TURNKEY ® iGAS® OPERATING INSTRUCTIONS

The following associated documentation is available from www.iGASES.uk

- ***iGAS Installation Instructions***
- ***Installing the Power Portal***
- ***Connecting iGAS to AirQWeb***

PREAMBLE

iGAS® operates automatically under the control of AirQWeb and associated programs and Apps. The instrument is supplied pre-configured so that it will start operating automatically as soon as it is connected to AirQWeb.

iGAS is factory set to measure the following

- Measurements are in SI units
- Reporting interval is 5 minutes
- Viewing interval is 2 seconds

Visit www.iGASES.uk to download more information.

The rest of this document gives deeper knowledge of the instrument to allow the operator to change its operating mode to suit their application. These changes can be made using AirQWeb or other programs and Apps. All sampling measurements must be stopped before any of the instrument's settings can be changed.

Operation of the instrument is controlled by the state of its **Feature Flags** and its **Instrument Settings**. Its operational state is indicated by the **Instrument Information** table, **Fault Flag** states and **Diagnostic & Housekeeping Readings.**

Please see Appendix of this document for full lists of the Feature Flags, Instrument Settings, Fault Flags and Diagnostic readings.

The electrochemical cells used in iGAS need to be held under a constant bias voltage even when the instrument is not being used. With 8 cells connected, this draws a current of about 10 mA from the battery, WHICH MEANS THE BATTERY WILL BECOME EXHAUSTED AFTER ABOUT 20 DAYS.

If you intend not to use the iGAS instrument for several days, disconnect the battery by clicking the power isolator switch to O. Return the switch to 1 when you wish to start using the instrument again. Note that the electrochemical cells may take several hours to recover stability if their bias voltage is removed for more than a few minutes

You may also momentarily click the isolator switch if, for whatever reason, you need to reboot the instrument.

SAMPLING

Sampling is the process by which the instrument measures and stores readings from its gas specific sensors. Each **sample** consists of a series reports measured over successive time intervals, this is the Reporting interval. The series of reports which make up the sample is known as the time series. The reported readings will be the average (or sometimes the peak) value over the reporting interval. Average (or peak) readings are also recorded over the duration of the sample.

Sampling may be started and stopped automatically as defined by the Feature Flags. Automatic samples are generally aligned with 1 minute boundaries.

The shortest reporting interval is one second, the longest 50 minutes. The recommended reporting intervals are between 1 minute and 15 minutes, these give the best compromise between memory use and time resolution. The shortest sampling period is one report interval, the maximum many days.

For those instruments with a display output, analogue output or micro-website, the Viewing Interval specifies how often the output is updated. The output is the average (or peak) over the specified viewing interval. The viewing interval can be in the range 1 second to 30 minutes and is independent of the reporting interval.

The instrument's memory can hold up to 100 samples each consisting of many reports. A sample is identified by its Sample Number. When the memory is cleared the sample number is reset. The total number of samples measured by the instrument over its life is the Sample Total.

SAMPLE CONTROL FEATURE FLAGS

If *Automatic Start* is set, sampling will automatically start on the next 1 minute boundary after the instrument is switched on. If *Timed Sample* is set the sample will last for the *Duration* number of reports (specified in the Instrument Settings) and, if *Automatic Start* is set too, another sample of the same duration will start immediately. This process will carry on till the memory fills when a Memory Full Fault Flag will end the current sample and prevent another restarting.

If *Circular Buffer* is set, the last sample (i.e. the one just finished) will be overwritten if the Instrument Settings *Sample Stack* value equals 0, if it equals 1 the last but 1 will be overwritten and so on. Hence it is possible to create a stack of N samples that will overwrite forever.

If *New Sample Daily* is set a new sample will start at precisely midnight but only if *Automatic Start* is set. This can be combined with the *Circular Buffer* flag and the value of the *Sample Stack* to create a rotating, N-day sample block.

POWER MANAGEMENT AND SLEEPING

The instrument is fitted with a 6 Volt, 5 cell NiMH battery.

If the battery voltage drops below 5.5 Volts, measurements will stop and the current sample will be terminated and the *Dead battery* Fault Flag will be set. If the battery drops below 5.2 Volts the instrument will go into a low power sleep to conserve energy (regardless of the state of the *AllowToSleep* flag). The *Dead Battery* flag will only be cleared when the battery voltage has recovered to > 5.8 Volt

The *Low Battery* Fault Flag is set when the battery voltage drops below 5.8 Volt. An existing sample will continue but a new sample cannot start while that flag is set.

When the instrument is on-charge the red light is always on

The iGAS internal battery capacity is 2000 mAH. The battery is intended to keep the instrument operating if the external +12V power disappears. Assuming a full charge, iGAS will continue to operate without external power for about 10 hours.

If the battery is discharged, a full recharge will take about 12 to 14 hours with the instrument automatically switching on before then when the battery reaches 6.5 Volt.

The battery is not required for data storage and the instrument uses flash memory to store the results. Data retention is more than 100 years.

When you have finished using the instrument, it is good practice to clear the *Automatic Start* flag, stop the instrument sampling, and set the *Allow To Sleep* flag. This will allow the

instrument to sleep until next required while only slowly discharging its battery. You can do this by clicking _Hibernate_ in AirQWeb. Remember, if you wish to turn off for several days, you must isolate the battery by clicking the isolator switch to 0

GETTING STARTED WITH iGAS®

Please refer to the latest versions of the associated documentation for instructions on how to install iGAS, the Power Portal, and connect to AirQWeb. All the latest documentation can be found at www.iGASES.uk .

To turn the instrument on, press the instrument's black RESET push-button. The red activity light on the underside will illuminate. This indicates the instrument has started to operate. The instrument will only start if the battery voltage is greater than 5.8 Volts. If it isn't you must connect the +12V power supply from the Power Portal and wait until the battery is sufficiently charged.

If a 12V power supply is connected, the instrument will automatically turn-on if the supply voltage is > 9 Volts and the battery voltage is > 6.5Volts.

The instrument can also be turned on remotely by sending a 1 second RS485 BREAK command from the WS3 web server in the Power Portal. Please refer to your AirQWeb documentation.

If the _Allow to Sleep_ Feature Flag is set and

1. there is no communications activity
2. the instrument is not measuring a sample

the instrument will automatically fall asleep after about 5 minutes and the red light go out. The instrument can be awoken again by pressing the RESET button, sending a BREAK command or simply connecting the +12 Volt supply. The instrument will not fall asleep if the +12 Volt supply is connected and the battery voltage is > 6.5 Volt.

Applying mains power to the Power Portal should automatically establish an internet connection between iGAS and AirQWeb. Please refer to **Connecting iGAS to AirQWeb** from www.iGASES.uk for more instructions.

Please contact techsupport@tunkey-instruments.com if you experience any difficulties.

APPENDIX

FEATURE FLAGS

The operation of iGAS is controlled by Feature Flags which may be set or cleared by the operator. They are normally set automatically by AirQWeb. The basic set of Feature Flags is as follows, preset factory defaults are shown ticked:

Feature Flag Name		Explanation/Description
iGAS	√	Measure gas concentrations
iMET		Measure meterological conditions, iMET module required.
iDUST		Measure particle concentrations, iDUST module required
US units		SI units by default
IGAS mass/volume		Express gas concentrations as µg/m^3 instead of ppb
Auto Start		Automatically start sampling whenever power is on and battery condition is OK
Daily sample		New sample starts at midnight each day, the Auto Start feature must be on. Will terminate active sample at midnight.
Timed sample		Each sampling period terminates after a set number of reports, specified in the Instrument Settings table (IS)
Stop if fault	√	Stops sampling if a fatal fault occurs
Continuous Zero	√	Continually determine sensor zero gas offset. Overrides Periodic Zero flag. Takes two Zero phases to complete (2 minutes by default).
Periodic Zero		Measure sensor zero gas offset at start of sampling and thence at the Zeroing interval specified in the instrument Settings. Takes three Zero phases to complete
Use Period Zero		Apply the zero offset readings determined by the Periodic Zero above. Over-ridden by the Continuous Zero Flag
Apply offsets		Apply the systemic zero offsets, manually entered into SEDs
iDUST Auto Zero		Only If the iDUST module is fitted, measures the zero dust particle count.
Circular Buffer		Use circular buffers to record stacked samples, number of stacked samples saved before overwrite is specified in the Instrument Settings Table (IS)
Swap Air Filters		Electronically interchanges the chemical air filters, so the sample filter becomes the zero gas filter and vice-versa
Use iGAS Matrix		Correct for gas species interferences. Gas matrix elements must be defined in SEDs
Age correction		Apply the sensor cell ageing characteristic from SEDs.
Save iGAS	√	Save the iGAS readings in the dataset
Save iMET		Save the iMET readings in the dataset
Save iDUST		Save the iDUST readings in the dataset
Save housekeep.		Save the Housekeeping readings in the dataset
Save diagnostic		Save the Diagnostic readings in the dataset
Save GPS		Save the GPS co-ordinates if GPS module is fitted
Allow to sleep	√	Allow to fall asleep after about 5 minutes if not sampling and no communications. Toggle switch or send break to command from WS3 to awaken. Will automatically awaken and not fall asleep if +12V connected and battery > 6.5V

INSTRUMENT INFORMATION

The Instrument Information table (II) provides additional information about the instrument. It is read only and cannot be modified by the user

Information Table (II)	Explanation/Description
Serial Number	Instrument serial number
Instrument type	iGAS Monitor
Manufacturer	Turnkey UK
Software Version	Software version programmed into instrument
Cal. Due by	Date next instrument re-calibration is due.
CH0 to CH7 names	Names of the primary measurements
CH0 to CH7 units	Measurement units for the primary measurements
Gas-A to Gas-H cal. dates	Calibration dates of the individual gas sensors
Gas-A to Gas-H type	Species and type of the individual gas sensors. For example, NO-B4 is a 4 -electrode electrochemical nitric oxide sensor
Gas-A to Gas-H ID	The two character GasCode and serial number of the individual gas sensors
Gas-A to Gas-H cell zero	Intrinsic zero offset of the electrochemical cells
Gas-A to Gas H sys. zero	The systemic zero offset determined for the manifold
Gas-A to Gas-H signal/ppm	The sensitivity of the electrochemical cells, typically in nA/ppm gas
Gas-A to Gas-H auto zero	The cell zero offset as determined by the latest periodic zero.
Gas-A to Gas-H step T90	The 90% response time (in seconds) to a step function change in gas concentration
Gas A to Gas H mass/vol	The mass per volume of each gas species used to convert, for example, ppb to ug/m^3
Gas-A to Gas-H ageing	The sensitivity ageing characteristic for the individual gas sensors in % per month.

INSTRUMENT SETTINGS

These settings control the instrument's reporting and sampling. They are normally controlled automatically by AirQWeb.

Instrument Setting	Explanation/Description
Sample Total	Running count of total number of samples taken by the instrument over its life. Never normally reset.
Sample Number	Next sample number, is reset to 0 when memory is cleared. Increments by 1 every time a sample is completed. Range is 0 to 99. Sample 0 is always the first sample.

Reporting interval (sec)	Time interval when new results are reported. AirQWeb normally sets this to 5 minutes (300 secs)
Flow (scc/min)	The set point sample flow for iDUST
Zeroing (sec)	The interval in seconds between iGAS and iDUST periodic zeros, if 0 will just do zero at start of sampling
Viewing (sec)	The display refresh rate for those instruments with a display
Start time	If sampling, start timestamp of current sample. If not, start timestamp of last sample
Stop time	If sampling, timestamp of latest report. If not, stop timestamp of last sample
Sample Stack	Number of samples in the stack before loopback if *Circular Buffer* Feature Flag is selected
Zero phase (sec)	The length, in seconds, of each iGAS zero phase, either continuous of periodic.
Zero trigger dT	The temperature change in C of the gas sensor manifold since the last periodic zero to trigger another.
Report Number	Number of reports in the current sample, or last sample if not sampling.
Duration	Number of reports in a sample before it auto-stops, only if *Timed Sample* Feature Flag is selected
Company	Company name string, up to 16 bytes
Location	Location name string up to 16 bytes
Gas Sensor Mask	Mask showing which sensors are fitted in the iGAS manifold
Zeroable Mask	Mask showing which of those sensors are suitable for continuous or periodic zeroing
Manifold Hours	Hours the gas sensor manifold has been used.
Last AZ Temp.	Temperature of manifold during last periodic zero
Last AZ humidity	Humidity of sample gas flow during last periodic zero
Last AZ time	Time and date of last periodic zero
Filter changed	Date when air filters of iGAS and iDUST were changed
Manifold fitted	Date when Manifold was fitted in instrument, manifold is normally exchanged during routine calibration and servicing.

FAULT FLAGS

These flags indicate the faults or errors the instrument has encountered. Many of these are managed automatically by AirQWeb.

FAULT FLAG	Explanation/Description
Directory FULL	100 samples have been stored. Sampling is stopped and canniot restart. Upload and clear memory
Memory FULL	The IvIbe memory is full. Sampling has stopped. Upload and clear memory. Depending on length of samples, may occur before 100 samples have been saved.
Dead battery	Battery voltage < 5.5Volts. Sampling will have been stopped and cannot re-start until battery voltage . 5.8 Volts.
I'm too hot!	The case temperature is >60C. Sampling is stopped
Fatal Error	One of the above faults has occurred, sampling is stopped until fault condition clears.
Memory 90% full	Memory is at 90 % capacity, stop sampling and clear memory.
Low battery	The battery voltage is < 5.8 Volts. Recharge battery. New sample cannot be started.
Cal. < 50 day	Calibration is due in less than 50 days. Have instrument recalibrated.
Cal. OVERDUE	Calibration is now overdue. Soon the instrument will be disconnected from AirQWeb server. Have instrument recalibrated as soon as possible..

NOTES

Please visit www.iGASES.uk to access other iGAS and iDUST documentation

If you need assistance, please contact:

Turnkey Instruments Ltd, Dalby Court, Gadbrook Business Centre, Northwich, England CW9 7TN
Tel: +44 (0) 1606 330020   Fax: +44 (0) 1606 331526
Email: techsupport@turnkey-instruments.com

Revision History

- Original, 7 May 2017
-

© 2017 Turnkey, MJL, Issue 1, May 2017
CE 2017

www.turnkey.tel

Turnkey®, iGAS ® and iDUST® are registered trademarks