor may be selected externally (the HIGH setting enhances dynamic range, the LOW setting increases sensitivity). The typical device quantum efficiency is shown in Figure 4.

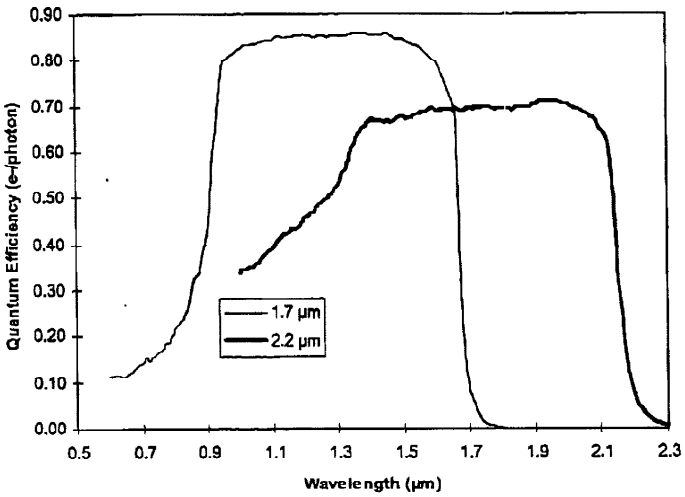


Figure 4: Detector Quantum Efficiency (1.7µm device).

8.4 Optical Design

The instrument is a line-scan type observing a linear array of surface tiles. The fore optics comprises a telescope lens system and optical filters. The particular optical configuration is

determined by Thoth's custom design tool. Line-Scan Cameras may be customized for particular spectral ranges or resolution by choice of focal length and filter configurations.

8.5 Flat Field Response

The typical flat field response of Aurora is shown in the figure below.

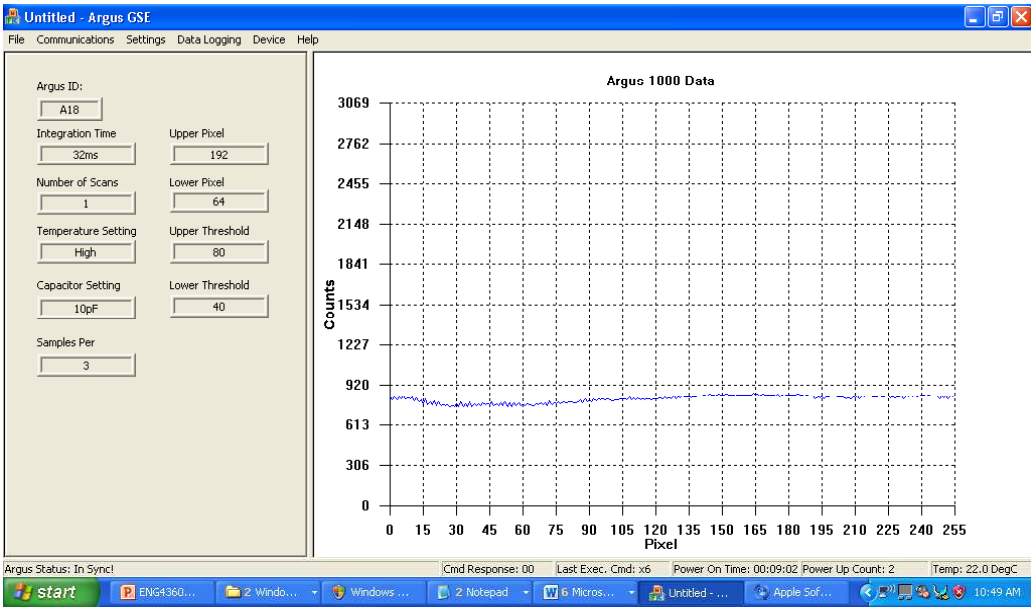


Figure 5: Flat field response to collimated halogen light source reflected from a barium sulfate white screen (typical results).

8.6 Angular Sensitivity

The angular sensitivity by Aurora 1000XY-G in response to 2 mm hot source (temperature 230°C) is shown in the figure below. The angular size of this target is 0.029°, comparable with the 0.038° angular resolution of 1000XY-G. The full-width-half-maximum is estimated to be ±1 pixel.

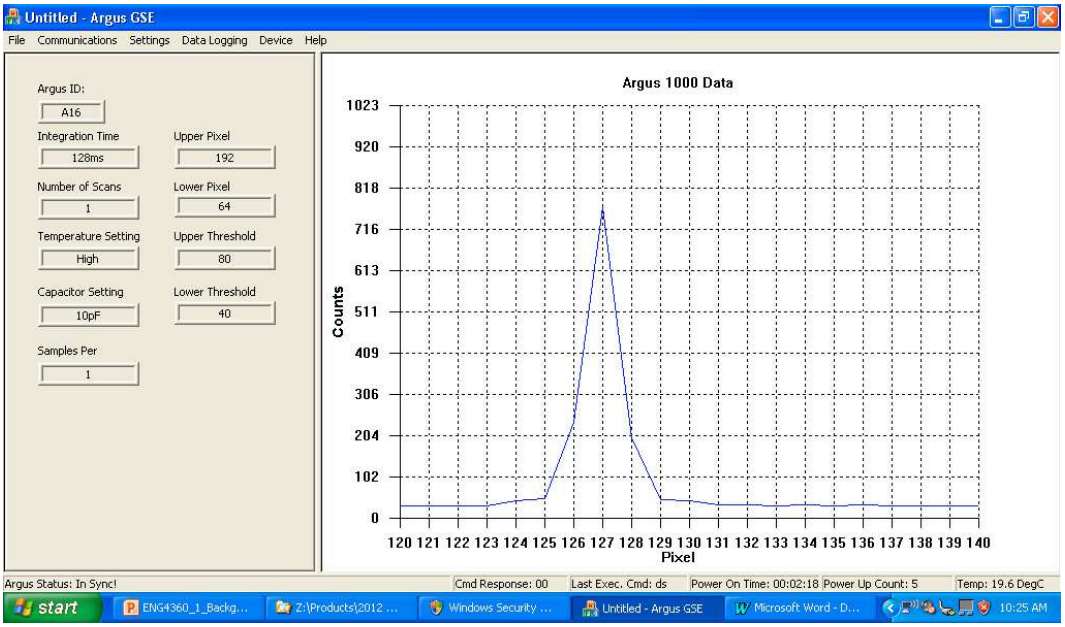


Figure 6: Angular resolution test (pixel response enlarged, AURORA-1000XY-G).

8.7 Functional Design

The system utilizes a microprocessor for the sequencing and processing of spectra. A functional diagram for the instrument is provided in Figure 7.

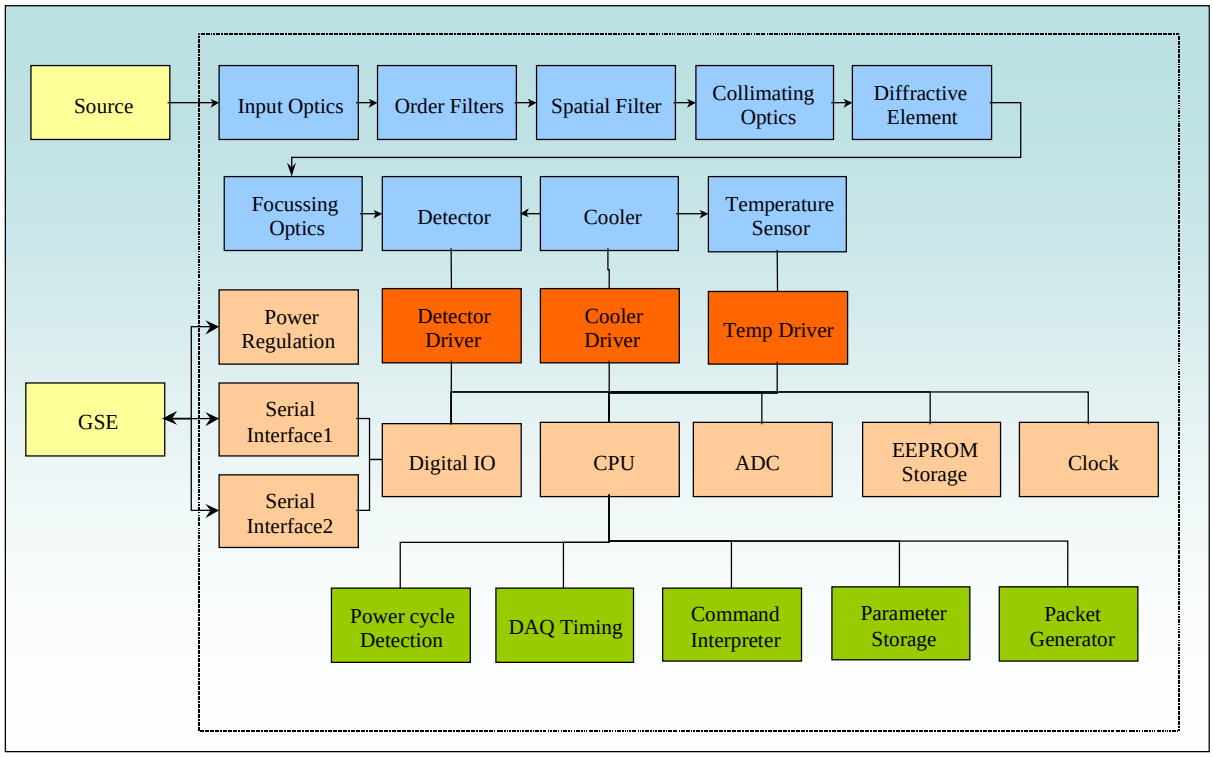


Figure 7: Aurora Functional Diagram (optical train shown in blue; cooler components in red, electronics in brown and software functions in green).

9 Ground System Electronics Setup

Referring to Figure 4 for item identification:

1. Setup the Aurora Laptop Display Terminal and power it up.
2. Connect the Aurora power and communications USB adapter to USB port on the laptop.
3. Place or mount the instrument unit in a safe condition.
4. Aligning the connector key on the Power and Communications Interface Cable connector mate the DF-11 plug with the instrument.
5. From the start menu, select and run the Instrument GSE application.
6. After correct setup Aurora GSE application will report instrument spectra and "Aurora Status: In Sync" (bottom left of window).

The interface and cable setups are configured for a particular Aurora GSE and instrument and are not designed to be interchangeable with other Aurora instruments. For reliable operation and as a condition of warranty it is not recommended that the Aurora GSE laptop terminal be connected to the internet either wirelessly or by LAN connection or that other applications be installed or operated on the Aurora GSE laptop. Thoth recommends that the display terminal be dedicated solely to instrument operation. A USB key is provided for transfer of data and calibration documents.

10 Aurora GSE Application

Software for the operation of Aurora is provided on the ground station laptop. Launch the "Aurora GSE" application from the start menu or by shortcut to access a data display terminal developed for testing purposes. This terminal is not intended for data analysis but provides a means to command the instrument and check basic functionality.

The application comprises two windows. The left pane shows the instrument status. The right pane shows the spectra as a function of counts against frequency number. A screenshot of the GSE application is shown below.

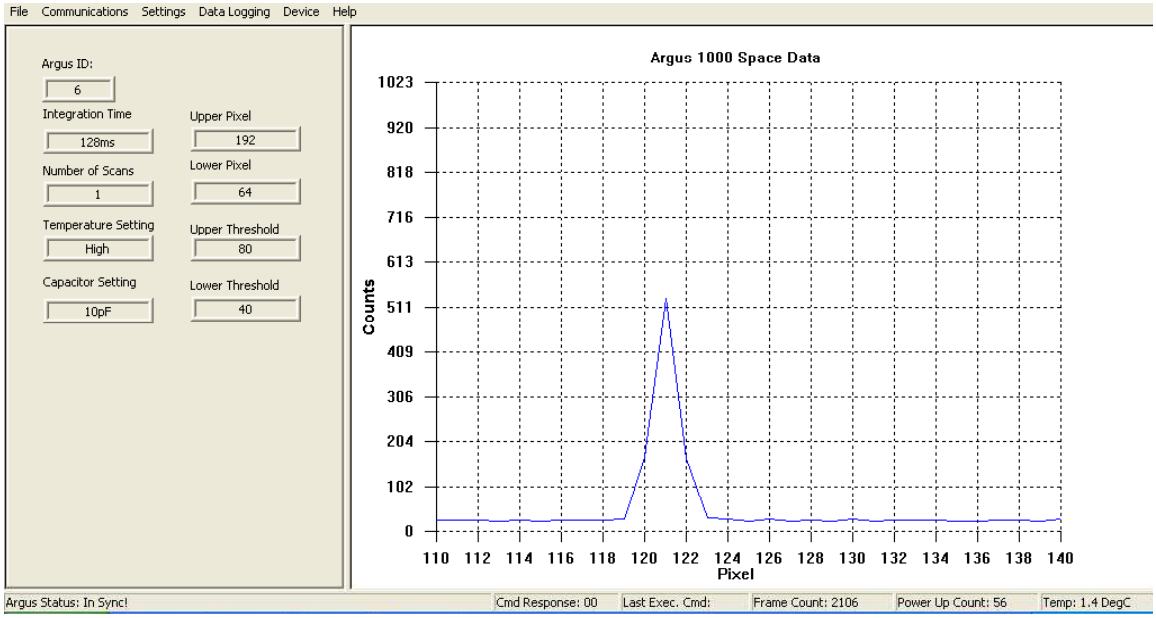


Figure 8: Aurora GSE Screenshot.

10.1 Aurora Status Message

The Aurora Status message is displayed in the bottom left of the application window. "Aurora Status: Lost Sync" occurs if Aurora GSE has lost contact with Aurora or is waiting for a frame with an integration time exceeding 0.5 seconds. "Aurora Status: In Sync" is indicated when the Aurora GSE application is in communication with the instrument.

10.2 Adjusting Pixel Range

The pixel range may be adjusted by right-clicking with the cursor on the spectral display pane. The upper pixel and lower pixel display range may be set using the increment buttons or by inserting a value between 0 and 255.

10.3 Commanding the Instrument Settings

The instrument may be commanded by selecting the settings tab. Note that the pane containing the Aurora ID must be active (selected by the cursor) in order to command the instrument. Exposure time, Number of Scans, Capacitor, Temperature, Adaptive exposure and Load/Save Default settings may be programmed from the window menus.

10.4 Data Logging

The Aurora GSE application may be used to log instrument data using the "Data Logging" tab. The data logging interval to create a new file with automatic time-stamped file name can be set as 1 min, 10 min or 60 min. Raw data is recorded, preceded by a windows standardized time stamp encoding the packet write time. Alternate serial port logging programs may be utilized if raw-only data is required.

10.5 Communications

The Aurora GSE applications defaults to standard instrument communications settings on startup and utilizes a serial to USB converter port on COM3. Other settings may be specified using the "communications" tab.

11 Integration

11.1 Power Interface

11.1.1.1 Aurora requires a continuous input feed of 572 mA (375 mA typical) at 3.2V DC to 4.6V DC (nominally), while the instrument remains powered.

11.1.1.2 Aurora provides current regulation over the specified input voltage ranges and typically draws 375 mA at standard temperature and pressure (STP) conditions. If the temperature and/or voltage are varied over the design range then Aurora may draw up to 575 mA. Additionally, the instrument functions over a wider range of DC voltages however, this is not recommended. The power supplied to Aurora should never exceed 5.0V DC.

11.1.1.3 The power supplied to Aurora may be switched on and off depending on whether Aurora operation is required. Aurora will power down automatically at approximately 3.0V DC however this is not recommended.

11.1.1.4 The in-rush current (that occurs when the instrument is powered) may reach 1500 mA. In-rush current transients settle within 10 ms of Aurora activation.

11.1.1.5 The Aurora instrument casing shall be maintained at ground potential.

11.2 Communications Interface

11.2.1.1 The instrument features two asynchronous RS-232 serial ports.

11.2.1.2 Both serial ports are connected and configured at 115,200 baud, 8 bits, one stop bit, no parity (data format 8N1).

11.2.1.3 Both serial ports deliver the instrument's data packet stream and may receive correctly formatted instrument commands on either port. Only one port should be used for commanding. Simultaneous commanding of ports is not recommended.

11.2.1.4 The maximum data rate between the instrument and either OBC is 230kbps.

11.2.1.5 The payload electronics is designed to tolerate a constant logic high on its inputs, even when the unit is powered off.

11.3 Timing of Spectra Acquisition and Co-Adding Feature

11.3.1.1 The instrument shall acquire spectra for duration determined by the Integration_Time_Setting and then packetize and transmit this data in a subsequent 55 mS time slice. Where the Number_of_Scans_Setting setting is set to between n = 2 and 9, the instrument shall acquire n successive spectra co-adding them to a maximum precision of 16-bit before transmitting them in the last 55 mS timeslice according to the following example timing diagram:

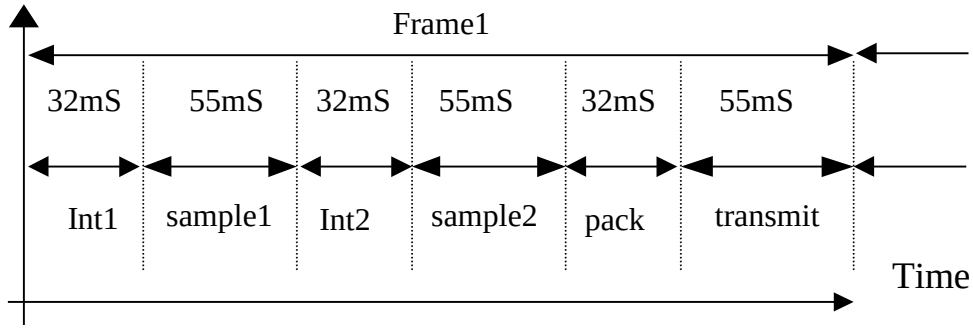


Figure 9: Spectra Acquisition Timing Example for 32mS integration time and number of scans set to 2 resulting in a (32+55)*3=261mS total integration time at a resolution of 11-bit.

11.4 Data Packet Format

11.4.1.1 The Line-Scan Camera provides data over the serial communications interface to an Onboard Computer or listening device in fixed length unsigned 8-bit words. Data packets are transmitted continuously at a cycle period determined as (55mS+Integration_Time_Setting) * (Number_of_Scans_Setting + 1). The packet format is shown in Table 8.

Table 8: Aurora Data Packet Format.

Word Number	Description
1 – 2	Synchronization Characters '(' and ')' provided to indicate packet start.
3 – 4	Device ID identifies Argus Instrument serial number [3] [4].
5 – 6	Command acknowledgement and errors provided in two-character format: [5] [6]. (see section 12.1).
7 – 8	Last command received provided in two-character format [7] [8] (see section 12.1).
9 – 12	Time since power on in Seconds computed as: [9]x(60x60x24) + [10]x(60x60) + [11]x(60) + [12].
13	Integration Time for Exposure in Seconds computed as: 2^[13] x 0.00005.
14	Number of scans to co-added before data transmission.
15	8-bit binary word comprising: [15 Bit 1] Dynamic Range Setting 0 = High Sensitivity, 1 = High Dynamic Range. [15 Bit 2] Cooler Temperature Setting 0 = High Temp, 1 = Low Temp. [15 Bit 3] Auto-exposure time setting 0 = Mode OFF, 1 = Mode ON.
16 – 17	Detector Temperature (DT) computed in degrees Celsius as: V0=3.25*([16]*256 + [17])./1023; Rt=26.7e3*(3.22-V0)./(V0+1.78); DT=1/(1.289e-3 + 2.3561e-4 * ln(Rt) + 9.4272e-8 * (ln(Rt)^3));
18 – 19	Lifetime power ups computed as: [18]*256 + [19].
20-21	Adaptive exposure mode: pixel range for adaptive exposure defined as lower pixel number [21] to upper pixel number [20] to include.
22-23	Adaptive exposure mode: upper [22] and lower [23] thresholds to trigger changes in integration time expressed in percent of full dynamic range.
23 – 535	spectral data encoded as 512-bytes in repeating unsigned MSB and LSB 8-bit words [MSB]*256 + [LSB].
536	Parity word computed bitwise as: ∑ (I=1...534) XOR(byte_i, byte_i+1)

11.4.1.2 The electronics reads the detector thermistor resistance and record this data with every spectra. The thermistor reading will be conditioned to a temperature in °C according to the algorithm given in Table 8.

11.5 Connectors

11.5.1.1 The instrument has a bulkhead mounted Hose DF11 type connector with 6 pins. Hose 6-pin DF-11 (part number H2021-ND) are requed for mating to the instrument.

11.5.1.2 The pinouts are given below.

Table 9: Power Connector Pinouts

Signal Description	Pin No.	Description
COMMAND_RECEIVE1	1	Serial Data Receiving Port A
V_POS	2	Positive Power (may be switched)
COMMAND_RECEIVE2	3	Serial Data Receiving Port B
DATA_TX1	4	Serial Data Transmission Port A
GND	5	Ground
DATA_TX2	6	Serial Data Transmission Port B

11.6 Mechanical Interfaces

11.6.1.1 The instrument mechanical axes are defined as follows:

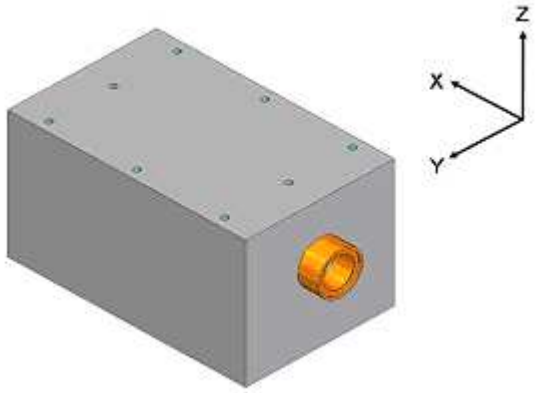


Figure 10 Mechanical Axes. Orange cone illustrates instrument FOV.

11.6.1.2 The instrument dimensions are given in Table 2.

11.6.1.3 The instrument is mounted using 4-40 taped and helicoiled holes in the base of the instrument. WARNING: Mounting hardware must be sized so as to avoid exceeding the maximum thread depth of 4.0mm. Example 4-40 threaded mounting hardware is included; however, actual hardware must be correctly sized for the depth of the mounting fixture and countersink (if applicable). The instrument should be retained by a minimum of six of the eight mounting points. The fastener torque requirement is fastener dependent but should never exceed 10 Nm. Do not over torque or exceed maximum thread depth as damage to instrument may result. The mounting-hole configuration is 21.5 mm x 30 mm for all instruments. Aurora 1000XY-A/E have 8-hole mounting configuration. Aurora 1000XY-F/G have 10-hole 4x3 mounting configuration.

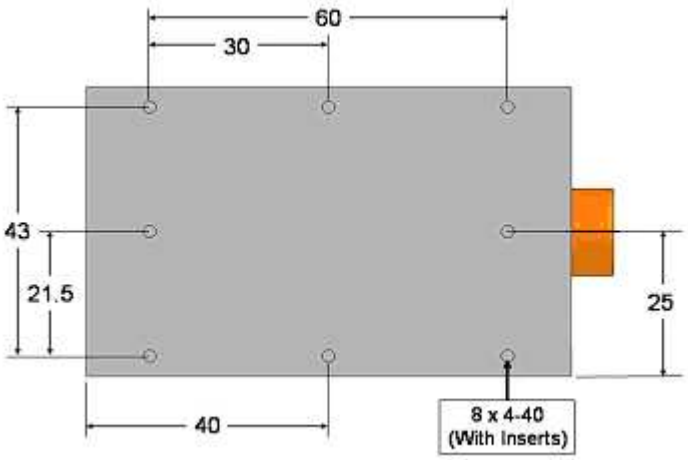


Figure 11: Line-Scan Camera Mounting-hole Locations for Aurora 1000XY-A (ANSI/ASME 4-40 threads). Aurora 1000XY-F/G have 4x3 hole configuration with same spacing. Mounting hardware should not extend more than 5.0mm into threads. Do not over torque.

11.6.1.4 The entrance aperture is on the -X face. Its center is centered at 25 mm in the +Y dimension and 22.5 mm from the +Z side. The Line-Scan Camera entrance aperture is 15mm diameter. The instrument has no outer protrusions (except the power connector) and should be mounted under the spacecraft skin, co-aligned with a 16mm circular aperture to allow light entry. Optimally, the 16mm circular aperture port should be between 10mm and 50mm from the front face of the instrument and should have blackened edges. Line-Scan Camera faces other than the mounting face should have no physical contact with other spacecraft components. A minimium 2 mm gap on all external Line-Scan Camera faces is recommended.

11.6.1.5 The connector is on -Y, with its center 20.5 mm from the -X face and 15mm from the -Z face.

11.6.1.6 The approximate instrument mass is given in Table 8.

11.7 Environment

11.7.1.1 The instrument core temperature should be maintained within tolerances for operation and survival specified in Table 8.

11.7.1.2 Aurora type-S instruments are capable of surviving a vibration load of at least 12g rms random and sinusoidal on all axes. Aurora type-A instruments are capable of surviving a vibration load of at least 10g rms random and sinusoidal in the X-axis.

11.7.1.3 Aurora instruments contain no more than 0.1% collected volatile condensable material.

11.7.1.4 Aurora instruments should be accommodated in a clean room of cleanliness class no worse than 100,000 during assembly integration and test; class 10,000 recommended.

12 Operation

12.1 Command format

A command string consists of five bytes arranged as follows:

Header	Header	Parameter	Setting	Parity

The header is two bytes in length and is the characters '(', ')'. The parity byte is the logical XOR of the bytes making up the command string, excluding the parity byte. As an example, the command to set the exposure time to 2048mS is as follows:

(	)	x	<	0x65? 0x45?

An acknowledgement of a command is normally returned by the instrument in the subsequent telemetry packet (see Section 11.4 for the message location in the data packet). If an error occurred during the command reception/execution process the system may respond with a data packet beginning with a different message. The message and corresponding codes that may be received are given in the table below.

Table 10: System Messages (see Section 11.4 for message location in data packet).

Message Description	Packet Start Characters
NO STATUS MESSAGE TO COMMUNICATE	"00"
PARAMETERS LOADED SUCCESSFULLY	"PL"
POWER UP INITIATED	"PU"
COMMAND ACKNOWLEDGED	"AK"
RESET TO DEFAULT PROGRAM	"DP"
ERROR RX TIMEOUT	"EC"
ERROR EXPOSURE OUT OF RANGE	"XR"
ERROR BAD PARITY	"BP"
ERROR INVALID PARAMETER	"IP"
ERROR SCAN COUNT OUT OF RANGE	"SR"
ERROR CAP SELECT OUT OF RANGE	"CR"
ERROR COOLER SELECT OUT OF RANGE	"TR"

12.1.1 Command List

12.1.1.1 Exposure Time

Parameter: 'x'

Setting:

'0'	500uS
'1'	1.0mS
'2'	2.0mS
'3'	4.0mS
'4'	8.0mS
'5'	16.0mS
'6'	32mS
'7'	64mS
'8'	128mS
'9'	256mS
':'	512mS
';'	1024mS
'<'	2048mS
'='	4096mS

12.1.1.2 Select Capacitor Setting

Parameter: 'c'

Setting: '0' High Sensitivity

'1' High Dynamic Range

12.1.1.3 Select Cooler Temperature Setting

Parameter: 't'

Setting: '0' High temperature setting, (reduced current draw by 70 mA)

'1' Low temperature setting, (100mA cooler current draw)

12.1.1.4 Set Number of Scans to Count

Parameter: 's'

Setting: '1-9' Number of spectra to co-add before data transmission.

12.1.1.5 Load Default Settings

Parameter: 'd'
Setting: 'l'

12.1.1.6 Save Current Settings as Default

Parameter: 'd'
Setting: 's'

12.1.1.7 Set Adaptive Exposure Mode

Parameter: 'a'
Setting: '0' is OFF '1' is ON.

12.1.1.8 Load Factory Parameters

Parameter: 'i'
Setting: '0'

12.1.1.9 Set Adaptive Exposure Mode Upper Threshold

Parameter: 'u'
Setting: Threshold value in percent (%).

12.1.1.10 Set Adaptive Exposure Mode Lower Threshold

Parameter: 'l'
Setting: Threshold value in percent (%).

12.1.1.11 Set Adaptive Exposure Mode Upper Pixel

Parameter: 'e'
Setting: Pixel Number.

12.1.1.12 Set Adaptive Exposure Mode Lower Pixel

Parameter: 'b'
Setting: Pixel Number.

13 Troubleshooting

The following table provides information on identifying and resolving possible problems when using an Aurora 1000 Line-Scan Camera.

Table 11: Troubleshooting Information.

Problem	Possible Cause	Solution
'Aurora Status: Lost Sync' reported by Aurora GSE application.	No serial communications and power. Instrument interface not mated. Long Integration Time setting. Communication lost by Aurora GSE.	Connect USB interface cable and restart GSE application. Connect GSE cable to instrument. Wait for integration to complete. Reset timing. Restart Aurora GSE application.
Aurora Communication settings pop-up window appears when Aurora GSE launched	Aurora USB to serial adapter not plugged in to recommended laptop USB port.	Mater adapter to port or select appropriate COM port.
Settings menu inoperable (grayed out)	Parameter Pane (Left Window) not active.	Select Instrument pane with mouse click. Reselect from settings menu.

14 Warranty

This limited warranty is provided by Thoth Technology Inc. ("the Company") and covers product defects in your Aurora 1000 Line-Scan Camera. In case of delivery of faulty merchandise, especially faulty construction, defective material, or defective manufacture, the Company shall, at its reasonable discretion, repair or replace the merchandise provided that the Customer notifies the Company of faults in writing within thirty (30) days of delivery; in such cases, the faulty merchandise becomes the property of the Company and must be returned to the Company.

There shall be no warranty for damages arising from normal wear, improper use, improper handling, faulty installation or startup by the Customer or by a third party or for deficient building provisions, including but not limited to unsuitable electrical provisions, exposure to fire, exposure to water or other liquids, or other unsuitable site properties. If, on inspection by the Company of returned merchandise within the warranty period, it becomes apparent that a fault is due to improper handling or use by the Customer, the Company may offer to fix the merchandise, and the costs of repair shall be borne by the Customer.

Any repair or modification to the merchandise performed by the Customer or by a third party without the prior written permission of the Company invalidates any warranty for faulty merchandise.

14.1 Disclaimer

THIS LIMITED WARRANTY IS THE SOLE AND EXCLUSIVE WARRANTY PROVIDED BY THOTH TECHNOLOGY INC. IN CONNECTION WITH THE AURORA 1000 LINE-SCAN CAMERA AND IS, WHERE PERMITTED BY LAW, IN LIEU OF ALL OTHER WARRANTIES, CONDITIONS, GUARANTEES, REPRESENTATIONS, OBLIGATIONS AND LIABILITIES, EXPRESS OR IMPLIED, STATUTORY OR OTHERWISE IN CONNECTION WITH THE PRODUCT, HOWEVER ARISING (WHETHER BY CONTRACT, TORT, NEGLIGENCE, MANUFACTURER'S LIABILITY OR OTHERWISE) INCLUDING WITHOUT RESTRICTION ANY IMPLIED WARRANTY OR CONDITION OF QUALITY, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

The Company makes no warranty that the items described herein are suitable or fit for a particular purpose. The Company makes no representation as to condition or character of the merchandise and in no event will be liable for any special, direct, indirect, incidental or consequential damages, losses, costs or expenses however arising whether in contract or tort including without restriction any economic losses of any kind, any loss or damage to property, any personal injury, any damage or injury arising from or as a result of misuse or abuse, or the incorrect installation, integration or operation of this product. The company may vary product specifications, production methods, software and components without prior warning.