AN-010 API Interface Specification

OmniPreSense modules have an easy to use API to control the output of the modules. The simple commands can be used to configure the operation and output information provided by the module. Default settings are noted below. Upon powering on the module, the default settings are used.

Terminal Control

A simple Command Terminal can be used to control the module operation with the API commands. Examples of simple but very useful Command Terminals are Tera Terminal and PuTTY. Both are free, open source terminal tools for the PC/Mac which can easily connect to a serial port and accept data over USB from the OminPreSense module.

To begin using the OmniPreSense module, first download Tera Terminal or PuTTY onto your PC/Mac. With the OmniPreSense module plugged into the USB port of your PC/Mac, start Tera Terminal or PuTTY. A configuration window such as in Figure 1 or Figure 2 will appear. TeraTerm can detect the active COM port (greyed out to right of Serial button if TCP/IP is selected). Select the Serial button and press OK. For PuTTY, you'll need to know which COM port is used, set its value, select the Serial button, and Open.

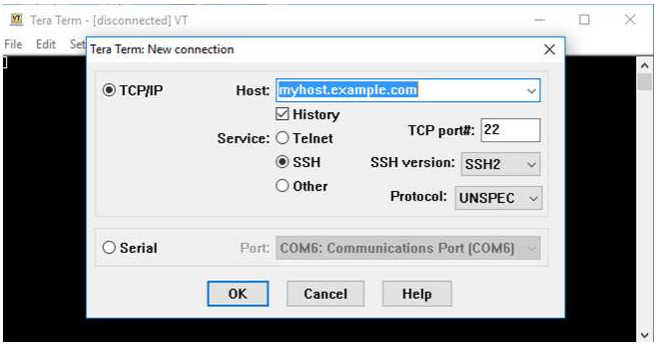

Figure 1. Tera Term Startup Menu

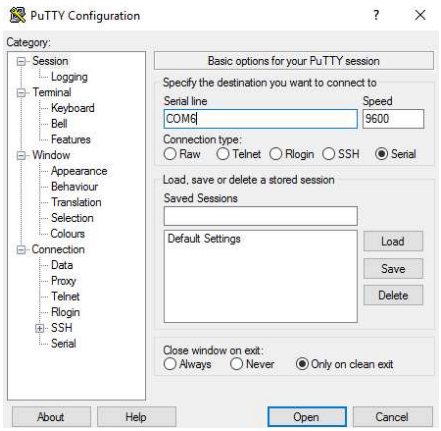

Figure 2. PuTTY Startup Menu

Once connected, the data reported by the module will start streaming to the terminal when an object in motion appears. The default settings are shown in Table 1. If there is no object moving in front of the module, no data is reported or streamed to the terminal. A simple wave of the hand will show data like that shown in Figure 3. Any of the API commands can now be executed to change the output data or query the configuration.

Figure 3. Streaming Data with Tera Term

Figure 4. Streaming Data with PuTTY

Default Settings

The default settings of the module are set to provide solid performance over a wide range of applications. Upon power-up the default settings are used and operation begins. Future updates will allow the module to retain the settings of the module from the last operation. The default settings are listed in Table 1.

Table 1. Default Settings

API Command	API Command	Default Value
Output Units	UM	m/s
Data Accuracy	F2	2
Sample Rate	SX	10,000
Sample Buffer Size	S>	1024
Reported Speed Filter	R=*n*	Off
Reported Direction Filter	R|	Off
Quash Noise	QQ	On
JSON Output	Oj	Off
LED Control	OL	On
Magnitude Report	Om	Off
Number Reports	O*n*	1
Raw Data Output	Or	Off
Speed Report	OS	On
Time Report	Ot	Off
Module Power	PA	Active

Operating Range

The maximum speed reported is determined by the Sampling Frequency. For slow moving objects, a sample rate of 5,000 (SV command) is perfectly fine. The default setting of 10,000 (SX command) provides a detectable speed of up to 31.1 m/s (69.5 mph) while 20,000 (S2 command) provides up to 62.2 m/s (139.1 mph). The accuracy of the reported speed increases as the sample frequency goes down. The range of values is summarized in Table 2.

Table 2. Maximum Operating Speeds

Sample Frequency	API Command	Maximum Speed (m/s)	Maximum Speed (mph)	Accuracy* (m/s)	Accuracy* (mph)
1,000	SI	3.1	7.0	0.006	0.014
5,000	SV	15.5	34.8	0.030	0.068
10,000	SX	31.1	69.5	0.061	0.136
20,000	S2	62.2	139.1	0.121	0.272
50,000	SL	155.4	347.7	0.304	0.679
100,000	SC	310.8	695.4	0.608	1.358

* 1024 buffer size, 512 buffer size accuracy will be twice these values, 256 four times

API Commands

The following are the API commands supported by the OPS241-A and OPS242-A. These commands can be sent by typing into the command terminal to change settings on the module or control its operation. The commands provided include simple queries to fetch information about the module and it settings or write commands which control or change the operation of the module.

Module Information – returns information about the module and it's reporting setting.

Command	Name	R/W	Value
??	Module Information	Read	{"Product":"OPS-241A"} {"Version":"1.1.1"} {"SamplingRate":10000, "resolution":0.0607} {"SampleSize":1024}{"Clock":"54"}{"PowerMode":"Continuous"} {"Quash":"true"} {"RequiredMinSpeed":"0.000"}

Module Part Number – returns model number of moduleas either OPS241 or OPS242..

Command	Name	R/W	Value
?P	Module Part Number	Read	{"Product":"OPS-241A"}

Firmware Version – returns current firmware version of the module. Firmware version consists of a major revision, minor revision, and patch revision in the form of xx.yy.zz.

Command	Name	R/W	Value
?V	Firmware Version Number	Read	{"Version":"1.0.0"}
?B	Firmware Build Number	Read	{"Build":"20170905_1500"}

Speed Output Units – read or set the units for the velocity output. Units supported include m/s (default), cm/s, ft/s, km/hr, and miles per hour.

Command	Name	R/W	Value
U?	Current Velocity Units	Read	{"Units":"m-per-sec"}
UC	Centimeters per second	Write	{"Units":"cm-per-sec"}
UF	Feet per second	Write	{"Units":"ft-per-sec"}
UK	Kilometers per hour	Write	{"Units":"km-per-hr"}
UM	Meters per second	Write	{"Units":"m-per-sec"}
US	Miles per hour	Write	{"Units":"mph"}

Data Precision – set the number of digits for the data reported.

Command	Name	R/W	Value
F*n*	Decimal Places	Write	Set *n* to the number of decimal places to be reported. For example, setting to F2 will report 2 decimal places (ex. 10.35). F0 will provide the integer value only. Valid values of *n* are 0-5.

Sampling Rate/Buffer Size – set these values to control the sample rate of the module. This setting influences the output data and the rate at which the data is reported. The buffer size influences the report rate and accuracy. A buffer size of 512 will have a report rate between 5-30Hz. The accuracy becomes worse by a factor of two with a 512 buffer size versus 1024 (Figure 5) and worse again at 256 buffer size.

Command	Name	R/W	Value
SI	1K samples/second	Write	
SV	5K samples/second	Write	
SX or S1	10K samples/second	Write	
S2	20K samples/second	Write	
SL	50K samples/second	Write	
SC	100K samples/second	Write	
S>	1024 buffer size	Write	1024 samples are collected before processing
S<	512 buffer size	Write	512 samples are collected before processing
S{	256 buffer size	Write	256 samples are cleected before processing

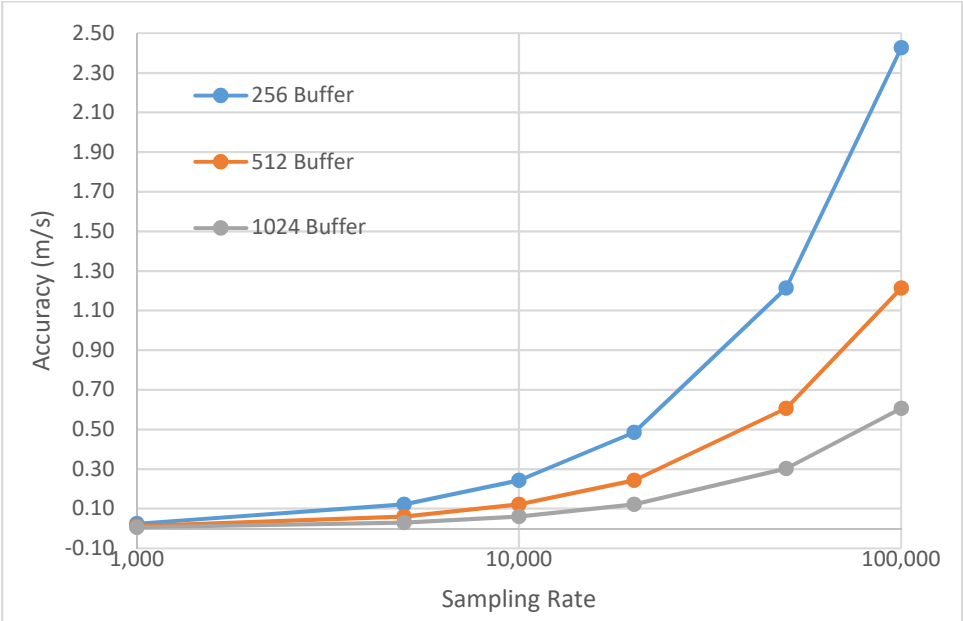

Figure 5. Buffer Size versus Accuracy

Reported Speed/Direction Filter – use these settings to set the minimum value or direction to report. Reported speed can be used to set the sensitivity level of detection. Any values below the number *n* will not be reported. This command requires a return (↵) after the number. Direction filter allows reporting only a single direction or both.

Command	Name	R/W	Value
R>*n*	Reported Speed Filter	Write	n is any number upon which no detected speeds below that number will be reported
R+	Inbound Only Direction	Write	Only reports inbound direction
R-	Outbound Only Direction	Write	Only reports outbound direction
R|	Clear Direction Control	Write	Reports both directions

Frequency Control – use this setting to set the desired transmit frequency. Set *n* to a positive or negative number to set the frequency. T=0 is the default setting for 24.125GHz. Each increment steps approximately 18MHz. The programming steps are limited to 24.0 through 24.25GHz for the OPS242 and 25.6GHz operation for the OPS241. The limits on *n* are -6 (24.0GHz) and 93 (25.6GHz) for the OPS241 and -4 (~24.0GHz) to 4 (~24.25GHz) for the OPS242 which has some guard banding to ensure it stays within the 24.0-24.25GHz ISM band. See Figure 6 for approximate values of *n* for each frequency. Depending on the spread between the current frequency and the newly set frequency, there may be a long settling time on the order of 5-10 seconds or longer based on the size of the jump in values. Writing ?F will provide the current transmitter output frequency.

Command	Name	R/W	Value
T=*n*	Frequency Setting	Write	T=0 is the default setting for 24.125GHz.
?F	Frequency Output	Read	?F returns the output frequency of the transmitter in GHz.

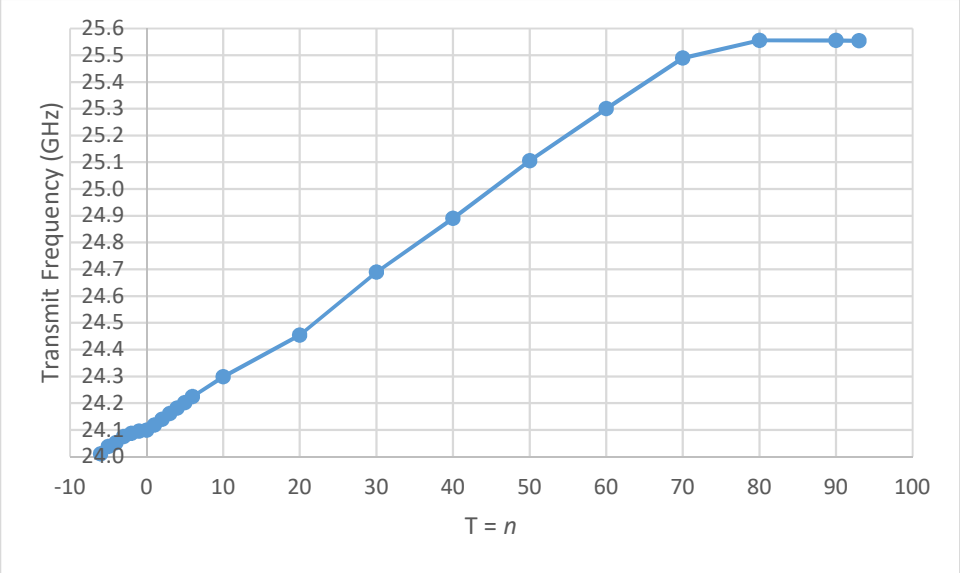

Figure 6. Frequency Setting T Values

Data Output – set to control the data which is output.

Command	Name	R/W	Value
OF	FFT Output On	Write	Results from the FFT processing of each buffer will be sent. Each buffer is 1024 samples. Data is output with json output format.
Of	FFT Output Off	Write	Turns off FFT output.
OJ	json Mode On	Write	'Turns on output to format data in json format. An example would output: {"speed":0.58, "direction":"inbound", "time":105, :tick":135}
Oj	json Mode Off	Write	Turns off json output mode.
OR	Raw ADC Output On	Write	I and Q output buffers from the ADC will be sent. Data will alternate between outputting the I buffer and then Q buffer.
Or	Raw ADC Output Off	Write	Turns off output of the I and Q buffers.
OL	LED Control	Write	Turn the LEDs on (OL) or off (Ol). Turning off the LED's can save approximately 10mA of current consumption.
O*n*	Number Reports	Write	Define how many reports to provide. *n* is a number between 1 and 9. The number *n* holds for time, magnitude, and speed.
OM	Magnitude Report	Write	Turn on reporting of the magnitude associated with the speed. The magnitude is a measure of the size, distance, and reflectivity of the object detected. Type Om to turn magnitude off. When turned on, magnitude information comes before speed information. For example,
OS	Speed Report	Write	Turn speed reporting on or off. Default operation speed is reported. Use Os to turn it off and OS to turn it back on.
OT	Time Report	Write	Turn the time report on. Time is reported as the seconds and milliseconds since the last reboot or power on. For example, 137.429, 3.6 is read as 137 seconds and 429 milliseconds with a speed of 3.6 m/s. If magnitude is turned on, the data is provided as time, magnitude, speed.
BZ	Zero Blank Reporting	Write	If measured data is zero, sensor will report out a zero value with every chirp of the signal. Use BV to turn this feature off.

Timing Report – set to control the reporting of the time. The time is measured in seconds/milliseconds from power on of the module. Use the OJ command to report the time in seconds and milliseconds along with the speed and direction information (or direction can be turned off). When the module is put in low power state, the clock will continue counting. If you wish for the module to provide "the real time", then set it to "the Unix time" (see wikipedia.org/wiki/Unix_time).

Command	Name	R/W	Value
C?	Query Time	Read	Ex. {"Clock":"50"} reports 50 seconds since power on.
C=*n*	Set Time	Write	Reset the clock start time. For example, n = 10 will start the clock at 10 seconds and then continue counting.

Module/Transmit Power – set to control the operating mode (PA, PI, PP) or the transmit power. The typical maximum transmit power is 9 dB. Reducing the transmit power does not reduce the overall power consumption of the module. Note that the detection range will decrease with decreased transmit power.

Command	Name	R/W	Value
PA	Active Power Mode	Write	Normal operating mode.
PI	Idle Power Mode	Write	No activity, waits for Active Power command. The RF is powered down for further power savings.
PP	Single Shot Mode	Write	Use this mode to capture and process a single buffer of data. The module will stay in PP mode until either a PA or PI command is given. While in PP mode, the RF device is powered off to save power.
P7 or PN	Transmit Power Control or Min Power	Write	Transmit is set at -9 dB below max power.
P6	Transmit Power Control	Write	Transmit is set at -6 dB below max power.
P5	Transmit Power Control	Write	Transmit is set at -4 dB below max power.
P4	Transmit Power Control	Write	Transmit is set at -2.5 dB below max power.
P3 or PD	Transmit Power Control or Mid Power	Write	Transmit is set at -1.4 dB below max power. PD has additional "overdrive" of 0.2 dB when utilized.
P2	Transmit Power Control	Write	Transmit is set at -0.8 dB below max power.
P1	Transmit Power Control	Write	Transmit is set at -0.4 dB below max power.
P0 or PX	Transmit Power Control or Max Power	Write	Transmit power is set at its maximum value with maximum range. PX has additional "overdrive" of 0.2 dB when utilized.

Duty Cycle Control – set to control the duty cycle operation. The time set is the amount of time the module will sleep between transmit/receive pulses and processing. During the sleep time the orange LED will be on. For settings longer than 1 second, the RF will be powered off to save power. In this manner, lower power operation may be achieved.

Command	Name	R/W	Value
Z0	Sleep 0 Second	Write	Use to set back to normal operation.
ZI	Sleep 1 Second	Write	
ZV	Sleep 5 seconds	Write	
ZX or Z1	Sleep 10 seconds	Write	
ZL	Sleep 50 seconds	Write	
ZC	Sleep 100 seconds	Write	
Z2	Sleep 200 seconds	Write	
Z=*n*	Set Sleep Time	Write	Set the amount of time to sleep between data processing. Ex., n = 5 would set the module to sleep for 5 seconds (RF powered off) between a transmit/receive pulse and processing.

Squelch Control – provides control over the sensitivity of the module to detect moving objects. Low numbers are most sensitive, high numbers are least sensitive.

Command	Name	R/W	Value
QI	Squelch Control - 100	Write	Highest sensitivity setting.
QV	Squelch Control - 500	Write	
QX	Squelch Control – 1,000	Write	
QL	Squelch Control – 5,000	Write	
QC	Squelch Control – 10,000	Write	
Qn	Squelch Control	Write	Set *n* to the desired squelch number x 1000. For example, setting to Q2 will set the value to 2000. Valid values of *n* are 0-9. 0 provides no squelch control and all data will be reported.
Q=n	Squelch Control	Write	n = any arbitrary number between 1 and 4 billion.
QQ	Quash On	Write	Quash filters out the lowest frequency components around DC.
Qq	Quash Off	Write	Turns quash off.

Debug Modes – provides debug information about the module.

Command	Name	R/W	Value
DR/Dr	Red LED	Write	DR to turn on red LED, Dr to turn off.
DY/Dy	Yellow LED	Write	DY to turn on yellow LED, Dy to turn off.

Appendix

Table 3. Feature versus Code Version Matrix

Feature	V1.0.0	V1.0.2	V1.1.0	V1.1.1	V1.2.0	Notes
Module Information	●	●	●	●	●	
Module Part Number	●	●	●	●	●	
Firmware Version	●	●	●	●	●	
Firmware Build			●	●	●	
Speed Output Units	●	●	●	●	●	
Data Precision	●	●	●	●	●	
Sampling Rate	●	●	●	●	●	
Buffer Size			●	●	●	
Reported Speed Filter			●	●	●	
Reported Direction Filter			●	●	●	
Frequency Control			●	●	●	OPS242 limited to 24-24.25GHz
Frequency Reporting				●	●	
256 Buffer Size					●	
LED Control					●	
Number Reports					●	
Magnitude Report					●	
Speed Report					●	
Time Report					●	
Zero Reporting					●	
Data Output	●					Direction control removed, always on with V1.0.2
Timing Report	●	●	●	●	●	
Module Power	●	●	●	●	●	
Transmit Power	●	●	●	●	●	
Duty Cycle Control	●	●	●	●	●	
Squelch Control	●	●	●	●	●	Corrected values in V1.1.1
Quash Control			●	●	●	
Debug Modes	●	●	●	●	●	

Revision History

Version	Date	Description
A	Apr. 19, 2017	Initial release.
B	Sep. 15, 2017	Added update for V1.0.2 • Eliminated Direction control OD/Od, it is always on with V1.0.2 Added changes incorporated in V1.1 • Added Buffer size API • Added Reporting control API • Added Direction control API • Added Frequency setting API • Added 100K sampling rate API • Added Quash control API • Added Build reference • Added Appendix, feature versus code version table
C	Nov. 16, 2017	Added changes incorporated into V1.1.1 • New API reporting frequency setting • Default Squelch setting change to 100 • Corrected Squelch codes • Faster lock time to set frequency
D	August 12, 2018	Added changes incorporated into V1.2.0 • Support for OPS242-A added • Added frequency reporting API command • LED on/off control • Number of reports provided • Magnitude report control • Speed report control • Time report control • Updated reported Module information (??) • Clarified restrictions on the frequency setting for OPS242 • 256 buffer size support • Added BZ command information