



Harmonic
Drive AG

Edition 1 | 2008



newdrive

The **Magazine** of Harmonic Drive AG

application ²

Maximum power
- well concealed



Trade fairs ³

Manufacturing & Electronics,
Manufacturing Technology,
Science Technology & Innovation

Project ⁴⁻⁵

Getting underway in
the Nano cosmos

application ⁶

At the top of the world's
international research

subsidiaries ^{7,10}
of Harmonic Drive AG

Team ¹¹

Growth in the South of Europe



development ⁸⁻⁹

When true greatness is a question of detail



The silent element: The drive unit of the Trolley Lift inconspicuously renders its services for 25 years.



Taking off with Harmonic Drive

maximum power – well concealed

Designing the reliable drive unit for a conventional lift in a fixed building is generally not really a challenge. But if that lift is intended to unobtrusively provide the maintenance-free supply line between the various decks of the new Airbus A380, the engineers see themselves faced with an extraordinary challenge in the specifications involved.

For example, the lift must work in a comparably soft environment, which can be subject to deformation due to the inner pressure of the aircraft or due to extreme flight loads. This sets high demands on the rigidity of the structure, which must cope with more than four times the acceleration of gravity. The required optimisation of weight and the extension of the temperature range are obligatory in aviation engineering. But that alone is not sufficient in this case, as the lift is also intended to work as silently as possible – after all, there are passengers on board.

Harmonic Drive AG has developed a gear system for use in the A380, which fulfils all these requirements. To do so, we have modified existing Harmonic Drive components to match aviation requirements. The entire gear system is then acoustically decoupled from the structure for noise minimisation. For this individual solution we are now able to verify the maintenance-free function over the entire service life of more than 25 years or more than 150,000 flying hours.

The smaller size of our solution requires less space to comparable constructions, whereby we were able to stay below the set cost limits – a much appreciated feature amongst our customers.



The trolleys are transported back and forth in the A380 at two points between the middle deck and the upper deck.



Science Technology and Innovation 2008

BNFL Risley, Hinton House
25th September 2008



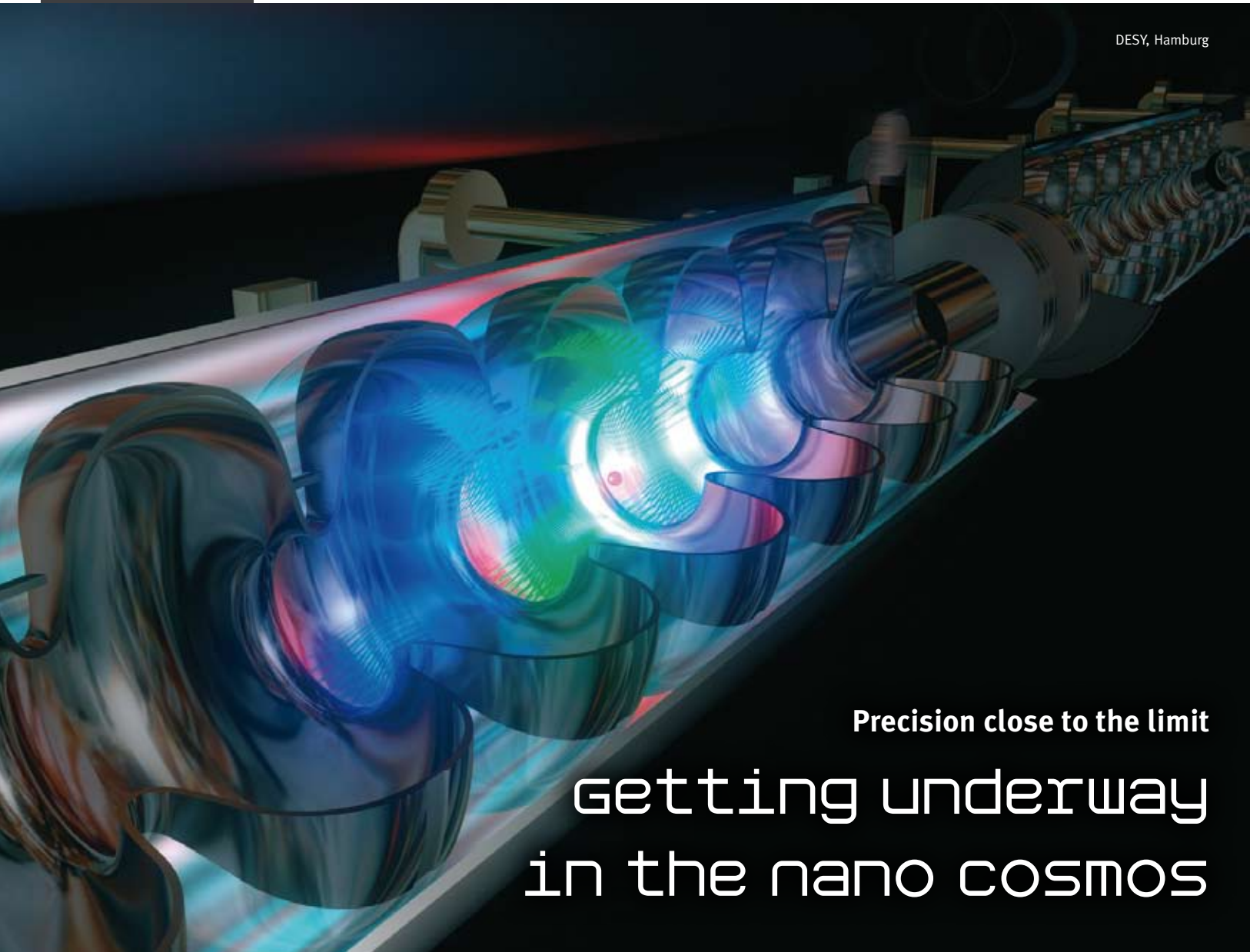
Ekrem Sirman
Chairman of the Board
of Harmonic Drive AG

At the beginning of this year, the management structure of our company changed. In the special edition of newdrive in December 2007, Reinhard Ernst – majority shareholder through Interglobal Industrieholding and Board Chairman of Harmonic Drive AG up to the end of last year – described the impressive development the group in detail. Over a period of 37 years he had a major impact on the history of Harmonic Drive AG and led the company to success. As of April he takes on the position of Chairman of the Supervisory Board, which will allow him to continue to be involved in shaping the future of the Harmonic Drive group of companies.

On January 1st, I myself took on responsibility as Board Chairman, sharing this position with Masanao Kobayashi, who is responsible for the areas of production, logistics and IT. In this issue we report that single power of attorney has been assigned to each of our experienced colleagues Thomas Berger, Dr. Matthias Mendel and Bernd Wittmann so that they will be able to provide support for the Board in future in the areas of entrepreneurial, technical and sales management.

In 2008 we are in a good position to achieve double-digit growth after a highly successful year in 2007. We stand to profit not only from the positive economic cycle but especially from the pleasing fact that more and more users are opting for our diverse range of drive solutions. You will find a number of interesting examples in this issue of newdrive.

I wish you happy reading!



Precision close to the limit

Getting underway in the nano cosmos

Harmonic Drive gears are renowned for their trouble free function under the most adverse environmental conditions. So searching for sophisticated solutions belongs to the everyday tasks of the specialists at our Harmonic Drive Development Centre. And yet there are still applications beyond the norm. For example the European X-ray laser project XFEL (X-ray free-electron laser), in which the well known Research Centre DESY in Hamburg is intensely involved (see top right for more information), and which will start operations stage by stage from 2013.

The planned X-ray laser, with a tunnel length of 3.4 kilometres is the longest artificial light source in the world and will stretch from Hamburg-Bahrenfeld to Schenefeld near Pinneberg. There the X-ray laser flashes will be received and used for research purposes. The unique Y-ray laser flashes of the XFEL are intended to open up new scientific experimental possibilities. Because the XFEL will not only be the longest artificial light source in the world, but also one of the strongest sources of X-ray radiation, much larger and stronger than conventional X-ray

radiation. This not only makes it possible to film chemical reactions, but also to decode the smallest atomic details of molecules. It pushes the door to the Nano cosmos that bit further open and provides three-dimensional pictures not previously known. Top researchers from all over the world are waiting with baited breath for the XFEL to be put into operation, as more than 15 years of work have gone into its development.

This technology plans to accelerate electrons using electro-magnetic fields to almost the speed of light, before they are stimulated to issue X-ray flashes. Acceleration takes place in special elements, so-called resonators, the particular shape of which ensures that the electrons meet the stringent requirements specified by the required obligatory high quality of the XFEL X-ray laser flashes.

These resonators are cooled down to two Kelvin (-271°C), so that supra-conductive acceleration can be activated. And that is where Harmonic Drive AG comes in: So that the resonators supply precisely the specified frequency, deformations caused by the extreme cooling down process must be compensated in order to obtain the reference diameter. A hyper-sensitive adjustment mechanism is used for this purpose, which continuously adjusts the resonators in the μm range to the exact dimensions which supply the required frequency. And exactly this adjustment mechanism is currently in the test phase with Harmonic Drive gears – the highest possible reliability is called for here. A necessary repair of defective drive units would have far-reaching consequences, as the entire system would have to be heated up to room temperature again in such a case. This would



not only involve immense operative effort, but also that fact that no measurements are possible during the entire repair period would result in the loss of valuable research time.

Hence, our developers had to make sure right from the material selection stage for the gear components, that the precise function of all components is guaranteed with absolute reliability despite the great temperature differences. For this reason we have only used stainless steels with very similar expansion coefficients, in order to achieve the compulsory adjustment accuracy of more than half a μm . Furthermore, the gears should be provided with a special coating, as all conventional lubricants no longer function at these extreme temperatures.

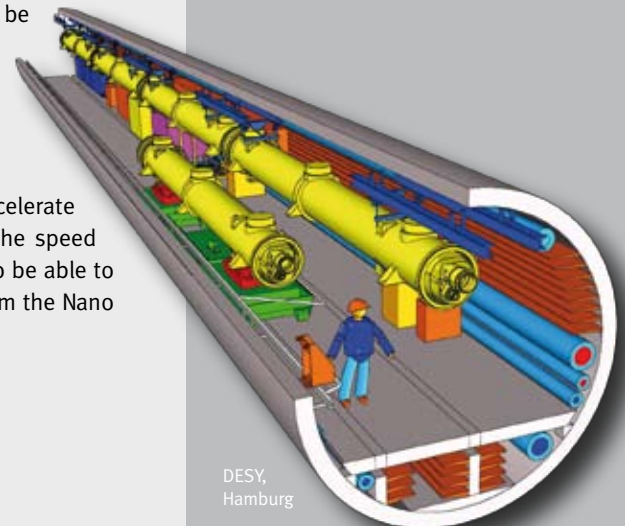
In about six years, XFEL will accelerate its electrons extremely close to the speed limit of the universe, so as then to be able to provide breath-taking pictures from the Nano cosmos.

Deutsches Elektronen-Synchrotron DESY

The »Deutsche Elektronen-Synchrotron« (DESY), founded by treaty in 1959, is involved in fundamental scientific research at both locations, Hamburg-Bahrenfeld and Zeuthen near Berlin. The three DESY core research themes are the development, construction and operation of particle accelerators, research with photons and particle physics.

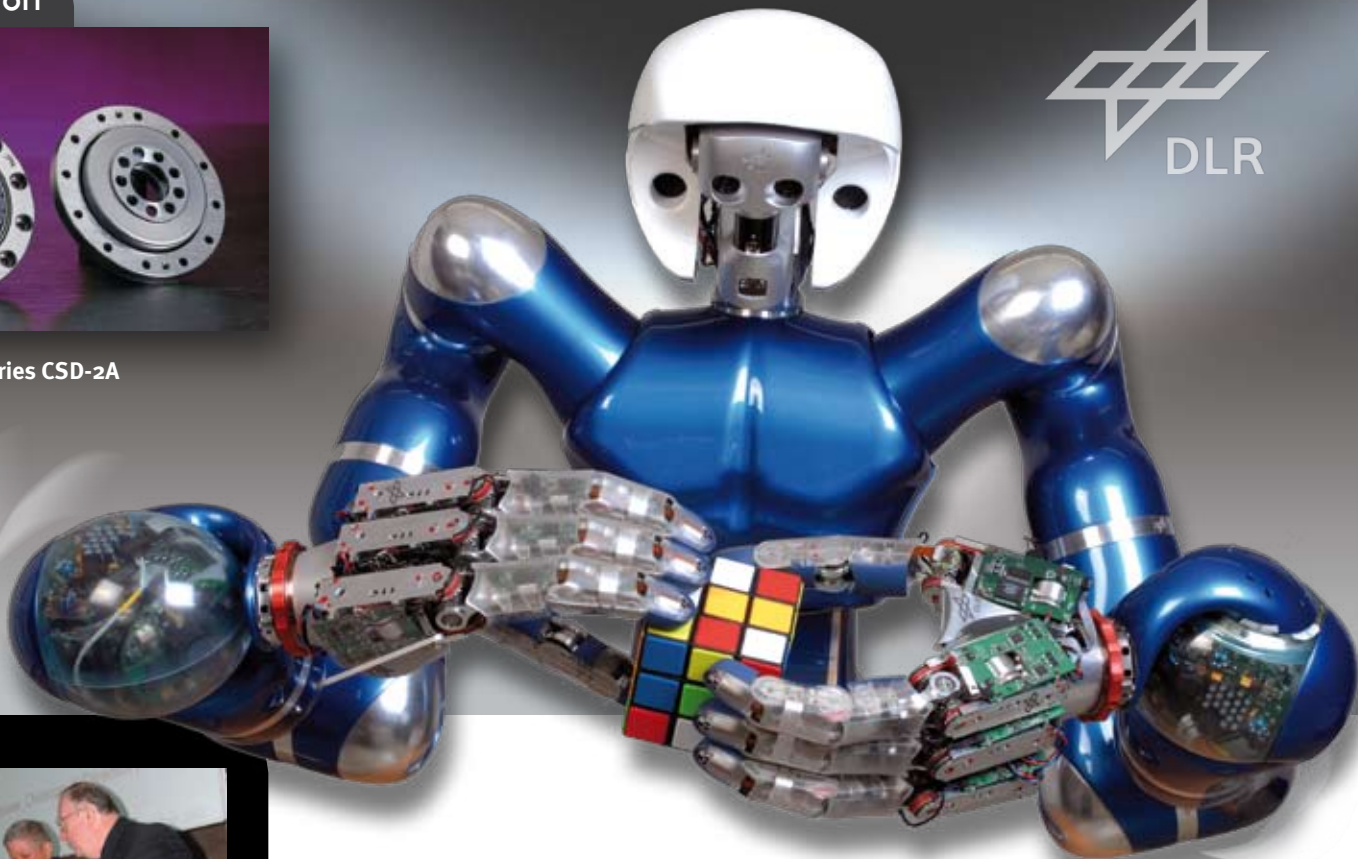
The Research Centre employs a 1900-strong workforce and works on a mainly international level. At present, approximately 3,000 scientists from more than 40 countries make use of the DESY systems.

The European XFEL X-ray laser system was developed and proposed by the DESY in cooperation with international partners. It will be built and operated DESY will largely contribute to the construction and operation of the unit, which will then be used by numerous research facilities and University institutes.





Installation kits, series CSD-2A



DLR Institute for Robotics and Mechatronics

At the top of the world's international research



Award in Rome:

At the »International Conference on Robotics and Automation« (ICRA) Prof. Dr.-Ing. Gerd Hirzinger (links), Head of the Institute for Robotics and Mechatronics at the Deutschen Zentrum für Luft- und Raumfahrt (DLR) (German Aerospace Centre), was the first European to be awarded then »IEEE Technical Field Award Robotics and Automation«. This prize is the highest award of the Robotics and Automation Society of the IEEE.

Experts agree: The Institute for Robotics and Mechatronics at the Deutschen Zentrum für Luft- und Raumfahrt (DLR) (German Aerospace Centre) is the global leader in the field of applied robotics research. Only recently, NASA Chief Michael Griffin, emphasized after his visit to the institute, that German robot technology is the world's best. This exceptional position has now been additionally underlined by a series of awards.

At the »International Conference on Robotics and Automation« (ICRA) in Rome, the Head of the Institute, Prof. Dr.-Ing. Gerd Hirzinger was the first European to be awarded the »IEEE Technical Field Award Robotics and Automation«, the highest award granted by the Robotics and Automation Society of the IEEE. The ICRA offers more than 1,000 researchers the possibility to exchange research results and is the most important of its kind world-wide.

»JUSTIN« (see above) also received an award. It embodies a fully new generation of robots,

which interacts with us and works very sensitively. The video documentation about »JUSTIN« received the esteemed »Best Video Award«.

Members of the Institute's staff received two first prizes at the European »EURON Technology Transfer Award«, granted at the EURON annual conference of European robotics researchers in Crete: The development of a multiple-fingered hand was distinguished as well as a new surgical robot.

Finally, the German engineers voted the lightweight robot of the DLR built in series by the robot manufacturer KUKA as the »Most Innovative Product 2006«.

The institute received all of these awards because the jury was convinced that its results take up a position at the top of international research.

Harmonic Drive AG congratulates the award winners – and looks forward to more demanding product challenges in future.





OVALO



Active roll stabilizer by Ovalo

TURNING GOOD into EVEN BETTER

Ovalo GmbH, a 100 % subsidiary of Harmonic Drive AG, was founded in 2006 with the objective of developing mechatronic drive systems for large series applications. The Ovalo precision gears are based on the proven Harmonic Drive principle, whereby the outstanding product characteristics in precision

and compactness allow completely new actuator concepts – for example active roll stabilizers. In order to increase safety and comfort in modern vehicles, various roll stabilizers are available.

Usually, these systems are equipped with semi-

active or fully-active hydraulic actuators. The active stabiliser links the left-hand and right hand sides of the vehicle by means of a torsion spring and can thus substantially reduce vehicle roll. The regulating effect of the stabiliser must cover an extremely wide dynamics range and torsion stiffness requirements.

Because achieving a level of comfort with single-sided load torque, meaning the comfortable decoupling of the stabiliser halves, requires a highly dynamic torque release. In comparison, interferences must be counteracted under high torque loads – for example during fast cornering.

The new Ovalo drive system is based on a brushless Ovalo hollow shaft motor and an Ovalo precision gear. It is a challenge for the developers to reach or, better still, to exceed the regulation level of a hydraulic system using an electro-mechanical actuator. The limited power resources of the current on-board supply systems and the limited installation space do not exactly simplify the matter.

Even so, the functional samples provided until now already show that we will reach the desire level of regulation due to the used of out extremely compact hollow shaft motors. However, the re-design of the regulation concept and the connected power electronics are essential elements for this purpose. In close cooperation with the project partners from the automotive industry, it should be possible to establish the electro-mechanical roll stabilisers to be ready for series production within a reasonable time.

The advantages at a glance:

- Zero backlash
- Excellent transfer and repeatability accuracy
- Small size, low weight
- High torque capacity
- High gear reductions in one stage
- High levels of efficiency
- High torsion stability
- Central hollow shaft possible
- High degree of reliability and long service life

OVALO GmbH
Hoenbergstraße 14
D-65555 Limburg/Lahn
☎ +49 6431 5008-134
📠 +49 6431 5008-139
✉ info@ovalo.de
www.ovalo.de



RSF Super-mini servo actuators

When true greatness is a question of detail

Inspired by semi-conductor and medical technology, the miniaturisation of components is also progressing in the machine engineering sector. Apart from micro-electronics, the last few years have seen the advanced development of in particular the stated micro-system technologies. The central requirements on such micro-drive systems for positioning tasks are compactness, low weight and highly precise, zero backlash movement sequences. Harmonic Drive AG is the pioneer in the development of such servo actuators.

Our RSF super mini servo series is exemplary for a highly-integrated mechatronic solution. Thus the RSF-5A provides a torque of up to 1.4 Nm with a weight of only 66g, an overall length of 58 mm and a diameter of 20 mm. The even

smaller RSF-3B, weighing only 31g, tops that with a torque of up to 0.3 Nm. Both actuators consist of a highly precise Harmonic Drive gear, an AC servo motor, an optical TTL encoder for speed and position regulation as well as HALL sensors for rotor position detection.

The precise RSF servo actuators represent the key technology for a new generation of miniaturised products. They are ideally suitable for positioning applications in medical technology, optical industry, micro-robotics, semi conductor production – in all fields where small, lightweight products have to be highly dynamically and positioned with great accuracy.



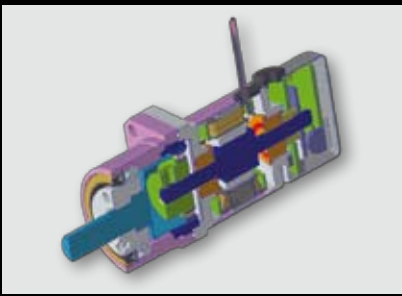
Please send me the following brochures:
 RSF-Supermini AC servo drive
 CSF mini gearboxes

Street no. _____
 Company _____
 Last name, first name _____
 Postcode, town _____

Fill in, detach and post to: Harmonic Drive UK Limited • Unit 36, Walsley Court
 Staffordshire Technology Park • Stafford • ST 18 0GA
 or send an e-mail to newdrive@harmonicdrive.co.uk

CSF mini gear boxes

compact, accurate and powerful



The advantages:

- Super compact
- Extremely light
- Excellent positioning accuracy
- Zero backlash
- Four-point output bearings
- Synchronous motor with single-pole winding
- TTL encoder and HALL sensors

Progressing miniaturisation is not, of course, only noticeable in servo drives alone. This trend also demands all our know how in other fields, for example gear systems. The new CSF mini gear box is here what the RSF series is to the super-mini drives. In its class it sets totally new performance standards with regard to extreme compactness, greatest possible precision and a huge performance capacity.

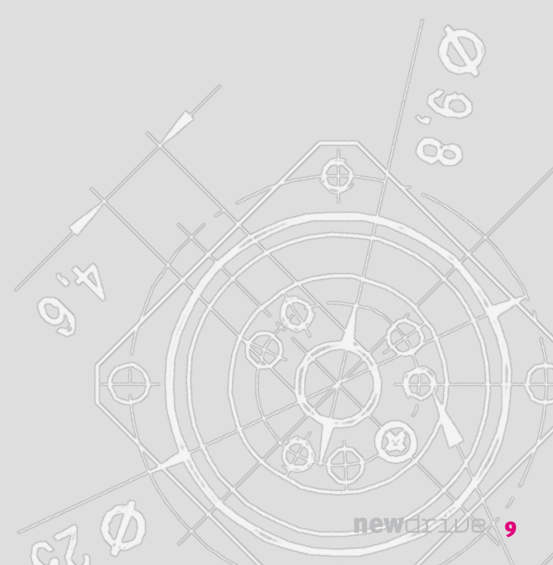
The proven HFUC gear component sets come into use in standardised gear boxes for the first time in the CSF mini gear boxes. Compared to the gear component sets formerly used for the mini gear boxes, they are characterised by a considerably shorter construction and even better precision. The torque capacity and torsion stiffness are also higher; in some applications the maximum speed can also be considerably increased. In conjunction with the recently introduced gear reduction $i=30$, comparably high output speeds are also possible in the CSF mini gear boxes.



A specially developed four-point flange bearing is used as the output bearing in our new gear boxes. This enables the drive element to be optionally designed as a shaft or flange, depending on customer requirements. The drive takes place optionally via an input shaft or a directly coupled motor.



In the new CSF production series, the HFUC gear component sets are used for the first time in standardised gear boxes.





Harmonic Drive
VERZÄHNUNGSTECHNIK



Special planetary gear for electric motor production

standstill despite high speeds



Compact design paired with highly accurate production and assembly: The special planetary gear WM 4.4 guarantees trouble-free production in three-shift operation.

Harmonic Drive Verzahnungstechnik GmbH
Wilhelm-Mast-Straße 15 • 38304 Wolfenbüttel
☎ +49 5331 9 00 99-0
☎ +49 5331 9 00 99-29
✉ newdrive@hdverzahnungstechnik.de
www.hdverzahnungstechnik.de

Elmotec Statomat GmbH has been producing semi-automatic single machines and fully automated production lines for the production of stators and alternators for more than 50 years now. These highly productive machines are used in the manufacture of household appliances or in the automotive industry, where large quantities are in demand. Production systems with extremely short clock pulses are used, and speeds of more than 4000 1/min for wire guidance are more usual rather than the exception.

The unbelievably complex requirements in the production of such stators were able to be met due to a highly specialised planetary gear in the area of the winding spindle. Using this, the actually contradictory task of guiding a wire radially to the outside through a fixed tube and at the same time rotate it by 360° was able to be fulfilled. In this special planetary gear, which is produced and assembled at Harmonic Drive Verzahnungstechnik GmbH in Wolfenbüttel,

two sun gears, one double planetary gear and the housing are assembled to create one compact gear unit.

Drive takes place via the housing, which is at the same time the planetary support. The upper sun gear is firmly connected to the machine bed, the lower sun gear is inserted into the housing so that it can rotate freely. The double planetary gear connects both sun gears, exactly identical toothing data guarantee an overall gear ratio of 1 and thus the standstill of the lower sun gear.

The application purpose demands the highest possible failure resistance, ease of maintenance and robustness, which can be ensured thanks to high specification aluminium alloys, optimised toothing, accurate individual component production and sophisticated assembly processes. The gear system receives its final touches by means of the dynamic balancing in its assembled condition.





Fernando Aramendia
Certified Engineer

aramendia@harmonicdrive.es

Our new subsidiary in Spain is led by Fernando Aramendia. The frequently travelling engineer from Bilbao has two children and can definitely be counted as an active hobby sportsman, as he is an enthusiastic inline skater, mountain biker, skier and tennis player in his spare time.

HARMONIC DRIVE España, S.L.U.
Polígono Industrial Leguizamón
C/ Araba nº 1, 2ª planta –
Oficinas 07 y 08
48450 ETXEBARRI. Vizcaya.
☎ +34 94 4266415
📠 +34 94 4490003
newdrive@harmonicdrive.es
www.harmonicdrive.es

Harmonic Drive España, S.L.U.

Growth in the south of Europe

Markets can only become larger, when you know them and are part of them. The more intensive closeness to the customer, targeted market observation and the optimisation of sales strategies are but three of numerous reasons why the international subsidiaries of Harmonic Drive AG are so important to us.

Hence the growth of Harmonic Drive AG has been taking place far beyond the German borders. With our subsidiaries in England, France, Italy and Austria we are pleased to announce the foundation of a further subsidiary in Spain: Harmonic Drive España, S.L.U. in Etxebarri.



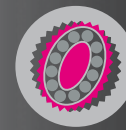
Gail Softley
Administration Assistant

gsoftley@harmonicdrive.co.uk

Harmonic Drive UK

Gail joined the Harmonic Drive UK team in March and is responsible for the day to day sales order processing and accounting within the organisation. Gail is a key contact in the sales administration process, through initial order entry to dispatch and invoicing. She also provides assistance in the marketing activities and organised the recent Drives and Controls exhibition and is now planning two more exhibitions later this year.

When away from Harmonic Drive, Gail likes to spend time with her husband and 3 children and is actively involved in the scouting movement.





Globally there for you:



GERMANY



Harmonic Drive AG
Hoenbergstraße 14
65555 Limburg/Lahn

 +49 6431 5008-0
 +49 6431 5008-119
newdrive@harmonicdrive.de
www.harmonicdrive.de



UNITED KINGDOM

Harmonic Drive UK Limited
Unit 36, Wolseley Court
Staffordshire Technology Park
Stafford • ST 18 0GA

 +44 1785 245190
 +44 1785 240126
newdrive@harmonicdrive.co.uk
www.harmonicdrive.co.uk
Contact:
Graham Mackrell



FRANCE

Harmonic Drive France SAS
685 rue Juliette Récamier
69970 CHAPONNAY

 +33 437 23 66 30
 +33 437 23 59 61
newdrive@harmonicdrive.fr
www.harmonicdrive.fr
Contact:
Laurent Noraz



ITALY

Harmonic Drive Italia S.r.l.
Via dell'Industria n.50
25030 Erbusco (BS)

 +39 030 7721 588
 +39 030 7731 154
newdrive@harmonicdrive.it
www.harmonicdrive.it
Contact:
Dr. Franco Nobili



AUSTRIA

Harmonic Drive Austria GmbH
Percostraße 31
1220 Wien

 +43 1 256 3808-0
 +43 1 256 3808-99
newdrive@harmonicdrive.at
www.harmonicdrive.at
Contact:
Robert Schachinger

SPAIN



Harmonic Drive España, S.L.U.
Polígono Industrial Leguizamón
C/ Araba nº 1, 2ª planta –
Oficinas 07 y 08
48450 ETXEBARRI. Vizcaya.

 +34 94 4266415
 +34 94 4490003
newdrive@harmonicdrive.es
www.harmonicdrive.es
Contact:
Fernando Aramendia



imprint

newdrive, the news magazine of Harmonic Drive AG, is an informative publication for customers and interested parties of Harmonic Drive AG and appears regularly. All trade names are protected by the copyright of their respective owners and are explicitly respected. Harmonic Drive AG reserves the right to change the specifications of the products mentioned herein without prior notice or exclude them from the range. The information published herein does not form part of any contract.

Publisher: Harmonic Drive AG
Hoenbergstraße 14 • D-65555 Limburg/Lahn
 +49 64 31 50 08-0  +49 64 31 50 08-119
www.harmonicdrive.de • newdrive@harmonicdrive.de
Responsible according to press law: Bianca Stamm
Concept, design: P.A.D., Meinerzhagen • Printing:
LM Druck, Neunkirchen. We thank everyone involved in the production of this publication!