On-Motion Press Release – For Immediate Release

The World's First *g*-Force Wristwatch Movement

On-Motion ltd. has developed the world's first *g*-force wristwatch movement. The brand new movement, *Analogue Watch Instrument* AWI-P-G6, bases on a standard Swiss made movement. The groundbreaking innovation integrates an acceleration sensor into a watch movement. This innovation allows measurement of *g*-forces from the user's wrist. This way the new movement will push pilot watches to a totally new era.

Picture 1, Pilot's *g*-meter watch

The movement bases on a 13-jewel Swiss quartz movement. The functions of the movement include: instant *g*, maximum *g*, hours, minutes, seconds and date. The movement has diameter of 12 ½''' lines, height of 7mm and weight of 12g including battery.

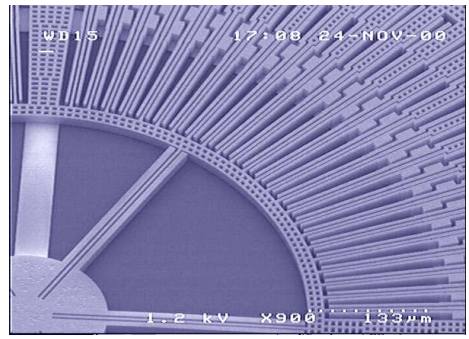
Target group

G-force is critical information to all aviation professionals, both civil and military. Normally, everything on earth is constantly under 1*g* force due to earth gravitation. Whenever an aircraft manoeuvres, e.g. accelerates, turns or yaws, the aircraft will be affected with a *g*-force different from 1*g*.

The military aircrafts have *g*-meters as a standard to measure the aircraft's stress load. However, many smaller civil aircrafts lack a *g*-meter and the case is even worse for sailplanes and gliders. The case is this even though every aircraft can bear only a limit amount of g-force. More importantly even though the aircraft could bear the force the pilot may not. A very fit person can bear a 5*g* stress for a while but still all the time risking an injury. By wearing a *g*-suit a pilot can bear even higher *g*-forces but even with a g-suit it is not without a risk of an injury. Research results indicate a clear need for personal pilot *g*-meter which would allow monitoring of each pilot's *g*-force stress history.

Measurement unit

In the heart of the measurement unit lies a three-axial micro-electro-mechanic (MEMS) acceleration sensor. MEMS accelerometers employ a technique called surface micromachining. Surface micromachining allows creation of mechanical structures in micrometer size.

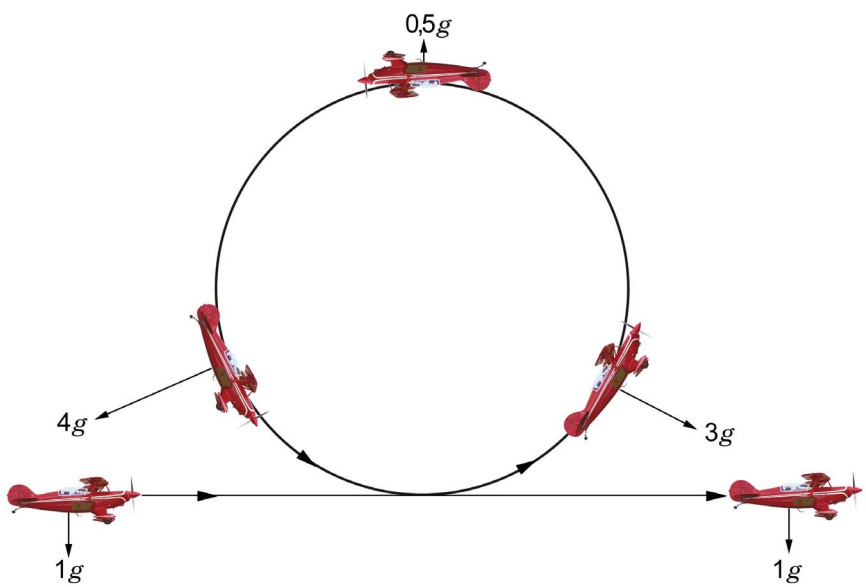


Picture 2, Micro mechanic surface

MEMS acceleration sensor's basic idea in one dimension is to spring balance a moving beam. Whenever there is force acting along the beam's motion axis the beam will move a distance relative to the affecting force and the spring constants. Now, it is possible to determine the force and the resulting acceleration using Hooke's law. (Hooke's law: F = -kx)

Measuring *g*-force

When measuring *g*-force with a device on pilot's wrist there are a few complications. The first one is obviously the fact that the pilot's hand will be moving. Therefore, the device's coordinate frame is not fixed. Therefore, it is impossible to separate the various sources of acceleration affecting the sensor. More precisely the sources are airplane, pilot and earth's gravity. However, it is possible to cut down the errors to minimum with intelligent filters and algorithms.



Picture 3, *g*-forces during an aerobatic loop

In addition to filters the measurement takes advantage of certain characteristics of the measurement environment. When considering *g*-forces in aviation it precisely means *g*z component of the affecting force in the aircraft's coordinate frame. Even though the sensor's coordinate frame is not the same as the airplane's coordinate frame concentration on *g*z component enables more accurate determination of acceleration sources.

Background of *g*-force symbol

The symbol *g* was used as a unit first in aeronautical and space engineering, where it is important to limit the accelerations experienced by the crew members of aircraft and spaceships: the " *g*-forces," as they are called. This use became familiar through the space programs, and now a variety of accelerations are measured in *g*'s.

aircraft's *g*-meter

The **acceleration due to gravity** denoted *g* (also *gee*, *g-force* or *g-load*) is a unit of acceleration defined as exactly 9.80665 m/s² (=N/kg), which is approximately equal to the acceleration due to gravity on the Earth's surface at sea level.

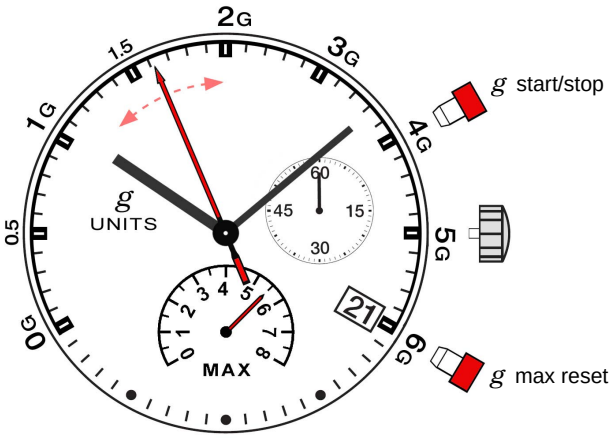
The symbol *g* is properly written in lowercase and italic, to distinguish it from the symbol *G*, the gravitational constant, which is always written in uppercase; and from g, the abbreviation for gram, which is not italicized.

AWI-P-G6 *g*-meter functions

The user interface of the AWI-P-G6 is very simple: Button1 starts and stops measurement and Button2 resets maximum *g* indicator.

While not measuring the big center hand is at 0*g*. The device starts measuring immediately after the user presses *start*. If the device is positioned statically the big center hand will climb from 0*g* to 1*g* due to earth's gravity. While measuring big center hand indicates instant *g*, i.e. the *g*-force currently affecting the sensor. The measurement lasts until the user presses *stop*.

In addition to instant *g* a small hand at 6 o'clock shows the maximum *g* measured since the last reset. The maximum *g* hand follows the instant g hand seamlessly. Whenever the instant *g* hand increases to indicate a value greater than the current maximum *g* the maximum *g* hand also steps forward.



Picture 4, *g*-meter functions

Picture 5, AWI-P-G6 Movement

AWI-P-G6 Movement

AWI-P-G6 movements are of standard calibre, 12 ½ ‘’’ lines, and fit into any standard analogue quartz case. Adhering to casing standards set the button positions and movement dimension. The further constraints involve the hands. The big center hand shows instant g and small hand at 6 o’clock shows maximum g.

Dial design is very flexible within the framework described above. 0g and maximum g positions are freely selectable within the hand resolution. Likewise, the g scale can be adjusted altogether.

Beside the g-function there are two more adjustable design issues. A running second can be included in a small hand at 3 o’clock or left out. Likewise, a date display can be included or omitted.

AWI Family

AWI-P-G6 is the firstborn of the AWI movement family. The future will see the whole family of movements. The fundamental idea in the heart of the AWI family is to integrate single carefully selected function to a watch movement.

The idea is that the function is well defined together with its application environment. Furthermore, the function is thoroughly tested and compared against other well known professional instruments. High quality is self-evident among AWI family and all these factors together bring ‘I’ to AWI.

Company

On-Motion Ltd. is a company where traditional watch making meets the latest technology and ice cold Finnish imagination. Kari Nyberg leading the team Valdemar Hirvelä and Seppo Sandberg innovatingly harness new technologies when Stepan Sarpaneva fosters all the finest watchmaking traditions.

Picture 6, Installed movement

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