



NuLAB

Automated Nutrient Analyzer

Terminal Communications Guide

Terminal Configuration

Commands are issued to each channel of a NuLAB through its dedicated RS232 serial port configured to 9600 baud, no parity, 8 data bits, 1 stop bit and no parity or handshaking. Common free terminal programs such as Tera Term (recommended) or Putty can be used to communicate with each NuLAB channel independently. With the absence of serial ports on most modern computers, a USB to serial converter must be used. Please verify that the USB to serial converter you are using functions properly before connecting to a NuLAB channel.

Each instruction issued to a NuLAB channel at the terminal prompt requires a **case sensitive**, single letter command, a numeric argument and an enter (ASCII Carriage Return char also satisfactory).

Examples: I0[enter] will display the channel configuration string (good comms test)
G1[enter] will align the valve to port one

Terminal Command Set

Valve and Syringe Commands		
Command	Argument	Description
A	0 - 8000	Homes the syringe to the fully depressed position. The argument is the expected number of steps to home. After homing is complete, the A command can be sent again with 0 as the argument and the NuLAB channel will return the difference between the actual steps traveled and the expected steps required to home sent with the previous A command. A0 will also return an error if the difference between the expected and actual steps value is greater than 300.
G	1	Aligns the valve to port one
p	1 - 8	Moves the valve to the port designated by the argument
+	1-65535	Moves the syringe up the steps designated by the argument Note: The full travel of the syringe is 8000 steps and continuous moves beyond the travel of the syringe may result in damage to the syringe drive system.
-	1-65535	Moves the syringe down the steps designated by the argument. Note: The full travel of the syringe is 8000 steps and continuous moves beyond the travel of the syringe may result in damage to the syringe drive system.
Macro commands		
Command	Argument	Description



M	1 - 8	Runs the macro designated by the argument
m	1 - 8	Repeats the macro designated with the argument the number of times previously set with the 'r' command
r	1 – 255	Sets a repeat value for the subsequent macro run with the 'm' command. The number of repetitions is designated by the argument.
U	1 - 8	Uploads a macro from the computer into the NuLAB memory and assign it the macro number designated by the argument (see Uploading Macros below)
V	1 - 8	Outputs the loaded macro designated by the argument (macro comments are removed)
v	0 - 65535	When the argument is: 0 – Outputs the version of the last macro run 1 – Writes the version of the running macro to memory (inside macro only)

Detector Commands

Command	Argument	Description
d	0 - 65535	Brings the detector to a temperature set in configuration by the 'h' command and holds it at the specified temperature for the seconds designated by the argument
H	0 - 4	Detector heater commands, when the argument is: 0 – Turns off both heaters 1 – Turns on heater one 2 – Turns on heater two 3 – Turns on heaters one and two 4 – Brings the detector to the target temperature specified in the configuration and then turns off both heaters
K	1 - 4	Sets the active detector channel for subsequent commands Note: Low sensitivity detectors only have channel 1, high sensitivity detectors have channels 1 (active) and 2 (reference). Values of 3 and 4 are reserved for future use.
L	0 - 4095	Turns on the detector channel LED previously specified by the 'K' command with a drive current (brightness) designated by the argument Note: Typical value is 3276
l	0 - 2	Only for high sensitivity detectors When the argument is: 0 – Sets the LED brightness on channel one directly to a configuration value previously set with the 'j' command. 1 – Runs a light targeting routine that adjust the LED brightness of the reference channel (2) until it reaches a “target” received light value previously set into the detector configuration with the 'k' command. The active detector channel (1) then uses the reference channel LED brightness used to achieve the target received light for subsequent readings. 2 – Turns off LEDs on both channels
S	1 - 255	Take and outputs the number of detector readings designated by the argument See NuLAB Data below

Detector Configuration Commands

Command	Argument	Description
h	0 - 65535	Sets the target detector temperature in bits into NuLAB channel configuration To convert bits to °C:



		$^{\circ}\text{C} = (\text{bits} - 804.5) / 455.4$ Ex: 15000 bits = 31.2 $^{\circ}\text{C}$
j	1 - 65535	Writes the "set direct" active channel LED current value in bits to configuration. This value is used by the 'I0' command on high sensitivity detectors.
k	1 - 65535	Writes the target received light configuration value to memory that is used by the 'I1' command.
I	0	Outputs detector configuration data Detector string: time stamp, serial number, detector wavelength, total data lines, downloaded lines, not downloaded lines, target received light, direct light setting, station number, target detector temperature
S	0 - 65535	Sets a station number into NuLAB channel configuration
W	300 - 1500	Sets a detector wavelength number into NuLAB channel configuration
Data Commands		
Command	Argument	Description
N	0 - 50	Outputs the number of new data lines specified by the argument. Once data has been polled it is no longer available until the data pointer is reset by sending N0.
X	5525	Erases all stored data lines

Uploading Macros

Macros are uploaded via the terminal program's "send file" function. First, a three (3) ms character and new line delay must be set in the terminal program (under the Set Up>Serial Port menu in Tera Term). Then type U(macro number)[enter] at the prompt. The NuLAB is now waiting to receive the text file and load it into the macro designated by the U command argument. Select the text file and send it via the terminal program (under the File>Send file menu in Tera Term). When complete, the NuLAB should return to the prompt. It is advisable to view the loaded macro with the V command to insure it was uploaded properly (macro comments designated with the '#' are removed).

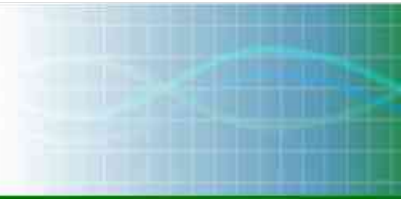
NuLAB Data

A NuLAB data line has the following elements.

Date Stamp, Data Flag, Channel 1 (active) Light Signal, Channel 1 Ground, Channel 2 (reference) Light Signal, Channel 2 Ground, Channel 1 LED Current, Channel 2 LED Current, Detector Temp, Reserved A to D, Heater Status

example data line: @00/00/00 00:00:00,024,39115,00029,54478,00023,26216,00037,12381,65469,00

In the above line, the Date Stamp is all zeros, because the NuLAB normally is supplied without an internal clock and channel 2 and the heaters are turned off. For normal data processing, only the Data Flag and the Channel 1 signal are required. Please refer to Green Eyes' Data Processing guide to calculate sample concentration from the raw data.



Data flags indicate the measurement taken and are set in the macros.

<flag> = XYZ (e.g. 021)

Where: X = Nutrient
 Y = Macro
 Z = Reading Type

The key to each separate flag number are given in the tables below:

Nutrient	X	Macro	Y	Reading	Z
0	Nitrate + Nitrite	1	Sample	1	Sample Reference (Bs)
1	Phosphate	2	On-board Std.	2	Sample Reaction (Rs)
2	Ammonium	3	1+2	3	On-board Std. Reference (Bt)
3	Silicate	4	Prime	4	On-board Std. Reaction (Rt)
4	Urea	5	Test Blanks	5	Reagent Blank Reference (Br)
5	Nitrite			6	Reagent Blank Reaction (Rr)
6	Iron			7	Utility Rerence (Bu)
7	Chloride			8	Utility Reaction (Ru)

Such that, flag 021 would represent a Nitrate plus Nitrite, On-board Std. Reference reading. The flag convention can be easily changed by the user, but it may make it difficult for Green Eyes to assist with technical support.