

# APGS7D

## Piezoelectric Micro Air Pump

Packaging with 2 cores in parallel, APGS7D perform with high flow as well as high pressure. The flow rate and pressure respectively surpass 300 ml/min and 300 mmHg under driving at  $\pm 17V$  or less. The unique design of the piezoelectric actuator is robust and durable. It is driven around 28 kHz which assures the silent running.

## Specifications

|                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Dimensions LxWxT (mm)<br>(refer to the drawing also)                                                                   | 38.9×16.8× 3.9 Max. (Port and Lead excluded)<br>Port height: 2.1 Max.<br>Port diameter: 4.4-5.2 Taper.<br>Lead length: 1.1 Min. (some area may be covered with glue, at least 0.4 mm is exposed)                                                                                                                                                                                                                                                                                                                                                                                              |
| Maximum Mass                                                                                                           | 5g                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| OQC Criteria<br>(Outgoing Quality Control<br>by the OQC Test Sequence<br>under 25°C* and 150 ml<br>rigid tank loading) | <ol style="list-style-type: none"> <li>1. <math>P_{max} \geq 300</math> mmHg (at <math>\pm 17V/34V_{pp}</math> or less)</li> <li>2. <math>RT_{300} \leq 40</math> sec. (Rising Time from <math>P=0</math> to 300 mmHg)</li> <li>3. <math>FT_{15} \leq 10</math> sec. (Falling Time from <math>P=300</math> to 15 mmHg)</li> <li>4. <math>Q_c \geq 300</math> ml/min (Cold state flow rate or maximum flow rate during the first 5 second under <math>\pm 15V</math>)</li> <li>5. <math>W_{max} \leq 1400</math> mW per core (Maximum power consumption under <math>\pm 17V</math>)</li> </ol> |

\* At the lower temperature like below 15°C, some more driving voltage ( $>17V$ ) or time ( $RT_{300}$ ) is needed to meet the specifications.

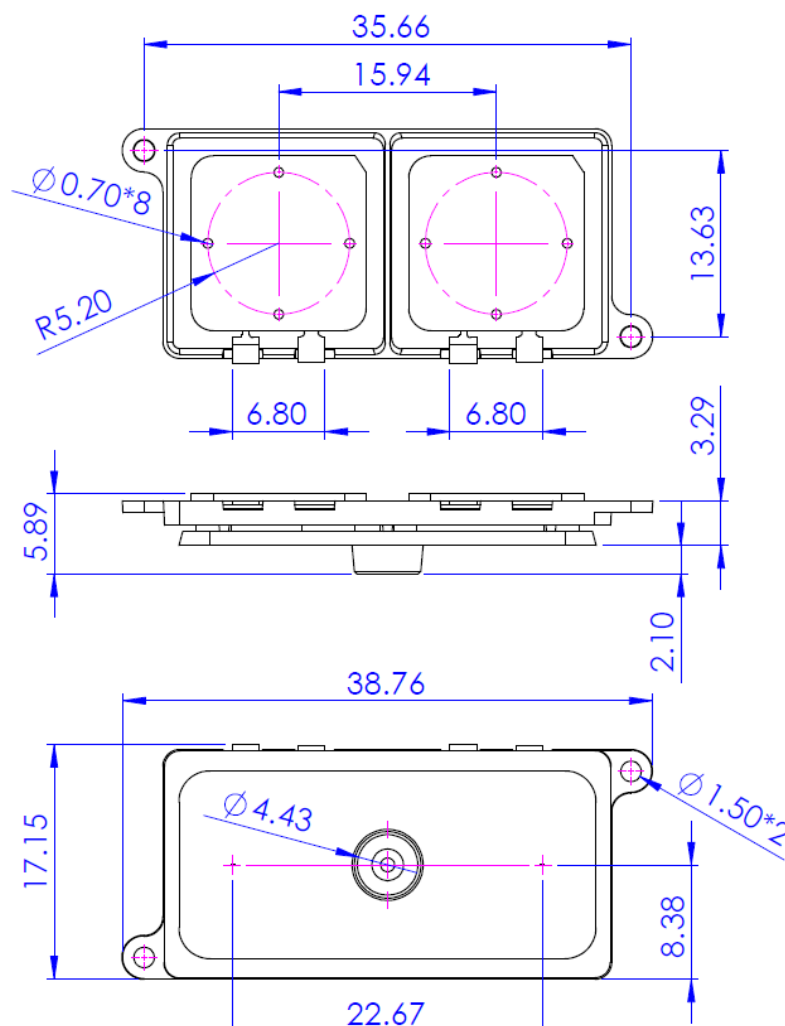
## Maximum Ratings

|                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Storage Temperature     | - 20 to 55 °C                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Operation Temperature   | 5 to 45 °C                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Operation Frequency     | 24.0 to 34.0 kHz                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Maximum Driving Voltage | <ol style="list-style-type: none"> <li>(1) Restriction of normal usage: <math>\pm 15V</math> (30Vpp) for long time periodic running (50s on/ 30s off).</li> <li>(2) Restriction of unfrequently short period higher performance demand usage: <math>\pm 17V</math> (34Vpp) or a little more depends on the environment temperature or the value of deviation from the resonant frequency but no more than <math>\pm 20V</math>.</li> <li>(3) To drive over <math>\pm 15V</math>, having a back pressure above 100 mmHg is recommended that means the pump should be running below <math>\pm 15V</math> before achieving 100 mmHg.</li> </ol> |

|                            |                                                                                                                                                                                                                                                                                                                                                          |
|----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Maximum Power Input        | <p>(1) Restriction of normal usage: the 600 mW per core power input limit on the piezoelectric actuator is recommended for long time periodic running (50s on/ 30s off).</p> <p>(2) Restriction of unfrequently short period higher performance demand usage: the 1400 mW per core power input limit on the piezoelectric actuator must be complied.</p> |
| Maximum Inflation Pressure | Pump driver must lower down the voltage to assure long life as the pressure runs over 330 mmHg.                                                                                                                                                                                                                                                          |

## Drawing (Dimension in mm)

The APGS7D is packaged with double cores, so that the double pairs of wiring is input accordingly.

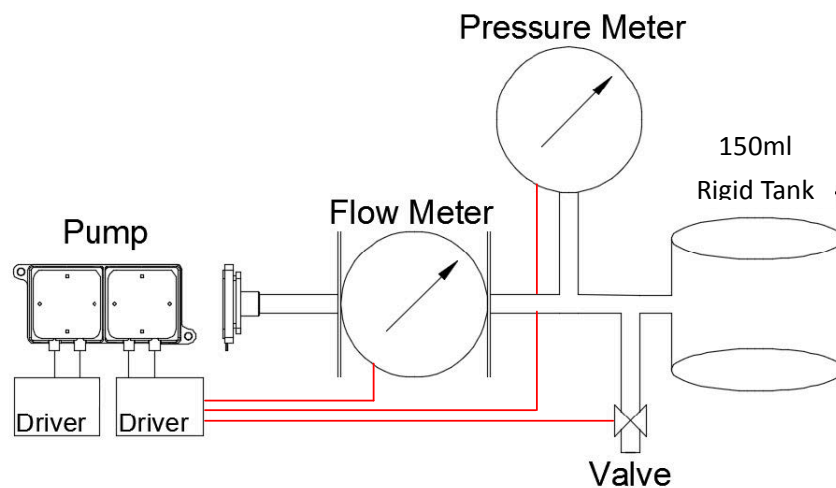
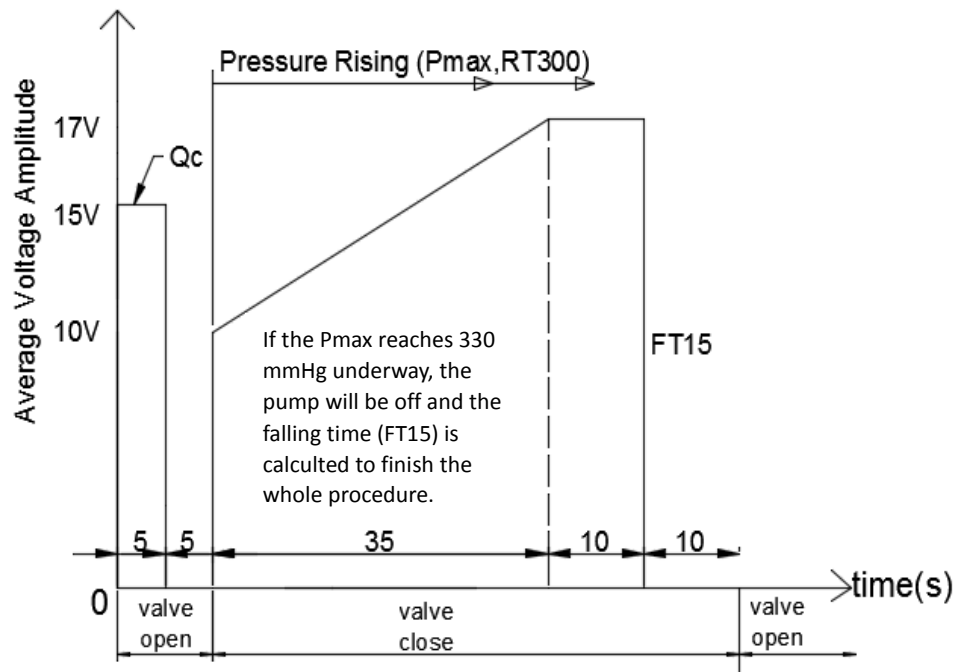


## Test Method

### (I) OQC Test Sequence

By the sequence and setup shown below, at the first 5 seconds the pump runs at  $\pm 15V$  and flow rate data are received and the calculated cold state flow rate ( $Q_c$ ) is the maximum flow rate during this period. The following 5 seconds is the break time.

From the tenth second onward, the pump runs by increasing the voltage linearly from  $\pm 10$  V to  $\pm 17$  V during the following 35 seconds and then keeping at  $\pm 17$  V for 10 seconds. And, the data are taken and the rising time (RT300) is calculated for the pressure from 0 to 300 mmHg and the maximum pressure (Pmax) is also obtained. If the Pmax reaches 330 mmHg underway, the pump will be off and the falling time (FT15) is calculated to finish the whole procedure. The FT15 is the time for pressure from the shutdown value to 15 mmHg.



## (II) Life Test (over 10,000 cycles)

The pump is able to pass the 10,000 cycles life test under the procedure curve shown below. The procedure comply with the maximum voltage and maximum power input limit of the normal usage restriction.

# APG7ST

## Piezoelectric Micro Air Pump

Featured with even thinner size, the APG7ST is only 2.5 mm in thickness comparing with the 3.8 mm of the APG7SW. It uses the same core design and has the same performance as the APGS7SW. The small size, light weight and ultra flat shape make it more accessible to be implemented in the wearable or portable products.

## Specifications

|                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-----------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Dimensions LxWxT (mm)<br>(refer to the drawing also)                                                                  | 15.2×15.2× 2.5 Max. (Port and Lead excluded)<br>Port length: 2.2 Max. (Type A)<br>Port diameter: 1.9-2.7 Taper.                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Maximum Mass                                                                                                          | 2.0g Max.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| OQC Criteria<br>(Outgoing Quality Control<br>by the OQC Test Sequence<br>under 25°C* and 50 ml<br>rigid tank loading) | <ol style="list-style-type: none"> <li>1. <math>P_{max} \geq 300</math> mmHg (at <math>\pm 17V/34V_{pp}</math> or less)</li> <li>2. <math>RT_{300} \leq 35</math> sec. (Rising Time from P=0 to 300 mmHg)</li> <li>3. <math>FT_{15} \leq 10</math> sec. (Falling Time from P=300 to 15 mmHg)</li> <li>4. <math>Q_c \geq 100</math> ml/min (Cold state flow rate or maximum flow rate during the first 5 second under <math>\pm 15V</math>)</li> <li>5. <math>W_{max} \leq 1400</math> mW (Maximum power consumption under <math>\pm 17V</math>)</li> </ol> |

\* At the lower temperature like below 15°C, some more driving voltage ( $>17V$ ) or time ( $RT_{300}$ ) is needed to meet the specifications.

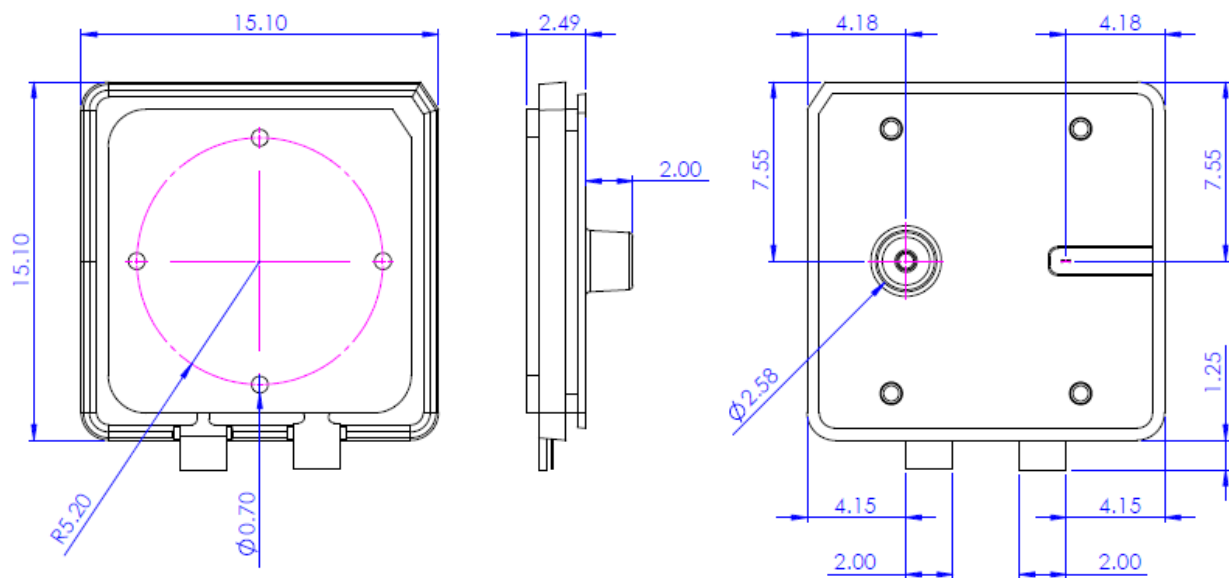
## Maximum Ratings

|                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Storage Temperature     | - 20 to 55 °C                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Operation Temperature   | 5 to 45 °C                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Operation Frequency     | 24.0 to 34.0 kHz                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| Maximum Driving Voltage | <ol style="list-style-type: none"> <li>(1) Restriction of normal usage: <math>\pm 15V</math> (30Vpp) for long time periodic running (50s on/ 30s off).</li> <li>(2) Restriction of unfrequently short period higher performance demand usage: <math>\pm 17V</math> (34Vpp) or a little more depends on the environment temperature or the value of deviation from the resonant frequency but no more than <math>\pm 20V</math>.</li> <li>(3) To drive over <math>\pm 15V</math>, having a back pressure above 100 mmHg is recommended that means the pump should be running below <math>\pm 15V</math> before achieving 100 mmHg.</li> </ol> |
| Maximum Power Input     | <ol style="list-style-type: none"> <li>(1) Restriction of normal usage: the 600 mW power input limit on the piezoelectric actuator is recommended for long time periodic running (50s on/ 30s off).</li> <li>(2) Restriction of unfrequently short period higher performance</li> </ol>                                                                                                                                                                                                                                                                                                                                                      |

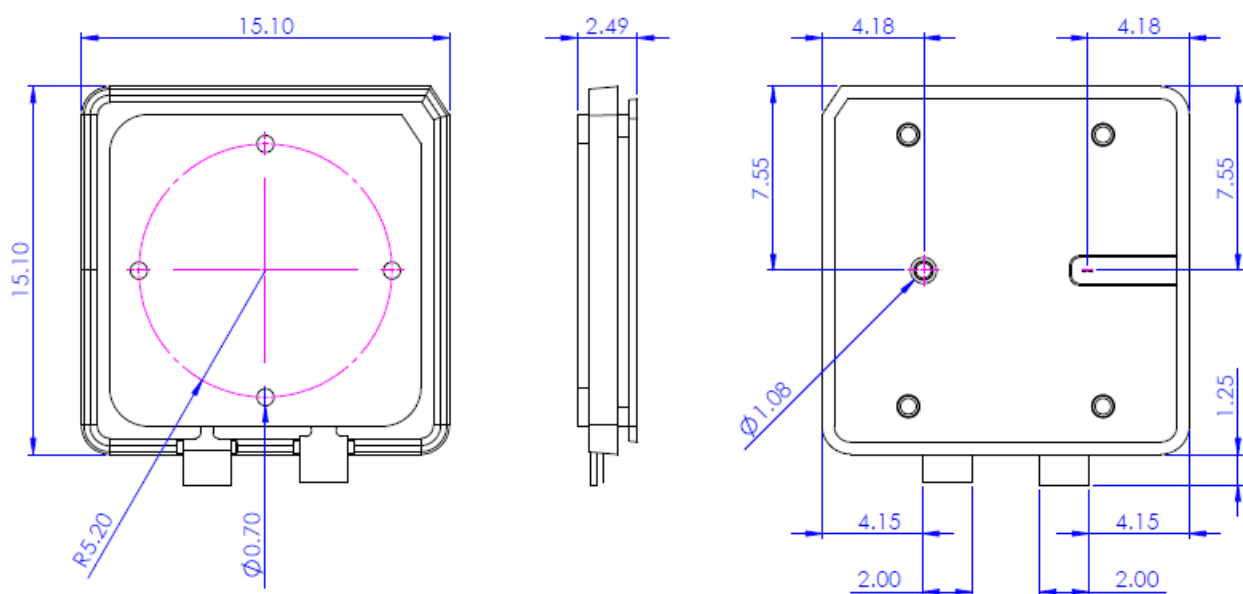
|                            |                                                                                                 |
|----------------------------|-------------------------------------------------------------------------------------------------|
|                            | demand usage: the 1400 mW power input limit on the piezoelectric actuator must be complied.     |
| Maximum Inflation Pressure | Pump driver must lower down the voltage to assure long life as the pressure runs over 330 mmHg. |

## Drawing (Dimension in mm)

### (I) Type A (tube port)

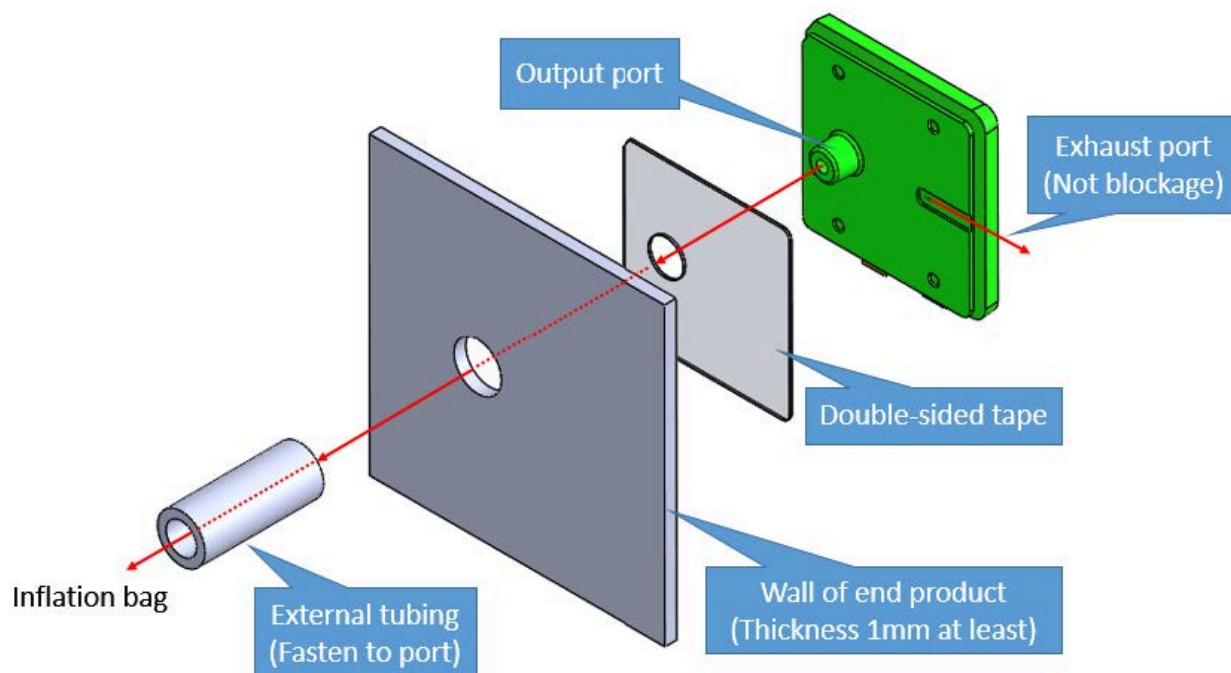


### (II) Type B (hole port)

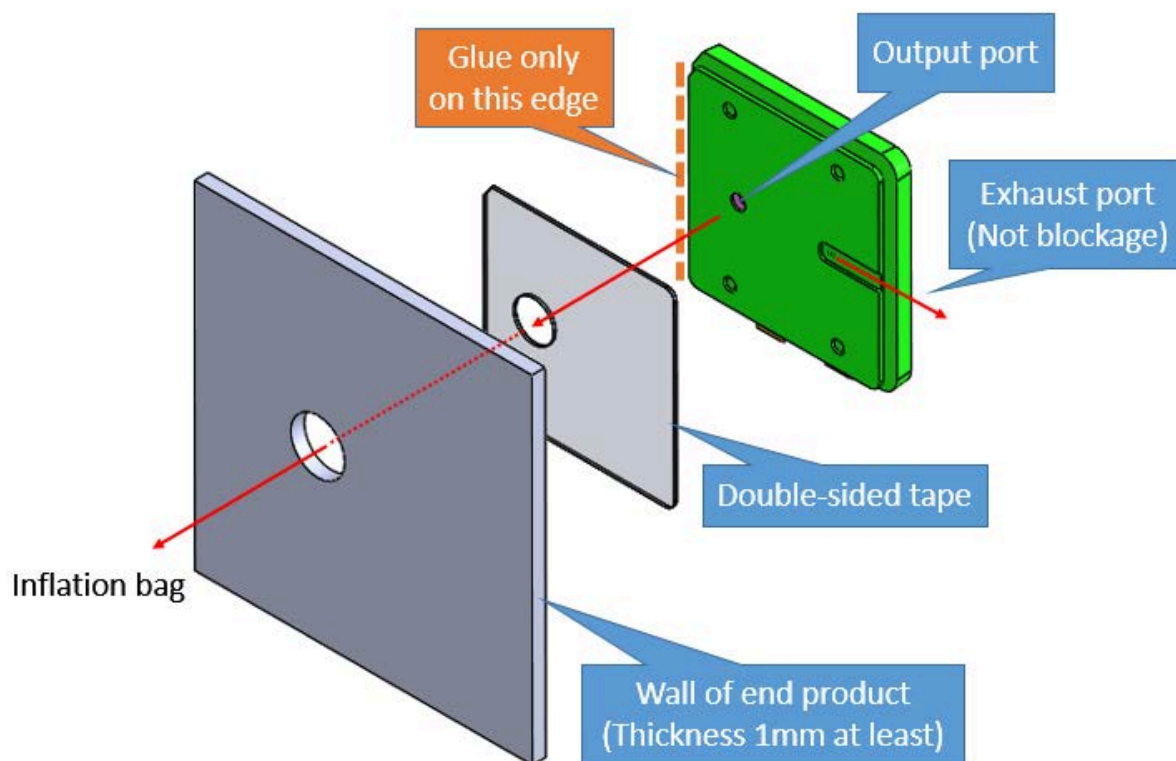


# Mounting Guide

## (I) Type A (tube port)



## (II) Type B (hole port)

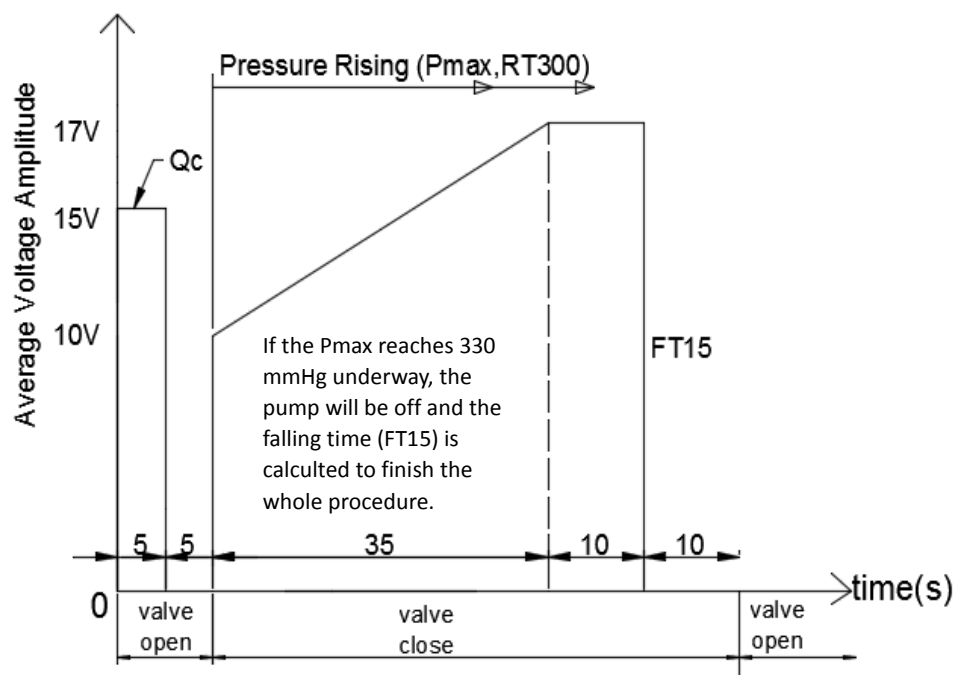


## Test Method

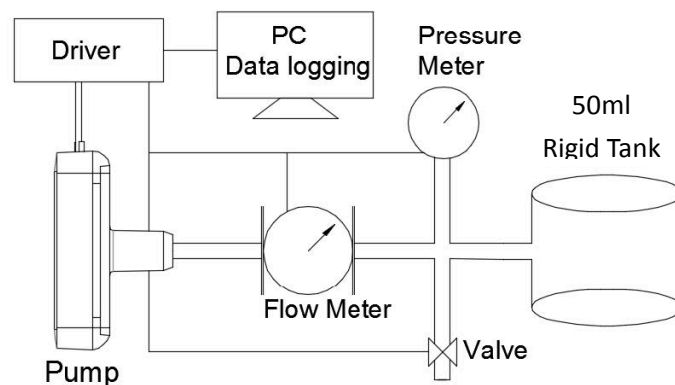
### (I) OQC Test Sequence

By the sequence and setup shown below, at the first 5 seconds the pump runs at  $\pm 15V$  and flow rate data are received and the calculated cold state flow rate ( $Q_c$ ) is the maximum flow rate during this period. The following 5 seconds is the break time.

From the tenth second onward, the pump runs by increasing the voltage linearly from  $\pm 10V$  to  $\pm 17V$  during the following 35 seconds and then keeping at  $\pm 17V$  for 10 seconds. And, the data are taken and the rising time ( $RT_{300}$ ) is calculated for the pressure from 0 to 300 mmHg and the maximum pressure ( $P_{max}$ ) is also obtained. If the  $P_{max}$  reaches 330 mmHg underway, the pump will be off and the falling time ( $FT_{15}$ ) is calculated to finish the whole procedure. The  $FT_{15}$  is the time for pressure from the shutdown value to 15 mmHg.

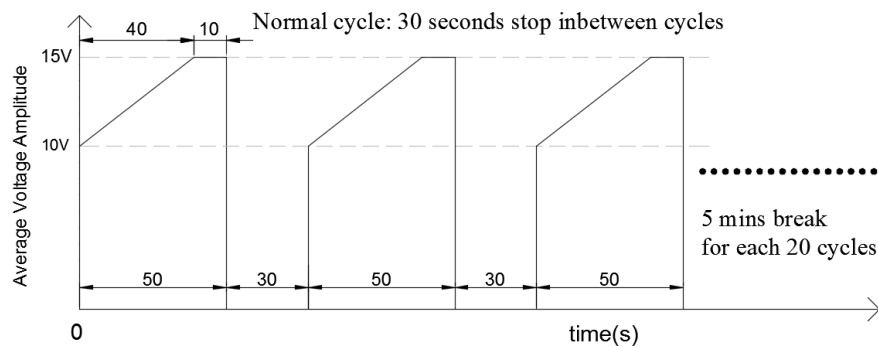


OQC test or PR curve and PQ curve measurement



## (II) Life Test (over 10,000 cycles)

The pump is able to pass the 10,000 cycles life test under the procedure curve shown below. The procedure comply with the maximum voltage and maximum power input limit of the normal usage restriction.





# APGS7SW

## Piezoelectric Micro Air Pump

### Features

- Small size
- Flat shaped
- Silent running
- Resonant operation around 26-29 kHz
- Low power consumption
- High flow rate
- High pumping pressure up to 300mmHg (40kPa)
- Low driving voltage
- Unique patented actuator design
- Light weighted
- Instant start and stop (compare to solenoid pump)
- Duty ratio operation accessible
- Pressure release check valve included
- Long life at least 10,000 cycles

### Description

The APGS7SW is a high performance piezoelectric air pump. As shown in Fig.1 and 2, it is capable to generate a high flow rate up to 90 ml/min and pressure above 300 mmHg consuming low power as Fig.3 and 4 shown. The unique design of the piezoelectric actuator is robust as well as durable. The actuator is driven around 26-29 kHz, which assures its silent running. Its small size, light weight and flat shape make it accessible to be built in the wearable or portable devices.

The APGS7SW consists of the core module and the casing module. The dimensions of the core module excluding the lead are only 12.8×12.8×1.3 mm (L×W×H), and casing module can be customized to serve different purposes.

## Applications

■ Blood pressure device    ■ Smart watch    ■ Wearable device    ■ Portable device

## Maximum Ratings

|                            |                                                                                                                                                                                                                                                     |
|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Storage Temperature        | - 20 °C to 70 °C                                                                                                                                                                                                                                    |
| Operating Temperature      | 0 °C to 40 °C, see also Fig. 10 and 11 in page 9 and 10.                                                                                                                                                                                            |
| Maximum Driving Voltage    | Short-time running : $\pm 17\text{V}$ (34Vpp) or a little more depends on environment temperature<br>Long-time periodic running (90s on/ 90s off) : $\pm 15\text{V}$ (30Vpp)                                                                        |
| Operating Frequency        | 26.0 to 29.0 kHz (Auto tracking by BX2R PCB as page 13)                                                                                                                                                                                             |
| Maximum Inflation Pressure | 320 mmHg, pump driver shall reduce voltage to assure long life as the pressure running over this maximum value.                                                                                                                                     |
| Maximum Power Input        | (1) 1400mW, short-period (below 10 seconds) as if the last period in voltage-rising running of the OQC test procedure.<br>(2) 600mW, long-time time periodic running (90s on/ 90s off)<br>As power exceeds limit, pump driver shall reduce voltage. |

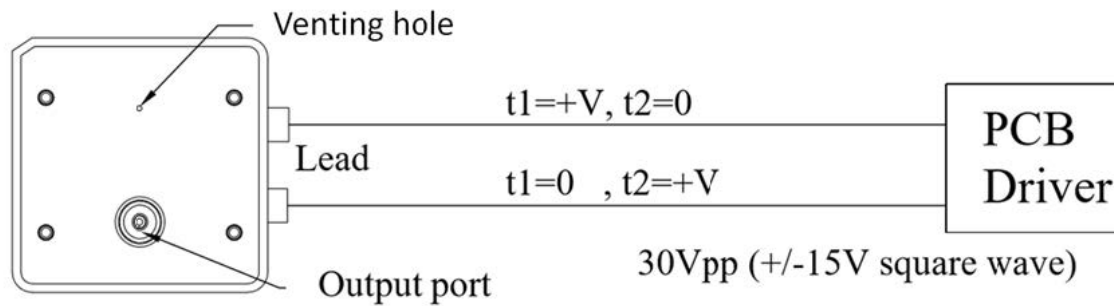
## Specifications

|                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|---------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Dimensions LxWxT (mm)<br>(refer to the Drawing also)                            | 15.2×15.2× 3.8 Max. (Port and Lead excluded)<br>Port length: 4.2 Max. (Type A), 2.2 Max. (Type B)<br>Port diameter: 1.9-2.7 Taper.<br>Lead length: 1.1 Min. (some with glue covered, 0.4 mm minimum exposed as the photo shown in the Drawing)                                                                                                                                                                                           |
| Maximum Mass                                                                    | 2.0g Max.                                                                                                                                                                                                                                                                                                                                                                                                                                |
| OQC Criteria, Test at 25°C<br>(Outgoing Quality Control, see OQC Test Sequence) | 1. $P_{\max} \geq 300$ mmHg (at $\pm 17\text{V}/34\text{Vpp}$ or less voltage)<br>2. $RT_{300} \leq 45$ sec. (Rising Time from P=0 to 300 mmHg)<br>3. $FT_{15} \leq 10$ sec. (Falling Time from P=300 to 15 mmHg)<br>4. $Q_c \geq 90$ ml/min (Cold state flow rate, Maximum flow rate before the first 5 second under $\pm 15\text{V}$ )<br>5. $W_{\max} \leq 1.4$ W (Maximum consumption at $\pm 17\text{V}$ )<br>6. Noise under 40 dBA |

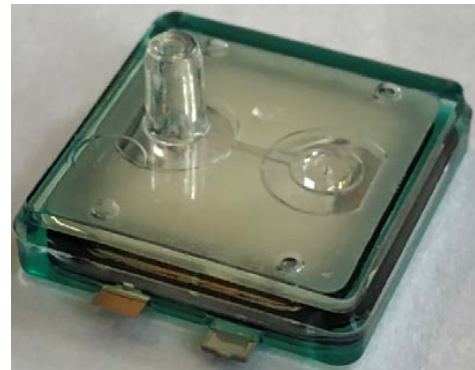
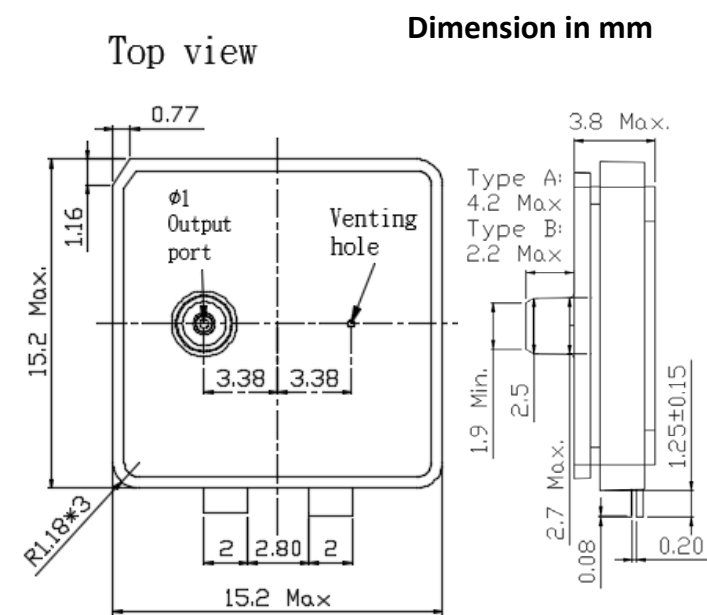
Note:

1. At the lower environment temperature like below 15°C, a little more driving voltage ( $>17\text{V}$ ) or time ( $RT_{300}$ ) is needed to meet specifications.
2. The 600mW input limit on the piezoelectric loading is recommended unless pumping to a high pressure only for a short period below 10s.
3. To drive over 15V, the pump has to be with a back pressure above 100 mmHg.

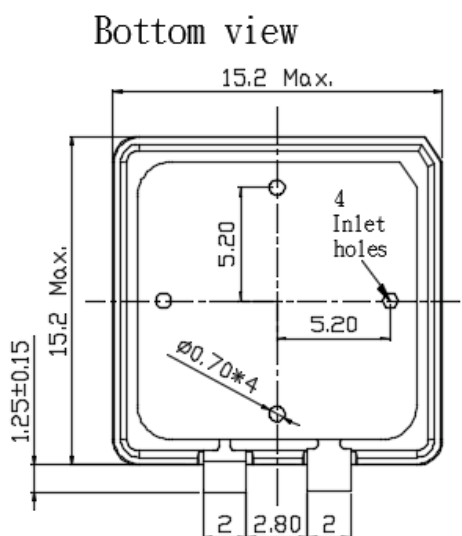
## Wiring



## Drawing



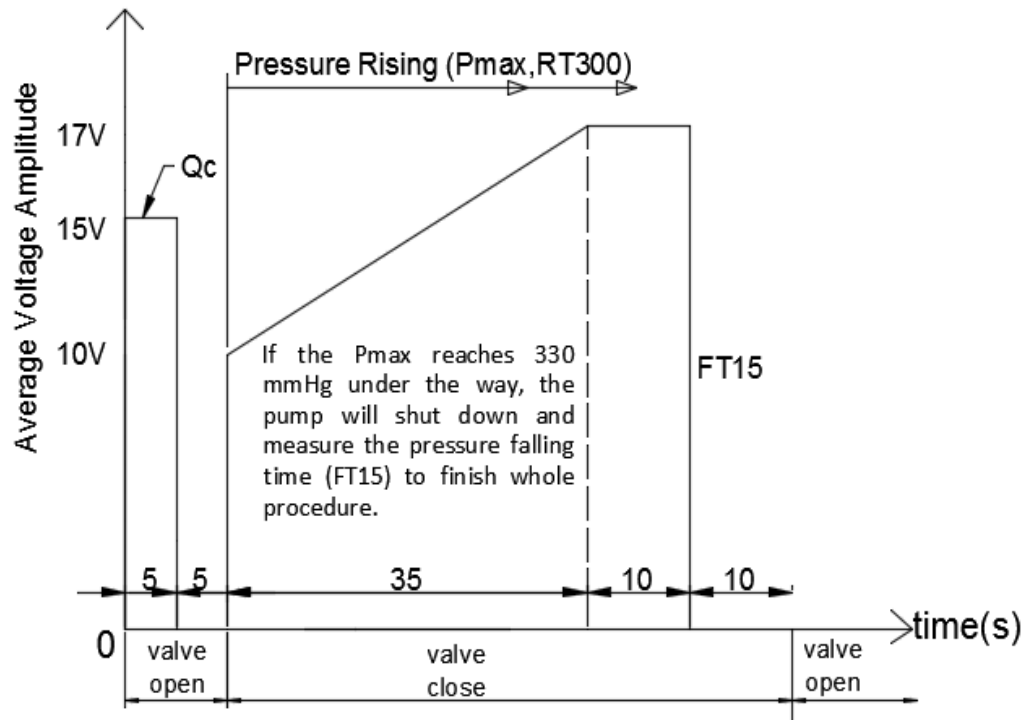
N version: Pump without wire  
W version: Pump with wire



0.4mm Min.

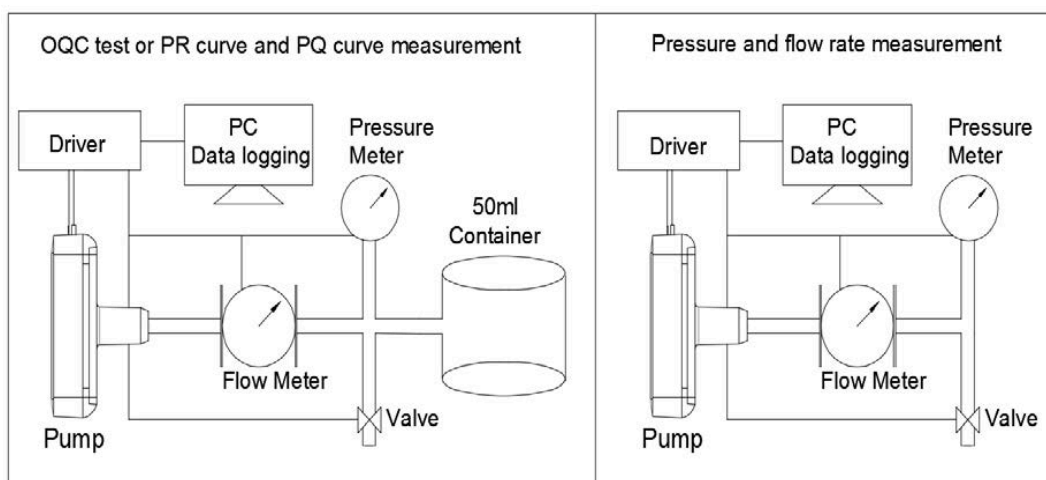
## Test Method

### (I) OQC Test Sequence/ PR curve (Rising voltage test)

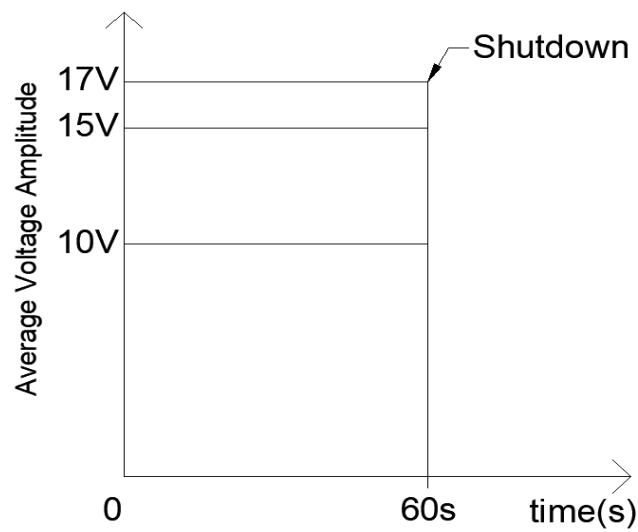


- (1) 0-5s: Keep 15V and measure the cold state flow rate ( $Q_c$ ) that is the maximum flow rate before the first 5 second.
- (2) 5-10s: Break.
- (3) 10s afterward:

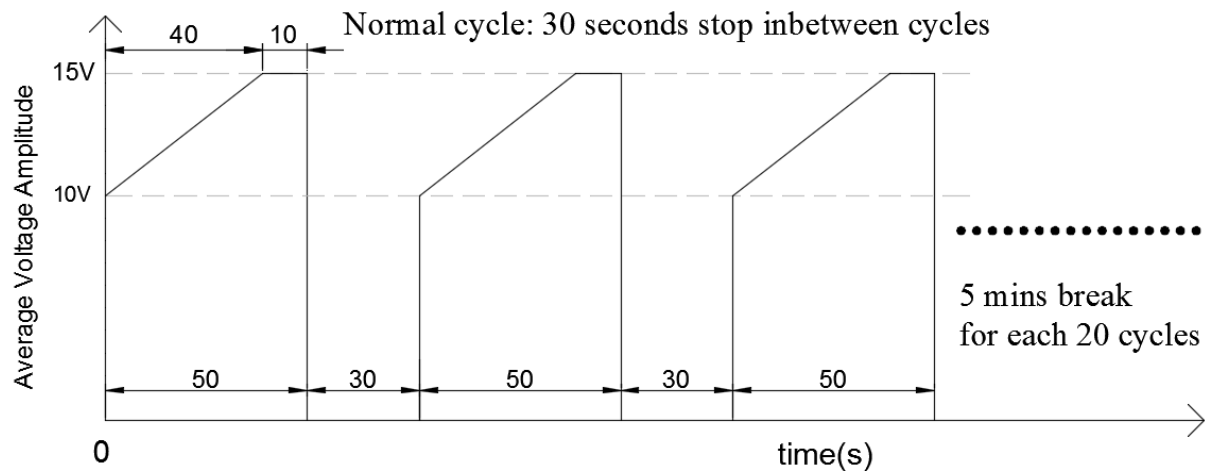
Increase voltage linearly from 10 to 17V during the first 35 seconds and keep at 17V for 10 seconds. Measure the rising time ( $RT_{300}$ ) for pressure from 0 to 300 mmHg and the maximum pressure ( $P_{max}$ ). If the  $P_{max}$  reaches 330 mmHg under the way, the pump will shut down and measure the pressure falling time ( $FT_{15}$ ) to finish whole procedure. The  $FT_{15}$  is the duration for pressure from top to 15 mmHg.



## (II) PQ Curve/ Flow rate/ Pressure (Constant voltage test)



## (III) Life Test (over 10,000 cycles)



## We are here for you. Addresses and Contacts.

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