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Service Note

Service Note 22-002

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REST API TUTORIAL FOR NUMAVIEW™ SOFTWARE INSTRUMENTS

I. PURPOSE:

To provide examples of how the REST protocol can be used to poll live data, change parameters, extract data logs, poll groups of parameter values, and trigger calibration functions.

II. TOOLS:

For GET commands, any web browser
For PUT commands, postman (www.postman.com) or other API platform
For Calibrator-unique tags, Section VII, this document.

III. PARTS:

Computer with internet access and NumaView™ software instrument both connected on the same network

IV. IMPORTANT NOTES FOR REST PROTOCOL:

Use only an External Datalogger for polling live data frequently or regularly in order to avoid slowing the instrument's software routines, tasks, and responses to external datalogger polling requests.

The instrument internal datalogger should only be used for occasional needs such as a one-time data dump or if the external data logger is offline for an extended time where the need for historical data can't wait.

V. REST GET COMMANDS:

GET commands are used to read or "get" a value. These can be utilized using just a web browser and do not make any changes to the instrument. Note that most modern web browsers will download the response as a file with no file extension, whereas older web browsers such as Internet Explorer will display the response within the browser. The file without an extension can have .txt added to the end in order to view the response in a text document.

1. **TAGS**

   Tags are any parameter within the instrument that is used or measured. The example below uses a concentration tag. **Note that tag names and command strings are case sensitive.**

   Using a web browser, we can view full details of the tag using the below command example:

   http://10.20.22.10:8180/api/tag/CO_CONC

   The response will be as shown below:


```
{"name":"CO_CONC","type":"float","value":"0.145923003554344","properties":"{\
"Precision\":3,\"RawMin\":0.0,\"RawMax\":500000.0,\"EuMin\":-
1000.0,\"EuMax\":200000.0,\"EuTag\":\"SV_USER_UNITS\",\"Default\":0.0,\"Name\
":\"CO_CONC\",\"HmiLabel\":\"CO Concentration\",\"Description\":\"CO
Concentration in
PPM\",\"Group\":\"PRIGAS,LOG,TRIG,AOUTMAP,HIST,TRACK_ALL_UPDATES\",\"Units\":
\"PPM\",\"IsValueValid\":true,\"IsReadOnly\":true,\"IsNetwork\":true,\"IsVisi
ble\":true,\"IsNonVolatile\":false,\"IsDashboard\":false,\"CanDashboard\":tru
e}"}
```


Here is a breakdown of the response string where commas separate each line. We won't go over every line in this tutorial but will cover some key ones:

`"name":"CO_CONC"` **This is the name of the tag**

`"type":"float"` **This is how the value is viewed; float refers to floating point which is a type of number where the decimal is not in a fixed position**

`"value":"0.145923003554344"` **This is the current value of the tag**

`"properties":"{\"Precision\":3` **This refers to the number of places after the decimal that the value is viewed on the instrument display**

`\"RawMin\":0.0`
`\"RawMax\":500000.0`
`\"EuMin\":-1000.0`
`\"EuMax\":200000.0`
`\"EuTag\":\"SV_USER_UNITS\"`
`\"Default\":0.0`
`\"Name\":\"CO_CONC\"`
`\"HmiLabel\":\"CO Concentration\"`
`\"Description\":\"CO Concentration in PPM\"`

`\"Group\":\"PRIGAS,LOG,TRIG,AOUTMAP,HIST,TRACK_ALL_UPDATES\"` **This tells us which groups of tags that the tag we're viewing reports in. We'll discuss groups further in the tutorial.**

`\"Units\":\"PPM\"`
`\"IsValueValid\":true`

\"IsReadOnly\":true **This tells us if this is a tag that we can change with a PUT command, or if it can only be changed by the software**

\"IsNetwork\":true
\"IsVisible\":true
\"IsNonVolatile\":false
\"IsDashboard\":false
\"CanDashboard\":true}"}

2. **TAG VALUES**
   When we know a tag name, and only want to get the value of the tag, we can use the below command which will generate the subsequent response:
   http://10.20.22.10:8180/api/tag/CO_CONC/value

   Response:

{"name":"CO_CONC","value":"0.496683984994888"}

3. **TAGLIST**
   The taglist is a printout of all the tags that the instrument will respond to, and the properties of each tag as we saw with the tag command. Below is the command to generate a taglist, but the response string will be 100+ pages long if pasted into a word document so we will not include the entire taglist in the example.

   Searching for a tag on the taglist can be difficult to find the correct tag you're looking for, so if you have any questions, please contact us at API-TECHSUPPORT@TELEDYNE.COM
   http://10.20.22.10:8180/api/taglist

   Response:

{"group":"","tags":[{"name":"NATIVE_APP_STATE","type":"string","value":"INITIALIZED","properties":"{\"Default\":\"Undefined\",\"Name\":\"NATIVE_APP_STATE\",\"HmiLabel\":\"Native App State\",\"Description\":\"Synchronization tag between native and managed\",\"Group\":\"\",\"Units\":\"\",\"IsValueValid\":true,\"IsReadOnly\":false,\"IsNetwork\":true,\"IsVisible\":true,\"IsNonVolatile\":false,\"IsDashboard\":false,\"CanDashboard\":false}"},{"name":"INSTRUMENT_MODE","type":"string","value":"SAMPLE","properties":"{\"Default\":\"SAMPLE\",\"Name\":\"INSTRUMENT_MODE\",\"HmiLabel\":\"Instrument Mode\",\"Description\":\"Specifies the text that shows up for the instrument mode\",\"Group\":\"TRACK_ALL_CHANGES,LOG\",\"Units\":\"\",\"IsValueValid\":true,\"IsReadOnly\":true,\"IsNetwork\":true,\"IsVisible\":true,\"IsNonVolatile\":false,\"IsDashboard\":false,\"CanDashboard\":false}"},{"name":"INSTRUMENT_TIME","type":"string","value":"02/17/2022 5:00:28 PM","properties":"{\"Default\":\"\",\"Name\":\"INSTRUMENT_TIME\",\"HmiLabel\":\"Instrument Time\",\"Description\":\"Current time on the instrument\",\"Group\":\"\",\"Units\":\"\",\"IsValueValid\":true,\"IsReadOnly\":false,\"IsNetwork\":true,\"IsVisible\":true,\"IsNonVolatile\":false,\"IsDashboard\":false,\"CanDashboard\":false}"},{"name":"DO_OUTPU

T1","type":"bool","value":"False","properties":"{\"HmiValueMap\":null,\"Default\":false,\"Name\":\"DO_OUTPUT1\",\"HmiLabel\":\"Digital Output 1\",\"Description\":\"Physical Digital Output #1\",\"Group\":\"DOUT\",\"Units\":\"\",\"IsValueValid\":true,\"IsReadOnly\":true,\"IsNetwork\":true,\"IsVisible\":true,\"IsNonVolatile\":false,\"IsDashboard\":false,\"CanDashboard\":false}"},{"name":"DO_OUTPUT1_MAP","type":"string","value":"Not Mapped","properties":"{\"Default\":\"\",\"Name\":\"DO_OUTPUT1_MAP\",\"HmiLabel\":\"Digital Output 1 Map\",\"Description\":\"The tag mapped to digital

4. TAGLIST GROUP VALUE LIST

In our first example, we saw that CO_CONC belongs to the following groups:

PRIGAS
LOG
TRIG
AOUTMAP
HIST
TRACK_ALL_UPDATES

Other parameters are also collected in these groups which makes it easier for data logging when the number of command strings that can be sent to the instrument are limited by the data logging program, but the response string does not have a limit. See below example.

http://10.20.22.10:8180/api/valuelist/?group=HIST

Response:

{"group":"HIST","values":[{"name":"O2_CONC","value":"10"},{"name":"O2_STABILITY","value":"0"},{"name":"CO2_CONC","value":"10"},{"name":"CO2_STABILITY","value":"0"},{"name":"CO_CONC","value":"-0.496628105640411"},{"name":"CO_CONC_2","value":"50.9321937561035"},{"name":"CO_STABILITY","value":"0.00023593577498104 4"}]}

5. DATA LOG LIST

The data log list command just shows a list of all the data logs that are setup on the instrument. See below example:

http://10.20.22.10:8180/api/dataloglist

Response:

{"logs":[{"name":"HIRES","description":"","active":true}]}

6. DATALOGS

Datalog data can be polled from the instrument in two different formats. This could either be extracted based on a defined page number, and number of records viewed on each page, or it can be extracted in between two different time periods.

Example 1

Defined number of records and pages. Page 1 would be the newest records, so if we ask to see page 2 with 5 records per page, this would generate a response starting from the 6th oldest record.

http://10.20.22.10:8180/api/datalog/HIRES?page=2&recordperpage=5

Response (NOTE: spaces added to the response for line clarity for the purposes of the tutorial):

```
Date & Time (Local), Date & Time (UTC), Auto Ref Ratio, Bench Temp, CO
Concentration, CO Stability, Meas Detector, Oven Temp, PHT Drive., Ref
4096mV, Ref Detector, Ref Ground, Sample Flow, Sample Pressure, Wheel
Temp
2/17/2022 5:40:00 PM, 2/18/2022 12:40:00 AM, 1.19251823425293,
47.98388671875, -0.496541202068329, 0.000250347424298525, 1922.47155761719,
45.972541809082, 2637.181640625, 4095.70874023437, 1637.97973632812, 0,
1760.56591796875, 28.6962261199951, 62.0275955200195

2/17/2022 5:39:00 PM, 2/18/2022 12:39:00 AM, 1.19251823425293,
47.9788818359375, -0.496563524007797, 0.000250347424298525, 1922.91455078125,
46.0130233764648, 2637.37158203125, 4095.77221679687, 1637.91650390625, 0,
1767.51098632812, 28.7013912200928, 61.975700378418

2/17/2022 5:38:00 PM, 2/18/2022 12:38:00 AM, 1.19251823425293,
47.9851303100586, -0.496568530797958, 0.00024774792836979, 1922.97778320312,
46.0400161743164, 2637.498046875, 4095.77221679687, 1638.54919433594, 0,
1782.30383300781, 28.6979465484619, 62.0370330810547

2/17/2022 5:37:00 PM, 2/18/2022 12:37:00 AM, 1.19251823425293,
47.9876327514648, -0.496535062789917, 0.00024774792836979, 1923.54736328125,
46.0142440795898, 2637.24487304687, 4095.70874023437, 1639.11877441406, 0,
1775.22009277344, 28.6983776092529, 61.9772567749023

2/17/2022 5:36:00 PM, 2/18/2022 12:36:00 AM, 1.19251823425293,
47.98388671875, -0.496587187051773, 0.000245207193074748, 1923.61059570312,
45.9541549682617, 2637.30810546875, 4095.77221679687, 1638.80236816406, 0,
1763.48278808594, 28.7000980377197, 62.0354537963867
```

Example 2

Defined time periods. In this example, we will ask for data between 2pm and 2:30pm on 02/17/2022. Note that we can omit the seconds field in the command as it will be assumed to be 00 if left out.

http://10.20.22.10:8180/api/datalog/HIRES?t1=202202171700&t2=202202171705

Response (NOTE: spaces added to the response for line clarity for the purposes of the tutorial):

```
Date & Time (Local), Date & Time (UTC), Auto Ref Ratio, Bench Temp, CO
Concentration, CO Stability, Meas Detector, Oven Temp, PHT Drive., Ref
4096mV, Ref Detector, Ref Ground, Sample Flow, Sample Pressure, Wheel
Temp

2/17/2022 5:00:00 PM, 2/18/2022 12:00:00 AM, 1.19251823425293,
47.98388671875, -0.496670335531235, 0.12853892147541, 1939.17663574219,
45.9921722412109, 2636.99169921875, 4095.70874023437, 1651.83728027344,
0.0632743835449219, 1774.87268066406, 28.6923522949219, 62.0354537963867

2/17/2022 5:01:00 PM, 2/18/2022 12:01:00 AM, 1.19251823425293,
47.98388671875, -0.49669149518013, 0.000218664499698207, 1939.30322265625,
46.0032119750977, 2637.05517578125, 4095.77221679687, 1652.02709960937, 0,
1758.96850585937, 28.6906280517578, 62.0055694580078

2/17/2022 5:02:00 PM, 2/18/2022 12:02:00 AM, 1.19251823425293,
47.9863891601563, -0.496633052825928, 0.000218664499698207, 1937.9111328125,
45.9983062744141, 2637.11840820312, 4095.64526367187, 1650.88818359375, 0,
1761.330078125, 28.6897678375244, 62.0212936401367

2/17/2022 5:03:00 PM, 2/18/2022 12:03:00 AM, 1.19251823425293,
47.9826354980469, -0.49664306640625, 0.000217841588892043, 1937.9111328125,
45.9394378662109, 2637.30810546875, 4095.70874023437, 1650.69836425781, 0,
1744.45336914062, 28.6906280517578, 62.0071487426758

2/17/2022 5:04:00 PM, 2/18/2022 12:04:00 AM, 1.19251823425293,
47.98388671875, -0.496636807918549, 0.000217841588892043, 1936.70886230469,
46.0007629394531, 2637.498046875, 4095.70874023437, 1649.8125, 0,
1777.025390625, 28.6936454772949, 62.0244445800781

2/17/2022 5:05:00 PM, 2/18/2022 12:05:00 AM, 1.19251823425293,
47.98388671875, -0.496623158454895, 0.000219163266592659, 1936.89868164062,
46.0154800415039, 2637.56127929687, 4095.77221679687, 1650.44519042969, 0,
1767.8583984375, 28.6919212341309, 61.9882736206055
```

VI. REST PUT COMMANDS

Put commands are commands that are used to either write to a value or change a tag to a preset list of acceptable modes. Earlier in the tutorial, we spoke about tag parameters which include a read only value. Any tag with a read only value of false can be written to via the REST protocol. Using a PUT command requires software development tools, but we can use postman to test these functions.

Next, we will need to open postman.com which is a free, web based API platform. First, create a workspace, and try a get command to make sure it's working, also so that we can copy the response, because we will need this in order to fill in the body of our PUT command that we will push to the instrument.

1. PUT A VALUE TO A NUMERIC PARAMETER:

   In this example we're going to change the target span concentration for range 2 of our CO analyzer.

   Example:

   First, we will use a GET command to see how the response body is formatted

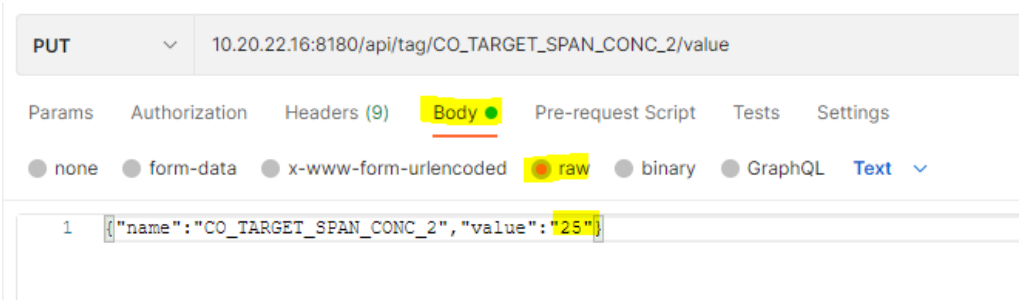
   http://10.20.22.10:8180/api/tag/CO_TARGET_SPAN_CONC_2/value

   Response:

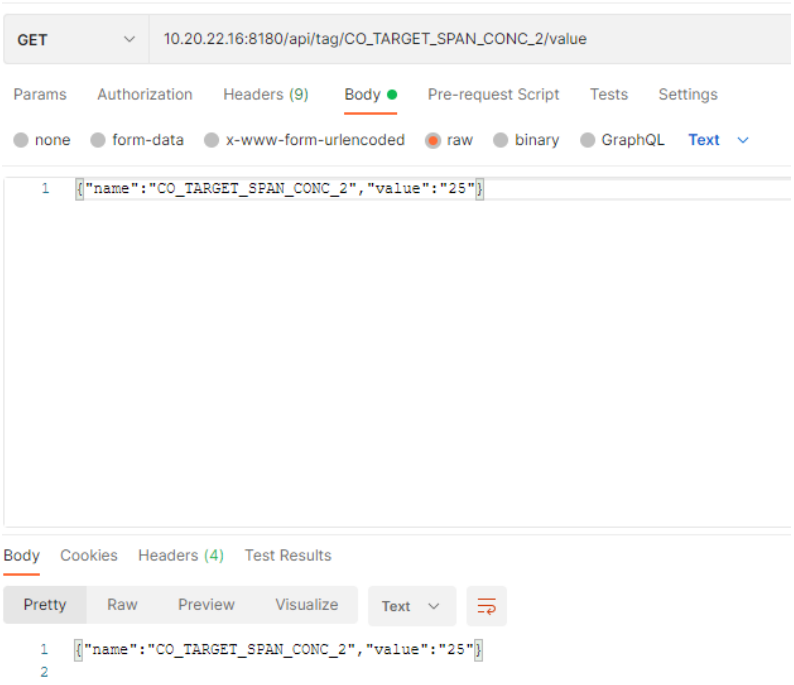
   {"name":"CO_TARGET_SPAN_CONC_2","value":"40"}

   Now we can take the same response, and paste it into the body of the response for our PUT command. After pasting, we can change the "value" to another number and send the PUT command.

   Example:



After sending the target concentration change command, we can use the GET function again to verify that the target concentration is now 25.



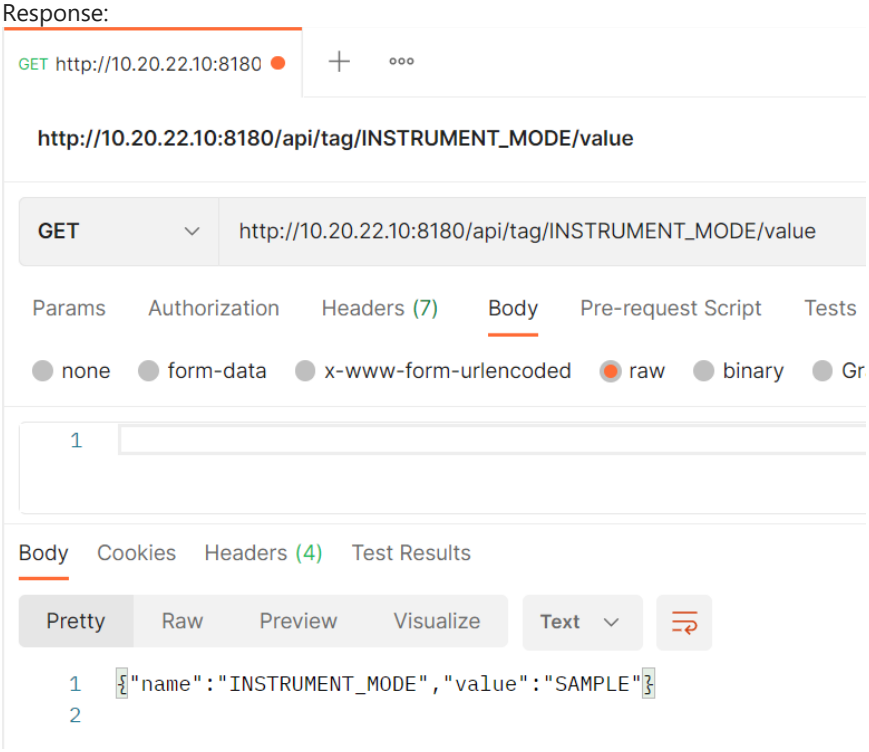
2. PUT A COMMAND TO THE INSTRUMENT

PUT commands can also be used to put the instrument into diagnostic or calibration modes. In the below example, we will check the current instrument mode, and then put the instrument into an auto reference calibration mode.

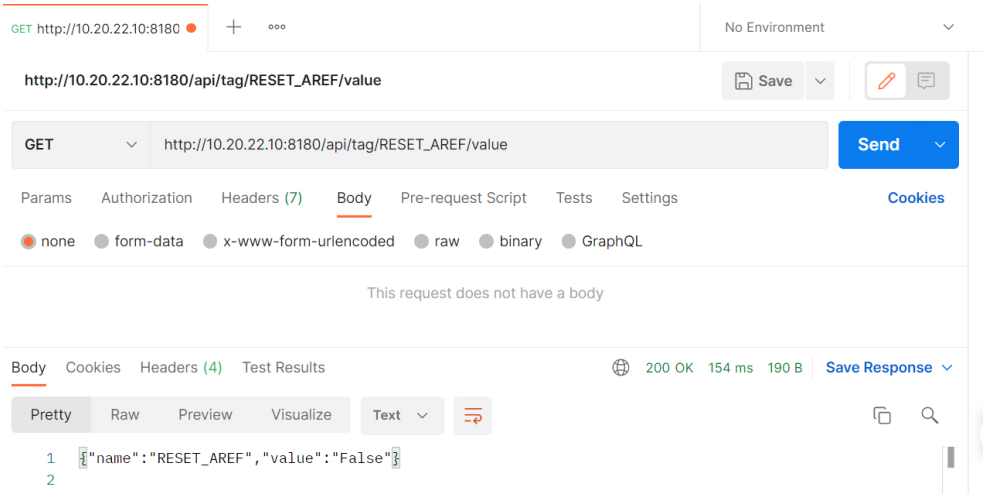
Example to check the current mode:

10.20.22.16:8180/api/tag/INSTRUMENT_MODE/value

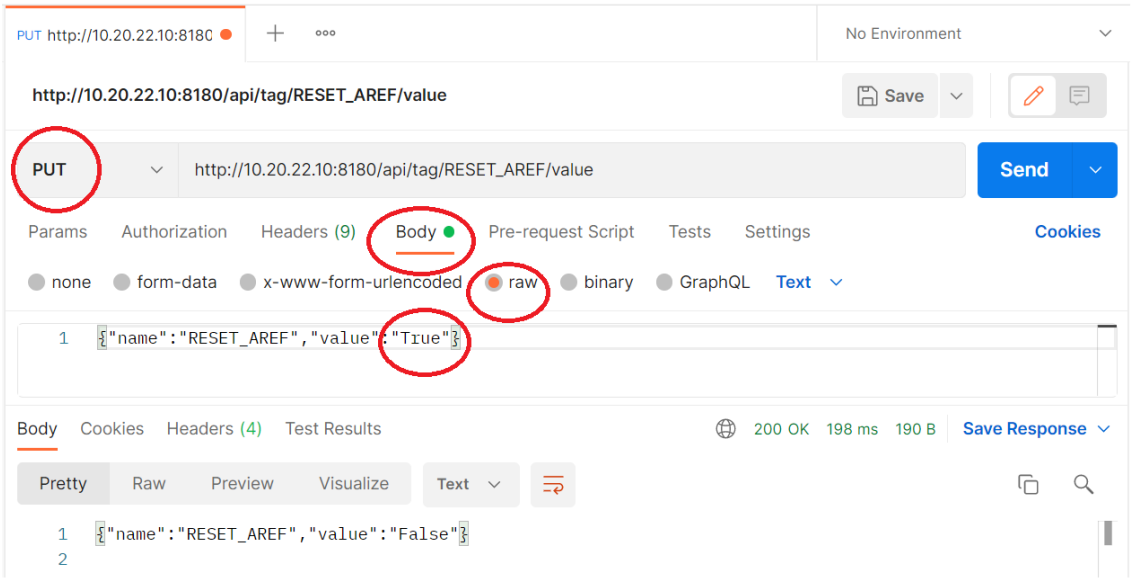
Response:



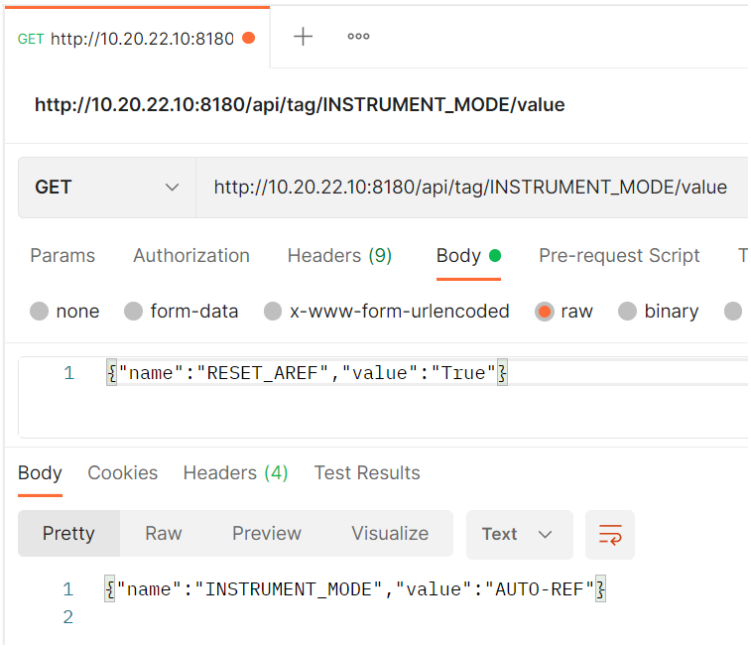
Next we will use a GET command to see the response body for the reset aref var which will trigger the instrument to run an aref if the value is set to true.



Once we know the body response, we will then PUT the value to “True” which will now put the instrument into an aref mode.



Lastly, we will use the GET command again to verify the instrument mode is now showing that the instrument mode is in AUTO-REF



VII. CALIBRATOR OPERATION VIA TAGS

Please refer to your Teledyne API calibrator's user manual regarding use of the parameters and commands presented here in the form of tags, which can be used to operate the calibrator. The Calibrator Modes listed in this section match the same functions as the modes in the user interface (UI), NumaView™ software Remote, and in Sequences. They include:

- Standby
- Execute a sequence
- Execute a level
- Generate a dilution from automatic control
- Generate a dilution from manual control
- Generate a GPT dilution
- Generate a GPTZ
- Generate a GPTPS
- Execute a purge function
- Set the optional NOy valve position if equipped.

The below tables of operational parameters indicate which tags must be populated and how they should be set to execute each specific function. Many of the tags reference input fields from their respective UI pages. Refer to the applicable NumaView™ software UI pages for the necessary inputs.

Following the operational parameters tables is an actual command line string as an example.

Notes:

- Tag values can be sent as strings
- GAS_GENERATE_CONTROL: IDLE can be sent on each new Generate command to ensure that the calibrator GAS_GENERATE_STATE is set to NONE

PLACE CALIBRATOR INTO STANDBY

TAG	SET TO	NOTES/COMMENTS
GAS_GENERATE_MODE	STBY	
GAS_GENERATE_CONTROL	IDLE	
GAS_GENERATE_CONTROL	APPLY	

EXECUTE A SEQUENCE

TAG	SET TO	NOTES/COMMENTS
EXECSEQ_SEQUENCE_NAME	[Sequence Name]	Name assigned during configuration in the Setup>Sequences menu
GAS_GENERATE_MODE	EXECSEQ	
GAS_GENERATE_CONTROL	IDLE	
GAS_GENERATE_CONTROL	APPLY	

EXECUTE A LEVEL

TAG	SET TO	NOTES/COMMENTS
EXECLEV_LEVEL_NUMBER	[Level Number]	Number assigned during configuration in the Setup>Levels menu
GAS_GENERATE_MODE	EXECLEV	
GAS_GENERATE_CONTROL	IDLE	
GAS_GENERATE_CONTROL	APPLY	

GENERATE AN AUTOMATIC DILUTION

TAG	SET TO	NOTES/COMMENTS
AUTO_TARG_CONC	target concentration based on units	
AUTO_TARG_GAS_NAME	ZERO, O3, SO2, H2S, N2O, NO, NO2, NH3, CO, CO2, HC, USR1, USR2, USR3, USR4	
AUTO_TARG_TOTAL_FLOW	flow in LPM	
AUTO_TARG_GAS_UNITS	PPB, PPM, PPT, PCT, MGM, UGM	
GAS_GENERATE_MODE	AUTO	
GAS_GENERATE_CONTROL	IDLE	
GAS_GENERATE_CONTROL	APPLY	

GENERATE A MANUAL DILUTION

TAG	SET TO	NOTES/COMMENTS
MAN_TARG_GAS_NAME	ZERO, SO2, H2S, N2O, NO, NO2, NH3, CO, CO2, HC, USR1, USR2, USR3, USR4	
MAN_TARG_CAL_FLOW	flow in LPM	
MAN_TARG_DIL_FLOW	flow in LPM	
MAN_O3_GEN_MODE	OFF, CNST, REF, BNCH	OFF, CNST, REF on units without photometer. OFF, CNST, BNCH on units with a photometer
MAN_O3_GEN_MV	(only if using REF or CNST)	
MAN_O3_GEN_PPB	(only if using BNCH)	
GAS_GENERATE_MODE	MAN	
GAS_GENERATE_CONTROL	IDLE	
GAS_GENERATE_CONTROL	APPLY	

GENERATE A GPT (Note that the correct order of operation is GPTZ, followed by GPTPS, then GPT); refer to the user manual for an understanding of these operations).

TAG	SET TO	NOTES/COMMENTS
GPT_NO_TARG_CONC	target concentration based on units	
GPT_O3_TARG_CONC	target concentration based on units	
GPT_TARG_TOTAL_FLOW	*set to flow in LPM	
GPT_O3_TARG_UNITS	PPB, PPM, PPT, PCT, MGM, UGM	
GPT_NO_TARG_UNITS	PPB, PPM, PPT, PCT, MGM, UGM	
GAS_GENERATE_MODE	GPT	
GAS_GENERATE_CONTROL	IDLE	
GAS_GENERATE_CONTROL	APPLY	

GENERATE A GPTZ (Note: will reuse the same parameters as GPT)

TAG	SET TO	NOTES/COMMENTS
GPT_NO_TARG_CONC	target concentration based on units	
GPT_O3_TARG_CONC	target concentration based on units	
GPT_TARG_TOTAL_FLOW	*set to flow in LPM	
GPT_O3_TARG_UNITS	PPB, PPM, PPT, PCT, MGM, UGM	
GPT_NO_TARG_UNITS	PPB, PPM, PPT, PCT, MGM, UGM	
GAS_GENERATE_MODE	GPTZ	
GAS_GENERATE_CONTROL	IDLE	
GAS_GENERATE_CONTROL	APPLY	

GENERATE A GPTPS (Note: will reuse the same parameters as GPT)

TAG	SET TO	NOTES/COMMENTS
GPT_NO_TARG_CONC	target concentration based on units	
GPT_O3_TARG_CONC	target concentration based on units	
GPT_TARG_TOTAL_FLOW	flow in LPM	
GPT_O3_TARG_UNITS	PPB, PPM, PPT, PCT, MGM, UGM	
GPT_NO_TARG_UNITS	PPB, PPM, PPT, PCT, MGM, UGM	
GAS_GENERATE_MODE	GPTPS	
GAS_GENERATE_CONTROL	IDLE	
GAS_GENERATE_CONTROL	APPLY	

RUN PURGE ON CALIBRATOR

TAG	SET TO	NOTES/COMMENTS
GAS_GENERATE_MODE	PURGE	
GAS_GENERATE_CONTROL	IDLE	
GAS_GENERATE_CONTROL	APPLY	

OUTPUT VALVE SELECT (option on machines with NOy dual output valves)

TAG	SET TO	NOTES/COMMENTS
OUTPUT_A_B_SELECT	OUTPUTA, OUTPUTB	

Example of an Automatic Dilution with Tags:

To run an automatic dilution of 400 PPB of NO at a flow rate of 5.0 LPM, the script would read as follows:

```
tags_to_send = {
   'values':[
      {'name':'AUTO_TARG_CONC','value':'400'},
      {'name':'AUTO_TARG_GAS_NAME','value':'NO'},
      {'name':'AUTO_TARG_TOTAL_FLOW','value':'5.0'},
      {'name':'AUTO_TARG_GAS_UNITS','value':'PPB'},
      {'name':'GAS_GENERATE_MODE','value':'AUTO'},
      {'name':'GAS_GENERATE_CONTROL','value':'IDLE'},
      {'name':'GAS_GENERATE_CONTROL','value':'APPLY'}
   ]
}
```