True to the original on a 1:14.5 scale
True to the original replicas of commercial vehicles not only gladden the heart of any model car collector but also find increasing use as simulation vehicles for high-quality industrial products – provided, that is, they match the form, function and technical specifications of the original as closely as possible. Producing a miniature version of the many complex functions and auxiliary devices requires the finest mechanical precision and expertise. Space in any model vehicle is just as tight as in the original, so designers are forced in both cases to come up with compact solutions. This is where brush-commutated microdrives come into their own. Their high, battery-saving efficiency ensures a particularly long operating time. The simple control system facilitates true to life, precise movements and allows them to be used as affordable training devices for drivers of the original vehicles.
High-quality, technically authentic vehicle models place special demands on material and technology. For one thing, the structural shape of the original has to be reflected as faithfully as possible in the model version, and for another the technical function often leads to compromises for logistical and physical reasons, in such things as the gear heads or hydraulic components. ScaleArt in the Waldsee district of the Pfalz region has risen to the challenge and produces trucks, front-end loaders and other models that not only look like the originals but perform the same way. In order to make these models move as realistically as possible in every respect, the precision experts work with microdrive specialist FAULHABER. Compact DC drives of various sizes and performance categories allow the models to move just like the originals.

In the field of drive technology, you have to focus on maximizing every millimeter and gram, without compromising the performance, high efficiency and simple operation of the model. FAULHABER drives are always the first choice for that. This is evident in the tracked loader: The chains are each powered independently which requires thorough training for the operators of such equipment. But training people on full-size versions of industrial equipment is very expensive and comparable with the cost of pilot training. Unlike training a pilot, however, on a very expensive simulator, the helmsman of a concrete pump, for instance, can be trained relatively inexpensively. Instead of positioning a 32-meter trailer with high fuel consumption on a suitably large site, a faithfully reproduced model can be used. All of the necessary processes can be operated via the original control unit. The model then performs the commands exactly as the original would to set the machine in motion.

Customized drives. The limited amount of power today’s batteries can deliver is a real killjoy for radio controlled models. Real driving pleasure requires the longest possible operating periods. Graphite-commutated motors with 78 to 85% efficiency are an optimal way to translate that limited amount of power into the desired motion. Depending on the kind of drive required in the model, the large range of standard motors in the product portfolio of the Schönaich specialists allows the right drive to be selected every time. Power ratings of 1.5 to over 200 W and shaft diameters of 6 to 38 mm support the realistic operation of additional functions and allow the vehicles to make powerful headway via the main drive. For instance, the hydraulic pump installed in many models adds a system pressure of around 17 bar. In the case of a digger or grader, this allows the bucket of the vehicle to lift up to 50 kg. These “power minis” are ideal for ancillary functions like extending the semi-trailer ramps of a flat-bed trailer, where pure power is not what is called for but instead compact dimensions and precise control.

One thing all the motors have in common is simple control of torque and output power via pulse width modulation. This allows users to adapt the motor to their particular technical needs via their own control modules. In the case of the models, this is essential to ensure all movements occur in a speed range appropriate to the scale of the model. In addition, this type of drive is highly efficient, tolerates fluctuations in supply voltage and can be designed to be very robust.

Putting fun to practical use. As fascinating as the models are for hobby collectors and model car enthusiasts, there are other uses for these miniature vehicles. The industry is increasingly working with more and more complex machinery, of one another by a 200 W motor, which enables them to “turn on a dime” or rotate around its vertical axis on chains moving in the opposite direction.

Further information
FAULHABER, Germany
www.faulhaber.com
ScaleART OHG, Waldsee
www.scaleart.de

Functional models that not only look the part but work just like their big brothers

Not only wheeled vehicles but also this tracked loader works with one drive per chain, making it as agile as the original

Compact construction is required for all components, like this gearbox with flange-mounted electric motor
Micromotors for electric field meters

The non-contact way to gauge voltage potentials

High electric voltages are required for many applications. However, they always involve a potential danger. Static discharges and high field strengths, for instance, can easily destroy electronic components. If a discharge is accompanied by a spark, flammable vapors may even explode. In view of these hazards, shielding and grounding are mandatory in many areas. On the other hand, the advantages of electrostatic charging are frequently exploited by state-of-the-art technology, e.g. laser copiers, electrostatic application of coatings, or flue gas scrubbing. In such cases it is important to know the actual amount of electric potential. In areas such as these, an electric field meter is the appropriate instrument. These handy devices are also equipped with miniature drives. As a result, field strength, and hence the applied voltage, can be determined on a non-contact basis without any distortion of measurements.
High voltages can be produced in many different ways. There is the "natural" charge separation, which occurs when rubbing surfaces against each other, when transferring liquids with a pump, or when exposing an object to radiation. Another method is the artificial generation of high voltage potentials for technical purposes. In all cases it is important to determine the strength of the electric fields. Electrostatic charges are very difficult to measure without actually influencing them. With this in mind, Kleinwächter GmbH, based in Hausen, Germany, developed a compact electric field meter for precision measurement.

Measuring principle. Designed along the lines of an electrostatic generator, the meter is designed specifically for non-contact measurement of electric field strength. A rotary shielding vane temporarily prevents the penetration of the measuring instrument by the field. In this way, the field hits the measuring electrode at regular intervals; electrostatic induction thus generates an alternating voltage. What is actually measured is the alternating current proportional to it.

Applying this principle, it is possible to measure electric charges and fields without removing energy from them. Since field strength $E$ is measured in volts per meter at a known distance (d), the instrument uses the figure to calculate the voltage ($U=E*d$). If the phase angle of the voltage generated by electrostatic induction is compared with the position of the impeller, the polarity of the voltage and the direction of the field can also be determined.

The user-friendly instrument, which comes in an antistatic plastic housing, can cover a wide span of voltages in five measuring ranges. The ranges are measuring distances of 1, 2, 5, 10, and 20 cm. For example, at a distance of 1 cm it is possible to measure a voltage of 0 to 10 kV, while at a distance of 20 cm one can measure 0 to 200 kV. For use in inaccessible locations the display can also be frozen and read afterwards. The digital display shows the selected measuring distance at the top and the measured charge at the bottom. The high zero-point stability of the measuring principle makes it possible to dispense with the otherwise customary procedure of zero-point balancing. The instrument is only 122 x 70 x 26 mm in size and weighs approx. 130 g. An extended version of the instrument provides additionally an analog voltage output, ±1 V. As a result, measurements can also be subjected to further processing on a PC, with the aid of the A/D converter UAC 110. Power is supplied by a 9 V rectangular battery. To allow longer operating times with the limited power supply of the battery, all the components of the field meter must be optimized for minimal power consumption. This particularly applies to the drive motor for the impeller. To drive the shielding vane in the new electric field meter, Kleinwächter soon found a suitable motor in the extensive product range of FAULHABER.

Small, light, efficient. The selected Flat DC-Micromotor is scarcely 6 mm in height, not including the shafts, which saves space for integration into the head of the measuring instrument. The net diameter is only 15 mm. The DC motor features precious metal commutation and is ideal for use in devices operated by rechargeable batteries. Depending on the power supply of the device, motors can be used with an operating voltage of 3 V, 6 V, or 12 V. The level of efficiency is 67% and that extends the operating time per battery charge. Idling speed is around 12,000 rpm. With its plastic housing the motor weighs only 4.3 g. Depending on the voltage version the power output is between 0.15 W and 0.22 W. As a Flat DC-Micromotor, the speed of the motor can easily be controlled via the supply voltage. Another advantage of these miniature motors is their low starting voltage and easy start-up even after a lengthy period of non-use. Consequently, it is also possible to safely operate measuring instruments that are not used on a regular basis. If the standard version does not optimally match the particular application, the drive can be customized accordingly. In addition to the mounting plate, the armature shaft can be adapted to suit special requirements. The shaft then projects at both ends of the motor; through it the impeller charge essential for measurement is supplied via the motor from below.

Nowadays, state-of-the-art DC miniature drives are suited for a very wide field of applications. They range from measuring and control equipment and simple actuators to precision instruments. Sturdy, long-life design, simple control via operating voltage, and good electromagnetic compatibility enable use in sensitive measuring instruments or medical equipment.
Ocean-floor seismometer

With a combination of high torque density and precision motion, compact stepper motors provide full 360° of correction for instrument tilt.
Geophysicists depend on seismometers to monitor earthquakes generated by the motion of the tectonic plates that form the Earth’s crust. In order to function, the instruments need to be leveled prior to operation. That’s easy enough for a device deployed on dry land, but when it comes to seismometers placed on the ocean floor thousands of feet below the surface, the process gets a bit more challenging. To solve it, Nanometrics Inc. (Kanata, Ontario) combines sophisticated gimbals and microprocessors, along with ultra-reliable, efficient stepper motors from FAULHABER.

At its simplest, a seismometer consists of a frame that moves with the underlying rock, a pendulum that essentially acts as an inertial mass, and electronics that track the displacement between the two. Nanometrics seismometers feature three inertial masses aligned on orthogonal axes to allow the instruments to measure in three dimensions.

Broadband seismometers typically use some form of inverted pendulum, in which a spring, rather than gravity, provides the restoring force. Inverted pendulums aren’t self-centering; they need to be balanced.

Ocean-floor seismometers operate several kilometers below the surface, far deeper than practical for cables. Instead, the battery-powered instruments operate in isolation for the duration of an experiment, which can last as long as a year. After, they’re brought back to the lab for analysis – and only then do users know whether they worked.

The ships that deploy and retrieve ocean bottom seismometers are very costly, so you need to be absolutely sure the sensor will perform perfectly every time. Reliability is only the start of the requirements. Researchers place ocean-bottom seismometers by attaching them to a weighted sled and letting them sink to the ocean floor, a process that can take hours. At the bottom, they land on an arbitrary, often muddy surface with unknown local topography, and the leveling process begins. For undersea applications, conditions tend to be thermally stable, but mechanical tilt can be both extreme and dynamic. As a result, the mechanical leveling system needs to be able to right the sensors even when the instrument comes to rest upside-down.

The three axes of the Trillium Compact OBS (seafloor) and Compact All-Terrain (dry land) are rigidly attached to each other so that the system levels the platform as a whole. To provide a broad range of adjustment, Nanometrics mounts the seismometer in a motorized gimbal. The inner frame rotates the instrument around its own axis, then the outer frame rotates the instrument with respect to the case. Accelerometers on the seismometer and case determine the degree of tilt, then the microprocessor commands the motors to adjust the position as required, fully leveling the system in 20 minutes.

The positioning mechanisms need torque in order to level the instrument payload. Normally, the easiest way to increase torque is to choose a larger motor or a combination with a gear with appropriate reduction ratio. The problem the engineering team faced was that the design was space constrained, but choosing a larger motor wasn’t an option. The motor would have made the instrument a couple of centimeters bigger in diameter. A larger instrument would require a larger sled in order to carry the device to the seafloor, increasing weight and costs, as well as dimension. The team needed rugged, reliable, compact motors with high torque density, and MICROMO, the FAULHABER sister from USA, provided the solution.

The design incorporates two stepper motors from FAULHABER controlled by a microprocessor. The leveling algorithm uses the accelerometer readings to calculate the motor motions needed to level, but the final leveling result is checked using the seismometers themselves. Using a stepper motor for the motion task brings an important benefit of dependability.

The design transfers motion from the motor to the gimbaled seismometer using a worm gear, which yields a more compact, robust design. The gear also offers stability, even under exposure to shock and vibration. Worm gears cannot be back driven, for example, which protects the gearbox load. Next, the design team needed to integrate the worm gear with the gearbox. One obvious method was to tie the two together with a set-screw, but the motor shaft is just 2 mm in diameter. So this kind of fastening was not sufficiently reliable for the scientists. Together with the application specialists of MICROMO a way to weld a gear directly onto the gearbox output shaft was developed. Receiving motors with a gear already integrated speeds and simplifies the assembly process for Nanometrics.

Further information
MICROMO, Clearwater, USA
www.faulhaber.com
Nanometrics Inc., Ontario, Canada
www.nanometrics.ca
Modern civilization cannot do without a working wastewater system. It is important that contaminated water makes its way safely to the sewage treatment plant. As many drainage systems and household pipe connections are now decades old, they often need to be repaired or replaced. Expensive repairs can be precisely planned and restricted to the affected areas by first conducting an underground video inspection. Microdrives facilitate complete mobility of the camera head of such inspection devices, ensuring optimal coverage of all sections of the drain and delivering a panoramic view to the camera operator. Compact dimensions are important for all components of the inspection system to ensure even narrow drains and thin pipes are properly checked.
Waste removal was and is an essential task for the survival of modern civilization. One such area is the underground sewage system, which is responsible for drawing off surface water and transporting wastewater to the sewage treatment plant. Any damage in this area can lead to both wash-outs and flooding of roads as well as contamination of the soil or groundwater. For this reason, many sewage regulations require drain inspections to be conducted at regular intervals. To take stock of the underground situation and check for any damage, the Kiel-based company IBAK developed a mobile inspection system with very compact dimensions, the centerpiece of which is a miniature telecamera. Drainage experts worked with FAULHABER microdrive specialists to come up with the ideal configuration. Several tiny motors with transmission attachments now move the camera so that the operator can view the system from any angle.

Estimates suggest the true total in Germany is closer to 1 million km of drainage. All of these underground pipes and channels are subjected to several different pressures at the same time: “interior assault” or corrosion, due to chemical and biological reaction of the water with the pipe walls, and external impacts such as traffic vibration or ground subsidence. There is also interference from tree roots causing damage to the seals, or cracks in walls that can make even the strongest pipe walls burst. Sooner or later this leads to major disruption to traffic above ground. The more accurately the extent of the damage can be identified and localized in advance, the better any repair work can be planned and carried out. With the help of IBAK inspection systems, it is possible to have the camera travel the full extent of the sewage systems, checking and documenting the condition of all pipes and components along the way.

**On-site controller.** In addition to the requisite telecamera, a modern inspection system normally comprises a carriage that allows the camera to make its way through the pipes. To illuminate the visual field, IBAK cameras also have an integrated lighting element. For use in pipes with large diameters, IBAK offers additional headlamps that have greater reach. As well as lighting, plenty of electronic sensors form part of the “on-board” equipment; they help determine the route to be taken through the underground pipes, in addition to providing objective measurement of any objects viewed along the way. A camera cable up to 500 meters long is used to supply the necessary power and data transmission. It connects the inspection system with the above-ground control terminal. Apart from this hardware, the inspector also requires extensive software so that the readings and images generated by the sensors can be accurately received and evaluated. The essential feature of any components used in underground drains is compact dimensions and a high degree of reliability. In the case of the ORION camera profiled here, this means the compact camera head must be able to move in all directions. The “neck muscles” to enable such 360-degree dexterity come from the three gear-motor units of the product range of FAULHABER. One motor is responsible for activating the (constant) turning motion of the head, the second performs the camera panning action and the third works as the focus motor to ensure the images are crystal clear. All three drives work independently of one another. For instance, whenever the operator has the video head pan up and down, the entire headpiece is also able to rotate around its longitudinal axis at the same time to reveal the contents of the whole pipe from all angles.

**Small yet perfectly formed.** The rotary drive moves the entire camera head. It uses a 12-mm-diameter motor with metal casing operating at around 0.5W and 6V. As a stainless steel, commutated DC motor, its speed is easily controlled via pulse width modulation (PWM). A 10-mm planetary gearhead with a reduction ratio of 256:1 scales back the overall speed and increases the output torque. Preloaded ball bearings minimize the play and allow for continual movement, which is very important for shudder-free filming. The swivel drive and focus are each run by an 8-mm-wide motor with a suitably compact gearhead. With around 0.2W power output and a reduction ratio of 1024:1 these drives facilitate delicate swiveling, panning and focus settings. Here, too, the emphasis is on precision and versatility. After all, the camera can only take as good an image as the angles set by the operator allow. Despite its tiny dimensions of no more than 8 to 12 mm, these motors work with an efficiency rating of more than 70% and 50% respectively. Compact, stainless steel, commutated DC motors combined with suitable gearheads offer ideal adaptation of the output speed to each particular use. The operator can also easily control the torque via simple pulse-width modulation. Preloaded, lightweight and long-life ball bearings in the motor and gearheads enable sensitive, smooth movements at rates of 0 revolutions per minute upwards. It means these miniature powerhouses are ideal for even the most demanding of tasks, where high continuity of speed or exact positioning is paramount.

Further information
FAULHABER, Germany
www.faulhaber.com
IBAK Helmut Hunger GmbH & Co. KG, Kiel
www.ibak.de
Market demand will determine serial production of what is technically feasible

The current and future limits of micro-actuation

The definition of “micro-actuation” is not entirely clear. On the one hand it is generally understood to mean drive and propulsion mechanisms that can be precisely positioned within the micrometer range. Some tried and tested solutions have been on the market for many years now, but they are constantly being improved. These include piezo drives, hexapods and stepper motors with proven micro-step operation. However, the same term is also used to describe very small actuators with components and parts measuring a few 100 micrometers. The latter differ somewhat from the rest due to the technology used. A distinction is made between micro-actuators that can be produced micro-mechanically and those manufactured using a lithographic masking technique (similar to that used for semiconductors), whereby the individual components are etched out of a basic structure.
Manufacturing problems largely solved. Both forms of microdrives with small mechanical dimensions can be manufactured with a good degree of reproducible consistency. Intensive research in these fields over the past 15 years, particularly in purpose-built research units has had a significant effect on advancing the technology involved to the point that excellent results can now be achieved in this field.

Feasibility, however, and usage in industrial practice are two different things. A drive, in the original sense, serves the purpose of moving a load along a certain pathway. Drives with dimensions of about 1 mm or less can naturally only generate infinitesimal torque and force. The forces and torques produced are often so minimal that overcoming their own internal friction forces and frictional torques is an immediate problem.

By comparison, drives manufactured in the 2 to 5 mm range produce enough force and torque to master real propulsion tasks. More and more applications are now gradually emerging for such drives. The most common examples of practical industrial use are currently to be found in the field of medical devices for minimally invasive surgery and diagnostic tools that can be used in the human body, such as heart catheters or X-ray capsules. But optometry is also a field where microdrives are proving their worth – in such devices as laser beam systems.

Basic conditions are a barrier to market demand. The key to further development and more widespread dissemination of microdrives is existing user demand. Without it, these drives will not be further enhanced or find a wider market. In other words, applications are needed which rely on very small mechanical drives and cannot be realised without such microdrives.

It is only the technology pull or market demand that will ensure microdrives make their way into industrial applications. As already mentioned, the technology has been around for some time to produce these microdrives, but without the right technology push or a concerted effort to bring an existing and accomplished technology to market, it simply will not work.

In addition, the popularity of microdrives will be slow to develop due to the prevailing conditions. Customers for such drives must first learn how to handle them. In order to work with microdrives, a different environment from that of drives with conventional, familiar dimensions is required. It starts with entirely different measuring technology and includes the fact that working with micro-actuators requires a much higher standard of cleanliness in the operating environment, such as flow boxes or even a clean room. More highly qualified staff are needed and particular care has to be taken in dealing with incoming goods inspections. These few points alone illustrate how much effort and change is required of anyone wanting to work with microdrives.

As I see it, microdrives in the 2 to 5 mm range will be used in the next five years in many different areas, but uptake of even smaller actuators is unlikely in the industrial sector from today's perspective. This means the market for microdrives as a whole will develop at a relatively slow pace. However, the high sales potential predicted many years ago, when the technology was brand new, can still be achieved. The spread of micro-actuators is interestingly not a matter of technology – we can already do much more than we need to – it is more a matter of the feasibility of applying this technology to industrial uses.

Further information
FAULHABER, Germany
www.faulhaber.com
The most compact of its range

**Brushless DC-Servomotors Series 1218 ... B**

The new Brushless DC-Servomotors series 1218...B complements the current 12 mm product range with a new 18 mm length. This new Series is designed to address applications where compactness is a key requirement. This 1218...B series implements highly dynamic characteristics and extended lifetime specific to brushless technology.

- Short length of 18 mm, ideal for compact size applications
- Continuous torque up to 0.8 mNm, speed up to 60 000 rpm
- Temperature range –20...+100 °C
- Long lifetime
- Ideal for combination with planetary and spur gearheads.

Robust stainless steel design

**Planetary Gearheads Series 15/10**

New 15/10 precision gearheads are able to meet high-performance requirements in a minimum space. Through the use of state-of-the-art materials, FAULHABER has achieved new levels of performance and lifetime.

With an outer diameter of 15 mm and intermittent torque capability of 500 mNm, the 15/10 series is available with a large range of reductions ratio from 3.33:1 to 1.367:1. The range includes gearheads with sintered sleeves or ball bearings.

- Continuous torque up to 350 mNm
- Up to 30 standard reduction ratios
- Temperature range –30...+100 °C
- Ideal for combination with DC-Micromotors and Brushless DC-Servomotors
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FAULHABER MINIMOTOR SA

50 years of innovation

FAULHABER MINIMOTOR SA is based in Croglio, Malcataone (Switzerland). It may be surprising to know that the Ticino-based company founded in 1962 by Dr. Fritz Faulhaber and Hans Stüssi is a product of chance – Fritz Faulhaber, a German entrepreneur who founded a workshop for precision engineering in 1947 in Schönaich and made a name for himself in the sector by developing the skew-wound ironless rotor coil, had his secondary residence close to today’s head office.

On September 14/15, 2012, the company celebrated its 50th anniversary together with business partners and employees. The festivities actually began in the months before, where employees had the chance to visit the parent company in Germany and to attend the summer party. The invitation was reciprocated by the site in Croglio at the end of August. The open day in September attracted over one hundred customers and Swiss-based suppliers who were able to visit the production departments and the research and development unit. In doing so, visitors had the opportunity to get better acquainted with the extensive range of products manufactured and marketed by FAULHABER MINIMOTOR SA. By way of entertainment and to provide a taste of the company’s diverse applications, visitors were also treated to a whole host of performances involving robot technology such as an electronic football game designed to challenge FAULHABER drives.

The potential target market is extremely wide-ranging. Miniature drive systems are used in a vast array of applications – The target segments for FAULHABER products, tend to be high-tech applications, for which precision, durability in a small space are decisive.

Hungary location

FAULHABER Motors Hungaria celebrates 15th anniversary

Originally established in 1997 by Ferenc Iker, Ikertechnika Kft. Hungary was merged into FAULHABER Motors Hungaria Kft. in 2004. The company initially operated solely as an assembly and production site with a focus on coil technology and the manufacture of both brush and brushless Flat DC-Micromotors. Over the years, however, FAULHABER Motors Hungary Kft. steadily evolved into a high performance supplier of end to end solutions for all companies within the FAULHABER Group – as a manufacturing and process specialist.

In 2006, the company built a new extension for the purpose of expanding its production and administration premises to 12,600 m². In close cooperation with FAULHABER’s headquarters in Schönaich the entire infrastructure was transformed into a sophisticated, highly automated unit that is capable of handling every aspect of the process chain from engineering services required in product development through to manufacturing operations using systems and equipment developed and made by the company itself.

At present, the company employs 150 people at its plant in Albertirsá. The site is responsible primarily for producing and assembling industrial thin profile motors from the FAULHABER portfolio as well as for developing customized drive solutions based on Flat DC-Micromotor technology.
At the official opening of the company’s new premises, Dr. Bertolini, the Administrative Board Chairman of Rolla Microgear AG, described it as the jewel in the crown – not just because it had weathered the financial crisis of the past few years but more importantly because CEO Philippe Nicotera had announced two years ago that Rolla Microgear – a specialist in micro gear solutions – was actually on a growth course. Its success is primarily due to its focus on production for the medical, optical and mechanical engineering sectors, as well as the needs of the aerospace industry. As a result, the company’s headcount of 19 in 2010 has now increased to 27. Rolla Microgear purchased its new premises, boasting 2,850 m² in floorspace, back in 2011. Dr. Fritz Faulhaber, CEO of the FAULHABER GROUP, traveled from the US to attend the opening ceremony and applauded the performance of the production business – particularly in view of the strong global competition in the sector. Guest speaker, city mayor Boris Banga, was also in good spirits: “I am delighted you have chosen to retain this Grenchen location, which is probably the most important place in the Canton.” After the ceremonial cutting of the ribbon, the invited guests relished the opportunity to take a guided tour of the new premises in Lengnaustrasse.

Environment

Certificate EnBW Comfort Nature

For the protection and preservation of natural ecosystems, FAULHABER continues its consistent policy of improving its environmental balance. With this EnBW Comfort Nature certificate, TÜV Nord certifies that the Schönaich location uses 100 % emission-free and renewable electricity from hydropower.

The electricity is produced in certified hydropower plants. This is periodically examined and confirmed by TÜV Nord. The certificate underlines the active contribution of FAULHABER to sustainable environmental management and the responsible use of natural resources.
Higher power in small volume

FAULHABER DC-Micromotors Series 0816…SR
The new 0816…SR DC-Micromotor delivers first class performance in the 8 mm diameter range. This new product series provides continuous torque up to 0.7 mNm and ensures an optimal behavior among different load conditions through a superior speed-torque characteristic. These DC-Micromotors are the perfect fit for highest demanding applications.

- Various nominal voltages available: 3 V, 6 V, 9 V and 12 V
- Continuous torque up to 0.7 mNm
- Speed/Torque curve 11 200 rpm/mNm
- Combination with optical or magnetic encoders and with planetary, spur or low backlash gearheads

BEST IN CLASS!

Hagar the Horrible

ARE YOU GOING TO SPEND ALL DAY LIKE THAT?

NO