maxon motor Australia Pty Ltd
Unit 1, 12-14 Beaumont Rd.
Mount Kuring-Gai NSW 2080

Tel. +61 2 9457 7477
sales.au@maxongroup.com
www.maxongroup.net.au

June 10, 2021

Press Release

Engineering DC motors for outer space.

Successful space missions require specialised equipment. Head of maxon Group's SpaceLab, Robin Phillips spoke to Suzanne Deffree at Design News about how to get DC motors just right for space travel.

Designing space-ready DC motors is a meticulous and complex process. Engineers need to account for extreme temperature fluctuations that persist for days at a time while operating during drastic changes in atmospheric conditions, where rotor blades cut through significantly fewer air molecules than in Earth's atmosphere, simply to maintain flight. Every component needs to accomplish numerous mission-critical tasks while also withstanding the harshest of conditions. A very high priority is placed on the DC motors and drives within the equipment.

maxon Group has more than 100 motors on Mars currently and over 20 years of experience working on successful missions to the Red Planet. Most recently, NASA launched the Ingenuity Mars Helicopter, which successfully took flight on April 16, hosting six specialised brushed DC motors from maxon.

On June 15 Robin Philips will be speaking at the event Virtual Engineering Days, a three-day online event for the global manufacturing community that looks at critical issues and trends affecting today's engineers. Robin will address how to design reliable DC motors and drives that offer greater precision while operating in demanding and harsh environments.

Suzanne Deffree at Design News spoke with Phillips, who shared a sneak peek into what attendees can look forward to learning about during his talk.

As the head of the SpaceLab at maxon, you are heavily involved in projects that demand heavy modifications for use in space. Could you walk us through your role and how maxon is driving innovation in space exploration?

Robon Phillips: My role is to use the experience I have gathered over the years from previous projects and my general observations of how the space industry is evolving, defining the kinds of products we offer as solutions for our customers. This involves both the development of new or modified motor and gearbox designs as well as the processes needed to build them. I ensure all the SpaceLab products are designed to a similar standard and that the build quality matches our customers' expectations. I think maxon's most significant contribution to innovation in the space industry is our catalogue of "COTS space products." For these, we have taken custom designs that we have developed for space agency applications (ESA, JPL, etc.) and then removed some of the customization, but retained the core modifications that enabled the designs to be qualified for the extreme environmental conditions and are now offering these at reasonable prices as catalogue products to the rest of the space industry.

Recently, NASA sent a maxon drive system to space. What are the no-fail design requirements necessary for motors to properly function during the brutal lift-off conditions and the six-month-long journey through space?

Phillips: The requirements can be classified into two groups: 1) Environmental compatibility, which includes things like vibration and shock resistance for rocket launches but also, and more difficult to achieve, compatibility with the wide temperature ranges due to diurnal (day/night) cycling 2) quality requirements on all the production processes (both for our suppliers and us) that are needed to ensure to the maximum extent possible that the motors are correctly built.

What are the primary challenges design engineers face in this highly complex and mission-critical industry, and what approaches does maxon take to overcome them?

Phillips: One of the biggest challenges is changing the mindset of the engineers designing these products. Most of the time, they will be working on industrial products where the aim is high quality but strongly emphasizes cost-efficient solutions since we are constantly under pressure to have the lowest possible sales prices. For space applications, since we are just a component supplier, the cost of our product is secondary as it is only a tiny fraction of the overall spacecraft cost. This means that things like the mass and dimensions and requirements for absolute reliability are much more important than the cost. This often leads to completely different design solutions – e.g. For an industrial solution, we might have two separate, easily producible components made out of different materials, which we then glue together.

For the space solution, we would worry about differential expansions of the differing materials and the reliability of the glued connection. This would lead us to design a single-piece part, which is much more expensive due to its complex shape. Getting the engineers to understand this difference and switch between the two mindsets depending on what project they are working on is the challenge. We generally tackle this by using the same design engineers or performing design reviews where an engineer with space product experience is involved.

You are a keynote speaker at the upcoming Virtual Engineering Days addressing "Motors in Space -To Mars and Beyond." What are a few learnings attendees can expect to take away from your keynote address?

Phillips: I will be giving a review of the history of Mars exploration so that the context of motors and the rovers they propel can be understood. I will discuss some of the design issues that we face to explain why we can't just use a standard industrial motor, then review how we use the experience gained in the Mars applications to develop lower-cost "space catalogue" motors for the wide variety of new space applications.

What excites you most about connecting with your community at the upcoming virtual event?

Phillips: As engineers, we are always most excited in learning about the applications our products are used in. I always say, somewhat "tongue in cheek," that motors are boring: they are just a cylinder with a shaft that turns – it is the applications that make the work interesting. Of course, the internal details are interesting to those of us that work on them, but this is how we want the motors to remain for our customers: boring cylinders, but with a shaft that they can absolutely rely on to turn when they power the motor on!

maxon motor Australia tel. +61 2 9457 7477.

Length of this update: 1018 words

The press release is available on the internet at: www.maxongroup.net.au

maxon

Robin Phillips, Head of maxon SpaceLab spoke about the DC motors used in the Perseverance Rover
© maxon Group

maxon motor Australia Pty Ltd
Unit 1, 12-14 Beaumont Road
Mt Kuring-Gai NSW 2080

Tel: +61 2 9457 7477
sales.au@maxongroup.com
www.maxongroup.net.au
Twitter @maxongroupAus

The Swiss specialist for quality drives

maxon is a developer and manufacturer of brushed and brushless DC motors. as well as gearheads, encoders, controllers, and entire mechatronic systems. maxon drives are used wherever the requirements are particularly high: in NASA's Mars rovers, in surgical power tools, in humanoid robots and in precision industrial applications, for example. To maintain its leadership in this demanding market, the company invests a considerable share of its annual revenue in research and development. Worldwide, maxon has more than 3000 employees at nine production sites and is represented by sales companies in more than 30 countries.

maxon